Apalachicola NERR 2026 Symposium Presentations

Keynote Speaker: Dan Tonsmeire

dan@apalachicolariverkeeper.org

Apalachicola River, Floodplain and Bay

Largest forested floodplain in Florida (112,000 acres)

Highest Species Diversity of any River System in North America

UNESCO Biosphere Reserve

Outstanding Florida Water (OFW)

National Estuarine Research Reserve

Florida Aquatic Preserve

River Floodplain/ Habitat Diversity

Apalachicola River Floodplain hosts the highest biodiversity of any River System in North America

- 50 species of mammals
- 1300 species of plants
- 40 species of amphibians
- 80 species of reptiles
- 300 species of birds

See Apalachicola National Estuarine Research Reserve info

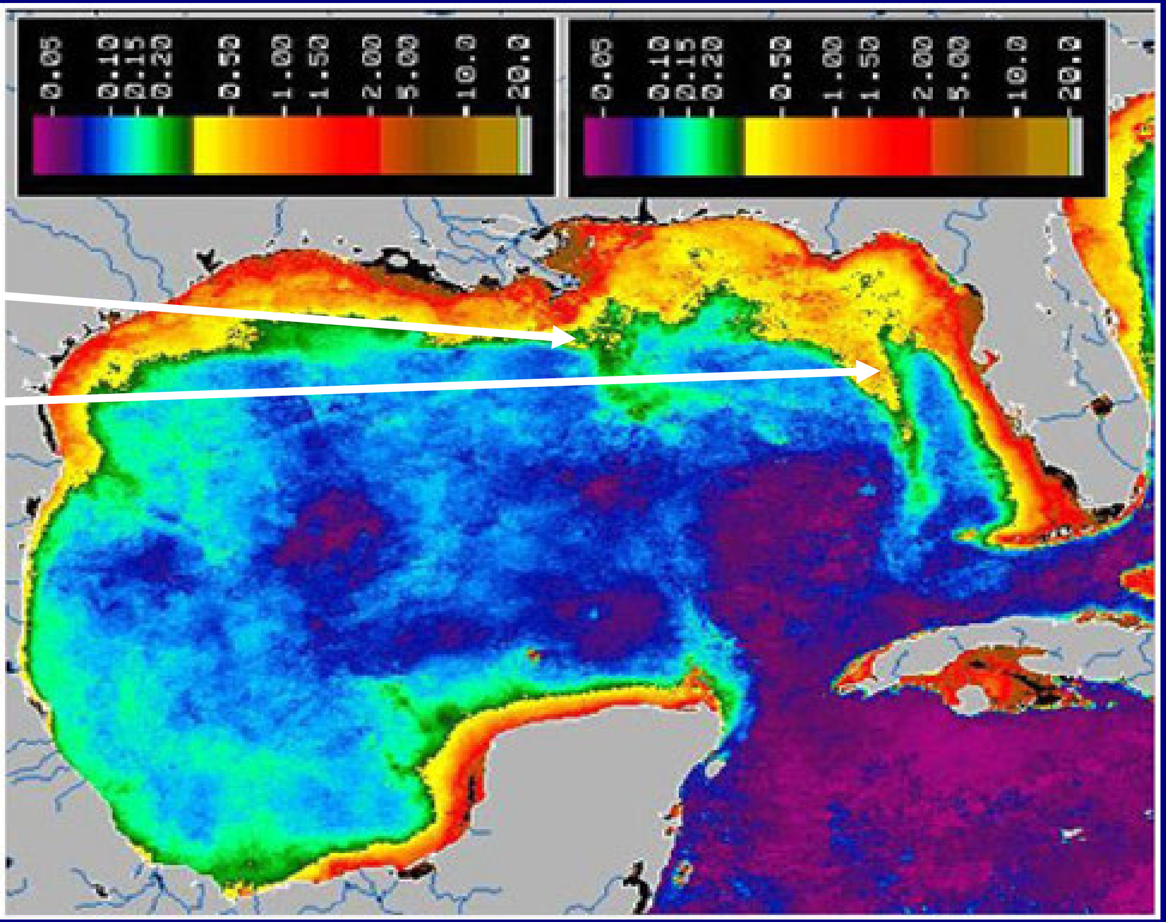
The Apalachicola River System

The Apalachicola River System consists of the river and a 112,000 acre floodplain that ranges from 1-5 miles wide and discharges to the Bay and Eastern Gulf of Mexico

Nutrient Input - freshwater discharge

Linking Coastal Watersheds to Fisheries

Chlorophyll plumes from
- Mississippi River
- Apalachicola River

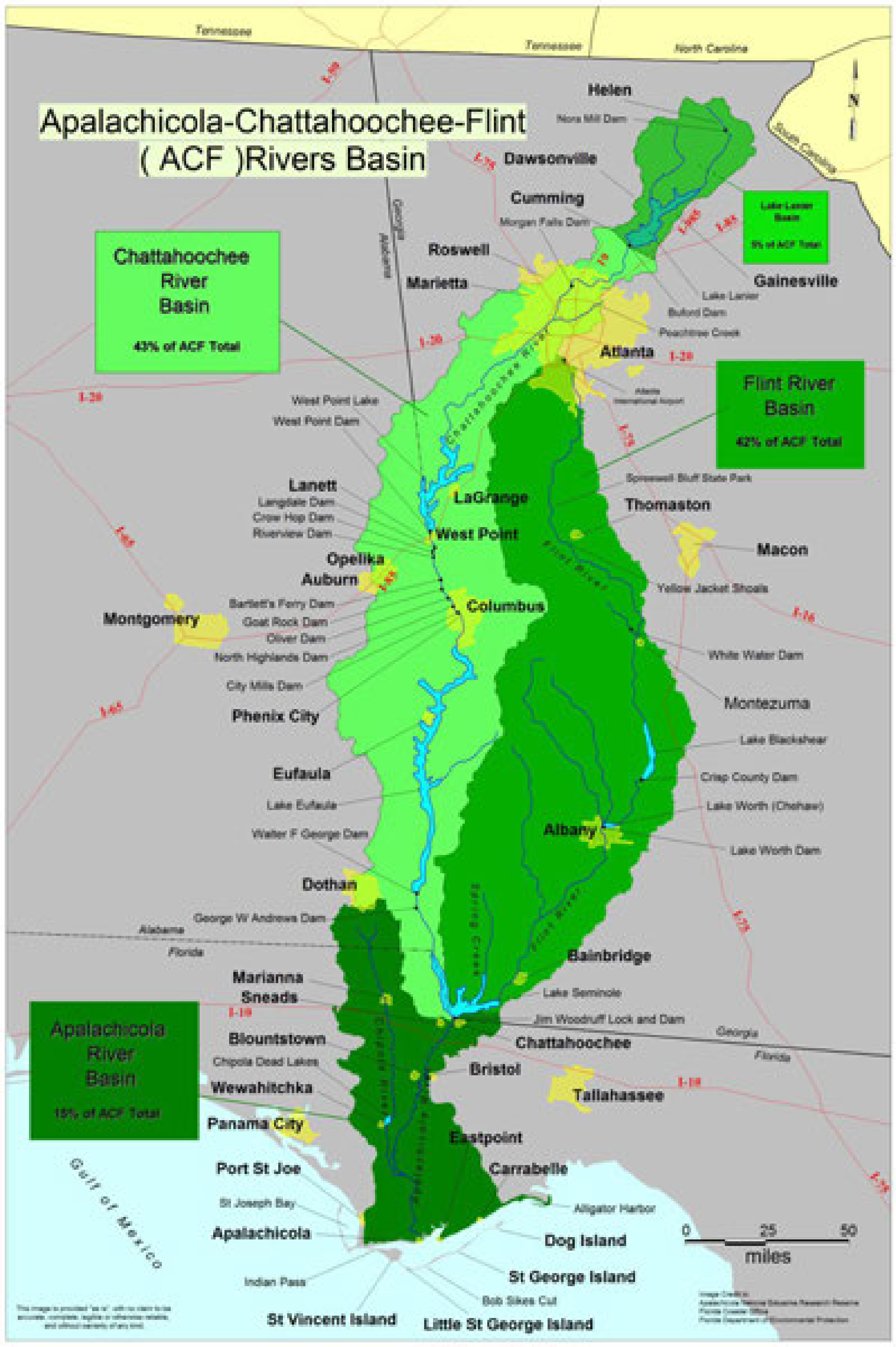


Felicia Coleman
Florida State University

River Basin

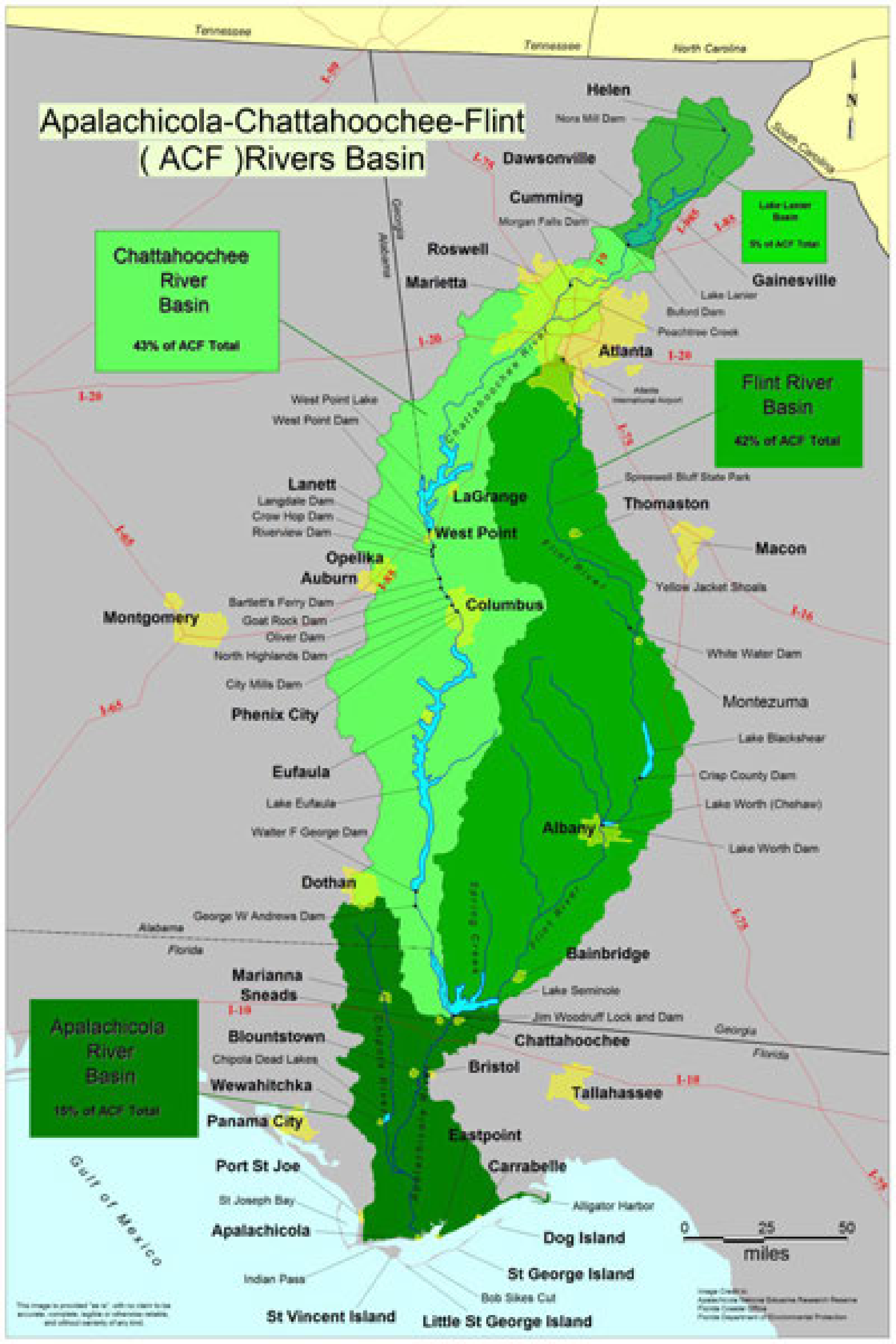
*Conflicting Goals

- Chattahoochee River - Corps operates 5 Federal Reservoirs
- Lower Flint & Chipola Rivers - Breadbasket of the SE
- Water uses include: Lifeblood of Apalachicola Ecosystem, Flood Control, Hydropower, Navigation, Recreation, M&I, Water Quality, Cooling, Ag



Partnerships
ACF River Basin

- ANERR Adv. Board, FOR
- Apalachicola Bay Partnership
- (ABSI) – FSU Marine Lab
- ARSA - Land Mgt Agencies
- PRRT
- Riparian County Stakeholder Coalition – 6 River Counties
- ACF Stakeholders AL, FL, GA
- Apalachicola Caucus – Members of the ACFS from Florida
- ACF Drought Monitor (NOAA)
- Pew Charitable Trust
- Miccosukee Indian Tribe of FL
- Apalachicola, Chattahoochee, & Flint Riverkeepers
- Apalachicola Restoration & Collaboration Space



Our Overarching Goal:

Preservation, Protection and Restoration of the Apalachicola River and Bay System

FLOW (Timing and Volume)
HYDROLOGIC CONNECTIVITY
RESTORATION OF HABITAT
SEAFOOD INDUSTRY

FLOW Decision Points

- Water Resources Development Act (WRDA)
- USACOE ACF River Basin Water Control Manual for the ACF Basin
- US Supreme Court Water Allocation Decision in FL vs GA

FLOW Decision Points

- Water Resources Development Act (WRDA) Every 2 Years by Congress

- USACOE ACF River Basin Water Control Manual for the ACF Basin

  Updated every 5 years or when changed

  2018 Legal Challenge ongoing

- US Supreme Court Water Allocation Ruling was convoluted

US Supreme Court Water Allocation

- While no relief was provided, Georgia was admonished to respect that Florida had rights to water and GA must be good stewards.

- The Corps agreed they would necessarily abide by the Court's ruling, but would have to do a WCM

Bay Productivity/Harvest

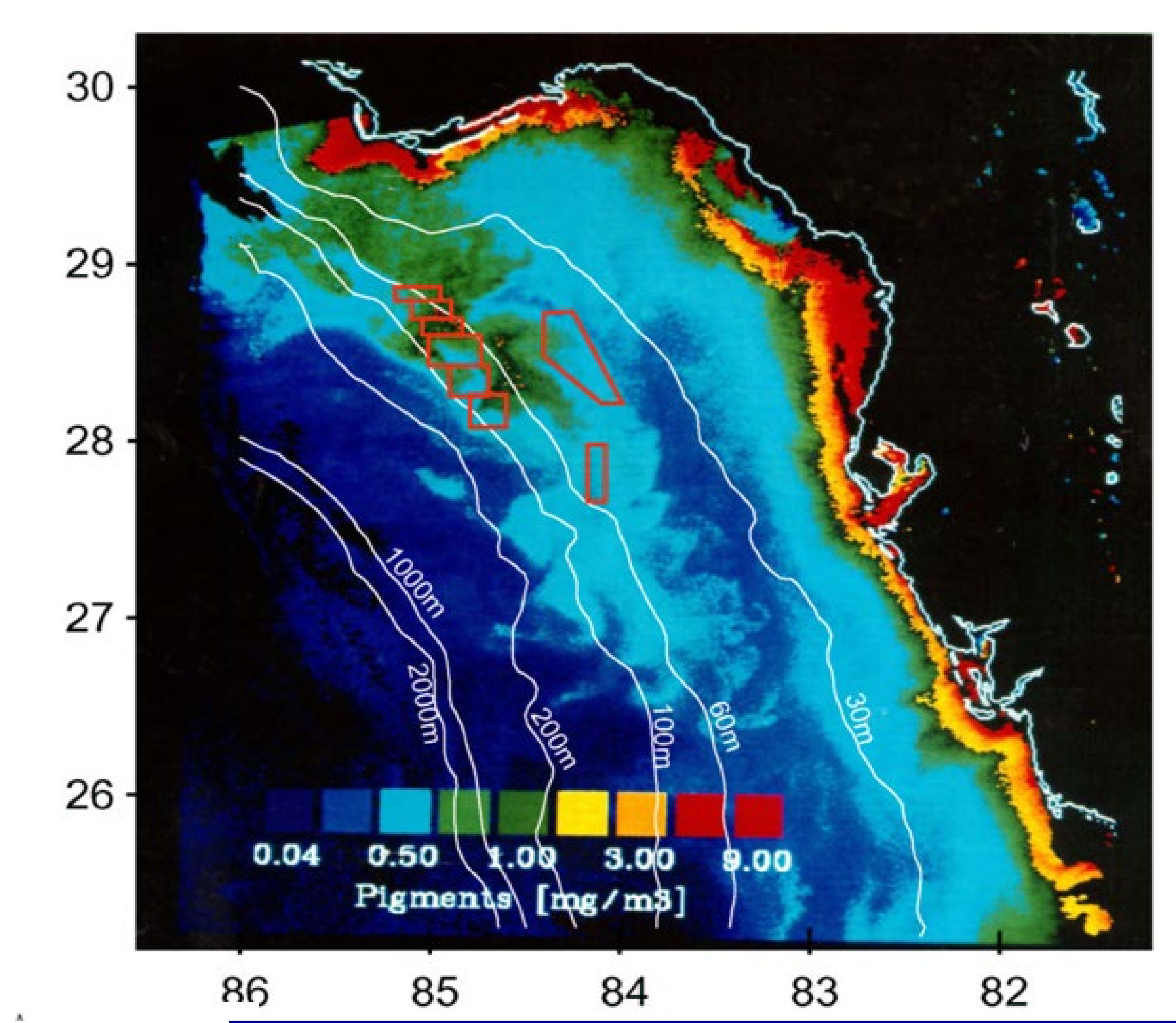
- $200 million Local Seafood Industry,
90% of Florida Oysters, and 10% of US oysters,
plus shrimp, crab and finfish.

- In 1994, Five Million lbs. of Seafood were produced from the Apalachicola Bay region.

- Over 90% of all commercially harvested species in the Gulf spend some part of their life cycle inshore on the marsh and seagrass environment.

- Commercial fisheries of Eastern Gulf value to west Florida over $8 Billion dollars per year/80,000 jobs

Linking Coastal Watersheds to Fisheries



Felicia Coleman

Changes We Have Faced:

DECLINING RIVER STAGE

Reduced flow
Woody debris removal
Loss of Fish Habitat and Fish
Reduction of aquatic species

DRYING OUT OF FLOODPLAIN FOREST

Decrease in Forests Density - Tupelo Forest
Loss of 4 million trees
Disconnected Sloughs

DECLINING SEAFOOD HARVEST

River flow drives the Bay and Eastern Gulf
Loss of Nutrients and Organics
Increased Salinity, Temperature and Disease
Chain reaction thru Food Chain

Challenges
We Will continue to Face

FLOW
Instream Flow Studies (Metrics)

HYDROLOGIC CONNECTIVITY
GIWW Flow Loss to the West
Sikes Cut
Slough/Floodplain Restoration

RESTORATION OF HABITAT
ANERR Programs, Projects, Plans
Floodplain Restoration
East Bay Habitat Restoration
Floodplain - Land Acquisition
Local Critical Shoreline Ordinances
Living Shorelines

SEAFOOD INDUSTRY
Recreating the Driving Force of Our Economy

Success Moments

DECLINING RIVER STAGE

NFWF Funding - Slough Restoration
Pew Charitable Trust Funding - Mapping and Modeling
Other NFWF Projects on Apalachicola National Forest, Box R Ranch, MK Ranch, etc.
Hydrodynamic Modeling of St. Joe Bay

DRYING OUT OF FLOODPLAIN FOREST

NFWF Funding - Slough Restoration
Hydrologically reconnecting the Floodplain to the River and Bay

DECLINING SEAFOOD HARVEST

ABSI Report
Oyster Research ABSI, Emily Fuqua
ANERR Management Plan
FAMU/FSU Modeling
Oyster Recovery
Habitat Restoration

Helen Light Video

SCAN ME

Coastal Zone Soil Survey of Apalachicola Bay: Progress and Outcomes

Presenter: Andrew Reuben Wilson

In Fall of 2023, the Apalachicola National Estuarine Research Reserve (ANERR) and local stakeholders formally requested a coastal zone soil survey of Apalachicola Bay. A coastal zone soil survey is a specialized inventory of soil resources and characteristics in coastal wetland and subaquatic environments; the purpose is to provide land managers and producers with a better understanding of the soil resources and inform land use decisions. The USDA designated ANERR's request as High Priority and began conducting fieldwork in Fall 2024. The project area consists of approximately 280,000 acres of Apalachicola Bay, encompassing the area from Indian Pass to Alligator Point; the survey also includes Lake Wimico and up to eight kilometers of the Apalachicola River. A variety of soils and environments were inventoried including riverine swamps, brackish tidal marshes, and historic oyster reefs. As of Winter 2025, the fieldwork is 90% complete and slated for publication no later than October 2027. This presentation will provide a brief introduction to soil survey and then review soil composition across the bay and its wetlands including soil particle size distribution, soil organic carbon content, and indicators of sulfidic materials. The goal of the soil survey is to provide ANERR and other land managers with an interpretive map highlighting areas suitable for oyster restoration and to provide a better understanding of Apalachicola Bay's soil resources.

Slides unavailable publicly. Please contact Andrew Reuben Wilson for more information: Andrew.Wilson@usda.gov

Recent Acceleration in Regional Sea-Level Rise and the Future of Coastal Wetlands in the Apalachicola Bay Region

Presenter: Dr. Josh Breithaupt

There is growing global concern that many coastal ecosystems will be unable to keep pace with predicted acceleration in sea-level rise (SLR) by the end of this century. Using data from 66 tide gauges along the US southeast Atlantic and Gulf coasts, Dangendorf et al. (2023) demonstrated that regional SLR from 2010-2021 exceeded 10 mm yr-1, a trend that is double or triple prior rates in the prior record. Thus, the past decade offers a glimpse of the future, and an opportunity to investigate whether a response to this increase in SLR occurred in substrates in the Apalachicola Bay region. This talk will use data from several completed and ongoing projects including: A) rates of surface elevation change measured with ANERR's surface elevation table (SET) stations, B) vertical accretion rates obtained from feldspar marker horizons and 210Pb dating of soil cores, and C) aerial and geochemical records of vegetation change on the barrier islands. Though there is substantial variation between environments and vegetation types, in general rates of accretion after 2010 are similar to or exceed 10 mm y-1; multi-decadal average rates vary substantially by environment and vegetation type, ranging from 1-2 mm y-1 in some locations and 8-9 mm y-1 in others. Surface elevation trends indicate a disconnect between accretion and elevation change, with several sites showing net elevation loss despite positive accretion. The talk will include a discussion of methodological challenges and data limitations to inform plans for improved monitoring of coastal ecosystems in the context of SLR.

Slides unavailable publicly. Please contact Dr. Josh Breithaupt for more information: jbreithaupt@fsu.edu

Drone the NERRs:
Assessing the Efficacy of a Drone-based Coastal Wetland Monitoring Protocol

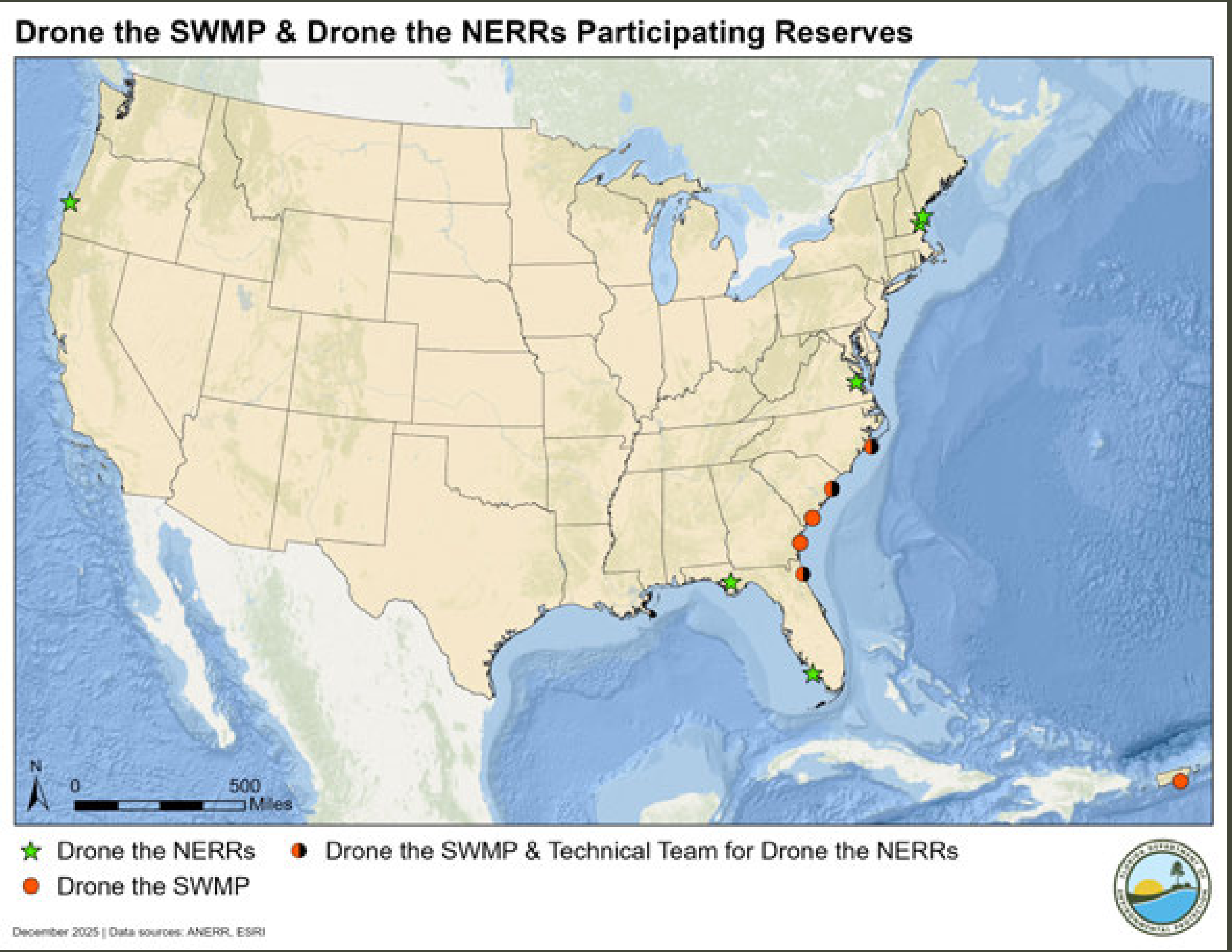
Rebekah Pagliaro, Lexington Preheim, Megan Lamb
Apalachicola National Estuarine Research Reserve (ANERR)
Florida Department of Environmental Protection

Eastpoint, FL | Feb. 26, 2026

Project Grants & Teams

"Drone the SWMP"

- System-Wide Monitoring Program (SWMP).
- Grant: 2020 NERRs Science Collaborative Catalyst.
- Create and test standard operating procedures (SOP) for use of unmanned aerial systems (UAS) in wetland monitoring.



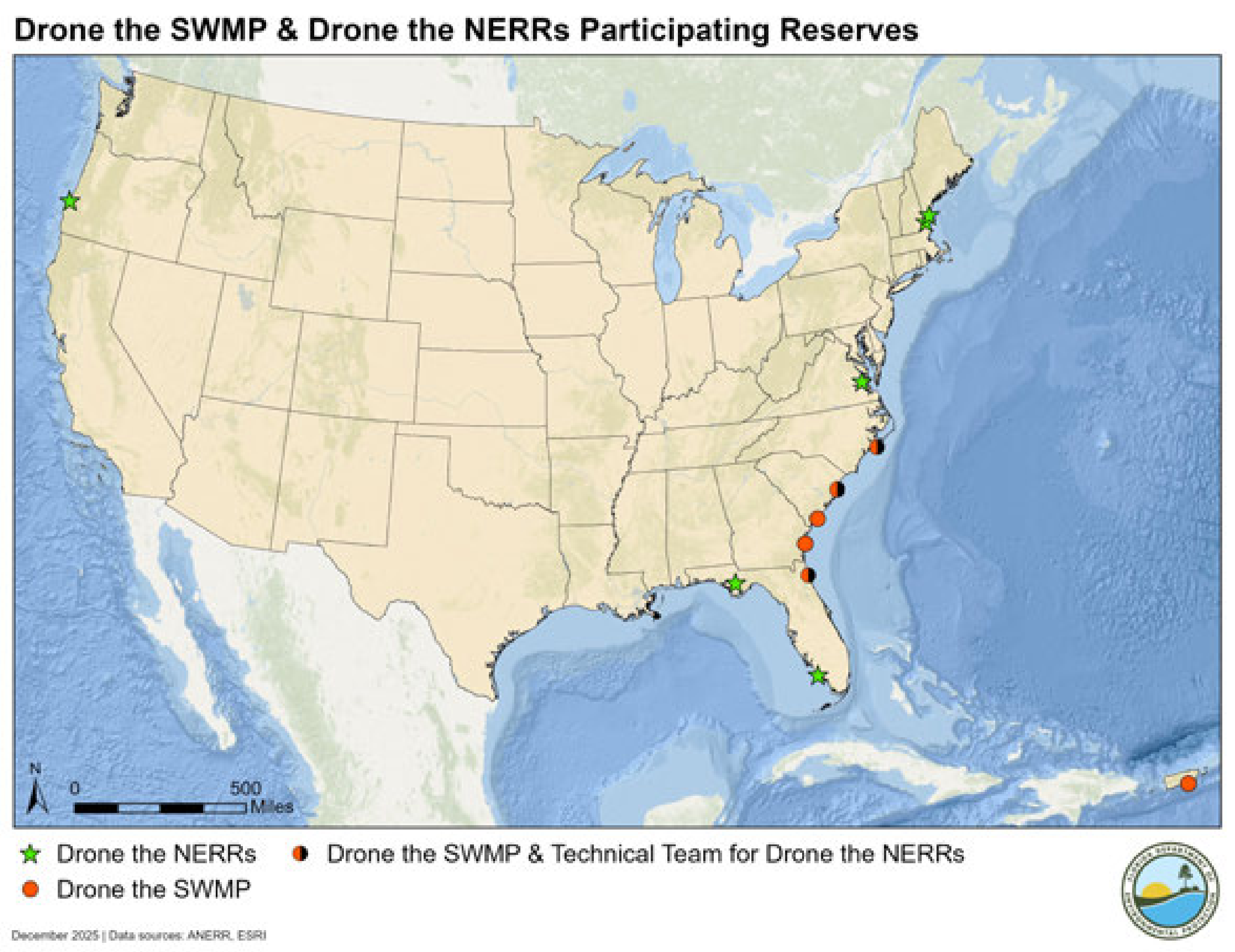
Project Grants & Teams

"Drone the SWMP"

- Grant: 2020 NERRs Science Collaborative Catalyst.
- Technical team for Drone the NERRs.

"Drone the NERRs"

- Grant: 2024 NERRs Science Collaborative Science Transfer.
- Assessment of SOP.
- Build a Community of Practice.



Project Grants & Teams

"Drone the SWMP"

- Grant: 2020 NERRs Science Collaborative Catalyst.
- Technical team for Drone the NERRs.

"Drone the NERRs"

- Grant: 2024 NERRs Science Collaborative Science Transfer.
- Assessment of SOP.
- Build a Community of Practice.

Apalachicola
Megan Lamb
(Collaborative Lead)
Lexington Preheim
Rebekah Pagliaro

Chesapeake Bay
Scott Lerberg
Alex Demeo

Great Bay
Chris Peter
Katie Callahan

Rookery Bay
Donna Pace
(*Fiscal Lead*)
Jared Franklin
(Project Lead)
Jill Schmid
Greg Curry
Marissa Figueroa
Danielle Ogurcak

South Slough
Jennifer Kirkland
Jenni Schmidt

Wells
Jake Aman
Sue Bickford
(In Memoriam)

Technical Advisory Team
Allix North, FDEP/Florida NERRs
Brandon Puckett, NOAA
Erik Smith, North Inlet-Winyah Bay NERR
Justin Ridge, North Carolina NERR

Project Background & Goals

Background

- All NERRs monitor emergent vegetation – ANERR has been monitoring for 10 years.
  - Three sites, three transects at each site.
  - Two sites chosen to monitor with UAS in 2024.

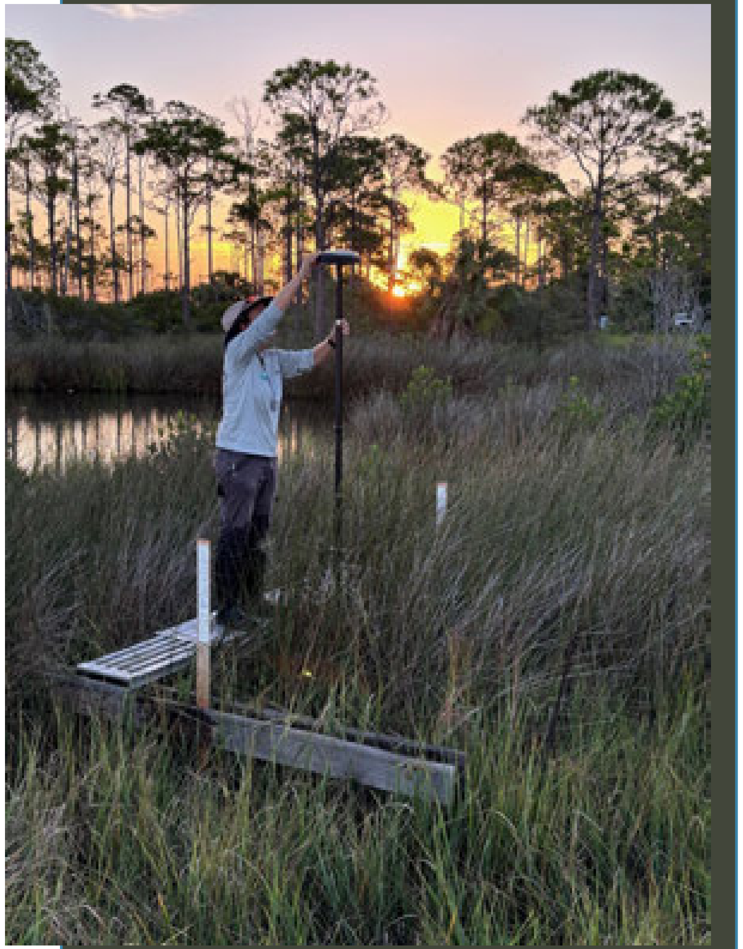
Project Background & Goals

Background

- All NERRs monitor emergent vegetation – ANERR has been monitoring for 10 years.
  - Three sites, three transects at each site.
  - Two sites chosen to monitor with UAS in 2024.

Project Goals

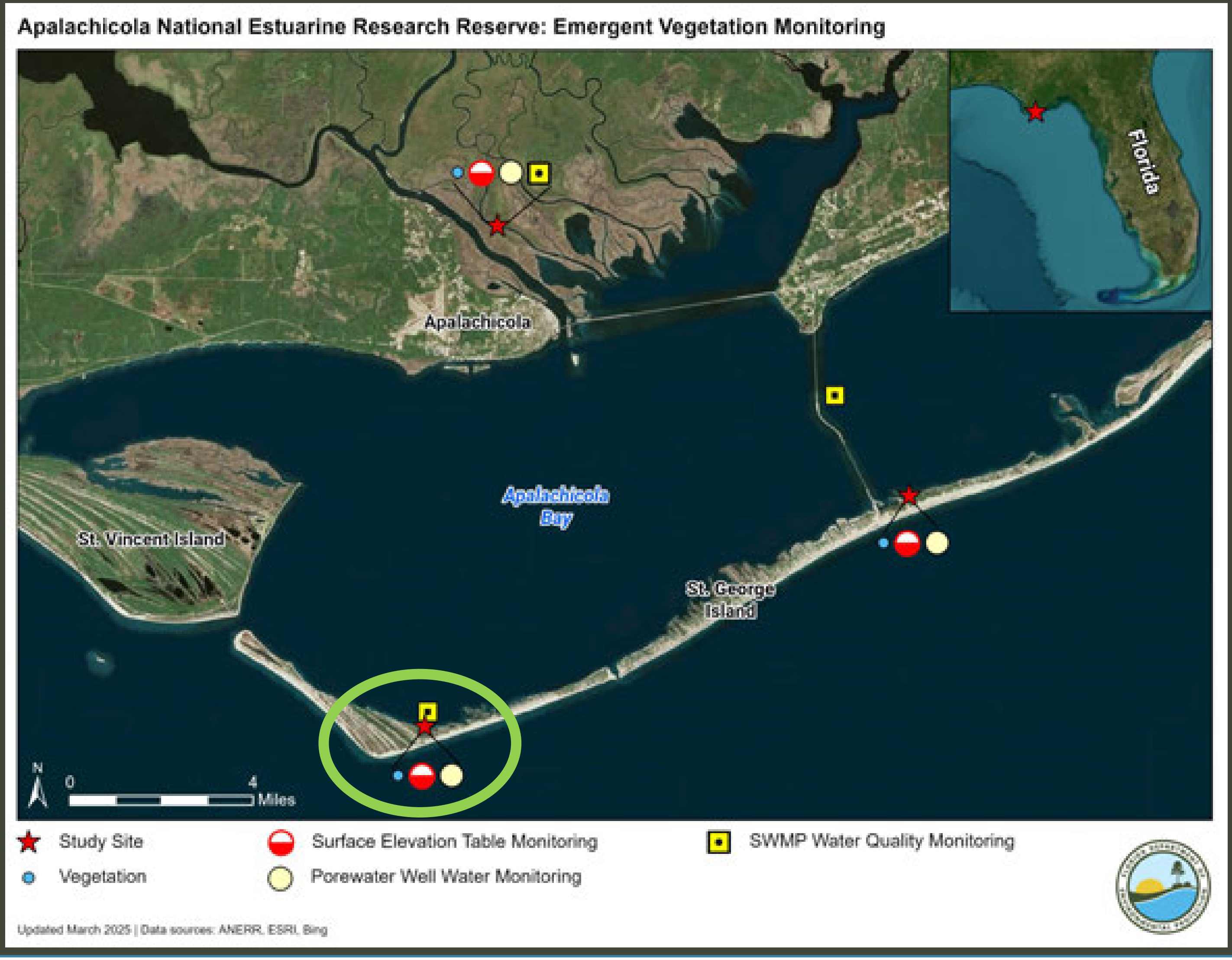
- Provide a less invasive alternative to traditional ground-based monitoring for emergent vegetation.
- Increase overall drone monitoring capacity.
- Establish UAS community of users.



Site Habitats

Pilot's Cove

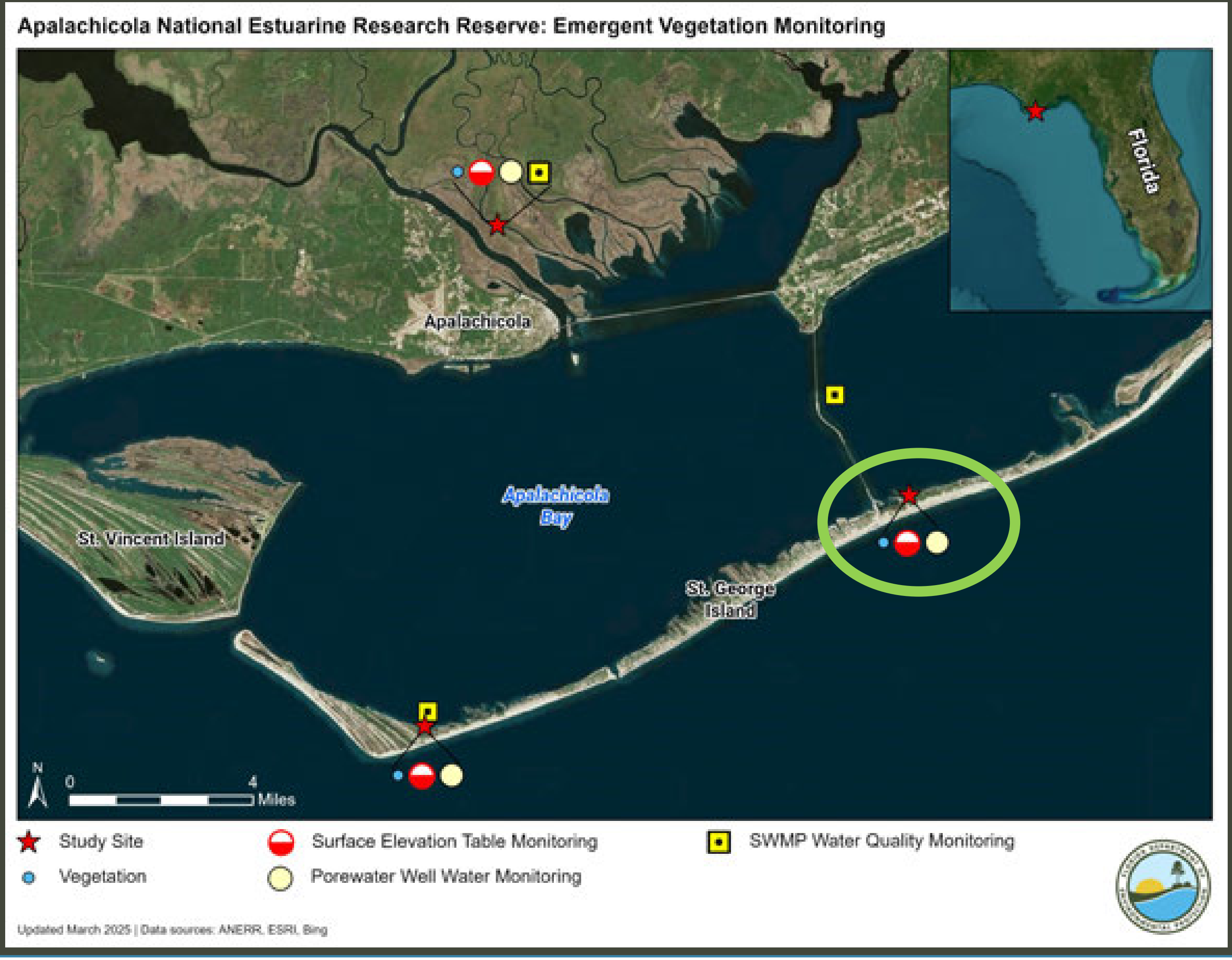
- Saltmarsh
- Dominant vegetation:
  - Smooth cordgrass (*Spartina alterniflora*)
  - Black needlerush (*Juncus roemerianus*)
- Location:
  - Bay side of Cape St. George Island



Site Habitats

Unit 4

- Saltmarsh
- Dominant vegetation:
    - Black needlerush (*Juncus roemerianus*)
- Location:
    - Bay side of St. George Island



Field Methods

1 m x 1 m Subplots

- Three transects at each site.
- Subplots (6 - 10) along transect.
- Perpendicular to shoreline.
- Waters edge to upland edge.

Parameters

- Species
- Percent Cover
- Canopy height
- Stem density

Image Capturing Methods

- Drone: **IF800 Tomcat**
- Camera: **MicaSense Red Edge-P**
- Image Software: **Drone2Map**

Image Capturing Methods

- Drone: **IF800 Tomcat**
- Camera: **MicaSense Red Edge-P**
- Image Software: **Drone2Map**
- Distribute GCPs > RTK locations (GCPs, control points) > Fly

Image Capturing Methods

- Drone: **IF800 Tomcat**
- Camera: **MicaSense Red Edge-P**
- Image Software: **Drone2Map**
- Distribute GCPs > RTK locations (GCPs, control points) > Fly
- Acres flown:
  - Pilot’s Cove: **13.2**
  - Unit 4: **5.67**
- # of GCPs:
  - Pilot’s Cove: **9**
  - Unit 4: **9**

Image Capturing Methods

- Drone: **IF800 Tomcat**
- Camera: **MicaSense Red Edge-P**
- Image Software: **Drone2Map**
- Distribute GCPs > RTK locations (GCPs, control points) > Fly
- Acres flown:
  - Pilot's Cove: **13.2**
  - Unit 4: **5.67**
- # of GCPs:
  - Pilot's Cove: **9**
  - Unit 4: **9**
- Ground-based vegetation surveys of 1x1 m subplots: **June 2024.**
- UAS vegetation surveys: **August 2024.**

Project Analysis Goals vs. ANERR Outputs

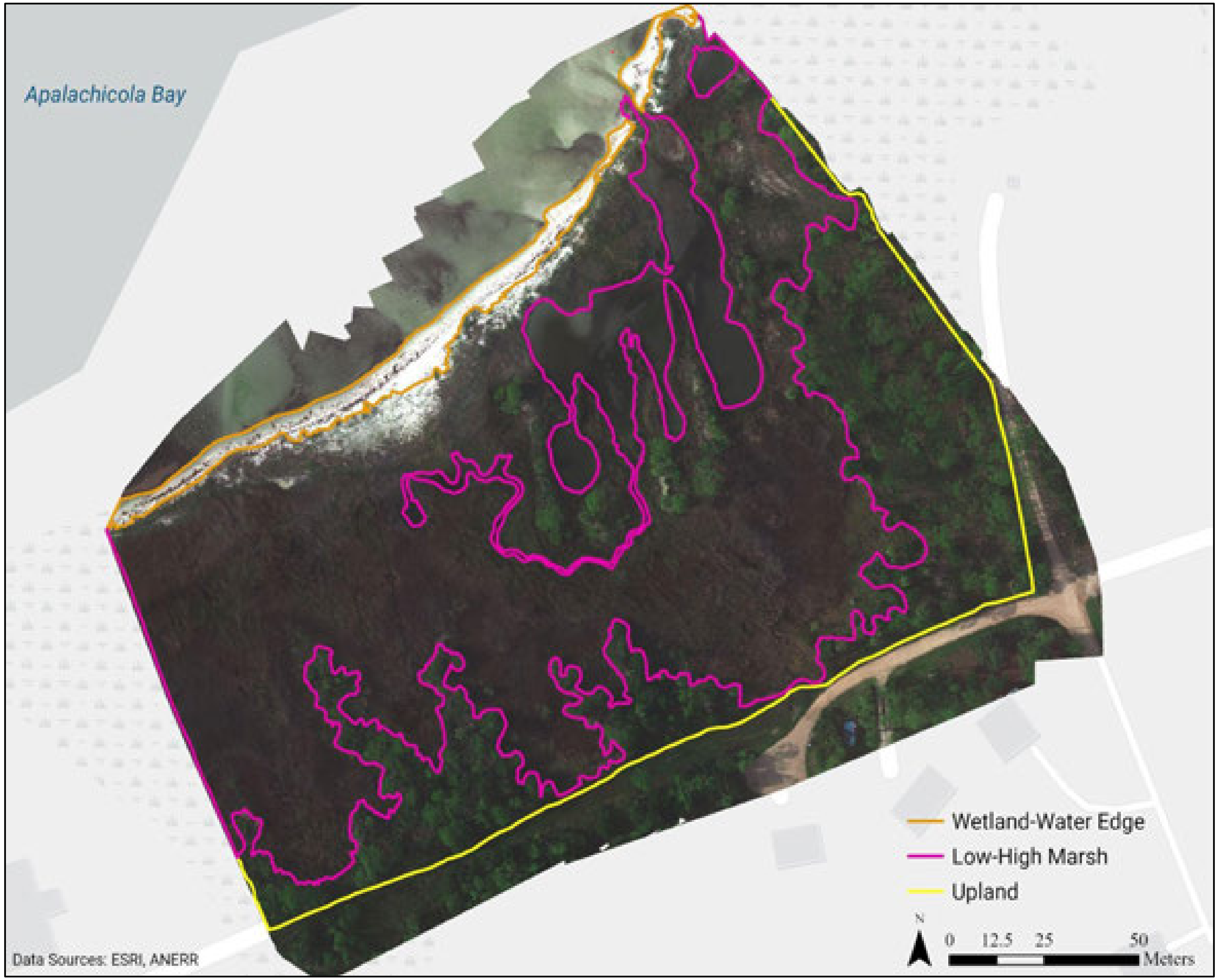
Four Goals

- Elevation Models + Canopy Height
- **Ecotone Delineation**
- **Percent Cover**
  - **Total**
  - Species Specific
- Above-Ground Biomass

Results: Ecotone Delineation
Pilot's Cove

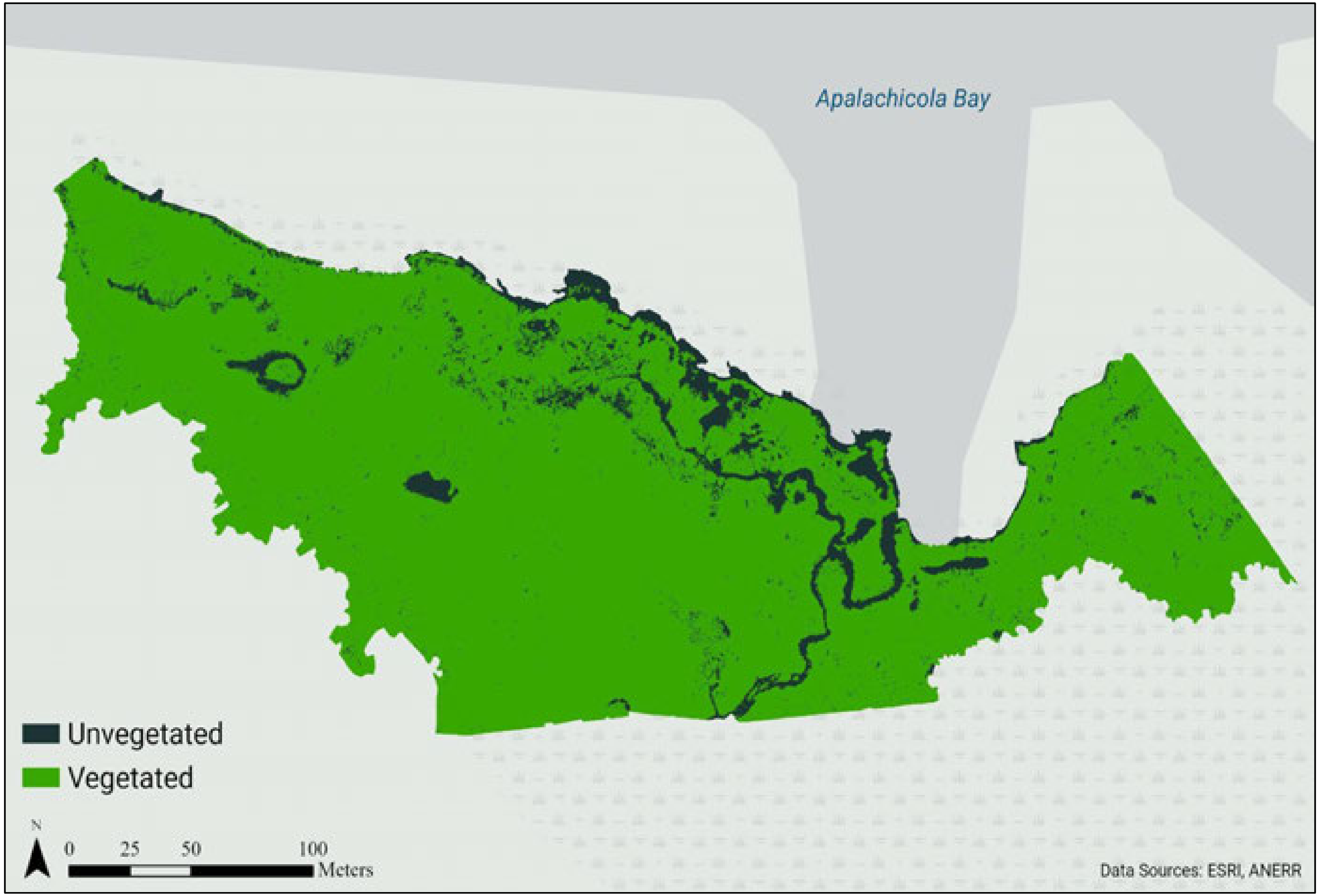
Results: Ecotone Delineation

Unit 4



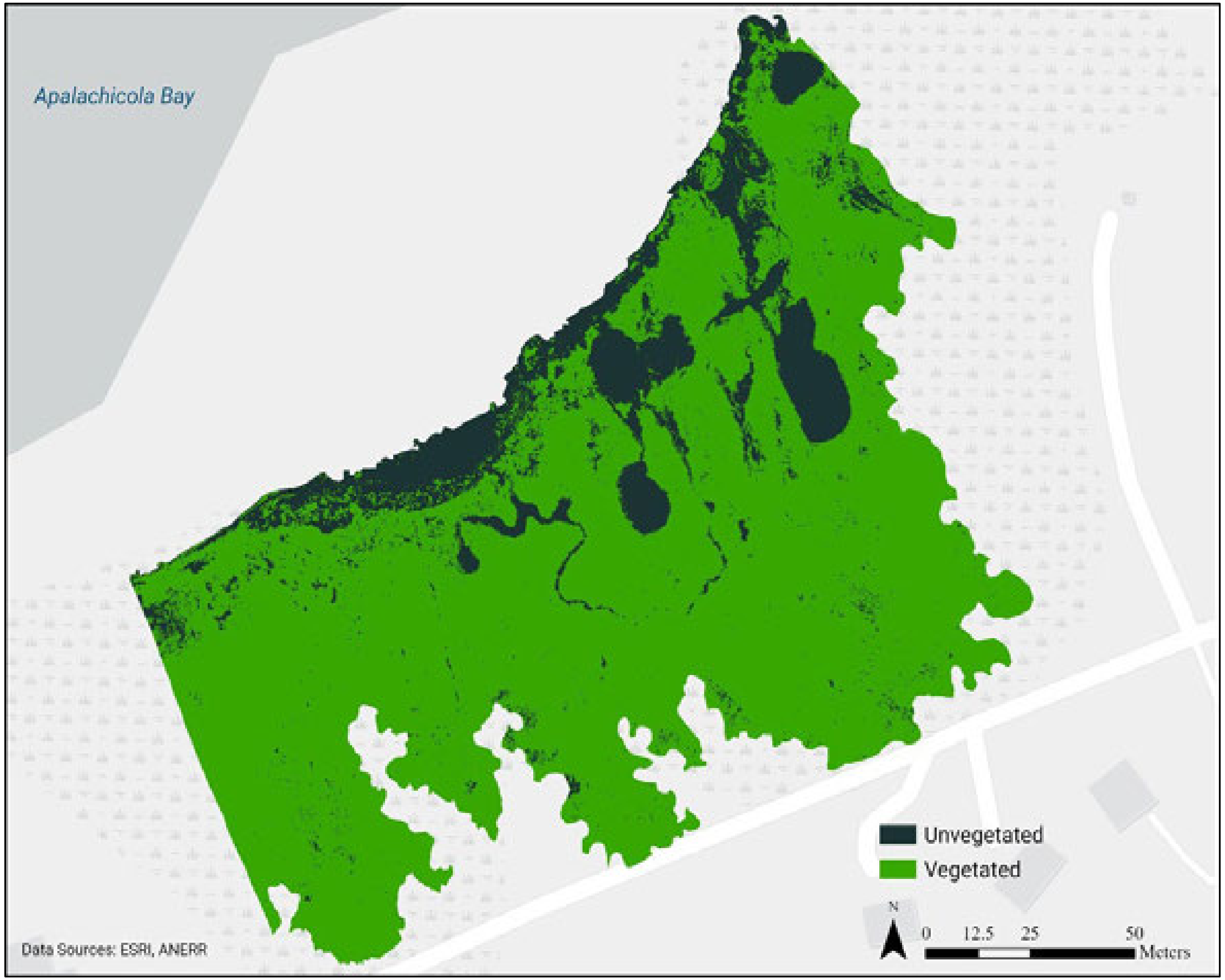
Results: Autoclassification

Pilot's Cove: Random Trees | RGB + DSM



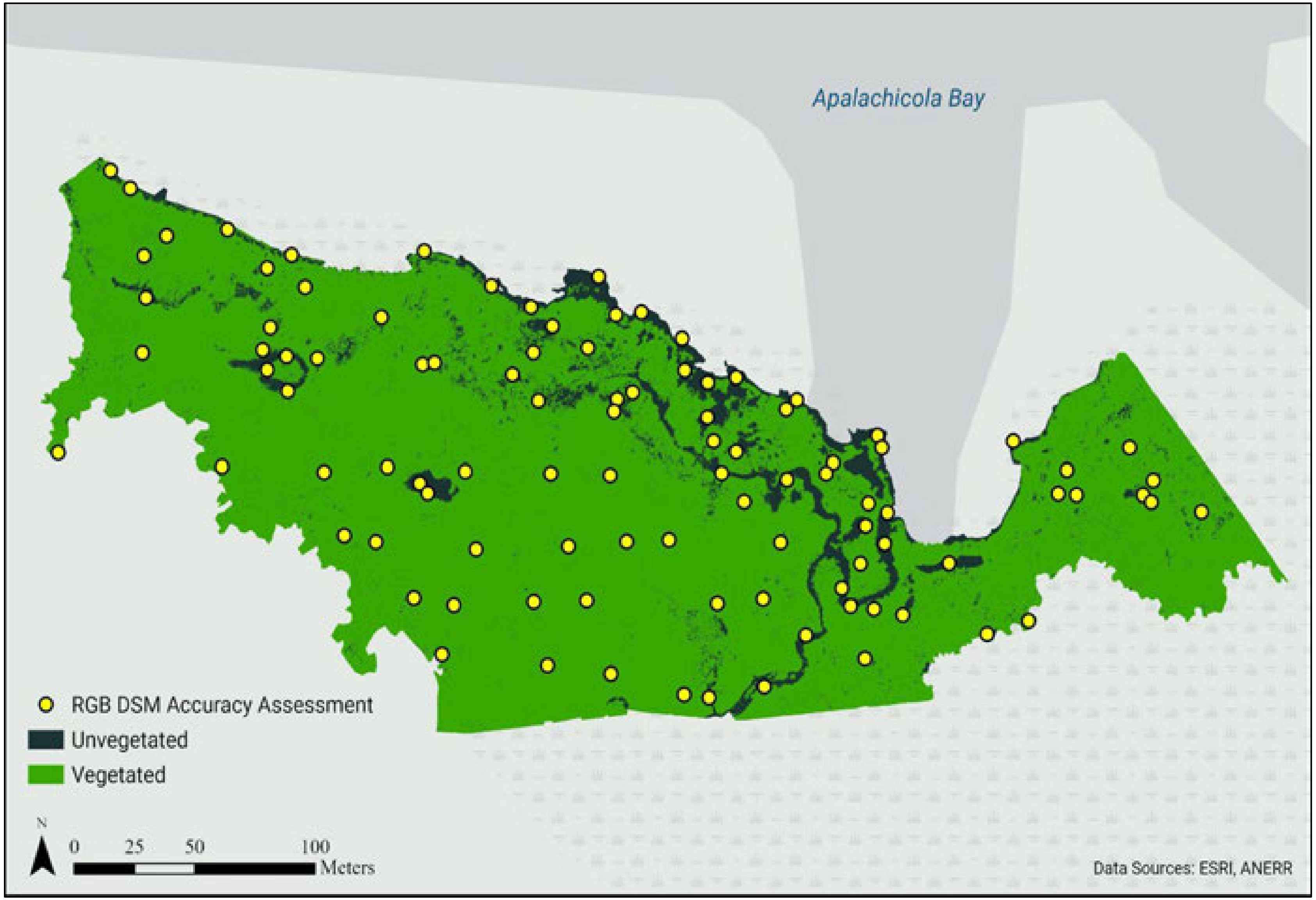
Results: Autoclassification

Unit 4: Random Trees | RGB + NDVI



Results: Accuracy Assessment

Pilot's Cove: Random Trees | RGB + DSM



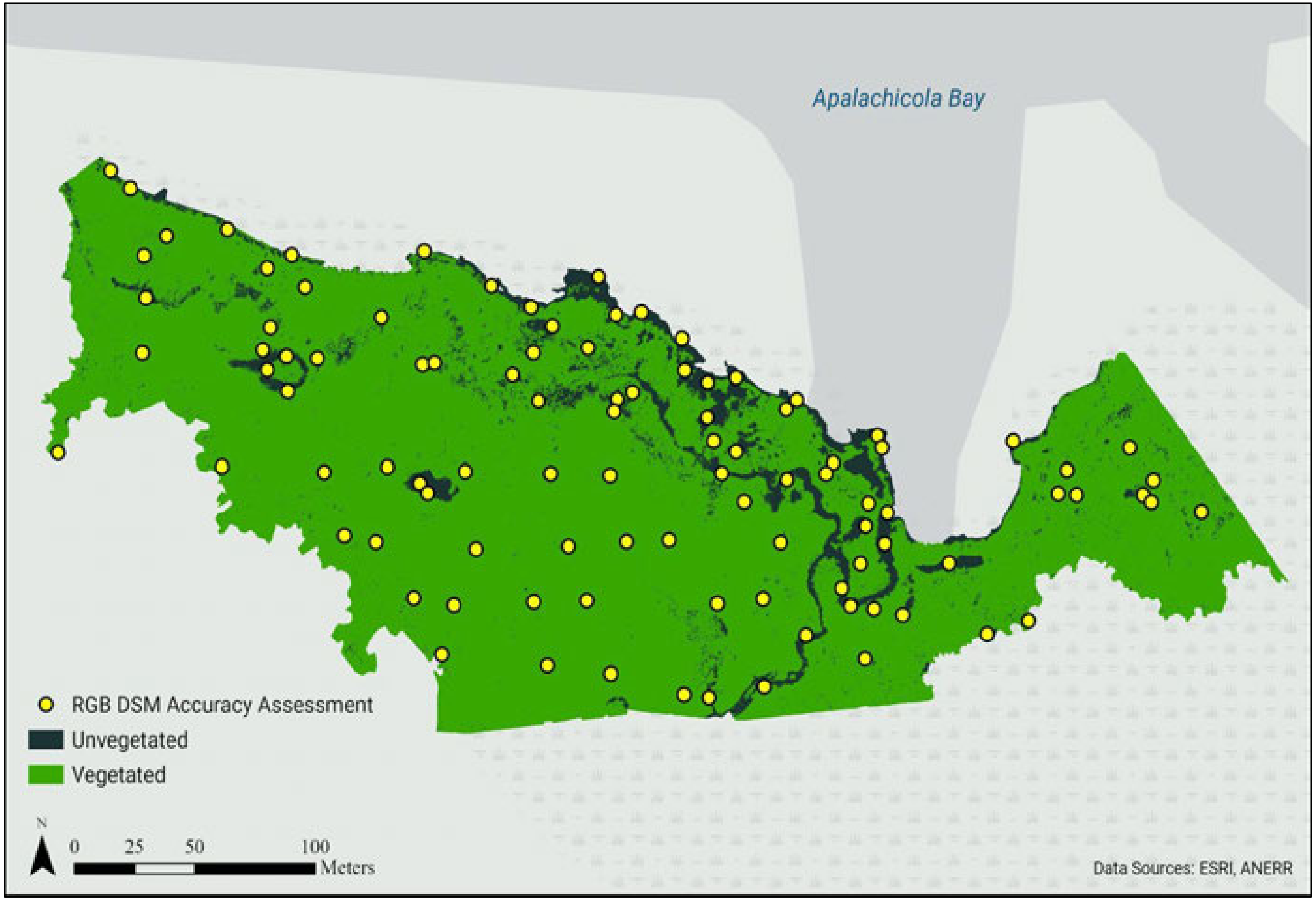
Results: Accuracy Assessment
Pilot's Cove: Random Trees | RGB + DSM

PreferredChoice_APA_...SM_ESR_CCMatrix

Field: Add Calculate Selection: Select By Attributes Zoom To

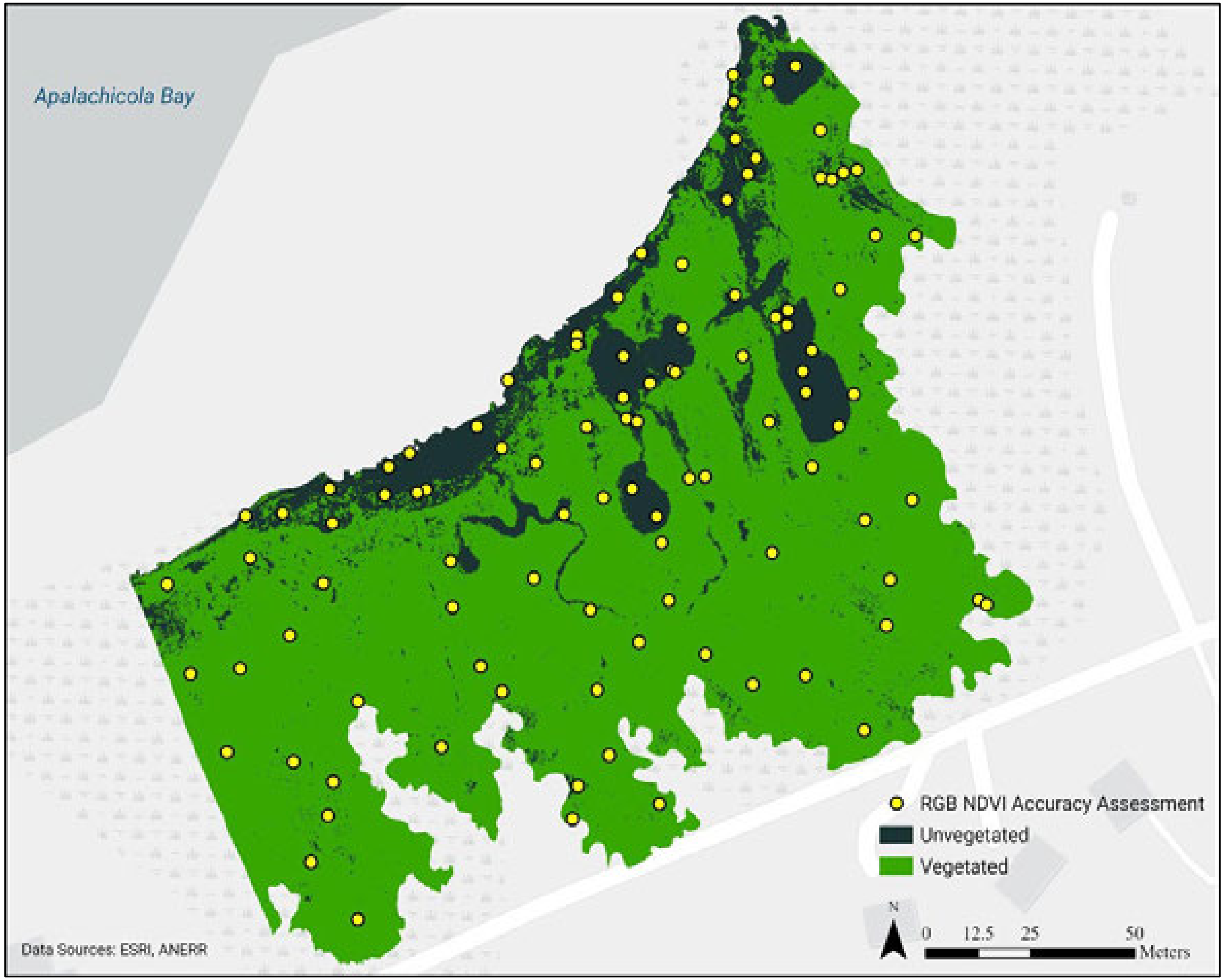
	OBJECTID *	ClassValue	C_0	C_1	Total	U_Accuracy	Kappa
1	1	C_0	40	10	50	0.8	0
2	2	C_1	6	44	50	0.88	0
3	3	Total	46	54	100	0	0
4	4	P_Accuracy	0.869565	0.814815	0	0.84	0
5	5	Kappa	0	0	0	0	0.68

Click to add new row.



Results: Accuracy Assessment

Unit 4: Random Trees | RGB + NDVI



Results: Accuracy Assessment

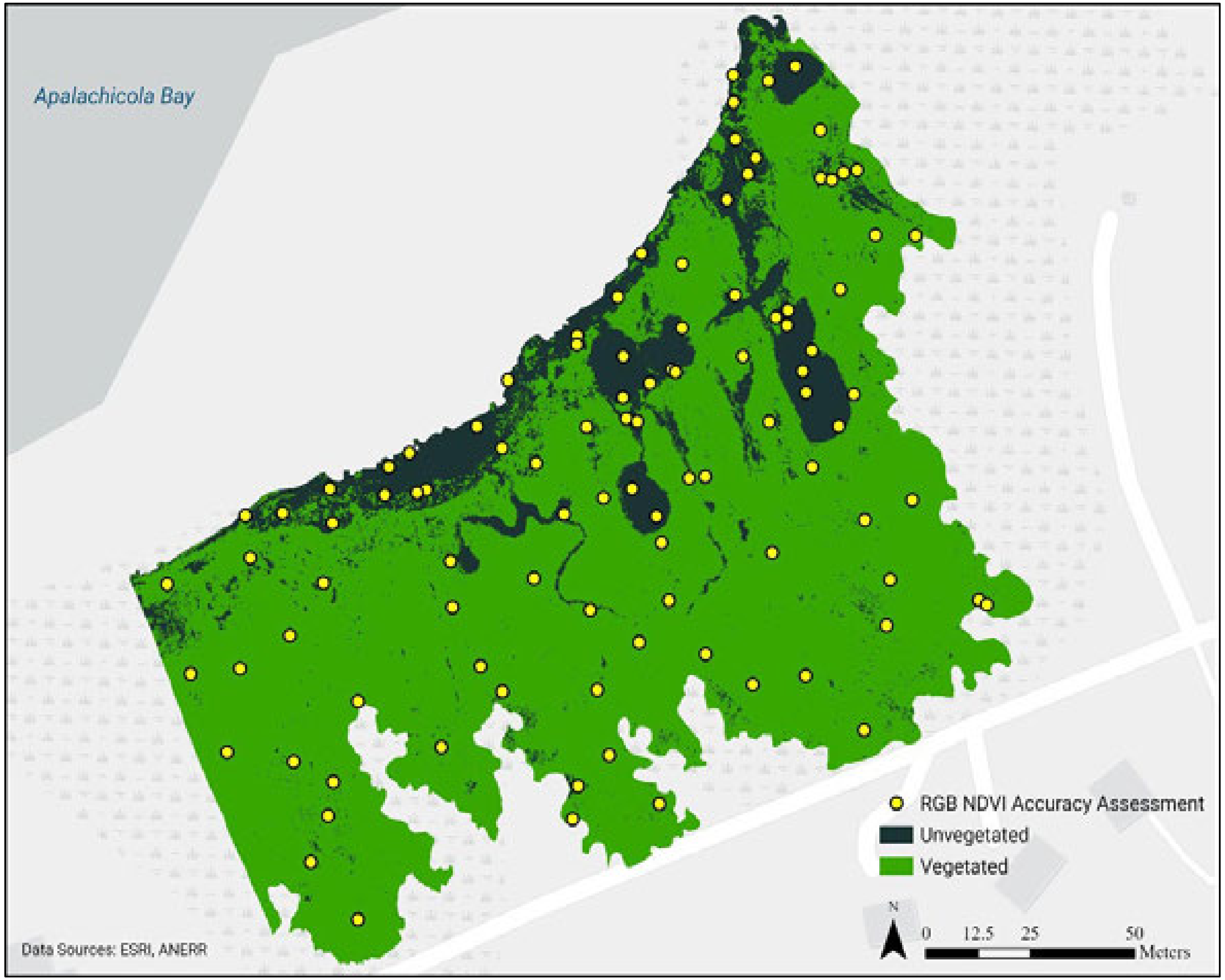
Unit 4: Random Trees | RGB + NDVI

PreferredChoice_APA_...AA_ESR_CCMatrix

Field: Add Calculate Selection: Select By Attributes Zoom To

	OBJECTID *	ClassValue	C_0	C_1	Total	U_Accuracy	Kappa
1	1	C_0	42	8	50	0.84	0
2	2	C_1	5	45	50	0.9	0
3	3	Total	47	53	100	0	0
4	4	P_Accuracy	0.893617	0.849057	0	0.87	0
5	5	Kappa	0	0	0	0	0.74

Click to add new row.



Results: Vegetation Cover

Pilot's Cove: Field Data 6/4/24 | Drone Flights 8/28/24

		Drone Data		Field Data	
PLOT ID	Plot Size (m^2)	Actual % Unvegetated	Actual % Vegetated	% Unvegetated	% Vegetated
Transect 2 Plot 1	0.938599	12.1	87.7	80	20
Transect 2 Plot 2	0.966081	48.2	51.9	25	75
Transect 2 Plot 3	0.871603	21.8	78.3	75	NA
Transect 2 Plot 4	0.952062	0.0	100.0	20	80
Transect 2 Plot 5	0.819308	0.0	100.1	50	50
Transect 2 Plot 6	0.884562	3.5	96.6	50	50
Transect 2 Plot 7	0.870974	0.0	100.1	10	90
Transect 2 Plot 8	0.806761	0.0	99.8	5	95
Transect 2 Plot 9	1.095539	0.0	100.0	35	65

Results: Vegetation Cover

Unit 4: Field Data 6/6-7/24 | Drone Flights 8/26/24

		Drone Data		Field Data	
PLOT ID	Plot Size (m^2)	Actual % Unvegetated	Actual % Vegetated	% Unvegetated	% Vegetated
Transect 3 Plot 1	0.794602	17.0	83.8	25	76
Transect 3 Plot 2	0.964786	36.9	63.1	10	90
Transect 3 Plot 3	0.897777	0.0	99.7	9	91
Transect 3 Plot 4	0.993778	4.5	95.6	49	51
Transect 3 Plot 5	0.937705	0.0	100.0	5	95
Transect 3 Plot 6	0.951477	0.0	99.9	3	97
Transect 3 Plot 7	0.732334	0.0	99.6	0	100
Transect 3 Plot 8	0.638373	20.0	80.5	9	91
Transect 3 Plot 9	0.649722	0.0	100.0	19	81
Transect 3 Plot 10	0.9112	0.0	100.3	10	90

Lessons Learned & Future Plans

Lessons

- Everything will take more time than you think!
- Clarification needed on ground-based sampling.
- SOP improvements needed – addressed by technical team.
- Keep pilot skills proficient.

Future Plans

- Working to incorporate UAS surveys into yearly vegetation surveys.

THANK YOU

Rebekah Pagliaro
Apalachicola National Estuarine Research Reserve
Florida Department of Environmental Protection

Contact Information:
850-670-7713
Rebekah.Pagliaro@FloridaDEP.gov

More information:
nerrssciencecollaborative.org/project/Franklin23

Long-Term Estuarine Shoreline Change and the Coastal Heritage at Risk Tool (CHART)

Presenter: Dr. Kathryn Smith

Robust estimates of estuarine shoreline change are essential for informed coastal management, particularly for safeguarding vulnerable resources and communities, yet these data are often scarce or underutilized. For example, where on-going estuarine erosion impacts Native American cultural sites situated near the shoreline, understanding shoreline change trends can guide proactive management and help prevent irreversible loss. Using historical data and imagery, we measured rates of estuarine shoreline change for the Apalachicola estuary. Preliminary data suggest that although overall shoreline change in Apalachicola is low, it is highly spatially variable, with shoreline segments along St Vincent and St George Islands eroding at roughly 2 m yr-1, whereas shorelines near the Apalachicola River mouth are accreting at more than 2 m yr-1. This spatially dynamic pattern complicates system-wide management but provides valuable insights for targeting restoration or mitigation efforts to areas at greatest risk, including potential installation of living shorelines where erosion threatens communities, infrastructure, or natural and cultural resources. Guided by an advisory panel of Tribal representatives, archeologists, and land managers, we plan to use these foundational data to evaluate the likelihood of shell midden site loss due to future shoreline erosion and to develop a risk evaluation tool that can support decision-making for the most vulnerable sites.

Slides unavailable publicly. Please contact Dr. Kathryn Smith for more information: kelsmith@usgs.gov

Changing Shorelines at Archaeological Sites around Apalachicola

Presenter: Dr. Jayur Mehta

Surveys of archaeological sites around Apalachicola were conducted in Summer 2025 to document exposed archaeological features and artifacts. Sites were investigated using various archaeological methods including pedestrian survey, RTK-GPS mapping, hand-drawn sketch maps, photography, and airborne remote sensing using a WingtraONE GenII fixed-wing UAV. Results from the field surveys are compared to legacy datasets and newly developed shoreline change models to define the extent of change at these significant and non-renewable cultural resources.

Slides unavailable publicly. Please contact Dr. Jayur Mehta for more information: jmehta@fsu.edu

Archaeology Institute
UNIVERSITY *of* WEST FLORIDA

NORTHWEST FLORIDA
MARITIME LANDSCAPE
ALLIANCE for PRESERVATION

PEOPLE OF THE APALACHICOLA SYSTEM

Exploring Cultural Heritage to Support Ecosystem Planning, Management, and Adaptation

Nicole Bucchino Grinnan, M.A., RPA
Mike Thomin, M.A.
ngrinnan@uwf.edu

A 2023 NOAA National Estuarine Research Reserve System
Science Collaborative Catalyst Grant (SUBK00020277) Project

Image courtesy: M. Thomin

HERITAGE UNDER ACCELERATED CHANGE

- Coastal heritage as a link between people and the environment
- How do we respond when heritage is exposed or at risk of loss?
  - Limited funding and capacity
  - Not all aspects of heritage can be stabilized
- Need defensible prioritization strategies

Image courtesy: M. Thomin

RESEARCH QUESTIONS

1. How is environmental change affecting coastal cultural heritage resources?

1. In what ways do archaeological site assessments and environmental data contribute to understanding patterns of heritage vulnerability?

1. How do local communities define, value, and prioritize cultural heritage?

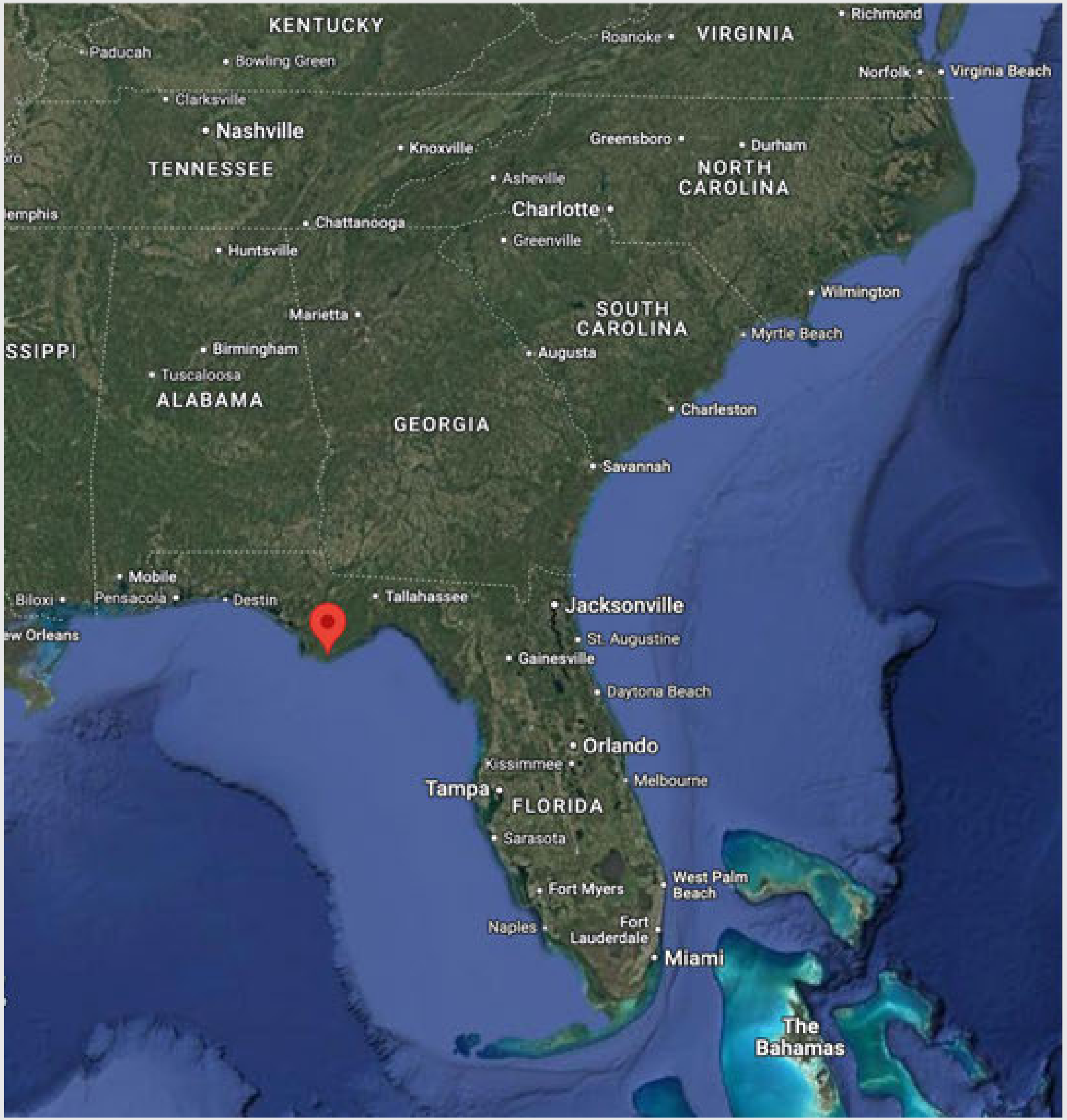
1. Can an integrated methods approach inform preservation action?

Images courtesy: M. Thomin (Background); British Museum (Self-portrait drawn by Josiah Francis in England in 1815); State Library and Archives of Florida (Apalachicola, c. 1907)

PROJECT SCOPE

- 2024 multi-methods study:
  - Archaeological site assessment and high-resolution shoreline mapping
  - Sea Levels Affecting Marshes Model (SLAMM) and Archaeological Triage Assessment (ATA)
  - Community engagement
- Conducted within Apalachicola National Estuarine Research Reserve
- 2023 NOAA National Estuarine Research Reserve System Science Collaborative Catalyst Grant (SUBK00020277)

Image courtesy: M. Thomin


KENTUCKY
Richmond
Paducah
Roanoke
VIRGINIA
Bowling Green
Norfolk
Virginia Beach
Clarksville
Nashville
Knoxville
Greensboro
Durham
TENNESSEE
Asheville
NORTH CAROLINA
Charlotte
Chattanooga
Greenville
Huntsville
Wilmington
Marietta
SOUTH CAROLINA
Myrtle Beach
Birmingham
Augusta
Tuscaloosa
ALABAMA
Charleston
GEORGIA
Savannah
Mobile
Biloxi
Pensacola
Destin
Tallahassee
Jacksonville
St. Augustine
Gainesville
Daytona Beach
Orlando
Kissimmee
Tampa
Melbourne
FLORIDA
Sarasota
West Palm Beach
Fort Myers
Naples
Fort Lauderdale
Miami
The Bahamas

Blountstown
Wewahitchka
Apalachicola National Forest
Tate's Hell Wildlife Management Area
Carabelle
Port St Joe
Apalachicola

01/
SITE ASSESSMENT + SHORELINE MAPPING

- Site condition assessments using HMS Florida
  - 15 priority archaeological sites

- Transect-based shoreline change measurements
  - 7 adjacent coastline areas

- Photogrammetric documentation
  - 3 priority archaeological sites

Image courtesy: M. Thomin

HERITAGE MONITORING SCOUTS

Site Monitoring Form:
Archaeological Sites and Cemeteries

Master Scout ID: ____________________

FMSF Name: ____________________

FMSF Site ID (i.e. 8SJ00405): ____________________

Type of Visit: __________

Time of Day: __________

Date: __________

Site Location:

- ☐ Site location verified
- ☐ Site could not be found
- ☐ Site found, but in different location (note corrected location in comment field below)

Scout Visit Condition Assessment:

- ☐ Good => Stable
- ☐ Fair => Declining
- ☐ Poor => Unstable

Threats Observed (check all that apply):

- ☐ Active Erosion
- ☐ Storm surge
- ☐ Wind
- ☐ Flooding
- ☐ Wave action
- ☐ Vegetation Growth
- ☐ Animal disturbance
- ☐ Visitor traffic
- ☐ Vehicle damage
- ☐ Development
- ☐ Other (describe below)

Describe Other Threats Here

Visible Artifacts (check all that apply):

- ☐ Shell midden
- ☐ Prehistoric pottery
- ☐ Lithics
- ☐ Shell tool
- ☐ Faunal remains
- ☐ Ship timbers, sheathing or rigging
- ☐ Glass
- ☐ Architectural (nails, wire, bricks, etc.)
- ☐ Grave markers
- ☐ Historic ceramics
- ☐ Other (describe below)
- ☐ Ship anchor

HERITAGE MONITORING SCOUTS

Site Monitoring Form:
Archaeological Sites and Cemeteries

Describe Other Visible Artifacts Here

Site Impact Comments

Site Priority:

- ☐ High
- ☐ Medium
- ☐ Low

Recommendations:

- ☐ Repeat visit
- ☐ Defense
- ☐ FMSF update
- ☐ Other

Final Evaluation Notes


N
N

Image courtesy: State Library and Archives of Florida (No. KOR1973, c. 1900)

Image courtesy: State Library and Archives of Florida (no. N043947, c. 1950)

Image courtesy: M. Thomin

01/
SITE ASSESSMENT + SHORELINE MAPPING

- ~~Site condition assessments using HMS Florida~~
- Transect-based shoreline change measurements
- Photogrammetric documentation

Image courtesy: M. Thomin

Image courtesy: M. Thomin

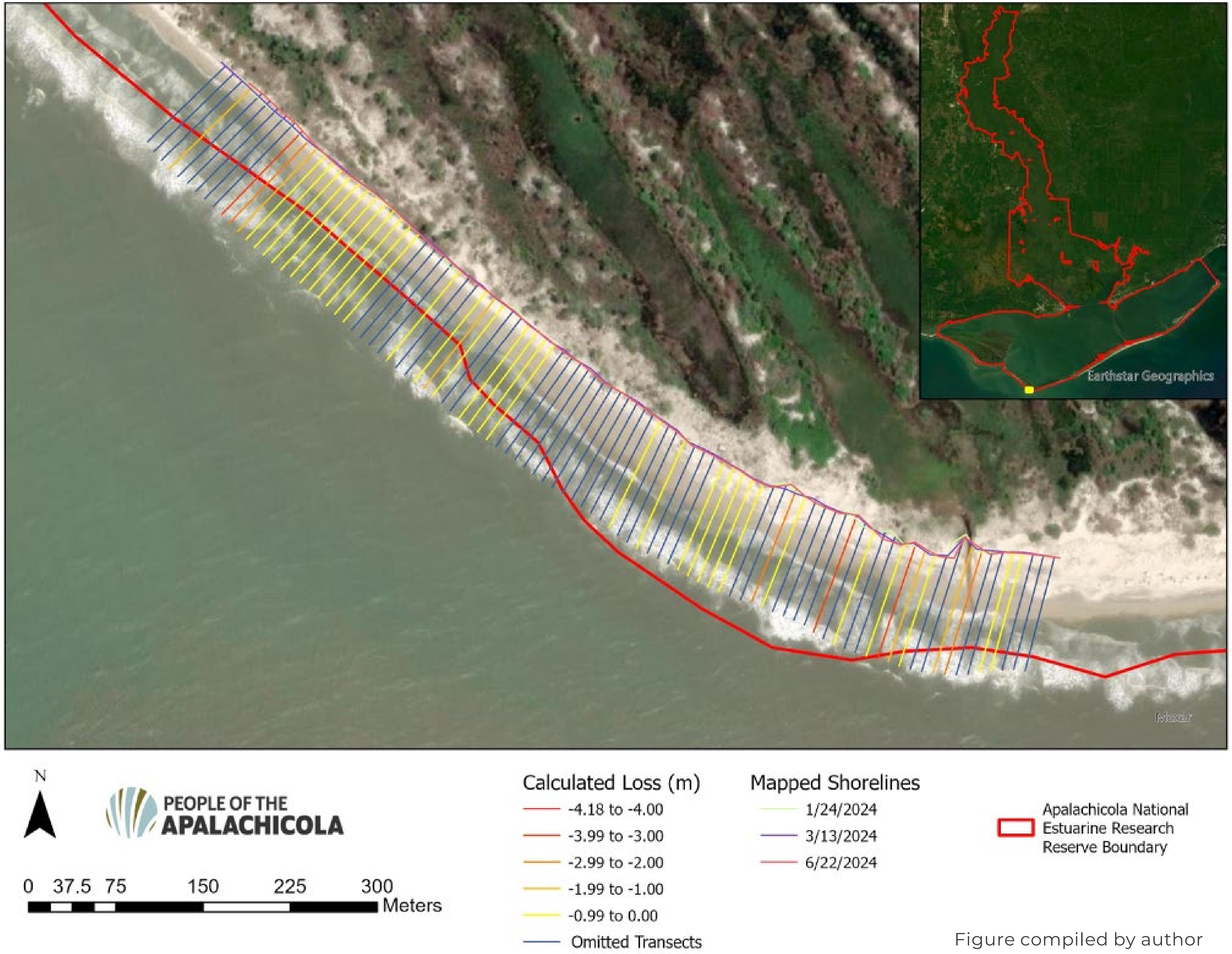


Figure compiled by author

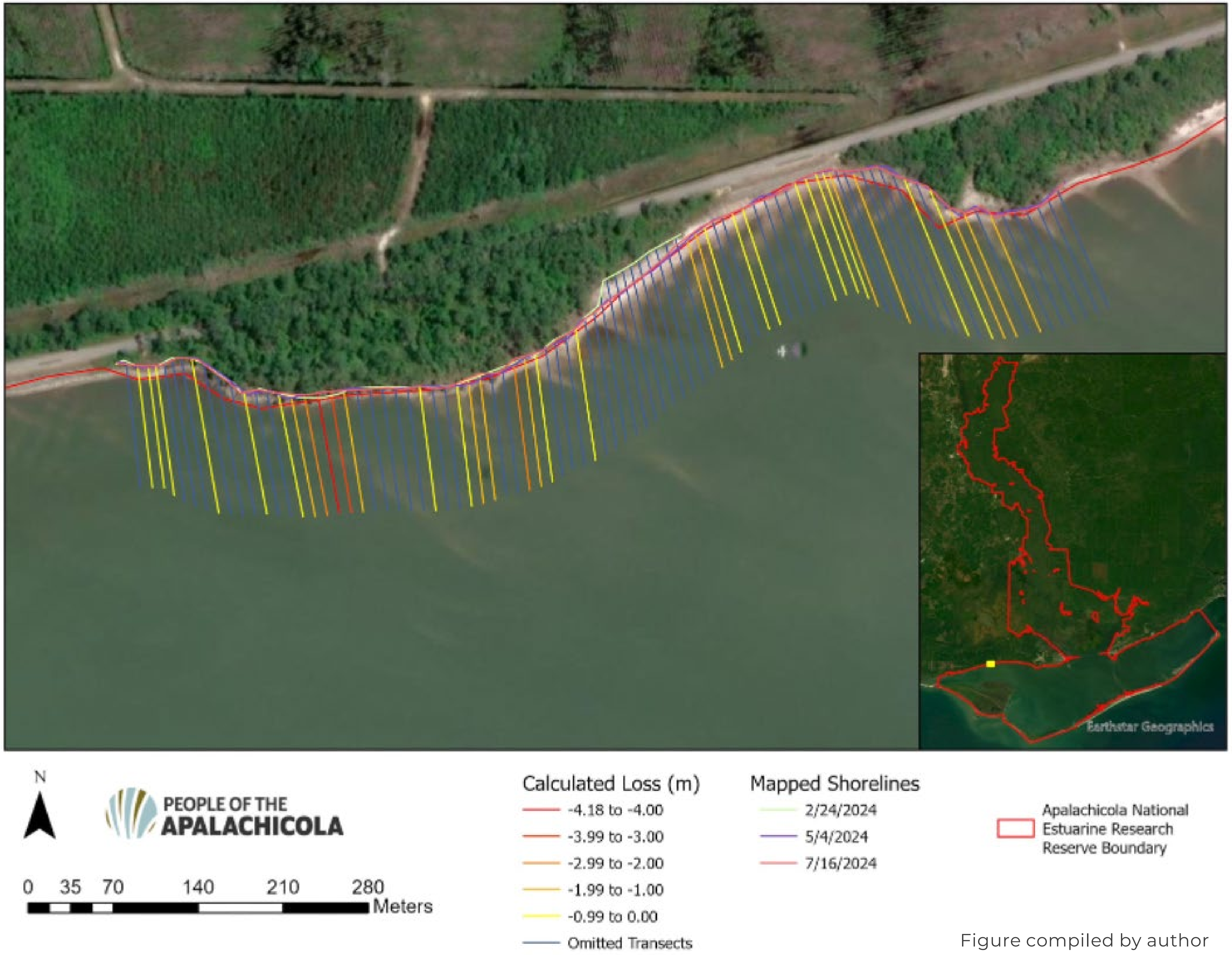


Figure compiled by author

01/
SITE ASSESSMENT + SHORELINE MAPPING

- ~~Site condition assessments using HMS Florida~~
- ~~Transect-based shoreline change measurements~~
- Photogrammetric documentation

Image courtesy: M. Thomin

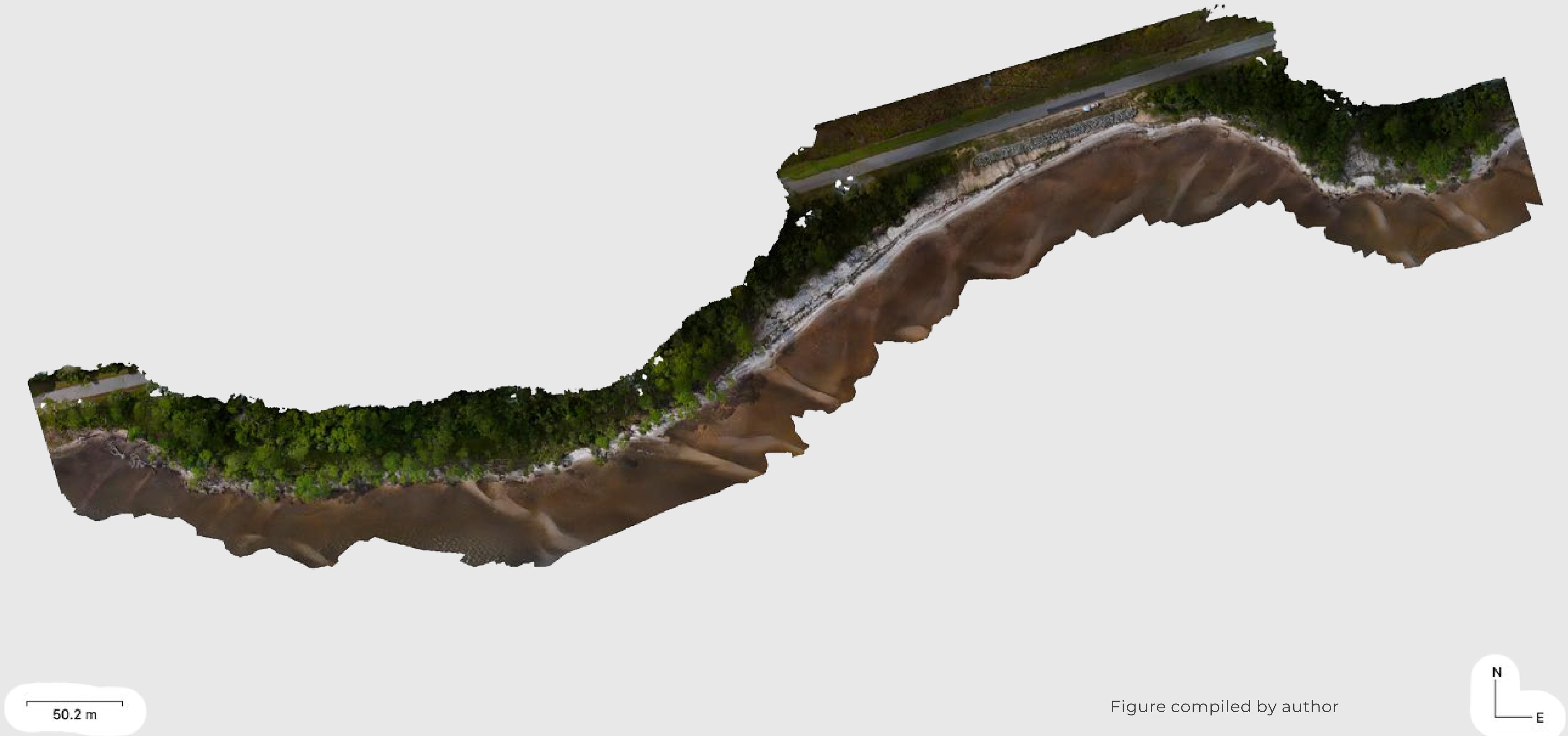


Figure compiled by author

01/
KEY TAKEAWAYS

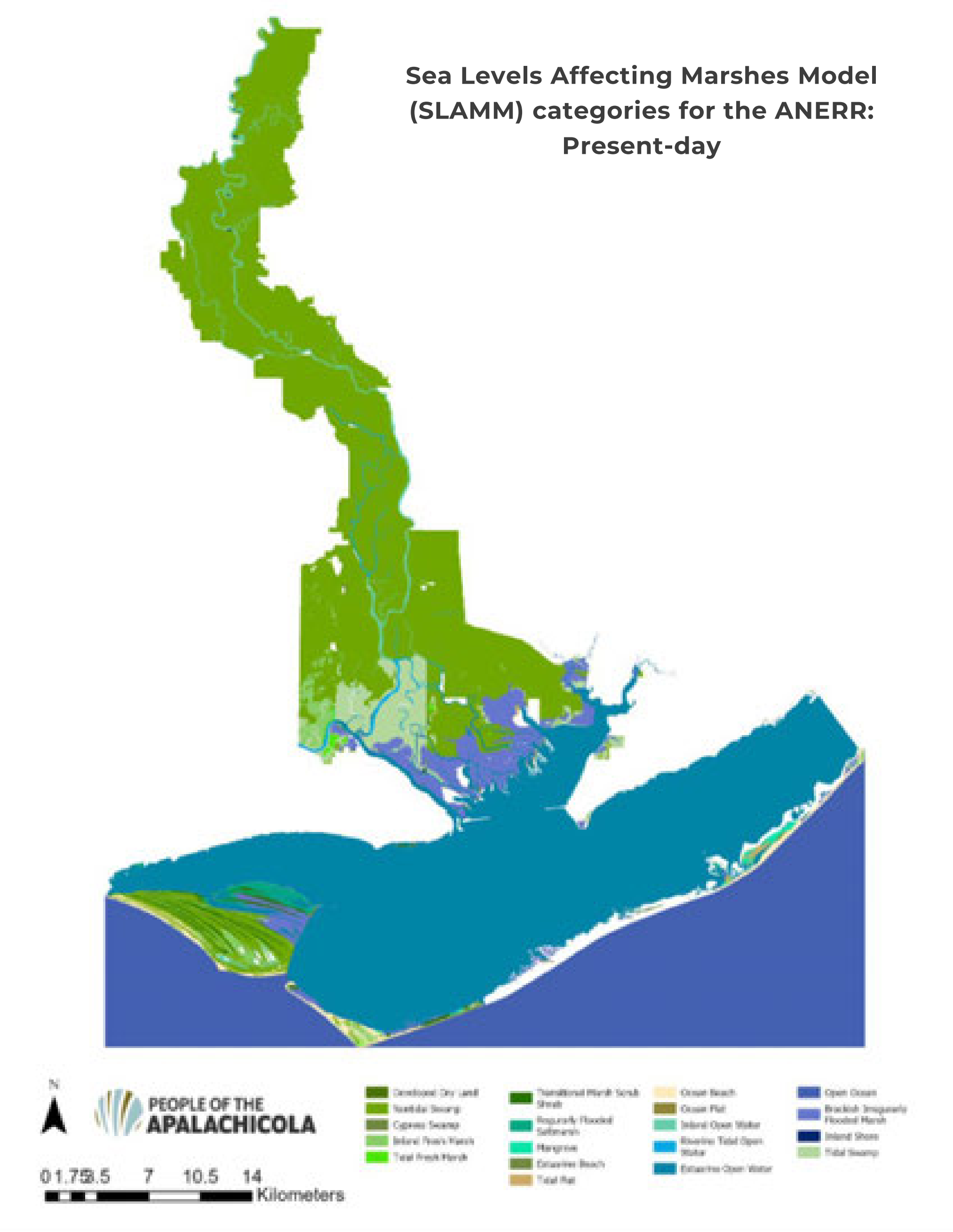
- Highest erosion rates at exposed Gulf-facing sites, then Bay-facing sites
- Accretion zones do not equate to stability
- 11 of 15 monitored priority sites have archaeological integrity
    - 7 of 11 have visible impacts from erosion
- Exposure and undisciplined artifact removal remain significant threats

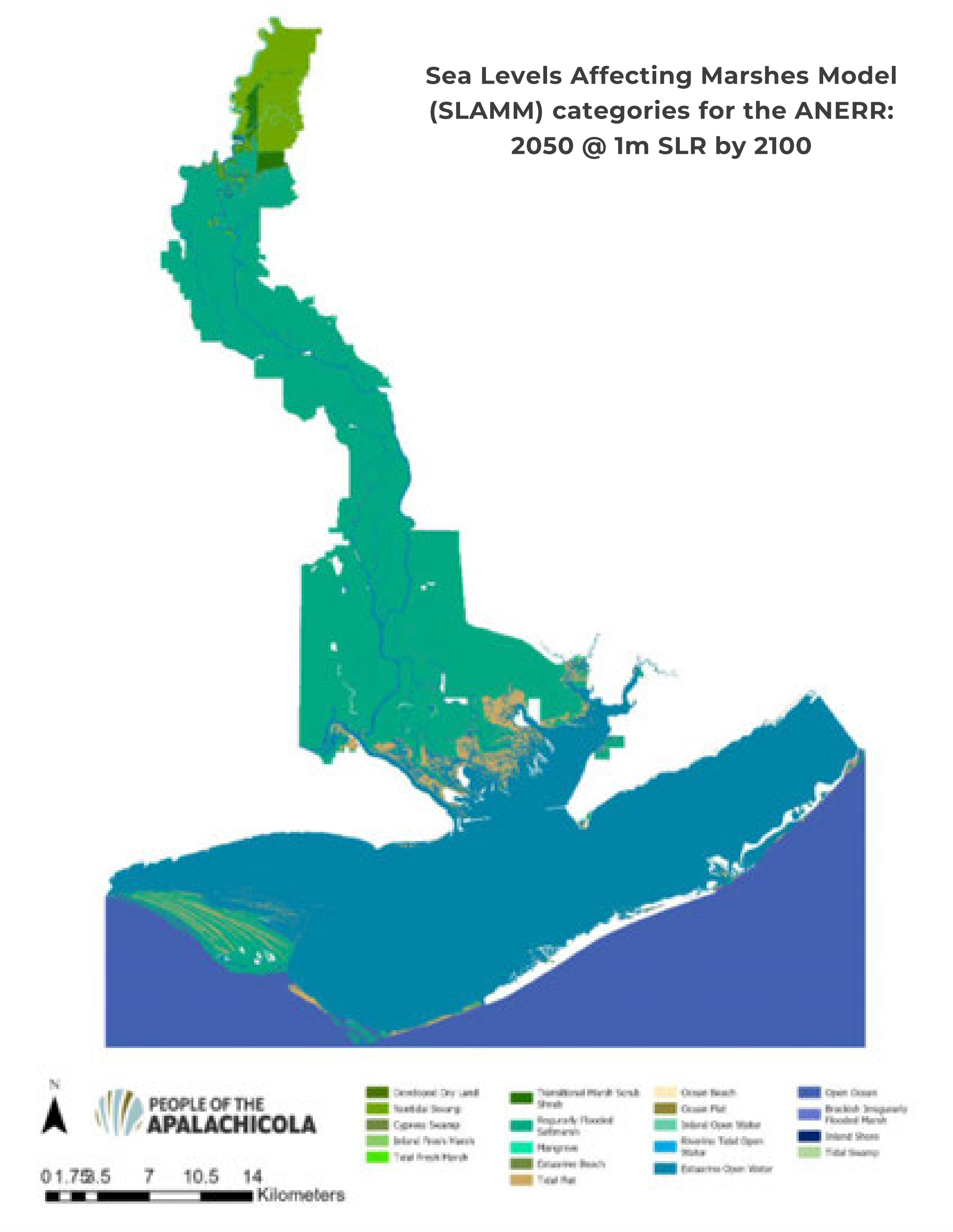
Images courtesy: M. Thomin

02/
SLAMM + ATA

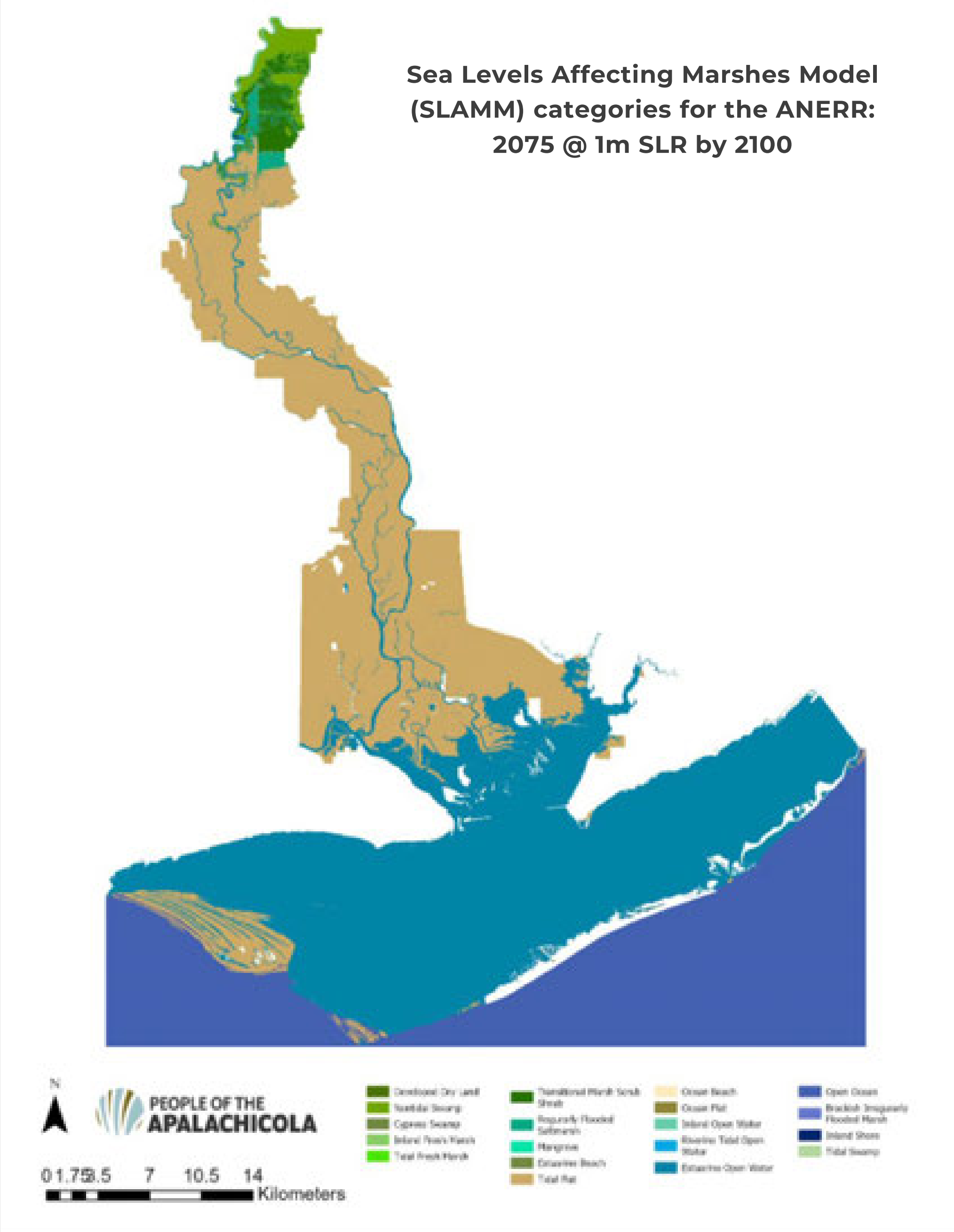
- Sea Levels Affecting Marshes Model (SLAMM)
- Archaeological Triage Assessment (ATA)
- Reflects changes seen on the ground

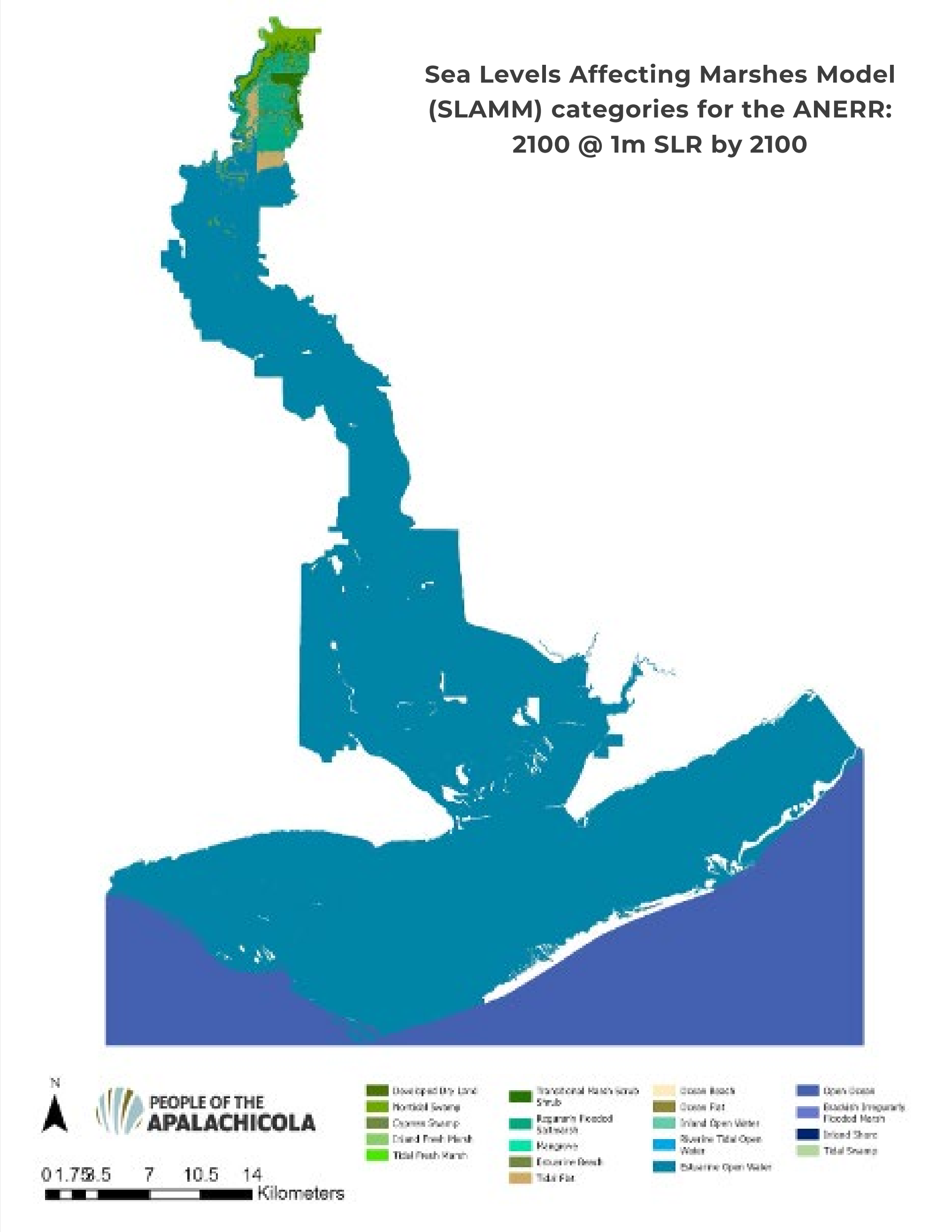
Image courtesy: M. Thomin





Figures courtesy: Cochran, 2024





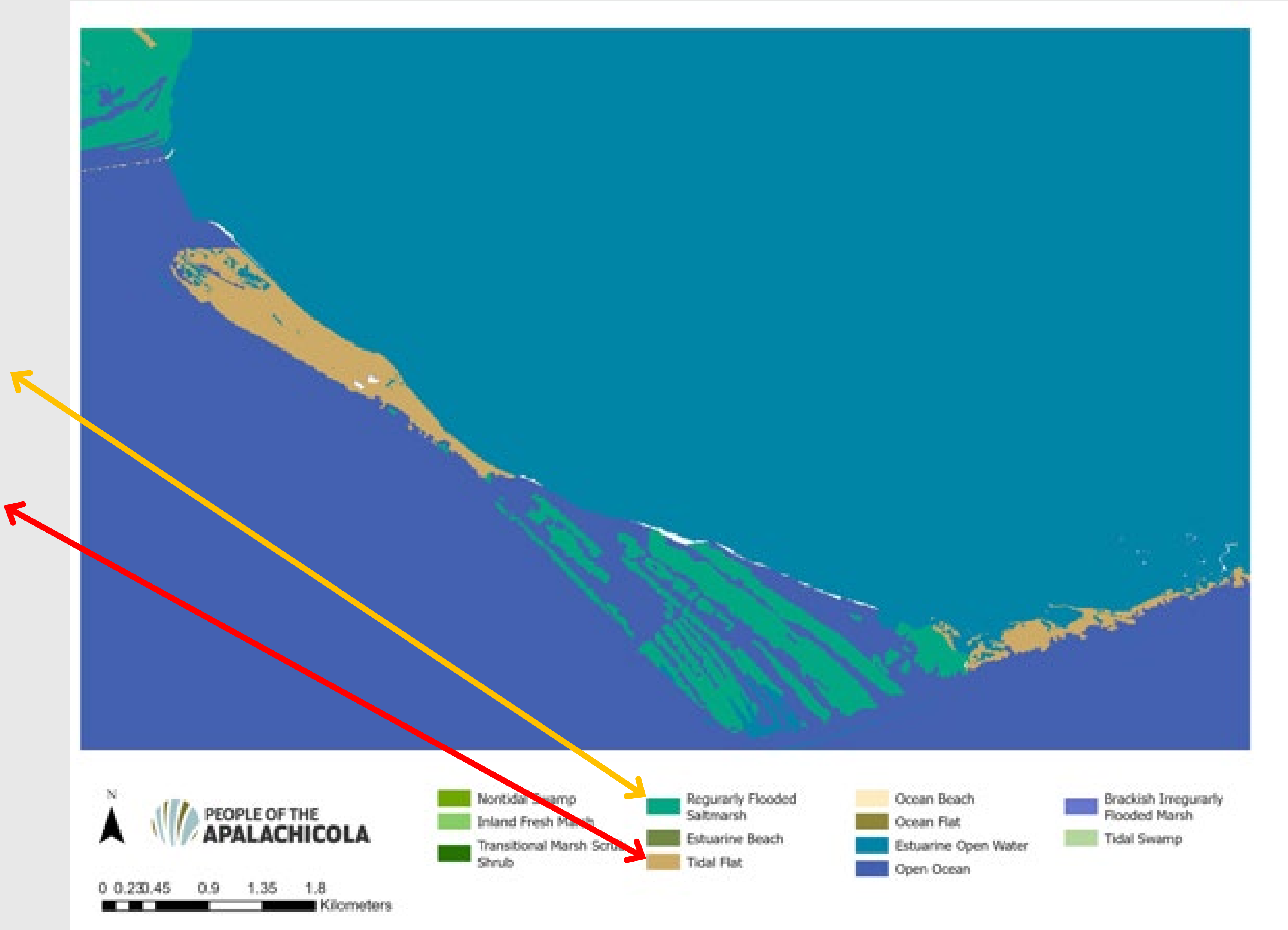
Figures courtesy: Cochran, 2024

02/ SLAMM + ATA

- ~~Sea Levels Affecting Marshes Model (SLAMM)~~
- Archaeological Triage Assessment (ATA)
- Reflects changes seen on the ground

Image courtesy: M. Thomin

SLAMM Category	National Wetlands	Model Color Code	Archaeological Triage
1	Developed Dry Land		No impacts
2	Undeveloped Dry Land		No impacts
3	Nontidal Swamp		Threatened
4	Cypress Swamp		Destroyed/Submerged
5	Inland Fresh Marsh		Threatened
6	Tidal Fresh Marsh		Damaged
7	Transitional Marsh Scrub		Threatened
8	Regularly Flooded		Damaged
9	Mangrove		Damaged
10	Estuarine Beach		Damaged
11	Tidal Flat		Destroyed/Submerged
12	Ocean Beach		Damaged
13	Ocean Flat		Damaged
14	Rocky Intertidal		Damaged
15	Inland Open Water		Destroyed/Submerged
16	Riverine Tidal Open Water		Destroyed
17	Estuarine Open Water		Destroyed
18	Tidal Creek		Destroyed
19	Open Ocean		Destroyed
20	Brackish Irregularly		Damaged
22	Inland Shore		Destroyed/Submerged
23	Tidal Swamp		Destroyed/Submerged



Western portion of Little St. George Island SLAMM categories in 2050 in a 1m SLR scenario.
Figure data from Cochran, 2024; figure compiled by author.

