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

December 12, 2022

Meeting Objectives:
1. Review and prioritize existing Reef Resilience scopes of work.
2. Update TAC members on LAS projects and products and SCTLD status and response efforts.
3. Setting the stage on Florida's Restoration Plan for future feedback needs.
4. Presentation on Port Everglades turbidity data as requested by TAC members.

Attendance
Staff

Name	Affiliation	December 12, 2022
Allie Shatters	DEP CRCP	X
Rachel Skubel	DEP CRCP	X
Patrick Connelly	DEP CRCP	X
Lara Bracci	DEP CRCP	X
Taylor Tucker	DEP CRCP	X
Katie Lizza	DEP CRCP	X
Jose Guarderas	NSU	X

TAC Members

Name	Affiliation	December 12, 2022
Erick Ault	FWC FWRI	virtual
Ken Banks		X
Don Berhinger	UF	virtual
Richard Dodge	NSU	X
Phil Dustan	C of C	virtual
John Fauth	UCF	virtual
Piero Gardinali	FIU	X
Dave Gilliam	NSU	X
Lew Gramer	NOAA AOML	
Kurtis Gregg	NOAA	X
Jay Grove	NOAA	X
Judy Lang	AGRRA	virtual
Joe Lopez	NSU	X

Caitlin Lustic	TNC	X
Arthur Mariano	UM RSMAS	
Valerie Paul	Smithsonian Marine Station	virtual
Esther Peters	GMU	virtual
Stephanie Schopmeyer	FWC FWRI	virtual
Xaymara Serrano	NOAA NMFS	X
Manoj Shivlani	UM RSMAS	virtual
Jack Stamates		virtual
Josh Voss	FAU HBOI	X
Brian Walker	NSU	X
Dana Wusinich-Mendez	NOAA CRCP	virtual

Public Attendees

Name	Affiliation	December 12, 2022
Melissa Sathe	SEFCRI/FOFR/Coastal Eco Group	X
Angela Delaney	SEFCRI, Broward County	X
Elizabeth Kelly	Martin County	X
Tori Barker	DEP CPR	X
Mitchell Latzman	UM	X
Sam Cook	DEP CPR	X
Nick Jones	NSU	X
Jocelyn Karazsia	NOAA NMFS	virtual
Ron Kothera		virtual
Lisa May		virtual
Jennifer Schull	NOAA NMFS	virtual
Cheryl Woodley	NOAA	virtual
Anne Laird		virtual
Samanth King	University of Arizona	virtual
Julia Lombardo		virtual
Murphy McDonald		virtual
Jennifer Moore		virtual
Martha Guyas		virtual
Michael Jenkins		virtual
Alistair Harborne	SEFCRI, FIU	virtual
Kristi Kerrigan	DEP CPR	virtual
Anthony Priestas	USACE	virtual
Sara Thanner	MDC DERM	virtual
Melissa Quiroz		virtual

Alexandra Mamontoff	Florida House of Representatives	virtual
Laura Eldredge	MDC DERM	virtual
Katelyn Armstrong	PBC	virtual
Josh Kilborn	USF	virtual
Jessica Garland	Martin County	virtual
Ileana Suarez	Broward County	virtual
Erik Neugaard	SEFCRI, Port Everglades	virtual
Derek Cox	SEFCRI, FWC	virtual
Christie Hurley	SEFCRI, Cummins Cederberg	virtual

Welcome and Introduction

Alycia Shatters
- Alycia Shatters from Florida DEP was the moderator and facilitator of the TAC meeting.
- Thanks for those who were able to show up in person. Unfortunately, we have some TAC members that could not come but are joining us through zoom. Thanks to you too for joining and listening. We are excited to be back in person after two years.
- For those who don't know, I'm the Assistant Manager and Land-Based Sources of Pollution Coordinator for DEP's Coral Reef Conservation Program. There are some new faces and new staff, they will introduce themselves as we start with some project updates as the first part in the agenda.
- I want to introduce Mollie Sinnott. She is the new Regional Administrator, congrats Mollie.

Mollie Sinnott
- Hello everybody. Most of you already know me, I was most recently the Coral Reef Conservation Program Manager and just stepped up to the Southeast Regional Administrator role taking over for Jamie Monty.
- I'm excited to be working with you all in this new role and I appreciate your patience as I get up to speed in all the projects we are working on.
- We appreciate everybody joining as we work towards getting back to fully in person TAC meetings.
- Last meeting we used a hybrid format, but it was difficult facilitating group discussion so for this meeting we are getting to full in person participation and including virtual participants in listening mode only.
- Hopefully next meeting we are all back in person even though it's tough times, but it is when we get the most interactions and discussions so that's one of the most valuable parts of the TAC.
- Thank you everyone for joining. Alycia will get us started with the DEP project updates.

Alycia Shatters
- Food and beverages outside provided by Friends of Our Florida Reef, thanks we appreciate it.

- Sign up, agendas, name tags and public comment cards for public session are outside. If you wish to speak, fill out a card, each person will have 3 minutes and only what you write will be recorded.
- Get started for the day, LAS project updates.
- I want to say that CRCP works on other projects as well, but we are going to focus only on these local action strategies today.

Local Action Strategy (LAS) Project Updates

Land Based Sources of Pollution – *Alycia Shatters, DEP CRCP*

- LBSP 4 Goal: Establish a technical advisory panel/committee (TAC) to review/assess data and advise the SEFCRI.
    - Active ongoing LBSP LAS Project – TAC, thank you for all your work and time you put into this.
- Dale Griffin retired from USGS and he also resigned from his position as a TAC member. We are looking to fill this position. If you know of anyone with a similar expertise, send me and email with the name and we will reach out.
    - The way it works is that we take nominations, anyone interested can send an application. That will then get reviewed by the SEFCRI Vice Chairs for a final decision.
    - Thanks to Dale for all of his hard work and all of the years he was a TAC member.

Awareness and Appreciation – Rachel Skubel, DEP CRCP

- Active ongoing LAS Projects:
    - Coral reef education trunks.
    - SEFCRI & Florida's Coral Reef websites.
    - Outreach materials and events.
    - Communication Campaign.
- Coral Reef Education Trunks
    - Last year after covid we reestablished our Coral Reef Education Trunks. We work with local educators to develop curricula that covers science and STEM points but focus on Florida's Coral Reef. Four sets of trunks for kids are divided by grades 3 – 5, 6 – 8 and 9 – 12.
    - This project started again last October/November and we reached more students than ever before, over 6,000 students. Grades 3 – 5 trunks have proven to be our most popular project by far.
    - We made a couple changes this year as well. We added another trunk in Broward County for grade 3-5 to meet increased demand (13 trunks total).
    - We began a pre/post impact evaluation survey for students and teachers about their interest in STEM and teaching and what we are doing.
    - We are going to branch out to have more online content. Next year, 2023, we are going to provide video content for lessons with ASL and Spanish translations.
- Community outreach events and materials

- o We are trying to make sure we are covering Miami Dade and Martin Counties as well as more consistent events in Broward and Palm Beach Counties.
  - o If you have other events we might cover in these counties let us know.
  - o Spring 2022:
    - Broward Earth Day
    - WLRN Eco-Fest
    - Tortuga Music Festival
  - o Summer 2022
    - iCast 2022
    - SE District Open House
    - Pompano Pier Cleanup
  - o Fall 2022
    - Vamos Á Pescar
    - Ft. Lauderdale Boat Show
    - LagoonFest 2022
    - Winterfest Ocean Conservation Village
  - o We are trying to have a diverse outreach approach by making all of our literature available in English and Spanish.
- SEFCRI and Florida's Coral Reef Websites + SEFCRI Newsletter
  - o Moving from print to a more digital footprint. Newsletters where we share what we are working on.
  - o Share bigger accomplishments of Florida's Coral Reef and partners we are working with.
  - o 360-Degree videos, educational resources, platforms for taking action, etc.
- Communication Campaign
  - o Floridacoralreef.org
  - o 360-Degree videos available where you can dive into our reefs, even if not have been physically able to do so.
  - o Working with Tallahassee to develop other videos, available in January/February 2023.
  - o This project focuses more on the people side of the reef, connection with this incredible resource.
  - o Accessible to everyone - Hispanic content.

Questions/Comments:
- Xaymara Serrano: I have a question about the trunks, how do you connect with the schools?
  - o Rachel Skubel: We have an email list of teachers we have worked with in the past or that have been referred by other teachers. Every time we release a new list of signups, when we send out emails, we ask people to send it to other people that might be interested to reach out more people in that way. That way we have a lot of internal distribution. Also, in our outreach events people can know what we are doing and increase our reach.

SEAFAN and Marine Debris – *Lara Bracci, DEP CRCP*

- Associate Coordinator of the SEAFAN program
- Active Ongoing Reef Resilience projects in Southeast Florida
  - Citizen Science Programs:
    - SEFAN: Southeast Florida Action Network.
    - BleachWatch: Classroom or in-water training.
  - RIPR: Reef Injury Prevention and Response.
- Southeast Florida Action Network (SEFAN)
  - A community-based reporting and response program for marine incidents affecting Southeast Florida's coral reef ecosystems.
  - Community can report these incidents when they are out in the water doing different activities:
    - Vessel groundings,
    - Anchor damage,
    - Fish kill and disease,
    - Marine debris,
    - Thermoclines,
    - Coral disease and bleaching,
    - Algae blooms,
    - Discolored water,
    - Invasive species,
    - Other incidents.
  - No need for special training, you just need to report when and where the incident is taking place in the website: southeastfloridareefs.net
- SEAFAN Umbrella Program
  - Reef clean ups, Marine Debris Reporting and Removal Program run by Lara Bracci.
  - Vessel Groundings and Anchor Damage, Reef Injury Prevention and Response Program run by Jessica Price.
  - Coral Disease and Bleaching, BleachWatch Program run by Taylor Tucker.
- Bleach Watch program
  - SEFAN is for any citizen to report coral bleaching or disease (still encourage BleachWatch training).
  - Sign up on the web: www. SEAFAN.net/BleachWatch
  - All materials available online:
    - Program Overview.
    - Bleaching Fact Sheet.
    - Disease Fact Sheet.
    - *Datasheet*.
    - Datasheet Instructions.
    - Coral Condition ID Guide (booklet).
    - Coral Cheat Sheet (beginner level).
  - Recently had classes with RSMAS Recue the Reef Program, Jupiter Dive Center, Diver's Paradise, and Reef Institute at Palm Beach. Taylor taught classes.
- SEAFAN Recent Updates
  - Historically, SEAFAN's jurisdiction is from Martin County to Miami Dade, just expanded to Monroe County by partnering with the Florida Keys.

- o Keys previously ran the MEERA project of ecosystem response and assessment. They acted as an early warning system, people in the water doing different recreational activities would report.
    - Similar to our reporting system that we have in place.
  - o We decided to collaborate with the Keys moving forward, for any report that comes from the Keys, report information will be sent to the right personnel in Monroe County that will be able to handle these types of incidents.
- Marine Debris
  - o 11th Annual Southeast Florida Reef Cleanup
    - 268 reef cleanup volunteers.
    - 2,424.7 lbs of debris removed.
    - 20 sites visited, Miami Dade, Broward, Palm Beach and Martin Counties.
    - Partnered with dive shops and organizations.
  - o DIY Shore Cleanups
    - 739 shore cleanup volunteers.
    - 9,171 lbs of debris removed.
    - 5.5 miles of shoreline covered.
  - o Type of materials:
    - 71% Plastic
    - 19% Metal
    - 4% Glass/Ceramics
    - 2% Cloth
    - 1% Paper/Cardboard
    - 2% Other
  - o Open to new ideas, places, dive shops.

Questions/Comments:
- Ken Banks: You have been doing this for years. Did the relative composition of debris change over time? Did plastic increase?
  - o Lara Bracci: No raw data to show, just from looking at previous data it seems like it is growing. There is also more effort, more beach cleanups, participants, dive shops and more awareness than before. There is also more people that clean but not report, specially dive shops and recreational divers. We want to put the word out there so that they report this so that we can have more accurate data.
  - o Ken Banks: But specifically about composition, intuitively plastic must be going up?
  - o Lara Bracci: Definitely, plastic has increased more overall looking at all of the other materials.

- Kurtis Gregg: I have a comment on the report on plastic, for those proportions of plastic, are they proportioned by weight?
  - o Lara Bracci: No by number. All the material was collected and then sorted by number.
  - o Kurtis Gregg: One of the biggest pollution types is single use plastic bags and the way that the current drags and drapes them over what they catch on, wondering if the numbers are going up or if you are classifying the types of plastics. Because I

know that in other places where they have started charging for or prohibit plastic bags in the US, this type of information can be helpful to change behavior in particular for this problem on Florida's Coral Reef.

- o Lara Bracci: I would be interested in that for the next clean ups, if there are plastic bags that we can count that separately.

- Brian Walker: I was wondering if you have a lot of reports for disease and where they go?
  - o Lara Bracci: For coral disease, we do not have many on SEFAN, they report in BleachWatch. We encourage doing the training since there is confusion between bleaching and disease. There haven't been too many reports which is good but as I said most of them are being reported through BleachWatch.
  - o Brian Walker: We run disease intervention, we are always looking for reporting from other folks on where they see disease. Historically we have received reports from SEAFAN.
  - o Taylor Tucker: When disease is reported either through SEAFAN or BleachWatch I will take it into my own file and I will send all of the reports to you, Dave, Andrew and Diego. For the marine debris, we have plastics category broken down including plastic bags. In the last clean up, we saw that most plastic pieces were trapped in the sargassum and there were more microplastics floating at the surface as well.
  - o Brian Walker: Do you know if those other groups are doing interventions?
  - o Taylor Tucker: Don't know, but when I send reports they are already aware. Other groups are aware, and they monitor and report back on it.
  - o Brian Walker: We try to maintain all the activity and know where it is more prevalent.

