97 CORALS AND COUNTING:

A LARGE-SCALE ASSISTED MIGRATION ACROSS FLORIDA'S CORAL REEF

UNIVERSITY OF MIAMI
ROSENSTIEL SCHOOL of MARINE & ATMOSPHERIC SCIENCE

Taylor Gill[1], Martine D'Alessandro[1], Joe Unsworth[1], Nikkie Cox[2], Erich Bartels[3], David Gilliam[4], Grace Hanson[4], Jessica Levy[2], Kerry Maxwell[5], Amelia Moura[2], Erinn Muller[3], Diego Lirman[1]

1 University of Miami, 2 Coral Restoration Foundation, 3 MOTE Marine Laboratory, 4 Nova Southeastern University, 5 Fish and Wildlife Commission

Introduction

- Florida has lost > 95% of its coral cover partly due to the decline of *Acropora cervicornis* (staghorn).
- *A. cervicornis* is especially important as it is a fast grower and provides much of the 3D structure in shallow reefs.
- Staghorn has been the focus of restoration efforts in Florida for 15 years. Nurseries now house hundreds of staghorn genotypes that are used for restoration.
- One tool being considered for restoration is Managed Relocation. Managed relocation is a process in which corals from warm environments are moved into cooler environments to prime these populations for the next bleaching event.
- Moving corals already adapted to warm environments can be an effective way to enhance survivorship of susceptible populations, as well as introduce "warm" genes into these populations in advance of changing conditions.
- In this study, staghorn corals sourced from 4 regions of the Florida Reef Tract were reciprocally transferred and tracked within 4 nurseries.

Figure 1. Outplanted Acropora cervicornis by the University of Miami's Rescue A Reef Program.

Methods

- Staghorn corals of multiple genotypes were sourced from 4 coral nursery programs: Nova Southeastern University (NSU, Broward County, **18 genotypes**), the University of Miami (UM, Miami-Dade County, **15 genotypes**), Coral Restoration Foundation (CRF, Upper Florida Keys, **23 genotypes**), and MOTE Marine Lab (MML, Lower Florida Keys, **25 genotypes**).
- The corals were reciprocally distributed to each nursery in July 2020. Each coral genotype consisted of 4-6 fragments (5-10 cm) that were collected from locations throughout each region.
- The size of the corals was measured at the time of deployment and after 6 months at each nursery.
- Size was estimated as total linear extension (TLE, cm), and growth/productivity was calculated as: (6-month TLE – initial TLE)/ Initial TLE.

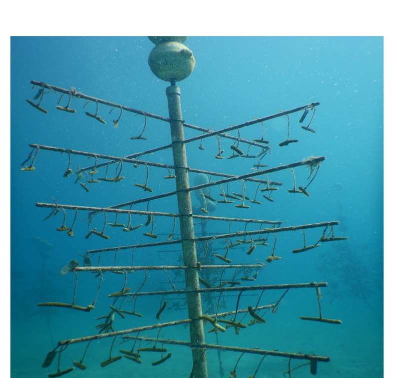


Figure 2. Coral swap tree in the field with different genotypes hung from each branch.

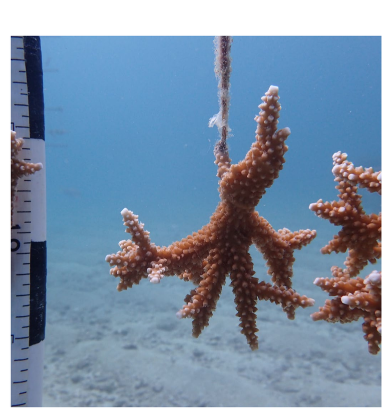


Figure 3. Diver measuring TLE of swap coral using a PVC scale bar.

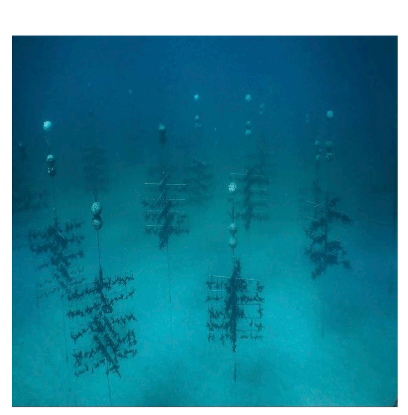


Figure 4. UM Coral Nursery.

