

# *The Everglades: At the Forefront of Transition*



**Fred H. Sklar, Ph.D., Director and Section Administrator**

Everglades Systems Assessment Section

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[sfwmd.gov](http://sfwmd.gov)

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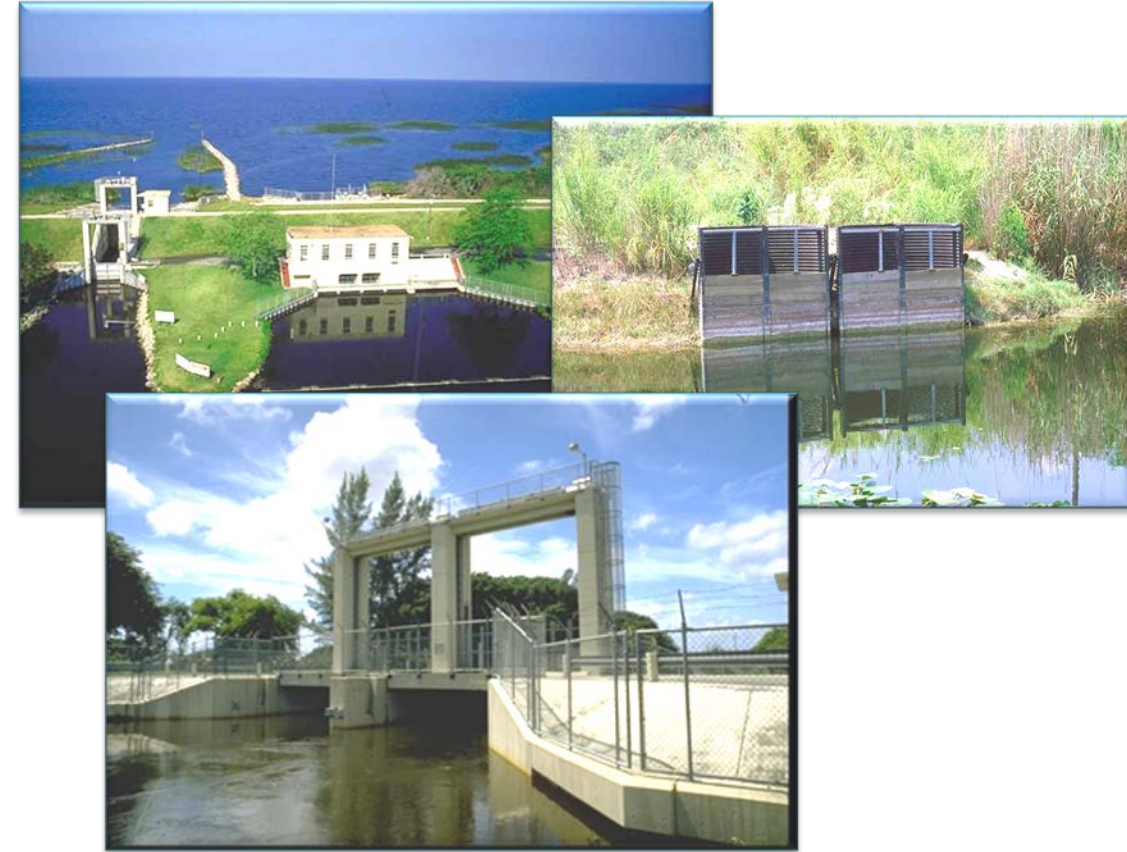
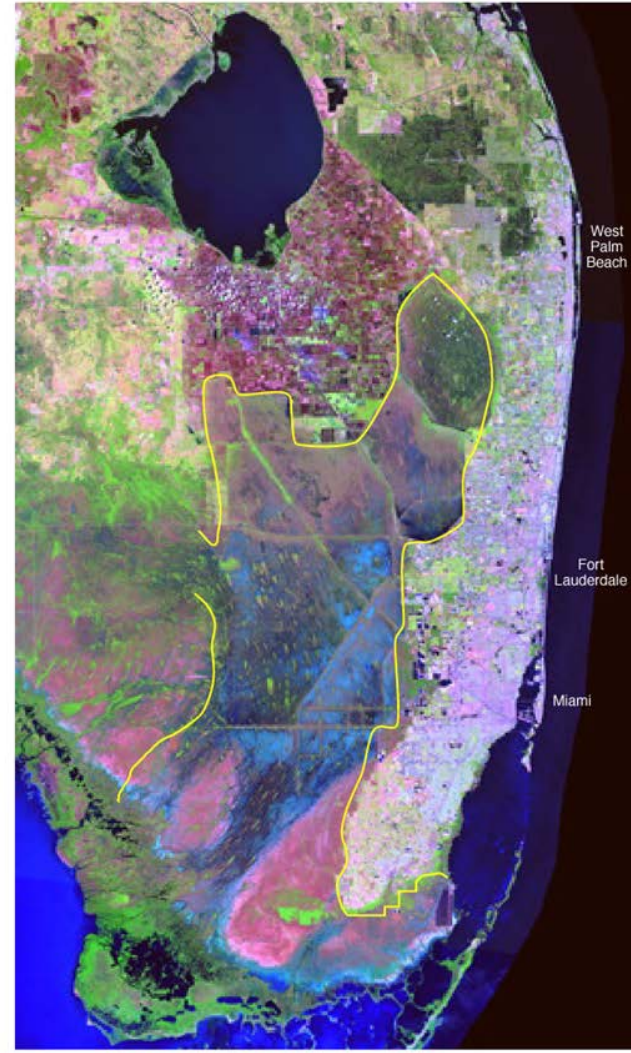
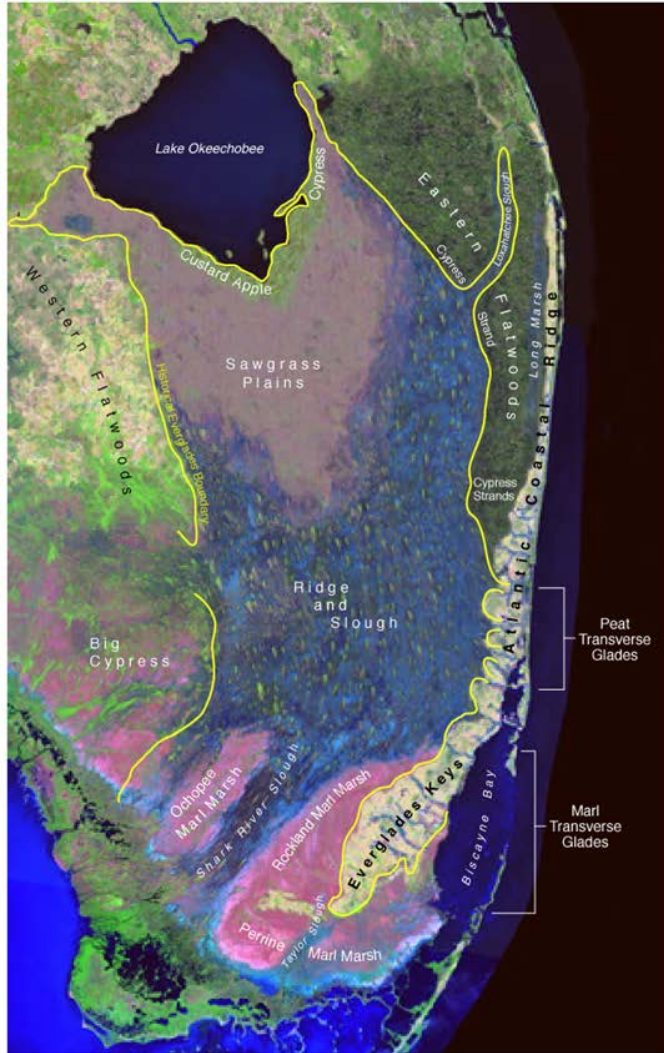


# HYPOTHESIS

A photograph of a coastal wetland landscape. In the foreground, there is a body of water with some green lily pads. A dense patch of tall, green reeds is in the middle ground. The background shows a flat, grassy plain under a bright blue sky with scattered white clouds. In the far distance, several power line towers are visible on the horizon.

