



# Coral Health and Fish Diversity in the Solomon Islands Before and After 2007 Tsunami and Earthquake

## Abstract

Coral health and fish diversity were examined by the Planetary Coral Reef Foundation (PCRF) at Sagharughombe Reef, Solomon Islands, in 2000, 2002, 2006, and 2008. Observation of coral colonies indicated a significant decline in overall health ( $p < 0.05$ , t-test) over the eight year period, and fish species diversity declined significantly for six years ( $p < 0.05$ , Simpson's index). Fish diversity has increased following the 2007 earthquake and tsunami in the area. Since 2000, this site has also been impacted by bleaching, sedimentation, and over-exploitation of fisheries. The decline of this reef system is critical to the people of the area. This is an ideal location for marine conservation outreach efforts to be concentrated.

## Introduction

In April 2007, the site was affected by an 8.1 Richter earthquake and its subsequent tsunami. The continental shelf of the volcanic island Ghizo receded one meter, and the east coast fringing reef on Ranongga Island uplifted three meters above sea level and remains completely exposed (Fig. 1).

Fig. 1. Ranongga reef, Boulder *Porites* spp. exposed.



The damage to the coral reefs was extensive and potentially more affected by the earthquake than the tsunami. Branching corals were shattered, and boulder corals toppled over from their bases (Fig. 2 and 3).



Fig. 2. Reef destruction from earthquake and tsunami, photo taken in 2008.



Fig. 3. Damage to tissue and skeleton of *Porites* sp.

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## Methods

Sagharughombe reef (S08°07.0' E156°54.7') is located 10 km east of Ghizo in the Solomon Islands (Fig. 4). Qualitative and quantitative observations were made by PCRF divers using methodologies developed by Dr. Phillip Dustan, College of Charleston, including; Vitareef (a system to assess reef health), transects (for coral, fish, and invertebrate species counts), and Pointcount 99 (for estimating ground cover). In addition, the reef contour was mapped using GPS and Landsat imagery ([www.landcover.org](http://www.landcover.org), Fig. 5).



Fig. 4. Satellite image of Sagharughombe reef survey area.



Fig. 5. GPS reef tracks from 2002, 2006, and 2008.

## Results

In 2008 52% of the reef showed signs of threatening edge damage. Edge damage occurs when filamentous algae trap sediment on the coral's margin resulting in tissue necrosis.

Comparison of transect imagery analysis between 2006 and 2008 provides a possible indicator to the extent of damage caused by the earthquake/tsunami. Prior to the event, the shallow zone (3-5m) contained 46.8% live coral cover and 26.8% in the deep zone (5-7m). In 2008, these figures were reduced to 28.1% and 20.2% respectively.

Massive, table, foliaceous, branching, and digitate coral growth forms were all affected by the 2007 event. Encrusting coral species have prospered and may be better adapted to settle on new substrate. Branching coral species were found in newly recruited colonies. Coralline algae and *Halimeda* spp. were both also present. Coral reef surveys indicated a significant overall decline in coral health over the eight-year period (Fig. 6).

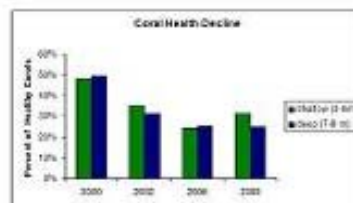
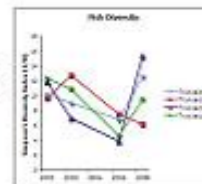


Fig. 6. Four years of coral health averaged into shallow and deep zones. Significant decline in coral health for 2000 vs. 2008 (t-test,  $p < 0.05$ ).

Despite the 2007 events, fish life remains abundant and diverse. A total of 292 different fish species were recorded on Sagharughombe reef. Mean fish species richness for transects in 2008 was 81.2 species, and mean number of fish observed was 1078.5 fish.

The past six years have experienced a significant decline in fish species diversity ( $p < 0.05$ , Simpson's index, Fig. 7). In 2008, following the tsunami, fish diversity is thought to increase. Aronson and Precht (1995), achieved maximum coral diversity with intermediate disturbance to the reef. These results may suggest fish populations are also subject to the intermediate disturbance hypothesis.

Fig. 7. Fish diversity, Simpson's index, of four transects surveyed in 2000, 2002, 2006, and 2008 ( $p < 0.05$ ).



Aronson, RB and Precht, WP, 1995. Landscape patterns of coral diversity: A test of the intermediate disturbance hypothesis. *Journal of Exp. Mar. Biol. and Ecol.* 182:1-14

## Discussion

The overall decline in coral health at this site between 2000 and 2008 is likely due to bleaching events in 2000 and 2006 (Fig. 8), and increased sedimentation. The variation in fish diversity may be attributed to over exploitation of fish stocks from socio-economic impacts (Fig. 9). Both coral health and fish diversity have been impacted by the 2007 earthquake and tsunami which caused destructive substrate damage.



Fig. 8. Possible bleaching of *Acropora* sp., photo taken in 2006.

The current level of pressure on the reefs has increased due to the slim distribution of recovery funding from the tsunami events and increased stress on already diminished marine resources. Current marine conservation outreach efforts include a giant clam farm at the World Fish Center, community involvement with a local dive operation, and research on neighboring reefs by World Wildlife Fund. Supplementary efforts to those already in place are critical because of the dependence by the local population on their marine resources.

Fig. 9. Every day scene of reef fish for sale at Gizo fish market.



## Acknowledgements

We thank the people of Ghizo Island who welcomed us and joined in our efforts to understand their reef's ecology. Thank you to PCRF and its crew who participated in the four studies, and to Dr. Phillip Dustan who has continued to provide his expertise and knowledge to our research.