

Reconstructing Vegetation Response to Altered Hydrology and its use for Restoration, Arthur R. Marshall Loxahatchee National Wildlife Refuge, Florida

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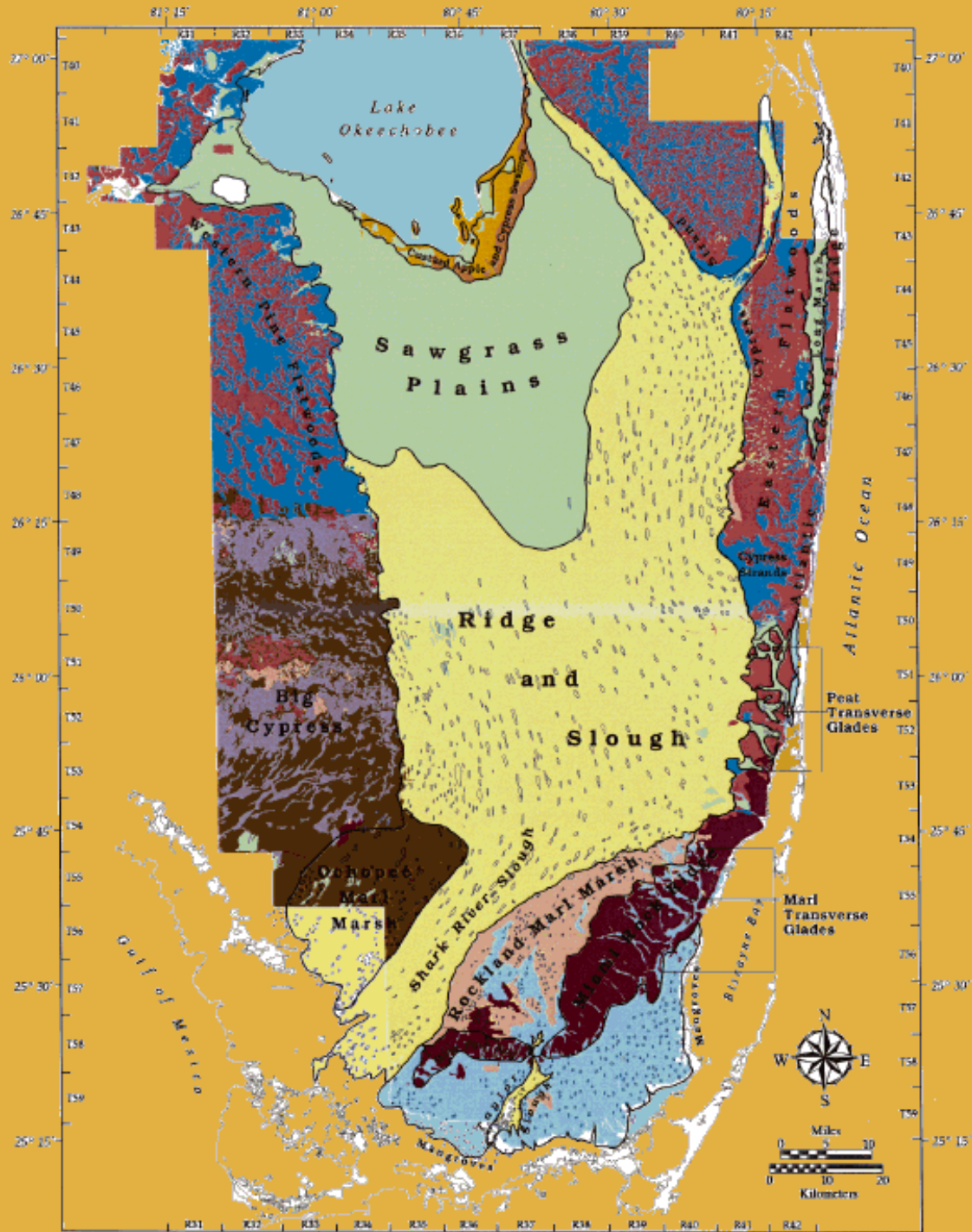
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NCER 2011



