Latitudinal and temporal changes in mangrove height on the Florida Gulf Coast

Christopher Miller, Saint Leo University

Yiyang (Calvin) Kang, University of Florida

Dekle Beach, 1982

Cedar Key, 1948

Dekle Beach after late January, 2022 freeze

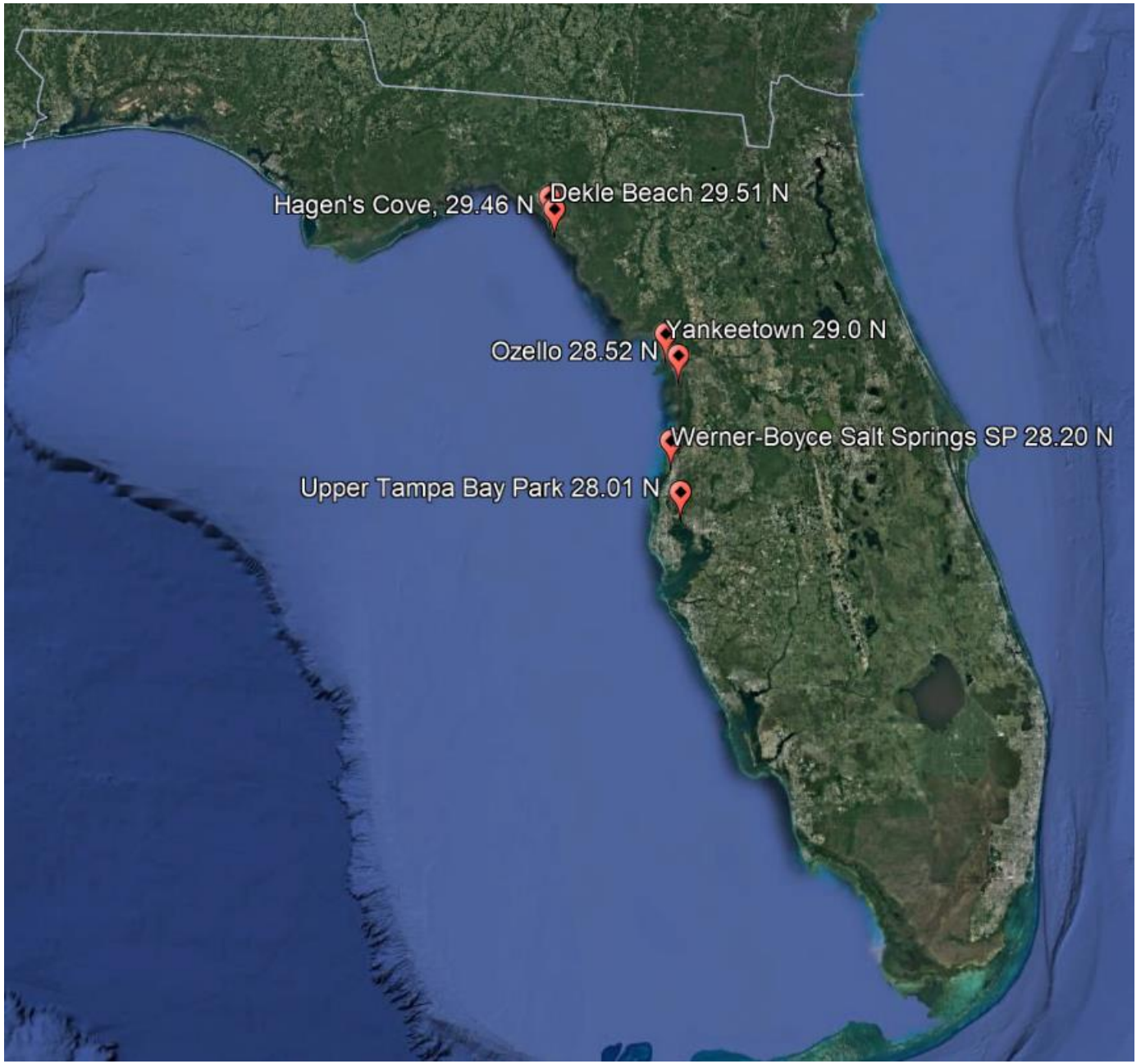
Camera in fixed location

Pasco Palms County Preserve, Pasco County

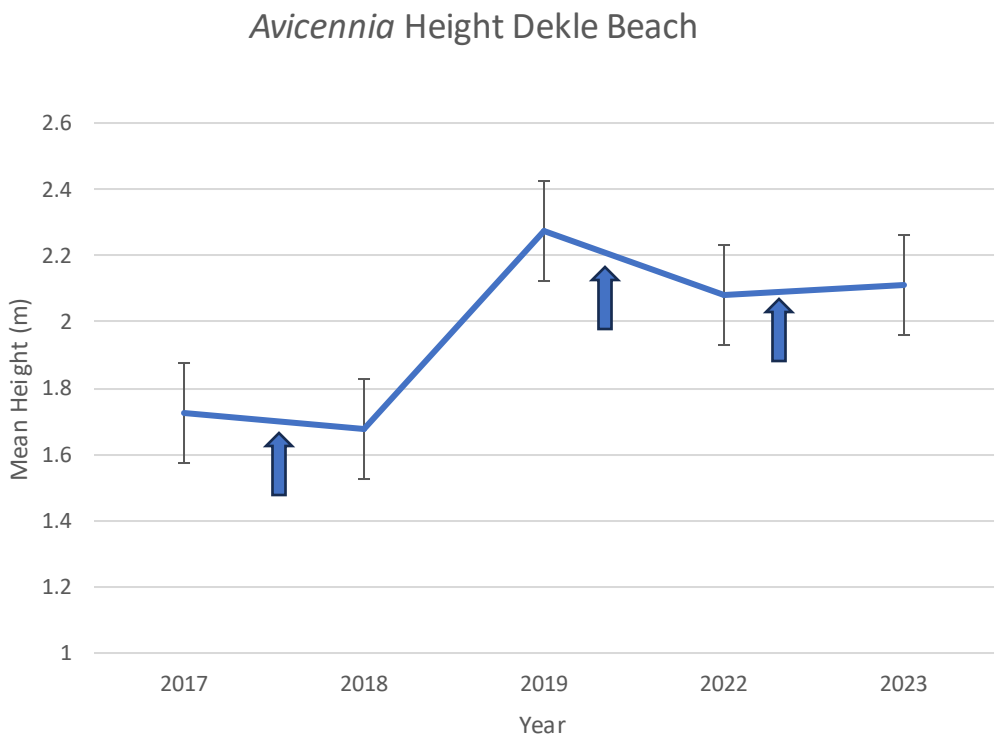
Methodology: Assessing growth of mangroves

