

Southeast Florida Coral Reef Initiative Technical Advisory Committee
Agenda for June 23-24, 2020
Adobe Connect Webinar

Attendance:

- **TAC Members:** Erik Ault, Ken Banks, Don Berhinger, Dick Dodge, Phil Dustan, Piero Gardinali, Dave Gilliam, Kurtis Gregg, Dale Griffin, Judy Lang, Jose Lopez, Arthur Mariano, Valerie Paul, Esther Peters, Stephanie Schopmeyer, Manoj Shivlani, Jack Stamates, Josh Voss, Brian Walker, Jay Grove
- **CRCP Staff:** Joanna Walczak, Jaime Monty, Kristi Kerrigan, Allie Shatters, Michelle Gaulty, Shelby Wedelich
- **Other Presenters:** Dave Whitall (NOAA), Ben Ralys (DEAR), Laura Eldredge (BBAP), Kai Lorenzo (UF), Jennifer Stein (FWC), Maurizio Martinelli (SeaGrant), Erinn Muller (Mote), Murphy McDonald (NSU), Karen Bohnsack (NOAA)
- **Public Attendees:** Wendy Wood-Derrer (NSU), Giancarlo Chaparro (NSU), Jamie Hamilton (Surfrider), Pepper Uchino (FSBPA), Alastair Harborne (FIU), Amanda Kahn (SFWMD), April Price (MIA Treasure Coast), Crystal Anderson, Daniel Fahy (NSU), David Vance (FOFR), Derek Cox (FWC), Gary Jennings (ASA), Ileana Suarez, Jeff Beal (FWC), Jena McNEal, Joana Figueiredo (NSU), Kathy Fitzpatrick (Martin County BOCC), Kirk Dotson (FOFR), Kirk Kilfoyle (Broward County), Maurice Pierre, Melissa Sathe (FOFR,SEFCRI), Santiago Acevedo, Sara Thanner (DERM), Steve Blackburn (EPA), Susana Hervas (UF), Tori Barker (coral fellow), Wilson Mendoza (Broward County), Xaymara Serrano, Chris Bergh, Kellie Ralston (ASA), Nicole Hayes (NSU), Nick Jones (NSU), Rob Ruzicka

DAY 1, June 23, 2020
12:30 – 5:00 pm

- Welcome to the newest member of the TAC: Jay Grove (lead of NCRMP, NOAA fisheries, Miami), filling the Fisheries Management seat.

Session I: Introduction

1. **Covid-19 updates** – *Jamie Monty (DEP CRCP)*

- Negative impacts of COVID-19 on FDEP CRCP
 - Travel ban for staff and contractors, shipping delays, field work delays, SE FL boat ramps closed, university laboratories closed (large impact on disease research, though water quality labs are back open), and funding concerns (project extensions for this fiscal year where possible, and an unknown state budget for the next fiscal year, including a hiring freeze with two open positions)
- Potential positives:
 - Potential for environmental recovery (fewer divers, boaters, and anchoring, though there has been no official assessment). All staff has been teleworking since mid-March. A shift from in-person meetings to online has expanded reach (1,711 people attended the Coral Reef Webinar week ID Presentations- more than all our in-person trainings combined)

2. **State-wide focus** – *Joanna Walczak (RCP SE Region)*

- The DeSantis administration has considered water quality to be a priority. They created this website (below) for all state water quality information, with the goal to link the tools of the department to the work going on offshore. Resources for this topic are growing.
 - Protectingfloridatogether.gov
- **Priorities:**
 - 1. Ensure that **water quality projects continue and expand**
 - 2. **Pair water quality with data** from benthic monitoring sites
 - 3. Through a triennial review, want to better understand what **coral reef specific criterion** can be proposed and is feasible, particularly for coastal construction projects (starting with turbidity)
 - The EPA, through the coral reef task force, has offered assistance to the DEP to create an action plan to move things forward. The criteria that they have given is based on non-unique ecosystems, and coral reefs have been overlooked in setting standards. Turbidity has been identified as a starting point, and the questions is what next: what is a standard that's protective?
 - 4. **Ocean Outfall closures:**
 - We are entering the official timeline for the outfall closures. A bill was signed into law stating that in 2020-2025, each county that has ocean outfalls need to be strategically working to minimize their use to the point that they are only using them for emergency overfills.
 - 5. **Wastewater and stormwater BMPs**
 - Closing outfalls will require somewhere else for wastewater, and need to prioritize treatment plans near ecologically sensitive locations
 - 6. **Florida Keys Shallow Injection Wells Study**
 - The shallow injection wells may be coming up through the "swiss cheese" geology and into inshore waters, we are trying to test that perception. If it is true, will need recommendations to address that
 - Have identified the **Government Cut Inlet Contributing Area (ICA) as a priority coral reef watershed** for SE Florida (along with the Boynton ICA)
 - Want to understand the contribution of urban environment to the watershed at Government Cut. There is a perception that there is agriculture and freshwater additions, we want to pair what we know with the gradient of contributors across the whole area
- **Funding:**
 - At the time of the TAC meeting the state budget had not been signed. Because of the COVID-19 response, the budget that was approved by legislature will have significant changes to balance state spending. If the coral reef-related funding remains intact, it will be a large budget: \$5 million for the coral disease outbreak (an ongoing pot of money that has supported the response) and \$10 million for coral reef protection and restoration. (That is \$15 million for coral related work, for context, the national budget for coral reefs is ~\$26 million)

3. Florida's Coral Reef Campaign – Michelle Gaulty (DEP CRCP)

- Florida's Coral Reef Campaign was launched in January, when it was announced by DeSantis at Frost Museum
 - Want to refer to the reef as "Florida's Coral Reef" instead of FRT, to promote a feeling of ownership
- Super Bowl LIVE Exhibit
 - Total of 40 volunteers including DEP staff, reached nearly 3000 people
- Launched FloridasCoralReef.org
 - Includes ways to get involved, work from partners, newsletters, and more updated info on our reef
 - Created new PSAs in English and Spanish directing to that website
- Outreach done since last meeting:
 - Miami Shores Green Day, Broward County OceanFest, SOS Conservation/ Winterfest, Super Bowl LIVE, Sierra Club Broward 50th Anniversary Earth Day, Gumbo Limbo Sea Turtle Day, Coral Reef Webinar Week
- Outcomes from the SCTLD Workshop:
 - Added some representatives to the core team: CRF, Force Blue, AZA

Session II: Northern Florida Reef Tract Nutrient Water Quality Analysis

1. Data analysis Sept 2016 – Dec 2019 – Dave Whitall (NOAA)

- These results were published last year in NOAAs technical memorandum:
 - NOAA Technical Memorandum published in 2019 (NCCOS Tech Memo #271)
 - <https://repository.library.noaa.gov/view/noaa/22999>
 - Raw data can be made available
- Today's presentation is focused on nutrients and sedimentation- these are only some components of water quality (there are others, such as heavy metals, pesticides, etc., that are also important and are not addressed here), and that water quality in general is only one of many threats being faced by coral reefs.
- This work was done by a large collected of federal, county, and academic partners
- **Study Region:**
 - Spans the **109 linear miles of reef between Biscayne Bay and St. Lucie Estuary**. Nine inlets bring freshwater into the coastal zone in this area, the watersheds associated with these inlets are referred to as "Inlet Contributing Areas" (ICAs)
 - In addition to these 9 inlets, another source of nutrient inputs are six offshore wastewater outfalls which discharge partially treated sewage
- **Project History:**
 - In 2015-2016, NOAA and DEP identified data gaps and what was needed for assessing Florida water quality. Sampling for the SEFCRI Water Quality Project began in Government Cut and St. Lucie in Sept 2016 and has now expanded to include all nine ICAs as of 2017. NOAAs day-to-day involvement ended in December 2018. Field sampling continues, led by DEP. Over 2000 samples are collected per year which generate over 15,000 data points per year
- **Sampling Design:**
 - 115 sites across 9 ICAs are sampled monthly
 - Three site types: Reef (random, surface and bottom samples taken), Inlet (targeted, surface and bottom samples taken), and Outfall (targeted, only surface samples taken "at the boil" of visible effluent at the surface to ensure that the plume is captured)
 - Analytes: Nitrate/ nitrite, ammonium, urea, total nitrogen, TKN, orthophosphate, total phosphorus, silicate, TSS, turbidity
- **Results:**
 - 1. There is a **detectable influence from inlets and outfalls**
 - High TSS values around the inlets clearly shows freshwater inputs and a relationship between inlets and sediments. There are sometimes high values on reef sites, but this might also be due to high wind events that resuspend sediments
 - High silica values around inlets indicate large freshwater inputs (the primary source of silica is crustal erosion)
 - There is a significant difference in mean turbidity between site types and is highest at the inlet sites, indicating that freshwater inflow at these areas is high
 - Ammonium (Bakers Haulover NH₄⁺) is highest at outfall sites. (The primary form of nitrogen in wastewater is organic (urea), which is converted to ammonium and then oxidized to nitrate, but since the pipe is anoxic, the process is incomplete, so all of the nitrogen coming out is ammonium and urea.
 - 2. There are **spatial differences between the ICAs** which could be attributed to differences in land use (manageable) or physical oceanographic (not manageable) factors
 - The land use associated with the 9 ICAs have significant differences between the percent urban vs. the percent agricultural
 - Mean Total TSS by ICA: significant differences between many of the ICAs, highest TSS at Boynton inlet
 - Silica: much higher in St. Lucie due to the big river inflow

- Mean Orthophosphate: is also associated with freshwater flow, tracks with Silica as highest out of St. Lucie
 - Mean Nitrate: variable between ICAs
 - Relationship between land use and water quality by ICA:
 - there is a pattern between total land area vs silica (which is used as a proxy for freshwater). This is driven by St Lucie.
 - There is an apparent pattern in urban land use and ammonium, this is driven mostly by Government Cut
 - 3. This data can be used to evaluate the water quality status at individual sites as it relates to previously proposed water quality thresholds
 - The EPA and DEP are working on developing criteria that relates to coral reefs. Right now, there is no criterion that is specific to corals. We need to look for what researchers have proposed to compare our data to, while understanding that none of these are “magic” numbers, getting values above/below them may not be meaningful.
 - Have chosen to compare data to Lapointe 1997, which includes values specific to S. Florida for this work.
 - DIN threshold = 1 uM (0.014 mg N/L)
 - SRP threshold = 0.1 uM (0.0095 mg P/L)
 - Note: the threshold values are only applicable to the reef bottom water data (where the coral lives)
 - Results of comparison:
 - For most reef sites, phosphorus levels do not exceed published threshold values above which harm to corals would be expected. The exception to this is near Miami and near St. Lucie, where the reef sites do exceed the threshold
 - The mean values of DIN at every site exceed the published threshold values above which we might expect harm to corals
 - 4. There are large swings (order of magnitude difference in concentration) at reef sites that can have acute effects; using existing data (such as DB Hydro) can help us understand what is driving these patterns
 - Ex: a spike of ammonium at the BOC reef (BOC74) in November 2017 that might be harmful to corals illustrates the importance of sampling monthly to capture events like this
 - How this relates to DB Hydro Flow Sites:
 - All flow data for the sampling period was binned as either “high flow” (> one SD above mean) or “base flow” (all others). For a water quality sampling date, if “high flow” of relevant DB Hydro sites was observed within 3 days prior to sampling, that time point was binned as “high flow.” This allowed for statistical comparison between periods of high vs base flow.
 - Comparison of high and base flows:
 - For a number of analytes in a number of ICAs (total nitrogen, total phosphorus), there is a significant, positive relationship between flow regime and observed concentration (i.e. at high flow, higher concentrations are observed). This is consistent with the increased mass flux of nutrients/sediments during high flow events resulting in higher water column concentrations.
 - However, for a number of analytes in a number of ICAs (nitrate), there is a significant, negative relationship between flow regime and observed concentration (i.e. at high flow, lower concentrations are observed). This probably reflects dilution effects.
 - 5. Comparing the WQ data with biological datasets can shed light on the influence of WQ on reef health
 - This is a rich dataset that can also be used for:
 - Comparison with relevant disease data to look for correlations
 - Development of SEFCRI specific water quality thresholds
 - Detect change over time as management of nutrient pollution changes (for example, what will chemistry look like when outfalls are decommissioned in 2025?)
- **Future Directions:**

