FWC/FWRI Integrated Mapping and Monitoring Programs

Horseshoe Cove and Suwannee Sound Workshop Report




Hosted by the

Florida Fish and Wildlife Conservation Commission

Fish and Wildlife Research Institute

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Executive Summary

Workshop Background and Goals

FWRI's integrated mapping and monitoring programs compile and coordinate mapping and monitoring information for seagrasses, coastal wetlands, and oyster reefs across the state of Florida. Statewide reports have been published documenting the status and trends of these coastal ecosystems, and multiple workshops have focused on improving collaboration and information sharing. The Horseshoe Cove and Suwannee Sound region (from Cedar Key to Pepperfish Keys, see Fig. 1) was selected as a target area for a collaborative workshop focused on a variety of coastal living resources due to the loss of oyster reefs, seagrass beds, and landward migration of salt marshes in one of the most undeveloped coastlines in Florida (and the United States). The area also receives less scientific and public attention compared to other coastlines in Florida.

The goals of the Horseshoe Cove and Suwannee Sound workshop were to:

- Discuss status, needs, and opportunities for living resources in the Horseshoe Cove and Suwannee Sound and its associated watershed.
- Facilitate communication and coordination among local experts, land managers, and funding entities working in Horseshoe Cove and Suwannee Sound.

The workshop was held virtually over three days and was attended by 86 participants, including the organizing committee. The 20 presentations and three sets of facilitated discussions focused on fish and wildlife, habitat and water quality, and the local funding arena. Presentations from the workshop are available at https://ocean.floridamarine.org/OIMMP/.

Key Findings and Conclusions

Seagrass beds have declined over several decades in the Horseshoe Cove and Suwannee Sound region, likely as a result of increased light attenuation caused by phytoplankton growth associated with nutrient output from terrestrial sources. Offshore oyster reefs in Suwannee Sound have also declined, presumably because of some combination of harvest and increased salinity due to sea-level rise and reduced freshwater flow, which may have increased rates of predation and disease. The loss in oyster reefs has resulted in a reduction of nesting habitat for the American Oystercatcher. Salt marshes are shifting inland due to both sea-level rise and reduced surface water flow, often overtaking regions previously occupied by upland forests which were killed by saltwater intrusion ("ghost forests"). Imperiled bird species that depend on salt marshes for nesting habitat avoid nesting near ghost forests as the dead trees provide perches for predators. The region is also experiencing tropicalization, whereby more tropical species such as mangroves, common snook, and corals have been found in increasing number as their ranges expand northward in response to warming temperatures (and a decreasing frequency of cold events). Water quality data (e.g., flow rate, discharge, and nutrient concentration) are

available for nearshore waters and the associated watershed from the Suwannee River Water Management District and Big Bend Seagrasses Aquatic Preserve.

A commonly discussed theme at the workshop was the need to provide synthesis of existing data across multiple habitats to determine ecosystem-wide connections and necessary management actions to improve conditions for coastal resources. A conceptual ecological model (Fig. 2) was developed with input from workshop participants that showed the variety of factors that impact coastal living resources in the region (e.g., land use, habitat loss, water quality, species shifts). The conceptual ecological model can be used to help to link the importance of healthy coastal resources with the local economy and enhance the local and political conversation.

Conclusions from the workshop indicate the need for collaborative capacity to facilitate proactive conservation action, including development of a communication strategy to engage local governments and citizens. This region has numerous governmental agencies, non-governmental organizations (NGOs), academic partners, and local entities committed to the protection and enhancement of the natural resources. This informal partnership with a shared vision would benefit from dedicated leadership and support.

Recommendations

- Compile and synthesize existing scientific data across coastal habitats.
    - While scientific and monitoring gaps remain and should continue to be filled, enough is known about the region to understand general status and trends information.
- Using the synthesis, develop a clear storyline and method of communication for reaching the public and policymakers.
    - Link the importance of healthy coastal resources to the local economy and livelihoods (e.g., fishing, scalloping, tourism).
    - Use tools such as the conceptual ecological model, a cohesive storyline, and talking points as part of broadscale communication.
    - The message should be proactive rather than reactive, highlight economic importance, instill a sense of stewardship, and demonstrate how the region could change if conservation action is not taken.
- Reinvigorate the Big Bend Conservation Area Partnership or similar multi-partner coordination team to establish a vision for the larger Big Bend region and facilitate collaborative, proactive conservation action.
- Identify management actions to address ecosystem stressors.
    - For instance, nutrient reduction is a reasonable goal and is likely to benefit a variety of coastal habitats, particularly seagrasses.
- Continue large-scale restoration efforts that improve broader ecosystem conditions.
    - Models can be used to help select locations and predict impacts, but models should be critically evaluated with data.

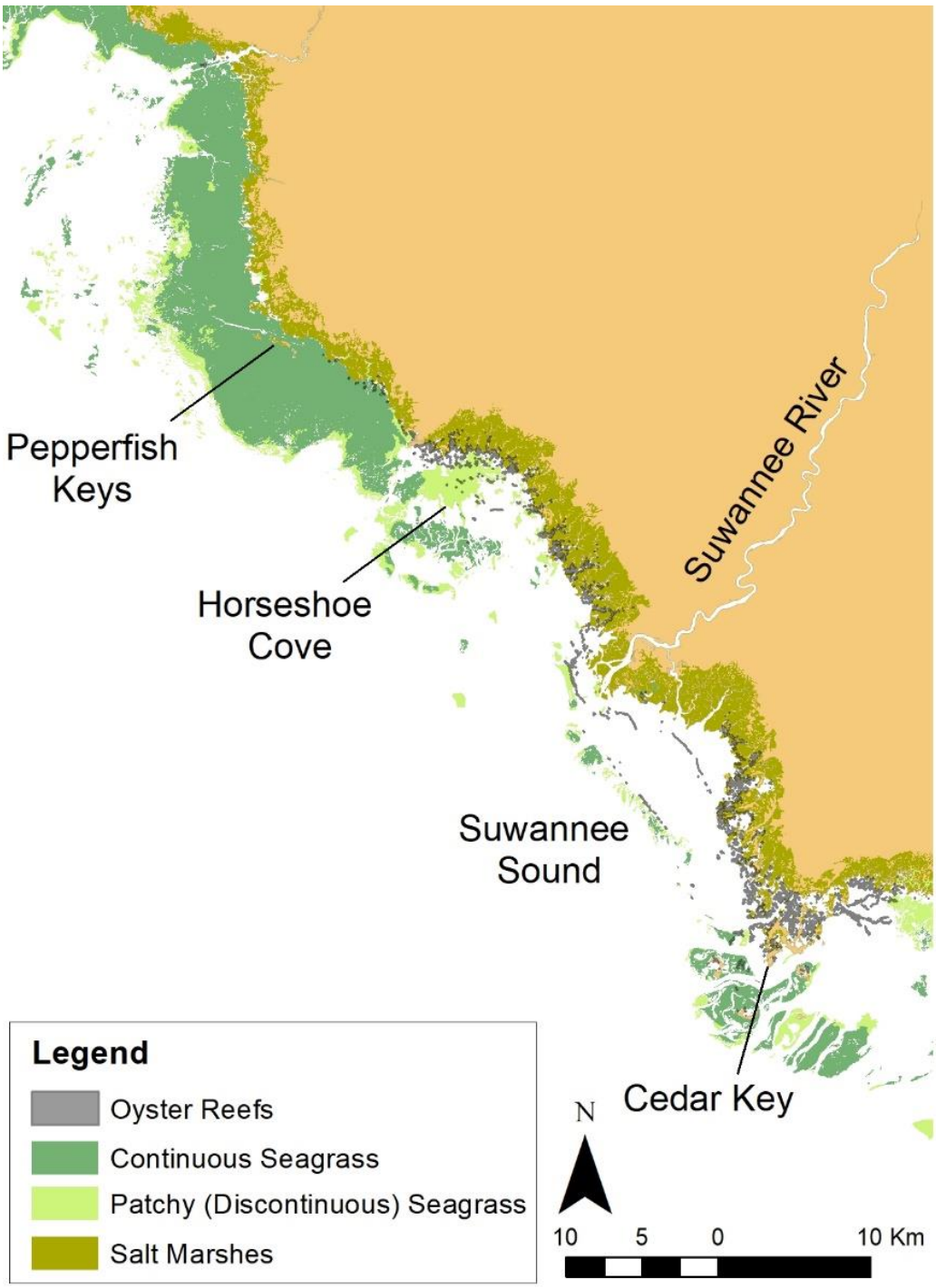


Figure 1. Mapped coastal habitats within the region of focus for the workshop, from Pepperfish Keys to Cedar Key. The shapefiles used to create this map were obtained from https://geodata.myfwc.com/.

