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# Historical Salinity and Flow in Biscayne Bay – The Pathway to Performance Measures

G. Lynn Wingard<sup>1</sup>, Bethany L.  
Stackhouse<sup>1</sup>, and Andre M.  
Daniels<sup>2</sup>

<sup>1</sup>U.S. Geological Survey, Florence Bascom  
Geoscience Center, Reston, VA USA

<sup>2</sup>U.S. Geological Survey, Wetlands and  
Aquatic Research Center, Davie, FL USA



# One of Joan's overarching goals:

- “The goal of the South Florida restoration process is to reestablish a sustainable ecological system that approximates the predrainage system ...”
- “A critical step in the restoration process is to describe the predrainage system with sufficient detail to capture the essential landscape features ....”
- “Promising approaches being used are analyses of historic records, paleoecological interpretation of sediment cores, and simulated modeling.”

From Browder & Ogden 1999 “The natural South Florida system II: Predrainage ecology; *Urban Ecosystems* 3:245-277.



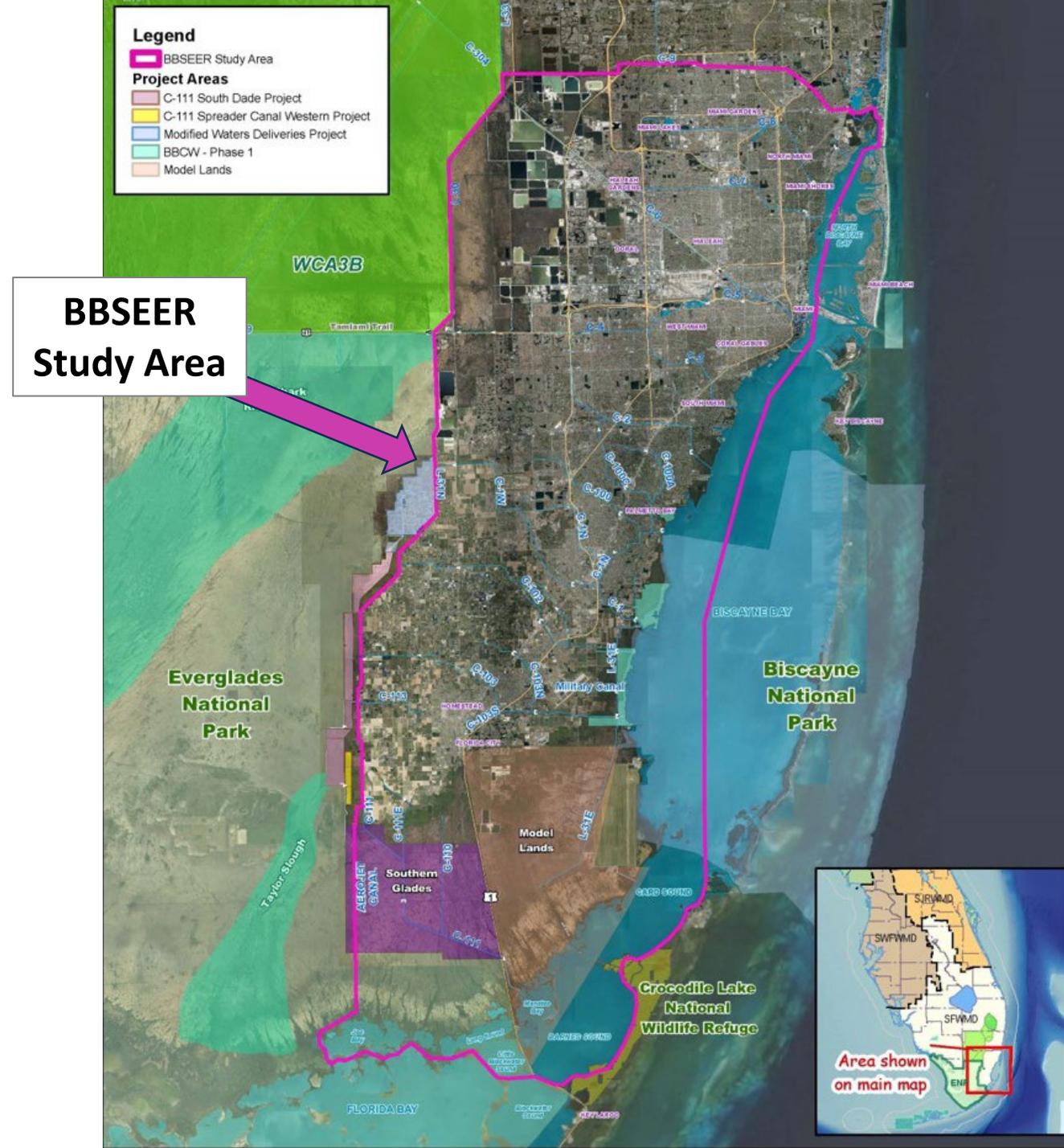
# BBSEER – Nearshore Salinity Subteam\*

## Four BBSEER Project Objectives

Our focus was on objective #1:  
Restoration of a 500-m oligo-  
mesohaline strip year-round and  
reduction of un-natural pulse  
releases.

\*Nearshore Salinity PM Working group:  
**Joan Browder, NOAA / NMFS**  
Joe Serafy, NOAA/NMFS/SEFSC  
Lynn Wingard, U.S. Geological Survey  
Sarah Bellmund, National Park Service  
Melody Hunt, National Park Service  
Ramon Martin, U.S. Fish and Wildlife Service

