

# BENTHIC FORAMINIFERAL ASSEMBLAGES IN BISCAYNE BAY

Implications of Natural and  
Anthropogenic Change in South  
Florida Marine and Marine-Margin  
Ecosystems

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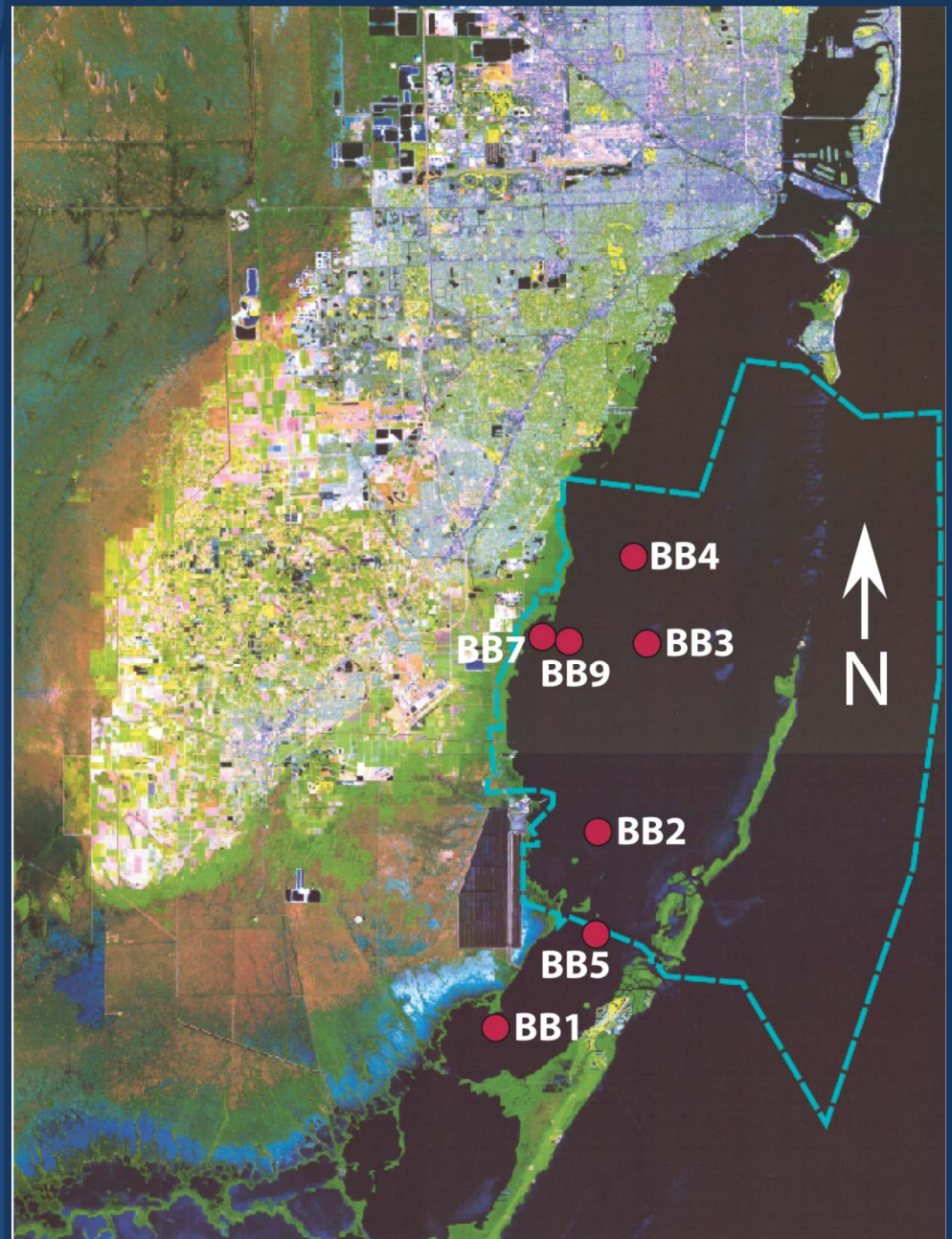
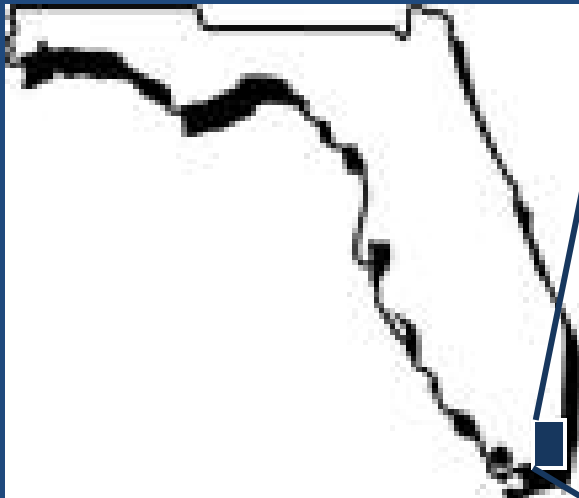
# Acknowledgements