Conceptual Ecological Model

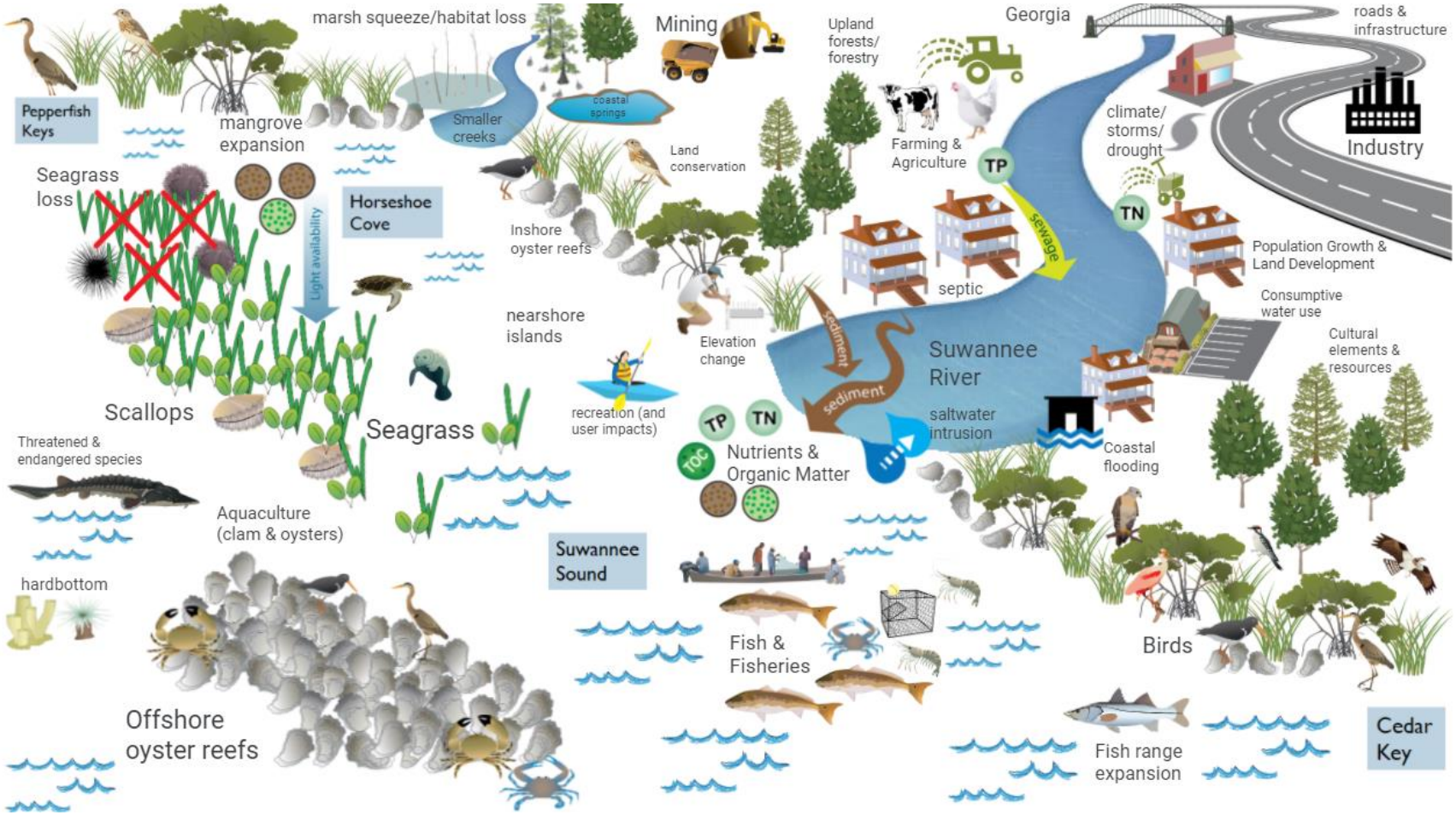


Figure 2. Conceptual ecological model of the Horseshoe Cove and Suwannee Sound region. The model was drafted with input from regional experts prior to, and during, the workshop. This model attempts to capture the major ecological resources, threats, and processes in the region. It is not intended to be fully comprehensive, and many components and interactions in the model could be further described by their own conceptual sub-models. Further information related to the model discussion can be found under Day 2, Question 4 facilitated discussion notes.

Facilitated Discussion Summaries

The discussion summaries below were compiled from written notes documenting verbal discussion and typed chat comments during the workshop. A further list of references and resources from the workshop can be found in the "Useful References and Websites" section of this report.

Day One Theme: Fish and Wildlife

1. What are the key information gaps which have been identified based on the presentations and your own knowledge and understanding?

- Oyster reefs
  - Given the observed decline in oyster abundance, refinement of the causal factors of observed declines is needed, including changes in salinity and commercial harvest. Any other causal factors that may be involved also need to be identified.
  - Most oyster data are based on commercial landings at this time. Fisheries independent monitoring is needed, but this gap will be largely addressed by FWC monitoring efforts in the Suwannee Sound starting in 2021.
  - Collapsed oyster reef systems are very difficult to restore. It is preferable to maintain and enhance existing reef systems.
  - The interactions between salt marshes and adjacent oyster reef communities, including the impact of oyster restoration on salt marshes, need further research.
  - There is a big difference between intertidal and subtidal oyster reef communities, which require different approaches in term of monitoring and their management. For instance, differences in the catch per unit effort and commercial landings between different intertidal and subtidal oyster reef communities have been observed.
  - More emphasis on subtidal reefs in the region in terms of our individual and collective monitoring efforts is needed.

- Coral and hard-bottom
  - There is a need to track changes to marine hard bottom communities —there is a lot of lime rock substrate for the organisms to form colonies.
  - Further information is needed on whether a transition to new coral reef communities in the southernmost areas of our region is occurring (see Furman et al. 2020).
  - Stony coral disease responses need to be factored into sampling efforts.
  - There is need to understand the role of sponge communities and mixed seagrass/sponge/soft coral communities with regards to inshore/offshore connectivity and fisheries productivity.
  - FWC fisheries independent monitoring may be under sampling 5 to 15 m depths due to the current structure of the random sampling design.

- Modeling efforts
  - There have been some larger scale modeling efforts which have captured parts of this region in the past (e.g., SLAMM).
  - There have been some modeling and studies of social and economic factors of communities in this region (e.g., the Conservation Fund's Economic Analysis for Big Bend Region of Florida, and Planning for Coastal Change in Levy County).
  - Many modeling (and other research and monitoring) efforts are being driven by specific research project funds which only last for several years.
  - There is need to confirm accuracy of model predictions to assist with conservation efforts.
  - There is a need for more reliable fish diet composition information, particularly for the purpose of predicting the impact of increasing snook (*Centropomus undecimalis*) populations in the entire Big Bend region.

- Other comments and needs
  - Better mapping of coastal fronts—e.g., saltwater intrusion, changes in saltmarsh—is needed to address temporal and spatial scales to ensure the best data are available to make regional decisions and understand the most vulnerable habitats.
  - Understanding the attitudes of the people living in this region is needed.
  - It is necessary to test actual hypotheses during restoration efforts and examine if results met expectations or not. Framing clear hypotheses will enhance understanding of what is behind observed ecosystem responses.
  - Work with regional partners to fill in these recognized data gaps.

2. What are the gaps in the existing monitoring programs which need to be filled to address those information gaps?

- Associated wildlife
  - Salt marsh avian and mammal communities need to receive more emphasis. Existing monitoring data are sparse spatially and temporally and are not adequate to answer important research questions.

- Oyster reefs
  - If a similar discussion had been held 4 years ago, there would have had a much longer list of oyster monitoring and mapping needs. Fortunately, some of those gaps have been filled for oyster reefs with recent and upcoming mapping and monitoring.
  - The new oyster monitoring and habitat suitability indices by FWC will provide more information to link our different tools together.
  - As oyster habitat suitability indices are built, information gaps (and, therefore, monitoring gaps) need to be considered as the habitat suitability index are linked with other management tools and management decision-making needs.
  - All the monitoring programs for the Cabbage Key reef restoration project are 100% grant funded. Many other monitoring programs presented at this workshop are also grant funded, which makes it difficult to collect long-term datasets.

- Funding long-term monitoring programs
  - Monitoring programs which have specific objectives (or management decision-making objectives) are more likely to be funded, especially in the long term.
  - There are other monitoring program designs based on funding models which can be sustained in the long term, even in times of budget crunches.
  - There must be an identified need for the monitoring itself, but there also needs to be a unified stakeholder community support for the need to secure sustained funding for monitoring programs.
  - In this region, there is need to transition from a user-based need—e.g., fisheries independent monitoring—to management-based needs for monitoring when seeking funds for monitoring programs.
  - The community needs to be ready well in advance with a clear set of monitoring needs and "shovel ready" projects to get a monitoring or restoration program started up rapidly in order to take advantage of the state and federal funding sources. Tailoring those monitoring program to the funding source is also important.
  - Agencies do have funds dedicated to specific issues and needs which could be invested in monitoring. However, those responsible for securing funds through state budgets are challenged with an array of funding priorities. Many of our sources of funds can be used to start up a monitoring program, but not for long-term funding to sustain an established monitoring program.

3. What additional management actions need to be taken to address current status and longer-term trends in the fish and wildlife resources and their habitats?

- Oysters
  - There is need to determine if oyster harvesting is sustainable.
  - From the state perspective, this is a concern regarding overfishing or sustainability of harvest given other harvest closures in the state.
  - Future resiliency should be created on a scale that will make an actual difference on these issues. For instance, the Lone Cabbage reef restoration is an example of an appropriately sized restoration project for regional impact.
  - Modeling tools can help determine the location for a specific restoration project which can incorporate resiliency at the necessary level.

- Other fauna
  - Continue to use monitoring data to effectively manage bird habitat.
  - There is a good toolbox in place for using the monitoring and mapping data. However, monitoring and adaptive management need to be continued to avoid losing bird populations.
  - There are some endangered and threatened species plus Species of Greatest Conservation Need non-game wildlife in the region.

- Habitat
  - Resource managers are interested in the best places to locate restoration projects.
  - The Nature Conservancy is working at system-level scales (e.g., land, freshwater, estuaries, etc.) rather than at the scale of individual habitats.
  - Understanding how an entire system reacts is critical to understanding how the same system will respond to specific restoration projects and programs.

- Climate change
  - For the Water Management District, sea-level rise is a critical issue.
  - Climate change impacts on land and water need to be fully considered as we continue to take a whole-system approach.
  - The smaller communities along this region's coastline do not have the resources necessary to better plan for the effect of continued sea-level rise.
  - There is need to help smaller communities with planning for continued sea-level rise, their supply of freshwater, the effects of more people moving to the region, and other impacts influencing aquatic, estuarine, and marine resources.

- Water use
  - The State of Florida's own water modeling efforts suggest the Suwannee River Basin will be facing significant water capacity issues in the coming years to the next decade.
  - Freshwater discharge will continue to be a growing issue given the absence of surface water storage (e.g., reservoirs) and reliance on groundwater storage.
  - Importance of surface and groundwater freshwater flows needs to continue to be emphasized. Thermal refuge of groundwater flows into coastal habitats is critical for manatees.
  - The pending 'water war' for this region needs to be recognized and addressed before it occurs.
  - Water quality and quantity improvement projects is another important priority for the Water Management District.

- Regional ecosystem and restoration
  - The creation of a hierarchy of key uncertainties is needed, including how the existing efforts in this region are helping to inform and quantify these uncertainties.
  - Different models which can be combined will help show where to focus restoration work for the best return on investments in term of restoration responses across species/communities.
  - It would be beneficial to have a collective understanding of where resource communities are heading in the coming decade or two given past and recent trends.
  - Having an objective or a series of objectives for the region from the collective community would be very helpful to managers that have statewide responsibilities.
  - Rather than thinking in terms of individual restoration projects, restoration and management efforts should focus on the resiliency for the future state of the ecosystem. Put individual decisions in the context of the desired future state.

- Human uses and economic impacts
  - Issues are often approached from a natural systems viewpoint. However, they should also be approached from an economic perspective.
  - The unintended consequences of human uses, even in this relatively undeveloped region, need to be quantified and addressed. Examples include the use of bird nesting habitats for recreation and scallop harvesting.
  - Although the area is relatively unimpacted directly, it is still being impacted indirectly as evidenced by the documented losses of seagrasses and declines in oyster reefs. Those impacts are only likely to increase into the future.
  - Scientists and managers are going to continue to play catch up for a while as they continue to build up an understanding of the resource communities within this region.

