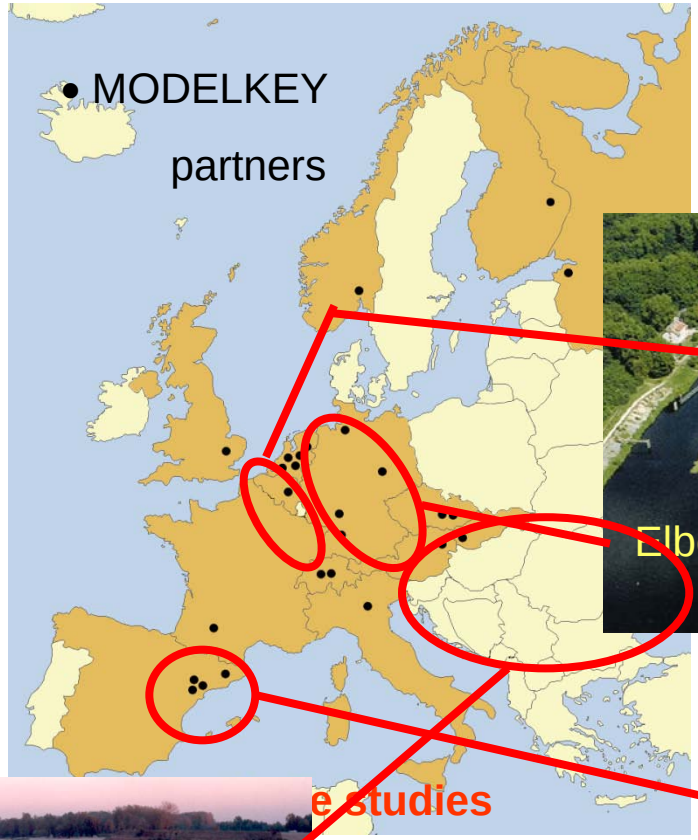
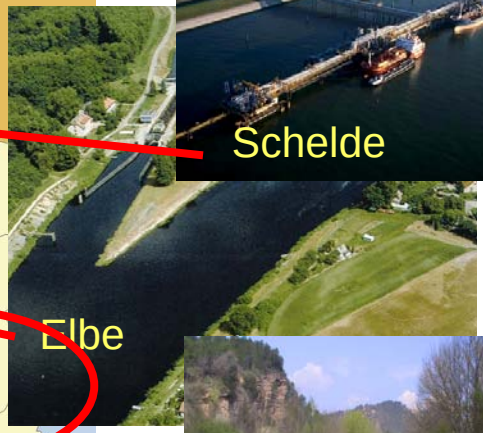
Impact of polluted sediments on biodiversity

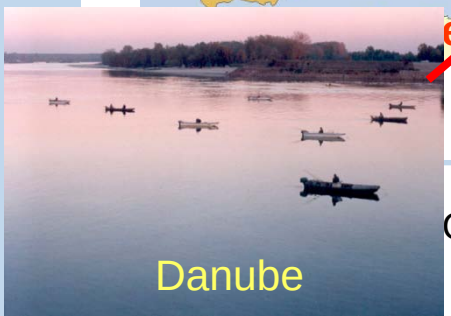
Eric de Deckere, Sebastian Höss, Isabel Muñoz, Claus Orendt, Claudia Schmitt, Chris Van Liefferinge & Georg Wolfram, Dick de Zwart & Peter von der Ohe

MODELKEY

MODELKEY aimed to establish links between the ecological status and toxic contamination







- Risk-based key toxicant identification
- Assessment of risks to ecosystem health and biodiversity
- Diagnostic and predictive modelling tools for exposure and effects
- Decision support system for toxicant, risk, and site prioritisation

