



# Overview of research activities

Ellen van Donk

Department of Aquatic  
Ecology

Netherlands Institute of  
Ecology

NIOO-KNAW

# Department of Aquatic Ecology

## KNAW positions

- Ellen van Donk (*Head*)
- Wolf Mooij (*Sen. scientist*)
- Bas Ibelings (*Sen. scientist, 2009*)
- Liesbeth Bakker (*tenure track, 2010*)
- Steven Declerck (*tenure track, 2010*)
- Lisette De Senerpont Domis  
(*proj. manager research valorization, 2012*)
- Michaela Brehm (*assistant*)
- Suzanne Wiezer (*assistant*)
- Nico Helmsing (*assistant*)
- Koos Swart (*assistant*)
- Dennis Waasdorp (*assistant*)

total 11

## Externally funded positions

5 Postdocs

10 PhD students

9 external PhD students

10 MSc Students

### Guest researchers:

Anthony Verschoor (*Ingrepro*)

Miquel Lüring (*WUR*)

Jan Janse (*PBL*)

Koos Vijverberg (*retired*)

Ramesh Gulati (*retired*)

total 39

# Outline



- Research questions
- Research projects



# Research questions

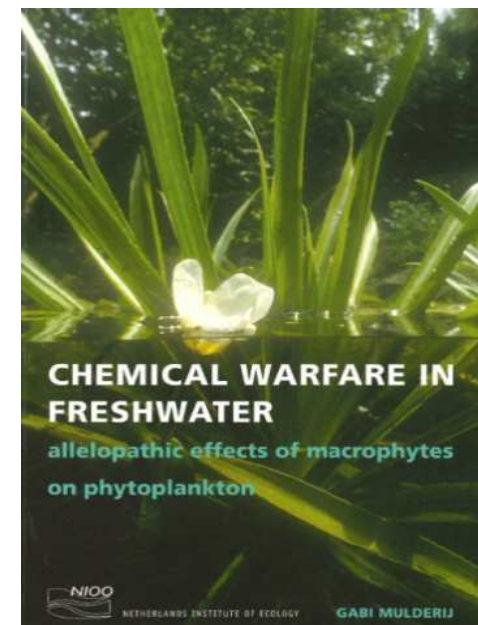
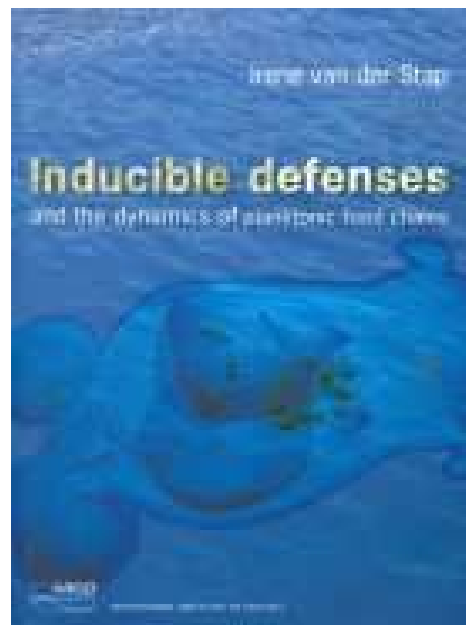
- 1. Can we identify the ecological drivers of species interactions in aquatic systems?*
- 2. How does environmental change affect food web interactions in lakes?*
- 3. Which are the main drivers of aquatic biodiversity in space and time?*
- 4. How to make ecological knowledge applicable for restoring and developing ecosystem services?*

# Research Question 1

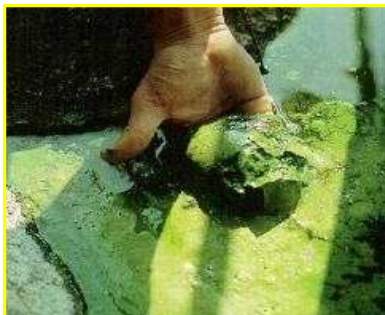
*Can we identify the ecological drivers of species interactions in aquatic systems?*

