NORTH SEA BALLAST WATER OPPORTUNITY

Ecological risk of treated ballast water: a mesocosm experiment

Andrea Sneekes, Klaas Kaag & Edwin Foekema

IMARES – *Institute for Marine Resources & Ecosystem Studies*

contact: andrea.sneekes@wur.nl

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NORTH SEA BALLAST WATER

IMARES WAGENINGEN UR

contact: andrea.sneekes@wur.nl

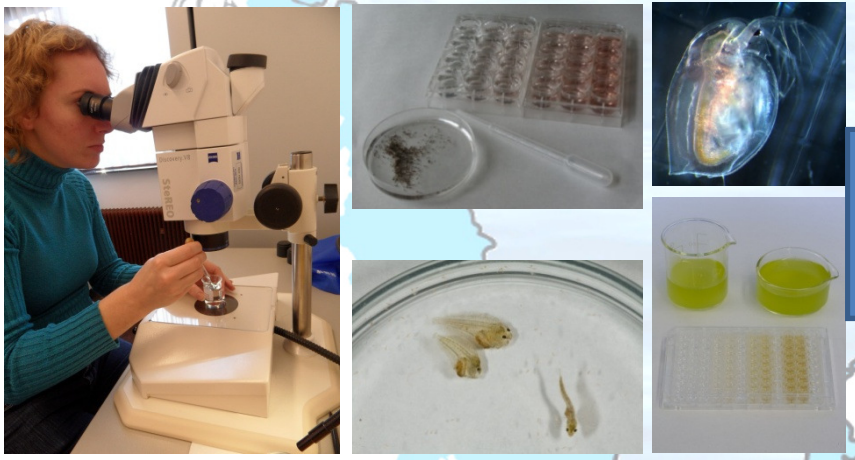
Outline

- Introduction
- Background of mesocosm testing
- Research questions
- Preliminary results from pilot study
- Test result summary
- Conclusions

contact: andrea.sneekes@wur.nl

Ecological risk of discharge ballast water that use active substances (G9)

- Modelling with MAMPEC-BW
- WET Toxicity testing with:
  - "algae"
  - "crustacean"
  - "fish"



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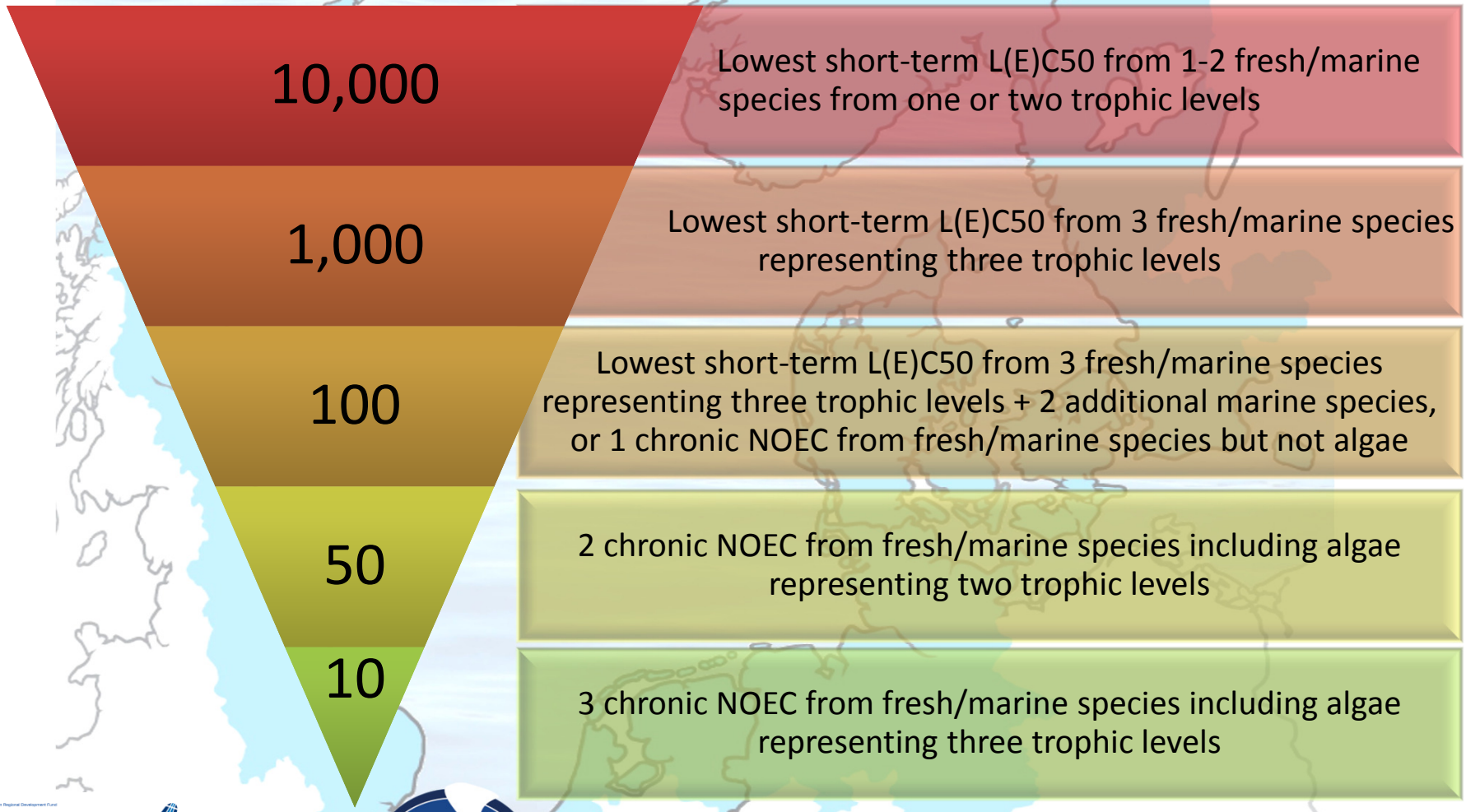
Assessment factors
GESAMP 38th meeting (PNEC general)



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Assessment factors

- Experimental ecosystems
  - Realistic semi-natural conditions
  - Reduce uncertainty in extrapolation to complex multi-species studies

Assessment factor

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Experimental ecosystems challenges for treated ballast water

- How to discriminate between effects caused by replacement of water and effects of toxic substances?
- How predictive are toxicity test results (i.e. bioassays) for effects of treated ballast water on ecosystems?

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Set-up of the mesocosm experiment

- Eight tanks of 5 m^3 each
- Sediment layer & Water fraction
- Stable community of:
  - micro-flora
  - invertebrates
- Static systems
- Continuous aeration
- Similar water quality conditions

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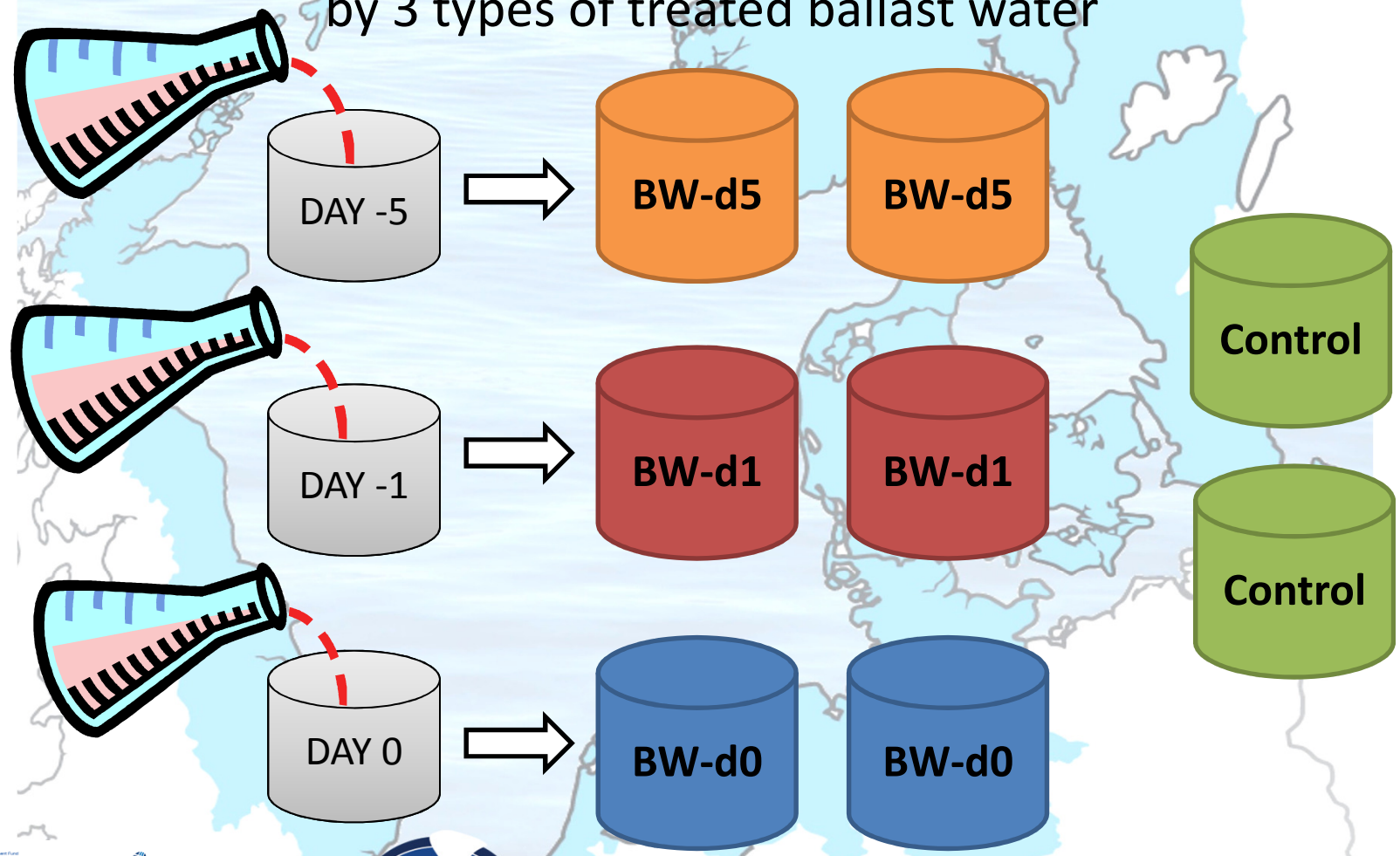
Dosing of treated ballast water