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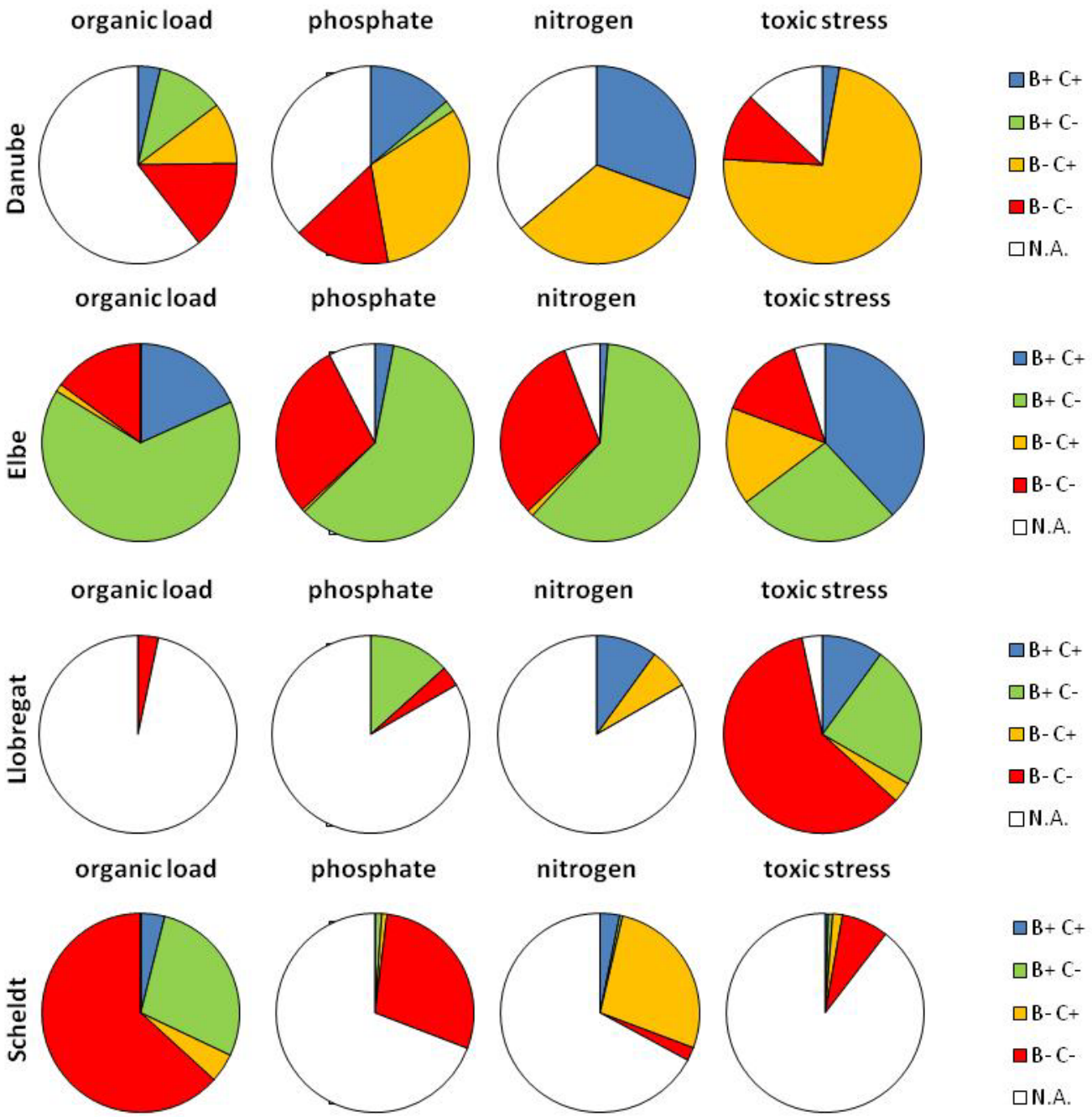
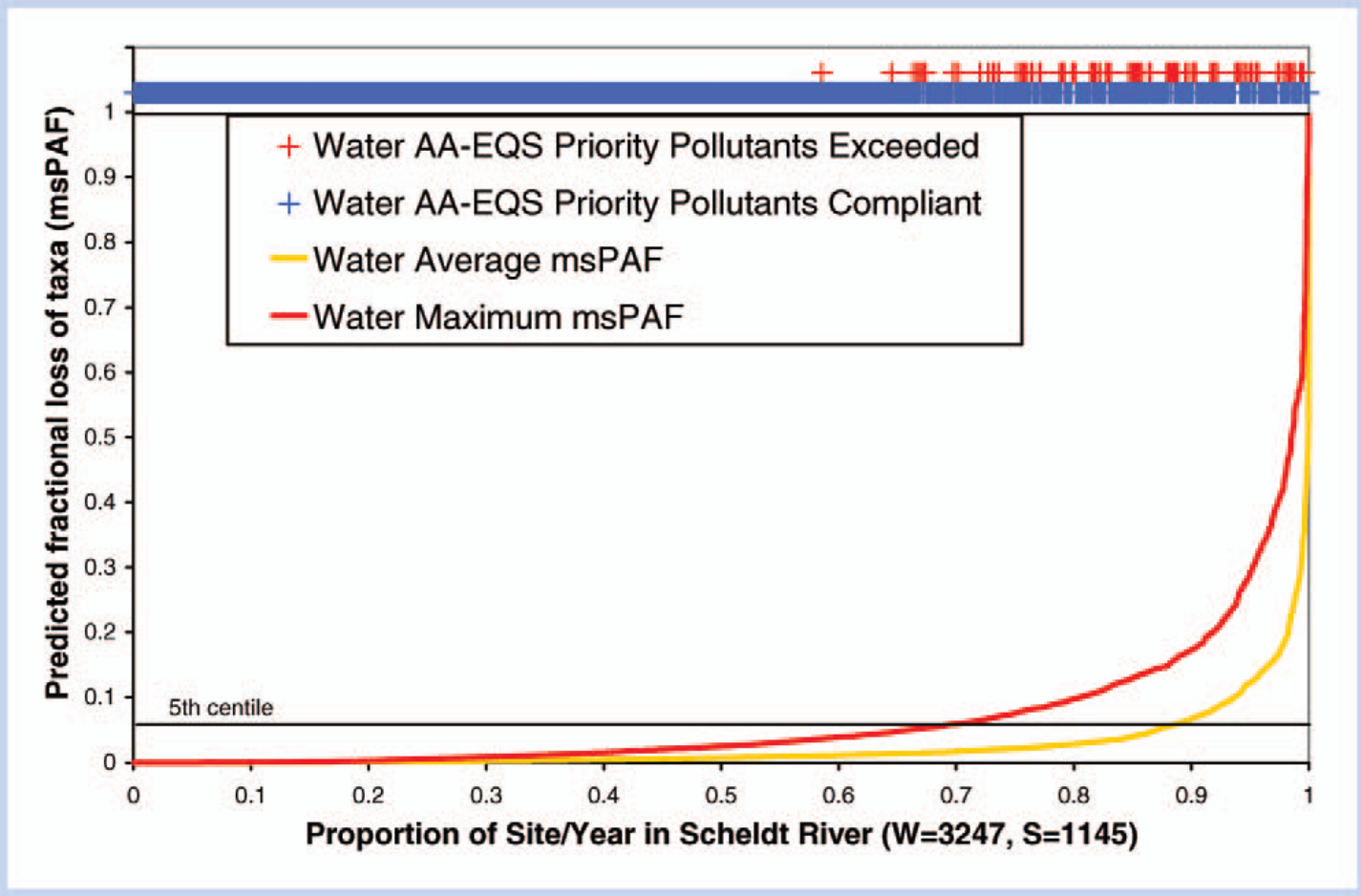
Identification of the major stressor based on a combination of biotic and chemical assessment



Toxic impact on basin scale

-> decreasing biodiversity



(De Zwart et al, 2009; IEAM, 5: 38–49)

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Toxic impact on basin scale

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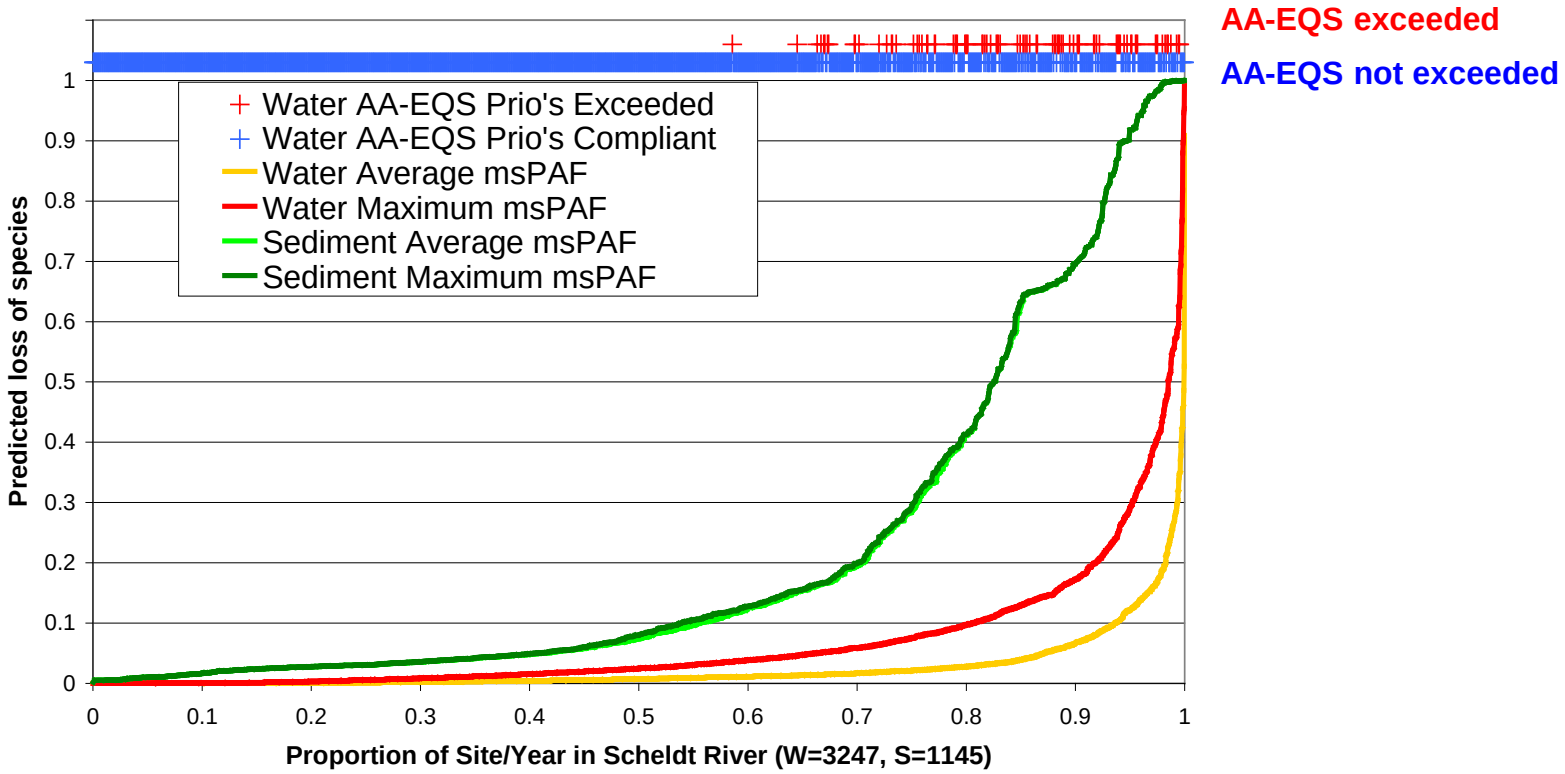

