Southeast Florida Coral Reef Initiative (SEFCRI)
Technical Advisory Committee (TAC) Meeting

May 3-4, 2022

Attendance

Staff

Name	Affiliation	May 3, 2022	May 4, 202
Alycia Shatters	DEP CRCP	X	X
Mollie Sinnott	DEP CRCP	X	X
Jamie Monty	DEP ORCP		X
Katie Lizza	DEP CRCP	X	X
Tyler Momminy	DEP CRCP	X	
Rachel Skubel	DEP CRCP	X	X
Taylor Tucker	DEP CRCP	X	X
Wedny Wood	NSU	X	
Marina Garmendia	NSU	X	X

TAC Members

Name	Affiliation	May 3, 2022	May 4, 2022
Erick Ault	FWC FWRI	X	X
Ken Banks		X	X
Don Berhinger	UF		
Richard Dodge	NSU	X	X
Phil Dustan	College of Charleston SC	X	X
John Fauth	UCF	X	X
Piero Gardinali	FIU Institute of Environment	X	X
Dave Gilliam	NSU	X	X
Lew Gramer	NOAA AOML		
Kurtis Gregg	NMFS	X	X
Dale Griffin	USGS		
Jay Grove	NOAA Fisheries		
Judy Lang	AGRRA		X
Joe Lopez	NSU	X	X
Caitlin Lustic	TNC	X	X
Arthur Mariano	UM RSMAS		
Valerie Paul	Smithsonian Marine Station	X	X
Esther Peters	George Mason University	X	X
Stephanie Schopmeyer	FWC FWRI	X	X
Xaymara Serrano	NMFS	X	X
Manoj Shivlani	University of Miami	X	X
Jack Stamates		X	X
Joshua Voss	FAU Harbor Branch		
Brian Walker	NSU	X	X

Dana Wusinich-Mendez	NOAA CRCP	X	X

Public Attendees

Name	**Affiliation**	**November 3, 2021**	**November 4, 2021**
Alex Wagner		X	
Allie Kozachuk		X	
Amanda Zummo		X	
Andrew Baker	RSMAS		X
Angela Smith	FOFR	X	X
Casey Harris	NSU	X	
C. Ciarlariello			X
Elizabeth Shaver	NOAA	X	
Greta Aeby		X	
Hunter		X	
Jackie Larson		X	X
Jennifer Stein	FWC	X	X
Jeremiah Blondeau	NOAA	X	X
Joanna Walczak	DEP CPR	X	
Josh Kilborne	FIU		X
Kristi Wallmo	NOAA		X
Mary Allen	NOAA	X	
Maurzio Martinelli	SeaGrant	X	X
Morgan Hightshoe	NSU	X	
Nick Jones	NSU	X	
Nicole Hayes	NSU	X	X
Reagan Sharkey		X	
Sabrina Lovell	NOAA		X
Samantha Buckley		X	
Sasha Wheeler	NSU	X	
Shane Wever	NSU	X	
Zachary Graff		X	

Day 1: May 3rd, 2022

Announcements:

- Hybrid meeting
- Alycia Shatters from Florida DEP was the moderator and facilitator of the TAC meeting
- The 2022 coral champion was announced at the last SEFCRI meeting and was recognized as Lisa Gregg for her efforts and contributions to the conservation and preservation of the Coral ECA. Lisa, thank you for all your hard work! This award is posted on the SEFCRI website if you want to check it out.
- Technology overview and check

DEP legislative founding for Florida's Coral Reef – *Joanna Walczak*

Goal: Update on the DEP legislation founding for all Florida's coral reef priorities.

- Coral Protection and Restoration (CPR) program goals:
    - Guide national coral reef policy and unite Florida's agencies to ensure effective state-wide coral reef-related authorities, policies, and procedures.
        - Representing Florida to make sure all our priorities are loud and clear at an international level.
    - Provide leadership for stony coral tissue loss disease (SCTLD) response, restoration of Florida's Coral Reef (FCR), and regional water quality priorities with a focus on Biscayne Bay.
    - Effectively administer state funding for Florida's Coral Reef priorities.
- Highlight main goals for water quality (WQ)
    - Ultimate unify the offshore network of reef WQ monitoring programs to make sure these programs can connect with each other and be a united network.
    - To better inform regional and local management of the impacts of water quality in all these ecosystems.
    - Understand what needs to be researched and understand reef related WQ indicators and thresholds.
    - Implement and track the success of management actions to reduce land-based sources of pollution.
- State Coral Funding 2020-2022 has gone to resilient coastlines and waste funding (~$7M RECURRING)
    - Funds are used for mitigating the impacts of coral disease through research, intervention, propagation infrastructure, and restoration trials.
    - Supporting the continued regional offshore water quality monitoring for northern reefs.
    - Getting a ~ 2 million-plus up for the next fiscal year resulting in $9 M for 2022-2023
- In 2020 there was a $10M grant for the coral protection and restoration, supporting projects such as:
    - University of Miami - SE FL Coral Restoration Hub.
    - Boy Scouts of America – Florida Sea Base's Coral Restoration STEM program.
    - Mote Marine Laboratory – Researching and growing disease-resistant coral.
    - Miami-Dade County - Reduce pollutants in Biscayne Bay.
- There is a new $20M recurring Biscayne Bay Water Quality Improvement Grant specifically for nutrient reduction. The funds will support local governments and non-state entities for:
    - Septic to sewer conversions.
    - Stormwater infrastructure upgrades.
    - Water quality monitoring and modeling.
    - **2022-2023 application proposal portal for this grant will open soon (June/July): www.ProtectingFloridaTogether.gov**
- Government cut Inlet Contributing Area (ICA) is a sub-delineation of a watershed that contractors believe most closely aligns with an area that could show change if we reduce

nutrient pollution from it. Ultimately, recognize that is hard to establish a WQ management system in an effective management area so it's a place to start when thinking about where to establish construction projects.

- Miami-Dade County put together a report card about the health of Biscayne Bay WQ. When looking at the 2021 overall scores from nitrogen and phosphorus show one particular area that keeps coming out red and that is in the basin south of the Miami DEP office. That basin is adjacent to the litter river and has been a spotlight for sea-level rise and pollution studies.
    - They also looked at chlorophyll, nitrogen, and water bodies' ID
- County and state boards are focusing on what to do in terms of nutrient reduction priorities in these areas. The information presented and WQ monitoring data from Miami-Dade County and partners will be used as a transplanting tool to achieve WQ betterment. Based on all the information we hope they select that little river area as the best place to focus.
- There were 9 locations with funded projects during the Biscayne Bay grant program fiscal year of 2021-2022.

Project Number	Partner	Project Name	DEP FY 2021-22 Funding Award
1	City of Coral Gables	Coral Gables Waterway / Biscayne Bay Water Quality Improvements - Construction	$900,000
2	City of Coral Gables	King's Bay Septic-to-Sewer Conversion	$2,750,000
3	Florida International University - Institute of Environment	Biscayne Bay and Reef Observation, Interpretation and Prediction System (B-BROIPS)	$1,250,000
4	Miami-Dade County	Phase 2 - Implementation of Biscayne Bay Task Force Recommendations	$12,940,463
5	Miami Shores Village	Miami Shores-NE 8th Avenue Drainage Improvement Project	$300,000
6	Miami Waterkeeper	Improving Water Quality in Biscayne Bay through Coordination, Outreach, Monitoring and Source Tracking	$600,000
7	North Bay Village	North Bay Village Stormwater Pump Station	$600,000
8	South Florida Water Management District with Tulane University	Biscayne Bay Water Quality Model Development and Application	$500,000
9	Village of Key Biscayne	Stormwater Sustainability Pilot Project	$159,537
Total			**$20,000,000**

Questions/Comments

- John Fauth: I have a question that goes back to the ICAs, I remembered that they were delineated based on normal flows so I was wondering if there is any effort or funding that will be dedicated to updating them, especially during storm events and flushing of water that probably reduce transit times.
    - Joanna Walczak: Great question, two or three years ago we requested that the NOAA coral program prioritizes the Miami-Dade Government Cut inlet as the next priority for watershed plan creation, they do have funding for this year to get that started. We will update all the information including fixing those boundaries based on those scenarios and contemplating wet and dry seasons etc.
    - John Fauth: That is really critical, especially for anything that has direct connections to Lake Okeechobee one way or another since that is the bathtub that keeps overflowing and is unfortunately in really bad shape.
    - Dana Wusinich-Mendez: We should be able to get started in the Fall, the contract will initiate on October 1st, so hopefully soon after that we will be able to start meditating with the consultants and get that process started.

- Brian Walker: We have been focusing on the data coming out of the ICA and what we can do to prepare rainfall and water quality data and we found some interesting results that will be discussed in the later talk today. Also, to put John at ease we have found certain ICAs correlate with other ICAs in terms of total flow, so if we look at correlations between the three major ones in South Miami-Dade and Broward, the Port Everglades and Miami-Dade correlate higher closer together in terms of flow, and Hillsboro and Haulover are more closely related and the two pairs are less related. Seeing some sort of fluctuations in the design but it does seem to work in a lot of ways.

Session I: Restoration- State Strategy and ECA Plan Overview

1. Restoration planning tool – *Elizabeth Shaver, TNC*

Goal: A manager's guide to coral reef restoration planning and design to assist managers in many places around the world with restoration planning. This restoration planning tool was put together in collaboration with NOAA Coral Reef Conservation Program, the United States Environmental Protection Agency, The Nature Conservancy, Reef Resilience Network, U.S All Islands Coral Reef Committee, and other collaborators.

- The Reef Resilience Network program is a global program that works to connect coral reef managers, practitioners, and scientists with each other all over the world to foster information and learning exchange. While trying to synthesize and share the latest coral reef science and management resources to restore the reefs more effectively, as well as looking at resources and seeing where there are gaps, this was one instance where they decided to create a restoration guide.
- This two-year project used workshops to gather input and managers to pilot this process, the Manager's Guide to Coral Reef Restoration Planning and Design was finalized in October 2020.
    - The final version is available for download on the NOAA CoRIS website along with several tools and resources that accompany the guide.
- The guide is structured around a 6-step process that considers climate change adaptation and is meant to be flexible; meaning it can be tailored to people who are just starting restoration as well as those who already have a project or program underway.
    - Completing the first 4 steps of the guide leads users to develop a Restoration Action Plan.
    - The guide includes background information, resources, and a suggested process for restoration planning with small teams including considerations for stakeholder engagement.
    - Case study examples are provided to help illustrate the process.
- Step 1: set restoration goals and identify a broad geographic area to focus restoration efforts based on those goals.
    - In this step, example goals are provided based on other recent published resources, and users are guided to craft SMART goals that include more specifics and are measurable.

    - Goals are small, specific and include time frames of what is being envisioned.
- Step 2: Identify, prioritize, and select sites where restoration will occur.
    - Provides a framework of how sites could be evaluated, compared, and prioritized in both a quantitative and semi-quantitative approach.
    - There is an excel-based tutorial and an example provided to illustrate this process.
- Step 3: Identify, design, and select restoration interventions based on goals.
    - Provides a process for brainstorming options, applying climate-smart design considerations, and going through an evaluation process for selecting a final set of interventions based on the five criteria suggested as steppingstones that are adaptable to meet each need.
- Step 4: Develop the Restoration Action Plan.
    - Users define objectives, activities, and timelines and pull everything together into a Restoration Action Plan.
    - Provides examples of objectives that are used to set shorter milestones for the restoration work and help track progress towards the goal.
- There are several tools that can be used alongside the Guide to aid users in this process.
    - The first is the Workbook which can be downloaded as a separate word document. It provides a place where they can document important information and decisions made during the planning process and can be used as reference documentation supporting the Restoration Action Plan as well as used in future efforts to revise the plan.
    - An action plan template is another tool that provides a layout that can be used to build an action plan. It is designed to be populated directly from the Workbook so the information can be plugged in.
    - The last two resources that accompany the Guide are an excel-based tutorial and a tool. For Step 2, a worked example is provided of how to compile, sort, and analyze data to assist in this selection process. For Step 3, a tool is provided that helps compile and visualize results from evaluating intervention options to help select final interventions to move forward with.
        - These are both available as direct downloads on the NOAA CoRIS website.

Questions/Comments

- No questions

2. Overview of Tier I plan: Statewide Restoration Strategy – *Caitlin Lustic, TNC*

Goal: Provide an update on the efforts to develop a statewide coral reef restoration strategy and present the adaptations of the manager's guide presented by Elizabeth Shaver into the strategies of tier 1.

- The strategy is part of the Florida Reef Resilience Program (FRRP).
    - The FRRP has been in existence since 2005. It is a program that brings scientists and reef managers together to discuss general topics in leading efforts to make Florida's Coral Reef healthier (more flexible on any coral reef issue).
    - More information for FRRP on the website www.frrp.org.

