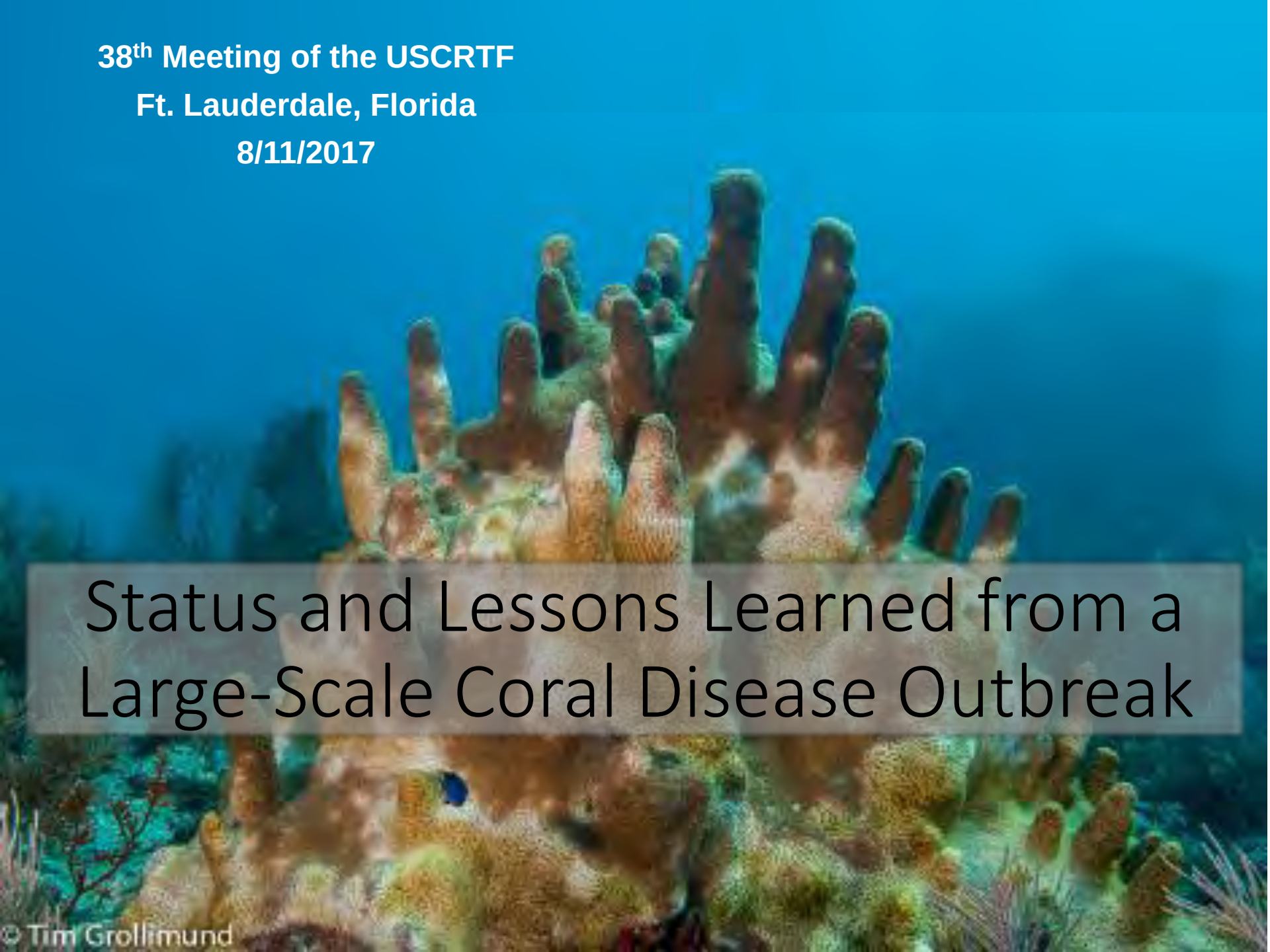
38th Meeting of the USCRTF

Ft. Lauderdale, Florida

8/11/2017



Status and Lessons Learned from a Large-Scale Coral Disease Outbreak


Photo: NSU GRRAM

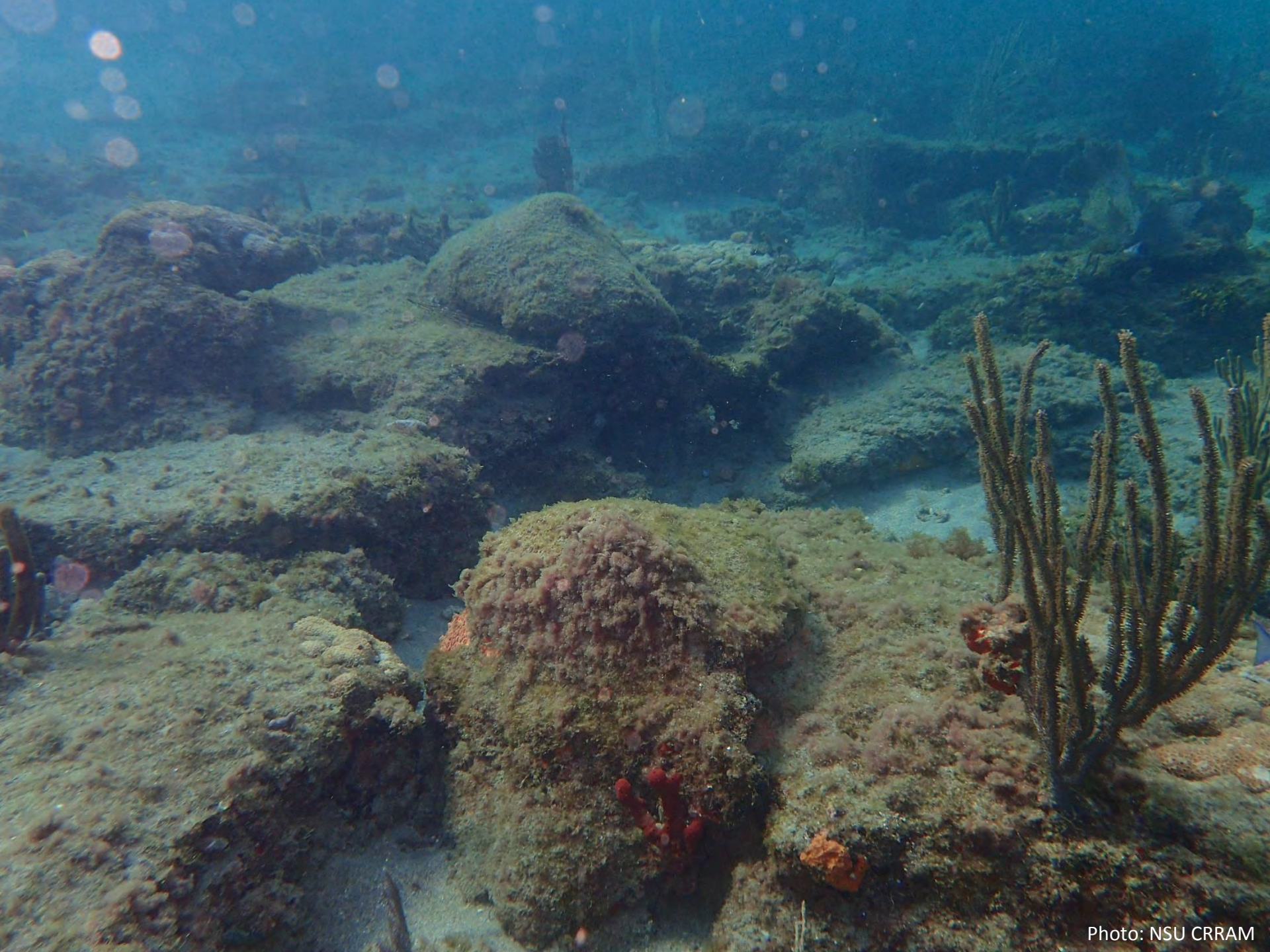


Photo: NSU CRRAM

Overview

- Introduction to Coral Disease
- Florida Reef Tract Coral Disease Outbreak Status
- Disease Investigation and Response Efforts
- Lessons Learned and Next Steps

Disease

Disease is defined as:

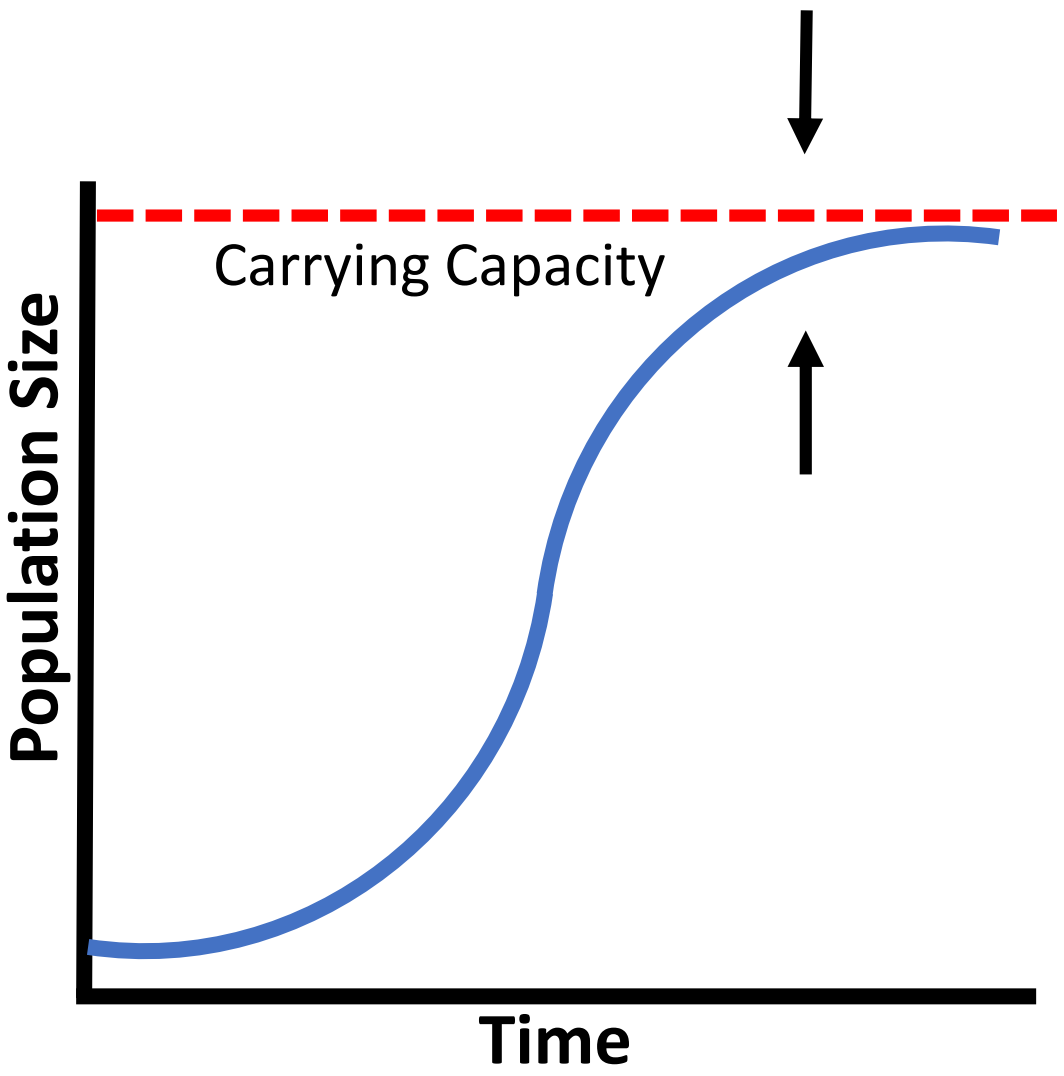
Any impairment of vital body functions, systems, or organs.

- **Infectious**
  - Causal agent a living organism
  - Pathogens such as viruses or bacteria
  - Parasites

- **Non-infectious**
  - Causal agent a genetic defect or environmental stressor
    - Health habits
    - Exposure to toxicants

[1]Peters, 1997

Disease



Competition
Trauma
Disease
Emigration

Birth rate
Immigration

Disease Outbreaks

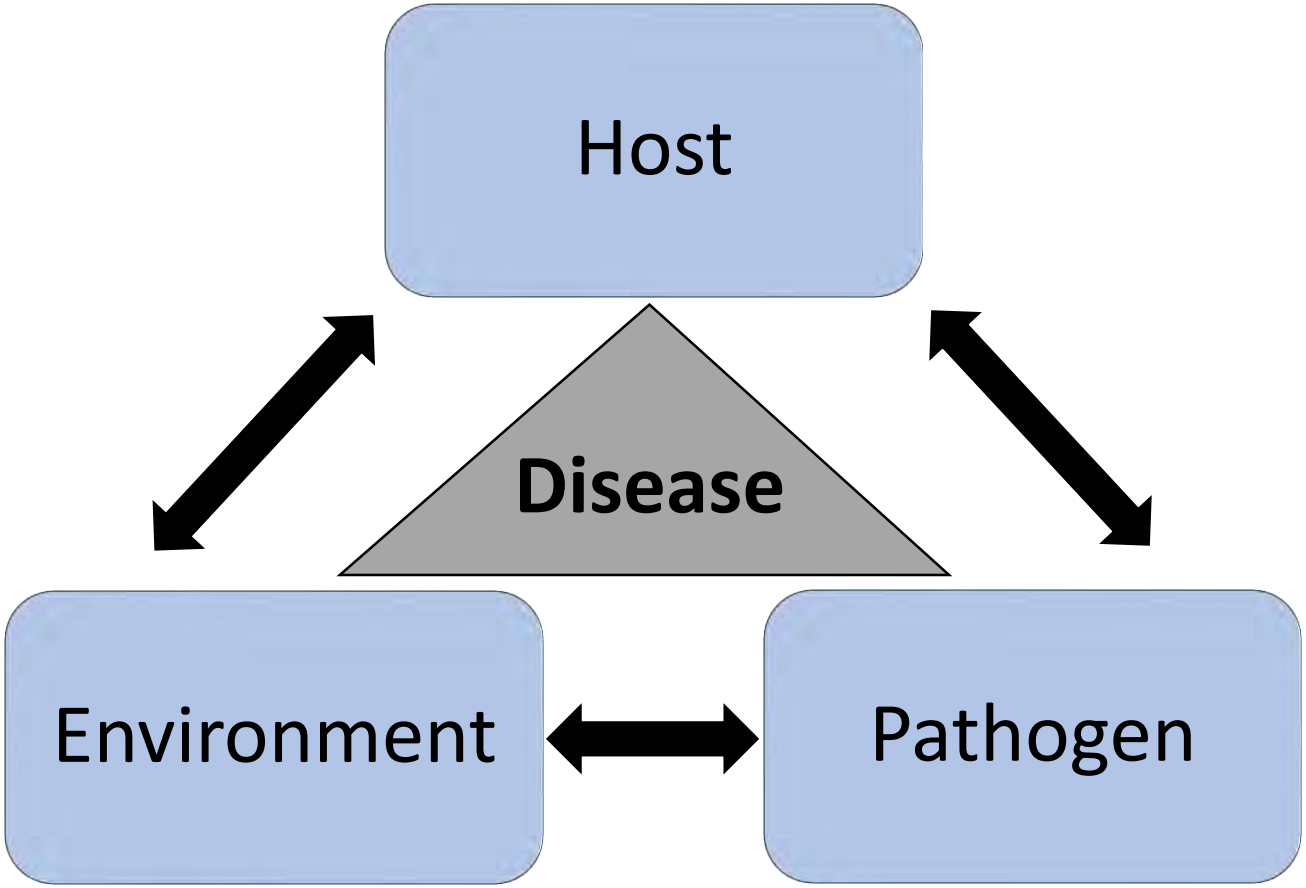
1918: "Spanish flu" H1N1 Pandemic

The most devastating flu pandemic in modern times, killing more than 500,000 people in the United States, and some 50 million people worldwide. Somewhere between 20 and 40 percent of the global population was ill.

