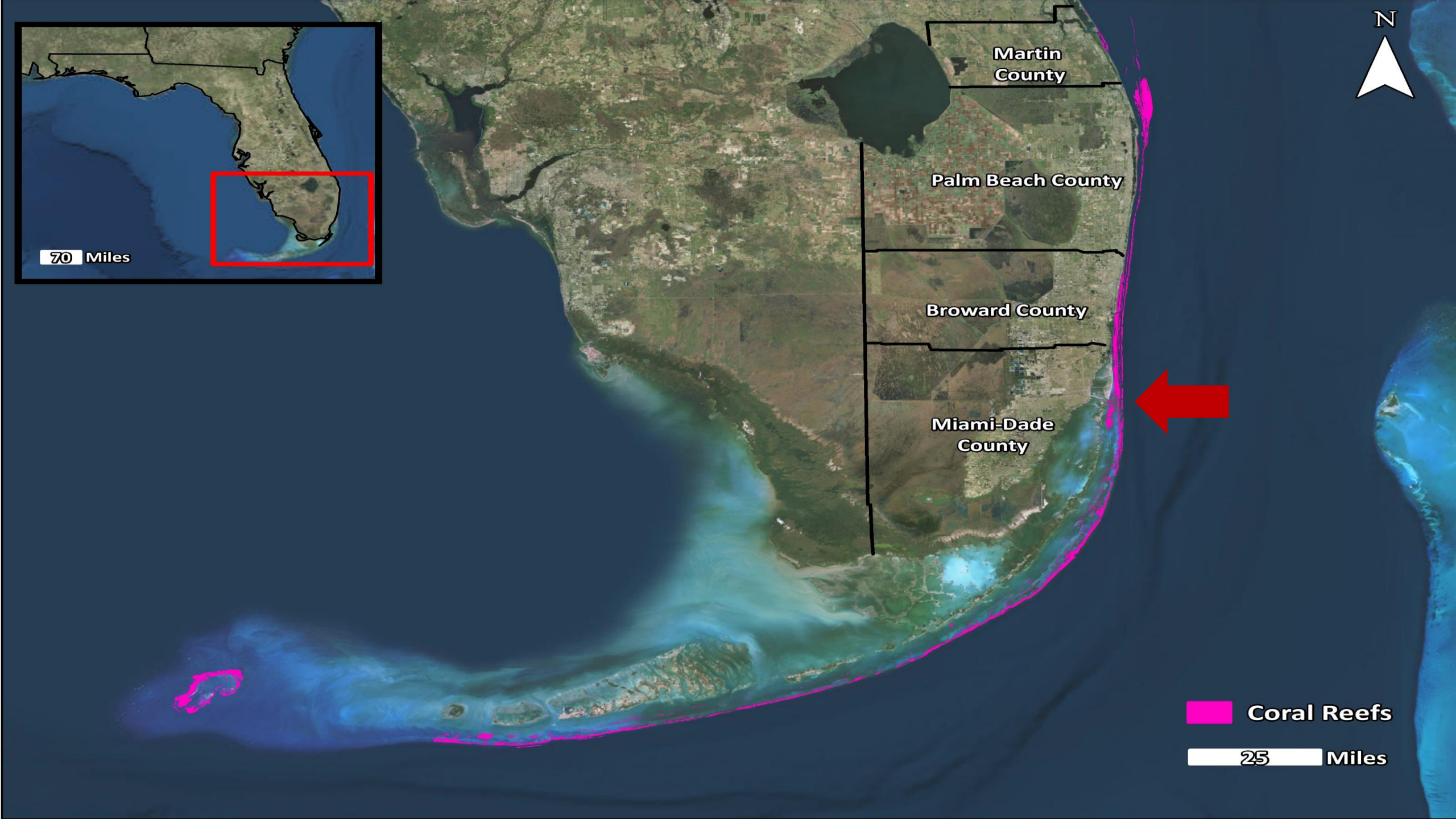
Overview on Stony Coral Tissue Loss Disease and Response to it in Florida

Rob Ruzicka
Coral Program Manager
Fish & Wildlife Research Institute

This presentation was adapted from other talks prepared by Maurizio Martinelli, Florida's Coral Disease Response Coordinator, and The Coral Rescue Team


Martin County
Palm Beach County
Broward County
Miami-Dade County
N
70 Miles
Coral Reefs
25 Miles