- The FRRP released a Resilience Action Plan for Florida's Coral Reef (2021-2026), which is an update to the previous 2010 Resilience Action Plan.
- The three main goals of this plan are:

    1. Enable resilience-based management of Florida's Coral Reef aimed at reef managers and scientists.
    2. Support public policy that creates the enabling conditions for reef recovery aimed for policymakers.
    3. Enable stakeholders to support the future of the reef and those who depend on it aimed at reef users.
        - For more information visit: https://www.nature.org/content/dam/tnc/nature/en/documents/ Resilience-Action-Plan-for-Floridas-Coral-Reef-2021- 2026.pdf

- Restoration in the Resilience Action Plan (two objectives in the first goal)
    - Goal 1, Objective 2: Enhance reef ecosystem condition with disease interventions and restoration.
    - Goal 1, Objective 3: Conduct research to support threat abatement and reef restoration.
        - Individual actions that support the strategy development effort focus on both, the restoration strategy development and site selection.
- Tiered structure: To identify what the state needed as a strategy, they divided it into a tired structure.
    - Tier 1: Statewide strategy; high-level guidance and focal area prioritization to achieve large-scale ecological goals.
    - Tier 2: Jurisdiction-level plans; identification of goals specific to each jurisdiction, further narrowing of area prioritization based on those goals, and guidance on how to achieve them, e.g. upcoming planning effort for ECA.
    - Tier 3: Site-specific plans with detailed information about the site and methods, e.g. Mission: Iconic Reefs.
        - Design in the future by restoration practitioners or a combination of managers and practitioners.
- Risk managers are key stakeholders for tier 1. Thus, planning started with a small group and will circle back with those ideas to a larger group.
- Restoration practitioners will be key for Tier 2 and 3 when narrowing down site selection and include more details on potential restoration methods.
- Importance of Tier 1.
    - To achieve goals that can only be successful at the scale of the entire reef tract.
    - To leverage and prioritize resources, funding, and expertise.
    - To effectively communicate goals and needs.
    - To avoid duplication of effort.
    - To think about restoration in the larger context of other management activities.
    - To inform future detailed planning efforts.
    - To ensure that MOST (not all) effort is focused in areas most likely to contribute to overall reef recovery.

- For Tier 1 development, they focused on the first two steps in the mangers guide; first set goals and geographic focus and then identify, prioritize and select sites.
    - Sites will be considered focal areas because they are way larger than what would be considered a site.
- They set statewide restoration visions and goals:
    - Vision: Restore Florida's Coral Reef to a thriving, diverse, resilient condition that sustains ecosystems and their valuable services for current and future generations.
    - Goals are based on functions and processes that don't happen naturally. All of these goals get around the idea that successful restoration is to provide the conditions and supplement populations to the point they can re-populate the reefs themselves.

1. Enhance coral population and coral community resilience.
2. Enhance habitat quality in support of coral recruitment.
3. Increase coral survivorship.

- Focal area identification: Create a series of maps based on a set of area selection criteria. Identify priority areas that can be used where individual restoration efforts are contributing to the bigger picture and the majority of funding and effort is placed on areas that can benefit the entire ecosystem.
    - Apply criteria that are relevant at the FCR scale and could be overlooked at a local scale – coral larval connectivity.
    - Use existing data sets to predict where corals may be likely to survive to sexual maturity.
    - Coral larval connectivity was a site selection criteria. A connectivity workshop was held to learn what information was already available in Florida. The workshop and allowed researchers to provide a deeper understanding of how existing models and results could be used specifically to inform restoration planning efforts.
        - Established the desired outcome: to improve reproductive capacity on reefs that are good sources and that are likely to support out-planted corals long enough to reproduce.
        - Proposed connectivity (good source sites) and coral demographics (current/recent past size distribution) as the proposed criteria. Identified four proposed key species: *Acropora cervicornis, Pseudodiploria clivosa, Orbicella faveolata* and *Montastrea cavernosa.*
            - Species were chosen because they are widely distributed along Florida's Coral Reef, these species serve as a proxy to other similar species, and they are the most used species for restoration activities.
- Identifying restoration principles to include in the strategies.
    - Integrate restoration with other management approaches - use adaptive management.
    - Do no harm.
    - Innovate cautiously.
    - Engage communities.

- Make sure to provide guidance to reef managers and practitioners for Tier 2 and 3 planning to include:
    - Setting goals at jurisdictional and site-specific levels.
    - Further narrowing site selection while considering Tier 1 goals.
    - Providing a larger framework for how restoration should be conducted to support FCR-wide goals.
- Proposed timeline:
    - Final draft by end of May for Tier 1 strategy development plan.
    - June/July time frame to start Tier 2 planning for ECA.

Questions/Comments

- John Fauth: Have you thought about incorporating the idea of ecosystem services, I'm thinking of two different aspects of it, supporting things like recreational diving could be considered a high priority in certain protected areas since it's very important for education and tourism purposes. The other aspect of ecosystem services is for water quality, sponges for example are very important for cleaning the water and being filters. Adopt a more formal structure to look at ecosystem services like reef architecture supporting fisheries, sponges supporting water quality, and filtration, which might help advance this effort faster. I notice you have it in there but is not formalized like the rest of it.
    - Caitlin Lustic: We decided that to achieve the goals of that it didn't need to be conducted at a statewide scale, but would be more appropriate for Tier 2 level. We do have a significant plan to include that but just not on Tier 1 since we wanted to focus on things that if they are planned at a statewide level, won't get incorporated. That is where we landed with coral larvae connectivity since if you are looking at your region you are not necessarily thinking about how what you do in your region affects other regions. Whereas is if a regions goal is to create a network of great diving reefs, you can do that in just your region and be successful at it.
    - John Fauth: That makes sense, the other suggestion I have is to reconsider the list of species that were suggested since, in order to restore the reefs, you need the strong weedy species. I love *Acropora* but there is a reason why it is listed. *Porites,* for example, is tough as nails. I would strongly advocate for planting the weeds and culture those, and then establish the conditions that aren't there now for other more sensitive species second. Use the ecological succession approach, if you think about it on land, the weeds came first before the trees.
    - Joanna Walczak: FYI - DEP CPR program is funding sponge restoration as part of our 2021 Biscayne Bay Water Quality Initiative grant to Miami-Dade County.
    - Caitlin Lustic: The weedy species have less structured habitat needs since they grow anywhere, so we are investing the money to look at key species but that doesn't mean that restoration will only be with those species. We talk about the rare species that will have their own planning efforts and the weedy species can be restored and placed anywhere because they can grow everywhere. We are looking for the middle level where they are widespread across the reef tract, are

important for restoration, and we feel like we need to find the right places to put the so they can be successful.

- Joanna Walczak: One of the challenges right now is the lack of knowledge, so we are trying to prioritize where we can learn how to grow some of these other species, especially the non-*Acropora*, so we are targeting a couple of the SCTLD related species right now. Our ultimate goal is to make sure that there is a well-balanced portfolio with those weedy species that are easily raised. So, John, it sounds like you want to advocate for a stronger portfolio for weedy species, where would you put *Montastrea cavernosa* (MCAV) on this list? I would have considered that to be weedier/hardier before this outbreak. What is to say the next disease outbreak doesn't target *Porites*?
- John Fauth: That's the problem, we keep getting whacked by unprecedented events and so that's why I'm really advocating for going for the weedy species, the ones that are as tough as nails, and there are only a few of those. They are found everywhere but they are not superabundant necessarily. They will give you a chance to get a foothold and get things started. We would be deluding ourselves to think there is any species out of the reach of harm- all sites are highly vulnerable.
- Brian Walker: MCAV is hardy but it's not weedy.
- Val Paul: Advocating for a more ecosystem approach is important. *Porites* are generally doing really well and with brooding larval propagation they are continuously doing really well without much assistance unless as we mentioned something comes and whacks them. I don't know any data from reef literature that suggest a good foundation of *Porites* is going to lead to the establishment of anything else. Without propagules, which is a big problem we face in Florida now for some of these species, I don't see how all other things could recruit. I'm not sure putting the weeds out is going to help with the other species recruiting, I certainly agree with you that the weeds are important and could provide some structure in the absence of some of these others.
- John Fauth: You brought up an important question, how have some of these weedy species expanded, or if in the places where they are, are they facilitating the establishment of other species. Maybe we could use the adaptive management cycle approach that Caitlin talked about and maybe address early efforts to target key questions to help advance those goals.
- Val Paul: Data of USVI from Pete Edmunds long-term studies that show that *Porites* keep hanging in there, but the other ones keep declining. They are not facilitating other things, but I don't know about Florida. I don't think anyone has looked.
- John Fauth: That's my point, maybe we could get on that.
- Dave Gilliam: Our data showing strongly that some of the weedy species, *Porites astreoides* (PAST), *Porites porites* (PPOR), *Siderastrea siderea* (SSID), are doing pretty good and were not impacted by the disease event and their density is increasing vs the density of the other susceptible species. That data is clear in the ECA, but we don't have data that ties the increasing density of those species and possibly facilitating recruitment or survival by other species, so that is a question that should be addressed.

    - Stephanie Schopmeyer: Numbers of weedy species are not going down, so we are focusing on the restoration of species that are in decline. Without active restoration, numbers of *Acropora* are never going to go back up. For this restoration plan, we are using the data that we have available, for example larval connectivity models for *Acropora*, to start restoration planning for the species that we have in propagation already. That is why we have the species that are listed.
- Brian Walker: I understand the desire to use modeling, but models are only as good as the data going in. Is there enough info to generate a useful connectivity model? Are there plans to look at connectivity through genetics?
    - Joanna Walczak: Brian - we agree that models alone won't cut it. We're coupling modeling data with multi-year demographic data from FRRP/NCRMP until more refined models and data can be incorporated.
    - Brian Walker: Okay. Because the present models are very limited.
- Joe Lopez: John makes a good point with ecosystem services since it could help towards restoration. Points about focusing on one species and seeing if that is going to make a difference, might not work because the ecosystem is a system and you have to look at all the other components, other keystone species that are involved in making that ecosystem work. So sea urchins for example, what is their role, can we look at the literature, and see what makes them successful or thrive in the ecosystem? The answer is healthy reefs. So, go to that reef and use them as models and examples and populate the reefs you want to restore on those susceptible reefs. The literature is probably there on what species to focus on, it can't be just one.
- Caitlin Lustic: I wanted to reiterate some things, the key species are just for identifying focal areas, not the species that we plan to do restoration with, we do plan to do a full ecosystem restoration. One of the big conversations we have been having is, what other things need to happen on the reefs to make it conducive to corals, do we need to add herbivores or remove palythoa. That will be incorporated into Tier 2 and 3 plans, not Tier 1. The Tier 2 and 3 plans will be the real meat of what we really need to do, what sites, and what species. It will be more than just the 4 focus species those were just for the focal area identification process, and possibly sponges.

3. **Tier II progress towards the development of ECA Restoration Plan – *Caitlin Lustic, TNC***

Goal: Present the ideas being planned for the restoration of the Kristin Jacobs Coral Reef Ecosystem Conservation Area, focusing on tier 2.

- Why Tier 2?
    - Because management agencies may have different goals for restoration within their jurisdictions.
    - To maximize chances of success at achieving both Tier 1 and jurisdiction-specific goals.
    - To provide further guidance to be used when developing site-specific (Tier 3) plans.

        - It will likely be designed by scientists, reef practitioners, and stakeholder groups.
        - They will engage with a variety of experts to get different opinions, strategically they will meet with different groups for time-efficiency.
- For Tier 2 development, they re-visit the first two steps in the mangers guide- first set goals and geographic focus and then identify, prioritize and select sites- and step 3: the identification, design, and selection of interventions (species and methods).
- Jurisdiction level example goals:
    - Population enhancement of threatened species.
    - SCTLD recovery.
    - Enhance fish production.
    - Increase coastal protection.
- The final plan will include the restoration status of the ECA, the specific goals that are identified in the region (ecological and socioeconomic), a site selection criteria for different goals, and some high-level intervention discussions for each goal.
- Tier 2 ECA planning timeline:
    - January/ July 2022 – Kick-off meeting.
    - January 2023 - Updated connectivity modeling available.
    - February 2023 – Draft ECA restoration plan.
        - Most likely, involve the TAC in this discussion to get feedback before the plan is finalized. Want local knowledge and feedback incorporated into the draft.
    - April 2023 – Final ECA restoration plan.

Questions/Comments

- Dave Gilliam: I am conflicted with connectivity models as long as they are just one step in the process. I had experienced in the past that the scale that they provide doesn't get me any close to site selecting than my personal knowledge of sites. If connectivity models are going to be used effectively to do site-level restoration, will the scale be better for these models?
    - Caitlin Lustic: The scale for the Tier 1 level for the connectivity models will be a 500 m to 500 m cell, and it could be forward narrow with site selection criteria for Tier 2 and 3 levels. There is desktop analysis of best place to put corals, but still have to get in the water at chosen sites. There are many levels of site selection, the idea is through the tiers we continue to narrow more, we don't want to narrow it too much and say go here because it could not be an optimal area. We want enough space and enough places identified that could then be narrowed over time. That's why we want everyone to be involved in Tier 2 and 3 planning because we need that local knowledge for the site selection.

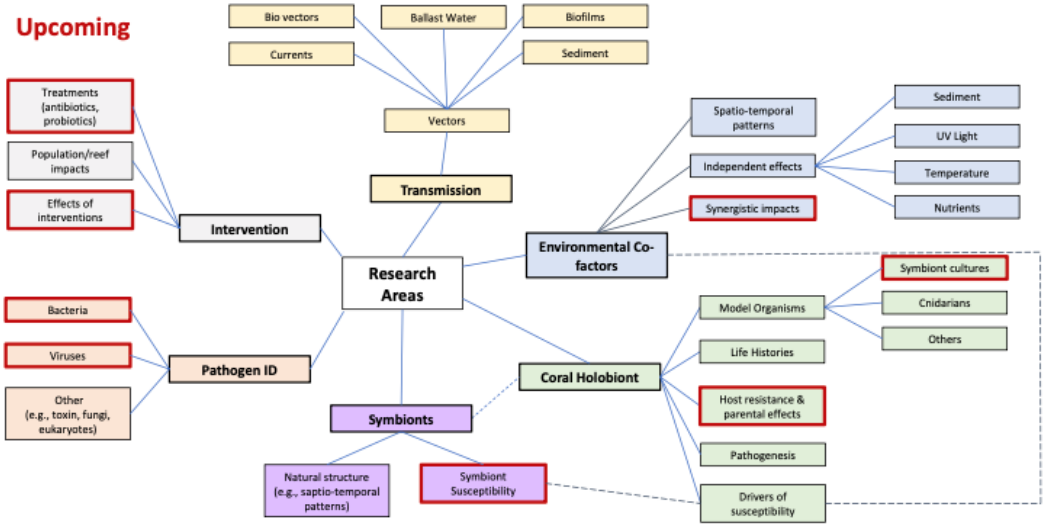
Session II: Coral Disease and Environmental Drivers

1. **SCTLD update –** ***Maurizio Martinelli, Sea Grant***

Goal: Provide an update on SCTLD disease response progression, research, and other updates about the SCTLD in Florida and the Caribbean.

- Disease progression: in May of 2021 the disease made the jump from the Marquesas to the Dry Tortugas and has been observed in all locations within the national park.
    - Still observing epidemic stages in some areas, especially in the susceptible species and some other areas the disease is categorized as endemic.
        - Still observing significant species declines.
    - This disease is endemic to the system since sites that were infected 6-7 years ago still have the presence of active diseased colonies and is likely to stay. This is one of the things we must manage when moving forward.
- Disease progression in the Caribbean at this point is widely distributed throughout the regions and most recently, two new countries where the disease has been seen have been added to the list: Saint Berthelemy and Dominica.
- Research updates: as part of the SCTLD response network they established a research project review process that simultaneous reviews and evaluates projects as a cohort, they separate technical and management reviews, and finish prior to the state fiscal year.
- Four research priorities for 2022 (with areas of particular interest):
    - Is SCTLD a biotic, abiotic, or combination disease?
        - Conduct a time-series study of SCTLD.
        - Determine if any 'bacteria of interest' can be cultured and used to recreate SCTLD.
        - Isolate and characterize the virus-like particles (VLPs) and/or related viruses observed in TEM slides. - Develop an SCTLD inoculum for laboratory transmission studies.
    - What factors (genotypic, colony-specific, or environmental) drive resistance and/or resilience to SCTLD?
        - Explore genotypic differences in disease susceptibility.
        - Explore options for stress hardening corals against disease.
        - Further explore the role of symbionts in driving resistance or resilience to SCTLD susceptibility.
    - What conditions (environmental, ecological, anthropogenic, etc.) have allowed the outbreak to persist and spread?
        - Investigate the effects of environmental co-factors, including heat stress, eutrophication, and sedimentation.
        - Explore the effect of co-occurring, multi-stressor environmental variables on SCTLD.
        - Assess and, as appropriate, utilize existing large-scale, long-term datasets.
    - Will antibiotics remain a viable treatment in the future? Are there viable alternatives?
        - Evaluate any changes to antibiotic treatment efficacy and reinfection rate over time.
        - Evaluate any adverse effects of amoxicillin treatment on the coral holobiont, nearby organisms, or the environment.
        - Develop and trial new, alternative treatment methods that do not include antibiotic application.

    - They went through and identified areas of particular interest to be added to the conversation to be the middle ground for project managers, to better target project proposals. Follow up with PI to see if there are areas of interest and provide needed tools.
- Created a map where they identified six main research areas of the SCTLD in Florida where they included the research already been done, the recent research that is either wrapping up or in progress and highlights the upcoming research (red box).



DAC research highlights

- Understanding disease and intervention via ‘omics that are really trying to understand the impact of the dieses in coral symbionts, zooxanthella. It was interesting that they did not see a genomic change in corals suggesting the antibiotic interventions do not appear to have a substantial adverse effect on the coral themselves. However, they found that SCTLD exposure causes strong transcriptional changes.
    - In this experiment, they had corals ‘survivors’ that exhibit some SCTLD resistance around diseased coral (opportunity to research these corals).
- Transmission of SCTLD in simulated ballast water confirms the potential for ship-borne spread, it was found that water can transmit SCTLD without coral contact and the disease can persist in simulated ballast water.
- SCTLD resistance Research Consortium (RRC) lead by Brain Walker
    - Provides an understanding of *O. faveolata* holobiont at gross morphologic, genetic, biochemical, and molecular scales at three-time points.
    - The first update shows that the TEM showed symbiont abnormalities, where the endosymbiont was showing necrosis, but the surrounding animal was not showing any apparent disease sign.
        - Suggesting the symbiont is the first target of the SCTLD and maybe this is essential to unrevealed the mysteries of this disease.
- A lot of new research coming up for the DAC meeting, tune in every Wednesday from 1:30 to 3:00 ET for the following meetings:
    - May 4: Using a surrogate model system to screen for pathogens associated with SCTLD

        - Dr. Blake Ushijima
    - Larval connectivity study
        - Dr. Dan Holstein
    - May 11: SCTLD Monitoring & Intervention within Dry Tortugas National Par
        - Dr. Clayton Pollock
    - May 18: Development of alternative in situ treatment for SCTLD (probiotics)
        - Dr. Val Paul & Dr. Julie Meyer
    - May 25: ECA Intervention & Stats modeling
        - Drs. Brian Walker, Gareth Williams, Greta Aeby, & Dave Whitall
    - June 1: Development of alternative in situ treatment for SCTLD (probiotics)
        - Dr. Blake Ushijima
    - Virus metatranscriptomics updates
        - Dr. Blake Ushijima
        - Dr. Adrienne Correa & Dr. Rebecca Vega-Thurber
    - June 8: CISME & Florida Keys Strike Team updates
        - Dr. Karen Neely
    - Supporting aquarium induced spawning and experiments to enhance coral propagation and restoration
        - Dr. Nicole Fogarty
    - June 15: Investigation of Temperature as a driver of SCTLD
        - Drs. Val Paul, Julie Meyer, & Andrew Baker
    - June 22: The role of algal symbionts: Comparison of five genera
        - Dr. Andrew Baker
    - Methods to improve the success of SCTLD-susceptible coral species out planted for restoration: From nursery to reef
        - Dr. Diego Lirman
- Initially, the rescue program collected corals right before the disease outbreak in the most vulnerable areas. However, the rescue program has now recently rescued endemic susceptible species that survived the SCTLD outbreak. They collected more than 100 across seven species from Miami-Dade and Broward Counties. We are interested to see what made them survive and learn from them (great genetics for future propagation stages).
- In the propagation site, they recently had spawning of *Mycetophllia ferox* at the Florida Coral Rescue Center. Corals were rescued and collected through 2019 and 2020, this spawning show that the corals are happy in the system and this species is listed as threatened under the ESA, this is something very excited for our propagation restoration steps.
- Restoration research - reciprocal micro-fragmentation transplant study led by FWC showed 94% survivorship and 1-2% signs of SCTLD.
    - Good news to see high survivorship and low disease impacts.
- Dry Tortugas (DRTO) intervention, the disease has reached the entirety of the region in the park. They started interventions rapidly and fortunately SCHMIR cruise in September 2021 treated >6,000 corals with a total of >10,000 corals in the DRTO. They are scheduling a second SCHMIR cruise in June 2022.
    - The goal is to treat as many corals as they can get so this is an amazing example of what we can do.

Questions/Comments

- Dana Wusinich- Sea Flower reserve in Colombia has just been confirmed.
- Brian Walker: Thank you Mauricio for presenting that research, I wanted to point out that the connections between all those boxes (from the diagram) are more fluid and complex. Most of the research-driven work we are doing on coral resistance and environmental predictors are all driven by intervention activities, so there are a lot of different connections. The resistance project also deals with the holobiont, reproduction, pathology, and other things.
    - Maurizio Martinelli: Try to connect it in the best way possible but that is an excellent point being made. Tried not to silo things too much because so many of these projects inform each other.

2. **Environmental and human drivers of SCTLD incidence within the Kristen Jacobs Coral Reef Ecosystem Conservation Area –** ***Brian Walker, NSU***

Goal: Update on current findings of the first project component; Spatiotemporal analyses of SCTLD on large colonies within the Kristen Jacobs Coral Reef Ecosystem Conservation Area.

- Florida water issues that adversely affect coral reefs include pollution, nutrient enrichment, reduced water quality, increased turbidity and high sedimentation all coming from inlets on outgoing tides, sewage falls, rainfall-runoff, storm events, sewage spills, dredging, etc.
- Project goal: is to use advanced statistical modeling approaches to identify possible environmental correlates to coral disease and elucidate spatiotemporal patterns.
    - These will hopefully be able to inform management on where and what to address.
- This project is built on three main components and currently more are being developed (Today, focusing on the first project component)

1. Spatiotemporal analyses of SCTLD on large colonies: saving the oldest and more resilient reef organisms since they are the largest corals holding the highest reproductive potential, as well as they preserve existing reef structure and habitat and have highest reproductive potential. These corals provide information on disease infection rates (temporal and spatial).
    - Using most effective disease intervention (DI) treatments such as antibiotic paste (>90% effectiveness)
        - Treatments save live tissue and keep colonies alive to be able to continue to study them.
        - Target ~100 colonies now.
    - Corals were visited monthly, and lesions were treated at each visit.
    - New treatment is a proxy to the number of new lesions on a coral, showing there is a cyclical nature to the number of new treatments required in the population of Southeast Florida through times. They all seem to spike during raining season and summertime. What is driving those increases and new lesion formations?

        - Spatial extent: KJ Coral ECA.
        - Time frame: Sept 2019 – July 2021.
        - Sampling interval: monthly.

2. Spatiotemporal analyses of (dark spot) disease on Florida's Coral Reef.
    - Spatial extent: Florida's Coral Reef.
    - Time frame: 2005 – 2019, excluding 2017.
    - Sampling interval: annual.
3. Spatiotemporal analyses of SCTLD resistance (RRC).
    - Spatial extent: KJ Coral ECA and Lower Keys.
    - Time frame: May 2021 – March 2022.
    - Sampling interval: 4 months.

- Statistical modeling (spatial and temporal modeling)
    - Used a permutational distance-based multiple regression model framework
    - Examined predictor collinearity – removed one of the two predictors for any that equaled $r > 0.8$
- Spatial modeling: It included the total number of lesions to other spatial data
    - 66 coral colonies were selected from July 2019 to August 2021and predictors were quantified across 7 spatial ranges (1, 2, 3, 5, 8, 13, and 21 km from each coral)
    - Removed one of the two predictors (n=39) for any that correlated (r > 0.8)
        - Human population – # within 1, 2, and 21 km
        - High Land Use – # within 1, 13, and 21 km
        - Distance to outfalls – Virginia Key, North Miami, and Hollywood
        - Septic tanks – # within 2, 5, and 21 km
        - Coral size – length, width, and height
    - Results: two predictors explained 38% of the overall variation in the number of new lesions: there was a higher disease incidence of each coral with > 100 septic tanks within 5 km (25.4%) and the Virginia Key outfall distance (12.6%).
- Temporal modeling: number of monthly lesions on 47 large corals to concurrent changes in predictor variables.
    - 34 months (Sept 2019- June 2021)
    - Removed one of the two predictors (n=21) for any that correlated (r > 0.8)
    - Predictors were quantified across four temporal scales (previous 1, 3, 7, 14, 30, 60, 90 days)
        - Seawater temperature – "*HotSnap*" metric from the previous 3, 7, 30, and 90 days (35.6%)
        - Rainfall – Accumulation from the previous 3, 7, 14, 60, and 90 days (9.4%)
        - DBHYDRO flow data – Total flow (all inlets) from for the previous 7, 60, and 90 days (14.1%)
    - Results: three predictors explained 59.1% of the temporal variation in the number of new lesions explaining 35.6% of the variability in >150 HotSnap exposure hours over last 90 days, 14.1% flow collineated from inlets of >5,000 cubic ft per

second over last 7 days and 9.4% from <100 inches of rainfall over the last 90 days

- Model updates: Increased period to 34 months of data
    - Expanded the number of spatial scales and temporal windows
    - Updated all previous predictors to match the new temporal extent
    - Included a number of new predictor variables
        - Local land use in the ECA area adjacent to the corals, specifically impervious surfaces that would facilitate run-off
        - Human population density
        - Rainfall patterns
    - To do: Analyze temporal scale mismatch between Flow and WQ data
        - Flow data are continuous while WQ data are monthly
        - Investigate temporal windows in which the Flow data relate to WQ
- Water Quality:
    - Testing for links between inlet flow and reef water quality they synthesize WQ data collected across the ECA
        - Synthesized water quality data collected DEP across the ECA
        - Nitrate, Nitrite, Phosphorus, Orthophosphate, Silicate, TSS
        - Over 6132 analyte measurements from 2018 to 2020
        - Developed a novel R routine to streamline analyte pre-processing (minimum detection limits)
        - Weeks of manual work now achievable in days of runtime
        - Designed for data structure output from DEP database
        - Still requires some work to facilitate wider use
        - Used reef-level water sample collections
        - Initial data exploration showed that examining flow over the previous 3 days prior to water sample collections would yield the strongest relationships
        - Developed Generalized Additive Models (GAMs) in R
        - Accounted for effects of individual ICAs and years (random smooths across these terms)
        - Allowed us to identify global trends and where things diverge substantially from this
    - Inlet flow drives changes in near-reef water quality
        - Model performance ranged from 22.7 to 40.6%
        - Significant global effects of flow on nitrate and nitrite (after accounting for effects of ICA and year)
        - Patterns between flow and all other analytes driven by individual ICA and year effects
    - SE FL inlet flow effect reef water quality
        - Some ICAs have more pronounced patterns than others
        - In 2018, clear positive trend in Baker's and Hillsboro, but not in others
        - Positive correlations between flow and nutrients break down in some ye
- In conclusion, we can say hot snaps are increasing new SCTLD lesions on large corals, the water coming out of the inlets is likely increasing SCTLD, the inlet flow is driving

changes in near-reef water quality and spatial data indicate higher disease between North Miami Beach and Hallandale.

