The Fast-Growth Protocol:
Accelerating Coral Growth for Reef Restoration in the Hawaiian Archipelago

S.P. Ranson, N.T. Chan, C.S. Wolke, Z.H. Forsman, L. Del Rio Torres, and D.A. Gulko
Hawaii Coral Restoration Nursery, Division of Aquatic Resources, 1039 Sand Island Parkway, Honolulu, HI, USA

Introduction

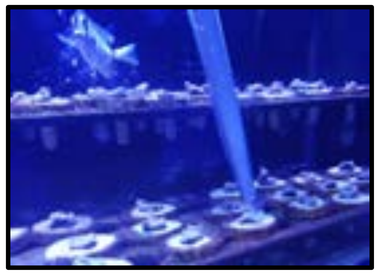
Tropical coral reefs worldwide have a high economic and environmental value. Changes due to natural and anthropogenic factors have led to numerous reef restoration efforts, but the success and scale of these projects have been highly variable. The majority of work has focused on *in situ* nurseries where faster growing colonies (primarily of the genera *Acropora*) are fragmented and left to grow in a natural setting. This has shown promise where growth rates are high, but in Hawai'i, calcification rates are amongst the slowest globally, posing a major problem for the future of Hawaiian reefs.

Our goal is to combat this problem by developing an innovative facility designed to accelerate the growth of Hawaiian corals using *ex situ* aquaria. We believe targeting specific variables important to coral growth will result in an efficient and effective approach to reef restoration in Hawai'i.

Methodology

We designed "**Fast-Growth**" systems which focus on controlling specific variables crucial to coral growth:

- **Temperature**
- **Water Chemistry**
- **Lighting**
- **Water Flow**
- **Heterotrophy**
- **Competition**
- **Sedimentation**

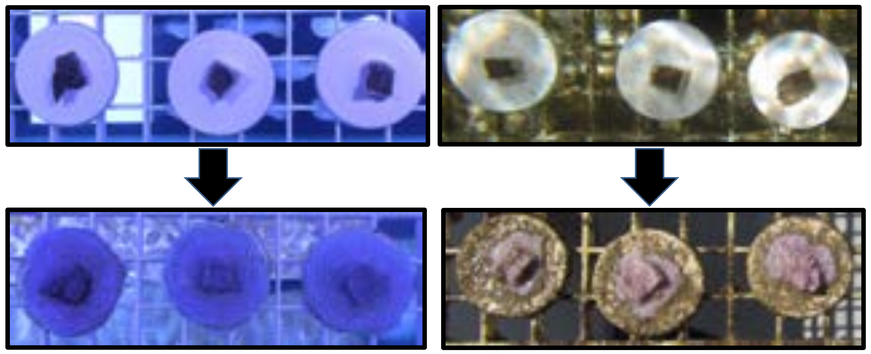


Using a variety of common Hawaiian species, we fragmented colonies into 1cm pieces and attached each to ceramic plugs. Replicates of each species were placed into either the controlled "fast-growth" aquaria or placed outdoors in tanks that incorporated natural seawater and ambient sunlight. Fragments remained in aquaria for a period of four months. Coral growth was measured using top-down photographs and ImageJ™ to calculate horizontal tissue spreading.