Marine Industry and Coastal Construction Impacts – *Patrick Connelly, DEP CRCP*

- Hello, I am Patrick Connelly, I'm the maritime industry and coastal construction coordinator. When I first got started with DEP, there was only one project, MICCI 28, that had to do with turbidity. The direction that was given was to establish a background on turbidity levels for the ECA, and water quality measurements.
- Active Ongoing MICCI LAS Projects
  - o MICCI 28: Identifying and Testing Methods of Measuring Turbidity and Suspended Sediments.
  - o Phase 1: Identified Technology
    - AT600: measures turbidity, NTU.
    - LISST Acoustic Backscatter sensor (mg/L): measures suspended sediment concentration.
    - Deployed at Port Everglades in 2020-2021. Will be redeployed in January 2023.
    - Noted that DEP water quality team has turbidity criteria already written. As phase 1 was being conducted, we realized we would have enough data to actually establish a background turbidity as we worked on the first draft, but it would take a long time for a rule to pass.

- This is one of the reasons why we wanted to use different tactics for the second phase this year.
  - o Phase 2: Alternative Methods
    - Compare Data – DEP SOPs to "experimental" instruments.
      - QA, calibration, verification, etc.
    - NOAA/Corps managing deployed instruments.
    - Sample Analysis – Broward Lab.
    - Water collection – Dr. Gilliam's group.
  - o DEP data is limited to discrete sampling, not keeping up with all technologies available, most available methods can't be used for monitoring turbidity for permit compliance.
  - o Alternative methods approval – comparison of data between different technologies. Cross compare anthropogenic effects in turbidity with different methods.
    - Helpful to not limit how we monitoring during larger projects like beach nourishments, Port Everglades.
    - Instruments identified in phase I will be re-deployed in January 2023 in Port Everglades, want to do alternative methods approval with those data/instruments.
- Turbidity Dose Response – Dr. Keisha Bahr (Texas A&M)
  - o Turbidity dose response experiments. Working with her for more data.
  - o Acute turbidity exposures (72 hr).
  - o Measuring biological/physiological responses with one coral species.
  - o Coordinating with Dr. Cheryl Woodley.
- Osborne Tire – Coral Relocation
  - o Dave Gilliam's Group (NSU).
  - o Lot of corals on the tires in Broward at this location.
  - o Great opportunity to rescue these corals before tires are removed and offer to laboratories or use for restoration purposes.
  - o Up to 700 corals relocated – tires to reef, will be monitored.
  - o Project will continue in 2023.

Questions/Comments:
- Kurtis Gregg: When did the survey for the polygon occur? I believe we did that map back in the 90s with Ken Banks. There is newer information from BIP, need to incorporate new data since some tires have been removed while others have been displaced. I was wondering if this project is incorporating newer surveys in other parts of the reef (outer reef)?
  - o Patrick Connelly: No, that would be a separate area, this permit is limited to that area shown in this map.
  - o Kurtis Gregg: The survey worked occurred right before the pandemic, there were a lot of areas where they identified tires in contact with the outer reef. Trying to prioritize this risk to reefs that are so close, as well as sediment that comes out when the tires are lifted, would be a different approach, wondering if this effort was related to this.

- Ken Banks: Surveys were done where you can still see a lot of tires inside that polygon.

- Jack Stamates: Regarding the acoustic turbidity sensor. On the Sequoia instruments website they are promoting a new combined acoustic optical turbidity sensor. The 8MHz acoustic sensor (which is not as sensitive to biofouling as is the optical sensor), is used to keep the optical sensor in calibration. This instrument reports in NTU and mg/l. This instrument is called the LISST-ABS super-turbidity sensor.

Fishing, Diving, and Other Uses – Katie Lizza, DEP CRCP

- Katie Lizza, Fishing and Diving coordinator.
- Active Ongoing FDOU LAS Projects
  - FDOU 51: Assessment of Gaps Trends, Protocols of existing WQ/Fish/Benthic Data
    - Address the collection, analysis and potential data needed to create an adaptive management approach to coral reef research and monitoring. Specifically, this project will identify and understand trends/gaps in existing data, contribute to coral reef management strategies by assessing current protocols and inform future research and monitoring efforts.
    - Looking to post local collaborate meetings with scientists, experts, managers, and persons involved to get a better idea on where we want to go. During our first phase we discussed our management priorities and how to answer them and we ended prioritizing them. The second phase has more to do with a metanalysis using existing data sets (NCRMP, SECREMP, water quality and benthic data) to answer questions, address any gaps, and advise on how to improve monitoring programs in order to answer management questions and interpret our data.
  - FDOU 52: Data Needs for Fisheries Management
    - Concluded project.
    - Fisheries Stakeholder Engagement Process completed November 2022.
    - Conducted regional survey of recreational, commercial, and charter fishermen.
    - Public Meeting occurred on August 23rd, 2022.
    - SEFCRI feedback obtained through online comment form.
    - Last committee meeting occurred on November 15th, 2022 at 6:00 PM.
    - Finalized list of recommendations – with incorporated feedback from the public and SEFCRI.
    - Two and a half years working with the community, we did get them to a point where they built trust with the managing agencies. They were able to make recommendations. Lot of consensuses on spawning aggregations between fishing community and SEFCRI and we were able to assess that consensus through our surveys.
    - Regional Stakeholder Survey
      - Looked at the range of responses among fishing community groups.

- How do the fishing committee network responses compare to the representative samples of the fishing community?
- How does the fishing community's responses compare to SEFCRI Network responses (wider conservation community)?
- Assessed how stakeholder groups viewed the condition of the resources.
- Assessed stakeholders' views on the most important factors impacting the coral reef ecosystem.
- Assessed stakeholder support for various management options related to water quality, fisheries, and habitat as examples.
- We saw a lot of similarity in all the responses from the different groups, but there were some differences. All the groups found all of the measures were important factors that impact coral ecosystems and fishing quality. One thing to point out is that they did consider reducing fishing pressure as less important than the other measures.
- Most significant outcomes of this process were finding consensus among all stakeholder groups on:
  - Spawning aggregation closures
  - Marine reserve, marine protected area
  - Need more work and consensus and recommendations
- FDOU 55: Coordination of Reef Management Plan for Coral ECA
- Create a coordinated management plan for the Southeast Florida Region incorporating pertinent information and data generated from previous and ongoing SEFCRI LAS Projects.
- Incorporating internal edits and comments from FWC.
- Looking to focus on an immediate plan. Chapter 5 looks at all the issues that the ECA faces, objectives and priorities.
- TAC members' comments will be involved as well, probably in June 2024. We will incorporate another advisory committee for putting this plan through. Very lengthy process.

Questions/Comments:
- Josh Voss: In June 2024 we will have to submit our comments?
  - Katie Lizza: No, the whole process will be completed by June 2024 with all the edits incorporated.

- Kurtis Gregg: When will we be seeing the plan?
  - Katie Lizza: We are still working on completing some of the projects, templates will be sent by the end of December after FWC sends back their edits. Probably by the end of spring.

- Josh Voss: Can it be sequential, or does it have to be parallel?
  - Katie Lizza: We want to have FWC first, but it will be more of a collaborate effort after the internal processes.

- Kurtis Gregg: You mentioned an advisory process and the advisory team, for the ECA to become an aquatic preserve?
  - Katie Lizza: That is the easiest rout. A legislative request is in place to do that but hasn't been approve yet. So they don't know where we stand with that yet.

- Brian Walker: Do you anticipate that this plan might be too different from the current trajectory? Or is it just to have something on paper to say this is our plan.
  - Katie Lizza: We have a more formalized managed area with a boundary set, so we are preemptively hoping we will have authority at some point. We did base it off of the plans for an aquatic preserve.

- Jay Grove: Do you have the data needed for the spawning aggregations?
  - Katie Lizza: We need more information, part of the recommendation is to collect more data and evidence.
  - Jay Grove: I mention that because it's a challenge finding historical spawning data. I also mention because the coral reef conservation program has prioritized funding for that so there could be a funding stream for casting a wide net for people interested in collecting that data.
  - Katie Lizza: That recommendation will be coordinated with FWC for development.

Summary and Recommendations from the Phase-I Activities of FDOU-51 – *Joshua Kilborn, USF*

- Thank you all for giving me the opportunity to talk today. I am going to go through what went on with FDOU-51: Meta-Analysis of Water Quality, Fish, and Benthic Data within the Kristin Jacobs Coral Reef Ecosystem Conservation Area.
- Southeast Florida Coral Reef Initiative (SEFCRI) identified need to:
  - Synthesize the existing data collection efforts that are ongoing within the Coral ECA and focusing on long term monitoring and full coverage throughout the entire Coral ECA programs. The idea being we could hopefully be able to provide a holistic review of the coral reef ecosystem mediated through the framework of the subsystems, specifically the water quality, fish, and benthic subsystems. The main goal is to identify patterns and trends over space and time, and try to understand the synergies and dynamic interactions between the different subsystems, the components within them and the Coral ECA as a whole.
- Goals and Objectives:
  - Identify patterns, trends, and synergies among the data related to benthic habitats, fishes, and water quality within the Coral ECA.
    - Determine which management priorities are relevant to the contemporary Coral ECA system and its stakeholders;
    - Characterize existing datasets available for targeting those priorities and identify limitations and knowledge gaps;
    - Assess the statistical feasibility of conducting a meta-analysis given the available data and management priorities;

- Develop recommendations for improving future research programming and data collection to satisfy stated management goals.
- Phase I concludes with this talk and the final report that provides recommendations for future research and Phase II.
  o Phase I started with the data discovery process and deep dive into all of the existing data for the three subsystems in the Coral ECA. Culminated in an extensive report that outlines all programs: long term monitoring, short term monitoring, full coverage, short coverage. Not everything in there is useful for the goals of this project.
  o Collaborative meeting #1: March 23-25. Stakeholders: management, monitoring collection programs, counties, states and federal stakeholders, academic people involved. Tried to understand what data we have available, what questions are important to the stakeholders and can we actually do these things. Came up with a lot of ideas and listed out different gaps and areas where we can improve through the Coral ECA.
  o There were more meetings with the advisory groups, the TAC. A lot of back and forth and another report was written summarizing what we did in that meeting and the priorities.
  o Collaborative meeting #2: May 18 and 23. Took all of the priorities collected, organized them and had more meetings with advisory groups and other stakeholders that focus on the statistical modeling and data set aspect of it. Discussed which of the priorities where more likely to be completed moving forward. Develop a framework to accomplish that. Collaborative meeting #2 report written. Process to tie everything together to finish with the final report.
- Monitoring the Subsystems:
  o To conceptualize the Coral ECA and the subsystems we turn to the Drivers, Pressures, State, Ecosystem Services, Response (DPSER) framework.
  o Very complex system. There is a lot of inputs into the system from the oceanic side, and the land side. There are far and local-field influences. Million different diversities of stakeholders. Spatial scales, processes, interactions, and a lot of potential for emergent behavior in all of the components of the system.
  o If we take a closer look within the boundaries of the Coral ECA we have the geomorphology of the shelf that plays its own role, influence from land, physical circulation, in-water benefits and a lot of this crosses over a service and a pressure, or a state and a driver. Very complex system.
  o Fishing Opportunities and Access
    - Increase in number of vessels over time
    - Recreational fishing vessels increasing at a larger scale than commercial fishing vessels, so we know that recreational fishing has a huge impact in the Coral ECA.
  o The Coral ECA is a complex System
    - Looking at a top-down schematic we can look at a different perspective such as the run off, urban development, reef structure and how it interacts with the Florida Current and Gulf stream
    - General morphology of Florida's Coral ECA is important. It's a unique system, we have differences in the geomorphology in the North vs South.

The inner and middle reefs are absent in the Northern portion whereas we have them present in the other areas. Complex and variable geomorphological complex throughout the reef track.

- The Gulf Stream comes closest in the USA in the Coral ECA, complex and dynamic water system that interact with the geomorphology.
- Inlet Contributing Areas (ICAs) - One of the most populated areas in the state of Florida. Huge amount of inputs from the anthropogenic side of the equation. We can look at where the influential constituents of fresh water are coming through and relate the impacts they are having on the reef back to anthropogenic use.
- Lots of factors to consider and the interactions among them.
  - o Coral ECA Water Quality Monitoring
    - 2 Programs we are interested in:
      - ECA-WQA – best, monitored monthly, solid coverage, random fixed monitored stations focused on ICAs.
      - NCRMP-CCC – water quality parameters measured, specific to coral dissolution and effect of changing climate on corals. Don't match perfectly with WQA.
      - STORET and WIN are other databases that we can get information from.
  - o Coral ECA Fish Monitoring
    - Fishery Independent Monitoring (FIM)
      - No influence of the commercial fisheries' economic pressures on the sampling design.
    - Fishery Dependent Monitoring (FDM)
      - Directly tied to economics of commercial fisheries.
      - Fleet types: Commercial and Recreational.
      - Looks into extractions, targets.
      - Fishing modes: commercial, charter, head boat, private boat, shore, tournament.
      - Problem with FDM is that it is not useful since there are mismatches between the scale of observation and the inferential scale we are interested in.
      - No good FDM data for the Coral ECA, there is some movement into trying to fix that in the future.
    - NCRMP-RVC
      - FIM – National Coral Reef Monitoring Program, Reef Fish Visual Census.
      - Sampling Universe NCRMP and FRRP-DRM, happens at same location for benthic and fish monitoring.
      - 2012 - 2016, annual (baseline).
      - 2018 – present, bi-annual.
      - Compliments existing RVC survey in FL Keys.
      - May – October sampling.
      - Stratified random sample design.

