Long-Term Patterns of Coastal Response to Changing Land Use and Climate: Examples from the Atlantic and Gulf Coastal Plains

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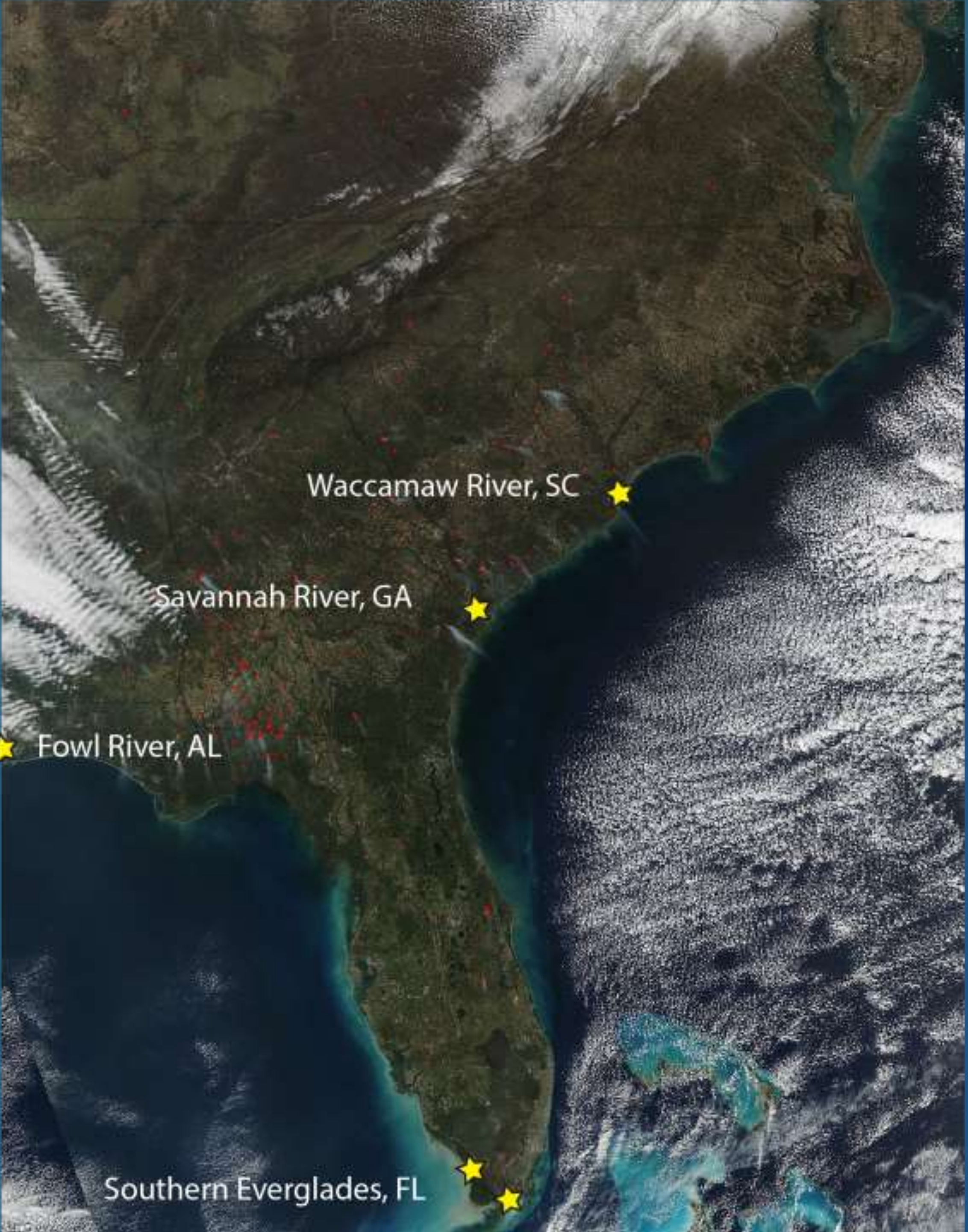
USGS



What do paleoecological and contemporary ecological studies tell us about patterns, timing, and drivers of vegetational shifts in coastal and riparian wetlands in the southeastern U.S.?

- Tidally influenced freshwater forested wetlands – Atlantic and Gulf Coastal Plains
- Freshwater marshes and mangrove environments – south Florida

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Marci Marot, Chris Smith, Chuck Holmes – *St. Petersburg Coastal and Marine Science Center*

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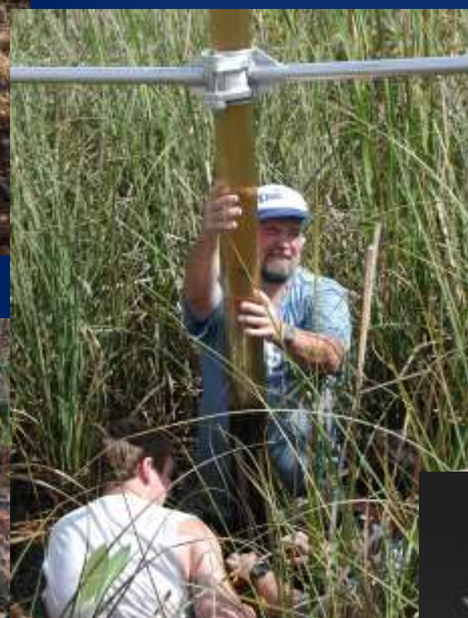
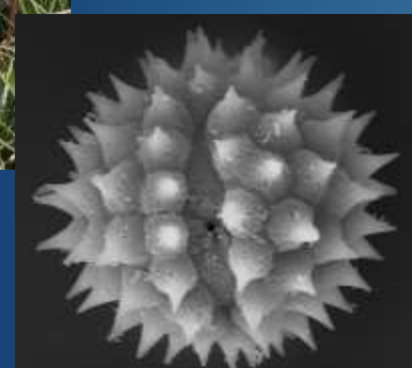
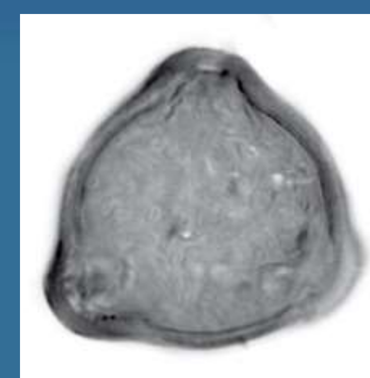
Paleoecological Reconstruction of Past Vegetation and Carbon Accumulation Rates



- Calibration Datasets (surface samples)
- Collection of sediment cores
  - Vibracore
  - Piston core
  - Russian corer
- Dating of sediments
  - Radiocarbon
  - Lead-210
  - Cesium-137
  - Pollen biostratigraphy
- Loss on Ignition
- Pollen Analysis
- Plant Macrofossil Identification



Ragweed-www.geo.arizona.edu



Casuarina

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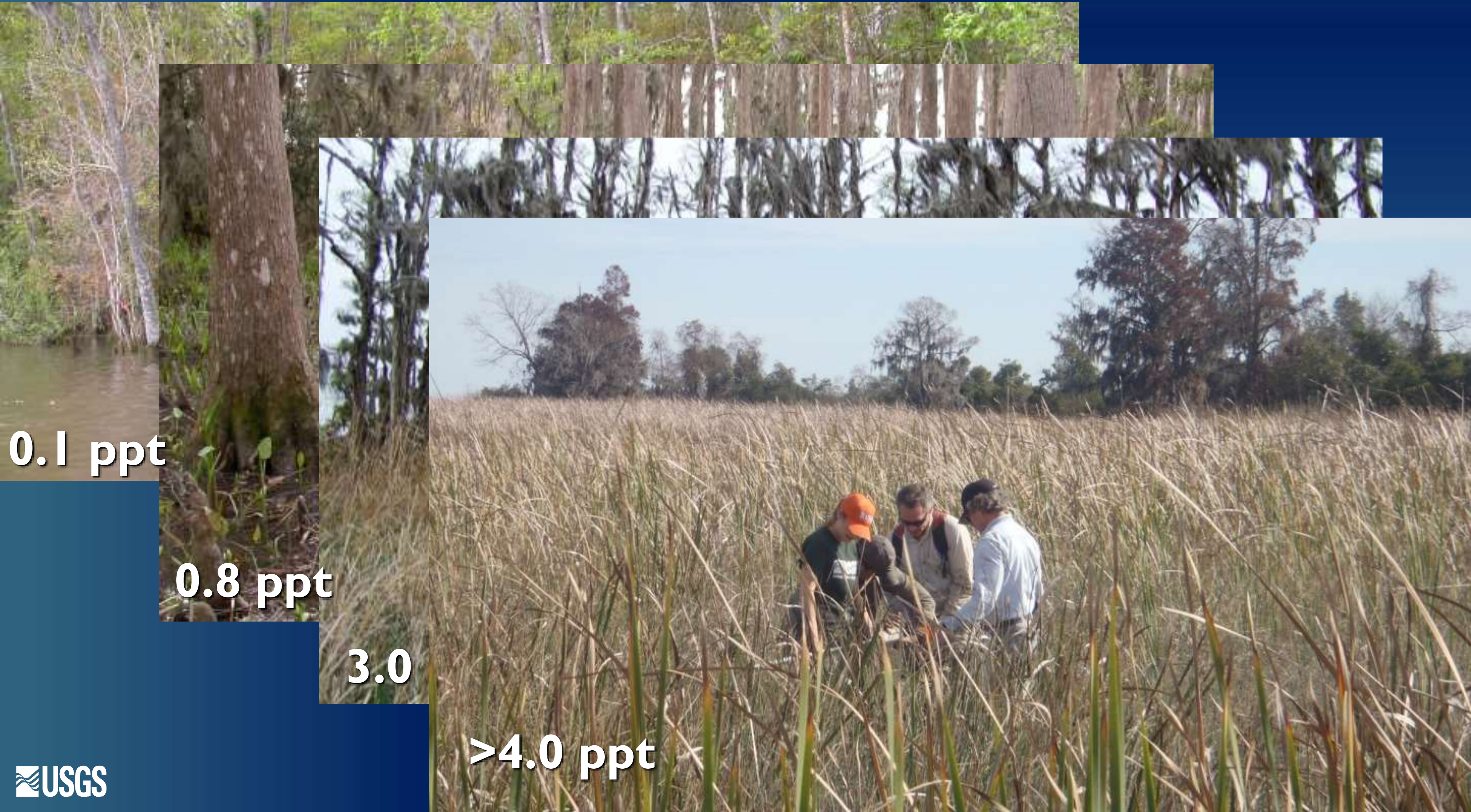
Tidally-influenced Freshwater Forested Wetlands of the Atlantic and Gulf Coastal Plains