First signs of trouble in 2014 in SE FL

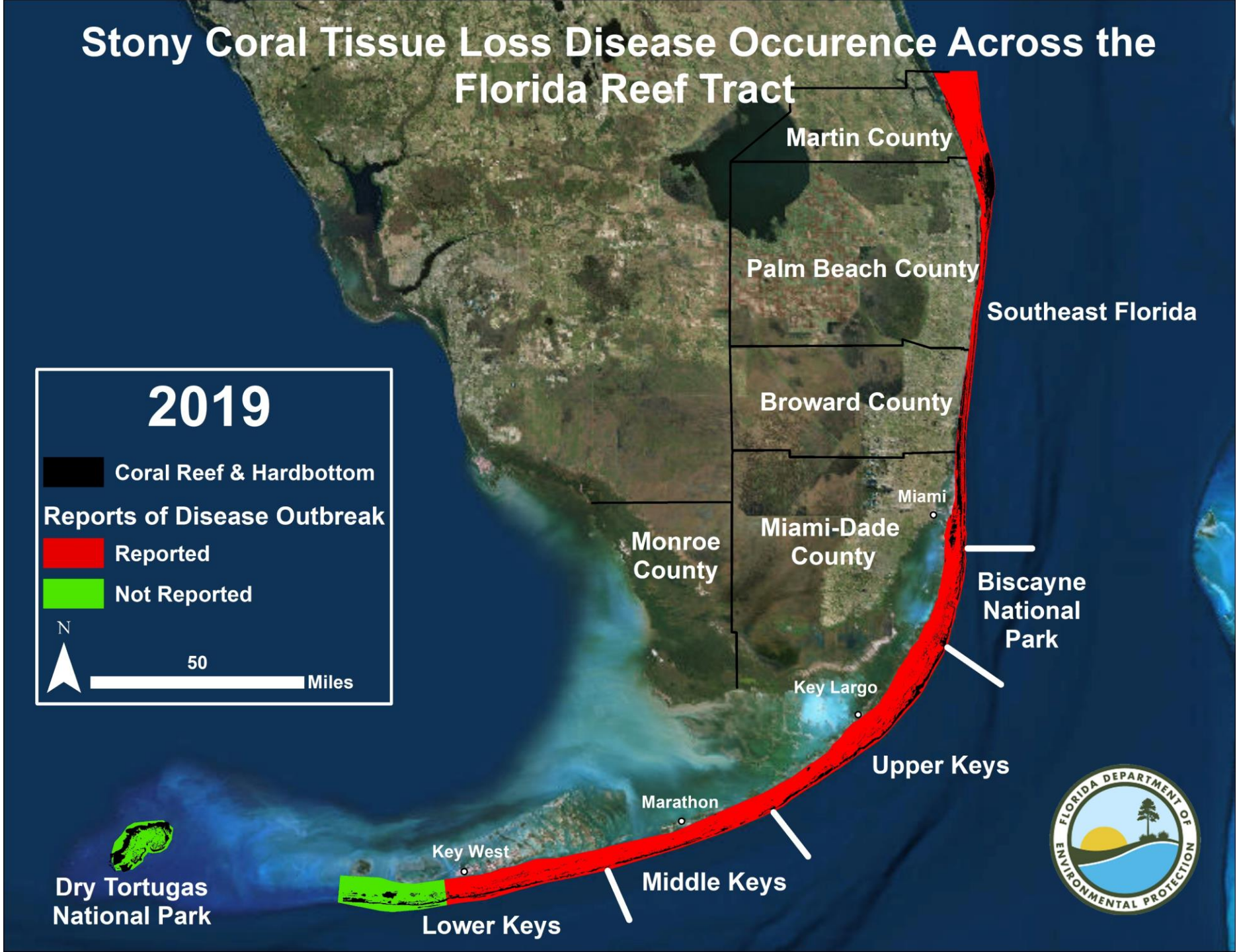
Diploria labyrinthiformis

Pseudodiploria strigosa

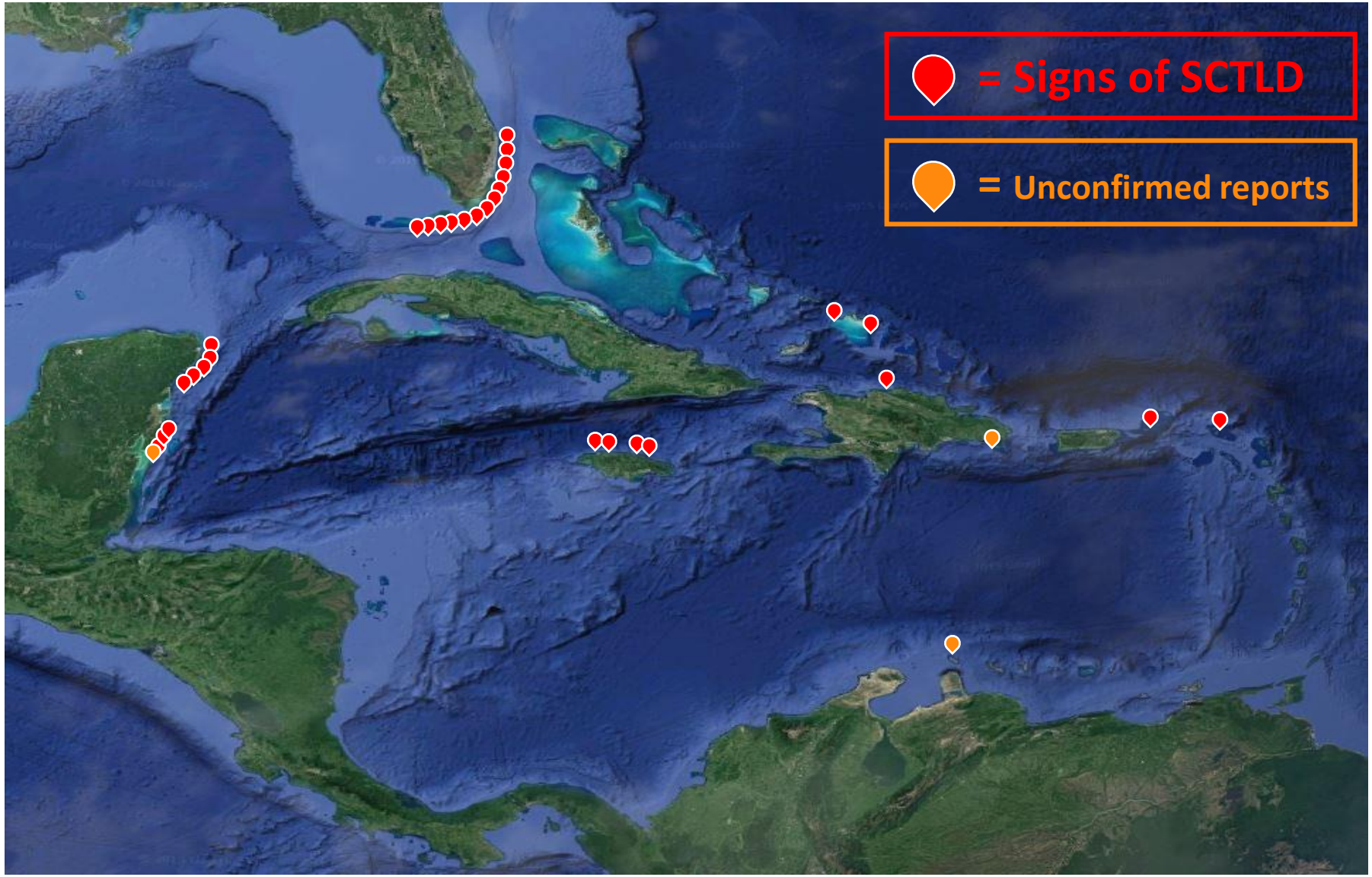
Dichocoenia stokesii

Meandrina Meandrites

Eusmilia fastigiata

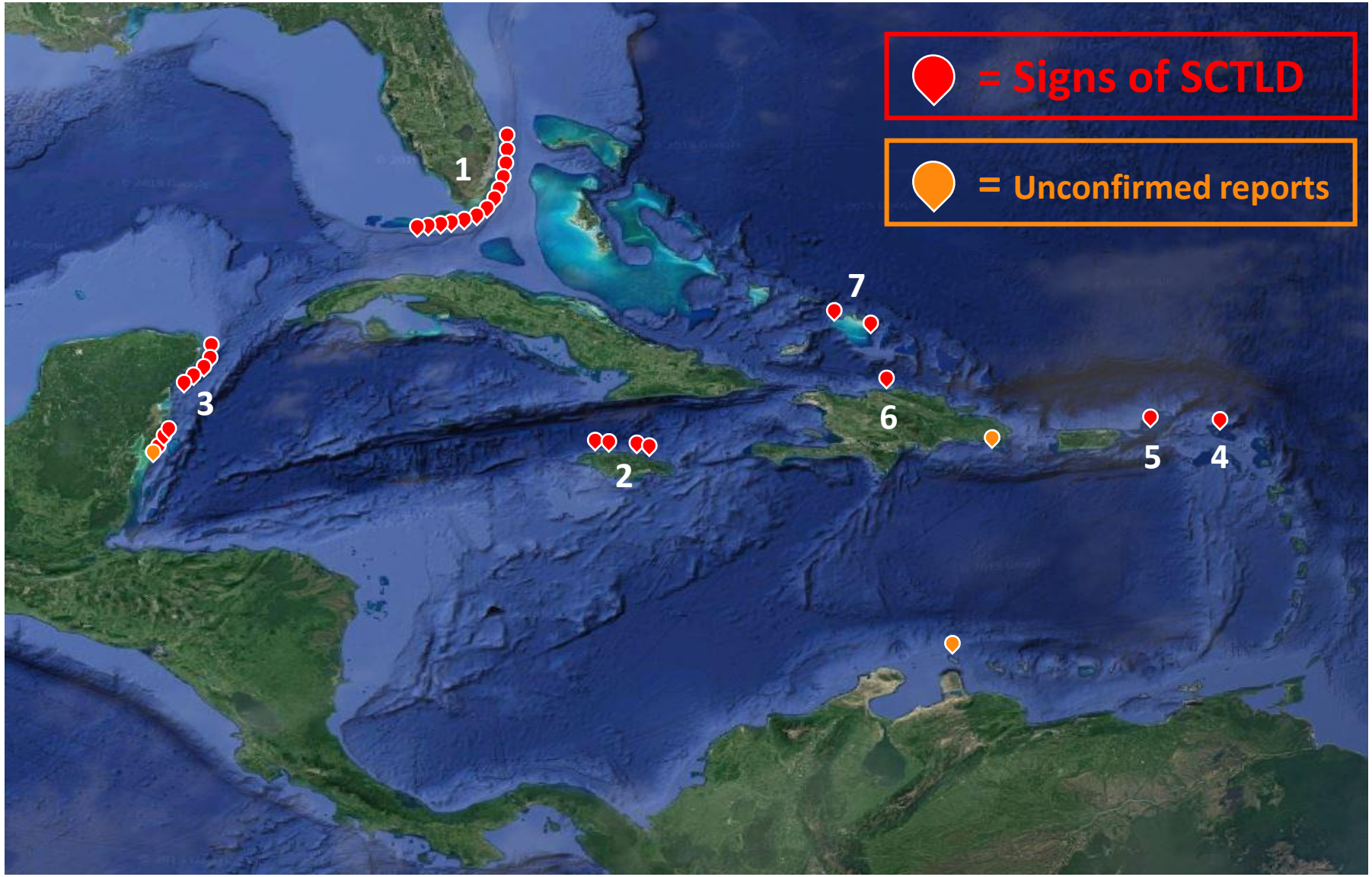

Stony Coral Tissue Loss Disease Occurence Across the Florida Reef Tract
Martin County
Palm Beach County
Southeast Florida
Broward County
Miami
Miami-Dade County
Monroe County
Biscayne National Park
Key Largo
Upper Keys
Marathon
Middle Keys
Key West
Lower Keys
Dry Tortugas National Park
2019
Coral Reef & Hardbottom
Reports of Disease Outbreak
Reported
Not Reported
N
50
Miles
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Wider Caribbean



