Investigating Occurrence of Harmful Phytoplankton Species in Harpswell Sound Through Imaging Flow CytoBot Data

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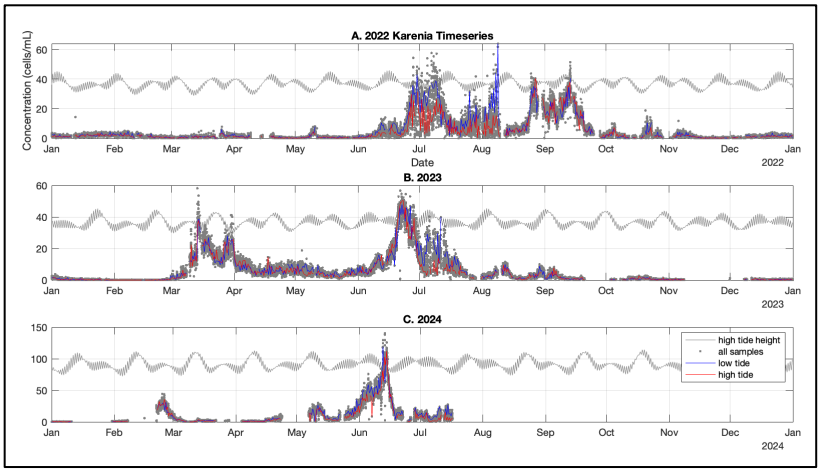

Figure 1. 3-year timeseries of Karenia *species in Harpswell Sound, 2022-2024. Gray dots show all samples, red lines represent high tide samples, blue lines represent low tide samples, and gray background curve represents relative height of high tide, indicating spring and neap tidal cycle.*

The Gulf of Maine supports a diverse coastal economy and a productive natural ecosystem that is rapidly changing in response to warming. This summer, I studied the microscopic organisms that may be responding to warming ocean waters, and that have the potential to throw that intricate web out of balance: harmful phytoplankton. This describes single-celled photosynthetic organisms that produce toxins, which can bioaccumulate in bivalves and make oysters, mussels, clams, and scallops poisonous to humans when consumed. This project focused on 4 key toxin-producing genera: *Karenia spp., Dinophysis spp., Alexandrium spp.,* and *Pdseudo-Nitzschia spp.* The study took place in Harpswell Sound and Lombos Hole, a small embayment in the Sound that has been identified as a potential incubator for harmful phytoplankton species. For the past 3 years, Bowdoin has deployed an instrument called an Imaging Flow CytoBot (IFCB) in the flowing seawater laboratory at the Schiller Coastal Studies Center. This instrument draws a 5-mL sample from the flow every 25 minutes and collects an image of each chlorophyll-containing particle in the sample. My research dug into this 3-year record, using auto-classifications of the IFCB photos to construct a highly-resolved timeseries of all of the target species (Figure 1). This revealed strong annual variation in the seasonal patterns of each genus, with the exception of a June-July increase in concentrations present for most studied genera in most of the 3 years. Additionally, I spent significant time manually classifying images and assessing the accuracy of the auto-classifier itself, learning the systems used to convert image data into taxonomic data. Supplementing the historical timeline of phytoplankton blooms in Harpswell Sound, I also looked at spatial dynamics of these species. To do this, I collected weekly discrete water samples at 4 sites within the Sound, two in Lombos Hole and two outside, and processed them with the IFCB. This work supported the hypothesis that Lombos Hole is a source for some harmful species, particularly dinoflagellates, but further work is required to parse finer patterns. I will continue this research in the fall, zeroing in on the genus *Karenia,* which was present in notably large numbers this summer. Improving the accuracy of auto-classification for this genus and better understanding its dynamics is crucial for detection and prediction of *Karenia*, and will aid substantially in future mitigation efforts.

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