Marshes and Mangroves of the South Florida Coast

Tidal Freshwater Forested Wetlands (TFFW) and SLR

Over recent decades, have observed significant changes to ecosystem structure and function - shift of TFFW to marsh, altered C budgets, biogeochemical processes, and hydrological cycling



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Interdisciplinary research on Waccamaw River, SC and Savannah River, GA TFFW and marshes

- Generation of contemporary data sets to understand ecological, biogeochemical, and geomorphological responses of TFFW to changing salinity and land management
- Develop process-based models to predict future habitat coverage, and nutrient, carbon, and hydrologic changes
- Document long-term (centennial- to decadal-scale) changes in vegetation and carbon accumulation in different habitats

USGS

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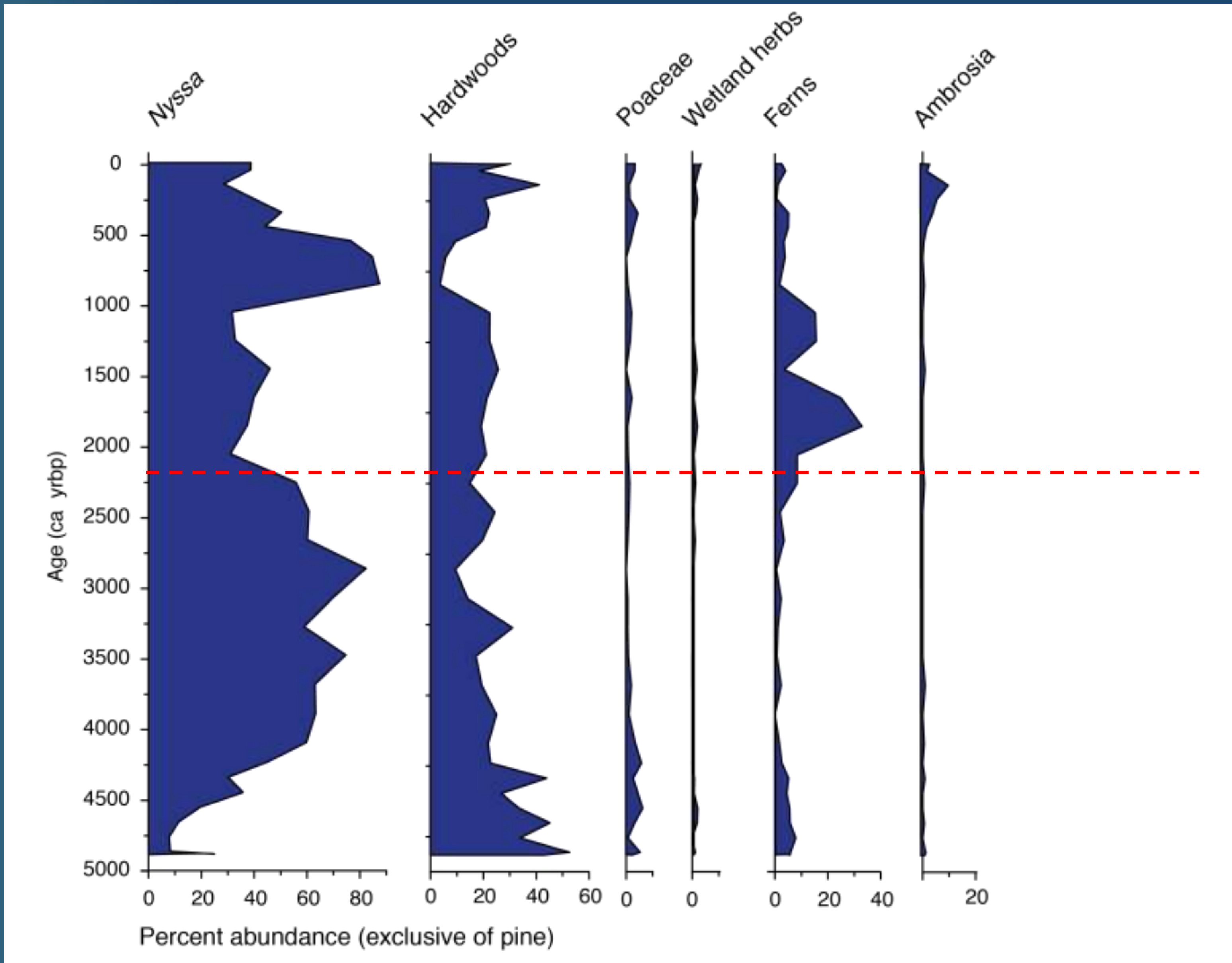
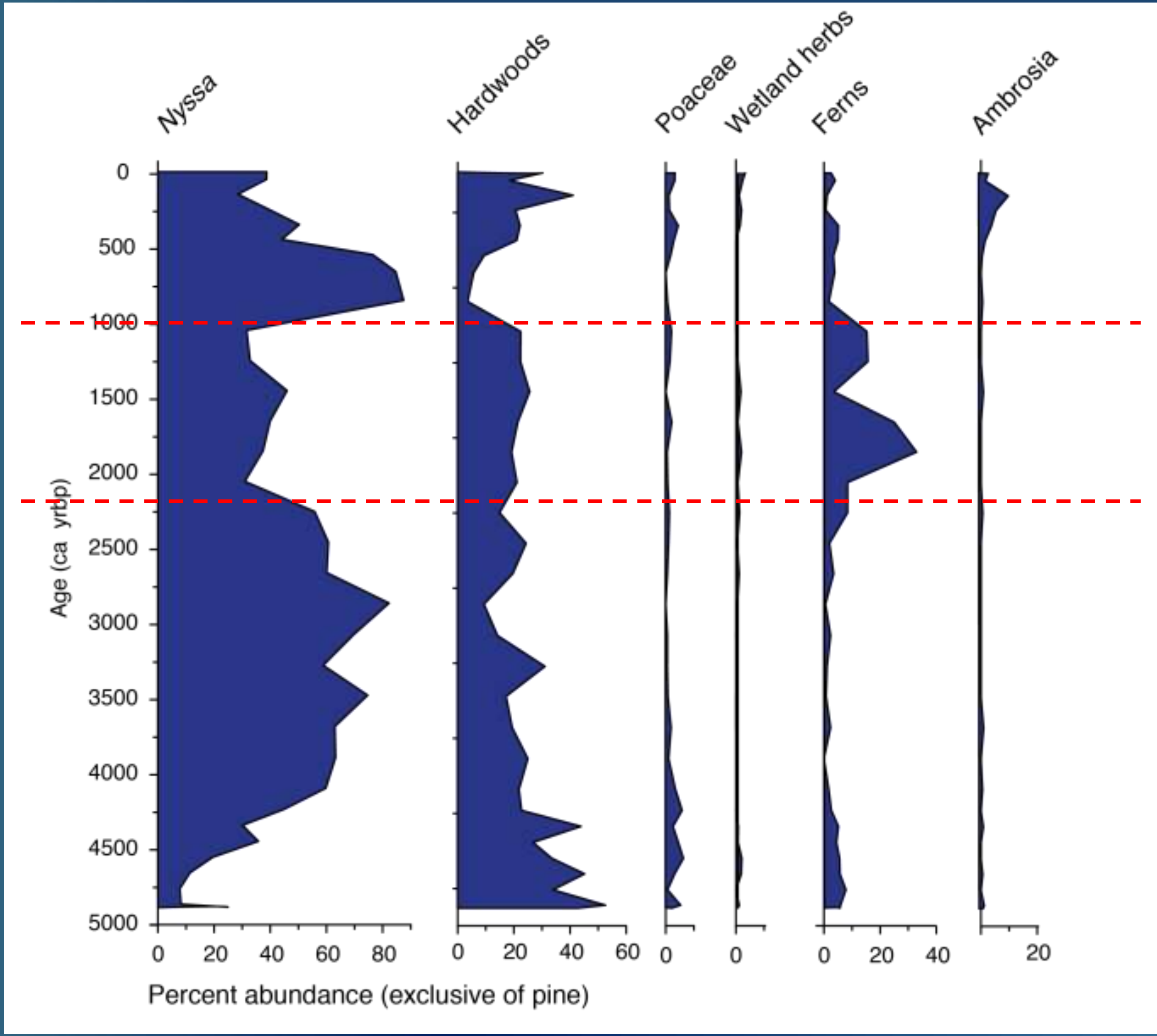
Vegetational Trends at Fresh TFFW site – Savannah River, GA



Backswamp

Vegetational Trends at Fresh TFFW site – Savannah River, GA



Mixed Hardwoods – reduced flow (?)