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- ▣ The United States Geological Survey
- ▣ South Florida Water Management District
- ▣ Biscayne National Park

# Purpose and Data

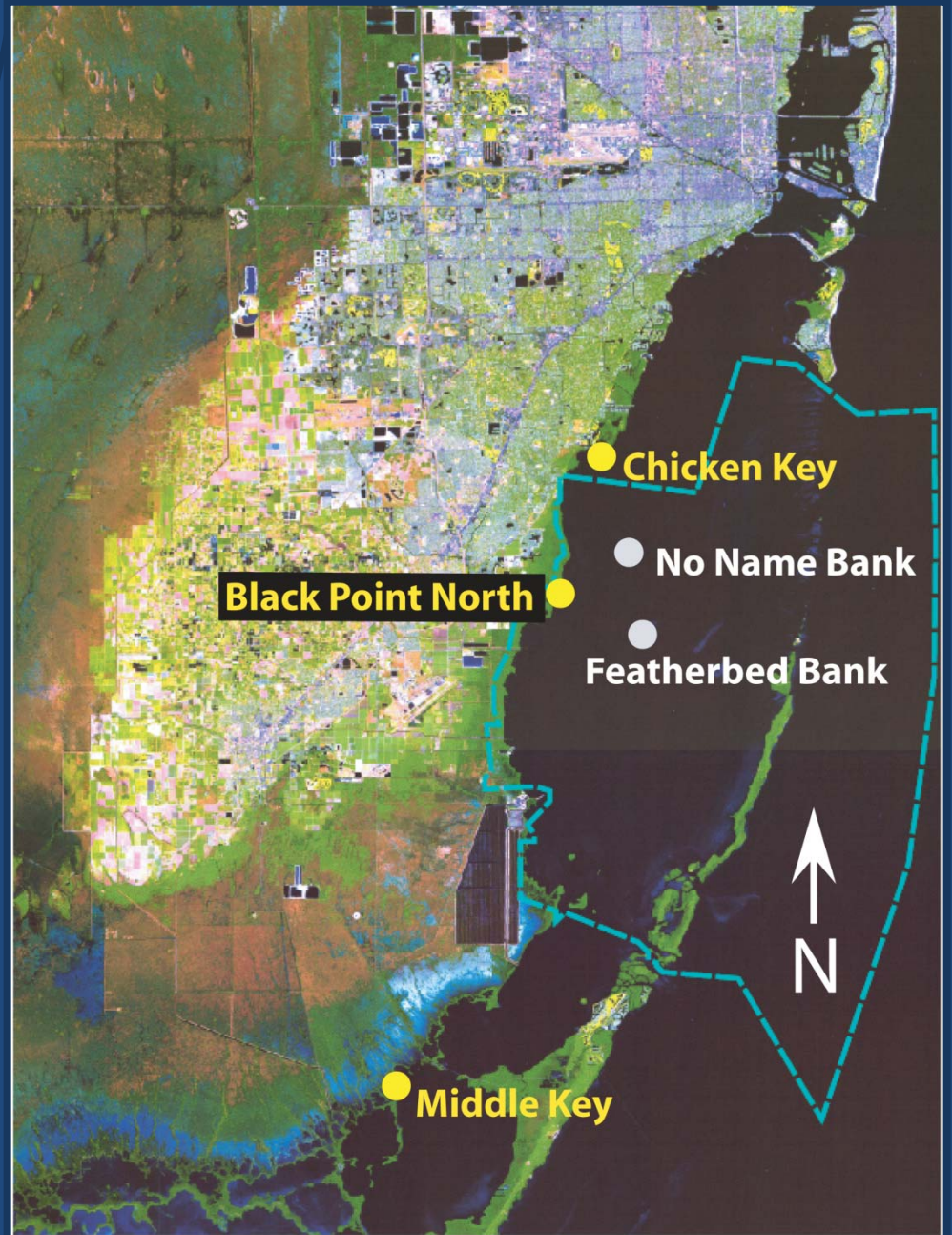
- ▣ Identify natural and anthropogenic changes to the marine environments of Biscayne Bay in recent history
- ▣ Provide information about past environmental conditions and thus restoration goals
- ▣ Benthic foraminifera are excellent indicators of environmental conditions and therefore of ecosystem changes
- ▣ Seven modern sites and five core sites and statistical analyses of the assemblage data