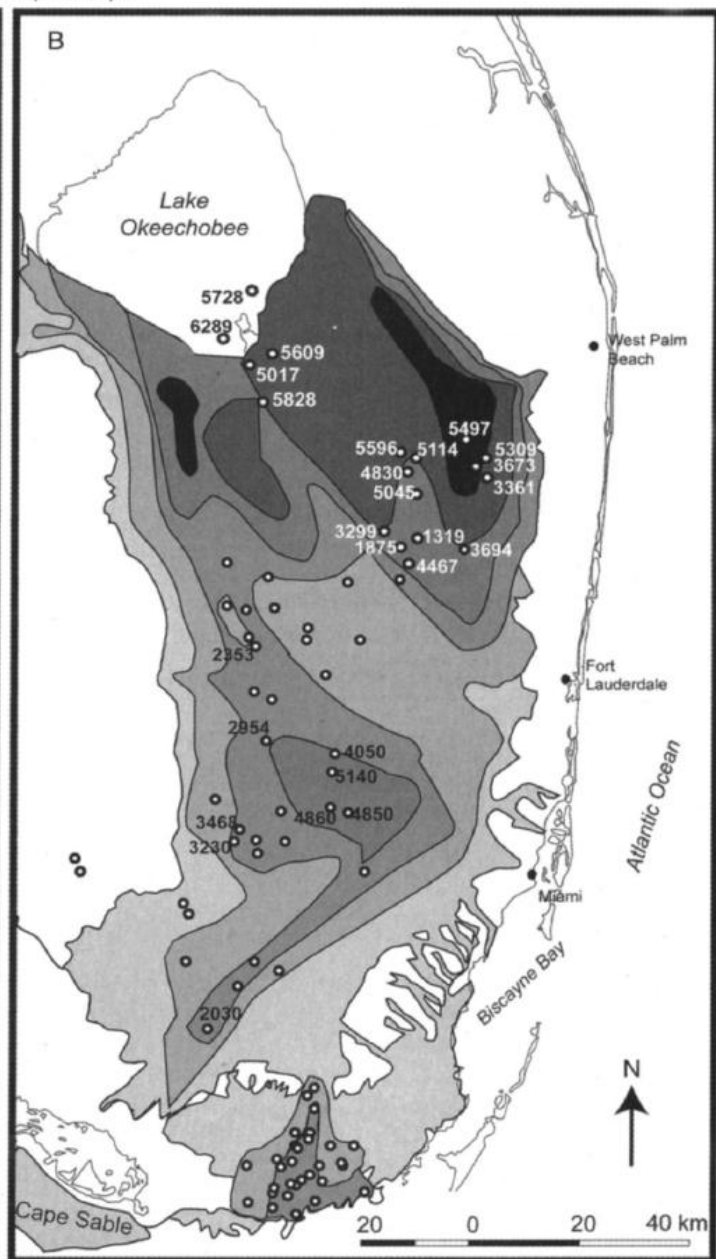
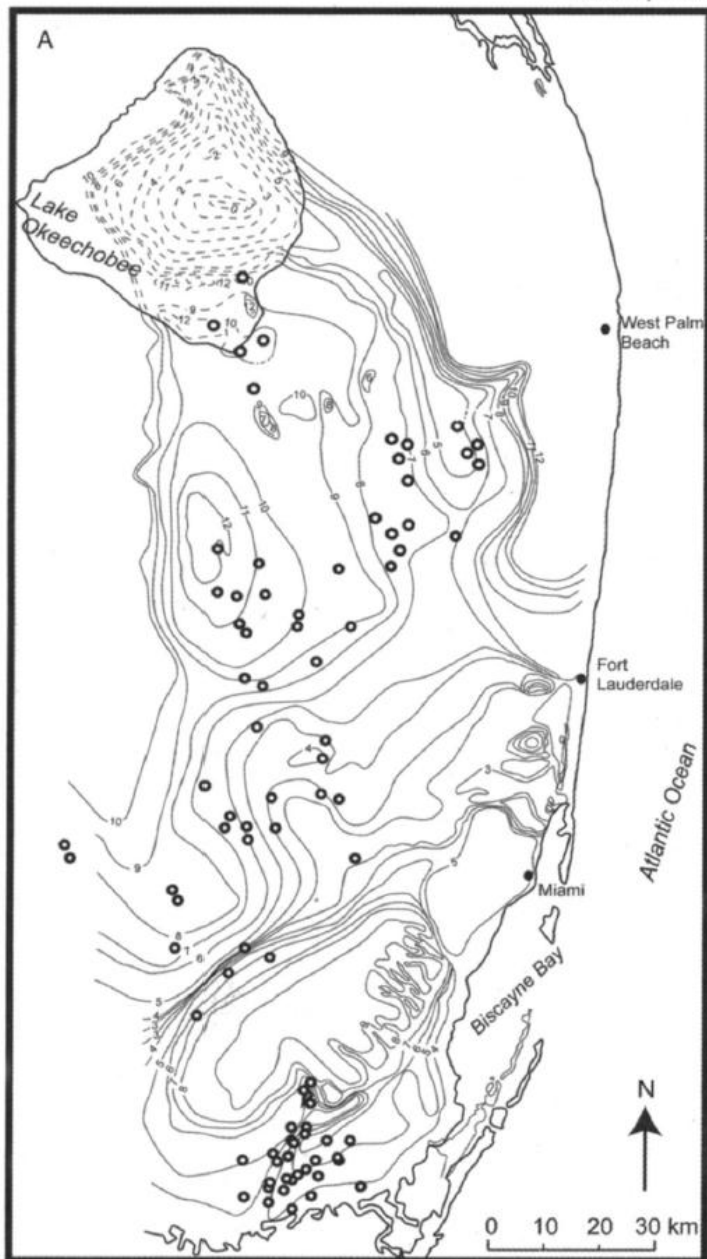
- A brief history of the Everglades and A.R.M. Loxahatchee National Wildlife Refuge
- Sampling and analysis
- Results
- Management implications

