Title

Critical values for phosphorus loading in ditches and streams.

Jeroen de Klein,
Annelies Veraart,
Jan Janse

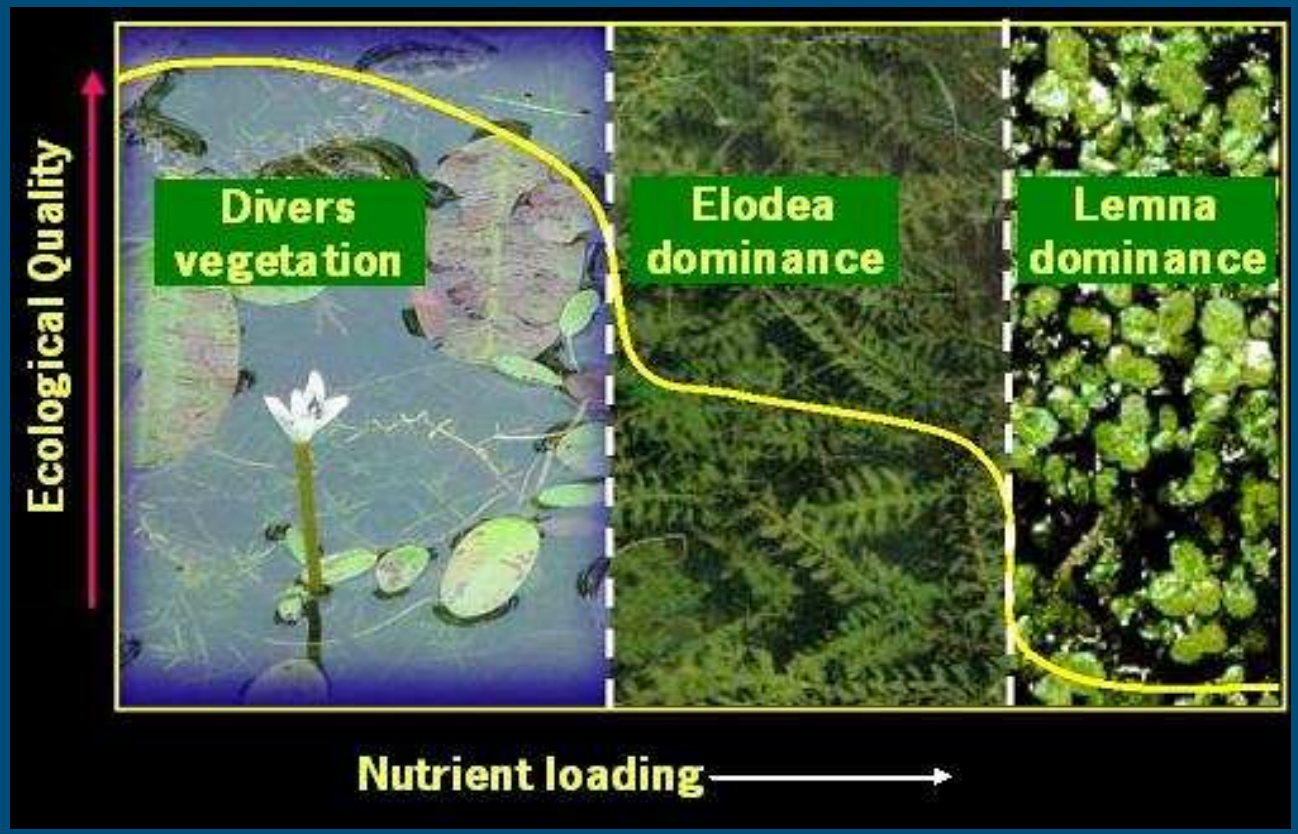
WAGENINGEN UNIVERSITY
ENVIRONMENTAL SCIENCES

Introduction

- good ecological status ditches
- P and N loading
- alternative stable states
- global warming → biochemical processes
- complex feedbacks → ecological model

Introduction

- Good ecological status ditches → submerged macrophytes
- Ecological quality affected by P and N loading



