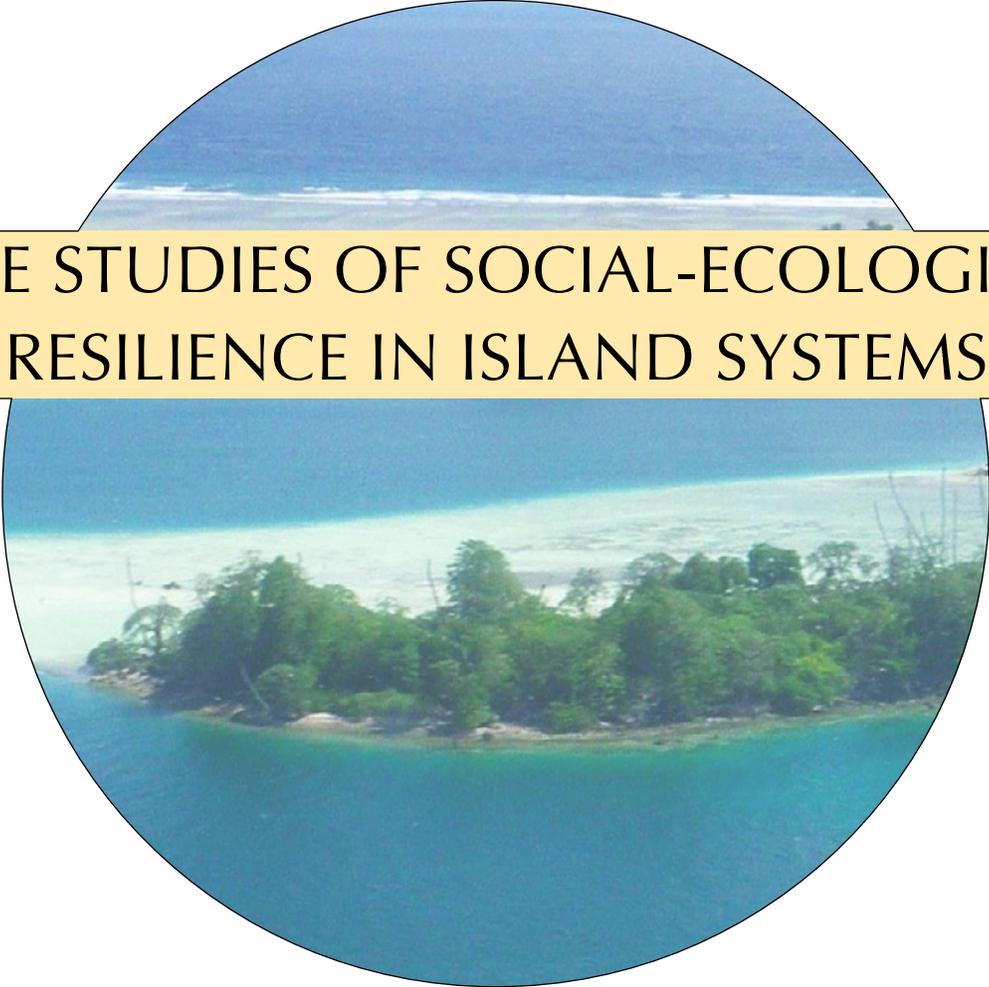


RESILIENCE SOURCEBOOK

INSPIRED BY THE 2013 MILSTEIN SCIENCE SYMPOSIUM
UNDERSTANDING SOCIAL AND ECOLOGICAL RESILIENCE IN ISLAND SYSTEMS
INFORMING POLICY AND SHARING LESSONS FOR MANAGEMENT



