INDIGENOUS TRADITIONAL ECOLOGICAL KNOWLEDGE AND SPECIES DISTRIBUTIONS UPDATE WATER LEVEL TARGETS

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Monitoring & Management

- Decline of tree islands through 20th century spurred monitoring effort
  (Patterson & Finck, 1999)

- Monitoring of tree islands in recent decades
  - Suggested haven't been further "lost" and generally in good shape
    - "Lost" in elevation or function?
    - Any further improvement/restoration?

  * Unclear because limited research of many aspects

Monitoring & Management

- Management and restoration have not implemented tree island targets
- Current interagency meetings are developing targets
- As technology and ecological understanding improve,
  - Update goals, targets, and methods accordingly
    - **Ecologically sound**
    - **Up-to-date science**
    - **Interagency agreement/ adoption**
    - **Ground-truthing**

Monitoring & Management

- **RECOVER** 2020 interim goals (RECOVER, 2020)
  - Flood TI <10% of time
  - 50% of “core” (central Miccosukee WCA 3AS) TIs have hammock

- **SFWMD** TI flood index (Wu et al., 2002; Sklar et al., 2012; USFWS, 2023)
  - TI “flood tolerance” exceeded when >1.0’ water for >120 days

  * Constraint, not a goal

Current Operations

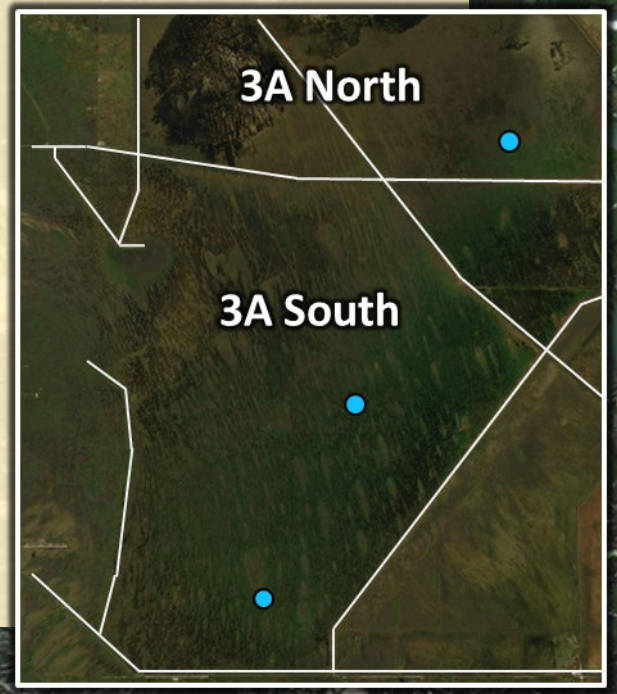
- Flaws with current operations

In Miccosukee WCA 3A

8.34 + 1.5 + 1 = **10.84’ NGVD**

(1) Marsh elev. based on 3AVG
(2) Tree Island elev. = rough benchmark
(3) 1’ of water depth is NOT ecologically meaningful

- Differential soil loss between areas
  - Elevations shouldn't be averaged
- Omits local heterogeneity
- Flood impacts begin when surface exceeded