Macrophyte State

State Transition

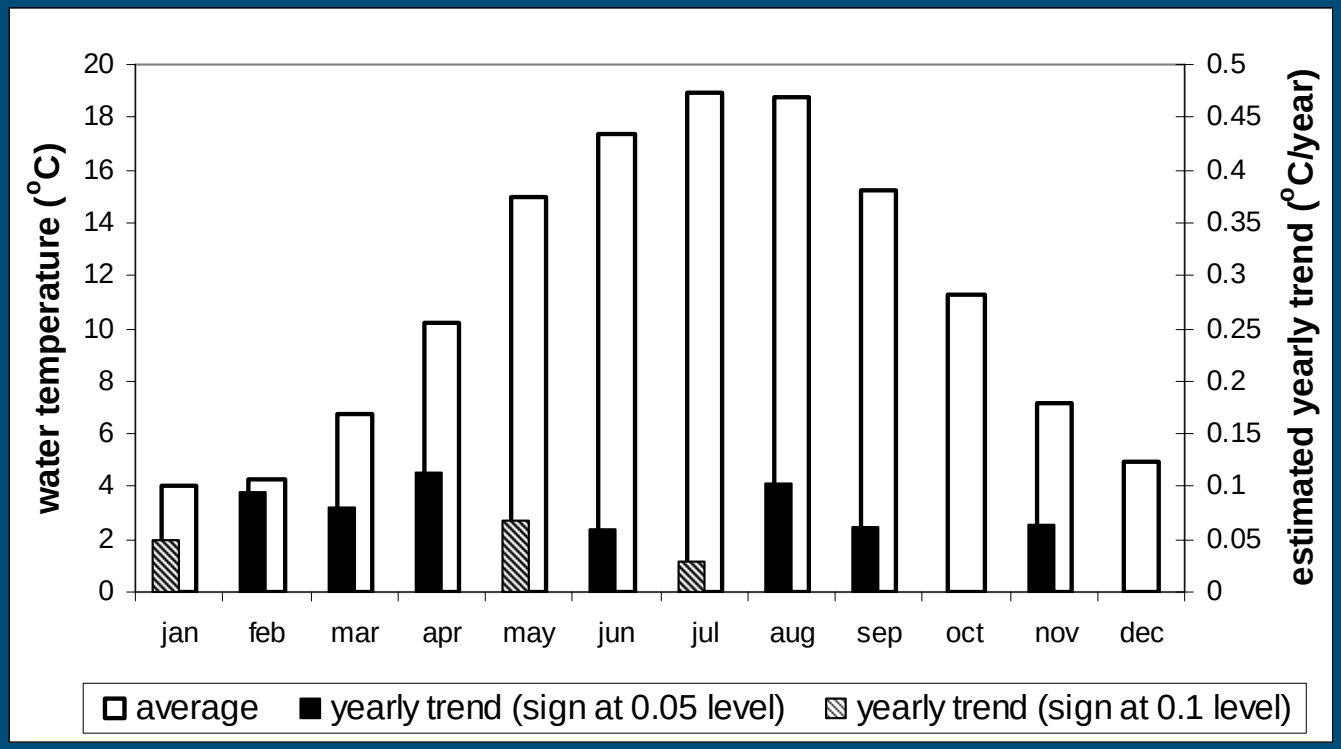
- vegetation state can differ from year to year
- N P loading, depth
- Management and maintenance

Complex !