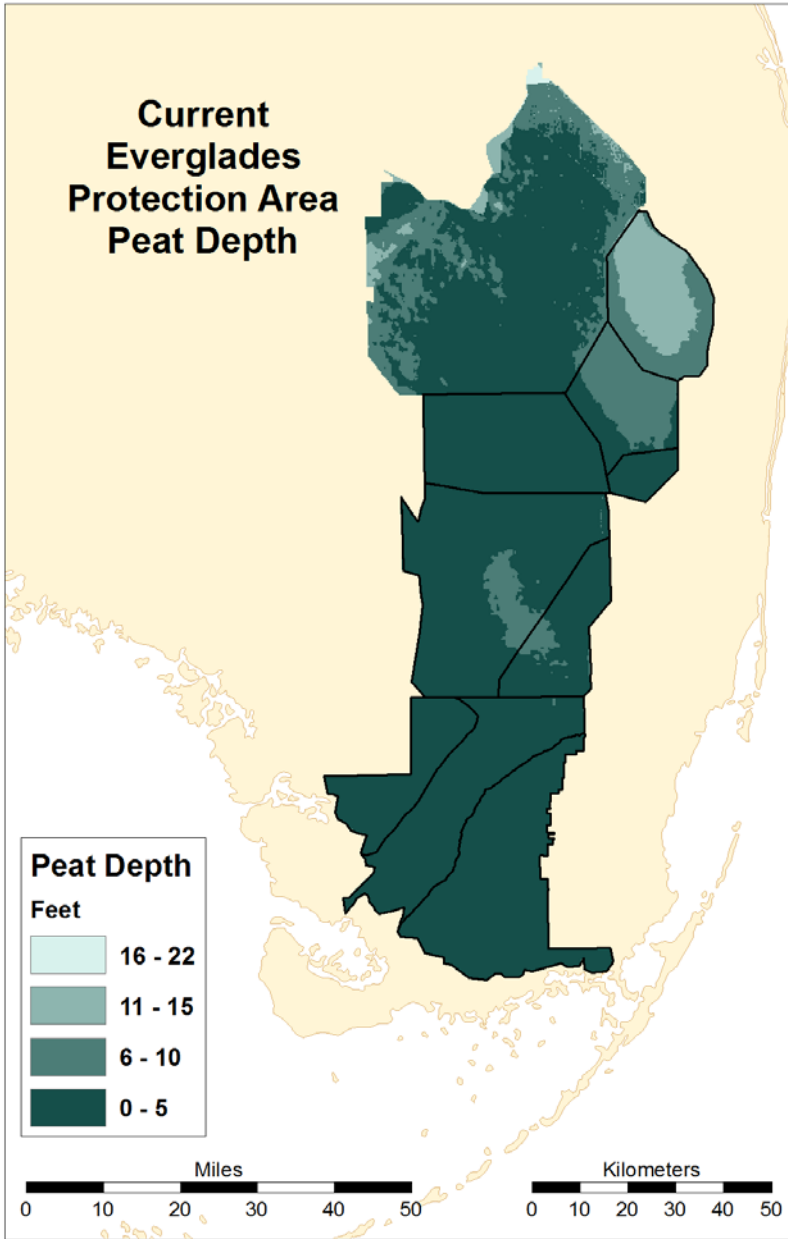
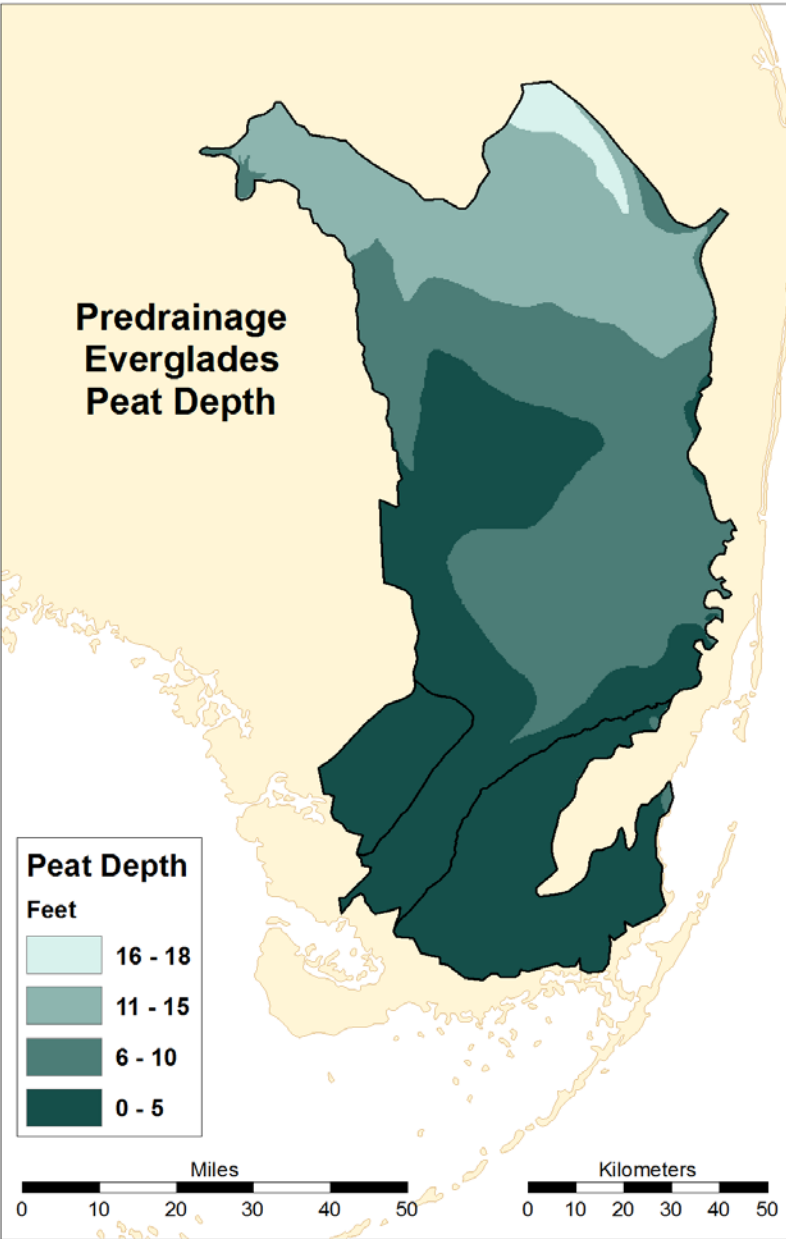
The interactions of coastal wetland biology, ecology, water management and sea level rise in coastal Everglades peatlands will determine the capacity for coastal wetlands to provide carbon sequestration, storm surge attenuation and habitat restoration.

# Water Management System Components



- ~3400 km of canals
- ~3200 km of levees/berms
- > 600 water control structures
- 71 pump stations

Pre-drainage Everglades (150 ybp) had a peat depth of 2 m, a peat volume of 20 billion m<sup>3</sup>, and a carbon content of about 900 million metric tons

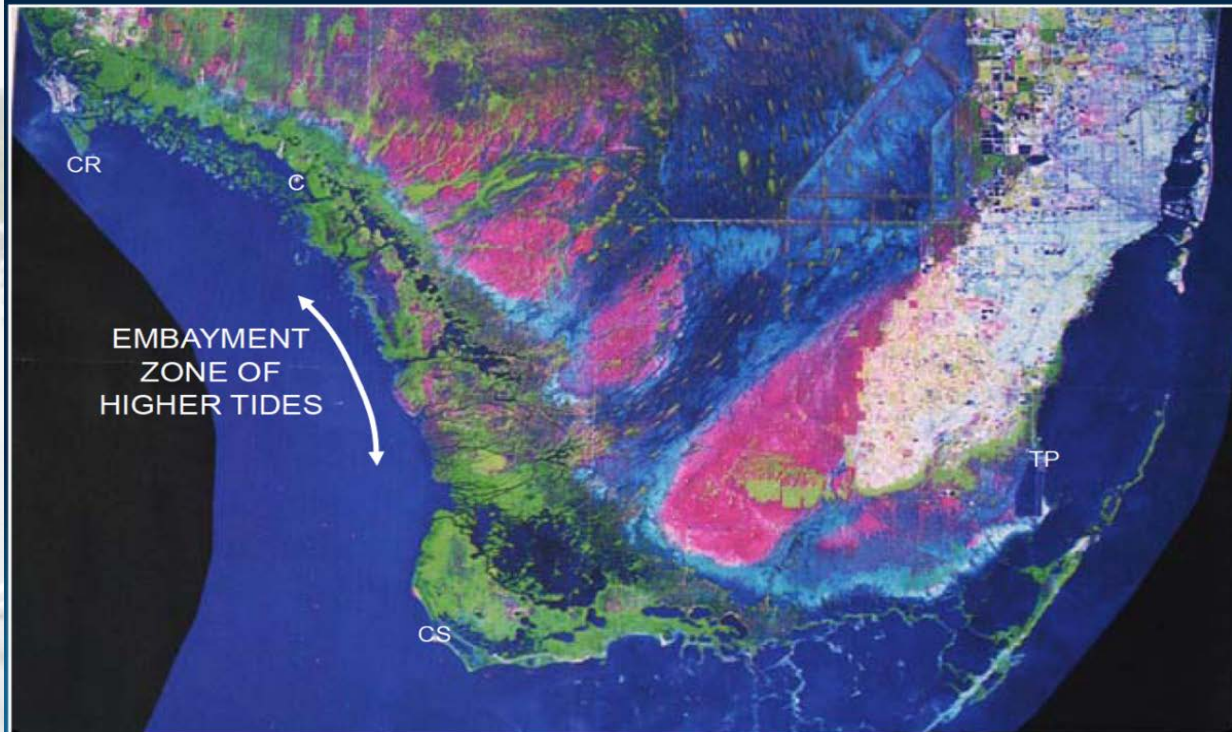


Current Everglades has a peat depth of 0.75 m, a peat volume of 5 billion m<sup>3</sup>, and a carbon content of about 200 million metric tons.

