The Future of Bonaire's Coral Reefs

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Introduction

- Ocean temperatures are increasing around the globe, leading to a dramatic rise in the frequency and severity of coral bleaching events.[1] Around the Caribbean, there has been a 22% decline in coral cover since 2010.[2]
  - Coral bleaching is when corals lose symbiotic algae from their tissues and appear pale or white. The loss of symbionts reduces their ability to obtain energy, increasing their risk of mortality.
- Coral reefs make up about 1% of the world's oceans, but they house nearly 25% of life in the ocean.[1]
  - Bonaire is an island in the southern Caribbean that experiences annual bleaching events. Communities on Bonaire are reliant on these reefs for food security, tourism, and culture.
- Coral susceptibility to bleaching and speed of recovery from disturbance varies between genera and can be influenced by environmental factors like water quality and depth.
  - Previous research has shown that massive reef-building corals like *Orbicella spp*. and *Montastrea cavernosa*, showing slower but sustained recovery, while weedy corals like *Agaricia spp*. and *Porites astreoides* exhibit faster recolonization.[2]
    - How does the intensity of coral bleaching vary among different coral species and reef sites around Bonaire?
- Corals in Bonaire experiences a severe coral bleaching event in November 2023, and a second bleaching event in November 2024. Assessing the recovery of corals between bleaching events is important to understand the impacts of successive disturbance on coral reefs.

Methods

Data Collection

We conducted field surveys at eight reef sites in June 2024. At each site, a 50 meter transect was photographed at a depth of 15 meters. Photographs were taken to document the size and health status of coral colonies – two parallel lasers were mounted to the camera to help size the coral colonies. The images were processed using the program TagLab where coral colonies were identified to genus or species level, and their health status was categorized based on visible bleaching and other signs of stress.

Research questions

1. How does coral health vary among different coral species around Bonaire?

2. How does coral health vary among reef sites around Bonaire?

Hypotheses:

1. Based on historical data, reef building corals like *Stephanocoenia Intercepta* will be the healthiest at all sites.
2. Sites further from urban areas will have the healthiest corals because there are fewer stressors.

Analysis:

We calculated the percent of coral colonies that were unhealthy versus healthy for each genus and at each site using R. We used simple descriptive statistics to visualize these differences in R.

Results

Site	Boka Barkol	Cliff	Delfins	Invisibles	Oil Slick Leap	Parke Tululi	Te Amo	Vista Blue
Total Colonies	231	147	417	589	232	411	444	402
Percentage Unhealthy	21.6	37.4	30.7	16.1	24.1	32.6	20.7	9.2

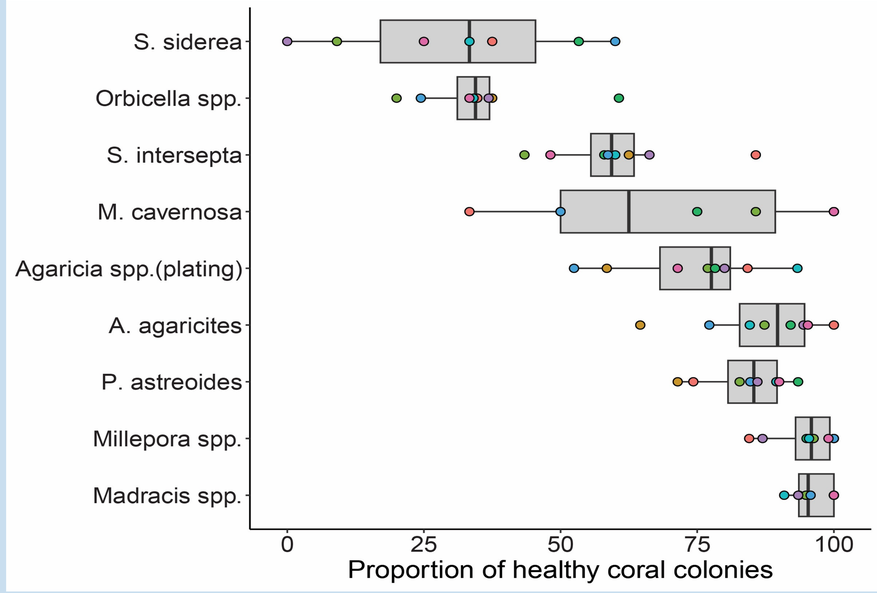


Figure 1. For each coral genus, or species the proportion of healthy coral colonies. Dots represent values at different sites.

