Estimation of predevelopment and current hydrology for ecological restoration of a Florida pine flatwoods

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Abstract

The ~24,500 hectare J.W. Corbett Wildlife Management Area (WMA) contains a large portion of the remaining pine flatwoods east and northeast of the Everglades. Historical accounts indicate this mosaic of flatwoods and ponds was periodically covered by sheetflow, including regional inputs from the north. Sheetflow was not restricted to the large cypress strand in western Corbett; rather it flowed seasonally through much of the pine flatwoods. Drainage and development of surrounding areas eliminated regional sheetflow inputs, while drainage structures within Corbett WMA also had eco-hydrological effects.

We used real-time kinematic (RTK) GPS to measure elevational transects through flatwoods, ponds and cypress and combined the elevation data with vegetation surveys and soil observations to estimate predevelopment hydrology as well as the degree of current deviation from predevelopment conditions. Field measured elevations of a number of biomarkers, including apple snail (*Pomacea paludosa*) egg masses, adventitious roots, moss/lichen collars, water marks, patch edges of saw palmetto (*Serenoa repens*) and of surfaces of peat deposits supplemented our understanding of hydrology. Elevations were measured along twenty-six transects within seven landscape units (LSUs).

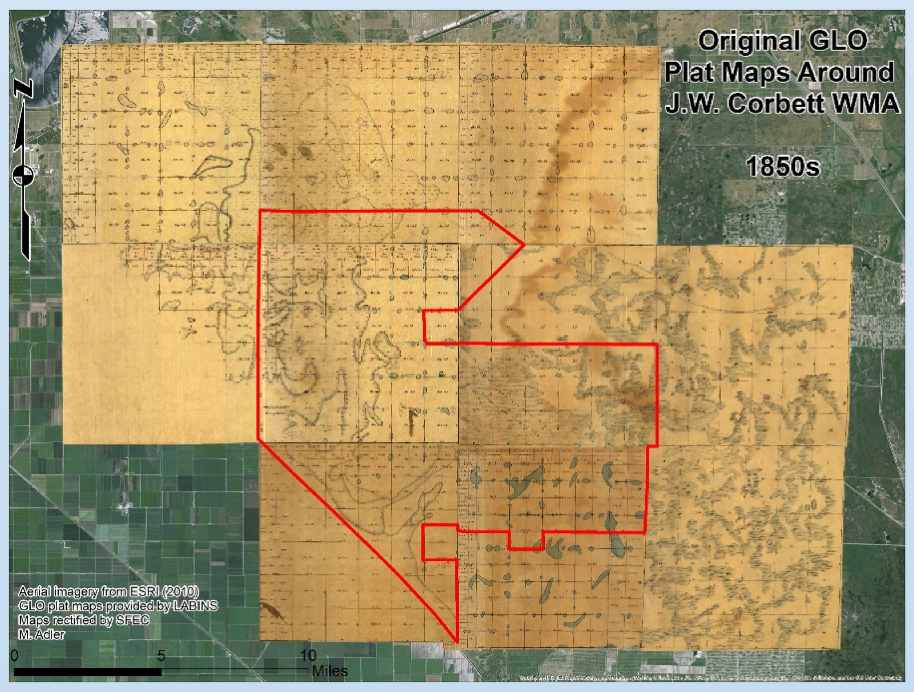
Quantification of the elevation differences between pond bottoms, hydric flatwoods and mesic flatwoods constrained estimates of the predevelopment hydrology. The discovery of deep (> 1m) peat deposits in the centers of otherwise sand-bottomed ponds also proved useful. We are combining the topographic, vegetation and soils field data with hydrologic simulations of regional surface and groundwater (S2DMM model, developed by Tomasello Consulting Engineers Inc.) to refine our understanding of current and predevelopment hydrology. We are also using the modeling to evaluate several future water management scenarios within the Corbett WMA and in adjacent urban areas. Scenario goals for the Corbett WMA are improved hydroperiods, increased hydrologic connectivity, protection of peat deposits, and improved timing of fire.

