Restoration of Coral Reefs:
Insights from a practitioner

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CARIBBEAN
coastal ecosystem services

Background & Caribbean context for Ecosystem services restoration baseline: 1980

Caribbean shallow fore-reef/crests were dominated by the golden course-branching elkhorn coral, *Acropora palmata*

Define "dominated"?

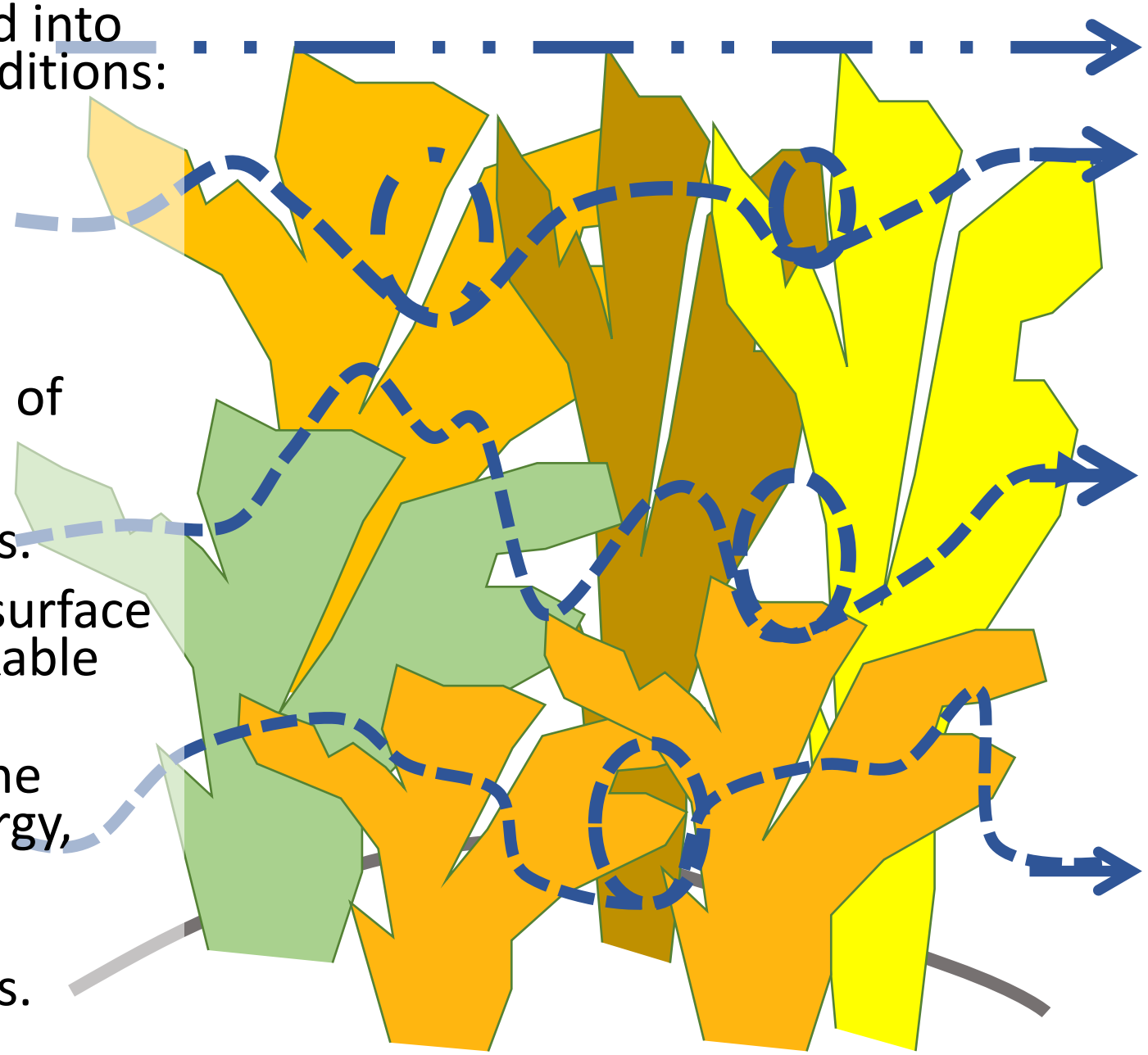
- Filled the water-column with branch-fronds toward & to the surface from as deep as 3m.
- Colloquial name "*Pond-Tile*" as children walked about on the pretty fronds.
- Golden is the natural background reefscape hue/colour,

  as ***reflected from the clouds***

Rapid, upward branch-growth tangled into the water-column in high-energy conditions:

- *reduced depth*
- *increased benthic rugosity*

- Attenuating of waves for protection of downstream habitats and/or infrastructures,
  IE: seagrasses & sandy beaches.
- “Pond” of Pond-Tile described sea-surface conditions as protected by the walkable branch-lattice.
- Water volume continued through the lattice without damaging wave energy, carrying sediments for downstream habitats and/or infrastructures,
  IE: seagrasses & sandy beaches.

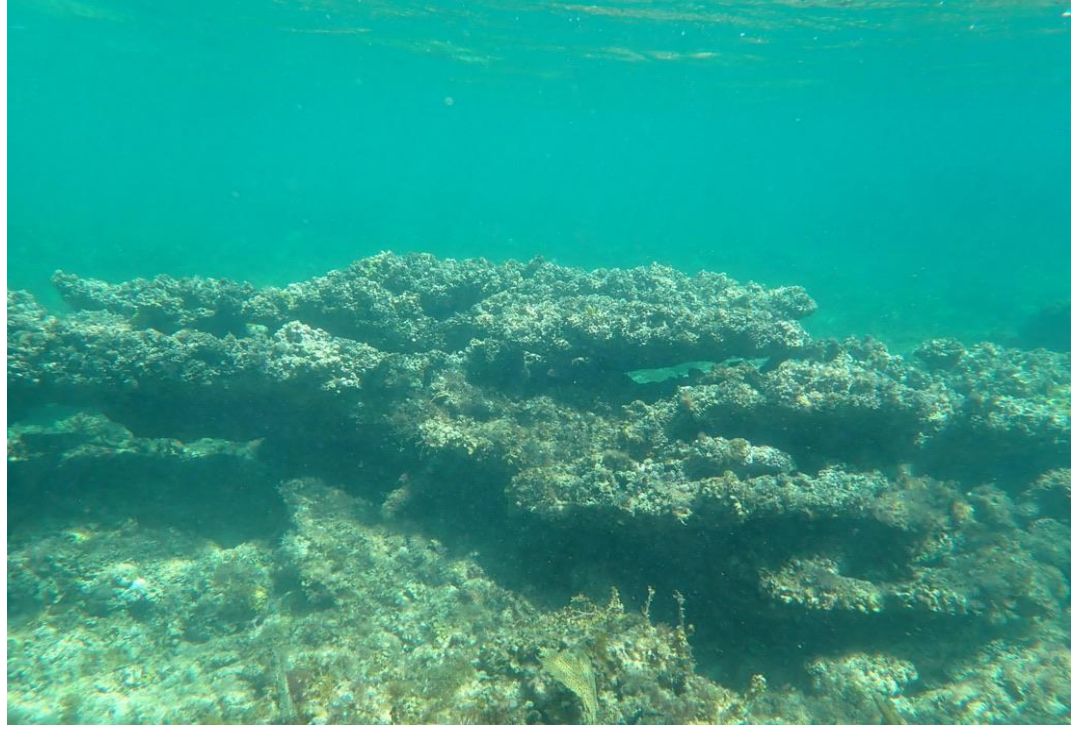


Starting in about 1980…

- Regional disease event killed 90~97% of the standing crop.
- Branches eroded and fell in storms:
  - Rapid increase in depth
  - Rapid reduction in rugosity

    … all before the computers required to understand their hydrodynamics.

