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

April 1-2, 2021

Meeting Objectives and Main Outcomes:

1. Have TAC help narrow down feedback and define SOW for LAS MICCI 28/28b and FDOU 51 projects.
2. Present latest results of local and national reef monitoring efforts.
3. Discuss with TAC the possibility of adding additional capacity for emerging areas of concern.
4. Update TAC on CPR projects, connect water quality issues in ECA with Keys, and understand the new Biennial Assessment of Impaired Waters from DEAR.
5. Share current water quality research and results in ECA region.
6. Update TAC on status of SCTLD and share related research and results.
7. Inform TAC of State-wide restoration plan.

Attendance

Staff: Allie Shatters (DEP CRCP), Jamie Monty (DEP CRCP), Kristi Kerrigan (DEP CRCP), Mollie Sinnott (DEP CRCP), Shelby Wedelich (DEP CRCP), Jenn Coley (DEP CRCP), Jenna Dilworth (DEP CRCP), Jessica Price (DEP CRCP), Laura Eldredge (DEP BBAP), Joanna Walczak (DEP CRCP), Giancarlo Chaparro (NSU), Murphy McDonald (NSU)

TAC Members: Erick Ault (FWRI FWC), Don Behringer (UF), Richard Dodge (NSU), Phil Dustan (College of Charleston, SC), Piero Gardinali (FIU), Dave Gilliam (NSU), Kurtis Gregg (ERT, Inc. supporting NOAA Fisheries Service, Southeast Regional Office, Habitat Conservation Division), Jay Grove (NOAA Fisheries), Judy Lang (AGRRA), Joe Lopez (NSU), Caitlin Lustic (TNC), Arthur Mariano (UM RSMAS), Valerie Paul (Smithsonian Marine Station), Ester Peters (George Mason University), Stephanie Schopmeyer (FWRI/FWC), Manoj Shivlani (NTVI), Jack Stamates, Joshua Voss (FAU Harbor Branch), Brian Walker (NSU), Dana Wusinich-Mendez (NOAA)

Public Attendees: Alastair Harborne (FIU), April Price, Barbara Waelkends, Christine Hurley, Dan Clark (Cry of the Water), David Vance (FOFR), Derek Cox (FWC), Elizabeth Pudlak, Gary Jennings, James Boyle, Jennifer Stein (FWC), Jessica Ward, (Broward County), Jocelyn Karazsia, Katy Brown, Kevin O'Donnell (DEP DEAR), Maurizio Martinelli (Sea Grant), Melissa Sathe (FOFR), Pat Quinn (Broward County), Samantha Jarvis (Broward County), Stephanie Clark (Cry of the Water), Xaymara Serrano (USACE), Alberto Alvarado (USACE), Allison Klein, Andrew Baker (UM RSMAS), Ashley Carreiro, Ashley Gonzalez (USACE), Brian Ng (FIU), Carly Dennison (UM RSMAS), Cat Bilodeau (NSU), Erin Shilling, Gareth Williams (SymbioSeas), George Duncan, Kirk Dotson (FOFR), Kirk Kilfoyle, (Broward County), Luke McEachron (FWC), Nick Jones (NSU), Nicole Hayes (NSU), Samantha Cook, Sara Thanner Miami Dade (DERM), Sarah Newton, Carolin Ciarlariello, Daryll Joyner (DEP DEAR), Jennifer Baez (Palm Beach County), Kaitlyn Sutton (DEP DEAR), Kathy Fitzpatrick (Martin County), Morgan Hightshoe, Stephanie Kedzuf, Talia Smith (DEP DEAR)

Announcements

- Mollie Sinnott has been promoted to Assistant Manager of CRCP
- Kristi Kerrigan has been promoted to Manager of CRCP
- Jaime Monty has been promoted to the new SR region program administrator

Session I: LAS Project MICCI 28/28b Scope of Work Development Activity

Goal: to collect feedback and define the SOW for LAS MICCA 28/28b and FDOU 51 projects, which were both identified as priority projects that met current funding abilities by the SEFCRI Team

LAS MICCI 28/28b Introduction- *Shelby Wedelich (DEP CRCP)*

- **Project Overview**: The goal of LAS MICCI 28/28b is to A) identify an improve the methods, measurement, and monitoring of turbidity, suspended sediments, and sediment deposition during construction, and to use this information to support turbidity criterion revision, improve monitoring methods, and improve coastal construction practices; and B) to test new or existing turbidity monitoring techniques identified in 28A

- **Topics of discussion during team meetings in 2018:**
  - **28A**: Discussed supplementing existing turbidity criterion process, considering light attenuation, considering material geotechnology and toxicity, the different needs of differently sized projects, dose intensity, frequency, and duration of impact, possible synergistic effects of multiple stressors, environmental windows of special interest, the turbidity sonde port, and possible construction practices and industry partnership
  - **28B**: Discussed turbidity sondes (compliance and applicability, biofouling maintenance and cost, long term datasets from other projects), light and sediment trap data, the pros and cons of aerial monitoring, benthic measurements, evaluation of the mixing zone, real-time monitoring that would be critical for projects, and turbidity calibration and lab concerns
- **Data Gaps and Guiding Questions for SEFCRI**
  - What consideration should be given to different life stages/ morphologies of corals? What are the implications of different size projects? Can we work within rule restrictions or data to assist with the new rule development? Should there be more focus on the background levels or impact levels? Are there any new technologies that were not considered previously? What is their cost and feasibility?
- Three **SOW ideas** were identified:
  - 1) establish regional background turbidity levels
  - 2) conduct species and life-stage specific dose-response threshold studies (lab and *in situ*)
  - 3) compare construction turbidity and sedimentation to background, extension of CRCP 9
- **Breakout Group Discussion:**
  - **Goal**: provide enough data to set a more protective numeric turbidity criterion by next triennial review
  - **Group 1 Topic: Establishing Background Turbidity**
    - Facilitator: Jaime Monty, Mollie Sinnott, Talia Smith (DEAR)
    - TAC Members: Erick Ault, Dave Gilliam, Arthur Mariano, Caitlin Lustic, Esther Peters, Piero Gardinali
    - **Question 1: Any feedback to the overall approach? Are there steps missing? Should we modify the steps in any way?**
      - Esther Peters: Are there any gaps in existing resources and efforts? Just the ECA or other areas too?
        - JM: Funding for data collection/analysis will be specific to the ECA. Gaps, project CRCP 9 focused on turbidity data collection near a construction project. We have more data here than in other areas of the ECA. Some data also collected near Boca Raton inlet (Deerfield?). Otherwise, turbidity data does not exist for whole ECA, only associated with certain project areas.
      - Talia Smith: There is project specific data, some DEP turbidity data in areas up to Martin, but it's sparse and not enough to establish background. Data also exists from dredging and beach renourishment projects, background compliance data - it's all stored in Oracle database, but mostly in PDF form. We're trying to get a better data submission format in Excel. This will help build data at specific sites. DEP suggested at least 20 data points for statistical purposes.
      - Eric Ault: How is the data collected? Dedicated team or from contractors doing the work?
        - JM: Majority of data comes from construction projects, like a municipality renourishment project, pre and post turbidity data is required for projects. (TS confirms most is from contractors). Grant funding would hire a contractor to do whatever necessary to mine data or collect data at set locations.
      - TS: It would also include more detailed sampling, we are planning sampling at the surface and near the bottom.
        - EP: 20 samples from surface and 20 from bottom?
        - TS: Yes. Projects are only required to sample at the surface.
      - Piero Gardinali: A true baseline does include multiple seasons and episodic events at the reference place.
        - TS: Yes, and that is why we need more data, to establish seasonality. We would also need more data from before and after storms. Also, would need to avoid any port outlets.

- **Question 2: What locations would you recommend as reference sites for turbidity in the Coral ECA?**
    - EA: Looking at areas with no construction and far enough outside of impacts, would be ideal. Then maybe somewhere for true baseline, like a remote area (DRTO). Compare this with areas adjacent to construction.
    - TS: Also, would need to avoid any port outlets
    - PG: This is a philosophical comment, but background is a subjective term. We are looking at the "typical"+ or- a normal distribution of places that are relevant. Not sure anything is "pristine" anymore.
        - TS: We need to establish a natural background. Data does not show us natural background turbidity levels at different locations. Get away from pristine and aim for natural. What is natural around the reefs, what are labs finding to best keep the reefs alive. After a storm, what is the resilience of a reef, with turbidity fluxes. Need to answer this as well as fill in data caps, ideal if done at the same time.
        - JM: Variability within the background.
- **Question 3: Would you recommend higher frequency sampling at one location or les frequency at multiple locations? Why?**
    - TS: Identifying where the plume is and where the best location to sample from the plume is important. Some compliance and background data are very ambiguous. Unclear about sample location within the plume.
    - EP: But is there a plume at the ECA?
    - Jamie Monty: Collecting turbidity data and compare with previously collected data at construction sites, also need natural site variability. Relate to port dredging, to beach renourishment, etc., eventually makes a plume out of the inlet. We need to collect data in such a way that the sample is collected within the plume, overhead photos could confirm boat location. Need to figure out how we would sample and account for variability, with and without construction in the ECA.
    - PG: Criteria are site specific. For that reason is better to do more frequency on a "relevant site" than low frequency in a larger area. Look at what it did take to develop a nutrient criteria for Biscayne Bay.
- **Question 4: Is it better to do a meta-analysis of the data we already have, start new sampling or both? Alternatively, what gaps are in existing background turbidity methodologies?**
    - EP: Meta-analyses can be very challenging. Figuring out the statistics to use may be difficult.
    - TS: I think new sampling is good, we may or may not be able to get the previous data from all of the dredging and beach nourishment projects. I think taking some time to use statistics to help with the study design is important though. DEP has a turbidity SOP. I also think that we should have a good system in place to check the work of the consultants, to make sure they are following the correct SOPs. I think it would be good to talk with permitting and discuss what contractors have worked best.
        - EP: Agree, do new study. Be sure most appropriate SOP is used for measuring turbidity
    - Jessica Ward: We've examined historic data here at Broward and the problem is that it doesn't always fit the criteria in the draft rule
- **Question 5: Are you interested in joining this LAS Project Team? Do you have suggestions for a potential contractor or other project advisors?**
    - TS: I would like to be a part of that as well.
    - JW: Yes, interested.
    - TS: I think it would be good to talk with permitting and discuss what contractors have worked best.
    - EP: Agreed.

- **Group 2 Topic: Construction to Background Turbidity Comparison**
    - Facilitators: Shelby Wedelich, Daryll Joyner

- TAC Members: Don Berhinger, Dick Dodge, Dana Wusinich-Mendez, Val Paul, Manoj Shivlani
- **Question 1: Any feedback to the overall approach? Are there steps missing? Should we modify the steps in any way?**
    - usable dataset at least 20 measurements - benthic, surface, mid?
    - source of dataset with at least 20 measurements (basis of impaired waters rule), open number of measurements up to group, dependent on project goal. Collect as much data as possible around dredging operations
    - USACE feedback of BMP solving problem
    - USACE near surface and benthic sonde 6 min interval PE O&M Oct20 - Mar21, useful dataset to track once available
    - Data provided to DEAR, surprised by higher mean values and variability (sondes pre-dredging) clarify if 2017 that included hurricanes or O&M to be released 2021. Look at QA/QC and data drift from biofouling
    - Sediment collection to account for relevance of the type of soil? e.g. sand, clay for the turbidity effect?
- **Question 2: What parameters would you recommend for choosing construction projects? And background/ reference stations?**
    - Issues with construction projects not being continuous, stop for loading dredge. Dredge production rates considered proprietary in the US, make sure that times work is done vs. idle will help with data interpretation
    - Got an offer from dredging community to provide data from previously permitted operations, helps with generating a database (as opposed to mining data from .pdfs)
    - Previous projects only measured surface, critical to focus on benthic monitoring
    - Ensure any new measurements are made in as close proximity to the corals as possible, data adjacent to corals. Dredging projects spatially divorced from reef, but not divorced from impacts
- **Question 3: In addition to nephelometers, what other technology monitoring turbidity and/or sedimentation would be helpful and feasible within time and budget allowed? Should any other parameters be measured beyond the ones listed?**
    - trial station at PE (AquaPearl) turbidity sonde optical sensor maintenance 2 week interval
    - LISST/ABS acoustic, less maintenance
    - copper plate minimize biofouling
    - evaluate acoustic vs. optical CBA
    - If independent of maintenance (covered by staff funds/existing staff labor) could afford that instrumentation. With maintenance in project cost, not feasible?
    - Satellite images + drones, some utility but cloud coverage less feasible for short term. May work for longer term or if drone usages. (seconded drone use)
    - Follow up with regulatory on methods (would need QA for this purpose but could use for research)
    - Satellite data - good for detecting change, but not as good for absolute values. Similar concern for dredge? Need to follow up with someone who has drone expertise to evaluate data use
    - Richard Dodge: I think use of drones is very wise. It would be easy to use at Port Everglades. Drones can go high and take photographs. They can be programmed to go to the same place time after time. Let's get one (drone) Good ones can be had for $1K. Worth the investment to access.
- **Question 4: Would you recommend doing a data mining exercise and analysis of project data we already have to supplement field sampling?**
    - No comments/notes recorded
- **Question 5: Are you interested in joining this LAS Project Team? Do you have suggestions for a potential contractor or other project advisors?**
    - Jocelyn Karazsia (interest) - contractor on PE O&M limited familiarity with instruments. Need to ensure contractor is comfortable of technology (DHI)

