

A Comparison of Wild and Nursery-Raised Corals

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Gantt, S.E., Keister, E.F., Manfroy, A.A., Merck, D.E., Fitt, W.K., Muller, E.M., Kemp, D.W. Wild and nursery-raised corals: comparative physiology of two framework coral species. *Coral Reefs* 42, 299–310 (2023). <https://doi.org/10.1007/s00338-022-02333-9>

Anthropogenic global warming has caused an increase in the bleaching of corals around the world. Coral bleaching occurs when ocean temperatures are too high, causing the coral polyps to expel their photosynthetic symbionts. Corals can survive for some time without their symbionts, but if temperatures remain too high for an extended period, the corals will die. With temperatures rising globally, this destruction of corals is becoming more prevalent.

Coral reefs are home to a large portion of marine biodiversity, despite only covering a small percentage of the seafloor. In an effort to preserve this biodiversity, conservation groups have established methods to restore coral reefs that have been lost to elevated ocean temperatures. One such method is the propagation of corals raised in nurseries. This process involves raising corals in a nursery until they reach a certain size and then planting them on the damaged reef (Gantt et al. 2023). The hope is that these propagated corals will then grow to replace the corals that have died.

Gantt et al. (2023) investigated whether these nursery-raised corals could serve as sufficient replacements for wild corals. The nursery-raised corals undergo extreme stress when outplanted to a new environment, which can impact short-term and long-term survivorship. For this restoration method to be successful, it is important to minimize stress (Gantt et al. 2023). In this study, the authors aimed to identify ways to minimize the stress on the corals. They addressed this question by comparing the physiology of nursery-raised and wild corals.

Two species of corals (*Acropora palmata* and *Orbicella faveolata*) were raised in a land-based nursery. These corals were sampled while in the nursery in both the spring and summer. For each sample, the authors measured the photosynthetic efficiency by calculating the ratio of variable fluorescence to maximum fluorescence (F_v/F_m). They also analyzed symbiont cell density per coral surface area, chlorophyll *a* concentration, and coral tissue biomass, as well as a few other parameters. Measurements from wild populations of both *A. palmata* and *O. faveolata* were based on data collected from wild Florida Keys reef sites in the previous 23

years. Comparing these measurements for both the nursery-reared and wild corals allowed for an understanding of the physiological differences between the two.

Gantt et al. (2023) found that chlorophyll *a* concentrations were higher in the symbiont cells of the nursery corals than the wild corals (Figure 1a.). They also found that algal symbiont cell densities were significantly greater in the wild corals for all cases except spring *O. faveolata* (Figure 1b). Nursery-raised corals had much lower tissue biomass than the wild corals. F_v/F_m was higher for all nursery corals in the summer, but higher for all wild corals in the spring.

Based on these results, it was concluded that nursery-raised corals are acclimated to low-light conditions. The authors came to this conclusion because the nursery corals seem to have made the trade off to increase the amount of pigment (chlorophyll *a*) per cell, rather than maximizing the photosynthetic yield. The nursery-reared corals had high F_v/F_m levels for some time points, which correlates with the F_v/F_m values of corals acclimated to low-light or deepwater conditions. Because they are acclimated to low-light conditions, the corals experience stress when exposed to the high-light conditions on the reefs where they are outplanted. Gantt et al. (2023) suggest that slow acclimation to high-light conditions could reduce the stress on the corals. However, the authors acknowledge that it would be costly to mimic natural reef conditions within these land-based nurseries. New technologies that can increase the realism of coral nurseries will need to be developed to resolve this issue in a cost-effective manner.

The lower tissue biomass of the nursery-reared corals has a negative effect on the long-term survivorship of the corals. Currently, it is unclear as to why the nursery corals would have a lower tissue biomass. It could be due to their diet in the nursery, or the method of microfragmentation used to asexually reproduce the corals, but it is impossible to know with the current data. To continue to improve the long-term survival of these propagated corals, this element of coral physiology should be more closely examined.

The differences in the physiologies of the nursery-raised and wild corals provides insight into how to improve the survivorship of propagated corals used in coral reef restoration. For this method of restoration to be effective, it is essential to optimize the acclimation of nursery-reared corals. To improve the transfer of nursery-raised corals into wild habitats, more needs to

be learned about how to mimic natural light conditions in artificial coral nurseries, as well as how to increase the tissue biomass of nursery corals.

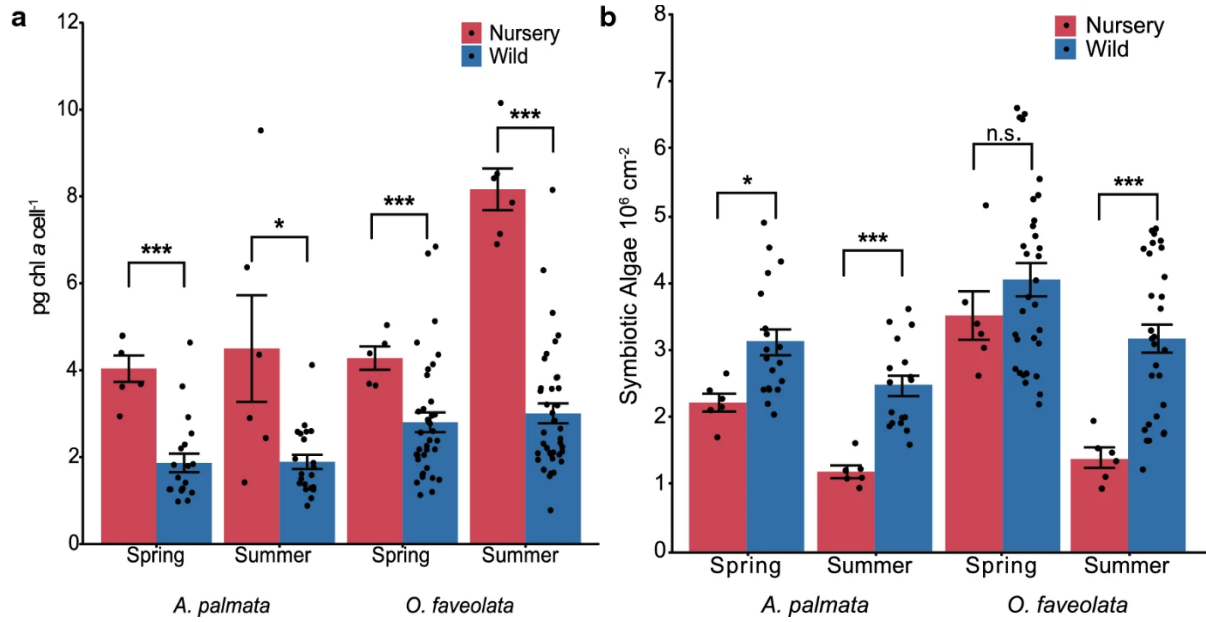


Figure 1. a. Chlorophyll *a* concentrations per symbiont cell. b. Algal symbiont cell densities per coral tissue area.