TRACKING SALINITY INTRUSIONS IN A COASTAL FORESTED FRESHWATER WETLAND SYSTEM

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Coastal forested freshwater wetlands are sentinel sites for salinity intrusions associated with large, tidally influenced, storm-driven or drought-induced incursions of estuarine waters into freshwater ecosystems. These incursions may also be exacerbated by rising sea levels associated with climate change. A coastal forested freshwater wetland in South Carolina - Strawberry Swamp - has experienced dieback of freshwater forested wetland trees due to increased salinity levels within the wetland (Williams et al. 2012). Strawberry Swamp comprises a drainage area of 236 hectares at its outlet into the tidal creek. Ground elevations in the watershed range from mean sea level (MSL) at its outlet to 1.5 m above MSL at the watershed boundary. Historical aerial images of the swamp show considerable changes to forest structure vegetation through the last few decades (Williams et al. 2012, Jayakaran et al. 2014). Vegetation in the wetland is transitioning from a closed canopy of common freshwater tree species such as bald cypress, water tupelo and swamp tupelo at its upper reaches to a more open canopy due to the establishment of salt tolerant grasses closer to the outlet. The wetland is prime habitat for several wildlife species and amphibians as evidenced by game cameras. The wetland drains into a tidal creek at its outlet through a pipe culvert; the tidal creek is connected to Winyah Bay which receives freshwater from the third largest watershed on the eastern coast ultimately discharging into the Atlantic Ocean. Tidal dynamics influence the wetland outlet, while at its upper sections, the water flows are driven by rainfall and topographical slope. Backwater effects from Winyah Bay also appear to impact flow dynamics at the wetland outlet when large river flows discharging into Winyah Bay force freshwater into tributary tidal creeks and swamps. A corollary to the phenomenon of high flows in the rivers is the influence of drought or low flow conditions in the rivers that results in the movement of the salt-freshwater wedge landward, causing increased salinity in the Bay and its tributary systems (tidal creeks and connected wetlands). In June 2013, water level, temperature, and conductivity sensors were installed along the salinity gradient to measure temporal variations in hydrologic conditions within the swamp. Microclimatic conditions were also measured and water flux at the tidally influenced watershed outlet was logged using an acoustic Doppler flow velocity sensor installed within the pipe culvert to measure bi-directional flows. At the upper extent of the watershed, a groundwater well was installed and instrumented with a depth, temperature conductivity sensor to characterize groundwater position and groundwater salinity. A conductivity temperature depth (CTD) sensor was also deployed within the tidal creek to measure water level and salinity changes in that section of the system. For the purposes of this extended abstract, data measured between June 2013 and January 2015 will be reported and discussed.

Results from 16 months of monitoring salinity in Strawberry Swamp show a pronounced salinity gradient between the upper reaches of the swamp and its lowest tidally influenced section at the outlet with the highest salinities measured at the swamp outlet. The upper reaches of the swamp were influenced primarily by incident rainfall within the watershed, with salinity levels in the two healthy zones ranging from 0.2 to 1.5 PSU, while at the mid-

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stressed zone, salinity ranged from 1.6 to 3.6 PSU. At the zone that is currently experiencing the most dieback of trees (stressed zone), salinity ranged from 3.3 to 7.0 PSU. At the outlet there appears to be a complex dynamic driven by tides, local rainfall, and estuarine backwater effects. Salinity ranged from 0.3 to 15.6 PSU over the period of record. The data show that average salinity in the outflow is marginally higher than the average inflow salinities. Flow measurements at the outlet suggest that the wetland exports that represents 7.9 percent of rainfall incident on the watershed (Table 1). Tidal flows at the outlet summed over a daily time step showed that there were consecutive days of net flow into the swamp (inflows) between

Table 1—Total inflows and outflows measured at Strawberry Swamp outlet between June 2013 and January 2015.

