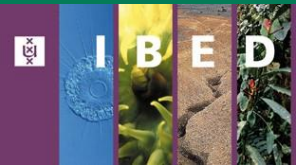


# Changes in planktonic bacterial community composition in constructed wetlands

Bram T.M. Mulling<sup>1,2</sup>, A.M. Soeter<sup>1</sup>, H.G. Van der Geest<sup>1</sup>, W. Admiraal<sup>1</sup>

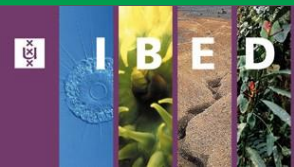
<sup>1</sup>*University of Amsterdam, Institute for Biodiversity and Ecosystem Dynamics*

<sup>2</sup>*Stichting Waternet*



# Index

- Introduction
- Research questions
- Research site
- Sampling and analyses
- Results
  - Constructed wetland
  - Comparison sites
- Conclusion



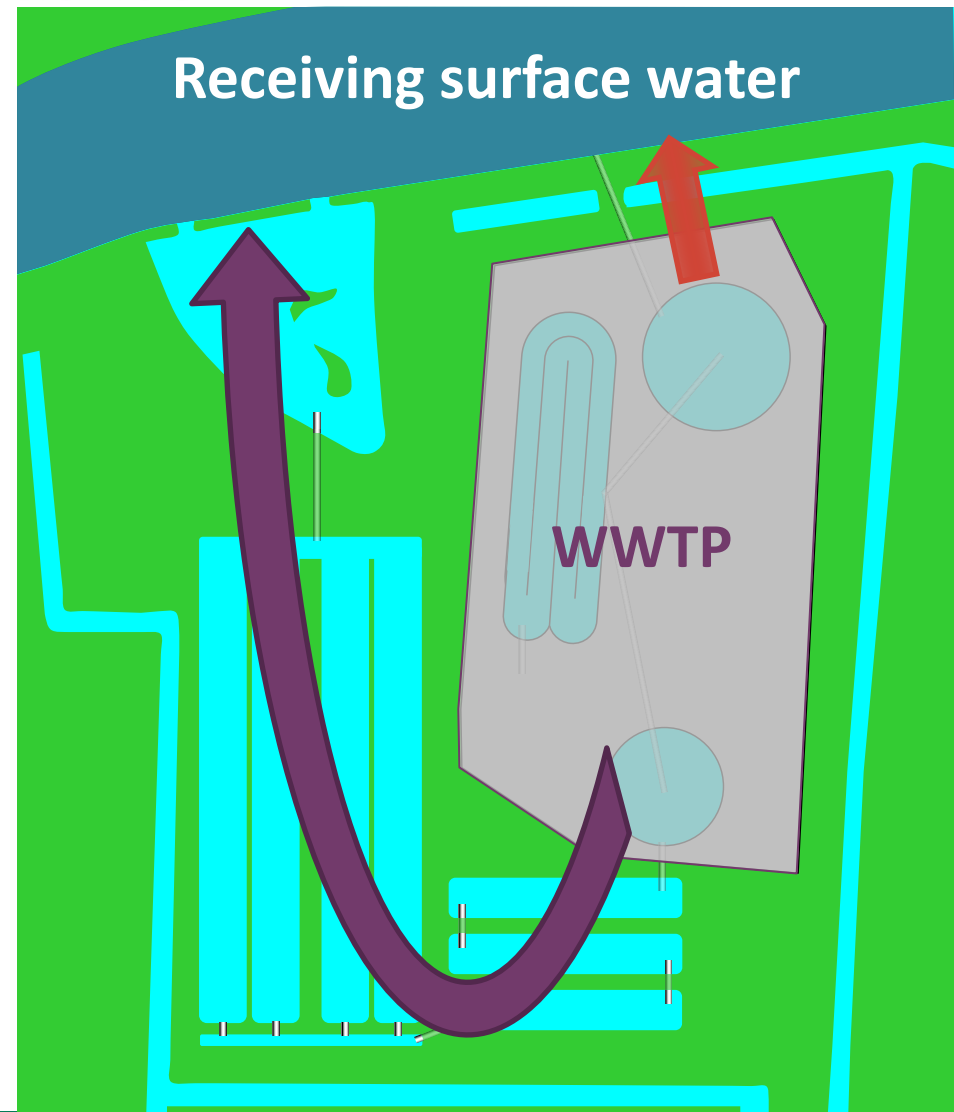
# Introduction: Constructed wetlands

- WWTP impact receiving surface waters

- Nutrients
- Metals
- Oxygen demand
- Micropollutants
- Suspended particles
- Bacteria (pathogens)

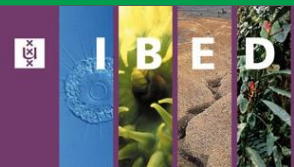
- CW's can be used for polishing treated waste water before discharge

- Thereby reducing the impact on receiving surface waters

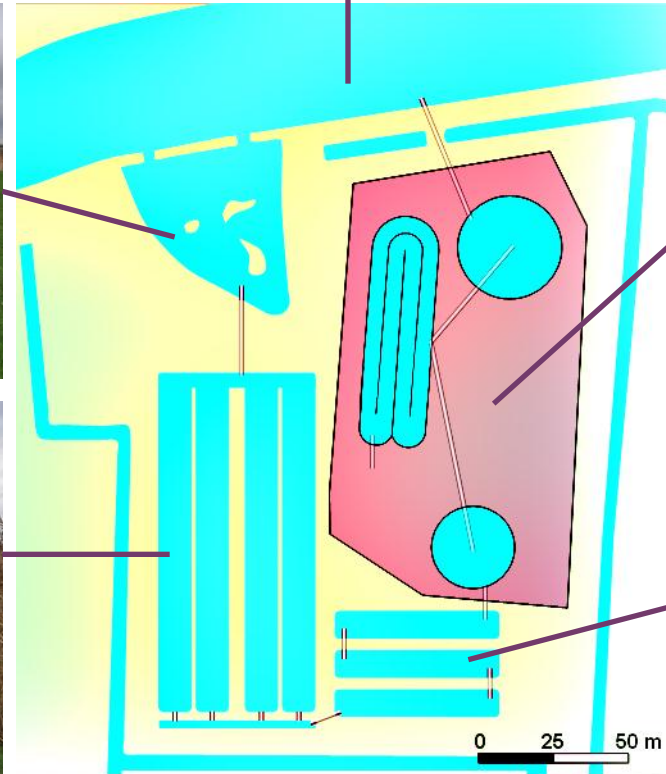


# Research questions

- 1) Is the planktonic bacterial community from a technical installation changing during residence in a surface flow constructed wetland?
- 2) Do changes result in a bacterial community with a composition and functioning similar to surface waters?