From <https://www.saj.usace.army.mil/BBSEER/>





**8/2021 - Cove & natural creek north of Black Creek – psu = 22.12 = polyhaline**

# Historic Map – Library of Congress Collection – published 1781



Cartographer: Bernard Romans



# Historic Map – Library of Congress Collection – published 1781

Enlargement of shoreline of southern Biscayne Bay

*“all these rivulets are Fine Fresh Water”*



# Historic Map – German Cartographer De Brahm – drawn 1770s

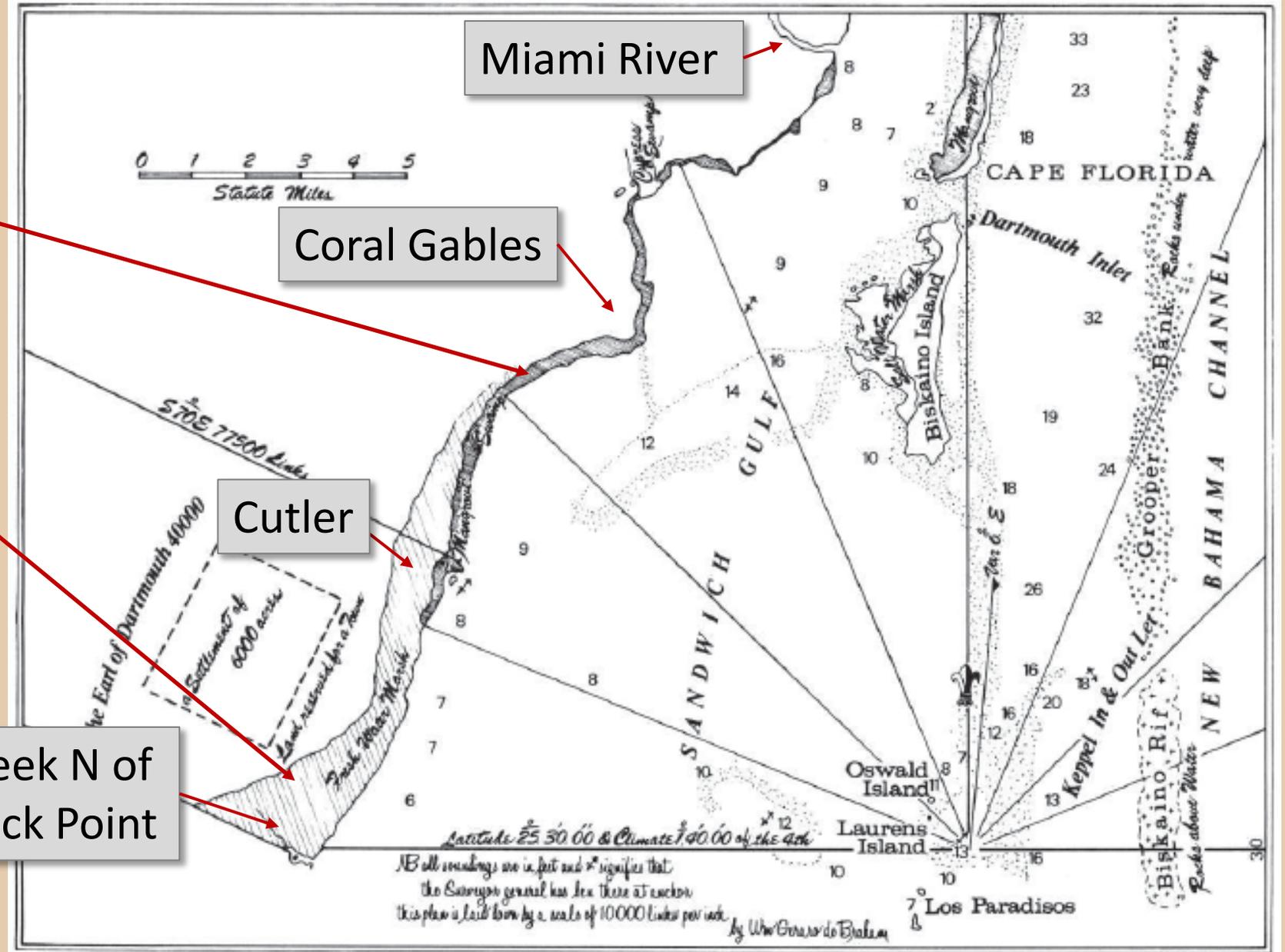
 "Mangroves"

 "Fresh Water Marsh"

Freshwater marshes indicate nearshore zone was oligohaline to mesohaline salinity

Creek N of Black Point

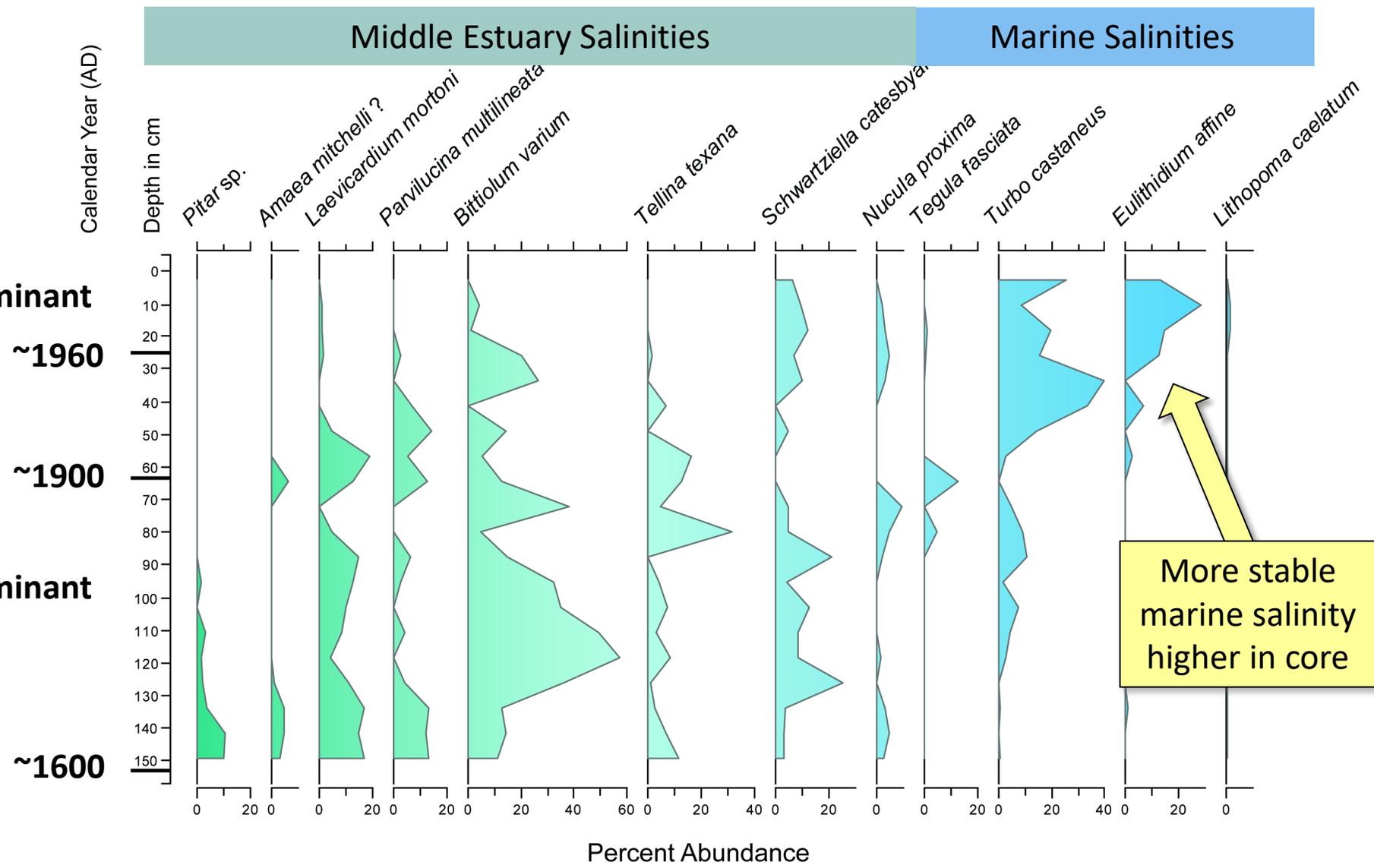
Map included in Chardon, 1975, Tequesta, n. 35