Results

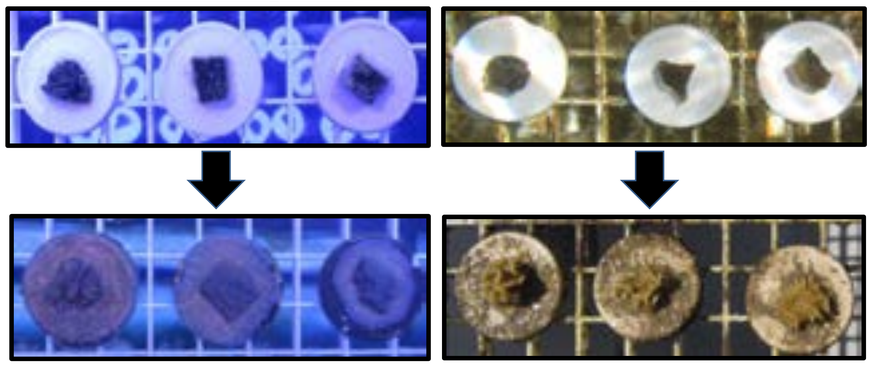
Montipora flabellata

Controlled Aquaria | **Ambient Aquaria**



Pavona varians

Controlled Aquaria | **Ambient Aquaria**



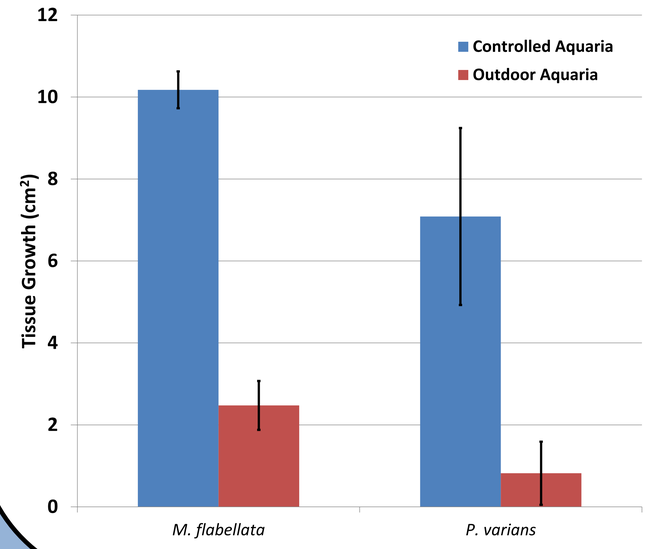
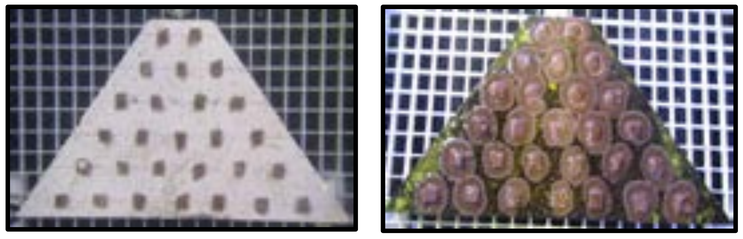


Figure 1: Mean±SE total horizontal tissue growth over a period of four months of *Montipora flabellata* and *Pavona varians* in controlled and ambient/outdoor aquaria

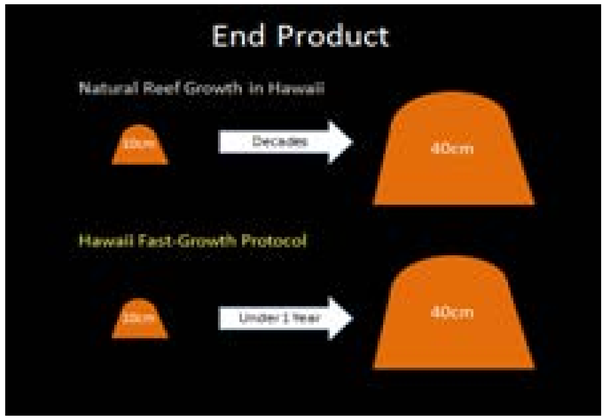
Discussion

- The majority of corals grown in the "**Fast Growth**" systems have shown substantial differences in tissue growth compared to those in ambient conditions

- Using this method we can begin to mass produce large coral colonies (40cm) that would be sexually mature and robust to various environmental conditions
- Changing our growth substrate has allowed for simple fusion and attachment onto concrete modules for out planting



- Designing species-specific systems creating optimal conditions for all Hawaiian reef-building corals



Acknowledgements

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