JOURNAL OF PLANKTON RESEARCH | VOLUME 32 | NUMBER 8 | PAGES 1223–1225 | 2010

COMMENT AND RESPONSE

How does salinity influence the swimming speed of the estuarine calanoid copepod *Eurytemora affinis*?

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Received March 3, 2010; accepted in principle March 14, 2010; accepted for publication March 16, 2010

Corresponding editor: Mark J. Gibbons

Michalek *et al*. (Michalek *et al*., 2010) report that, in the absence of food, increase in salinity (i.e. 5, 15, 25 and 30) steadily decreased the instantaneous speed of *Eurytemora affinis* reproductive stages (male, non-ovigerous female and ovigerous female). This contradicts previous observations conducted on individuals obtained from a laboratory culture in the presence of food, i.e. a mixture of *Isochrysis galbana* and *Nanochloropsis oculata*, showing an increase in overall swimming activity, speed and path complexity for males and non-ovigerous females, but not for ovigerous females (Seuront, 2006). To account for this discrepancy, Michalek *et al*. (Michalek *et al*., 2010) stressed the importance of the experimental conditions employed for observations, but barely discussed the implications of their findings in an ecological context as was done by Seuront (Seuront, 2006, see their Figure 6).

It is agreed that it is difficult to compare behavioural responses of copepods originating from a continuous culture (Seuront, 2006) and from the field (Michalek *et al*., 2010). For instance, a diet based on a mixture of *Isochrysis galbana* and *Nanochloropsis oculata* (Seuront, 2006) negatively impacts *E. affinis* post-embryonic development (Devreker *et al*., 2007) and reproductive traits such as interclutch time (Devreker *et al*., 2009). The physiology of copepods reared under such limiting conditions may then be significantly impacted, which in turn might affect their swimming behaviour. In addition, copepods behave differently depending on the presence, quality and quantity of food (e.g. Tiselius, 1992; Saiz, 1994; van Duren and Videler, 1995; Seuront and Vincent, 2008). As such, Seuront's results (Seuront, 2006) might have been biased by a synergistic effect of food and salinity.

In an attempt to clarify these discrepancies, I present (Fig. 1) the results of original behavioural observations conducted in the presence and absence of food on *E. affinis* males, non-ovigerous and ovigerous females originating from the continuous culture used in Seuront (Seuront, 2006) and from the field location reported in both Seuront (Seuront, 2006) and Michalek *et al*. (Michalek *et al*., 2010). Behavioural observations were conducted as described in Seuront (Seuront, 2006). New individuals were considered for each salinity treatment in both fed and unfed conditions. Specifically, the acclimation of cultured *E. affinis* individuals to the experimental salinity has been carried out over a few hours, typically 4–8 h, to mimic the tidal time frame encountered in their environment. In contrast, to minimize handling effects on individual copepods, the behavioural properties of *E. affinis* originating from the field were investigated *in situ* immediately after collection using a portable version of the video set-up described in Seuront (Seuront, 2006). For both cultured and wild

doi:10.1093/plankt/fbq040, available online at www.plankt.oxfordjournals.org. Advance Access publication May 27, 2010