- It is necessary to: 1) shift the focus to what is valued; 2) quantify the risks to what is valued; and 3) quantify the economic impacts or benefits of specific decisions and restoration actions.
- Economic and social data sets need to be combined as well as findings that are being collected by an array of state, federal and regional agencies, and academic institutions.
- Focusing on economic impacts and benefits should be a collective target.
- Different economic scenarios should be examined, including in the context of a desired future state.

4. Other ideas and feedback: Identification of key user groups and their participation

- The actual user groups are missing from this workshop —e.g., commercial and recreational fishers— that have a significant amount of local knowledge and insights.
- There have been a lot of discussions with local government leaders, but many of the participants in this workshop are not aware of those interactions.
- The larger community is not learning incrementally about what local stakeholders are thinking and what are their perspectives.
- Many local partners have received similar repetitive inquiries and are now to the point of wondering why they are being asked similar sets of questions.
- There is more longevity in the local decision makers and stakeholders versus the higher turnover that can occur among academics and scientists.
- It is necessary look at what local outreach has been already done and benefit from those findings.
- Local partners and decision makers have been involved in the past and are continuing to be engaged. This effort should proceed in a way that others benefit from these engagements without repeating what has already been done.
- Other stakeholder groups that should be engaged include the business community and tourism industry.
- Stakeholder groups may be more easily engaged in smaller groups.

Day Two Theme: Habitat and Water Quality

1. What are the key information gaps which have been identified based on the presentations and your own knowledge and understanding?

- Coastal forests
  - The demise of coastal forests is well understood. K. Ewel, E. Raabe, and others have documented the decline of salt-intolerant tree species such as red cedar and sabal palms over the past three decades (e.g., Raabe and Stumpf 1997, 2016).
  - McCarthy et al. (2018) have shown that salt marsh species invade and ultimately replace "ghost forests."

- Salt marsh
  - Scientists have not seen signs of die-off in the marsh, but marsh banks might be degrading, and the location of salt marshes are shifting inland. The frequency and duration of tidal inundation of marsh banks will change as a result of sea-level rise.
  - Remote sensing and GIS are useful in mapping changes in salt marsh habitat.
  - More information is needed to quantify inundation stress on salt marsh species.
  - The effects of mangrove colonization in Big Bend salt marshes are still largely unknown.

- Seagrass
  - The spatial pattern and chronology of seagrass loss in Horseshoe Cove is well documented and alarming (Carlson et al. 2010). However, perhaps because the area is sparsely populated, the level of concern is not sufficient to drive management action to protect and restore seagrasses. There is an urgent need to inform policy makers of seagrass losses in the area and to determine strategies to restore seagrass.
  - Unfortunately, seagrass recovery in Horseshoe Cove might not be possible, but we do have a window to save the seagrasses in smaller estuaries such as the Steinhatchee and Econfina. Smaller watersheds are more tractable and responsive to nutrient reduction actions.
  - There is a need to communicate the implications of seagrass and other habitat loss on the fisheries and ecotourism economies of the area.

- Data synthesis
  - There is a need to recognize that synthesis is important, not just data collection. Big drivers over time are important to understand, such as changes in freshwater discharge. Florida Monitoring and Adaptive Management (MAM) RESTORE funds related to Deep Water Horizon may be a resource.

2. What are the gaps in the existing monitoring programs which need to be filled to address those information gaps?

- Salt marsh
  - Long-term monitoring is needed in salt marshes. Mapping data is more readily available than monitoring data. Historically, the National Wetlands Inventory has provided status and trends information on coastal and freshwater wetlands throughout the United States. However, the

most recent NWI data were published in 2009. More recent wetland mapping data are available at geodata.myfwc.com and from the Water Management Districts.

- FDEP
  - The Aquatic Preserves need a solid nutrient monitoring program to track trends. Currently very limited data are collected.
  - There is a lot of ongoing monitoring, but coastal and estuarine areas are not as well represented. Some data are not available to the public, so are not available. FDEP is not aware of a seagrass database (however, FWC Information Science and Management staff collate statewide data).

- SRWMD
  - There are gaps in the current monitoring networks. SRWMD focuses on watersheds, rivers, and springs. Consolidating and synthesizing data from other entities to look at patterns holistically is needed. The Watershed Information Network and STORET (WIN/STORET) are good starting places for water quality data; biological data does not appear to be in one place.

- Sediment data
  - Sediment accretion and subsidence information are very important for understanding how the coast will respond to sea-level rise. More information and data are needed. There are a few efforts around the state, for instance feldspar marker horizons to quantify sediment deposition and Surface Elevation Tables (SETs) to monitor elevation change. Techniques are standardized, and monitoring is in place in other areas. There are two SETs in the NWR—they are no longer monitored, but they are still out there.

3. What additional management actions need to be taken to address current status and longer-term trends in habitat and water quality?

- With the declines in seagrass, oysters, salt marsh stress, quantity and quality of freshwater inflow seems to be key. This may be as much of a political discussion as a management issue.
- Three courses of actions are needed:
  - Understand the available science and data
  - Identify management actions to address stressors
  - Develop clear and digestible storyline for the public and policymakers
- There is need to synthesize and link coastal changes to broad-scale and upstream effects, such as land use and climate change.
- Both a synthesis and citizen support are needed to reach the policy makers. A storyline is needed for the public, so that they can let their governmental representatives know. Managers need to help get this information to the public.
- The broader effort about communicating science in SW Florida and Everglades is a good resource and example.

4. Conceptual model and creating a storyline

- Conceptual model general comments
  - It helps to show complexity in a visual way will help to share information with the public.
  - With many factors in the diagram, any stakeholders can find something with which they relate.

- Newspapers and journalists love conceptual diagrams/graphics along with the scientists telling the story.
- This model could be used as an interactive outreach tool, such as by asking the public to describe the link between the model components.
- Smaller sub-models are also needed to clearly show interactions between components.
- Having multiple models has been beneficial and allows for showing the connections and agreement between each sub-model. Alternatively, a sub-model could be tailored to a specific industry (hotels, restaurants, fishing, etc.) to show how the various components impact their business.
- It is possible for the models to be so complex that it confounds the most important linkages.
- Conceptual models help find data gaps, but funding sources need to be connected to the people. If it can be shown how these products fit to the management goals of each district, it would help the governing board understand the importance of a project.

- Conceptual model components
  - Fishing, recreation, and clam and oyster aquaculture are important economic drivers in this region.
  - Sea-level rise, leading to saltwater intrusion, is major factor impacting coastal ecosystems.
  - Septic tanks in Levy and Dixie county are another major component; there is need for septic-to-sewer conversion.
  - Storms and hurricanes impact many of the systems within the model.
  - Dylan Sinnickson's existing Ecopath model has the potential to look at a lot of the components of the conceptual model.
  - The University of Florida was recently funded to study and model "The ecological and economic impacts of land use and climate change on coastal food webs and fisheries" in the Suwannee River Basin.

- General storyline comments
  - Make the connection clear between water resources, habitats, and fisheries (e.g., water quality → seagrass → scallops).
  - This is analogous to the Chesapeake Bay example: fertilizer → water quality → crabs → crab cake sandwiches.
  - Livelihoods and cultures rely upon having a healthy coastal ecosystem.
  - Link natural productivity to the economy of the area (recreational benefits as well as impacts).
  - Show that change is coming and fairly rapidly, not just changes due to sea-level rise, but changes as a result of species expansion, and changes to drinking water availability.
  - It is necessary to communicate to the public the importance of change that will be occurring in the future and how this change will directly impact them.

Day Three Theme: Funding and What's Next for the Region

Horseshoe Cove and Suwannee Sound: What's Next?

1. We heard a need for synthesis—what are the key next steps that should be taken coming out of the workshop? Who is willing to take the lead?

- There is a need to create a story with details on who is involved and what projects and programs exist.
- There is a need to create a team that can promote the story and find a ringleader – this can start with a comprehensive contacts list generated from the workshop.
- Finding the right group may be a challenge. The Big Bend Conservation Partnership is no longer active. A new opportunity may exist within the Landscape Conservation Catalyst Fund opportunity.
- A systematic approach should be taken to define goals, then steps should be taken and mechanisms identified to reach those goals.
- Nutrient reduction is a reasonable goal, as any nutrient reduction will benefit coastal resources.
- Promoting the region and its story effectively will require two parallel tracks merging data from the policy and science realms. This working group is largely a science group, so there is a direct need to get the political group involved. There is optimism that both State and Federal political regimes could be favorable to environmental issues in the region now.
- The Big Bend Science Symposium is a potential storytelling outlet to raise the profile of the region. The symposium needs to expand the audience to incorporate policy as well as science and include local leaders and county officials. This workshop has provided good background and potential opportunities to reinvigorate the symposium.
- FWC has the potential to provide some regional leadership through the hiring of a regional landscape biologist within the division of habitat and species conservation in aquatic habitat conservation and restoration.
- Turn-over of collaborators is a challenge to piece things together. Bring in newcomers so that they can get up to speed on the storyline.

2. The conceptual ecological model garnered a lot of attention during the workshop. Who in the community would be willing to work together to take the conceptual model to the next level and help build out several storylines?

- Other conceptual models for the Suwannee River Basin are in the process of being created by UF (Mike Allen and colleagues) through their new project "Ecological and Economic Impacts of Land Use and Climate Change on Coastal Food Webs and Fisheries." Part of this UF project is communication. A Community Advisory Panel will be formed as part of the integrated modeling approach, and the framework is already in place. While a conceptual model specific to the project already exists, it would be helpful to consider the model developed in this workshop as an opportunity to represent the region with broader focus. A key to all model development is to get local stakeholder input.

- The region may have a problem of perception – many think it is in good condition now, or think if you identify and fix one problem, you do not need to do more work. Taking proactive measures that integrate multiple "problems" the public cannot otherwise see and communicating those needs via the conceptual model may be a great way to tell the story.
- No action vs. action – target specific stakeholders to long-term stewardship. Subsets of models could reach those specific stakeholders and tell different messages to different audiences. Different audiences need different messages, e.g., fishing guides, restaurants, and entities such as the Soil Conservation District have different perspectives and priorities.
- Demographics are very different in this region than other areas of Florida. In most regions, stakeholder engagement drives environmental policy changes, here this group is trying to reach out to stakeholders.
- It is necessary to directly engage with resource users such as fishing guides, who can be very influential and important for outreach. An economic argument should be made first, followed by the environmental argument to support conservation efforts. Fish camps and hunt clubs are powerful cultural forces in the region.
- There is a need to bring in communication and outreach specialists early in the process, especially for policy level and broader audiences. Could one person be the designated communicator?
- Livelihoods and economics link to healthy environments. Look to Pew for help with communications in this arena.

