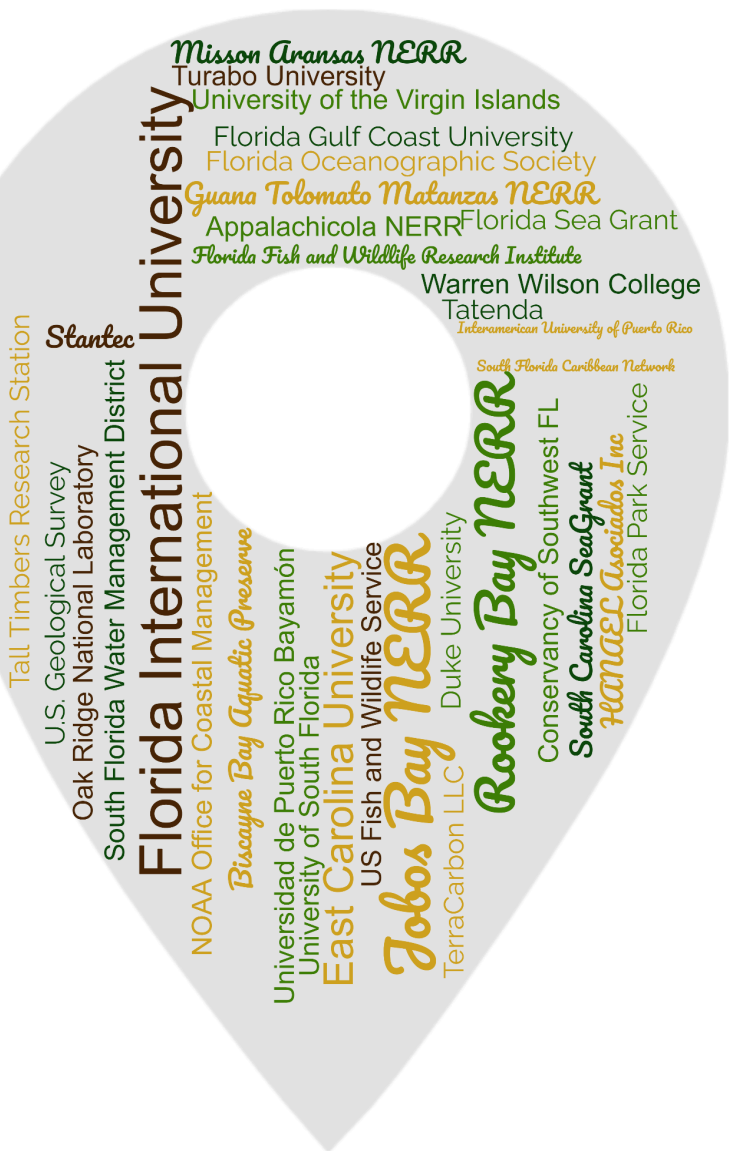


Mangrove Coast Collaborative Meeting: Highlights from the Mangrove Science & Management Forum (March 12-13th, 2024)



Summary

The Mangrove Coast Collaborative (MCC) is a project funded by the National Estuarine Research Reserves (NERRs) Science Collaborative (2020-2024), intended to develop data and tools for the management of mangrove ecosystems following hurricane disturbance. The MCC meeting, held March 2024 in Miami, FL, brought together natural resource managers, mangrove researchers, and staff from several NERRs located across the Southeast U.S. and Caribbean. The purpose of the meeting was to share research conducted at the Jobos Bay (Salinas, PR) and Rookery Bay (Naples, FL) NERRs and to foster discussion on regional mangrove recovery and management. The forum provided opportunities to make connections across scientific disciplines and geographies and generate new ideas for collaborative science relating to the management of mangroves.

The “drop pin” word cloud (left) depicts the 37 different institutions from which the participants hail. Image above: Participants pose for a group photo at the International Center for Tropical Biology (FIU), in Miami, FL.

Discussion of Project Outputs

During the forum, each of the project technical leads shared methods and results from each research objective. Following the presentations, there was an opportunity for Q&A. During concurrent breakout sessions, participants were asked to consider management applications, uncertainties and limitations, and opportunities associated with project outputs. Links to the presentations and take-aways from each discussion can be found below.