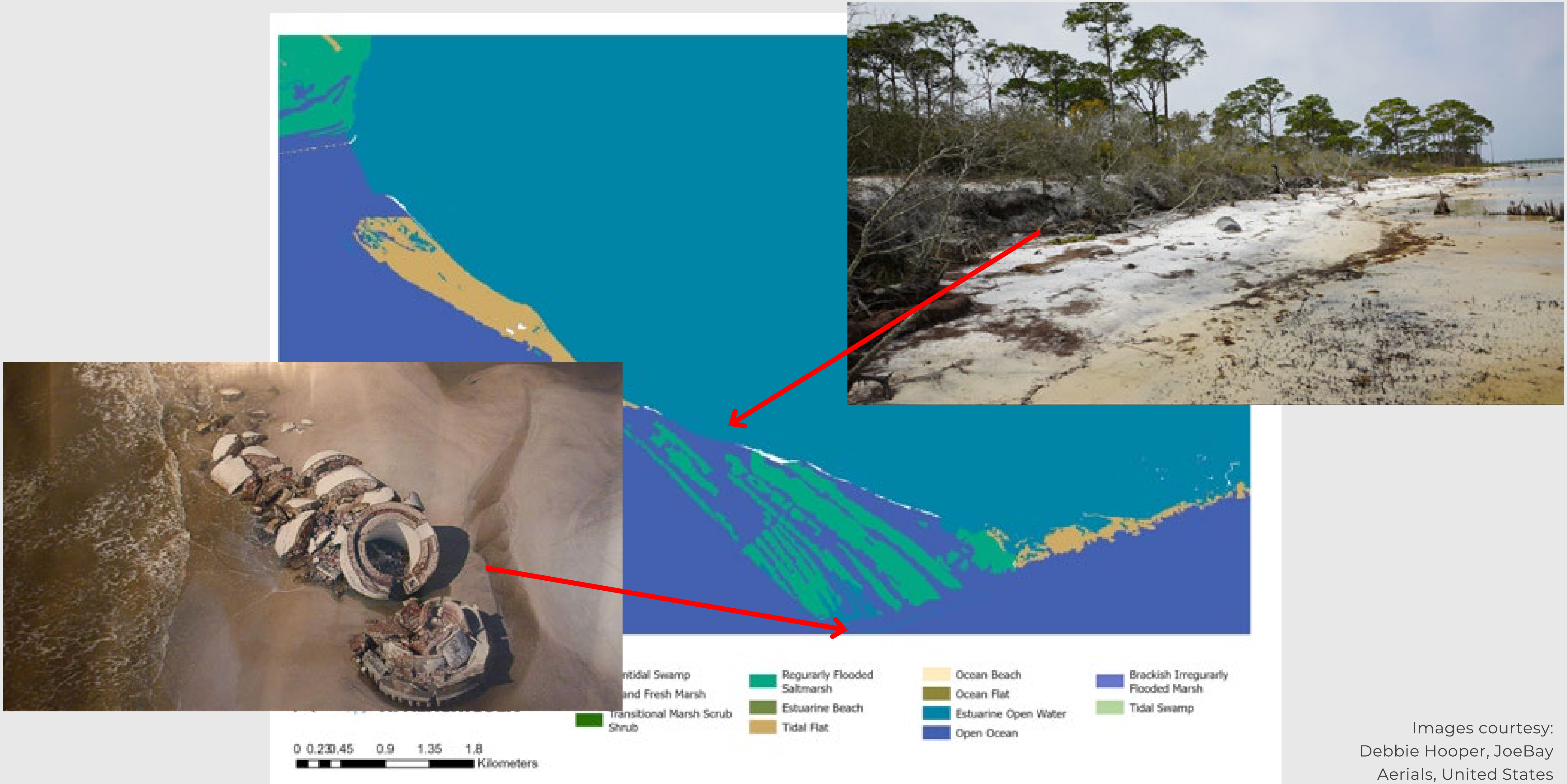
SLAMM Category	National Wetlands Inventory Category	Model Color Code	Archaeological Triage Assessment
1	Developed Dry Land		No impacts
2	Undeveloped Dry Land		No impacts
3	Nontidal Swamp		Threatened
4	Cypress Swamp		Destroyed/Submerged
5	Inland Fresh Marsh		Threatened
6	Tidal Fresh Marsh		Damaged
7	Transitional Marsh Scrub Shrub		Threatened
8	Regularly Flooded Saltmarsh		Damaged
9	Mangrove		Damaged
10	Estuarine Beach		Damaged
11	Tidal Flat		Destroyed/Submerged
12	Ocean Beach		Damaged
13	Ocean Flat		Damaged
14	Rocky Intertidal		Damaged
15	Inland Open Water		Destroyed/Submerged
16	Riverine Tidal Open Water		Destroyed
17	Estuarine Open Water		Destroyed
18	Tidal Creek		Destroyed
19	Open Ocean		Destroyed
20	Brackish Irregularly Flooded Marsh		Damaged
22	Inland Shore		Destroyed/Submerged
23	Tidal Swamp		Destroyed/Submerged

St. Vincent Island near West Pass SLAMM categories in 2050 in a 1m SLR scenario.
Figure data from Cochran, 2024; figure compiled by author.

02/ SLAMM + ATA

- ~~Sea Levels Affecting Marshes Model (SLAMM)~~
- ~~Archaeological Triage Assessment (ATA)~~
- Reflects changes seen on the ground

Image courtesy: M. Thomin



Western portion of Little St. George Island SLAMM categories in 2050 in a 1m SLR scenario.
Figure data from Cochran, 2024; figure compiled by author.

Images courtesy:
Debbie Hooper, JoeBay
Aerials, United States
Lighthouse Society
Archive (left); M.
Thomin (right)

02/
KEY TAKEAWAYS

- SLAMM suggests areas of greatest vulnerability
  - Barrier islands
  - Shorelines without substantial wetlands
- Developed areas have limited adaptive capacity
- Forward modeling can support anticipatory monitoring/recovery
- Structured triage framework improves transparency

Image courtesy: M. Thomin

03/
COMMUNITY FEEDBACK

- Community Conversation on Heritage at Risk (CCHAR)
- Online Qualtrics survey
- Qualitative Data Analysis

Image courtesy: M. Thomin

1. What is your favorite thing about living in the Apalachicola, Florida, area?
2. How do you define cultural heritage?
3. What is significant about the Apalachicola's area's cultural heritage resources?
4. What are the threats facing Apalachicola-area cultural heritage resources?
5. If we can't do further research at or take action to preserve every cultural heritage site, how should we decide which sites to prioritize?
6. What are your aspirations for Apalachicola-area cultural heritage by 2030? What needs to happen to get there?
7. In order to achieve aspirations, where do roles and responsibilities lie? If work to preserve sites is required, who should pay for this work? (Local community, local authority, national heritage agencies, other?)
8. What would be the impact on the Apalachicola if we lost cultural heritage sites? How do you think people here would feel about it?

It’s a place of powerful history, [a] place of black and indigenous resistance that many don’t know about. But you can feel it here. The spirit is here. ***You can feel this place [is] past meeting the future****, looking at sea level rise and climate chaos that’s coming, it’s a place that lives in this really precarious and beautiful balance of the history of this country and then the things to come*

"…something that's so significant about Apalachicola is that it's one of the only sort of surviving places in this country. There's coastal towns that have survived the longest where ***there is a working shore, where people who live here work the water and make their living doing so****, and bringing that food back to the community, which then feeds what we eat. And that is disappearing."*

Something...that was touched on, but I thought I'd bring up...the fact that Apalachicola has a working waterfront. ***And I think we're about to lose a lot of that.*** *And it's sad. I mean, it's a wonder it's a really it's what sets us apart from all other tourist communities.*

03/
COMMUNITY FEEDBACK

- ~~Community Conversation on Heritage at Risk (CCHAR)~~
- ~~Online Qualtrics survey~~
- Qualitative Data Analysis

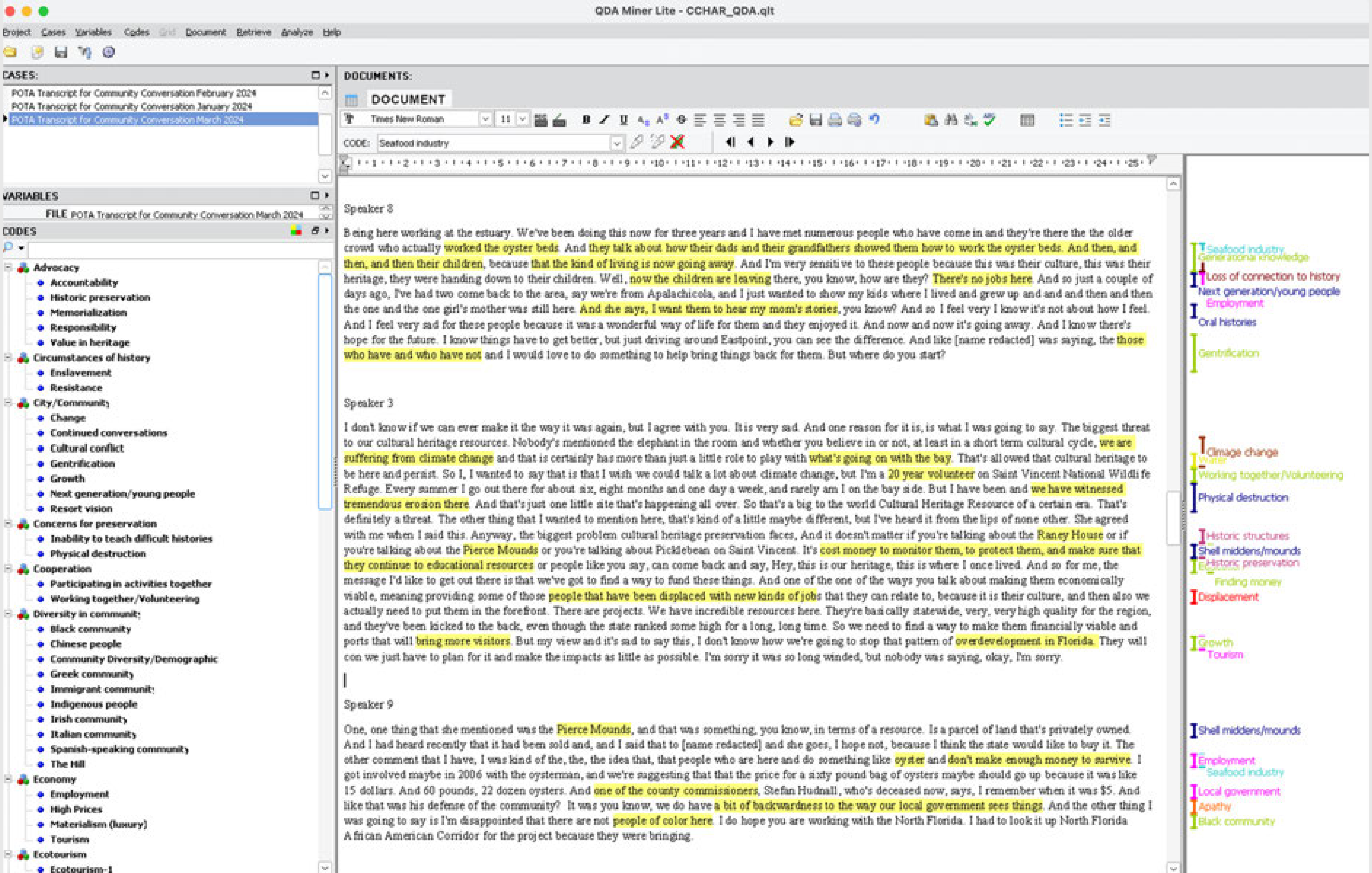
Image courtesy: M. Thomin

THEMES

1. Heritage preservation
2. Community and identity
3. Ecosystem services
4. Quality of life
5. Concerns for the future
6. Places and conditions of history
7. Emotions connected to heritage

7 Themes > 22 Subthemes > 78 Codes

Image courtesy: State Library and Archives of Florida (no. BP012, 1946)


QDA Miner Lite - CCHAR_QDA.qlt
Project Cases Variables Codes Grid Document Retrieve Analyze Help
CASES:
POTA Transcript for Community Conversation February 2024
POTA Transcript for Community Conversation January 2024
POTA Transcript for Community Conversation March 2024
VARIABLES
FILE POTA Transcript for Community Conversation March 2024
CODES
Advocacy
Accountability
Historic preservation
Memorialization
Responsibility
Value in heritage
Circumstances of history
Enslavement
Resistance
City/Community
Change
Continued conversations
Cultural conflict
Gentrification
Growth
Next generation/young people
Resort vision
Concerns for preservation
Inability to teach difficult histories
Physical destruction
Cooperation
Participating in activities together
Working together/Volunteering
Diversity in community
Black community
Chinese people
Community Diversity/Demographic
Greek community
Immigrant community
Indigenous people
Irish community
Italian community
Spanish-speaking community
The Hill
Economy
Employment
High Prices
Materialism (luxury)
Tourism
Ecotourism
Ecotourism-1
DOCUMENTS:
DOCUMENT
Times New Roman 11
CODE: Seafood industry
Speaker 8
Being here working at the estuary. We've been doing this now for three years and I have met numerous people who have come in and they're there the the older crowd who actually worked the oyster beds. And they talk about how their dads and their grandfathers showed them how to work the oyster beds. And then, and then, and then their children, because that the kind of living is now going away. And I'm very sensitive to these people because this was their culture, this was their heritage, they were handing down to their children. Well, now the children are leaving there, you know, how are they? There's no jobs here. And so just a couple of days ago, I've had two come back to the area, say we're from Apalachicola, and I just wanted to show my kids where I lived and grew up and and and then and then the one and the one girl's mother was still here. And she says, I want them to hear my mom's stories, you know? And so I feel very I know it's not about how I feel. And I feel very sad for these people because it was a wonderful way of life for them and they enjoyed it. And now and now it's going away. And I know there's hope for the future. I know things have to get better, but just driving around Eastpoint, you can see the difference. And like [name redacted] was saying, the those who have and who have not and I would love to do something to help bring things back for them. But where do you start?
Speaker 3
I don't know if we can ever make it the way it was again, but I agree with you. It is very sad. And one reason for it is, is what I was going to say. The biggest threat to our cultural heritage resources. Nobody's mentioned the elephant in the room and whether you believe in or not, at least in a short term cultural cycle, we are suffering from climate change and that is certainly has more than just a little role to play with what's going on with the bay. That's allowed that cultural heritage to be here and persist. So I, I wanted to say that is that I wish we could talk a lot about climate change, but I'm a 20 year volunteer on Saint Vincent National Wildlife Refuge. Every summer I go out there for about six, eight months and one day a week, and rarely am I on the bay side. But I have been and we have witnessed tremendous erosion there. And that's just one little site that's happening all over. So that's a big to the world Cultural Heritage Resource of a certain era. That's definitely a threat. The other thing that I wanted to mention here, that's kind of a little maybe different, but I've heard it from the lips of none other. She agreed with me when I said this. Anyway, the biggest problem cultural heritage preservation faces, And it doesn't matter if you're talking about the Raney House or if you're talking about the Pierce Mounds or you're talking about Picklebean on Saint Vincent. It's cost money to monitor them, to protect them, and make sure that they continue to educational resources or people like you say, can come back and say, Hey, this is our heritage, this is where I once lived. And so for me, the message I'd like to get out there is that we've got to find a way to fund these things. And one of the one of the ways you talk about making them economically viable, meaning providing some of those people that have been displaced with new kinds of jobs that they can relate to, because it is their culture, and then also we actually need to put them in the forefront. There are projects. We have incredible resources here. They're basically statewide, very, very high quality for the region, and they've been kicked to the back, even though the state ranked some high for a long, long time. So we need to find a way to make them financially viable and ports that will bring more visitors. But my view and it's sad to say this, I don't know how we're going to stop that pattern of overdevelopment in Florida. They will con we just have to plan for it and make the impacts as little as possible. I'm sorry it was so long winded, but nobody was saying, okay, I'm sorry.
Speaker 9
One, one thing that she mentioned was the Pierce Mounds, and that was something, you know, in terms of a resource. Is a parcel of land that's privately owned. And I had heard recently that it had been sold and, and I said that to [name redacted] and she goes, I hope not, because I think the state would like to buy it. The other comment that I have, I was kind of the, the, the idea that, that people who are here and do something like oyster and don't make enough money to survive. I got involved maybe in 2006 with the oysterman, and we're suggesting that that the price for a sixty pound bag of oysters maybe should go up because it was like 15 dollars. And 60 pounds, 22 dozen oysters. And one of the county commissioners, Stefan Hudnall, who's deceased now, says, I remember when it was $5. And like that was his defense of the community? It was you know, we do have a bit of backwardness to the way our local government sees things. And the other thing I was going to say is I'm disappointed that there are not people of color here. I do hope you are working with the North Florida. I had to look it up North Florida African American Corridor for the project because they were bringing.
Seafood industry
Generational knowledge
Loss of connection to history
Next generation/young people
Employment
Oral histories
Gentrification
Climage change
Water
Working together/Volunteering
Physical destruction
Historic structures
Shell middens/mounds
Historic preservation
Finding money
Displacement
Growth
Tourism
Shell middens/mounds
Employment
Seafood industry
Local government
Apathy
Black community

Themes and codes with highest frequencies in CCHAR and Qualtrics data

Theme	Frequency %
Heritage Preservation	19.9%
Community and identity	19.9%
Ecosystem services	17.4%
Quality of life	14.6%
Concerns for the future	13.5%
Places and conditions of history	9.5%
Emotions connected to heritage	3.4%

Code	Frequency %
Historic preservation	4.1%
Loss of connection to history	4.1%
Water	3.9%
Working together	3.6%
Seafood industry	3.6%
Tourism	3.2%
Education	2.8%


Generational knowledge
Participating in activities together
Outdoor recreation
Immigrant community
Not much change
Archaeology/archaeological sites
Shell middens/mounds
Italian community
Ecotourism-1
Historic structures
Responsibility
Finding money
High Prices
Food-1
Hunting
Prioritization of work
Indigenous people
Gentrification
Resort vision
Waterfront
Education
Growth
The Hill
Seafood industry
Disempowerment
Museum/exhibiting
Memorialization
Generational history
Natural resources
Water
Tourism
Local government
Resistance
Turpentine
Cemeteries
Neglect
Physical destruction
History
Managed land
Traditions
Historic preservation
Development
Materialism (luxury)
Displacement
Change
Lumber industry
Enslavement
Small town
Loss of connection to history
Value in heritage
Oral histories
Employment
Working together/Volunteering
Documenting
Big city
Apathy
Black community
Next generation/young people
People-1
Prospect Bluff
Community Diversity/Demographics
Health
Climage change
Historical trauma
Continued conversations
Natural resource preservation
Inability to teach difficult histories

03/
KEY TAKEAWAYS

- Heritage value as place-based and social:
  - “The waterfront”
  - Historic buildings and cemeteries
  - Activities that take place within these spaces, aka “working together”
- Vulnerable heritage as cultural and social loss:
  - Seafood industry, beekeeping
- Prioritization of vulnerable heritage as an ethical and representational process
  - High frequency of underrepresented group mentions
- Responsibility for heritage preservation is shared, but unevenly distributed
  - Community feels the burden of care

Images courtesy: M. Thomin

WHERE TAKEAWAYS INTERSECT

01/

- Highest erosion rates at exposed Gulf-facing sites, then Bay-facing sites
  - Accretion zones do not equate to stability

- 11 of 15 monitored priority sites have archaeological integrity
  - 7 of 11 have visible impacts from erosion

- Exposure and undisciplined artifact removal remain significant threats

02/

- SLAMM suggests areas of greatest vulnerability
  - Barrier islands
  - Low-elevation shoreline areas

- Developed areas have limited adaptive capacity

- Forward modeling can support anticipatory monitoring/recovery

- Structured physical triage framework improves transparency

03/

- Heritage value as place-based and social:
  - The waterfront
  - Historic buildings and cemeteries
  - Activities that take place in these spaces, aka "working together"

- Vulnerable heritage as cultural and social loss:
  - Seafood industry, Beekeeping

- Prioritization of vulnerable heritage as an ethical and representational process
  - High frequency of underrepresented group mentions

- Responsibility for heritage preservation is shared, but unevenly distributed
  - Community feels the burden of care

FROM DATA TO DECISION SUPPORT

- High risk / High expressed value → Immediate attention
- High risk / Lower expressed value → Documentation strategy
- Lower risk / High expressed value → Monitoring and engagement
- Low risk / Low expressed value → Minimal intervention

Image courtesy: M. Thomin

RECOMMENDATIONS

For resource/land managers:

- Combine vulnerability data with community value-indices
- Plan for documentation where stabilization is not feasible
- Integrate community voices into planning
- Broaden opportunities for education and engagement

Images courtesy: M. Thomin

RECOMMENDATIONS

For researchers:

- Expand high-resolution shoreline baselines
- Longitudinal monitoring datasets
- Pair ecological restoration with heritage preservation
- Cross-agency collaboration and data sharing
- Broaden opportunities for education and engagement

Images courtesy: M. Thomin

CULTURAL HERITAGE AS AN ECOSYSTEM SERVICE

Understanding “heritage” as:

- More than just archaeological sites or physical sites
- Part of resilience
- Part of identity-based adaptation
- Part of what makes the Reserve (and the greater area) worth sustaining

Image courtesy: M. Thomin

THANK YOU!

NOAA NERRS Project Page with Public Datasets:

Archaeology Institute
UNIVERSITY of WEST FLORIDA

NORTHWEST FLORIDA
MARITIME LANDSCAPE
ALLIANCE for PRESERVATION

University of
St Andrews

Apalachicola
National Estuarine
Research Reserve

National Estuarine
Research Reserve System
Science Collaborative

FLORIDA PUBLIC
ARCHAEOLOGY
NETWORK
A PROGRAM OF THE UNIVERSITY of WEST FLORIDA

A social-ecological exploration into the impact of oyster population collapse and fishery closure of the Apalachicola Bay oyster

Dr. Betsy Mansfield
Florida State University – Coastal & Marine Lab
emansfield@fsu.edu

Foundation Species

Ecological

Numerically abundant

Near the base of ecosystem networks

Non-trophic interactions modulate ecosystem

Ellison 2019

Cultural

Multiplicity of use

Use in resource acquisition

Persistence and memory of use

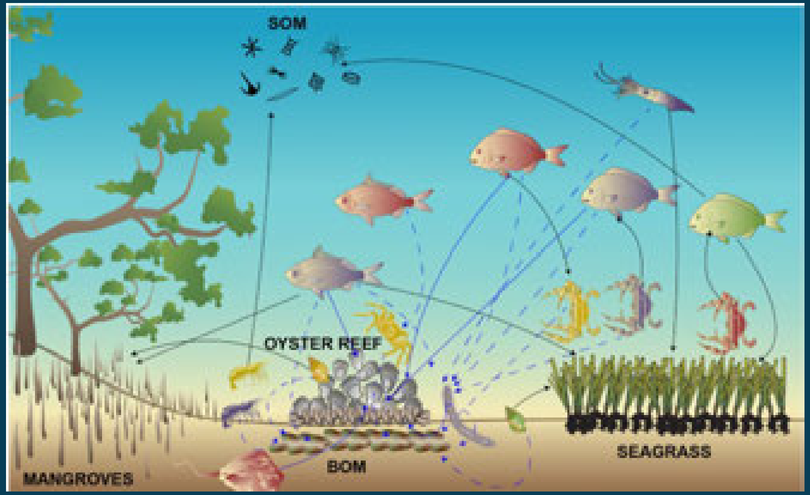
Level of unique position in culture

Garibaldi & Turner 2004

Oysters as ecological foundation species

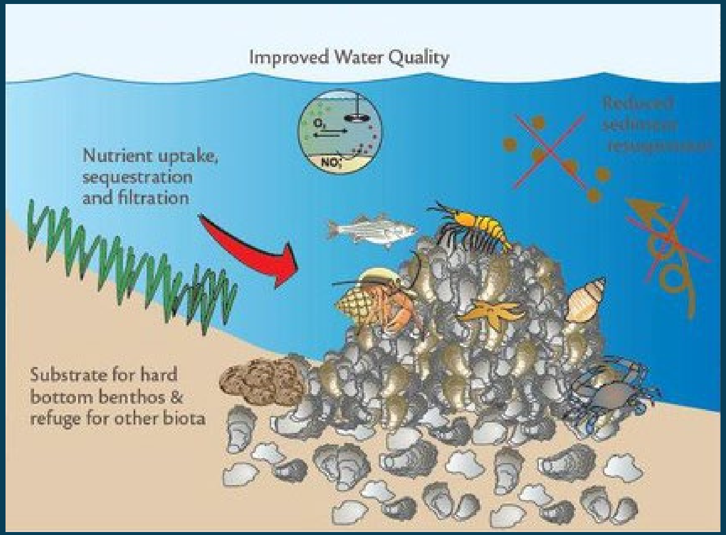
Numerically abundant

Near the base of ecosystem networks



Martinez-Baena et al. 2023

Non-trophic interactions modulate ecosystem



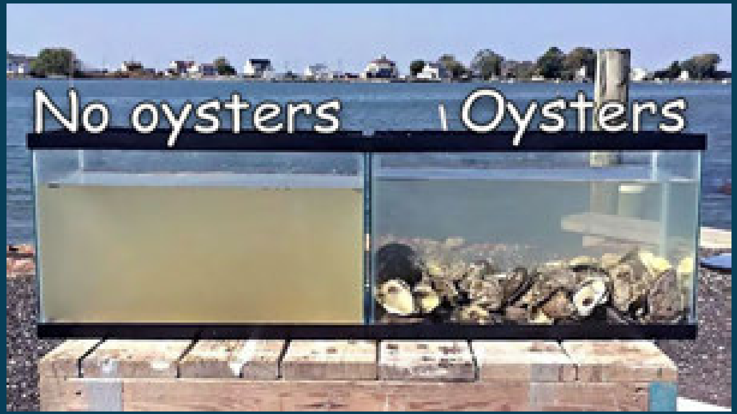
Ozbay et al. 2014

Oysters provide many services for humans



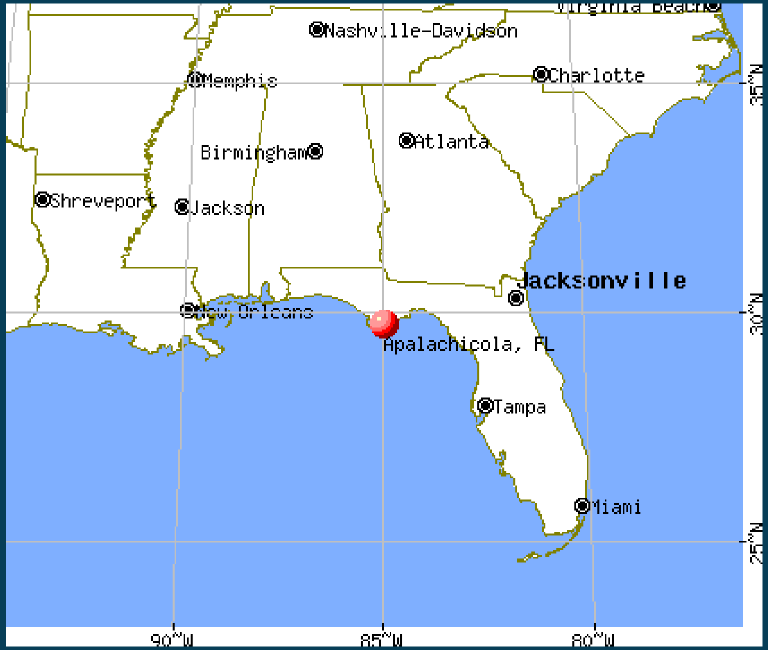






Ecosystem Services: Food, habitat for other fisheries, shoreline protection, water filtration and more

Apalachicola Bay oyster reliance over time



At one time over 700 people held oyster harvesting licenses in Apalachicola Bay

1830
Commercial oyster harvest begins

1870s
Oysters become primary industry

1900s
AB oysters provide 90% of oysters harvested in FL

2010
Populations decline rapidly

2013
Declaration of a Federal Fishery Disaster

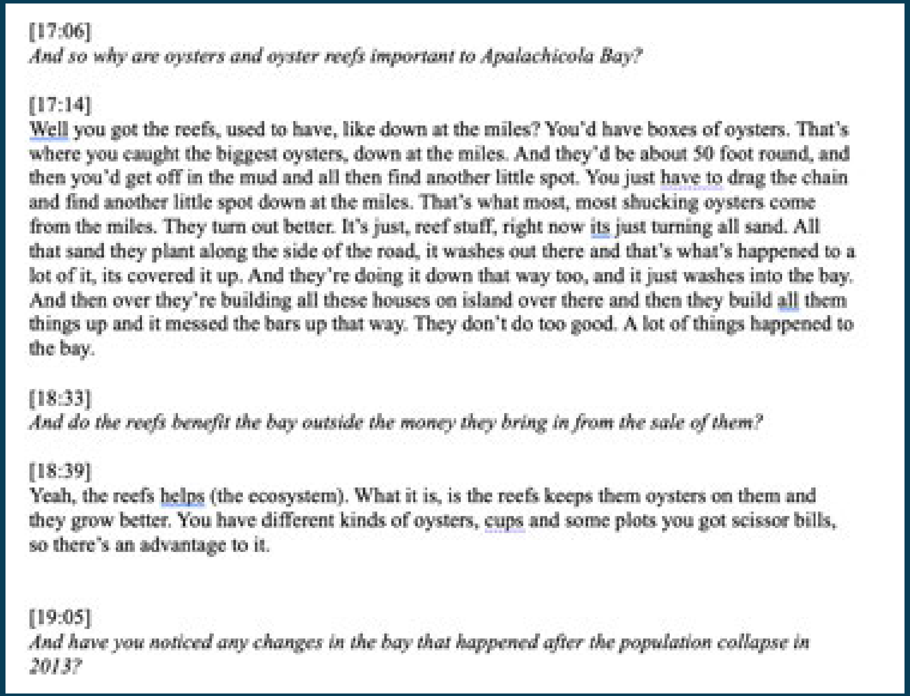
2020
5 year commercial harvest closure

WHAT ARE THE INDIVIDUAL AND COLLECTIVE SOCIAL AND CULTURAL IMPACTS OF FOUNDATION SPECIES LOSS?

HOW WERE DIFFERENT USER OR COMMUNITY GROUPS IMPACTED BY THE OYSTER POPULATION COLLAPSE IN APALACHICOLA BAY?

Diverse stakeholders hold diverse connections to oysters

Methods – Semi-structured interviews



[17:06]
And so why are oysters and oyster reefs important to Apalachicola Bay?

[17:14]
Well you got the reefs, used to have, like down at the miles? You'd have boxes of oysters. That's where you caught the biggest oysters, down at the miles. And they'd be about 50 foot round, and then you'd get off in the mud and all then find another little spot. You just have to drag the chain and find another little spot down at the miles. That's what most, most shucking oysters come from the miles. They turn out better. It's just, reef stuff, right now its just turning all sand. All that sand they plant along the side of the road, it washes out there and that's what's happened to a lot of it, its covered it up. And they're doing it down that way too, and it just washes into the bay. And then over they're building all these houses on island over there and then they build all them things up and it messed the bars up that way. They don't do too good. A lot of things happened to the bay.

[18:33]
And do the reefs benefit the bay outside the money they bring in from the sale of them?

[18:39]
Yeah, the reefs helps (the ecosystem). What it is, is the reefs keeps them oysters on them and they grow better. You have different kinds of oysters, cups and some plots you got scissor bills, so there's an advantage to it.

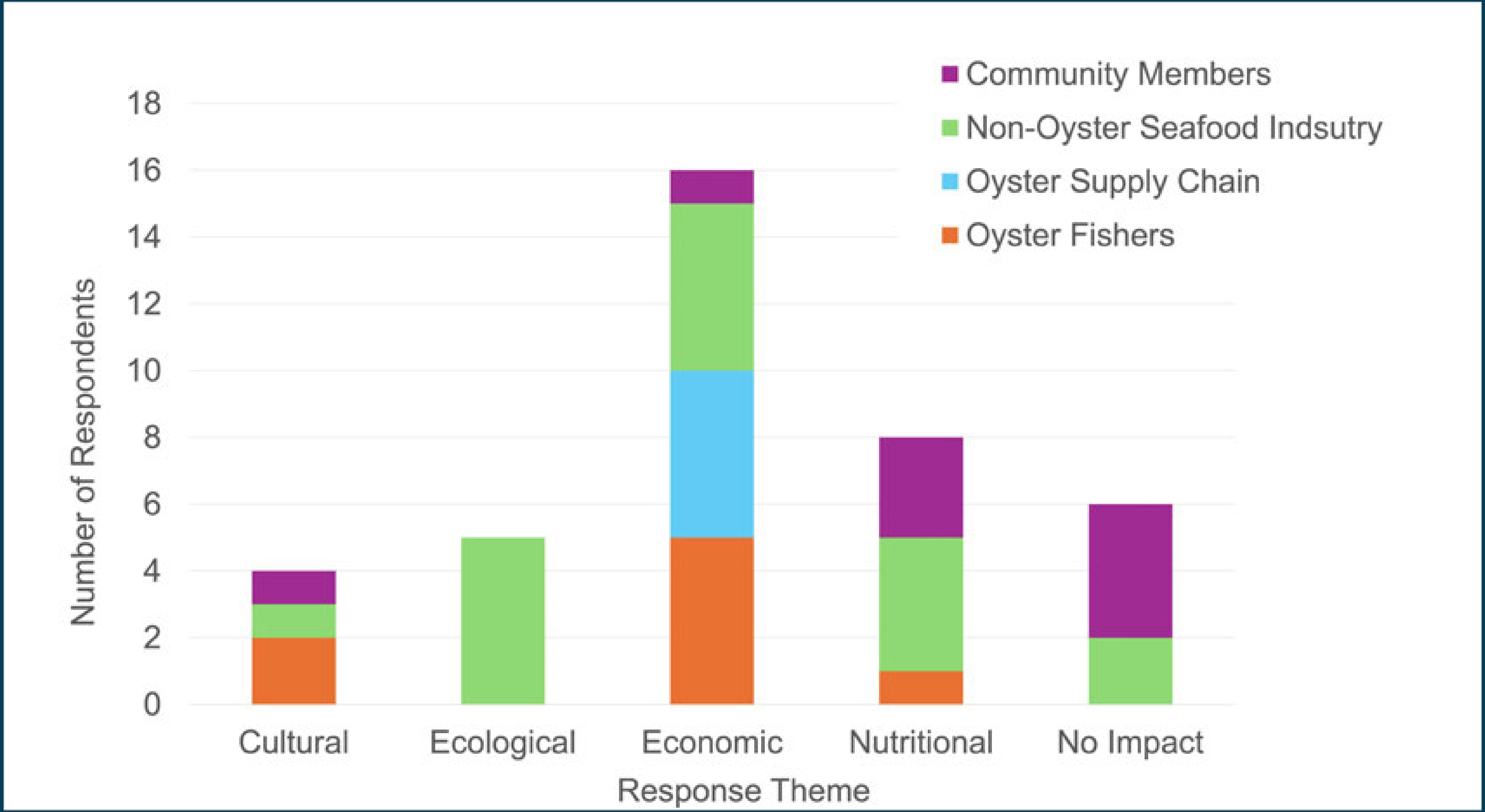
[19:05]
And have you noticed any changes in the bay that happened after the population collapse in 2013?

NVIVO

Directed and open-ended questions on the ecological and social impacts of oyster loss and fishery closure

Interview participants = 28

Impacts felt by respondents directly



Economic shifts occur with individuals in a variety of ways

1.OYSTER FISHERS

Early retirement, shift to charter fishing, shift outside fishing

2.SEAFOOD DEALERS

Shift purchase location, shift species focus, reduce work hours

3.LOCAL BUSINESSES

Shift clientele focus, change business model

But oyster loss is about more than money

Ecological Impacts

- Changed fishing location
- Reduction in oyster reef-associated species

"We were catching big redfish like that almost guaranteed; you go out there and I can catch them like that (*snaps*) all the time... We haven't done that in years."

But oyster loss is about more than money

Ecological Impacts

- Changed fishing location
- Reduction in oyster reef-associated species

"We were catching big redfish like that almost guaranteed; you go out there and I can catch them like that (*snaps*) all the time... We haven't done that in years."

Nutritional Impacts

- Loss of accessible, free and readily available food option

"We just can't get over the fact that we've got to go buy oysters to eat when we've done it all our lives"

But oyster loss is about more than money

Ecological Impacts
- Changed fishing location
- Reduction in oyster reef-associated species

"We were catching big redfish like that almost guaranteed; you go out there and I can catch them like that (*snaps*) all the time... We haven't done that in years."

Nutritional Impacts
- Loss of accessible, free and readily available food option

"We just can't get over the fact that we've got to go buy oysters to eat when we've done it all our lives"

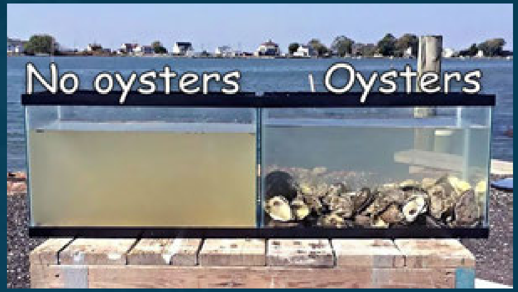
Cultural Impacts
- Loss of way of life
- Reduction of time spent on the water

"My life-long dream is to retire and come back home, make my living in the bay, to supplement my retirement, or do whatever I wanted to do, but there is nothing there."

Emergent themes of community impact

- Provisioning (n=12)

- Regulating (n=13)



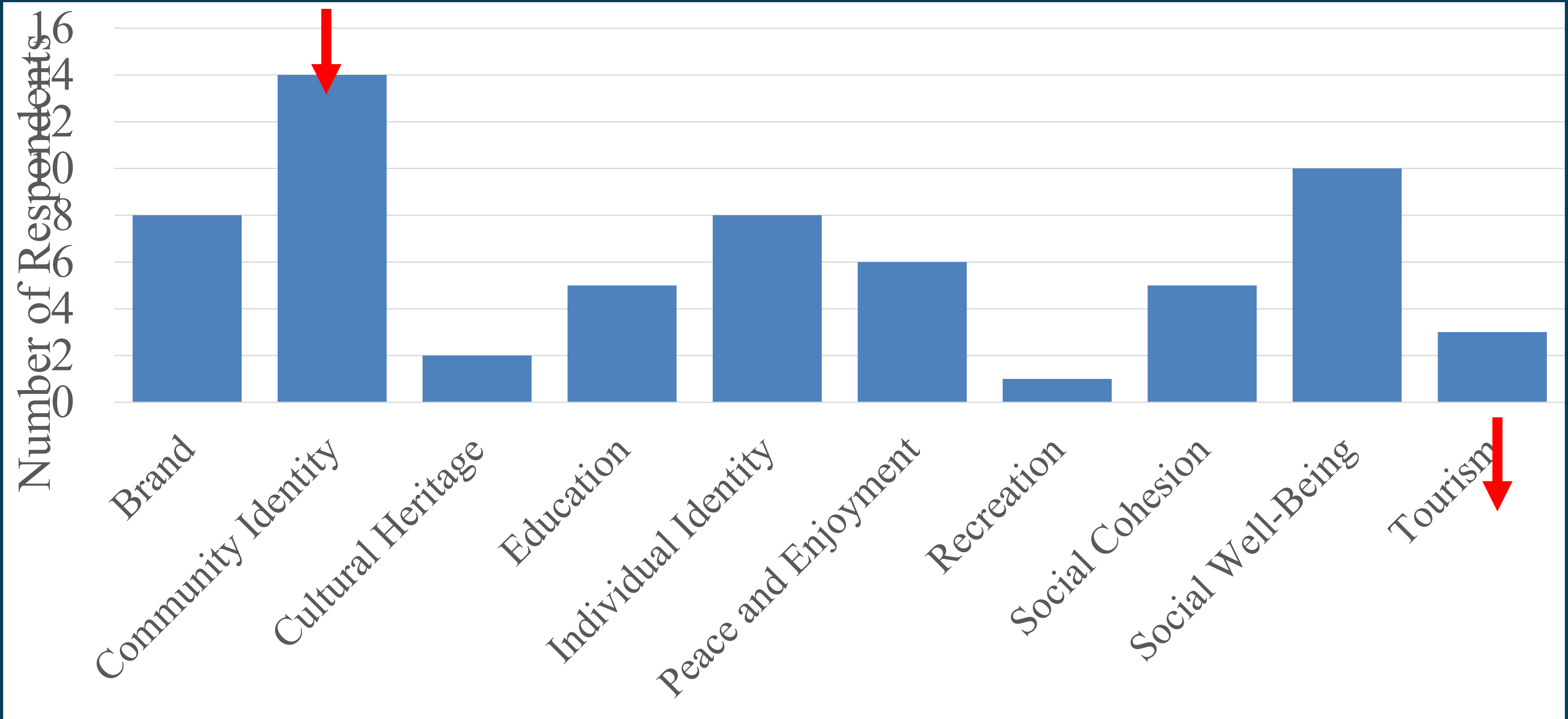
- Supporting (n=19)

- Cultural (n=28)

Non-material benefits obtained from ecosystems

Millennium Ecosystem Assessment 2005

Loss of oysters resulted in loss of connectivity and identity



No longer the Forgotten Coast...

Community identity was tied to the oyster

Apalachicola is (*was?*) a working waterfront

Despite the lack of oysters to eat, tourism continues to grow

Loss of the ecological foundation is reflected in the loss of the social

"They still come down here and sit at these restaurants and eat a Louisiana oyster and be happy. They don't know."

- Guide Fisher

"No, they're gonna keep coming. Until that beach is gone, they'll still be here."

- Business Owner

Species can be multidimensional foundation species

Ecological

Numerically abundant

Near the base of the ecosyste

Modulate non-trophic interact

Social/ Cultural

Level of unique position in culture

Used in resource acquisition

Persistence of use

“The oyster used to be the heartbeat of Apalachicola”

Mansfield, EJ, SE Lester, A Rassweiler, and S Brooke. (2025) Collapse of the oyster population in Apalachicola Bay: cascading social impacts from an ecologically and culturally significant species. Ecology and Society 30(1):37.
URL: https://www.ecologyandsociety.org/vol30/iss1/art37

QUESTIONS?

Many Thanks to:

- Interview participants
- Dr. Sandra Brooke
- Dr. Sarah Lester
- Dr. Andrew Rassweiler
- Dr. Joel Trexler
- Office of Research
- The Rasster Lab

RASSTERLAB

FLORIDA STATE UNIVERSITY
OFFICE OF RESEARCH

FLORIDA STATE UNIVERSITY FSUCML Est. 1949 COASTAL & MARINE LABORATORY

TRIUMPH GULF COAST

emansfield@fsu.edu

“It was a way of life. I really miss it. You wake up early in the morning to go hunting before daylight and you see the oyster boats running everywhere. They're all over the place. They're non-existent now.”

PROJECT HIGHLIGHT
FRANKLIN-98 LIVING SHORELINE

AN APALACHEE REGIONAL PLANNING COUNCIL PROJECT

Presented By:
William Mather |
Consultant Environmental Science

Harter Restoration & Consulting, LLC

Will Mather

Been with WSP USA Inc. for 7 years

Located in Tallahassee, FL

B.S. Environmental Science from The Ohio State University

Project Manager & Coastal Restoration Specialist

- PM for the Franklin-98 Living Shoreline Project, DARPA Reefense project, and multiple other living shoreline projects along the Florida Panhandle

Destiny Bates

Recently joined ARPC in December 2025

Located in Tallahassee, FL

M.S. Urban and Regional Planning, Environmental Planning from Florida State University

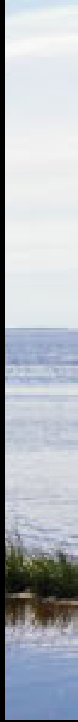
Environmental Project Manager

- PM on ARPC's side for the Franklin 98 Living Shoreline Project, as well as other environmental and resiliency projects that come our way

Project Overview

Living Shoreline Along Highway-98

- Project aims to create nearshore oyster reefs and plant salt marsh
- Primary objectives are to improve nearshore habitat and protect critical infrastructure
- Project broken up into phases (1-3)
- Funded by National Fish and Wildlife Foundation



Franklin-98

Phase 1 (Public Land)

- ~5,500 ft of shoreline

Phase 2 (Private Land)

- ~2,150 ft of shoreline

Phase 3 (Private Land)

- ~5,250 ft of shoreline

Harter Restoration & Consulting, LLC

Phase 1

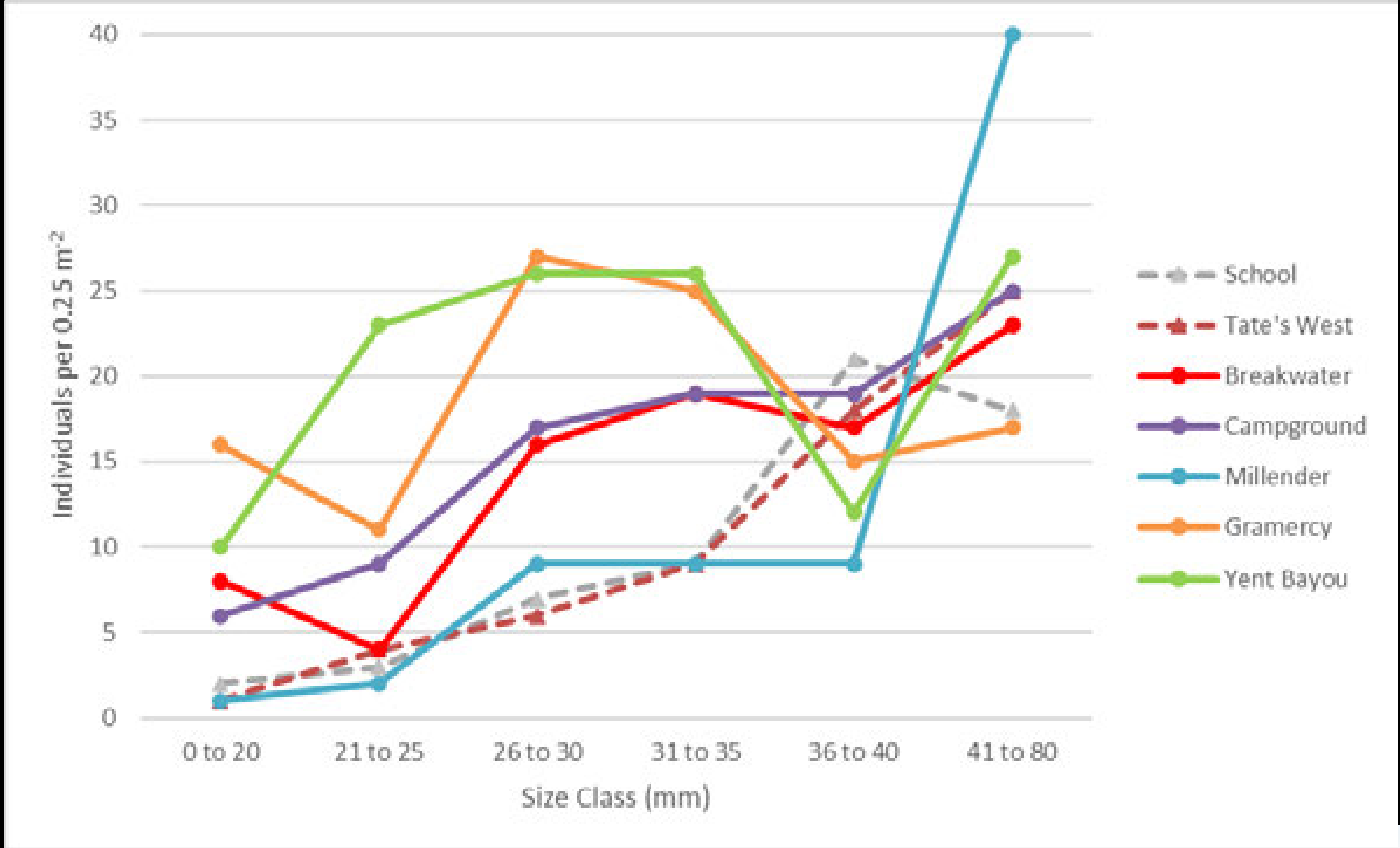
Metrics Overview

- Approximately 2.5 acres of reef created
- Approximately 3.0 acres of salt marsh created
- Three sites in Phase 1
  - Franklin County School, Tates West, and Tates East
- 99 reefs created between the three sites
- Over 10,500 tons of limestone deployed
- Oysters have colonized all Phase 1 reefs
- All Phase 1 reefs have been installed for over 2 years now
- Oyster and salt marsh goals have been met at all Phase 1 sites

Phase 1 Oyster Metrics

Breakdown

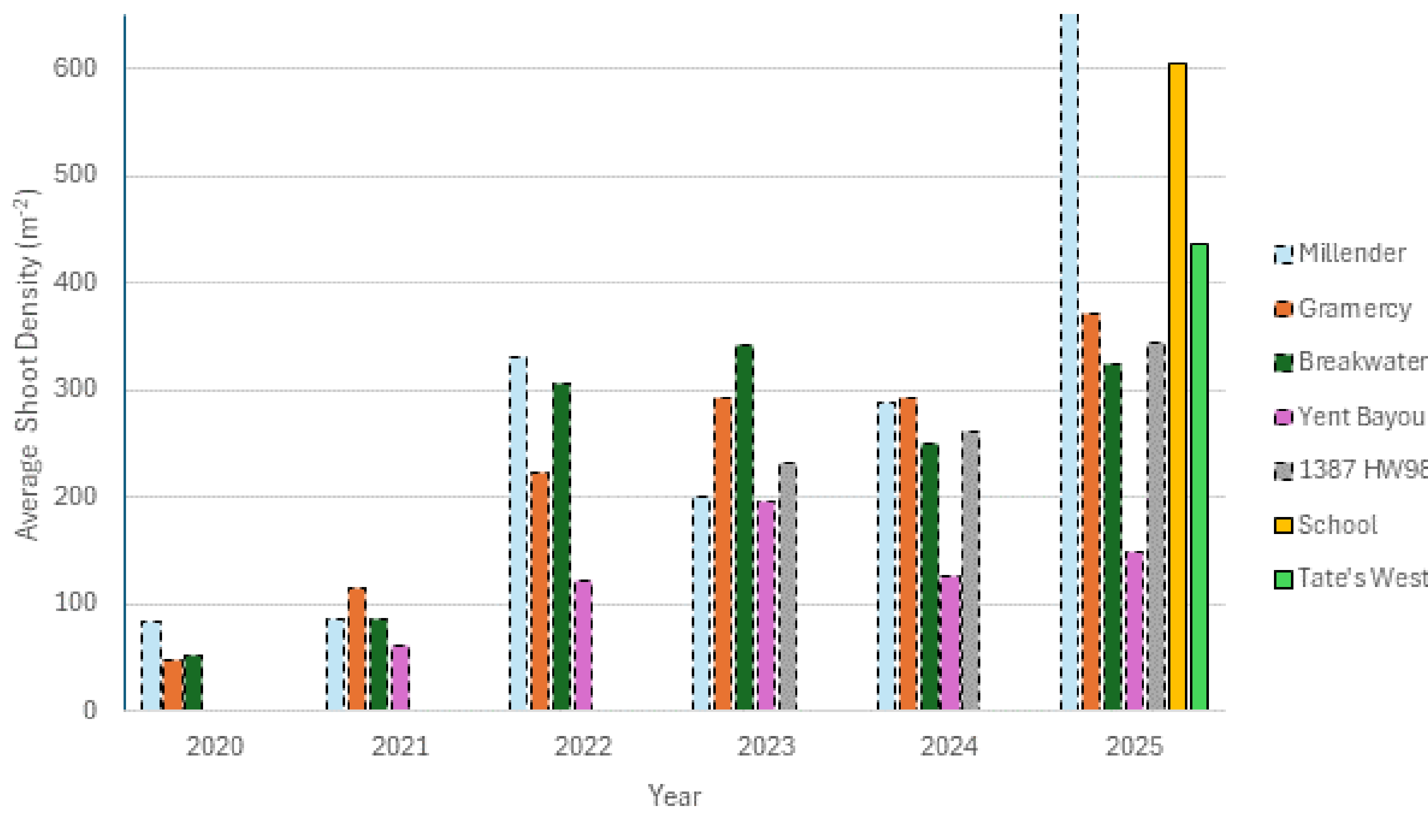
- Oyster quadrat surveys at project sites were compared to reference sites
- Project sites were mostly outcompeted in the lower oyster size classes (<35mm)
- Though Project sites were competitive in the larger size classes (>36mm)
- All the Phase 1 reefs have recruited oysters in sufficient densities to meet out oyster performance metric of at least 50% of the live oyster density compared to the reference sites.



Phase 1 Salt Marsh Metrics

Breakdown

- **Marsh quadrat surveys at project sites were compared to reference sites**
- **Project sites out competed all but one reference site in shoot density.**
- **Average shoot height for the project sites were lower than reference sites but was within ~5cm of reference sites.**
- **All the Phase 1 planted marsh areas have grown out to sufficient densities to meet our marsh performance metric of at least 50% of the live shoot density compared to the reference sites.**



Phase 1 Wave Attenuation

Breakdown

- Wave gauges were deployed in front and behind Phase 1 reefs, and control gauges were deployed nearby.
- Wave Gauges were deployed for at least a week.
- Analysis of the wave gauge data indicated that the reefs attenuated more wave energy than bed friction alone.
- A wave transmission coefficient was calculated and the Phase 1 reefs had periods of 100% wave attenuation.

Phase 1 Next Steps

Salt Marsh Plantings

- Phase 1 has accreted a considerable amount of sediment since April 2024
- Additional planting efforts are in the works to capture sediment and expand the marsh areas
- Planting areas are still being finalized but approximately 1.7 acres of additional planting is anticipated

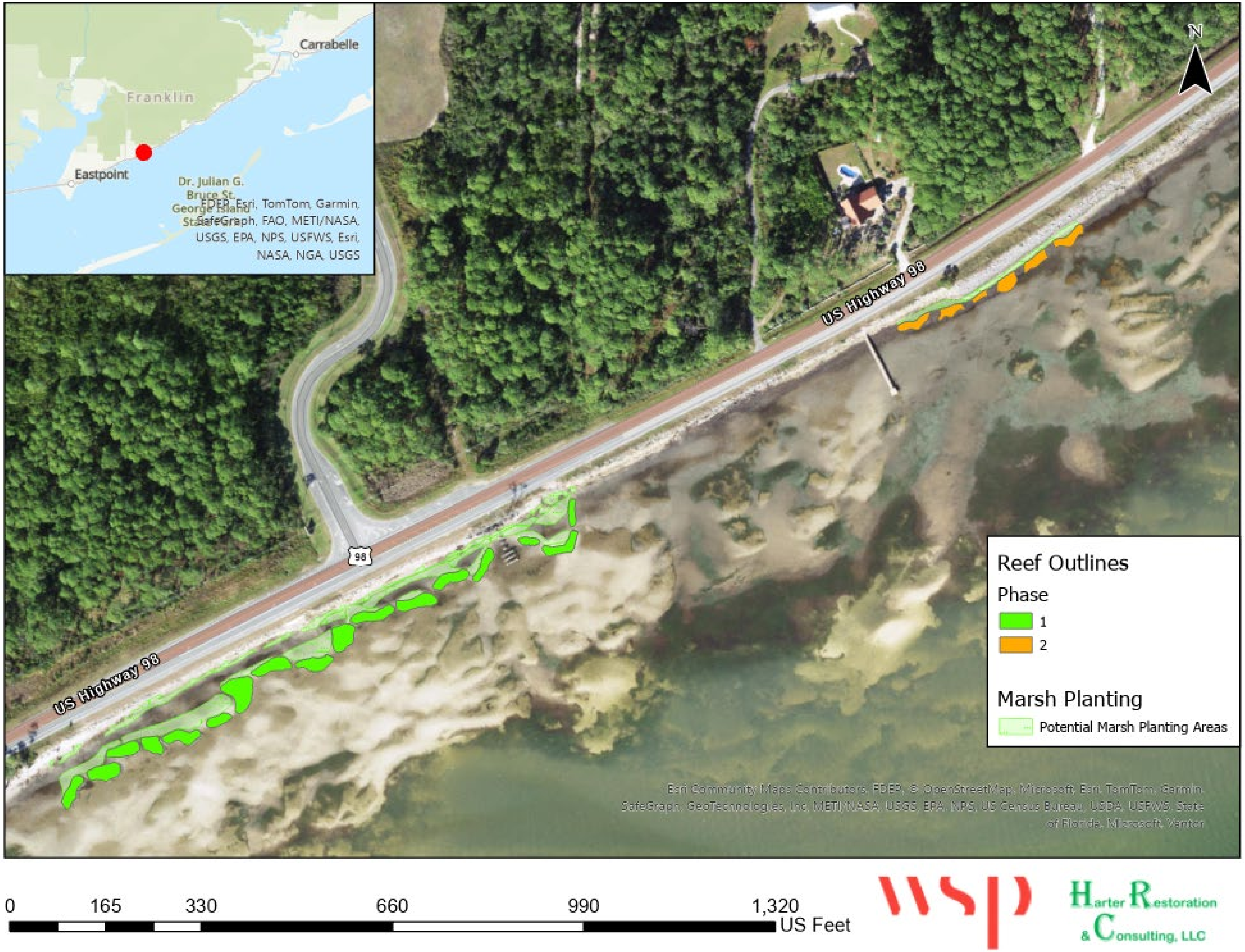
Phase 2

Metrics Overview

- Approximately 0.5 acres of reef planned
- Approximately 0.6 acres of salt marsh planned
- Two sites in Phase 2
  - Franklin County School Extension, Tates East Extension
- 23 reefs planned between the two sites
- Estimating over 1,900 tons of limestone
- All of Phase 2 sites will be adjacent to private properties
- All permits needed for Phase 2 in-hand
- Anticipated to start construction in approximately 1 month.

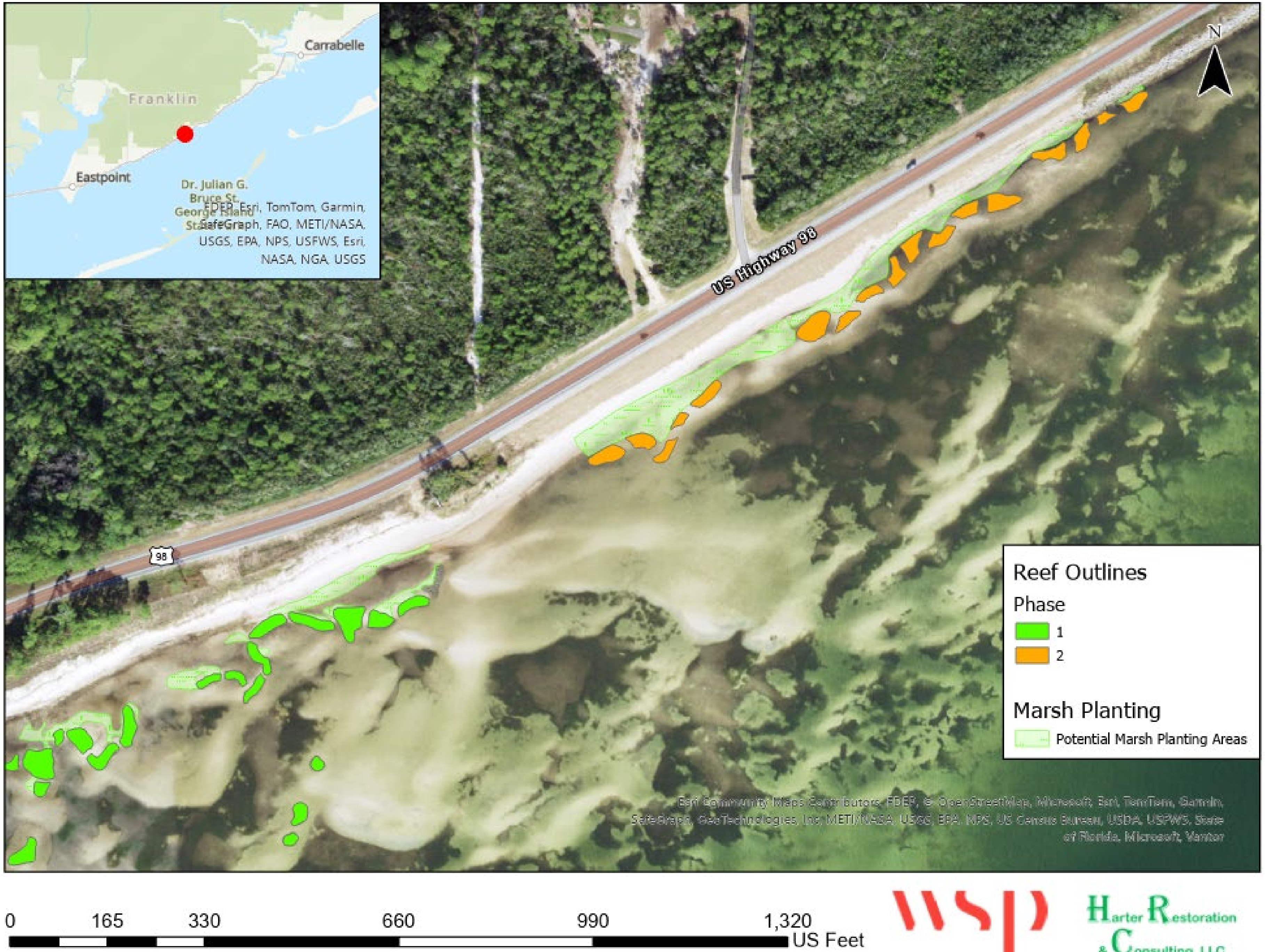
Phase 2 Areas

Franklin School Extension



Phase 2 Areas

Tates East Extension



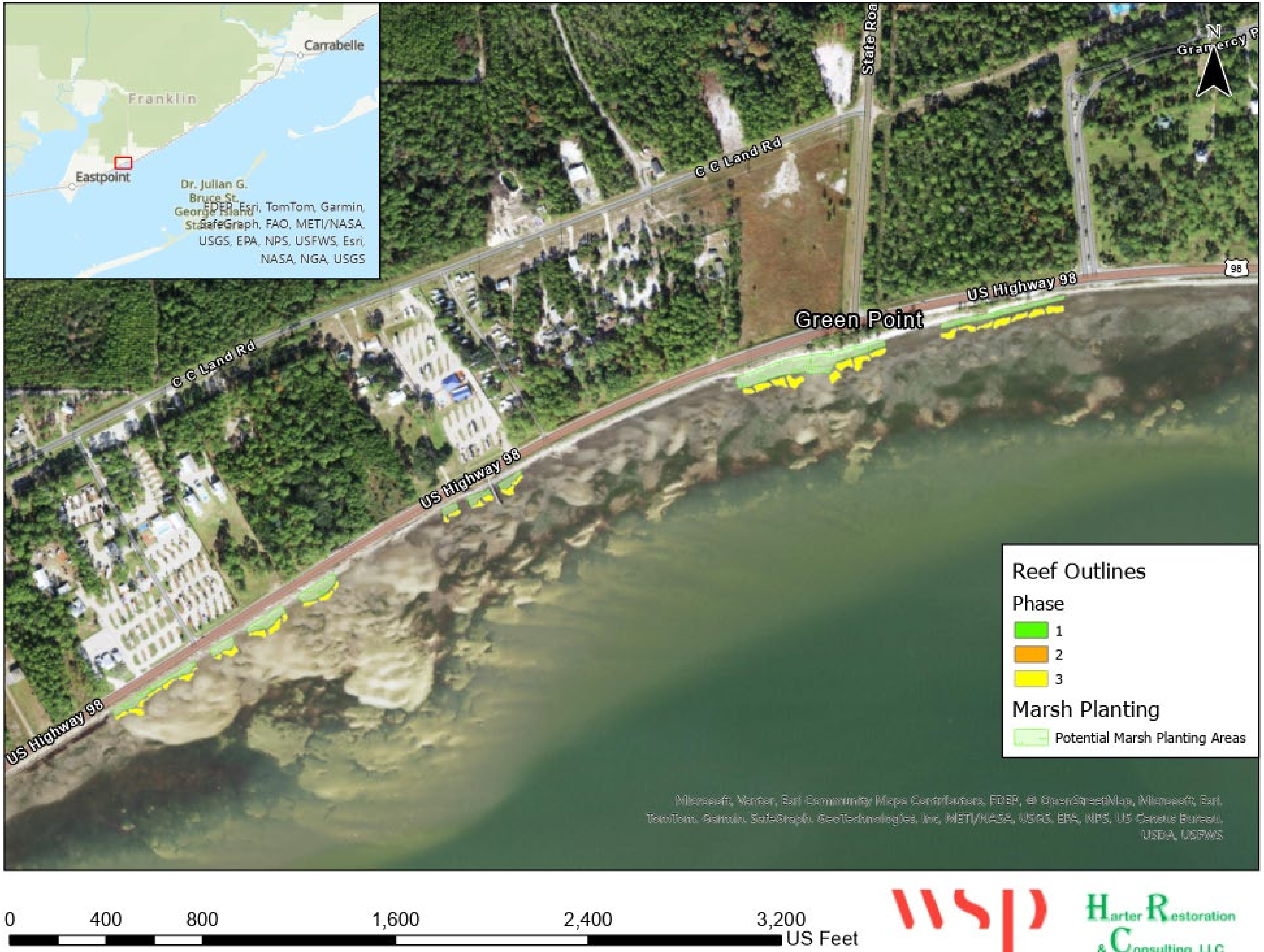
Phase 3

Metrics Overview

- Approximately 1.8 acres of reef planned
- Approximately 1.3 acres of salt marsh planned
- Multiple sites in Phase 3
  - Various private landowner addresses
- 69 reefs planned between the various sites
- Estimating over 7,500 tons of limestone
- All of Phase 3 sites will be adjacent to private properties
- USACE Permit in-hand, but FDEP Permit is still pending
- Anticipated start in late summer

Phase 3 Areas

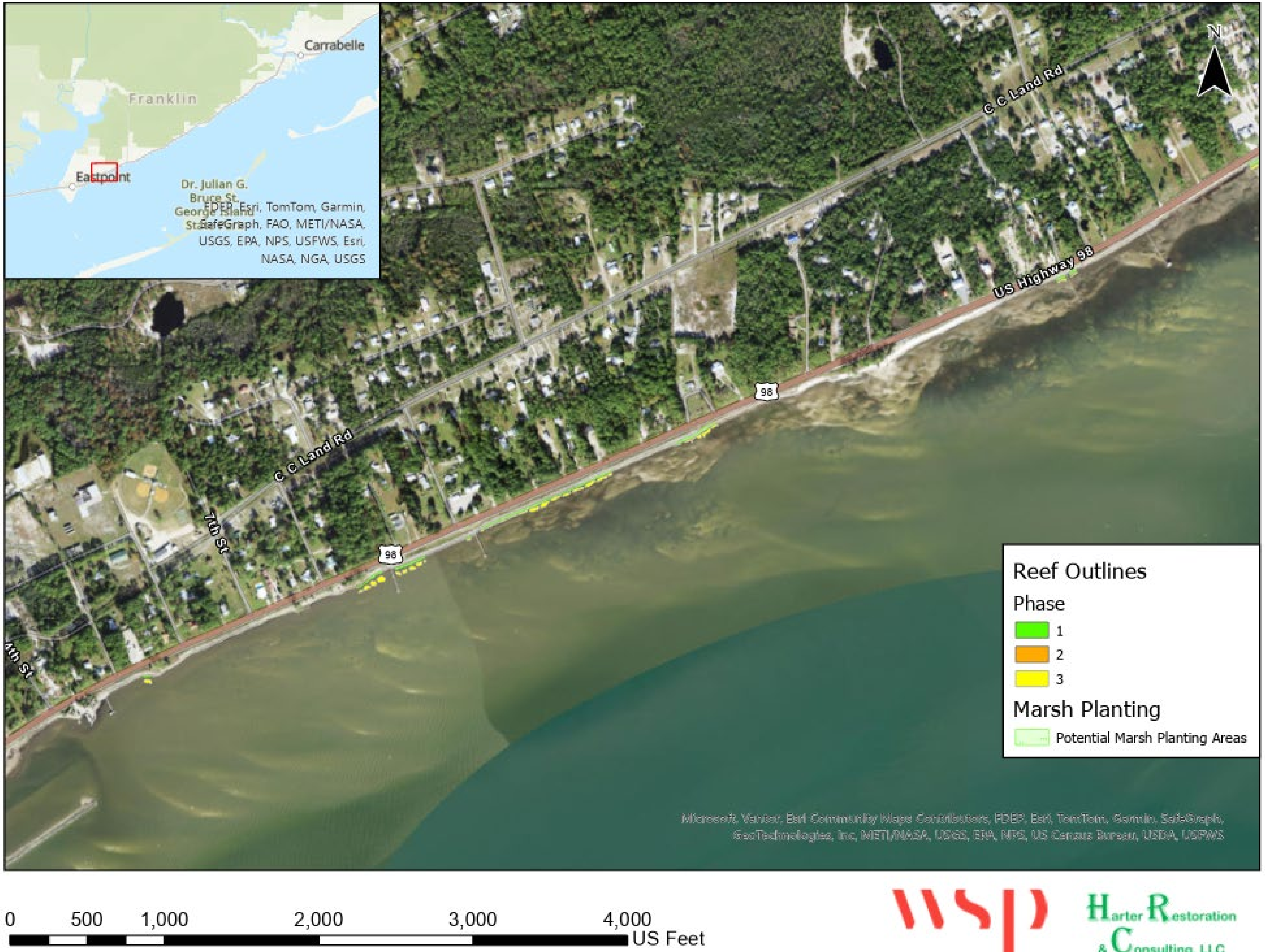
Near Highway-65



Harter Restoration & Consulting, LLC

Phase 3 Areas

Near Eastpoint Breakwaters



For More Information:

Destiny Bates

Environmental Project Manager

Dbates@arpc.org, (850) 312-3789

Will Mather

Consultant, Environmental Science

Will.Mather@WSP.com (575) 200-6735

Thank you!

APALACHICOLA WATERSHED COORDINATION BLUEPRINT

Working better, together

February 26, 2026

Apalachicola National Estuarine Research Reserve

2026 ANERR Research Symposium

Eastpoint, FL

the balmoral group

Presentation Agenda

- AWCB Project Overview & Progress Updates
- AWCB Information Hub
- AWCB Advisory Committee
- Introducing *ARCS: Apalachicola Restoration Collaboration Space*
- ANERR Site Profile Update
- AWCB Longevity Plan
- Next Steps

AWCB Project Overview & Progress Updates

AWCB: Overarching Project Goal

Improve collaboration and coordination among partners working to manage the natural systems within the Apalachicola River and Bay System by creating a **trusted source of Watershed information & improving how people work together**

AWCB Study Area

Apalachicola River Watershed and Adjacent Areas within Florida

Figure 2-2 Apalachicola River and Bay Watershed

AWCB Study Area; Map from 2017 NWFWMD SWIM Plan

AWCB Year 1 & 2 Milestones

1. Interested Parties Inventory →
2. Management & Restoration Plan Document Review & Analysis →
3. Workshops, Focus Area Meetings, and Expert Interviews →
4. Literature & Document Repository →
5. Funding Opportunity Database →
6. Information Hub/StoryMap Development & Transfer to DEP →
7. Topic-Specific Focus Area and Collaboration Workspace Development →
8. Advisory Committee Establishment

the balmoral group

AWCB Year 3 Milestones

1. Continued Projects, Literature, Funding, Interested Party Information Gathering
2. Information Hub Review by DEP
3. Advisory Committee Development
4. Apalachicola Restoration & Collaboration Space (ARCS) Development
5. ANERR Site Profile Update
6. AWCB Longevity Plan Development & Transition to ANERR

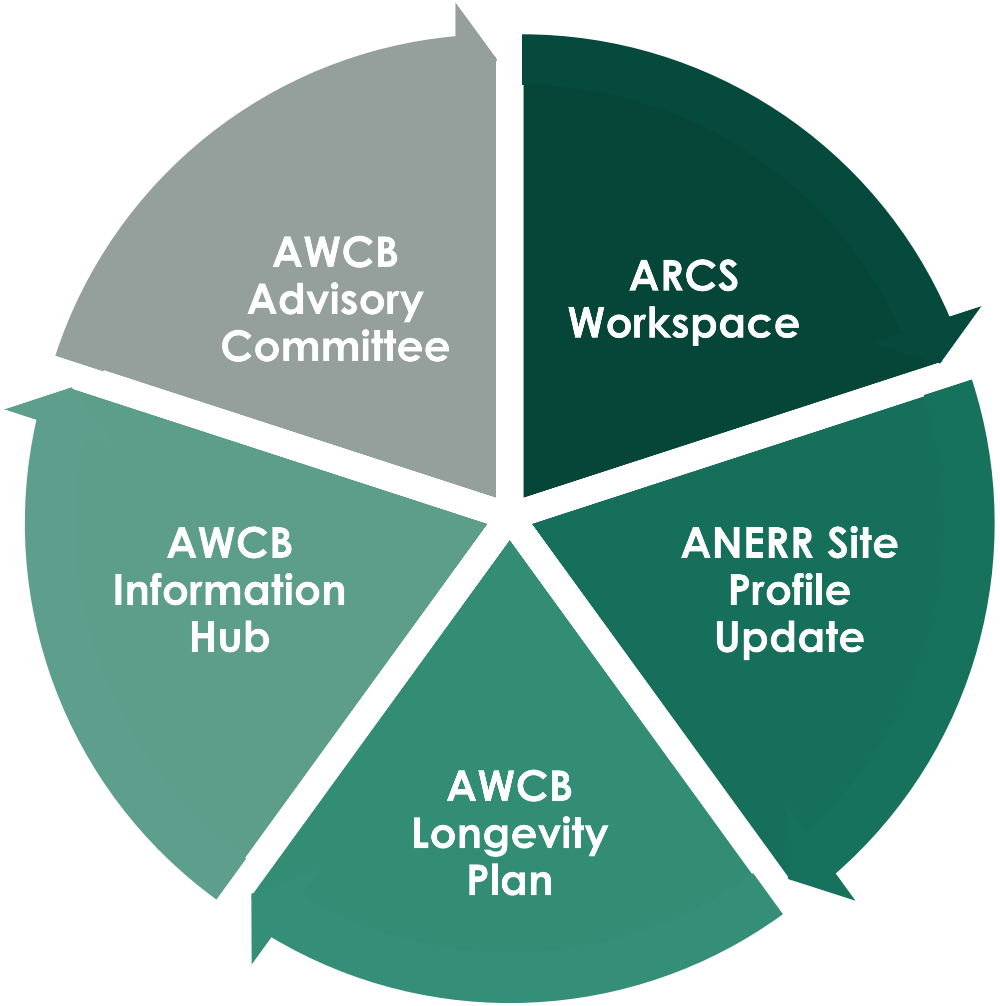
AWCB Interested Parties' Shared Goals

- Trusted Source of Watershed Information
- Strengthen Community Resilience
- Improve Water Quality
- Restore & Conserve Fish and Wildlife
- Conserve and Restore Critical Habitats

- Support Natural Resource Economy
- Reduce Sedimentation
- Help People Work Better Together
- Ensure Habitat Connectivity
- Respond to Threats
- AWCB Longevity Plan

the balmoral group

AWCB Resources



AWCB Information Hub

AWCB Information Hub

What it is: Source of trusted information to support Apalachicola restoration collaboration designed with interested parties' input to ***help people work better together***

What it provides:

- Highlights of ecological restoration projects/partnerships
- Dashboards on restoration projects; interested parties; funding opportunities; literature and management plans
- Upcoming events, news, articles

Apalachicola Watershed Coordination Blueprint

Connecting People, Data, and Action for a Resilient Apalachicola River & Bay System

The AWCB Info Hub will provide a public-facing source of information to support ecological restoration collaboration in the watershed - Currently in DEP Comms review; anticipated to go live Spring/Summer 2026

AWCB Advisory Committee

AWCB Advisory Committee Scope

AWCB Goal Monitoring & Longevity Planning	• Support shared watershed restoration goals and the ANERR Restoration Coordinator
Resource Leveraging & Partnership-Building	• Cross-pollinate across AWCB Focus Areas of Coastal, Hydrologic, and Upland Restoration
Information & Resource Sharing	• Demonstrate leadership through the AWCB collaboration workspace & Info Hub
Project Prioritization, Conceptualization & Funding	• Keep project priorities in focus, identify gaps, form teams to pursue funding

ARCS: Apalachicola Restoration Collaboration Space

ARCS: Collaboration Space

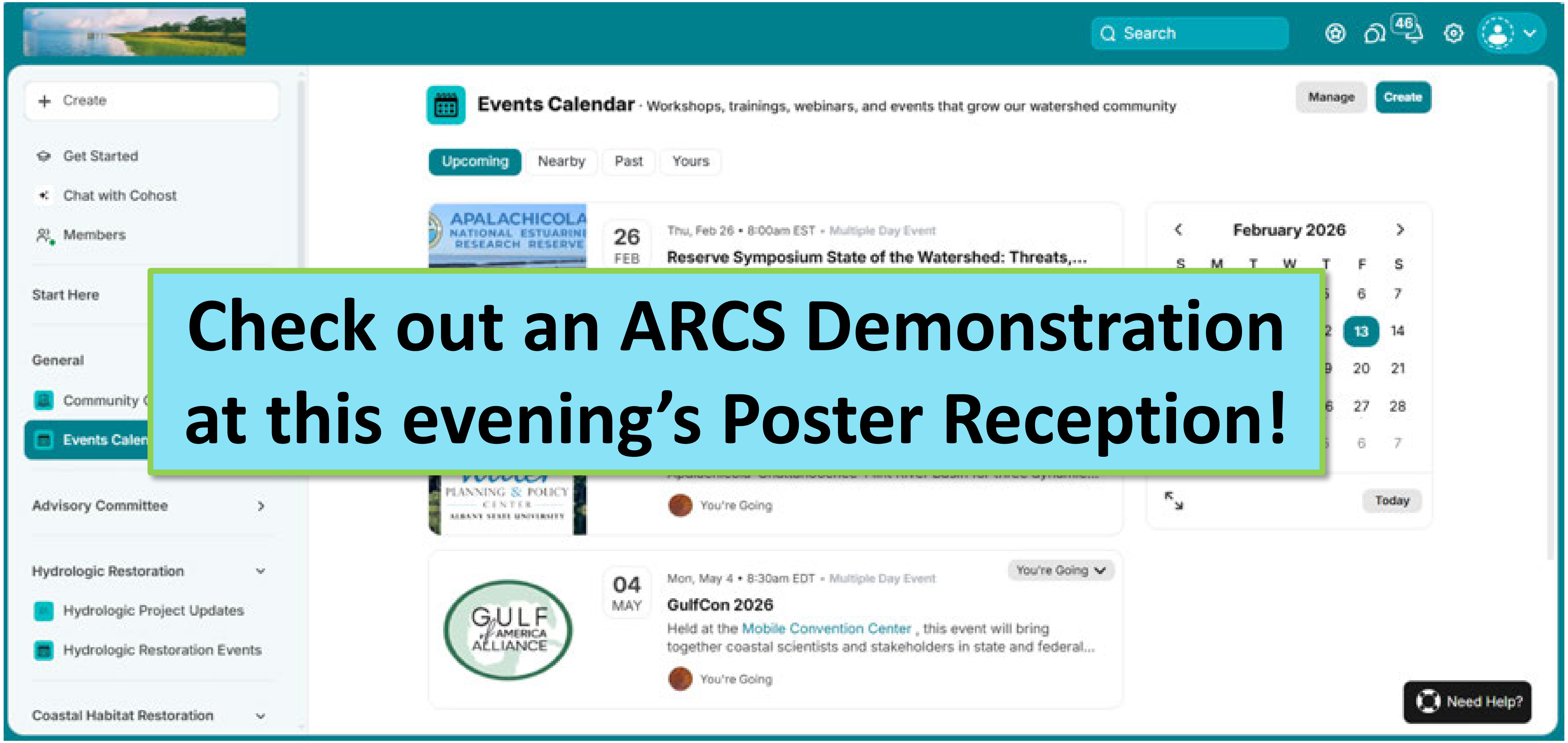
What it is: The Apalachicola Restoration and Collaboration Space is a place to connect, share knowledge, and create new partnerships through communication and collaboration

What it provides:

- Discussion Forums & Collaboration Space
- Advisory Committee Space
- Focus Area Resources: Coastal, Hydrologic, Upland
- Funding and Resource Sharing
- Calendar & Event Coordination

the balmoral group

ARCS Preview



Check out an ARCS Demonstration at this evening's Poster Reception!

AWCB Site Profile

Site Profile

What it is: A collection of data interactively displayed to tell the story of the Apalachicola River and Bay System that match NOAA guidelines

What it contains:

- Estuary Overview and Setting
- Community and Historical Ecology
- Estuary Characterization, Biological Communities, and Conditions
- Research and Monitoring Activities
- Learning Opportunities

AWCB Longevity Plan

AWCB Longevity Plan

Goals:

- Outline path forward for AWCB leadership by ANERR
- Facilitate knowledge sharing through tools
- Establish a clear path for community engagement
- Summarize milestones and clear metrics for success
- Identify and address challenges and risks

AWCB Project: Next Steps

- Finalize DEP Comms review and launch AWCB Info Hub
- Finalize ANERR Site Profile Update
- Engage participation in ARCS
- Finalize AWCB Longevity Plan

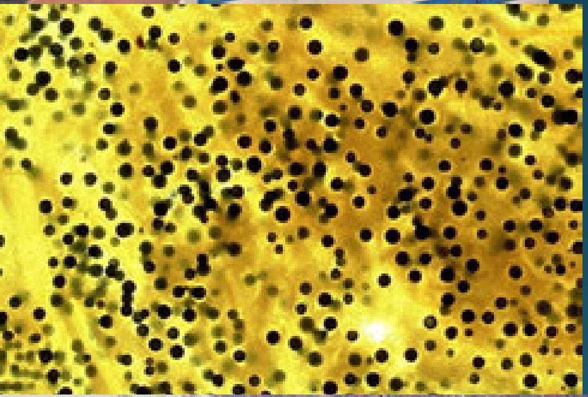
Thank You!

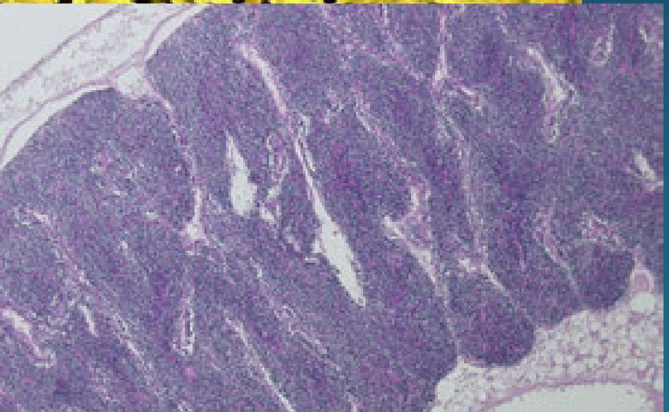
Questions?

TBG Contact: Laila Racevskis
Director of Economics & Policy
LRacevskis@balmoralgroup.us

The Current Status and Future of Apalachicola Oysters

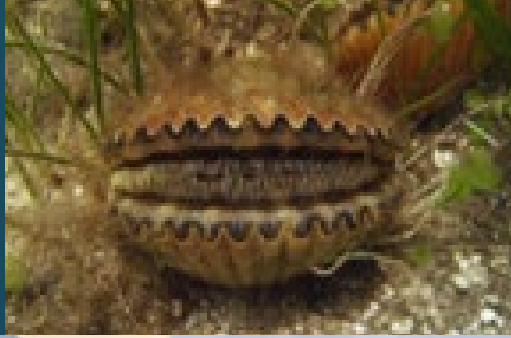
Matthew Davis
Associate Research Scientist
Florida Fish & Wildlife Conservation Commission
Matthew.Davis@myfwc.com
February 26, 2026





Fish & Wildlife Research Institute

- Operate from the Apalachicola/Eastpoint Field Lab
- Scallops
  - Population Survey
  - Recruitment
- Oysters
  - Individual condition
  - Disease (Dermo)
  - Reproduction
  - Recruitment
  - **Population Survey**



Oyster Population Survey

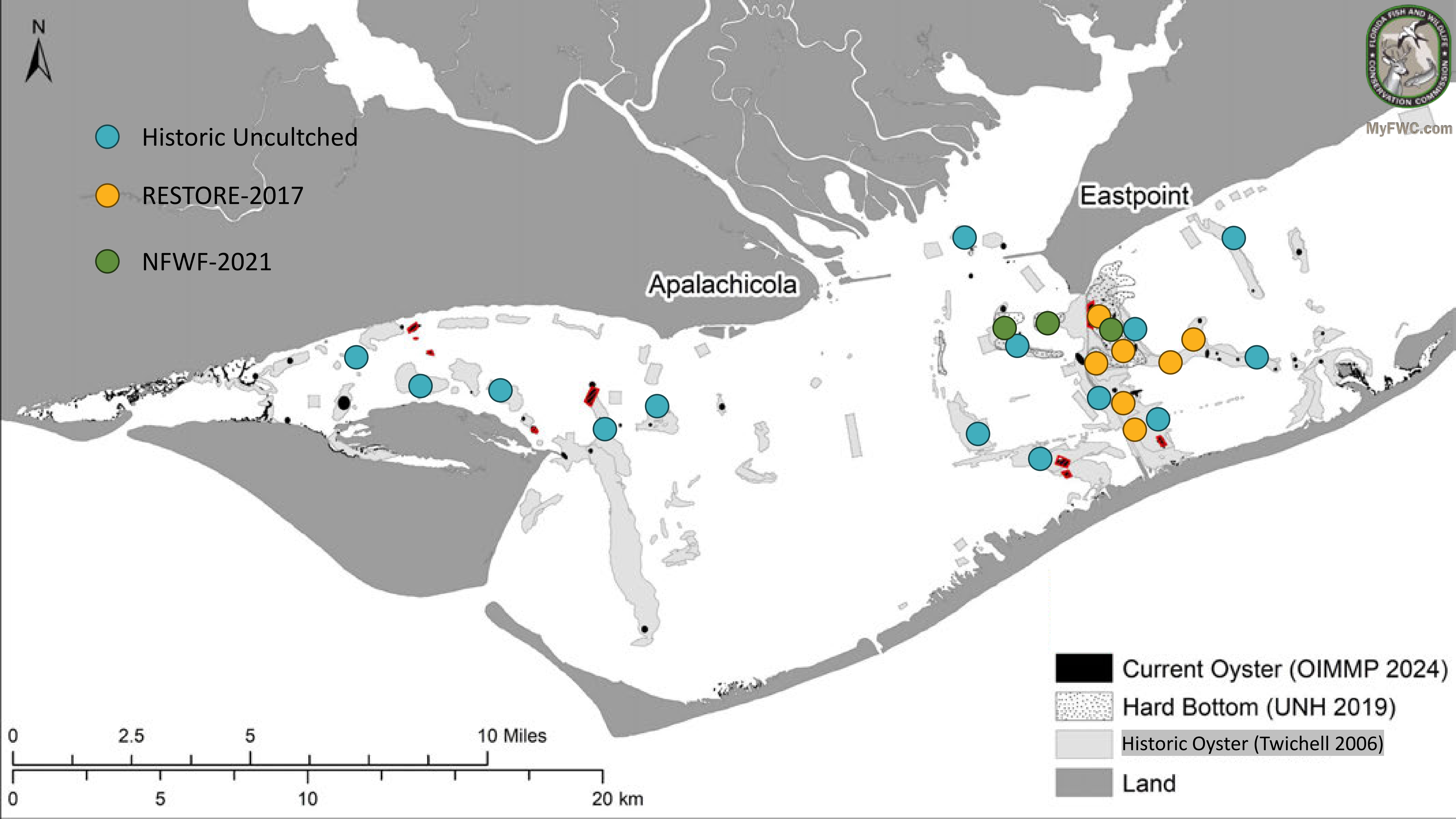
- SCUBA divers use ¼ meter^2 quadrats
- Data recorded:
  - Substrate Weight
  - Number and size of live oysters
  - Number of recently dead oysters
  - Number of legal (>= 75 mm SH) oysters
  - Number of oyster drills
  - Shell heights of first 50 oysters encountered
- Detailed field methods online
  - Chapter 11 of Oyster Integrated Mapping and Monitoring Program (OIMMP) Report

https://myfwc.com/research/habitat/coastal-wetlands/oimmp/

- **Surveys performed annually between March and June**

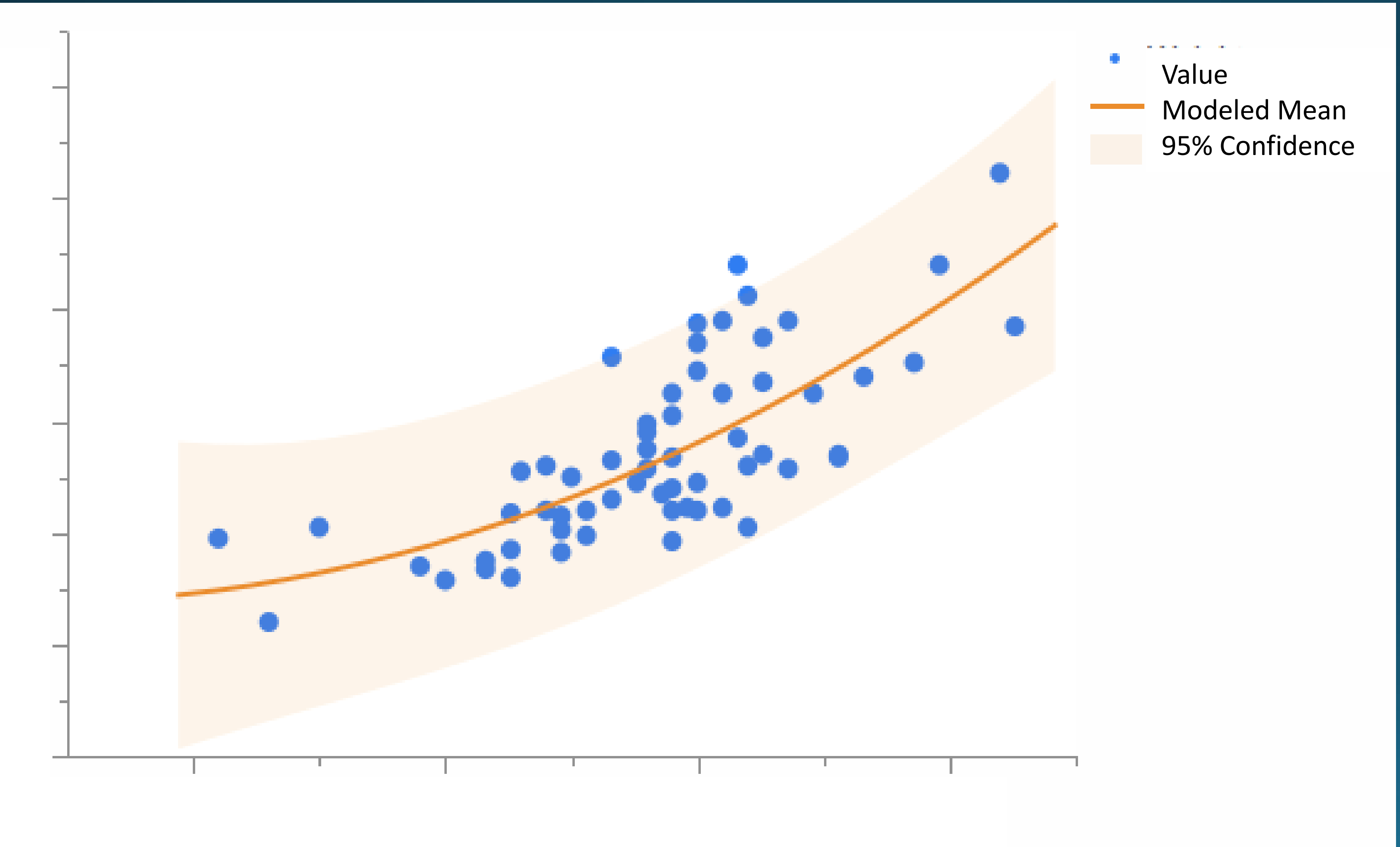
- **Historic Uncultched**:
  - No cultching since 2015.
  - Fifteen quadrat samples collected at each reef.
- **RESTORE-2017:**
  - Limestone cultch material in 2017.
  - Thirty to fifty quadrat samples collected at each reef.
  - Reefs vary in size between 12 and 50 acres.
- **NFWF-2021**:
  - Limestone cultch material in 2021.
  - Thirty quadrat samples were collected at each reef.
  - Reefs vary in size between 9 and 18 acres.

Reef Name	Old name	Acreage
RESTORE-01	Cat Point	50
RESTORE-02	Monkeys Elbow	27
RESTORE-03	Peanut Ridge	21
RESTORE-04	Cat Spur	12
RESTORE-05	Platform	22
RESTORE-06	Bulkhead South	24
RESTORE-07	Easthole	43
NFWF21-01	Lighthouse	11
NFWF21-02	East Lumps	9
NFWF21-03	Cat Point	18



N
Historic Uncultched
RESTORE-2017
NFWF-2021
Apalachicola
Eastpoint
MyFWC.com
Current Oyster (OIMMP 2024)
Hard Bottom (UNH 2019)
Historic Oyster (Twichell 2006)
Land
0
2.5
5
10 Miles
0
5
10
20 km

How We Estimate Oyster Densities



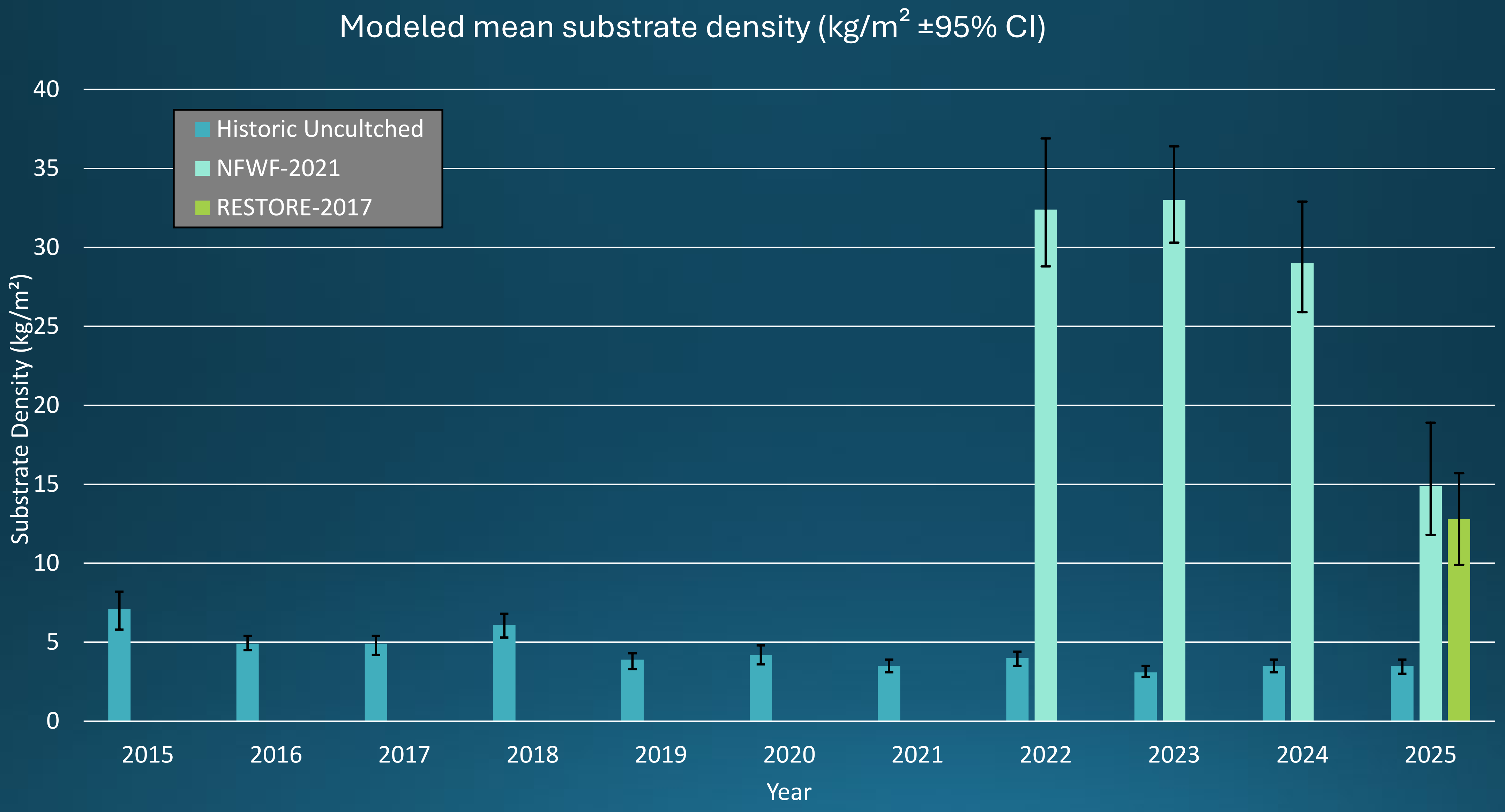
- Modeled means
- 95% confidence intervals
- Accounts for site and year variation

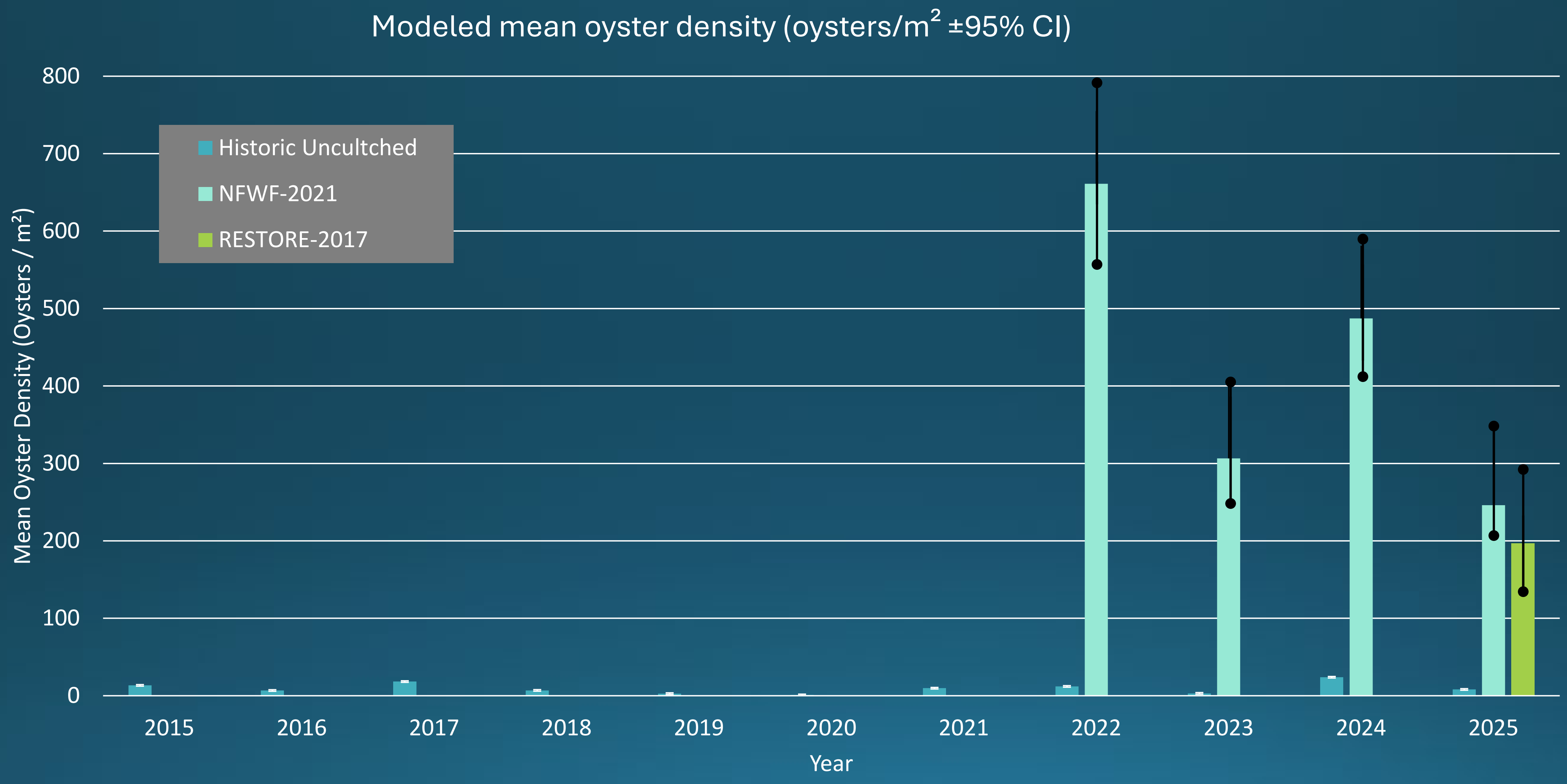
Results

- April and May 2025

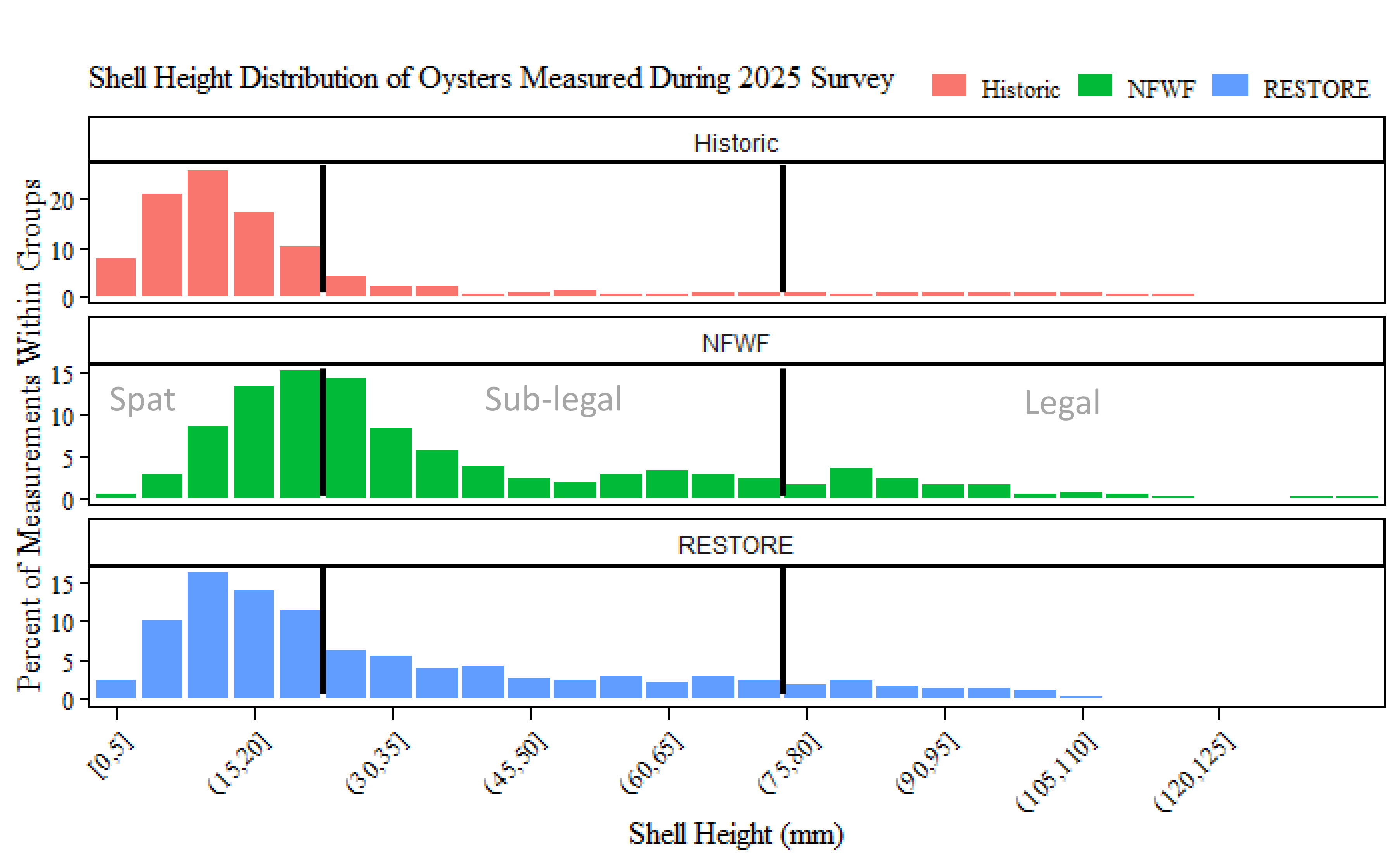
- Twenty-four reefs surveyed
  - Fourteen Historic Uncultched reefs
  - Seven RESTORE-2017 reefs
  - Three NFWF-2021 reefs

- 550 quadrats processed
  - 1,350 kgs of material processed
  - 20,361 oysters counted
  - 13,981 oysters measured for shell height.

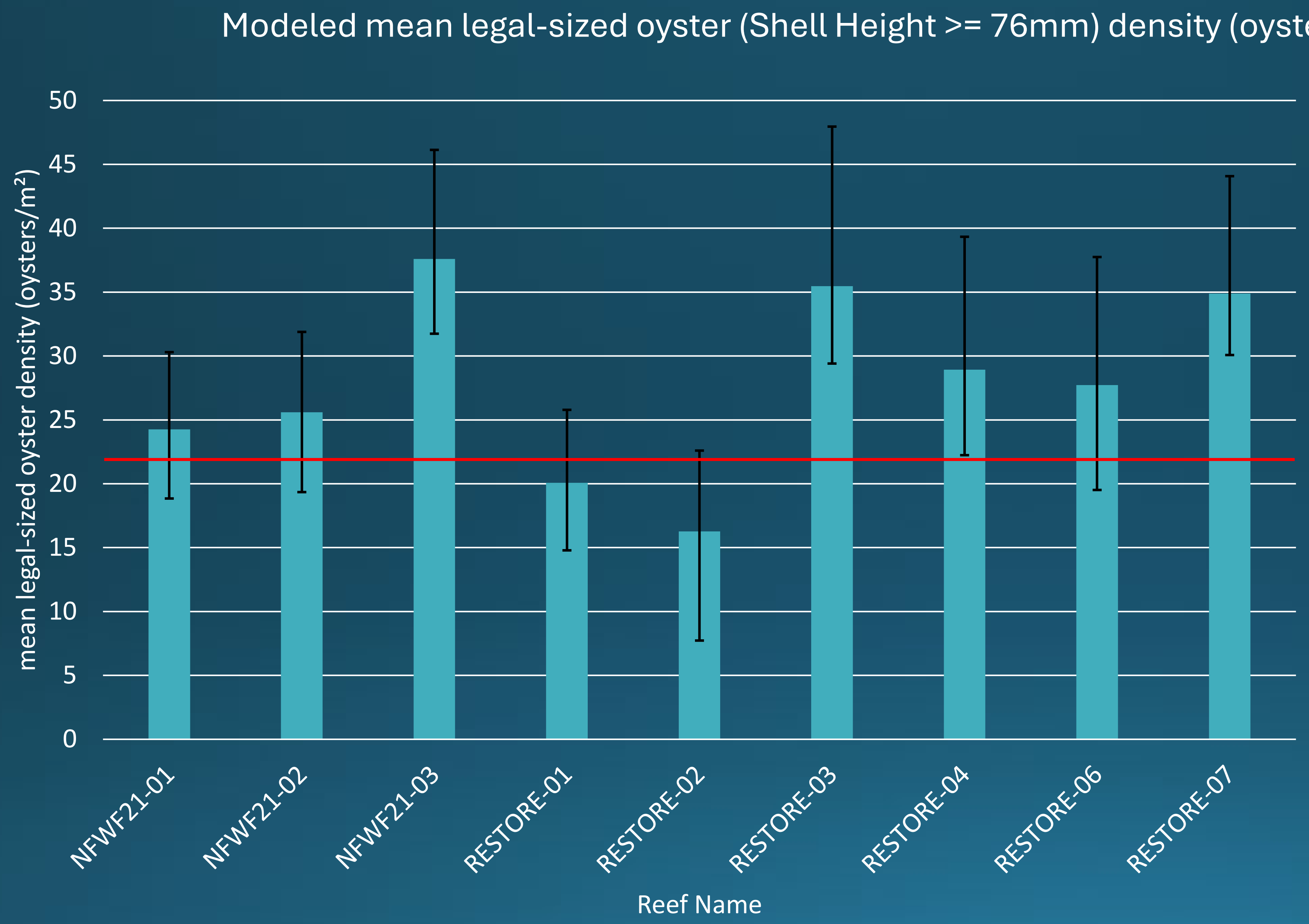

Modeled mean substrate density (kg/m2 ±95% CI)
Historic Uncultched
NFWF-2021
RESTORE-2017
Substrate Density (kg/m2)
40
35
30
25
20
15
10
5
0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Year



Modeled mean oyster density (oysters/m² ±95% CI)
Historic Uncultched
NFWF-2021
RESTORE-2017
Mean Oyster Density (Oysters / m²)
800
700
600
500
400
300
200
100
0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Year



Shell Height Distribution of Oysters Measured During 2025 Survey
Historic
NFWF
RESTORE
Percent of Measurements Within Groups
Spat
Sub-legal
Legal
0
10
20
0
5
10
15
[0,5]
(15,20]
(30,35]
(45,50]
(60,65]
(75,80]
(90,95]
(105,110]
(120,125]
Shell Height (mm)



Reef Name	Old name	Acreage
RESTORE-01	Cat Point	50
RESTORE-02	Monkeys Elbow	27
RESTORE-03	Peanut Ridge	21
RESTORE-04	Cat Spur	12
RESTORE-05	Platform	22
RESTORE-06	Bulkhead South	24
RESTORE-07	Easthole	43
NFWF21-01	Lighthouse	11
NFWF21-02	East Lumps	9
NFWF21-03	Cat Point	18

22.2 legal-sized oysters / m^2 = 400 bags / acre

January 2026 Season Annual Harvest Levels

Oyster reef	Reef type	Total AHL	Commercial AHL	Recreational AHL
NFWF Cat Point	Subtidal	1042	989	52
RESTORE Cat Point Spur	Subtidal	498	473	24
RESTORE Easthole	Subtidal	2318	2202	115
RESTORE Peanut Ridge	Subtidal	1085	1030	54
Total	**--**	**4943**	**4694**	**245**

- Conservative harvest limits
- Utilizes lower 95% confidence interval
- Harvest of 10% legal-sized oysters
- Similar regulation to other gulf states

Future

- Mapping in 2006 suggested at least **12,000 acres** of potential oyster habitat.
- Sidescan Mapping in 2019 suggested **only ~600 acres remain**.
- Our 2025 data show **only ~70 acres** had potentially harvestable oyster densities.
- FWC and other partners continue to seek out grant funding for future cultching projects.
- $10 million dollars were spent to cultch ~75 acres in 2024.
- FWC is working to secure funding to reestablish a cultching program

Summary

- Historic Uncultched reefs
  - Low substrate densities
  - Low oyster densities dominated by spat.
- NFWF-2021 and RESTORE-2017 reefs
  - Higher substrate densities
  - Higher oyster densities and a broader size distribution
- Legal-size oysters remain a small fraction of the total population but are increasing on several reefs
- Efforts to secure funding for further and more consistent cultching are ongoing.

