



NEW RESEARCH ON VULNERABILITY AND RESILIENCE OF HAWAI'I CORAL REEFS TO HUMAN-CAUSED THREATS

Through its Marine 30-by-30 Initiative, the State of Hawai'i has committed to effectively manage 30% of state waters for healthy coral reefs, sustainable fisheries, and local communities by 2030. The Hawai'i Division of Aquatic Resources (DAR) will engage communities and other stakeholders in a public process to identify potential nearshore areas for increased management to enhance resilience. State officials are also seeking to better understand the vulnerability of coral reefs to climate change and their ability to adapt.

The Lenfest Ocean Program is funding SymbioSeas and The Nature Conservancy's (TNC) Hawai'i Chapter to assess:

- Vulnerability and resilience of coral reefs to human-caused threats, including climate change;
- Types of climate-induced disruptions to marine ecosystems
- Adaptation potential of coral reefs over time to warming temperatures; and
- Relationships between herbivorous, or plant-eating, fish and coral reef condition.

THE MARINE 30-BY-30 INITIATIVE

Hawai'i's ways of life depends on healthy oceans and coral reefs for food, cultural traditions, recreation, tourism, and protection from storms. However, over the years Hawai'i's coral reefs have been degraded by an array of threats, including unsustainable fishing, pollution, warming temperatures and rising seas. In 2014 and 2015, high ocean temperatures triggered back-to-back mass bleaching events that led to the most severe losses of corals ever recorded in the islands. In response, the state launched the Marine 30-by-30 Initiative in 2016 to reduce locally driven impacts and to enhance resilience of nearshore reefs.

To achieve its target of effectively managing 30% of state waters by 2030, DAR is working with local communities and other stakeholders to implement the initiative through four key components:

RESEARCH TEAM

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- Eric Conklin, The Nature Conservancy Hawai'i
- Kim Hum, The Nature Conservancy Hawai'i

COLLABORATORS

- Gareth Williams, Bangor University & SymbioSeas
- Lisa Wedding, University of Oxford
- Larry Crowder, Stanford University
- Greg Asner, Arizona State University
- Brian Neilson, Hawai'i Division of Aquatic Resources
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- Ruben van Hooidonk, University of Miami
- Jamison Gove, NOAA Fisheries
- Mary Donovan, Arizona State University
- Dieter Tracey, Science Graphics

1. **Place-based planning** to build a cohesive, ecologically connected network of areas for improved marine management.
2. **Pono (Sustainable) practices** that enhance local partnerships, encourage responsible behavior, update regulations, strengthen enforcement, and support education and outreach.
3. **Protection and restoration** to prevent damage to fragile ecosystems and restore ecosystems in need.
4. **Monitoring** to measure current conditions and track effects from new management actions and use the data to improve existing efforts and identify new areas in need of intervention.

RESEARCH APPROACH

The research team from SymbioSeas aims to model and map coral reef vulnerability and resilience to multiple threats, including ocean warming caused by climate change.

Vulnerability and Resilience of Coral Reefs

The team will first project exposure of coral reefs to warming ocean temperatures and coral bleaching events in Hawai'i by scaling down climate model outputs from the Intergovernmental Panel on Climate Change (IPCC) from global to regional and local areas. They will use annual severe bleaching as a metric, the point at which reefs and associated ecosystem services are likely to decline as a result of warming temperatures. The team will then assess resilience to climate change using indicators such as macroalgae cover, herbivorous fish biomass, and rugosity (or reef ruggedness) derived from data compiled by the Hawai'i Monitoring and Research Collaborative (HIMARC).

Finally, the team will combine data on exposure and resilience with data on human impacts like reef fishing, invasive species, and sediment pollution to assess vulnerability to climate change. The team will use the vulnerability assessment framework adopted by the IPCC, which compares exposure of reefs with their sensitivity to climate stress.

Adaptation Potential of Coral Reefs

A growing body of evidence suggests coral reef communities may be adapting to warming ocean temperatures. For example, scientists have observed shifts in thermal tolerances among generations of coral species. In the second part of the project, the research team will estimate how a reefs' ability to adapt affects their vulnerability to future warmer temperatures. Specifically, they will re-examine projections of annual severe bleaching, and the degree of adaptation required to shift its onset.

Relationships between Herbivorous, or Plant-Eating, Fish and Coral Reef Condition

Strong populations of herbivorous fish living on coral reefs is a key indicator of reef resilience. In the third part of this project, the research team will model the relationship between coral reef habitat condition and the presence of herbivorous fish to explore the size and scale of conservation areas necessary to improve reef health. The models will also allow researchers to investigate if there are thresholds in herbivore biomass beyond which there is either an increase or decrease in corals.

INTEGRATING WITH MANAGEMENT

The project started in May 2020 and will span the next two years. Throughout, the research team will work with DAR to integrate project outputs, including spatial datasets, professionally designed maps and brochures, and peer-reviewed publications into the Hawai'i Marine 30-by-30 Initiative and other planning processes.

CONTACT

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