- Chemical information transfer
- Co-evolution

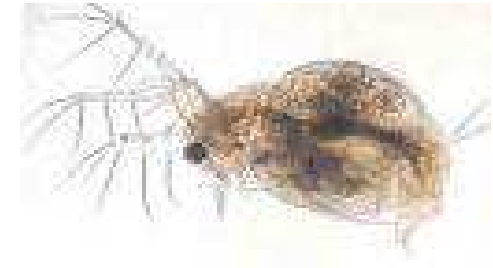
# Chemical information transfer



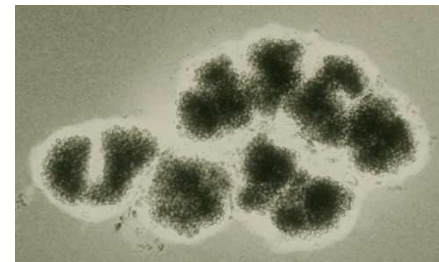
# Induction of toxin in cyanobacteria



*Daphnia magna*



*Moina macrocopa*

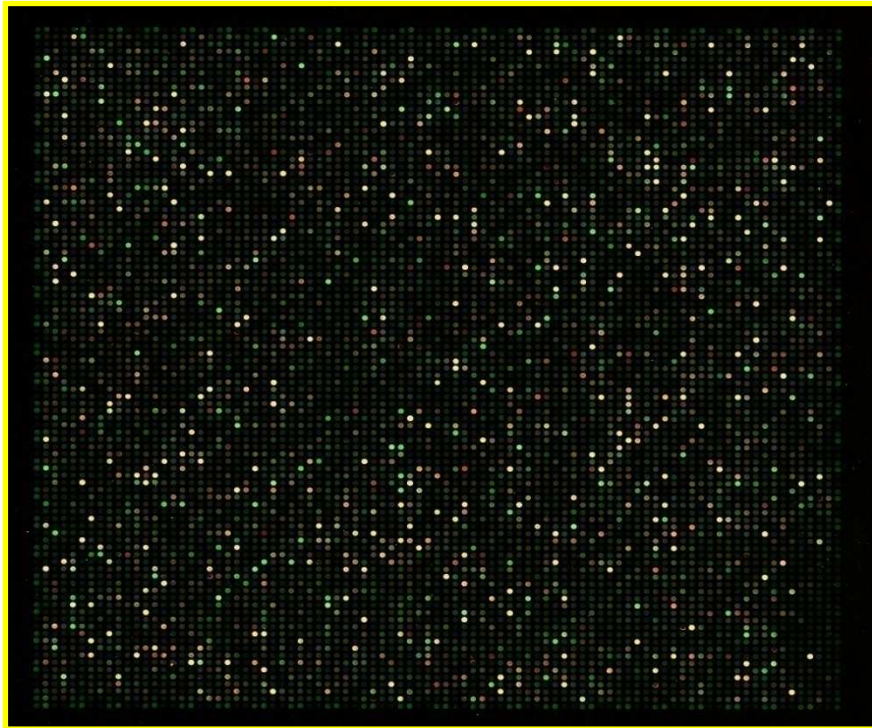


*Microcystis aeruginosa*

Microcystin ↑



# Genomics: induced defenses



microarray

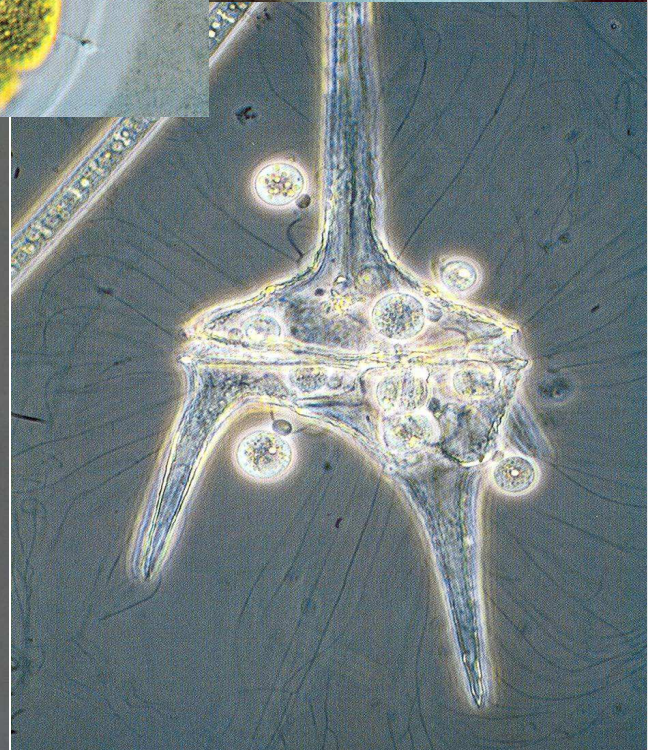
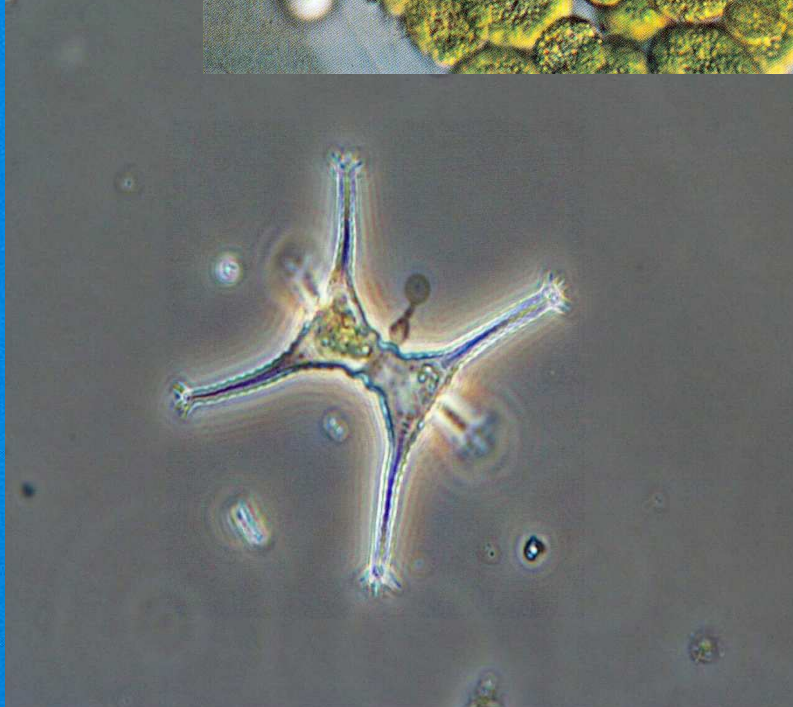
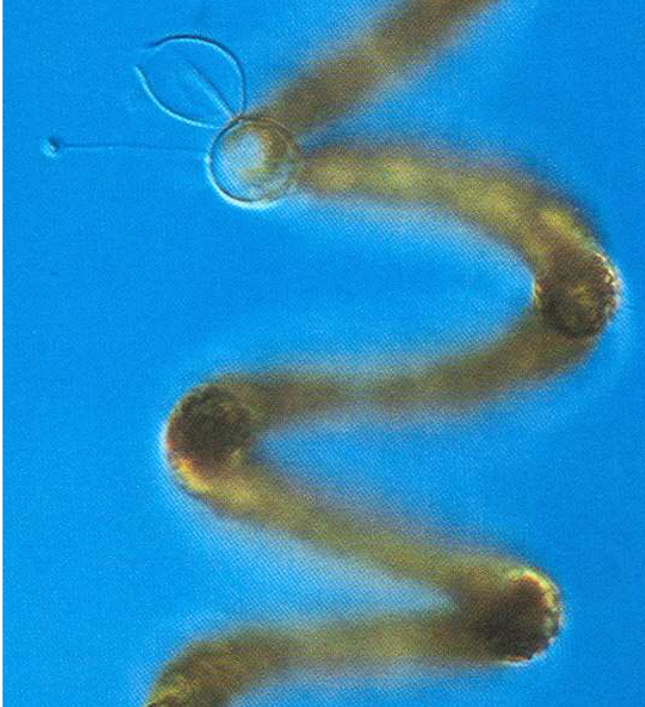
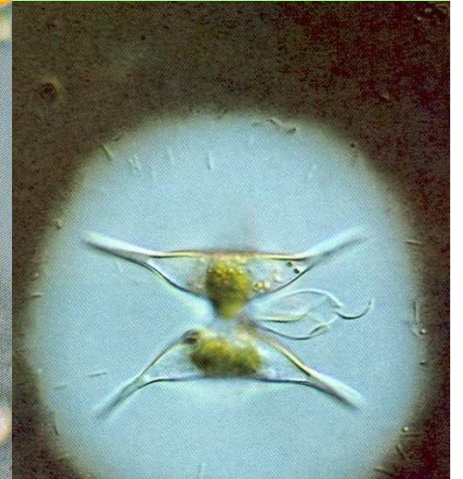
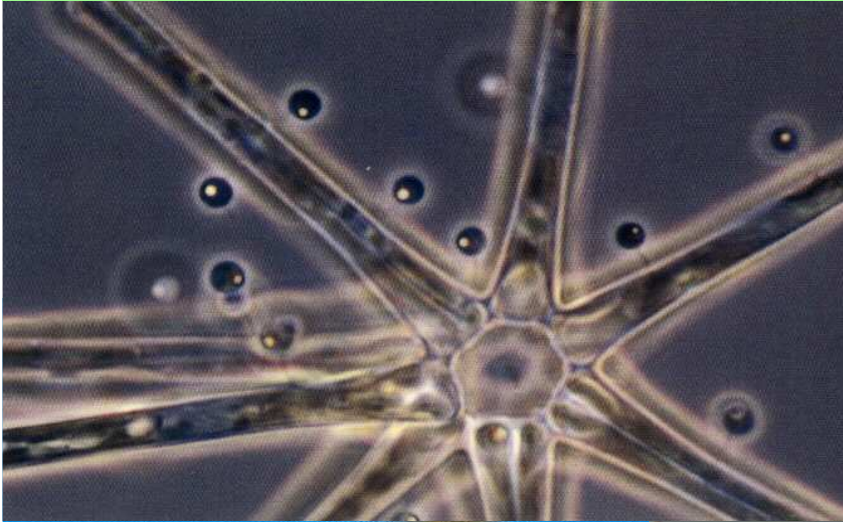
## Expression of genes in *Microcystis*:

- 1) Toxin production
- 2) Colony formation

Cooperation with:  
UVA

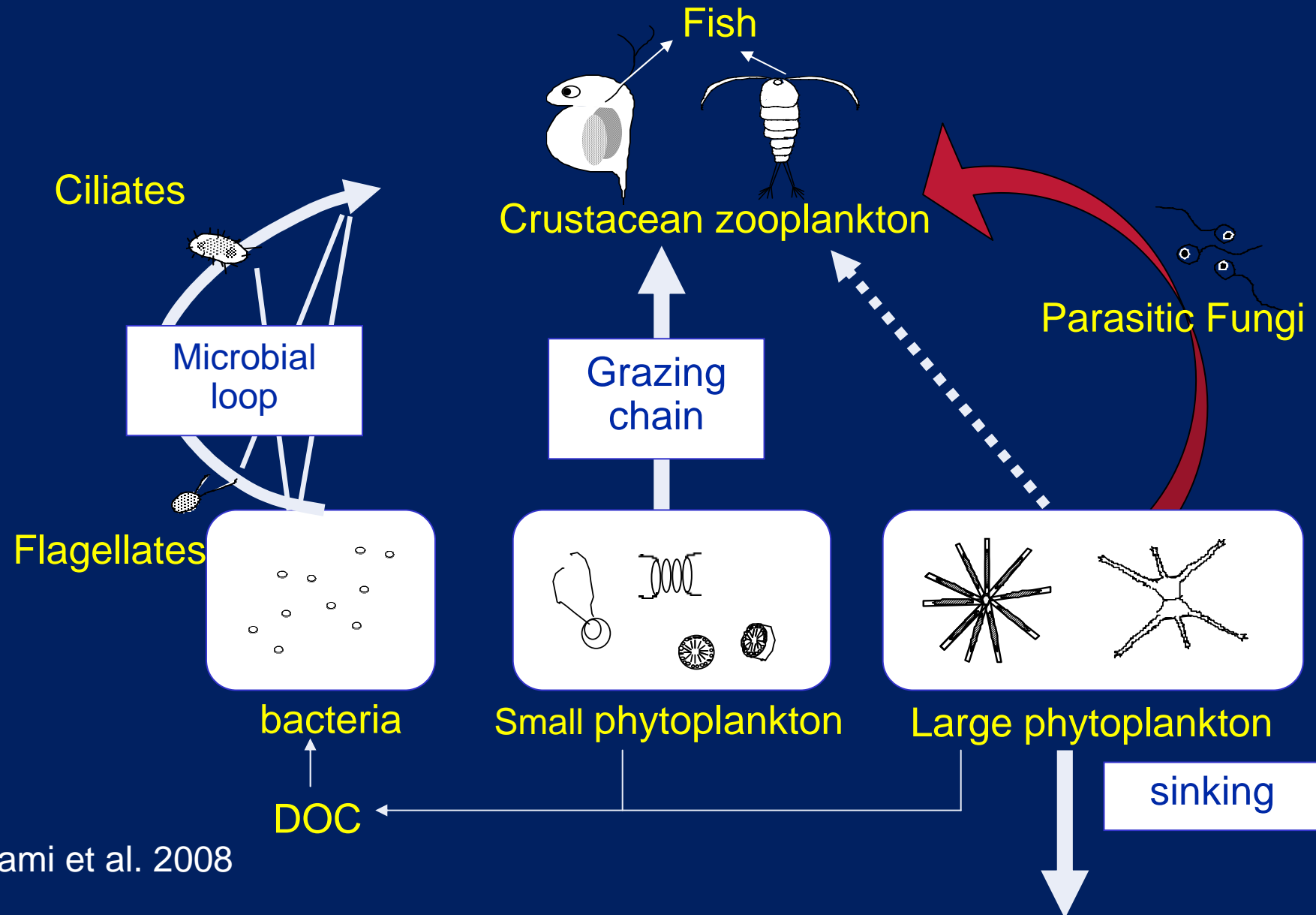


# Parasitic fungi on algae





# Aquatic Food Webs





# Parasitic fungi on algae

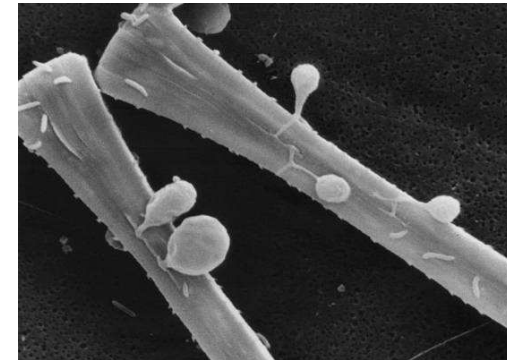
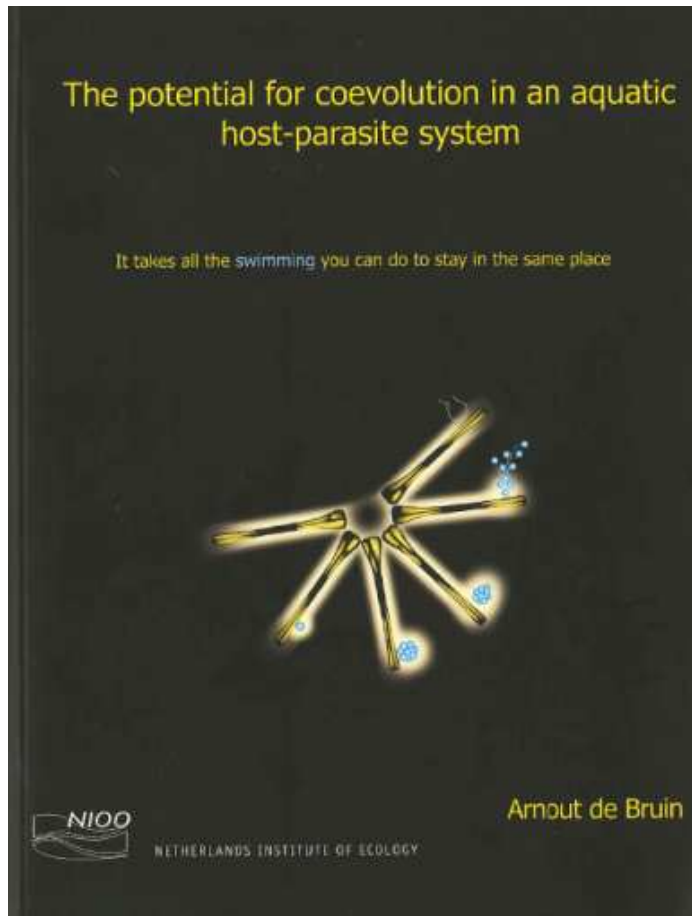