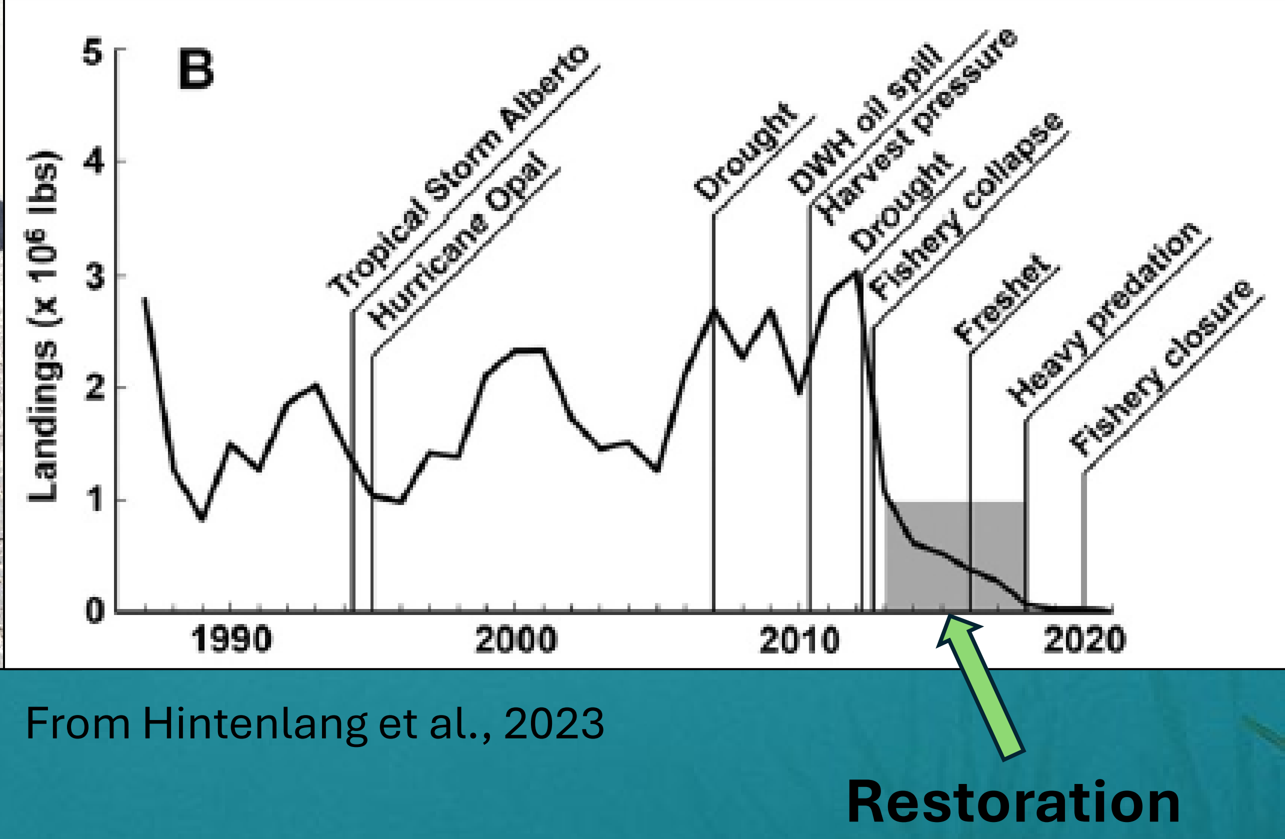
Restoration works — but scale and sustained investment will determine whether Apalachicola oysters truly recover

Questions

Apalachicola Bay oyster population response to the five-year fishery closure

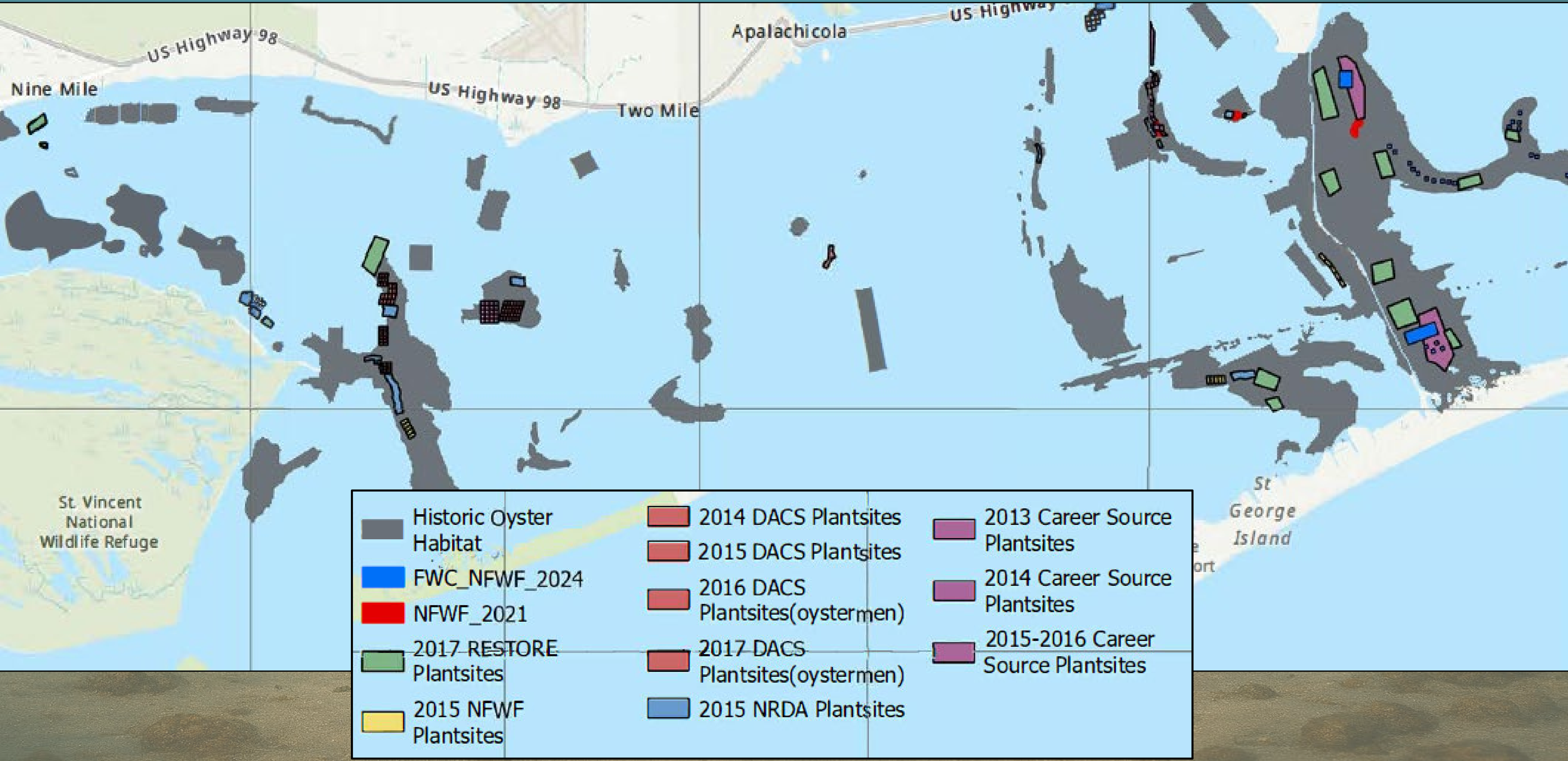
Sandra Brooke, Shannon Hartsfield, Natalie Horn, Lauren Calvin, Caitlin Turnbull, Adam Alfasso, Adin Domen, Harrison Clark, Joel Trexler

Apalachicola Bay oyster fishery fluctuation over time



From Hintenlang et al., 2023

Apalachicola Bay restoration post fishery-collapse



Before fishing closure: No sites reached 400 bags/acre

FLDEP RESTORE Act project
2017: Deployed 317 acres limestone
Sampled Summer 2019

Site	Bags/acre
8-Mile	0
9-mile	0
Cabbage Top	0
Cat Point	3
Cat Point Spur	12
East Hole 1	0
East Hole 2	0
Hotel Bar 1	0
Hotel Bar 2	0
King 9-mile	0
Monkey's Elbow	0
North Spur 2	0
Peanut Ridge	0
South Bulkhead	0

FLDEP NRDA project
2015: Deployed 124 acres fossil shell
Sampled Fall 2019

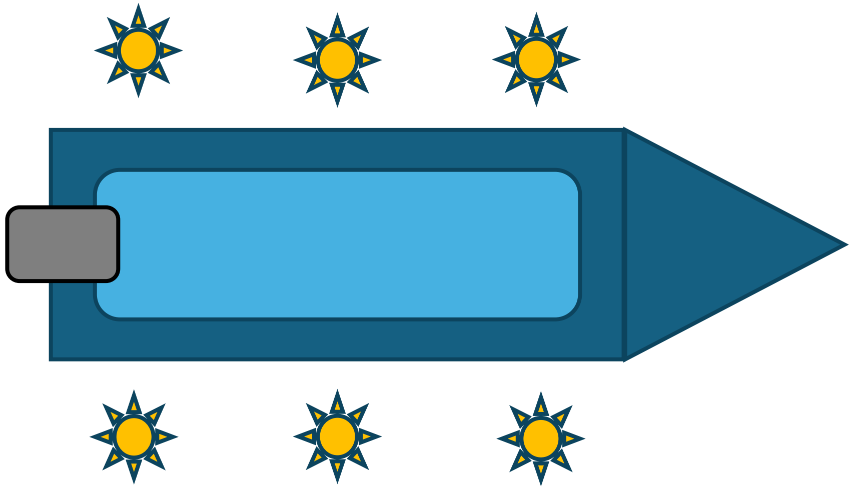
Site	Bags/acre
Bayou Flats	0
Cabbage Lumps	0
Cabbage Top	0
Cat Point	0
Dry Bar	0
Eleven Mile North	0
Eleven Mile South	0
Green Point	0
Hotel Bar	0
Lighthouse	0
Little Gully	0
Norman's Bar Middle	0
Norman's Bar North	5
North Spur	0
Redfish Creek 1	0
Redfish Creek 2	0

ABSI Annual monitoring 2020-2025

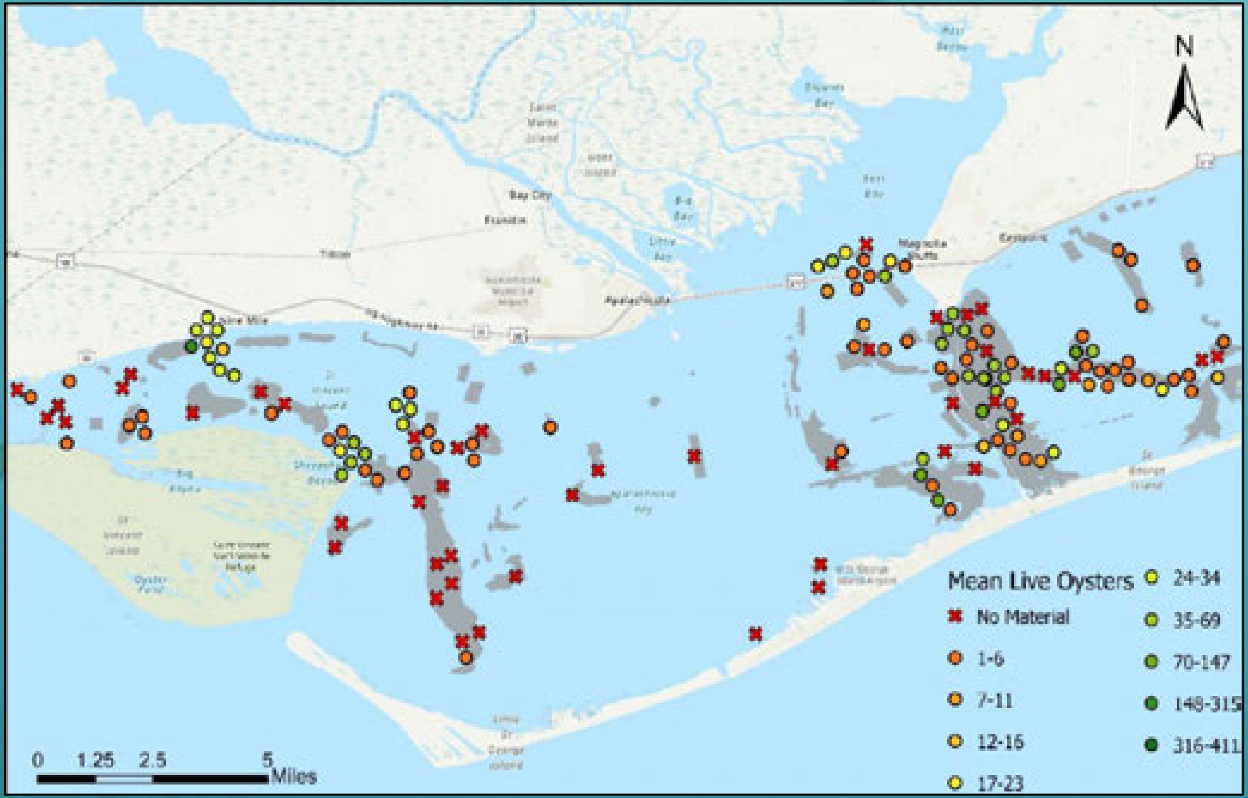
Samples taken using tongs

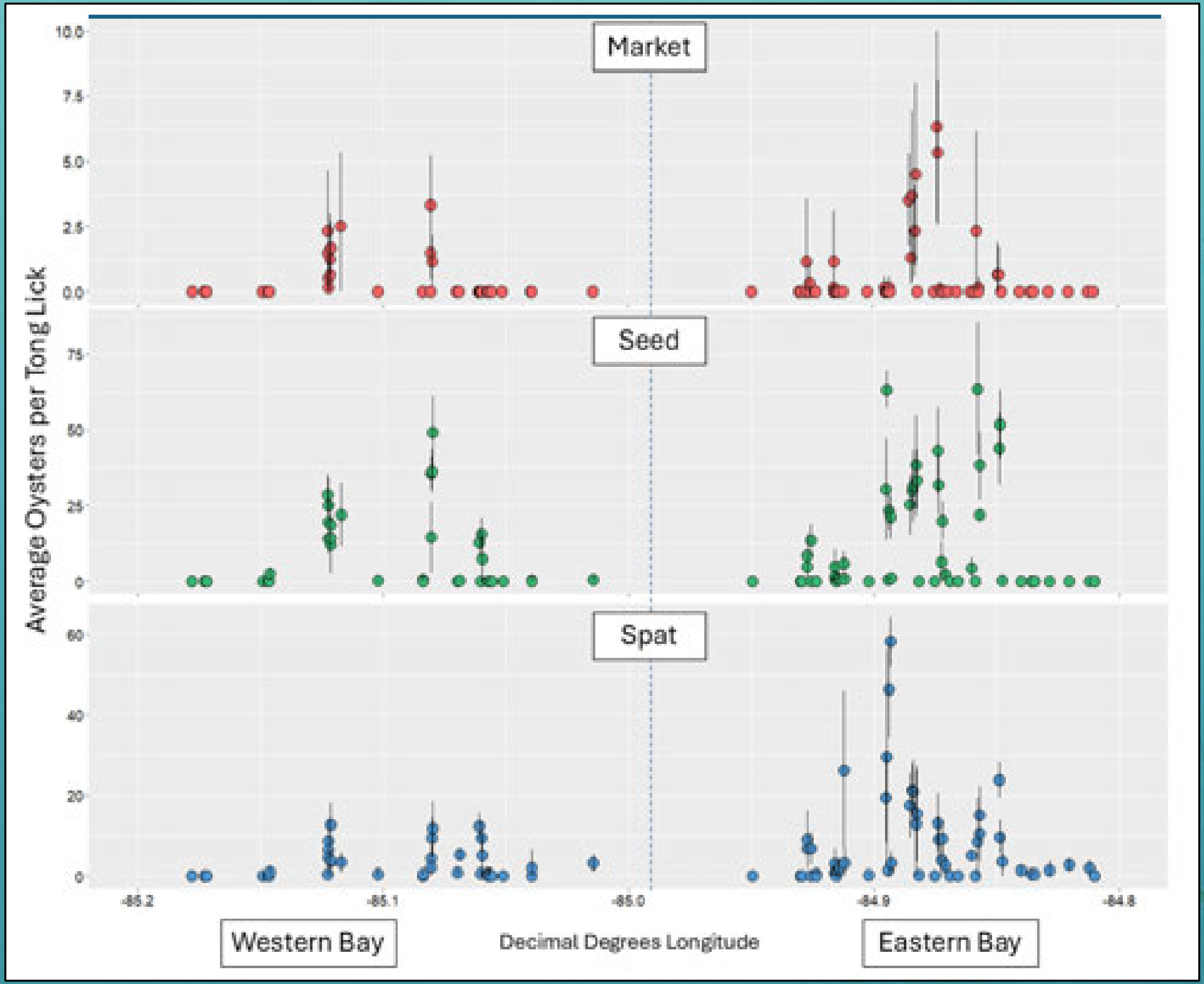
<u>Six samples per site</u>

- Total volume and weight
- Number of spat (<25mm), seed (25-75mm), market (>75mm), boxes
- Shell height of all live oysters
- Predator count
- Water quality



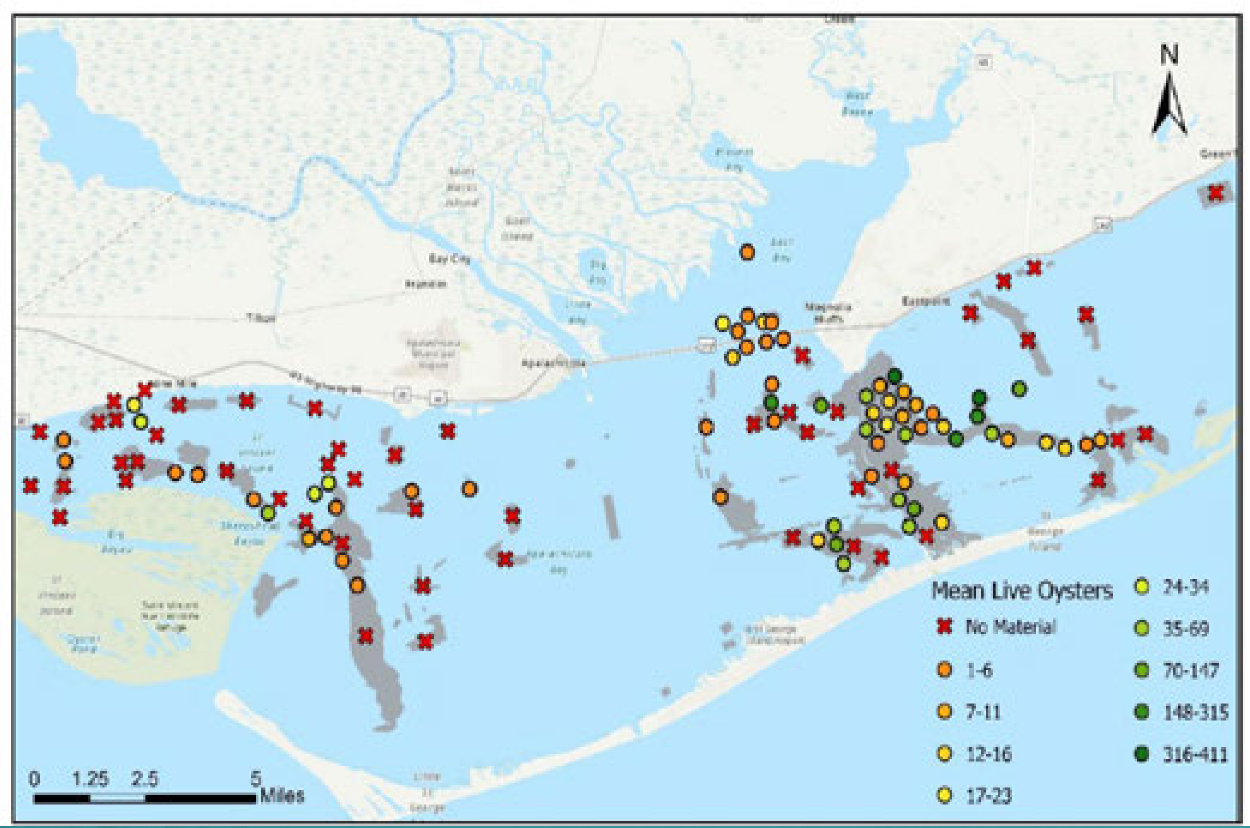
Round 1 Bay-Wide Monitoring
Oct 2020-May 2021
103 sites

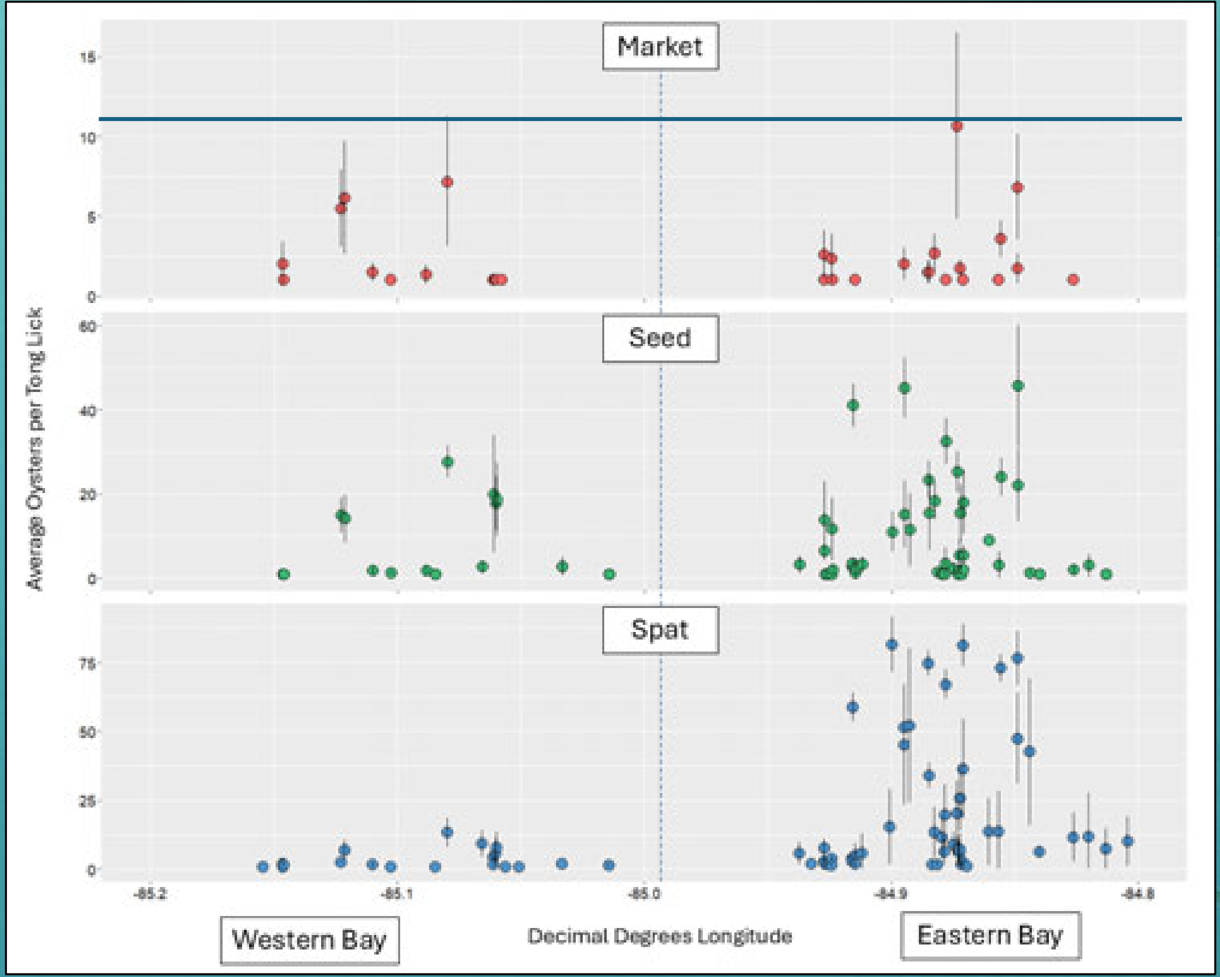




No sites reached harvestable threshold

Round 2 Bay-Wide Monitoring Dec 2021-Mar 2022 117 sites





One site almost reached harvestable threshold

2021-2022: Three limestone sites (56 acres) reached 400 bags/acre

FWC monitoring 2022

Site	Jan	Feb	Mar	May	Sep
Bulkhead			0		0
North		29		14	
South		14		14	
Cabbage Top			58		29
Cat Point			0		0
Restoration	10			5	
Shallow	0			0	
Dry Bar North			0		0
East Lumps			0		0
Restoration	0			0	
East Hole 7			0		0
Green Point			5		48
Site 6		14		96	
Halfmoon					0
East		0		0	
Hotel			0		0
West		0		0	
Lighthouse			5		0
Restoration		0		5	
Site 8		0			
Normans			0		0
Paradise Flats			10		38
Platform			0		0
Porters			0		0

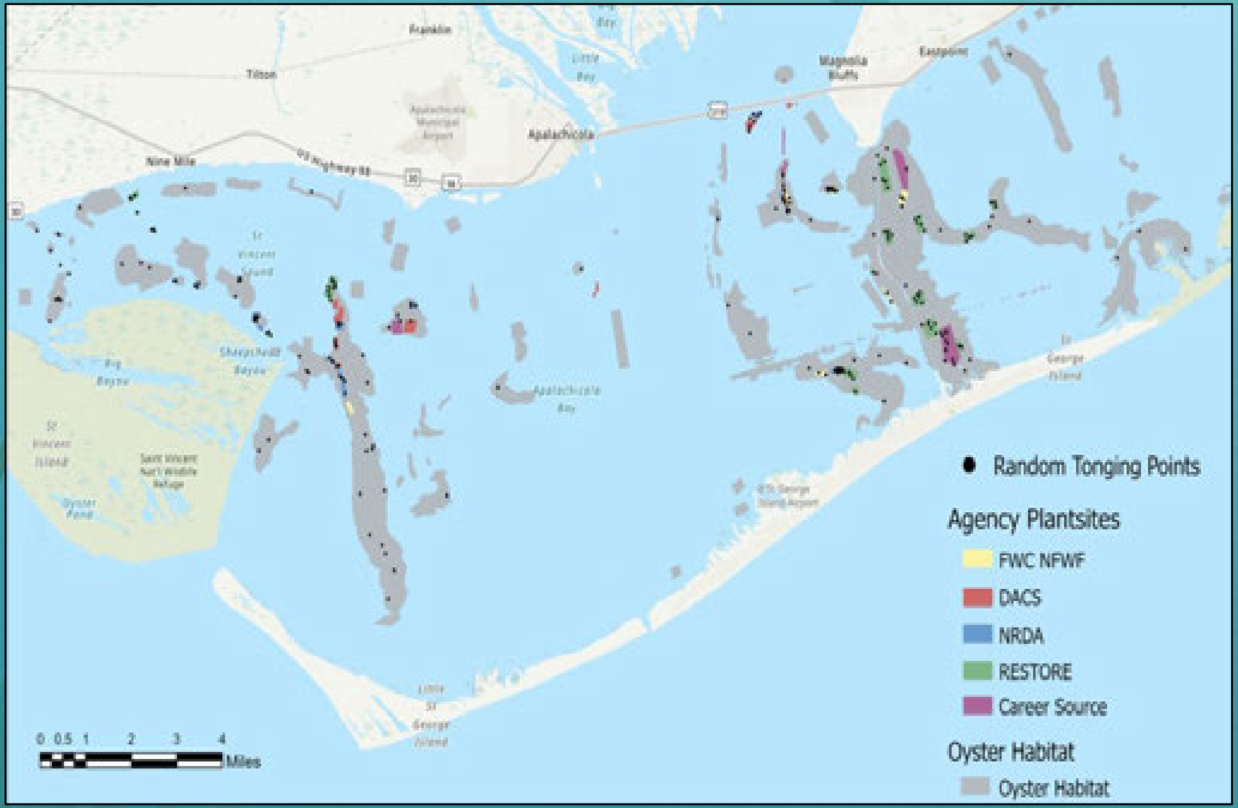
FLDEP RESTORE Act project
2017: Deployed 317 acres limestone
Round 3: Spring 2021

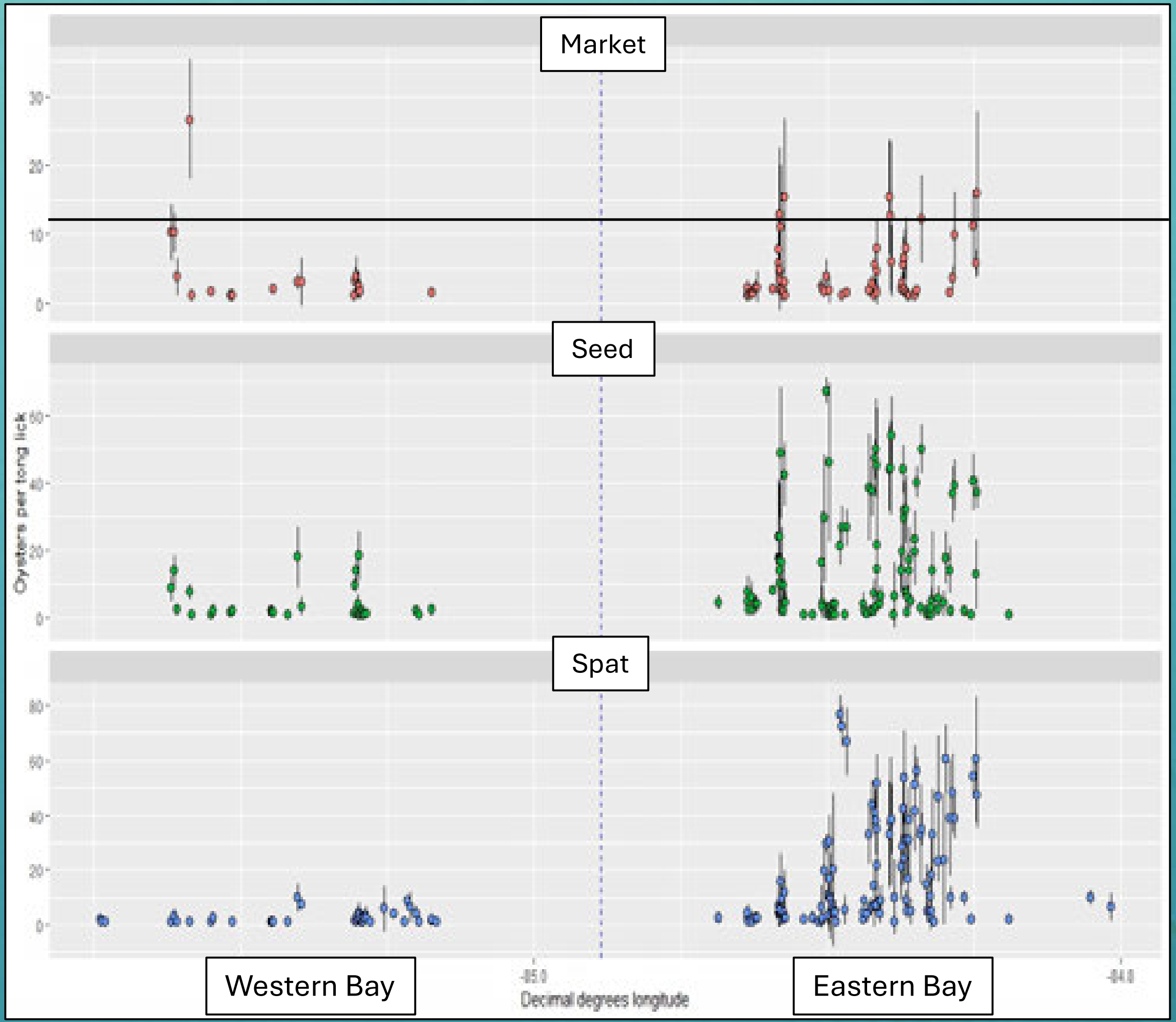
Site	Bags/acre
8-Mile	175
9-mile	5
Cabbage Top	34
Cat Point	98
Cat Point Spur	**441**
East Hole 1	31
East Hole 2	2
Hotel Bar 1	5
Hotel Bar 2	29
King 9-mile	82
Monkey's Elbow	285
North Spur 2	0
Peanut Ridge	**403**
South Bulkhead	**652**

FLDEP NRDA project
2015: Deployed 124 acres fossil shell
Sampled Fall 2021

Site	Bags/acre
Bayou Flats	24
Cabbage Lumps	14
Cabbage Top	0
Cat Point	5
Dry Bar	0
Eleven Mile North	5
Eleven Mile South	19
Green Point	0
Hotel Bar	0
Lighthouse	17
Little Gully	0
Norman's Bar Middle	10
Norman's Bar North	22
North Spur	0
Redfish Creek 1	5
Redfish Creek 2	5

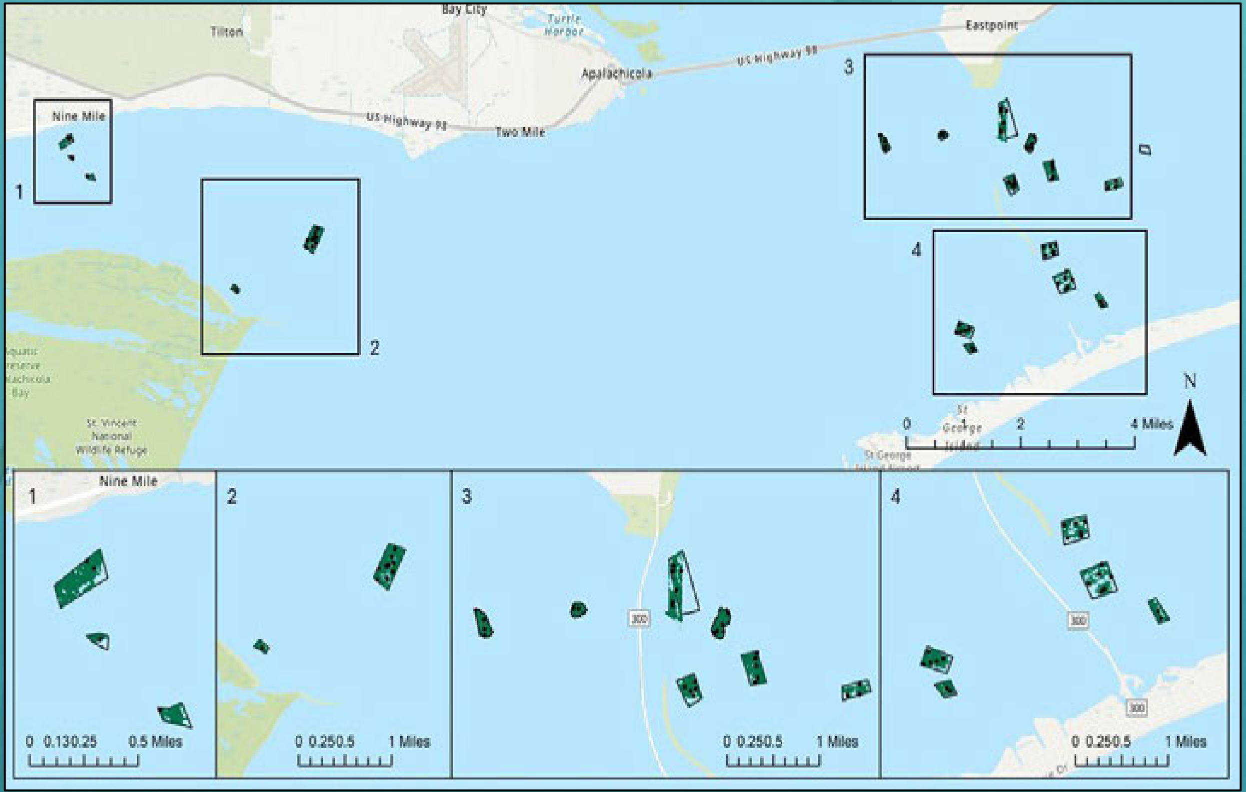
Round 3 Bay-Wide Monitoring
Jan-Mar 2023
227 sites

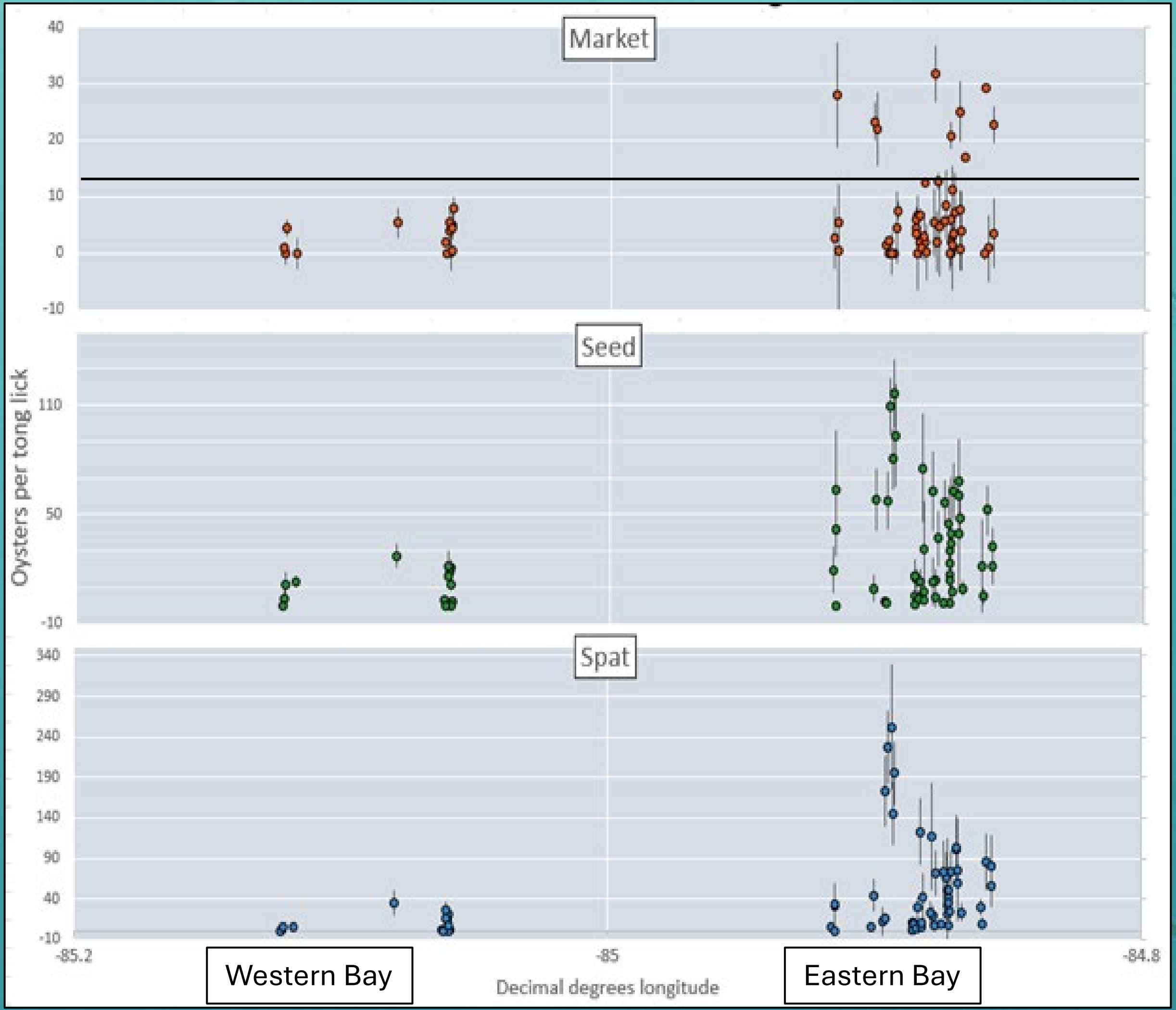




7 sites reached harvestable threshold

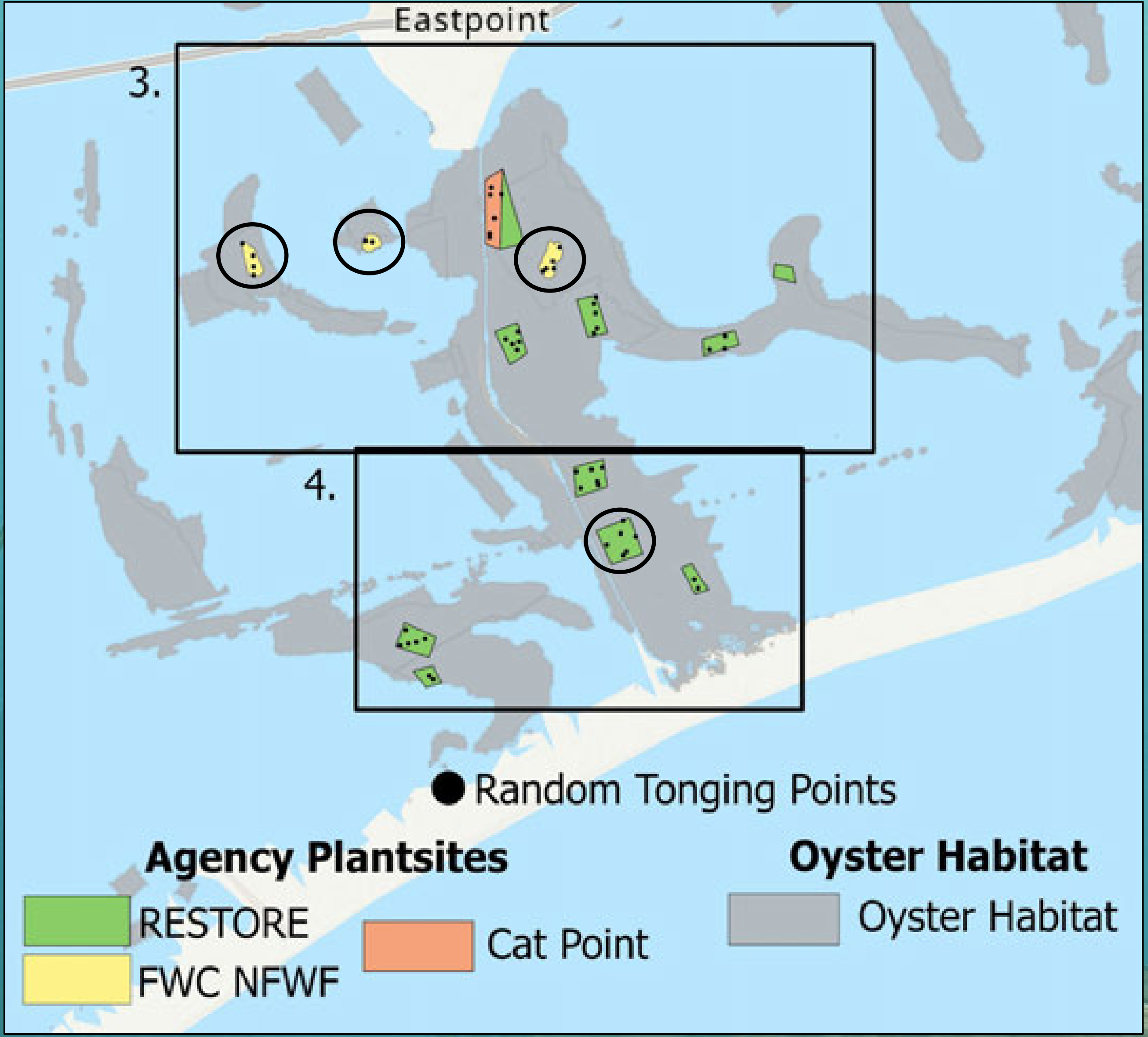
Round 4: Focused on limerock areas
Jan-Mar 2024
66 sites





12 sites reached harvestable threshold

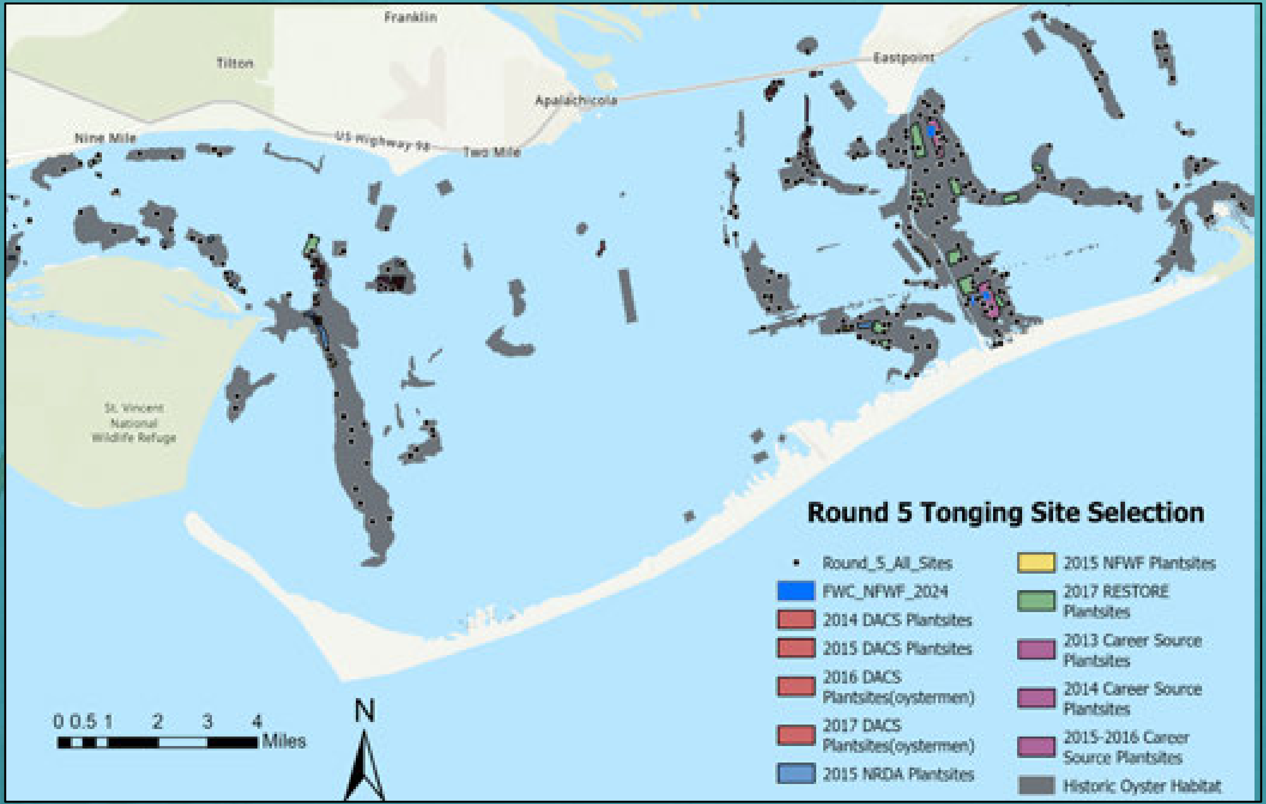
Four areas have average >400 bags/acre

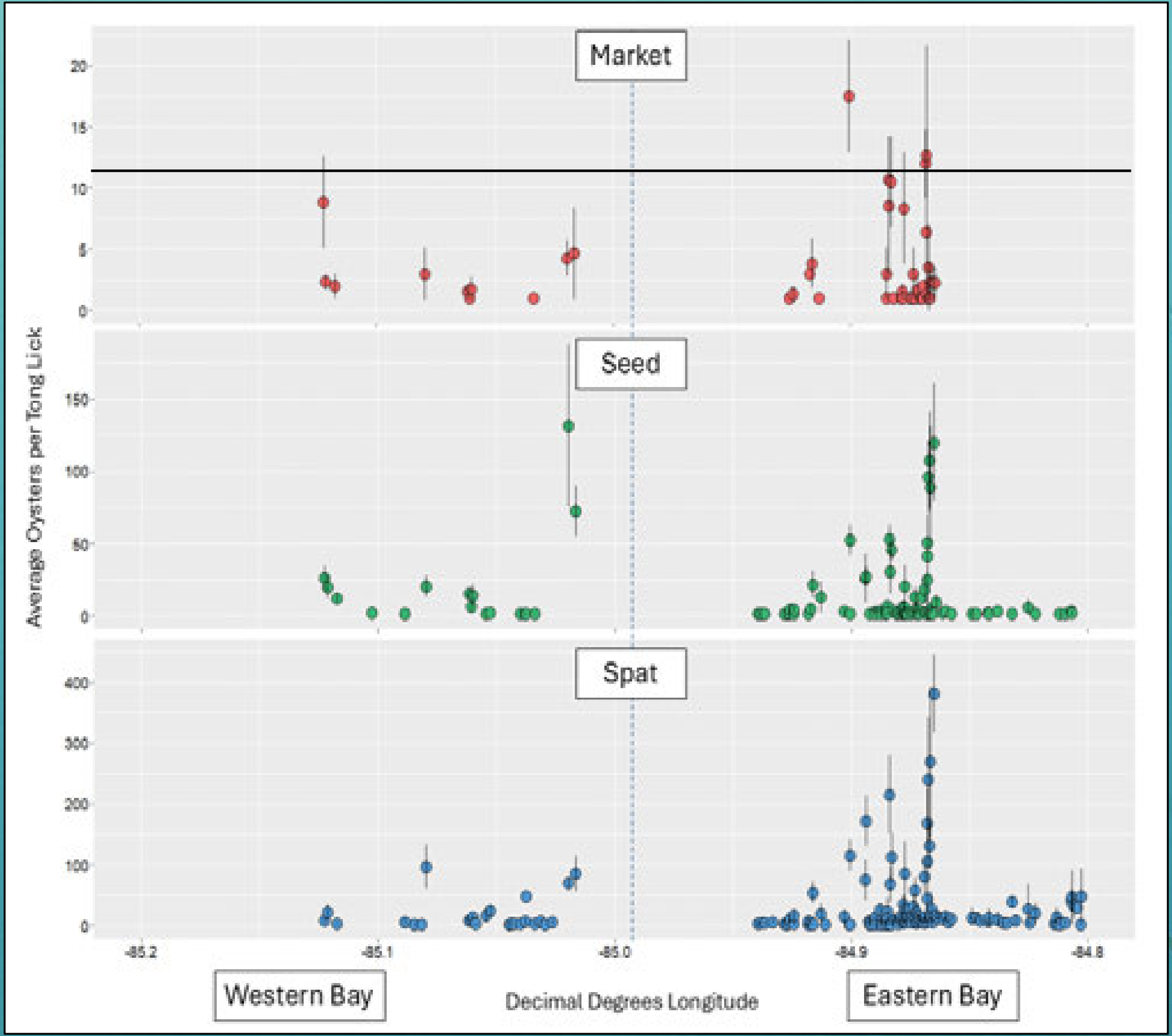


Hard-bottom area, average bags/acre and total bags per area based on averages

Reef (West-East)	Acres hard-bottom	Average bags/acre	Total bags available
8M	12	18	216
9MK	1	192	192
9M	4	156	624
CT	5	180	900
NS	36	113	4,068
LHN	**15**	**448**	**6,720**
ELN	**9**	**450**	**4,050**
HB1	21	48	1,008
HB2	10	171	1,710
CP	38	130	4,940
ME	20	161	3,220
CPN	**18**	**480**	**8,640**
PR	25	209	5,225
SB	18	237	4,266
EH1	**25**	**497**	**12,425**
EH2	11	24	264
CPS	12	379	4,548
Total	**280**		**63,016**

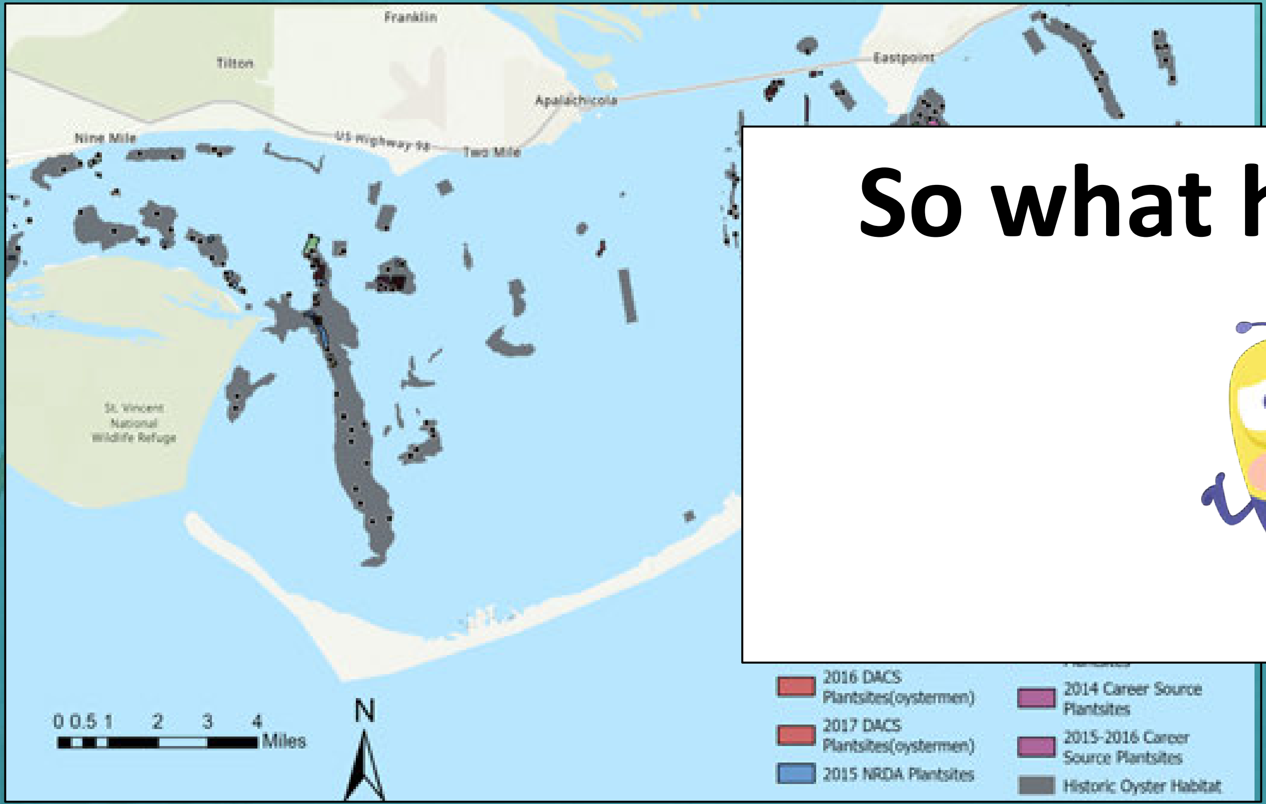
Round 5: Bay-wide monitoring
Jan-April 2025
185 sites

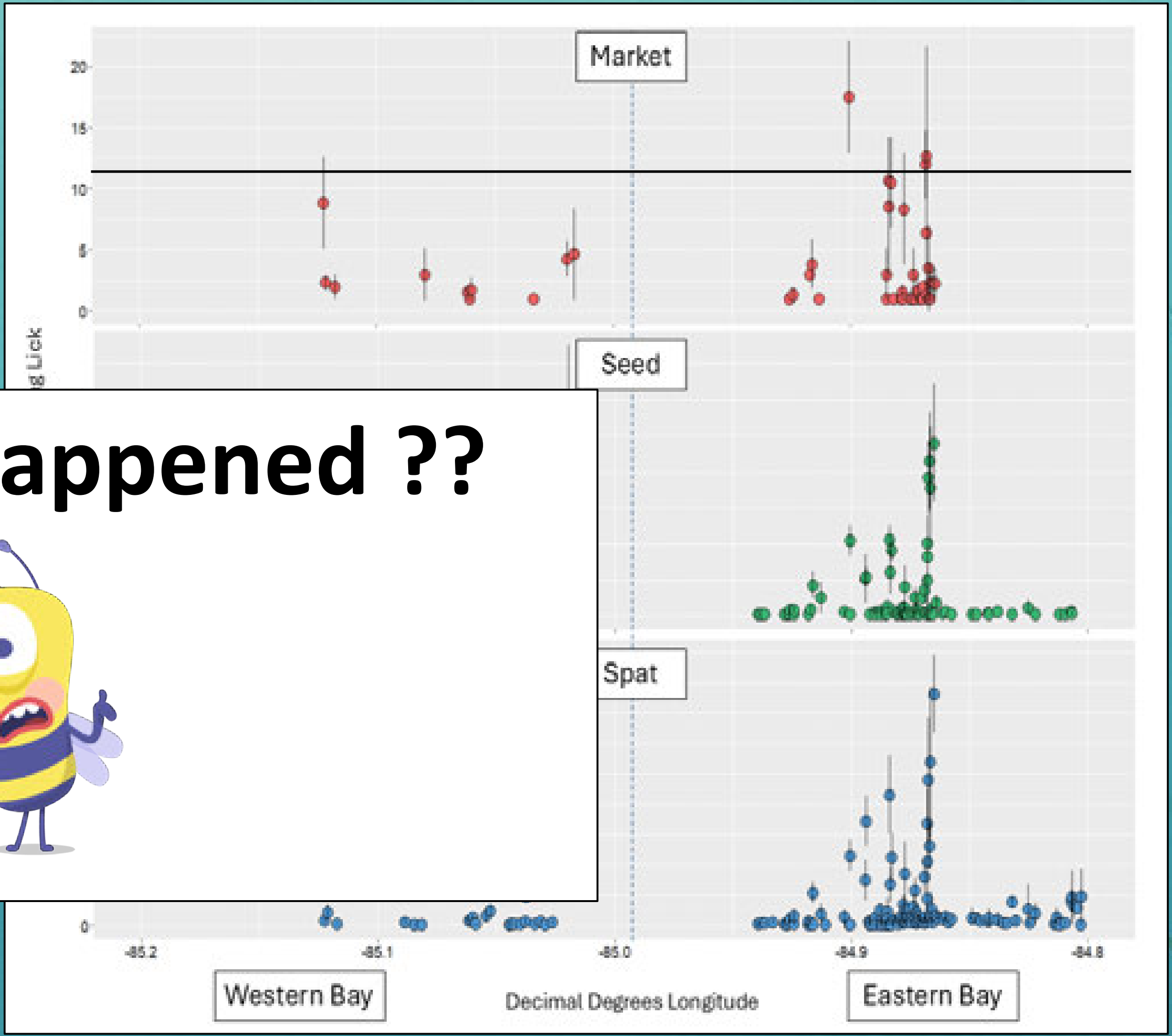




2 sites reached harvestable threshold

Round 5: Bay-wide monitoring
Jan-April 2025
185 sites



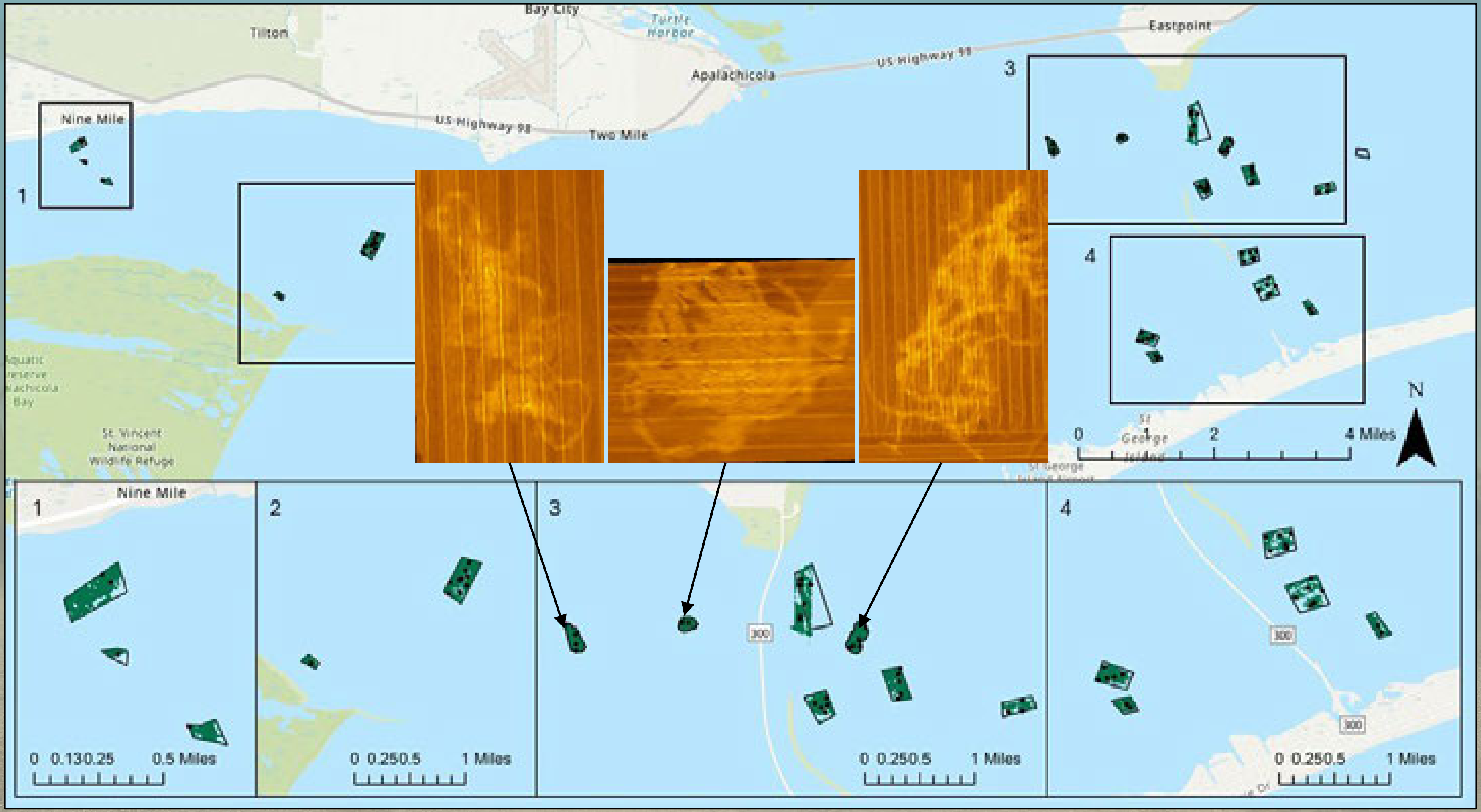


So what happened ??

2 sites reached harvestable threshold

Challenges of oyster population monitoring

- Habitat heterogeneity
- Spatial and temporal mortality
- Spatial and temporal variability in population drivers
- Timing of monitoring and analysis prior to harvest
- Methods matter!



Takeaway messages

- Oyster populations are increasing but their status is fragile
- Limerock is the only material that consistently supports oyster growth
- Extensive restoration is required
- Monitoring is needed to support management
- Adaptive management is needed to sustain fishery
- Re-shelling is essential part of fishery management

QUESTIONS?

FOR ADDITIONAL INFORMATION:

ABSI website: https://marinelab.fsu.edu/absi/
ABSI email: fsucml-absi@fsu.edu

Evaluating Experimental Materials in Restoration of Highly Degraded Oyster Habitat in Apalachicola Bay, Florida

Natalie Horn, Emily Fuqua, Shannon Hartsfield, Sandra Brooke

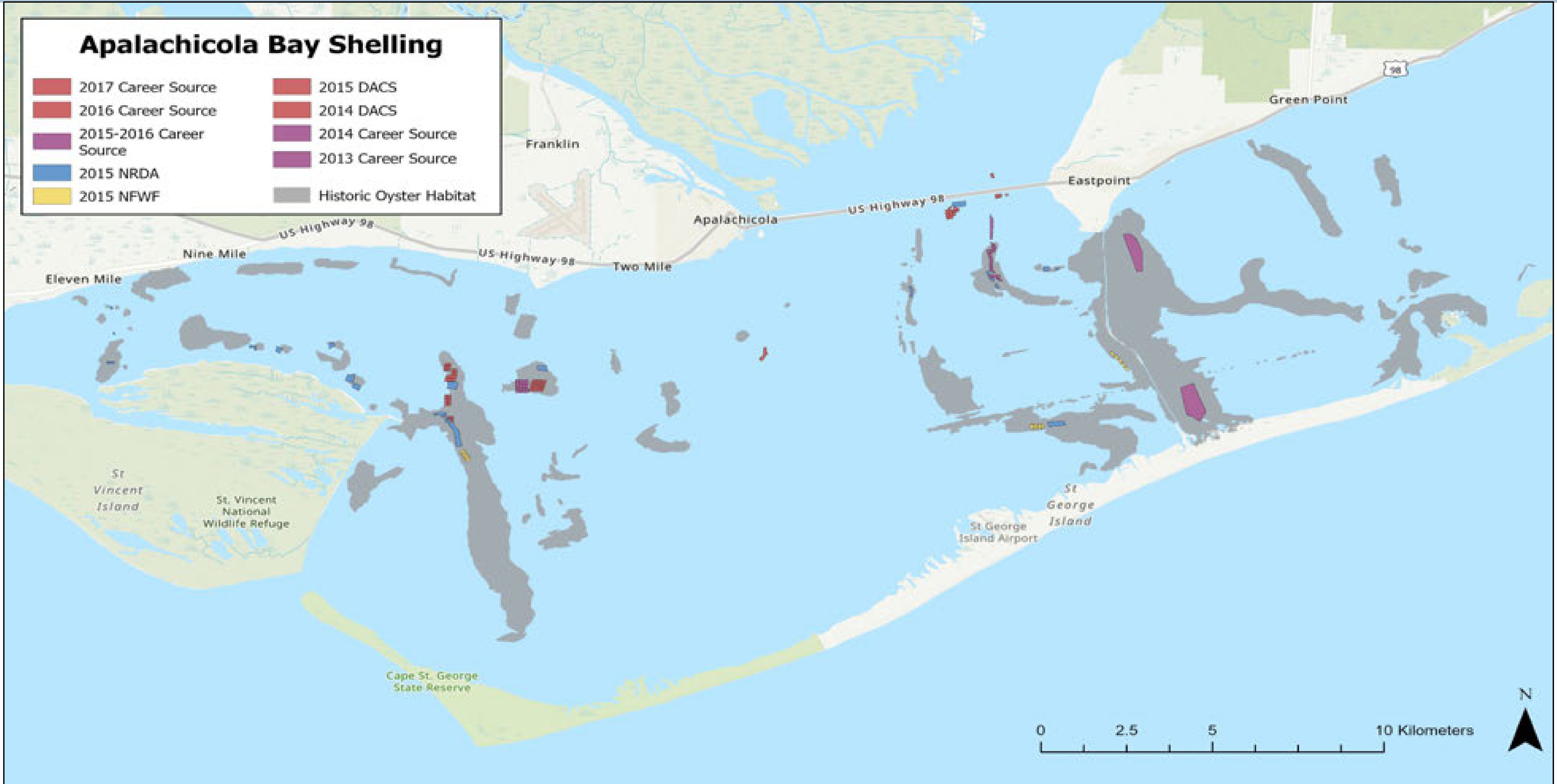
Florida State University's Coastal and Marine Laboratory

nh23l@fsu.edu

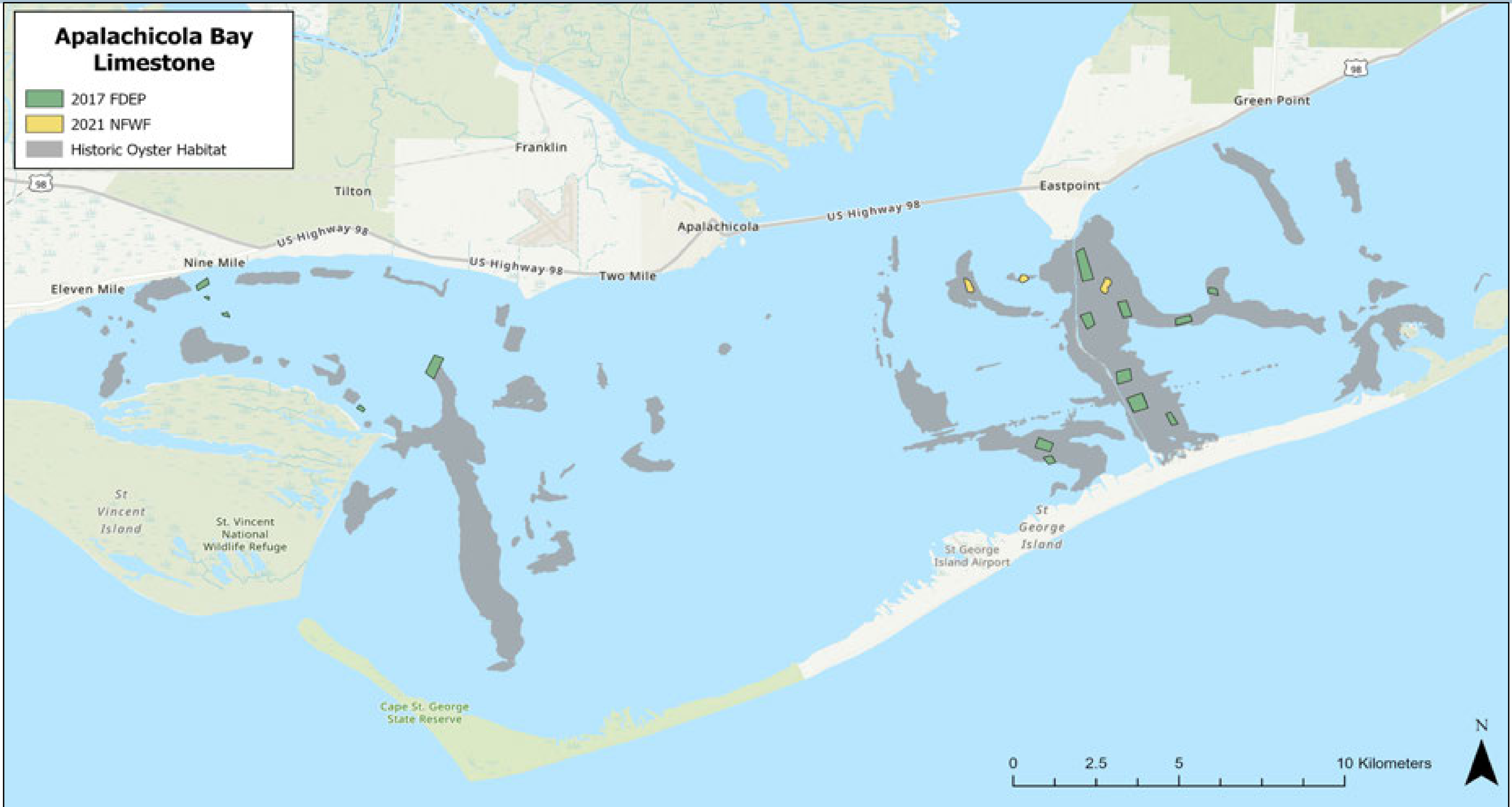
Oyster Harvesting

- Apalachicola Bay produced 90% of oysters for human consumption in Florida and 10% of oysters in the US
- 2012 fishery collapse
- 2020 commercial fishery closure

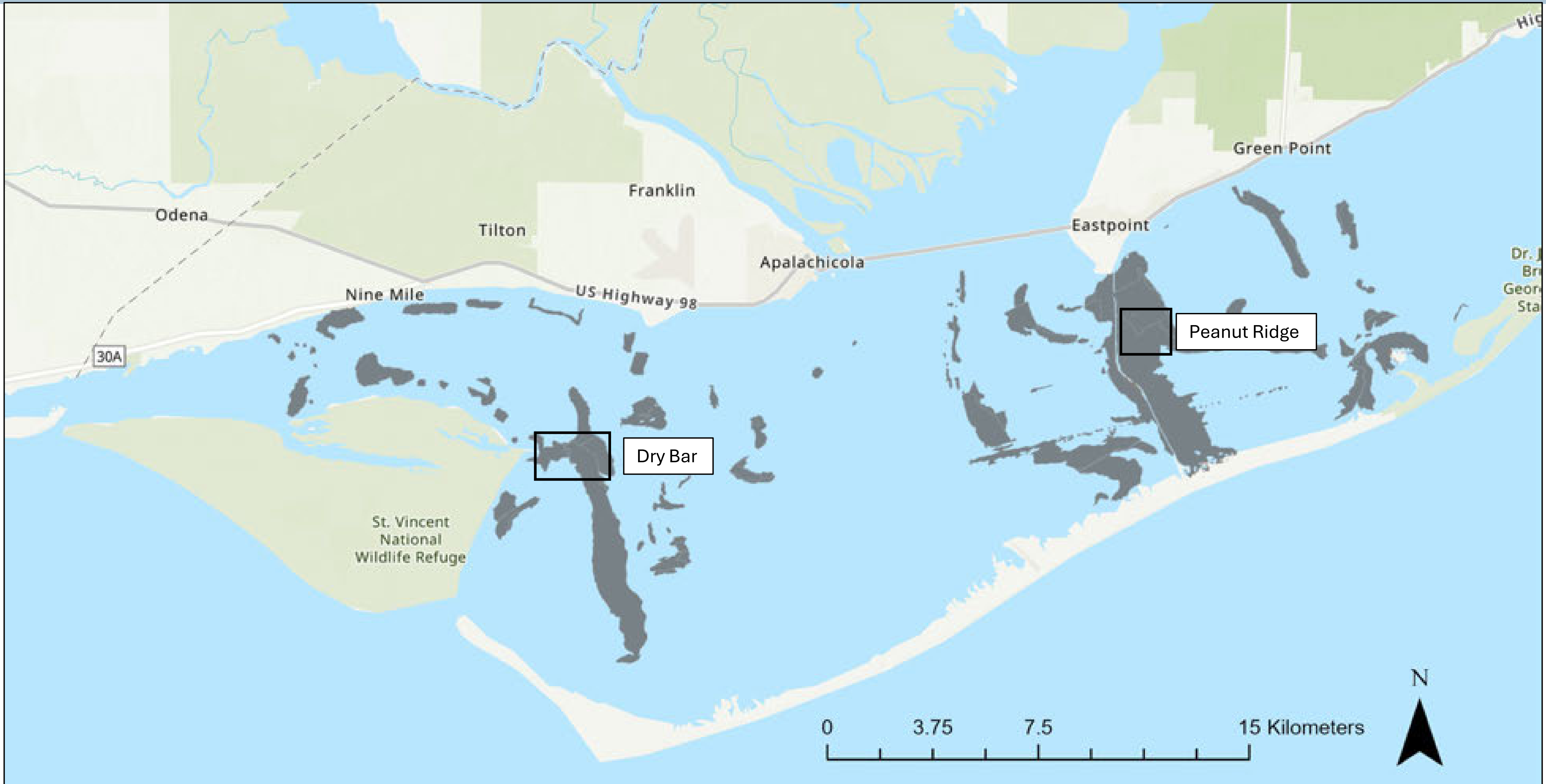
Background – Shelling Programs



Background – Limestone Restoration



Experiment I - Sites



Experiment I - Introduction

Objectives:

- Construct elevated reefs
- Test previously used restoration materials
- Monitor oyster growth and abundance
- Monitor persistence and composition of material over time

Experiment I - Materials

Cured Oyster Shell

Small Limestone
8 cm

Large Limestone
13-18 cm

Experiment I - Deployment

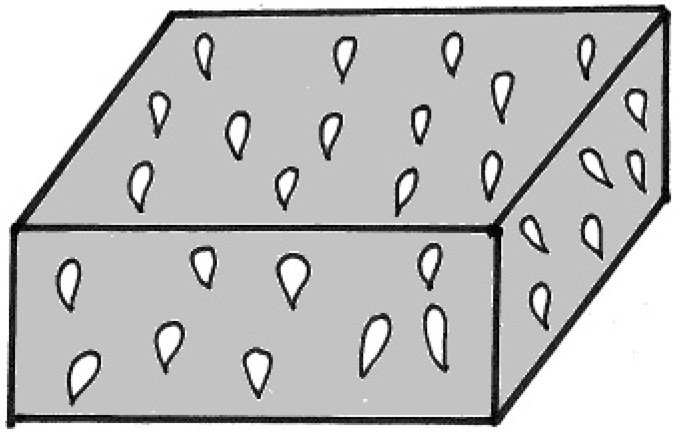
May to June 2021

30 reefs created

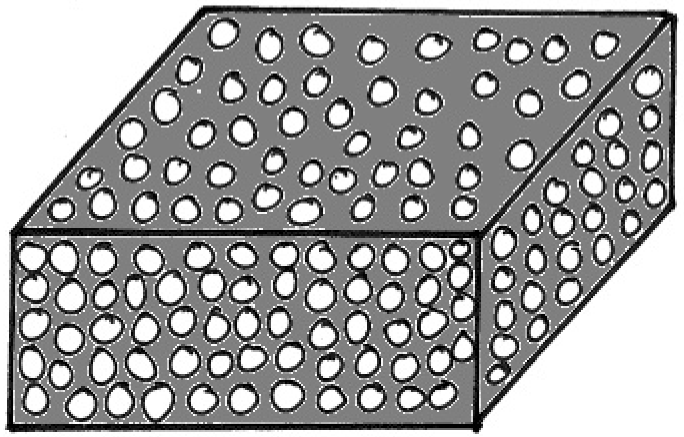
Experimental Design I - Materials

Reefs contained ~38 m^3 of material

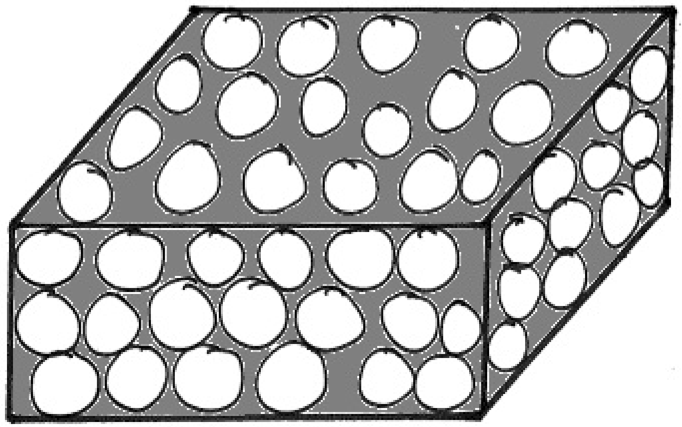
9 x 9 x 0.45 m



Cured Oyster Shell

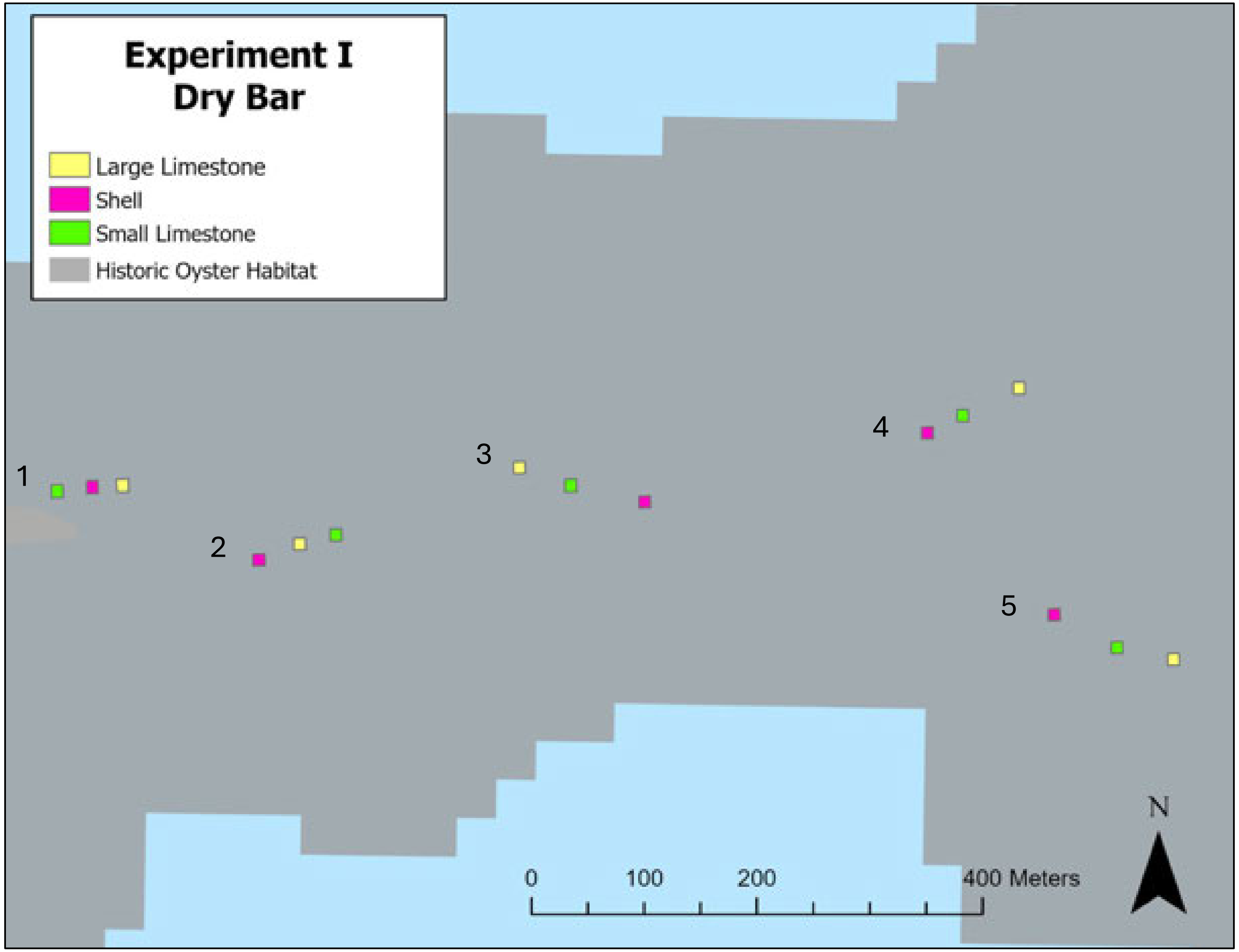


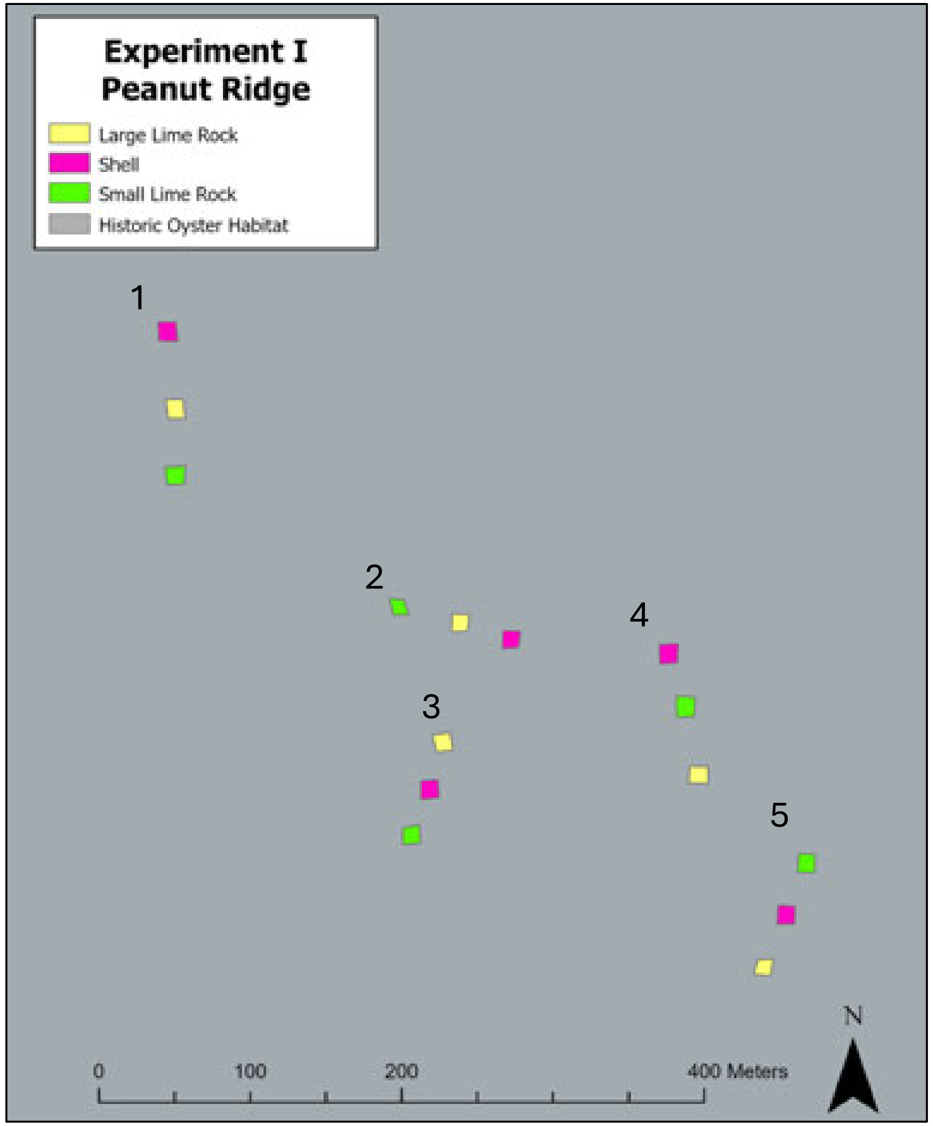
Small Limestone
8 cm



Large Limestone
13-18 cm

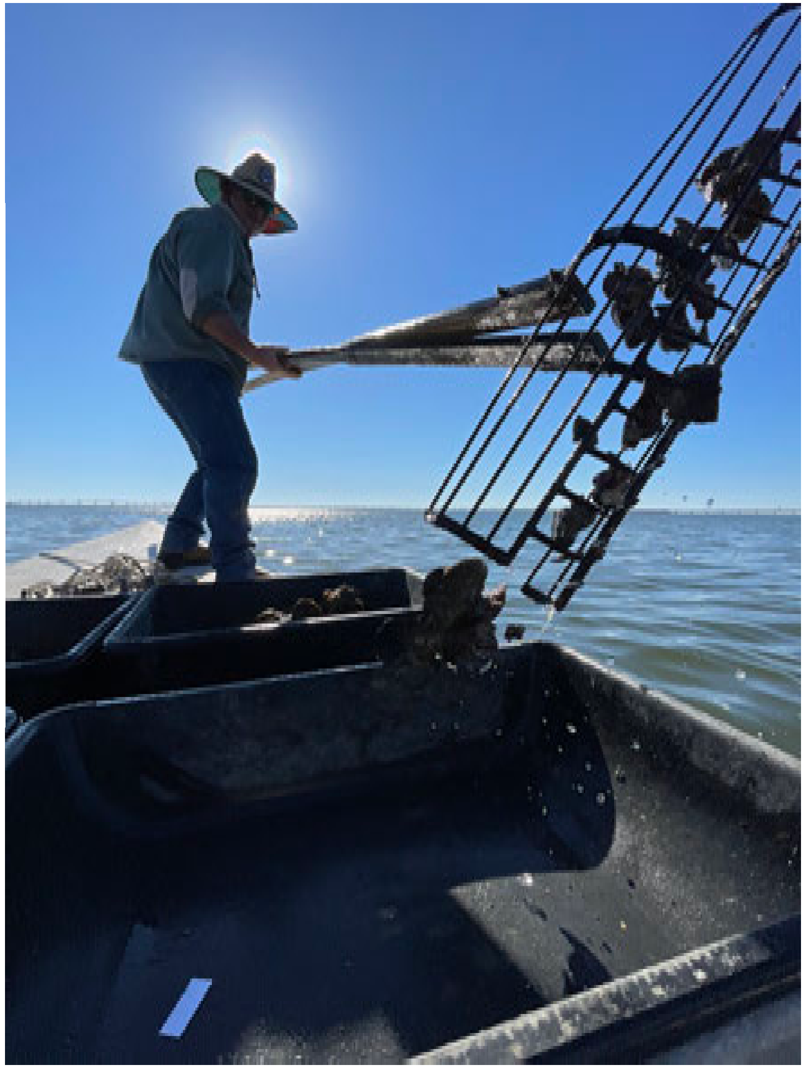
Experiment I - Study Area





Experiment I- Sampling Methodology

Sample Date	Reef Site	Monitoring Method
Spring 2022	Dry Bar, Peanut Ridge	Hand Tonging
Fall 2022	Dry Bar, Peanut Ridge	Hand Tonging
Fall 2023	Dry Bar, Peanut Ridge	Hand Tonging
Spring 2024	Dry Bar, Peanut Ridge	Hand Tonging
Fall 2025	Dry Bar, Peanut Ridge	Hand Tonging



Hand Tonging

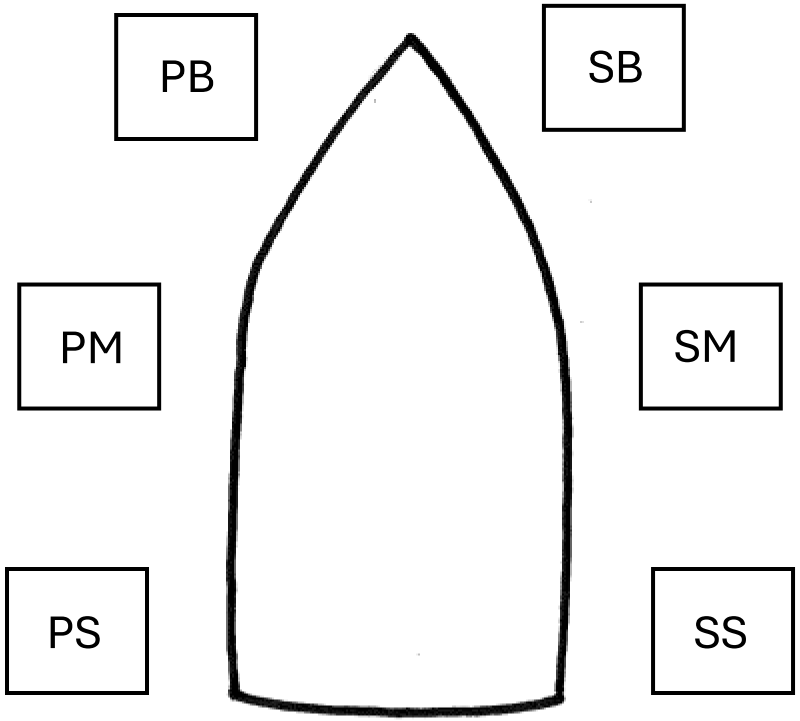
- Long wooden handles (~14 feet long)
- Metal head with many teeth
  - Break apart oyster clumps
  - Work into the substrate



Hand Tonging

It is HARD

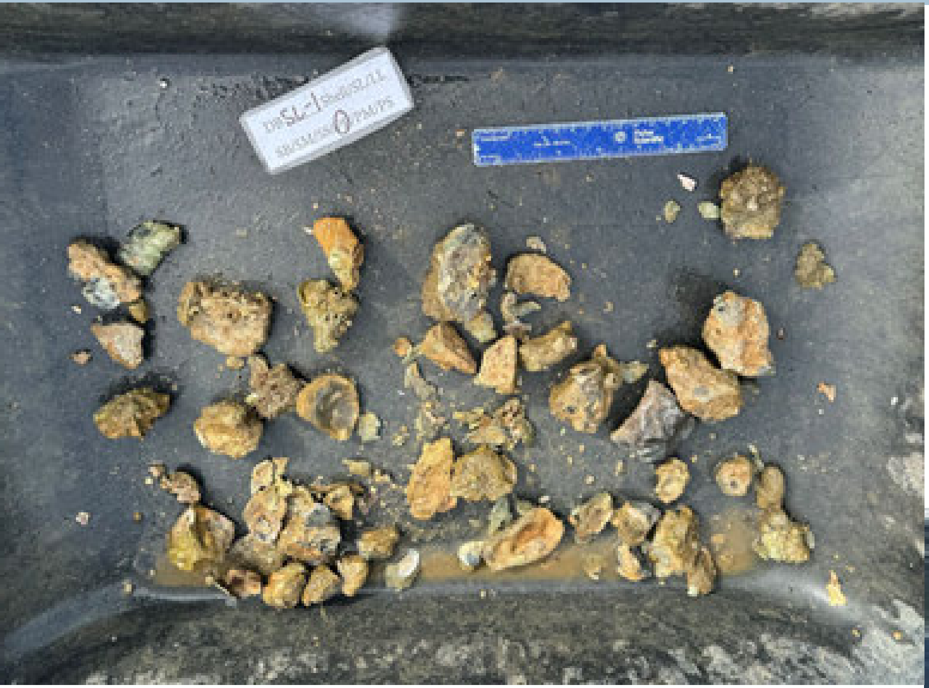
Experiment I- Sampling Methodology



- Six subsamples were taken at each reef
- Mass (kg) and Volume (L)
- Live and dead oyster shell height (mm)
- Sample photos taken to monitor material composition and persistence

Experiment I- Results

Dry Bar



Small Limestone

Large Limestone

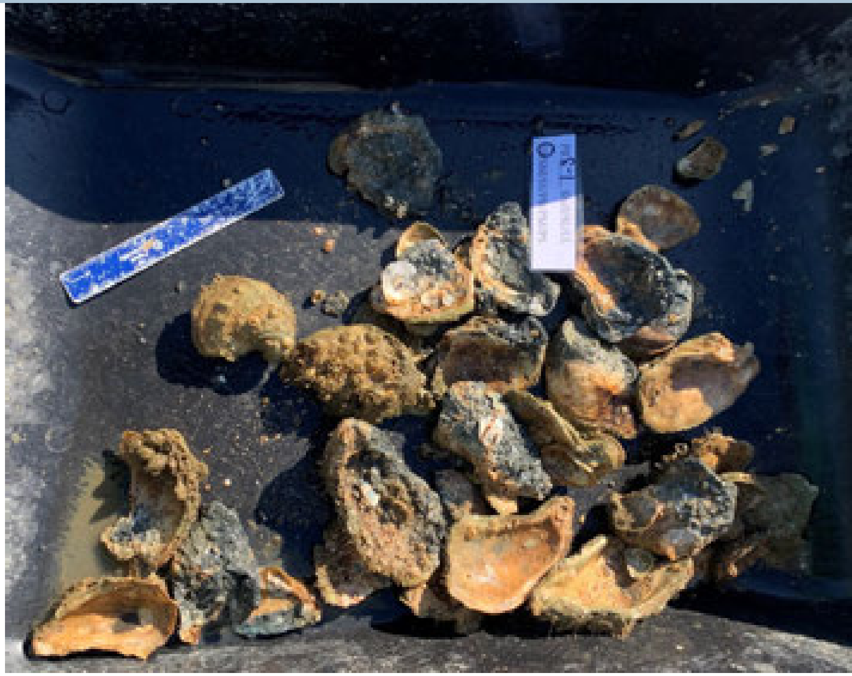
Shell

Experiment I- Results

Peanut Ridge

Small Limestone

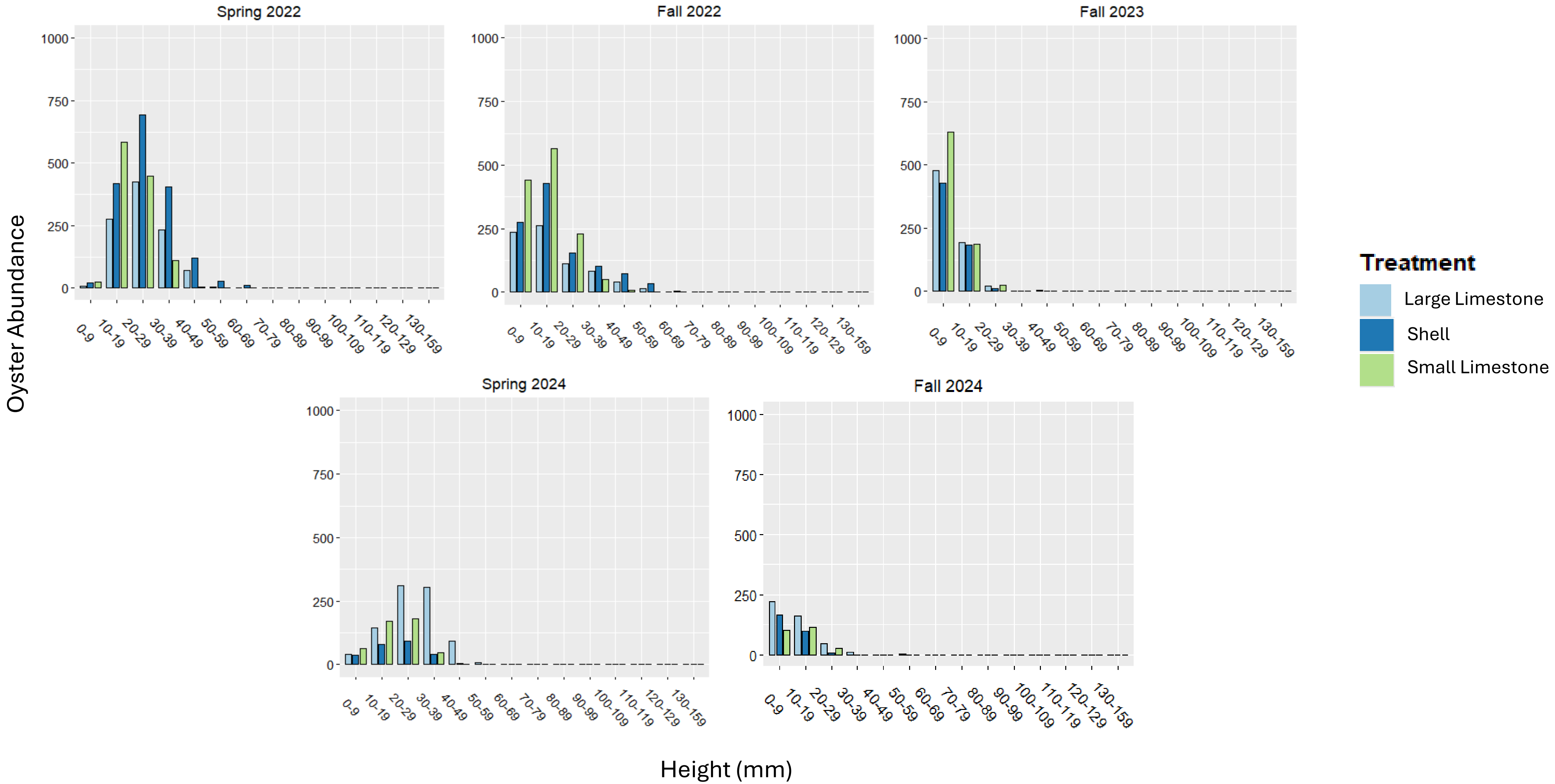
Large Limestone



Shell

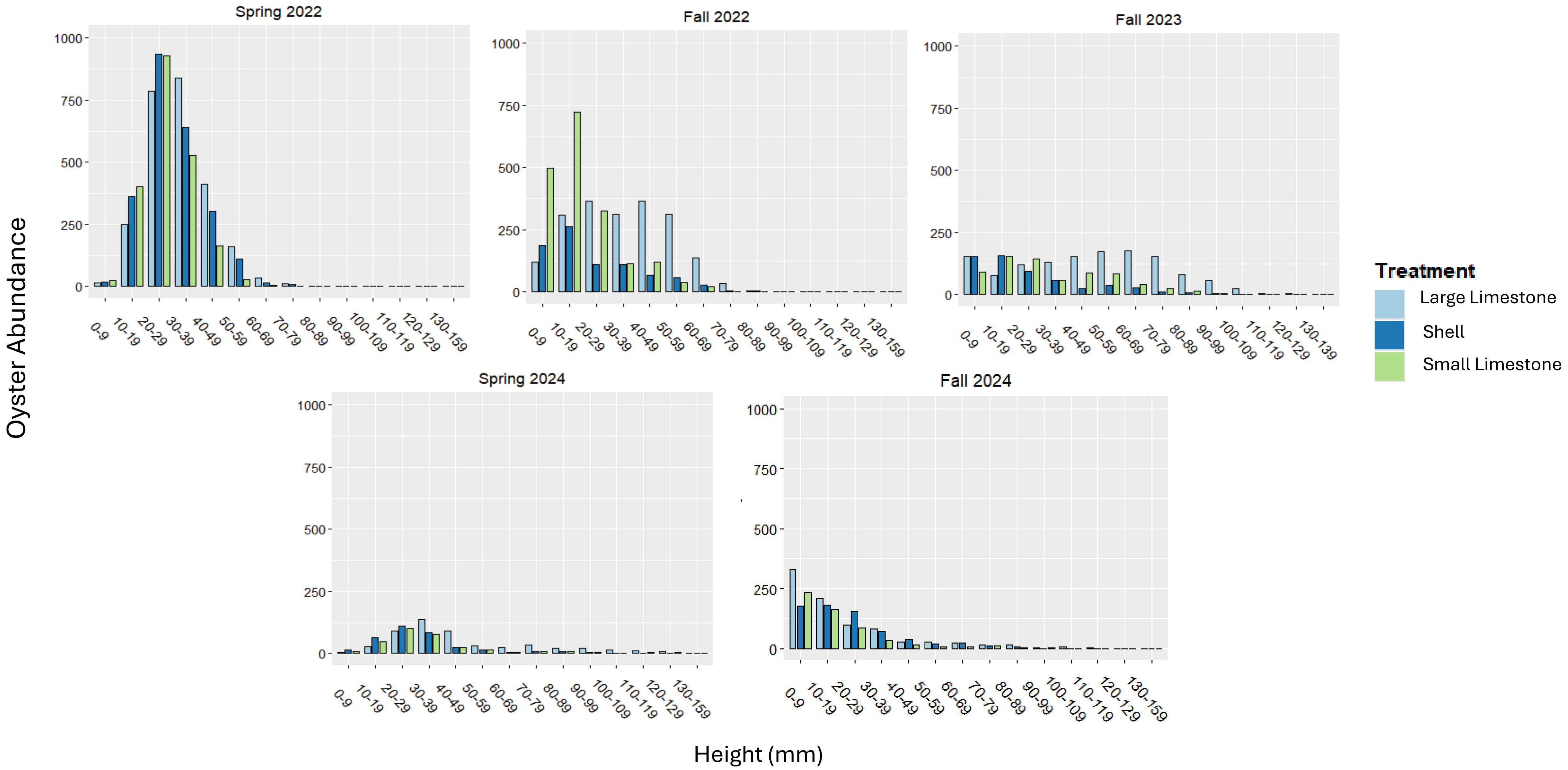
Experiment I- Results

Dry Bar



Experiment I- Results

Peanut Ridge



Experiment I- Take Aways

Site had a significant effect on live oyster density (G_{15} = -17.7, $P << 0.001$)

- Peanut Ridge had a mean of 17.1 live oysters L^{-1} (± 11.2)
- Dry Bar averaged 10.9 live oyster L^{-1} (± 9.2)

Peanut Ridge

Treatment	Average Abundance	Average Size
Large Limestone	13.8 live oysters L^{-1} (± 5.8)	30.5 mm (± 13.4)
Small Limestone	22.0 live oysters L^{-1} (± 16.6)	21.1 mm (± 6.4).
Shell	16.0 live oysters L^{-1} (± 7.6)	24.3 mm (± 7.9)

Experiment I- Take Aways

Site had a significant effect on live oyster density (G_{15} = -17.7, P << 0.001)

- Peanut Ridge had a mean of 17.1 live oysters L^{-1} (± 11.2)
- Dry Bar averaged 10.9 live oyster L^{-1} (± 9.2)

Peanut Ridge

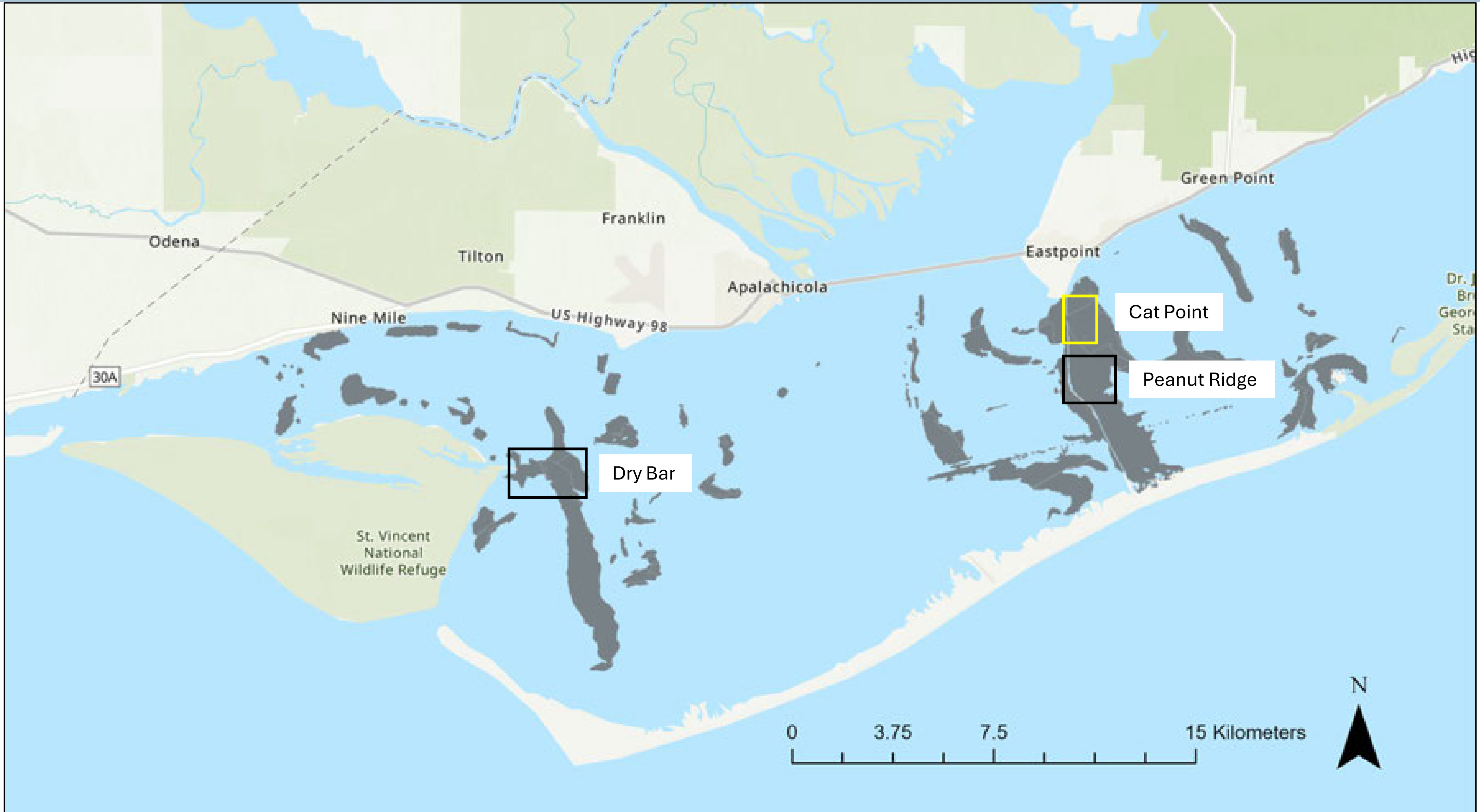
Treatment	Average Abundance	Average Size
Large Limestone	13.8 live oysters L^{-1} (± 5.8)	30.5 mm (± 13.4)
Small Limestone	22.0 live oysters L^{-1} (± 16.6)	21.1 mm (± 6.4).
Shell	16.0 live oysters L^{-1} (± 7.6)	24.3 mm (± 7.9)

Experiment II- Introduction

Objectives:

- Evaluate study site success
- Compare larger sized materials with and without presence of oyster shells
- Cost analysis of materials
- Monitor material persistence and composition over time

Experiment II- Introduction



Experiment II- Materials

Concrete
(10-15 cm)

Concrete
Cured Oyster Shell

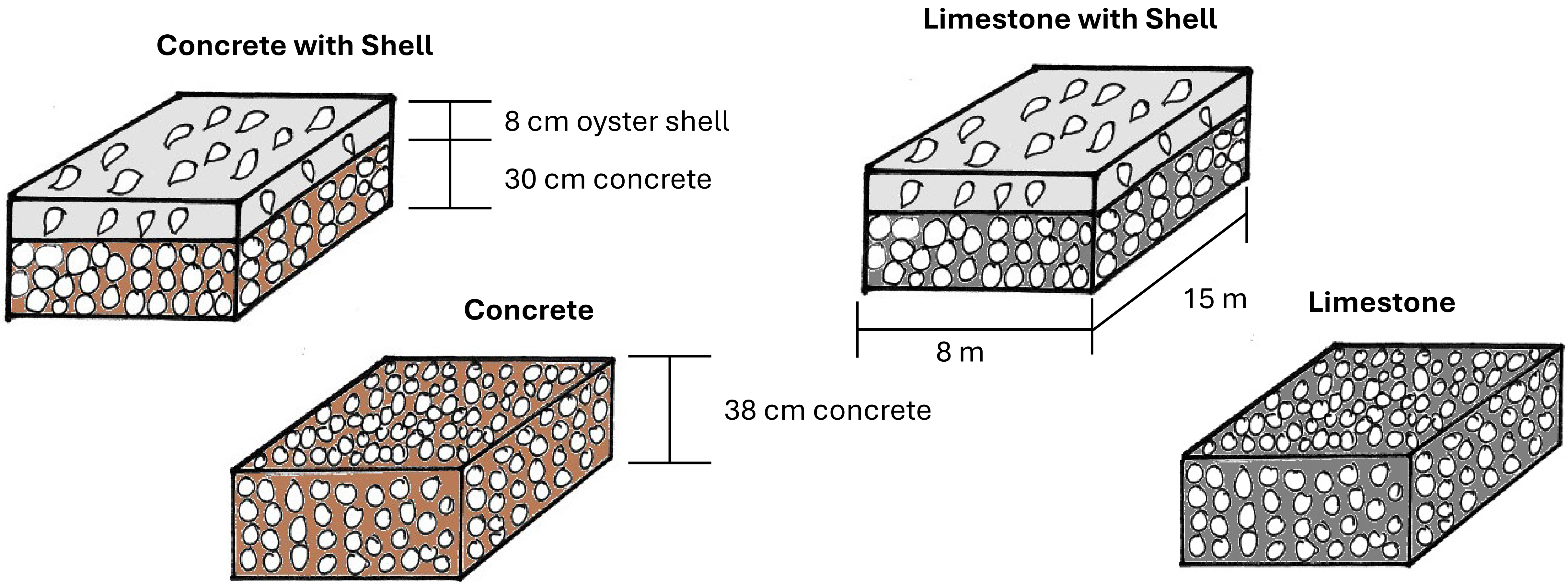
Limestone
(13-18 cm)

Limestone
Cured Oyster Shell

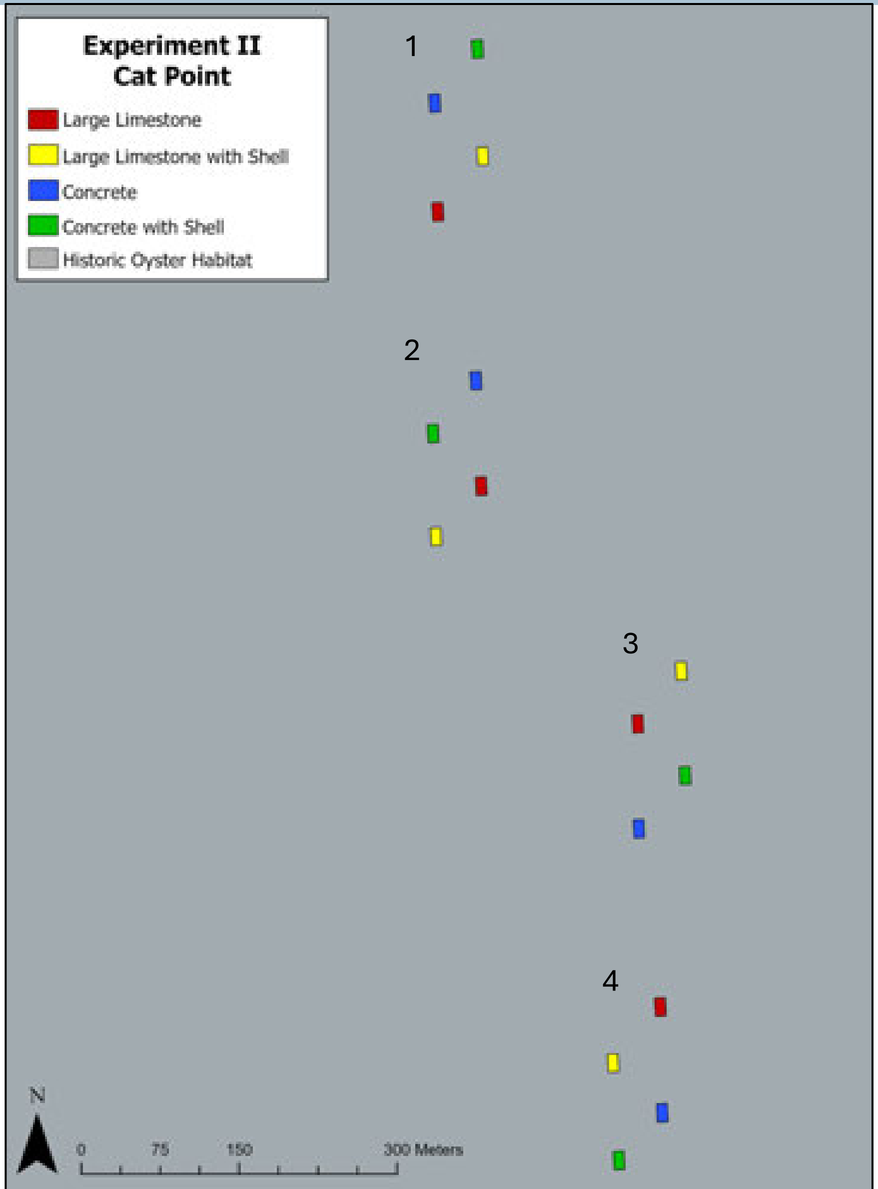
Experiment II- Deployment

April to May 2023
16 Reefs Created

Reefs contained ~46m^3 of material
8 x 15 x 0.38 m



Experiment II- Study Area



Experiment II- Sampling methodology

Sample Date	Reef Site	Monitoring Method
Fall 2023	Cat Point	Hand Tonging
Spring 2024	Cat Point	Hand Tonging
Fall 2025	Cat Point	Hand Tonging
Spring 2025	Cat Point	Hand Tonging
Fall 2025	Cat Point	Hand Tonging

- Six subsamples were taken at each reef
- Mass (kg) and Volume (L)
- Live and dead oyster shell height (mm)
- Sample photos taken to monitor material composition and persistence

Experiment II- Results

Cat Point

Limestone

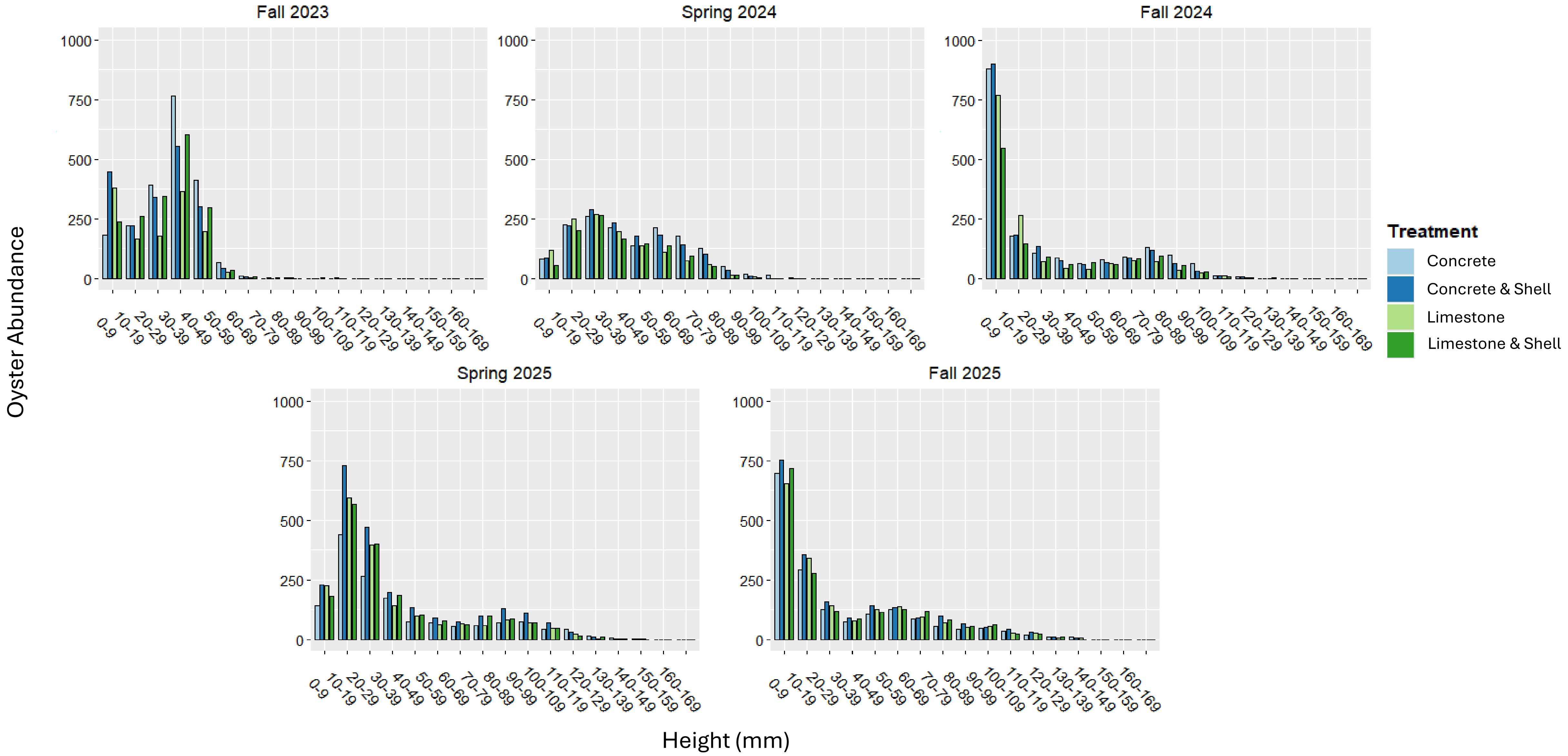
Concrete

Limestone with Shell

Concrete with Shell

Experiment II- Results

Cat Point



Experiment II- Take Aways

Treatment	Average Abundance	Average Size
Limestone	0.93 live oysters (± 0.03)	38.5 mm (± 7.6)
Limestone With Shell	0.93 live oysters (± 0.03)	-
Concrete	0.91 live oysters (± 0.05)	43.3 mm (± 7.1)
Concrete with Shell	0.91 live oysters (± 0.04)	-

Experiment II- Take Aways

Treatment	Average Abundance	Average Size
Limestone	0.93 live oysters (± 0.03)	38.5 mm (± 7.6)
Limestone With Shell	0.93 live oysters (± 0.03)	-
Concrete	0.91 live oysters (± 0.05)	43.3 mm (± 7.1)
Concrete with Shell	0.91 live oysters (± 0.04)	-

Discussion

- Increased material size and height of reef supports oyster growth
  - Creates stable platforms
  - Useful for cost analysis for restoration projects

- Small scale restoration experiments allow for close monitoring

- Experimental reefs function as microhabitat contributing to reproduction and recruitment within the bay

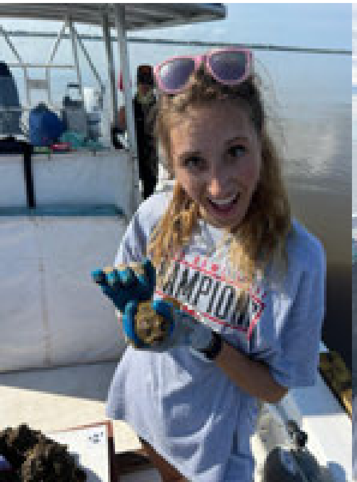
Thank you & Acknowledgements

- ABSI Technicians and Graduate Students over the years

  Current Team: Harrison Clark, Lauren Calvin, Caitlin Turnbull, Grant Walsh and Adin Domen (graduate student)

- FSUCML Staff

- Shannon Hartsfield







Seasonal variations in larval connectivity of *Crassostrea virginica* in Apalachicola Bay, FL

ADAM ALFASSO

FLORIDA STATE UNIVERSITY – EARTH, OCEAN, AND ATMOSPHERIC SCIENCES

FSU COASTAL & MARINE LABORATORY

AALFASSO@FSU.EDU

FLORIDA STATE UNIVERSITY

Crassostrea virginica

The eastern oyster
- Estuarine species

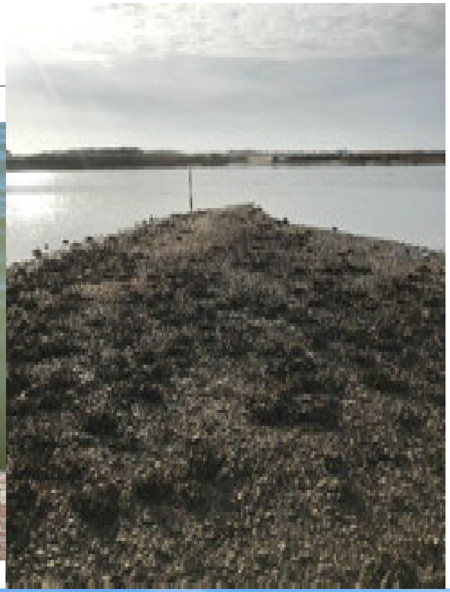
Important reef builder
- Atlantic Coast
- Gulf of Mexico

Stabilize coastlines, improve water quality

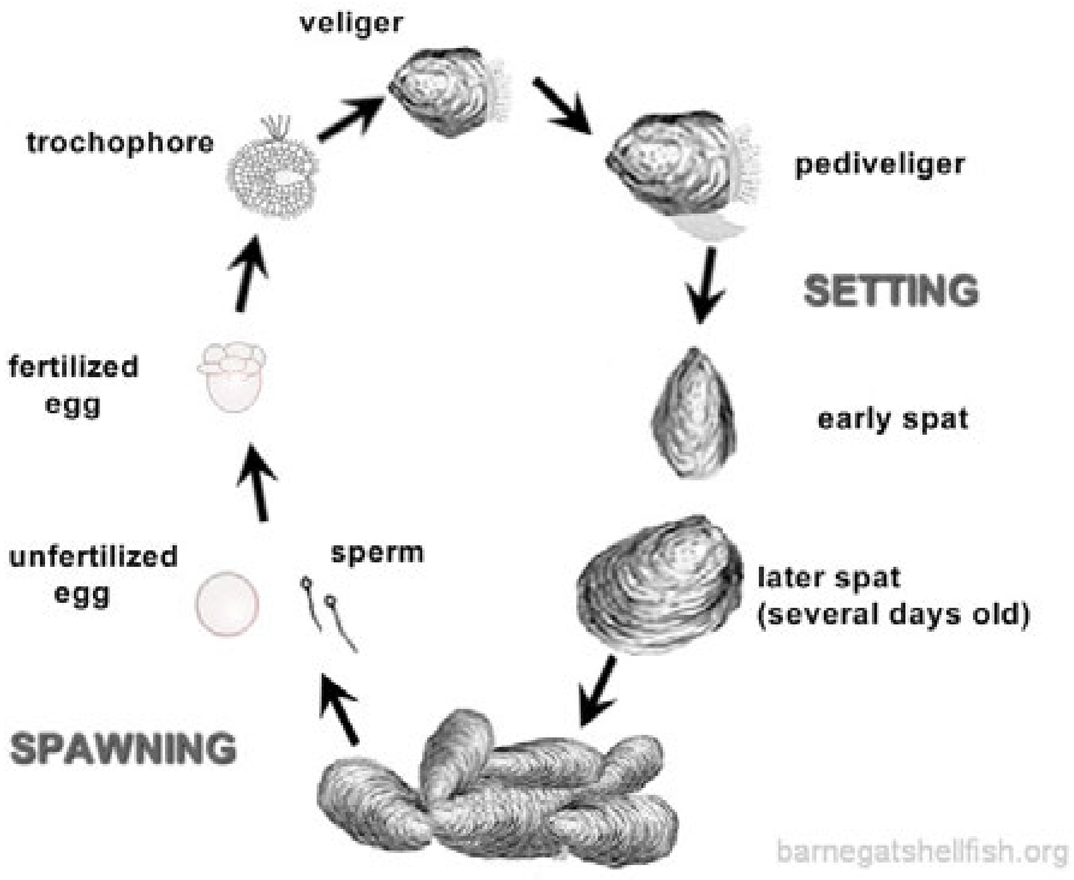
Historical food source & fishery
- One of seven commercially harvested oyster species
- Wild Harvest
- Aquaculture