- o 100 m x 100 m grid cells
  - o Updated to 50 x 50 m (2018)
  - Observations in ≤ 30 m depth.
  - Subregions (x5)
    - o Broward-Miami, Deerfield, South Palm Beach, North Palm Beach, Martin
  - Slope relief (x3)
    - o High, Low, n/d
  - Habitat Classification (x17)
    - o Reef type: ridge, linear, patch, colonized pavement, spur and groove
    - o Depth: deep, shallow
    - o Position: inner, outer, middle
  - Other Habitat Class:
    - o Seagrass, unconsolidated sediment, scattered coral/rock, other
  - RVC Stationary Point-counts
    - o SCUBA diver teams
    - o 15 m diameter cylinder
    - o From water surface to seafloor
  - 1st Five Minutes:
    - o Record names of all spp. present
    - o Highly migratory spp. are enumerated immediately
  - 2nd Five Minutes:
    - o Record number of individuals
    - o Fork length (mean, min, max)
    - o New species encountered
- o Coral ECA Benthic Monitoring
  - SECRMP, DRM, NCRMP, extensive coral demographic surveys (species level), bleaching, disease, rugosity and other parameters.
  - SECREMP and NCRMP – point-counts images to estimate percent cover. The concept is the same as the line-point intercept except digital images are taken along a transect and then random points are looked at on the images.
  - DRM – disturbance report monitoring, looks at diseases and bleaching, SCTLD susceptible species.
  - NCRMP and DRM look at macroinvertebrates and endangered species.
  - SECRMP adds barrel sponges – *Xestospongia muta.*
- Data and Monitoring Gaps
  - o Some issues:
    - Temporal issue, only in 2018 we are able to have data for all three subsystems.
    - Gaps in years, NCRMP samples every other year.
    - DRM added new transects to focus on STCLD in 2020.
    - SCREMP, fixed 22 stations, not all sites were monitored until 2013.

Table 1:

	Water Quality		Fish	Benthic		
	NCRMP-CCC	WQA	NCRMP-RVC	DRM	NCRMP	SECREMP
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						
2013						•
2014						•
2015						•
2016		x				•
2017						•
2018	#		#		#	•
2019						•
2020	#		#	+	#	•
2021				+		•
2022	#		#	+	#	•

Table 1: Sampling frequency comparison. Colored cells represent years with data for that program. Symbols correspond to a peculiarity of a program's data collection in the year noted, specifically: **#** denotes when NCRMP switched to 50x50 m site grid instead of 100x100 m, **X** denotes data not analyzed in a NELAC certified laboratory, **+** denotes when 2 new transects were added to focus on SCTLD, • denotes when all 22 fixed stations were implemented and monitored.

- Gaps in the logistics of some of these programs, not all intendent to do the same thing.

		Instantaneous Status	Temporal Trends	Spatial Trends	ICA Framework	Fixed Sampling	Randomized Sampling	Sampling Frequency	Spatial Inference	Depth Sampled	Original Intent/Notes
Water Quality	NCRMP-CCC	x		x	•	x	x	2 yr	Coral ECA	≤ 30 m	The effects of planetary changes in ocean temperatures and acidification on the vital processes and rates that govern coral reef structure and function.
	WQA	x	x		x	+		1 mo	ICA	< 30 m	Comprehensive characterization Coral ECA's water quality status and track trends over time.
Fish	NCRMP-RVC	x		x	•		x	2 yr	Coral ECA	≤ 30 m	Assess the status and trends in the benthic and reef-associated fish communities.
Benthic	DRM	x	x	x	•		x	1 yr	Coral ECA	≤ 20 m	Originally developed to gather information about the effects of increasing temperature and coral bleaching on shallow-water reefs. Later augmented to collect more detailed data on diseased coral colonies.
	NCRMP	x		x	•		x	2 yr	Coral ECA	≤ 30 m	Assess the status and trends in the benthic community and, in particular, the reef-building corals.
	SECREMP	x	x			+		1 yr	Coral ECA	< 17 m	Documenting coral reef community changes through time over the entire spatial extent of the Coral ECA.

Table 2: Comparison of analytical capacities. Colored cells indicate areas that could be improved upon using recommendations from project FDOU 51 (see project report for details). Symbols refer to the original experimental design, specifically: **X** denotes a capacity included in original design, **+** dentoes where fixed sampling locations were selected using randomly stratified designs, ● denotes analyses potentially adaptable to the ICA framework with careful data quality controls.

- Data and Monitoring Gaps Identified
    - Biological constituents utilizing the Coral ECA and their population dynamics.
    - Water quality related concerns.
    - Dedicated future funding for status quo and…
        - New funding to: increase frequency, spatial resolution, and program compatibility.
    - Details included in recommendations for: management strategies and focus areas, augmenting existing Coral ECA monitoring.

- 23 Research Priorities:
    - Graph of importance vs feasibility
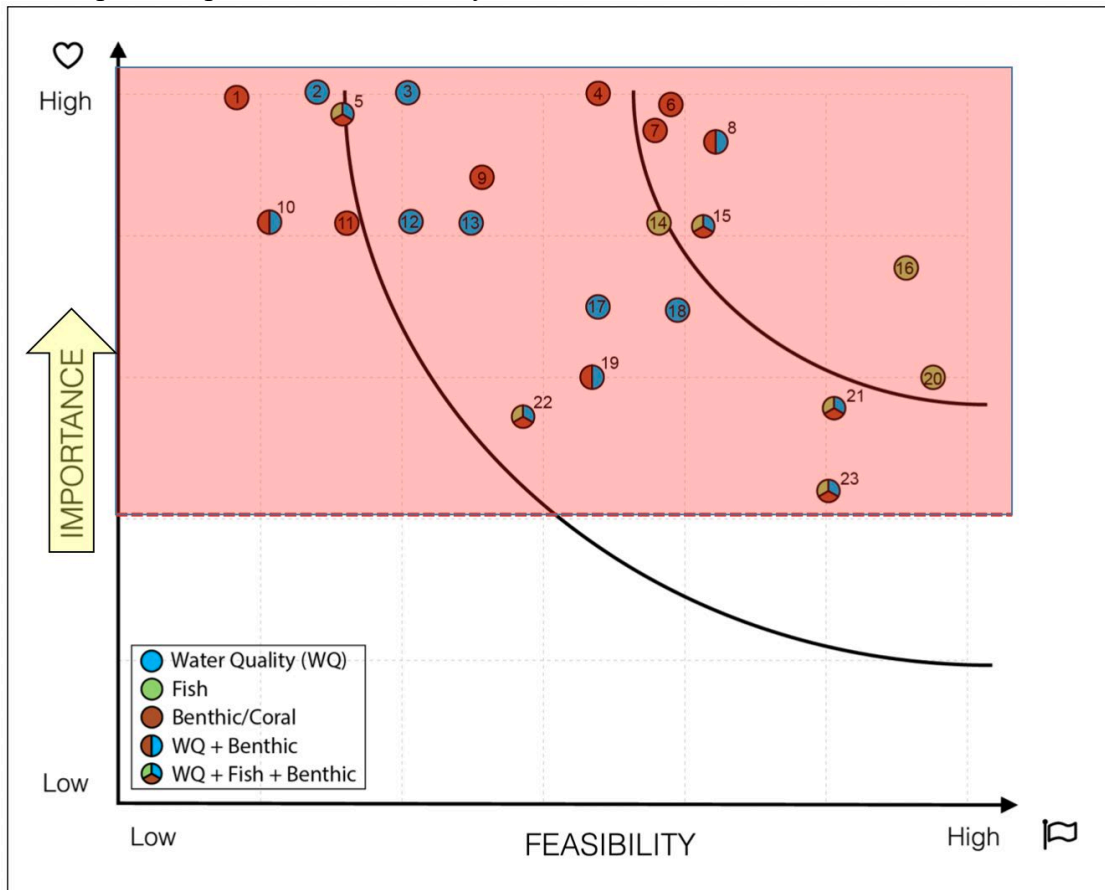
Figure 1: Importance vs. feasibility diagram. Numbers denote groups for discussion purposes, see below.

- Divided into 5 different groups for discussion purposes

- Research priorities 16, 20, 21, 23 – Beta-diversity of fishes/fish catches as indicators of Coral ECA/WQ/Fish/Benthic health/structure/function.
- Research priorities 10, 14, 15, 17, 18, 19 – WQ effects on Fish/Benthic. Characterize indicator species/keystone attributes with greatest impacts. Species focus on sedimentation and spatial considerations. Identify Benthic indicators of "health".
- Research priorities 1, 6, 7, 8 – 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.
- Research priorities 3, 4, 9 – Coral disease sources and impacts on land-based sources of pollution, dredging, and SCTLD.
- Research priorities 11, 12, 13 – Defining "healthy" coral reef ecosystem. Define eutrophication thresholds and assess acute vs. chronic impacts of WQ changes in the Coral ECA.

- Stakeholder research themes
  - Research Theme 1: "To investigate the diversity, abundance, and size composition trends in fish resources on natural habitats within the Coral ECA. Examine any relationship between changes to water quality and/or benthic habitat. Identify fish species/functional groups indicative of different environmental conditions".
    - 20 – Ecologically driven fish assemblage shifts.
    - 16 – Fish abundance and density trends in the Coral ECA.
    - 21 – ID indicator spp. for WQ and benthic "health".
  - Research Theme 2: "To define the key environmental conditions that associate with benthic assemblages. Determine which benthic species are most indicative of water quality regimes in the Coral ECA".
    - 15 – "Keystone" WQ attributes for fish and benthic "health".
    - 14 & 19 – ID Fish and Benthic indicator spp. for WQ "heath".
  - Research Theme 3: "Examine the varying rugosity and geomorphology of reefs in the Coral ECA, and determine how this impacts the capacity of the system to provide risk-mitigation services to adjacent coastal communities. Estimate any relationships between reef rugosity and fish assemblages and benthic composition".
    - 6 – Reefs as coastal risk-mediation services over time.
    - 7 – Role of rugosity on reefs.
  - Research Theme 4: "Investigate the response of the Coral ECA's benthic communities (i.e., resilience and resistance) to coastal construction and sedimentation".
    - 8 – Reef resiliency (independently and due to WQ changes).
    - 17 – Sedimentation effects on coral and benthic condition.
    - 10 – Effects of coastal construction on benthic communities.
- New Management Focus Areas
  - What we can monitor moving forward or focus on more.

- Focus area 1: Sources and Transmission Vectors of Waterborne Pathogens
  - 4 – Coral diseases and land-based sources of pollution.
  - 9 – SCTLD proximity to harbors.
  - 3 – Coral disease relations with sedimentation/dredging.
  - Not only specific to benthos, fish and shellfish are also vulnerable.
- Focus area 2: Acute vs. Chronic Impacts, Eutrophication, and Condition
  - 13 – Defining eutrophication in the Coral ECA.
  - 12 – Acute vs. chronic WQ impacts.
  - 11 – Define a "healthy" coral reef ecosystem.
- Focus area 3: Coral Larval Supply and Recruitment Variability
  - 1 – Coral larval supply and recruitment success.
- Focus area 4: Utilization of Additional Fish Monitoring Methods and Data
  - 5 – Monitor coral and fish to measure restoration success; account for inputs and outputs.
  - 15 - "Keystone" WQ attributes for fish and benthic "health".
  - 16 – Fish abundance and density trends in the Coral ECA.
  - 20 – Ecologically driven fish assemblage shifts.
  - 21 – ID Indicator spp. for WQ and benthic "health".

- Augmentations to ECA Monitoring
  - Water Quality and Hydrodynamic Modeling
    - Improve analyte method detection limits.
      - Low mdl's, too many non-detects, revisit or think of different analytical methods.
    - Increase the spatial coverage and resolution of the survey design, and include more random sampling stations.
    - Increase sampling frequency and/or deploy autonomous monitoring platforms in order to work toward real-time water quality surveillance and prediction.
    - Add more analytes to the program, including nutrients, pollutants, and pathogens.
    - Upgrade field gear to safely obtain water samples at greater depths.
    - Add flow-through observation systems for water sampling while in-transit between regular monitoring station.
    - Develop hydrodynamic model that can be used to predict near real-time fluid dynamics for the Coral ECA.
    - Perform concurrent water quality sampling with the fish and benthic subsystem to the extent possible.
  - Fish subsystem monitoring
    - Perform annual sampling within NCRMP-RVC program.
    - Monitor artificial reefs across the entire Coral ECA for fishes.
    - Diversify monitoring methods, particularly camera-based surveys that can be deployed in almost any environment or depth.
    - Additional biological sampling such as plankton trawls and eDNA.

- Work with state and federal fisheries data analyst to develop a protocol for downscaling FDM data if possible.
  - o Benthic Subsystem Monitoring
    - Collect high-resolution censuses of non-scleractinian benthic habitats, including macroalgae, seagrasses, sponges, octocorals, anthozoans, gorgonians, tunicates, and macro-invertebrates.
    - Develop and implement a larval supply and recruitment success monitoring program in the Coral ECA, or augment an existing program to include this aspect.
    - Implement large-scale substrate monitoring for erosional and depositional-rate changes across the Coral ECA using stakes and sediment traps at fixed sampling stations.
- FDOU-51 Phase-II Framework
  - o Based on Research Theme 1 – Fish and how fish resources are changing over space and time, whether we can use it as indicators.
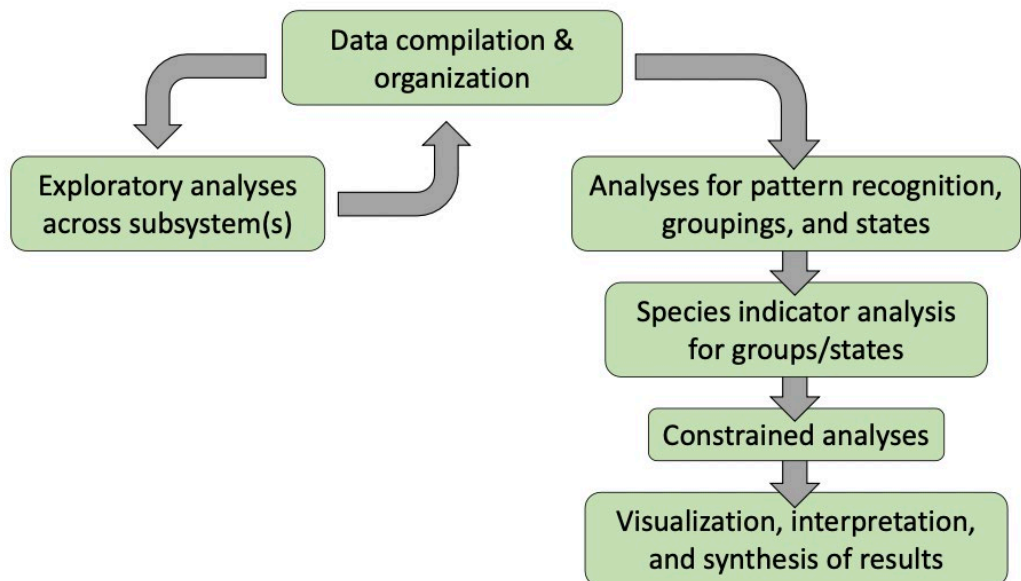
Figure 2: Analytical outline for Phase II of LAS Project FDOU 51.

