Innovative Restoration Using Resilient Corals to Enhance Coastal Protection in Hawai□i

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Problem

Corals bleached in Kāne‘ohe Bay, HI during a 2015 warming event. Photo: Chris Wall
Coral reefs are one of the most diverse and threatened ecosystems that provide valuable services to our local communities, fish and wildlife. Reefs can dissipate up to 97% of wave energy caused by storms and buffer sea level rise impacts, providing coastal protection for an estimated 500 million people worldwide. The total economic value of coral reefs in the main Hawaiian Islands alone is nearly $34 billion. However, the absorption of greenhouse gas emissions is heating up the ocean, resulting in warming events that occur faster than corals can naturally adapt. It is predicted that only 10% of corals will survive past 2050 as ocean warming events become more frequent and last longer. "Coral bleaching" occurs in response to thermal stress, causing corals to expel the algae living in their tissues, leaving the coral to appear white and potentially die without their main food source.

Restoration

A large ship ran aground near the Honolulu Airport in 2009, damaging an estimated 375k corals. Photo: NOAA/Matt Parry
Microfragmented corals at the DAR nursery to increase growth rates.
We will infuse existing restoration projects with resilient corals to increase the return on investment and enhance future success. Fragmentation and microfragmentation methods will be used to increase coral growth rates.

Plan

This project will cover five acres total at three locations across O‘ahu.
We will out-plant a total of five acres of resilient corals at three locations across O‘ahu. We have existing *in situ* coral nurseries at South Shore and Kāne‘ohe Bay. We will test best practices for incorporating community effort into coral restoration at Maunalua Bay.

Outcomes

Out-planted coral fragments. Photo: Carlo Caruso
Out-planted corals will continue to grow and reproduce naturally, further enhancing resilience. We anticipate a model for effective natural coastal protection for communities, fish and wildlife with best practices that can be scaled up across the State of Hawai‘i for greatest impact.

Solution

SCUBA divers prepare an experiment with resilient corals in Kāne‘ohe Bay, HI. Photo: Shayle Matsuda
In situ coral nursery structure near Honolulu Airport. Photo: NOAA/Matt Parry
We are investigating whether resilient corals will enhance restoration efforts. We will identify coral stocks that are more resilient to thermal stress, grow them in *in situ* nurseries, and propagate them in close proximity to their origin.

Identifying Resilience

A stress test performed on coral fragments from Kāneʻohe Bay. Photo: Carlo Caruso

A "living library" of resilient colonies in Kāneʻohe Bay. Photo: Chris Wall

Methods We Have Used to Investigate Coral Resilience Include:

- "Living Library"
  - Tagging colonies that did *not* bleach during a warming event.
- Stress Testing
  - Exposing fragments from unique individuals to temperature stress and selecting those that are more resistant to bleaching.
- Genetic Markers
  - Determining whether a coral is more likely to bleach or not at the molecular level.
- Hyperspectral Imagery
  - Mapping resilient corals using signatures from hyperspectral equipment or an *in situ* spectrophotometer

Corals of opportunity that have broken off from the reef will be the preferred material to support large-scale efforts. When accessing new locations, stress testing can be used to identify more resilient corals. When a "living library" is available, we can use corals with a known bleaching history in restoration efforts. We are still fine-tuning genetic markers and investigating the source of hyperspectral imagery signatures, but this will have a great impact on our ability to scale-up.

Community Effort

Volunteers fragmenting corals at the Hawaiʻi institute of Marine Biology. Photo: Shayle Matsuda

This community approach only works if people like YOU participate! Let's work together to protect our coral reefs.

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