Marl Prairie vegetation response to 20th century land use and its implications for management in the Everglades

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Marl Prairie Ecosystem History

- Heterogeneous
  - Surface sediment
  - Down core sediment
  - Timing of marl accumulation
  - Past vegetation responses

- 20th century impact on vegetation
- Increase in fires with drying in 20th century?
What is a Marl Prairie?

- Short hydroperiod (3-7 months)
- Calcareous soil
- High plant diversity (>100 species)
- Dominated by grasses and sedges
- ~1,900km²/6,000km² of current Everglades

Neighboring Communities
- Wet Prairie
- Fresh Water Marsh
- Sawgrass Marsh
- Big Cypress Slough
- Cypress Strand
The Cape Sable Seaside Sparrow (CSSS)

CSSS listed as T&E in 1967 due to limited distribution and threats to its habitat by land-use changes

Nesting bird, occupies marl prairies with short hydroperiods and sparse vegetation

Cape Sable Seaside Sparrow Distribution: Early vs. Late 20th Century

- Stimson (1956)
Recent research indicates that sustained changes in hydroperiod played significant roles in structuring tree islands and the ridge and slough landscape. These changes resulted both from natural climate fluctuations and anthropogenic alteration of Everglades hydrology.

Examine the long-term history of marl prairie habitats of the Everglades which provide critical refuges for rare and endemic species, including the endangered Cape Sable Seaside Sparrow (CSSS).

This research is intended to document the longevity and stability of the marl prairie habitat using paleoecological proxies for vegetation and hydrology.

Strategies to stabilize and maintain habitats are an important component of Everglades restoration planning.
Methodology

Collection of surface samples for calibration dataset
Methodology

Collection of cores in historic CSSS habitat
Methodology

Current CSS habitat
**Methodology**

Collection of sediment cores
Methodology

- Core/sediment description (sediment type, color)
- Carbon-14 dating and Lead-210 dating
Methodology
Analysis of downcore pollen assemblages and calibration with modern analogs
Variability of Surface Sediments within Modern CSSS Subpopulations

Surface sediment type varies considerably within CSSS subpopulations
Variability of downcore sediment profiles within Modern CSSS Subpopulations

- Marl over peat
- All marl
- Organic rich marl
- Peat over marl
Percent Abundance of Pollen of Major Plant Taxa, Core 03-9-16-6, CSSS Population A, Big Cypress National Preserve
Percent Abundance of Pollen of Major Plant Taxa, Core 08-5-19-8, CSSS Population B, Everglades National Park
Percent Abundance of Pollen of Major Plant Taxa, Core 08-8-7-2a, CSSS Population D, Everglades National Park

The diagram illustrates the percent abundance of various pollen taxa over different depth intervals. The x-axis represents depth (cm) with intervals marked as 1st occurrence, 730-530 BP, 960-790 BP, 2850-2740 BP, 3570-3390 BP, and 3350-3090 BP.

Key taxa include:
- Pinus
- Querues
- Casuarina
- Myrica
- Amaranthaceae
- Poaceae
- Cyperaceae
- Cladium
- Typha
- Asteraceae
- Fern Total

The y-axis represents percent abundance, ranging from 0 to 60.

The graph shows a detailed analysis of the pollen distribution over time, highlighting changes in the abundance of different taxa at various depths.
Many cores... the same pattern
Marl Prairie Fire History

Microscopic charcoal results


Charcoal μm²/grains
Conclusions

Surface sediments vary between and within modern CSSS populations

Timing of marl accumulation varies
- Some sites it was initiated during the 20th century and corresponds to shifts to modern pollen assemblages.
- Other sites marl was initiated well before onset of water management practices, ranging from 300 to nearly 3000 cal yrBP.

Down core sediment types heterogeneous (marl, marl over peat, peat, peat over marl)

20th century water management had an effect on all pollen assemblages examined
- Toward modern conditions

At some sites, significant changes in pollen assemblages occurred during the last few millennia – probably tied to climate fluctuations

Microscopic charcoal increases after the 20th century, however some sites record similar increases in the past
Climate Change and Management Considerations

The marl prairie landscape is not homogeneous
    -different sediment types and marl accumulation timing

Varying hydrologic conditions at varying times through the late Holocene and 20\textsuperscript{th} century initiated marl accumulation

This study demonstrates that plant communities within the current marl prairie habitat have fluctuated during the last few millennia in response to both natural hydrologic variability and anthropogenic modification of the ecosystem -but modern landscape est. in 20\textsuperscript{th} century?

However, 20\textsuperscript{th} century water management may have had the greatest impacts -must keep this in mind when managing current system
• Characterize spatial variability of surface sediments within each CSSS subpopulation

• Characterize temporal variability of sediment types at multiple sites within CSSS subpopulations

• Document temporal and spatial variability in vegetation and hydrology throughout current CSSS habitats using pollen and seed assemblages and stable isotopes

• Characterize temporal/spatial variability of sediment, vegetation, and hydrology in historic CSSS subpopulations

• Identify timing of vegetation and substrate changes during last few decades to millennia throughout CSSS habitat
Historic Cape Sable Seaside Sparrow Distribution: 1918-1956

1918-1935: *Spartina* marshes on Cape Sable

1928-1942: *Spartina* marshes inland of mangroves

Post-1940: marshes inland of mangroves and initial expansion into Big Cypress