

Supplemental Material:

Figure 1:

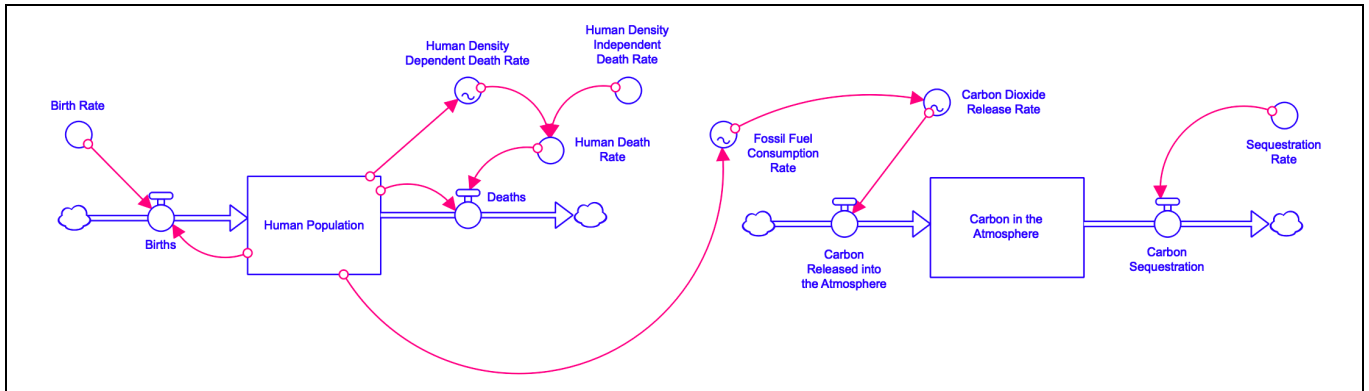


Figure 1: Stock and flow diagram of a simplified global climate system. Stocks of Human Population (global total) and Carbon in the Atmosphere (global total, parts per billion) are connected via the global Fossil Fuel Consumption Rate and the global Carbon Dioxide Release Rate. The model was parameterized and validated with data from the IPCC Fifth Assessment Report and a literature review.

Figure 2:

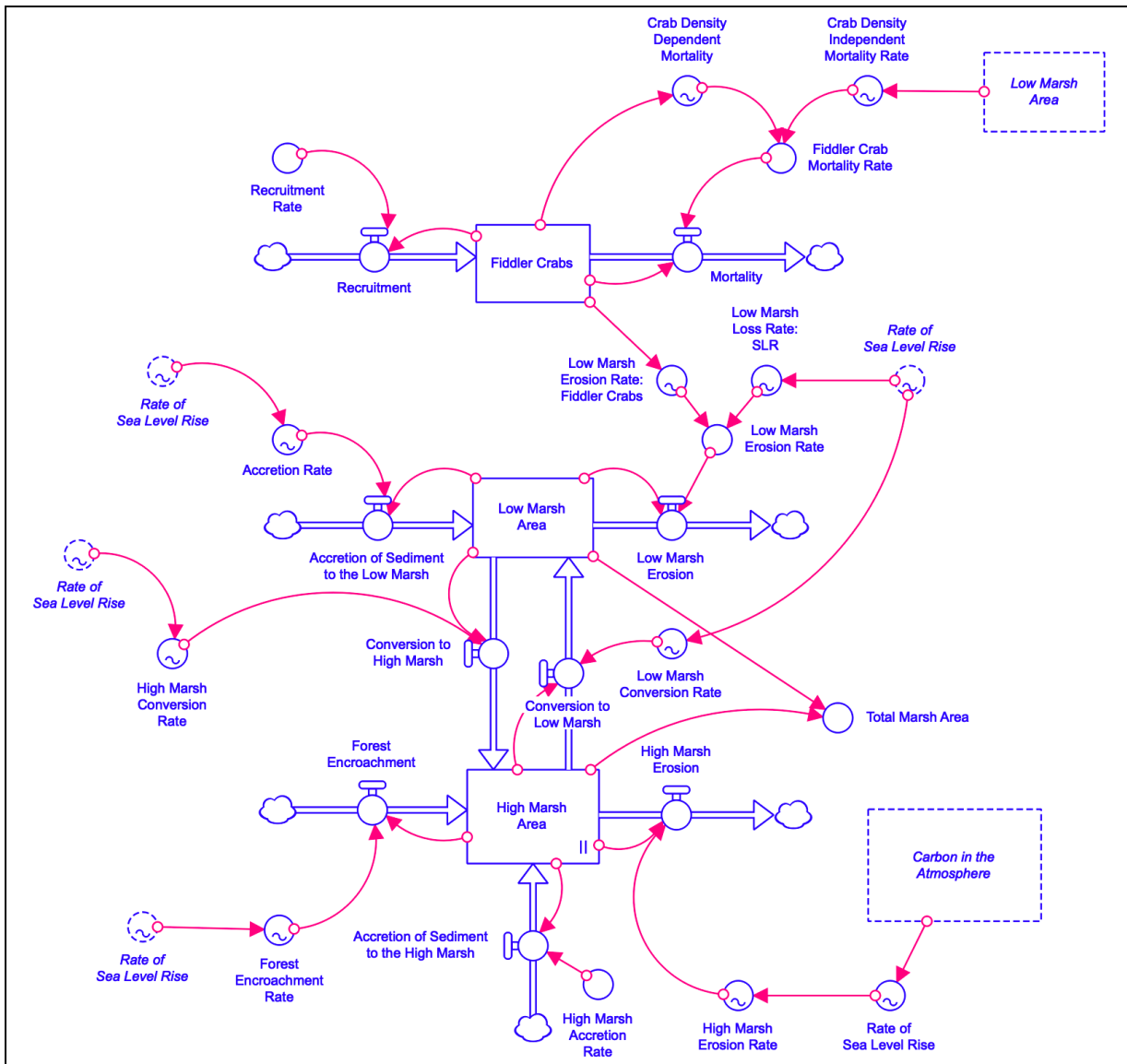


Figure 2: Stock and flow diagram of Plum Island Estuary (PIE) salt marsh area that incorporates sea level rise and the species range expansion of the mud fiddler crab *Minuca pugnax*. Stocks include Low Marsh Area (m²), High Marsh Area (m²), Fiddler Crabs (fiddler crab density per m²), and a ‘ghost’ stock of Carbon in the Atmosphere from the global climate system model. Sea level rise was modeled independently by removing the link between the convertor Low Marsh Erosion Rate: Fiddler Crabs to the convertor Low Marsh Erosion Rate. Fiddler crabs were modeled independently by assuming some minor sea level rise and setting a very low rate of change in the graphical convertor Rate of Sea Level Rise. Sea level rise and fiddler crabs were modeled together by maintaining the model structure as shown here. The model was parameterized and validated with data from the IPCC Fifth Assessment Report, PIE LTER database, a literature review, and Roy et. al *in prep*.

Figure 3:

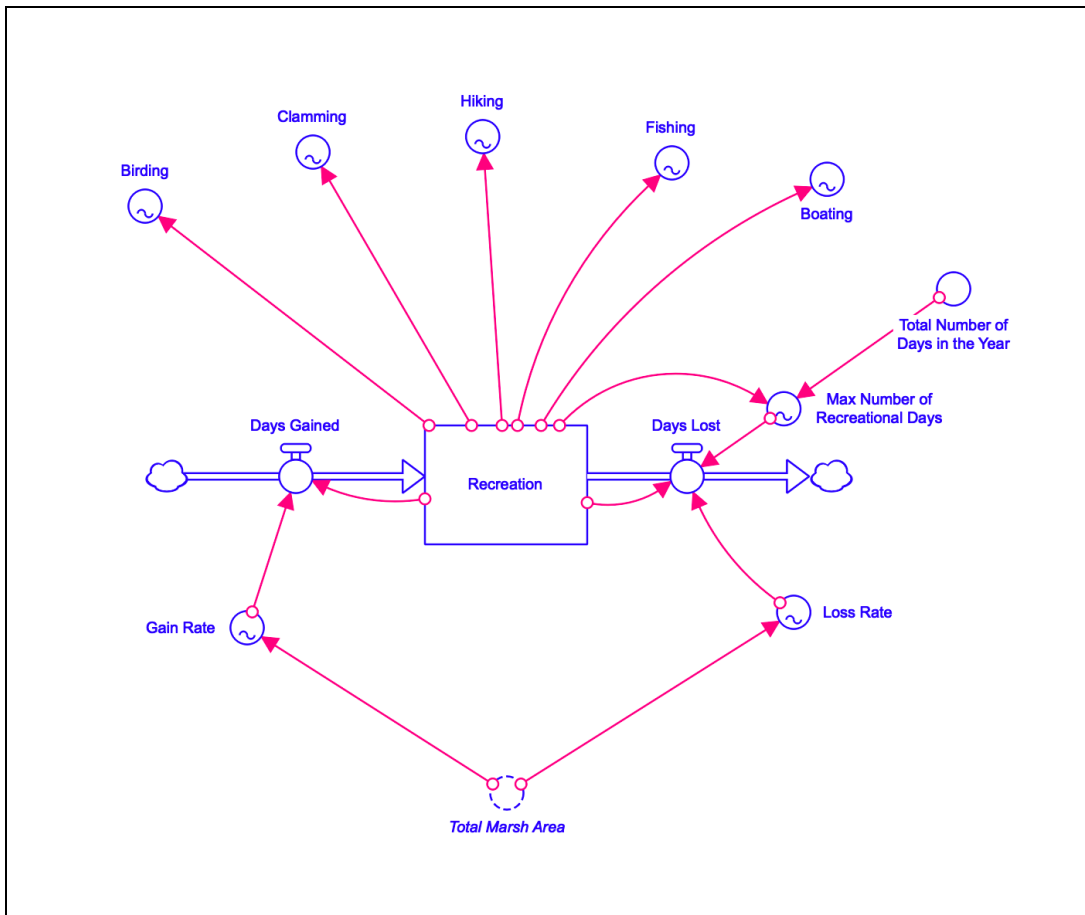


Figure 3: Stock and flow diagram of changes in recreational activity by residents living near the Plum Island Estuary. The stock is Recreation (days recreating per year), which is dependent on the ‘ghosted’ convertor of Total Marsh Area taken from the diagram in Figure 2 and graphical convertors Gain and Loss Rates on the number of days gained and lost due to gained or lost marsh area. The four recreational activities modeled here are Birding, Clamming, Hiking, Fishing, and Boating. The model is currently being parameterized and validated with a literature review and stakeholder surveys.

