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逃散応答の水理学的刺激に対する
Oithona davisaeの観察
Escape responses of *Oithona davisae* to hydromechanical stimuli

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**Purpose**

Planktonic copepods live in aquatic environments where light, chemical and hydromechanical signals change spatially and temporally. With mechanoreceptory setae on the first antennae, they can detect and respond to even low levels of hydromechanical signals. Because hydromechanical signals in the nature may derive from potential predators, preys, another copepod or even the surrounding fluid, how copepods respond to different hydromechanical stimuli is thus critical for their survival. How copepods respond to hydromechanical stimuli can be known through quantification and comparison of their swimming behaviors between with and without stimulus.

Previous studies have emphasized on the thresholds of hydromechanical stimuli, kinetic characteristics and response latencies of different copepod species. In this study, we investigated whether individuals of the same copepod species exhibit different swimming behaviors or not. Moreover, how copepods accommodate to their local environment at individual level was also studied through observing single individual from a stable hydromechanical stimulus continuously.

**Methodology**

Swimming behaviors of single female *O. davisae* were firstly observed in still water and then observed successively under spatially changing deformation rates. The hydromechanical stimulus was generated by gravity-forced draining of seawater through a suction tube.

**Results and discussions**

Swimming behavior (intensity and direction) of female *O. davisae* varied significantly among individuals both with and without hydromechanical stimuli. Against hydromechanical stimuli, female *O. davisae* jumped at positions where deformation rates ranged between 0.1 and 5.3 s\(^{-1}\).

Jumps against hydromechanical stimuli were faster and longer than those in still water. Female *O. davisae* jumped 0.8 ± 0.2 BL (body length) at speed of 6.3 ± 0.8 BL·s\(^{-1}\) in still water. However, it jumped 2.2 ± 0.5 BL with speed of 15.0 ± 2.7 BL·s\(^{-1}\) when the deformation rate was over 0.1 s\(^{-1}\). All jumps stimulated by hydromechanical stimuli were clearly directed towards lower-deformation regions. Therefore, female *O. davisae* wants to leave environments with deformation rate higher than 0.1 s\(^{-1}\). Moreover, the jump intensities were positively correlated with deformation rates.
In still water, female *O. davisae* spent 96% of time in sinking. With existence of prey, female *O. davisae* was also reported to sink for 98% of time. Female *O. davisae* spent most of time in sinking because the weak hydromechanical signal for prey detection is less interfered by self-generated noise.

**Conclusions**

The escape behavior of female *O. davisae* is not merely triggered by the threshold deformation rate, but also is correlated with its previous experiences against hydromechanical stimuli. However, how previous experiences modify copepods’ behaviors remains unclear. Female *O. davisae* can adjust its jump intensities according to the hydromechanical signal levels in local environment.

Female *O. davisae* wants to leave environments where hydromechanical signal is higher than 0.1 s\(^{-1}\). Hydromechanical signal higher than this level may interfere the signal from prey. Therefore, female *O. davisae* jumps intensively and directionally towards a world with lower hydromechanical signal level.

Female *O. davisae* usually jumps less than 1 BL in clam water. However, it can jump over 2 BL with speed of 15 BL\(\cdot\)s\(^{-1}\) when hydromechanical signal is higher than 0.1 s\(^{-1}\). Moreover, female *O. davisae* can adjust its jump intensities according to environmental hydromechanical signal levels. Regions with higher hydromechanical signals may represent existence of predators, swimming copepods or even strong wind in the ocean. Escape from higher deformation region may thus help female *O. davisae* reduce mortality rates, decrease competitions with co-occurring copepods, or leave turbulent conditions.