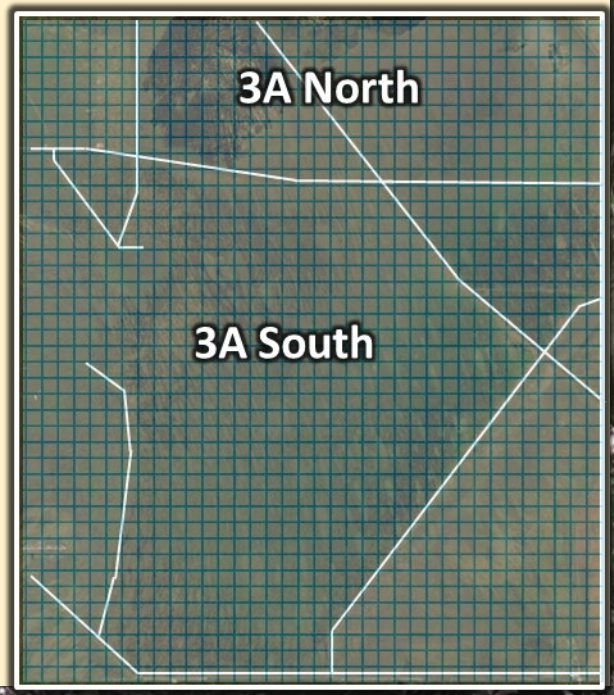
Proposed Operational Changes

In Miccosukee WCA 3A

8.34 + 1.5 + ~~1~~ = **10.84' NGVD**

(1) Use marsh EDEN grid model
(2) Recalculate/integrate local TI elevations
(3) Flooding when water level ≥ ground surface

- Accounts for heterogeneity across marsh
- Accounts for heterogeneity of TI elevations
- Flood impacts fully considered



Proposed Operational Changes

- In addition to adjusting the high-water threshold (all 3 components)…
- **Reduce flood duration towards natural levels**
  - Must be:
    - **Ecologically meaningful**
      - Hammock community most sensitive to high-water
      - Identify characteristic species (hardwood hammock)
      - Determine hydrologic optima and tolerances
        - Optima = Hydrologic target
        - Tolerance = High-water threshold

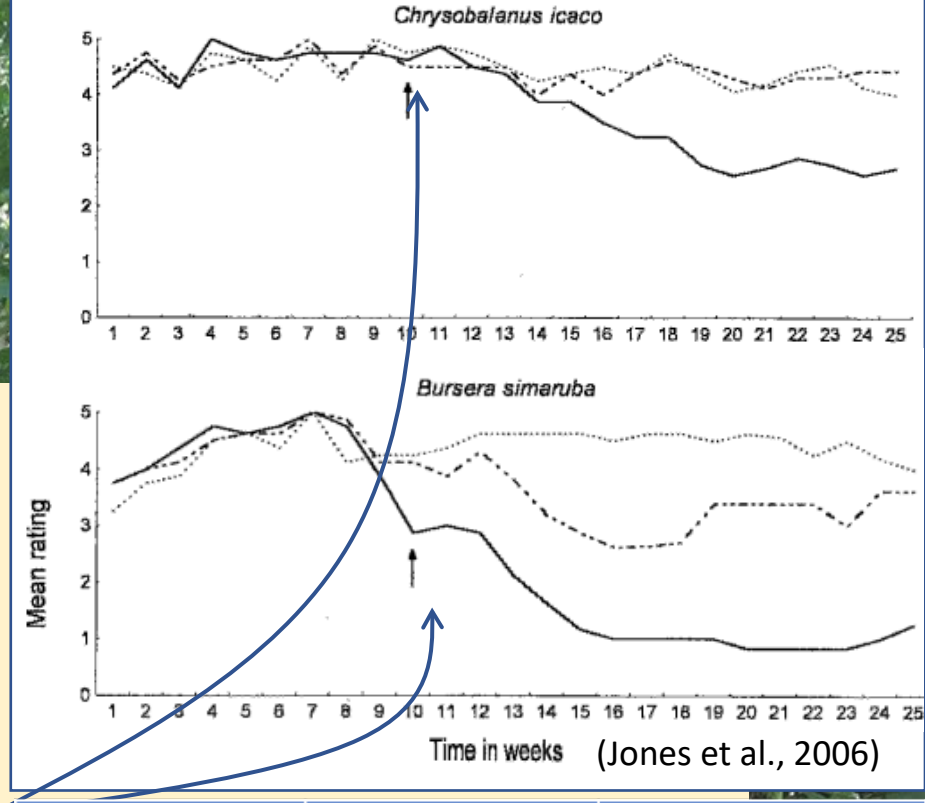
Proposed Operational Changes

- In addition to adjusting the high-water threshold
- **Reduce flood duration to natural levels**
  - Must be:
    - **Based on data**
      - Ross & Jones, 2004
      - Jones et al., 2006

