Experimental impact of ammonium, carbon dioxide and water levels on amphibious softwater plant communities

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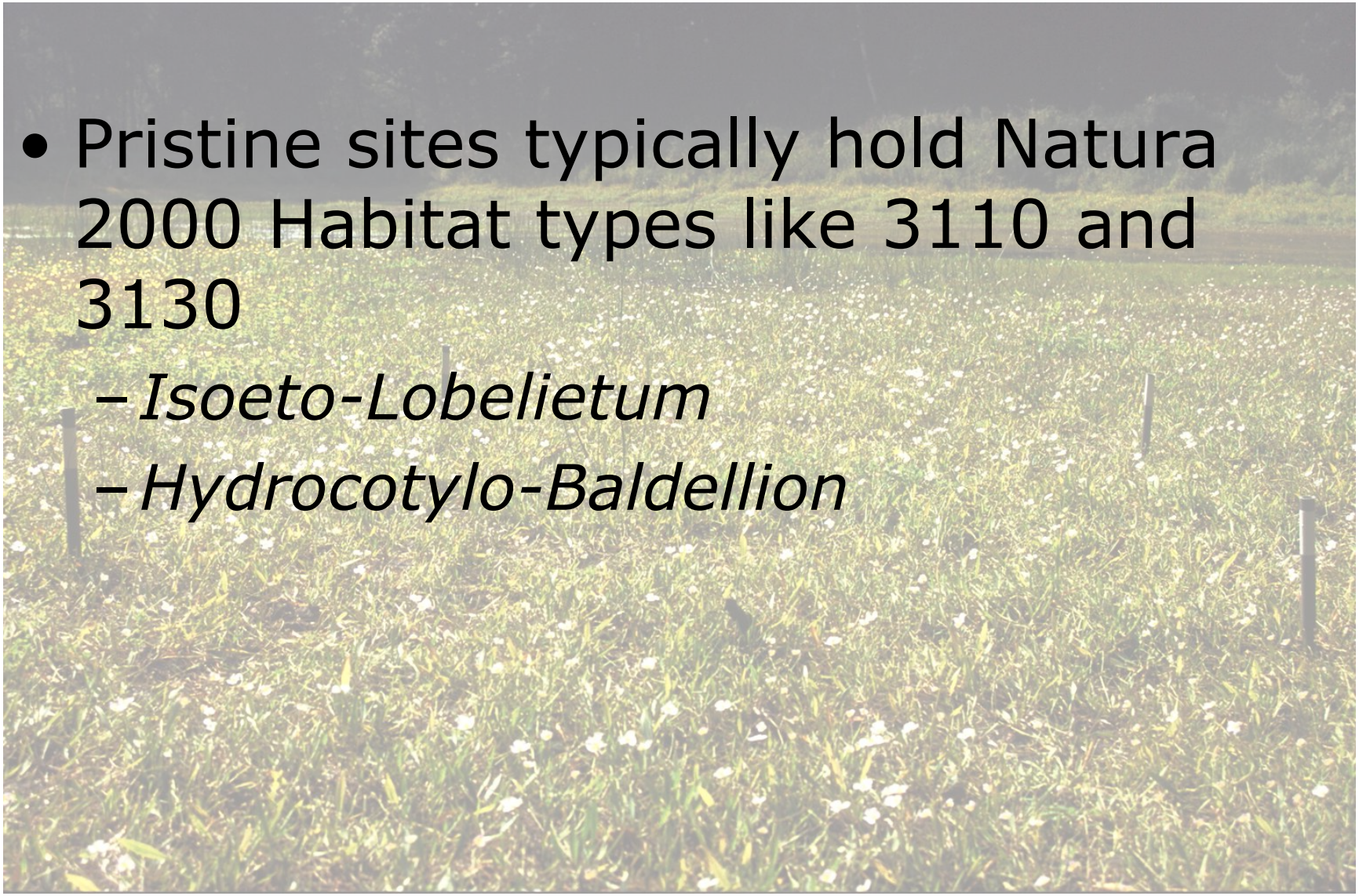
Shallow softwater lakes

- Common in NW Europe, mainly on sandy(-loamy) soil
- Fluctuating water tables: ecologically a disturbance
- Very stressful (in its pristine state): low on N, P and aquatic C
- Vulnerable to acidification and eutrophication

Shallow softwater lakes



- Pristine sites typically hold Natura 2000 Habitat types like 3110 and 3130
  - *Isoeto-Lobelietum*
  - *Hydrocotylo-Baldellion*

Shallow softwater lakes

- Challenge:
  - to improve the efficacy of conservation measures
  - to advance predictive ecology for these plant communities

➔ insight is needed in the response of macrophyte species to stress and disturbance in various competitive environments

Questions

1. Considering plant community composition:
   - what is the importance of water level, NH_4^+ and (aqueous) CO_2 nutrient availability …
   - … relative to intrinsic properties of the actual species that are present (species identity; life strategy)?
2. Is competitive suppression at work under high NH_4^+ and CO_2 level?