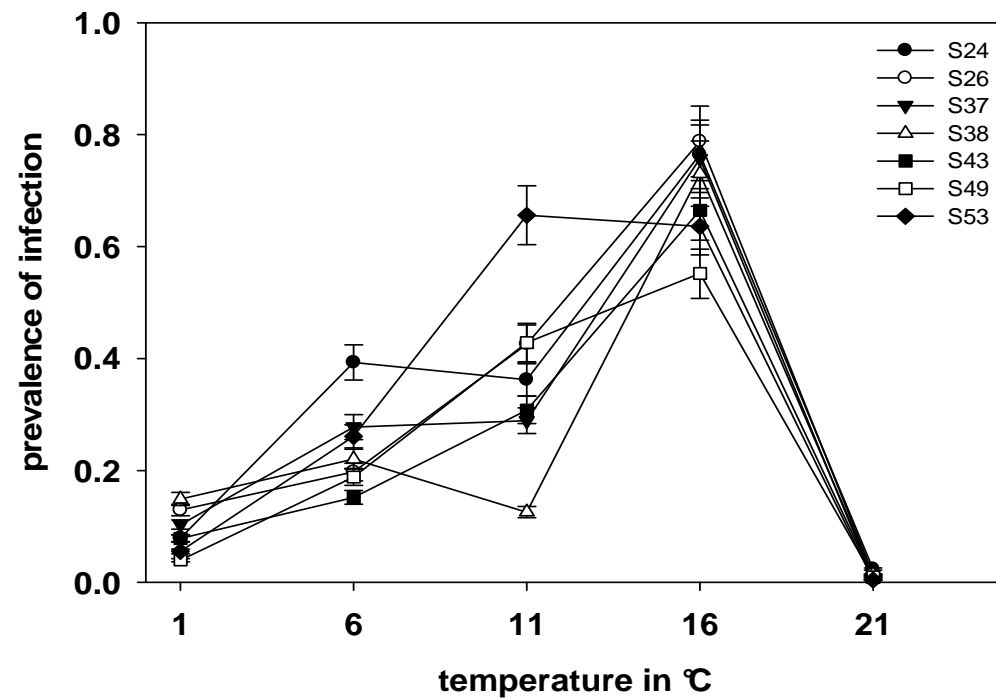
Photo E. van Donk

Host genetic diversity holds back parasite evolution



# Infection success

depends on host  
genotype and  
temperature effects

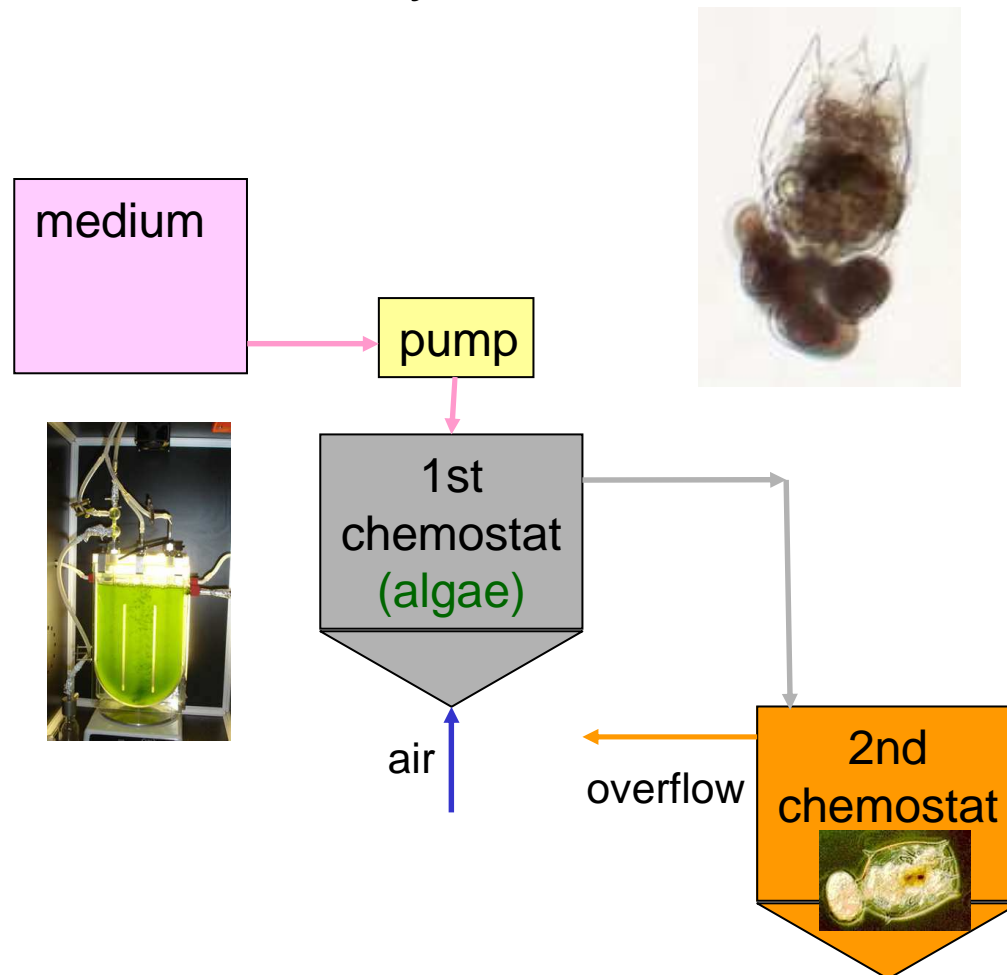






# Feedbacks between ecology and evolution

Experimental evolution using small aquatic metazoans, such as the rotifer *B. calyciflorus*