Goals and objectives

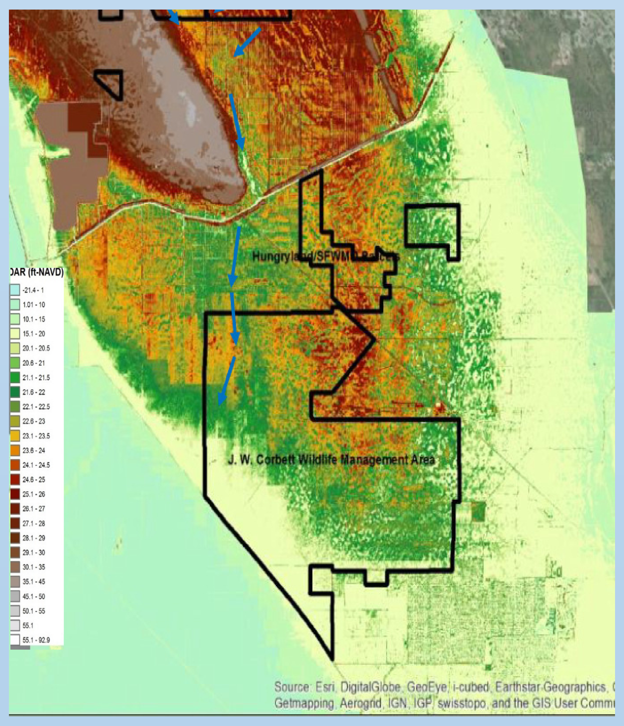
Develop restoration strategies that reestablish sheetflow and rainfall driven hydroperiods to improve the function of both terrestrial and aquatic habitats.

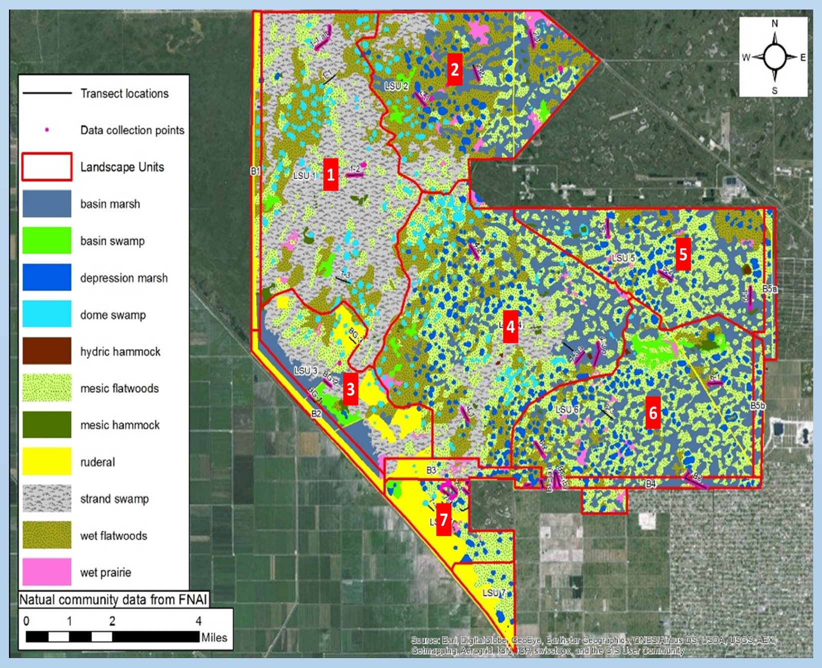
Methods

- Georeference General Land Office (GLO) surveys (Fig.1) & historic aerials (Fig. 2) and reviewed regional Lidar (Fig. 3)



- RTK GPS transects stratified across 7 landscape units (Fig. 4) and measured:
  - Elevation within and between habitats
  - Elevation of biological indicators
  - Organic layer elevation and thickness



