Deconvolving Tidal Transport and Daily Production/Grazing Cycles in Concentration Fluctuation Patterns of Four Major Diatom Taxa with Imaging FlowCytoBot in Harpswell Sound, Maine

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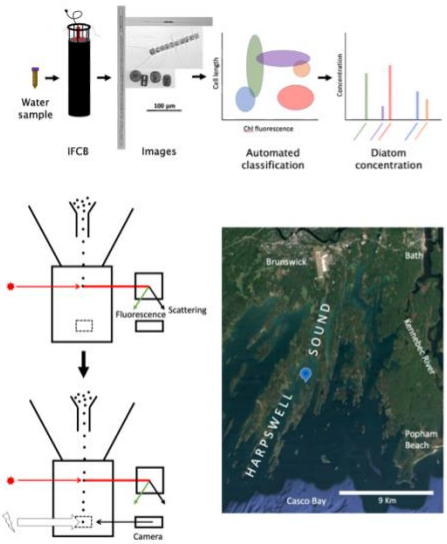
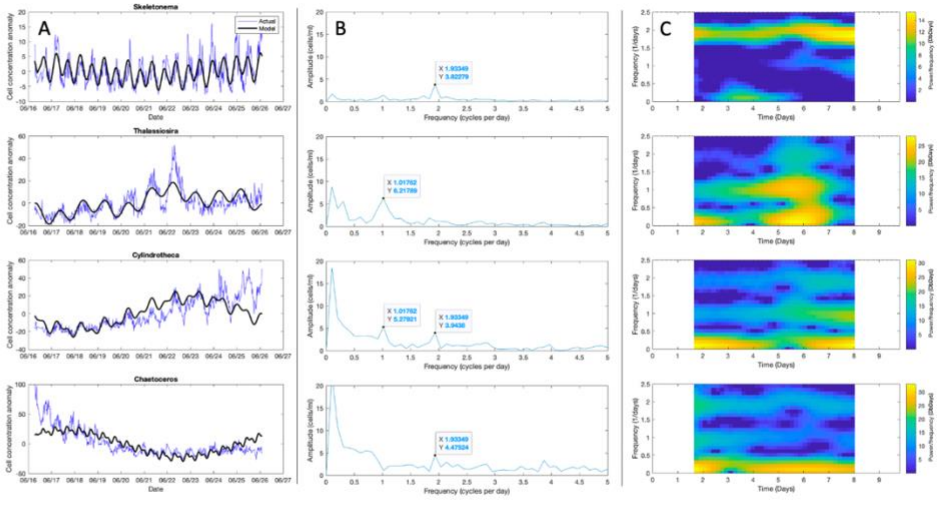
Research shows that phytoplankton blooms occur from an imbalance between population growth and mortality due to changing variables such as nutrient availability and grazing pressure, but the ecological regulators on coastal phytoplankton abundance remain difficult to deconvolve in situ. Still, we need to understand the influences on coastal phytoplankton abundance, given how they contribute substantially to CO_2 drawdown and O_2 production and fuel ecosystems humans rely on. We have found two major influences on cell concentration that operate on varying temporal and power scales, depending on taxa.

We examined the most abundant and well-studied phytoplankton, known for their glass cell walls: diatoms. This class exhibits distinct temporal variations in composition and concentration in coastal waters, which are observable thanks to recent advancements in automated microscopy. Continuous use of an inline Imaging FlowCytoBot beginning in 2020 at the Bowdoin Coastal Studies Center in Harpswell, Maine, U.S.A., has recorded diatom bloom events and concentration fluctuations in detail, measuring diatom genera abundance twice per hour. We used Fourier analysis to produce spectrograms that show the period and power of the cycles that influence *Skeletonema* spp., *Thalassiosira* spp., *Cylindrotheca* spp., and *Chaetoceros* spp. abundance most strongly over time.

Our results indicate that the 12-hour-25-minute tidal cycle and daily production and grazing cycles influence diatom genera abundance to different degrees, even over the same time interval. For instance, in mid-June of 2021, the temporal pattern for *Skeletonema* spp. abundance over time closely reflected the tidal period, while *Thalassiosira* spp. abundance more closely followed the daily period. With broader application of spectrograms to diatom concentration time series, we will be able to determine when shifts occur between cell import by tides and selective grazing of each taxon.



Adapted from McLane Laboratories 2020 Imaging FlowCytoBot User Manual and Google Earth



The concentrations of four major diatom species oscillate during a ten-day period in June 2021, shown in (A), and the pattern can be decently replicated by using a model that sums the three strongest sinusoidal components. The frequency and amplitude of the strongest sinusoidal components are represented as peaks in (B). The spectrograms in (C) show how the power of each sinusoid component persists or changes over time.

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