
# New Caribbean Coral Restoration Efforts:
# Welcome & Background

## Caribbean Cooperation Team Network Meeting

Judith (Judy) Lang

April 8, 2024

AGRRA

MPA connect

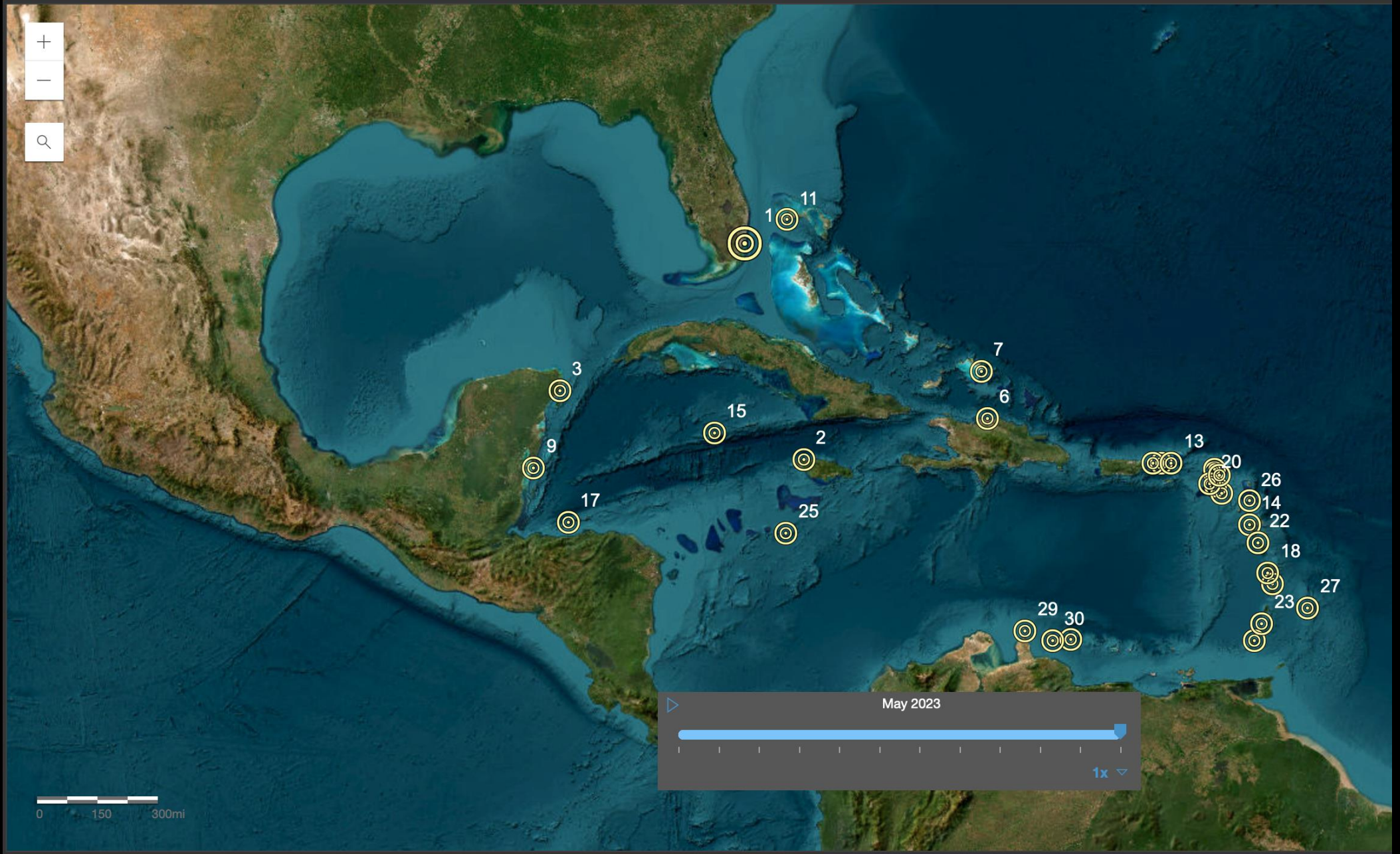
cordap Coral Research & Development Accelerator Platform

ORE Ocean Research & Education Foundation

Live Visual Map see:
earth.nullschool.net

# Stony Coral Tissue Loss Disease (SCTLD) Outbreak in the Caribbean

Last Updated: October 2023



# Stony Coral Tissue Loss Disease (SCTLD) Outbreak in the Caribbean

Last Updated: October 2023

**# of Countries/Territories**

**30**

**with SCTLD Present**

**# of Countries/Territories**

**12**

**with SCTLD Treatments**

**# of Countries/Territories**

**32**

**Monitoring for SCTLD**

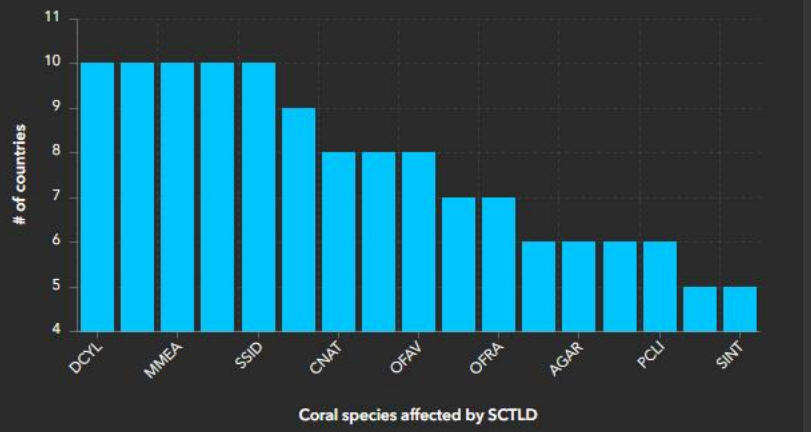
**# of Countries/Territories**

**10**

**Engaged in SCTLD Rescue**


**SCTLD Epidemics: Dates & Locations**

| Year | Date* | Location | Map ID |
|---|---|---|---|
| 2014 | Nov 18 | Florida | 1 |
| 2017 | Dec | Jamaica | 2 |
| 2018 | July 3 | Mexico | 3 |
| | Nov 22 | Sint Maarten | 4 |
| 2019 | Jan 29 | U.S. Virgin Islands | 5 |
| | Mar 3 | Dominican Republic | 6 |
| | early Mar | Turks and Caicos Islands | 7 |
| | June 5 | Saint-Martin | 8 |
| | June 21 | Belize | 9 |
| | Aug 13 | Sint Eustatius | 10 |
| | Dec | The Bahamas | 11 |
| | Dec 23 | Puerto Rico | 12 |
| 2020 | May 17 | British Virgin Islands | 13 |
| | June 9 | Guadeloupe | 14 |
| | June 29 | Cayman Islands | 15 |
| | Aug 9 | St. Lucia | 16 |
| | Sept 25 | Honduras | 17 |
| | Oct 24 | Martinique | 18 |
| 2021 | Jan 17 | St. Kitts & Nevis | 19 |
| | Apr 15 | Saba | 20 |
| | May 18 | Saint Barthélemy | 21 |
| | May 21 | Dominica | 22 |
| 2022 | Feb 14 | St. Vincent & the Grenadines | 23 |
| | Mar 2 | Grenada | 24 |
| | Apr 13 | Colombia | 25 |
| | July 26 | Antigua and Barbuda | 26 |
| | Nov 18 | Barbados | 27 |
| 2023 | Feb 10 | Bonaire | 28 |
| | April 1 | Aruba | 29 |
| | April 4 | Curaçao | 30 |


**# of Coral Species**

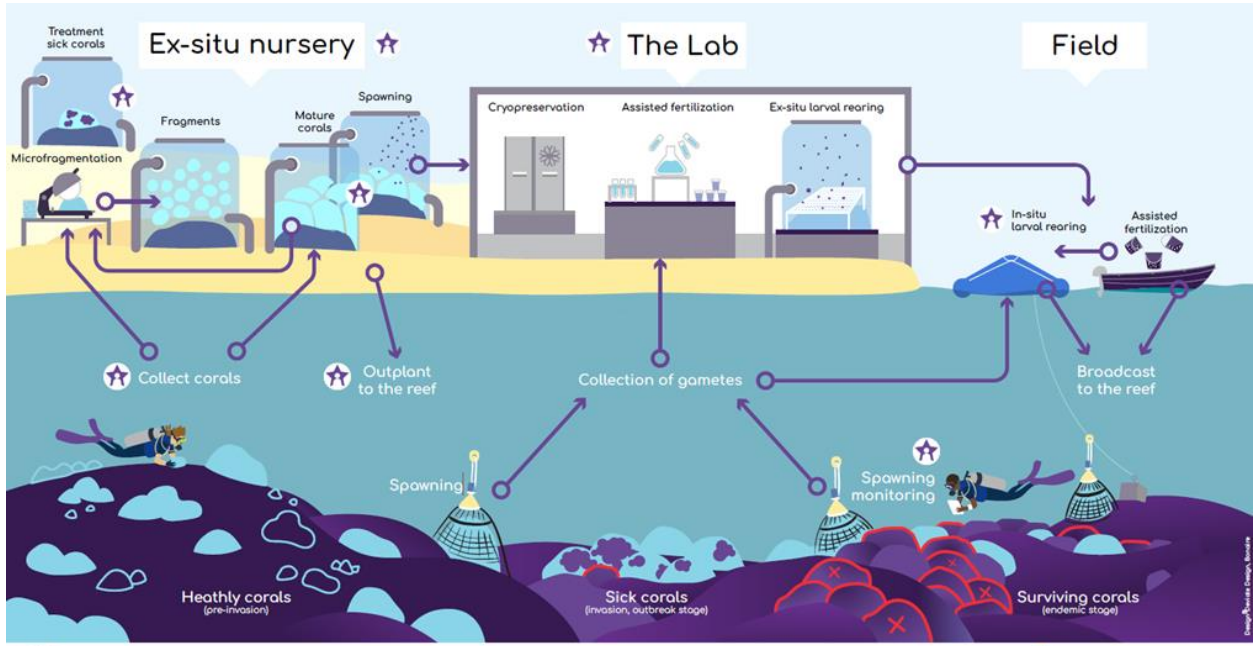
**34**

**Affected by SCTLD**

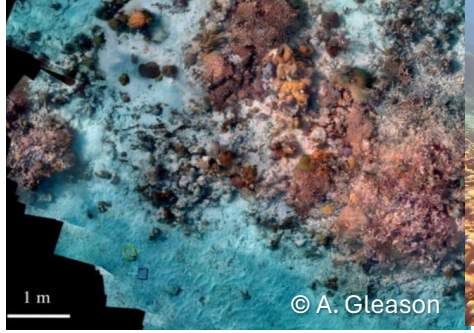
https://www.agrra.org/coral-disease-outbreak/

# Planning for Coral Rescue as a Response to SCTLD in the Caribbean

Reef Futures Symposium - Ocean Reef Club, Key Largo, FL
September 26, 2022




MPA Connect guide to
Stony Coral Rescue




# Caribbean Cooperation Team Partners Meeting

## April 8, 2024

# New Caribbean Coral Restoration Efforts

**Agenda**

CCT Background — Judith Lang, AGRRA
CORDAP — Anderson Mayfield

**Part One**

*Upscaling and optimizing coral sexual propagation technologies for coral restoration in the Caribbean*
Maria Villalpando, Fundación Dominicana de Estudios Marinos

*Interventions to improve the health, growth, and survival of larvae and settlers for sexual restoration of the Mesoamerican Reef (MAR)*
Andrea Godoy Mendoza, Roatan Marine Park

*Giving Caribbean corals a future: SCTLD and the use of probiotics in coral restoration projects*
Valeria Pizarro, Perry Institute for Marine Science

*Establishing the Global Coral Cryopreservation Network*
Anastazia Banaszak, Universidad Nacional Autónoma de México

*AGRRA-MPAConnect's Caribbean Restoration Roadmaps Initiative - expanding coral rescue and recovery in Marine Protected Areas (MPAs)*
Patricia Kramer, AGRRA

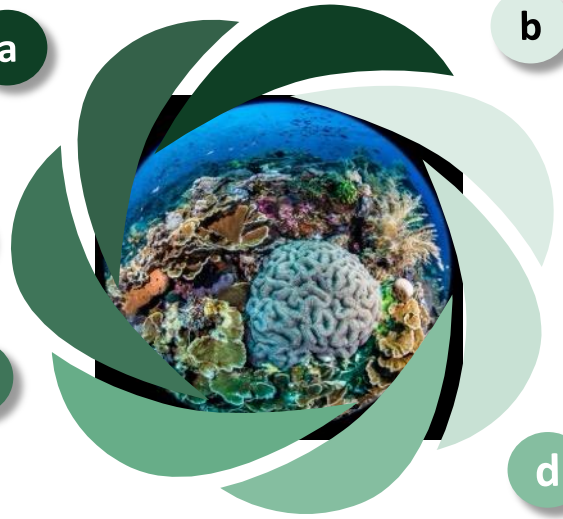

**Contact me at anderson.mayfield@kaust.edu.sa**

# CORDAP's Goals and Objectives

current

**a** Fund and deliver the best novel scientific and technological solutions to conserve corals and restore coral reefs

**b** Connect national, regional, and international research programs



in progress

**g** Develop and share novel scientific tools

**c** Support a global, gender-balanced, transdisciplinary community of scientists and innovators

**f** Facilitate access to information & research facilities

**d** Engage the R&D capacity of the private sector

**e** Provide advanced research training to scientists from developing and least developed countries

just started

Our main activity is the funding, management, and execution of coordinated, collaborative, and targeted global research programs for coral conservation and restoration.

# Current Activities


## R&D Funding Programs

- "Coral Accelerator Program" (CAP) 2022 – $18MUSD awarded to 14 projects
- CAP 2023–reviewing the top 37 proposals, of which ~1/3 will be funded
  - Decision to be made in late June 2024

## CORDAP R&D Scoping Studies and Roadmaps

- Areas where further study & planning are required before funding will be effective.
- Delivering actionable "roadmaps" to and align research activities.

**Past themes:** ***Assisted Evolution*****, *Coral Aquaculture*, *Cold-Water Corals*, *Ecological Risk*, *Capacity development***

## Capacity Development – Developing Countries (i.e., "Global South")

- Raising coral research and conservation leadership in the Global South (launched in Mar. 2024 in Africa).
- Design and develop a global school for coral restoration and conservation (launching soon).

## Resourcing the Programs – fundraising

- Raising awareness of the value of corals and reefs to the public, decision-makers, and key stakeholders.
- Seeking multi-annual commitments for the sustainable effort required at scale.

$ € ¥ £

# Coral Accelerator Program (CAP)

- Funds international collaborative research teams with impactful ideas to transform coral conservation and restoration.
  - Minimum three applicants on a team from at least two countries.
  - Teams must include at least one low-middle income (OECD) country partner.
  - Full range of novel early-phase research projects through to final proof-of-concept development and testing.
  - USD 1.5 million per project–can run between 1 and 3 years.
- 2-stage review: concept note (pre-proposal) followed by full proposal (~1/3 of initial applicants)
- Policies: IP developed made freely available for coral use:
  - Outputs➔open access
  - Technological developments made free (or at least affordable).