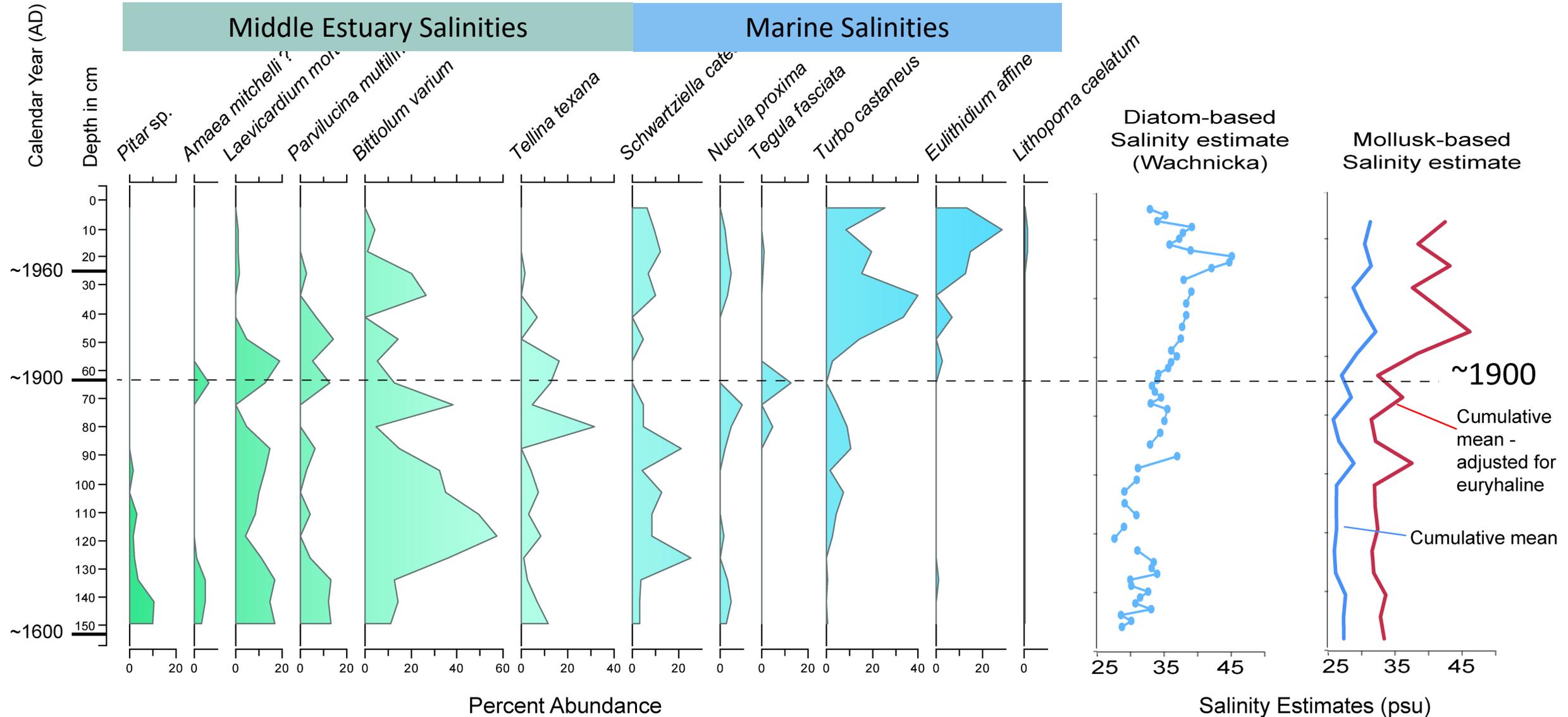
# Centennial-Scale Changes in Biscayne Bay

No Name Bank,  
Biscayne Bay

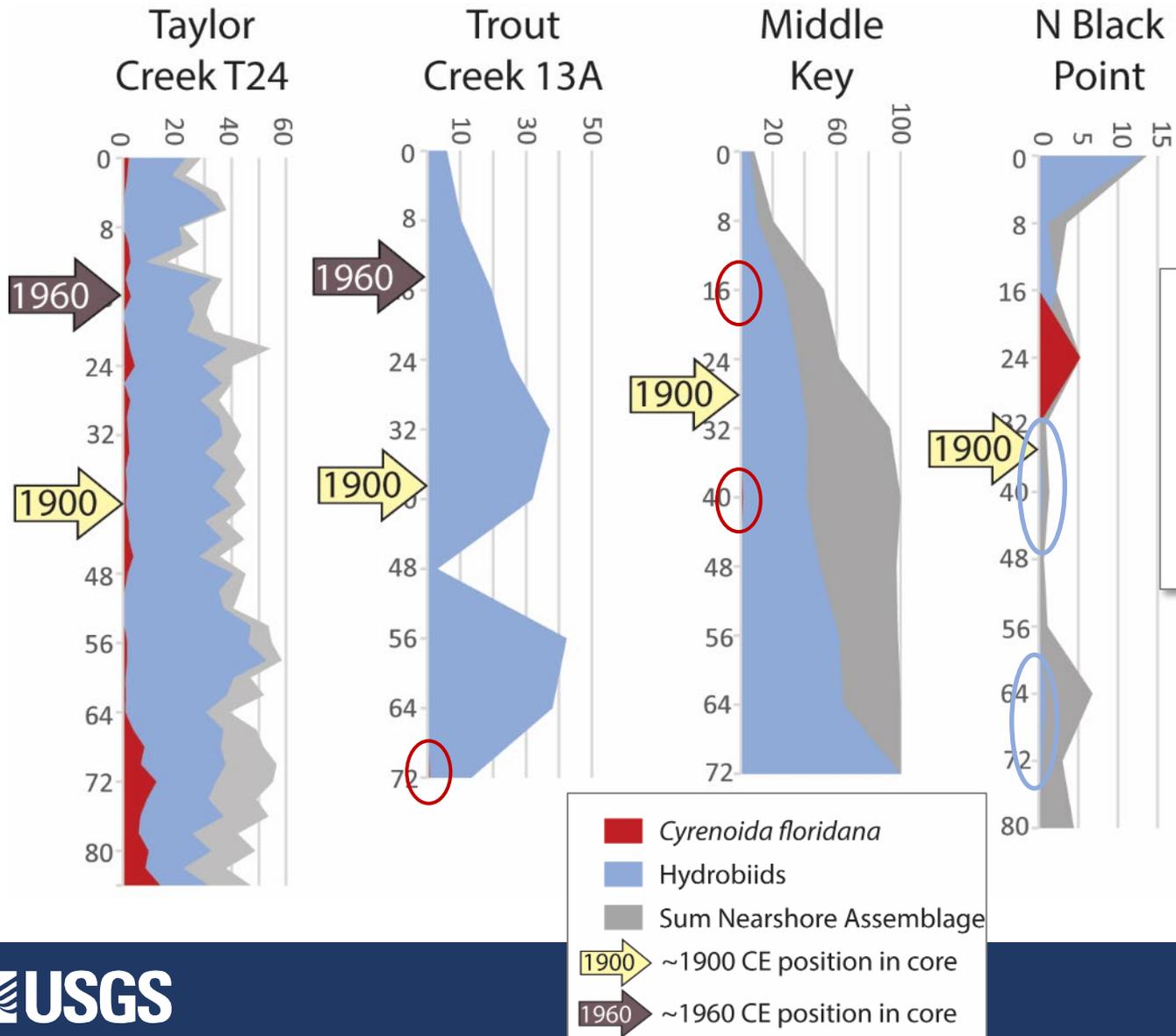
**Euhaline species dominant**  
↑  
**Polyhaline species dominant**



