Pre-restoration mangrove cover change in the Cutler Wetlands

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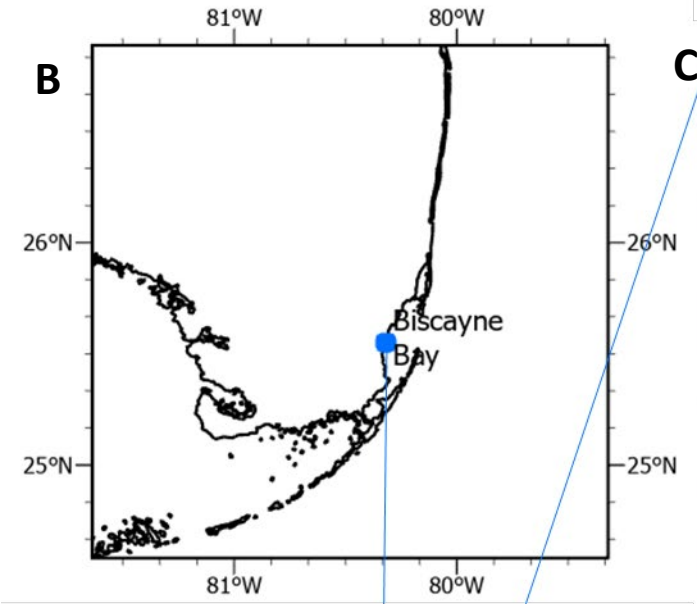
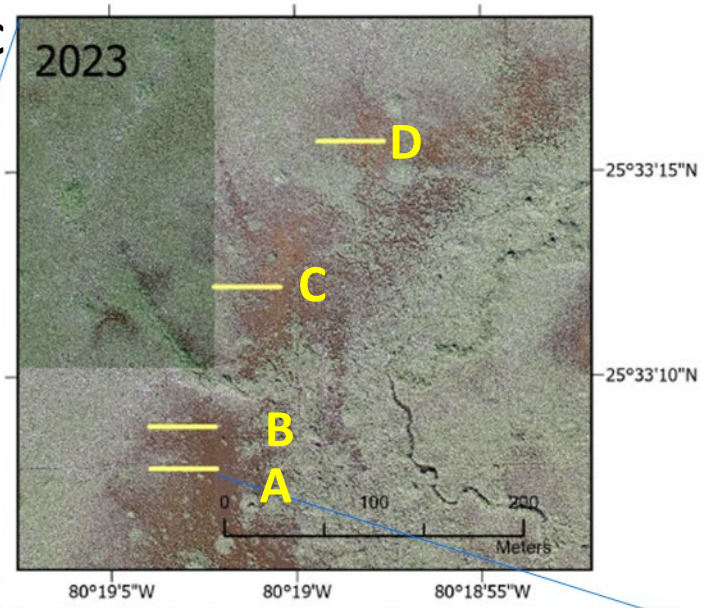
- FIU Aquatic Ecology Lab
- South Florida Terrestrial Ecosystems Lab
- CREST- CAChE
- Randy Parkinson and Jack Meeder

Cutler Wetlands





SFWMD

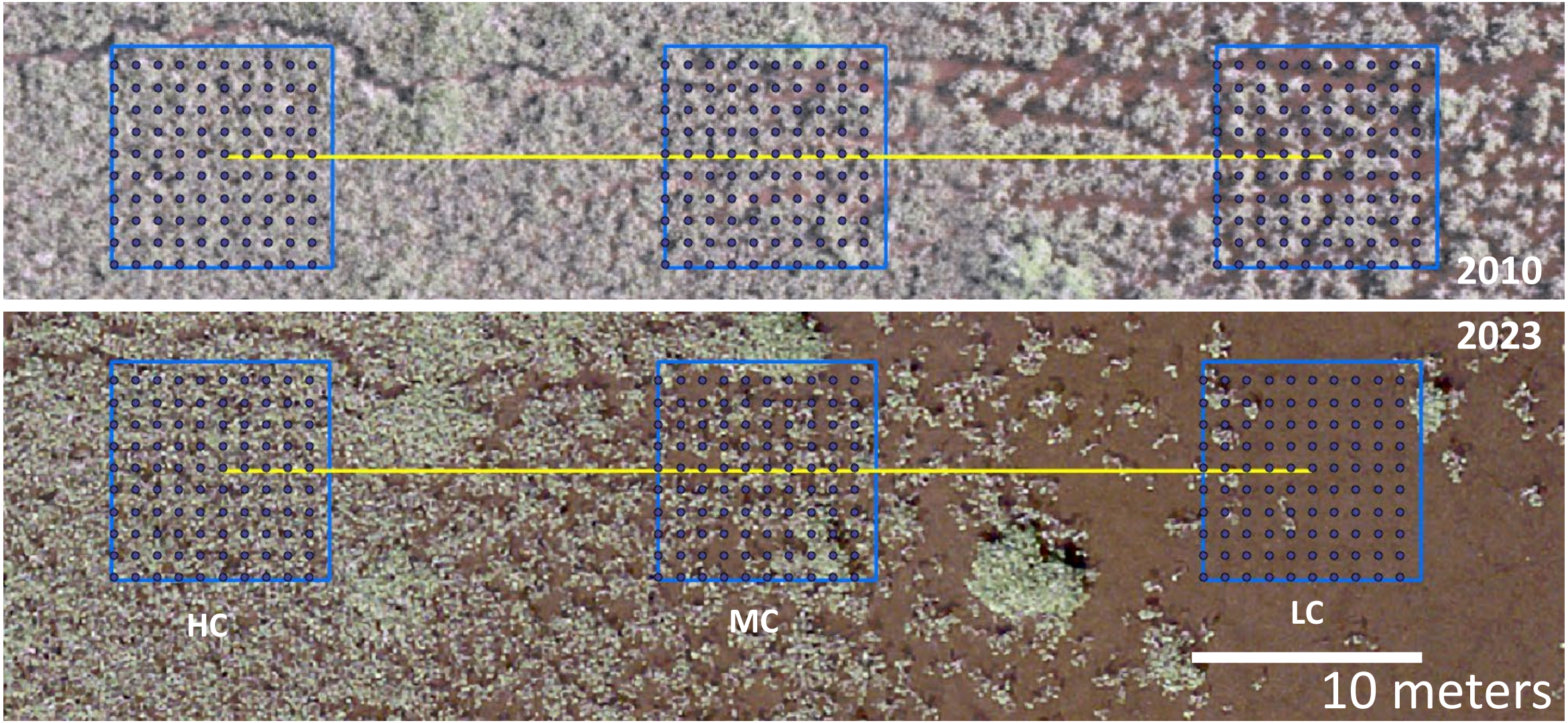
Objectives

To determine:

- Pre-restoration cover change rate,
- Plant signals of stress in areas of loss or transitioning to loss,
- Possible environmental causes of loss
  - Ponding or lower elevation
  - Bedrock depressions
  - Soil subsidence or collapse
    - Lower soil OM
    - Higher soil bulk density

Low cover area at different points in the tidal cycle, Transect A.