# Coral Accelerator Program 2023–*under external review*


**Priority areas**:

- Assisted evolution
- Aquaculture
- Cold-water corals
- Preserve and conserve existing corals
- Limit early life stage mortality
- Intervention planning and monitoring
- Blended artificial and natural reefs
- R&D capacity-building
- Developing country R&D methods

$18M USD

120 eligible proposals from all major coral reef regions on the planet:
total amount requested: $159M USD, i.e., funding rate = ~11%

# Upcoming events and initiatives

- **Oct. 2024**: coral disease workshop in Puerto Morelos, Mexico
- **Nov. 2024**: CAP2024 (the 3rd)-hopefully another $18 million USD
- **Late 2024 or early 2025**: Coral rescue workshop in early 2025 in Florida
  - Emergency! I urgently need funds to save my corals. Can CORDAP help?
  - At present, no, but personally something I am working on.
  - These will be the new priority areas for CAP2024 or CAP2025.
- **TBD**: CORDAP coral conservation and restoration academy
  - Great online training modules from Living Oceans Foundation on coral biology.
  - Online coral restoration knowledge modules also exist (e.g., TNC).
  - Other good training resources so that we don't have to "reinvent the wheel?"
    - Let me know!

CORDAP CAP 2022

# Upscaling and Optimizing Coral Sexual Propagation Technologies for Coral Restoration in The Caribbean

fundemar
Fundación Dominicana de Estudios Marinos, Inc.

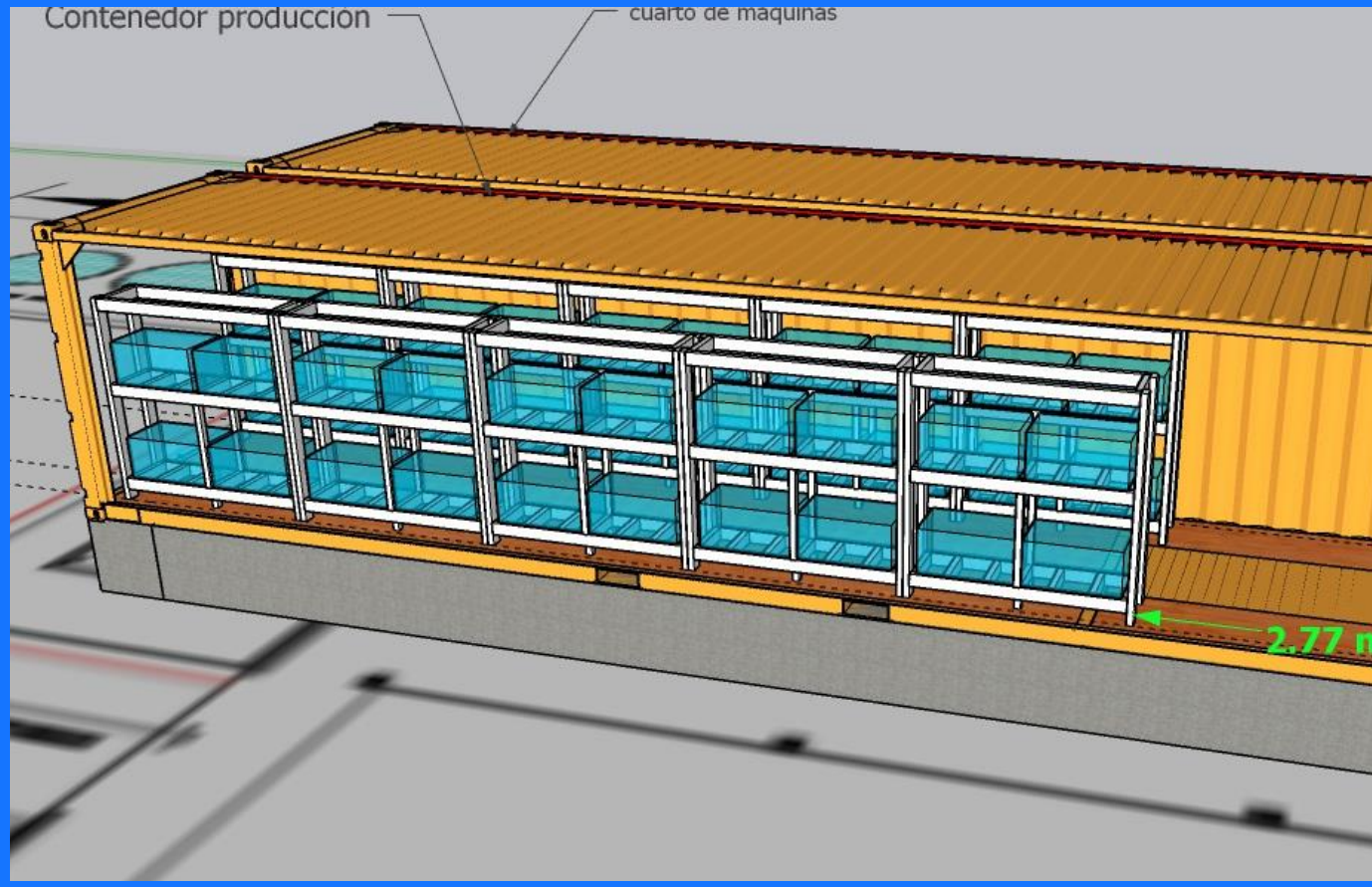
secore international

Reef Renewal Bonaire

# TASK 1: Implement and test novel technologies from SECORE International in the DR and Bonaire

- Refine individual gamete collector design and test massive production
- Design and test novel substrates
- CRIB space optimization for conventional and novel substrates
- Integrate early live feeds
- Test surface deployment of substrates
- Test larval in-situ enclosures

# TASK 2: Expand FUNDEMAR's land-based larval rearing facility in the DR and formally plan and design a facility in Bonaire

Fundación Dominicana de Estudios Marinos, Inc.

Dominican Republic Marine Innovation Hub

# CECOMAR

## Centro de Estudios Marinos Costeros


fundemar
Fundación Dominicana
de Estudios Marinos, Inc.

# TASK 3: Technology transfer between FUNDEMAR and RRFB

RRFB in DR:

- Larval rearing facility
- Gonochoric coral assisted sexual reproduction
- Recruit outplant

FUNDEMAR in Bonaire:

- In-situ larval tents
- Microfragmentation
- Large-scale photogrammetry

Overall:

- Nurseries, outplants
- Sustainable model
- Technology implementation feedback

secore international

fundemar
Fundación Dominicana de Estudios Marinos, Inc.

Reef Renewal Bonaire

# TASK 4: Communicate results with experts and stakeholders to promote technology replication

- White paper results summary report and protocols
- Documentary style video of the project and its impact
- Host training workshop in DR
- Host online webinar
- Present project results at scientific conferences

secore international

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Fundación Dominicana de Estudios Marinos, Inc.

Reef Renewal Bonaire

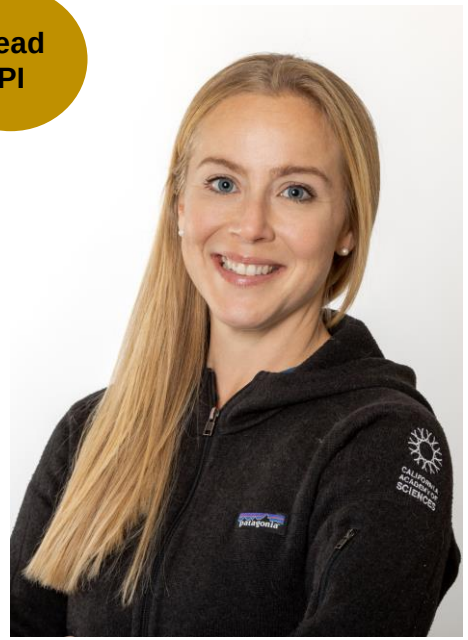
# *Interventions to improve the health, growth, and survival of larvae and settlers for sexual restoration of the Mesoamerican Reef (MAR)*

Presented by ***Andrea Godoy Mendoza***
co-Principal Investigator, Program Manager
**Roatan Marine Park**

Gayle Laird © California Academy of Sciences

# 4 Co-Principal Investigators

Lead PI



**Rebecca Albright, PhD**
Curator of Invertebrate Zoology, Founder of CoRL

**Elora López-Nandam, PhD**
Postdoctoral Researcher

**Jennifer Keck, MSc**
Education and Research Coordinator

**Andrea Godoy Mendoza**
Program Manager

CALIFORNIA ACADEMY OF SCIENCES

ROATAN MARINE PARK

# Project Objectives

1) Increase local capacity for coral restoration by training Roatán Marine Park (RMP) and other partners in the Mesoamerican Reef region to develop and implement coral husbandry and sexual reproduction techniques

2) Design and build a larval rearing and experimentation facility at RMP* (first of its kind in the country), and make associated designs, budgets, and protocols freely available in both Spanish and English

3) Test low-cost, low-tech interventions to increase growth and survival rates of coral recruits and to select for heat tolerant individuals


* Roatán, Bay Islands, Honduras

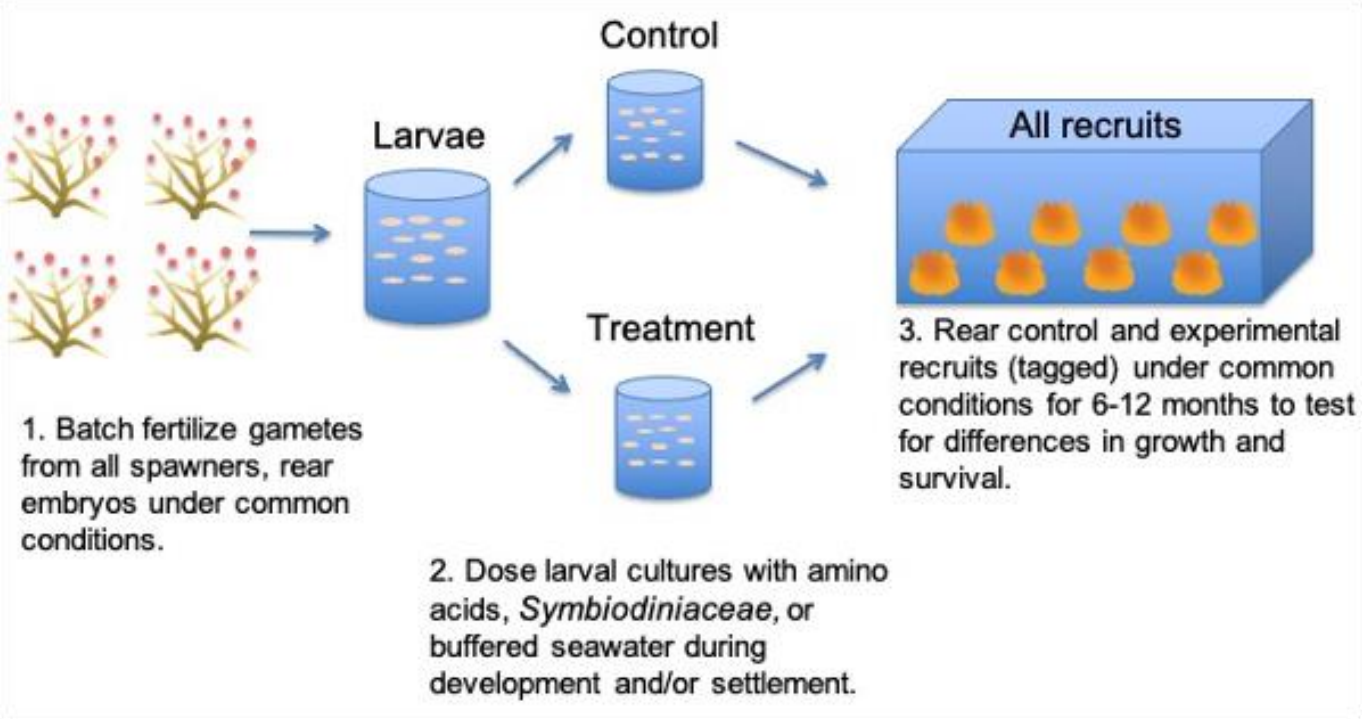
Project Duration:
36 months

# 4 Interventions

- **Seawater buffering –** increasing water alkalinity to enhance early skeletal formation in corals
- **Amino acid addition (during larval culturing) –** dosing larvae with amino acids to nutritionally assist coral growth and development
- **Symbiont addition (during larval culturing) –** inoculating larvae with algae (*Symbiodiniaceae*) that may serve as a supplemental energy source
- **Heat selection –** select for thermally tolerant individuals at the larval stage to hasten adaptation to higher temperatures amongst the surviving population

*The "settlement" stage is a highly intensive process during which many young corals deplete their energy reserves.*

# 4 Interventions




*Preliminary results (January 2022, December 2023) suggest our interventions may promise to enhance two bottlenecks – settlement rate and post-settlement growth/survivorship.*

# Progress

- **November – December, 2023**

Three RMP team members visited the California Academy of Sciences and spent about 3 weeks facilitating the *Acropora millepora* ex-situ spawning event, learning husbandry, and testing our four interventions.

- **January 2024 – ongoing**

Analyses of *thousands* of images from experiments for recruit survival and growth

- **February 2024**

CORDAP Grant funds received!

- **March – April, 2024**

Finalizing details for coral larval rearing and experimentation facility buildout in Roatan.

All photos by *Gayle Laird © California Academy of Sciences*

# Upcoming Activities

1) **RMP coral facility construction complete and ready to go**
   *Expected July 2024**

2) **Acropora spawn #1 in Roatan –** first intervention experiments in new facility (*August 2024*)

3) **Second CAS spawn to refine testing of the most successful interventions –** *December 2024*

4) **Generate a better approach to image segmentation and analysis –** image segmentation to identify objects and measure change in size to keep track of recruit growth/survival

# About Partners

The Institute for Biodiversity Science and Sustainability at the California Academy of Sciences is at the forefront of efforts to regenerate the natural world through science, learning, and collaboration. Based in San Francisco, the Institute is home to more than 100 world-class scientists, state-of-the-art facilities, and nearly 46 million scientific specimens from around the world.


Roatán Marine Park is a community-based, non-profit organization dedicated to conserving Honduras' marine and coastal ecosystems. Most of our conservation efforts are carried out within the Bay Islands National Marine Park (BINMP) - the largest marine protected area in Honduras with approximately 650,000 hectares, where we also are one of the co-managers of this MPA.