- **Group 3 Topic: Florida spp. Turbidity Dose-Response Threshold Studies**

- Facilitators: Kristi Kerrigan, Kaitlyn Sutton
- TAC Members: Jay Grove, Brian Walker, Jack Stamates, Stephanie Schopmeyer, Judy Lang
- **Question 1: Any feedback to the overall approach? Are there steps missing? Should we modify the steps in any way?**
    - Need to consider the chemistry of the particles that make up the turbidity - as you dig deeper into the channel, the chemistry and size changes so it's important to be careful about the source for doses.
    - Coordinate with EPA and NOAA NMFS in study design; incorporate different species with specific details on feeding, etc.; consider ESA-listed species.
    - Develop study design first and foremost
    - Concern that were constricting the scope. Relationship between NTUs and other devices measuring turbidity.
    - High acute turbidity vs longer term lower turbidity -> determining the shut-off values of turbidity
- **Question 2: What technical considerations are there to consider for laboratory selection?**
    - Determining impact on the coral - very little visible markers before they die. Need to incorporate some metabalomics to identify stress inside the coral that isn't visually apparent to capture the effect of turbidity.
    - Lipid content has been studied to look at stress; perhaps other indicators?
    - Timing and reproductive cycle of the coral - this will vary depending on the time of year.
    - Turbidity and collected sediments are different. NTUs/Turbidity means that water is constantly being mixed. But the sediments that fall onto the corals are just as important. Need to factor that under a high turbidity event, there's some residual sediments left on the corals.
    - Lab needs to generate enough suspended material (~5 NTU) in a tank which is not easy (pumps)
- **Question 3: What spp and life stages do you recommend?**
    - Focus on the most common corals at the site that spawn during the Aug/Sept full moon. and maybe a psuedodiploria that spawns in the spring.
    - Colony size in the lab - standardized. Eliminate as many variables as possible.
    - Polyp size vs. tentacle size - could impact the boundary layer just above the coral and how water and sediments move and flow above it.
    - Consider where they are collected from - do they need to come from the area of interest?
    - Baker has found that certain clades of zoox impact resistance - those should also be monitored in this study.
    - Consider nursery-reared corals instead of wild collections to eliminate the pre-exposure scenarios
- **Question 4: What frequency, intensity, and duration of turbidity do you recommend?**
    - Will depend what Agencies need in the experimental design
- **Question 5: Are you interested in joining this LAS Project Team? Do you have suggestions for a potential contractor or other project advisors?**
    - Jack Stamates: did some projects at AOML - Chuck Featherstone and Chris Kelble
    - Ian Enochs system - have multiple tanks with computer controlled. Unsure if they can handle turbidity/sediment, but check with them.
    - Mark Ladd (NOAA SEFSC) - setting up a tank system that could work
    - Joana F/Abby R (NSU)

Session II: LAS Project FDOU 51 Scope of Work Development Activity

LAS FDOU 51 introduction – *Kristi Kerrigan (DEP CRCP)*

- **Goal**: to identify and understand trends and gaps in existing water quality/ fish/ benthic data and contribute to coral reef management strategies by assessing current protocols and information and informing future research and monitoring efforts
- An approach was presented to the SEFCRI team in Sept 2020 and received the following **feedback**
    - Important that the data is formatted in a way it can "talk" to each other.
    - Conduct modeling or statistical analyses between water quality, fish and benthic data to understand relationships.
    - Don't focus on changing the methods of 25+-year long datasets, focus on adding methods.
    - The project should focus on trends of existing data.
    - Ask questions to understand what would be causing changes in the environment…more relational studies of how one dataset influences or interacts with another.
    - It's helpful to have input from the people providing the dataset.
    - Make recommendations for actionable things at the end of the project.
- **FDOU 51 A: Assessment of Protocols and Methods (steps for accomplishing this project):**
    - 1. Compile protocols and methods from recurring sampling programs.
    - 2. Identify management Q's that are currently being answered by these datasets (individually and holistically) and what Q's need to be answered. Are we aware of any gaps in our knowledge of the system overall?
    - 3. Identify any gaps in the data being collected (sampling frequency? Location gaps? Parameters we are missing?
    - 4. Make recommendations to fill those gaps or improve protocols to help answer local reef management Q's.
- **FDOU 51 B: Meta-analysis of fish/ benthic/ WQ data approach**
    - 1. Want to identify management questions that need to be answered. Are we aware of any gaps in our knowledge of the system overall?
        - Example management questions to answer: Are there sites or sub-regions that have changed more dramatically than others? Are there sites that would benefit from extra protections or restoration? Are locations with lower coral cover and fish associated with poor water quality? Do fish increase where coral cover is greater? Are there statistical differences in changes of fish communities over time and space? Are sites with a decrease in coral cover also showing a decrease in fish populations? Is there enough recruitment data to determine size class bottlenecks? Are corals not growing past certain sizes that could inform a minimum size for outplants in restoration projects?
    - 2. Compile list of datasets from recurring sampling programs and re-format, as appropriate, so the data can "talk" to each other.
        - **Current list of recurring sampling programs:**
            - SE FL Coral Reef Evaluation and Monitoring Program (SECREMP) –2003-present (Benthic),
            - FRRP Disturbance Response Monitoring (DRM) – 2006-present (Benthic)
            - National Coral Reef Monitoring Program (NCRMP) Benthic – 2013- present (Benthic)
            - Reef Visual Census (RVC) – Reef Independent Fisheries Assessment – 2013-present (Fish)
            - Fish Dependent Monitoring/FWC (Fish)
            - Fisheries Resource Status and Management Alternatives (FDOU 18&20A) – 1990-2009 (Fish)
            - SE FL Water Quality Monitoring Program (WQ)
    - 3. Conduct a meta-analysis of all the data to understand relationships, interactions and spatio-temporal trends.
    - 4. Identify any gaps in the data being collected.
    - 5. Make recommendations to fill those gaps to help answer local coral reef management questions.
- **Project Planning:**
    - July, 2021 – June 30, 2023 (2 years)
    - Budget = $90K ($50k in year 1, $40k in year 2, potentially)
    - Intent is to hire a contractor
- **Breakout Discussion:**

- **Goals**: discuss which of these two project approaches (A or B) we should focus on for the next 2 years, have an open discussion about glaring questions.
- **Main Feedback:**
  - Decided not to vote on 51 A/B, but instead to create FDOU 51 C
    - **FDOU 51 C:** Will synthesize the below suggestions and will: identify the management questions that need to be answered via interviews with managers themselves and with PIs to look all of the existing data that we have, determine whether it's what we need, and analyze if we have it. Looking at whether we have the right data, but not focusing on the analysis of the data right away.
      - JW: Yes, but if we think we have what we need, then analyze. If not fill in the gaps. The gaps may just be data, or maybe we're not capturing because the methods aren't there.
      - Richard Dodge: Data that is not analyzed may or may not be useful.
      - JS: build a big synoptic data set and distribute that?
      - Judy Lang: I agree that a new FDOU51 is needed.
- **General Discussion:**
  - JS: We just recently reanalyzed the water quality strategy, it was recently optimized for management needs.
    - KK: This project will be a little different because it will include fish and benthic data, not just water quality data.
  - JS: If we are going to add on, things that are indicative of climate change (such as dissolved carbon dioxide) may be a good addition to the study.
    - JS: I suggest referencing the paper from Ian Enoch
  - Phil Dustan: How does the accumulated peer-reviewed scientific fit into this project?
    - KK: we want anything that is recurring. So if the research can be made available that includes recurring sampling collections, we are open to those types of datasets.
    - Alastair Harborne: My lab has just finished a big analysis of the RVC data set looking at the key drivers of fish biomass along the reef tract that might be useful to this effort
    - JS: Hazen And Sawyer may have a copy of the SEFLOE data set. It would be a good comparison.
      - JS: I mentioned a south Florida water quality study titled SEFLOE. I participated in this and a lot of water quality data was collected during the study at many of the same sites where we are currently collecting data. (outfalls, inlets, etc.) This was in the 1990s. If anyone is interested in doing a retrospective analysis of water quality data. This would be quite valuable. Unfortunately the only remaining copy of the report that I am aware of is with the engineering firm Hazen and Sawer (maybe the Miami-Dade or Broward utility's may have a copy).
  - RD: Which/What data are to be analyzed? ALL? Subset?
    - KK: data from the recurring sampling programs listed above. Everything that is included into those monitoring programs I'm hoping would be analyzed, but it would depend on the management questions.
  - RD: How would contractors be chosen, given the wide variety of "data" available?
  - PD: These monitoring programs were not set up to establish causality, they were only established to describe trends. There is separate science in the literature designed to establish causality, that should be referenced.
    - KK: We have these data that are taken over many years, which is why we are focusing on these datasets in particular. But if you are aware of different data that is better suited to this application, we will take suggestions.
  - Mollie Sinnot: Are the different agencies amenable to standardizing methods, ex., for counting fish, etc.? Some of these methods are quite entrenched, so what may the methods activity achieve, in practical terms?
    - KK: We will have to take it up with the different agencies. if there are some glaring omissions, these recommendations will help. We will need to have all the agencies involved in those discussions.

- Val Paul: I agree that if we were to change these monitoring programs at all it would be to add to them, if anything.
- Jay Grove: how much would this assessment have the ability to modify these protocols? Some may not be flexible to changes. We can add things on, but when you are sampling on a large scale, a lot of adjustments are hard to accept for time and budget reasons.
- KK: In terms of modifying monitoring programs, that is difficult for many of the large scale projects. Perhaps a gap can be identified in a one-time sampling effort. It might not mean changing the long-term programs.

