Developing Coral Restoration Road Maps

Learning Exchange Meeting - An Overview

June 9-14, 2024

Key West, Florida

Patricia Kramer

On behalf of the Coral Restoration Roadmap Advisory Team

Ocean Research & Education Foundation/

Atlantic & Gulf Rapid Reef Assessment Program

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Website: www.agrra.org/restorationroadmaps/

The Rationale


Photo: Huggins


Photo: M. Figueroa

Challenges

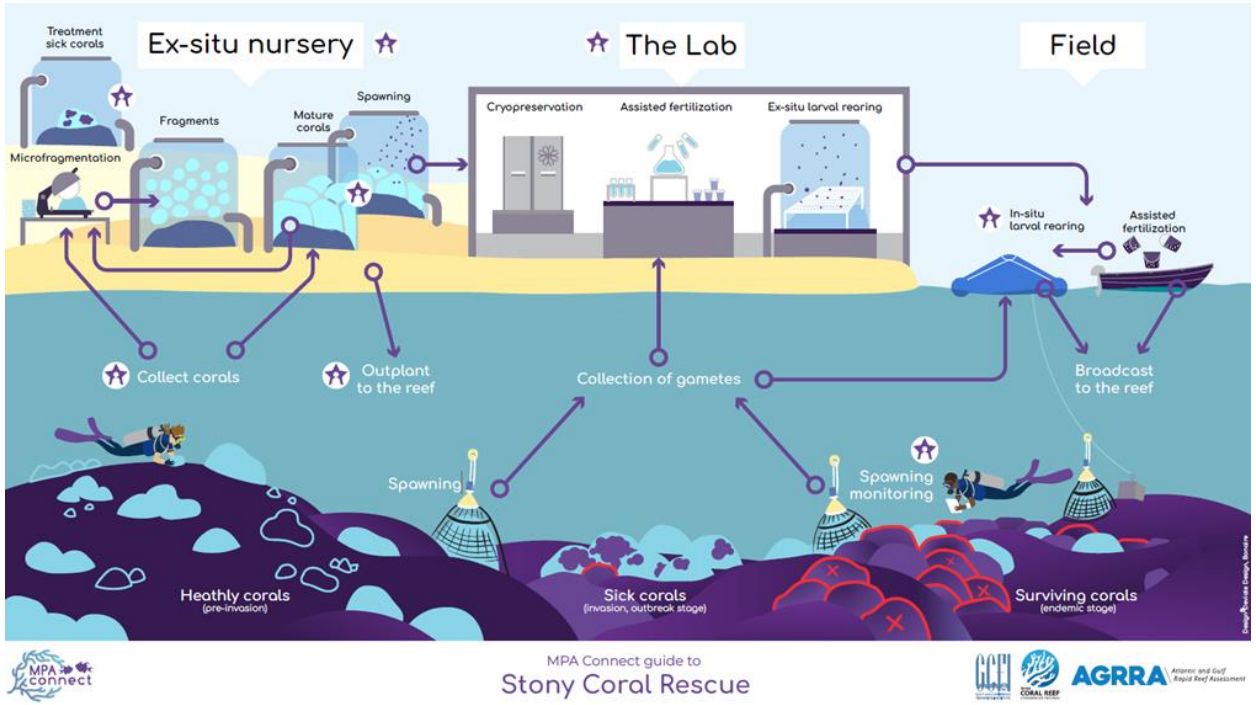
1. How to begin to rescue and recover corals after devasting impacts, especially those…

- 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.

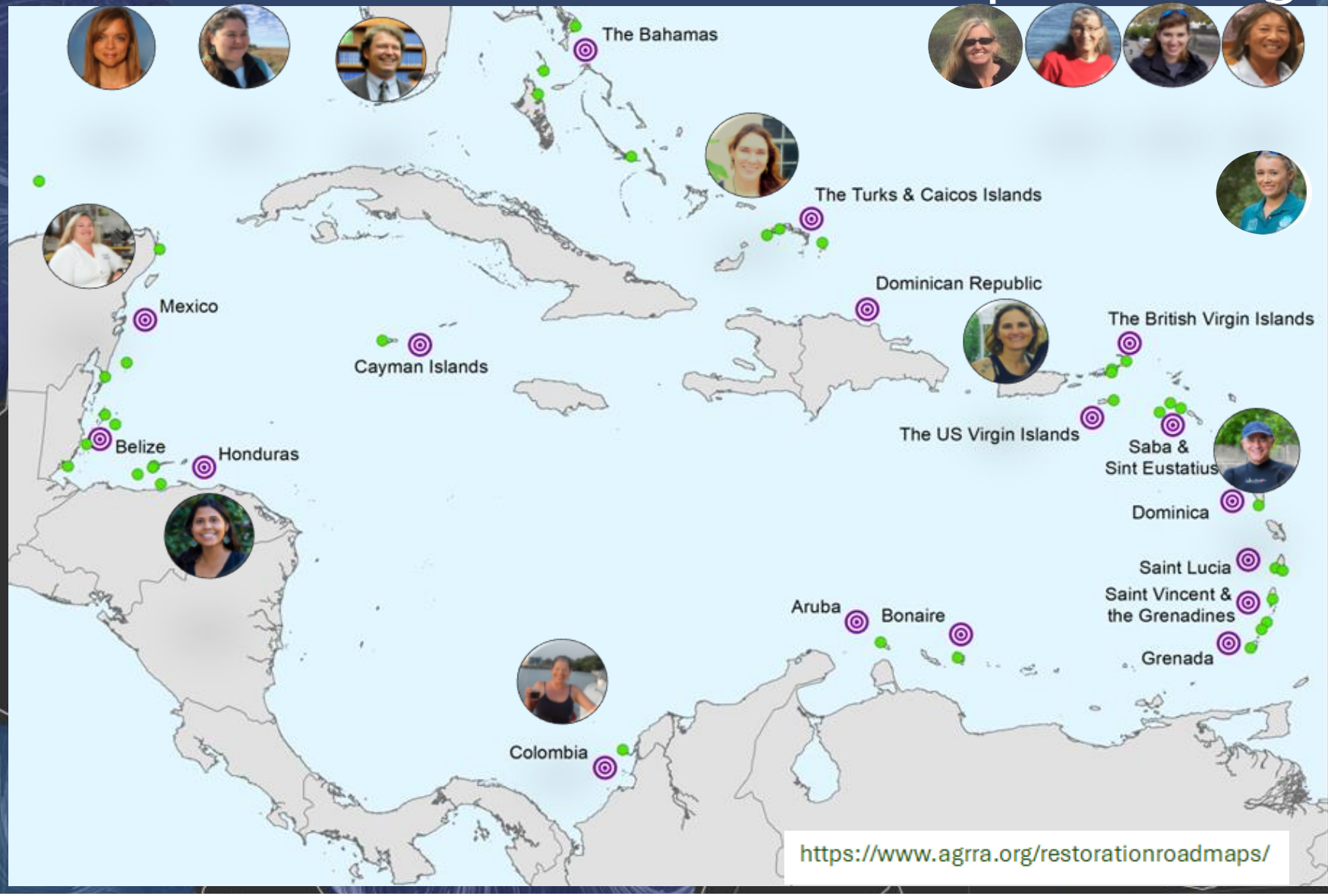
Planning for Coral Rescue as a Response to SCTLD in the Caribbean

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



MPA Connect guide to
Stony Coral Rescue

Coral Restoration Road Map Planning



Live Visual Map see:
earth.nullschool.net

Coral Restoration Road Map Planning

Objectives

- Increase coral populations and improve reef ecosystem function
- Develop science-based and management-relevant Restoration Roadmaps with MPAS
- Share and increase coral recovery technical expertise
- Synergize and catalyze restoration efforts within Caribbean MPAs to increase recovery potential regionally

Website: www.agrra.org/restorationroadmaps/

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earth.nullschool.net

Restoration Roadmaps

Opportunities

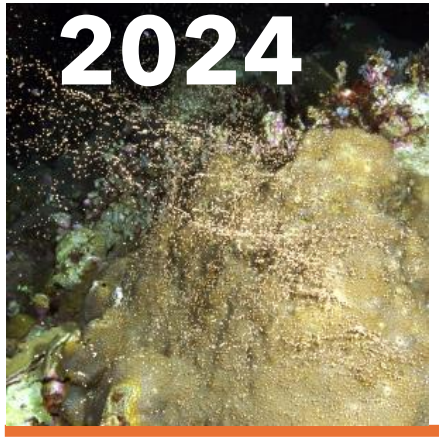
- **Learning exchanges: Be a mentor, meet a mentor**
- **Technical trainings: Online and field courses**
- **Coral rescue planning: Develop action plans, share expertise**
- **Recovery potential: Locally focused, regionally important**
- **Small grants program: Planning and implementation**

Live Visual Map see:
earth.nullschool.net

Website: www.agrra.org/restorationroadmaps/

cordap Coral Research & Development Accelerator Platform

Timeline & Milestones



Year 1

Identify Restoration Goals, Sites, & Techniques in the Caribbean

Develop Road Maps

Technical Trainings

Year 2

Implement restoration at Legacy sites

Communicate, educate, and guide

Year 3

Continue restoration at Legacy sites

Evaluate restoration progress

Examine options for scaling up regional recovery

Continue to communicate, educate and guide

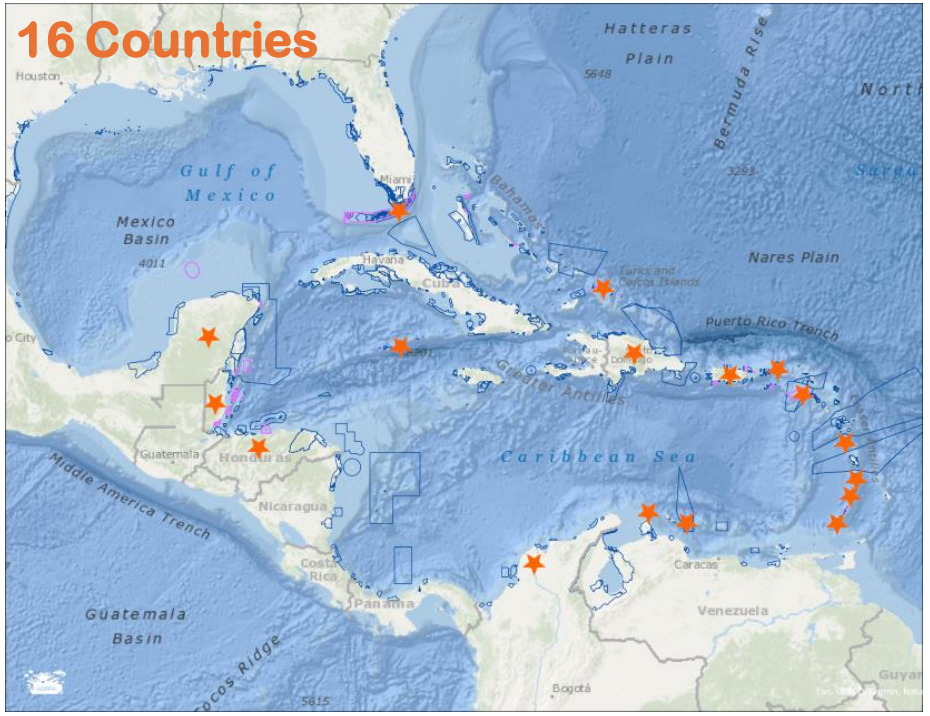
Evaluation

Examine options for scaling up regional recovery

Communicate, educate and guide

Examine next steps

Coral Restoration Learning Exchange (June 2024)

