# Relevance of historical data for managing west Florida's oyster habitats in a changing world


Greg Herbert
School of Geosciences
University of South Florida


OIMMP
OYSTER INTEGRATED MAPPING AND MONITORING PROGRAM

Historical reference baselines (where reefs were)

Characteristics that contribute to resilience (how reefs work)

**Backward-looking Traditional**

**DEFINING RESTORATION GOALS**

**Forward-looking**

Gedan et al. (2014)

Oyster reefs “notoriously” collapse rather than fade (Johnson et al., 2022)

Once reefs collapse, they resist restoration (Pine et al., 2023)


Reef balls | Mesh bags | Loose shell

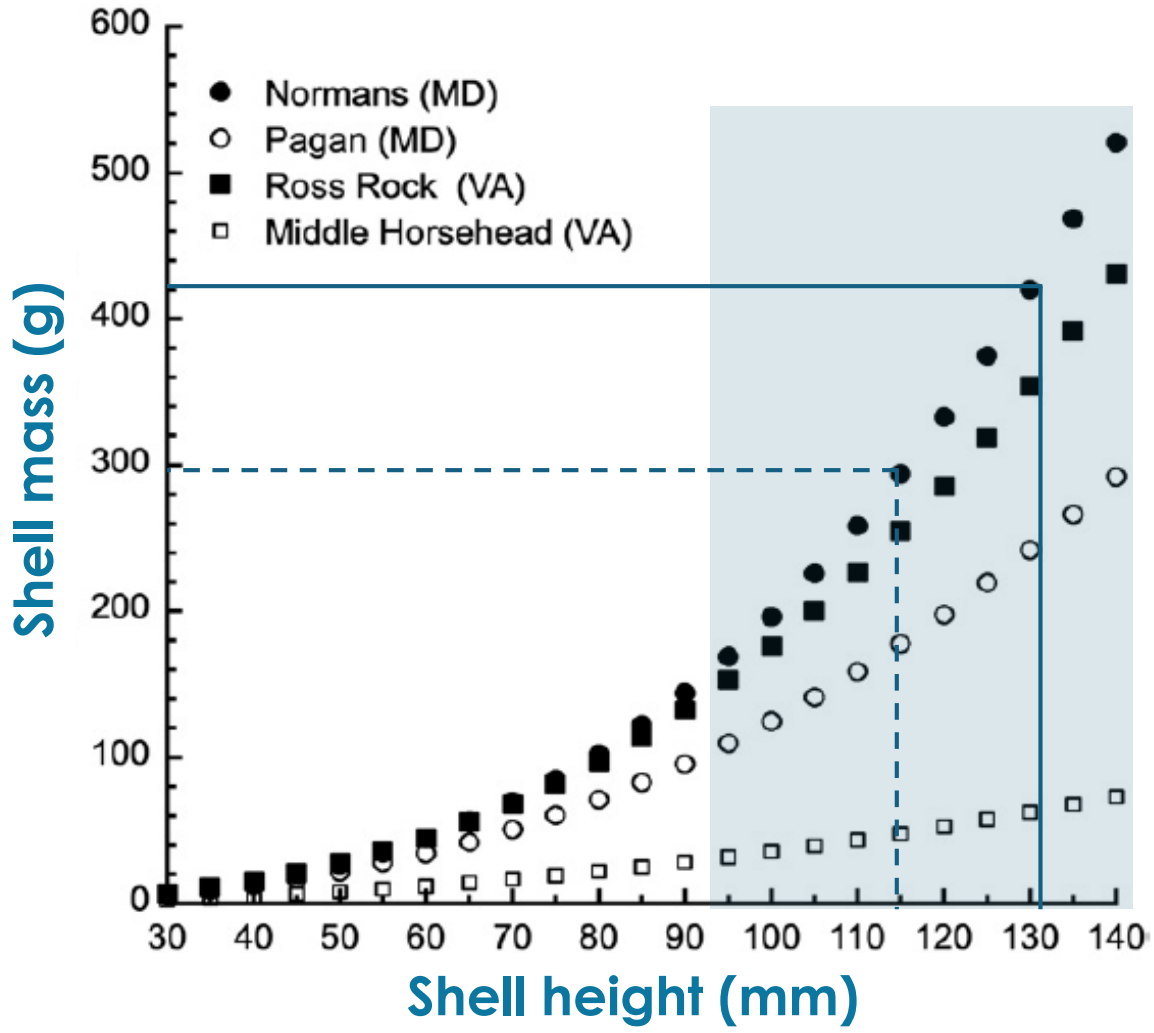
## Flawed restoration designs?

**Reef ‘systems’ trapped in a persistent collapsed state?**

# Reef persistence depends on shell budget

- Shell production on top balances shell loss below
- Both production and loss parameters are affected by SHELL MASS PER OYSTER
- Shell mass per oyster affected by
  - LONGEVITY (shell height)
  - SALINITY REGIME (shell thickness)
- Shell mass trap now acts regardless of initial cause