- Coastal erosion, beach loss
  - *Absent understanding/models, hard-engineering is the recourse.*



Seascape Caribbean is a regional private contractor based in Jamaica, providing enhancement and restoration of coral (reef) ecosystem services under contracted, goal/deliverable and timeline-oriented landscaping and soft-engineering themes

Clients and/or value propositions currently include:

- **Tourism** as snorkeling gardens and/or green-branding exercises;
- **Engineers** & **developers** related to impact remediation;
- **National governments**/government collaborations related to grants and groundings;
- **NGO/community** collaborations/contracts related to grants, fishery enhancements and fisher employment;

And value propositions being pursued:

Engineering: soft, hard and hybrid

Restoration of the historic reefal conditions that protected coastlines and generated beaches, dunes and seagrass meadows.

Specific tooling, materials and methods:

- Inventions for efficiency. For in-house, collaborative and/or at-cost sale;
- Novel approaches to boost scalability,

  SIDS applicable;
- Novel approaches to boost thermal tolerance, incl. evolutionary nudging.
- **Ecosystem-holistic approaches** including MPAs, mariculture and "ranching" approaches.
- **Collaboration,** sharing, presenting, teaching.

Current projects:

WANSEC is a

- CBF-supported UWI multi-campus/multi-island project demonstrating, quantifying and modeling how a restored (pre-1980) elkhorn coral branch lattice (reef) changes wave breaking patterns, attenuating erosive energies and accumulating sediments (sands):
  - 15,000 temperature-tolerant elkhorn corals nursery cultured and planted and maintained to 15,000m^2 of shallow limestone "pavement" hard-bottom, as
  - 2x 2500 plots planted with one coral per metre^2 on each of three Caribbean islands:
    - Jamaica
    - Antigua
    - Barbados

Entering into year two of three

Current projects:

Montego Bay Barge Grounding Restoration

NEPA (Govt. of Jamaica environmental regulator) "impactor pays" mixed-species, mixed-media reefscape restoration from a Feb.2000 oceanic barge grounding. 2800m² impacted.

- Detailed mapping and baseline monitoring of the impact zone plus surrounding reference and/or buffer areas;
- "Long-swim" surveys seeking parent corals, particularly of species made rare through the 2023 high-temperature (bleaching/mortality) event;
- Nursery culture, planting and on-reef maintenance of 5000 coral isolates;
- Fabrication and installation Jamaican anodized artificial reef modules;
- End-of-project handover to trained fisher-staff as managed/maintained paid-access snorkeling area.

Entering year two of three

Current projects:

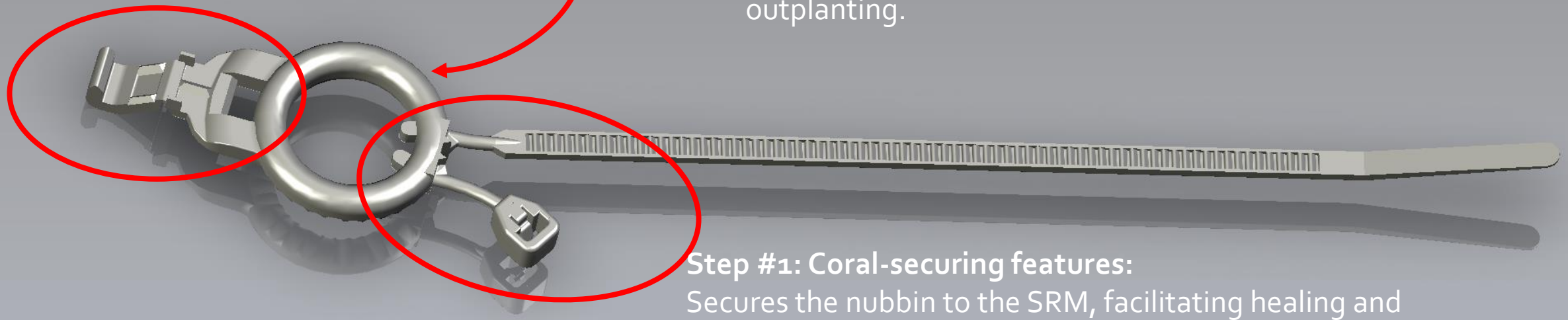
Both of these projects are under silvicultural themes wherein large counts of very small coral isolates are kept in the nursery for the minimal amount of time before planting. This allows scales of both count and coverage area applicable to the restoration of ecosystem services.