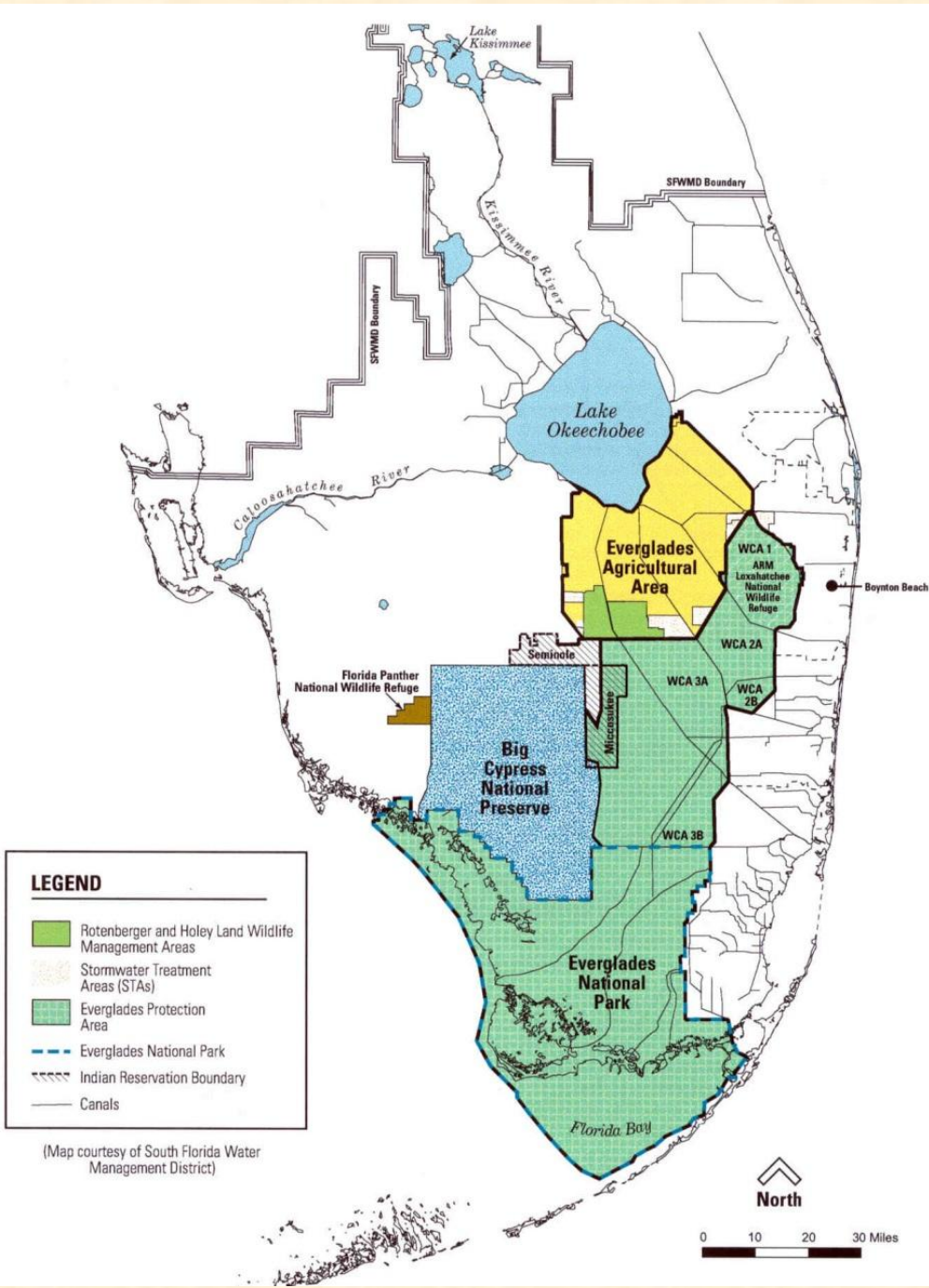


Peat depth (cm)



