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Potential Impacts of Climate Change and Sea Level Rise on South Florida's Coastal Wetlands

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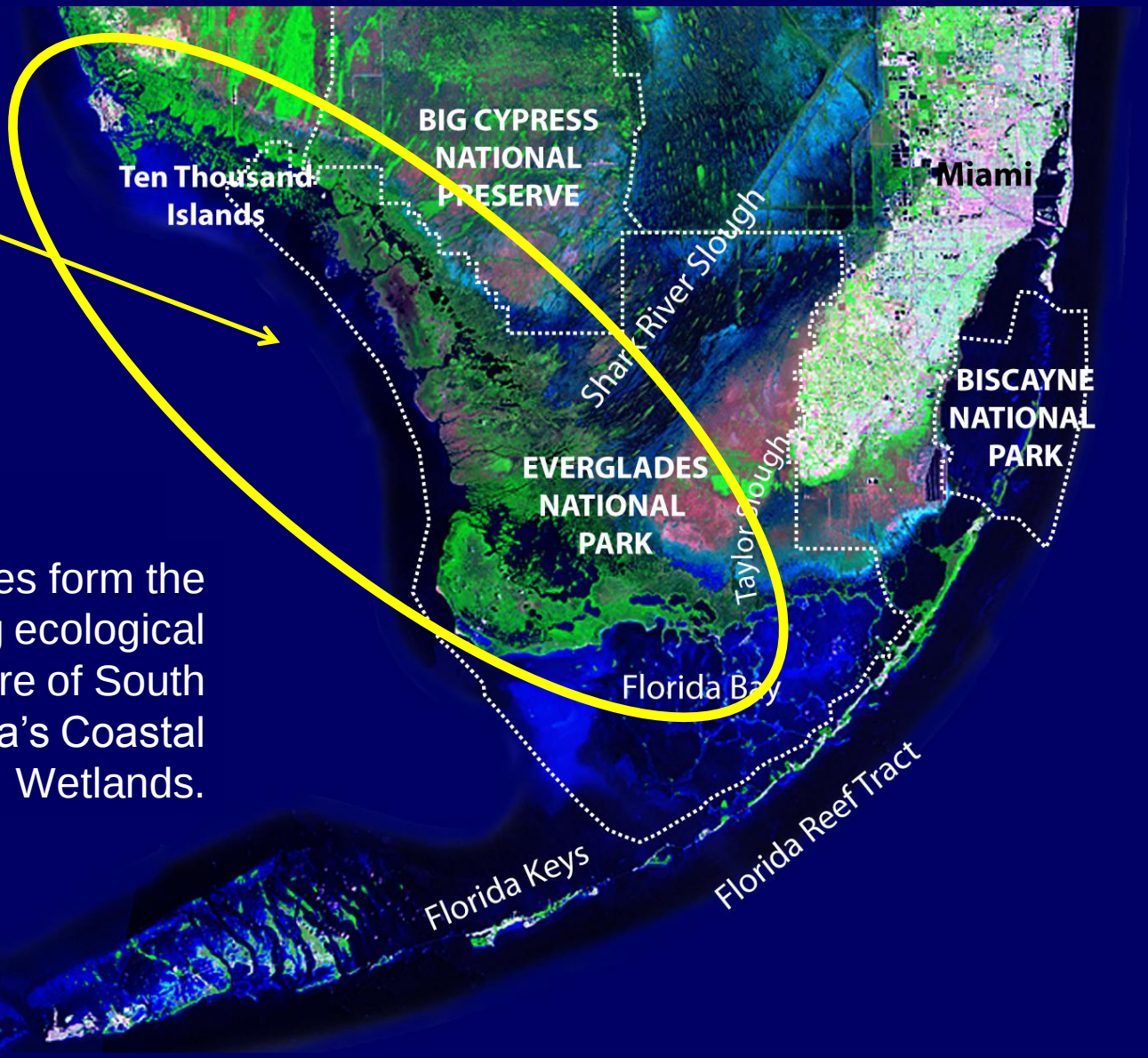
U.S. Department of Commerce
National Oceanic and Atmospheric Administration

Importance of the mangrove ecotone

148,263 acres of mangroves

Largest continuous mangrove coast in US



Mangroves form the defining ecological structure of South Florida's Coastal Wetlands.

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Importance of the mangrove ecotone: Ecosystem Services

- Habitat, nursery and food source for many marine species, commercially valuable fisheries, and protected species
- Stabilize coastline – provide protection from storms and coastal flooding
- Improve water quality – filter nutrients
- Carbon sequestration
- Aesthetic, recreational, and tourism value

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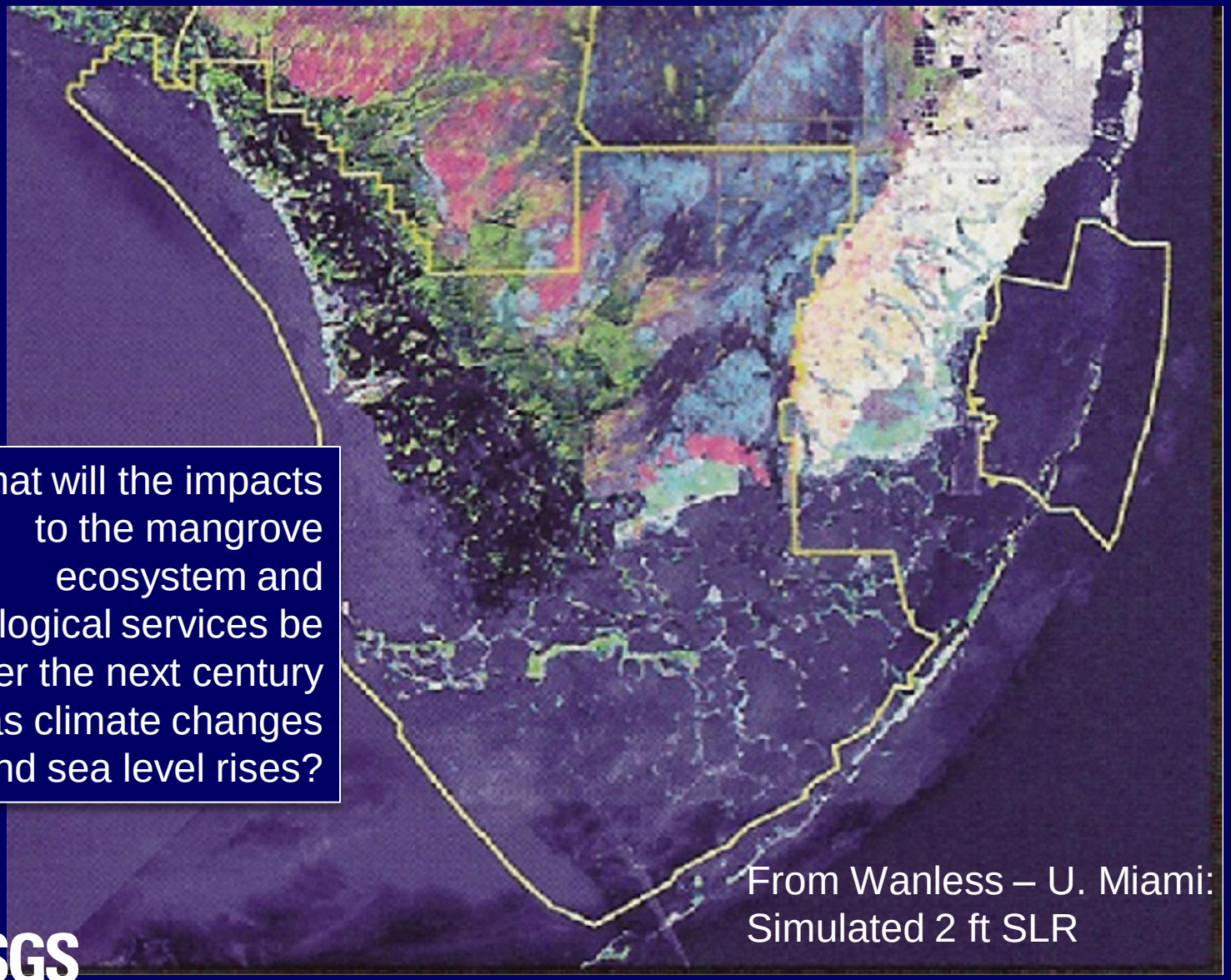
Critical Management and Research Question:



What will the impacts to the mangrove ecosystem and ecological services be over the next century as climate changes and sea level rises?

