Restoration Strategies are Preventing the Local Extirpation of Florida's *Acropora* Species

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Conservation Biology

PRACTICE AND POLICY

Success of restoration strategies in preventing extirpation of 2 critically endangered coral species

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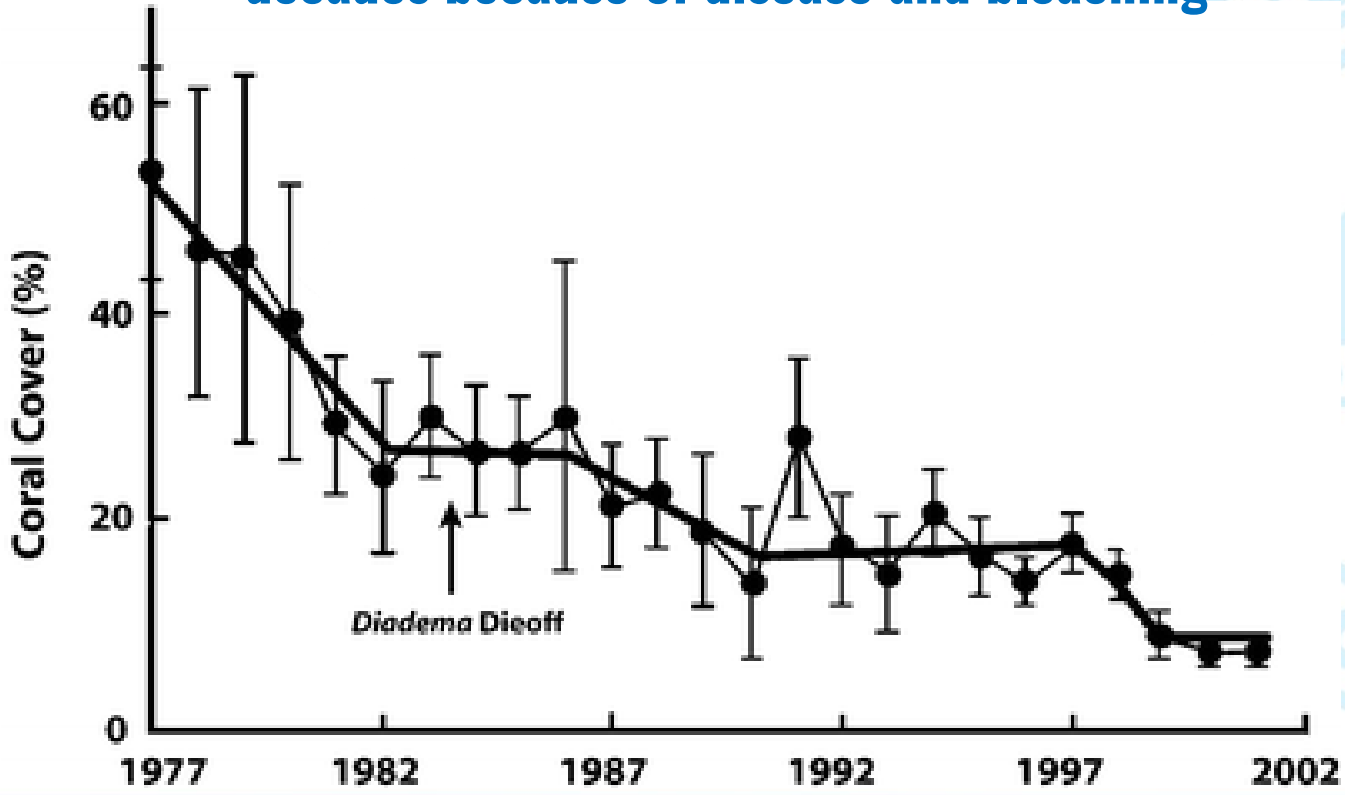
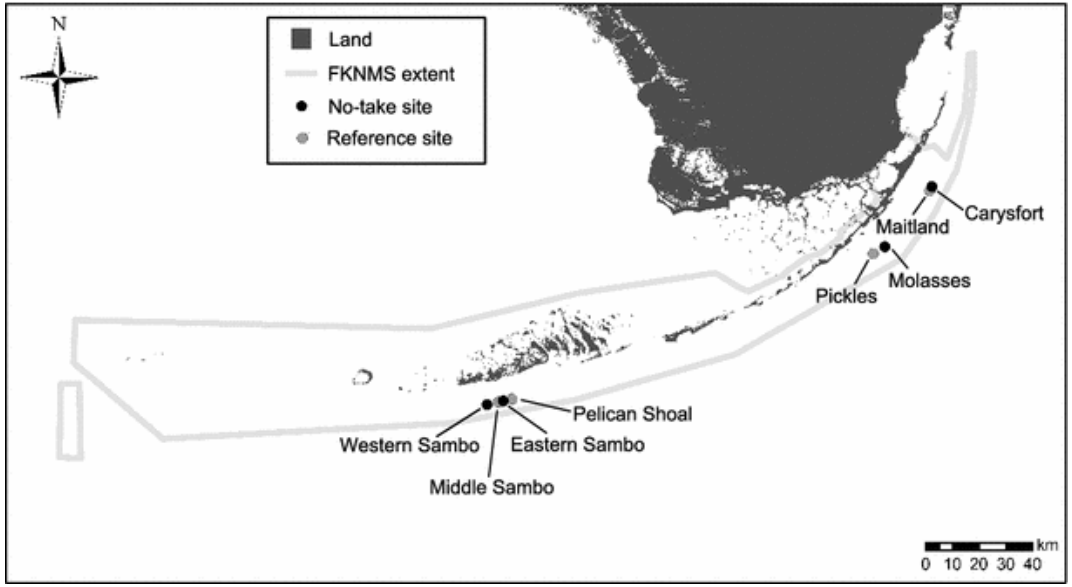
Coral reefs of the Caribbean and Atlantic have been declining for decades because of disease and bleaching

