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TITLE: How zooplankton feed: mechanisms, traits and trade-offs

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ABSTRACT:

Zooplankton is a morphologically and taxonomically diverse group and includes organisms that vary in size by many orders of magnitude, but they are all faced with the common problem of collecting food from a very dilute suspension. In order to maintain a viable population in the face of mortality, zooplankton in the ocean have to clear daily a volume of ambient water for prey particles that is equivalent to about 106 times their own body volume. While most size-specific vital rates and mortality rates decline with size, the clearance requirement is largely size-independent because food availability also declines with size. There is a limited number of solutions to the problem of concentrating dilute prey from a sticky medium: passive and active ambush feeding; feeding-current feeding, where the prey is either intercepted directly, retained on a filter, or individually perceived and extracted from the feeding current; cruise feeding; and colonization of large particles and marine snow aggregates. The basic mechanics of these food-collection mechanisms are described, and it is shown that their efficiencies are inherently different and that each of these mechanisms becomes less efficient with increasing size. Mechanisms that compensate for this decline in efficiency are described, including inflation of feeding structures and development of vision. Each feeding mode has implications beyond feeding in terms of risk of encountering predators and chance of meeting mates, and they partly target different types of prey. The main dichotomy is between (inefficient) ambush feeding on motile prey and the more efficient active feeding modes; a secondary dichotomy is between (efficient) hovering and (less efficient) cruising feeding modes. The efficiencies of the various feeding modes are traded off against feeding-mode-dependent metabolic expenses, predation risks, and mating chances. The optimality of feeding strategies, evaluated as the ratio of gain over risk, varies with the environment, and may explain both size-dependent and spatio-temporal differences in distributions of various feeding types as well as other aspects of the biology of zooplankton (mating behaviour, predator defence strategies).

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