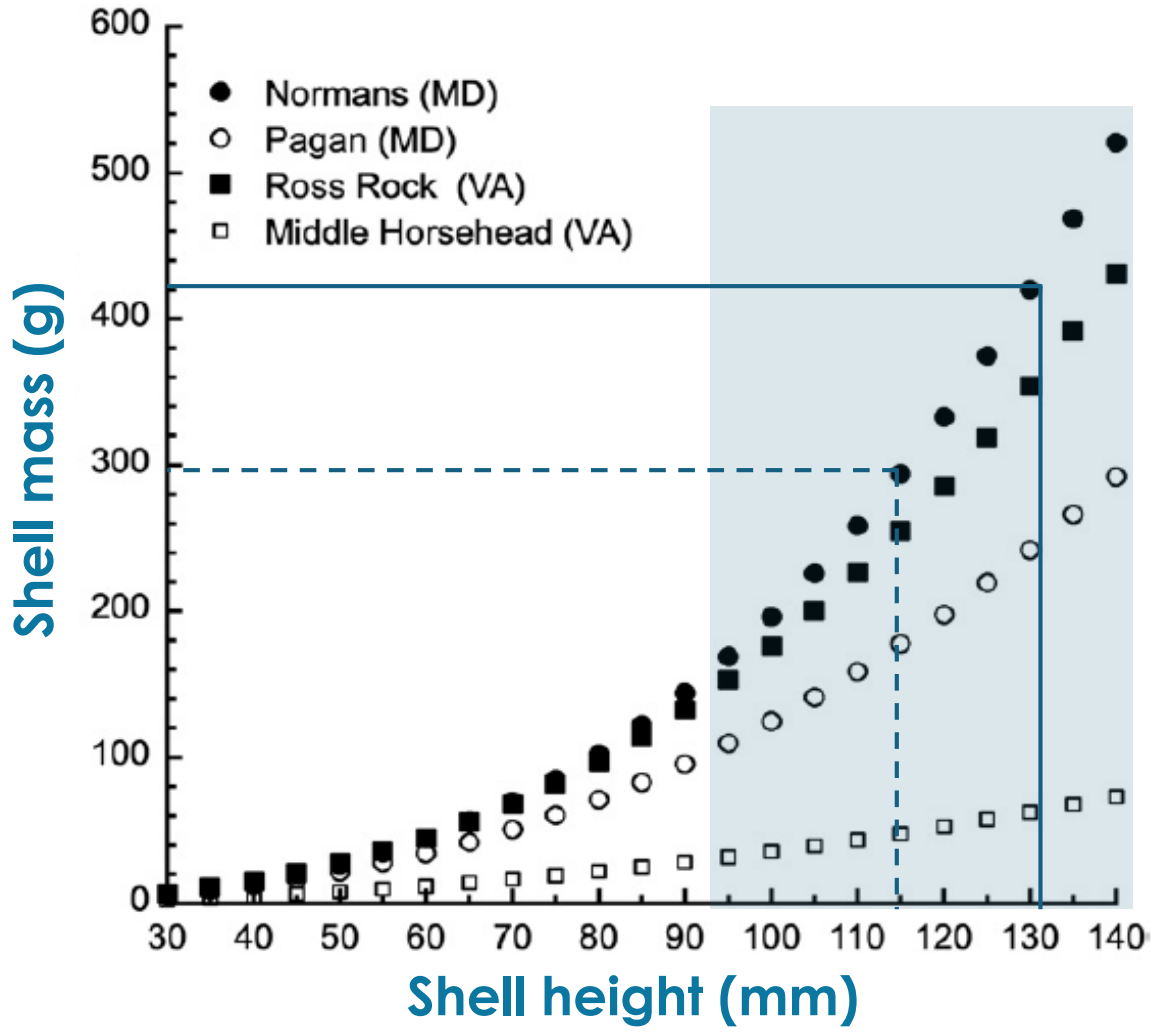
# SHELL MASS AFFECTED BY LONGEVITY




- **Small decreases in shell height result in disproportionate decreases in shell mass**

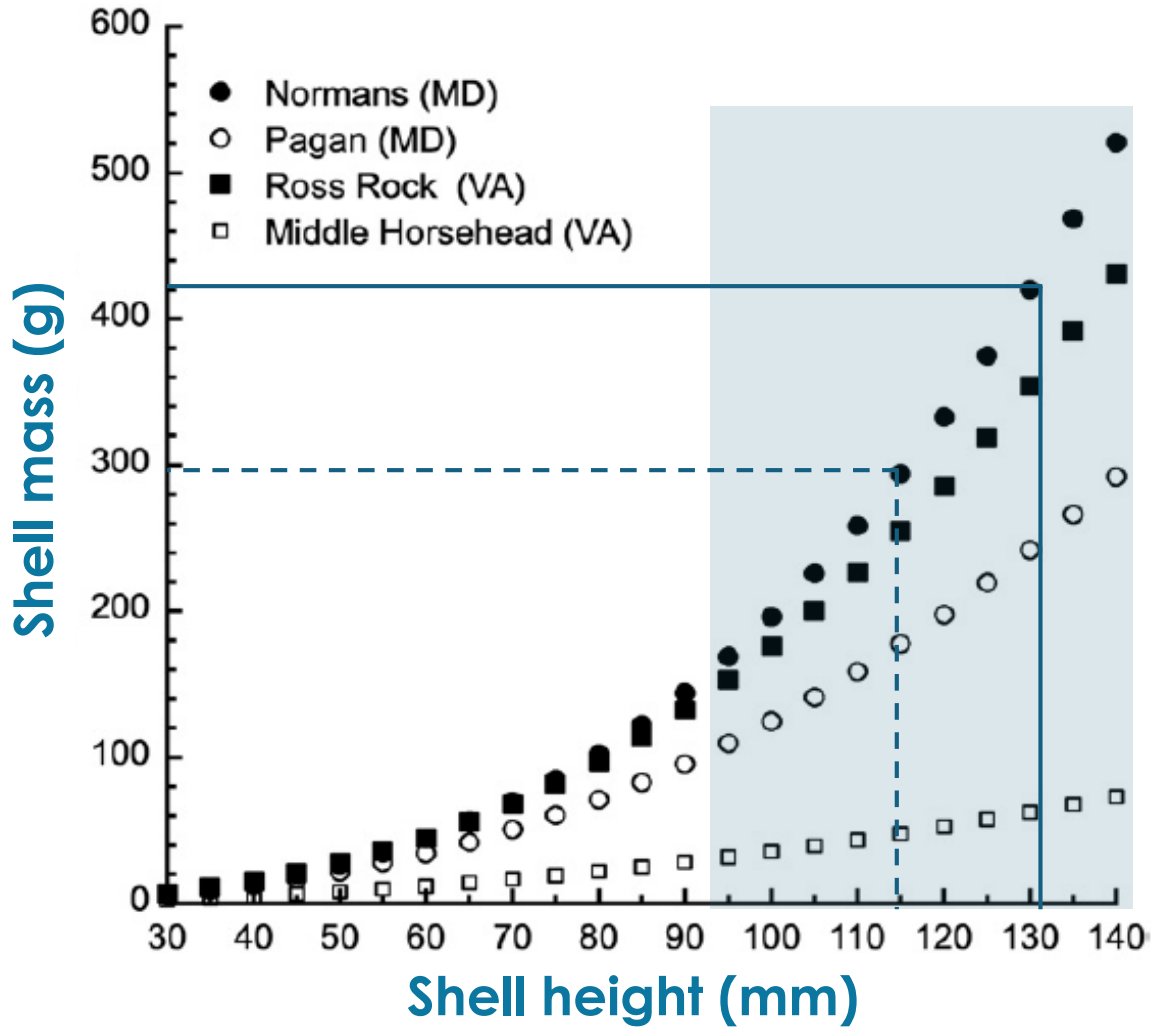
Mann et al. (2022)

# SHELL MASS AFFECTED BY LONGEVITY




- Small decreases in shell height result in disproportionate decreases in shell mass
- Potentially also decreased proportion of females and lifetime fecundity

# SHELL MASS AFFECTED BY LONGEVITY




- Small decreases in shell height result in disproportionate decreases in shell mass
- Potentially also decreases proportion of females and lifetime fecundity
- Shell loss should decrease if more shell sequestered in older, <u>living</u> oysters