Source: http://www.agrra.org/coral-disease-outbreak/

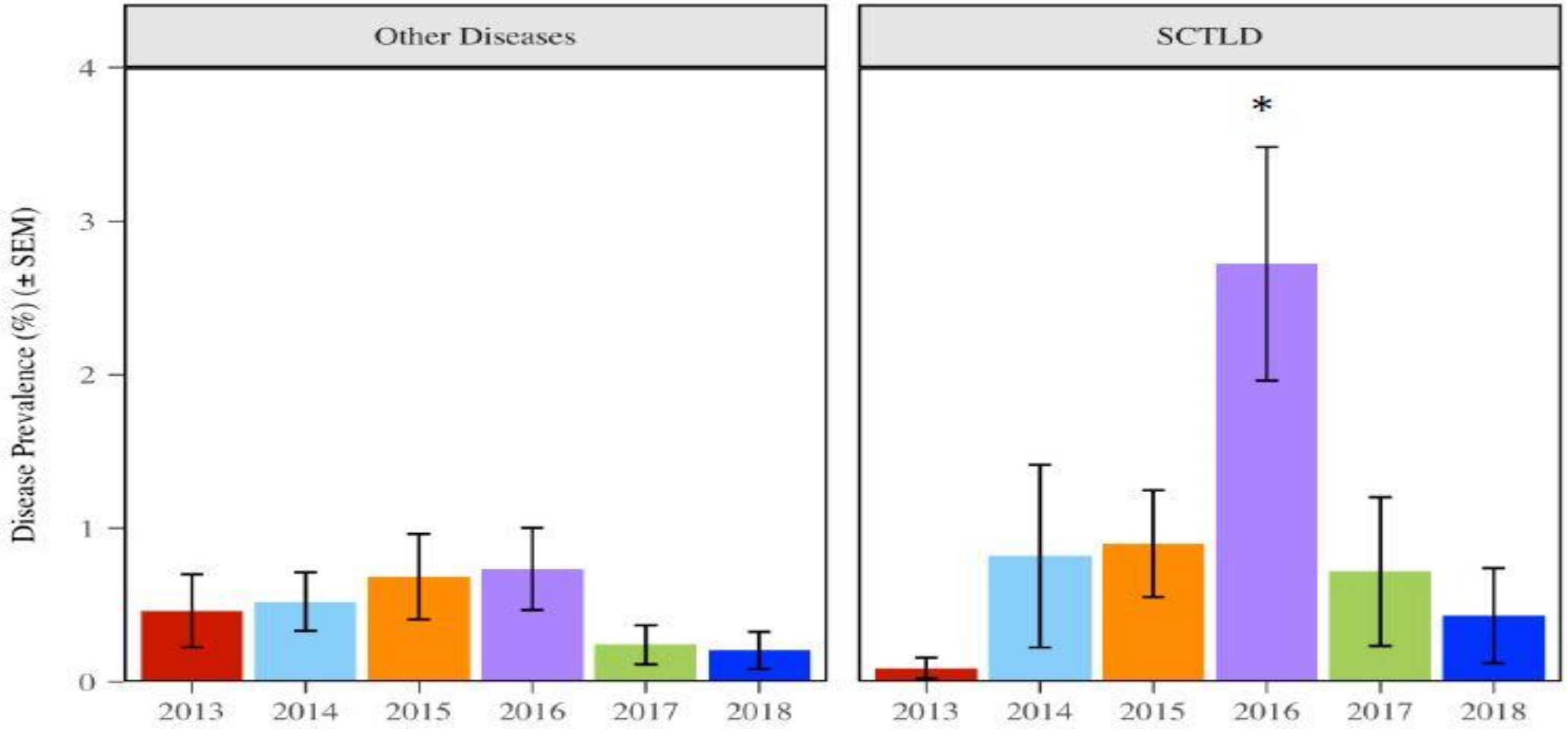
SCTLD Occurrence in the Caribbean



Data: http://www.agrra.org/coral-disease-outbreak/

SCTLD Statistics & Consequences

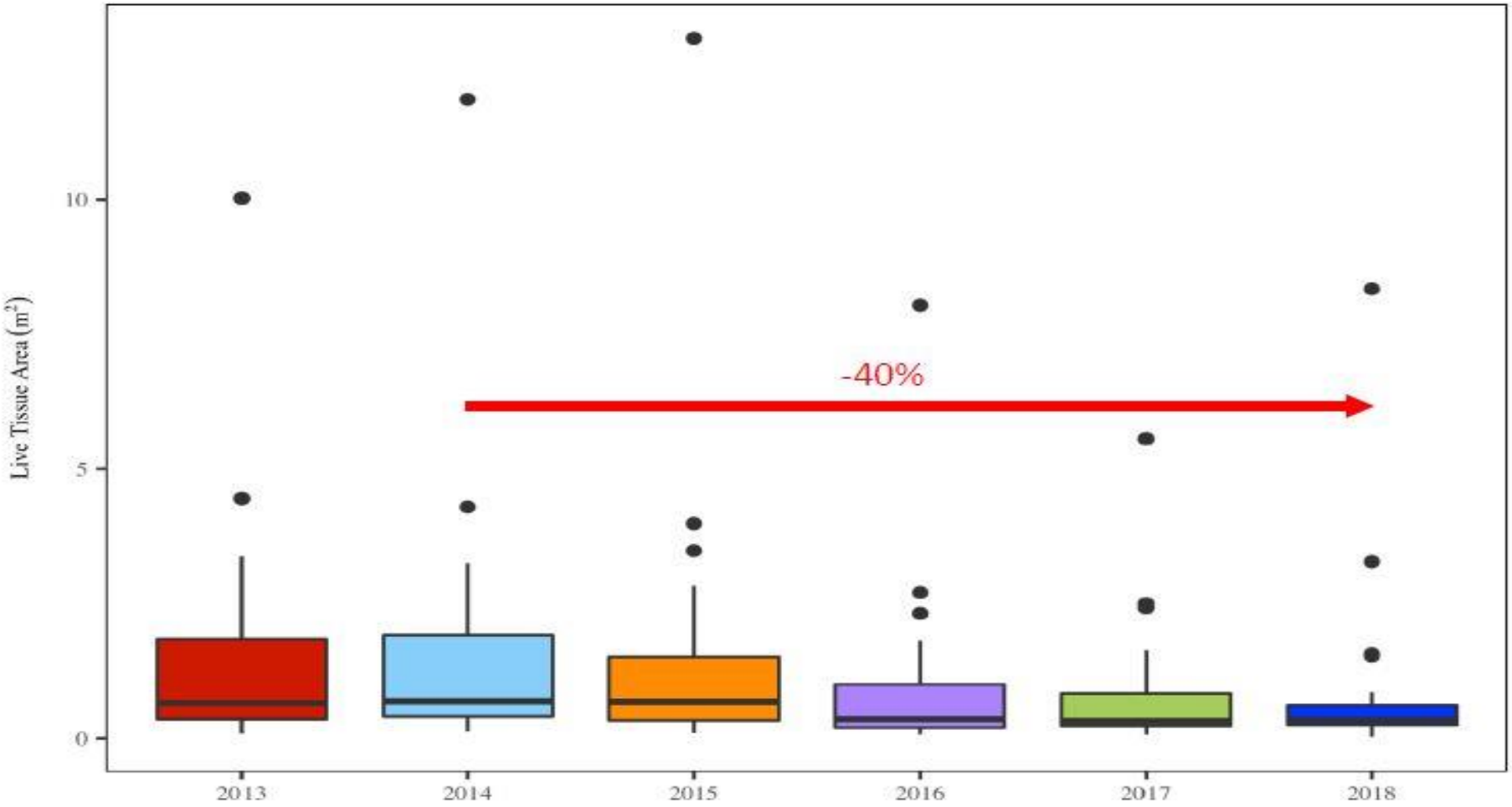
Regional disease prevalence



Source: Walton et al. 2018; SECREMP 2018; Hayes et al. In prep; SECREMP 2019 In prep

SCTLD Statistics & Consequences

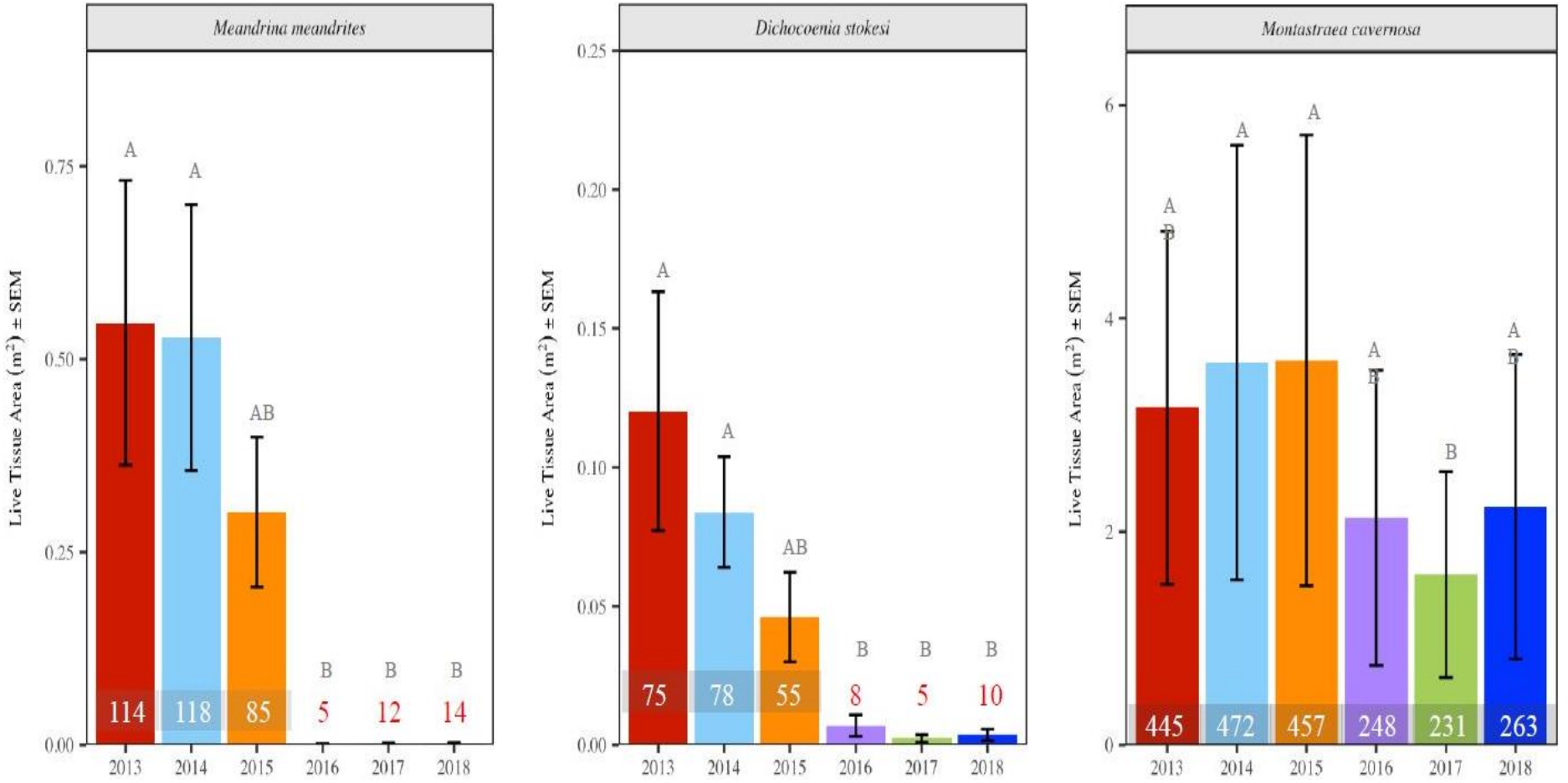
Loss of Regional live tissue area



Source: Walton et al. 2018; SECREMP 2018; Hayes et al. In prep; SECREMP 2019 In prep

SCTLD Statistics & Consequences

Species-specific live tissue area and abundance



Source: Walton et al. 2018; SECREMP 2018; Hayes et al. In prep; SECREMP 2019 In prep