# Research site



# Research site

Channel



Fish pond



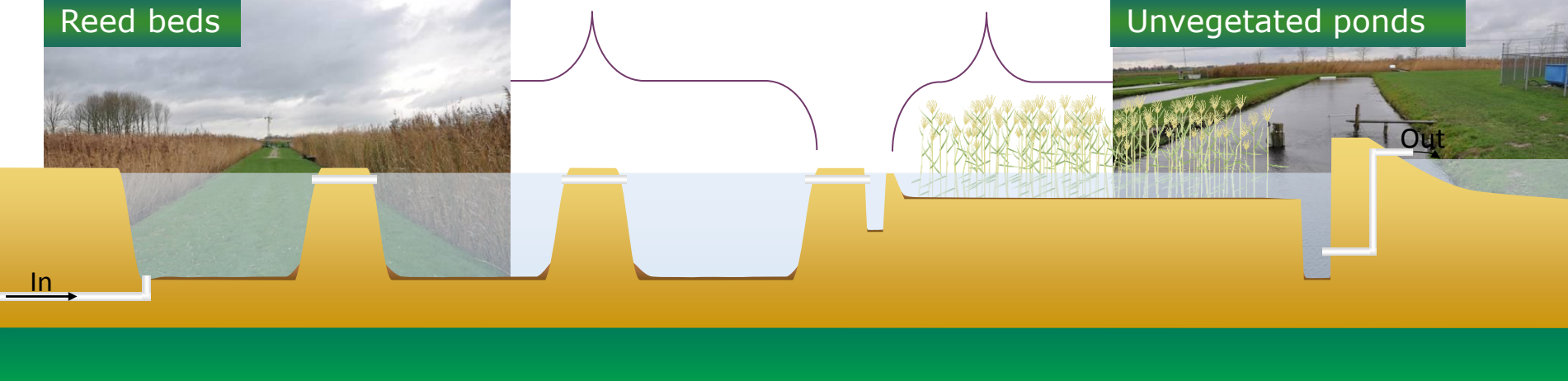
WWTP Grou



Reed beds



Unvegetated ponds



# Research site

Length (m)	165 (3x55)
Wide (m)	7.9
Depth (m)	1.4

Volume (m <sup>3</sup> )	1190
Debiet (m <sup>3</sup> day <sup>-1</sup> )	1200

Hydraulic retention time (h)	<b>17.9</b>
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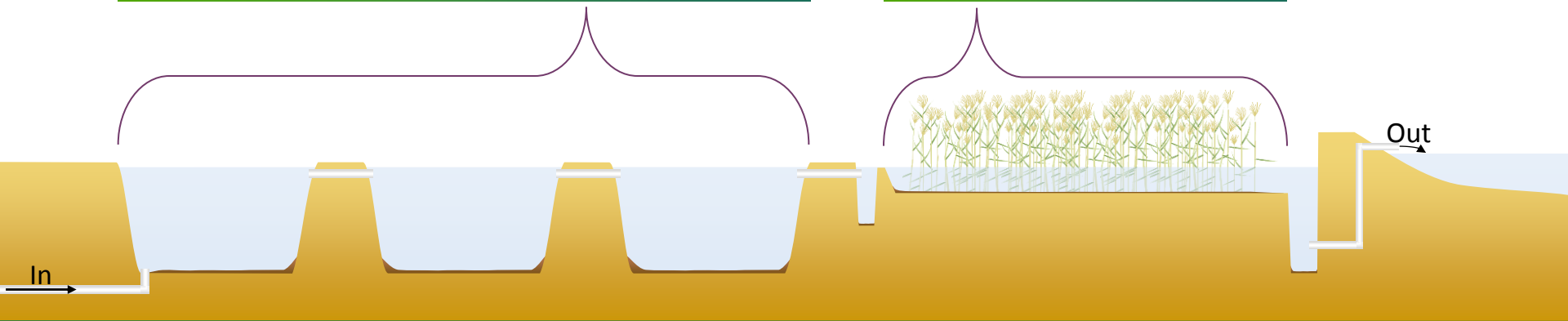
Vegetation	None
------------	------

110
11.5
0.4

443
300

<b>23.6</b>
-------------

Phragmites australis
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# Sampling and analyses