3. We heard an interest in further collaboration to fill gaps in monitoring among the existing monitoring programs—what could be the next steps? Who can take the lead to convene a group work on filling these gaps?

- There are a number of programs and data portals already serving the region, including: SRWRD's water data portal, Florida Water Resources Monitoring Council, and the Watershed Information Network (WIN/STORET). Water-CAT includes metadata on who is doing what, contact info, attribute table, sample locations. Terra-CAT, hosted by FWRI, includes a metadata catalog and information on aquatic and terrestrial species. FWRI's geodata website provides a repository of GIS data.
- There is need for more coordination and understanding the role of autonomous monitoring.
- FWRI's OIMMP will continue to collaborate with others to fill gaps for oysters and collaboratively monitor resources in the region. OIMMP serves as a place to accumulate statewide monitoring information into one system.
- Pew Charitable Trust is looking for areas where policy can be used to change the conversation and facilitating coalitions.
- There may be an interesting opportunity for a social science project to study local user group level of understanding and attitudes towards current and emerging issues along the Big Bend.
- If a need for a place/expertise-based position is demonstrated, USFWS may be able to establish a position to focus on addressing need. This community would need to identify and articulate the need(s) to make this happen.

4. What are the upcoming planned events and ongoing efforts where we could continue this collective dialogue and work further on collaboration?

- Big Bend Science Symposium could consider expanding to include the public, elected and community leaders, outreach and communication, and schools. However, this is currently on hold due to the pandemic and it is unclear when the event may return.
- Cedar Key public events- art festivals, fishing tournaments, and sailing events and provide opportunities to get the storyline out to the general public.
- Family Fishing Days- promoted conservation.
- Chili Cookoff- combining food and science is always good.
- Nature Coast Biological Station is good at getting people involved.
- Conduct outreach Beach clean-ups, other public events- outreach.
- Put hunters on National Wildlife Refuge mailing list. Use this to get the message out?
- The Aquatic Preserve piggybacks on other events (e.g., Steinhatchee Fiddler Crab Festival, Science nights at schools).
- Florida Birding Trail, Florida Paddling Trail, State Parks, Cedar Key Library lecture series.
- Those that want to know, know about the declining resources. How to reach others that may need to know? There is a need for communicating this, but how to do it? For instance, it is general knowledge that oysters are declining, but many do not know why this is an issue. Providing a common set of talking points is very important.

Horseshoe Cove and Suwannee Sound: Funding potentials and communication avenues

5. Are there other available funding entities which could help address the information gaps we have identified?

- For private landowners, USDA NRCS (Natural Resources Conservation Service) is a good source of funding, specifically the Regional Conservation Partnership Program and the Conservation Effects Assessment Project.
- Federal funding sources: U.S. Fish and Wildlife Service Coastal Program, USFWS Service North American Wetlands Conservation Act Grant, USFWS National Coastal Conservation Grant Program (work through Florida state agencies), National Oceanic and Atmospheric Administration Marine Debris Removal, Prevention and Research Grants, NOAA Fisheries Cooperative Research Program (local, state and federal partners), National Coastal Resilience Fund (NOAA funds administered by NFWF), numerous U.S. Environmental Protection Agency grant programs (Region 4 webpage), including the Wetland Program Development Grant.
- State funding sources: Florida's State Wildlife Grant Program (USFWS funds administered by Florida Fish & Wildlife), Coastal Partnership Initiative Grant Program (NOAA funds administered by Florida DEP), Springs Restoration funding, Water Protection Grants through the State's Environmental Grant Project Proposal Portal.
- Suwannee River Water Management District Funding Initiatives, including Alternative Water Supply Grant Program (AWS), Agricultural Cost-Share Program, Regional Initiative Valuing Environmental Resources (RIVER) Cost-Share Program, School & Community Water Resource Grants
- Disney Conservation Fund

- Rotary International recently added "Protecting the Environment" as an area of focus. To find Rotary Clubs in the area, go to the Rotary District 6940 website.

6. You are in charge of this region—what are the top funding priorities which need to be addressed to start addressing the needs identified through this workshop?

- This region was selected as a workshop focus because it was believed to be information-poor and it has seen declines in resources, e.g., seagrasses and oyster reefs. Given the work underway in the shoreline and nearshore environments, there is likely a need to look upstream into the watershed to address concerns about freshwater flow and excess nutrient runoff.
- Communicating the current status of our resources is a critical need.
- Define the vision and objectives for this region.
- Although more research may be needed (e.g., complete pilot-scale work), there is enough understanding about the sources and effects of excess nutrient runoff to implement projects that address the pollutant loads.
- The seagrass community's trends show a compelling need for intervention, but the message needs to be spread to a wider array of audiences and needs political support.
    - There is need to develop user-specific talking points outlining the current state of the region.
- Identify a focal point for our efforts—could be a specific habitat or animal (e.g., scallops).
- A state-level funded outreach effort is needed that is focused on relaying the science to the public to engage the local and broader community in the region's conservation future.

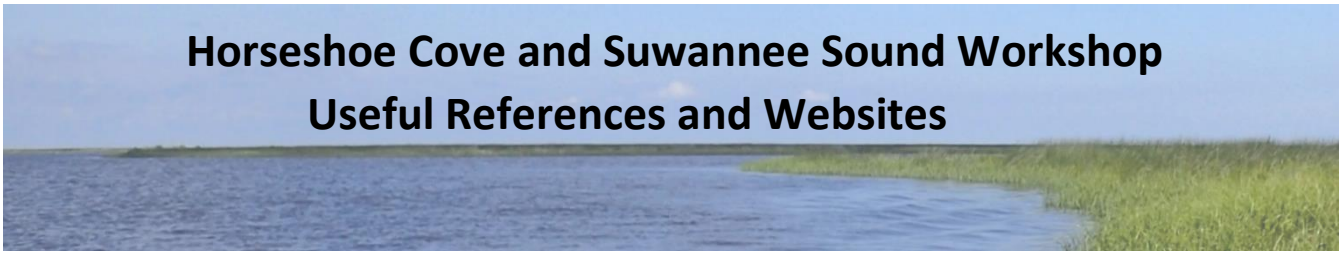
7. Should key results of this workshop be communicated to the people living in this region? To policy makers? To the workshop participants? If so, how?

- Yes, results should be communicated well beyond the workshop participants, including: commercial and recreational fishers, fish camps, hunt clubs, local business owners (hotels, restaurants, other entities linked with tourism etc.), and city and county governments.
- Develop a communication scheme or strategy for the region.
    - It should be proactive rather than reactive, instill a sense of stewardship, and demonstrate how the region could change if conservation action is not taken.
    - Identify next steps to bolster engagement, and then develop and implement user-specific messages.
    - Use the region's science synthesis to develop the communication strategy and messages. This synthesis should be developed through a collaborative effort across multiple government, private, academic entities. It should be presented in an easy-to-understand, public-friendly format. The economic impact of the region's resources should be included.
    - Use public events, like marsh cleanups, scallop monitoring, marsh planting with education components, to build a network of supporters that can advocate for the region and its resources.
- Agencies participating in this workshop should get their communications staff engaged in addressing some of the communication needs identified during the workshop.
    - While it is important to engage with hunters and fishers, we also should highlight the importance of this region's coastal resources beyond those that directly rely on them.

    - It is easier to rally around a specific estuary where people see and use the system on a regular basis. Our region is difficult to reach and access on the regular basis for those who do not live there.
    - Would the State structure support development of more proactive communications and outreach effort? Yes, but communications tend to focus on emergency response or high and/or high priority topics (e.g., related to rule-making). Limited staff are devoted to communications, so the proactive items are not always prioritized.
- The State of Florida Ecological Report Card v1.1 (led FWC-FWRI) is another opportunity to communicate some of the messages discussed during the workshop. Ecological Report Cards make it into regional news feeds, so they reach a broad audience. The terrestrial and freshwater report card has been released on the Florida Conservation Planning Atlas, while the marine and estuarine report card will be released later this year. The report card provides a broad habitat-based framework to evaluate current conditions and desired future conditions (quality, quantity, location, and spatial configuration) of a set of Conservation Assets (e.g., High Pine and Scrub, Coastal Uplands, Springs, Seagrass, etc.). For more details on the Conservation Assets, view the Conservation Asset Profiles document at the link above. FWC staff utilized workshops, one-on-one meetings with data providers, and attended meetings/workshops hosted by other entities to collect, synthesize, and develop this report card.

8. What are some of the more critical upcoming decisions which will influence the ecosystems and resources within this region?

- The Nature Coast Aquatic Preserve was recently established just south of this region along Citrus, Hernando, and Pasco county coasts.
- The oyster restoration and monitoring efforts currently underway by UF and FWRI will help to better understand current and future trends along the Gulf coast. This information is important given the temporary suspension of wild oyster harvest in Apalachicola Bay and increased harvest in the Big Bend.
- Florida Department of Transportation's M-CORES (Multi-use Corridors of Regional Economic Significance) project proposed a toll road through the region, but the current legislative session includes two bills that would repeal M-CORES (HB763, SB1030).