- Toxic pressure from sediment exposure higher than from water exposure
- Toxic pressure from sediment exposure less variable than from water exposure
- Low toxic pressure → No EQS exceedence
- High toxic pressure → Mostly No EQS exceedence

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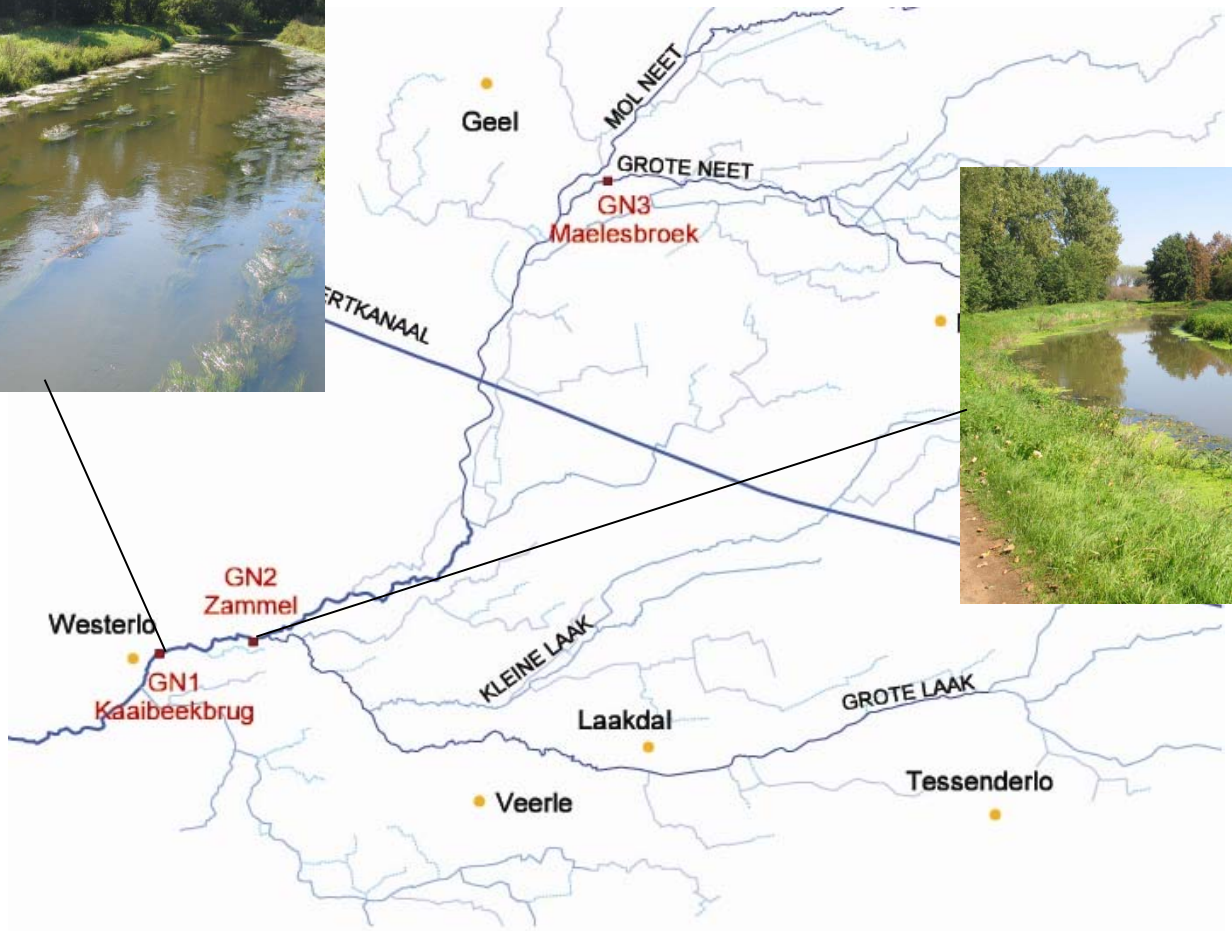
Grote Nete



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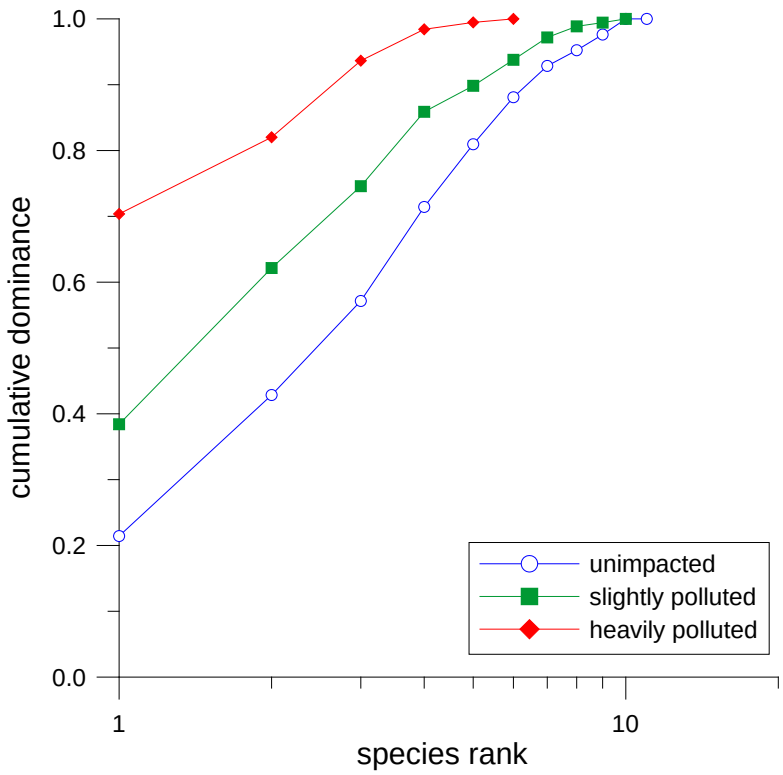
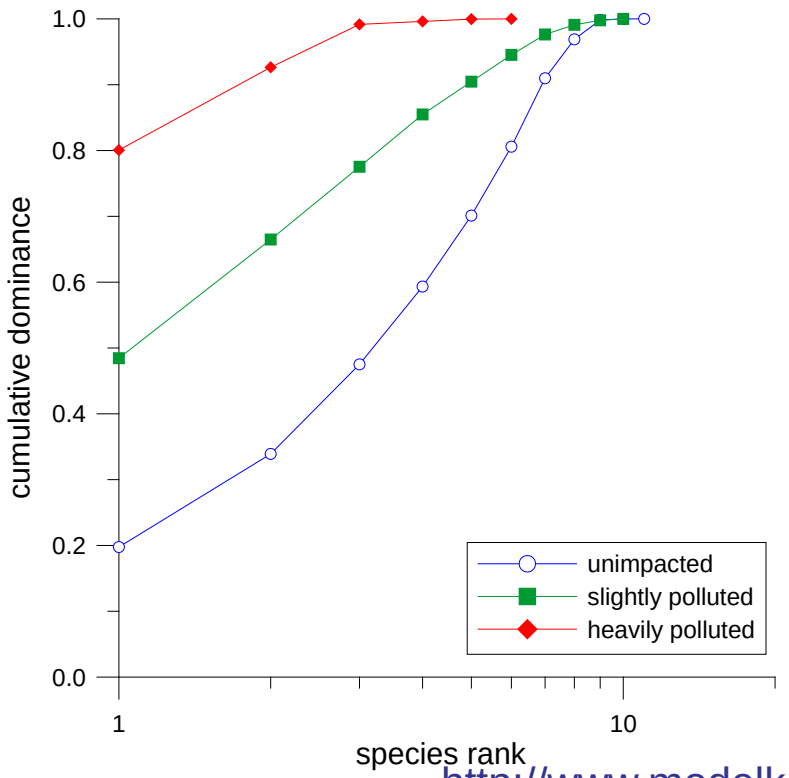
Density and biomass