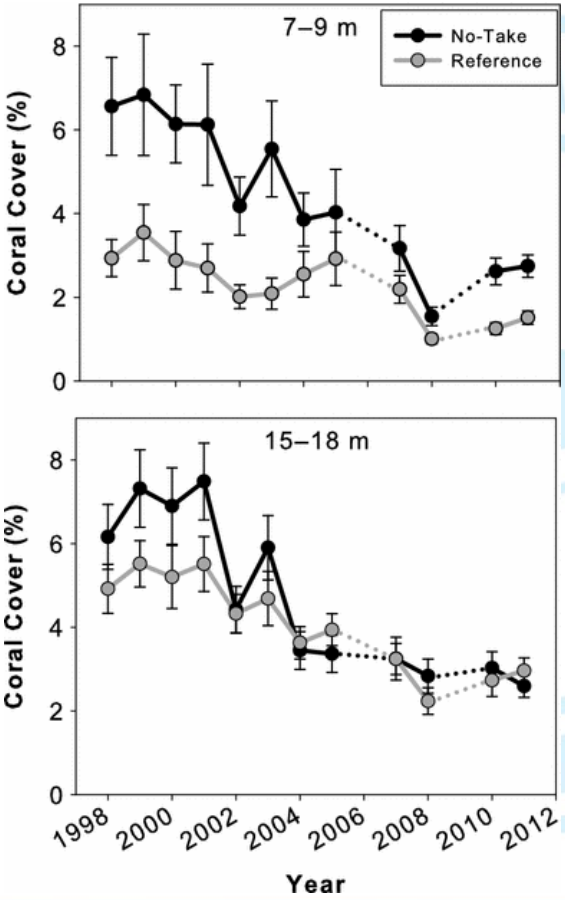


Gardner et al. 2001
Aronson et al. 2006

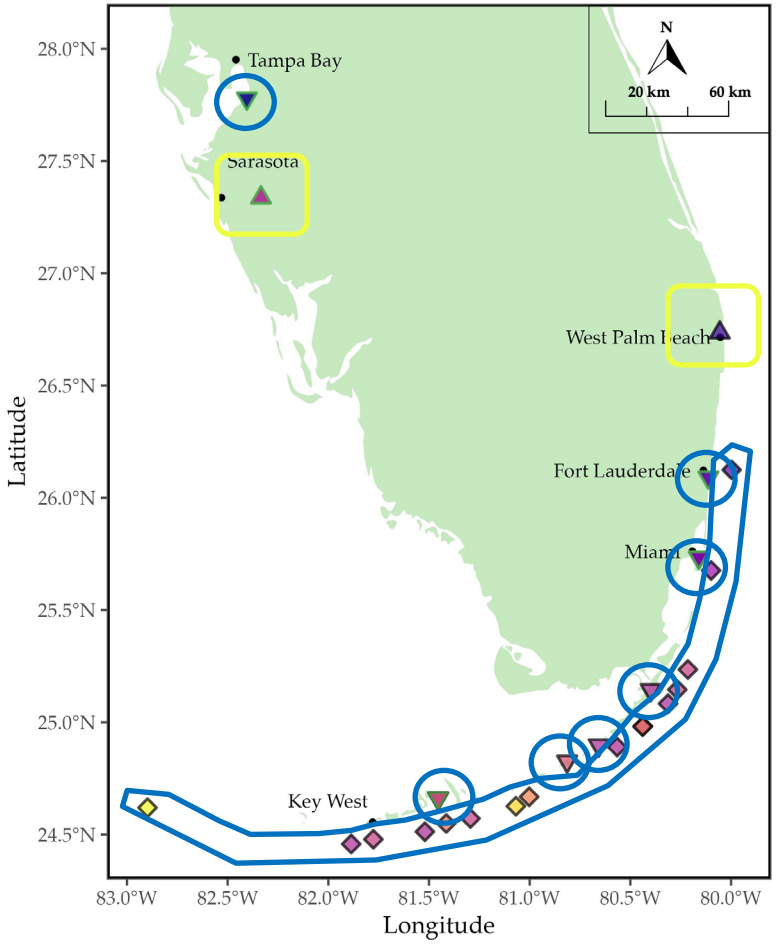
Even with protection status there were no signs of natural recovery



Toth et al. 2014



A Network of Coral Nurseries



Organization
- The Florida Aquarium
- The Reef Institute
- Nova Southeastern University
- NOAA SEFSC
- University of Miami
- Mote
- CRF
- Keys Marine Laboratory
- Reef Renewal
- FWC
- Plant A Million Corals Foundation
- Scouting America
- FWC/Reef Renewal
- Dry Tortugas National Park

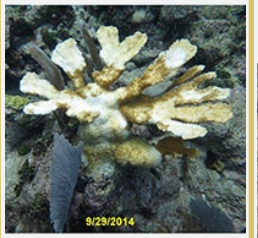
Nursery type
- Land-based gene bank
- Land-based holding facility
- In-water nursery