The trade-off to horticultural themes is the absence of a more photogenic nurseries holding larger corals, and a relatively extended timeline to on-reef visibility of the coral. Although unitary survivorships should be reduced in the smaller outplants, this has not been the observed case due to the relative on-reef stability of the smaller coral, thus few are lost. Increased losses there also eclipsed by the greatly increased isolate count

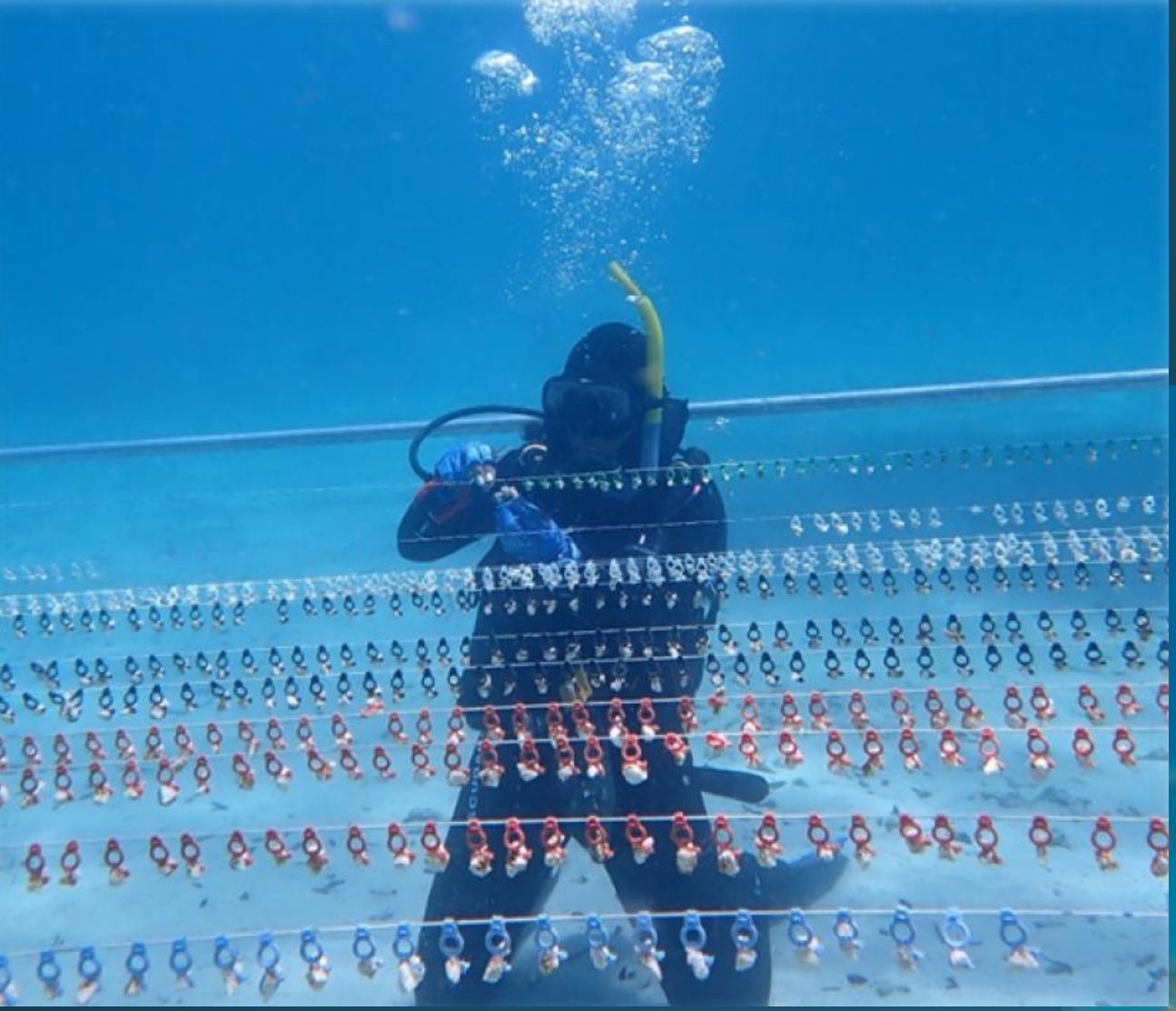
Silvicultural Ring Mount Device: *Three (3) primary action-elements*