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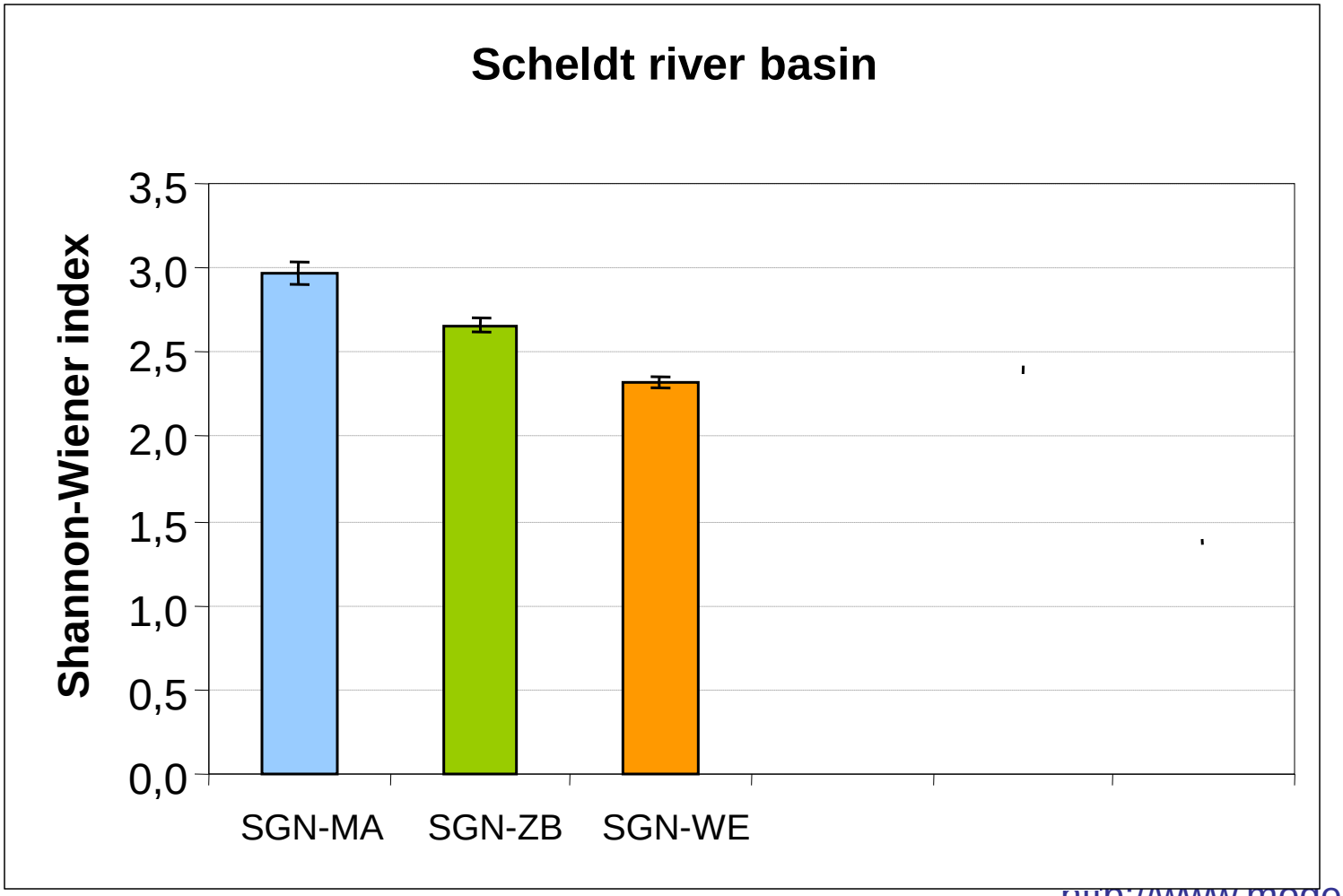
Diversity