Questions/Comments:

- Kurtis Gregg: Wanted to provide some information on the disconnect between high rainfall and high flow. When worked on the ICA delineation, what we learned from South Florida Water Management District is that they manage their operations based on three conditions: the normal condition, the water supply when there is a drought and the flood control when there is flooding in the area. They will hold back water for water supply that can affect flow going to the inlet and I think how the canal system is being managed is probably relating to that disconnect that you are finding between rain falls and flows.
    - Brain Walker: We agree completely with that. I have an extra slide showing the flow vs the rainfall in inches at Bakers Haulover and Hillsboro, showing large flows with no rainfall and low flows with higher rainfall. This is indicative of that system management and that is why rainfall hasn't been a good predictor in the past so filling this gap with this flow data is really an eye opener.
- John Fauth: A suggestion when using the spatial and temporal data, seems like you are using overlapping regions, another way of doing it is with bands which gives you a bunch of donuts so none of those areas overlap and that will help you to get rid of some collinearity and pickup more subtle variations on land in things like number of septic tanks. As the distances get greater the amount of area increases with the square of the distance, once you get beyond 25% of the area then they are not colinear, but if you use not overlapping bands that will eliminate the problem and give you more insight. The second question I have, is weather you used zero inflated regression analysis which allows you to add the logistic and linear regression together. Found this has been very useful with similar issues you seem to be confronting where you have a lot of zeros (like with rainfall), and then you have a pattern beyond it. It lets you look at those comprehensively. Is very easy to run in R and interpret.
    - Brain Walker: We do have to deal with the 0 inflated data and the distance-based permutation that he is running has a lot of flexibility to deal with that, so I don't know the specifics, but it is part of the design.
    - John Fauth: The nice thing about the zero inflated regression is that it treats the data basically as two sets but at the same time, so you have the set of zero vs something present, and then the pattern within the presence. So it's better than having a flexible regression because it is really treating the zeros like zeros. It doesn't allow the other data to move the intercept on those. I hate giving you more work, but it is one of those things that once you incorporate in the R code it's lickity split.
    - Brain Walker: Thanks for the feedback, is very important since we are thinking on publishing the data this summer.
- Piero Gardinali: I have a question based on the distance with the septic, I was wondering if there is any better way of doing it? The outfalls are relatively easy because you have a point. But when you do a number of septic's with distance how can you account for where those septic's put the effect in terms of the circulation. I'm thinking about a storm water system where you have a lot of collection that ends up in one point and instead of

using distance to the manholes you do distance from a specific inlet instead of the manholes, septic's would be a similar issue.
    - Brain Walker: This was one of the things we recognized with the spatial modelling approach is that it is very unlikely those septic tanks are directly connected to the coral locations, and that they would likely be more affecting the inlet water coming out of the ICAs. We choose to keep them in there just to show the interesting relationship to them but the results of what we have done so far are most interesting with regard to the temporal modeling. The challenge with the spatial modeling is that you have to link it to the inlet mouth, but we also have a lot of hydrographic challenges, and we don't have enough hydrographic data to understand if that inlet mouth is actually making it to the coral, how frequently or what time of the year. For the spatial modeling we put it here because we did it, and to say that it is what it is. I would be hesitant to say that if you repair those septic tanks within the 5 km that the corals will stop getting disease, I would not be able to say that recommendation. As a proxy for nearness, it is not good for proximity to populations for example. We probably would not pursue too much of this spatial modeling context. The temporal models are more informative.
- Richard Dodge: Have you tried cumulative rainfall over various time periods vs cumulative flow over various time periods? Maybe that would be useful to help sort out co-dependencies.
    - Brain Walker: I don't think they have yet. Dave Whitall and Gareth and I are looking at the relationship between flow and rainfall, but I don't think there has been any progress about that yet. We just got global models now, assuming you want more of the flow vs rainfall at each ICA, I think it is a good suggestion.
- Jack Stamates: You should have sonars in the inlets, but those inlets are subjective to extreme events sometimes, where for example water management opens the valves and a big spike happens so wandering if you had an opportunity to look at for instance the first moment of the time series and if that relates, because these extreme events can be extreme in terms of flow.
    - Brain Walker: I don't think we have, there is so much to think about here, we just summed the flow over those time periods and once we found a relationship, we used that. Based on the data we can see that those extreme events occur they are rare but they happen, however we did not look at dissecting that data further. If you would like to do that during your retirement, please let me know!

3. **Dark Spot Disease patterns on Florida's Coral Reef – *Greta Aeby, University of Hawaii***

Goal: Use the statistical modeling that Brian Walker just presented but focused on the dark spot disease along the Florida's Coral Reef.

- Dark spot disease (DSD)
    - DSD is a focal or multifocal dark purple or gray lesion presented in the coral.
    - This disease was first reported in the 1990s in reefs off Columbia and now is found across the wider Caribbean.
        - Similar sings of disease in the Indo-pacific and Red Sea.

    - 16 coral species affected with *Siderastrea siderea* (SSID) as the most common host.
    - Etiology is still unknown primarily because it has not been studied that much but is suggested to be an endolithic fungal infection or a zooxanthellae disease from stress responses.
    - Disease progression is variable, since lesions can resolve and reappear, and usually cause chronic tissue loss but with minimal colony mortality (lesser than other diseases).
- Factors affecting the DSD prevalence variables:
    - Colombia shows higher water temperature and shallow sites to have higher DSD prevalence.
    - Bahamas has higher DSD prevalence during winter and coral size shows no relationship.
    - Dominica shows no seasonality at all, but larger colonies seem to be more affected by the disease.
        - These studies are almost all the reports done on this disease showing how little work has done and how little we know about it. Therefore, it is very important to continue researching all diseases and get as much information about general drivers of coral disease, to better handle future disease outbreaks.
    - Is the diversity of disease lesions more regional? Or is it host response? Or is the etiology different and how is the environment involved in the development of this disease?
- Patterns of DSD across the FRT between 2005- 2019
    - Patterns were based on yearly DRM survey data from 2005-2019 from Southeast Florida to the Keys and showed dark spot disease in *Siderastrea sidera* to 2,508 individual surveys out of 43,363 colonies examined.
        - Annual DSD prevalence of 0.045% - 4.4% of the colony (showing how common is the disease in the population) but with an overall average prevalence of 2%.
        - Annual DSD frequency of occurrence of 4.8-30.9% of the sites with an overall average frequency of occurrence of 14.1% of the sites.
    - General patterns show that DSD prevalence has increased through time, with 0.51% DSD prevalence in 2005 to 3.3% in 2019.
    - The proportion of sites show that DSD frequency of occurrence has increased through time with 4.8% proportion of sites in 2005 to 28.3% 2019.
        - Even though DSD has been increasing through time there is no effect on coral cover, in fact SSID cover is increasing through time with 1.7% average SSID cover in 2005 to 4.9% in 2019.
        - Relative abundance of SSID is also increasing with 27.5% an average proportion of SSIDS in 2005 to 38.1% in 2019.
    - Pattern of DSD prevalence is affected though time, initially it showed that DSD prevalence was more common in Southeast Florida than in the Keys but in 2009 there was a significant regional shift increasing DSD prevalence in the Keys.

        - The regional shift in DSD frequency of occurrence showed the same regional shift between Southeast Florida and the Keys. Causing higher proportion of sites in the Keys than in Southeast Florida.
        - Average SSID cover showed that the Keys had always more SSID abundance than Southeast Florida but before 2009, Southeast Florida had higher prevalence and higher frequency of occurrence of the DSD.
        - Relative abundance of SSID increased in Southeast Florida and the Keys.
    - The hots spot analysis spatial statistic tool was used to analyze potential spatial clustering of DSD prevalence for all sites and years combined (2005- 2019, excluding 2017).
        - Seeing DSD "hotspots" in both Southeast Florida and the Keys region.
- Underlying environmental factors affecting DSD – statistical model
    - Statical modeling where potential predictor variables where examined such as host abundance, depth, year, and habitat characterization. These predictors were under six core themes: human use of reefs, wastewater treatment, septic/sewer area, land use, in-situ water quality, and human population density.
    - 18 significant predictors explain the variability of DSD cases that together explained 64.4% of the underlining deviance in the response variable.
        - Reduction of water quality has a larger impact on the degree of the SSIDs getting this diseased.
        - Main 3 underlying environmental drivers explaining DSD variability among sites found to be the amount of silica in surface water (freshwater input), host density, and proximity of survey site to septic systems.
- In summary: we found that DSD in SSID populations has increased through time along Florida's Coral Reef.
    - Increases in prevalence and frequency of occurrence reflect the pattern in the Fl Keys while DSD declined in Southeast Florida.
    - Distinct reef areas along Florida's Coral Reef where high levels of DSD consistently occur – "hotspots".
    - SSID cover remains steady with slight increases and the relative abundance is increasing.
    - SSID is becoming a more dominant component of Florida's coral community.
    - Recommend more research on DSD and other SSID diseases.

Questions/Comments:

- Phillip Dustan: How has the abundance of colonies of SSID changed through time?
    - Greta Aeby: The colony density through time is stable but increasing a little bit.
    - Phillip Dustan: How does that compare to other data of the total abundance of coral colonies over time, is that still going down?
    - Greta Aeby: I didn't look at total abundance, so I will have to look at that because it is a good question.
    - Phillip Dustan: We are basically looking at the last 2% of what is used to be there, so now we try to understand all of these statistics but in reality, what are we really looking at?

- Greta Aeby: We have been talking about water quality issues, since 70s, so it is very frustrating when the issues of the negative impact of poor water quality on coral health in general. We have known this for decades and to be fair there has been progress, they are changing out septic systems etc., but it has been slow and clearly as you say not fast enough. The amount of coral cover is not great.
- Phillip Dustan: The reef is a result of the process, the coral reef is an emergent entity that comes out of a whole series of processes that operate, and what we have been doing is playing pick-up stick and taking the whole system apart, and we have been doing that for years. But the other question I have is that DSD doesn't kill SSID, so what does it do?
- Greta Aeby: It can cause partial colony mortality, but like I said there has only been a small handful of studies that looked at it. There have been surveys but nothing like tagged colonies or looking at histologies, so it's just a very poorly studied disease.

Public Comment

John Fauth: An effort is underway to add a Right to Clean Water amendment into Florida's state constitution. The effort requires collecting >800,000 valid petitions to place the issue on the 2024 general election ballot. More information is at https://www.floridarighttocleanwater.org/

4. **Spar Orion - Clipper Lasco restoration five-year monitoring report – *Shane Wever, NSU***

Goal: Discuss the results of a 5-year monitoring report describing resource recovery after structural stabilization and rehabilitation of the M/V Spar Orion and M/V Clipper Lasco grounding sites.

- Port Everglades is adjacent to an extensive reef track in southeast Florida and brings in billions each year from cruise ships and the cargo industry, because of this high volume of traffic there have been some incidents where impacts with the reef have occurred including anchor drags and ship groundings.
    - After two most recent groundings, Spar Orion and Clipper Lasco in 2006, the anchorage was moved outside of the outer reef in March of 2008 and no major groundings have occurred since.
- While there have yet to be any major groundings since the anchorage change, resource managers are still trying to fix the damaged caused previously to the reef.
- M/V Spar Orion and Clipper Lasco groundings caused fundamental changes to the benthic community structure while crushing and displacing corals and other invertebrates.