- In addition Climate Change

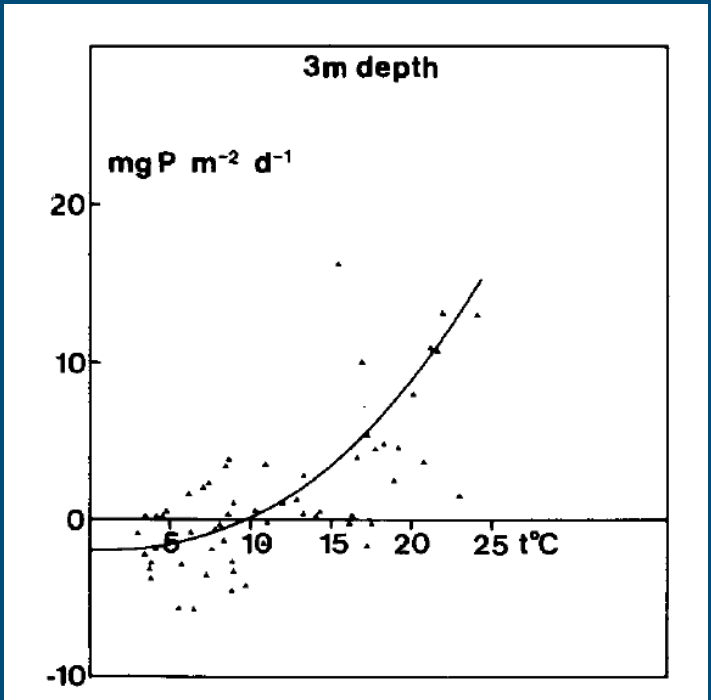
Temperature in ditches

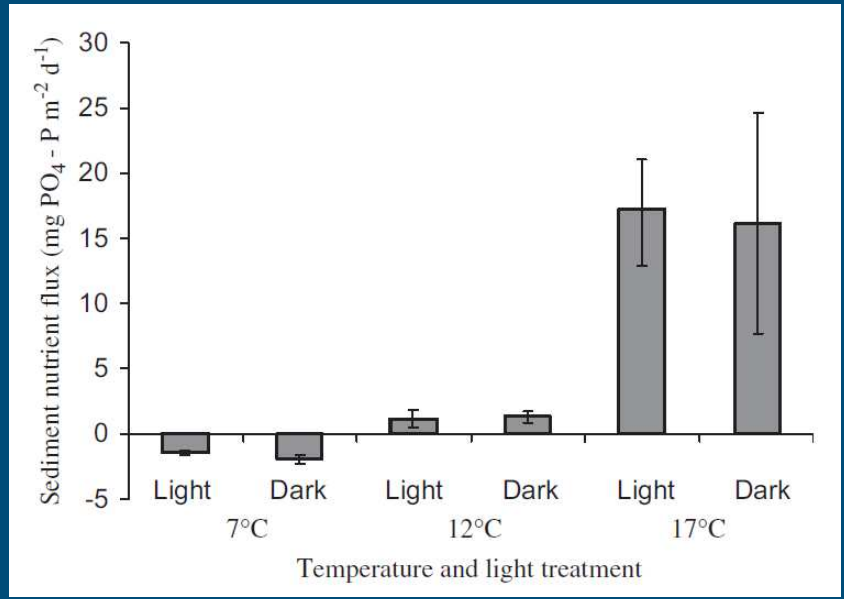
- 3000 ditches national LimnoDatabase



P-release and temperature

- P release from sediment will increase

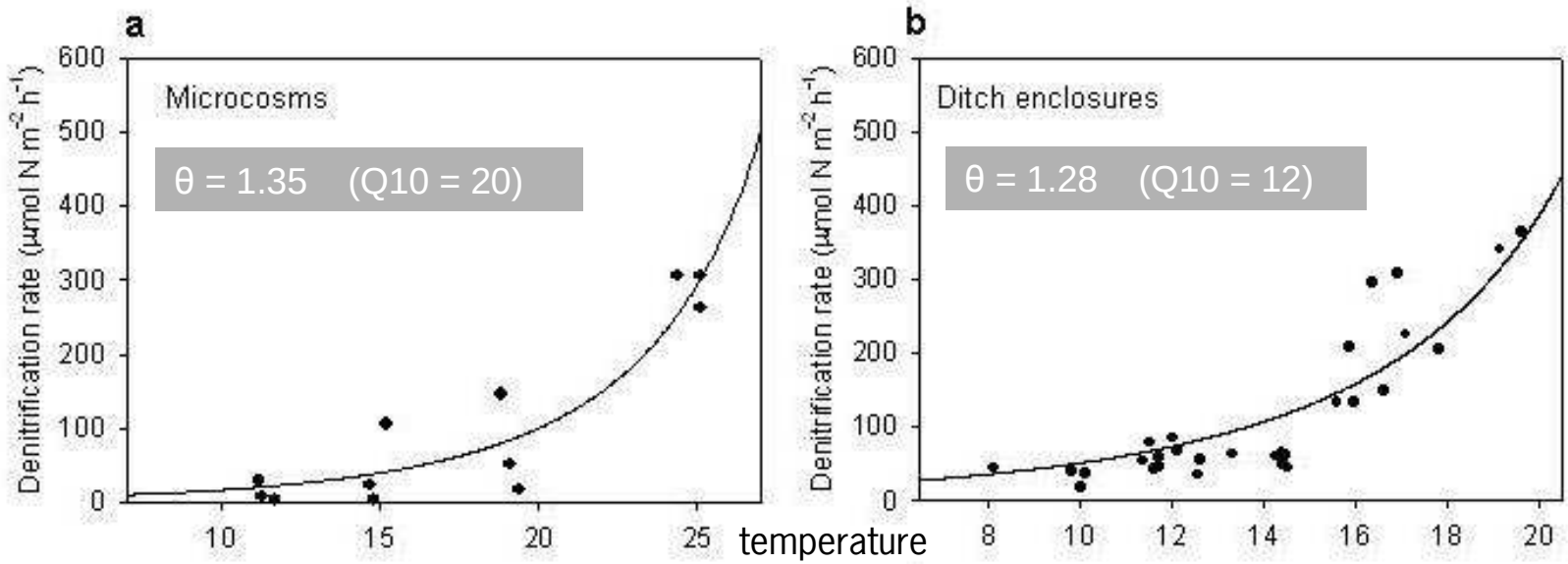




Speaers et al 2008, sediment cores

Kamp-Nielsen 1975, sediment cores

Denitrification and temperature



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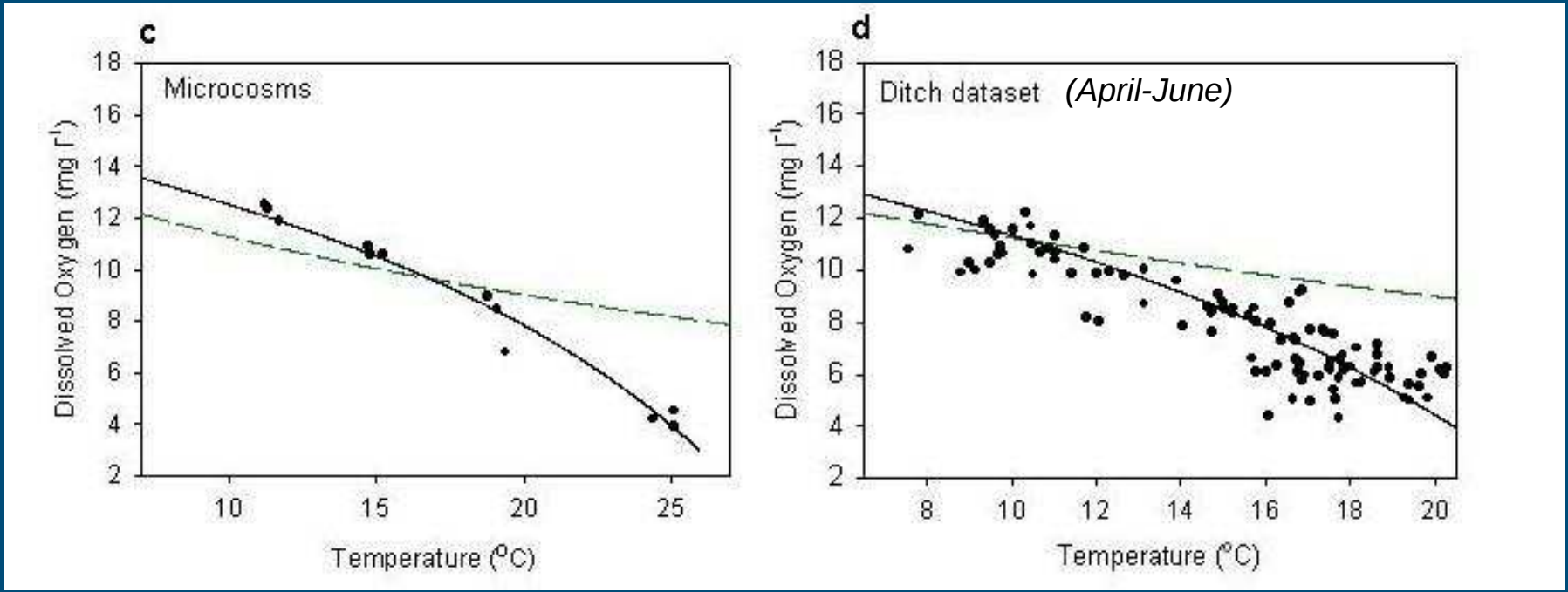
Veraart & de Klein submitted

