# Interaction between stress induced by competition and an insecticide on the response of aquatic invertebrates

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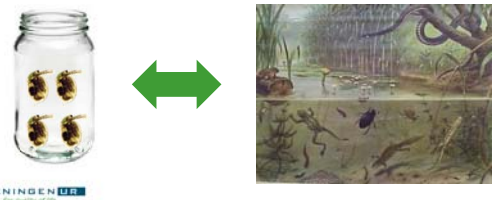
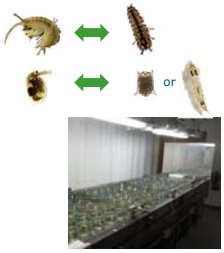
## Introduction

- ERA based on extrapolations from single-species tests to the whole ecosystem
- Ecological interactions are not taken into account
- Effects on sensitive populations could be underestimated



## Objective

- To study how and to what extent ecological interactions influence the effects of chemicals on aquatic invertebrate populations
- Two experiments:
  - *Gammarus pulex* (Amphipoda) *vs Asellus aquaticus* (Isopoda)
  - *Daphnia pulex* (Cladocera) *vs Brachionus calyciflorus* (Rotifera) *vs Chaoborus sp.* larvae (Insecta)
  - Chlorpyrifos (OP insecticide)



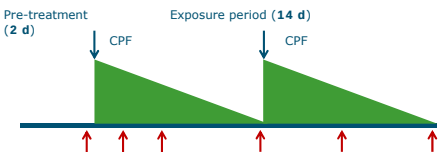
## *Gammarus pulex* experiment

- Glass jars with 1L filtered pond water
- Water bath (T=15°C; 12h photoperiod)
- Food source: 3.5 mg poplar leaf fragments (*Populus nigra L.*)
- Competition (*n*=3):

| | Intraspecific | Interspecific |
|---|---|---|
| Control | 5 *G. pulex* | 5 *G. pulex* |
| Low | 10 *G. pulex* | 5 *G. pulex* + 5 *A. aquaticus* |
| Medium | 15 *G. pulex* | 5 *G. pulex* + 10 *A. aquaticus* |
| High | | 5 *G. pulex* + 15 *A. aquaticus* |

## *Gammarus pulex* experiment

- Chlorpyrifos: Control, 0.15, 0.20, 0.25 µg/L
- Representing the LC0, LC10, LC30 and LC50 (Rubach et al. 2011)
- Pesticide application:




- Survival: day 0, 2, 4, 7, 11, 14 after the first application

## *Gammarus pulex* experiment

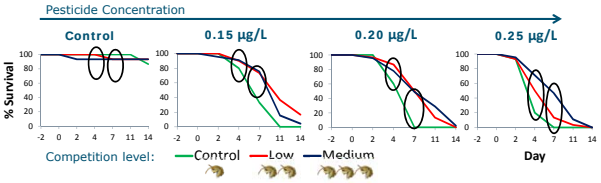
- Statistical analyses
  - Effects of pesticide, competition treatment and their interaction
  - Generalized Liner Models (GLMs) with GenStat

Abundance = α + CPF + Competition + Inter.

  - Binomial distribution with a logit link
  - *G. pulex* experiment: EC50s

## *Gammarus pulex* experiment

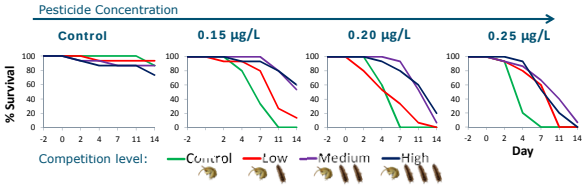
- Intraspecific competition




- Sign. effect (day 4 and 7)
- ↑Density ↑Survival
- EC50-7d: Control 0.07 - Low 0.09 - Medium 0.12 µg/L

## *Gammarus pulex* experiment

- Interspecific competition




- Sign. effect (all sampling days)
- ↑Density *A. aquaticus* ↑Survival *G. pulex*
- EC50-7d: Control 0.07 - Low 0.18 - Medium >0.25 - High >0.25 µg/L