CRCR
CORAL RESTORATION
CENTER ROATAN

# THANK YOU!

Gayle Laird © California Academy of Sciences

## PI CONTACT INFORMATION

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Elora López-Nandam
elopez-nandam@calacademy.org

Jennifer Keck
rimsed@anthonyskey.com

# Giving Caribbean corals a future: SCTLD and the use of probiotics in coral restoration projects

Valeria Pizarro – Perry Institute for Marine Science

Blake Ushijima – University of North Carolina Wilmington

Sarah Gignoux-Wolfsohn – University of Massachusetts Lowell

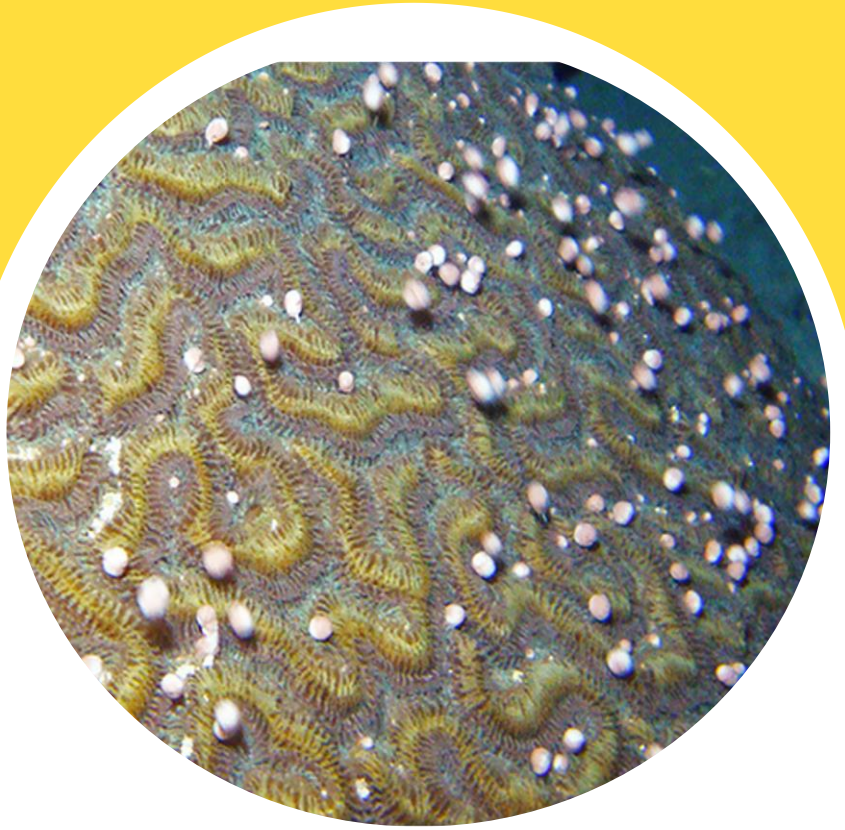
Elvira María Alvarado – Fundación Ecomares

María Fernanda Maya – Blue Indigo Foundation

Nacor Bolaños - CORALINA

# SCTLD and reef degradation

# Restoration strategies



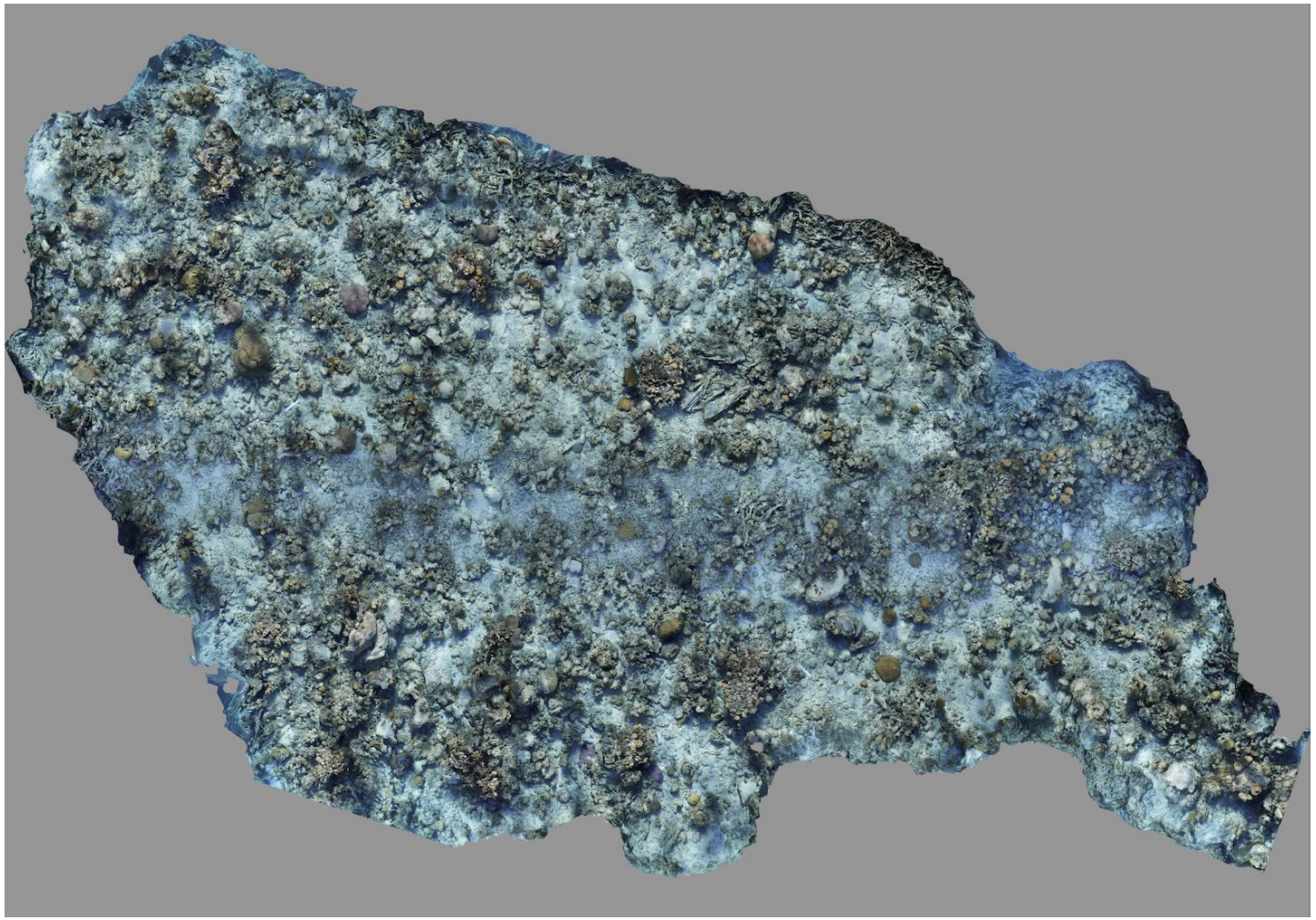
# Goals

- Develop probiotics for four SCTLD susceptible species
  - OFAV
  - DLAB
  - PSTR
  - MCAV
- Evaluate the potential role of probiotics on:
    - Coral immunity
      - SCTLD treatment effectiveness (compared to amoxicillin)
      - Healthy corals
    - Coral fecundity
      - Adult colonies
    - Coral growth
      - Microfragments
      - Recruits


**Study site**
San Andrés Island – Southwestern Caribbean

**Five stations**
Nirvana
Punta Padi
Montañita
Plaza de Toros
El Arbol

# SCTLD assessments & treatments – Coral population assessments



Photomosaics – permanent plots

1. Status of coral populations
- Coral health
- SCTLD

2. SCTLD treatment
- Yr1 – yr3 Antibiotic
- Yr2 – yr3 Probiotics

# Metagenomics-informed probiotic development

Metagenomics

GCTGACTAACTG

AGTGACTGACTA

ACCCACAGATTG

AGTGACTGACTA

GCTGACAGAGGG

ATGACTGAGGTG

ACCGACCGACTT

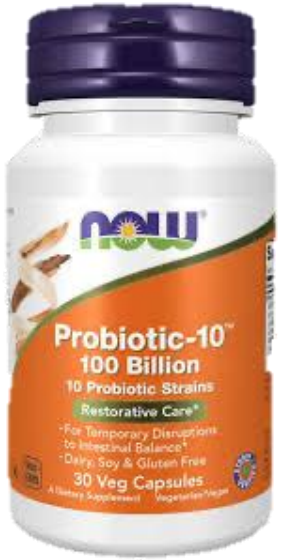
Identify bacterial strains or genes associated with resistance

GCTGACAGA

AGAGGG

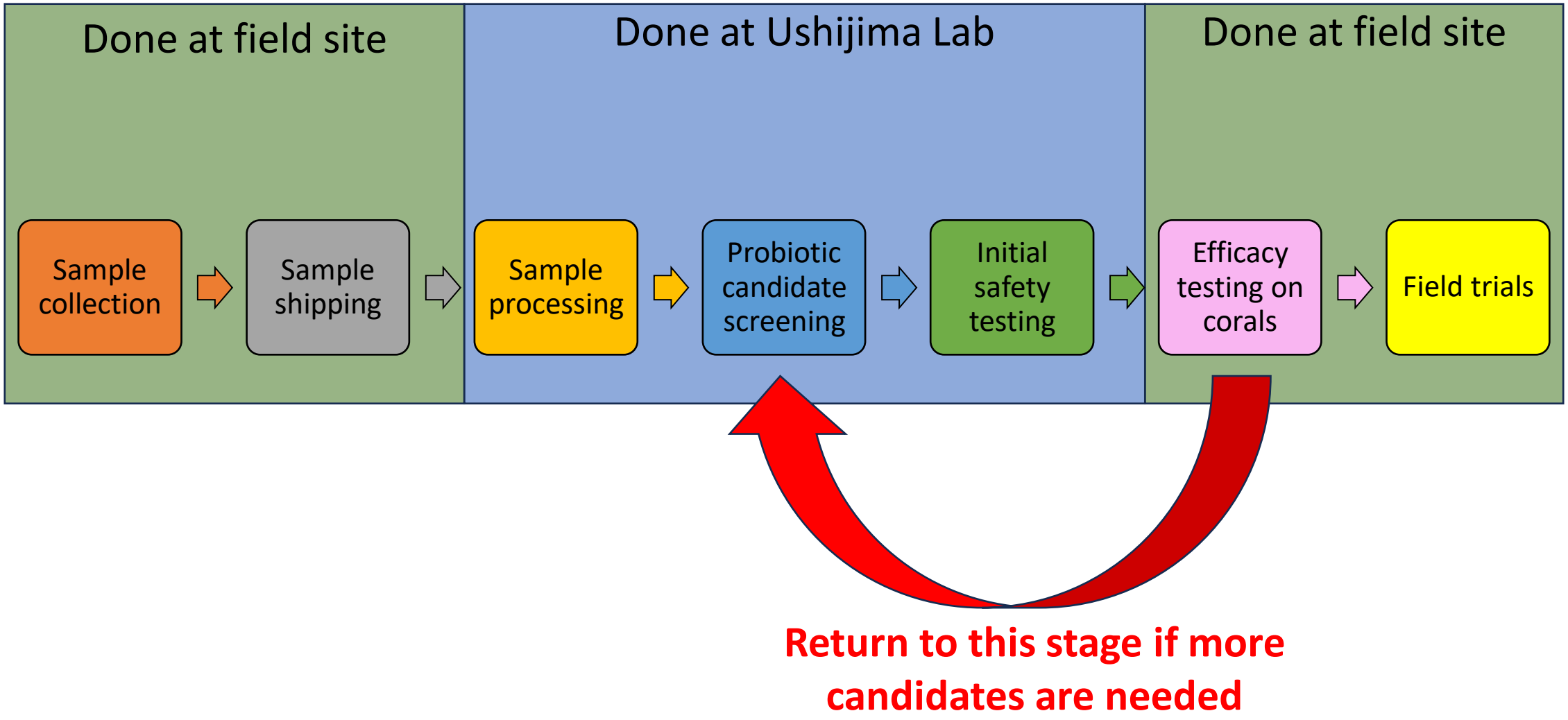
Develop primers to target these biomarkers

Screen bacteria for markers

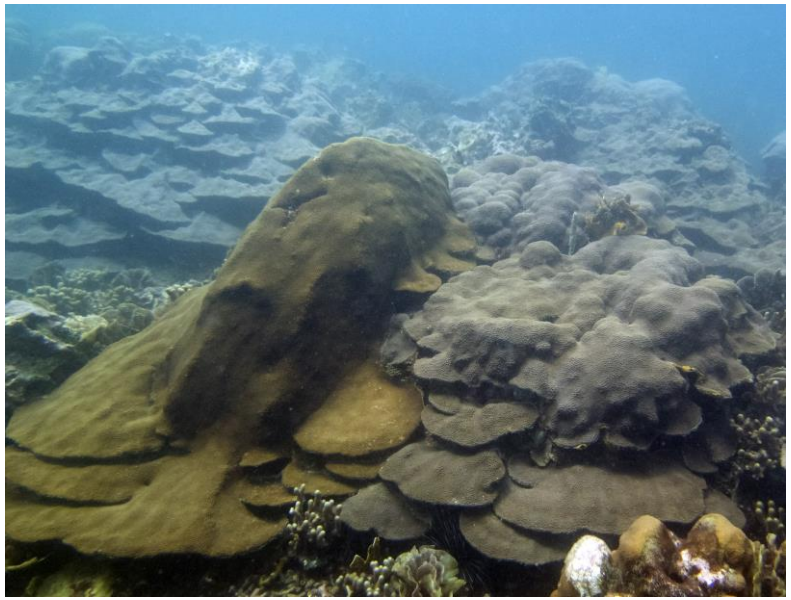



Faster, more targeted, more beneficial probiotic development!

# What are done with probiotic candidates?

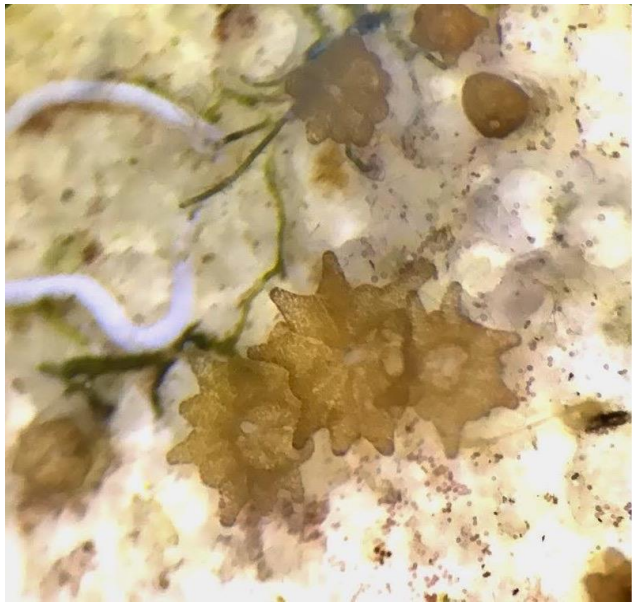


# Probiotics treatments in four species yrs 1&2



Healthy corals
- Immunity / resistance
- Fecundity

Microfragments
- Immunity / resistance
- Growth



Recruits
- Growth
- Immunity?