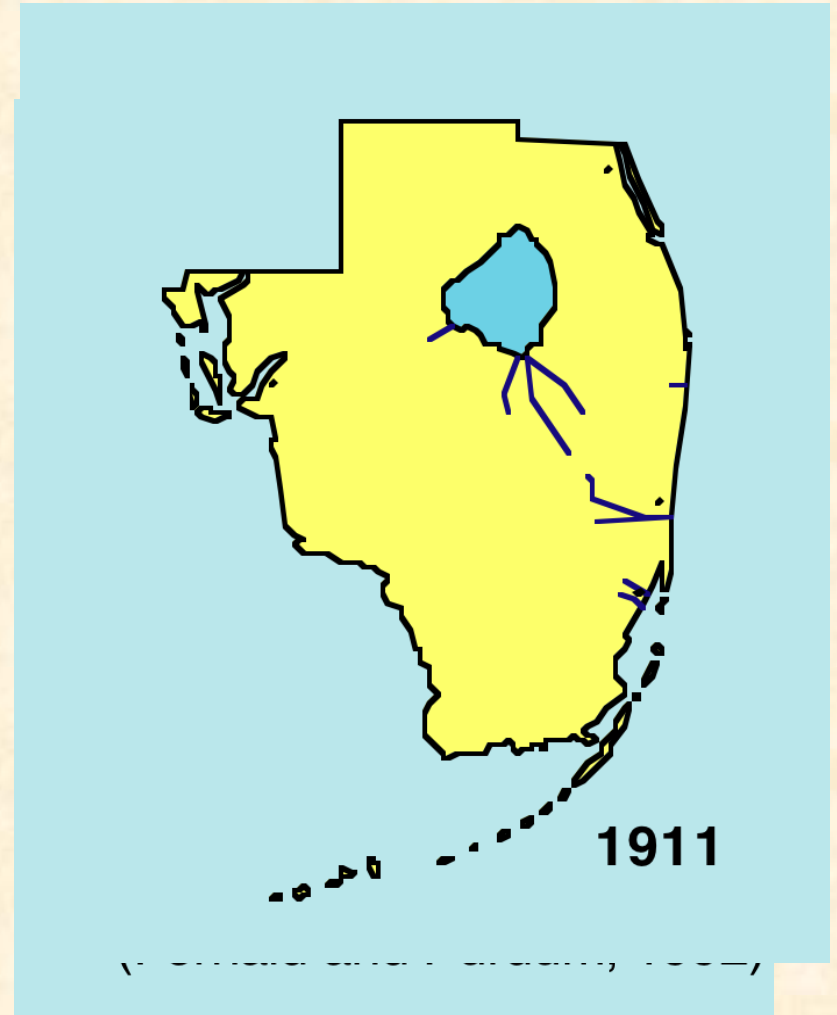
• Control points for peat depth



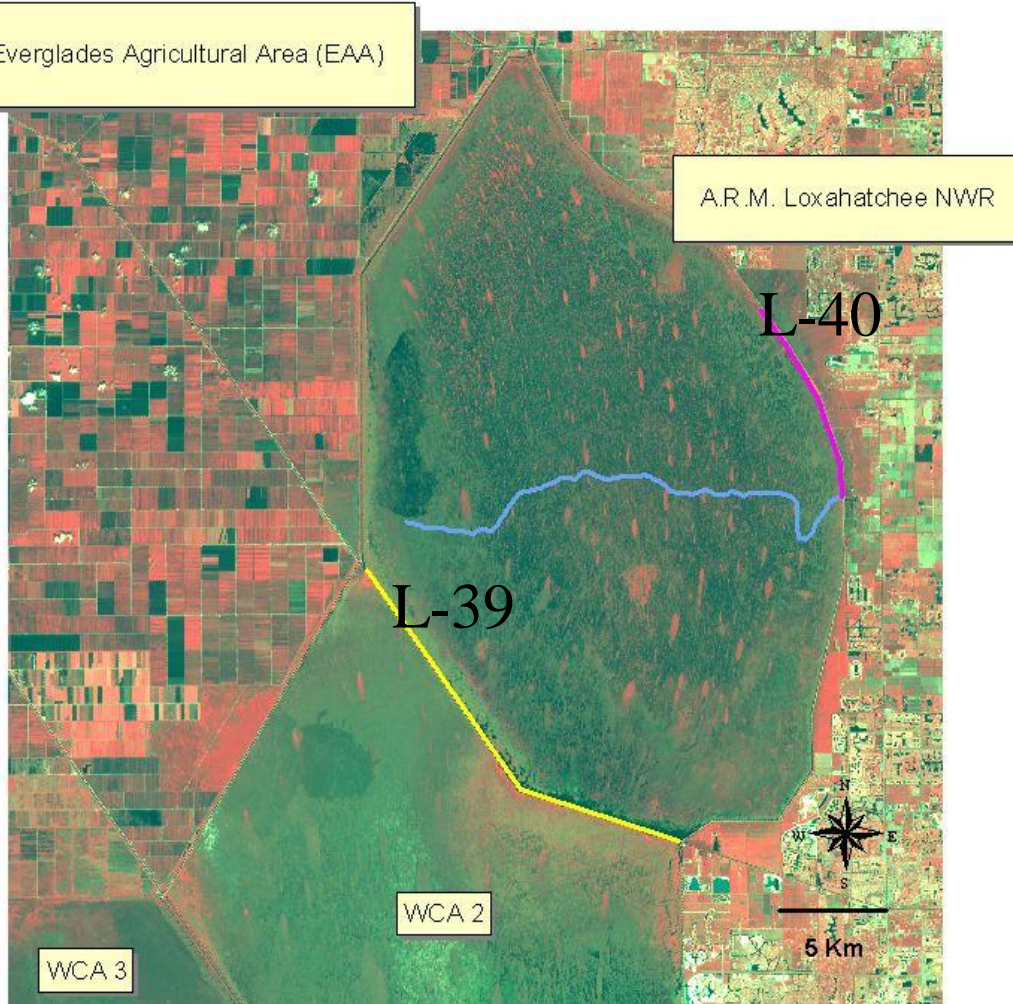


Phases of Drainage

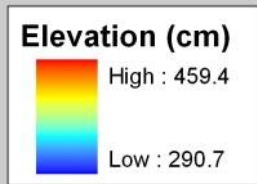
- 1882-1896- Lake Okeechobee phase
- 1906-1930- Muck canal phase
- 1950-1975- Impoundment phase (Central and South Florida Flood Control Project)



Loxahatchee National Wildlife Refuge



- Established in 1951 under the Migratory Bird Conservation Act and as mitigation for the C&SF project
- Overlay of State lands (WCA-1) plus fee title
- Managed by USFWS as part of the National Wildlife Refuge System
- Water levels managed under a water regulation schedule







Hydrologic Change Timeline

- 1951 establishment of Loxahatchee National Wildlife Refuge
- 1952-1961 Construction of levees and canals around refuge
- 1960-1969- First water regulation schedule established by COE
- 1969-1975- Request to increase minimum stage
- 1975-1995- Request to decrease water levels in dry season
- 1995-present- Request to increase wet season water levels

Objectives

- Reconstruct vegetational and hydrologic trends of the last three centuries in three areas of the refuge
- Compare patterns to known water-management actions
- Use the information to help define future desired conditions for the refuge