# Modern Sample Locations



● Modern Samples

# Core Sample Locations



● 2002 mid-bay cores

● 2003 near-shore cores

# Comparison of Samples

## MODERN SAMPLES

### Near-shore samples

BB7 and BB9 experienced fluctuating mesohaline and polyhaline halinities

### Mid-bay samples

BB1, BB2, BB3, BB4 and BB5 had relatively stable euhaline conditions

## CORE SAMPLES

### **Near-shore cores**

**Chicken Key, Black Point North**

and **Middle Key** hypothesized to be most like modern sites BB7 and BB9

### Mid-bay cores

**No Name Bank and Featherbed Bank** hypothesized to be most like modern sites BB1-BB5

# Preliminary Data

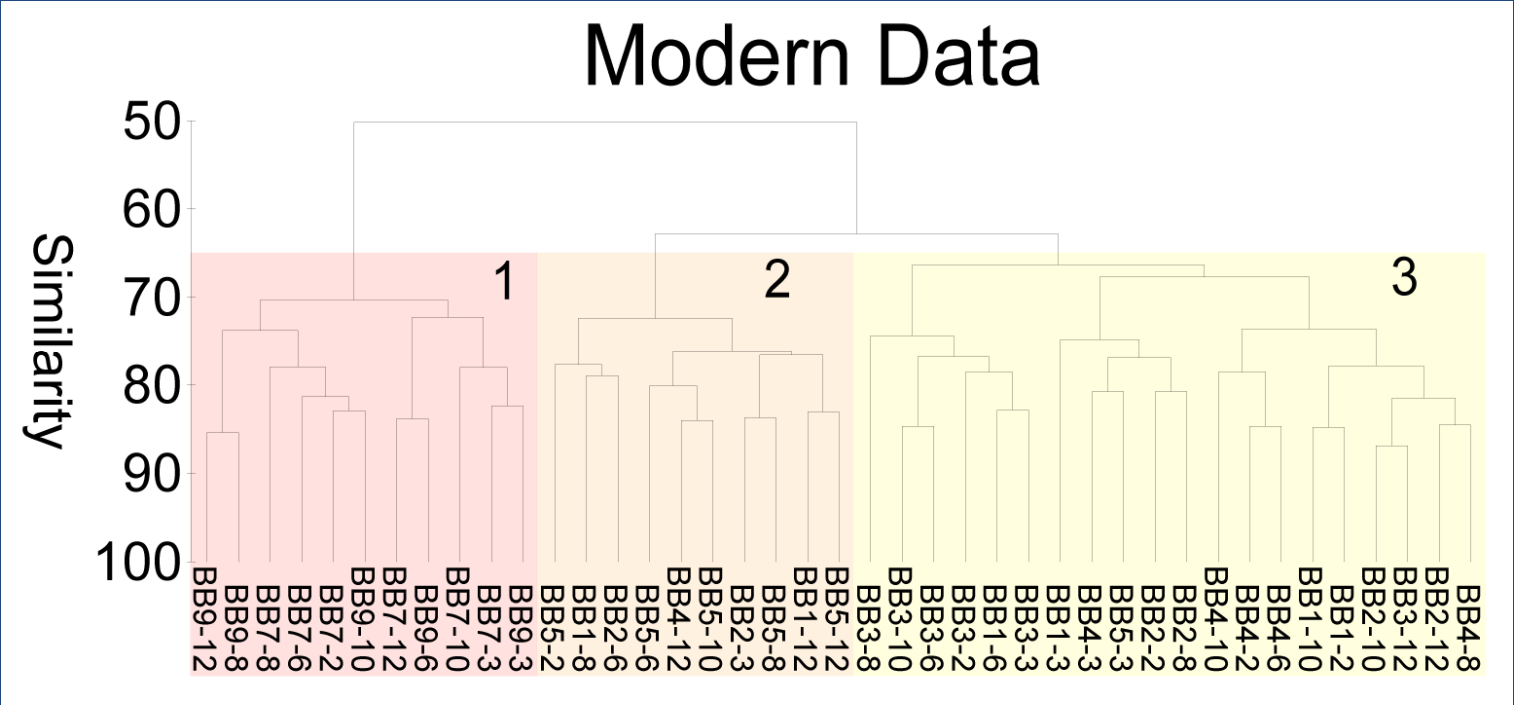
- ▣ Preliminary data on benthic foraminifera for this study were first published in United States Geological Survey Open File Reports 03-375 and 2004-1312 of Wingard et al.
- ▣  $^{210}\text{Pb}$  geochronology data for the cores are from these reports and United States Geological Survey OFR 2007-1203 of Wingard et al.