GOALS

1) **Create a genetic repository across regions**
2) **Understand how coral genotypes perform in novel environments**
3) **Determine whether Managed Relocation across FL regions can be used in restoration efforts**

Hypothesis: "Local" genotypes will grow faster within their own nurseries compared to "away" genotypes brought in from other regions

Results

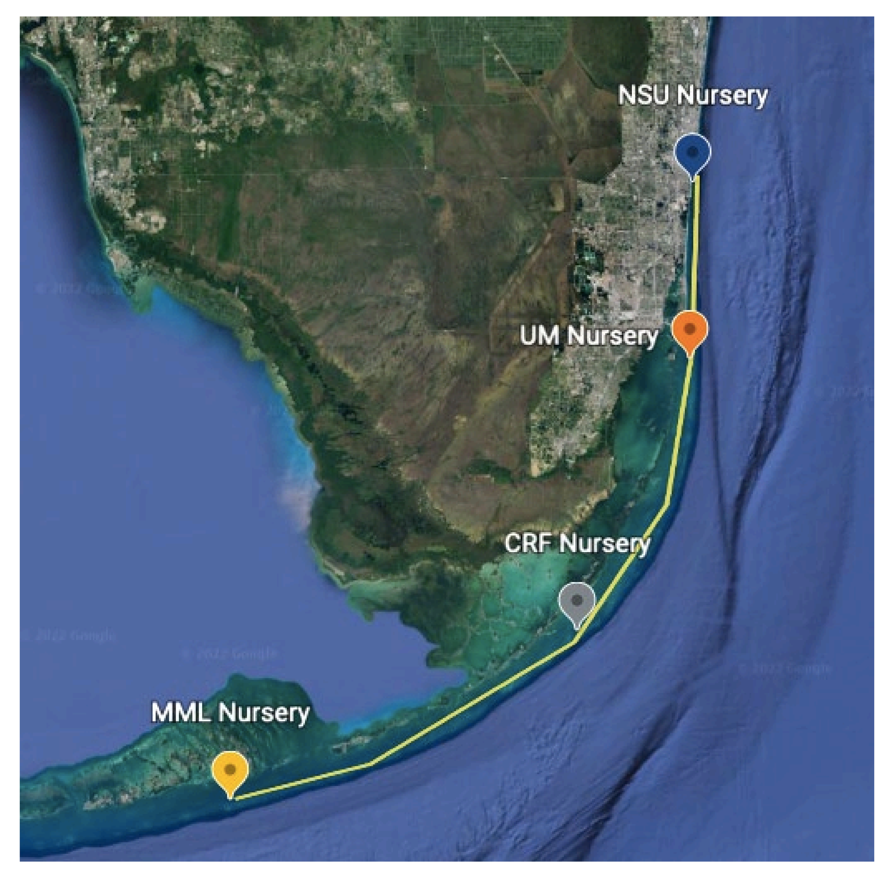
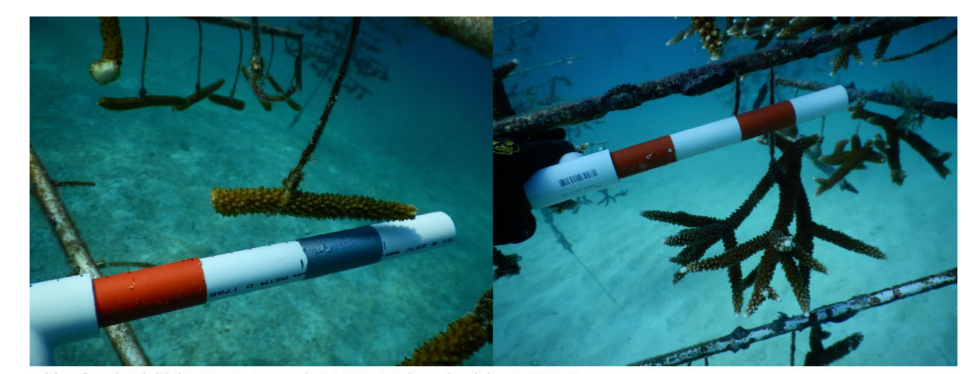


Figure 5. Map of the nurseries that donated and transferred corals throughout the swap. The total distance from the northernmost nursery to the southernmost nursery is ~243 km.