# Centennial-Scale Changes in Biscayne Bay

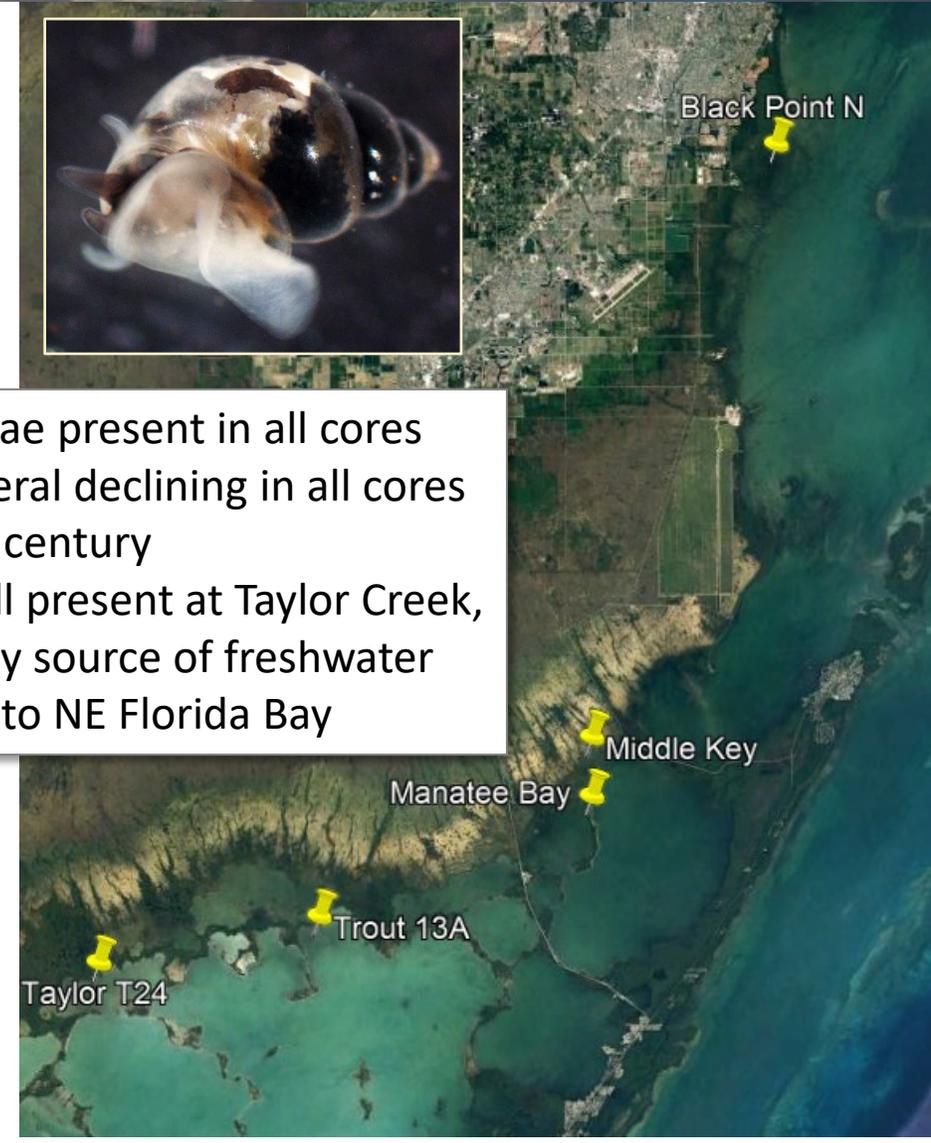


# Low Salinity Indicator Species in Nearshore



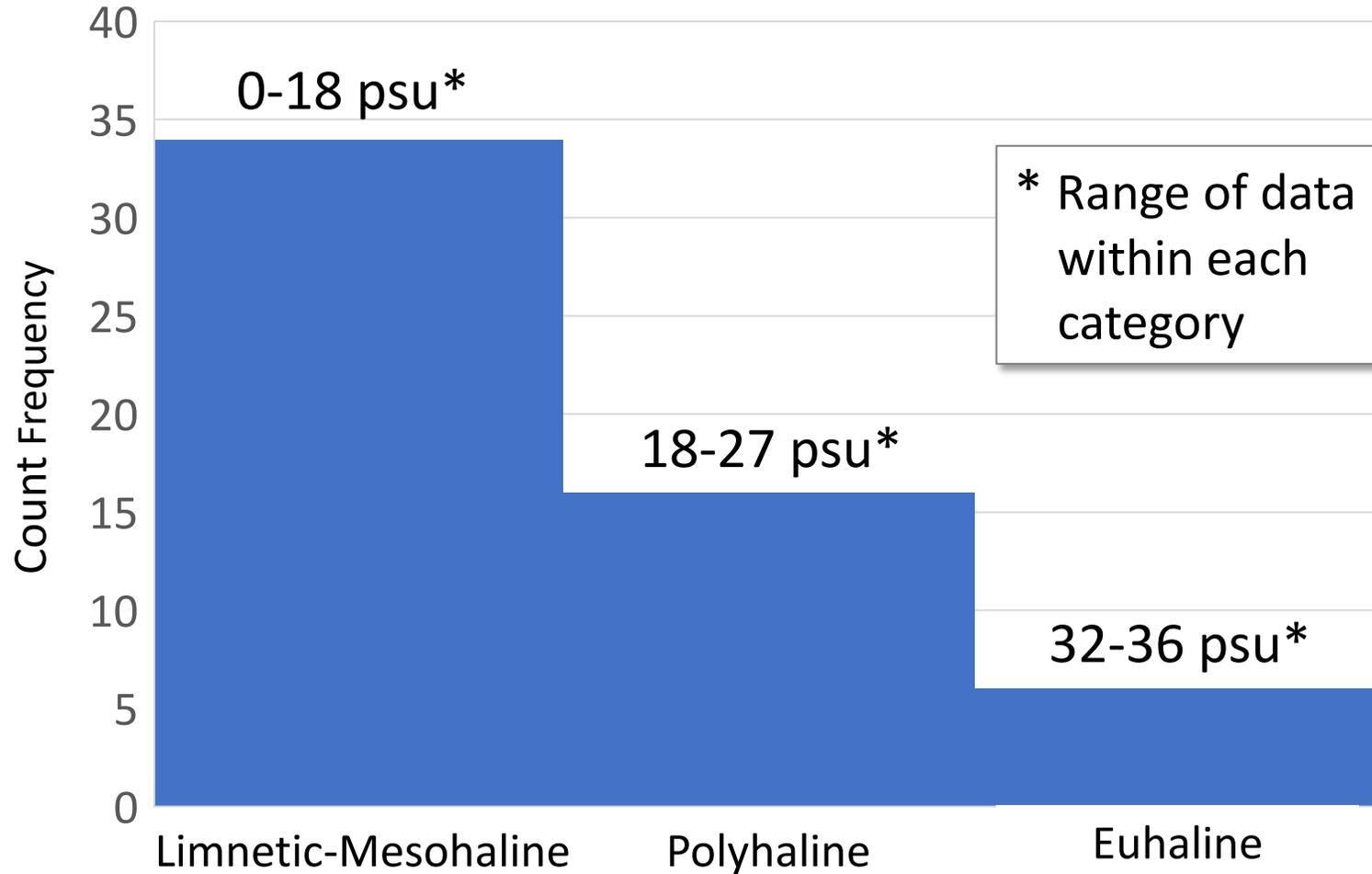
Hydrobiidae present in all cores

- In general declining in all cores in 20<sup>th</sup> century
- But still present at Taylor Creek, primary source of freshwater flow into NE Florida Bay



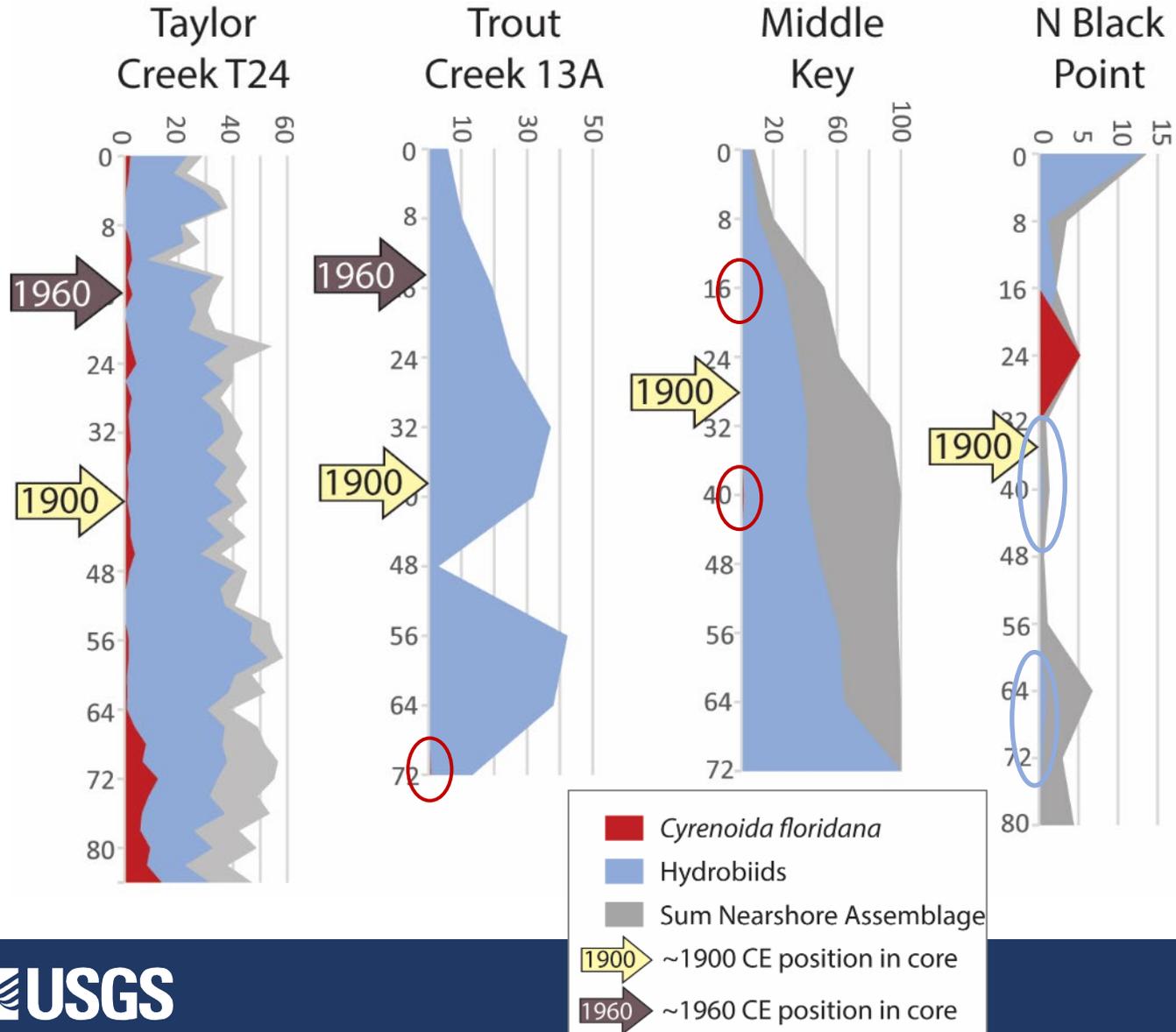
# Low Salinity Indicator Species in Nearshore

## Live count Hydrobiid salinity data



- Minute freshwater to very low salinity snails, capable of rafting on freshwater flows into higher salinity waters.
- Always found near freshwater sources.

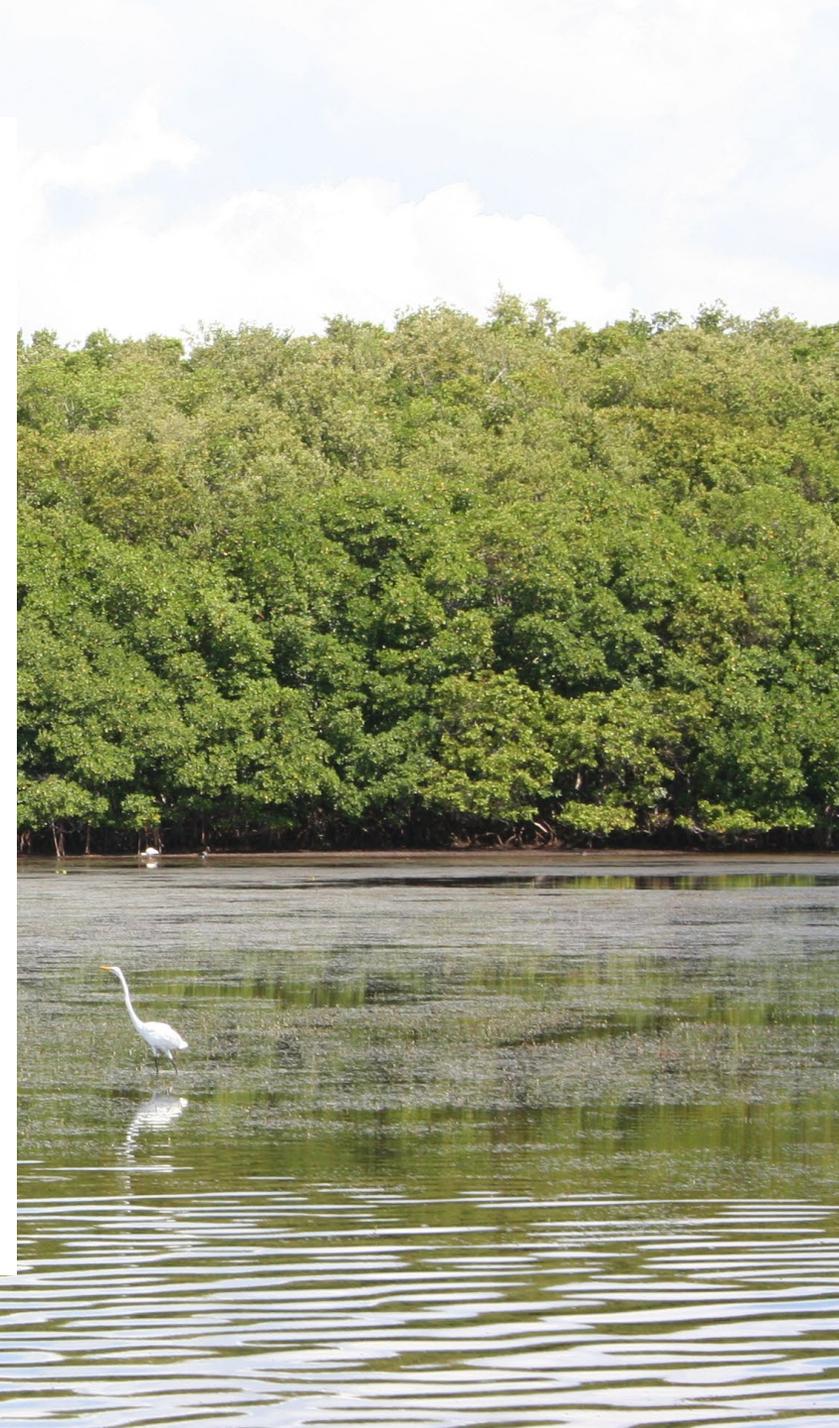
# Low Salinity Indicator Species in Nearshore



