

Water level manipulation during harsh environmental conditions: a tool for mitigating effects of invasive dreissenid mussels in impounded river sections

by

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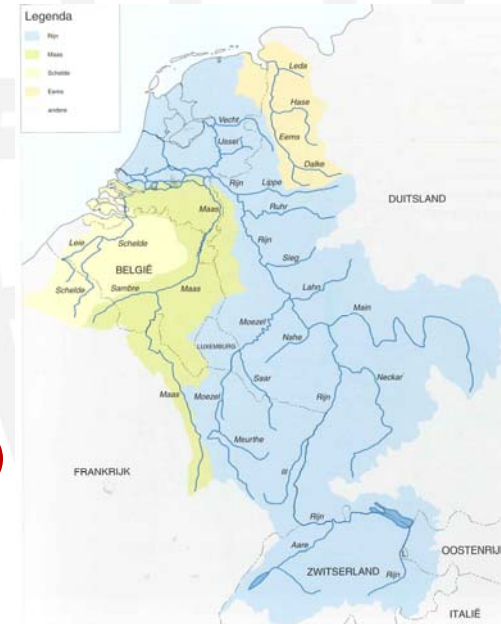
International Conference on Aquatic Invasive Species
Niagara Falls, Ontario, Canada



Problem statement

Strong decrease in biodiversity of Dutch rivers (1950-1986)

- River regulation
- Habitat deterioration
- Water pollution
- Etc.



Only partial recovery after ecological rehabilitation (> 1986)

- Exponential increase in non-native species
- Strong dominance of communities by invasive species
- Differential sensitivity and competitive abilities
- Facilitation by climate change and disturbance
- Ponto-Caspian dreissenid mussels strongly determine ecosystem functioning
- Effects on native mollusks (e.g. competition for food and space, biofouling)

Research question

What are feasible management options to mitigate negative effects of dreissenids?



Hypothesis:

A fast water level decrease during harsh environmental conditions is an effective management tool to control invasive non-native mussels

Werner & Rothhaupt, 2008. Hydrobiologia 613: 143-150.



-> Falsification seemed to be infeasible (shipping)