## FISH

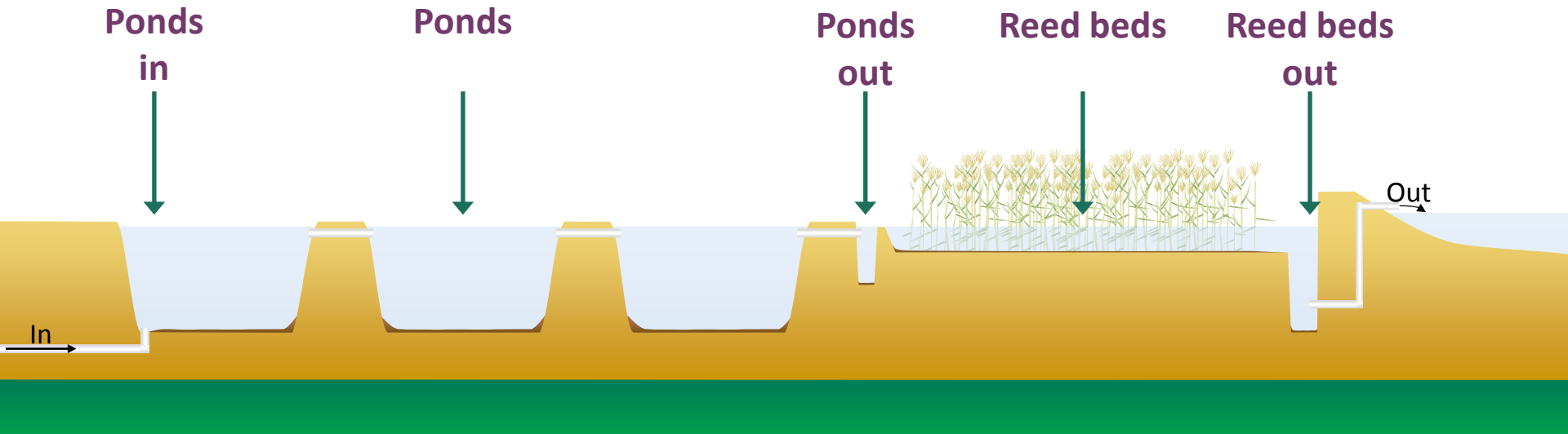
- Bacterial abundance

## BIOLOG

- Bacterial activity
- Functional diversity

## DGGE

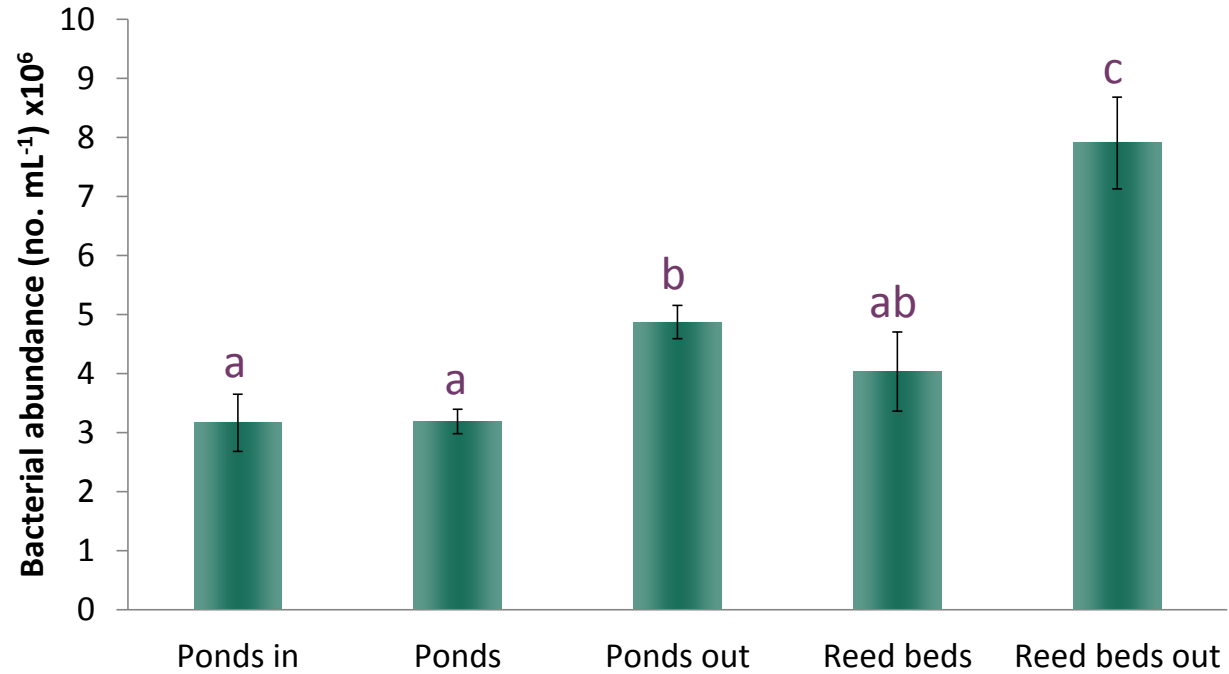
- Community composition
- General bacteria
- CH<sub>4</sub> oxidizing bacteria





# Bacterial abundance (FISH)

- Abundance:  $10^6 - 10^7$  mL<sup>-1</sup>
- Comparable with surface waters\*
- 2.5 fold increases in CW

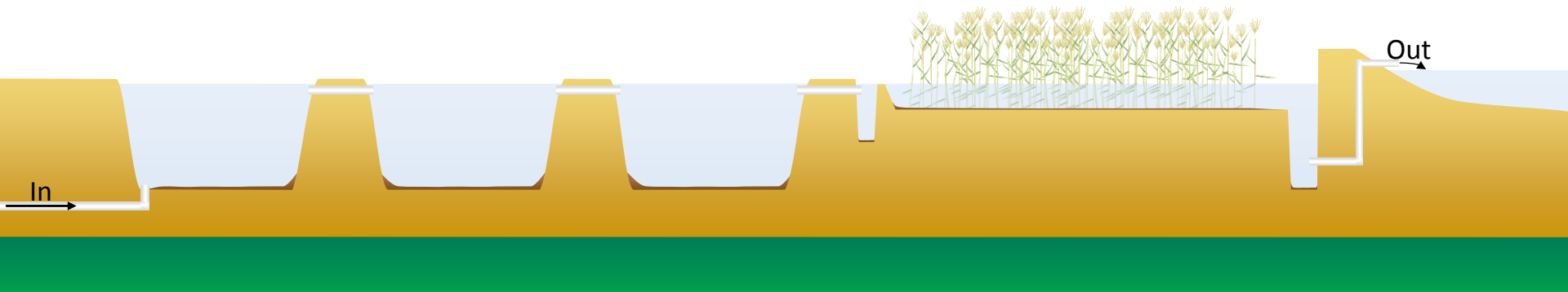
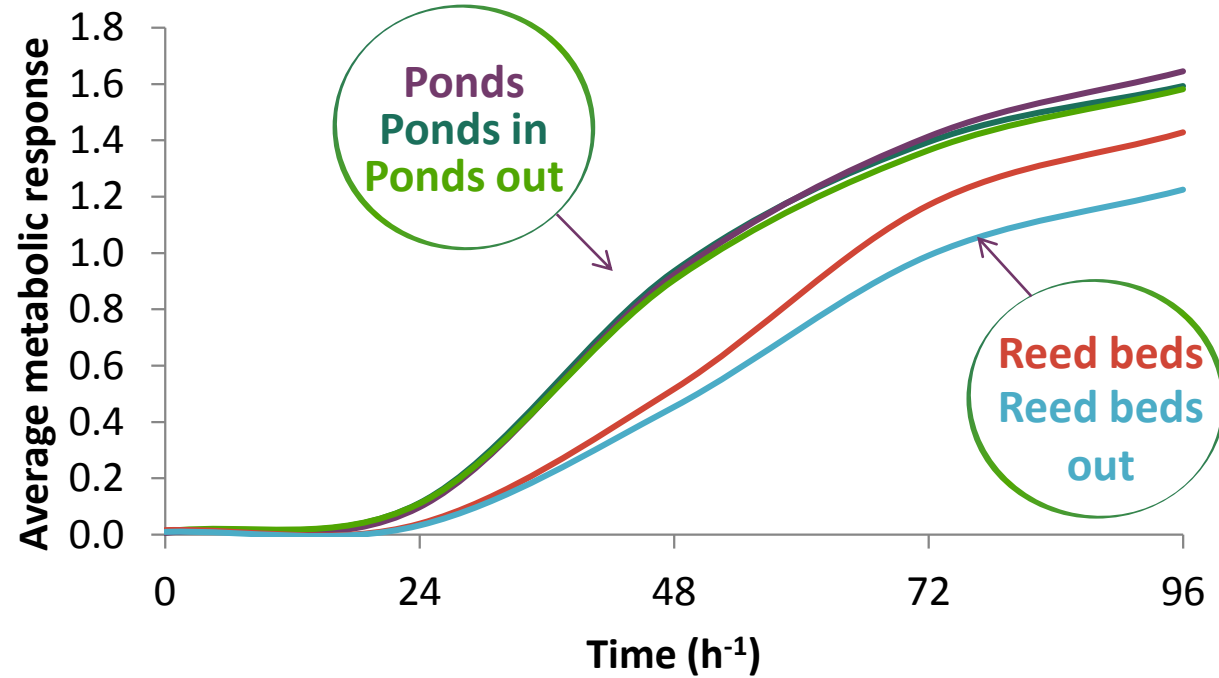


