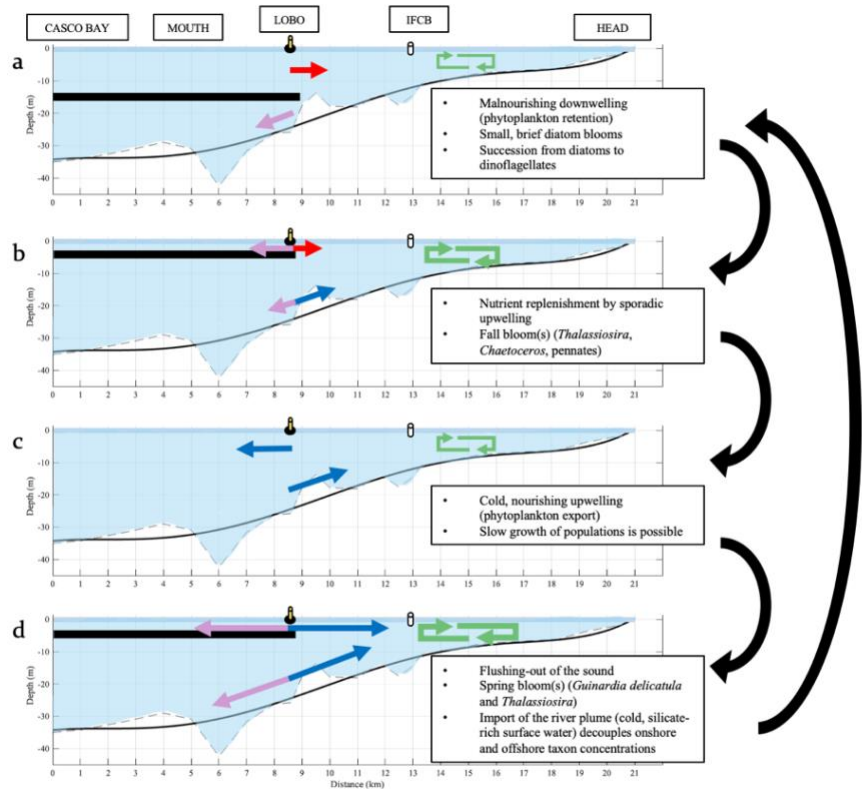


# Diatom blooms in Harpswell Sound: seasonality, succession, and origin

Charlie O'Brien, '23

Harpswell Sound (HS) is an inlet in northeastern Casco Bay that exerts control on Gulf of Maine ecosystem health, yet its complex phytoplankton community dynamics have not been characterized with sufficiently detailed analyses. In this research, high-resolution automated microscopy and current velocity observations were used to test the seasonality, ecological succession, bloom origin location, and potential toxicity of populations in HS between 2020 and 2022. Winter months could exhibit slow accumulation of diatom biovolume. Cold, salty surface water has net outflow in winter as nutrients from depth are replenished during net upwelling conditions, and populations could be exported from the inlet at the surface. Extreme current velocity variability in spring due to the Kennebec River plume in HS destabilizes spatially uniform populations. Warm, low-salinity surface water with net inflow in summer (net downwelling which retains populations at the head of the sound) corresponds with temporally separate dinoflagellate and diatom blooms. Large, multi-peaked spring and fall diatom blooms are recurrent, contrasting small, short-lived blooms in summer. A successional pattern from diatoms to dinoflagellates is confirmed for summer but refuted for other seasons. The hypothesis that diatom succession during all blooms in HS is characterized by large centric cells preceding small cells or pennate cells was explored but no clear pattern in decreasing cell size was observed. Observed tidal effects on biovolume concentration could mask that blooms develop at coherent times but spatially separated. A diverse community of toxic phytoplankton, including dinoflagellates and *Pseudonitzschia*, are observed throughout the year.

*HS transect cross sections: average residual current patterns, water properties, and corresponding phytoplankton bloom dynamics observed in summer (a), fall (b), winter (c), and spring (d). Thick black line is the mixed layer depth. Arrow color symbolizes water temperature (colder=blue, warmer=red) and arrow length symbolizes current velocity. The bathymetry (gray curve; NCEI DEM Global Mosaic) is approximated by the black curve.*



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