Horseshoe Cove and Suwannee Sound Workshop
Useful References and Websites

Conceptual Ecological Model drafted for Horseshoe Cove & Suwannee Sound

- https://jamboard.google.com/d/1MWkVOY4AY0lkCgDfvBcErcXGS1RbIZRHLjP5pOv96Kw/viewer?f=3

Florida Department of Agriculture and Consumer Services

- Shellfish harvesting areas https://geodata.fdacs.gov/datasets/shellfish-harvesting-areas-all-year
- FDACS map viewer https://fdacs.maps.arcgis.com/apps/webappviewer/index.html?id=57f7d4b7d900496d99891f22681c66d0

Florida Department of Environmental Protection

- SEACAR data discovery interface is repository of water quality, oyster, coastal wetland, and seagrass data https://dev.seacar.waterinstitute.usf.edu/
- Florida Water Resources Monitoring Council https://floridadep.gov/dear/watershed-monitoring-section/content/fwrmc (*link to Water-CAT and Terra-CAT below under USF*)
- Watershed Assessment Section https://floridadep.gov/DEAR/Watershed-Assessment-Section
- Impaired Waters Rule database http://publicfiles.dep.state.fl.us/dear/IWR/
- Interactive Map Gallery https://fdep.maps.arcgis.com/home/index.html
- Basin 411 https://floridadep.gov/dear/watershed-assessment-section/content/basin-411-0
- Coastal Partnership Initiative/Florida Coastal Management Program https://floridadep.gov/rcp/fcmp/content/coastal-partnership-initiative; https://floridadep.gov/rcp/fcmp/content/grants
- Big Bend Seagrasses Aquatic Preserve https://floridadep.gov/rcp/aquatic-preserve/locations/big-bend-seagrasses-aquatic-preserve

Florida Fish and Wildlife Conservation Commission

- Oyster Integrated Mapping and Monitoring Program Report https://myfwc.com/research/habitat/coastal-wetlands/projects/oimmp; workshops and resources website https://ocean.floridamarine.org/OIMMP/
- Statewide oyster map http://geodata.myfwc.com/datasets/oyster-beds-in-florida
- FWC 1984 – present commercial harvest data https://public.myfwc.com/FWRI/PFDM/ReportCreator.aspx
- Compilation of 1950-1984 commercial harvest data https://ocean.floridamarine.org/OIMMP/
- FWC/FWRI Shellfish Research https://myfwc.com/research/saltwater

- Coastal Habitat Integrated Mapping and Monitoring Program Report https://myfwc.com/research/habitat/coastal-wetlands/projects/chimmp/; workshops and resources website https://ocean.floridamarine.org/CHIMMP/
- Seagrass Integrated Mapping and Monitoring Program: https://myfwc.com/research/habitat/seagrasses/projects/active/simm/
- Roadblocks to Seagrass Recovery and Seagrass Recovery Potential Model
- Aquatic Habitat Conservation and Restoration https://myfwc.com/aquatichabitats
- Florida's State Wildlife Action Plan https://adobeindd.com/view/publications/9502ec1c-89dc-4c07-82b1-f098ad600878/t8uw/publication-web-resources/pdf/SWAP_cover.pdf
- Florida State Wildlife Grant Program Goals https://myfwc.com/conservation/special-initiatives/fwli/ and grant application information https://myfwc.com/conservation/special-initiatives/fwli/grant/; Marine and Estuarine Enhancement contact is Victoria.Ruddle@myfwc.com, Research and Monitoring contact is Amy.Clifton@myfwc.com

Gulf Coast Ecosystem Restoration Council

- https://restorethegulf.gov/

Pew Charitable Trust

- Pew's Nature Coast Aquatic Preserve Importance of Seagrass Brief https://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2019/10/healthy-seagrass-forms-underwater-meadows-that-harbor-diverse-marine-life
- Florida Forage Fish Coalition & Forage Fish Research Program - https://floridaforagefish.org/
- Pew contact is JGrubich@pewtrusts.org

National Fish and Wildlife Foundation

- Gulf Environmental Benefit Fund https://www.nfwf.org/gulf-environmental-benefit-fund/florida
- National Coastal Resilience Fund https://www.nfwf.org/programs/national-coastal-resilience-fund

National Oceanic and Atmospheric Administration

- NOAA ENOW Digital Coast https://coast.noaa.gov/enowexplorer/#/
- Cedar Key sea level trends 1914-2020 https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8727520
- Sea Level Affecting Marshes Model (SLAMM) https://coast.noaa.gov/digitalcoast/tools/slamm.html
- Gulf Spill Restoration https://www.gulfspillrestoration.noaa.gov/
- Florida Trustees Seek Public Comment on Draft Restoration Plan https://www.gulfspillrestoration.noaa.gov/2021/02/florida-trustees-seek-public-comment-draft-restoration-plan

North Florida Regional Water Supply Partnership

- https://northfloridawater.com/

Suwannee River Water Management District

- Funding initiatives https://www.mysuwanneeriver.com/373/Funding-Initiatives
- Water data portal https://www.mysuwanneeriver.com/507/Water-Data-Portal
- Document center https://www.mysuwanneeriver.com/documentcenter

United States Department of Agriculture

- Natural Resources Conservation Service (NRCS) programs (easement programs and conservation practice programs). https://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/, contact is nina.bhattacharyya@usda.gov

United States Fish and Wildlife Service

- USFWS Coastal Program https://www.fws.gov/coastal/; https://www.fws.gov/southeast/our-services/coastal-conservation/, contact is tiffany_lane@fws.gov
- Partners Program https://www.fws.gov/partners/

University of Florida

- Projects
    - Planning for Coastal Change in Levy County https://changinglevycoast.org/about/
    - Online Resource Guide for Florida Shellfish Aquaculture https://shellfish.ifas.ufl.edu/
    - Horseshoe Beach water quality monitoring https://shellfish.ifas.ufl.edu/water-quality-monitoring/horseshoe-beach/
    - Ecological and Economic Impacts of Land Use and Climate Change on Coastal Food Webs and Fisheries https://waterinstitute.ufl.edu/research/featured-projects/ecological-and-economic-impacts-of-land-use-and-climate-change-on-coastal-food-webs-and-fisheries/; news release at http://blogs.ifas.ufl.edu/news/2021/03/10/how-uf-scientists-are-predicting-the-future-of-the-suwannee-river-basin/
    - Lone Cabbage Reef Restoration Project https://lcroysterproject.github.io/oysterproject/
- Shiny apps
    - Water quality data in the Suwannee Sound https://oysterprojectck.shinyapps.io/wq_lcr_shiny_app/
    - Harvest landings data https://oysterprojectck.shinyapps.io/landing/
    - Suwannee River discharge visualization tool here mimicking USGS displays https://oysterprojectck.shinyapps.io/display_quantile_app/

University of South Florida

- Water-CAT https://water-cat.usf.edu/map/water-cat/
- Terra-CAT https://terra-cat.usf.edu/
- Water atlas https://wateratlas.usf.edu/about/

Scientific Literature mentioned in presentations and discussions

Brush, J.M., Schwarzer, A.C. and Frederick, P.C., 2017. Importance and function of foraging and roost habitat for wintering American Oystercatchers. *Estuaries and Coasts*, *40*(1), pp.286-295.

Carlson, P. R., L. A. Yarbro, K. Kaufman, R. A. Mattson. 2009 Vulnerability and resilience of seagrasses to hurricanes and runoff impacts along Florida's West Coast. Hydrobiologia 649:39-53. DOI: 10.1007/s10750-010-0257-0

Frederick, P., Vitale, N., Pine, B., Seavey, J. and Sturmer, L., 2016. Reversing a rapid decline in oyster reefs: effects of durable substrate on oyster populations, elevations, and aquatic bird community composition. *Journal of Shellfish Research*, *35*(2), pp.359-367.

Furman, B.T., Peterson, B.J. and Heck Jr, K.L., 2020. Will the Florida Big Bend Area Become the Next Gulf of Mexico Reef Tract? *Frontiers in Marine Science*.

McCarthy, M.J., B. Dimmitt, F. Muller-Karger. 2018. Rapid coastal forest decline in Florida's Big Bend. *Remote Sens.* 2018, *10*(11), 1721; https://doi.org/10.3390/rs10111721

Moore, J.F., Pine III, W.E., Frederick, P.C., Beck, S., Moreno, M., Dodrill, M.J., Boone, M., Sturmer, L. and Yurek, S., 2020. Trends in Oyster Populations in the Northeastern Gulf of Mexico: An Assessment of River Discharge and Fishing Effects over Time and Space. *Marine and Coastal Fisheries*, *12*(3), pp.191-204.

Seavey, J.R., Pine III, W.E., Frederick, P., Sturmer, L. and Berrigan, M., 2011. Decadal changes in oyster reefs in the Big Bend of Florida's Gulf Coast. *Ecosphere*, *2*(10), pp.1-14.

Vitale, N., Brush, J. and Powell, A., 2020. Loss of Coastal Islands Along Florida's Big Bend Region: Implications for Breeding American Oystercatchers. *Estuaries and Coasts*, pp.1-10.

Relevant reports and news articles

Economic Analysis for Big Bend Region of Florida
https://www.conservationfund.org/projects/economic-analysis-for-big-bend-region-of-florida

Suwannee River Basin and Estuary Integrated Science Workshop: September 22-24, 2004 Cedar Key, Florida https://pubs.usgs.gov/of/2004/1332/pdf/ofr2004_1332.pdf

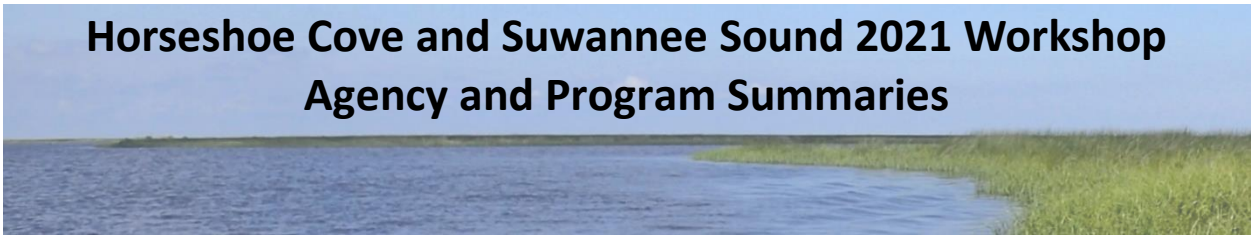
Toll Roads update article https://www.wuft.org/news/2021/03/03/florida-senate-committee-approves-major-changes-to-proposed-toll-road-through-north-central-florida/

Example of a Conceptual Ecological Model being used to guide ecosystem-based fisheries management: A description of system dynamics of scamp populations in the Gulf of Mexico and South Atlantic to support ecosystem considerations in the assessment and management process
http://sedarweb.org/docs/wpapers/S72_AW_02_ecosystems_considerations.pdf

Example of a Conceptual Ecological Model in Tampa Bay: Determining Biotic Effects of Sediment Contaminants in McKay Bay. #1802.12.029643
https://drive.google.com/file/d/1bckzBymXOpCindy8xnIIoD9IenwhYOGO/view

Example of science and advocacy working toward improved water management in SW Florida
https://www.naplesnews.com/story/news/environment/2021/03/09/corkscrew-swamps-water-problems-subject-research-efforts-collier/4626679001/