# BBSEER Nearshore Salinity Performance Measure

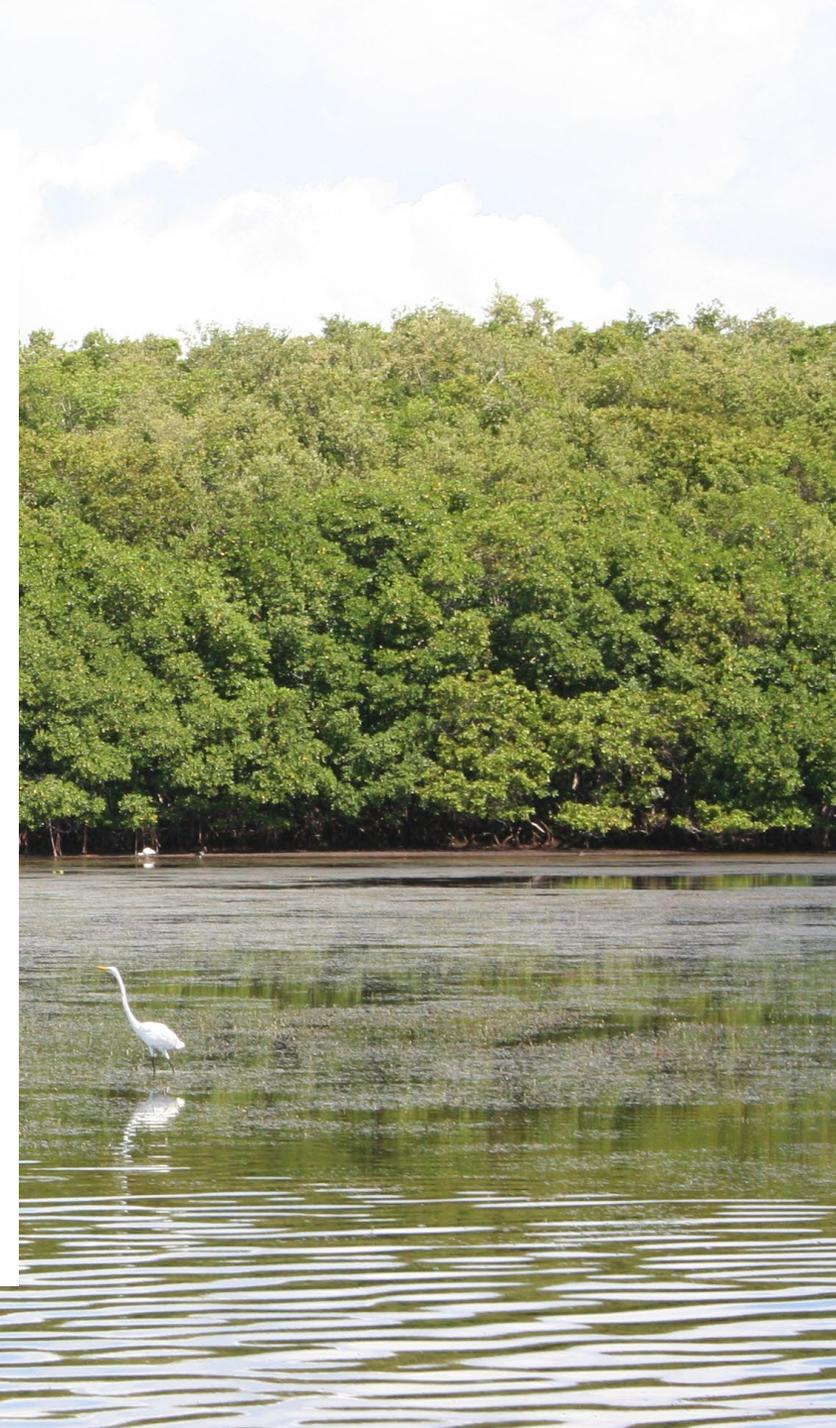
- ✓ Described the past condition
  - Historic maps and reports
  - Analysis of sediment cores
  - Known salinity preferences of species that occurred in the Bay prior to hydrologic alteration (Crocodile habitat, fisheries reports, oysters (Meeder)).

Demonstrated that low salinity oligohaline to mesohaline conditions existed along western shore of Biscayne Bay prior to hydrologic alteration



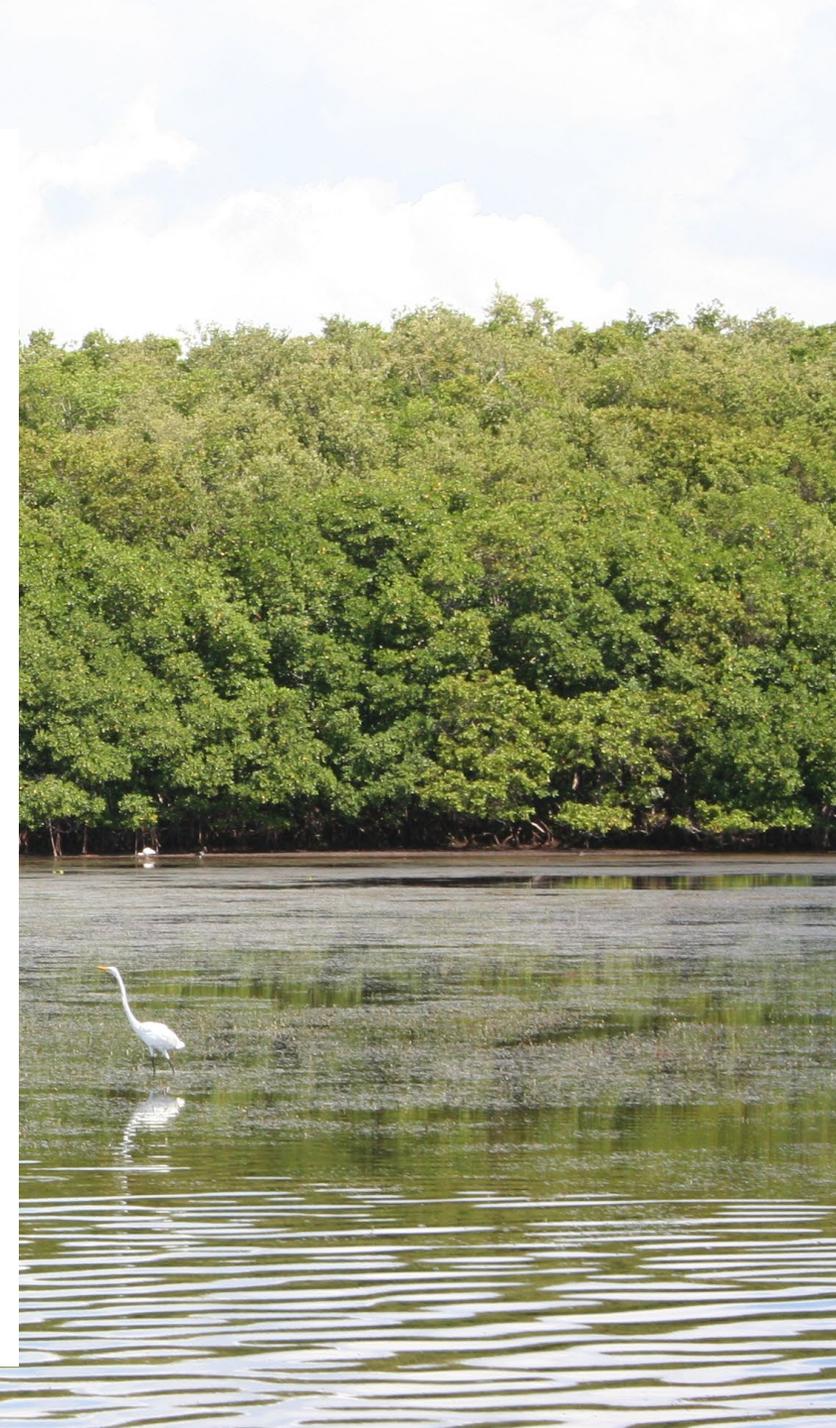
# BBSEER Nearshore Salinity Performance Measure

