HYDROLOGIC MONITORING OF A HARDWOOD ENCROACHED, ISOLATED DEPRESSIONAL WETLAND, SOUTHWEST GEORGIA

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REFERENCE: *Proceedings of the 2007 Georgia Water Resources Conference*, held March 27–29, 2007, at the University of Georgia.

Abstract. Hardwood encroachment into isolated depressional wetlands may change their hydrologic function. To gain a better understanding of this process we installed 12 shallow wells (5-12 ft. deep), in December 2005, on 2 transects crossing a 2.2 acre wetland in southwest Georgia. From March to October 2006, we collected hourly data in the wells and the wetland. Soil boring data showed that soil permeability increased close to the wetland and decreases up-gradient in the catchment. The deeper sandy soils in the ecotone store water which may be hydraulically connected to the wetland. Daily diurnal fluctuations in the water-level of the shallow wells in the ecotone suggests that the vegetation may have an effect on the shallow groundwater.

INTRODUCTION

Isolated depressional wetlands are common landscape features in fire-maintained pine plantations in the southwest Georgia Costal Plain. Because of fire frequency, oak species are suppressed in the uplands. Thus, the long-term establishment of hardwood species is more probable in wetlands with more extended hydroperiods (Kirkman et. al.,). With long durations in hydroperiod, the absence of fire through wetlands, or land use practices, successional development of dense shrub and hardwoods could dominate ecotonal areas. This change in overstory structure could lead to changes in the hydrologic function of the wetland. It is hypothesized that the flow of water into isolated marsh wetlands in our study area is primarily through diffused lateral movement of rainwater within the soil layers underlying the wetland catchment. Because of low topography, relatively permeable soils and minimally disturbed landscape, vertical infiltration and shallow groundwater transport, rather than rapid runoff of rainfall is thought to fill and maintain wetlands. Transpiration rates of hardwoods in the catchment may reduce subsurface flow, thus, reducing the volume of water available to the wetland. The trees may also reduce the hydroperiod by removing stored water from the shallow water table that may be hydraulically connected to the wetland.

STUDY SITE

Our study area is located in Baker County Georgia, at the Joseph W. Jones Ecological Research Center at Ichauway, which is a 29,000 acre fire maintained plantation. Numerous isolated depressional wetlands dot the landscape in this karst system in the Dougherty Plain district of the Coastal Plain physiographic province. Our study wetland is classified as a marsh that has a grassy groundcover and open canopy. Typical hydroperiod is from late winter to early summer with inundation depth less than 5 ft. The wetland is 2.2 acres in size with a catchment area of 79.4 acres and a topographic relief of 22 feet.

The base of the wetland is an impervious clay layer which results in a perched pond during much of the year. Water chemistry data indicate that there is no direct link between the limesink wetlands on Ichauway and the Upper Flordian aquifer (Battle and Golladay 1999).

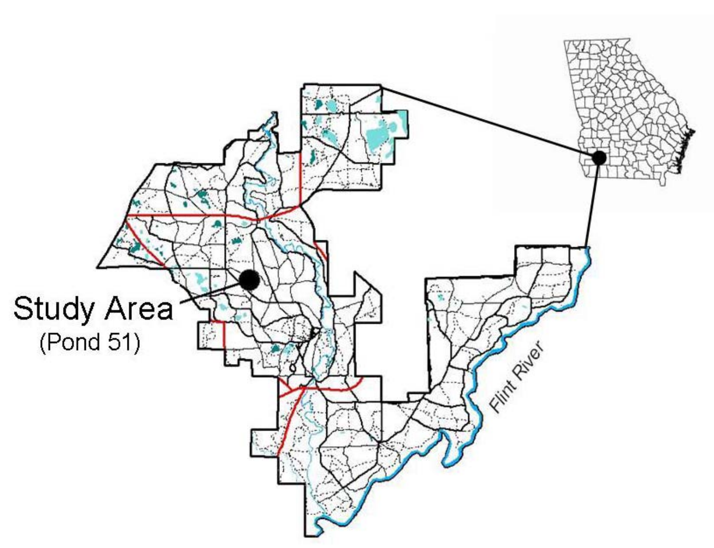

Figure 1. Location of study area

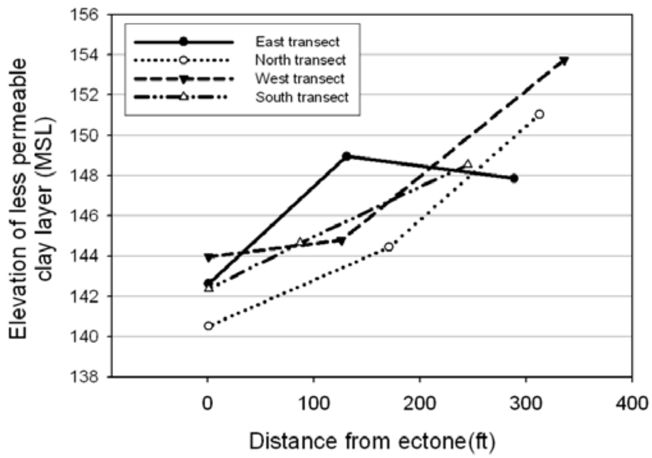

Figure 2. Elevation of less permeable clay layer in the wetland catchment.

