

Keri Bryan

Summer 2010 Internship with Dr. Andy Nyman, Louisiana State University

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Bald Cypress Project

A majority of my time and efforts during my summer internship went towards a study of Bald Cypress leaf chemistry as an indicator of growth conditions and limitations of Bald Cypress swamps. A graduate student of Dr. Nyman's, Vanessa Tobias, had recently completed her dissertation on indicators of limiting factors of *Spartina patens* productivity. *Spartina patens* is a salt water marsh grass and is the most common salt tolerant plant in Louisiana's coastal marshes. This study used an agricultural technique for assessing limits to crop productivity and applied it for the first time to scientific research. This technique can serve as a much more practical and inexpensive means of determining limiting factors to wetland productivity. In Louisiana wetland productivity is typically limited by one of three things: salinity stress, flooding stress, and nitrogen limitation. Water salinity can be measured in the field, but nitrogen availability and flooding stress were measured by collecting samples of *Spartina patens* and doing a chemical analysis of the leaf tissue according to the agricultural test mentioned above. Nitrogen was measured using the N:C ratio, and manganese was found to be an indicator of flooding stress in this study. The bald cypress project is seeking to apply this same process to a freshwater wetland species. Once practical indicators for limiting factors on wetland productivity are identified, they will serve as powerful tools for wetland restoration projects. This is especially the case since

the hydrology of the area is largely human controlled and can be theoretically altered to address the problem if one of these factors can be identified as limiting. The long term hope for these two projects is that they can allow for the creation of a map of the coast based on the stresses limiting wetlands that policymakers can use in deciding on wetland restoration approaches.

The bald cypress project consists of two main components: leaf tissue analysis from samples collected in the Atchafalaya basin, and sapling growth at varying levels of flooding and nitrogen in a greenhouse study. In the field component I assisted in gathering leaf samples from Bald Cypress at multiple sites, marking sites in a portable GPS and recording the coordinates in a field notebook, and in preparing samples by washing them, drying them in a drying oven, and then grinding them to a homogenous powder that can be tested by a chemical analysis lab. For the lab component I was responsible for the daily management of water levels in the tanks containing the Bald Cypress saplings, for recording the height and diameter of saplings, and for entering monthly flooding data, height, and diameter measurements for each tree into SAS computer software. This program then computed the statistical correspondence between growth of trees and flooding, and growth of trees and nitrogen availability, and also the nitrogen-flooding interaction. This interaction is very important because if tree growth corresponds to a set of conditions defined by both nitrogen and flooding level more closely than it corresponds to flooding level independent of nitrogen availability or nitrogen availability independent of flooding level, then it is possible to manage a wetland limited by one of these by changing the other. Very preliminary data may indicate that the effects of flooding stress can be counteracted by increasing nutrient availability.

Nitrogen Cycling Project

A second area of focus during my internship was a nitrogen cycling study being carried out by Amy Sarconi, a PhD student in Dr. Nyman's lab. The study site was the Atchafalaya basin, through which one third of the Mississippi River's water is channeled by the old river control structure that was constructed in the 1960's. The control structure along with extensive levee systems represent the huge degree of human manipulation of the hydrology of the area, which has been necessary to prevent the Mississippi River from fully switching course away from the important port in New Orleans to the Atchafalaya. The watershed of the Mississippi is massive and contains extensive agricultural land far north from its mouth in Louisiana, and channels vast amounts of nitrogen rich fertilizers into the watershed into the Gulf of Mexico. This has caused a massive "dead zone" of deoxygenated ocean in the gulf where no aerobic organisms can live. This study was an investigation of nitrogen sequestration by the Atchafalaya basin. The basin consists of three habitat types: seldom or never flooded bottomland hardwood forest, occasionally flooded bald cypress swamp, and constantly flooded lakes, each of which have a differing potential for nitrogen sequestration. By measuring nitrogen removal in each of these three habitat types future estimates of nitrogen removal can be made based on current trends in habitat change: sedimentation of the Atchafalaya by Mississippi waters is increasing the seldom flooded habitats and decreasing flooded habitats.

Nitrogen can be cycled out of the water in three ways, denitrification by denitrifying bacteria associated with the anaerobic wetland soils, uptake into plants as woody biomass, and by sedimentation and settling to the bottom. This study measured nitrogen removal

from the basin using microcosms to measure denitrification, tree cores to estimate nitrogen stored in woody biomass, and soil cores to measure gross sedimentation rates and the amount of nitrogen in that amount of sediment. My participation in this experiment consisted of helping in taking and preparing these soil cores. Soil cores were taken by pressing a clear plastic tube into lake bottoms whose sedimentation patterns were not affected by boat wake, taping up the cores, pressing the core out of the tube in the lab, and then slicing them into 2-3cm cookies, measuring wet weight, and placing them in a drying oven. After this the cookies' dry weight will be measured and then they will be sent off to a chemical analysis lab to be cesium dated. Cesium dating is a process whereby peaks in cesium fallout from nuclear testing indicate the year 1963, because there was a rush to complete nuclear testing before the Nuclear Test Ban Treaty came into effect. Based on the amount of sediment above the 1963 depth annual sedimentation rates can be determined, and then average nitrogen content of the post 1963 core segments can be used to determine annual nitrogen storage in soils for the three habitat types. Nitrogen content of waters entering and exiting the basin was measured as well. Preliminary estimates show that the Atchafalaya may be removing 15% of total nitrogen. The hope for this project is that it can serve as a tool for policymakers in managing the flow of the Mississippi to maximize nitrogen removal by the basin. Currently the amount of water that is directed through the Atchafalaya Basin at the Old River Control Structure is fixed at about 30% of the Mississippi's water, however it may be advantageous to direct floodwaters through the basin and keep flow through the Mississippi fixed.

Deepwater Horizon Oil Spill and Cleanup

I also learned a lot about the Deepwater horizon oil spill and the cleanup response. On the first day of my internship I got to travel to Grand Isle, a barrier island of the coast of LA to attend a workshop on a citizen science project for documenting oiled birds across the gulf coast. This workshop included a quick overview of shorebird identification, on how to recognize an oiled bird and document the degree of oiling in a way that is compatible with NRDA protocol, and the effect oil has on birds. I also attended a public hearing on the oil spill response at the state capitol, where I got some insight into the frustrations and confusions of the political aspect of the oil spill response and the huge range of entities involved in the response. My internship was concluded with my attendance to the 2010 LAPB Fall Symposium whose focus session this year was on the oil spill and the effects of oil and various responses on wetlands, and included talks on the effects on plants, marine invertebrates, birds, and major fisheries especially with respect to seafood toxicity. I also read some of Dr. Nyman's past research on the effect of dispersants and oil on wetland plants. From these two things I have learned that oiling itself is often much less detrimental to marshes than any cleanup effort, that toxicity of oils and dispersants are more effectively measured by actual organism mortality than by content of harmful substances as can be found in complex chemical testing, that dispersant is more toxic than oil, and that toxicity of oil is increased by dispersants, but also that concentrations of both oil and dispersant in the gulf are much lower than in the studies discussed.

Between these three areas of focus, this internship experience provided me with an excellent context of the range of research concerning wetland habitats, which is primarily what I wanted to gain from the experience. I was also very interested in the way all of these studies were directly applicable to conservation efforts and public policy, by developing

tools for policymakers so that they can make more informed decisions when it comes to wetland management.