Mapping the Spatial Extent of Hurricane Effects and Recovery

Digna Rueda Roa, Technical Lead, University of South Florida

Management Applications for Mapping Hurricane Effects & Recovery:

- Change Detection: Identify trends and changes in mangrove distribution, including recovery after disturbance, urban development, and encroachment into marshes
- Prioritization: Identification of priority areas for management (land acquisition and restoration, areas under stress) and for future research
- Impact Assessment: Evaluate whether management actions are achieving the intended impacts

Limitations & Uncertainties

- Detail Detection: Difficulty in identifying specific vegetation details (species, stress, seedlings) due to inconsistent satellite imagery and understudied color variations.
- Seedling Detection: Current algorithms cannot detect seedlings and may miss younger, less dense mangroves or those with different canopy colors.
- Defoliation Detection: Detecting defoliated or dead mangroves is challenging with single images; however, time-series analysis allows to infer this information.
- Species Differentiation: The current tool cannot distinguish between different species of mangroves.

Assumptions & Context

- Pixel Classification: A pixel previously classified as mangrove and later classified as non-mangrove might indicate defoliation or mortality.
- Accuracy Assessment: The best method to assess accuracy involves using field-collected ground reference data and examining ultra-high resolution imagery.
- Expert Verification: Local experts are crucial for providing necessary information on the accuracy of the maps.

Opportunities & Recommendations

- Seedling Tracking: Develop algorithms to specifically monitor seedling recovery.
- Enhanced Data Sets: Incorporate hyperspectral and aerial imagery to differentiate mangrove species and improve accuracy.
- Real-Time Monitoring: Implement real-time monitoring of mangrove communities.
- Stress Detection: Create algorithms to detect mangrove areas under stress.

Field Assessment and Ecological Driver Modeling

Danielle Ogurcak, Project Lead, Florida International University

Hugh Willoughby, Professor, Florida International University

Management Applications for Field Assessment & Modeling:

- Managers can use data to inform management plans and secure funding for monitoring and research
- Useful prior to disturbance as baseline and to plan for future impacts

Limitations & Uncertainties

- The rapid single survey completed as part of the MCC does not attempt to integrate multiple temporal disturbance events.
- Dynamic conditions (including those related to hydrology) are unlikely to be well-represented by a single sampling event.

Assumptions & Context

- Mortality can sometimes, but not always, be attributed to storm impact rather than other contributing factors.
- Site hydrology has been influenced by hurricane disturbance at some locations.
- Maximum wind speeds for each hurricane are determined from the radius of maximum winds.
- Tropical storm force winds associated with Hurricane Ian (2022), did not have a substantive impact on mangrove forest structure in Rookery Bay.

Opportunities & Recommendations

- There is a need for increased understanding of regional hydrology and its effects on mangrove recovery and resilience.
- Consider utilizing remotely sensed datasets & technologies (e.g., drones) as part of post-storm monitoring.
- Integrate the ecological model to include pathways within the RAD framework for management intervention.
- Investigate ways to combine long-term plot monitoring with rapid sampling events.

Potential Impacts to Mangrove Ecosystem Services

Sara Mason, Technical Lead, Nicholas Institute for Energy, Environment & Sustainability, Duke University

Management Applications for Ecosystem Services Evidence Library and Gap Map

- Identification of research priorities for grad student projects or to include in management plans
- Securing research funding for the study of linkages highlighted in the gap map
- Utilization of the gap map could help identify important outcomes to monitor
- Ecosystem Services Conceptual Models can be used by managers to consider ecosystem services outcomes of a management decision or changing mangrove system
- Education and outreach materials - the conceptual model can help illustrate connections between the mangrove system and the public or individual homeowners
- Supporting advocacy efforts to help policy-makers to understand the importance of mangroves and their associated services

Limitations & Uncertainties	Assumptions & Context	Opportunities & Future Recommendations
<ul style="list-style-type: none">● Do end-users have the knowledge needed to interpret and/or use the product?● Some evidence search terms are specific, how do we know the right terms were used to find relevant evidence?● Evidence searches were limited to research published in English.● There may be gaps in the evidence we found due to publication bias (i.e. only publishing “interesting” results) as well as funding bias (i.e. there are certain research topics that are “trendy” to fund).	<ul style="list-style-type: none">● The key services selected are relative to people’s values & “services” are perceived as valuable based upon the individuals who find it important.● All users who are benefitting from these services at each reserve were not necessarily engaged to select key services, we assume that representatives attending our workshops raised important points.	<ul style="list-style-type: none">● Product could be adapted to be more dynamic & interactive, enabling users to input estimated changes & the anticipated result on how the system would be expected to change.● Incorporating risk assessment into the model to help evaluate the risk of making a “wrong decision” as a way to consider how high the stakes are for trusting the information included in the evidence library.● Expand to include case studies with specific example sites where services have been impacted by a particular storm.● Create one-page fact sheets to make the document more accessible to particular user groups like policy-makers or homeowners.● Connect this product to applications for benefit-cost analysis (BCA) – use the conceptual model to help ensure ALL costs and benefits are included in a BCA.