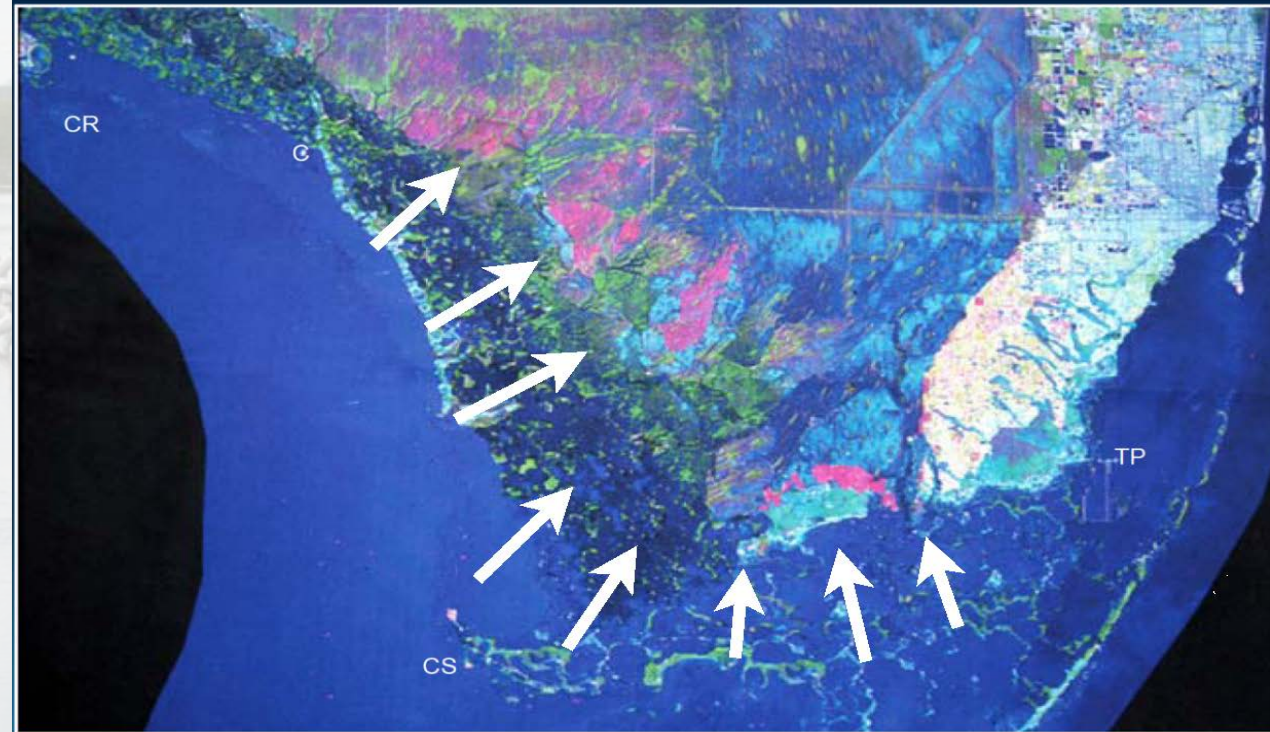
65% Peat Loss  
77% Carbon Loss

# Sea level rise threatens coastal marshes

South Florida 1995



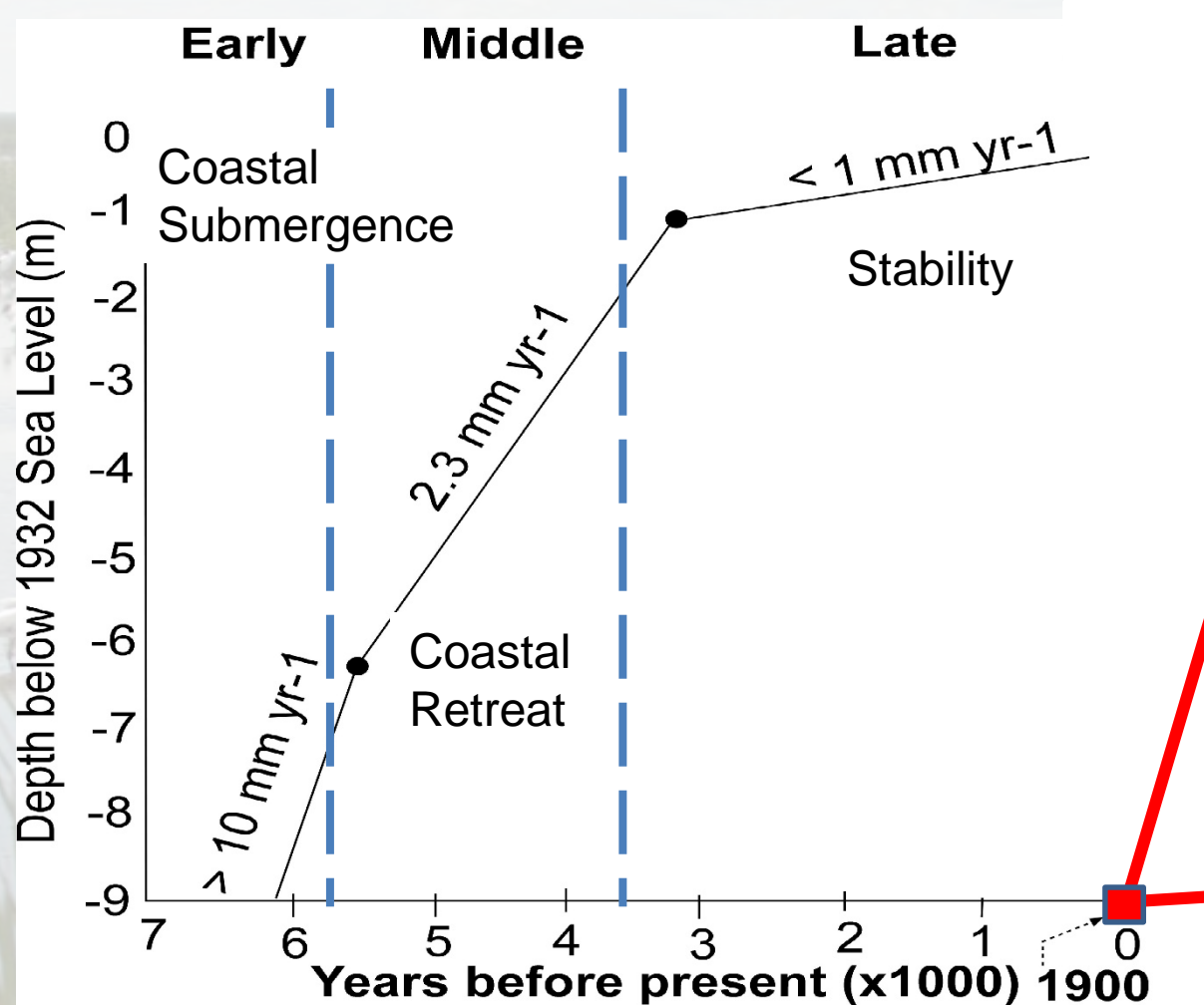
+2 foot rise (mhhw = +4.5' above 1929 MSL) South Florida 2100



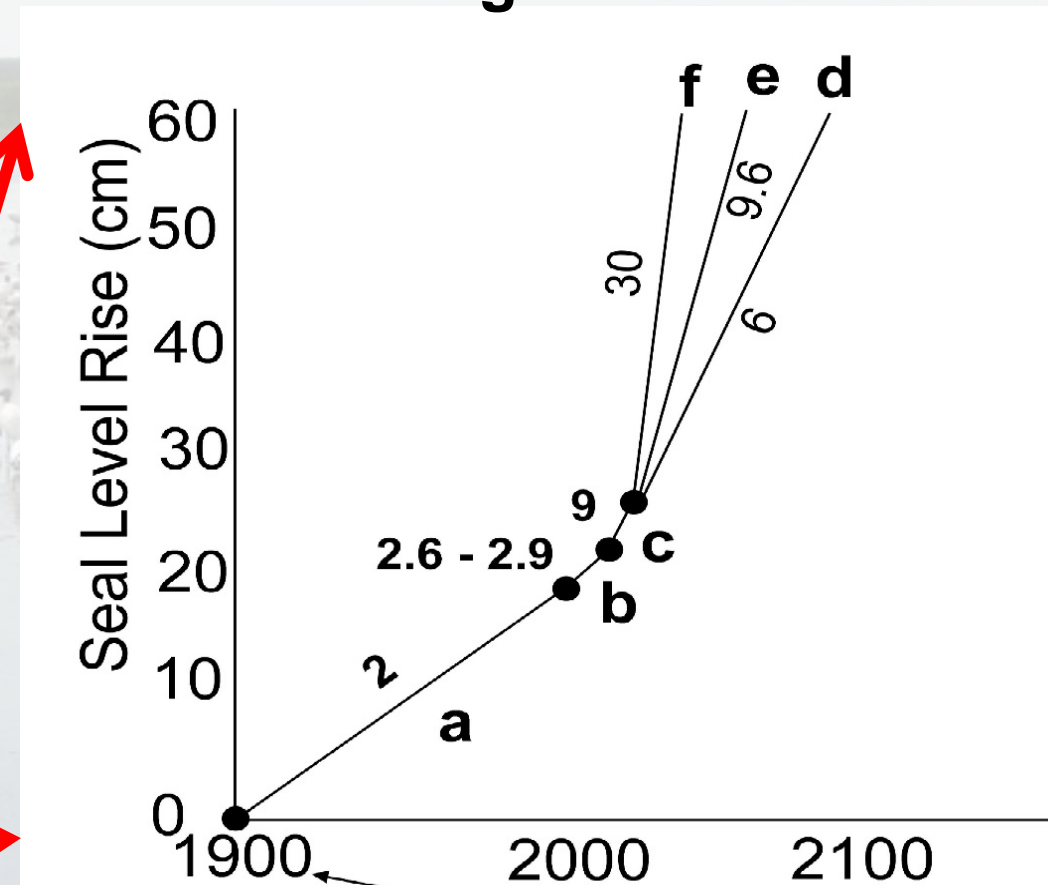
Maps showing current (left) and projected (right) coastline change, peat collapse and habitat movement resulting from a 2ft rise in sea level, projected by Dr. Hal Wanless, University of Miami in 1998

Increasing pressures from sea level rise combined with the geological history of Florida puts the Everglades at the “forefront of transition”