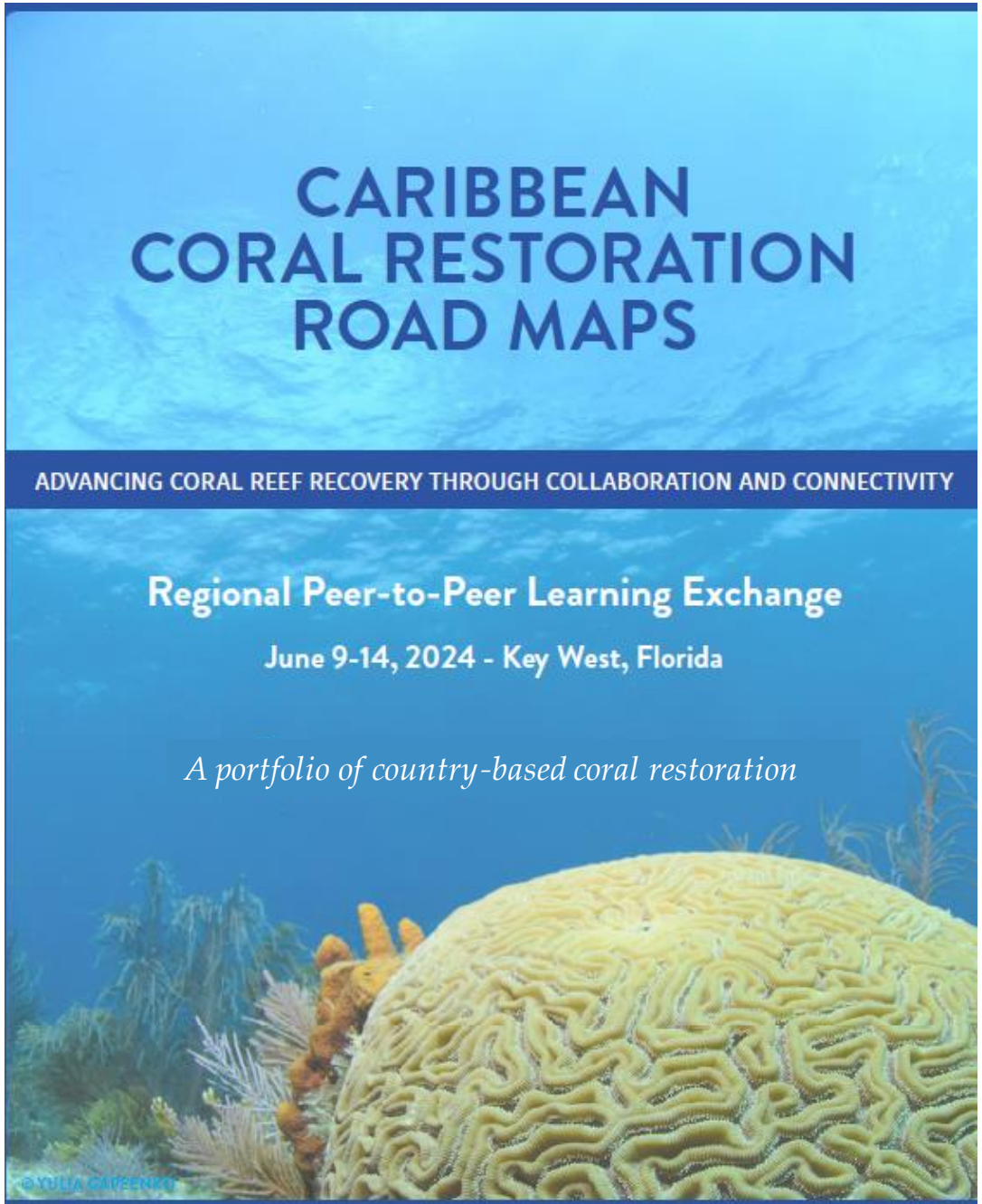


Countries

Aruba
Belize
Bonaire
British Virgin Islands
Cayman
Dominica
Grenada
Honduras
Mexico
Saba
Saint Lucia
St Vincent & The Grenadines
Turks and Caicos Islands
Dominican Republic
Colombia
US (FL, Puerto Rico)

The Caribbean Restoration Road Map Initiative is a new 3-year partnership between the Atlantic and Gulf Rapid Reef Assessment Program (AGRRA), MPAConnect, coral restoration experts, and resource managers to expand coral rescue and restoration in the Caribbean, made possible with support from CORDAP.

As a first step, 30 marine resource managers and restoration practitioners from 16 Caribbean countries came together to begin to develop site-specific, science-based and management-relevant action plans. The planning framework included identifying measurable restoration goals and objectives, prioritizing and selecting restoration sites, learning about restoration approaches relevant for their goals, sharing lessons learned about various restoration approaches, and examining feasibility, opportunities and challenges of integrating and implementing restoration with overall management responsibilities.



CARRIBEAN CORAL RESTORATION ROAD MAPS

SPONSORS:

PARTICIPANTS:

See Portfolio at: https://myflipbook.net/view/TVlGMzE4MDc2MTA/Caribbean-Coral-Restoration-Road-Maps--2024.htm

Developing Caribbean Coral Restoration Road Maps Learning Exchange

June 9-14, 2024

Key West, Florida

Goal: Together begin to develop Coral Restoration Road Maps to guide coral restoration in the Caribbean and the MPAConnect Network.

Objectives:

- Learn about coral rescue and restoration techniques and planning strategies
- Begin to develop coral restoration road maps for high priority coral reefs, marine protected areas and Caribbean vision
- Share lessons learned with restoration experts, resource managers, and the MPAConnect Network
- Develop strategies and next steps for restoration technical trainings, planning, and implementation
- Increase collaboration to catalyze recovery efforts in the region

Developing Coral Restoration Road Maps

June 9-14, 2024

Agenda

Day 1 Restoration Techniques & Road Map Planning (Step 1)

Day 2 Coral Rescue Café -Restoration Techniques & Road map planning (Steps 2 & 3)

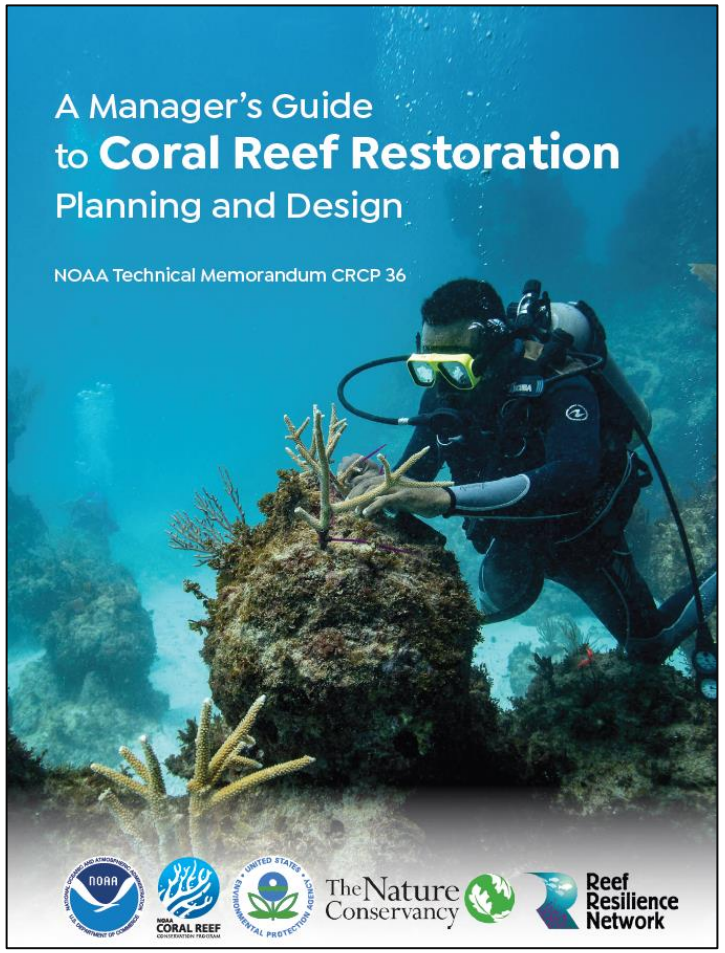
Day 3 Develop Restoration Action Plan (Step 4) & Field Trip to Mote Marine Lab

Day 4 Integrating Restoration & Management
Country Road Map Presentations
Regional Collaboration

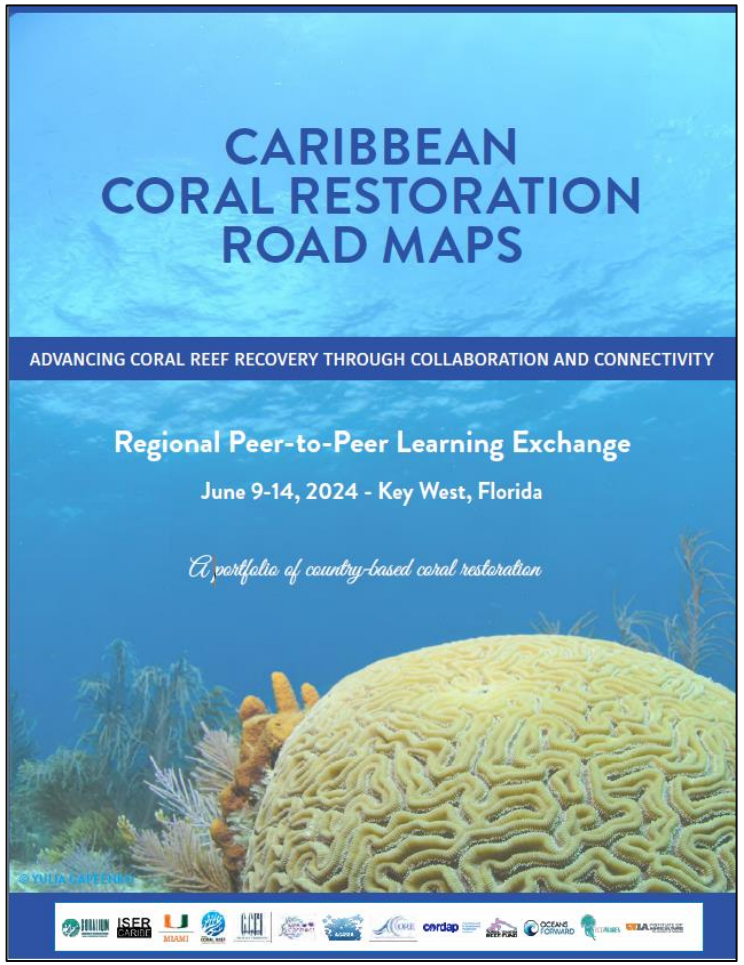
Coral Restoration Planning

Edwards et al 2010

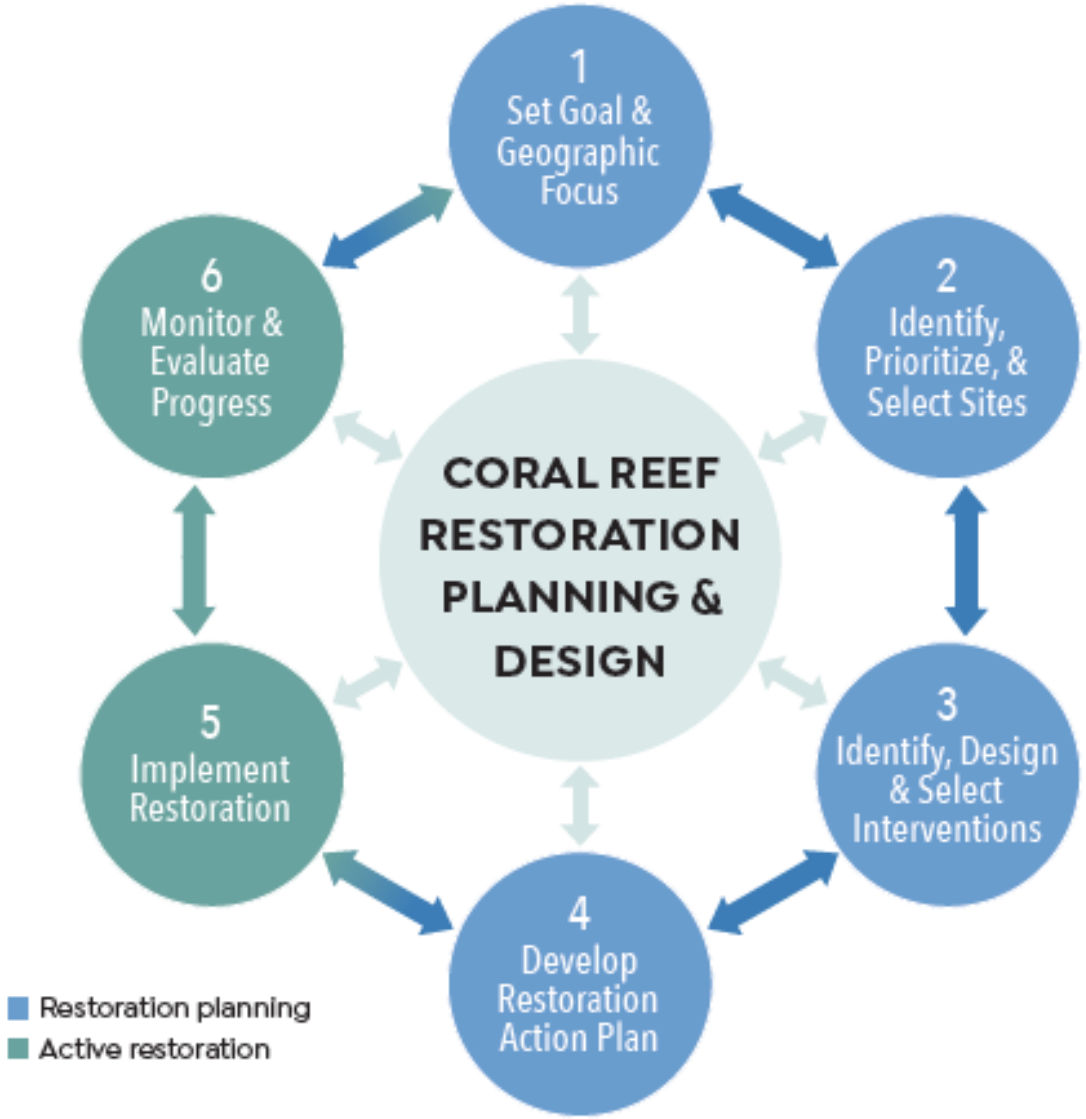
Shaver et al 2020



Living Document....



