Summary of Paleoecology Workshop, GEER Conference June 2006
Application of Paleoecological Information to Restoration Planning and Resource Management

Workshop Organizers: G. Lynn Wingard, USGS and Patrick Pitts, USFWS

Goals of Workshop

The purpose of the workshop was to bring together scientists conducting paleoecologic research in the Greater Everglades Ecosystem with managers and stakeholders responsible for making resource management and restoration planning decisions. Scientists presented summaries of their latest results in ecosystem history and paleoecologic research with an emphasis on the application of their findings to perceived management needs. Natural cycles of change (climate, sea level) versus anthropogenic changes were discussed in terms of the impact on restoration goals and targets. The morning workshop presented a case study in how scientific results from paleoecologic research are being utilized by managers to set targets and performance measures for the southern estuaries. An important component of the workshop was to illustrate how paleoecologic data is being utilized by modelers.

The discussion session following formal presentations allowed managers and stakeholders to discuss their information needs related to the history of the ecosystem and what gaps in information exist. These discussions allowed direct interaction between the scientists and the managers and led to interesting discussions on the challenges of restoring a dynamic system that has a long-term history of change.

Session I: Case History of Application of Paleoecologic Data in the Southern Estuaries

Lynn Wingard, USGS — *Ecosystem History of South Florida's Estuaries - What do We Know and What does it Mean for Restoration?*

Patrick Pitts, USFWS – *Using Paleosalinity Data to Refine Salinity Targets in Florida's Southern Estuaries*

Don Deiss, EPJV — *Applying Paleoecological Information to Target Setting for Florida Bay Restoration*

Frank Marshall, ECT Inc. — *The Use of Statistical Models with Paleosalinity Data to Simulate the Pre- Drainage Hydrology in the Greater Everglades Ecosystem*

Session II: Paleoecologic Data in the Wetlands and Innovative Approaches

Debra Willard, USGS — *Response of Loxahatchee Tree Islands and Marshes to 20th Century Hydrologic Change*

Colin Saunders, FIU — *More Sawgrass, More Problems: Confronting Ecosystem Models with Paleo-ecological Proxies to Hindcast Cladium jamaicense Biomass over the Last Century in Everglades National Park*

Brian Beckage, UVT — Reconstructing Historic Fire Regimes and Vegetation Patterns by Linking Landscape Models to Global Climate

Bane Schill, USGS — *Assessment of Historical Ecological Changes Using a Molecular Approach*

Session III: Estuarine Ecosystem History and Large Scale Factors Affecting GEER

William Orem, USGS — *Historical Changes in Carbon, Nitrogen, and Phosphorus in Sediments from Biscayne Bay and Florida Bay*

Michael Savarese, FGCU — *Holocene History of Oyster Reef Development along the Southwest Florida Coast: Implications for Coastal Evolution and Estuarine Restoration*

Thomas Cronin, USGS — *Climate Variability, Sea-level Rise, and Coastal Ecosystem Restoration*

Summary of Key Points from Workshop:

CONCEPT I: Changes in the estuaries have been occurring over the last several thousand years, but the rates of change have accelerated in the 20th century

- Paleosalinity data indicate gradual increases throughout the south Florida estuaries over time, and some of these changes are consistent with sea level rise [Wingard]
    - HOWEVER – the rate of change in salinity regimes has increased in the 20th century
    - Homogenization of the estuarine environment seems to be taking place in the later part of the 20th century
- Geochemical data show that rates of N and P accumulation are much higher in the estuaries than in Greater Everglades wetlands [Orem]
    - In Biscayne Bay increases in concentrations of C, N, and P have occurred in the second ½ of 20th century, with concentrations being higher in the south and accumulation rates higher in the north
    - In Florida Bay also has seen increases in 20th century, with increases in N and P concentrations at most sites in eastern Bay, and increases in C, N, and P in the west