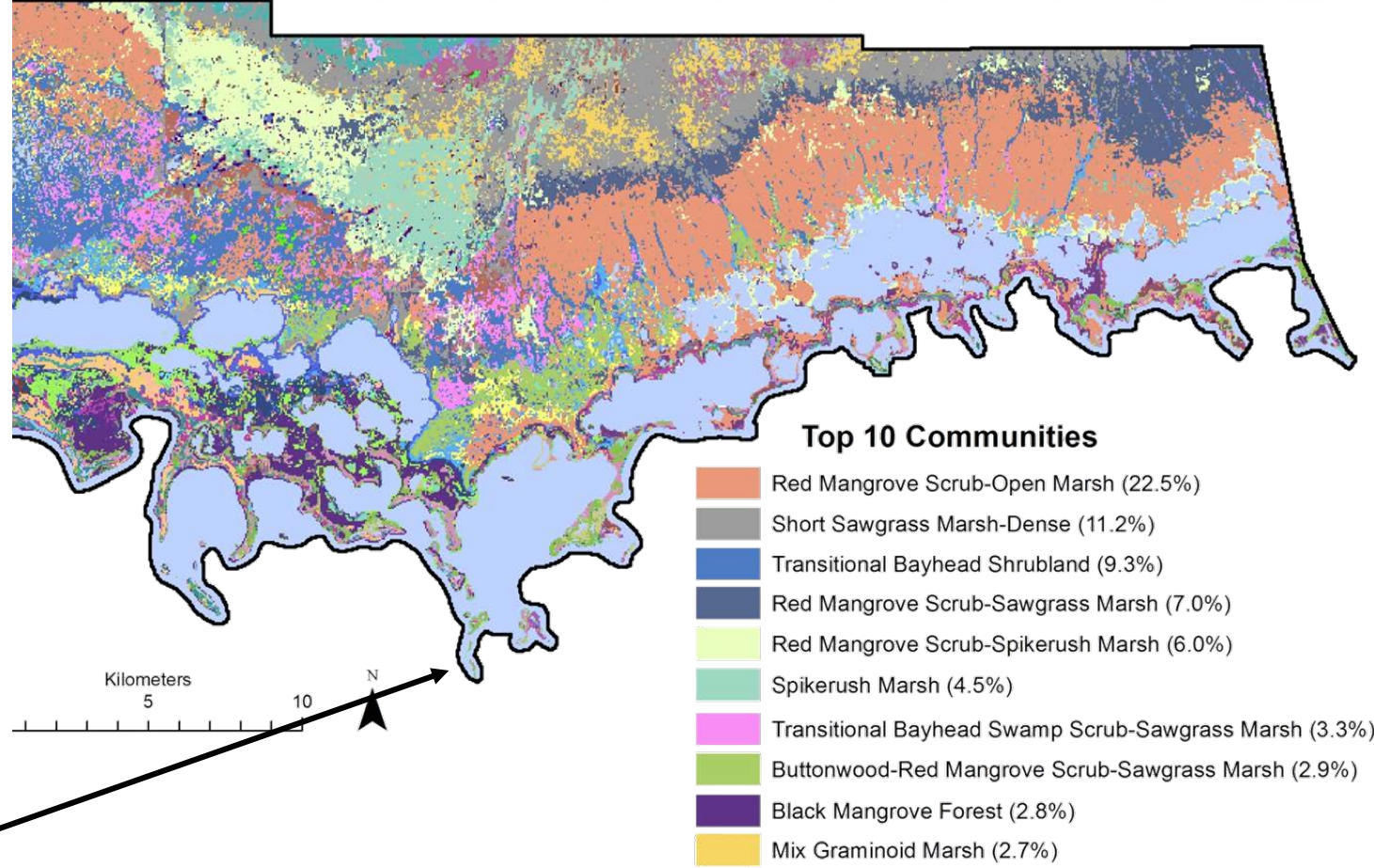
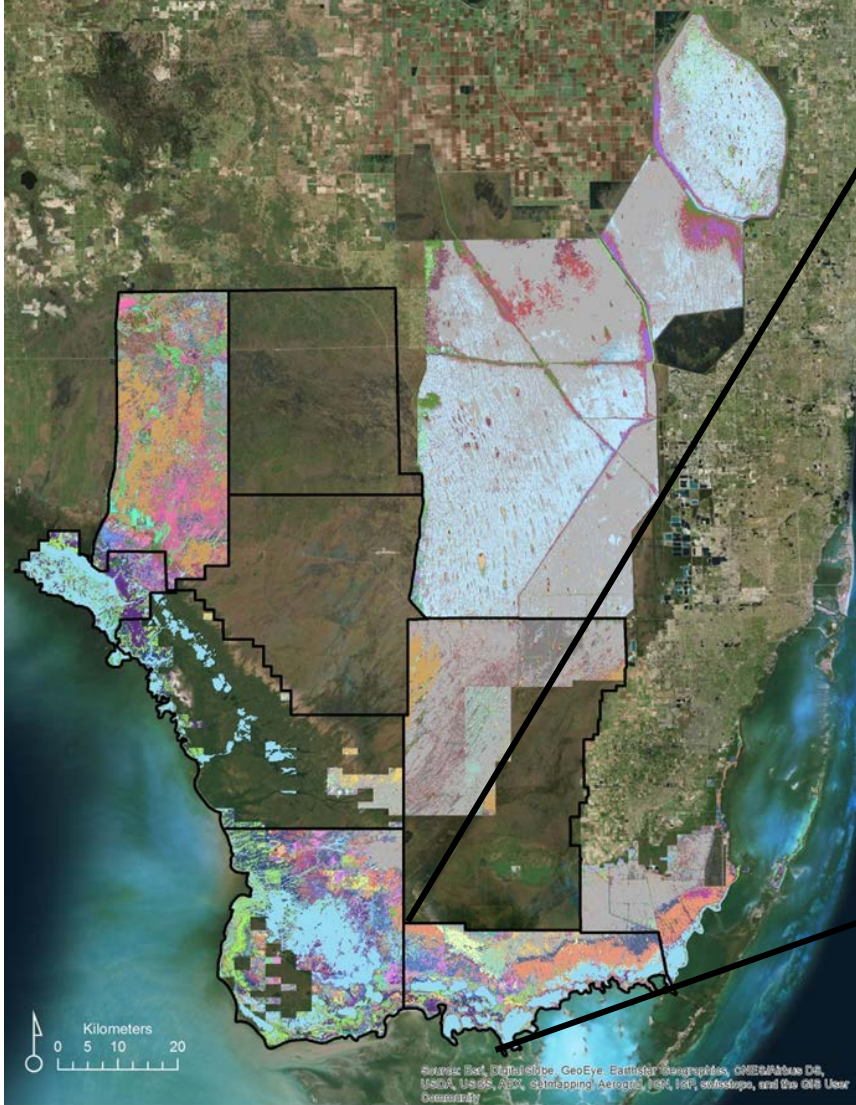
## Holocene



## Anthropocene Marine Transgression



# Southeast Saline Everglades





# Why are we focused upon the southeast saline Everglades?

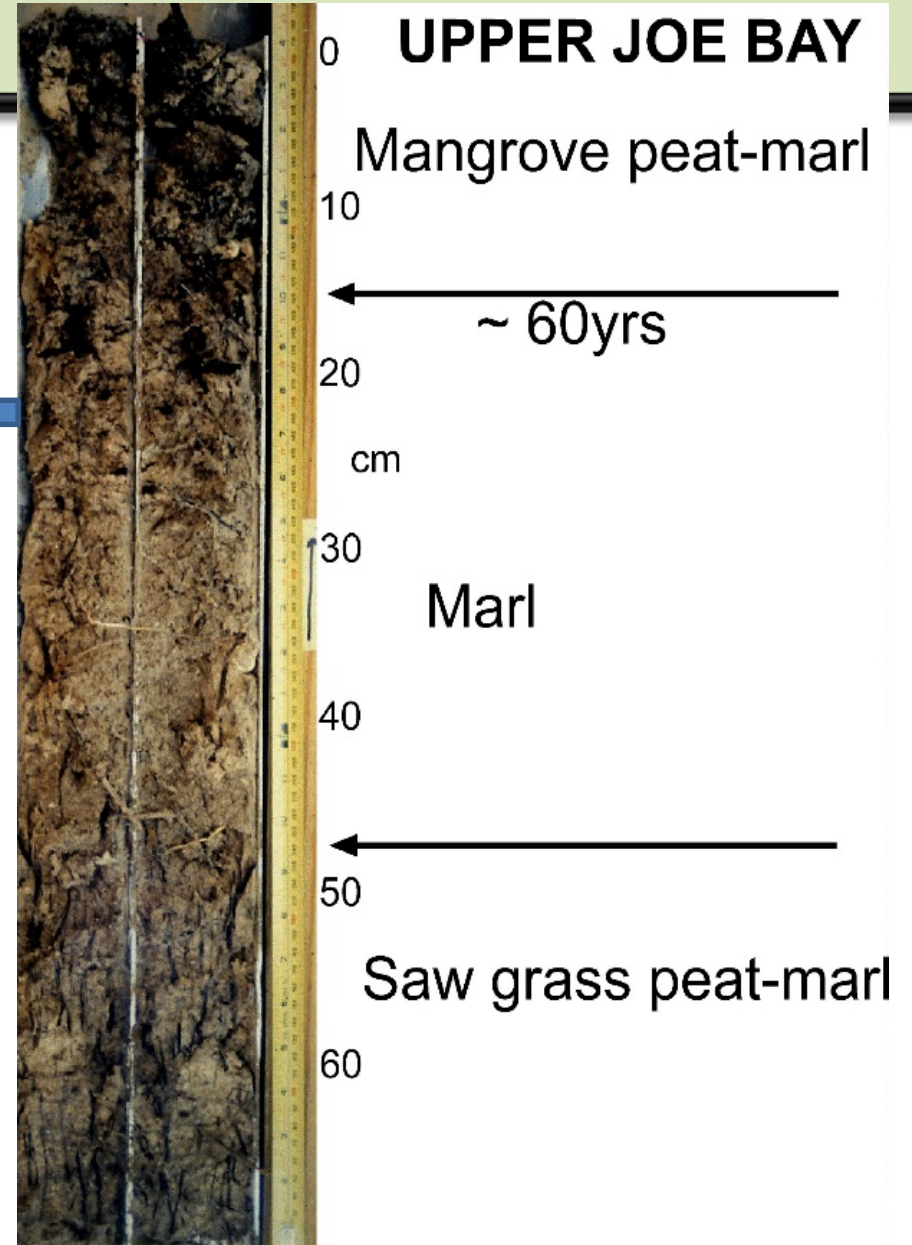
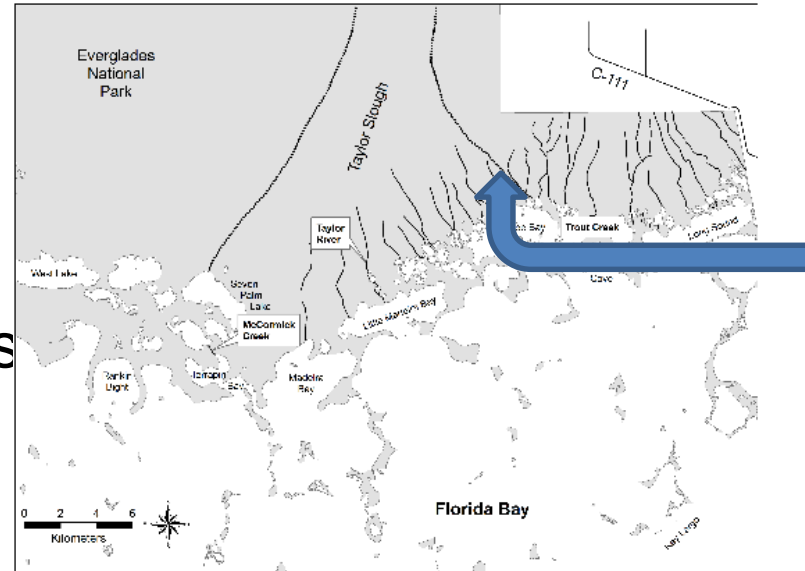
1. As a flat, low-lying landscape, the conventional thinking is that Everglades coastal habitats will gradually migrate upslope with increases in sea level as a transgressive process and as freshwater sawgrass marshes transition into brackish water marshes.