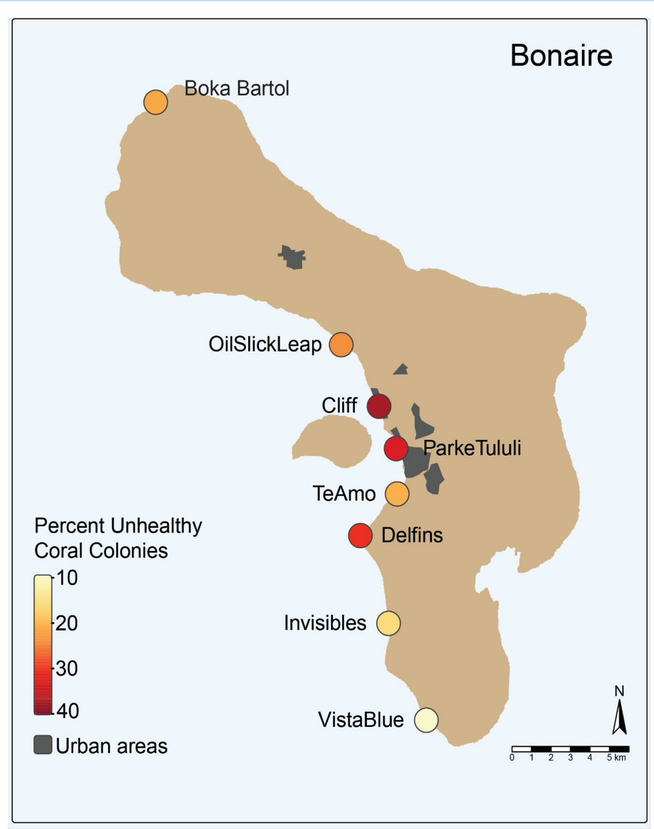
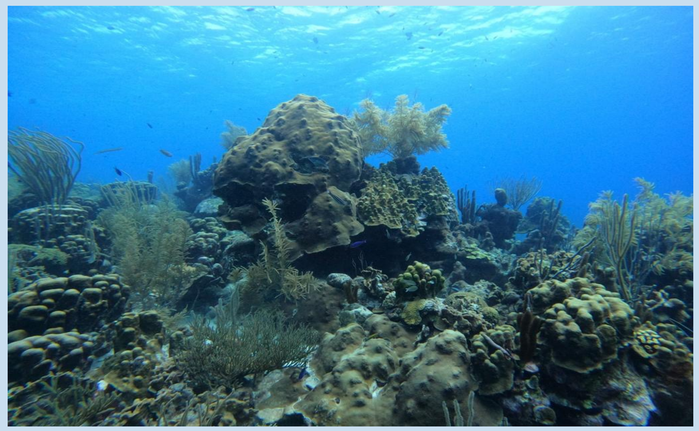


Figure 2. Proportion of unhealthy coral colonies at each study site.



Conclusions

- Reef building corals (stress tolerant) are more unhealthy than weedy corals, which may indicate changes to primary coral species on the reef and reductions in reef building.
- Coral health varies between sites, with healthier reefs in the South of Bonaire, but the differences are likely driven by species-specific health differences.
- If unhealthiness is an indication of survival or susceptibility to future bleaching events, certain corals will fare worse in the future.

Resources

1. Bonaire: A model in reef sustainability. NOAA Ocean Explorer Podcast RSS. (n.d.). https://oceanexplorer.noaa.gov/explorations/08bonaire/background/mpas/mpas.html
2. Steneck, R. S., Arnold, S. N., Boenish, R., de León, R., Mumby, P. J., Rasher, D. B., & Wilson, M. W. (2019, May 3). Managing recovery resilience in coral reefs against climate-induced bleaching and hurricanes: A 15 year case study from Bonaire, Dutch caribbean. Frontiers. https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2019.00265/full