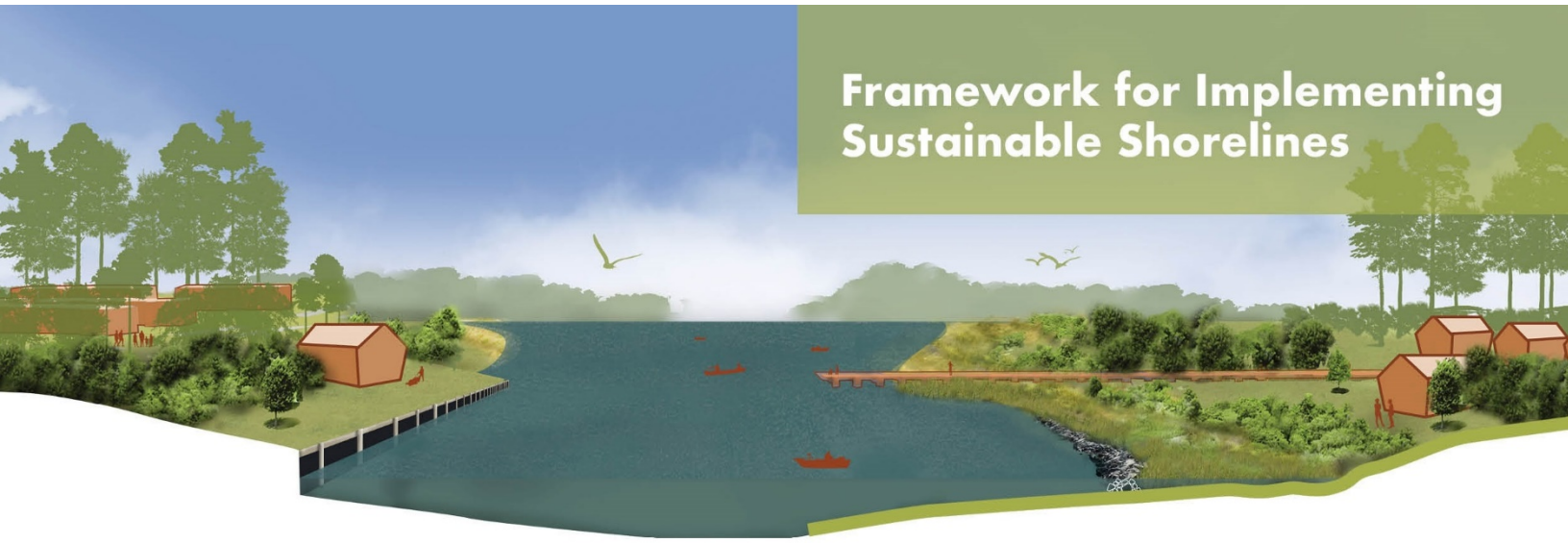


Summary of Natural Science Investigations:

Carbon and Nutrient Storage in Marshes

Project Activity: Carbon and Nutrient Storage in Living Shoreline Marshes

Objective: Our work documents the standing stocks of carbon (C), nitrogen (N) and phosphorus (P) in Living Shoreline marsh soils and plants, for comparison with natural fringing marshes. The accretion of organic matter and nutrients post-creation of Living Shoreline marshes has been examined in relation to marsh age and marsh composition/connectivity. We are using soils and plant analyses to help quantify the functional comparison of Living Shoreline and natural fringing marshes along a continuum of shorescape settings.

Methods: From each Living Shoreline marsh and paired, natural fringing marsh, we collected triplicate soil cores from the lower marsh (dominated by *Spartina alterniflora*) and the upper marsh (dominated by *S. patens*). The soil cores were sectioned by depths 0-5 cm, 5-10 cm, 10-20 cm, and 20-30 cm. Bulk soil characteristics including water content, bulk density, percent organic matter (LOI), and total carbon, nitrogen, and phosphorus were determined using standard analytical methods. Near the end of the growing season we collected leaf samples of the dominant plants for determination of tissue C, N and P. The C, N and P pools in aboveground biomass have been estimated based on average stem height and stem density, coupled with total C, N and P measures from all plant material.