Using sexual reproduction
- Yes
- No

We are living in a time of extremes

2014

Massive regional coral bleaching



2014-present

SCTLD

2017

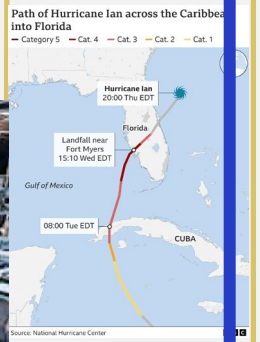
Hurricane Irma

2020

COVID

2022

Hurricane Ian



2023

Extreme Bleaching

2024

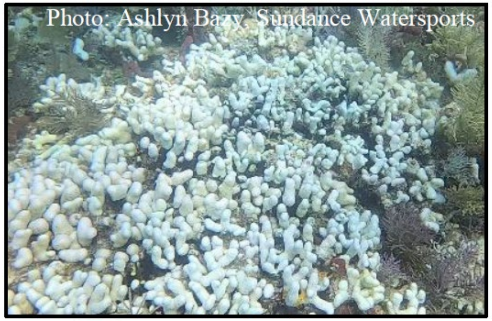
Hurricanes

Debby

Helene

Milton

FL Keys Reefs



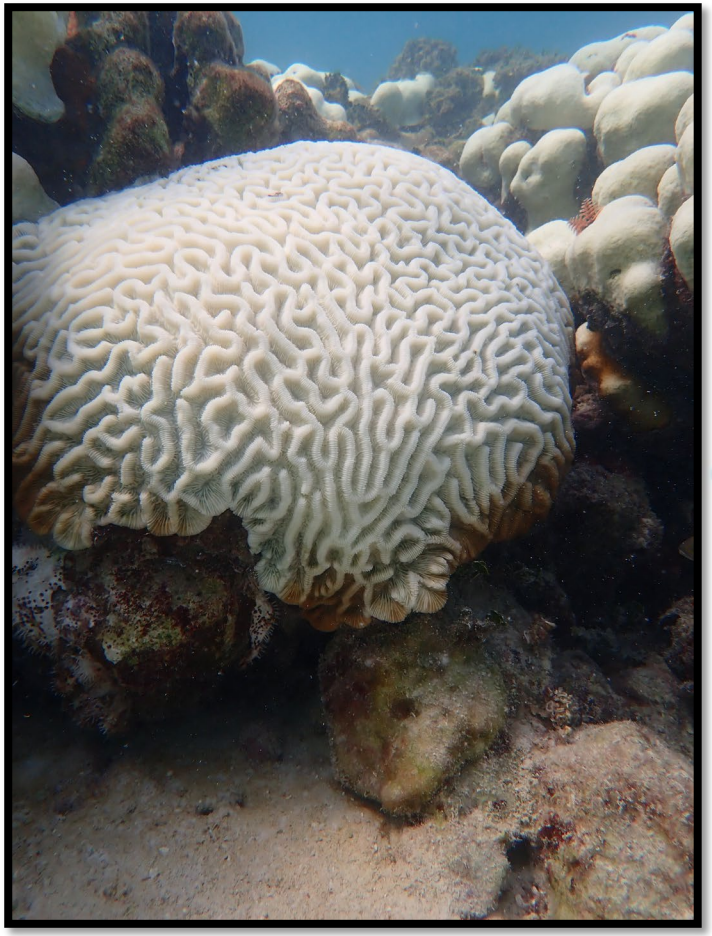
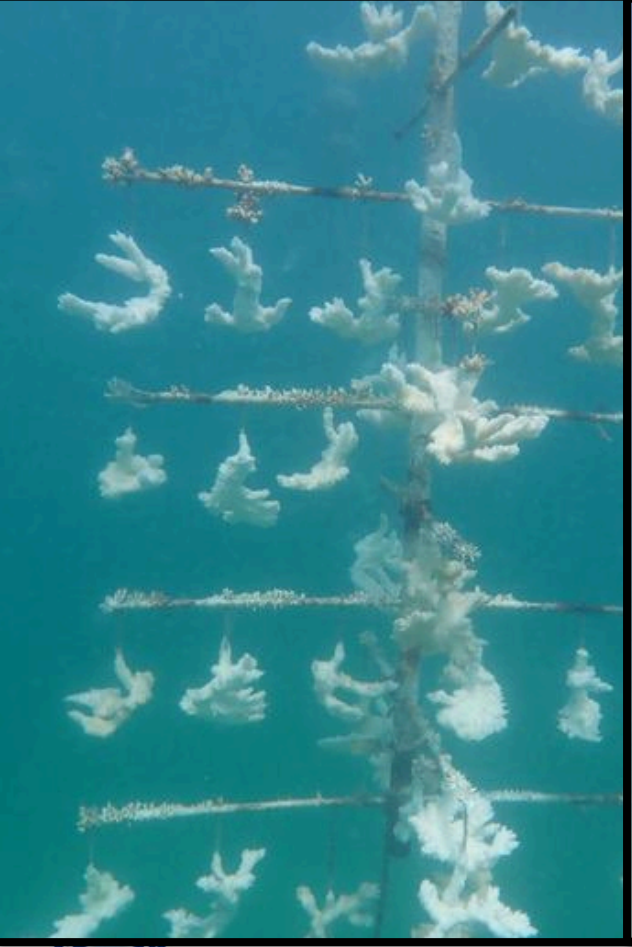
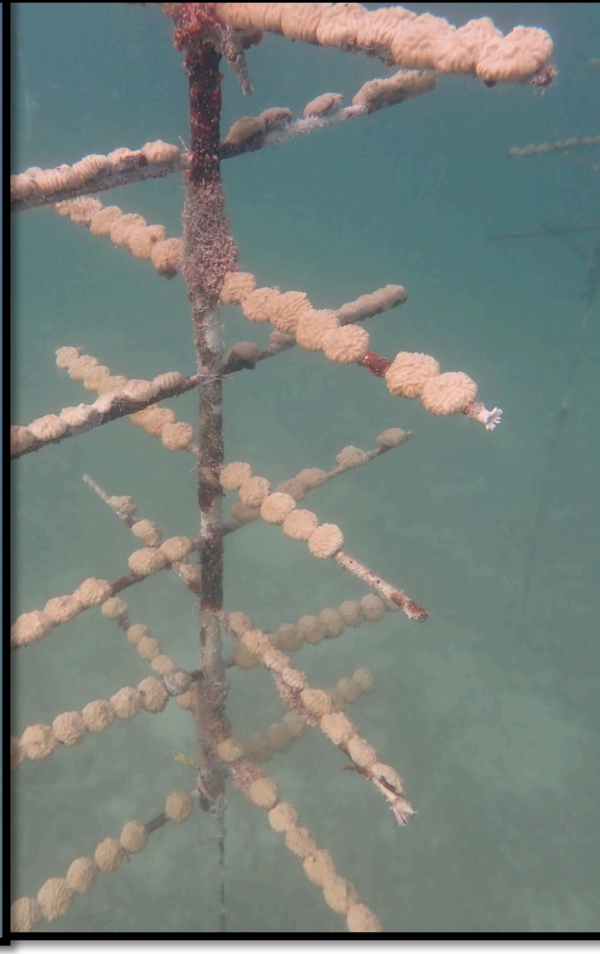


