Does fire have a role in the transition of a healthy tree island to a ghost island? A fire history analysis.

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Introduction

Background: In the Everglades, tree island "loss" is one endpoint in a dynamic in which woody and herbaceous plants vie for dominance under the influence of stresses such as flooding and/or fire. Like flooding, fire is known to strongly favor graminoids over woody plants (Hanan et al. 2010), and the size, stature, and even the presence of a tree island may be a product of its recent fire history.

Sharp declines in the number and area of tree islands have been reported for some portions of the Everglades. Tree island loss has generally been attributed to management-related changes in hydrologic regime, either prolonged periods of high water, which can cause death in all but the most flood-tolerant woody species, or excessively dry conditions, which increase the likelihood of catastrophic peat fires.

The term "ghost island" has been applied to tree islands that have recently lost all or most of their forest canopy. Despite the absence of trees, they remain evident as landforms on current aerials.

Objective: Our objective was to determine whether the 'ghost islands' current structure is enforced by the recent fire history.

Hypothesis: Tree island exposure to frequent fire causes a transition into a ghost tree island.

Study Site

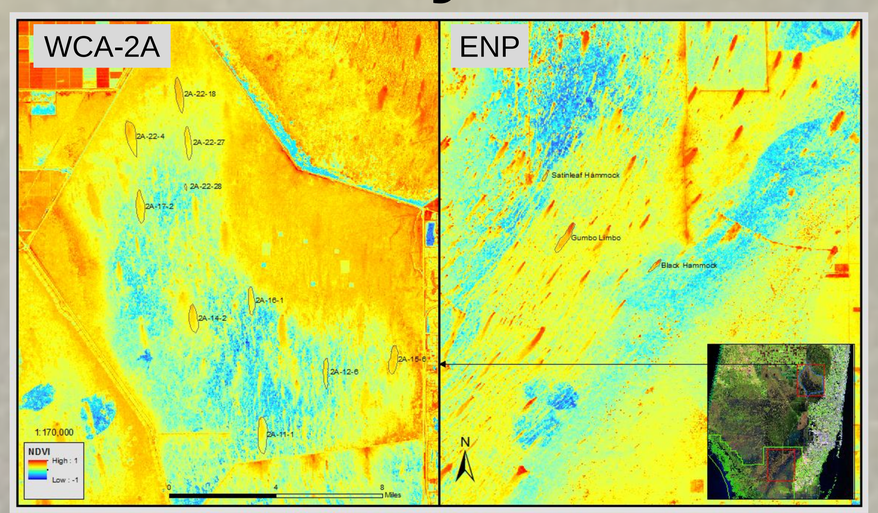

Figure 1. NDVI of ghost tree islands in WCA-2A (left) and healthy tree islands in ENP (right).

- Ten tree islands in WCA-2A, 8 ghost islands, and the 2 northernmost with trees remaining but seemingly transitioning to ghost island status.
- Tree islands in WCA-2A are located along a hydrologic gradient, the above N-S sequence in tree island health occurs within a gradient in marsh water depth, with ghost islands toward the south receiving longer deeper flooding periods (Ewe et. al 2010).
- Three tree islands in Everglades National Park (ENP), all considered healthy.

Methods

- Reconstructed the recent fire history of 10 ghost tree islands in WCA-2A and 3 tree islands in ENP from 1980 to 2013
- Fifty-five Landsat images were visually inspected for noticeable fire scars.
- Fire scars were digitized if any part of the tree island fell within the fire boundary.
- Fire frequency was calculated for each island for a 33 year period.
- Linear regression was used to analyze the relationship between fire frequency and water depth (10 year average) in the surrounding marsh.