CASE STUDIES OF SOCIAL-ECOLOGICAL
RESILIENCE IN ISLAND SYSTEMS



AMERICAN MUSEUM OF NATURAL HISTORY

**CENTER FOR BIODIVERSITY
AND CONSERVATION**

DETECTION OF A CORAL DISEASE OUTBREAK AND LESSONS FOR THE FUTURE

HANALEI, KAUA'I, HAWAII, USA

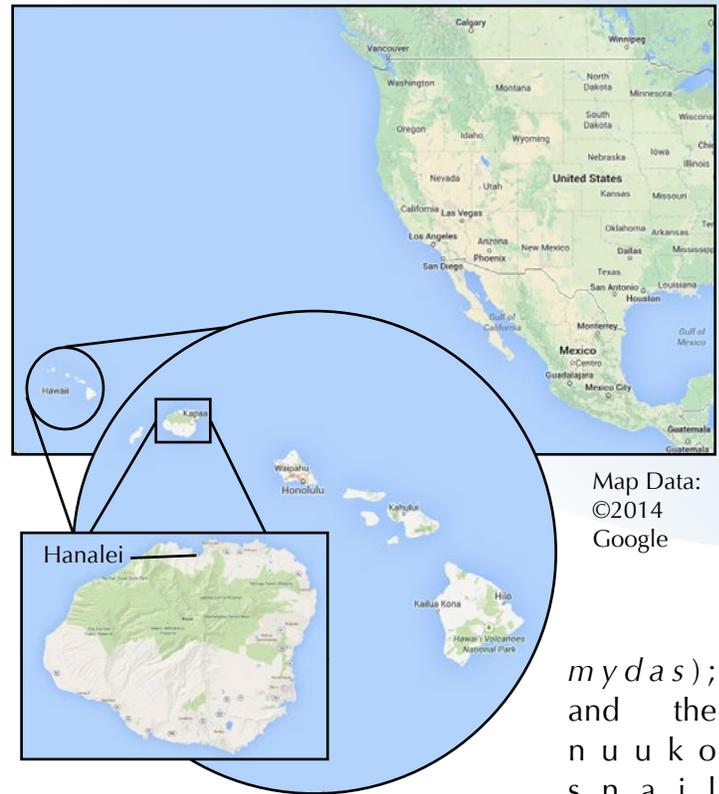
Anne Rosinski¹ and Maka'ala Ka'auomoana²

THE SETTING

Hanalei, on the North Shore of Kaua'i, Hawaii, is a small community of about 450 permanent residents. A one-lane bridge over the Hanalei River connects Hanalei to the east and south of the island. About 80% of the taro in Hawaii is grown in Hanalei, mainly for markets on Oahu.

Tourism is the main economic driver on Kaua'i. Many community members operate small-scale tourism businesses. On the North Shore, only about 25% of the residents are long-term, permanent residents; many residential properties have been converted to vacation rentals, with many of these visitors and seasonal residents originating from the mainland United States.

The Hanalei region is rich in biodiversity and cultural tradition. It is home to species of high conservation value: five threatened or endangered waterbirds, including Newell's shearwaters (*Puffinus auricularis newelli*) and Hawaiian petrel (*Pterodroma sandwichensis*); endemic freshwater 'o'opu (Hawaiian stream gobies, in the Gobiidae and Eleotridae families); green sea turtles (*Chelonia*



(Achatinellidae family). Five ahupua'a, the traditional Hawaiian land division, drain into Hanalei Bay. There are also three culturally important fish ponds, a traditional Hawaiian aquaculture technique that encloses or diverts stream waters into an enclosed near shore area for purposes of rearing fish for local consumption. The Hanalei River is one of fourteen American heritage Rivers in the United States.



¹ Marine Resource Specialist, Division of Aquatic Resources, Hawaii Department of Land & Natural Resources

² Hanalei Watershed Hui

Hanalei River and Valley
Photo credit: Hanalei Watershed Hui

Several conservation and management measures have been taken by organizations in the Hanalei watershed, as outlined in documents including the Hanalei Watershed Action Plan, the Watershed Management Plan, and the Disaster Resilience Plan. These plans provide data, guidance and management of the watershed with a focus on water quality and resilience issues. The community is highly engaged in natural resource management and planning and has identified major causes of land-based pollution including the conversion of single family homes to more intense commercial uses, inefficient waste water management systems, natural erosion, over-use of fertilizers, and erosion and disturbance caused by feral pigs. Strong wave action characterizes the ocean waters surrounding Hanalei, ensuring that the water surrounding Hanalei's reefs are generally well mixed and water residence times are low.

THE DISTURBANCE

In 2004, scientists studying the reefs on the North Shore of Kaua'i first observed a black band coral disease at low levels. Then, in 2012, outbreak levels of the disease were reported to the volunteer reporting network, Eyes of the Reef (EOR). Scientists with the United States Geological Survey (USGS), Hawai'i Institute of Marine Biology (HIMB), and the National Ocean and Atmospheric Administration (NOAA) have now confirmed that the disease affects three species of rice corals (*Montipora capitata*, *M. patula*, and *M. flabellata*), and, with some variation across sites, approximately 1-8% of colonies of these species. While these percentages



Lesions from black band disease on a coral (healthy coral is to the left of the disease front, dead coral is to the right)
Photo credit: Hawaii Institute of Marine Biology

are relatively low, *Montipora* corals are the dominant reef-building corals on North Shore reefs and therefore the disease has the potential to have a significant impact on reef structure and function.