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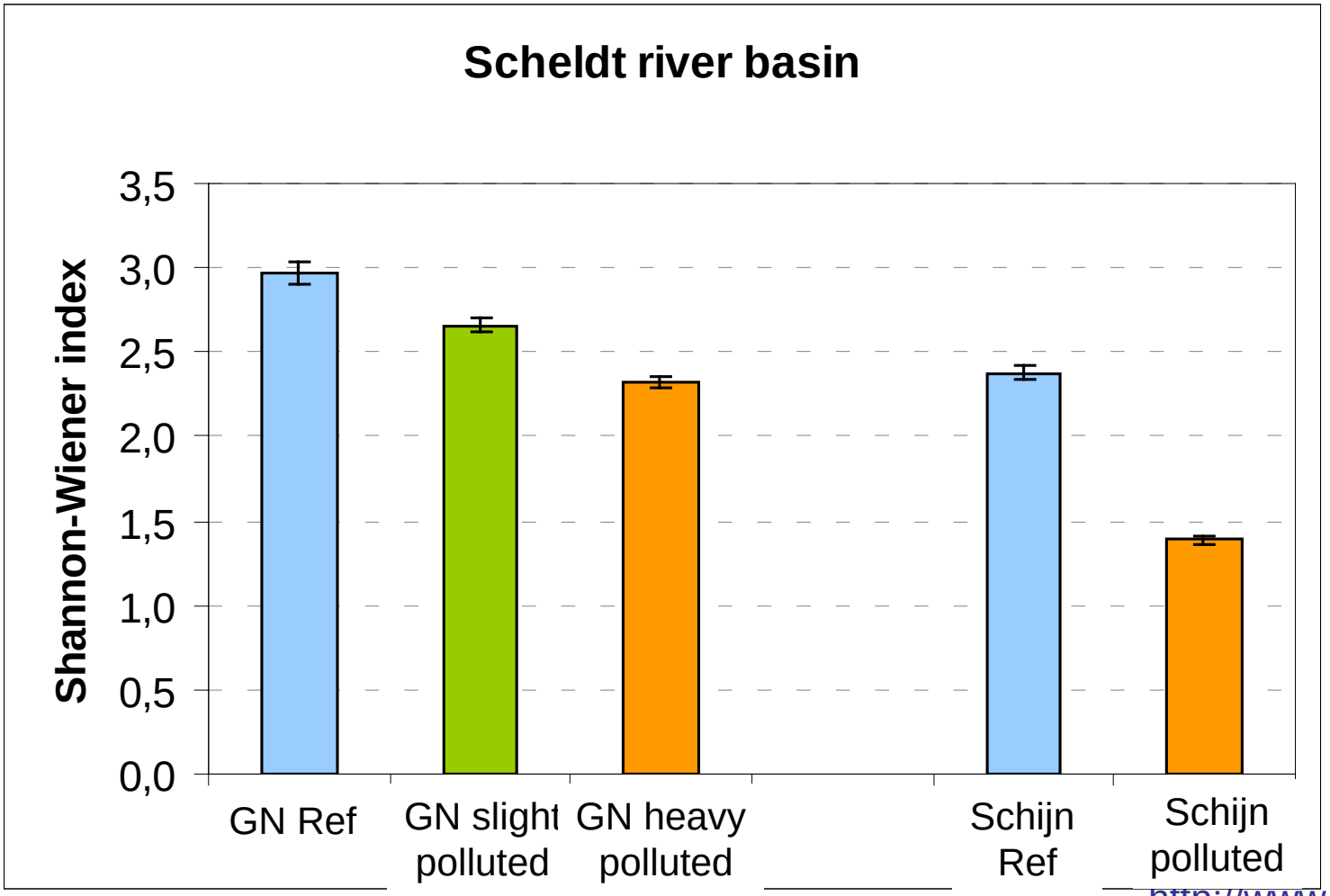
Diversity



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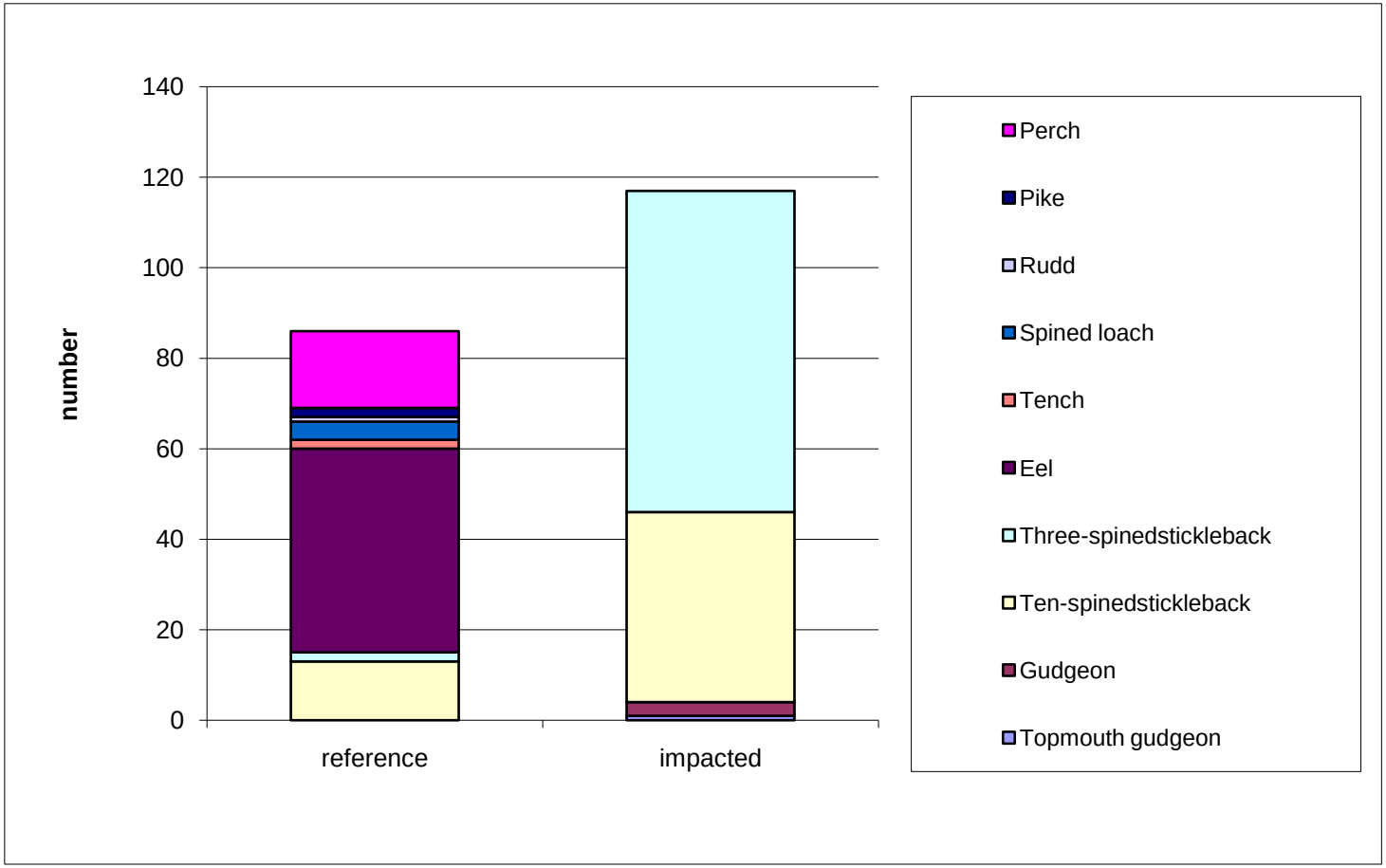
Fish community