Restoration Plan Components



Steps:

1. Set goal & geographic focus
2. Identify, prioritize & select sites & corals
3. Identify, design & select interventions
4. Develop draft restoration action plan

Shaver et al 2020

Planning considerations

Why rescue, rebuild, restore?

- Ecological Goals
- Socio-Economic Goals
- Disturbance-Driven Goals
- Climate Change Adaptation Goals

Goergen et al 2020

Develop SMART Goals

Table 1.1. Attributes of SMART Goals and Objectives. Adapted from the *Open Standards for the Practice of Conservation* (CMP 2020). Examples are illustrative and not intended to be comprehensive.

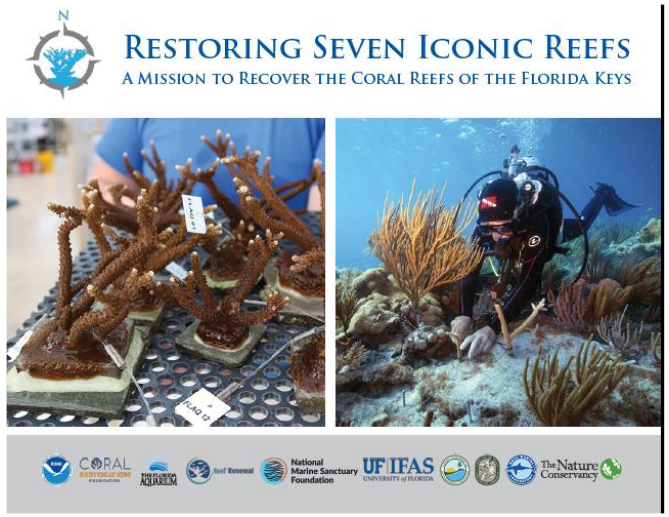
Attribute	Description (from CMP 2020)	Examples
Specific	Clearly defined so that all people involved in the project have the same understanding of what the terms in the goal or objective mean	Identifies the restoration site, species or techniques to be used in the restoration intervention, or biophysical conditions
Measurable	Definable in relation to some standard scale (numbers, percentages, fractions, or all/nothing states)	Identifies the area to be restored (e.g., square m or km area), number of corals outplanted or percent survival compared to a baseline, or amount of reef crest accretion
Achievable	Practical and appropriate within the context of the project site and in light of the political, social, and financial context (especially relevant to objectives; goals may be more aspirational)	Considers numbers of corals or measurable outcomes that are feasible within the project scope, considers local and climate threats (e.g., land-based pollution, sea level rise) to restoration activities
Relevant	Ensures the significance of the outcome within regional or local management context	Coral species selected is particularly resilient, endangered, or ecologically critical
Timebound	Achievable within a specific period of time, generally 10–20 years for a goal and 1–10 years for an objective	Identifies deadlines considering biological and ecological parameters (e.g., year achieved)

Box 1.2. Developing a SMART restoration goal.

Shaver et al 2020

Restoration Road Maps – where to begin?

Example

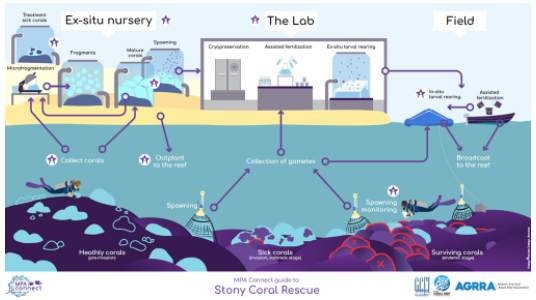


Reef status & Selecting Priority Sites

Table 2. Ranking of criteria important to selecting a restoration site by 18 re

What criteria are most important for reef restoration?	A	B	C	D	E	F	G	H	I	J
Ecological Services: Shoreline protection	3	2	1	3	3	3	1	3	2	3
Ecological Services: Fisheries habitat	2	3	2	3	3	2	3	3	1	3
Ecological Services: Tourism value (both aesthetics and stewardship potential)	2	3	3	3	2	2	3	2	3	2
Ecological Services: Ecological diversity	3	2	3	2	3	2	3	3	3	3
Likelihood of success	3	?	3	3	3	?	3	3	3	3
Biodiversity and habitat (what can be built, not necessarily what is already there)	3	3	3	3	3	3	3	3	3	3
Sustainability/connectivity	3	3	3	3	3	3	3	2	3	3
Sufficient size	2	2	2	2	2	2	2	1	2	3
Allowable/compatible uses (at time of restoration)	2	2	2	2	1	?	2	2	2	1
Suitability as reference areas/monitoring sites	1	2	2	2	2	1	1	1	2	2
Facilitation of enforcement and compliance	1	1	3	1	1	1	1	1	2	2
Adjacent habitats appropriate for restoration	2	2	2	1	1	2	2	2	1	2
Genetic health/complexity	3	1	3	2	3	3	3	3	3	2
Ability to manage uses within restoration area (closures, removal of buoys etc.)	2	2	3	2	2	2	2	1	3	1
Interest of community or other partners with resources	2	3	3	2	2	2	2	1	3	1
Geographic separation	1	3	2	1	2	1	2	2	2	1
Adequate information about habitat across the entire reef area	1	1	2	2		?	1	1	2	1

Techniques and trainings



Planning & Cost Analysis

Table 1. Summary cost per unit for each budget category.

Site Prep (Day)	$3,527
Cost p/Coral	$259
Monitoring (Day)	$4,652
Maintenance (Day)	$2,502
Grazers	$36
Adaptive Mgt (% of subtotal)	10%

Setting Targets & Timelines

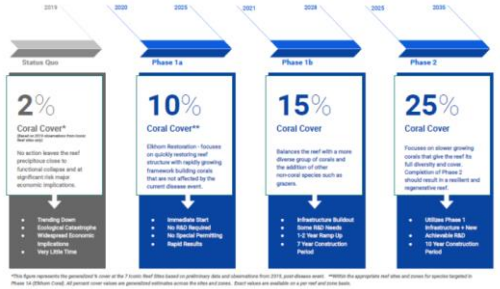
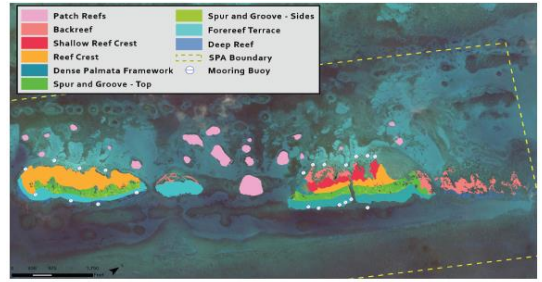


Figure 4. Depiction of the phased approach to meeting the overall targets at a reef site.

Final Roadmap

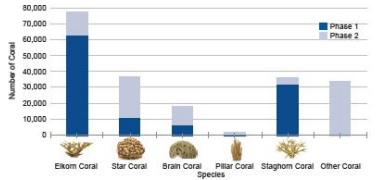


The map of Carysfort Reef (above) depicts the reef habitat zones to be restored through Mission: Iconic Reefs. The map also depicts portions of the SPA boundary and locations of mooring buoys.

The table (top right) depicts the area to be restored, numbers of corals to be outplanted, and target total percent coral cover for Carysfort Reef by Reef Zone and Phase.

The graph (bottom right) depicts the number of corals to be outplanted to Carysfort Reef by species and phase. There is an emphasis on outplating elkhorn and staghorn corals in Phase 1 with more emphasis on the star, brain, and other corals in Phase 2. Carysfort will also receive outplants of pillar coral.

Zone	Area to be restored (m2)	*Phase 1* Corals to be planted	*Phase 2* Corals to be planted	Total coral cover (%)
Shallow Reef Crest	5,185	1,255	1,221	11.00
Reef Crest	44,979	54,422	32,264	33.50
Spur and Groove - Top	32,534	34,566	27,835	19.75
Spur and Groove - Sides	6,467	795	3,382	2.00
Forereef Terrace	12,762	6,734	8,754	14.50
Deep Reef	4,258	2,809	1,988	16.50
Back Reef	6,107	4,736	5,851	20.00
Dense Palmata Framework	519	251	0	10.00
Patch Reefs	13,078	6,661	11,732	10.50
TOTAL	125,890	112,228	93,026	



Coral Restoration Cafe

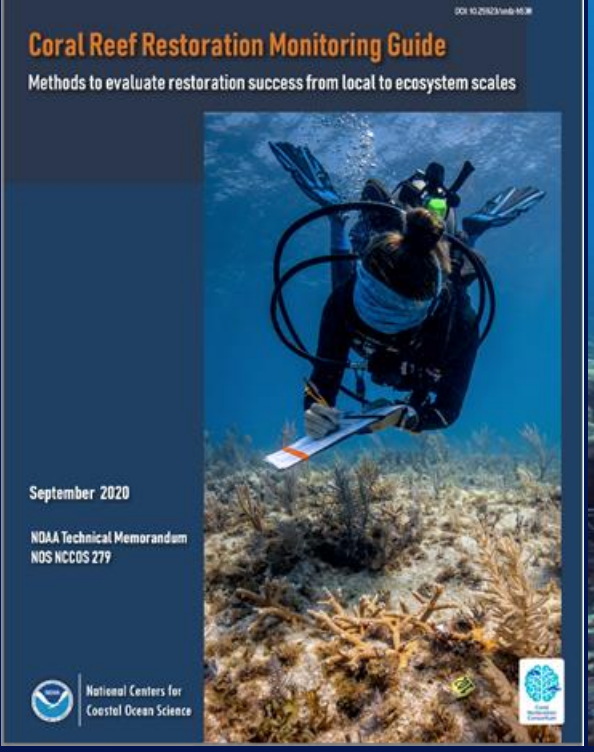
Table 1: Guiding coral rescue with monitoring data
Judy Lang, Lynnette Roth

Table 2: Large-area imaging of coral reefs for restoration
Art Gleason

Table 3: Sexual coral reproduction
Rita Sellares, Elvira Alvarado

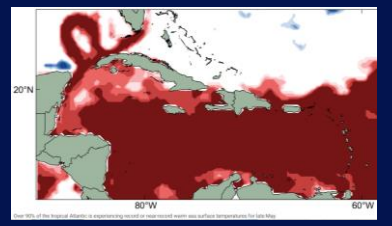
Table 4: Asexual coral propagation and herbivore propagation
Stacey Williams, Simon Walsh