6” max



2-3” mean

# Tampa Bay size decline







6” max

2-3” mean

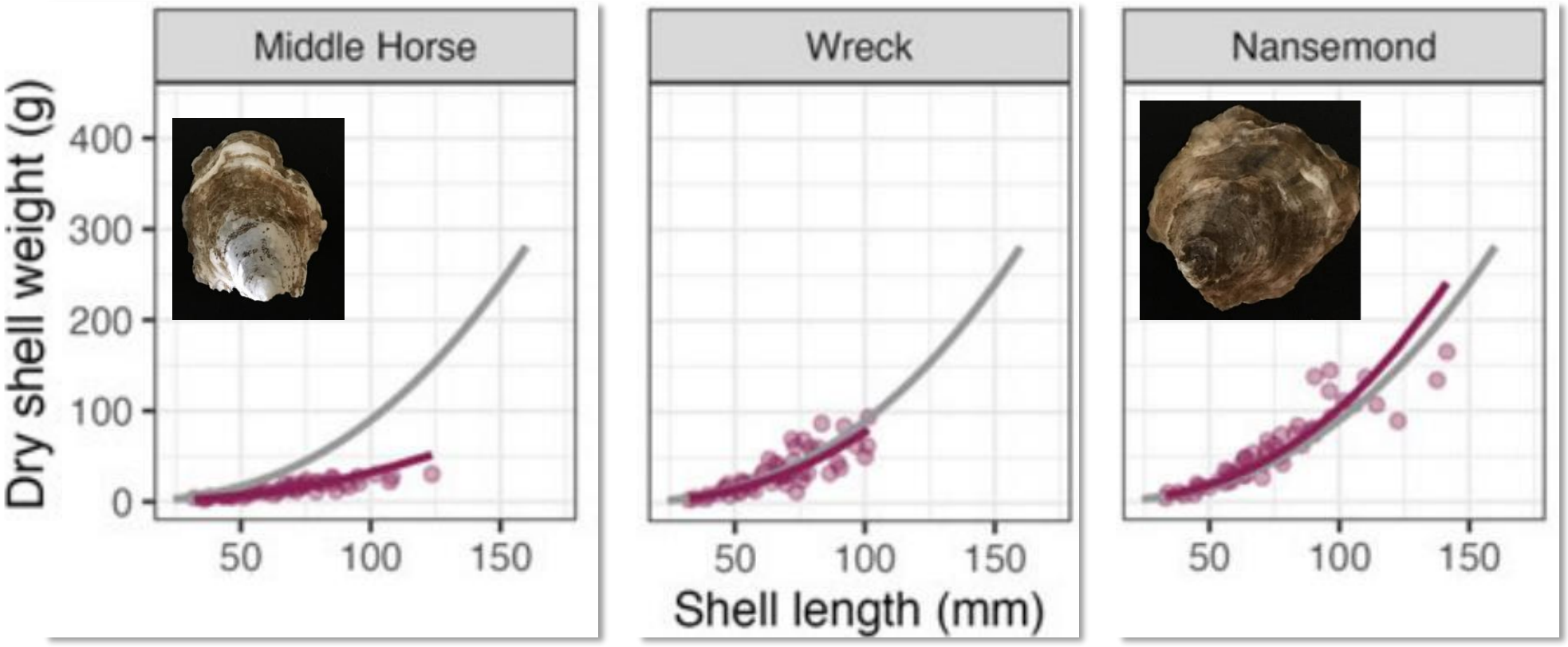
Safety Harbor Mound 11”

# Tampa Bay size decline

## Shell mass (shell budget) also affected by salinity regime

- **Oysters clustered near freshwater inputs (refugia from enemies)**
- **Drawbacks of low salinity conditions for oysters:**
  - Low $Ca^{2+}$ and $CO_3^{2-}$ ion availability, low pH
  - Shell growth is energetically costlier, slower, more prone to dissolution

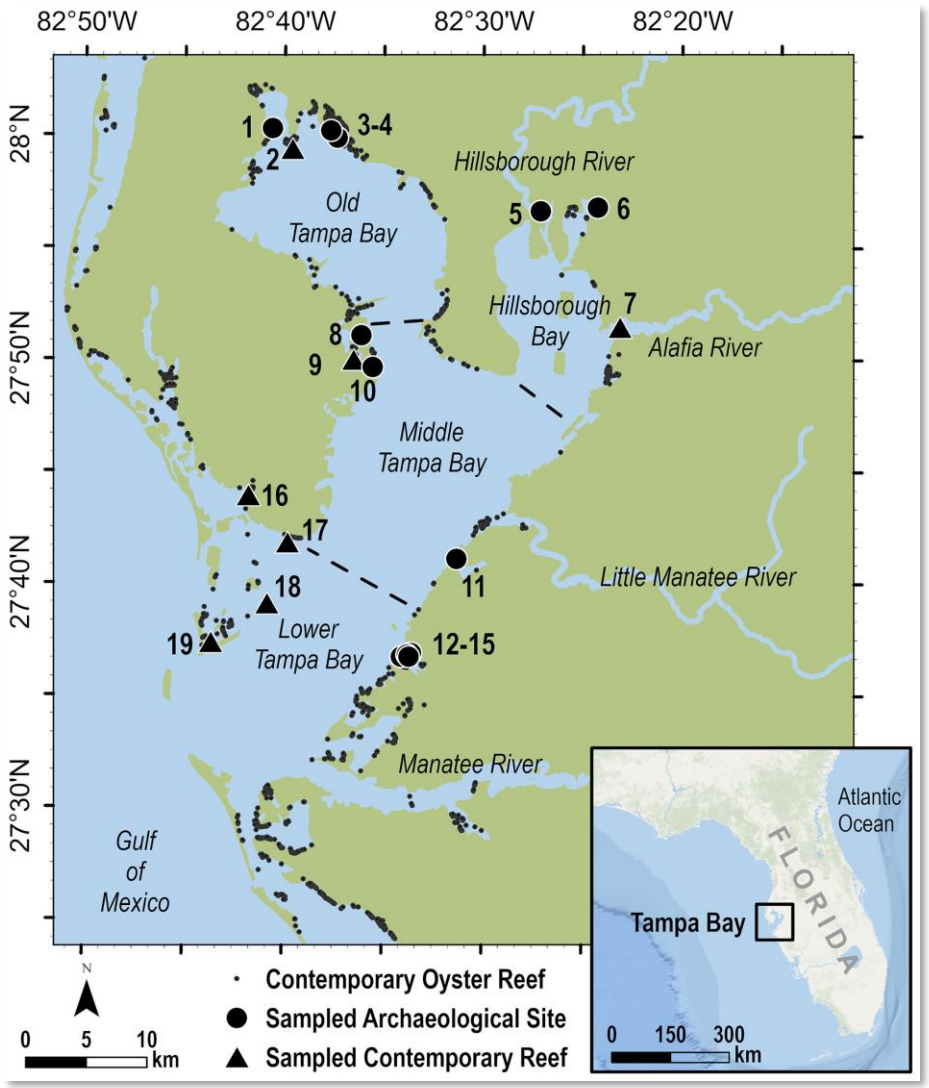
# Oysters grow slowly and produce thin, fragile shells at low salinities (Marquardt et al., 2024)