- EP: When the recurring sampling programs were set up, there were probably statements made as to what management questions those programs would support. Can they be pulled out first to see which of the programs work with which questions?
  - KK: That is a great suggestion. Especially in the earlier phases of these projects we can do that. Especially in 51 A, we would want to conduct those interviews with the PIs to determine original research intent, etc.
  - RD: Maybe a better tract is to better tune the Management Questions.
- Brian Walker: we need to identify what management questions need to be answered, that may need to come from the managers. That seems to be a higher priority to conduct either one of these. To me. 51B is too open. It is just a meta-analysis of all the data to determine trends, but that may be absurd. It will come down to what data is available and is appropriate to compare to each other. That needs to be incorporated into 51B.
  - KK: the first step in either of these will be to hone in on management questions to determine what we want to learn and glean from this data.
- JG: I agree with Brian and Esther. Each of these programs were created with different intents. So, what do the managers need? When I read them, A and B are very similar, it is just the way you go about them. From the fish component side, we know a lot of the gaps that exist- would the managers determine which of those gaps are important to address? Also, PIs recognize what you are saying from a management side- we are trying to partner with climate folks, etc., and are trying to have overlapping data whenever possible. We are interested in looking at the ecosystem holistically.
- Caitlin Lustic: How is this different from the SEACAR project?
  - KK: SEACAR is housing all the data in one central repository. I don't think there is the intent for analyses.
  - CL: I am not sure, but it seems like it could be related.
- Don Beringer: Seems that there is quite a bit of data existing in the monitoring studies that are ongoing and a meta-analysis (51A) of those data will be important in identifying gaps or deficiencies among them, thereby fulfilling some of the goals of 51A.
- Dana Wusinich-Mendez: I want to advise against compartmentalizing this process too much between scientists, managers, practitioners, etc. I think it is okay to start some interviewing for information as far as gaps and priorities, but I recommend having a collaborative conversation between the two groups to discuss big questions and what data is being collected on a regular bases, and what support there might be offered from both groups.
- JL: My experience with AGRRA is when the reefs drastically change, sometimes you need to change the monitoring in response and it doesn't take $90K to recognize that something's no longer relevant .
- EP: Management of reefs depends on development of regulations to change the reef's environmental quality. The fish and benthic studies are showing issues. Maybe we need more water quality data, but that must translate into programs that will change (improve) water quality, and that does not seem to be happening in SE Florida waters., or not to the extent needed at the level of the state legislature?
- KK: These comments will be very helpful when we dive into the technical work in both of these routes. I want to hear whether there are glaring concerns in choosing between these two routes (A/B). Are there issues in deciding which route to go?
  - RD: I think both options are too broad and nearly impossible to productively choose between. I suggest to combine 51A and 51B into one.
- JW: Seems like we need to 1) identify what management questions really need to be answered, 2) look at existing data to see if we have what we need, 3) analyze if we have it, or set out new methods or survey to collect what is needed. Needs to be streamlined and focused
  - KK: That seems like a modification of 51 A- less doing analysis of the data itself, but looking at what actually exists. I am open to that.

        - JL: I like Jessica's proposal plus adding Dana's suggestion that researchers and others also be asked what's needed
        - RD: I don't see how you can separate methods and data. Jessica said to look at data, not methods. I don't see this in 51A.
        - KK: we can modify 51 A to incorporate Jessica's suggested steps and Dana's suggestion for collaborative discussions.

Session III: Restoration

State-wide restoration strategy – *Caitlin Lustic (TNC)*

- Florida's coral reefs are the basis of our economy and contribute over 9.4 billion annually in the region, but they are facing a variety of threats such as overuse, poor water quality, and SCTLD. Because of this decline, reef restoration focused on a few key species began 20 years ago and now can be executed at scales that can restore local sites. The sciences behind restoration have advanced to include managed selection, stress hardening, etc.; and outplanting efforts have grown from ~10,000 A. cervicornis fragments outplanted in 2012 to over 60,000 fragments outplanted in 2019. More recently, the effort to move corals ahead of the SCTLD disease margin to be used as broodstock for future restoration activities has created the **need for new collaboration that requires a statewide restoration planning process.** Many such plans exist, and this new process will not replace those or dictate how future plans should be written. It will provide guidance for the restoration of Florida's coral reefs and lay the groundwork for future decisions by agencies and scientists.
- Teams have been developed to support this process (the list of teams is not final, contact Caitlin Lustic if a group is missing):
    - **Core team**: provide advisory oversight
        - The Nature Conservancy, Florida Fish and Wildlife Conservation, Commission Florida Department of Environmental Protection, National Park Service, Florida Keys National Marine Sanctuary, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Fish and Wildlife Foundation of Florida
    - **Planning team**: support decisions and provide bulk of plan
        - The Nature Conservancy (facilitating), Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection, National Park Service, Florida Keys National Marine Sanctuary, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Mote Marine Laboratory, Coral Restoration Foundation Reef Renewal, University of Miami, Nova Southeastern University, U.S. Geological Survey
    - **Technical advisors**: scientists provide insight and expertise
        - SECORE International Florida Aquarium, Nova Southeastern University
- Recently published **A Manager's Guide to Coral Reef Restoration Planning and Design** to help managers plan how/where/when to plan restoration activities for certain goals
    - Funded by NOAA TNC and EPA
    - Document: https://www.coris.noaa.gov/activities/restoration_guide/welcome.html
    - Webinar: https://reefresilience.org/a-managers-guide-to-coral-reef-restorationplanning-and-design/
- **4 main planning steps**:
    - 1. Set a goal (ex: ecological and socio-economical, such as preserving biodiversity or recovering resources)
    - 2. Determine site selection criterion and identify sites
    - 3. Design interventions options
    - 4. Identify objectives and put information together into state-wide strategy
- **Additional resources** for this plan:
    - A Research Review of Interventions to Increase the Persistence and Resilience of Coral Reefs: Consensus Study Report (Website: nap.edu/catalog/25279/a-research-review-of-interventions-to-increase-the-persistence-and-resilience-of-coral-reefs)
    - Considerations for maximizing the adaptive potential of restored coral populations in the western Atlantic (Baums et al.) (Website: https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.1978)

    - Coral Reef Restoration as a Strategy to Improve Ecosystem Services: A Guide to Coral Restoration Methods (Website: https://wedocs.unep.org/handle/20.500.11822/34810)
- Once state strategy is published, future plans are to create a more detailed site selection process based on the criteria developed in step 2 and to create detailed plans for certain jurisdictions like the ECA.
- **Questions**:
    - JL: Forgive me if I sound rude but we all know that restoration activities alone won't restore reefs unless the water in which they live can be cleaned up to the extent that healthy corals can flourish on their own. Restoration attracts attention more easily from the public, so I'm wondering if you are planning to capitalize on their interest by assertively noting the need for more funding for pollution removal.
        - CL: We do plan to emphasize that restoration needs to occur within the context of threat abatement, and that restoration alone will not solve all of the problems we are facing with reefs. The idea with restoration is to bridge the gap while we (hopefully) deal with the large issues - water quality, climate change, etc.
        - JL: Glad to hear, because too often historically this is just given in a sentence somewhere but not emphasized.
        - EP: And we need to get people to understand that if the corals are not healthy due to water quality and climate change impacts then all other reef organisms AND people are not going to be healthy either!
        - JL: Indeed my hope is that if societies get responsible about environmental racism and start to "green" disadvantaged communities the oceans will also benefit.

Session IVa: Reef Monitoring Updates

SECREMP – *Nicole Hayes (NSU),Dave Gilliam (NSU)*

- **Program Summary**: SECREMP is an annual project that uses permanent stations to monitor the current status and temporal/ spatial trends of coral reef resources within the SE Florida Coral Reef Ecosystem Conservation Area (Coral ECA). It is an expansion of the Keys and RTO Coral Reef Evaluation and Monitoring Project (CREMP)(FWC). These monitoring projects together encompass the entire FRT. All information is available in annual reports.
- **Regional Partners**: FL DEP CRCP, FWC/ FWRI, NSU
- **Federal Partners**: NOAA CRCP
- SECREMP has added sites and changed methodology throughout different events and management needs. Currently there are 22 sites: 8 Miami Dade, 7 Broward, 5 Palm Beach, 2 Martin County
- **Site and Station Set-up:**
    - Each site has **4 permanent stations**
    - Each station has:
        - **1 still image transect**
            - percent benthic cover- 0.4 x 22m transect
            - digital camera ~40 cm above reef substrate
            - 15 random pts/image, ~50-60 images/ transect
            - functional groups: stony coral species, octocoral (branching/ encrusting), macroalgae, CCA, substrate
        - **1 belt transect**
            - Stony corals= 1x22 m transect
                - ID and measure all colonies >2cm diameter (down from 4cm to capture more of population)
                - Record % mortality, # isolates, health conditions
                    - In response to disease event new descriptions for mortality and conditions:
                        - Type: tissue loss, color loss, discoloration, growth anomaly, mucus sheathing
                        - Distribution: focal, multi-focal, diffuse, whole

        - Margin: rate and % affected
        - Tally of all species <2cm diameter (looking at recruitment to give a sense of future recovery)
        - Count long-spined sea urchins
    - Barrel Sponges= 1x22m transect
        - Record location, measure max diameter, base diameter, height, osculum diameter, record condition and injury, take images
    - Octocorals= 1x10 m transect (cut down from 22 m because they are so abundant)
        - Count all individuals
        - ID 3 target species: *Gorgonia ventalina, Antillogorgia Americana, Eunicia flexuosa* (stopped recording *Eunicia calyculata* and *Pseudoplexaura porosa*)
        - measure height, record disease (% affected), document compromised health including predation and overgrowth
- **1 temp recorder per transect** (2 per site total)

- **Annual Report:**
    - **Regional disease prevalence:**
        - Disease lesions consistent with SCTLD peaked in 2016, significantly higher than all years 2012-2020
            - SCTLD was observed on 15 of the 29 total species
            - Only includes colonies with active disease lesions at the time of the survey, so the actual prevalence is likely much higher
            - SCTLD Species by year:
                - 2013 (2 sites): D. stokesii, P. astreoides
                - 2014 (4 sites): A. agaricites, D. stokesii, M. meandrities, P. astreoides, S. intersepta, S. sidereal
                - 2015 (9 sites): D. stokesii, O. annularis complex, M. cavernosa, M. meandrities, P. astreoides, S. bournoni, S. intersepta, S. sidereal
                - 2016 (13 sites): E. fastigiata, O. annularis complex, M. cavernosa, P. astreoides, S. bournoni, S. intersepta, S. sidereal
                - 2017 (6 sites): O. annularis complex, M. cavernosa, P. astreoides, S. Intersepta
                - 2018 (6 sites): O. annularis complex, M. cavernosa, P. astreoides, S. Intersepta
                - 2019 (2 sites): O. annularis complex, M. cavernosa, S. bournoni
                - 2020 (2 sites): O. annularis complex, M. cavernosa, S. bournoni
        - All other disease lesions showed a similar trend (peaked in 2016) but there was no significant difference between years and the overall prevalence stayed below 1%
    - **Regional Stony Coral Density:**
        - Density in 2020 was significantly higher than 2012, 2013, 2014, and 2016
            - The decrease in 2016 was driven by the loss of M. cavernosa and some M. meandrites
            - The increase in 2020 was driven by the increase of P. astreoides with some contribution form A. agaracites and P. porites
        - **Regional Stony Coral Size Distribution:**
            - From 2012- 2015, the distribution of colony sizes was stable. Beginning in 2015, there is an increase in mid-sized colonies. In 2016, there is a loss of mid-size and large colonies. From 2016-2020, the distribution becomes heavily weighted to small colonies. **Overall, there is an increase in small colonies and a loss of mid-sized and larger colonies from 2012-2020**.
        - **Regional Stony Coral Live Tissue Area (LTA):**
            - LTA was consistent between 2012-2015 but dropped dramatically in 2016 (between 2015-2018, there was an overall loss of >50% or live coral tissue). The increase in density seen in 2020 is driven by weedy species, which has little effect on regional LTA.
            - LTA by site:
                - **Martin County** lost all P. clivosa colonies in 2018, which dominated the local population, causing a dramatic loss in LTA. The increase between 2018-2020 was caused by an increase in P. astreoides colonies (6-fold increase between 2016-2020).
                - **Palm Beach County** experienced a large drop in LTA in 2016 driven by the loss of M. cavernosa and M. meandrites that has since stabilized.