Table 5: Fundamentals of invertebrate disease investigations & Managing Closed land-based systems
Michelle Dennis & Alizee Zimmermann



Status of Caribbean Coral Reefs &

Guiding Coral Rescue with Monitoring Data



Judy (Judith C.) Lang
jlang@riposi.net

AGRRA

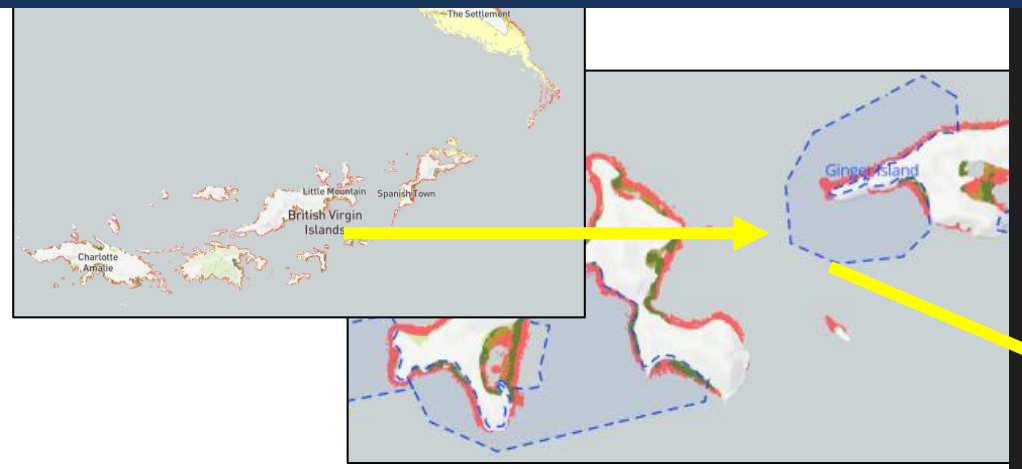
Atlantic and Gulf Rapid Reef Assessment

ORE
Ocean Research and Education Foundation

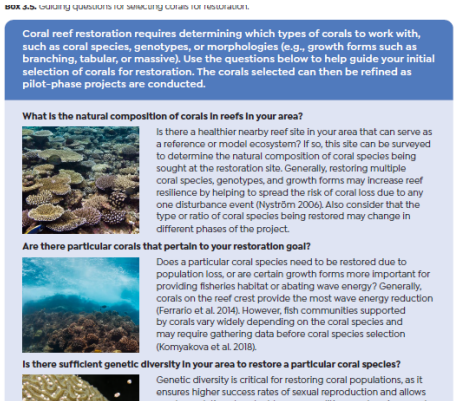
Identifying sites & corals species

Guiding criteria:

1. **Management is in effect**
2. **Reef value is high**
3. **Data are or can become available**
4. **Establish a monitoring program (e.g., BACI)**
5. **Have control, intervention and reference sites & adapt**



Which corals?



Coral reef restoration requires determining which types of corals to work with, such as coral species, genotypes, or morphologies (e.g., growth forms such as branching, tabular, or massive). Use the questions below to help guide your initial selection of corals for restoration. The corals selected can then be refined as pilot-phase projects are conducted.

What is the natural composition of corals in reefs in your area?

Is there a healthier nearby reef site in your area that can serve as a reference or model ecosystem? If so, this site can be surveyed to determine the natural composition of coral species being sought at the restoration site. Generally, restoring multiple coral species, genotypes, and growth forms may increase reef resilience by helping to spread the risk of coral loss due to any one disturbance event (Nyström 2006). Also consider that the type or ratio of coral species being restored may change in different phases of the project.

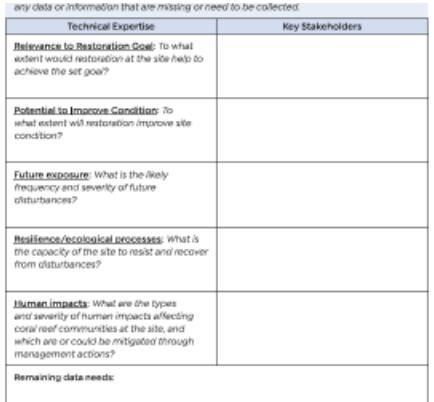
Are there particular corals that pertain to your restoration goal?

Does a particular coral species need to be restored due to population loss, or are certain growth forms more important for providing fisheries habitat or abating wave energy? Generally, corals on the reef crest provide the most wave energy reduction (Ferrario et al. 2014). However, fish communities supported by corals vary widely depending on the coral species and may require gathering data before coral species selection (Komyakova et al. 2018).

Is there sufficient genetic diversity in your area to restore a particular coral species?

Genetic diversity is critical for restoring coral populations, as it ensures higher success rates of sexual reproduction and allows

Which sites?



any data or information that are missing or need to be collected.

Technical Expertise	Key Stakeholders
Relevance to Restoration Goal: To what extent would restoration at the site help to achieve the set goal?	
Potential to Improve Condition: To what extent will restoration improve site condition?	
Future exposure: What is the likely frequency and severity of future disturbances?	
Resilience/ecological processes: What is the capacity of the site to resist and recover from disturbances?	
Human impacts: What are the types and severity of human impacts affecting coral reef communities at the site, and which are or could be mitigated through management actions?	
Remaining data needs:	

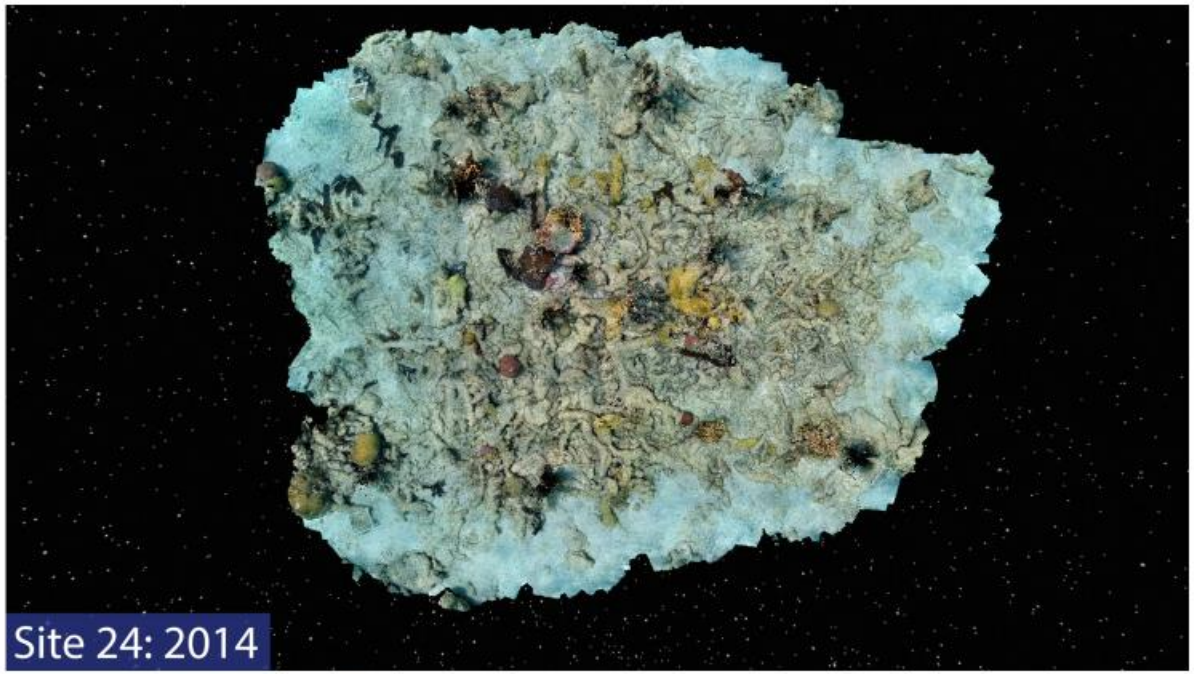
Rank Sites w/ criteria

Reef Name	Priority Level FINAL	Average	Relevance to Goal	Potential to Improve Condition	Short and long-term Survivorship [Climate vulnerability]		
					Future Exposure	Resilience	Human Impacts
Geranium Reef	HIGH	4.52	4.92	4.92	4.92	4.92	2.92
Tulip Reef	HIGH	3.73	3.84	4.97	4.93	1.93	2.97
Lily Reef	HIGH	3.71	3.97	3.88	3.88	4.88	1.92
Periwinkle Reef	HIGH	3.71	2.91	3.91	3.91	3.91	3.91
Rose Reef	HIGH	3.35	1.95	3.95	3.95	1.95	4.95
Orchid Reef	MEDIUM	3.33	3.93	3.93	2.93	3.93	1.93
Petunia Reef	MEDIUM	2.27	1.87	1.87	1.87	2.87	2.87
Azalea Reef	MEDIUM	2.10	3.90	1.90	1.90	1.90	0.90
Chrysanthemum Reef	LOW	3.76	0.96	4.96	4.96	2.96	4.96
Lavender Reef	LOW	3.58	3.98	3.98	4.98	0.98	3.98
Hydrangea Reef	LOW	2.43	4.83	0.83	0.83	2.83	2.83
Daisy Reef	LOW	2.29	2.89	0.89	0.89	4.89	1.89
Marigold Reef	LOW	2.11	1.91	0.91	0.91	3.91	2.91
Buttercup Reef	LOW	1.70	0.97	0.96	0.84	3.89	1.84

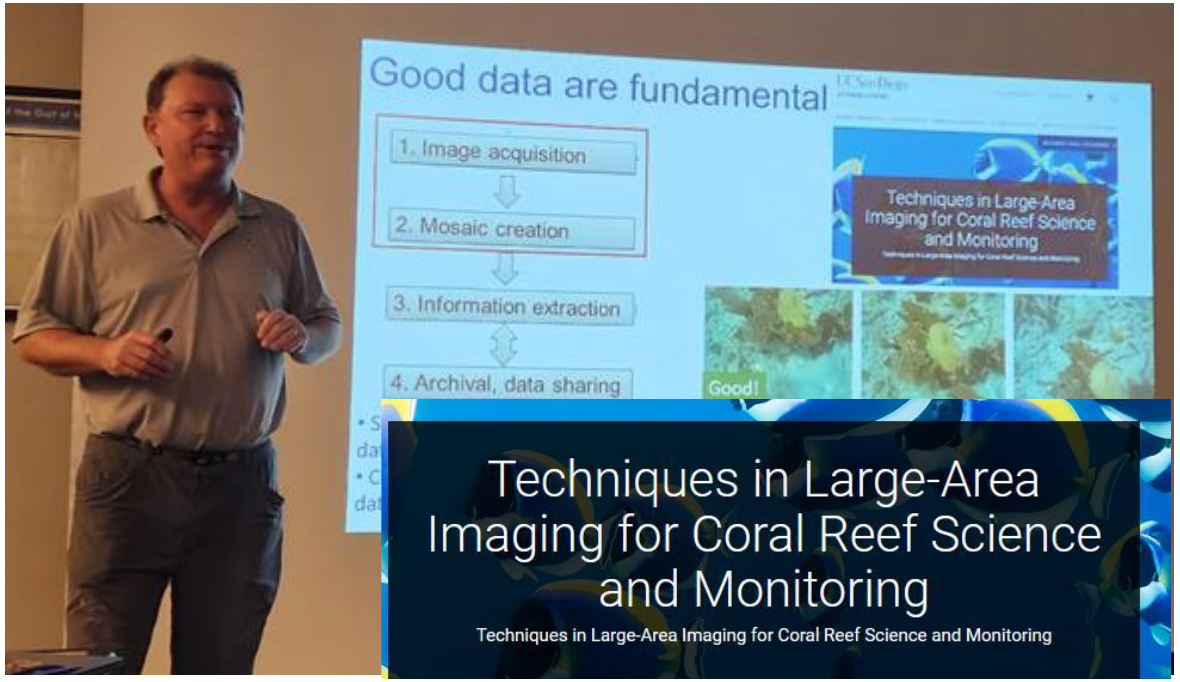
Shaver et al 2020

Large-area imaging of coral reefs for monitoring and restoration

Art Gleason



Model from Lisa Carne, Fragments of Hope



Caribbean Coral Restoration Roadmaps Initiative at Florida Keys Eco-Discovery Center in Key West, Florida