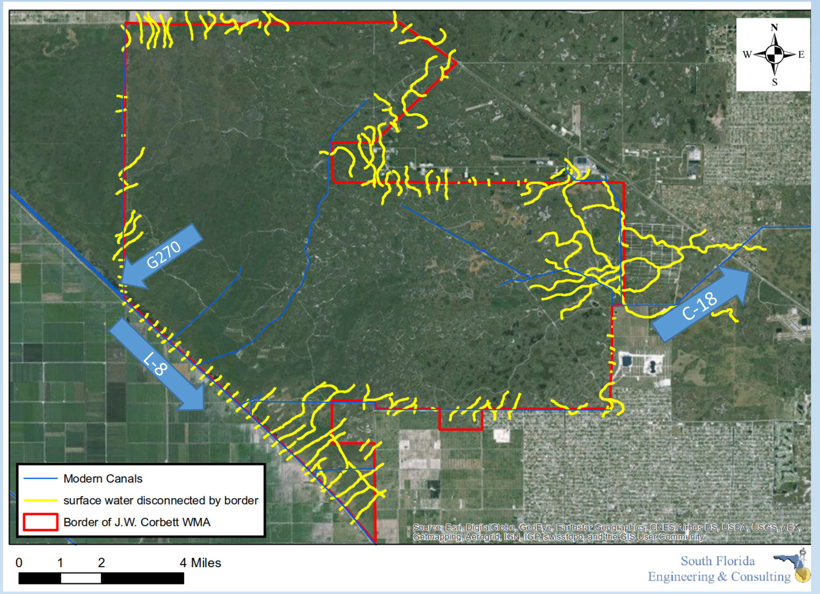


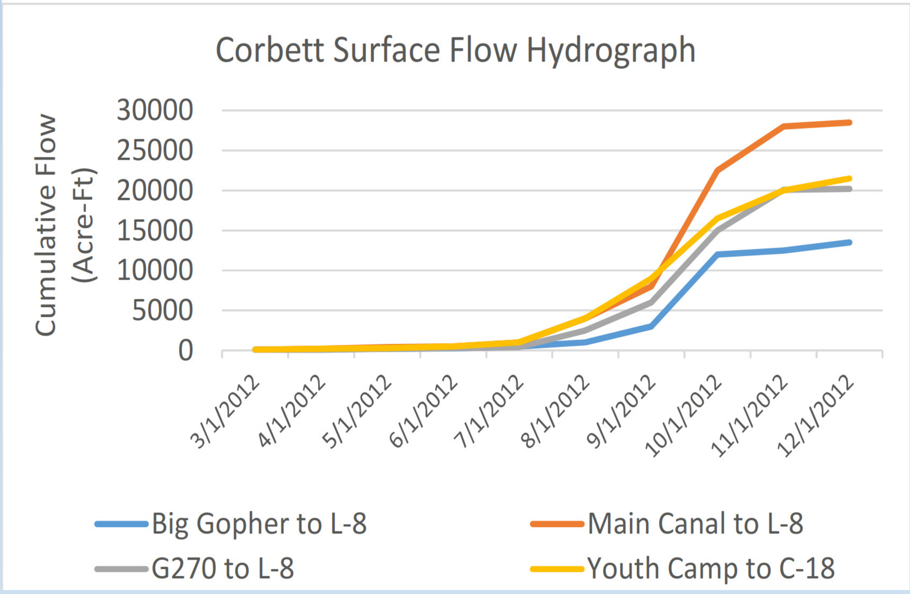
Figs. 3 & 4: Regional Lidar & natural community map used for hydroperiod calculations

- Characterized plant cover and structure
- Hydrologic model development of existing and natural system conditions