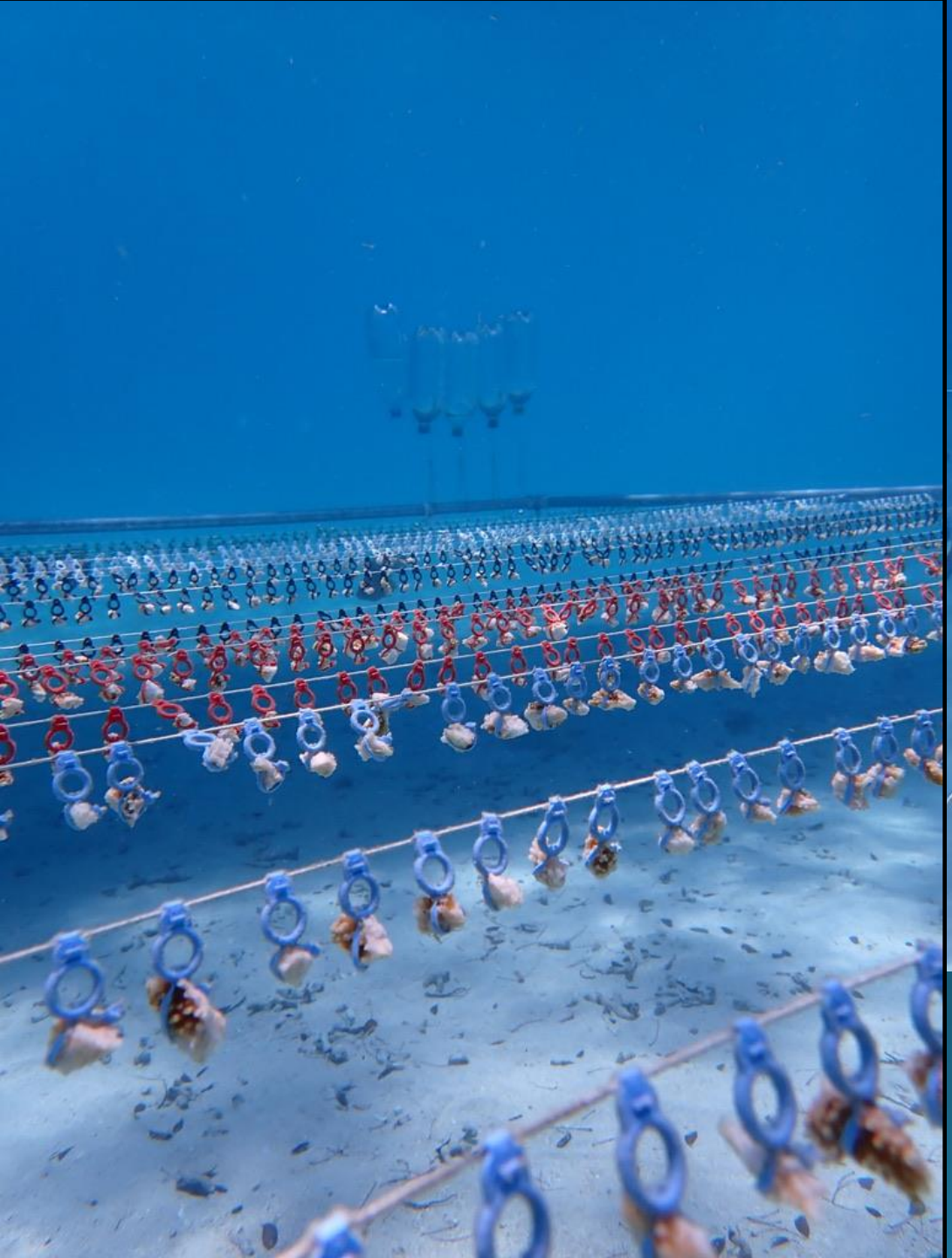
Step #2: Clip feature:
Secures the SRM+coral to a taught line nursery system. Adaptable to tables and raceways.