\* Sanders, R.W., Caron, D.A., Berninger, U-G., 1992. Relationship between bacteria and heterotrophic nanoplankton in marine and fresh waters: an inter-ecosystem comparison. Marine Ecology Progress Series, 86; pp 1-14



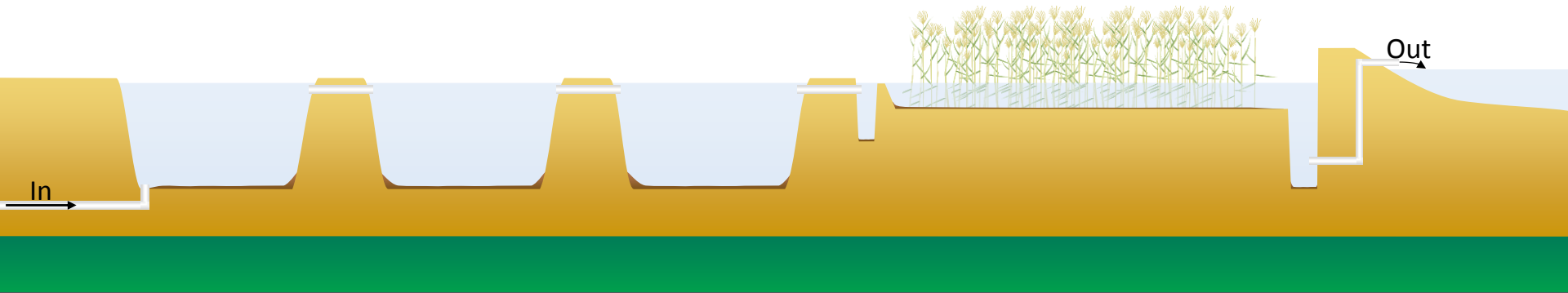
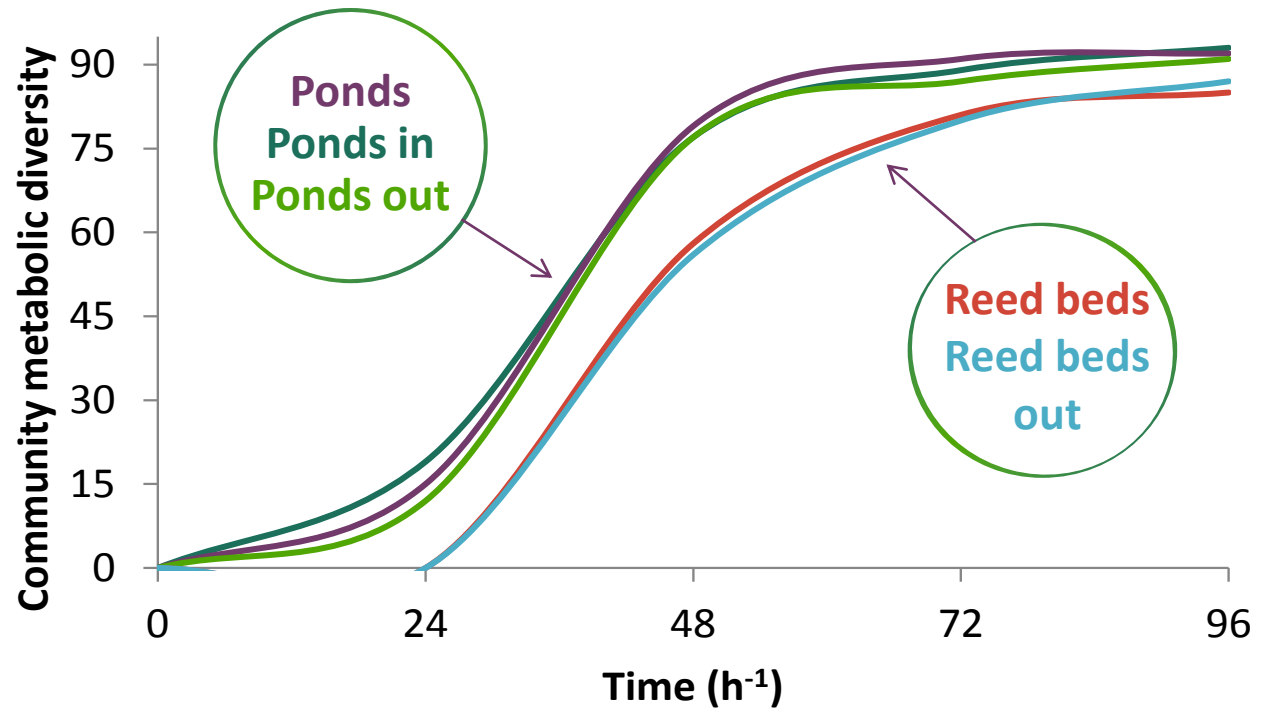
# Metabolic activity (BIOLOG)