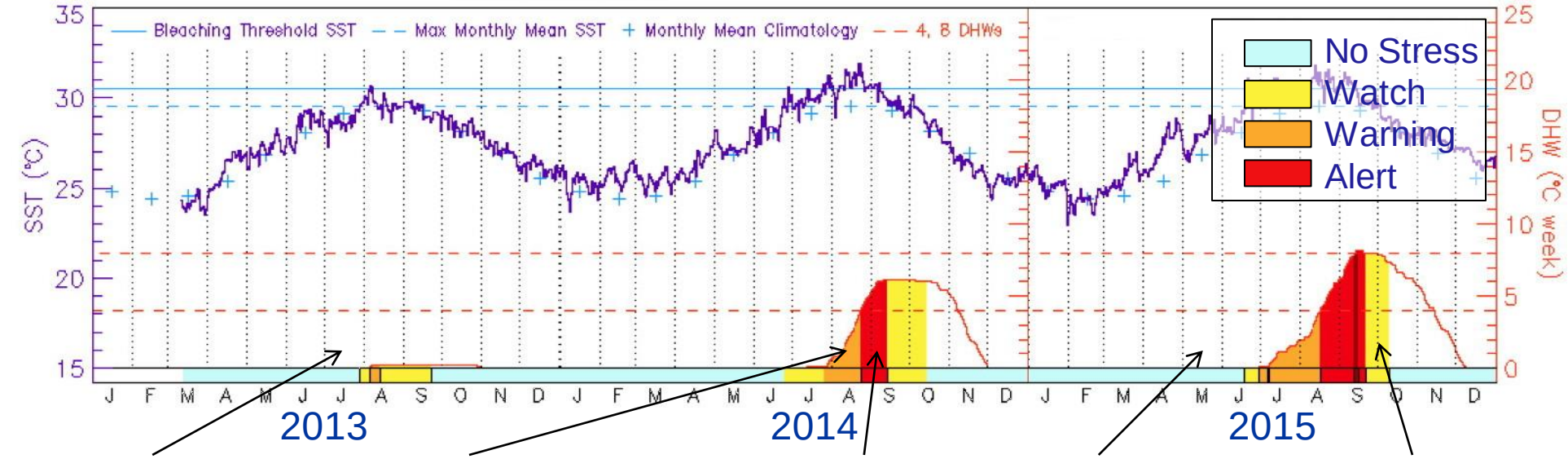
June 9th – 14th, 2024

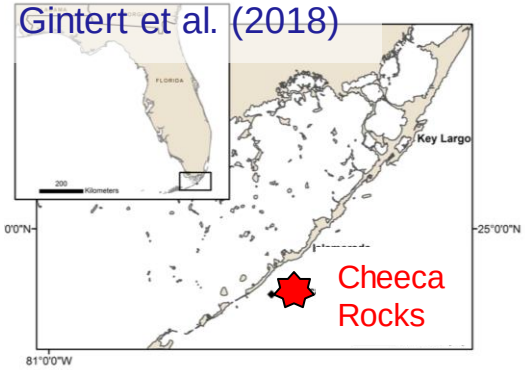
AGRRA

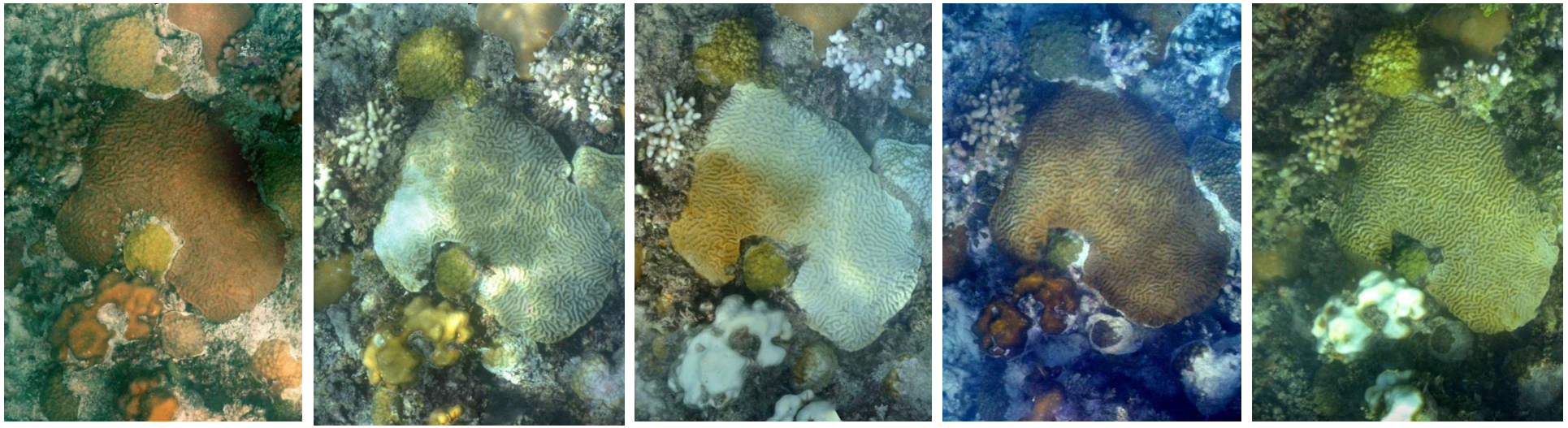
cordap Coral Research & Development Accelerator Platform

MPA connect

UNIVERSITY OF MIAMI







- "Virtual tagging" with mosaics permits fate tracking: **4,234 colonies over 6 years**
- Repeat visits = higher power to detect change than random transects
- Also allows you to take past history into account when looking at coral dynamics
- **Corals at Cheeca Rocks seem to have become more resistant following multiple successive bleaching events**

Coral restoration using sexual recruits: state of knowledge, best practices, current techniques

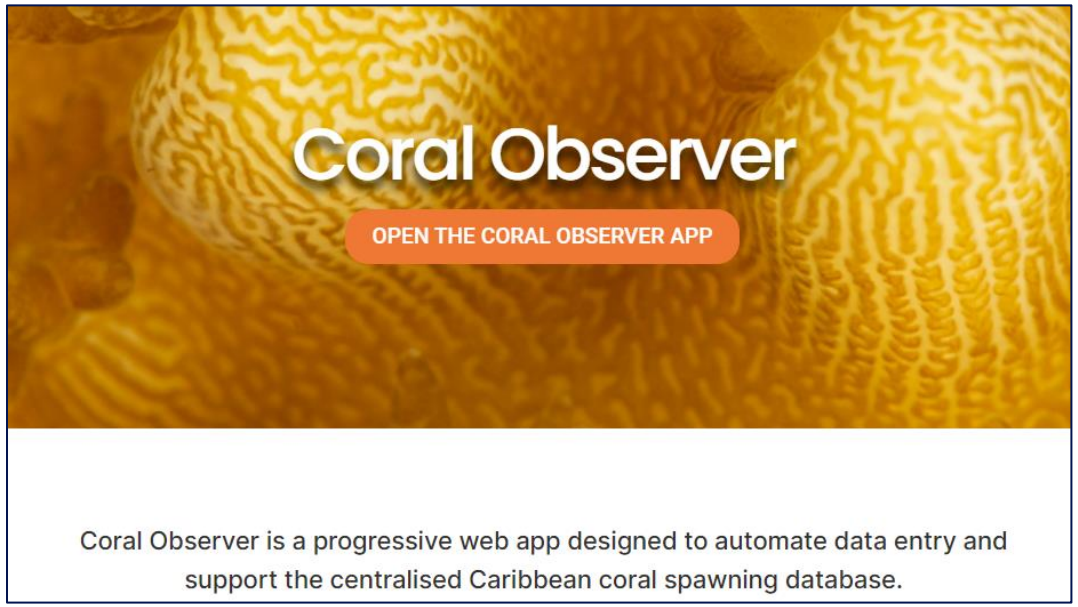
Anastazia Banaszak (UNAM, Coralium)
Rita Sellares (FUNDEMAR)
Elvira Alvarado (Ecomares)

Coral Spawning Predictions

Rita Sellares (FUNDEMAR) / Elvira Alvarado (Ecomares)
Based on Dr. Chamberland and Dr. Banaszak's
(SECORE International and Coralium Lab) /CRC Larval Propagation Group Presentation

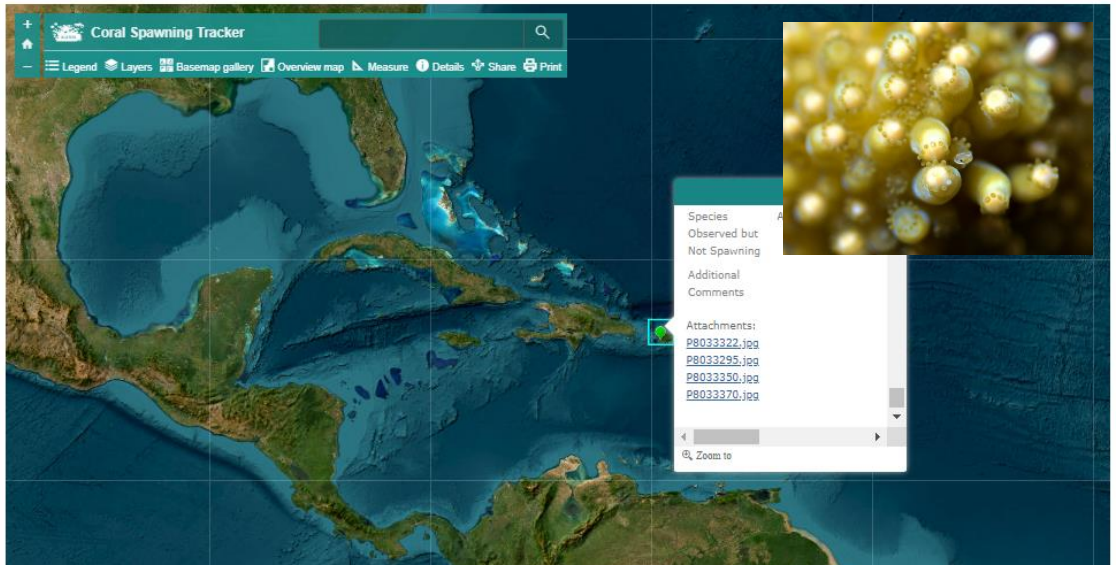
- Spawning calendars
- Key considerations
- Exercises
- Data collection

Contribute to the new Centralized Caribbean Coral Spawning Database



Tracking Coral Spawning in the Caribbean

This new map has just been developed. As new data is entered, it will appear on the map. Stay tuned for more!



Ex situ- Open temporal lab

Materiales y equipos

Item	#	US$
colombian substrates	960	$ 756
incubators	12	$ 104
water flow valves	12	$ 40
wooden boards	6	$ 80
concrete blocks	90	$ 82
Canastas CRIB	12	$ 77
plastic organizing boxes	4	$ 139
250 l water storage tanks	2	$ 143
100 l water tanks to store water	2	$ 33
buckets	2	$ 9
20 l drums with shut-off valve	5	$ 89
Gravys 1 L Norpro	5	$ 116
Cinta metalizada Tesa x 25m	1	$ 18
Beaker 1000 ml	2	$ 9
Plug adapter	1	$ 3
Thermometer	2	$ 18
Washing bottle 500 ml	3	$ 20
aerators and air stones	6	$ 40
Plastic hose (6 m)	6	$ 67
mesh of 10,30 and 100 microns	2	$ 45
Microscope with cámara	1	$ 6.444
Stereoscope with cámara	1	$ 6.000
glass and others		$ 89
polypropylene salad bowls	200	$ 67
cheicals for washing and desinfecting		$ 67
plastic tables	5	$ 147
plastic seats	2	$ 18
fans	4	$ 124
Microfiltrartion system	1	$ 4.000
Total basic materials and equipment		**$ 18.841**

ECOMARES

Lessons learned:

- Develop a strategic goal and plan
- Be resourceful
- Keep it simple
- Have a good team
- Work with partners & stakeholders

Ex situ- Closed lab in a Container

Progress in 2 days

Estereoscopio (Amscope SM-1TSW2-L6W-5M)	908,64
Copias llaves y carabiners	13,23
Nasas materiales	15,27
hermetico	15,88
Regleta	6,62
Martillos (Monas)	23,92
Envío equipos de buceo	20,2
Gravy Norpro	43,02
Vaso precipitado 1000ml + probetas 250 y 25 ml	32,66
Vaso precipitado 500 ml	11,11
Mallas para filtros	42,75
Compra containers	12500
Compra sistema de filtración	4835,43
Tubos falcon, cajas petri, frasco lavador, jarra medidora	37,87
Pipetas pasteur, jabon	13,98
Bombas de aireación	104,22
Canastas	232,82
Materiales laboratorio	331,09
Tanques de 250 L	130,15
Clavos de acero, pistola silicona	12,76
Baldes y cepillos	20,64
Flete envio sistema microfiltración	158,81
Tiosulfato de sodio	34,79
Laminación y marcadores	7,39
malla, pegante pvc y otros	15,76
Lona, tubos, cegueta, tijera	28,7
Kit de destornilladores	6,35
Capital equipment	12500
Total	**32104,1**

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Fundación Dominicana de Estudios Marinos, Inc.