# Modern Data

- ▣ 41 samples collected from 7 sites
- ▣ A minimum of 300 specimens collected from each sample
- ▣ Data compiled in a spreadsheet of species related to individual samples
- ▣ Data were reduced to remove rare occurrences of taxa, analyzed via Bray-Curtis similarity for the hierarchical cluster analyses and processed in the Non-Metric Multidimensional Scaling (MDS) algorithm

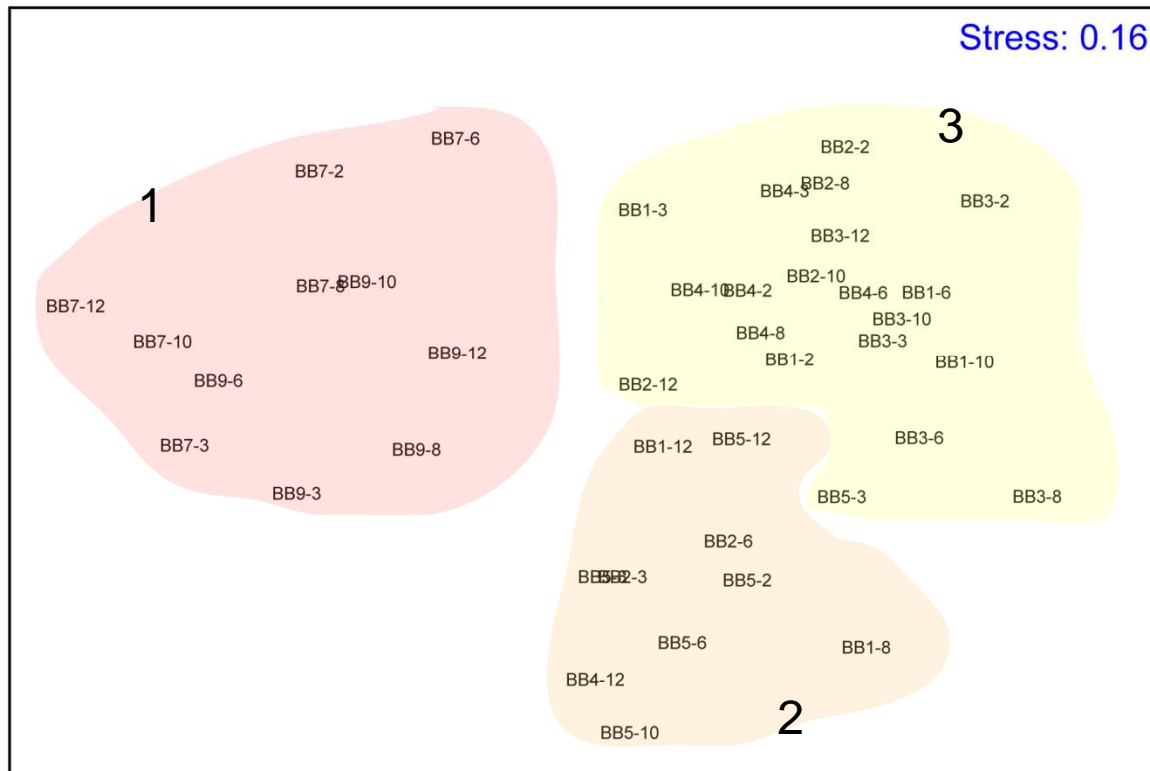


# Modern Hierarchical Cluster



# Modern MDS Plot

Modern Data



# Modern Data Discussion

- ▣ Group 1 clearly divides from Groups 2 and 3 at 65% similarity
- ▣ Group 1 includes the brackish, near-shore modern samples
- ▣ Groups 2 and 3 are divisible at 65% similarity: Group 2 has many samples from a hard ground dominant site and Group 3 is mostly soft sediment bottom sites
- ▣ Groups 2 and 3 are both euhaline