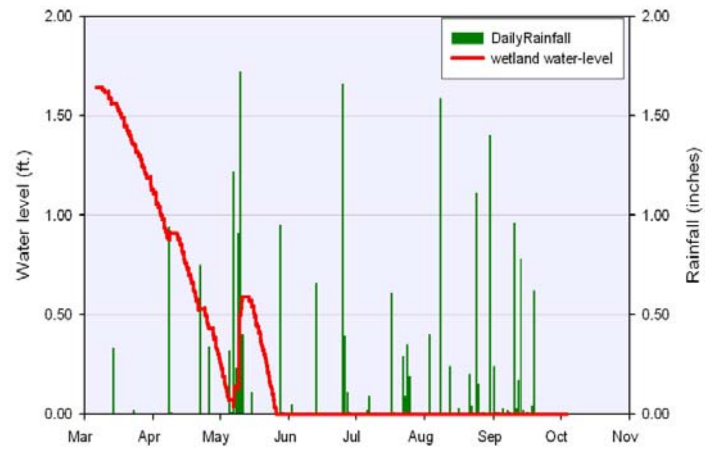

Figure 3. Daily Rainfall and wetland water-level

BACKGROUND

Often over looked because of there relatively small size, depressional wetlands are highly biologically diverse. Approximately 41% of the vascular plant species found on Ichauway occur in and around depressional wetlands. Because of the cycle of inundation and drying, these wetlands also serve as an essential breeding site for numerous amphibian species.

Aerial photos taken in 1948 show a landscape much different than today. Our study wetland (pond 51) has undergone a vegetation change in and around the wetland. Past land use practices are not known. Historically, hardwoods were only found on the north end of the wetland and in small clusters. Today, hardwoods, primarily oak species, have encircled the wetland in the ecotone and caused a fire shadow, thus, reducing the chance of prescribed fire to burn through the wetland. As the oaks grow in size, canopy size increases reducing sunlight to grasses and forbs essentially eliminating the groundcover and the fire carrying capacity while decreasing flora diversity in the ecotone.

METHODS

Two cross-sections were established through the wetland approximately north and south and east and west. Twelve vertical soil borings were drilled with six sites per transect. Each bore hole was converted to a monitoring well with 2-inch diameter PVC well casing. Sand was used to fill the well annulus above the screened interval and bentonite was used to seal the well from vertical leakage rain water. Well depth ranged from 5 to 12 ft.

Wells were outfitted with data loggers (Ott, Orphimedes) to monitor water-levels at one-hour intervals. A platform was installed in the deepest part of the wetland and a stilling well was constructed to house a float operated automated water-level data logger (Ott, Thalimedes). Water fluctuations in the wetland were monitored at one-hour intervals. Rainfall is measured on site with a solar powered tipping bucket gauge (Campbell Scientific, TB5) mounted to the platform.

RESULTS

Soil borings were used to define soil characteristic at the 12 sites. Soil data show an increase in permeable soils in the ecotone and thins moving up into the uplands. Because of this thinning and natural topography, the less permeable clay soil horizon is 10 feet higher, in some transects, than the ecotone clay horizon (Figure 2). This elevation change creates a down gradient mechanism for subsurface flow toward the wetland in the overlying sandy soils. Rainfall infiltrates vertically through the more permeable surfical soils through the wetland catchment and moves laterally along the interface with less permeable soil layers under the force of gravity toward the wetland. Water stored in the permeable soil in the ecotone, proximate to the wetland, may provide water to the wetland dependent of pressure gradients of wetland water-levels. Rapid rainfall infiltration is absorbed in the permeable soil zone near the wetland; however, the response to rainfall is delayed higher in the catchment. Water-level fluctuations in the permeable soil zone can be correlated with evapotranspiration induced fluctuations in the wetland. Evapotranspiration rates exceeded rainfall during early summer resulting in declining water levels

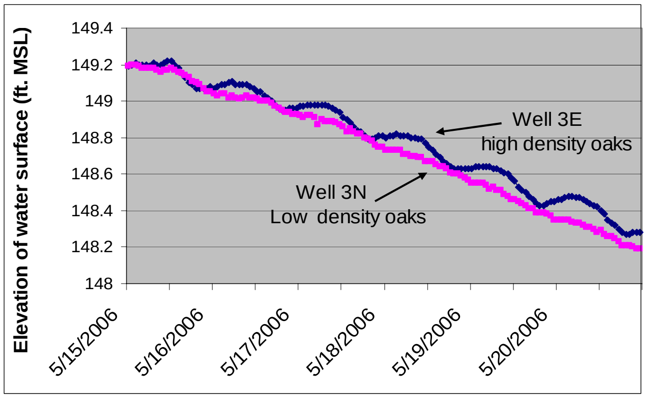

Figure 4. Hydrograph of wells located in oak dominated area and a non-oak dominated area.

and abbreviated hydroperiod. Even though several rainfall events occurred, the hydrologic system did not respond to this precipitation during the summer months (Figure 3).

Wells located in high density, oak dominated areas show diurnal patterns of daytime drying and nighttime rebound in the groundwater level data (Figure 4). Well located in low density areas show a linear drawdown response (Figure 4).

CONCLUSIONS

The development of hardwoods in the ecotone seems to play a role in the hydrologic function of the wetland, to what extent is not known at this time. Because of drought conditions during our 2006 study period, and the relatively short length of the study period, these findings should be considered primarily. Data will need to be collected under differing climatic conditions to fully understand the complex interactions of subsurface flow and storage, and evapotransipiration loss in the wetland system.

LITERATURE CITED

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