Methods

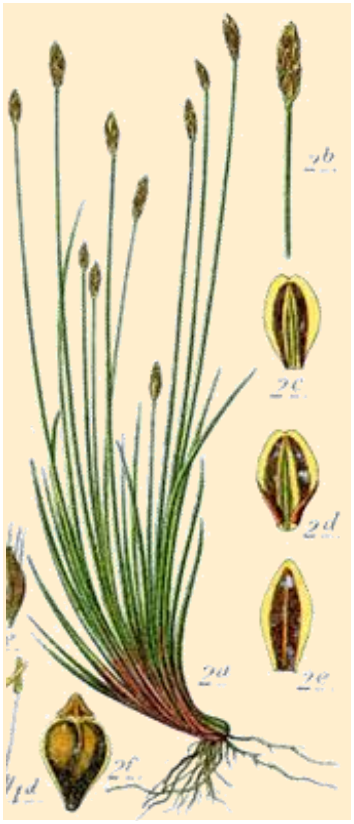
- Multispecies experiment with 4 selected species:
  - *Luronium natans*
  - *Baldellia ranunculoides ssp. repens*
  - *Eleocharis multicaulis*
  - *Hydrocotyle vulgaris*
- they all combine traits of 2 or more plant ecological strategies

4 species

Luronium

Baldellia

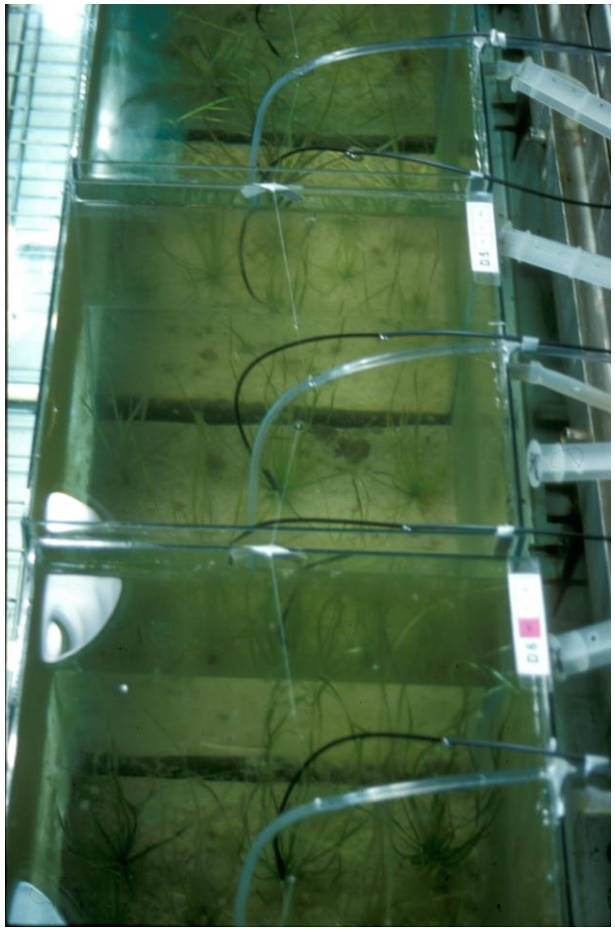
Eleocharis



Hydrocotyle

Experimental design

Experimental plant communities in glass aquaria



Experimental design

- Duration: 202 days in order to simulate one complete growing season
- From day 93 till 115, water level was gradually lowered to attain an emersed state with groundwater at ground level