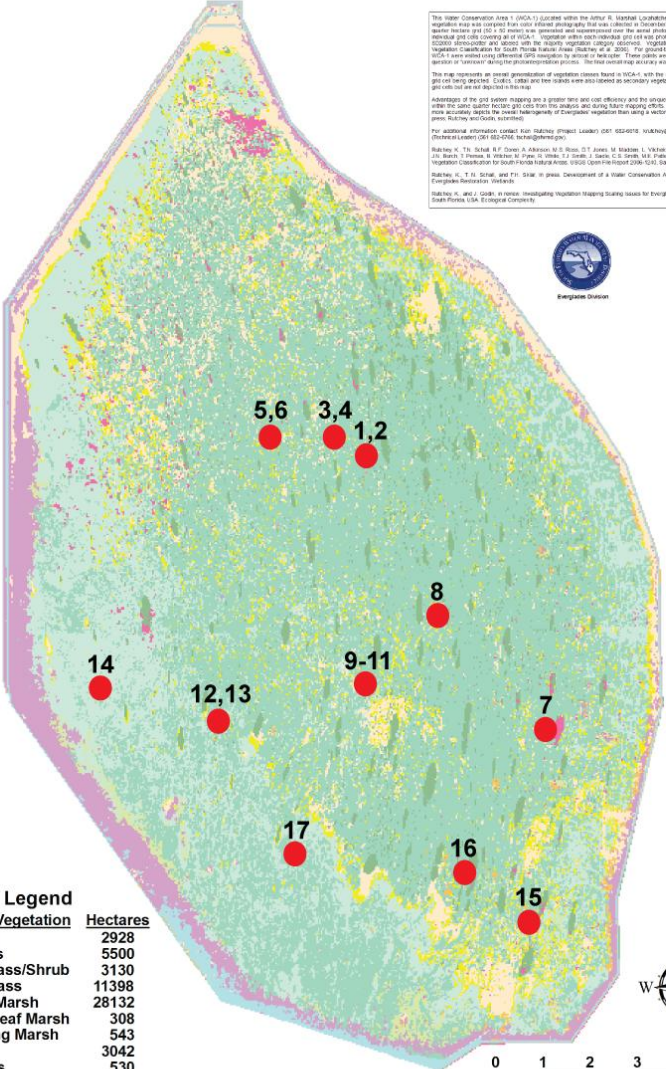
Methods

- Collection of sediment cores
- Core description



WATER CONSERVATION AREA 1 CERP RECOVER VEGETATION MAP

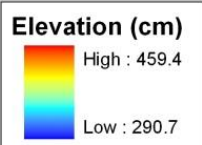
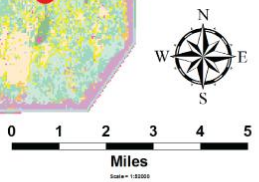
This Water Conservation Area (WCA-1) located within the central St. Leger National Wildlife Refuge (NWR) contains a large area of wetlands and is a critical component of the Everglades ecosystem. The map displays the current vegetation cover and the potential for recovery of the Everglades ecosystem. The map is based on a 2008 aerial photograph and a 2008 digital elevation model (DEM) derived from a 2008 lidar scan of the area. The map is based on a 2008 aerial photograph and a 2008 digital elevation model (DEM) derived from a 2008 lidar scan of the area. The map is based on a 2008 aerial photograph and a 2008 digital elevation model (DEM) derived from a 2008 lidar scan of the area.



- Core Number**
- 1 = 04-9-20-1
 - 2 = 04-9-20-2
 - 3 = 04-9-20-4
 - 4 = 04-9-20-5
 - 5 = 04-9-20-6
 - 6 = 04-9-20-7
 - 7 = 05-7-25-2
 - 8 = 00-3-7-1
 - 9 = 02-05-20-2
 - 10 = 02-05-20-3
 - 11 = 02-05-20-4
 - 12 = 04-9-21-1
 - 13 = 04-9-21-2
 - 14 = 95-4-21-2
 - 15 = 05-7-26-2
 - 16 = 05-7-26-4
 - 17 = 05-7-26-6

Legend

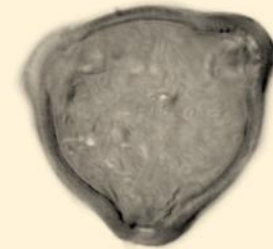
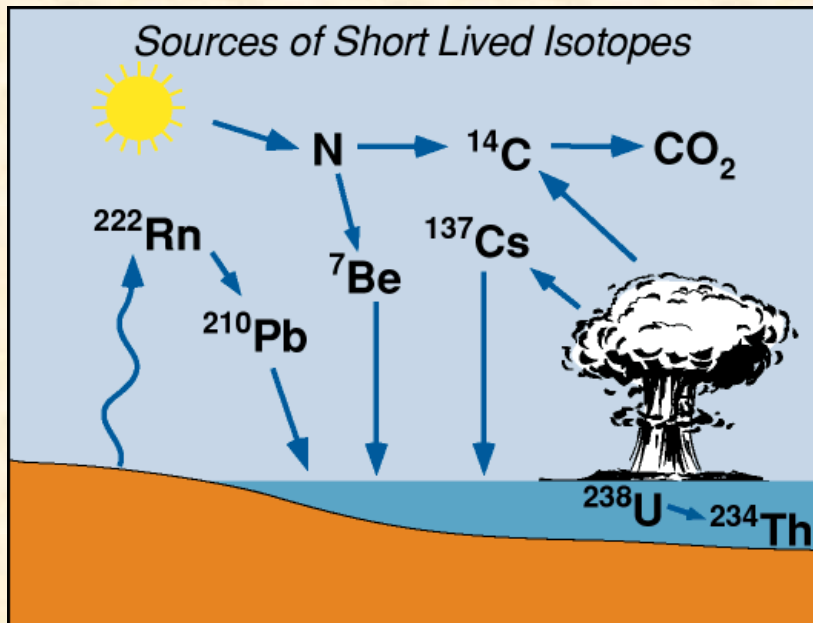
Dominant Vegetation	Hectares
Trees	2928
Shrubs	5500
Sawgrass/Shrub	3130
Sawgrass	11398
Open Marsh	28132
Broadleaf Marsh	308
Floating Marsh	543
Cattail	3042
Exotics	530
Open Water/Canals	983
Spoil Areas	363



Source: Everglades Depth Estimation Network (EDEN) January 2010 Digital Elevation Model

Dating and Age Models

- Lead-210 dating
- Carbon-14 dating
- First occurrence of *Casuarina* pollen in early 20th century



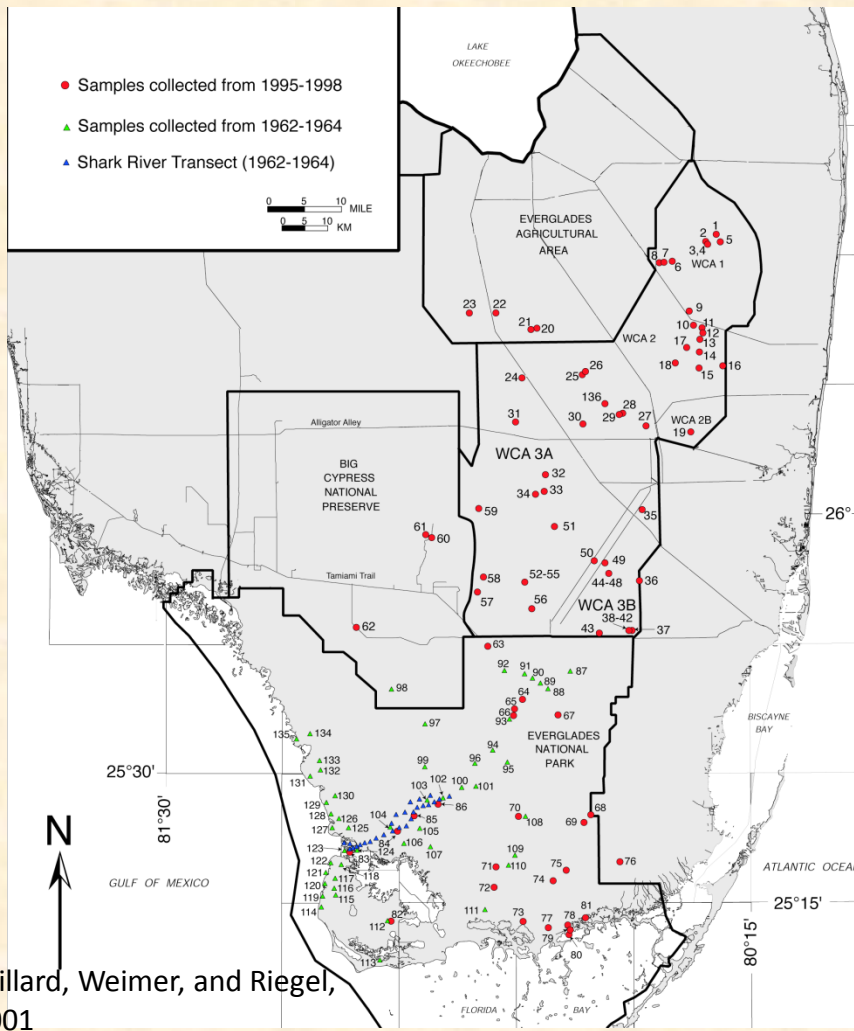
Analysis of downcore pollen assemblages and calibration with modern analogs

