American Samoa Assessment and Rapid Reef Response Plan

2013

INTRODUCTION:

Coral reefs around the world are in steep decline due to a wide variety of factors. Corals can be damaged or killed by major damaging events, and harmed by human impacts like overfishing and pollution. The greatest threat to the future of coral reefs is mass coral bleaching, which is projected to occur more throughout the 21st century as a result of climate change. Diseases, Crown-of-Thorns starfish outbreaks, and hurricanes can also do major damage to coral reefs, making them more weak and susceptible to bleaching events. To document and better understand the condition of coral reefs and the impacts different events have made on coral reefs, it is necessary to monitor the effects of major destructive events on coral reefs. These events can come on suddenly, and without a careful plan, recording of the effects of the events may be inadequate or not occur.

Disease outbreaks, Crown-of-Thorn starfish outbreaks, and hurricanes can all cause large amounts of coral damage and mortality. They all need to be monitored in a very similar fashion to that for bleaching, for the same reasons.

BACKGROUND:

Coral Reefs in American Samoa:

Coral reefs support rich biodiversity, providing American Samoa with an abundance of fish, plants and other animals. In addition, corals support human subsistence recreational activities. There are three types of coral reefs: fringing reefs, barrier reefs, and atolls. Fringing reefs are located close to shore, separated from land by only shallow water. Barrier reefs lie farther offshore, separated from land by lagoons more than ten meters deep. Atolls, on the other hand, are formed far offshore and they make a ring-shaped reef that close a circular lagoon. Coral reefs are the largest biological structures on the planet, and American Samoa boasts many species of Indo-Pacific corals, other invertebrates, and fishes.

Sunlight is the key to the survival of coral reefs. They need it to power the millions of microscopic algae, called zooxanthellae that live in their tissues. Algae provides the corals with food and oxygen in return for raw materials and a secure place to live. This teamwork is what allows the reef to survive in nutrient-poor tropical seas.

All in all, coral reefs provide numerous benefits to the island, from recreational economic to cultural. But despite these benefits, coral reefs are beginning to experience more and more stress due to pressures from humans and the exacerbation of natural stressors. Natural stressors to coral reefs include Crown-of-Thorns starfish (COTS) invasions, periodic bleaching events, and damaging hurricanes. Corals have largely been able to recover from these natural

disturbances over time. However, the coral system has begun to witness more and more human disturbances including a high population growth rate, harmful fishing practices, fishing pressure, sedimentation and pollution. One major impact that humans have had on corals is the increased amount bleaching and acidification due to climate change. The section below highlights climate change impacts in American Samoa and the projected increase of coral bleaching due to climate change.

Climate Change in American Samoa:

Climate change is caused by an increased amount of greenhouse gases such as carbon dioxide in the atmosphere. Greenhouse gases are produced by the use of fuel such as gasoline, oil, coal, natural gas, and even wood. Although some amount of these greenhouse gases in the atmosphere is normal and necessary to protect and radiate heat to the Earth, the concentration of these gases has skyrocketed since the Industrial Revolution. This has caused the naturally thin layer of the gases in the atmosphere to become thicker (akin to putting a blanket around the earth), making the world warmer and producing a number of effects.

The people of American Samoa have experienced a number of natural impacts from climate variability, including hurricanes, drought, heavy rainfall and coastal inundation. These have impacted natural resources both directly and indirectly. The people of American Samoa possess a knowledge governed by the natural environment that assists them in the way they prepare for and become resilient to these events. The future climate impacts that the people of American Samoa are most concerned about include coping with flooding and the increased frequency and intensity of tropical storms.

Presently, climate change is experienced as changing weather patterns, air and sea surface temperature increase, and sea level rise. These changes have produced longer rainy season, increasing the occurrence of landslides, floods, damaged crops, droughts and airborne diseases. This threatens our health, food, land and economic security.

In the future, these changes are expected to increase. This will result in damage to marine life and habitat, changes to food security and impact the local economy. The knowledge of the impacts of climate change, both historically and presently, continue to strengthen the policies and regulations which will guide development and implementation of best practices as better policies are developed to ensure resilient communities in American Samoa. The uncertainty of climate change leaves our coral reefs in a vulnerable state, but through collaboration and knowledge sharing, communities will be better equipped to be more resilient and better able to adapt to climate change impacts to coral reefs.

Climate Change and Coral Bleaching:

Corals contain microscopic single-celled algae called zooxanthellae or dinoflagellates. These algae make food in the sun by photosynthesis, and provide part of the nutrition corals require. If sea temperatures rise high enough, the algae are expelled, taking their color with them. This leaves the tissue clear, and the white skeleton can be seen through the tissue. Thus, corals turn

white in what is called “bleaching,” The term “bleaching “ refers to the white color, however; no chemical bleach is involved. Corals commonly bleach when temperatures rise more than 1^{o} C above the average summer high temperature. If the temperature rises no higher, the corals may recover. More than 2^{o} C above the average summer high temperature causes some corals to start to die.

High temperature periods can produce vast coral mortality, devastating reefs. Although natural climate variability has led to occasional bleaching events around the world, these bleaching events are projected to increase due to the climate change impact of increased sea surface temperature. With global warming, periods of mass coral bleaching are projected to become more and more common. Such mass coral bleaching events are likely to change the composition and reduce the health of our reefs greatly. It is vital to document these events and the changes they produce.

Other impacts of Climate Change:

Climate change will impact corals in both direct and indirect ways. It has been projected that global climate change will result in future increases in diseases of marine organisms. Although this impact remains relatively uncertain, this plan will also assist in quantifying and mitigating changes to coral reefs due to disease. Additionally, it has been hypothesized that increased population growth combined with global climate change may increase the occurrence of Crown-of-thorns starfish. Again, this plan will be beneficial in helping to track the occurrence of COTS, quantifying the impact, and mitigating and managing the impacts and recovery.

BLEACHING RESPONSE PLAN DESIGN:

This plan is designed to monitor coral reef bleaching. This plan will be put into effect to determine if sites have experienced coral damage or loss, what the cause of the coral loss is, the amount of loss at sites, document the progression of the loss episode, and monitor survival rate at those sites. The sites selected cover a broad geographic range, but note that the data will not give an estimate of the percent of coral loss across the whole territory; rather, it will quantify loss at the focus sites.

Lead: Coral Reef Monitoring Benthic Ecologist, DMWR

Key partners: Marine Science Coordinator at ASCC, Marine Ecologist at NPS, Research Coordinator at FBNMS, Manager of Rose Atoll

BOX 1 - MONITORING

Monitor SST-based predictions for coral bleaching, and other weather related coral threats in American Samoa via the NOAA Coral Reef Watch website (http://coralreefwatch.noaa.gov/satellite/index.html) and associated email alerts.

Monitor sea surface temperatures. Sea surface temperatures recorded by NOAA temperatures buoys will be monitored by a daily email that reports the previous day's temperatures. This will continue as long as NOAA maintains the buoys.

- Monitor two reef sites for bleaching on a biweekly to monthly basis. This has continued since 2004. The two sites are Alofau and the airport pool. At Alofau, the slope can be monitored as well as the reef flat and pool. Disease, Crown of Thorns, and other kinds of damage are recorded as well. If SST data indicates a potential bleaching event or coral threat event (Alert Level 1 or 2), notify partners and proceed to Box 2.

- If SST data does NOT indicate a potential bleaching or coral threat event, continue monitoring.

BOX 2 - INITIAL OBSERVATIONS TO ASSESS IF CORAL DAMAGE OR LOSS IS PRESENT

If SST data indicates a potential coral threat event, or if coral damage or loss has been reported, an easy- access site will be explored to determine if coral damage or loss has occurred. Evidence that may indicate the probable cause will be gathered from the pattern of damage and/or the presence of causative agents such as Crown-of-Thorns starfish. Evidence that can be used to identify the likely causes of damage can be identified using the Benthic Identification for Coral Reef Monitoring in American Samoa (Fenner, 2011). Tips for distinguishing these stressors can be found in the Global Protocol for Assessment and Monitoring of Coral Bleaching (GPAMCB; Oliver 2004) on page 9. Additionally, investigators should determine if the living tissue is still present on the colony, and if there are signs of mortality.

- If signs of coral damage or loss are observed, attempt to identify the cause and notify partners and other appropriate agencies and proceed to Box 3.

- If corals do not exhibit signs of damage or loss, continue to monitor SST data and re-check sites as needed.

BOX 3 – RAPID ASSESSMENT OF AREA AFFECTED AND SEVERITY

At the same site just assessed, estimate the percentage of the reef area that is experiencing coral bleaching or mortality and the severity of the bleaching. If a substantial percentage of corals are affected (suggested value 5%), further quantification is advised.

Method: Estimate percent and intensity of coral loss using roving snorkel survey or timed swims (methods and data sheets in the GPAMCB [Oliver 2004] p26 and Appendix 1), with towed GPS, coral color charts (www.coralwatch.org), and camera/video to document loss.

- If over 5 % of reef experiencing coral bleaching or mortality, move to Box 4.

- If less than 5% is showing bleaching or mortality, continue to monitor the area and SST data.

BOX 4 - MORE RIGOROUS QUANTIFICATION OF CORAL LOSS

Return to site with additional equipment and personnel needed for more detailed quantitative surveys that will give a more accurate assessment of the extent and severity of coral loss at this site.

Method: Survey methods used will depend on the agency responsible and will likely follow their typical survey protocols, so that data is comparable across time and available before, during, and after the threat event. If the number of coral affected is high, a method that covers a relatively small area such as the point-intercept method should be used. Point-intercept is the fastest and easiest of all methods, and gives results as accurate as other methods, but covers a very small area. If the number of corals affected is moderate, then a method covering a larger area will be necessary. Such methods include belt transects, video transects (essentially recorded belt transects), quadrats and photoquadrats. Quadrats have the disadvantage of having an opportunity for large bias in siting the quadrats which can affect the results. If the number of coral affected is low, then a method that covers a larger area is needed, such as roving diver, timed swims, or manta board. Such methods have low quantitative accuracy usually.