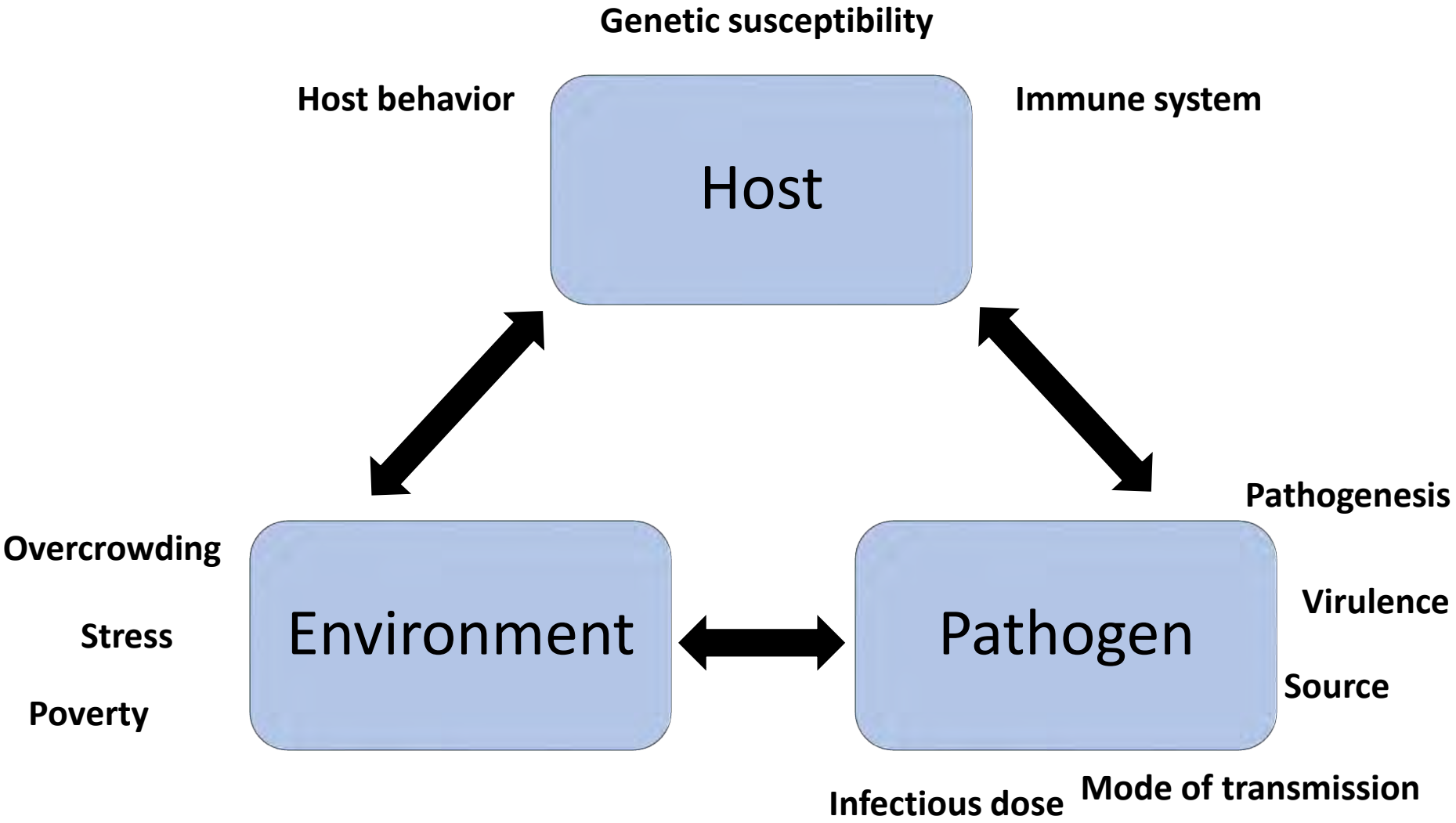
An emergency hospital during 1918 influenza epidemic, in Camp Funston, Kansas.
Credit: National Museum of Health and Medicine, Armed Forces Institute of Pathology

Disease

Triad of disease causation:



Disease


Genetic susceptibility
Host behavior
Immune system
Host
Pathogenesis
Overcrowding
Stress
Poverty
Environment
Pathogen
Virulence
Source
Infectious dose
Mode of transmission

Disease Outbreaks

- novel pathogens introduced into naïve host populations

- endemic pathogens spread within a population due to altered external factors, which affect host-pathogen ecology

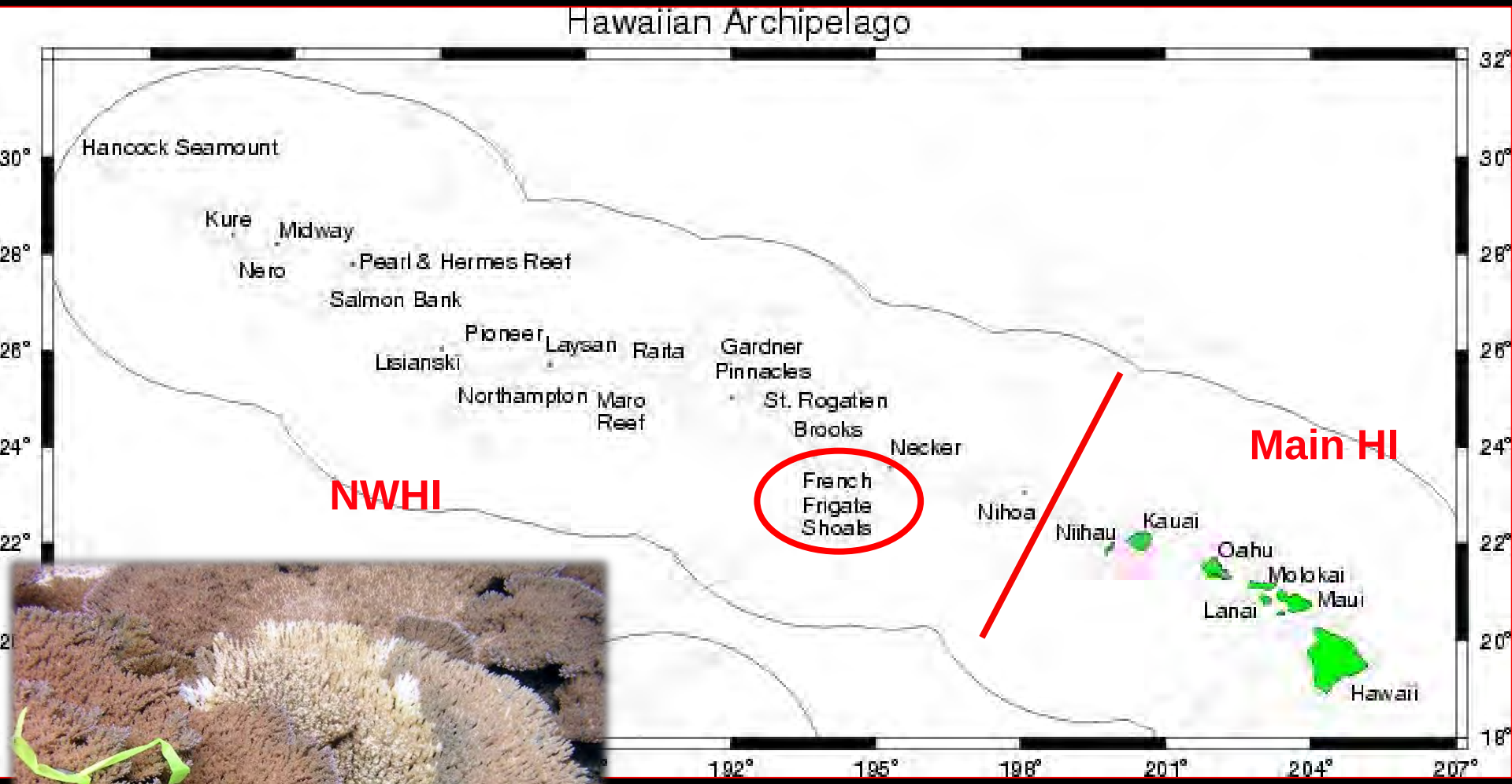
An emergency hospital during 1918 influenza epidemic, in Camp Funston, Kansas.
Credit: National Museum of Health and Medicine, Armed Forces Institute of Pathology

Disease

Is disease a problem for coral reefs?

First disease outbreak in Hawaii

2003



***Acropora* white syndrome**

Northwestern Hawaiian Islands

May 2005

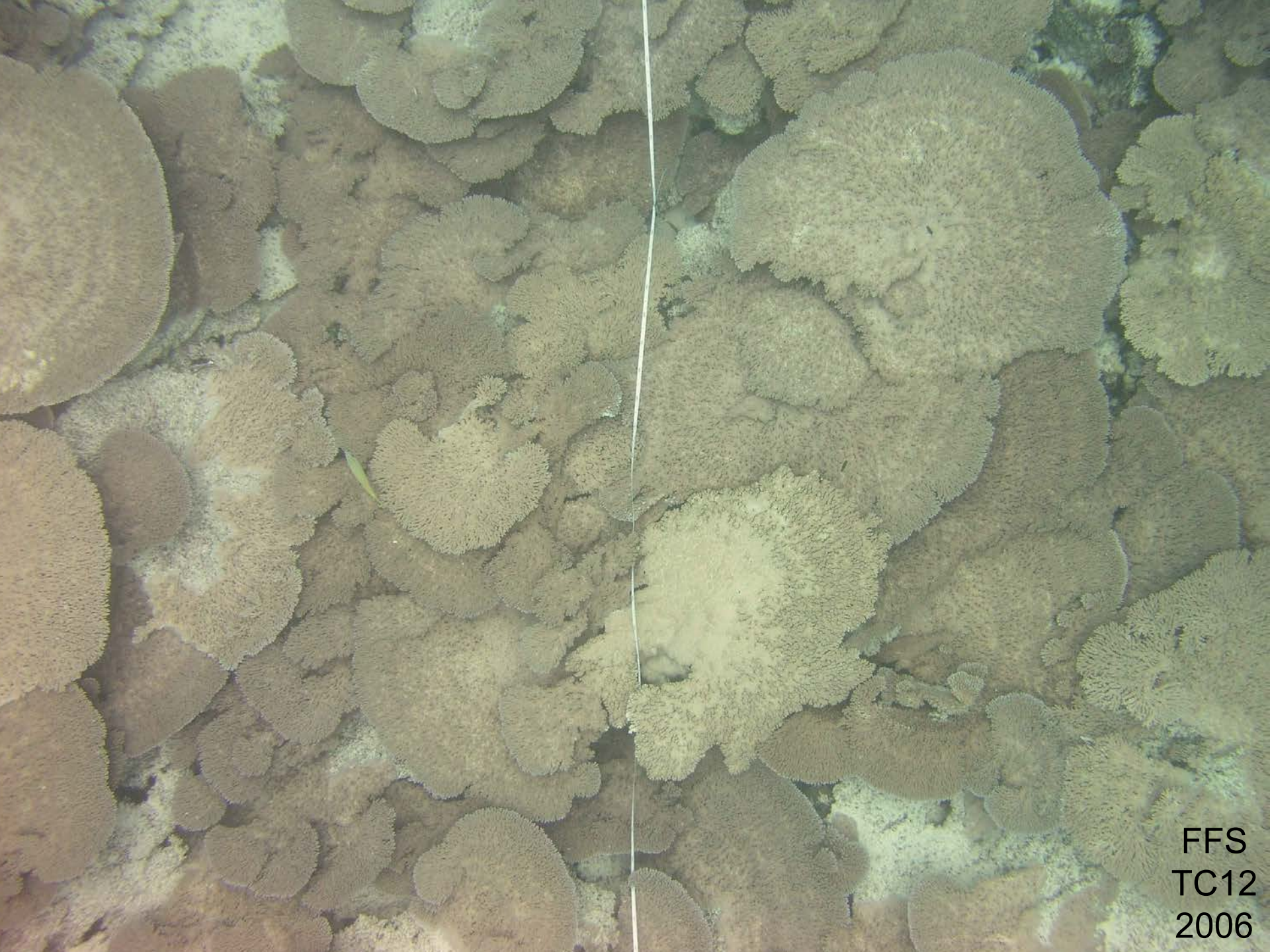
41 tagged colonies relocated

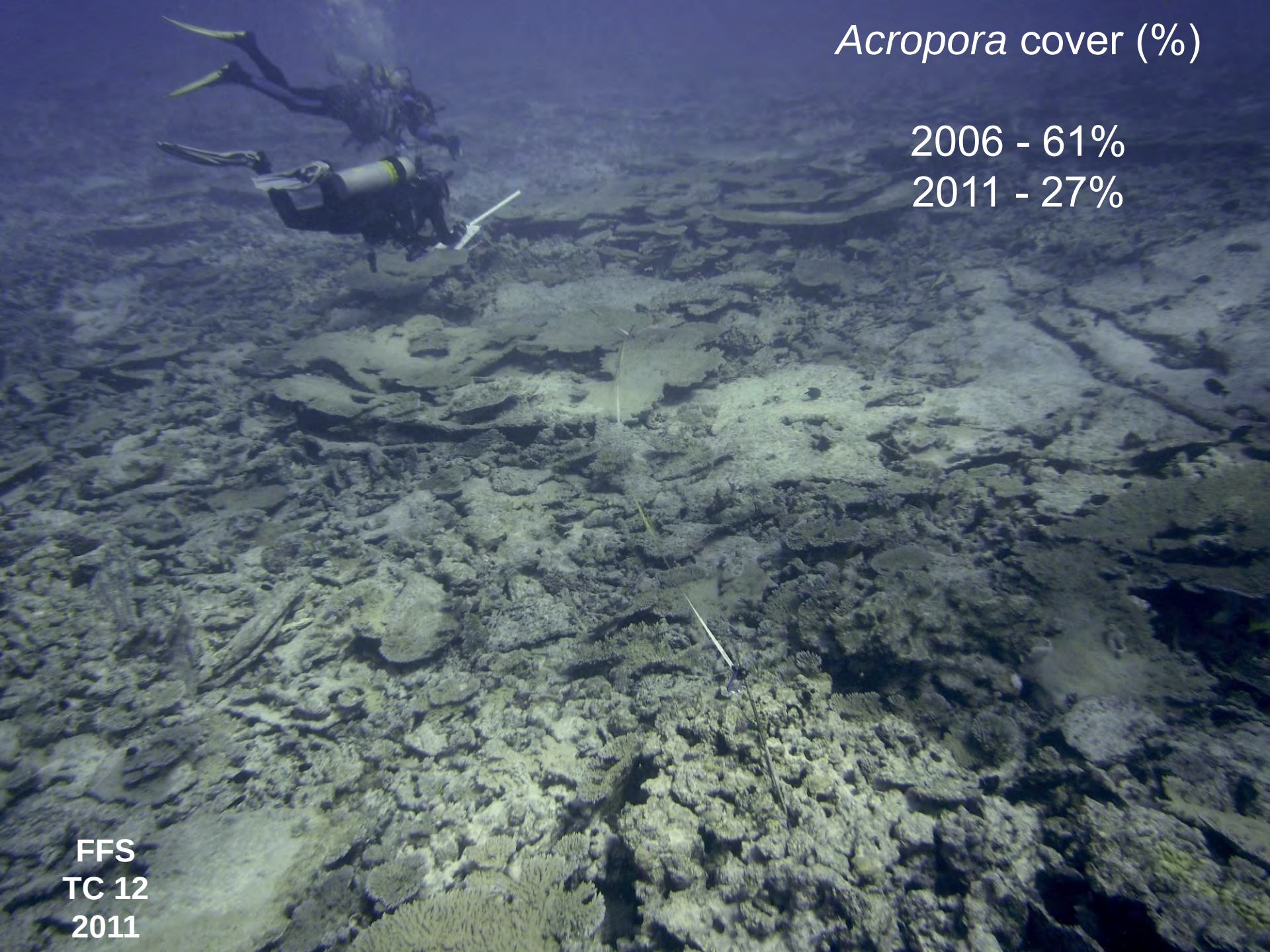
May 2006

40 colonies
partial to total mortality (97.6%)

Case fatality rate=46%
19 colonies dead

Aeby et al. 2011


FFS
TC12
2006


Acropora cover (%)
2006 - 61%
2011 - 27%
FFS
TC 12
2011

Acropora white syndrome is spreading across FFS

Year	# reefs surveyed	# reefs w/ AWS
2002	6	0
2003	7	1
2004	6	3
2005	5	4
2006	9	7

Rapid disease killing coral in Kaneohe Bay

Posted: Apr 02, 2010 10:38 AM
Updated: Apr 02, 2010 7:23 PM

By Jim Mendoza - bio | email

KANEOHE (HawaiiNewsNow) - In Kaneohe Bay the backbone of an ecosystem is under attack.