Hammock

- **Target = 0 days**
- **Threshold = 7 – 50 days**
  - Need more accurate **threshold**

(Ross & Jones, 2004)



(Jones et al., 2006)

Flood stress ensues when water reaches the surface (even for flood-tolerant species)

Species	Optima (days)	Tolerance (days)
C. laevigata	0 – 6	20 – 50
S. foetdissimum	0	37 – 50
E. axillaris	0	2 – 50
C. diversifolia	0	50
C. oliviforme	2 – 6	4 - 13
M. cubana	2 - 5	7 – 50
S. palmetto	2	50
B. simaruba	12 – 26	20 – 60

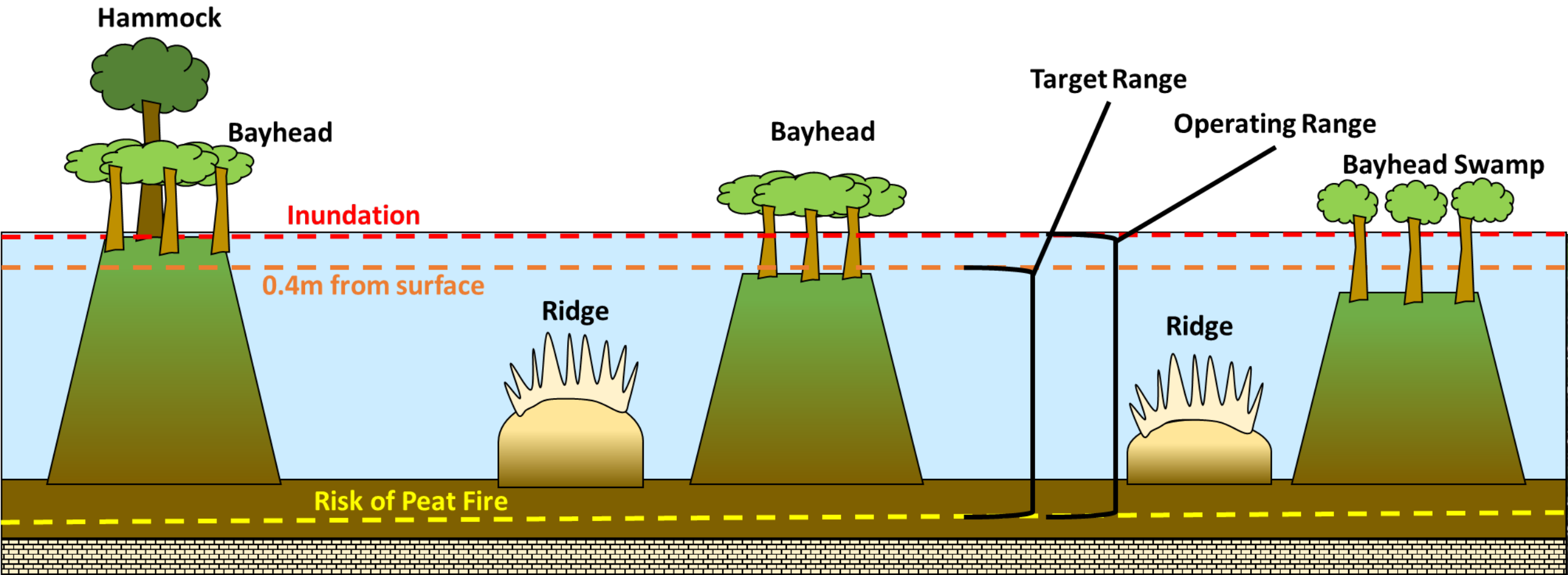
Use Surface or -40cm criteria?

Emergency High Water
- ***Max. Condition*** **- Don't exceed hydro tolerance of hammocks (7 – 50 days)**

Recommended Maximum
- ***Target Condition*** **- Don't exceed hydro optima of hammocks (0 – 7 days)**

OR

- ***Max. Condition*** **- Don't exceed hydro tolerance of hammocks (7 – 50 days)**
- ***Target Condition*** **- Don't exceed hydro optima of hammocks (0 – 7 days)**



Indigenous Traditional Ecological Knowledge

- Fire & flooding → loss of hardwood hammocks
- Field surveys of hammock species
- Interviewed tribal elders on historical accounts
  - Tree island characteristics
  - Plant species
  - Wildlife species

Elevation Resurvey

- **Ground-truthing to improve model accuracy**

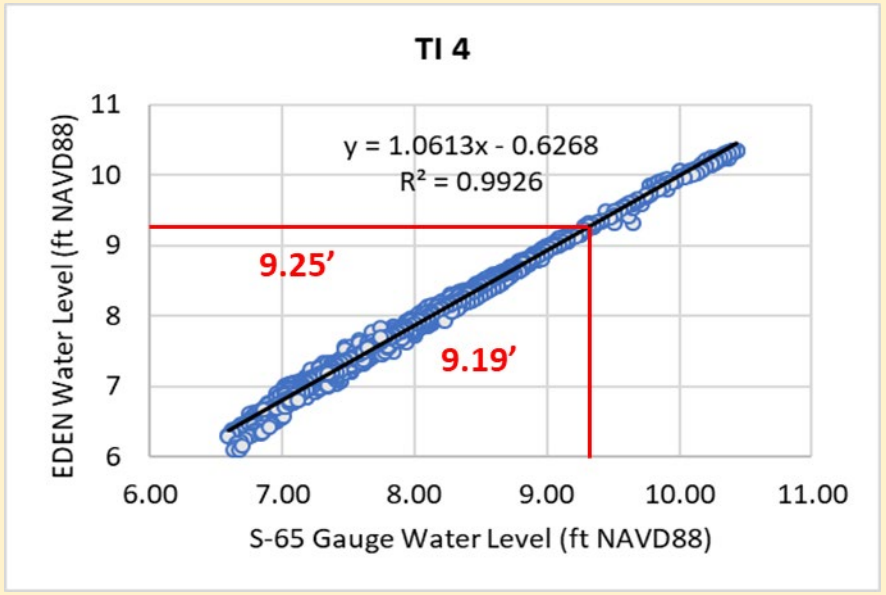
- Measures elevation across historic and current hammocks.
  1. Depth transect on tree island heads
     - Convert depths to elevation (Water level – Depth = Elevation)
  2. Trimble R12i Rover
     - Measure hardwood tree elevation on tree islands
     - Real-Time Extended (RTX) leverages real-time satellite data and a network of stations to correct in-field measurements

Analyses

- Tree island hydrology (via EDEN grid cells) were compared to multiple nearby water level gauges
- Multiple correlations determined best gauge to predict tree island flooding

- S-65 gauge = Best predicted water levels at South islands
- L28S1 gauge = Best predicted water levels at North islands

