

# How Are American Samoa's Coral Reefs Doing?

## Results from long-term monitoring conducted over the last 25 to 40 years



### American Samoa Coral Reef Historic Monitoring Project

American Samoa is very fortunate to have numerous long-term coral reef surveys that began in the 1970s and 1990s. Recently, the Coral Reef Advisory Group (CRAG) at the Department of Marine & Wildlife Resources (DMWR) invited two of the original scientists who have been monitoring our reefs for the last 25 – 40 years back to American Samoa to repeat these surveys. These scientists were also involved in resurveying the Aua Coral Transect on its 100 year anniversary in May, 2017.

The aim of this project was to repeat historic surveys conducted in American Samoa to evaluate the health of the coral reefs and fish communities, and to understand the changes that have taken place over the last 25-40 years. Baseline surveys were conducted throughout the Samoan Archipelago in 1994 and 1995 (including all of the main islands in American Samoa), and the sites around Tutuila and Manu'a were surveyed again in 2002. In 2018 we repeated these baseline surveys on Tutuila, in Manu'a, and Rose Atoll.

A total of 43 sites were surveyed on six islands between 15<sup>th</sup> October and 11<sup>th</sup> November 2018 by expert scientists Dr. Alison Green (reef fishes), Prof. Charles Birkeland and Dr. Douglas Fenner (corals), and CRAG ecologists Alice Lawrence, Georgia Coward, and Motusaga Vaeoso.

Surveys of coral reef fishes (species, size and abundance), corals (species, abundance and colony size), benthic habitat (abundance of algae, corals and other invertebrates), juvenile corals and giant clams (abundance and size) were conducted on three 50 meter transects at each site. Approximately 16,000 individual reef fishes (199 species from 27 fish families), 5,613 coral colonies (113 species in 34 genera) and approximately 50 giant clams were recorded and measured, and over 8,233 observations were made of the benthic habitat.



Survey Team: Alice, Georgia, Alison, Charles, Doug

**Preliminary Observations** indicate that the condition of American Samoa's coral reef ecosystem is highly variable both within and among islands. This is likely to be due to the varying oceanographic and geological conditions throughout the archipelago, in addition to the presence of villages, fishing activities, and sources of pollution. Further data analyses will be conducted over the next six months and this information will be collated in a final report by mid-2019. Village-based report cards will also be produced to summarize the condition of the coral reefs at each site based on key factors (such as coral cover, diversity and colony size, and fish abundance and biomass), along with management recommendations.



Bluefin trevally (*Caranx melampygus*) at Rose Atoll

### Coral Reef Fishes

Dr. Alison Green has surveyed coral reef fish communities throughout American Samoa on three occasions over the last 24 years (1994/1995, 2002, and 2018). Dr Green's initial observations suggest that populations of fisheries species remain lower than expected at most of the sites surveyed. Reef fish larger than 30 cm in length are relatively uncommon on Tutuila and in Manu'a. Some vulnerable species (such as sharks and humphead wrasse) are rare while others (such as bumphead parrotfish and giant grouper) were not observed at all in 2018.

The exception is at Rose Atoll, where there are still healthy populations of fisheries species with more big fish and reef sharks, although diversity is naturally lower than on Tutuila and Manu'a. Less fishing around Rose Atoll has enabled reef fishes to grow larger and produce more offspring, providing a refuge for some of these species in American Samoa. But even at Rose the populations of the largest species such as sharks are less than on other remote reefs in the Pacific Islands.

## Coral Communities



Dr. Birkeland surveying coral at Fagatele Bay

- Prof. Charles Birkeland and Dr. Douglas Fenner have conducted surveys of coral communities in American Samoa on several occasions from the late 1970s to 2018.
- Initial observations from this survey suggest that coral communities are relatively healthy at the majority of sites (particularly at Fagatele and Vatia). However, there are some locations (e.g. Nu'uuli, Faga'alu and Fagafue) where the corals are not exhibiting the same rapid recovery rates following disturbances such as crown of thorns starfish outbreaks, coral bleaching, and hurricane damage. These could be priority sites for watershed and fishery management efforts.