Mangroves “migrating” past a freshwater tree island in the southeast saline Everglades in response to the Anthropocene Marine Transgression. North is to the top, mangrove clumps range between 1 and 3 m in diameter. (Photo by Mike Ross).

# Why are we focused upon the southeast saline Everglades?

2. Inland transgression of mangroves has been suggested as a means by which sub-tropical and tropical coastal landscapes will “adapt” to increasing SLR.



A core 5 km north of Joe Bay displays a transgressive stratigraphic sequence and documents saltwater encroachment. The date, based upon  $^{210}\text{Pb}$  dating of mangrove peat-marl soils indicates an accretion rate of  $3.2 \text{ mm yr}^{-1}$  (Meeder et al. 2017).

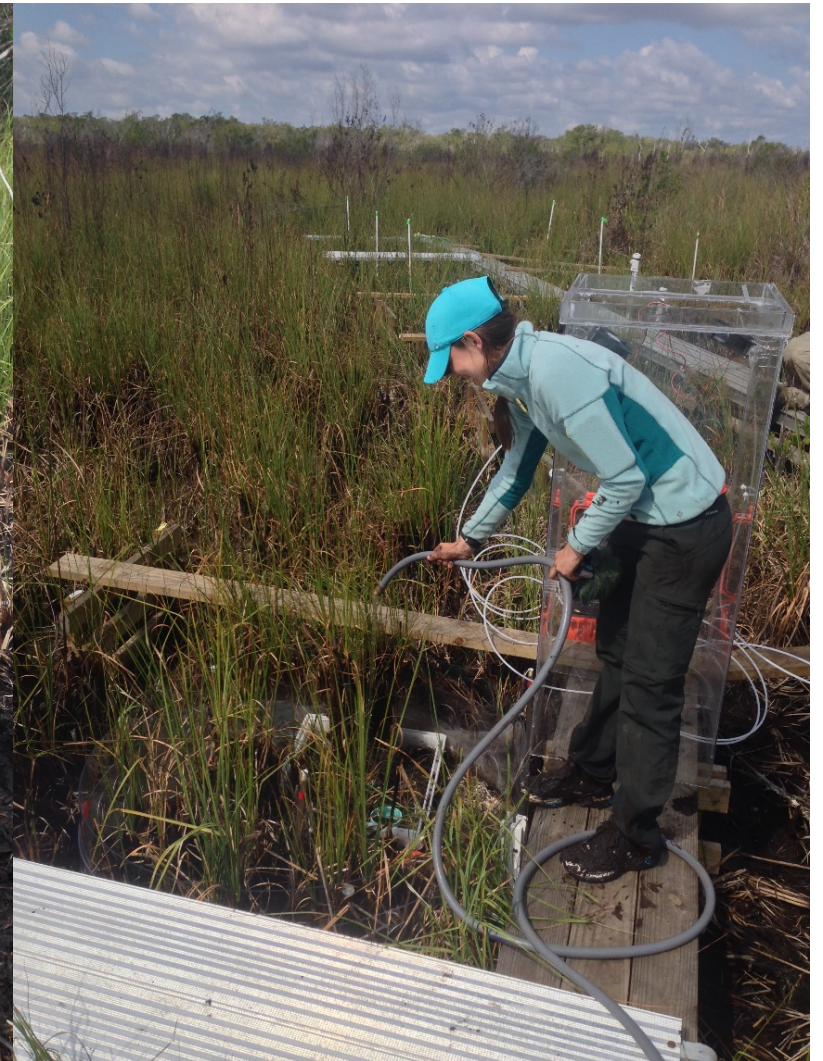
# Why are we focused upon the southeast saline Everglades?

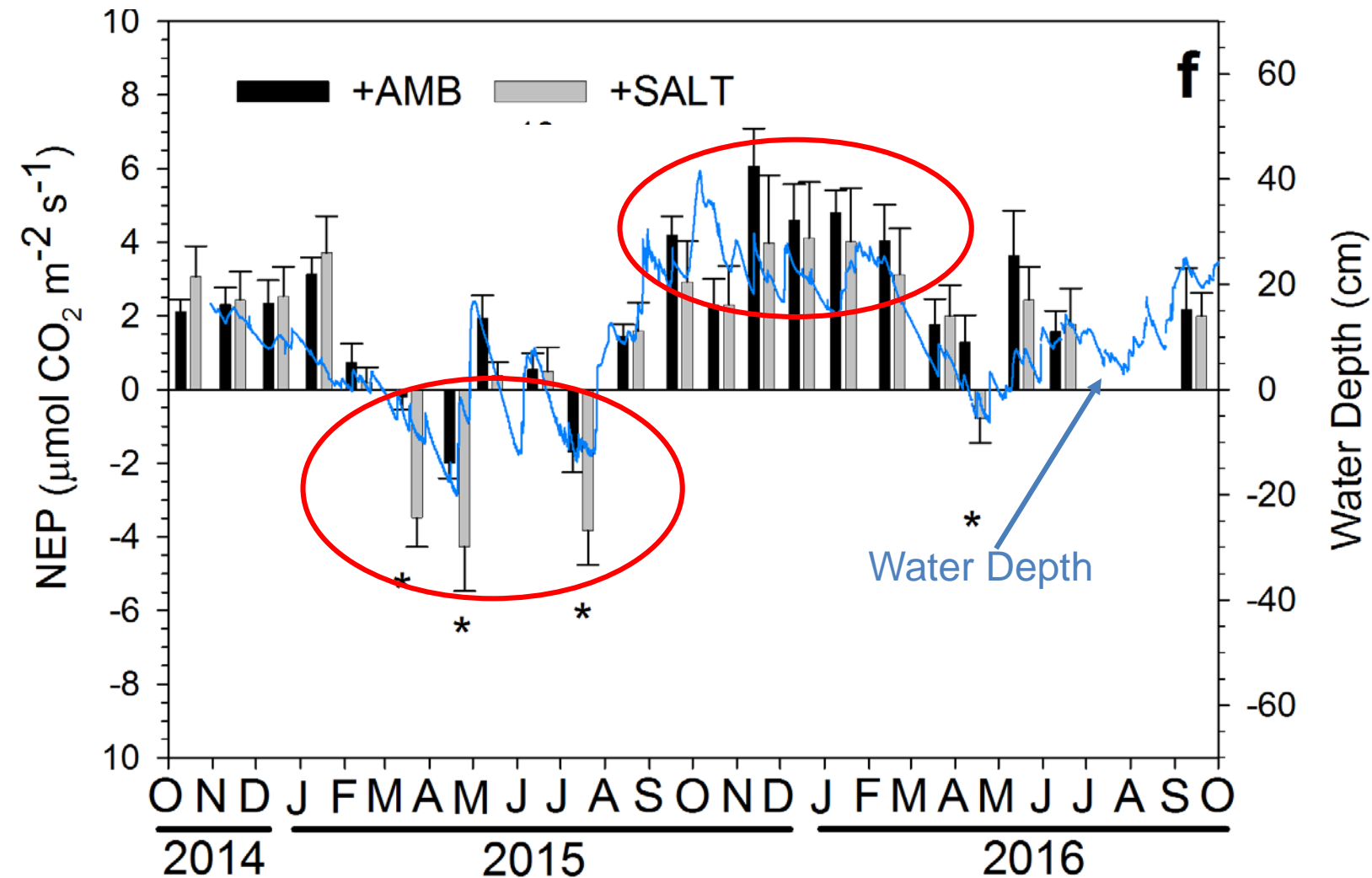
3. Erosion of coastal peats, inundation, ponding and overstep (i.e., salt water encroachment too fast for all communities to retreat) has already been observed in the southeast saline Everglades.