Photo: CRF™





Preserve Remaining Genetic Diversity

Table 5: Summary statistics of genets in four F3P institutions as of February, 2023. (see Appendix 6 for details)

Category	Number
Sexual recruits	200
Wild founders	150
In human care	*142*
not in human care	*8*
TOTAL GENETS	350

Jennifer Moore
NOAA Fisheries Protected Resources Division
Threatened coral Recovery Coordinator

Rodriguez-Clark et al. 2025

Significant Hurdles:

- All practitioners used different local IDs for the same genets
- Used different forms of inventory management
- Some had genotype information and some did not

Preserve Remaining Genetic Diversity

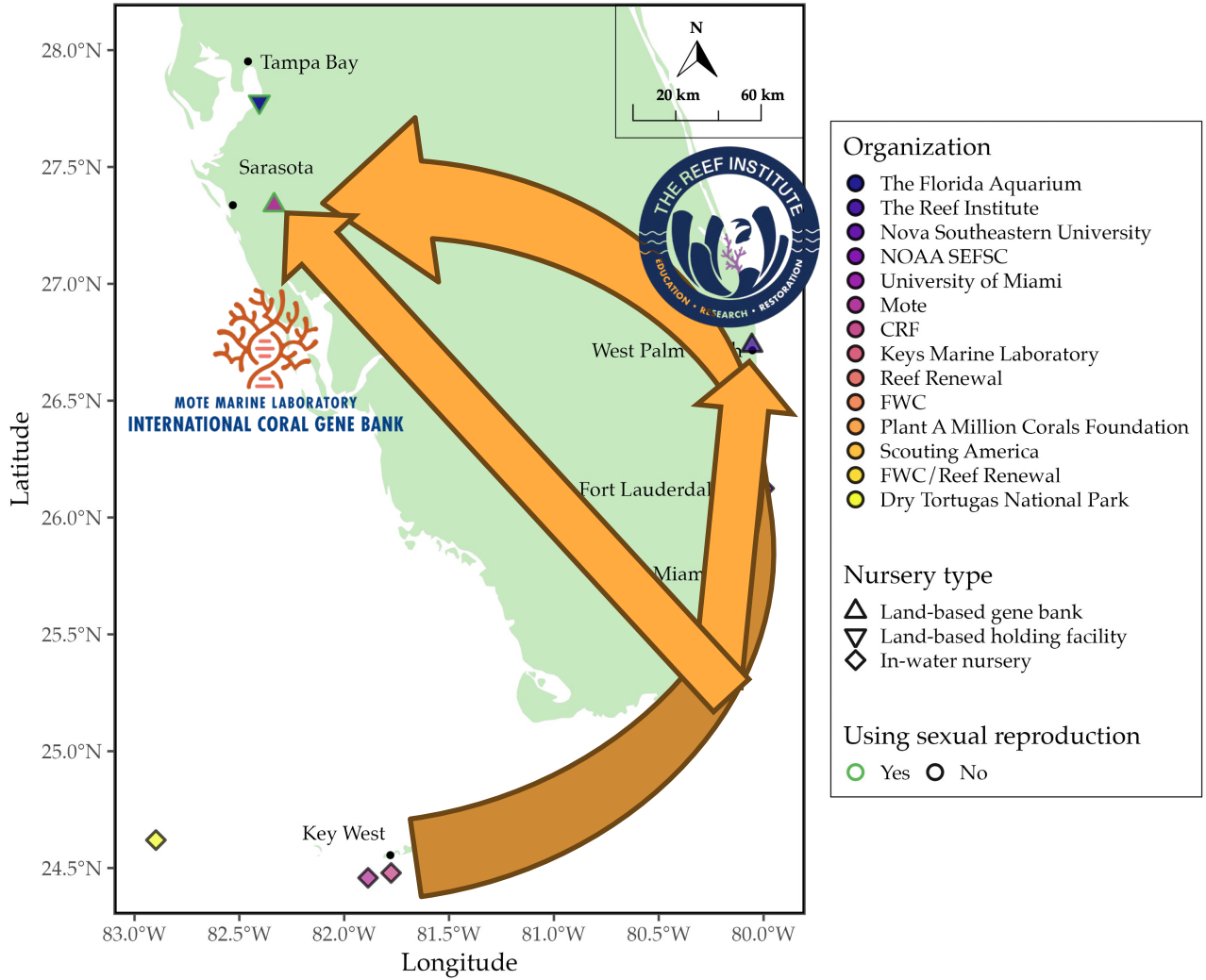
Caitlin Lustic
The Nature Conservancy

Genetic Swaps for *Acropora cervicornis*:

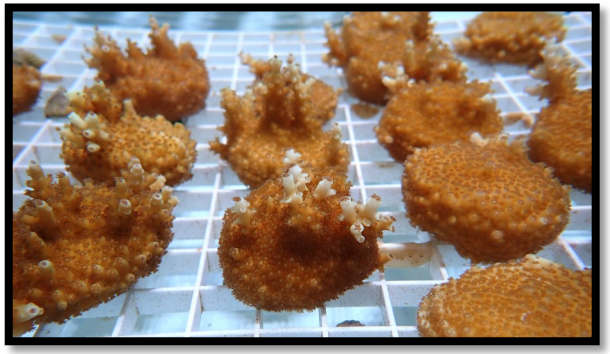
- Began in 2015
- Thousands of fragments had been swapped
- Many already present in at least three different nurseries

Targeted Transfer

Sourced Genotypes:



MOTE MARINE LABORATORY
INTERNATIONAL CORAL GENE BANK



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EDUCATION • RESEARCH • RESTORATION

Species	# Acroporid fragments received in 2023
ACER	165
APAL	118

Species	# Acroporid fragments received in 2023
ACER	280
APAL	179

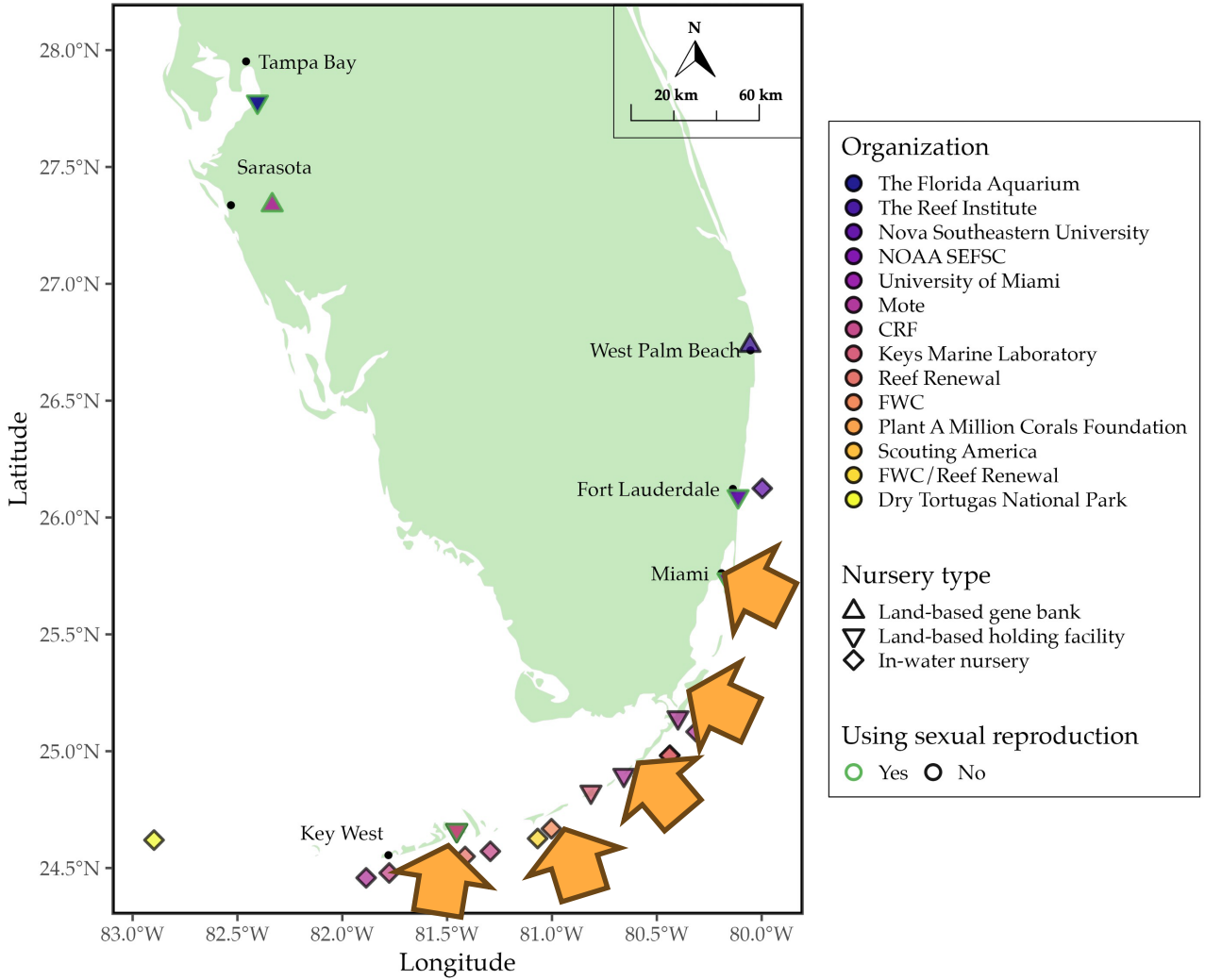
~250 genotypes

~150 genotypes

Preserve Biomass:
in water nursery evacuations

Large coral evacuation ever

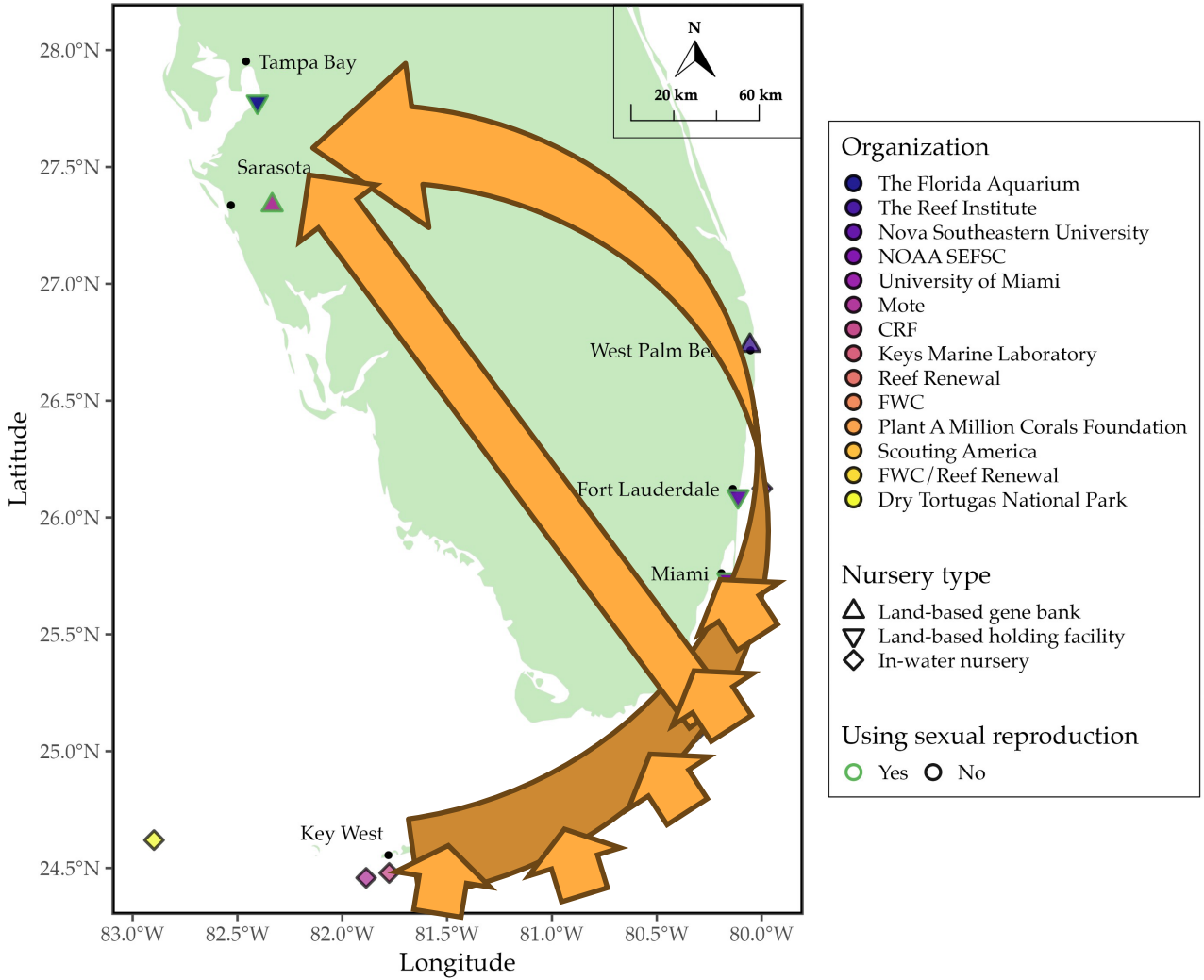
- Tens of thousands of corals moved out of ocean-based nurseries and into land-based holding facilities

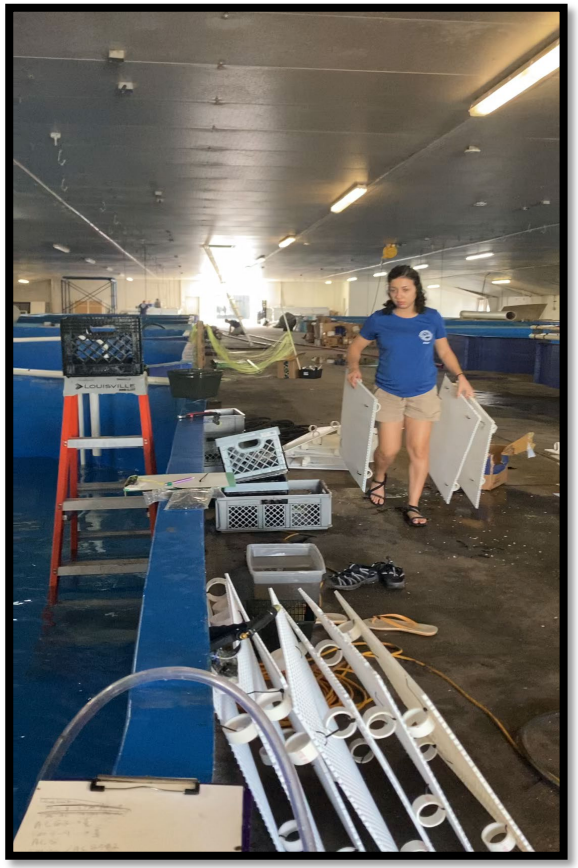


Brought thousands into land based nurseries

Large coral evacuation ever

- Tens of thousands of corals moved out of ocean-based nurseries and into land-based holding facilities





Herald-Tribune

MONDAY, SEPTEMBER 11, 2023 | HERALDTRIBUNE.COM

Coral rescued from Keys heat recovering at Mote

Mote Marine Laboratory & Aquarium marine biologists Chloe Manley, from left, Kari Imhof and Lauren Burk feed essential nutrients to staghorn corals rescued from the Florida Keys after increasing water temperatures that started in mid-July prompted a mass coral bleaching event. THOMAS BENDER/HERALD-TRIBUNE

Biologists hope to save enough to repopulate reefs

Earle Kinzel

Herald-Tribune | USA TODAY NETWORK

Marine biologist Lauren Burk leaned down and squeezed out several ounces of a nutritious soup of amino acids, phytoplankton and brine shrimp from a pipette into a kiddie-pool size tub filled with two dozen fragments of staghorn coral.

It was feeding time at the Mote Aquaculture Research Park for corals rescued after a mid-July wave of warm water in the Florida Keys triggered a mass bleaching event.

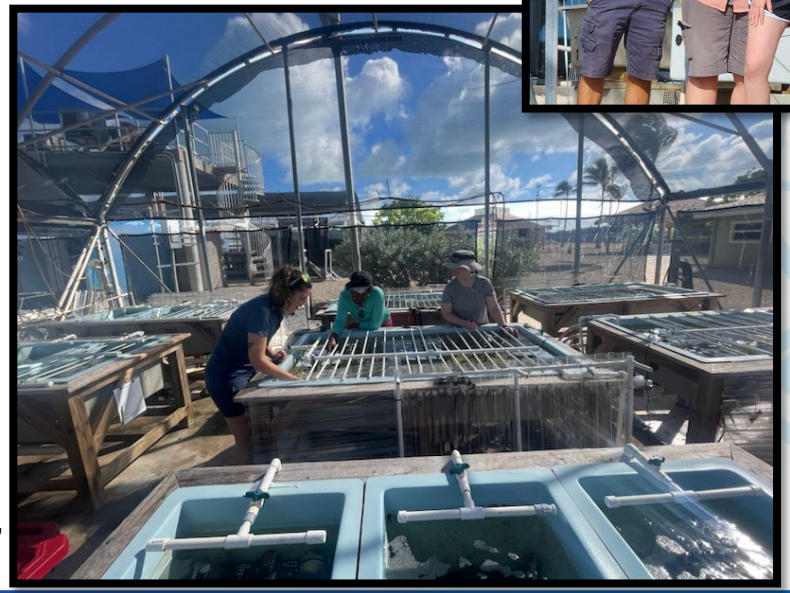
They arrived with more than 2,000 other staghorn and elkhorn corals evacuated from nurseries designed

See CORAL, Page 8A

A network of trained professionals: AZA HeaRT Collaboration

ASSOCIATION OF ZOOS & AQUARIUMS

J.Rawlings, AZA



S.Stevens, AZA

J.Rawlings, AZA

Large scale evacuation resulted in high losses

- *Acropora cervicornis*
  - 13.4% survival
- *Acropora palmata*
  - 2.5% survival

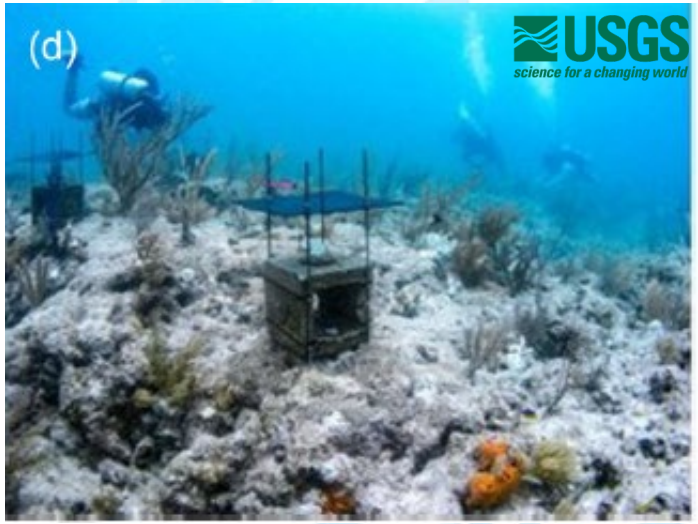
Why?

- High density transfers
- Not enough infrastructure to hold the corals
  - Facilities did not have the necessary resources for holding
- Corals were already stressed prior to some transfers

Innovative Response: Established Deep Water Coral Nurs within days

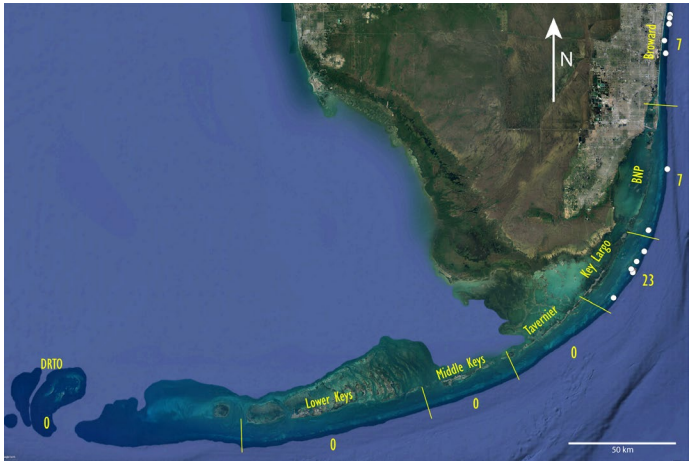
- Highlighted the need for trusted relationships between practitioners and management agencies
  - FL Keys National Marine Sanctuary
  - US Coast Guard

Innovative Response:
Trial methods for light mitigation



The reality of 202

Only 37 wild *A. palmata* present on Florida's Coral Reef



D. Williams et al. 2024

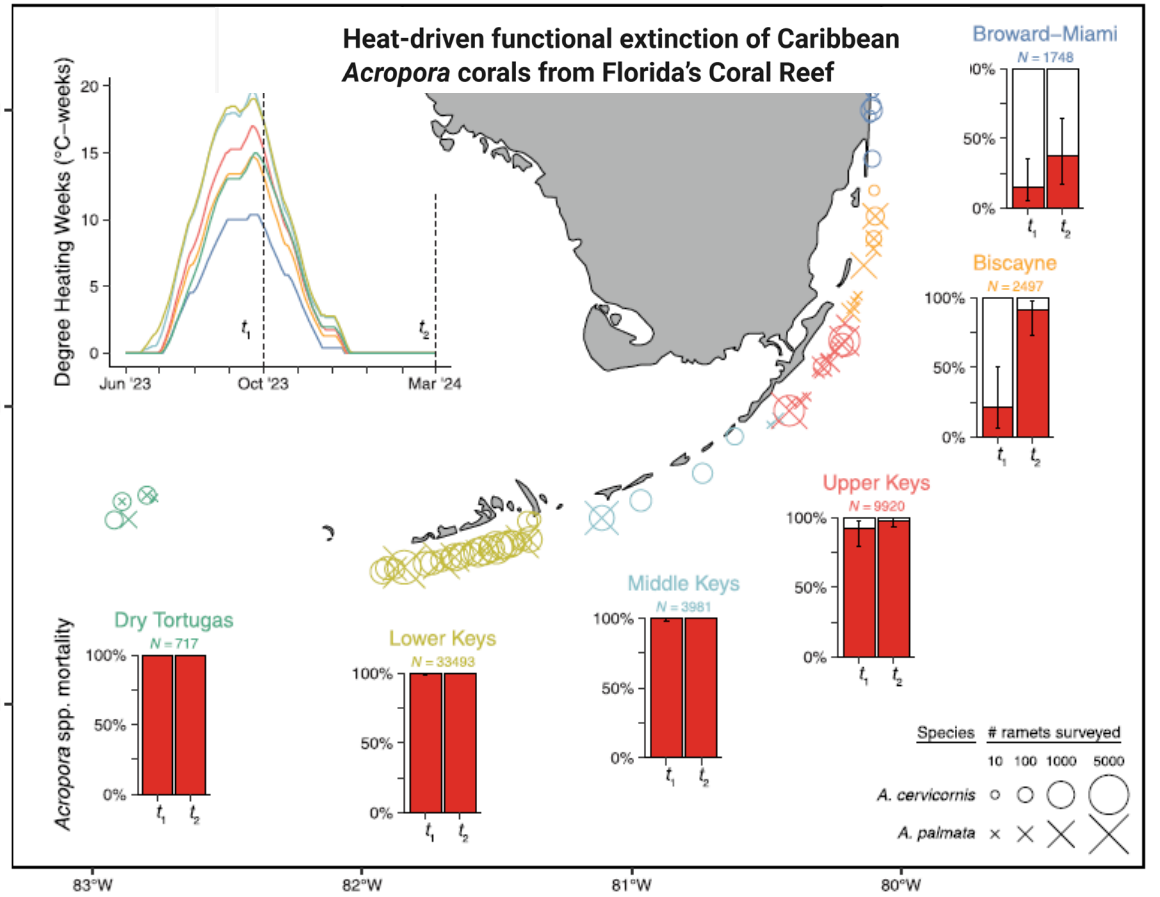
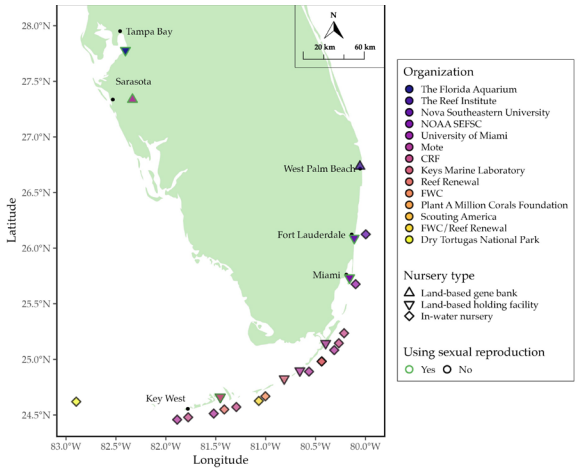


Fig. 3. Overall mortality of *Acropora* spp. on Florida's Coral Reef. Points represent site clusters where *A. palmata* (X's) and *A. cervicornis* (circles) were surveyed, with point size scaled by the number of distinct ramets observed ("ramet" refers to an individual, physically separate coral colony). Bar plots show the percent mortality (±95% confidence interval) of all *Acropora* (which did not differ between species) on 1 October 2023 (t_1) and 1 March 2024 (t_2), with the conservative estimates of the total number of ramets observed in each subregion given above the bar plots. (Inset) Mean degree heating week trajectory colored by subregion, with dashed vertical lines at the two time points of interest.

Manzello, Cunning et al. 2025

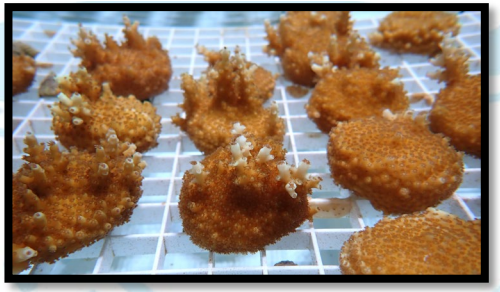
The coral restoration community prevented the local ext (extirpation) of remaining genetic diversity of *Acropora palmata* and *Acropora cervicornis*

Established Coral Restoration Network



Trust Focused Relationships

Gene Banking Efforts



CORAL BIOREPOSITORY ALLIANCE

Critical Strategies For Other Regions to Consider:

1. Extend collaborative restoration efforts to solidify a network of trained experts
2. Establish trust-focused relationships among management agencies and restoration groups
3. Test direct interventions to reduce light/temperature stress early during thermal anomalies
4. Develop redundant ocean-based and land-based nurseries
5. **Establish living coral gene banks prior to major threats to prevent the local extinction of coral species**

Thank you to the Coral Restoration Community of Florida!