Replacement of 10% water volume
by 3 types of treated ballast water



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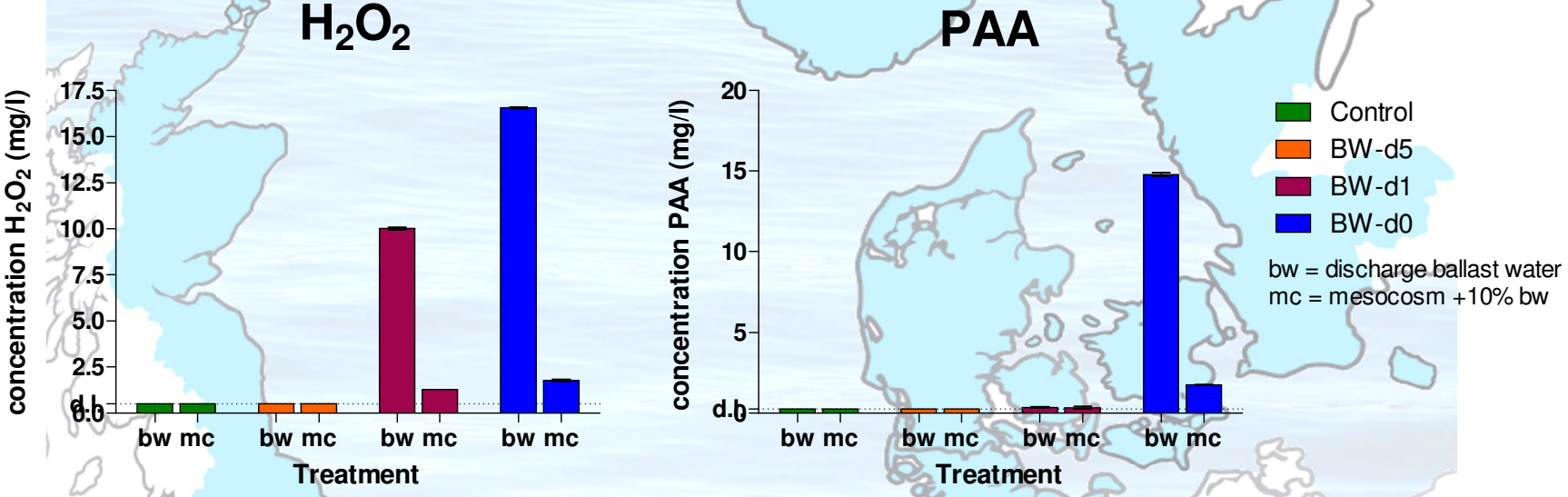
Chemistry at start of exposure