"What we're starting to see is whole clusters, ten, twenty, thirty colonies all dead in an area as the disease has passed from on other within the last four to five weeks," said Greta Aeby, a researcher with the Hawaii Institute of Marine Biology.

Acute Montipora White Syndrome -- a tissue killing slaughtered more than 100 colonies of red rice c Island.

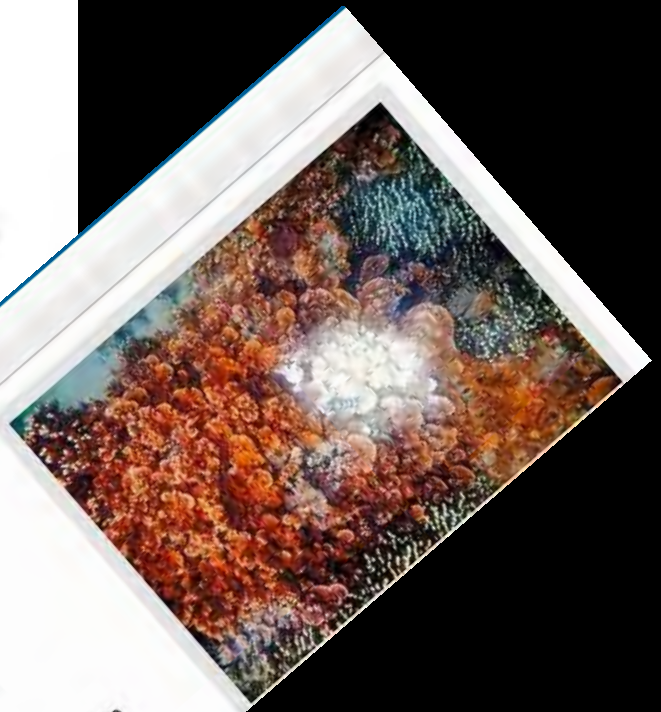
"It usually comes in as a very bright whi colony. That white is where it's stripp said. "The problems here is that co you're wiping out a decade's wo

Most of the damage is in t quality's the poorest.

"Our reefs have be pollution for de the result of for the shr there's no pl she said.

Aeby and other res zones and are analyzing coral samp

"One thing that we want hat may be causing this disease. So we're using histology, w microbiology, we're using molecular techniques to see might have been caused by a bacterial infection," she said.



LOCAL NEWS

Posted on: Monday, April 5, 2010

Disease hits Kāne'ohe Bay reefs

MWS has killed 100 colonies of red rice coral

Print this page E-mail this article Share

Recommend (1) Comments (15)

By John Windrow
Advertiser Staff Writer

Hawai'i scientists are battling a new threat to coral reefs in Kāne'ohe Bay that could imperil the biological balance in the bay's ecosystem.

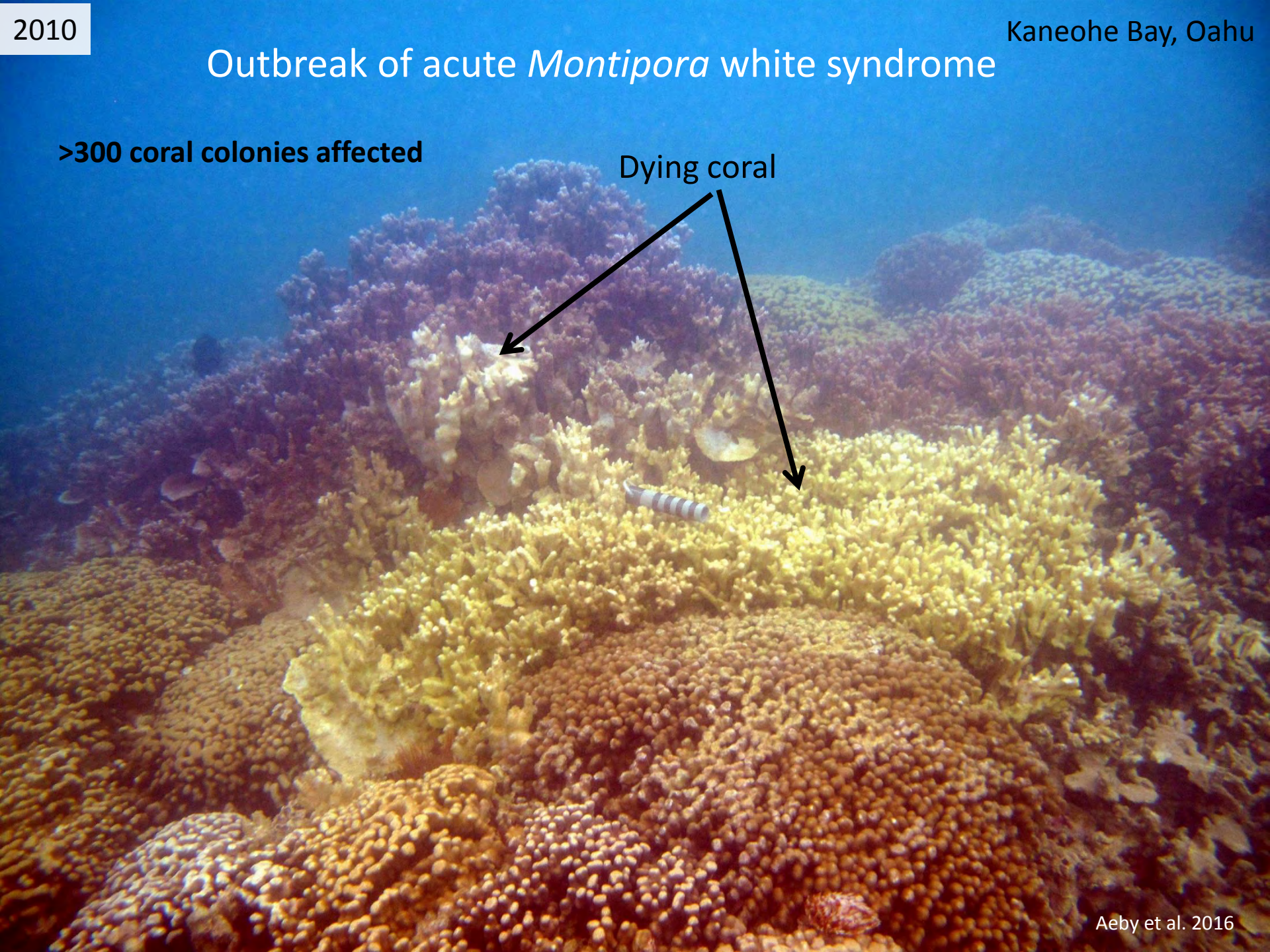
show
homes
e crumbles,
e bigger guys,"

2010

Kaneohe Bay, Oahu

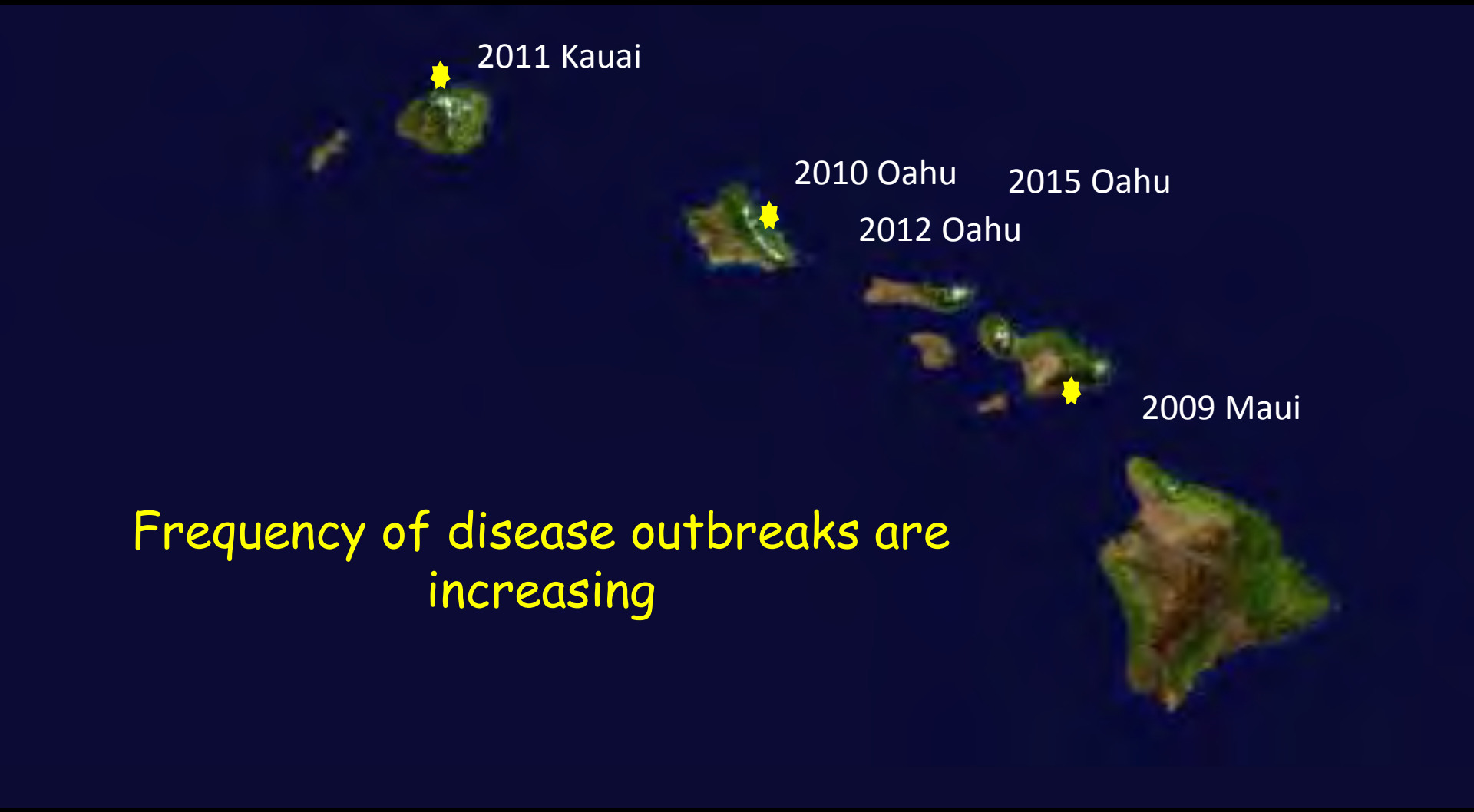
Outbreak of acute *Montipora* white syndrome

>300 coral colonies affected

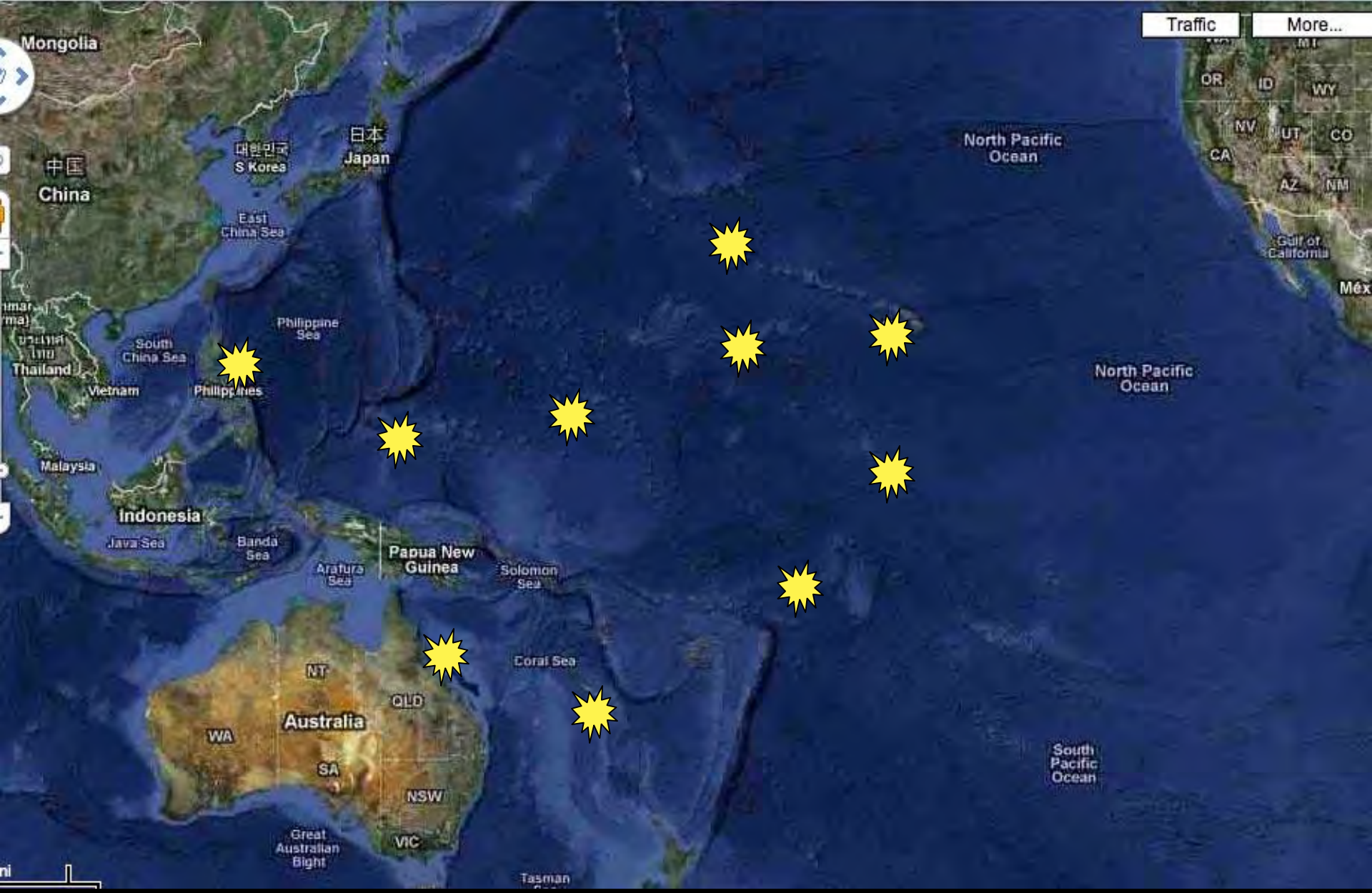


Aeby et al. 2016

Disease outbreaks in the Hawaiian archipelago



Frequency of disease outbreaks are increasing



Disease outbreaks across the Indo-Pacific

CORAL DISEASE

Increasing worldwide

Caused extensive damage to reefs in W. Atlantic

Emerged as a problem in Indo-Pacific

CORAL DISEASE

Why?