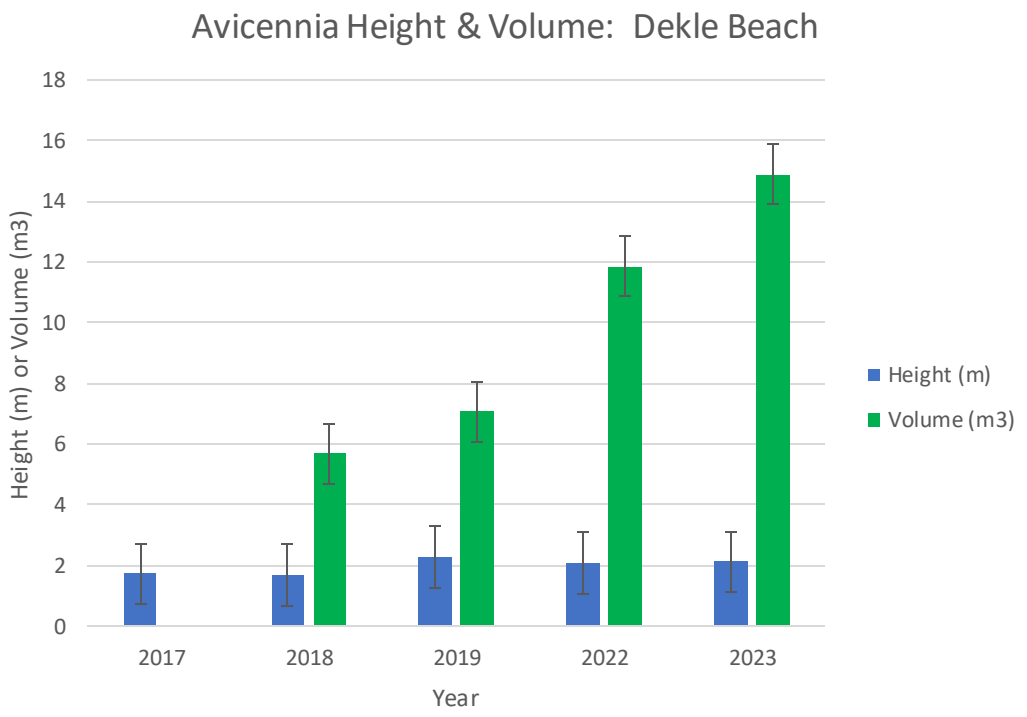
- Sites chosen based on accessibility and areas in the salt marsh-mangrove ecotone
- Periodic (approximately yearly) height and width measurements of *Avicennia* and *Laguncularia* (*Rhizophora* uncommon in sites)
- Canopy volume based on Osland, et al., 2017

Sites located in salt marsh-mangrove ecotone



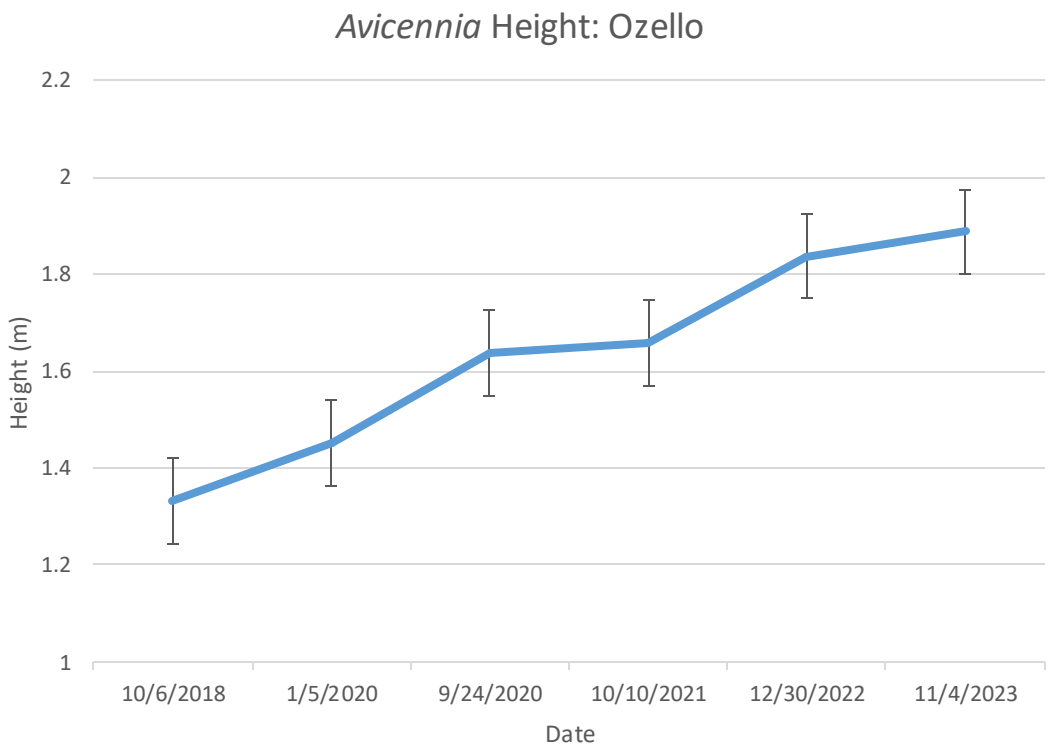
Dekle Beach (29.51 N): *Avicennia*

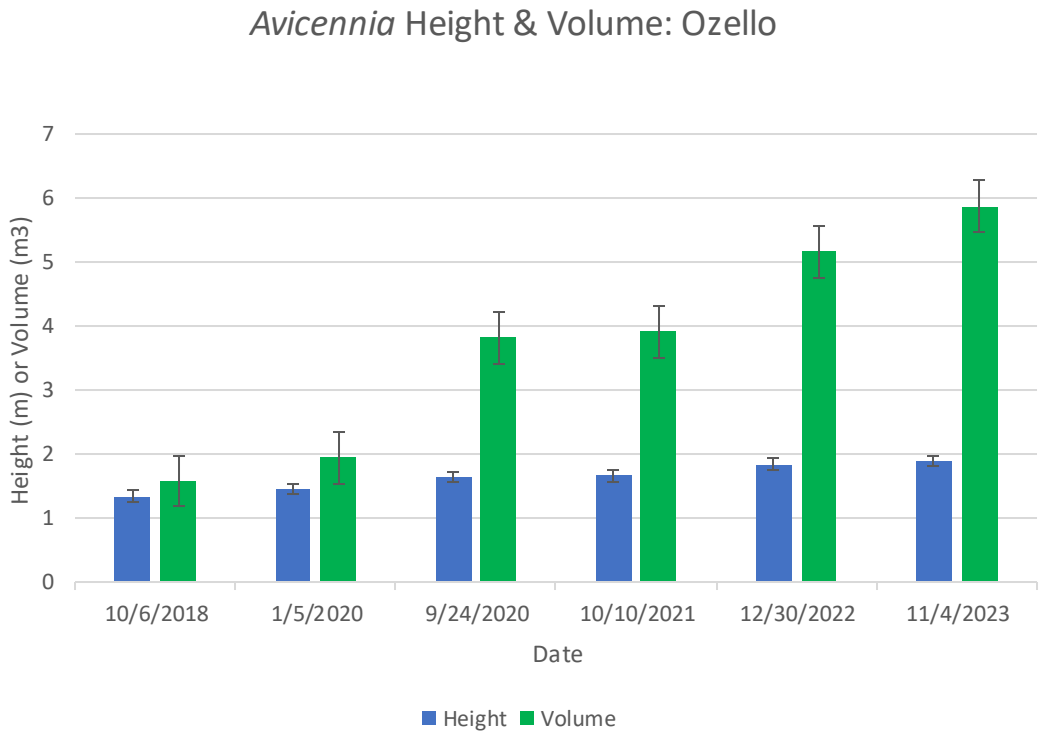