- Need to consider analytical detection limits (limits that are low might be high for corals) and choosing labs that are able to work with this
- This program can adapt with changing questions, but should be mindful that any changes to protocol can have implications for any temporal analysis
- DEP-led sampling will continue at all 9 ICAs. We should consider using this effort as a logistical framework/backbone when proposing new water quality work in the region (e.g. sunscreen related compounds, sucralose)
- **Questions:**
 - Joana Figueiredo [JF]: Can Dave please show the Ammonia levels? They seemed levels which are toxic for corals. It's not just the fact that promotes growth of algae, ammonia is directly toxic for corals! In aquaria we aim for 0, absolute maximum 0.01
 - DW: Good point, not just ammonium and other nutrients have direct effects on corals, they effect zooxanthellae productivity and spawning, etc., so absolutely the nutrient themselves can be a problem. The algae point was to make the point that the Lapointe study was talking about that. But good point that there are direct effects.
 - Phil Dustan [PD]: If the reef were at or just below the threshold there would be big trouble because the DIN would be too high. Brian's threshold is a maximum value, not the tolerable, or optimal concentration
 - DW: Good point, hopefully I made the point that the values we are seeing for nitrogen are high, my point of picking Brian's threshold is not that that's the value we should be shooting for, but to have something to compare our data to, and we agree that that threshold is a problem
 - Piero Gardinali [PG]: How do the DIN numbers compare with other coastal systems in the US? If all values are high, then the "threshold" does not mean a lot. What are the values of DIN from upwelling waters? Any relationships between DIN and Silica?
 - DW: I didn't directly compare the nutrient values in Florida with other places in the country. A good comparison would be to other reef systems in the country, I have that data. I don't know if it's appropriate to compare to all waters. Like comparing estuary to coral reef systems, etc. in terms of DIN and silica we have a correlation table in the report that looks at all the relationships between analytes. If you want to look up the report you can see that table, I can email the answer when I get off here.
 - PD: be nice to see molar concentrations instead of mass/liter
 - DW: That may be a matter of preference, anyone is welcome to do that conversion with access to the data.
 - Jack Stamates [JS]: recall that the outfalls will fade out as wells are done
 - Brian Walker [BW]: curious about the DB hydro data. Do you guys have those data, and have you analyzed them in other ways, or just the ways you've shown here? It might be possible to do so me statistical modelling from these as well
 - DW: Yes- its simple, we didn't mess around with too many methods and did not do a lot of datamining. There are more elegant modelling ways to approach that, all that data is publicly available, and I can send that, we can discuss how to get the most out of that dataset as we can.

2. Discussion and talking points one-pager – Alycia Shatters (DEP CRCP)

- The purpose of this discussion is to gather feedback from the group on a one-pager hand-out that will include the main take-away messages of the above presentation on the water quality results. There are two documents: one is a detailed account for technical partners, and the second will be a high-level overview for managers and stakeholders. Dave has drafted an initial set of talking points for the technical one-pager, from this we will choose what to include in the higher-level document. We will use this draft as a starting point, please provide edits and input on the themes in the following talking points:
- **1. While nutrient criteria protective of Florida coral reefs do not yet exist, when compared to previously published ecologically based threshold values, all sites exceed the thresholds for nitrogen and a handful of sites exceed the threshold for phosphorous**

- PD: Looks like the threshold values will be proposed as the target values. I'd suggest we adopt much lower values that speak to an environment that supports coral reefs, not the coral reef community remnants we have today.
- PG: We need to be more specific on that statement. The values are compared to ONE value only. Also, we need specifics on what values, the max, min, averages, medians etc. it's a lot more granular than the statement.
 - DW: we have all that information and can include it, but from a communications perspective, 1) are we writing a policy recommendation (that is not what I can do at NOAA, but you can) and 2) how much information should we include to make it useful to the audience? I agree that there is more information and more details. What we would like to do is hand someone one piece of paper to summarize our report, that's the way I tried to write this.
 - Alycia Shatters [AS]: we want to have a document that has a communications document that has this big picture, and then there is also a report for people to get more specifics. That doesn't mean that more specific information can't be included, it is just what level do we want to get into?
- JS: comparison with recent lab studies for nutrient thresholds would be good
 - DW: Jack, do you any specific studies in mind? If so, can you share refs?
 - JS: I'll look. I'm thinking of studies at Nova.
- Maurice Pierre [MP]: Do we know what the effect of higher nutrient values are on coral systems? Do they affect metabolic processes/growth, or is it that they lead to increase in algae or conditions that make it unfavorable for coral growth and development?
 - DW: is that a question for the group? Yes. Or is that a comment that we should be including this in the document
 - Esther Peters [EP]: Do affect metabolic processes and coral growth, affect zooxanthellae, increase susceptibility to infectious agents
- PD: we are all talking like reductionist scientists when we also know, as ecologists, that most reefs thrive in super low nutrient waters. The data that has been presented today is a study in time but only that. The reef tract is highly degraded and needs conditions to return to optimal.
- Dale Griffon [DG]: you identified the inlets and outfalls as primary sources, have you thought about addressing atmospheric sources?
 - DW: Good question, I feel like I planted that question. I did my PhD on atmospheric nitrogen deposition, we did not compare that as part of this study, there are NADP sites in the coastal region of Florida, I don't know Dale if you've done that exercise before to look at the relative flux of directly deposited atmospheric deposition vs what's happening in the inlets. If its deposited on land it is captured in the inlet signal. We did not address this in the report, but we could do that
 - DG: there are a number of traps in that region. So far offshore that's a significant area. We did the rough calculations for annual deposition and the input was significant
 - DW: I would love to see the numbers. That's an important thing to consider that you do get significant emissions from power plants and emissions. This was looking more at ambient concentrations and how to explain them- how do we tease out what's from fossil fuel combustion, from human waste and agriculture, throughout the scope of this study.
 - DG: Gene Shinn was always curious about contribution from sugar cane burning.
- **2. Data clearly shoes the influence of the inlets on the water quality in the coral reef ecosystem, especially for nitrate. This bears out in terms of the concentration data, but also in terms of how concentration data relates to flows in the watershed drainage areas**
 - PG: On the second item how strong is the evidence of the flow lag of the 3 days to make it such a strong conclusion. We use the word "suggest". Are we willing to infer that 3 days after water is released from structure X we impact reef Y? I understand this is a policy statement but generalizing to that extent may be overreaching. Not trying to be difficult, this is great work. Just keeping it within the box of a defensible objective argument.
 - DW: If we have reason to believe that 3 days is not a good lag time, if we have data for how long it takes from each flow station, we can go back and redo all those analyses, I don't mind that. Using 3 days we do see patterns, so I don't think it's out of the realm of possibilities. So, if anyone has hydro information to correct this, we can do that. But I think that bullet to, as Dale

- pointed out, there are other studies that show this, so I don't think that were out too far on a limb that the inlets are affecting water quality offshore.
- Amanda Kahn [AK]: Regarding flow lag and reaching reef, suggest looking at published min/max averaged flushing times of the estuary/inlets
 - DG: Dave comments on complimentary data, if you're looking for data on the influence of inlets and outfalls the NOAA microbiology group has info on that and this study [the Northern Florida Reef Tract Nutrient Water Quality Analysis – Dave Whittall] clearly shows the inlets and outfall are the primary sources in the region. Definitely complimentary to Dave's dataset
 - DW: there are other datasets like the one that Dale just mentioned, I wanted to do something that we could apply to the whole region and a lot of those studies are focused on a few inlets, so I wanted to be as uniform as possible across the region. There are other studies that have shown the same thing.
 - DG: I agree, the microbiology studies that I'm thinking of are definitely more limited in scope than your study.
 - Kurtis Gregg [KG]: I think the point that this item makes is that what we do has to occur landward of the inlets
 - DW: I don't disagree with that, as we write this let's be sure to be cautious about how we walk the line between policy recommendations and not policy recommendations. It's tricky for NOAA. We might be able to write this in such a way...
 - KG: I agree, but so much effort is in land and on the watersheds and doesn't connect to the coral reef, and this dataset helps us do that
 - DW: Agree, maybe you can help us write that in a good way
 - PD: Consider that the biological metrics of today are not the biological metrics of a vibrant reef. maybe we can never go back to the "intact" system but at least realize that nutrients have probably been high (above thresholds) for some time and there is a need to reduce them to approach values closer to optimal values.
 - PG: We already covered that question and it was answered.
- **4. Concentration values for urea and ammonium are highest around the wastewater outfalls, confirming the importance of these sources to the nutrient budget of the system**
 - AK: suggest replacing word "importance" with "impact" or "contribution"
 - PD: the word importance is vague - how about something like overloading or fertilizing?
 - **5. Although correlation does not equal causation, water chemistry data are significantly correlated with a variety of biological metrics. While WQ is certainly a contributor to coral reef health, it is likely that a variety of factors (temperature, disease, overfishing of key species) play roles in coral reef decline**
 - Judith Lang [JL]: I would add coastal shoreline alteration as a result of development--anything that adds additional sediment or destroys existing reef and related ecosystem structure--ports, beachside buildings, channel dredging, landfills of nearshore, etc. etc.
 - DG: the atmosphere and climate change might also be contributing factors and population growth
 - JL: Thanks Dale. We tend to think of LBSOP as being restricted to what comes directly off the land, but really it should also mean atmospheric inputs coming from the land, too...ignoring that allows folks in the Chesapeake to talk about nutrient reductions without mentioning that the proportionately lower percentages coming directly from land means that the proportion from the atmosphere as it increases is overlooked
 - KG: Water quality is a contributor to coral reef "condition". I would avoid the term "health", which usually applies to individual organisms.
 - PD: "vitality" is a more appropriate word for an ecosystem than health
 - **6. This assessment also highlights the power of state/ federal partnerships. This work would not have started without an influx of resources and expertise from NOAA and could not have been expanded or continued without the commitment of FDEP.**
 - JL: Might be better to switch this to an acknowledgment for NOAA and state for their contributions to its development.
 - JL: yeah--Thanks to NOAA, FDEP, would sound better to me at least