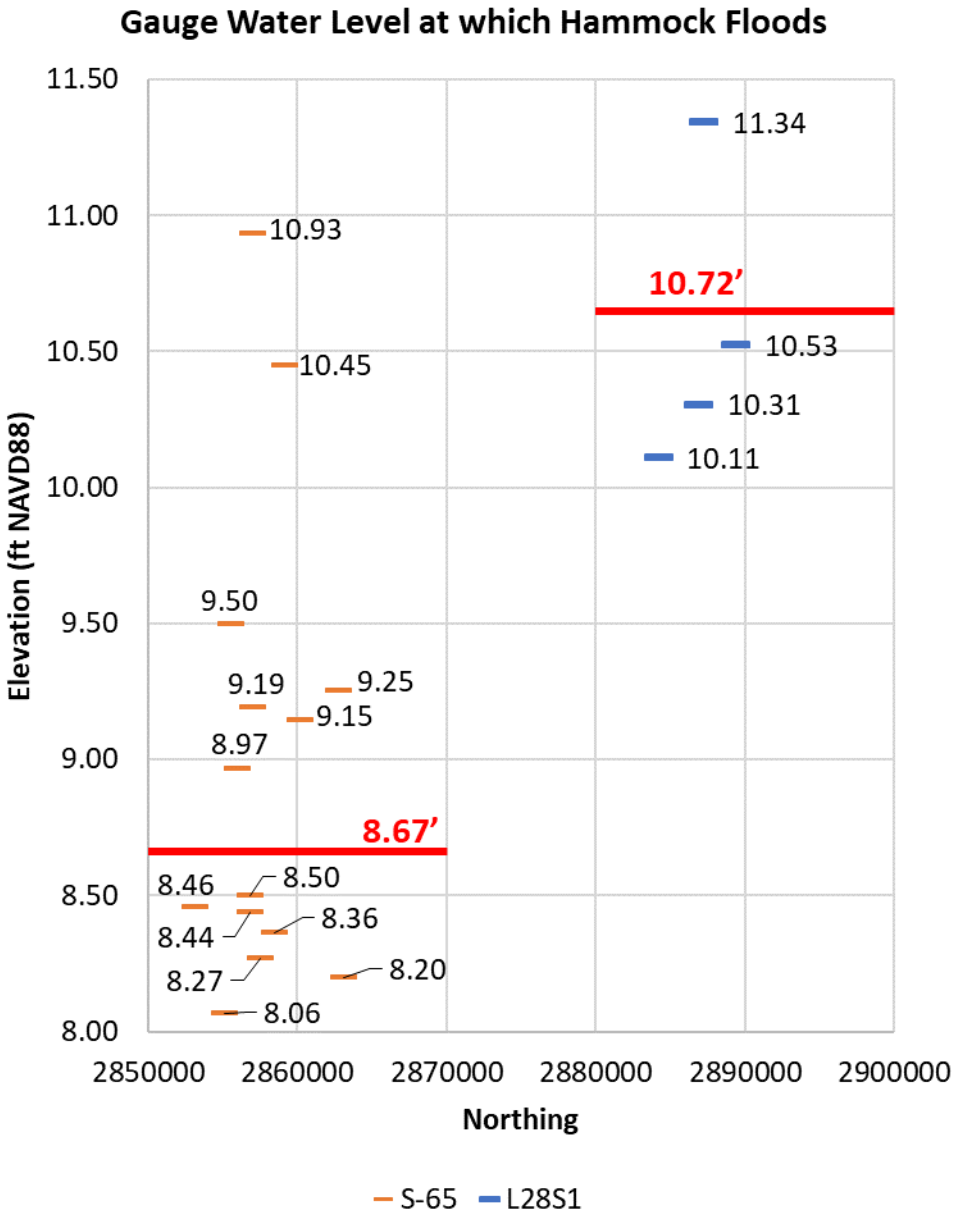
Ex.



Analyses

- The plotted island elevations are the minimum elevations at which water levels at the corresponding gauge flood hardwood hammock species.
  - These elevations = Water level at which hammocks flood

  - The current high-water criteria for WCA 3A (10.84’ NGVD29 at 3AVG) translates to
    - **8.67’ NAVD88 at (S-65)**
    - **10.72’ NAVD88 at L28S1**
  - This results in frequent and excessive inundation of hardwood hammock tree species on tree islands (e.g., white stopper, gumbo limbo, hackberry).