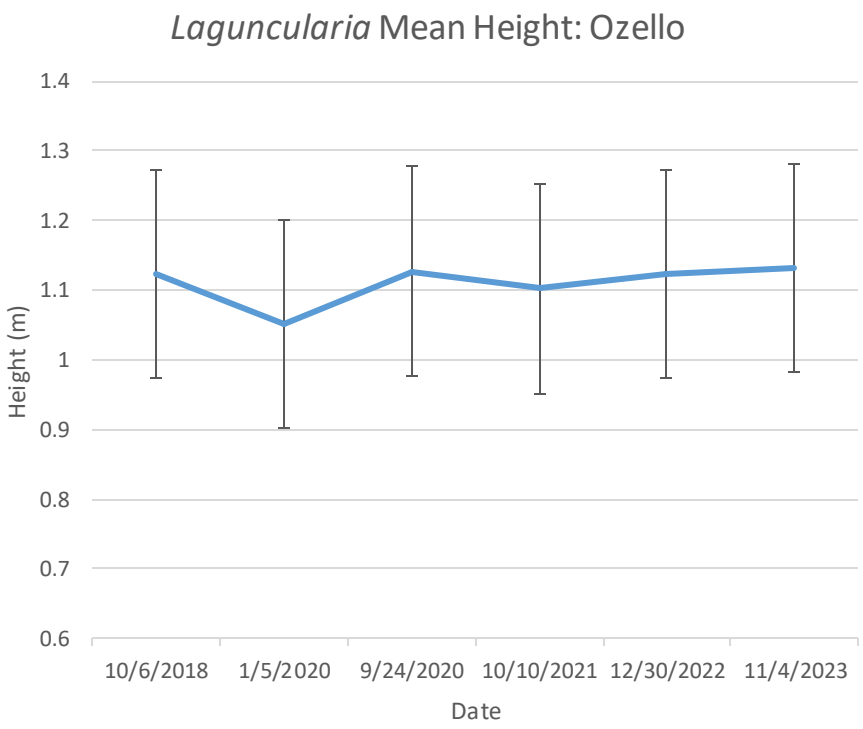
= hard freeze

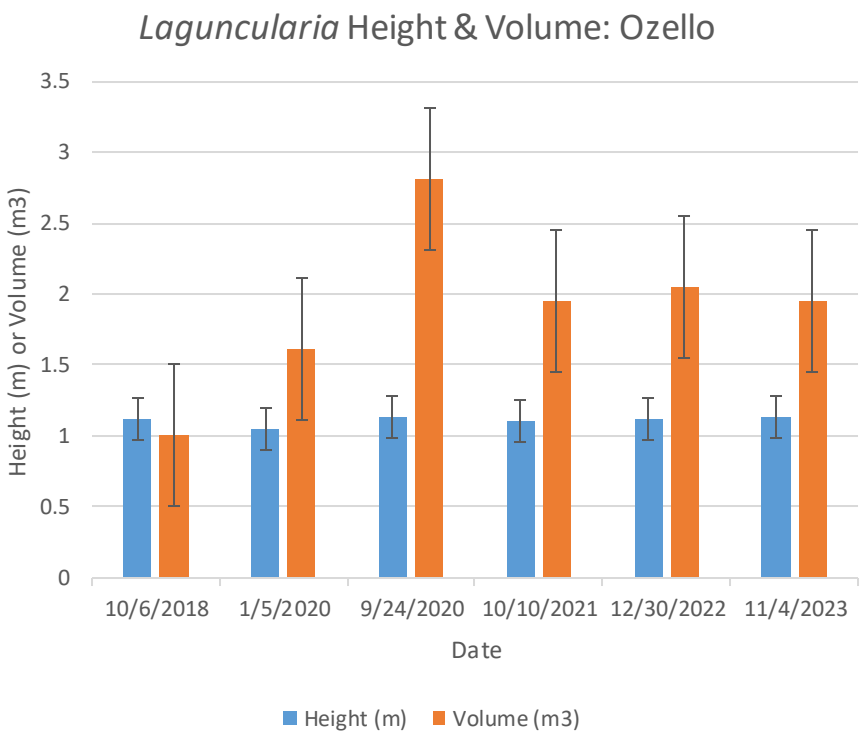
Ozello (28.52 N): *Avicennia*



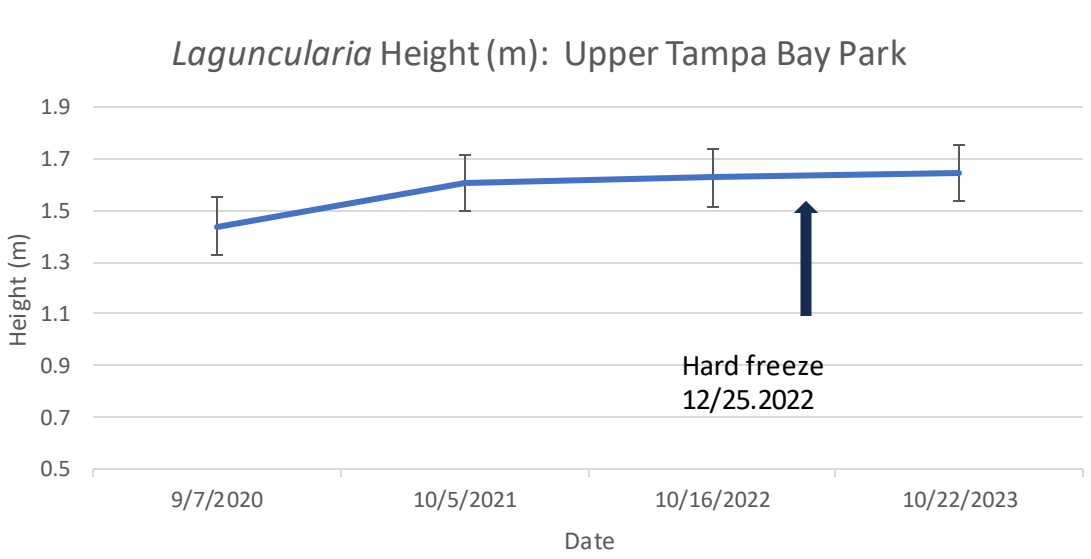


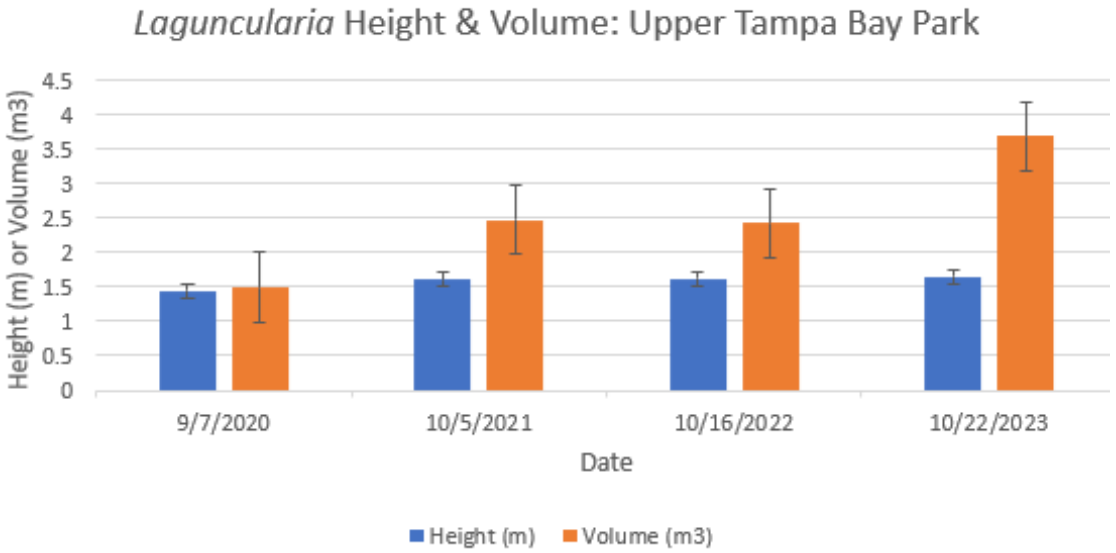