Sampled Wetland types

- Tree islands
- Mangrove forests
- Brackish marshes
- Cattail marshes
- Sloughs
- Sawgrass ridges
- Sawgrass marshes
- Marl Prairies
- Cypress strands and domes

Environmental Parameters

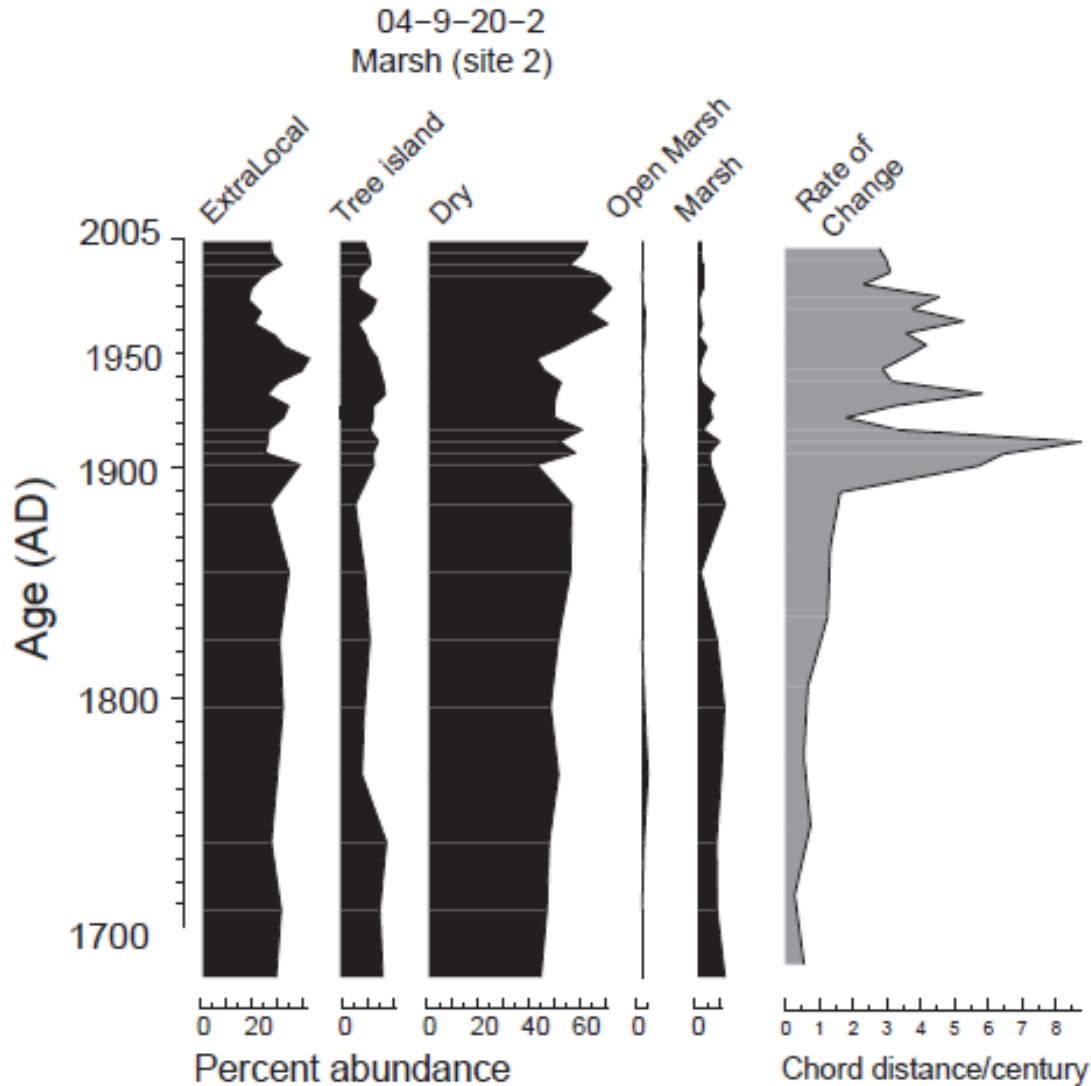
- Hydroperiod
- Water depth
- Nutrient status
- Substrate type