- A site in Leloaloo, on the north side of Pago Pago Harbour is remarkable, with high coral cover of mainly plating species. It is the best community of such corals Dr. Fenner has seen in the archipelago. It is remarkable that such a healthy looking coral community is inside the harbour.
- The survey site at Aunu'u looks like it has a few more dead corals than in the past, which may have been killed by recent coral bleaching events. The Leone site had terrestrial sediment in between corals, unlike the nearby DMWR monitoring site a few years ago. This could be a difference over space or time, and will be investigated further.
- Rose Atoll has a different coral community than any of the other islands in American Samoa. In fact it has two distinct communities, one on the outer slope, and one in the lagoon. The lagoon is a unique habitat in the entire archipelago, including Independent Samoa. The Lagoon has a high abundance of massive faviid corals, and some places are dominated by massive *Astreopora* unlike anywhere in American Samoa except western Ta'u. It also has a species (*Montipora capitata*) which is rare elsewhere in American Samoa, only being seen in the Ofu Pools by Fenner, and even there it is pretty rare. There appear to be some species in Rose that are not on the other islands.

## Coral Reef Recovery and Resilience

- American Samoa is known for its strong, resilient coral reefs (particularly in Ofu Lagoon and Fagatele Bay), and researchers from around the world come to study the reefs to understand why.
- The coral reefs at some sites have recovered well from large-scale disturbances such as hurricanes, coral bleaching, and crown of thorns starfish outbreaks over the last 40 years (e.g. Fagatele and Vatia), while others have not recovered as well (e.g. Aua and Fagasa's outer bay).
- There are many factors that affect coral reef resilience (how well reefs recover from these disturbances). The survey scientists believe that some sites are healthier and more resilient than others because of better water quality conditions, which is the result of good watershed management practices and less damaging land-based activities nearby. Furthermore, the condition of the coral reefs in Pago Pago Harbour have improved since the cannery outfall pipe was moved from the inner to outer harbour in 1992. It is encouraging to know that we can make a difference to our reef ecosystems by ensuring better water quality in our villages. However, healthy populations of herbivorous reef fishes (e.g. parrotfishes) also play a critical role in coral reef resilience. Therefore good fisheries management is also important.
- One benefit that American Samoa has over perhaps most other reefs around the world is the prevalence of crustose coralline algae (CCA). CCA is a red alga that consists mostly of calcium carbonate that binds reef rubble and forms ideal settlement surfaces to facilitate the growth and recovery of coral reef communities. Recent surveys found rapid and abundant coral recruitment in areas where rubble from recent mortality of branching corals was bound by the CCA, *Porolithon onkodes*. On the reef flat at Aua, where *P. onkodes* is not prevalent and the rubble has not been bound (possibly since the 1930s), the reef community is still not showing signs of recovery after possibly as long as 85 years. Fortunately, *P. onkodes* was prevalent in most areas surveyed in Tutuila, Manu'a Islands and Rose Atoll and so the reef communities appeared either in good condition or on the way to recovery.



Crustose Coralline Algae cementing the reef structure

## National Marine Sanctuary of American Samoa

- The coral communities in Fagatele Bay section of the National Marine Sanctuary of American Samoa are healthy and thriving and are looking the best that the survey team have seen them in 40 years of monitoring (see photo top of page 2). Unfortunately, the fish populations are still low in the Sanctuary, and there are very few big fish.
- In 1994, DMWR staff (Fale Tuilagi and Alison Green) found one of the world's largest and oldest coral colonies, which they named Fale Bommie (the shape resembles a Samoan fale). It is now part of the Ta'u Management Area of the National Marine Sanctuary of American Samoa. The survey team were pleased to see that the bommie is still healthy and appears to be recovering well from coring studies to estimate its age and study the climate records in the skeleton.



Fale Bommie in Ta'u (with SCUBA diver for scale)

## Rose Atoll National Wildlife Refuge: 25 Years of Recovery from the Ship Grounding

- Rose Atoll is a special place. The reef is naturally dominated by a lush growth of pink CCA, which forms castle-like tower structures on the reef front.