Material and methods 1

An unintended large scale field experiment unfolded

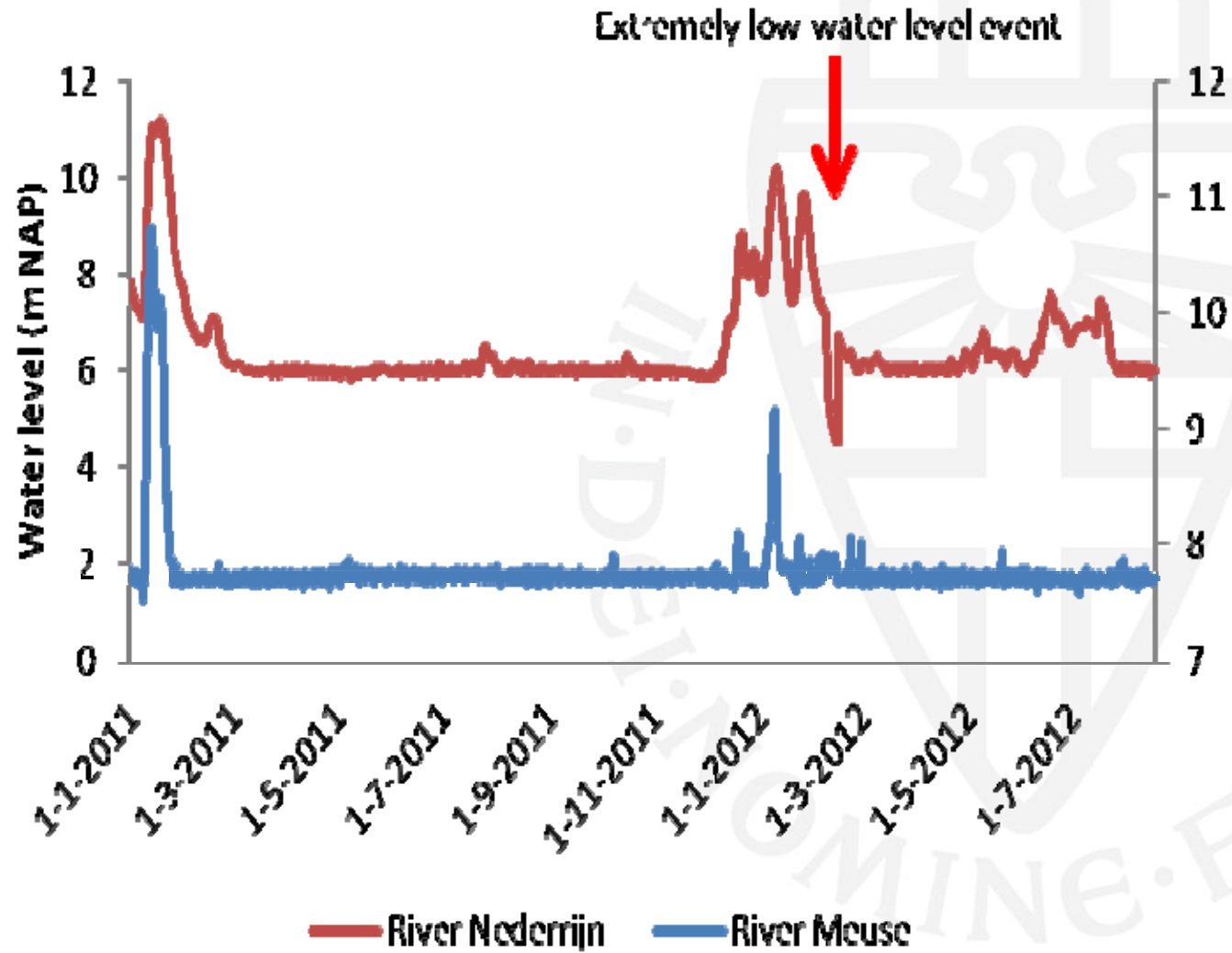
- Rivers Rhine and Meuse in the Netherlands
- Impounded river sections
- Severe winter 2011-2012: break up and drift of ice
- Weirs in River Nederrijn opened to prevent damage