Visual Dot Grid Observations

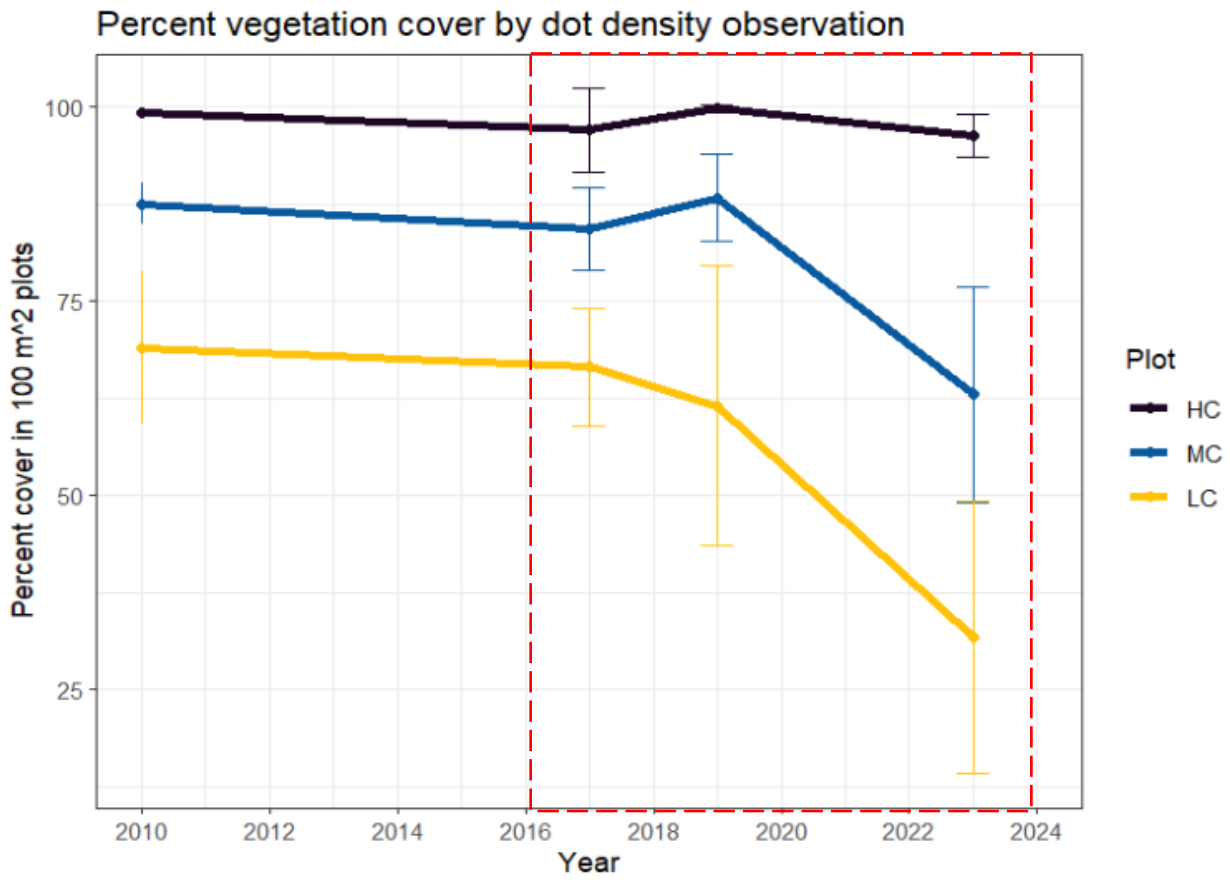


Miami Dade County Aerial Imagery, 2010 and 2023

Vegetation Cover Change: 2010 - 2023

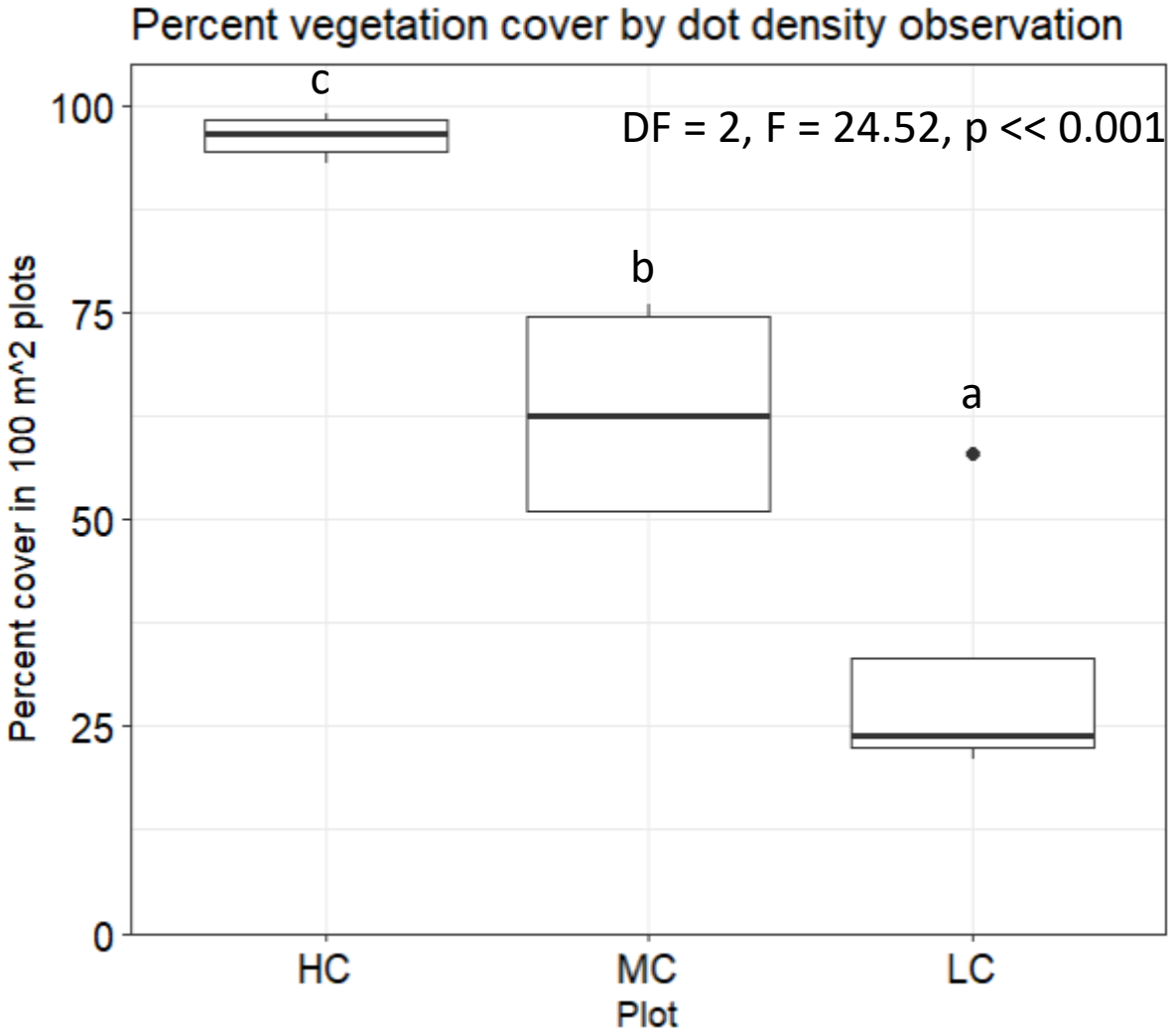
	Average % Cover by Year			
Plot	2010	2017	2019	2023
Low Cover	69	67	62	32
Moderate Cover	88	84	88	63
High Cover	99	97	100	96

	Average Annual Rates of Cover Change		
	Low	Moderate	High
2010 - 2017	-0.4	-0.5	-0.3
2017 - 2019	-2.5	2.0	1.4
2019 - 2023	-7.4	-6.3	-0.9
Overall	-2.9	-1.9	-0.2

