Managing for biodiversity and blue carbon in the face of sea-level rise and barrier-island migration

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Dr. Sunny Jardine, Dr. Keryn Bromberg Gedan, Dr. Jorge Lorenzo-Trueba, Dr. George Parsons and Dr. Christopher Hein are pictured at the Virginia Institute of Marine Sciences Eastern Shore Laboratory in Wachapreague, Virginia.

Barrier islands serve as buffers between the coastal ocean and mainland agricultural lands, human population centers, and infrastructure and protect these investments from devastating storm impacts. The marshes, bays, lagoons and tidal flats behind these barriers support a high degree of biodiversity and also provide other ecosystem services including blue carbon storage. The proposed research focuses on the geologic and ecologic response of coupled barrier-backbarrier systems to relative sea level rise (RSLR), and the implications for the backbarrier ecosystem services of biodiversity provision and blue carbon sequestration.

Investigators involved in this regional project will collect field geologic, ecologic, and modern-process data from four target barrier systems along the New Jersey coast and Delmarva Peninsula. These sites are diverse in terms of their degree of human development and stabilization, as well as their historical migration rates (Fig. 1). Such diversity among study sites will allow the field data to provide input to a broadly-applicable morphodynamic model, which addresses evolution of barrier profiles by focusing on mass balances and sediment fluxes driven by overwash, the process responsible for barrier migration (Fig.2). The model will be applied to investigate the net benefit from various barrier-systems management plans, and how introducing biodiversity considerations changes the optimal management plans as well as the quantifiable ecosystem services generated by the system.

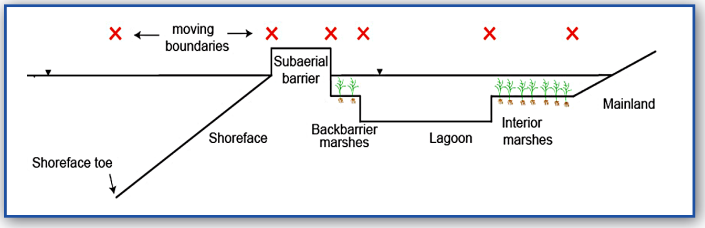

Figure 2. Cross-shore barrier-marsh-lagoon-marsh-mainland model set-up.

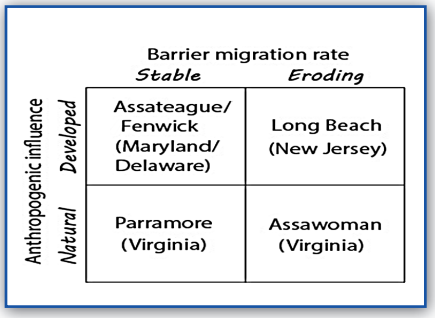

Figure 1. Target study sites for proposed field work. All sites front vulnerable, low-lying mainland communities. These barrier-backbarrier systems display a mix of fully developed and largely undeveloped barriers (with cross-site and intra-site variability). They have all experienced similar rates of relative sea level rise change over the past 5,000 years, yet display diversity in terms of their distance from the mainland shoreline, ratios of marsh-to-open-water in their backbarriers and migrational stability (stable vs. rapidly landward migrating) in the face of relative sea level rise.

Overall, this project will provide: (1) a concrete framework crucial to understanding the natural processes responsible for spatially non-uniform barrier-migration vulnerability; (2) insight into the volumes of blue-carbon storage within the barrier and backbarrier stratigraphic frameworks; (3) data on habitat quality and the contribution of salt marsh plants to blue carbon accumulation; and (4) insight into the best-practices for designing optimal marsh conservation and restoration programs, which consider the net benefits from protecting blue carbon stocks and biodiversity.