The Next Generation of Bonaire's Coral Reefs

Kassandra Sevila, Laurel Field, and Dr. Sarah Lester

Tyler Center for Global Studies Undergraduate Research Award

Introduction

- Global coral reef extent has decreased by 50% since the 1950s due to increased ocean temperatures and pollution.
- Bonaire is an island in the southern Caribbean that is impacted by annual coral bleaching events and coral disease.
  - When corals bleach, they lose symbiotic algae from their tissues and appear pale or white, leading to coral starvation and mortality.
- The density of juvenile corals can indicate a coral reef's potential to recover from disturbance. However, juvenile coral abundances often vary between nearby reef locations and coral genera.
  - In Bonaire, previous research has found that juvenile corals were most abundant in the southern part of the island, away from coastal development.
- The coral composition on Caribbean reefs is shifting towards smaller and "weedier" coral species that are fast growing, and away from larger, slow-growing coral species that build the reef.
  - In Bonaire, previous research has found that "weedy" juvenile corals were the most abundant.
- There have been no recent studies in Bonaire that examine patterns of juvenile corals by depth or location despite coral reef declines.

Methods

Data Collection

We conducted juvenile coral surveys at 17 reef sites, covering about 30m² per site, along the west coast of Bonaire in June 2026. Our sites spanned the coastline from North to South and included urban areas. At each site, we counted, identified, and sized juvenile corals within three 5m² transects at 10m and 20m depths. We also assessed the percent cover of coral, algae, and sand at each site and depth, from photos, using the program CoralNet. In total, we surveyed 525m² of the reef and counted 1,134 juvenile corals with the most common species being *Agaricia agaricites* and *Porites asteroides*.

Research questions

1. How does the average density of juvenile corals vary geographically?
2. How is the density of juvenile corals related to benthic cover?
3. How does the density of juvenile corals vary between genera and between functional groups (weedy and slow growing)?
4. Does juvenile coral density vary by depth?

Hypotheses

1. Juvenile coral densities will be lowest in urban areas and generally increase north to south.
2. Juvenile coral densities will be higher at 20m, but dependent on genus.
3. Coral cover and crustose coralline algae will be positively correlated with recruit density and macroalgae, while sand cover will be negatively correlated.
4. Across sites, juvenile corals of weedy species will be more abundant than juvenile corals of slow growing species.

Results

- Juvenile coral density was significantly higher at sites in urban areas compared to sites along the northern west coast of Bonaire, including those within the National Park.
- Density of juvenile corals by depth was found to vary between genera/species and by site.
- Benthic composition of the reef was not found to be a significant predictor of juvenile coral densities.
- Average densities of juvenile corals differed significantly between coral genera/species as well as between weedy and slow-growing groups of corals.

Results

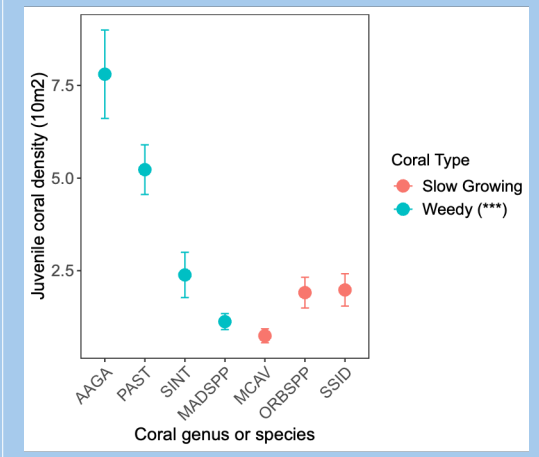

Figure 1. Average juvenile coral density compared between coral genera or species. Slow growing and weedy coral types have significantly different densities of juvenile corals on average (generalized linear mixed effects model, significance level: *** = $p < 0.001$.)

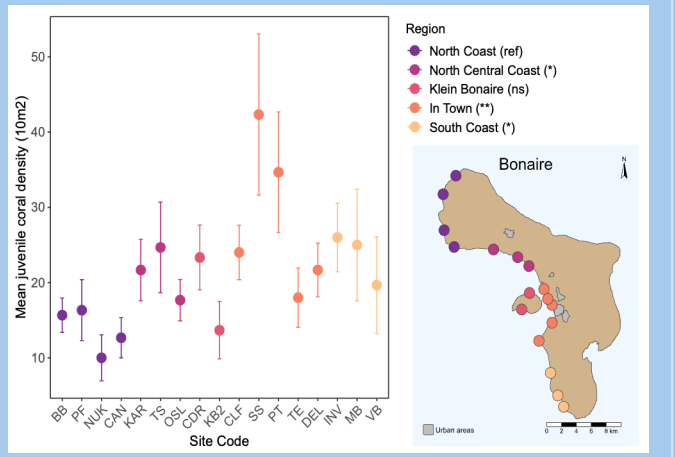

Figure 2. Average density of juvenile corals at each survey site. Density varied significantly between northern sites and all other regions, except Klein Bonaire (generalized linear mixed effects model, significance levels: * = $p < 0.05$, ** = $p < 0.01$. Ref = reference region, ns = nonsignificant.)



Kassandra Sevila reeling the transect tape after graduate student, Laurel Field, surveyed the reef.



Agaricia Agaricites juvenile coral at survey site, Thousand steps.

Conclusions

- Patterns of juvenile coral abundance are best explained by region, with little to no effect of including depth or benthic cover in the models.
- Sites in urban areas may have higher resilience potential than sites in northern areas, but our results could be confounded by recent disturbance (small corals could be fragments of adults).
- Future research should compare patterns of juvenile coral abundance to data on the health of adult coral colonies. From my previous research, I know that sites in urban areas have lower coral health. This could counteract the higher coral recruitment found in this region.
- Bonaire relies on healthy reefs for tourism, food security, and cultural identity. Therefore, it is important to focus conservation efforts on increasing the abundance of slow growing juvenile corals as they contribute to reef growth.

Resources

Couch, C. S., Oliver, T. A., Dettloff, K., Huntington, B., Tanaka, K. R., & Vargas-Ángel, B. (2023). Ecological and environmental predictors of juvenile coral density across the central and western Pacific. Frontiers in Marine Science, 10, Article 1192102. https://doi.org/10.3389/fmars.2023.1192102

Eckrich, C., Francisca, R. L., Rempel, H. S., & Ren, E. (2021). Coral bleaching in the Bonaire National Marine Park 2016–2020. STINAPA Bonaire. https://stinapabonaire.org/wp-content/uploads/2021/03/2016-2020-STINAPA-Coral-Bleaching-Report-Final.pdf

International Union for Conservation of Nature. (2011). IUCN conservation outlook for World Heritage coral reefs. https://portals.iucn.org/library/sites/library/files/documents/2011-008.pdf

Vermeij, M. J. A., Smith, J. E., Smith, C. M., Vega Thurber, R., & Sandin, S. A. (2011). Survival and settlement success of coral recruits on different reef substrates. Diversity, 3(3), 296–303. https://doi.org/10.3390/d3030296