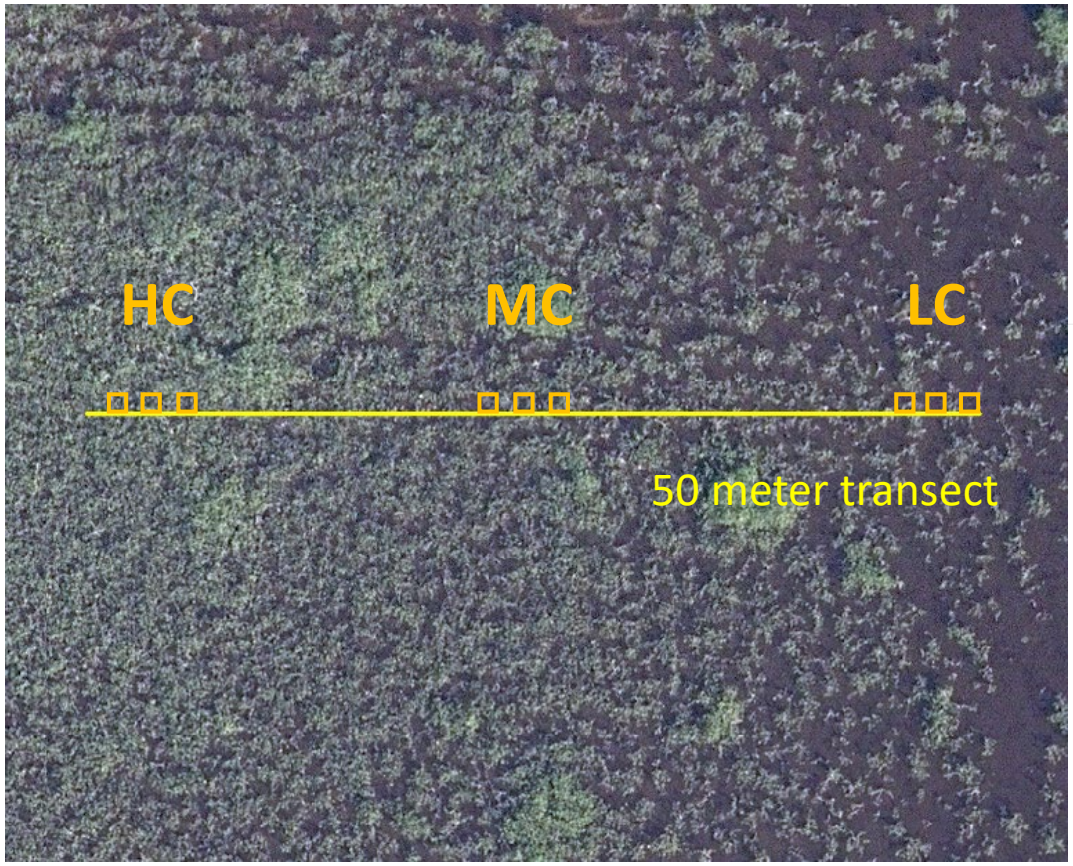


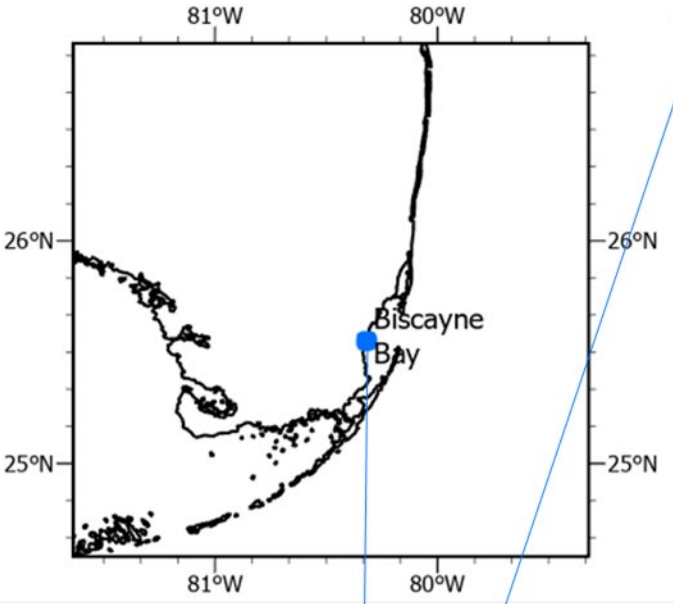
Visual Cover Estimates in 2023

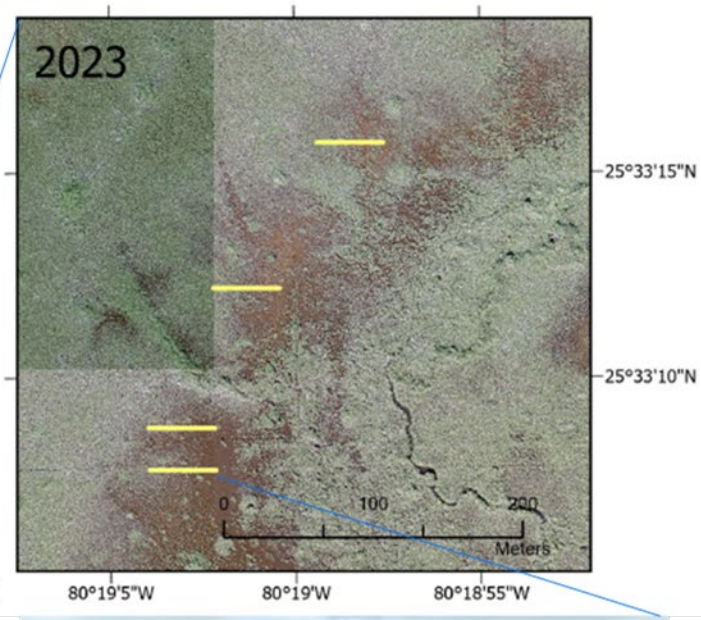
Plot	% Cover
HC	96
MC	63
LC	32



Field Sampling



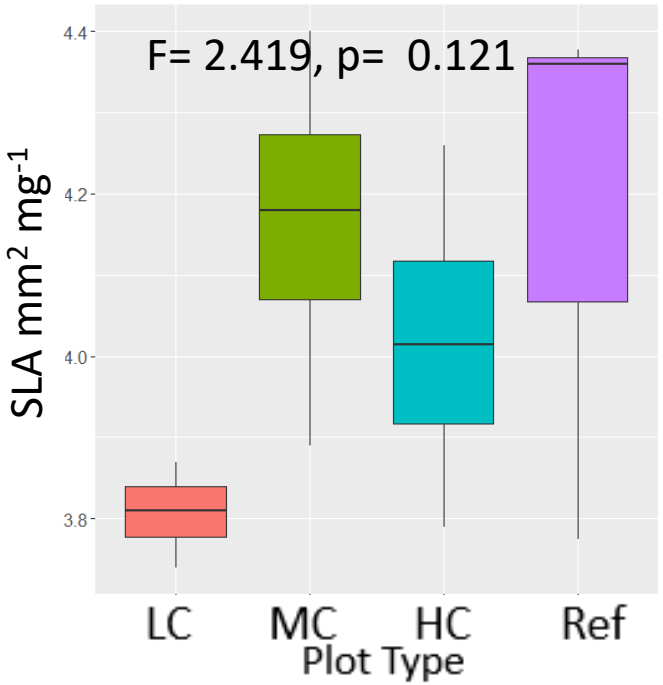


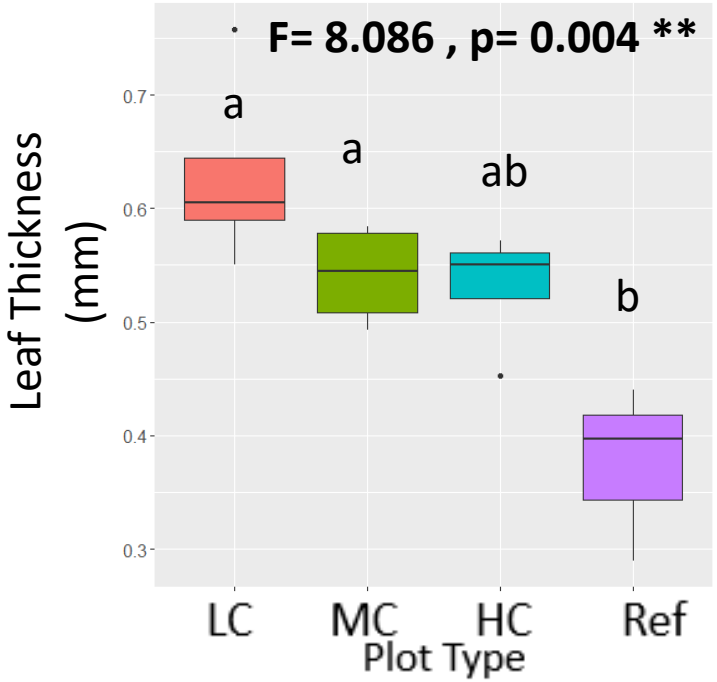


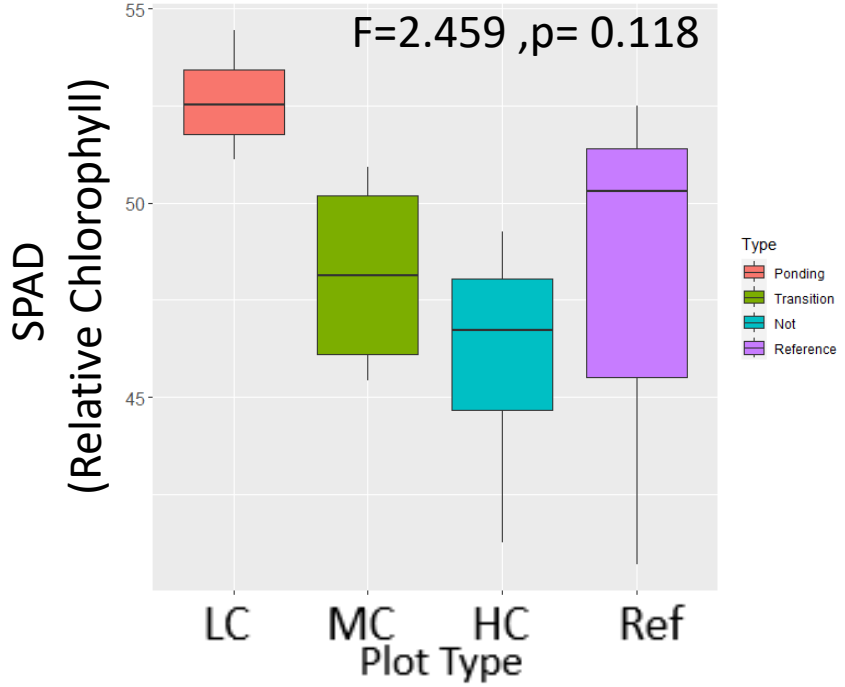
Is there a detectable plant response?

- Leaf traits were compared to those of *R. mangle* from reference sites south of the Cutler Wetland along the L-31E canal.

Konica Minolta



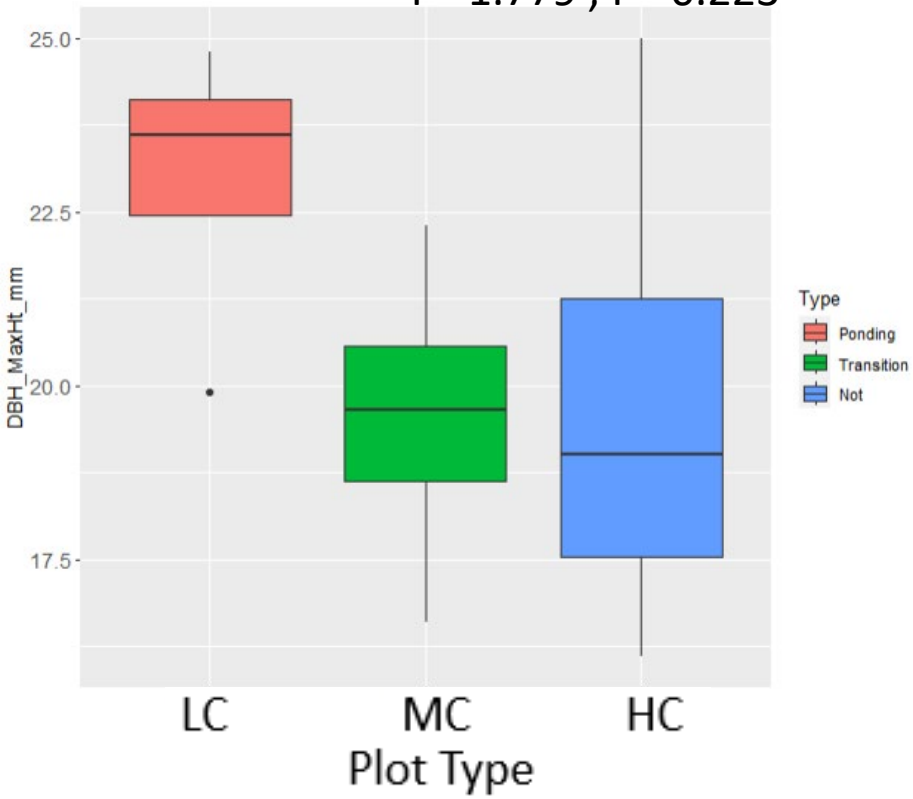




Is there a detectable plant response?

