Trophic Dynamics in Mangrove Ecosystems in Port Everglades, Florida- Stable Isotopic Differences in Mangrove Species

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Background

Mangroves

- Facultative halophytes, exhibit hydrochory, exceed ½ meter in height, and some exhibit cryptoviviparity.
- Confined to sub-tropical and tropical latitudes
- Florida has 4 species:
  - *Rhizophora mangle*
  - *Avicennia germinans*
  - *Laguncularia racemosa*
  - *Conocarpus erectus*

Mangrove Ecosystem

- Coastal ecosystem -interface of the ocean and dry land
- Mangal will collect detritus from both ocean and dry land
- Mangrove roots and trunks provide structure complexity

Stable Isotope Analysis

- This is a measurement of the ratio of the heavier to lighter elements
  - Uses naturally occurring elements with one extra neutron
  - The extra neutron affects the rate in which the element is utilized
- Carbon stable isotopes ($\delta^{13}C$): shows primary energy source
  - Mangrove signatures: -27.0 to -14.1 ‰
- Nitrogen stable isotopes ($\delta^{15}N$): shows trophic position
  - Mangrove signatures: -21.6 to -0.1 ‰ depending on the species.

Hypotheses

- There is a statistically significant difference between the mangrove ecosystem from the three different sites at varying distances from the Intercoastal canal.
- There is a statistically significant difference between the different tissues of the mangrove tree (leaves, stem, and roots).

Study Site

- Three sites were chosen near Port Everglades
- All sites contained all four mangrove species found in Florida
- All sites had medium-high mangle density
- Each site had variable accessibility
  - based on amount mangrove available to organisms
- Site activity was based on tidal and wave action

Figure 1: The three sampling sites located in Florida (Google Earth).

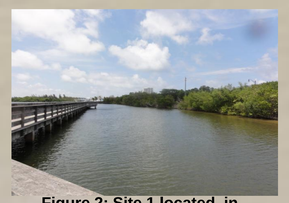

Figure 2: Site 1 located in Hollywood State Park

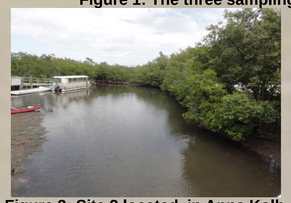

Figure 3: Site 2 located in Anne Kolb Nature Center

Figure 4: Site 3 located in Westlake Recreation Park

Experimental Design

Field Collection

- Collection was bi-monthly for one year starting in October 2010
- Temperature, salinity, and conductivity taken using a YSI meter
- Multiple samples from all 4 species at each site were taken
  - Individual trees were marked for re-sampling each month
  - All species had samples of leaves and stem samples taken
  - *R. mangle* and *A. germinans* had samples of aerial roots taken
- Samples of detritus were taken from each site
- Each sample was placed in labeled plastic baggies and frozen

Lab Analysis

- Each sample was washed with distilled water and placed in a tin dish
- The samples were placed in a drying oven for up to a week
- Each sample was crushed with a mortar and pestle then crushed down to powder with a Wig-L bug machine
- Each sample was weighed (5-8 mg) into tin capsules put in a tray
  - These samples were mailed to the Smithsonian Support Institute for mass spectrometry

Figure 5: Collecting mangrove detrital material

Figure 6: Volunteers taking mangrove plant material

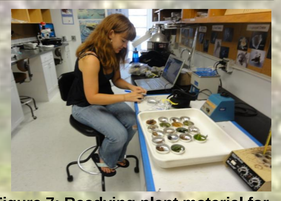

Figure 7: Readying plant material for the drying oven

Results

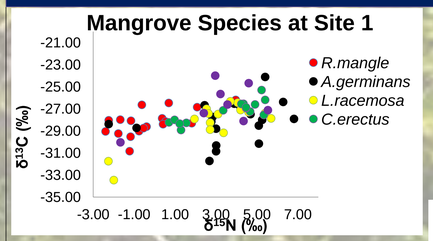

Figure 8: $\delta^{15}N$ vs. $\delta^{13}C$ of all mangrove species at Site 1.

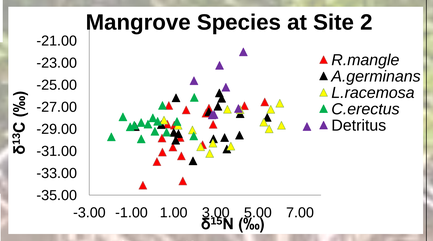

Figure 9: $\delta^{15}N$ vs. $\delta^{13}C$ of all mangrove species at Site 2.

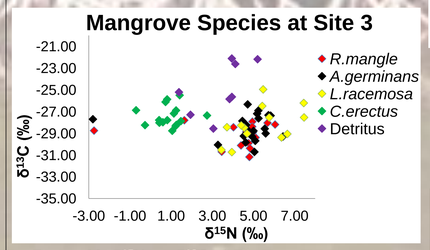

Figure 10: $\delta^{15}N$ vs. $\delta^{13}C$ of all mangrove species at Site 3.

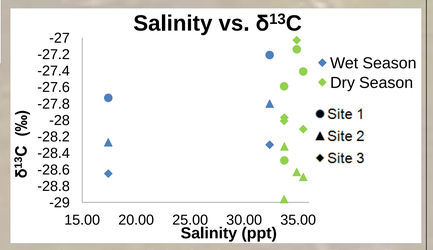

Figure 11: Salinity (ppt) vs. average $\delta^{13}C$ of all mangrove species at all for wet and dry seasons.

Results

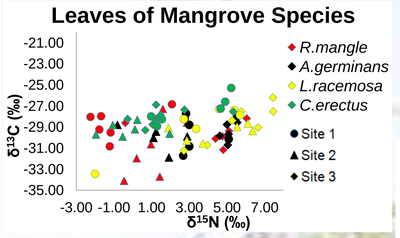

Figure 12: $\delta^{15}N$ vs. $\delta^{13}C$ of leaves of all mangrove species at all sites

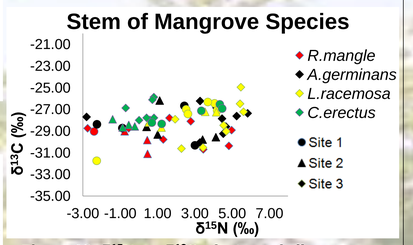

Figure 13: $\delta^{15}N$ vs. $\delta^{13}C$ of stem of all mangrove species at all sites

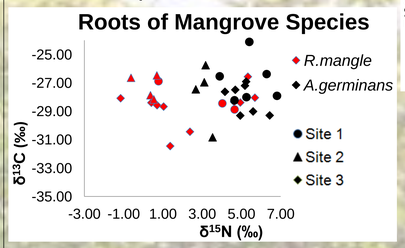

Figure 14: $\delta^{15}N$ vs. $\delta^{13}C$ of root of *R. mangle* and *A. germinans* at all sites

Discussion

- variability of $\delta^{13}C$ determined by variations in the concentration of CO^2 of the internal leaf space–determined by the stomatal conductance to CO^2
  - Can be affected by environmental factors such as salinity, humidity, etc.
- $\delta^{15}N$ values represent the form of nitrogen and the source the tree absorbs it from.
- Differences in $\delta^{13}C$ and $\delta^{15}N$ values between species can be attributed to differences in morphology and chemical composition
  - Such as tannins, lignin material, proteinaceous enzymes, etc.

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