Black band coral disease can move through a coral colony very fast. Typically a disease front of cyanobacteria can be observed. It leaves behind dead coral tissue and algae covers the exposed skeleton.

THE RESPONSE

Once the EOR Network confirmed the coral disease outbreak, USGS, UH, and NOAA conducted an initial assessment, according to the established protocol of the Rapid Response Contingency Plan (RRCPP). The RRCPP provides the Hawai'i Division of Aquatic Resources (DAR) and its partners with a plan to respond to events affecting reef health, including coral disease, coral bleaching, and crown-of-thorn starfish (COTS) outbreaks. The first step after receiving the report was getting partner scientists and government biologists to confirm and assess the extent of the disease. In 2012, a UH microbiology laboratory identified a cyanobacteria responsible for the disease, similar to diseases that have been observed in the Caribbean and the Indo-Pacific. A UH doctoral student surveyed Kaua'i's reefs in 2013 and confirmed that the disease was predominantly affecting the North Shore (86% of the 21 northern surveyed sites had the disease present, while only one site out of four in the south had the disease). The press covered the disease



Answering media questions about the coral disease response
Photo credit: Division of Aquatic Resources



Documenting the impact of the black band disease
Photo credit: Division of Aquatic Resources

outbreak extensively, which brought attention and community concern about the issue.

There is relatively little known about coral diseases and less about how to manage diseased reefs; therefore, research is a major part of the first phase response. DAR partners are currently undertaking studies on diverse topics including disease transmission, potential treatments, the influence of coral health on coral susceptibility to the black band coral disease, how environmental factors correlate to the incidences of black band disease, and an experimental treatment option. This research will provide essential information to more effectively identify management options.

Members of the coral disease laboratory at HIMB have been piloting an experimental treatment for affected coral colonies. Application of marine epoxy putty to edges of the disease lesions on affected corals has been found to effectively stop or slow disease progression on corals and a larger trial of effectiveness is a next step.

In January 2014, DAR formed a Management Response Team with the partners that conducted the initial disease assessment as well as the Environmental Protection Agency (EPA), DAR

biologists and education specialists, and a coral specialist from the Kewalo Marine Laboratory. The purpose of the Team, as described in the RRCP, is to review incoming data regarding the disease outbreak, communicate the event to the public, and evaluate management options. Thus far, the team has prioritized projects that will identify environmental drivers for the disease, evaluate potential management strategies, and launched a website where they will continue to post the latest information about the response.

The black band disease outbreak is ongoing and no recovery can be reported as of yet.

LESSONS LEARNED

- *A plan facilitates a coordinated response.* The existence of the Rapid Response Contingency Plan enabled DAR and its partners to respond to the black band coral disease in an organized manner. Some diseases move quickly and can cover large areas, so it is good to be prepared and to know what resources are available to respond to these events.
- *Community involvement is key.* The citizen science network Eyes of the Reef is able to recognize coral disease outbreaks more quickly than if DAR staff had been working alone. In this case, community members expanded the capacity of managers to monitor for coral disease disturbances and will play a key role in the reef's recovery.
- *Communication is critical when responding to this type of disturbance.* Having a communication plan or involving a communication expert from the beginning would have aided the team in informing all partners and the community on Kaua'i of what was known about the coral disease and about the research being done.
- *Contingency funding continues to be a substantial barrier.* It is difficult because you cannot predict when, where, and how much funding will be needed for a disease event. A finance plan needs to be created that will allow funds to be isolated specifically for coral disease, bleaching, and COTS disturbances.

- *Partnerships are essential.* Investigating a coral disease takes a multi-disciplinary team of scientists, managers, NGOs, communication experts, community leaders, private sector participants, etc. Collaboration can allow more resources to be leveraged in a timely and efficient way during a coral disease disturbance. DAR is building on this lesson by establishing the first global learning exchange of managers who respond to these types of coral reef impacts at the September 2014 U.S Coral Reef Task Force Meeting.