Coral Rescue Nurseries- Bayahibe, DR

Rita Sellares, CEO, fundemardr.org

2 Pros/cons/challenges benefits

ACER NURSERY

P- Rapid growth, gamete source

C- Permanent maintenance

C- Disease, bleaching, Huracan's

APAL NURSERY

P- Rapid growth, Insitu production minifrags

C- Anchors from boats

G- Disease, bleaching, Hurricanes

CRIB'S

P- High production

C- Contamination, no control of environment

G- Storms, Hurricanes, out planting

LAB

P- Control environment

C- Limited production

G- Maintenance




Costs and Challenges For EX Situ Sytems In Small Island States

Dominica

Simon Walsh

OCEANS FORWARD

REZDM

Lessons Learned:

- Location considerations
- Partner with government and other stakeholders
- Costs to consider
  - Ez Situ Total system parts
  - Solar System. Challenges and Solutions
  - Shipping
  - Construction Costs
  - Total Cost to date US$48,000
- Funding sources
- Local human resource skill sets and costs
- Buy backups of ALL essential parts, run a lot of tests!

APPROACHES TO IMPROVING CORAL SURVIVAL

Stacey M. Williams
Institute for Socio-Ecological Research
www.isercaribe.org

ISER CARIBE

Ways to enhance herbivory

- Protection of parrotfish
- Redistribute healthy populations
- Larval rearing in the laboratory
- Collect post-larval settlers

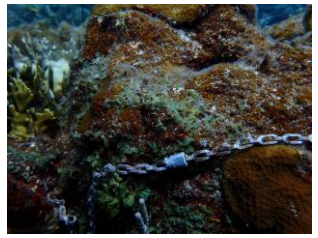
Caribbean Reef Project: Taking an ecosystem-based approach to coral reef restoration. We will restore 5 acres of coral reefs in La Parguera, Mayagüez and Fajardo. At each reef, we will outplant more than 21,000 coral fragments of different species (ESA-listed) and four species of herbivores, including 3 species of sea urchins and herbivorous crab.

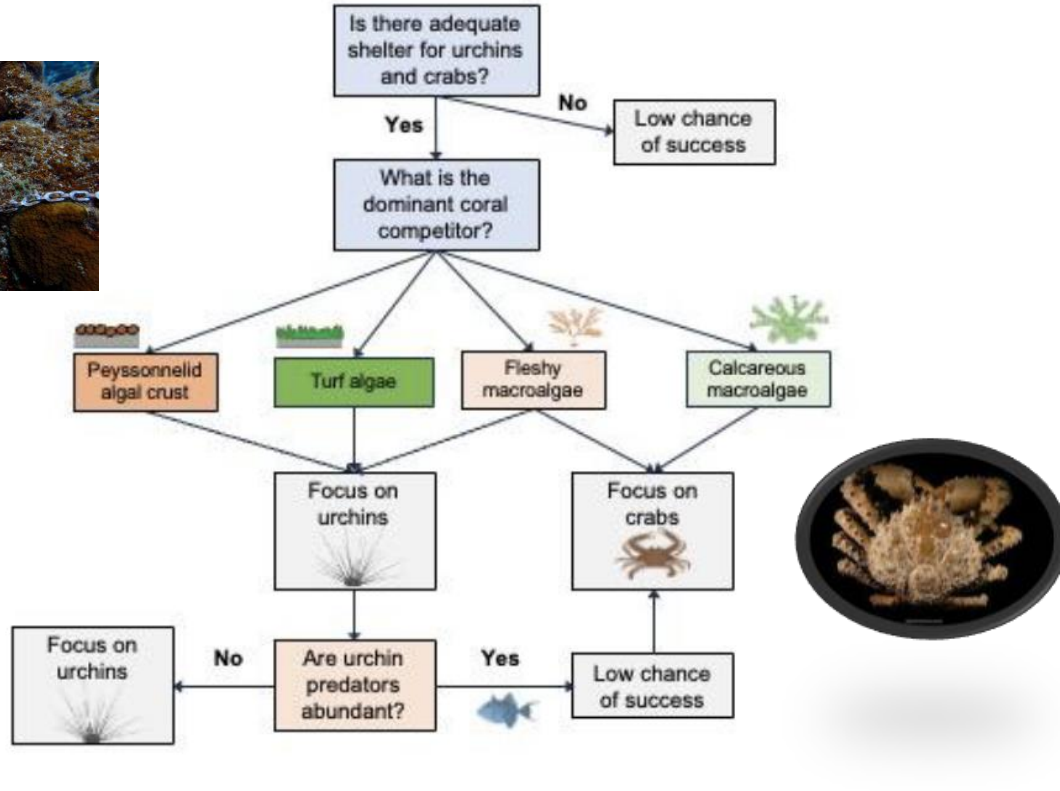
Restoration of Herbivory on Caribbean Coral Reefs: are Fishes, Urchins, or Crabs the Solution?

Mark J. Butler IV[1*], Alain Duran[1], Colette J. Feehan[2], Alastair R. Harborne[1], Alwin Hykema[3,4], Joshua T. Patterson[5], William C. Sharp[6], Angelo J. Spadaro[7], Tom Wijers[3,4], and Stacey M. Williams[8]

Baseline monitoring:
- Habitat: identify primary coral competitors
- Predation: identity predators & pressure
- Density: urchiins & *M. spinosissimus*
- Rugosity: shelter for urchins & crabs?

Assumptions:
- Repeated stocking of grazers unless/until a stock-recruitment relationship is evident
- Grazers stocked at appropriate size and density to minimize predation





Mar Biol (2012) 159:2697–2706
DOI 10.1007/s00227-012-2027-1

ORIGINAL PAPER

Herbivory by the Caribbean king crab on coral patch reefs

Mark J. Butler IV · Angela M. Mojica

Not losing the forest for the trees:

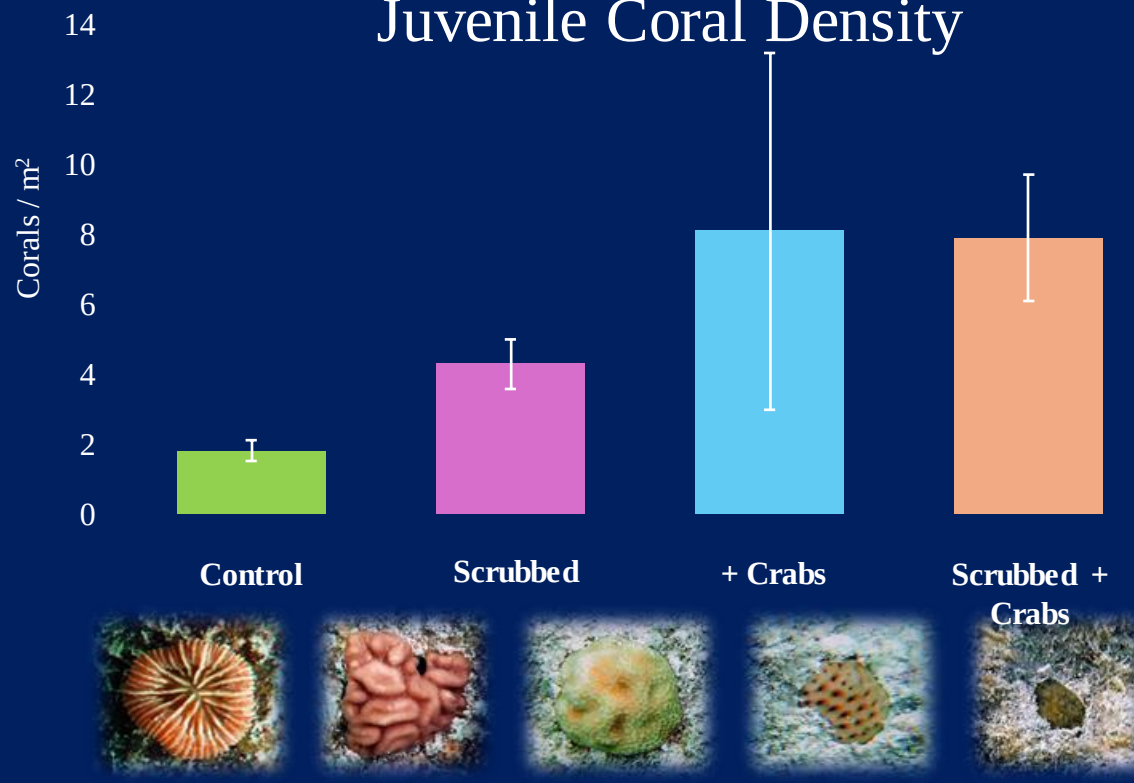
Integrating grazers into Mote's holistic coral reef restoration strategy

Jason Spadaro, PhD
Staff Scientist | Program Manager
Coral Reef Restoration Research Program
Mote Marine Laboratory

Algae cover

- Fish Richness
- Fish Abundance
- Coral Recruitment

Juvenile Coral Density



Jason Spadaro, 2024

Closed System Land Based Holding

Alizée Zimmermann

Turks & Caicos Reef Fund

TURKS & CAICOS REEF FUND
www.TCReef.org

Alizee@TCReef.org

May 2024 – Key West

CONSIDERATIONS FOR LAND-BASED CLOSED SYSTEMS

COMMITMENT
You can start small but holding coral on land is a commitment. They are endangered animals in need of daily attention.

RESOURCES
Is it cheap? No. But it is doable AND you can start small. What Resources do you have available? Government support? Can you apply for a grant?

INFRASTRUCTURE
Closed systems need a controlled environment. Either a room or a container. Power, Water and Insulation (temp control)

LONGTERM CARE
What is your support capacity for coral husbandry and aquaria maintenance? Can you bring on a staff member?

YOUR MISSION
Understanding the "why" behind your build will help you answer "what" you want to accomplish.

KNOWLEDGE
Finding the right advisor to help is crucial.
Never underestimate the importance of knowledge.
ANYONE CAN LEARN, BUT YOU CAN'T LEARN FROM ANYONE.

CHALLENGES
Scenario setting and Action Plans. There will be challenges:
Water, Power, Natural Disasters, Biosecurity etc..
Having a plan for multiple scenarios will set you up for success

LEARNING CURVE
Ex-situ is completely different to in-situ. It requires patience and time but the rewards are worth it.

YOUR MISSION
We start and end with your mission because that's what drives the bottom line.

- MISSION
- PERFORMANCE METRICS
- TIMEFRAME
- ACTIVITIES
- COST

Fundamentals of invertebrate disease investigations

Michelle M Dennis DVM PhD DACVP

Associate Professor, Anatomic Pathology

THE UNIVERSITY OF TENNESSEE KNOXVILLE

Fundamentals of Invertebrate Disease

- What types of diseases have you seen on your reefs?
- Are you interested in future tissue sampling training and collaboration?