## *Daphnia pulex* experiment

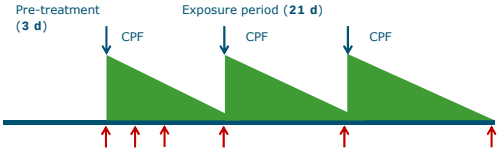
- Glass jars with 1L WC-medium
- Water bath (T=20°C; 12h photoperiod)
- Food source: *Scenedesmus obliquus* (0.5g/C per jar)
- Competition and predation (*n*=3):

| | Intraspecific | Interspecific | Predation |
|---|---|---|---|
| Control | 10 *D. pulex* | 10 *D. pulex* | 40 *D. pulex* |
| Low | 20 *D. pulex* | 10 *D. pulex* + 333 *B. calyciflorus* | 10 *D. pulex* + 1 *Chaoborus sp.* |
| Medium | 40 *D. pulex* | 10 *D. pulex* + 666 *B. calyciflorus* | |
| High | | 10 *D. pulex* + 999 *B. calyciflorus* | |

20% adults 80% sub-adults

## *Daphnia pulex* experiment

- Chlorpyrifos: Control, 0.10, 0.40, 0.75 µg/L
- Representing the EC0, EC10, EC30 and EC50 (pre-test)
- Pesticide application:




- Abundance: day 0, 2, 4, 7, 14, 21 after the first application
- Separated into age classes: adults, sub-adults, juveniles

## *Daphnia pulex* experiment

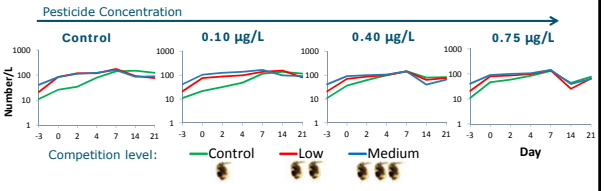
- Statistical analyses
  - Effects of pesticide, competition/predation treatment and their interaction
  - Generalized Liner Models (GLMs) with GenStat

Abundance = α + CPF + Competition/Predation + Inter.

  - *D. pulex*: Poisson distribution with a log link

## *Daphnia pulex* experiment

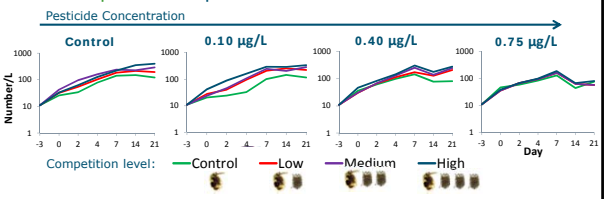
- Intraspecific competition




- CPF effects only after 2nd application
- No sign. effects of competition
- Sign. decrease juveniles and sub-adults highest exposure

## *Daphnia pulex* experiment

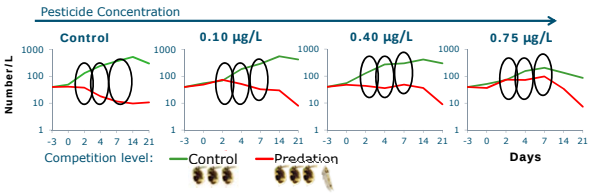
- Interspecific competition




- Low exposure, competition favours survival
- No sign. effects of competition
- Sign. decrease sub-adults at highest exposure (day 14)

## *Daphnia pulex* experiment

- Predation




- Sign. effect (day 2, 4, 7)
- Largest effects at controls and low exposure
- Sing. increase of adults/juveniles with concentration

## Conclusions

- *Gammarus pulex* experiment
  - Antagonism between pesticide exposure and competition
  - Intraspecific: social behaviour/cannibalism?
  - Interspecific: predation
- *Daphnia pulex* experiment
  - Competition effects more evident on population structure than on species abundance
  - Predation results in higher effects than competition (Poster WE055)
  - Effects of predation are lower at high exposure concentrations

## Conclusions

- Stress by ecological interactions does not necessarily result in higher toxic effects at population level
- Predation seems to result in more evident effects than competition
- Effects of competition on pesticide sensitivity more complex than expected
- Species and context specific e.g. cannibalism/predation
- Inclusion in intermediate tiers of ERA is still challenging
- Valuable information for ecological models used in higher-tiers of ERA

## Thanks for your attention

**ChimERA**: an integrated modelling tool for ecological risk assessment – towards more ecologically realistic assessment of chemicals in the environment

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