# What have we done so far…

- Setting up permanent plots for monitoring
- Collected samples for metagenomics and probiotics
- SCTLD treatments with amoxicillin

# QUESTIONS?

Perry Institute
FOR MARINE SCIENCE


**WEBSITE:**

www.PerryInstitute.org

**EMAIL:**

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**PHONE:**

+1 242 468 4249


# THANK YOU!

CORDAP funded project:

# Establishing the Global Coral Cryopreservation Network


Mary Hagedorn

Smithsonian institution and HIMB

Kristen Marhaver

Multiplier and CARMABI

Anastazia Banaszak

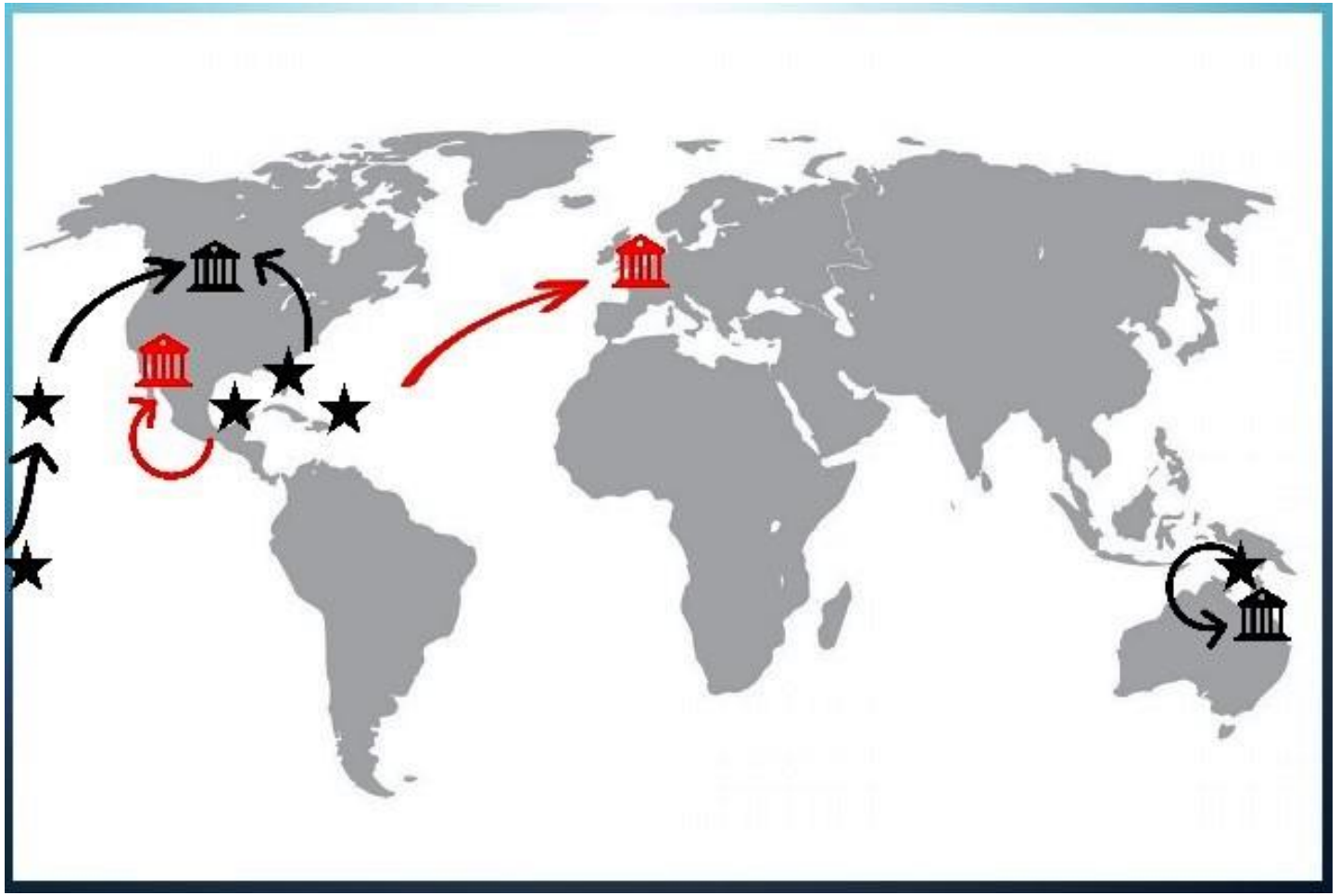
UNAM

Jonathan Daly

Taronga Conservation Society

Keri O´Neil

FLAQ

# Project objectives

1: Establish core infrastructure for the global coral cryopreservation network

2: Train the full project team in larval cryopreservation and implement this technology at all five project nodes

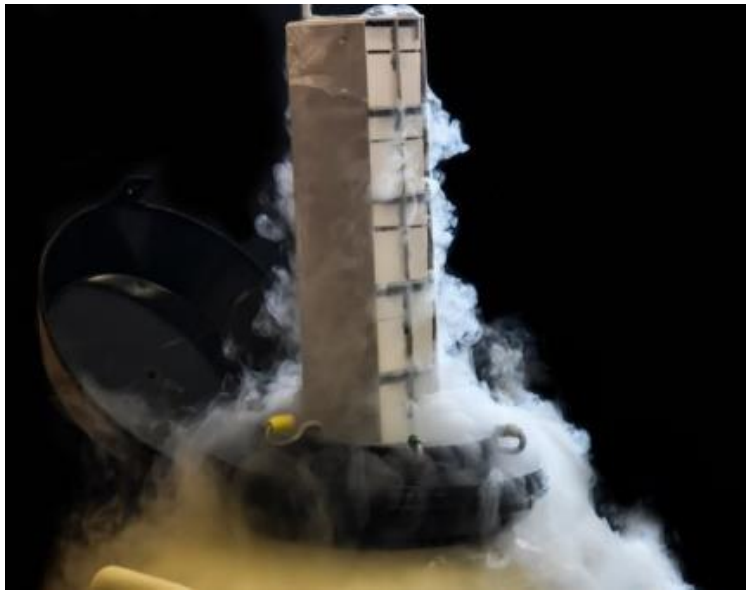
3: Build an online cryopreservation training system for practitioners

4: Build a unified database system for coral biorepositories

5: Conduct in-person cryopreservation training with new stakeholders

# CRYOPRESERVATION

- Freezing and storing live tissues and cells in an adequate medium at very low temperatures
- All biological processes are halted
- Cellular structures and integrity of biomolecules are maintained intact, thus avoiding decomposition
- Allows for maintenance over long periods



# WHY CRYOPRESERVATION?

- Maintain the viability and potential of sperm to fertilize
- Production of new genotypes through genetic recombination over time and space
- Genetic rescue in the face of loss of connectivity
  Production of sexual recruits outside of mass spawning seasons
- Support restoration and conservation efforts of threatened species

Instituto de
Ciencias del Mar y
Limnología

CORALIUM
INTEGRATIVE REEF CONSERVATION RESEARCH LAB

# MEXICAN CORAL GAMETE BIOREPOSITORY

Since 2016
6 species of reef building corals
77 spawning collections
33 arrecifes
1172 accessions
124 genotypes

# Coral Restoration Road Maps

## Expanding regional restoration of coral reefs in Caribbean Marine Protected Areas

AGRRA

cordap Coral Research & Development Accelerator Platform

MPA connect

CORALIUM Laboratorio de Investigación Integral para la Conservación de Arrecifes

Turks & Caicos Reef Fund

ISER Caribe

Nature Island Dive Dominica

ECOMARES

NOAA Coral Reef Conservation Program

GCFI Gulf and Caribbean Fisheries Institute, Inc.

University of Miami

ORE Ocean Research & Education Foundation

UTIA Institute of Agriculture, The University of Tennessee



Photo: Huggins


Photo: M. Figueroa

## Challenges

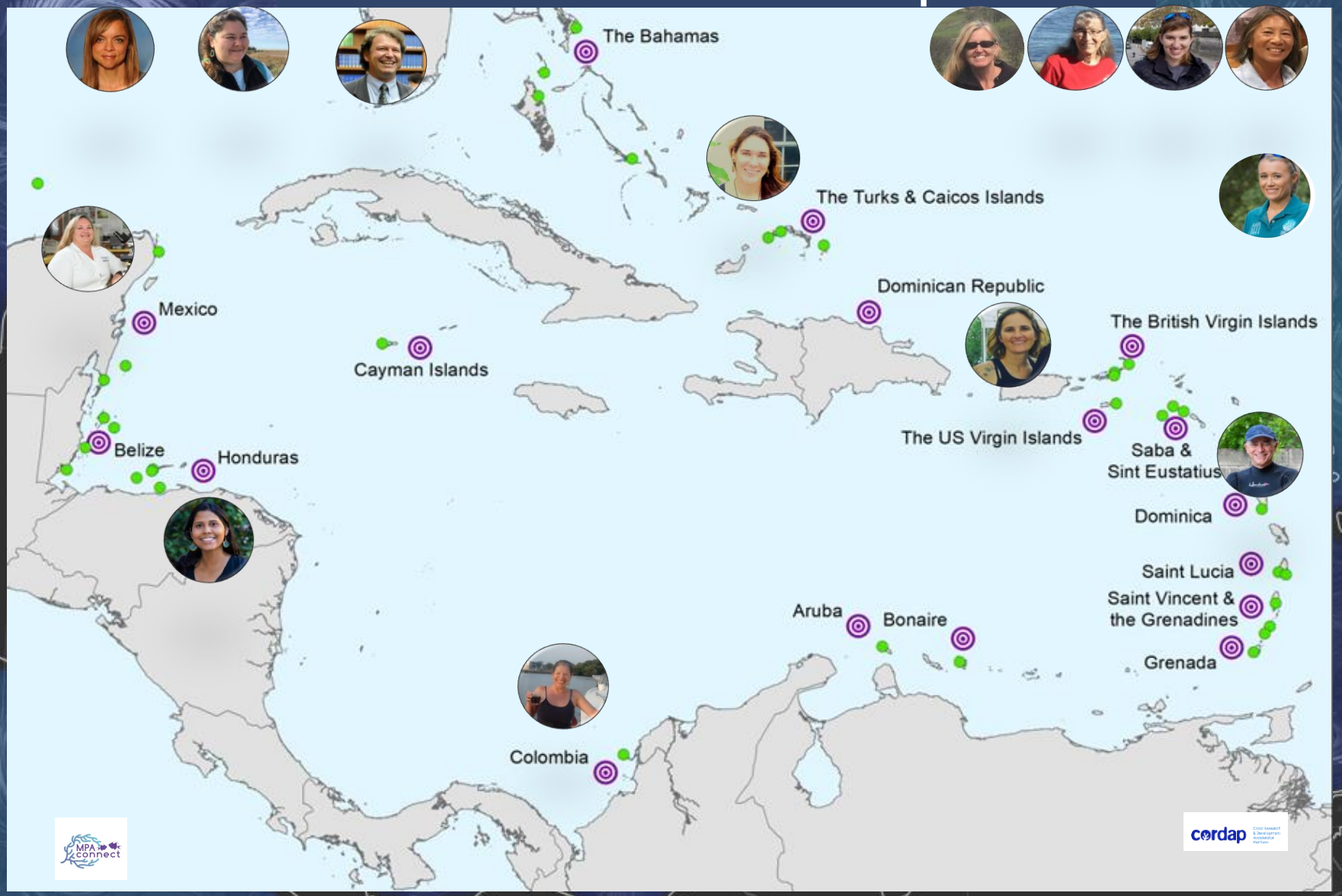
1. How to begin to rescue and recover corals after devasting impacts, especially those…

- species at risk to SCTLD,
- species in Families that are endemic to the Caribbean,
- species highly susceptible to disease or bleaching,
- species at risk of genetic loss and functional extinction, and
- species not normally included in current restoration activities.

2. How to expand coral recovery and ecosystem restoration in the Caribbean at the local level and at scales meaningful for recovery of high-risk corals and enhance ecosystem structure and function.

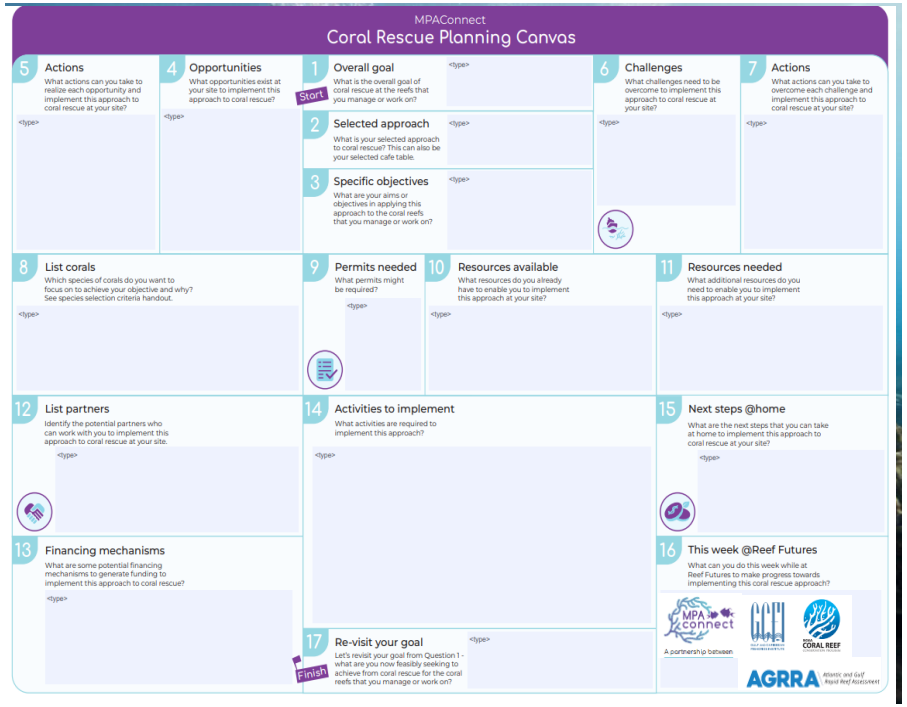

MPA connect
The Bahamas
The Turks & Caicos Islands
Mexico
Cayman Islands
Puerto Rico
The British Virgin Islands
Saint Croix
Guadeloupe
Dominican Republic
Saba &
Sint Eustatius
Belize
Honduras
Dominica
Saint Lucia
Saint Vincent & the Grenadines
Bonaire
Grenada
18
countries/
territories
39
MPAs

# Restoration Roadmap Team




Live Visual Map see:
earth.nullschool.net

# Learning Exchanges




Managers Coral Rescue Exchange:
In-Situ Coral Rescue Approaches
Roatan, Honduras
July 11-18th

Photos: Francesca DeWeerdt

# Restoration Roadmaps

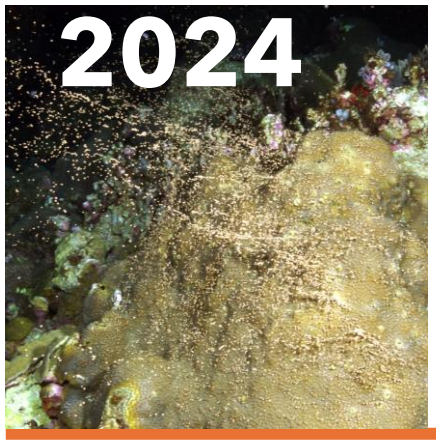
## Objectives

- **Increase coral populations and improve reef ecosystem function**
- **Develop science-based and management-relevant restoration roadmaps**
- **Share and increase coral recovery technical expertise**
- **Synergize and catalyze restoration efforts within Caribbean MPAs to increase recovery potential regionally**
- **Expand restoration with MPAs in the Caribbean region**

Live Visual Map see:
earth.nullschool.net

cordap Coral Research & Development Accelerator Platform

# CORDAP Timeline & Milestones




## Year 1

Develop Portfolios & Roadmaps

Identify Restoration Sites & Techniques in the MPA Connect Network

Technical Training courses


## Year 2

Implement Restoration at MPA demonstration sites

Communicate, educate and guide


## Year 3

Continue Restoration at MPA demonstration sites.

Evaluate restoration progress

Examine options for scaling up regional recovery

Continue to communicate, educate and guide


## Evaluation

Examine options for scaling up regional recovery

Communicate, educate and guide

Examine next steps

# 2024

## CARIBBEAN RESTORATION ROADMAPS (YEAR 1)

## Spring

- Coral Monitoring Training
- Photomosaic Training
- Restoration Roadmap Workshop –*June
- Develop Restoration Roadmaps

## Aug-Sept

### Field Training - Mexico

- Coral Propagation
- Coral Spawning
- Larval Propagation
- Assisted Fertilization

## July

### Field Training – Puerto Rico, US

- Land-based & In situ nurseries
- Coral Propagation
- Herbivore Propagation
- Ecosystem based restoration

## Fall

- Planning for implementation Year 2-3
- Disease Tissue Sampling Training
- Peer to Peer Mentoring
- Learning Exchanges

# Coral Propagation


- Monitoring & Mapping
- Coral spawning & calendars
- Larval propagation
- Assisted fertilization
- Best Practices

CORALIUM

Banaszak, A.et al. 2023. Applying coral breeding to reef restoration: best practices, knowledge gaps, and priority actions in a rapidly evolving field. Restoration ecology, p.e13913.

# Ecosystem based restoration

- Coral propagation techniques (sexual vs micro-fragmentation)
- Focus on SCTLD susceptible corals
- Design, development, and maintenance of land- based and in situ nurseries
- Sea urchin propagation (post-larval collection vs larval rearing in lab)
- Techniques to restore corals and herbivores

https://www.isercaribe.org/projects

Land based

In situ nursery

Photos: ISER

# Restoration Training Hub


Access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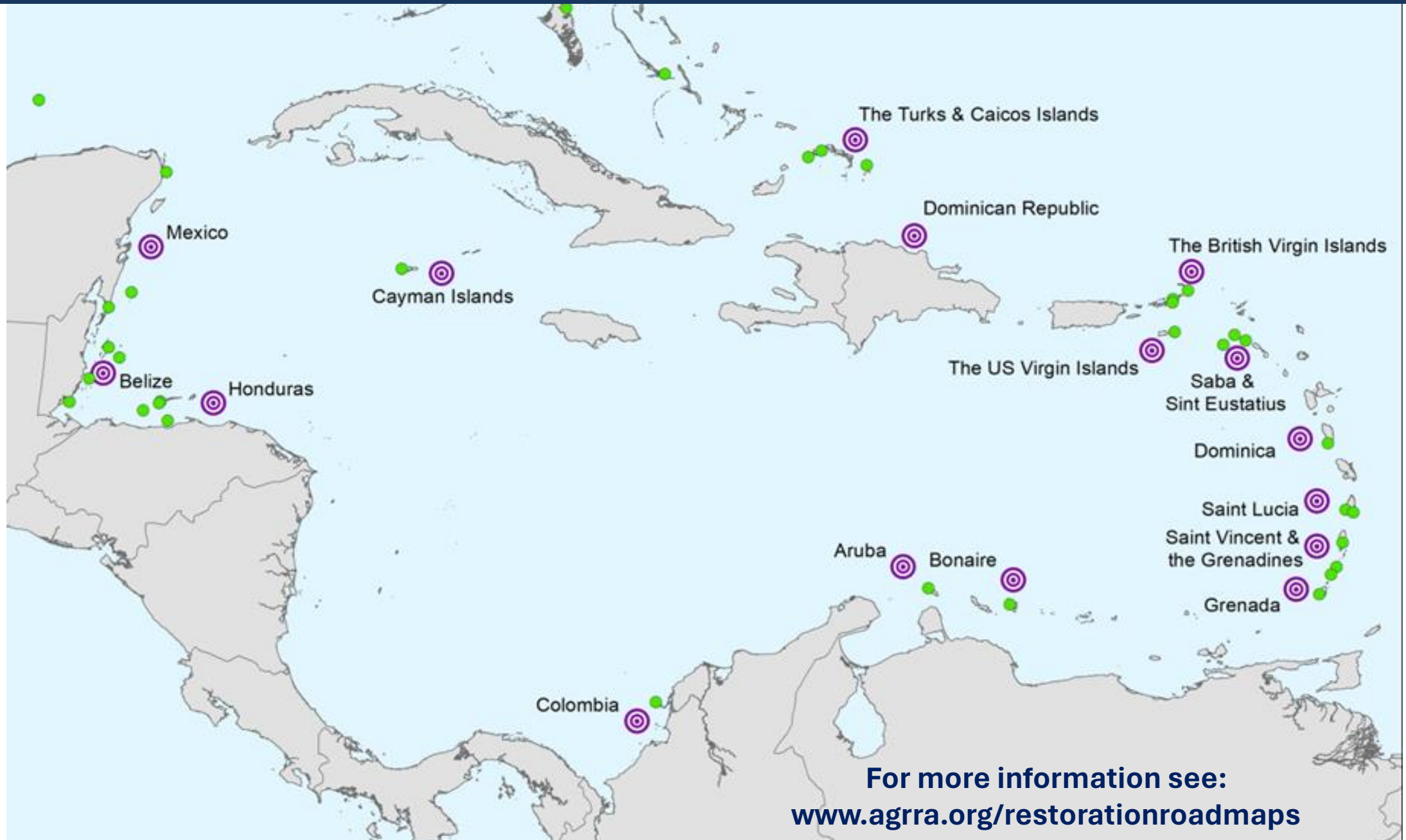
# Advancing coral reef recovery through collaboration and connectivity




**For more information see:**
**www.agrra.org/restorationroadmaps**

*Hope for the future through collaboration & sharing….*

**Opportunities:**

- **Learning exchanges**: Be a mentor, meet a mentor
- **Technical trainings**: Online and field courses
- **Coral rescue planning**: Develop action plans, share expertise
- **Recovery potential**: Locally focused, regionally important
- **Small grants program**: Planning and implementation

@F. Krysiak

# Coral Restoration Roadmap Training Hub


Access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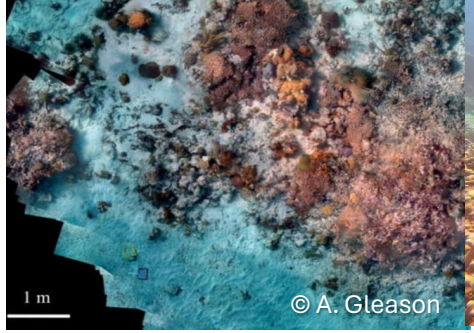
https://www.agrra.org/restorationroadmaps/




# Caribbean Cooperation Team Partners Meeting

## April 8, 2024

# New Caribbean Coral Restoration Efforts

**Agenda**

**Part Two**

*Introduction to the AGRRA-MPAConnect Training Courses*
Patricia Kramer, AGRRA

*Monitoring*
Judith Lang, AGRRA

*Introduction to large-area imagining for coral reef science and monitoring*
Art Gleason, University of Miami

*Techniques in coral spawning collection and assisted fertilization*
Anastazia Banaszak, Universidad Nacional Autónoma de México

*Ecosystem-based coral restoration of corals & herbivores*
Stacey Williams, ISER-Caribe

*Coral disease and tissue sampling techniques*
Michelle Dennis, University of Tennessee


Early AGRRA expedition Cuba-A 2001


# Coral Restoration Roadmap Monitoring

Judy Lang (jlang@riposi.net)

April 8, 2024

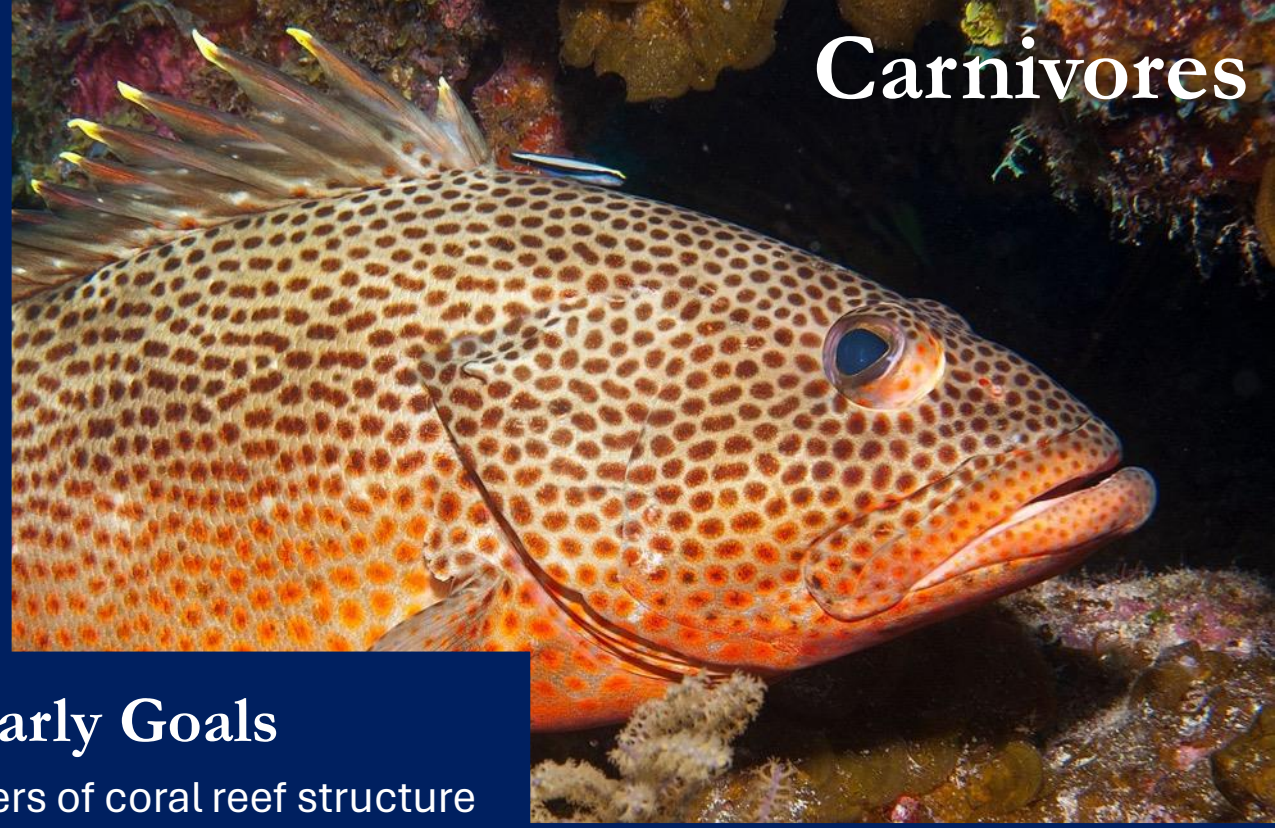
AGRRA

MPA connect

cordap Coral Research & Development Accelerator Platform

ORE Ocean Research & Education Foundation

Live Visual Map see:
earth.nullschool.net


## AGRRA Early Goals

- Rapidly assess key drivers of coral reef structure and function
- Provide fishery-independent estimates of fishing pressure
- Keep methods reproducible, simple, robust
- Fill gaps and create baseline data, especially in remote areas
- Early emphasis on spatially balanced sampling designs
- Involve in-country colleagues in training and surveys
- Provide standardized training, data analysis


# Coral Restoration Roadmap Monitoring Course

Instructors: Judy Lang, Patricia Kramer, Lynnette Roth (AGRRA); Alizee Zimmermann (TCRF)

## Why Monitor Your CORDAP Project Sites?

- To assess the health of coral populations and reef ecosystems,
- To track any temporal changes (positive or negative), and
- Evaluate the outcomes of interventions compared to control sites.


## Course Outline:

Module 1: Coral restoration roadmap monitoring (sampling design, metrics)

Module 2: Coral population enhancement goals (coral ID, coral pop metrics)

Module 3a: Reef ecosystem enhancement goals

- 3a. Reef Benthos (benthos ID, benthos metrics)
- 3b. Reef Fish (fish ID, fish metrics)
- 3c. Reef structure (relief metrics)

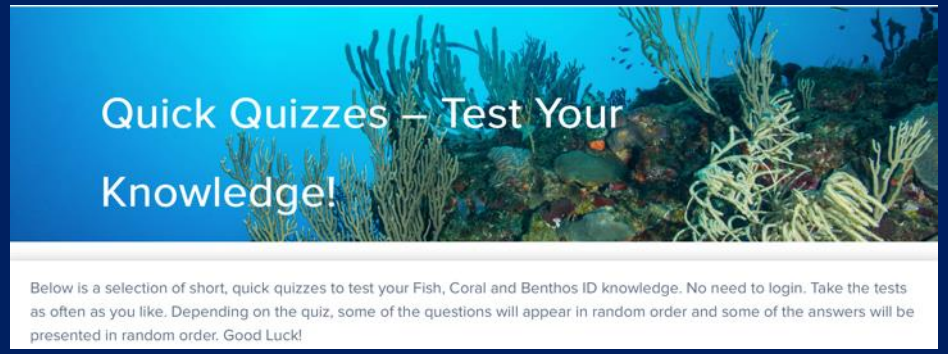
Module 4: Restoration Evaluation (data management, interpretation)

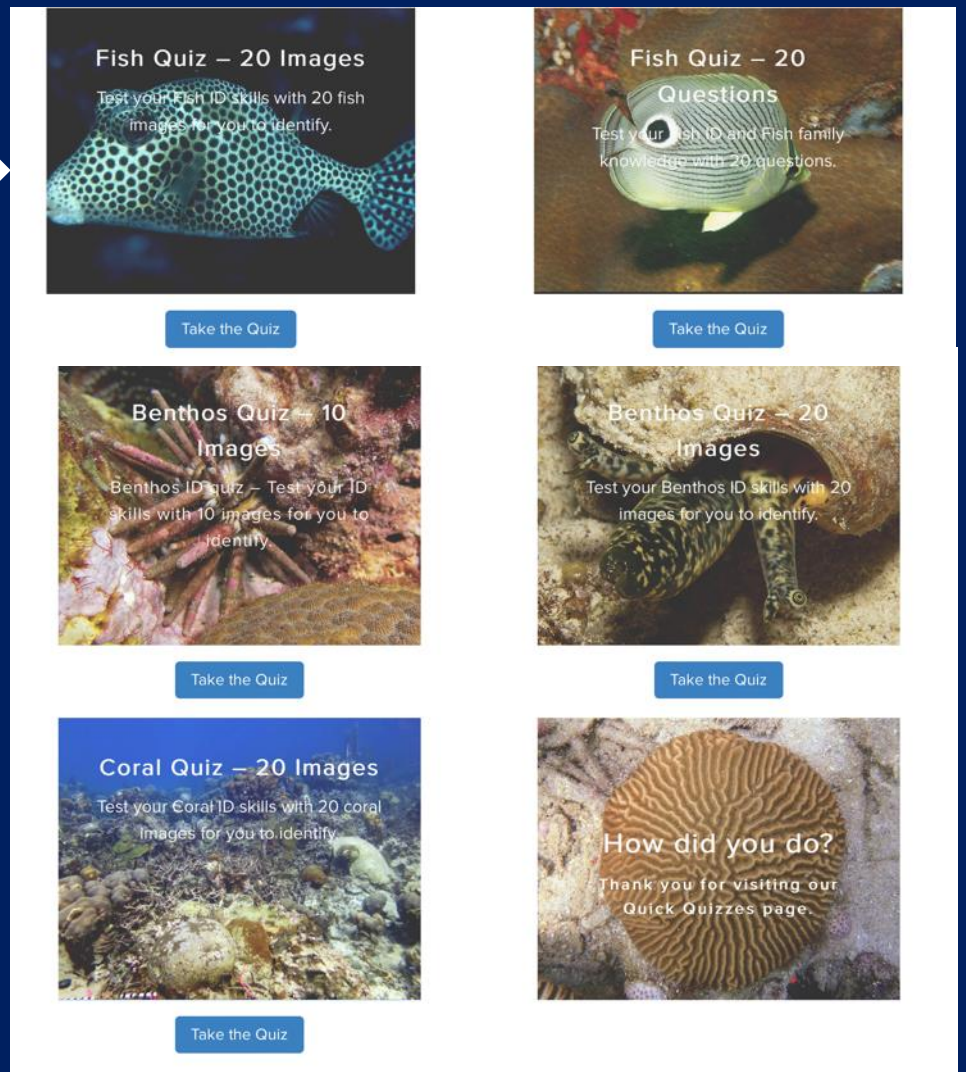
# AGRRA Training

AGRRA has developed visual training tools to help participants learn how to identify key reef organisms, their role in reef health, and how to survey, track and interpret observed trends.

Online quizzes are available to test identification skills in fish, benthos and stony corals.

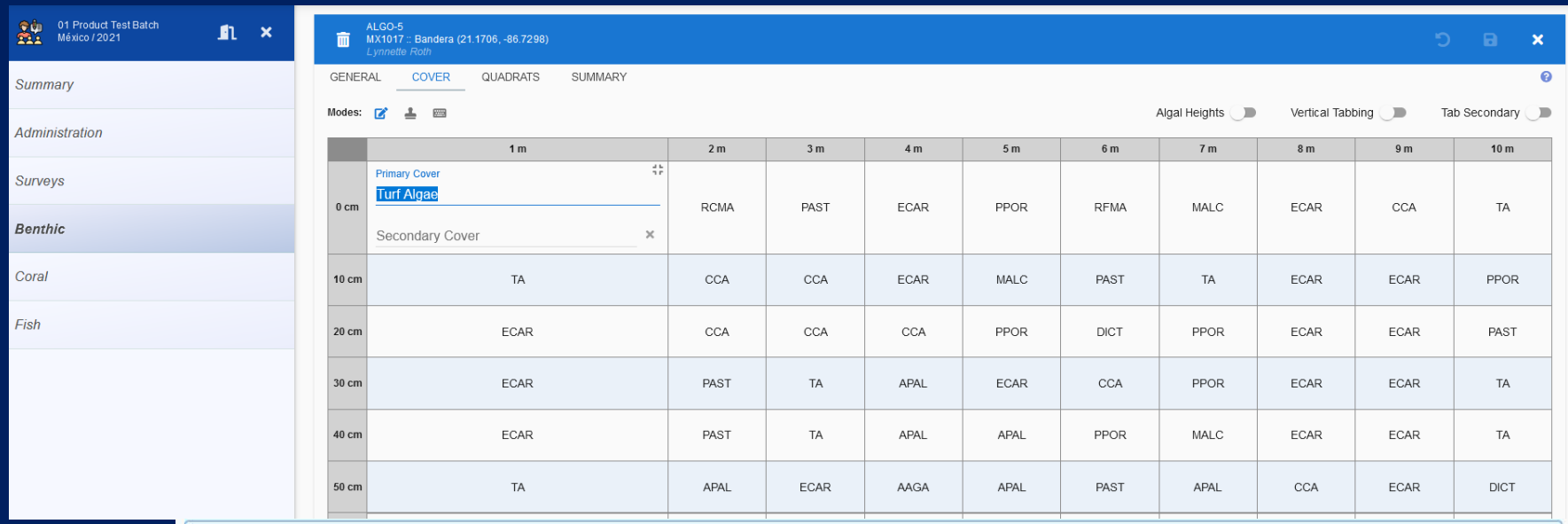
Courses combine virtual (or in-person) classes with structured, supervised dives and assessments on a final exam plus demonstrated efficiency during practice surveys  on local reefs.

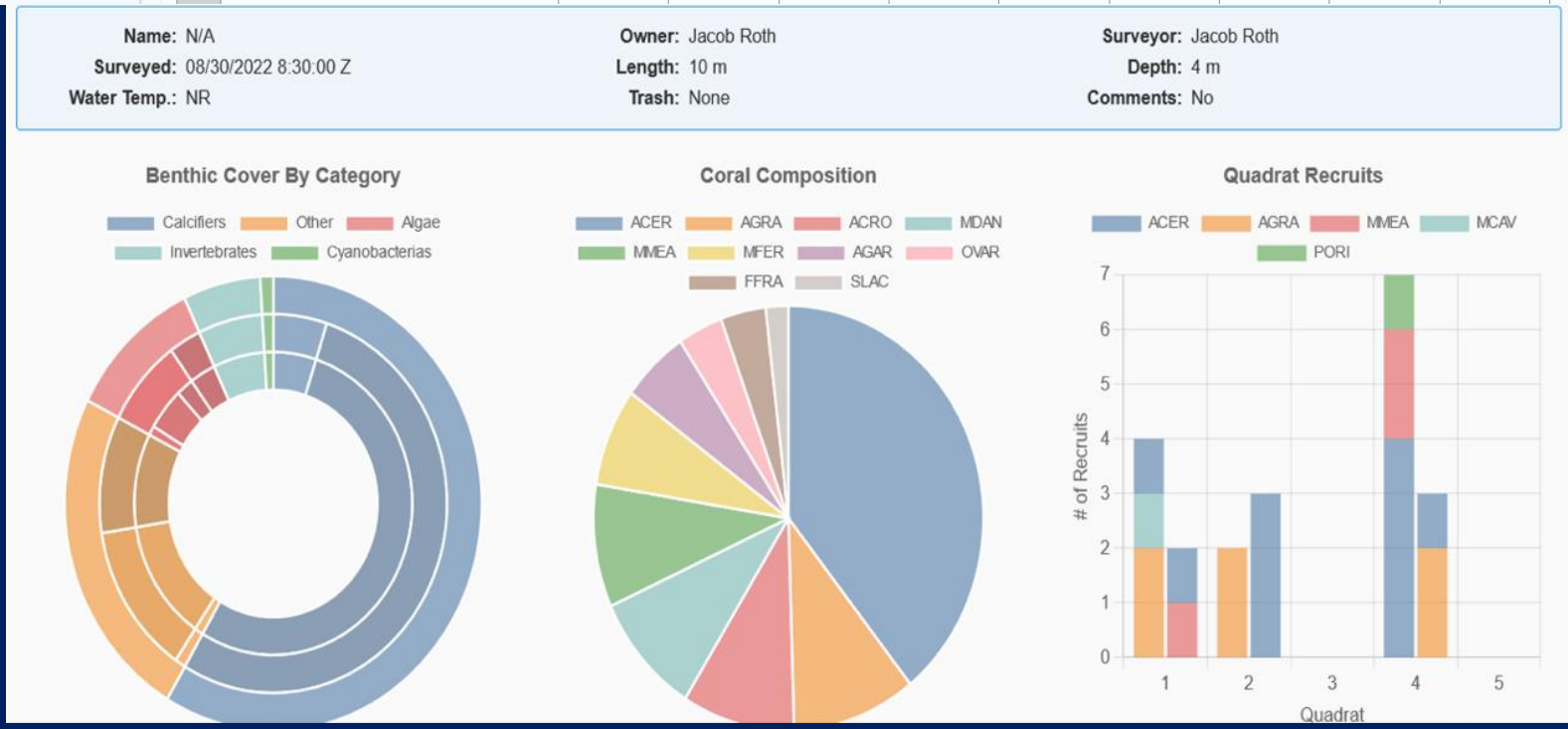



# Examples of New AGRRA Data Entry and Visualisation Tools

Date Entry: e.g., Benthic Cover




Visualisation: e.g., Benthic Cover, Coral Composition, Quadrat Recruits




Explore the Online Data Explorer at: https://agrra-data-explorer-oref.hub.arcgis.com

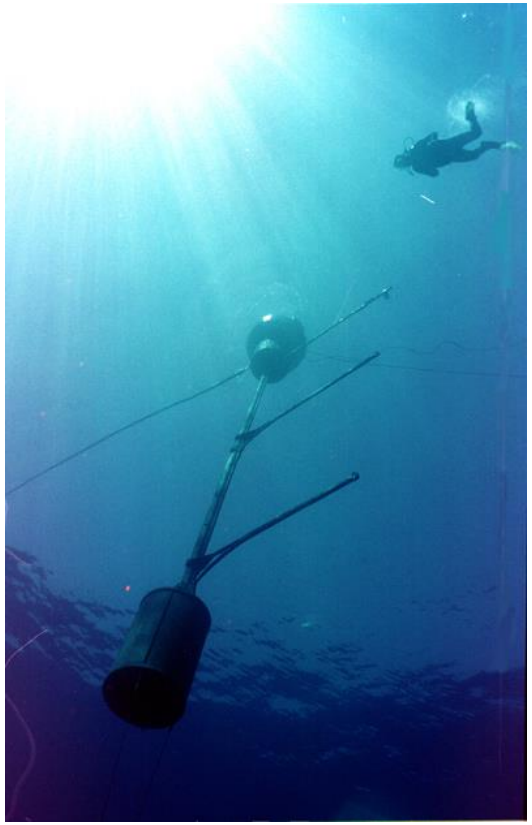
# Art Gleason

MIAMI

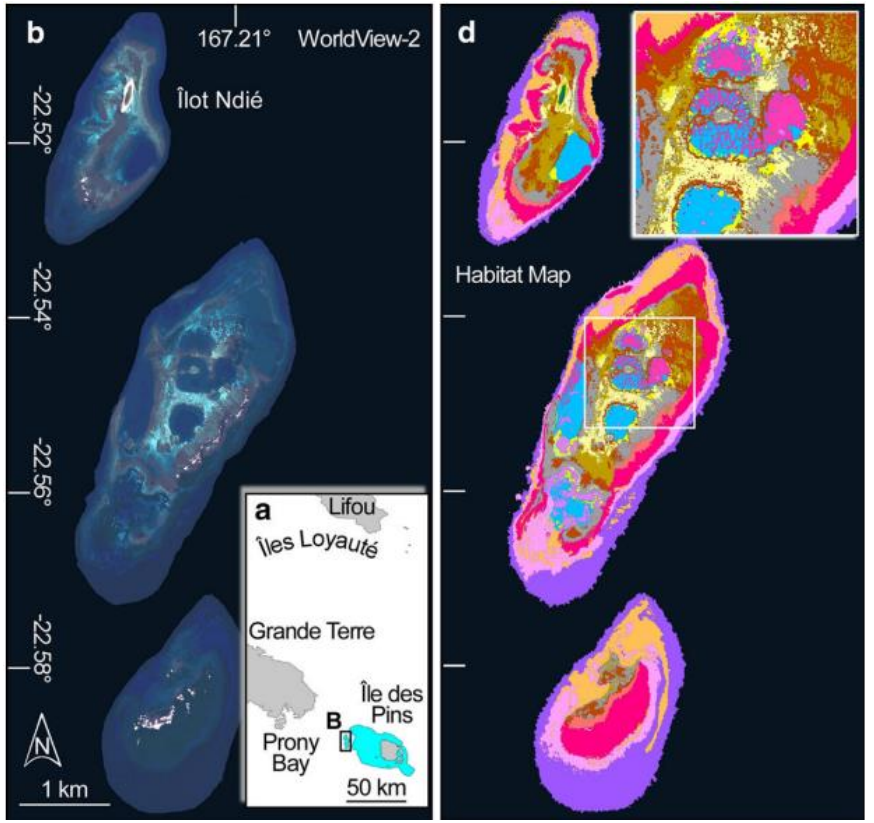
COLLEGE OF ARTS AND SCIENCES
PHYSICS

web3.physics.miami.edu/~agleason

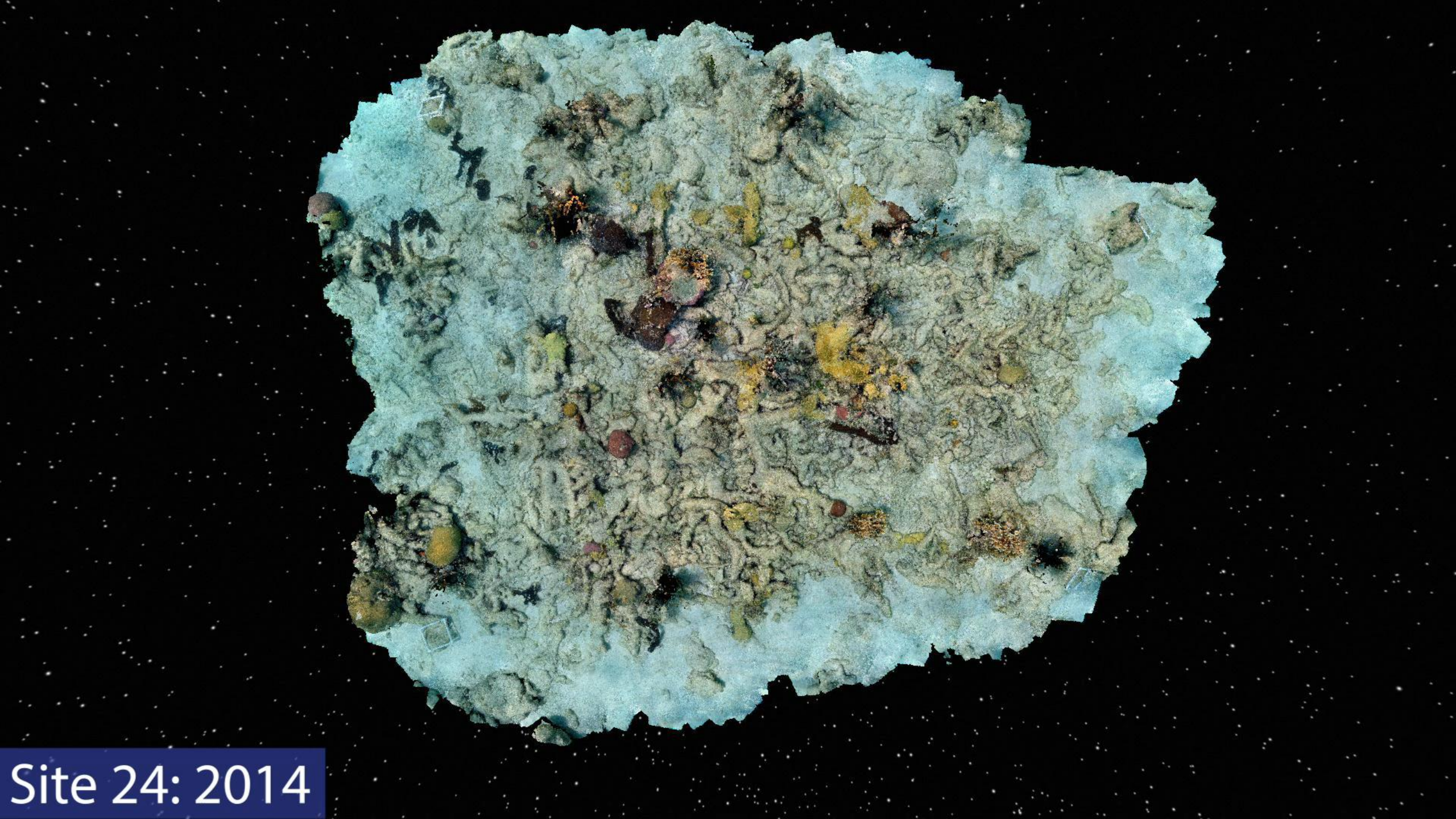
## Satellite image calibration

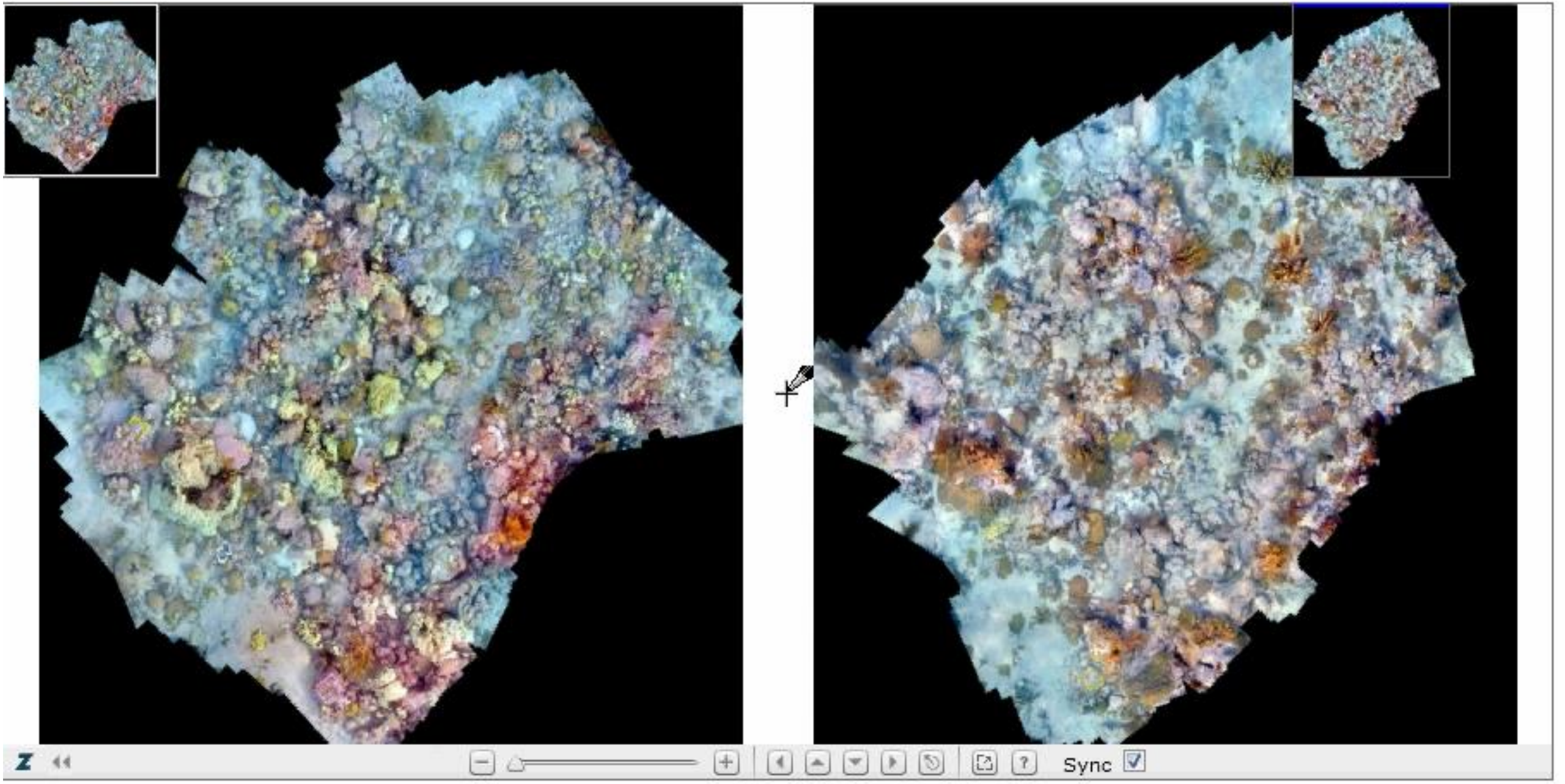


## Benthic habitat mapping




## Underwater photogrammetry


Site 24: 2014


Sync

- Online “reverse learning” class prepared by SIO, NOAA, UMiami instructors
- 14 recorded modules (~8 hours) + weekly “office hours” for open questions and discussion
- Previously offered spring 2022, summer 2023 with 76 participants from 13 countries
- Now: April – June 2024.


Getting Started
- Introduction Spring 2024
- Why are we here?
- Overview of the contributors

Getting Familiar with Large Area Imagery
- Widening our view of the reef
- How did we get here? Photogrammetry background
- Case studies in monitoring, research, restoration
- Image collection and Agisoft Metashape

Planning Your LAI Project
- Designing your survey
- Implementing your survey
- Equipment
- Computational Infrastructure

“Getting into the weeds” with LAI
- Evaluating model quality
- Lessons from the field
- Data management best practices
- Agisoft Metashape products and features

# Techniques in coral spawning collection and assisted fertilization

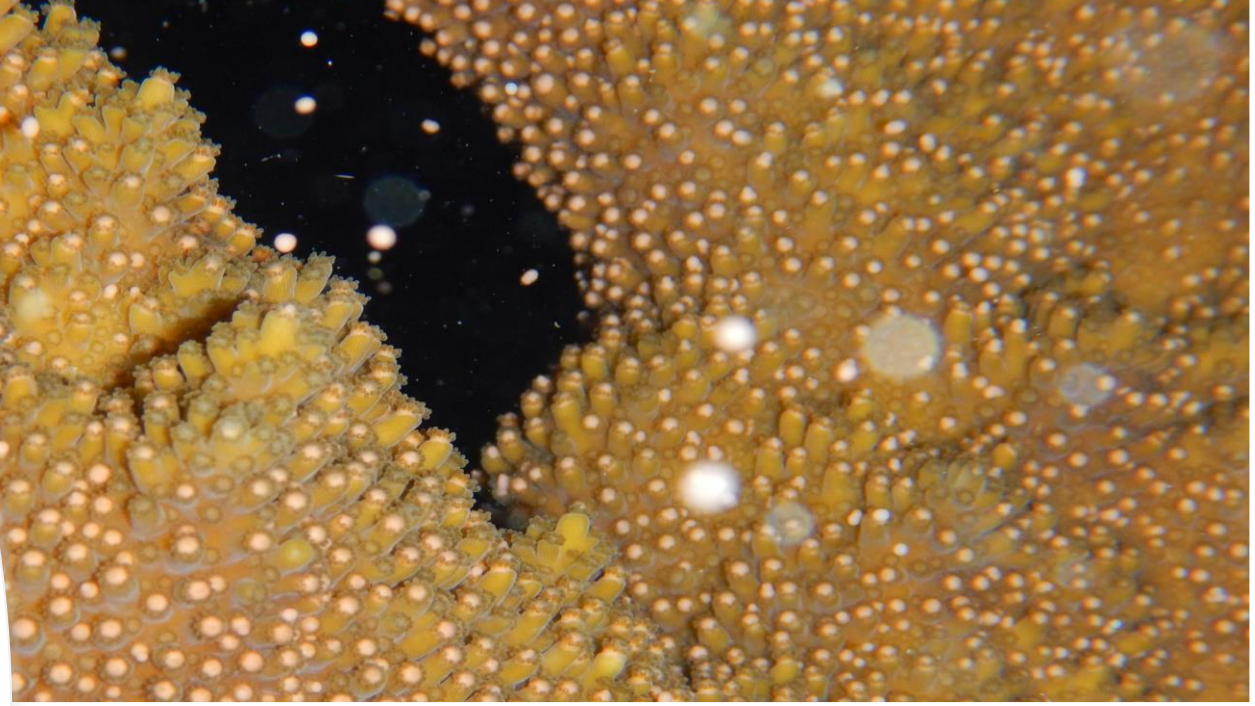
Dr. Anastazia Banaszak

Coralium team

Mexican SECORE team

# Components:

- Introduction to basics and methods of coral gamete collection and assisted fertilization (Virtual, 10 hours)
    - Coral life cycle and coral reproduction and methods in restoration
    - Predicting coral spawning
    - Preparation for field work, choosing sites for monitoring spawning
    - Making collecting nets
    - Spawning monitoring
    - Gamete collection
    - Assisted fertilization in the field and lab
- Advanced in-person training for those with facilities or capacity to culture embryos, settle larvae and culture coral settlers (in person, 4-7 days depending on species)



# Prerequisites

- Prior to start
  - Marine biology/science background or equivalent experience
  - Diving is not a prerequisite
  - Certified, medically cleared and insured diver (if planning to dive)
- Prior to virtual classes

Watch the Reef Resilience Network training course on Coral Reef Restoration (available in English and Español. https://reefresilience.org/coral-reef-restoration/ Self-paced – approx. 7 hours

Watch the following webinars: Coral Spawning Research and Larval Propagation Self-paced – approx. 2.5 hrs https://reefresilience.org/caribbean-coral-restoration-coral-spawning-research-larval-propagation/

Spawning of the grooved brain coral *Diploria labyrinthiformis* https://www.crc.world/webinars (scroll down to May 8, 2020) Self-paced – approx. 2.5 hrs