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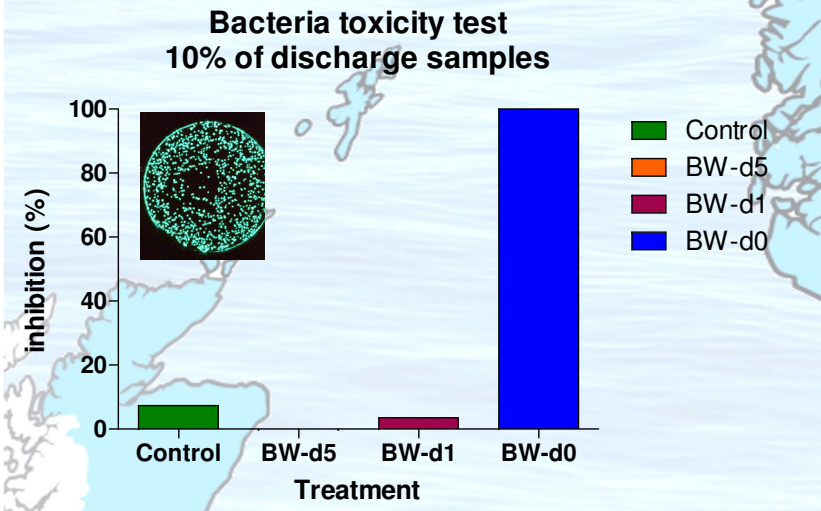
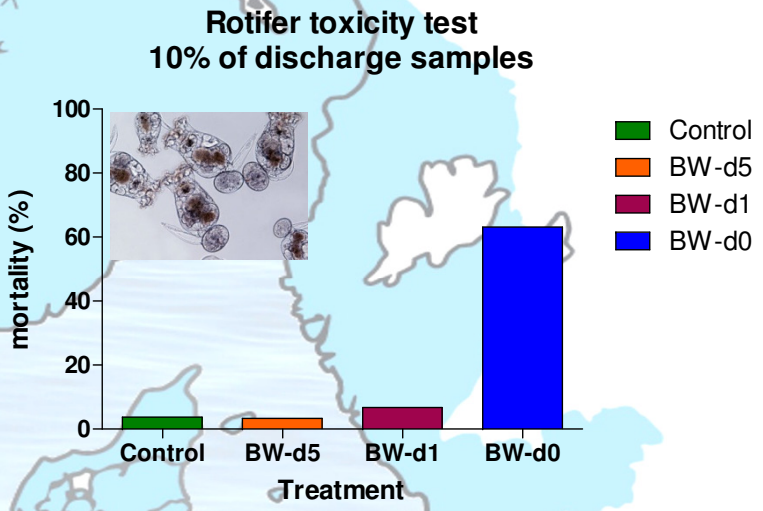
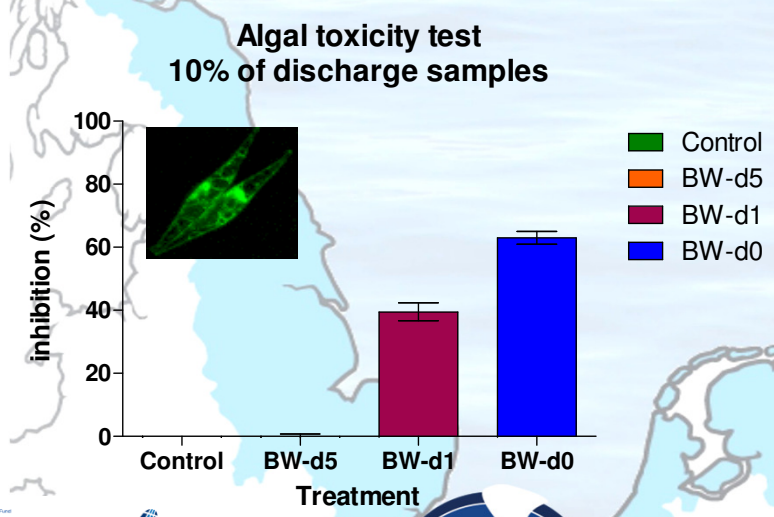
Toxicity testing







	Bacteria	Rotifer	Algae
Control	NO	NO	NO
BW-d5	NO	NO	NO
BW-d1	NO	NO	YES
BW-d0	YES	YES	YES

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Measurements & Analysis

- Water quality parameters
  - pH, oxygen, salinity, temperature, turbidity
  - TOC, DOC, POC, hardness
  - Nutrients (NH4, NO3, NO2, PO4, SiO2)
  - Weather conditions
- Zooplankton
- Phytoplankton
  - Biomass as chlorophyll-a
  - Community, periphyton
- Benthic organisms
  - Mudshrimps, lug worms,
- Invertebrates
  - Cockles, breadcrumb sponges, periwinkles, mussels