Complex life cycle

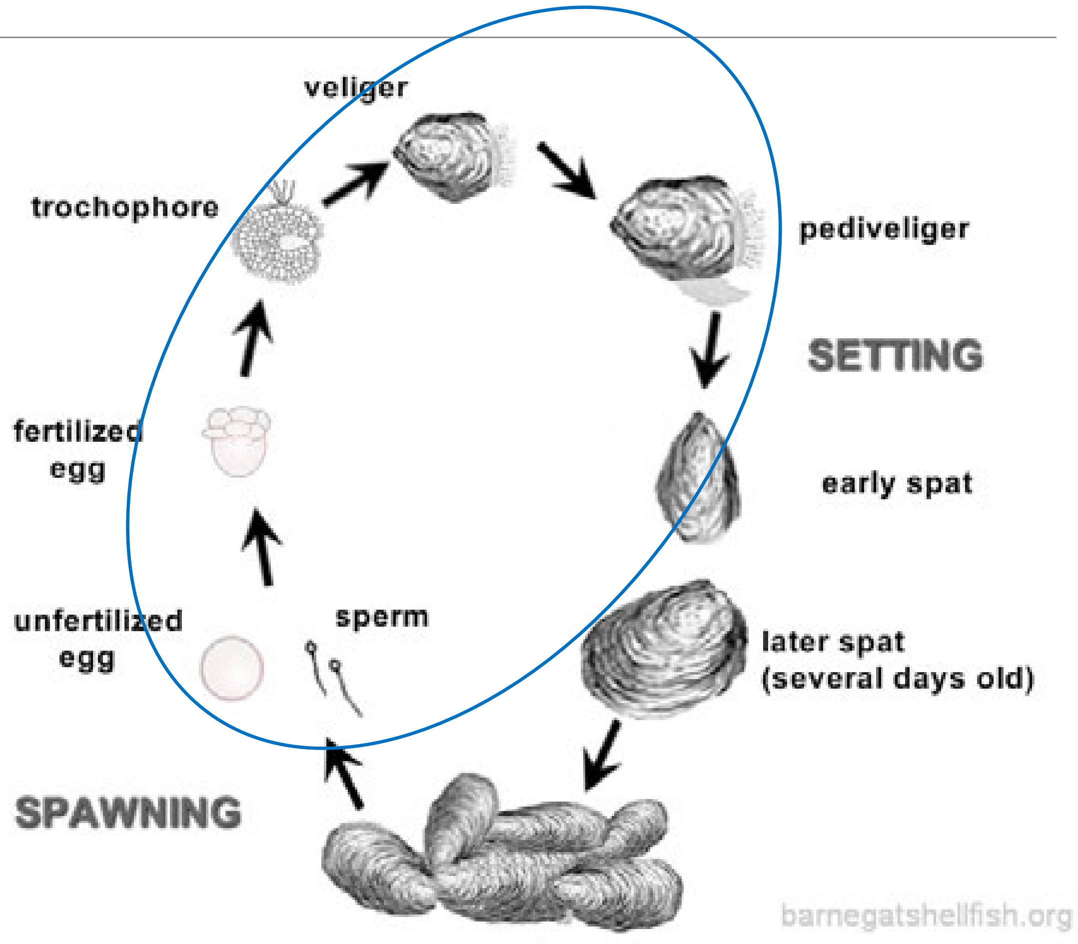
Declining throughout range 85-90%



Larval Dispersal & Distribution



Larval Dispersal & Distribution



Larval Dispersal & Distribution

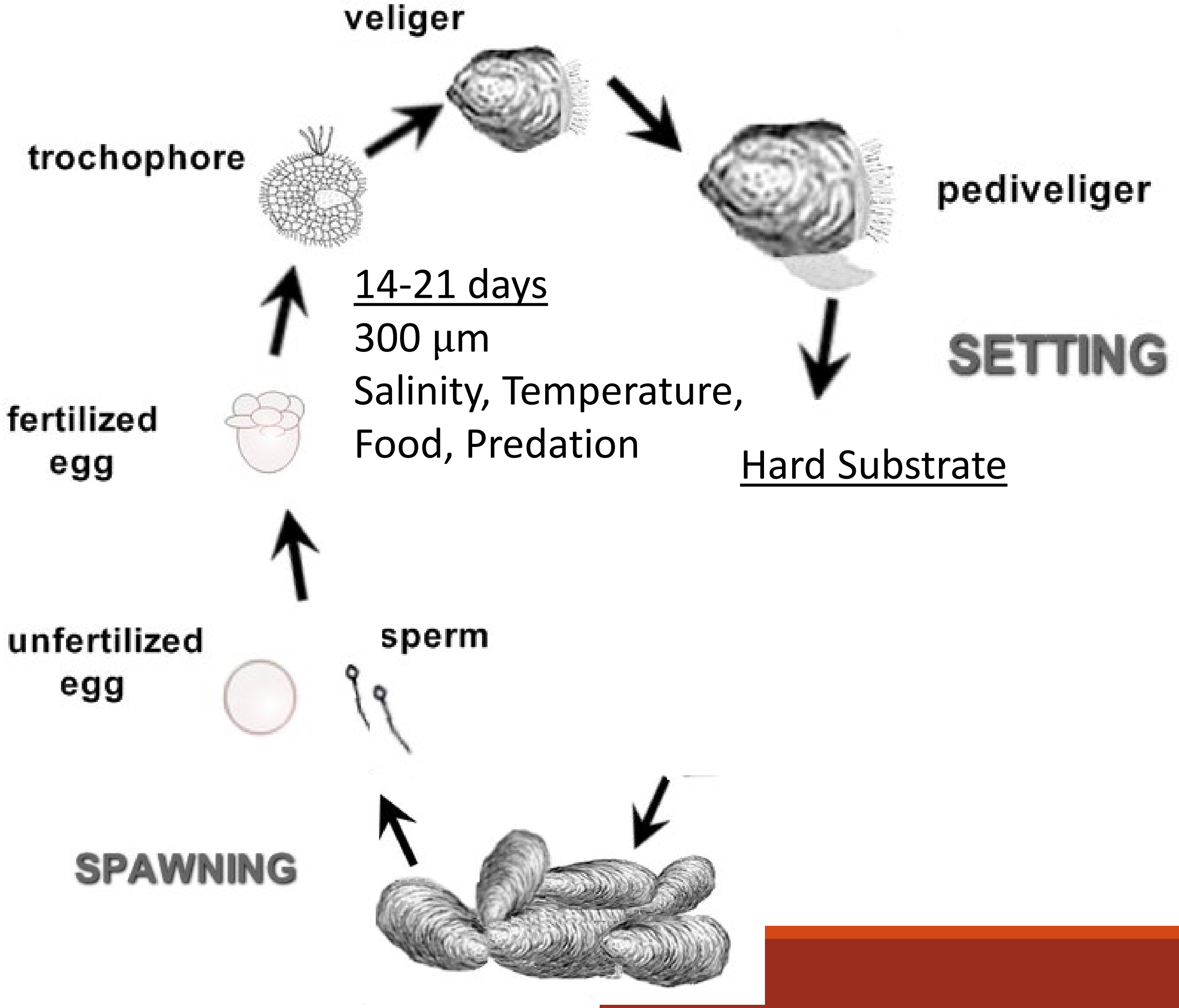
Most mobile, most vulnerable

Spawning behavior

- Broadcast spawn
- Correlated with temperature, changes in seasons

Dispersal

- Planktonic – limited swimming, goes where the water takes it
- Growth and mortality varies with S,T
- Survival requires hard substrate



14-21 days
300 μm
Salinity, Temperature, Food, Predation

Hard Substrate

Larval Dispersal & Distribution

Most mobile, most vulnerable

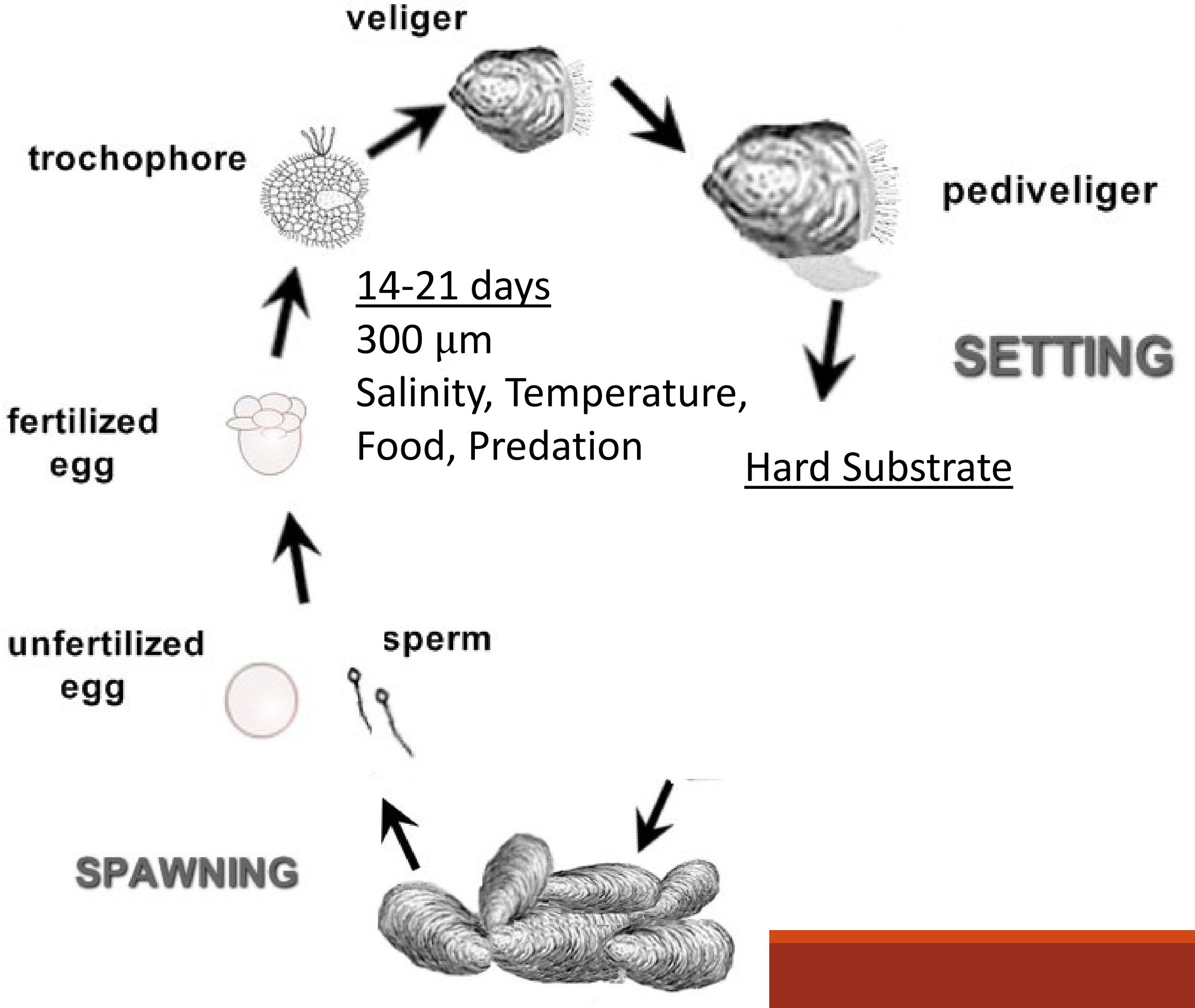
Spawning Behavior

- Broadcast Spawn
- Correlated with temperature, changes in seasons

Dispersal

- Planktonic- limited swimming, goes where water takes it
- Growth and mortality varies with S,T
- Survival requires hard substrate

Environment influences larval growth and survival

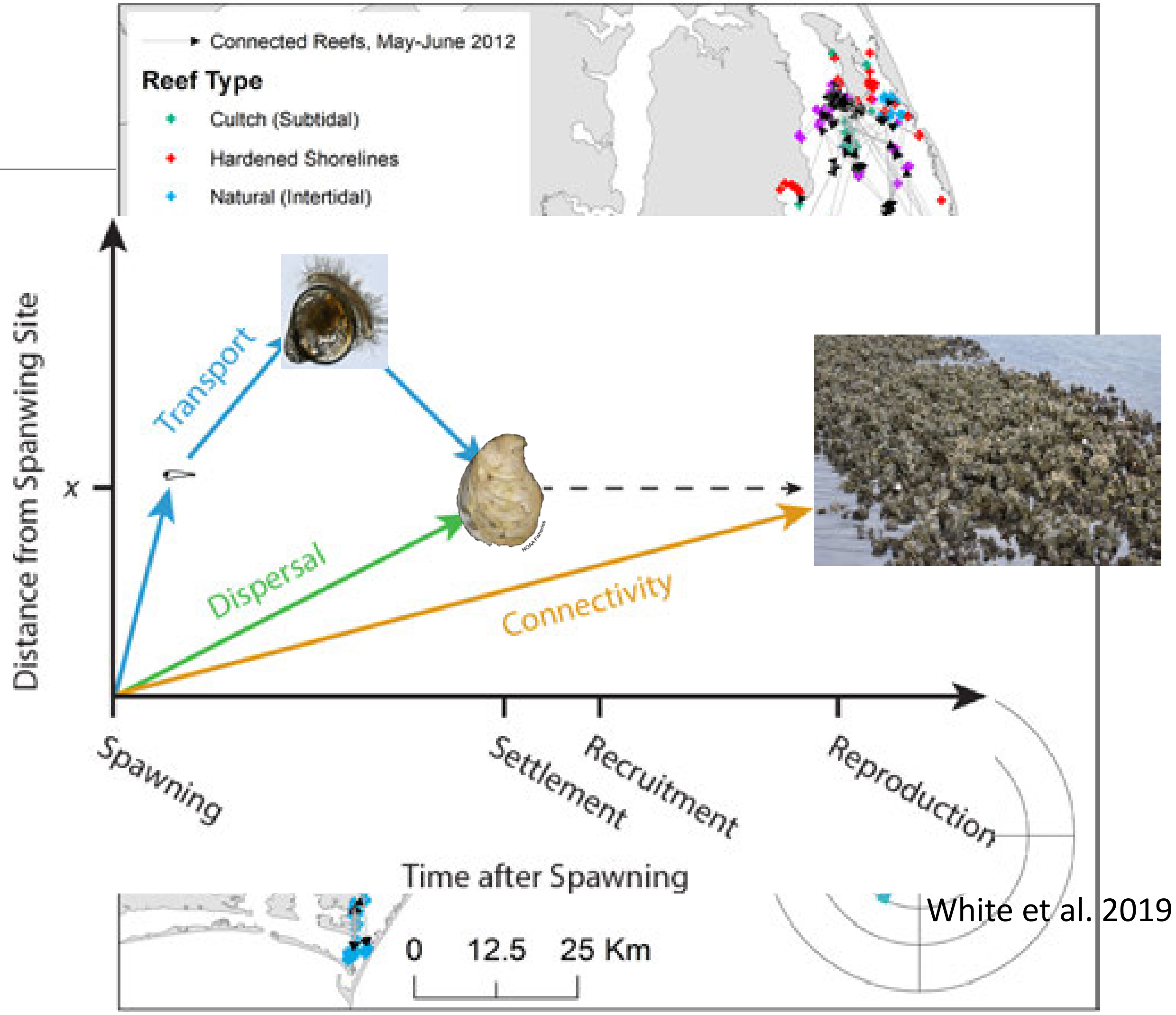


Larval Connectivity

Recruitment dynamics
- Larval Supply – Who survived?
- Source – Produced more than settled
- Sink - Settled more than made

Connectivity
- Did they settle anywhere different?
- Impacts resilience, recovery potential

Spatial planning
- Exploration
- Identification
- Restoration
- Protection



White et al. 2019

Theuerkauf and Puckett 2021

Modeling Approach

Goal

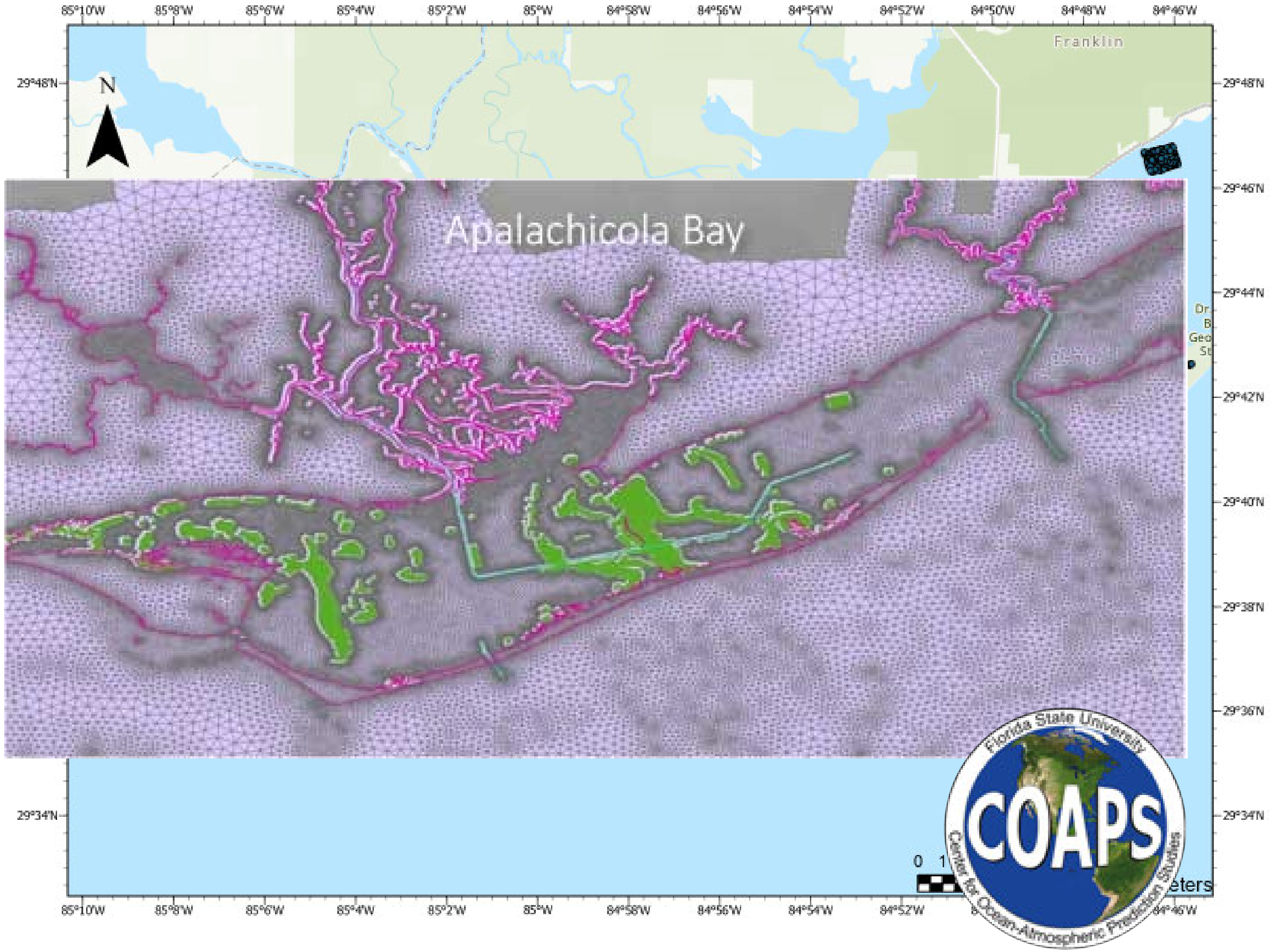
- Understand effect of environment on larval survival
- Create a coupled bio-physical model of larval growth and mortality

Methods

- Novel hydrodynamic model – COAPS
- Hatchery derived growth experiments – Fuqua and Brooke, 2025
- Modeled larval spawn

Analysis

- Calculate larval survival
- Estimate larval dispersal patterns



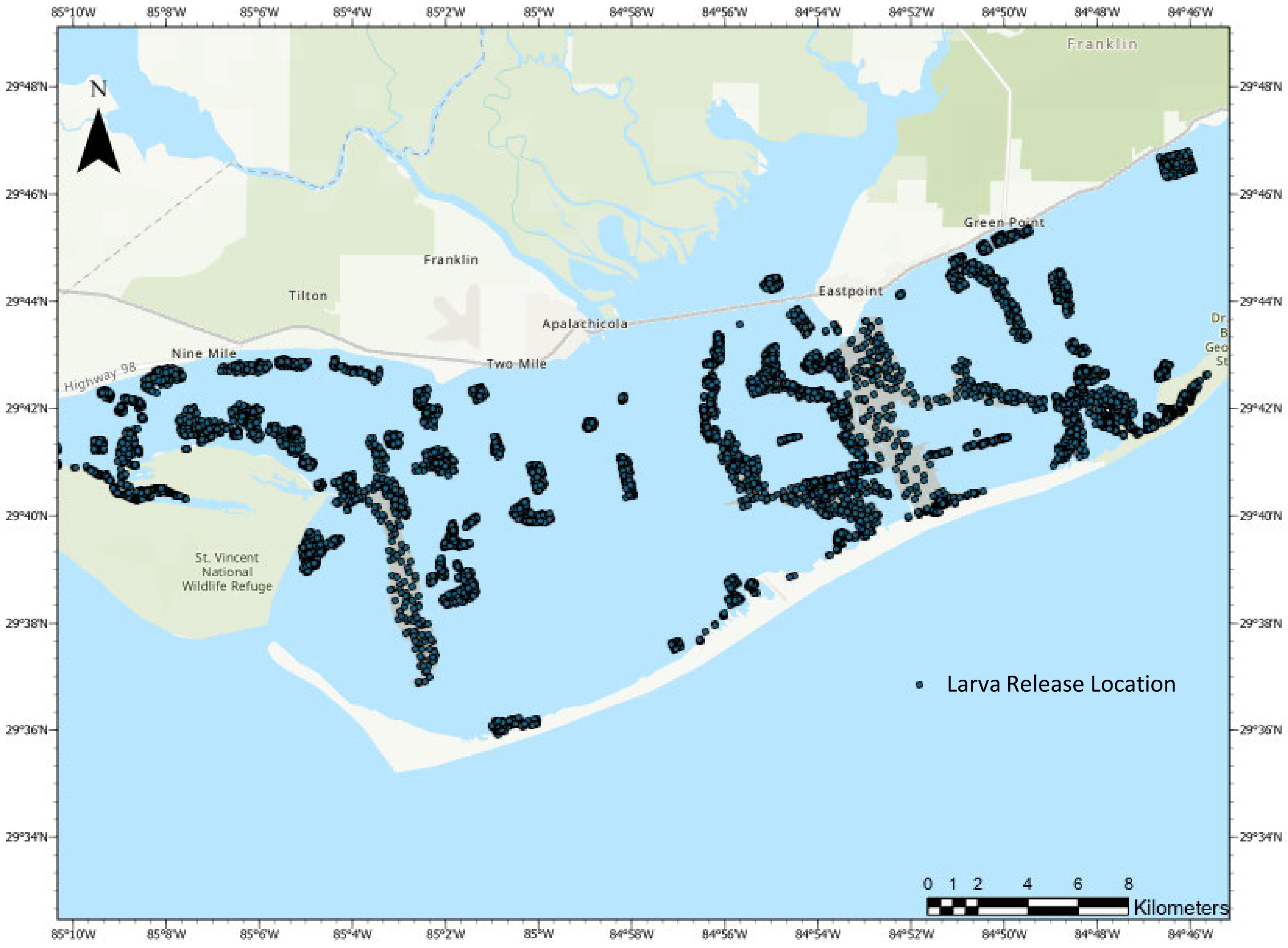
Environmental Conditions

Two major known spawns

- Spring - Early May - June
- Fall - Sept-October

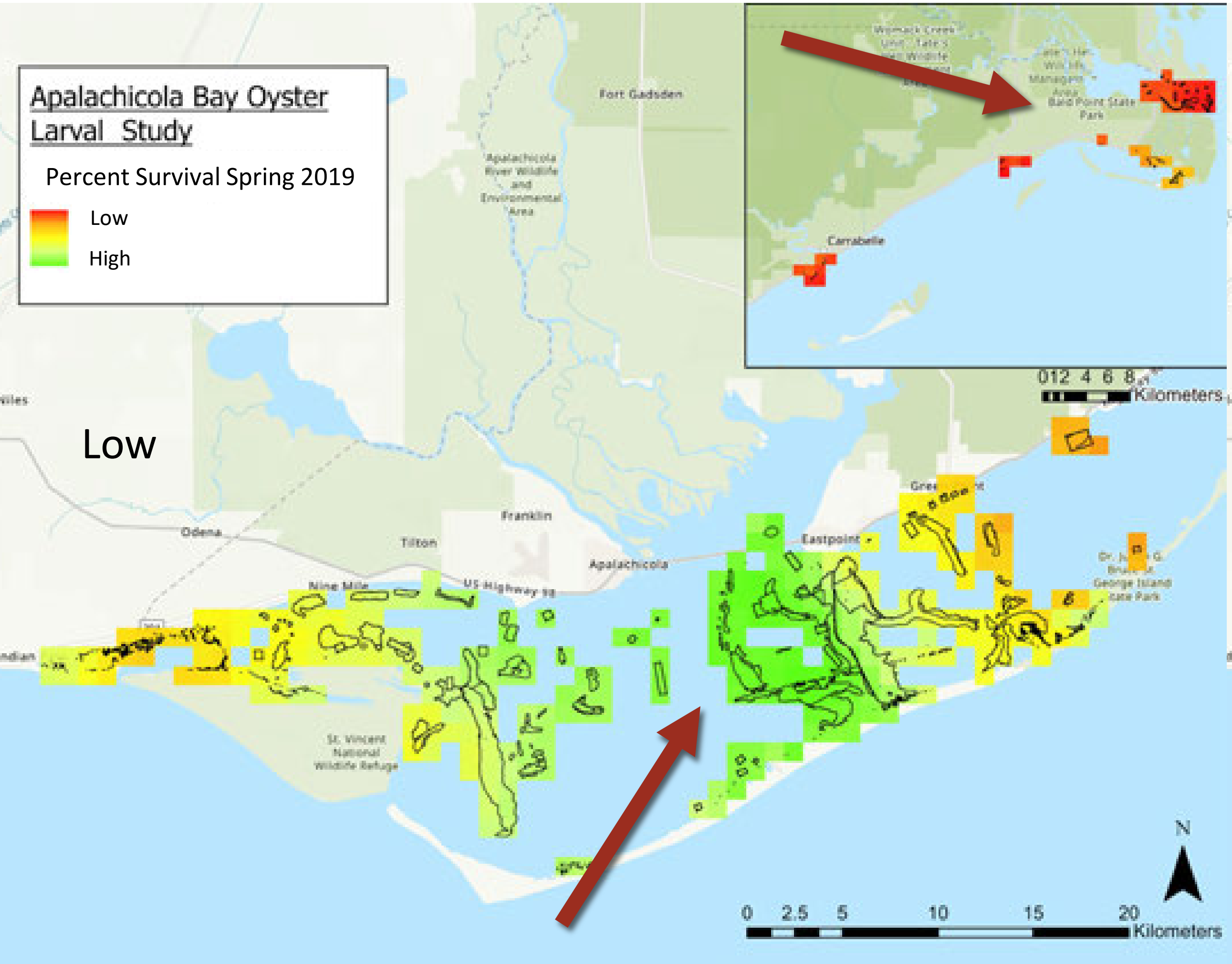
Climate scenarios

- Normal -2019
- 'Drought' - 2012
- 'Flood' – 1998



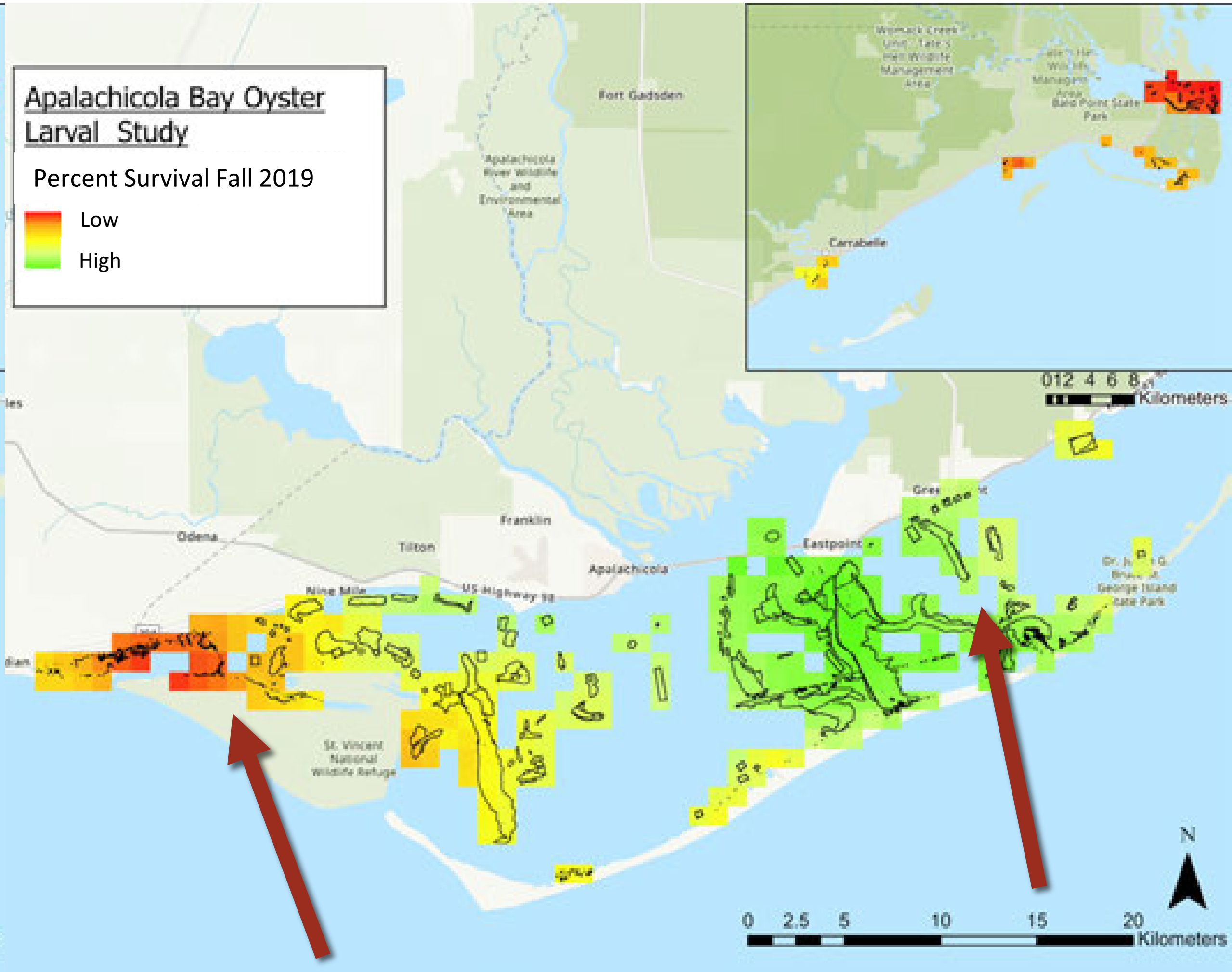
Seasonal Survival

Spring



- Middle of bay high survival
- Ochlokonee low

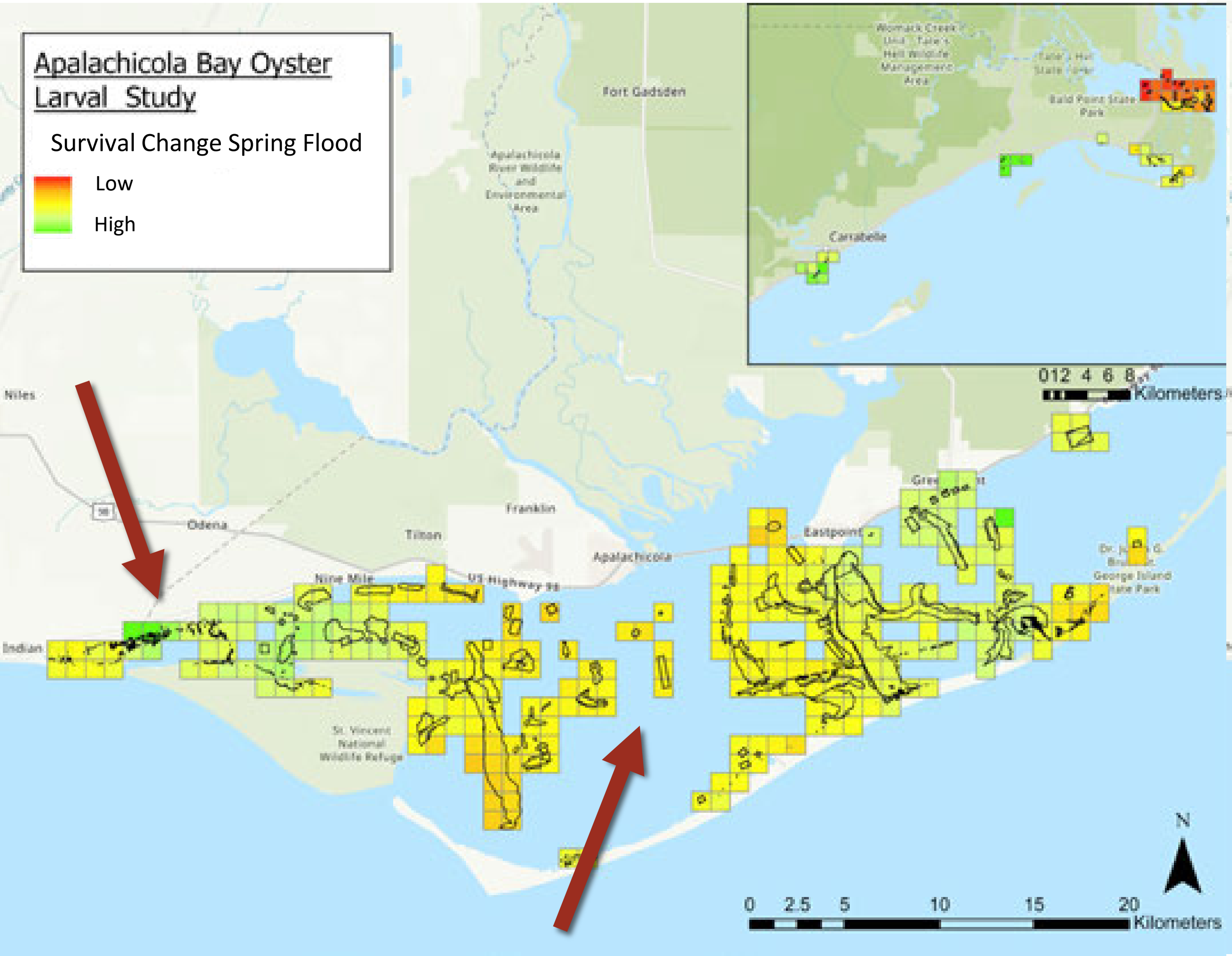
Fall



- East reefs high
- West reefs low

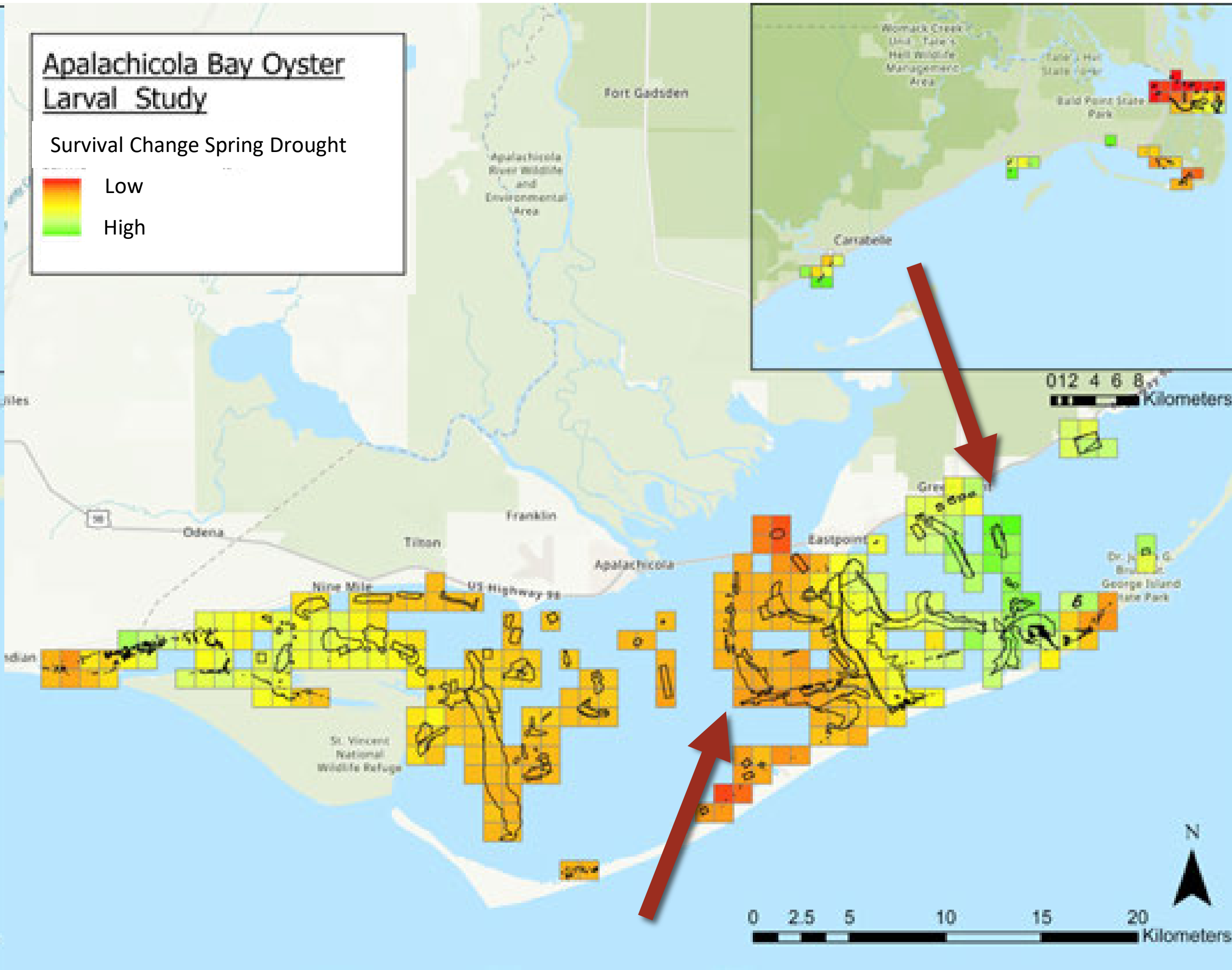
Spring

Flood



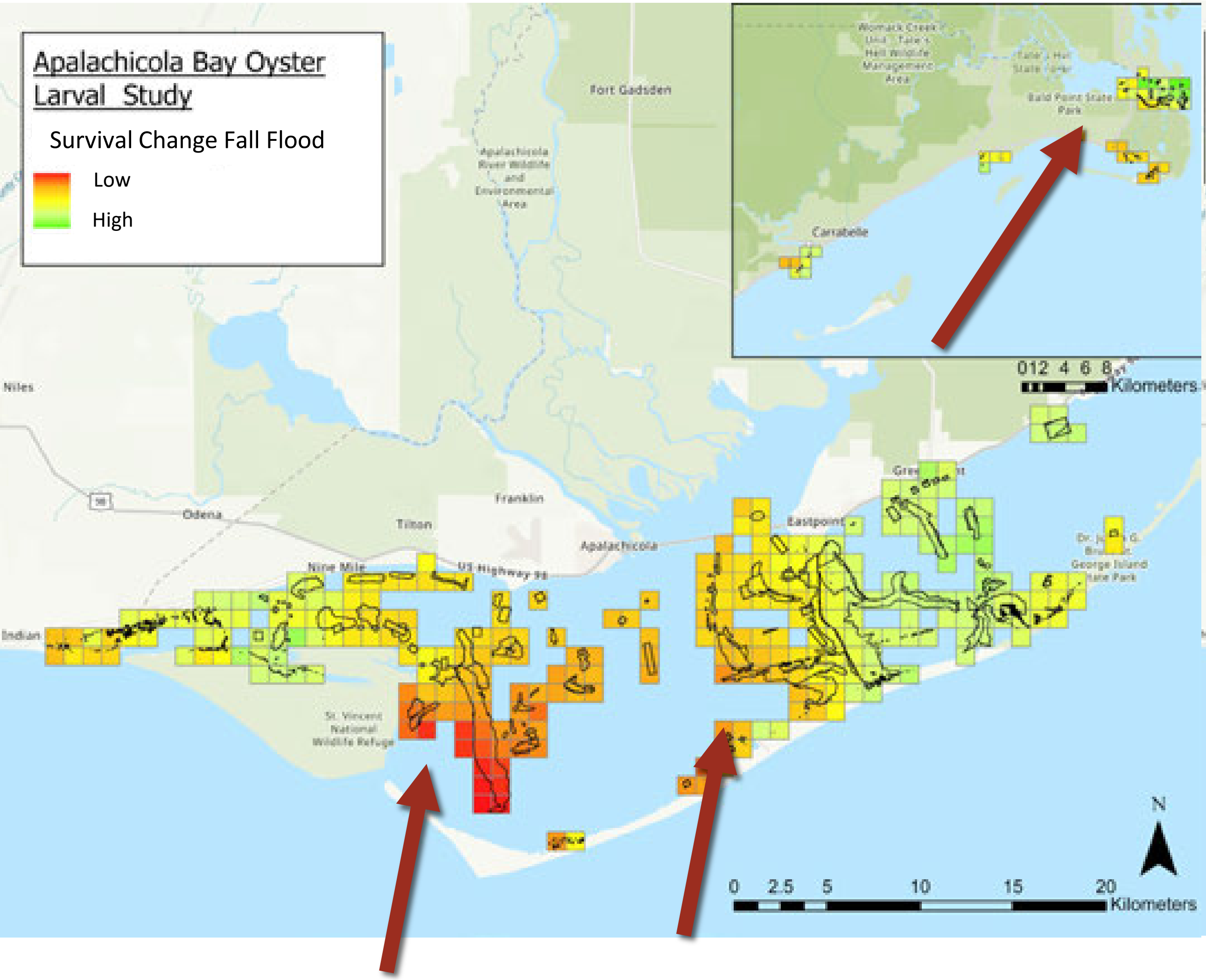
- Middle of bay low impact
- Slight increase in small area of east
- Ochlokonee loss

Drought

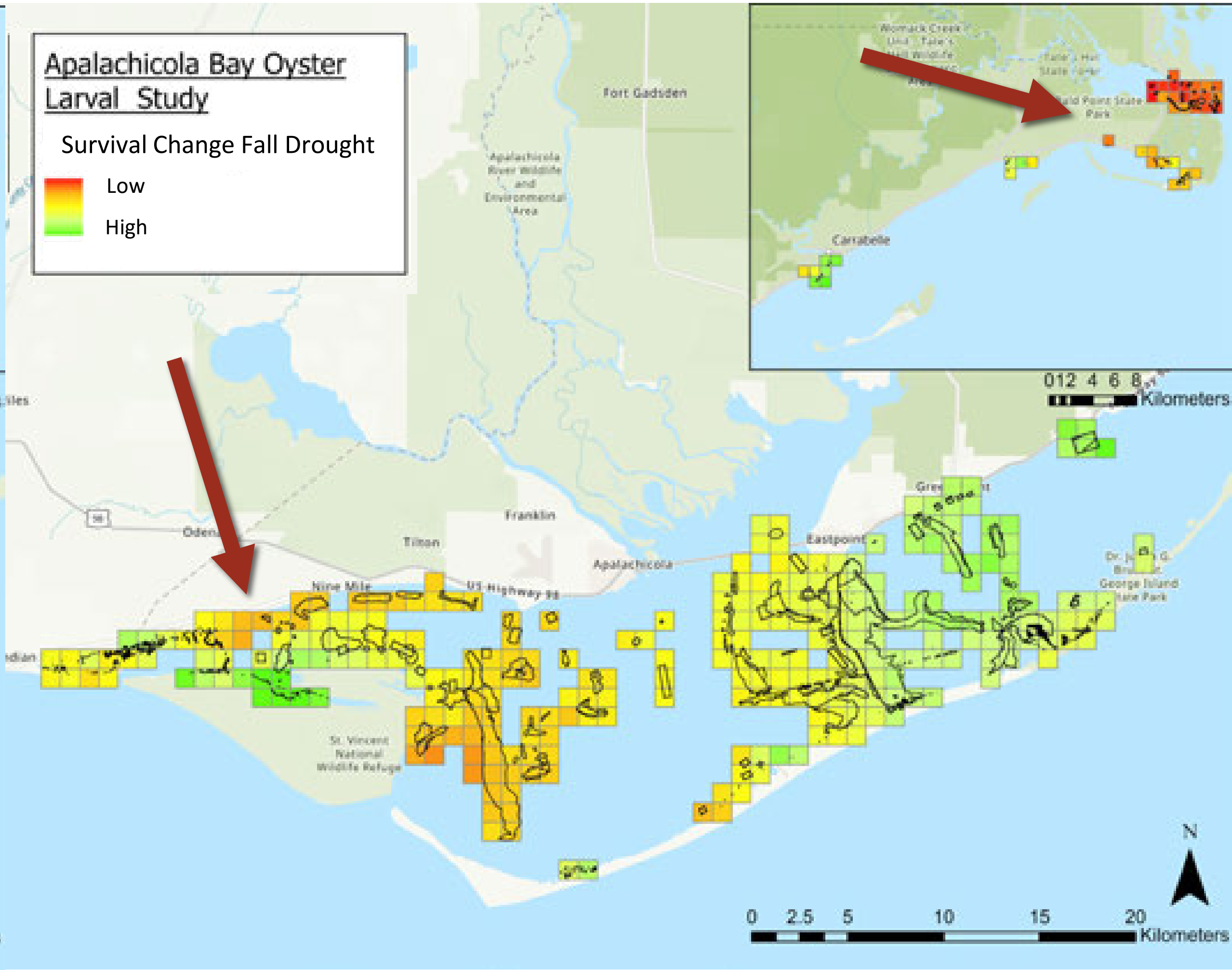


- Some east reefs increase
- Mid bay, west reefs survival loss

Flood **Fall** Drought



- Middle of bay survival loss
- Ochlokonee increase

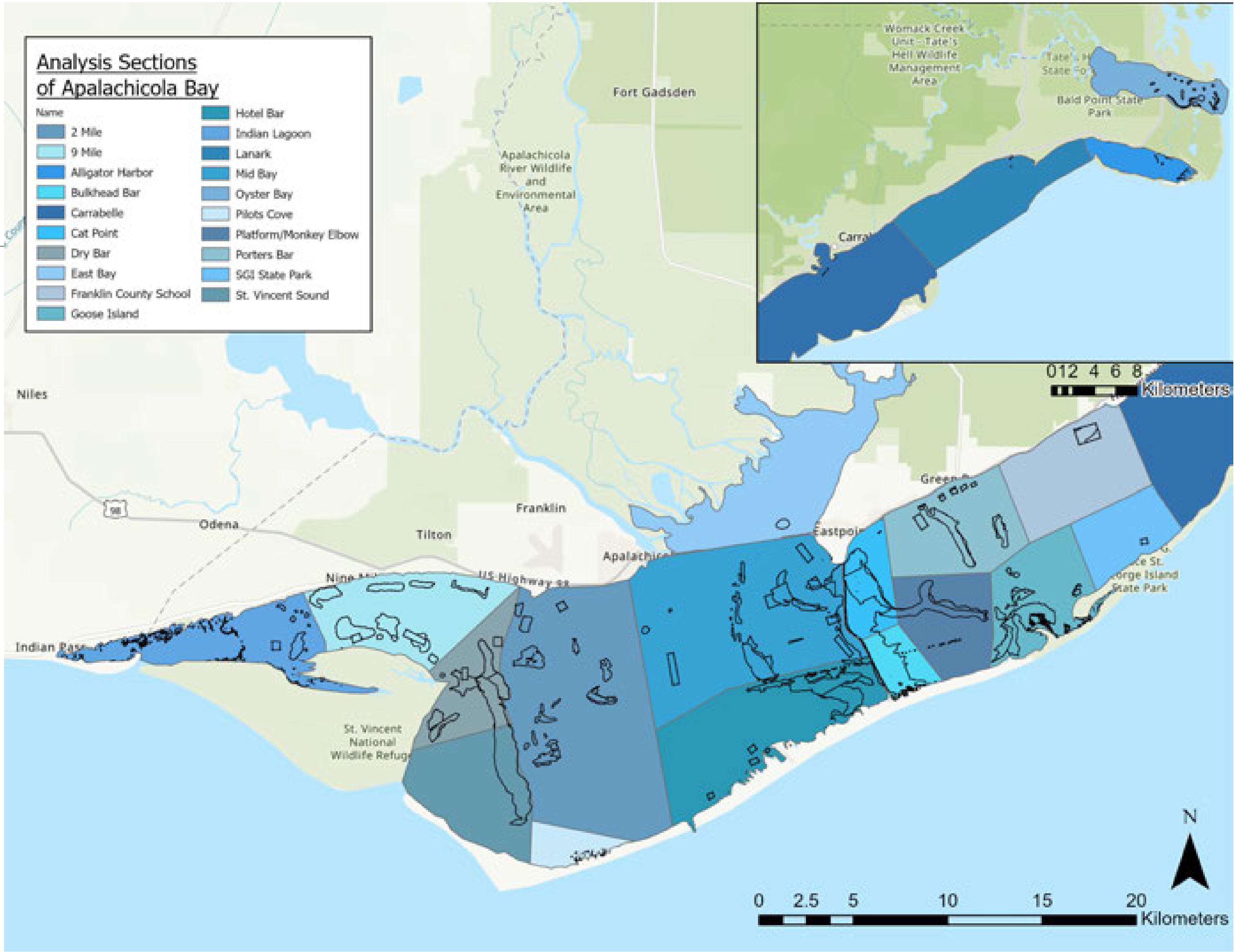


- Mid bay mild decrease
- Ochlokonee decrease
- Some east reefs increase

Results

Connectivity patterns

- distribution of larva across study region
- Colloquial reef complex names



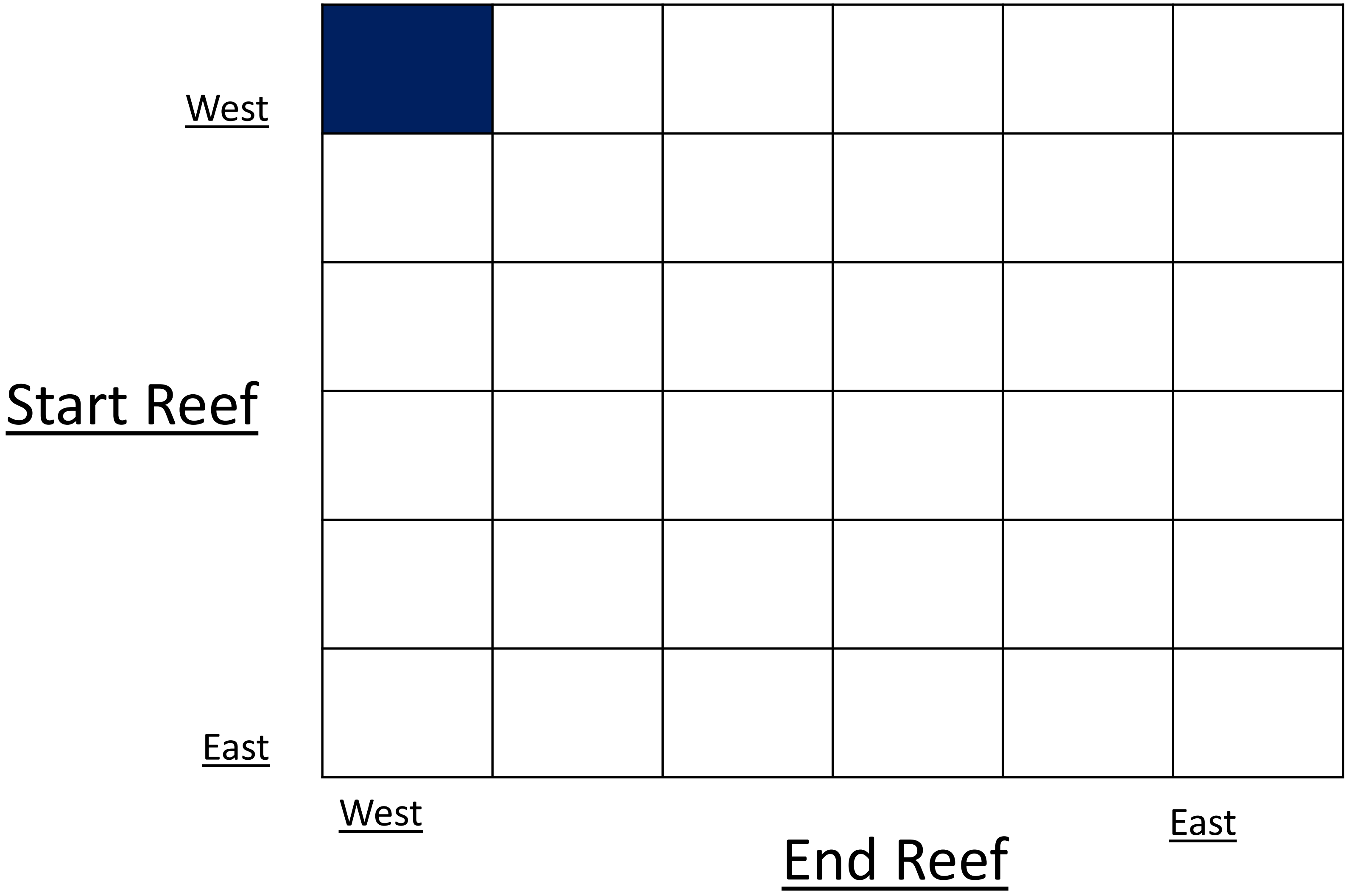
Connectivity matrix

Start Reef ↓ / End Reef →	West					East
West						
East						

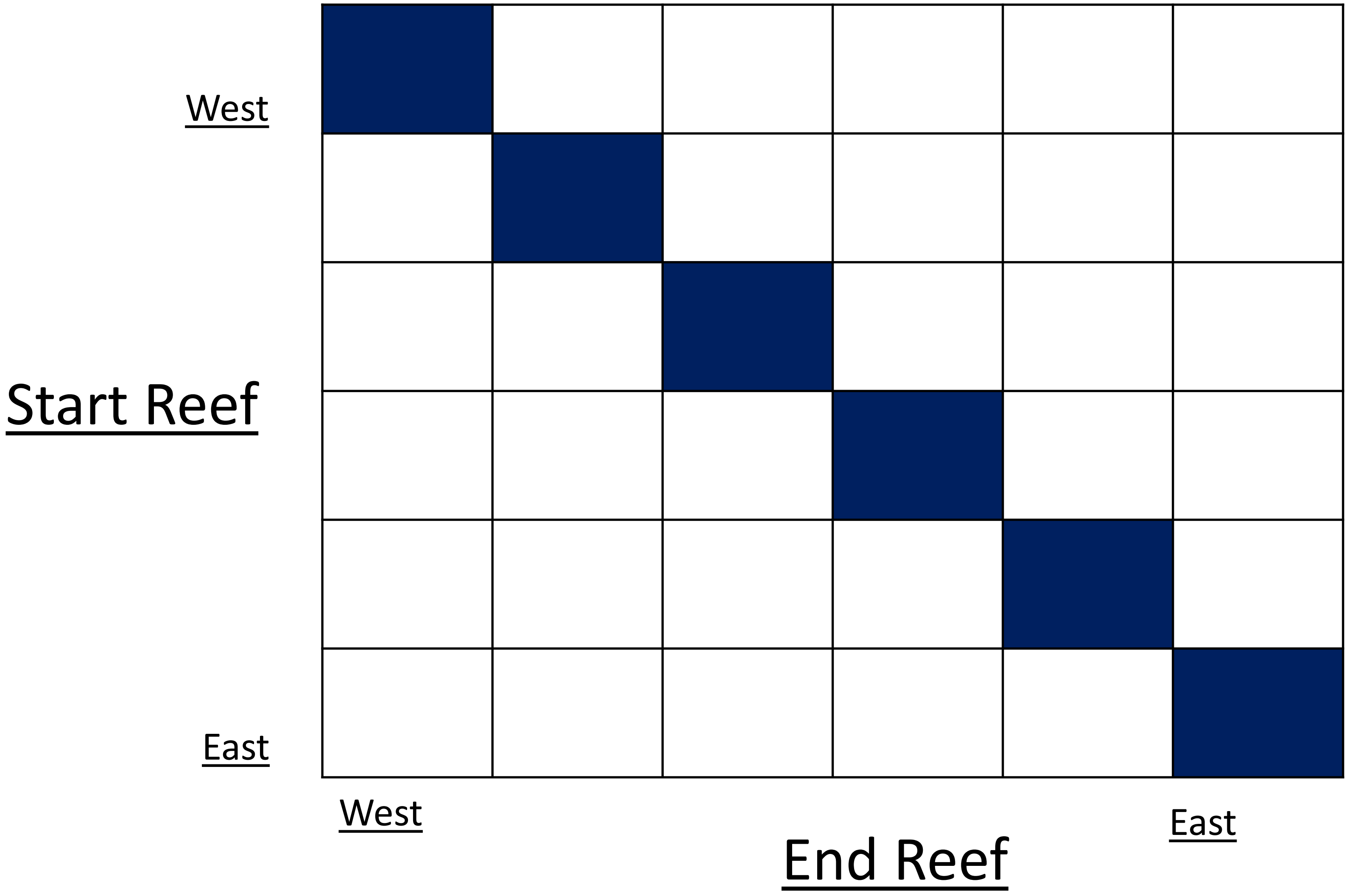
Start Reef

End Reef

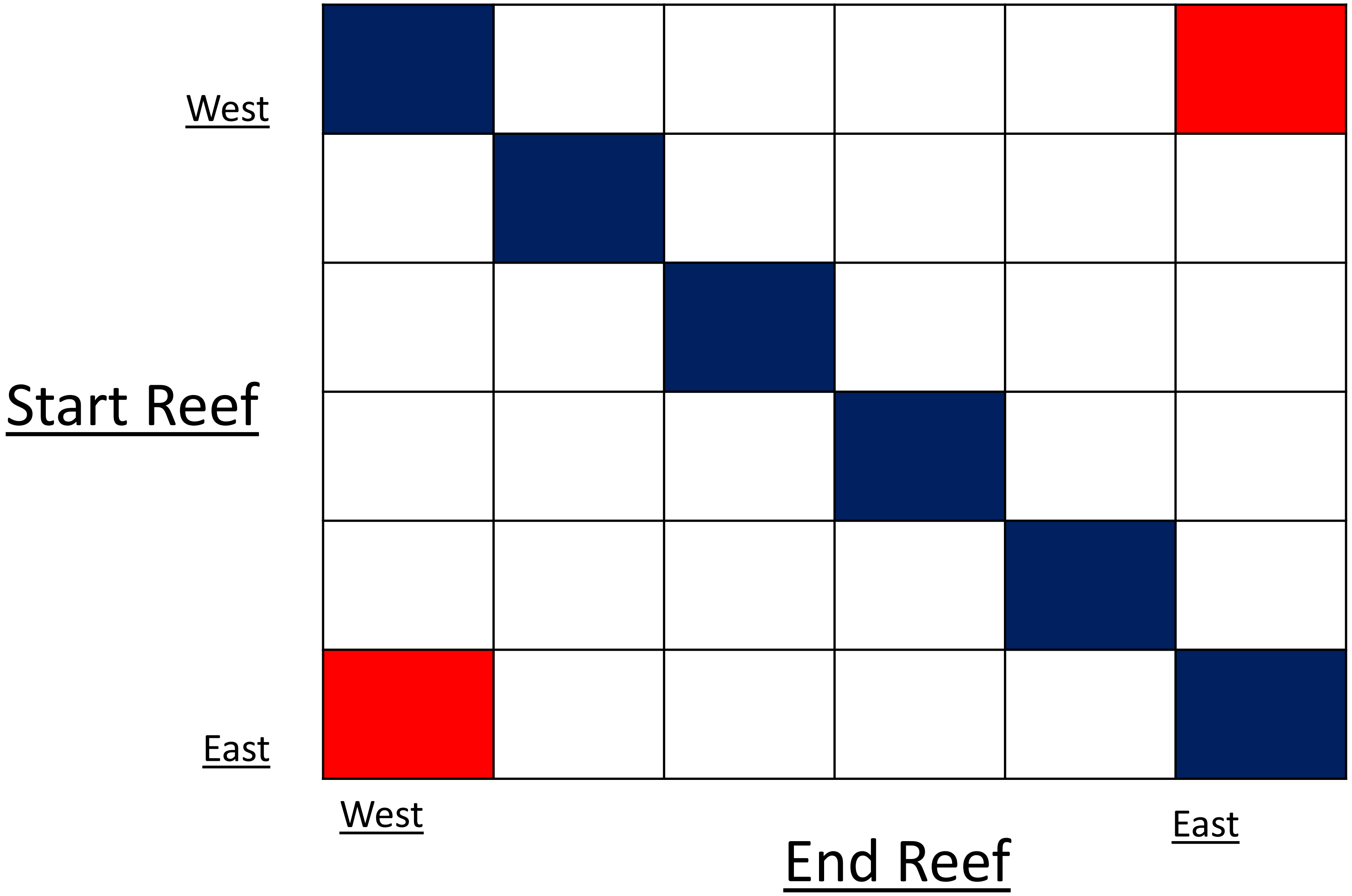
Connectivity matrix



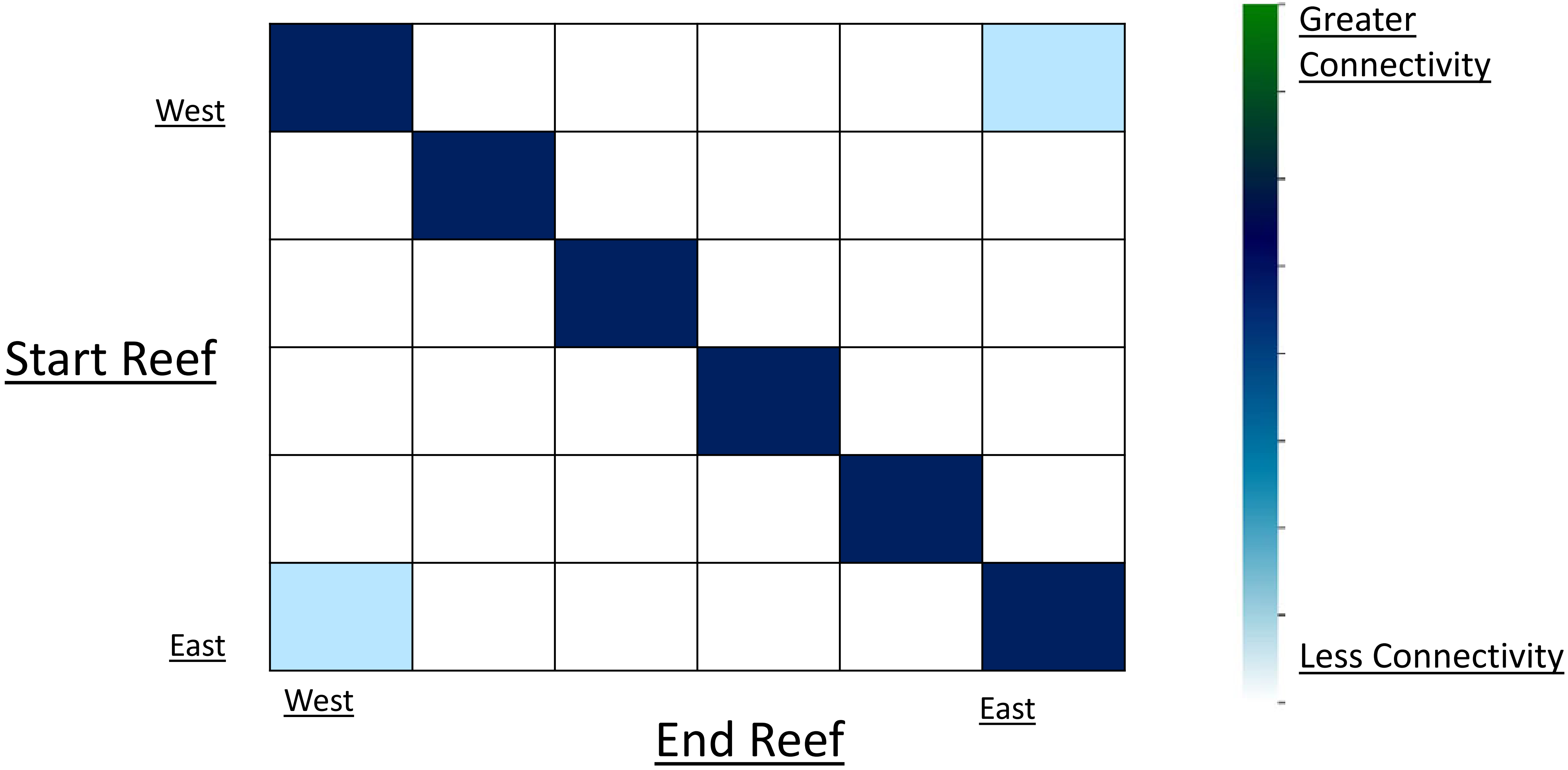
Connectivity matrix



Connectivity matrix

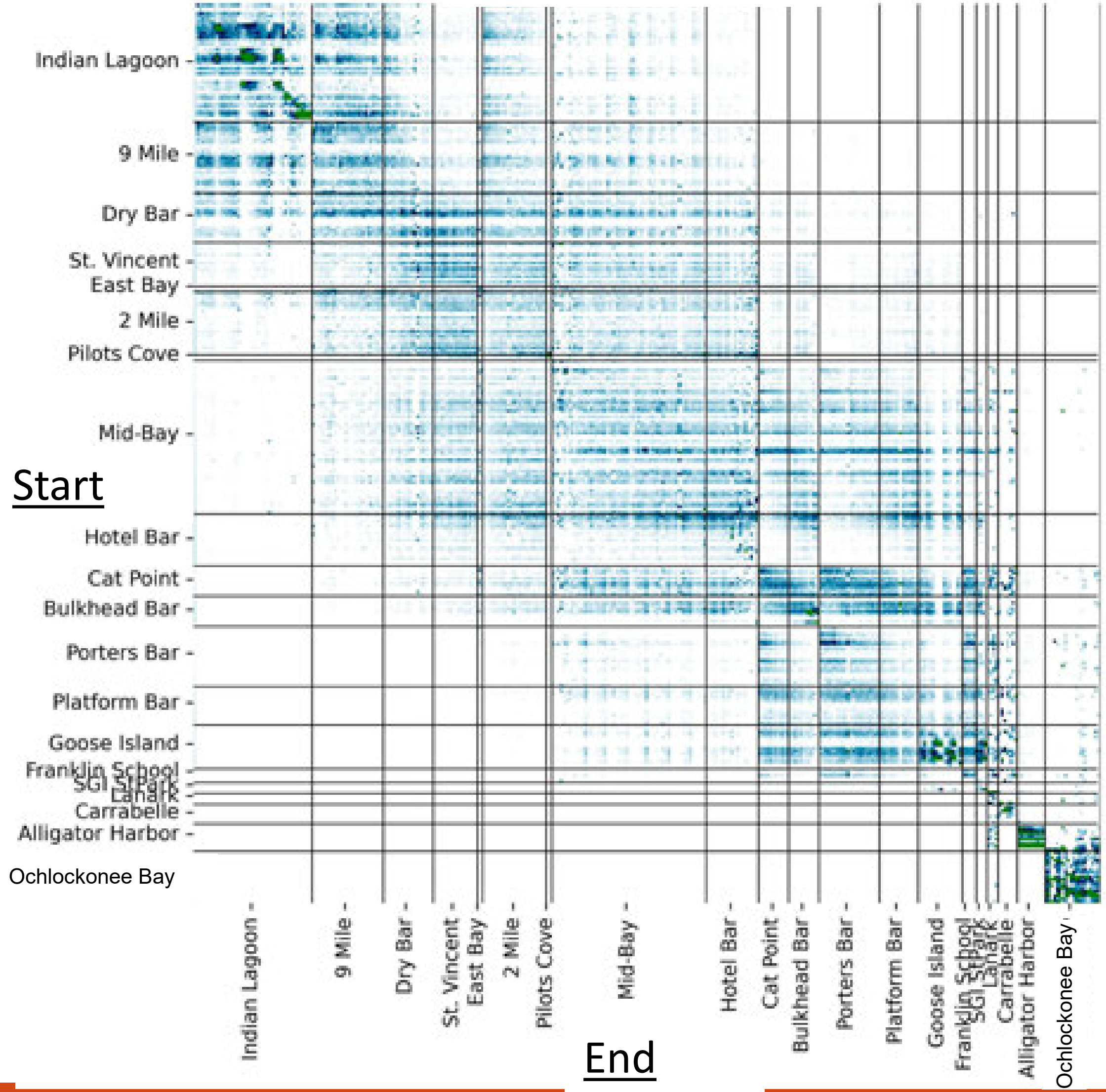


Connectivity matrix

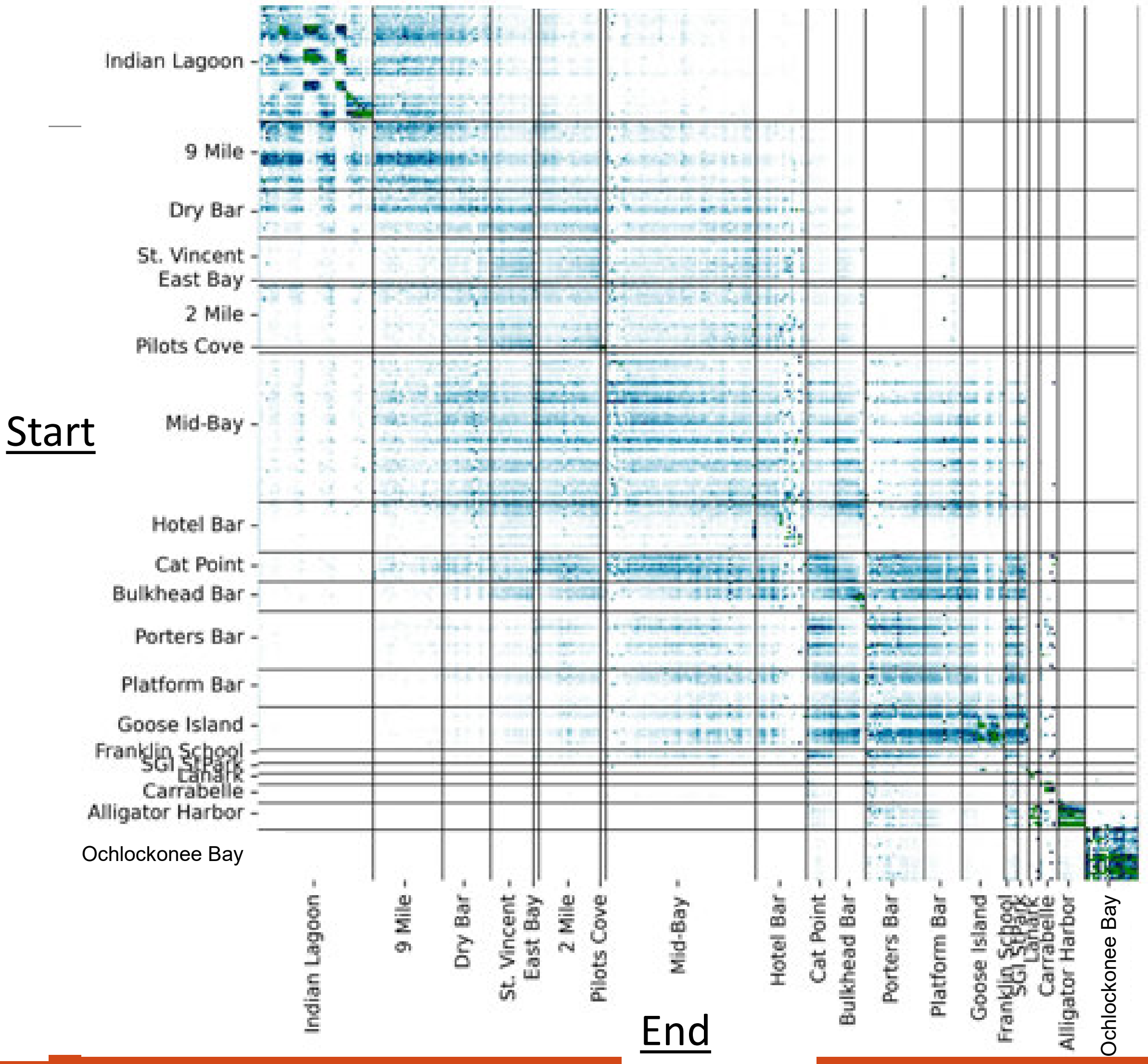


Results : Connectivity Matrices

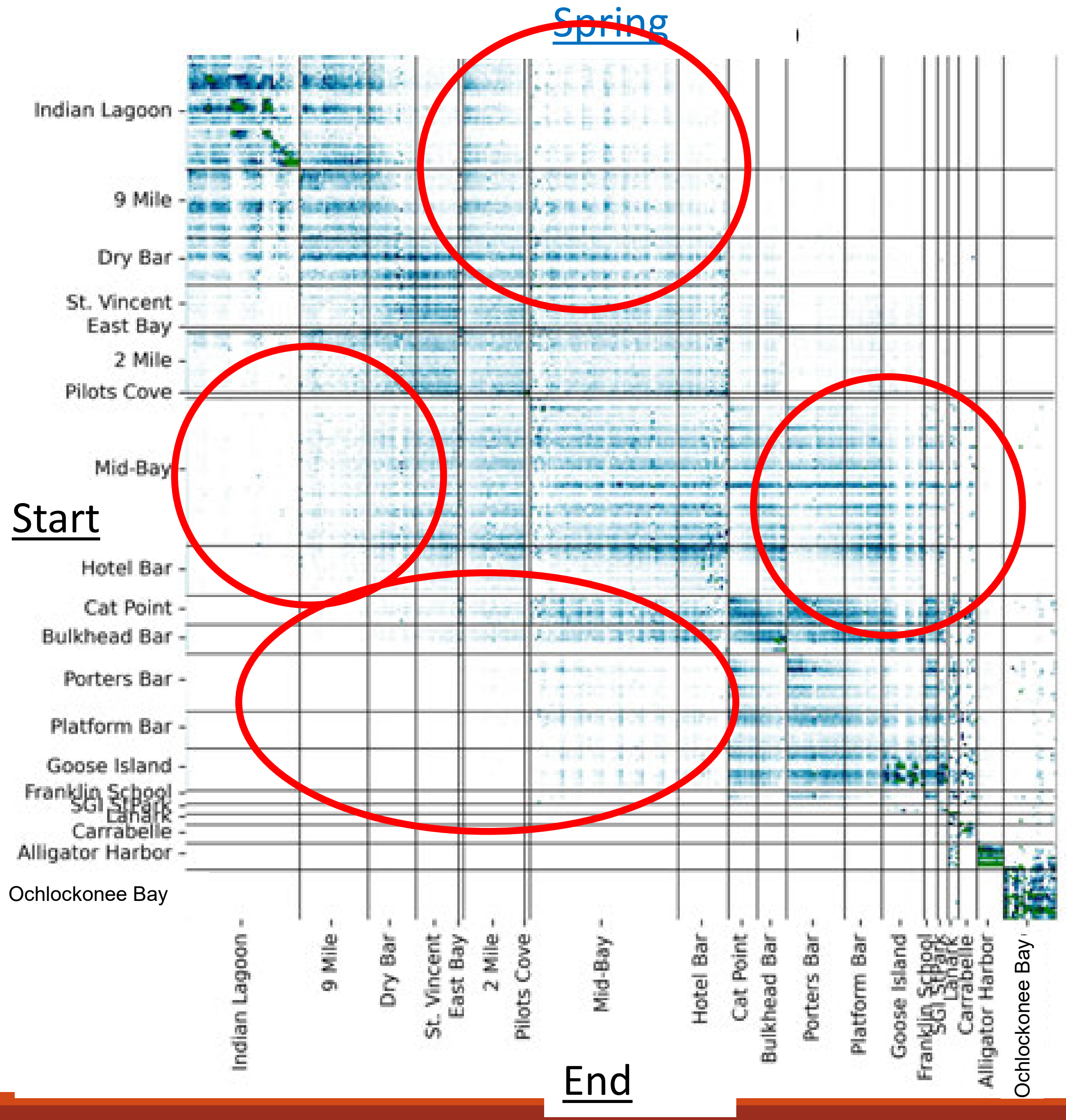
Spring

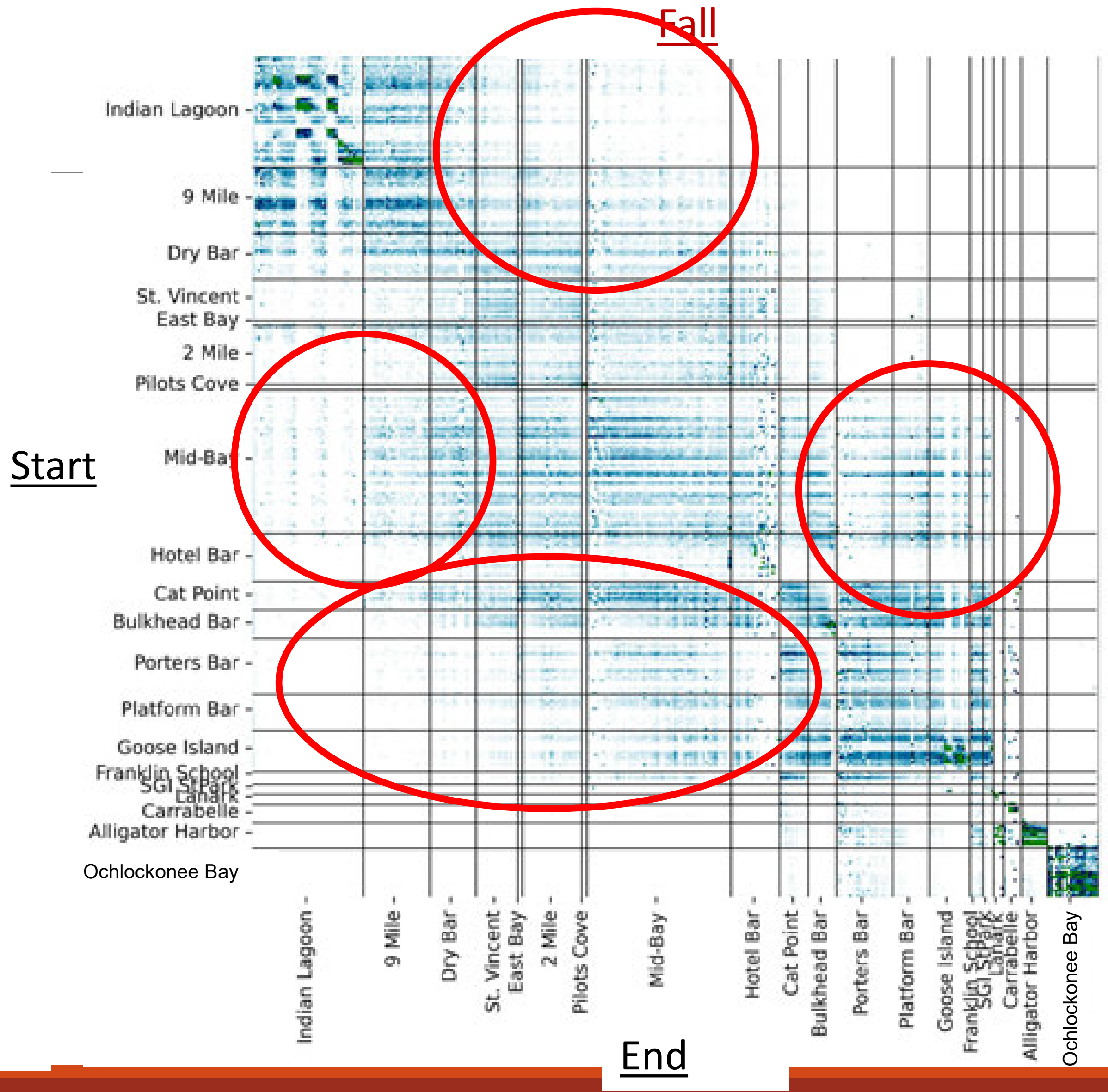


Fall

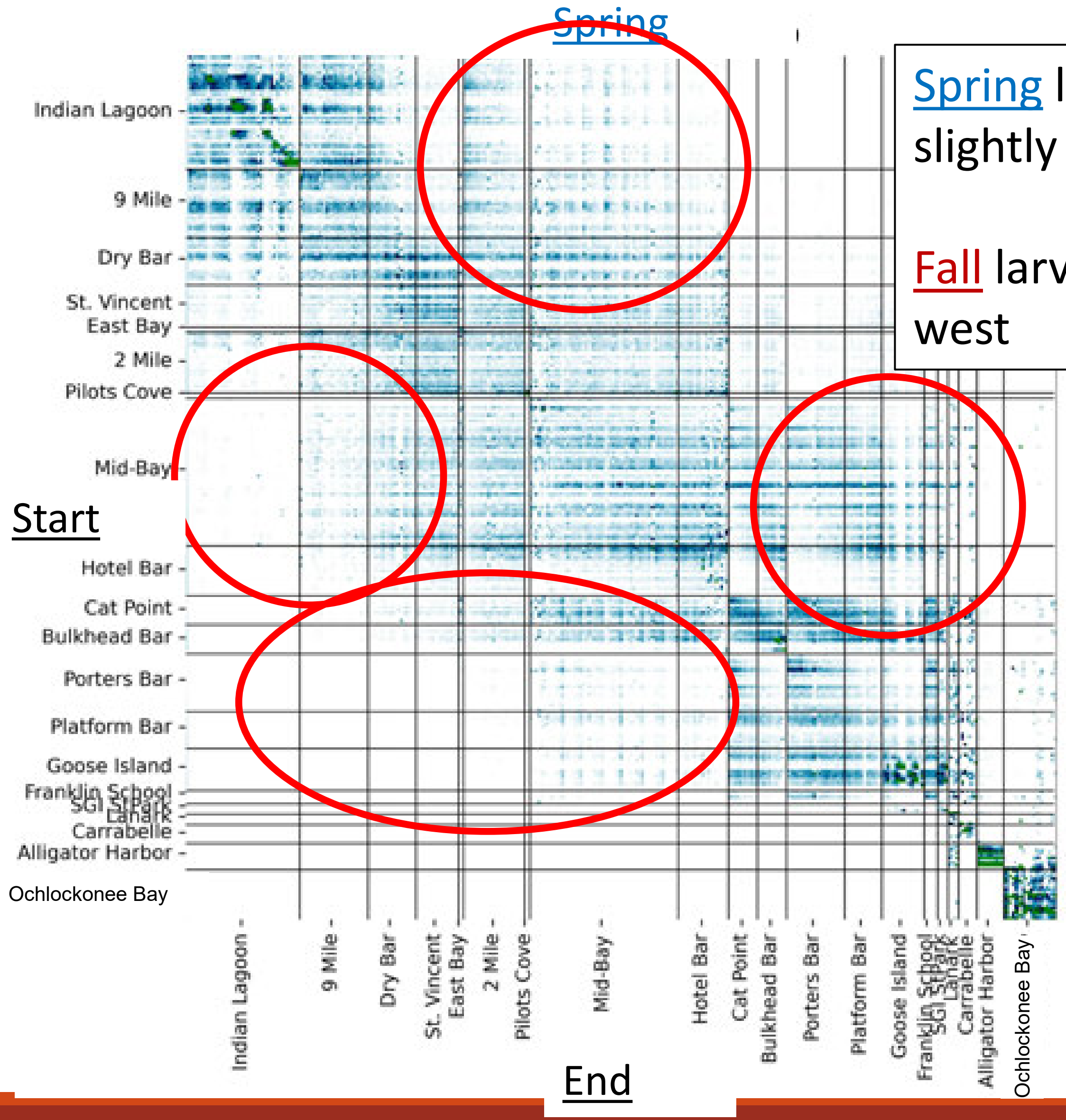


Results : Connectivity Matrices



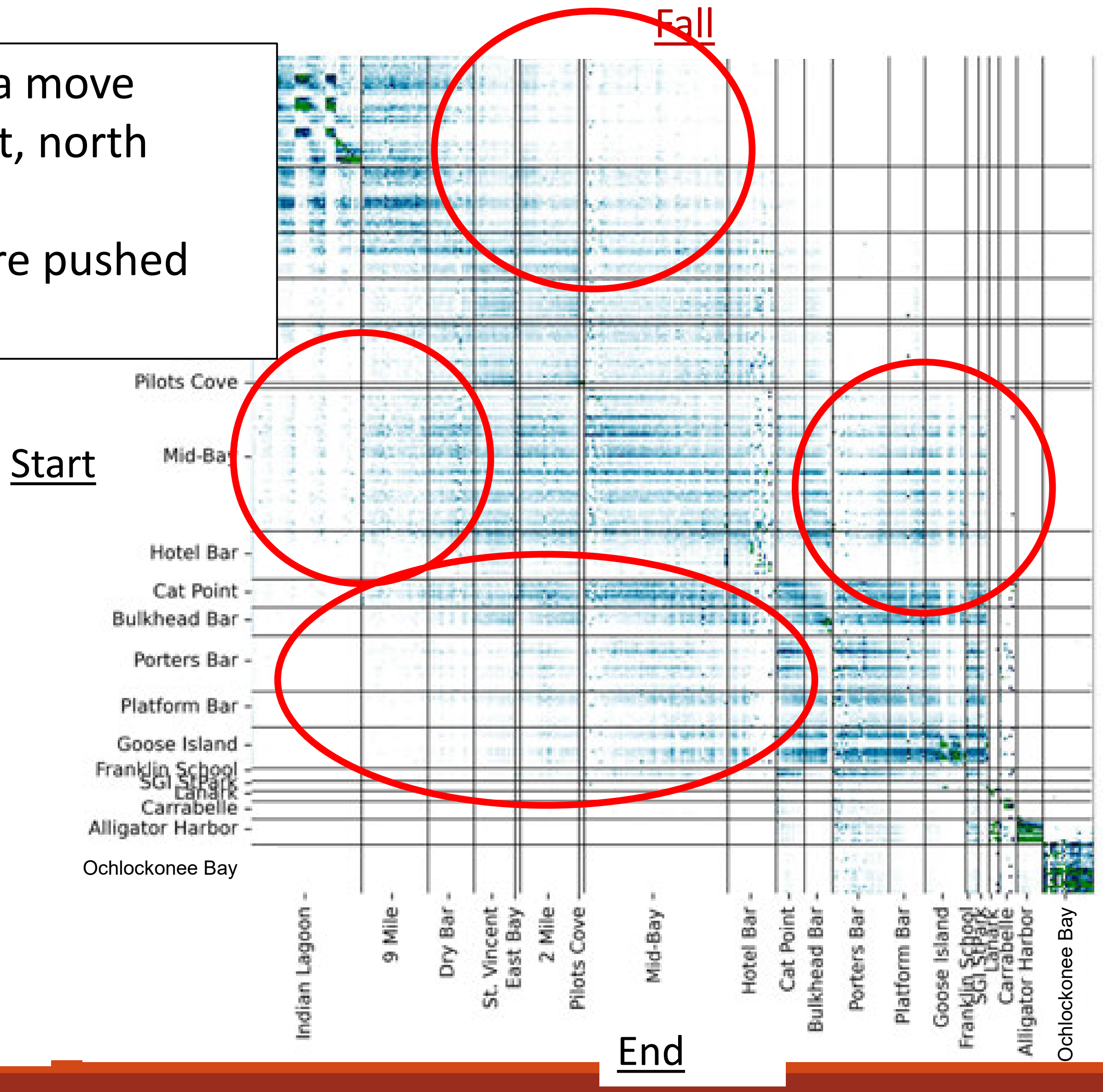


Results : Connectivity Matrices

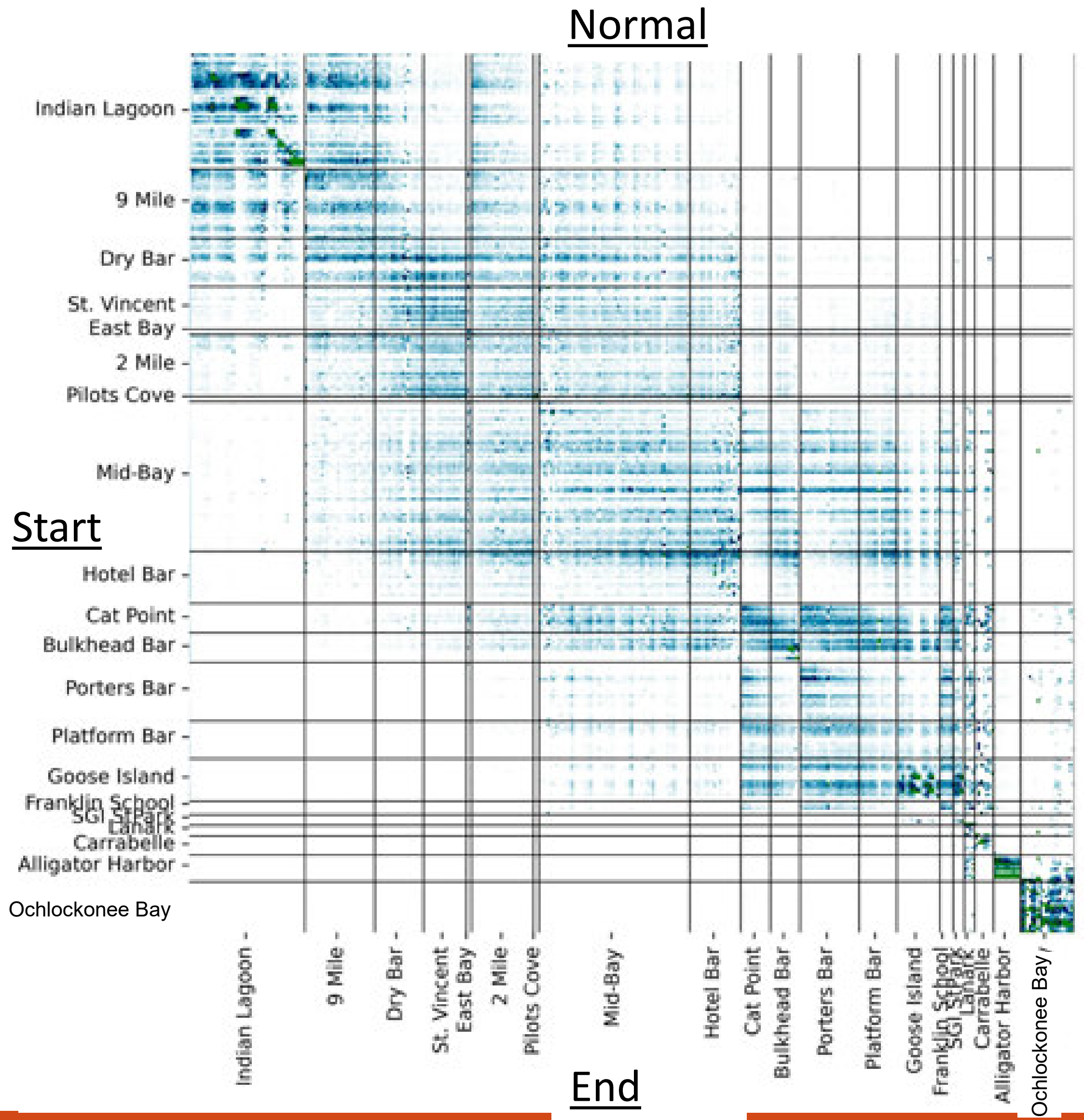


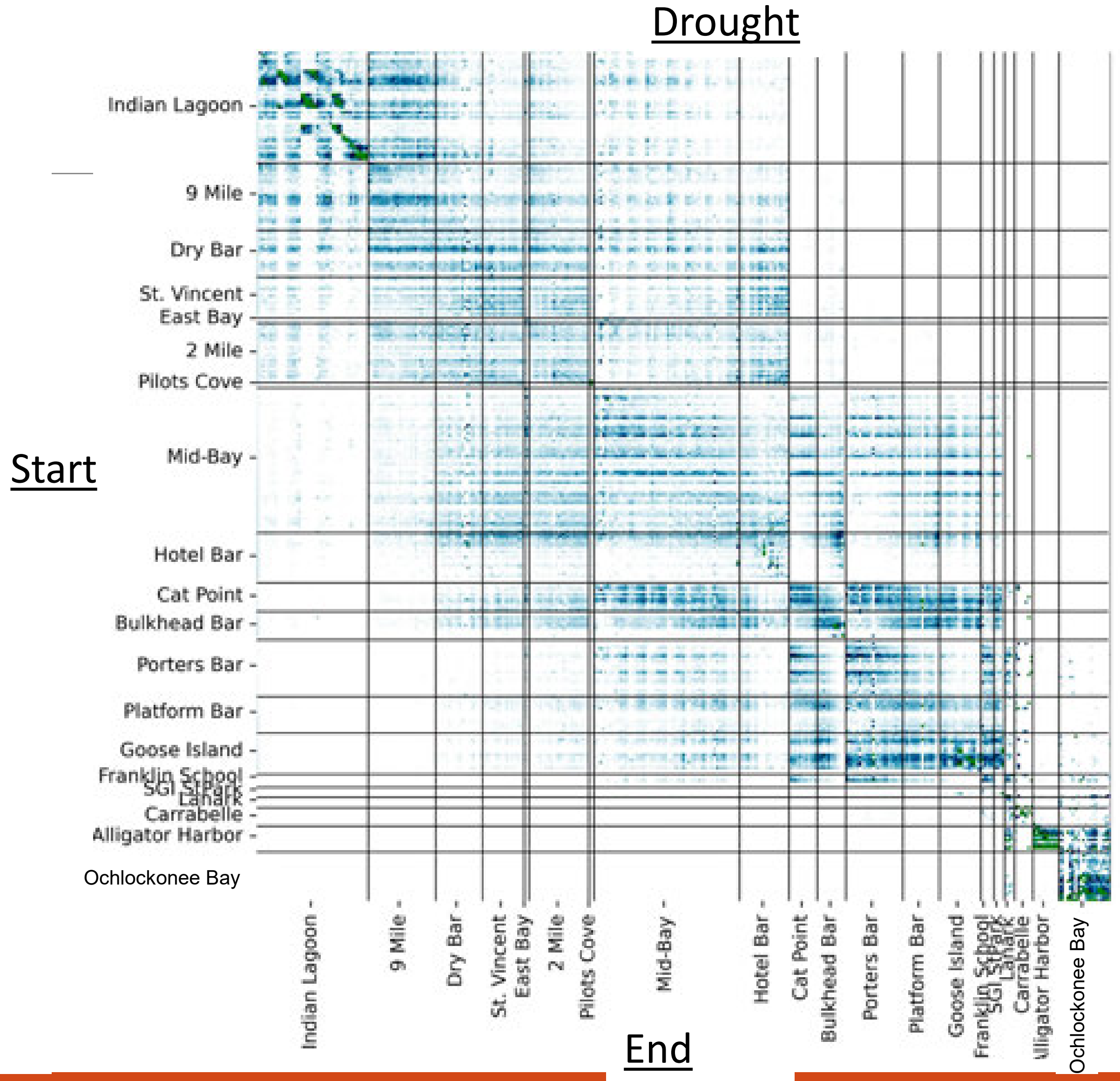
Spring larva move slightly east, north

Fall larva are pushed west

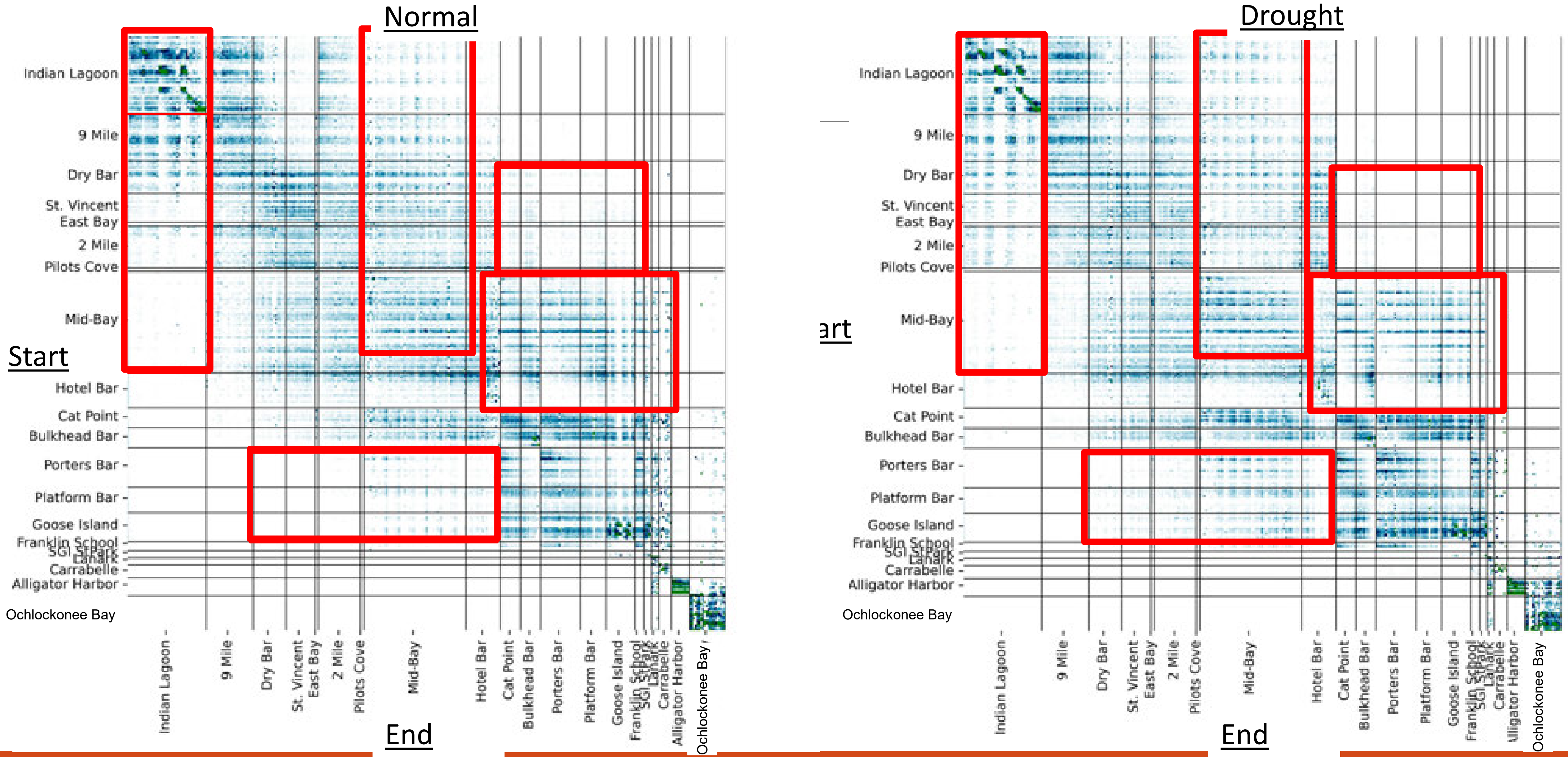


Results : Connectivity Matrices - Spring 'Drought'



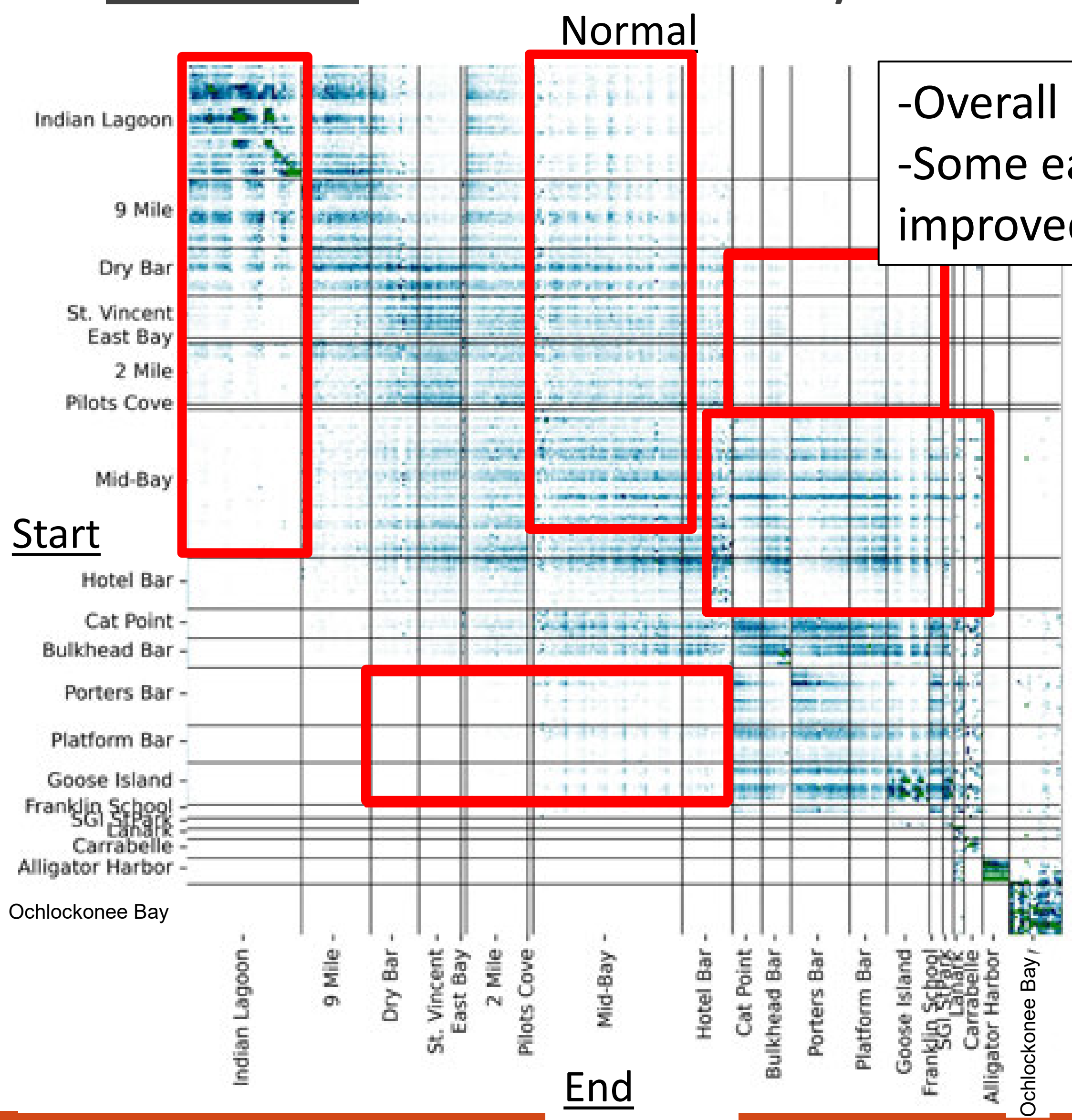


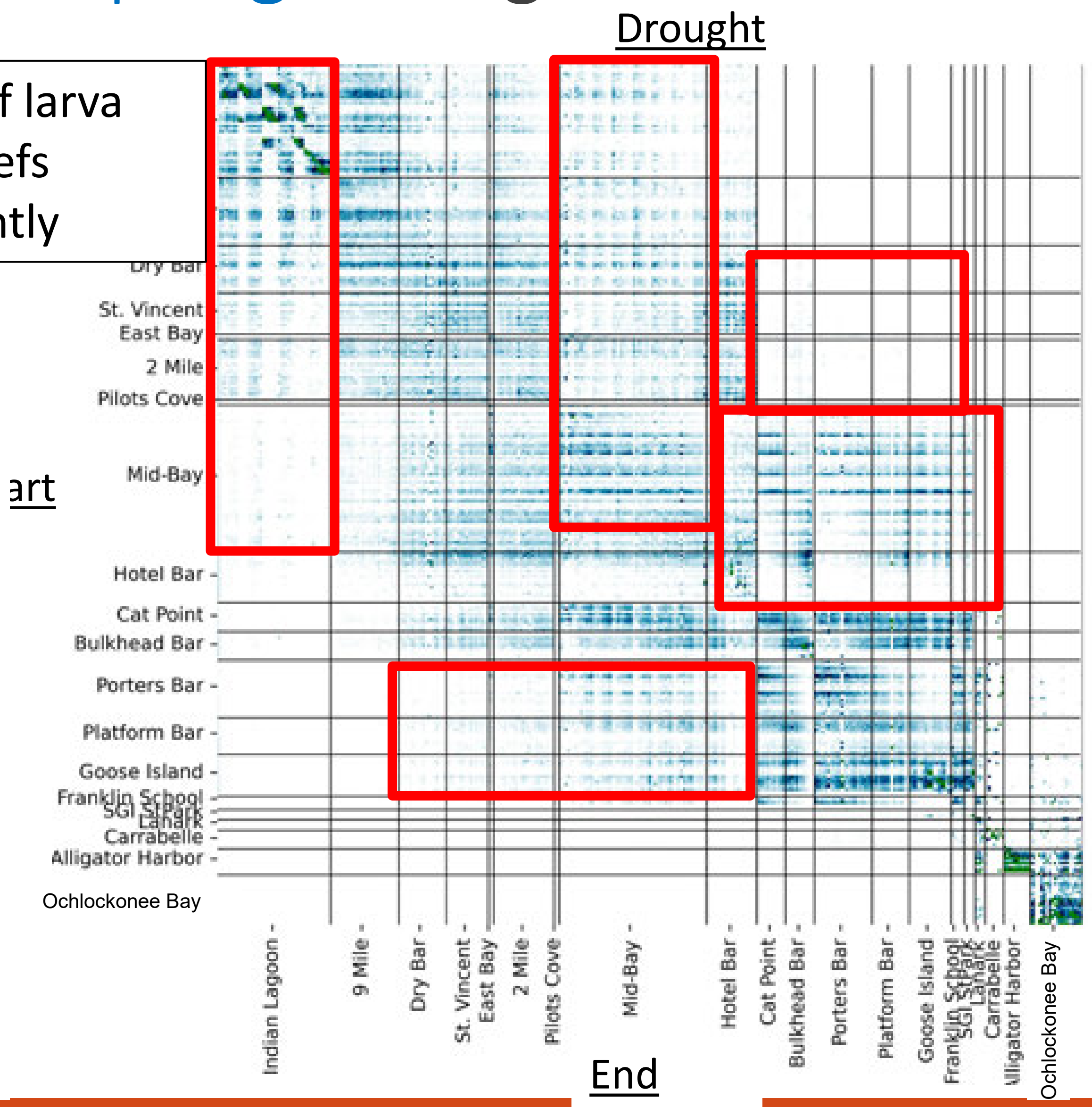
Results : Connectivity Matrices - Spring 'Drought'



Results : Connectivity Matrices - Spring 'Drought'

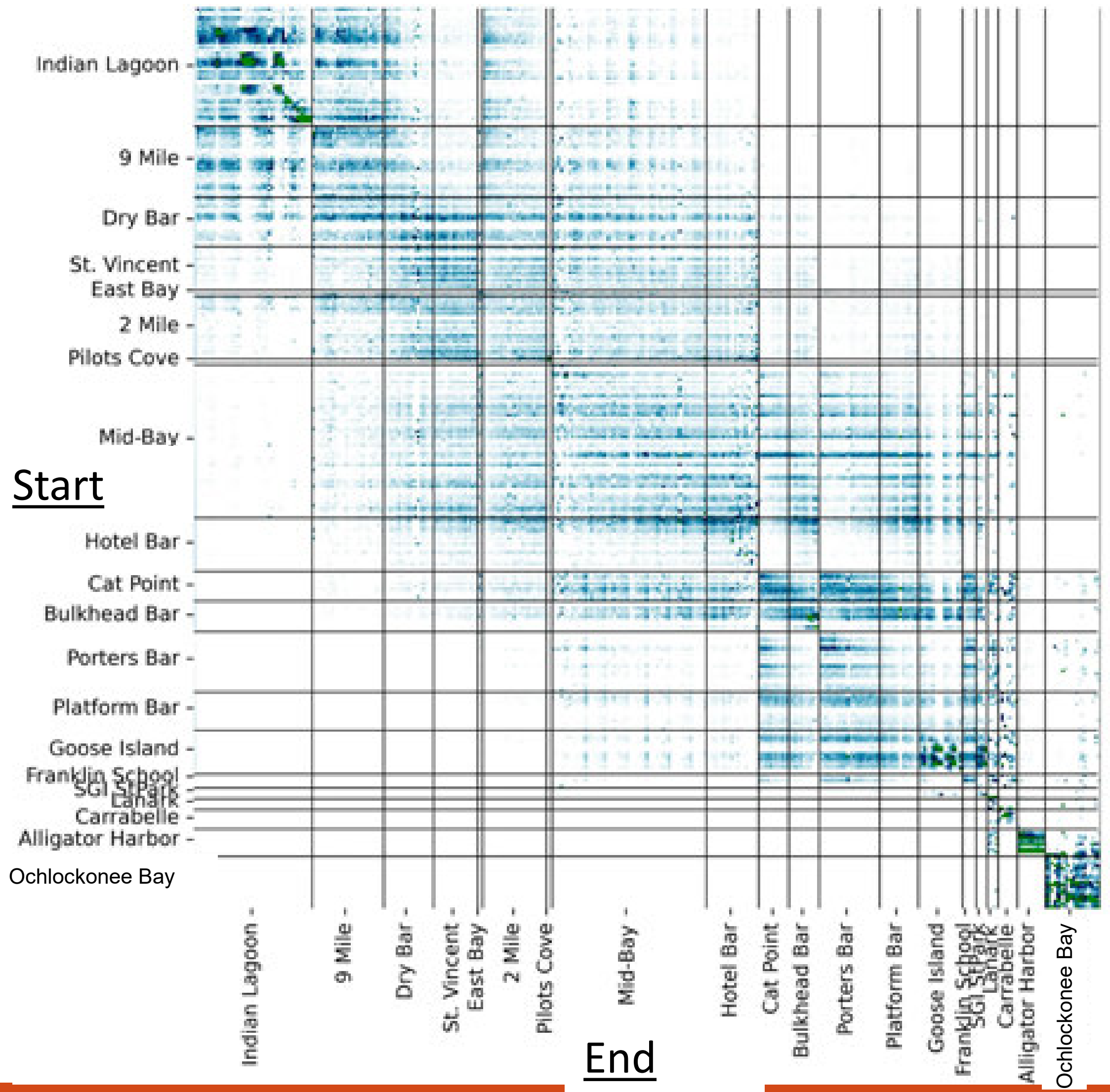
-Overall loss of larva
-Some east reefs improved slightly



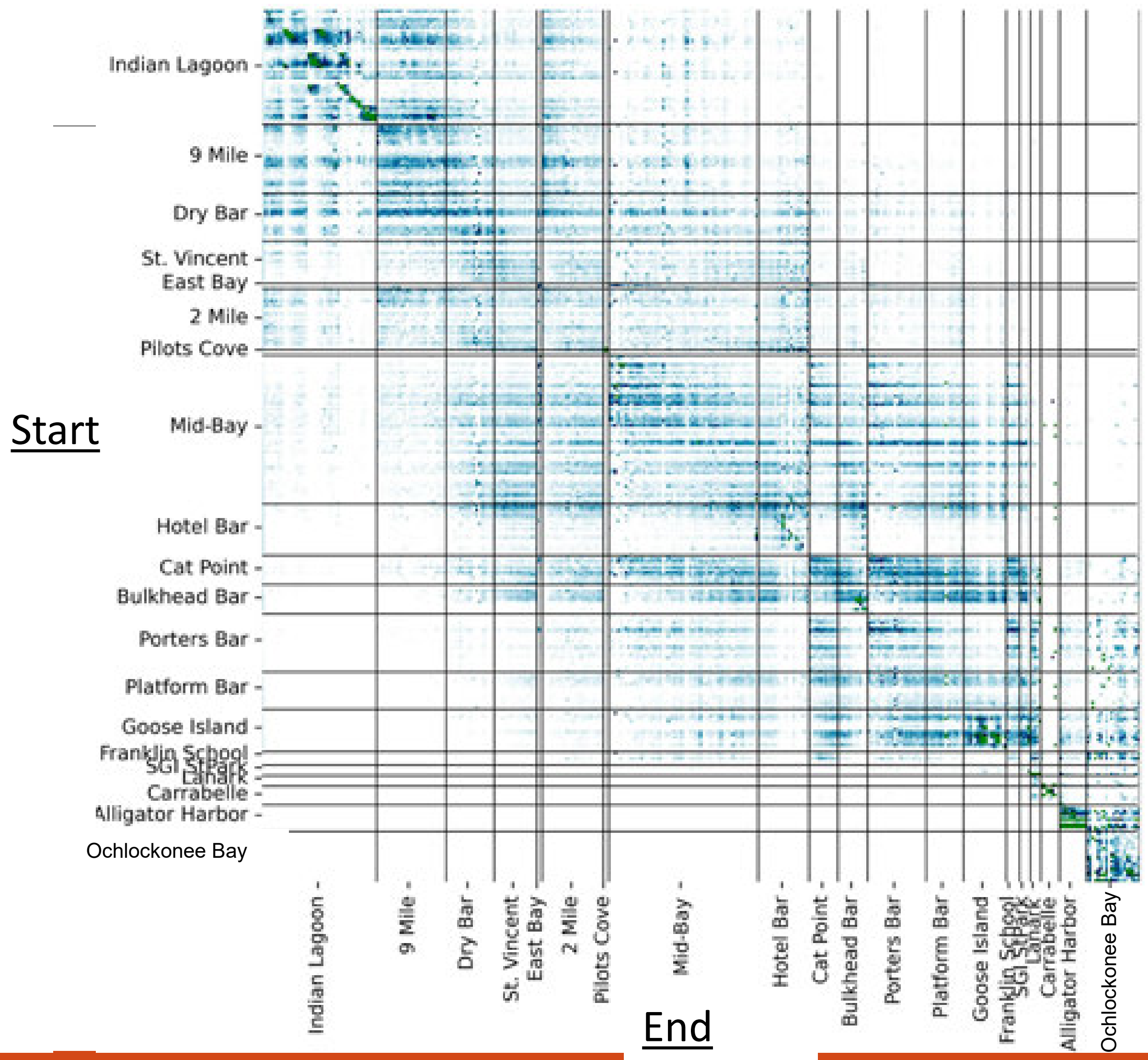


Results : Connectivity Matrices - Spring 'Flood'