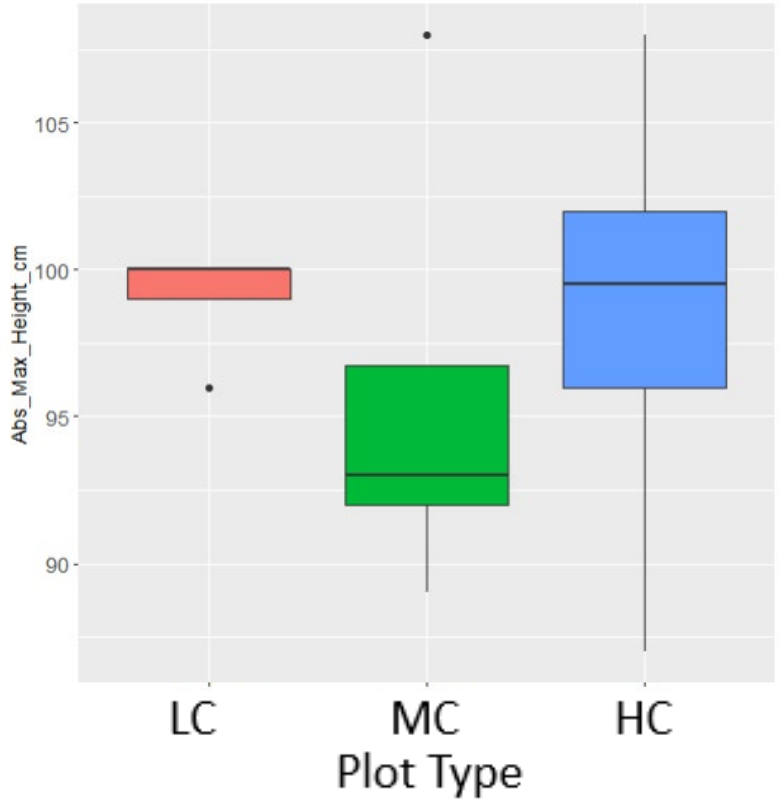
DBH

F= 1.779 , P= 0.223



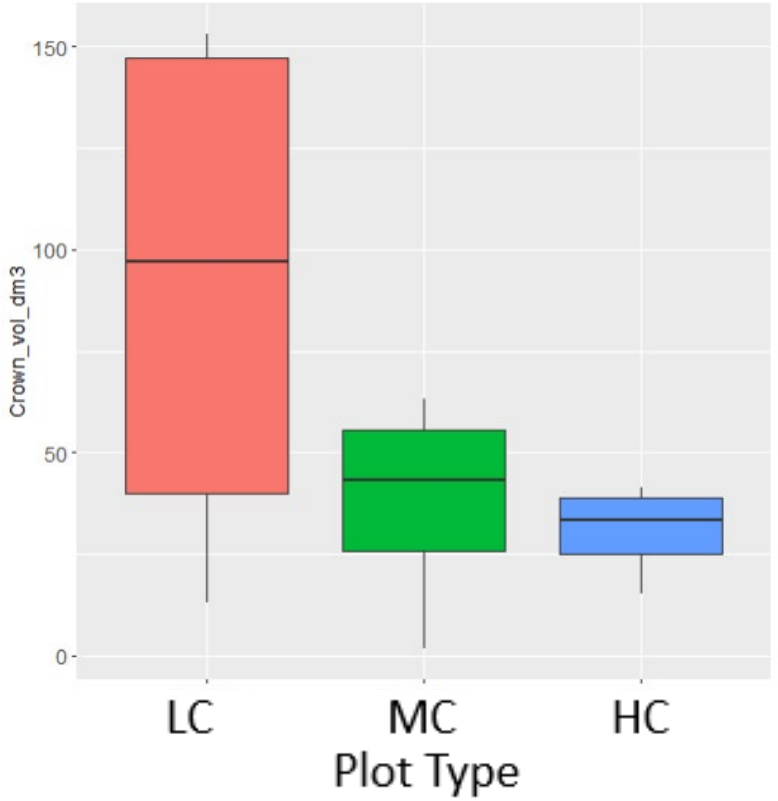
Maximum Height

F=0.246,P= 0.787

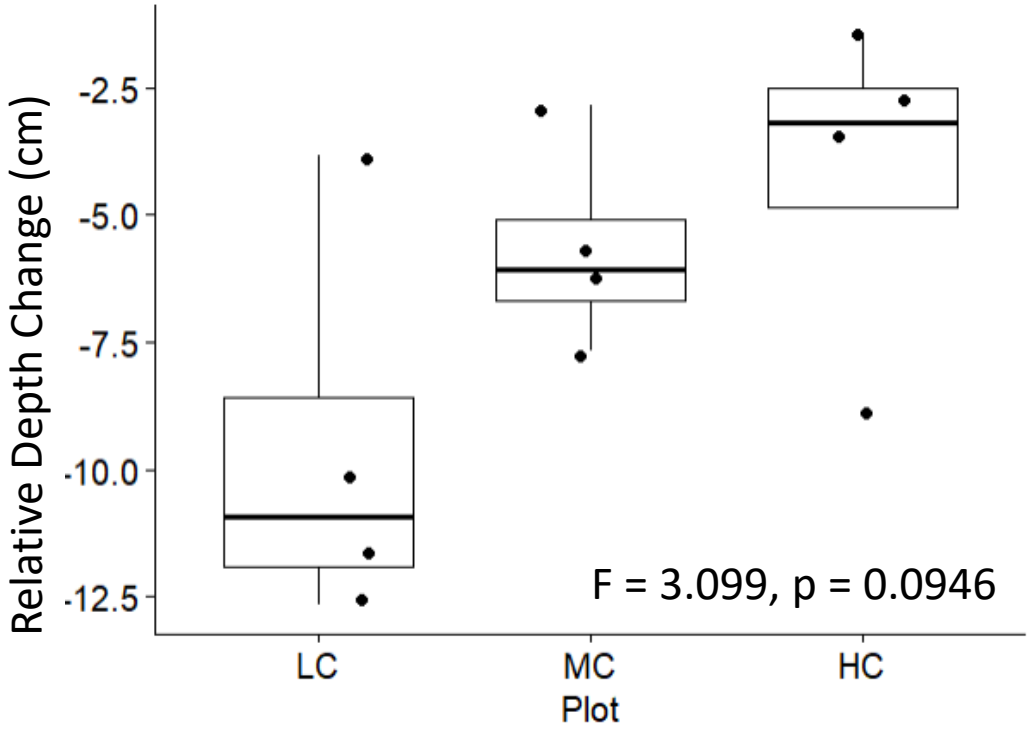


Crown Volume

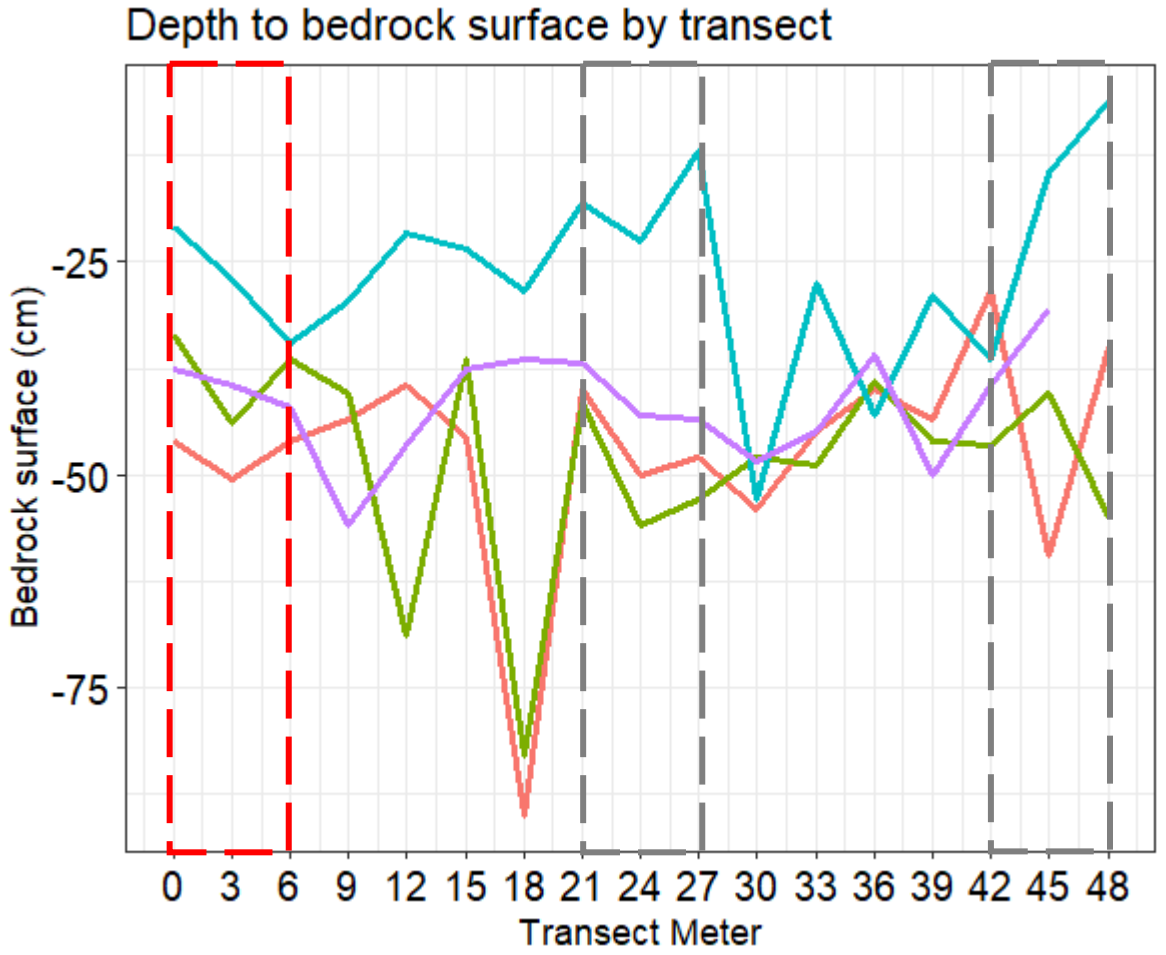
F=1.489 ,p= 0.276



Are areas of low cover at lower elevations or along bedrock depressions?