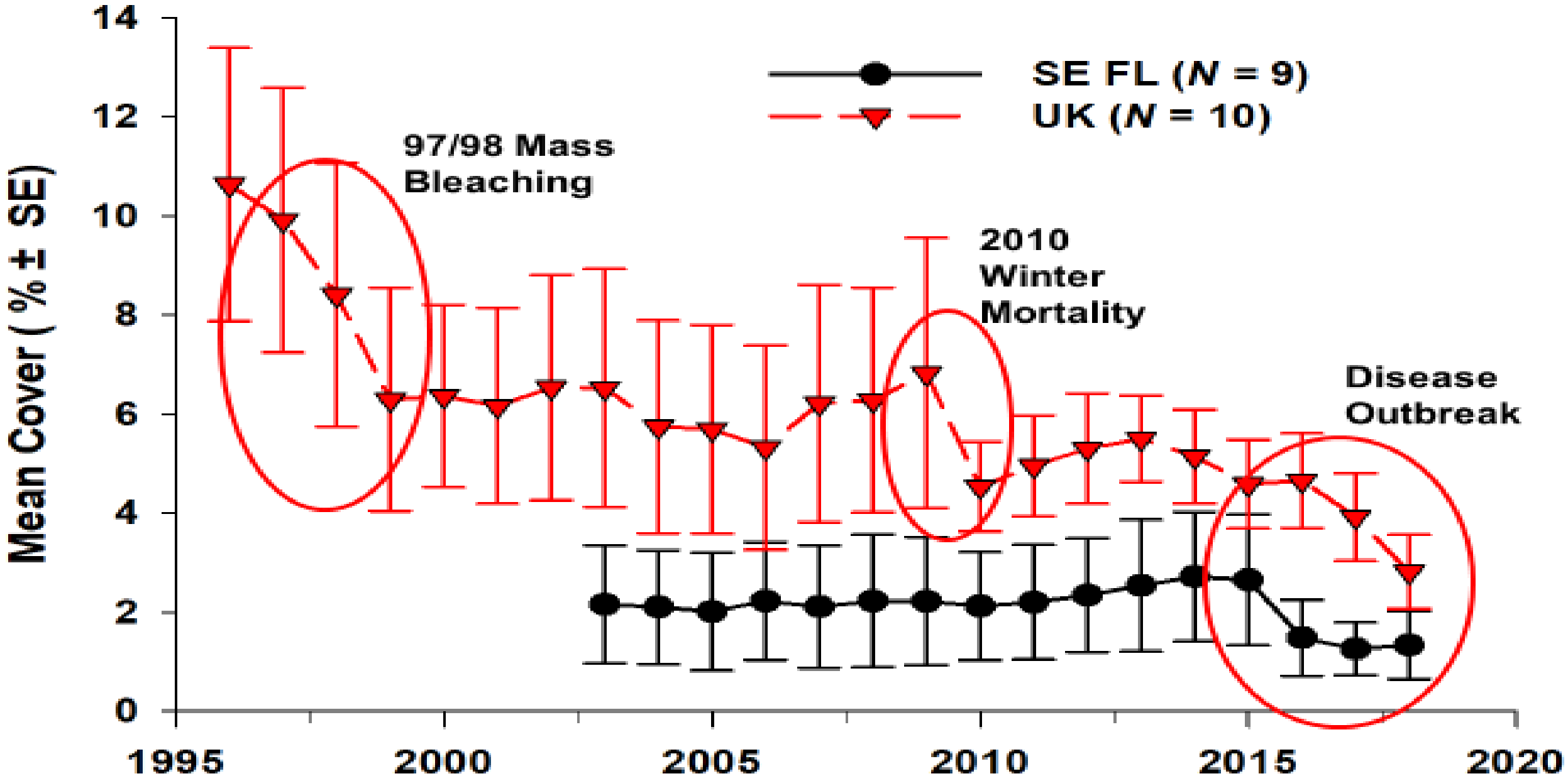
CREMP Changes in Abundance in the Upper Keys Due to Stony Coral Tissue Loss Disease

Year	CNAT	DLAB	DSTO	MCAV	MMEA	PSTR	SSID	ORBI	Total
									
2014	15	11	31	66	10	12	652	70	2343
2015	13	11	33	72	11	15	682	81	2293
2016	7	13	29	83	11	14	773	69	2349
2017	11	14	11	40	0	6	689	70	2098
2018	0	1	5	35	0	3	649	60	1934

- $N = 14$ sites in the Upper Keys;
- Totals pooled for sites
- Lesions still active on several species

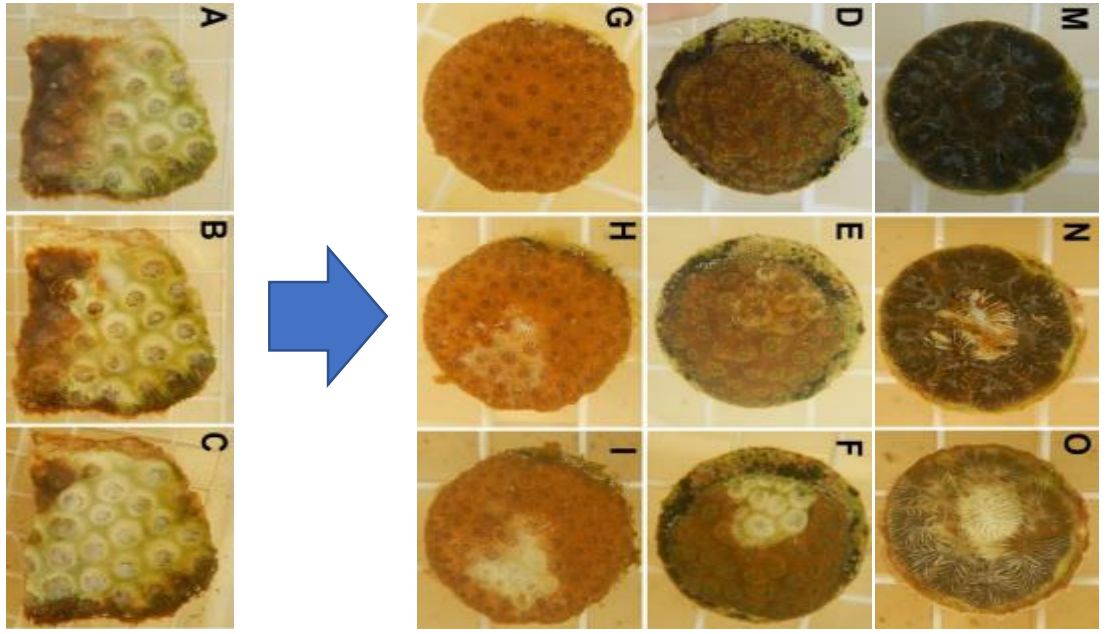
Source: Rob Ruzicka et al., Coral Reef Evaluation & Monitoring Project Update US EPA WQPP Steering Committee Meeting, 2019

CREMP & SECREMP Coral Cover



Stony Coral Tissue Loss Disease factors

Infectious, waterborne disease

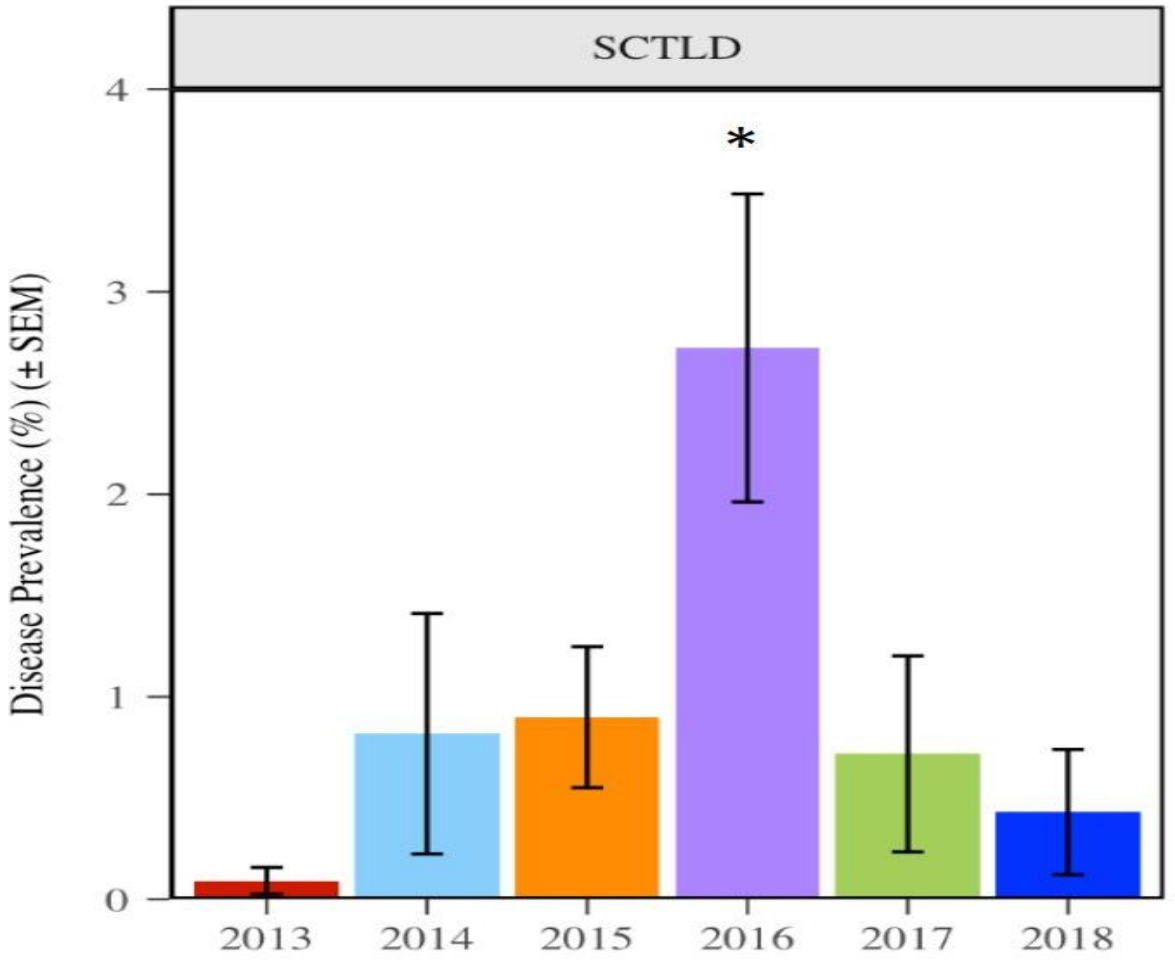


Source: Ushijima & Paul, Smithsonian. Unpublished.