Ozello (28.52 N): *Laguncularia*



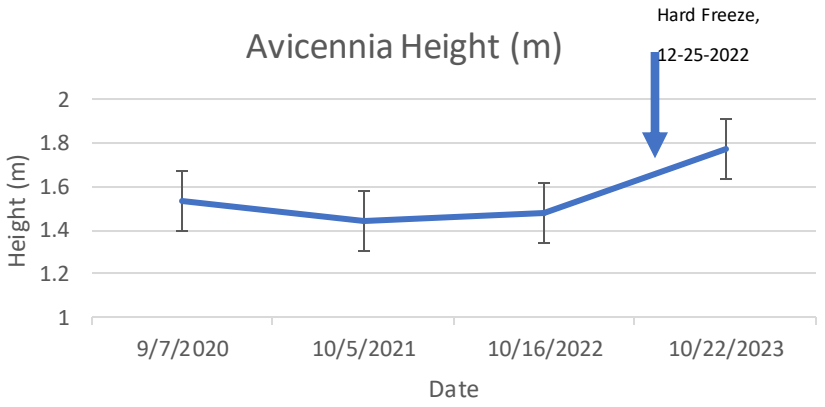


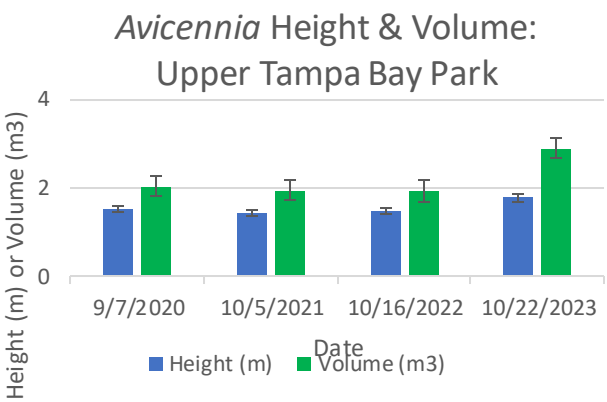
Upper Tampa Bay Park (28.01 N): *Laguncularia*