Denitrification and temperature



- Oxygen key role !
- Decomposition stronger affected than production
- Denitrification and P-release

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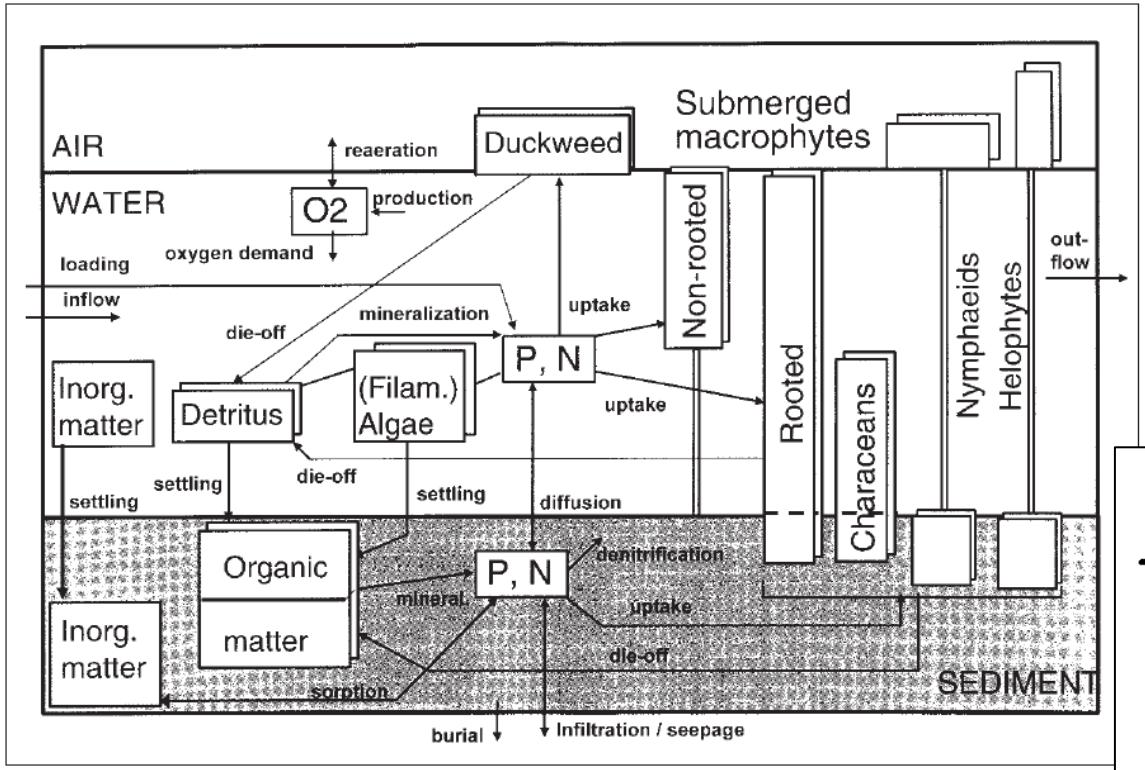
Veraart & de Klein submitted

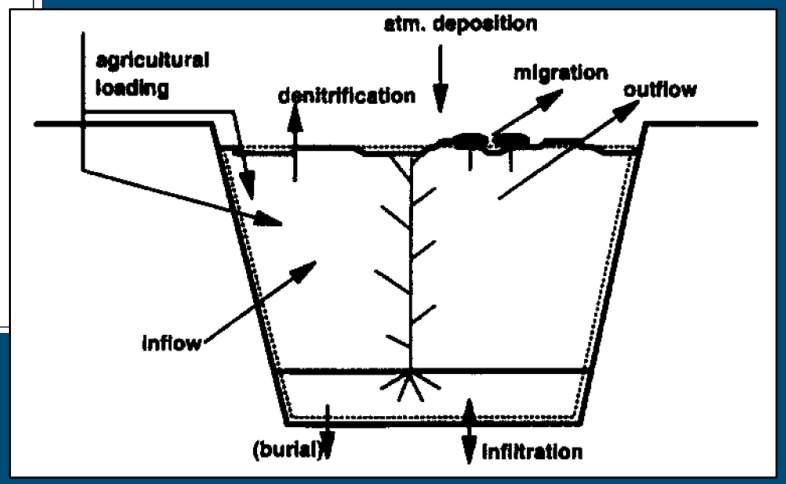
Ecological Models

- PC-Lake and PC-Ditch *(Janse, 1997)*
- biomass, N, P, O_2, light
- food web and competition
- calibrated on experimental research and data