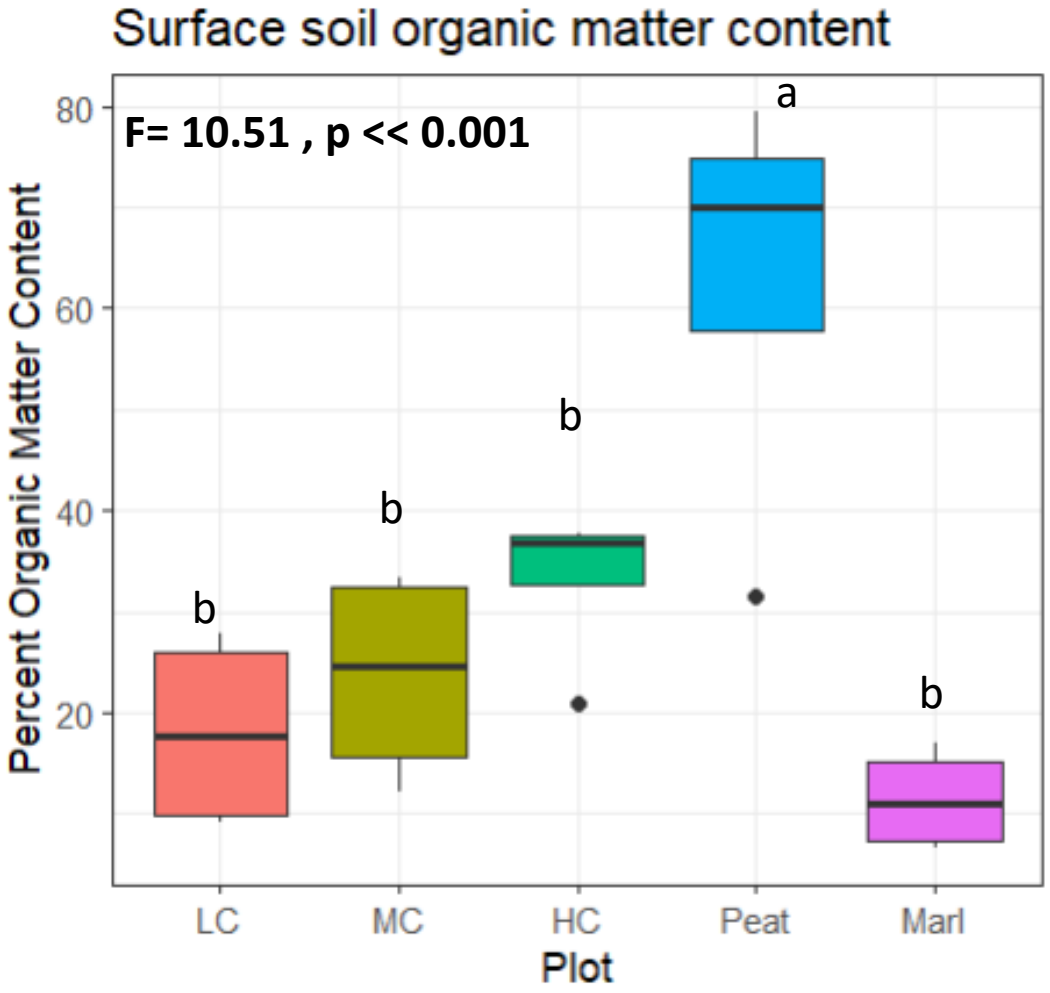


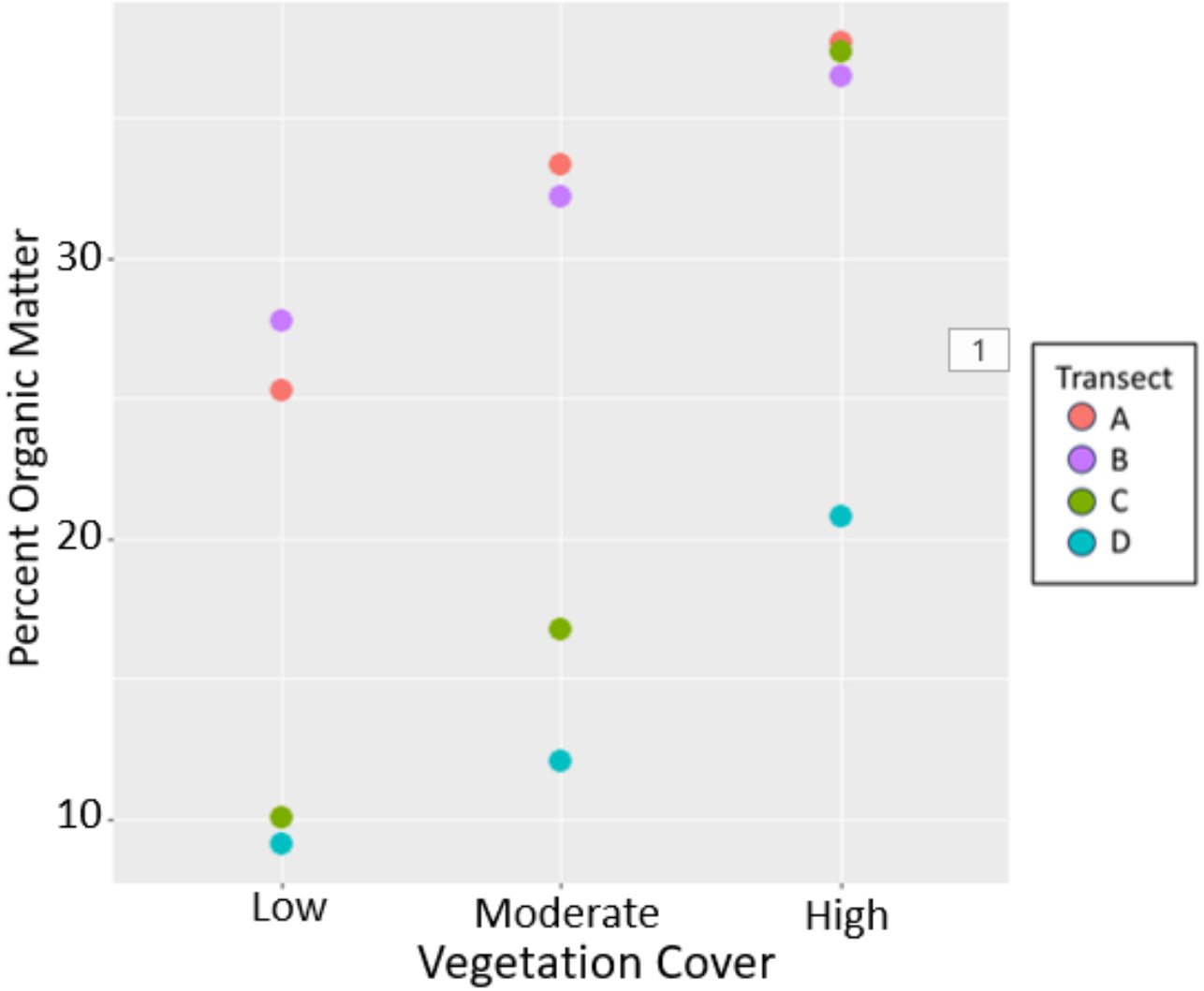
Relative difference in elevation ranged from 4 – 13 cm but was not significantly different between plot types.



Bedrock surface was not lower in the low cover areas (meters 0 – 6).

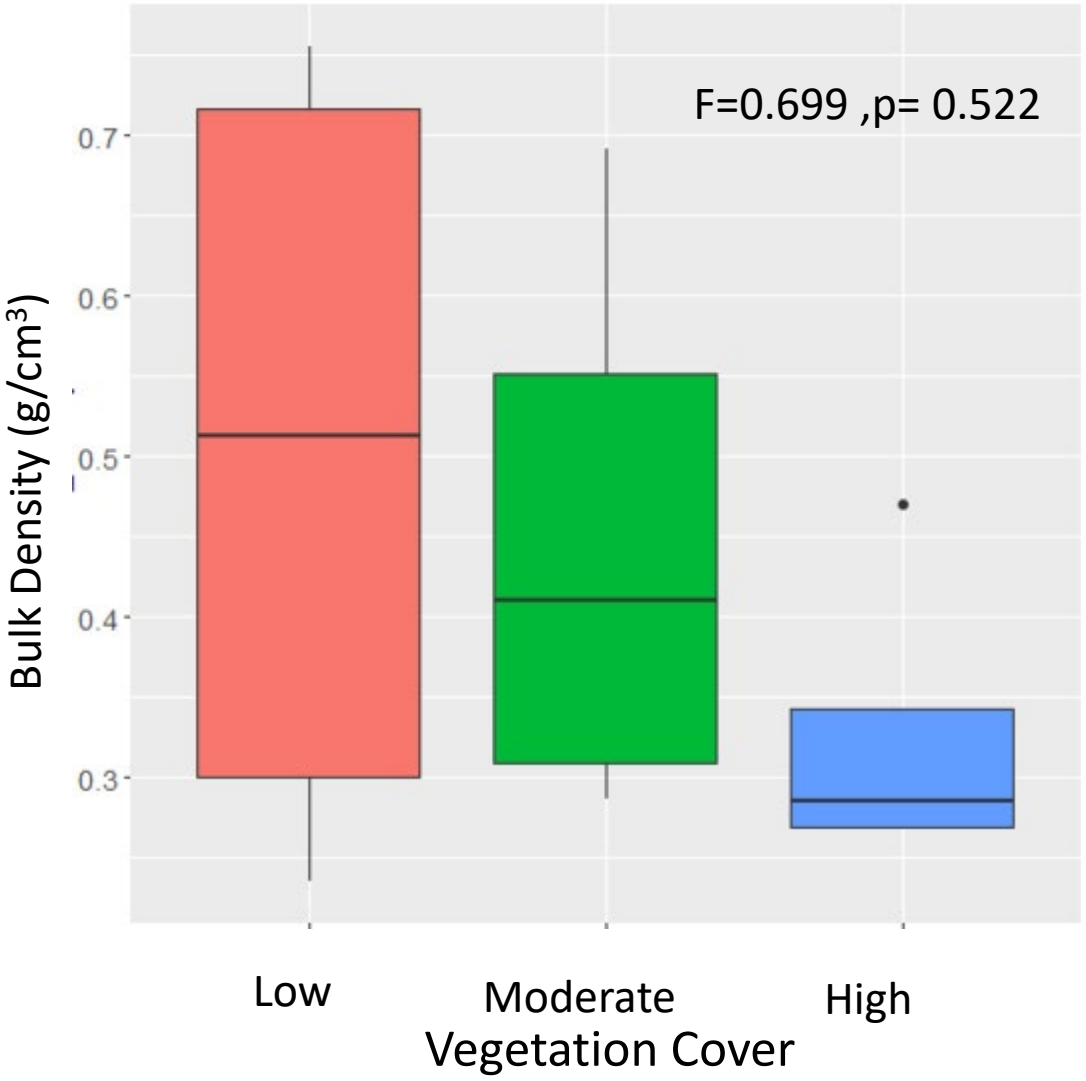
Organic matter:
Are there signs of soil subsidence?

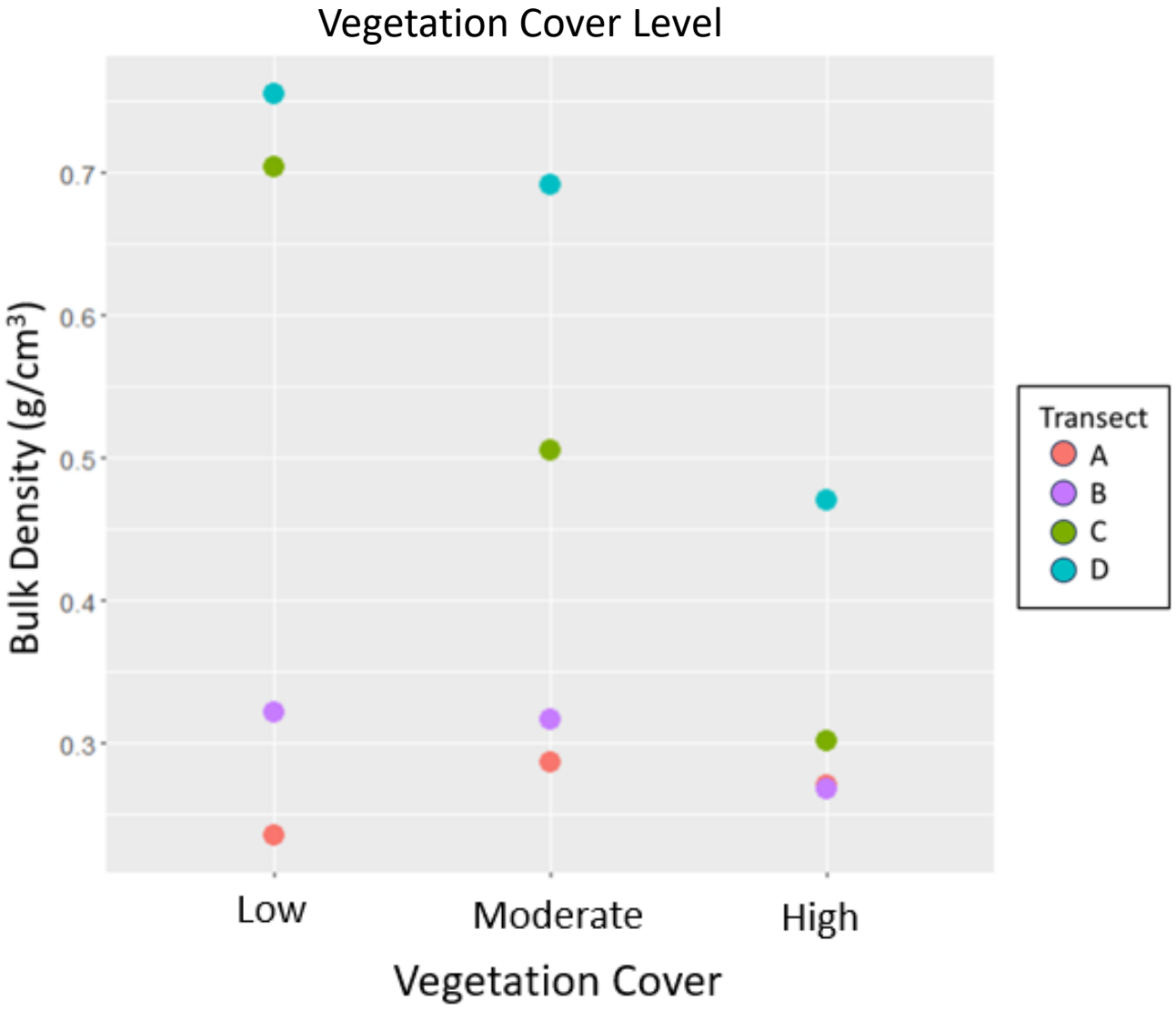




Reference peat and marl data from Gaiser et al. 2022

Bulk density:
Are there signs of soil subsidence?





Conclusions

- There was a sharp decrease in mangrove cover between 2017 and 2023.
  - Collaborative work with water level and salinity monitoring could improve interpretation of trends and larger scale vegetation mapping efforts.
- Relative elevation was not consistently lower in areas of vegetation loss.
- Areas of vegetation loss are not above bedrock depressions.
- The presence of soil collapse, subsidence, or organic matter loss could not be determined.
  - Fine scale and subsurface soil studies are needed
  - Marl and peat soils can be expected to respond to differently
- Leaf traits did not provide a strong metric of incipient (or current) vegetation loss.
  - Scrub mangrove vegetation may:
    - 1. Have low flexibility in traits, hence the loss in vegetation cover, or
    - 2. May respond more to nutrient resource gradients than water stress gradients

References

Gaiser, E., Ross. M.S., Vidales, R., Hormiga, S. Vegetation and Periphyton Monitoring of the L-31E Flow Way, Cutler Wetlands, and North Canal Wetland. Report submitted to South Florida Water Management District. Miami, FL. 2022. pp 235.

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Wright, I. J., Reich, P. B., Westoby, M., Ackerly, D. D., Baruch, Z., Bongers, F., Cavender-Bares, J., Chapin, T., Cornelissen, J. H. C., Diemer, M., Flexas, J., Garnier, E., Groom, P. K., Gulias, J., Hikosaka, K., Lamont, B. B., Lee, T., Lee, W., Lusk, C., … Villar, R. (2004). The worldwide leaf economics spectrum. Nature, 428(6985), 821–827. https://doi.org/10.1038/nature02403

Questions?