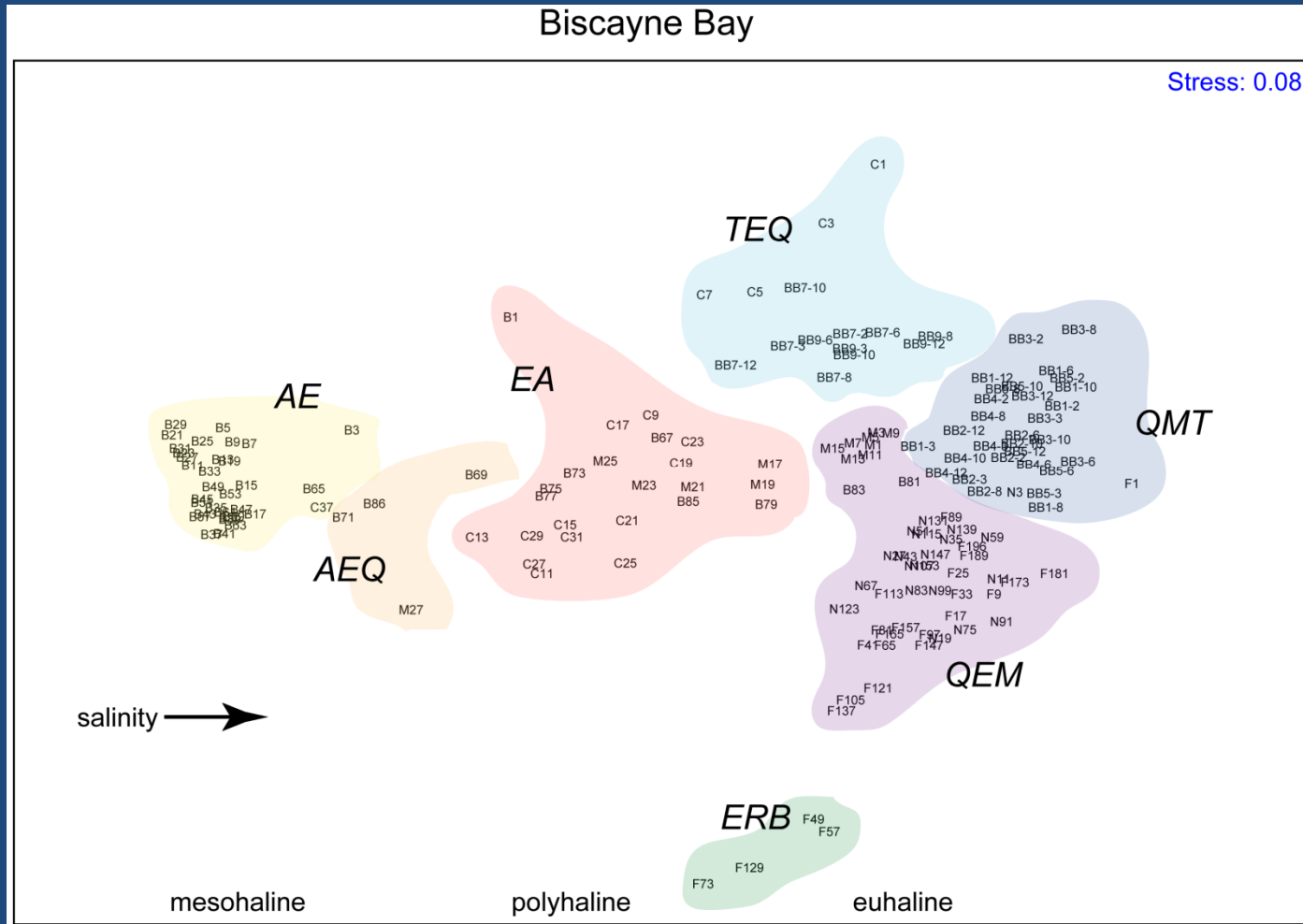
# General Trends

- ▣ Mesohaline sites have dominant occurrences of the taxa *Ammonia* and *Elphidium* that decrease as salinity increases
- ▣ Euhaline sites have higher abundance of the taxa *Miliolinella*, *Quinqueloculina* and *Triloculina* with rare occurrences of *Ammonia* and *Elphidium*
- ▣ Polyhaline sites have taxa occurrences that are transitional between those observed in the mesohaline and euhaline sites