# Probable dates for spawning in Mexican Caribbean

Dlab: July 31-Aug 3

Apal: July 23-26, Aug 21-25

Apal, Ofav, Oann, Pstr: Aug 24-28

Oann, Pstr, Pcli: Sep 23-25

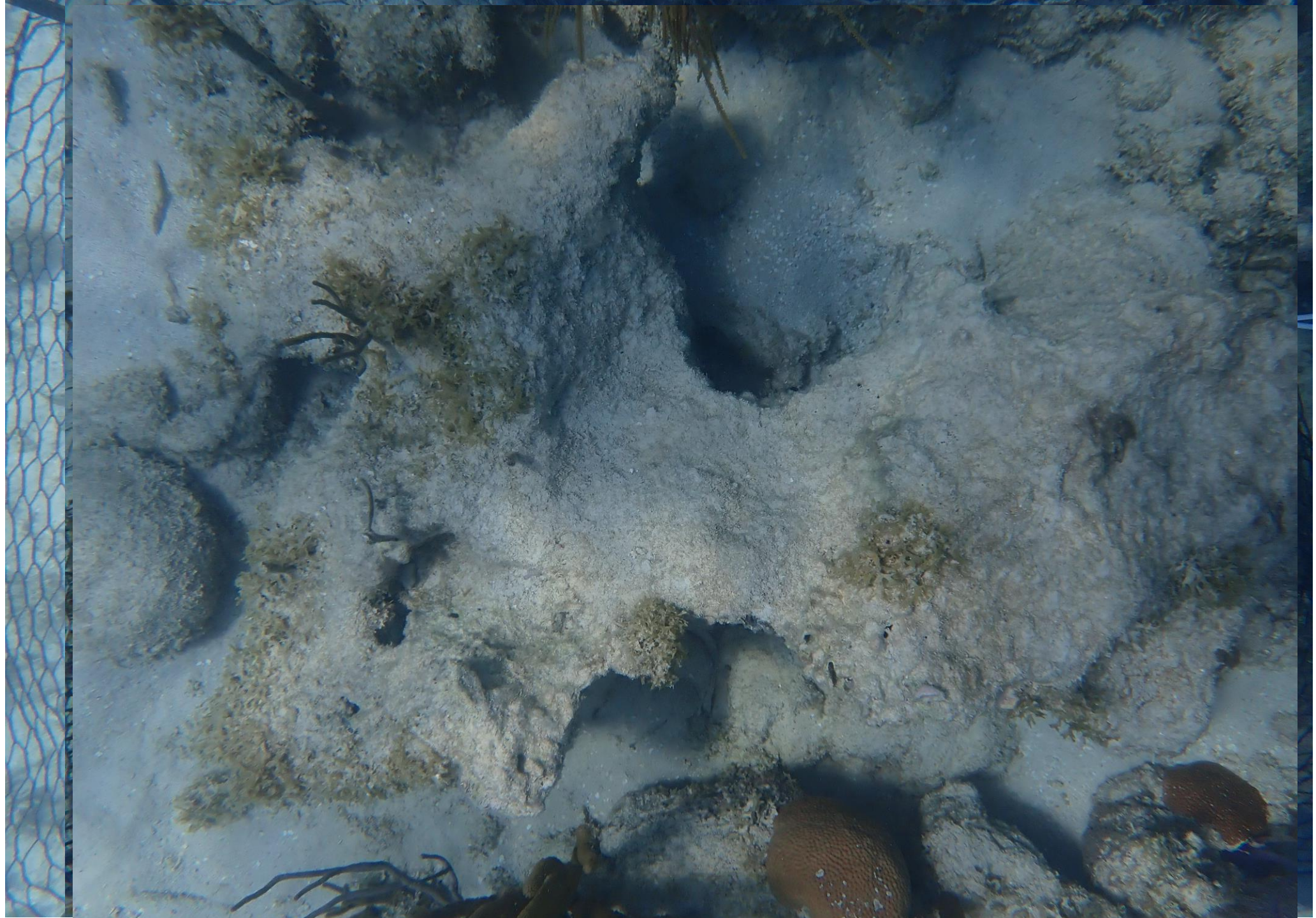
# Ecosystem-based coral restoration

**Stacey M. Williams**

**Institute for Socio-Ecological Research**

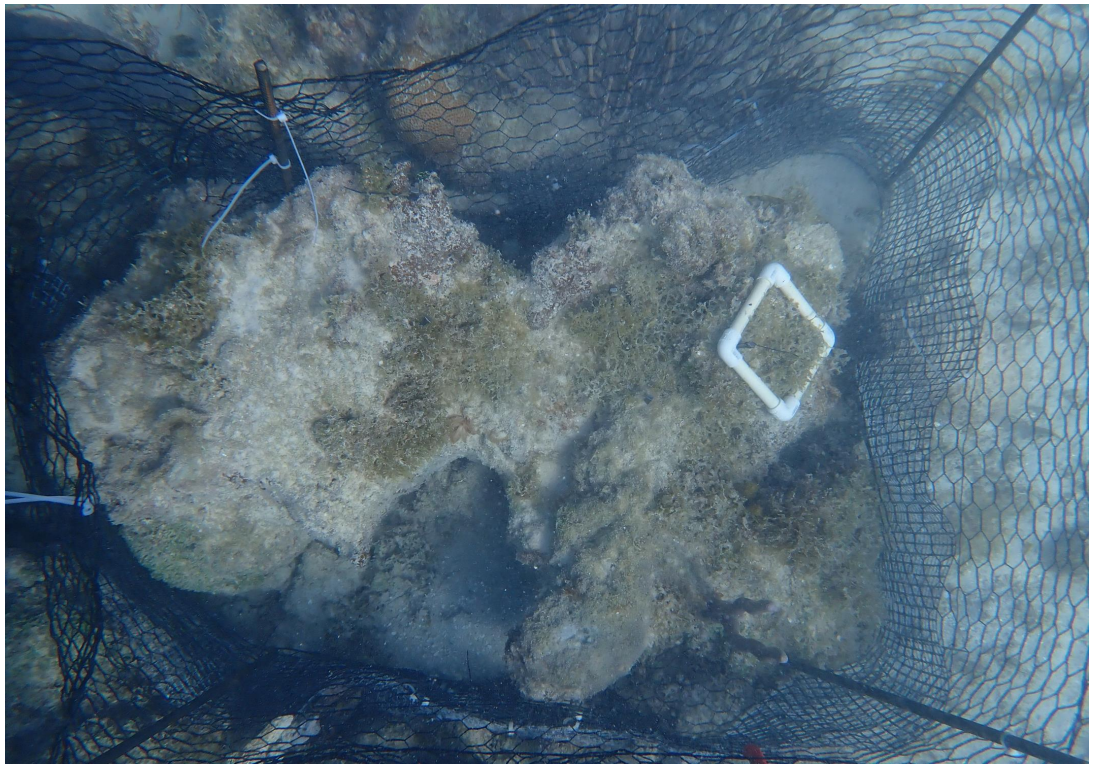
**www.isercaribe.org**

**Stacey.Williams@isercaribe.org**

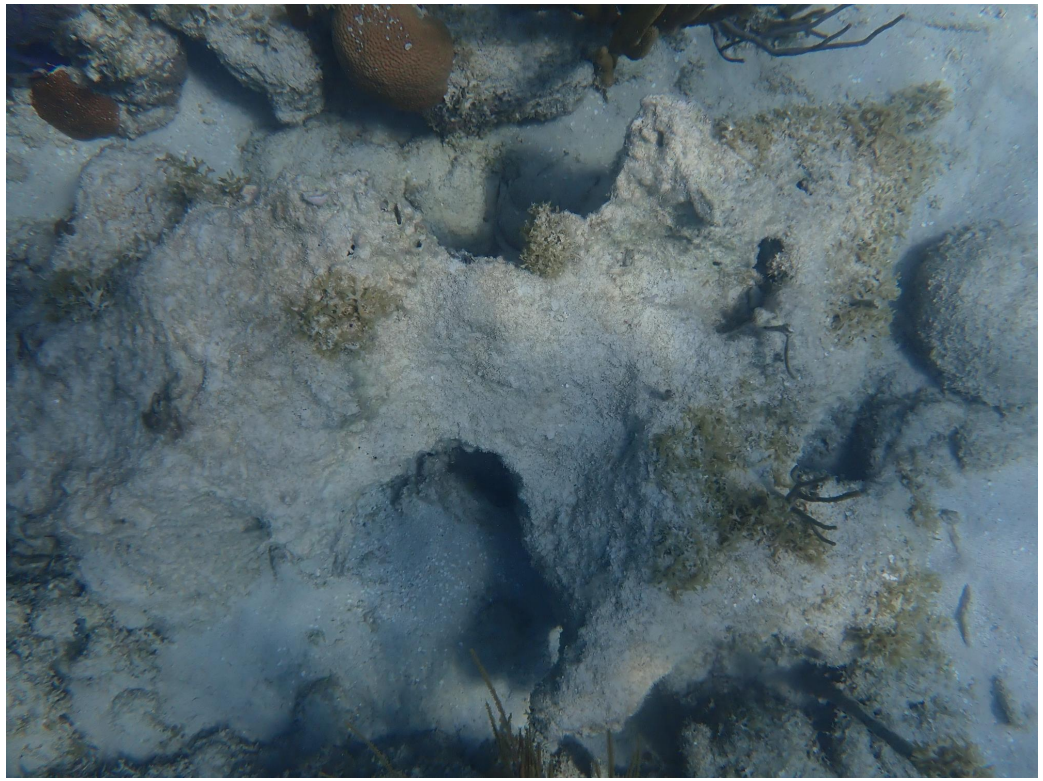


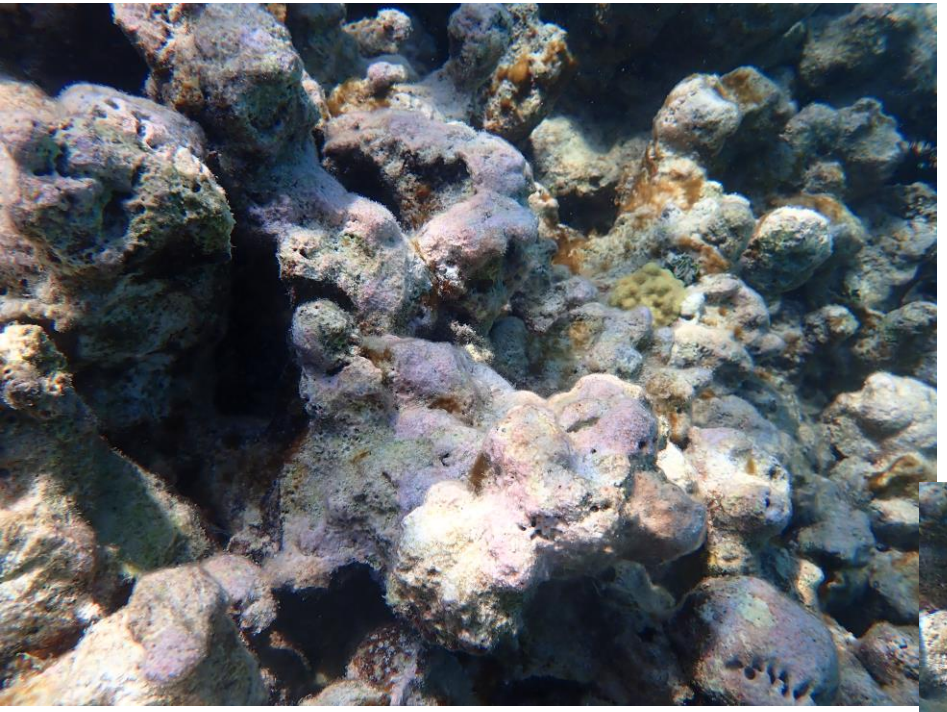
# *Diadema* restoration-Fajardo

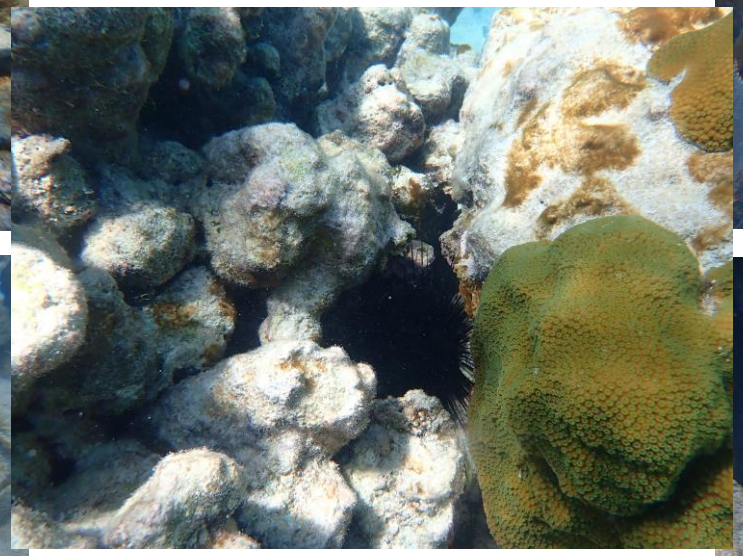
**2021**



**2024**







# Principles of ecosystem-based coral restoration

## Online course

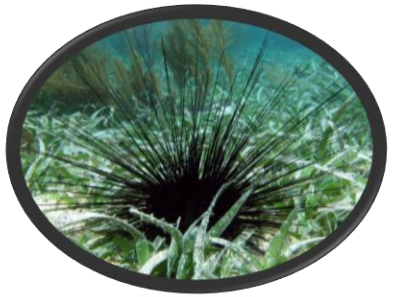
- Ecosystem-based restoration
- How to start ex-situ nursery
- Sea urchin restoration
- Coral microfragmentation

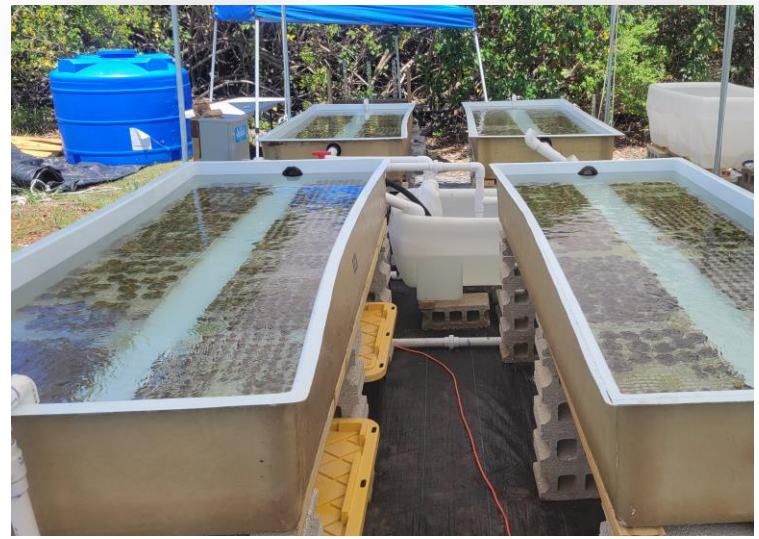
## On site week course

- Tour of CIROM La Parguera and Ceiba
- Ex- and in-situ coral nursery design
- Different approaches to producing herbivores
- Site visits to restoration and in situ nurseries

# CIROM

Centro de Investigación y Restauración de Organismos Marinos

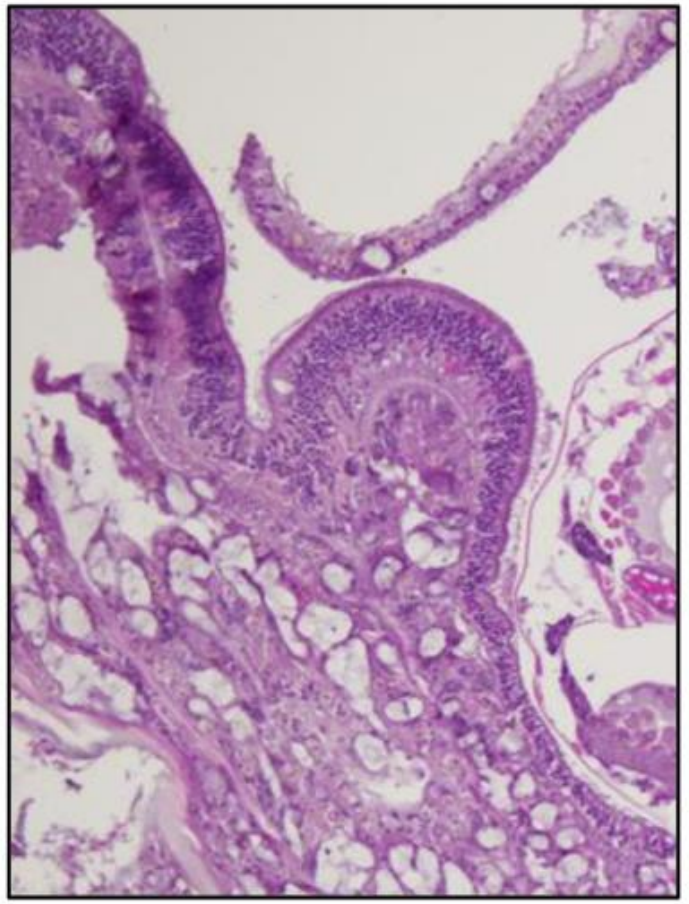


**Course name:**

**Diagnostic investigation of aquatic invertebrate diseases, with focus on corals**

**Course Instructor:**
Michelle Dennis, DVM, PhD, DACVP
Associate Professor, University Tennessee
College of Veterinary Medicine



**Coral disease & tissue sampling techniques**

**Course name:**
Diagnostic investigation of aquatic invertebrate diseases, with focus on corals

**Course information:**

- Steps in mortality event response
- Field investigation is integral to the diagnostic investigation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- How to sample and supply necessary information


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- How to sample and supply necessary information
- Pathological assessment paired with other diagnostic tests

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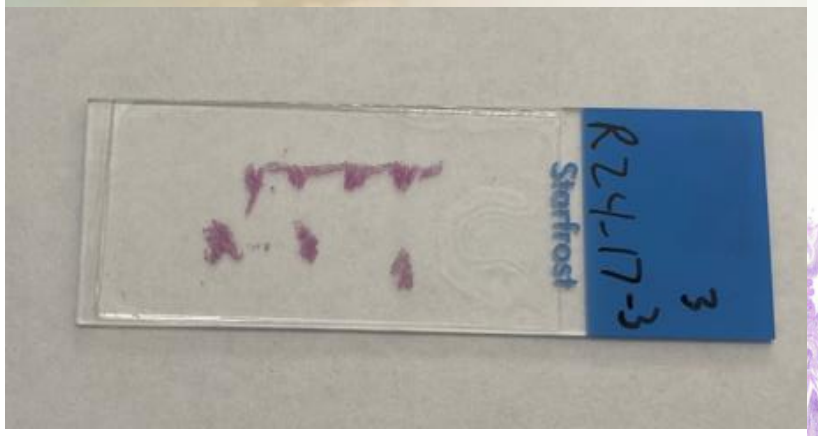
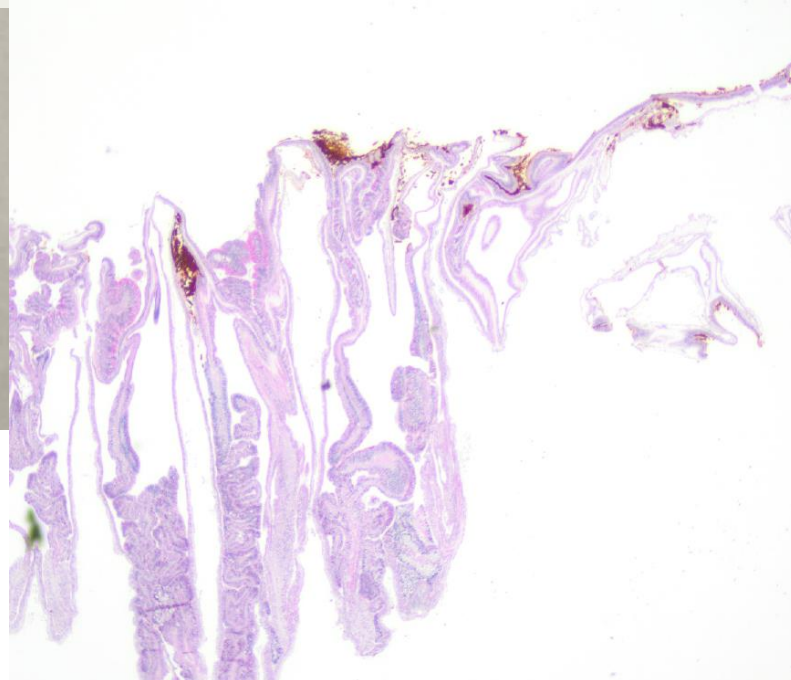
- Pathological assessment paired with other diagnostic tests
- How the lab makes sense of the samples provided



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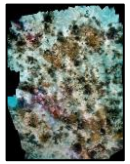
Diagnostic investigation of aquatic invertebrate diseases, with focus on corals

**Course information:**

- Steps in mortality event response
- Field investigation is integral to the diagnostic investigation
- How to sample and supply necessary information
- Pathological assessment paired with other diagnostic tests
- How the lab makes sense of the samples provided
- Disease is always an issue with “farmed” animals – mitigations require knowledge

# Coral Restoration Trainings - learn, act, and inspire

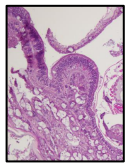

- **Coral reef monitoring – how to select and monitor reef sites & coral species**
  Dates: Online (May-July)
  Field Course (Summer)
  Instructors: Judy Lang, Patricia Kramer, Lynnette Roth (AGRRA), Alizee Zimmermann (TCRF)



- **Introduction to large-area imaging for coral reef science and monitoring**
  Dates: Online (April-July)
  Field assistance available
  Instructor: Art Gleason, University of Miami

- **Coral spawning & larval propagation techniques**
  Dates: Online (May-July)
  Field Course (Mexico: one-week openings in July-August-September)
  Instructor: Anastazia Banazsak, UNAM

- **Ecosystem-based restoration of corals & herbivores**
  Dates: Online (June-August)
  Field Course (Puerto Rico: July 29-August 3, 2024)
  Instructor: Stacey Williams, ISER



- **Coral disease & tissue sampling techniques**
  Dates: Online (Fall 2024)
  Field /lab assistance available
  Instructor: Michelle Dennis, University of Tennessee

- **Restoration Road Maps for your MPA**
  Dates: Online (TBD)
  Learning exchanges (TBD)
  Instructors: Restoration Roadmap Team

Online courses open. Space limited. Registration Required.
Learn more at Restoration Road Map Hub
For more information contact us at roadmaps@agrra.org

**Applications for field courses open soon. Prerequisites required. Space limited. Scholarships available.**


# Thank you to all our speakers and everyone for joining today!

## New Caribbean Coral Restoration Efforts

Caribbean Cooperation Team Network Meeting
April 8, 2024

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MPA connect

cordap Coral Research & Development Accelerator Platform

ORE Ocean Research & Education Foundation