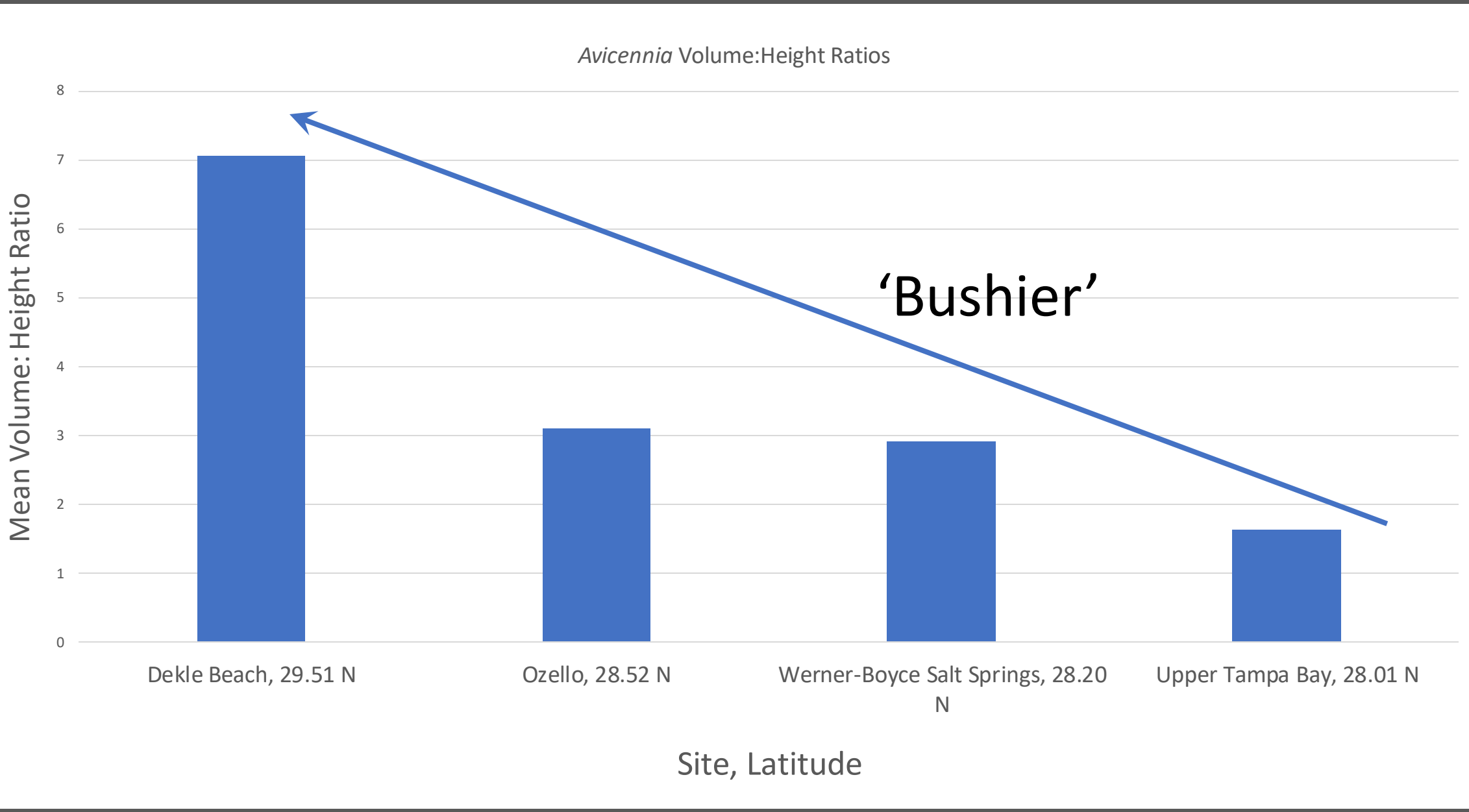


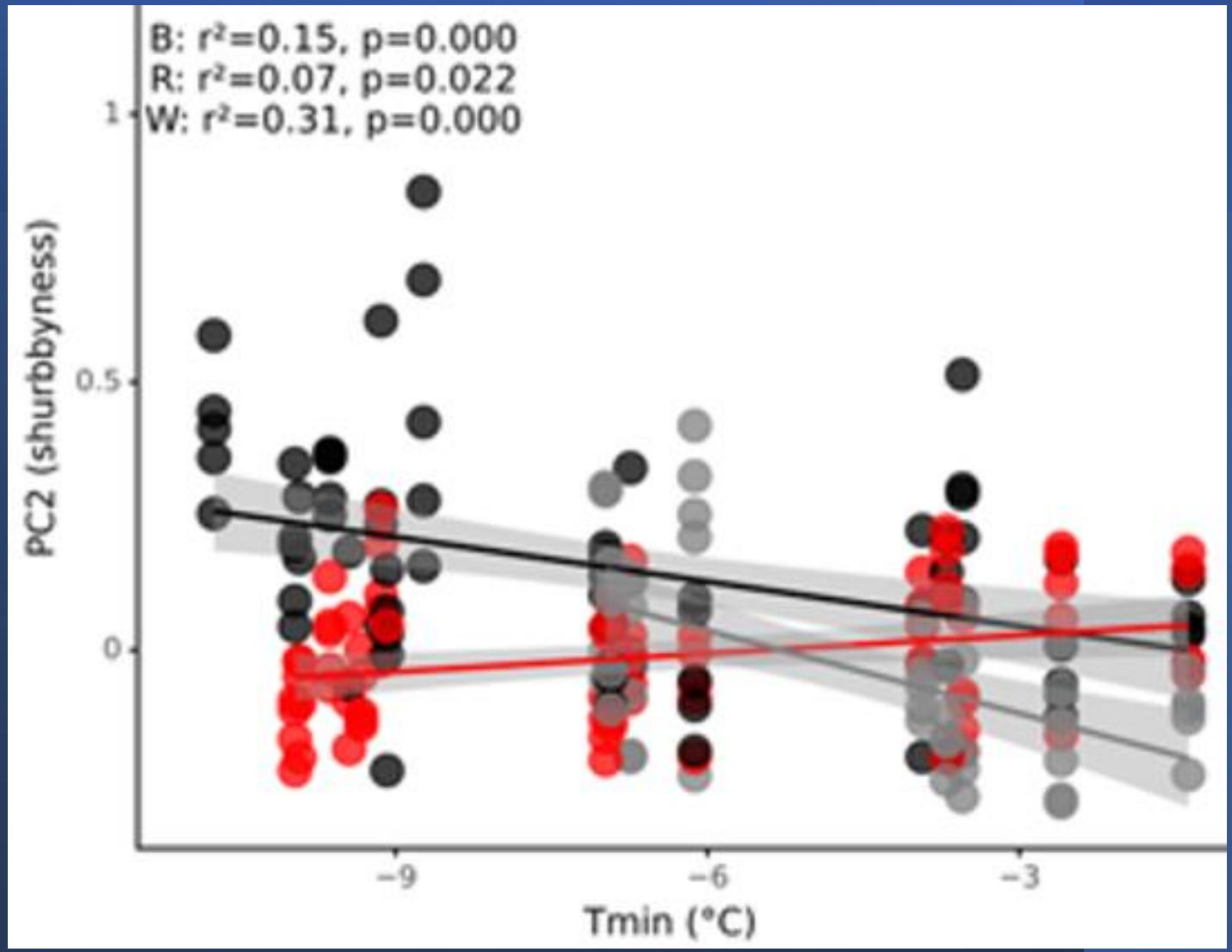


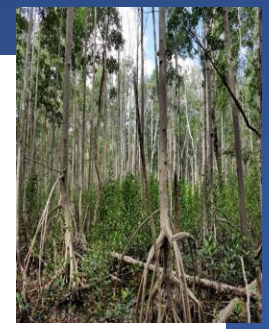
Upper Tampa Bay Park (28.01 N): *Avicennia*

