Effect of hydrology and fire on vegetation species composition within the Ridge and Slough landscape across the Everglades ecosystem

Deusdedit Rugemalila¹, Jay P. Sah¹, Susana Stofella¹; Santiago Castaneda¹, Katherine Castrillon¹, Blanca Constant¹, James Heffernan², Michael Ross¹

1Department of Earth and Environment, Florida International University, Miami, Florida, USA
2Nicholas School of the Environment, Duke University, Durham, NC, USA

1. Introduction

- Wetlands are diverse ecosystems that provide critical ecological and economic functions such as wildlife habitat and water source.
- Anthropogenic activities such as hydrologic alteration and eutrophication (nutrient enrichment) cause wetland degradation and loss by changing water quality, quantity, flow-rates, and promoting the proliferation of invasive or aggressive native plant species.
- Similar trends have been documented in the Florida Everglades ecosystem, which comprises a mosaic of flow-oriented sawgrass ridges and sloughs with tree islands interspersed throughout the landscape.
- Previous studies show that change in hydrology and nutrient enrichment from agricultural areas resulted in vegetation shifts from sawgrass (Cladium jamaicense) dominance to cattail (Typha domingensis).
- However, the extent to which variability in hydrology, soil depth, and fire legacies influence overall vegetation species composition across the Everglades freshwater ecosystem has received little attention.

2. Objectives

- The objective of this study was to assess how fire legacies (fire frequency and return intervals) interact with hydrology and soil depth to explain plant community assembly at different spatial scales within the historic ridge and slough landscape in the Everglades National Park (ENP) and Water Conservation Areas (WCAs) (Fig. 1).

3. Study Area

- The interactive effect of fire return intervals (TSLF) and fire frequency was more substantial in the northern part of the ecosystem and the effect varied by landscape classification.
- The interactive effect of fire return intervals (TSLF) and fire frequency was significant in WCA3A-N and was regulated more by soil depth than the water depth.
- Long-term mean water depth was the most critical factor influencing species composition patterns across the ecosystem, and the effect varied by landscape classification.
- Future studies should investigate how hydrology and fire alter soil and water nutrients to influence vegetation species composition

4. Methods

- Data collection: We conducted a system-wide landscape monitoring campaign covering the greater Everglades Ecosystem (Everglades National Park, and the Water Conservation Areas (Fig. 1) at fifty-eight 2x5 km permanent sampling units (PSUs), each containing up to 135, 1x1 m quadrats.
- Within each quadrat, vegetation characterization consisted of identifying all taxa present to species level and estimating the abundance of each species as a percentage (%) cover of the plot area.
- Water depth was measured using a meter stick, and soil depth data was collected by probing to the bedrock using a 1-cm diameter metal rod.
- We used expert knowledge to classify landscape as ridge, slough, and transition.
- We used the water depth data to quantify mean daily water levels over time at each location using EDEN data (https://sofia.usgs.gov/eden/).
- We obtained fire data for the ENP from 1948 to the present and WCAs from 1997 to the present and then calculated fire frequency and fire return intervals as Time since the Last Fire (years)
- Data analysis: We analyzed vegetation community composition and performed community-environment relationships with NMDS and linear mixed models.

5. Results

- Long-term mean water depth was the most critical factor influencing species composition patterns, and it varied by landscape classification. The interactive effect of fire return intervals (TSLF) and fire frequency was more substantial in northern WCAs and non-existent from the central WCAs to southern ENP.

6. Results

- Fig. 2 Long-term mean water depth was the most critical factor influencing species composition patterns, and it varied by landscape classification. The interactive effect of fire return intervals (TSLF) and fire frequency was more substantial in northern WCAs and non-existent from the central WCAs to southern ENP.

7. Discussion and conclusions

- Fire return interval and water depth interactively affected species composition in WCA2.
- The effect of fire frequency on species composition was significant in WCA3A-N and was regulated more by soil depth than the water depth.
- Long-term mean water depth was the most critical factor influencing species composition patterns across the ecosystem, and the effect varied by landscape classification.
- Future studies should investigate how hydrology and fire alter soil and water nutrients to influence vegetation species composition.

8. Acknowledgements

- Jesus Blanco, Rosario Vidales, Allison Jirout, Alexander Martinez-Held, Josue Sandoval, Zenia Bravo, Carlos Pulido, and several other members in the SOFTEL lab helped in field sampling.
- Funding was provided by the US Army Corps of Engineers (USACE) agreement #W912HZ-15-2-0027

9. References