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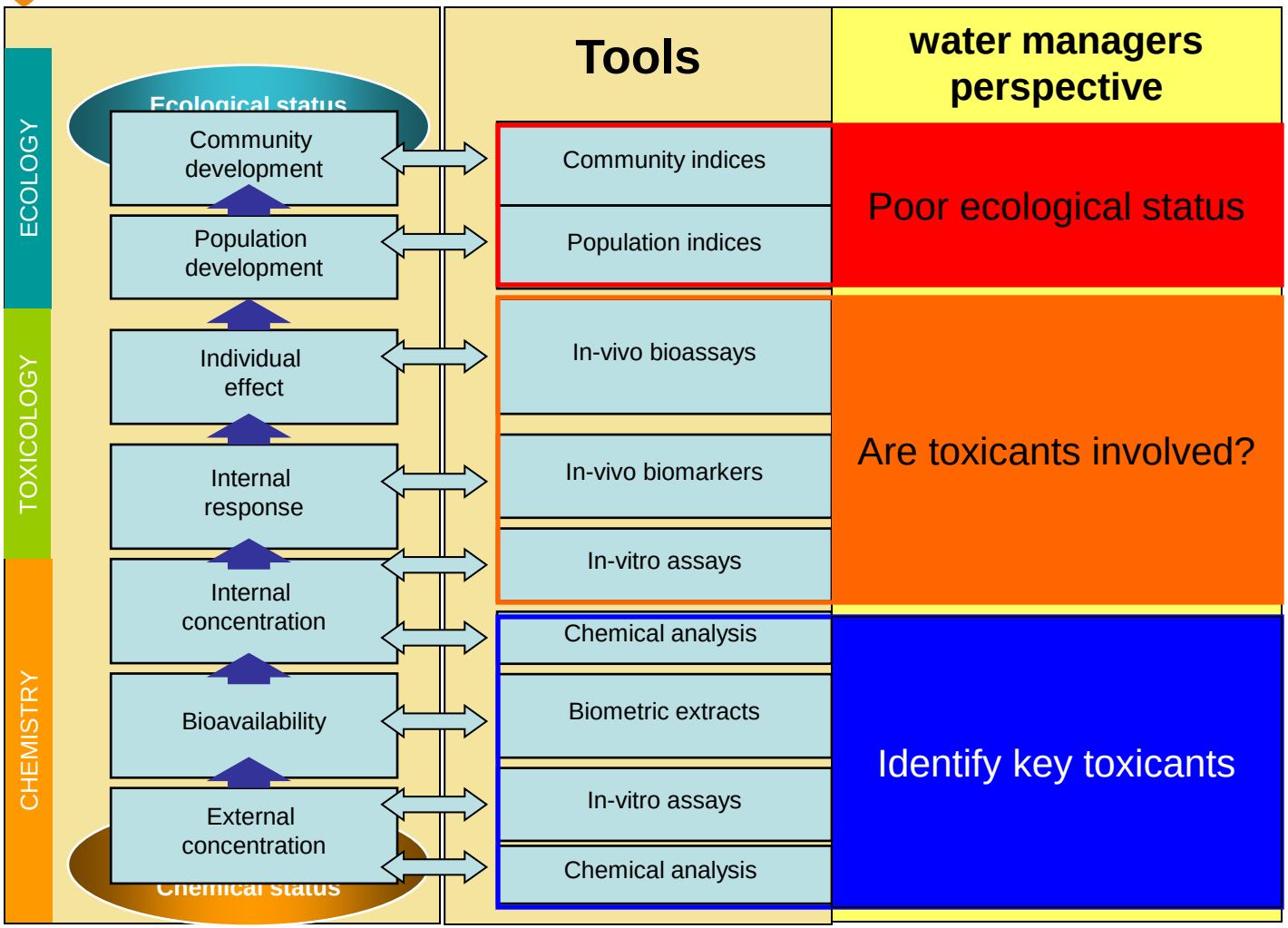

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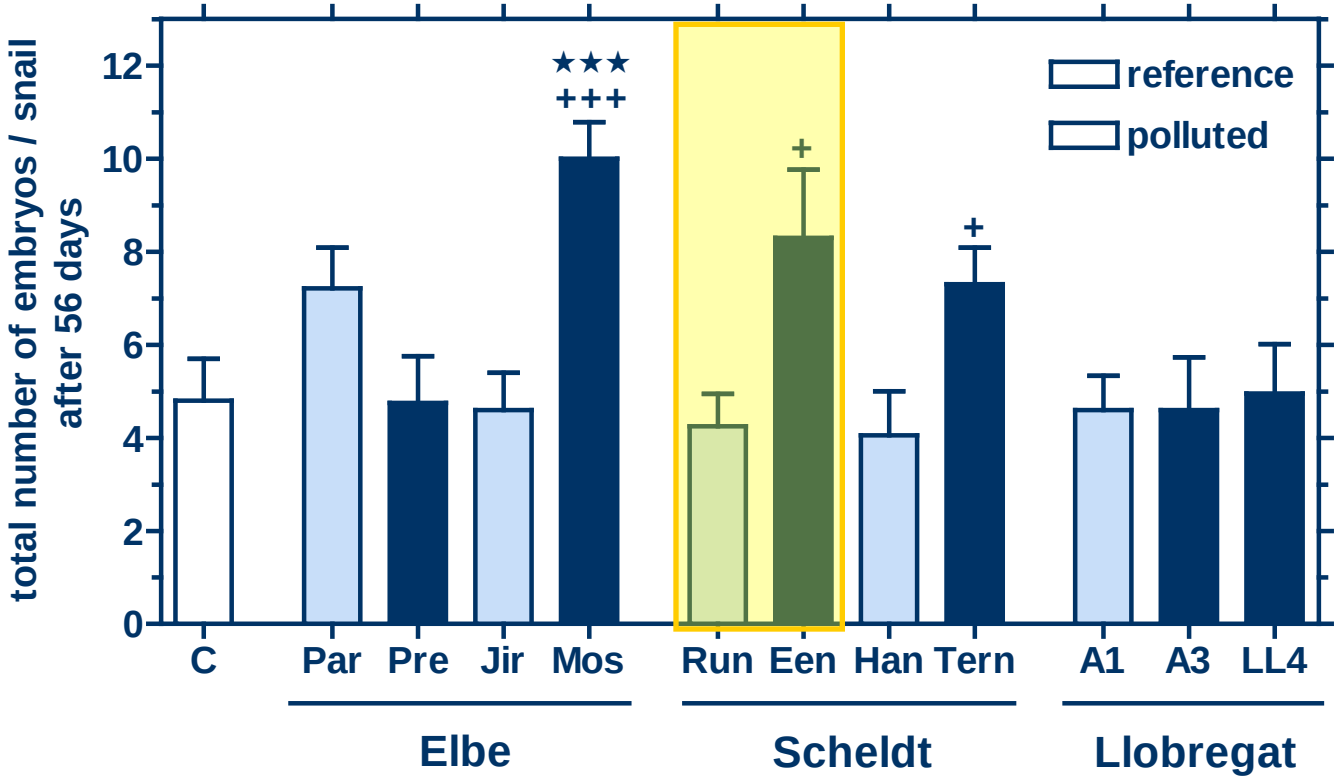
Testing sediment toxicity



Mean (± SEM); C=artificial sediment control; n=20; ★ significant differences to control; + to corresponding reference site; + $p < 0.05$, ★★★/+++ $p < 0.001$; Mann-Whitney U-test)