Results

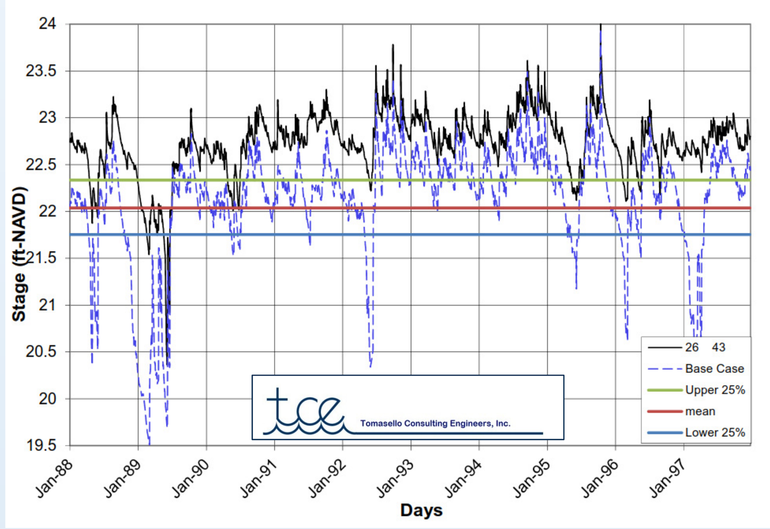
Historic surface water connectivity (Fig. 5, in yellow) compared to existing condition discharge distribution (Fig. 5, canals in blue & Fig 6):





Results Continued

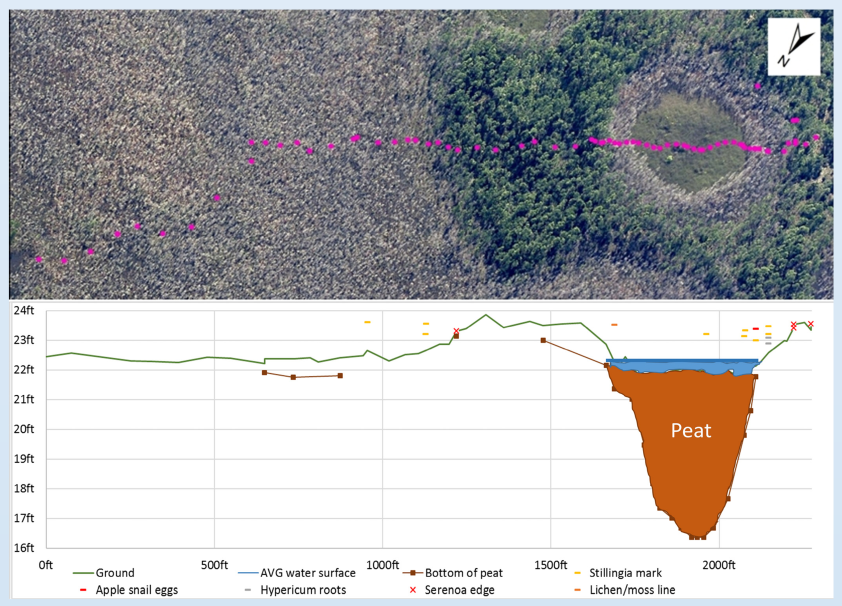
Hydrograph of historic and existing conditions in Cypress strand (LSU-1) (Fig. 8) and LSU weighted average hydroperiod tolerance (Table 1):