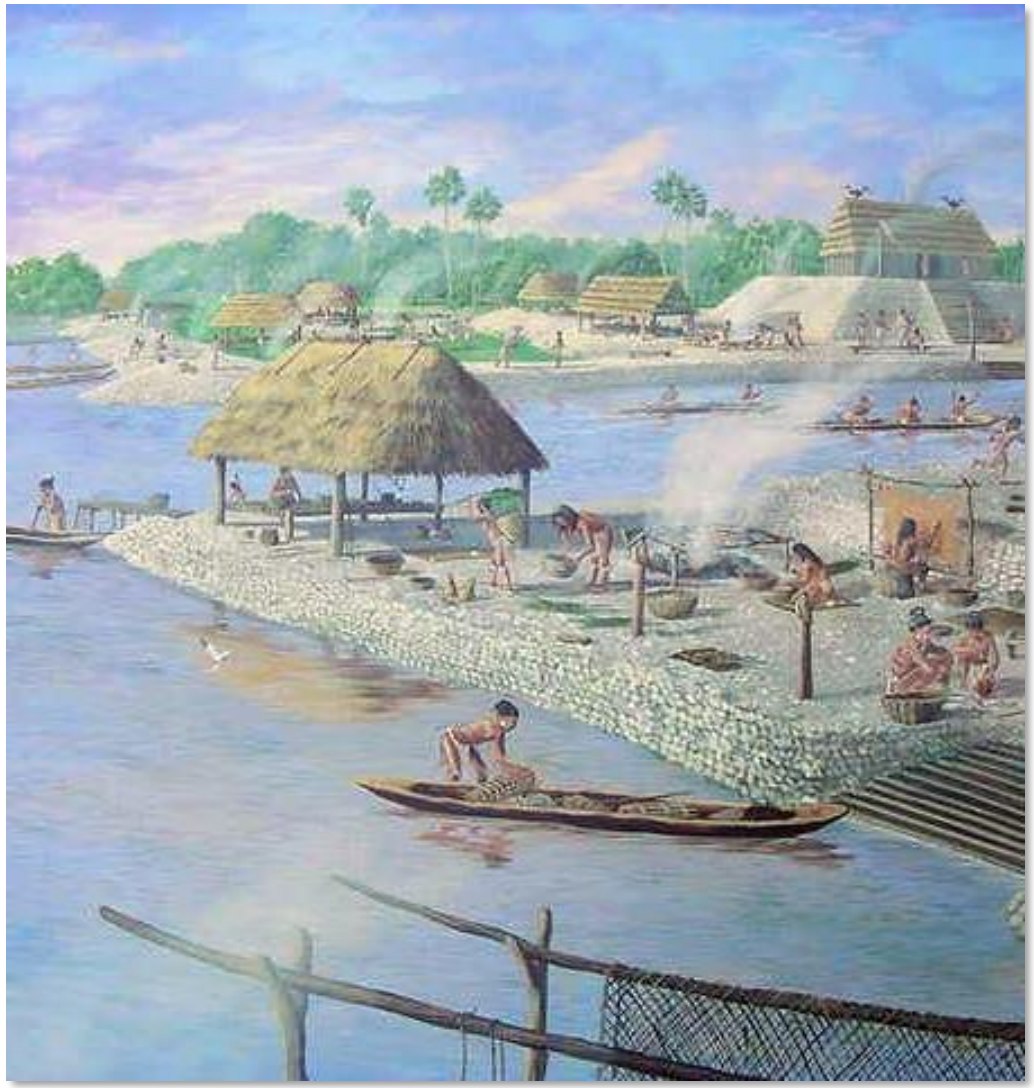



**Lower salinity**
**Lower shell mass per size**

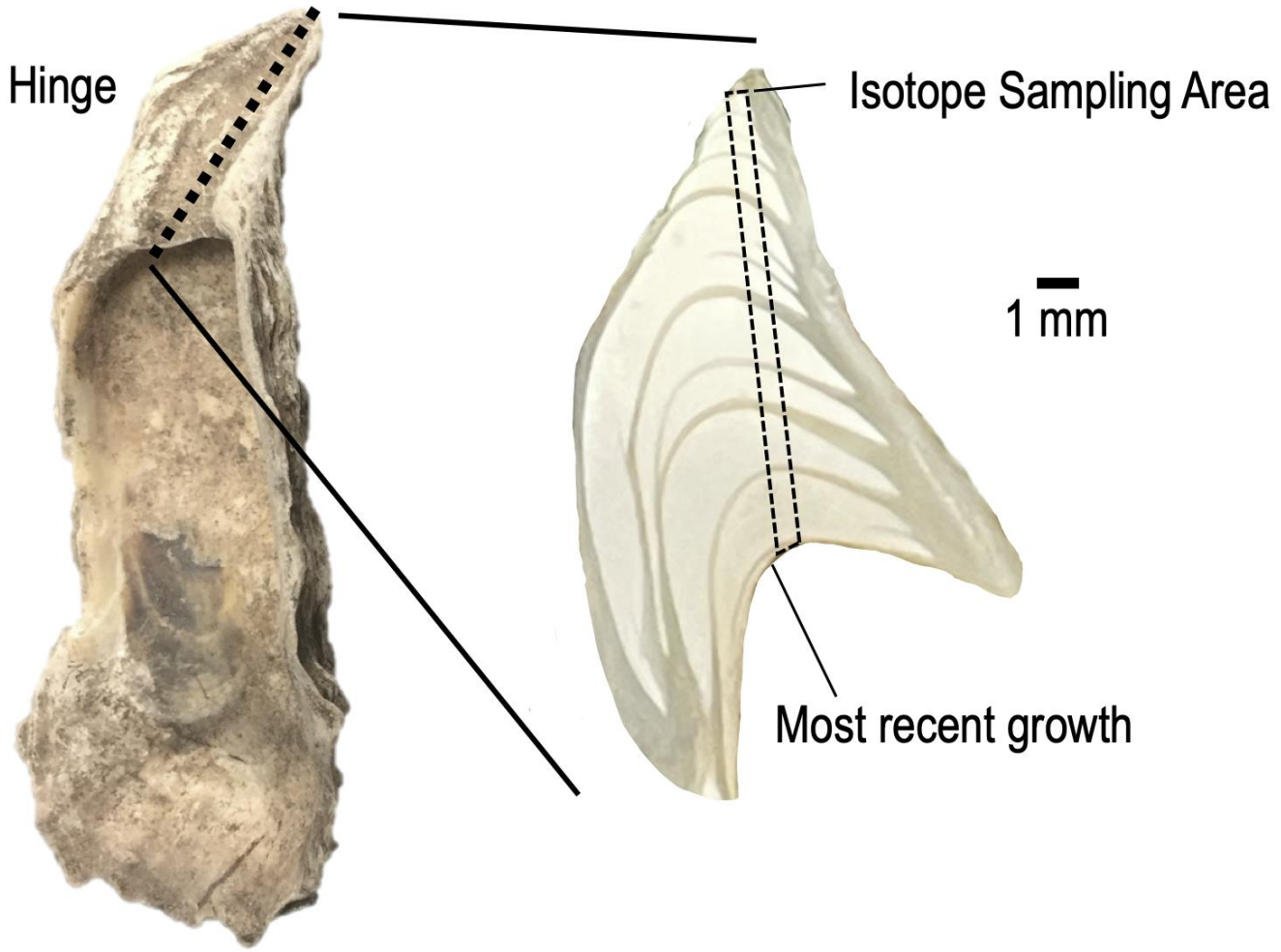
**Higher salinity**
**Higher shell mass per size**