- Alternative Stable States
- Critical loads

PC-Ditch


AIR
reaeration
Duckweed
Submerged macrophytes
WATER
O2
production
loading
oxygen demand
inflow
mineralization
uptake
Non-rooted
Rooted
Characeans
Nymphaeids
Helophytes
out-flow
die-off
P, N
Inorg. matter
Detritus
(Filam.) Algae
uptake
settling
settling
die-off
settling
diffusion
Organic matter
P, N
denitrification
mineral.
uptake
Inorg. matter
die-off
sorption
SEDIMENT
burial
Infiltration / seepage

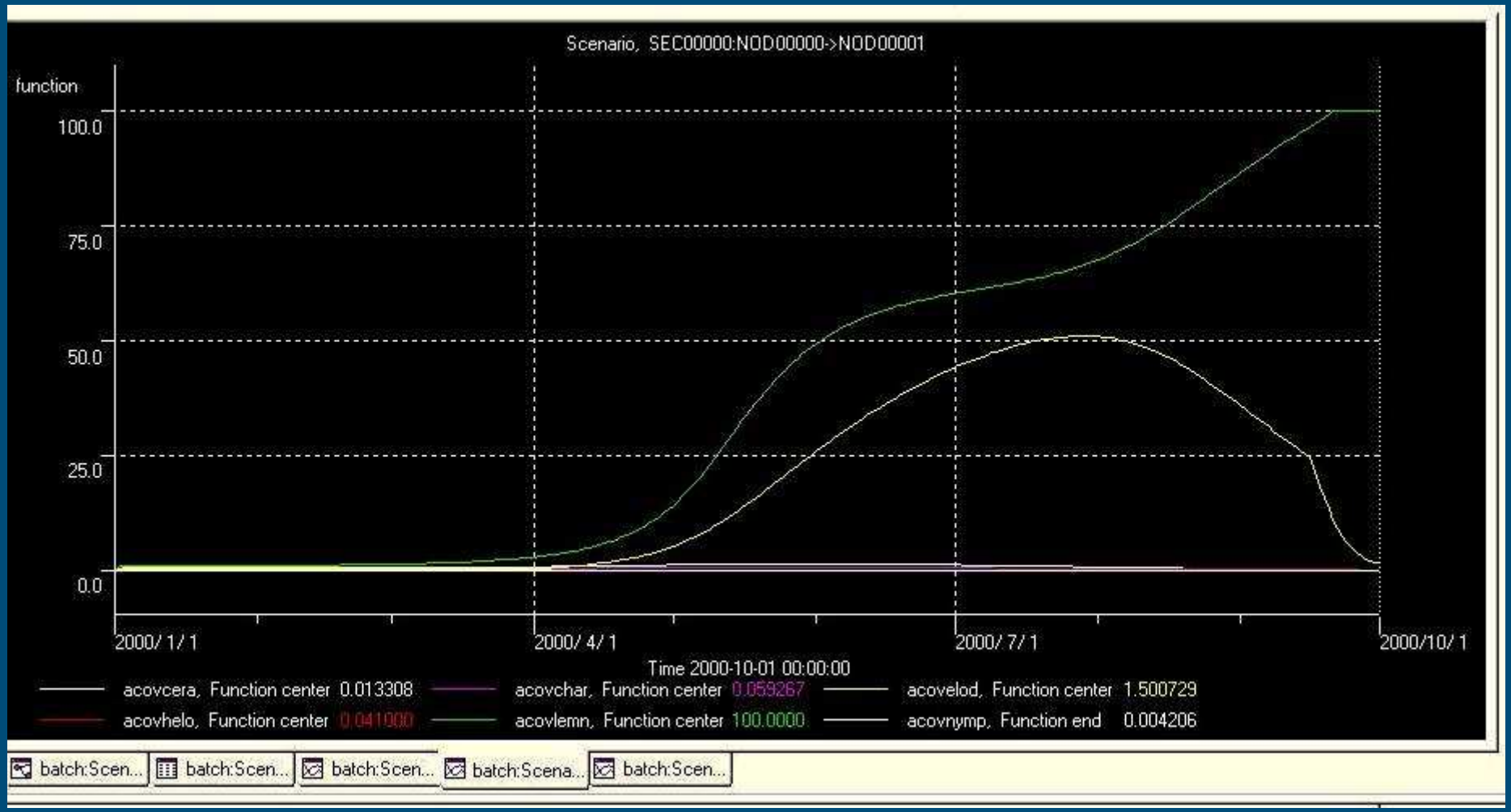

atm. deposition
agricultural loading
denitrification
migration
outflow
inflow
(burial)
infiltration