Backswamp

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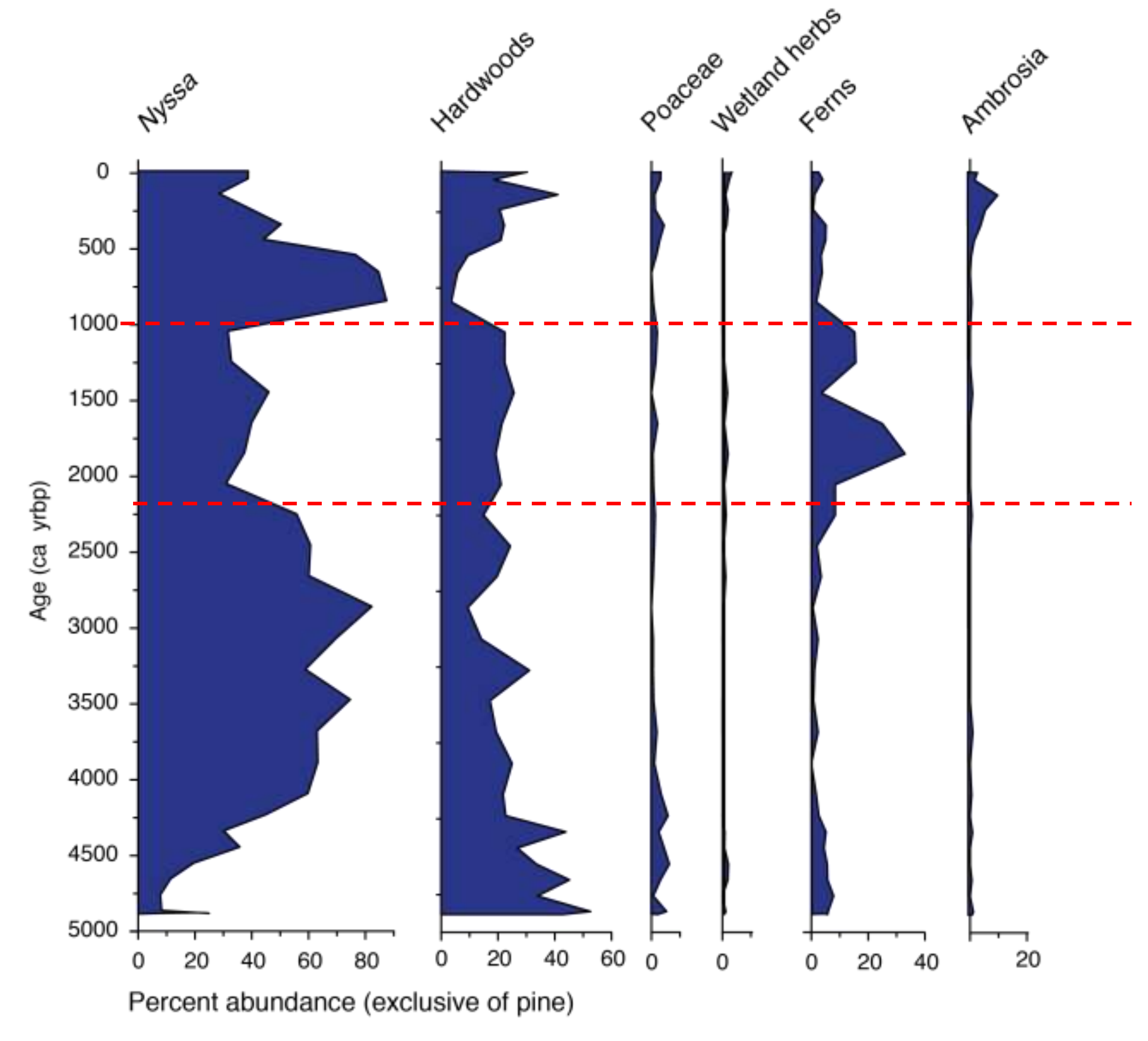

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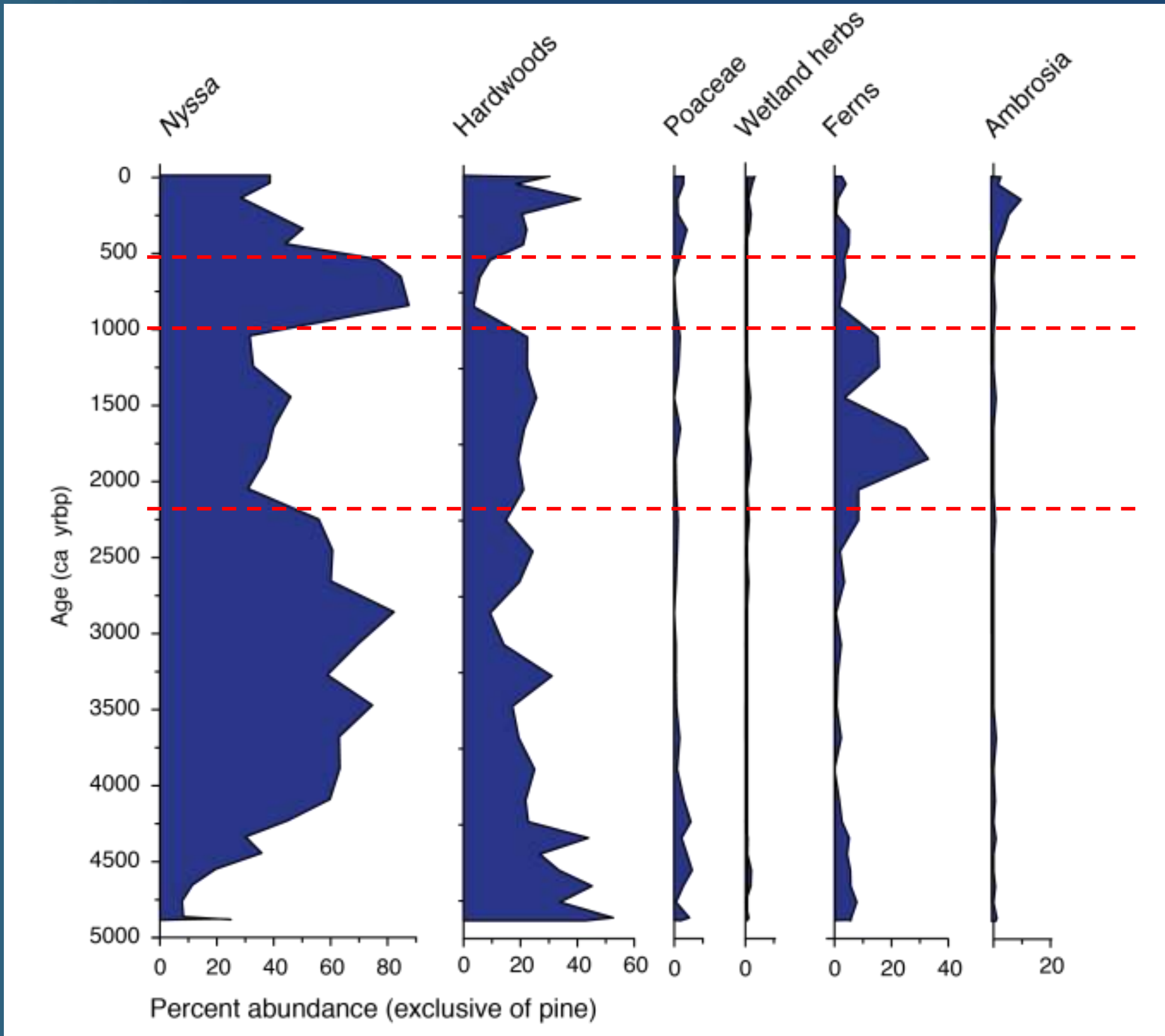

BHW Forest

Backswamp

Mixed Hardwoods – reduced flow (?)

Backswamp

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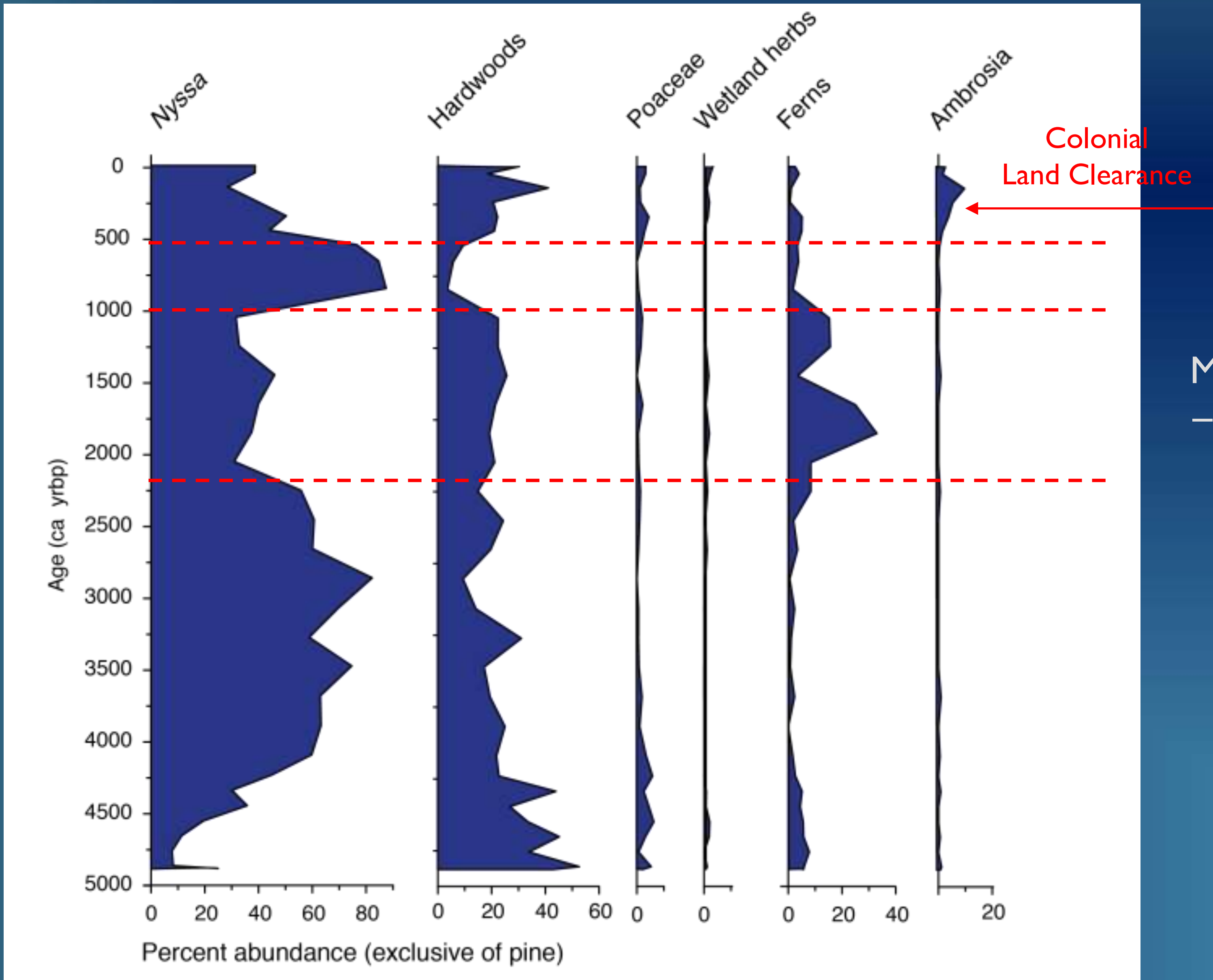