        - **Broward County** lost most of the tissue of its highest-cover site between 2015-2017, the loss has since stabilized
        - **Miami Dade County** had a lower cover at all sites but loss at each was still evident
    - Species driving changes:
        - **Highly susceptible species**: M. meandrites and D. stokesii were the first species to exhibit significant loss. In 2016, LTA was near zero for both species but they were never completely lost from the sites. In 2019-2020, recovery appears to be beginning, though the increase is not significant as of yet.
        - **Intermediately susceptible species**: M. cavernosa and O. faveolata exhibited losses later (beginning in 2016). Recovery for these species is not yet evident and there are still observations of active disease in 2020.
        - **Low susceptibility species**: P. astreoides LTA was stable between 2013-2018 and significantly increased in 2019 at all sites.
  - Tally data of juvenile corals (<4 cm) along transects:
    - All highly susceptible species are represented in the juvenile size class
    - O. faveolate is the only intermediately-susceptible species not represented in the juvenile size class
    - S. siderea are the largest contributors to juvenile corals
- **Regional Octocoral Density:**
  - Density increased between 2013-2017 and then decreased in 2018 due to Irma. There is a significant increase in density in 2020, indicating that the population is recovering from that event.
- **Regional Barrel Sponge Density:**
  - Population also exhibits a loss in 2018 due to Irma, but relatively stable between years 2012-2020
- Mean Annual Cover for All Taxa:
  - Still calculating long term trends, will be available in this year's comprehensive report
- **Recent SECREMP Products:**
  - Annual SECREMP Reports and 2-page outreach documents
    - https://floridadep.gov/rcp/coral/content/sefcri-project-reports-and-products
  - Completed MS Thesis: 2018 - Nick Jones (cover data); 2019 - Nicole Hayes (stony
  - coral demographic data), Alanna Waldman (Xestospongia muta data), Alex Hiley
  - (Octocoral Data)
  - **Recent Publications:**
    - Walton et al. 2018: Impacts of a Regional, Multi-Year, Multi-Species Coral Disease Outbreak in Southeast Florida (Frontiers in Marine Science)
    - Jones et al. 2020: Thermal stress-related spatiotemporal variations in high latitude coral reef benthic communities (Coral Reefs)
    - Hayes et al. provisionally accepted: Tissue loss disease outbreak dramatically alters the Southeast Florida stony coral assemblage (Frontiers in Marine Science)
    - Waldman et al. In prep: Density trends of Xestospongia muta (giant barrel sponge) and its impact on Southeast Florida Reefs
    - Hiley et al. In prep: Spatial and temporal trends of Southeast Florida's octocoral community
    - Jones et al. In prep: Status and trends of the benthic community on the Florida Reef Tract

- **Questions/ Comments:**
  - BW: There's no question that disease prevalence has gone down at the reef scale, however, it is still relatively high in Mcav, Ofav, and Pstr/cliv in the nearshore. I wonder how the loss of 50% of live tissue area and the addition of new disease resistant colonies affects the SECREMP prevalence estimates and is there a way to account for those factors?
    - NH: We can only speak to this snapshot of data taken during the surveys. There are other ways to get an idea of true disease prevalence, this is only a snapshot at a certain timepoint.

NCRMP Florida Sampling in 2019-2020– *Jay Grove (NOAA)*

- The National Coral Reef Monitoring Program (NCRMP) samples climate, benthic, socioeconomic and fish community (RVC) data. The Florida Keys and Dry Tortugas have ben sampled since the late 90's; Southeast Florida was added in 2018.
- **NCRMP Products**:

    - For the scientific community: raw data and primary documentation
        - https://www.coris.noaa.gov/
    - For Management: technical reports
        - https://www.coris.noaa.gov/monitoring/data_summary_report_2018/
    - For stakeholder groups and officials: summary reports
        - https://www.coris.noaa.gov/monitoring/status_report/
    - For general public: report cards by region
- **Benthic Methods**:
    - Benthic Assessment: surveys benthic composition, topographic complexity, macroinvertebrates, ESA-listed coral
    - Demographic Assessment of all corals >4 cm: surveys density, size, richness, and condition (bleaching, disease, mortality)
- **Reef Visual Census (RVC) Stationary Point Count Survey**:
    - Two divers survey paired cylinders from the bottom to the surface to estimate reef abundance, richness, occurrence, etc. for each species (Bohnsack and Bannerot, 1986)
    - In 2020 made the change of reducing 4 divers to 2 in 50x50 m grid cells.
- **Sampling Cycles**:
    - As of 2014, sampling in Florida was done every other year, with SE Florida joining the rotation in 2018. In 2020, completing sampling in the region was difficult due to COVID-19 related obstacles- DRTG and the Florida Keys were not sampled, Biscayne was partially sampled, and SE Florida completed all sampling (thank you to Nova Southeastern University and Miami Dade County).
        - Sampling in SE Florida: Completed 99 benthic sites and 244 fish sites (some sites in the norther portion of the region will be completed this Summer, the southern portion is complete. Working towards a total goal of 300-360 sites)
    - Returning to Florida sampling in 2021 to fill any gaps, as well as sampling in the Caribbean and Flower Banks.
- The fish data was QA/QC'd for this meeting to address **fisheries management questions for 2018-2020** related to Hogfish and Mutton snapper
    - In 2017, the FWC state water regulations changed the **Hogfish** regulations from 5 to 1 fish bag limit and 12 to 16 inches TL.
        - There is no significant change in hogfish density between 2018-2020
        - Appear to be recruiting to the survey and hardbottom habitat at 10-15 cm. They are present in high numbers up to 30-35 cm. Surveys are not capturing 35-40 sm fishes yet- would expect to see more of these larger fishes now that the TL limit was extended, but it is not apparent yet. Seeing the opposite trend with more fish in the 30-35 size class.
    - In 2017, the FWC state water regulations changed **Mutton snapper** from 16 to 18 inches TL and a 5 fish bag limit.
        - There is no significant change in mutton snapper density between 2018-2020 (similar density to hogfish)
        - Appear to be recruiting to the survey at 15-20 cm. The original size drop-off was 41 cm, and has now moved to 46 cm.
- **NCRMP 2021 Sampling**
    - Changing to 50x50 m grid cells
    - Continuing the benthic partnership with DRM
    - Working to get benthic and fish data at the same locations, planning cruises in DRTG in July and August (TBD)
    - GIS site tracker app to keep an eye out for SCTLD
    - **Online data resources:**
        - Data and status reports are publicly available NOAA CoRIS website (coris.noaa.gov)
        - SEFSC Fish Lead
            - R fish package (GitHub): https://github.com/jeremiaheb/rvcQuestions
            - Jay Grove (jay.grove@noaa.gov) or Jeremiah Blondeau (jeremiah.blondeau@noaa.gov)
        - NOS NCCOS Benthic Lead
            - R benthics package (GitHub)
                - https://github.com/shgroves/NCRMP_benthics
                - https://github.com/shgroves/NCRMP.benthics.statusreport

- Shay Viehman (shay.viehman@noaa.gov) or Sarah Groves (sarah.groves@noaa.gov)

Session IVb: Reef Monitoring Updates

FRRP DRM: 2020 Summer Quick Look Report Overview & Outlook for 2021-22 – *Jennifer Stein (FWC)*

- **2020 Results and Milestones**
  - 389 sites were completed across 9 subregions making this year the largest DRM effort to date
  - Acquired a new partner, SHEDD Aquarium, who was able to reallocate their time to surveying in the Florida Keys
  - Completed 2 multi-day cruises in the Marquesas and DRTQ, no SCTLD was present in the DRTG.
- **Project Summary**: The DRM Program was established in 2005 by the Florida Reef Resilience Program to survey the shallow coral reefs from Martin County to the Dry Tortugas during the months of peak thermal stress. DRM is the largest unified monitoring program for the entire FRT and is the largest coordinated coral condition monitoring program in the world.
- **DRM 2020 Methods**: In 2020, expanded the survey area from 2 1x10m belt transects to 4 with a new focus on species most effected by SCTLD, and a juvenile census on all transects to determine whether recovery is occurring broadly or locally. Transects 1&2 target all adult coral species and juvenile families, transects 3 & 4 only survey target adult species and juvenile families. Additional sample sites were also added in 2020.
  - **Target adult coral species surveyed on transects 3 & 4**: C. natans, D. stokesii, D. labyrinthiformis, M. meandrites, M. angulosa, M. aliciae, M. ferox, M. lamarckiana, P. clivosa, P. strigose
  - **Target juvenile families surveyed on all transects**: subfamily Missinae (includes Isophyllia, Mussa, Mycetophyllia, Scolymia), subfamily Faviinae (includes Colpophyyllia, Diploria, Favia, Manicina, Pseudodiploria), and family Meandrinidae (includes Dendrogyra, Dichocoenia, Eusmilia, Meandrina)
- **2020 Bleaching Prevalence:**
  - 389 sites surveyed across 9 subregions
  - Pooled by site: moderate bleaching was observed at 36 sites (Broward-Miami had the highest number of sites with moderate bleaching recorded [11]), severe bleaching was observed at 2 sites (both in Martin County, mostly driven by S. radians)
  - Pooled by subregion-zone: all areas were considered mild to no-bleaching with the exception of Marine Inshore Zone.
  - When paling was included, prevalence values increased to moderate and severe in approximately half of the sites. The Florida Keys experienced less bleaching and paling, and what was recorded may have been skewed by S. radians.
    - Pooled by site: moderate bleaching and paling was observed at 168 sites (35 in Broward Miami, 35 in the Dry Tortugas, 25 in the Lower Keys, and 23 in the Marquesas); severe bleaching and paling was observed at 26 sites (11 in Broward Miami)
- **2020 Disease Prevalence:**
  - Pooled by site: Medium disease (6-10%) recorded at 21 sites (10 in the Marquesas, 5 in Broward-Miami); High disease (>10%) was recorded at 6 sites (3 in the Marquesas)
  - Pooled by subregion-zone: all were low to no disease prevalence except for the Marquesas mid channel and offshore patch reefs, which were recorded as having high disease prevalence, largely driven by P. astreoides and S. sidereal with unknown diseases.
- **Total colonies reported with SCTLD:**
  - In total, 216 corals were recorded with SCTLD. The highest number of SCTLD cases were in the Marquesas (168- 60% M. cavernosa, 20% S. siderea), followed by the Lower Keys. No SCTLD was recorded in Martin County or Upper Keys subregions.
- **Average Density of Target Species by Region:**
  - The Dry Tortugas had the highest density of all species besides M. lamarckiana
  - D. stokessi had the highest density in SE Florida and the Florida Keys
  - P. strigose was the most dense in the Marquesas and Dry Tortugas

- The lowest density site and species was P. clivosa in the Marquesas, this is likely due to the lack of shallow sites included in this region.
- **Average density changes over time:**
  - **Southeast Florida:**
    - **D. stokesii and M. meandites** declined in both desnity and colony width in 2016, 2 years after SCTLD was first recorded in 2014. D. stokesii is showing signs of recovery with density increasing from 2017-2020.
    - **C. natans** declined in 2016 with no colonies recorded in 2018 in SE Florida.
    - **D. labyrinthiformis** had 3-or-fewer colonies counted in SE Florida between 2011-2018. Density declined in 2015 and colony diameter declined in 2016 and has remained low. Density increased in 2019-2020, with 2019 being the highest year.
    - **P. clivosa** had the lowest density values recoded between 2016-2020, and was not recorded in 2013 due to lack of sites. Density varied between years due to low colony counts.
    - **P. strigosa** had its lowest density values recorded between 2015-2020.
    - **Mycentophyllia spp.** had consistently low colony counts in SE Florida, the loss of this species in 2016 was consistent with other SCTLD species but it is speculated that the population was impacted due to small colony numbers.
  - **Florida Keys**:
    - There is an overall decline in average density between 2016-2018, and is lowest in 2020 for all 6 species.
    - The colony width of D. stokesii, M. meandrites, D. labyrinthiformis, P. strigosa, and P. clivosa declined in 2016-2018 and were the lowest in 2020
    - The density of D. stokesii and M. meandites declined in 2018; of C. natans, D. layrinthiformis, and P. strigose declined in 2019, if P. clivosa declined in 2018, 2019, and 2020.
    - The density of Mycetophyllia spp. has been consistent since 2012 and increased in 2019. The colony width reached its max in 2015 and has remained consistent since.
  - **Marquesas** (only surveyed in 2109 and 2020):
    - SCTLD was not present in the MQ until 2020
    - The desnity of all species declined between 2019-2020 except for P. clivosa (not observed in 2019 due to fewer sites).
    - D. stokesii had the greatest decline.
    - The colony diameter of C. natans, M. meandrites, Mycetophyllia spp., and P. strigose all declined in diameter between 2019-2020.
- **Average density of juvenile families:**
  - 256 sites had at least 1 juvenile family recorded
  - Across regions, juveniles of Missinae and Meandrinidae were highest in the Marquesas, juveniles of Faviinae were highest in the Dry Tortugas
  - There was a high density of juveniles in the Marquesas, potentially indicating that it is an important contributor of coral recruits.
  - Each family was observed across all regions. They either survived SCTLD or were recruited after they were endemic. It is important to know where natural recovery is happening for determining whether they will be able to survive on post-SCTLD reefs.