  - o Taking into account the temporal aspect but also the specific design considerations.
  - o We can look into the specific subsystem, identify spatial and temporal regime states and nail down the fish communities that are responsible or indicative of them.
  - o Constrained analyses across subsystems or including all three and producing visualizations to understand complexity of impacts across all elements.

Questions/Comments:

- Kurtis Gregg: Regarding your comment on non-detect limits, if you have a long data set that shows that there are mdls and suddenly you start picking up parameters that are being detected that has some benefit as well. So rather than just discarding because we haven't seen it before, we've got some things in Southeast Florida that are changing, ports that are changing and expanding, it can be dangerous to stop looking for them.
  - Joshua Kilborn: That is fair. I should clarify that I was thinking about the return investment idea, where if we are not getting usable data from those samples we should change gear. I totally agree with what you are saying, and I agree and will keep that in mind.

- Piero Gardinali: You do environmental work, why are we set on a regulatory framework (NELAC)? I think your first point on getting better detection limits is worth exploring. Maybe a variance of a NELAC certified method. Other thing is looking at proxies, for example fluorescent organic matters could be a proxy for breakwaters; easy to measure, start looking at relationships of the things that we measuring in much more detail.

- Melissa Sathe: There are a lot of permit-required data for nearshore beach area projects, is that mentioned in the report?
  - Joshua Kilborn: We talked about coastal construction, if we did decide to look into that we would have to look at specific permitted projects. We haven't looked much into where/how to pull permits and data associated with them.

Reef Resilience Focus Area Scopes of Work Exercise (Taylor Tucker)

RR Project 1
This project is a literature review of available studies and existing legislation on eco-toxicity to assess the impacts of potentially toxic compounds known to affect corals and coral reef systems across the Florida Reef Tract. The project will also investigate any potential interactive/synergistic effects with fresh water, nutrients, sedimentation, or turbidity.

1. **Is there anyone currently, or has anyone previously done this work?**
   a. Kurtis Gregg – 2013
   b. Abby Renegar – NSU
   - Jennifer Moore: As part of the development of the proposed Caribbean coral critical habitat rule under the ESA we conducted a literature review of contaminants that affect Caribbean corals.
   https://www.federalregister.gov/documents/2020/11/27/2020-21229/endangered-and-threatened-species-critical-habitat-for-the-threatened-caribbean-corals

   - Stephanie Schopmeyer: The ARIT has compiled a list of ecotoxicants and their effect on corals - the working group is finalizing a white paper. For the ARIT review, please contact Erinn Muller

   - Manoj Shivlani: I'd recommend Dr. Danielle McDonald's work at the Rosenstiel School. She has done work on toadfish contamination.

2. **Are there any publications or documents related to the goals of the project?**
   a. Depends on the toxicant – literature review
   b. Literature review of effects in other countries (However it has to relate back to Florida and that is translatable to our corals and ecosystems)
   c. Fish toxicity - ecosystem
   • Phillip Dustan: The literature is full of pubs that describe the impacts of bottom paint, fertilizers, weed killers, and sunscreen...….and much more

3. **Is the project as a whole or in part still relevant to move forward?**
   a. Goal is very wide
   b. Toxicants vs. environmental data
   c. It's very important but complex

RR Project 2
Determine which of the compounds that may be toxic to reef organisms identified in RR Project 1 are reaching the reef. Using this information, design an in-situ sampling project to <u>quantify and characterize the sources of pollution and identify the relative contributions of point and non-point sources</u>.

1. **Is there anyone currently, or has anyone previously done this work?**
   • John Fauth: I'm finishing an EPA project on endocrine disrupting compounds. We have a structured sampling design with 50 stations across the 5 county region, and contaminant data on a subset of those sites. >800 analytes for that subset. Our sampling design includes waters off communities serviced by septic tanks. Plus inlets, ocean outfalls, origin and discharge of ag canals, residential canals, nearshore & offshore reefs, etc.

   • Stephanie Schopmeyer: *Acropora* Recovery Implementation Team

   • Phillip Dustan: Re Josh and the TAC's work in general: This was a lucid presentation of research that, in an ideal world, the scientific community would love to be able to chew over. But in 2022 ideas like this have been articulated in TAC meetings for XX years during which "the fire has burnt the house down and only ashes remain for analysis." Of greater importance now is what can we do that will so grab the public's attention as to activate them to (1) require policy makers implement the kinds of local controls that will result in measurable improvements in local water quality (sediments, all chemical contaminants), (2) voluntarily reduce their own contribution to the increased conc of CO_2 in seawater.
   Esther Peters: You are so right!

- Don Behringer: Isabel Romero (USF) has done a great deal of work on contaminants in FL and the Caribbean. She is working with us to identify any potential organic contaminants that might be involved in the recent Diadema mortality event. Some of the samples I believe she will be processing are from the Keys, as well as the wider Caribbean.

2. **Are there any publications or documents related to the goals of the project?**
   a. Water quality sampling design – test for analytes within samples
   b. Sediment sampling may be a better approach
3. **Is the project as a whole or in part still relevant to move forward?**
   a. Yes – focus on specific toxins
   b. Effect of Septic tanks on the reef (NOAA)
   c. Measure non-traditional contaminants & trace elements
   d. Hard to differentiate between point and nonpoint sources in the coastal system

RR Project 3
Determine the toxicity of and threshold limits for toxins identified in RR Projects 1 and 2 for coral reef environments.

1. **Is there anyone currently, or has anyone previously done this work?**
   a. Abby Renegar – UV filters in sunscreen, hydrocarbon toxicity, future steps chronic studies of toxins in corals.
   b. Cheryl Woodley
   c. Middle East – sunscreen
   - John Fauth: Dr. Craig Downs has published data on several compounds: Irgarol, petrochemicals, sunscreens.

2. **Are there any publications or documents related to the goals of the project?**
   a.
3. **Is the project as a whole or in part still relevant to move forward?**
   a. Acute threshold vs. chronic exposure – Abby Renegar conducting studies on effect of short exposure and high concentration of toxins in corals. Next steps would be long exposure with low concentration.
   b. Difficult and expensive
   c. Threshold for nutrients first. Look at sediments as well. First understand effects of the things we already know are there before looking into any exotic chemical.
   - Phillip Dustan: We need a Zilinsky Moment - we don't need more studies we need more "guns" to mobilize and affect behavioral changes in the population

   - Esther Peters: Note: "toxin" refers to a compound produced by a living organism that is toxic in some way to another organism (e.g., microcystins produced by

cyanobacteria). Chemical compounds produced by humans that are toxic are referred to as "toxicants." Must be careful to specify which we are dealing with here.

- Esther Peters: You are so right, Pierro! (about conducting toxicity tests and the many issues)

RR Project 8
Promote greater understanding of the toxins identified in RR Projects 1-3 to raise awareness of their effects on southeast Florida's reef systems, and how stakeholders may assist in the amelioration of their effects.

1. **Is there anyone currently, or has anyone previously done this work?**
    1. General messaging already being done
    2. Dr. Richard Pierce – ecotoxicology research, mosquito control and pesticide, red tide neurotoxins, natural and anthropogenic estrogens, ocean acidification and climate change
    - Judith Lang: Well continuing in this forum, I was trying to think of what can be easily shared with the public to grab them as they've never responded before: the web cams for fish that Josh mentioned but at depths that divers fish could work especially if historical photos are available for comparison, and what about high-resolution photomosaics of the benthos now against images of what was present when monitoring started

    - Phillip Dustan: People love the little patch reef webcam off Miami. WHy not have more?

    - Manoj Shivlani: We have some excellent NGOs and educational centers doing that type of outreach.Waterkeeper, the Frost Museum, and several others.

    - Judith Lang: Hi Manoj, The excellent outreach that's been done has raised awareness, but not spurred sufficient remedial action. We don't want to stimulate the sorts of quasi-destructive actions of throwing food at famous paintings protected by glass, as that approach really doesn't work, but maybe there is a way that research/monitoring could achieve some direct good for nature, including humanity, if they felt more engaged in what we do…hence webcams and mosaics that they could rotate on their monitors and arrive at a better understanding of all that's been lost in recent years.

2. **Are there any publications or documents related to the goals of the project?**

- Esther Peters: For RR Project 8, we have the information in the literature that we can use to get the word out. We just need to do this "awareness raising" to the folks who control the money and project funding.

3. **Is the project as a whole or in part still relevant to move forward?**
   1. Yes – depends on the other three projects
   - John Fauth: Better outreach to the FL Legislature is critical. The scientific community has identified sources of pollution and local governments have enacted legislation to address the problem (from single-use plastics to lawn fertilizer to chemical UV filters) only to have the Legislature pre-empt the local legislation, at the behest of corporate interests.

   - Judith Lang: Unfortunately not just in Florida!

   - Phillip Dustan: These are all great efforts but they do not reach, nor influence, the right people. We need something that will go viral!

   - Esther Peters: In which case we need to connect the toxicant on the reef, in the ocean, to human disease issues. Of course, that might not do it either. But people who swim frequently off south Florida beaches (esp. Ft. Lauderdale-Miami) are reported to get sick (Univ. Miami had a program that was looking at this, but I am not sure it exists anymore).

   - RR Project 7: Create a compendium of management activities including those in other Local Action Strategies, that may be implemented to reduce the various stressors and improve reef resilience.

Public Comment

Brian Walker:

Meeting Date: _Dec 12, 2022_

Southeast Florida Coral Reef Initiative

Comments:

Two large colonies and many small were impacted by Hurricanes Ian & Nicole. It would be good to set up groups to canvas the shallow reefs & turnover corals after large wave events. Perhaps something like a reef clean up with a different focus

Name: Brian Walker

Affiliation: NSU

Address:

Email: walkerb@nova.edu

Colonies toppled by waves from Ian & Nicole
Brian Walker, Nova Southeastern University GIS and Spatial Ecology Lab

Public Comment: Is it feasible to organize groups to dive shallow areas of the reefs searching for and righting corals that have been flipped from high wave events? Something like a reef cleanup with a different purpose.

Two large corals (LC-110 and LC-114) were recently overturned during the high wave event after Ian passed over Florida. These colonies are of 107 rare colonies left in SE FL not impacted by disease or other conditions. Their hardiness speaks to their resilience, and their value in reef recovery.

On Oct 7 as part of our partially NOAA -funded monthly large coral monitoring we found LC-114 overturned and broken apart. This coral was ~2m in diameter and 1 m tall and was monitored since August 2018. On October 10, we revisited both colonies to overturn them so they would not die. LC-110 was intact and little else is required for that colony. LC-114 was broken apart extensively. Five of the largest fragments were placed together in hopes they would stabilize each other. Multiple smaller colonies of opportunities were collected and brought to

NSU's ex situ nursery for future NOAA-funded restoration efforts. LC-114 needs work if the larger pieces are to remain alive. Pieces must be reconfigured and stabilized.

LC-114 original state
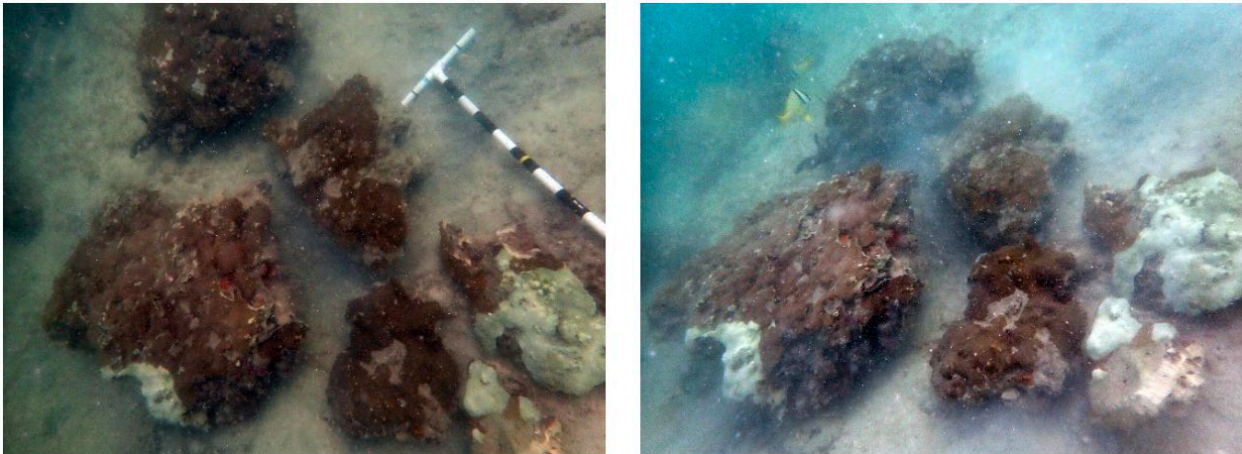
LC-114 on Oct 10, 2022

On November 16 divers focused on other activities covered about 300 m of reef over six dives and flipped 9 colonies from Key Biscayne to Sunny Isles. On November 17 divers focused on other activities covered about 365 m of reef over three dives and flipped 8 colonies from Birch SP to Pompano moorings.

