Evaluating Woody Plant Species and Their Associations with Salinity and Hydrology in the Mobile-Tensaw Delta

***Andrew Balder**, Christopher J. Anderson, Thomas Kavoo, and Latif Kalin*
Auburn University, College of Forestry, Wildlife and Environment Auburn, AL, USA

Tidal freshwater forested wetlands (TFFWs) are understood to be ecologically diverse and important areas that are vulnerable to anthropogenic disturbances, including channelization, dredging, and climate-induced sea level rise. Despite their ecological significance, important knowledge gaps persist related to the role of tidal influence on TFFW communities. To address this gap, we surveyed 47 forest plots across the tidal gradient of the Mobile-Tensaw River Delta (MTRD) along the northern Gulf of Mexico using 400-m^2 circular plots to document canopy and midstory species composition and canopy tree diameters. We integrated species composition data with predicted salinity and digital elevation analysis to assess environmental influences on vegetation distribution. To develop the salinity model, we deployed nine sensor dataloggers across the tidal gradient to record hourly salinity, water level, and temperature from November 2022 to July 2024. Using these and other publicly available data, we developed a hybrid deep neural network model with a residual network technique to predict salinity dynamics at each forest plot over the previous 15-year period (2008-2023). Species composition varied significantly across the tidal gradient in response to two key environmental parameters: salinity and elevation. Distinct zonation patterns were observed in both the midstory and canopy layers, with more tidal species such as *Morella cerifera* and *Nyssa biflora* persisting in areas of higher salinity, while less tolerant species like *Ilex verticillata* and *Nyssa aquatica* were more prevalent in fresher, less tidal environments. Other species, such as *Taxodium distichum* and *Ilex verticillata*, were most prevalent in low-elevation forests prone to more prolonged flooding. Threshold analysis identified distinct change points in species composition along the salinity gradient, with the percent exceedance of 2 psu emerging as the most ecologically informative threshold at 13.9% (more tidal sensitive species) and 16.4% (more tidal-tolerant species) exceedance. Additionally, long-term average salinity thresholds corresponded with a transition from large tree-dominated forests at approximately 0.4 psu to shrub/scrub tidal zones near 0.8 psu, highlighting a critical shift in vegetation communities. Our findings highlight species-specific salinity thresholds and emphasize the vulnerability of MTRD forests to increasing salinity intrusion driven by sea level rise and anthropogenic modifications.