Herbivorous reef fish at the ship grounding site

- On October 14, 1993, the Taiwanese longline fishing vessel Jin Shiang Fa ran aground on the SW side of the atoll, breaking up and spilling over 100,000 gallons of diesel fuel, 500 gallons of lube oil, and over 300 tons of metallic and other debris onto the reef. This caused a rapid deterioration of the reef ecosystem on the south-west and north-west sides of the atoll, including a large die-off of sea cucumbers, urchins, giant clams, and the important reef-building CCA. Iron from the wreckage stimulated the growth of cyanobacteria (a blue-green algae), which opportunistically took over the reef flat, reef crest, reef front, and some lagoon pinnacles on the affected sides of the atoll.
- The U.S. Fish and Wildlife Service (USFWS) and the American Samoa Department of Marine and Wildlife Resources (DMWR) worked together to remove the majority of the wreckage over the span of 15 years. However, some relatively small pieces remain on the reef at the grounding site and possibly more in deeper water.
- DMWR/CRAG and USFWS surveys from 1994/95 to 2018 indicate that Rose Atoll appears to be recovering well from the ship grounding. There appears to have been a substantial decrease in the area of opportunistic cyanobacteria, and recovery of the reef-building CCA, on the south-west and north-west sides of the atoll over the last few years. However, some physical damage to the reef and the cyanobacteria bloom remain at the grounding site, possibly due to iron continuing to leach from the remaining wreckage. Populations of herbivorous reef fishes also remain high at the grounding site, where they are feeding on the algae.
- The USFWS have existing plans to remove the remaining wreckage in 2019, which will hopefully further improve the health of the reef.
- Since it has now been 25 years since the ship grounding, we recommend: 1) repeating the detailed study of algae on the reef flat and iron enrichment to document the recovery on the south-west and north-west side of the atoll; and 2) compiling a comprehensive benchmark report (incorporating all previous studies) describing the recovery of the atoll from the ship grounding, and the cost/benefit of the clean-up operation.



Healthy pink crustose coralline algae at Rose Atoll

## Rose Atoll National Wildlife Refuge: Giant Clams

- Giant clams (*Tridacna* sp.), known locally as *faisua*, are an important food item in American Samoa, but their accessibility and life history characteristics make them vulnerable to overharvesting.
- In the 1990s, DMWR (Dr. Alison Green and Dr. Peter Craig) conducted an extensive survey that found that Rose Atoll was an important refuge for giant clams that have been overfished throughout most of the Samoan Archipelago. They estimated that ~28,000 clams were present on the atoll, and more than 20% were juveniles (a sign of a healthy population).
- In our 2018 survey, we found that clam densities remain low on Tutuila and in Manu'a, with less than 30 individuals recorded. More importantly, we only recorded ~20 individuals on survey transects in the lagoon at Rose Atoll, which is a lot less than we recorded over a similar area in the 1990s. Furthermore, we saw very few juvenile clams at Rose Atoll this time, and large numbers of long-dead giant clam shells at the bottom of some of the pinnacles.
- This indicates that there appears to have been a mass mortality of giant clams on the atoll sometime over the last 25 years. Although, the likely reason(s) for the death of such a high number of clams remains unclear. This is of great concern and we recommend that we repeat the full giant clam survey conducted by DMWR in the 1990s to confirm if the population on the atoll has collapsed, and invite giant clam experts to help investigate the possible causes of the collapse.



Giant clam or *faisua* within the coral reef structure

## What Can You Do?

- Every place is different, and local communities can have a big role in improving the condition of their reefs and fish populations. We need to work together with local communities to implement fishery and watershed management tools to help enhance fish population recovery and keep coral reef ecosystems healthy.
- Examples of better watershed management practices include deterring deforestation and supporting protection of upland, lowland, and coastal forests, especially wetlands (mangrove habitats). Existing and new developments also need to be environmentally friendly, promoting vegetation growth and its many ecosystem functions, and allowing rain to soak into the ground to reduce runoff that reaches coral reefs. Septic systems and pig pens must remain at least 50 feet away from a stream, lagoon, or ocean.



Black tip reef shark inside Rose Atoll lagoon

- To ensure that the fish communities rebound on Tutuila and in Manu'a, Dr. Green recommends improved fisheries management and regulations, including enhancing our existing network of marine managed areas (MMAs). To help the fish populations recover, these MMAs need to be well managed and designed to be effective ecologically. For example, they will need to be in the right location, large enough and in place long enough to support the growth and successful reproduction of bigger and more vulnerable fish species. Existing regulations will also need to be fully enforced to protect rare and vulnerable species to ensure the health and recovery of the entire ecosystem.
- The lack of big, rare and threatened fish species recorded on this survey (see above), indicates that overfishing may be a concern for these species throughout most of American Samoa (less so at Rose Atoll). Improved fisheries management will be required to ensure that these species do not become locally extinct. In particular, the scientists recommend that the ban on fishing and possession of sharks in American Samoa should be reinstated, because their life history characteristics make them particularly vulnerable to overfishing.

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