Opportunities to validate the hypothesis

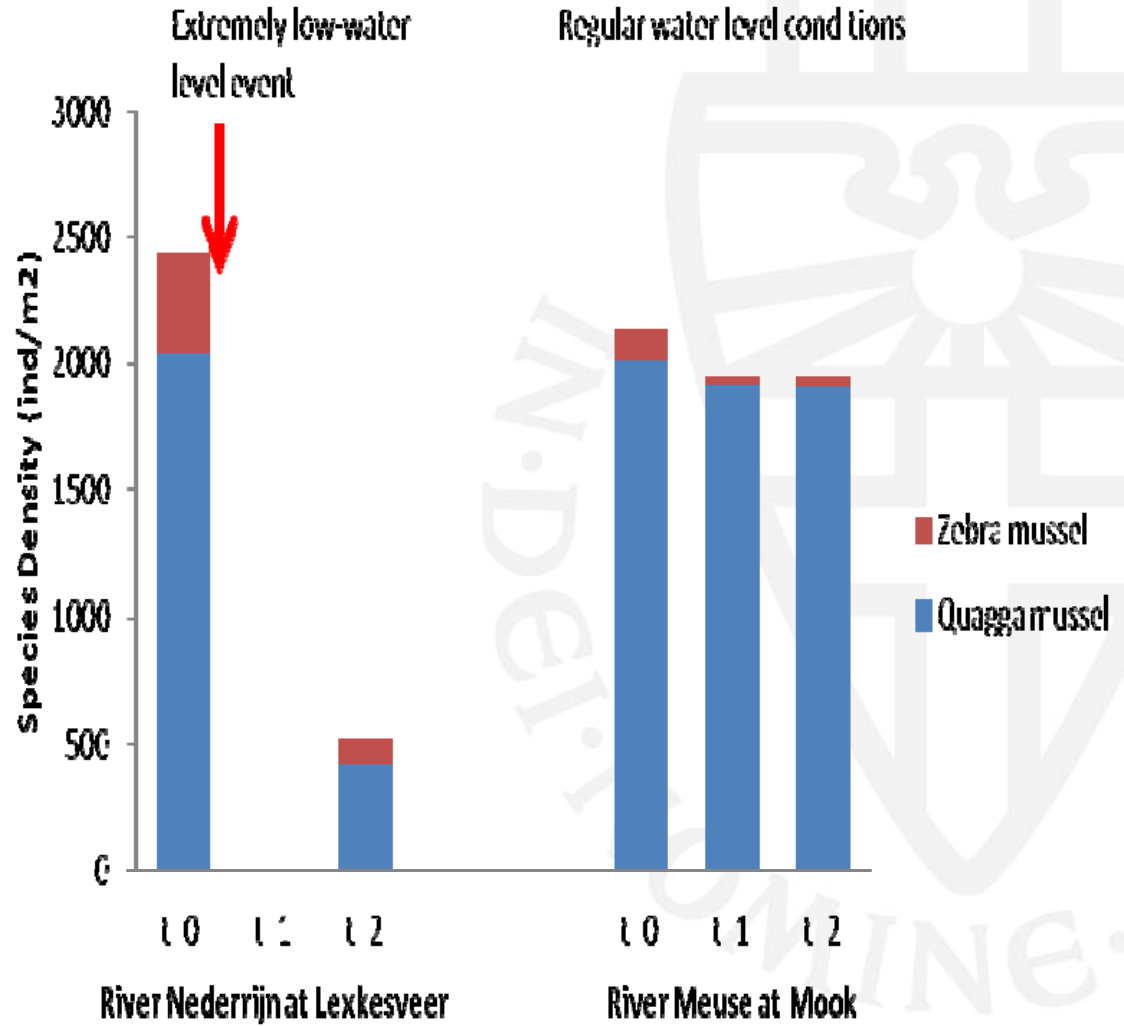
- Sudden decrease in water level (0.5 up to 3.4 m)
 - Air temperature < -5 °C
 - Extreme event lasted several days
 - Ongoing monitoring program
 - River Nederrijn: weirs open (before - after analyses)
 - River Meuse: weirs closed (control)
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- Standard sampling of hard substrates (5 stones)
 - Quantification of wash (dead mussels on river banks)



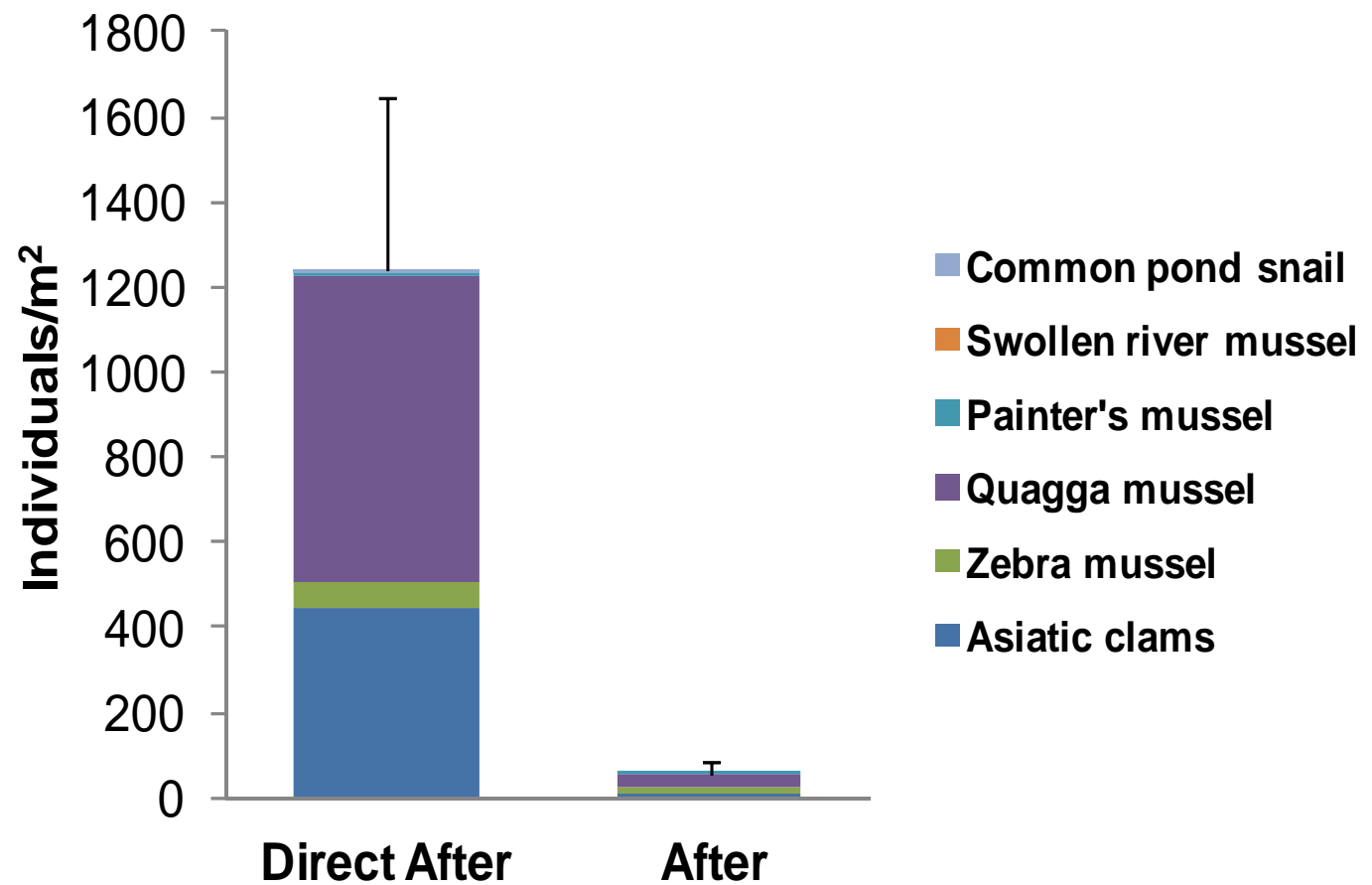
Results 1: Water levels in impounded sections