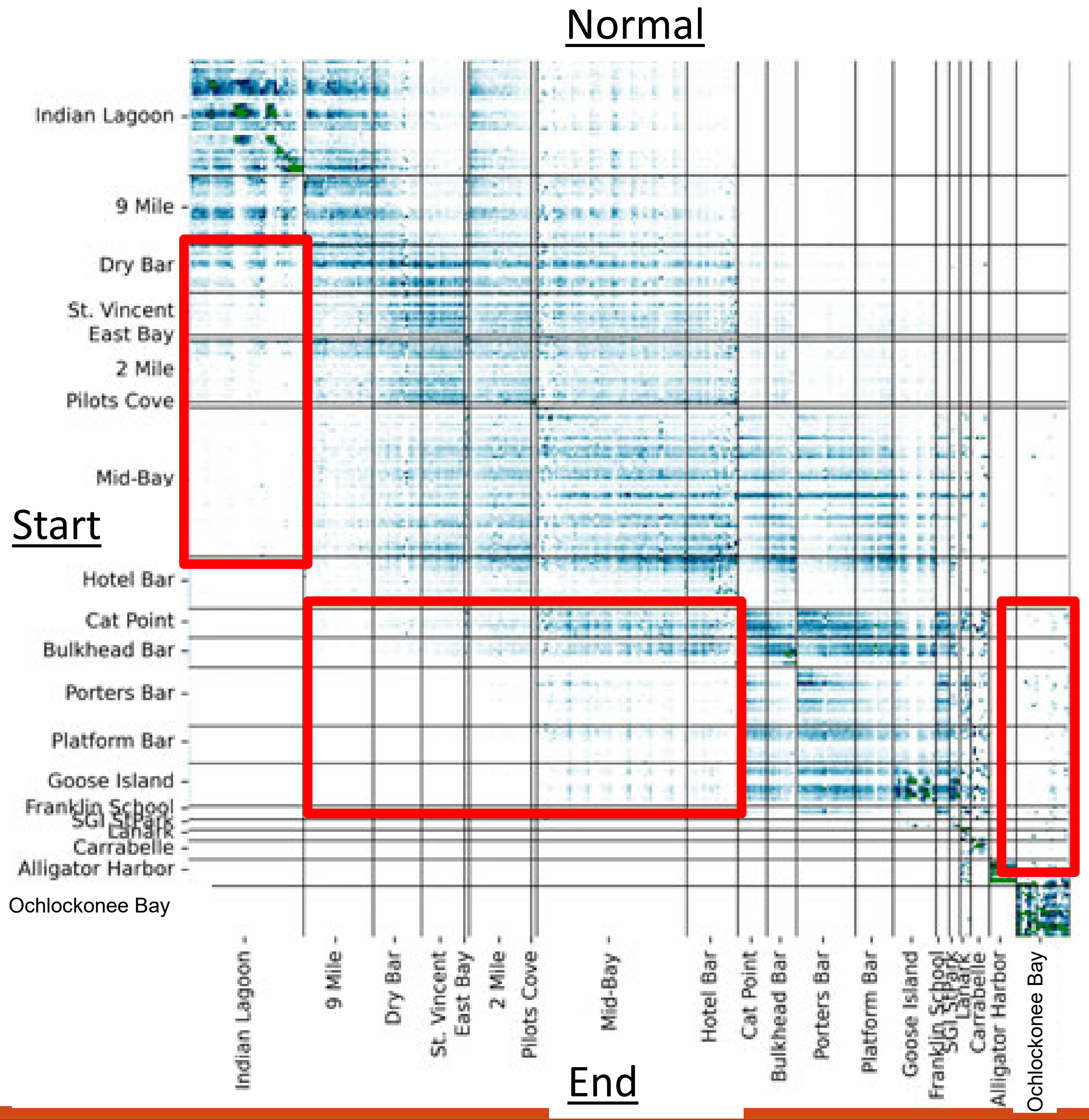
Normal

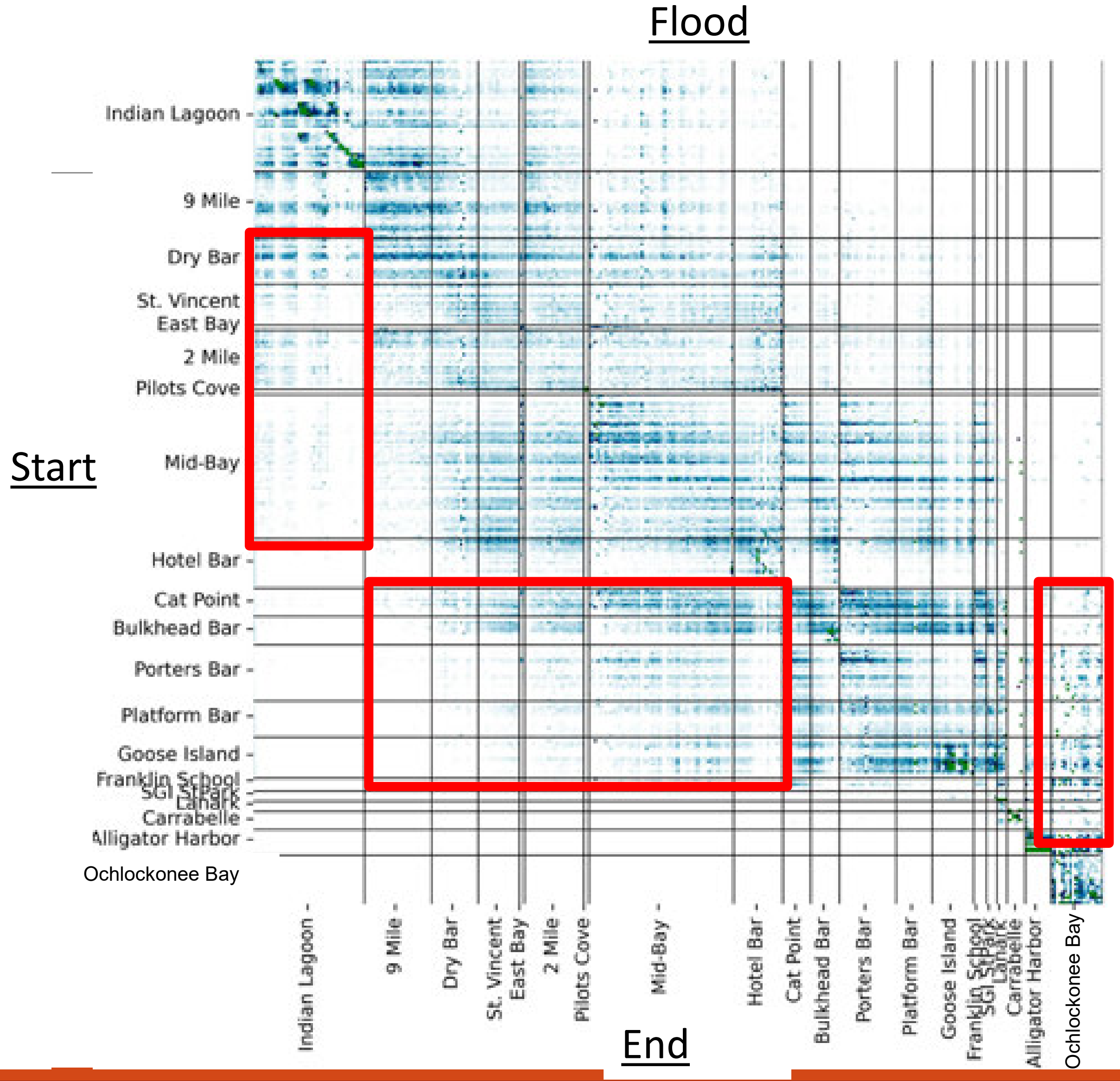


Flood

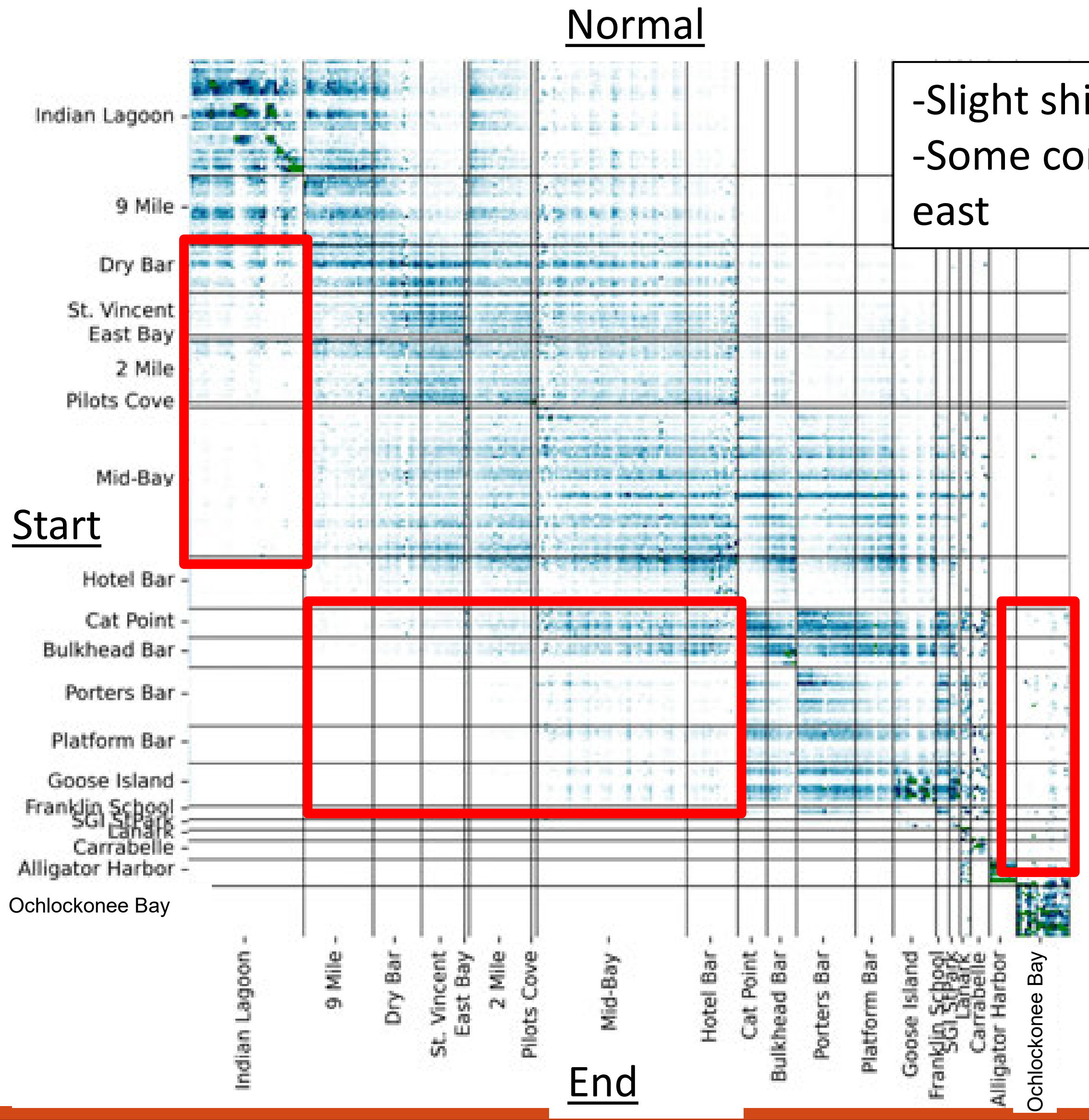


Results : Connectivity Matrices - Spring 'Flood'

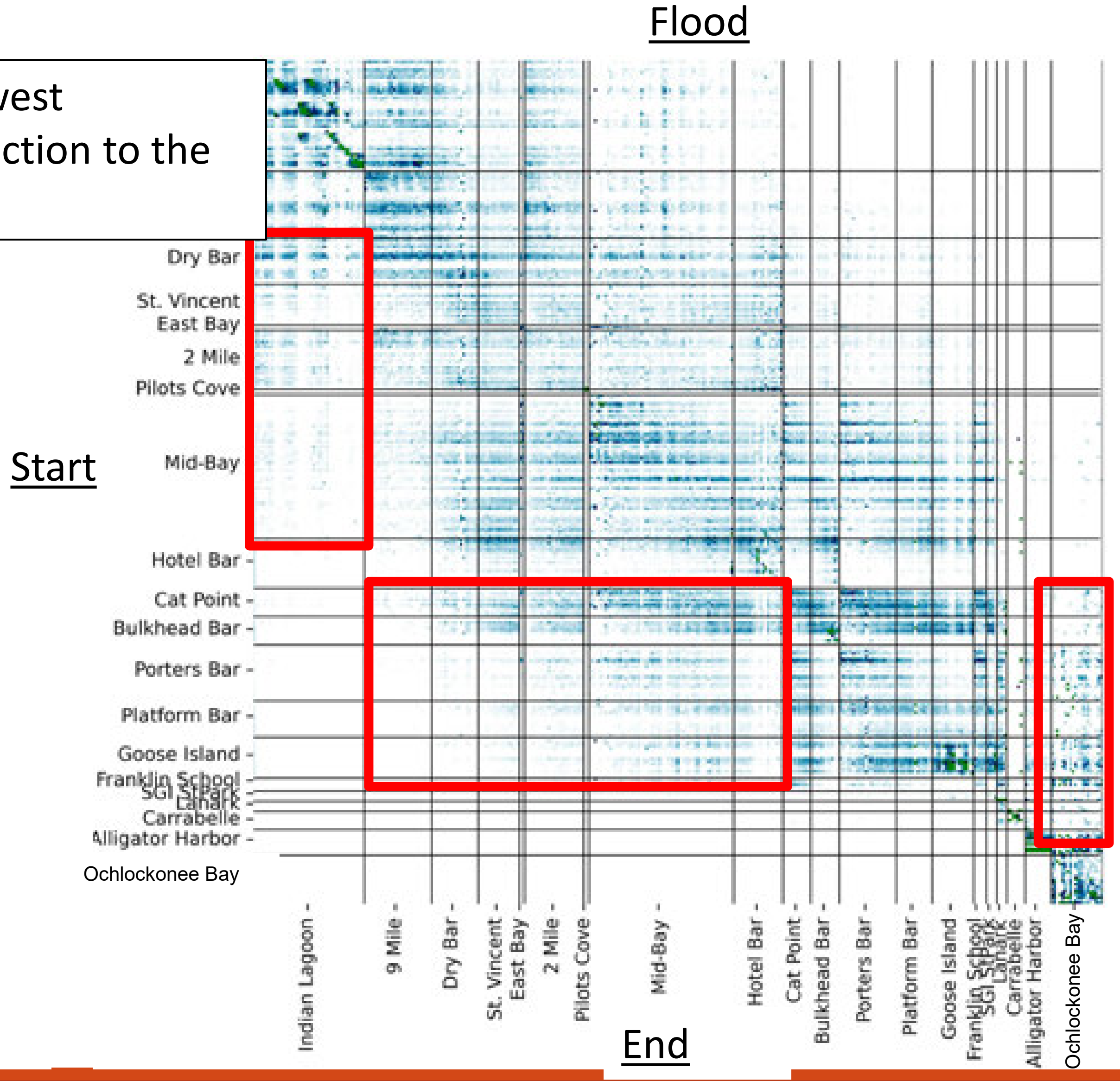




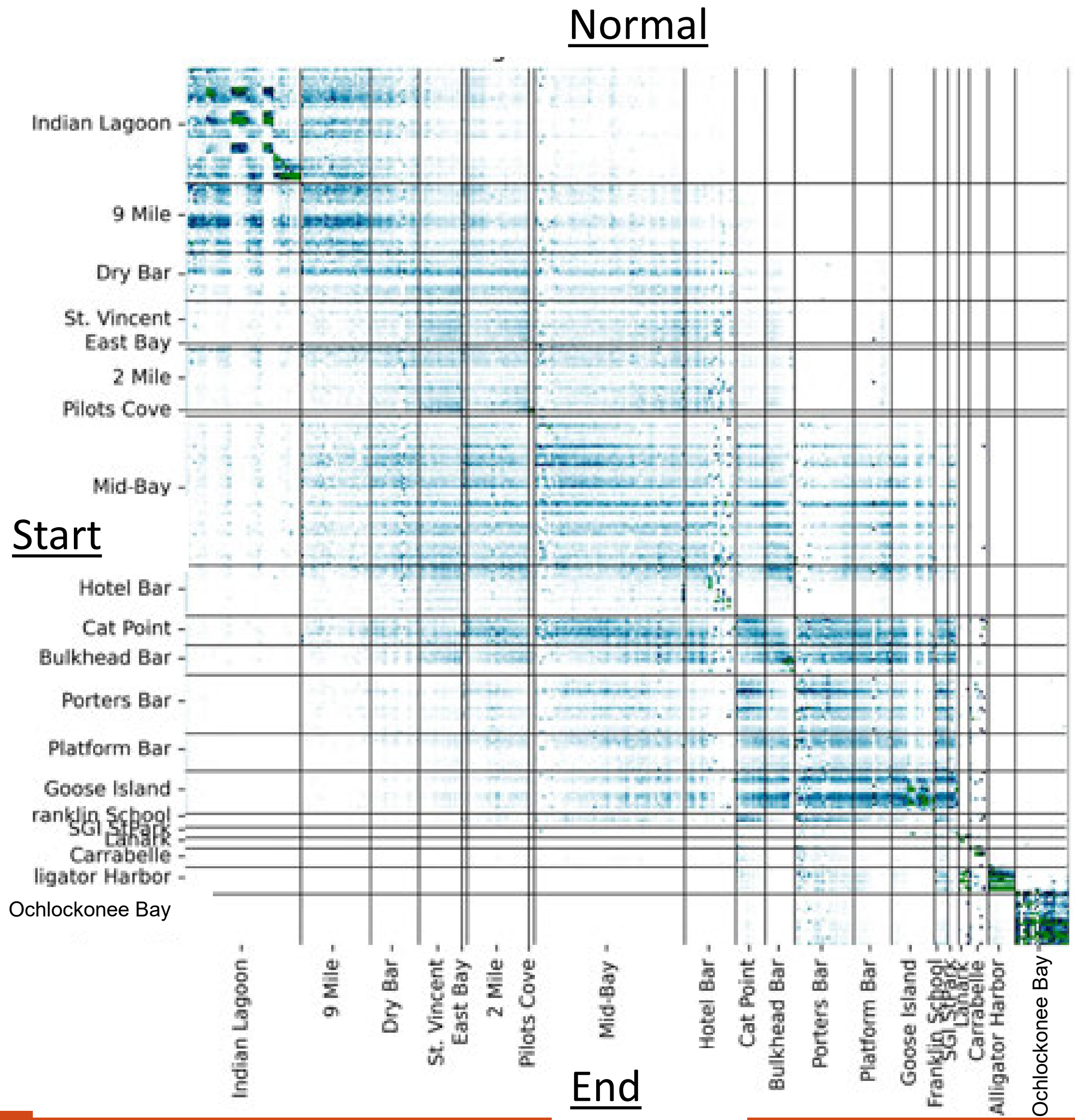
Results : Connectivity Matrices - Spring 'Flood'

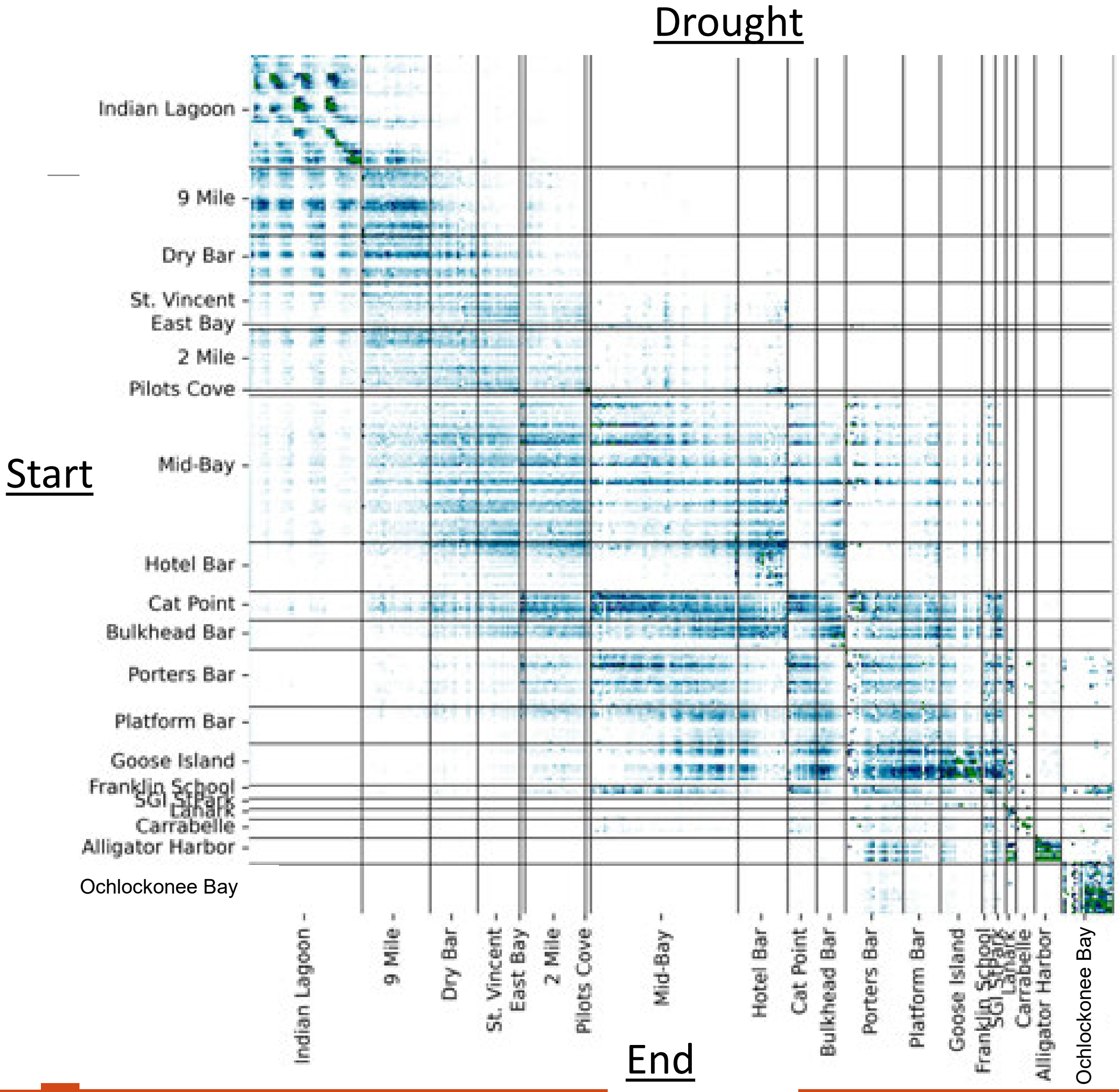


-Slight shift west
-Some connection to the east



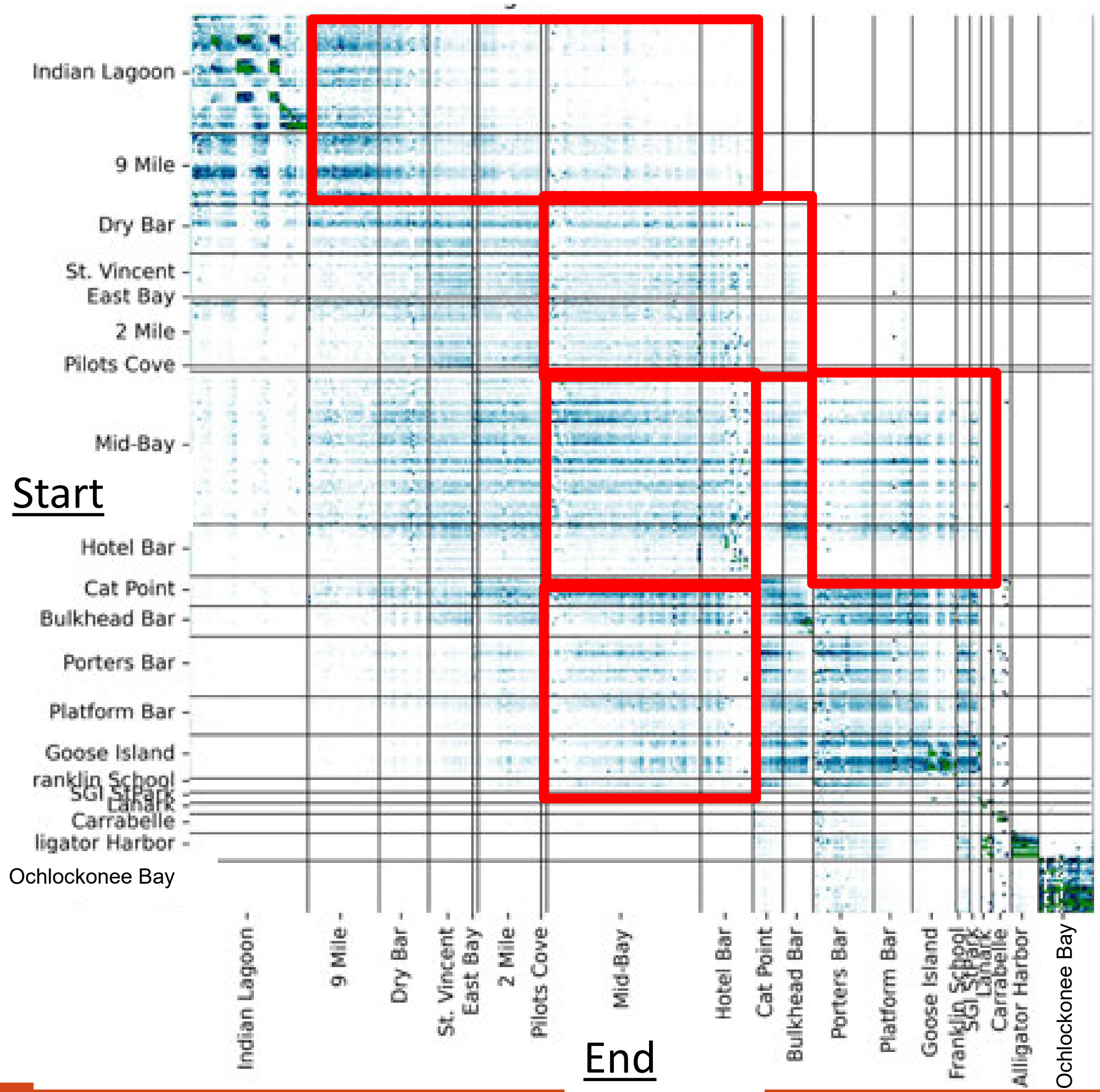
Results : Connectivity Matrices–Fall 'Drought'



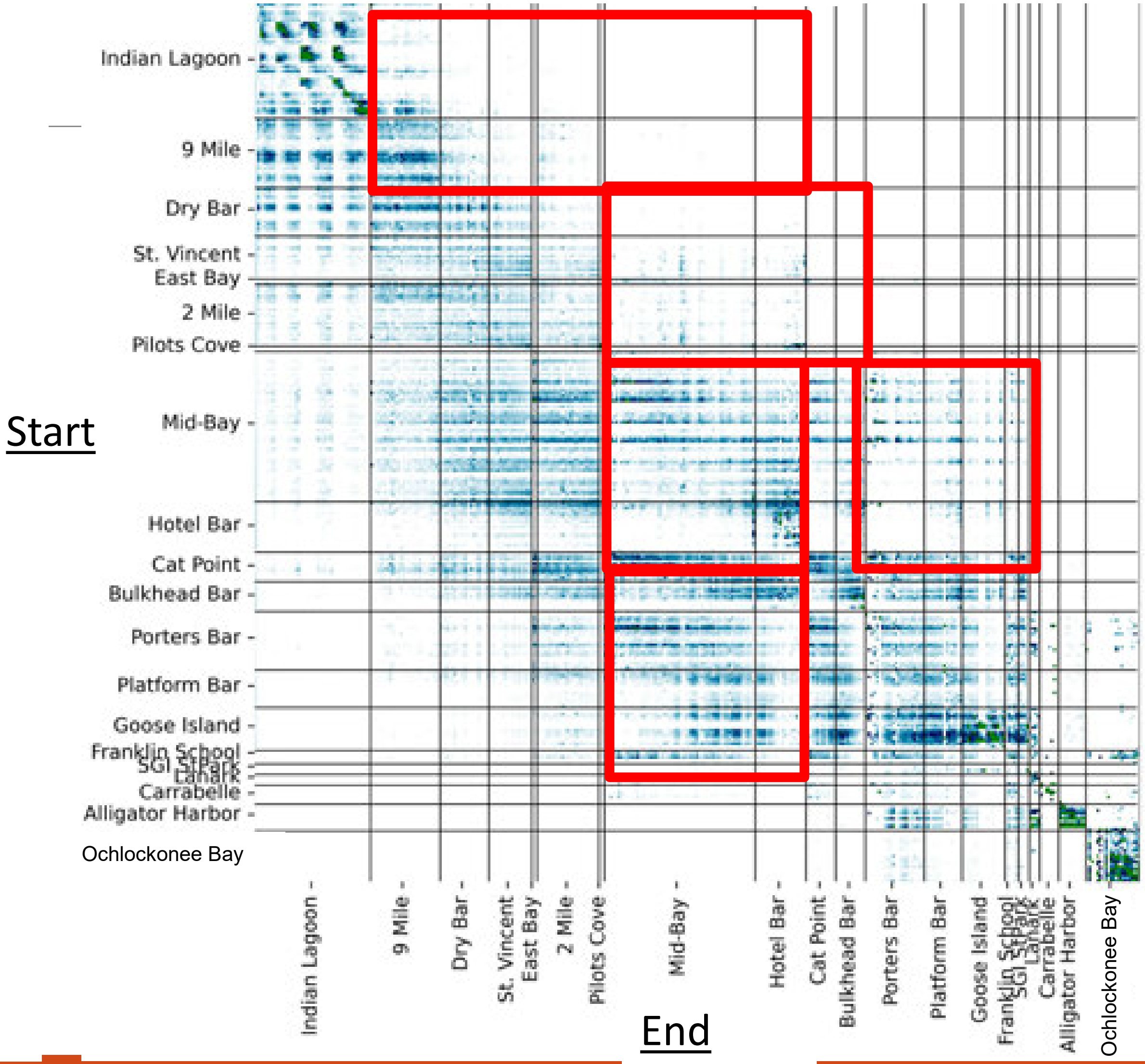


Results : Connectivity Matrices–Fall 'Drought'

Normal

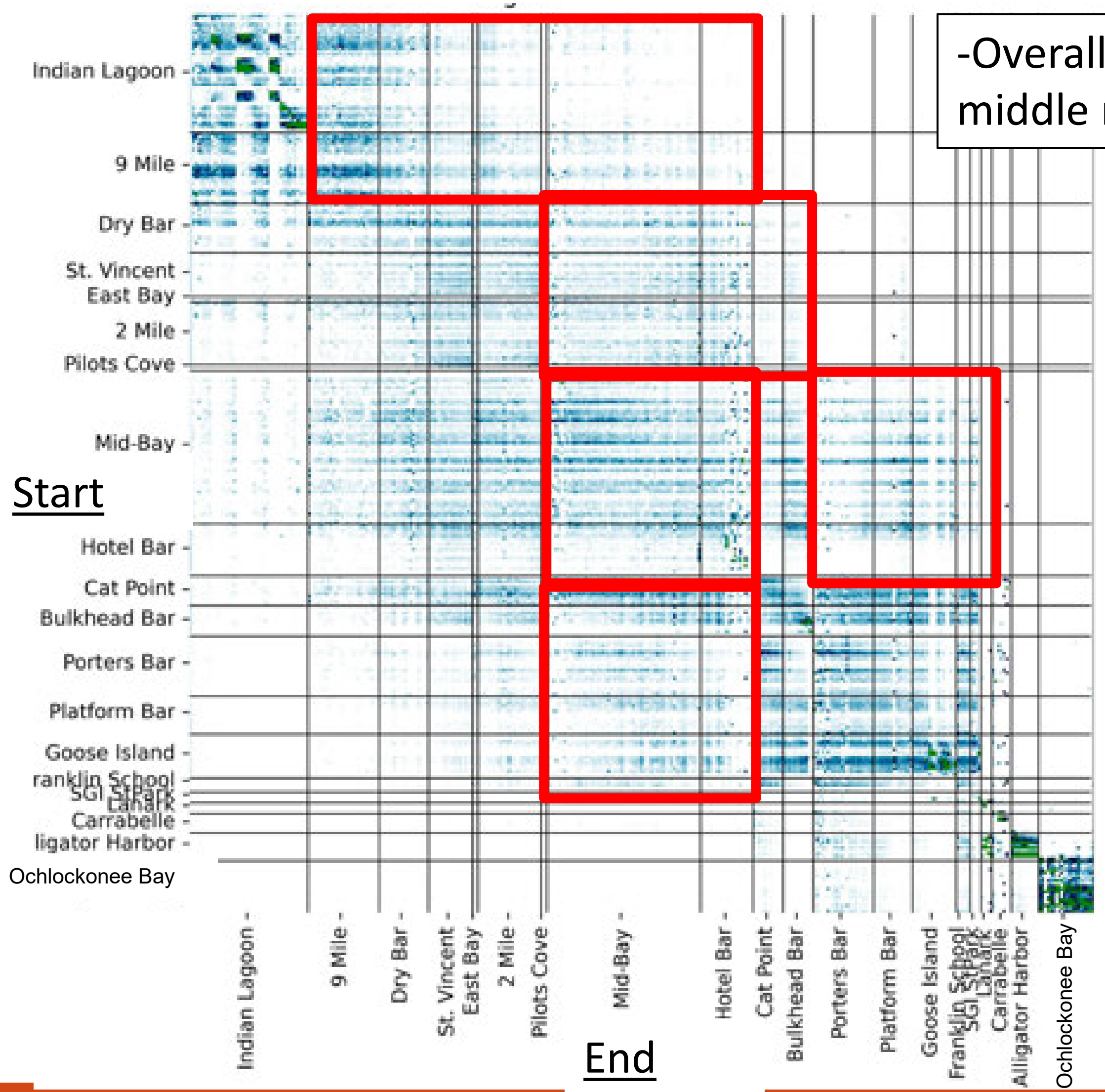


Drought



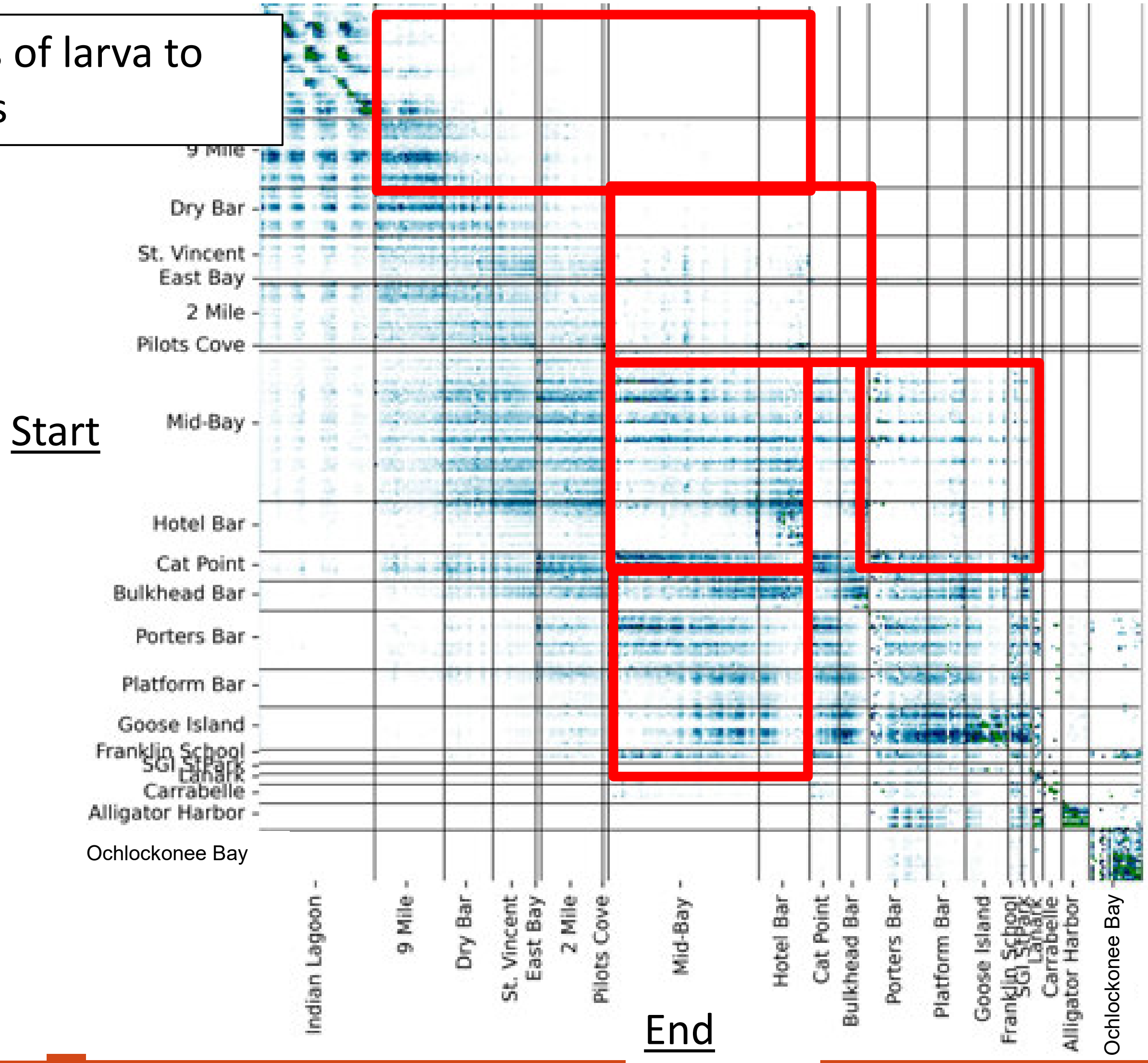
Results : Connectivity Matrices–Fall ‘Drought’

Normal

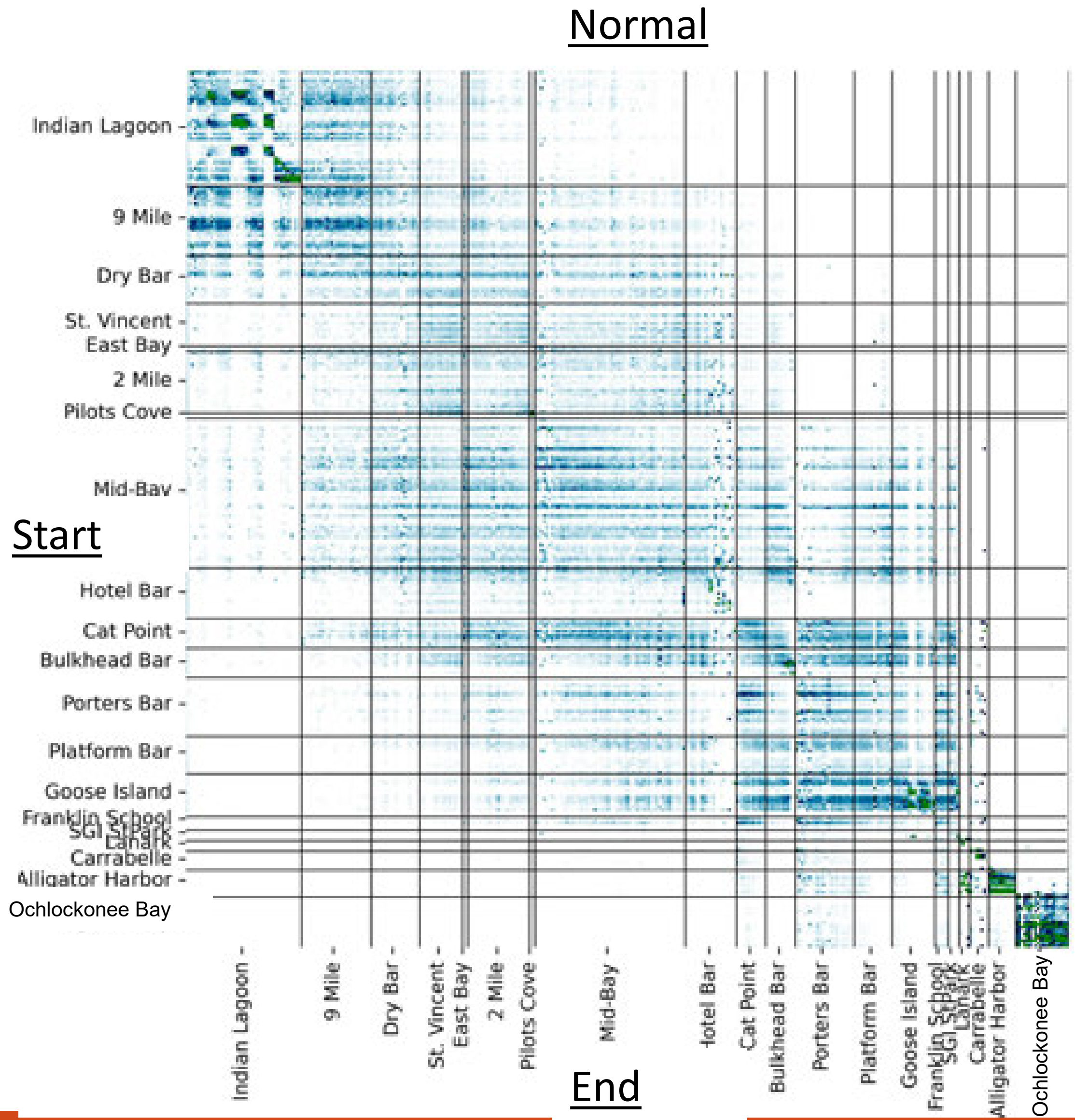


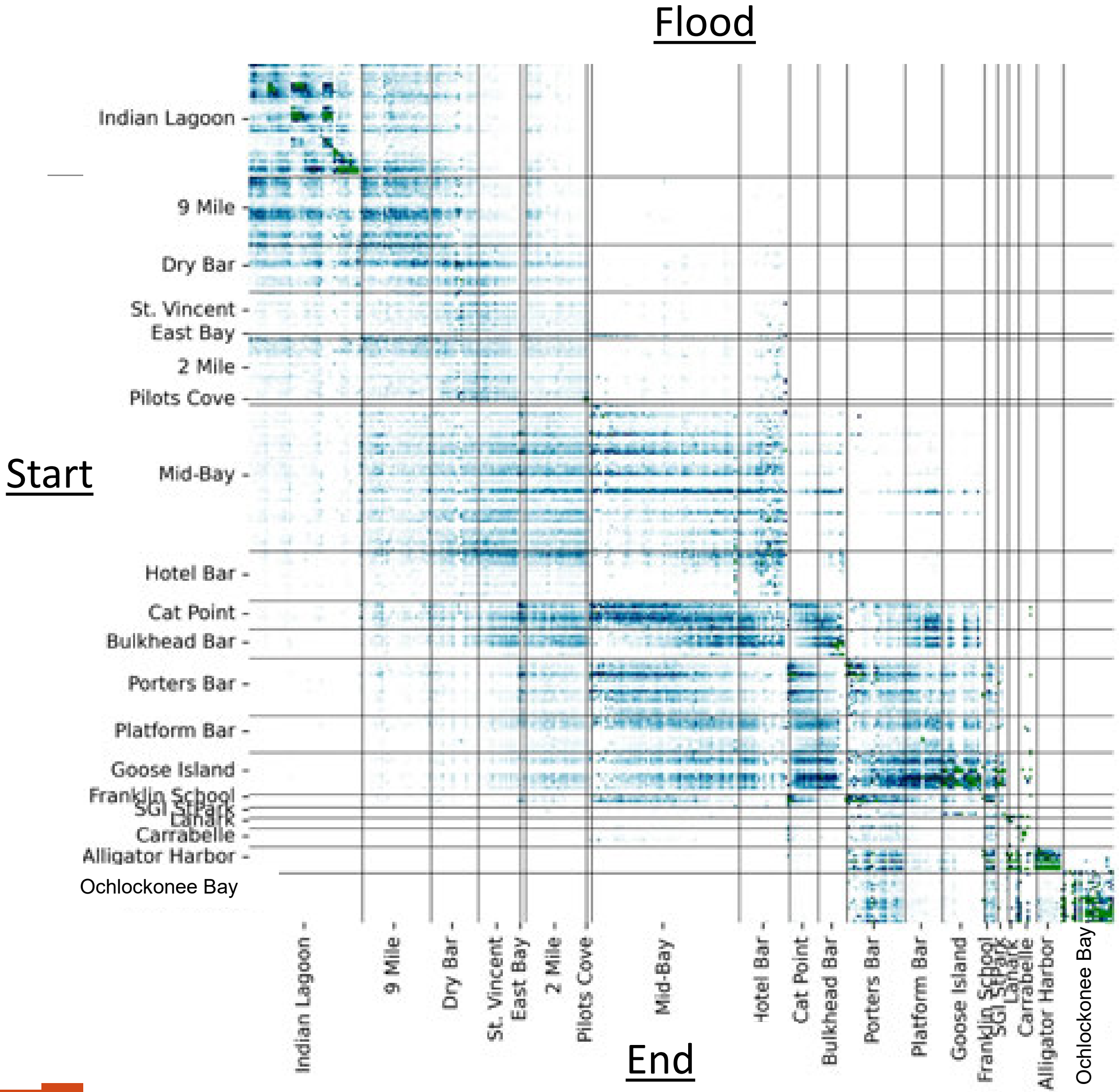
-Overall loss of larva to middle reefs

Drought

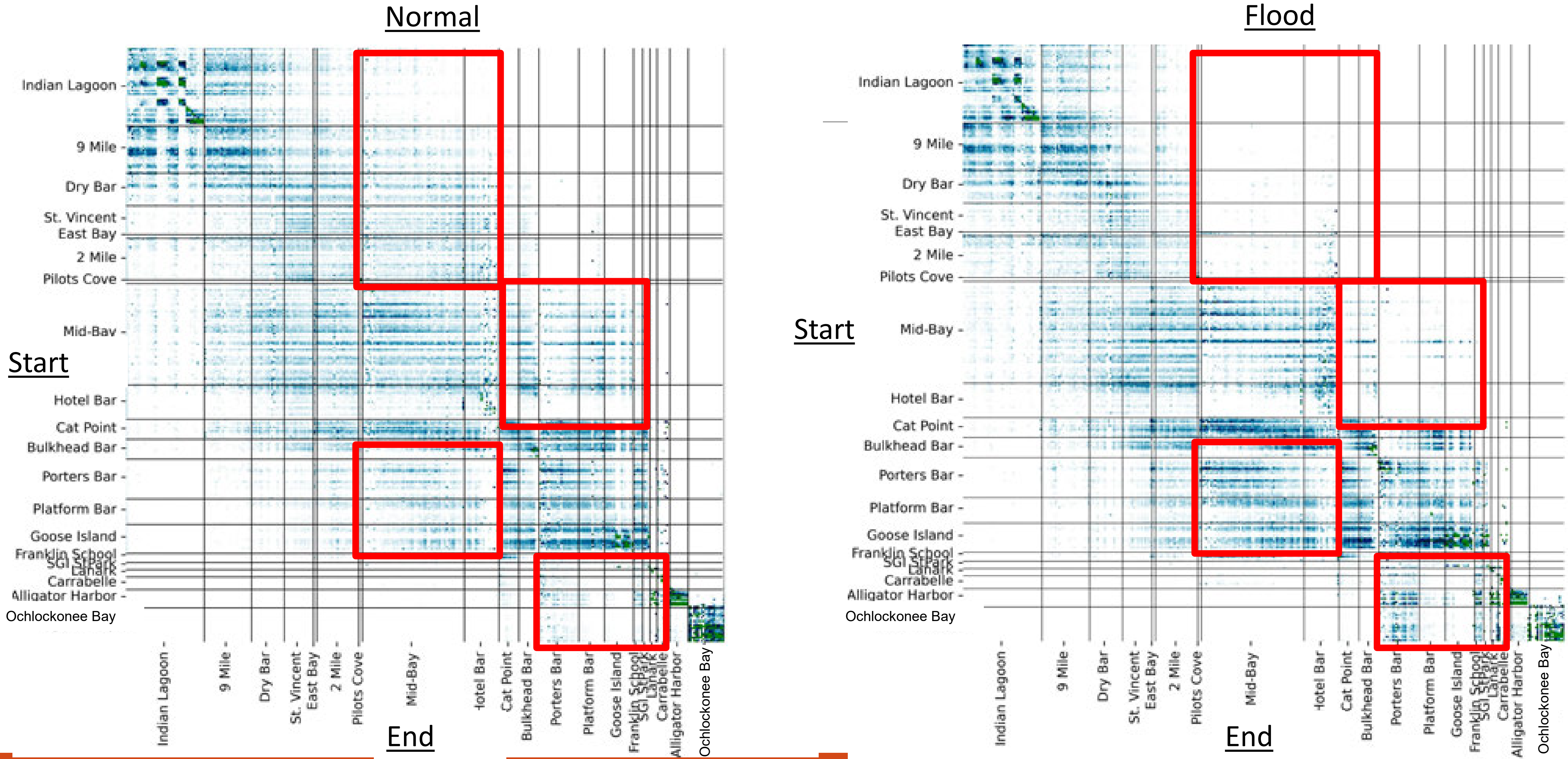


Results : Connectivity Matrices–Fall 'Flood'





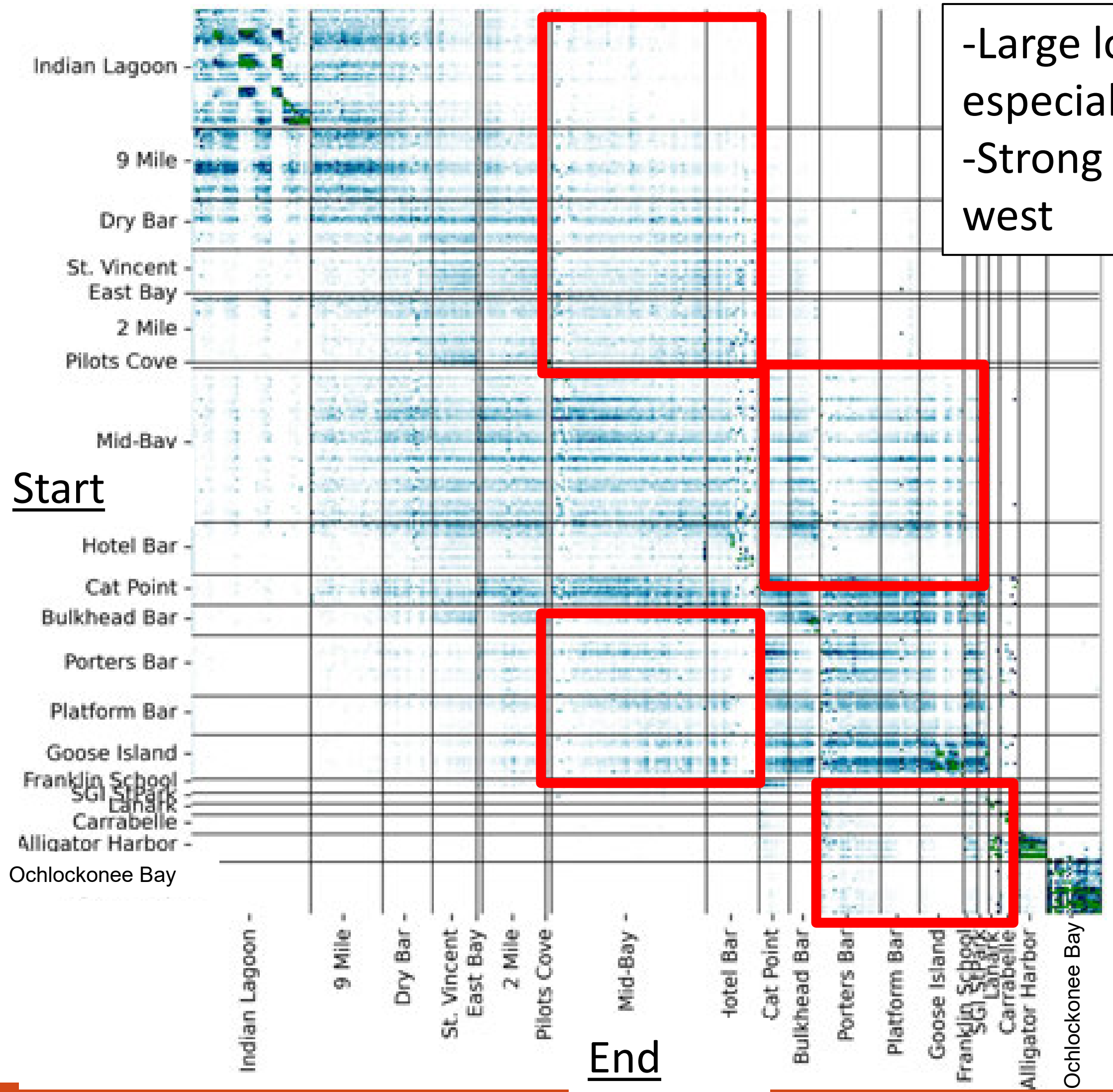
Results : Connectivity Matrices–Fall 'Flood'



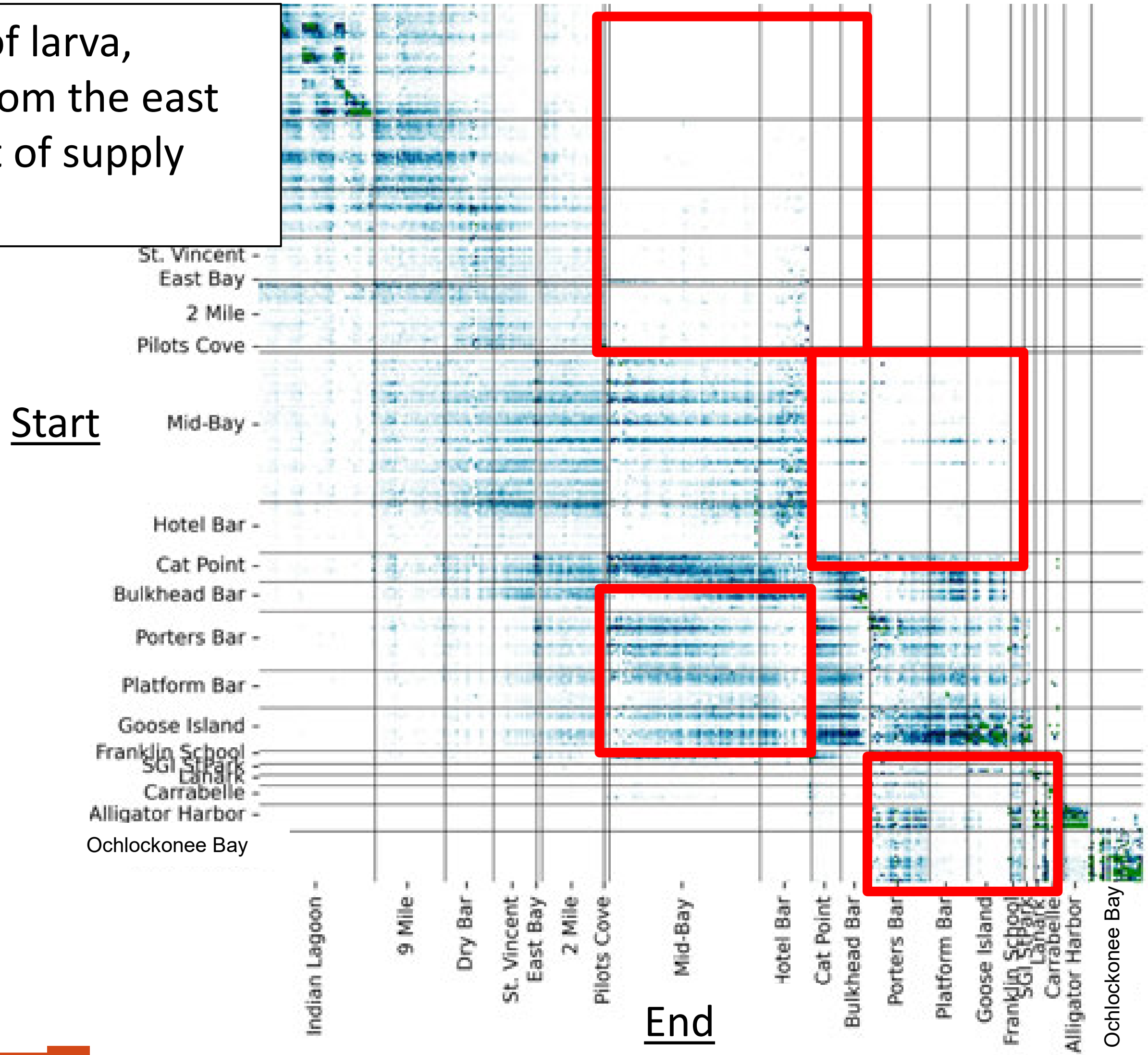
Results : Connectivity Matrices–Fall ‘Flood’

-Large loss of larva, especially from the east
-Strong shift of supply west

Normal



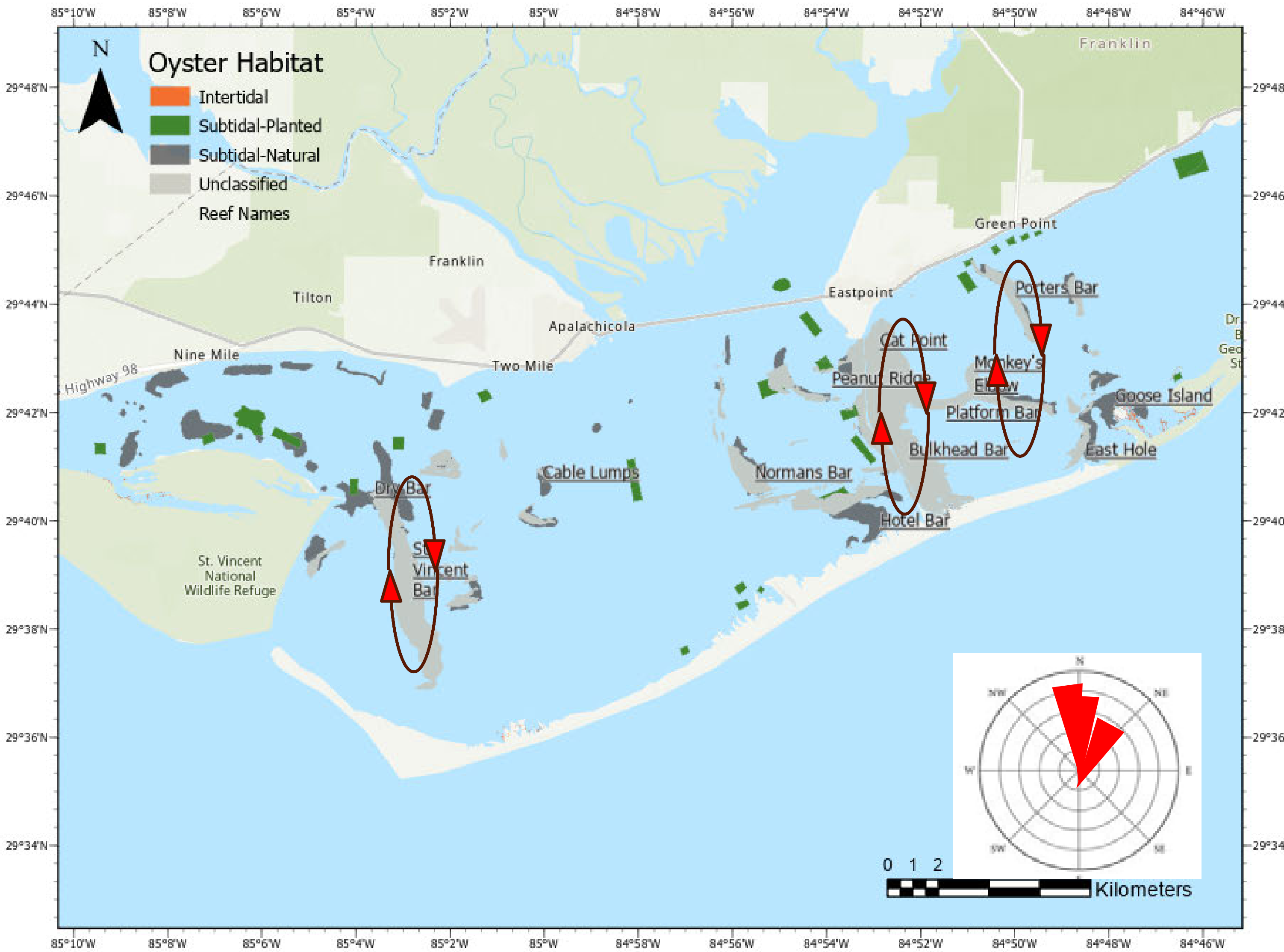
Flood



Implications

Spring

- Larva tend to settle on or near home reefs, connectivity across bay is limited



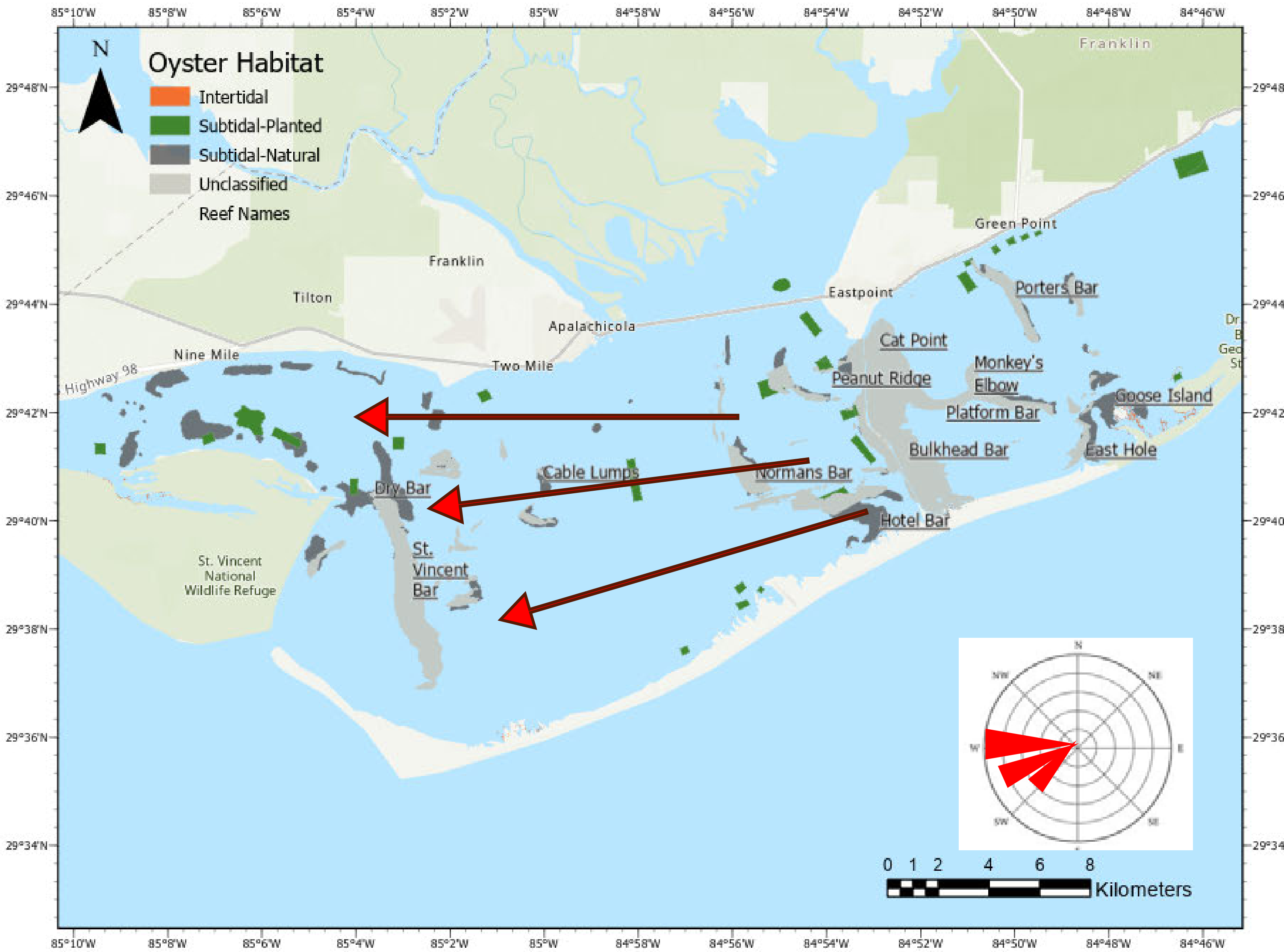
Implications

Spring

- Larva tend to settle on or near home reefs, connectivity across bay is limited

Fall

- Higher mortality
- Increased westward connectivity, flow of larval supply from east to western reefs



Implications

Spring

- Larva tend to settle on or near home reefs, connectivity across bay is limited

Fall

- Higher mortality
- Increased westward connectivity, flow of larval supply from east to western reefs

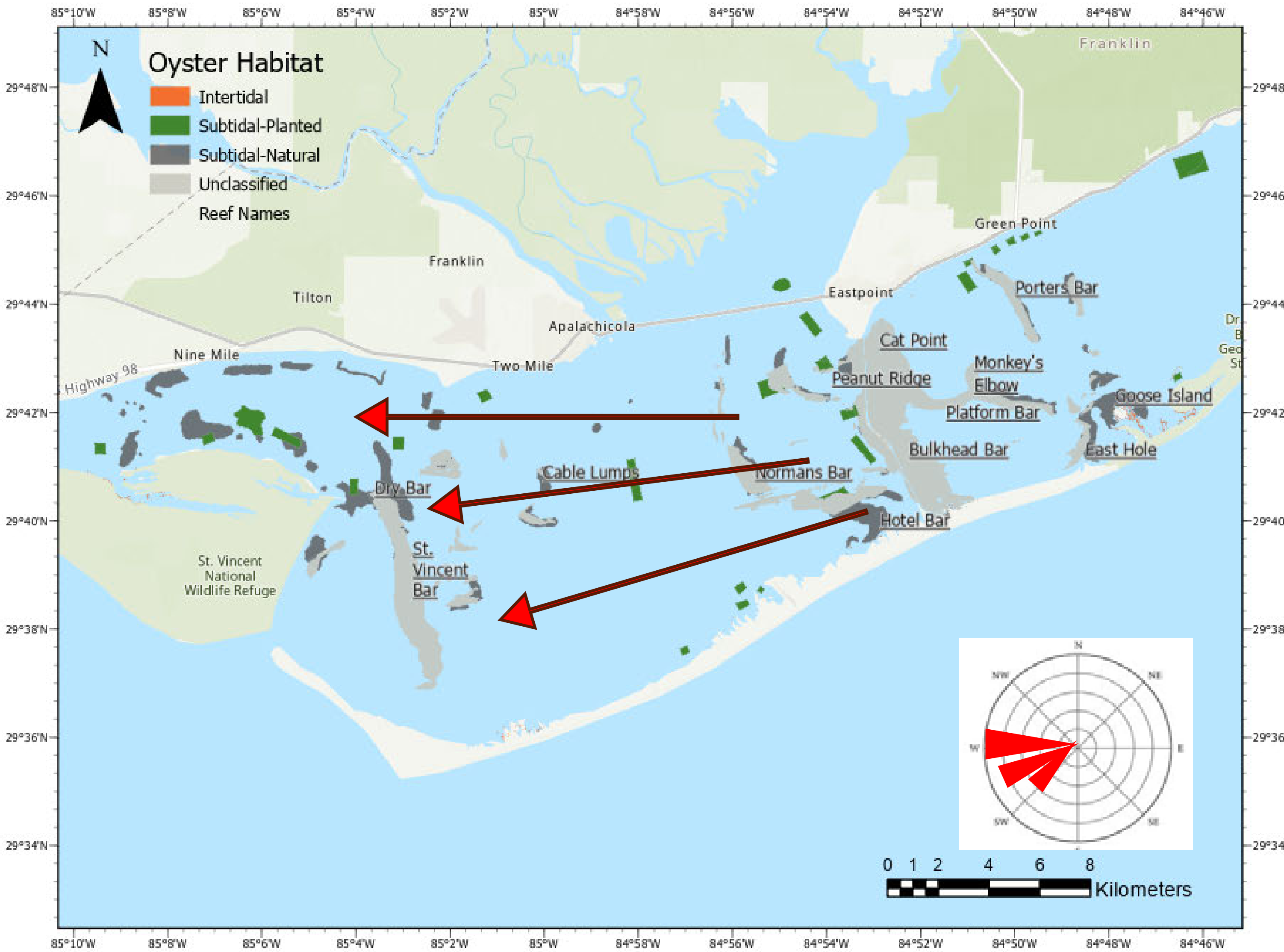
Flood

- Greater impacts to Fall survival, connectivity dynamics

Drought

- Greater impacts to Spring survival, connectivity dynamics

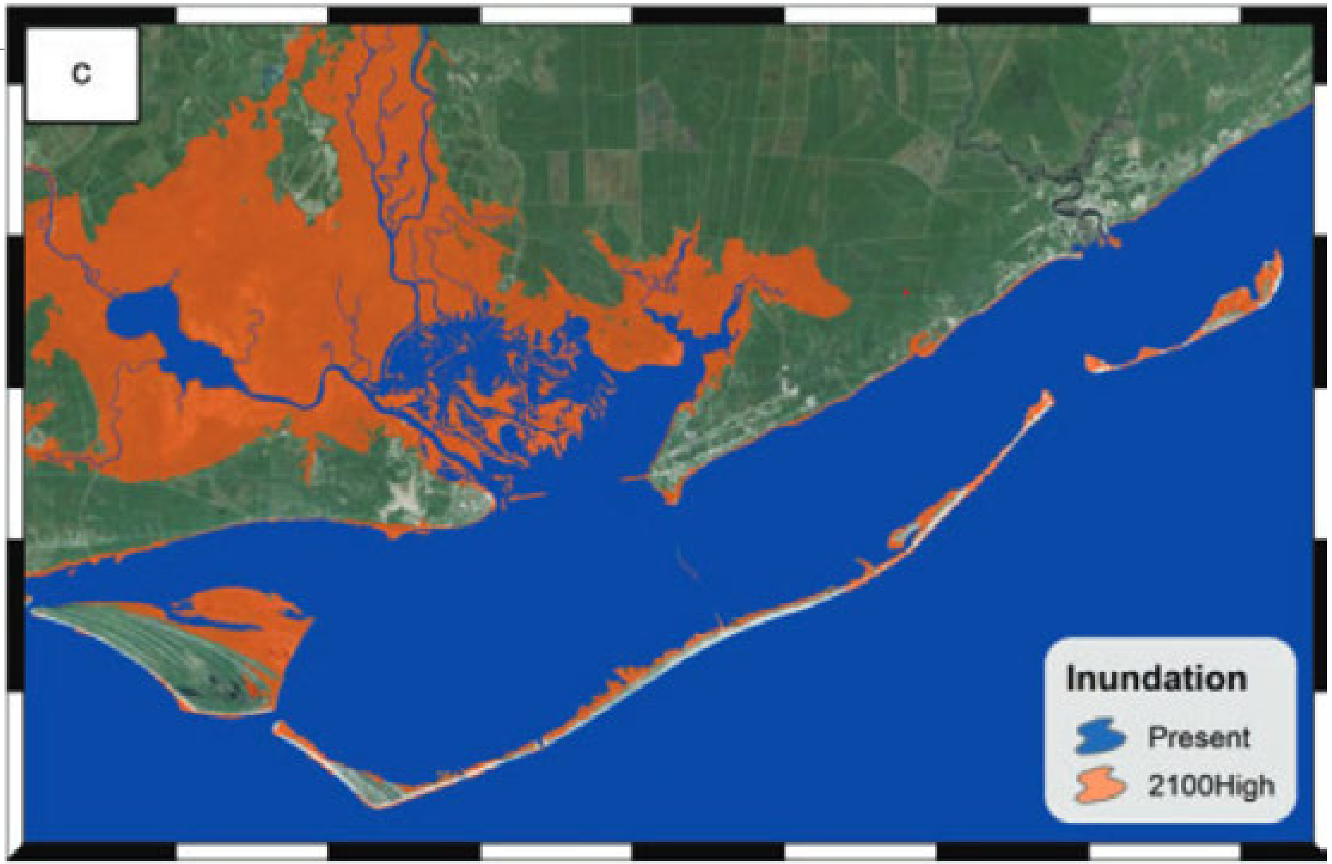
Restoration and experiments can be influenced by seasonal variations in larval supply and connectivity



Future work

Habitat Suitability Model (Index)

Projection under future climates



Passeri et al. 2016

Thanks!

Apalachicola Bay System Initiative – Dr. Sandra Brooke, all the marine tech’s

Center for Ocean and Atmospheric Predictive Services – Dr. Steve Morey, Dr. Xu Chen

FSU Coastal Marine Laboratory

Apalachicola National Estuarine Research Reserve

Florida Fish and Wildlife Conservation Commission

Triumph Gulf Coast Inc. – Grant #69

Questions?

Comparisons of Crassostrea virginica Growth, Condition, and Mortality Rates Between Oyster Bars within Apalachicola Bay, Florida

Presenter: Lauren N. Rice

Substantial investment has been dedicated to restoring Eastern oyster (Crassostrea virginica) populations in Apalachicola Bay following their collapse, yet wild populations remain depressed compared to historic levels. While some areas in the eastern bay have shown moderate recovery, understanding of the environmental stressors affecting oysters remain vital to future restoration efforts. We investigated the health, growth, and mortality of post-settled C. virginica, and compared these metrics across three historically productive oyster bars within Apalachicola Bay: Cat Point, East Hole, and North Spur. We obtained offspring from wild oysters reared in the Florida State University Coastal and Marine Lab research hatchery. Oysters were transferred into experimental cages at each study site. We monitored growth rates for 21 weeks and assessed mortality and condition every three weeks. We recorded temperature and salinity at each site using HOBO loggers. Oysters at North Spur had the highest average growth rates, greatest condition indices, and the lowest mortality. In contrast, East Hole oysters showed the lowest condition indices, and Cat Point oysters had both the lowest growth rates and highest mortality. Average temperatures were similar among sites, but East Hole had notably higher salinity. Both East Hole and Cat Point displayed greater variability in salinity over the study period. These results suggest that spatial differences in salinity regimes contribute to varying performance among young oysters within Apalachicola Bay. Our findings highlight how environmental stressors may influence the recovery potential for wild oyster populations and provide insight to better inform future restoration efforts.

Slides unavailable publicly. Please contact Lauren N. Rice for more information: lnrice@fsu.edu

Apalachicola National Estuarine Research Reserve Symposium

Impacts of droughts on inorganic nitrogen and phosphorus transport into Apalachicola Bay

Sumon Hossain Rabby & Ebrahim Ahmadisharaf

Dept. of Civil and Environmental Engineering,
FAMU-FSU College of Engineering, Tallahassee, FL 32310

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

FAMU-FSU College of Engineering

RIDER
Resilient Infrastructure & Disaster Response Center

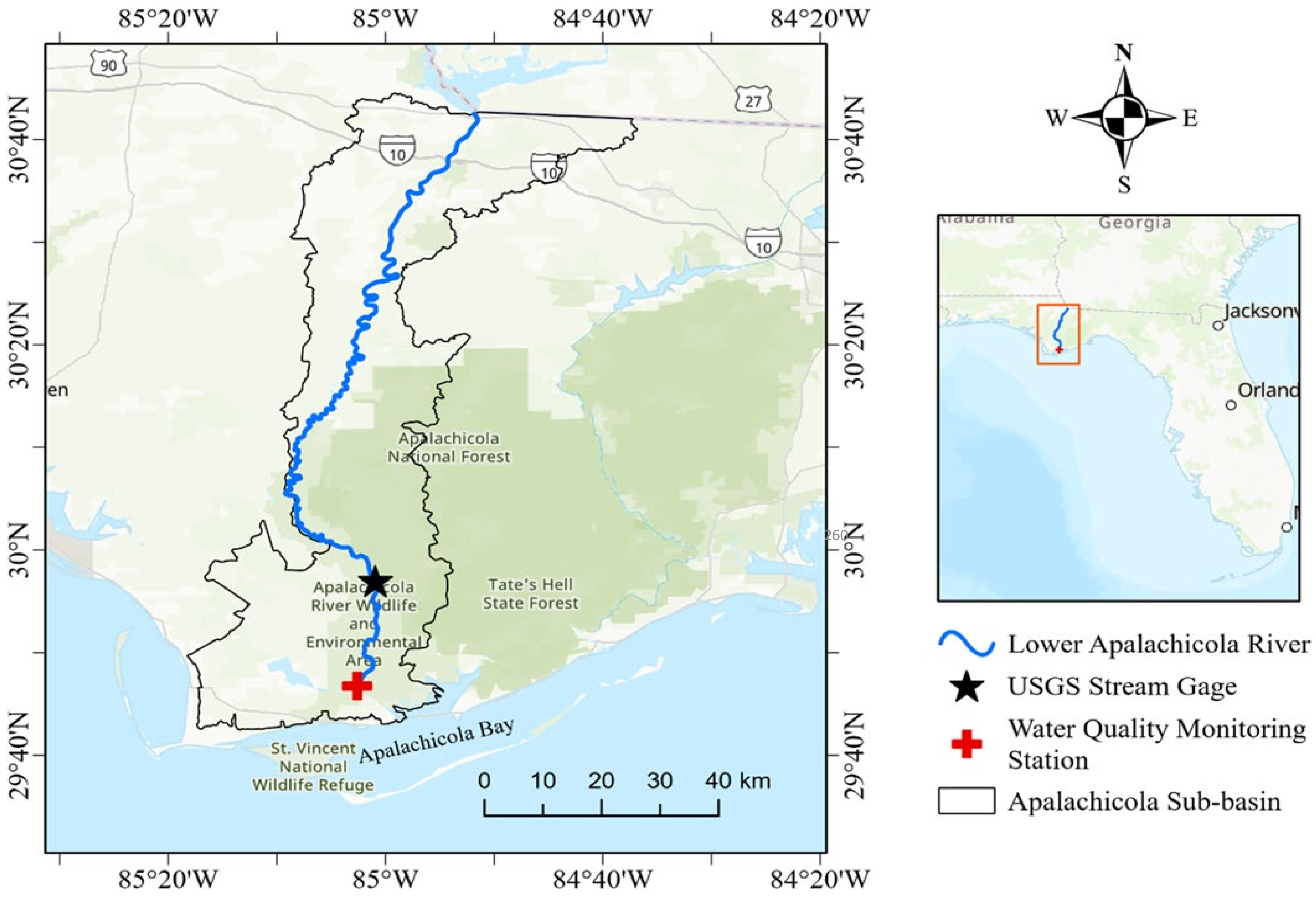
Background

- Substantial flow reduction in Lower Apalachicola River Estuary for two decades

- Ecological disruptions such as algal blooms.

- Understanding nutrients' (phosphorus and nitrogen) responses to the streamflow droughts remain understudied

Study area and data

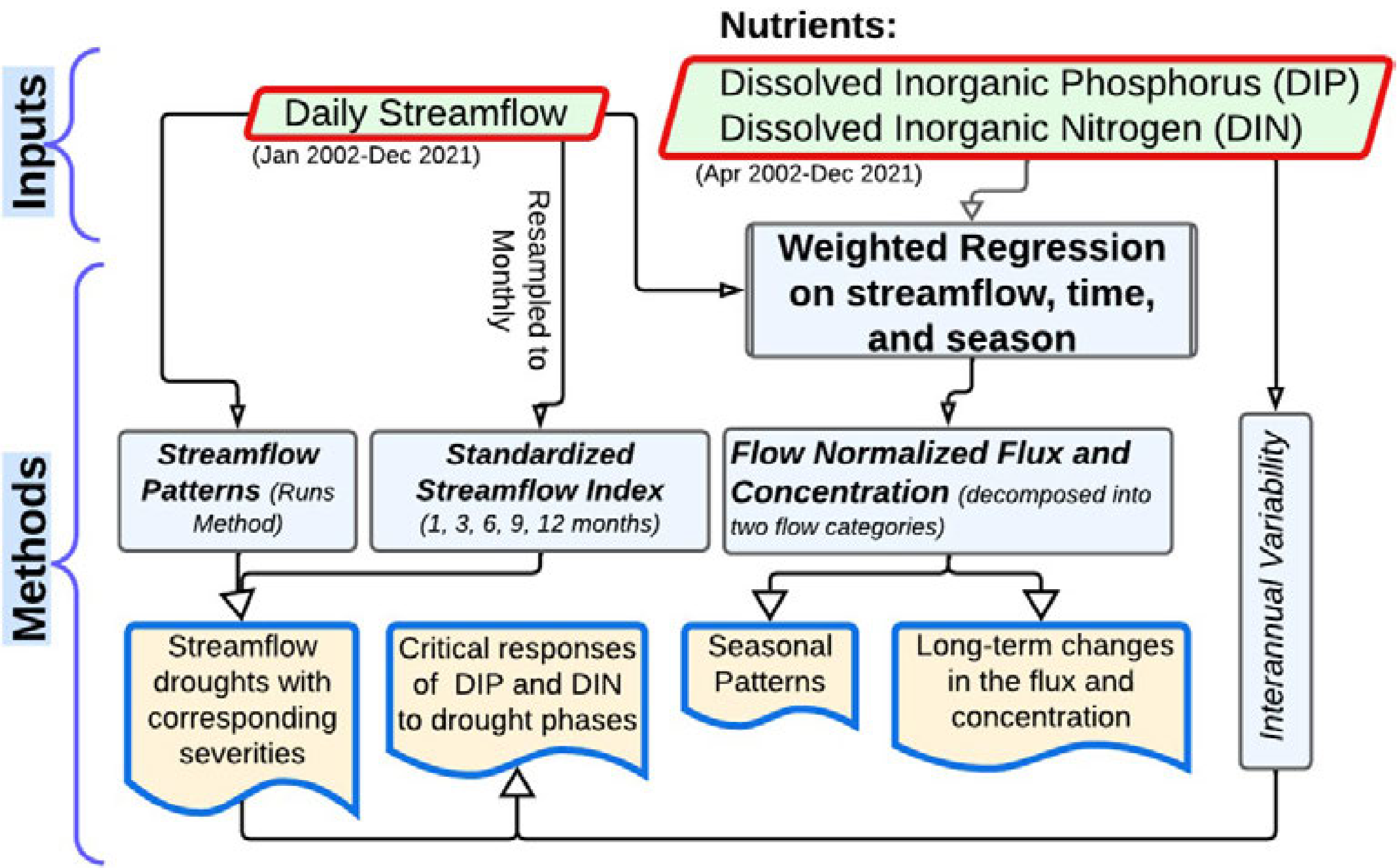


(2002-2021)

- ❑ Monthly Nutrients
- ❑ Daily Streamflow

APALACHICOLA NATIONAL ESTUARINE RESEARCH RESERVE

Methodology

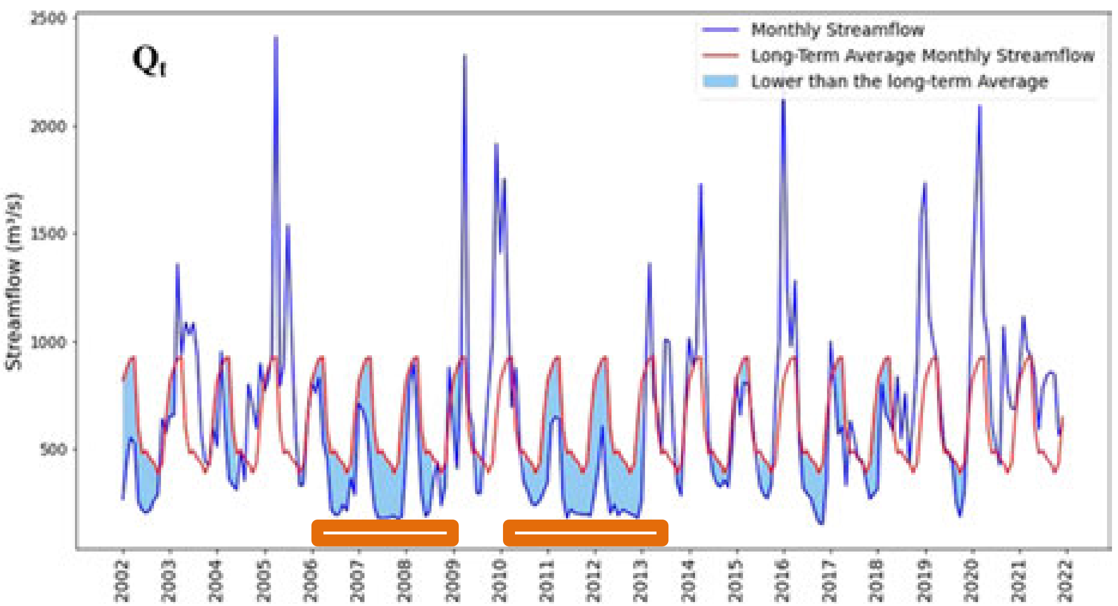


Results

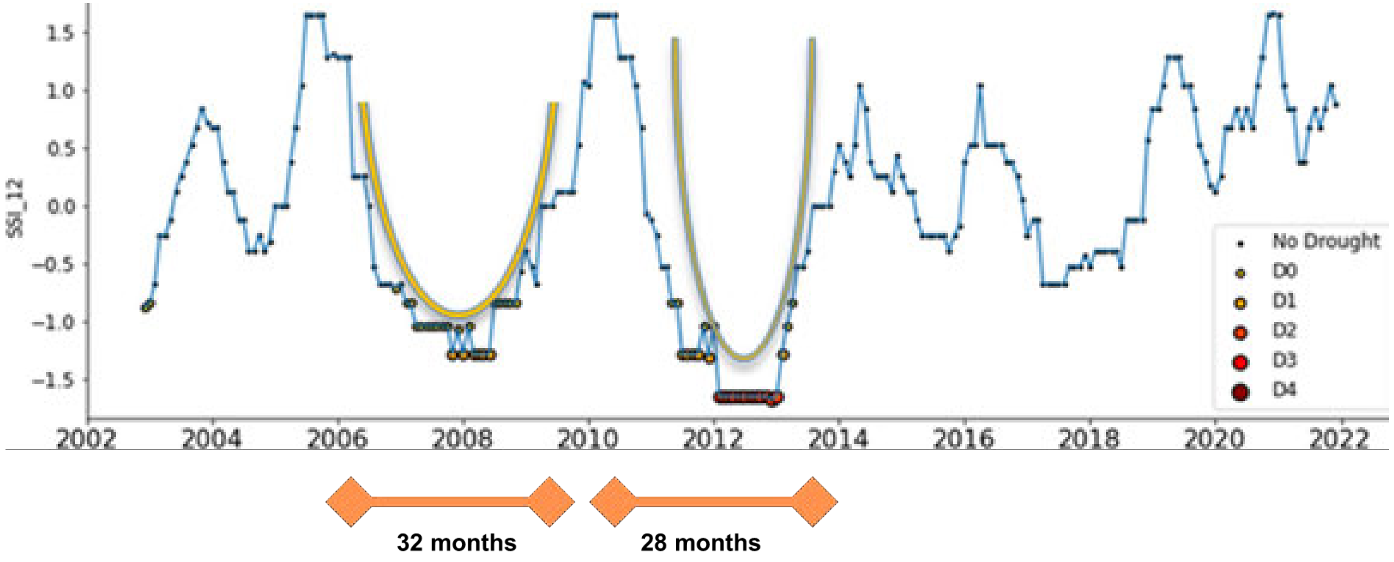
1. STREAMFLOW DROUGHTS

Two major consecutive drought periods:
- ❑ Aug 2006 – Mar 2009
- ❑ Mar 2011 – June 2013

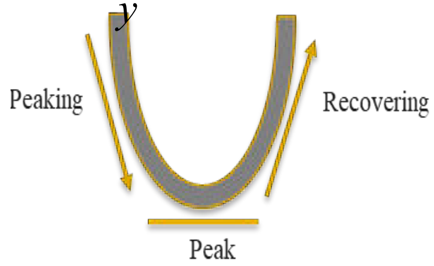
Streamflow Patterns and Anomalies



Standardized Streamflow Indices (SSI)

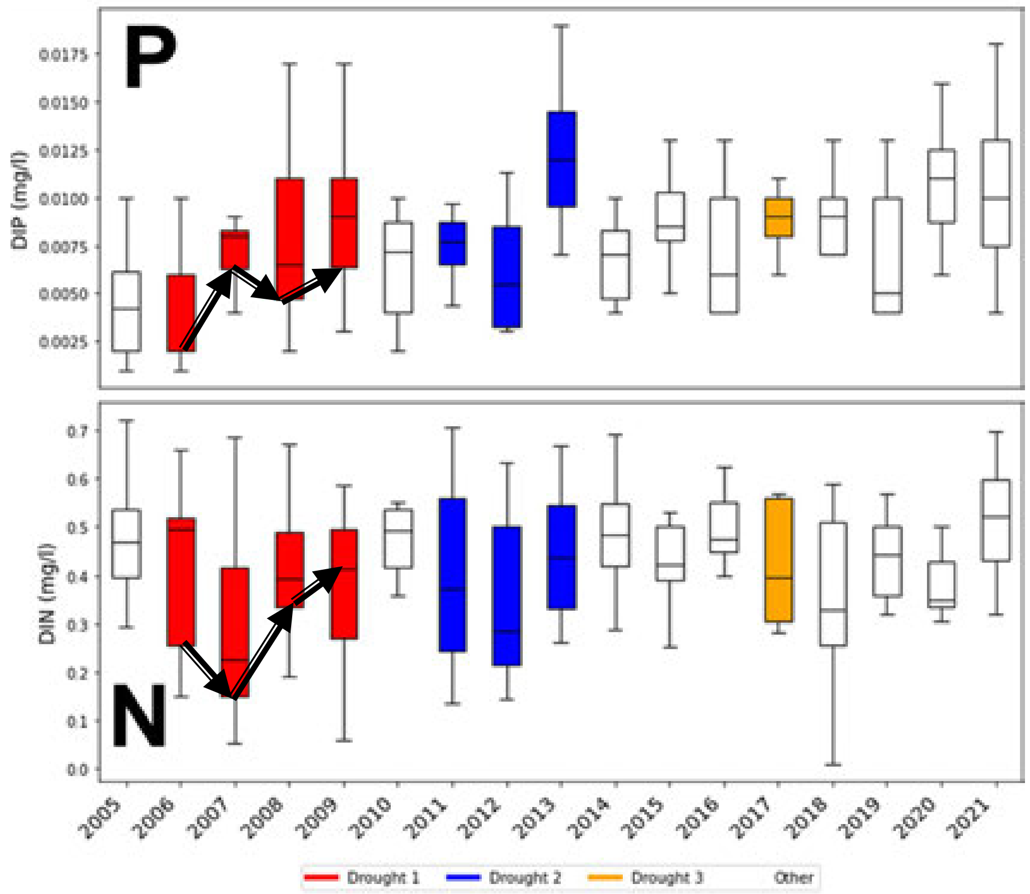


Phenolog y

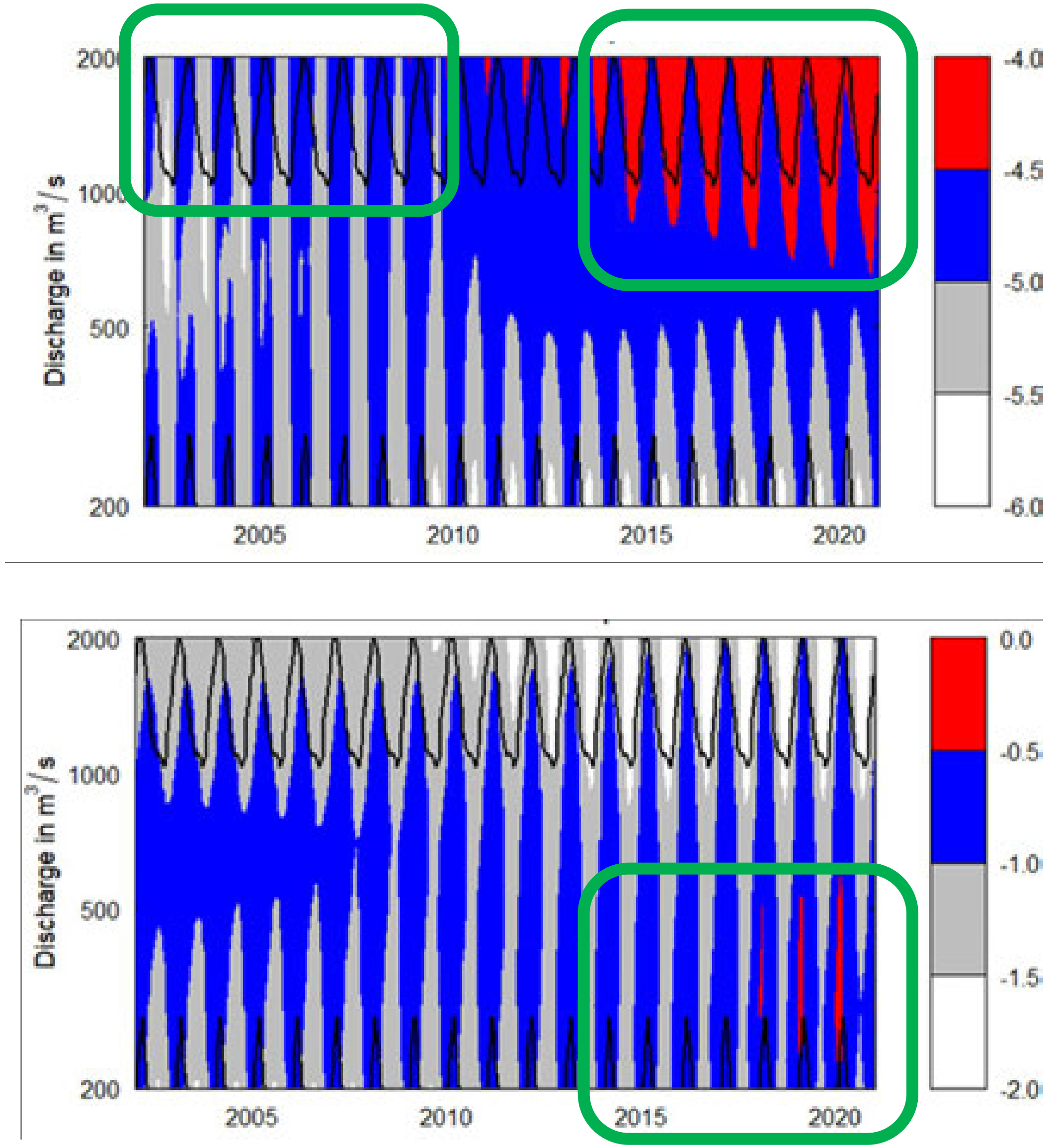


2. CHANGES IN NUTRIENTS (N & P)

Annual Distribution of Nutrients



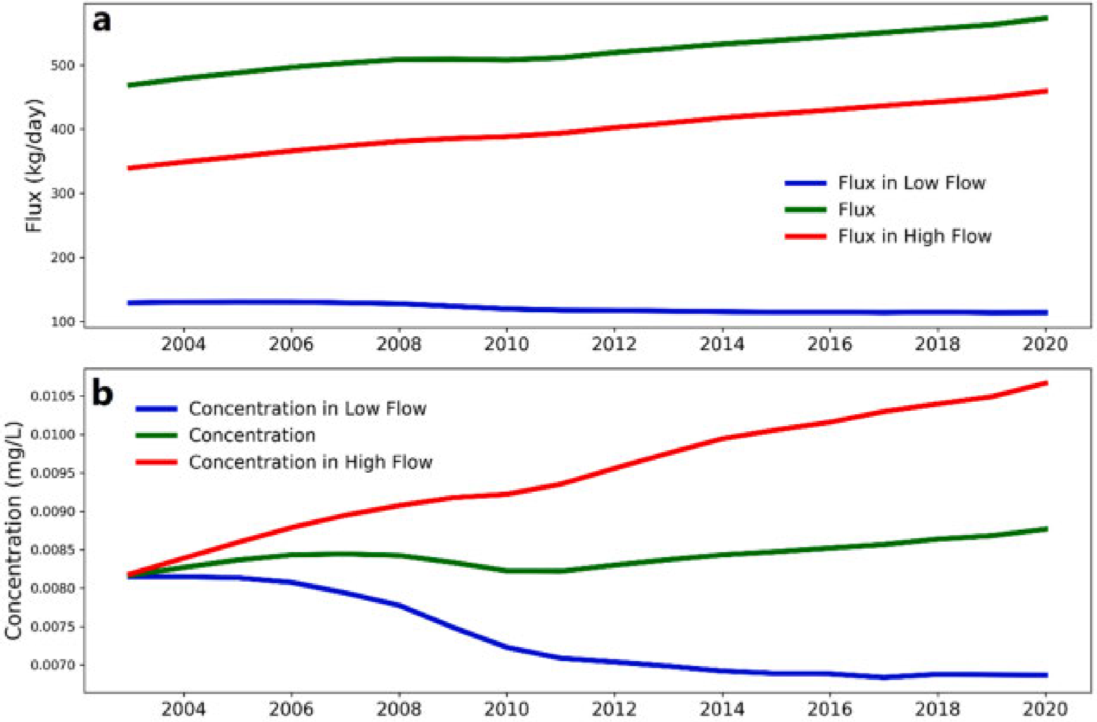
Estimated Concentration:
Regression surface from WRTDS model



- ❑ Distinct response pattern in DIP and DIN
- ❑ Long-term impacts

2. CHANGES IN NUTRIENTS (N & P), contd.

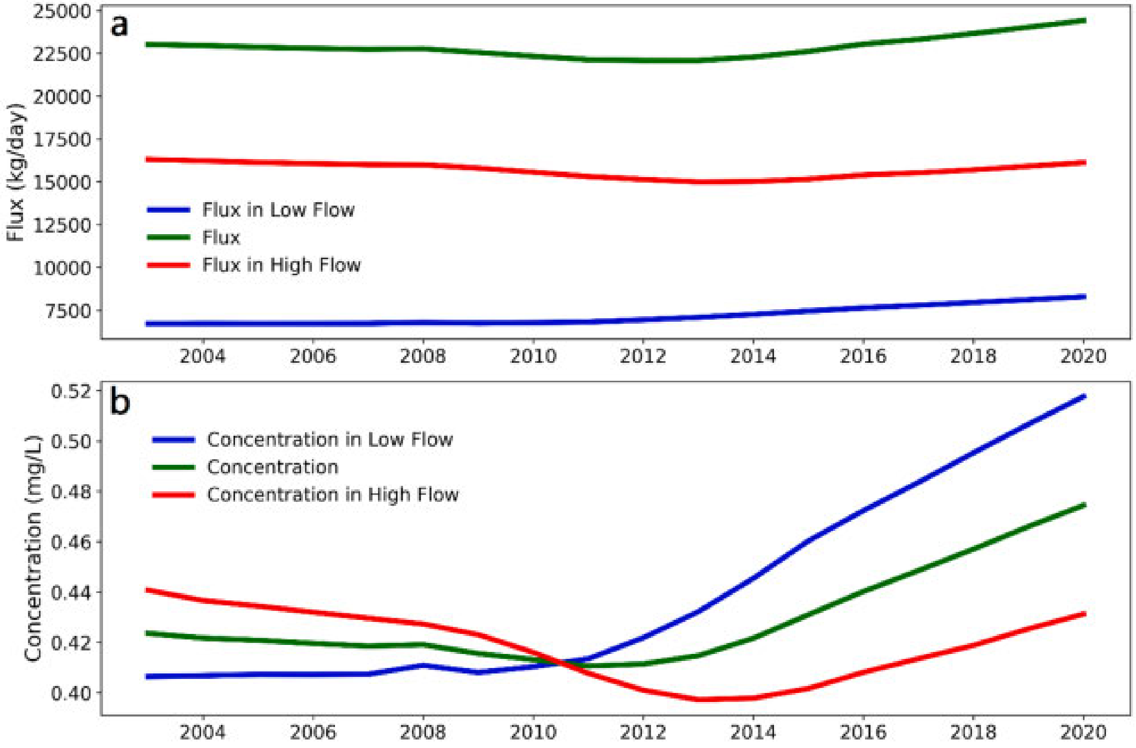
DIP



Flu
x

Conc
.

DIN

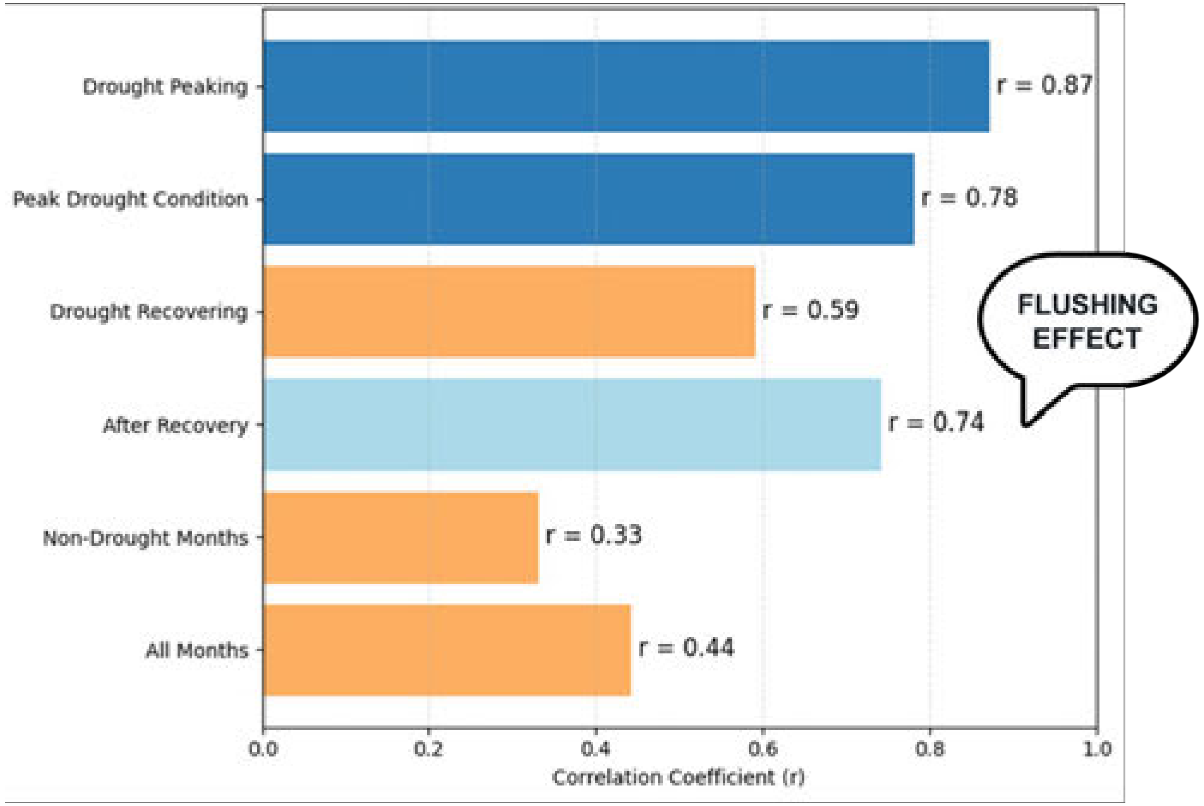


Flow-normalized flux and Concentration Patterns

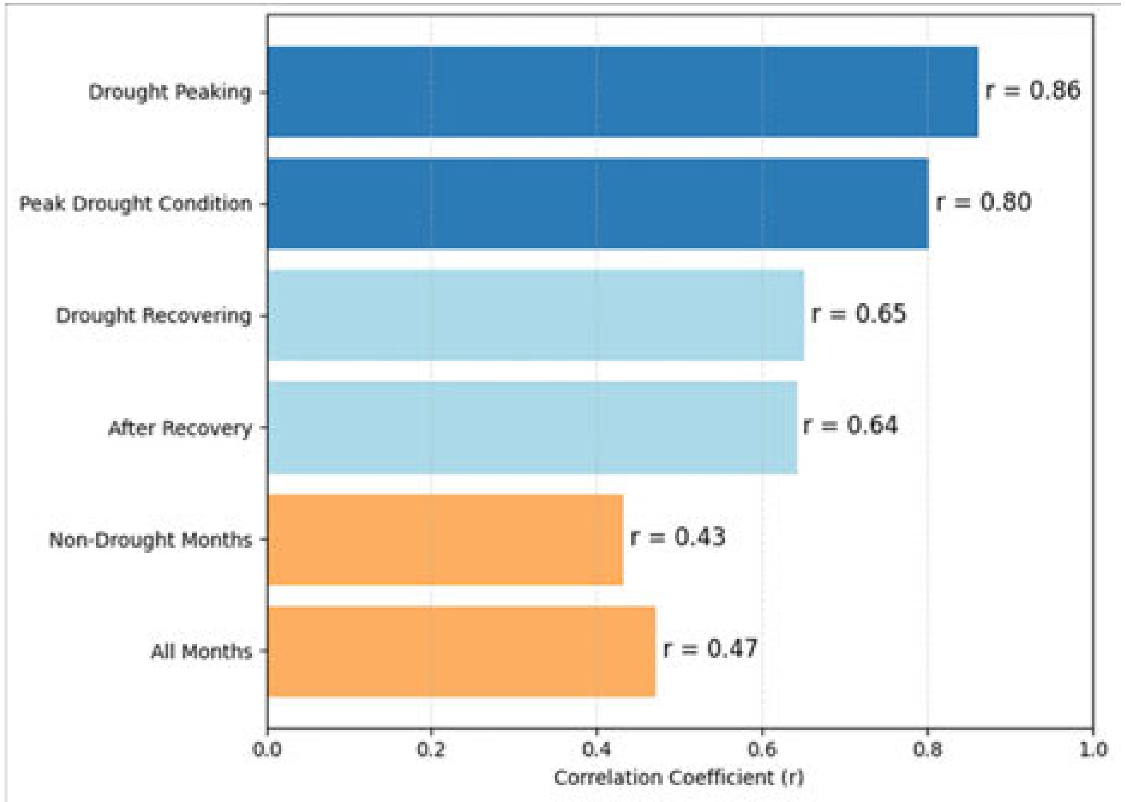
❑ Long-term change patterns in nutrient flux are different for different flow-regime

3. Flow vs nutrient flux in different drought phases

DIP



DIN



- ❑ Strong positive correlation between flow and flux during drought period (weakens with drought phase propagation)
- ❑ DIP flux increases with "hydrological whiplashes".

Summary

- A detailed framework for analyzing droughts' impact on water quality
- Better understanding on the dynamic impact of streamflow drought on nutrients.
- Broader implications include supporting upstream water management strategy for downstream impact mitigation

Full Paper

Water Research

Volume 264, 15 October 2024, 122238

Dynamic disparities in inorganic nitrogen and phosphorus fluxes into estuarine systems under different flow regimes and streamflow droughts

267

Sumon Hossain Rabby [a b], Leila Rahimi [a b], Ebrahim Ahmadisharaf [a b], Ming Ye [c], Jason A. Garwood [d], Ethan S. Bourque [e], Hamid Moradkhani [f]

Acknowledgement

Grants: INV29 and MOU28

Grants: NA21NOS4200044 and NA22NOS4200069

Thank You!

Any Questions?

Email: sr22bi@fsu.edu

Long-Term Trends and Hydroclimatic Influences on the Apalachicola Bay Estuarine System, from Monitoring and Trend Analysis 2001-2022

Presenter: Xiuming Sun

This study analyzed long-term (2001–2022) water quality and environmental drivers of eight monitoring stations in the Apalachicola Bay and its contributing basins to assess temporal trends, changepoints, and linkages with hydroclimatic variability. Monthly measurements of five nutrients (phosphate, ammonium, nitrite + nitrate, total nitrogen, and chlorophyll-a) and five high-frequency (15- to 30-minute) physical-chemical observations (salinity, temperature, dissolved oxygen, pH, turbidity) from ANERR stations were integrated with meteorological, hydrologic, and land cover data from NOAA, USGS, and NLCD. The environmental drivers included land cover, atmospheric deposition, precipitation, temperature wind, storm tide, as well as hydroclimatic extremes. Our statistical analyses revealed increasing phosphate and chlorophyll-a concentrations and declining nitrogen species, indicating a transition toward phosphorus-driven eutrophication. Dissolved oxygen decreased at inner-bay sites after 2010, while salinity and turbidity increased after 2016. These shifts coincided with declining atmospheric nitrogen deposition, reduced freshwater inflow, increasing impervious surfaces, and rising temperatures. Streamflow droughts during the periods of 2006–2009 and 2011–2013 promoted phosphorus accumulation, followed by post-drought high-flow years that enhanced nutrient delivery and algal growth. Hydroclimatic extremes—heatwaves, heavy rainfall, and storm surges associated with hurricanes Hermine (2016), Irma (2017), Michael (2018), and Sally (2020)— produced compound effects on salinity, turbidity, and oxygen dynamics through sediment resuspension and stratification. The findings demonstrate the Apalachicola Bay's vulnerability to interacting stressors, including nutrient imbalance, altered hydrology, and hydroclimatic extremes. They underscore the need for integrated management that address nutrient source reduction, enhance monitoring during extreme events, and improve resilience of this nationally significant system.

Slides unavailable publicly. Please contact Xiuming Sun for more information: xsun3@fsu.edu

Environmental Fluxes Controlling Biological Health in Apalachicola Bay

Presenter: Harald Mumma

Apalachicola Bay, a shallow, bar-built estuary located in the northern Gulf of Mexico, is one of the most productive estuaries in the Northern Hemisphere. The bay is principally fed by the Apalachicola River, an alluvial river which drains a large watershed of 12,544,000 square acres. The river is characterized by spring floods, high interannual variability, and a trend of decreasing mean annual riverine discharge over the past half century. This decreasing trend has coincided with the collapse of the bay's oyster population in 2012, a key fishery which once supplied 90 percent of all oysters from Florida. Declines in freshwater inflow are likely to continue given the United States Supreme Court ruling against limitations on upstream water consumption [1]. This study is designed to understand how riverine flow conditions impact productivity, respiration, acidification, and calcification rates in the bay. Diurnal measurements of estuarine metabolism across two different benthic environments are performed monthly in mudflats and seagrass meadows. In order to quantify and model water column metabolic processes, key environmental parameters across both interfaces and in the water column itself are continuously monitored. At the air-water interface, eddy covariance measurements of CO_2 flux are made in addition to waterside and airside pCO_2 and dissolved oxygen. This has allowed estimates of CO_2 flux in addition to model-based O_2 using the calculated CO_2 transfer velocity (k). At the benthic-water column interface, the gradient flux method [2] is used to quantify the O_2 flux and calcification/dissolution. Within the water column, automated light-dark incubations are made over the diurnal period that allow for the calculation of GPP, NEP and R. Water column PAR measurements are also taken to map photosynthesis-irradiance (PI) curves. The synthesis of these measurements allows for better constraints on estuarine metabolism, both spatially and seasonally, across differing benthic environments. In addition, correlations to riverine flow provide a greater understanding of the role that riverine inputs play on estuarine production and respiration. [1] Florida v. Georgia (2021), 592 U. S. 433. [2] McGillis et al. (2011), Geophysical Research Letters, 38(3).

Slides unavailable publicly. Please contact Harald Mumma for more information: hmumma@nd.edu

SPATIAL AND TEMPORAL DISTRIBUTIONS OF ZOOPLANKTON IN APALACHICOLA BAY

Samantha Lucas[1], Megan Lamb[1], Jason Garwood[2], Michael Palandri[1]
1. Apalachicola National Estuarine Research Reserve (ANERR), 2. GHD Services

Office of Resilience and Coastal Protection / ANERR
Florida Department of Environmental Protection

ANERR Research Symposium | Feb. 27th, 2026

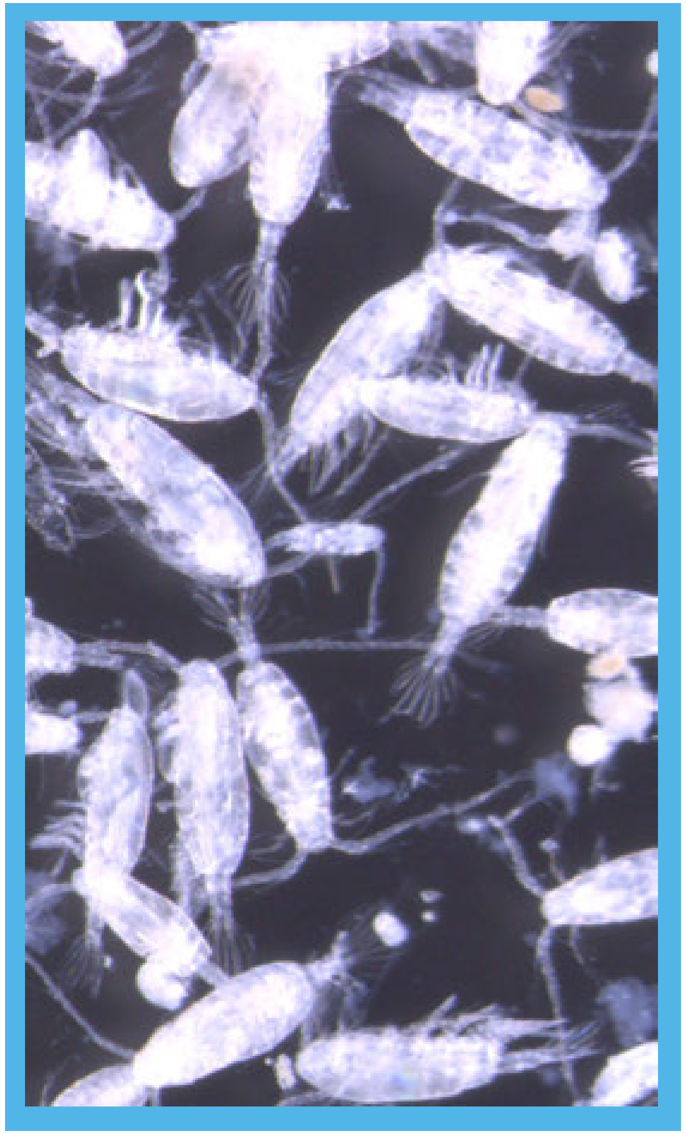
ZOOPLANKTON IN APALACHICOLA BAY

- Zooplankton play an integral role in coastal food webs.

- A greater understanding of zooplankton community structure is necessary to link primary producers and secondary/tertiary consumers.

- Past studies have looked at zooplankton ecology, primary and secondary productivity of Apalachicola Bay.
  - Edmiston, 1979.
  - Chanton & Lewis, 2002.
  - Putland & Iverson, 2007.
  - Putland et al., 2009.

- Apalachicola National Estuarine Research Reserve (ANERR) initiated zooplankton monitoring in 2016.



ZOOPLANKTON SAMPLING DESIGN

- Zooplankton sampling was conducted quarterly (spring, summer, fall and winter) from 2016 to 2022. Paired with nutrient sampling.
- Three, one-minute surface tows at each station.
- Net dimensions: 153 µm mesh, 0.5 m diameter x 1.5 m length. Flowmeter attached.
- Samples were preserved immediately then split and subsampled for identification via microscopy.
- Copepods were identified to species, all else to major group.
- Analysis conducted in PRIMER.

Today's focus:

- Two years of data, 2018-2019.
- Zooplankton distribution in Apalachicola Bay.
- Potential linkages to environmental parameters and nutrient inputs.

NUTRIENT & CHL-*A* MONITORING

- Part of the System-Wide Monitoring Program (SWMP).
- Monitoring began in 2002 and continues through present day.
- Samples are collected monthly.

Parameters:

- Phosphorous species: PO4, TP.
- Nitrogen species: NO23, NH4, DIN, TKN and TN.
- Chlorophyll-*a*, uncorrected Chlorophyll-*a*, phaeophytin.
- Total alkalinity, total suspended solids.

Additional field parameters:

- Temperature, DO, salinity, specific conductivity, pH and turbidity.
- Secchi depth, weather conditions and tidal stage.