From Wanless – U. Miami: Simulated 2 ft SLR

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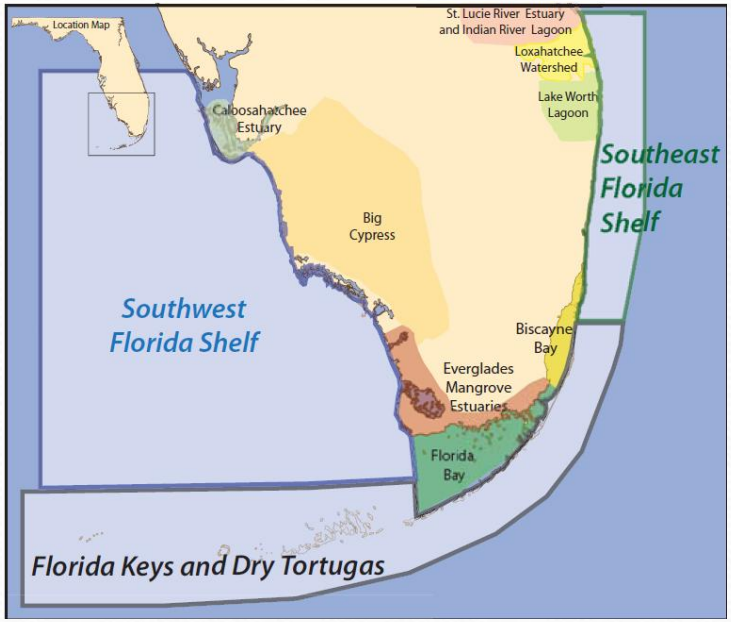
MARES

Marine and Estuarine Goal Setting for South Florida

NOAA

MARine and **ES**tuarine Goal Setting for South Florida

- A consortium of Federal, State, University, and NGO collaborators
- Three year project – began in September 2009 – final report due September 2012
- Developing Conceptual Ecological Models for each coastal region – picks up where CERP CEMs left off



NCCOS

NOAA's NCCOS, Center for Sponsored Coastal Ocean Research

This project was funded by the *National Oceanic and Atmospheric Administration* (NOAA), *Center for Sponsored Coastal Ocean Research* (CSCOR; http://www.cop.noaa.gov/).

MARES Goal:

"To reach a science-based consensus about the defining characteristics and fundamental regulating processes of a South Florida coastal marine ecosystem that is both sustainable and capable of providing the diverse ecological services upon which our society depends."

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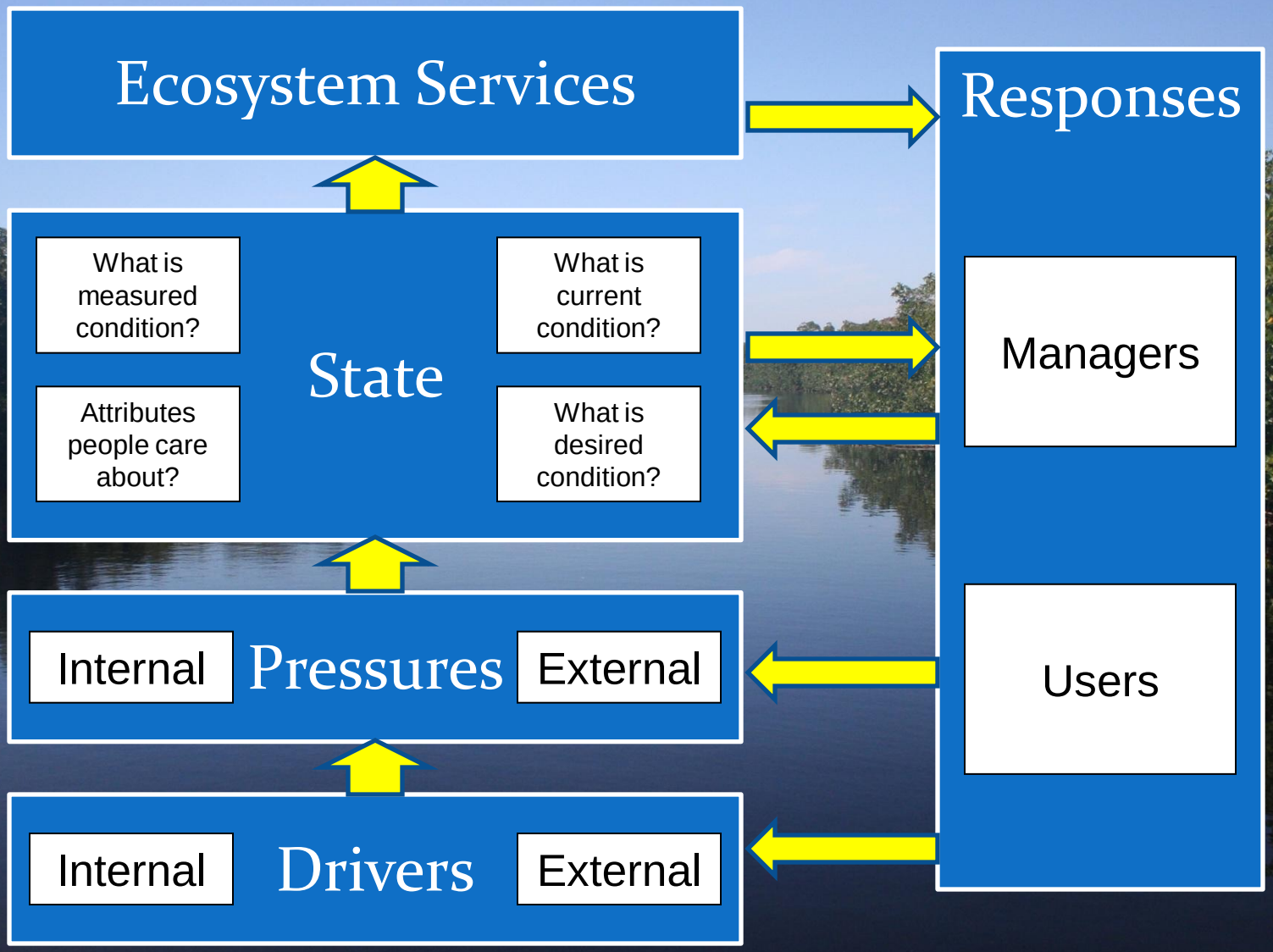
MARES Framework – DPSER Model



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MARES CEM: Drivers

Balance between salt water influx from the marine systems and freshwater flow from the terrestrial systems is what defines the transitions within any coastal wetland environment.

- Climate Change
  - Sea level rise
  - Precipitation patterns
- Anthropogenic alteration
  - Land use
  - Altered freshwater flow

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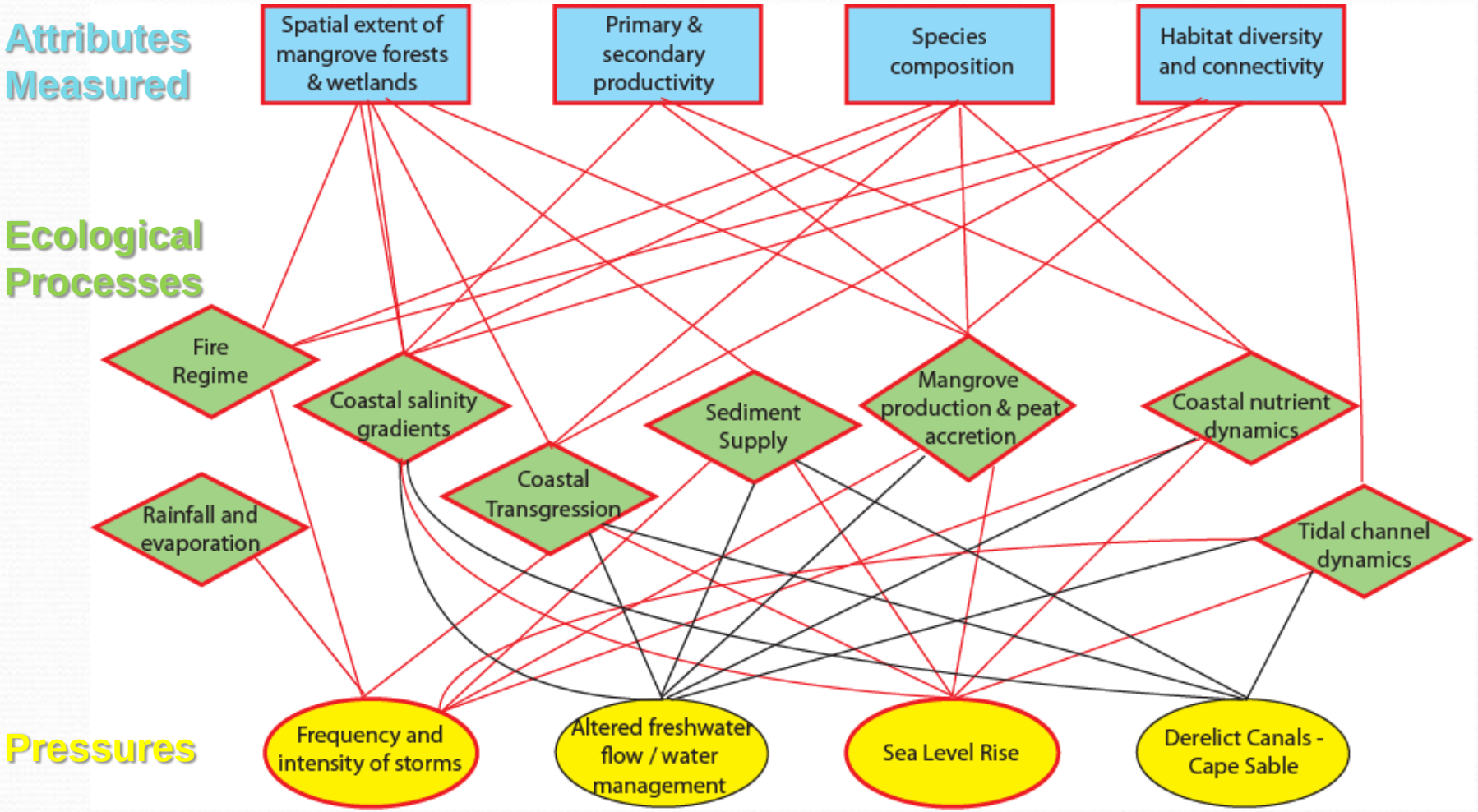
MARES SW Coastal Wetlands CEM



