Environmental impact of pH and temperature variation on *Zostera Marina* meadow structure, physiology, and epifaunal community

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Introduction

The foundational species eelgrass (*Zostera marina*) is one of the primary marine habitat formers in the Northern Hemisphere. Eelgrass ecosystems have high productivity and biodiversity since they provide structure for algae and other organisms that cling and grow on the eelgrass (*1*). These marine algae (epiphytes) are grazed by marine organisms, especially small epifauna (small invertebrates that cling or live on eelgrass blades). Shifts in environmental conditions across time and space may change eelgrass structure, leading to different epifaunal communities (*2*, *3*). The research I conducted last summer in the DuBois lab indicated eelgrass meadow structure and epifaunal community vary across the Gulf of Maine throughout the growing season.

From 1997 to 2010, 35% of Maine's eelgrass has disappeared (*4*, *5*). Prevailing hypotheses suggest intense Gulf of Maine warming resulted in widespread eelgrass death (*4*, *6*, *7*). Current climate predictions indicate the Gulf of Maine will continue to warm two to three times faster than the global average (*8*). Last summer, the entire Gulf of Maine experienced an extreme marine heat wave resulting in widespread die-offs of eelgrass meadows. This summer, I investigated the recovery response of Gulf of Maine eelgrass meadows and their resulting communities post-marine heat wave.

Methods

To survey the biological diversity of epifauna found in *Zostera marina* beds, we sampled previously established transect lines in 6 field sites in Maine ranging from Machias, Maine (44°41′ N) to Portland, Maine (43°40′ N). At each transect line, we measured the overall health of each eelgrass bed by quantifying shoot density and canopy height. We then surveyed the community of each site by using a mesh bag to collect eelgrass and any epifauna samples. In addition, we measured the physiological stress of the eelgrass using chlorophyll fluorescence analyses. Furthermore, we deployed temperature loggers at each site to record the variation in water temperature. I then identified and counted the microorganisms in the lab.

Results

Throughout the summer, I conducted three samplings at each of my 6 different sites. We observed that shoot count significantly decreased after the 2022 marine heat wave, with recovery from some sites during 2023. Although northern populations displayed lower stress values from chlorophyll fluorescence analysis, eelgrass across all sites and sampling dates had high values suggesting eelgrass across the Gulf of Maine were not stressed. This could suggest that surviving post-marine heat wave plants have developed heat resistance. I will continue my research in this fellowship year as my senior honors thesis, where I will finish processing the eelgrass community samples.

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References

1. R. J. Orth, J. Van Montfrans, *Aquat. Bot.* **18**, 43–69 (1984). 2. S. P. Newman, R. D. Handy, S. H. Gruber, *Bull. Mar. Sci.* **80**, 529–553 (2007). 3. D. A. Smale, G. Epstein, M. Parry, M. J. Attrill, *Ecol. Evol.* **9**, 3958–3972 (2019). 4. S. R. Valdez *et al.*, *Front. Mar. Sci.* **7** (2020). 5. Eelgrass - Science and Research Species Information: Department of Marine Resources. 6. A. J. Pershing *et al.*, *Science*. **350**, 809–812 (2015). 7. V. S. Saba *et al.*, *J. Geophys. Res. Oceans*. **121**, 118–132 (2016). 8. K. M. Kleisner *et al.*, *Prog. Oceanogr.* **153**, 24–36 (2017).