Experimental design

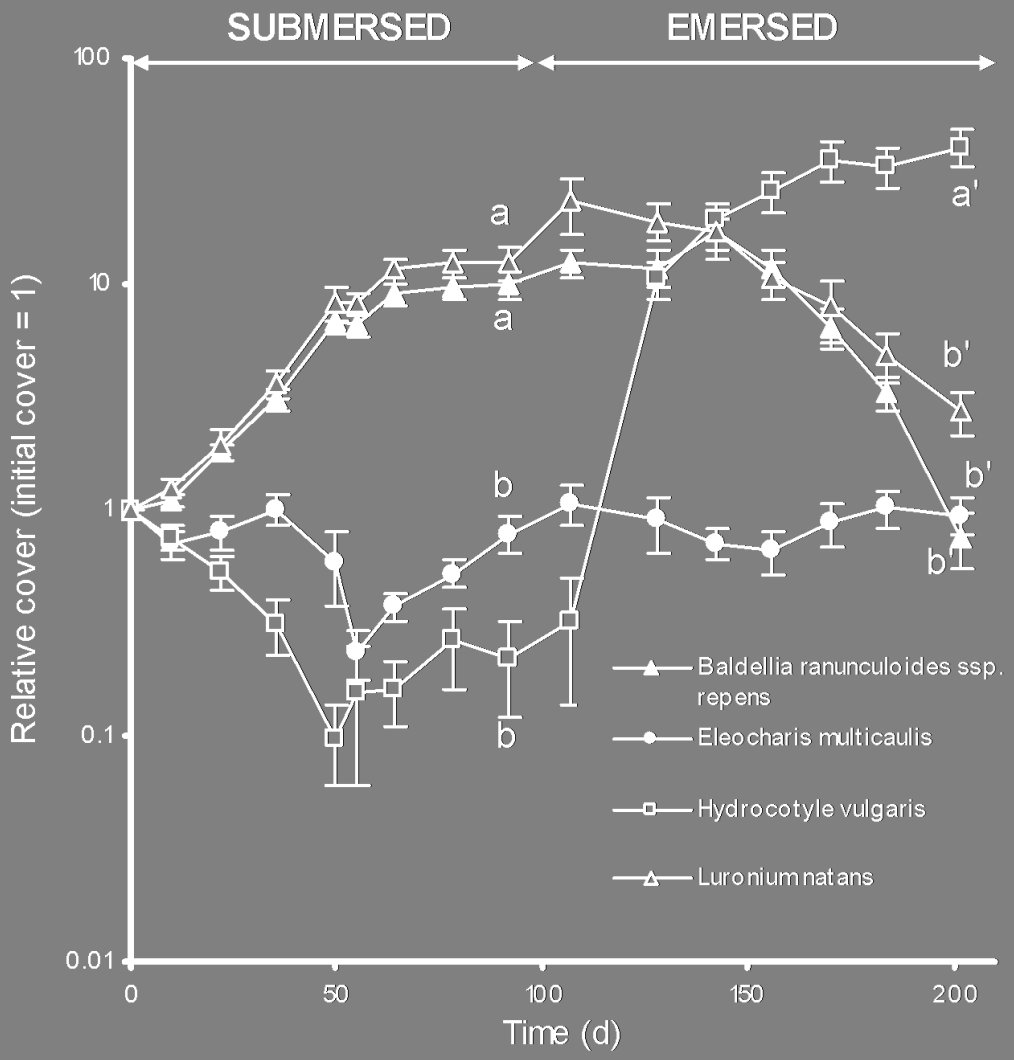
- Communities were subjected to:
  - 2 levels of CO_2 (none added / 500 µmol L^{-1})
  - 2 levels of NH_4^+ (0 / 50 µmol L^{-1})

  → *full-factorial design*
- Monocultures of *Eleocharis* and *Baldellia* were grown at high NH_4^+ and high CO_2 levels, for comparison with their response in community

Experimental design

- Treatments were replicated 4 times
- Every two weeks, several population performance measures were collected
- Analyzed as a split-plot design with repeated measures, allowing direct comparison between species

