Droughts:
while tree islands can expand,
can tropical hardwood hammocks VANISH?

Tropical Hardwood Hammocks along a water availability gradient

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Tropical hardwood hammocks – HEAD of tree islands in Shark River Slough, ENP
Tropical Hardwood Hammock:

Plants of Caribbean/Neotropical origin, high diversity, habitat for terrestrial fauna in a wetland
Cannot tolerate frost, floods.

Source: USGS
Tropical Hardwood Hammock - Occurrence

Areas of highest elevation in South Florida:

1. Miami Rock Ridge
2. Tree islands in Shark River Slough
3. Coastal ridges
4. Shell mounds

Flood intolerant.

Susceptible to DROUGHT?
Lowered water tables due to
1. Dry season water withholdings (mgmt)
2. Drought years
Tropical Hardwood Hammocks along a water availability gradient

<table>
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<th>Tree island hammock</th>
<th>Miami Ridge Hammock</th>
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<td>Year-round water availability</td>
<td>Seasonal water availability</td>
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<td>Evergreen trees</td>
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<td>Lower water stress ?</td>
<td>Higher water stress ?</td>
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Tree islands: hammocks use groundwater in dry season

Saha et al. 2010. Wetlands Ecol & Mgmt
Miami Rock Ridge Hammocks: groundwater use in dry season

Saha et al. 2009. Ecohydrology
Tropical Hardwood Hammocks:
Is DRY SEASON water uptake ADEQUATE?

Plant water stress --- Stable Isotope of Carbon ($\delta^{13}C$)

Plants discriminate against $^{13}C$ during photosynthesis

CO$_2$ enters leaf

Water stress $\rightarrow$ Stomatal closure

Reduced discrimination

Leaf tissue

High $\delta^{13}C$ indicates photosynthesis is being limited
Ridge Hammocks: **Significantly** water stressed in DRY SEASON

Tree Island Hammocks: no significant difference in seasonal foliar d13C
Leaf Phosphorus (mg/ml): period of water and nutrient uptake

Tree islands: no significant seasonal difference

Ridge Hammocks: Significant seasonal difference

Leaf P higher in wet season
-> season of water (and nutrient) uptake
RESULTS

Ridge Hammocks are drier (lesser water availability) than tree island hammocks

Ridge Hammocks

• Suffer greater water stress in dry season
• Take up most of their water (and nutrients) in the wet season
• A greater degree of deciduousness (eg Lysiloma latisiliquum)

Why is water availability less in Ridge Hammocks?
Limestone bedrock restricts DRY SEASON water access to existing cracks

Wet season

Dry season
Lowered water table – tree island hammocks may face similar conditions as Ridge Hammocks

Additional Fire danger from dried Peat in slough.

Dry conditions will allow hammocks to expand ONLY IF successive wet season flooding does not kill saplings.

Multidecadal droughts can lead to hardwood hammock expansion.

But the Everglades also faces Sea Level Rise, with attendant salinization of The groundwater.
Vanishing Coastal hammocks:
Sea Level Rise and Decreased Freshwater Inflows
Considerations for ENP tree islands management

Water management – increase period of inflows through S12s.

1. **Flood intolerance** – monitor daily stage on tree islands so as not to inundate hardwood hammocks (the head). *Especially in years of HIGH precipitation, and sudden releases of water into Everglades NP.*

2. **Drought susceptibility** – monitor daily stage so as to not drop below low levels (swamp forest) in dry season thereby increase drought and fire susceptibility. *Especially for years with below normal precipitation.*

Fire management
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