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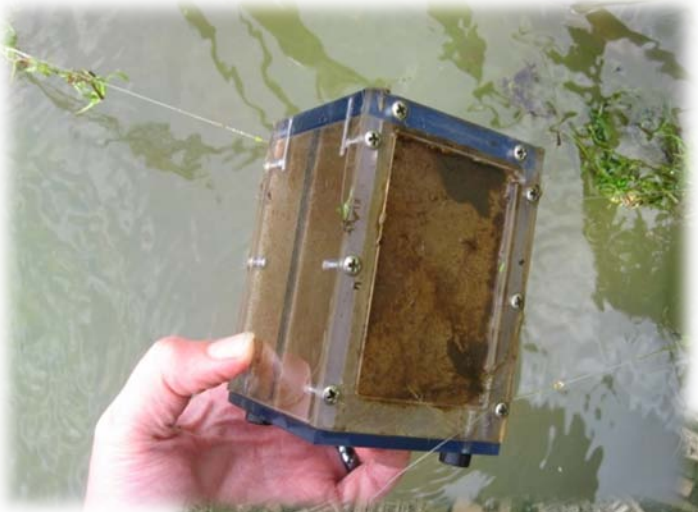
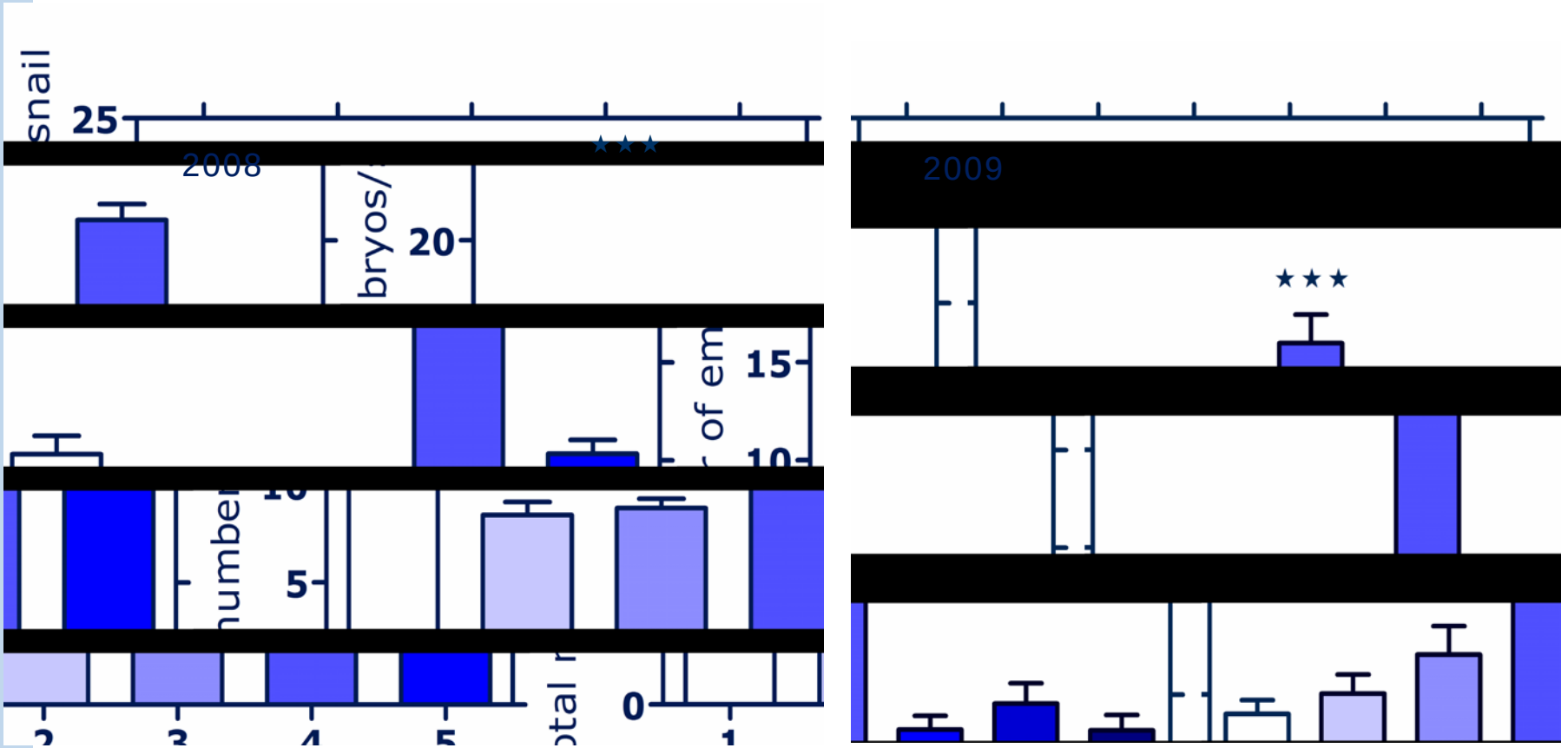
In situ confirmation toxicity



In situ confirmation toxicity



Mean (± SEM) number of embryos for in situ cage experiment at the river Schijn in 2008 and 2009, ★★★ significant difference vs. reference site 1, $p < 0.001$; Kruskal Wallis with Dunn's post test

Schmitt et al 2010. Ecotoxicology and Environmental Safety, 73: 1574–1579

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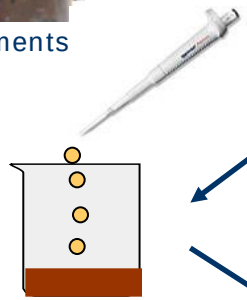
Cause-effect?

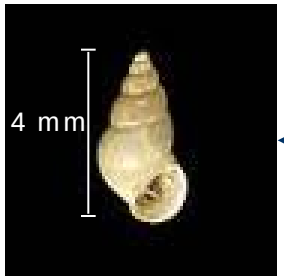
Field sediments

Extraction/Fractionation

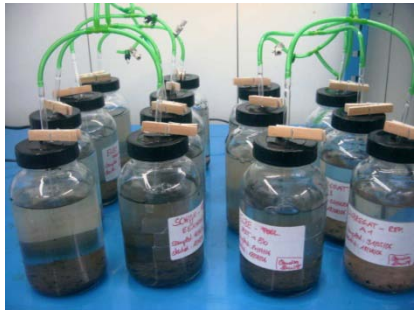
Laboratory culture of *Potamyrgus antipodarum*