Corals need clear, clean seawater to flourish

- light for symbiotic zooxanthellae
- prevents algae from growing overly fast

Abundance of herbivores to keep the seaweeds in check

Kauai

Corals need:

Clean, clear water

Human Impacts on Reefs

- **Coastal Development**
  - Sedimentation
  - Pollution
  - Nutrient runoff
    - Injection wells, cesspools, septic tanks
    - Agriculture, ranching
- **Overfishing**

Disease Outbreaks

- novel pathogens introduced into naïve host populations

- endemic pathogens spread within a population due to altered external factors, which affect host-pathogen ecology

An emergency hospital during 1918 influenza epidemic, in Camp Funston, Kansas.
Credit: National Museum of Health and Medicine, Armed Forces Institute of Pathology

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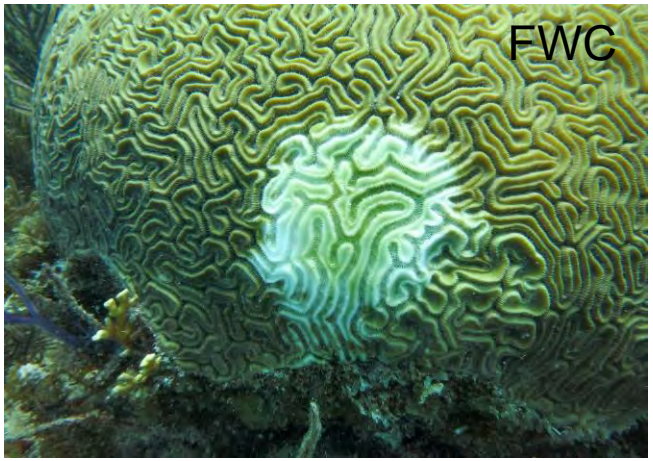
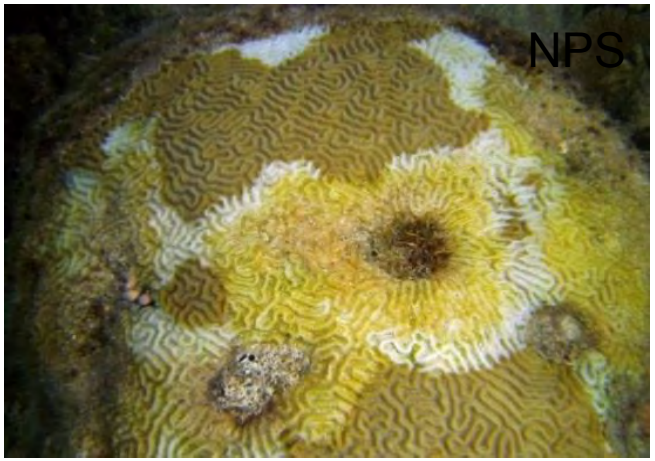
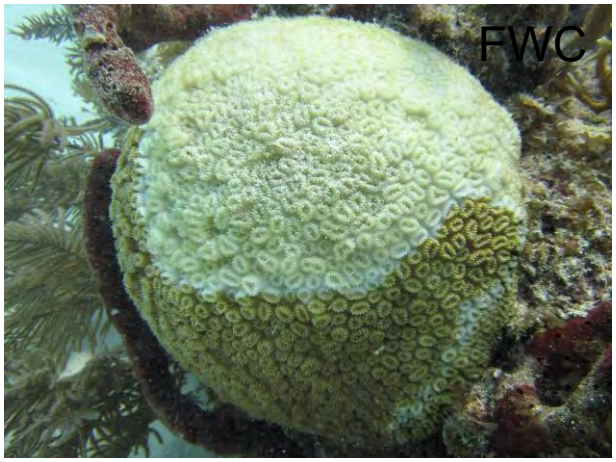
Outbreak Overview



Diploria labyrinthiformis

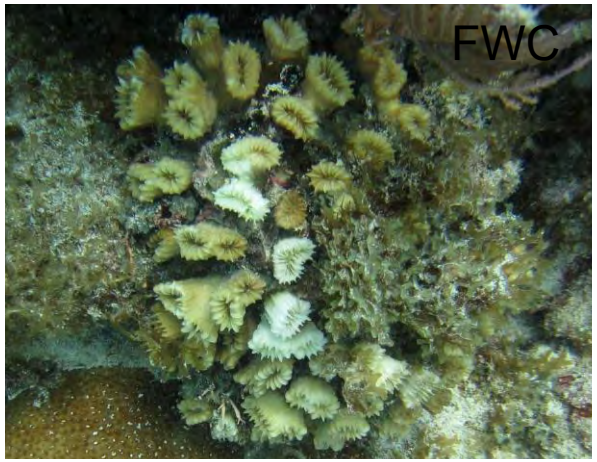


Pseudodiploria strigosa



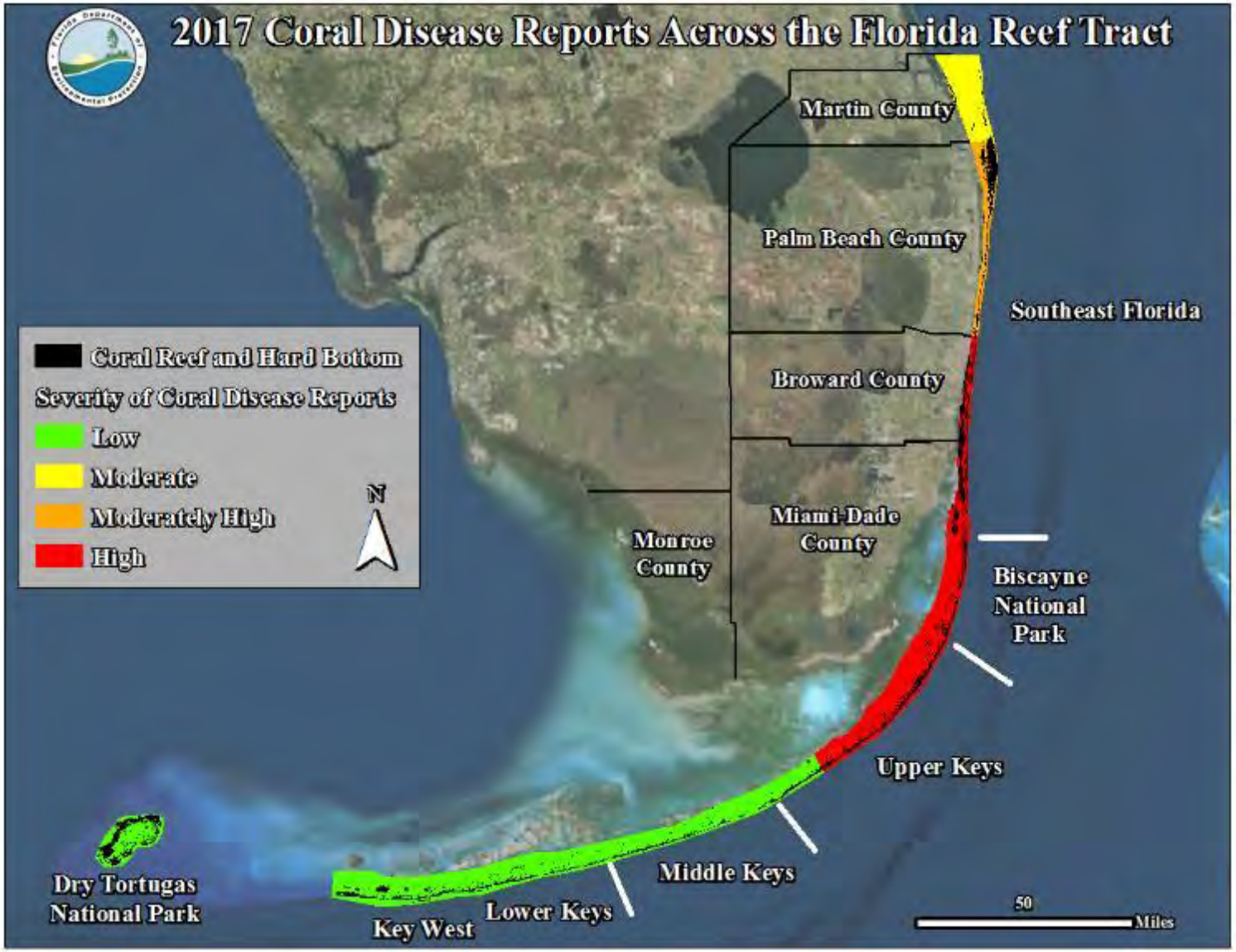
Dichocoenia stokesii

Meandrina Meandrites

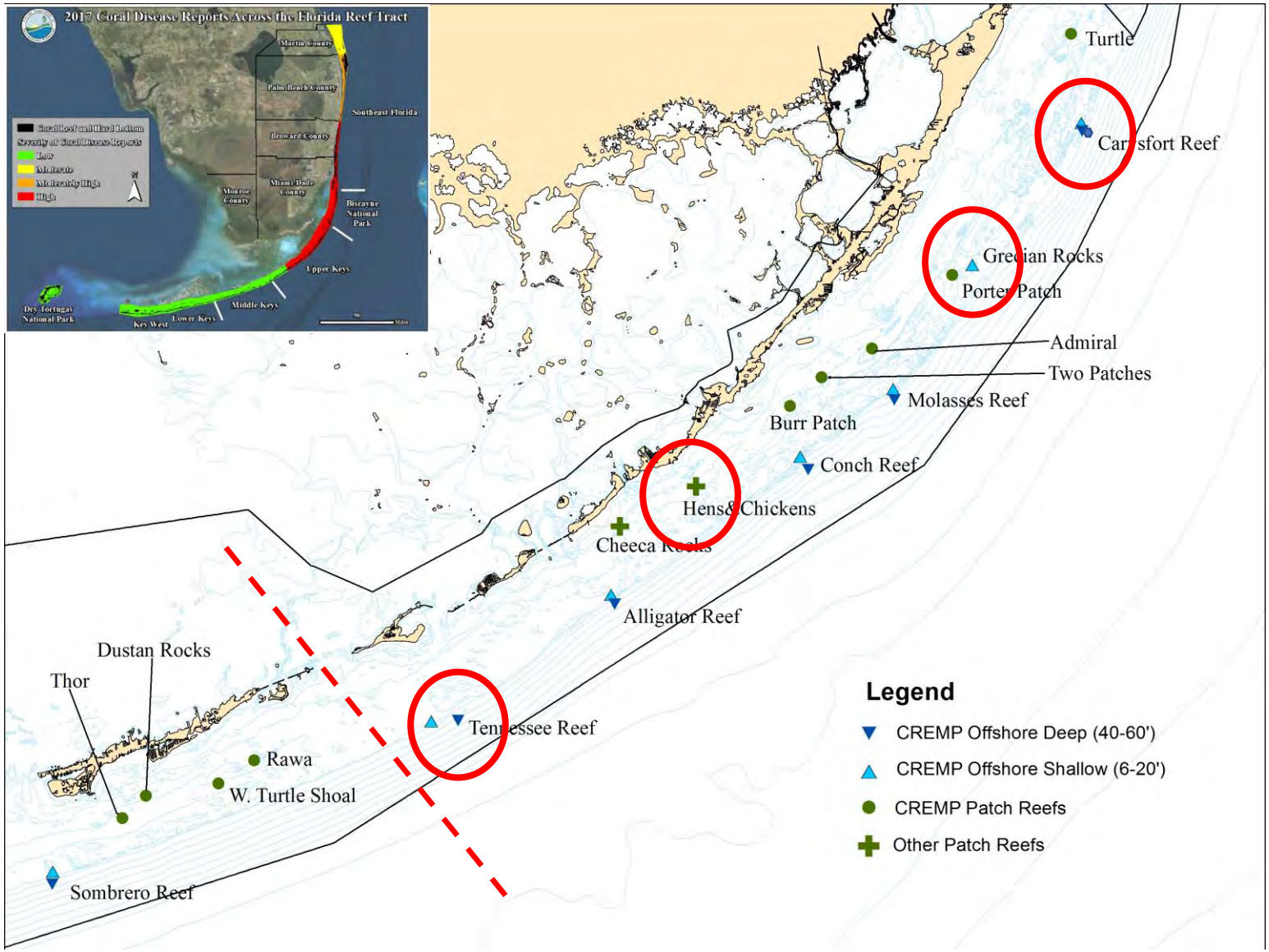


Eusmilia fastigiata

Spatial Overview



Spatial Overview



Outbreak Overview

A background level of disease is normal for coral reefs.

Endemic Disease Prevalence:

2-3%

Outbreak Overview

At some sites: >25% of the entire coral population is affected.