BHW Forest

Backswamp

Mixed Hardwoods
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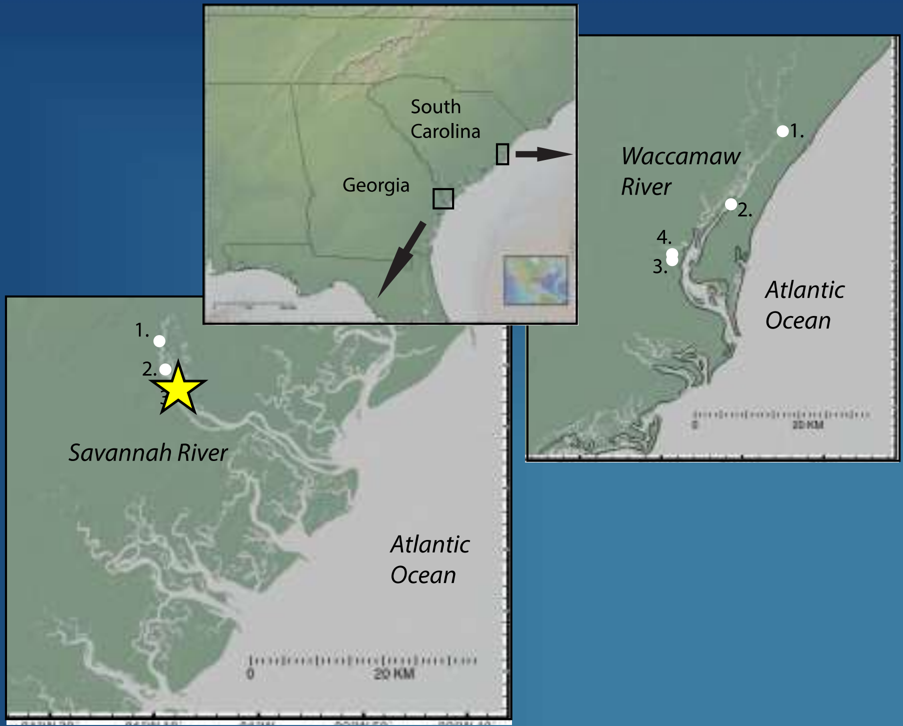
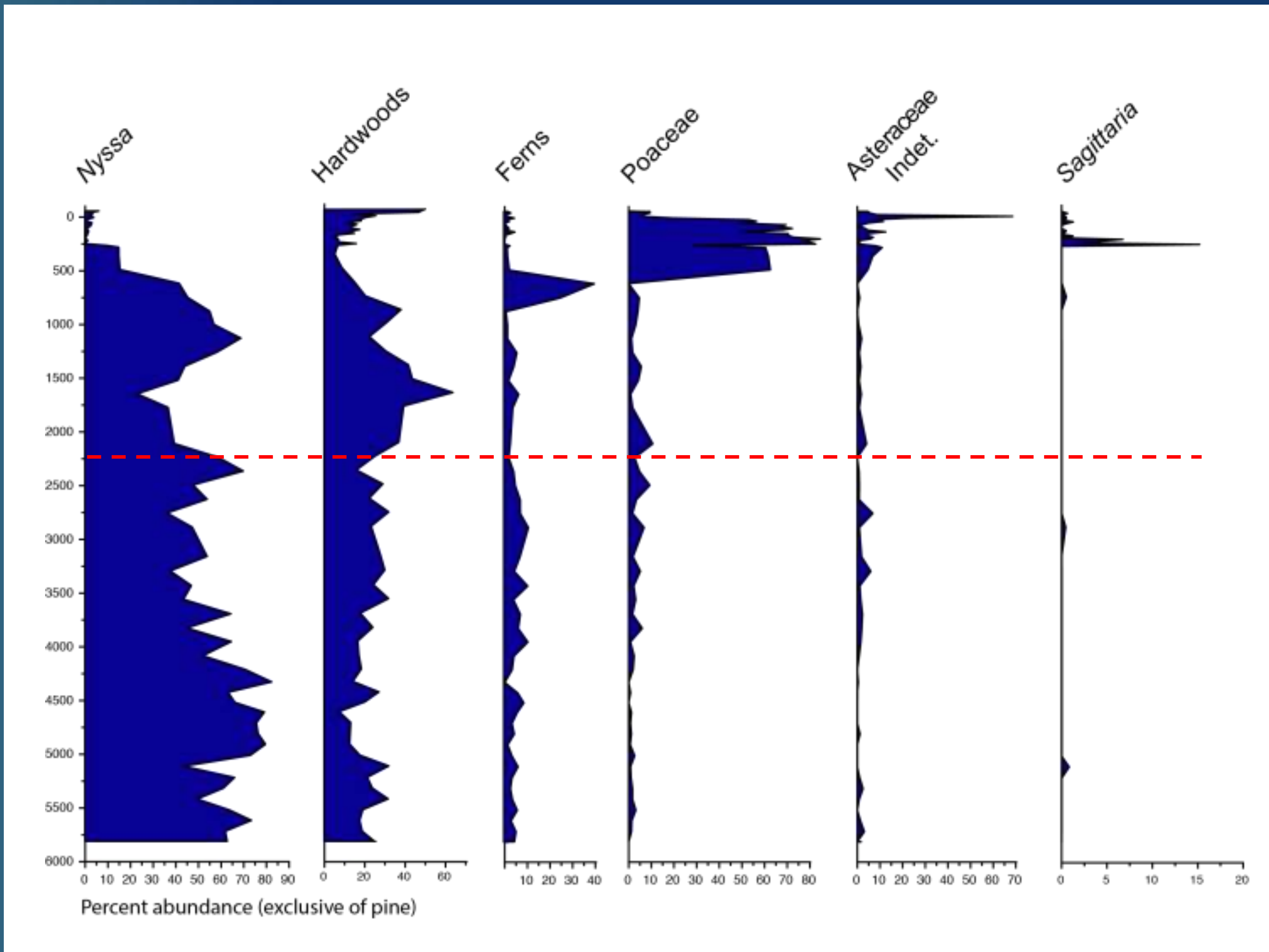
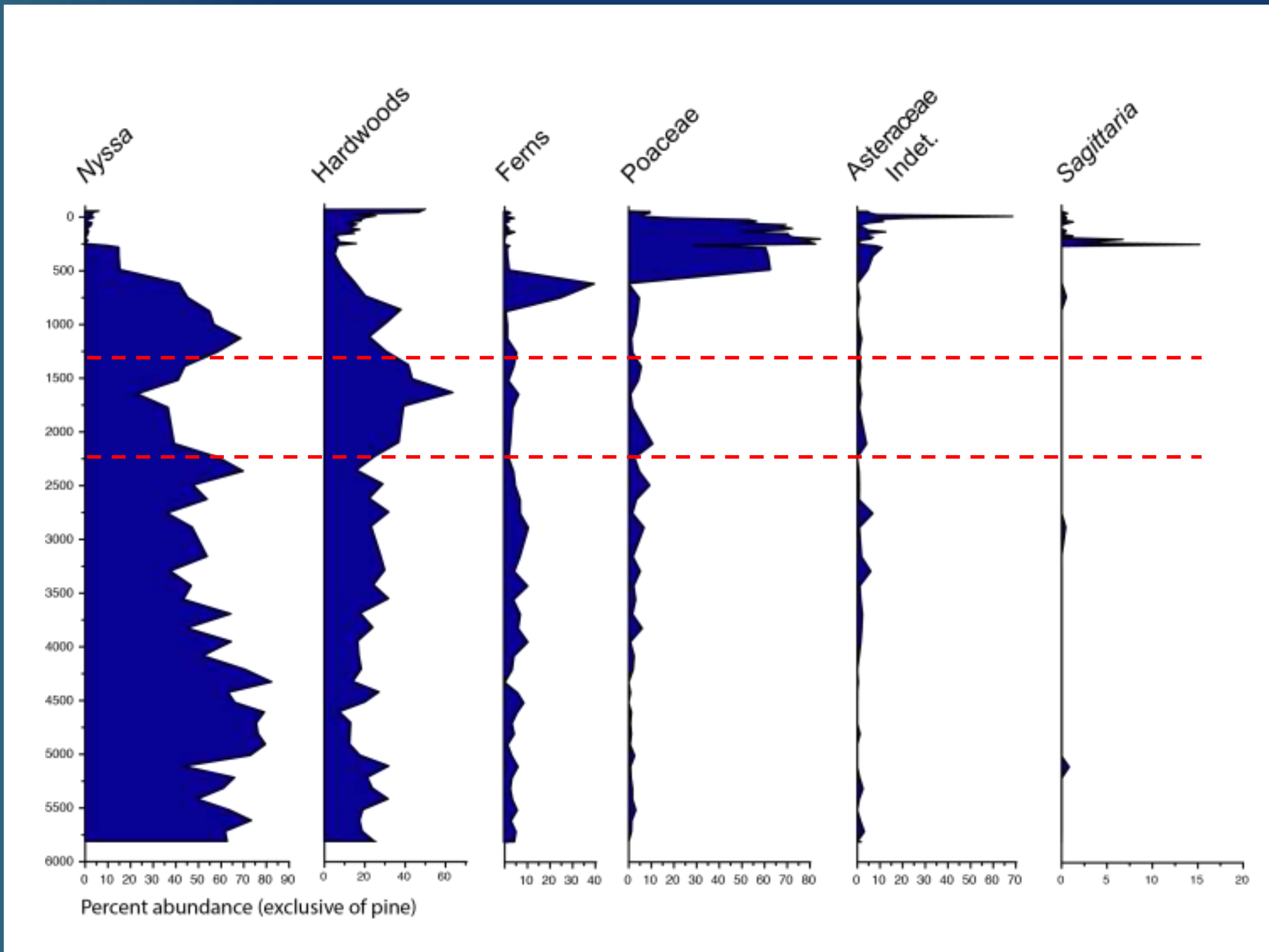