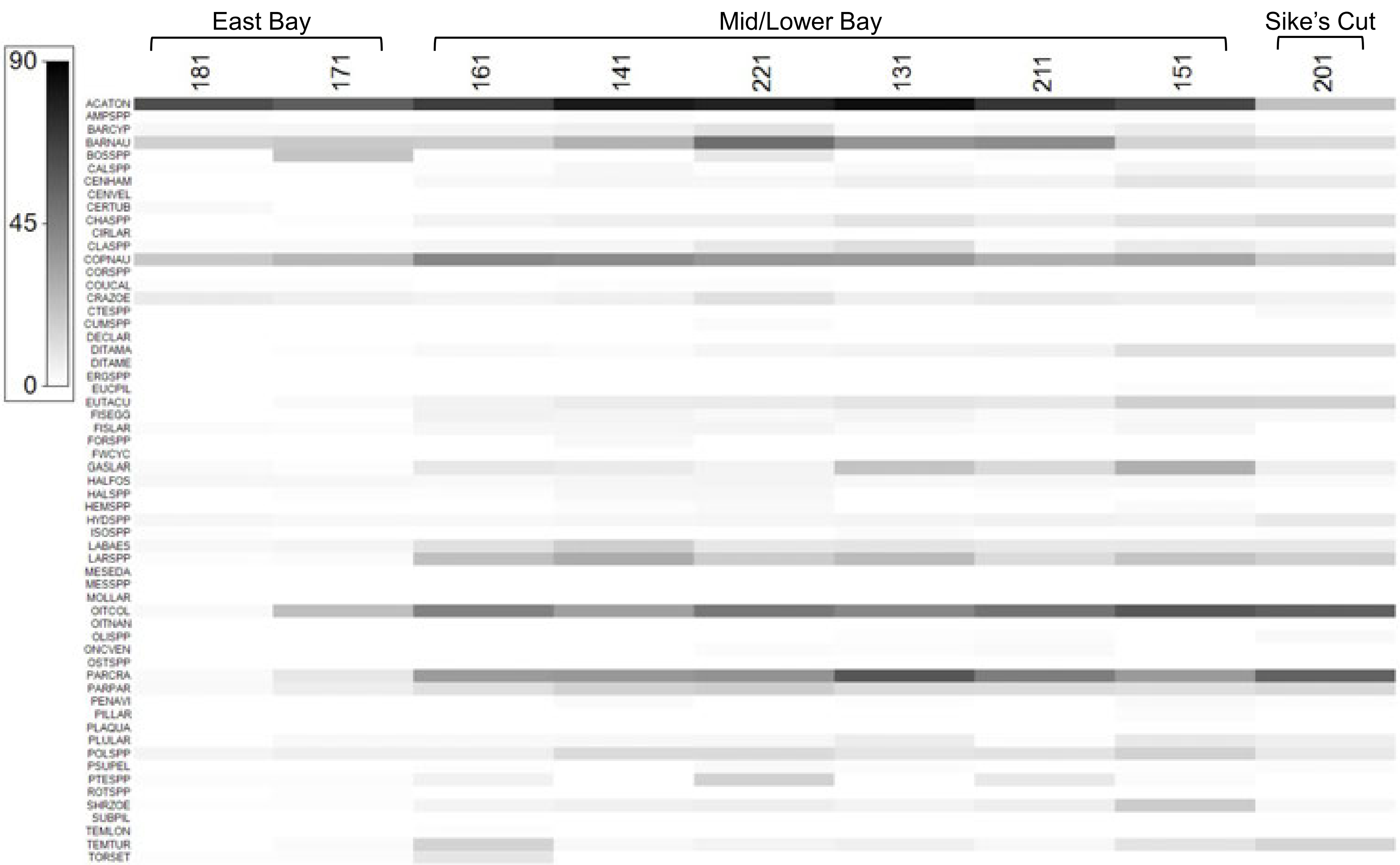
SAMPLING LOCATIONS

Apalachicola NERR System-Wide Monitoring Program

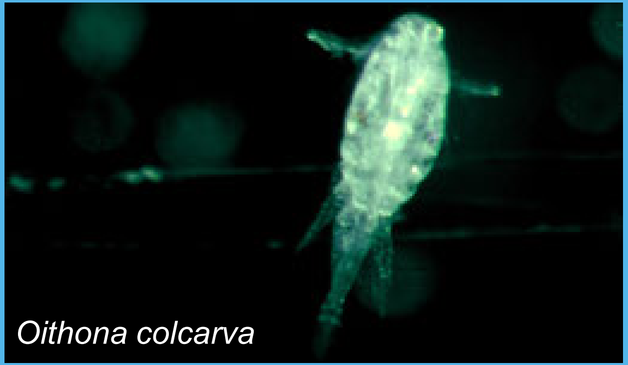
Updated October 2025 | Data sources: ANERR, ESRI

ZOOPLANKTON SPECIES

DATA SQUARE ROOT TRANSFORMED



Acartia tonsa

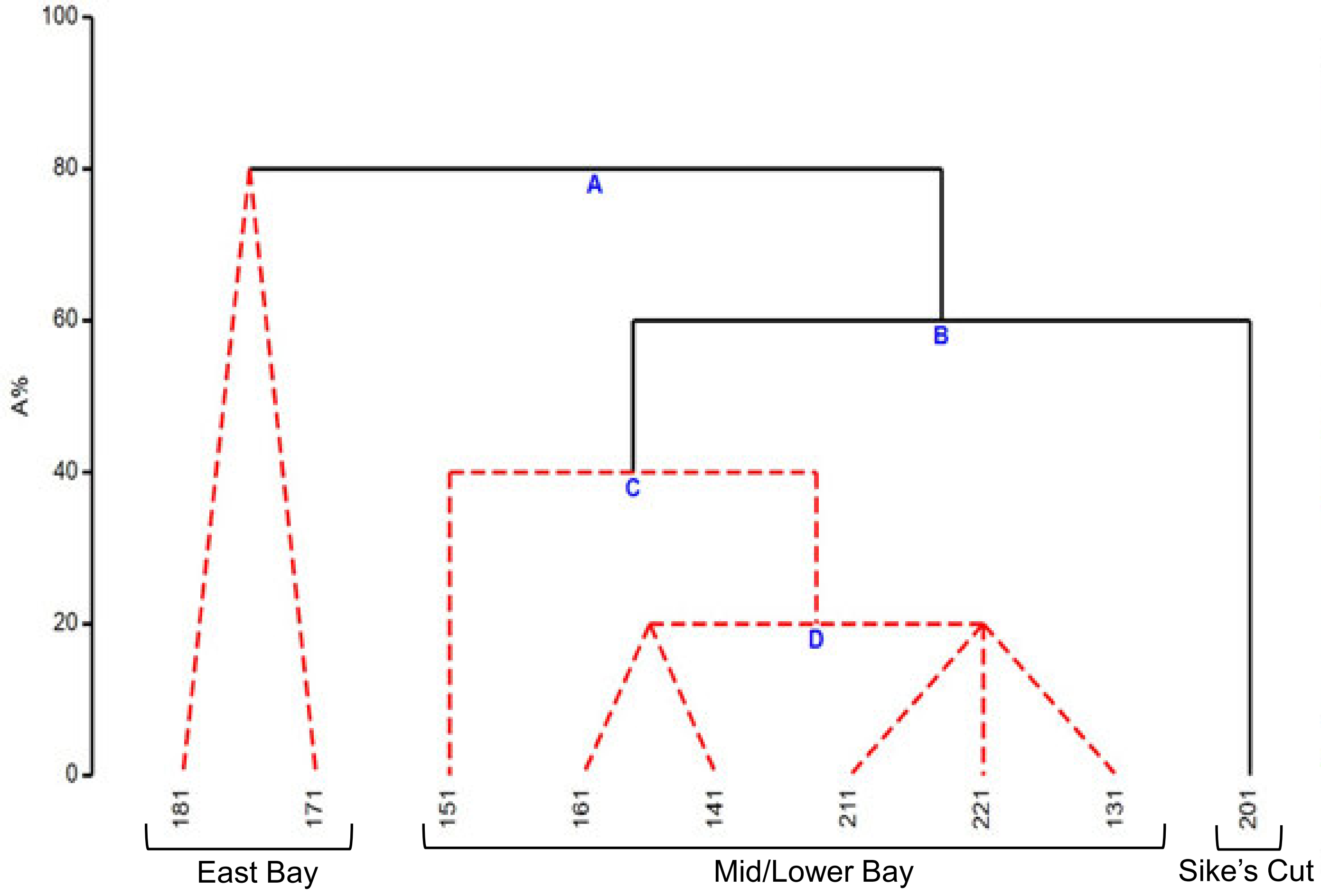


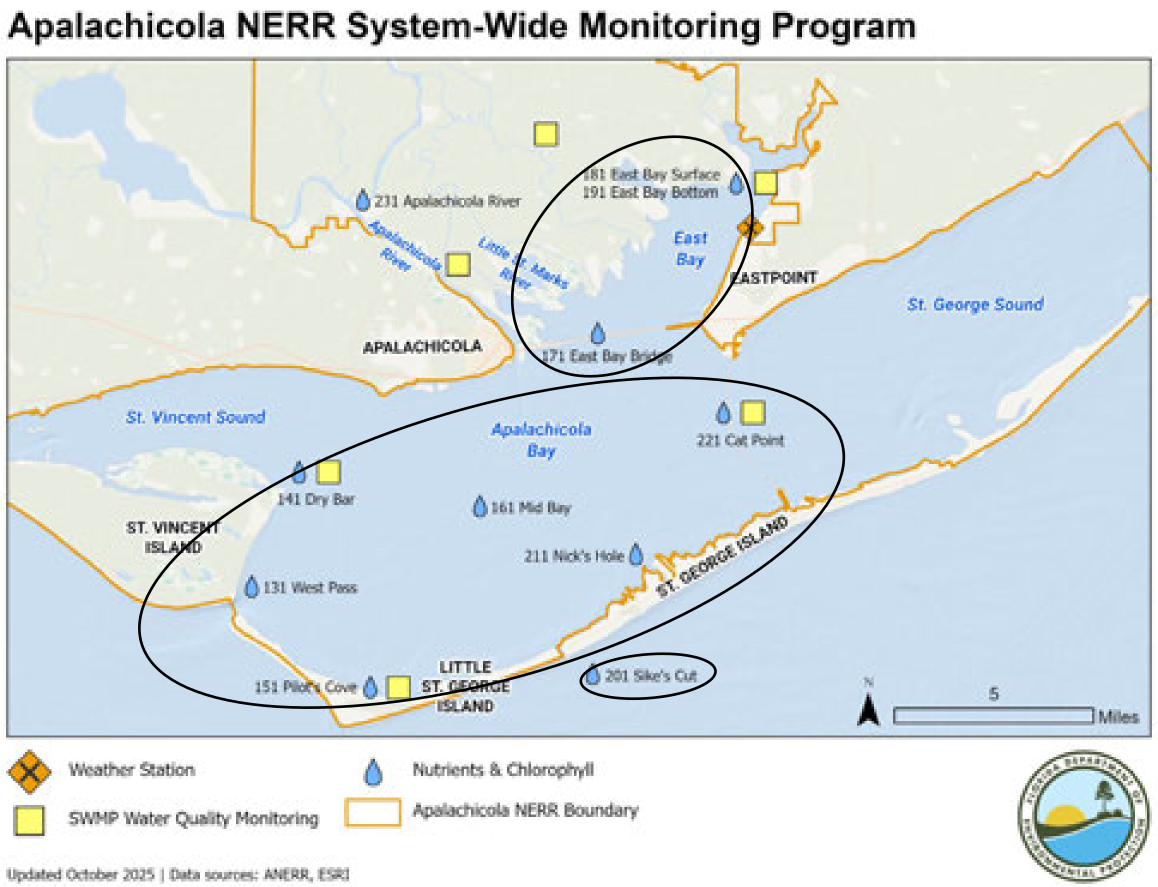
Oithona colcarva

Parvocalanus crassirostris

ZOOPLANKTON DATA 2018-2019

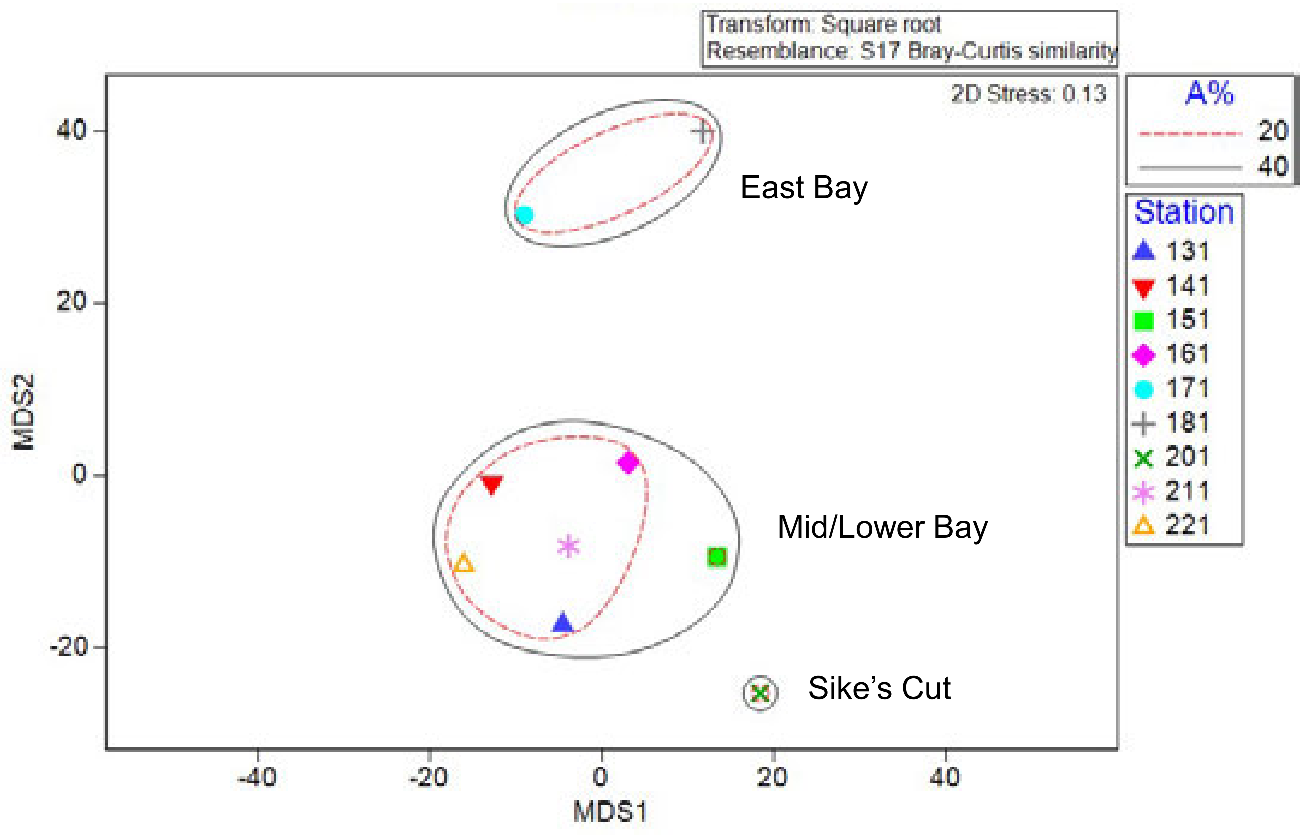
CLUSTER ANALYSIS DENDROGRAM

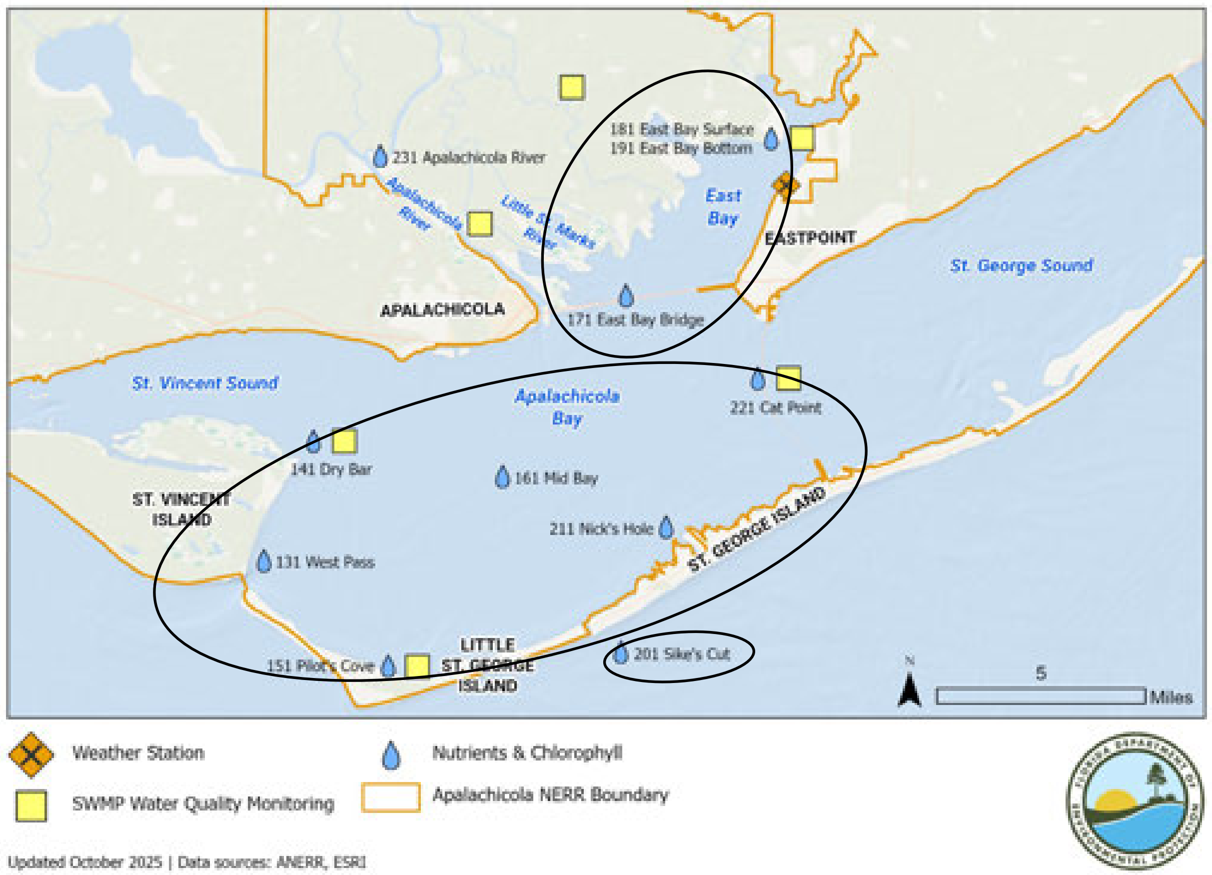




ZOOPLANKTON DATA 2018-2019

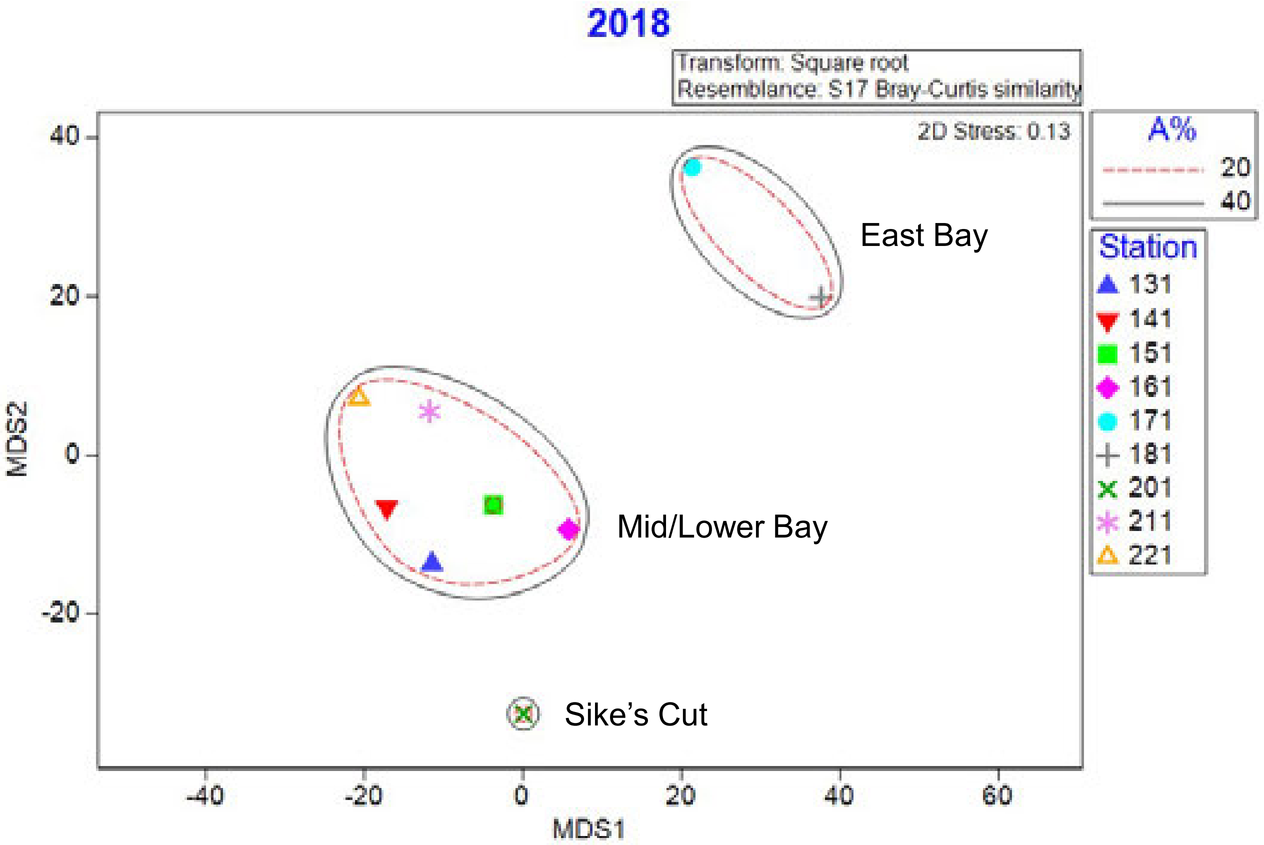
METRIC MDS PLOT

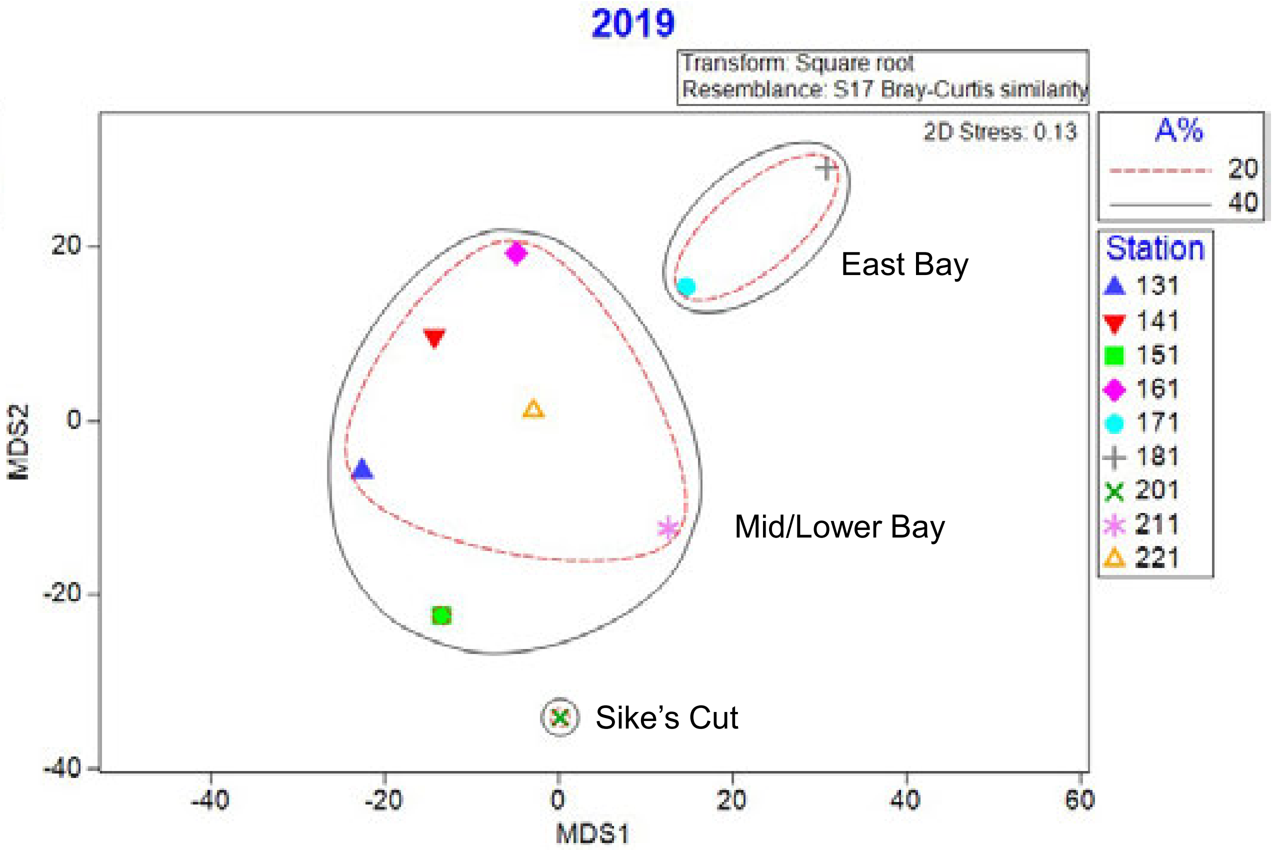




ANNUAL ZOOPLANKTON DATA

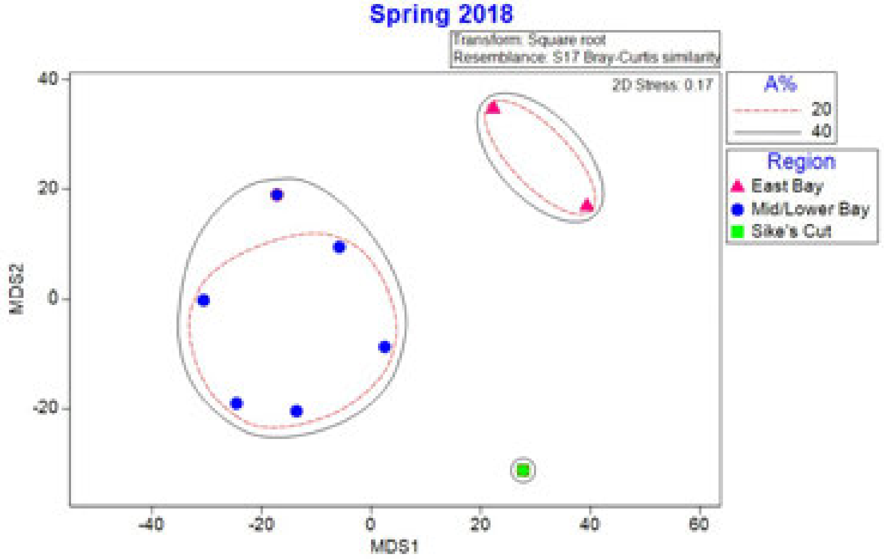
METRIC MDS PLOT

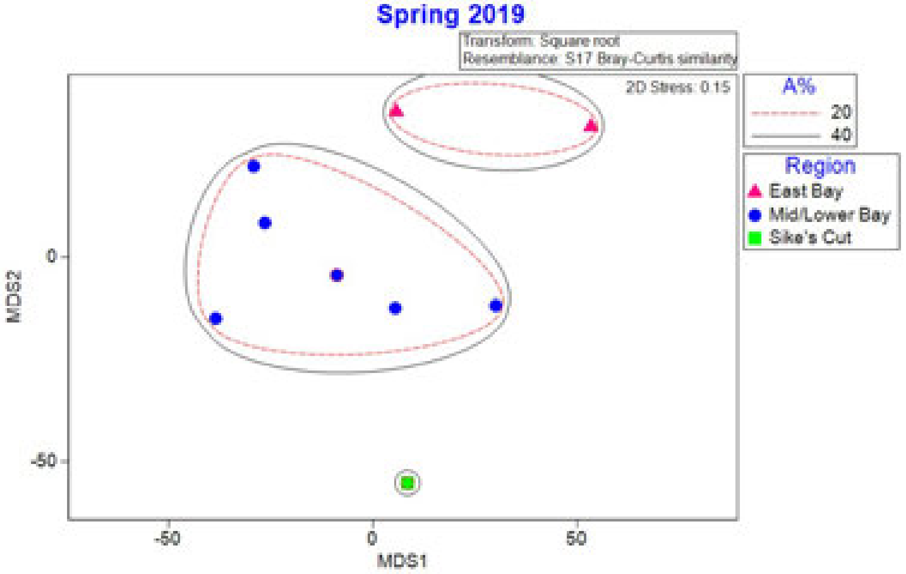


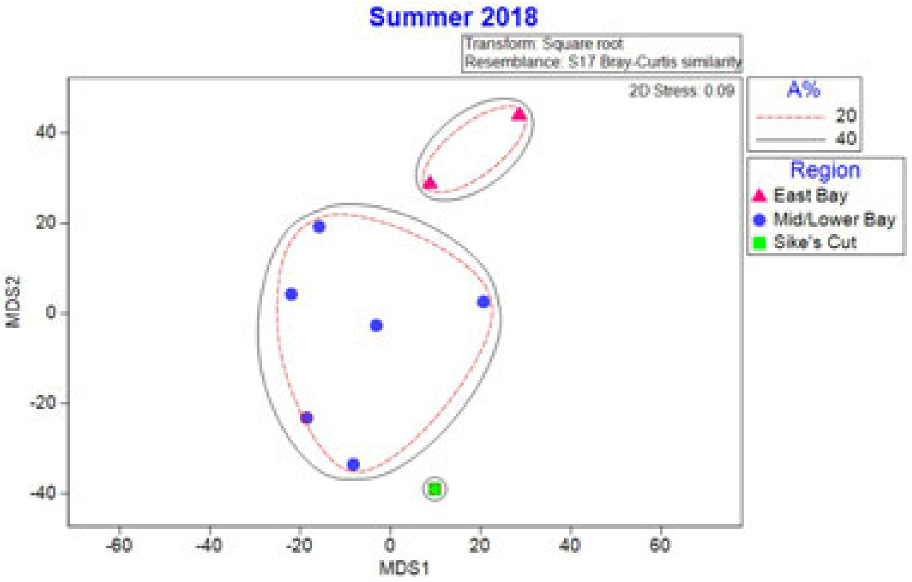


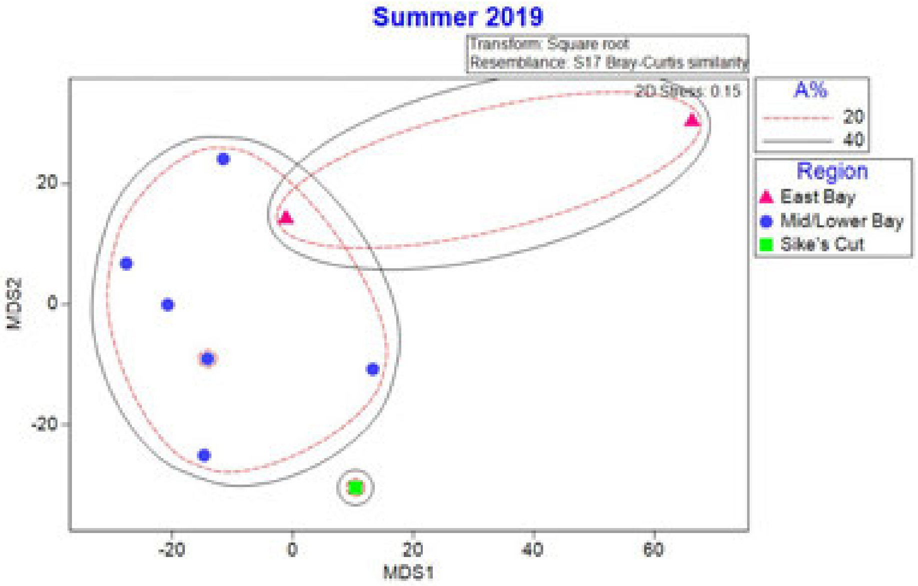
SEASONAL ZOOPLANKTON DATA

METRIC MDS PLOT



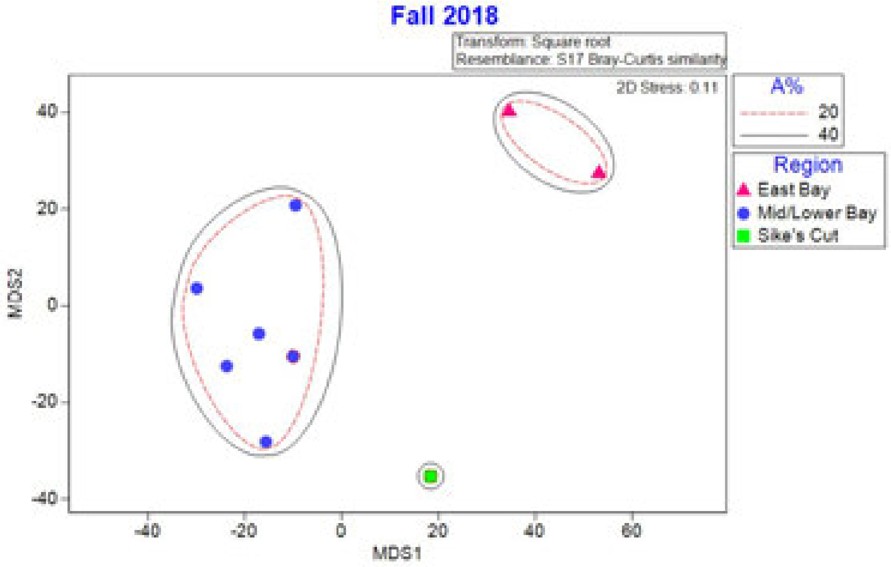


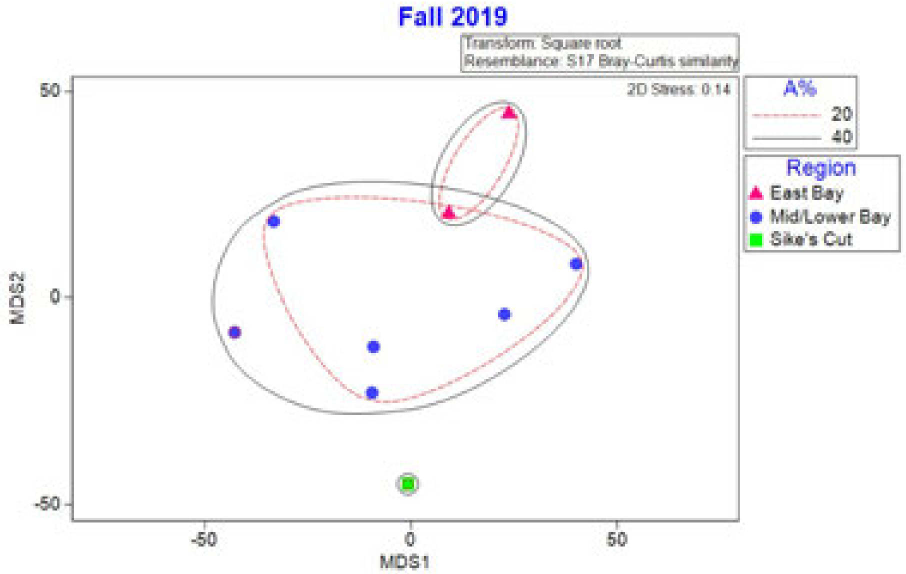


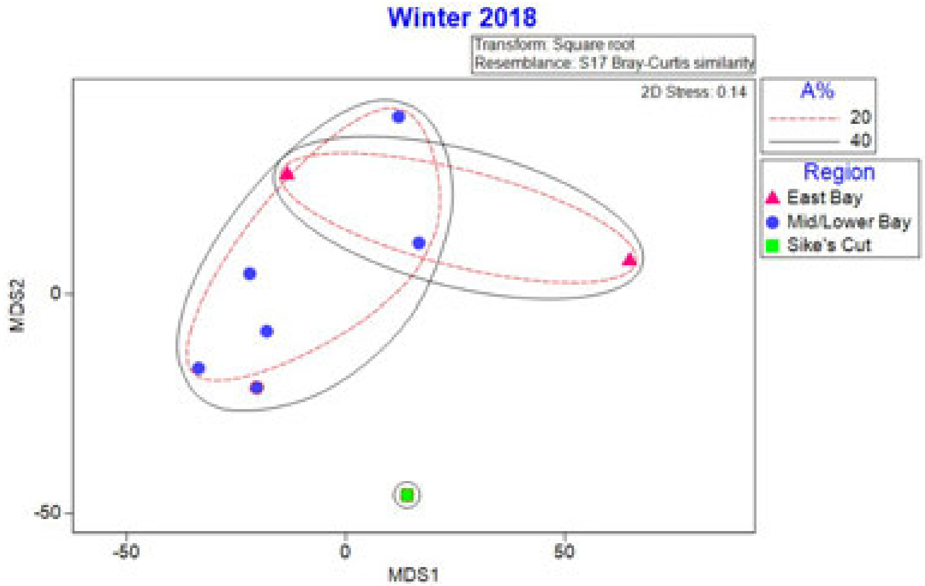


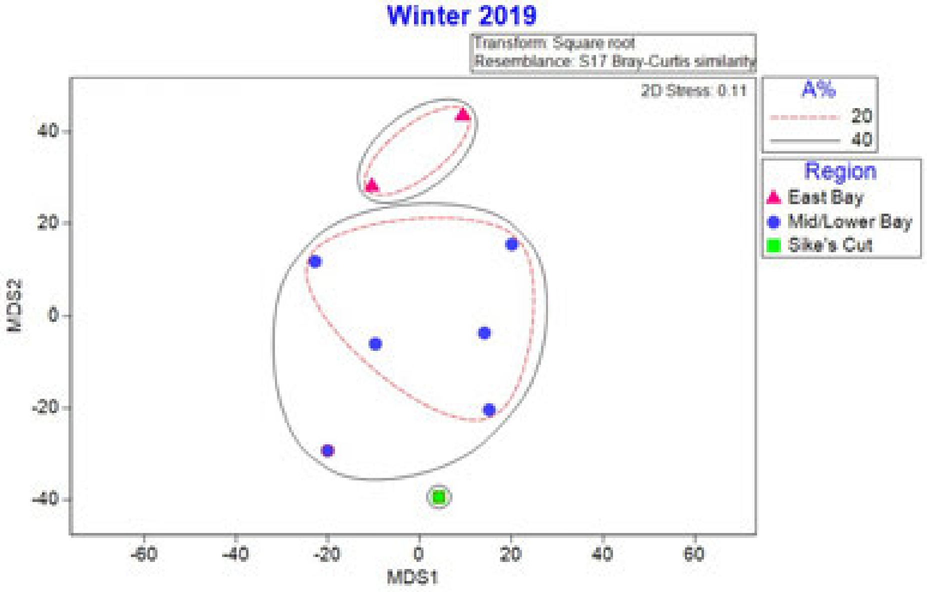
SEASONAL ZOOPLANKTON DATA

METRIC MDS PLOT



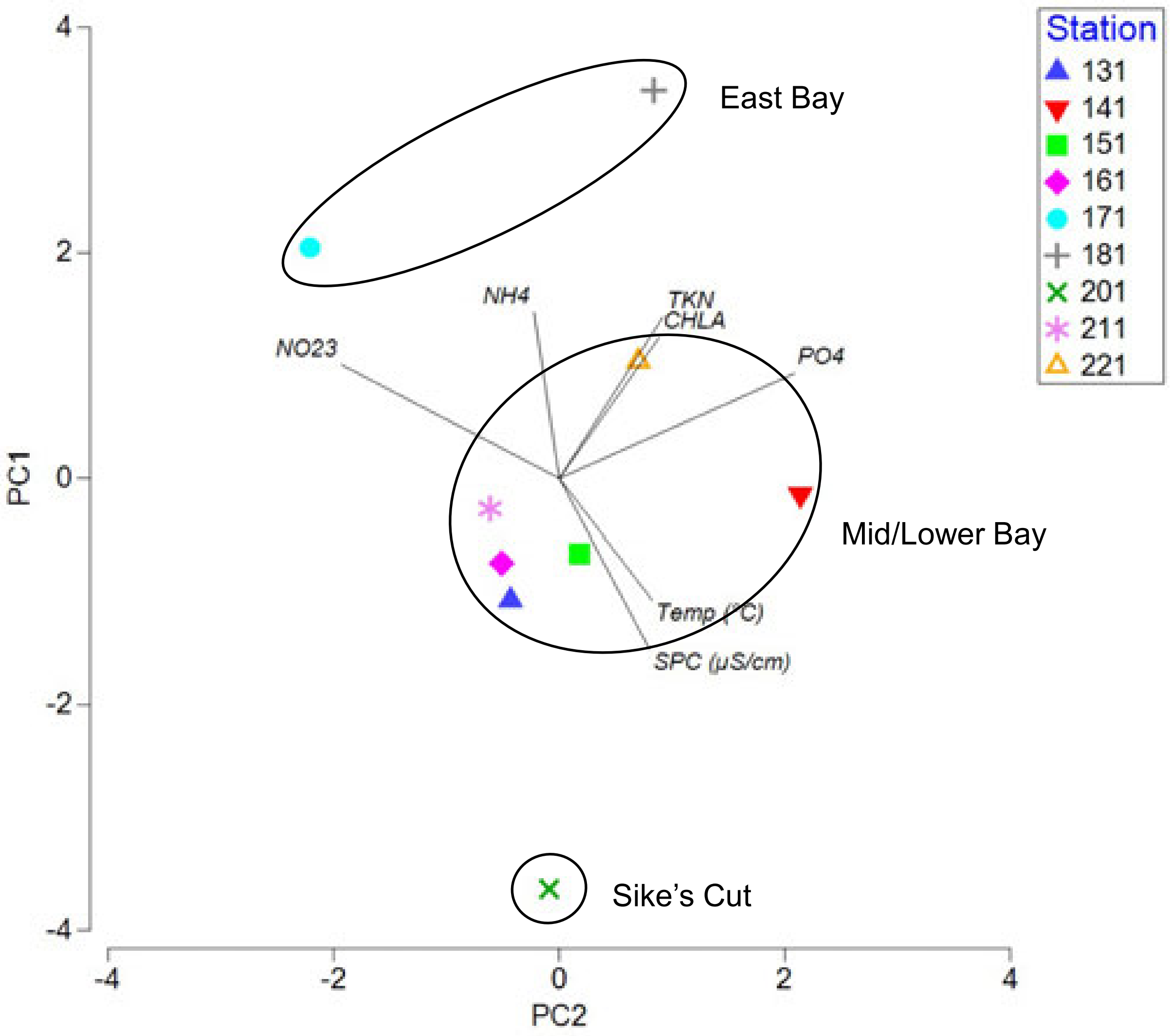


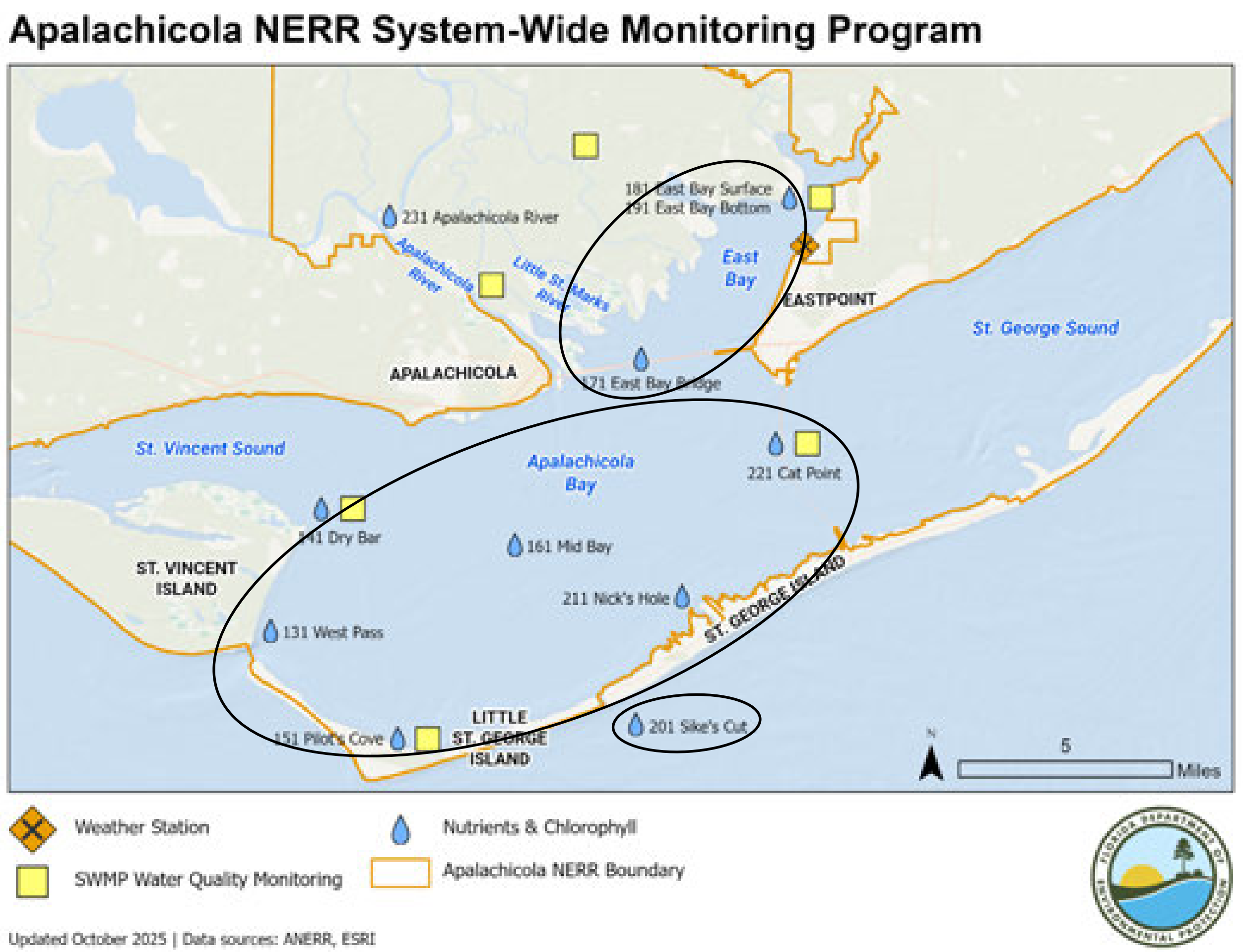




NUTRIENT & CHL-*A* DATA 2018-2019

PCA

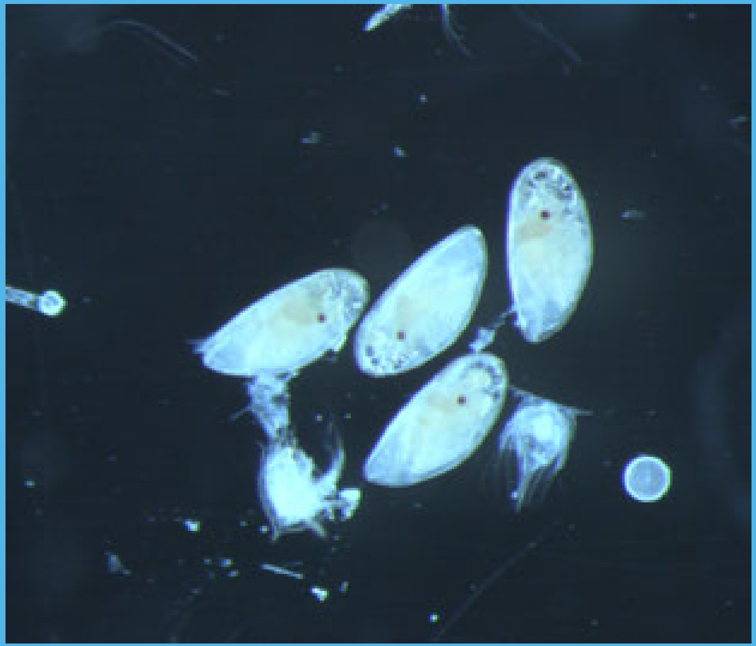


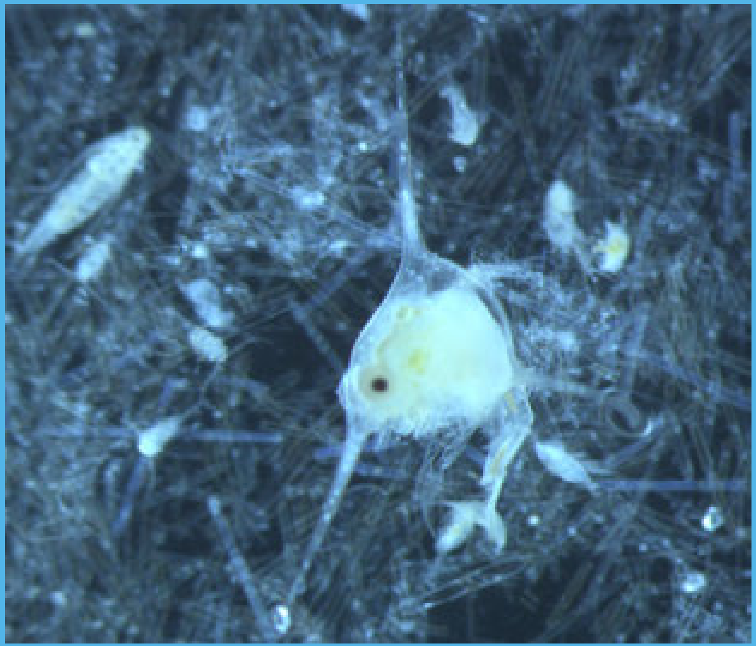


CONCLUSION

Preliminary results:
- Three distinct regions of zooplankton communities.
- Seasonal effects on these communities need further investigation.
- PCA indicates nutrient levels and physical parameters are linked to community distribution.

What's next?
- Data analysis.
- More data, continue microscopy work.
- Apalachicola River influence, dry vs wet years.





THANK YOU

Samantha Lucas
Office of Resilience and Coastal Protection / ANERR
Florida Department of Environmental Protection

Contact Information:
850-670-7743
Samantha.B.Lucas@FloridaDEP.gov

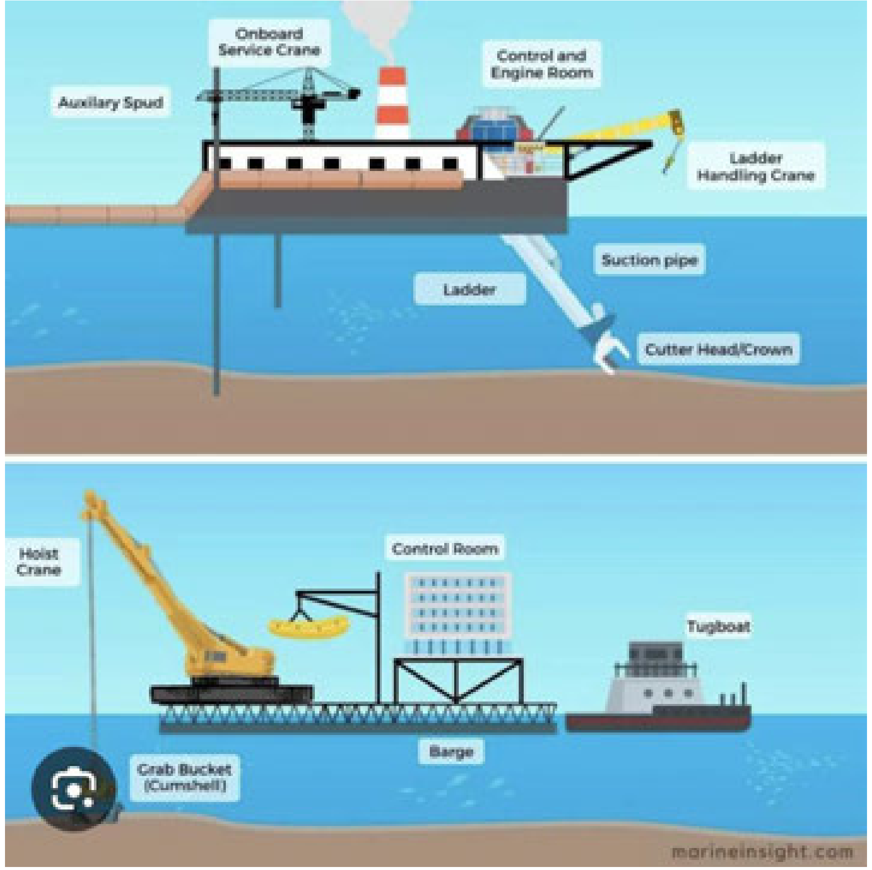
Understanding Impacts of Navigational Dredging in Alluvial Rivers: the Apalachicola

Matt Kondolf
University of California Berkeley

Navigational Dredging

Impacts and related measures:

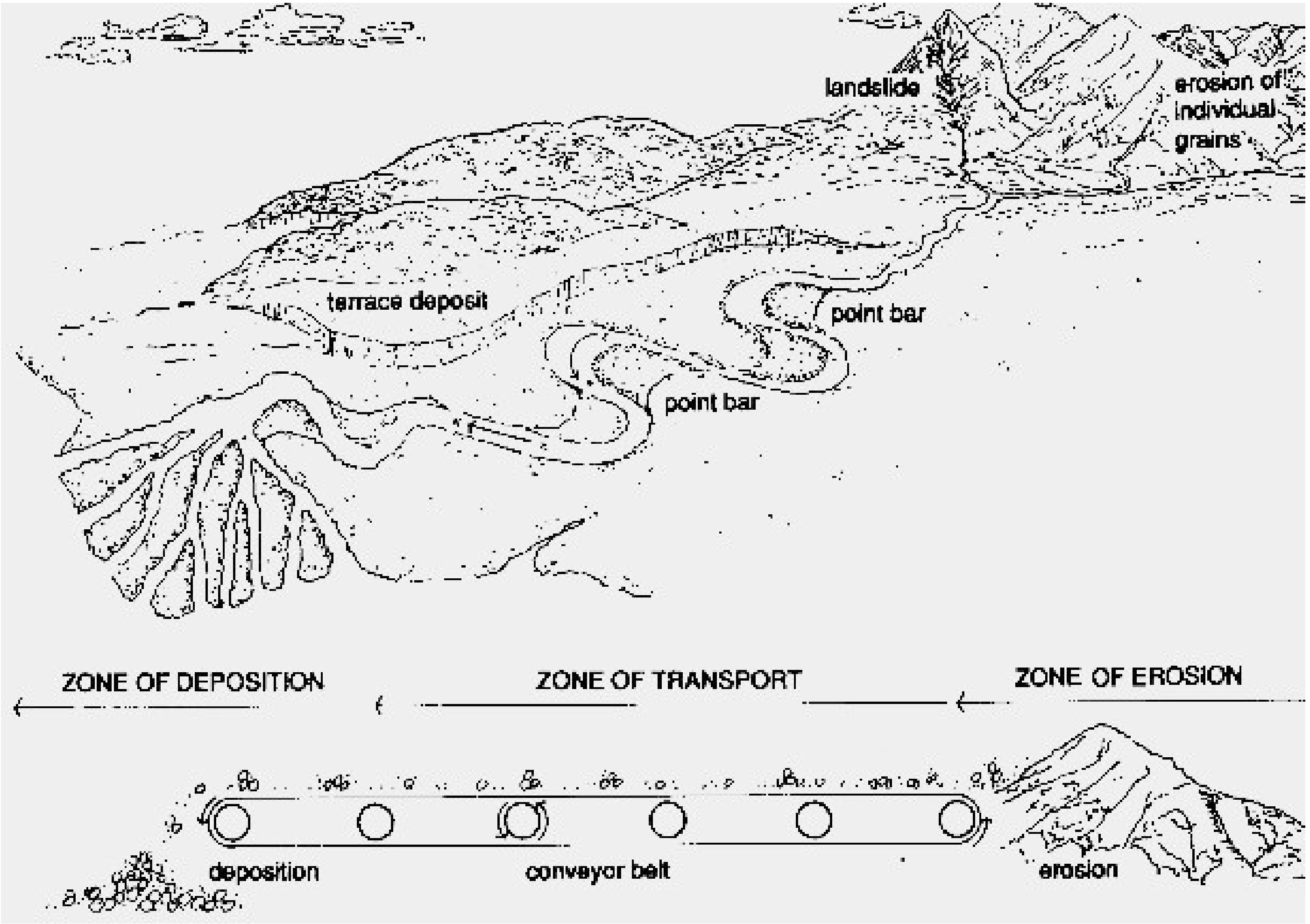
- direct impacts of removing sediment from channel
- propagation of incision up- and downstream
- water quality impacts of disturbance
- spoil disposal
- channel straightening and simplification
- snagging (removing trees and limbs)
- constructing wing dikes



Source: https://www.radco-int.com/comprehensive-overview-of-dredging-techniques-methods-and-environmental-implications/

First: Step back and consider the river as a system.

Rivers carry not only water, but also sediment



Essential to maintain channel form, beaches and deltas
Transport zone = a conveyor belt
Over geologic time, sediment is in motion
Temporary storage in bars, floodplains,

Source: Kondolf 1997 ‘Hungry Water’, *Environmental Management*

The riverbed at any point reflects a balance between the supply of sediment and the river’s energy to transport the sediment. If you take away the river’s sediment, you de-stabilize the river.

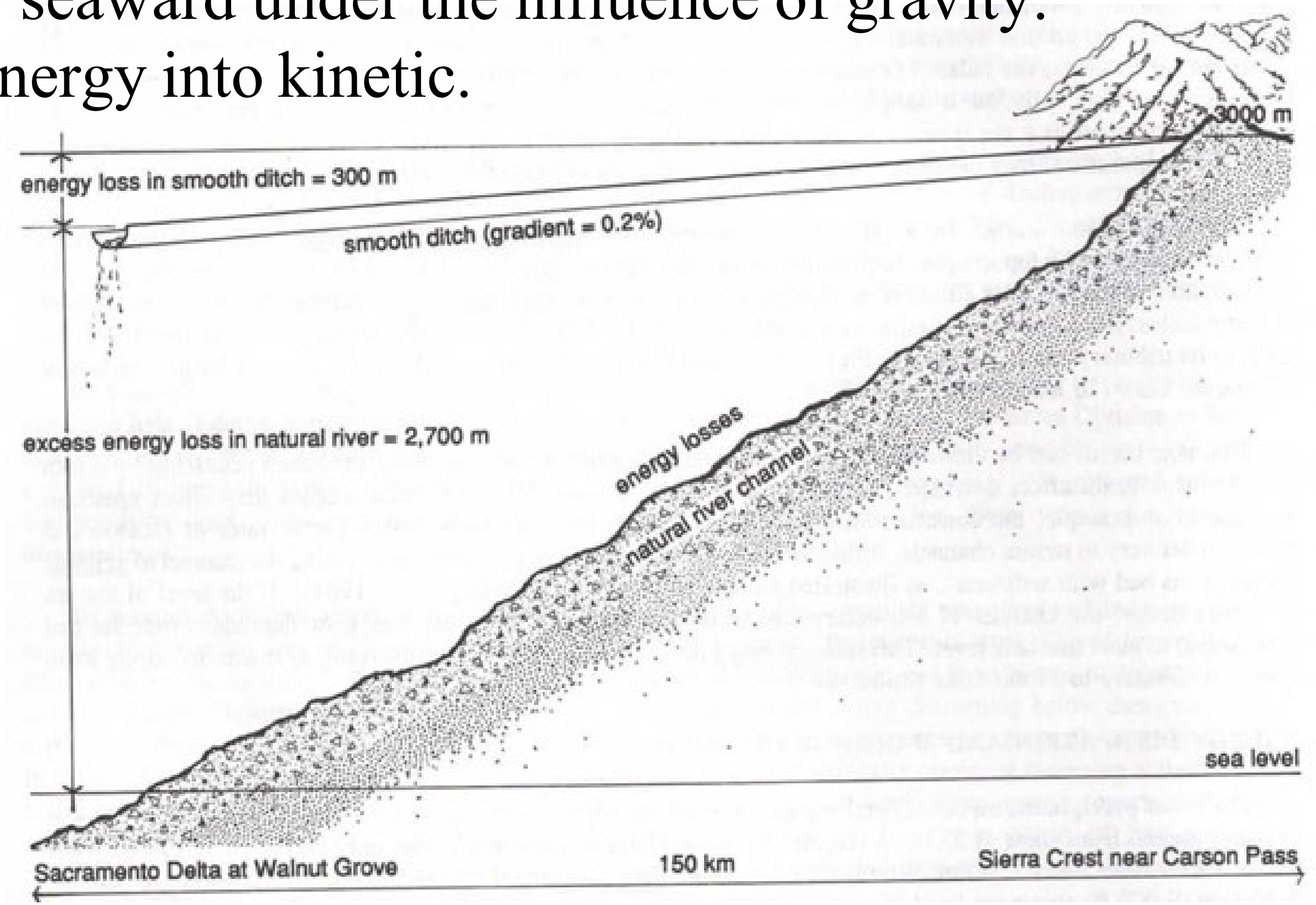
Consider energy in the river system

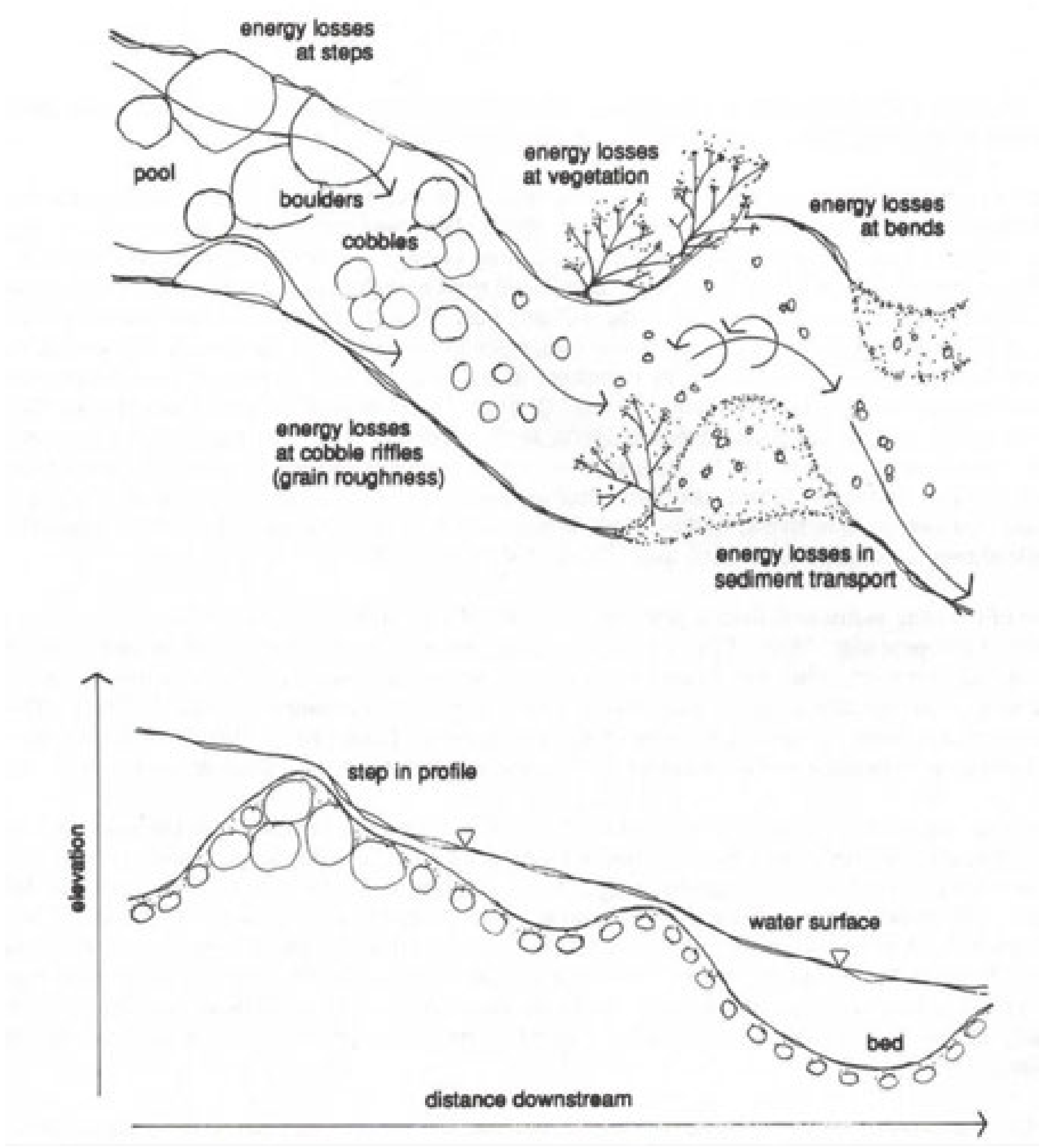
Net transfer of water from the oceans to the continents.

Rivers carry this water seaward under the influence of gravity:

Converting potential energy into kinetic.

A thought experiment:
A volume of water is precipitated as rain or snow at the crest of the Sierra Nevada. How to get it to the Delta 90 mi west?

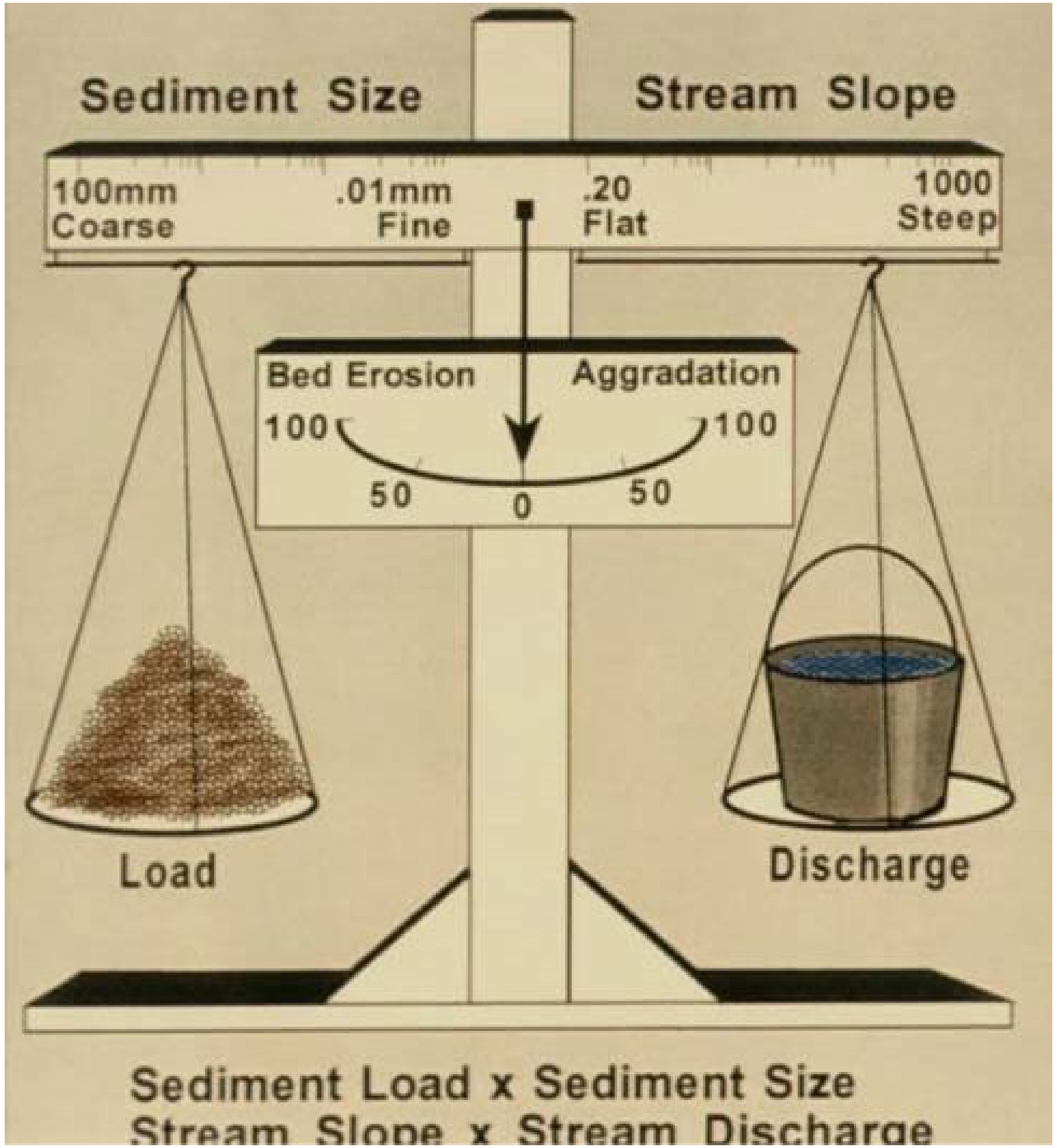




Energy is dissipated in a variety of ways, including sediment transport and frictional losses from channel morphology

Dredging disturbs the balance between sediment and the river's energy, causing local erosion. Long-term erosion of the bed is termed ***incision***.

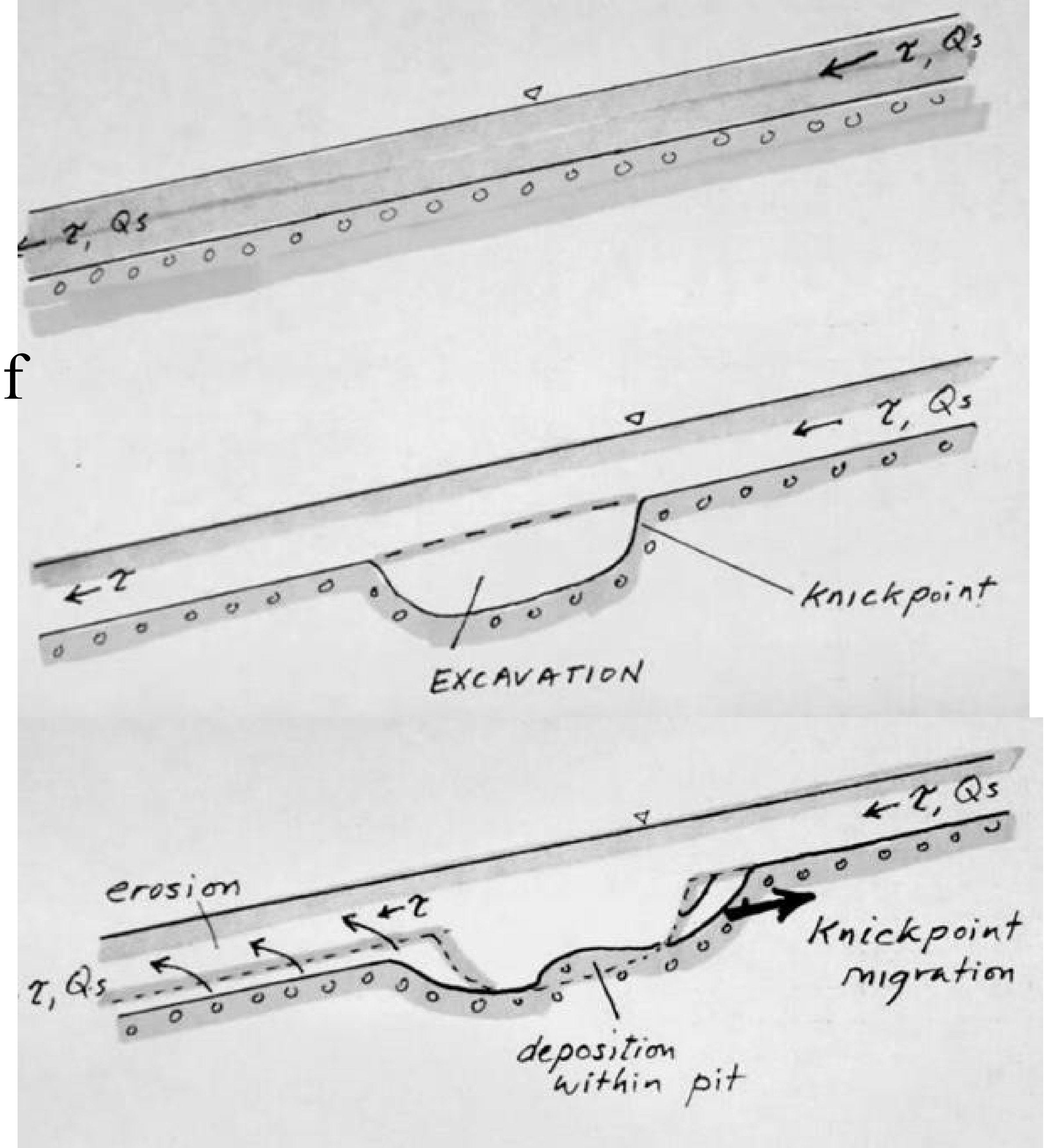
This is often called *Hungry Water* because the river tends to erode its bed and banks to compensate for its lost sediment



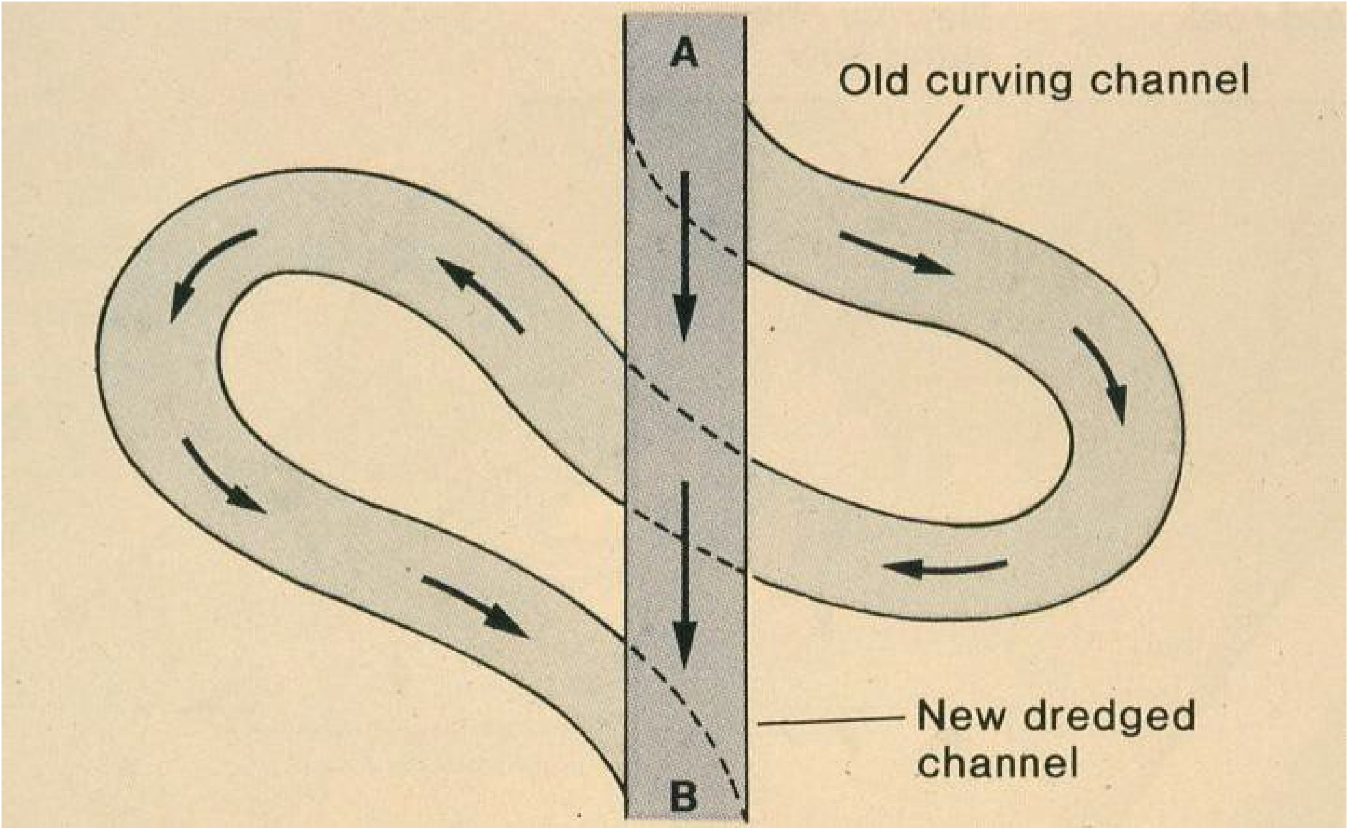
Incision propagates upstream and downstream of the point of dredging:

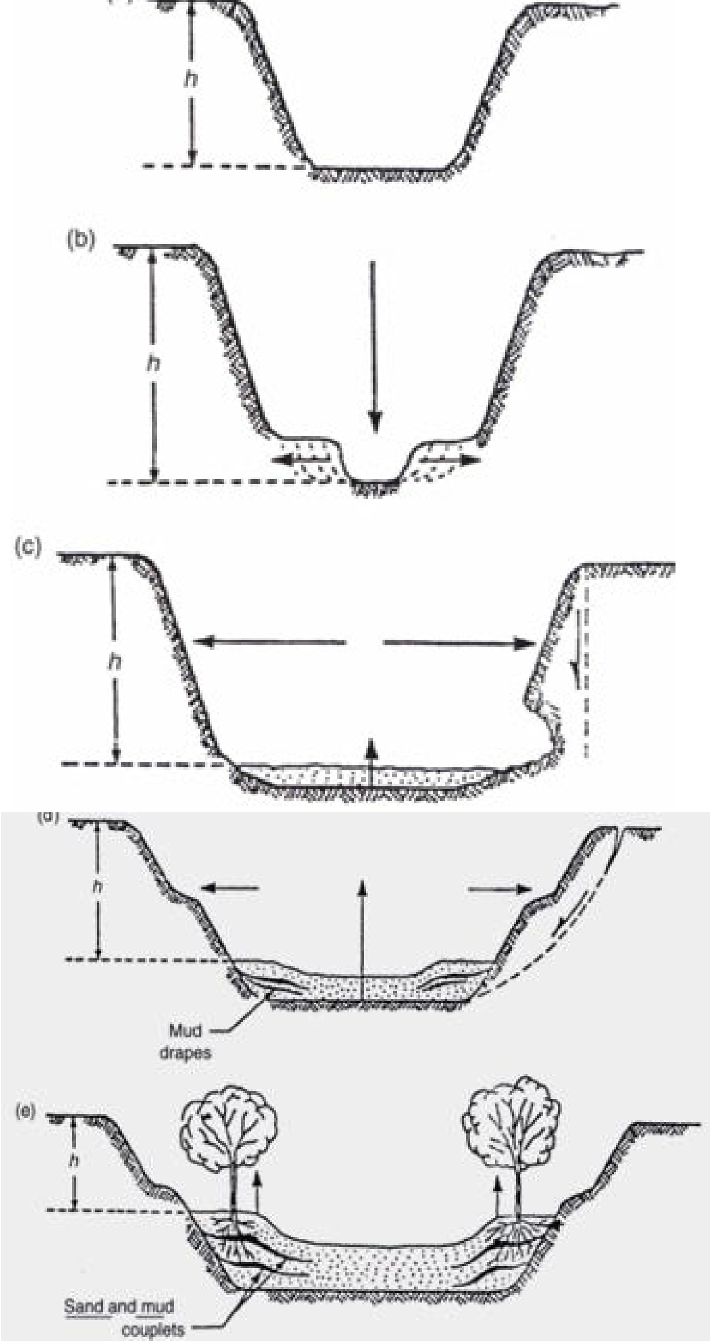
-upstream from headcutting,

-downstream from sediment starvation



Channelizing a river causes the slope to increase, increasing its energy, and thus causing the channel to incise (downcut)
The incision propagates up- and downstream.





(Schumm 1977)

A well-known example : the Obion River, West Tennessee

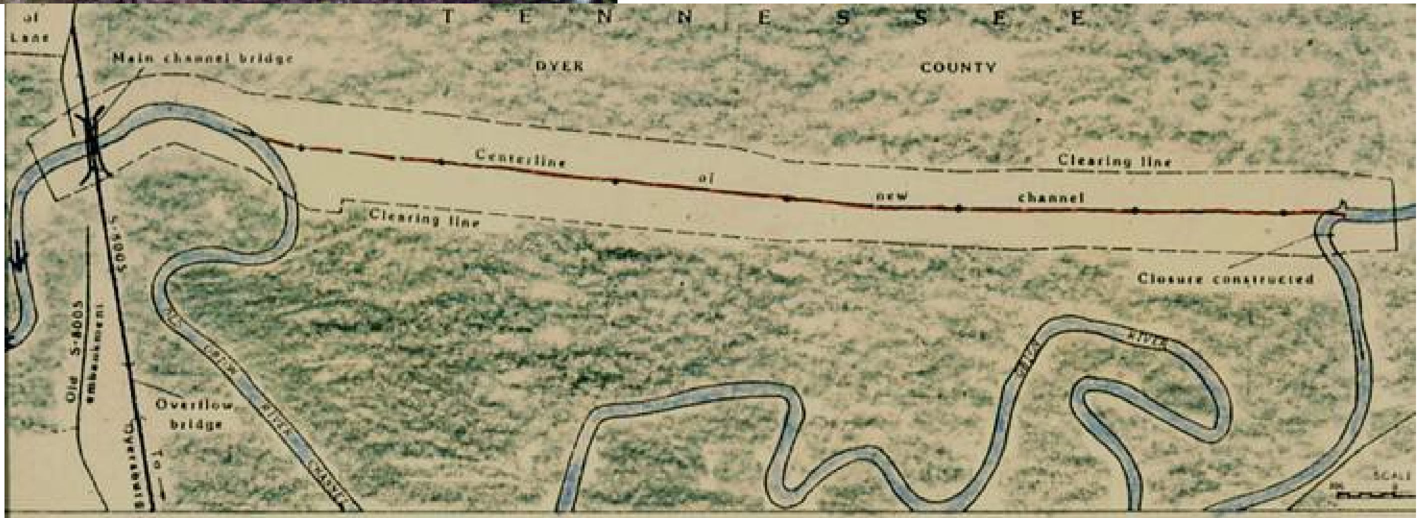
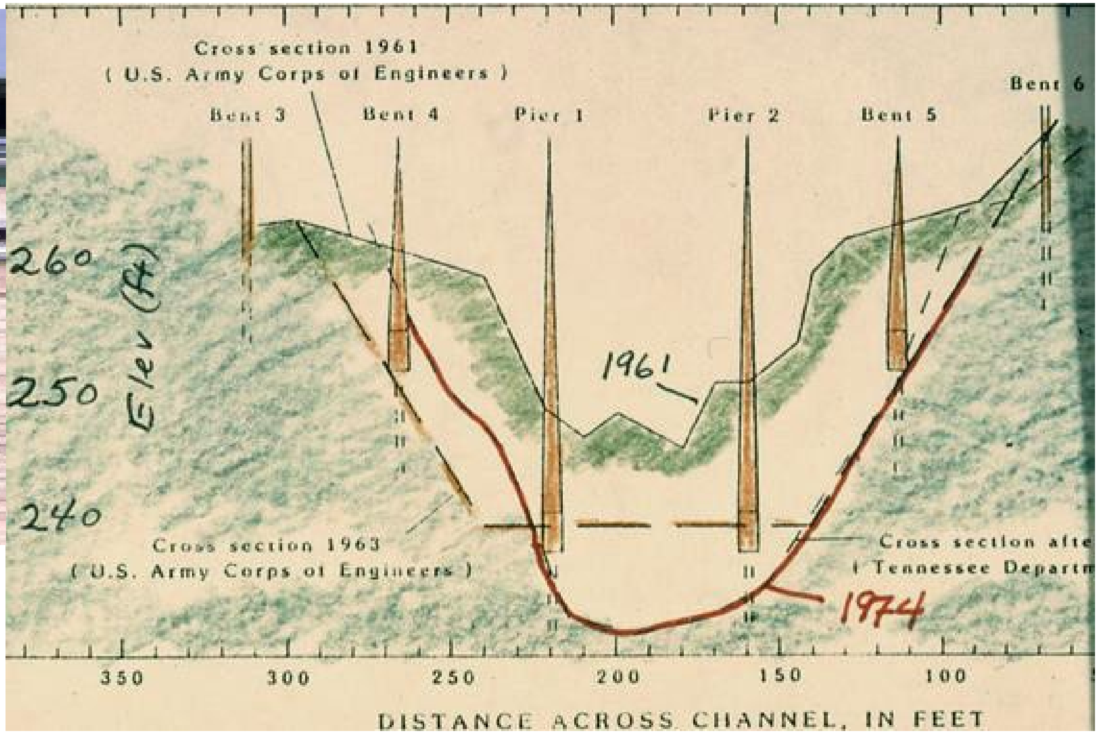


Figure 13.--Sketch showing original channel and present-day channel (1982) in relation to bridge openings on Obion River at Lane, Tennessee.



Incision undermined bridges
(lots of new bridges here!)

Incision propagated
up tributaries

On the Apalachicola: A failed navigation project

(authorized 1945)

140. The commerce considered prospective for the Apalachicola River was not analyzed separately from the Chattahoochee and Flint Rivers, as this river is considered to be only a necessary outlet for these two streams and its improvement to a greater depth than now authorized would be dependent on the improvement of one or both of them. In the discussions that follow, references to the improve-

Navigation project components:

Upstream dams to store water

Channel ‘improvements’

- Meander cutoffs and “Bend easings”
- Dredging a 2.75-m deep channel in sand
- Disposal of dredge material

76th Congress, 1st Session - - - - - House Document No. 342

APALACHICOLA, CHATTAHOOCHEE, AND FLINT RIVERS, GA. AND FLA.

LETTER

FROM

THE SECRETARY OF WAR

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED APRIL 20, 1939, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION, ON A REEXAMINATION OF APALACHICOLA, CHATTAHOOCHEE, AND FLINT RIVERS, GA. AND FLA., REQUESTED BY RESOLUTION OF THE COMMITTEE ON RIVERS AND HARBORS, HOUSE OF REPRESENTATIVES, ADOPTED APRIL 28, 1936

Dredging for navigation 1950s-1990s.
Modest navigation and economic benefits, but huge environmental impacts.
Futile attempt to keep a 9-ft-deep channel in loose sand
Channel collapsed, banks eroded outward, creating still-shallower channel

Scientific/engineering literature distinguishes between

Capital dredging – initial, large-scale dredging to create navigation channel and

Maintenance dredging – smaller routine dredging to maintain channel over time

Check for updates

A Review of Current Scientific Perspectives on the Effects of Dredging in Freshwater Environmental Restoration

Brendown Eiji Dias Kato · Pedro Henrique Ribeiro Morari · (
Gabriel Liboni Del Pino Rodrigues · Pedro Henrique Santarelli
Natan Guilherme Dos Santos

Received: 15 January 2025 / Accepted: 3 July 2025 / Published online: 15 July 202

Abstract Mechanical dredging has been used to desilt and remove excessive vegetation in aquatic environments, with the aim of restoring water quality and local physical characteristics. However, the biotic

ecosystem
the databa
for evalua
in freshwa

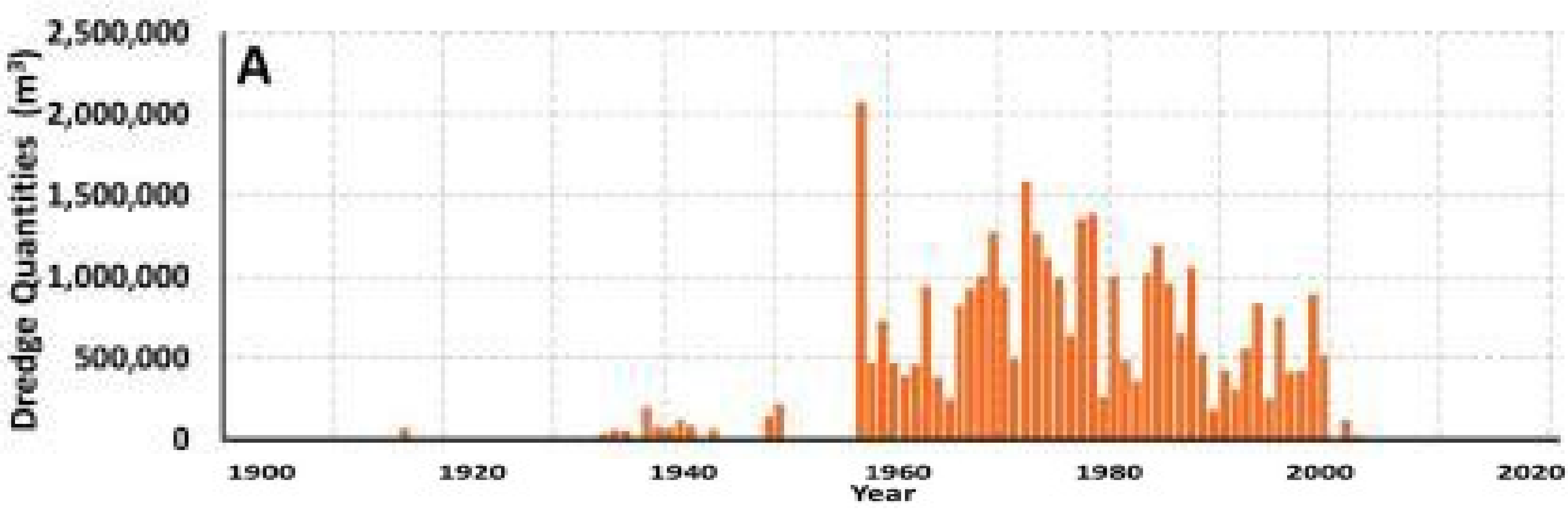
IIARD International Journal of Geography & Environmental Management (IJGEM)
Vol. 9 No. 5 2023 E-ISSN 2504-8821 P-ISSN 2695-1878 www.iiardjournals.org

Dredging of Harbours and Rivers: Review of Practices and Associated Environmental Impacts.

Eke, C. C., Frank, U. P., Ahaji, V. K., Ezeh, P., Amadi, C. C. and Okeke, O. C.
Department Of Geology.
Federal University of Technology Owerri
Corresponding authors Email: Eke Chinedu C., l., chineducharleslucky@gmail.com

D.O.I: 10.56201/ijgem.v9.no5.2023.pg22.36

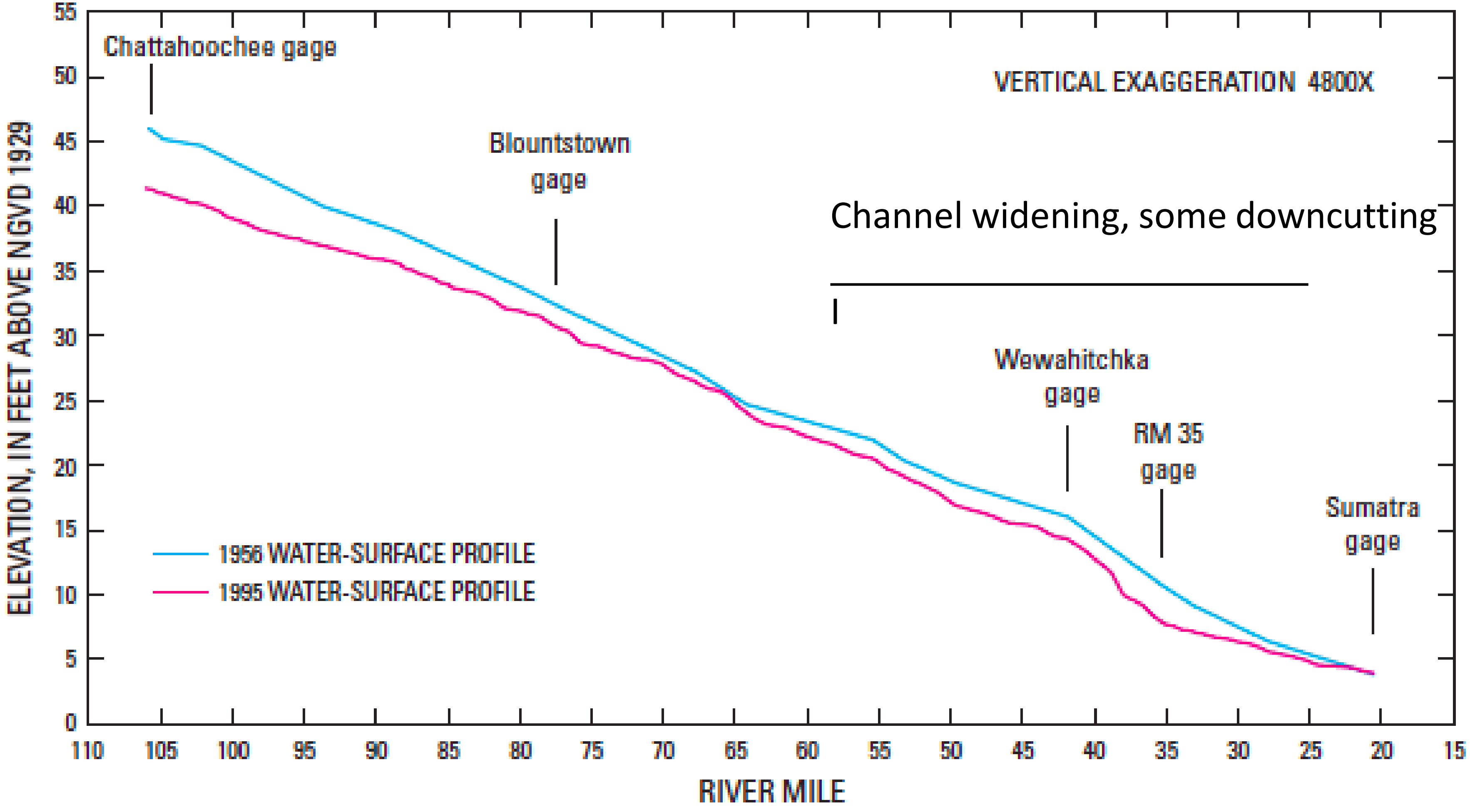
On Apalachicola, intensive dredging continued throughout period of 1960s-1990s.
In loose sand, unable to establish a deep channel requiring only "maintenance".
About 30 million cubic meters (39 million cubic yards) dredged.
No dredging since ~2000.



Source: Mossa & Chen 2022 *Geomorphology*

Impacts of Dredging on Channel

Below dam and from heavy dredging, channel widening & destabilization, resulted in lower water levels



Channel Straightening on the Apalachicola River:

It goes way back

Civil War battery installation and trap for Union ships resulted in changed course – and shorter channel overall.

From 1958-1969, Corps cut off meander bends at six sites between RM26 and RM 36.3, shortening the river by a total of 2 mi. The largest cutoff was Battle Bend (RM29)

From 1958-1969, Corps cut off meander bends at six sites between RM26 and RM 36.3, shortening the river by a total of 2 mi. The largest cutoff was Battle Bend (RM29)

Shortening the river steepened the channel – so more erosive energy, caused further incision.

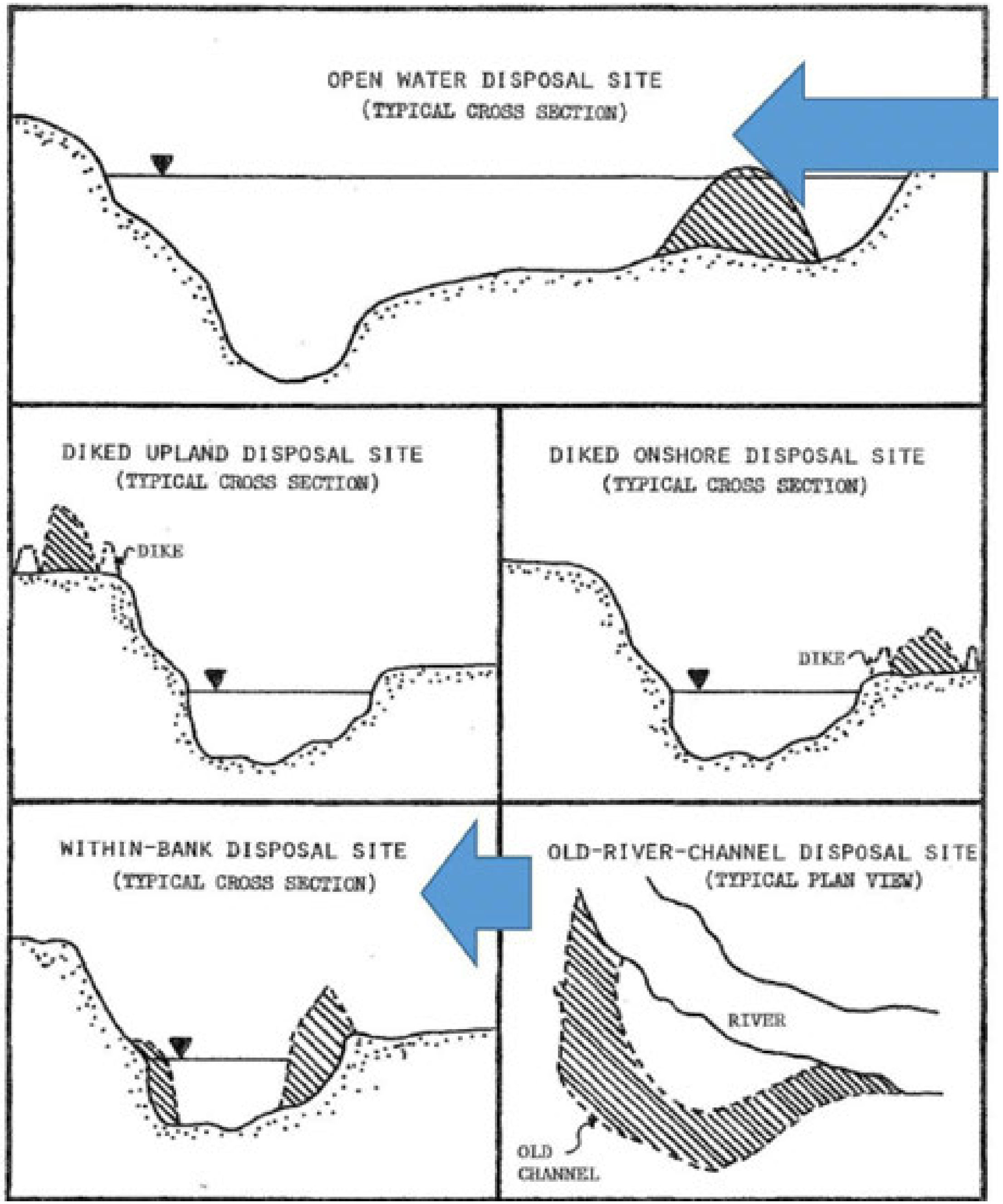
Some cutoff meanders were used as disposal sites

Where to put the dredged sand?

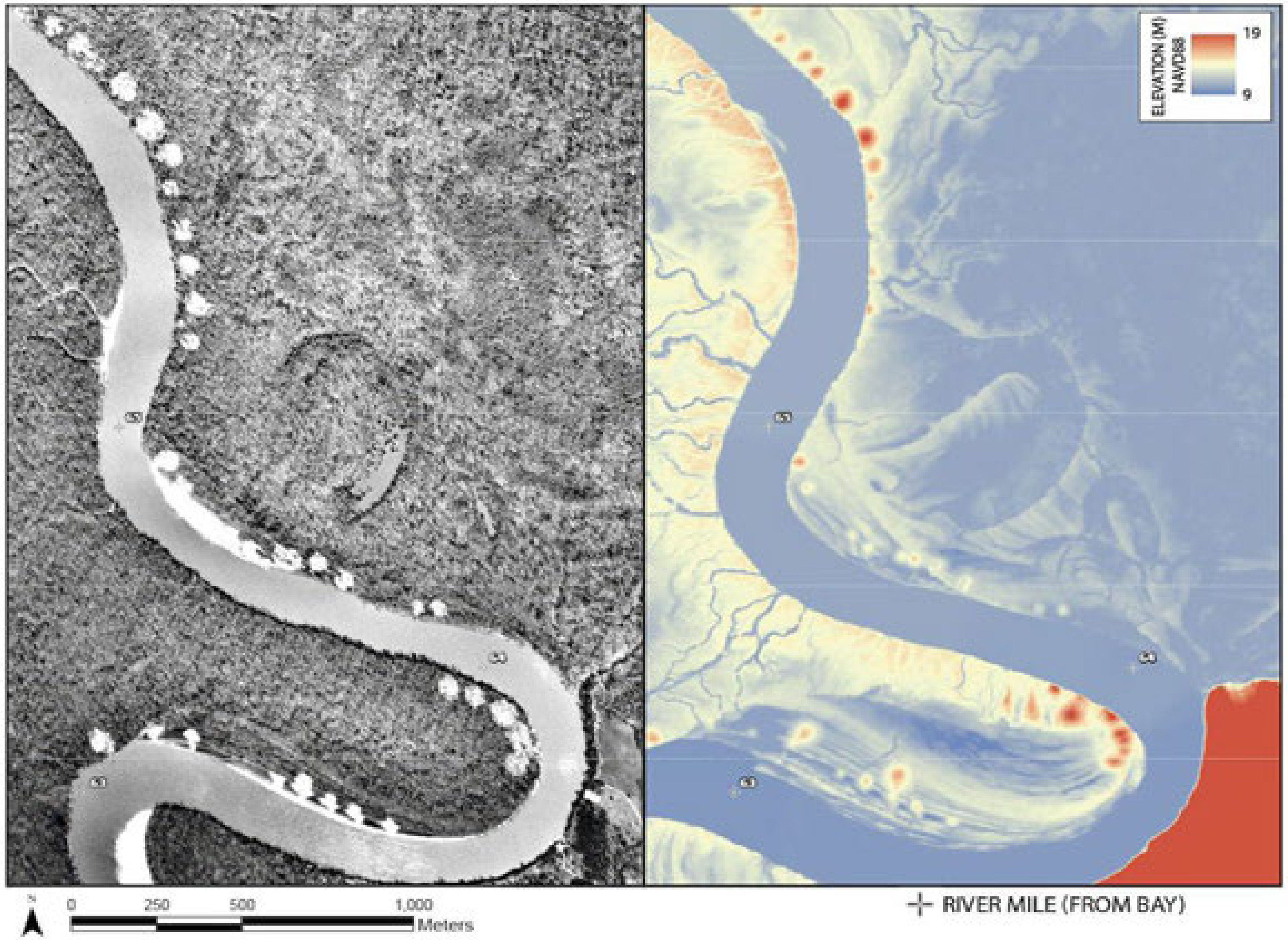
At first, on the floodplain, later “in-channel disposal”

Where to put the dredged sand?

Lateral bars "on steroids" from dumping of spoils on natural point bars and along other channel margins.



Dredge disposal site options as shown in USACE 1986

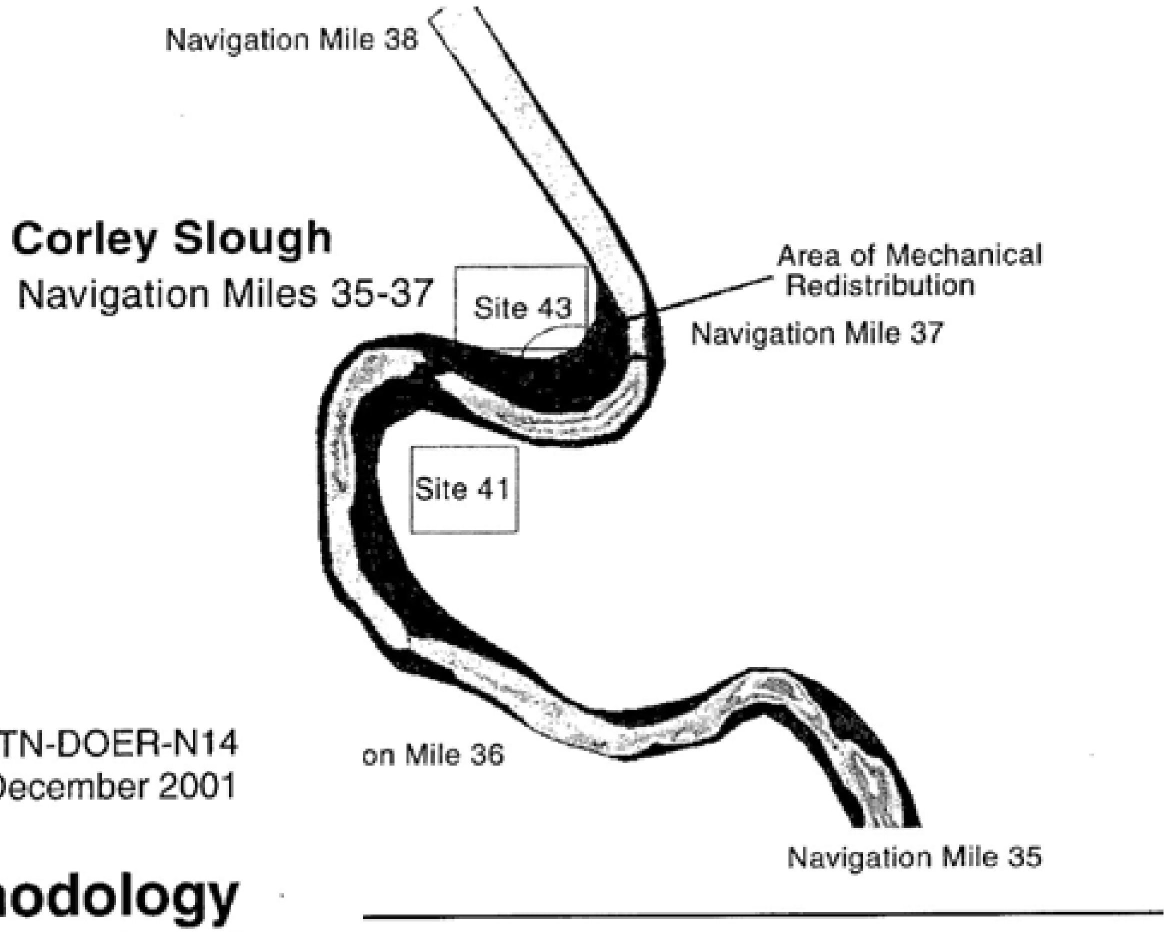


Spoil piles on 1957 aerial photography, and LiDAR RM 63 to RM 66.
Round forms = conical spoil piles, long patches are in-channel disposal sites

Spoils still visible along river banks in many reaches.

“Mechanical Redistribution”

Corps ran out of disposal sites, so began to bulldoze spoils into river during high flows, so sediment would be redistributed downstream.

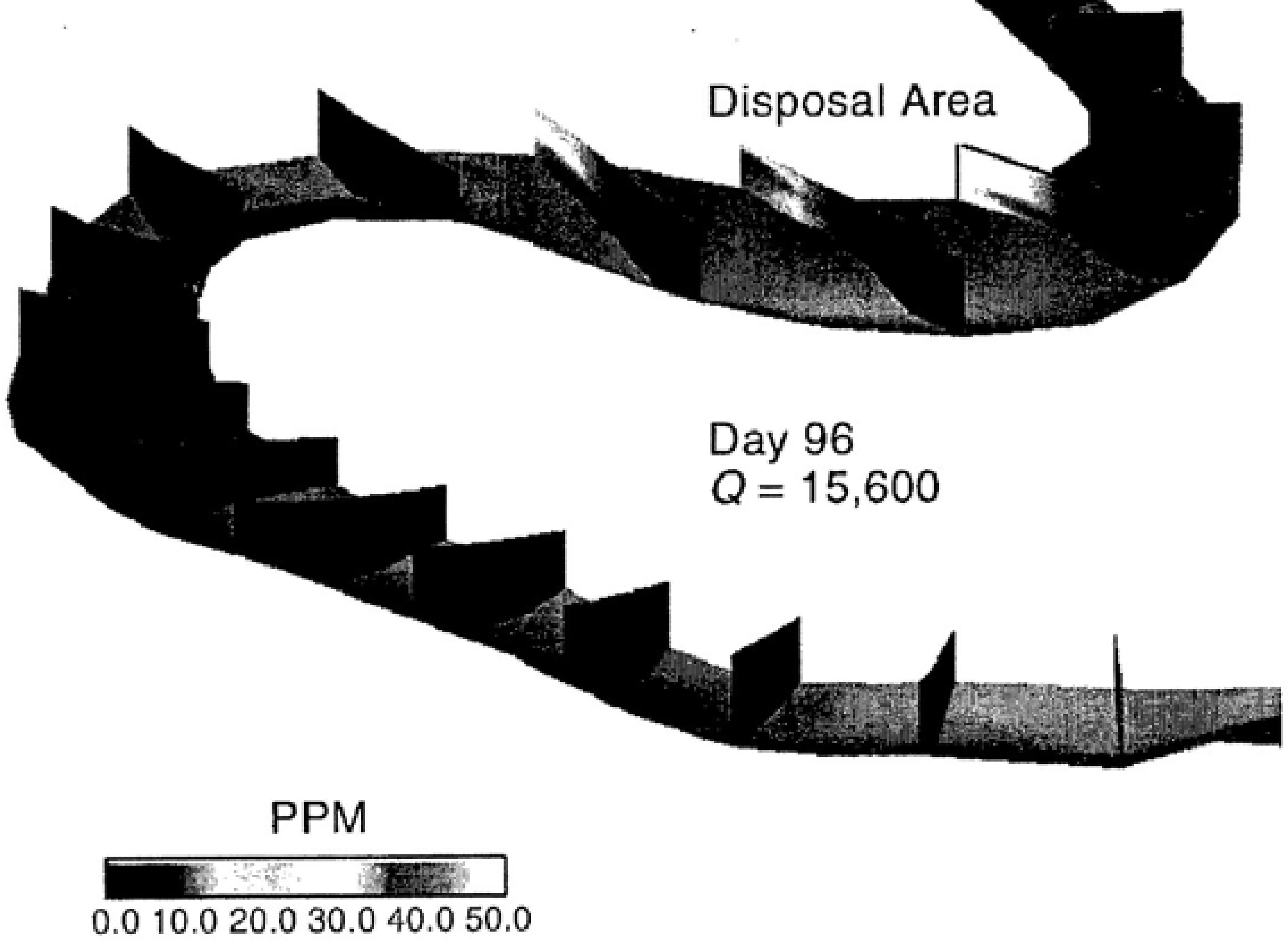


ERDC TN-DOER-N14
December 2001

Development of Methodology for Predicting Fate of Dredged Material Placed on Riverbanks

PURPOSE: A method of dredged material disposal used by site managers on inland rivers is called mechanical redistribution. This involves initially placing the dredged material on the adjacent banks of the channel where the material is dredged. With the onset of high flows moving down the river, the material is then either pushed back into the stream or is expected to be eroded by the overbank

Measurements and modeling showed elevated concentrations of sand resulting from mechanical redistribution (and bed disturbance generally)



. Scenario 2, Day 96, suspended sediment concentration in ppm

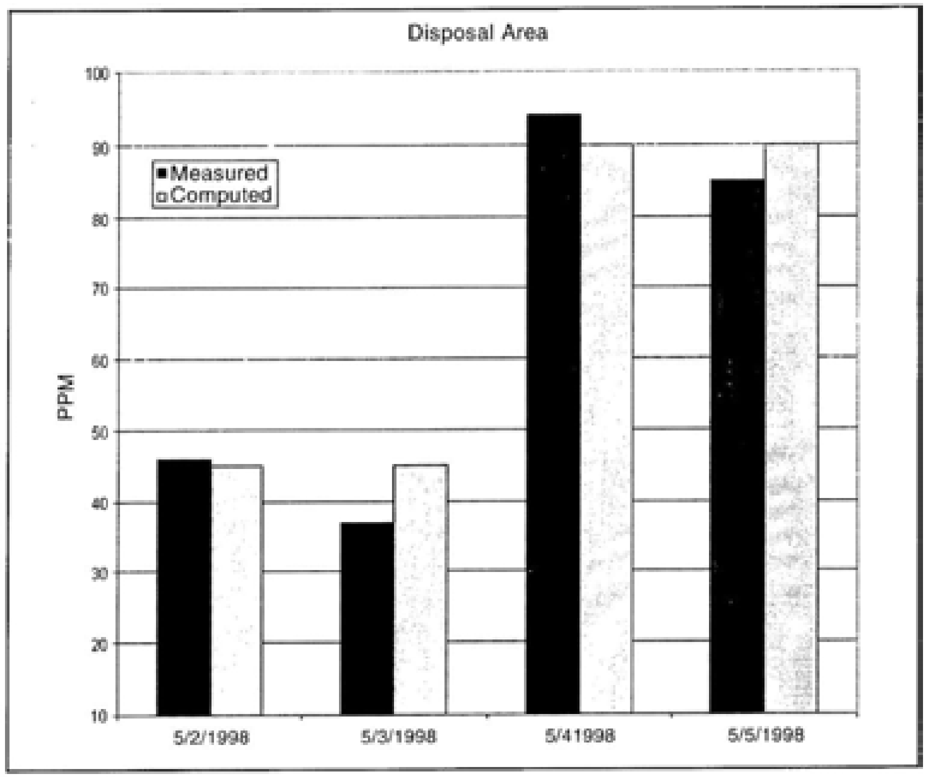


Figure 6. Comparisons of suspended sediment concentration at disposal area

Some sand was carried into sloughs
Disturbance from dredging and spoil disposal put vast quantities of sand into suspension, some carried into sloughs and deposited, now blocking water circulation.

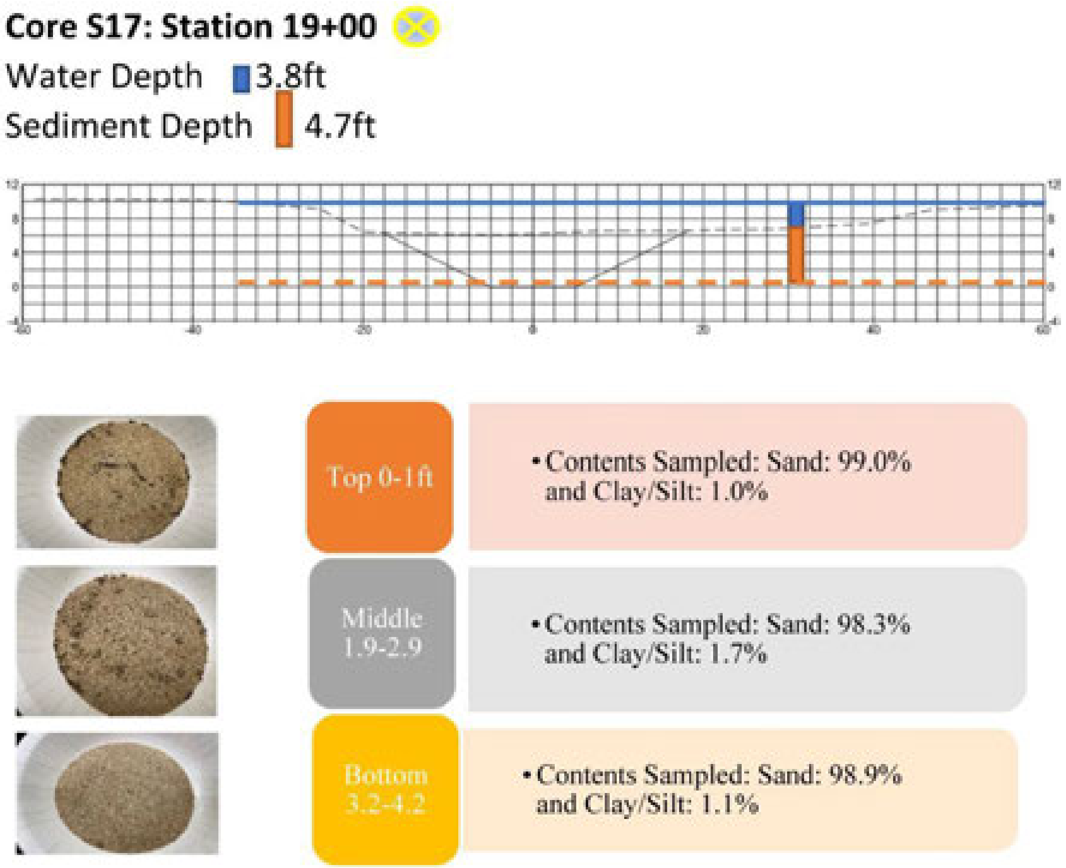
Some sand was carried into sloughs

Disturbance from dredging and spoil disposal put vast quantities of sand into suspension, some carried into sloughs and deposited, now blocking water circulation.

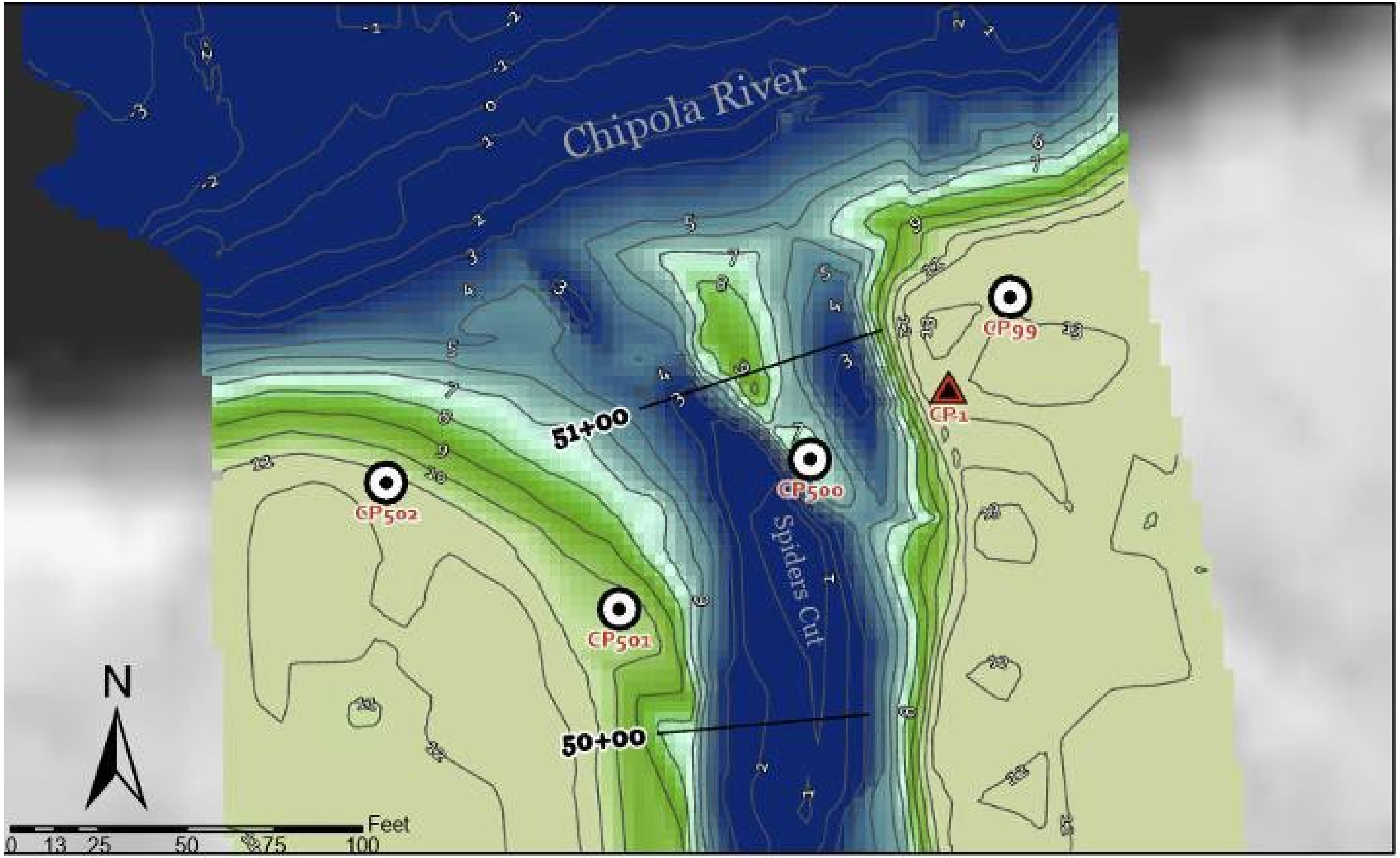
Sand deposits occurs in multiple sloughs.

Stratigraphy
Clean sand deposits unconformably overlie former channel bottom:
Below 2.4 ft of sand, we find *Corbicula*, an invasive clam that arrived in the Apalachicola in the late 1950s.
Thus the sand is more recent than 1950s, aligns with the active dredging era

< *Corbicula*



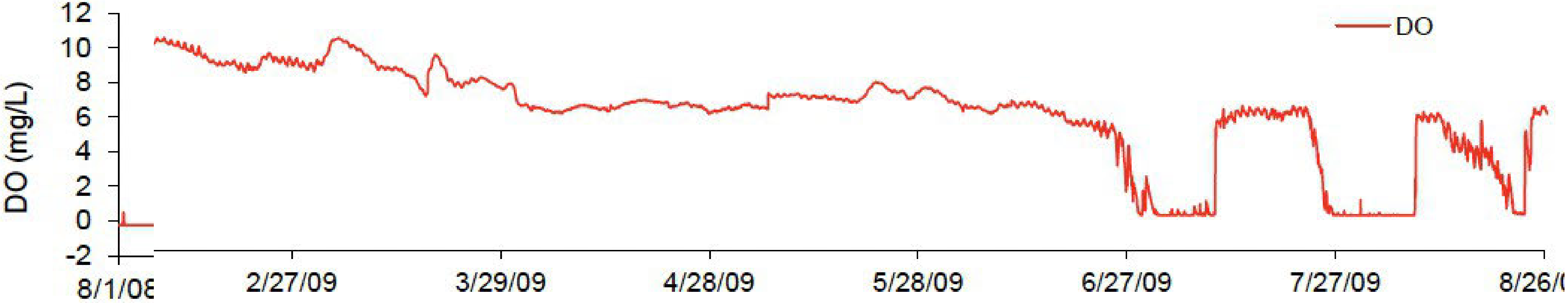
We analyzed 23 sediment cores (from 1-2m deep) from Spiders Cut. All cores were almost pure sand, marking them as being from the dredging by the Corps .