FM-6 Coral 4: Initial 9.386 to 6 month 91.915; total productivity 8.792776

Figure 6. Change in size between initial (T=0) and 6-month survey periods

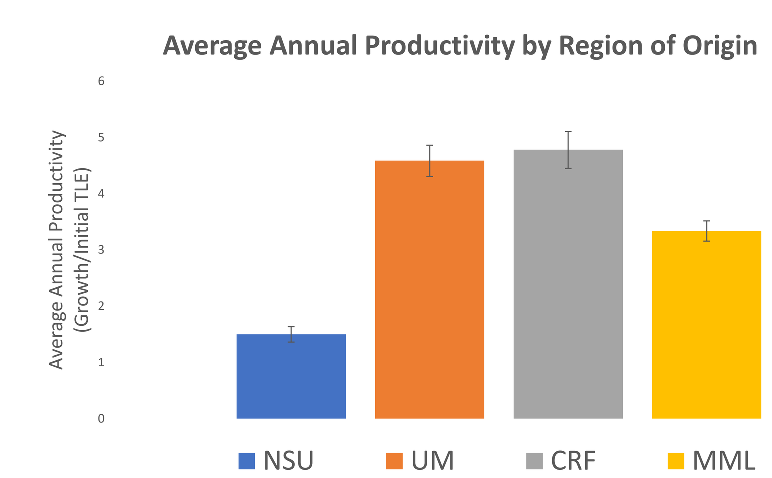


Figure 7. Average Annual Productivity by region of origin. ($p = 3.25 \times 10^{-10}$)

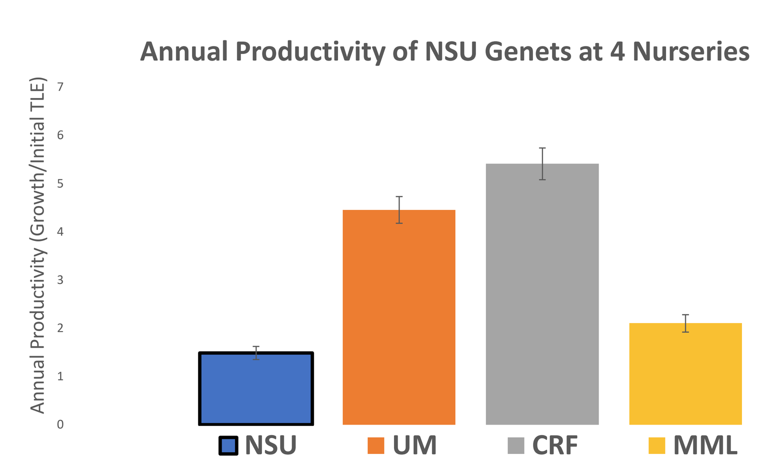


Figure 8. Annual Productivity of NSU Genets at 4 Nurseries. The "local" genotypes are highlighted by the bold boundary. ($p = 7.51 \times 10^{-14}$)

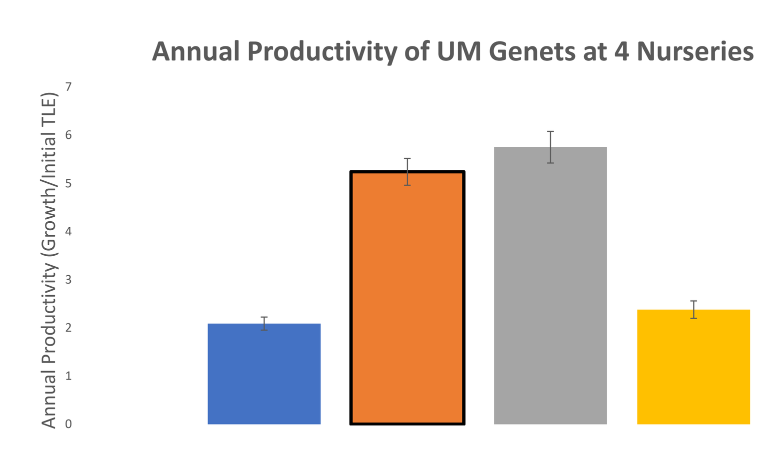


Figure 9. Annual Productivity of UM Genets at 4 Nurseries. The "local" genotypes are highlighted by the bold boundary. ($p = 0.02$)