Long-term Vegetational Trends – Modern Oligohaline Marsh, Savannah River, GA



Backswamp

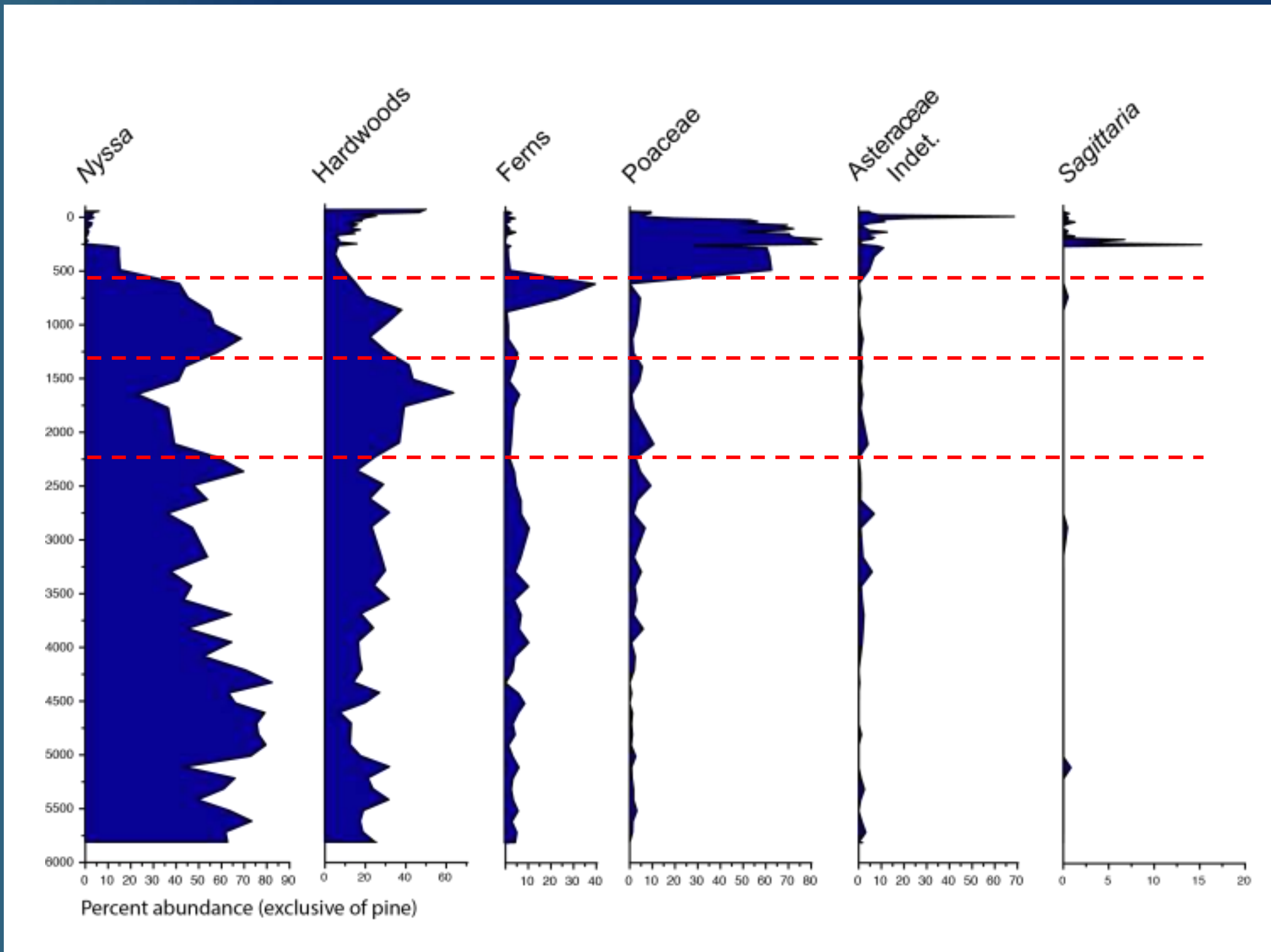
Long-term Vegetational Trends – Modern Oligohaline Marsh, Savannah River, GA



More Hardwoods

Backswamp

Long-term Vegetational Trends – Modern Oligohaline Marsh, Savannah River, GA



Backswamp

More Hardwoods

Backswamp

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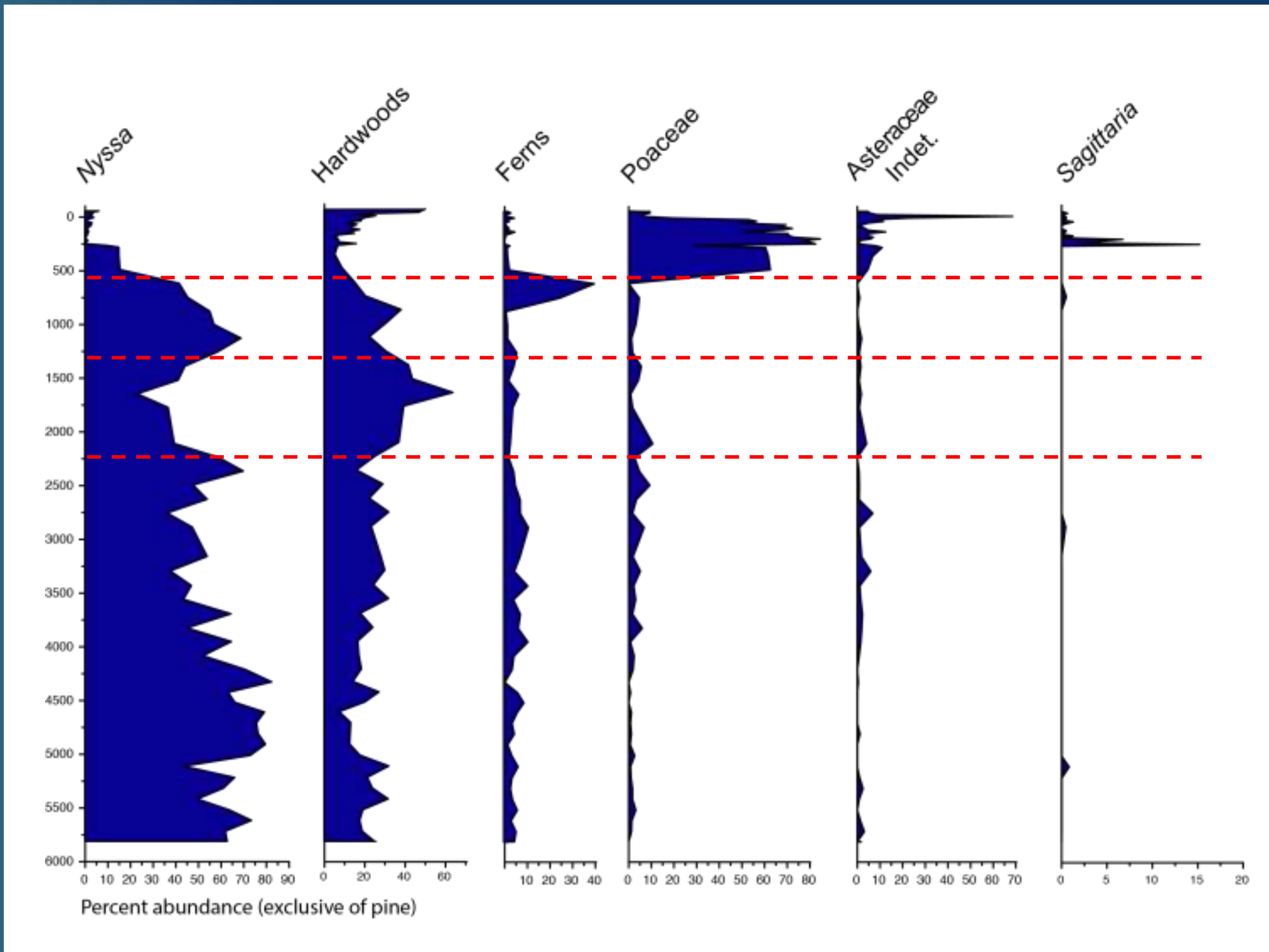


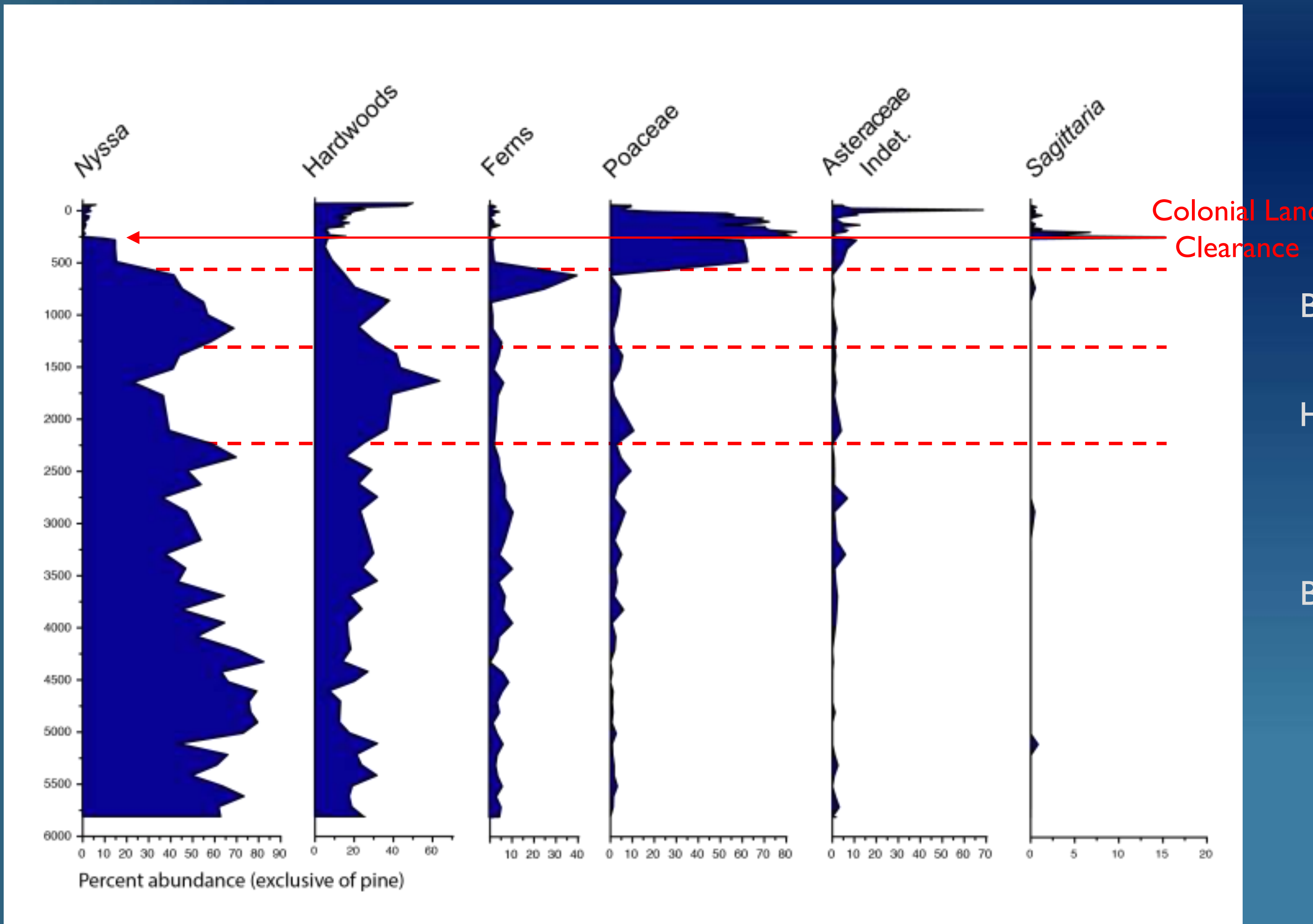
Marsh

Backswamp

More Hardwoods

Backswamp

Long-term Vegetational Trends – Modern Oligohaline Marsh, Savannah River, GA



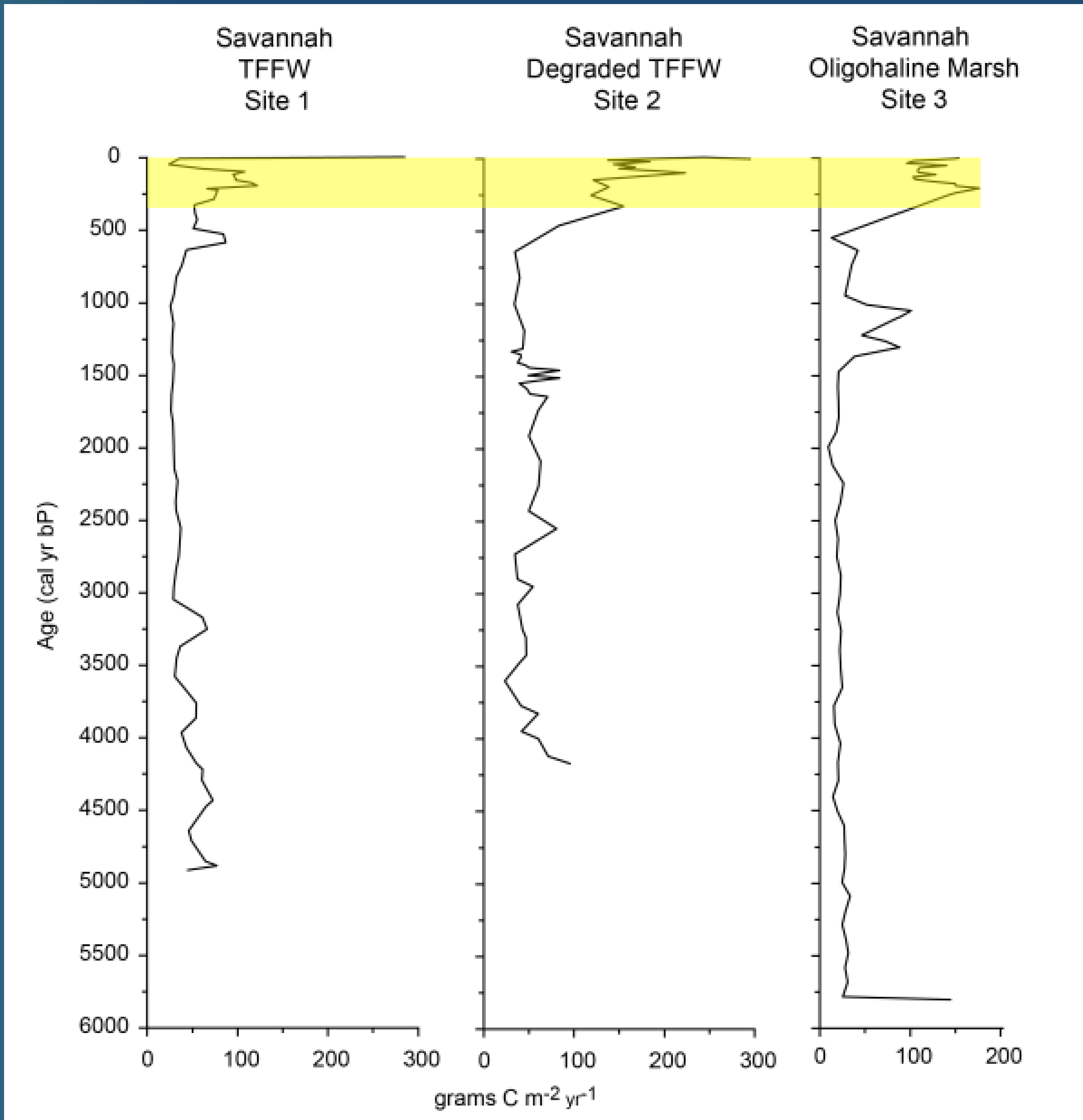
Marsh

Backswamp

More Hardwoods

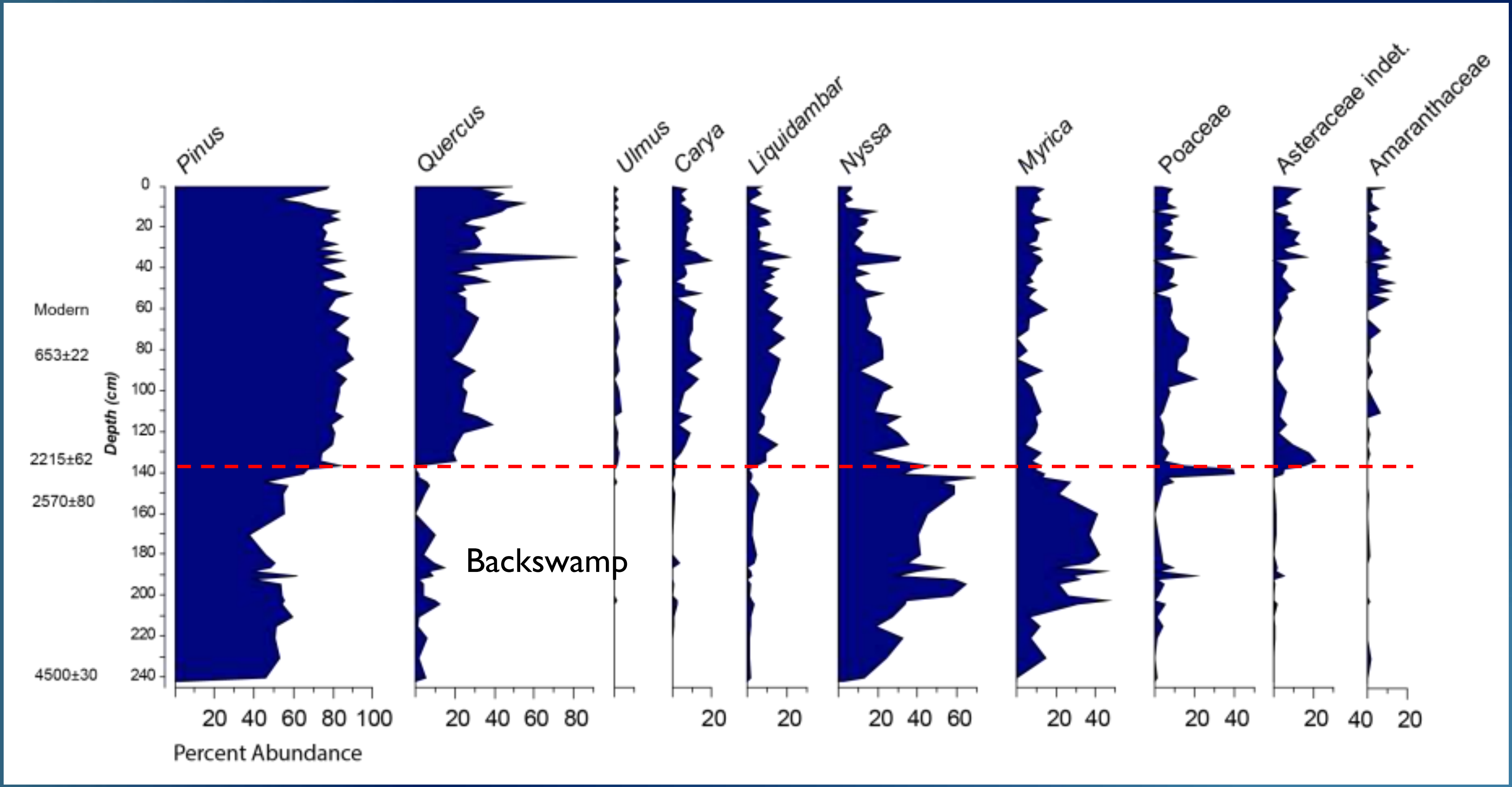
Backswamp

Carbon Accumulation Rates – Savannah Wetland Sites



Carbon accumulation rates varied during the late Holocene, but greatest rates occurred after Colonial land clearance, when large quantities of sediment was transported downstream.