# What was the long-term salinity regime of Tampa Bay oysters?



# Oyster shells “record” salinity variation in their carbon and oxygen isotope geochemistry as they grow



# Oyster shells “record” salinity variation in their carbon and oxygen isotope geochemistry as they grow

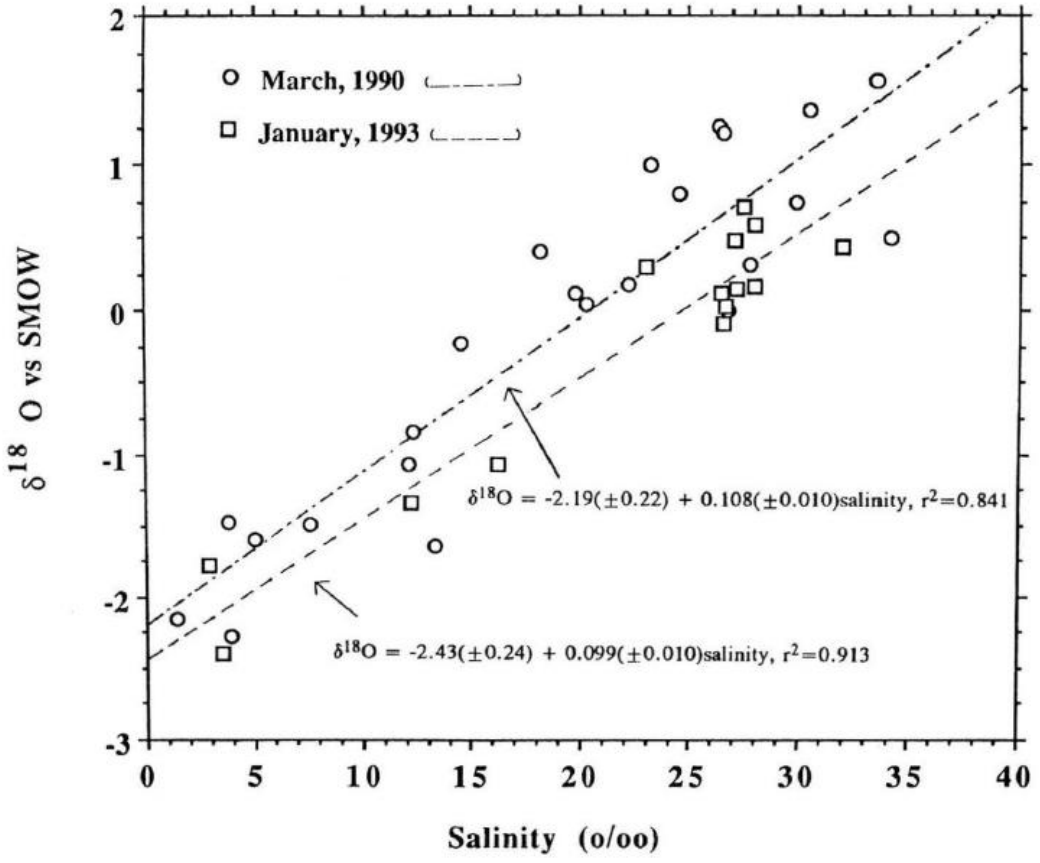



Figure 13a. Linear Correlation between Salinity and $\delta^{18}O$ in Tampa Bay, Florida

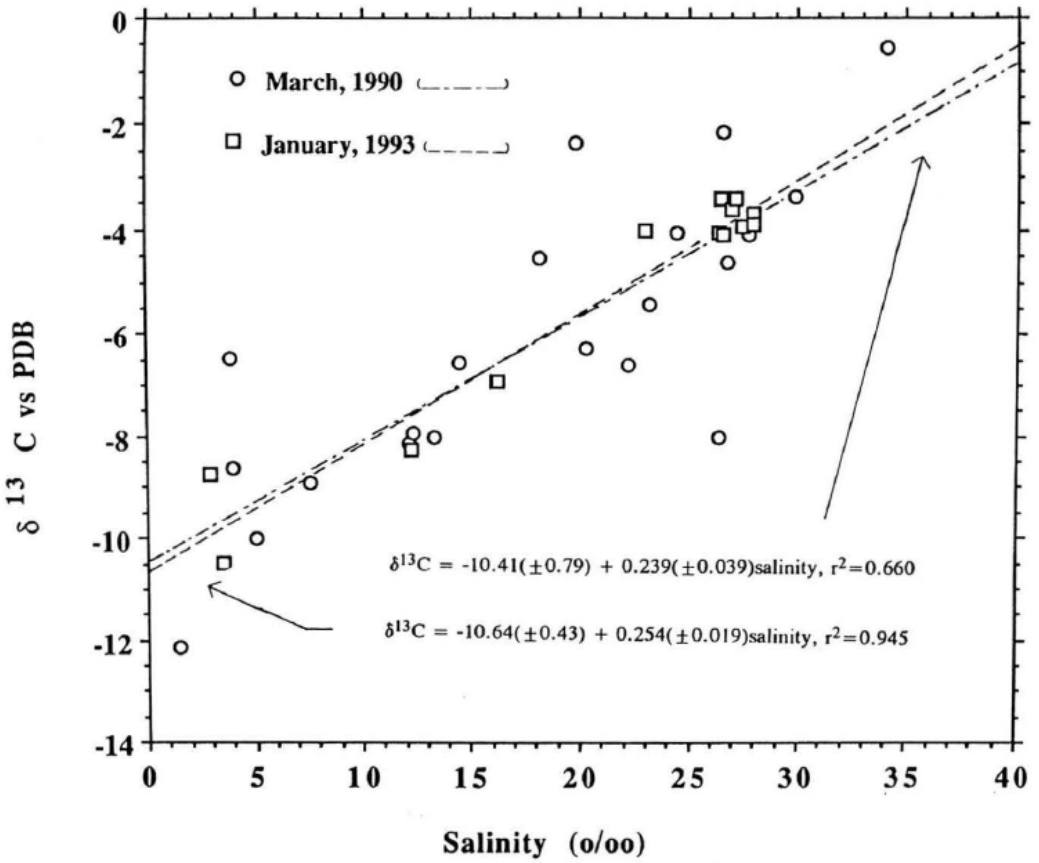
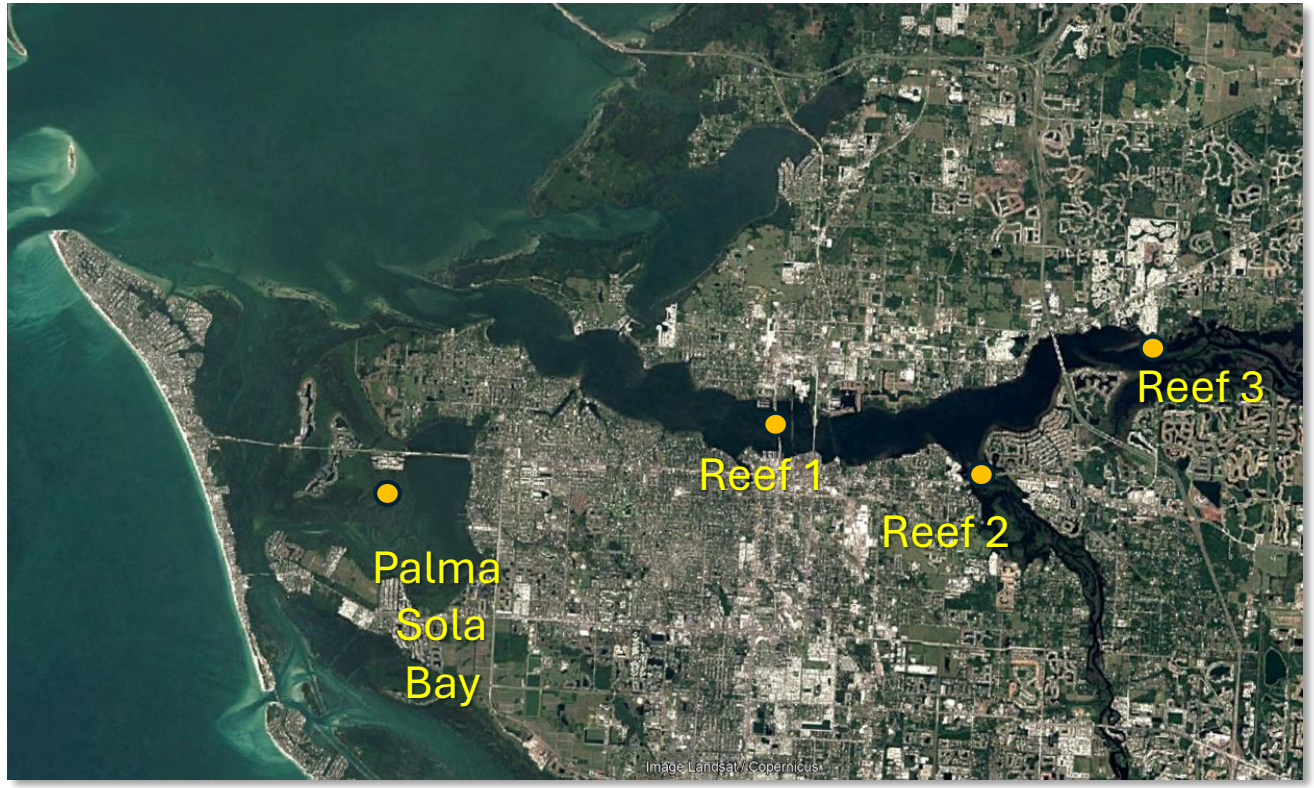
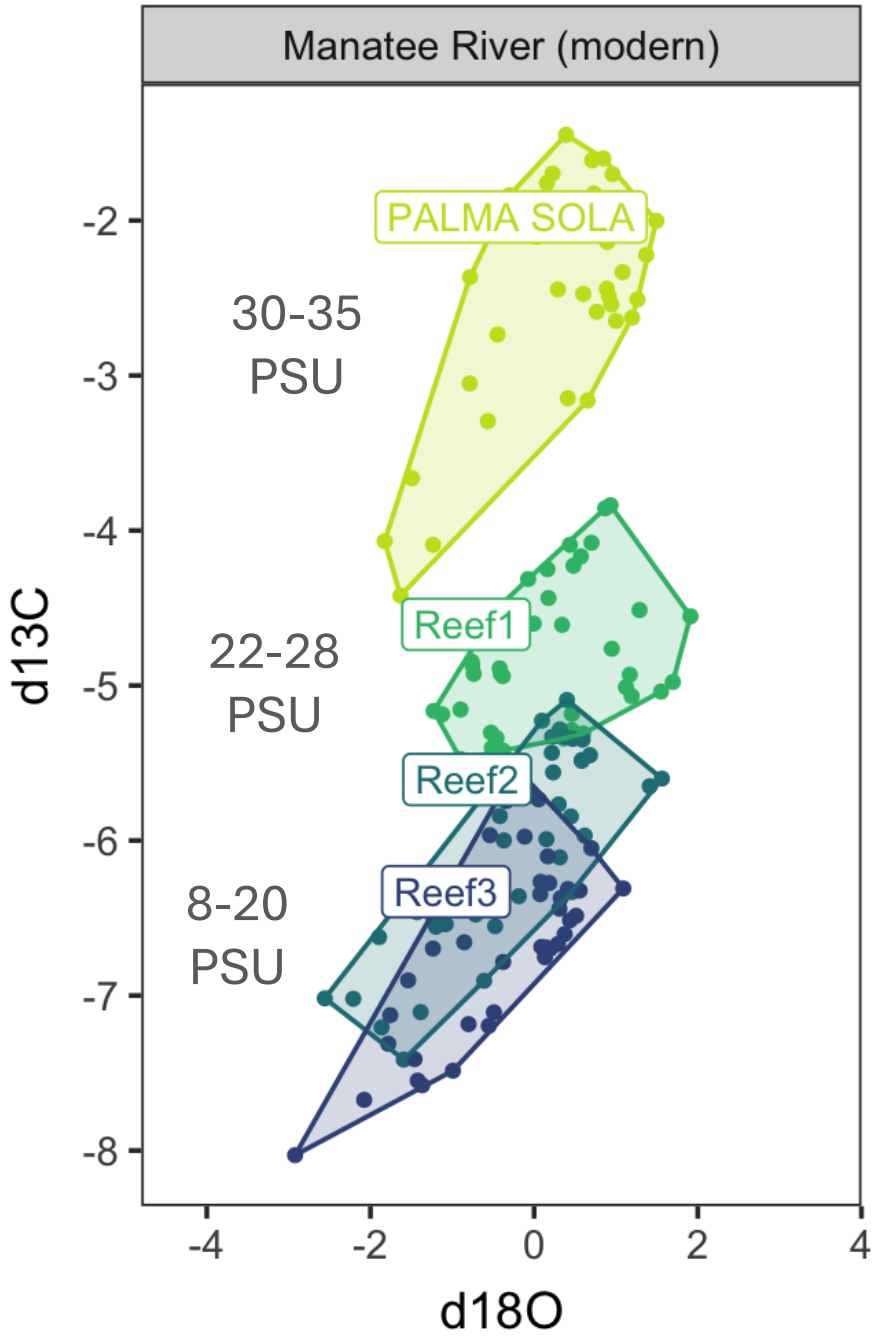