Session III: Future of Water Quality Assessment

1. Overview of available water quality tools – Ben Ralys (DEP DEAR)

- **Florida WQ Requirements:**
 - Section 303(d) of the Federal CWA
 - Surface Water Quality Standards 62-302, F.A.C.
 - Florida Watershed Restoration Act (Chapter 403.067, Florida Statutes), established in 1999
 - Impaired Waters Rule (IWR) 62-303, F.A.C.
- **Water Quality Restoration process:**
 - 1. Set water quality standards (numeric nutrient criteria)
 - 2. Monitor water quality (collect data)
 - 3. Assess water quality (evaluate attainment)
 - 4. Set restoration goals (determine TMDL)
 - 5. Establish restoration plans (develop strategies for projects/ activities)
 - 6. Implement restoration
- **Timeline:**
 - Assessing waters to determine if they're impaired: every 5 years
 - Develop the restoration goal/ targeted development (TMDL): 1-10 years
 - Develop projects/ activities to achieve TMDL (BMAP): 1-3 years
- Assessing waters to determine if they are impaired:
 - Water quality data uploaded to WIN/ IWR Database to create WBID (water body identification number) parameter assessment
 - Other sources of data: SBIO- FDEP Biological Database, External Biology, FDOH- Fish and Beach Advisories, DACS- SEAS Classification, USGS
- **TMDLs**
 - TMDLs are a restoration target: the maximum amount of a pollutant that can be introduced into a waterbody without causing exceedances of water quality standards. The goals are to determine the sources contributing to current loading and how much the load must be reduced to achieve the target
 - Significant technical work is needed, including waterbody-specific data collection and analysis
 - States adopt TMDLs that are approved by the EPA
 - Can change existing WQ nutrient criteria
- **BMAPs**
 - BMAPs are TMDLs that are being addressed, or areas that are being governed by a restoration plan to meet the TMDL and a process to assess progress towards achieving it, including a monitoring plan, project reporting, and follow-up meetings.
- There are two types of **alternative restoration plans**
 - 1. **Reasonable assurance plan (RAP)**
 - Assessment category 4, NOT placed on the 303-d list, replaces both a TMDL and a BMAP
 - 2. **Pollutant reduction plan**
 - Assessment category 4e, INCLUDED on the 303-d list, delays TMDL development
 - These are stakeholder-driven processes. Benefits include:
 - A faster path to restoration (one EPA review loop, no rulemaking process)
 - Allows stakeholders to control the path to restoration for their waterbody and avoid TMDL-related regulatory requirements
 - Acknowledges proactive efforts- stakeholders receive credit for pollutant reductions, benefits to downstream impaired waters
 - Combines many of the steps and enhancing public relations
- **Contacts:**
 - Ben Ralys, Environmental Consultant, Watershed Assessment Section
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- Moira Homann, Environmental Consultant, Division of Environmental Assessment and Restoration
 - (850) 245-8460
 - Moira.homann@floridadep.gov
- **Questions:**
 - KG: WIN is replacement for STORET?
 - BR: yes
 - PD: TMDL is awful in terms of its ecological significance- a better term might describe what is optimal, not maximum pollution level.
 - Jaime Monty [JM]: the first process where you outline the TMDL and BMAP are both defined in statute so there is no other possibility besides identifying a maximum daily load. But in the second process with the alternative plan, is that something that the group of stakeholders through the RAP could define the quantities that they are looking for in the different chemical constituents that could cause pollution problems? Could they define it as an optimum instead of maximum?
 - BR: Yes. We're mandated by what the WQ standards are, but if it is deemed to be protective of corals then the standards need to be changed, then through the 4b plan there is a component where the standards can be changed.
 - Shelby Wedelich [SW]: do you have an example of an Alternative Restoration Plan within Florida?
 - AS: Shelby we will be talking about that next!
 - Karen Bohnsack [KB]: Shelby, there's one in FKNMS.
 - Laura Eldredge [LE]: Tampa Bay
 - BR: Yes, we have 5 RAPs in Florida: Florida Keys, Lake Seminole, Tampa Bay, Mosquito Lagoon, all are on the below website:
 - KK: <https://floridadep.gov/dear/alternative-restoration-plans>
 - LE: Well BBAP doesn't have one yet...
 - Wilson: How can one establish nutrients TMDL if there are no established water quality standards, particularly in SE Florida freshwater and estuarine waters?
 - BR: The standard would have to be developed after the impairment, so during the TMDL process, that's when the standard will be developed. I will check on that.
 - PG: Did you learn anything from the tracers yet?
 - BR: These are not indicative of the last year larger darker circles are indicative of higher human involvement. Tracing data, these are 6 of the 9 nutrients we're looking at, this yellow bar and the green are little river values, can see things for ammonia we were 10x the amount we want.
 - Piero Gardinali: I am interested to see if you did find Oxycodone.
 - BR: I'll have to look at it. There are 7 of our analytes that we haven't found any value, and I can't remember which those are. But everything else we are getting some sort of value above the MDL
 - Phil Dustan: or cocaine?

2. Biscayne Bay Aquatic Preserves assisting a Reasonable Assurance Plan process through research – Laura Eldridge (DEP BBAP)

- Data limitations often effect management decisions, and those decisions can be delayed due to those gaps. We are trying to assist in that process.
- The SEFCRI region has 41 aquatic preserves with a total of 2 million acres of protection.
- In 1974, the preserves in Biscayne Bay obtained a unique status with stricter regulations and restrictions for things such as permits, and turbidity.
- **Research projects:**
 - **North Bay Seagrass Die-Off**
 - There was a big die-off near the South basin in between Halover and Government Cut inlets
 - 5 step research project with benthic habitat assessments, stable isotope tissue analysis, sediment analysis, monthly water quality bottle grabs, and datasonde stations
 - Sampling started at 21 stations in May 2018
 - Analytes from the bottle grabs:

- Nutrients: Chlorophyll a, Organic Carbon, Ammonia-N, NO₂NO₃-N, Kjeldahl Nitrogen, Total-P, Total Suspended Solids
 - Sweeteners: Sucralose, Acesulfame
 - Pharmaceuticals: AMPA, Acetaminophen, Carbamazepine, Hydrocodone, Ibuprofen, Naproxen, Primidone
 - Herbicides/ Fungicides: Endothall, Glufosinate, Glyphosate, 2 4-D, Bentazon, Diuron, Fenuron, Fluridone, Imazapyr, Linuron, Pyraclostrobin, Triclopyr, Mandestrobin, MCPP
 - Insecticides: Imidacloprid, Acetamiprid, Afidopyropen, Benzofindifupyr, Clothianidin, Dinotefuran, Thimethoxam, Tolfenpyrad
- Datasondes:
 - Chlorophyll a, conductivity, nLF conductivity, depth, DO, pressure, salinity, special conductivity, total dissolved solids, turbidity, TSS, pH, temperature, vertical position
- **Southern Research Expansion**
 - Received \$275,000 in EPA funding for assisting WQ, focusing on the river and southern expansion. Interested in continuing the ideas of the watershed approach, connecting the waiko discharges to Biscayne Bay. Hoping to add flow data from the Miami River, and can also look into DB Hydro and water management districts. Want to identify the contributing LBSPs dilution vs. contribution effect.
 - All data is publicly available on DEP repositories (WIN, SEACAR, FloridaAPData.org)
 - Preemptively collecting data for a reasonable assurance plan with a focus on LBSP
 - Preference for RAP over TMDL- More data vs. “let’s create action”. There is also concern over funding and a positive response to hearing that RAP can make NNC levels stricter.
- **Questions:**
 - Jaimie Monty: For the reasonable assurance plan that you’re working on for the BBAP, do the areas overlap and match up perfectly? Is the area that was identified as impaired share the same borders as the preserve? I ask because we have such a large region within the ECA, for a RAP do we need to subdivide our region up? How does that look for you?
 - LE: You aren’t required to have a specific acreage or size of a bounded area for your RAP, you can break up an area into multiple smaller RAPs for different concerns and wants. Can be piecemealed, not limited in any way by that. You can have completely different types of goals and actions that you want out of a RAP.
 - BR: this could be the whole watershed or broken up how you see fit.
 - LE: Speaking more closely to the task goals you can look at the ICAs as their own separate RAPs, nutrient sources coming out of those inlets, can piece that up. You can start one and see how it goes, then continue, etc. a lot of openness to make it whatever you want it to be, which is a benefit.
 - MP: Is there any involvement with wastewater and storm water groups to determine areas of point source pollution?
 - LE: When you think of RAP you can get a group of stakeholders together, but you might not get to an end goal if you don’t pull in the people that are running the contributions. You need the people that are leading to the discharges or are controlling the infrastructure. For wastewater, you would want to pull in WASD or focus on fertilizers, private septic tanks and lateral line inspections, etc., so you can really go the public vs. private route. Need to make sure the agencies and people that are really responsible are involved and in agreement.