Analyses

- The following alternative metrics are being proposed to replace the current high-water criteria (in MWCA 3A-South):

Alternative 1

- Minimum elevations at which hardwood hammock species are known to occur

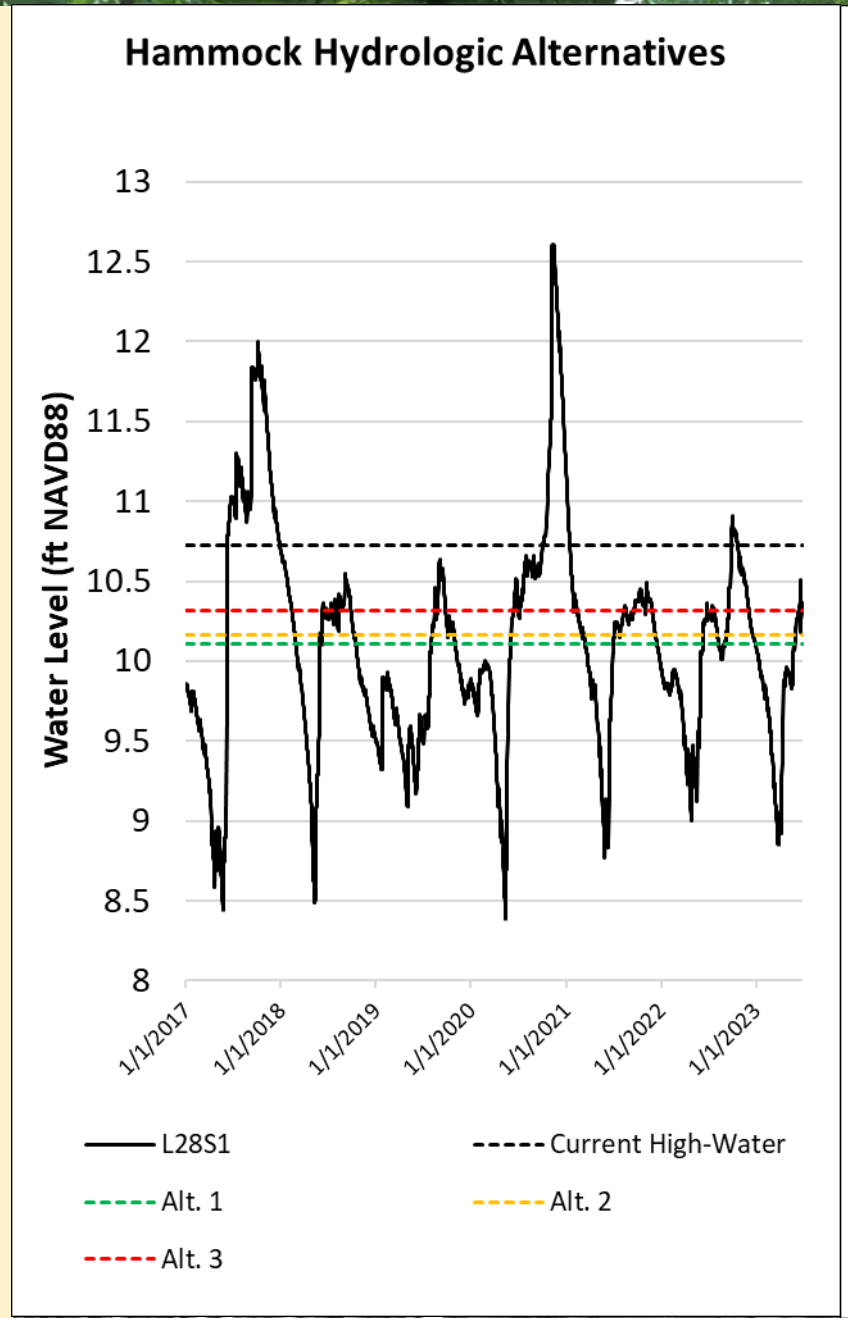