Modeling approach

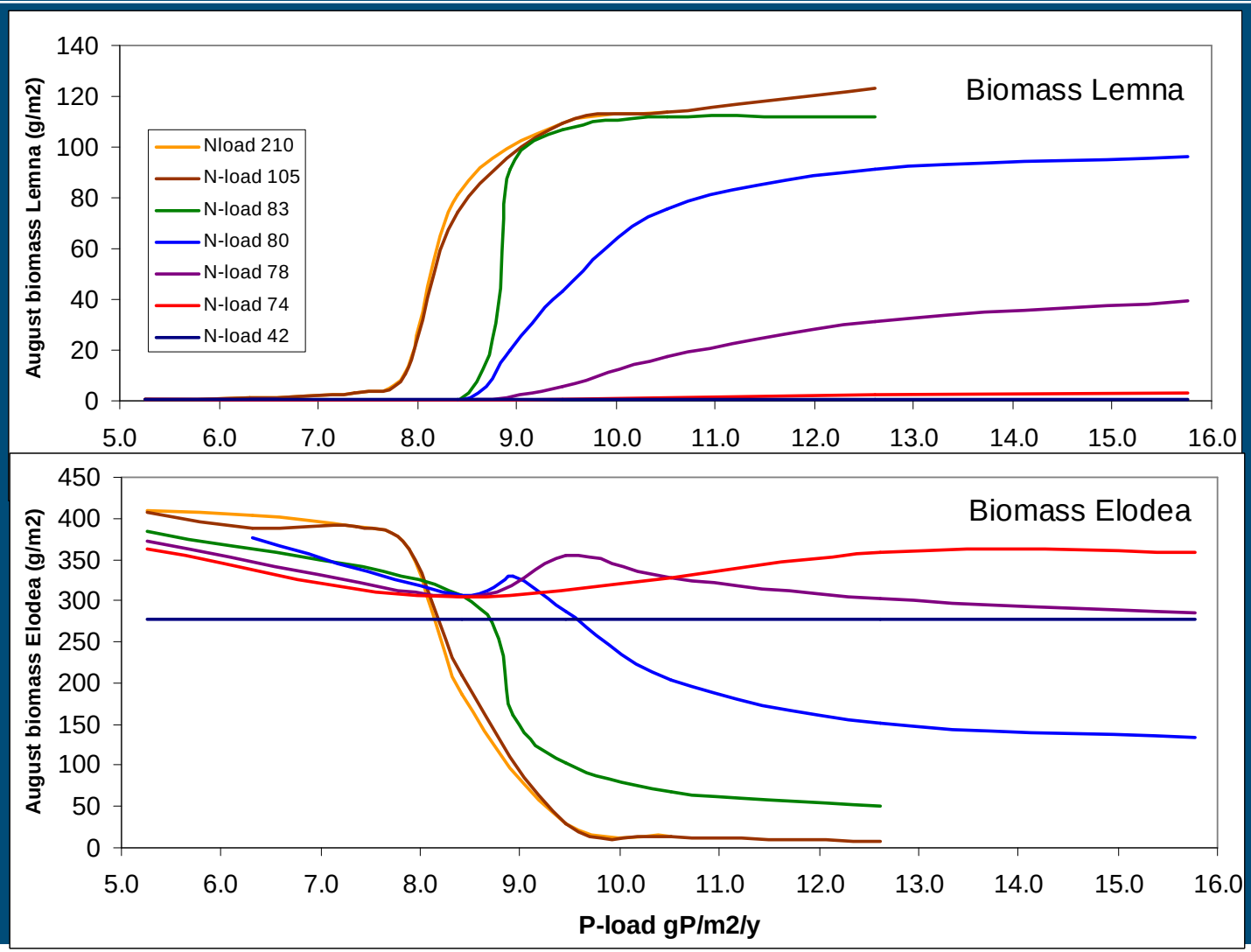
- PC-Ditch connected to hydrodynamic model
- Biomass Elodea (submerged) and Lemna (floating)
- summer biomass *(average August)*
- critical P-load for transition *(50% coverage of lemna)*

- 'Standard' ditch (1m depth), organic layer sediment (10 cm)
- seasonal light and temperature
- stable inflow
- (network of ditches)

Model results



Model results (critical P-load)