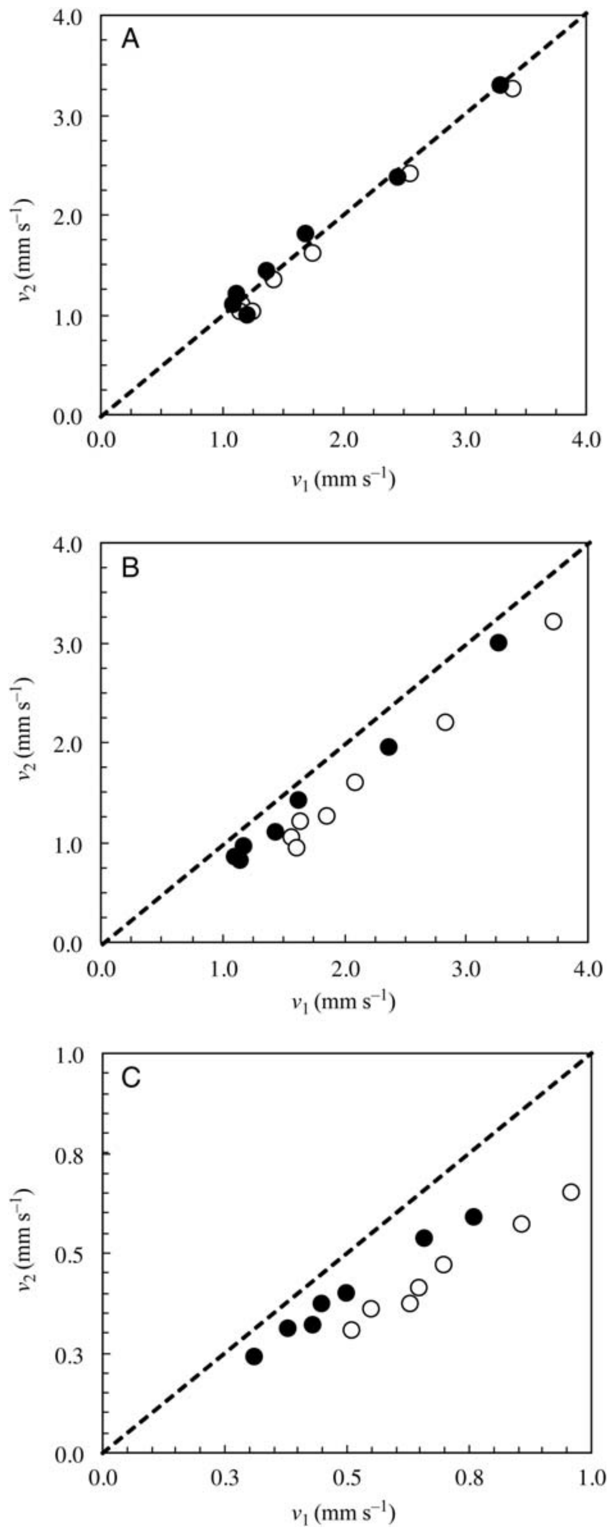

Fig. 1. *Eurytemora affinis* swimming speeds measured for salinity ranging from 0 to 35 in the presence (v_1) and the absence (v_2) of food for males (**A**), non-ovigerous females (**B**) and ovigerous females (**C**) originating from a continuous laboratory culture (black dots) and from the field (open dots). The dashed lines are the first bissextrix, i.e. $v_1 = v_2$.

E. affinis, the salinity treatments were repeated with new individuals after vacuum filtration of culture and field water through Whatman GF/F glass fibre filters. The swimming speed of males, non-ovigerous females and ovigerous females consistently significantly increased with salinity in both the presence and absence of food ($P < 0.05$). More specifically, male swimming speeds were not significantly different (Wilcoxon–Mann–Whitney U-test, $P > 0.05$) in the presence and the absence of food and did not significantly differ between cultured and field individuals (U-test, $P > 0.05$; Fig. 1A). In contrast, non-ovigerous females (Fig. 1B) and ovigerous females (Fig. 1C) swam significantly faster in the presence of food (U-test, $P < 0.05$), and cultured females swam significantly slower than females originating from the field (U-test, $P < 0.05$). This indicates a higher foraging activity of *E. affinis* in the field than under laboratory controlled conditions. These results are consistent with an increased foraging activity of *E. affinis* non-ovigerous females and ovigerous females in the presence of food, independent of the salinity. They also demonstrate that the behavioural response of *E. affinis* to salinity changes is not affected by (i) the origin (i.e. continuous culture versus field) of the organisms tested, hence confirming the innate nature of their behavioural flexibility (Seuront, 2006), or (ii) the presence/absence of food, hence ensuring the relevance and generality of earlier work (Seuront, 2006). Copepods reared under limiting conditions did not change their swimming behaviour, despite the related physiological stress (Devreker *et al*., 2007, 2009), suggesting a decoupling between physiological and behavioural responses in *E. affinis*.

FUNDING

This research was supported under Australian Research Council's Discovery Projects funding scheme (project numbers DP0664681 and DP0988554), by Flinders University and the Centre National de la Recherche Scientifique (CNRS). L.S. is the recipient of an Australian Professorial Fellowship (project number DP0988554).

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