    - Also caused fracturing of the reef platform, generating large amounts of unconsolidated reef rubble and loose sediment.
- After the ships were refloated some immediate restoration occurred including rubble consolidation and coral relocation, and in 2011 (5 years later) there was a site assessment that looked at the impacted sites to observe resource recovery.
    - They found minimal biological recovery with loose rubble persisting, indicating that loose substrate which could easily be mobilized was likely preventing settlement and survival of corals and other sessile invertebrates. especially when exposed to physical disturbances such as hurricanes.
- However, in 2015 local resource managers- DEP's Coral Reef Conservation Program- carried out a restoration project to stabilize the substrate by consolidating rubble and capping rubble with large limestone boulders secured with mortar at these two grounding sites.
    - Funds were derived from private settlements associated with the original grounding events as well as civil penalties collected through a provision of the Florida Coral Reef Protection Act.
- Monitoring took place from 2016 to 2021 at these restored sites, data was collected at 3 habitat types during the monitoring: on boulders used for stabilization, rubble that still persisted at the impact sites and on reference reef sites that would be representative of unimpacted reef communities.
    - The objective was to assess if the addition of boulders promotes reef recovery by looking at demographic data of colony density (stony corals, octocorals, *Xestospongia muta*), size class (stony corals and octocorals), community composition and functional group cover.
- Data was collected using size quadrants on both sides of a transect to obtain demographic data, photo transects were used to collect benthic cover and rugosity (chain method) was used to measured complexity of benthic structure.
- When looking at adult stony corals, defined as bigger or equal to 5cm in diameter:
    - Colony density over time
        - Adult density slowly increasing on boulders, while decreased on rubble due to the physical disturbance of hurricane Irma between 2017 and 2018. We also saw an increase in density on the reef between 2016 and 2021.
    - Size class of colonies
        - There was an increase in size class of corals on boulders, while rubble sites fluctuate interannually and the increase in size after Irma is most likely due to the loss of smaller colonies making the mean colony size increase. Reef sites declined between 2018-2020 is due to loss of a few large colonies.
    - Species richness
        - Across all habitats indicated that stable substrate promotes and maintains community development over time. Reef sites maintained a consistent species richness while rubble sites fluctuated interannually. Boulder sites tripled in the number of species from 2016-2021.
- When looking at stony coral recruits, defined as less than 5 cm in diameter:
    - Colony Density

        - Rubble sites significantly decreased from 2017-2018, losing more than half of the recruit density because hurricane Irma mobilized those rubble substrates. In the same timeframe reef sites remained relatively unchanged while boulder sites were less impacted and show an overall higher density.
        - Shows stabilization of rubble had an impact on recruitment and interannual survival.
    - Species richness
        - Suggests that the rubble had constant recruitment of species but had trouble retaining that species richness. Boulders did double throughout the study.
- Non-stony coral community: Reef had the highest density of gorgonians of all habitat types with boulders having significantly lower gorgonians than both reef and rubble.
    - Data shows no giant barrel sponge (*X. muta*) settled on the boulders even though all giant barrel sponges at rubble sites appear to have survived the grounding event, but no recruitment has been identified.
- Based on the NMDS community structure is still significantly different between each habitat, where the community is more developed on the reef site. Rubble is still looking like an unrestored site while boulders are at least showing an increase in some important taxa.
- Community structure requires more time to develop, six years is not enough, but overall are seeing increases in density and species richness of stony corals, limited octocoral recruitment and no *X. muta* recruitments.
- Boulders will always look like boulders so they are not the best representation of a reef but should be a primary restoration tactic, since stable substrate promotes and maintains community development overtime and during high energy weather events.
    - We recommend to not wait years to restores a site like this study show and implement boulder deployment as the primary restoration. Also, implement longer term monitoring research to be able to better quantify the community structure.

Questions/Comments:

- John Fauth: What species of corals recruited onto the boulders?
    - Shane Wever: *Siderastrea siderea* was a big part of that recruitment but I did have some interesting recruitment on those boulders as well, for example in 2020 we had recruitment of an *Orbicella, Colpophyllia*, and *Diploria*. This year we had some *Eusmilia*. So in terms of species reaches, we are getting some interesting species that recruit, but yes *Siderastrea siderea* represents a big part of that recruit.

Wrap up and Adjourn

- Tomorrow the first activity of the agenda we will be asking for feedback from some TAC members using the mirror interactive whiteboard to get your feedback and input. The link will be emailed this evening to enter the interactive activity.
- Looking forward to tomorrow it was great seeing everyone.

Wednesday, May 4

Announcement

- Welcome back to the second day of the TAC meeting

Session III: FDOU LAS 51: Research and Management Priority Scoping

1. **Activity to refine top priorities created during prior workshops – *Josh Kilborn, USF***

Goal: FDOU-51: Meta-Analysis of Water Quality, Fish, and Benthic Data within the Kristin Jacobs Coral Reef Ecosystem Conservation Area and address the collaborative meeting #1 debriefs and review of selected research priorities activity afterward.

Introduction

- FDOU-51 project is a Southeast Florida Coral Reef Initiative (SEFCRI) Local Action Stratagy that identified the need to synthesize existing data collection efforts in the coral ECA, provide a holistic view of the coral reef ecosystem, utilize a subsystem framework (water quality, fish, & benthos) and to investigate spatial & temporal patterns, trends, and synergies among and within subsystems and their components.
- The FDOU-51 project objective is to identify patterns, trends, and synergies among the data related to benthic habitats, fishes, and water quality within the Coral ECA.
    1. Determine which management priorities are relevant to the contemporary Coral ECA system and its stakeholders;
    2. Characterize existing datasets available for targeting those priorities and identify limitations and knowledge gaps;
    3. Assess the statistical feasibility of conducting a meta-analysis given the available data and management priorities;
    4. Develop recommendations for improving future research programming and data collection to satisfy stated management goals.
        - Collaborative meeting series #1 was on March 23-25, 2022, assessing number one and two of the project objectives.
        - Collaborative Meeting #2 will take place later this month (May 2022) to go over the statistical feasibility of all the priorities focusing on goal three and four.
- Scope of the Collaborative Meeting (CM) #1 subsystem meeting workshop, which was a working meeting with three deliverables:
    1. Updated subsystems conceptual model.
    2. Subsystem data triage/gap analysis.
    3. Subsystem top -10 priorities focused one the Coral ECA.
- Scope of the CM#1 all-hands meeting work, which also was a working meeting with three deliverables:
    1. Integrated coral ECA conceptual model.
    2. Coral ECA data triage/gap analysis.
    3. Coral ECA top 20-priorities and reduced to the most actionable and feasible.
- Conceptual Model updating among the ECA, had some issues since they were old with missing attributes, missing connections, confusing, over-simplified, and over-complicated.

1. The group decided that all the conceptual models need to be fully redone to clarify and standardize these conceptual models for future practical use.

- The subsystem scoping and prioritization selected seven developed focus areas for the water quality subsystem priorities, seven developed focus areas for the fish subsystem priorities, and eight developed focus areas for benthic subsystem priorities.
    - Recently developed 12 additional developed focus areas for the Coral EFA- level priorities.
    - The 23 most highly voted and important ideas were plotted in a diagram ranked by importance and feasibility based on 5 themes (Water quality (WQ), fish, benthic/coral, WQ + benthic, WQ + fish + benthic.
        - The most feasible four ideas are the beta diversity of fishes/fish catches as indicators of coral ECA/WQ/ Benthic health/ structure/ function.
            - 20 – Ecologically driven Fish assemblage shifts.
            - 16 – Fish abundance & density trends in the Coral ECA.
            - 21 – ID Indicator *spp.* for WQ & Benthic "health".
            - 23 – FDM effort compared to WQ & Benthic "health".
        - The following most feasible six ideas are WQ effects on Fish/Benthic. Characterize indicator species/keystone attributes with the greatest impacts. Specific focus on sedimentation and spatial considerations. Identify Benthic indicators of "health".
            - 15 – "Keystone" WQ attributes for Fish and Benthic "health".
            - 14 & 19 – ID Fish & Benthic indicator *spp.* for WQ "health".
            - 17 & 18 – Sedimentation & WQ effects on Benthic condition.
            - 10 – Effects of coastal construction on Benthic communities
        - The last four feasible ideas are core coral reef population dynamics and functional ecosystem services: larval supply, recruitment success, and resilient area mapping; changes to rugosity and overall coastal risk mitigation services from reef.
            - 8 – Reef resiliency (independently and due to WQ changes).
            - 6 – Reefs as coastal risk-mediation service over time.
            - 7 – Role of rugosity on reefs.
            - 1 – Coral larval supply and recruitment success (very important for least feasible).
- The next step is to develop detailed definitions of the priorities through a collaborative exercise that starts today.
- Identified specific data sources to address these priorities and conduct a feasibility analysis for each.
- Help me understand two main things, what is the appropriate level of focus for FDOU-51 projects? By focusing on areas/ aggregated ideas? Or break it into individual ideas?
    - Clarification of top FDOU-51 priorities for coral ECA: goals and visioning for each project and definitions of success for each.

Questions/Comments:

- Phillip Dustan: When looking at all these acronyms are you starting from the point of an intact reef or are you starting on the point of the reef as it is today?
- Josh Kilborn: Focusing on a contemporary system and figure out what we can figure out now so we can figure out how we can move forward, focusing on data that is relatively long term in the collection but there is not a lot of that, so we can't go back too much in time because data is not available. Because of that, we are taking a more contemporary view of the system.
- Phillip Dustan: So, what we are saying is that we are looking at this degraded system to the point where it is now so 3-5 % at best of what it once was?
- Josh Kilborn: Yes, we would like to see if we might be able to discover some of the trends that it got to where it is but again, we are data-limited for a holistic view of that. To see if we want to take the benthic, water quality, and fish to put them all together and see if we can understand how it works as a holistic system, so yes.
- Phillip Dustan: For example, when you say data are you looking at long-term surveys that started in the 90s, or are you looking at the early literature as well the geochemical literature data? Are you using that in this project as well?
- Josh Kilborn: We tried to stay away from the "snapshot" data set as much as we could and stick with things that are more spatially complete on the coral ECA and temporarily continue so things like MCRAM, are a good example of a program that's monitoring all these sub-systems that I mentioned. They did get a late start, but they collect comprehensive data on all the coral ECA. Looking at data collection efforts that were meant to be at the scale of the whole coral ECA, not just Miami or anything like that, and merge data together, to see if we can uncover any of those long-term trends. I think what you are describing is something like a meta-analysis. But we are looking at a holistic analysis. So, if you look at the description of the project and the title of the project they don't match entirely.
- Phillip Dustan: Sound like the data set you are using for the project was maybe at 10% and now is at 1% where it used to be at 80%, by the time that all the various monitoring were done we were almost that the 2000s almost. So, what we are looking at is a degraded system when that being. So, you haven't gone backward in the literature and looked at other things that might be chronologically and explain what happens. For example, the die-off of *Diadema* in the 1980s, how does that event fit in your analysis
- Josh Kilborn: So that would not be a part of this analysis. That is not what we are trying to do here, we are trying to figure out how we can take the existing monitoring programs, understand what they tell us, and tell us to determine if we can make these programs more efficient for future monitoring and efforts. My understanding is that we are not looking back historically and just looking at what is happening now and learning from that mainly because there was not too much information.
- Phillip Dustan: The question is we have a beautiful barn, but the barn started to decay and burned down and now we are going to monitor it moving forward to find out what? How does the barn continue to degrade or towards the way of how do we make the barn look like it used to be?
- Josh Kilborn: That is not up to me.
- Phillip Dustan: I'm trying to figure out, what's the point of this exercise to try to figure out if we should continue to monitor over time? Or looking for a cure to try to figure out what went wrong and see if we can get it back?

- Josh Kilborn: It is closely aligned with the forward.

Activity

TAC members, facilitated by Josh Kilborn, participated in an exercise using Mural, an online interactive whiteboard tool, to discuss and define the top 5 priorities settled on in prior working group meetings for fish, benthic, and water quality data. For each of the 5 priorities, TAC members were asked to review the research theme, help to define the goal for that project, and then identify what success will look like for that project. Josh will take the information gathered from this exercise and determine how to further define the goals of LAS project FDOU 51.

Session IV: Florida's Coral Reef Economic Impact

1. **Economic impact studies on recreational fishing and diving/snorkeling for Florida's Coral Reef – *Kristy Wallmo, Mary Allen, Sabrina Lovell, NOAA***

Goal: Study addressing the economic impacts on recreational fishing and diving/snorkeling on Southeast Florida's Coral Reef including natural and artificial reefs along 5 counties: Broward, Martin, Miami-Dade, Monroe, and Palm Beach.

- Economic impacts are dollars spent and re-spent in many different sectors, creating waves of economic activities.
    - Expenditures on a particular activity generate metrics: such as employment, value-added, labor income, and the output gross revenue.
    - IMPLAN is a commercially available input-output software used to estimate the four mentioned metrics (employment, value-added, labor income, output).
        - Offers a way to look at the contributions of spending on an activity (i.e. recreational fishing, diving, snorkeling) at different spatial scales.
        - Creates a picture of an economy.
        - Data for industry output (sales), employment, value-added, income, and final demand for 544 business sectors in each county in the U.S. (2019 version).
        - Social Accounting Matrix (SAM) determines multipliers for activity; calculates output changes in response to input changes.
        - NOAA Fisheries has been purchasing IMPLAN since the late 1990s and purchases updated datasets every 2 years.
- Impacts of diving and snorkeling on Southeast Florida Reefs
    - Defined impacts from spending on durable goods (mask, snorke, etc.) and trip level goods (air, food, etc.).
    - How do these expenses by participants affect the economies of the 5 counties Broward, Martin, Miami-Dade, Monroe, Palm Beach, and the state of Florida overall?
    - Work plan

        - There are no accessible sampling frames for divers and snorkelers thus, we built a frame of registered boaters and combined it with opportunistic samples from listservs, newsletters, NGOs, retail, etc.
    - Timeline used:
        - May 2016 – Sept. 2016: Qualitative research to help design survey & outreach with industry and NGOs to help publicize survey effort.
        - Oct. 2016: Boater license frame obtained, and postcards mailed to randomly selected boaters. Postcards delivered to retail outlets.
        - Fall 2016 & 2017: Electronic link to survey distributed via electronic listservs
        - Survey portal closed Oct. 2017.
    - Data collection: was kept simple based on participation, durable expenses, trip expenses and some demographic data.
        - In the durable expenses category, we can quantify the items purchased during the last 12 months mainly for the purpose of diving or snorkeling in Florida.
        - The survey was live for just under a year, we received 1,148 surveys.
        - Respondents took 18,928 dive trips and 4,409 snorkel trips to reefs in Florida during the previous year.
        - On average, respondents were 48.2 years old and the majority of respondents (~65%) were female.
        - Percentage of the respondent's last trip taken leaving from Broward County (26%), Martin County (4%), Miami-Dade County (10%), Monroe County(28%), and Palm Beach County (37%).
        - ~75% of respondents said they took a quarter or fewer of their trips to artificial reefs.
        - ~40% of respondents said the number of trips increased compared to other years (8% said their number decreased).
        - The total expenditure was $486,277 USD with a mean expenditure per respondent of $202.
        - There was a total of 11,000 trips among participants.
    - Only know the number of trips for their sample, not the total for Southeast Florida. Needed a better estimate of how to scale that number to estimate how many trips actually taken. Two alternatives:
        - Linear scaling by number of participants and/or trips, excel tool. But still don't know total number of trips.
        - Decided to use the Diving Equipment and Marketing Association (DEMA) to estimate diving and snorkeling applied to Census data by state and county.
    - County and State economic impacts from diving and snorkeling:

	Broward	Martin	Miami-Dade	Monroe	Palm Beach	Florida
Employment (jobs)	1,544	241	656	1,756	2,015	8,668
Labor Income ($)	60,845,493	7,541,305	25,486,882	49,938,559	82,892,100	339,569,164
Value-added ($)	92,648,855	11,331,353	38,771,521	79,847,609	123,396,545	529,464,622
Output ($)	155,223,207	20,396,651	64,989,113	149,164,491	202,511,112	902,069,703

- Impact of recreational fishing on Southeast Florida Reefs
  - Expenditure on durable goods (ex. Boat) and trip-level goods (what you will buy for your trip on that day).
  - How do those expenses by participants affect the economies of the 5 counties Broward, Martin, Miami-Dade, Monroe, Palm Beach, and the state of Florida overall?
  - The data utilized was existing information mainly from NMFS Marine Angler Expenditure.
  - However, we want to know what portion of all the recreation impacts from each county could be attributed from fishing in Southeast Florida Reefs.
    - Decided to use scaling trip numbers tool, because knew how many trips total. Classified fish species from MRIP as reef fish, opportunistic reef fish, or not a reef fish to determine % of trips that were "reef trips".
  - County and State economic impacts from reef-related recreational fishing:

	Broward	Martin	Miami-Dade	Monroe	Palm Beach	Florida
Employment (jobs)	442 (591)	286 (312)	440 (572)	1,677 (2,452)	803 (1,056)	3,787 (4,983)
Labor Income ($)	14,965,000 (20,006,000)	9,633,000 (10,517,000)	14,819,000 (19,271,000)	59,349,000 (86,767,000)	27,183,000 (35,767,000)	130,969,000 (172,328,000)
Value-added ($)	29,187,000 (39,021,000)	18,842,000 (20,570,000)	28,787,000 (37,434,000)	107,446,000 (157,085,000)	52,710,000 (69,356,000)	245,834,000 (323,466,000)
Output ($)	43,805,000 (58,562,000)	28,385,000 (30,988,000)	43,845,000 (57,016,000)	173,212,000 (253,234,000)	79,743,000 (104,926,000)	383,591,000 (504,726,000)

- Southeast Florida Reef Valuation Project, conducted a Stated Preference Choice Experiment Survey with residents and non-residents of Florida to estimate the economic value of access to reefs and the economic value of varying states of the reef
  - Residents of the five Southeast Florida counties are WTP a fee of $11.40 to access coral reefs and $9.30 to access artificial reefs.
  - Florida residents outside of the five counties are WTP $11.27 and $8.45 to access coral and artificial reefs, respectively.
  - U.S. residents are WTP:
    - ~$15 for a 1% increase in the amount of natural coral cover.
    - ~$8 for a 1% increase in the number of artificial reefs.
    - ~$6 for a 1% decrease in the number of visitors to reefs.
  - U.S. residents are indifferent (equally satisfied) between a 1% increase in the amount of natural coral cover and:
    - 1.9% increase in the number of artificial reefs.

        - 2.4% decrease in the number of visitors to reefs.
- Reports:
    - Wallmo, K., Edwards, P., Steinback, S., Wusinich-Mendez, D., and Allen, M. 2021. Economic Impact Analysis of Snorkeling and SCUBA Diving on Florida Reefs. NOAA National Ocean Service, National Coral Reef Conservation Program. NOAA Technical Memorandum CRCP 42. Silver Spring, MD. 48 pp. doi: https://doi.org/10.25923/g8ex-r982
    - Wallmo, K., Lovell,S., Gregg, K., and Allen, M. 2021. Economic Impact Analysis of Recreational Fishing on Florida Reefs. NOAA National Ocean Service, National Coral Reef Conservation Program. NOAA Technical Memorandum CRCP 41. Silver Spring, MD. 11 pp. doi: https://doi.org/10.25923/rsgj-ta64

Questions/Comments:

- Dana Wusinich-Mendez: Both FWC and DEP and representatives of southeast Florida played really key roles and helping to shape the questions and what are the studies were focused on. Important to know the final economic valuation study was funded by the state FWC through a grant to Martin County. It was jointly funded since NOAA funded the economic and technical expertise, but FWC funded the survey work that was conducted for that valuation study.
- Manoj Shivlani: How did you address response bias? Just curious with respect to how response types may then have affected WTP if there were a selection/response bias.
    - Kristy Wallmo: In the first components, the diving and snorkeling impacts, we could not address response bias. That is one of the downfalls of an opportunistic sample is that we don't really have a systematic way to address response bias. With the WTP study, we can address it. The company hired to implement the survey had very complex ways to address things like that even down to the level of item non-response in the survey. We can look at the response bias for the second phase, the first phase will be very difficult to look at response bias.
- Richard Dodge: Generally, how do these results compare to the Hazen and Sawyer studies of circa 2000?
    - Kristy Wallmo: We have some of those addressed on the report. When we first started many people were hoping for a repeat of Bob Leeworthy's study but that is not what this is. We didn't have the resources that he had, and the surveys and methodologies were very different as well. If you want to email me after I can better answer that question, we have a report where we compars our values to the others.
- Rachel Skubel: Were non-monetary values discussed with respect to the monetary values especially for cost-benefit analyses? I.e., this lens being one of many value lenses.
    - Mary Allen: NOAA CRCP is starting a multi-year Coral Reef Ecosystem Services Valuation Project, and will result in values similar to the previous studies: https://www.coris.noaa.gov/activities/coral_esv_project/welcome.html
    - The CRCP valuation study will also include non-monetary values
    - And here is the link to the FL economic impact reports. Thanks all! https://www.coris.noaa.gov/activities/florida_economics/welcome.html

- Kristy Wallmo: The Sawyer Hazen study was a bit different than ours and their numbers were generally larger - for example the estimate that reef related expenditures generated between 138 million and 1 billion in income per county. That said their sample was different - they included groups such as glass bottom boat visitors. I am happy to discuss off line if you want to email me

Public Comment

No public comment

2. *Diadema* die-off in the Caribbean – *Judy Lang, AGRRA*

Goal: Diadema responses taken in the Caribbean by the establishment of a response network to follow the recent Diadema die-off in the Caribbean

- Ealy in February (Feb. 6th) in St. Thomas they noticed *Diadema* die-off, thus immediately they started looking in the Virgin Islands and Puerto Rico to see evidence of sea urchins dying.
    - The *Diadema* die-off started expanding and has now established in St. John, St. Barth, Jamaica, St. Maarten, St. Eustatius, Mexico, Dominica, and St. Vincent lastly reported in early April. At the same time, different scientists and groups were contacted to get answers to why the die-off was occasioned.
    - When *Diadema* gets diseased and starts to die-off the disease gets spread insanely quickly becoming very concerning.
- A *Diadema* Response Network is an open, inclusive, international collaboration formed on March 29, 2022. One of its goals is to try to understand the cause of this recent die-off in the Caribbean region. This effort also includes collecting tissue sampling of *Diadema* tissue for histopathology and for diverse molecular, microbial, genetic, etc. analyses and/or for contaminant *Diadema* tissues and other environmental components.
    - The network is broken into information, tracking reports, monitoring, rescue, tissue sampling, environment, and demography.
- A tracking map was established, to follow the *Diadema* health, so far there has been:
    - 270 reports
    - 19 affected jurisdictions
    - 12 non-affected jurisdictions (including Florida)
    - > 380 photos in the photo library
- Some dead sea urchins have shown scavenging instances by fireworms or lobsters.

Questions/Comments:

- Josh Kilborn: Can anything be done to "contain" the spread? How can the FRT be protected?
    - We first need to know what it is, so this might be hard, I don't really know.

- Manoj Shivlani: Is this affecting more than Diadema, i.e. other species?
    - Judith Lang: Manoj—curious question, in a couple of locations the answer is a definite no, and in a couple, there are simultaneous observations of some dying Tripneustes, and/or Echinometra or even heart urchins
- Joe Lopez: Nice presentation Judy. How comparable is this current Diadema die-off to the 1980's die-off, with respect to the rate of spread?
    - Judith Lang: Joe it is spreading incredibly faster, took 13 months to get around in currents and counter-currents and within 2 months most of the northern Caribbean is already affected. Is spread waterborne once established somewhere but must be some other method of getting between jurisdictions. Ah—took 13 months in 1983-84.

Session V: Coral Monitoring Updates

1. SECREMP – *Nicole Hayes, NSU*

Goal: Update of the collected data including 2021 from the Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP).

- SECREMP is an annual project utilizing permanent stations to provide relevant and timely information on current status and temporal and spatial trends of coral reef resources within the Kristin Jacobs Coral Reef Ecosystem Conservation Area (Coral ECA). It is an expansion of the Keys and DRTO Coral Reef Evaluation and Monitoring Project (CREMP)(FWC). These monitoring projects together encompass the entire Florida's Coral Reef. All information is available in annual reports.
    - Regional partners include FL DEP CRCP, FWC/FWRI Coral, NSU.
        - Federal Partner - NOAA CRCP
- SECREMP: was established since 2003 and has added sites and changed methodology throughout different events and management needs. Currently, there are a total of 22 sites (8 Miami-Dade, 7 Broward, 5 Palm Beach, and 2 Martin) distributive between nearshore, inner, middle, and outer habitats.
    - Each site has 4 permanent stations with 1 still image transect:
        - percent benthic cover- 0.4 x 22m transect
        - digital camera ~40 cm above reef substrate
        - 15 random pts/image, ~50-60 images/ transect
        - functional groups: stony coral species, octocoral (branching/ encrusting), macroalgae, CCA, substrate
    - 1 Belt-transect
        - Stony corals= 1x22 m transect, to ID and measure all colonies >2cm diameter and record all conditions that each stony coral had
        - Count long-spined sea urchins
        - Barrel sponge *Xestospongia muta*= 1x22 m transect, location, measurements, and conditions were recorded