Tidally Influenced Freshwater Forest – Upstream Site, Fowl River, Alabama



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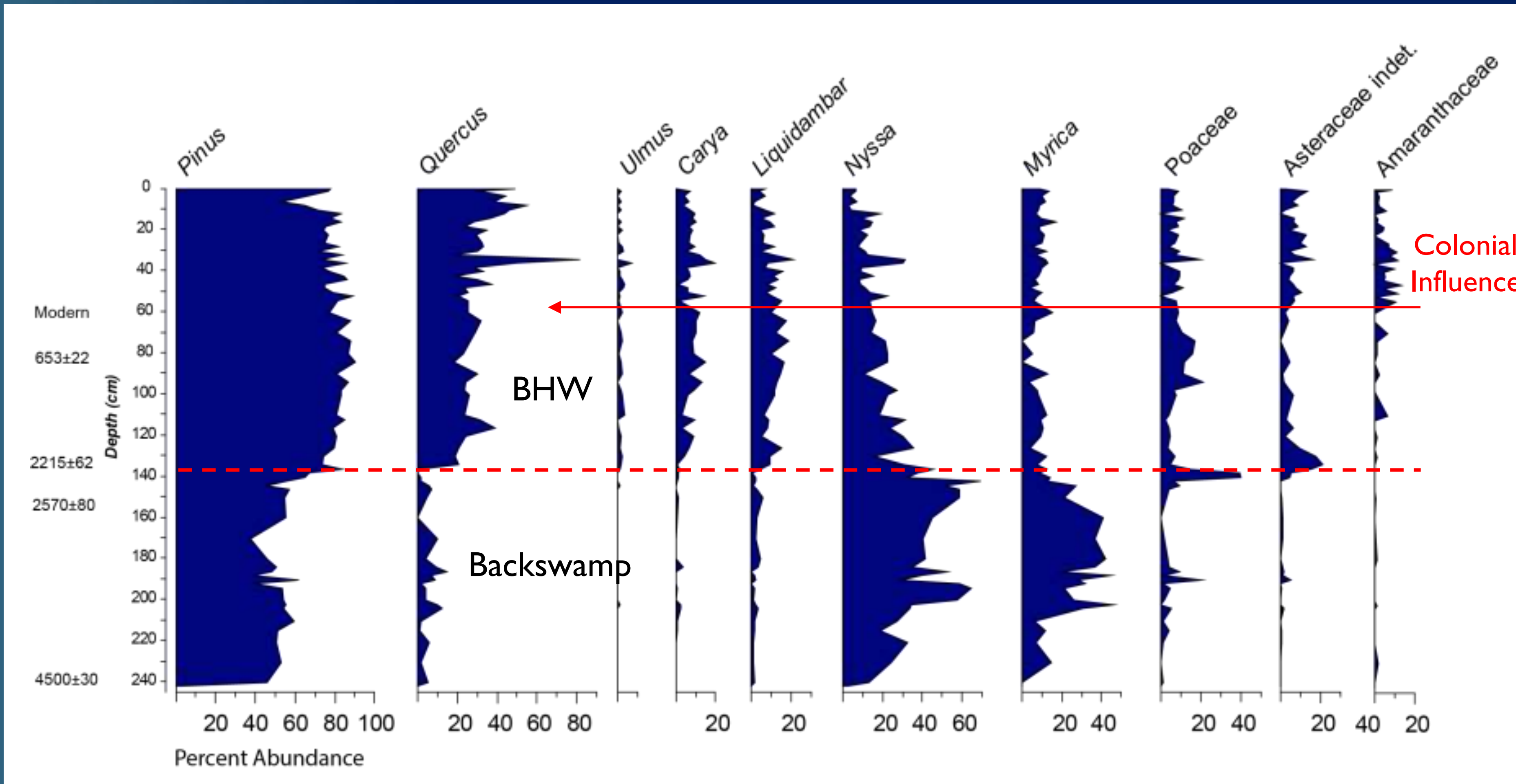
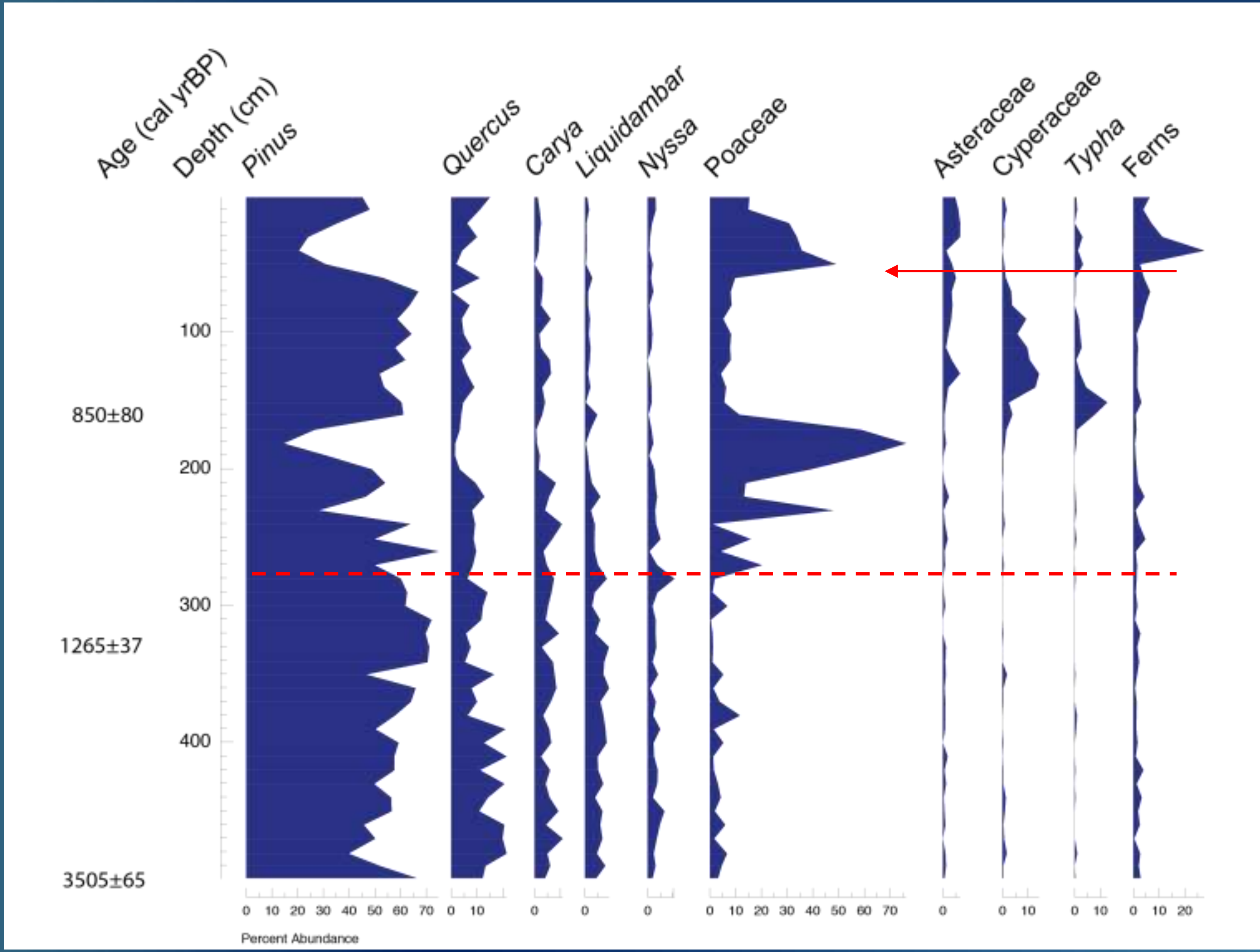


Vegetational Trends – Oligohaline Marsh, Mobile Delta, Alabama



Colonial Land Clearance

Marsh

Bottomland Hardwood Forest

USGS

Long-term Patterns of Vegetational Change in Coastal Plain Forested Wetlands and Marshes

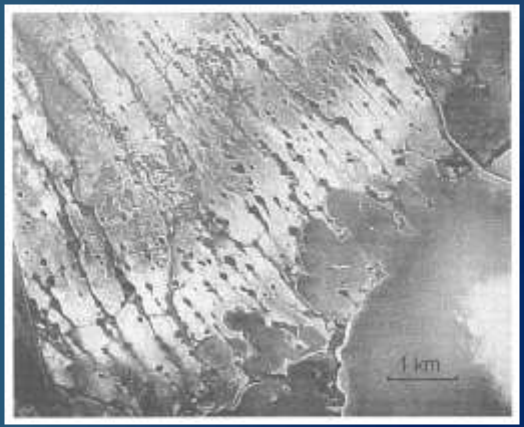
Shifts from backswamps to bottomland hardwood forests (and back) indicate fluctuations in hydroperiod and stream flow

- -~2200 yrBP
- ~1000 yrBP (Medieval Climate Anomaly)
- ~500 yrBP (Little Ice Age)

The modern downstream oligohaline marshes developed late in the Holocene (500-1000 yrBP) on sites that previously were forested wetlands.

Land clearance, beginning with European colonists, and subsequent agriculture and other changes increased sediment and carbon influx to marshes and affected composition of marsh vegetation.

Coastal Sites - Southwestern and Southern Everglades



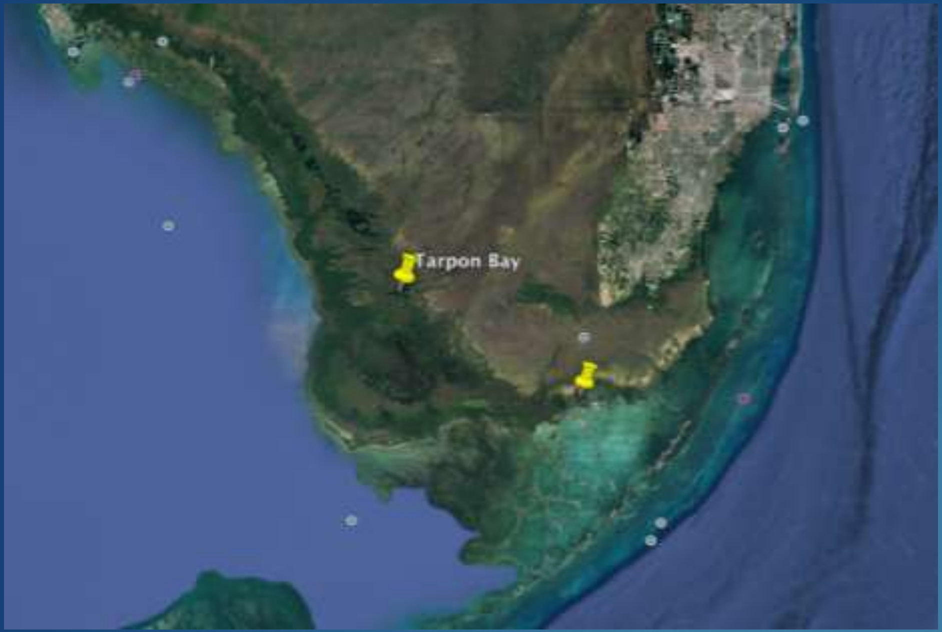
1940

1994

-Ross et al (2000)

Since the early 20th century, freshwater sawgrass marshes of the saline southeastern Everglades have been replaced by mangroves (Ross et al., 2000).

