Mapping Metal Contaminants with Mangrove Leaves in Jobos Bay, Puerto Rico

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Introduction

Mangrove forests are the critical point that connects freshwater and marine environments. Mangroves are the world's best carbon store and provide important habitat for fish nurseries and spawning grounds. These ecosystems could also act a filter by stopping pollution before it reaches the ocean, but more research is needed to understand this. Knowing the role of this ecosystem is more important than ever as mangroves are under increasing stress from more frequent hurricanes and sea level rise.
This project focuses on understanding mangrove forests by quantifying metal contaminants in mangrove leaves.

Goals

- Determine the metals present in mangrove leaves
- Relate the level of metal contaminants to mangrove species (*Avicennia germinans* and *Rhizophora mangle*), site location, and leaf age

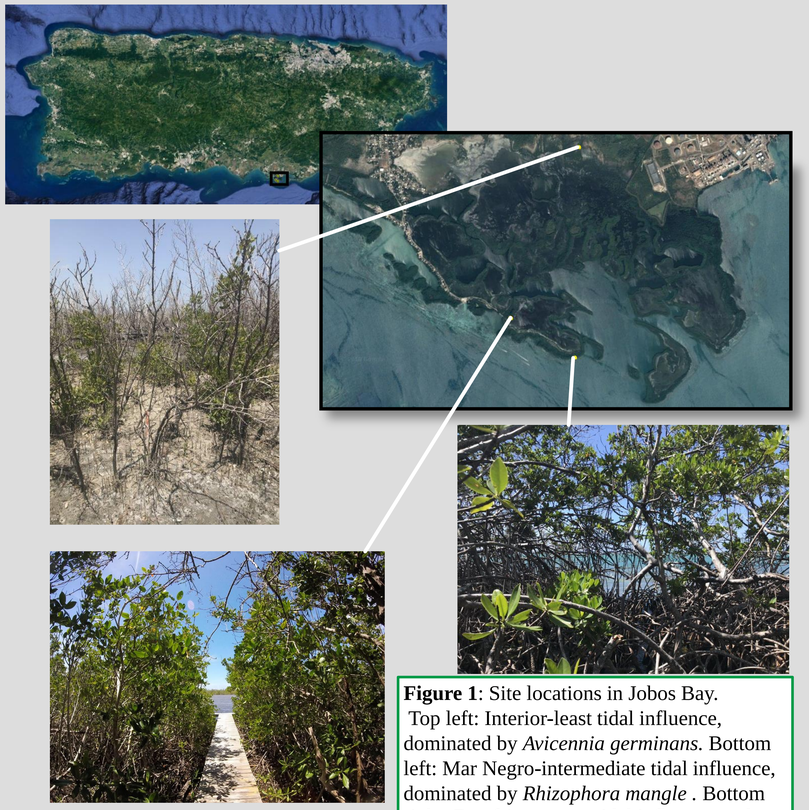


Figure 1: Site locations in Jobos Bay. Top left: Interior-least tidal influence, dominated by *Avicennia germinans*. Bottom left: Mar Negro-intermediate tidal influence, dominated by *Rhizophora mangle* . Bottom right: Bay fringe-most tidal influence, only *Rhizophora mangle* present

Hypotheses

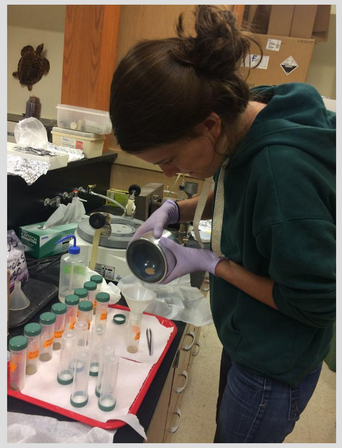
- *Avicennia germinans* is expected to have higher concentrations than *Rhizophora mangle* because species with salt excreting leaves have been found to have higher metal concentrations in their leaves (Chowdhury et al, 2015).
- Concentrations will decrease from the interior site to the bay fringe because concentrations in the sediment are found to decrease from the inner to the outer bay (Whitall et al, 2011).
- Older leaves will accumulate in higher concentrations in older leaves. Magnesium has previously been found in higher concentrations in older leaves (Lugo et al., 1998)

Methods

1. **Sample Collection:** At each site a branch was collected from three individuals of each species. Pairs of leaves from one stem of each branch were then removed in order of their age.

2. **Processing:** Samples were dried, then homogenized by grinding. 0.5 g of each sample was dissolved with nitric acid and hydrogen peroxide.

3. **Metal analysis:** Digested samples were diluted to differing concentrations and tested for various metals using an ICP-MS.



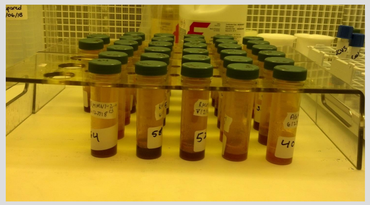


Figure 2: Top to bottom: Collecting samples, grinding samples, and dissolved samples in their digestion containers

Results and Discussion

Metals were found in the samples in the following order of concentrations:

Mn>Al>Cd>Cu>Mo>Cr>As>Be>Ag>Ni>V>Co

Lead, mercury, and zinc were also found to be present in the samples, but levels were not determined.

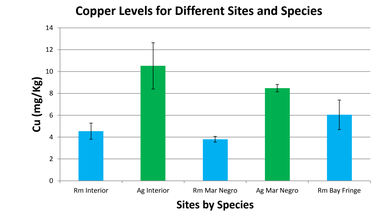


Figure 3: Copper levels were found to be significantly higher in *A. germinans* (H value=8.44 n=3 P=0.038)
Copper levels were not significantly different in *R. mangle* between the three sample sites (H value =3.47 n=3 P=0.177)

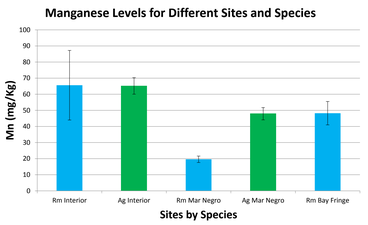


Figure 4: Manganese levels were significantly lower in *R. mangle* than *A. germinans* only in the Mar Negro site (F=7.59 n=3 P=0.013)
There was no significant difference found in *R. mangle* between all three sites (F=5.35 n=3 P=0.057)

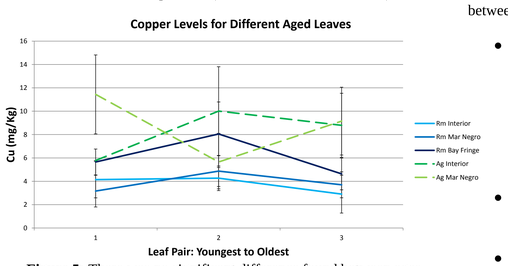


Figure 5: There was no significant difference found between ages of leaves (H value=35.58 n=3 P=0.669)

- Levels of up to 10 mg/Kg for copper and 25 mg/Kg for manganese are healthy for plants (Agriculture and Forestry)
- Manganese was higher than the healthy standard
- Middle aged leaves appear to have higher copper levels
- Levels are higher in the leaves of *A. germinans* suggesting that this species could be better for bioremediation.
- Higher levels of copper present in the bay fringe site could indicate a healthy forest or that more trace metals are introduced by tidal flushing than by run off.

Acknowledgments

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