HIGH SPEED VIDEO ANALYSIS OF ESCAPE RESPONSES OF FOUR CALANOID COPEPOD SPECIES TO SHADOW STIMULI

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Calanoid copepods, small planktonic crustaceans, serve as a crucial link in the marine food web due to their incredible abundance. They are an important food source for invertebrates, fishes, marine mammals and sea birds. They gain an important advantage by responding to predatory threats with rapid escape responses. These may be elicited by either hydrodynamic stimuli or sudden photic stimuli. Using high-speed video techniques, we studied the responses to simulated shadows in five species: *Acartia hudsonica*, *Tortanus discaudatus*, *Centropages hamatus*, *Temora longicornis*, and *Calanus finmarchicus*. Turning off diffuse overhead illumination of 90 μmol photons m^{-2} s^{-1} simulated the shadow of a potential predator. Three of the species (*A. hudsonica*, *T. discaudatus*, *C. hamatus*) responded with quick escape jumps (rapid swims) consisting of multiple "kicks" of the thoracic swimming appendages. *T. longicornis*, in contrast, responded by "freezing" (cessation of ongoing swimming with cephalic appendages), sinking passively through the water, and *C. finmarchicus* showed no detectable reactions. While 60-70% of individuals tested responded to the photic stimulus at temperatures below 15°C, above that temperature, responsiveness was depressed in *T. discaudatus* and *T. longicornis,* but not in the other two (to 46% and 33% respectively).

For the three species exhibiting rapid swims, we examined the latency of response, and velocity, direction and duration of escape. Between 12° and 18°C, mean latencies between the onsets of dimming and escape were almost identical at ca. 100 ms, independent of temperature. This is substantially longer than the 40 ms reported for *Acartia tonsa* from Texan waters run at 19°C (Buskey, E.J. and Hartline, D.K., *Biol. Bull.* 204: 28-37, 2003), and does not appear to be ascribable to the lower temperatures of the present experiments. Escape trajectories were predominantly upward, as shown in Fig. 1 (points spaced 2 ms apart). Average velocities during escape swims in all three species were around 150 mm s^{-1}, markedly slower than the 270 mm s^{-1} found for *A. tonsa* at warmer temperatures (Buskey and Hartline, 2003). The number of kicks in each escape response, which relates to how far the animal moves from the potential predator, ranged from 2.8 for *T. discaudatus* to 5.5 for *A. hudsonica* (in agreement with the Texan population), with *C. hamatus* intermediate (3.8). These differences could play a role in individual predator-prey interactions, which could have an effect on mortality rates of the different species.

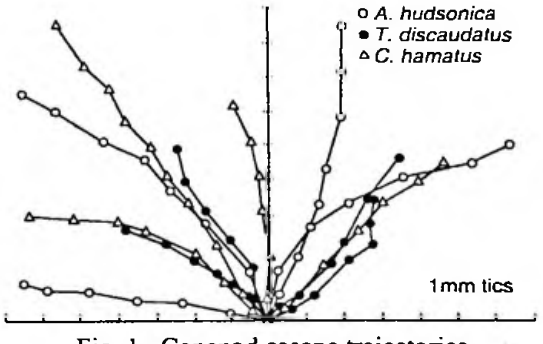

Fig. 1. Copepod escape trajectories

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