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Hydrodynamic trade-offs in different flagellar arrangements

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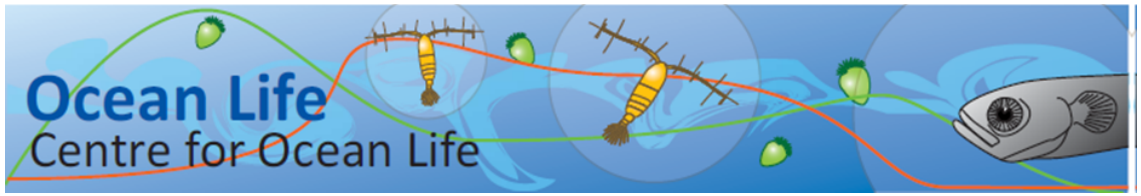

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abstract

Flagellates are few-micron sized unicellular organisms equipped with one or a few flagella, and play a key role at the base of oceanic food webs as the main consumers of bacteria and phytoplankton. The beating flagellum propels the organism through the water and generates a feeding current that facilitates prey encounters. At the same time the stirring generated by the flagellum exposes the cells to their flow-sensing predators. While hydrodynamics of flagella is most often studied in the context of propulsion, efficient foraging is likely a much more important component of their fitness than propulsion per se, giving rise to a great diversity of flagellar arrangements, morphology, and beat kinematics. We hypothesize that the significance of this diversity represents different outcomes of the fundamental trade-offs between resource acquisition, predator avoidance, and propulsion. Using computational fluid dynamics, we study these hydrodynamic trade-offs and investigate how at low Reynolds number, where viscosity impedes predator-prey contact, flagellates yield the necessary feeding current structure and at the same time avoid flow sensing-predators to secure their success and key role in the microbial food webs.