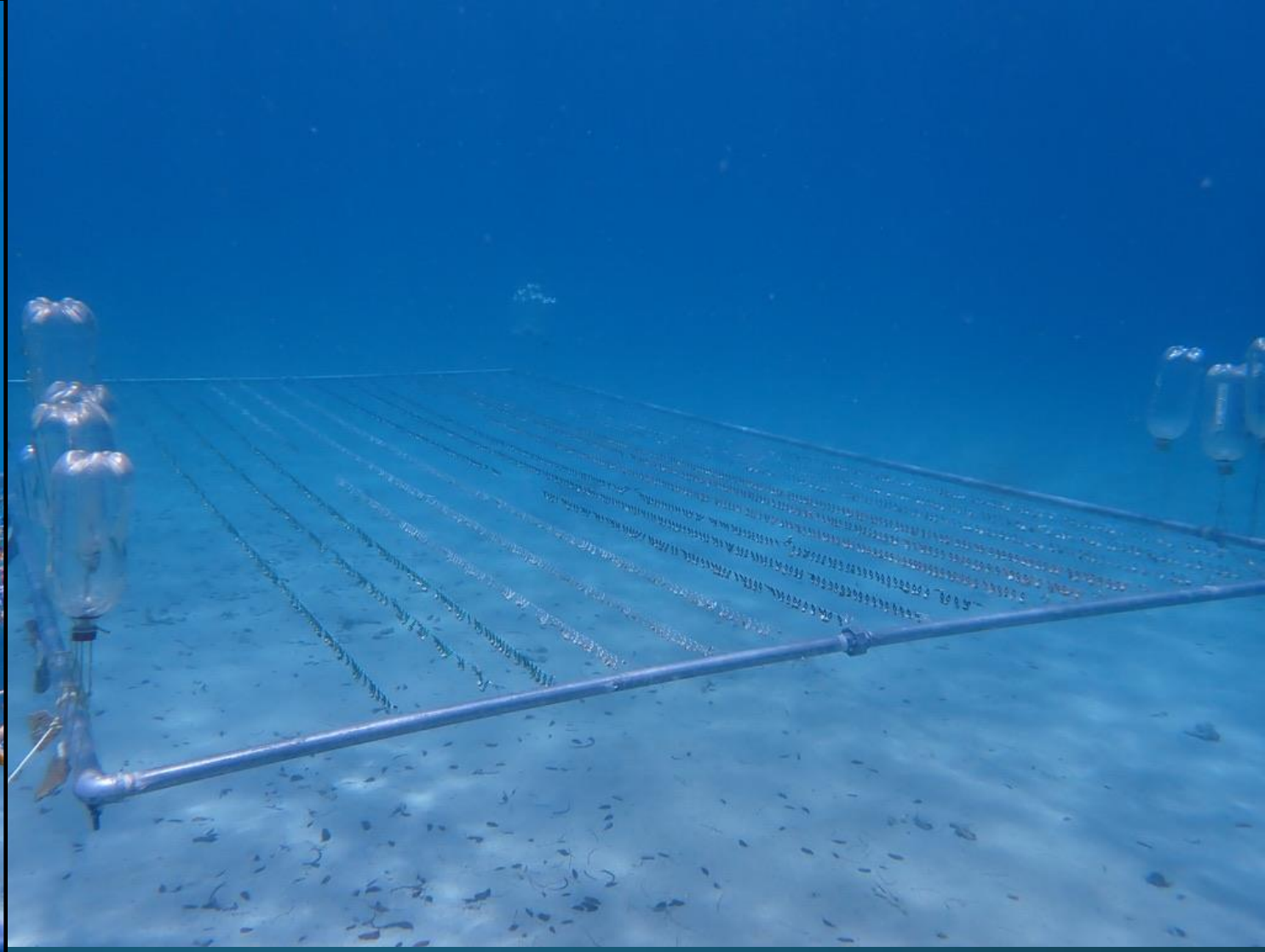
Step #3: Ring feature:
Operable as a washer in planting the prepared coral, employing a male fastener (screw, bolt, button or rivet) for intuitive/trainable and immediately secure outplanting.



