THE PHYSICAL BASIS OF PREY CAPTURE BY HETEROTROPHIC MARINE NANOFLAGELLATES

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ABSTRACT

Heterotrophic nanoflagellates play an important role in marine microbial processes as the principal consumers of, and a control point for, heterotrophic and photosynthetic bacterial production. Nanoflagellates are generally smooth spherical cells that capture picoplankton prey by chance contact with their cell surface as they swim randomly through the fluid medium. This mode of feeding is relatively simple and thus provides an opportunity for modeling the physical basis of an important trophic interaction in pelagic communities. I developed a numerical model of prey capture that considers hydrodynamic, van der Waals, electrostatic and solvation forces. Results from this model were used to generate testable hypotheses concerning the effects of prey size and surface charge on grazing rates.

The model prediction of prey-size selection was in conflict with other published size relationships. To resolve this discrepancy, I performed a series of feeding experiments with natural nanoflagellate populations using bacteria of different size. I provided statistical support for the size relationship predicted by my model. It was noted that the low statistical resolution of microscope counts limited the confidence with which the models could be distinguished.

To determine if size is of principal importance with regard to selection, I compared the ingestion rates of a nanoflagellate feeding on various prey type. To overcome the methodological limitation in statistical resolution mentioned above, I developed a flow cytometric (FCM) method which yields remarkably precise estimates of nanoflagellate grazing rates. Moreover, additional support was provided for the prey-size dependency of feeding that was predicted by my model.

To examine the potential importance of the hydrophobic interaction force, a series of grazing experiments were performed using plastic microspheres coated with polymers of

different hydrophobicity. Results indicate that prey hydrophobicity and grazing rates are strongly correlated and that modest changes in prey hydrophobicity can affect significant changes (ca. 300%) in grazing rates. The first data on the hydrophobicity of natural populations of heterotrophic bacteria, *Synechococcus* spp. and *Prochlorococcus* spp. are also presented in this chapter. These results suggest that all three taxonomic groups are primarily hydrophilic.