Mangrove Management Decision-Making Based on Data, Resources, and Values

Brita Jessen, Technical Lead, S.C. Sea Grant Consortium

Maitreya Suchocki, Undergraduate Student, Warren Wilson College

Limitations & Uncertainties	Assumptions & Context	Opportunities & Future Recommendations
<ul style="list-style-type: none">● Sample Size: Only able to do interviews & one focus group at each location.● Managers with prior experience or understanding of Resist-Accept-Direct may have an easier time responding to some of the questions.● There was some translation needed in the focus group in Puerto Rico; interviews were all conducted in English (which may have limited our sample size).● While we offered anonymity to all participants, we understand that some hesitation may exist to criticize the priorities or decisions within one’s professional agency.	<ul style="list-style-type: none">● Information gained through the focus groups and interviews are representative of the resource management communities in Puerto Rico and Florida.● We assumed that managers’ goals of healthy and sustained ecosystems were generally aligned; however, some agencies may have objectives that differ (e.g., prioritizing human recreation vs wildlife essential habitat)● It was assumed that managers attending our focus group or interview had a leadership voice in the decision-making of the resource organization they represented.	<ul style="list-style-type: none">● All participants of our focus groups and interviews stated a strong interest to develop a suite of options under climate scenarios using the Resist-Accept-Direct (RAD) method.● Based on this interest, developing inter-agency working groups and training opportunities for RAD-based collaborative discussions for U.S. mangrove systems is an important next step.● Managers identified several needs for continued multi-disciplinary research including: public perceptions of mangrove recovery; long-term effects of drought; monitoring data for hydrologic reconnection of mangroves and salt marshes.● Implementing adaptive and/or novel management options for changing systems will be contingent on agency priorities, rules, and public support. Therefore continued co-collaboration is an essential need.

Management Activity Using the RAD Framework

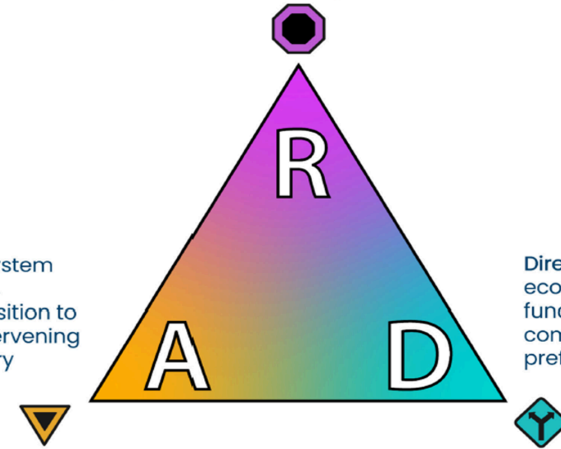
- This activity engaged participants to discuss the utility of close collaboration to develop strategies for managing mangroves within a changing climate.
- Various climate scenarios were provided to small groups and groups were asked to brainstorm potential adaptation actions and to outline the potential data and tools required for each.
 - Suggested adaptation actions spanned a range of strategies (Resist, Accept, or Direct) and often included a combination of strategies.
 - A summary of the proposed adaptation actions suggested by participants can be found online.

The RAD conceptual figure to the right was used for the above activity, courtesy of the [U.S. Geological Survey](#).

Resist: Work to restore or maintain ecosystem processes, function, structure, or function based upon historical or acceptable current conditions

Accept: Allow ecosystem processes, function, structure or composition to change without intervening to alter the trajectory

Direct: Actively shape ecosystem process, function, structure or composition toward new preferred conditions



Spotlighting Collaborative Science - Co-Production: What We Did & Why it Worked

Brita Jessen, Technical Lead, S.C. Sea Grant Consortium

Our working definition of Co-Production is defined by *Beier et al. 2016 Conservation Letters 10(3), p. 288-296*: “Collaboration among managers, scientists, and other stakeholders, who, after identifying specific decisions to be informed by science, jointly define the scope and context of the problem, research questions, methods, and outputs, make scientific inferences, and develop strategies for the appropriate use of science.”