Figure 4:

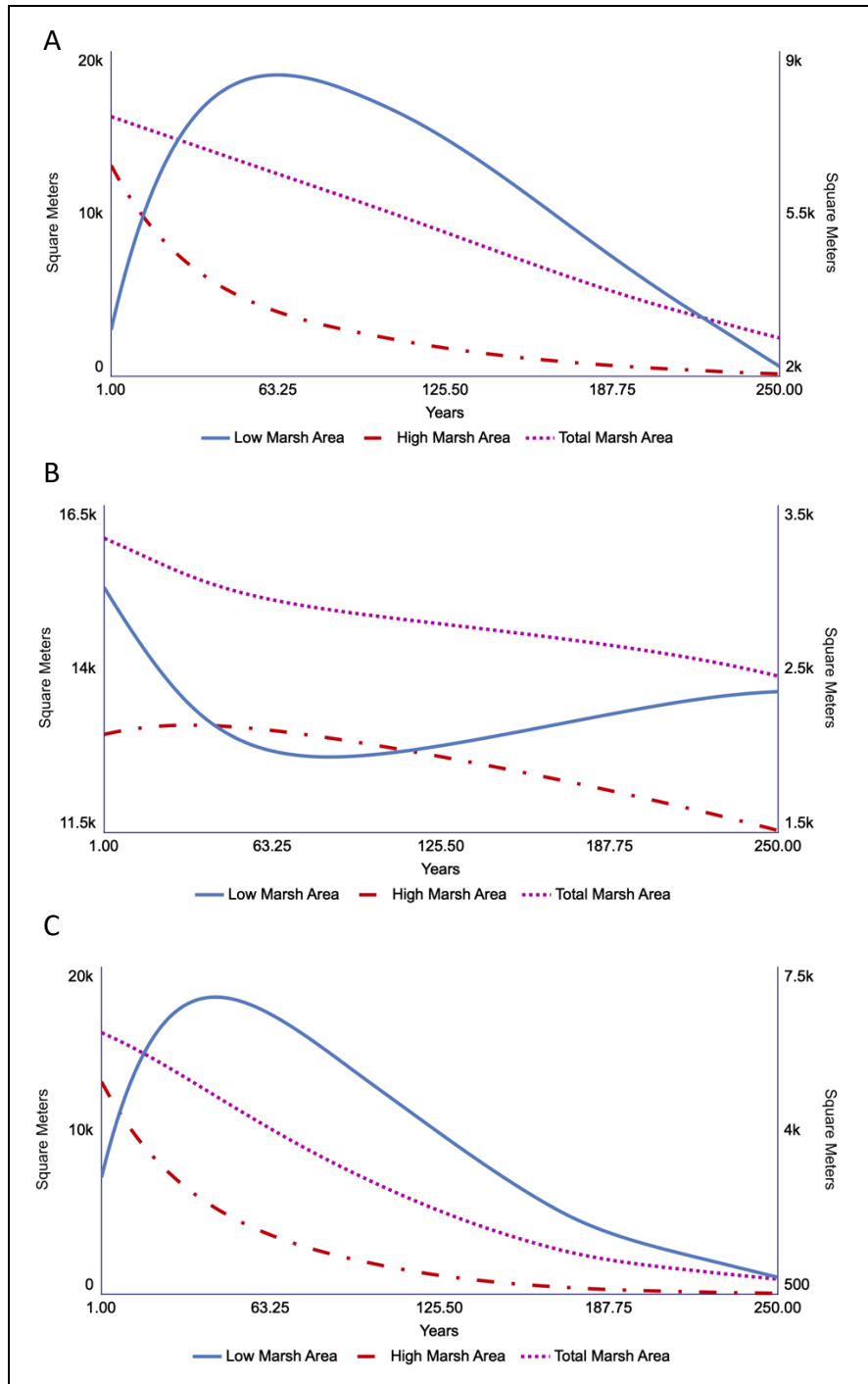


Figure 4: Changes in marsh area (low, high, and total marsh) across a 250-year time horizon due to: 1) the effect of sea level rise without the effect of the range expansion of the mud fiddler crab *Minuca pugnax* (4A); 2) the effect of the mud fiddler crab *M. pugnax* without the effect of sea level rise (4B); and 3) the combined effects of sea level rise and the presence of *M. pugnax* (4C). Solid blue lines represent low marsh area, dashed red lines represent high marsh area, and dotted purple lines represent total marsh area. Marsh area is measured in square meters across the entire extent of Plum Island Estuary salt marshes.