- High carbon utilisation activity in ponds
- Lower activity in reed beds



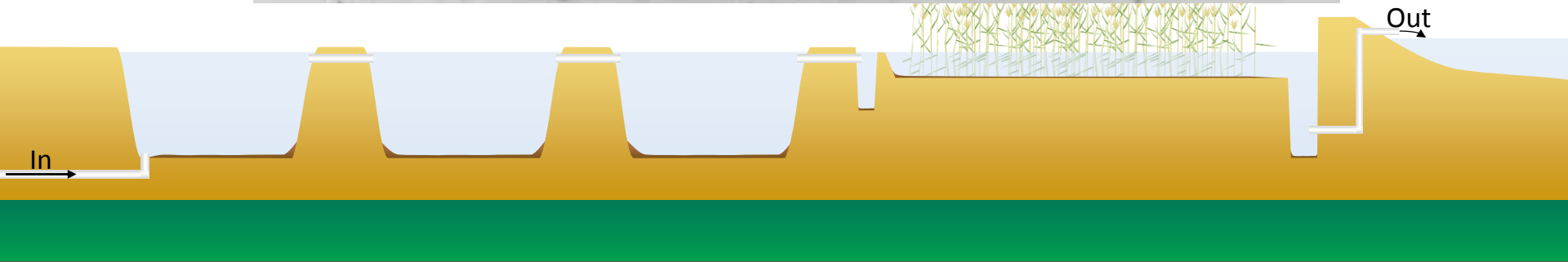
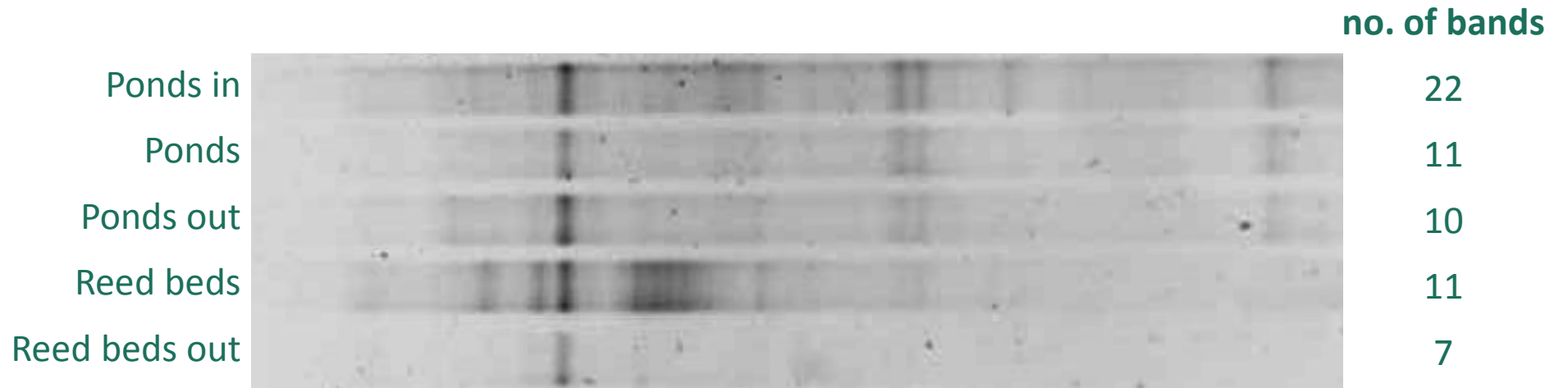
# Functional diversity (BIOLOG)

- >95% of carbon sources utilized in ponds
- Less carbon sources utilized in reed beds



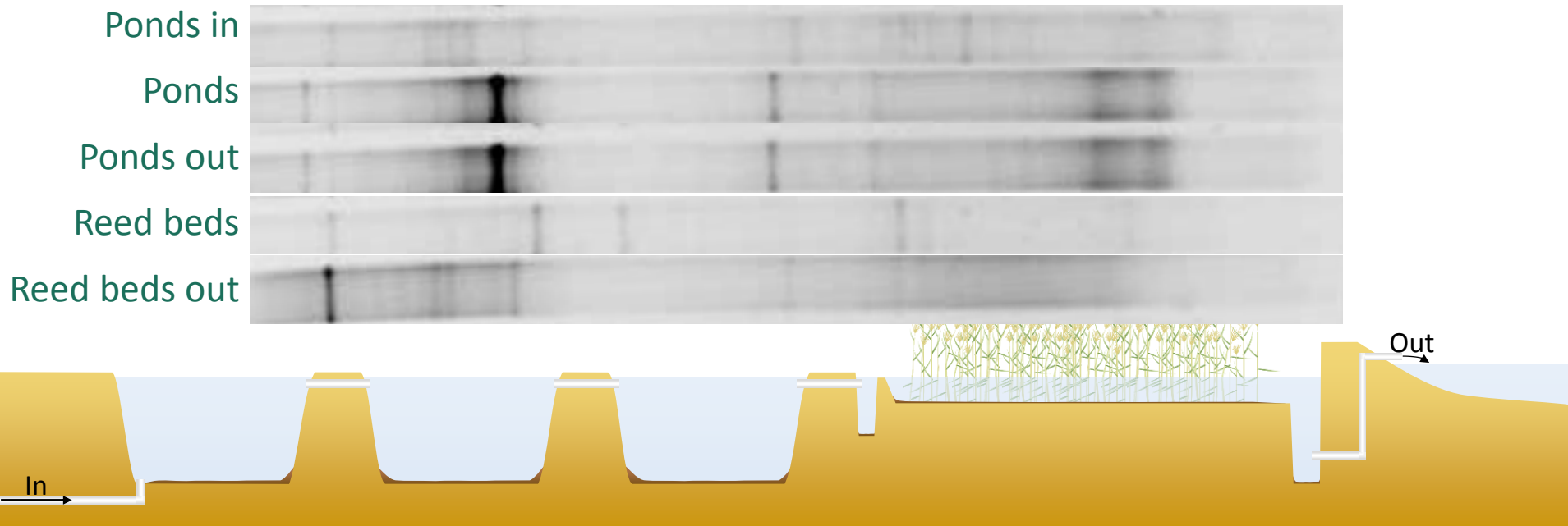
# Bacterial composition (DGGE general bacteria)

- Decrease in no. of bands
- Decrease mainly in ponds
  - Sedimentation of suspended particles
- Shifts in community composition

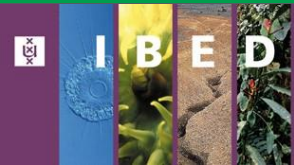


# Bacterial composition (DGGE CH<sub>4</sub> oxidizing bacteria)

- Profound shifts in CH<sub>4</sub> oxidizing bacteria community
- Changes reflect changes in conditions
  - O<sub>2</sub>, nutrients, (CH<sub>4</sub> availability)
- Strong dominance of fast growing taxa in ponds\*



\* Steenbergh AK, Meima MM, Kamst M, Bodelier PLE: Biphasic kinetics of a methanotrophic community is a combination of growth and increased activity per cell. FEMS Microbiol Ecol 2010, 71:12-22.



