



# Won't you be my neighbor? Ecological associations between *Acropora cervicornis* and other organisms and substrates in Bonaire, Dutch Caribbean

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## INTRODUCTION

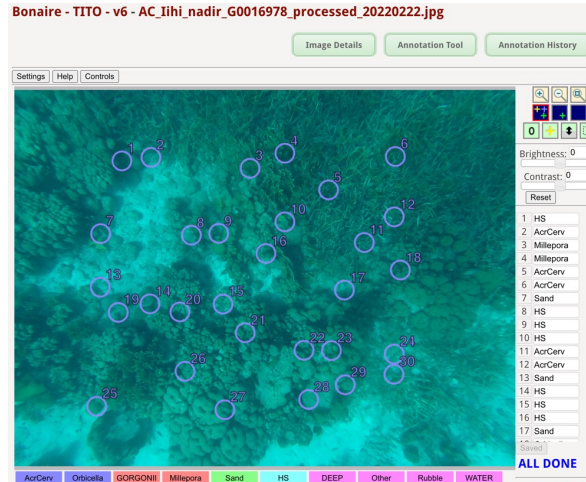


- Acropora cervicornis* is a structure-building coral that provides habitat and refuge for coral reef fishes and invertebrates, and shoreline protection from storm surges.<sup>1,2</sup>
- Acropora cervicornis* used to be the dominant species in the Caribbean but white band disease (WBD) caused a significant decline in the population in the 1970s.<sup>3</sup>
- Historically, *A. cervicornis* formed complex, dense, continuous "thickets" but now appear as fragmented patches throughout the region.
- QUESTION:** How is *Acropora cervicornis* associated with other organisms or substrates in the benthic community?
- HYPOTHESIS:** *A. cervicornis* will be positively associated with complex substrates or organisms such as rubble, fire coral, gorgonians, or hard substrates.
- The impacts of this study will give information regarding the most effective areas for restoration efforts.



**Top left:** Map of Bonaire, with study sites indicated by orange dots.  
**Top right:** Photo of the autonomous surface vehicle (ASV), a self-propelled robot equipped with GPS and GoPros to capture images over the benthos at a large scale.  
**Bottom left:** Example of a track driven by the ASV centered around an *A. cervicornis* patch.

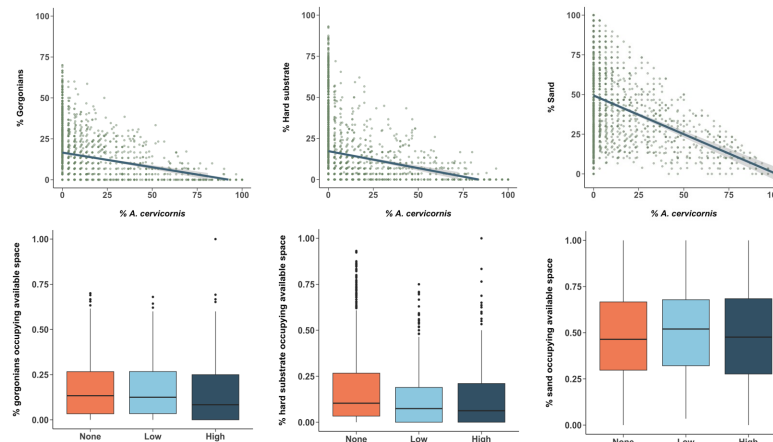
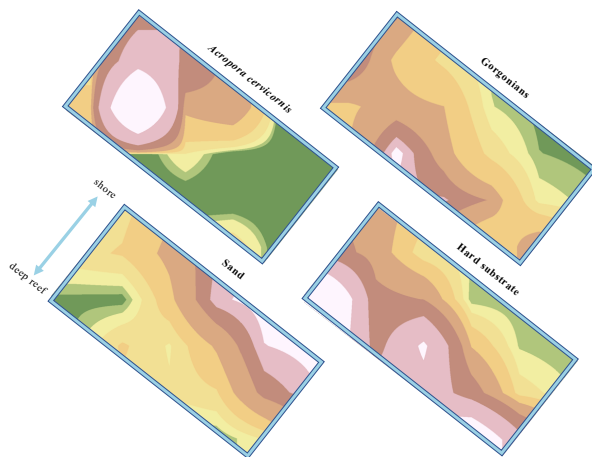
## METHODS



| Categories                  | % of annotations | Accuracy on CoralNet |
|-----------------------------|------------------|----------------------|
| Sand                        | 43               | 93                   |
| Rubble                      | 15               | 69                   |
| Gorgonians                  | 15               | 91                   |
| Hard Substrate              | 12               | 73                   |
| <i>Acropora cervicornis</i> | 7                | 94                   |
| <i>Orbicella</i> sp.        | 4                | 77                   |

- Benthic photos were taken using an autonomous surface vehicle (AKA Tito) equipped with a GPS and downward-facing time-lapsing GoPros. Tito follows a grid pattern (100mx50m) taking a photo every 0.5 seconds.
- Photos were uploaded to **CoralNet**, a resource that allows users to train an algorithm to classify organisms in benthic photos.
- 3716 photos total have been annotated with 30 points on each image**
- Points were classified into 13 different categories of substrates and organisms
- These annotated points were converted into a % cover of each organism/substrate
- Data was aggregated at the photo-level and the relationships between *A. cervicornis* and other benthic categories were explored.

## RESULTS

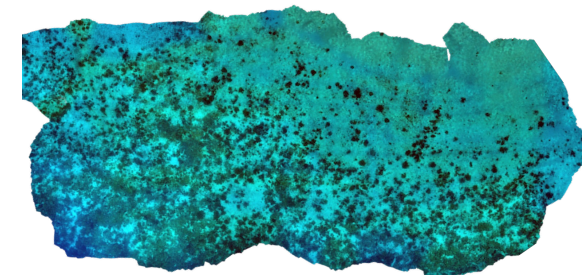


The heat maps above show the density of a single benthic organism or substrate at one site. Lighter, warm colors represent areas of high densities of the organism/substrate, where darker, cool colors represent areas of low densities of the organism/substrate.

**Top:** Scatterplots showing the linear relationship between % cover of *Acropora cervicornis* and the % cover of gorgonians, hard substrate, and sand (left to right). Each point represents a single hand-annotated photo.  
**Bottom:** Boxplots showing the relationship between different levels of *A. cervicornis* % cover (none, low <20% *A. cervicornis*, high ≥20% *A. cervicornis*) and the % cover of gorgonians, hard substrate, and sand (left to right) scaled to only the remaining available space.

## WHAT'S NEXT?

- We show negative relationships between cover of *A. cervicornis* and other benthic substrates or organisms, but no effect beyond the occupancy of space by *A. cervicornis*
- Next step is to analyze wild and restored *A. cervicornis* patches separately. Restoration sites are chosen to minimize damage to the existing ecosystem, so the surrounding environment and associations between wild *A. cervicornis* may be different from those at a restored site.
- Currently building **orthomosaics** of each site that will allow us to look at the expansion or contraction of each *A. cervicornis* patch over time and correlate it to other organisms and substrates.



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