Sand ‘plug’ at the inlet to Spiders Cut on the Chipola River, visible in channel bathymetry (1-ft contours), restricts flow into Spiders Cut. (cutting off slough at flows < ~6000cfs

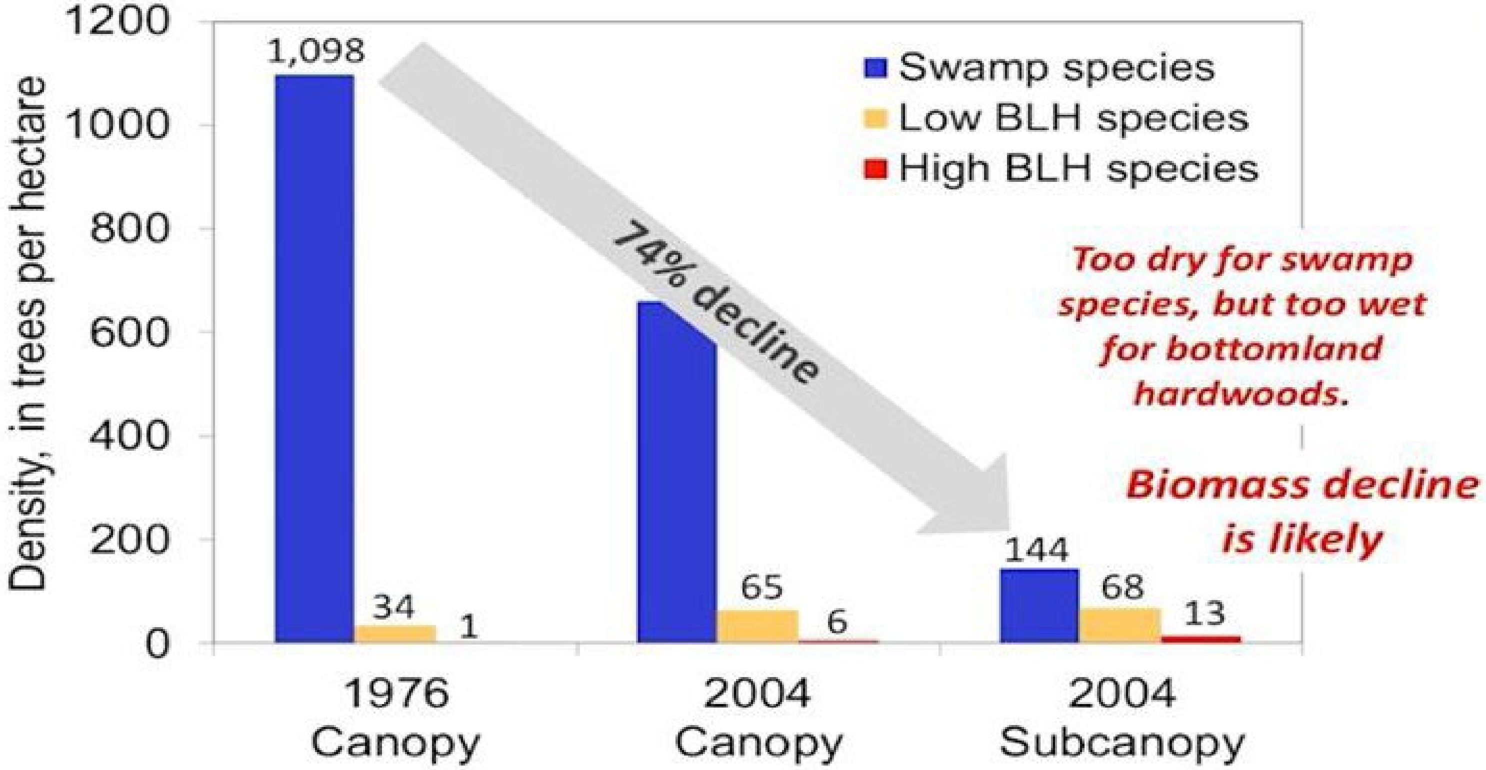
Sand deposits increase the flow threshold needed to connect sloughs

Result: sloughs are disconnected over more of the hydrograph, causing DO levels to drop to lethal levels for fish



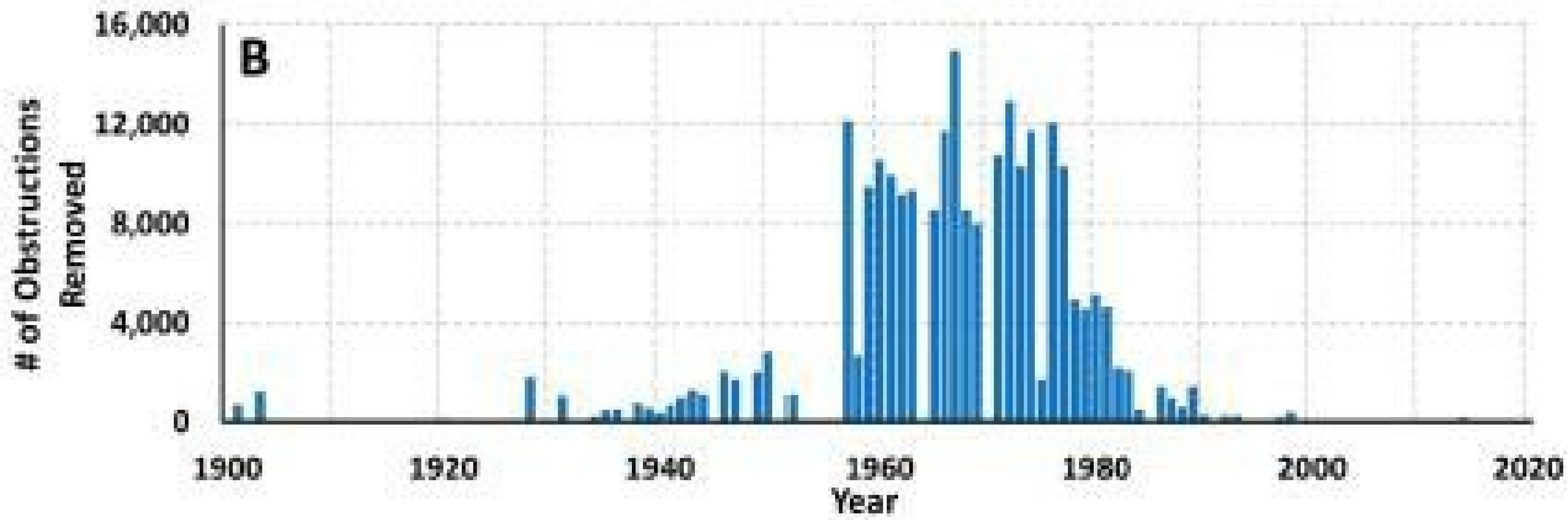
Environmental Science Associates and Helen Light. 2012. Apalachicola River floodplain monitoring report: Dissolved Oxygen Concentrations in Floodplain Sloughs and Oxbow Lakes in Relation to River Flow and Connectivity

Number of trees in swamps has declined dramatically

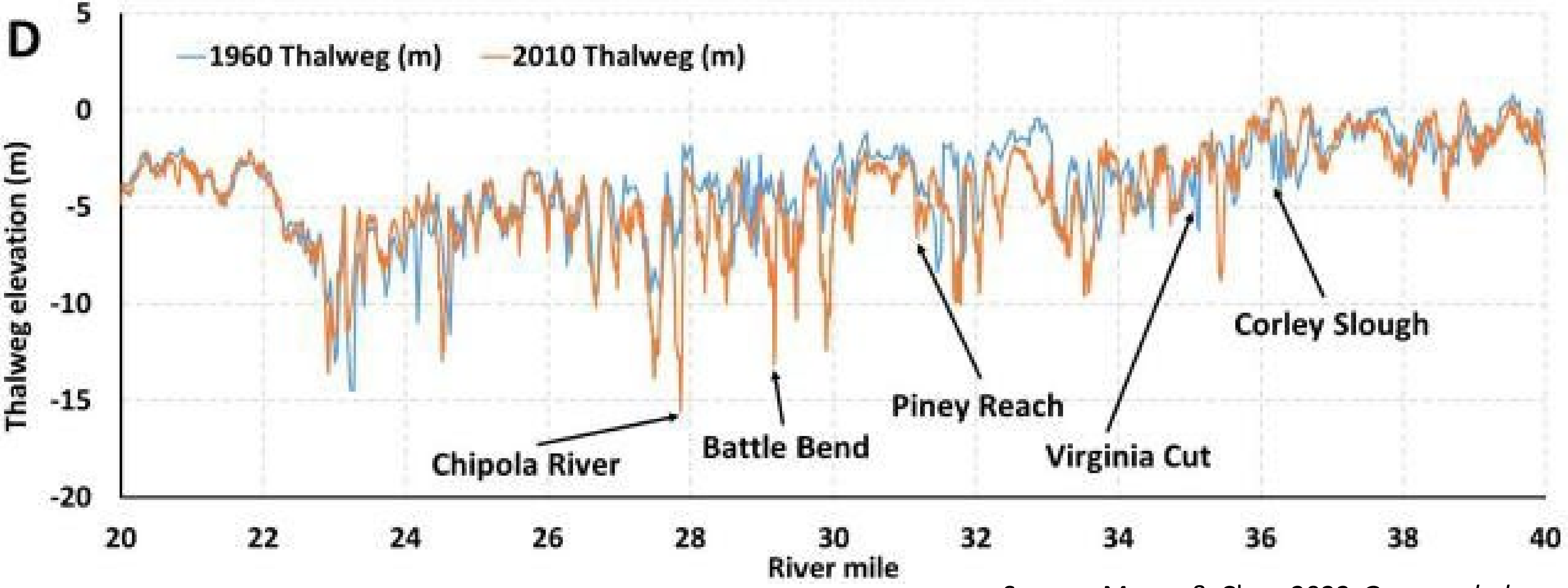


Darst & Light 2008

Removal of **Snags** on the Apalachicola
(i.e., trees and limbs that inhibit navigation
>237,000 snags removed from river by 2000.
Peak of 15,000 in 1967



Data compiled by Ted Hoehn, graphic from Mossa & Chen 2022 *Geomorphology*



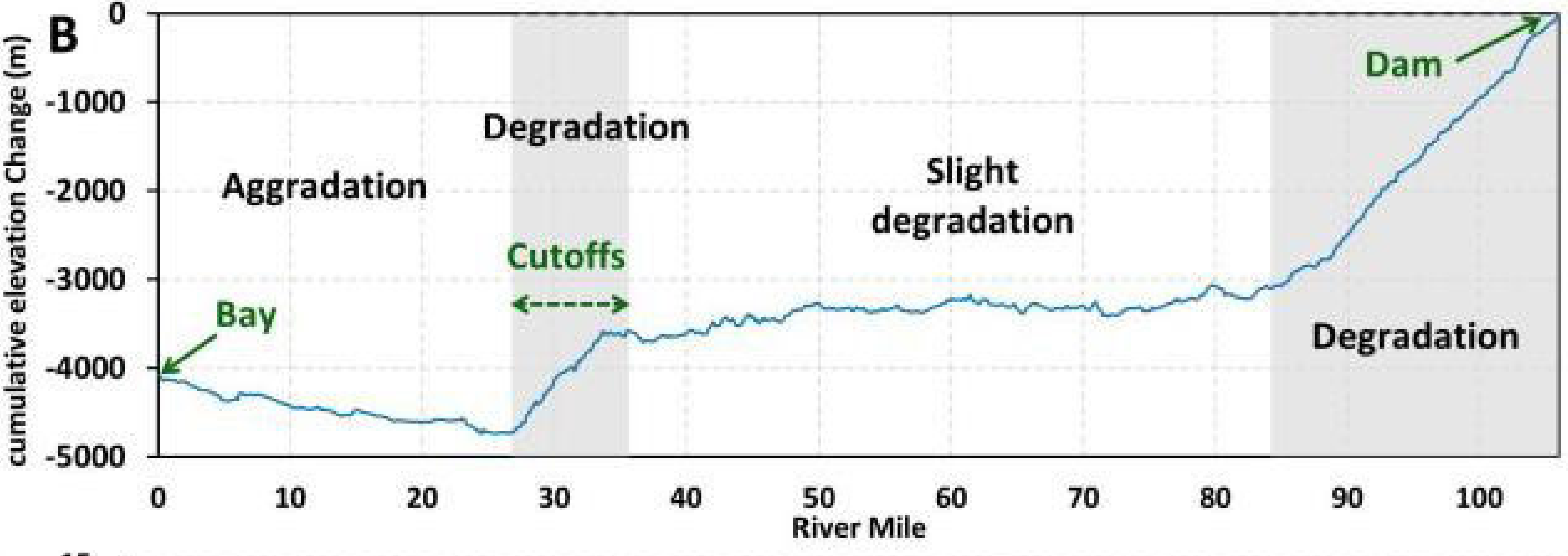
Source: Mosse & Chen 2022 *Geomorphology*

Channel instability from dredging caused bank erosion, channel widening.
Channel width increased from 390 ft in 1941 to 460 ft in 1999.
(in the lower non-tidal reach)

Result: Lower water levels in the river for the same flow

Longitudinal pattern of incision and aggradation (build-up of bed)

- Incision below dam, and in reach of intensive dredging and bend cutoffs.
- Aggradation downstream in tidal reach from increased sediment supply from erosion of disturbed reach



Source: Mossa & Chen 2022 *Geomorphology*

Recovery since end of dredging (~2001)

Bed elevations stabilized/recovering, channel narrowing, revegetation of point bars

Post-dredging recovery: channel narrowing by establishment of vegetation on point bars, RM 55.7

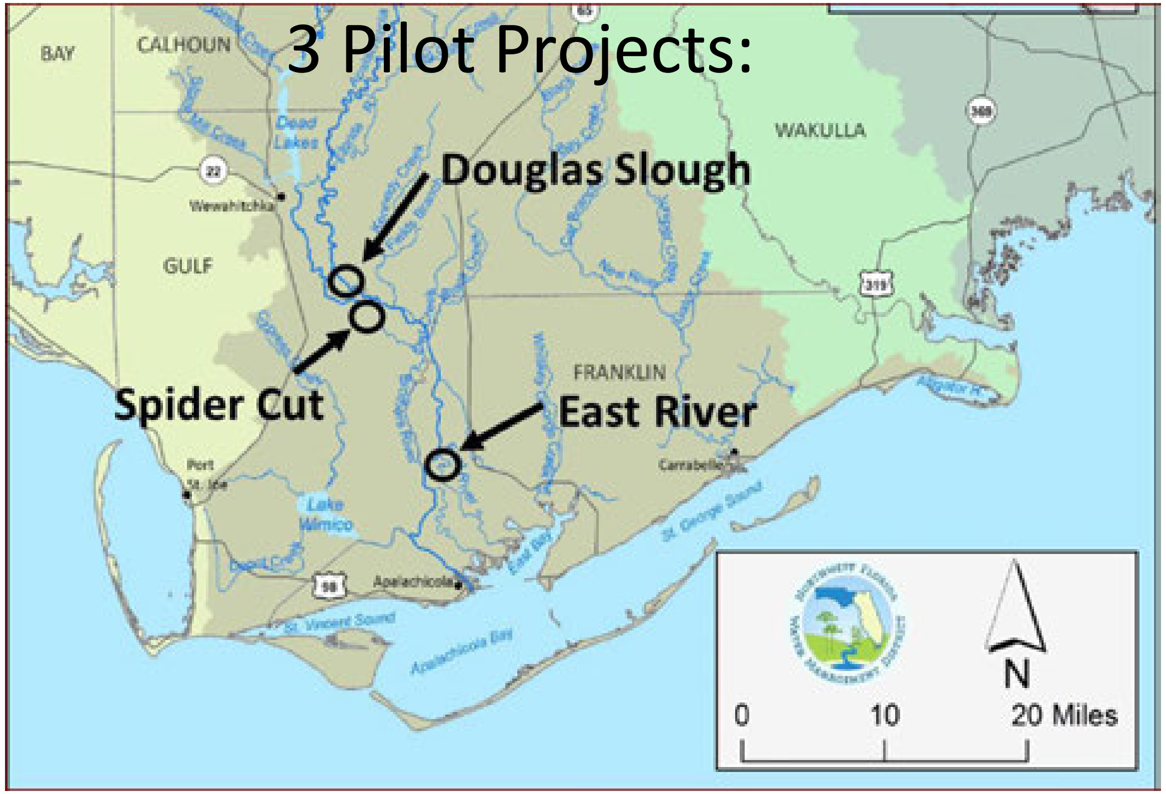
Overall, sandbar area decreased by 16% from 2005-2015 in study reach RM40-63

(Mossa et al *2022*)

Now that the system is recovering and there is less sand in suspension, can we remove sand deposits blocking sloughs to restore circulation?

3 pilot projects. Initial results are good!

Barging out excavated sand from Spiders Cut, Nov 2025



RiverKeeper Project supported by NFWF
(BP Horizon Oil Spill Funding)

Thank you!

Matt Kondolf, UC Berkeley Kondolf@Berkeley.edu

NFWF
NATIONAL FISH AND WILDLIFE FOUNDATION

APALACHICOLA RIVERKEEPER®

COAPS

Florida Wildlife Federation
Keeping the Wild in Florida since 1936!

Riparian County Stakeholder Coalition

UF | West Florida Research and Education Center
MILTON, FL

NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Apalachicola National Estuarine Research Reserve

MODELING AND ANALYSIS OF SLOUGH RESTORATION PROJECTS USING A RIVER ELEVATION MODEL (REM)

Scott Walls, walls land+water LLC

scott@wallslandwater.com

Apalachicola National Estuarine Research Reserve (ANERR) 5th Symposium

February 27, 2026

Support from:

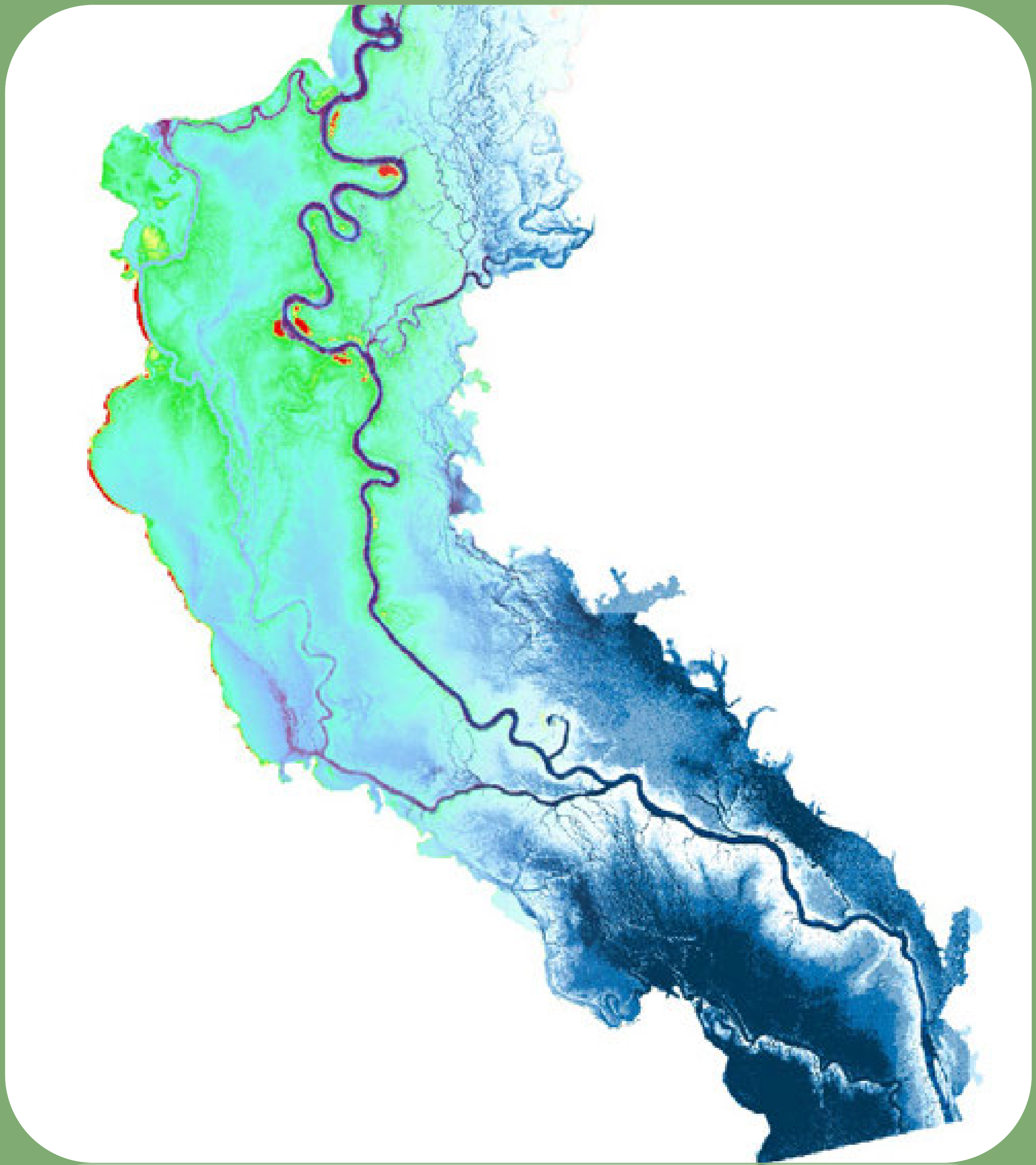
Apalachicola Riverkeeper

PEW Charitable Trusts

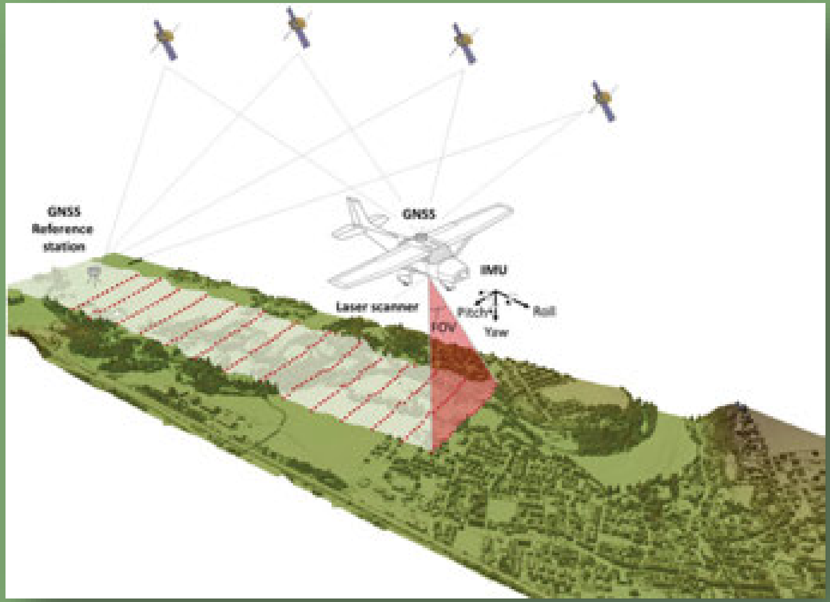
Florida Wildlife Federation, Inc.

NFWF

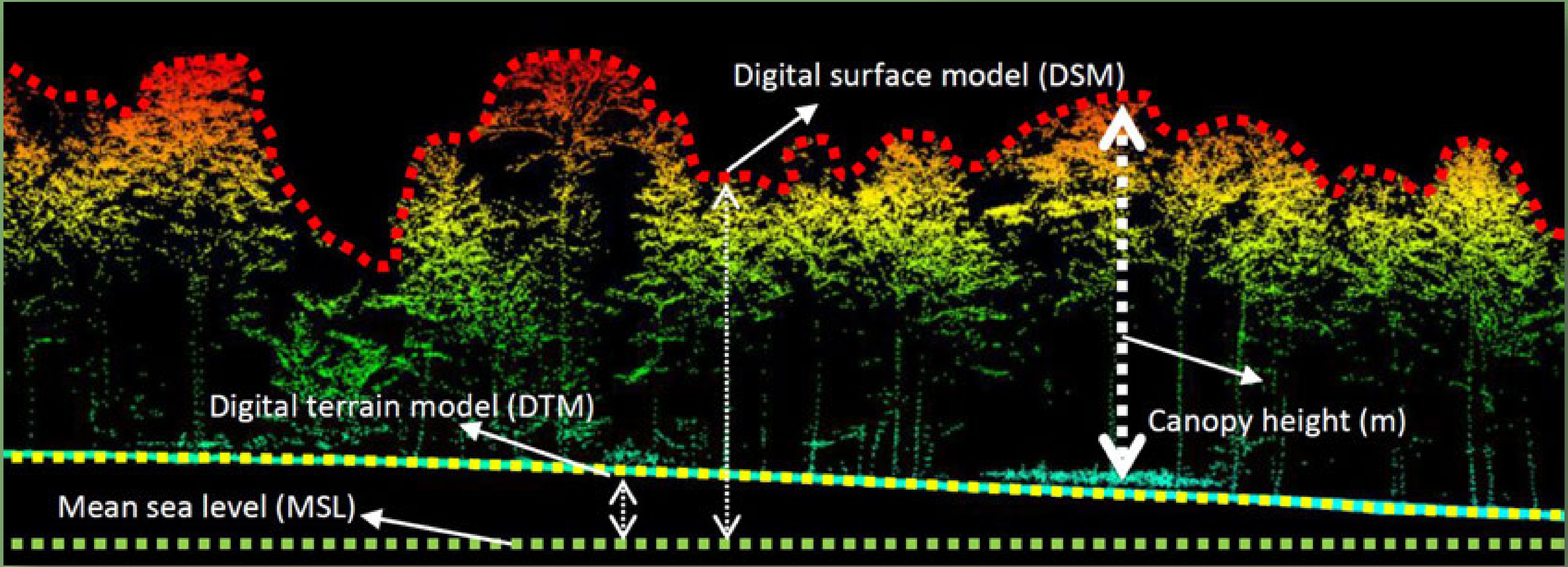
Rhumbline Consultants, PLLC

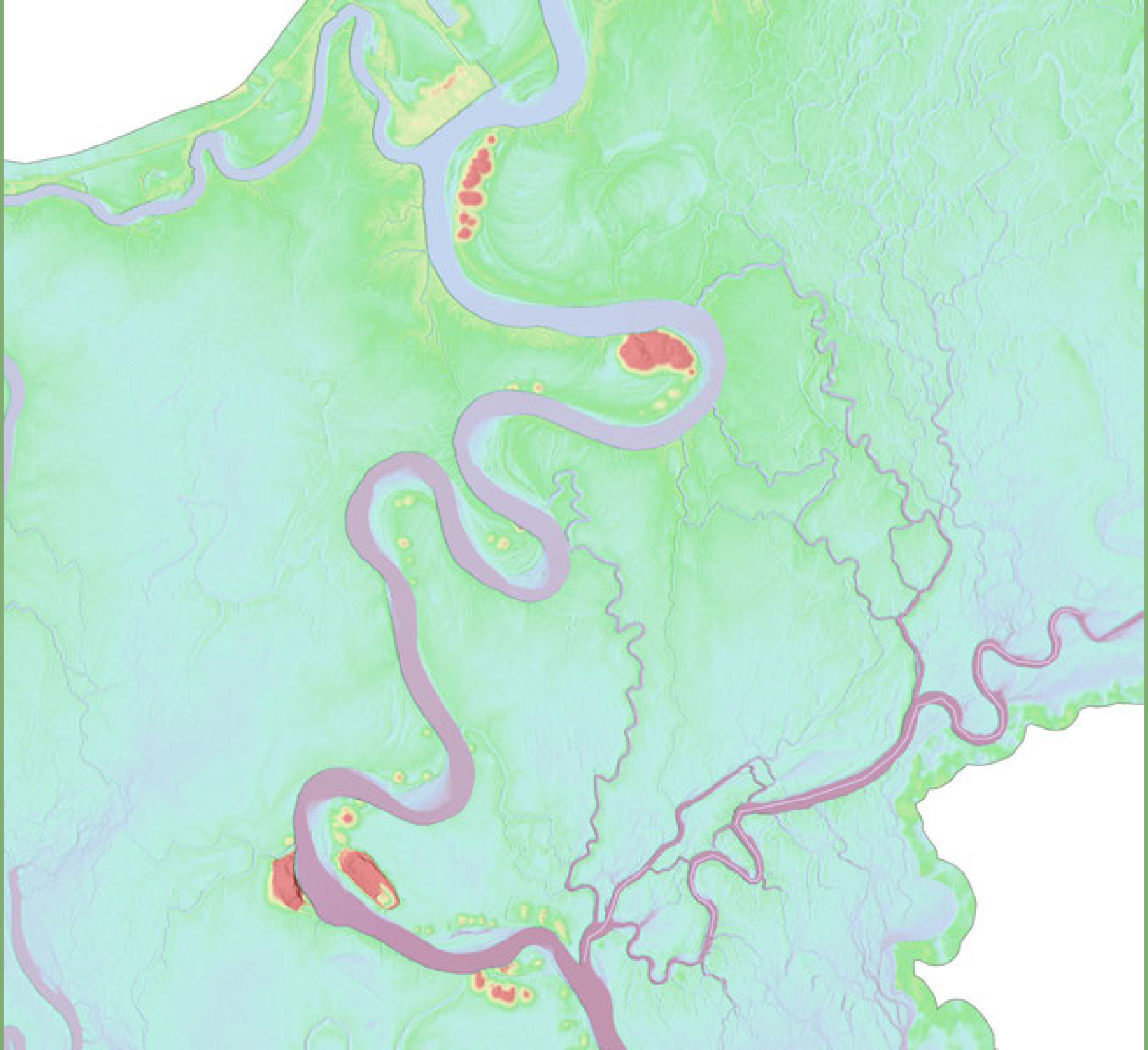


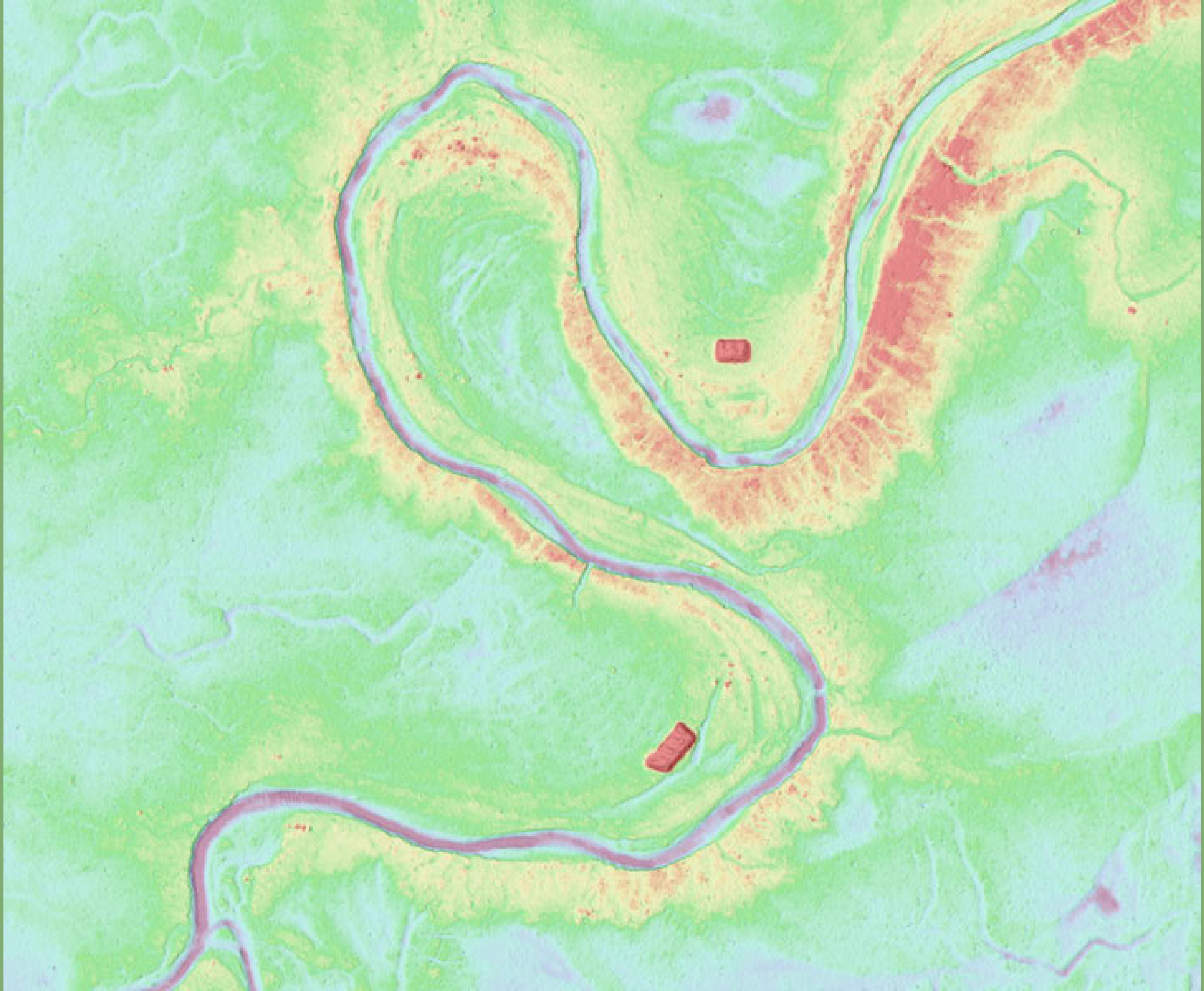
WHAT IS LIDAR?



- River Elevation Models (REMs) are derived from LiDAR Bare Earth Digital Terrain Models (DTMs)

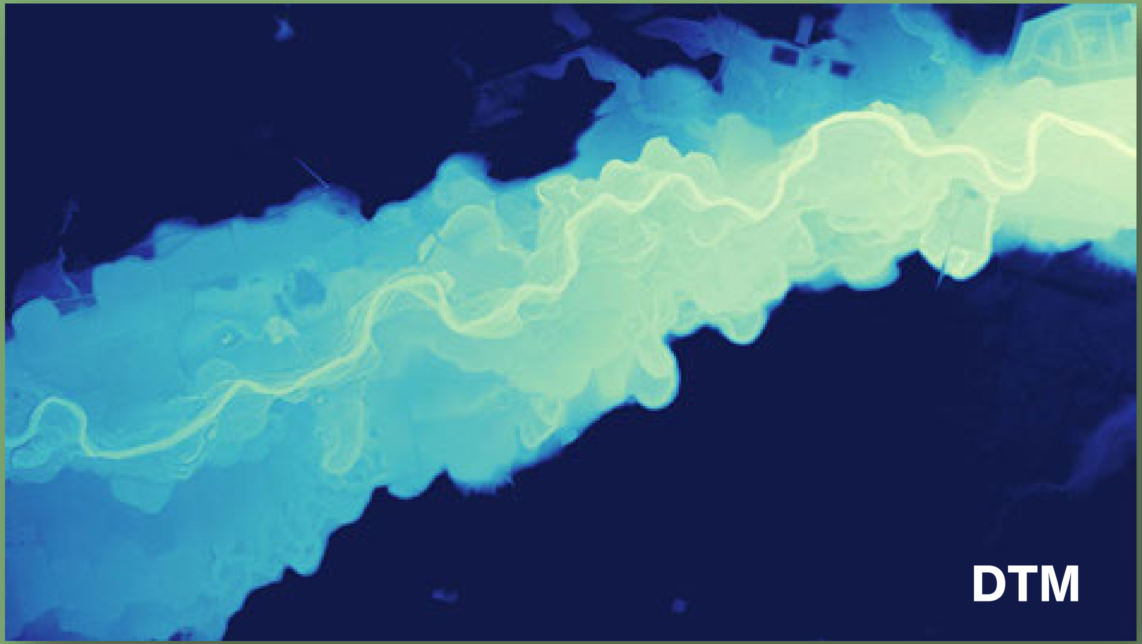






WHAT IS AN REM?

- DTMs are referenced to a single elevation datum (generally NAVD88 or appx. mean sea level)

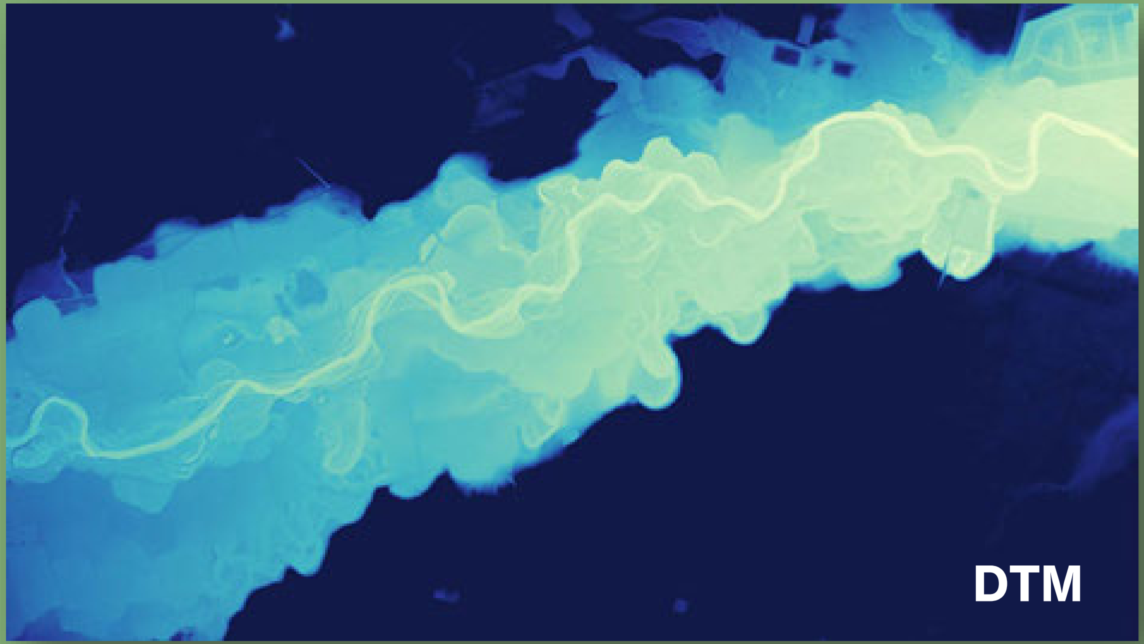


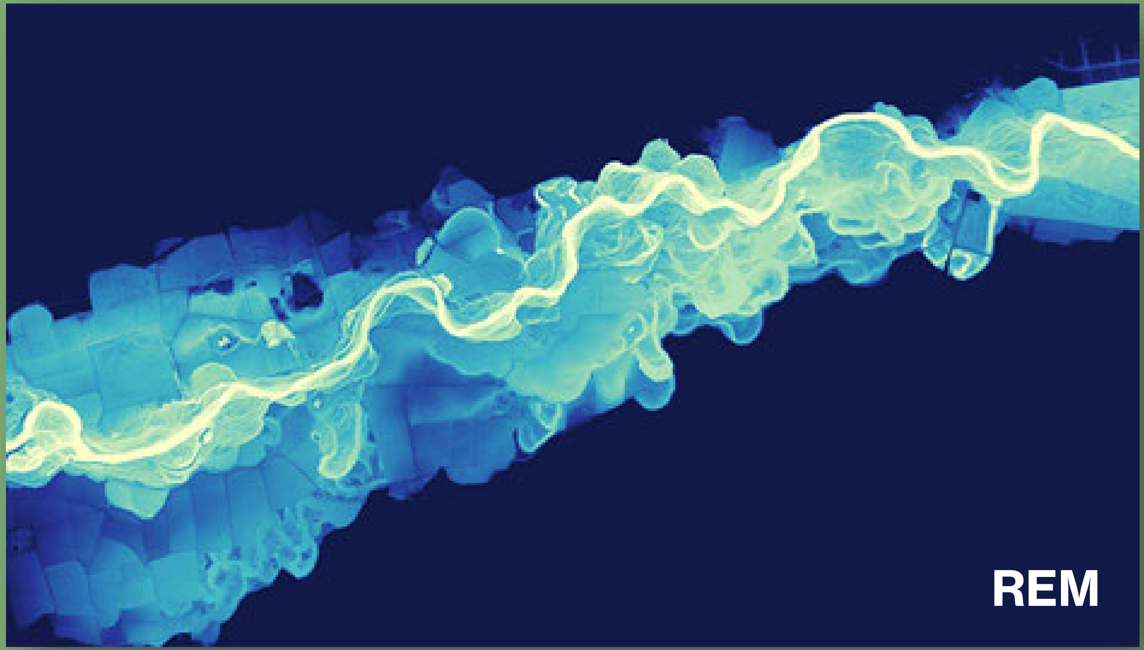
Carson River, NV. danecoecarto.com

WHAT IS AN REM?

- DTMs are referenced to a single elevation datum (generally NAVD88 or appx. mean sea level)

- **REMs are detrended by water surface elevation or valley slope**



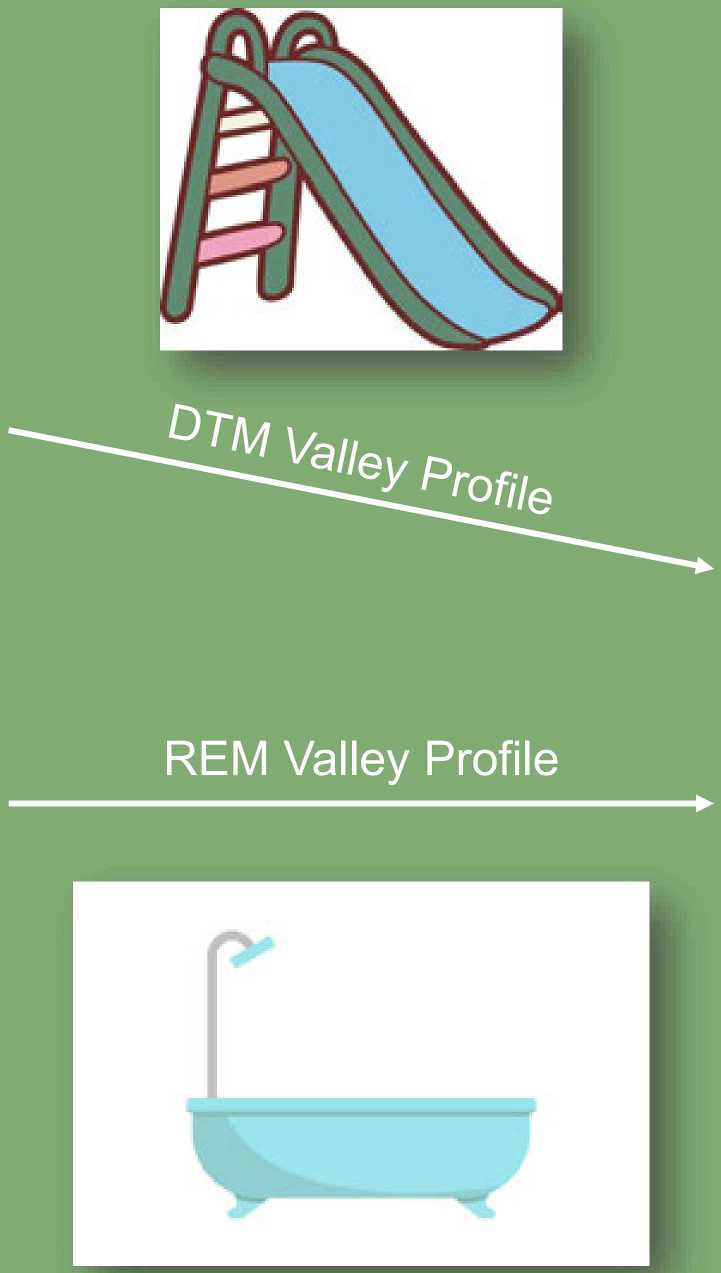


Carson River, NV. danecoecarto.com

WHAT IS AN REM?

- DTMs are referenced to a single elevation datum (generally NAVD88 or appx. mean sea level)

- REMs are detrended by water surface elevation or valley slope
- **Waterslide vs Bathtub**



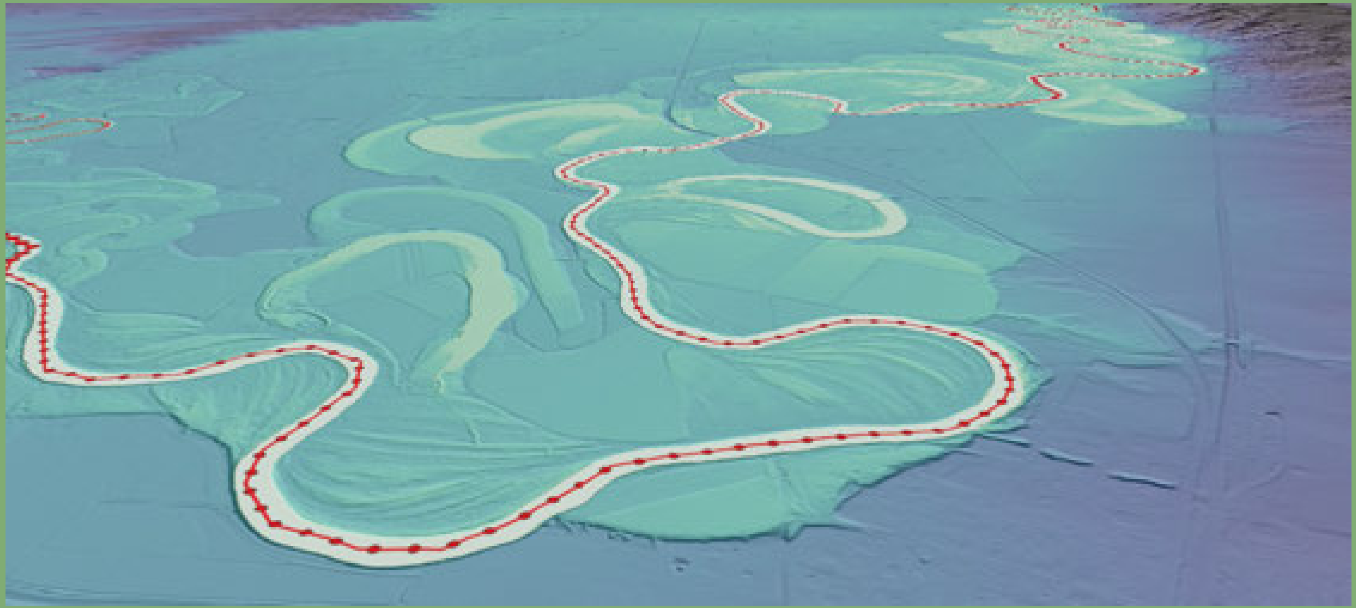
WHAT DO REMS PROVIDE?

- REMs are visually striking (eye candy), and easily digestible
- Fluvial geomorphology (erosion, sediment deposition)
- Floodplain connectivity and inundation potential
- Faster and cheaper than developing H&H models
- Particularly useful in braided or large floodplain rivers
- Excellent planning tool

WHAT DO REMS PROVIDE?

Snake River, WY. danecoecarto.com

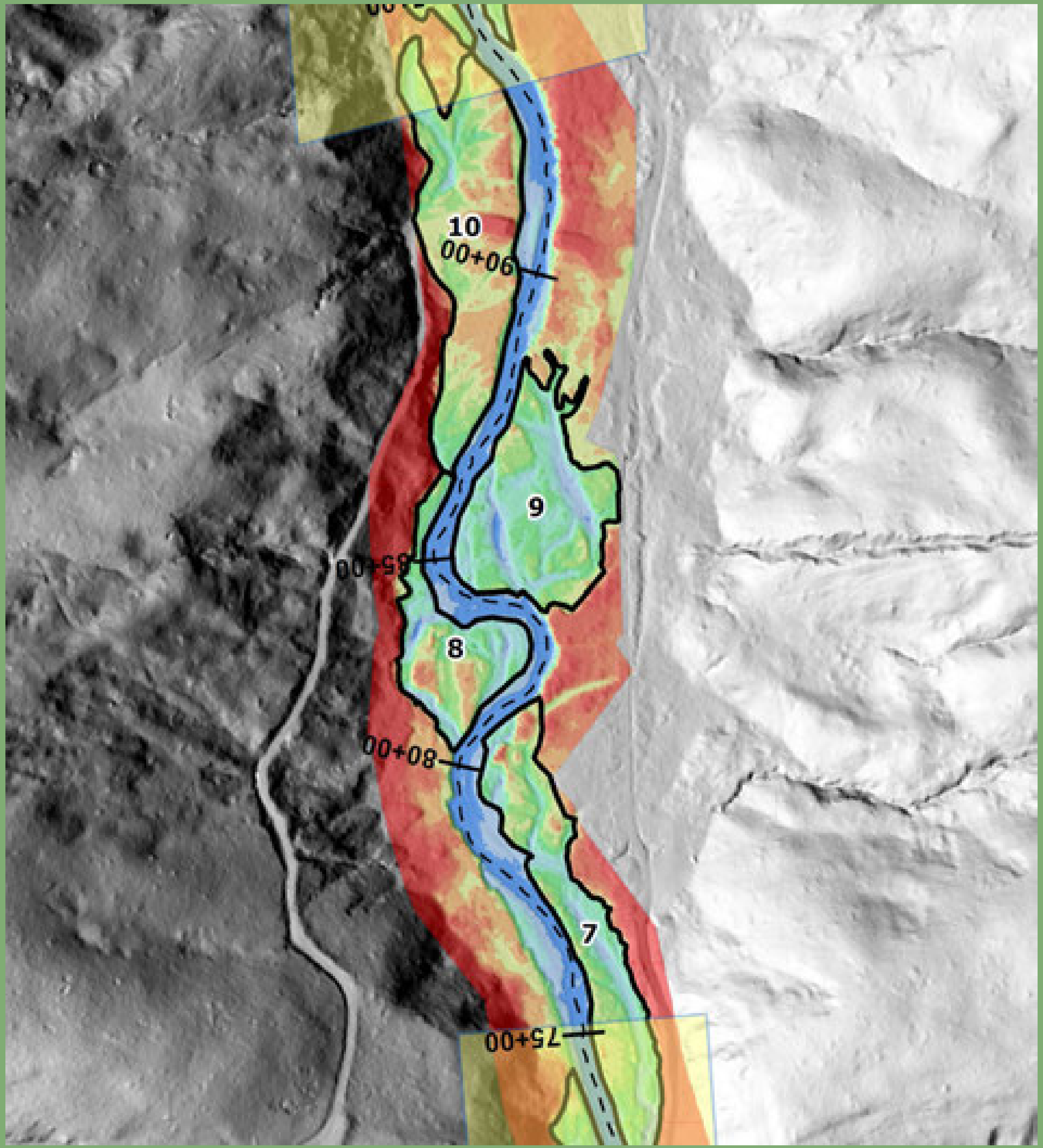
WHAT DO REMS PROVIDE?



Milk River, MT. opentopography.org

Mississippi River. USGS.

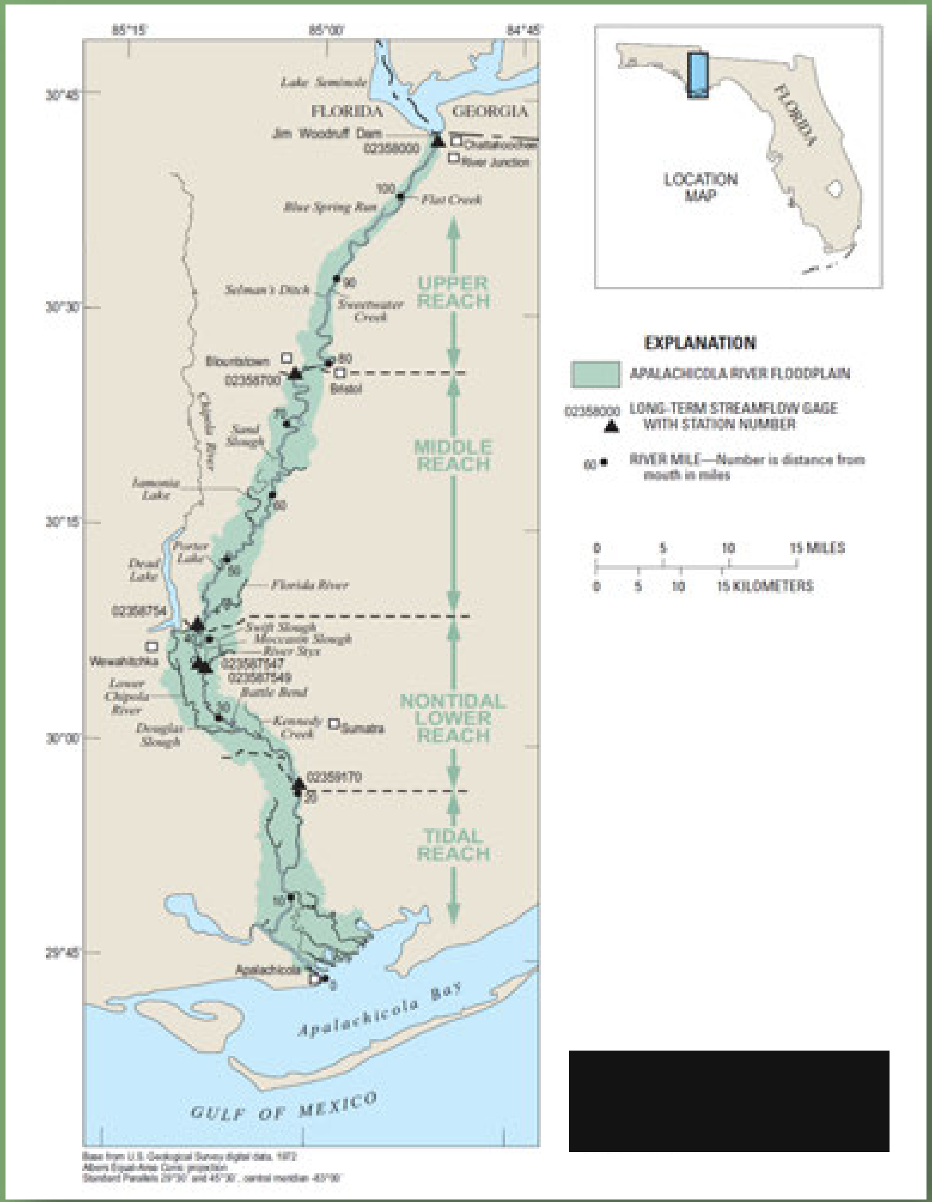
WHAT DO REMS PROVIDE?



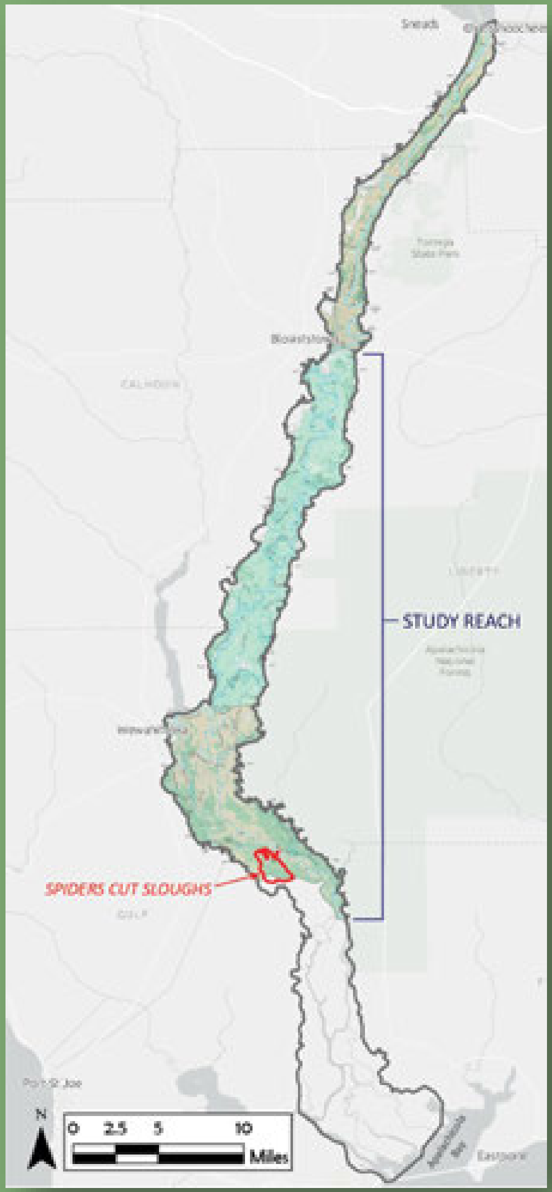
Soquel Cr, CA. WL+W.

DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN



Apalachicola River Floodplain and Reaches

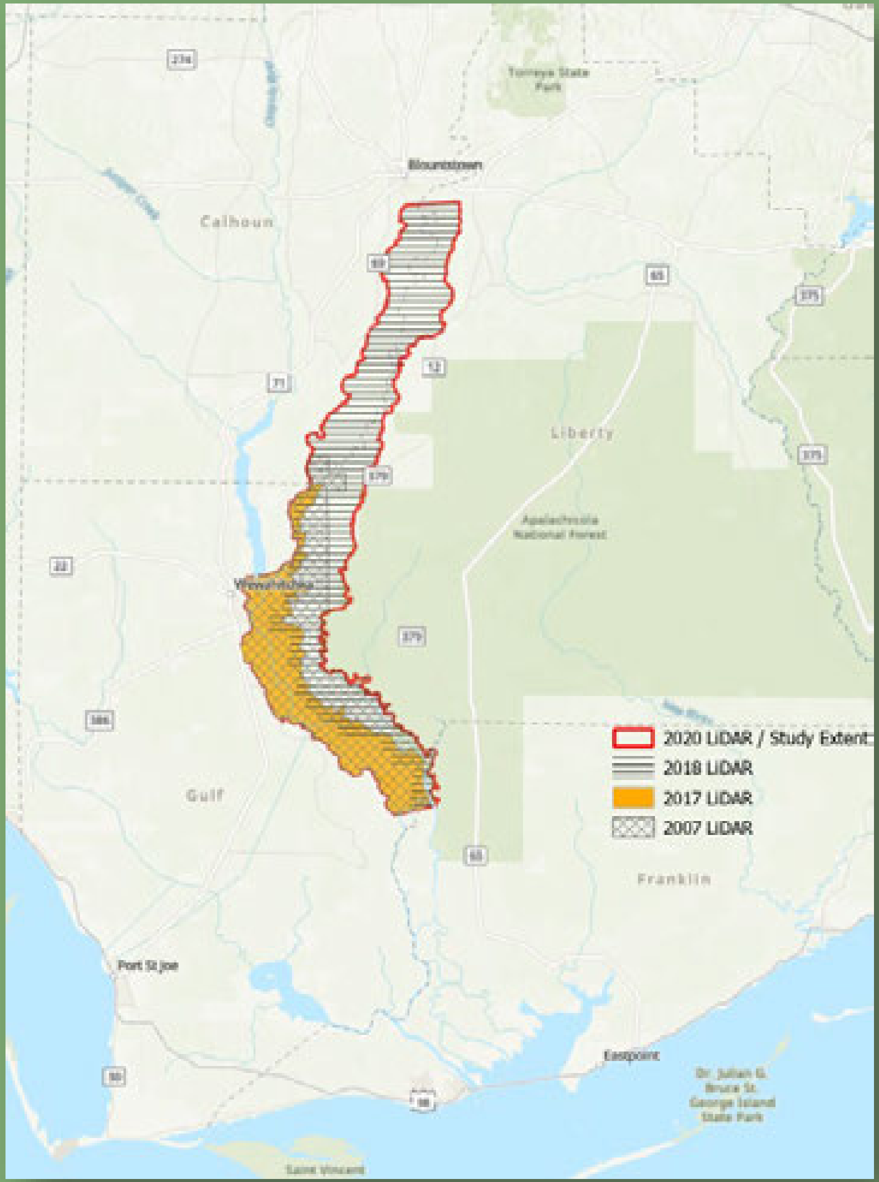


Study Reach (Middle and Nontidal Lower Reaches)

DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

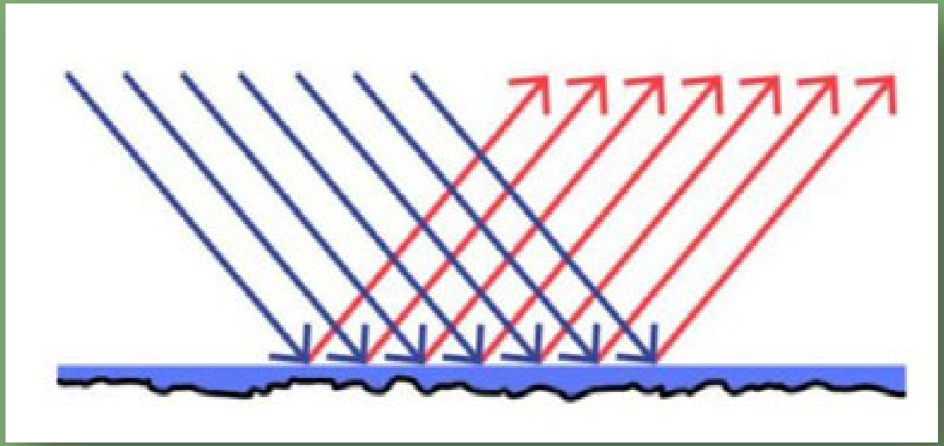
- Collect public LiDAR data
- Four LiDAR datasets with different dates, coverages, and flow conditions

LiDAR Dataset	Dates Flown	Counties Covered	Agency	Range of Flows (cfs) at Chattahoochee
FL Gulf 2007	July 9 – 22, 2007	Gulf	Florida Division or Emergency Management	5,100 - 6,100
FL Lower Choctawhatchee 2017	April 9 – May 17, 2017	Gulf	USGS	5,700 – 42,400
FL Panhandle 2018	April 10 - 25, 2018	Liberty, Calhoun, Franklin	USGS	16,300 – 22,800
FL Hurricane Michael 2020	December 16, 2019 – April 11, 2020	Gulf, Liberty, Calhoun, Franklin	USGS	8,940 – 172,000



DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

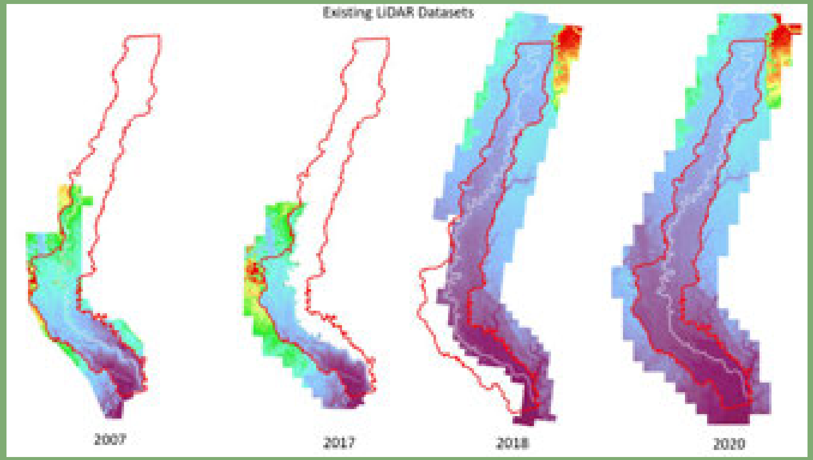
- Infrared LiDAR pulses do not penetrate water (they are reflected)

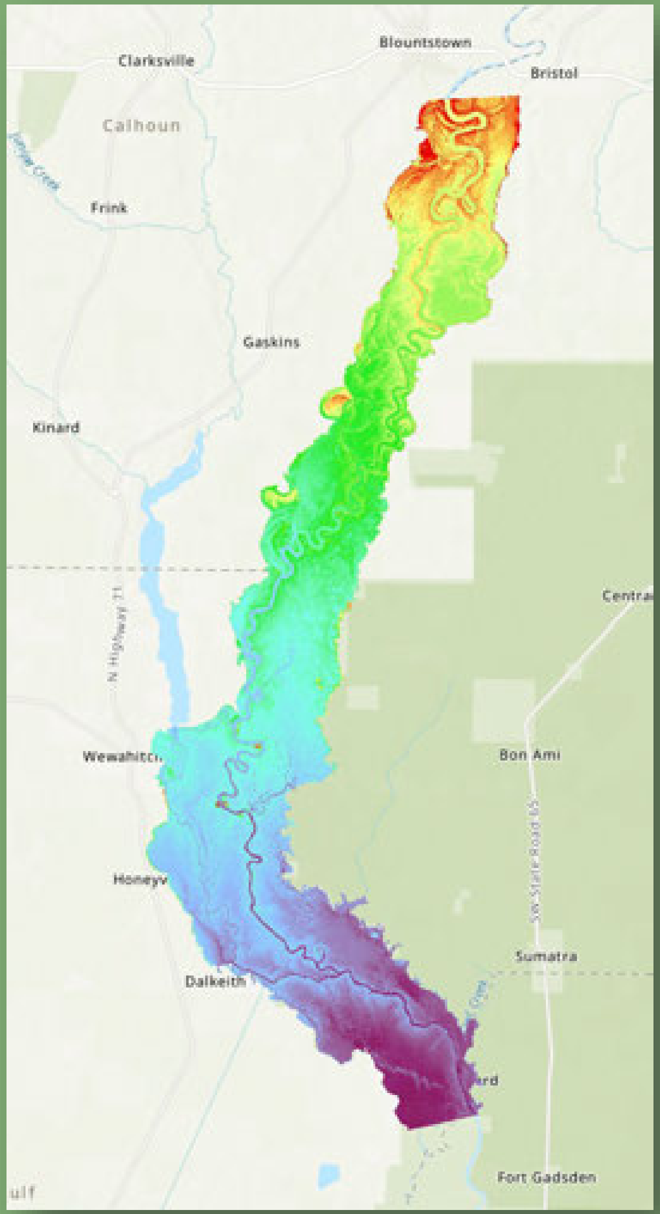


- When floodplain is inundated, topography is not revealed

DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

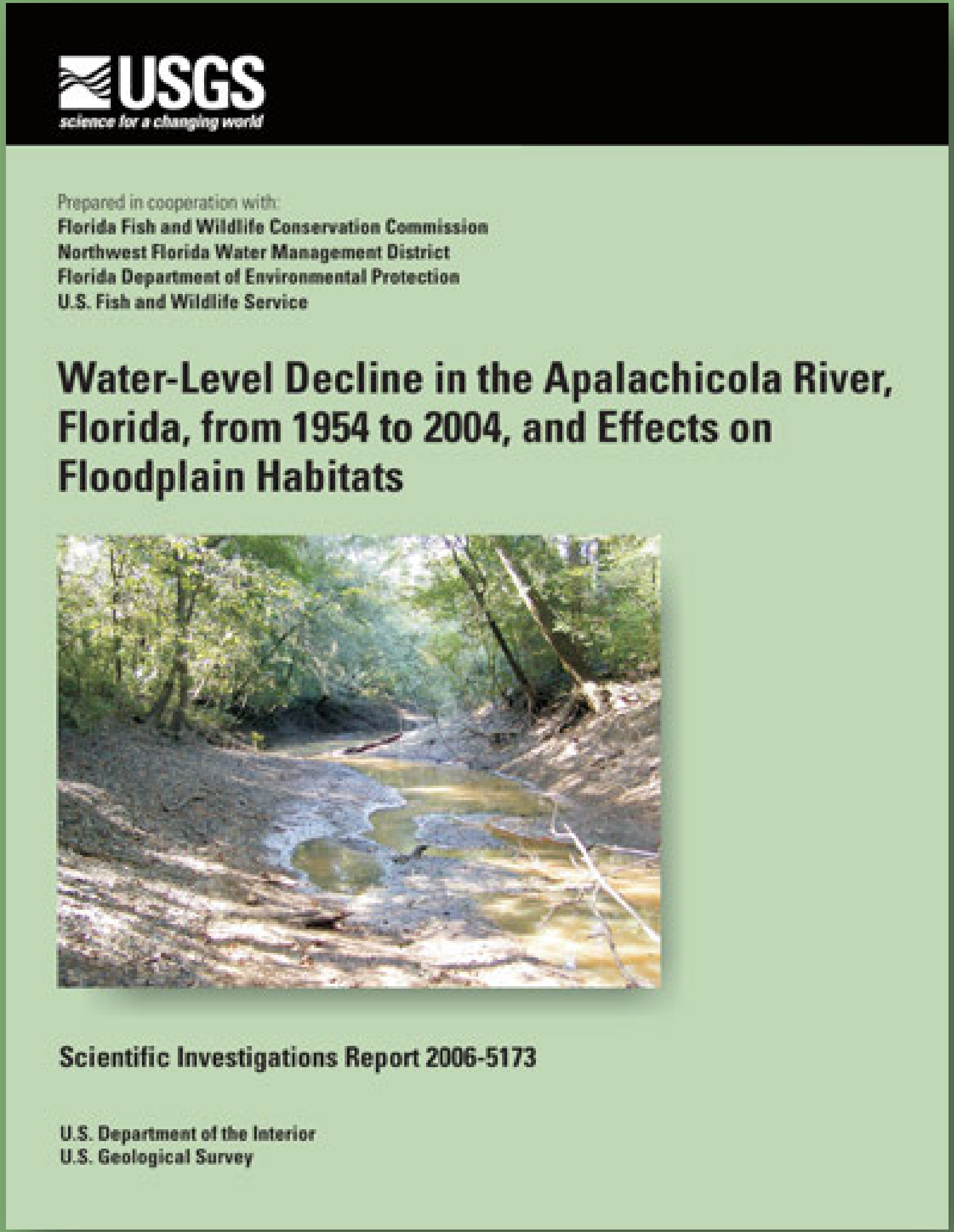
- Combined minimum DTM of all 4 flights
- Lowest flows from 2007 LiDAR (Gulf County), however this is the oldest LiDAR
- Newest (2020) LiDAR encompasses floodplain but essentially useless in floodplain due to high flows during survey





DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

- Most REMs utilize a single water surface elevation from the time of flight
- We used water surface elevations from Light et al 2006, which compiled for every 100 cfs above 4500 cfs, every 0.1 river miles

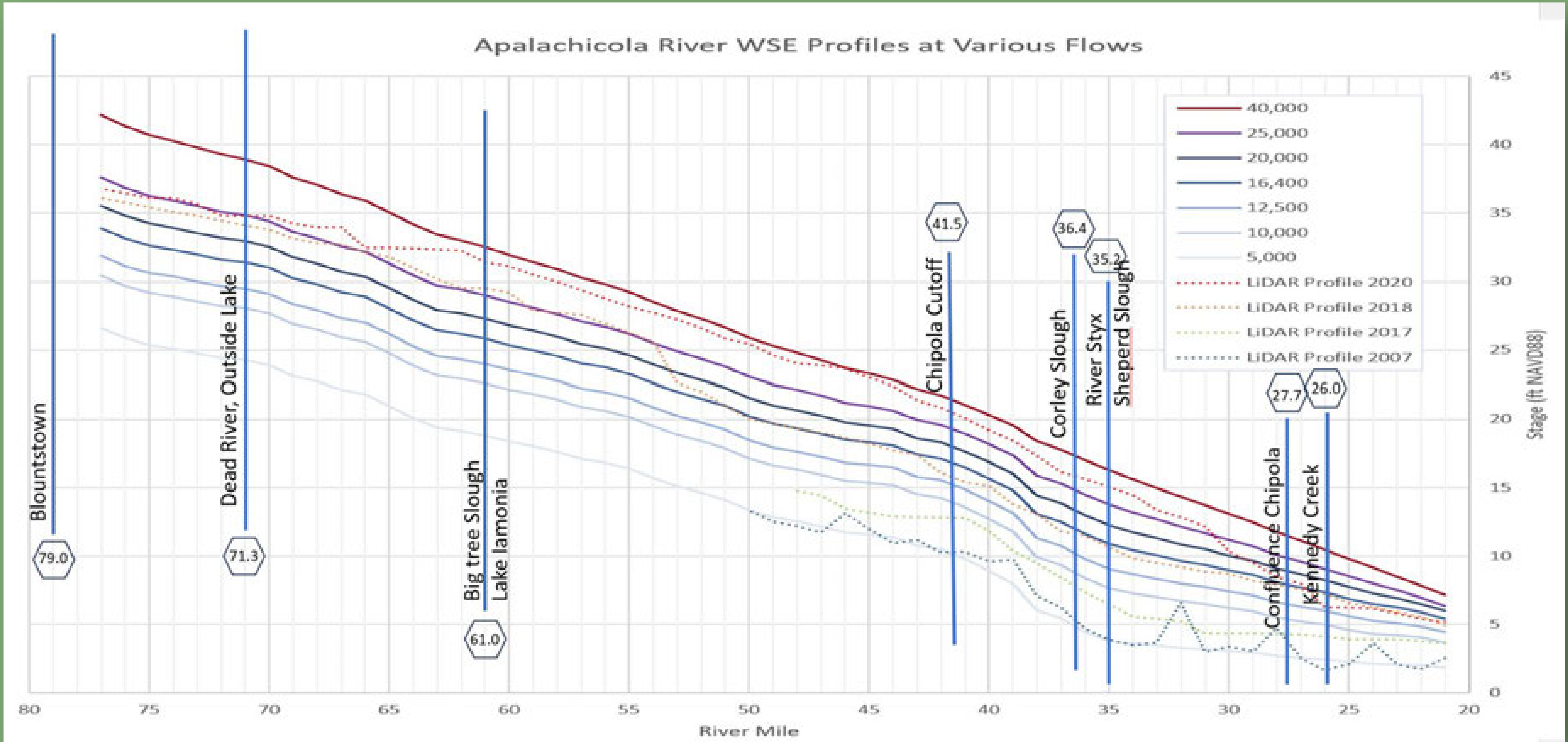


DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

- Most REMs utilize a single water surface elevation from the time of flight
- We used water surface elevations from Light et al 2006, which compiled for every 100 cfs above 4500 cfs, every 0.1 river miles.
- Converted water surface elevations from NGVD29 to NAVD88 to match LiDAR vertical datum

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	RECENT lower1 reach - RM 41.8 to 35.3 (Wewa gage to RM35 gage)													
2														
3	**ChattQ**	**Wewa gage**												
4	105.7	**41.8**	41.7	41.6	41.5	41.4	41.3	41.2	41.1	41	40.9	40.8	40.7	40.6
5	**4500**	**10.64**	10.28	10.20	10.12	10.05	9.97	9.90	9.83	9.76	9.69	9.60	9.52	9.43
6	**4600**	**10.76**	10.39	10.31	10.23	10.16	10.09	10.02	9.95	9.87	9.80	9.72	9.63	9.55
7	**4700**	**10.87**	10.50	10.42	10.34	10.27	10.20	10.13	10.06	9.99	9.91	9.83	9.74	9.66
8	**4800**	**10.98**	10.61	10.53	10.45	10.38	10.31	10.24	10.17	10.09	10.02	9.94	9.85	9.77
9	**4900**	**11.08**	10.72	10.64	10.56	10.49	10.42	10.34	10.27	10.20	10.13	10.04	9.96	9.87
10	**5000**	**11.19**	10.83	10.75	10.66	10.59	10.52	10.45	10.38	10.31	10.24	10.15	10.06	9.98
11	**5100**	**11.29**	10.93	10.85	10.77	10.70	10.62	10.55	10.48	10.41	10.34	10.25	10.17	10.08
12	**5200**	**11.39**	11.03	10.95	10.87	10.80	10.73	10.65	10.58	10.51	10.44	10.35	10.27	10.18
13	**5300**	**11.49**	11.13	11.05	10.97	10.90	10.83	10.75	10.68	10.61	10.54	10.45	10.37	10.28
14	**5400**	**11.59**	11.23	11.15	11.07	11.00	10.92	10.85	10.78	10.71	10.64	10.55	10.47	10.38
15	**5500**	**11.69**	11.33	11.25	11.16	11.09	11.02	10.95	10.88	10.81	10.74	10.65	10.56	10.48
16	**5600**	**11.79**	11.42	11.34	11.26	11.19	11.12	11.05	10.97	10.90	10.83	10.75	10.66	10.57
17	**5700**	**11.88**	11.52	11.44	11.35	11.28	11.21	11.14	11.07	11.00	10.93	10.84	10.75	10.67
18	**5800**	**11.97**	11.61	11.53	11.45	11.37	11.30	11.23	11.16	11.09	11.02	10.93	10.85	10.76
19	**5900**	**12.06**	11.70	11.62	11.54	11.47	11.39	11.32	11.25	11.18	11.11	11.02	10.94	10.85
20	**6000**	**12.15**	11.79	11.71	11.63	11.56	11.48	11.41	11.34	11.27	11.20	11.11	11.03	10.94
21	**6100**	**12.24**	11.88	11.80	11.72	11.64	11.57	11.50	11.43	11.36	11.29	11.20	11.12	11.03
22	**6200**	**12.33**	11.97	11.88	11.80	11.73	11.66	11.59	11.52	11.45	11.37	11.29	11.20	11.12
23	**6300**	**12.41**	12.05	11.97	11.89	11.82	11.75	11.67	11.60	11.53	11.46	11.38	11.29	11.20
24	**6400**	**12.50**	12.14	12.06	11.97	11.90	11.83	11.76	11.69	11.62	11.55	11.46	11.37	11.29
25	**6500**	**12.58**	12.22	12.14	12.06	11.99	11.91	11.84	11.77	11.70	11.63	11.54	11.46	11.37
26	**6600**	**12.66**	12.30	12.22	12.14	12.07	12.00	11.93	11.85	11.78	11.71	11.63	11.54	11.46
27	**6700**	**12.75**	12.38	12.30	12.22	12.15	12.08	12.01	11.94	11.86	11.79	11.71	11.62	11.54
28	**6800**	**12.83**	12.46	12.38	12.30	12.23	12.16	12.09	12.02	11.95	11.87	11.79	11.70	11.62
29	**6900**	**12.90**	12.54	12.46	12.38	12.31	12.24	12.17	12.10	12.02	11.95	11.87	11.78	11.70
30	**7000**	**12.98**	12.62	12.54	12.46	12.39	12.32	12.25	12.17	12.10	12.03	11.95	11.86	11.78
31	**7100**	**13.06**	12.70	12.62	12.54	12.47	12.39	12.32	12.25	12.18	12.11	12.02	11.94	11.85
32	**7200**	**13.14**	12.78	12.69	12.61	12.54	12.47	12.40	12.33	12.26	12.19	12.10	12.02	11.93
33	**7300**	**13.21**	12.85	12.77	12.69	12.62	12.55	12.47	12.40	12.33	12.26	12.18	12.09	12.01
34	**7400**	**13.28**	12.92	12.84	12.76	12.69	12.62	12.55	12.48	12.41	12.34	12.25	12.17	12.08
35	**7500**	**13.36**	13.00	12.92	12.84	12.77	12.69	12.62	12.55	12.48	12.41	12.33	12.24	12.15
36	**7600**	**13.43**	13.07	12.99	12.91	12.84	12.77	12.70	12.63	12.55	12.48	12.40	12.31	12.23
37	**7700**	**13.50**	13.14	13.06	12.98	12.91	12.84	12.77	12.70	12.63	12.56	12.47	12.39	12.30
38	**7800**	**13.57**	13.21	13.13	13.05	12.98	12.91	12.84	12.77	12.70	12.63	12.54	12.46	12.37
39	**7900**	**13.64**	13.28	13.20	13.12	13.05	12.98	12.91	12.84	12.77	12.70	12.61	12.53	12.44
40	**8000**	**13.71**	13.35	13.27	13.19	13.12	13.05	12.98	12.91	12.84	12.77	12.68	12.60	12.51
41	**8100**	**13.78**	13.42	13.34	13.26	13.19	13.12	13.05	12.98	12.91	12.84	12.75	12.67	12.58
42	**8200**	**13.85**	13.49	13.41	13.33	13.26	13.19	13.12	13.05	12.98	12.90	12.82	12.73	12.65
43	**8300**	**13.91**	13.56	13.48	13.40	13.32	13.25	13.18	13.11	13.04	12.97	12.89	12.80	12.72
44	**8400**	**13.98**	13.62	13.54	13.46	13.39	13.32	13.25	13.18	13.11	13.04	12.95	12.87	12.78
45	**8500**	**14.05**	13.69	13.61	13.53	13.46	13.39	13.32	13.25	13.18	13.10	13.02	12.94	12.85
46	**8600**	**14.11**	13.75	13.67	13.59	13.52	13.45	13.38	13.31	13.24	13.17	13.09	13.00	12.92
47	**8700**	**14.17**	13.82	13.74	13.66	13.59	13.52	13.45	13.38	13.31	13.23	13.15	13.07	12.98

DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN



Comparison of water surface profiles taken from the available LiDAR flights versus water surface elevations from Light et al 2006.

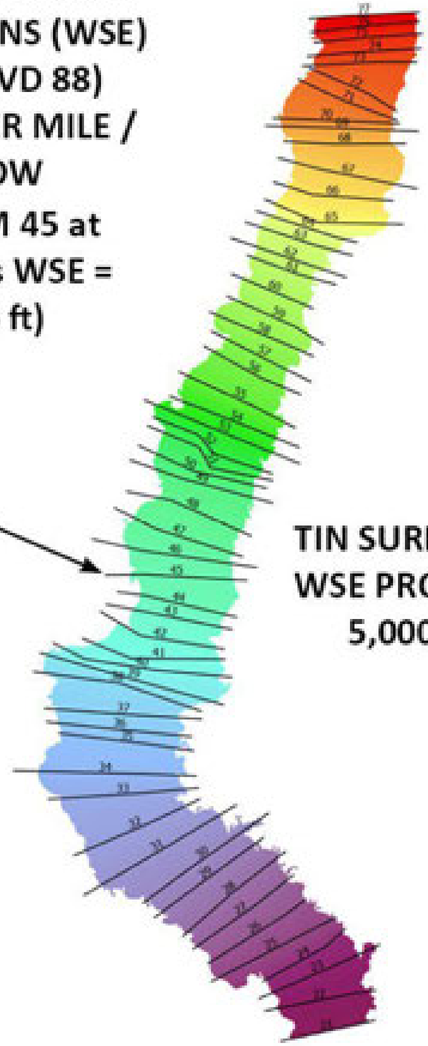
DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

FLOWS (CFS)
(e.g. q5000 = 5,000 cs)

RIVER MILES (RM)

River Mile	q5000	q10000	q12500	q16400	q20000	q25000	q40000
39	8	11.8	13.1	14.8	16	17.4	19.5
40	8.9	12.7	14	15.6	16.8	18.2	20.3
41	9.8	13.6	14.9	16.5	17.7	19	21
42	10.5	14.3	15.5	17.1	18.3	19.6	21.7
43	10.8	14.5	15.8	17.4	18.6	20	22.2
44	11.4	15.2	16.5	18.1	19.3	20.6	22.8
45	11.6	15.4	16.7	18.3	19.5	20.9	23.3
46	11.7	15.5	16.8	18.5	19.8	21.2	23.7
47	12.2	15.9	17.3	19	20.2	21.7	24.3
48	12.5	16.3	17.7	19.4	20.6	22.1	24.8
49	12.8	16.6	17.9	19.7	21	22.5	25.3
50	13.3	17.1	18.5	20.2	21.5	23	25.9
51	14.1	17.9	19.2	21	22.3	23.8	26.7
52	14.6	18.4	19.8	21.5	22.8	24.4	27.3
53	15.1	18.9	20.3	22	23.4	24.9	27.9
54	15.7	19.5	20.8	22.6	23.9	25.5	28.5
55	16.4	20.1	21.5	23.2	24.6	26.2	29.2
56	16.8	20.6	22	23.7	25.1	26.7	29.8
57	17.1	20.9	22.3	24	25.4	27.1	30.3

WATER SURFACE ELEVATIONS (WSE) (FT NAVD 88) PER RIVER MILE / FLOW
(e.g. RM 45 at 5,000 cfs WSE = 11.6 ft)

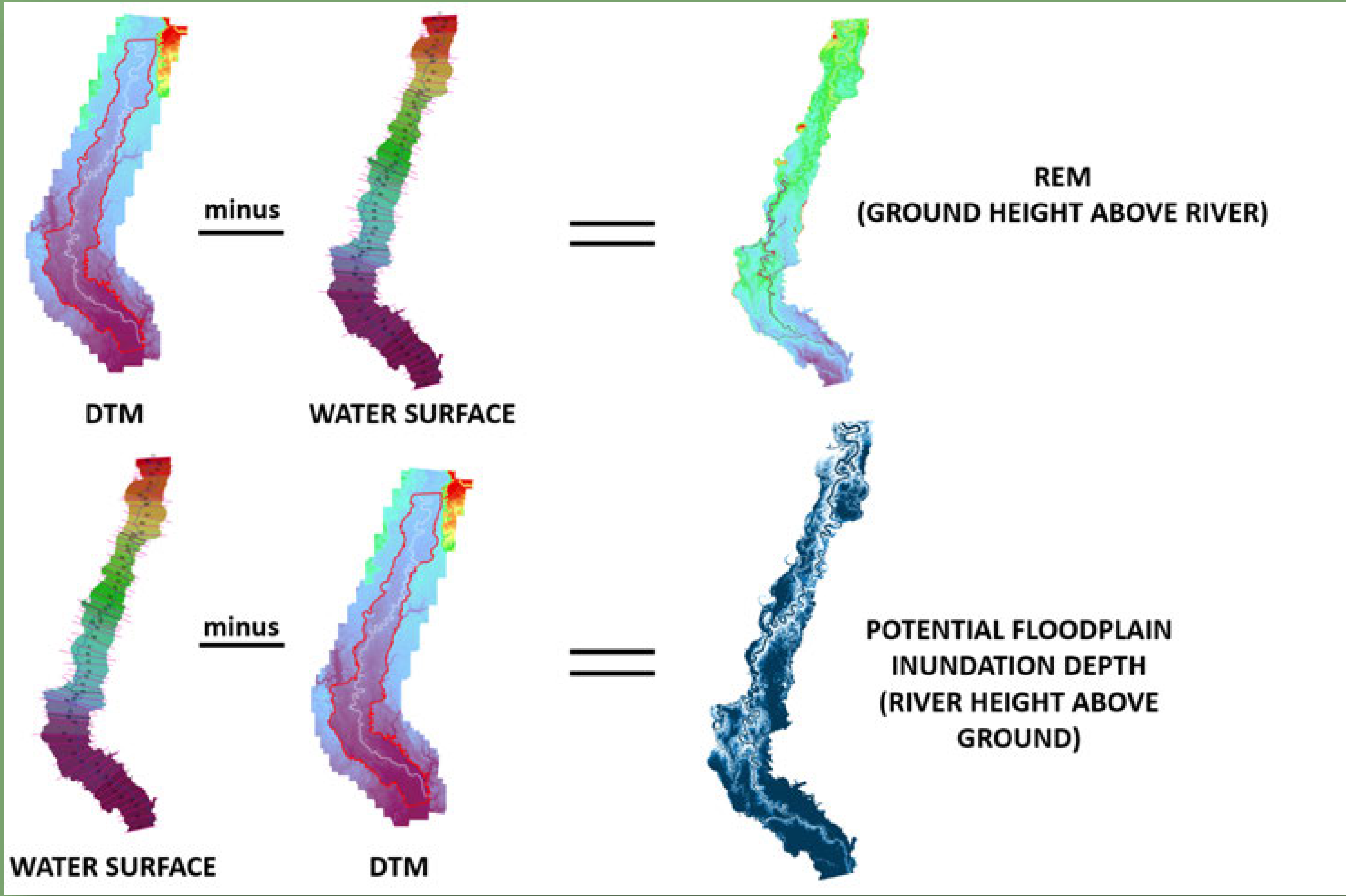


Example of translating the GIS database of 5,000 cfs river surface elevations to river mile transects and generation of a floodplain-wide water surface TIN.

DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

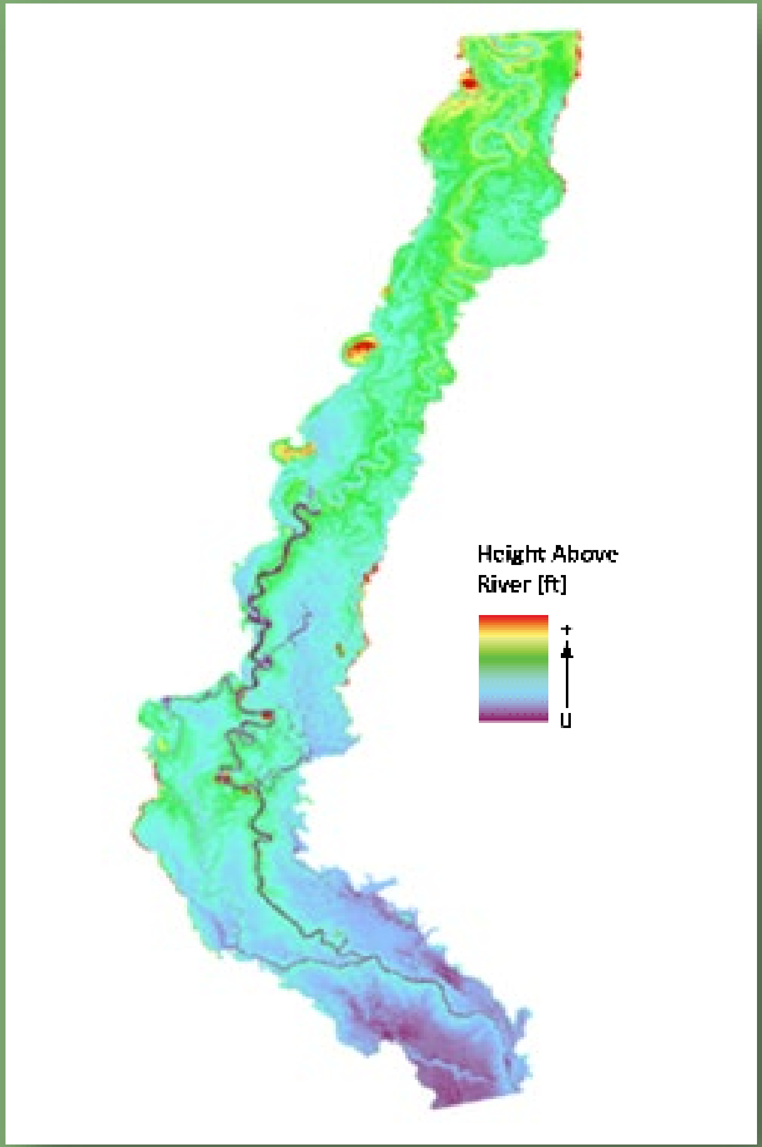
Detrend raster by subtracting water surface profile from DTM to calculate ground height above river

Floodplain inundation depth calculated by the inverse

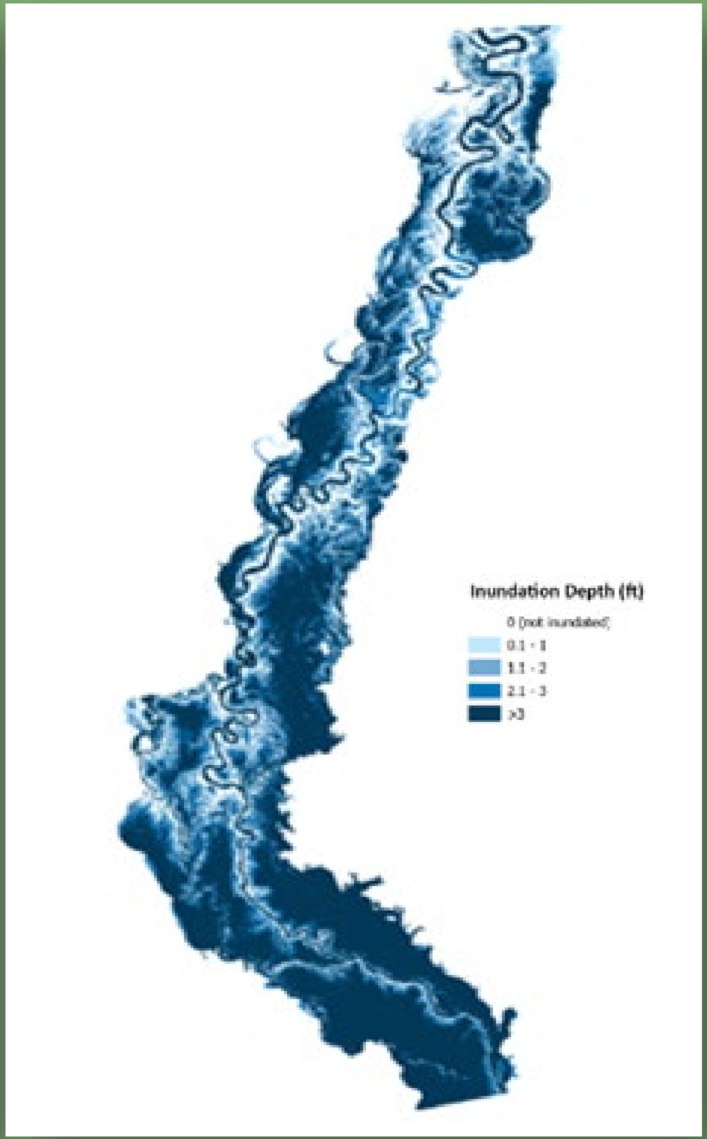


DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

Comparison of the 40,000 cfs height above river (HAR) (left) versus potential floodplain inundation depth (PFID) (right) models.

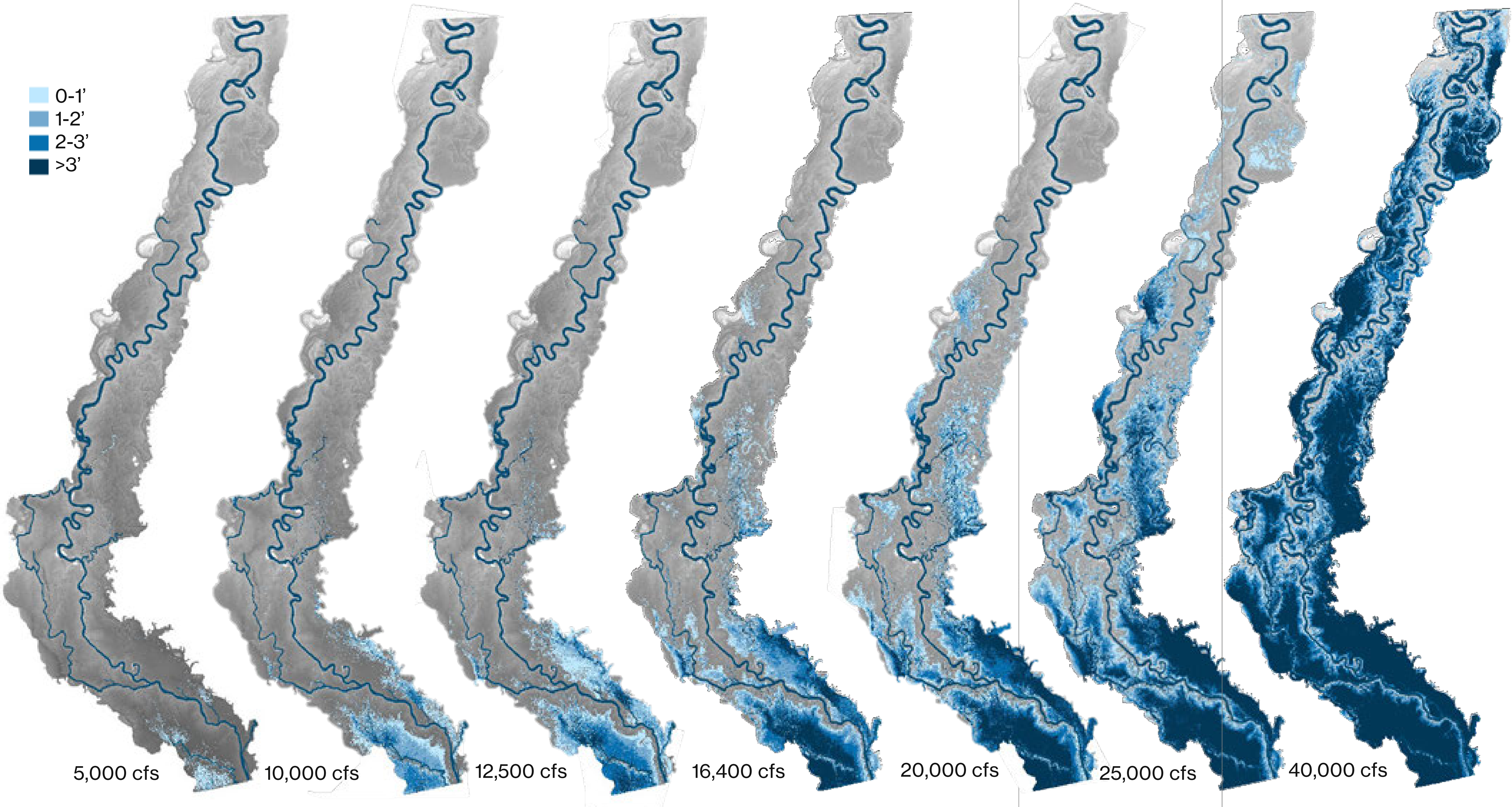


Ground Height Above River

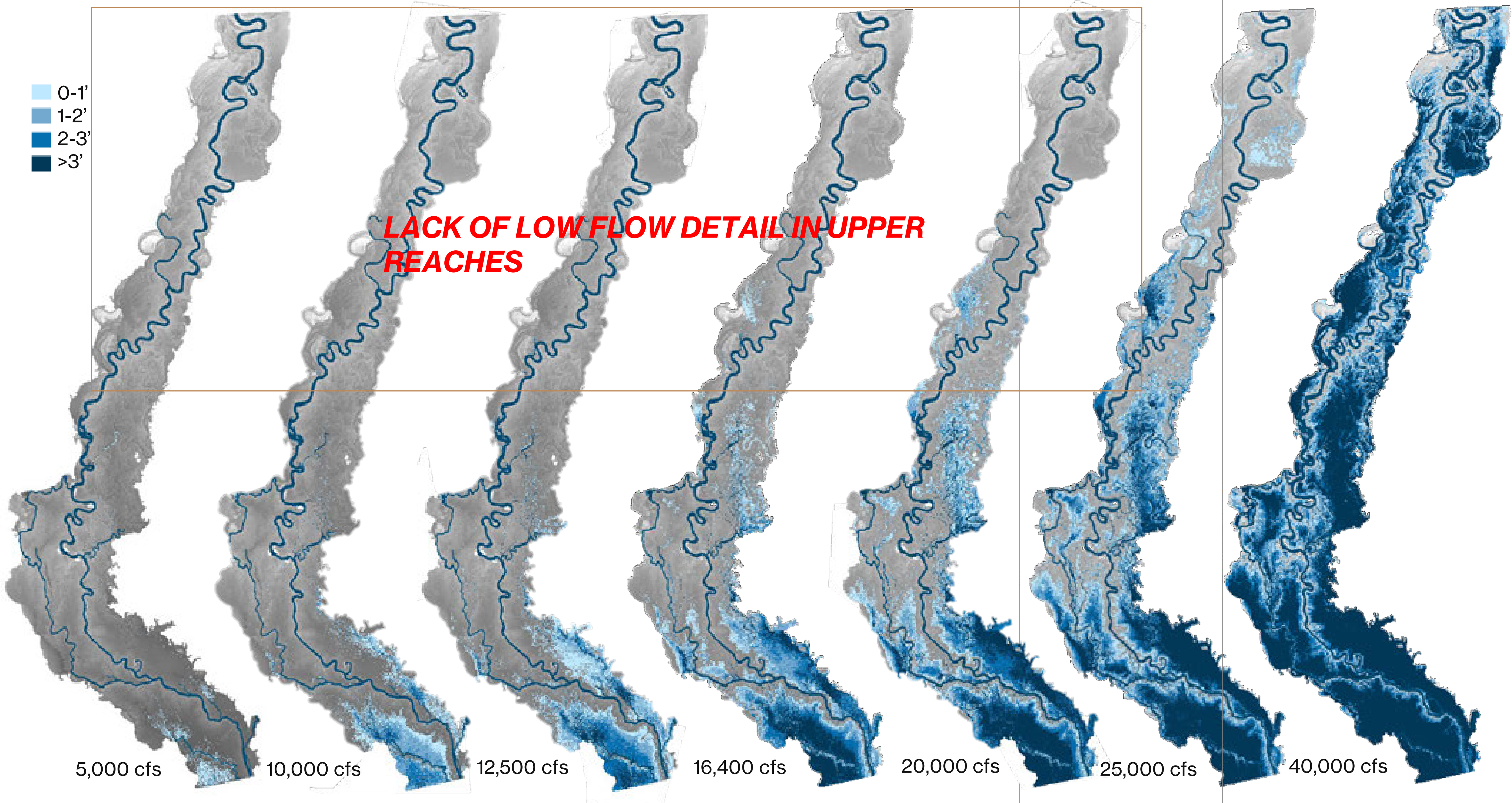


Potential Floodplain Inundation Depth

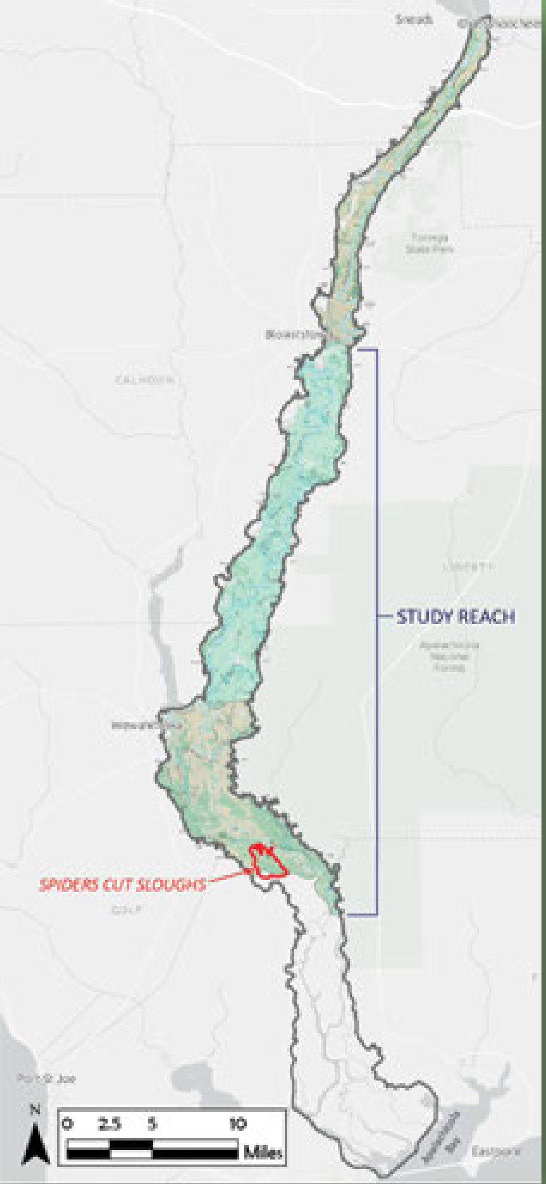
FLOODPLAIN INUNDATION DEPTH AT VARIOUS FLOWS



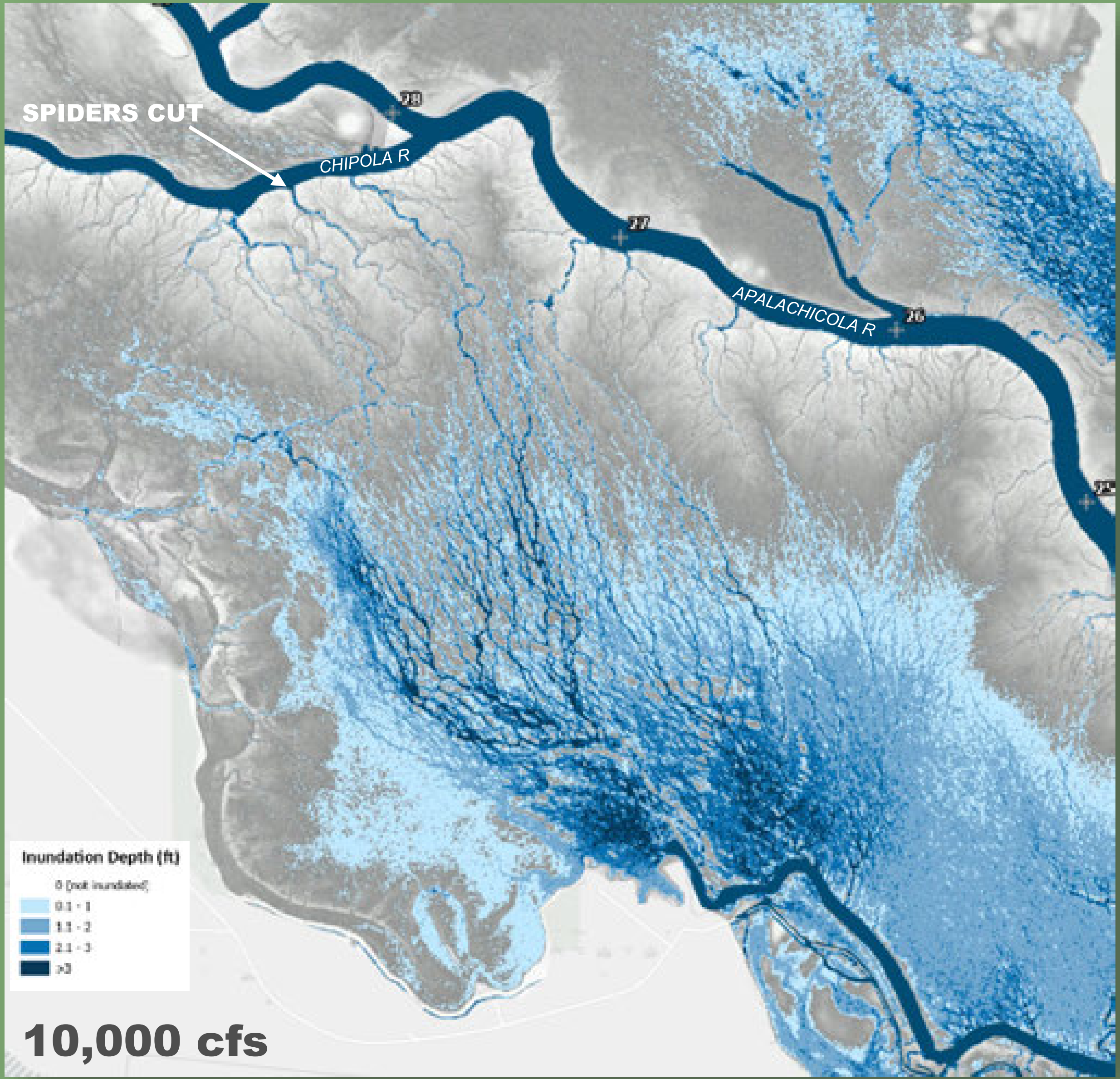
FLOODPLAIN INUNDATION DEPTH AT VARIOUS FLOWS



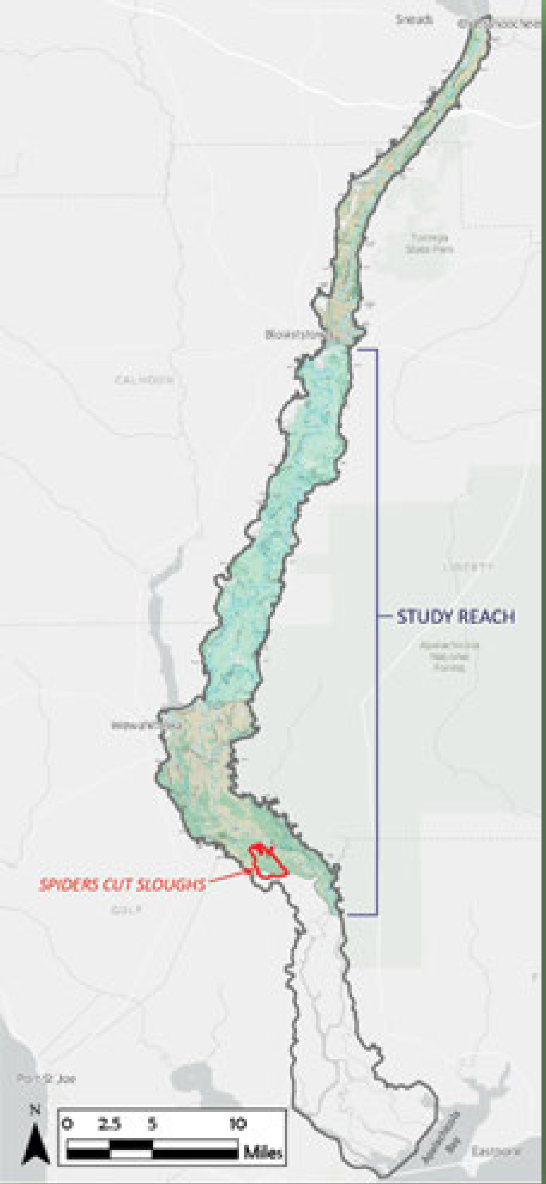
DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN



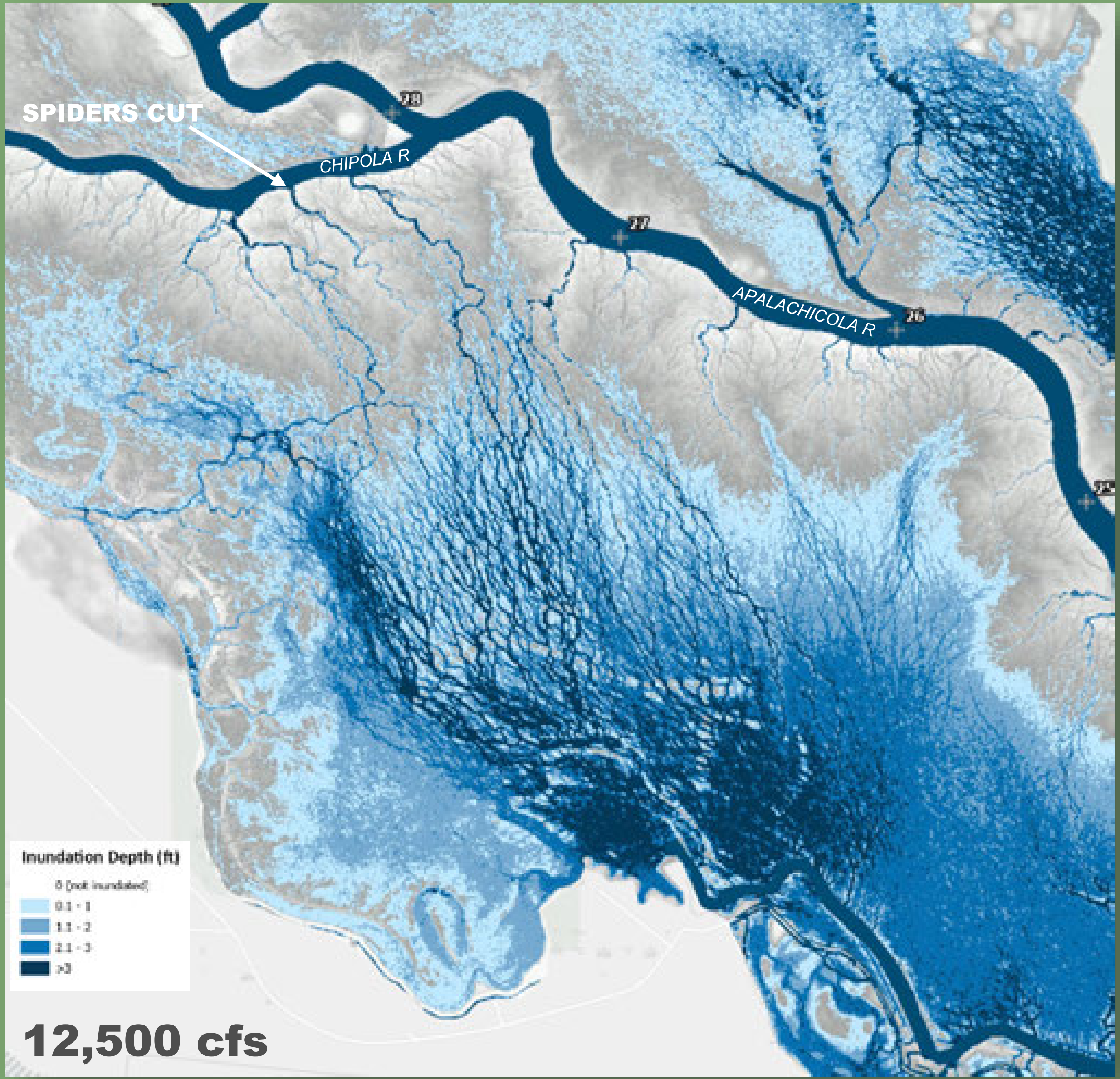
POTENTIAL FLOODPLAIN INUNDATION DEPTH



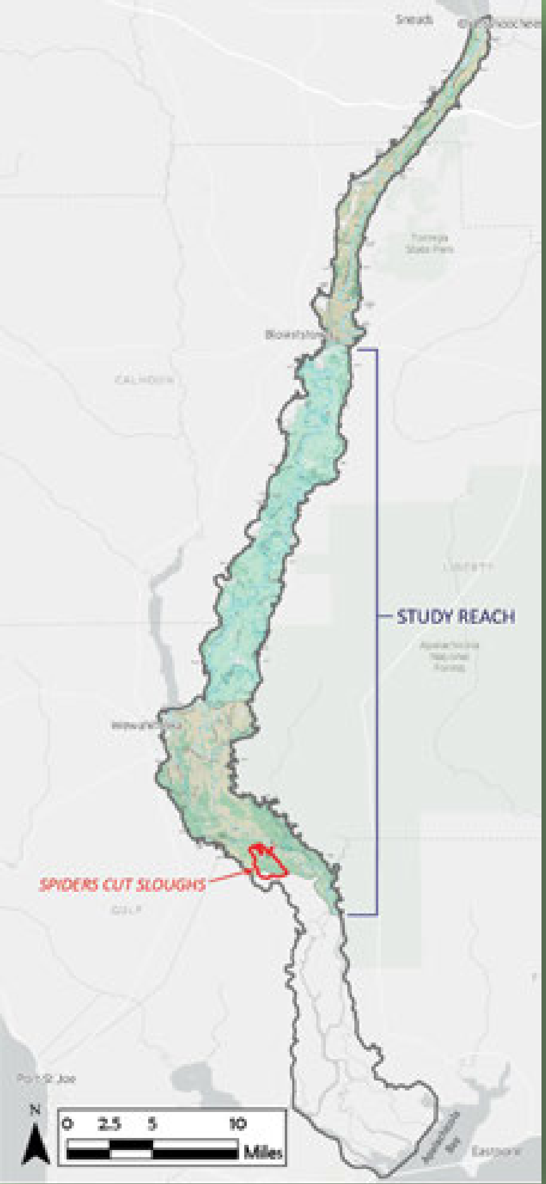
DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN



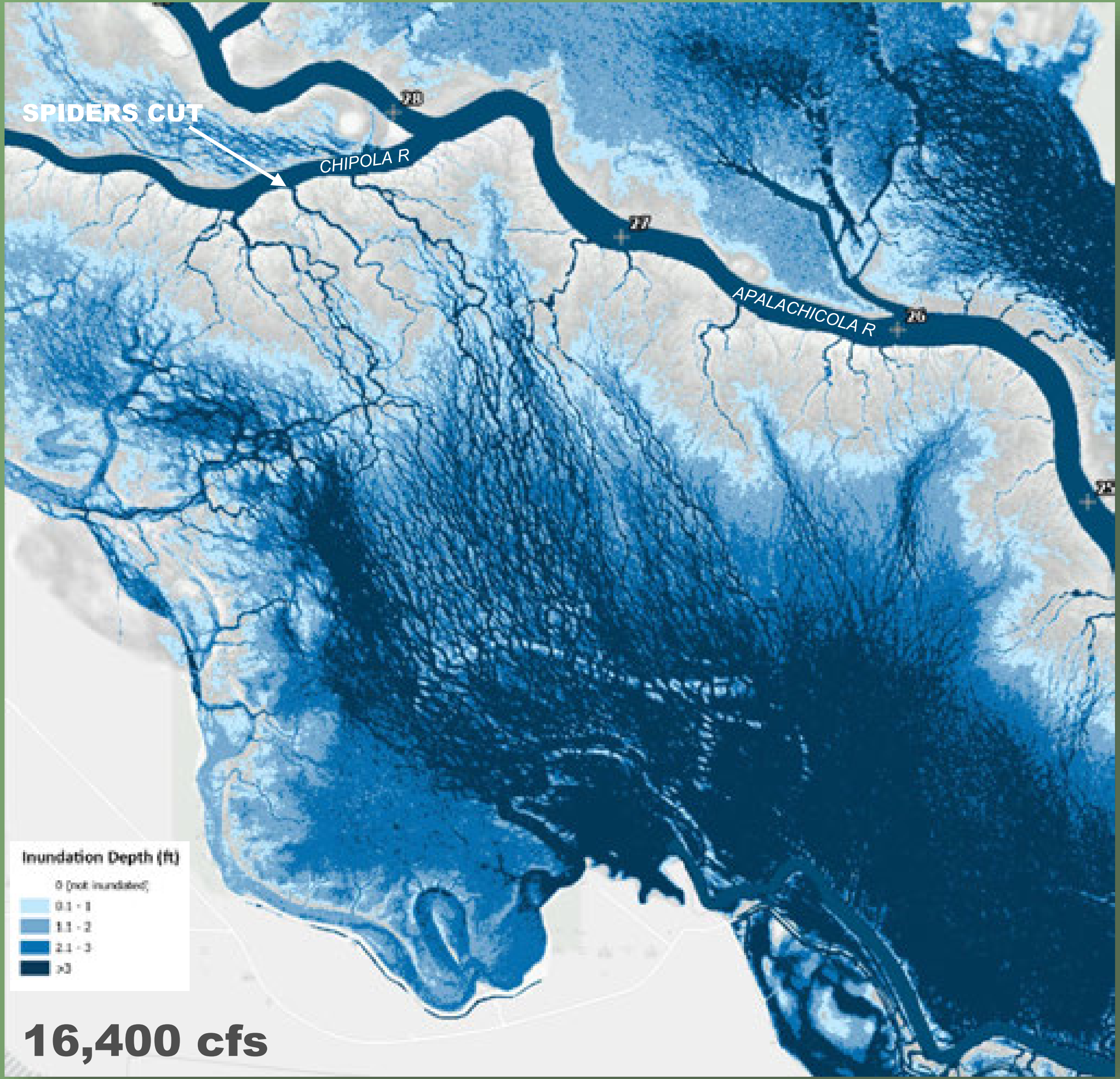
POTENTIAL FLOODPLAIN INUNDATION DEPTH



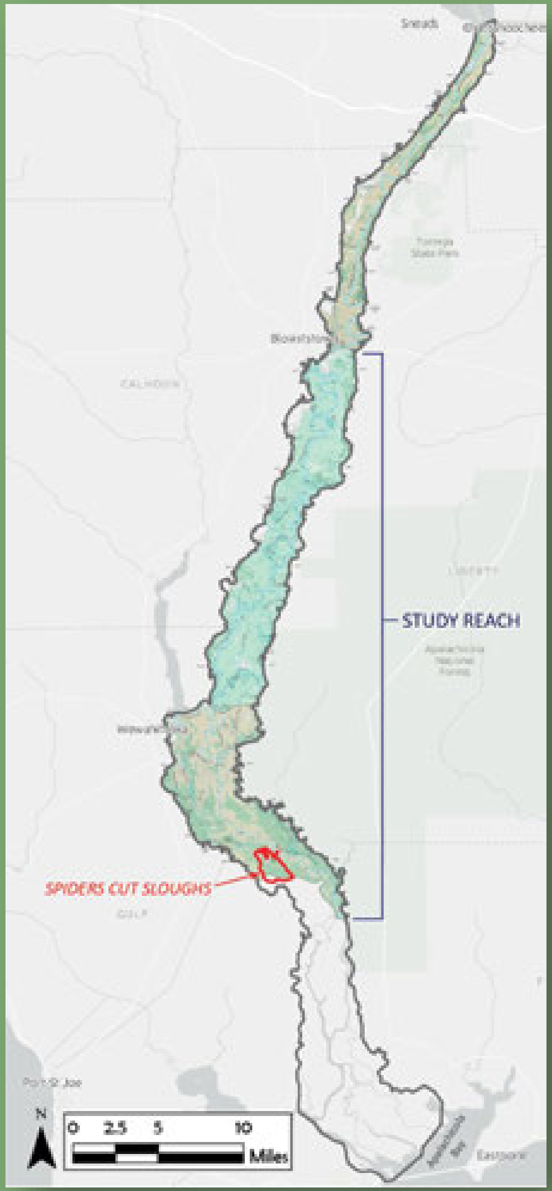
DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN



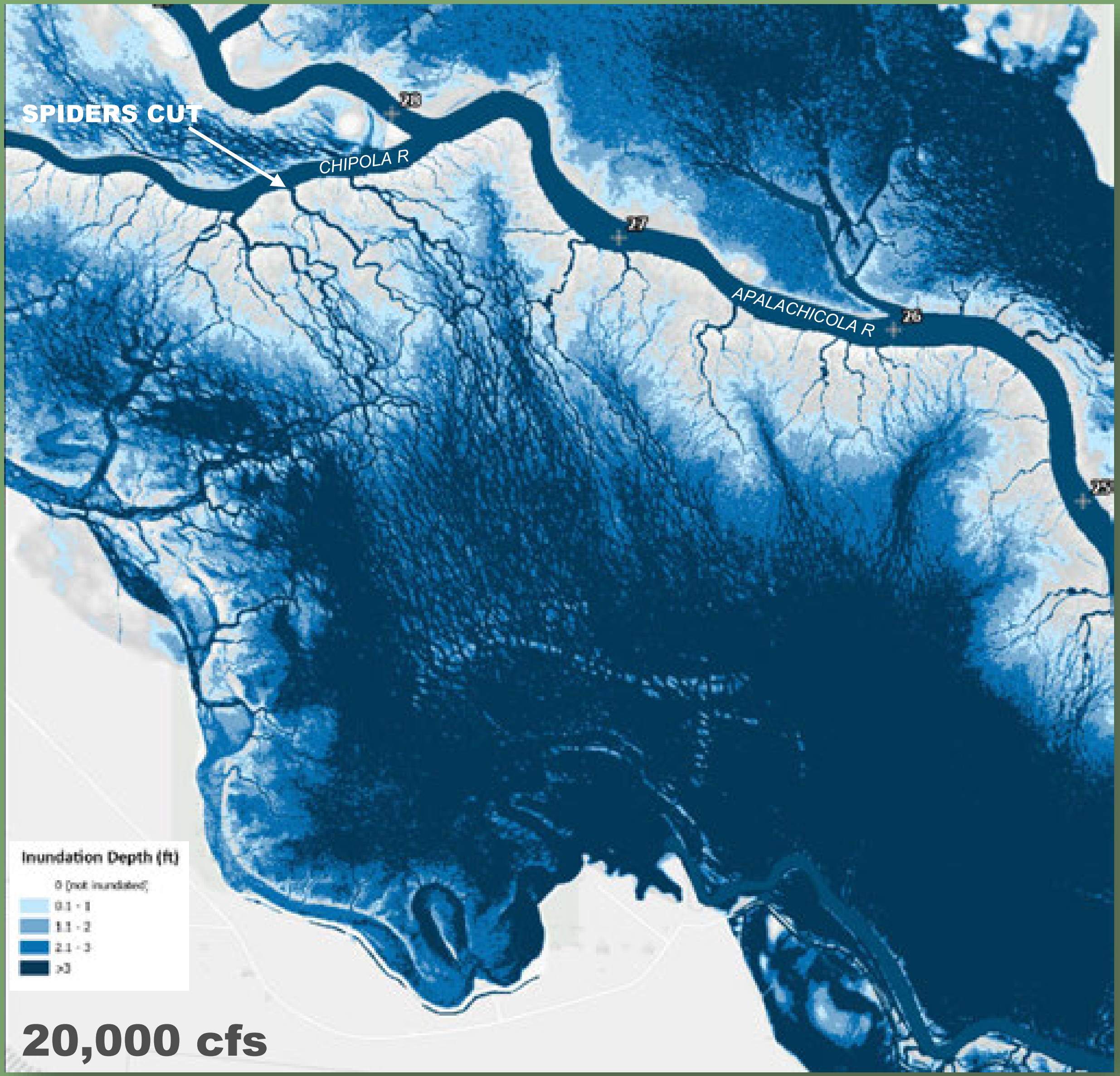
POTENTIAL FLOODPLAIN INUNDATION DEPTH



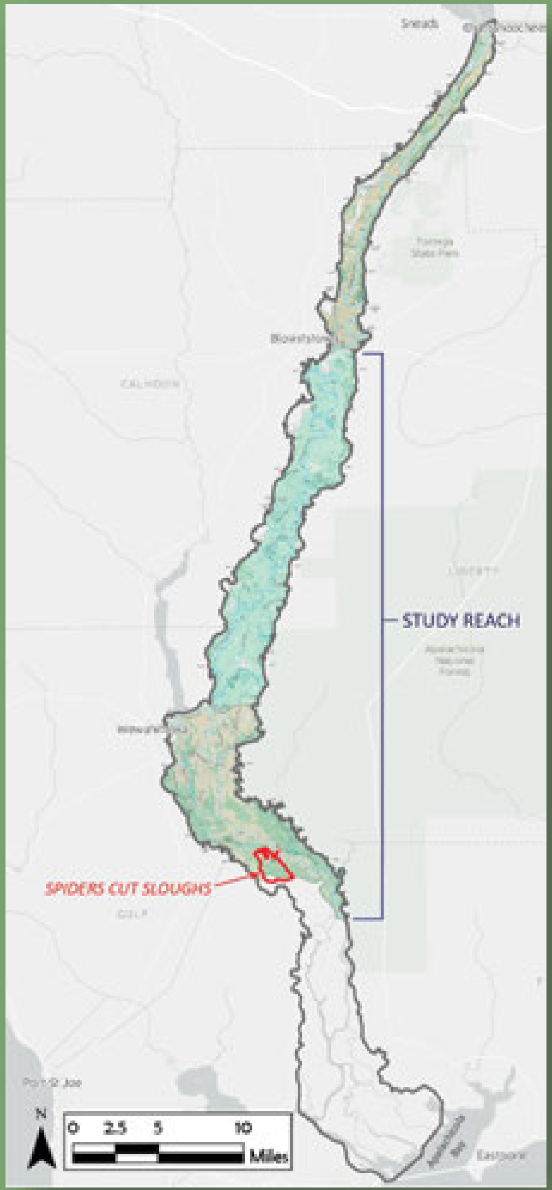
DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN



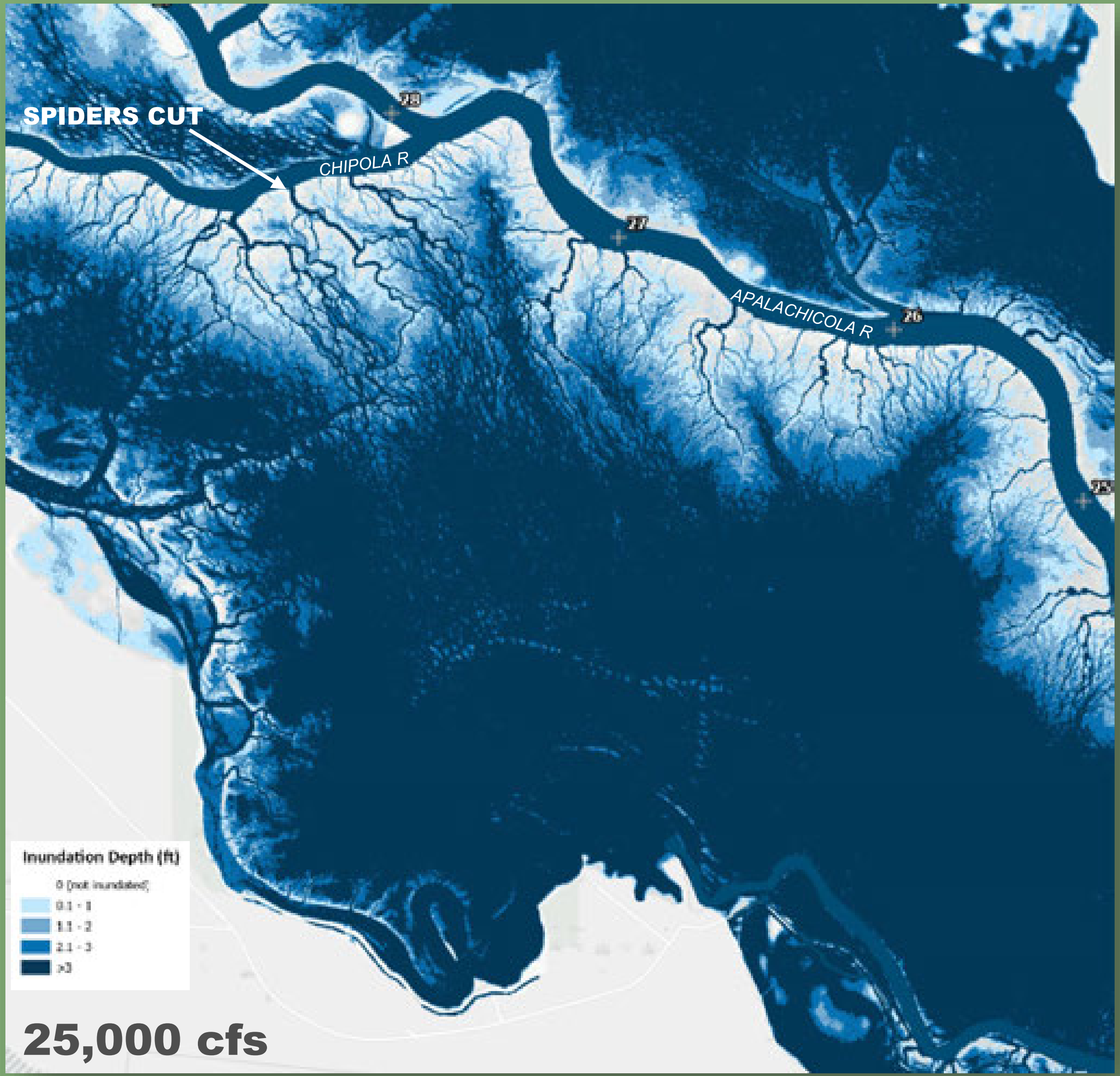
POTENTIAL FLOODPLAIN INUNDATION DEPTH



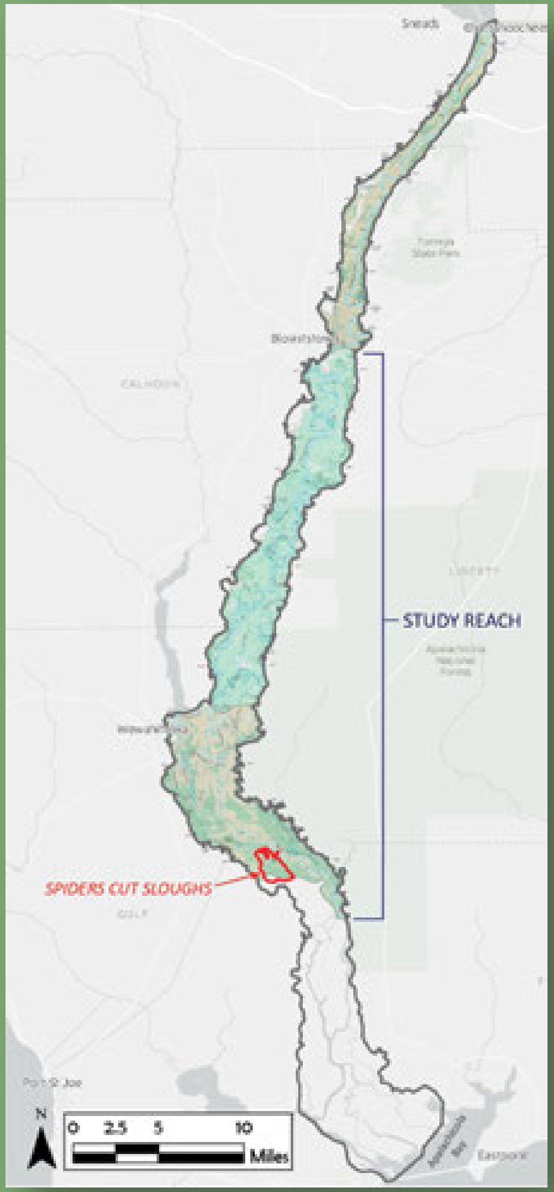
DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN



POTENTIAL FLOODPLAIN INUNDATION DEPTH



DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN



POTENTIAL FLOODPLAIN INUNDATION DEPTH

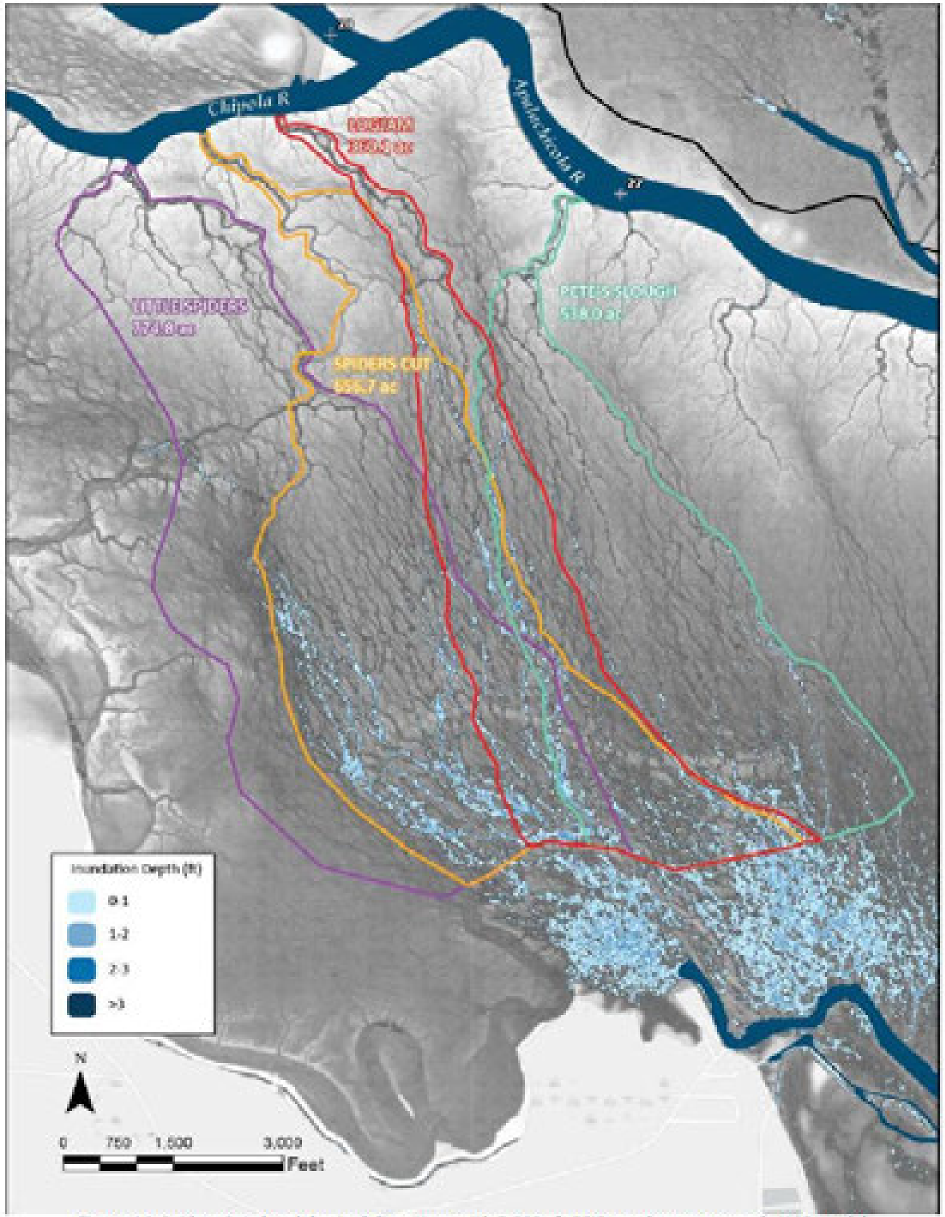


Figure 14. Spiders Cut slough basin delineations with 5,000 cfs PFID overlay on grayscale HAR model.