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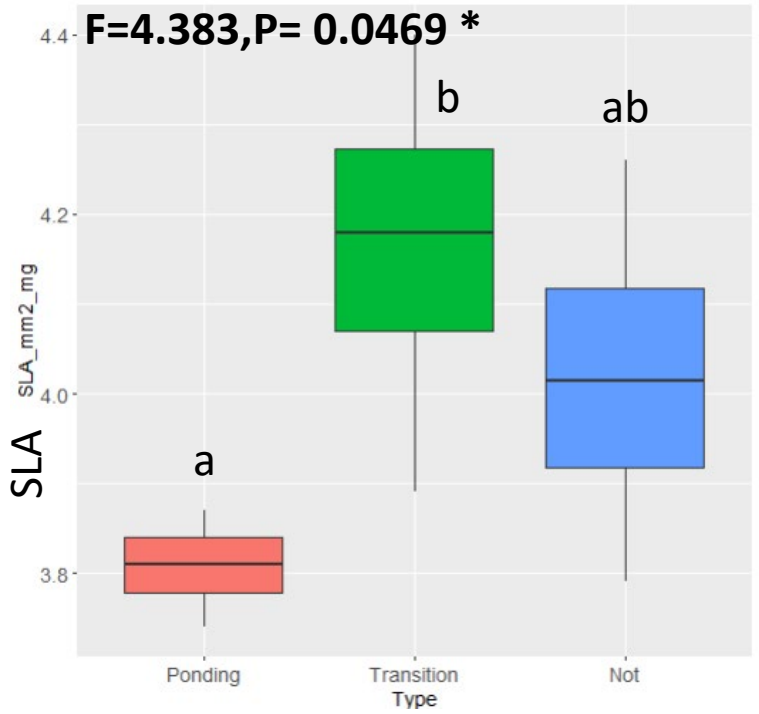
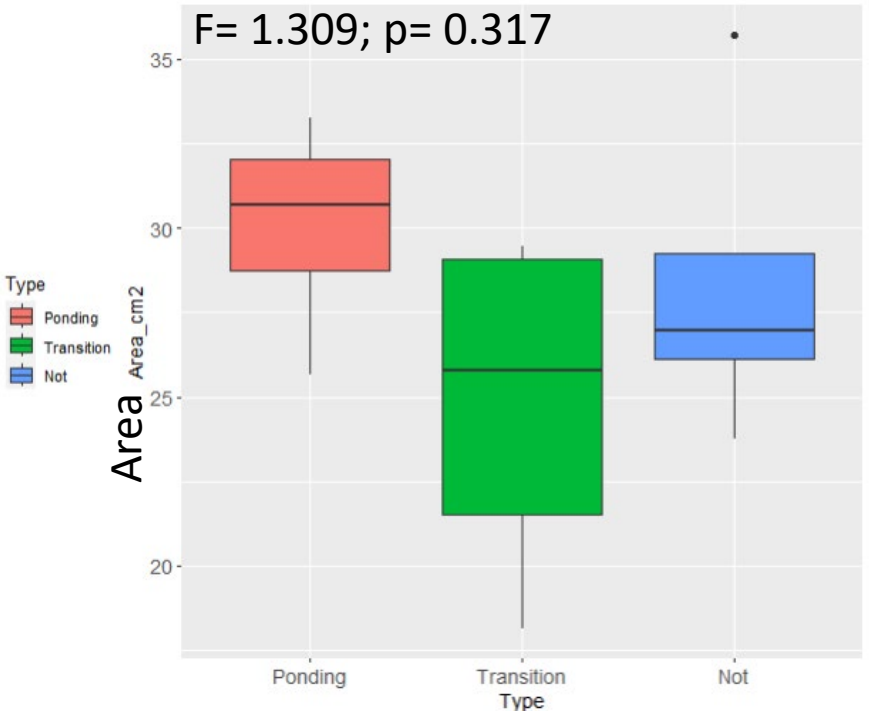
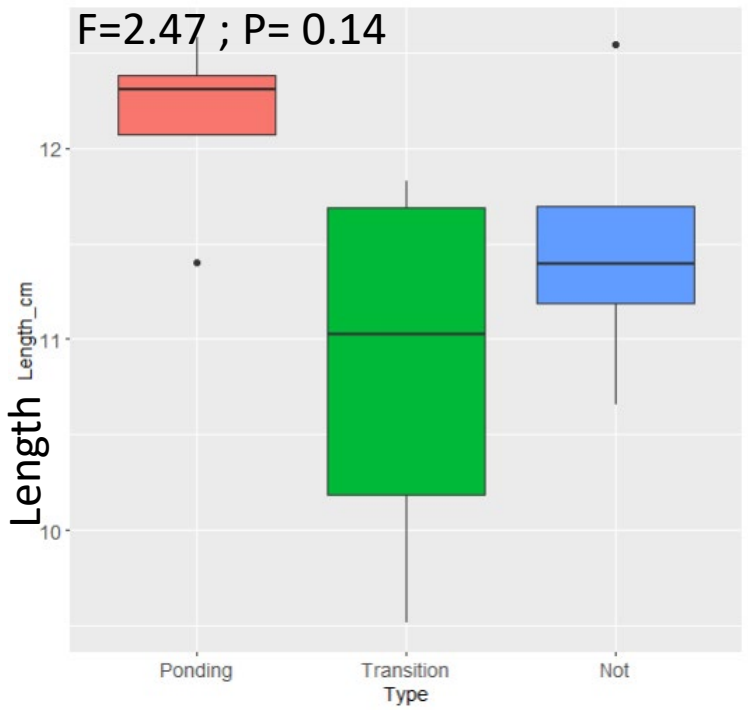
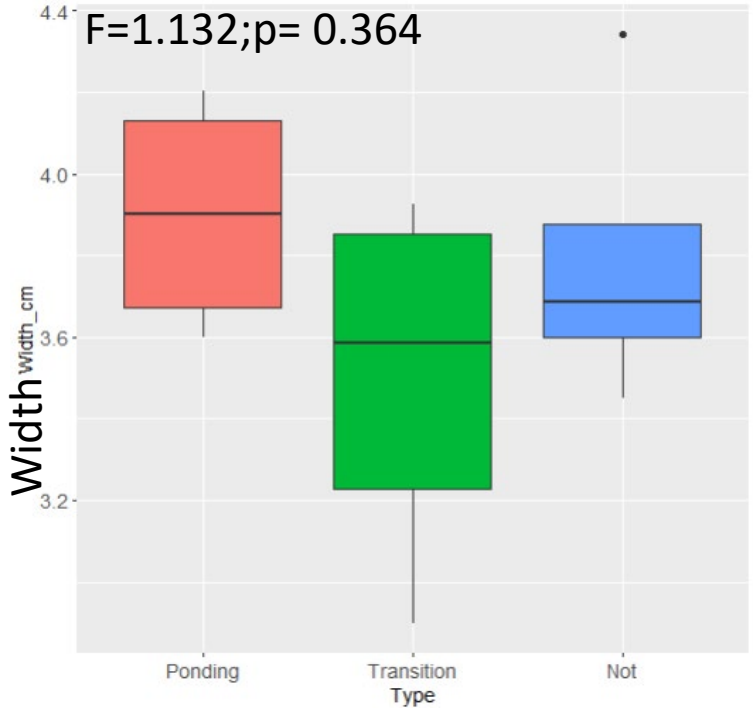