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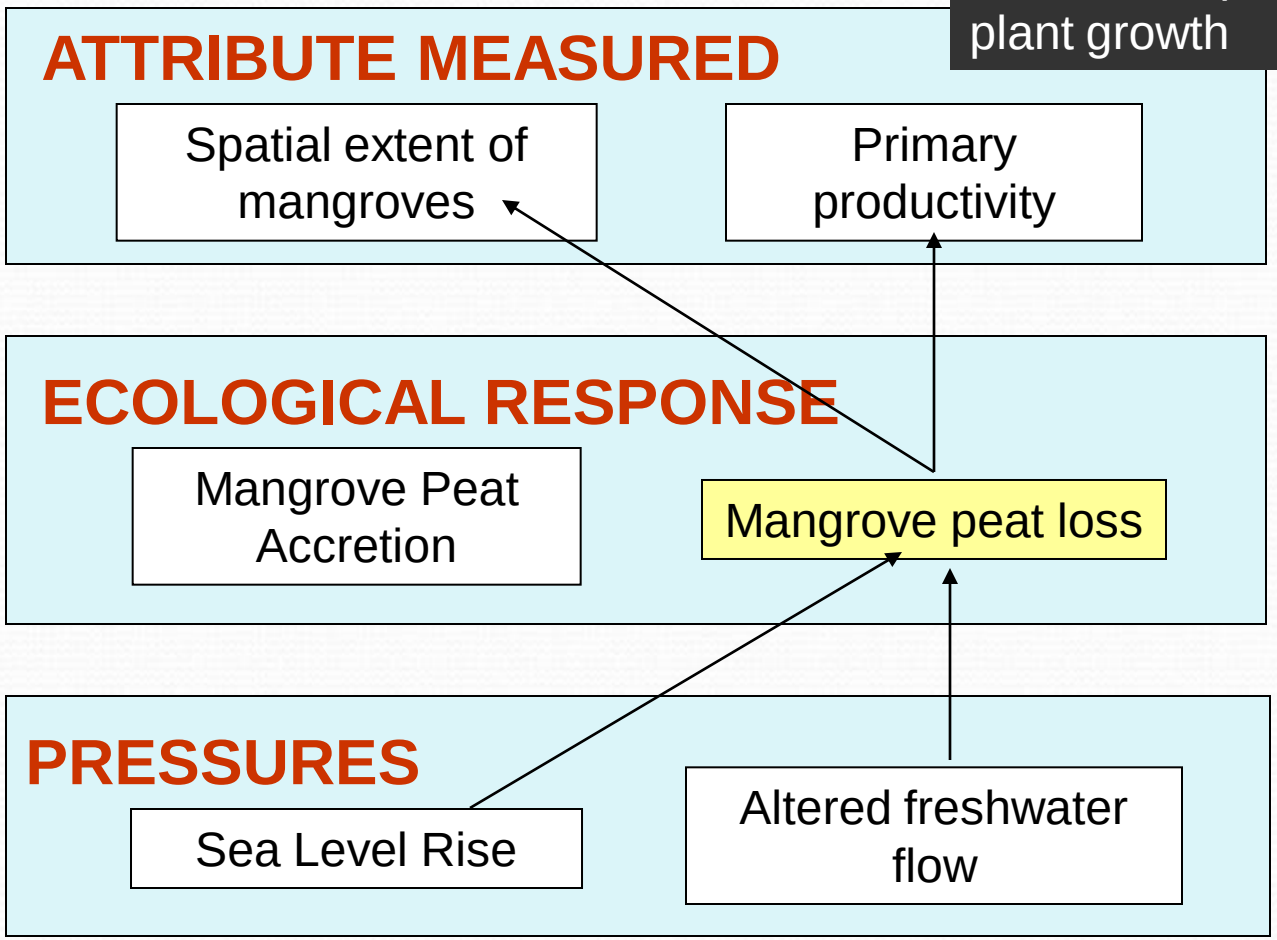
SW Coastal Wetlands – SLR and related pressures

If rates of sea level rise surpass ability of mangroves to
al. (2000) predicts "catastrophic loss of the coastal m
inundation and/or erosion of the low-lying coastal w

Diverting or limiting freshwater flow affects supply of sediment to build up the coast and nutrients to promote plant growth

If SLR >rate of accretion:



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What are potential rates of Sea Level Rise?

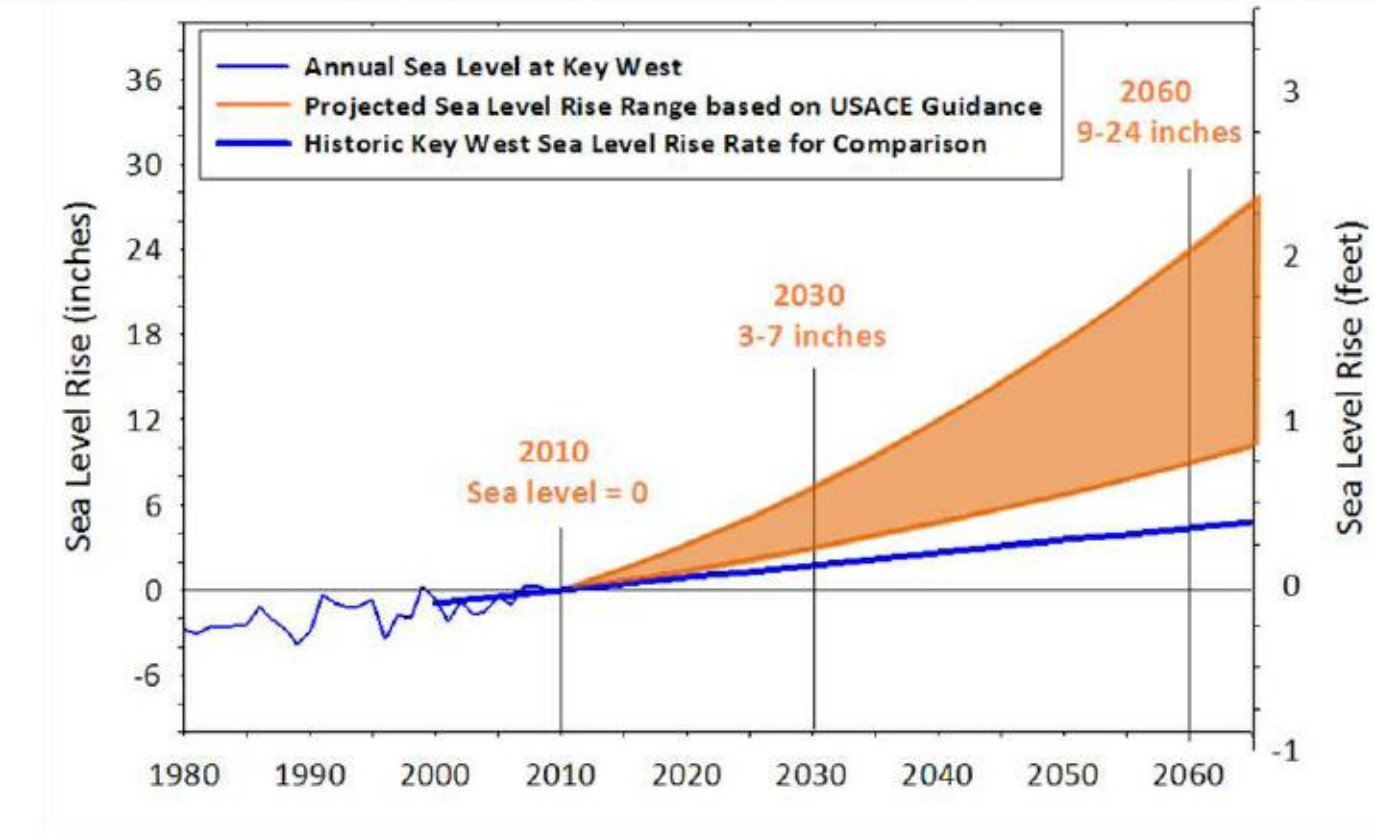

Figure 2. Unified Southeast Florida Sea Level Rise Projection for Regional Planning Purposes. This projection uses historic tidal information from Key West and was calculated by Kristopher Esterson from the United States Army Corps of Engineers using USACE Guidance (USACE 2009) intermediate and high curves to represent the lower and upper bound for projected sea level rise in Southeast Florida. Sea level measured in Key West over the past several decades is shown. The rate of sea level rise from Key West over the period of 1913 to 1999 is extrapolated to show how the historic rate compares to projected rates.