Some coral species are likely to be much more affected than others. It may be more efficient to record bleaching only among the species affected. That will require some ability to identify coral species, but could produce separate measures of what proportion of corals are bleached for different species.

Both bleached corals and dead corals need to be measured, and recorded in separate categories. The intensity of bleaching varies between corals, between different parts of corals, and over time. It is important to record a measure of the intensity of bleaching on each colony, such as minor bleaching, about half bleached, almost completely bleached.

- Unless coral loss is expected at only this site, move to Box 5.
- Re-survey the site periodically (at pre-determined intervals or as time allows) to monitor the progression of the loss and the survival/mortality over time**.**

BOX 5 - EXPAND ASSESSMENT TO SITES THROUGHOUT THE TERRITORY

If the severity of coral loss exceeds 5% at the initial site, more exploratory measures should be taken by assessing other sites around the territory.

Method: Same as rapid assessment methods in Box 3.

Predetermined sites: Faga'alu, Alofau, Coconut Point, Fagamalo, Alega, Aunu'u, Airport tide pools, Amalao, Fagatele Bay, Larson's Bay, and Amanave. Consider expanding to sites in Manu'a, Rose, and Swains if resources and personnel allow.

- For a given site, if the coral damage or mortality estimate is over 5%, proceed to Box 6.
- For a given site, if the coral damage or mortality estimate is under 5%, repeat monitoring in this manner to see if coral loss increases to over 5% during the bleaching season or over a specific time frame.

BOX 6 - QUANTIFY CORAL LOSS AT SITES ACROSS THE TERRITORY

For sites with over 5% of corals lost, do a more rigorous quantitative assessment.

Methods: Same as in Box 4.

If coral loss exceeds 5% at 10% of sites explored,

- Alert regional partners of possible mass coral loss event in American Samoa
- Notify community leaders and the public through press and media outlets
- Continue to monitor monthly throughout bleaching season or coral threat event, or until corals return to a healthy state, whichever is longer.
- Report results to national and international tracking agencies, for example a coral bleaching database, such as ReefBase.
- Proceed to Box 7.

If coral loss does NOT exceed 5% at 10% of sites explored, continue observation and monitoring of sites throughout bleaching season or threat event using methods in Boxes 3 and 4, as appropriate.

BOX 7 - MANAGEMENT ACTIONS

If a wide-spread coral loss event occurs, management actions (though limited) may be employed. Management actions may include continued monitoring (via roving snorkelers/divers and temperature loggers), education and outreach opportunities (community engagement in resilience efforts - i.e. reduction in sediment and nutrient runoff, fishing pressure, etc), as well as experimental reversal (cooling, shading, COTS Removal etc) techniques. Also, press should be notified to help educate local communities and raise awareness.

Methods: Reduce sedimentation and nutrient runoff/overfishing, deploy temperature loggers to bleached areas for monitoring purposes; initiate reversal techniques at select sites, pinned sites, photoquads.

BOX 8 – FOCUSED MONITORING OF RECOVERY/MORTALITY

Mass coral bleaching does not always produce mortality, if bleaching is mild many corals may recover. The effects to the reefs are much greater if there is mortality. It is important to gather information on mortality. Dead corals quickly become covered with algae, and in time cannot be distinguished from corals that were dead before the event. If the event lasts for months, the total number of corals killed will exceed the number of dead colonies recorded at any one time, so mortality could be underestimated. One of the few ways to get accurate measures of mortality is to tag many individual corals and periodically record their condition.

Should agencies desire more detailed data on the recovery of specific corals over time, they may choose to employ permanent transects or quadrats, or other methods that are designed to answer specific research questions.

> **Methods**: To be determined by the Lead Agency and the Key partners. The NPS method is: A three-pin method will be used. Permanent pins (SS all-thread) will be installed at the sites, with the site GPS location marking the center pin. An x-axis pin will be installed 25 meters along the coast in a random direction (up or down coast), and a y-axis pin will be installed 25 meters from the center pin heading offshore at a 90 degree angle to the x-axis. Cattle tags will be used to identify every coral within the 25X25 meter area, with the x and y coordinates recorded for each coral. Photographs of tagged corals will be used to follow their fate over time. Photo-quadrants will be taken along the x and y axes to estimate percent bleaching. A temperature logger will be deployed at the center pin to track changes in temperature.

BOX 9 – REPORTS AND PUBLICATIONS

Data should be analyzed and compiled into agency reports. Ideally, data will be published in a peer-reviewed scientific journal. Agency collaboration is encouraged.

References:

Fenner, D. 2011. Benthic identification for coral reef monitoring in American Samoa. DMWR, pdf.

Marshall, P., et al. Reef Manager's Guide to Monitoring Coral Bleaching.

Oliver, J., P. Marshall, N. Setiasih, L. Hansen. 2004. A Global Protocol for Assessment and Monitoring of Coral Bleaching. 1st Edition. World Fish Center and WWF Indonesia. 35pp.