Spatial dynamics



Ecological interactions



Evolution



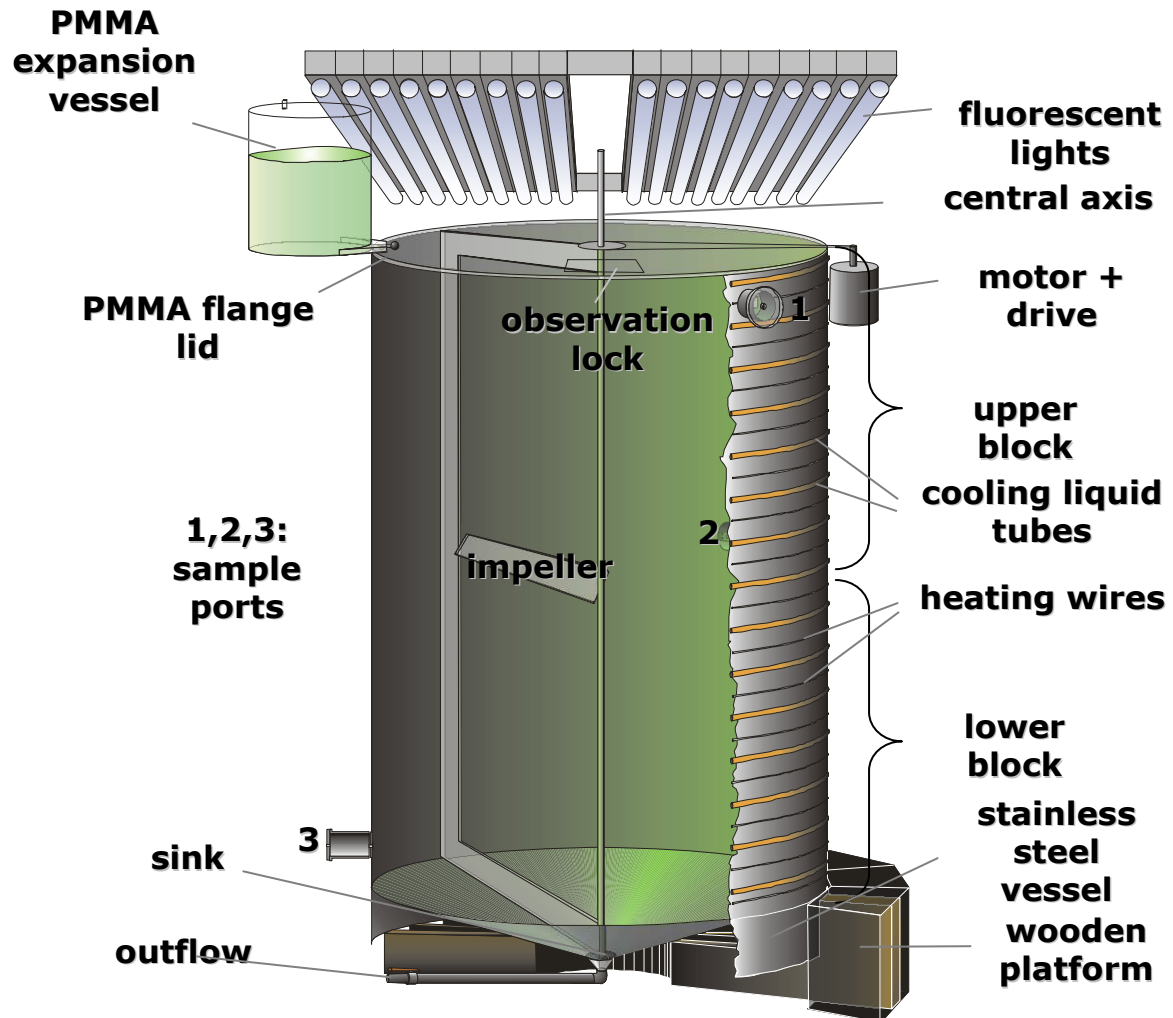
Community, food web,  
ecosystem

# Research Question 2

*How does environmental change affect food web interactions in lakes?*

- Increased Temperature
- Increased CO<sub>2</sub>
- Eutrophication and Re-oligtrophication
- Exotic species

