Guana Tolomato Matanzas National Estuarine Research Reserve (GTM NERR)
~~ RESEARCH UPDATE ~~

RESEARCHERS MAP MARCHING MANGROVES IN CLIMATE CHANGE STUDY

After two severe freezes in 1983 and 1989, the black mangrove trees (*Avicennia germinans*), once prominent in the southern portion of St. Johns County, Florida, died. Over the ensueing decades the trees gradually reappeared in salt marshes along the coastal estuary and are now spreading in patchy communities in St. Johns County as far north as St. Augustine. Researchers at the Guana Tolomato Matanzas National Estuarine Research Reserve (GTM Research Reserve) are mapping and studying the mangroves in their quest to learn more about these trees and how their march from tropical to 'subtropical-to-temperate' zones relates to global climate change.

The Research: In addition to looking at mangrove distribution and climate change, a number of researchers want to know what effect, if any, the spreading mangroves are having on the salt marsh habitat. The mangroves, by dropping sprouting seeds into the wet soil around them, are managing to walk right into cordgrass (*Spartina alterniflora*) marsh territory, which serves as home for young fish and shell fish such as clams, oysters, crabs and shrimp.

Mangrove roots provide food and shelter for a great variety of other marine organisms which could out-compete or eat some of the original salt marsh inhabitants and change species composition. The pressing question is, if warmer weather is motivating the mangroves to move northward taking with them their own variety of marine life, how will that change cordgrass-marsh-dependent communities?

Apparently due to warming, yet another tropical and subtropical exotic species, Brazilian Pepper (*Schinus terebenthifolius)*, is moving northward into the mangrove and existing cordgrass-marsh territory. While assessing and modeling mangrove dynamics ranging from Sebastian Inlet to their northern extent near St. Augustine, GTM Research Reserve Graduate Research Fellow Susan Leitholf wrote in her 2008 Master's thesis that the highly invasive scourge of Brazilian pepper was rapidly winding its way into St. Johns County marshes. Her resulting simulation model led to the conclusion that Brazilian pepper "would dominate the landscape if allowed to invade and establish in areas where it is not currently present."

Animals seem to have been affected by the changing vegetation, too. Such popular species as roseate spoonbills and pelicans are among the shorebirds that follow the mangroves and nest in their mature branches. Now researchers are wondering if the entire ecology is in the process of change. They want to know if southern marine plant and animal communities are slowly migrating northward in mass, if non-native species are competing with and possibly overtaking native species, and if this potential turnover is a valid indicator or product of global climate change.

Dr. Rick Gleeson, Research Coordinator for the Reserve, says it's hard to know at this stage if the movement of the mangroves is related to warmer conditions and/or changes in rainfall patterns caused by global climate change, or if the trend is indicative of some sort of regional cycle. He and his research team are compiling temperature and water quality data from the Reserve's weather station at Pellicer Creek, monitoring short term variations, long term trends and how the climate influences change over time. Another researcher, GTM Research Reserve Scientist Matt Love is mapping the extent of the spreading mangroves. The Reserve team is also networking with Dr. Nisse Goldberg, a Jacksonville University (JU) professor who has an interest in the ecology of black mangroves, who hopes to build upon the Reserve's mapping effort by examining various ecological factors potentially contributing to the mangrove expansion.

How long the black mangrove trees inhabit cooler zones and how far and wide they spread can be important indicators in a larger study of human-caused, rising carbon dioxide levels in the atmosphere, which is thought to raise temperature levels. To measure and map the spread of the trees the Reserve has turned to high technology.

The Mapping: Another Reserve team member, Geographical Information System Specialist Randy Altman, is teaching his computer to assist in mapping the expanding mangrove communities. His focus is within the southern boundaries of the Reserve from south of St. Augustine in St. Johns County to Pellicer Creek just north of Flagler County. Isolating black mangroves in aerial imagery allows Altman to develop regional maps indicating their precise population size and distribution at specific moments in time. "Our aim," Altman says, "is to quantify and characterize the current state of the black mangrove within the Reserve boundary in such a way that it can be repeated in the future, comparing apples to apples to measure how populations are expanding over time."

Tina Jackson, JU intern under Professor Goldberg, assisted the project by 'geo-referencing' (linking photos to known coordinates on the earth) ground level photos of typical mangrove cover that were taken by Altman and his team with a GPS camera that encodes longitude and latitude. By linking high resolution aerial photos and GIS data provided by St. Johns County to ground level photos, Altman can draw circles around the mangroves on the aerial survey and identify 'mangrove' or 'salt flat,' essentially distinguishing mangroves from all other ground cover.

Altman relies on sophisticated computer classification models developed by Coastal Services Center, a NOAA (National Oceanic and Atmospheric Administration) facility in Charleston, SC, to classify mangrove communities. In the process, he is attempting the challenging job of training his computer to 'think' in such a way that it can identify and isolate mangrove images from water and other ground cover. In a long drawn-out procedure, sometimes running on the computer for 30 hours or more, and sometimes breaking it down and nursing it back to health again, he is gradually teaching it to 'see' 6" x 6" image pixels and 'decide' whether the pixel is a mangrove or some other type of land cover.

To test for accuracy, researchers go into the marshes and randomly 'ground truth' decisions made by the computer, seeing if it correctly predicted the presence of mangroves. They also want to make certain that the 'thinking' computer is properly differentiating between large, mature trees and fairly close to the ground shrubs from just-sprouted seedlings. To date, the computer's progress is promising according to Altman.

The Whole Picture: By bringing fragmented bits and pieces of the marsh vegetation puzzle together to form a more complete picture, scientists are beginning to get a better understanding of what is going on with the marching mangroves, how they affect the existing marsh habitat and how temperatures are changing over time.

As Dr. Gleeson summarizes, "It is these sorts of collaborations of expertise and data gathering here at the Reserve, and within the National Estuarine Research Reserve system in general, that will help us better understand how the complex dynamics of coastal ecosystems might be altered by climate change. Such studies serve as important foundations for the wise management and protection of our coastal habitats."

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Fact: *Worldwide, humans have destroyed more acres of mangroves than any other type of ecosystem.* **Fact:** *Mangroves contain 10 to 100 times more salt than uplands and freshwater plants, which they expire through their leaves. Source: Florida Marine Research Institute.*

Weather Facts: *A NOAA Florida Hazardous Weather Report shows that prior to 1994 the earliest documented severe freeze in Jacksonville occurred in 1835 when the temperature dropped to eight degrees, while the lowest statewide temperature occurred in 1899 when it was minus two degrees. Since the 1800s, three catastrophic (wide spread destruction of crops and trees) freezes occurred in Florida, in 1917 and again in 1983 and 1989.*

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