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Testing performance of biotic ligand models for Cu, Ni and Zn in Northern European water chemistries

- ***Bioavailability based Environmental Quality Standards require new approaches in the EU member states for metal compliance assessment in freshwater systems***
- ***Biotic Ligand Models (BLMs) have been developed to predict metal bioavailability under different physico-chemical conditions of the water***
- ***The models are based on chronic toxicity data and speciation modelling***
- ***Regulatory jurisdictions need to select a model and set a framework for determining compliance***
- ***Surface water chemistries in Northern Europe are often outside the validation ranges of the current models which complicates model selection and use***
- ***The purpose of this project was to produce toxicity data performed in typical Fennoscandinavian water chemistries and to compare measured point estimates (EC10/NOEC) to toxicity estimated by the BLM***
- ***Consistency between predicted and measured toxicity would support the use of the BLM models in the Northern European conditions***
- ***Inconsistency between modeled and measured toxicity would call for further toxicity testing and/or model development***

Materials and Methods

- Seven surface water samples from Finland and Norway were spiked with either Cu, Ni or Zn and chronic toxicity was observed for *Daphnia longispina* (reproduction), *Lymnaea stagnalis* (growth) and/or *Pseudokirchneriella subcapitata* (growth)
- Local invertebrate populations were applied in soft and acidic waters (Table)
- 28 measured vs. modelled EC10/NOEC estimates were produced
- EC10s were based on the nonlinear logistic curve (OECD 1997)
- The actual exposure metal concentrations were analyzed either by ICP-OES or ICP-MS
- WCA Environment (A. Peters) performed the species specific full BLM modelling based on the measured water chemistries

Table. Selected water chemistries for the test waters.

Test waters	pH	DOC mg/L	K mg/L	Ca mg/L	Na mg/L	Mg mg/L	Cl mg/L	SO4 mg/L
Atnsjøen	6,6	1,3	0,3	1	0,5	0,2	0,4	1
Konnevesi	7,2	8,6	1,2	3,9	2,1	1,6	1,7	4,2
Kontiolampi	4,8	19,4	0,8	2,6	6,4	0,6	7,9	3,3
Kuorinka	6,5	2,1	1,1	2,5	1,1	0,9	1,8	6,7
Säkkilänjärvi	6,7	4,4	1,3	10,5	1,1	2,3	1,7	3,8
Särkilampi	6	16,6	0,6	2,6	1,3	0,7	2,6	2,3
Valkealampi	6,9	2,4	0,6	2,1	1,1	0,6	0,4	4,5