What are the longer-term trends in this region?



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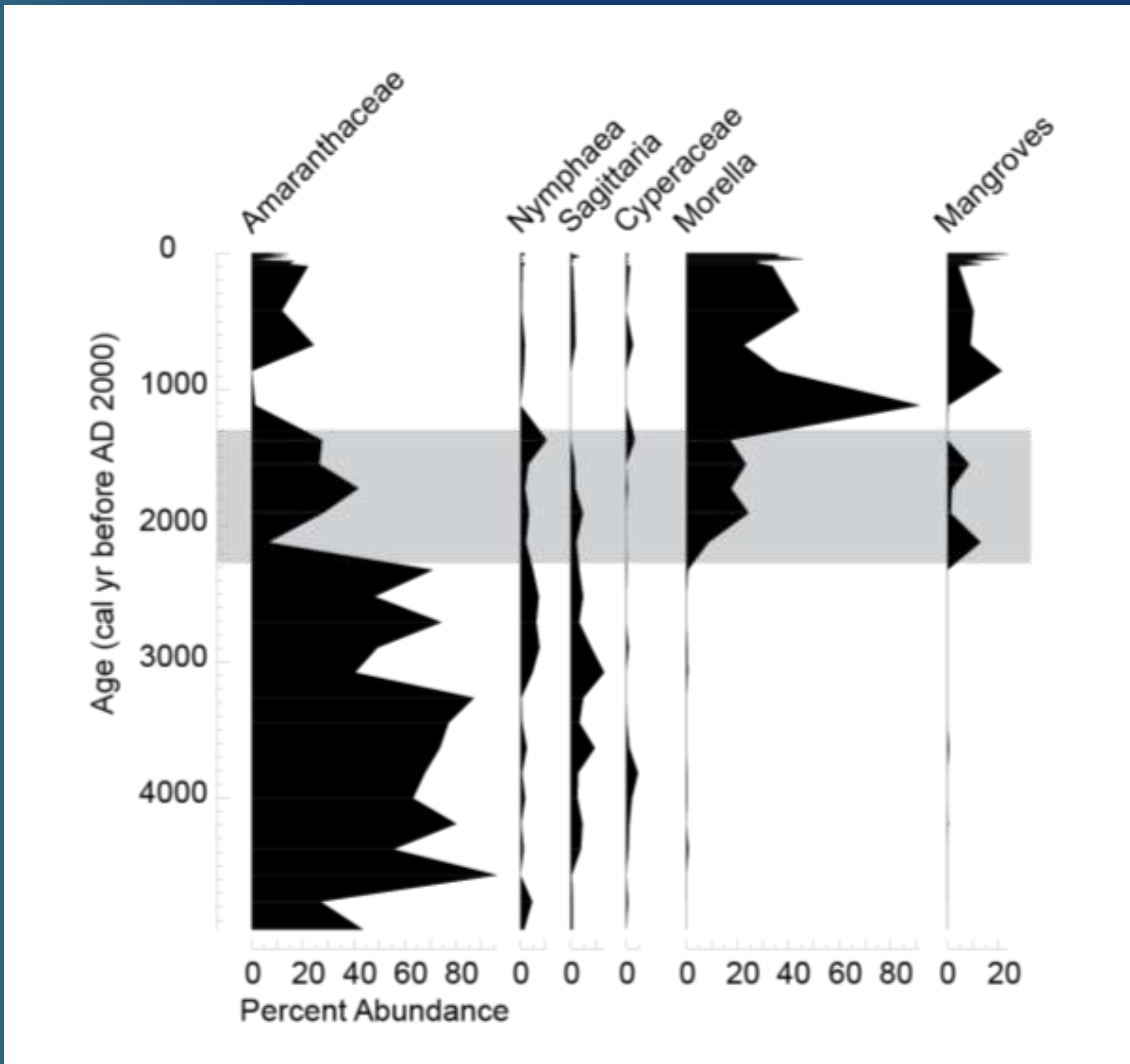
Vegetational Changes along the Southwest Coast of Florida – Tarpon Bay

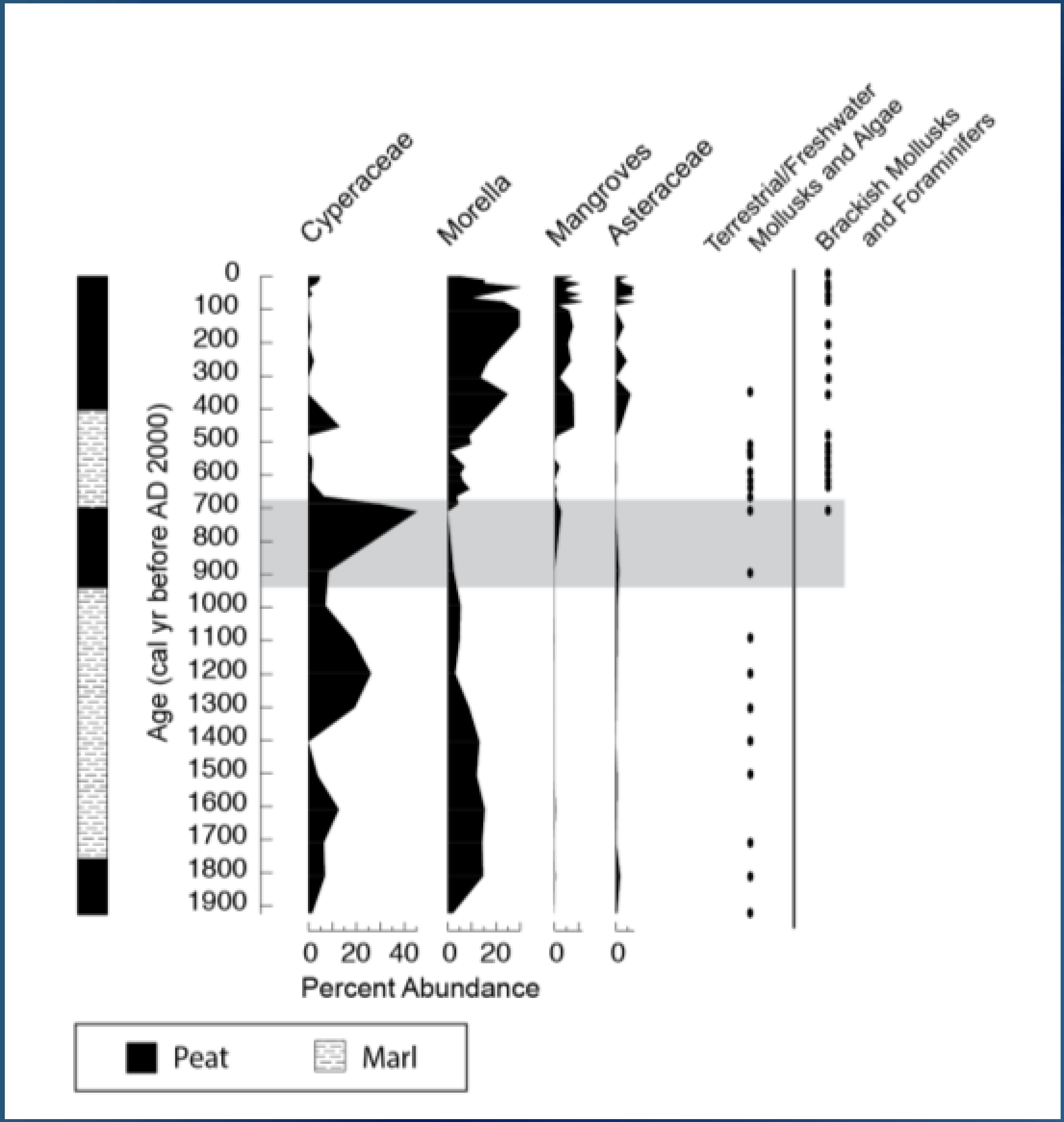


Mangroves

Transitional vegetation

Freshwater marsh

Vegetational Changes along the Florida Bay Coast – Mud Creek, Florida



Dwarf Mangroves

Transitional vegetation

Freshwater marsh

General Patterns of Coastal Everglades Vegetation – last 5,000 years

- From ~5,000 to 3,000 years ago, moderate- to long-hydroperiod freshwater marshes occupied much of the Florida coast.
- Oldest definitive mangrove peats have been dated to 3,600 – 2,900 years from Ten Thousand Islands, Whitewater Bay, and Gopher Key (Parkinson, 1989; O'Neal et al. 2001; Scholl and Stuiver 1967).
- The transition from freshwater marshes to mangroves began later at more inland sites – such as Tarpon Bay (~2,200 bp) and Mud Creek (~1,000 bp).
- The apparent increased rates of inland migration of mangroves and the white zone are likely due to the combined effects of sea level rise and reduction of freshwater flow from the Everglades.

Summary

Fluctuations in coastal vegetation are a natural component of the system – with natural variability in hydroperiod affecting both herbaceous and forested wetlands.

Evidence for natural regime shifts include late Holocene transitions from forested wetlands to marshes in tidally influenced Coastal Plain rivers and the change from freshwater marshes to mangroves in south Florida:

- sea level
- sustained droughts and altered stream flow and fluvial geomorphology

Colonial land clearance and subsequent changes in land use and water management have further altered these habitats – the combination of paleo and contemporary ecological studies are clarifying how the rates and patterns of recent and ongoing change compare to the longer-term record.