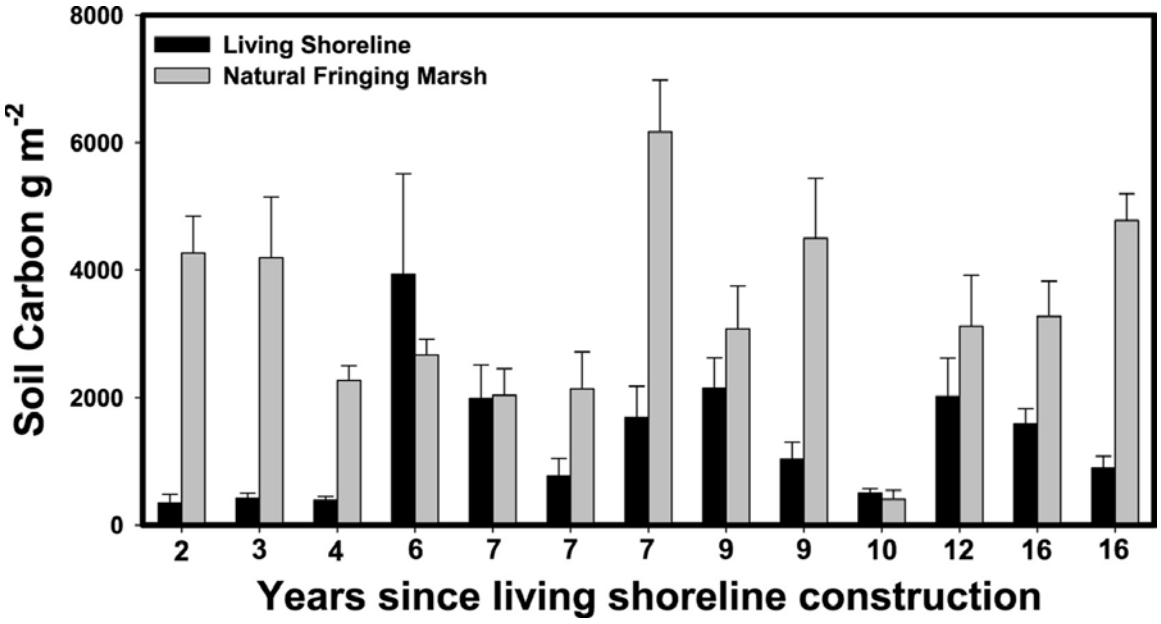
Progress to date: Processing of all soil and plant material was completed during the 2018-2019 academic year.

Visuals:

Collection of Soil Cores from a Living Shoreline marsh. Note the sandy soil structure in the bottom of the core (20-30 cm) versus the darker, organic components near the top of the core (0-5 cm).

Findings: Relative to most of the natural marsh soils, the Living Shoreline soils are on average significantly higher in bulk density and lower in organic matter and total carbon, nitrogen and phosphorus. Among Living Shoreline-natural marsh pairs, however, variance among these metrics was high.

The larger pool of nutrients by far resides in the soils of the natural fringing marshes, where 1-13% of the total nutrient mass is found in the aboveground portions of the plants. The living plants do comprise a larger percentage of the total marsh nutrient pools in the Living Shoreline marshes (6-47%). From initial regression analysis, variation in nutrient pools among Living Shoreline marshes is not significantly associated with either shorescape isolation or urbanization. Rates of N and P (but not C) accumulation in Living Shoreline marsh soils is weakly correlated with marsh age.



Soil carbon in living shoreline marshes is typically lower than in natural fringing marshes—but not always; nor does soil carbon necessarily increase with marsh age.

Owing to rapid plant growth, the visual appearance of Living Shoreline marshes quickly approaches that of natural fringing marshes. With respect to nutrient pool sizes in soils, however, the "time to equivalence" with the 13 natural marsh pairs ranges from 0-63 y for carbon, 0-31 y for nitrogen and 0-23 y for phosphorus.

Product: Chambers, R, Gorsky, A., Isdell, R., Mitchell, M., Bilkovic, D.M. **2021.** Nutrient accumulation in living shoreline and natural fringing marshes. *Ocean & Coastal Management*, *199*, p.105401. https://doi.org/10.1016/j.ocecoaman.2020.105401