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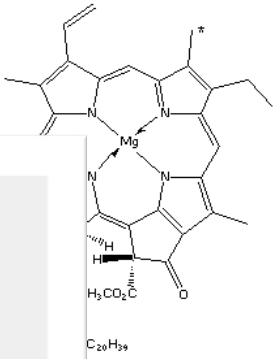
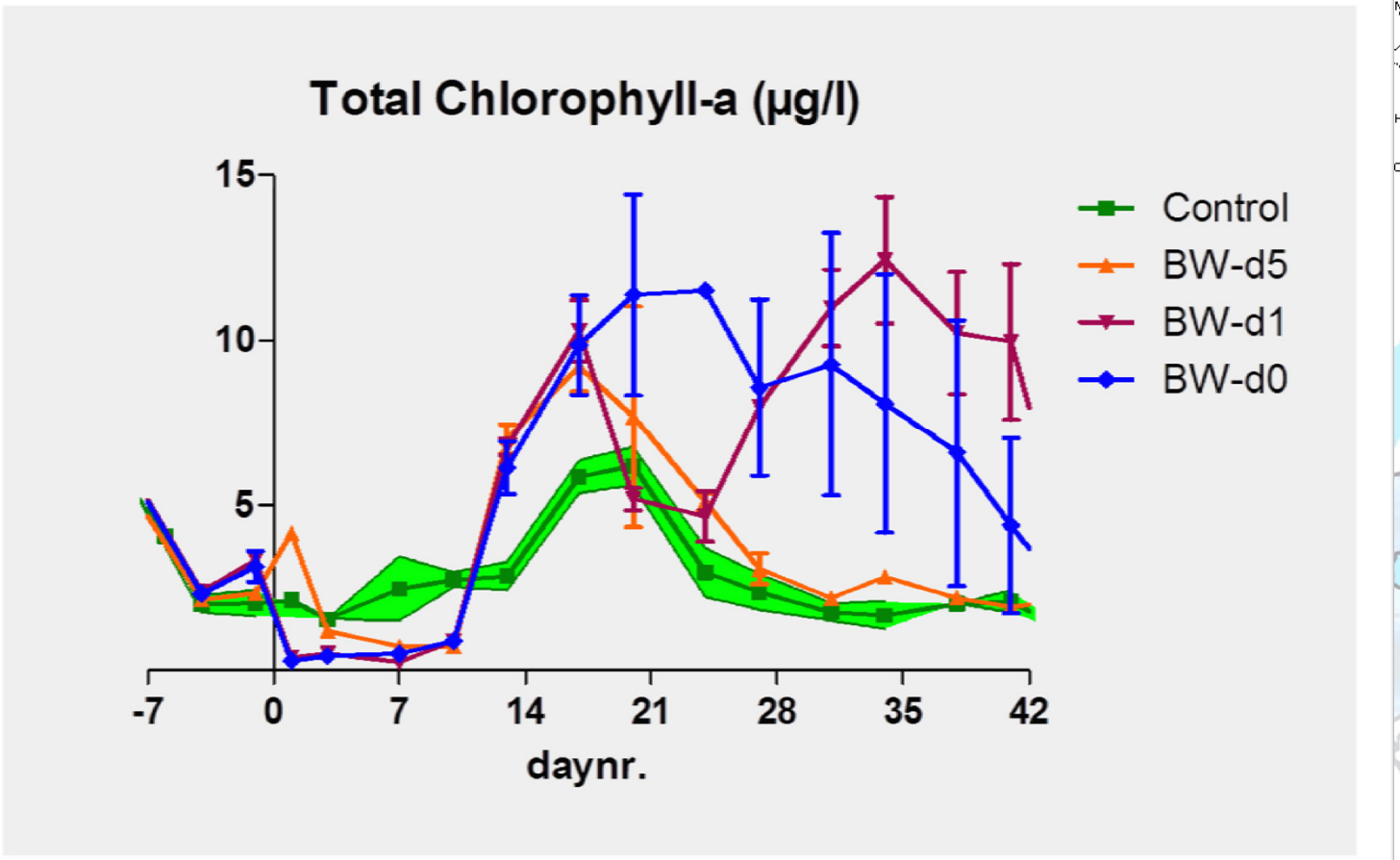
Phytoplankton





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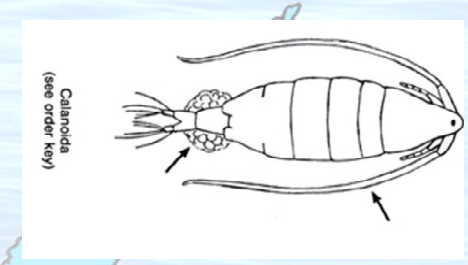
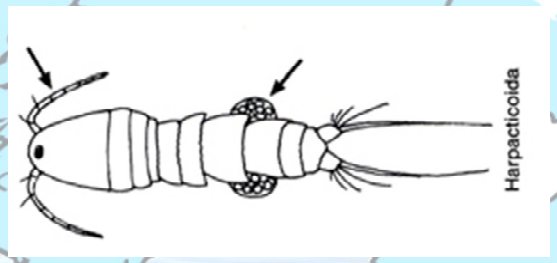
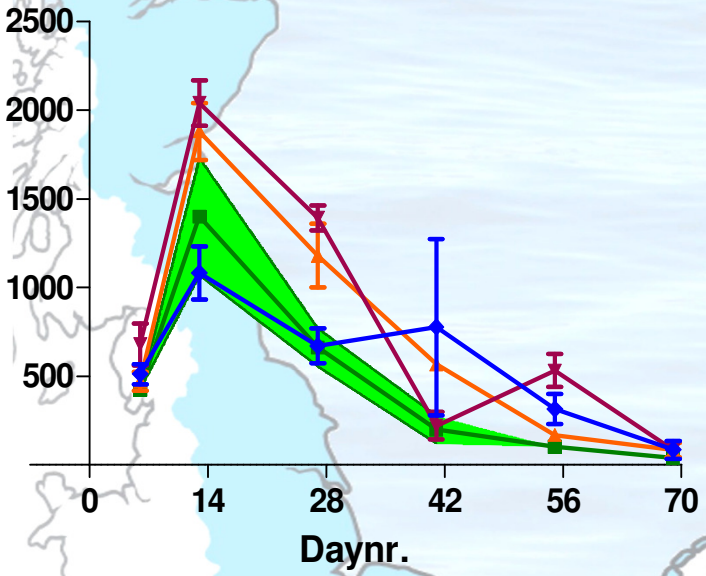
Zooplankton

