

## **Towards resilient reef restoration, using larval propagation of Stony Corals**

### **Hacia la restauración de arrecifes resilientes, utilizando la propagación de larvas de corales pétreos**

### **Vers une restauration résilience des récifs, en utilisant la propagation des larves de corail pierreux**

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#### **EXTENDED ABSTRACT**

Coral reefs provide habitat to many organisms, while protecting shorelines and contributing to sustainability of livelihoods. Unfortunately, these valuable ecosystems are exposed to multiple stressors that are significantly reducing coral populations faster than they can reproduce and recover. In the largest archipelago of the Caribbean basin, The Bahama's, the majority of coral loss has been attributed to mass bleaching events and consecutive disease outbreaks (Dahlgren et al., 2020). After mass mortalities of corals, the remaining resilient populations have shown adaptation abilities. However, owing to their low abundance, their capacity to produce viable offspring during spawning events have been compromised. Several coral restoration techniques have sparked to help counteract coral reef decline, such as coral gardening (increase abundance of coral populations) and larval propagation (increase genetic diversity). Genetic variability may influence the capacity to adapt under changing conditions and influence susceptibility to disease, acidification and heat, therefore, applying larval propagation techniques is needed. Sexually produced corals could improve resilience and connectivity, leading to positive impacts on long-term survival. The aim of this study is to gain understanding of trade-offs between thermo-resilience in early life stages, their survival, resistance to diseases and withstanding grazing, since they are crucial to enhance population recovery. Four research questions will be investigated in The Bahamas. Do thermo-resilient recruits grow better/worse in the lab than controls? Do heat resistant larvae and recruits thrive on reefs? Are thermo-resilient recruits better capable to withstand grazing and resist coral diseases? The main goal of this study is to identify and breed heat resistant corals that can survive climate change conditions. Over time, this could prove to maintain reef functions and support thriving communities, while building resilience to major disturbances.

During coral spawning events, gametes can be collected and reared in lab-based facilities, where fertilization has higher rates than would occur naturally (Chamberland et al. 2017). The resulting coral offspring can then be returned to the reef where they will continue to grow and increase coral cover on degraded reefs. For this study a brooder (*Favia fragum*) and a broadcaster (*Orbicella faveolata*) will be used. In brooders, fertilization and embryogenesis occurs internally, they release competent swimming larva during several months per year, which are much more tolerant to environmental stressors compared to other corals. Broadcasters, release large number of eggs and sperm into the water column, during mass spawning events, typically one or more consecutive months

For broadcast spawning: gametes will be collected using a series of gamete collectors, collected spawn will be brought to the wet lab facilities at The Cape Eleuthera Institute. The larvae and coral recruits will be monitored for growth and development and samples will be taken for experiments and heat experiments will be conducted. For brooder species: corals will be collected and kept at the wet lab, every morning tanks will be monitored; any released larvae will be placed in settlement tanks to record growth and survival rates per species and heat stress experiment.

Recruits and larvae exposed to heat stress will be used and compared with larvae and recruits that settle under normal conditions. For larvae, 90 tubes with 5ml of seawater and five larvae each will be exposed to a heat ramp. The same amount will be used as control. For recruits, 100 larvae will be added to 15 small containers with a substrate, and they will be exposed to the same heat ramp as the tubes and also the same amount will be used as control.

Understanding and studying early life stages, while identifying thermo-resilient corals could enhance survival of corals exposed to changing conditions and environmental stressors (Holstein et al., 2022). Thermo-resilient recruits obtained from larvae that survived the first heat ramp will have a higher heat tolerance than the control. Their capacity to resist changes in temperature will ensure their survival. Is it expected for coral recruits that are capable of resisting heat stress to survive and grow faster once they are placed on reefs. Even if coral recruits experience low survival as juveniles. Recruits that resist heat stress will have higher survival rates than those that weren't exposed to the heat ramp when exposed to grazers. A correlation between thermo-resilient recruits and vulnerability of Stony Coral Tissue Loss Disease will be established. Resilient corals identified in early life stages will be able to withstand the exposure of the disease

Healthy coral reefs are needed in many small island developing nations like The Bahamas, where tourism is the number one source of income for the country and many residents make their livelihoods through commercial fishing (Weiler et al., 2019). With genetic diversity comes resistance and resilience to many common stressors such as ocean temperatures rising and coral diseases (Koch et al. 2022). Therefore, repopulating coral reefs with corals bred from larval propagation is an effective and efficient way to restore coral reefs.

**KEYWORDS:** Larval propagation, heat resistance, genetic diversity, coral restoration

#### **LITERATURE CITED**

- Chamberland, V., Vermeij, M., Brittsan, M., Carl, M., Schick, M., Snowden, S., Schrier, A. & D. Petersen. 2015. Restoration of critically endangered elkhorn coral (*Acropora palmata*) populations using larvae reared from wild-caught gametes. *Global Ecology and Conservation*. 4: 526 – 537
- Dahlgren, C., Sherman, K., Haines, L., Knowles, N. & K. Callwood. 2020. Bahamas Coral Reef Report Card Volume 2: 2015 – 2020
- Holstein, D., Smith, S., Van Hooidonk, R. & C. Paris. 2022. Predicting coral metapopulation decline in a changing thermal environment. *Coral Reefs*. 41: 961 – 972
- Koch, A., Bartels, E and Muller EM. 2022. No apparent cost of disease resistance on reproductive output in *Acropora cervicornis* genets used for active coral reef restoration in Florida. *Frontiers in Marine Science*. 9:958500. doi: 10.3389/fmars.2022.958500
- Weiler, B., Van Leeuwen, T. & K. Stump. 2019. The extent of coral bleaching, disease and mortality for data deficient reefs in Eleuthera, The Bahamas after the 2014-2017 global bleaching event. *Coral Reefs*. 38: 831-836.