- **Overall Summary for 2020:**
  - **Bleaching and Disease:**
    - Mild Bleaching Year
    - Moderate Bleaching and Paling Year.
    - Florida Keys had less paling than Southeast Florida and the Dry Tortugas
    - Low disease prevalence across the reef tract with the exception of the Marquesas Mid Channel and Offshore Patch Reefs.
      - Disease prevalence heavily influenced by SCTLD in the Marquesas
    - Throughout the reef tract, the colonies that were observed with SCTLD were mostly SSID, MCAV, OFAV.

        - No SCTLD observed in the Dry Tortugas.
    - **Target SCTLD susceptible species/ families**
        - Declining trend in average density of SCTLD susceptible species attributed to the disease across Southeast Florida, Florida Keys, and Marquesas.
        - Additional years of increased survey area (four transects) and survey sites is needed to provide accurate density and size data for now rare species.
        - At least one of the target juvenile coral families was recorded at 65% of the surveyed sites in 2020.
- **Proposed plans for DRM in 2021 and 2022** with the EPA 2-Year Cooperative Agreement Award
    - 1. Maintain the primary objective to monitor the status of bleaching along the FRT.
    - 2. Continue to monitor for SCTLD along the endemic areas of the reef tract and saturate vulnerable areas of Dry Tortugas with DRM sites to increase the probability of identifying the disease.
    - 3. Assess the abundance of a subset of coral species that were highly susceptible to SCTLD including juvenile corals (< 4cm and > 1cm).
- **DRM Products**:
    - The 2020 DRM Quick Look Report is available on the DRM website (https://ocean.floridamarine.org/FRRP/)
    - All trainings, protocols, and surveyor resources are also available on the DRM website on the 'Surveyor Trainings and Resources' page.
    - DRM data from 2005-2020 can be downloaded from the 'Reports' page.
- **Questions**:
    - JL: This is a minor taxonomic point: the Faviinae and Mussinae are now classified as two subfamilies of the Faviidae family
    - PD: FYI for perspective: The density of juvenile corals estimated in this talk is about 2-3 orders of magnitude lower than Carysfort Reef in 1975.
    - JL: But I am buoyed in that these juvenile corals are alive and just yesterday I was looking at photos of newly dead small SCTLD-susceptible corals along the north coast of the DR.

Session V: Adding Capacity to the SEFCRI TAC

Ideas for expanding the expertise of SEFCRI TAC – *Kristi Kerrigan (DEP CRCP)*

- TAC was created in 2004 as one of the original LBSP projects with the goal of collecting expertise to help review water quality data. In 2012, TAC grew to include other areas such as fisheries, molecular ecology, toxicology, etc. We have tried to cap the number of members at 25, but that is not required by the charter. There are new areas of interest that have made us revisit the issue of balanced membership- we would add seats to accommodate the addition of members with expertise in these areas. These areas are:
    - Restoration
    - Stormwater management
    - Translating science to policy
- **Are there any concerns in the TAC about bringing on these sets, or are there any recommendations for who should be considered to fill them?**
    - Comments in **favor** of expanding the seats to include these areas:
        - Dana Wusinish-Mendez
        - April Price
        - Judy Land
        - Jack Stamates
        - Brian Walker
        - Piero Gardinali
    - **Questions and Concerns**:
        - D W-M: I think the restoration expertise needed is at the ecosystem level, no not necessarily a field technical sort of expertise but a bigger picture restoration practitioner whose focus is at the system level.
        - RD: It would help to see a list of the current TAC and the "fields of expertise" of each. It may be that we already have these or some of these specialties well covered.

- JV: Are you thinking of adding one seat for each of these? There are several different types of restoration that we could be considering. Seagrass, coral reef, estuary, etc.
    - KK: In this case, we are more focused on coral restoration than on WQ and watershed restoration
- JV: All of these are hyper applied in their scope, so one tactic would be to get academic people, but we also might benefit from other perspectives other than academics
- AP: On translating science to policy, I can assist. Not an expert but I have access to folks who are
- RD: Don't we want technical expertise relevant to our region and its issues whether academic or not? I think we have enough for Restoration and Stormwater.
- JL: I was going to ask if we've forgotten the kinds of expertise that were being talked about in the first session on turbidity
    - KK: I think we are covered in turbidity
- PD: I would have thought that the translator would have been a staff member?
- PD: there should be a commercial aquarist on this TAC, that's a huge economic interest. I think that someone involved in that trade would be a good interface with the people and a good interface between the science and the public and also help us understand how to care for corals in captivity.
    - BW: People at Frost are very good at that...
    - D W-M: I disagree, we need someone who thinks bigger picture than aquarium expertise.
    - PD: I disagree- aquarium keeping is the biggest hobby in the world and its active in SE Florida. I think they have great expertise that we haven't tapped into
    - D W-M: I don't know how that expertise would be applied by the programs that the SEFCRI and TAC are implementing.
    - RD: I agree with Dana. Get them to come and give a Powerpoint. Not needed on TAC.
    - Phil Dustan: expertise on putting corals on the reef is just that, but it won't bring a new dimension.
    - D W-M: I don't think it should just be that, I think it should be someone with an ecosystem perspective and skill set.
    - Stephanie Schopmeyer: Through coral rescue we are tapping into the aquarist knowledge on caring for and raising corals.
    - PD: An aquarist must maintain a micro-reef and therefore become acutely aware of what it takes to keep a reef healthy.
- JL: Why not send around a list of who we are and maybe someone of us will decide we're redundant and gracefully exit, allowing the addition of new blood/expertise without having too unwieldy a group size. Dick made the point that we can invite outsiders in to talk and gain inspiration that way without growing the TAC, which I think is also a good idea.

Session VI: Disease/Water Quality Interactions

Disease patterns modeling results: Environmental drivers of SCTLD in Florida's Coral Reef ECA – *Brian Walker (NSU), Gareth Williams (SymbioSeas)*

- Materials to stay updated with the project:
    - Story Map of the actions to save the exceptional corals of the ECA: https://novasoutheastern.maps.arcgis.com/apps/Cascade/index.html?appid=cf2bf16f698d40968d437d402199e027
    - FWC Coral Disease Intervention Dashboard: https://www.arcgis.com/apps/opsdashboard/index.html#/55a759f02f3c486eb1d29a95f80fba0a
- **SCTLD Intervention**: The SCTLD outbreak began in 2014-2015, at the time it wasn't apparent that it was going to be a long-term reef-wide issue. Disease intervention is essential, but was impossible at a landscape scale. To preserve the existing habitat and structure, and to save some of the oldest reef organisms in S. Florida, we prioritized two main intervention efforts: (1) to treat any disease encountered and (2) to specifically target the

largest corals in the region. Reef mapping found 295 massive coral colonies (>2m), mostly O. faveolata with some M. cavernosa and S. siderea. Prioritizing these intervention actions also has the benefit of providing information on disease infection rates, both temporally and spatially, and buys practitioners time for management action and gamete acquisition for assisted reproduction.

- **Methods**: corals were treated on each monthly visit and observed for amount of live tissue, bleaching, and disease. Lesions not associated with a previous treatment were considered new infections and were treated and classed as new treatments. The number of priority corals treated in this project increased from 50-100; since 2015 we have a consistent database to monitor through time.
- **Infection Patterns**:
    - New treatments varied over time
        - Patterns emerge at different times of the year: low disease in January-May (11 corals/ 52 lesion treatments), more treatments are required from June-October (24 corals/ 132 lesion treatments).
    - There was no obvious temporal infection patterns per coral (the same corals did not get infected consistently), but did see that some corals get a low number of infections over many time periods, some get a high number of infections over very few periods, some get a few infections over a few periods, and some require no treatments at all.
    - There is no obvious spatial clustering of corals with differing infection patterns
        - Corals were classified into different infection patterns (high, moderate, low, once infected, never infected) via SimProf test and MDS plots that showed clustering based off of the number of periods requiring treatments, total treatments required per coral, and the number of periods requiring more than 4 treatments per coral.
- **SCTLD Resistance Research Consortium**:
    - The lack of spatial clustering in corals with different infection patterns led to the formation and funding of a new consortium of 10+ collaborators to investigate other differences between these colonies.
    - Methods: Corals from each infection category will be sampled for tissue collection at 3 time points to be analyzed for differences in endosymbionts, genotypes, metabolites, microbes, biological pathways, antimicrobial bioactivity, immune response, and histopatholgy.
- **What have we learned from disease intervention efforts so far**?
    - New infections vary with seasons
        - Disease infections are most abundant in the warmest, wettest months and are lower in the coolest, driest months. This pattern is not evident in the Florida Keys.
        - The onset of high rainfall and runoff coupled with temperature stress can increase coral disease outbreaks.
- **Environmental Drivers of SCTLD:**
    - **Project description**: This project will model the abiotic environmental and human drivers of SCTLD.
    - **Part 1: South Florida (SCTLD)**
        - Disease will be modeled as disease incidence (the occurrence of novel infections over time) (temporal model) and spatial variations in disease prevalence at any given point in time (spatial model)
        - Scale: SE Florida; monthly
    - **Part 2: Florida Reef Tract (TLD, DID)**
        - Will model spatial variations in disease hotspots occurring over time
        - Scale: Florida Reef Tract; yearly
    - **Datasets used to produce models:**
        - SECREMP temperature data (23 sites across 4 counties, HOBO sensors retrieve temperature data at each site every 2 hours)
        - WQ Assessment of the South Florida Reef Tract (115 sites across 9 ICAs, monthly sampling at each site since 2017 of the following analytes: nitrate/ nitrite, ammonium, urea, total nitrogen, TKN, orthophosphate, total phosphorus, silicate, TSS, turbidity)
        - Tributary Flow Data from DB Hydro to help explain the observed temporal differences in water quality
    - **Outcomes of S. Florida modelling**
        - **SCTLD Incidence:**
            - There are three distinct periods of higher disease levels in September 2018, December to January 2019, and June-August 2019
        - **Quantifying drivers:**

- **In situ temperature variability**: created a spatial join and matched the corals to their respective loggers to estimate the temperature they were experiencing. Used the hot snap method which the determines the number of hours the temperature exceeds the seasonal mean temperature. Set the 'period of accumulation' at a variety of different time points (3, 7, 30, 90 days) to determine how the time between the temperature anomaly and occurrence of disease might affect results.
- **In situ nutrient concentrations**: used NOAA sampling stations with data in 30-90-day windows, included the nearest 5 sampling stations for each large coral and focused on phosphate and nitrate analytes.
- **DB Hydro**: estimated the amount of terrestrial based flow the corals may be experiencing. Joined each DB Hydro sampling station to its nearest ICA, then linked that ICA to the nearest large coral. Built a custom R script to read and use the DB Hydro data (available for distribution). Extracted flow data for 3, 7, 30, and 90-day windows prior to disease surveys (aligned with HOBO temperature data).
- **Distance to outfall locations**: linear distance from each coral
- **Septic tank densities**: radial buffers from each coral following Fibonacci sequence
- **Host-specific morphometrics**: proportion of living tissue, surface area, linear width, linear height

- **Spatial Model:**
  - Modeled the total number of novel SCTLD infections across the entire disease timeseries (September 2018 to April 2020) using large corals as replicates against the suite of colony morphometric, human and abiotic predictors using distance-based permutational multiple regression
  - Used 9 predictor variables in the model: depth (m), linear width of the colony (cm), surface area of the colony (cm2), the proportion of live coral on the colony, the area of live tissue on the colony (cm2), number of septic tanks within 5 km and 21 km, mean total suspended solids (over 3 months prior to survey date) (this was highly correlated with the DB Hydro data, which is why the DB Hydro data was omitted from this model), and linear distance to nearest outflow (km)
  - Results: there are **3 core predictors** that capture 53% of the spatial variation in disease lesions:
    - **Number of septic tanks** in the largest radius analyzed (21 km distance) (positive relationship)
      - *Note: the septic tanks are used as a proxy for urbanization, this is not suggesting that there is a specific link between a septic tank-derived contaminant and disease
    - **Proportion of live tissue per colony** (negative relationship)
    - **Depth** (m)
- **Temporal Model:**
  - Modelled the number of novel SCTLD infections by month (September 2018 to April 2020) against our suite of colony morphometric, human and abiotic predictors using distance-based permutational multiple regression
  - Used 3 predictor variables in the model: DBHydro 7 days prior, total number of Hot Snaps over the previous 3 months, and mean total suspended solids over the previous 3 months
  - **DB Hydro data 7 days prior to disease survey** was the single variable that produced the optimal model and explained 49.7% of temporal variations seen in SCTLD infections. (positive relationship). In other words, the DB Hydro flow data taken one week prior to disease surveys was the single best predictor of disease incidence over time
- **Next steps**
  - Will model environmental drivers of regional tissue loss diseases and DSD 'hot spots' over space using much larger datasets throughout the FRT using the following predictors: TNC Ocean Wealth, FDEP Wastewater, Septic Tanks, Land Use (degree of urbanization), WQ (SERC), human population density

- Extend South Florida SCTLD analysis timeframe to include recent data and generate additional predictors to improve model performance
- Investigate environmental drivers with the SCTLD Resistance Research Consortium results
- Use machine learning modeling (Boosted Regression Trees and Random Forests) that allow disparate data types to be simultaneously included in a single modeling framework

- **Questions:**
  - PD: Have you thought of using impervious surface area as a predictor?
    - Gareth Williams: We have not- I'm guessing that would be an indicator of development?
    - PD: - it's basically a good indicator of development in an area. 5% in a watershed area means impact, 15-20% means the watershed is doomed. You may have some tag into this.
    - GW: Impervious surface is a good idea - we're working on finding what spatial data might exist for "urbanization". We certainly have this (or something similar) for the larger-scale hotspot modeling. We plan to also include rainfall in future efforts
    - Kurtis Gregg: Land use is quantified in the Southeast Florida watershed delineation report at: https://www.coris.noaa.gov/activities/projects/watershed/se_florida_lbsp/welcome.html
    - PD: Here's a reference to Fred Holland's paper on estuarine creeks and impervious surface area: Linkages between tidal creek ecosystems and the landscape and demographic attributes of their watersheds Journal of Experimental Marine Biology and Ecology Volume 298, Issue 2, 28 January 2004, Pages 151-178 lA.FrederickHollandaDenise MSangeraChristopher PGawleaScott BLerbergbMarielis SextoSantiagoaGeorge H.MRiekerkaLynn EZimmermanaGeoffrey IScottc
  - PD: Are large corals important because they are the only ones that are remaining, or the fact that they have been around for a long time and can manage the stress? We used to see the same phenomenon in the summertime. There was always the thought that the particulate organic material may be pathogenic. There has always been an idea that a coral that's large can harness more energy, but it also has more surface area to catch particles
    - BW: They persisted throughout the changes of water management that has occurred up to this point. We wanted to keep them around. Our efforts show that we have been successful in doing that.
    - PD: I think there's an analog in terrestrial restoration, people want to protect the larger trees, they die slowly, maybe that's what we're seeing here with these corals.
    - BW: we are going to try to outplant live tissue onto some of these that have died to try to regenerate them into a new coral on top of an old coral. Without addressing all the environmental factors that are playing into this, we will just be watching them die.
    - PD: We did an experiment with Diadema to introduce grazing, and the Diadema helped a lot. I wonder if it's possible to take some corals and put Diadema all over them and see if it helps.
    - BW: That is an idea that I'm pursuing. We are partners with UM and their SE Florida restoration hub. As part of that effort, Frost is trying to rear Diadema in mass. We want to use the Diadema in that project and identify certain corals that have a better chance of the Diadema staying put and do an experiment where we put out a bunch and see how that effects coral recruitment. That's a long-term project.
  - JS: was flow direction an input?
    - GW: No. We did look at various circulation model possibilities, but felt was beyond scope of this analysis
    - JS: the reason I mention it is that the southern flows can be more energetic.
  - PG: I wonder how far inland are the SFWMD flows used for the modeling. Do we have better flow data closer to the reefs? Also as Jack pointed out is this overall flow out?
  - Jose Lopez: Nice work Brian. Lack of a disease incidence spatial pattern suggests differential immunity of the corals.

        - BW: We'll be focusing on what those interspecific differences are. Just within the large OFAVs there is a range of patterns between some of these corals. It will be cool to see if they're genetically related, or have the same symbionts, etc.
        - EP: Or differential susceptibility of the Symbiodiniaceae in the corals? And if zooplankton food for the corals has changed or decreased due to environmental stressors in water quality and seawater temperature there may be other reasons the corals are losing tissue.
        - Andrew Baker: And zooplankton may also be a vector...
    - Laura Eldredge: DEP BBAP is looking at correlating the seagrass die off event to DBHYDRO flow data and also have an intent to compare to rainfall. We're also working within R and can chat further on the potential to talk scripts and making more connections to how water transference is affecting other trophic levels within the watershed (making a stronger connection between upland sources, estuarine bays, and offshore reefs).
        - GW: Laura - interesting. Happy to chat more and more than happy to share all my code
    - JV: Do the DBHYDRO data incorporate both flow and net flux of nutrients?
        - Gareth Williams: no, we kept it quite simple this time round and just looked at total flow, But we did include nutrient data from the in situ sampling

Session VII: Coral Disease

Stony coral tissue loss disease (SCTLD) update – *Maurizio Martinelli (SeaGrant)*

- **Disease progression in Florid**a: SCTLD has not yet been observed in the Dry Tortugas, they are actively monitoring and are ready for intervention should it come to the area
- **Disease progression in the Caribbean**: SCTLD observations have been added in Martinique and the French side of St. Martin in 2019.
- **Priority Research Questions for future SCTLD projects:**
    - Is SCTLD a biotic, abiotic, or combination disease?
    - What factors drive resilience and or resistance to SCTLD?
    - What conditions have allowed the outbreak to persist and spread?
    - Are there effective intervention options other than antibiotics?
    - Will antibiotics remain a viable treatment in the future? What is its efficacy through time, multiple treatments, and/or adverse impacts?
    - *The question relating to the role of symbionts in SCTLD has been removed because there are planned or ongoing projects that will address this.*
- **Revised research review process:**
    - Now simultaneous reviewing all of the proposed projects together, rather than reviewing on a rolling bases
    - Are separating the technical review form the management review
    - Project review will be completed before the next fiscal year, independent of funding opportunities. Previously, the review would wait until the last projects were completed, and the result was that the time to do the new projects was reduced. Now projects will have the entire year for work to be completed.
- **Intervention goals** agreed upon by the leadership of intervention teams:
    - Minimize losses of remaining coral colonies, living tissue, and living reef structure to protect ecosystem functions
    - Support innovation and development of effective/efficient intervention techniques
    - Design intervention research and apply outcomes to inform overall response efforts
    - Build capacity and resources for intervention activities
    - Improve and enhance communications related to intervention
    - Better integrate SCTLD intervention and statewide restoration efforts
- **Rescue coral offspring outplants**
    - 375 Colpophyllia natans offspring form the rescue coral broodstock were outplanted onto the reef but were heavily predated upon. Predation working group is being created to test predation mitigation measures and find solutions for the future.
- **Guidance for permit applications:**

    - Creating a document that will provide guidance to permit applicants with suggestions of alternatives to coral collections from natural reefs (such as utilizing existing samples, nursery reared corals, and corals collected during coastal construction projects), and provides information that the applicant will have to provide to prove that there will be no impact if they do require collection from wild populations.
- **Questions:**
    - JL: Could also point a web can on the little corals and see which corallivores they attract
        - SS: it's mostly parrotfish predation. They come to investigate and munch away even before the outplanting is complete!
        - VP: found the reference on what they call parrotfish deterrents: Experiment mimics fishing on parrotfish: insights on coral reef recovery and alternative attractors RS Steneck, SN Arnold, PJ Mumby Marine Ecology Progress Series 506, 115-127
        - SS: Val- thanks for that reference for predation controls. We have another outplanting scheduled for June that we might be able to try some with!
        - AB: Val- how about a probiotic anti-predation treatment for these recruits? Something toxic to fish/vertebrates but not corals/ inverts (I think its fish and not urchins)
        - JL: Andrew- it's also Hermodice (fireworm) and Coralliophila (snails) in addition to foureye butterfly fish, and honeycomb cowfish in A palmata + perhaps some other coral

Role of symbionts in disease susceptibility and resilience – *Carly Dennison & Andrew Baker (UM)*

- **Key observations about SCTLD that helped to develop our hypothesis**
    - Histology suggests that the first tissue layer affected by disease is the gastrodemis, which is where the algal symbionts reside in the coral. Field observations have also noted that the highly susceptible species associate primarily with Breviolum, and intermediately susceptible species often have flexible and dynamic associations with their symbionts. There is also anecdotal evidence that disease incidence changes with bleaching, with more SCTLD occurring during the winter months, and declining during the summer months when bleaching is more prevalent. The common thread throughout all of these observations is the algal symbionts that may be playing a role in SCTLD pathology.
- **Primary Hypothesi**s: algal symbionts influence SCTLD susceptibility
- **Secondary Hypothesis**: Algal association with Breviolum increases SCTLD-susceptibility relative to other Symbiodinceae
- **Methods**:
    - **Five target species collected within the endemic zone**: C. natans, D. labyrinthiformes, P. strigose, M. meandrites, O. faveolate
    - **Created replicate cores to be used in a series of manipulations and exposures**. Half of the cores were bleached and reinoculated with Durisdinium, half were maintained with their Breviolum symbionts. The final treatments of replicate cores were: (1) Dusisdinium eposed to SCTLD, (2) Durisdinium not eposed to SCTLD (control) (3) Bleached coral exposed to SCTLD, (4) Breviolum exposed to SCTLD, (5) Breviolum no exposed to SCTLD (control). SCTLD exposures were conducted as water baths with no direct contact.
    - **Analyses**: Symbiont community composition, microbiome characterization (16S and 18S),
    - gene expression of host (immune response) and symbionts, SCTLD susceptibility.
    - SCTLD Source Species: O. faveolate, O. annularis, C. natans, P. strigosa, P. clivosa, D. labyrinthiformes (core), M. meandrites (core)
- **Results:**
    - Lesions appeared between day 10-50.
    - The rate of SCTLD infection varies as a function of algal symbiont
        - Cores containing Durusdinium or Cladocopium significantly less likely to present with SCTLD compared to cores that were bleached or which contained Breviolum, however, Durisdinium and Cladocopium are NOT immune to SCTLD.
        - Durisdinium and Cladocopium are statistically less susceptible to SCTLD in comparison to Breviolum and Bleached
        - Algal symbiont SCTLD-susceptibility hierarchy: Breviolum >> Cladocopium > Durusdinium >> Symbiodinium
        - *Note: this only considers the genus Breviolum, but the cores may contain different species*
    - Species was not significant in determining infection rates

    - According to a separate model that accounts for proportions of symbionts in mixed communities found that a core is less likely to develop lesions when they host as little as 20% Durisdinium, and is more likely to develop lesions if it hosts 75% or more of Breviolum.
    - The survival of bleached cores was not significantly different than the survival of Breviolum-containing cores.
        - Bleaching did not appear to stop disease
        - This may be due to the aggressive bleach-out before exposures (1 week in high light and high heat before being immediately exposed to disease)
- Further work will investigate the **mechanisms behind SCTLD using the following datasets**:
    - 16S Microbial Dynamics: s (collaboration with Dr. Stephanie Rosales) to determine shifts in microbial communities and primary and secondary infections
    - 18S Eukaryotic (collaboration with Dr. Javier del Campo, Brad Weiler) to explore eukaryotic microbial dynamics (unexplored up to his point)
    - Transcriptomics (collaboration Dr. Nikki Traylor-Knowles, Ben Young, Ashley Goncalves) to explore gene expression in Symbiodiniaceae and the coral host
- **Proposal to DAC for reciprocal transport of inshore SCTLD-resistant colonies**
    - Following the disease outbreak, sampled the symbionts of inshore colonies that had survived the disease and found that the majority of these SCTLD-susceptible colonies hosted Durisdinium exclusively. Environmental factors select for Durisdinium, which may have protected these colonies form SCTLD. Durisdinium may provide both disease resistance and thermal tolerance, making it critical for real-world restoration application. We propose doing a reciprocal transplant between inshore and outshore colonies.
- **Additional thoughts (Andrew Baker)**
    - Durisdinium-containing colonies are not immune, there maybe be background symbionts present in these colonies that may be important in determining susceptibility
    - There are real-world applications to this work, such as interventions using salvaged corals to restore offshore reefs that might have higher Durisdinium and are more resistant to disease and bleaching.
    - Many SCTLD-susceptibly species are producing offspring in laboratory settings, we now have the ability to manipulate their symbionts, which may allow s to increase recruitment to reefs in a way that is scalable
    - Large colonies can be landscapes of different symbionts, and monitoring the change of those symbionts overtime could be interesting for patterns of susceptibility
- **Questions:**
    - BW: Do you know if the zooxanthellae play a role in the predation of outplants? If so, which clades are more attractive?
        - Carly/Andrew: No we don't know whether some make them more attractive. We know that the CNATs that were eaten had B in them, they were not manipulated, they probably get eaten for other reasons
    - SS: What's the likelihood of the corals shuffling their zoox back to SCTLD-susceptible zoox if we manipulate at the sexual propagation stage?
        - Carly/ Andrew: They could be dynamic. The same thing might happen as adults. As reefs get more warm and stressed, the D may become more stable over time and they may be less likely to shuffle back. Depending on where we put them, D may be more stable anyway. Some species maybe have a narrower window where they can pick up symbionts. ACER have an early window and once they have that, they are hard to modify. Very species specific.
    - VP: your bleached corals were less susceptible than B but more than C and D. I'm wondering whether that model does kind of fit the anecdotal? If those are bleaching… if they are mostly on corals that are containing C or D clades like CNATs and those. I'm wondering how that all fits together.
        - Carly/Andrew: The anecdotal evidence does not have tissue samples to say whether they have one symbiont or another. The jury is out, we really aggressively bleached these, that's why they might be susceptible. In the original files.
    - JV: any idea how long manipulated symbiont communities can hang on and provide potential benefit? Expect it to be a temporary short-term effect to promote early survival or ongoing long-term effect?
        - AB: Depends on outplanting environment and things that affect symbiont stability.
    - GW: I might have missed this, but what were the random effects included in the models?
        - CD: we included species and colony
        - AB: Yes, we could include random effects, that might further improve things.

- DB: I know you mentioned there is still much work to do RE the mechanisms but have you observed any differences in the behavior of individual polyps that have one symbiont or another? Do they feed heterotrophically to a similar level? Wondering about changes in the route of infection.
    - CD: In this experiment I did not note any differences in heterotrophic feeding or between polyps based on different symbionts but this is not something we were directly watching for. All cores were fed twice weekly for 45 minutes for this experiment but I will look back at daily photos to see if I notice anything on polyps.

Session VIII: Water Quality Connections

Coral reef protection and restoration grant update – *Joanna Walczak (DEP ORCP)*

- New program has been created within the DEP office of coastal protection, I will be working within the coral reef protection and restoration programs
- What we are working towards in this program:
    - Guide national coral reef policy and unite Florida's agencies to ensure effective state-wide coral reef-related authorities, policies and procedures
        - Continuing to work with the U.S. Coral Reef Task Force. We have established a restoration working group to help move these policy issues forward (such as by creating jurisdictional coral reef restoration plans, acknowledging that the scale that we need to achieve restoration is more broad than individual funding might allow for, so exploring large scale funding opportunities, such as FEMA funding, etc.)
        - Reauthorizing the only coral reef authority we have at the federal level: the Coral Reef Conservation Act (2000).
            - Have learned that it was a good approach at the time, but is not keeping up with the evolving problems that the ecosystem is facing. Need more stakeholder contribution into local action strategy and restoration, as well as some other changes.
    - Provide leadership for stony coral tissue loss disease (SCTLD) response, restoration of Florida's Coral Reef, and regional water quality priorities
        - Co-leadership between FDEP, NPS, NOAA, and FWC
    - Effectively administer state funding for Florida's Coral Reef priorities
- **FY 2020/2021 = $19.5 million**
    - Have successfully acquired a massive budget increase over the last few years, started with $1 million in 2017, thanks to many partners we have gotten an increase up to $19.5 million
        - Part of that sum is a $10 million coral reef protection and restoration grant
    - Funds support ongoing SCTLD response efforts, research to improve coral reproductive success, genetic diversity, and resilience, maintenance of land-based coral nursery aquaria, youth engagement in STEM and coral restoration, and water quality priorities in Southeast Region to ensure a healthy habitat
- Website of all WBID information for southeast counties to help us see where gaps are in WQ information and standards: https://protectingfloridatogether.gov/water-quality-status-dashboard

Water quality data compilation project – *Luke McEachron (FWC FWRI)*

- **Project Goal:** Given the recognized need to aggregate and visualize water quality data (which can be very variable between regions, programs, and years in both sampling consistency and detection methods, making it difficult to make good inferences about large scale WQ data), the primary goal of this project is to leverage existing water quality databases, sampling efforts, programs, and satellite imagery products to do four things: (1) to aggregate, crosswalk, and map water quality data, (2) to determine how we can compare quantities between programs, (3) identify spatial and temporal hotspots and changing patterns from aggregate data, and (4) to integrate remote sensing data to validate data and identify additional hotspots.
- **Current Status:** right now, this project has aggregated and mapped water quality data between all of the participating institutions and are beginning to determine how we can compare quantities between programs. In choosing data to be included in the aggregation, this project selected datasets that comprised of 5 to 10 years of sampling between Martin to Monroe Counties (including Biscayne and Florida Bays) and focusing on nine

analytes: Chlorophyll a, Temperature, Salinity, Nitrate+Nitrite (NOx), Soluble Reactive Phosphorus (PO4), Silica (Si), Turbidity, Total Nitrogen (TN), and Total Phosphorus (TP)

- **Process for aggregating data (data sources to date):**
    - Previous work and connections with FWC, NOAA, and non governmental institutions, sanctuary permits/ parks, DEP, cities/ counties (many are already collected in WIN/STORET and SEACAR)
    - Resulted in 80 potential programs that could be brought together, a total of 19 programs met our criteria (15 from WIN or SEACAR, 4 direct from provider)
- **Two questions for the TAC:**
    - 1. Are there any established water quality monitoring programs that we would have missed in this process? (Perhaps some that would not have been uploaded to WIN or SEACAR? There are not many NGOs represented in the data, so there might be some local groups that have been overlooked)
    - 2. Is there a community preference for a long-term database solution (similar to the Unified Reef Map for water quality)? Right now, everything needs to be downloaded and requested individually
- **Questions/ Comments:**
    - Kevin O'Donnell**:** Luke, I would recommend checking with EPA's Water Quality Exchange
    - BW: How will the data be summarized?
        - LM: We want to make a matrix that summarizes the metadata in those programs, and things to make the quantities in those programs comparable.
        - BW: Okay. Be aware that these programs may have different detection limits and some programs use statistical methods to extrapolate lower values/
        - LE: Yes- several databases average the method detection limit while others report out at the MDL which evaluates analytes
    - JS: The South Florida utilities that operate the outfalls have data
    - LE: Have you looked into buoy systems or https://fawn.ifas.ufl.edu/

Impaired waters – biennial assessment – *Kevin O'Donnell (DEP DEAR)*

- **Foundation of DEAR's Assessment and Restoration Programs:** Section 303(d) of the Federal Clean Water Act requires states to submit lists every two years of waters that do not meet water quality standards, including designated uses (referred to as "Impaired Waters") and requires states to develop TMDLs for those waters. Florida Legislature established DEP as the lead agency to implement the "TMDL Program, and they do so as part of the Watershed Management Approach started in July 2000. The Watershed Management Approach divides the state's 29 basins into five groups, then established a five-phase cycle that rotates through all basins over 5 years. This was originally designed to address the 1998 303(d) Consent Decree List, which was a 13-year schedule to collect data, assess waters, develop TDLS, or delist those waters that attained standards.
- **Current Status:** The 1998 303(d) Consent decree has ended, and the DEP has completed three 5-year cycles and the fourth cycle for Group 1&2 basins. The DEP has implemented numerous revisions of Florida's water quality standards into current assessments and have established a new TMDL Prioritization Process (referred to as the "Long Term Vision" by the EPA).
- **Moving Forward, switching to the Biennial Assessment:** instead of assessing one group every year, this would not assess all 5 groups every 2 years with one methodology applied to all basins.
    - **Benefits:**
        - Floridians would have access to a water quality assessment based on more recent data, providing a more current picture of Florida's water quality.
        - Water Management Districts, Department of Agriculture and Consumer Services, counties, municipalities, and other stakeholders across the state would have up-to-date, actionable information to promote effective water quality decisions and restoration.
        - Would allow for the consistent statewide application of current water quality criteria and use the same assessment period for all basins for simplicity
        - Would allow us to better synchronize with other EPA requirements
- **What steps are needed to implement a Biennial Assessment?**

    - This began last January as people loaded data into WIN, then we extract data in the Summer. Currently working on creating the draft list of impaired waters to be posted for public review in September
    - Requires **minor rule revisions** to the Impaired Water Rule:
        - Section 62-303.700: Removed text for rotating basin approach on a "five year cycle", added text for "all surface waters" to be assessed "within an assessment" cycle
    - **Changes to the internal workload:**
        - Reassigned Kissimmee basin assessments to staff covering S. Florida and developed a new schedule for staff
        - Intend to hold public meeting webinars to present basin assessment updates based on the IWR Run database
    - **Changes to assessment products**:
        - Added a column to include Florida counties, removed a column for planning unit (this information will be retained in the WBID data)
        - Use new Integrated Report assessment sub-categories to track the progress of restored waterbodies by individual parameter (the state can decide what sub-category they want their water bodies to go into)
        - Want to remove the "Revised Assessment List" step, which adds months to the process
        - Developing GIS layers for an interactive map showing draft impaired waters
- **What does this mean for data providers to WIN?**
    - Requesting that all data providers load data to WIN quarterly. If data are not loaded by the extraction date, it will be picked up in the next biennial assessment cycle.
- **IWR Runs:**
    - IWR runs will be produced 2-3 times per year between biennial assessment cycles in order to implement new functionality in the database, to implement site-specific criteria for applicable waters such as TMDLs, and to implement WBID and station revision based on new information. However, the IWR runs will not be used to update the draft assessment lists.
- **What does this mean for stakeholders?**
    - There will still be a public comment period for receiving feedback on draft lists. Typically the comment period is one month, but we are proposing extending that to two months.
- **Strategic Monitoring Plans:**
    - There will be no changes to the annual strategic monitoring plans, and we expect this to make it a more streamlined process. We will continue to update SMPs quarterly as data becomes available and maintain "SMP" GIS layer through the DEP interactive maps.
- **What does this mean for permitting entities?**
    - This change will provide more current assessment information that will better address environmental resource permits, NPDES – MS4 entities, and NPDES- Point Source Facilities.
- **Additional Information:**
    - Watershed Assessment Webpage has created pages on the Biennial Assessment, an FAQ document, and a Process document.
- **Next Steps:**
    - The first Statewide Biennial Assessment Draft Lists will be available in Summer 2021 (based on IWR Run 60)
    - Triennial Review Workshops of Florida's Water Quality Standards will be held in early Spring
- **Questions**
    - LE: How soon can we see the list for the year 1 versus year 2 assessment areas?
    - KO: It will be around Sept. timeframe.

Session IX: Water Quality Research and Results

CRCP 13 sediment microbial study – *Joe Lopez (NSU), Shelby Wedelich (DEP CRCP)*

- **CRCP 13 Rationale:** In other parts of the world, disease incidence increased with exposure to sediment plumes. The microorganisms Rhodobacterales and Rhizobiales are associated with SCLTD, btu the data for this has mostly been collected from surrounding water and not from the sediments.

- **CRCP 13 Goals:** To (1) characterize microbial communities in sediment of Port Everglades and adjacent reefs in the Coral ECA, (2) observe how microbial communities change (or not) after maintenance dredging, and (3) serve as a baseline if needed for adaptive management of Port Everglades Deepening Project.
- **Methods:**
    - 40 sampling sites across the port and reef (spanning all three reef tracts), with some outlier sites that are farther norther and south. Most of the samples from these sites (120 total, 3 replicates per site) will be used for microbiome analysis, a subset will be used for chemical analysis for heavy metals, total phosphorus, and carbon.
    - Collections were conducted in April and May of 2020.
- **Sequencing data:**
    - Average of 86,000 reads per sample
    - Alpha diversity (species richness) was similar between the port and reef
    - Chronos pie charts show the diversity of bacterial groups to the family level have typical consortiums in both port and reef samples.
    - Phylum level comparison shows overlapping taxa at both port and reef sites.
    - Beta diversity analysis: a PCA and MDS shows partitioning between port and reef sites. There is some overlap from channel sites. There is some overlap between reef and port sites.
    - Simper analysis identified some taxa might be contributing to the differences.
        - Thiotrichaceae, Anaerolinaeaceae, Desulfobullbaceae, Gammaproteobacteria incertae sedis_u_f, Desulfobacteraceae, Deferribeacteres incertae sedis_u_f, Helicobacteraceae, Ectothiorhodospiraceae, Desulfuromonadales_u_f, Planctomycetaceae.
- **Conclusions and Questions:**
    - There are significant differences between sediments int eh port and the adjacent reef based on 16S amplicon profiles
    - Some bacterial taxa have the potential to be pathogenic, but are not highly abundant
    - The impact of dredging and dispersion of microbes remains unknown
    - Deeper metagenomic sequencing of selected samples could provide more information on microbial and ecosystem functions.
- **Questions and Comments:**
    - BW: We also found links with DBHydro data to disease.
    - PG: I always wondered if we can "transplant" microbes to see what microbes from land grow and thrive in the reef waters. It could be done in a controlled lab setting. With the evidence that flow is related to SCTLD it may be worth to check which organisms survive, grow or dominate when seeded in the offshore waters.
        - JL: We can't grow the majority of microbes, they are our proxy (metagenomics) but we can grow some, so as long as they are the significant players in whatever were looking at…. I think to this day we still don't know what the pathogen of SCTLD is which is a big handicap in prevention and protection. Somehow I hope that Brains group will figure that out.
    - AM: The data looks like a perfect fir for K-means cluster analysis
        - Joe L: Yes, I will check that out
    - BW: They just dredged parts of the channel a few weeks ago
        - JL: Yes, we sampled after that dredge, so the samples will reflect what that disturbance might have done. Two sites were chosen as controls, the other sites were chosen to match up with shoaling in the plan. A downside to that is that most recent sampling efforts won't be a full representation of all the construction that occurred.
        - SW: post maintenance dredge sampling occurred on 03/08, 03/09, 03/16, 03/18, and 03/19
    - JS: Any plans to sample the sediments that will be uncovered when the channel is deepened?
        - JL: That's up to Shelby. I think it would be interesting to see what is n deeper sediments. Shouldn't we use cores to do this properly (e.g. avoid spurious sampling, etc.?)
    - PD: Any thought of including viruses in your surveys?
        - JL: We would need to do metagenomics to get the virus because of a lack of universal primers.
        - EP: Tom Walczak at UF looked for virus in some samples, I am not sure how exactly, but said he did not find anything significant. Need to contact him.
    - Xaymara Serrano: Shelby- regarding your comment about the O&M dredging schedule: Clamshell dredging started in 11/24/2020 and ended on 1/8/2021 whereas Hopper dredging (and beach placement) started on 2/11/2021 and ended on 3/5/2021.

St. Lucie Inlet freshwater impacts assessment on offshore reefs – *John Ramsey (Applied Coastal)*

- **Project Rationale:** An ongoing project is investigating salinities within the lagoon and estuary as it relates to oysters and seagrasses, but does not look at offshore areas. We are aware of the blackwater we see offshore, so this project looks at available data (NOAA and DEP monthly data on the reef, county continuous datasets) to determine whether these issues are critical.
- **Methods:** 12 stations where monthly salinity samples were collected beginning in 2016, with special focus on several "high flow" events in 2017 and 2018.
- **Monthly measurements:**
    - There is high variability in freshwater inflow based on rainfall from 2016-2020
    - 1 mile away from inlet:
        - There is a high inflow event in the Fall 2017 and Spring 2018
        - When there are freshwater discharges, the salinity drops dramatically, and can stabilize at levels as low as 24 ppt for several months. This extensive exposure to low salinity water can be detrimental to corals.
    - 3 miles away from inlet:
        - The same high inflow event of Fall 2017 is evident in the data, salinity drops below 25 ppt for several months
    - 6 miles away from inlet:
- **Influence of Lake Okeechobee:**
    - The watershed itself contributes a lot of freshwater to the system. When you have a freshwater inflow event, it hits the watershed first and then the lake is more of a storage reservoir that later is released and provides freshwater to the system over a long period of time, extending the duration of the impact. This is consistent for all freshwater inflow events- the lake is not the only cause of impacts, but it does contribute to and exacerbate the impacts.
- **Continuous Measurements:**
    - One of the short comings of monthly measurements is that they don't provide a true time series because they are collected at random tide cycles and are limited by not tracking high flow events in high detail. In the continuous measurement, a salinity meter was installed at sites to continuously measure salinity from September to November. There was an extreme salinity drop at one station below 10 ppt for a large inflow event.
- Salinity and freshwater inflow data can be utilized to simulate the full range of potential conditions in a **hydrodynamic model** and show locations of freshwater impact.
- **Freshwater impacts on offshore reefs:**
    - Data indicates a direct link between freshwater discharge and reduction in offshore salinity that is damaging to coral
    - Releases form Lake Okeechobee exacerbate and prolong damaging conditions within the estuary and offshore waters
    - Ongoing efforts are aimed at developing predictive tools that quantify impacts of freshwater releases on corals
- **Future data collection efforts:**
    - Continuous bottom salinity measurements at two locations along the reef tract
    - More detailed efforts to assess influence of freshwater inflow on estuarine and nearshore water quality
- **Questions/ Comments:**
    - PD: How do you think the discharge would differ if there were no development
        - JR: The amount of discharge would drop by at least 50% if the system was natural.
    - BW: Wasn't there a bigger freshwater aquifer?
        - The aquifer flows out the west coast, but that's going back a long way from the lake to the watershed- the watershed is about 2/3 of that flow, the lake is 1/3 of that flow. Its more the way the discharge comes out that makes it as destructive as it is.

- JV: To complement John and Martin County's efforts, we are planning to conduct some salinity threshold experiments. If any of you have unpublished data on FL coral salinity thresholds, we'd be most grateful if you can share

Understanding the occurrence and distribution of emerging pollutants and endocrine disruptors in sensitive coastal south Florida ecosystems – *Brian Ng (FIU)*

- **Purpose of the study:** To (1) develop a fast targeted screening tool for the evaluation of the quality of surface waters with respect to emerging pollutants of concern and endocrine disrupting compounds (EDCs) along the S. Florida coastal waters, (2) determine how these EDCs are distributed and the risk they pose to the aquatic environment, and (3) assess water quality through tracers and coliform/ E. coli.
- **What are endocrine disruptors?**
  - Chemicals that may interfere with the body's endocrine system and produce adverse developmental, reproductive, neurological, and immune effects in both humans and wildlife. EDCs can be both natural or man-made.
  - The body's normal endocrine functioning involves very small changes in hormone levels ◊ these small changes can cause significant developmental and biological effects.
  - EDCs can be found in a variety of materials and products (food, cosmetics, toys, etc.). Organisms are usually exposed to ECDs through diet, skin contact, or water.
- **Selected ECDs for surface water analysis:**
  - Hormones: Estrone (E1) β- estradiol (E2) 17α-ethynyl estradiol (EE2) Estriol (E3) Equilin
  - Pharmaceuticals & PCPs: Triclosan DEET Diclofenac Carbamazepine
  - Wastewater tracers: Caffeine Sucralose
- **Sample Locations:**
  - Biscayne Bay (2017-2019), Key West and Dry Tortugas (2018), and Tampa Bay (2016).
- **Screening method**: Targeted screening method using SPE-HPLC-HRMS requires minimal sample prep and is able to detect compounds at low concentrations.
- **Detection frequency of compounds:**
  - Caffeine and sucralose were detected 95% of the time
  - DEET was detected in 100% of the samples 100% of the time
  - All hormones were in 75% of the samples, though Diclofenac and Triclosan were present in very low abundance (it is possible that the amount in the water may be bound to particulates in the environment)
- **Distribution of Splenda in Biscayne bay**
  - Caffeine is often used as a tracer for human fecal contamination, but it can be metabolized and degrade in the environment. Splenda is not removed from the environment, and may be a better indicator and tracer.
  - The average concentration of Splenda in Biscayne bay was above 56 ng/L, which is a threshold linked with negative water quality and high nutrients.
  - Roughly 1600 samples have been analyzed for sucralose, and 24% had sucralose either not present or below our limit.
  - Samples in the 90^{th} centile were dominated by treated wastewater
  - Caffeine was the majority of detected tracers (Average sucralose concentration > 56 ng L-1, Average caffeine concentration < 400 ng L-1)
- **Spatial distribution of hormones across Florida environments**
  - Based on contaminant distribution an increased tendency of higher estrogenic activity is observed in the following order: Dry Tortugas < Key West < Miami < Tampa
  - This may be due to sewage spills/ wastewater inclusion in the highly-urbanized bay area, compared to the DRTG, which is pristine
- **Hazard Quotient:**
  - The HQ is used to evaluate the ecological risk of typical estrogenic endocrine disrupting compounds to adversely affect organisms, in this case, aquatic organisms. An HQ above one is considered a risk to aquatic organisms.
  - The majority of sites had an HQ above 1, indicating that there may be endocrine disrupting effects and may pose a substantial risk to organisms.
- **Coliforms as an indicator of potential estrogenic activity?**

    - These are commercially available plates that detect E.coli or coliforms in water samples. Coliforms and E.coli are correlated with the other target compounds, indicating that wastewater treatments or E.coli kits can be used to estimate the levels of ECDs.
- **Summary:**
    - EDCs are ubiquitous in Florida ecosystems and have been found to be of concern.
    - Sucralose and caffeine can be used to track wastewater movement with sucralose concentrations above 56 ng L−1 associated to other negative water quality parameters and caffeine concentrations above 400 ng L−1 are correlated to human fecal contamination.
    - Strong correlation between the tracers (sucralose and caffeine) and the studied hormones and E. coli ◊ less expensive.
    - Contamination increases northwards from Dry Tortugas to Tampa.
    - Further studies are still needed to better understand the potential impact of these compounds and risks to the aquatic ecosystem
- **Questions/ Comments:**
    - BW: Are there any plans to look at antibiotics?
        - BN: Not at this moment, but the methods can be modified to accommodate more compounds. Antibiotics can be looked at in the future.
    - KG: When will the article/ report be available for distribution?
        - BN: We recently published this work with more information: https://www.sciencedirect.com/science/article/abs/pii/S004896972037251X
    - PG: There are so many antibiotics and the chemistry is so diverse that we come up empty handed with them. This will be easier to assess larger areas and then can dig deeper if we need to.
    - LE: We are also seeing similar results in detections of sucralose and carbamazepine in Biscayne Bay.
        - BN: I'm glad to hear that the results are correlating to each other. Always a good sign.
    - KK: It would be great to determine the levels offshore, too!
    - LE: We have just started sampling up the Miami River and in the Rickenbacker Basin to help with understanding the potential distributions out of government cut.

Public Comment:

Stephanie and Dan Clark (Cry of the Water):
Monitoring, as far as gaps in monitoring, we continue to fail to capture major events such as green water events and algae blooms. The results of the monitoring that is being done needs to be put out in a timely manner. Nicole said we are still comprehending last year's data; it well be available soon. When was this data collected? This is important information that the TAC should be able to review and discuss at this meeting.

We agree with Phil Dustan that someone in the aquarium trade needs to be added as a member of the TAC. They would bring a great deal of experience and knowledge to the discussion. Perhaps, they would bring some new idea and shine a new light on raising corals.

The issue of hogfish came up yesterday. Divers were spearing hogfish, this is true.
However, we were told that lobster fishermen can sell hogfish out of there traps. We believe this is true but not sure of the numbers they can keep or sell. Per boat or per trap. But it is certainly a factor. Maybe someone from FWC can get us an answer on this.

After today's presentations we are glad to see some great projects coming along.

We must address what is killing our reefs in the first place, not just think we can restore our way out of it.