Coupled individual based models as a new tool to predict ecological effects in multi-species systems

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

[1] Ghent University, Laboratory of Environmental Toxicity and Aquatic Ecology, GhEnToxLab, Plateaustraat 22, 9000 Ghent, Belgium
[2] Alterra, Wageningen University and Research centre, P.O. Box 47, 6700 AA, The Netherlands
[3] Department of Aquatic Ecology and Water Quality Management, Wageningen University, P.O. Box 47, 6700 AA, The Netherlands
[4] Namur University, Research Unit in Environmental and Evolutionary Ecology, Belgium

Introduction

ECOLOGICAL RISK ASSESSMENT OF CHEMICALS

Need for **tools**
- Transparent
- Flexible
- Ecologically relevant

→ **Individual based model (IBM)**

Consider **ecological interactions** → **COUPLED IBM**

Materials and Methods

Philosophy: simple + generic

Generic model parameters

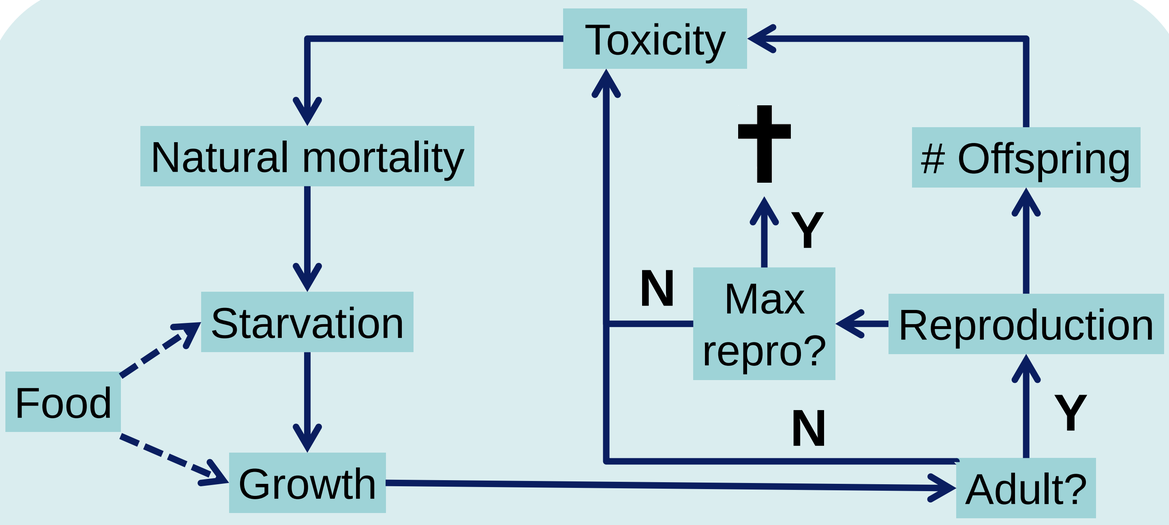
Initial size (m)	Age maturation
Maximum size (m)	Age first reproduction
Growth rate (d-1)	Maximum offspring
Background mortality	Reproduction events
Days until starved	

Modelling competition

Ingestion → ***Growth*** → ***Reproduction***

Modelling toxicity

$$Mortality = \frac{1}{(1 + e^{-slope * (\ln x - \ln LC_{50})})}$$



Flow chart of the processes in the IBM that an individual goes through each time step. Max repro = maximum reproduction.