Step #1: Coral-securing features:
Secures the nubbin to the SRM, facilitating healing and overgrowth of the textured cable-tie, teeth and ring elements to headstart for planting. *Adaptation to spawn culture are underway.*







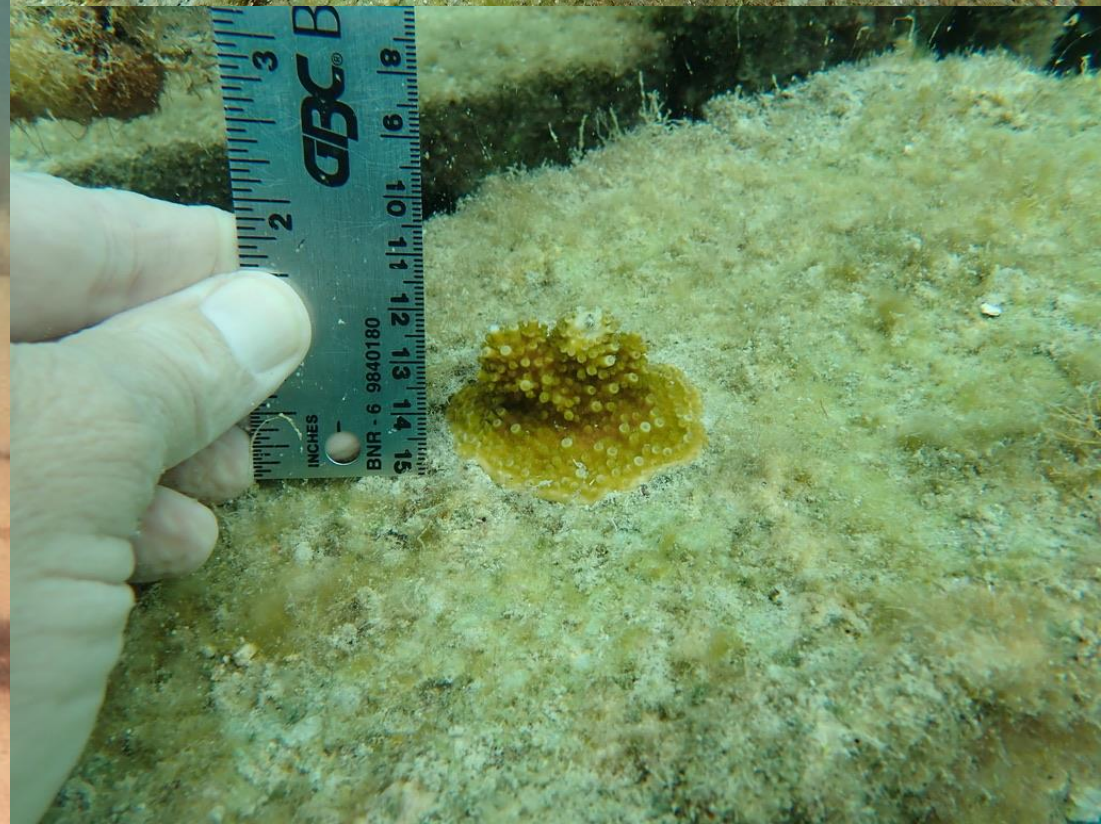
CBF-funded WANSEC project, Barbados (UWI Cave Hill)
600 nubbins in 5x lineages of Acropora palmata nubbins (N=3000) set by novice-volunteers in less-than three days.
No losses in Hurricane Beryl (relocated to 10m sand-depth)


April 2018


Aug 2019


Aug 2020

July 2019
Artificial reef enhancement



**** Is coral restoration a worthwhile investment for a warming ocean?*

Yes, it's imperative:

- 97% mortality is not *yet* extirpation
- Extirpation is not *yet* extinction
- Recent temperature mass-mortality events have shown the coral lineages that we should have been working with.

- Adaptive and evolutionary capacities are evident in corals
- Value propositions for investment are evident in coral reefs & specific spp.
- Recruitment failure and alee effects may be remediated
- Extirpations may be repopulated from elsewhere
- Techniques for breeding, rearing and planting are advancing, though need further development and/or innovation to attain evolutionary scales incl. economies of scale

Questions?

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