MARES
Marine and Estuarine Goal Setting for South Florida

From MARES SE Shelf DRAFT ICEM – July 2011

Project: Sea Level Rise and Climate Impacts on Greater Everglades Ecosystem

Goals:

- Determine salinity history of the region using indicators of freshwater flow & marine influence
- Determine rates of sea level rise in South Florida for the last 500 to 3000 years and compare to rates projected for 21st century by IPCC
- Examine impacts of changing sea level and freshwater availability on biota
- Examine record of climate effects on ecosystem
- Use results of core analyses to provide Southern Estuaries Recover Team with estimates of pre-1900 AD flow

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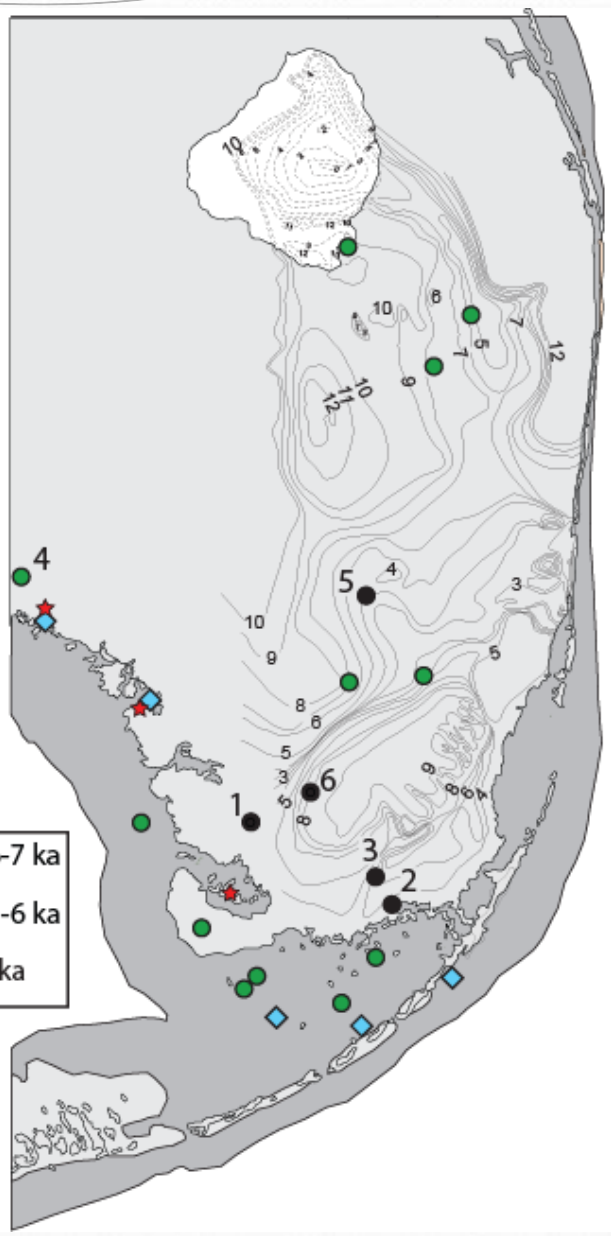
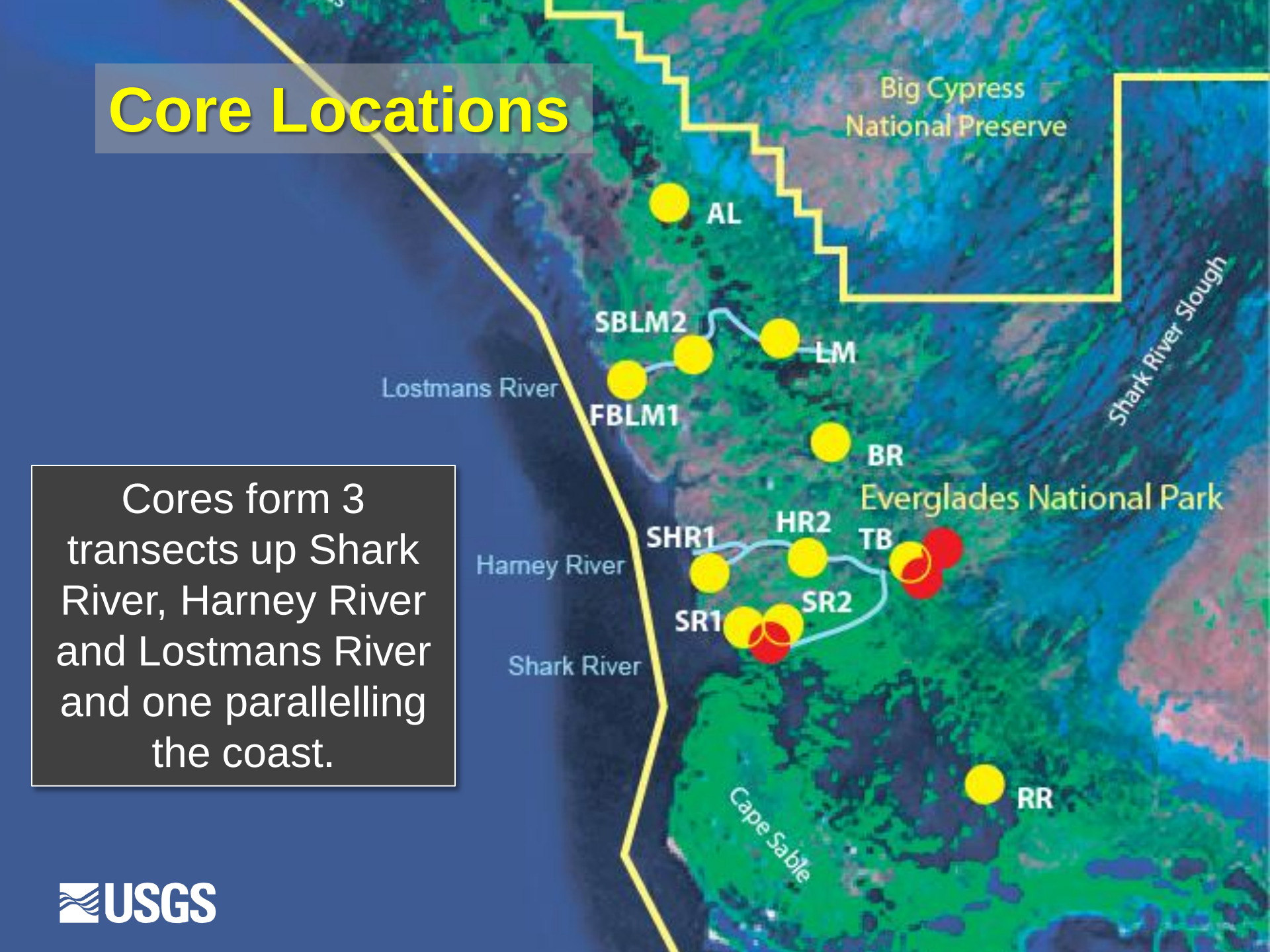
What is the history of Sea Level Rise for South Florida?

Years BP	
6-7000	Freshwater peats began forming on FL platform underlying FL Bay – Sea Level was ~6.2 m below present
5000	Sawgrass and water lily peats forming in area of present Everglades wetlands
~3000	Rates of SLR slowed and stabilized FL coastline – began transition to mangrove peats
Last 2000	Hydraulic fluctuations and global changes in climate and SLR have affected entire system
~1000	Temporary slowing or still-stand in SLR



From Willard & Bernhardt 2011
Climate Change, v. 107, p. 59-80.

Core Locations



Cores form 3 transects up Shark River, Harney River and Lostmans River and one parallelling the coast.

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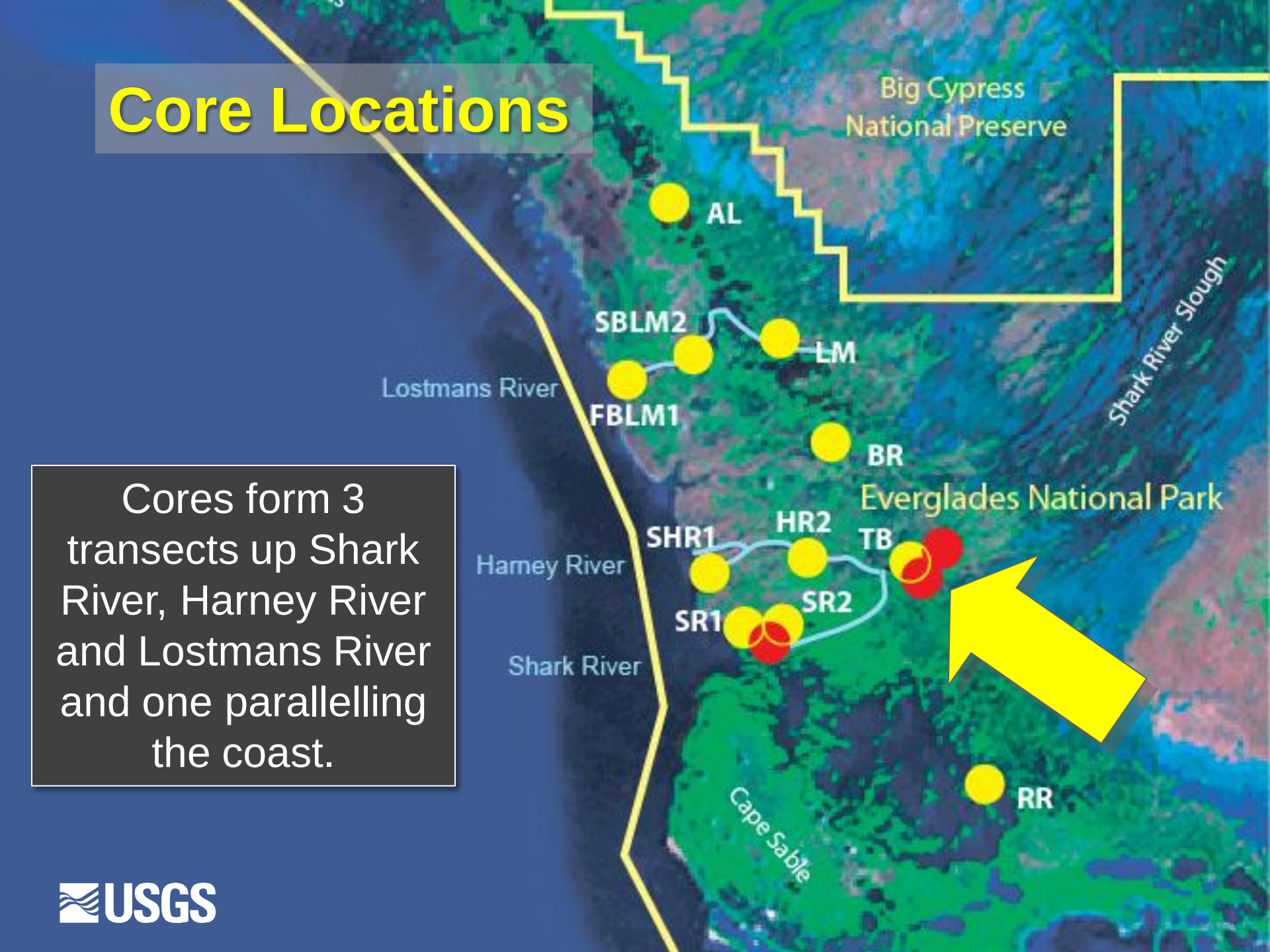
Core Locations