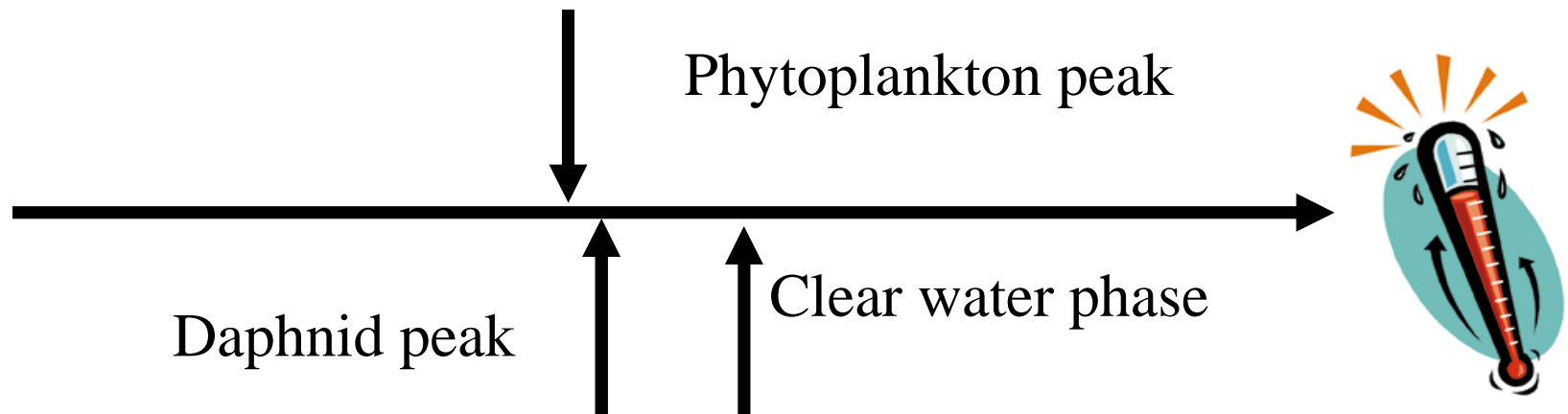
# Limnotrons





# Climate induced phenology shifts

Match

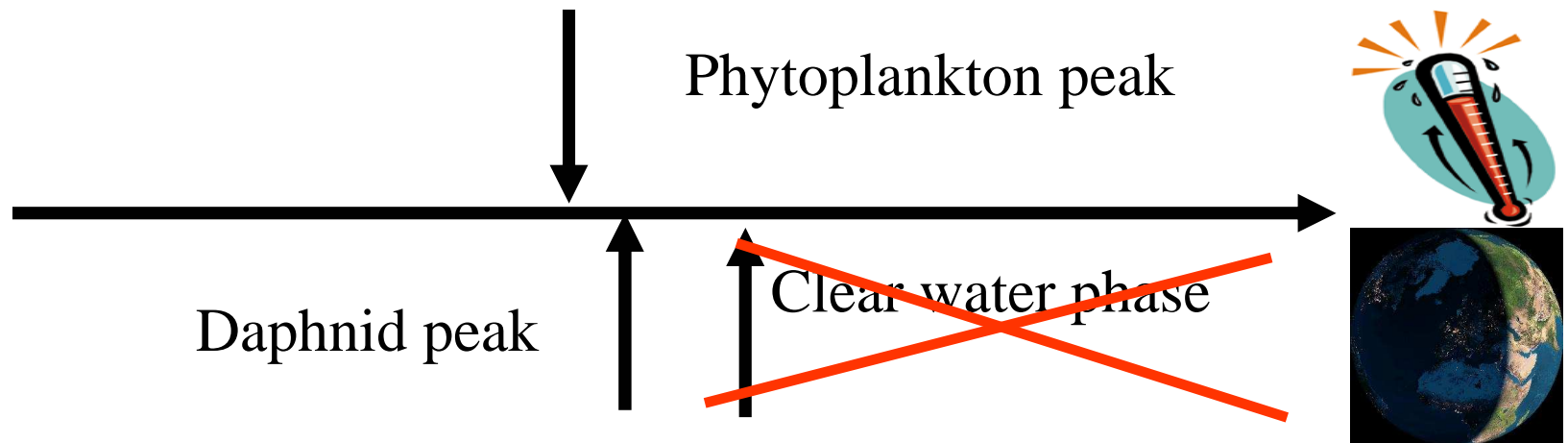






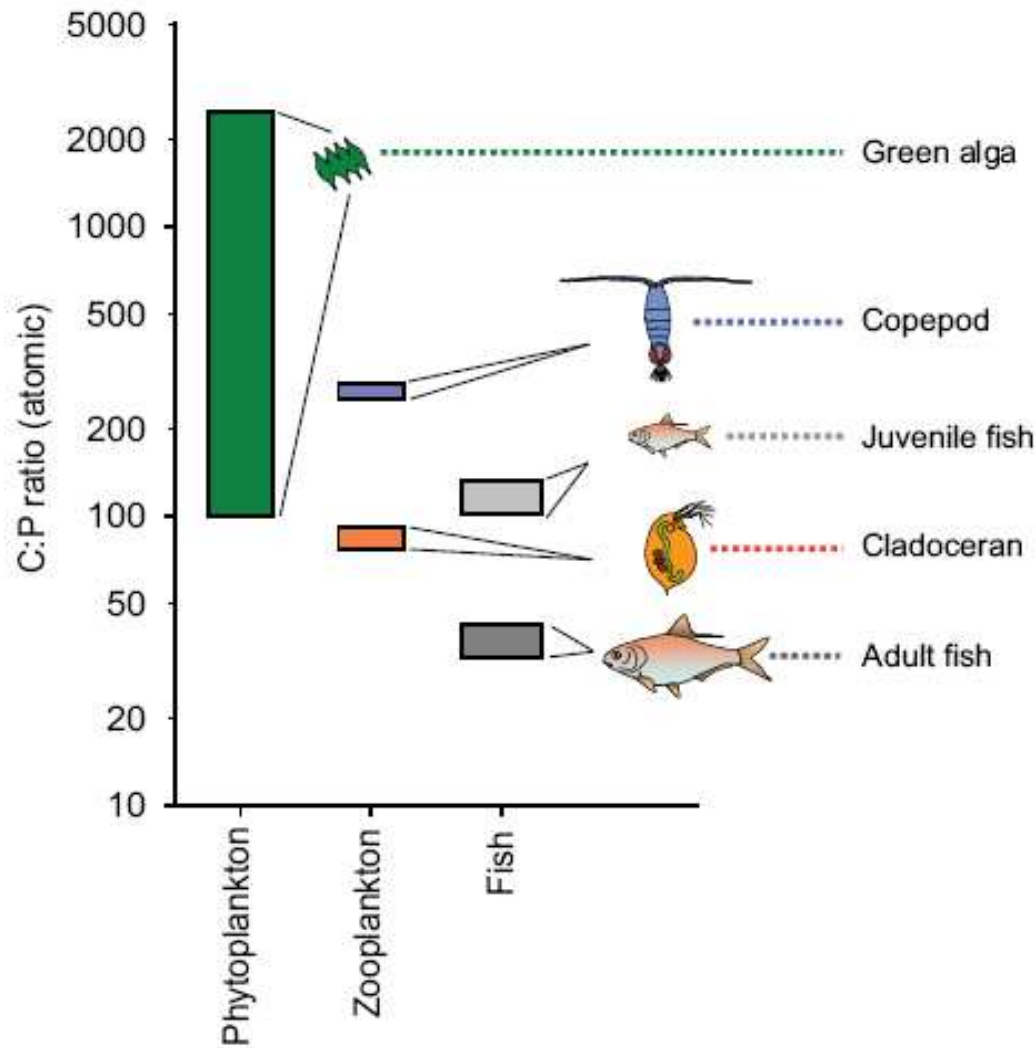
# Climate induced phenology shifts

## Mismatch



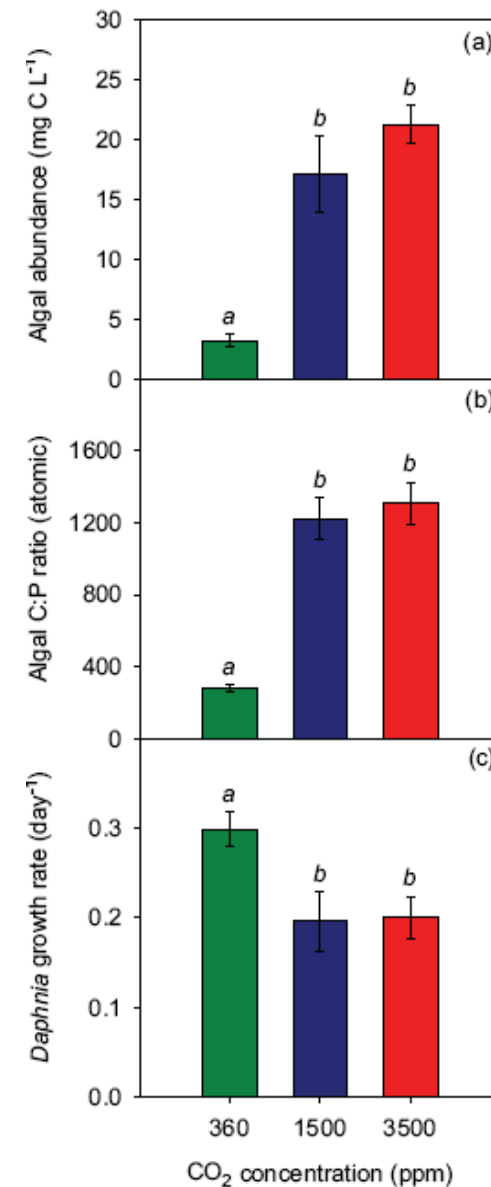


# Increased CO<sub>2</sub> and Stoichiometry



Cooperation with:  
UVA  
Univ. Oslo

Van der Waal et al. 2010





# Reoligotrophication of Lake IJsselmeer

Natura 2000



P

Cooperation with:  
Waterdienst  
Deltares  
Imares  
WUR





# Exploitation or eutrophication as threats for fisheries in Lake Victoria?



Lake Victoria 1969



Lake Victoria 1993

Cooperation with  
Imares  
WUR





# Interaction between macrophytes and herbivores

Stoichiometry, secondary metabolites, toughness



*Procambarus clarkii* (Crayfish)



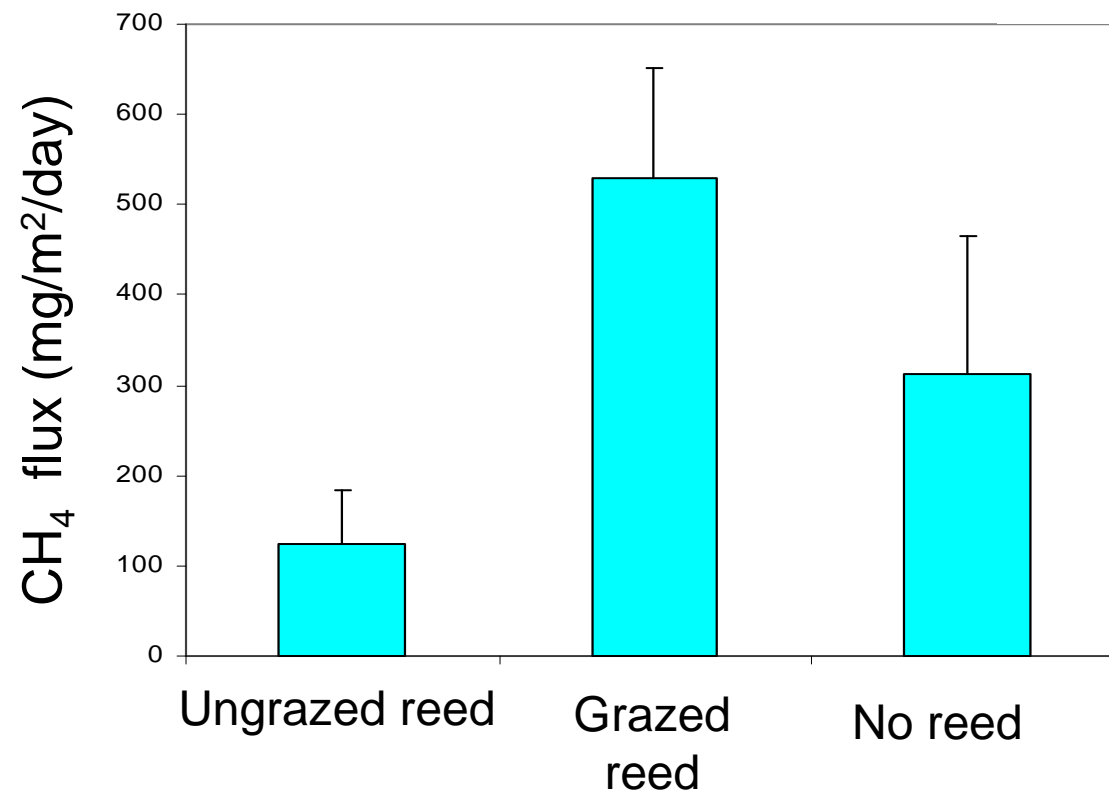
Coots

Cooperation with  
Waternet and  
Natuurmonumenten



# Herbivory by geese affects ecosystem functions

## Methane emission



Dingemans, Bakker & Bodelier,  
Ecology (2011)