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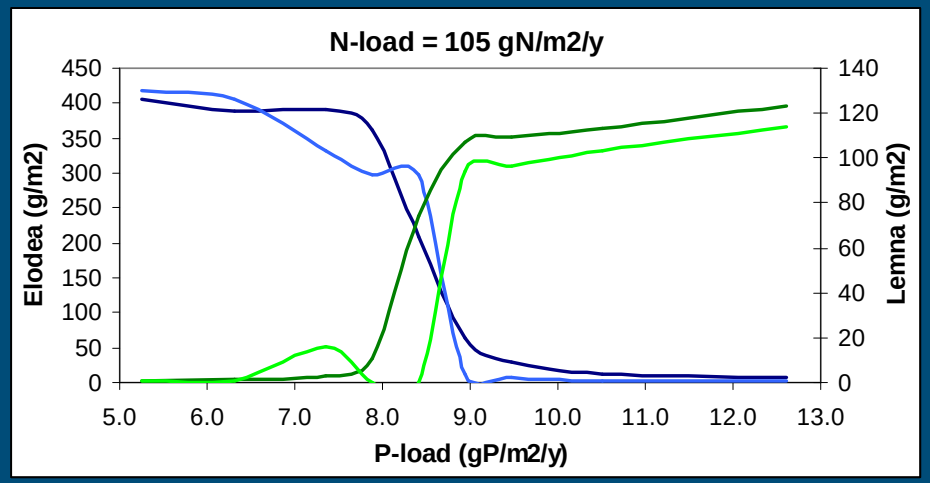
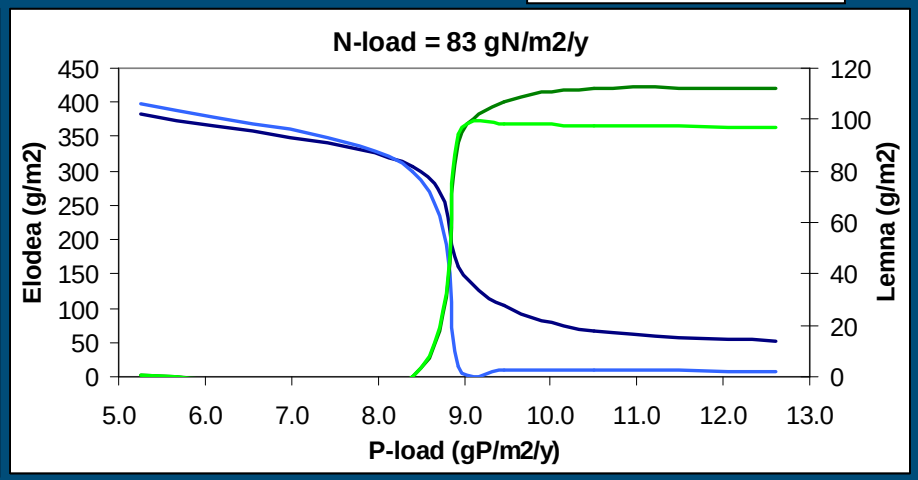
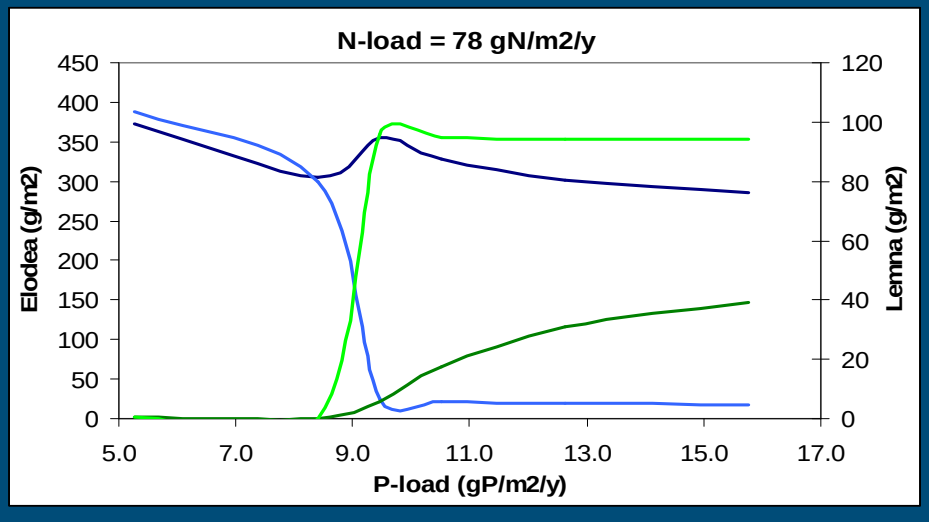
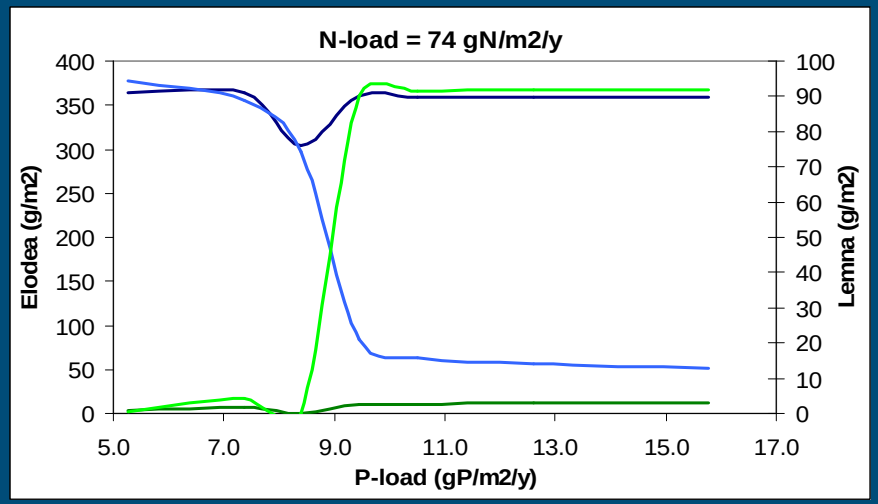
Model results (temperature)