Stony Coral Tissue Loss Disease factors

Infectious, waterborne disease

Persistence of pathogen(s)



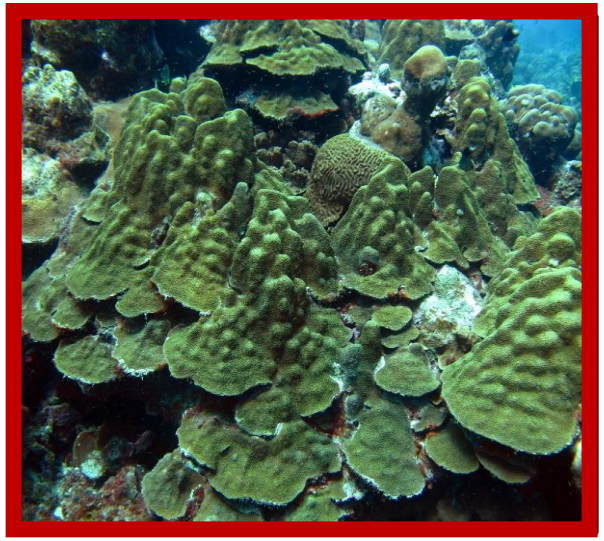
Source: Walton et al. 2018; Hayes et al. (in prep)

Stony Coral Tissue Loss Disease factors

Infectious, waterborne disease

Persistence of pathogen(s)

Impacts ~50% of stony coral species



Images: FWC

Susceptible species (★ = ESA listed species) (□ = major framework builders)

Highly susceptible

Colpophyllia natans (Boulder brain coral)

Dendrogyra cylindrus (Pillar coral)★

Dichocoenia stokesii (Elliptical star coral)

Diploria labyrinthiformis (Grooved brain coral)

Eusmilia fastigiata (Smooth flower coral)

Meandrina meandrites (Maze coral)

Pseudodiploria strigosa (Symmetrical brain coral)

Pseudodiploria clivosa (Knobby brain coral)

Intermediately susceptible

Montastraea cavernosa (Great star coral)

Orbicella annularis (Lobed star coral)★

Orbicella faveolata (Mountainous star coral)★

Orbicella franksi (Boulder star coral)★

Siderastrea radians (Lesser Starlet coral)

Siderastrea siderea (Massive starlet coral)

Solenastrea bournoni (Smooth star coral)

Stephanocoenia intersepta (Blushing star coral)

Unknown susceptibility

Agaricia agaricites (Lettuce coral)

Agaricia fragilis (Fragile saucer coral)

Favia fragum (Golfball coral)

Helioseris cucullata (Sunray lettuce)

Isophyllia rigida (Rough star coral)

Isophyllia sinuosa (Sinuous cactus)

Madracis arenterna (Pencil coral)

Mussa angulosa (Spiny flower coral)

Mycetophyllia spp. (Cactus corals)★

Scolymia spp. (Disk corals)

Stony Coral Tissue Loss Disease factors

Infectious, waterborne disease

Persistence of pathogen(s)

Impacts ~50% of stony coral species

High prevalence rates (66-100%)

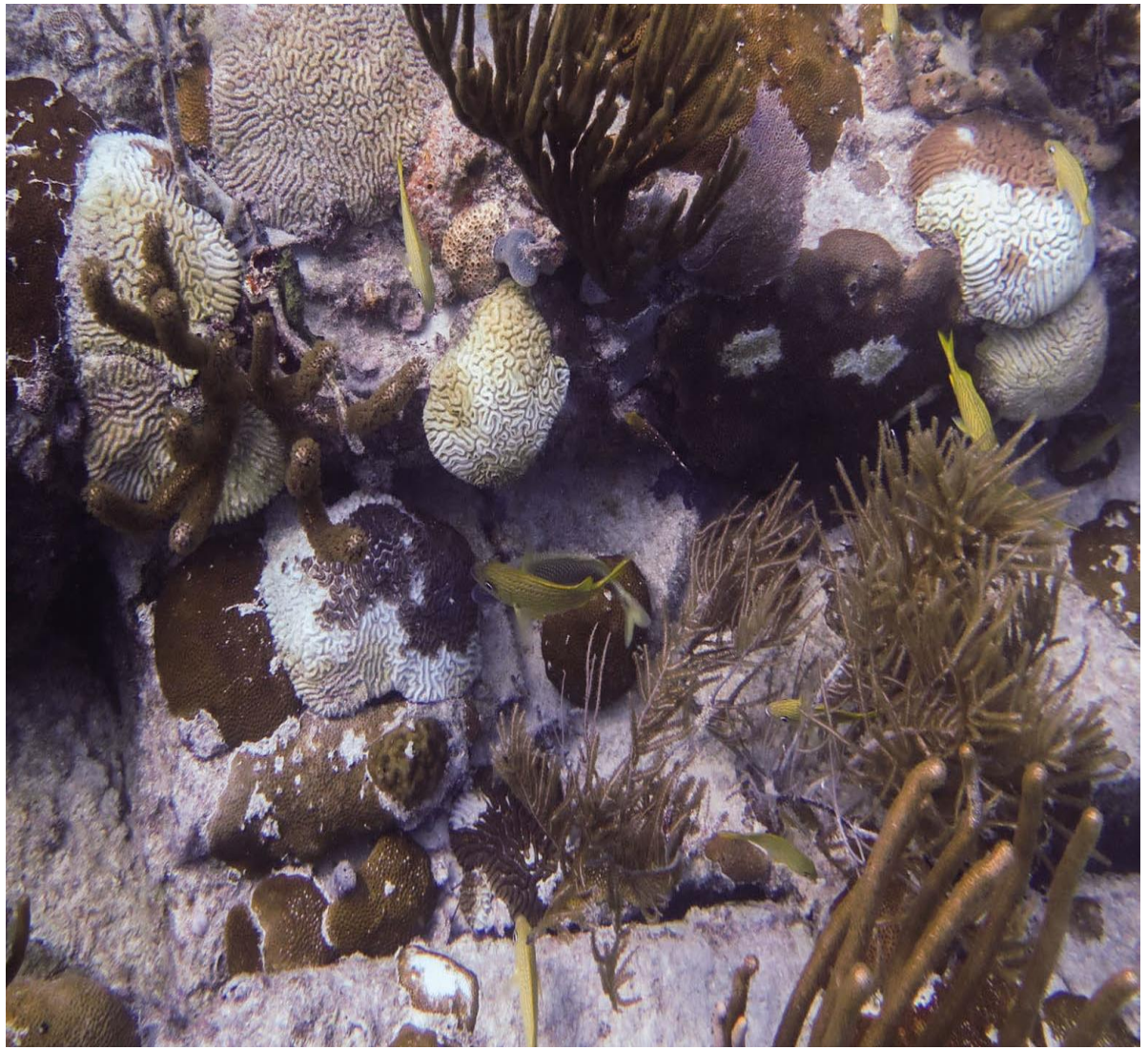


Image: Karen Neely, NSU

Stony Coral Tissue Loss Disease factors

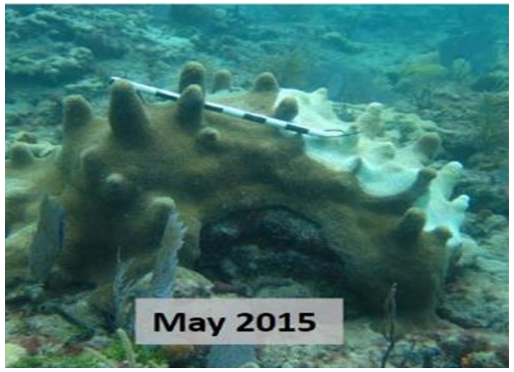
Infectious, waterborne disease

Persistence of pathogen(s)

Impacts ~50% of stony coral species

Very high prevalence rates (66-100%)

Complete tissue loss on nearly 100% of infected colonies



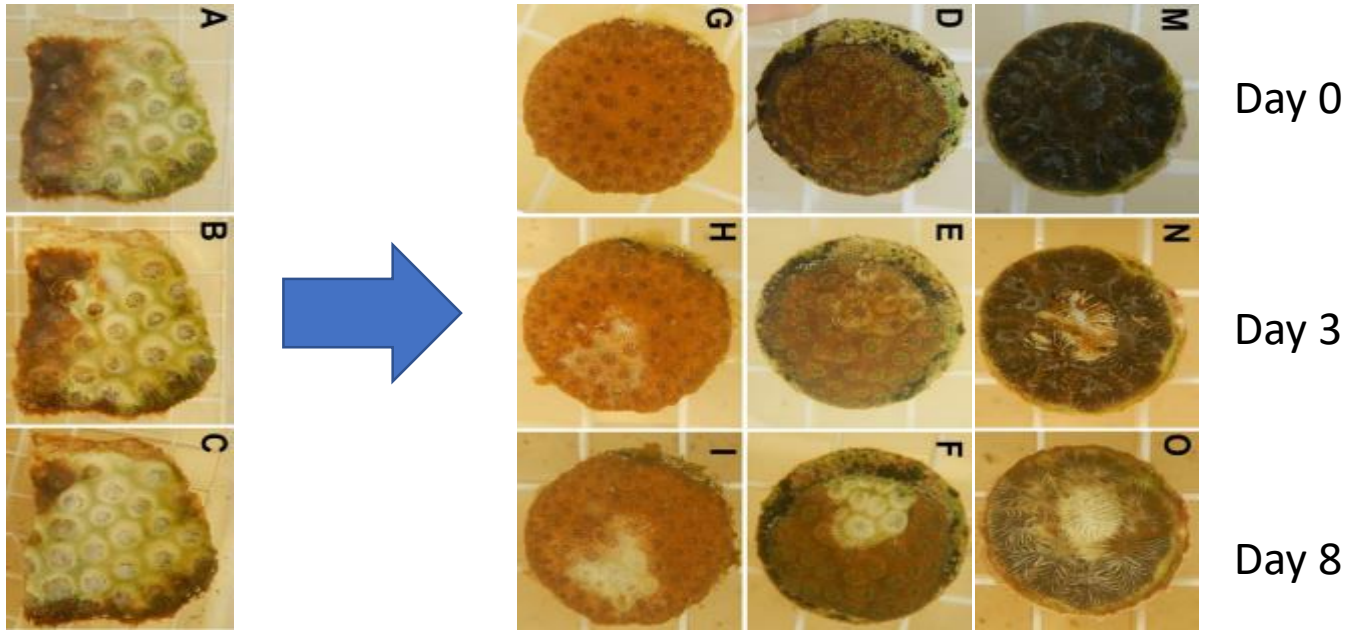
Images: FWC

Key research findings

Transmission experiments demonstrate this is infectious

Therapeutic diagnoses suggest bacterial pathogen(s) are involved

Microbiome & pathogenicity experimentation has identified prevalent taxa



Day 0

Day 3

Day 8

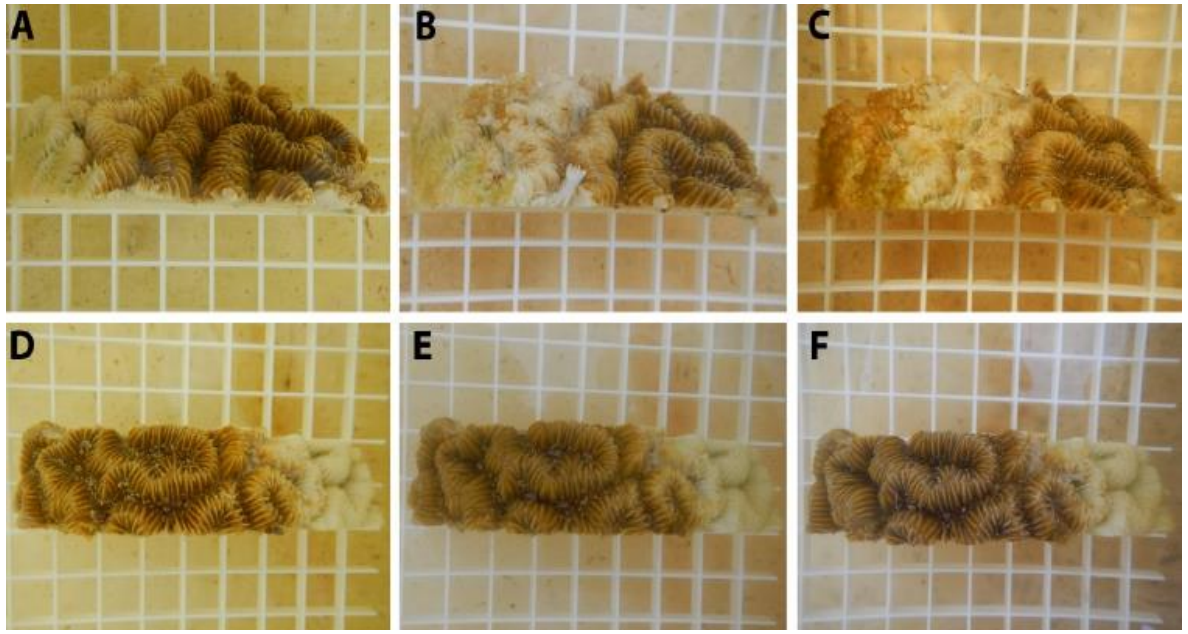
Transmission via direct contact and through sterile seawater

Source: Ushijima & Paul, Smithsonian. Unpublished.

Key research findings

Transmission experiments demonstrate this is infectious

Therapeutic diagnoses suggest bacterial pathogen(s) are involved



No treatment

Treated w/ amoxicillin & kanamycin

Source: Ushijima & Paul, Smithsonian. Unpublished.

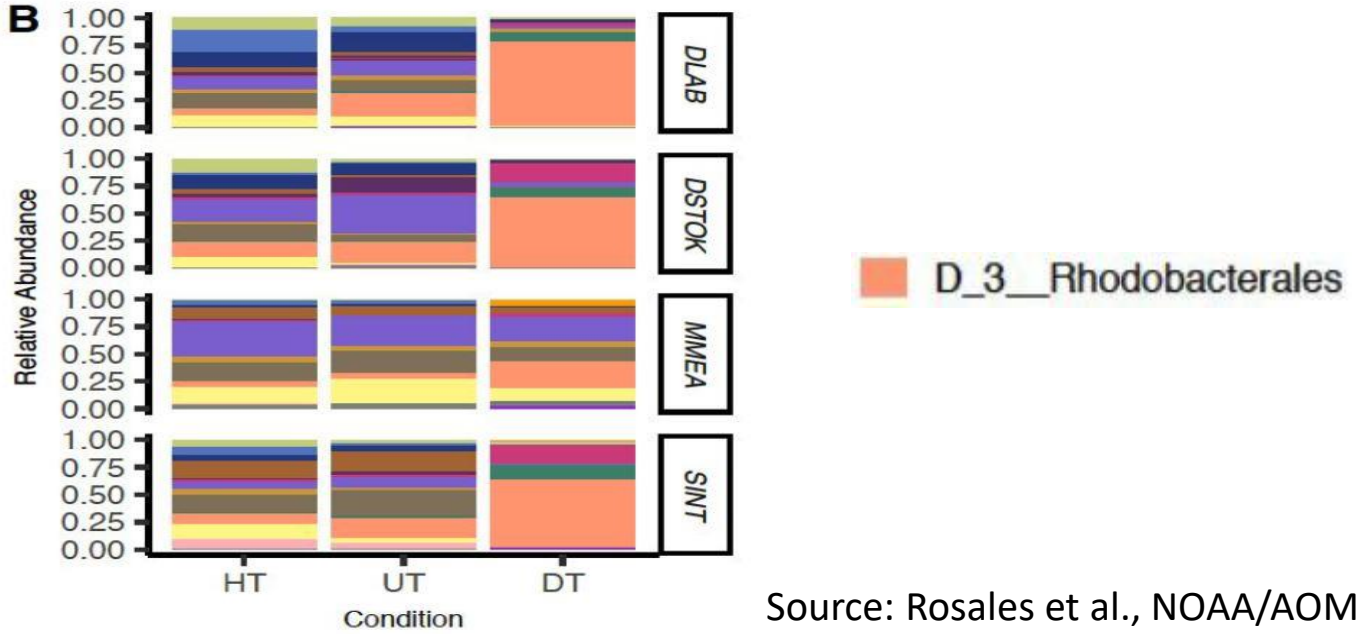
Key research findings

Transmission experiments demonstrate this is infectious

Therapeutic diagnoses suggest bacterial pathogen(s) are involved

Microbiome & pathogenicity experimentation has identified prevalent taxa

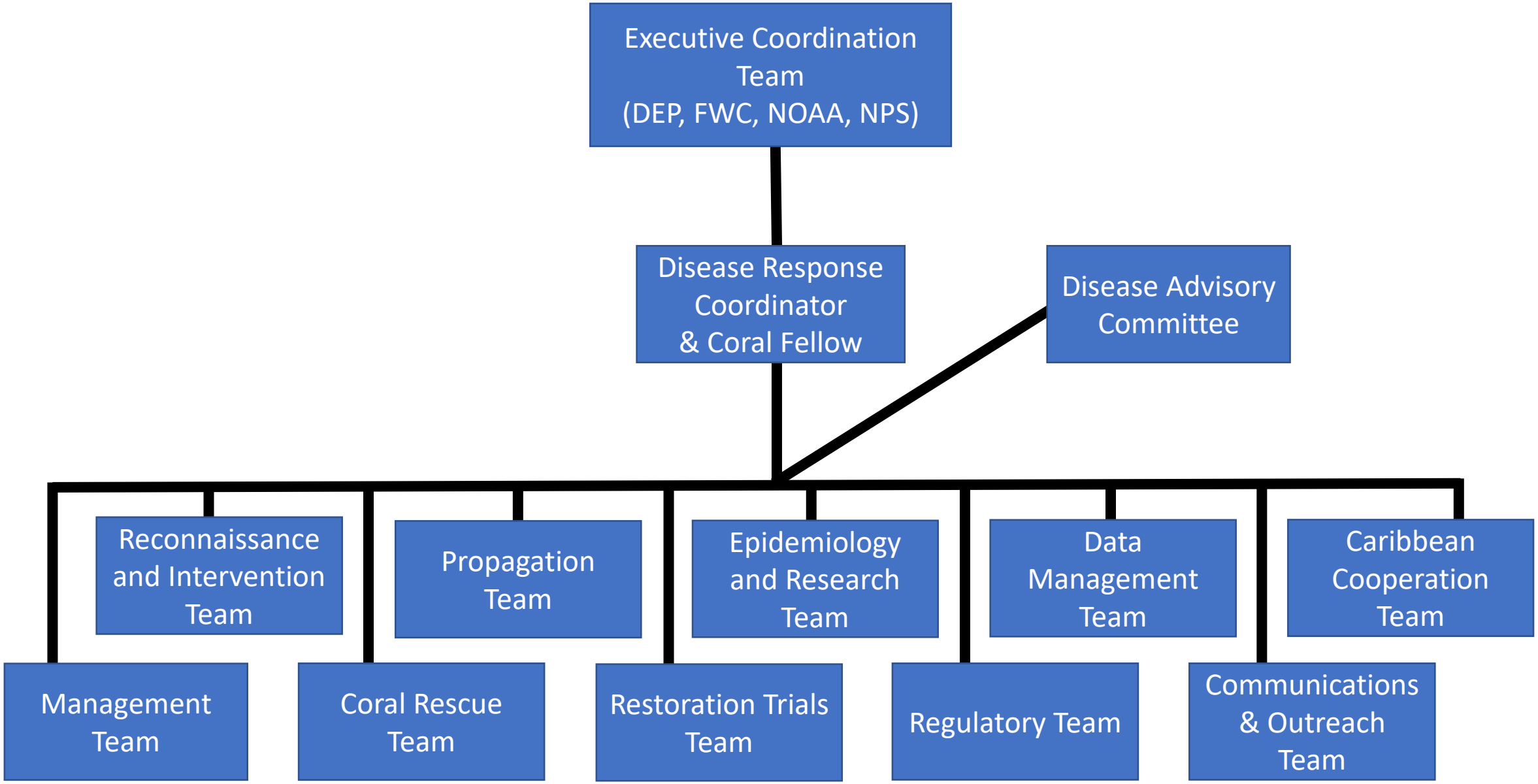
Credit: Florida Department of Environmental Protection



Source: Rosales et al., NOAA/AOML. Unpublished.