# Biscayne Bay Interpretation

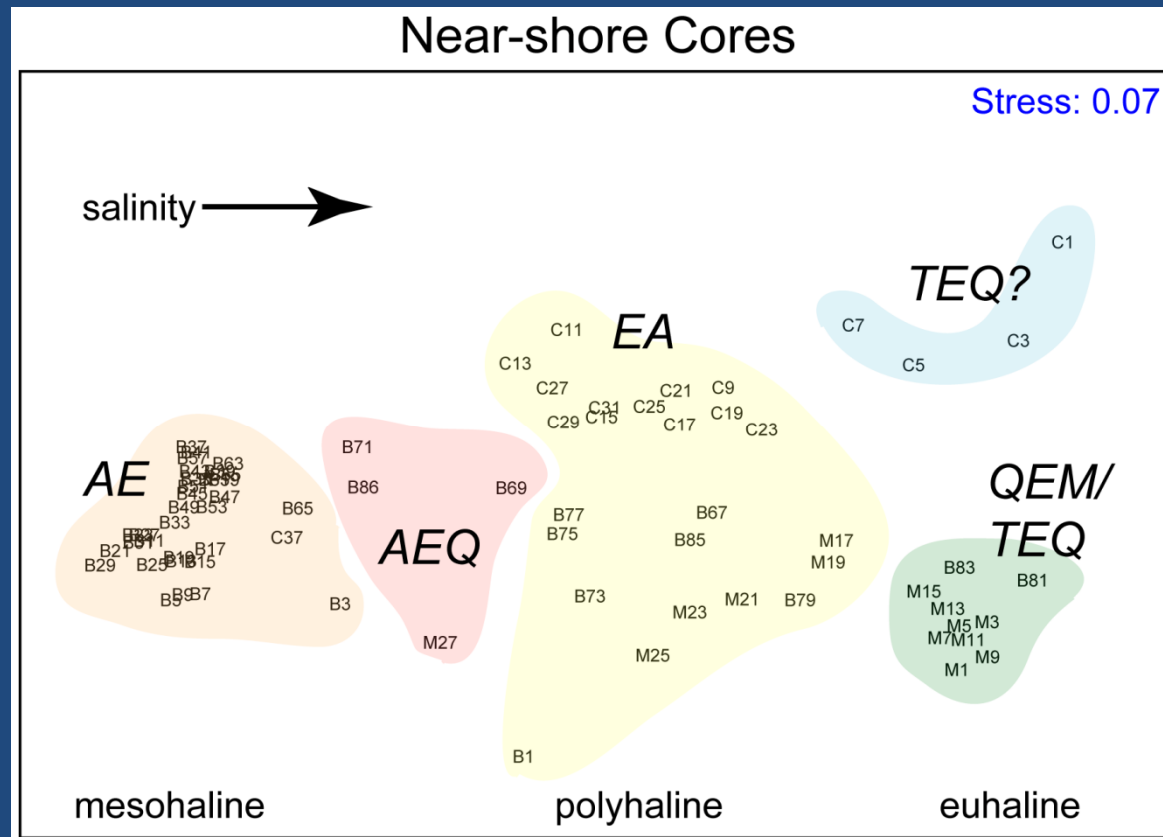


# Importance of Near-shore Cores

- ▣ Near-shore cores were collected based upon the hypothesis that they exhibit greater sensitivity to recent marine ecosystem change
- ▣ Mid-bay core assemblage data address historical seagrass change, particularly to *Thalassia*, but do not display significant ecosystem changes with respect to salinity
- ▣ The near-shore cores show rapid changes to the foraminiferal assemblages in recent history, including the 20<sup>th</sup> century