Peat collapse dosing experiments are in Shark River Slough in a brackish marsh area showing signs of peat collapse.

# Saltwater Dosing Experiments



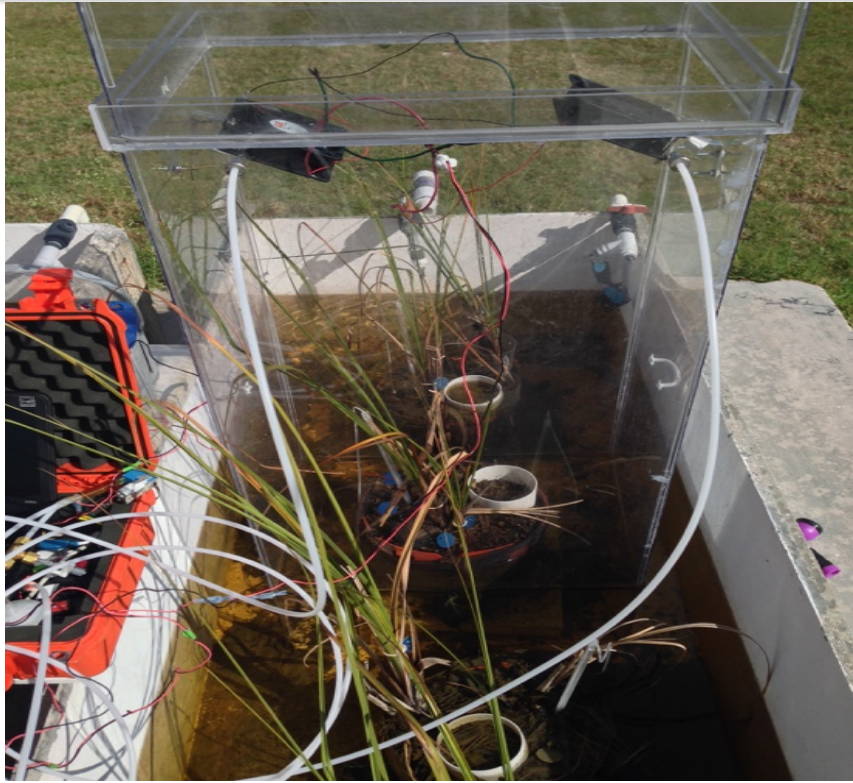


Brackish peat marsh field experiment with water level relative to soil surface plotted against net ecosystem exchange (NEE) for ambient (AMB) and 2X porewater salinity exposed (SALT) plots.

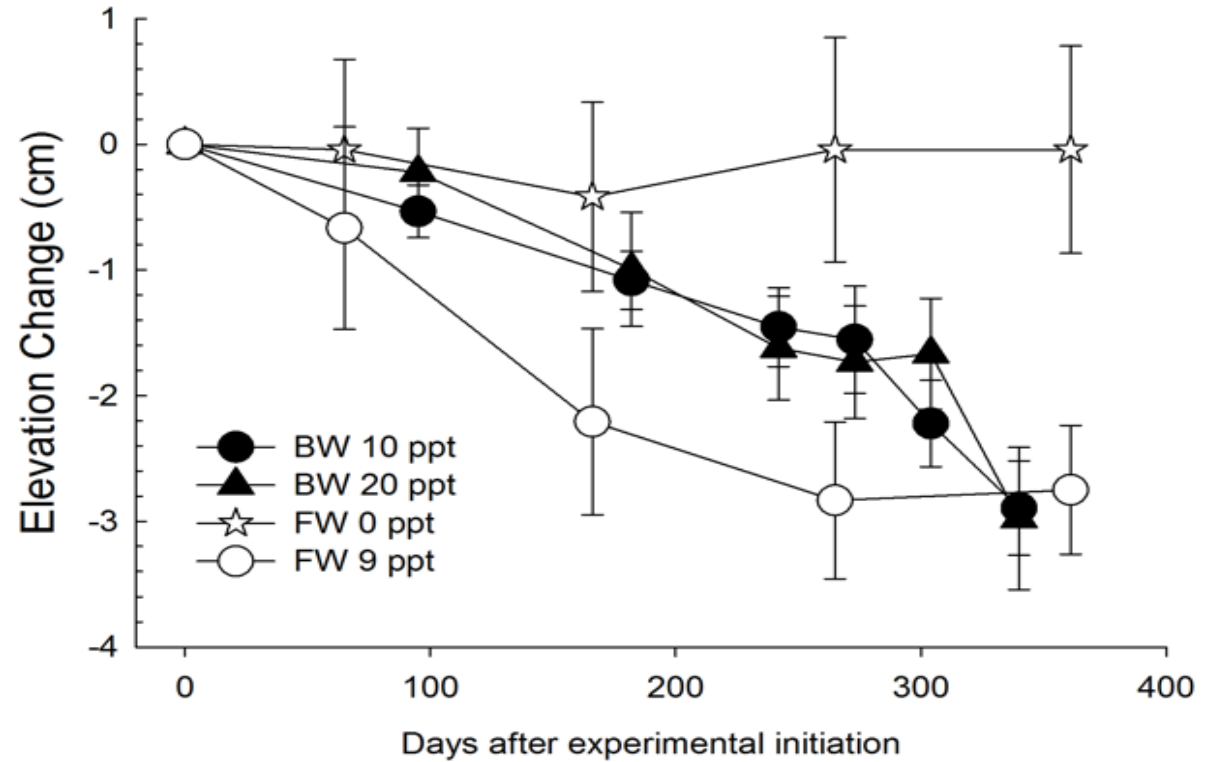
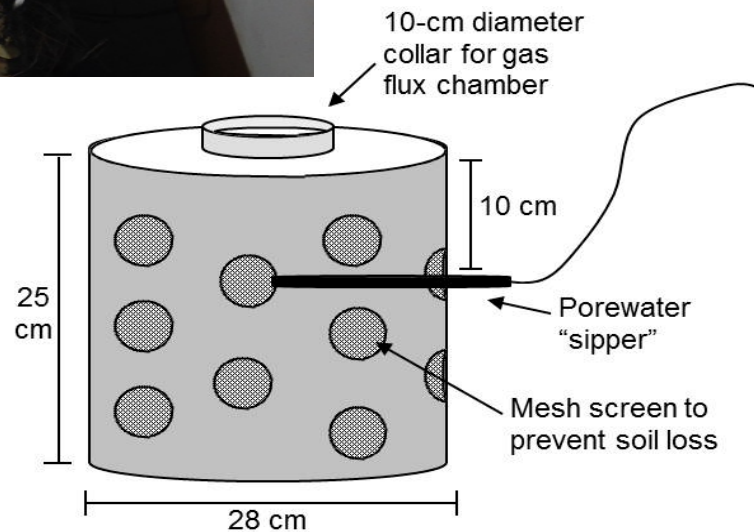
## Results

- An extended “dry-down” pattern can lead to increased porewater salinity.
- Elevated salinity reduced gross ecosystem productivity and belowground root growth.
- Drought stimulated organic matter mineralization and carbon dioxide loss from the marsh.

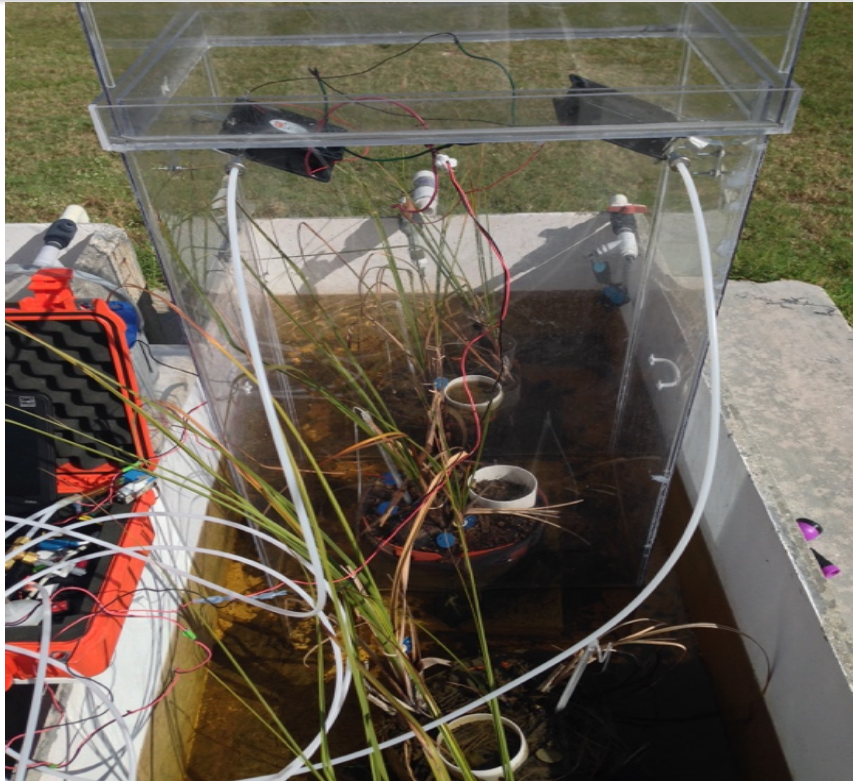
Ben Wilson et al. 2018. Salinity pulses in marshes interact with seasonal dry-down to increase ecosystem carbon loss in the Florida Everglades. *Eco Apps*. In press.