Functional Groups

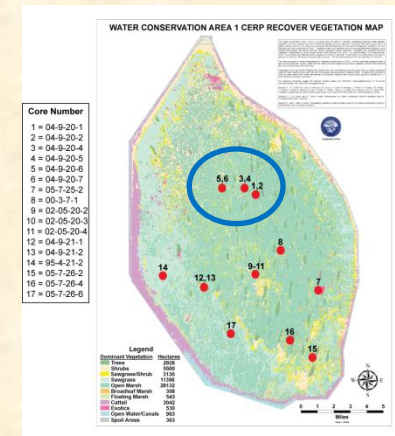
- **Extralocal-** *Pinus* and *Casuarina*
- **Tree island-** Subtropical hardwood trees and ferns
- **Dry-** plants who respond positively to extended drying conditions such as *Ilex*, *Morella*, *Amaranthaceae*, *Asteraceae*, *Polygonaceae*
- **Open marsh-** taxa from deeper water marshes with sparse vegetation cover (i.e., *Nymphaea*, *Utricularia*, and *Nuphar*)
- **Marsh-** taxa common in sawgrass marshes and wet prairies (i.e., *Cyperaceae*, *Sagittaria*, *Pontedaria*, *Poaceae*, *Typha*)

Results

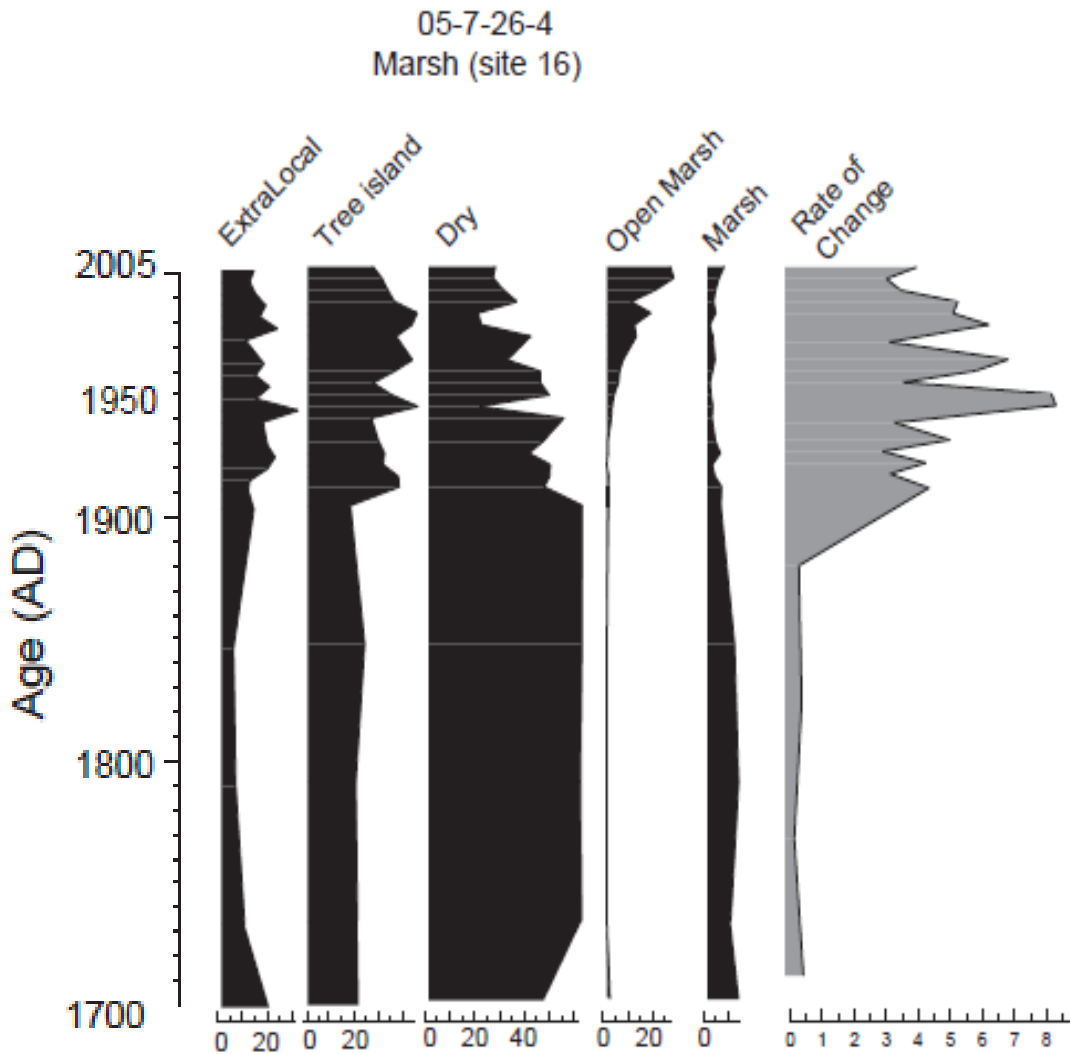


North

- Large rate of change after 1900
- Increase in Asteraceae after 1950
- Decrease in marsh
- Absence of Sagittaria