Response Partners

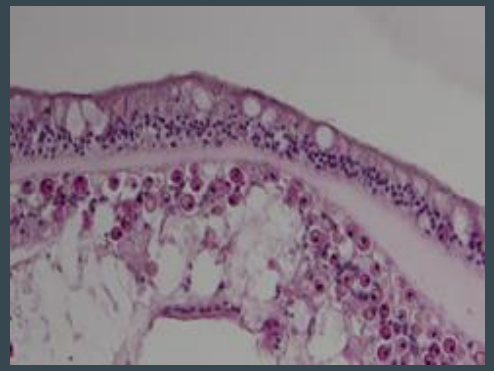
Response Structure

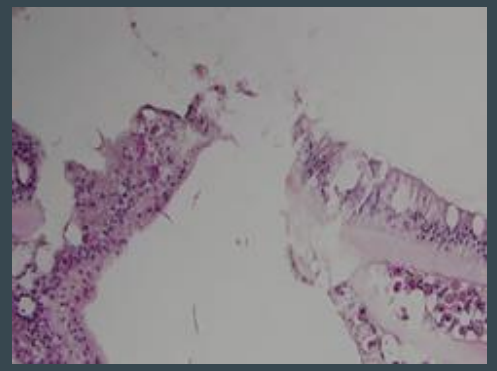


Florida Response Teams

Ten ‘Response Teams’ that address priority topic areas

Research & Epidemiology





Reconnaissance & Intervention

Caribbean Cooperation

Coral Rescue

Coral Rescue Goals

"Rescue" (collect and gene bank) healthy corals from ahead of the disease boundary

Hold rescued corals in land-based facilities to ***prevent*** them from becoming infected, to ***preserve*** genetic diversity, and to ***propagate*** for future restoration

Coral Rescue Plan

Coral Collection Plan

Species Prioritization – High, Medium, Low

- Disease susceptibility
- Speed of disease progression
- Whole colony mortality
- Reef building contribution
- Spatial distribution declines and current abundance
- Reproductive strategy
- Conservation status (ESA-listed)

22 species:

16 high and 6 medium

Genetic Management Plan

Genetic diversity thresholds and targets

- 50 unique genets = 200 colonies/species

Develop and apply genetic markers

Genet registry

Genetic connectivity studies for brooders

AZA Florida Reef Tract Rescue Project

AZA "Florida Four"

THE FLORIDA AQUARIUM™

MOTE MARINE LABORATORY

Disney's ANIMALS, SCIENCE and ENVIRONMENT

SeaWorld

AZA National Participating Facilities

- 16 Primary Holders (including Florida Four)
- 7 Secondary Holders
- 43 Project Friends

…and recruitment is ongoing…

ASSOCIATION OF ZOOS & AQUARIUMS

Phase 1: Pilot Collections

Who: 12 High Priority Species

What: 8 colonies/species in 2 size classes: <10 cm and 10-30 cm
Total of 180 corals

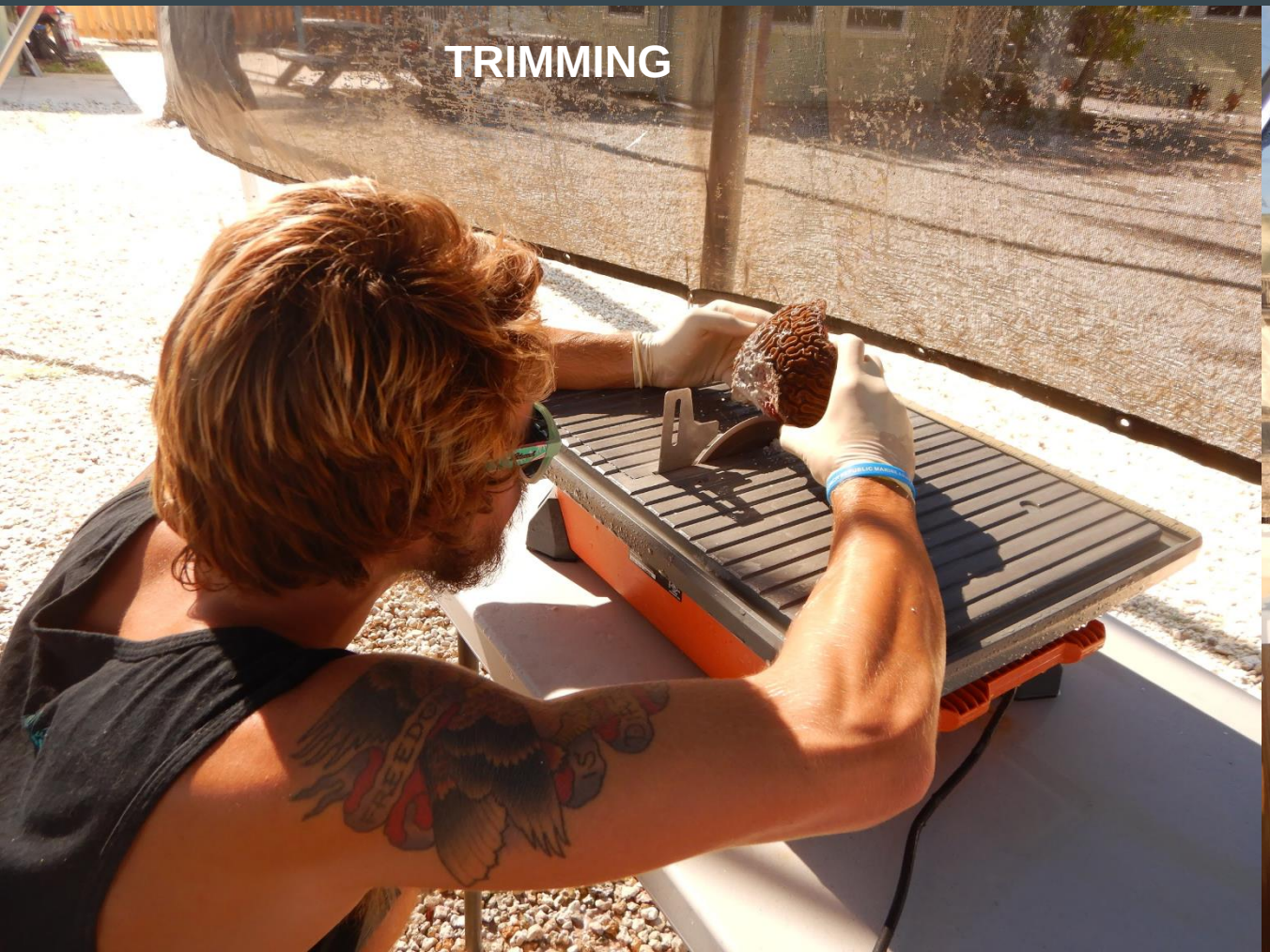
When: Fall 2018

Where: 7 disease-free sites in Lower Keys

Then Where: Temporary Holding @ KML
Intermediate Holding @ FL Aquarium (Apollo Beach), Mote Aquarium (Sarasota), University of Miami, Nova Southeastern University (Dania Beach)

CNAT
DLAB
DSTO
EFAS
MMEA
MCAV
OANN
OFAV
PSTR
DCYL
MALI
MANG
MAUR
MFER
MLAM
PCLI

Coral Care



Phase 2: High Priority Collections

Who: 15 High Priority Species

What: 200 colonies(ramets) per species
Total of 3,000 corals (includes pilot collections)

When: Summer and Fall 2019

Where: Marquesas and Dry Tortugas

Then Where: Intermediate Holding @ UMiami, Nova SE University
Longer-term Holding @ AZA facilities nationwide

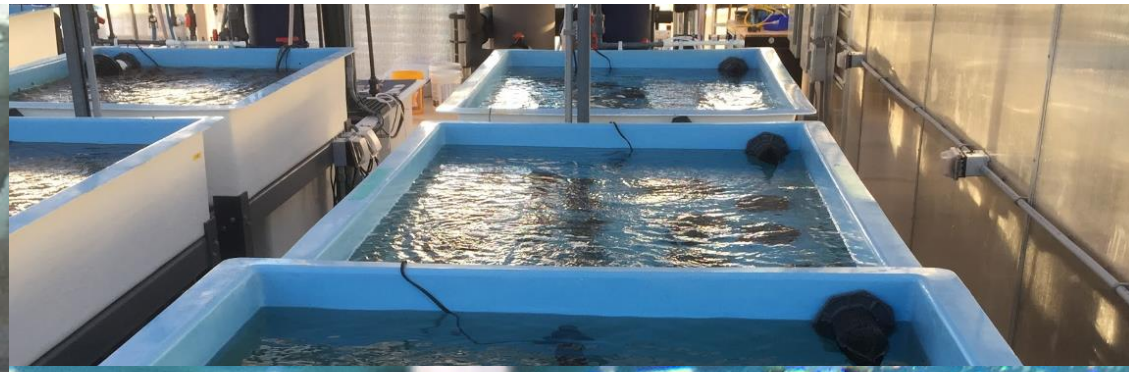
Coral Rescue


Coral Rescu

Genetic Sampling

Mounting and Tagging

Intermediate Housin



Ship

to

A

Z

A

AZA “Reefugees”

