Using the DEBkiss IBM framework to predict chemical effects on two interacting zooplankton species

Karel P. J. Viaene[1], Andreas Focks[2], Hans Baveco[2], Paul van den Brink[2,3], Colin R. Janssen[1], Frederik De Laender[4]

[1] Ghent University, Belgium, Laboratory of Environmental Toxicology and Aquatic Ecology, GhEnToxLab, www.ecotox.ugent.be
[2] Alterra, Wageningen University and Research centre, The Netherlands
[3] Wageningen University, Department of Aquatic Ecology and Water Quality Management, The Netherlands
[4] Namur University, Research Unit in Environmental and Evolutionary Ecology, Namur, Belgium

Introduction

Ecological risk assessment
Protection of higher levels of biological organization

→

Alternative approaches?
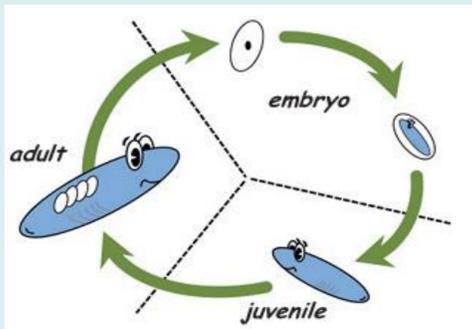Extrapolation from single species: insufficient

Ecological interactions
can alter the response of exposed populations

→

Ecological models
of interacting populations

Materials and Methods

DEBkiss*
Dynamic Energy Budget, "keep it simple, stupid"

+

Individual-Based Model (IBM)
Population properties emerge from individuals

- DEBkiss: assumptions reduce complexity
- Generic life cycle
- Toxicity: concentration-effect relationship for survival
- Parameterization: use available literature values

Schematic representation of the life cycle in the DEBkiss framework (adapted from Jager *et al.* 2013)
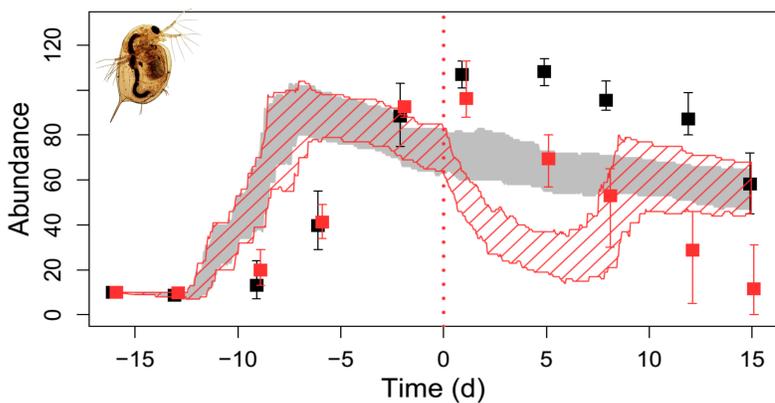
Proof of principle

Daphnia magna

Brachionus calyciflorus

Pattern Oriented Approach
**Can we predict observed patterns in populations using DEBkiss IBMs and literature values?**
- Isolated populations
- Competing populations
- Pyrene exposure

Results & Discussion

Isolated populations

OBSERVED
- ■ CONTROL
- ■ EXPOSED

PREDICTED
- CONTROL
- EXPOSED

- Strong population growth followed by decrease
- Population growth phase earlier than observed
- Immediate pyrene effects and population recovery were not observed
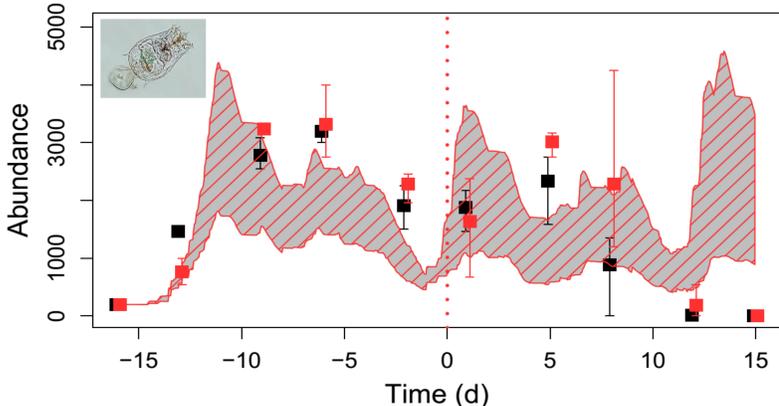
- Cycles of population growth and decrease
- End of experiment: nutrients depleted but nutrients not considered in the models
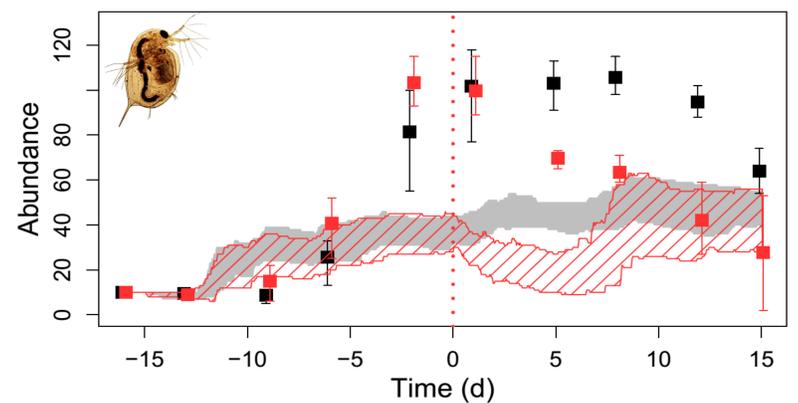- Pyrene effects absent
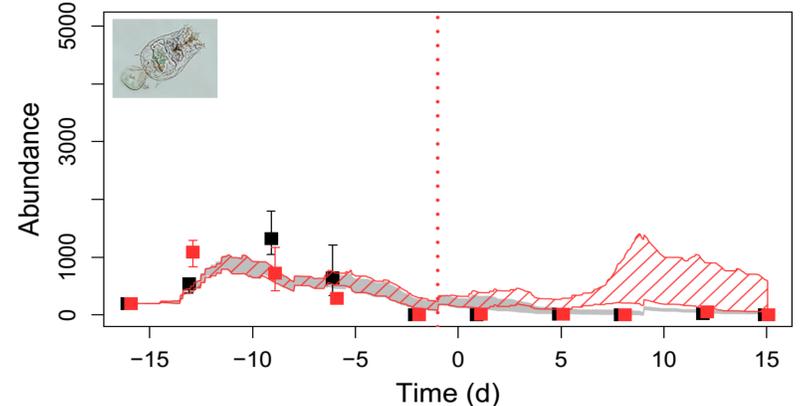
Competing populations

- Effect of competition stronger than observed
- Similar final abundance cfr. isolated population
- Predicted pyrene effects: similar to the isolated population

- *B. calyciflorus* outcompeted without pyrene stress
- Population growth after pyrene exposure predicted but not observed as rotifers were already outcompeted at that time in the experiment

Conclusions

Predictions for non-exposed isolated populations largely followed the observed patterns. The outcome of competition was predicted correctly but its effects on *D. magna* population growth were too strong. Predicted pyrene effects deviated from observed effects, suggesting that more complex effect models might be needed