



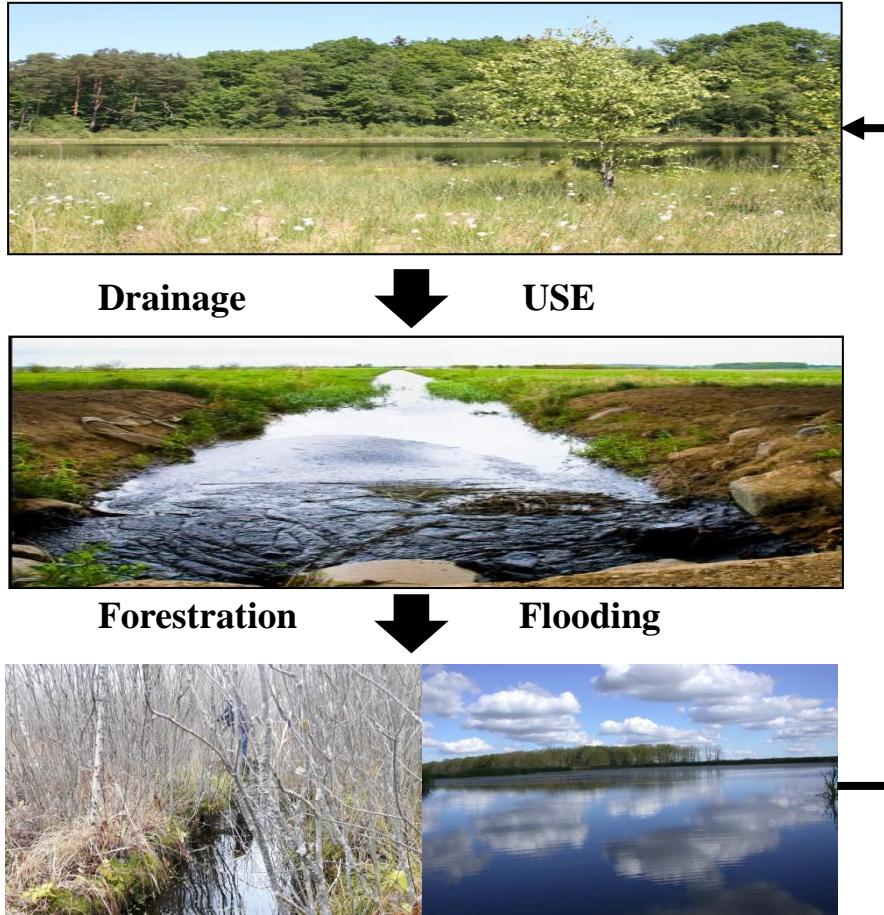
# „Managing nutrient and carbon release from inundated peatlands“

*Dominik Zak, Jörg Gelbrecht, Bärbel Tiemeyer, Robert  
McInnes, Jürgen Augustin, Peggy Steffenhagen, Anke  
Günther & Gerald Jurasinski*

**RRR 2017**  
**Greifswald, 28.09.17**



# „What happens if we do nothing?“



**Without any proper management the restoration becomes retarded over many legislative periods!**



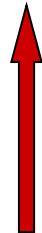
# „The side effect of „unmanaged peatlands?“

Methane  
emission  
(1-50 kg C/ha y)

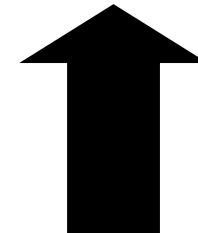


Natural growing  
peatland in NW-Polen

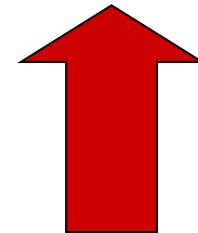
Net P  
mobilisation  
(~ 1 kg/ha y)



Methane  
emission  
(~ 400 kg C/ha y)



Net P  
mobilisation  
(~ 22 kg/ha y)



Polder Zarnekow in NE  
Germany (1 year rewetted)

(Gelbrecht, Zak & Augustin 2008)