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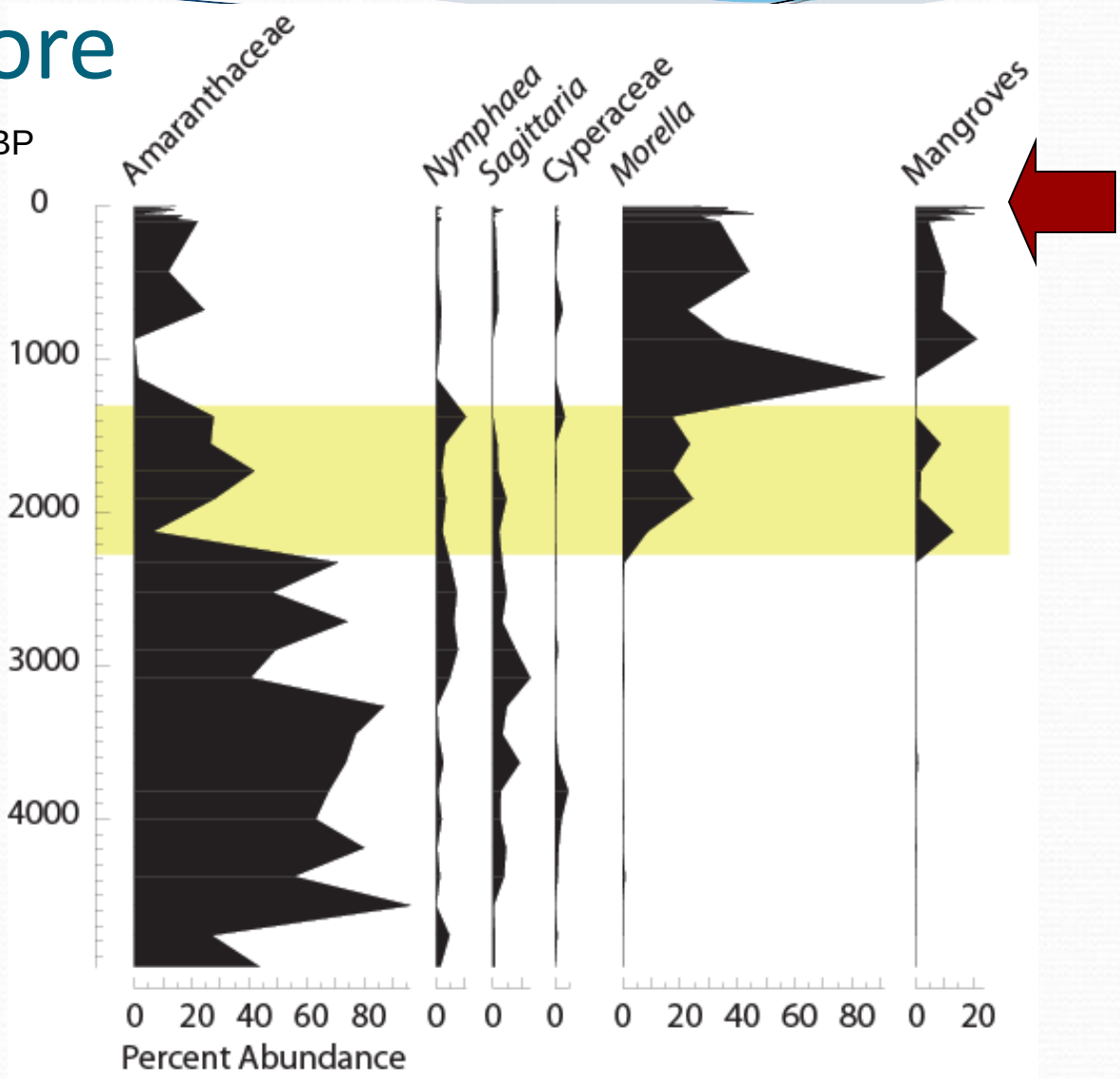
Tarpon Bay Core

Mangrove swamp – ~1 ka to present

Transition from fresh to mangrove - ~2.2 to 1.2 ka

Freshwater marsh – Prior to ~2.2 ka



From Willard & Bernhardt 2011 Climate Change, v. 107, p. 59-80.

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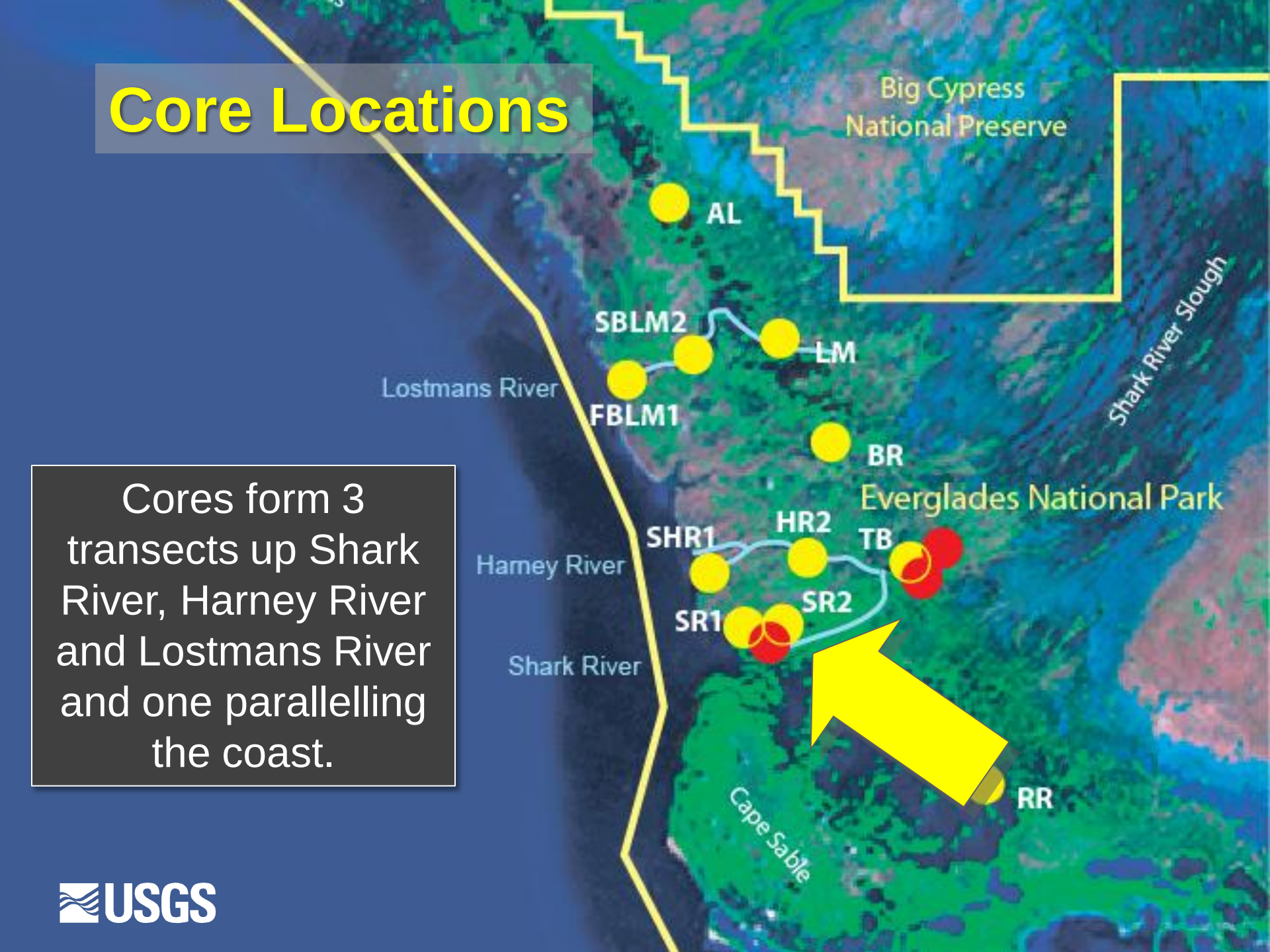
Core Locations



