Title: Ecohydrology of Forested Wetlands on the Texas Gulf Coast

Focus Category: WETLANDS; HYDROLOGY; LAW, INSTITUTIONS, AND POLICY

Keywords: Ecohydrology, Wetlands, Water Budgets

Duration: March 1, 2009 through February 28, 2010

Federal Funds Requested: $5,000

Non-Federal (matching) Funds Pledged: $11,559

Principal Investigator (graduate student):
Dex Dean, M.S. candidate
Ecosystem Science & Management, Texas A&M University
dexdean04@tamu.edu, (979) 845-4569
2138 TAMU, College Station, TX 77843-2138

Co-Principal Investigator (faculty advisor):
Dr. Bradford Wilcox, Professor
Ecosystem Science & Management, Texas A&M University
bwilcox@tamu.edu, (979) 458-1899
2138 TAMU, College Station, TX 77843-2138

Congressional District: Texas 22nd District

Abstract:

Wetlands provide critical ecological services, including flood control, water quality improvement, wildlife habitat, and enhancement of biodiversity. In the Texas Gulf Coast region, as in many areas of the country, industrialization and developmental pressures have led to a dramatic decline in wetland area over the past fifty years. Ironically, because many are considered to be isolated and not hydrologically connected to adjacent streams, they are without regulatory protection. However, very little work has been done to examine the connectivity of these wetlands to nearby streams. The study we propose will help us better understand hydrological processes of forested wetlands on the Texas Gulf Coast, as a means of investigating this issue. An important first step in understanding hydrological processes on these wetlands will be to develop quantified water budgets including rainfall, surface flow, soil water, and transpiration. We anticipate that this research will play an important role in determining the regulatory status of these wetland landscapes.

Statement of Critical Regional Water Problems:

Two of the most important water issues facing Houston and the Greater Houston area are flooding and water quality. High annual rainfall, widespread urban development, an extensive network of streams and floodplains, tidal surges, and generally flat terrain combine to make flooding a prevalent and expensive problem in and around the city of Houston. In addition, the quality of water in local watersheds and in the Galveston Bay Estuary is extremely important for regional fisheries, wildlife, and recreational use of the bay. The estuary is a nursery for many regionally important species of fish and shellfish, and serves as a migrational stop for waterfowl and other migratory birds. Between 1990 and 2008, four seafood safety advisories were issued for Galveston Bay because of chemical contamination. In addition, biological contaminants are a concern, especially with respect to recreational use of the bay and some bay tributaries.

Nature, Scope and Objectives of the Research:

Background

The Clean Water Act protects the integrity of waters of the United States—our nation's navigable and interstate water resources and waters that are important to the integrity of navigable and interstate waters. Wetlands that are adjacent to navigable waters or abut relatively permanent non-navigable tributaries of navigable waters are considered to be protected by the Clean Water Act (USEPA, 2008). However, wetlands exist that do not meet the above criteria, but do posses the potential to affect downstream waters for significant portions of the year. Currently, it is assumed that forested coastal wetlands in Texas are hydrologically isolated from waters of the United States and therefore do not merit protection under the Clean Water Act, but there is little or no hydrologic data to substantiate this assumption.

Forested wetlands, though easily overlooked, are potentially very important for detention of floodwaters and for early removal of water and sediment borne contaminants in stormflow. Since 1955, over 97,000 acres of coastal forested wetlands in Texas have been lost to development (TPWD, 1996). Development has affected forested wetland systems in two different ways. They have either been drained and filled for conversion to residential, industrial, or agricultural use or they have been converted to deepwater aquatic systems—inundated by runoff from newly developed, impervious residential or urban areas—such that that they no longer provide the same ecological functions. It is important that we promptly develop an understanding of the nature of water fluxes through these wetland systems to determine their hydrologic capacity to perform critical ecological functions.

Objective

The hydrology of coastal forested wetlands is not well understood. In particular, only limited work has been done to define water budgets and to evaluate the hydrological connectivity of these wetlands to other systems. As noted by Rodriguez-Iturbe et al. (2007), the study of wetland ecohydrology is a fairly recent endeavor, and quantified information including soil water profiles and plant transpiration is needed for the

development of new frameworks. The objective of the proposed study is to develop a better understanding of wetland ecohydrology by (1) quantifying the water budget of a forested wetland watershed in southern Harris County and (2) determining whether or not the wetland is hydrologically connected to adjacent waterways.

Proposed Research

In 2005, an experimental watershed was established within the Armand Bayou Nature Center. The center is located near Galveston Bay and urbanized areas such as southern Houston, Pasadena, and Clear Lake. The experimental watershed is currently instrumented with a rain gauge and an ultrasonic flow depth sensor on a weir at the outlet of the wetland. Rainfall and surface flow data from these two devices has been recorded on a continuous basis since April of 2005. The wetland typically produces significant runoff events during the winter and early spring, with additional runoff events normally occurring during the early to mid June and during the early fall.

With this proposal, we are requesting funds to supplement the surface flow study currently underway—to include measurements of plant transpiration and soil water. These measurements will help us gain a much more complete understanding of water dynamics in wetland landscapes. Plant transpiration is a very important water flux on many landscapes, and can provide insight into how plants use water over time and how plant water use influences the hydrologic cycle. We plan to use sap flow measurements, which allow for a continuous record of transpiration by dominant tree species. We also plan to install soil moisture probes to record soil moisture on a continuous basis. In addition to providing useful information about the soil storage component of the water budget, soil moisture measurements will allow us to determine how often forested coastal wetland soils are saturated, and for how long. The integration of transpiration, soil water, surface flow, and rainfall data will enable us to asses which fluxes are most important in forested coastal wetlands, and how the water budget and hydrologic cycle vary with time. The inclusion of the measurements will allow for a much more complete understanding of water dynamics in these wetland landscapes.

Results Expected From this Project:

By providing quantified analysis of wetland water fluxes, this study will aid in the understanding of how forested coastal wetlands function and why they are important for flood control and water quality. Expected results include:

- Quantitative documentation of wetland water fluxes.
- Integration of rainfall and surface flow data with soil water and plant transpiration data.
- Partitioning of fluxes between surface flow, soil storage, and plant uptake.
- Formulation of a water budget for coastal forested wetlands.
- Analysis of hydraulic detention time and the efficacy of surface flow and evapotranspiration as mechanisms for releasing water from a forested wetland system.
- Analysis of surface connectivity between forested wetlands and nearby waters.