# Summary

- *Constructed wetland*

- Increase in abundance
- Decrease in metabolic activity
- Decrease in functional diversity
- Shifts in community composition

- *Comparison with surface waters*

**Bacterial community changes**

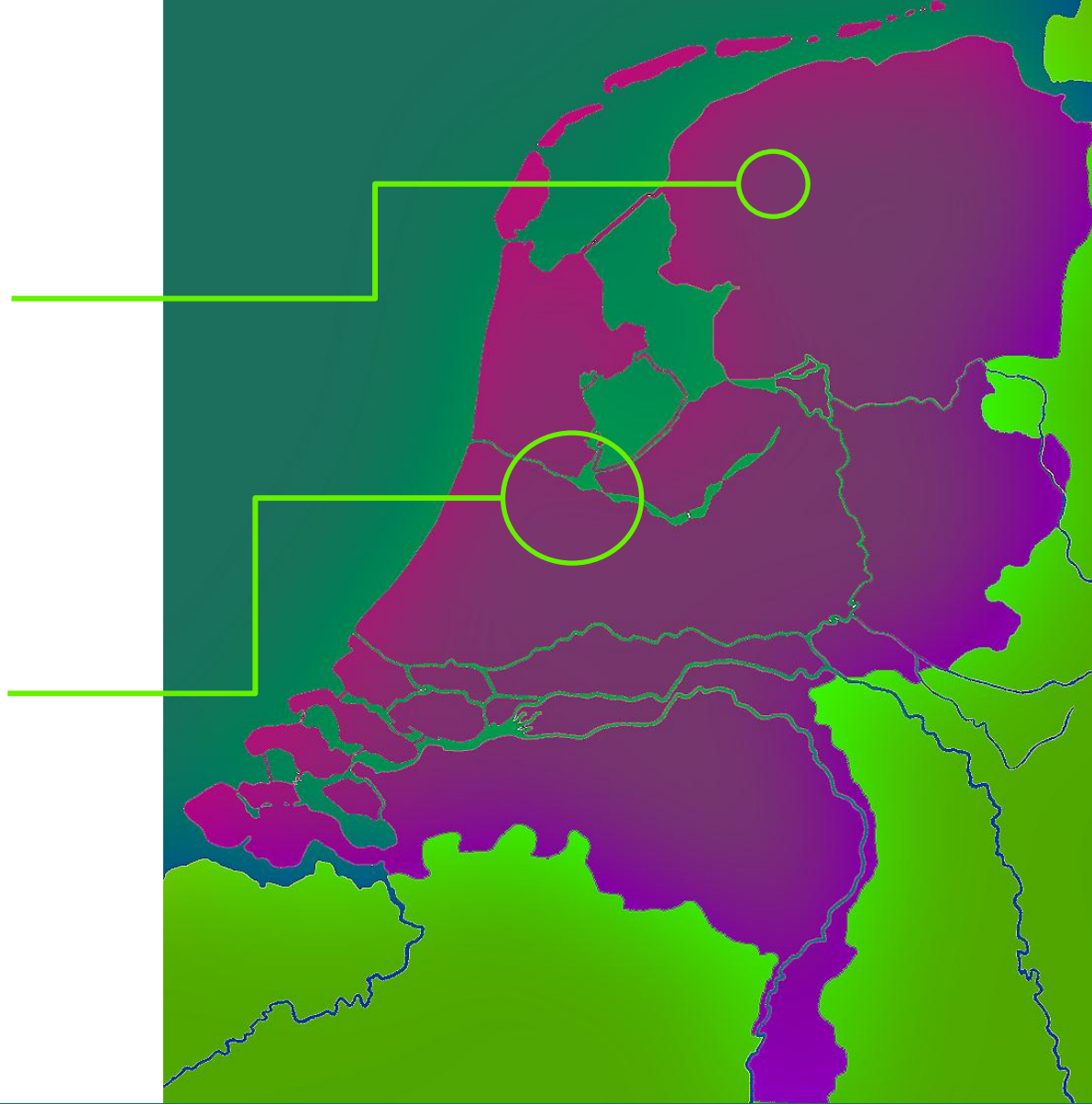
# Sampling sites

## Research site

- **Constructed wetland**

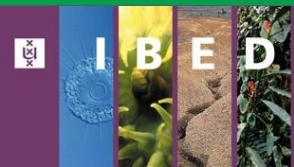
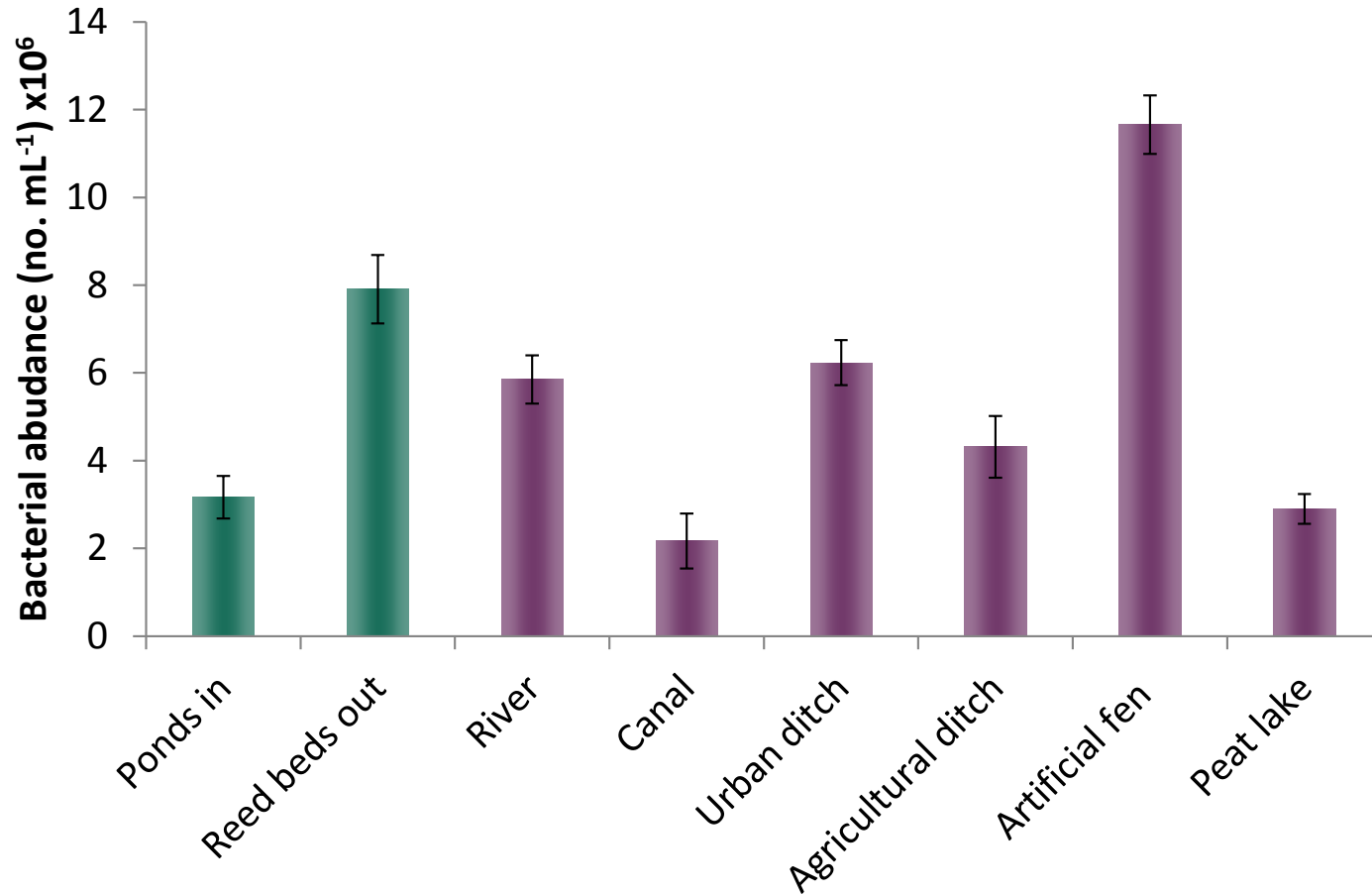
## Comparison sites