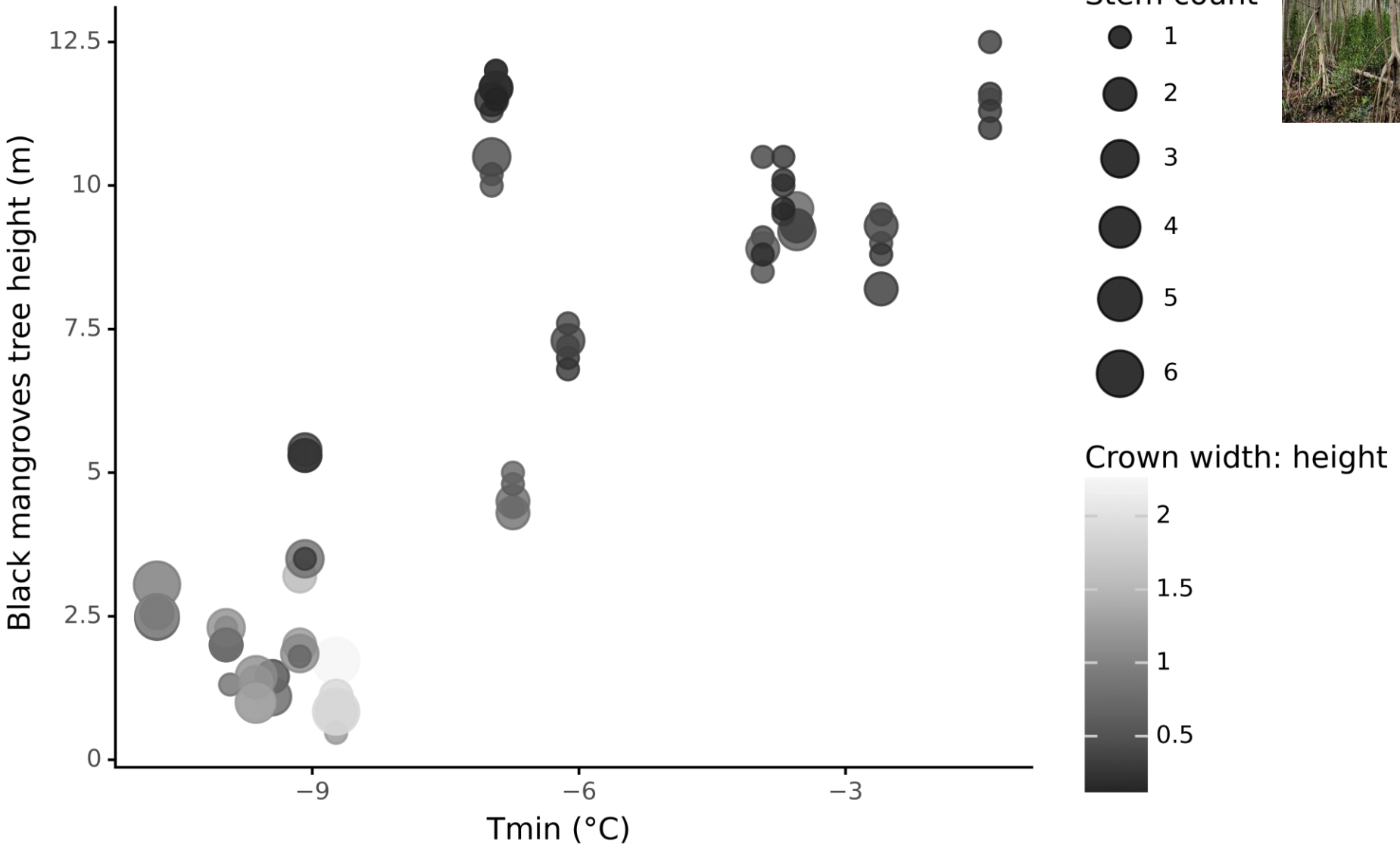





Avicennia Volume:Height Ratios
Mean Volume: Height Ratio
8
7
6
5
4
3
2
1
0
‘Bushier’
Dekle Beach, 29.51 N
Ozello, 28.52 N
Werner-Boyce Salt Springs, 28.20 N
Upper Tampa Bay, 28.01 N
Site, Latitude


B: r²=0.15, p=0.000
R: r²=0.07, p=0.022
W: r²=0.31, p=0.000
PC2 (shurbbyness)
1
0.5
0
−9
−6
−3
Tmin (°C)



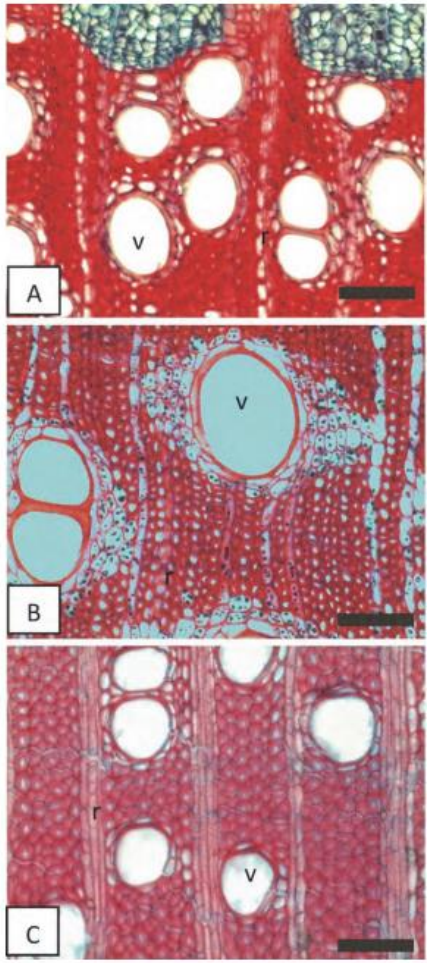

Black mangroves tree height (m)
12.5
10
7.5
5
2.5
0
−9
−6
−3
Tmin (°C)
Stem count
1
2
3
4
5
6
Crown width: height
2
1.5
1
0.5

Shrub-vantages

- Shrubs experience more favorable thermal micro-environments compared to taller vegetation (Götmark, et al. 2016; Treml, 2019;)
- There might be differences in temperature thresholds for wood formation between shrubs and trees (Li et al., 2016)
- Wood formation occurs earlier in shrubs, allowing them to grow and reproduce earlier than trees (Götmark, et al.; 2016 Treml, 2019)
- ‘Weather the storms’ better as shrubs
- Greater leaf area in shrubs (Götmark, et al. 2016)

Structural adaptations in mangroves

- Narrow vessels in northern populations of *A. germinans* makes them less prone to freeze damage (Madrid et al, 2014)
- Epicormic buds in *Avicennia* and *Laguncularia* allow for resprouting (Baldwin, 2002; Radabaugh et al, 2020)



