Landscape-scale trends and patterns of Ghost Tree Islands in the Everglades

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What is a Ghost island?

- “Ghost island” is a tree island with significant loss in community structure i.e. degraded islands
- Consequence of changing hydrology
- Area with the most number of ghost islands is WCA 2
Issues/concerns

• Water management practices in the last several decades have significantly reduced the number of tree islands in WCA 2A

• Today:
  • 3 living tree islands in WCA 2A
  • 4th island shows significant degradation i.e. transitional/”dying”.

• Part of the CERP goal: halt tree islands loss by 2020 (1999 Baseline Report for CERP)
• Eventual goal: restore tree islands in the Everglades
Objectives

- Identify information needed for successful restoration of “ghost” tree islands in WCA 2A.
Objectives

• The immediate objective is to assess the microtopography, soil structure and chemistry, and vegetation patterns on living and ghost tree islands in WCA 2A.

• Objective: increase understanding of the ecology and biogeochemistry of these islands and how to implement island restoration.
Study location

- Sampling in WCA 2A
- 10 islands surveyed
  - 8 “ghost” + 1 live island
  - 1 additional “dying” island surveyed
- Islands distributed across a range of water depths

Homebrew GIS:
Tree islands over Wdowinski’s amplitude of water depth change map
Experimental Design

- Island naming system by SFWMD, similar to islands in WCA 3

Live: 2A-22-18
Dying: 2A-22-4

North: 2A-22-27, 2A-17-2, 2A-22-28

Central: 2A-14-2, 2A-16-1

South: 2A-15-6, 2A-12-6, 2A-11-1
Sampling Design

Legend:
- Transect
- Primary soil sampling locations

Pre-impoundment direction of water flow
Method

- PVC sounding rod used to assess differences in elevation at 10 m intervals
- Metal rod used to assess changes in bedrock every 20 m
- Measured from across island from nearest western ridge to eastern ridge
Method

- Approximately 20+ km of transects across 10 islands completed (~2000 shallow and ~1000 deep points measured).
Method

Tree island  Marsh  Open slough
Results

- Pinnacle rock is observed at the historic center of the island.
- Historic head of island has been reduced to a mix of *Schinus terebinthifolius* and *Cladium jamaicense*.
- Average peat depth is 128 cm at the head of the island.
Results

- No large trees observed mid-island.
- Historic shift in island orientation appears to be observed.
- Average peat depth is 138 cm.
• No large trees and short (<2 m) sawgrass across island.
• Average peat depth is 133 cm.
Results

• Peat depth in the island and surrounding marsh ranged from 131-200 cm.
• Peat depth generally increased from south to north.
• Maximum peat depth was observed at the head of 2A-11-1 (310 cm).
• The shallowest peat depth was at 2A-12-6 (49 cm at the center of the head).
Results

- 3 theories of tree island formation:
  - Over pinnacle rock
  - Bedrock depression
  - No topographic high

![Graphs showing depth relative to surface water level](image)
Results

- Findings support all three theories of tree island formation
- Differences in bedrock elevation ranged from 0.5 – 1.0 m
- Sand layers and bones were periodically encountered in the peat.
Results

• Differences between the marsh and island differed with islands across the landscape.

• Islands in the south had greater marsh-island differences in microtopography.

• Islands at the north had on average ≤10 cm elevational differences between marsh-island.

<table>
<thead>
<tr>
<th>Transect:</th>
<th>South 2A-11-1</th>
<th>South 2A-12-6</th>
<th>North 2A-22-27</th>
<th>North 2A-22-18*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>26</td>
<td>28</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Mid-island</td>
<td>17</td>
<td>14</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Neartail</td>
<td>10</td>
<td>15</td>
<td>4</td>
<td>8</td>
</tr>
</tbody>
</table>

* Living island
Results

• Within island, peat microtopography was greatest at the head and lowest at the neartail.

• Bedrock microtopography was highly variable and did not appear to be coupled to surface microtopography.

• Microtopography of the live island was not different from the other islands (possible impact of fire?).

Evidence of fire on live island.
Summary: microtopography

1. There is still some topography observed on the islands, primarily on the head.
2. Island were formed over pinnacle rock, bedrock depressions, and also where there were no bedrock features.
3. Island-marsh elevational differences are highest in south WCA 2A.
4. Peat depth generally increased from south to north.
5. The live (2A-28-18) and transitional (2A-22-4) islands are degraded.
Temporal Patterns

• Focused on Dineen’s Island (2A-15-6)
• Examined changes in island extent over time
Results: temporal patterns

- Inter-decadal fluctuations of Dineen’s island areal extent observed
- Eastern boundary appears more dynamic than western edge
Temporal patterns

- Dineen’s Island woody tree extent has declined (1940-present)
- Community phase shifts observed between decades

1940: Woody plants throughout island
1973: Cattail dominated island
2003: Sawgrass dominated island
Summary: temporal patterns

1. Long-term datasets provide insight into shifts in areal extent
2. Community-level changes are clearly captured at decadal time scales

Tree island in WCA 3. Note the woody tree extent down the length of the island.

Ghost tree island in WCA 2. Note only the trees on the head of island.
Implications of findings

1) First intensive survey of elevational changes, soil structure, and vegetation patterns across WCA 2A landscape.

2) The data will allow for comparison across the landscape, between islands, between the marsh and island, as well as within island.

3) Findings (spatial and temporal) will provide baseline information for restoration.
Next step?

- Identify criterion for successful restoration of drowned (“ghost”) tree islands in WCA 2A.
- Identify restoration end-points.
- Implement adaptive restoration practices?

**Diagram:**
- Live tree islands
- Loss of island structure and function
- “Ghost” islands

**Legend:**
- RESTORATION
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