New Ground: Evaluating Factors that Influence Creation of Blue Carbon Soils in Restored and Natural Mangroves in Southwest Florida

Josh Breithaupt[1], *Joseph Smoak*[2], *Kara Radabaugh*[3], *Brad Rosenheim*[2], *Alejandra Aguilar*[2], *Isabel Romero*[2,4], *Ryan P Moyer*[4]

[1]Florida State University
[2]University of South Florida
[3]Florida Fish and Wildlife Conservation Commission
[4]University of South Carolina
[5]TerraCarbon LLC

Mangroves have lost much of their historic global extent because of human action. In recent years this trend of loss has slowed or reversed in some regions with growing recognition of the ecosystem services mangroves provide. Research has consistently shown that mangroves are amenable to restoration under the right conditions, including oabservations that restored mangroves are more likely to recover their historical function than are mangroves planted in locations where they were historically absent. However, evaluation of restoration success is often limited to measurements of aboveground biomass over 5 years or less. Building on previous work that has documented timeframes for mangrove recovery to mirror nearby natural mangroves, a major objective of this work is to evaluate how organic carbon (OC) can be used as a metric of restoration success using sites that were restored 19 – 41 years ago. This work evaluates rates and stocks of mangrove soil OC using data obtained from restored and natural mangroves from 24 plots at 4 sites in southwest Florida to evaluate temporal trends in mangrove soil building factors: differences in soil age, present day surface elevation, water inundation times, and nutrient stoichiometry of soil, water, and roots. Soil ages of restored sites were determined by identifying the Time 0 restoration horizon based on dry bulk density and loss-on-ignition demarcations between the sandy-shelly restoration substrate and organic-rich mangrove soils. All 24 natural and restored plots are being dated with Pb-210 to examine variable sedimentation and OC burial rates over time. Preliminary data, based on 18 of the 24 plots, show vertical accretion rates in restored plots that average 5.7 ± 2.0 mm y^{-1} compared to rates in the natural plots that average 3.2 ± 0.4 mm y^{-1}. However, greater accretion rates do not translate to higher OC burial rates; instead, average OC burial rates of restored soils were 121.21 ± 23.79 g m^{-2} y^{-1}, slightly less than the average for neighboring natural sites of 165.82 ± 23.71 g m^{-2} y^{-1}. Soil OC densities (which can be spatially up-scaled for stock estimates) of equivalent depths in the co-located restored and natural plots were mostly the same. However, when stocks were normalized to equivalent ages instead of depths, the two younger sites showed higher stocks in restored sites. Approximately 40 years after restoration, the age-normalized stocks were equivalent between restored and natural plots.