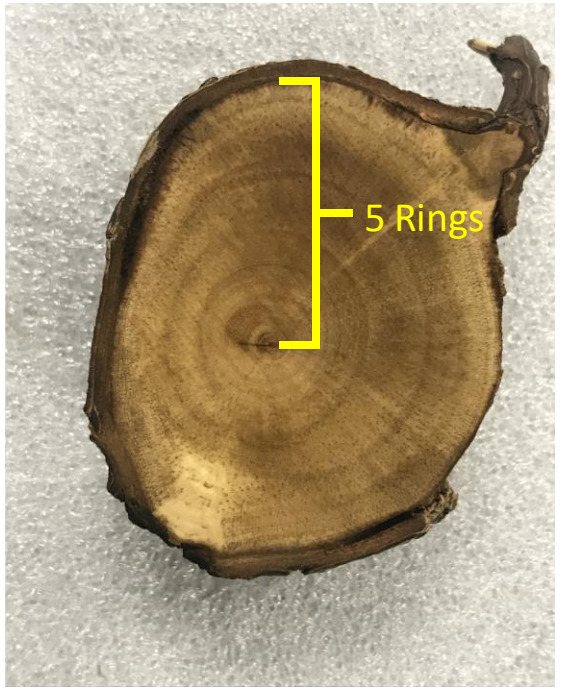
From: Yanez-Espinosa and Flores, 2011

From: Radabaugh et al., 2020

Growth rings

Do multiple cambia (growth layers) in secondary xylem help in resprouting/response to freeze in *Avicennia?*

Avicennia cross-section of 5-year old stem



Laguncularia cross-section of 5-year old stem


Thank You!
Questions?

Gotmart

- higher growth rate for a small shrub than a small tree.
- Further, a shrub will produce seeds faster than a tree (Hypothesis 2),
- multiple stems in shrubs insure future survival and growth if one or more stems die (Hypothesis 3),
- improve survival compared to tall tree stems (Hypothesis 4)—
  - Survive storms better (e.g. hurricanes)
  - Wider area = more light (e.g. in salt marsh-mangrove ecotone)
  - Less cavitation due to cold

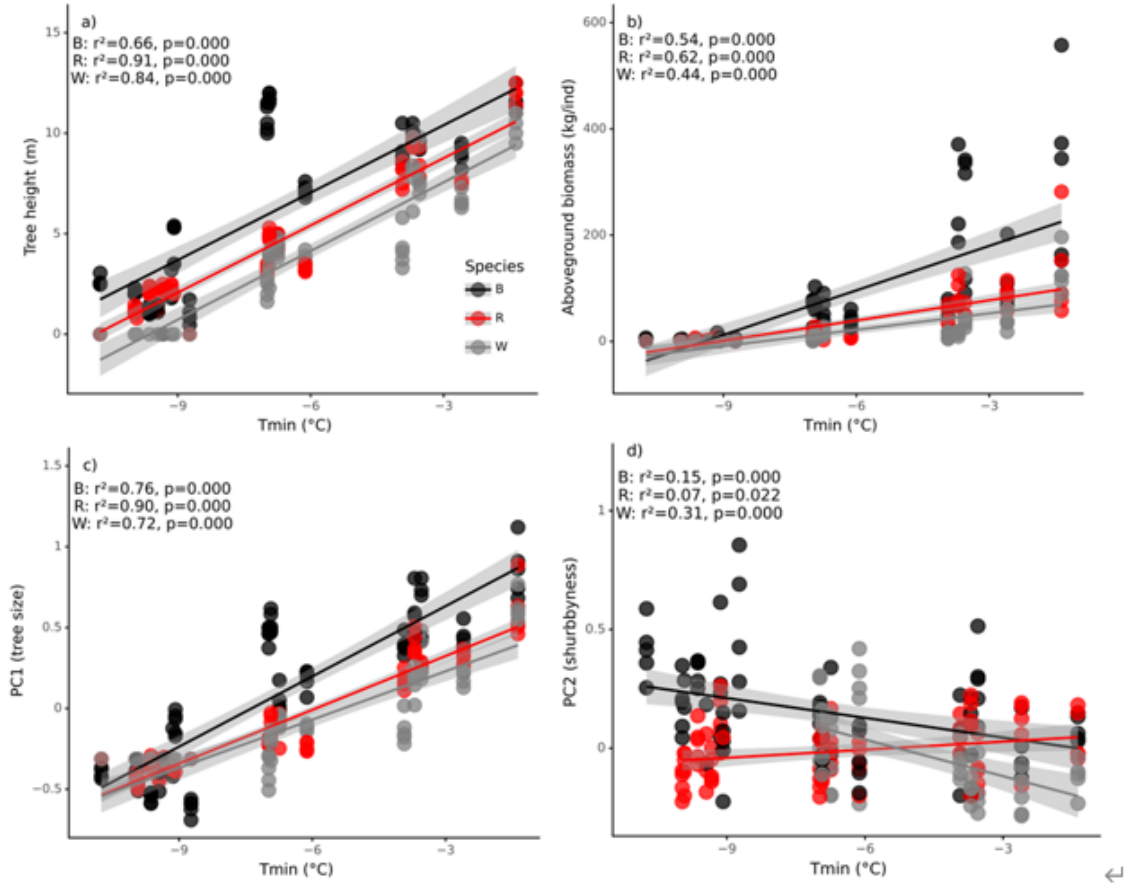


FIGURE 7 Linear regressions of air temperature minima (T_{min}) and tree height (a), aboveground biomass per individual (b), Principal Component 1 (PC1, represents tree size) (c), and Principal Component 2 (PC2, which represents shrubbyness) (d) for the synoptic tallest trees of *Avicennia germinans* (B, black dots), *Rhizophora mangle* (R, red dots), and *Laguncularia racemosa* (W, grey dots). ↵