Species Specific Disease Prevalence:

66-100%


Hens and Chickens
Sanctuary Preservation Area
Florida Keys National Marine Sanctuary
FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
MyFWC.com
Florida Fish and Wildlife
Conservation Commission

Ecological Impacts

Hens & Chickens: 28%
Grecian Rocks: 66%

Hens & Chickens: 96%
Grecian Rocks: 100%

Hens & Chickens: 33%
Grecian Rocks: 92%

Hens & Chickens: 100%
Grecian Rocks: 100%

Hens & Chickens: N/A
Grecian Rocks: 66%

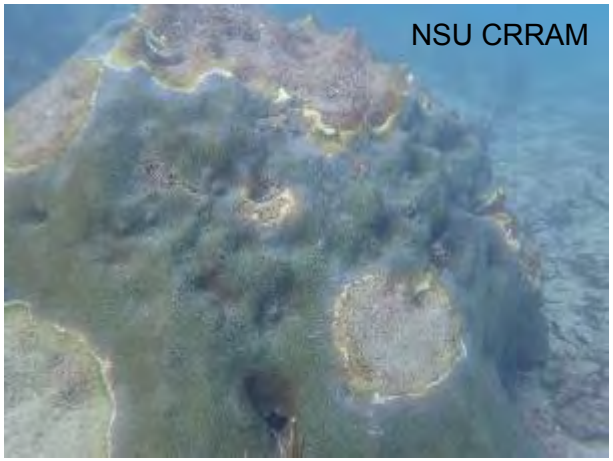
Rate of Tissue Loss

Rapid disease progression:

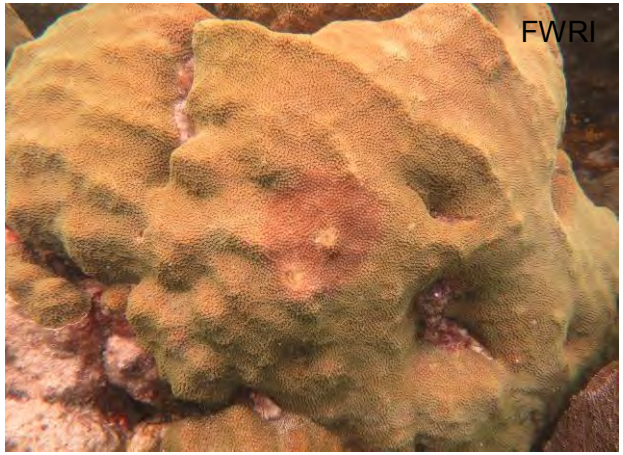
Photos: Brian Reckenbeil, FWC, Upper Keys

Ecological Impacts

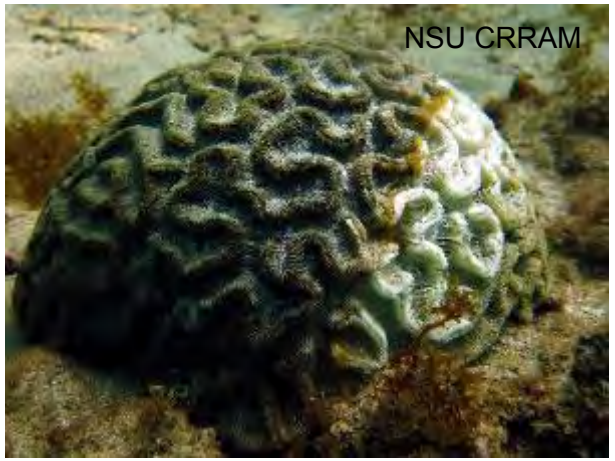
Primary reef-building corals:



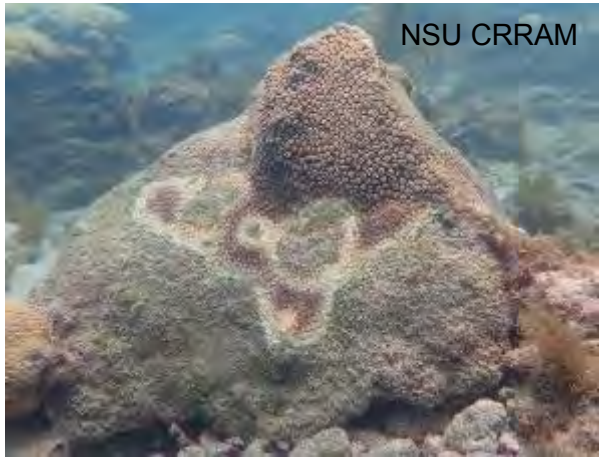
Orbicella faveolata 5.7%



Orbicella annularis 35.0%



Colpophyllia natans 51.6%

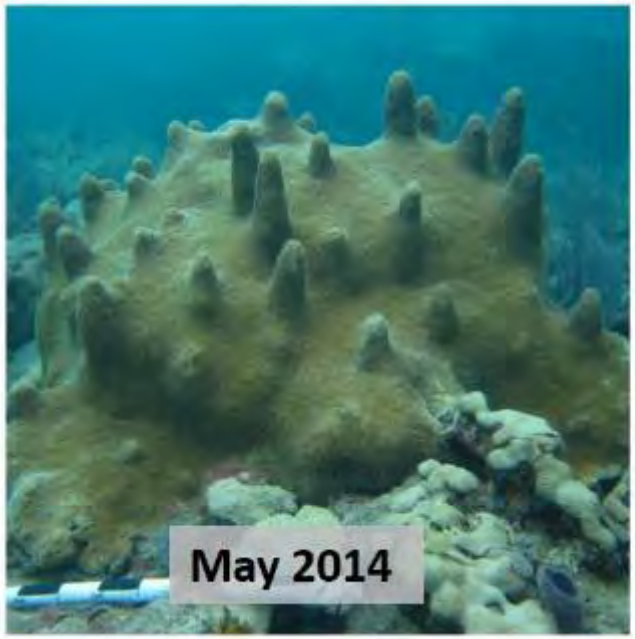


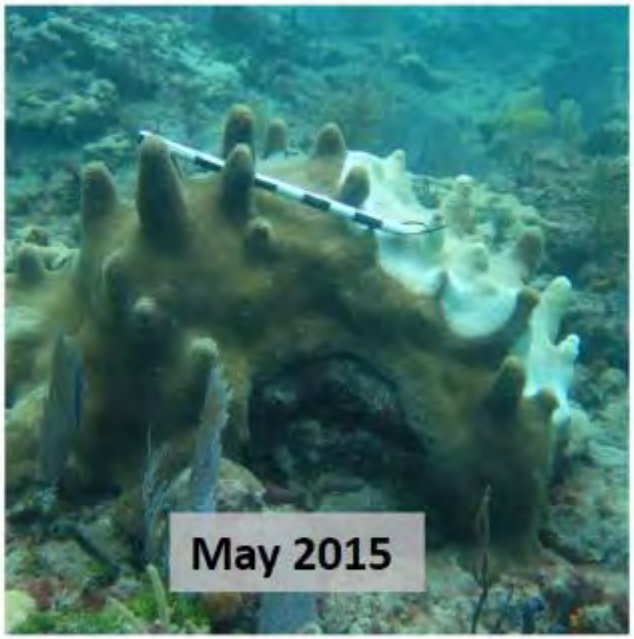
Montastraea cavernosa 20.0%

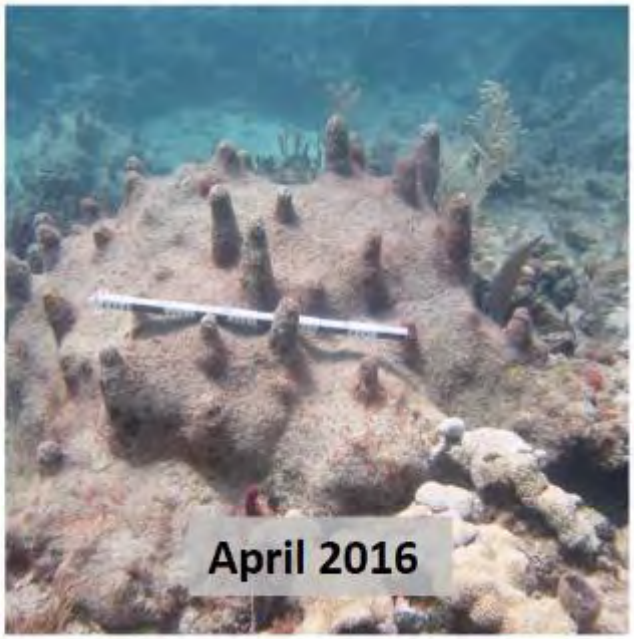
Siderastrea siderea 28.6%

Rate of Tissue Loss

Endangered Species Act (ESA)-listed species:





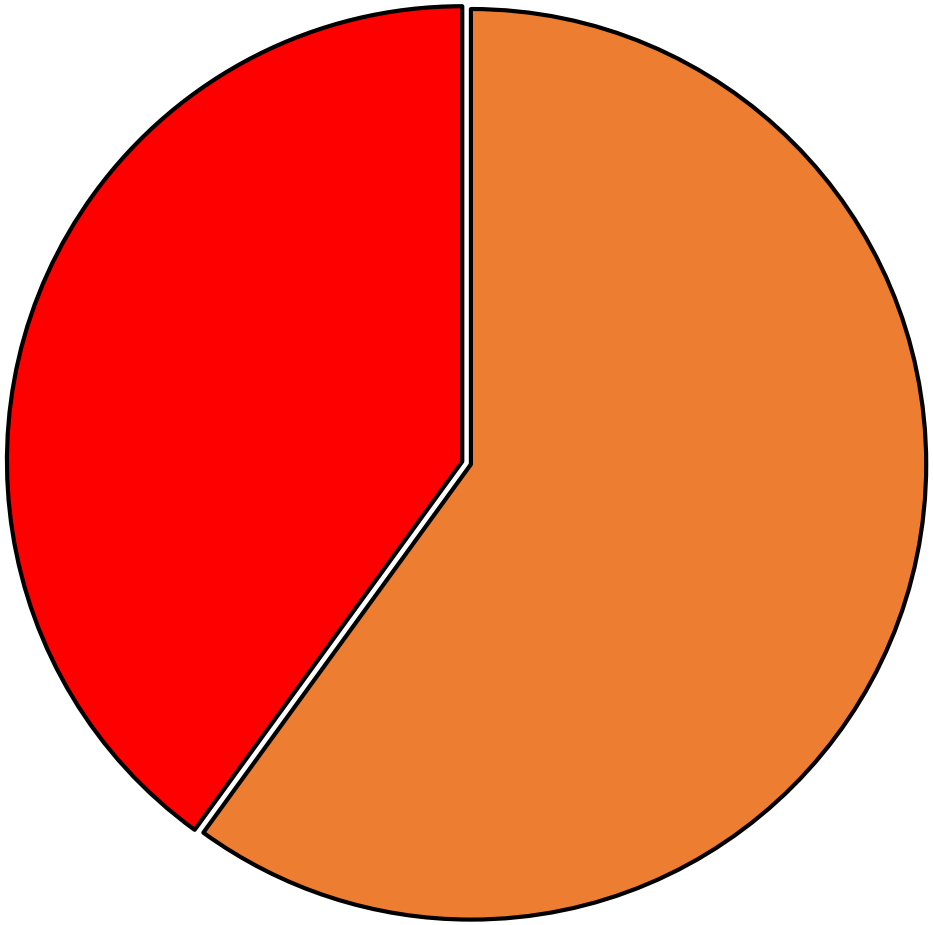


NSU CRRAM

Coral Susceptibility to Outbreak

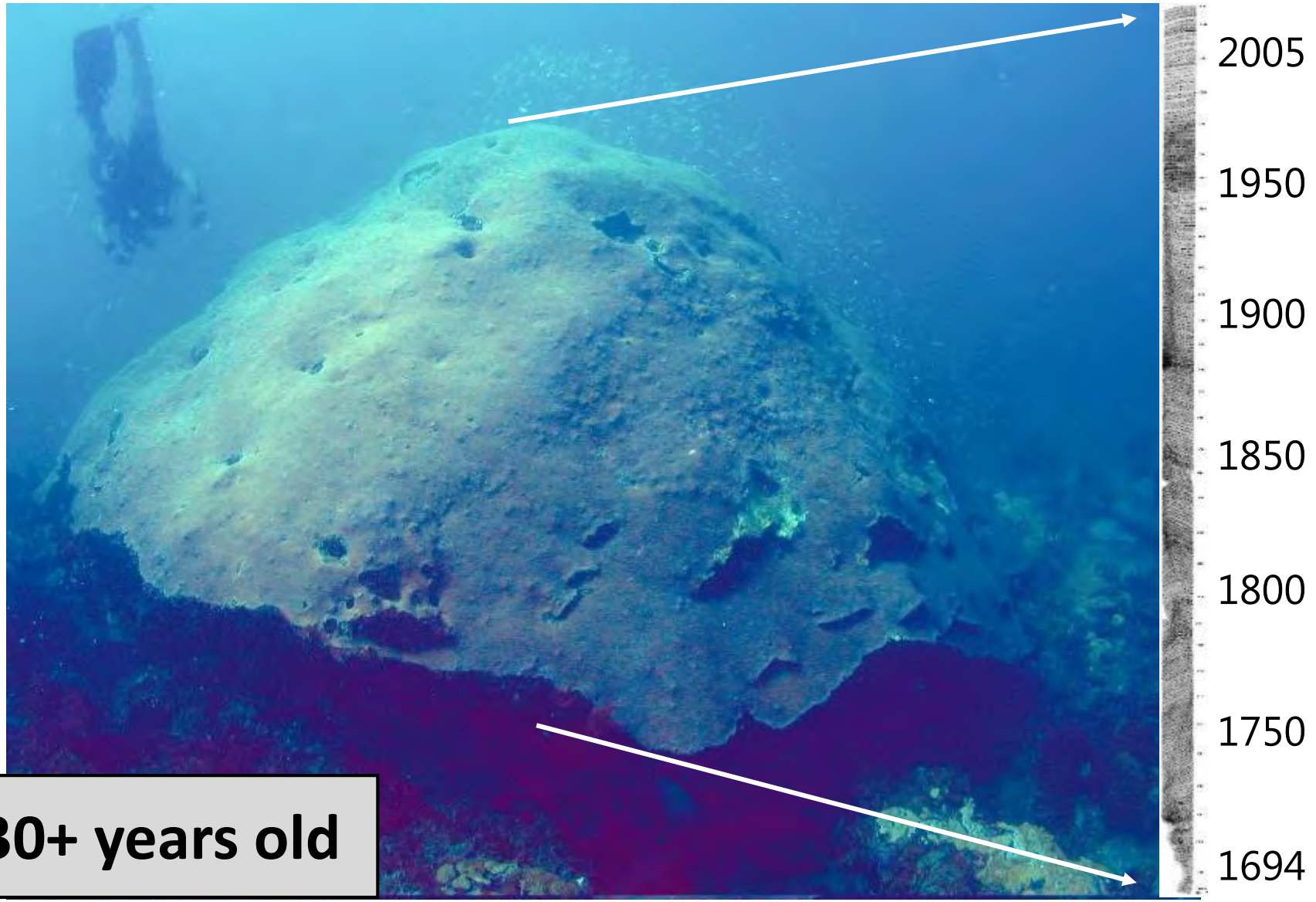
Nearly 50% of the species along the Florida Reef Tract have been affected during this outbreak

Species confirmed with tissue lesions



Unaffected species to date

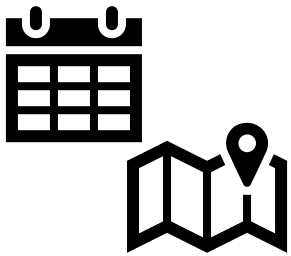
Loss of Oldest Living Corals



330+ years old

Loss of Oldest Living Corals

Economic & Ecological Significance



New time or place

Greater frequency

Species of concern

Unidentified lesions

UNPRECEDENTED EVENT

1. **Tenure of the disease outbreak.** Currently entering it's 3rd year and is still active in SE FL on coral species like MCAV. Actively starting on many reefs in the FL Keys with most vulnerable species
2. **The # of coral species affected.** This outbreak has impacted nearly half the species in FL. Documented on all the primary/massive reef builders along the FL reef tract
3. **Spatial scale.** It has now encompassed half of the Florida Reef Tract
4. **The incredibly high frequency of whole colony mortality.** If a colony becomes infected it will likely suffer 100% mortality
5. **Reduction in coral population structure.** The loss of massive, framework building species will disproportionally contribute to a loss of coral cover.
6. **The ramifications for FL:** FL depends on healthy reef ecosystems for economic vitality, loss of ecosystem services could be catastrophic. Recovery will require hundreds of years!

Why?