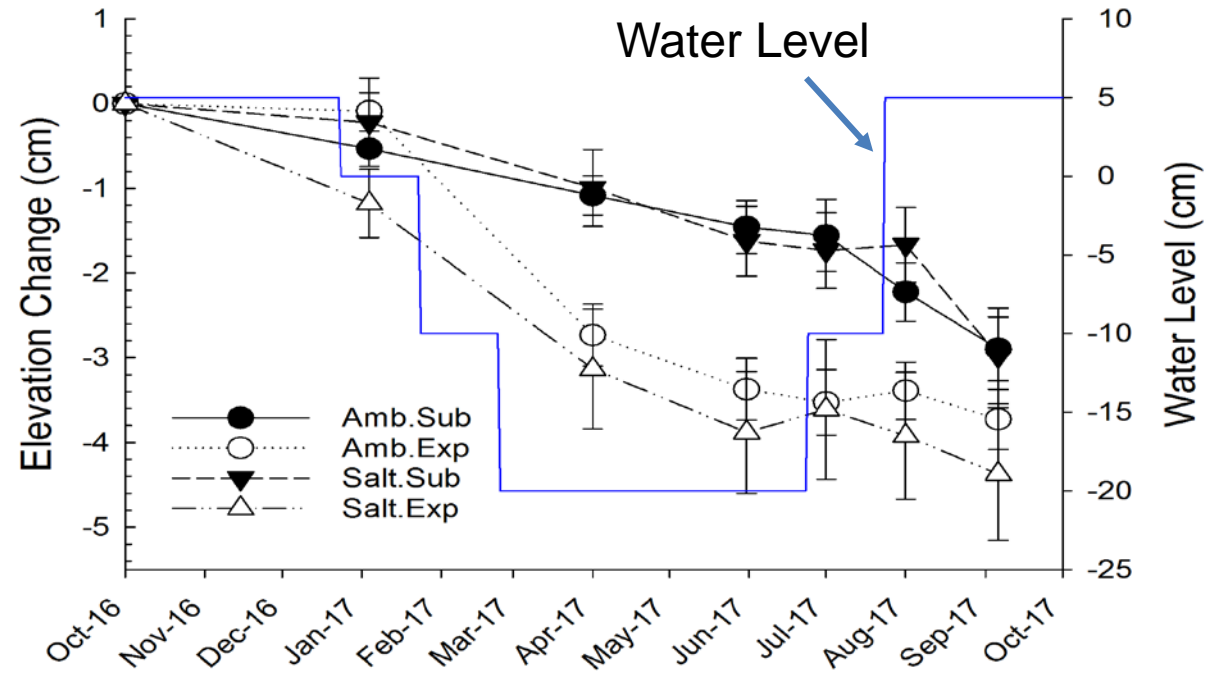
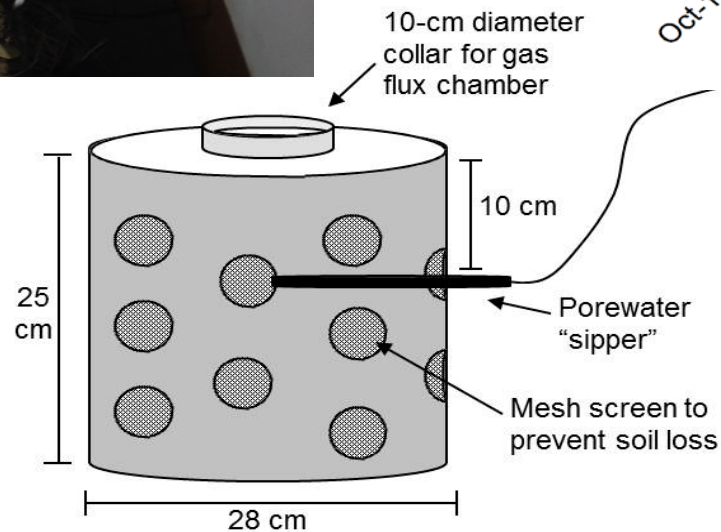
Schematic illustrating the mesocosm core design for the measurement of instantaneous NEE (right) and photo of the mesocosms (above) used to evaluate drought and salinity effects.



**Ben Wilson et al. 2018. Saltwater intrusion and drought drive peat collapse in a brackish coastal peatland. Nature. In review.**



Schematic illustrating the mesocosm core design for the measurement of instantaneous NEE (right) and photo of the mesocosms (above) used to evaluate drought and salinity effects.



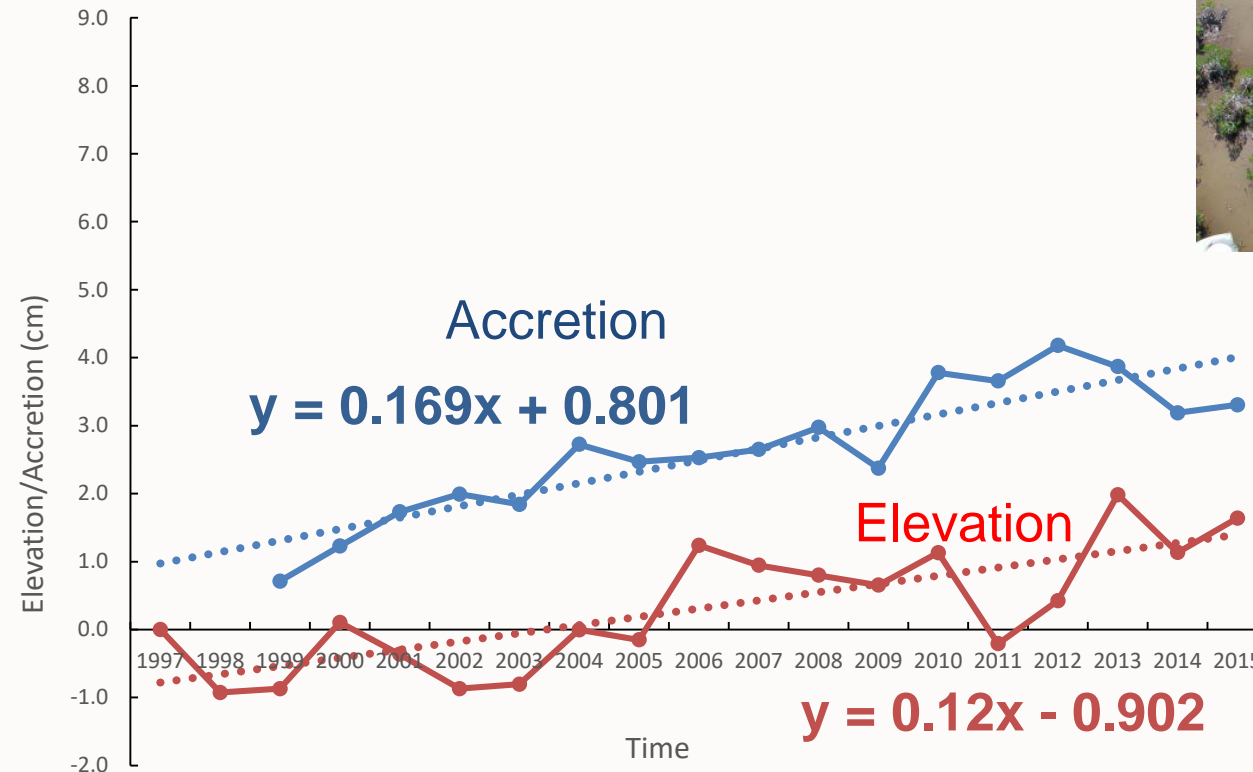
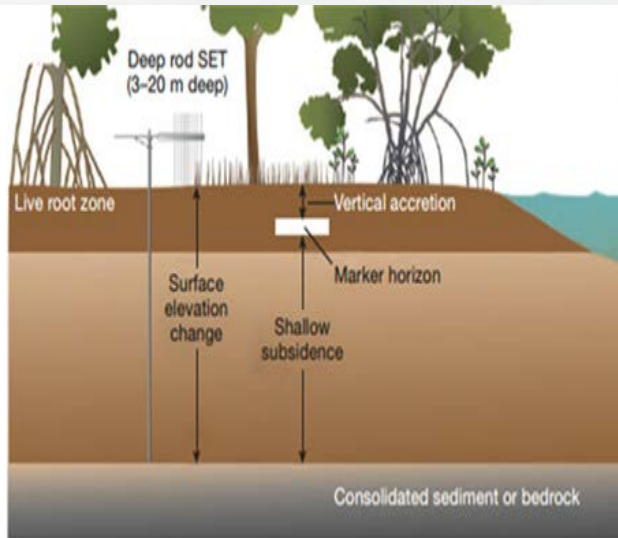
Results: Soil elevation declined ~2.9 cm in one year under brackish water conditions and by ~4.4 cm when elevated salinity was coupled with drought (exposed).

Ben Wilson et al. 2018. Saltwater intrusion and drought drive peat collapse in a brackish coastal peatland. *Nature*. In review.