# Research question 3

*Which are the main drivers of aquatic biodiversity in space and time?*

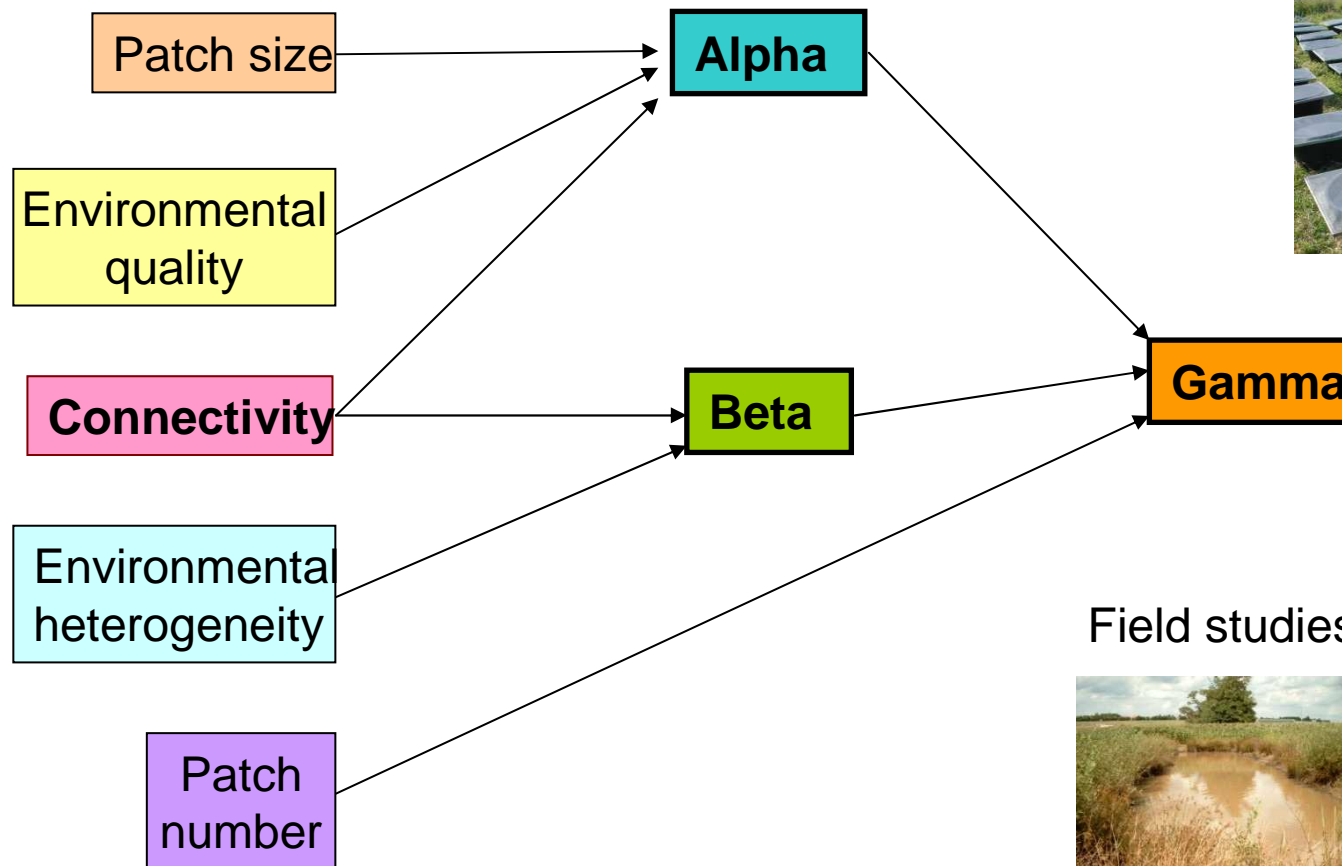


- Communities assemble
- Community composition and diversity are determined by local/regional spatial processes





# Metacommunity ecology: mechanisms that shape landscape wide aquatic biodiversity



Mesocosm experiments



Field studies







# Ecosystem functions and biodiversity of freshwater macrophytes

## Experimental ponds Loenderveen



Cooperation with:  
Waternet

# Research question 4

*How to make ecological knowledge applicable for restoring and developing ecosystem services?*

- Apply knowledge obtained from the other themes for water management, nature conservation and developing ecosystem services
- Use of ecosystem models like PClake and PCditch