Alternative 2

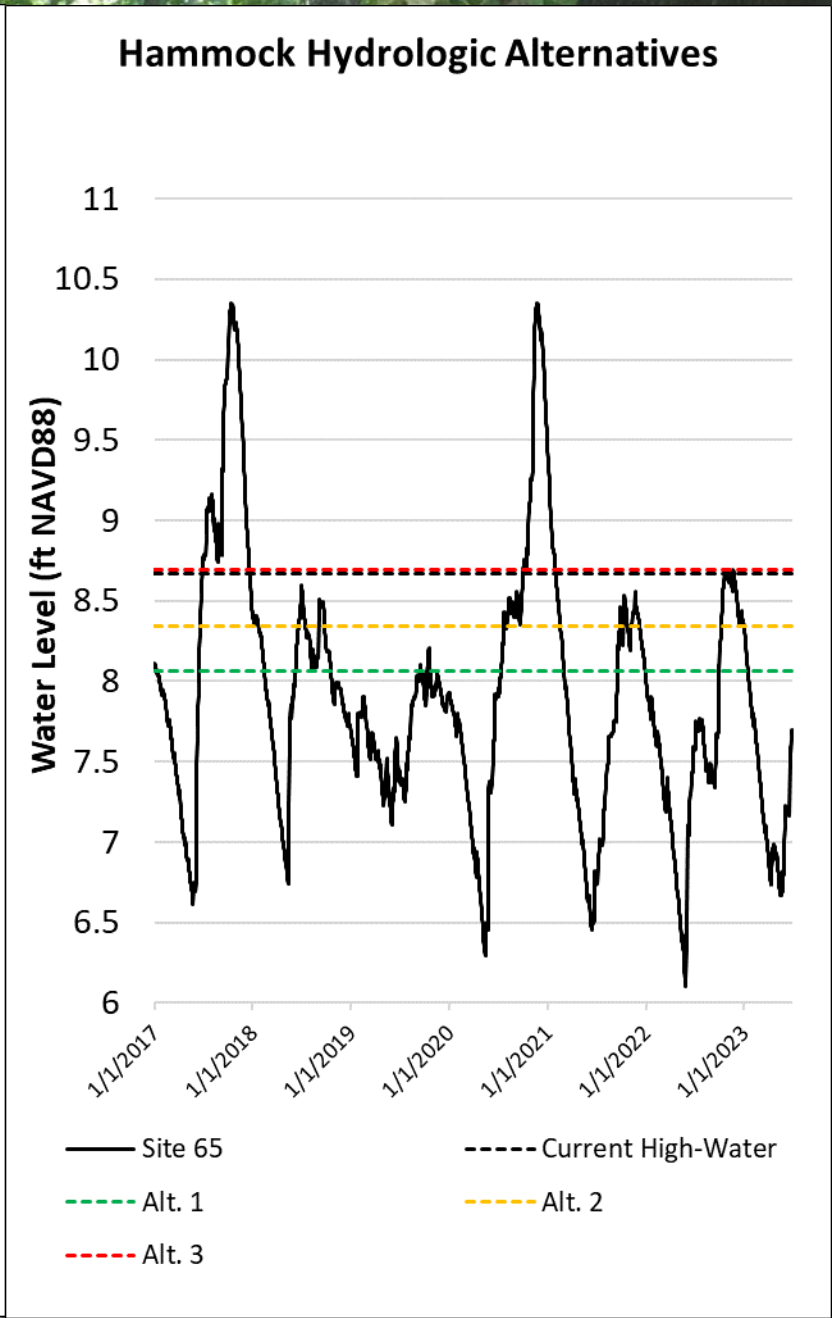
- Lower quartile of hardwood hammock elevations

Alternative 3

- Mean of hardwood hammock elevations

Reccomended High-Water Level			
Gauge	1st Minimum	2nd Q1	3rd Mean
S-65	8.06	8.34	8.69
L28S1	10.11	10.16	10.31

