# How Does Pollution Affect Coral Zooxanthellae?

Reef building corals around the world are experiencing major declines due to a variety of threats, and most importantly climate change induced rising sea temperatures. Warming oceans have led to an increase in coral bleaching, a process where corals expel their symbiotic algae (zooxanthellae) and lose their color. Prolonged or recurrent bleaching often leads to coral mortality, and consequently a loss in ecosystem services provided by corals including coastal protection, recreational value, and fish habitat[1].

**Figure 1.** *Acropora hyacinthus*, a common reef-building coral in the Indo-Pacific.

If bleaching is less severe, corals may induce a shift in their internal zooxanthellae communities, often in favor of more heat-tolerant species of zooxanthellae[2]. This zooxanthellae ‘shuffling’ may allow corals to better tolerate future climate change warming[3]. While these processes have been well-studied in response to warming stress, fewer studies have investigated how these processes respond when warming stress interacts with local stressors such as pollution.

This project aims to measure the differences in zooxanthellae communities in areas that have been differently impacted by pollution. Our samples were collected in American Samoa, where some reefs are exposed to heavy nutrient runoff and sedimentation from pollution, while others have been protected for years and are relatively pristine[4]. Based on preliminary physiological data, we hypothesize that pollution may stress corals and cause them to ‘shuffle’ their zooxanthellae, allowing them to better tolerate bleaching than pristine corals.

**Figure 2.** A qPCR plate.

In this project, zooxanthellae community composition will be measured in *Acropora hyacinthus*, a common branching coral found in American Samoa (Figure 1). To determine zooxanthellae community differences, DNA will be extracted from coral samples and qPCR will be performed using primers[5] that are specific to two of the most common zooxanthellae species in the Indo-Pacific: *Symbiodinium durusdinium* and *Symbiodinium cladocopium* (Figure 2). Subsequent statistical analysis in R will determine whether zooxanthellae community composition patterns match our hypothesis.

**As an undergraduate student assistant for this project, you will take charge of:**
• Collecting and analyzing genetic data to quantify zooxanthellae communities in coral samples

**Skills you will learn that I hope will make you more competitive:**
• DNA extraction
• Quantitative PCR
• Data analysis

**Additional skills you may be introduced to**
• Statistical analysis (likely using R)
• Troubleshooting molecular biology protocols
• Possible bioinformatics analyses

**You will need to be willing and able to:**
• Use sterile technique in a molecular lab setting
• Work independently
• Make a time commitment (4+ hrs/wk)

**Looking for someone who is:**
• Attentive to detail
• Comfortable in a lab environment
• Interested in using genetic methods to answer ecological questions

References

[1]Hoegh-Guldberg, O. (1999). Climate change, coral bleaching and the future of the world's coral reefs. *Marine and freshwater research*, *50*(8), 839-866.

[2]Berkelmans, R., & Van Oppen, M. J. (2006). The role of zooxanthellae in the thermal tolerance of corals: a 'nugget of hope' for coral reefs in an era of climate change. *Proceedings of the Royal Society B: Biological Sciences*, *273*(1599), 2305-2312.

[3]Logan, C. A., Dunne, J. P., Eakin, C. M., & Donner, S. D. (2014). Incorporating adaptive responses into future projections of coral bleaching. *Global Change Biology*, *20*(1), 125–139.

[4]Shuler, C. K., Dulai, H., Leta, O. T., Fackrell, J., Welch, E., & El-Kadi, A. I. (2019). Understanding Surface Water-Groundwater Interaction, Submarine Groundwater Discharge, and Associated Nutrient Loading in a Small Tropical Island Watershed. *Journal of Hydrology*, 124342.

[5]Cunning, R., & Baker, A. C. (2013). Excess algal symbionts increase the susceptibility of reef corals to bleaching. *Nature Climate Change*, *3*(3), 259.