2018 SWAAG Summer Research Scholarship

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“Detecting Saltwater Uptake of Trees Affected by Hurricanes”

Starting Date: 1 May 2018

Field Dates: 1-5 May 2018

Location: Grand Bay National Estuarine Research Reserve

Project Description

**Significance**

Historical observational records are limited in nature simply because data gathering and recording tools were not present before their invention (Landsea et al. 2004). Future risk from climate occurrences can suffer from a lack of data both spatially and temporally. One example of these climate risk projections is the calculation of return periods (Elsner, Jagger and Tsonis 2006). If an event happens once every 100 years, its return period is said to be once every 100 years. However, some confidence of that result must be sacrificed when the data set only extends 50 years. When proxy data are coupled to the observational record, data can be extended into the past as far as the proxy is available, which is often longer than the current historical record (DeLong et al. 2014, Liu 2004, Mann, Bradley and Hughes 1998). Specifically, this study attempts to understand why tree rings can resolve pre-observation hurricane activity.

**Background**

*Pinus elliottii* var. *elliottii* (slash pine) trees close to the coast (i.e., maritime trees) at GBNERR (30.42°N, 88.42°W) are sensitive to climate, and their stem growth is suppressed following tropical cyclone storm surge (Tucker et al. 2017). However, other preliminary data show tree growth further inland (on the order of a few kilometers or less) is not sensitive to the same parameters. Another study with *P. elliottii* trees on a nearly identical landscape to GBNERR occurs less than 100 km to its east (Rodgers III et al. 2006). Results show little correlation between tree growth and tropical cyclones at that site, but multiple issues arise with that study, including (1) non-traditional field methods, (2) confounding statistical methods, and (3) the study site itself is sheltered from tropical cyclones.

The sister species to *P. elliottii* var. *elliottii*, *P. elliottii* var. *densa* (South Florida slash pine), has also recently shown its usefulness in dendrotempestology (Trouet, Harley and Dominguez-Delmas 2016). A recent study matched its rings not only to historical weather observations, but also to pre-historical ship records and resolved nearly 300 years of tropical cyclones passing over or near the Florida Keys. Though this landscape is hundreds of miles from GBNERR, it has distinct climatic similarities (e.g., warm, moist). Additionally, its close proximity to the coast regulates tree growth similarly to the study of Tucker et al. (2017). Perhaps the issue of tree growth and tropical cyclones is not a northern Gulf Coast phenomenon, but instead is the result of specific site indices present along all coastlines.

**Methodology**

I hypothesize that trees further inland than those used by Tucker et al. (2017) may not be sensitive to climate as those at the coastal ecotone. The running hypothesis for the Tucker et al. (2017) study is that the desiccating effects of saltwater cause stress for trees, and thus they are sensitive to local climate. Non-halophytic species such as *Pinus elliottii* do not have mechanisms to excrete or store salts, so they must exclude the salt at the root-soil interface. However, inevitably some salts (primarily NaCl) do get consumed and stored in root, stem, and leaf tissue. Leaf tissue can be sampled for carbon, nitrogen, and environmental metals (such as Na). The ultimate goal for this study is to determine if trees that consume a certain amount of salt may be more sensitive to local climate.

Five 20m2 circular plots will be established at Grand Bay National Estuarine Research Reserve. They will be placed running inland, perpendicular from the coast, at 1km intervals. Ten (10) trees from each plot will be used for this study. Leaf samples will be collected using 18ft tree pruners and will be placed in *Whirlpak* bags for sampling in the lab. The Louisiana State University AgCenter Soil Test and Plant Analysis Lab will conduct plant tissue sampling for elemental compositions and concentration. Each tree will also be cored with a 5.15 mm diameter Haglof increment borer and processed to provide for proper ring counts and dates (Orvis and Grissino-Mayer 2002, Stokes and Smiley 1968). Tree rings from bark to pith will be measured from each core and then visually cross-dated with their sister cores and other cores from the same site. Ring width will be measured and recorded to the nearest 0.001 mm, and both the images and ring width measurements will be kept on a portable hard drive. Cross-dating and ring measurements will be verified using the cross-dating software COFECHA.

Tree-ring widths will be tested for significance with local precipitation, temperature, and drought measurements, as well as global climate oscillations such as the El Niño Southern Oscillation. The correlation for each site to climate parameters will be tested for significance against elemental results. For example, the r-squared result for “Site 1” versus precipitation will be compared to the elemental concentration of Na (sodium) for that site, and so on. These comparisons will be conducted for all climate parameters against all environmental metals, carbon, and nitrogen. The null hypothesis for these final comparisons will be that changes in environmental metals, carbon, and nitrogen will cause NO changes in r-squared values between tree-ring width and climate parameters.

References

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