Larval Dispersal and Connectivity of *Acropora* on Florida's Coral Reef – *Samantha King*

- Research done for Master thesis in Joana Figueiredo's Lab, and how we have improved in the couple years since.
- Current restoration methods have limited scale
  - Outplanting is great at increasing local coral cover, but there is limited scalability to restoration as far as being able to restore an entire reef system by planting coral
  - Produce through fragmentation = Asexual reproduction

- o Does not increase genetic diversity, not provide genotypes that have adaptive potential for natural selection to act upon, whereas if we use other forms of reproduction (sexual)
  - o Site selected based on environmental condition and ease of access
- Optimize restoration processes – Increasing connectivity, capitalizing on sexual reproduction and the natural ways that corals are able to repopulate themselves (sending larvae to other reefs, populating natural habitats, replenishing their own reefs)
- How can we outplant to replenish non-restored sites?
  - o Identify sites that are stronger sources of larvae, increase connectivity, thus increase resilience of the system. Prioritize regions for restoration and protection.
- Biophysical dispersal model
  - o Where could *Acropora* be?
    - Less where *Acropora* currently are.
    - Potential connectivity.
    - Where are the habitats that *Acropora* could potentially be living.
    - Wirt et al. 2015 *Acropora* habitat map (*A. cevicornis* and *A. palmata*), subdivided potential habitat into square polygons 500 m x 500 m, about 10,277 reefs used in our models across the Florida reef system.
  - o Where would larvae go?
    - SLIM model, high resolution hydrodynamic model
      - Unstructured mesh and high resolution (100m)
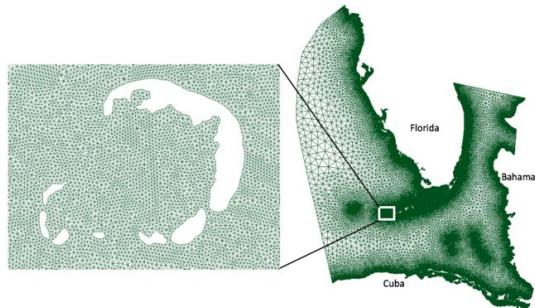   - Hydrodynamics for 2016 and 2017

Figure 3: Example of SLIM model.

  - o Would the larvae be able to settle?
    - Long term survival and competency
    - Experiments with *A. cervicornis* larvae to determine how long they could survive for in absent of a settlement queue and determine how long they can maintain their ability to settle.
    - Coral larvae don't feed in the water column, they depend on energy reserves from their parents.
    - Long pre competency period - How long it takes them to gain the ability to settle, increase their dispersal potential since there are going to be several days before they settle.
- Biological data
  - o Long term survival and settlement experiments

- o Model survival and competency
- o Day 5 can begin to populate reefs
- o Day 20 peak proportion of larvae able to settle
- o Larvae survival decrease after that
- o Input those parameters into biophysical model to inform the particles if the larvae where both alive and competent, determining ability to settle in habitat vs. time
- o SLIM particle tracking – where the larvae are going will be predominantly determined by the currents in the region rather than their swimming ability.
- o Run model for 2 months, assumed settle at a rate of 20% per hour.
- o Connectivity matrices were main output for this research, what proportion of larvae were sent and received from other reefs, connectivity index determined for restoration goals.
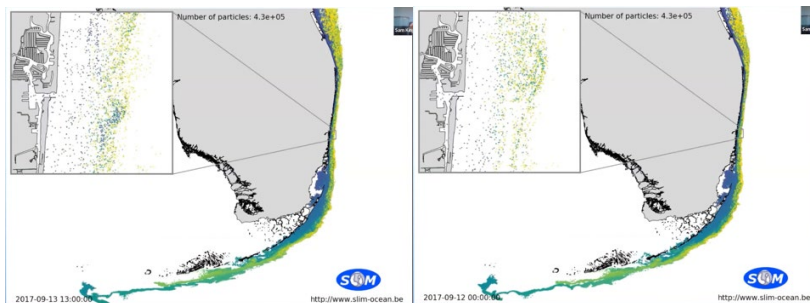

Figure 4: Biological dispersal model. Uses particle tracking to simulate coral larvae. These are screenshots from the model that runs for 2 months.

- • Source reefs – first metric
  - o Capacity to replenish other reefs, based on number of reefs that each reef is connected to as well as how strong that connection was.
  - o Kernel Density/Hot spot analysis, warm areas - stronger sources, cool areas - weaker sources
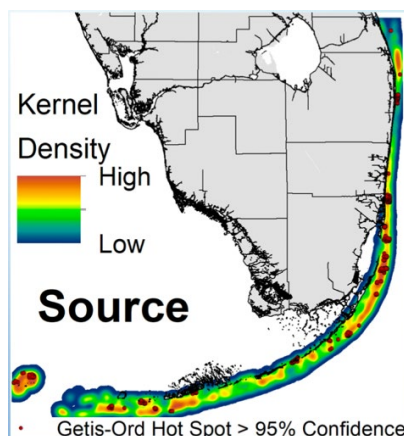

Figure 5: Getis-Ord Hot Spot analysis.

- o ANOVA - No significant differences between years (2016-2017) and management regions

- Sources throughout the whole Florida reef track, important for management mindset
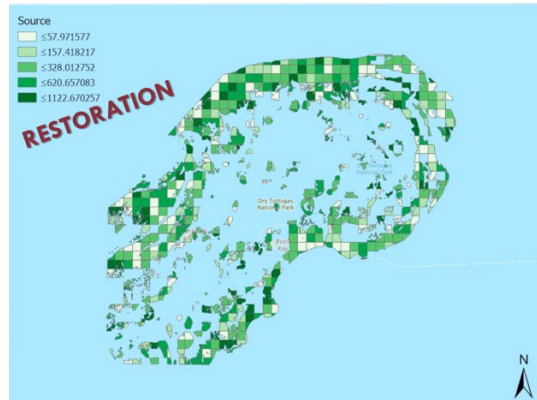

Figure 6: Example of coral larvae sources metrics in Dry Tortugas. Lighter colors are weaker sources, darker colors are stronger sources.

- Sink reefs – second metric
  - How many reefs they receive larvae from and how strong those connections are.
  - We found slight difference between 2016 and 2017.
    - Dry Tortugas and Upper Keys in 2016 slightly higher sink indexes than Southeast Florida reef track.
  - 2017 no significant differences.
  - Sites important to target for protections, good at receiving larvae, protection areas needed, improve environmental conditions.
  - Protection measures at these sites will improve odds of settlement. No natural recovery of reefs observed.
  - If you map where there is coral cover, any those where there is a high sink index might have higher diversity at sites, more genotypes for coral nurseries.
- Local retention – third metric
  - Measure of replenishment.
  - How many settled to reef based on total number of larvae that reef released.
  - Hotspots through reef system.
  - 2016 Middle Keys higher retention than Upper Keys.
  - 2017 no significant differences.
  - Useful for protection, less vulnerable to disturbance because they will be able to replenish themselves.
  - If reefs have coral, and conditions have improved, spawning occurs, they will be able to increase their stock on their own.
  - Higher levels of retention than expected – due to high resolution of hydrodynamic model.
- Self Recruitment – fourth metric
  - Measure of isolation
  - How much settled on the reef rather than how much larvae were released from reef.
  - No significant differences between regions.

- o More vulnerable to disturbance because if coral population gets wiped out, they aren't going to receive larvae from other reef sites, poorly connected within the system.
  - o Existing corals on reefs with high self-recruitment might have strong local adaptation to their environment, environmental conditions that are useful for targeting – useful genotypes useful to incorporate for sexual reproduction and coral nurseries (alleles of interest).
- Key findings
  - o Larvae predominantly transported north, but southward transport also occurs.
    - ▪ High resolution Hydrodynamic model can capture localized processes, resent research has shown periodic southward currents along Florida reef track.
    - ▪ Broward and Martin counties reefs that can be connected to Dry Tortugas.
  - o High potential for system wide larvae exchange across all regions.
    - ▪ Reefs strong in each metric found throughout the system.
      - If we are very targeted and species selective in how we outplant, could stimulate natural recovery.
      - No "perfect" reef
        - o Sources = restoration
        - o Sinks = protection
        - o Local retention = replenish
        - o Self-recruitment = isolated
  - o High resolution found higher local retention than expected.
- Putting it into practice: Metapopulation model developed to look at realized connectivity between reefs
  - o Closer estimation to realized connectivity between these reefs.
    - ▪ Took into account current coral cover, time to sexual maturity, asexual growth, fecundity, post settlement survival.
  - o Use model to test where to outplant in order to assess relative improvement of reef tract
  - o Compare sites abilities to replenish other reefs.
  - o Assess mesoscale spatial planning of restoration projects (site to site comparison).
  - o Assess relative improvement of reef tract via restoration.
  - o Spatial Scale
    - ▪ How to spread outplanting effort?
    - ▪ Better to outplant equal amount of effort across many reefs rather than condensing all effort into just a few reefs.
    - ▪ Increases connectivity.
- Work currently in review for publishing, coauthors: Antoine Saint-Armada, Emmanuel Hanert, Brian Walker, Joana Figueiredo

Questions/Comments:
- Xaymara Serrano: Great work. How deep does the SLIM model go? Is it depth a consideration in the connectivity models? Working with *Porites asteroides* and *Montastrea cavernosa* it is something to consider.

-        o   Samantha King: SLIM model is depth average, does not take into consideration how the hydrodynamics will differ relative to depth. *Acropora cervicornis* is found in shallower habitats so less depth partitioning than with say *M. cavernosa* with mesophotic populations.

- Brian Walker: Excellent work, the spatial analysis is fantastic. I'm curious, mostly based on two spawning seasons of *Acropora*, how much do you think it will vary in a longer time span like10-20 years? And how can you apply it to other species?
  - o   Samantha King: Larval dynamics will differ a lot between species. *Acropora* have a longer pre-competency period than something like *Dendrogyra* that have a small egg size causing faster time to competency or something like *Porites* that will be released as a larvae, immediately ready to settle. Will affect dispersal capabilities. No drastic changes year to year in larvae, although environmental conditions will affect fecundity and other abilities. Generally, their ability to reproduce will be similar in the lens of potential connectivity. For the hydrodynamic it model will be helpful in the future to have additional years. Since we found high potential connectivity think will be more accurate but will have similar results.

- Anthony Priestas: What consideration is there of the local water environment when identifying sites based on these metrics? Wouldn't local water conditions overwhelm the other factors?

- John Fauth: Has this model been tested empirically? I'm concerned that the language in this presentation suggests that *predictions* are actual patterns. The prediction that sinks would be species rich in corals that are broadcast spawners is easily testable.
  - o   Samantha King: Not yet. Prior to this work, there had been no estimate of coral connectivity in Florida, so this was an important first step to start to identify these sites. With this data soon to be publicly available, then further steps can be used on the ground to add in these other important layers of data such as environmental quality which would certainly impact how feasible these sites are for outplanting and for potentially receiving larvae

- Jack Stamates: The southern flow mentioned can be vertical stratified.

- Judy Lang: If bleaching events are unevenly distributed along the reef tract in a year, the larval productivity of the surviving corals will also be unevenly distributed in the following year.

- John Fauth: It's unclear to me how this relates to resilience as opposed to resistance (or perhaps refugia)? It's vital to differentiate - and to include - all three of these elements. See http://www.coastalwiki.org/wiki/File:ResistanceResilienceSystemEvolution.jpg for an example.
  - o   Samantha King: Hi John. I see what you mean, inclusion of these other terms would be useful, thanks for info. When I said resilience, I was thinking in terms of the importance of spatial connectivity in maintaining diversity and function of

these populations. But improving larval connectivity should increase the resistance of the metapopulation as well.
- o John Fauth: My concern is that resilience is being used as a blanket term when it is very different from resistance and refugia. I'm also concerned about untested assumptions, like metapopulation dynamics being important for corals and particularly their restoration. I also work on amphibians, and for decades folks concentrated on their supposed metapopulation dynamics. It turns out that most pond-breeding amphibians return to their natal ponds; they're not linked by migration as metapopulations. Populations also often are locally adapted, so gene flow does not improve fitness. Lack of genetic variation is not necessarily bad, per se. Often, it results from strong past selection and fixation of favorable alleles and strong linkage. For example, the heritability of eye number in humans is zero. Variation is eye number clearly is disadvantageous and it was weeded out long ago.

- Don Behringer: Great presentation, Sam. Do you have an overall probability of local retention for the Keys and ECA combined? I assume whatever is not retained is largely larval wastage?
  - o Samantha King: Thanks Don! The retention metric was calculated for each *Acropora* habitat reef on Florida. If I'm understanding, I think your question is more of overall settlement in the system? Which overall, most larvae are lost and never settle on any reefs (I think this was over 95%, perhaps 99% but it's been awhile. Retention for most reefs was just a very small portion of what settled, but that we captured any was exciting. A few reefs did retain most or nearly all of their larvae though, and these were scattered throughout the reef system.

- Esther Peters: Sam, yes, great presentation, fascinating. Did you say that you assumed 20% of larvae produced would be able to move in the currents?
  - o Samantha King: Thanks Esther! The maximum portion of larvae that could ever settle based on the larval experiments was around 30% with the peak at about 20 days (based on survival and competency modeling from our experiments). The 20% came from the settlement rate per hour of larvae in the dispersal model. So in the model, if a mass of larvae remained over a suitable site for long enough, some proportion of them were alive and competent per the biological data, for every hour that they remained over the site 20% of that quantity could settle. The very original version of the model we had, if the bio data said they could settle and they passed over a habitat reef, they were assumed to settle, this was a step we added for additional limitations

- Esther Peters: Do we have data on the genetics of *Acropora cervicornis* in the Dry Tortugas to south Florida that could explore links to larval migration?

- Judith Lang: Re Sam Cook's last slide: has there been any follow-up to find out what the subsequent survivorship of the treated corals has been?

- Stephanie Schopmeyer: Treated corals does not equal survival, so the calculation of 6483 corals being equivalent to 193,000 outplants isn't exactly beneficial.