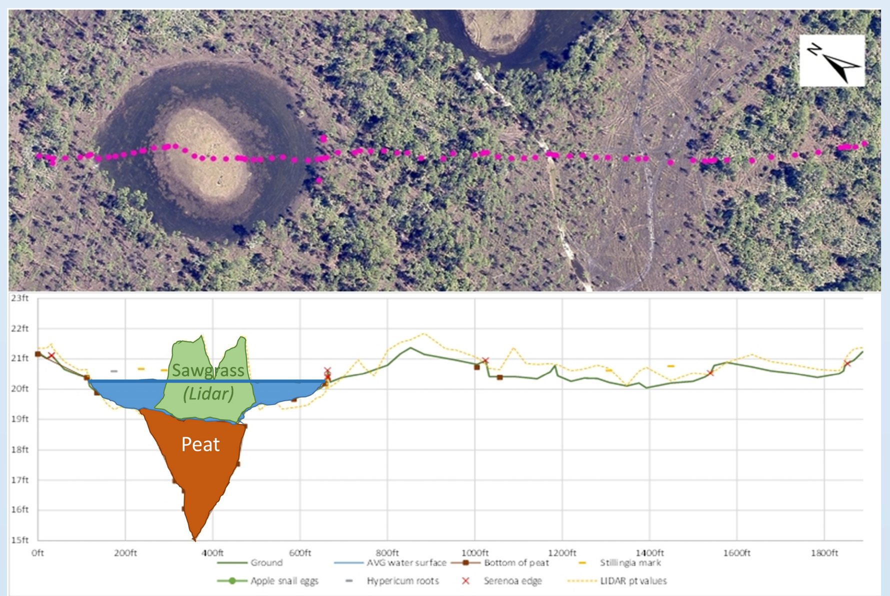


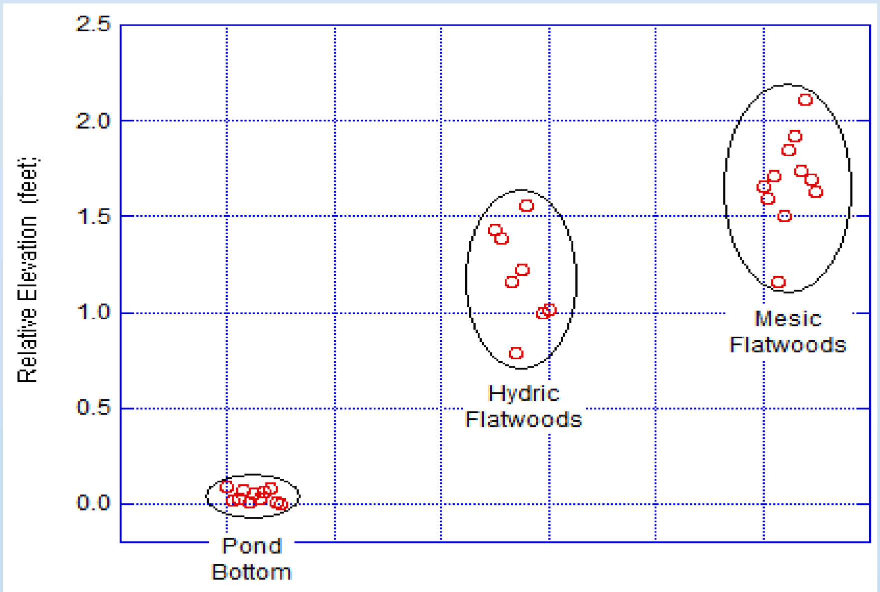
Habitat Type	Habitat Dry Tolerance	Habitat Wet Tolerance	LSU	LSU Dry Tolerance (Days)*	LSU Wet Tolerance (Days)*
Basin Swamp	180	300	1	112	214
Dome Swamp	180	300	2	76	160
Strand Swamp (Cypress Strand)	160	300	3	88/109	171/212
Basin Marsh	150	280	4	63	141
Depression Marsh	60	250	5	61	143
Wet Prairie	50	220	6	64	138
Wet Flatwood	30	60	7	51	139
Mesic Flatwood	0	30			

*Approximately 1 percent ruderal habitat was removed from each LSU for above calculations. LSU 3 includes two values based on with & without ruderal habitat. ruderal cover LSU 3 contains ~20%

Transect elevations for cypress strand to dome and depression marsh to flatwoods (Figs. 9-12):