- **River**
- **Canal**
- **Urban ditch**
- **Agricultural ditch**
- **Peat lake**
- **Artificial fen**



# Bacterial abundance (FISH)

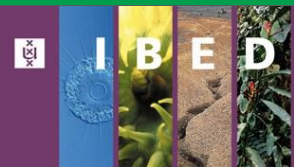
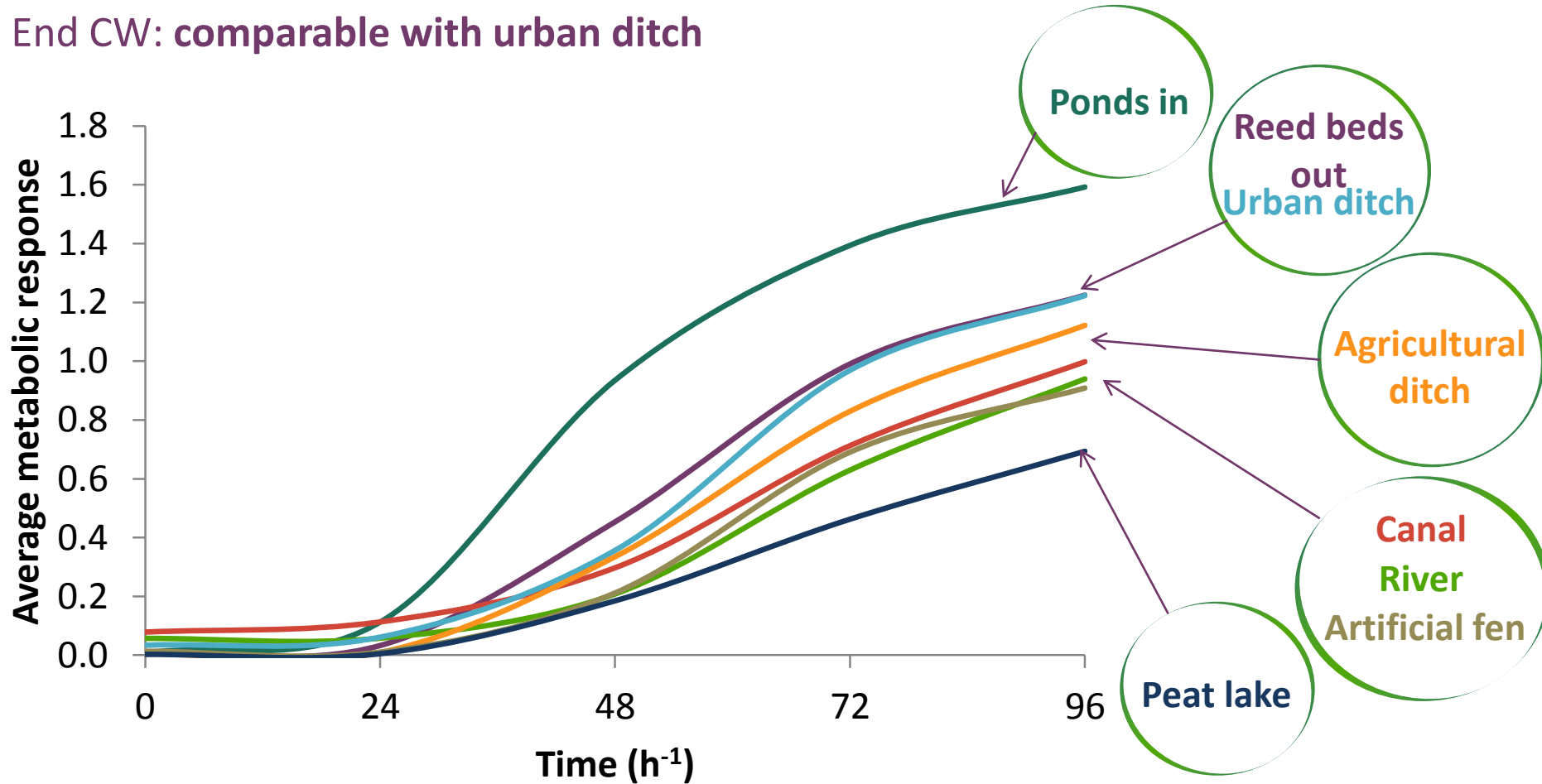
- Abundances CW in same range as surface waters