Restoration Strategy for Florida's Coral Reef – *Caitlin Lustic, TNC*

- Developing a Statewide Coral Reef Restoration Strategy
- Resilience Action Plan for Florida's Coral Reef (2021-2026):
  - Goal 1: Enable resilience-based management of Florida's Coral Reef
    - Restoration planning
    - Larval connectivity modeling
    - Restoration site selection
  - Goal 2: Support public policy that creates the enabling conditions for reef recovery
  - Goal 3: Enable stakeholders to support the future of the reef and those who depend on it
- Based on "A Manager's Guide to Coral Reef Restoration Planning and Design"
  - Focused on the statewide level, setting goals and prioritizing focal areas (larger than sites).
- Restoration can be done at different scales: Tiered planning structure
  - Tier 1: Statewide strategy; high level guidance and identification of focal areas to achieve large-scale ecological goals.
  - Tire 2: Jurisdiction-level plans; identification of goals specific to each jurisdiction, further prioritize focal areas based on those goals, and guidance on how to achieve them; e.g. upcoming planning effort for ECA January 2023
  - Tire 3: Site-specific plans with detailed information about site and methods; e.g. Mission: Iconic Reefs
- Tier 1 is needed to:
  - Achieve goals that can only be successful at scale of entire reef tract
  - Leverage and prioritize resources funding and expertise
  - Effectively communicate goals and needs
  - Conduct coral reef restoration in the larger context of other management activities
  - Inform future detailed planning efforts
  - Ensure that an increase in effort is focused in areas most likely to contribute to overall reef recovery
- Restoration goals
  - Preserve and enhance ecosystem resilience (obj: preserving and enhancing community structure)
  - Preserve, restore and enhance genetic diversity to allow for adaption to changing conditions
  - Restore sexual reproduction in species
  - Ensure genetic connectivity
  - Prevent/minimize loss of fishery species habitat (ecosystem service)
  - Prevent/minimize loss of aesthetic/tourism (ecosystem service)
  - Shoreline protection
- Tier 1 restoration visions and goals

- o Vision: Restore Florida's Coral Reef to a thriving, diverse, resilient condition that sustains ecosystems and their valuable services for current and future generations.
  - o Goals:
    - i. Enhance coral population and coral community resilience
    - ii. Enhance habitat quality in support of coral recruitment
    - iii. Increase coral survivorship
- Focal area identification
  - o Create a series of maps based on a set of area selection criteria:
    - Use existing data sets to predict where coral may be likely to survive to sexual maturity
    - Bring back ecological function and let reefs re-seed
    - Prioritize criteria that are relevant at the FCR scale and could be overlooked at a local scale
- Final Criteria used for Focal Area identification wanted to look at augmenting existing coral populations and coral connectivity
  - o Coral demographics:
    - Recent size distribution
    - Persistence over time
  - o Coral larval connectivity modeling
    - Good source sites (King et al., in review)
  - o Species used (wide-spread and have a lot of data):
    - *Acropora cervicornis*
    - *Pseudodiploria strigose*
    - *Orbicella faveolate*
    - *Montastrea cavernosa*
- Criteria 1: Coral demographics
  - o Size frequency distribution:
    - In which strata do we see a good distribution of both large and small corals?
    - If older corals and younger corals there should be spawning occurring
    - Environmental conditions that support both juvenile and adults
  - o Persistence:
    - Over the past 8 years, in which strata have *Acropra cervicornis* consistently been observed?
    - STCLD susceptible species
- Criteria 2: Coral larval connectivity
- Demographic score using DRM and NCRMP data overlayed with coral connectivity data
  - o Areas that have good demographics and are good sources should be prioritized for restoration
- TAC Exercise 2020 – Restoration site selection criteria
  - o Long-term goal to have natural re-population at the site
  - o Nearshore impacts from beach projects
  - o Larval connectivity modeling:
    - More hydrodynamic data from multiple years (10-15 years is ideal) during the spawning months

- Competency and larval dynamics from all 4 species to get species-specific larval connectivity models – Joana Figueiredo
- Areas that have lost their 'source'; sinks or self-recruiting sites
    - o Species composition vary across ECA, concerns with moving shallow water genotypes or colonies into deeper water
- Next steps:
    - o Additional larval connectivity modeling, by May we will have *A. cervicornis* and *M. cavernosa* updated models
    - o Tier 2 planning for the Kristin Jacobs Coral Ecosystem Conservation Area ECA in January

Questions/Comments:
- Xaymara Serrano: Have you given a thought about how to move from Tier 1 to Tier 2, delving into coral demographics and connectivity within a certain area, or are you thinking of bringing in some other criteria to make it more regional?
    - o Caitlin Lustic: In that first meeting that we are going to hold with the reef manager is when we will figure that out. We are going to bring more criteria to help narrow. Less sampling effort in SEFL, data set is less robust so may need to bring more data sets or just use expert opinions. Mix, more data sets and make it work better for areas with less information.

- Brian Walker: In 2015 we did mapping of all the less dense *Acropora* patches, don't know their conditions or extent now, they probably aren't captured in the demographic data, it will be need to supplemented and update data set with this info.
    - o Caitlin Lustic: That would be great. We need more analysis, will have to swim around to see where the corals are doing better and where we need to put our efforts.
    - o Brian Walker: Demographic is tough because it changes between years.
    - o Caitlin Lustic: Yes and you are extrapolating. We will need more ECA specific data.

Stony Coral Tissue Loss Disease Response Updates – *Samantha Cook, Sea Grant*

- I am the National Coral Reef Manager, I help to coordinate our disease response
- Disease progression
    - o Florida
        - STCLD is endemic to Florida's Coral Reef
        - Dry Tortugas update:
            - Observed at approximately all locations within the park.
            - 6 months ago we did an update, not too much has been seen but disease is still present, brain corals affected, more recently seen in OFAV and OFRA.
    - o Flower Garden Banks update:
        - Disease outbreak – lesions occurred on bouldering corals.
        - Three disease monitoring cruises.
        - Unsure if SCTLD because of slow progression rate.

- Samples taken for more definitive answers.
  o Caribbean
    - 2022 appeared in St. Vincent and the Grenadines, Grenada, Colombia, Antigua and Barbuda
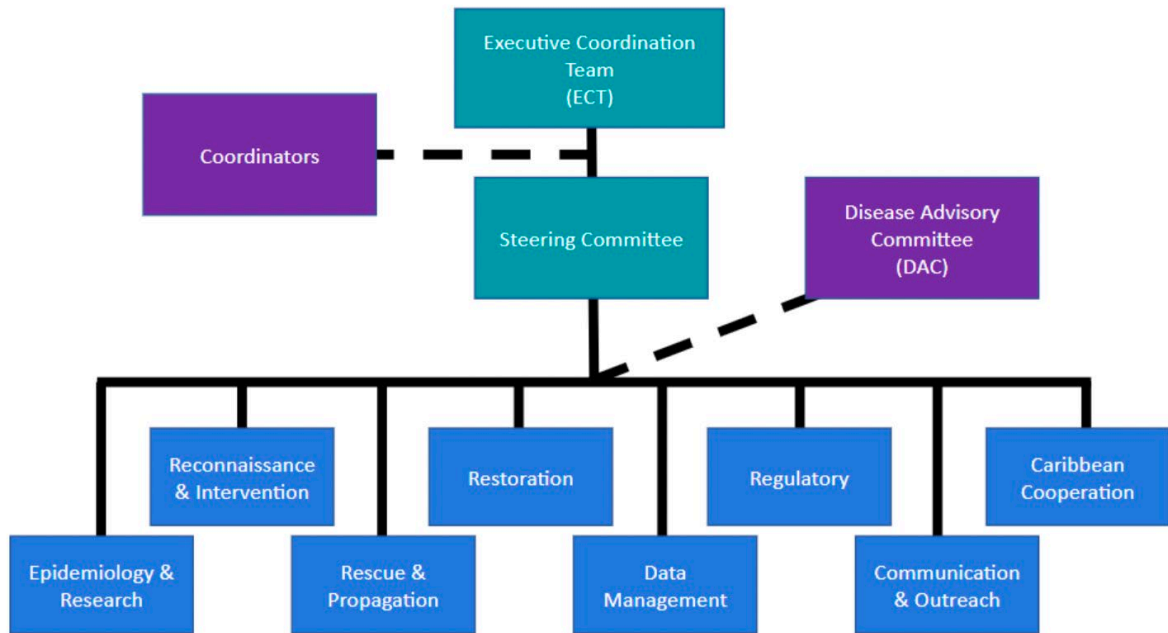

Figure 7: Current SCTLD disease Response structure.

- o 2 leadership: Executive Coordination Team (ECT) and Steering Committee, representatives from State of Florida, DEP, FWC, NOAA CRCP, etc.
- o 2 layers of representatives, executive coordination team, Disease Advisory Committee
- o 9 response teams, reconnaissance and intervention have split
- o Disease Advisory Committee meets twice monthly, everyone gets together, research updates and everything related, 8 years of SCTLD
- o In may our two leadership audiences had a workshop to discuss future of disease response now that SCTLD is endemic.
    - Don't want to lose the network that was built up
    - Research needs are changing
- Disturbance Response and Recovery Framework
  o Why?
    - SCTLD was tipping point - requires active management and targeted recovery
  o Disturbance Response and Recovery Framework:
    - NOT seeking to replace other efforts or subsume authorities.
    - Framework seeks to build on successes in coral ecosystem management and merge with historical management processes.
    - Will maintain a strong focus on SCTLD but will no longer be sole focus of coordination

- - - We are seeking partner thoughts and feedback. Reach out to mmartinelli1@ufl.com
- FY 23-24 Research Review Process
  - Process is clunky, making it more manageable
  - Removed Pre-proposal / Proposal step replaced with 500 word summary.
  - Active PI- Manager communication for project development.
  - More inclusive project, focus what you want to study but keep priorities.
- Next DAC meeting: Wednesday December 14, 1:30 – 3:00 pm
- DAC Research Highlights - Restoration Trials Experiment
  - Long term restoration monitoring. Project started 2 years ago (CRF/FWC), track presence of STCLD and tracking survivorship.
  - ~50% of bases with living fragments show some degree of fusing.
  - ~87% live tissue (survival).
  - 3.2% have shown signs of disease.
- Recent Publications
  - "Transmission of stony coral tissue loss disease (SCTLD) in simulated ballast water confirms the potential for ship-born spread"
  - "Advances in coral immunity 'omics in response to disease outbreaks"
  - "Biofilms as potential reservoirs of stony coral tissue loss disease"
- Other updates
  - *Acropora* Disease outbreak
    - Seen in Florida Keys
    - Mainly affecting APAL but also ACER – not STCLD (RTL?)
    - Concerns about disease moving between restored and native populations
    - Keep eyes in the water in Southeast Florida.
  - Bleaching Event Timeline
    - August – Bleach Watch
    - September – Alert Level 1.
    - October – No Stress (~8 weeks for coral recovery).
  - Surveillance Workshop
    - Major outcomes
      - Development of recommendations related to disturbance detection and rapid response, including event monitoring, sampling, and coordination of activities.
      - Annual meeting of the monitoring programs, beneficial to make data available to each other
      - Identification of the highest priority resource needs.
      - Identification of research questions that can be addressed through monitoring data.
  - Dry Tortugas Intervention – Summer 2022
    - Over two cruises:
      - Covered over 109,400 square meters of reef.
      - Conducted 247 hours of underwater work.
      - Treated 6483 corals (coral tissue equivalent to approximately 193,000 coral outplants).

Questions/Comments:
- Dave Gilliam: Not understand previous slide
  - *Brian Walker:* The presumption would be that if those coral weren't treated, you would lose the remaining tissue on them, so the remaining tissue equates to how many outplants

- Brian Walker: I had some concerns about the response and the change in direction of the current structure, you are going to get into more details on Wednesday?
  - *Samantha Cook*: More at DAC meeting.

- Piero Gardinali: What is artificial ballast water?
  - *Samantha Cook*: "Transmission of stony coral tissue loss disease (SCTLD) in simulated ballast water confirms the potential for ship-born spread".

Evaluation of Turbidity Generated by Natural and Ship-Induced Processes, Port Everglades, Florida – Anthony Priestas, USACE

- Anthony is a research physical scientist in the field data collection and analysis branch of the US ACE R&D Coastal and Hydraulics Laboratory. His work relates to turbidity monitoring off the coast of Port Everglades. Background in geology, coastal processes, geomorphology. My work in the lab consist of sediment in some form, geochemical fingerprint, sediment transport dynamics, dredging related stuff, etc.
- Port Everglades is about to embark on a dreading construction project to widen and depend its navigation channel, the footprint will extend all the way out to the outer reef primarily to accommodate larger Panama ships and improve navigation safety hazards as well. Concern in monitoring turbidity in this protected marine habitat. This project is helping to understand,quantify and differentiate between background turbidity from natural and ship induced processes and dredged induced plumes through the construction phase. This presentation focuses on the data analysis aspect of turbidity that has been taken from ACE and contractors, and will touch on some additional monitoring efforts that are forth coming.
- Turbidity Datasets:
  - Dial Crody and Associates (2017 – 2018)
  - SOL-GHD Inc. O&M Monitoring (2020 – 2021)
  - USACE-NOAA Trial Station I (2020)
- Instruments used:
  - YSI EXO (DCA)
    - Older data
  - In-Situ AT600 (GHD and USACE)
    - Newest data
- Informative data
  - Representative of processes that are occurring out there
  - Reliable - Quality control processes to determine "good" and "bad" data
  - Decisions about background turbidity and compliance need to have these considerations

