Effect of habitat configuration on the persistence of macroalgae in the Moorea coral reef system

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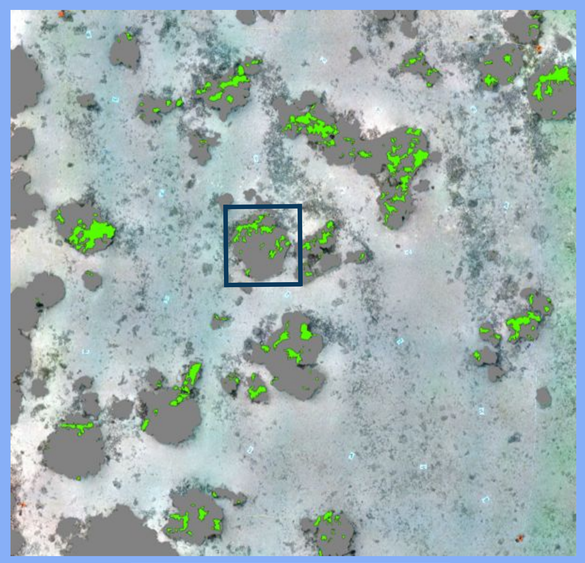
Background Information

- Coral reefs are threatened around the world due to global (e.g., climate change) and local (e.g., overfishing) anthropogenic stressors
- Phase shifts occur when coral reefs shift from majority coral cover to majority algal cover
- *Turbinaria ornata* is the macroalgae responsible for phase shifts in the lagoons of Moorea, French Polynesia, yet it has low dispersal
- We worked to learn how the spatial distribution of bommies (or patch reefs suitable for *T. ornata* settlement) affected the changes in *T. ornata* growth and spread over a two year period

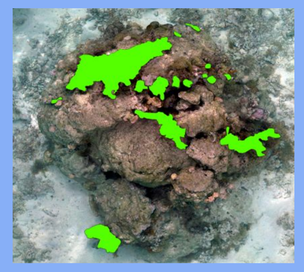
Map of the Island of Moorea with each orthomosaic site plotted

Methods

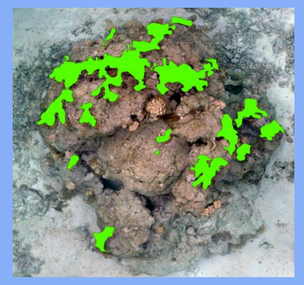
- Orthomosaics, high resolution photomosaics where distances are preserved, taken of the coral reefs were annotated in order to identify *T. ornata* and reef structure within ten 15m x 15m sites in the lagoon of Moorea, French Polynesia in 2019 and 2021
- Calculated the amount of each bommie occupied by *T. ornata* in both years to measure change at the scale of individual bommies
- Measured the size of each bommie and its proximity to others to determine whether these attributes of the bommies influenced the change in *T. ornata* cover over two years



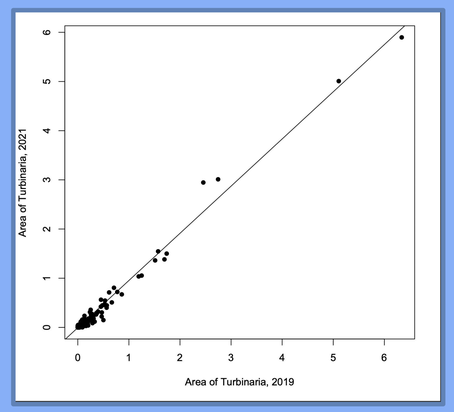
Fully annotated orthomosaic from one of our sites



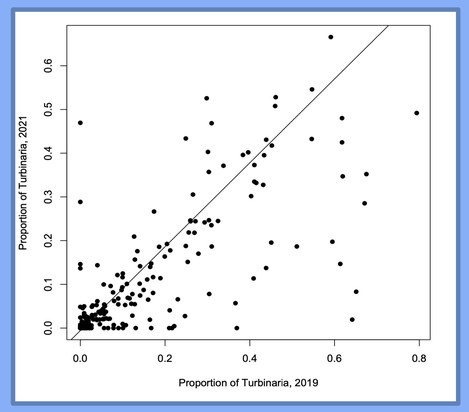
Highlighted bommie from 2019 with algae annotated



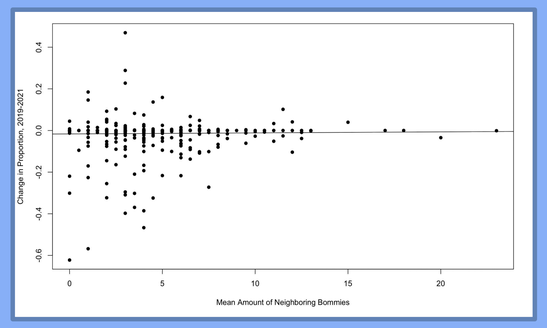
Highlighted bommie from 2021 with algae annotated



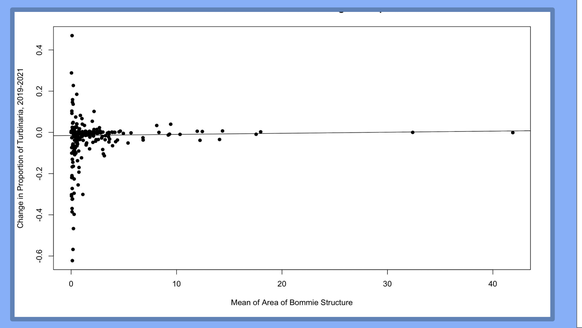
Change in Area of Turbinaria, 2019-2021



Change in Proportion of Turbinaria, 2019-2021



Correlation between the Mean of Neighboring Bommies and Change in Population, 2019-2021



Correlation between Mean of Area of each Bommie and the Population of Turbinaria, 2019-2021

Results and Discussion

- Although we hypothesized that there would be large differences in *T. ornata* over two years (at least 6 generations), the area of *T. ornata* on bommies was highly static between 2019 and 2021
  - This may lead us to believe that there is no overall correlation between Bommie size/Distance between Bommie structures and amount of Turbinaria consuming each bommie
- However, when analyzing the proportion of *T. ornata* on each bommie there was more variability, suggesting that effects may be seen on smaller bommies
- We found bommies that were larger and in closer proximity to other bommies were more stable in *T. ornata* cover through time, yet there was no significant directionality in the effect
- Our study found that *T. ornata* is more stable than we hypothesized and we may need to continue studying these dynamics over a longer timescale in order to come to a complete understanding of *T. ornata* and how it spreads through a complex landscape
- Our next steps are to investigate these patterns at each site to see if there are specific locations where *T. ornata* is changing and to see what may be driving these changes
- With this information, we can learn how to better protect our coral reefs and prevent phase shifts from taking place within these ecosystems

References

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2. Hughes. (1994). Catastrophes, Phase Shifts, and Large-Scale Degradation of a Caribbean Coral Reef. Science., 265(5178), 1547–1551. https://doi.org/10.1126/science.265.5178.1547
3. Schmitt, Holbrook, S. J., Brooks, A. J., & Adam, T. C. (2022). Evaluating the precariousness of coral recovery when coral and macroalgae are alternative basins of attraction. Limnology and Oceanography, 67(S1), S285–S297. https://doi.org/10.1002/lno.11929