        - Octocorals = 1x10 m transect (too abundant so the transect was cut down), ID 3 target species: *Gorgonia ventalina, Antillogorgia Americana, Eunicia.* Each was measured and conditions were recorded.
    - 1 Temp Recorder
- Reginal SCTLD prevalence peaked in 2015 in Martin County while Palm Beach County saw elevated SCTLD prevalence from 2014 to 2018, where prevalence peaked in 2016. Although it was lower in the Northern Counties, both still experienced SCTLD outbreaks.
    - Disease was highest and most evident in the southern counties, especially in Broward which had 5 years where at least 1 site had SCTLD prevalence of >5%.
    - SCLTD has been the most prolonged at site BC1 – the densest MCAV site
    - Miami-Dade saw increased disease concentrated around 2015 and 2016, but lower percentage than Broward
    - For 2021 the only disease site was BC1 being one *Montastraea cavernosa* the affected specie.
        - Important to remember these are annual surveys so we only capture a snapshot of current infections
    - There were active lesions on 15 of the 29 total species within the transect
- Regional Stony Coral Live Tissue Area (LTA) of corals > 4 cm:
    - In the northern counties, site MC1 is interesting, with the loss of *Pseudodiploria* but then a huge increase of *Porites astreoides* in that site.
    - On the southern counties, the most dramatic loss was at BC1, driven by being *Montastraea cavernosa* mostly and some *Orbicella favolata*
    - Just about all sites in palm beach had major losses between 2015 and 2016, with little recovery
    - LTA was consistent between 2012-2015 but dropped dramatically in 2016 (between 2015-2018, there was an overall loss of >50% or live coral tissue). The increase in density seen in 2020 is driven by weedy species, which has little effect on regional LTA.
- Regional Stony Coral Density:
    - Regionally, stony coral density stayed relatively consistent from 2013 to 2015, dropping in 2016 to the lowest recorded regional density.
    - Coral density has been increasing, while the LTA has been decreasing or remaining the same. This increase in density is driven by small, non-reef building colonies primarily driven by only *Porites astreoides, Porites Porites, Siderastrea siderea* and *Agaricia agaricites* that haven't significantly increased regional LTA.
        - Additionally, dramatic increases of these species are only happening at a few sites, like MC1
- Regional Stony Coral Size Distribution:
    - From 2012- 2015, the distribution of colony sizes was stable. Beginning in 2015, there is an increase in mid-sized colonies. In 2016, there is a loss of mid-size and large colonies. From 2016-2021, the distribution becomes heavily weighted to small colonies and a loss of mid-sized and larger colonies.
- Species driving changes:
    - Highly susceptible species LTA: *M. meandrites* and *D. stokesii* were the first species to exhibit significant loss. In 2016, LTA was near zero for both species,

but they were never completely lost from the sites. In 2019-2021, recovery appears to be beginning, but the increase is not yet significant.
    - Intermediately susceptible species LTA: The largest lost is mainly driven by *M. cavernosa* and *O. faveolata* beginning in 2016. Recovery for these species is not yet evident and there is still only one instance of active disease in *M. cavernosa* by 2021.
    - Low susceptibility species LTA: have been increasing in live tissue area across most sites, both *P. astreoides* and *P. porites* LTA have more than doubled in abundance since 2013.
- Tally data of juvenile corals (<4 cm) along transects:
    - Beginning in 2018, stony coral colonies <4 cm in diameter were identified to lowest taxonomic level and tallied across all SECREMP sites.
    - In 2021 a total of around 31 hundred colonies <4 cm was found
    - The three most abundance species in 2021 were *S. siderea, P. astreoides,* and *M. cavernosa* (210), which made up 84% of all colonies <4cm recorded, and with *S. siderea* contributing to the vast majority of those colonies.
    - Additionally, those highly susceptible to SCTLD have seen little realized recruits including *C. natans, D. labyrinthiformis, Orbicella spp.* and *Psuedodiploria species.*
- Octocoral Density
    - Region-wide octocoral density from 2015-to 2017 was significantly greater than in 2013 and 2014. However, in 2018 density was significantly lower than in 2017, driven by loss from Hurricane Irma. Octocoral density has since recovered, and density in 2021 was significantly greater than in 2013-2016, 2018, and 2019.
- *Xestospongia muta* density:
    - Region-wide *X. muta* density was significantly greater in 2015, 2016, and 2017 than it was in 2013; density in 2017 was also significantly greater than in 2014. However, as observed with octocorals, in 2018 density was significantly lower than in 2017, driven by loss from Hurricane Irma. Density in 2019-2021 was significantly greater than density in 2013, showing recovery post-disturbance.
- Mean Annual cover:
    - In 2021, stony coral percent cover averaged across all SECREMP sites was 0.7%.
    - Region-wide stony coral cover did not significantly change from 2020 to 2021.
    - Region-wide octocoral cover did not significantly change from 2020 to 2021 through an increase in the mean value was observed (2.7% to 3.9 %).
    - Changes in macroalgae cover were highly variable which reflects the ephemeral nature of macroalgae. There was a significant increase from 2020 to 2021.
    - Region-wide sponge cover significantly decreased from 5.0% to 4.4%.

- Recent SECREMP Products:
    - Annual SECREMP Reports and 2-page outreach documents
        - https://floridadep.gov/rcp/coral/content/sefcri-project-reports-and-products
- Recent Publications:
    - Walton et al. 2018: Impacts of a Regional, Multi-Year, Multi-Species Coral Disease Outbreak in Southeast Florida (Frontiers in Marine Science)

- Jones et al. 2020: Thermal stress-related spatiotemporal variations in high latitude coral reef benthic communities (Coral Reefs)
- Hayes et al. provisionally accepted: Tissue loss disease outbreak dramatically alters the Southeast Florida stony coral assemblage (Frontiers in Marine Science)
- Waldman et al. In prep: Density trends of Xestospongia muta (giant barrel sponge) and its impact on Southeast Florida Reefs
- Hiley et al. In prep: Spatial and temporal trends of Southeast Florida's octocoral community
- Jones et al. In prep: Status and trends of the benthic community on the Florida Reef Tract

Questions/Comments:

- John Fauth: Give us more detail on how the *Acropora cervicornis* is doing it looked like you had some small colonies recruiting there.
    - Nicole Hayes: Our Miami-Dade sites historically had some sites with a little bit of *Acropora*, we have an Acropora site called BCA, but we don't do demographic data on *Acropora* in-situ because it is one big patch. But data shows that is shrinking and decreasing in cover and moving. I would not say we have a lot of recruitment in the SECREMP sites, I would say it is more asexual recruitment from adjacent populations.
- Brian Walker: It's interesting how the variability in all these cover metrics decreases over time (at least that's what the Ybars show).
    - Nicole Hayes: As you lower the amount of tissue and amount of the coral that you have, the variability between sites goes down, all sites are considered decreasing and getting more similar if you will.

2. **NCRMP – *Jeremiah Blondeau, NOAA***

Goal: Focus on the fish aspect of the National Coral reef monitoring program (NCRMP)

- CRCP's National Coral Reef Monitoring Program (NCRMP)
- CRCP was an always funded monitoring -- NCRMP started in 2013 as one program
    - 4 themes including fish (RVC) and benthic sampling
    - The Florida Keys and Dry Tortugas – SE Florida added in 2018
- NCRMP is currently sampling all around the world, but the presentation is focused on SE Florida.
    - The biological monitoring summary of Florida 2021-2022 will be published this summer
- NCRMP is now every 2 years so this 2022 they will be back in Florida and will hit Flower Garden Bay
- New founded project (Ault et al.) to refine the SE Florida sampling grid to align with the rest of Florida (the grid cells got smaller, created new maps, and re-stratified the whole system in some areas). Hoping to re-stratified SE Florida and will be started this year and hopefully by 2024 will have a new sampling.

- Despite COVID challenges they still sampled Florida in 2020-2021 completing 305 fish sites in SE Florida.
- This year, 2022 they are back in business having a pretty ambitious site they want to fulfill this year, the plan to visit:
    - SE Florida: 325 fish sites and 280 benthic sites (NCRMP + DRM).
    - Tortuga: 400 fish sites and 205 benthic sites (NCRMP + DRM).
    - Keys: 480 fish sites and 280 benthic sites (NCRMP + DRM).
- NCRMP has added *Diadema antillarum* disease as part of the monitoring in FL for the 2022 sample season. Included in two ways, provide eyes on the reef for diseased *Diadema* or classify them as healthy, diseased, or dead.
- Survey showed:
    - In SE Florida there are 66 species with a coefficient of variation (cv) of density less than 20%. In some other species, they do better than 20% so they are doing really well in the NCRMP surveys.
        - The top species that they are trying to reduce the variance are triggerfish, yellowtail snapper, red grouper, hogfish, and mutton snapper.
    - No major changes in key species density observed over time.
        - Hogfish relative frequency was established throughout the last years after the Aug 2017 – change from 12 to 16 inches TL and 5 to 1 fish bag limit. The new 2020 regulation is 41 cm in TL.
        - Mutton's snapper: saw similar trends like the hogfish, after the Jan 2017 Mutton changes from 16 inches to 18 inches total length and bag changes from 10 to 5 fish per person. The new 2020 regulation is 46 cm in TL.
- Continued Fisheries Management Questions
    - Hogfish – August 2017 – Atlantic (FWC) change 5 to 1 fish bag limit, 12 to 16 inches TL, and 6-month season (May 1 – Oct 31).
    - Mutton snapper– January 2017 – change 16 to 18 inches TL in state (still 16in TL in fed waters) – state bag = 5 and fed bag =10 fish.
    - Black grouper – Length-at-maturity 83.4cm (33 inches, SEDAR 2010), min size at capture is 61cm (24inch), state: open, feds: closed Feb 1-Mar 31, 4 per person within 4 grouper aggregate.
- Online Data Sources
    - Data and status reports are publicly available NOAA CoRIS website (coris.noaa.gov)
    - SEFSC Fish Lead
        - R fish package (GitHub)
        - https://github.com/jeremiaheb/rvc
    - Jay Grove (jay.grove@noaa.gov) or Jeremiah Blondeau (jeremiah.blondeau@noaa.gov)
        - NOS NCCOS Benthic LeadR benthics package (GitHub)
            - https://github.com/shgroves/NCRMP_benthics
            - https://github.com/shgroves/NCRMP.benthics.statusreport
    - Shay Viehman (shay.viehman@noaa.gov) or Sarah Groves (sarah.groves@noaa.gov)

Questions/Comments:

- Judith Lang: Thanks for all the Florida data from the Disease Response Network!
- John Fauth: I'm puzzled on the emphasis on the coefficient of variation, me that especially for species that are up on the high end like bicolored damselfish they are everywhere, there is little space for them to go up. Then for the rare species there is a floor. Seems like a lot of effort and maybe that effort could be directed elsewhere. I'm thinking of other approaches like zero-inflated estimates because you will have true absences and even using things like Rao estimators where you look at a number of singletons and doubletons and try to estimate how much you actually miss. I'm betting that you guys are not missing much but doing a lot of work. I've done things like this in other habitats, you sort of get a feel for what you have to do to get species. I can see why you want targeted sampling, but worrying about where the CV is or trying to decrease that I don't understand.
    - *Jeremiah Blondeau:* That's why we allocate for certain species, like the mutton snapper, we are trying to control that variance of the muton snapper or yellowtail snapper so we can get a good estimate of those species. Then because we do good on that we do ridiculously good on our bicolor damselfish, our CV is nothing. Because we are targeting those we do great in other species, and we can break this even further in the Keys and Tortugas we are trying to control the variance and not only single species but at life stages of species like the adults of those species. So, we need these high numbers to control the variance of life stages of certain species.
    - John Fauth: But why control the variance? I can maybe understand getting the standard error of the estimate. What's the question that requires the CV to be controlled? I've never heard of anyone speak to that.
    - Jeremiah Blondeau: Ultimately, the CV is just an estimate of variance, an estimate around the population level mean, that's all it is. We are trying to control the variance around our mean density/occurrence. So if we want to be able to say the difference between outside or inside or the difference between year, we have to control the variability because if we don't we would never have a statistical difference. We will have two means on a plot but the error bars will be so big and never able to tell a difference. By actively targeting and controlling the CV, knowing the system (that's why the stratification is random and use the Namen allocation to put effort into certain areas that have higher variability). All that is trying to do is to reduce that variance and have the power to answer all the questions.
    - John Fauth: The power is different from a coefficient of variation, that's why I'm asking because I'm trying to explore what the issue is.
    - Jeremiah Blondeau: I think we use CV as an easy way to plot. It's unitless, very easy to plot and explain. We plot with standard error but our CV is the number we try to control. I like that a 20% CV roughly translates to a 40% change and that metric is a very straightforward thing to say. CV is also a very common thing for fisheries.

3. **DRM –** ***Jennifer Stein, FWC***

Goal: 2021 summer quick look report overview and 2022 planning

- 2021 results and milestones
    - A total of 378 sites were completed across 9 subregions.
    - 17 Partner Organizations.
    - Both Marquesas and Dry Tortugas were surveyed during multi-day research cruises in 2021 (4 months before the SCTLD finding in these areas).
    - FWRI provided funds to partners based on their survey effort.
    - Number of Sites: 6 Martin,29 Palm Beach, 70 Broward-Miami 34 Biscayne, 50 Upper Keys, 26 Middle Keys, 74 Lower Keys, 35 Marquesas, 54 Dry Tortugas.
- DRM methods 2020-2021 recap
    - Transects 1 and 2 follow traditional DRM for all adult coral species and target juvenile families.
    - Transects 3 and 4 only target adult species and target juvenile families.
    - The target juvenile coral sub(families) are Mussinae, Faviinae, and the family Mendrinidae.
        - Specifically designed to target susceptible species to the SCTLD and to record the presence or abundance of the 10 rare species.
- 2021 bleaching prevalence
    - 378 sites across 9 subregions.
    - Pooled by subregion-zone all mild to non-bleaching.
    - Pooled by sites, moderate beaching at 16 sites compared to 36 last year (6 Broward-Miami and 5 Palm Beach).
    - Zero cites had severe bleaching.
    - When paling was included, prevalence values increased to moderate in approximate half the subregion-zones surveyed in 2021.
        - Pooled by site: moderate BL and paling at 148 sites compared to 168 last year (34 Broward-Miami, 44 in the Keys and 20 Marquesas).
        - Severe BL and paling at 16 sites compared to 26 last year (5 Broward-Miami).
- 2021 Disease Prevalence of Tissue Loss
    - Pooled by zone within each subregion, all prevalence values for diseases resulting in tissue loss were either zero or low, except for the Dry Tortugas subregion.
        - Pooled by site, medium disease at 18 sites (9 Dry Tortugas, 5 Marquesas and 5 Broward-Miami).
        - High disease at 13 sites (11 Dry Tortugas).
- Total colonies recorded with SCTLD
    - Transects 1 and 2: had 323 coral colonies with SCTLD and 226 (70%) of those corals were recorded in the Dry Tortugas in 2021.
        - Among the diseases colonies; 29% *Siderstrea siderea,* 20% *Montastraea cavernosa,* and 11% *Pseduodiploria strigosa.*
        - In 2021, Broward-Miami only reported 10 disease colonies and the Marquesas 57.
        - 2020: 168 colonies in the Marquesas and 0 in the Dry Tortugas.
- Mean density and max diameter of the target species by region from 2010-2021

- Time-series comparison graphs in Southeast Florida (Broward-Miami, Palm Beach, and Martin) show:
  - SCTLD was first reported in 2014 in Miami County the most significant changes in mean density and max diameter appeared 2 to 3 years after the first instance of the disease.
  - *Dichocoenia stokesii*: recorded the highest recruitment in 2021 since 2015 but the mean density is still low.
  - *Meandrina meandrites:* after the decline through 2017, density values have remained at 0.02 meaning possible growth of the surviving colonies.
  - *Pseudodiploria strigosa*: Mean density has increased in 2021 but its still low compared to previous years although is higher than three previous years.
  - Density values remain low but seem like populations are starting to stabilize through time.
- Time-series comparison graphs in the Florida Keys (Upper, Middle, Lower keys, and Biscayne) show:
  - SCTLD first appeared in the upper keys in 2016 and was evident in the Lower keys until 2018, the slow progression of the disease show reduction of coral density in multiple years (most evident in 2017-2020).
  - In the Florida Keys, means density seems to start stabilizing for several of the target species despite low values over the past 2-3 years.
  - *Diploria labyrinthiformis, Dichocoenia stokesii, Meandrina meandrites, Pseudodiploria strigosa and clivosa* had a slight increase in density and mean maximum diameter through 2020-2021, suggesting that surviving colonies are continuing to grow.
  - SCTLD show to continue the decline of larger colonies while the growth of surviving juvenile colonies that have reached the 4 cm threshold have reduced the mean maximum diameter.
  - The mean density of *Colophyllia natans* continues to decline in 2020-2021 however this decline was much less pronounced compared to 2019, hoping it begging to stabilize.
- Time-series comparison graphs in the Marquesas show:
  - The impacts of SCTLD appeared in the targe species with sufficient abundance.
  - *Colophyllia natans, Dichocoenia stokesii, Meandrina meandrites, Pseudodiploria strigosa and Mycetophyllia* spp. all experience a dramatic decline in mean density from 2019-to 2020, although the mean density and maximum diameter values continue to decline in 2020-2021 of each of this species, it is a much less pronounced drop compared to previous years.
- Time-series comparison graphs in the Dry Tortugas show:
  - The surveys were taken in September 2021 where the mean density and maximum diameter of the target species were relatively consistent or no dramatic decline between 2020-2021 likely because the infection colonies still have some tissue remaining, therefore we anticipate to take several

years of DRM surveys to actually quantify the impacts of SCTLD in this region.
    - Target juvenile coral (sub)families (Mussinae, Faviinae, and Mendrinidae)
        - Out of the 378 sited they had 249 sites with at least 1 juvenile colony recorded between those target families, juveniles of two target families were present at 78 sites and all three families were observed at 48 sites.
        - Juveniles of all the families were recorded in all subregions except for Martin County (No juvenile corals of any target family were recorded).
- Overall, for 2021
    - Belching and disease
        - Mild Bleaching Year.
        - Moderate Bleaching and Paling Year.
        - The Broward-Miami and Marquesas subregions saw Moderate BL and P across all zones.
        - Low disease prevalence across the reef tract with the exception of the Dry Tortugas.
            - SCTLD was recorded at 33 of the 54 sites surveyed in the Dry Tortugas with SSID (29%), MCAV (20%) and *Pseudodiploria strigosa* PSTR (11%).
        - Throughout the reef tract, the species with most observations of SCTLD were SSID, MCAV, PSTR.
    - Target SCTLD susceptible species/families
        - Impacts of SCTLD were apparent in the time series comparisons with the exception of the Dry Tortugas.
        - Subsidence of SCTLD throughout the reef tract with the exception of the Dry Tortugas.
        - Densities remain low due to SCTLD but the worst may be over, and populations may be beginning to stabilize.
        - 249 of the 378 sites had at least one juvenile colony of the target (sub)families.

- Plans for DRM in 2022 objectives:

1. Maintain the primary objective to monitor the status of bleaching along the FRT.
2. Continue to monitor for SCTLD along with the endemic areas of the reef tract and saturate vulnerable areas of Dry Tortugas with DRM sites to increase the probability of identifying the disease.
3. Assess the abundance of a subset of coral species that were highly susceptible to SCTLD including juvenile corals (< 4cm and > 1cm). Now including MCAV!
    - *Montastrea cavernosa* will be added to the juvenile coral tally.
    - The presence-absence of both “Healthy Diadema” and “Diseased Diadema” will be added to the data collection to help track the spread of the current disease outbreak that is spreading across much of the Caribbean.

- The 2021 DRM Quick Look Report is available on the DRM website (https://ocean.floridamarine.org/FRRP/)

- All training, protocols, and surveyor resources are also available on the DRM website on the 'Surveyor Trainings and Resources' page.
- DRM data from 2005-to 2021 can be downloaded from the 'Reports' page.

Questions/Comments:

- Andrew Baker: Great news about the high number of juveniles on many reefs! Has the DRM program ever recorded any of these juveniles showing signs of SCTLD?
    - Jennifer Stein: Right now, the juvenile data collection is a simple abundance tally along all four transects. We are not collecting any condition information on the juvenile colonies at this time in an effort to maintain a "rapid" assessment at each site.
- Dana Wushinich-Mendez: Thanks Jenny, for the *Diadema* will you include numbers of healthy individuals and numbers of diseased individuals along the transect?
    - Jennifer Stein: No not at this time. Just a presence/absence.

4. Restoration project updates in the Coral ECA – *Andrew Baker, UM RSMAS*

Goal: Update on the current restoration projects in the Coral ECA within the Southeast Florida Coral Reef Restoration Hubb

- The Hub originated from a project started at the University of Miami in 2018 and in 2020 it grew through the National Coastal Resilience Fund (NFWF) and later became the Southeast Florida Coral Reef Restoration Hubb with 5 institutions and 9 PIs.
    - The Southeast Florida Coral Reef Restoration Hub has four pillars including restoration, climate resilience, coastal resilience, and education.
    - In 2021 they had the opportunity to grow the Hub through funding of the Coral Protection and Restoration Program with 6 institutions and 14 PIs.
        - More focus on research, less focus on outplanting.
- In 2021-2023 identified six activities
    - Building a network of spawning hub expansion through targeted outplanting.
    - In-situ and ex-situ spawning activities.
    - Field monitoring and interventions.
    - Ex-situ system improvements research, testing, testing, and prototyping.
    - Larval rearing, settlement, and recruit growth.
    - Measuring success and training.
- Southeast Florida Coral Restoration Hub: *Acropora* outplanting
    - >27,000 staghorn and > 600 elkhorn out planted.
    - Survivorship overall has exceeded regional benchmarks in such a short time frame.
- Southeast Florida Coral Restoration Hub: Massive corals
    - >4,000 colonies from 7 species outplanted.
        - Most mortality of fragged and smaller colonies is due to predation; no disease was observed on outplants or fragments.
    - Some diseases on large colonies used to assemble spawning hubs

        - Wondering if the aggregation of these large colonies in a small area what is creating the disease outbreak.
- Southeast Florida Coral Restoration Hub: Predation mitigation
    - Testing tools to help microfragments be protected from predation, including physical barriers to prevent predation.
- Southeast Florida Coral Restoration Hub: sexual reproduction
    - Coral gametes, SECORE Coral Rearing In-situ Basins (CRIBS) at Frost, coral recruits, and SECORE starts.
    - >40,000 larvae from 4 species ouptlanted.
        - Extremely low survivorship (only 1 recruit visible).
    - Algae (*Dictyota*) is a potential problem (need urchins).
- Southeast Florida Coral Restoration Hub: *Diadema* aquaculture as a solution of algae as a potential problem
    - 7 larval runs completed in 2021.
    - Larval mortality is extremely high.
    - 500 juveniles in grow-out tanks (at FLAQ and FROST) but still a long way off from outplaning.
- Southeast Florida Coral Restoration Hub: Disease interventions
    - Large colony monitoring and disease intervention.
        - >1,700 large colonies surveyed.
        - 400 colonies of 8 species treated with antibiotic paste and firebreaks.
- Southeast Florida Coral Restoration Hub: Coastal resilience
    - Trapezoidal reef model (base structure) populated with staghorn and brain corals. in the SUSTAIN tank to test how much wave attenuation you can get with outplanting corals.
        - Corals reduced up to 15% of wave energy through friction.
        - Branching corals are better at reducing wave energy than massive corals at the same cover. However, brain corals are more resistant to breakage.
- Southeast Florida Coral Restoration Hub: Outreach
    - Extensive media coverage.
    - Multiple social media outreach.
    - Rescue a reef citizen science expedition.
- Southeast Florida Coral Restoration Hub: 2020-2022
    - Collaborations/leverage, outreach, disease interventions, coastal resilience, and asexual reproduction of Acropora are going well.
    - Massive coral outplaning doing well with the exception of some disease and urchin husbandry is still a work in progress.
    - Sexual restoration is going well from point of generating recruits and maintaining them in ex-situ facilities, need to increase survivorship.
- The next stage is to include DARPA (Reefense Program) this 2022 which is a next-generation hybrid reef engineering to enhance future structures focusing on being more environmentally friendly ways to decrease our concrete footprint in coral restoration and wave attenuation.
    - Along with X-Reefs a next-generation reef engineering to enhance future structures.
    - 11 institutions with 27 PIs.

    - 5 year project to develop a 100 m long structure in two 50 m long sections.
- Technical approaches: UM, REEFS
    - Overview: to develop and deploy a hybrid engineered and biological coral reef-mimicking structure that is fast-growing, resilient, and provides immediate protection from waves.
    - Technical Area 1 Substrate Design and Structure (engineering aspect): Design a low-crested submerged breakwater using innovative structures, materials, 2D/3D hydrodynamic models, and world-class flume tests to deliver a durable, replicable deployment that maximizes wave attenuation and biological enhancement benefits.
        - Maximize wave attenuation while exploring new materials.
    - Technical Area 2 Ecological Engineering (hydrogels and anti-algal coating): Engineer ecological communities that promote coral growth and enhance recruitment to enhance the capacity of the structure to self-build and self-repair to enhance wave attenuation benefits.
    - Technical Area 3 Adaptive Biology (adaptive biology component): Identify, test, and deploy novel technologies to improve the adaptive capacity of corals and increase the long-term resilience of the structure.
        - Maximize survivorship of corals and increase heat tolerance.
- X-Reefs principal investigator is Andrew Baker, PhD (UM), and Laura Cherney, MBA (AECOM) is the project manager (starting June 1st 2022)
- Through the course of the pandemic, communication between institutions and PIs has been more effective and at its best.
    - A strong network facilitates information flow and decreases activation energy for new collaborations.

Questions/Comments:

- Jamie Monty: Can you talk about potential sites?
    - Andrew Baker: DARPA is interested in deploying it in a military installation but there is no actual deployment until phase two (3 phase program). The first phase is 18 months, the second phase is 18 months, and the third phase is 24 months. Where that site is going to be is still up to debate, DARPA initial desire is to be at a site in South Florida. We suggested, but we are aware of the difficulties, the air force station in Key West on Boca Chica Key but there are huge challenges there because is in the National Marine Sanctuary and this is an artificial reef structure so we will have to negotiate that with sanctuary staff and that is on our calendar to do. If those negotiation don't work we would want to propose alternative locations in South Florida. Whether those locations need to be at a military site or not is still up for debate, but in the meantime, we have what is called a test bed structure where in phase one we will test interventions on a small scale on three-sections 20 ft long that are about to be deployed off Miami Beach by surfside ~80th street. So will use that testbed structure to try out some of the TA2 and TA3 interventions so we can be ready to go when TA1 has a design with their optimal concrete and implement that at a site that is still to be determined.

Wrap up and Adjourn

- Thank you so much to all presenters, members, and everyone that join.
- For the TAC members, be on a lookout for a follow up email with the meeting evaluation surveys.
- Sending the minutes after they are completed.