Horseshoe Cove and Suwannee Sound 2021 Workshop Agency and Program Summaries



Agency: Florida Department of Environmental Protection
Program or Department: Office of Resilience and Coastal Protection – Big Bend Seagrasses Aquatic Preserves
Summary: Big Bend Seagrasses Aquatic Preserve (BBSAP) was established in 1985 encompassing approximately 985,000 acres of submerged land spanning five Gulf Coast counties of Florida from the St. Marks River southward to the mouth of the Withlacoochee River. The surrounding uplands bordering BBSAP's 1,200 miles of dynamic coastline are dominated by State or Federally managed land holdings or are undeveloped private lands. This creates one of the most pristine coastlines in the state, allowing for effective baseline management of BBSAP's aquatic resources. Big Bend Seagrasses Aquatic Preserve boasts ideal conditions for aquaculture and its productive estuaries provide ample commercial and recreational harvest opportunity for many target species like red drum, spotted sea trout, snook, blue crab, shrimp and stone crab. Staff focus primarily on water quality and submerged aquatic vegetation as two indicators for overall health of this aquatic preserve. Historical continuous water quality data is available for the Suwannee Sound region from 2009 to 2016.
Relevant websites: https://floridadep.gov/rcp/aquatic-preserve/locations/big-bend-seagrasses-aquatic-preserve
Contacts: Timothy.W.Jones@FloridaDEP.gov , Trisha.Green@FloridaDEP.gov
Relevant references: Big Bend Seagrasses Aquatic Preserve Management Plan: publicfiles.dep.state.fl.us/cama/plans/aquatic/Big-Bend-Seagrasses-AP-Management-Plan.pdf

Agency: Florida Department of Environmental Protection
Program or Department: Watershed Assessment Section, Water Quality Evaluation and TMDL Program
Summary: The Watershed Assessment Section (https://floridadep.gov/dear/watershed-assessment-section) monitors and assesses the ambient water quality of surface waters in Florida, with its core function being the identification of waterbodies that are not meeting the applicable water quality standards and designated uses based on the Impaired Waters Rule Chapters 62-302 and 62-303, Florida Administrative Code (F.A.C.). The impaired waters assessment process involves evaluating previous cycle's Planning and Study lists, implementing Strategic Monitoring Plans (SMPs) to support data sufficiency for water quality assessments, and developing draft and final assessment lists. Public meetings are held to present the draft assessments, and public comments received are addressed and incorporated as appropriate into the final lists. The final Verified and Delist lists are adopted by secretarial order, which begins a final 21-day challenge period. As the final step in the process the 303(d) list updates are submitted to EPA. The Horseshoe Cove and Suwannee Sound region is located in the Suwannee basin, one of 9 north Florida basins and 29 total basins assessed throughout the state.
Relevant websites: https://floridadep.gov/dear/watershed-assessment-section, https://floridadep.gov/dear/watershed-assessment-section/content/assessment-lists, https://floridadep.gov/dear/watershed-assessment-section/content/strategic-monitoring-plans
Contacts: Kenneth.Weaver@FloridaDEP.gov, Kevin.ODonnell@FloridaDEP.gov

Agency: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute
Program: Coastal Habitat Integrated Mapping and Monitoring Program (CHIMMP)
Summary: CHIMMP compiles information and contributes to mangrove and salt marsh mapping and monitoring programs across Florida. A statewide report was published in 2017, which includes regional chapters on status and trends for coastal wetlands and summaries of local mapping and monitoring programs. The report was published in 2017, but chapter updates are underway and are released on the report website. CHIMMP has also organized four workshops between 2014 and 2020 in order to bring together coastal wetland experts and managers and share mapping and monitoring progress; presentations from these workshops are available on the workshops and resources website. The program has also included pilot monitoring projects, a mapping publication (cited below), and establishment of long-term monitoring transects on the east and west coast of Florida.
Relevant websites: https://ocean.floridamarine.org/CHIMMP/, https://myfwc.com/research/habitat/coastal-wetlands/projects/chimmp/
Contacts: kara.radabaugh@myfwc.com, ryan.moyer@myfwc.com
References: Coastal Habitat Integrated Mapping and Monitoring Program Report for the State of Florida. FWRI Technical Report No. 21. https://myfwc.com/research/habitat/coastal-wetlands/projects/chimmp/ McCarthy, M.J., Radabaugh, K.R., Moyer, R.P. and Muller-Karger, F.E., 2018. Enabling efficient, large-scale high-spatial resolution wetland mapping using satellites. Remote Sensing of Environment, 208, pp.189-201.

Agency: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute
Program: Oyster Integrated Mapping and Monitoring Program (OIMMP)
Summary: OIMMP compiles information and contributes to oyster reef mapping and monitoring across Florida. A statewide report was published in 2019, which includes regional chapters on status and trends for oysters and summaries of local mapping and monitoring programs. Updates of selected chapters are underway and will be released on the report website. OIMMP has compiled available mapping data into a statewide oyster map, available for download in shapefile or KML format. OIMMP has also organized three workshops between 2017 and 2029 in order to bring together oyster experts and managers and share mapping and monitoring progress; presentations from these workshops are available on the workshops and resources website. The program has also included pilot monitoring projects and mapping efforts in the Suwannee Sound (cited below) and Tampa Bay.
Relevant websites: https://ocean.floridamarine.org/OIMMP/, https://myfwc.com/research/habitat/coastal-wetlands/projects/oimmp/, https://geodata.myfwc.com/datasets/oyster-beds-in-florida
Contacts: kara.radabaugh@myfwc.com, ryan.moyer@myfwc.com, steve.geiger@myfwc.om
Relevant references: Oyster integrated mapping and monitoring program report for the state of Florida. FWRI Technical Report 22. https://myfwc.com/research/habitat/coastal-wetlands/projects/oimmp/ Oyster Integrated Mapping and Monitoring Program Suwannee Sound Oyster Reef Mapping 2019. https://ocean.floridamarine.org/OIMMP/Resources/Suwannee%20River%20Oyster%20Mapping%202019.pdf

Agency: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute
Program: Seagrass Integrated Mapping and Monitoring (SIMM)
Summary: During the 20th century, seagrasses experienced large declines in acreage, as well as changes in species and in the density and size of beds. Recognizing the value of seagrass beds spurred agencies and governments, from local to federal, to restore and protect this resource. The FWC's Fish and Wildlife Research Institute developed the Seagrass Integrated Mapping and Monitoring (SIMM) program to protect and manage seagrasses in Florida by providing a collaborative resource for seagrass mapping, monitoring, and data sharing. The SIMM program works with scientists statewide to facilitate and coordinate mapping and monitoring of seagrasses and to report findings and assessments of seagrass health online. A statewide report and chapters on each estuary or coastal region are in an easy-to-read format that provides scientists, resource managers, legislators, and other stakeholders a summary of the status of seagrasses in Florida. Given the budget problems that many agencies face, the program also works to leverage resources and to decrease and share costs of seagrass mapping and monitoring. The FWC Seagrass Assessment and Restoration Group also recently completed a project called Roadblocks to Seagrass Recovery. One of the principal products is a Seagrass Recovery Potential spatial model in Google Earth format.
Relevant websites: https://geodata.myfwc.com/datasets/seagrass-habitat-in-florida https://myfwc.com/research/habitat/seagrasses/projects/active/simm/ https://myfwc.com/research/habitat/seagrasses/projects/roadblocks/
Contacts: laura.yarbro@myfwc.com; paul.carlson@myfwc.com
References: https://myfwc.com/media/11950/simm-report-1.pdf Carlson, P. R., L. A. Yarbro, K. Kaufman, R. A. Mattson. 2009 Vulnerability and resilience of seagrasses to hurricanes and runoff impacts along Florida's West Coast. Hydrobiologia 649:39-53. DOI: 10.1007/s10750-010-0257-0

Agency: Florida Fish and Wildlife Conservation Commission, Division of Habitat and Species Conservation
Program: Aquatic Habitat Conservation and Restoration - Marine/Estuarine
Summary: Healthy marine and estuarine habitats support fish and wildlife in a saltwater-based ecosystem. In Florida, these habitats include seagrasses, coastal marshes, mangroves and various types of reefs such as oyster reefs, coral reefs or rocky reefs. The marine/estuarine group within the Aquatic Habitat Conservation and Restoration Section works in partnership with other agencies to identify, design and implement marine and estuarine habitat restoration projects. In addition, this group coordinates with project partners and stakeholders in order to address larger marine and estuarine habitat management issues including non-native species, marine debris, public outreach, resource protection, environmental resource permitting, and imperiled species.
Relevant websites: https://myfwc.com/aquatichabitats
Contacts: Kent.Smith@myfwc.com (Statewide/Program Director); Katie.Konchar@myfwc.com (NW FL); Corey.Anderson@MyFWC.com (SW FL); Annie.Roddenberry@MyFWC.com (NE FL); Erin.McDevitt@MyFWC.com (SE FL)
References: Florida Fish and Wildlife Conservation Commission (FWC). 2020. A GIS Assessment of Florida's Aquatic Resources: A Framework for Restoration and Management. Tallahassee, Florida. Bock, J.A., Smith, K. Merrill, M., Furse, B., Anderson, C., Beal, J., Konchar, K., McDevitt, E., Roddenberry, A. 2021. Prioritizing Florida's Marine and Estuarine Resources. Journal of the Southeastern Association of Fish and Wildlife Agencies, 8:53-64. in press.

Agency: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute
Program: Shellfish Research and Monitoring Group: Upcoming FWC Oyster Monitoring Projects in Suwannee Sound
Summary: The Oyster program within the Shellfish Research and Monitoring Group at FWRI conducts long-term oyster population monitoring for assessment and management of the resource and contributes to oyster reef research and restoration projects across Florida. Funding for these projects is from State and Federal (CERP, NFWF, and NRDA) sources. Long-term oyster monitoring is ongoing in south Florida estuaries (St. Lucie, Lake Worth Lagoon, Caloosahatchee, Tampa Bay) and in the Panhandle (Apalachicola Bay). Monitoring and mapping will be expanded to the Suwannee Sound in mid-2021 as part of expanded NFWF funding. The objective of the NFWF project is to improve our understanding of the state of the oyster resource in Suwannee Sound area. This objective stems from the paucity of oysters in Apalachicola Bay forcing fishermen to focus efforts on the Suwannee Sound area causing concern of overfishing the area. Monitoring and mapping of the area will improve our understanding of the state of the resource in Suwanee Sound and allow for the development of oyster shell budget models. Beginning in July of 2021, work will begin on the first phase of a two-part grant from the Florida Trustee Implementation Group (FL-TIG). The objective of the first phase of the FL-TIG project is to assess and fill critical data gaps in monitoring and mapping to aid oyster restoration along Florida's Gulf coast. This effort will expand monitoring and mapping efforts to Pensacola Bay, St. Andrew Bay, Suwannee Sound, Withlacoochee Bay, Tampa Bay, and Charlotte Harbor to fill the data gaps in these regions and support a unified and publicly available resource that will include a GIS-based Habitat Suitability Index (HSI) for oysters to aid restoration efforts on along the Gulf. The HSI along with statewide trends from all ongoing FWRI oyster monitoring programs will be made publicly available through the structure developed by the Oyster Integrated Mapping and Monitoring Program (OIMMP) web page. We anticipate that this will greatly increase the resources available to anyone interested in future oyster restoration efforts in Florida.
Relevant websites: http://fwcresearch.com/programs/mfr/ https://myfwc.com/research/habitat/coastal-wetlands/projects/oimmp/
Contacts: tomena.scholze@myfwc.com, ryan.gandy@myfwc.com, matthew.davis@myfwc.com, steve.geiger@myfwc.com , kara.radabaugh@MyFWC.com