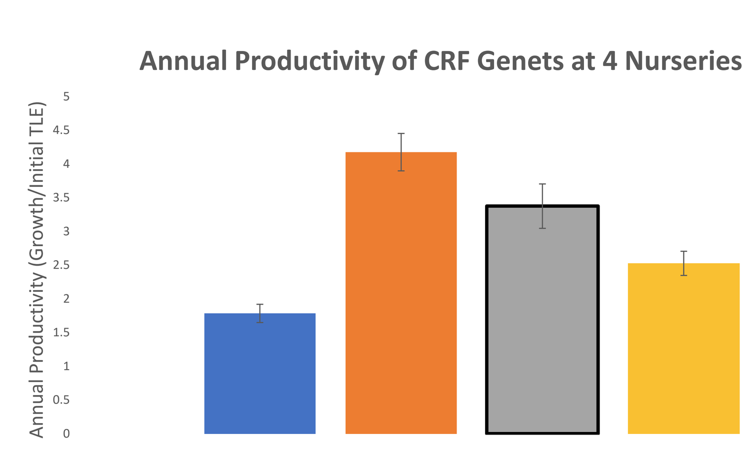


Figure 10. Annual Productivity of CRF Genets at 4 Nurseries. The "local" genotypes are highlighted by the bold boundary. ($p = 2.41 \times 10^{-7}$)

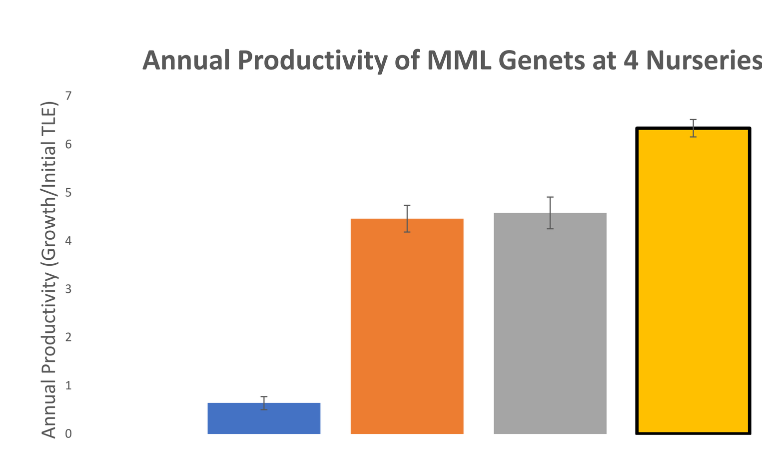


Figure 11. Annual Productivity of MML Genets at 4 Nurseries. The "local" genotypes are highlighted by the bold boundary. ($p = 2.0 \times 10^{-16}$)

Key Findings

- Productivity varied significantly among nurseries (CRF > UM > MML > NSU). The CRF and UM nurseries showed the highest annual productivities and were well-suited locations for each of the 3 fastest growers, suggesting a positive association between a specific genotype and environment.
- MML's local corals showed the highest productivity rate within its own nursery, showing that local adaptation may be present in this home environment (their productivity declined as they were moved to away environments).
- MML and UM corals had lower productivity when moved from their local nursery environment, while CRF and NSU corals had increased growth rates when moved to different environments, suggesting potential benefits of acclimatization for some genotypes and movements that can be used for increased growth by restoration practitioners.
- Productivity of staghorn corals was influenced by the local environment in which they were originally collected as well as the nursery environment in which they were grown in.
- Evidence of local adaptation (faster growth rate within home nurseries) was only documented for corals from MML.
- Mortality as part of the swap ranged from 8% to 22%. The main cause of this was disease. Long range exchanges are viable but may incur high costs due to mortality.

Future Recommendations

- Little is known of the genotypic and environmental influences on coral productivity. More genotype exchanges with other species like the one completed here are needed!
- Managed relocation is a viable tool to use if mortality can be controlled. The next step is to see how these genotypes perform when outplanted onto a reef after acclimation in different regional nurseries.
- This genotype swap successfully created genetic repositories and each nursery partner is now housing genotypes from all regions of the Florida Keys which can be used for restoration if there is coral loss in the local environment.

Acknowledgments

- Thank you to Dr. Diego Lirman, Martine D'Alessandro, and Joe Unsworth for being outstanding mentors.
- A special thanks to CRF, MML, FWC, and NSU for their help measuring, deploying, and recording data for use in this study.
- Additionally, this research would not have been completed without the funding from RSMAS through the SURGE award and a grant from the National Fish and Wildlife Foundation (Lirman PI). Thank you to everyone that was involved!