CONCEPT II: Application of Paleoecologic Data in the Southern Estuaries

- **Initial Steps by the CERP Southern Estuaries Team [Pitts]**
    - NSM used to validate/verify initial salinity targets, but comparisons were not favorable and revealed the need for additional information
    - Paleosalinity data used to validate/verify NSM predictions (lots of paleoecology data available)
    - Comparisons showed that NSM consistently predicted salinities that were higher than the paleosalinity data indicated for pre-drainage condition (3-24 ppt higher)
- **Recent Steps [Deis; Marshall]**
    - NSM used to convert paleosalinity regimes to paleosalinity time series to further investigate temporal variability
    - Statistical models (linear and multivariate linear regression models) used to:
        - Predict pre-drainage salinity conditions in basins where no paleosalinity data are available
        - Predict stages required in GEE to achieve paleosalinity regimes in the southern estuaries
    - Statistical models appear to be capable of simulating upstream hydrology from paleosalinity estimates. Implications:
        - May provide mechanism to validate GEE hydrology performance measures
        - Relationships can be established between southern estuaries and GEE regions since the Everglades hydrology and salinities in the estuaries are coupled through the models
        - Freshwater flow estimates can serve as an initial starting point for using mass balance and physical based models of the system (FATHOM, SICS/TIME and SFWMM)

<u>CONCEPT III:</u> Terrestrial Ecosystems have been evolving naturally over time, however, the rate of change increased in the 20th century

- Land-use and water-management practices of the late 20th century have caused greater changes to tree-island and marsh plant communities than changes due to natural climate variability [Willard]
- Ponding of water in the southern Loxahatchee Refuge has lengthened hydroperiods enough to alter composition of tree-island communities. In the north and central part of the Refuge diversion of water into canal sites has shortened hydroperiods and caused unprecedented changes in community composition on tree islands. [Willard]
- Returning to more natural hydroperiods may facilitate eventual recovery of previous communities, but recovery probably will occur over decades rather than years. [Willard]
- Hindcasting historic *Cladium* using inverse models shows a 50-60 cm decrease in water levels since 1930 [Saunders]

<u>CONCEPT IV</u>: Large scale global changes are outside the scope of CERP, but need to be factored into restoration planning

- **Climate Change – Factors that need to be considered: [Beckage; Cronin]**
  - Global Warming
  - Precipitation
  - Hurricane frequency
  - El Nino (ENSO) / La Nina
  - North Atlantic Oscillation (NAO**)**
  - Climate changes over the last century and predicted climate change over the next 50 years may not allow a return to the historic Everglades. [Beckage]
- **Sea Level Rise [Cronin; Savarese]**
  - Sea level has risen 21 cm / 100 years - Some of this is natural some is anthropogenic [Cronin]
  - Projections of future sea level rise are not taking ice melting into account [Cronin]
  - Holocene oyster beds in the SW coastal area shows average of ~ 4 cm sea level rise / century over the last 3000 years. This rate of rise is conducive to formation of oyster reefs and classic SW coast geomorphology [Savarese]
  - Last few decades – sea level rise has been 30-40 cm century and is outpacing oyster reef accretion; therefore there is the potential for gross geomorphological change of the SW coast line. [Savarese]

<u>CONCEPT V</u>: New or Innovative Paleoecologic Tools

- Study of relationship between seed profiles in cores and biomass of Cladium – demonstrated seeds are an accurate predictor of biomass [Saunders]
- Analysis of microbial DNA in cores is providing a new means of assessing environmental changes over time [Schill]

SUMMARY OF DISCUSSION POINTS

- Participants recognized that large-scale factors such as climate change and sea level rise will have a major effect on restoration in the long term
    - Ultimately these factors will change restoration targets – this will be part of the adaptive management
    - This may have significant implications for some of the current target species

- However, in the short term participants generally agreed that targets should be set at or close to pre-drainage conditions as defined by paleosalinity data

- Idea was proposed that instead of setting targets at pre-drainage conditions, pre-1900 natural trends or patterns be projected forward into the 21st century. Perhaps the goal of restoration should not be to return to the 19th century, but rather to return the ecosystem to the condition it would have reached through natural change by the middle of the 21st century

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Organizer Qualifications

G.L. Wingard has been conducting ecosystem history research in South Florida since 1994 and is Chief of the USGS Ecosystem History of South Florida Estuaries Project. She has served as a USGS representative on several CERP Project Delivery Teams, and helped to write the USGS Science Plan for South Florida and the DOI Science Plan for South Florida.

P.A. Pitts has been involved with CERP since 2002 and has served as the USFWS representative on several CERP Project Delivery Teams, such as the Biscayne Bay Coastal Wetlands Project. He is a member of CERP's RECOVER Evaluation Team (ET), which takes a system-wide approach to planning CERP. A former research scientist, Pitts recognizes the need to incorporate sound science into restoration planning decisions, and he was instrumental in guiding the ET Southern Estuaries sub-team to utilize paleoecological data to set salinity targets for Florida and Biscayne bays.