	Volume of water (m^3)	Volume expressed as depth per unit watershed area (mm)	Total Rainfall (mm) (10/2013 and 1/2015)	Rainfall runoff ratio (%)
Inflow	-285,981	-122	1,602	7.9
Outlow	583,435	249		
Net flow	297,454	127		

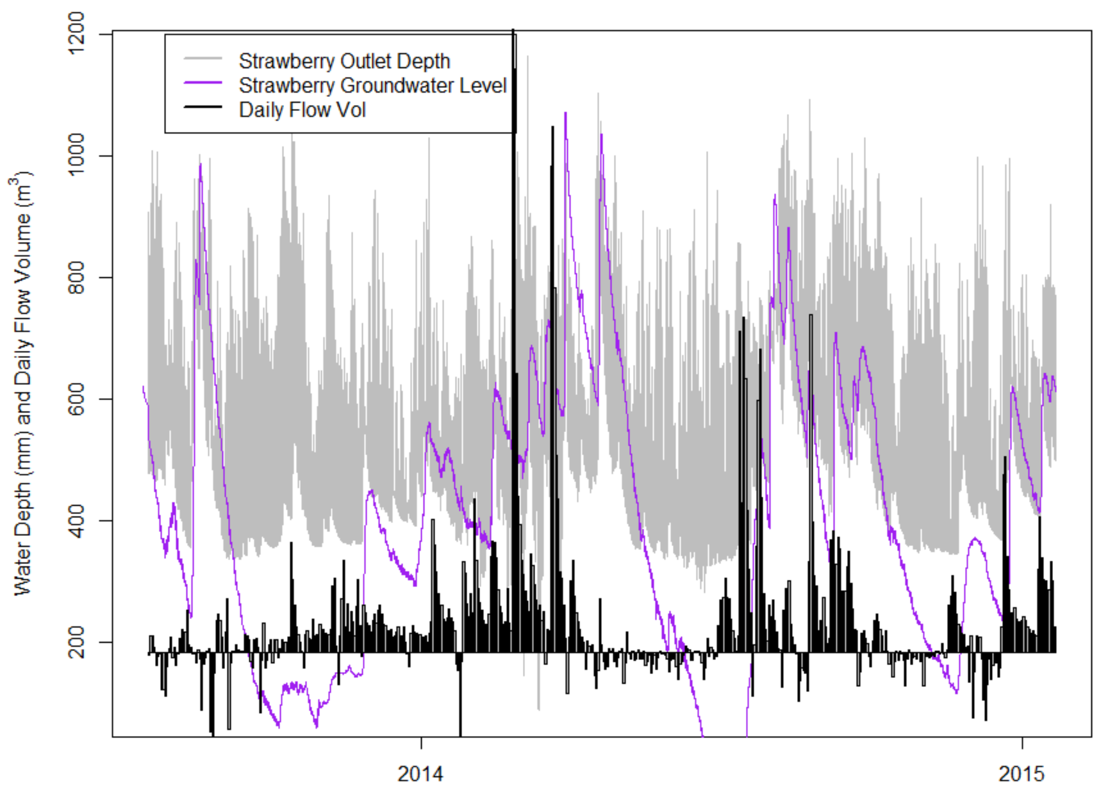

Figure 1—Net daily flow volumes measured at Strawberry Swamp outlet between June 2013 and January 2015 represented as vertical bars. Water level at the wetland outlet is depicted as a gray line and show the influence of tidal, backwater, and upland flow dynamics. Groundwater level measured at an upland location is shown with a purple line and represent water elevations above a datum that is 3.3m below the ground surface.

May and July 2014 as well as in November and December 2014 (Fig. 1). These periods appear to coincide with low groundwater levels in the watershed. However, this net inflow of water into the swamp does not appear to be repeated during another period of low groundwater elevation during November 2013. Data collection is ongoing and we hope to develop a clearer picture of flow and salinity fluxes in Strawberry Swamp.

LITERATURE CITED

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