DAR staff conducting teaching a local summer camp about coral health. Photo credit: Division of Aquatic Resources

FUNDING SUMMARY

- Division of Aquatic Resources (DAR) and Division of Boating and Ocean Recreation (DOBOR), Hawai'i Department of Land and Natural Resources
- The School of Ocean and Earth Science and Technology (SOEST)
- Hawai'i Institute of Marine Biology (HIMB)
- US Geological Survey (USGS)
- National Oceanic and Atmospheric Administration Coral Reef Ecosystem Division (NOAA-CRED)
- Several additional community partners also contributed resources and supplies

LEAD ORGANIZATIONS (MANAGEMENT RESPONSE TEAM MEMBERS)

- Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources
<http://dlnr.hawaii.gov/dar/>
- Hawai'i Institute of Marine Biology
<http://www.hawaii.edu/himb/>
- National Oceanic and Atmospheric Administration, Pacific Islands Fisheries Science Center, Coral Reef Ecosystem Division
<http://www.pifsc.noaa.gov/cred/>
- The Environmental Protection Agency, Pacific Island Region
<http://www2.epa.gov/aboutepa/epa-hawaii>
- U.S. Geological Survey Wildlife Health Center
<http://www.nwhc.usgs.gov/>
- University of Hawai'i Kewalo Marine Laboratory
<http://www.kewalo.hawaii.edu/>
- University of Hawai'i Department of

Microbiology

<http://www.hawaii.edu/microbiology/index.html>

PARTNERS

- Bubbles Below
<http://bubblesbelowkauai.com>
- Eyes of the Reef
<http://eorhawaii.org>
- Hanalei Watershed Hui
<http://www.hanaleiwatershedhui.org>
- Kaua'i Community College
<http://kauai.hawaii.edu>
- Seasport Divers
<http://seasportdivers.com>
- Waipa Foundation
<http://www.waipafoundation.org>

RESOURCES

- Reef Response: Black Band Coral Disease On Kaua'i
<http://dlnr.hawaii.gov/reefresponse/kaua-i-black-band-disease/>
- Eyes of the Reef Network
<http://eorhawaii.org>
- Reefology 101, Coral Health and Ecology Forum
<http://reefology101.wordpress.com/about/>

As told to Alexandra Donargo and Georgina Cullman.

THE MILSTEIN SCIENCE SYMPOSIUM

The collection of this case study and others like it results from the April 2013 Milstein Science Symposium, Understanding Ecological and Social Resilience in Island Systems: Informing Policy and Sharing Lessons for Management. Held at the American Museum of Natural History, the Milstein Science Symposium convened local resource managers, researchers, educators, island leaders, policy makers, and other leading conservation practitioners to examine characteristics, qualities, and processes that may foster resilience for coastal and marine systems as well as explore interactions, linkages, and feedback loops in complex social-ecological systems and what this means for management. The Milstein Science Symposium was organized in collaboration with The Nature Conservancy, the Gordon and Betty Moore Foundation, the National Science Foundation, The Christensen Fund, the Coral Reef Alliance (CORAL), the Scripps Institution of Oceanography at the University of California San Diego, the University of California Santa Barbara, the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States (UN-OHRLS), and the Wildlife Conservation Society.

The 2013 Milstein Science Symposium was proudly sponsored by the Irma and Paul Milstein Family.



CENTER FOR BIODIVERSITY AND CONSERVATION

In 1993, the American Museum of Natural History created the Center for Biodiversity and Conservation (CBC) to leverage its institutional expertise to mitigate threats to cultural and biological diversity. The CBC develops strategic partnerships to expand scientific knowledge about diverse species in critical ecosystems and to apply this knowledge to conservation; builds professional and institutional capacities for biodiversity conservation; and heightens public understanding and stewardship for biodiversity. Working both locally and around the world, the CBC develops model programs and tools that integrate research, education, and outreach so that people -- a key factor in the rapid loss of biodiversity -- will become participants in its conservation.

To learn more about the CBC, please visit our website:

<http://cbc.amnh.org>



CENTER FOR BIODIVERSITY AND CONSERVATION

© 2014 Center for Biodiversity and Conservation, American Museum of Natural History.

Cases can be found online at:

<http://tinyurl.cbc-resilience-cases>

Cover page photo by Felicity Arengo.

Edited by Georgina Cullman.

Design by Nadav Gazit.