Guiding Principles for Co-Production

Co-production begins with decisions that need to be made.
 Relationships & interactions are prioritized over products.
 End-user collaboration in project design & approach is key.
 Prioritize responding to change over following a plan.

Lessons Learned:

- Co-production takes more time, resources, and planning.
- Success and longevity are proportional to time devoted to relationship-building.
- Transparency between the project team and advisory committee was key.
- Co-production can lead you in a direction you didn't expect.

Strategies Used for Continued Engagement

Identify the issues: The challenges following hurricane disturbance were identified by local community members and the project team through cross-site visits.

Define the science: The project team addressed the identified issues by developing research questions to better understand the recovery of mangrove forests and associated services following hurricane disturbance.

Incorporate feedback: Two local and one technical project advisory committees (PACs) were created consisting of 38 members representing 25 different institutions.

Know when to pivot: The project management incorporated Agile techniques to respond to unanticipated opportunities, challenges, and needs for new products.

MCC Project Team Agile Approach

1. Schedule Meetings with PACs
2. Hold PAC Meetings
3. Summarize Meeting Notes
4. Discuss Recommendations
5. Project Team Review
6. Formalize Response
7. Communicate to PAC
8. Collect and Analyze Data
9. Prepare Outputs for PAC Review



Mangrove Science & Monitoring - A Regional Perspective

We had the opportunity to hear about mangrove science and management across the region. Below are the regional perspectives represented.

Managing and Monitoring Mangrove Habitats in the Mission-Aransas Reserve

Joan Garland - Mission-Aransas NERR, Coastal Training Program Coordinator

Growing Research, Restoration, Outreach and Education of USVI Mangroves

Allie Durdall - Center for Marine & Environmental Studies, University of the Virgin Islands

Spatio-temporal Dynamics of Mangroves at their Northern Range Edge in Apalachicola Bay, Florida

Jenny Bueno - Apalachicola NERR & Florida State University, Margret A. Davidson Fellow

Guana Tolomato Matanzas National Estuarine Research Reserve Mangroves

Lia Samson - Guana Tolomato Matanzas NERR, Reserve Manager

Mangrove Coast Collaborative Meeting Wrap-Up Discussion

Important Considerations for Future Mangrove Research	Collaborative Opportunities for Future Mangrove Research
<ul style="list-style-type: none">➤ Different perspectives of mangroves exist at their northern range extent compared to locations where mangroves are dominant along the coastline: mangroves as “invasive” vs. “protected”.<ul style="list-style-type: none">○ How do we reconcile these different perspectives and create a cohesive message from researchers and managers regarding the importance of mangroves to our coastlines?➤ How do our local communities view mangrove movement and migration?<ul style="list-style-type: none">○ Trying to fight (resist) the inland movement of mangroves is akin to fighting the ocean. There are strategies to delay coastal transgression but ultimately rising seas will result in net loss of coastal wetlands without pathways for inland migration.➤ Need to educate the public on strategies for coastal wetland management such that decisions related to resisting change versus managed retreat are well understood.<ul style="list-style-type: none">○ Importance of “knowing when to hold them and when to fold them.”	<ul style="list-style-type: none">➤ The mangrove-urban interface is a new challenge for mangrove research and management.➤ Language and education matters: emergent mangroves may be considered invasive in new regions; yet are protected at the state level.➤ There is a continued need for shared methodologies, transferability of monitoring data, and data and protocol accessibility.➤ Regional hydrology has changed substantially along many coastlines. It is important to manage for current conditions as we cannot often restore to historic conditions. However, freshwater restoration will be essential to aid in movement of mangroves inland.➤ Participants identified a need to develop and study effective nature-based solutions.<ul style="list-style-type: none">○ In Florida, lots of movement towards “protecting coastlines” with a focus on human infrastructure. More collaborative research and education is needed to develop and implement “green/gray” infrastructure projects.

Let's stay in touch!

Email the Project Lead, Danielle Ogurcak (dogurcak@fiu.edu) for questions & additional information.



If you would like more information or access to the resources, scan the QR code to the left or visit: <https://nerrsciencecollaborative.org/project/Ogurcak20>