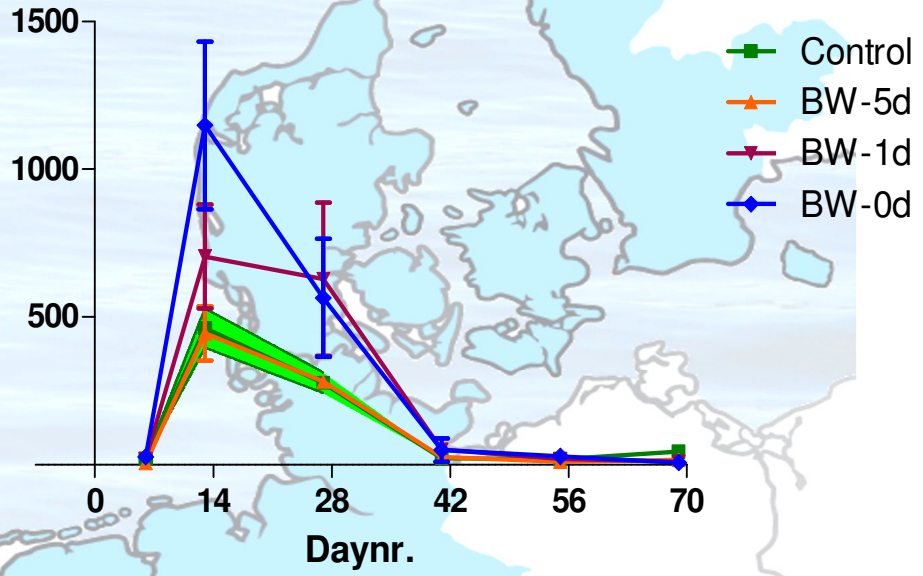




Copepod (calanoid)



Copepod (harpacticoid)



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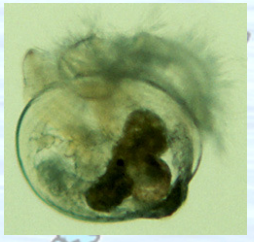
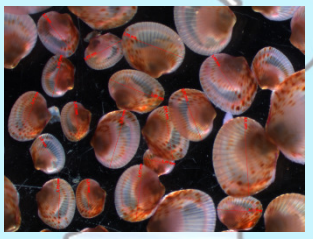
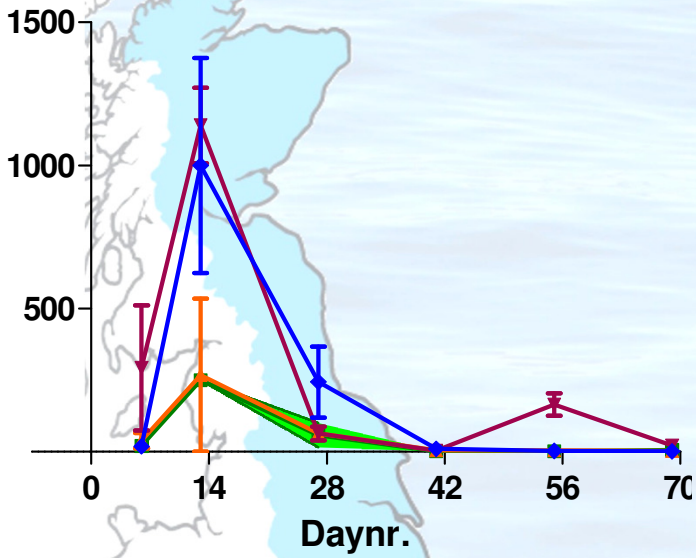
Bivalves

