Scaling Coral Reef Restoration in Climate-Stressed Island Systems:

Optimizing Nursery Time for Acropora species in Coral Restoration in Mafia Island, Tanzania

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BACKGROUND

- **Coral reef restoration commonly uses coral gardening**, where fragments taken from donor colonies are grown in nurseries before being outplanted onto degraded reef.
- Survival and growth can vary with **species, fragment size, nursery structure and outplanting method**.
- Practitioners are increasingly finding that for some species, the **nursery phase can be shortened or even skipped**, while others may still benefit from nursery conditioning.
- Much less is known about the **optimal nursery residence time for different coral species** and whether comparable outcomes can be achieved with shorter nursery periods.
- **Ropes of Hope (RoH)** is a community-based coral restoration program in Mafia Island Marine Park, Tanzania, working with local coral gardeners.
- If nursery time can be safely reduced, restoration could require **less labor, space, time and maintenance**, making it easier to scale.

EXPERIMENTAL DESIGN

1. Coral source

Nursery fragments + naturally occurring donor colonies

2. Nursery history

- **Freshly fragmented**
- **1 month**
- **2 months**

3. Outplanting

Secured with cable ties in 1 m × 1 m plots

4. Monitoring

- **Survival**
- **Condition**
- **Growth**

5. Photography

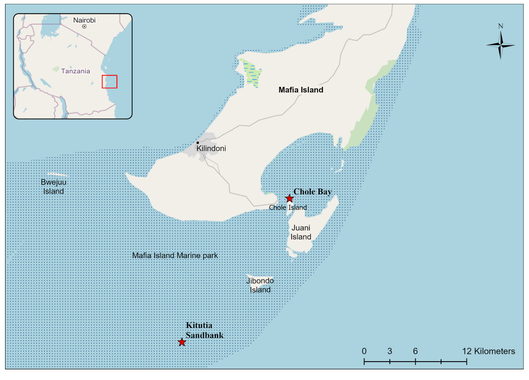
Standardized underwater plot photographs

RESEARCH QUESTION

Does limiting or omitting the nursery phase affect coral survival and growth compared with the traditional two-step nursery-based coral gardening approach?

METHODS

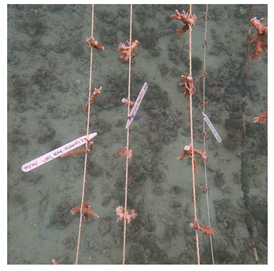
- Study sites: Kitutia experimental and Chole control site, Mafia Island Marine Park, Tanzania
- Four *Acropora* species: *A. humilis, A. austera, A. valida* and *A. muricata*
- *Pocillopora* included as a comparison group
- Fragments sourced from nursery plots and fragments sourced from nursery stock and naturally occurring donor colonies
- Compared freshly fragmented, 1-month and 2-month nursery treatments
- ~30 fragments per species x treatment targeted, subject to availability
- Fragments outplanted into labelled 1 m x 1 m plots and secured with cable ties
- Survival, condition and growth monitored after outplanting
- Standardized underwater photographs taken with an Olympus camera on a custom rig that I researched, designed and had locally fabricated



Study area in Mafia Island Marine Park, Tanzania, showing the Kitutia experimental site and Chole control site

WHY IT MATTERS

Coral nurseries can improve fragment recovery, but they also require time, space, materials and repeated maintenance. If some *Acropora* species can be outplanted after a shorter nursery period without compromising survival, community-led restoration programs could potentially restore larger areas with the same resources.



Left: *outplanting corals on diamond mesh fencing at Kitutia coral restoration site*
Above: *Acropora fragments in Chole nursery site*
Right: *sorting corals for outplanting with the Ropes of Hope team*

BENEFITS TO ISLAND COMMUNITIES

Coral reefs are closely linked to the livelihoods and wellbeing of many island communities.

Successful, scalable restoration may help:

- Support reef-based livelihoods and food security
- Protect biodiversity and healthy reef ecosystems
- Maintain tourism
- Reduce coastal exposure by supporting reef structure
- Create local skills, employment and stewardship through community-led restoration

Reducing nursery time could make these benefits more achievable by lowering the labor, space and cost required to restore larger reef areas.

KEY FINDINGS/ FIELD INSIGHTS

Nursery time cannot be considered in isolation. Fragment size, condition and species differed between treatments and may also influence restoration outcomes.

Real-world restoration creates experimental constraints. Unequal fragment availability meant identical sample sizes could not be maintained across every species and treatment.

Monitoring methods matter. A single overhead photograph did not consistently capture an entire 1 m x 1 m plot in focus. Testing multiple standardized images produced a more practical method for continued monitoring.

Long-term treatment effects are still being tested. Continued monitoring is needed before determining whether shorter nursery periods provide comparable survival and growth.

LIMITATIONS & NEXT STEPS

- Short field period prevented assessment of longer-term survival and growth.
- Fragment availability, size and condition varied among treatments.
- Continue monitoring survival, attachment and growth across nursery-time treatments.
- Determine whether shorter nursery periods can achieve comparable outcomes across *Acropora* species and fragment sizes.
- Assess whether reduced nursery time could lower the time, labor and cost of community-based coral restoration.

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