Integrative Approach to Understanding the Causes of Salt Marsh Dieback: Experimental Manipulations of Hydrology and Soil Biogeochemistry (Task II.2)

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Study Site Location(s): Greenhouse – Samples from Lake Felicity; Grand Isle; Bay Junop (Louisiana)

Keywords: Greenhouse

Project Type: Experimental

Project Outline:

Experimental Approach:

Greenhouse studies will be established to simulate different hydrologic functions that test the response of soil parameters to hydrologic drivers. This monitoring will be used for continued model calibrations. Greenhouse marsh-tidal mesocosms will simulate water drawdown and recharge to test the scenarios of marsh drought conditions. Scenarios will be established to simulate different degrees of water deficits followed by different sources of recharge (either precipitation or tidal).

Tidal recharge and precipitation will be done at varying durations of deficits. Different soil types will be tested (based on relative organic and mineral content) from Old Oyster Bayou. Biogeochemical parameters include soil salinities, sulfides, pH, redox potential, metals, nutrients, and selected iron forms that may indicate significant changes in soil biogeochemistry.

Experimental Design:

Our microcosm setup is composed of tidal platforms that can simulate different hydroperiods at selected ranges in salinity. These platforms consist of buckets (23 L, 48 cm deep) situated on top of a 190 L-reservoir. Seawater is pumped from the reservoir to individual buckets using a splitter. Tidal amplitude is controlled independently in each bucket by two concentric pipes that drain water back to the reservoir once the pumps are turned off. The depth of saturation can be controlled by the depth of holes in this central drain pipe. Timers control inundation frequency and duration by turning on and off the pumps on a daily pattern. We have been using this system for nearly a year to study mangrove/soil interactions under different hydroperiods. Air temperatures in the greenhouse are maintained above 8 C and within 2 C of the high summer temperatures. Light within the greenhouse is 53% of the ambient solar energy.

This tidal microcosm system will be designed to study different durations of lowered water levels and source of porewater recharge. Water levels will be lowered to –20 cm in each bucket and duration treatments will consist of one-day deficit (control), recharge after 7 day-deficits, and recharge after 30 day-deficits to simulate varying strength of drought conditions. At the end of each period, the 7-day and 30-day treatments will be recharged either by precipitation (freshwater), or tide (saltwater at salinity treatment level). These duration and recharge treatments will be operated at two salinities: 10 and 30 g/kg. Three types of marsh soil covering the range of soil types identified in brown marsh areas will be tested including sandy mineral, clayey mineral, and organic. This three by two by two by three factorial design will be replicated three times for a total of 108 experimental units.

Publications, reports, or web-accessible materials

Suggested citation: Georgia Coastal Research Council, 2004. Proceedings of the Marsh Dieback Workshop, held February 3-4, 2004, Savannah Georgia.