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To migrate or not to migrate, a question for prey facing a predator

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The authors developed this experimental study, in 2004, at the Laboratory of Limnology of the Biology Department, University of São Paulo, in Ribeirão Preto, SP, which was published in the Brazilian Journal of Biology, in February 2010.

Two groups of small microcrustaceans (~ 0.5-1.0 mm) and one invertebrate predator, the aquatic larvae (maximum size ~ 6 mm) of the terrestrial midge Chaoborus brasiilienis, all living in the Lake Monte Alegre, located inside the university campus, were submitted to laboratory experiments. These small crustaceans migrate within the water column, during 24 h, performing a diel vertical migration. Light is the main cause of the movement, the animals sensing the light-dark contrast.

Which is the meaning of the prey reaction to a predator? Physical contact with predators is fundamental or chemicals released by them are sufficient for unleashing prey response? Which is the value of sensing the chemicals and performing vertical migration? Survival is the answer, as a low increase of prey mortality could lead to population decline or, more severely, to local extinction. The adaptive value of the diel vertical migration has been suggested in the last two decades as an attempt to lessen the predator hunting success.

Populations are submitted to a set of factors in the lake, precluding the analysis of an isolated factor upon a particular population. This limitation rends impossible the study of the predator-prey relationship in the lake, the laboratory providing conditions to focus on the hypothesis to be tested. The control of several factors (e.g. temperature, light, food, dissolved oxygen) in the laboratory allowed to test the role of predator physical contact or their exudates on the vertical migration of prey.

Two experiments were undertaken within transparent acrylic cylinders, the optical features of the lake being simulated, i.e., light intensities lowering from surface to the bottom. The preys (cladoceran and copepod crustaceans) were monitored along the cylinders, sampled through taps positioned at three spots. The experimental design included two treatments for the experiment I: A. prey with physical contact with predator and the chemicals (kairomones) released by it; B. predator confined in net tubes inside the cylinders, propitiating prey contact only with the kairomones (Figure 1). The treatments in the experiment II were: A. without predator and kairomones; B. equal to the treatment B of the experiment I.

The cladoceran migrated only in the treatment A of the experiment I, where it was in contact with predator. Copepods did not migrate when the predator was in contact (A, experiment I) or absent (A, experiment II). It is likely that as the predator did not migrate in the treatment A of the experiment I, a clear reaction of the copepods was precluded. Copepods, however, migrate in the treatment B of both experiments, when in contact with kairomones. Copepods were more sensitive to the predator exudates than the cladoceran.

The nocturnal pattern shown by the cladoceran consists of descending to deeper waters during the day and ascending to superficial ones at night. This is the most common pattern performed by some organisms in lakes and oceans. The copepods migrated in a reverse way, moving upward during the day and downward at night. This uncommon pattern has been reported as an escape reaction to an invertebrate predator, which is not a visual hunter and migrates in a nocturnal way.
The same behavior has been found in the laboratory experiments and in the Lake Monte Alegre. The population of the cladoceran *Daphnia gessneri* always displayed a nocturnal pattern, the reverse one being detected only mor recently in copepod populations. A possible explanation for the reverse migration of copepods could be to decrease larvae predation, that could be expected owing to a lower spatial overlap between predator and prey, since when the predator ascends in the water column the prey descends to deeper water. Why copepods have adopted this kind of migration? The change to reverse migration coincided with a higher predation pressure by *Chaoborus* larvae on the copepods, whose contribution to their diet has increased after the virtual disappearance of their favorite cladoceran prey. Why, then, the cladoceran did not also migrate in a reverse way in the lake? A feasible reason is that the cladoceran is also preyed on by adult tilapia, which is a diurnal fish that is distributed in the open zone of the lake, exerting a stronger predation pressure on cladocerans than on copepods.

The application of this basic research is not immediate, but the comprehension of interactions in the lake, an example of ecosystem, has been improved. The organisms are subjected to an intrincated set of factors in the ecosystem, comprising abiotic (e. g., light irradiance, temperature, turbulence, dissolved oxygen) and biotic one: (e. g., food quantity and quality, predation by fishes and invertebrates, competition). The community structure, the fluctuations of the populations, the shifts in species dominance, all the life effervescence within the ecosystem are driven by several factors. The knowledge on the relationships among the organisms themselves and the abiotic factors can give support to management and conservation measures, through the transference of basic to applied research.

Artigo completo:

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