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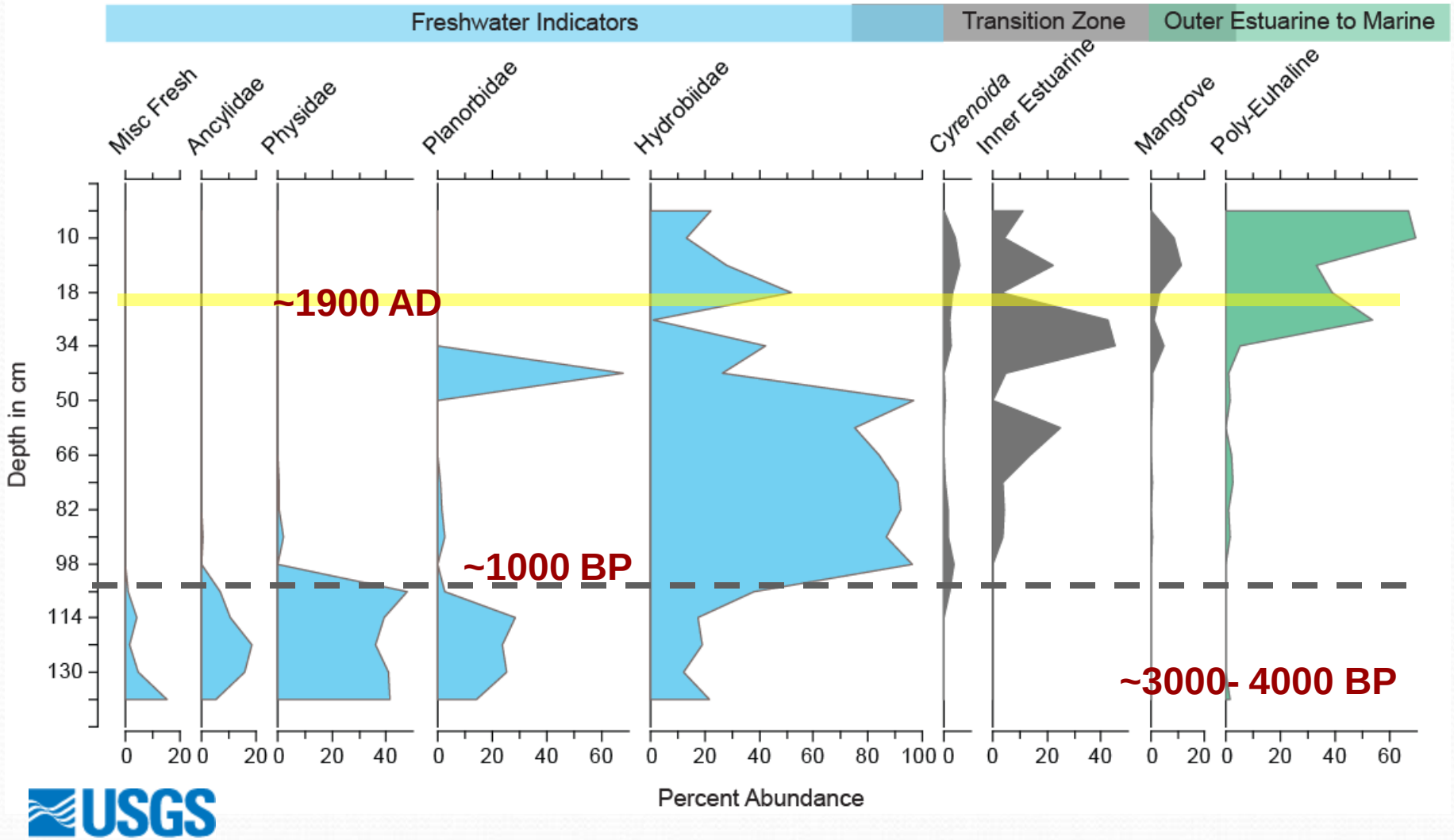
Shark River Slough Core 2A



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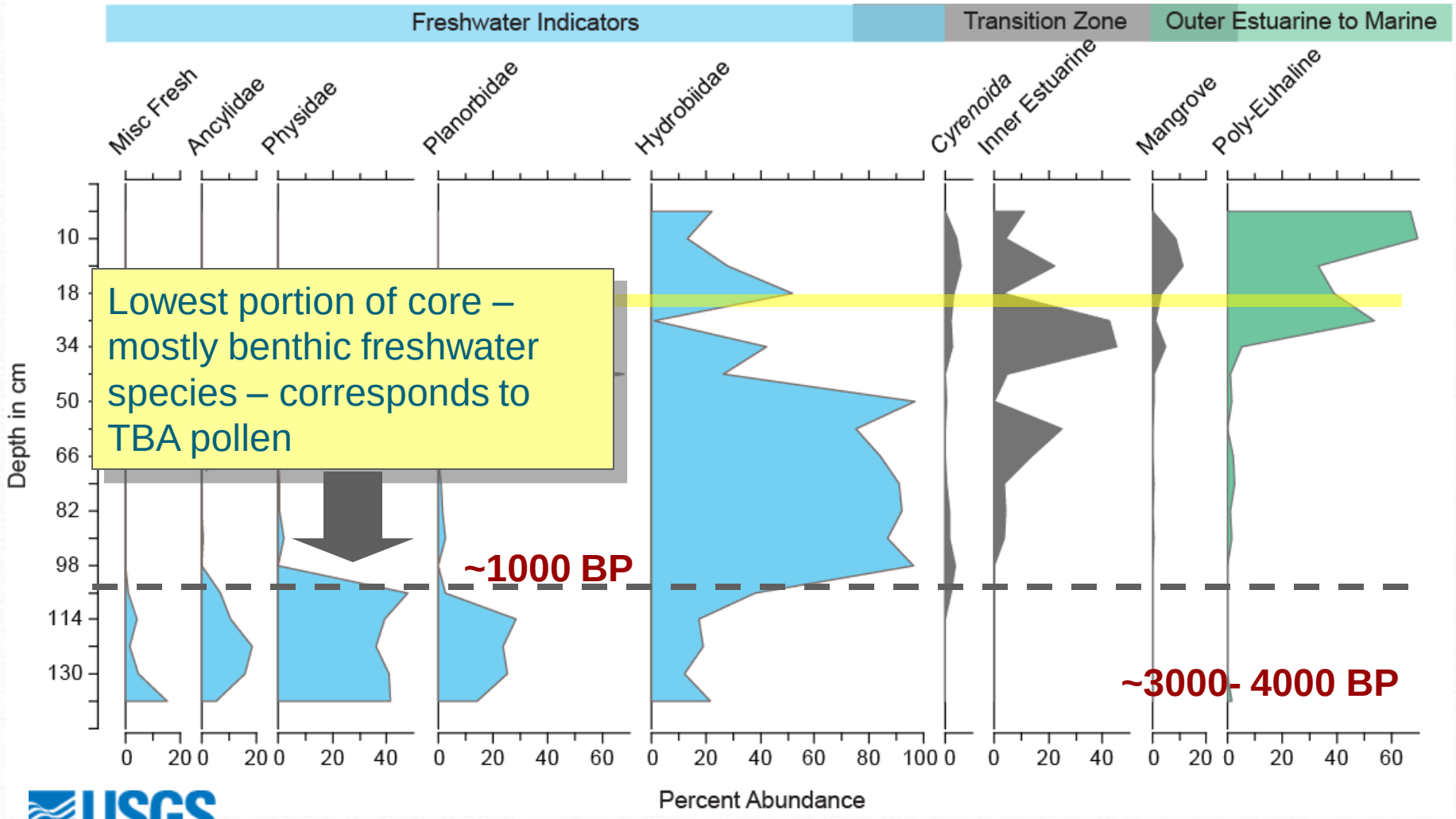

