Investigating life history toxicity in the copepod *Nitocra spinipes* by means of a Dynamic Energy Budget model

Koch Josef, Janssen Colin R. and De Schamphelaere Karel A. C.

GhEnToxLab, Animal Sciences and Aquatic Ecology, Ghent University, Coupure Links 653, 9000 Ghent, Belgium
E-mail: josef.koch@ugent.be

Copepods are an essential part of marine ecosystems and constitute a large portion of the total animal biomass on earth. Their small body size and short life cycle make copepods also convenient test organisms in ecotoxicity studies. Beside acute toxicity, multiple studies in the past focused on chronic effects on the development and reproduction success of copepods that were individually exposed to potentially harmful chemicals. Unfortunately, we usually lack an understanding of the physiological mechanisms that lead to the observed effects. Such a mechanistic understanding is, however, crucial for realistic laboratory-to-field extrapolations. Mathematical models rooted in the Dynamic Energy Budget (DEB) theory describe the life history of an individual in terms of its energy household. Such models can be very helpful to evaluate sublethal toxicity data considering effects on energy allocations (e.g. investment in growth, maturation, maintenance, or reproduction) in an animal. So far, only a handful of attempts have been made to calibrate a DEB model for a copepod species due to some characteristic life cycle peculiarities that distinguish copepods from other animals. In this study, we parameterized a DEB model for the harpacticoid copepod *Nitocra spinipes,* a species that is used in multiple regulatory ecotoxicity guidelines [1-3]. The model was parameterized on data from earlier studies including food- and temperature-dependent data on development times and reproduction rates per female [4], as well as newly measured data on body length as a function of time. Slight modifications to the typical DEB model structure ('standard model') were made to capture the abrupt stop in growth at the adult stage which is typical for copepods. Overall, the model fitted the life history data well with food and temperature effects reproduced adequately by the corresponding submodels. We performed a full life cycle experiment with the antidepressant citalopram and found that this pharmaceutical delays the development of *N. spinipes* while stimulating the number of offspring per female. The data were subsequently analyzed by means of the DEB model to identify possible physiological modes of action on energy allocations that can explain the observed effects.

References

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