Soft-Shell Clam and Eelgrass Interactions in Maine Mud Flats

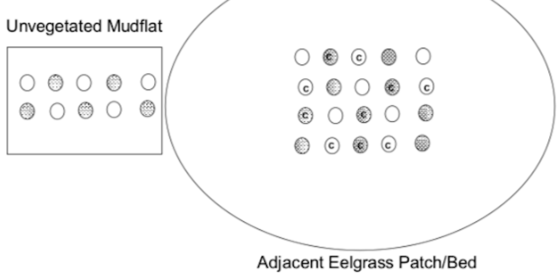
Everett Horch, Class of 2024

Climate change is raising sea surface temperatures in the Gulf of Maine (Bricknell et al., 2021). These warming temperatures have inflated populations of the invasive green crab (*Carcinus maenas*) (Ens et al., 2022). Green crab activity in addition to climate change have combined to disrupt two key coastal marine species: soft-shell clams (*Mya arenaria*) and eelgrass (*Zostera marina*). Eelgrass is a foundational species in the shallow subtidal along coasts worldwide, preventing coastal erosion, stocking carbon, and providing habitat for other species (Fourqurean et al. 2012). Soft-shell clams provide an important ecosystem role by filtering water and support a large commercial fishing industry in Maine (Beal 2006). Unfortunately for these clams, green crabs are their most deadly predator, largely accounting for the over 99% post settlement mortality now observed in soft shell clams in Southern Maine (Beal *et al*. 2018). Even worse, this green crab foraging activity can indirectly kill eelgrass through bioturbation (Neckles 2015). These factors have combined to decimate eelgrass and threaten the future of the soft-shell clam industry in Maine.

Positive interspecific interactions are a source of significant ecosystem resilience and can help mitigate environmental stress. There is hope that mutualistic interactions between eelgrass and clams could improve one another's growth and survival. For instance, in an eelgrass restoration project, introducing hard shell clams to a recently disturbed area improved eelgrass growth rates (Donaher *et al*. 2021). Eelgrass may also be able to increase clam survival because eelgrass roots can decrease green crab predation on soft-shell clams (Wong 2013). I designed an experiment to test these proposed mutualistic interactions by growing eelgrass and soft-shell clams separately and then together in a field experiment in Holmes Bay, Cutler, ME. My goal was to understand the sympatric interactions between eelgrass and soft-shell clams.

This is a schematic for one of five areas with each area containing an unvegetated mudflat and a bed/patch of eelgrass. The study is being conducted at Duck Brook Flat in Cutler, Maine, and was established on 5 June 2023 during the low tide.

Fig 1



The experimental design was adapted from Brian Beal's previous work involving soft-shell clams. 150 flowerpots were deployed, each pot was embedded in the mudflat. 12 juvenile hatchery raised clams from the Down East Institute were seeded in each pot labeled with a "C" (Fig 1). This entire design of paired eelgrass mud flat plots was repeated 5 times.

Throughout the summer the site was visited during the lowest tides of each month, to ensure that there had been no outside disturbance. During these trips eelgrass shoot counts were measured in the uncovered pots. To limit disturbance no data on clams could be collected. To maintain comparability to previous experiments conducted by Brian Beal, the experiment will be broken down at the end of October. Once the field grow out is over, I plan to measure growth, survival, and condition index of clams. As well as above and below ground biomass for eelgrass. This data will be collected and analyzed as part of my honors project.

Faculty Mentors: Katie DuBois, Brian Beal (University of Maine, Machias)
Funded by the: Rusack Coastal Studies Fellowship

Citations: "Bricknell *et al*. 2021. Rev. Aquaculture., 13: 460-503."; "Ens *et al*. 2022. *Environmental Reviews*. 30(2): 306-322."; "Fourqurean, J., Duarte, C., Kennedy, H. *et al. Nature Geosci* 5, 505–509 (2012)."; "Brian F. Beal, 2006. Journal of Experimental Marine Biology and Ecology, Volume 336, Issue 1, 1-17."; "Beal *et al*. 2018. Journal of Shellfish Research. 37. 1-27."; "Hilary A. Neckles 2015. Northeastern Naturalist 22(3), 478-500."; "Donaher*, et al*. 2021. *Ecosphere* 12(11)."; "Meysick, L., Infantes, E., Rugiu, L., Gagnon, K. and Boström, C. 2022. Limnol Oceanogr, 67: 621-633."; "Melisa C. Wong, 2013. Journal of Experimental Marine Biology and Ecology, Volume 446, 139-150."