Elodea 0
Elodea +3
Lemna 0
Lemna +3

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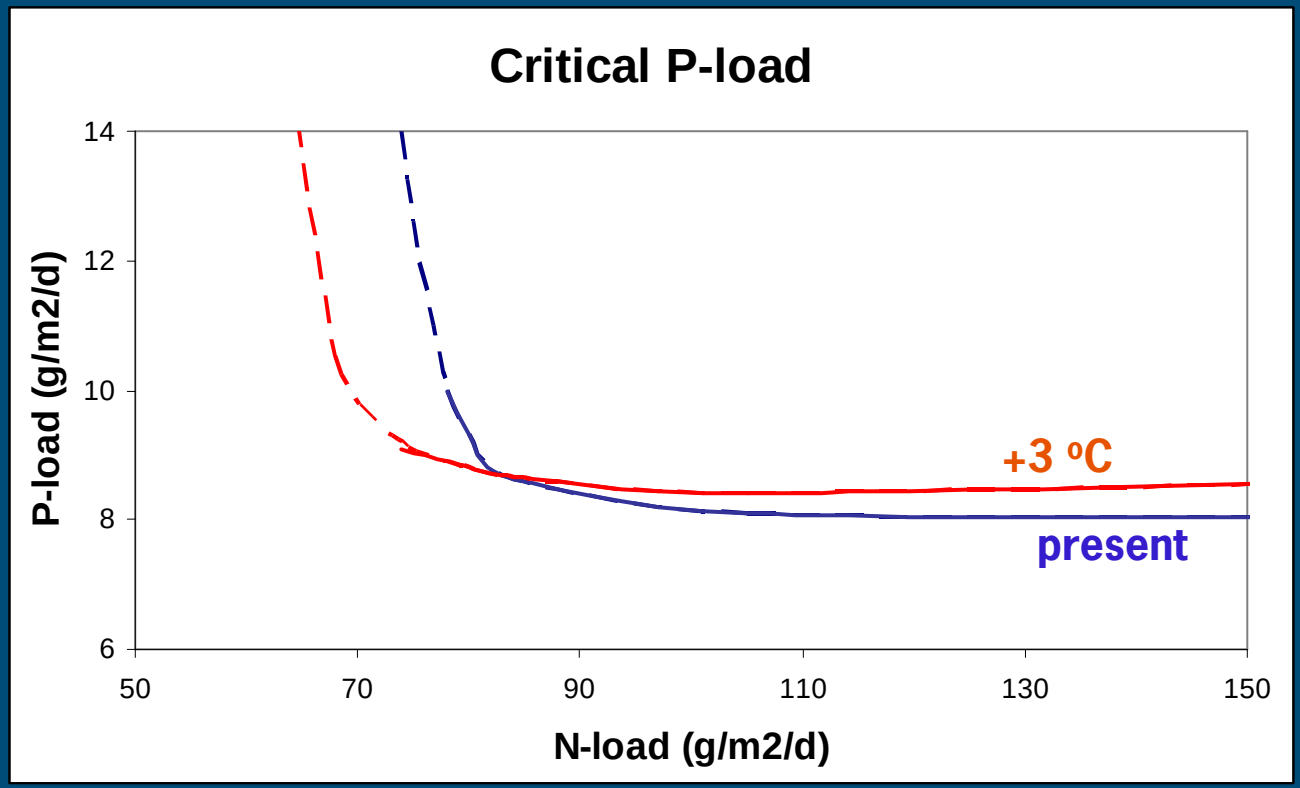
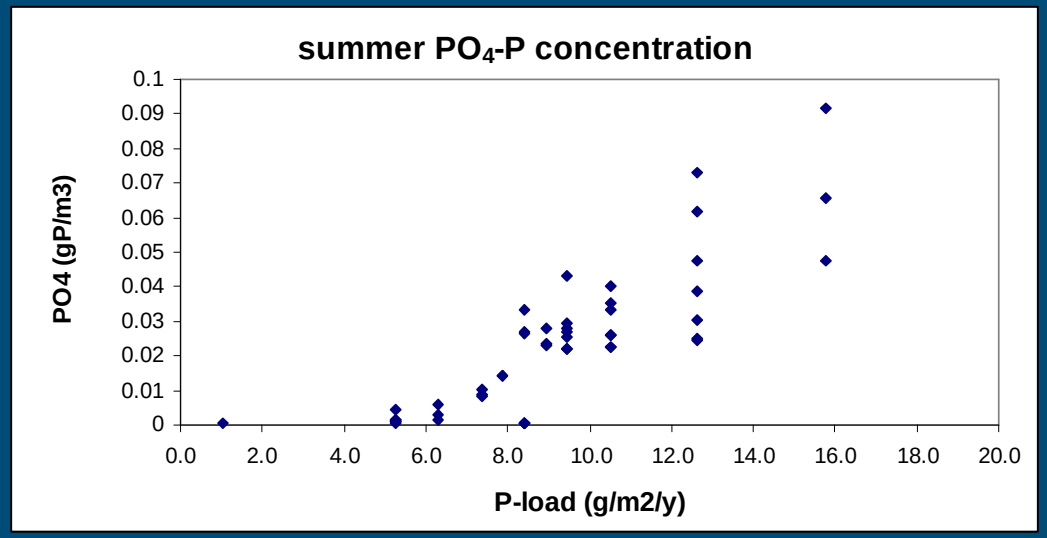
Critical P and N load



Discussion

- Load vs. concentration limits
- Arbitrary choices
- Model uncertainties



Summary

- sharp transitions of macrophyte communities in ditches
- critical P and N loading levels
- dependent on hydrology, morphology, soil, temperature
- Next step: Meta model for critical loads
  - depth
  - ditch type
  - flow rate
  - temperature