- ✓ Developed 6 salinity indices
  - Mesohaline index - % observations between 5 and 18 psu
  - Hypersalinity index - % observations >40 psu
  - Salinity variability index - % of days where salinity range >5 psu in single day
  - Mesohaline persistence index – max duration in days of uninterrupted mesohaline conditions
  - Hypersaline persistence index – max duration in days of uninterrupted hypersaline conditions
  - Salinity regime suitability index – combines mesohaline, hypersalinity, and variability indices



# BBSEER Nearshore Salinity Performance Measure

- ✓ Developed habitat suitability indices (HSIs) for suite of representative taxa
  - Sub-aquatic vegetation
    - *Thalassia*
    - *Halodule*
  - Fish & shrimp
    - Goldspotted killifish
    - Gulf pipefish
    - Gray snapper
    - Yellowfin mora
    - *Farfantepenaeus* and *Palaemon* shrimp
  - Juvenile crocodiles



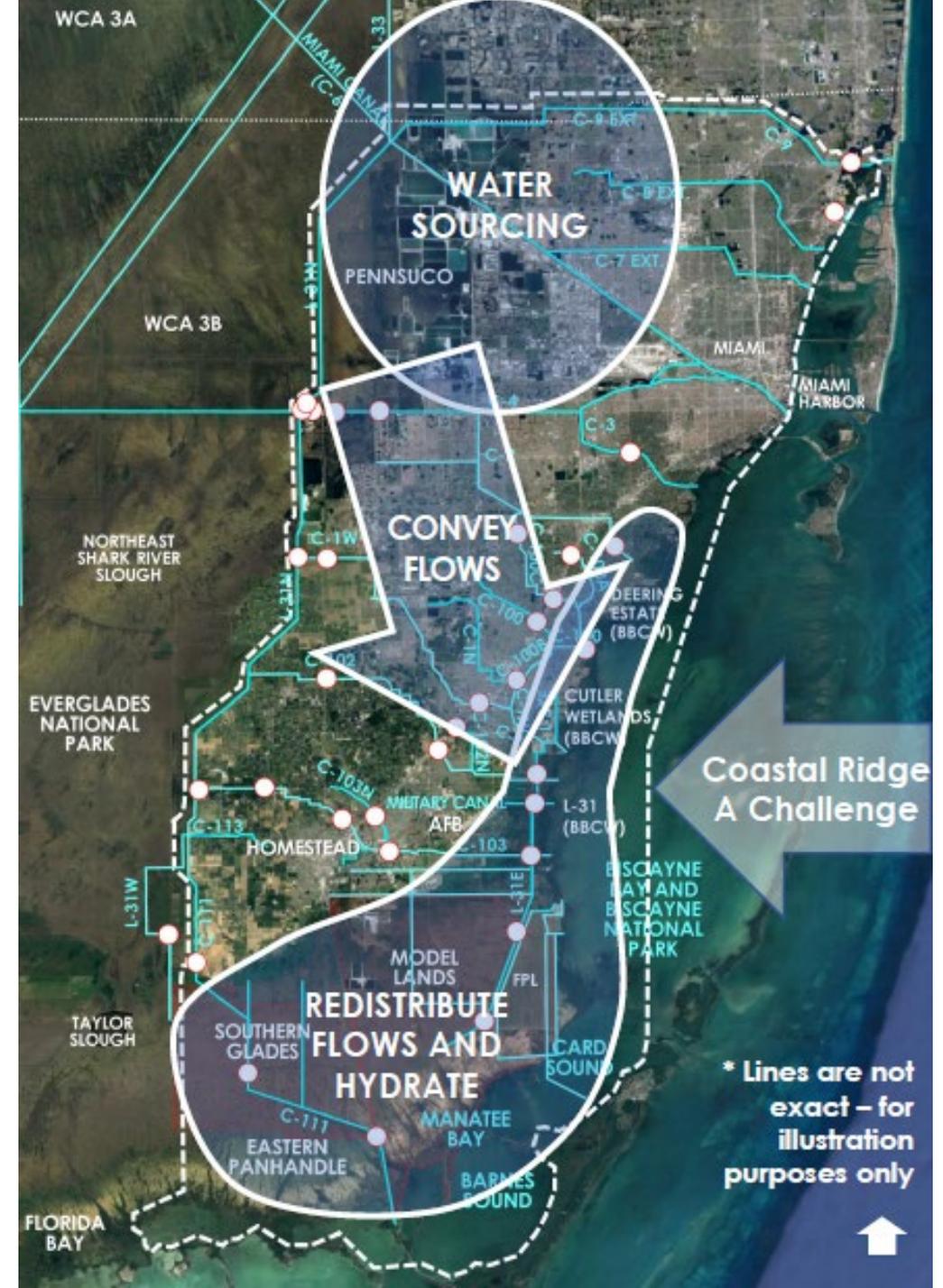
# Where are we now?

Scores from 4 separate PM sub-teams integrated for the nearshore objective:

- Nearshore salinity (our subteam)
- Direct canal releases
- Timing & distribution of flows to Bay

Then consolidated PM scores from 4 BBSEER objectives were used to

- evaluate models and ...
- select alternative that meets all BBSEER objectives for the wetlands and the nearshore area



Long road ahead –  
to implement hydrologic  
changes and then  
monitor those changes  
using the HSI for the  
nearshore zone





Joan & Anna

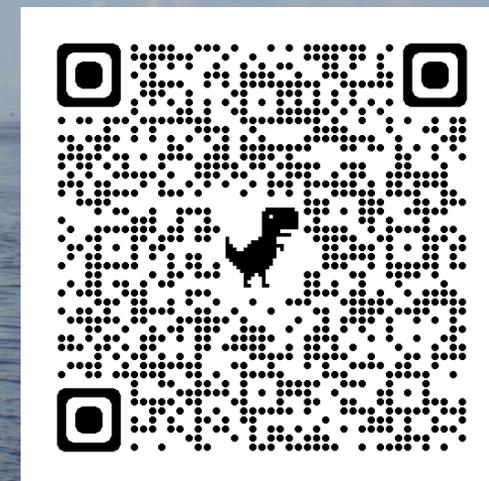
# Acknowledgements

A very special thank you to Joan who has been an inspiration to many scientists and a role model for the women who have followed her.



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Biscayne National Park for access to sites (BNP Study #02027)



For more information:

[usgs.gov/centers/fbgc/science/paleoclimate-and-paleoecology](https://usgs.gov/centers/fbgc/science/paleoclimate-and-paleoecology)