# Highway Creek: (Elevation Change = 1.2 mm/yr)

## Low flow -- Always inundated

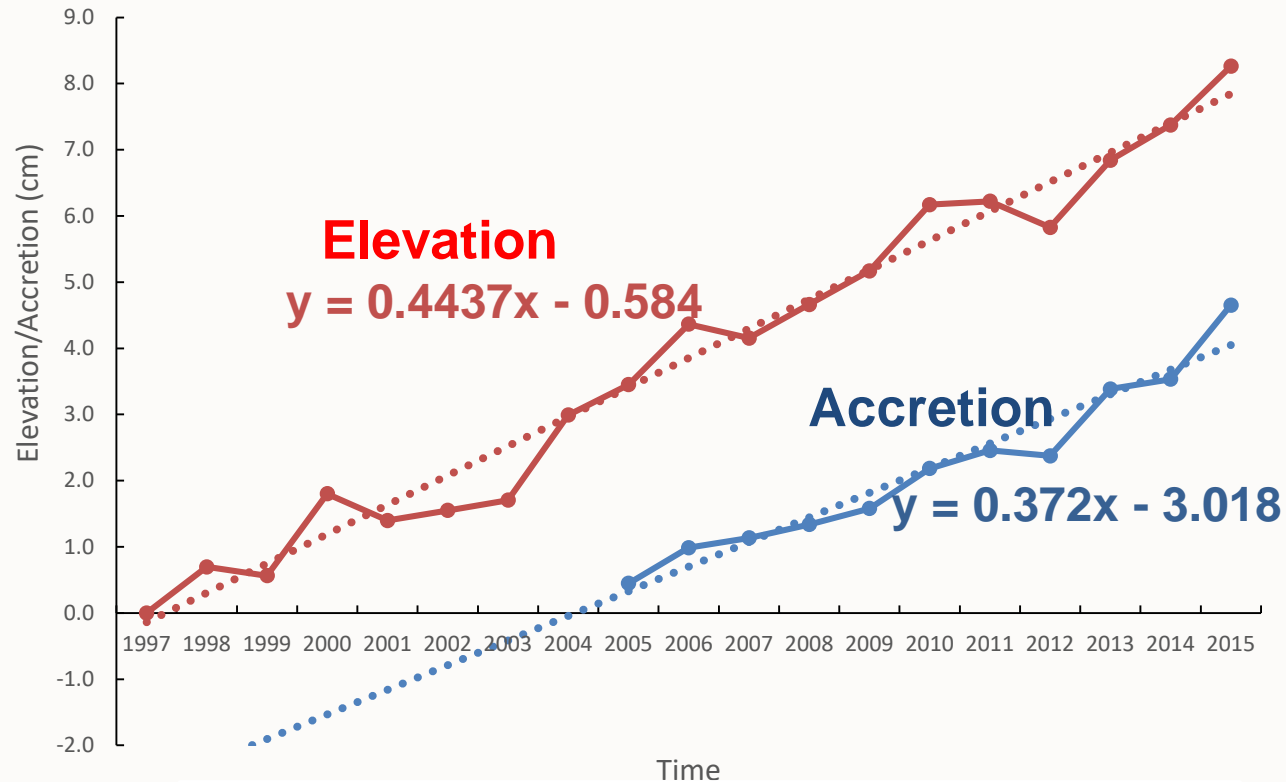
The SET-MH installation monitors changes in soil-surface elevation, soil accretion and shallow subsidence. Figure modified from Lovelock et al (2015).



Carlos Coronado et al. 2019. Mangrove stability. In: Chapter 6 South Florida Environmental Report, SFWMD. In press.

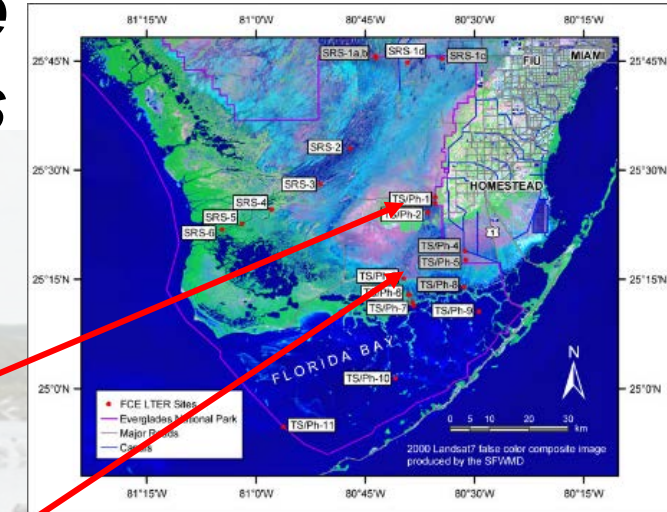
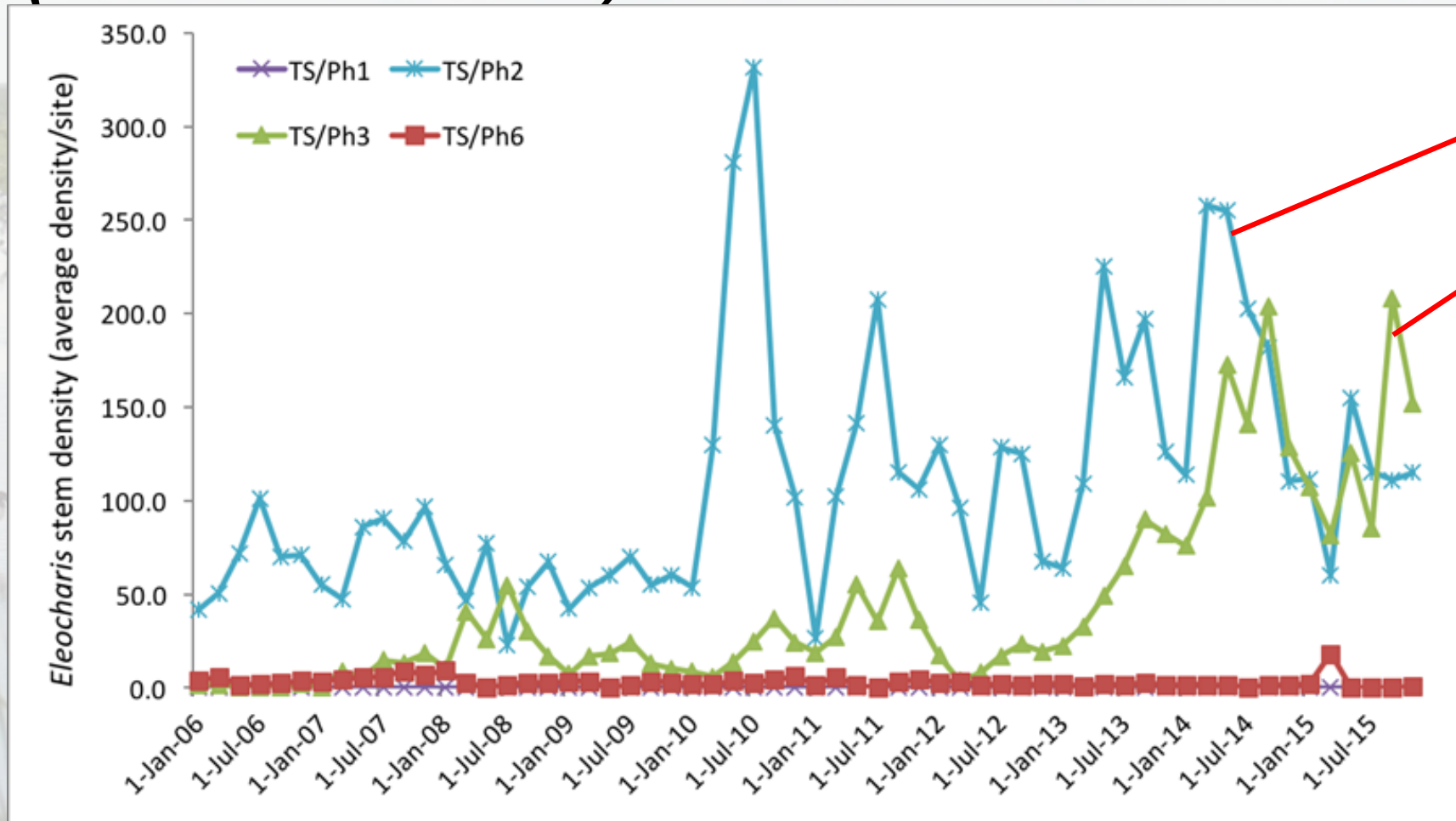


# Taylor Slough (Argyle Henry): (Elevation Change = 4.4 mm/yr) High flow -- Seasonal inundation with freshwater



Carlos Coronado et al. 2019. Mangrove stability. In: Chapter 6  
South Florida Environmental Report. SFWMD. In press.

# Hydrological restoration of Taylor Slough improves the distribution, community structure and viability of the southeast saline Everglades (Troxler et al. 2014)



High quality marsh habitat macrophyte species *Eleocharis* expanding at 2 sites downstream of C111 operations since 2012.

## CONCLUSION

Saltwater intrusion initially destabilizes peat soils and “dry-down” events exacerbate peat collapse. *Without restoration of freshwater flow to the Everglades, saltwater intrusion-induced peat collapse will be enhanced and landward migration of mangroves into freshwater peat soils stymied.*

# Thank You – Questions?

**Everglades National Park**

Sklar, F., J.F. Meeder, T.G. Troxler, T. Dreschel, S.E. Davis and P.L. Ruiz. In Press. The Everglades: At the Forefront of Transition (Chapter 13). In: E. Wolanski, J. Day, M. Elliott and R. Ramachandran. Coasts and Estuaries – The Future. Elsevier.