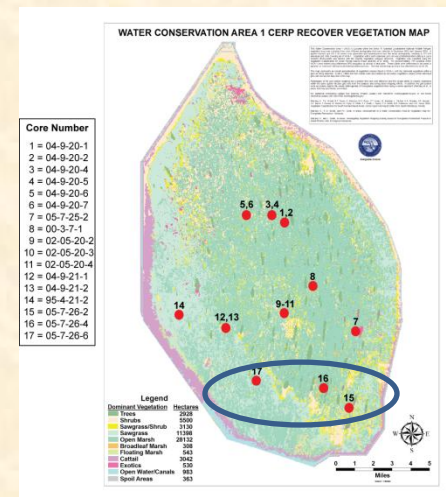


Results



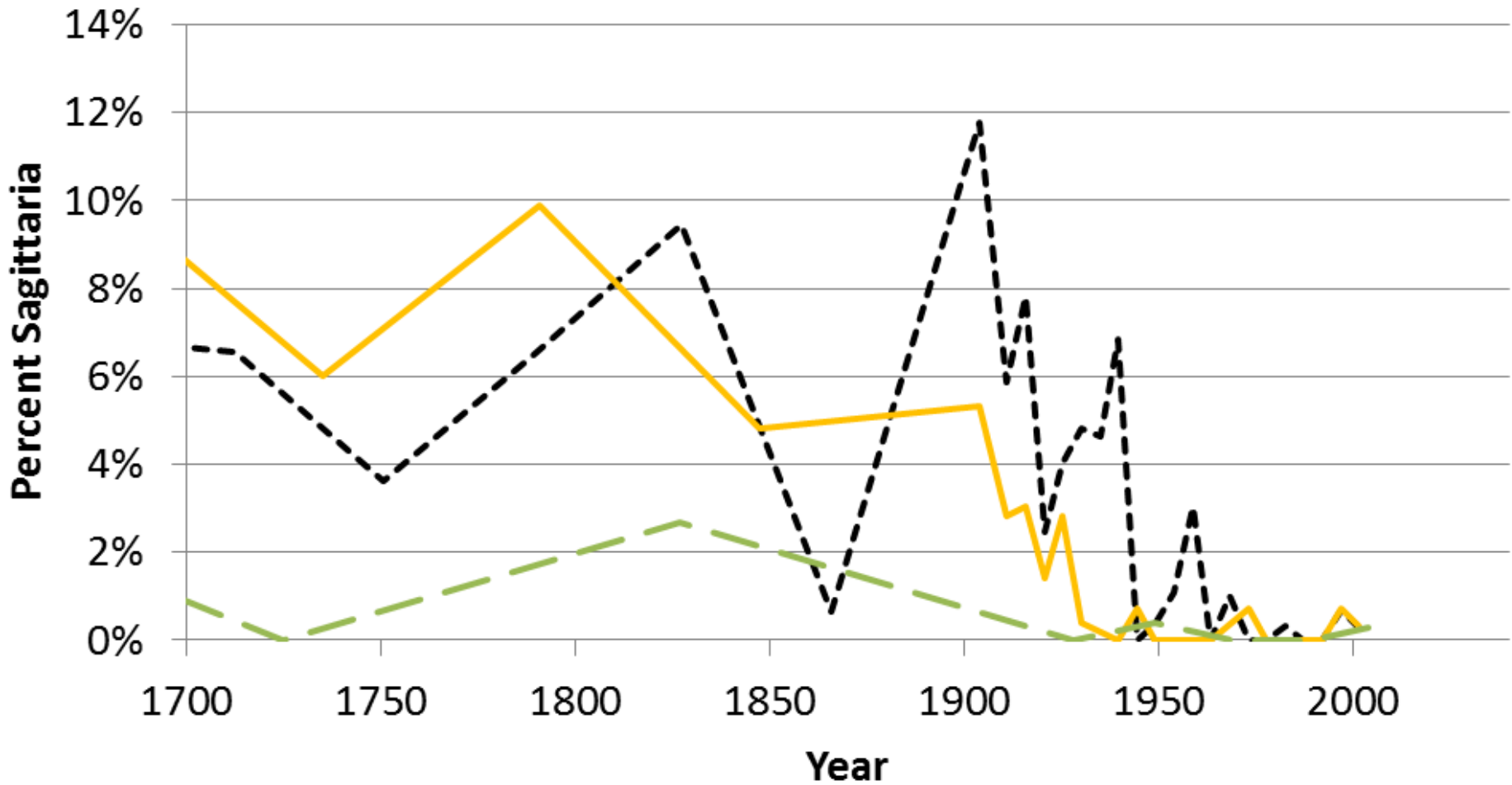
South

- Rate of change increased about 1900 -greatest around 1950
- Increase in open marsh after 1950
- Decrease in Sagittaria



Sagittaria

--- North — South - - Central



Post-Drainage Pollen Assemblages

- Overall: Asteraceae pollen abundance increased in all sites in the early 20th century, and pollen of typical marsh species (Cyperaceae, *Cladium*, *Sagittaria*) became rare
- Northern sites: pollen response is minor enough that there are no changes in modern analogs throughout the 20th century, but overall the response is toward drier conditions
- Central sites: more significant shifts to analogs found only in Loxahatchee
- Southern sites: the abundance of *Nymphaea* pollen deposited after 1950 indicates wetter slough-like conditions

Conclusions

- There have been larger changes to marsh vegetation in the refuge in the last 100 years compared to the previous 300 years
- Prior to AD 1900, pollen assemblages from all Loxahatchee marshes are analogous to Everglades sawgrass marshes near tree islands
- After AD 1900, weedy species, primarily the Asteraceae, became more abundant, but the assemblages remain analogous to sawgrass marshes

Conclusions

- A general decline in *Sagittaria* pollen is recorded in these cores throughout the Refuge after ~AD 1950
 - The suppression of seasonal to yearly variability due to water management is recorded by the decline in *Sagittaria* pollen throughout the Refuge
- The vegetation response throughout the Refuge is heterogeneous, from drier in the north to wetter in the south, though historically it was more homogeneous

Management Implications

- Refuge purpose
- Defining future desired conditions
 - Refuge policy
- Assessing water regulation schedule
 - Depth
 - Duration (hydroperiod)
 - Timing
 - Fluctuation

The Vision of the Refuge is:

*“To serve as an outstanding showcase for **ecosystem management** that restores, protects and enhances **a portion of the unique northern Everglades biological community**. This public asset provides for the enjoyment and enhanced quality of life for present and future generations.”*

From Refuge Policy

- **Biological Integrity** Biotic composition, structure, and functioning at genetic, organism, and **community levels comparable with historic conditions**, including the natural biological processes that shape genomes, organisms, and communities
- **Environmental Health** Composition, structure, and functioning of soil, water, air, and other abiotic features comparable with **historic conditions, including the natural abiotic processes that shape the environment**
- **Historic Conditions** Composition, structure, and functioning of ecosystems resulting from natural processes that we believe, based on sound professional judgment, **were present prior to substantial human related changes to the landscape**

Assessing the Water Regulation Schedule