DEVELOPING AN REM FOR THE APALACHICOLA RIVER FLOODPLAIN

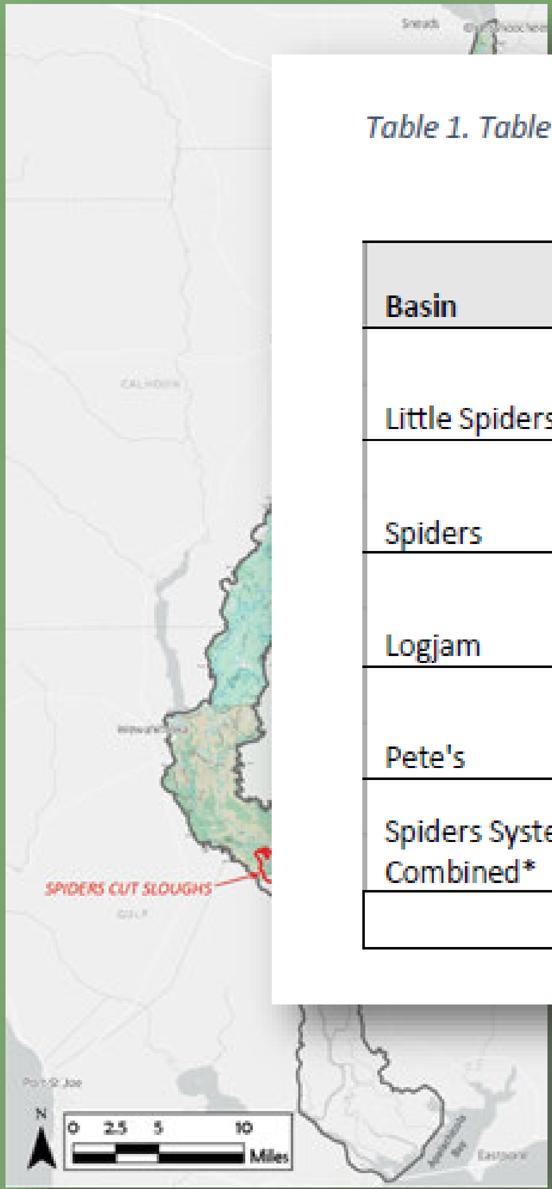


Table 1. Table of potential floodplain inundation areas at Study Flows for sloughs in Spiders Basin.

Basin	Total Area (ac)	Metric	Flow (cfs) 5,000	10,000	12,500	16,400	20,000
Little Spiders	774.8	Acres Inundated	58.5	435.4	588.4	683.6	726.7
		% Inundated	8%	56%	76%	88%	94%
Spiders	656.7	Acres Inundated	80.0	384.1	550.6	623.5	644.5
		% Inundated	12%	58%	84%	95%	98%
Logjam	360.1	Acres Inundated	47.9	249.7	314.6	350.0	356.5
		% Inundated	13%	69%	87%	97%	99%
Pete's	538.0	Acres Inundated	46.5	384.1	484.5	527.5	534.0
		% Inundated	9%	71%	90%	98%	99%
Spiders System Combined*	1477.9	Acres Inundated	102.8	844.9	1138.0	1335.7	1410.1
		% Inundated	7%	57%	77%	90%	95%

*Areas represent overlapping basins merged as single basin

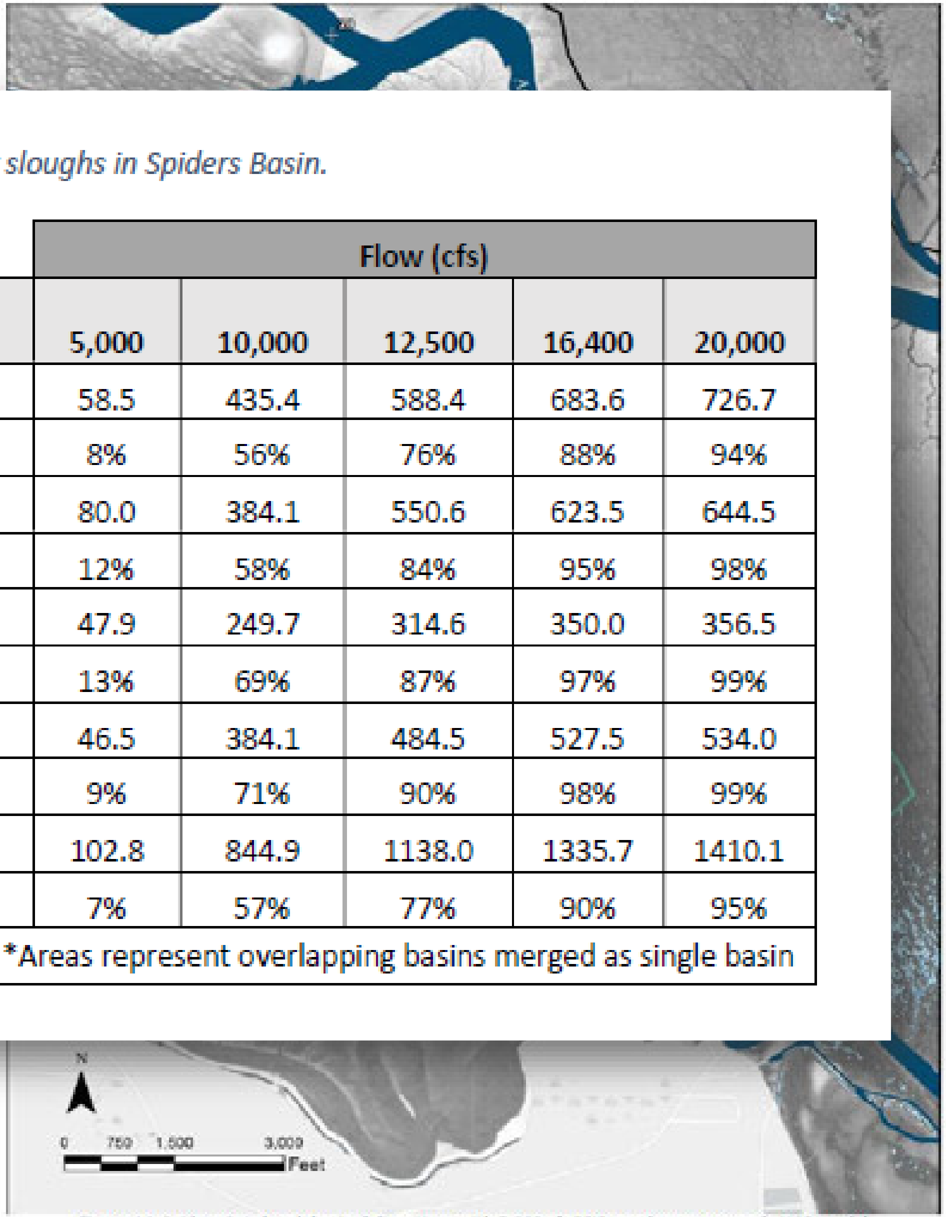


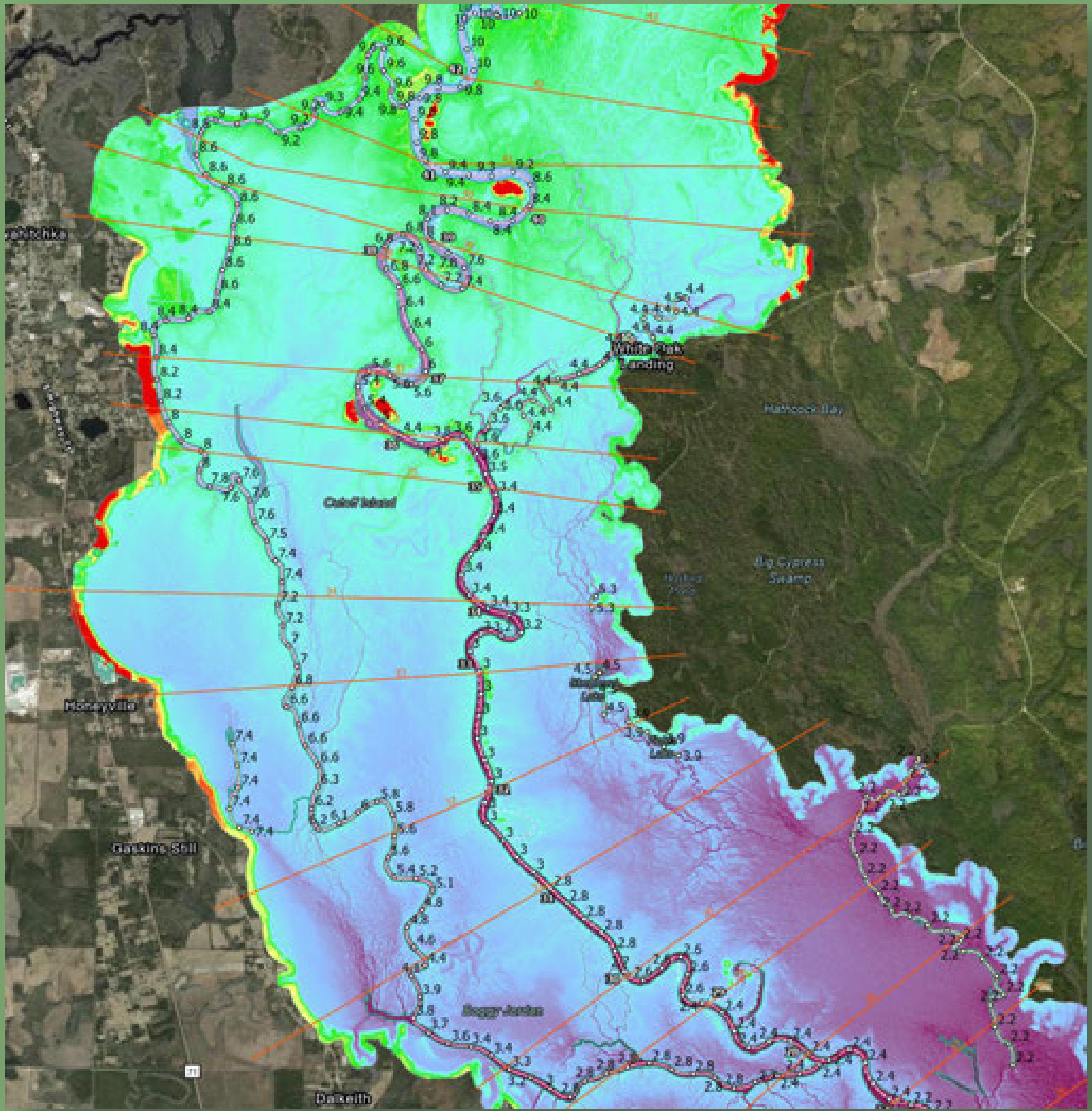
Figure 14. Spiders Cut slough basin delineations with 5,000 cfs PFID overlay on grayscale HAR model.

CAVEATS OF AN REM FOR QUANTITATIVE ANALYSIS

- PFID does not account for microtopography or blockages

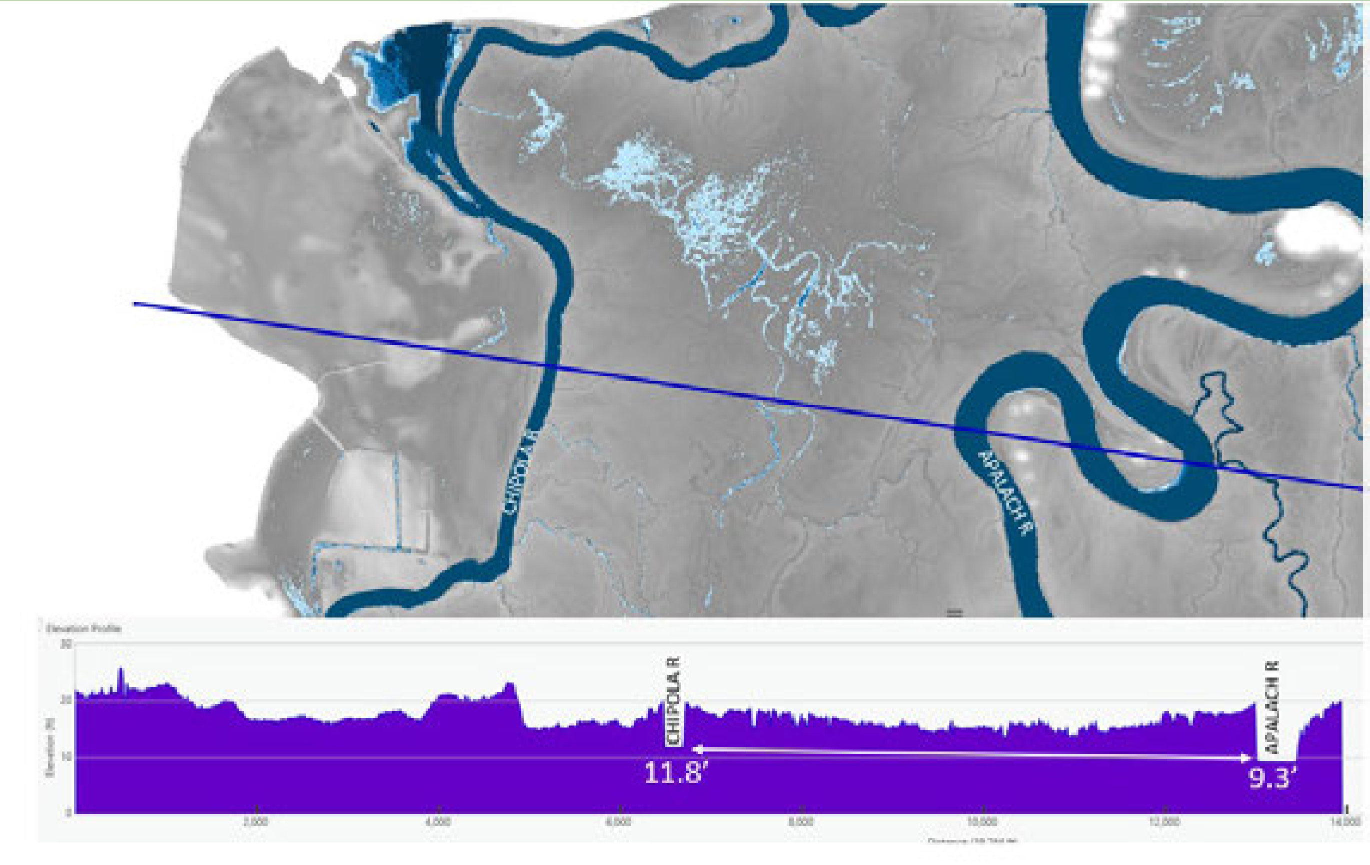
CAVEATS OF AN REM FOR QUANTITATIVE ANALYSIS

- PFID does not account for microtopography or blockages.
- **The Apalachicola River system is complex. Water surface elevations in sloughs and tributaries may not match mainstem river.**



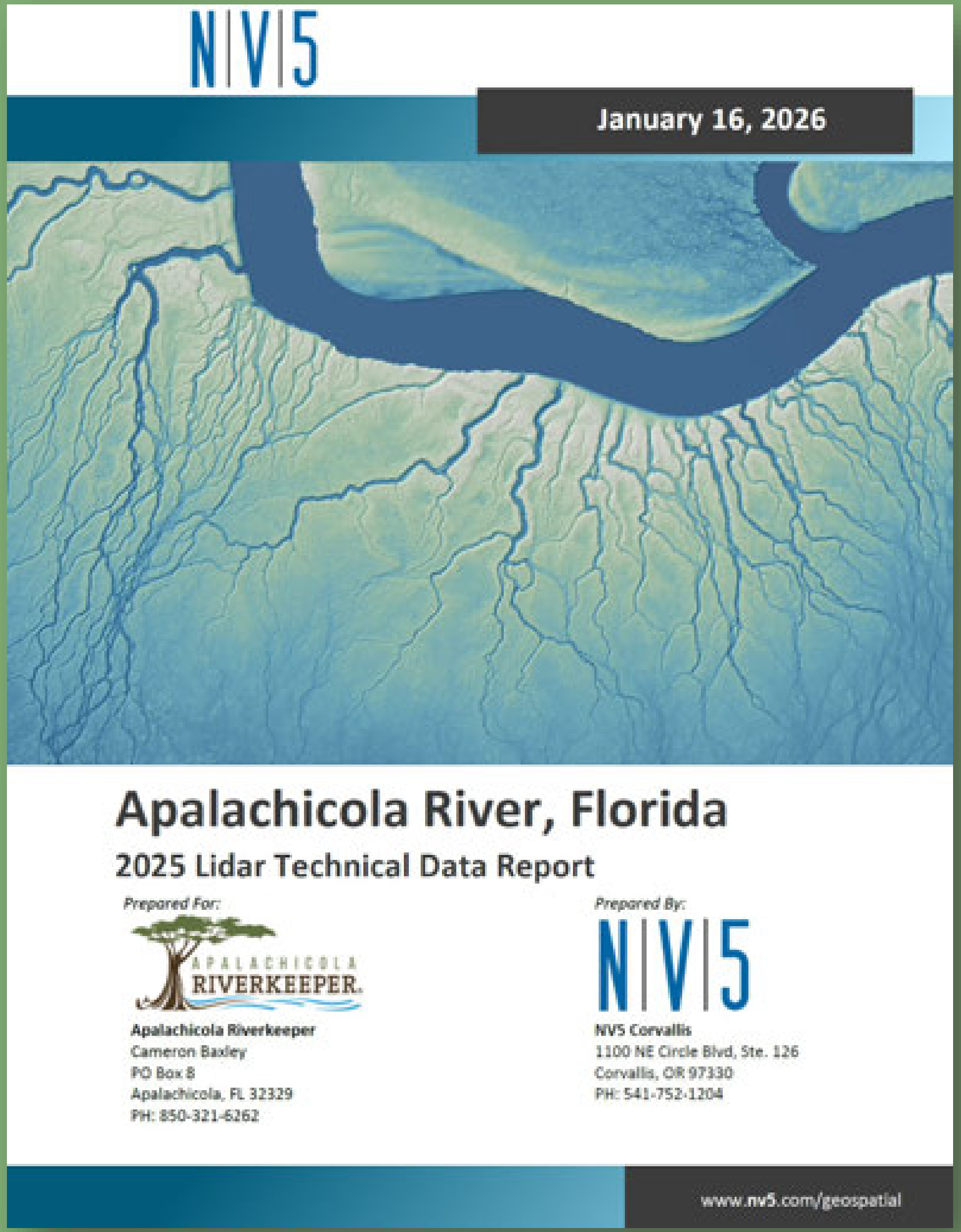
CAVEATS OF AN REM FOR QUANTITATIVE ANALYSIS

- PFID does not account for microtopography or blockages.
- **The Apalachicola River system is complex. Water surface elevations in sloughs and tributaries may not match mainstem river. Does not replace a hydraulic model.**



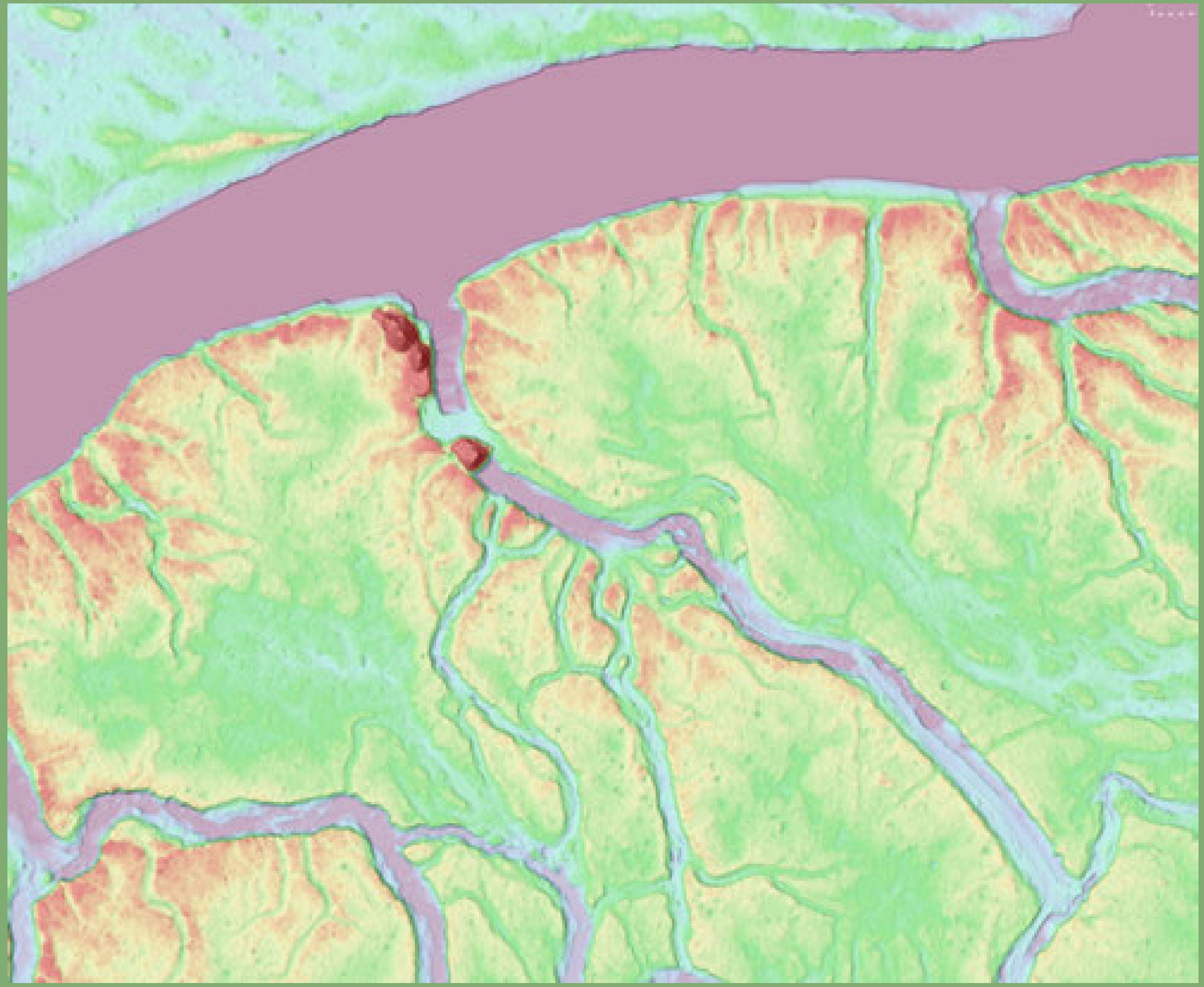
2025 LiDAR

- New LiDAR flown at low water (6,300 cfs) in October 2025 specifically for REM enhancement and slough restoration purposes.



2025 LiDAR

- New LiDAR flown at low water (6,300 cfs) in October 2025 specifically for REM enhancement and slough restoration purposes.
- **Double resolution (0.5m) of previous LiDAR datasets.**

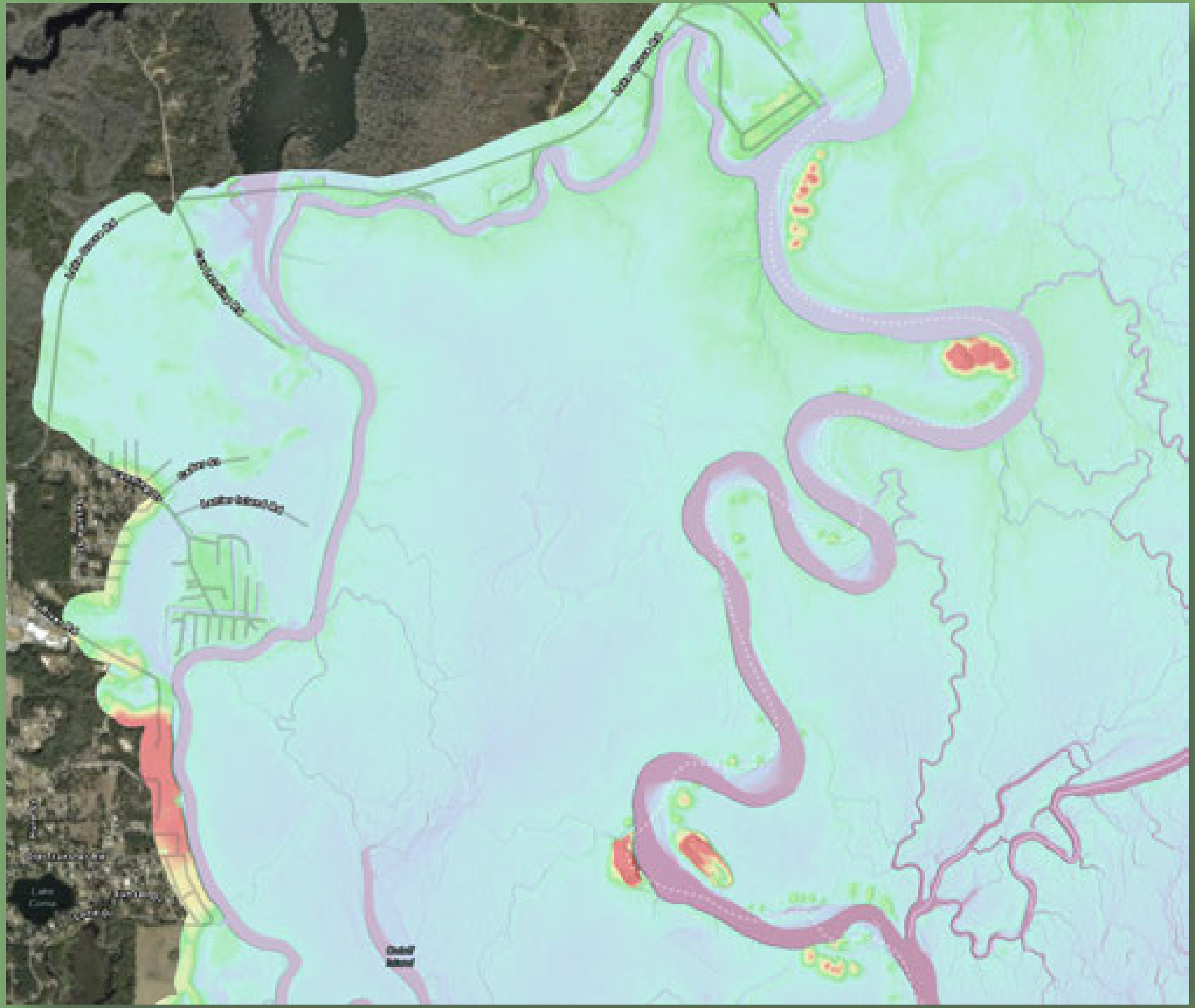


2025 LiDAR

- New LiDAR flown at low water (6,300 cfs) in October 2025 specifically for REM enhancement and slough restoration purposes.
- Double resolution (0.5m) of previous LiDAR datasets.
- **Captures most recent river changes**

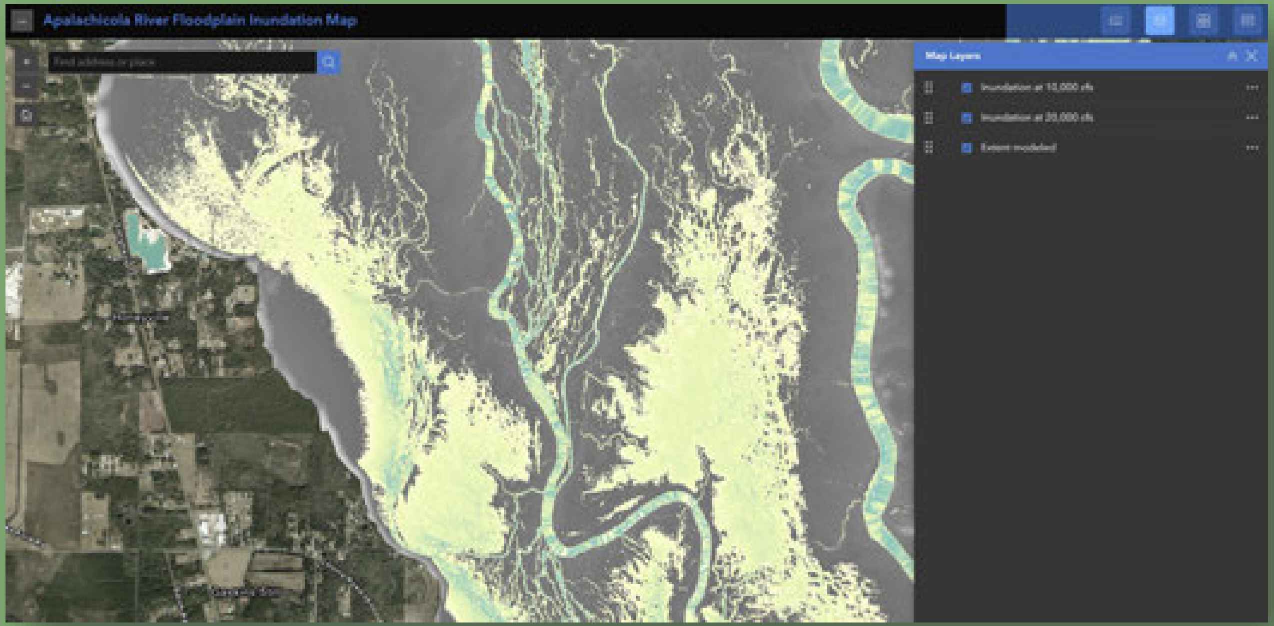
2025 LiDAR

- New LiDAR flown at low water (6,300 cfs) in October 2025 specifically for REM enhancement and slough restoration purposes.
- Double resolution (0.5m) of previous LiDAR datasets.
- Captures most recent river changes
- **Develop refined REM from 2025 LiDAR and tributary / slough WSEs**



2025 LiDAR

- New LiDAR flown at low water (6,300 cfs) in October 2025 specifically for REM enhancement and slough restoration purposes.
- Double resolution (0.5m) of previous LiDAR datasets.
- Captures most recent river changes
- Develop refined REM from 2026 LiDAR and tributary / slough WSEs
- **Create online tool for public access**



Make your own REM!

Creating REMs in QGIS with the Cross-Section Method

In this tutorial you will convert a digital elevation model (DEM) along a river of your choice into a relative elevation model (REM) in QGIS using the cross-section method. If you haven't tried the ***Creating REMs in QGIS using the IDW Method*** tutorial yet, I encourage you to start with those methods first, since they are generally faster and easier to replicate.

The example dataset is a bare-earth lidar DEM (aka digital terrain model or DTM) along the Carson River in western Nevada.

The tutorial is geared toward users who have some experience using GIS and have ***QGIS*** installed on their computer. Users will also need a DEM along a river of their choice to get started (***go here if you need a DEM***). This tutorial will likely take approximately 3 hours to complete, but the time may differ depending on the length of your river and processing time.

This tutorial can be done independently or in combination with the: ***Downloading and Preparing Lidar DEMs for REM Processing*** tutorial and the ***Exporting Images from QGIS tutorial***.

https://dancoecarto.com/tutorials

Questions?

scott@wallslandwater.com

CAN RESUMING NAVIGATION HAVE A POSITIVE INFLUENCE ON THE APALACHICOLA FLOODPLAIN AND BAY?

Dr. Steve Leitman
sfleitman20@gmail.com

PRESENTED TO:

APALACHICOLA NATIONAL ESTUARINE RESEARCH RESERVE CONFERENCE

Introduction – The ACF Navigation Project

- Collapse of the Apalachicola Bay's oyster industry in 2012:
  - What pushed a highly resilient ecological system to the point that it could collapse?

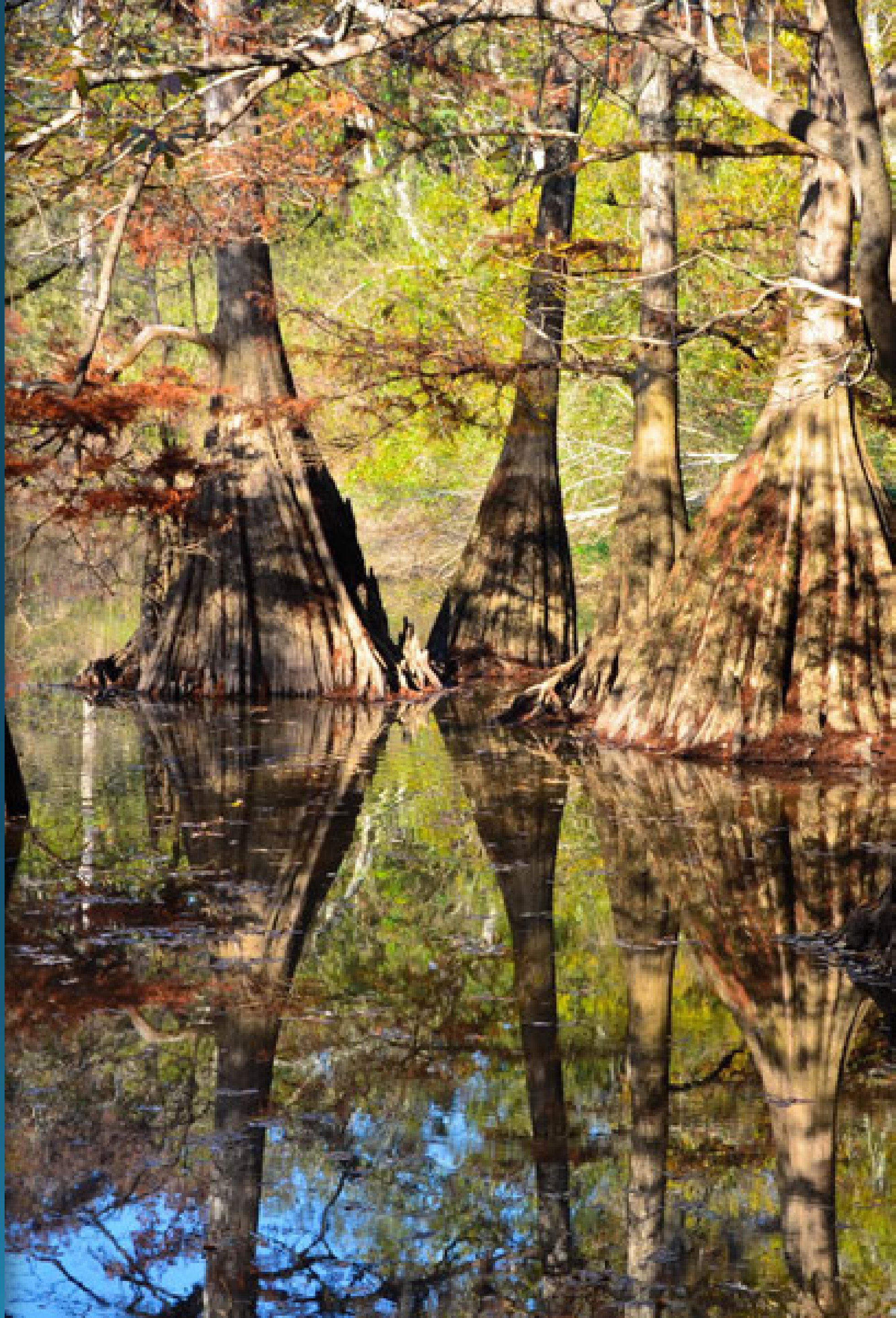
- Opportunities within the ACF Navigation Project:
  - Enhance the ecologic resilience of the floodplain
  - Drive a more sustainable Apalachicola Bay

Introduction – Rethinking Freshwater Inflow

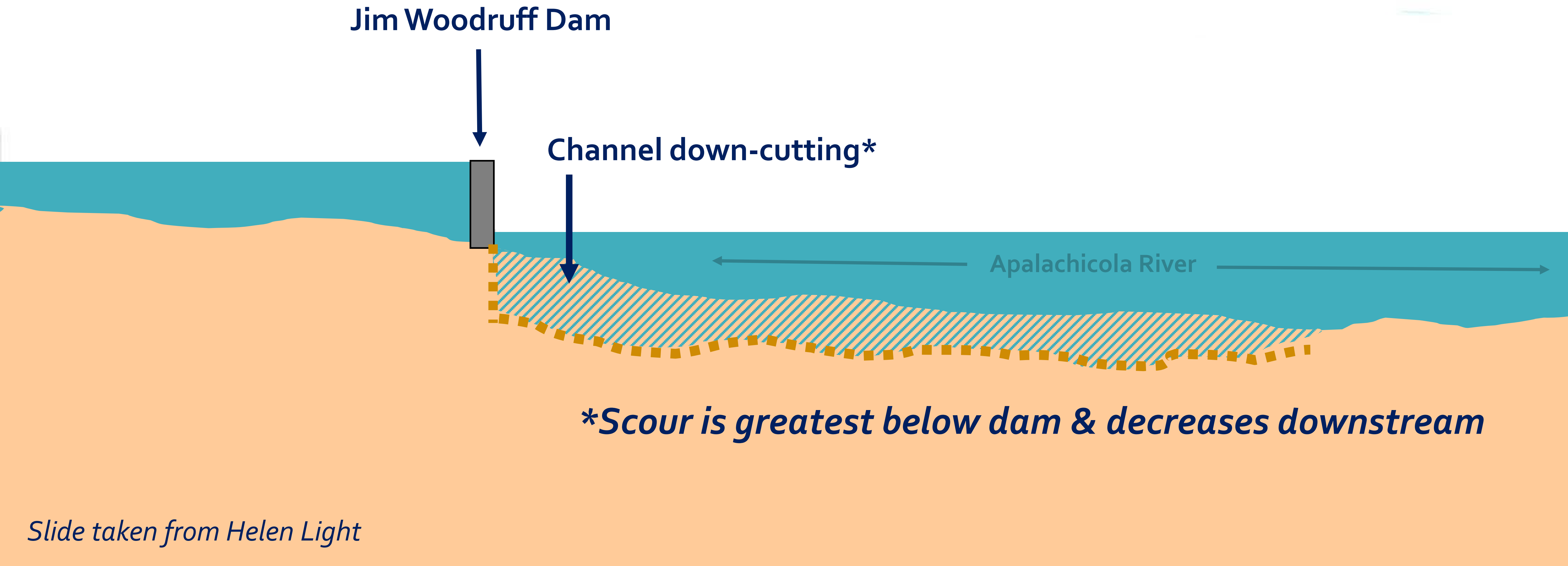
- Some attribute collapse to reduced freshwater inflow
- However, similar reduced inflow events occurred in the past without collapse and inflow since 2011-2012 drought has increased but Bay did not recover.
- Suggests freshwater alone does not explain the decline
- Points to a more complex set of causes:
  - Alteration of Habitat
  - Nutrient Inflow
  - Resource Management
  - Overfishing

Nutrient Inflow to the Estuary

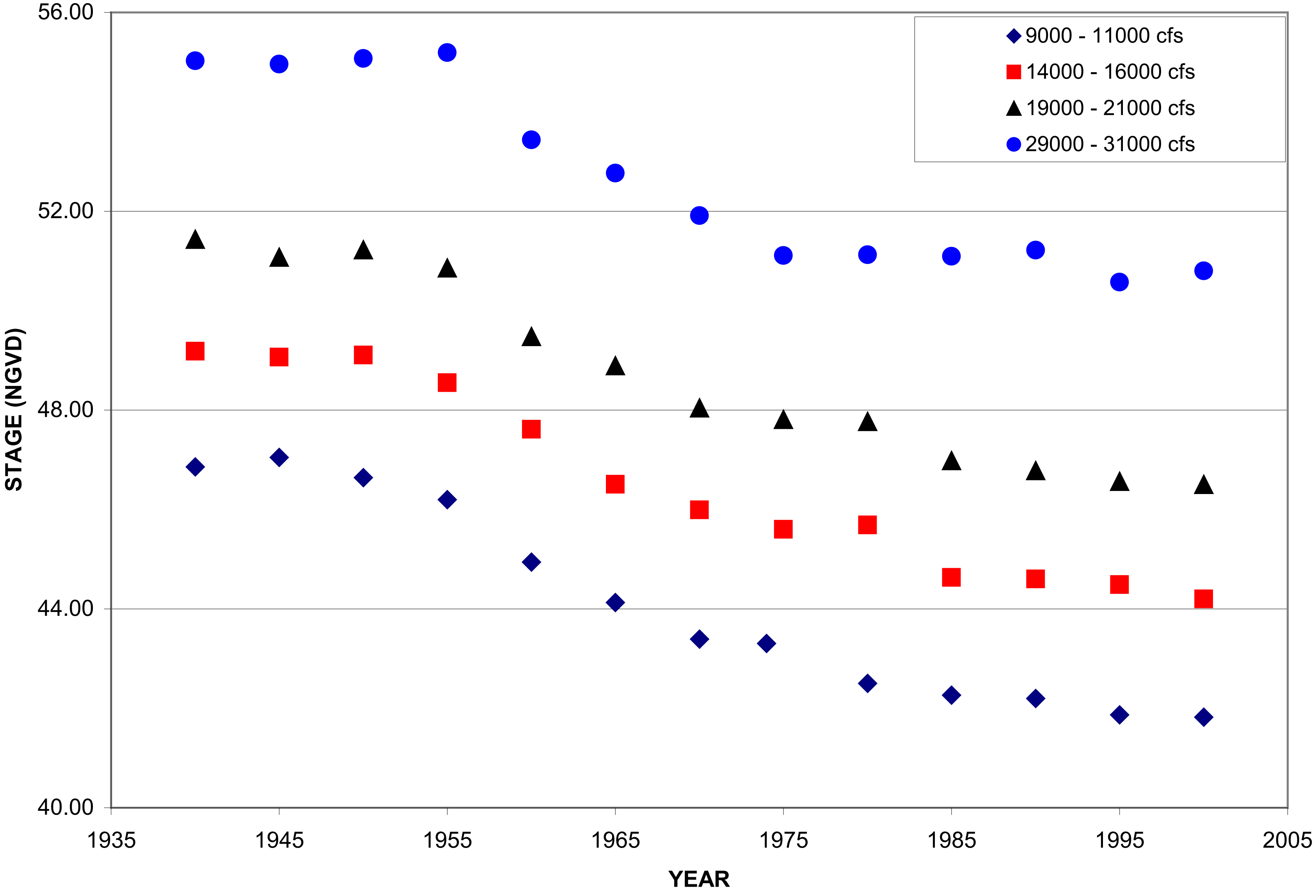
- Floodplain inundation is a major source of nutrients to the Apalachicola estuary (Livingston, 1981; Mattraw and Elder, 1984; Chanton and Lewis, 2002; and Chanton et al, 2022).
- River–floodplain connections have changed over the past 70 years
- Changes driven by riverbed degradation and navigation maintenance (Light et al, 2006, Mossa and Chen, 2022).
- Altered flow patterns have modified nutrient delivery to the estuary



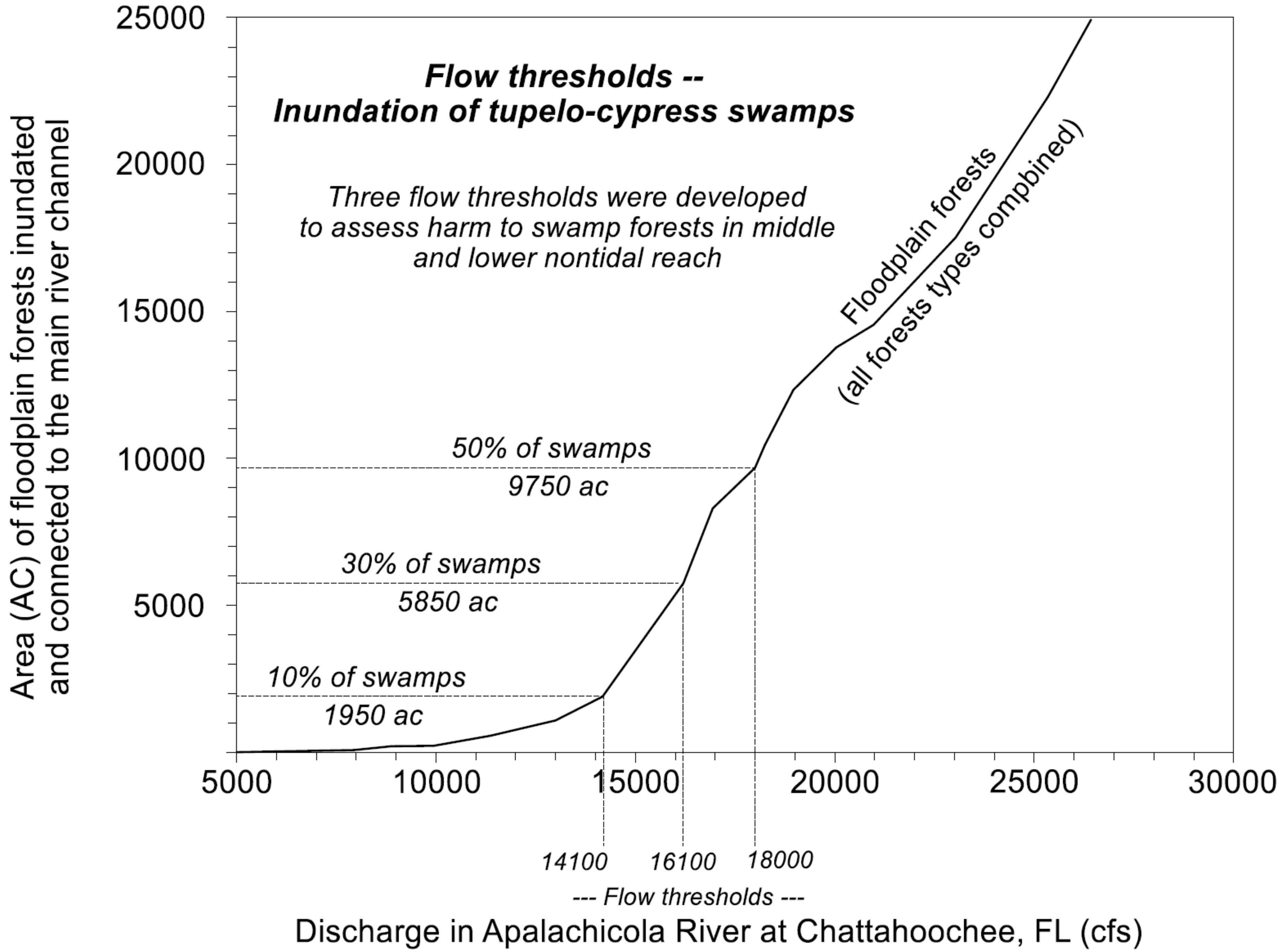
Erosion of Riverbed Downstream of Woodruff Dam



Relationship Between Elevation and Flow for the Apalachicola River at Chattahoochee Gage Over Time



DATA SOURCE: USGS Rating Curves



Flow thresholds --
Inundation of tupelo-cypress swamps
Three flow thresholds were developed
to assess harm to swamp forests in middle
and lower nontidal reach
Floodplain forests
(all forests types compbined)
50% of swamps
9750 ac
30% of swamps
5850 ac
10% of swamps
1950 ac
Area (AC) of floodplain forests inundated
and connected to the main river channel
25000
20000
15000
10000
5000
5000
10000
15000
20000
25000
30000
14100
16100
18000
--- Flow thresholds ---
Discharge in Apalachicola River at Chattahoochee, FL (cfs)

Nutrient Inflow to the Estuary – Riverbed Degradation

- Riverbed degradation necessitates higher flows to flood the floodplain
- Dredged sediment deposits worsen the reduced floodplain inundation
- Floodplain-estuary connections are increasingly changed
- Ecological impacts of this need further study



Watershed Management and Mitigation Opportunities

- Managing the watershed to alleviate the altered relationship between the river and its floodplain is a mitigative action
- Can alleviate impacts caused by the construction of Jim Woodruff Dam and dredging for the navigation project
- A way to address this issue is through the ACF Navigation Project

History of ACF Navigation Channel – ACF Navigational Design

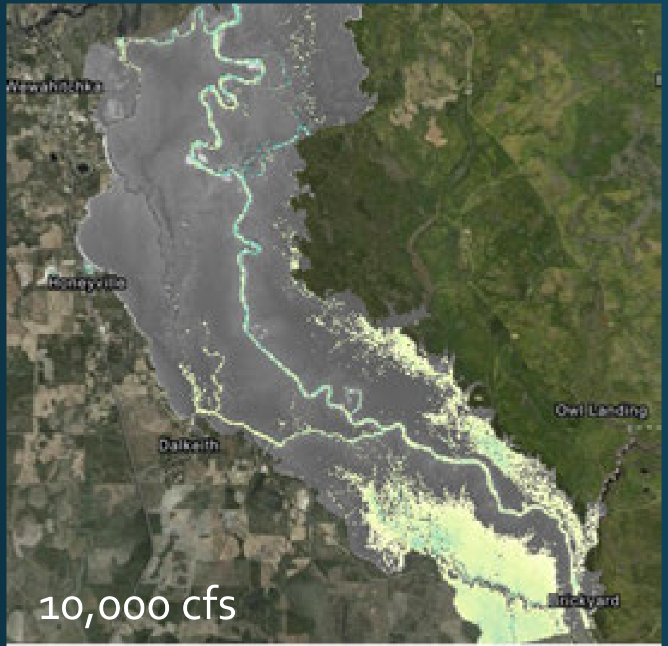
- Original design targeted a year-round 9-foot navigation channel
- Design based on a reference flow of 9,300 cfs at the Blountstown Gage
- 9,300 cfs served as the project's design standard
- Likely represents a flow available ~95% of the time during design

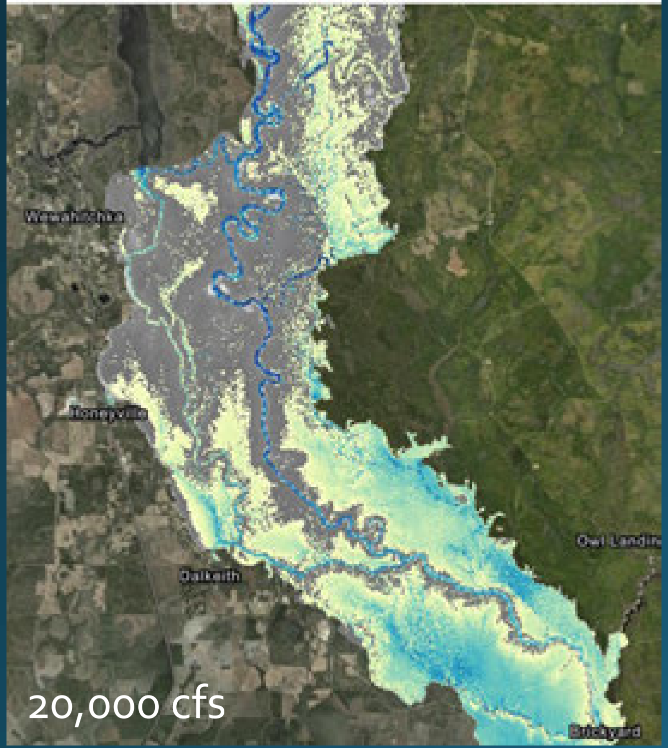
History of ACF Navigation Channel – Limits of Channel Maintenance

- Decades of river modifications have altered channel conditions yet a year-round channel is not attainable in most years:
  - Dredging
  - Dike Construction
  - Rock Removal
  - Reservoir Releases
  - Riverbend Cutoffs
- Year-round navigation channel is no longer considered realistic
- The flow available 95% of the time from 1939 to the present is about 6,000 cfs (far less than 9,300 cfs)
- The 2017 Water Control Manual states that a flow of 16,200 cfs is needed to provide a 7-foot channel

History of ACF Navigation Channel – Suspension and Current Scoping

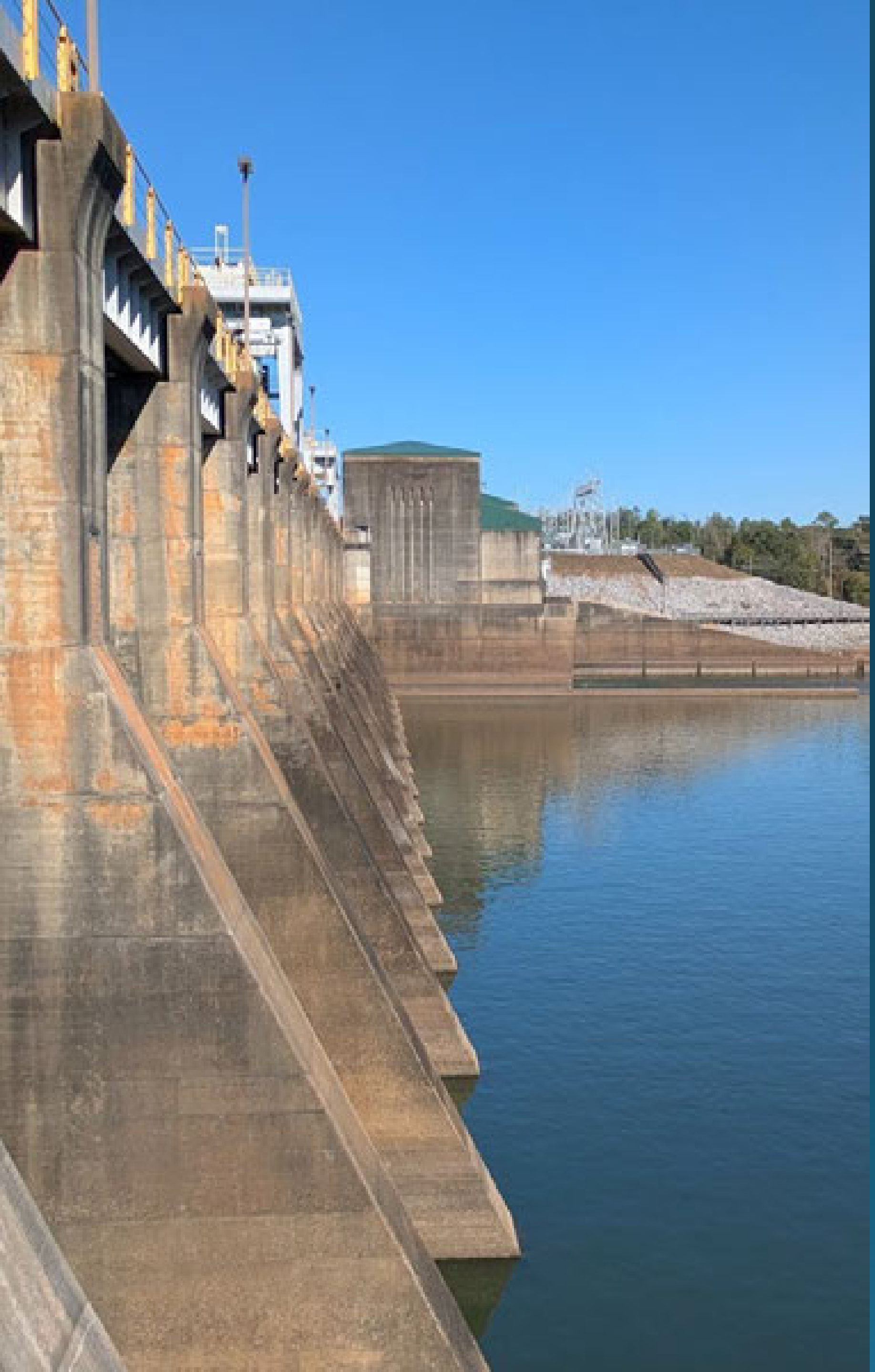
- Florida denied a dredging permit in 2005, ending channel maintenance
- Dredging and navigation-releases were discontinued
- The navigation channel has not been maintained since 2005
- Currently, the Corps is studying whether to resume channel maintenance for navigation
- A new permit request may be submitted as early as this fall





How to Alter Floodplain Inundation - Reference Flow

- Adjust reference flow to better match historical floodplain inundation
- Higher reference profile:
  - Increases floodplain inundation
  - Reduces reliance on dredging and lowers maintenance costs
  - Delivers more freshwater to the bay
- Can complement ongoing slough restoration efforts

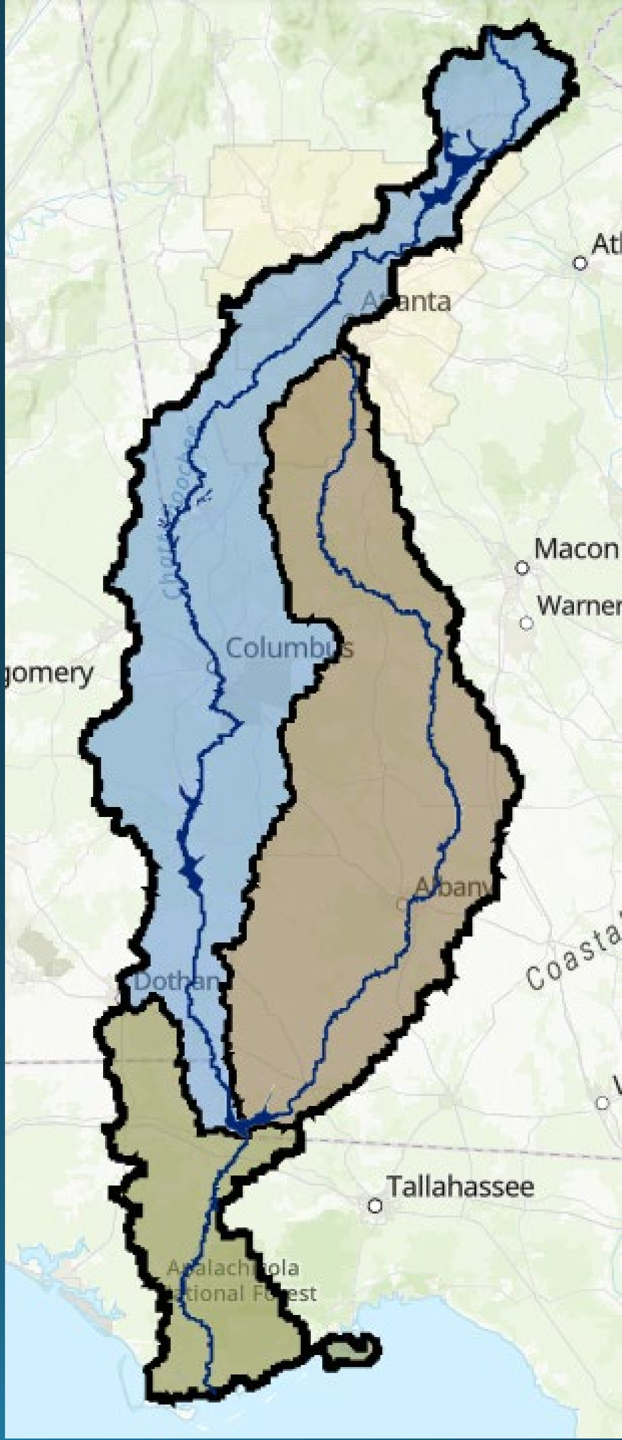


How to Alter Floodplain Inundation - Balancing Needs

- Key challenge is minimizing impacts on upstream water users
- Current Pew-funded project is developing resilience metrics
- Study focuses on modifying reservoir operations
- Aims to strengthen estuary and floodplain health while limiting upstream effects
- Project will evaluate the feasibility of this approach

How to Alter Floodplain Inundation – Common Ground Report

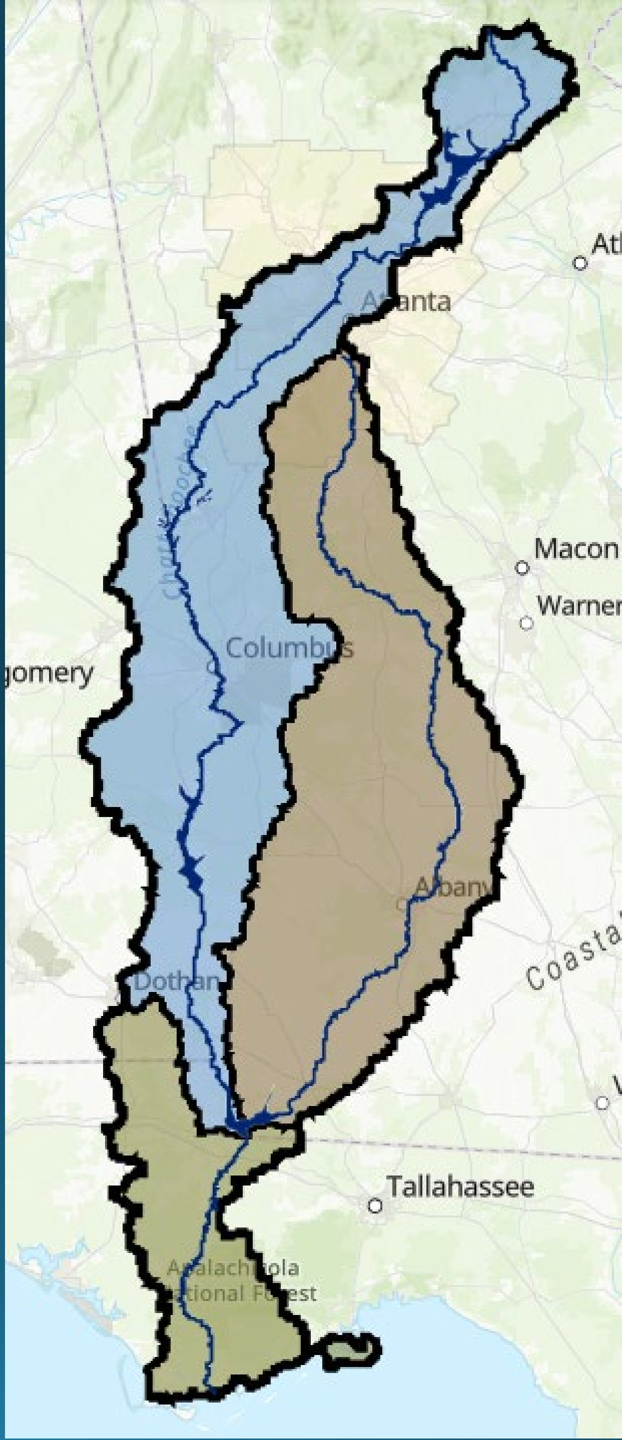
- December 2011 report: "*An Evaluation of the Common Ground Between Environmental and Navigation Flows in the Apalachicola-Chattahoochee-Flint Basin*"
- Prepared by Apalachicola Riverkeepers, Alabama Power, and the Tri-Rivers Waterway Development Association
- Funded by the U.S. Department of Agriculture



How to Alter Floodplain Inundation – Common Ground Report

Key Findings:

- Sustainable flow augmentation limit: ~2,000–3,000 cfs
- Reservoir system tolerates higher flows with no dredging than with dredging
- Dredging improves navigation but not environmental performance
- Most reservoir impacts occur at Lake Lanier
- Elevation changes at West Point Lake and Walter F. George Lake are limited



How to Alter Floodplain Inundation – Evaluating Flow Management Options

- Assess limits on reservoir flow augmentation for the Chattahoochee River
- Evaluate changes to navigation design flow on the Apalachicola River
- Compare options using metrics from the Pew Metrics project
- Focus on balancing navigation, storage, and ecological resilience

Restoring Lateral Connectivity in the Apalachicola Floodplain: Apalachicola River Slough Restoration Phase I

Funded by

NFWF — National Fish and Wildlife Foundation

Apalachicola Riverkeeper

COAPS — Florida State University Center for Ocean-Atmospheric Prediction Studies

Florida Wildlife Federation
Keeping the Wild in Florida since 1936!

Riparian County Stakeholder Coalition

UF | West Florida Research and Education Center
MILTON, FL

Florida Fish and Wildlife Conservation Commission

Northwest Florida Water Management District

Apalachicola National Estuarine Research Reserve

Project Sponsor –

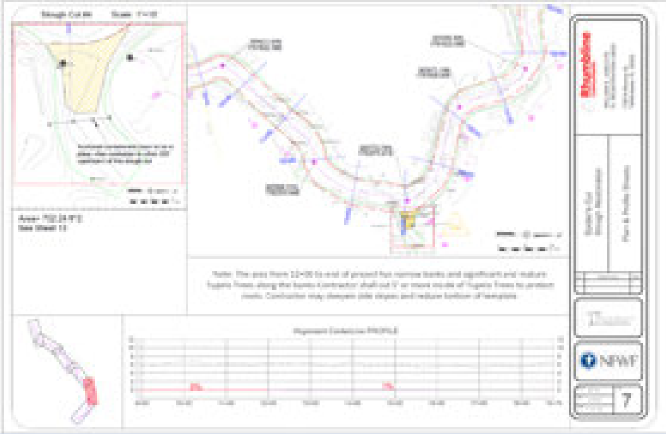
Apalachicola Riverkeeper – Cameron Baxley
Executive Director – Angel Ganey (ex ED Georgia Ackerman)
River Keeper – Cameron Baxley

Project team:

Matt Kondolf PhD - UC Berkeley
Matt Deitch PhD - UF Milton
Scott Walls – Land & Water
Ajay Sharma PhD - Auburn
John Tracy - PhD
Lauren William, Technician
Jiahua Zhou - PhD - modeling
Love Kumar – PhD water resources
Dan Tonsmeire - Construction Manager
Ken Jones PE - Engineer/Project Manager
Michael Gangloff PhD - Appalachian State
David Werneke PhD - Auburn
Andrew Gannon PhD
Melissa Samet - National Wildlife Federation
Policy and permit coordination

Geomorphology/Survey
Data collection

Floodplain/forestry



Engineering/
permitting

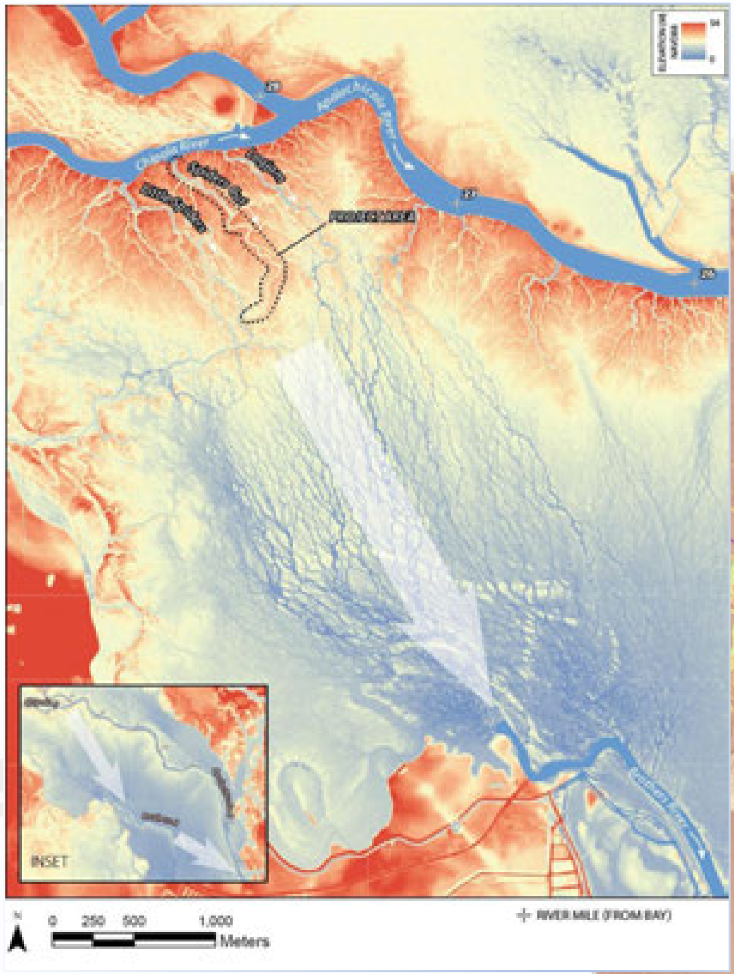
Ecological studies

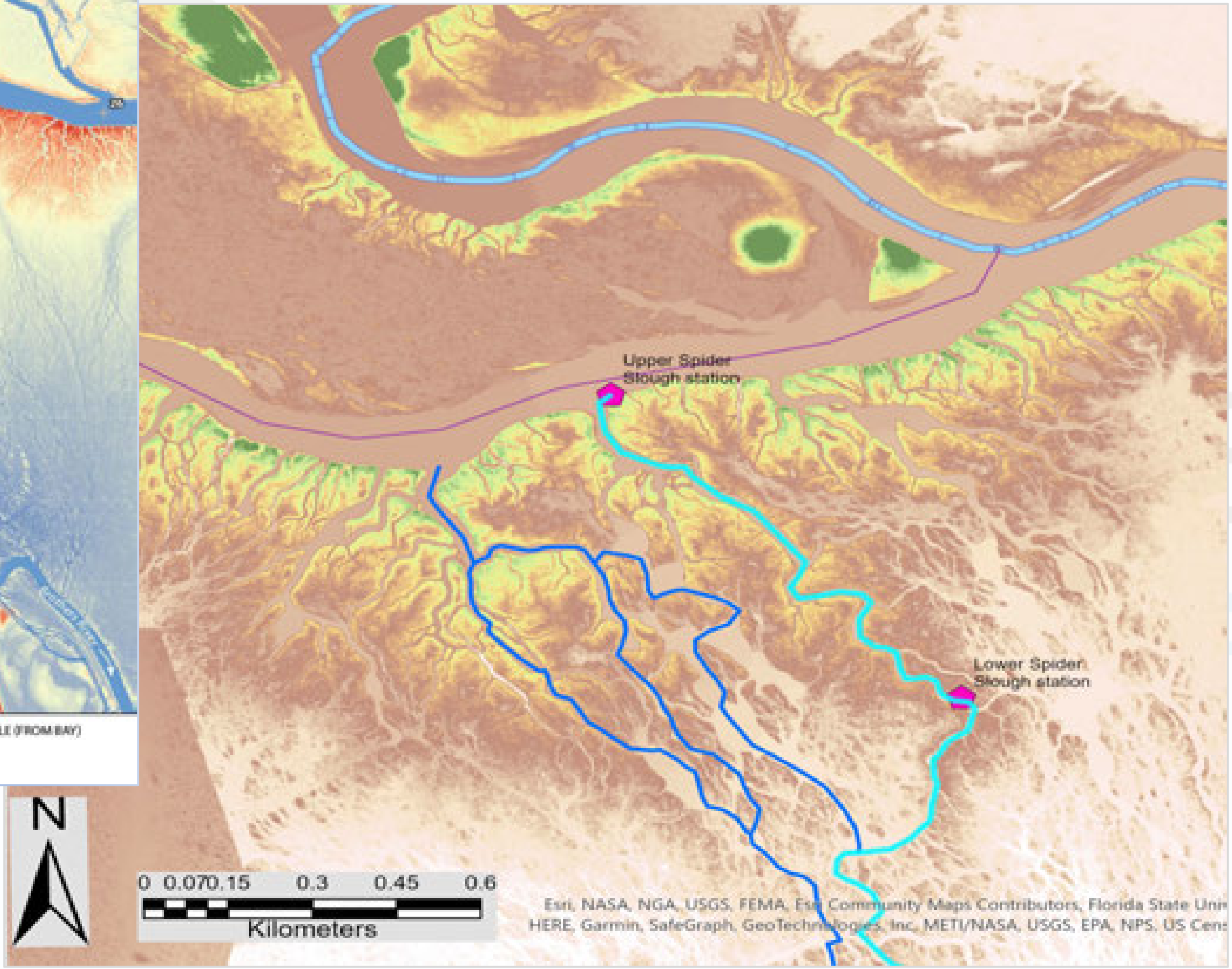
NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Watershed Specific Priorities and Objectives

Priority Issues	Conceptual Objectives
Hydrologic Impacts	
• Expansive areas of hydrologic alteration and disruption – including Tates Hell Swamp and M.K. Ranch • Physical impacts to the Apalachicola River floodplain • Disrupted connectivity between floodplain and main river channel • Impacted sloughs, streams, and other tributaries that serve as critical habitat for fish and wildlife, including protected species • Sedimentation impacts from unpaved roads, borrow pits, spoil sites, and other erosion sites	• Restore wetland and floodplain function and connectivity • Continue hydrologic restoration of Tate's Hell State Forest • Implement hydrologic restoration for MK Ranch property • Develop effective and scalable project approaches for slough restoration and floodplain reconnection and restoration • Address unpaved roads and erosion sites to reduce sedimentation

Spiders Cut slough system

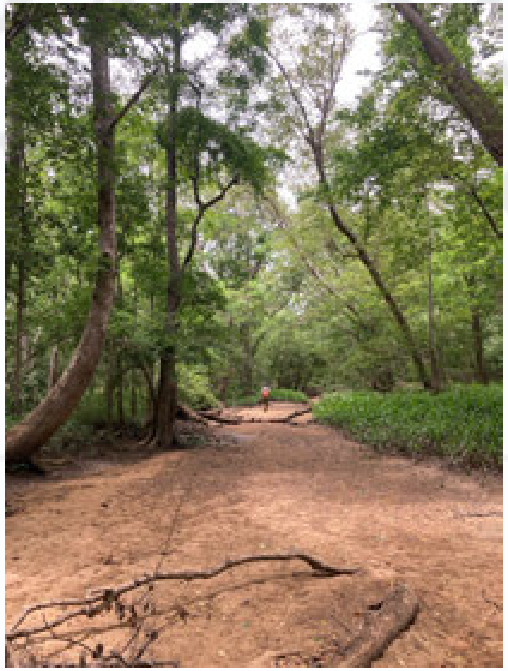




Spiders Cut pre-restoration conditions






Vegetative debris removal



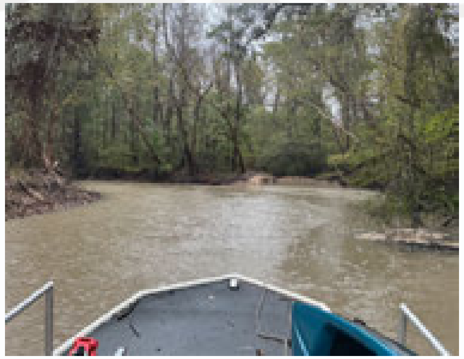


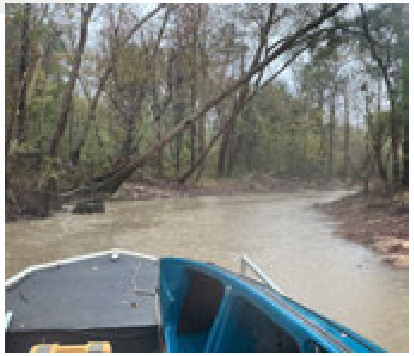

Spiders Cut Construction



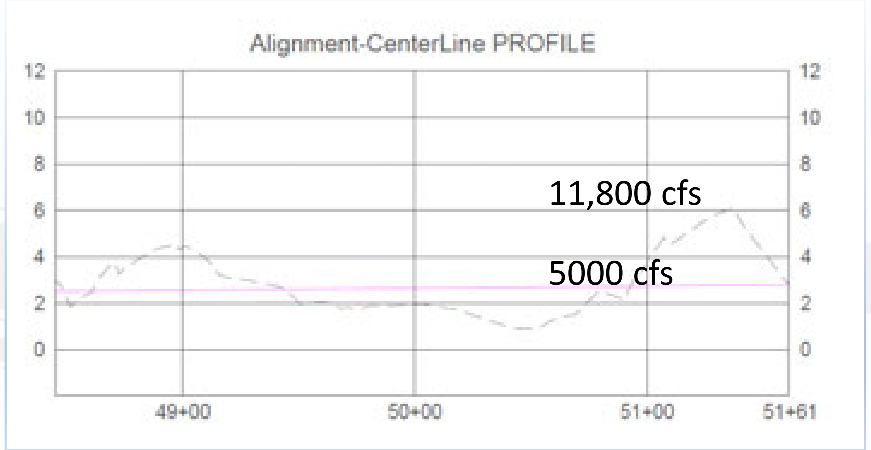



Spiders Cut post construction





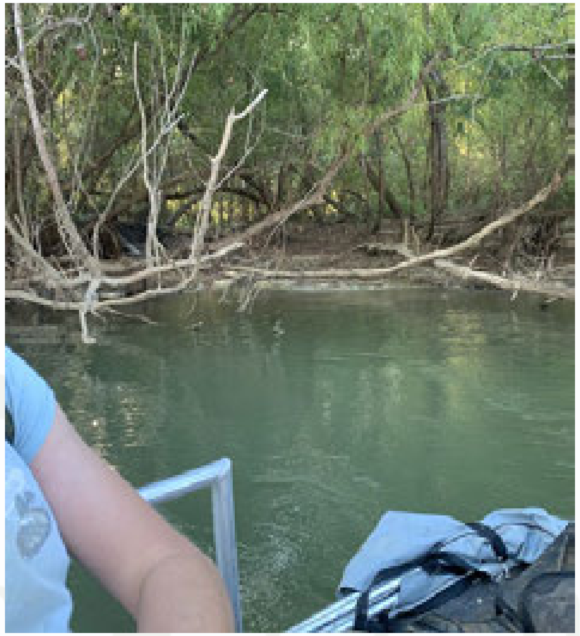
Spiders Cut

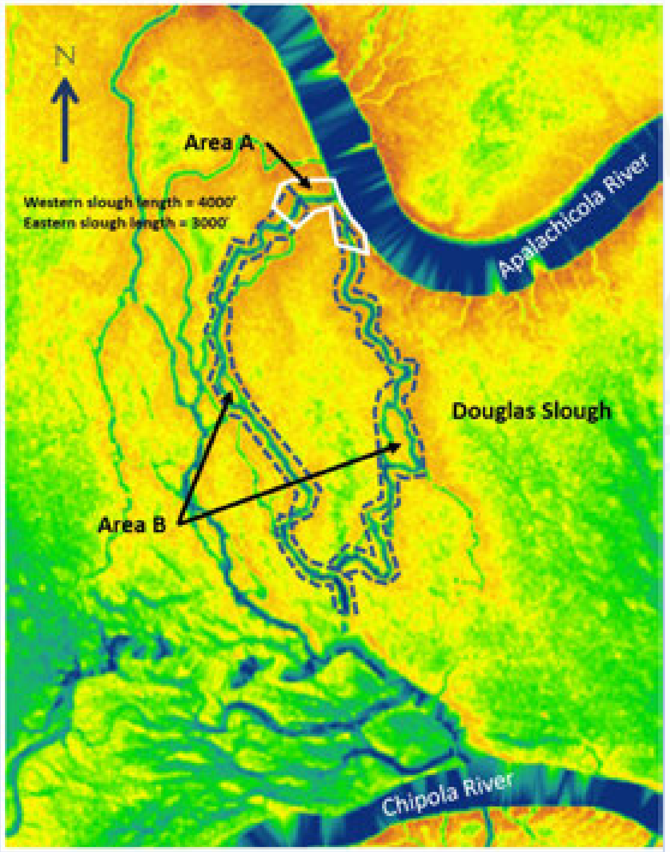

Alignment-CenterLine PROFILE
12
10
8
6
4
2
0
49+00
50+00
51+00
51+61
11,800 cfs
5000 cfs


pre construction

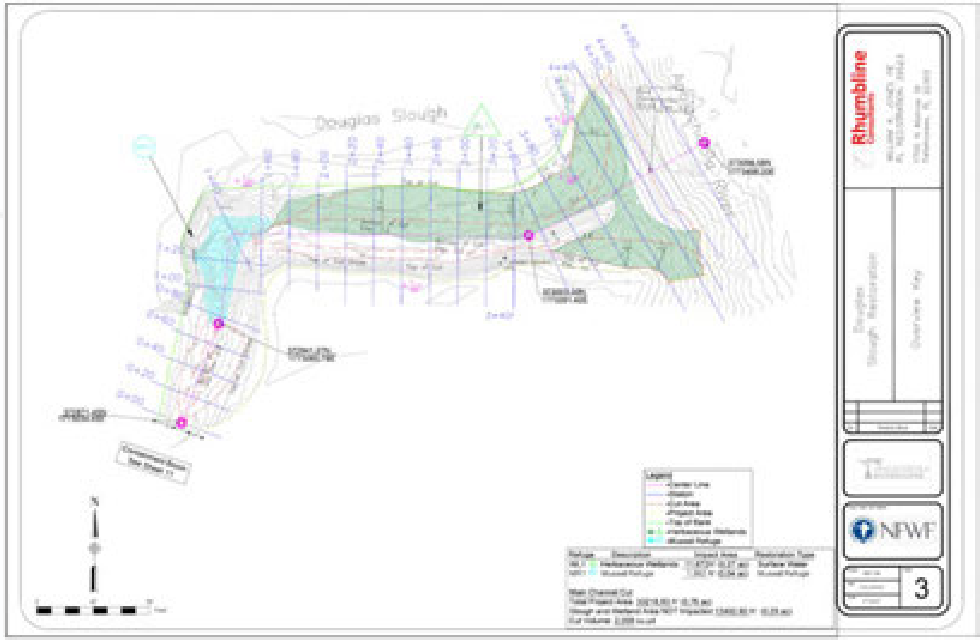

post construction

Douglas Slough





Douglas Slough



East River Restoration

East River Pre-construction

East River Construction

East River Construction

East River Post construction

Slough Restoration Construction

Douglas Slough	Length	Cost	
Vegetative debris removal	7000’	$127,420	$19/ft
Excavation	600’	$54,200	1500cy

Spiders Cut	Length	Cost	
Vegetative debris removal	5000’	$150,000	$30/ft
Excavation	5000’	$1,117,580	18000cy

East River	Length	Cost	
Vegetative debris removal	12500’	$150,000(est)	$12/ft
Excavation	12500’	$1,672,500	25000

Construction Totals	Unit	Cost	Cost/unit
Vegetative debris removal	24500’	$427,420	$17.44/ft
Excavation	44500cy	$2,844,280	$64/cy

Construction Management	Length	Cost	
Project CM	3 yrs	$380,444	

Significant work from graduate students

Hydrodynamic modeling – Lower Apalachicola Distributaries, in collaboration with ABSI Bay modeler

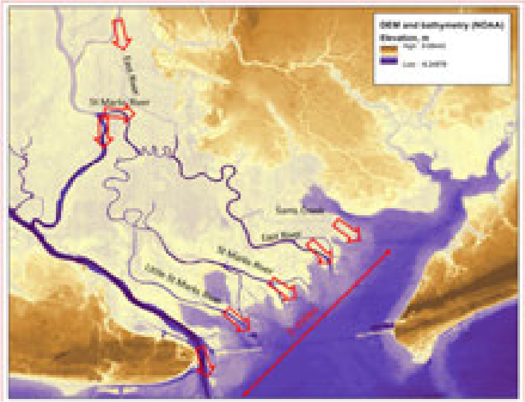
- Redefined the flow regime into East Bay
- Documented the value of excavating East River
- Examined the possibility of flows into Wimico

Defining increased from Spiders Slough Restoration through HEC modeling

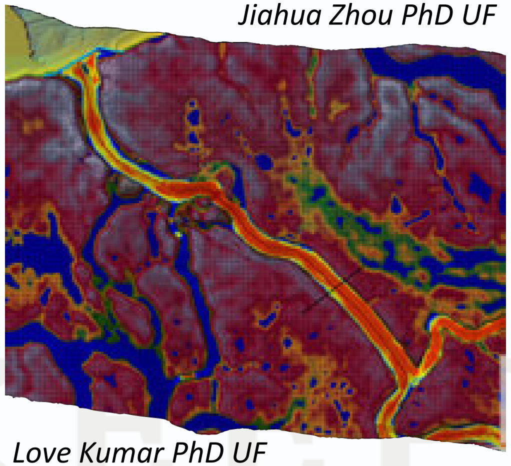
- Floodplain will be inundated much longer as the river levels fall, and begin flooding much earlier
- Demonstrated greater slopes through floodplain sloughs which drive flows to the floodplain swamps
- Established order of magnitude of flows through floodplain swamps

Investigating hydrologic alteration as a driver of shifting forest species composition in the Apalachicola river floodplain

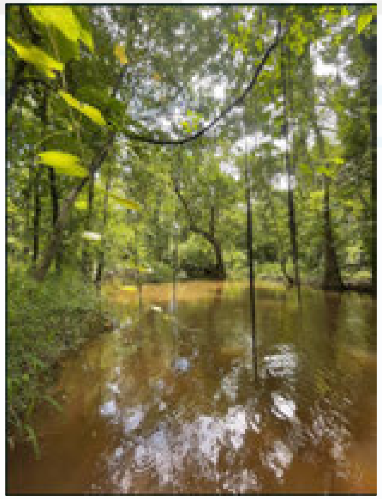
- Advancing the work of Darsy, Light and others
- Examining the flow dynamics required to restore a tupelo forest



Jiahua Zhou PhD UF

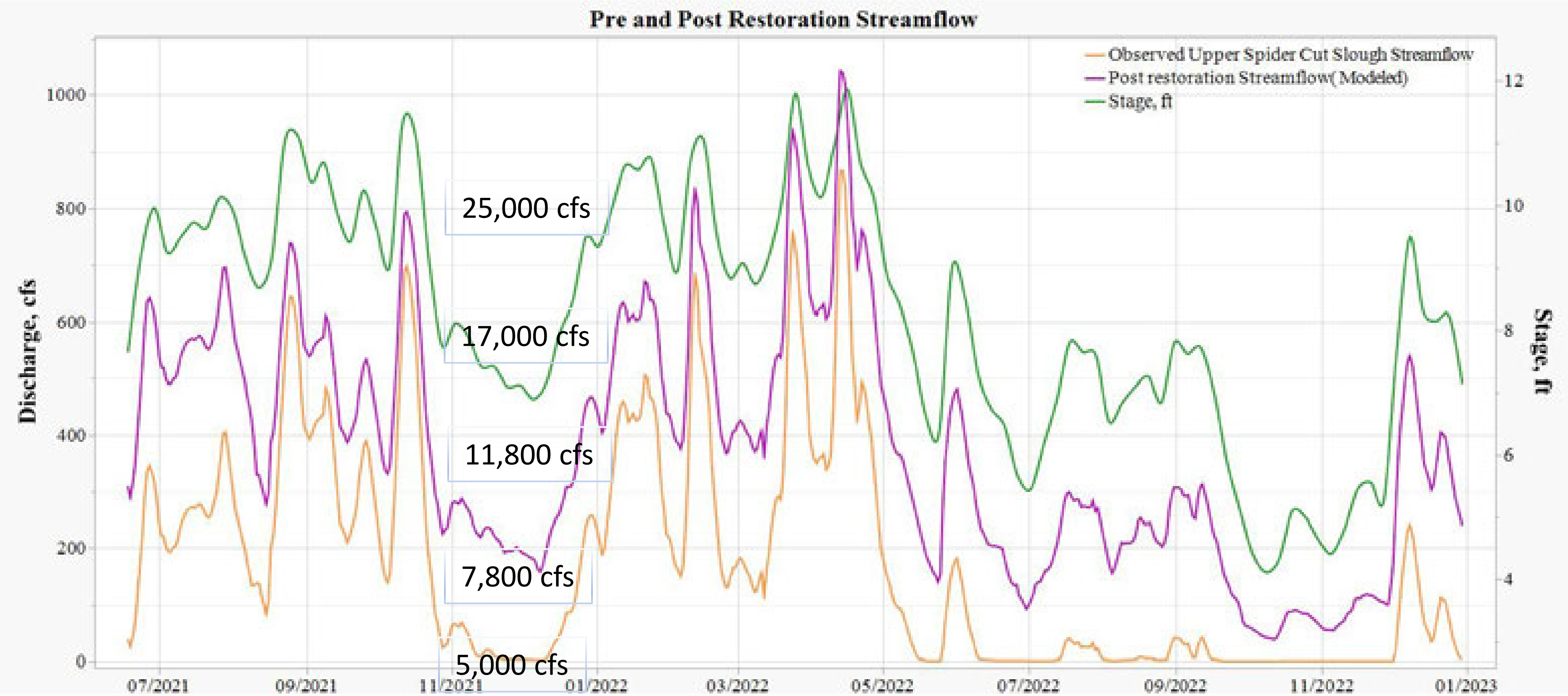


Love Kumar PhD UF



John Tracy PhD UF

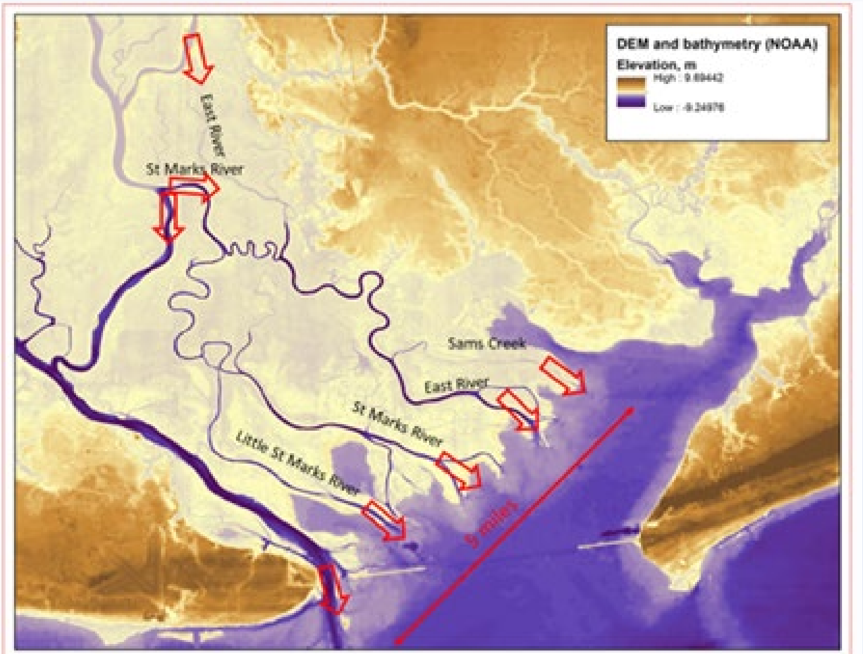
Pre and Post Restoration Streamflow



Nash Sutcliffe Efficiency (NSE)	86%
Coefficient of Determination (R^2)	96%

Hydrodynamic modeling findings:

- 20% of flows are diverted from the Apalachicola River to distributaries in low flow periods; 30% in higher flows
- Over ½ distributed flow goes to East River, about 30% to the St Marks River
- East River project will increase flows by 100% in lowest flow conditions



Flow Scenario (flows in m^3s^{-1})	Apalachicola River	Head of East River before Restoration	Head of East River after Restoration	Percent Change
Low	168	0.42	0.87	107%
Medium	340	3.9	7.2	84%
High	984	17.9	23.5	31%
Extremely High	2247	36.9	44.4	20%

Post-Restoration Projections

- **Spiders Cut** and **Douglas Slough** will flood at lower water levels, holding water in the floodplain longer in the spring. Sloughs will be free flowing at lowest river flows.
- **East River increased flow to estuary**.
- Greater nutrient transport to the estuary
- **Mussels -** increased overall density and richness. Possible habitat for other T&E species?
- **Fishes -** increased diversity & abundance. Shift from small stream assemblage to communities comprised of larger bodied taxa with riverine origins?
- Increase production and size of centrarchids and other game fishes?
- Improved role of sloughs as nursery habitats for riverine species?

Apalachicola River Slough Restoration Phase II

Prioritization of Loop Slough System Restoration and other Lateral Stream Connections in the Middle and Lower Apalachicola River Floodplain

Apalachicola River Slough Restoration Project, Florida

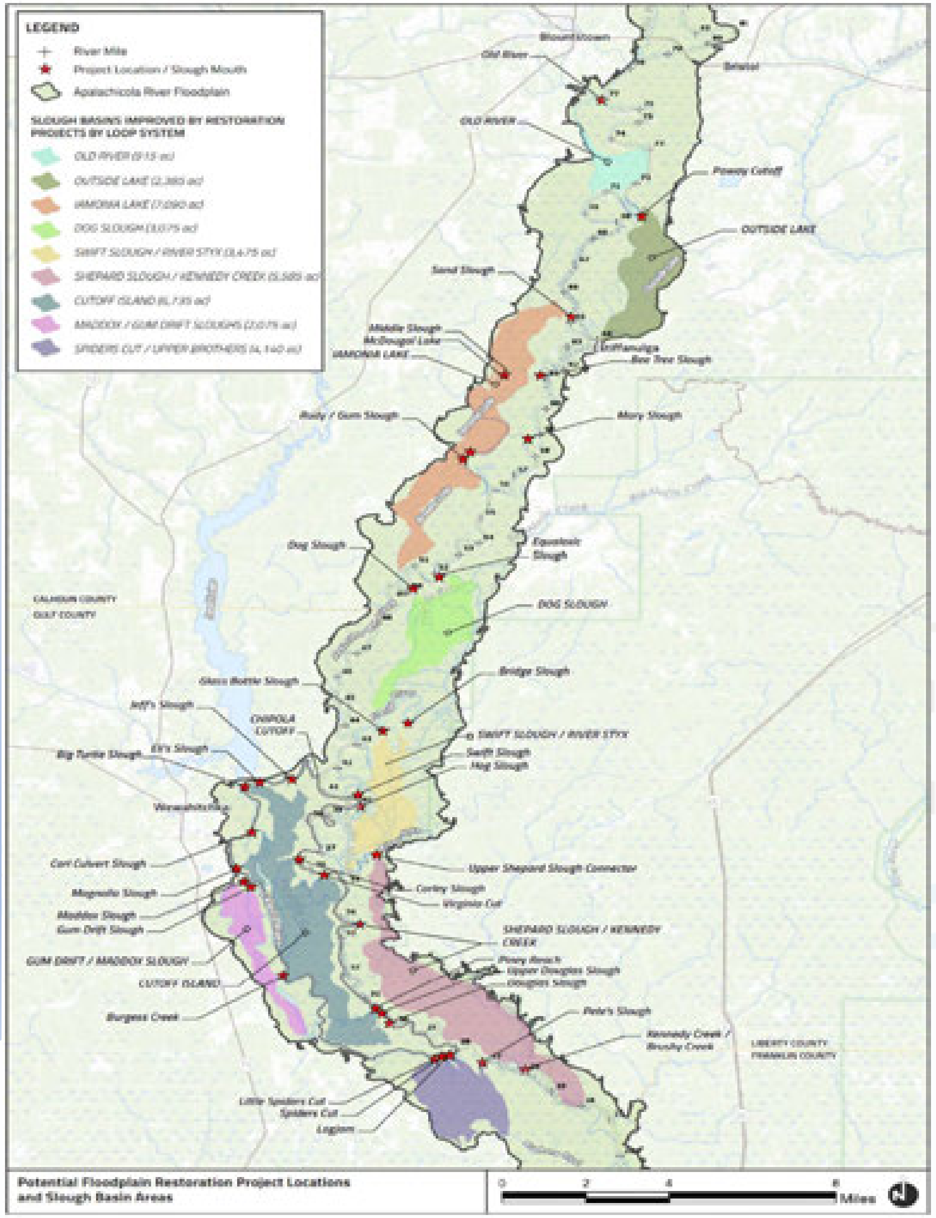
Funded by

National Fish and Wildlife Foundation

Gulf Environmental Benefit Fund

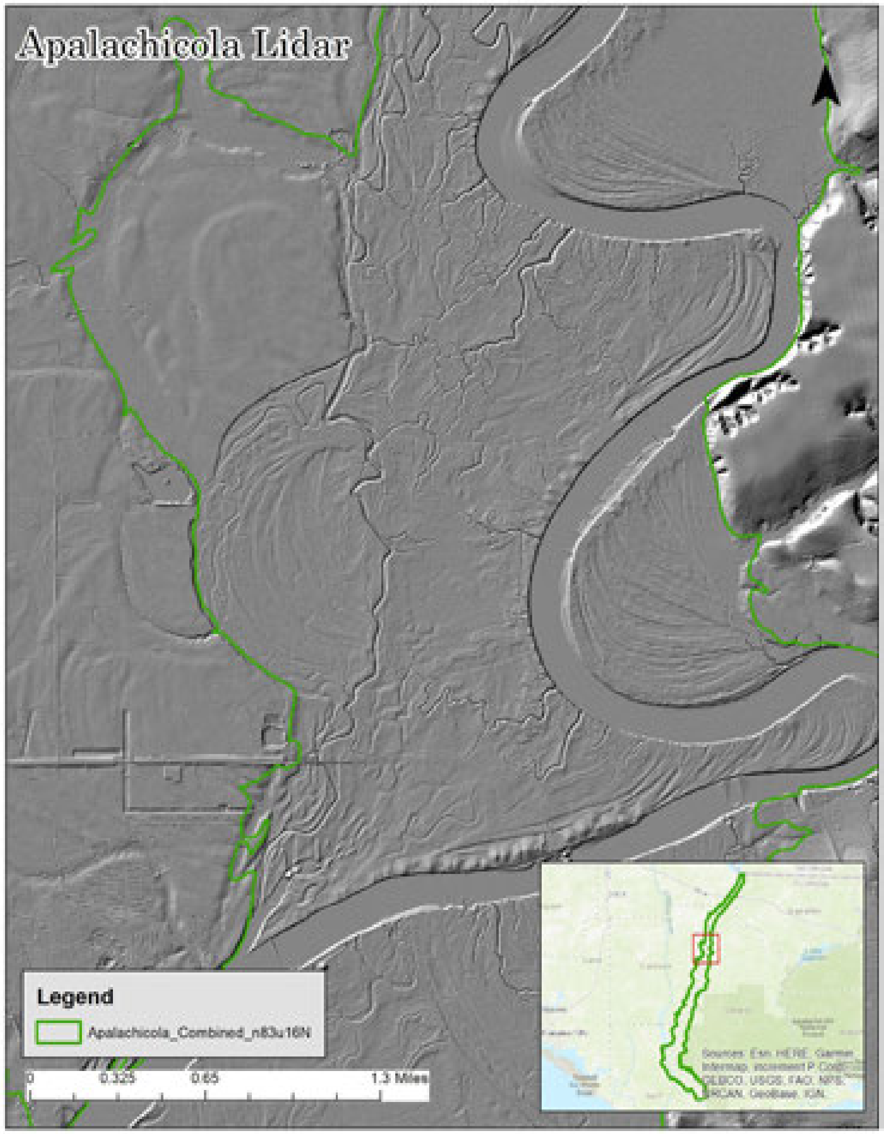
NFWF

Draft January 31, 2023



Apalachicola basin LiDAR

- Flown in October 2025 at ~6300 cfs
- 0.5m resolution
- From JWLD to Brickyard cutoff
- To be provided to public entities
- Incorporated into the REM funded by PEW



Criteria for restoration priorities

- Floodplain area where slough contributes
- Cost/benefit
- Areas where minimal dredging can occur at the head of slough to reintroduce flow to backwater areas
- Habitat improvement
- Other water sources draining to the same area
- Types of swamp areas affected ex. mixed BLH/tupelo, tupelo/cypress
- Maintain flow of water at a lower river stage
- Access and land ownership issues
- Disposal of dredged sediments

Kennedy Creek

Shepard Creek

Apalachicola River Slough Restoration						
Mainstem slough restoration priorities						$16,415,000
Slough Name	Looped system	RM	Lat	Long	Length	Budget
Kennedy Creek	River Styx/Kennedy	26	30.005	-85.062222	2800	$2,600,000
Shepards Slough	River Styx/Kennedy	33.6	30.065556	-85.129722	4000	$3,800,000
Corley Slough	Cutoff Island	36.5	30.093611	-85.153611	2000	$3,000,000
Swift Slough	Swift Sliough/River Styx	40.2	30.121111	-85.13	450	$815,000
Mary Slough	Iamonia	58.5	30.272778	-85.063056	500	$1,100,000
Bee Tree	Iamonia	60	30.299722	-85.026389	2500	$2,500,000
Poloway	Outside Lake	71.5	30.074722	-85.026389	1700	$2,600,000

Peer reviewed papers

John E. Tracy, Ajay Sharma, Matthew Deitch, James Colee, Mack Thetford, Daniel Johnson,
Flood dynamics and tree resilience: First-year seedlings of five floodplain forest species responding to diverse inundation scenarios, Forest Ecology and Management, Volume 556, 2024, 121724, ISSN 0378-1127, https://doi.org/10.1016/j.foreco.2024.121724.

John E Tracy, Ajay Sharma, Matthew Deitch, James Colee, Daniel J Johnson,
Investigating Thresholds for Drought Resistance in Floodplain Forest Tree Species, Forest Science, 2024; fxae021, https://doi.org/10.1093/forsci/fxae021

John E Tracey. INVESTIGATING HYDROLOGIC ALTERATION AS A DRIVER OF SHIFTING FOREST SPECIES COMPOSITION IN THE APALACHICOLA RIVER FLOODPLAIN OF FLORIDA, USA, A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY UNIVERSITY OF FLORIDA, 2024

Kumar, Love etal. Hydrological regimes change of the Apalachicola River basin: A systematic review of historical and future flow patterns (in review with minor comments)

Kumar, Love, HYDROLOGICAL CONNECTIVITY AND WATER CHEMISTRY OF A RIVER FLOODPLAIN SYSTEM IN SOUTHEASTERN UNITED STATES, A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY UNIVERSITY OF FLORIDA, 2025

Jiahua Zhou, Matthew J. Deitch, Sabine Grunwald, Elizabeth J. Screaton, Maitane Olabarrieta, 2021
Effect of Mississippi River Discharge and Local Hydrological Variables on 2 Salinity of Nearby Estuaries Using A Machine Learning Algorithm, Published by Elsevier.
https://www.sciencedirect.com/science/article/pii/S0272771421004777

Jiahua Zhou. ESTUARY SALINITY OF THE APALACHICOLA BAY IN RESPONSE TO A CHANGING CLIMATE AND HYDROLOGIC ENVIRONMENTAL VARIABLES
A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY UNIVERSITY OF FLORIDA, 2024

Reports

Love Kumar, Lauren Williams, Matthew Deitch; SEDIMENT PROFILING OFRESTORA TION PROJECT: EAST RIVERSPIDERS CUT/DOUGLAS SLOUGH Watershed Management Lab/University of Florida, for Apalachicola Riverkeeper, 2021.

Jiahua Zhou, Matt Deitch and William Jones, Estimating flow of a tidal river with multiple distributaries using high-resolution hydrodynamic modeling: Lower Apalachicola Bay Watershed Management Lab/University of Florida, for Apalachicola Riverkeeper, 2022

Michael Gangloff and Dave Werneke, PRE-RESTORATION ASSESSMENT OF MUSSEL AND FISH ASSEMBLAGES IN FIVE SLOUGHS IN THE LOWER APALACHICOLA RIVER BASIN Southeastern Aquatic Research and Auburn University Natural History Museum and Learning Center, for Apalachicola Riverkeeper, May 2022.

Kumar Love, Matt Deitch, William Jones and Scott Walls. Hydrodynamic modeling for assessing changes in flow dynamics of two restoration options at Spiders Cut Slough, Gulf County Florida, Watershed Management Lab/University of Florida, for Apalachicola Riverkeeper, 2024

NFWF

Thank you

Ken Jones PE
Rhumbline Consultants PLLC
ken@rlconsultants.net

What Conditions are Necessary for Tupelo and Other Relatively Light Seeded Floodplain Trees to Succeed?

Presenter: John Tracy

Dr. Tracy will provide information on his studies related to conditions important for the gemination and establishment success of Tupelo, Cypress and other trees normally found in the deep swamp areas. He will discuss his past work and experiments that he will be conducting at LSU to further our understanding of the life history of these trees. He will discuss the drivers of the migration of bottomland hardwoods into the deep swamp.

Slides unavailable publicly. Please contact John Tracy for more information: jtracy@agcenter.lsu.edu