Agency: Florida Department of Transportation
Program: Office of Environmental Management
Summary: The role of the FDOT Office of Environmental Management (OEM) is to develop and ensure the implementation of quality environmental policies, procedures and practices in the development of transportation improvements. OEM establishes policies and procedures to ensure implementation of environmental programs and initiatives of FDOT. OEM coordinates with federal and state agencies, such as FWC, FDEP, USACE, USFWS, and NMFS in the development and implementation of transportation projects to ensure consistency with environmental laws and regulations and to assist FDOT in achieving its mission.
Relevant websites: https://www.fdot.gov/environment
Contacts: Jonathan.Turner@dot.state.fl.us; Denise.Rach@dot.state.fl.us ; Harrison.Garrett@dot.state.fl.us

Agency: Suwannee River Water Management District (SRWMD)
Program or Department: Water Resources, Hydrologic Data Services, Minimum Flows and Minimum Levels, Water Supply, Agriculture and Environmental Projects
Summary: SRWMD is charged by the Legislature with the responsibilities of managing water supply, water quality, flood protection, and natural systems. SRWMD encompasses a unique area comprised of working and natural forests, farms, rivers, springs, and estuaries. Agriculture, silviculture, aquaculture, and springs-based tourism are major economic drivers in the region. Protecting water resources not only supports natural systems but also is necessary for future economic growth. The District maintains a water quality, biology, and hydrologic data collection network for both surface and groundwater. This network includes a groundwater coastal salinity network and adding specific conductivity to established river gages to monitor sea level rise and saltwater intrusion. These data are used for the District's Minimum Flow and Minimum Water Level (MFL) and Water Supply Programs which are charged with ensuring future water needs for the environment and humans are met. The District also manages cooperative funding programs and grant opportunities for water quality and quantity improvement projects to support Water Supply planning and to assist Basin Management Action Plans developed by FDEP within the Suwannee Basin and Coastal River Basins. These programs include Agricultural Cost Share, Regional Initiative Valuing Environmental Resources (RIVER) Cost Share, State Springs Grants, Alternative Water Supply Grants, and School and Community Water Resources Grants. The District is also charged with updating the Surface Water Improvement and Management Plan which is scheduled for 2022.
Relevant websites: https://www.mysuwanneeriver.com/; https://www.mysuwanneeriver.com/507/Water-Data-Portal; https://www.mysuwanneeriver.com/documentcenter; https://www.mysuwanneeriver.com/373/Funding-Initiatives
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Relevant references: 2021-2025 Strategic Plan, Suwannee River Water Management District https://www.mysuwanneeriver.com/DocumentCenter/View/17697/2021-2025-Strategic-Plan Coastal Rivers Basin Surface Water Improvement and Management (SWIM) Plan https://www.mysuwanneeriver.com/DocumentCenter/View/12025/Coastal-Rivers-Basin-SWIM-Plan Coastal Rivers Basin Surface Water Improvement and Management (SWIM) Plan Appendices https://www.mysuwanneeriver.com/DocumentCenter/View/12026/Coastal-Rivers-SWIM-Plan-Appendices- Suwannee River Basin Surface Water Improvement and Management (SWIM) Plan https://www.mysuwanneeriver.com/DocumentCenter/View/12027/Suwannee-River-Basin-SWIM-Plan Suwannee River Basin Surface Water Improvement and Management (SWIM) Plan Appendices https://www.mysuwanneeriver.com/DocumentCenter/View/12024/Suwannee-River-SWIM-Plan-Appendices Water Supply Assessment (2015-2035), Suwannee River Water Management District https://www.mysuwanneeriver.com/DocumentCenter/View/15162/2015-2035-Water-Supply-Assessment-PDF

Agency: U.S. Fish and Wildlife Service
Program: Coastal Program
Summary: The Coastal Program works with communities to voluntarily restore and protect habitats that benefit fish, wildlife, and people. We also develop resources that help land managers and practitioners deliver habitat conservation. By working together, we can sustain the people, economies, and wildlife that rely on coastal ecosystems. The Coastal Program provides financial assistance through cooperative agreements to coastal communities, conservation partners, and landowners to restore and protect fish and wildlife habitat on public and private lands. Our projects tend to focus on restoration and are typically between $10,000 and $70,000. We prioritize projects that would significantly contribute to not listing, downlisting, or delisting federally listed or at-risk species, which are species that have been petitioned for listing. Projects that do not involve a priority federally listed or at-risk species are unlikely to receive funding. We can assist with land acquisition projects. Although Coastal funds can't be spent on the acquisition cost for conservation easements or fee simple, the funds can be spent on surveys, appraisals, and other costs associated with implementing conservation easements and acquiring lands. Proposals are submitted annually in January.
Relevant websites: https://www.fws.gov/coastal/about.html https://www.fws.gov/southeast/our-services/coastal-conservation/
Contact: Tiffany_lane@fws.gov

Agency: U.S. Fish and Wildlife Service

Program: Lower Suwannee and Cedar Keys National Wildlife Refuges

Refuge Overview: Lower Suwannee National Wildlife Refuge was established in 1979, for the purpose of protecting, maintaining, and enhancing the riverine and estuarine ecosystem where the Suwannee River flows into the Gulf of Mexico. The 53,000-acre refuge, which is predominantly wetlands, is bisected by 24 miles of the Suwannee River and includes 30 miles of coastal marsh habitat along the Gulf Coast. Cedar Keys National Wildlife Refuge was established in 1929 to protect a breeding ground for colonial nesting migratory birds. The refuge is comprised of 13 islands ranging in size from 1 to 120 acres and totaling 800 acres and contains designated Wilderness Areas. Together these refuges have almost 300 shoreline miles, 194 miles of roads and trails, within an Acquisition Boundary of 88,000 acres. There are 51 named rivers and creeks flowing 126 miles with 400 miles of unnamed streams.
Refuge Projects: Cedar Keys: increasing wading and shorebird nesting habitat, artificial nesting platforms, recovering the Seahorse Key wading bird nesting colony, public use on beaches, Seahorse Key Marine Lab (with University of Florida and Sante Fe College), historic Cedar Key Light Station. Lower Suwannee: restoring upland pine habitats affected by commercial logging and ranching, prescribed fire program, maintaining 194 miles of roads and trails for public access, managing boat ramps, viewing and fishing platforms, hydrologic restoration to restore water flows to pre-development levels, Vista property and Shellmound historic preservation and interpretation, managing an extensive hunt program, facilitating scientific studies by partners.

Research and Management Partners:

- USGS SE Science Center, Gainesville Florida
- Suwannee River Water Management District
- University of Florida, IFAS Department of Wildlife and Ecology, Nature Coast Biological Station
- Dixie and Levy Counties
- City of Cedar Key and the Town of Suwannee
- Florida Fish and Wildlife Commission
- Florida Department of Environmental Protection
- The Conservation Fund

Relevant websites: https://www.fws.gov/refuge/lower_suwannee/, https://www.fws.gov/refuge/cedar_keys/

Contact: Andrew_Gude@fws.gov

Agency: University of Florida

Program or Department: Environmental Horticulture, Carrie Adams Restoration & Plant Ecology Lab

Summary: Die-off patterns of salt marsh vegetation and coastal forests in the Big Bend region are of interest to local, state, and federal land managers. Carrie Adams's Restoration and Plant Ecology Lab has been studying salt marsh plant community genetic diversity, invasion, and stress response in this region. The State of Florida, in conjunction with the US Fish and Wildlife Service, awarded a State Wildlife Grant to Dr. Bill Pine and Dr. Carrie Adams at the University of Florida to determine the influences of salinity on these two coastal ecosystems. Over the last 3 years, we have been working on research projects that assess salt marsh soil characteristics, salinity levels, and vegetation metrics to determine current conditions of Big Bend salt marshes and the influences of increased flooding duration and salinity has on coastal forest tree growth and regeneration. We have been studying patterns at multiple spatial scales for greater understanding and possible predictive ability of salt marsh vegetation responses to sea-level rise. We have salt marsh study sites that span from approximately Hagan's Cove to Shell Mounds in the Big Bend Wildlife Management Area and the Lower Suwannee National Wildlife Refuge. Preliminary results have been presented at conferences for the Society of Wetland Scientists and at the University of Florida's Water Institute Symposium. Final project results are currently being prepared for journal publication with a brief project synopsis has been published in UF/IFAS quarterly publication LAKEWATCH (cited below).

Contacts: s.verhulst@ufl.edu, rein0500@ufl.edu, billpine@ufl.edu

Relevant references: Verhulst, S. and C.R. Adams. 2020. Are coastal plants the marsh loss "canary in the coal mine"? UF/IFAS Florida LAKEWATCH, 90:9-12 https://lakewatch.ifas.ufl.edu/media/lakewatchifasufledu/extension/newsletter/Volume-90-Fall-2020.pdf

Presentations:

S. Verhulst and C.R. Adams. A Stress Test for Salt Marshes: How does Morphophysiology of Salt Marsh Dominant *Juncus roemerianus* Vary with Spatial Pattern and Marsh System in the Big Bend region of Florida? Society of Wetland Scientists Virtual Meeting. June 2021.

S. Verhulst and C.R. Adams. Piecing together the mud pie: Detecting relative stress in Florida's gulf coast salt marshes. Society of Wetland Scientists Virtual Meeting. December 2020.

S. Verhulst, C.R. Adams, and W. Pine. *Juncus roemerianus* stress response to elevated salt marsh salinity. Water Institute Symposium. Gainesville, Florida, February 2020.

S. Verhulst and C.R. Adams. Salinity-mediated coastal plant community change: Controlled experiments to inform thresholds. Society of Wetland Scientists Annual Meeting. Baltimore, Maryland, May 2019.