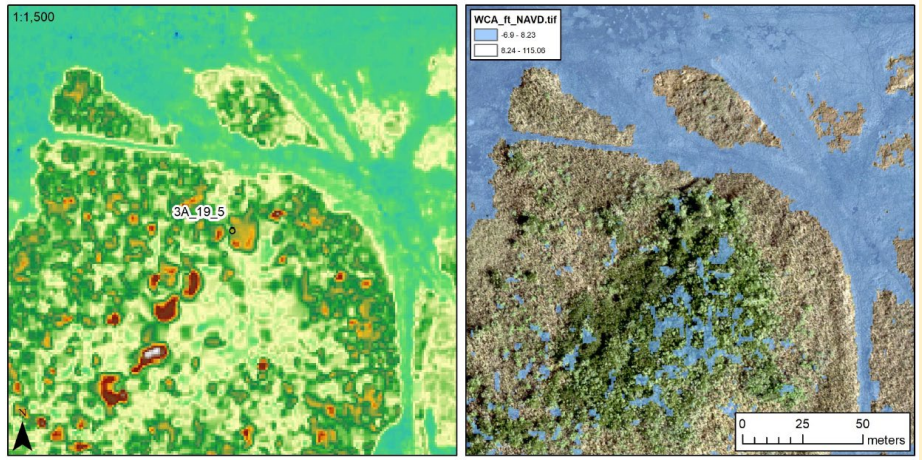




Implications

- The following alternative metrics are being proposed to replace the current high-water criteria for WCA 3A (specifically in Miccosukee WCA 3A-South):
- **Alt. 1 = 8.27 feet NAVD88 at 3AS3W1 (iModel gauge)**
    - Based on the minimum elevation at which hardwood hammock species were found to occur.
    - There were two 4x4 m plots with this elevation on island #5, and both plots had the presence of white stopper (*Eugenia axillaris*).

3A_19_5 – 8.27’ NAVD at 3AS3W1



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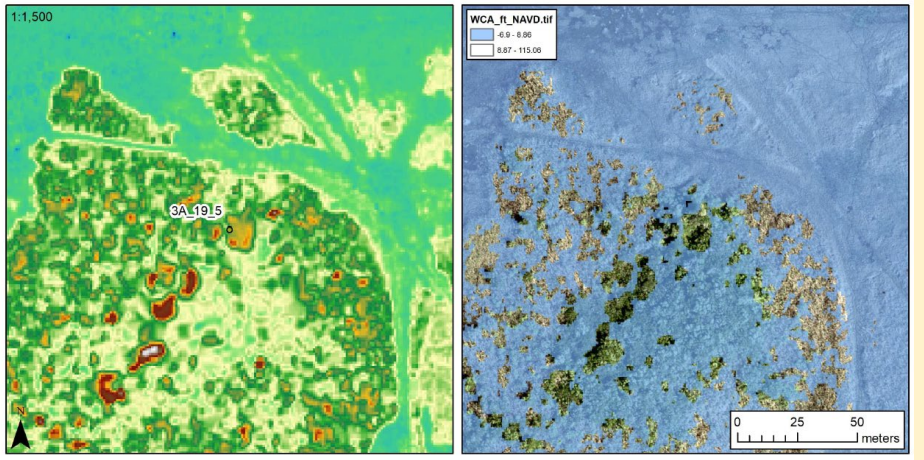
- **Current High-Water = 8.93 feet NAVD88 at 3AS3W1 gauge**
    - Based on the current high-water threshold (3AVG) for tree islands in 3A.

3A_19_5 – 8.93’ NAVD at 3AS3W1



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Implications

- Failing to meet all "**hammock**" criteria
  - **SFWMD criteria** = flood <120 days
  - **FWC criteria** = flood <60 days to avoid mass deer mortality
  - **RECOVER goal 2020** = flood <10% of time
  - **Vegetation tolerance** = flood < 7 – 50 days
  - **Vegetation optima** = flood 0 days

Upcoming Strategies

- Continue to collect ITEK and survey islands to locate hammocks
- Continue to survey hammock elevation
  - Reduce vertical error of GNSS elevation survey
- Greenhouse experiment: refine species' hydrologic (1) optima, and (2) tolerance

- Refine recommended high-water level for MWCA 3A and better manage tree islands

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