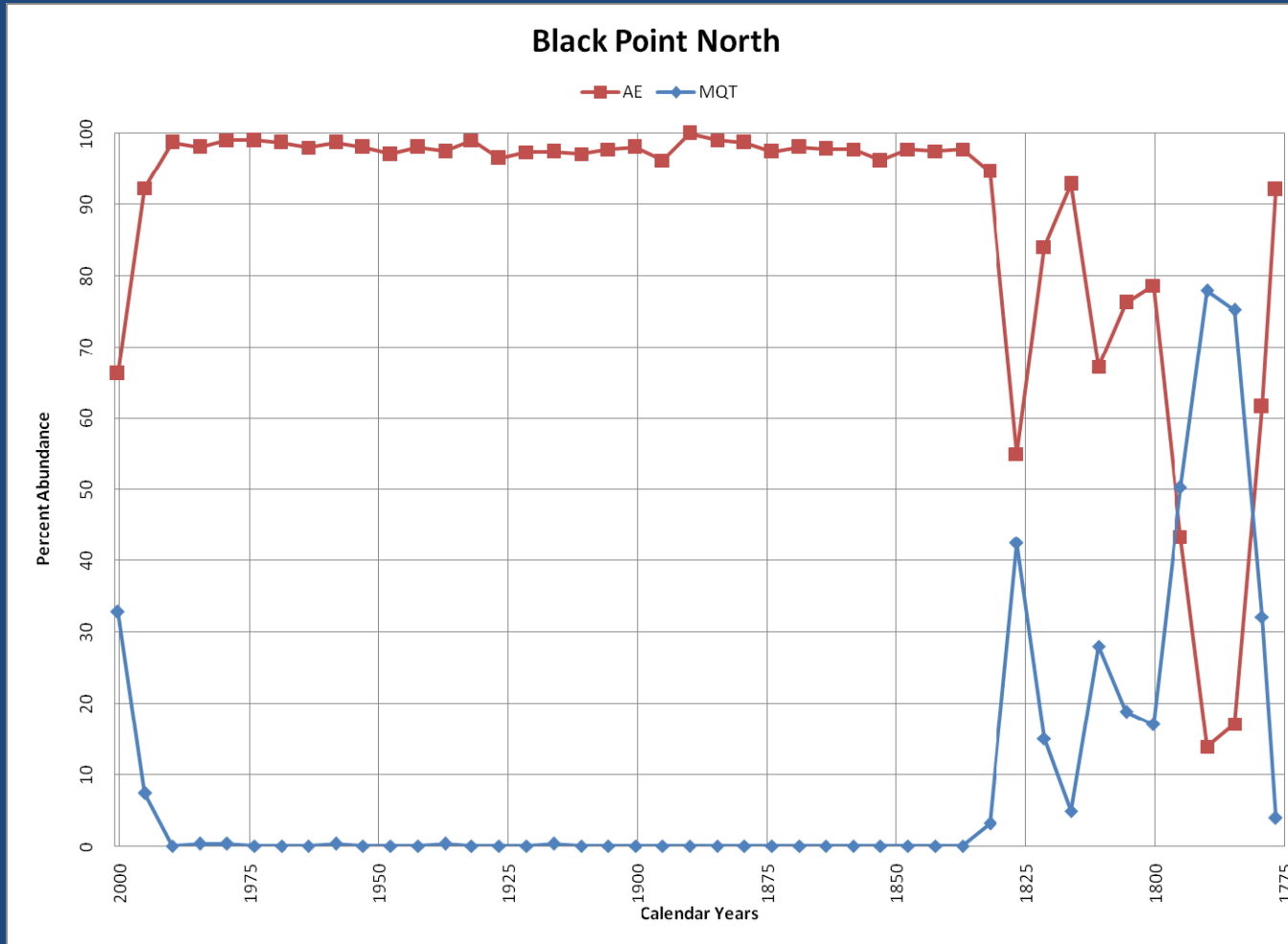


# Near-shore Cores Interpretation

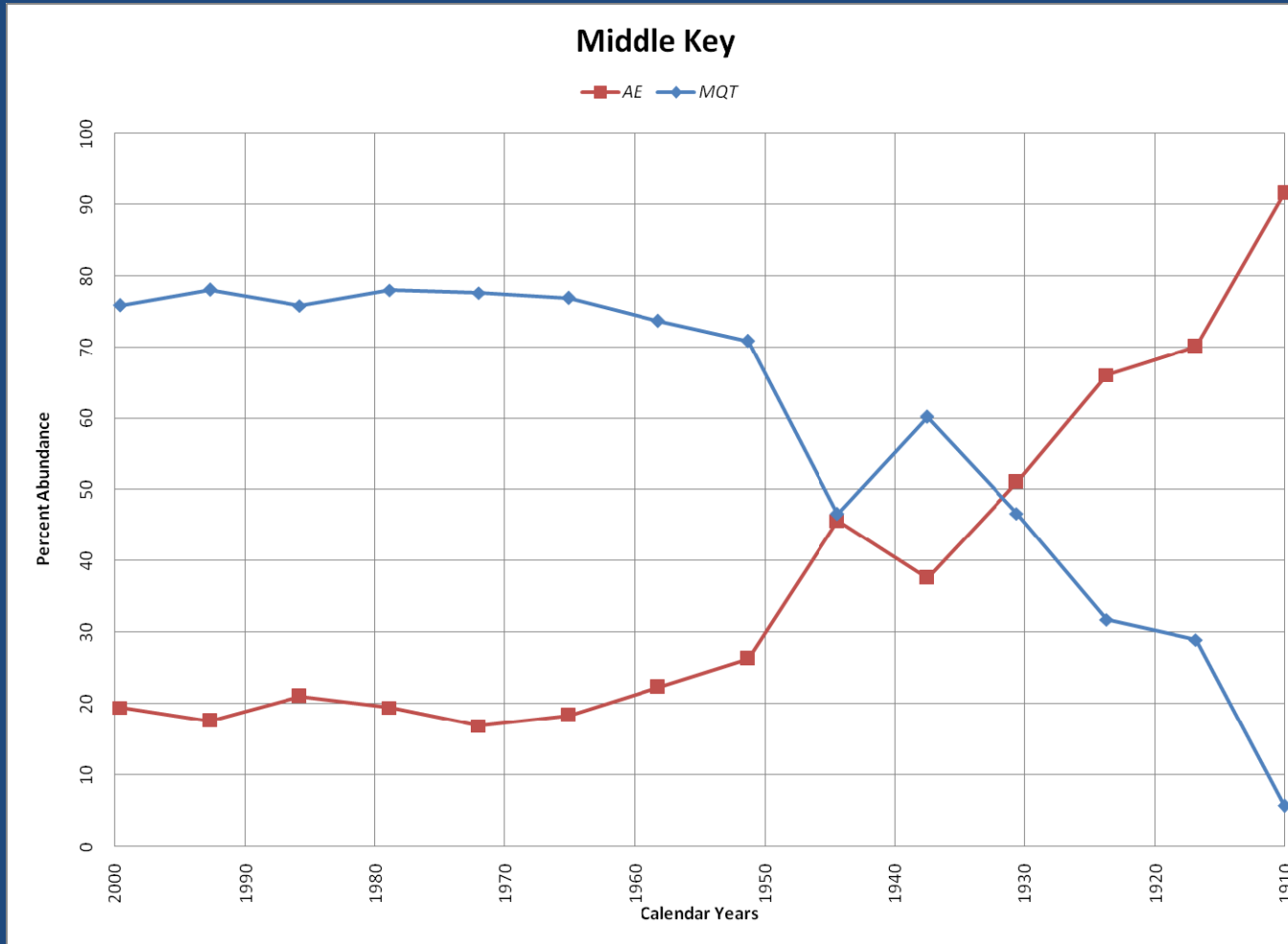




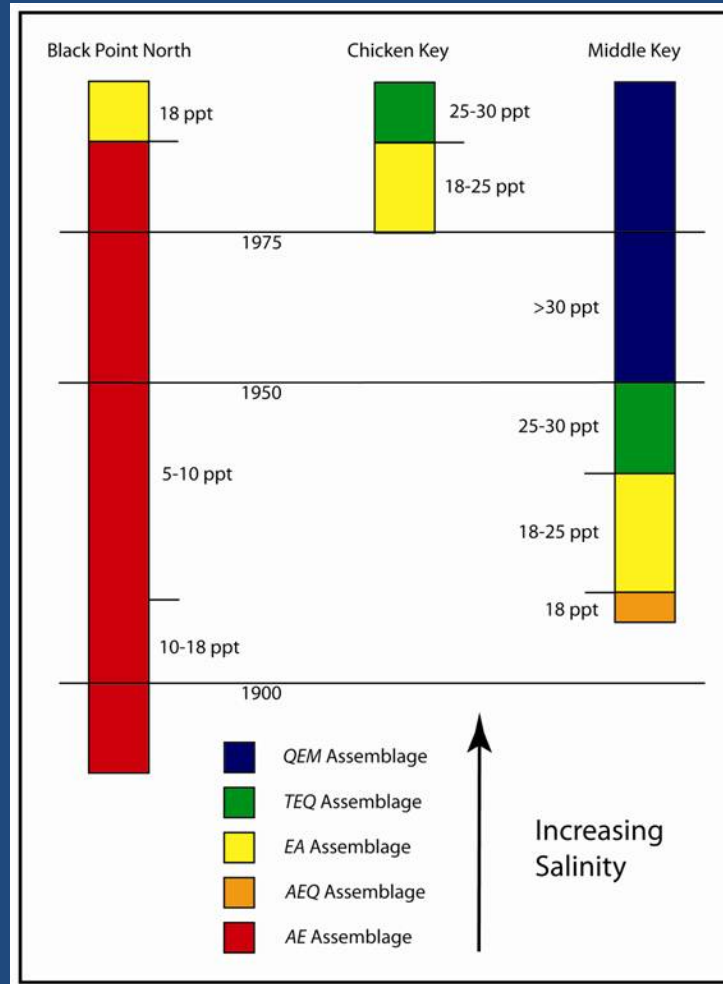
# Black Point North Foraminifera



# Middle Key Foraminifera



# Near-shore Cores Salinity Proxy



# Conclusions

- ▣ The Near-shore core benthic foraminiferal assemblages show distinct increases in marine salinity
- ▣ Corroborating data indicate that the base of the Middle Key core is terrestrial and it transitions to freshwater wetland mid-core, but conflicting geochronologic data do not pinpoint the timing of environmental deposition
- ▣ First significant occurrence of foraminifers at this site is in the early 20<sup>th</sup> century

# Conclusions

- ▣ The timing of the increase of salinity and abundant foraminifers correlates to the construction of the Key West Extension of the Florida East Coast Railway
- ▣ By 1950 A.D. the site assemblage is dominated by foraminifera indicative of euhaline conditions, but with a high degree of stress
- ▣ The Black Point North core has been dominantly mesohaline for most of the 19<sup>th</sup> and 20<sup>th</sup> centuries

# Conclusions

- ▣ In the mid-1980s the ecosystem rapidly shifted from a 5-10 ppt mesohaline environment to a mesohaline-polyhaline environment with salinity approximately 18 ppt
- ▣ The Chicken Key site reveals a mid-1980s shift from a lower polyhaline to upper polyhaline environment with increasingly marine-indicative foraminiferal assemblages
- ▣ Mid-bay sites show an increase in continental shelf species post 1950 A.D.



# Future Questions

- ▣ Sea-level rise in South Florida is a reality, and rapid ecosystem change in the past 30 years is clearly defined
- ▣ Are anthropogenic changes to the marine ecosystems real, or are they coincidental to natural environmental transitions in a marine transgression?
- ▣ Can the observed, fundamental environmental shifts be reversed, or has anthropogenic activity merely accelerated the effects of the Holocene marine transgression?