Agency: University of Florida/Institute of Food and Agricultural Sciences

***Program*:** Fisheries and Aquatic Sciences, School of Forest Resources and Conservation

Summary: **Modeling the Impacts of River Discharge on Trophic Pathways in an Estuarine Food Web**

The Suwannee River Estuary of Florida's Big Bend Coastline has historically been a productive and diverse estuarine ecosystem supported by significant freshwater inputs from the Suwannee River. In recent years, significant changes in land use and climatic conditions have resulted in lower discharges from the Suwannee. Since 2003, the river has experienced four of its six most extreme low flow events in the past 100 years. Researchers at the University of Florida's IFAS Nature Coast Biological Station have attempted to understand the impact of freshwater inputs from the Suwannee River on the estuarine fish communities downstream. This has been done by utilizing Ecopath with Ecosim to simulate changes in nutrient concentrations and the respective effects on the estuarine ecosystem. First, a mass-balanced Ecopath model was created by assigning dominant taxa to functional biomass pools. In Ecopath, fifty-nine functional groups have been created that capture the dominant ecological and recreational fish species along with benthic invertebrate groups and primary producers. Model inputs were obtained from a long-term fisheries independent monitoring survey. Following the completion of a balanced Ecopath model, we calibrated the time dynamic Ecosim model to biomass densities from 1997 to 2018. The calibrated model was used to project future flow scenarios on the ecosystem. This model demonstrated changes in populations affected by nutrient pulses as well as ecosystem wide effects resulting from food web dynamics.

Model output from Ecosim was also used to analyze time lags of energy transfer within the estuarine food web. We attempted to assess how trophic pathways are influenced by freshwater flow by conducting a time series analysis of nutrient concentrations, abundances of planktonic species, and densities of anchovies (*Anchoa* spp.), which are ecologically important forage fish in the region. We hypothesized that the impact of nutrient enrichment on anchovy productivity would be evident at a given time lag. To test this hypothesis, we utilized empirical dynamic modeling (EDM) to assess the time delays between nutrient concentrations and densities of phytoplankton, zooplankton, and anchovies. We found strong evidence of defined time lags between these different time series, but when observation error was multiplied to the simulated output, these relationships were not as significant. This demonstrates the efficacy of EDM for assessing the dynamics of systems with limited stochasticity, but model accuracy decreases significantly in more variable environments. Both the Ecopath and EDM models have strong applications for management of freshwater flow and fisheries resources.

Relevant websites: https://ncbs.ifas.ufl.edu/

Contacts: dsinnickson@ufl.edu, dchagaris@ufl.edu, msal@ufl.edu

Agency: University of Florida

Program: Wildlife Ecology and Conservation, Fisheries and Aquatic Sciences, Nature Coast Biological Station

Summary: The University of Florida has been involved in intertidal oyster reef restoration and research efforts in the Big Bend since 2010. Through a series of pilot projects working with SeaGrant, TNC, FWC, NOAA, and now with funding from NFWF, UF has led efforts to restore a large portion of the relic Lone Cabbage Reef in Suwannee Sound. This project restored approximately 5-km of reef using more than 11,000 cubic meters of locally sourced limestone rock. Ongoing monitoring efforts include a network of autonomous conductivity sensors near the restored reef, monthly water quality samples to track nutrients and other variables, and line transect sampling of restored and wild (not restored) intertidal oyster population (counts and height measurements). These monitoring efforts are supported by an advanced data management system and open data policies following best practice guidelines developed by the UF Library Academic Research Computing group. Oyster monitoring is informed in an adaptive framework through simulation and analyses prior, during, and after the winter field season. In this way we can maximize efficiency and learning form field efforts. The water quality and field monitoring approaches, databases, publicly viewable data visualizations and analytical/reporting framework is scalable and could be more widely used. The project is scheduled to end in 2024 and if cooperators are interesting in mimicking, expanding, or continuing these monitoring, data management, and analyses systems then that knowledge transfer should begin soon.

Relevant websites: https://lcroysterproject.github.io/oysterproject/ (data visualizations of water quality information)

Contacts: billpine@ufl.edu

Relevant references:

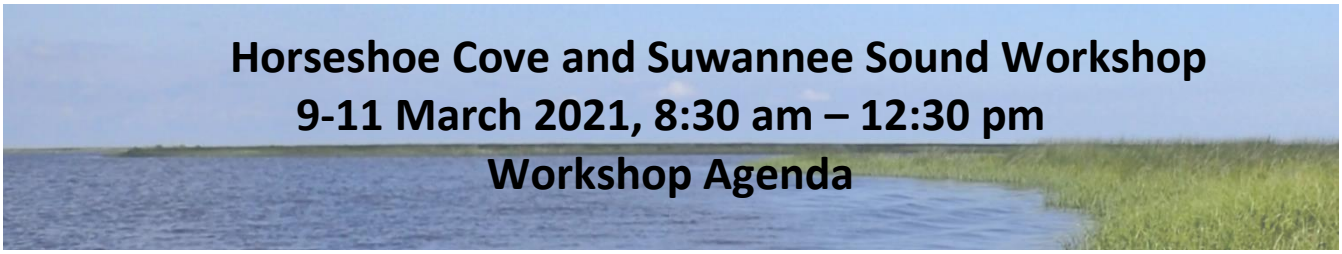
Moore, J.F., W. E. Pine, P. C. Frederick, S. Beck, M. Moreno, M. J. Dodrill, and L. Sturmer. 2020. Trends in oyster populations in the Big Bend region of the northeastern Gulf of Mexico: An assessment of river discharge and fishing effects over time and space. Marine and Coastal Fisheries 12:191-204.

Seavey, J. R., W. E. Pine, III, P. Frederick, L. Sturmer, and M. Berrigan. 2011. Decadal changes in oyster reefs in the Big Bend of Florida's Gulf Coast. Ecospace. http://www.esajournals.org/loi/ecsp

Frederick, P., N. Vitale, W. E. Pine, III, J. Seavey, and L. Sturmer. 2016. Reversing a rapid decline in oyster reefs: effects of durable substrate on oyster populations, elevations, and aquatic bird community composition. Journal of Shellfish Research 35: 359-367.

In-review: Moore, J. F. and W. E. Pine. Using Resampling Methods to Assess Monitoring Program Informativeness – An Alternative to Traditional Power Analysis. Peer-J.

In-review: Johnson, F.J., W. E. Pine, and E.V. Camp. A Cautionary Tale: Management Implications of Critical Transitions in Oyster Fisheries. Journal of Applied Ecology.



Horseshoe Cove and Suwannee Sound Workshop
9-11 March 2021, 8:30 am – 12:30 pm
Workshop Agenda

Workshop Goals

- Discuss status, needs, and opportunities for living resources in the Horseshoe Cove and Suwannee Sound and its associated watershed.
- Facilitate communication and coordination among local experts, land managers, and funding entities working in Horseshoe Cove and Suwannee Sound

Tuesday, March 9th

8:30 am Workshop introduction, background, and goals. Introduction to FWC's integrated mapping and monitoring programs

9:00-9:50 am Fish and Wildlife Presentations

Time	Presenter	Presenter affiliation	Title
9:00	Tyler Coleman, Bill Pine	University of Florida	Lessons learned from the restoration and monitoring of Lone Cabbage Reef
9:10	Mike Allen, Brad Ennis	University of Florida	Update on mapping efforts associated with Lone Cabbage Reef Restoration Project
9:20	Kara Radabaugh	FWC	Oyster mapping and monitoring resources
9:30	Ryan Gandy, Tomena Schulze	FWC	Upcoming FWC oyster monitoring projects in Suwanee Sound
9:40	Janell Brush	FWC	The importance of the Nature Coast for American Oystercatchers

9:50-10:00 am Presentation question and answer session

10:00-10:15 am 15-minute break

10:15-10:45 am Fish and Wildlife Presentations, continued

Time	Presenter	Presenter affiliation	Title
10:15	Amy Schwarzer	FWC	Imperiled salt marsh birds of the Florida Gulf Coast
10:25	Leslie Sturmer	University of Florida	Leases and aquaculture in Suwannee Sound
10:35	Anthony Knapp	FWC	Fisheries Independent Monitoring (FIM) in Big Bend

10:45-11:00 am Presentation question and answer session

11:00 am - 12:20 pm Discussion on monitoring and management gaps and needs

12:20-12:30 pm Conclusion and wrap-up of Day 1

Wednesday, March 10th

8:30-8:45 am Welcome and overview of Day 2 agenda

8:45-10:15 am Habitat and Water Quality Presentations

Time	Presenter	Presenter affiliation	Title
8:45	Stephanie Verhulst	University of Florida	Spatial patterns and environmental factors contributing to salt marsh stress in the Big Bend
8:55	Paul Carlson	FWC	Seagrass status and trends in Horseshoe Cove
9:05	Dylan Sinnickson	University of Florida	Modeling the impacts of river discharge on trophic pathways in an estuarine food web
9:15	Tim Jones	FDEP	Big Bend Seagrasses Aquatic Preserve: Horseshoe / Suwannee Region Overview
9:30	Darlene Velez	Suwannee River Water Management District	SRWMD Monitoring, Projects, and Priorities for Coastal Resources
9:45	Kevin O'Donnell	FDEP	Horseshoe Cove and Suwannee Sound: Impaired Waters Assessment Overview

10:00-10:15 am 15-minute break

Time	Presenter	Presenter affiliation	Title
10:15	Clayton McCoy	US Army Corps of Engineers	McGriff Pass Dredging and Beneficial Use Placement at Cat Island

10:30-11:20 am Presentation question and answer session, followed by discussion on habitat and water quality needs for the Horseshoe Cove and Suwannee Sound Region

11:20-12:30 pm Ecological Model Presentation and Discussion

Time	Presenter	Presenter affiliation	Title
11:20	Steve Geiger	FWC	Examples of Conceptual Ecological Model use in other systems

11:30 am - 12:20 pm Discussion of the conceptual model for the Horseshoe Cove and Suwannee Sound region

12:20-12:30 pm Conclusion and wrap-up of Day 2

Thursday, March 11th

8:30-8:45 am Welcome and overview of Day 3 agenda

8:45 am – 9:45 am Understanding the Funding Arena Presentations

Time	Presenter	Presenter affiliation	Title
8:45	Justin Grubich	Pew Charitable Trusts	Building partnerships for ecosystem research and coastal conservation along the Nature Coast
9:00	Gareth Leonard	FWC	Deepwater Horizon funding overview
9:15	Tiffany Lane, Andrew Gude	USFWS	USFWS: Serving our coastal communities
9:30	Victoria Ruddle	FWC	Florida's State Wildlife Grants Program: Marine, Estuarine, and Aquatic Habitat Restoration

9:45-10:00 am Presentation question and answer session

10:00-10:15 am 15-minute break

10:15 am-12:20 pm Compilation and discussion of workshop feedback, gaps and needs, and major conclusions

12:20-12:30 pm Overview of upcoming events and workshop conclusion

Workshop Participants

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