Figure 13b. Linear Correlation between Salinity and $\delta^{13}C$ in Tampa Bay, Florida

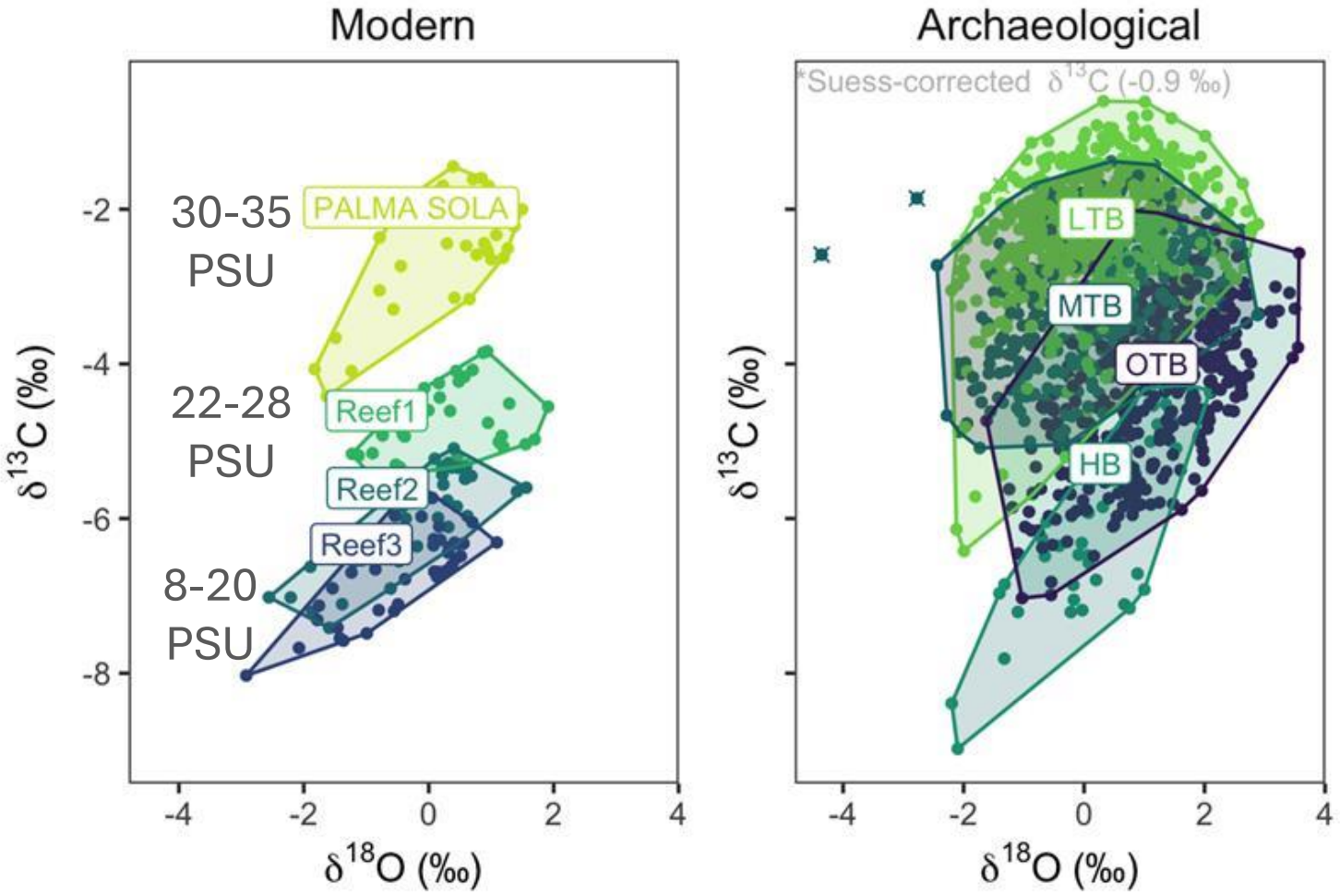
*Netratanawong (1995)*

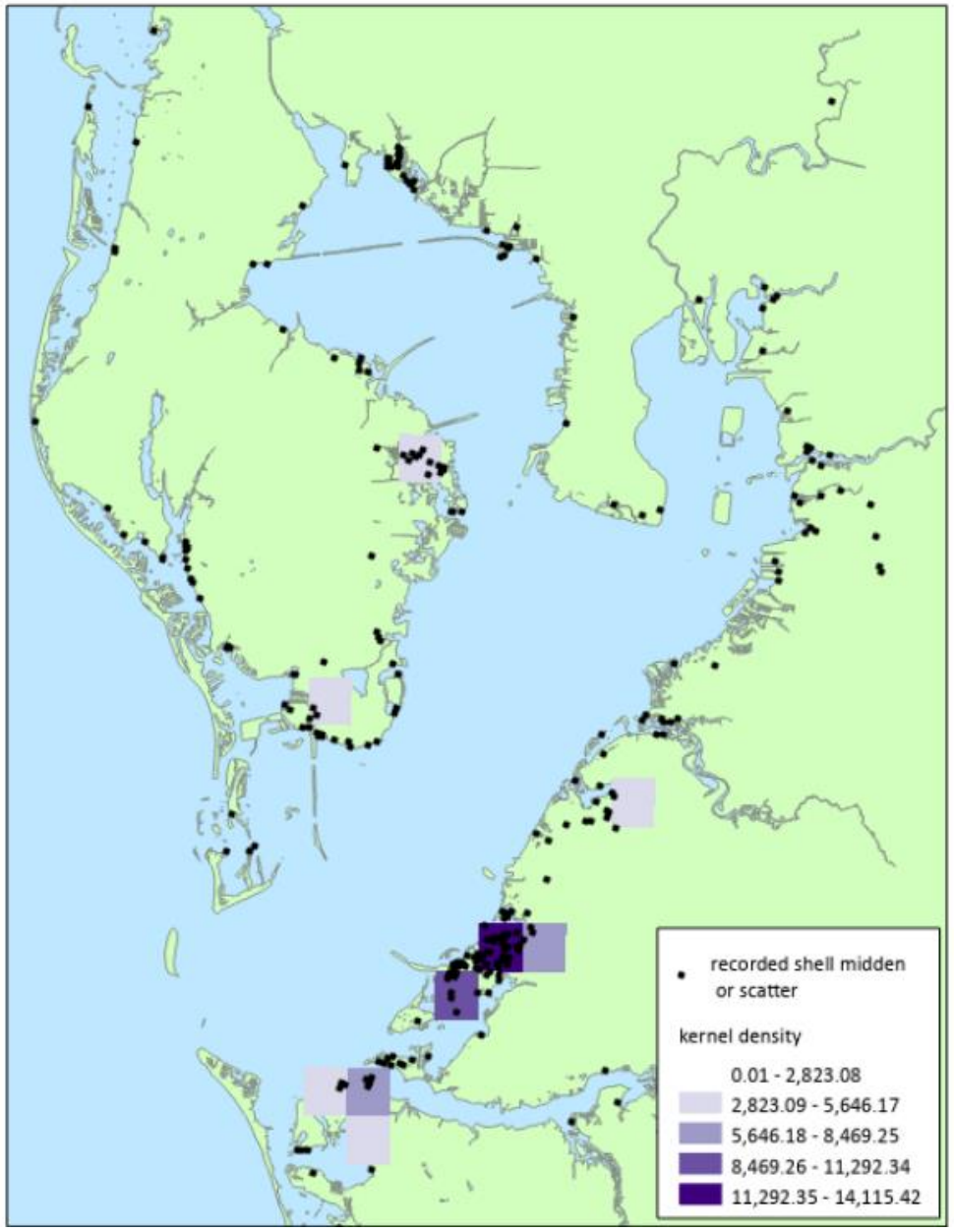
# Carbon isotope ratios in modern oyster shells reflect dissolved inorganic carbon sources along freshwater-marine gradient