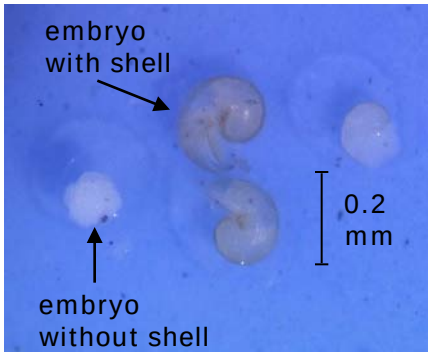
Spiked artificial sediment



Endpoint growth



Sediment contact test



Endpoint reproduction

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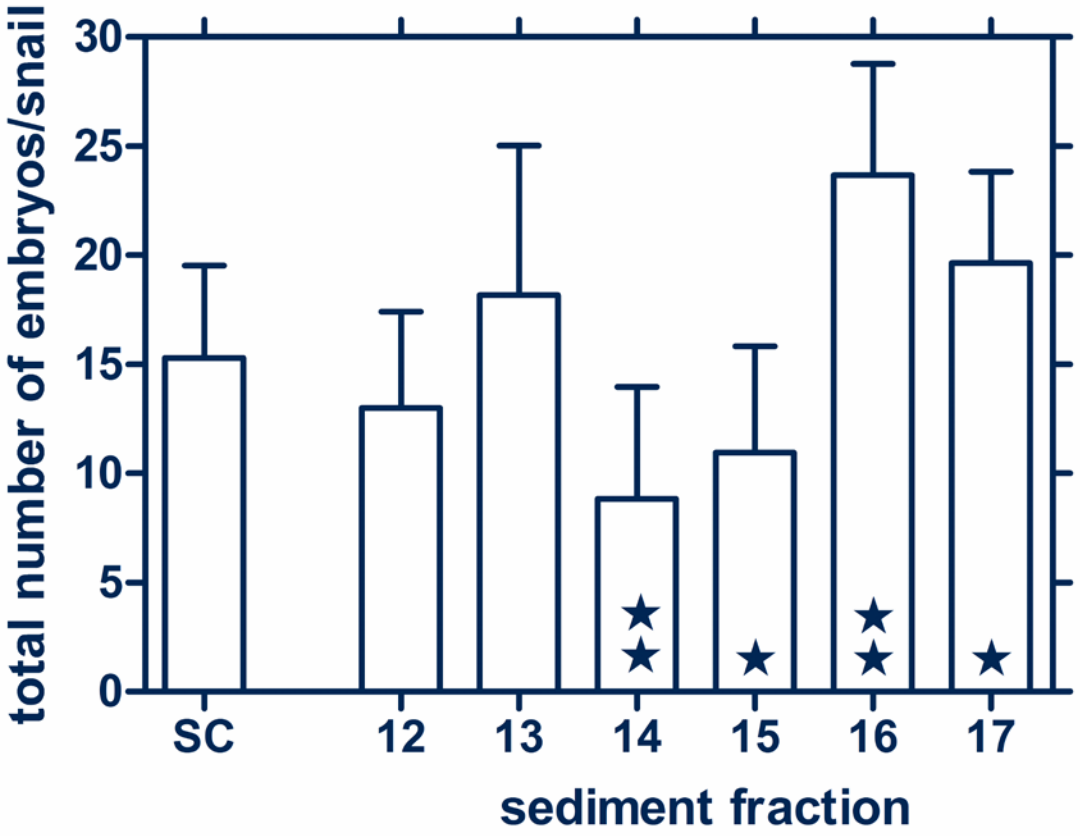
Toxic fractions



Mean number (± SD) of *P. antipodarum* embryos per snail, exposed for 28 days to sediment extracts of the polluted site at the river Schijn at Een (SC = solvent control; n = 30; ★ significant differences to solvent control; p < 0.01-0.05; one way ANOVA with Dunnett's post test)

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Identification of toxic compounds

	fraction					
	12	13	14	15	16	17
compound	(ng/g SEQ)					
AHTN	-	-	10	-	-	-
HHCB	-	26	6	-	-	-
triclosan	-	-	26	-	-	-
diphenylsulfone	-	-	-	430	-	-
DEP	-	-	0.026	0.238	-	0.012
DBP	< blank	< blank	< blank	0.74	0.066	0.218
BBP	-	-	-	0.03	-	-
DEHP	0.004	< blank	8.29	0.068	0.068	0.132
DOP	-	-	-	-	0.002	-
mono-TMS-octylphenol	-	-	-	4	-	-
mono-TMS-nonylphenol	-	-	-	210	-	-
di-TMS-bisphenol A	0.5	-	0.5	0.5	1	8.5
mono-TMS-coprostanol	0.5	0.5	1	396	1900	3.5
mono-TMS-cholesterol	9	7	7.5	> range	4,254.5	15.5

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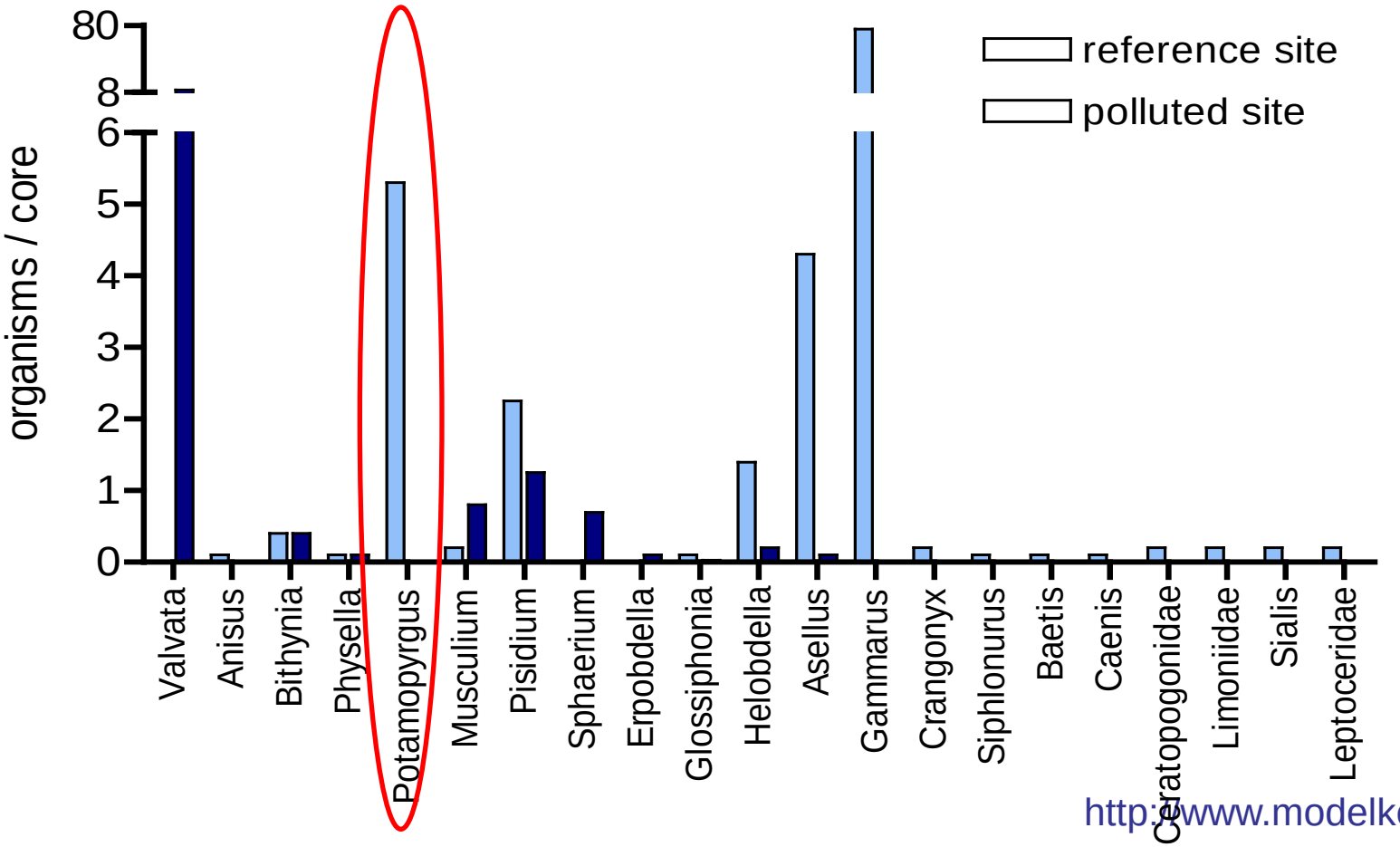
Did we find the cause-effect link?

Genus composition of the macroinvertebrates at the Schijn



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Conclusions

- Toxicity is an important stressor for the ecological community
- Biotic assessment confirms the toxic stress, but a causal link to toxicants in the water phase is often lacking
- Toxic compounds in the sediment is the gap in monitoring programs to find this causal link
- At a local scale the tools are available to identify toxic compounds in the sediment that affect the biodiversity

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Thank you

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