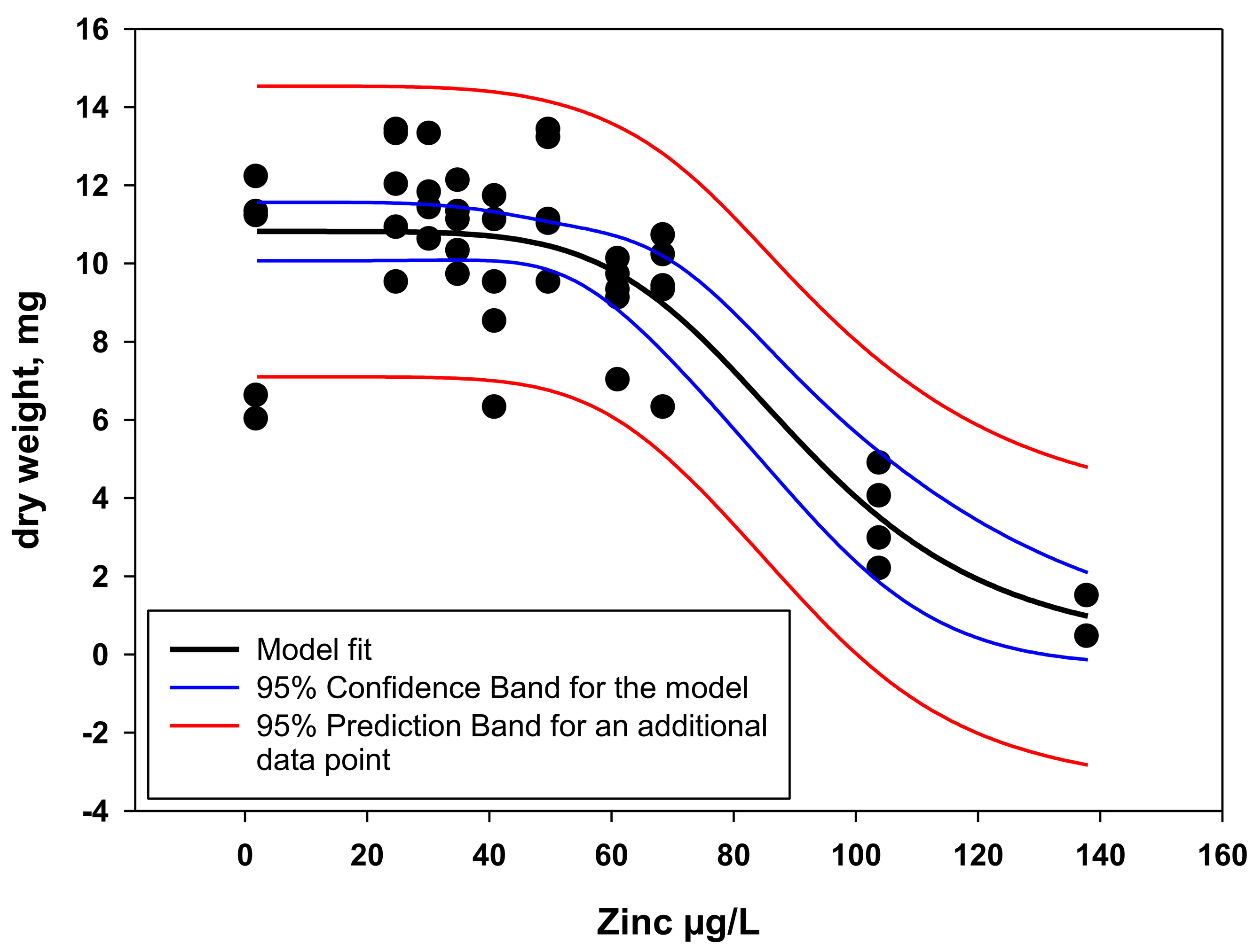

Figure 1. An example of toxicity data and model fitting. The growth of juvenile *L. stagnalis* snails after 3 weeks exposure to zinc. EC50 = 91 ± 5 µg/L, EC10 = 61 µg/L. NOEC = 69 µg/L. LOEC = 104 µg/L.

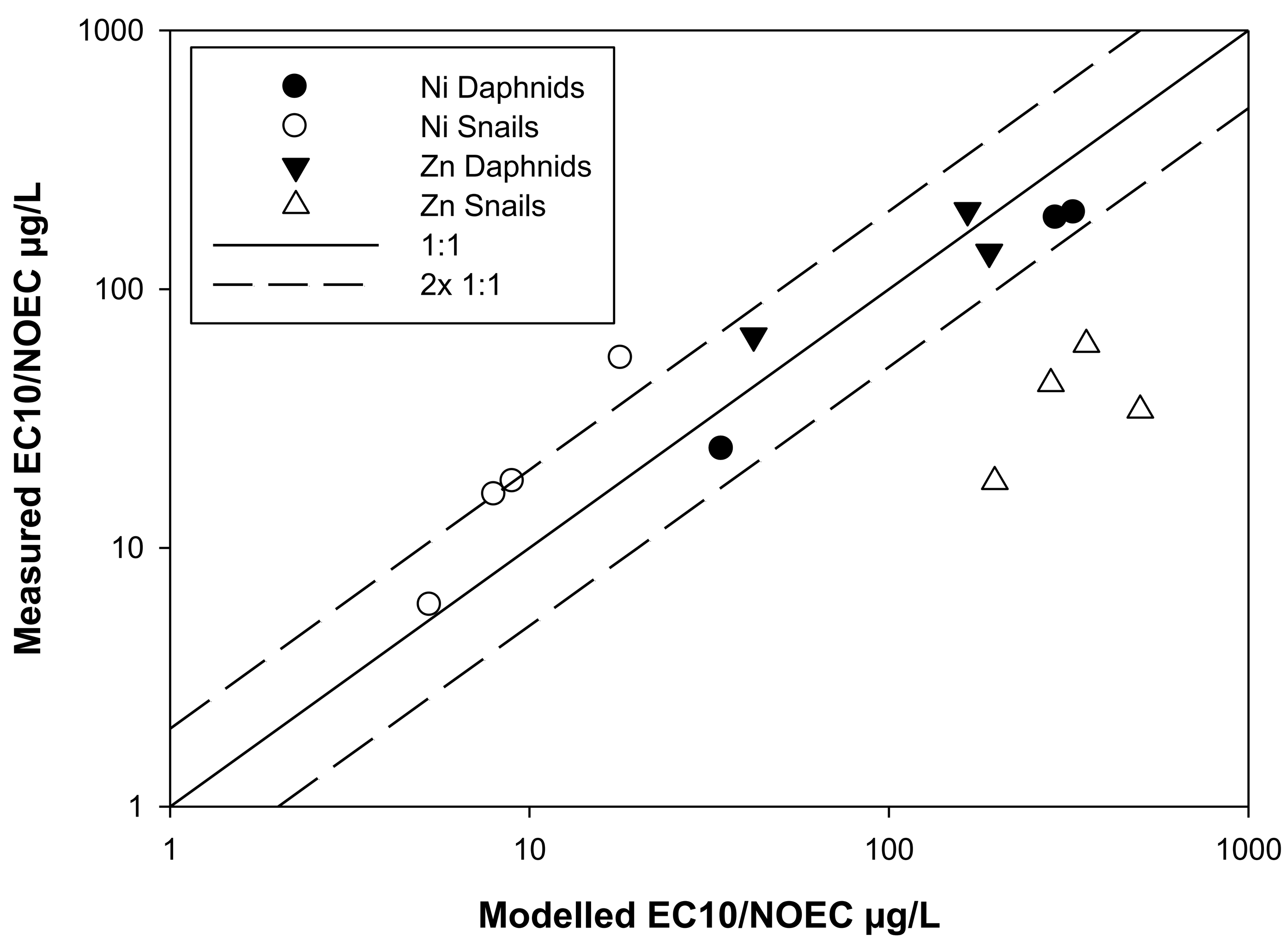

Figure 2. Comparison between test data based EC10/NOEC (y) and full BLM model based (x) EC10/NOEC estimates . All comparisons are for the matching species and no cross-species extrapolation was needed.

Results and Discussion

- Establishing a new daphnid and snail culture using local populations was successful
- Feeding conditions were critical for successful growth of snails in experimental set up and allowed concentration-response modelling (Fig.1)
- All Ni and Zn daphnid and Ni snail effect point estimates generally followed the modelled estimates (2x difference accepted) (Fig. 2).
- Algae (for all metals, not shown) and snails (for Zn) were more sensitive than the BLM model estimated (Fig.2)

- The results corroborated nickel BLM model for daphnids and snails
- The reasons for algae and snail (for Zn) model deviations are unclear and require data checks and further testing before BLM model adjustments are considered as an option

References

OECD 1997. Report of the final ring test of the Daphnia magna reproduction test. Series on Testing and Assessment No.6.

Acknowledgements

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