- Dataset types in this analysis
  - Casts: vertical profiles, depth profiles, snapshot in time, good spatial coverage, 1 HZ
  - Fixed stations: time series analysis, good temporal coverage, lack spatial coverage, 5-15 min averaged intervals
- 3 Datasets (DCA, Sol-GHD, USACE-NOAA)
  - >400 vertical profiles (Turning Basins, Outer Entrance Channel (OEC), Inner Entrance Channel (IEC), South Port Access Channel (SAC))
  - 529 days time-series data (OEC)
  - 58 days time-series data (IEC)
- Quality Control Measures
  - Outlier detection and fill.
    - Cast Data:
      - Outlier Detection: >3 scaled Median Absolute Deviation (MAD) from the median (less sensibility to outliers than common method of 3 times the interquartile range)
      - Fill: Linear interpolation
      - Smoothing: None
    - Station Data
      - 60-min moving window
      - Outlier Detection: >3 scaled MAD from the median
      - Fill: Linear interpolation
      - Smoothing: Gaussian kernel 1- or 4-hr moving window
        - Turbidity data are inherently noisy
        - Don't want to smooth it too much where you reduce magnitude of turbidity signal where it looks less significant that it really is
  - A lot of biofouling – Disregard biofouled data segments
- SOL-GHD Inc. Dataset
  - Harbor Maintenance Dredging
  - Clamshell dredging: 11/24/2020 – 01/13/2021; zones: North Turning Basin (NTB), Middle Turning Basin (MTB), South Turning Basing (STB), Inner Entrance Channel (IEC), South Access Channel (SAC), Turning Basin (TB)
  - Hopper dredging: 02/11/2021 – 05/03/2021; zones: IEC, SAC
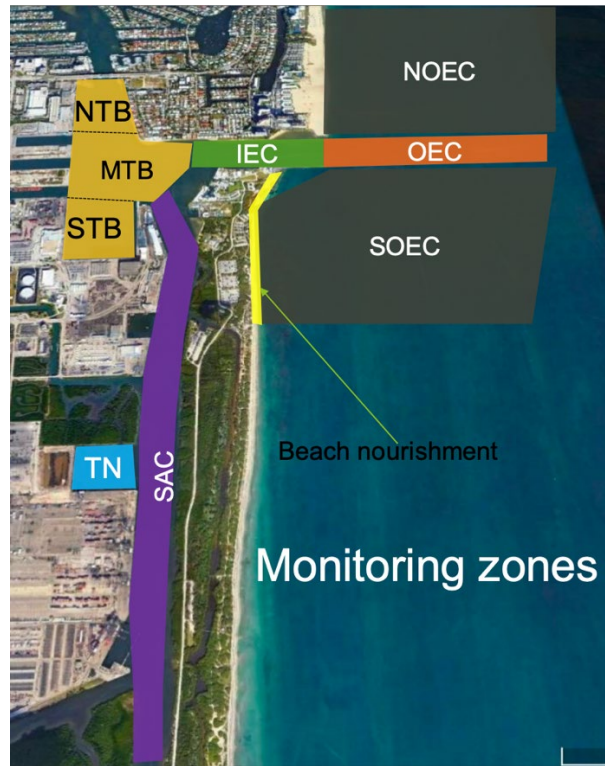 - Associated beach nourishment project

Figure 8: Monitoring zones during harbor maintenance dredging.

- o SOL-GHD Inc. Casts Data
    - ▪ Pre-dredge dataset
        - • Turbidity generally very low with instances of high
        - • A lot of turbidity generated within turning basins
        - • Just vessel maneuver that can cause these values of turbidity.
        - • High turbidity occurs at the depth
    - ▪ During dredging dataset
        - • Values of turbidity can get very high (100-150 NTU)
        - • Material exported offshore
        - • If contractors see something interesting like a plume, they are likely to go sample it, with a fixed station you might not be able to capture this
    - ▪ Post-dredging dataset
        - • Less activity, higher turbidity instances occur at depth
    - ▪ Summary: Medians are very low, Max's are very high (shows means and medians are less informative of the turbidity event)
- o SOL-GHD Inc. Station Data, during-dredge IEC stations
    - ▪ Each station has 2 instruments, one meter below the surface and one meter below the benthos
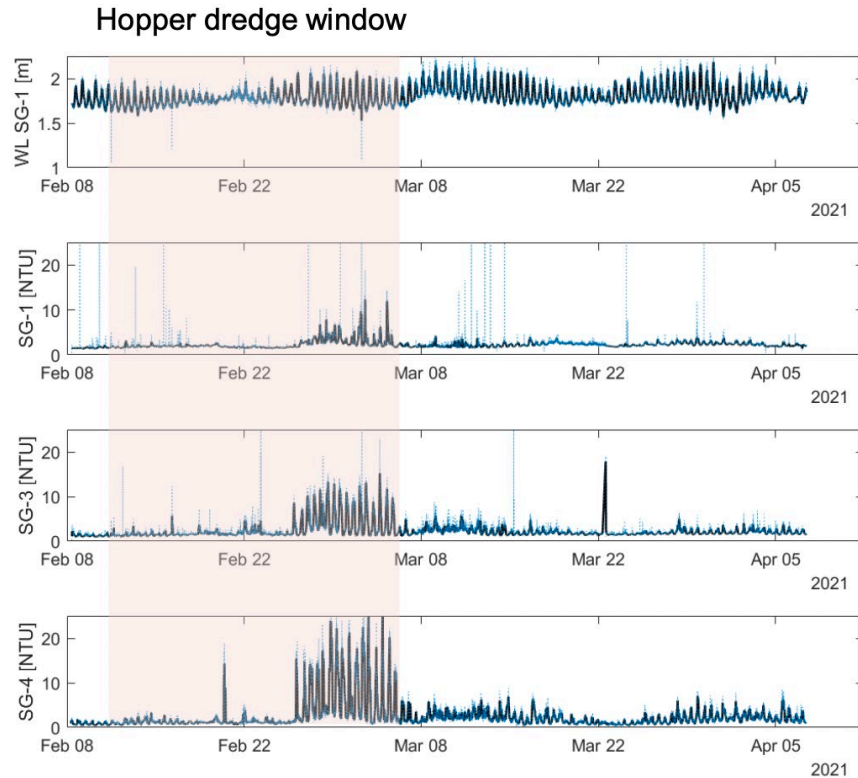   - ▪ Collected between 02/08/2021 – 04/07/2021

Figure 9: Turbidity plots for during-dredge station data from February to April 2021. Light blue is raw data, black is QA/QC'ed and filtered data. Red area is the hopper dredging window denoted on the contractors reports. Top graph shows water level taken from Aqua-Troll instruments. Bottom 3 graphs shows turbidity data from stations SG-1, SG-3, and SG-4.

- ▪ Nice data set, no signs of biofouling, turbidity event captured, but you can still see some outliers, turbidity events can last longer than the duration of the collection interval
- ▪ Station 4 higher turbidity because greater proximity to the turning basin
- ▪ Not clear, hard to tell if turbidity will be exported
- ▪ Turbidity events modulated by tides
  - • Residence time, tidal cycle, not dissipating with time, not a lot of flushing seem to be occurring
- ▪ Summary: Median and Max values are divergent, lower values are diluted by tide.
- o In general, excessive biofouling, particularly bottom instruments. Challenge to extract data where this has occurred since it appears like extreme values of turbidity, dramatic rise and noisy in contrast with real turbidity events.
- o SOL-GHD Inc. Station Data, during-dredge OEC stations
  - ▪ No wave meters to correlate to turbidity events so used local data
  - ▪ A lot of biofouling (particularly bottom instruments). Biofouling tends to have an exponential rise that does not fall
    - • Made much of the data set practically useless, had to extract data that can be used

- - Sometimes biofouling occurred as soon as 1 week from maintenance
    - Discarded biofouled data and NaN segments to derive statistics
  - Station 4: Wind wave driven event vs. Dredge event
    - Wave driven event reaches up to 10 NTU vs. dredge event is more persistent and 3 to 4 times greater in magnitude.
  - Summary IEC vs OEC averages: Mean IEC slightly higher than for OEC, unreliable, 50% of the data not used because of biofouling
- Monitoring efforts USACE-NOAA (AOML) Dataset - stations
  - Trail Station I: monitored water quality and wave occurring conditions remotely
  - Bottom-mounted – 12/11/2020 and 02/13/2021 (hit by a vessel)
  - Instruments deployed:
    - Nortek AWAC (WVHT, T, WVDIR)
    - AT600 sonde (turbidity)
    - LISST-ABS (SSC)
    - PAR Sensor (photon flux density)
    - Echologger altimeter
    - Wrapped in copper tape to avoid biofouling, missing from previous data set
  - Station 1km offshore, 200 m north of OEC, instruments connected with buoy telemetered to NOAA server live (20 min interval). Near real-time water quality data on web UI
  - 45 day data set, shows one wave-driven, small turbidity event, short duration, correlates with waves heights of 2m at 5sec wave periods, cold front, with these types of conditions expect high nearshore turbidity
    - Shows very strong correlation between turbidity sonde and LISST-ABS
  - Comparison to closest GHD station
    - GHD data is very noisy, hard to relate
- DCA Dataset - stations
  - 1 year continuous data July 2017-2018 (nearshore and offshore stations)
    - No dredging going on
  - Potential biofouling occurring mostly at the end (offshore station but not nearshore)
  - Turbidity events driven by storms
    - Hurricane Irma: ~1wk above 7 NTU, larger amounts of turbidity in offshore stations similar to what was observed in turning basins of harbor
    - Hurricane Nate: ~4d above 7 NTU, had pretty significant turbidity
- Summary of all non-dredge-related turbidity data
  - Less than 1% of data exceed 26 NTU threshold
  - Descriptive statistics like this have little utility to describe turbidity EVENTs
  - Does show the likelihood of exceedance
  - Since data are so noisy, how do you define a turbidity event?
  - Produced Exceedance probability distribution (excluding storms)
    - Combined DCA-USACE-NOAA data
    - Determine what is the probability that a turbidity even will exceed a certain threshold

- 12% of data > 7 NTU
- 0.8% of data > 29 NTU
- How to quantify impact potential in corals?
    - Exposure - time above threshold, previous analysis
        - Exposure to sensitive conditions, does not take into consideration the magnitude of the turbidity. How much time was spend above threshold
    - Exposure - Integrated time above threshold… incorporates exposure time and intensity
    - Exposure in this sense only related to sediment, not light availability
- Takeaways
    - Background turbidity
        - Low, generally 1-4 NTU Harbor & SAC
        - <1-2 NTU Ocean
        - Higher propensity for turbidity in harbor
    - Natural events
        - Wind-wave driven – 10-20, up to 50 NTU
        - Can be tide modulated
        - Storm driven – 100 – 150 NTU
    - Non-natural event
        - Most of mass of material remains in harbor, not exported offshore
        - Data quality issues prevented correlation of turbidity events in harbor to time series data near the channels
    - Biofouling a major issue
        - Bottom sondes more susceptible
        - Anti-fouling measures – up to 45 days good data
- Questions
    1. What criteria constitutes a turbidity event?
        - Exceedance criteria: Threshold or time above threshold?
    2. Are decisions made using raw data or filtered data?
        - How to implement in real-time monitoring? 20 min data blocks.
    3. Can real-time data be used to monitor biofouling?
        - Human versus algorithm. Pair with LISST-ABS instruments
        - Divers can go assess state of instruments
- Lessons
    1. Anti-fouling KEY to reliable data and reduce maintenance cycles
        - Antifouling tape in cables, helpful, smart thing to do
    2. Encourage use of MAD outlier detection (vs IQR) and smoothing algorithm (inherently noisy data!)
        - Does not affect descriptive statistics, get a better representation of events that are exceeding the threshold
    3. Wave and met sensors should be deployed to help validate turbidity events
    4. Precautions to avoid vessel impact
- Ongoing Work – PE trial station II
    - Bottom station with acoustic modem
    - Issues with station in first test, process of retesting and calibration, scheduled for deployment in Jan 2023

  o Goal: Collect 1-yr of background data prior to construction

Questions/Comments:
- Xaymara Serrano: Anthony thank you, I want to add a few things in addition to the sensors that are listed there. Have a PAR sensor in the water and in a buoy to look at light attenuation. Water quality data live in test, public dashboard, idea to make data available, working on transmitting properly. Hopefully available publicly, biggest achievement of this project. Both NOAA and SOL-GHD projects were using the same aquatroll instruments, but NOAA was getting better data thanks to all of the anti-biofouling procedures that Anthony was using. They talked to SOL-GHD to have them start incorporating these recommendations to improve data set. Data Gap that is being filled.
    - o Anthony Priestas: PAR sensor will degrade as well, small optical sensor.

- Joe Lopez: Great data set, very cool to see detail you have put into it. Are you planning to publish? Is it available for the public?
    - o Anthony Priestas: Happy to right it as a technical report if funding is there. I got the funding for the data analysis and created an internal, unofficial report. All data collected is public, but it takes strong effort to get it written up. US ACE doesn't have data tools but happy to share dataset (raw and clean).
    - o Joe Lopez: I will get in touch with you. We are about to publish a paper on microbiome data for project CRCP 13 and too late to add this but could be a nice supplement to add.
    - o Anthony Priestas: Any request I can make it available. I think, I have to make sure I'm not overstepping my boundaries. Useful for graduate students. Not a lot of turbidity data collected historically, at least not published. If there is funding I'd be happy to do it.

- Kurtis Gregg: Question about Port everglades station 1, the altimeter, was it effective since it made it to phase II design. How did it perform? Similar challenges like need for copper tape?
    - o Anthony Priestas: Data were fine but a little noisy since not a lot of bed elevation change. Where the station was located was on a hard bottom platform, there is really not a lot of sediment out there, so you don't see sand ripples. There is not much sediment. It worked really well, however there was nothing really meaningful that came out in that short time window. The goal was to use these altimeters to measure bed elevation changes to help corroborate with the observations divers make on the biological monitoring when they do their transects, they use a ruler and poke around in the sand, altimeter was meant to correlate any changes in bed elevation measurements with wave, current and turbidity data. I have done some testing with the altimeter in the lab, in ideal conditions that acoustic altimeter can resolve bed elevation changes of <1mm. Roughness of bed is a challenge. Altimeter is mounted on a bipod intentionally to reduce hydrodynamic interference, but at the same time if it's swinging around it can detect false bed elevation changes because of the angle it is reading. Maybe there is a better design for the future.

- Piero Gardinali: Question about the LISST-ABS, because it's acoustic, is it calibrated to particle size?
  - Anthony Priestas: Yes, it is sensitive to particle size, so is the turbidity sonde, but the range of particle size where it becomes more sensitive to is different between optical and acoustic sensors. The optical are very sensitive to small grain size range particles (~2-30um, what you are sensing for turbidity), and the acoustic sensor is not as good resolving the return from those smaller signals. That is why it surprised me how good the correlation was between the LISST-ABS and the turbidity sonde even at those low NTU values. Part of resolving those questions, what can it do, how can we resolve those differences compared to turbidity sonde. Patrick is proposing work to piggy back off data from this trial stations and also collecting water samples at same depth for TSS and grain size distribution.

- John Fauth: Anthony - are commercial satellite images available to resolve whether some questionable events are biofouling? Or perhaps video from buildings that overlook the channel?
  - Anthony Priestas: John, sat imagery are available but in one case the time resolution is generally poor and in the other the spatial is poor (MODIS vs Landsat). Have to get lucky, it seems.

- Jack Stamates: The distribution of turbidity data is often logarithmic stats must be carefully considered. It's great to see acoustical sensors being used. They are much less sensitive to biofouling and make a great QC tool for the optical data.

- Judith Lang: It's also great to see the integration of intensity with time above exposure being considered, and urge further pursuing of that long-standing concern of some TAC members. Anthony, In addition to making your data available, what will be most useful to also have a written record of your thoughts of what it all means…I.e., your interpretations throughout your presentation. So hope you can produce a technical report or equivalent.
  - John Fauth: A technical report would be great. This is very thoughtful and precise work, with lots of valuable information on data summaries, instrumentation, etc., that other researchers will find useful. Long answers are good - write 'em down for us.

- Jack Stamates: The altimeter would be great during dredging. A multi frequency acoustic sensor would be valuable.

Spatiotemporal Environmental Drivers of Coral Disease on Florida's Coral Reef – *Brian Walker, NSU*

- Provide everyone an update on the projects going on.
- Project Goals: Use advanced statistical modeling approaches to identify possible environmental correlates to coral diseases and elucidate spatiotemporal patterns.

- Three main projects
1. Spatiotemporal analyses of SCTLD on large *Orbicella* colonies
    o Spatial extent: KJ Coral ECA
    o Time frame: Sept 2018 – July 2021
    o Sampling interval: monthly
2. Spatiotemporal analyses of dark spot disease on Florida's Coral Reef
    o Spatial extent: Florida's Coral Reef
    o Time frame: 2005 – 2019, excluding 2017
    o Sampling interval: annual
3. Spatiotemporal of SCTLD resistance (RRC)
    o Spatial extent: KJ Coral ECA and Lower Keys
    o Time frame: May 2021 – March 2022
    o Sampling interval: 10 months
    o How environmental factors might drive resistance or susceptibility to the disease.
- Component 1: Spatiotemporal analyses of SCTLD on large *Orbicella* colonies
    o Reef mapping found the presence of many massive coral colonies (>2m) scattered along the coast, Broward and Miami Dade
    o Largest, oldest, most resilient colonies in the KJ Coral ECA. One dated ~330 years old.
        ▪ 295 total corals found (2014 – early 2018)
        ▪ Mostly *Orbicella spp.,* some *M. cavernosa,* and *S. sidereal*
    o Prioritized corals based on amount of live tissue, size, and species
    o Monitored monthly for about 4 years and treating them for coral disease
    o Separate project to map symbiodinium in these corals
    o Lesions not associated with a previous treatment were considered new infections
    o New infections were treated and classified as new treatments
    o New treatments were tabulated for each monitoring period
    o Started with 55 now 107 throughout region, takes 4 days to cover them all
    o Keeping these corals alive over the long term
    o New lesions and number of disease corals vary in a cyclical pattern. Correlation with summer months and disease, higher treatment and more corals treated.
    o Could this be due to environmental factors? Such as water quality, temperature, rain fall, land use?
    o Project goal: Use statistical models to identify drivers of SCTLD in order to explain and predict patterns of new treatments on *Orbicella faveolata* colonies
        ▪ Step 1: Created a spatiotemporal model to identify key drivers
        ▪ Step 2: Tested for a link between inlet flow and reef water quality
    o Methods – Temporal Model Predictors
        ▪ Data sets from each of the ICA, we know that a lot of the water associated with these regions come from this inlets – Associated coral to closest inlet
        ▪ 44 colonies from Sept 2018 to June 2021
        ▪ Predictors quantified across 7 temporal scales to understand if it's an acute vs chronic stress
        ▪ Predictors included:
            • Seawater temperature – SECREMP stations
            • Rainfall

- DBHYDRO flow data
  - o Results – temporal model
    - ▪ 59.1% of the temporal variation in number of new SCTLD lesions were explained by 3 predictors:
      - Temperature strongest relationship, Hotsnap exposure over previous 90 days - 35.6%
      - Higher flow rates from ICAs over previous 7 days – 14.1%
      - Rainfall over the previous 90 days – 9.4%
  - o Recent Model Runs
    - ▪ Optimal predictors (Mean Temperature 90 days, mean rainfall 90 days mean rainfall 30 days, HotSnap 60 days, Flow 7 days) explain 60.6% of total lesions and (Mean Temperature 90 days, mean rainfall 90 days, mean rainfall 3 days, mean rainfall 14, days, flow 7 days, HotSnap 60 days) 63% of total corals
    - ▪ Main take-home: majority of disease is explained by temperature, and then either rainfall or flow
  - o Trends in Data
    - ▪ Mean temp highly correlates with SCTLD infections
    - ▪ ICA flow and rainfall also follow similar patterns
    - ▪ Each hill is associated with inlets - ICAs
    - ▪ Corals taken into analysis were the ones only found in all monitoring periods
    - ▪ If see relationships between flow and rainfall data, why aren't seeing relationships to water quality metrics? Miss match of scale.
      - Flow data are near continuous, nutrient data only once a month, so took different approach how the nutrient data relates to flow
  - o Results – Water Quality
    - ▪ Looked at 3 days of flow data before each water quality collection, saw significant global effects of flow on nitrate and other nutrients – higher nutrient values on the reefs that indicate flow coming from the inlets is affecting the nutrient water quality data.
    - ▪ Inferential relationship where we can see flow and disease are related, flow and water quality are related
    - ▪ Relate how water quality relates to different locations
    - ▪ Different patterns found between ICAs
    - ▪ Relationship break-down in some years
    - ▪ Dave Whitall is writing a paper on this
  - o Conclusions
    1. Exposure to heat stress, as a result of high seawater temp, lead to increased SCTLD
    2. Significant relationship between inlet flow and SCTLD incidence
    3. Correlation between on-reef nutrient concentrations and ICA inlet flow
- Component 2. Spatiotemporal analyses of dark spot disease on Florida's Coral Reef
  - o Yearly FRRP DRM survey data (2005-2019)
  - o SE FL to Keys
  - o Dark Spot Disease in *Siderastrea siderea*

- n= 2,442 individual surveys
- We found that dark spot prevalence change over time, in earlier days prevalence was low (2005), recently more spikes since 2010
  - Average prevalence of 1.1% to 2.9%
  - Proportion of sites with DSD also increased from 7.4% to 22.1%
- Environmental factors that could be associated with this disease
  - Predictor variables examined
    - Host abundance
    - Depth
    - Year
    - Habitat Characterization
  - Generated various predictors under 6 core themes
- Results
  - 18 significant predictor variables for DSD cases explained 64. 4% of the underlying variability in #DSD cases
  - Top three:
    - Silica – freshwater indicator
    - Host density
    - Septic area
- Spatial relationship to factors
  - Relative influence (%) of the 18 significant predictor variables for DSD cases that together explained 64.4% of the underlying deviance in the response variable
  - Upper Keys region shows highest mean DSD prevalence - high values of silica, places with septic tanks prevalent in area
  - Host density spatial relationship
    - Areas with high coral abundance and cover don't necessarily align with areas of high DSD prevalence.
    - Upper Keys show high DSD prevalence even though coral abundance is lower than other areas.
  - Looking at cumulative mean DSD prevalence from 2005-2019 see higher prevalence in early years off Broward and Miami. But in later years prevalence is higher in the Keys.
- Summary
  - DSD in *S. siderea* population has increased through time
  - Consistent increases in prevalence and FOC occurred after 2012
  - Main 3 underlying environmental drivers explaining DSD variability among sites found to be amount of silica in surface water (freshwater input), host density and proximity of survey site to septic systems
  - Key Largo Ecoregion has the prevalence and frequency of occurrence
  - High Silica sites off Key Largo
- 3rd Component. Spatiotemporal of SCTLD resistance (RRC)
  - Saving susceptible corals
    - Regular monitoring and disease intervention are saving the largest corals.
    - Allows susceptible individuals to remain in the system effectively controlling for susceptibility differentials.

- Unveils coral disease dynamics.
  - Intervention treatment data
    - Number of treatments and frequency of disease can be used to classify coral into a susceptibility classification.
    - Which corals are more susceptible to getting disease over time and which ones aren't.
  - Susceptibility/Resistance Classification
    - Susceptibility based on statistically derived resemblance.
  - Group of experts – The SCTLD Resistance Research Consortium (RRC)
    - Try to understand every aspect that can be driving these differences in susceptibility.
  - RRC Sampling
    - 3 Synchronous core samples (ECA and Keys)
      - Period 1 – 8 cores – May/June – rainy season onset, low heat stress
      - Period 2 – 5 cores – August/September – spawning, speak heat stress and rainy season
      - Period 3 – 6 cores – January/February – dry season, low heat stress
    - TEM core samples:
      - Sample at lesion and healthy-looking tissue on the opposite side of colony
      - 7 colonies: 3 Looe Key, 2 Sand Key, and 2 ECA
  - RRC Monitoring
    - Bi-monthly
      - Whole colony pictures and condition data
      - Treat all new lesions
      - Core site framer pictures
        - Image J analysis to measure tissue healing/loss
  - Data analyses
    - Disease resistance, sequence genetic parts, (Genomics, Transcriptomics, Metabolomics, Proteomics, Chemical Defenses, Microbiome, Symbiodinicease, Viruses, Gross morphology.)
  - Promising Prelim Results
    - Temporal differences in metabolomics
      - Between regions and time periods, understand what those relationships are about
    - Genotype not a factor
    - Proteomics indicate energy production could be a factor in SCTLD resistance
      - Proteins that could be a factor in resistance, expressed in susceptible colonies and not in healthy colonies
    - Symbiodiniacea effects might be at the species level
      - Indications that we need to dive more into species level to see if there are interactions between
    - In all this context we will be seeing environmental drivers as well. Correlate these results (coral history) to the environmental data.

Questions/Comments:
- Kurtis Gregg: Puzzled about the high silica in Upper and Middle Keys, not areas that I would think to be large freshwater inputs. What comes to mind is the Florida Keys aqueduct authority and their nine wastewater treatment plants to get flow data from.
    - Brian Walker: My understanding is that they have gone to deep well injection. Not obvious freshwater sources linked to the recent change in dark spot.

- Xaymara Serrano: In susceptibility classification figure, is colony size a factor?
    - Brian Walker: Small influence, colony size does not explain the amount of disease that a colony will get.
    - Xaymara Serrano: If it is completely white, does it mean that the colony was never treated?
    - Brian Walker: Not sure, think all colonies shown here have been visited. Not distinguished here, but have a different visualization with light gray if it was visited and white if it was missed. These are assorted by latitude so you can see a blue band where disease was more present.

- Piero Gardinali: Flow measured from the district is really far from the inlet. Had an opportunity to correlate flow data from inlet to what is being used. Problem with DBHYDRO data is that it doesn't give you a good indication of ground water.
    - Brian Walker: What is interesting is that the rainfall and flow data are correlated, so feel like it does a good job of capturing water in the system, more of a relative effect rather than an exact amount. We are not trying to claim the exact amount that is coming from each inlet, we are trying to get a relative contribution.
    - Piero Gardinali: You are assuming that the water is coming out of that inlet at some point, it might sit in there.
    - Kurtis Gregg: They will hold water back sometimes to recharge during the dry season.
    - That's why we are finding the relationship with mean rainfall in the last 90 days is a strong relationship since it captures whatever it is being held and released in that time period. That might be why we are seeing this longer term data sets being more influential. The mean rainfall 30 days correlates to the 3 day flow data which is interested as well. All this info is brand new so we need to analyze it still.
    - Piero Gardinali: We have data from inside the canals with the gates closed, 20% is still getting through.
    - Kurtis Gregg: 20% is consist with groundwater flow numbers in Lake Worth Lagoon freshwater contributions for example. There are some canals that are not instrumented for flow, so they are feeding into the ICA and estuary and not being counted.
    - Brian Walker: We are not trying to say we know exactly what is coming from each ICA, but we are using it as a relative gauge to understand if how we are measuring relates to what we are seeing on the reef.
    - Kurtis Gregg: We don't understand why, but exciting that you are seeing trends and important to follow up on questions like these.

- John Fauth: Brian- On SCTLD, really great results. Explaining >60% of variance is incredible, especially given the complexity of our offshore environment on both spatial and temporal scales. On nutrients, try expressing water flow on log-scale. That should make residuals better behaved; they're much larger at larger water flows. Actually, a log-log relationship would model the regression of nitrate on water flow better, not the semi-log.

- Phillip Dustan: Could silica also be a proxy for development as silica sand is used to make concrete? The Keys and South Florida are mostly carbonate and might not be as high in silica as silica sand used in building

- John Fauth: To reduce collinearity in the rainfall data, you can group into mean rainfall for days 0-3, days 4-14, and days 15-90.

- Don Behringer: Really interesting results. Any associations between anomalous rainfall events and SCTLD appearance/progression elsewhere in the Caribbean that corroborates the observations from Florida?

- Phillip Dustan: Brian, the large monument corals are all survivors of a long past. They would also suggest that they have been through all the same sort of selection events and might be more similar to each other than a wider selection of the population.

Wrap up and Adjourn

- Thanks everyone, really nice to see all of your faces again. I will quickly pass an evaluation. Thanks for everyone that joined online.
- Hopefully we are transitioning to the in-person meeting, bringing everyone in to have this discussion. If you have any questions email me. Thanks Jose for transcribing this whole meeting, all of the comments will be included and sent to you all.