Session III Cont.: Future of Water Quality Assessment

3. Guided discussion on the water quality assessment project

- When we started, the goal was to characterize the current status of nutrients across the inlets, outfalls, and reef areas in the region. Now that we have years of data and analysis, we want to transition this goal to reducing LBSP in the region through management.
- **GOAL: reduction of LBSP in the ECA through management actions**
- **1. We just heard what data and analysis are available for our region, and about available tools (TMDL, BMAP, RAP...). Do any of these tools make sense to use with the data we have for the ECA? Why or why not?**
 - JM: it looks like we have 2 lines- TMDL BMAP process, agency led process that takes longer, or RAP, which is stakeholder led and takes less time. We would all probably like to take the shorter path, but that would be stakeholder led.
 - PD: are you interested in regulatory tools or actions that can be done?
 - JM: both. I think both of these regulatory tools lead to the actions that would reduce certain parameters for LBSP. One process takes longer the other shorter, the other big difference is who leads, but whichever we chose it will be a regulatory process that has projects that seem applicable. Wastewater treatment agency, agriculture agencies, depending on what we focus on. Whichever we chose does want those reduction actions for the overall goal
 - EP: Would the SEFCRI Teams be involved in the "stakeholder led" approach
 - JM: it seems to me a logical place to start is SEFCRI TAC leading a RAP. So that seems like the best path forward, but we don't want to sign you up for something you're not planning. Then we can come up with follow up steps
 - DG: with the outfalls closing in the near term the longer approach may be the better path
 - PD: And what is the goal of the reduction action? To keep what is there alive or to see the reef regrow - if possible?
 - JM: potentially both, the goal of any action to be taken would depend on who sets it. In TMDL/ BMAP it would be an agency set goal, in the other the stakeholders would set the goal. In either case whatever we decide on would at minimum keep what we have, potentially it could be coupled with coral reef restoration work and regrowth would be encouraged. But those might be 2 plans working simultaneously
 - KG: back to the plan for the Boynton ICA, is to figure out what is happening in the ocean and source track it to what land uses they're coming from. The data that has been presented to the TAC this afternoon is a huge investment and step forward from where we were a few years ago, but I'm wondering if we be looking at the involvement of other watershed planners for this action in addition to DEAR?
 - JM: I'm not sure I follow you. In my mind DEAR oversees and continues to work on the regulatory side of the house, identifying impaired WBIDS and going through the – are you asking in addition to that work they need external help to where we have to go?
 - KG: to clarify the Boynton plan was developed with members of (inaudible) and I was wondering if DEAR has the in-house ability and capacity to do that role and compile the various datasets and use it to assess LBSP and what the actions would be? Or is that capacity we need to get from somewhere else?
 - JM: is Ben still on? If you're still here, does that fall into the assessments that DEAR typically does? Or is this broader scale than what DEAR is typically involved in
 - BR: I think that might be broader scope than what we normally do, but I can check on that and get back to the group
 - JM: thank you Kurtis, I appreciate you thinking about logistics and the help that we might need regardless of which path we choose to go down
 - PD: We know that LBSP contribute to reef degradation. We know this from the biomarker studies we did in the 2005's. Now the water quality confirms it. South Florida is virtually all impervious surface from Lauderdale south so how does one go about thinking it can be changed without some serious reconstruction of the terrestrial environment?
 - JM: that's a good point, it might not be any of the actions we take, the actions will take a lot of time and partnerships and are not necessarily going to be easy to implement, S Florida is nearly completely built out. I can speak to the TMDL process, we would potentially pick one of the WBIDS and work backwards from there to do some additional water quality monitoring to identify sources. Pick up a parameter that we want to focus on and would ding the WBID with the highest amount of that parameters, and work with them to reduce that point source. Its an

intense process, it requires the people your working with who is contributing that pollutant to be on board and to make it worth their while (like reducing their bills, etc.) so it's a step wise process with all these different partners

- PD: this is simply basic watershed ecology that takes the infrasystem cycle into consideration. intrasystem cycle - maybe sea-level rise will be faster? pollutant tracing was the thrust of other tac's work in the 2005's and we pretty much found that the whole system was a pollution shed....
 - PG: We may have to apply the recycling concept to water. All waters. Reduce, Reuse, Recycle
 - DG: the short approach the long might be better with the fact that the outfalls are going to be closed with certain waivers and then there are county wide efforts to replace septic systems with sewer lines in the Keys and so forth and other legislation here in St. Petersburg like you can't buy fertilizer int eh summer here. So, there are things that can change over time and we might be able to pick up these changes over time in the long term over short. For reef health, short path is better. But for picking up changes and developing standards the longer approach might be the better one to take
 - PG: Without investing in functional shorelines and inland natural polishing systems and creating a functional, modern sewage system we will keep going the same route. Every plastic and fertilizer initiative usually gets challenged
 - KG: The difference from 2005ish is we now have watershed sand sub watersheds identified that can be assessed at finer scales than prior work was able to. The watershed management planning process also engages partners that have not previously been part of the coral reef conservation community
 - BR: Hi Kurtis, I would like to help answer your previous questions better. Would you mind emailing them to me at benjamin.ralys@FloridaDEP.gov
 - AK: Several regions also have improved hydrological models available since early 2000's, hopefully these latest models will be helpful in predictive capacity for water movement from the estuaries to at least the near offshore/inlet region as this moves forward
- **Are there any other ideas of how we can use the WQ data to reduce LBSP through management actions? Knowing that Boynton inlet and government cur ICAs have been identified as priority areas for LBSP reduction, is there a specific region we should focus our efforts in? Which parameters should LBSP reduction be focused on?**
 - EP: Any possibilities of working on the Broward LBSP reductions?
 - JM: I think everything is on the table at this point. Boynton and government curt have been identified as priority, but if TAC members identify other areas and recommendations of why to choose one over another that's the info were trying to get at here. Why focus on certain areas
 - DG: one the parameters, are we just talking chemical>
 - JM: if you feel we should reduce anything else well need some data to base those decisions on. What do you have in mind?
 - DG: using tracing to identify current wastewater sources coming from inland locations vs what might be coming off from precipitation, back to the issue of fertilization vs sewage. That's getting away from what we're talking about today, I was thinking more about it along the lines of microbiology. Runoff vs. subsurface movement
 - JL: I'm remember how Gene used to tell us that the groundwater (subsurface) water would mostly empty into the intracoastal waterway and be released via the inlets
 - DG: yeah that's what I'm talking about. Along with precipitation driven nutrients. So, if you're going to remediate, what are the percent contributions of each. Where can you get the best bang for your buck? We haven't really looked at that yet
 - PG: In order for us to make reductions we need to do apportioning first. We clearly need to reduce P, N TSS and DOC but without been able to chemically and biologically track sources it will be a challenge. There is no lobbying for septic tanks, so they always get blamed with very little data.
 - KG: Sediment tracing has been successfully done in Palm Beach. Sod farms in the L-8 basin are the source of organic silts accumulating at the S-155 structure
 - **What changes should be made to the current WQ assessment in order to meet the goals you described? (e.g. methods, logistics, parameters, sites, etc.)? It may be that nothing needs to be changed**
 - JM: in the ideal world we would have the funding to continue our WQ monitoring and have special projects to get to these projects like finding the largest contributor of a LBSP, but if we can't do things simultaneously, we might have to augment the existing way we've been doing it to look at a certain water

- body and chose TMDL process for that parameter. If you think that's necessary> What are some areas within the current project that we could reduce to balance out with the new projects to inform reductions
- **Brian Walker:** we are starting a process to investigate coral disease infections along our coast through time, we have 1.5 years data so we are compiling datasets together to look for co-variates that might be a problem. That will be a bit of a process, but it might help inform some of the project better in terms of one source over another or the whole system. and I think we wouldn't be able to do this without the data you've collected so far. Perhaps some of the data that has been collected could allow us to identify a minimum amount of information so we can pare down the effort to save somewhere else. But losing that database without the chance to compare it to other data is unfortunate
 - **JM:** there is no guarantee, right, the coffers might be overflowing this next year, if we don't have the pare things down, we are not intending to, but in case we do, we can plan a detailed analysis.
 - AK: Is DOC being measured at the sites?
 - AS: Amanda, DOC is not currently being measured at our sites
 - PG: DOC has proxies such as FDOM and CDOM. they are routinely measured in some sondes. It helps decoupling the biology and the chemistry signatures
 - MP: In critical canals (Little River, Mowry Canal, etc.) begin using autosamplers to figure out actual load entering the Bay and to further quantify frequency of discharges
 - KG: The new data we have needs to be assessed on a watershed and sub watershed basis, so we can see which parameters need to be prioritized for reduction. Using the new models Amanda mentioned could result in actionable information and potentially compelling outcomes
 - BW: I agree that the dataset that has been collected has a ton of information that hasn't been looked at and needs dedicated eyes to evaluate it spatially and temporally with the corals in mind. I don't know the difference between surface measurements and reef measurements have been looked at, but I'm sure that Dave Whitall can attest that they've only skimmed the surface
- **Are there any other questions/ goals that can be answered simultaneously?**
 - JM: we know we don't want this WQ analysis to be a report that just sits on the shelf, we want to use them to reduce LBSP. The way we do that is through one of these two processes. As we are going through the regulatory process, are there other goals we can address through this data? Other research we can do simultaneously to the regulatory process
 - DG: I noticed that pharmaceuticals were listed as one of the chemicals that was assessed by some group, is that right?
 - JM: not within the WQ we're performing, that I think is in BBAP adjacent to our region
 - DG: I'm curious if anybody in intercoastal environments have looked for affects as we did with the outfalls and antibiotic resistance. I'm wondering if there is a marker that we can use to measure whether river A or River B is worse. Something that could be done, addressing that issue of subsurface transport vs. fertilizers
 - JL: I'm wondering if any of the organic contaminants (pharmaceuticals, insecticides) that are turning up in the Biscayne-type analyses have known impacts on any of the metabolomics (sp?) being analyzed in corals at RSMAS /AOML as part of bleaching or SCTLTD research
 - DG: I remember an early study we did on the outfall and did a suite of pharma on the outfalls and were able to identify a few. So, getting inside the inlets and getting into the land to see if we can detect pharmaceuticals there. It could be an interesting source tracking tool. Of course, I am biased on my perspective of that
 - EP: Judy, we need to ask Nikki Traylor-Knowles and Andrew Baker about RSMAS research
 - JL: Esther, there's also Anderson Mayfield at AOML working on bleached corals at a site I think of Islamorada in the Keys
 - PG: As a point of reference Tampa Bay is loaded with Splenda while Biscayne Bay is not that bad. Canals are much higher than the bay itself. yes, we can use tracers as sourcing, we just have to be smart on which ones to use
 - AK: Splenda can be difficult to use in regions with high flushing rates and tidal mixing from what I understand from others who have worked with it in regional estuaries. Useful in canals, yes
 - KG: Piero-Acetaminophen? Short period of degradation in the environment...If you measure some, you are close to the source

- LE: acetaminophen - in FW pond has 1/2 life of 0.9 days, Sucralose (Splenda) is ubiquitous at this point - we found it at every site in BBAP
 - PG: Kurtis: almost never detected so is not useful enough. You need detections to assess trends
 - PG: Laura, yes is in tap water at 300 ppt too. But the concentration matters and is conservative with dilution
 - PG: Laura, your numbers in the BBAP should be in the order of 20 to 50 ppt
 - LE: we have found aceta. from Little River and Miami Beach - Indian Creek sources
- AK: Dave, based on the data you presented today, would it also be important to recognize that the different regions may have different primary issues, which may require slightly different approaches for detecting effects and affecting positive change
 - AS: Dave is off of the call, but we can reach out to him separately with specific questions
 - PG: The answer that we are all seeking for will come in the form of % Septic= Zinc+triethylphosphate+carbamazepine/Splenda + a conservative tracer of dilution. We are not there yet