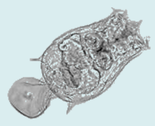
Results & Discussion

Current status
Two coupled grazers

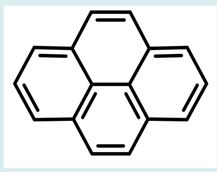
Example

See poster WE055

Daphnia magna

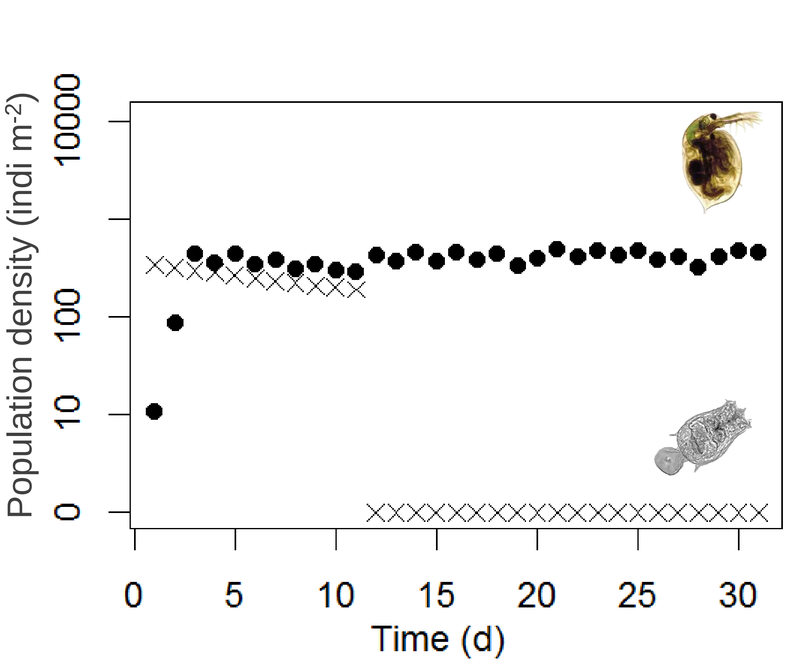


Brachionus calyciflorus

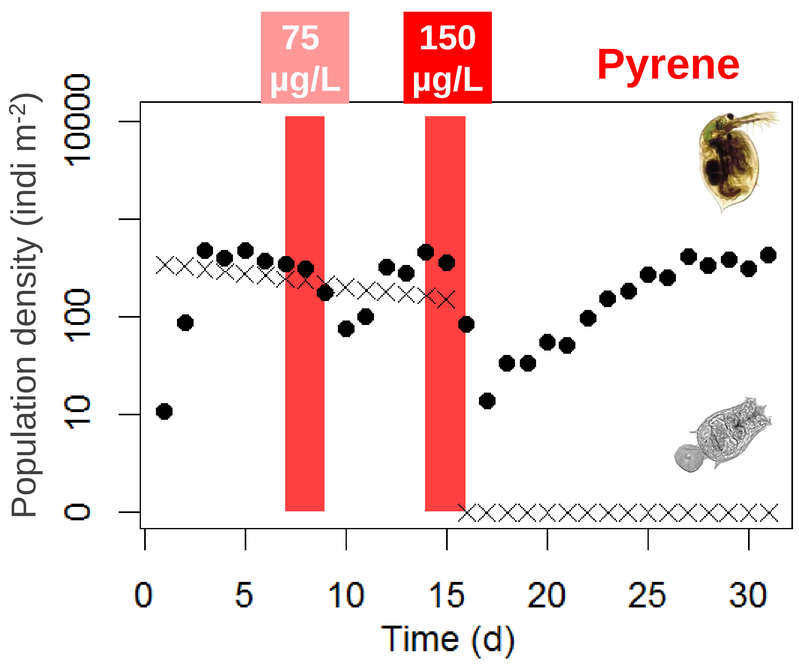


Pyrene

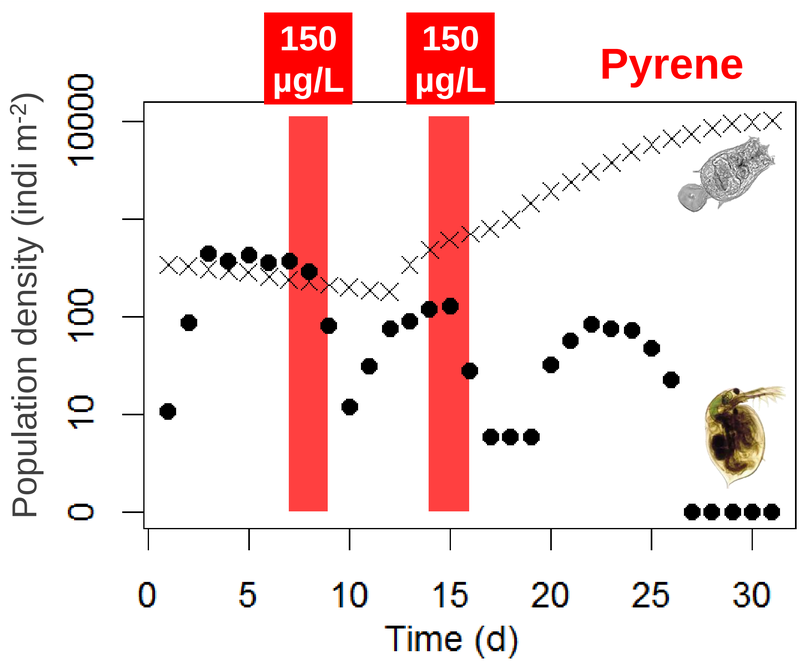
48h LC_{50}	
	140 µg/L
	2000 µg/L



➢ *D. magna:* superior competitor



➢ Extinction of *B. calyciflorus* is postponed in this scenario



➢ *B. calyciflorus* dominates
➢ *D. magna* outcompeted

Conclusions

Realistic dynamics (competition and chemical effect) can be modelled using generic model parameters
Concentration-response functions seem sufficient to model pyrene toxicity
Challenges: predator-prey relationships + coupling >2 species

Contact: Karel.Viaene@Ugent.be

Acknowledgements: The Chimera project is financed by the Long Range Initiative of CEFIC (www.cefic-lri.org) (project code: LRI-ECO19)