Overview

- Introduction to Coral Disease
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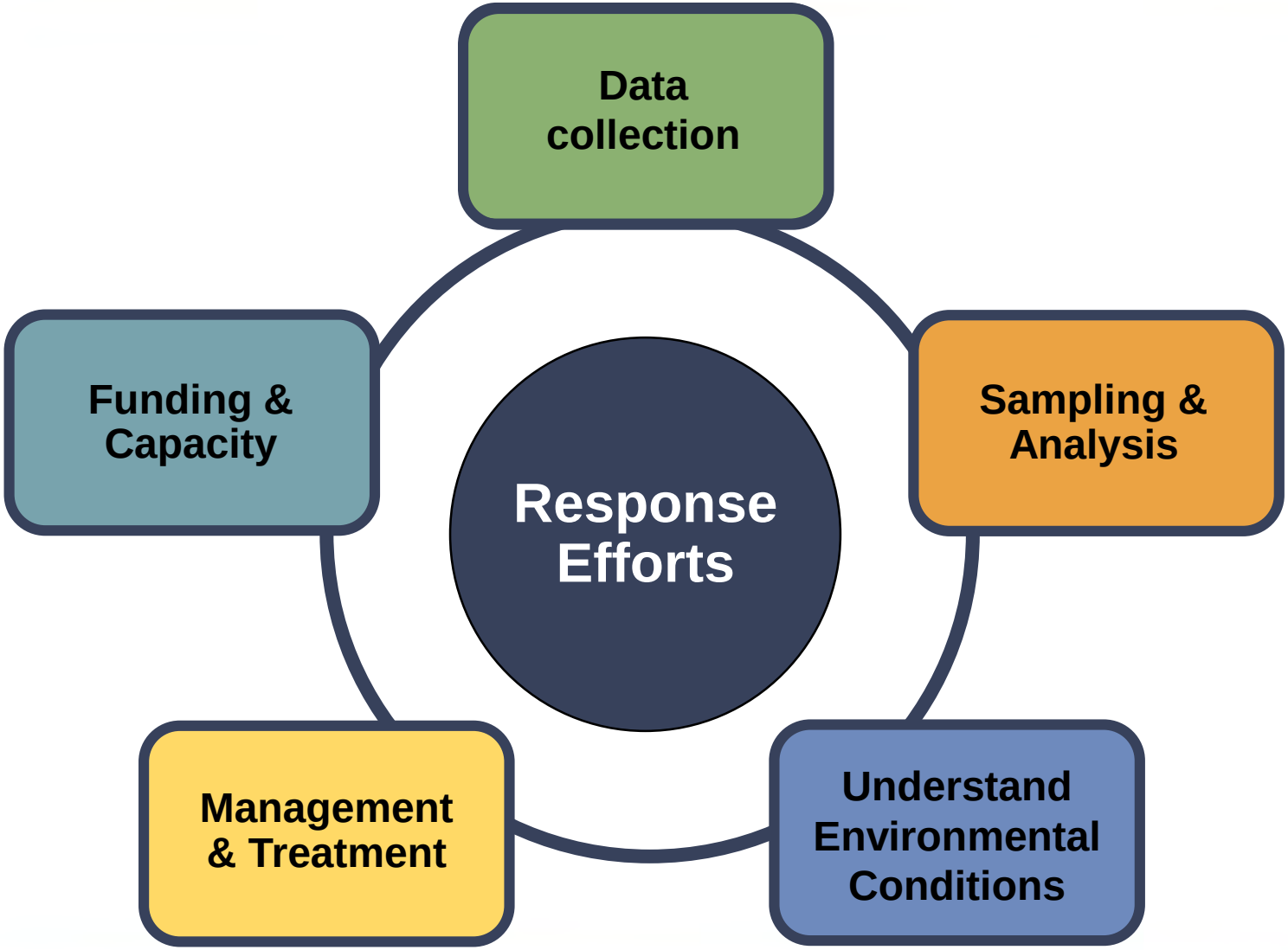
Response Efforts

Response Efforts



Response Efforts

Data Collection

Document the distribution, prevalence, severity and impacts associated with the disease outbreak.

- Reef tract-wide monitoring programs

Coral Reef Evaluation and Monitoring Projects

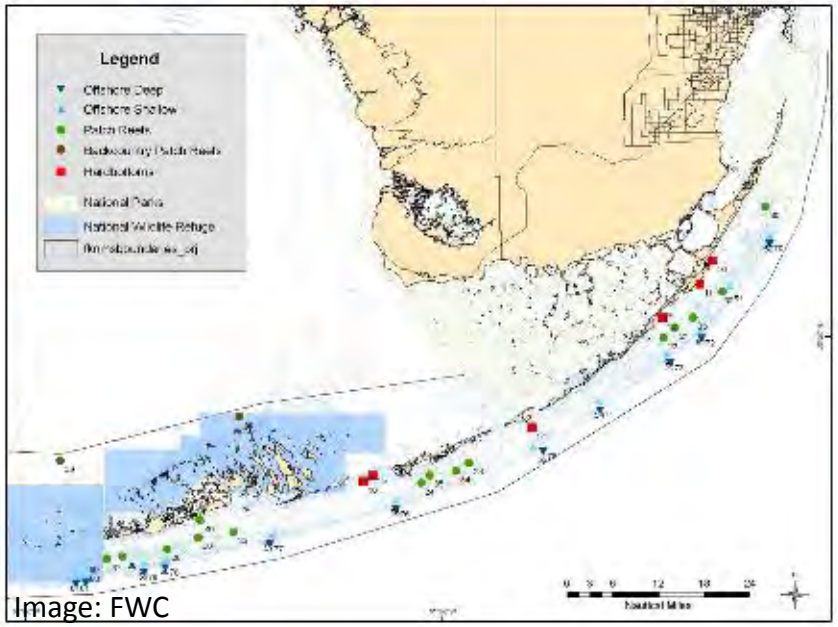


Image: FWC

Florida Reef Resilience Program

Photo: NSU

Response Efforts

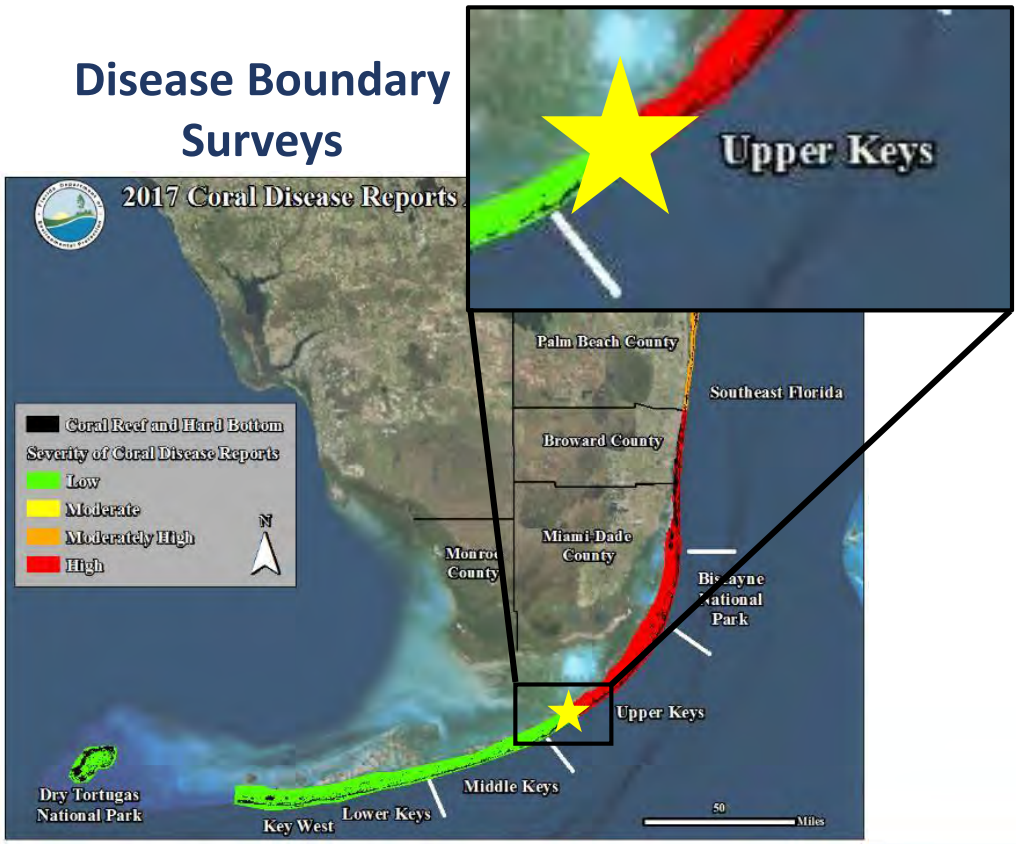
Data Collection

Document the distribution, prevalence, severity and impacts associated with the disease outbreak.

- Targeted coral disease surveys

Large Coral Assessment

Disease Boundary Surveys



Response Efforts

Data Collection

Document the distribution, prevalence, severity and impacts associated with the disease outbreak.

- Citizen science

SEAFAN

Southeast Florida Action Network

We're All Connected ~ Keep It Protected

COCEAN

COMMUNITY-BASED OBSERVATIONS OF COASTAL ECOSYSTEMS AND ASSESSMENT NETWORK

Response Efforts

Sampling & Analysis

Identify potential pathogens and characterize the disease(s).

- Coral tissue sample collection


Photo: FWC FWRI

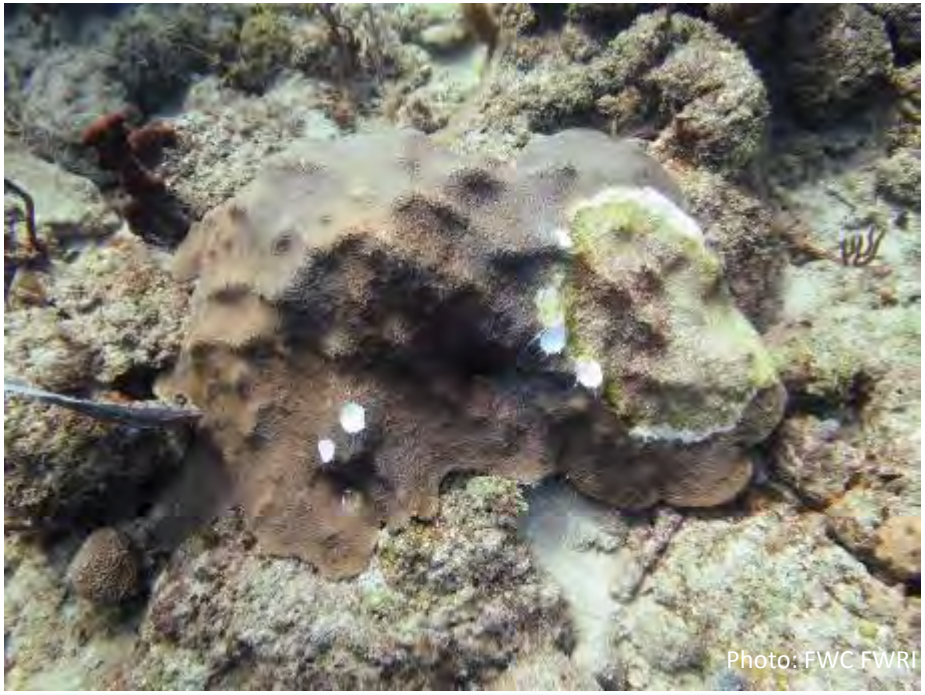


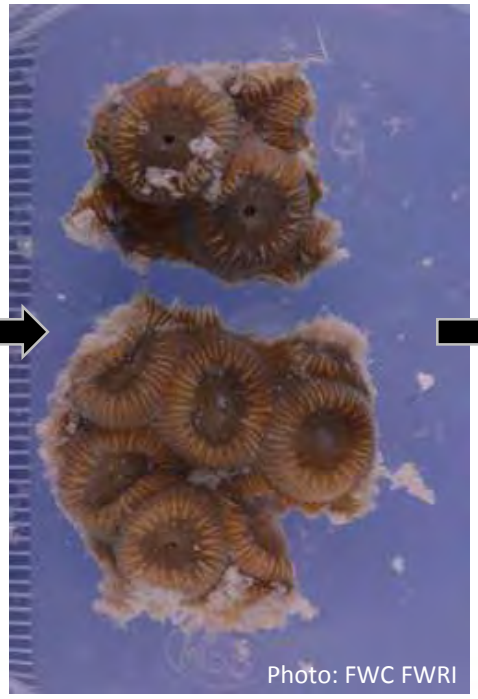
Photo: FWC FWRI

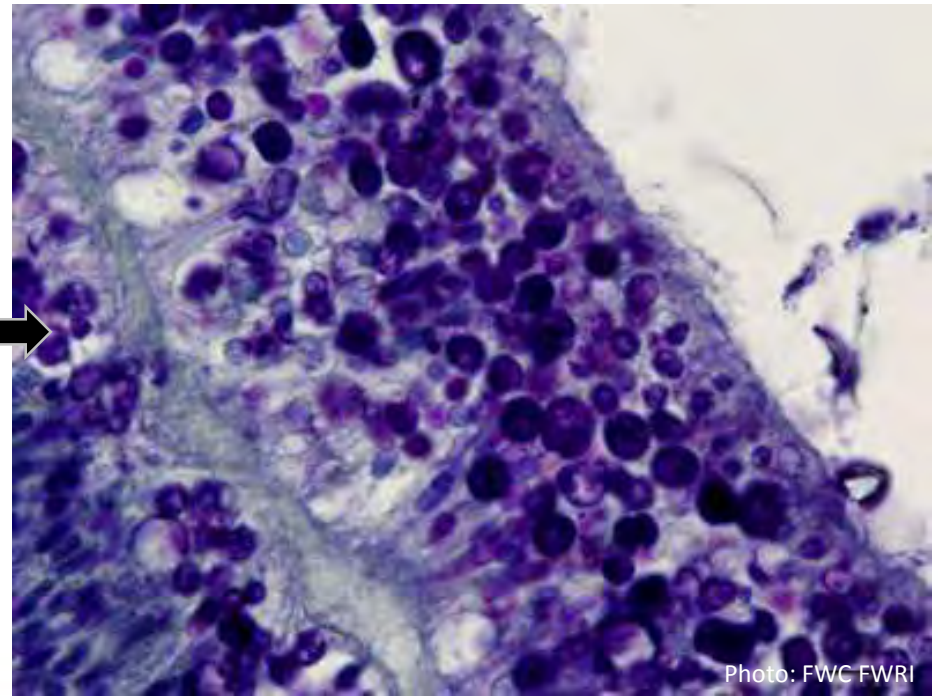
Response Efforts

Sampling & Analysis

Identify potential pathogens and characterize the disease(s).

- Laboratory analysis





Response Efforts

Understand Environmental Conditions

Understand if changes in environmental conditions may have caused or contributed to the outbreak.

Why did this coral disease outbreak happen when it did?

Coral Data

Photo: DEP

Water Temperature

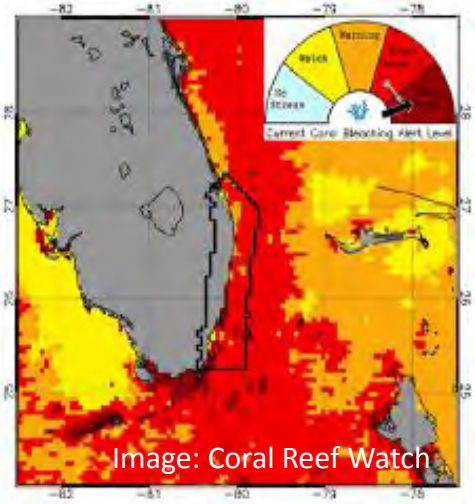


Image: Coral Reef Watch

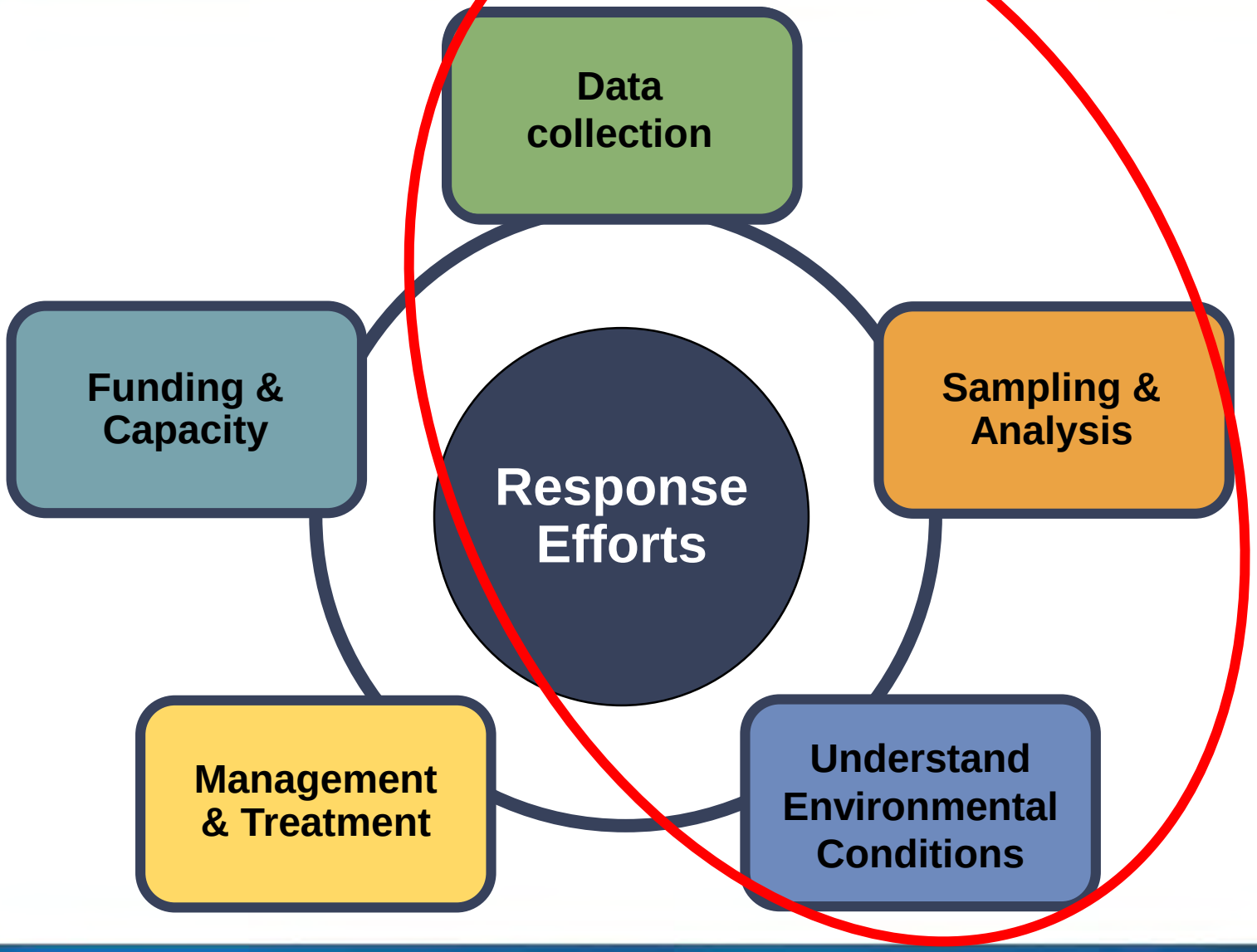
Water Quality

Photo: NSUOC

Sedimentation

Photo: DEP

Response Efforts



Response Efforts

Management & Treatment

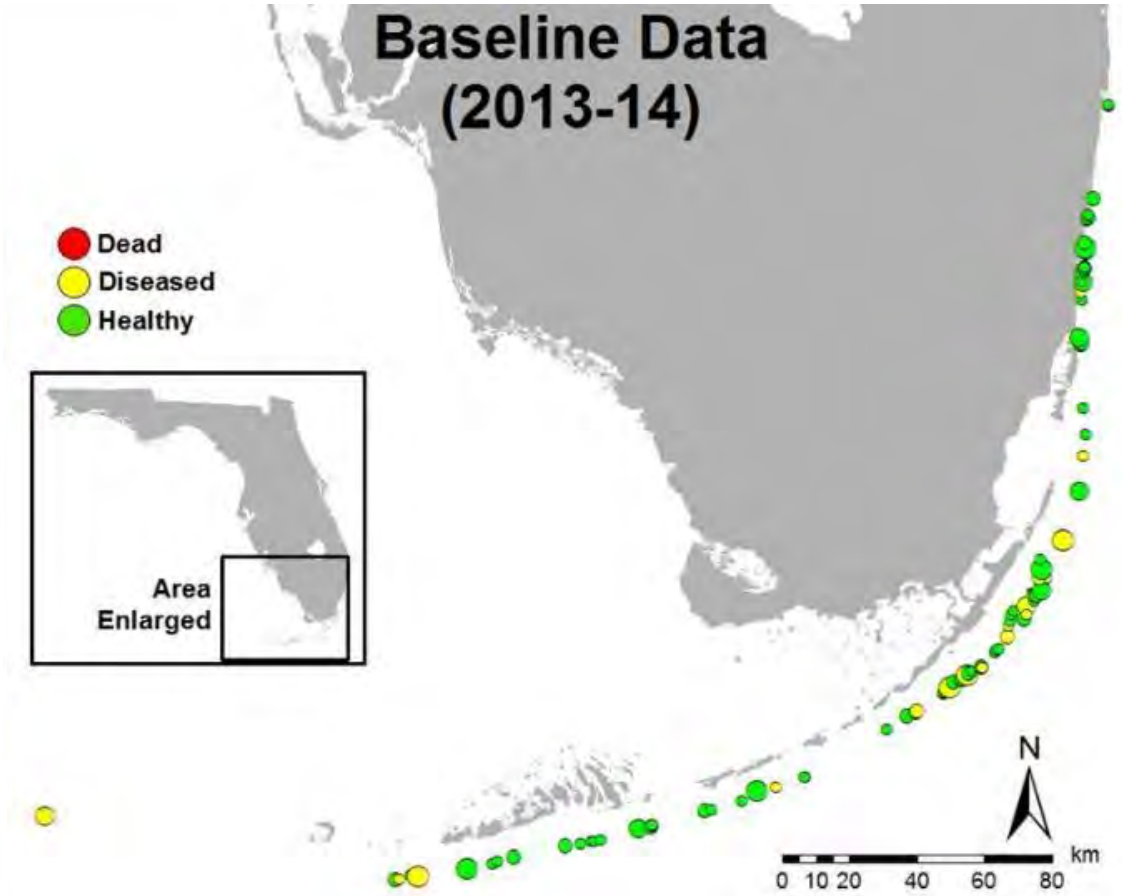
Implement management interventions and experiment with treatments.

Response Efforts

Management & Treatment

Implement management interventions and experiment with treatments.

The status of known pillar coral colonies across the Florida Reef Tract.



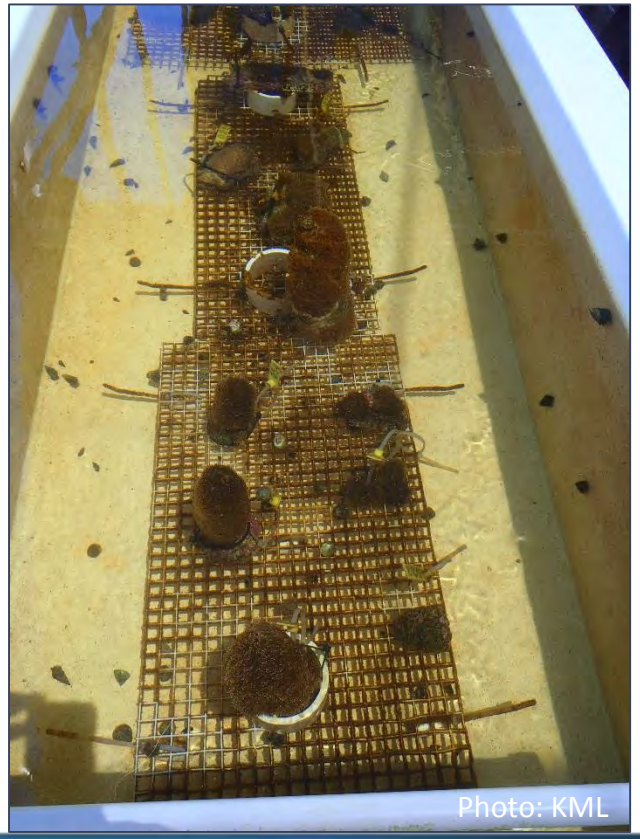
Images: FKCC

Response Efforts

Management & Treatment

Implement management interventions and experiment with treatments.

- Pillar coral rescue effort



Response Efforts

Management & Treatment

Implement management interventions and experiment with treatments.

- Laboratory-based treatment experiments

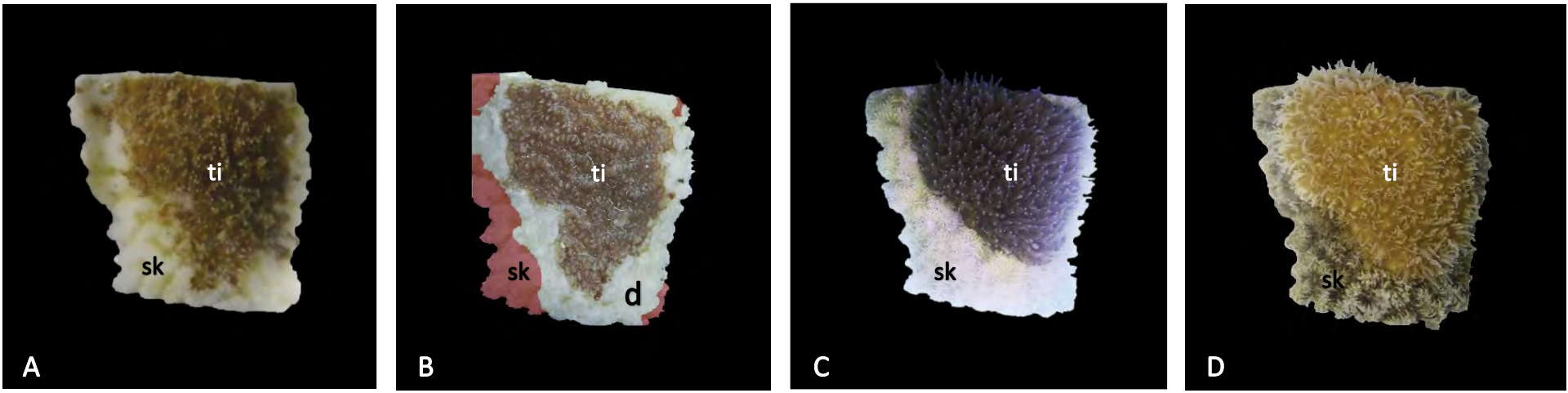
Photos: NOAA

Response Efforts

Management & Treatment

Implement management interventions and experiment with treatments.

- Laboratory-based treatment experiments



Photos: NOAA

Response Efforts

Funding & Capacity

Seek additional funding and capacity to support more comprehensive response efforts.

USCRTF
UNITED STATES
CORAL REEF TASK FORCE

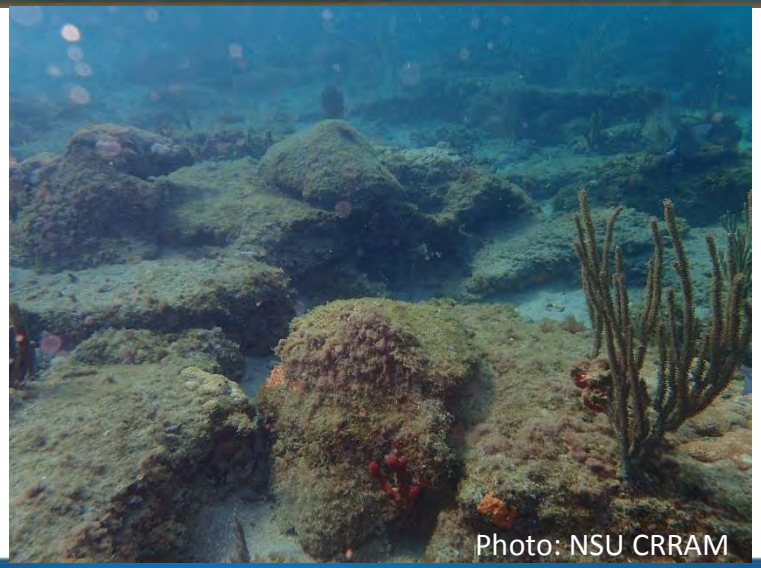


Photo: NSU CRRAM


Photo: NSU CRRAM

Overview

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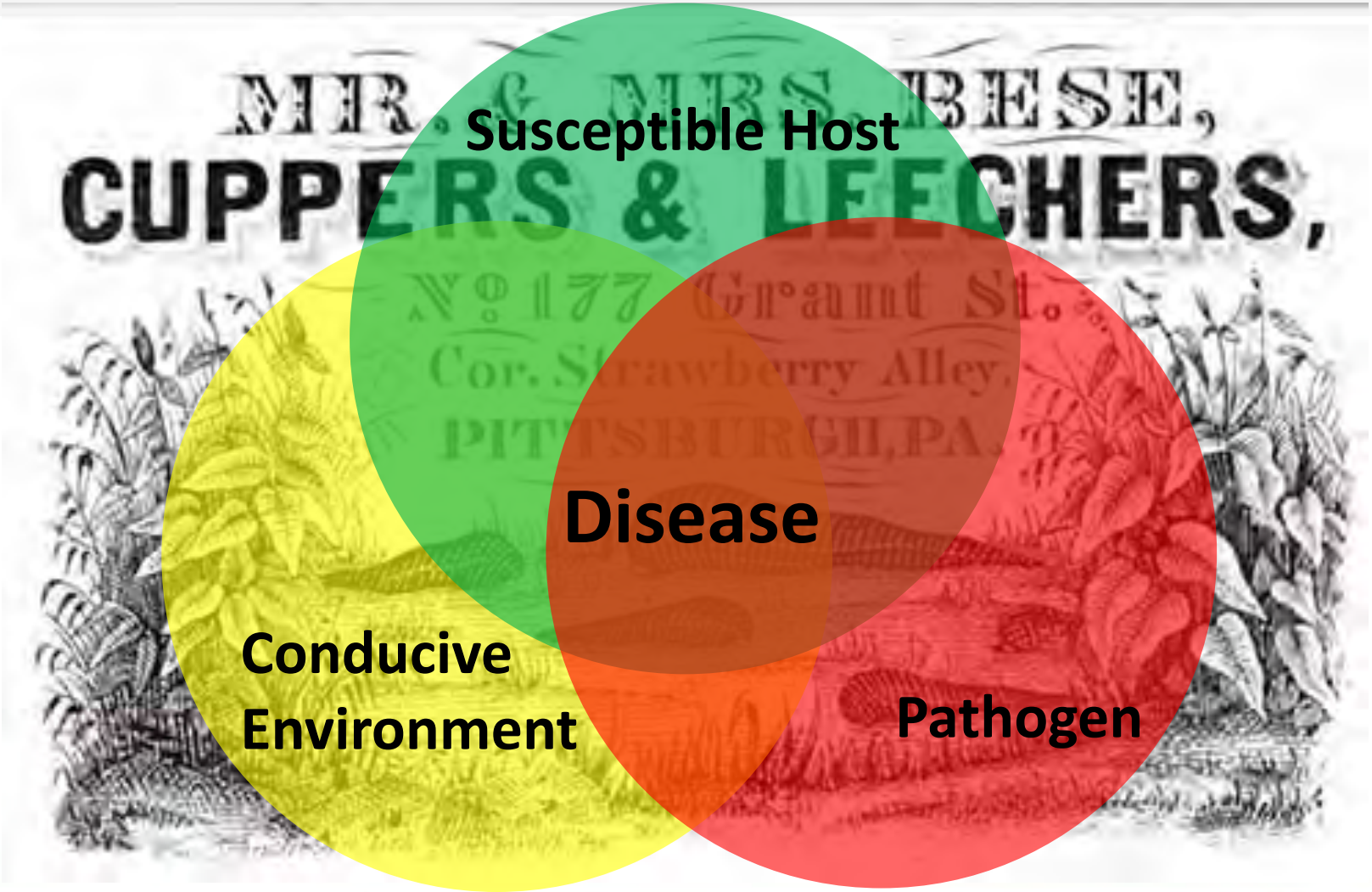
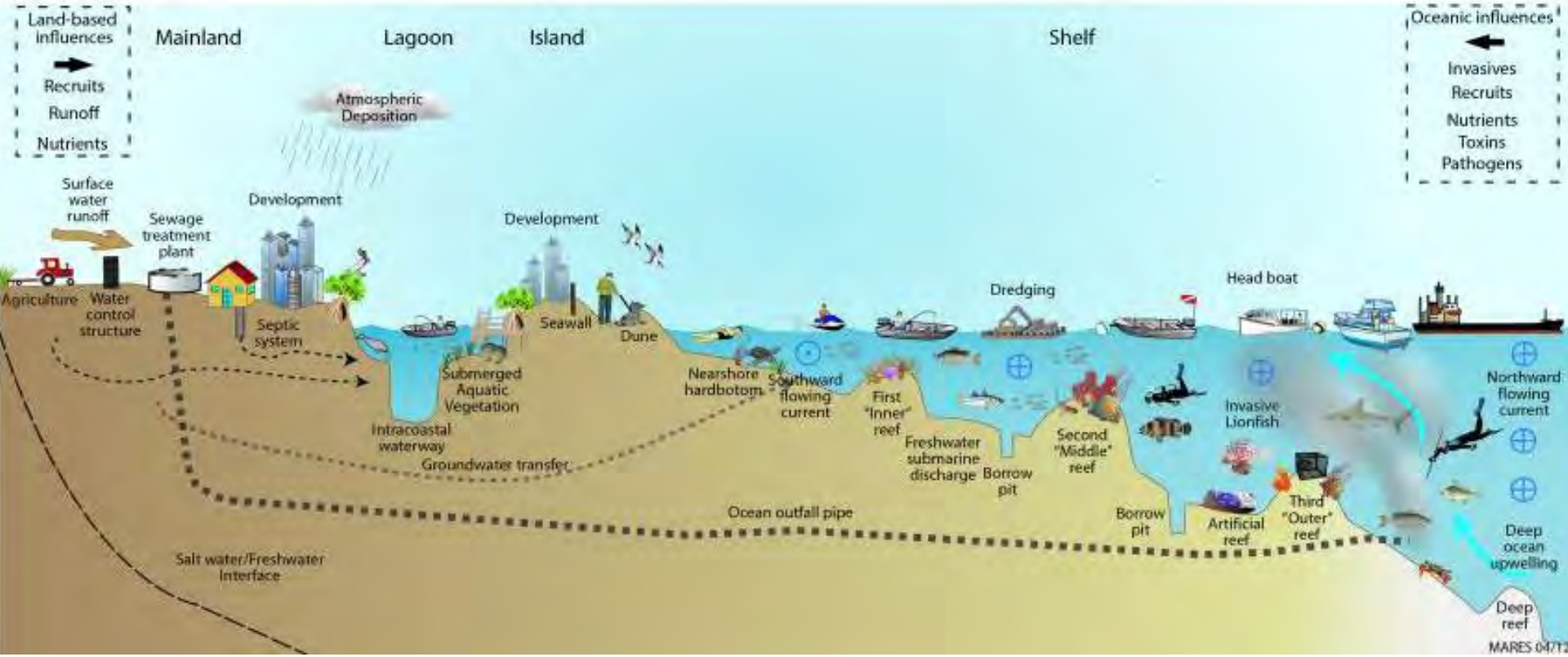
Challenges

1. Much remains unknown about coral disease ecology.



Challenges

2. Intense urban pressures.



Local pressures across the southeast Florida geographic region

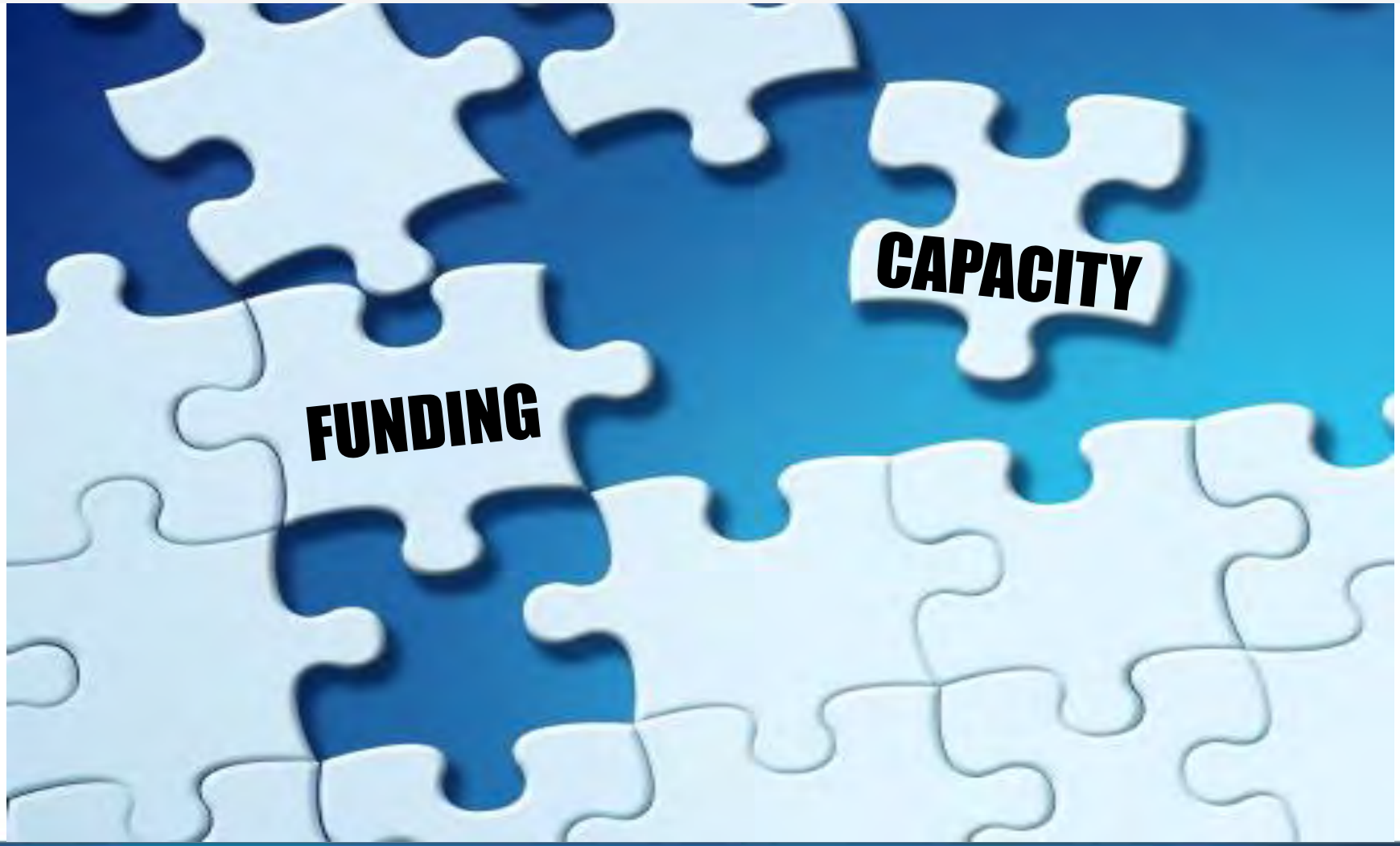
Challenges

3. Insufficient coral disease monitoring data.

Photos: DEP

Challenges

4. Lack of funding and capacity.



Recommendations

1. Continue coral disease investigation.

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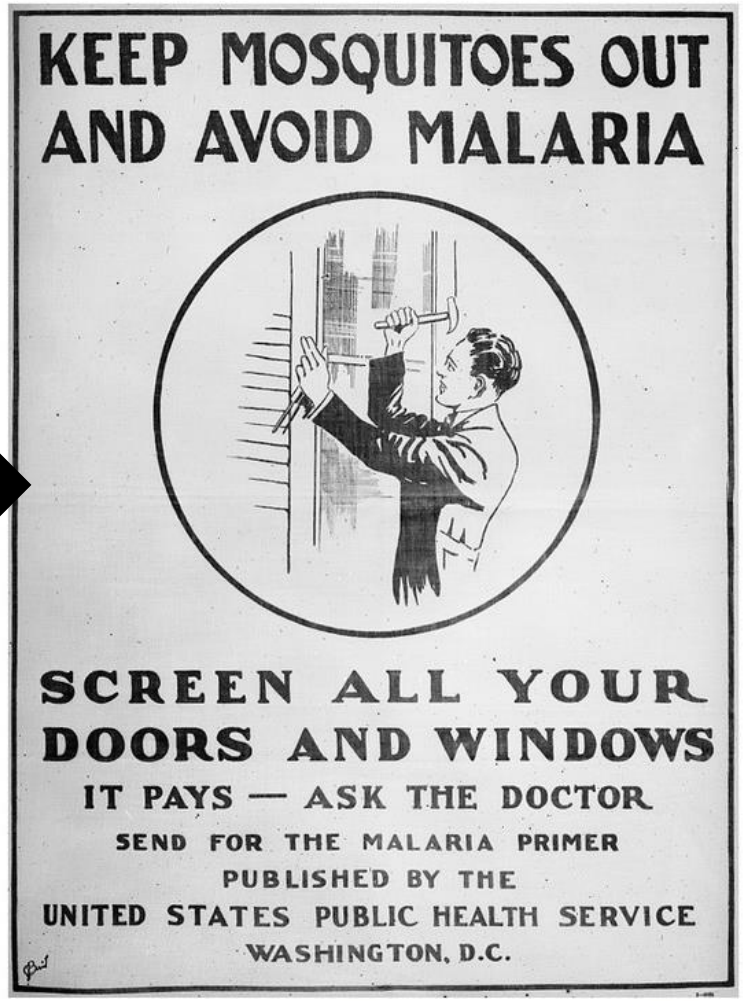
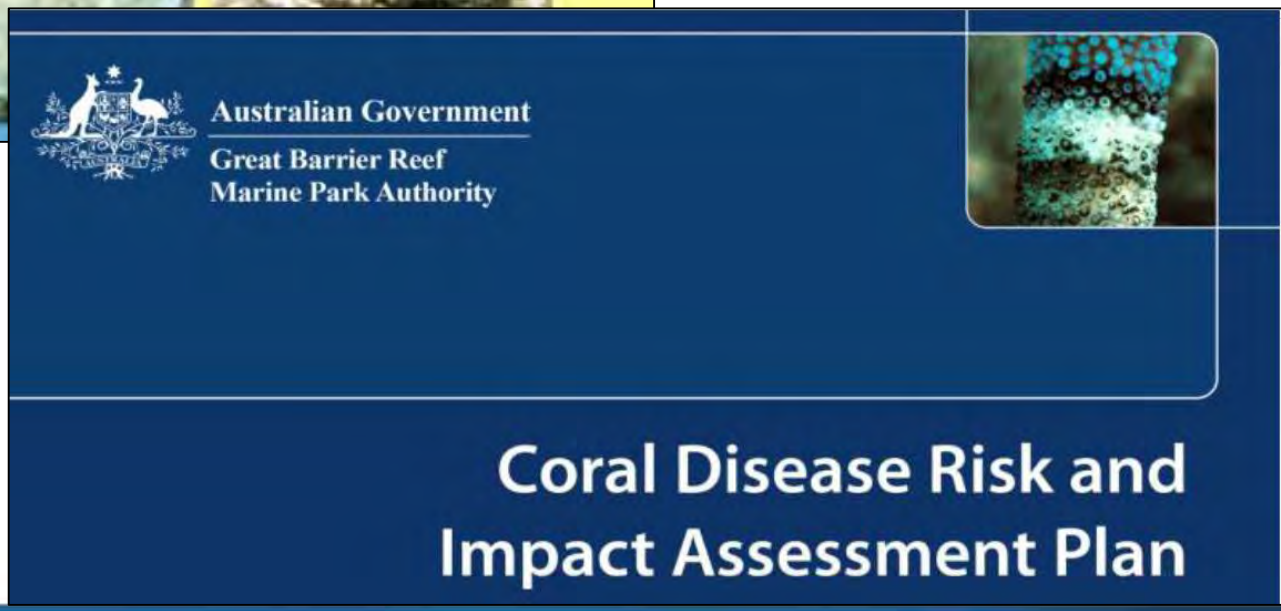


Recommendations

2. Control what we can: Address underlying environmental conditions.

Recommendations

3. Support the establishment of a disease rapid response program.



Recommendations

4. Establish a flexible emergency response mechanism.

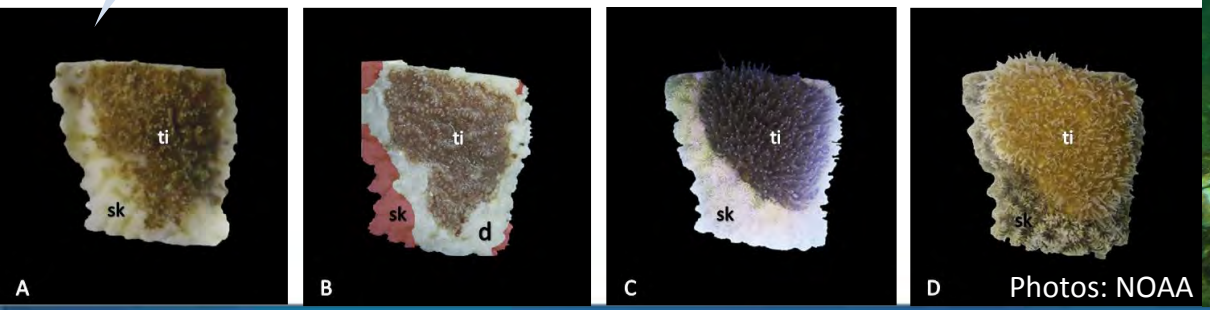
Recommendations

5. Adapt the regulatory framework.

Laboratory studies

Small-scale field trials

Larger-scale field application



Photos: NOAA

Photos: NSU CRRAM

Recommendations

6. Continue coordination with partners.


Thank You
Photos: NSU CRRAM