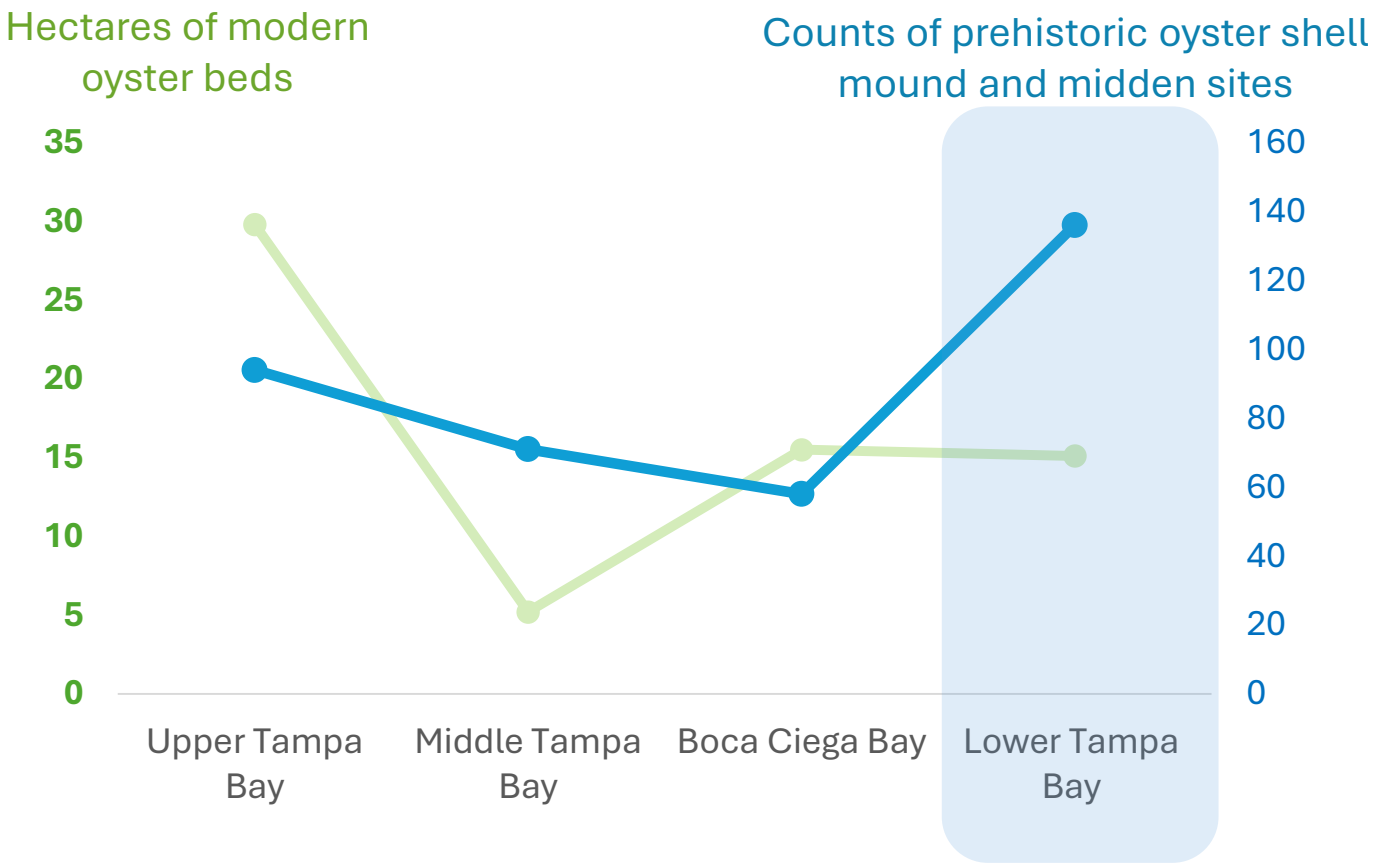



**Archaeological oysters were collected from a wide range of salinities. There were HIGH salinity reefs in the open bay for thousands of years.**

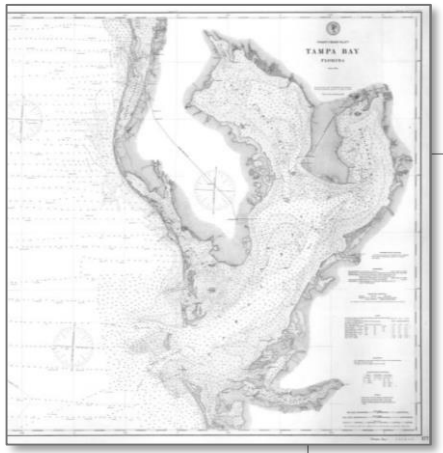





# High salinity reefs were not only present but the **most common pre-1900s reef habitat in TB**



# No sign of extensive fringing reefs from 1920s t-sheets for Tampa Bay

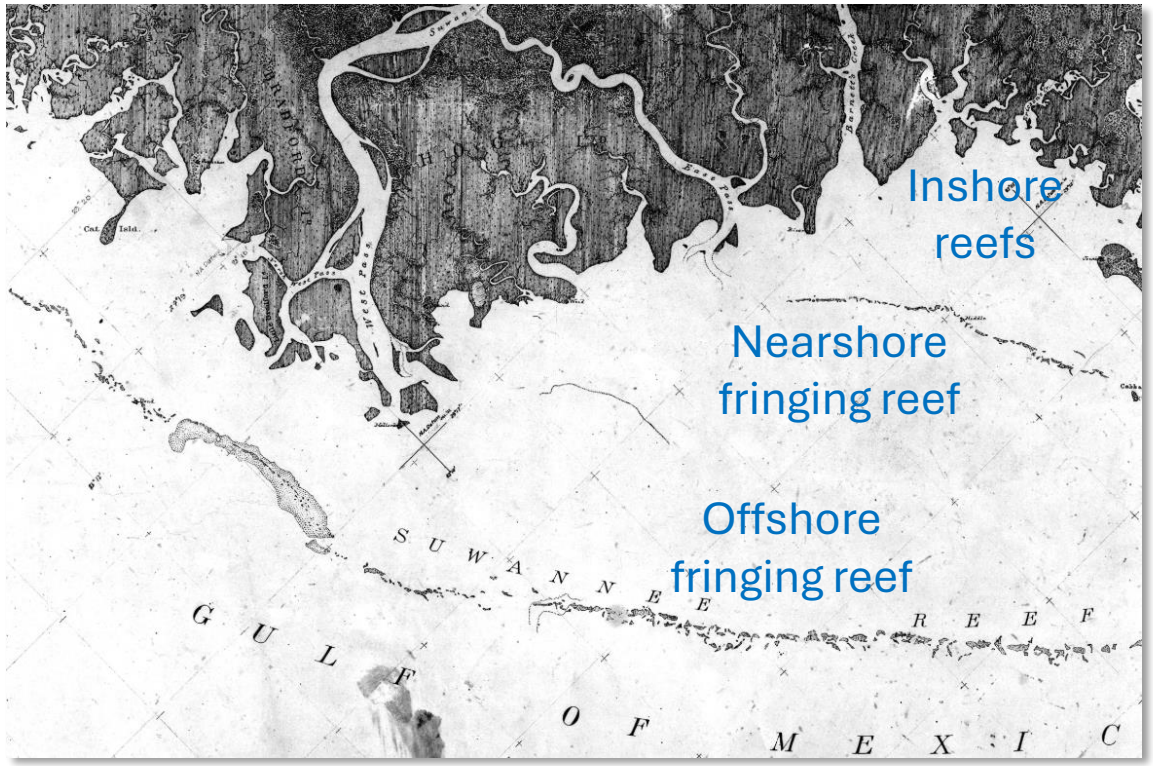


**Tampa Bay Oyster Bar Mapping and Assessment**

**Final Report to Tampa Bay Estuary Program**

**Submitted by:**
**Kathleen O'Keife, William Arnold, David Reed**

**Florida Fish and Wildlife Conservation Commission**
**Fish & Wildlife Research Institute**
**February 14, 2006**




https://geodesy.noaa.gov/pub/Shoreline/T-Sheet%20Raster%20Images/T01426B.jpg

# Removal by harvest/mining

**1793 Letter from Spanish W FL governor Folch**
Entrance to Manatee River and Sarasota Bay blocked by oysters

**Manatee River Journal (1901)**
"dozens of oyster boats came winter after winter from Tampa and St. Petersburg, and carried away almost everything except the water and the sandy bottom . . . there is nothing left for spawn to cling to"

Dead shell deposits but also live reefs were removed by industrial-scale mining from late 1800s through 1970s

# RECAP

- Long lifespans, large size favored by selection for thousands of years to keep with sea level rise and local shell loss rates and *may be a precondition for sustainable shell budgets*

- Oysters thrived in open Lower Tampa Bay, imply former extensive reef chains that impounded freshwater as in Big Bend