Behavioral response as a predictor of seasonal depth distribution and vertical niche separation in freshwater phytoplanktonic flagellates

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ABSTRACT: The distribution of phytoplanktonic flagellates in aquatic ecosystems has been widely attributed to a number of driving factors. In this study, we evaluated the influence of behavior on the daytime, seasonal depth distribution and vertical niche separation of five phylogenetically contrasting species of freshwater flagellates. A model predicting distribution was formulated using the dominant behavioral preferences for light, oxygen, and carbon dioxide, previously quantified in laboratory experiments, and was subsequently applied to the physical and chemical conditions measured in a small, strongly stratifying, hypertrophic lake. This model predicted the daytime depth distributions of natural populations of flagellates well, with an average areal fit of above 56% for all species; above 74% for *Ceratium furcoides*, *Chlamydomonas* sp., and *Dinobryon sertularia*; and of up to 93% during stratification. Regression analyses showed no significant variation from a 1 : 1 relationship between the predicted and observed average depths of species in the water column. The model also predicted the constriction into discrete vertical niches upon stratification and delineated the progression from *Plagioselmis nannoplanctica* in surface waters, through *C. furcoides* and *D. sertularia*, to *Chlamydomonas* sp. and *Euglena gracilis* deeper in the water column. Changes in observed distributions could not be directly correlated with other members of the plankton community or explained by the segregation of nutrients. The model's wider, transferable applicability suggested that behavioral response to environmental gradients may predict many patterns of distribution, particularly during stratification. In addition to known physiological and biochemical influences, this investigation emphasized the importance of behavioral response in the functional ecology of phytoplanktonic flagellates.

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