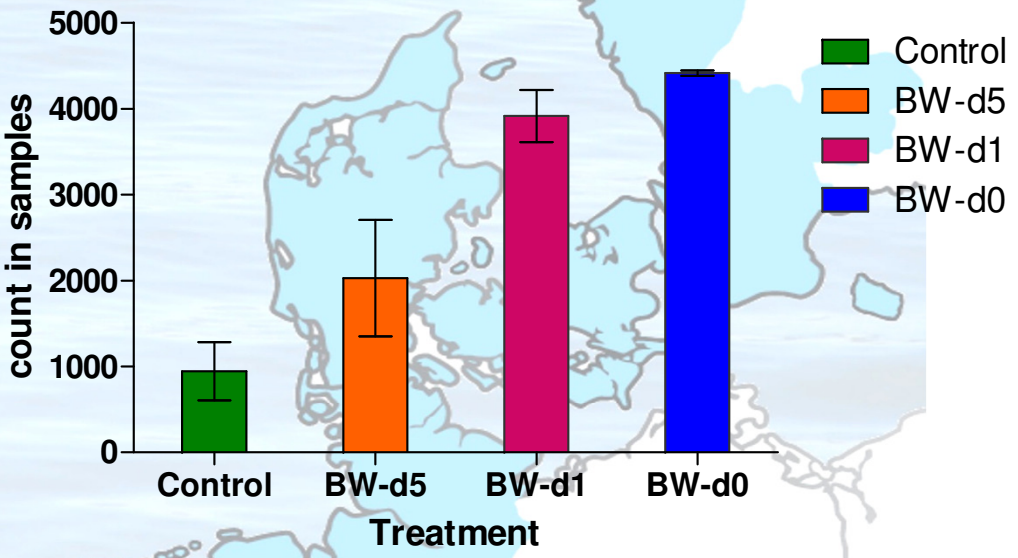


Bivalvia



Cockle (juveniles)





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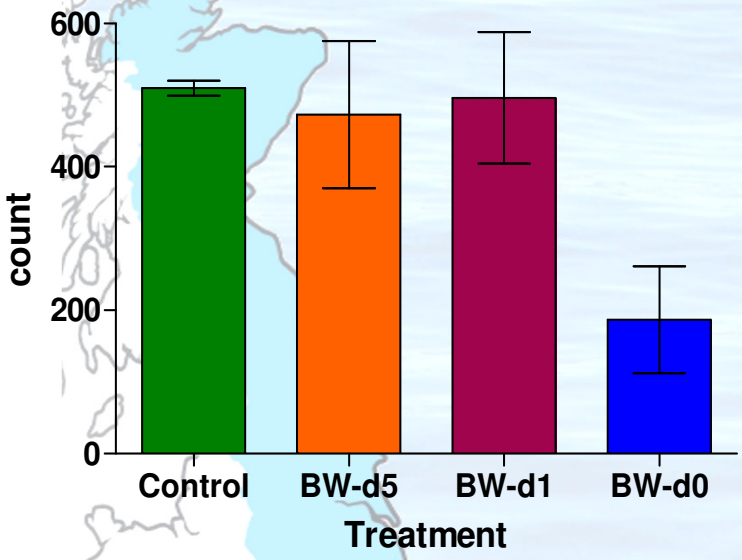
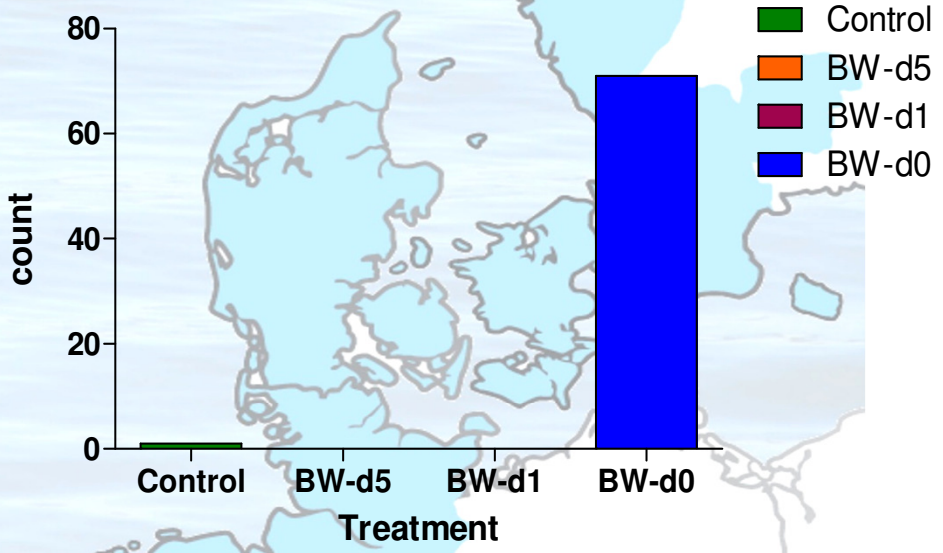
Macro-invertebrates

Corophium volutator

Microdeutopus gryllotalpa





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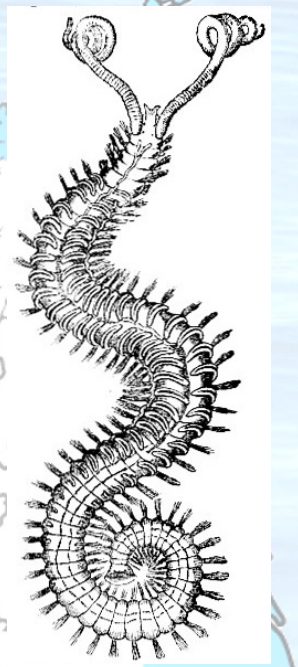
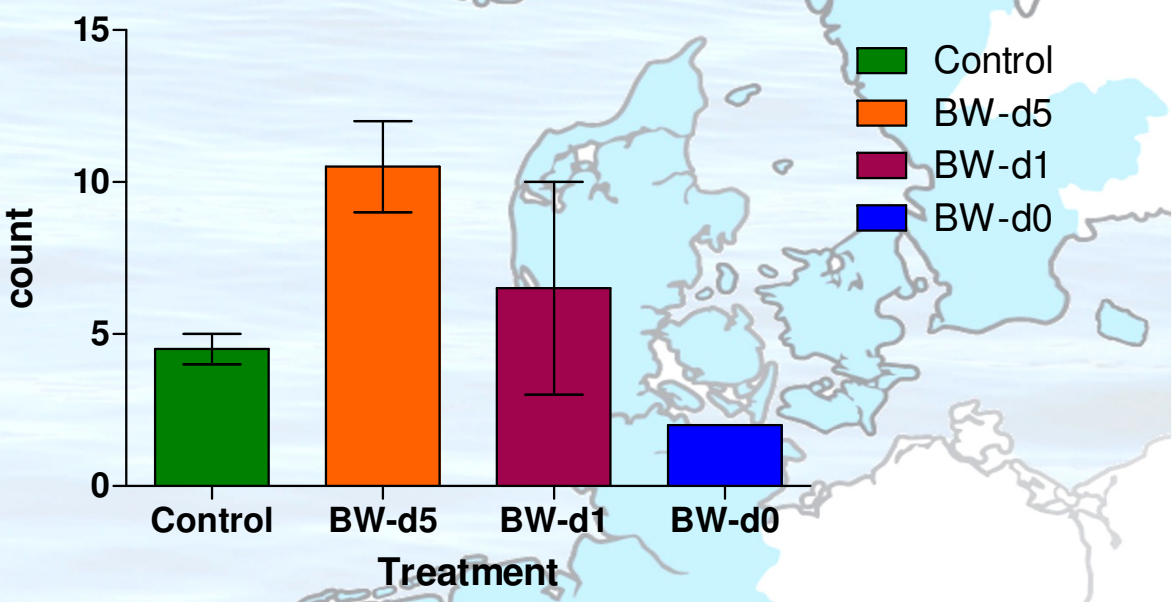
Macro-invertebrates





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Summary

Control versus →		BW-d5	BW-d1	BW-d0
Bacteria test	-			
Algae test	-			
Rotifer test	-			
Total Chlorophyll-a	C			
Copepod (calanoid)	N			
Copepod (harpacticoid)	N			
Bivalvia larvae	N			
Cockles (juveniles)	N			
Corophium volutator	N			
Microdeutopus gryllotalpa	N			
Polydora ciliate	N			
Halichondria panicea	G			
Mytilus edulis	G			
Ctenodrilus serratus	N			
Cockles (adults)	N			
Oligochaeta sp.	N			
TOC	C			
DOC	C			
Acidity	C			
Oxygen	C			
Ortho-phosphate	C			
Littorina littorea	N			
Arenicola marina	N			
Ammonium	C			

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Conclusions

- **How to discriminate between effects caused by replacement of water and effects of toxic substances?**
  - Replacement of water with no active substances is not free from effects.
  - However, the level of toxic substances present in the treated water corresponded with the amount of effects.
- **How predictive are toxicity test results (i.e. bioassays) for effects of treated ballast water on ecosystems?**
  - Effects seen in bioassays are not directly copied in mesocosms.
    - *results might be affected by physical characteristics like pH, oxygen, DOC, N/P.*
  - However, high risk indicated by the toxicity tests corresponded with high level of disturbances of the ecosystem.