Results

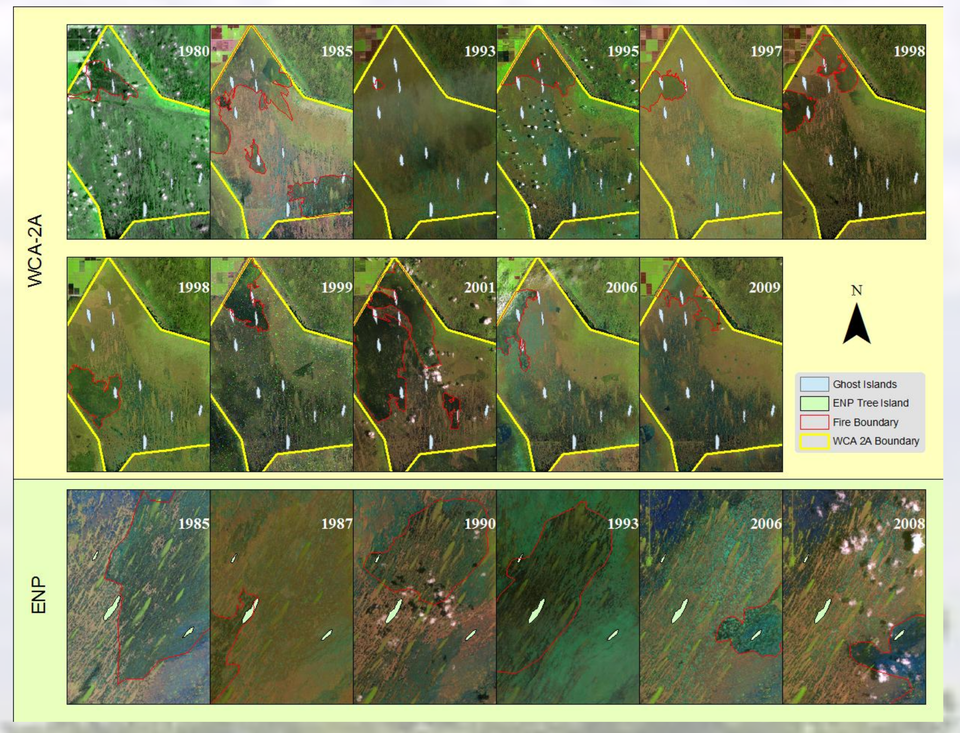

Figure 2. Fires affecting tree islands in WCA-2A (top 2 rows) and in ENP (bottom row). Years denote year of Landsat Image.

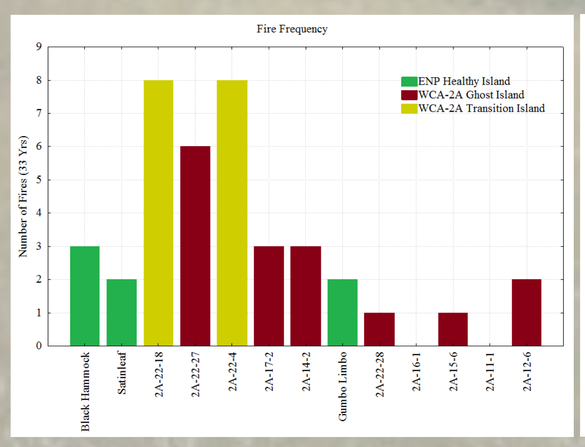

Figure 3. Fire frequency for 10 ghost islands in WCA-2A, and 3 tree islands in ENP. Islands arranged from shortest to longest hydro-period (10 year average).

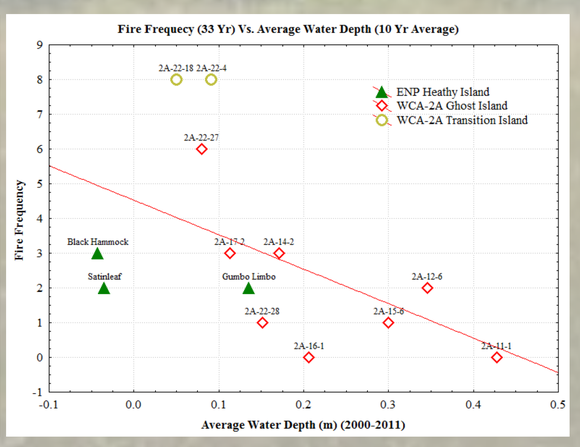

Figure 4. Fire frequency plotted against average water depth for a 10 water year average (2000-2011).

- Fire frequency varied between 1 to 3 fires for most ghost islands, and was not much different from that of healthy islands in ENP.
- Two ghost islands (2A-11-1; 2A-16-1) were not burned in 33 years.
- Both transition islands (2A-22-18; 2A-22-4) burned 8 times.
- Fire frequency was negatively correlated with water depth.

Conclusions

- Fire frequency did not enforce current ghost tree island structure.
- Flooding might have played an indirect role in conjunction with fire by controlling fire frequency.

Bibliography

1. Ewe, S., J. Vega, K. Vaughan, and R. Bahe. 2009. Survey of living and ghost tree islands in Water Conservation Area 2A: Assessment of island microtopography, soil bulk density, and vegetation patterns. Final Report from Ecology and Environment to the South Florida Water Management District, Contract No. ST060579-WO09.
2. Hanan, E.J., M.S. Ross, P.L. Ruiz, and J.P. Sah. 2010. Multi-scaled grassland-woody plant dy-namics in the heterogeneous marl prairies of the southern Everglades. Ecosystems 13: 1256-1274.