DAY 2, June 24, 2020
12:30 – 5:00 pm

Session IV: Data Needs for Fisheries Management

1. **Final results from Phase I (Situation Analysis)– Kai Lorenzen (UF)**

- Fishing in the OFR Process:
 - Fishing stakeholders were included in the OFR process as part of a ‘wider community working group,’ but participation in OFR was difficult to sustain. OFR made recommendations for management (RMAs), but some were opposed by fishing interests at the state and federal levels and were not taken up by management agencies.
- Aims of the Situation Analysis:
 - 1. Identify fisheries stakeholders
 - 2. Characterize their experience and attitudes towards fisheries and conservation efforts
 - 3. Develop a stakeholder engagement plan
 - 4. Inform stakeholders of the plan and the results of the situation analysis.
- Situation analysis methods:
 - Based on extensive semi-structured interviews (45 total)
 - Reanalyzed perceptions and information from a previous survey (on goliath grouper, 2013)
- **Major outcome: fishing stakeholders perceive existence of two largely separate networks**
 - **“Angler” network:** all fishers, fishing charter, marine industries, FWC
 - **“Diver/ Environmentalist” network:** Divers, diver operators, E-NGOs, FDEP
 - The angler network perceive that the diver network was the driving force behind the OFR process and felt disempowered from the start.
 - Perceived impacts on the reef:
 - Fishing stakeholders perceive overfishing as a threat but also perceive other threats to be more important, such as WQ, habitat loss, coastal development, and invasive species, that are a higher priority for managers to address.
 - 2/3 of fishing stakeholders see fishing impacts to be important-very important
 - Divers saw fishing pressures as higher priority
 - All supported fishing regulations in principle, but views for spatial management were complex and conflicted (majority of conflict in the OFR process)
- What went wrong with the engagement of fishing stakeholders in OFR?
 - “Angler” network:

- Felt that the OFR was driven by “diver/ environment” network and that fishing stakeholders were marginalized
 - Perceive the process as unfair, felt unheard and perceived a hidden agenda from the OFR
 - Largely disengaged from the process but informed others in their network
 - Admitted to interfering after the event and having the power to do so
 - Are interested in re-engaging
 - “Diver/ environmentalist” network:
 - Felt that OFR was a fair process, felt that fishing stakeholders had a seat at the table but did not participate
 - Frustrated that the angler network opposed OFR through political channels
- Examples of conservation-oriented actions by engaged fishing stakeholders:
 - FishSmart process for King Mackerel in S. Atlantic, FWC Snook Workgroup, handle and release practices to improve discard survival, Captains for Clean Water, Sarasota Fisheries Forum
- Implications
 - The fisheries information gap in the OFR process may be filled through fisheries-centric processes that harness the capacity of fishing stakeholders to advance conservation
- Proposed stakeholder engagement process:
 - A fisheries-centric process will complement the wider OFR
 - A committee will be formed to co-create decision-making processes and identify key areas of concern and actions. Science inputs to decisions will be provided and supported.
 - (the CRCP and DEP have developed a set of recommendations for the engagement approach which are outlined in the next section).
- *No questions.*

2. Proposed methodology for Phase II – Kai Lorenzen (UF)

- **Objectives:**
 - Strengthen the engagement of fishing stakeholders in conservation initiatives, review the recommendations from the OFR process and implement opportunities for fisheries stakeholders, develop a set of fisheries-related management recommendations, consult with the SEFCRI team, TAC, and other stakeholders for feedback and additional perspectives.
- Layout of the projects:
 - Stakeholder committee made of fishing stakeholders that represent their constituents and develop recommendations for the SEFCRI chair, then that SEFCRI chair will make those recommendations to the relevant management bodies (FWC, FDEP, etc.)
 - Project team: support all of these things (committee activities, drafting recommendations, connection with SEFCRI team)
- Personnel:
 - Kai Lorenzo, Fisheries professor, PI (overall lead)
 - Susana Hervas, Project Scientist & Coordinator Co-PI (communications, coordination, research)
 - Joy Hazell, IFAS Extension, Lead Facilitator, Co-PI (facilitation)
 - Chelsey Crandall, Project Scientist, Co-PI (research)
- Planned Activities for the first year:
 - Committee Meeting 1 (6/4/2020): discussed the project, discussed the mode of committee operation and committee membership
 - Committee Meeting 2: discuss member perceptions of reef status and management options
 - Public Meetings: to inform the wider fishing community about the project and the committee, and to obtain additional inputs on perceptions of reef ecosystem status and management/ conservation options for the wider public.
 - Committee Meeting 3: Review scientific info on reef ecosystem and review OFR management recommendations
 - Committee Meeting 4: Identify recommended management actions for fisheries
- Planned Activities for the second year:

- Committee Meeting 5: Synthesis of scientific information on potential fisheries management recommendations, committee co-development of stakeholder survey
- Committee Meeting 6: review stakeholder survey results, prioritize fisheries recommended management actions
- Public Meetings: inform the wider fisheries public about the project outputs and draft recommendations, obtain input on the draft
- Committee Meeting 7: Finalize recommendations
- What happens to the recommendations?
 - The committee will make recommendations to the SEFCRI chair, that chair will provide the recommendations to the relevant management agencies, those agencies then decide what to take forward into their work plans and rule-making processes
- **Questions:**
 - BW: Seems good, but how can we be sure this won't be hijacked again?
 - Manoj Shivlani [MS]: same question as Brian.
 - Well, this is an interesting experiment in a sense, we are giving a lot of the power in the process to a diverse set of fishing stakeholders. There not a lot of processes that are conservation related where fishing stakeholders are taking the lead. We have a fairly diverse group of people. People who have different perspectives on where we are with the reefs and the fisheries resources. The hope is that the process in itself will be productive and the fact that we have a diverse group will make it harder for one or the other group to hijack the process. A lot of the meat there is in having a diverse group and facilitating that process well. There's never complete guarantee that it will go well and fairly, but we are putting our best expertise.
 - PD: It has been my experience that most fishers will agree that management is important but rarely give it more than lip service. So, an interesting question to ask then is "what are they willing to pay, or give up, to help the fish populations become more vibrant?" Another way to phrase it is " what rewards can be given to people for "obeying" fishing regulations - maybe social media or?
 - The limited experience we have with processes where fishing stakeholders were in the lead often show relatively conservation-minded outcomes. There is a range, obviously, but it is not the case that that ends up being lip service in most cases. It changes the dynamic if you put the community at the heart of the process instead of the receiving end. We are looking at several things- fisheries recommendations, but also the community promoting and advocating other aspects of reef conservation and we have good examples in the WQ process from other regions in Florida where the advocacy of the community has been important for advancing conservation. We're looking at the whole package here for what the community can support and things that are associated with fisheries management.
 - JS: are we looking for diversity in terms of wealth?
 - We do have some of that diversity, but we didn't ask people to declare their income. We have reps from 5 different groups and a range of wealth present.
 - MS: is Covid being considered as having an influence on support where economic concerns now supersede ecological ones?
 - The planning of the project preceded COVID, and as everything else we will have to see how that develops. It will be naïve to think it will have no impact. But it is difficult to say at this stage how that will play out.
 - JL: Why are two years needed to finish this survey? COVID-19 and the societal unrest of the last month has shown us that motivated people can decide very quickly how to respond (work on viruses or decide of new social policies) and I wonder why we aren't behaving with greater urgency since livelihoods and reef health are both of great concern.
 - We get this a lot. Firstly, this is not just a survey. We could do that in a month. It's a process that puts fishing stakeholders in charge of developing recommendations. From our experience with participatory processes, that can't be done overnight. Example, Brian's below comment, the important thing we are trying to do is to give people time to get to know each other and build trust and consider issues where they don't see eye to eye. That can't be pushed very quickly. We have had good experiences doing this in other processes, you may be familiar with habitat management, but there as with others the experience of 2 years is almost the minimum. Need a lot of meetings to build enough trust for the committee to consider these hard questions constructively. The idea here is to build a community driven process and recommendations, and that's different from doing a survey.

- JM- logistical perspective, the majority of our projects require funding, in this project we went with this team because its respected from the fishing community and works with fishers in the human dimension. That's their expertise. The grant funding is 3 years in advance of when were hold the project. There are some things we can do without funding, but this we can't. We want to make sure that we take the time we need to get it done. I will also clarify that there was something in the presentation of sharing the results w managers. There will be an interim step when these will be reviewed by SEFCRI and TAC. This will take more time but feel that it will make these more well-rounded. We won't be telling them what they can't do but suggesting things they might be more receptive to.
- BW: During OFR, there was a diverse range of fishers involved, but they don't see eye-to-eye. They tend to only care about what affects them. How can a meaningful agreement be met with a diverse group of fishers who aren't willing to concede their own interests? I fear this is another delay tactic that will hold off progress.
- KG: I look forward to seeing what solutions are proposed by the key stakeholders for hard management challenges. Status quo is not going to maintain a sustainable coral reef ecosystem if we don't make progress on all the threats.

Session V: Reef Monitoring Updates

1. SECREMP – Dave Gilliam (NSU), joined by Nicole Hayes, project manager of SECREMP, to assist with questions

- **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 2013-2018**
 - Rapid increase from 2013-2016, then prevalence continues to decline. There is a similar trend in SCTL D and non-SCTL D diseases in the same timeframe, which indicates that there is a potential connection between environmental conditions and SCTL D outbreak.
 - Half of species are infected (15 of 29 total species in region).
 - **SCTL D Disease 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*
 - 2019 (2 sites): *O. annularis complex*, *M. cavernosa*, *S. bournoni*
 - Observed 2020 (2/5 sites): *A. agaricites* (BCA), *M. cavernosa* and *O. annularis complex* (BCI)
 - **Regional Stony coral density**
 - Significant decrease in 2016, no change in 2017. Coral density is a measure of the health of the resource by measuring the entire loss of a colony- a significant loss of density is an important proxy for entire system health (it does not just capture lost tissue, but loss of entire individuals).
 - Density increase from 2017-2019, but this is driven by a few weedy species such as *P. astreoides* and *A. agaricia*
 - **Regional live tissue area (LTA)**
 - LTA is a finer scale index- uses demographic data (height and diameter and partial mortality) with ellipsoid equation to calculate live tissue area. Doesn't rely on loss of entire colony.
 - Have lost ~54% of LTA between 2014-2019, with most lost during 2015-2016. Loss has been reduced in 2017-2018.
 - Northern Counties + Southern Counties LTA:
 - Dramatic loss regionwide, unprecedented change in terms of the spatial area- dramatic loss in all 4 counties, and all reef habitats.
 - **Species-Level Changes**
 - DSTO (Highly susceptible): dramatic loss between 2014-2015
 - MMEA (Highly susceptible): Dramatic loss, one of the first species to show significant decline related to the disease
 - CNAT (Highly Susceptible): not as abundant of DSTO and MMEA, but also captured significant decline
 - MCAV (Intermediately Susceptible): contributes most coral cover in the regional system, but also has significantly declined since 2016