Results

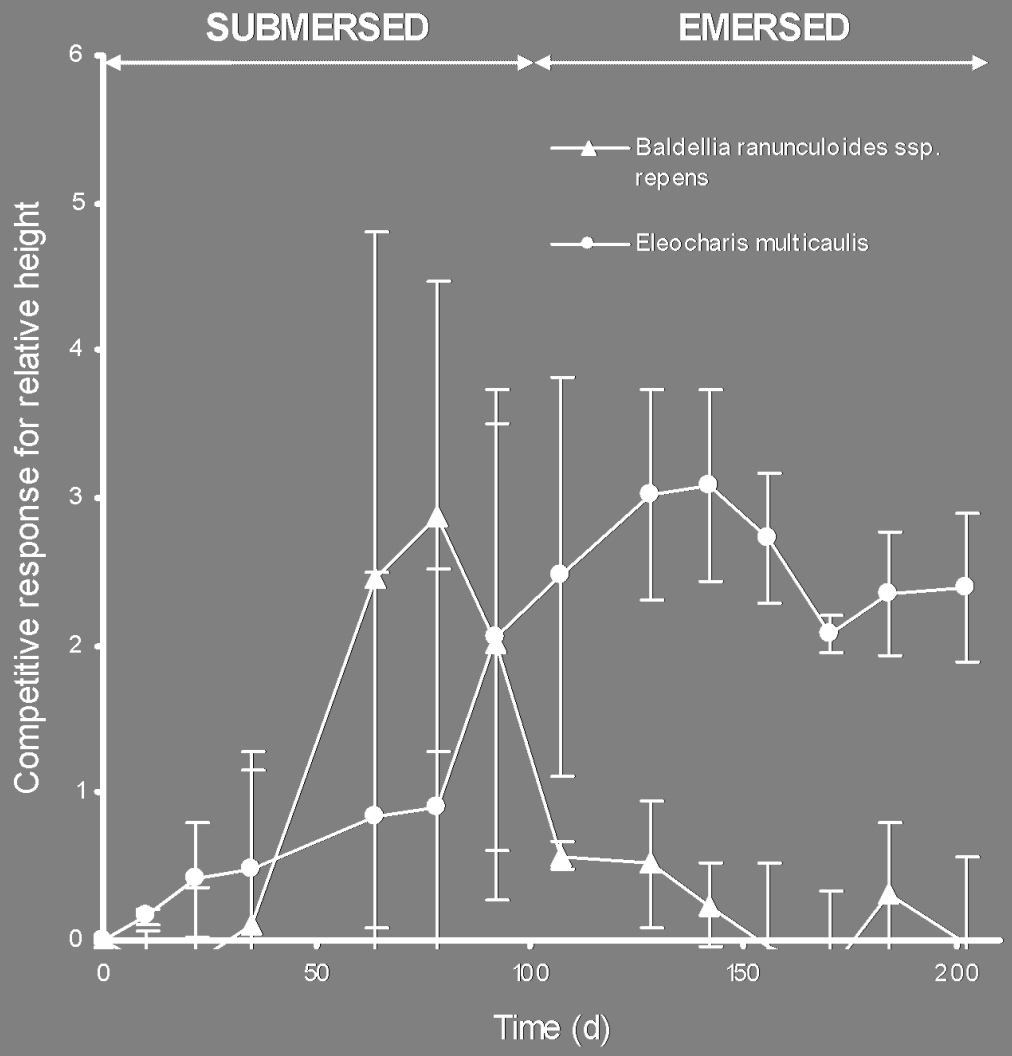


Relative species performance (dominance hierarchy)

- was strongly impacted by water level, but generally not by N or C availability
- was not the same as expected from life strategy theory

(Vanderhaeghe et al., subm.)

Results



Competitive response

- was significantly larger than zero
- depended on species, hydrological stage and performance measure

(Vanderhaeghe et al., subm.)

Discussion

- Submersed and emersed stage each had a stable dominance hierarchy, which was hardly affected by nutrient levels

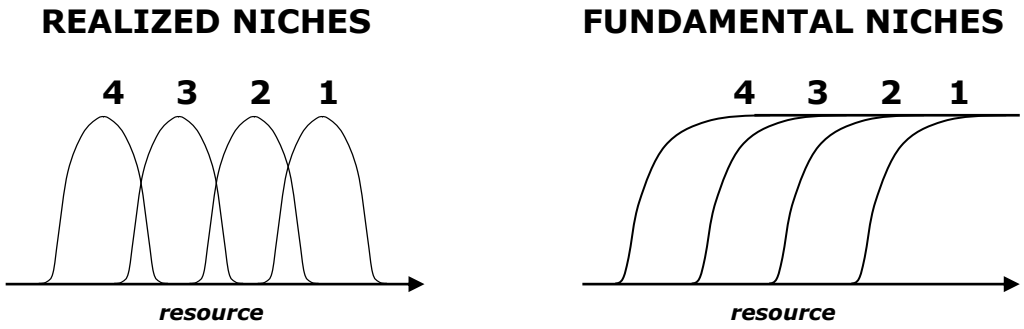
  ➔ intrinsic species characteristics seem to have outweighed the importance of nutrient levels

Discussion

- Dominance hierarchy in freshwater macrophytes seems difficult to predict
  - ➔ possibly because of their functional plasticity

Discussion

- Competition was at work
  - ➔ the actual *presence* of certain species determines the species positions along the resource gradient (their realized niches)
- Keddy's model



Conclusions

- **Hydrological stage** was the most important environmental factor
- Plant performance was **species-dependent**
- **Nutrients** did not have major effects during this one growing season
- Dominance hierarchy in freshwater macrophytes seems **difficult to predict** from current plant ecological theory
- **Experimental data** of the performance of macrophytes in a community setting are rare and much needed

Many thanks

- Thanks to the owners and nature managers for permissions
- Thanks to all co-workers
- Special thanks to RU Nijmegen for their lab facilities
- Financial support: Fund for Scientific Research – Flanders

Experimental design

- One replication series: