Restoration 2021
Expansion & Advances

Jessica Levy
Restoration Program Manager
In 2021, we aim to return **41,000 corals** at nine sites
- 21,615 staghorn
- 14,939 elkhorn
- 4,700 boulder

Efforts in support of M:IR
- Carysfort Complex
- Horseshoe Reef
- Cheeca Rocks
- Sombrero Reef
- Newfound Harbor
- Looe Key
- Eastern Dry Rocks

To support restoration efforts 2021 will focus on **capacity building and innovation** within nurseries and restoration methods.
Expansion

Nursery-based

- Carysfort expanded from 100 to 160 structures.
- Key West expanded from 50 to 150 structures
- Addition of Pickles table nursery
- Addition of Looe Key nursery
Nursery-based Advances

Novel Coral Propagation Methods

- Multi-species
- Corals collected from FKEC structures from Marathon to Card Sound
- Represent novel source of coral w/o damaging wild stands
- 458 colonies from 13 species
- Established in new Pickles table nursery as an intermediate step.
Nursery-based Advances

Coral Propagation Methods

• Pillar Coral

• Investigating both in-situ and ex-situ fragmentation methods and nursery performance

• Assist R&D phase 1 of M:IR
  • Goal to produce stock for outplant efforts in phase 2
Outplant-based Advances

Staghorn novel methods

- In 2019, we began developing techniques that will allow us to restore ecosystem functionality more quickly.
- This work involves getting larger corals out onto the reef – immediately restoring structural complexity.
- We are working with sustainable materials including bamboo and hemp rope.
Outplant-based Advances

Boulder coral novel methods

• Developed in collaboration with the Coral Restoration Consortium Engineering/Innovations group

• Engineered structures for outplanting boulder corals
  • Can “skirt” in nursery first
  • Expedited planting
  • Provides pristine substrate
Thank you for spreading ocean awareness

Work supported by:
NOAA #NA19NMF4630260
Monroe County TDC
Ocean Reef Club
Restore Act
National Fish & Wildlife Foundation *(NOAA & Armaco)*
And many others...

Work permitted under:
FKNMS-2019-012-V1
FKNMS-2019-193
FWC and ACOE
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Restored mountainous star corals spawn

*Orbicella faveolata*
First corals of any slow-growing massive or mounding species documented to sexually reproduce after being restored to the reef

Restored Corals Spawn Hope for Reefs Worldwide

Hanna R. Koch, Erin Muller, Michael P. Crosby | Feb 1, 2021

Novel technologies establish a new paradigm for global coral reef restoration, with in situ spawning of mature, environmentally resilient corals in five years instead of decades.

Coral grown in lab is thriving on reef

Hanna Koch said that she had seen signs of hope for the coral reef.

Laboratory-salvaged coral and a method by which coral can be induced to reproduce are promising steps toward the goal of restoring the world's reefs. Coral is a keystone species with multiple ecosystem services, and Dr. Koch's research has shown that it can be successfully reproduced in a laboratory setting.
Microfragmentation + land-based nursery grow-out
Outplanting + reskinning
Monitoring
Cook Island Case Study (August 2020)

• Natural reproductive rhythms
  – Spawned during predicted peak window (NAFM) & timeframe (MAS)
  – Can cross-fertilize with outplants + wild colonies
    • Maximizes diversity

• High synchrony
  – Spawned within 10-min window
    • Supports more successful fertilization

• Resilient
  – Survived:
    • Bleaching events
    • Category-4 hurricane
    • SCTLD (most)
      • 2 treated with antibiotics
  – Spawned after being cored
Acropora assisted sexual reproduction

Staghorn (A. cervicornis)

Stress-tested parental genotypes

3 yrs = >1500 new sexually produced genotypes into Mote’s restoration gene pool

Outplanted:

300 genotypes, > 1750 corals, 100% genotype survival, 96% frag survival
Acropora assisted sexual reproduction

Elkhorn (A. palmata)

~300 new sexually produced genotypes
Implications

• Promotes faster population & ecosystem recovery
  – Quicker recolonization of dead coral heads
  – Rapidly increases living coral cover
  – **Faster onset of sexual maturity/reproduction**
  – Diversity generated more quickly & more likely retained

• Sources for assisted sexual reproduction work

• Should work for any other species/region of the world
Mote’s coral genotype holdings currently consist of >1,600 genotypes from 17 species, with ~3k additional genotypes from 3 species that are expected to be added over next years.
Thank you
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Reef Renewal USA

- Florida Keys based 501 (c) 3
- 20 Species of Coral
- Community based volunteer program
Reef Renewal USA
Regional Coral Nurseries

- Looe Key
- Marathon/FWC
- Tavernier
Acropora Corals

Elkhorn Coral
Acropora palmata

Staghorn Coral
Acropora cervicornis
Star corals in the Genus *Orbicella*

- **Mountainous Star Coral**
  *Orbicella faveolata*

- **Lobed Star Coral**
  *Orbicella annularis*

- **Boulder Star Coral**
  *Orbicella franksi*
Other Star Corals

Giant Star Coral
Montastrea cavernosa

Smooth Star Coral
Solenastrea bournoni

Blushing Star Coral
Stephanocoenia intersepta
Other Star Corals

Massive Starlet Coral
*Siderastrea siderea*

Elliptical Star Coral
*Dichocoenia stokesi*
**Brain Corals**

**Knobby Brain Coral**  
*Pseudodiploria clivosa*

**Grooved Brain Coral**  
*Diploria labyrinthiformis*
Brain Corals

Boulder Brain Coral
Colpophyllia natans

Symmetrical Brain Coral
Pseudodiploria strigosa
Other Corals

Knobby Finger Coral
*Porites furcata*

Mustard Hill Coral
*Porites astreoides*

Pillar Coral
*Dendrogyra cylindrus*
Other Corals

Rough Cactus Coral
*Myctophyllia ferox*

Ivory Tree Coral
*Oculina diffusa*

Blade Fire Coral
*Millepora complanata*
Looking for the Survivors

• Collecting corals from throughout the Keys

• Collecting corals from multiple habitat types
  • Inshore
  • Offshore
  • Mid channel

• Looking for corals that survived:
  • 2010 Cold Fronts
  • 2014/2015 Bleaching
  • Ongoing Stony Coral Tissue Loss Disease
Orbicella faveolata Collections
Collecting Corals

Tagging and measuring at the Reef

Tagged coral at the nursery
Processing Corals on Land

- Initial Collections
- Drilling, Trimming, Mounting
Processing Corals on Land

- Initial Collections
- Drilling, Trimming, Mounting
Mounting Broodstock Corals

- Initial Collections
- Drilling, Trimming, Mounting
- The Broodstock System
Broodstock Growout

- Initial Collections
- Drilling, Trimming, Mounting
- The Broodstock System

4 months

6 months
Mounting MicroFfrags

- Initial Collections
- Drilling, Trimming, Mounting
- The Broodstock System
- The Grow Out System
Modular Grow out Tree
Knobby Brain Coral

*Pseudodiploria clivosa*
Replacing Trees with Ropes
Rope Nurseries at the Reef
Rope Nurseries at the Reef
Expedited Outplanting