Coral Rescue - Coral Monitoring Dashboard

Select Site to Filter Data: None

Total Rescue Sites
34

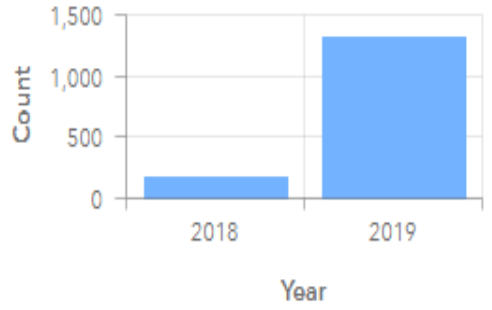
Colonies Under Care
1,487

Most Recent Rescue
7/3/2019

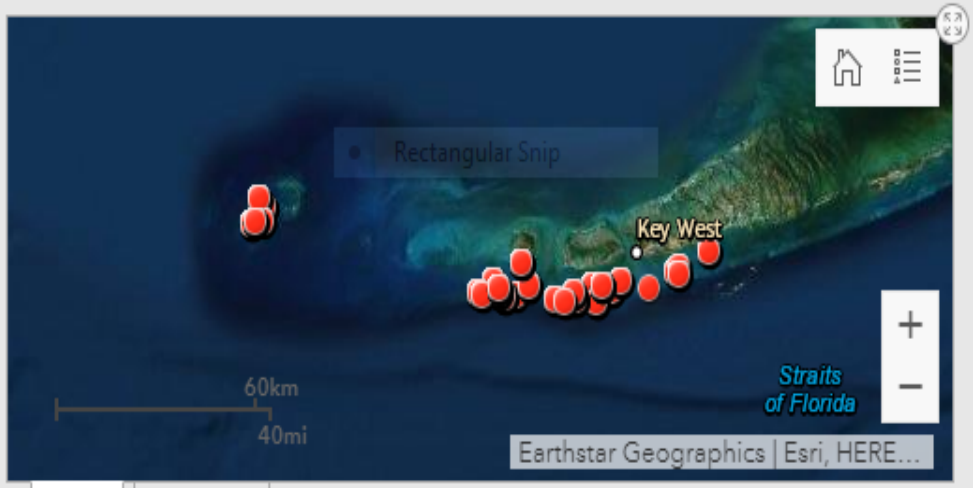
Latest Data Update
8/15/2019

Total Tissue Area
104,325 cm^2

Corals Rescued



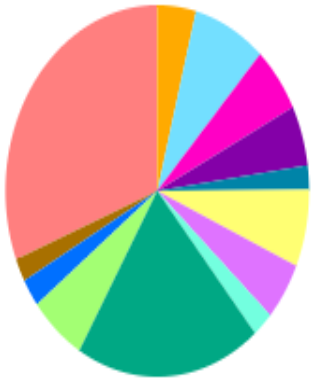
Year | Genotype | Coral Codes



Map | Glossary

Current Housing Facility

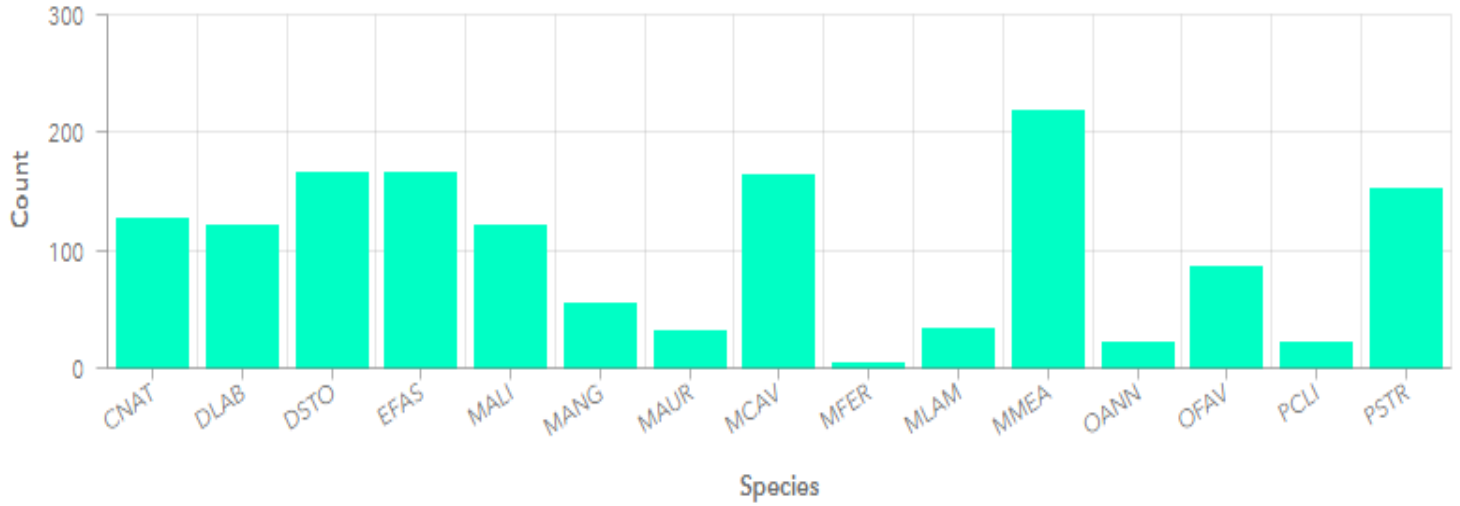
(Click pie chart to filter data)



- Aquarium*
- Nova Southeastern University 293
- Omaha's Henry Doorly Zoo* 89
- Riverbanks Zoo & Gardens* 36
- Texas State Aquarium* 30
- University of Miami 461

*Denotes Association of Zoos and Aquariums (AZA) accredited facilities. **Number of corals may change over time as colonies are added, removed, or re-distributed across holding facilities.

High Priority Species Rescued

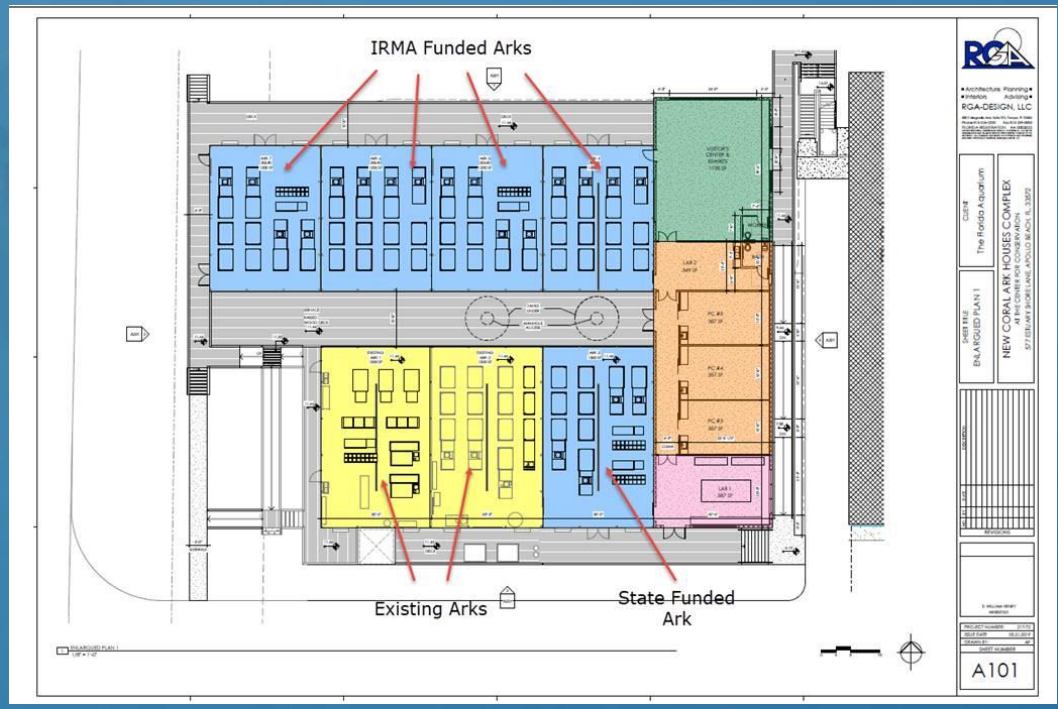


Species | Facility | Diameter | Tissue

VISION: Phase 4

Phase 4 – Propagation

- Form Coral Propagation Team
- Activities and needs assessment
- Develop Coral Propagation Plan
- Build out of on-land propagation facilities
  - Florida Aquarium - 4 greenhouses
- Transfer from AZA Facilities to on-land propagation facilities
- Collections from endemic zone
- Expansion of in-water nurseries for grow-out



Propagation Team

- Brand new!
- Develop a Coral Propagation Plan (including sexual, asexual, and sexual-to-asexual), to include collections of corals/gametes from the endemic zone.
- Develop an infrastructure expansion plan.
- Develop and maintain species-specific propagation genetic management plans
- Serve as the coordinating hub for funding, communication, logistics, etc.

Website Resources for SCTLD!

Florida Focused

FKNMS SCTLD Web Portal (general information)
https://floridakeys.noaa.gov/coral-disease/

DEP Disease Site (technical information)
https://floridadep.gov/rcp/coraldisease

Caribbean Wide

AGRRA webpage (reporting & general information)
http://www.agrra.org/coral-disease-outbreak/

GCFI website (awareness raising)
https://www.gcfi.org/emerging-issues-florida-coral-disease-outbreak/

TNC Reef Resilience Network SCTLD page
http://reefresilience.org/managing-for-disturbance/managing-coral-disease/stony-coral-tissue-loss-disease/

Questions?

Rob Ruzicka

Coral Program Manager

Fish & Wildlife Research Institute

(o) +1 727 892 4127

(c) +1 727 242 0557

(e) rob.ruzicka@myfwc.com

Maurizio Martinelli

Florida's Coral Disease Response Coordinator

Florida Sea Grant

(o) +1 305 795 1221

(c) +1 352 665 9920

(e) mmartinelli1@ufl.edu