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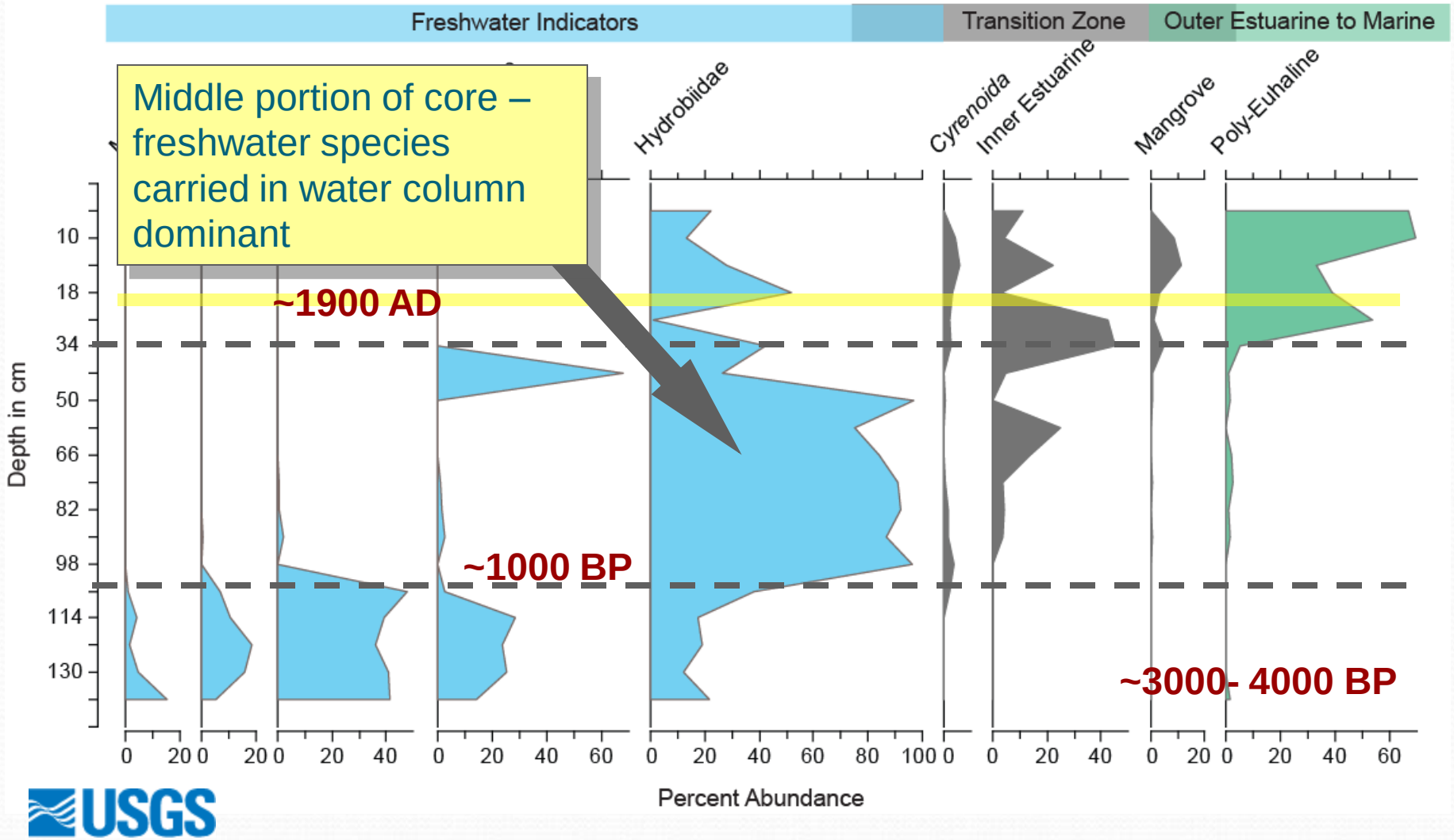

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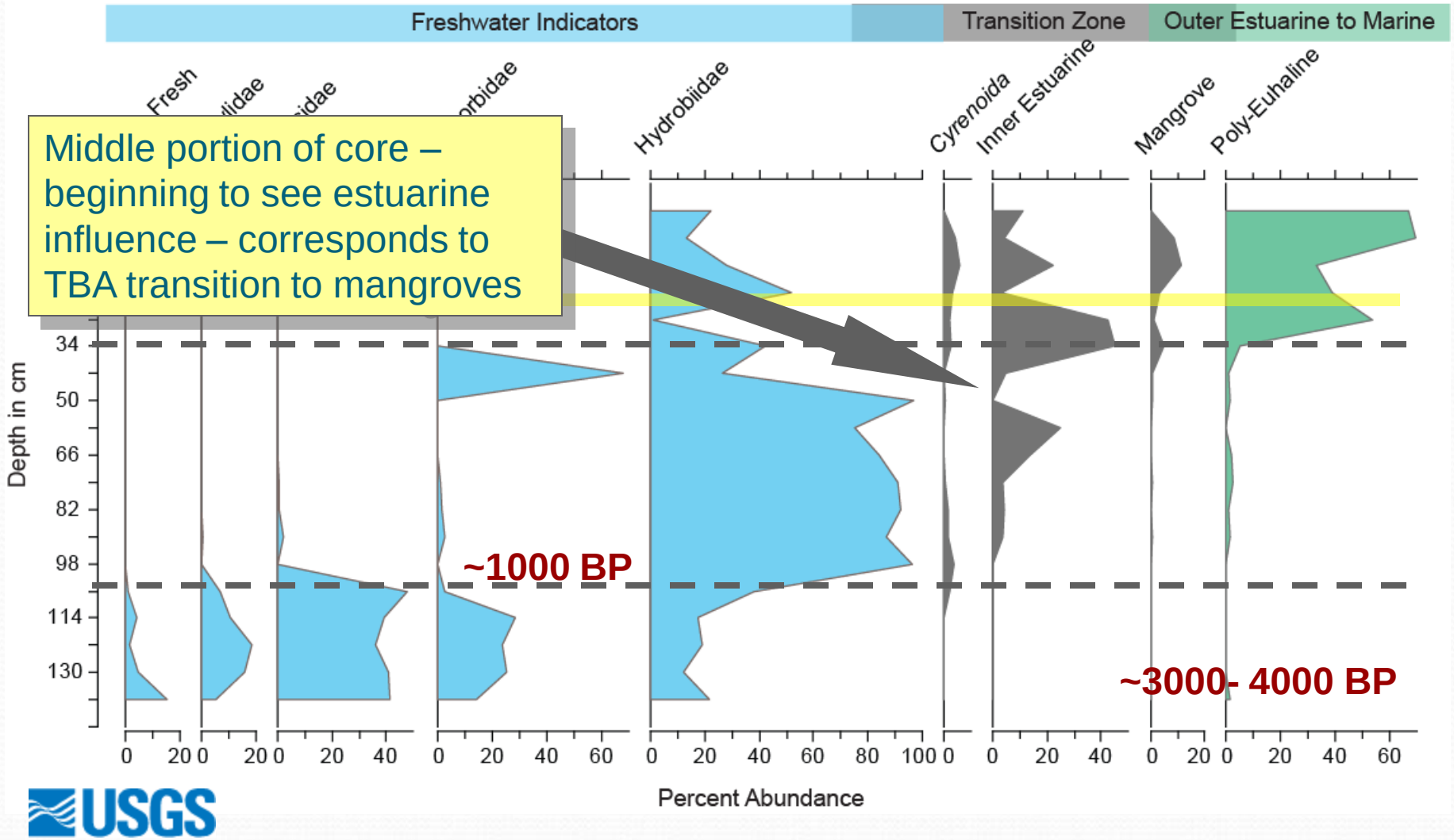

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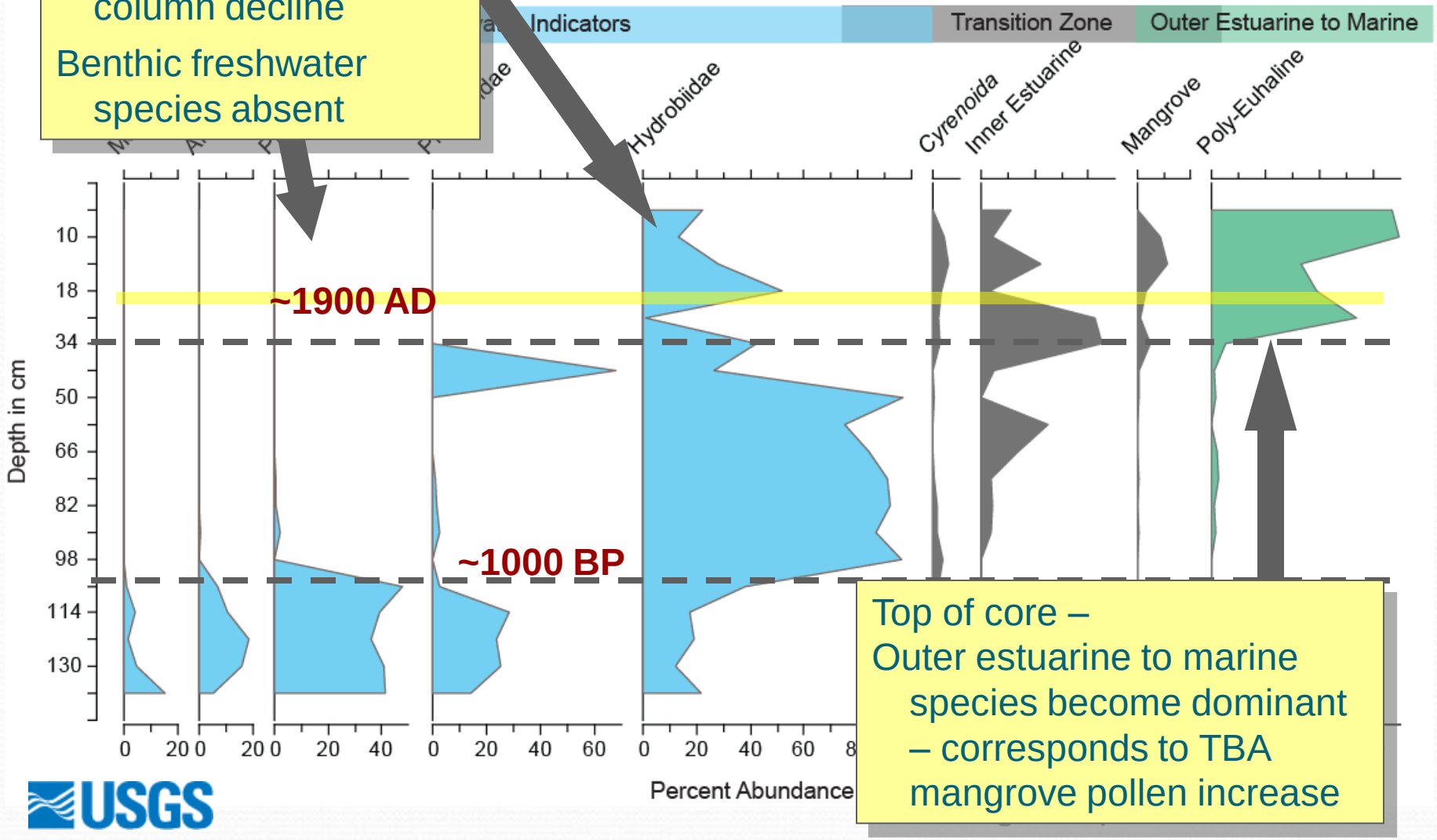
Slough Core 2A