- Orbicella complex (Intermediately Susceptible): significant loss after 2015
- PAST (low susceptibility): increase in LTA
- **2018-2019 Functional Group Cover:**
 - Stony coral cover:
 - Regionally 2019 was significantly higher than 2018
 - Significant increases at 4 sites, no sites had significant decreases
 - Octocorals:
 - No significant difference from 2018 to 2019
 - Significant increases at 3 sites, 3 sites had significant decreases
 - Sponge Cover:
 - No significant difference from 2018 to 2019
 - Significant increases at 5 sites, no sites had significant decreases
 - Macroalgae Cover:
 - Regionally 2019 was significantly higher than 2018
 - Significant increases at 12 sites, 3 sites had significant decreases
- **Recent SECREMP Products:**
 - Annual SECREMP reports, 2 age outreach documents
 - Graduate Theses:
 - Completed 2018 MS Thesis: Nick Jones (cover data)
 - Completed 2019 MS thesis: Nicole Hayes (stony coral demographic data), Alanna Waldman (Xestospongia muta data), Alex Hiley (Octocoral Data)
 - 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 stressors drive coral reef community change (Coral Reefs)
 - Hayes et al. In prep: Recovery Potential Following a Regional Stony Coral Disease Outbreak Along the SEFLRT (will include 2018 and 2019 data)
 - 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:**
 - PD: What is the pixel dimension of the images?
 - Nicole Hayes [NH]: We use Olympus TG4 and TG5 cameras - the recording image size is 4000 x 3000
 - BW: Did you look at potential hurricane Irma impacts from 2017-18?
 - NH: We did in depth in the 2018 comprehensive report - Irma had a far greater impact on our octocoral and *Xestospongia muta* colonies
 - PD: What are the units of LTA?
 - NH: LTA units are in meters squared (m^2). We have also seen significant loss in stony coral cover. However, LTA as a metric is more sensitive to change compared to cover as Southeast Florida does not have very high coral cover
 - Rob Ruzica: LTA = cm^3/m^2
 - PD: how does this compare to percent projected cover of live coral tissue?
 - PD: so, 15 points with a 4000x3000 image?
 - NH: Correct we do 15 points per image and around 50-60 images per transect so >900 points per transect
 - PD: So, LTA is calculated from imagery or is each colony measured by a diver?
 - NH: LTA is calculated from our in-situ measurements of maximum diameter and maximum height with % mortality estimates. Our imagery is only used for cover
 - PD: lots of bottom time - or are there so few corals it's not too bad?
 - NH: It is very site dependent but as a general rule these measurements are very manageable underwater

- Michelle Gaulty (DEP): Thanks for incorporating the Coral ECA and Florida's Coral Reef messaging, Dave + team!
- Rob Ruzicka: The demographic survey is very, very similar to an AGRRA survey. From it you can get LTA, size class composition for your corals, disease and bleaching prevalence so the investment is well worth the effort and highly complementary to benthic cover surveys.
- NH: It is difficult with data collection every other year to catch some of these significant, unexpected changes and loss that management would benefit from knowing. More sites of course would be beneficial!
- Brian Walker: Also, tough to maintain personnel

Session V Cont.: Reef Monitoring Updates

2. NCRMP – Jay Grove (NOAA)

- CRCP's National Coral Reef Monitoring Program (NCRMP) started in 2013 sampling in the Florida Keys and Dry Tortugas. As of 2018 sampling includes SEFCRI, now will be a program comparing all coral reefs in the US using the same methods. The program includes jurisdictions in the Pacific and Caribbean, this group is in charge of the Atlantic Ocean
- **Sampling cycles:**
 - 2013- FGB & USVI
 - 2014- FL & PR
 - 2015- FGB & USVI
 - 2016- FL & PR
 - 2017- USVI
 - 2018- FL & FGB
 - 2019- USVI & PR
 - 2020- FL & FGBs
- **NCRMP Products:**
 - **Project Summary:** NCRMP synthesizes its information in products designed for a variety of audiences, including raw data for the scientific community, technical documents for the management community, reports for stakeholders, and status reports for the general public.
 - **Benthic Methods:**
 - Benthic Assessment: documents benthic composition, topographic complexity, macroinvertebrates, and ESA-listed corals
 - Demographic Assessment: includes all corals > 4cm diameter, and documents density, size, richness, and condition (disease, bleaching, mortality)
 - **NCRMP 2018:**
 - **Dry Tortugas:**
 - 139 Benthic Sites (completed 100%), 338 Fish Sites (completed 94%)
 - **Keys:**
 - 90 Benthic Sites (+ 73 DRM) (completed 100%), 434 fish sites (completed >100%)
 - **SEFCRI**
 - 77 Benthic Sites (+72 DRM) (completes 86%), 301 Fish Sites (completed 100%)
 - 5000 Individual dives
 - **Big Questions from 2016-2018:**
 - Interested in assessing the first sampling since Irma, effects of new management in 2017 for hogfish and mutton snapper, and assessing the SE Florida data
 - RECORDING
- **Questions:**
 - PD: Spearfishing using SCUBA should be outlawed along the entire Florida Reef Tract for a beginning

- Don Behringer: Agree, or at least eliminating certain particularly vulnerable species from spearfishing, such as hogfish and most grouper species.
- PD: ALL spearfishing with SCUBA and very narrow limits with snorkel and sling only- no spearguns
- Arthur Mariano: I agree with Phillip that a Scuba +spearguns ban is necessary
- AM: Total ban, not specie specific, too hard to enforce otherwise
- BW: What is the link to the tracker?
 - Kurtis Gregg: We are uploading the site tracker now with the SE Florida sites and will share the link with partners as soon as it is available
 - JG: We are uploading the site tracker now with the SE Florida sites and will share the link with partners as soon as it is available
- KG: What other management tools do we have to protect large, most fecund reef fish?
 - Jay Grove: Management tools include eliminating gear types (e.g., as suggested spearfishing), implementing seasons (e.g., closures during spawning), area closures (i.e., MPAs), length limits (currently in place to protect smaller fishes), and slot limits (can protect both smaller and larger fish).
 - JG: Also, more training and/or clarity for anglers on rules wouldn't hurt
 - KG: Gear bans are fiercely opposed, seasons have some stakeholder support; max length limits result in truncated length frequency distributions and no large fish out on the reef, slot limits have release mortality issues... Spatial managed areas would be the fairest to all users, while protecting the large individuals that are the most important for spawning output
 - PD: At some point the rubber meets the road. Either gear bans and the like are used, or the system simply degrades- which has been happening for 50 years. When will some ecologically relevant management decisions be applied? Nature, like Covid - really does not care about fierce opposition as witnessed by the uptick in the virus this week. If all, or almost any, of the goals espoused at this and other coral reef meetings are to work, there must be some "wins" for nature, not politics and commerce
 - KG: Meant minimum legal size, not max length limit
 - JG: Circling back to the fish comments. As mentioned, spatial management is an effective tool for all fishes (species and sizes) and has been shown to increase fish in the surrounding areas as well. To be effective for targeted species the management area needs to be large enough to encompass more than the reef fishes' home range (varies for grouper, snappers, etc.). From a management perspective it is also easier for anglers to follow compared to varying seasons, lengths, etc. by species. However, this tool is also opposed by some that would like access to the entire reef (i.e., prefer to fish outside their home) and/or prefer other methods to be used first. An example of anglers catching larger fish outside a protected area on the east coast of Florida is outside Cape Canaveral

3. Florida Reef Resilience Program (FRRP) Disturbance Response Monitoring (DRM) Program – Jennifer Stein (FWC)

- **Project Summary:** The DRM Program was established in 2005 by the Florida Reef Resilience Program (FRRP, a collaborative program guided by a steering committee of managers, scientists, and conservation organizations to implement resilience-based management on Florida reefs) 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 Surveys:**
 - Surveys are designed to monitor coral reef health after a disturbance, where trained experts survey corals during peak annual temperatures (mid-August through mid-October). To date, 3,000 DRM sites have been surveyed.
 - In-Water Methods: random sites are generated and assigned to teams, then survey four 1x10m belt transects (new 2020 method). The stratified sampling design is based on the FRRP spatial framework which is made up of sub regions, zones, and strata.

- DRM Adapts to new disturbances to provide valuable information:
 - In 2005-2016 these surveys focused on coral bleaching,
 - in 2017 they focused on coral disease, hurricane impacts and coral bleaching,
 - in 2018 focused on coral disease and coral bleaching.
 - Post-bleaching surveys are also completed after bleaching years (2014-2015), 3-4 months after the event if it is considered 'severe'. From 2005-2017
- **2019 Bleaching Prevalence:**
 - 285 sites were surveyed across 11 regions
 - 33 sites had moderate bleaching (11 in Broward-Miami, 11 in dry Tortugas)
 - 3 sites had severe bleaching (1 in north palm beach, 1 in south palm beach, and 1 at Broward-Miami)
 - Remaining sites had mild to no bleaching
 - When paling was included, prevalence values increased to moderate and severe in over half of the sites surveyed
 - Moderate bleaching and paling at 130 sites (27 in Marquesas', 25 in dry Tortugas, and 25 Broward-Miami)
 - Severe bleaching and paling at 44 sites (22 in dry Tortugas, 9 in the lower keys)
 - When pooled by zone within each subregion, 16 of the 31 subregion-zones were recorded with moderate bleaching and paling.
- **2019 Disease Prevalence**
 - 285 sites were surveyed
 - 13 sites had moderate disease (5 in Broward-Miami, 4 in the lower keys)
 - 7 sites had high disease (3 in Broward-Miami)
 - When pooled by subregion-zone, only Deerfield inshore reef was recorded with high disease prevalence
 - Only one site was surveyed in the Deerfield inshore reef- four observations of "unknown" disease on SBOU
 - Across all belt transects surveys, 82 corals were recorded with SCTLD. 73 of those corals were in the lower Keys subregion:
 - 18 SSID, 12 MCAV, 10 CNAT, 10 OFAV, 5 PSTR
- **2019 Roving Diver Results**
 - Purpose: to identify the leading edge of SCTLD, to locate where corals with SCTLD are most active, and locate where SCTLD was persisting in the endemic zone
 - 263 RDS were completed
 - 8550 total coral colonies tallied
 - 783 had active tissue loss from disease, 630 of which were in the lower keys
 - 323 of the total diseased corals were CNAT, 316 were in the lower keys
 - RECORDING
- **Proposed plans for DRM in 2020**
 - 1. Maintain the primary objective to monitor the status of coral bleaching along the FRT.
 - 2. Continue to assess the progression of SCTLD westward along the FRT and identify areas where the disease continues to impact corals after the initial disease boundary had passed.
 - 3. Assess the abundance of coral species that are highly susceptible to SCTLD including juvenile corals (< 4cm and > 1cm).
- **Modifications of the underwater data collection**
 - To assess the remaining population of SCTLD susceptible species, the survey area will be expanded at each site to increase the probability of capturing the presence and condition of a subset of SCTLD susceptible coral species, which includes some species that were already less common.
 - To expand the survey area, two additional belt transects will be added to the survey at each site. Two transects will target all coral species (traditional DRM method) and two additional transects will target only 10 coral species.
 - Target coral species: *Colpophyllia natans*, *Dichocoenia stokesii*, *Diploria labyrinthiformis*, *Meandrina meandrites*, *Mussa angulosa*, *Mycetophyllia aliciae*, *Mycetophyllia ferox*, *Mycetophyllia lamarckiana*, *Pseudodiploria clivosa*, and *Pseudodiploria strigosa*.
 - Tally SCTLD susceptible juvenile corals (< 4cm and > 1cm) along all transects at a site.
 - 1. Family Mussidae, subfamily Mussinae: includes *Isophyllia*, *Mussa*, *Mycetophyllia*, *Scolymia*
 - 2. Family Mussidae, subfamily Faviinae: includes *Colpophyllia*, *Diploria*, *Favia*, *Manicina*, *Pseudodiploria*
 - 3. Family Meandrinidae: includes *Dendrogyra*, *Dichocoenia*, *Eusmilia*, *Meandrina*