F=4.383,P= 0.0469 *
SLA
SLA_mm2_mg
a
b
ab
Ponding
Transition
Not
Type


F= 1.309; p= 0.317
Area
Area_cm2
Type
Ponding
Transition
Not


F=2.47 ; P= 0.14
Length
Length_cm
Ponding
Transition
Not
Type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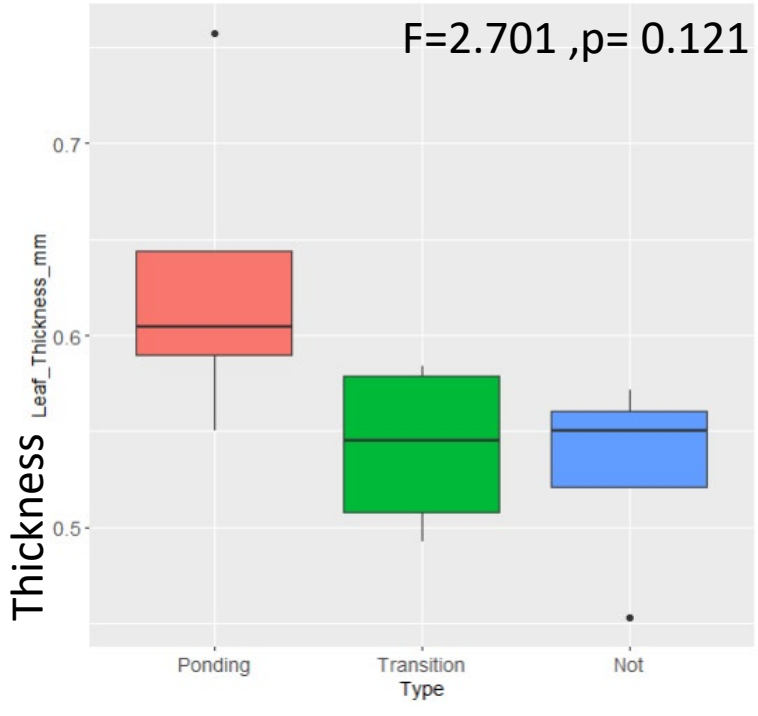
Width
Width_cm
Ponding
Transition
Not
Type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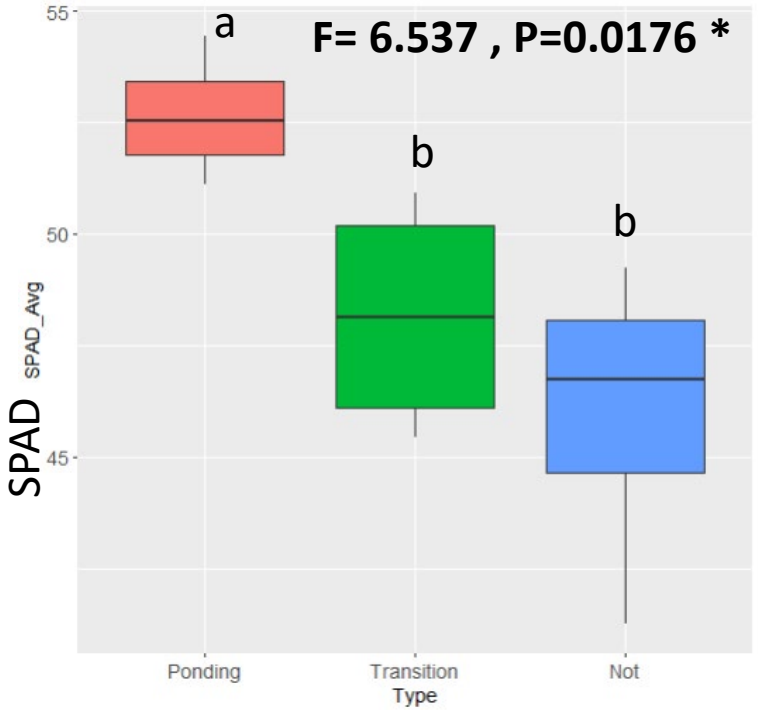
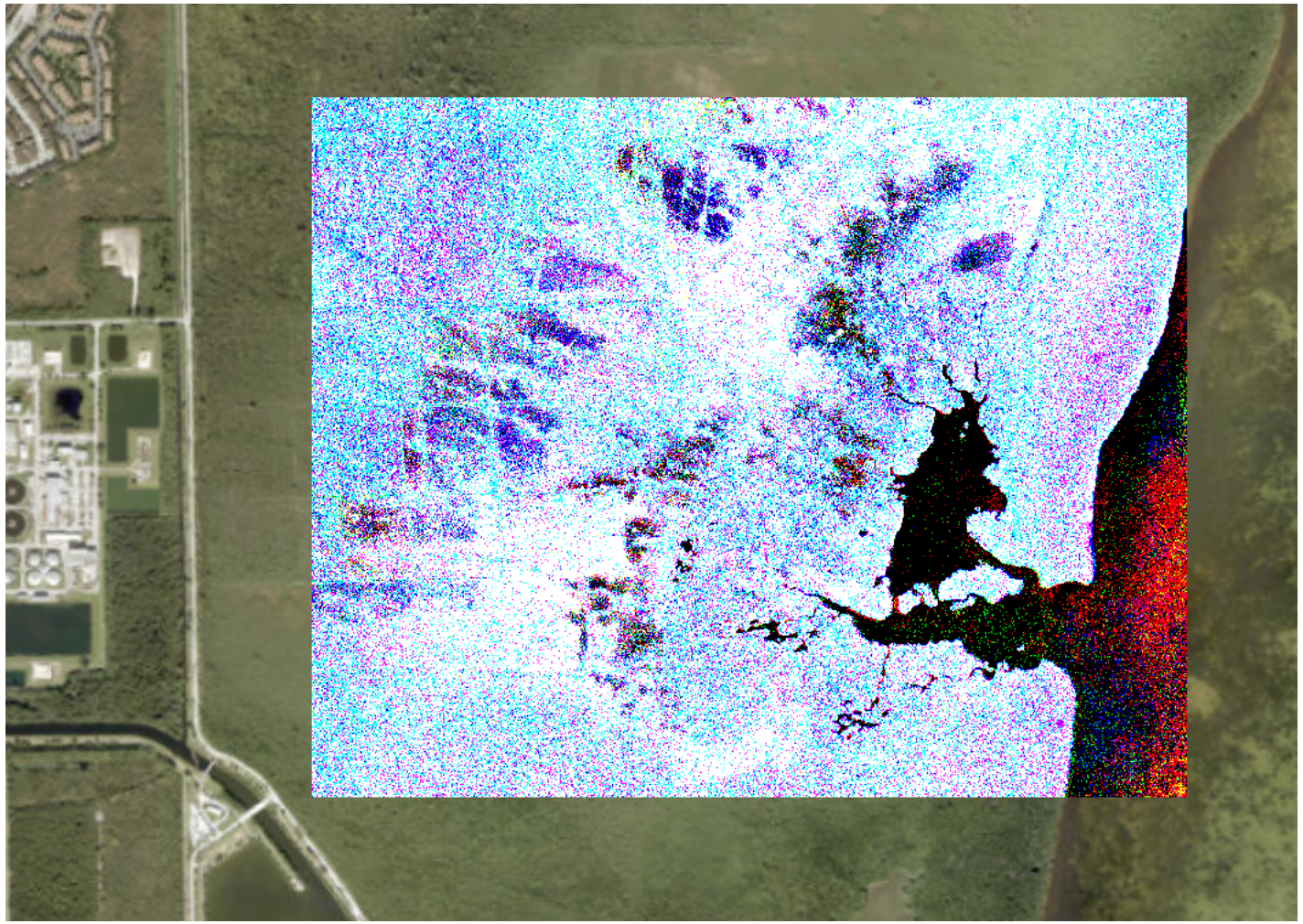
Thickness
Leaf_Thickness_mm
Ponding
Transition
Not
Type


F= 6.537 , P=0.0176 *
SPAD
SPAD_Avg
a
b
b
Ponding
Transition
Not
Type

Large Scale Cover Change

- Object based Maximum Likelihood Classification
- Vegetated vs Non-Vegetated Pixels for 2010, 2017, 2023
- Change detection using a composite red, blue, green image.

Large Scale Cover Change



- Low confidence, high noise at high resolution, and may be improved with increased training points.

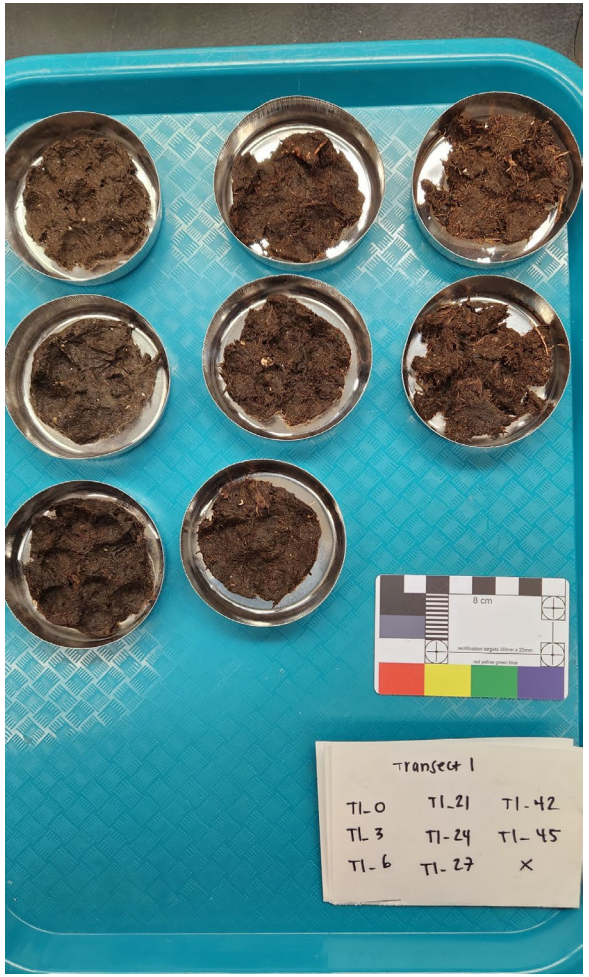
Interpretation of the RGB Composite Image

Additive color	2010 (Red)	2017 (Green)	2023 (Blue)
Red	Present	Absent	Absent
Green	Absent	Present	Absent
Blue	Absent	Absent	Present
Yellow	Present	Present	Absent
Magenta	Present	Absent	Present
Cyan	Absent	Present	Present
Black	Absent	Absent	Absent
White	Present	Present	Present

Table adapted from Pujiono et al. 2013

Soil Tray images

LC MC HC



Transect 1

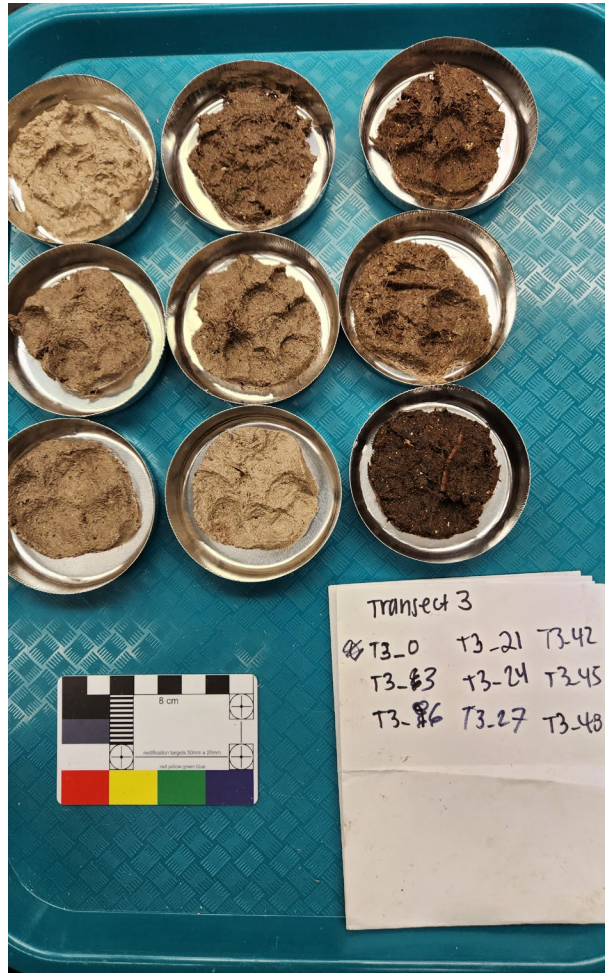
LC MC HC

Transect 4

LC MC HC

Transect 2

LC MC HC



Transect 3