Top of core –
- Freshwater species carried in the water column decline

Benthic freshwater species absent



Top of core –
Outer estuarine to marine species become dominant – corresponds to TBA mangrove pollen increase

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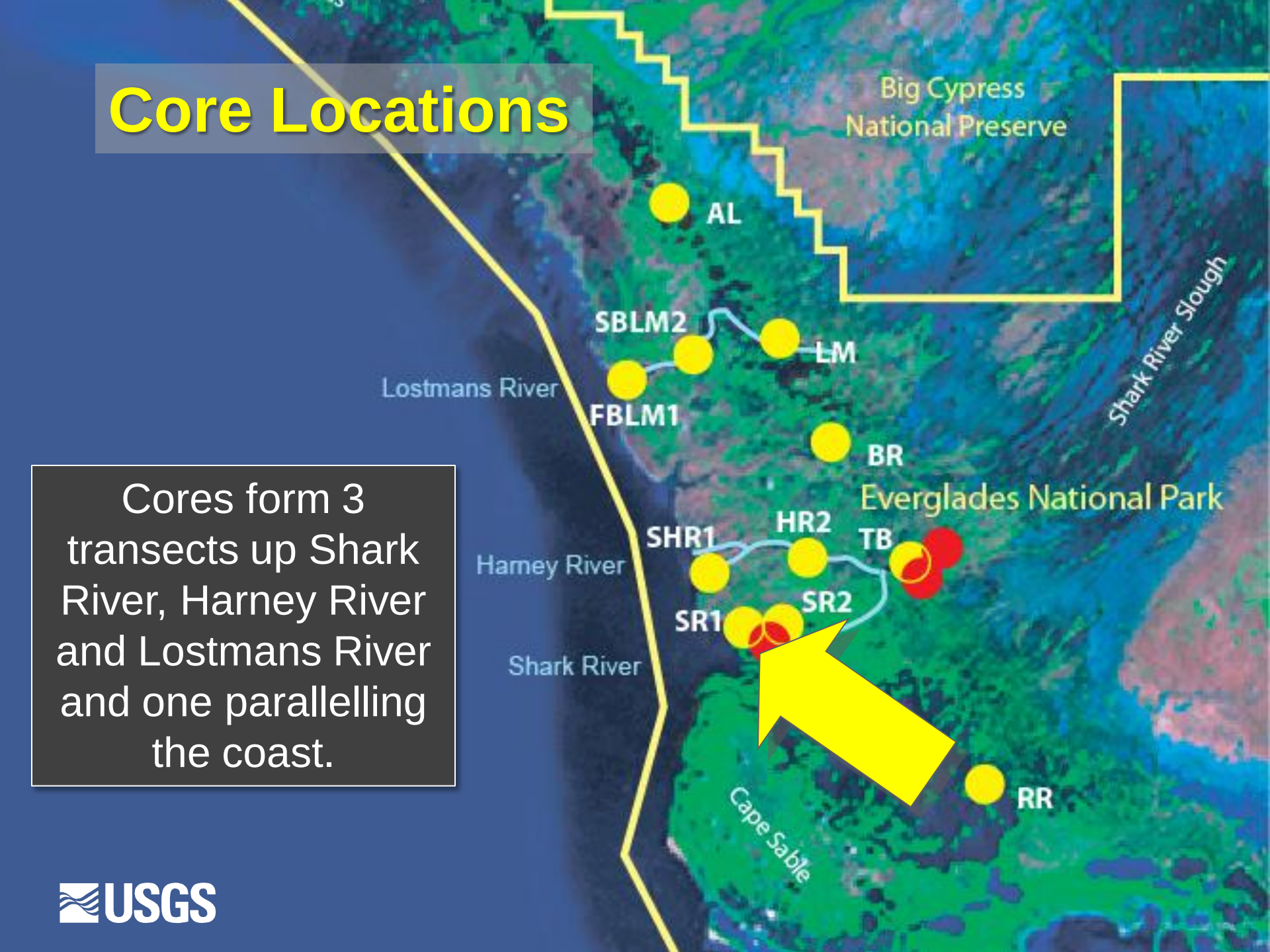
Core Locations



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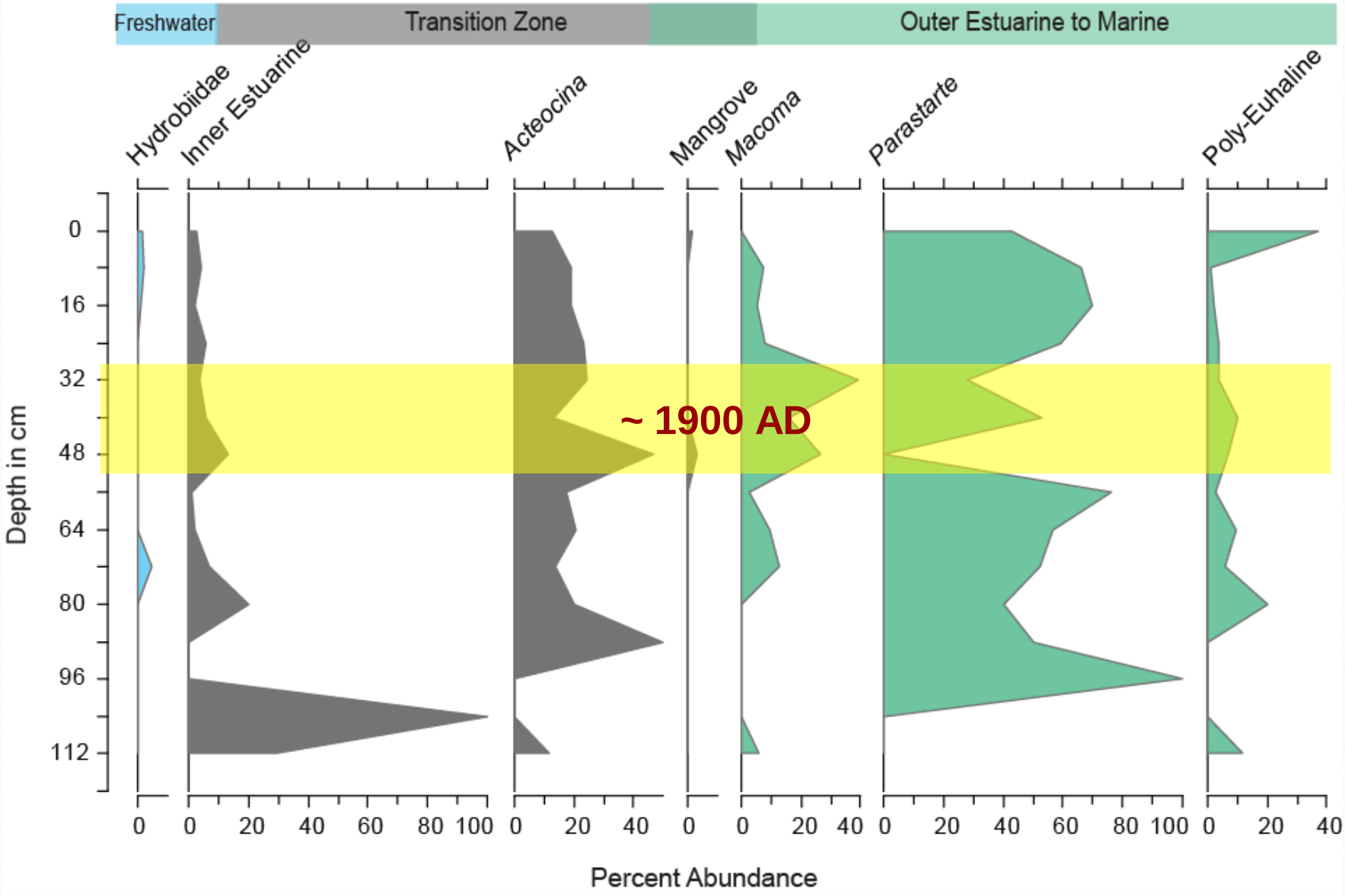
Shark River Slough Core 1A



What we know . . .

- Development of South Florida's coastal wetlands has formed due to a balance of processes – rates of sea level rise, climate, and freshwater supply
- Changes in these variables in the past have produced shifts in species composition
- Migration of vegetation zones has tracked sea level changes throughout the last 6-7000 years
- Past shifts seemed to be marked by transition periods, followed by periods of relative stability in species composition

Results will provide the context to predict future changes associated with accelerated SLR

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What next . . .

- Complete our age models and analyses of existing cores
- Identify areas where additional coring is needed – new cores will be collected with accurate elevation data
- Improve our modern analog dataset for the SW coast (see Stackhouse & Colley poster tonight)
- Develop Linear Regression Models for the SW coast to derive salinity and flow targets for the SW estuaries (Frank Marshall's talk Friday 9:20am Waterside A)

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For more information on research visit:
http://sofia.usgs.gov/

Thank you!

SOFIA
South Florida Information Access
Integrated Science for the Greater Everglades

For more information on MARES visit:
http://sofla-mares.org/

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