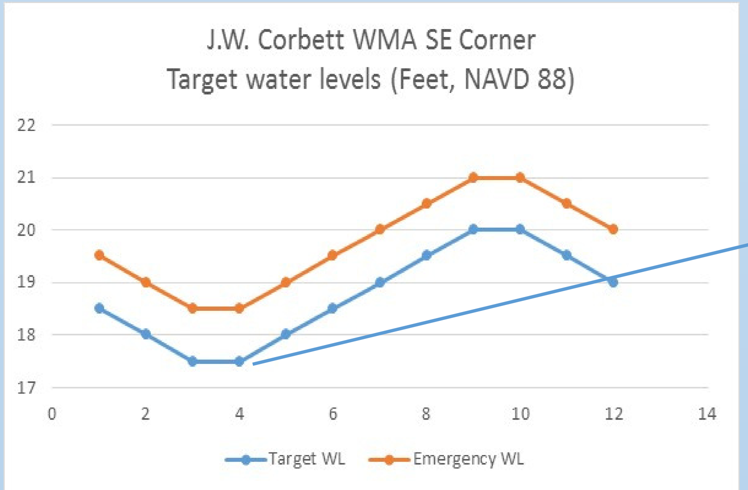


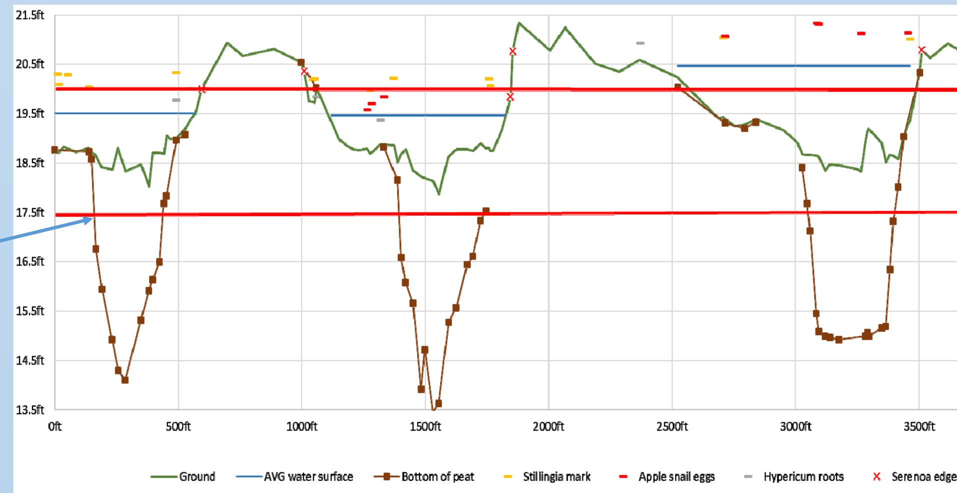




Figs. 9- 12: Transect elevation results in LSUs 1 & 4, showing elevations of habitat and biomarkers (9 & 10). Figure 10 shows an example of common Lidar bias (~2 feet in examples) in depression features. These areas contain Sawgrass (*Cladium jamaicense*), *Cephalanthus sp*., and *Salix sp. (Fig. 11)*. Figure 12 shows the relative elevation differences between marshes and flatwoods.

Linking field assessment to regulation schedules





Figs. 13 and 14: Target water levels in Fig. 13 appear too dry and would likely oxidize peat in depression marshes, while upper stages of the emergency schedule would likely decrease the extent of flatwoods.

Conclusions/Discussion

- Regional inflow to the strand has been reduced
- Discharge distribution has been reduced due to canals and levees and the predominance of structure discharges to the C-18 & L-8 canals.
- Peat surface below the elevation of surrounding sand bottom, where found, suggests peat oxidation due to lowered average water elevation

Improving hydroperiods:

- will help restore native plant communities,
- will minimize carbon loss (peat oxidation)
- is expected to decrease need for intensive management activities such as herbicidal control of exotic plants, roller chopping of saw palmetto and intensive fire management schedules.

Next steps

- Develop detailed species based optima/tolerances
- Resolve Lidar bias in ponds and determine implications to seasonal surface water flow
- Integrate threatened & endangered species needs
- Develop long-term habitat distribution/ community structure goals
- Recommend structural/operational measures to improve hydroperiods & habitat suitability
- Develop monitoring plan to evaluate achievement of performance goals.

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