

ABSTRACT

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Organisms have to move to encounter food, but motility also generates fluid disturbances that can be detected both by rheotactic predators such as copepods and by zooplankton prey on guard. This thesis evolves around a mechanistic description of zooplankton behavior in the light of food encounter and predator avoidance. Two types of organisms were studied; (i) copepod nauplii that exhibit elaborate motility and sensory capabilities, and (ii) the heterotrophic largely non-motile dinoflagellate *Noctiluca scintillans*.

Motility and escape behavior of various stages of nauplii from six copepod species were quantified from video observations (3D). Motility is specific to both stage and species, but can be categorized into 2 general types: (i) a jump-sink type that jump at different frequencies and (ii) smooth swimmers that cruise more or less continuously. Swimmers encounter food by scavenging, and do well on non-motile food. In contrast, jump-sink types require motile food. By jumping to a new spot, jump-sink types may maximize the effect of prey motility by preventing the prey diffusion into their dining spheres from reaching steady state.

The implications of nauplius behavior for predation risk were examined by simple models, and from video observations of interactions with copepod predators, as well as in feeding- and siphon flow experiments. Differences in nauplius motility, remote detection and escape abilities contribute to differences in copepod clearance rates. 'Silent' cruisers limit hydrodynamic signal generation and thus their detectability and predator encounter rates, while they are comparatively poor at remotely detecting predators. Jumping nauplii are conspicuous and therefore generate enormous predator encounter rates, but jump-sink types counteract with efficient remote detection and escape abilities.

In a combined field and modeling effort we investigated fine scale distributions of copepod developmental stages, including nauplii. We combined models of temperature dependent growth, mechanistic models of predation risk from fish and copepods and a habitat optimization model. By applying behavior from the laboratory studies, and forcing the model with ambient predator and temperature regimes we generated vertical profiles of predation risk and growth. Optimal diel and ontogenetic distribution patterns were predicted and compared with field observations.

While the behavior of nauplii needs to be interpreted in light of both predation risk and food encounter, *Noctiluca* is an example of an organism where the functional biology is related largely to food acquisition. *Noctiluca* has virtually no active motility of its own, yet it feeds and grows best on non-motile diatoms. Feeding experiments using various phytoplankton and latex beads of a wide size range as prey in combination with video observations and simple models demonstrated that *Noctiluca* encounters food by direct interception while slowly rising passively in the water column. Starving *Noctiluca* cells increase in size, thus enhancing their relative velocity and increasing the chances for food encounter. Interception feeding scales with prey radius squared and is independent of collector size. The functional biology of *Noctiluca* is discussed in relation to its field distributions. While turbulence affects feeding negatively, intermediate levels of turbulence prevent cells from accumulating in the surface.