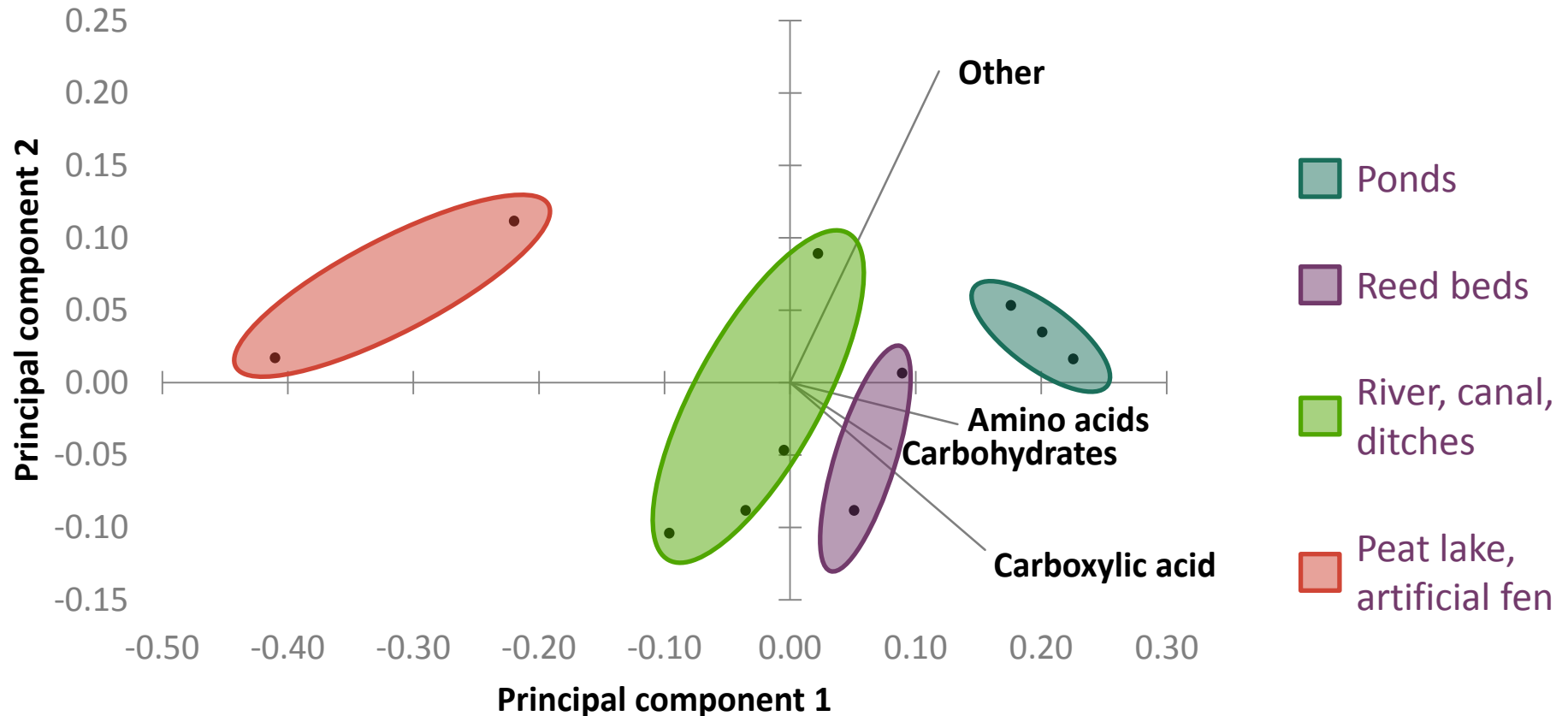
# Metabolic activity (BIOLOG)

- Start CW: very high carbon utilization
- End CW: comparable with urban ditch



# Functional diversity (BIOLOG; PCA)

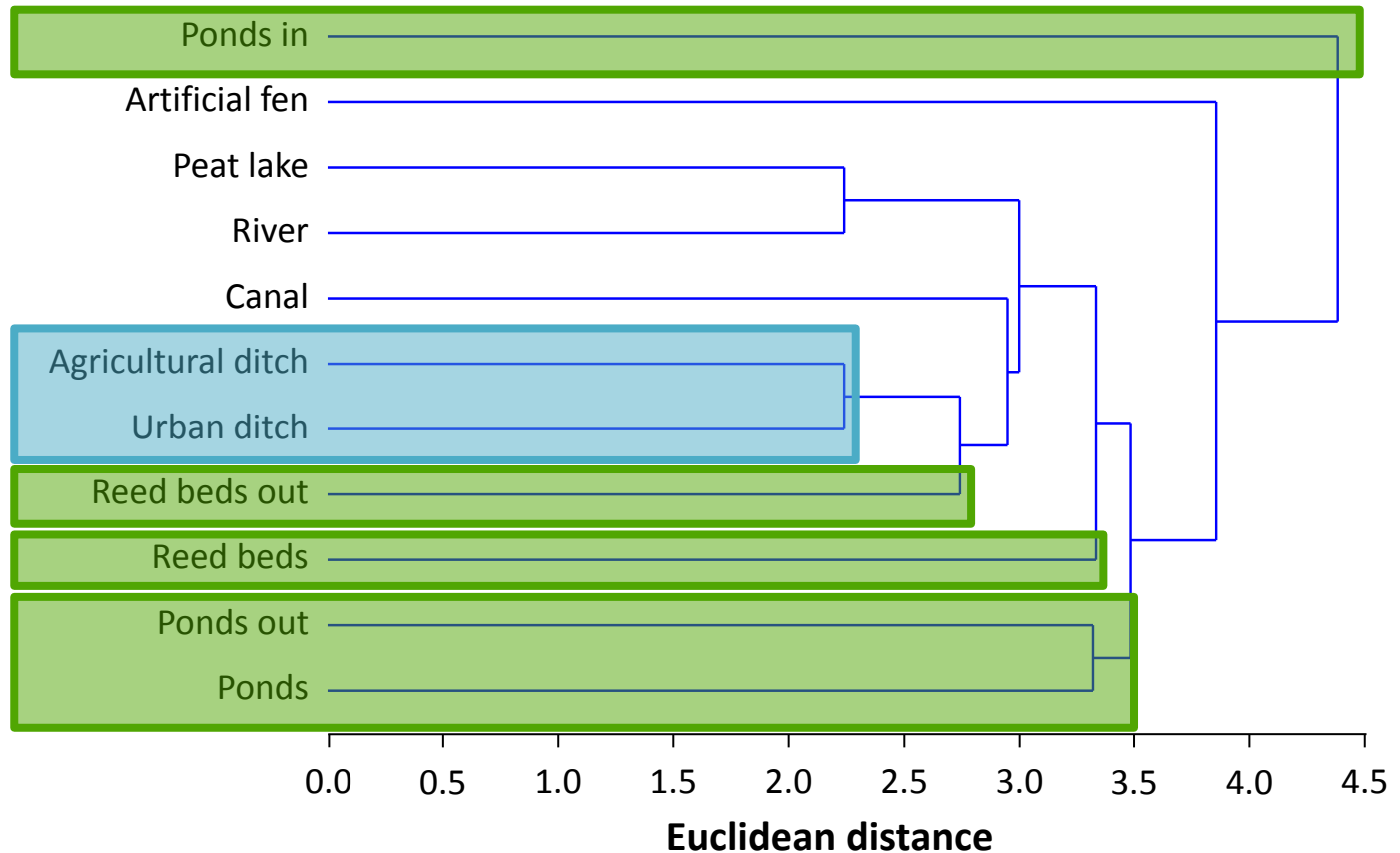
- Ponds: high functional diversity (carbon utilization)
- Reed beds: comparable with river, canal and ditches



# Community composition (DGGE; cluster analyses)

- Start CW: **unique composition**

- End CW: **comparable with ditches**



# Summary

- ***Constructed wetland***

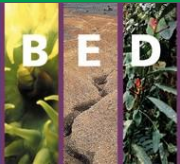
- Increase in abundance
- Decrease in metabolic activity
- Decrease in functional diversity
- Shifts in community composition

- ***Comparison with surface waters***

- Abundance in range with surface waters
- Metabolic activity decreases to level comparable with ditches
- Functional diversity at end of CW comparable with river, canal and ditches
- Community composition at end of CW comparable with ditches

**Bacterial community changes**

**into a ditch community**



# Acknowledgements

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