Pathway forward

1. Educate managers and stakeholders on importance of disease investigations
2. Have a disease sampling plan in place
3. Have investigator field kit ready
4. Have permits in place
5. Guidance and support is available

Your disease investigator field kit:

Image Source:
T. Work. Collecting corals for histopathology. A practical guide

Options:

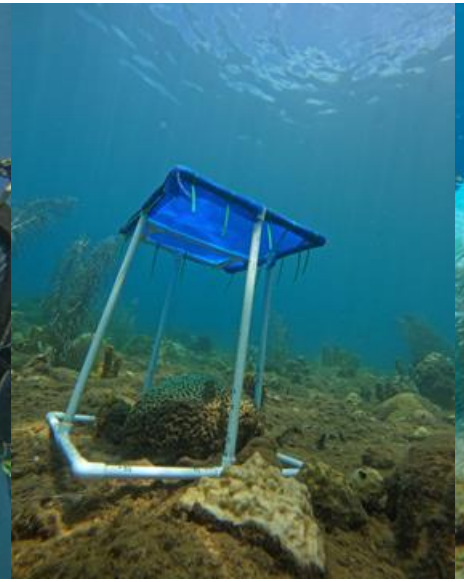
- Kit up now & start sampling
- Emergency response

Coral Disease Investigator

Supplies Checklist

ITEM	PURPOSE	I HAVE	I NEED TO GET
Underwater camera	Photograph gross lesions before and after sampling with sample bag number		
Permit	Permission to sample corals in advance		
Mesh bag	Something to hold collected samples in underwater		
Cores	Such as hole-saw drill bit; to collect biopsies from boulder corals (some recommend one per colony)		
Chisel or flathead screwdriver	To collect biopsies from boulder corals		
Hammer	To collect biopsies from boulder corals		
Epoxy tube	If wanting to minimize biopsy damage to skeleton		
Tool bag	Or other method to secure tools to body while diving		
Whirlpacks	Plastic bags to keep samples identified and contained under water		
Scale	To measure coral/lesion size		
Fixative	Z-fix concentrate (diluted when used) preferred for histology, 70% ethanol for PCR		
Measuring cup			
Mixing bottle			
Parafilm	Wrap around formalin containers to keep from leaking		
Nitrile gloves	Protect your hands from fixative; use when sampling corals		
Sample jars	Formalin containers, falcon tubes, Eppendorf tubes; for samples for histopathology		
Sharpie	To label things		
Clipboard & pencil	To record data		
Data sheets	To record metadata matched to coral sample		

Dominica Response- 2023 Bleaching event
Simon Walsh


- Act early. This year as soon as we reach 86f/30c we will shade.
- Our efforts resulted in increased survivability in the Coral Nursery.
- In Situ while all shaded CNATS survived we had no controls and by mid October the oceanic temps started to drop
- We were surprised that there was very little difference in temperatures at depth
- Coral Feeding seemed to help
- https://public.tableau.com/app/profile/bingqian/viz/DominicaCoralRescueCenter-CoralRescueOverview/DominicaCoralRescueCenter

See coral bleach webinar:
www.agrra.org/webinars/

How to adapt restoration to climate vulnerability

Rita Ines Sellares Blasco
CEO, fundemardr.org

How to adapt restoration to climate vulnerability

1 *Acropora cervicornis* (ACER) nursery

1.1 2011-2023: 3km of ACER lineal tissue, divided in 110 structures and 250 m

1.2 2024: bleaching event caused over 80% lost

1.3 Rescue small fragments alive, building ropes against the flow

1.4 DNA extraction- now processing

The fragments are growing healthy

Doubled size in 6 months

2 Assisted sexual reproduction strategy

2.1 Pre calculate the number of colonies needed

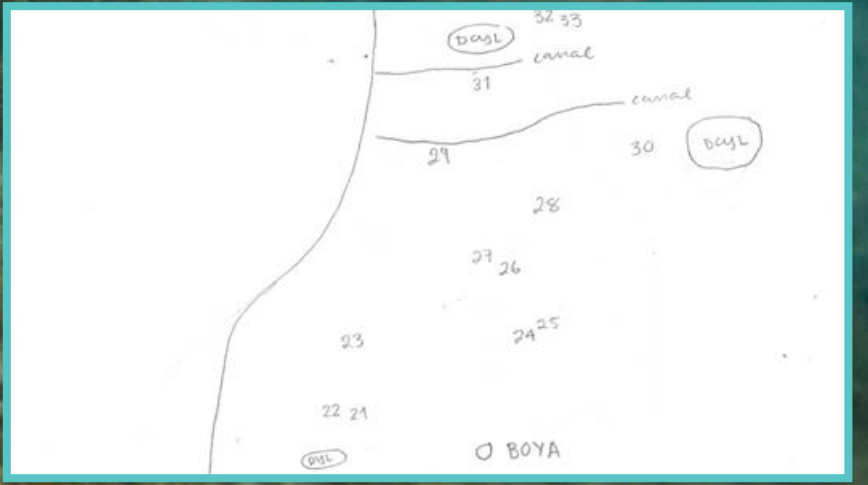
2.2 Mark colonies and set a line if they are too far from each other

2.3 Nets for each colonies

2.3 Prepare you team and engage community and dive centers

- Assisted sexual recruits 2-5 times more resilient to bleaching and SCTLD
- Donors of gametes in the following years
- Increase sites from 1 to 3

Buzos	Snorkel	Zona	Bote	# Colonias
David (Lider)	Gioia	1	Slow Dive	1-10
Slow Dive 1	Melina (lider)	1	Slow Dive	
Yuli (lider)	Jari (lider)	2	Dressel	11-20
Scuba Caribe 1	GIZ 2	2	Dressel	
Maria (lider)	Rita (lider)	3	Dressel	21-30
Nimisha	Scuba Caribe 2	3	Dressel	
Andre	Omar (lider)	4	Viva	31-40
Viva 1	Viva 2	4	Viva	
Michael (lider)	Cristobal (lider)	5	Viva	41-50
GIZ 1 (Samantha)	Rayner	5	Viva	
Randel (lider)	Luis (lider)	6	Dana	51-60
Dana 1	Dana 2	6	Dana	
Wilkin (comodin)				



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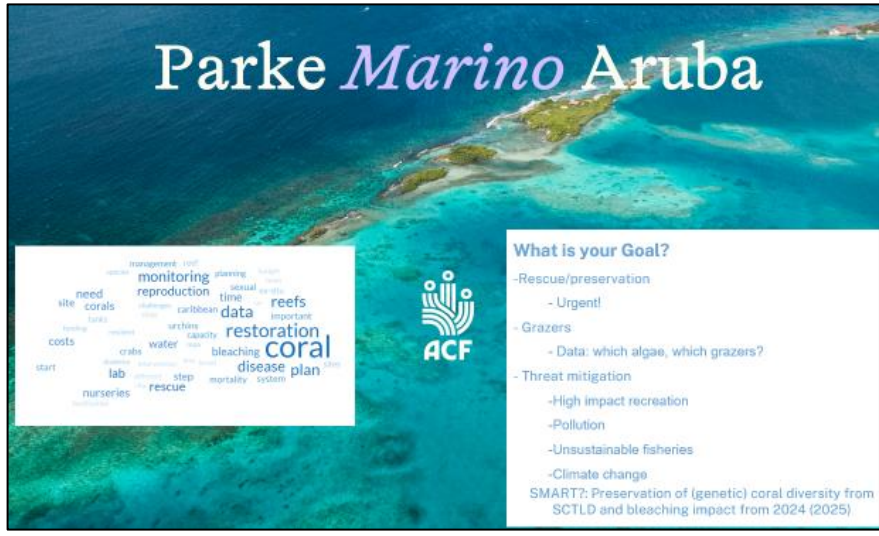
Country Restoration Road Map Presentations

1. What is your goal? Why and How? (Step 1A & 1B)
2. What are your potential sites and species? (Step 2)
3. What is your potential restoration intervention (Step 3)?
4. Who are your potential stakeholders/ partners?
5. What technical assistance do you need (Step 4 -Google Survey)?



Regional Collaboration

- Be a mentor, meet a mentor
- Track coral species at highest risk – Map Regionally
- Track coral spawning –Regional Database and Map
- Regional atlas of photomosaics of MPA restoration sites
- Training Courses – online & field courses
- Continued Road Map Planning
- Continued conversation / collaboration
- Other?




Recapping Management Capacity for Coral Restoration in the MPAConnect Network

Dana Wusinich-Mendez and Gabriela Ochoa

Key West, June 11, 2024

Photos by: CONANP[1], Fundacion Cayos Cochinos: Nicole Webster [2], TIDE[3], Fundacion Cayos Cochinos: Shelley Wilson[4]

GULF AND CARIBBEAN FISHERIES INSTITUTE

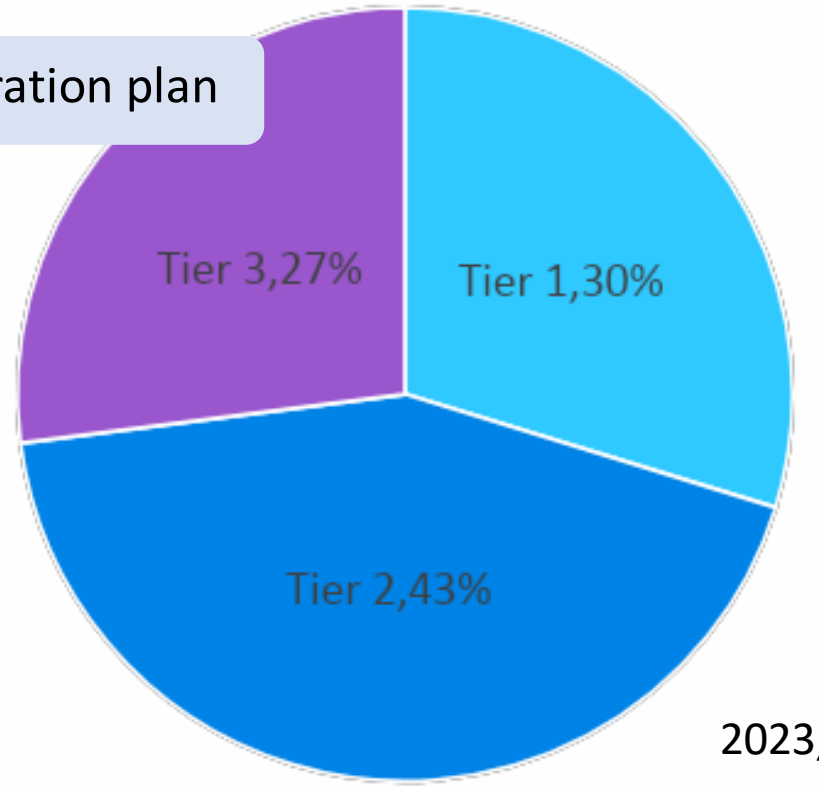
MPA connect

NOAA CORAL REEF CONSERVATION PROGRAM

AGRRA Atlantic and Gulf Rapid Reef Assessment

Restoration capacity in MPAConnect

Approx 1/4 of MPAs have restoration plan



2023, n=37 MPAs

Nearly 3/4 of MPAs have some restoration activity

Approaches to coral restoration

	Mentions
In-situ nursery	19
Outplanting in MPA	9
Assisted reproduction	9
Ex-situ nursery	4
Other approach (reef balls, biorock)	4
Grounding response	3
Microfragmentation	2
Herbivore co-cultivation	2

Elements of effective MPA implementation

Adequate support

- Reliable, long-term financing
- Clear and full legal framework
- Up-to-date, approved management plan

Effective management

- Adequate staff with skills and knowledge
- Formal coordination with agencies and partners
- Community and stakeholder engagement

Core programs

- Active, consistent enforcement
- Outreach program to build stewa
- Livelihood opportunities developed
- Fisheries management program
- Tourism management p