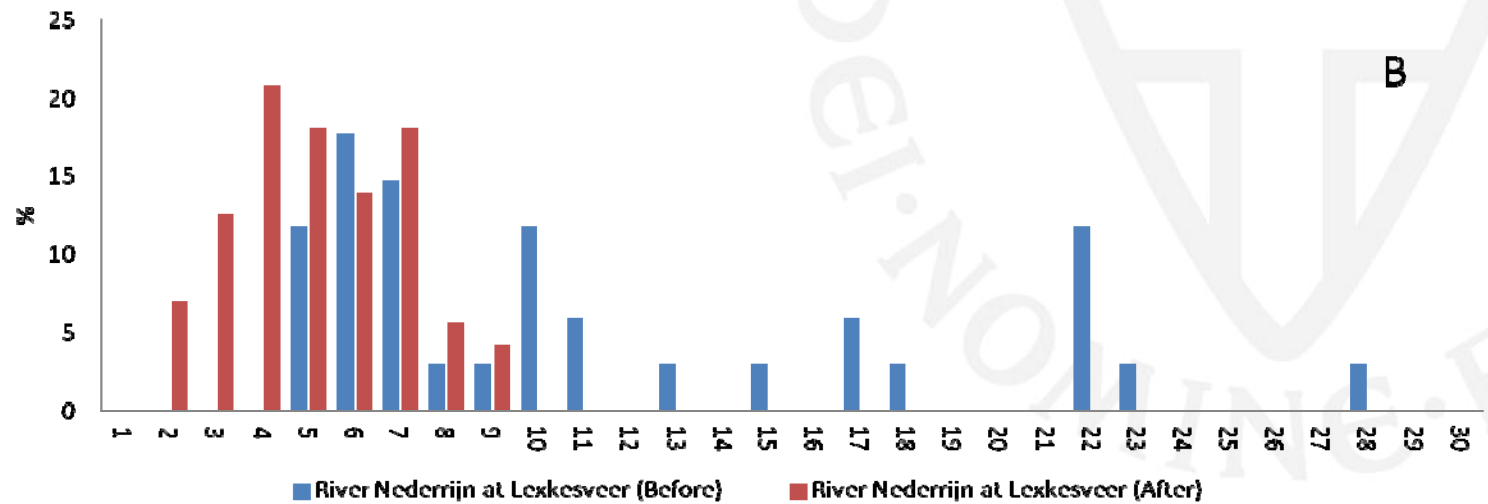
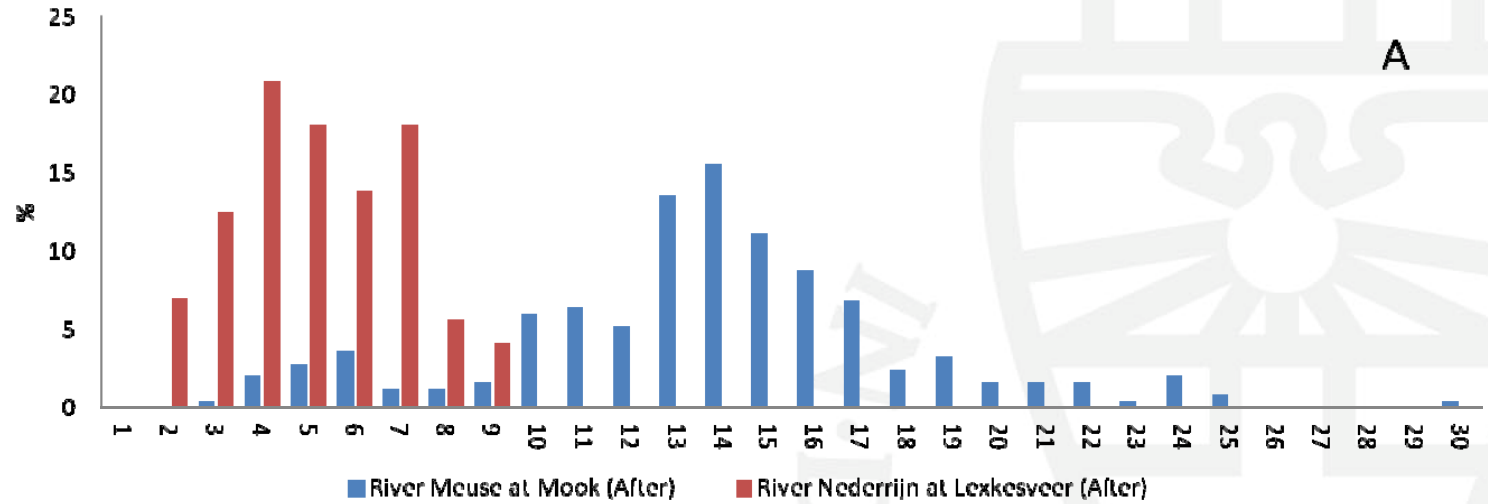
Results 2: Mussel densities before-after and control



Results 3: Shore wash from the River Nederrijn at Lexkesveer



Results 4: Proportion of Quagga mussel individuals per size class



Discussion



1. Cost-effective measure: no additional costs and no problems shipping
2. Timing and duration is relevant!
3. Recovery time of populations?
4. Effects on non-natives versus invaders?
5. Also effective for Asiatic clams (Lake Constance)
6. Other extreme events: e.g. extremely low discharge combined with high water temperature (NL, Portugal, Hungary)
7. Mass mortality of invaders -> mechanism and role in resources subsidy



Conclusions

1. Creating extremely low water conditions by weir management during severe winters appeared to be a feasible tool to control population densities of invasive mussels in impounded river sections
2. Full recovery of invasive mussel populations after extreme mortality events will take at least several years
3. Understanding of effects on species composition and densities of natives and invaders requires long term monitoring
4. Effect analyses of mass mortality during various types of extreme events contribute to a mechanistic understanding of effects of multiple stressors and key factors for management of bioinvasions



Thanks for your attention - Questions?