# Introduction of mussels

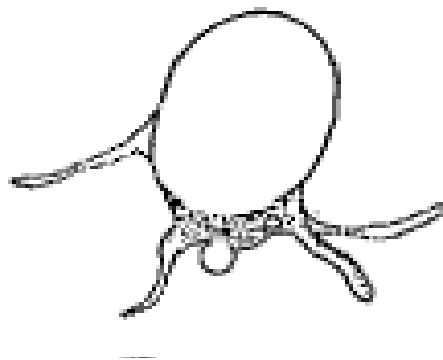




# *Ochromonas* grazing



*Ochromonas globosa*



Cooperation with:  
UVA  
Univ. Oslo





# Lake restoration

## Increasing macrophyte abundance and biodiversity



Water level fluctuations



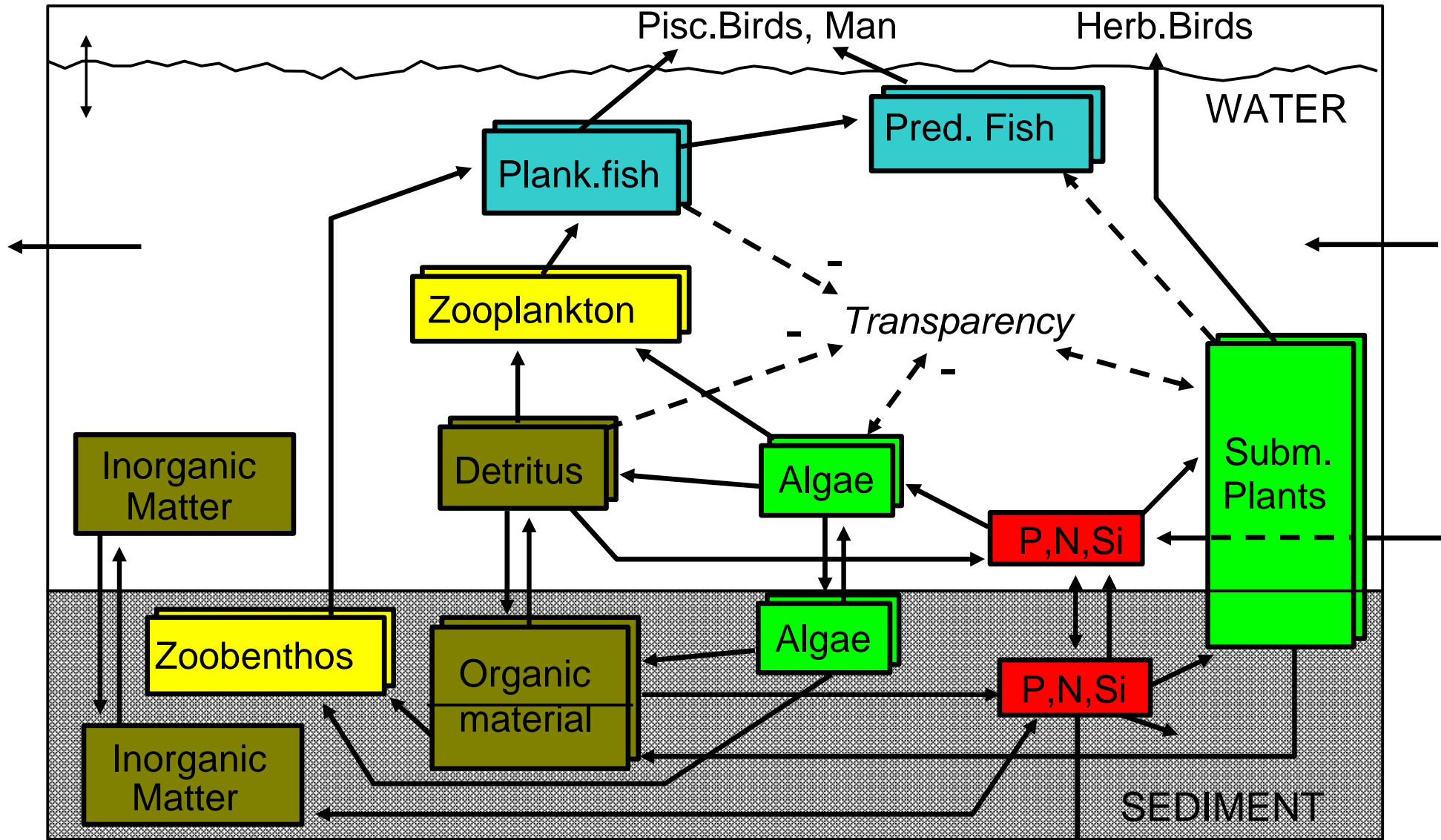
Iron supplementation



Cooperation with:  
Waternet  
Agentschap NL



# Complex dynamic models (PC Lake)



Collaboration with Jan Janse, PBL



# Model PCLake and PCDitch: research applications

## ***Historical applications:***

- Eutrophication studies/critical nutrient loading
- Alternative stable states in shallow lakes

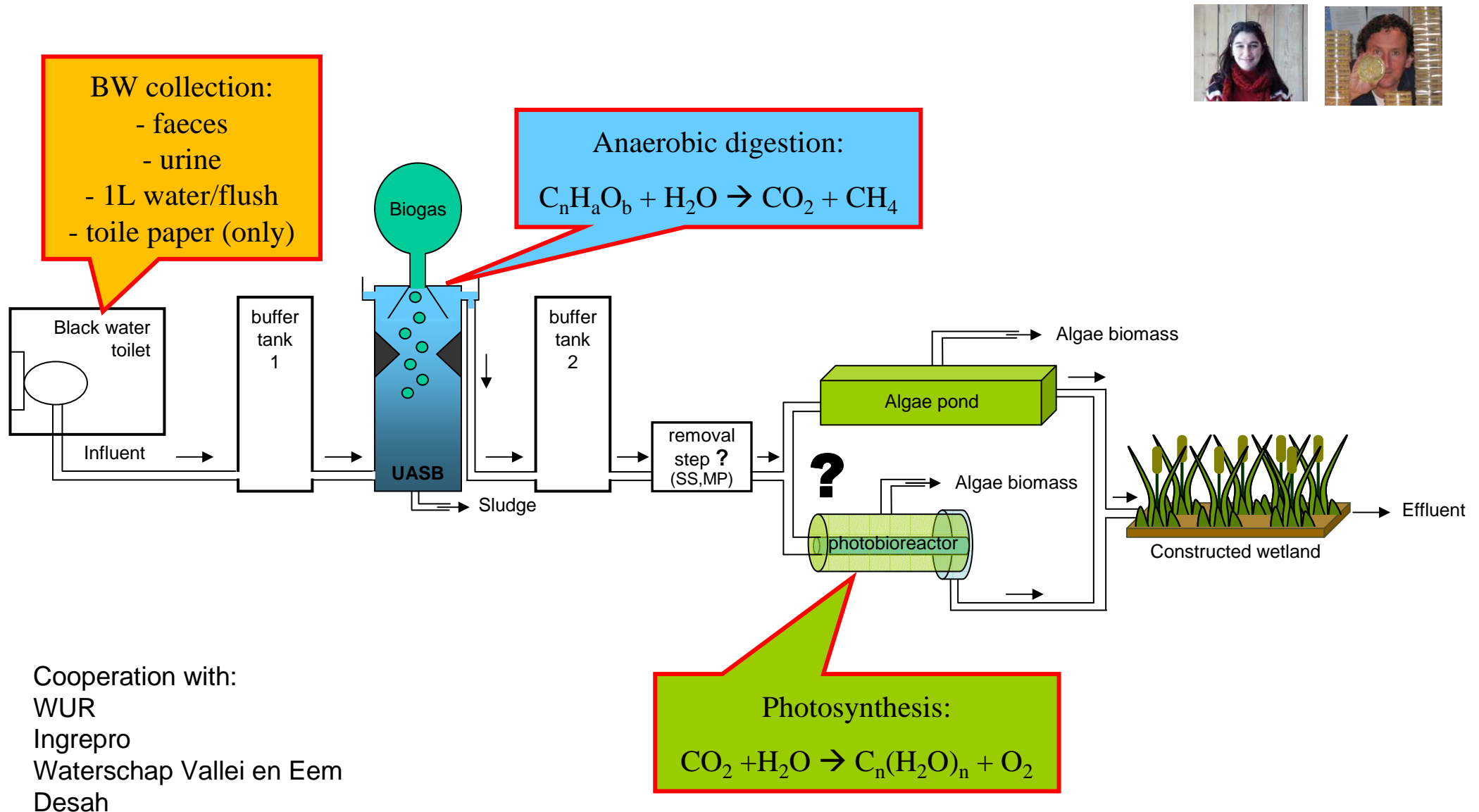
## ***Current applications:***

- Climate change
- Coupling between lakes and wetlands

## ***Potential applications:***

- Paleo-climate
- Benthic-pelagic coupling
- Stoichiometric aspects of nutrient loading

# Recycling Black Water (BW) nutrients by algae-based photobiodegradation (ALGOBIOLOOP)





# Recycling Black Water (BW) nutrients by algae-based photobiodegradation (ALGOBIOLOOP)

## Objective:

- Recover nutrients (N, P, K) present in anaerobically treated BW (toilet water) by photobiodegradation (growing algae)

### end products:

- clean water suitable to discharge in surface water
- algae biomass suitable for further use (e.g. fertilizer)

## In addition:

- Determine best way to remove faecal pathogens present in BW
- Determine persistence of micro-pollutants (pharmaceuticals, hormones) and heavy metals throughout treatment steps



# Valorization:

AKWA (Aquatisch Kenniscentrum Wageningen)

- Advice
- Training (courses)
- Research focusing on applied issues

# Department of Aquatic