100%

97%

94%

Evaluation

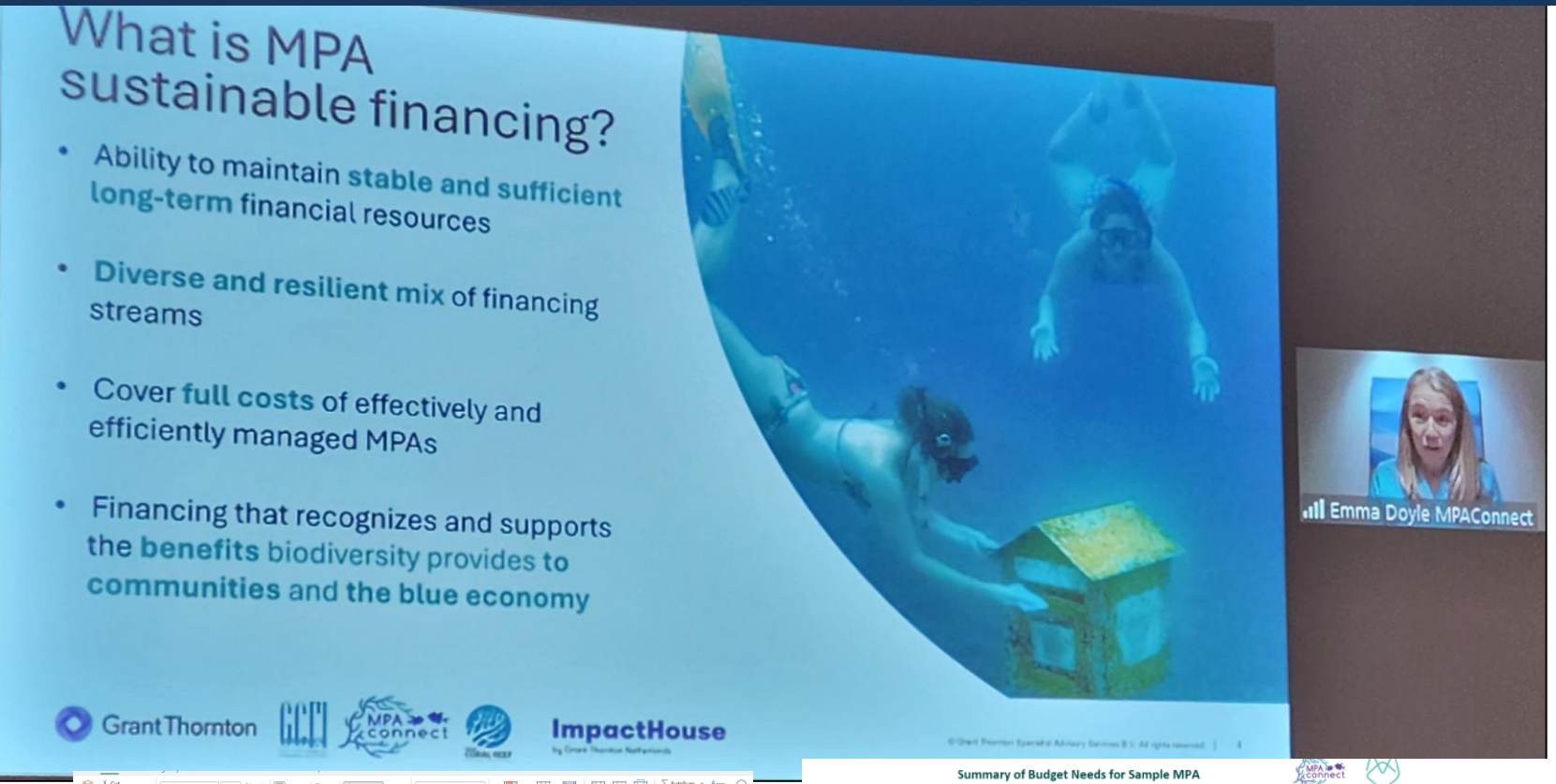
- Bio-physical monitoring program
- Socio-economic monitoring program
- Economic valuation
- Management effectiveness evaluation program

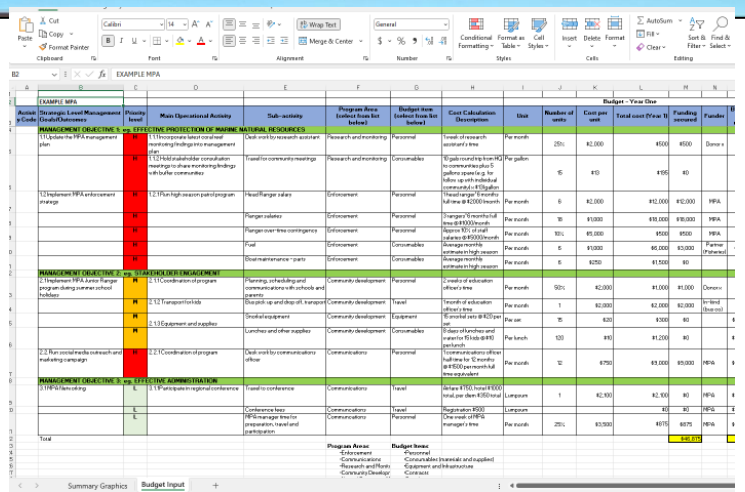
Adaptive management

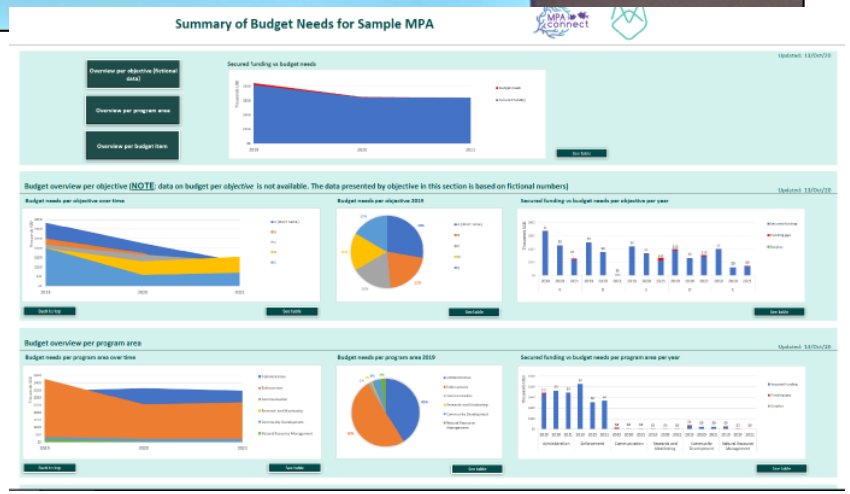
- Response to disturbances
- Resilience to climate change
- Habitat restoration
- Communications

Enhanced biodiversity conservation

Grounding coral restoration planning into MPA sustainable financing







Take home messages:

- Tools to help develop sustainable financing
- Define specific goals linked to your management objectives (put these in your budget)
- Prioritize your goals within your budget
- Identify potential funders per objective
- Diversify your funding, identify in-kind
- Consider & plan for risk
- Revisit & adapt budget with activities

Integrating Restoration into MPA Planning

Take home messages:

- Take time to develop country-wide restoration plan
- Create a cross-disciplinary team of experts for guidance
- Define specific goals linked to your management objectives
- Encourage community participation & empower partners to be active in restoration activities
- Monitor and use data to guide and adapt
- Create SMART objectives
- Restoration is a long-term investment - decades
- Develop a long-term sustainable finance plan
- Diversify your type and areas of restoration -spread out risk
- Plan for unexpected, revisit, & adapt
- Be honest / accurate, not alarmist, offer solutions/hope

Mote Marine Lab: Hands-on Learning Exchange

Regional Collaboration

INSPIRE
EMPOWER
MOTIVATE

Website: www.agrra.org/restorationroadmaps/

Live Visual Map see:
earth.nullschool.net

Opportunities - Restoration Training Hub

Online

Road Map Resources


Coral Monitoring Training


Imagery Training


Larval Propagation Training


Ecosystem based Training


Tissue Sampling Training

Field Training Courses

CORALIUM


Coral spawning & larval propagation

Course Dates: One week July, Aug, or Sept 2024

ISOR CARIBE


Ecosystem-based restoration

Course Dates: One week July 28-Aug 3, 2024

Website: www.agrra.org/restorationroadmaps/

Techniques in Coral Spawning & Larval Propagation

CORALIUM

Course name: Techniques in coral spawning & larval propagation

Course Dates:

Part 1: Virtual Online Summer 2024

Part 2: One week Field Course (Puerto Morelos, Mexico)

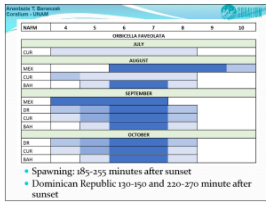
(various dates based on coral species spawning – July, Aug or Sept 2024)

Credit: Certificate of Completion

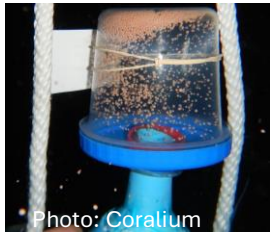
Course Information:

1. Coral reproduction
2. Coral spawning observations & calendars
3. Collecting spawn & assisted fertilization in the field or lab
4. Larval propagation & larval settlement
5. Outplanting & monitoring

- **Coral spawning**

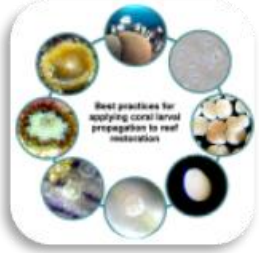


- **Spawning calendars**



- **Larval propagation**

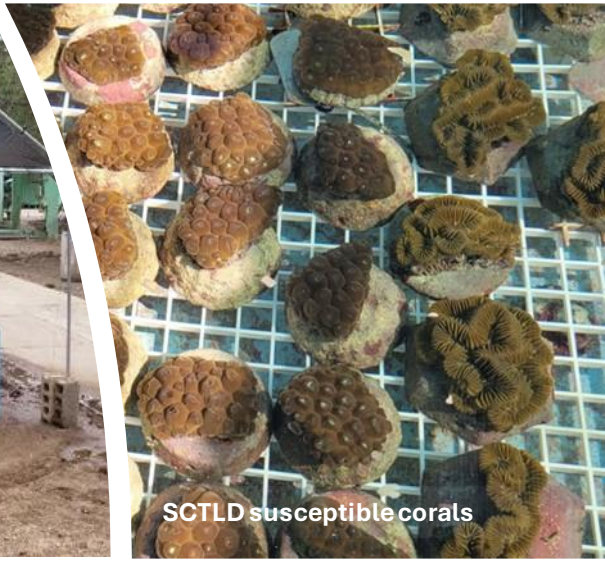
- **Assisted fertilization**



- **Best Practices**

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.

Techniques in Ecosystem-based restoration



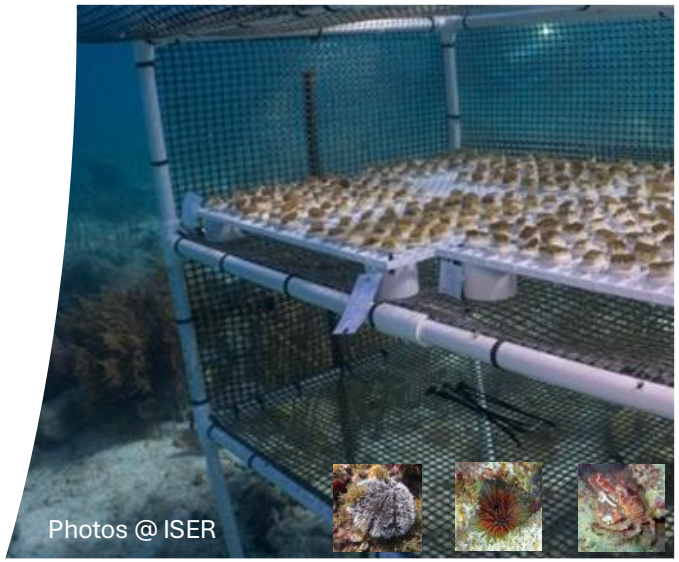
Techniques in ecosystem-based restoration
Course Dates:

Part 1: Virtual Online Summer 2024
Part 2: One Week Field Course July 28-August 4, 2024 (Puerto Rico)

Credit: Certificate of Completion

Course Information:
The goals of this course are:

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



https://www.isercaribe.org/projects

Advancing coral reef recovery through collaboration and connectivity

Thank you to all the coral restoration researchers, resource managers, and MPAConnect partners at the 2024 Key West Meeting for joining together to catalyze regional coral restoration efforts within the Caribbean. Thank you to CORDAP for supporting this inspiring and productive learning exchange.