- Juveniles are grouped at the family/subfamily level due to the difficulty in identifying juvenile colonies to the genus and species level. No other juvenile coral families will be tallied during the survey.
 - Increase number of sites
 - Increasing the number of sites surveyed is the best method for providing an accurate representation of the population. This is especially important when trying to get an accurate assessment of the remaining population of SCTLD susceptible species.
- **DRM Trainings and Surveyor Resources**
 - Three virtual trainings in 2020 (July 9th, July 27th, and August 4th) to introduce new methods, familiarize surveyors with identifying juvenile corals, provide a list of assigned sites, and to develop payment plans for each partner in an effort to increase the number of sites surveyed in 2020.
 - The 2019 DRM Quick Look Report is available on the DRM website (<https://ocean.floridamarine.org/FRRP/>)
 - All trainings, protocols, and surveyor resources will be updated on the DRM website on the ‘Surveyor Trainings and Resources’ page prior to the start of the season.
 - DRM data from 2005-2019 will be available for download from the ‘Reports’ page on the DRM website in July 2020.

Session VI: Coral Disease Updates

1. SCTLD updates and disease workshop – Maurizio Martinelli (SeaGrant)

- **Updates on Disease Progression**
 - Florida- Outbreak started in 2014, disease front is now through the Marquesas’. Progression has been slow for the first half of this year and has not yet been detected in the Dry Tortugas.
 - Caribbean- progression in Mesoamerican reefs, now spreading within Belize, PR, Bahamas, and BVI.
 - Upcoming position available: Florida Sea Grant National Coral Disease Coordinator to manage the disease response in all jurisdictions
- **Updates on Response Activities**
 - Leadership meeting outcomes
 - Meeting facilitated by USGS in December 2019
 - Detected a shift in mindset from emergency disease response to a focus on environmental health
 - Overarching goals:
 - Improve diversity on Florida reefs, maintain colonies of susceptible species and enhance natural reef structure, support development of new treatments for managing reefs, build capacity and resources for response and reef conservation, enhance communication.
 - Want to strategically plan to ensure we are working efficiently as we move forward, so want to develop a SCTLD 2020-2022 Strategic Action Plan
 - Will include background and historical information, and overview of the response structure, and response team action plans (description of the team, ongoing activities, and activities for the next ~2 years)
 - Technical workshop
 - 175+ participants
 - Updates from all teams, ballast research and other wildlife disease responses
 - Research- discussed and agreed upon priority research questions
 - Intervention- discussed scaling up and evaluating antibiotic impacts
 - Comms & outreach- SWOT analysis and new directions
 - Caribbean cooperation- shared information and facilitated networking
 - Priorities moving forward
 - Want to take some outcomes from the workshop to design an “RFP” to help guide the development of research proposals towards the questions we’ve identified as priority
 - Determine how to evaluate the impacts of antibiotic treatments

- Build infrastructure and expertise for coral propagation
 - Collect and preserve resilient genotypes
 - Finalize a strategic action plan
 - Draft a broader response plan (10-15-year vision, this disease will likely be a long-term part of this ecosystem)
 - Address environmental conditions
- Disruptions from COVID-19
 - Limited disruptions of fieldwork, research projects have been the most heavily impacted. Intervention has been largely unaffected. Rescue cruises resumed in May and June
 - Significant disruption to laboratory research. Most projects have been delayed, which makes navigating next year difficult
- **Questions:**
 - Joe Lopez [JL]: A big problem is that don't really know what the pathogen is. That should be the first step, upon which treatment and management would flow. Possible progress with a recent 16S study from AOML points to some specific bacterial associations based on 16S rRNA data - <https://www.frontiersin.org/articles/10.3389/fmicb.2020.00681/full?report=reader>. This is promising and should be verified with more species or sites
 - VP: In response to Joe's comment we probably aren't going to answer questions about the cause via microbiome analyses alone. The bacteria composition will of course change in disease lesions, but that may be secondary.
 - BW: Disease Interventions and NCRMP may be affected by the most-recent increases in COVID cases.
 - EP: Agree, Val, note end of abstract: "...Rhodobacterales and Rhizobiales may play a role in SCTLD and that sediment may be a source of transmission for Rhodobacterales and Rhizobiales associated with SCTLD lesions." Too many "maybes" still. But we are all working on this!
 - JL: Also remember that Val Paul's lab is working up non-human- non-veterinary antibiotics and other interventions that could replace the amoxicillin method when better known

Session VI cont.: Coral Disease Updates

2. Disease dispersal modelling results preview – Erinn Muller (Mote)

- SCTLD appears transmissible. It follows a clustered pattern suggesting contagious mode of transmission (Muller et al. 2020), and waterborne transmission in a laboratory setting (Aeby et al. 2019)
- SCTLD rates of spread: quarterly measurements suggest ~92 meter spread per day from 2014-2017. This is lower than reported average surface currents, but hydrodynamics likely plays a significant role.
- **Objectives:**
 - 1. Conduct a meta-analysis on existing laboratory transmission data to parameterize epidemiology models
 - 2. Couple epidemiological SIR model with ocean currents over two time periods:
 - 6 months in 2014 (onset of disease- where did it come from?)
 - 12 months in 2018 (data-rich period) and predict disease propagation based on epidemiological parameters estimated from existing data
 - 3. Determine type of current that could move SCTLD among reefs in predictable manner
- **High-resolution hydrodynamic modelling-** we have applied the high-resolution ocean model SLIM to the FRT. It allows us to simulate the circulation around reefs and islands with a resolution of 100m (~10x more than existing models)
- **Epidemiological modeling**
 - The classical SIR model divides the population in 3 states: susceptible (healthy), infectious (diseased) and removed (dead)
 - Transition between states is proportional to transmission and mortality rates.
- Epidemiological and hydrodynamic models are coupled through the **connectivity matrix**. Infectious corals can infect susceptible corals from other reefs through the connections of this matrix.

- **Methods:**
 - Data for model validation
 - Transmission probability: laboratory experiments and in situ data
 - Time between exposure and disease signs from laboratory experiments
 - Within site dynamics from moles permanent SWG sites (nearshore: north birthday; Midchannel: wonderland; Offshore: Acer 17/18)
 - Transmission meta-analysis
 - Average probability of transmission = 44.8 +/- 3.8%
 - Average time between exposure and disease signs= 9.7 +/- 1 day
 - Species of main disease fragment influenced probability of transmission
 - Highly susceptible transmitted ~55% of the time
 - Medium susceptible species transmitted ~35% of the time
 - We consider 3 modes of transport for the disease agents
 - 1. Bottom currents take 60% of depth-averaged currents, 15 degrees to the left
 - 2. Surface currents add 1.5% of wind speed, 45 degrees to the right (Arduin et al., 2009)
 - 3. And a depth-averaged current generated by SLIM
 - These 3 different currents allow us to represent the transport of particles floating at the surface, staying in the water column or sitting near the bottom. Exchanges between reefs are recorded in monthly connectivity matrices.
 - Model calibration is based on observations in 2018-2019
 - The transmission and mortality rates have been calibrated based on the disease prevalence observations averaged over 6 permanent sites in the lower keys. On average, the epidemic is weak.
 - $\beta^{-1} = 6.45$ days, $\sigma^{-1} = 6.99$ days.
 - $R_0 = 1.0345$
- **Results (2018):**
 - Depth-averaged currents seem to transport disease agents
 - For the 3 modes of transport, we computed the epidemic front speed and the mean distance between reefs where the disease was observed and predicted by the model.
 - The depth-averaged (barotropic currents appear to be the most likely mode of transport of disease agents.
 - There is a well-defined range of values for the infection threshold I_0 . The small value of I_0 suggests a small resistance of corals to the disease.
 - Particles can also be transported backward in time
 - By reversing time, we can find where particles that reached a certain location came from.
 - Backtracked particles lose mass as they move \Rightarrow they leave a trace over all the area from where they could have originated.
 - Why did SCTL D start in 2014 at Virginia Key?
 - Precht et al. (2015) report the first observations of the SCTL D on Virginia Key reef in Sept. 2014, which is just South of the navigation channel leading to the Port of Miami. That channel was dredged between Dec. 2013 and May 2014. Most dredging material was dumped at a disposal site offshore. However, some “non-conventional” dredging operations were reported for which sediments and rock fragments were not removed.
 - Could these non-conventional operations have “contaminated” VK? What about wastewater leakage from nearby outflow pipes?
 - Where could the disease agents have come from?
 - We simulated the hydrodynamics from May to Sept. 2014 and run the particle transport model backward in time for particles released on VK.
 - While most particles that would hit VK come from the South, our model suggest that particles released immediately north could also have affected VK
 - There was no connection between the dumping site and VK
 - These are preliminary results that need to be confirmed by simulating the hydrodynamics from Dec. 2013 and looking more carefully at different particle types within the water column.
- **Conclusions:**
 - Transmission meta-analysis provided important SCTL D ecology data: ~44% transmission, ~10 days after exposure.

- Hydrodynamic modeling can explain the transmission of SCTLD among reefs; neutrally buoyant particles in barotropic currents are the most likely mode of transport for disease agents.
- If SCTLD came from another location to Virginia Key, most particles come from the South, but our model suggest that particles released immediately north could also have affected the area during the modeled time period.
- **Next Steps:**
 - Epidemio-hydrodynamic model study publication (ready to submit by end of June 2020)
 - Refine and finalize sediment transport model simulations within the dredged area surrounding Virginia Key in 2014
 - Model the hydrodynamic connections between the Marquesas and the Dry Tortugas; spoiler alert...DRTO is not isolated.
 - Couple hydrodynamic models with environmental data to further explore SCTLD dynamics and the potential for this approach to aid in coral restoration efforts
- **Questions:**
 - KG: Monitoring from the Port Miami dredging project showed stony coral tissue loss disease was first observed in time series photos of tagged corals in May 2014, not the September 2014 date used in Precht et al. 2016. May 2014 is prior to the thermal stress of the 2014 summer season. The location it was first observed is not far from the Virginia Key water treatment plant outfall
 - Judy Lang: Kurtis, can you send us the reference to that May 2014 dredging monitoring, please?
 - KG: Judy-Jocelyn has the monitoring data. It was not in a report that has a reference
 - JL: Kurtis, can you please share Jocelyn's full name and email address?
 - KG: Jocelyn.Karazsia@noaa.gov
 - Xaymara Serrano: Erin/Lew - what was considered as "non-conventional" dredging?
 - RECORDING
 - AM: Very nice modeling studies. There are better ways to include windage with surface currents. Depth averaged currents worked well because they have less noise in them
 - Lew Gramer: Arthur, would love to talk more with you about that. Shall I send an email, and include my collaborators (who did the real work) on that?
 - AM: Yes, LG: Will do.
 - DB: Are organic aggregates (e.g., marine snow) being considered as a possible transport mechanism (in addition to the other potential vectors mentioned)?
 - EM: Don...I think that is an important next step. Since neutrally buoyant particles appear to play a role, marine snow would be a good place to look
 - LG: Don, particles with non-trivial aerodynamic profiles would be interesting, particularly for the ongoing 2014 study
 - LG: Don, do you have a reference or good contact on the prevalent types of "snow" in this type of environment?
 - DB: @Lew, yes, Evan Ward (UConn) and Fred Dobbs have done some work on marine aggregates as transport mechanisms for pathogenic bacteria in oysters. Evan has now expanded that to include aggregates as transport mechanisms for microplastics, so he should be a good resource
 - KG: Erinn-The sediments suspended during the rock chopping are colloidal, as well as being really fine. Would that affect the buoyancy of the particles?
 - EM: Kurtis, yes. Emmanuel is modeling different sediment types (fine, medium, large) using the SLIM model during the dredging time period
 - Emmanuel Hanert: Kurtis: We don't have a clear idea yet of the density/size of these particles (+ potential for flocculation). We're planning to look into that in the future
 - KG: Erinn-fine, medium, and large sediments may mask some of the characteristics that affect how the sediment behaves in suspension (e.g. electrically charged colloids and fine sediments). We have a sedimentology report from a colleague at University of Miami that may be informative
 - EH: Kurtis: Would it be possible to have a copy of that report?
 - KG: Emmanuel-please contact me at Kurtis.Gregg@noaa.gov
 - Rob Ruzicka: The progression/pattern of SCTLD down the FRT was consistent as indicated in Erinn's presentation. The marine snow observation by Don is a good one because the one-time the pattern was severely disrupted was after Hurricane IRMA. SCTLD lesions that appeared on corals on reefs did not follow the pattern pre-IRMA for about 6 months. Whether it was tissue

- loss particulates being either carried in the water column or bound to sediments it provided a different mechanism/experiment to spread the disease
- BW: Emmanuel Have you looked at how the 2014 modeling matches us to Brian Barnes' remote sensing?
 - EH: Yes, we did a qualitative comparison and it compares quite well. The sediments plumes obviously mostly impact reefs North of the navigation channel.

3. Cell death in stony coral tissue loss – Murphy McDonald (NSU)

- This project is on the histopathology of SCTLD, specifically investigating the mechanisms of cell death responsible to SCTLD lesions.
- There are two main mechanisms of cell death that this project will be differentiating between:
 - Necrosis- passive, degenerative process of cell deterioration
 - Programmed cell death (PCD, aka apoptosis)- genetically mediated process of intentional cell suicide
- Why investigate PCD vs. necrosis?
 - PCD can be difficult to detect when looking at morphology alone
 - PCD is an important mechanism to the corals innate immune system, can tell us more about how the coral host is responding to whatever pathogen is responsible
- Methods:
 - 3 species: *P. strigosa*, *M. cavernosa*, *O. faveolata*
 - 3 sample types: Diseased (tissue core taken from an active tissue margin), Unaffected (taken from the visibly healthy portion of a diseased colony), and Healthy (taken from a healthy colony with no signs of disease)
 - Serial tissue sections will be processed for histology (to stain areas of necrosis and other signs of disease) and immunohistochemistry for apoptosis (to stain for areas with fragmented DNA indicative of PCD using the TUNEL method)
- Preliminary Results: *P. strigosa*
 - Preliminary results from diseased tissues of *P. strigosa* reveal widespread apoptosis throughout tissues
 - Evident in all tissue layers (epidermis, gastrodermis, mesenteries, basal and surface body walls)
 - Evident in all areas of complete tissue rupture
 - Future work:
 - Overcome COVID-related delays to complete staining on full sample set of all three species using samples collected by FWRI in 2018
 - Describe the spatial patterns of cell death in SCTLD
- Implications
 - If PCD is determined to be playing a driving role in SCTLD pathology, future work needs to investigate the role of the corals immune response in mediating or contributing to lesion virulence.
 - Factors that influence pro- and anti- antibiotic signals in coral cells can be biotic (intracellular pathogen, remote sensing of a pathogen in close proximity, viral infections), or abiotic (thermal stress, pesticides/ toxicant exposure, etc.).
 - Implications for relative susceptibility/ resistance between species: some species that are considered disease resistant (such as *Porites*) have been shown to favor other immune strategies before resorting to PCD, whereas species that are considered disease susceptible (*P. strigosa*, *O. faveolata*) favor PCD as a primary immune response.
- Questions:
 - Dan Holstein [DH]: Murphy - Will necrotic cells stain orange, as well? Is it only intact orange nuclei that indicate apoptosis?
 - The stain should only stain the fragmented DNA ends in apoptotic nuclei orange while leaving necrotic cells unstained.
 - Val Paul: I may have missed this but how are you staining for apoptosis
 - Jen Salerno: Valerie TUNEL method
 - EP: Traditional way of staining in histology will show apoptosis, but coral nuclei very small, this IHC method really helps visualize
 - DH: - would you be willing to share the staining protocol for corals

- Yes, will follow up after the meeting
 - DH: dholstein1@lsu.edu
- VP: Are there ways to block or suppress apoptosis as a way to treat corals
 - Not that I know of as of yet, but medical literature may be a place to consult.
- DH: Is there any indication that calicodermis has a particularly high rate of apoptosis
 - These results are preliminary, and I have not yet quantified the abundance of apoptotic cells in each tissue layer. But I can say that it is consistently present in the calicodermis in what appears to be very high abundance. This may be because there are so few nuclei in this tissue layer to begin with, or could be that it is just a dynamic layer with a lot of cell turn over. I will be looking into this in the larger set of samples.
 - DH: I'm only guessing - but corals kind of shed their calicodermis as they lay down CaCO₃...? Something to tease out. Very cool
 - EP: Yes, calicodermis is dynamic layer and calcification varies with depth of polyp in skeleton

Session VII: Link to Keys Water Quality Efforts

1. Water Quality Protection Plan and reinvigorating FKNMS TAC – Karen Bohnsack (NOAA)

- Water Quality Protection Program Overview
 - Established as part of the FKNMS and Protection Act- 1990 by the EPA and FDEP
 - **Purpose:** identify and recommend actions to address sources of pollution, and to restore and maintain a balanced population of corals and other wildlife and recreational water activities
 - **Framework:** run by 3 different committees
 - Steering committee: Inter-agency and stakeholder leadership
 - Technical advisor committee provides scientific support, scientists from state/ federal, academic institutions, nonprofits, citizens
 - Management committee: state agencies to coordinate and facilitate the activities of the steering committee and TAC
 - **4 Primary types of activities**
 - Corrective actions – reduce pollution through management, enforcing regulations
 - Comprehensive monitoring- to determine pollution sources, assess success of management activities
 - Research and special studies- to better understand emerging management issues and the effects of pollutants on sanctuary resources
 - Education and outreach – raise awareness of pollution issues and engage public in implementing the program
 - **Examples of WQPP achievements**
 - Storm water improvements (most of the keys have been transitioned to advanced water treatment), Elimination of vessel discharge (no discharge zones established, free mobile pump out services), canal WQ improvements (canal management master plan, testing methods for restoring WQ), research and monitoring (tracked the status of WQ and benthic communities since 1995)
- Next Steps for the WQPP
 - Priorities
 - Subgroup with management and TAC members was created to draft a shortened list of WQ priorities to pursue in the future. Recognized that there is a lot of local state and national agencies that have authority over activities that impact WQ in the Florida Keys, this program is in the position to speak with a unified voice on these issues. Focused on activities that would make a significant difference.
 - Upcoming steering committee meeting
 - August 2020
 - Will discuss priorities and make action plans accordingly

- For the first time, looking at how to plan as a joint meeting between the steering committee and the Sanctuary Advisory Council (provides advice and recommendations on the management of the sanctuary, and serve as liaison with management and the community).
- WQ issues spotlight
 - **Shallow injection well monitoring**
 - The city of Marathon has several shallow injection wells (min depth 90 ft) that meet the states requirement of advanced water treatments, but stakeholders have expressed concerns that the treated effluent is migrating through the limestone and affecting waterways.
 - To address this, the staff and TAC are working together to develop a monitoring project of the shallow wells to investigate these issues
 - Want to determine whether the effluent is migrating through groundwater, and if so, if that is contributing to degradation of WQ.
 - **Vessel pump out services**
 - Pump Out USA has provided services throughout the Florida Keys free of charge for 9 years, but the agreement expires June 2020 and the service is being discontinued. There will be a request for proposals for a new keys-wide pump out service. During the months that this is underway, no service will be available. FKNMS is concerned about the potential discharges during this gap.
 - Long term goal- that all marine facilities with more than 10 slips or 1 live-on slip have permanent pump-out services. Want to make sure that Keys vessels continue to have access to pump out infrastructure. Welcome input on similar services in SE Florida that might temporarily cover the gap.
- Big Picture Goals
 - **Reinvigorate the WQPP and TAC**
 - Competing priorities and capacity has caused the program to falter. Working with co-leads and steering committee to re-engage, to ensure we have proper administrative support and strengthen the feedback loop between monitoring results and updating priorities. Looking at the SEFCRI TAC for a new TAC co-lead, collecting member biographies, and establishing more routine meeting schedules.
 - **Improve education and outreach**
 - There is a lack of awareness about WQPP and efforts being made to protect keys WQ. This leads to the perception that “nothing” is happening at all. The office of FKNMS sees community involvement is vitally important to protecting resources. The WQPP is intended to be that form of community involvement.
 - **Better integration of regional issues**
 - One of the biggest challenges in the keys and SE Florida is the high level of hydro-connectivity between these regions and further. WQ in the sanctuary is not just dictated by local action. It's important to strengthen engagement on regional issues, otherwise local efforts will be limited in benefit.
 - Efforts so far:
 - Southeast Florida Ecosystem Restoration Task Force- NOAA task force seat, NOAA Ecosystem Restoration Team, Working Group and Biscayne Bay Team Membership, Community Coordination.
- **Questions**
 - Rob Ruzicka: Good job Karen. Nice to see all the WQPP information put together in one presentation.
 - Judy Lang: Karen, I think we agree it's all part of the same FL reef system, so welcome
 - Kurtis Gregg: Glad coral reef people are integrating into the Everglades Restoration processes!