# „The three management questions/suggestions for today“



**1. The effect of „rewetting intensity“?**



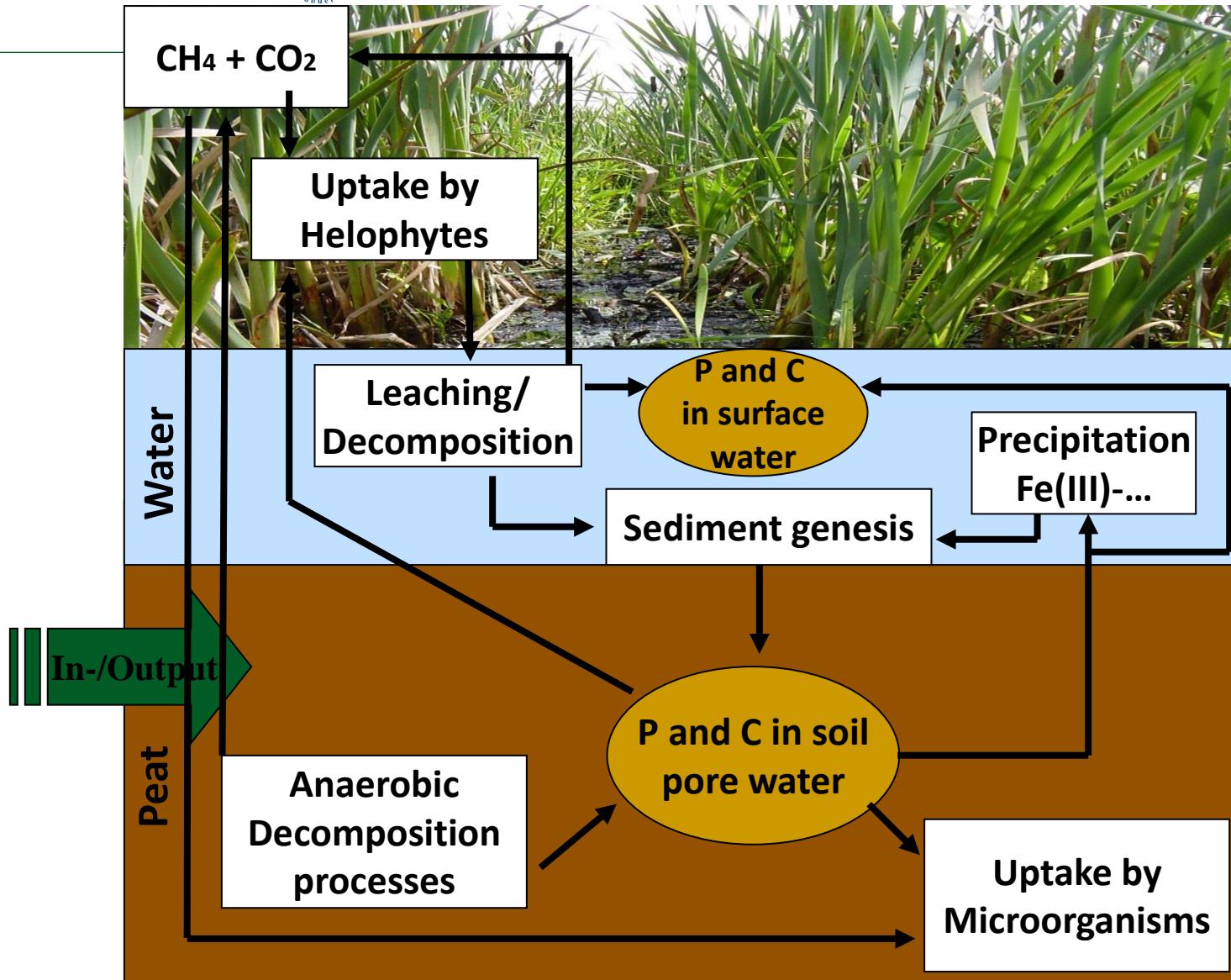
**2. The effect of rewetting & harvesting above ground plant biomass?**



**3. The effect of top soil removal before of rewetting?**



# „Processes we should know/consider to improve the management!“



(modified  
after Zak et  
al. 2017)



# „Some of the Methods to proof management“



## 1. Sampling of shoot biomass

(*Phalaris*, *Ceratophyllum*, *Typha*, *Phragmites*, *Carex spec*) end of growing season



## 2. Sampling of soil cores

## 3. Analytics of chemical composition of plant litter (C, N, P, polymers etc.)



## 4. Incubation experiments for the determination of GHG and P fluxes



# „Sites under investigation“



**Natural  
calcareous  
peatlands (= fens)**

Water table closed to surface  
and less decomposed peat



**Degraded fens  
inundated post-  
rewetting**

„Shallow lake“ with underlain  
highly decomposed peat

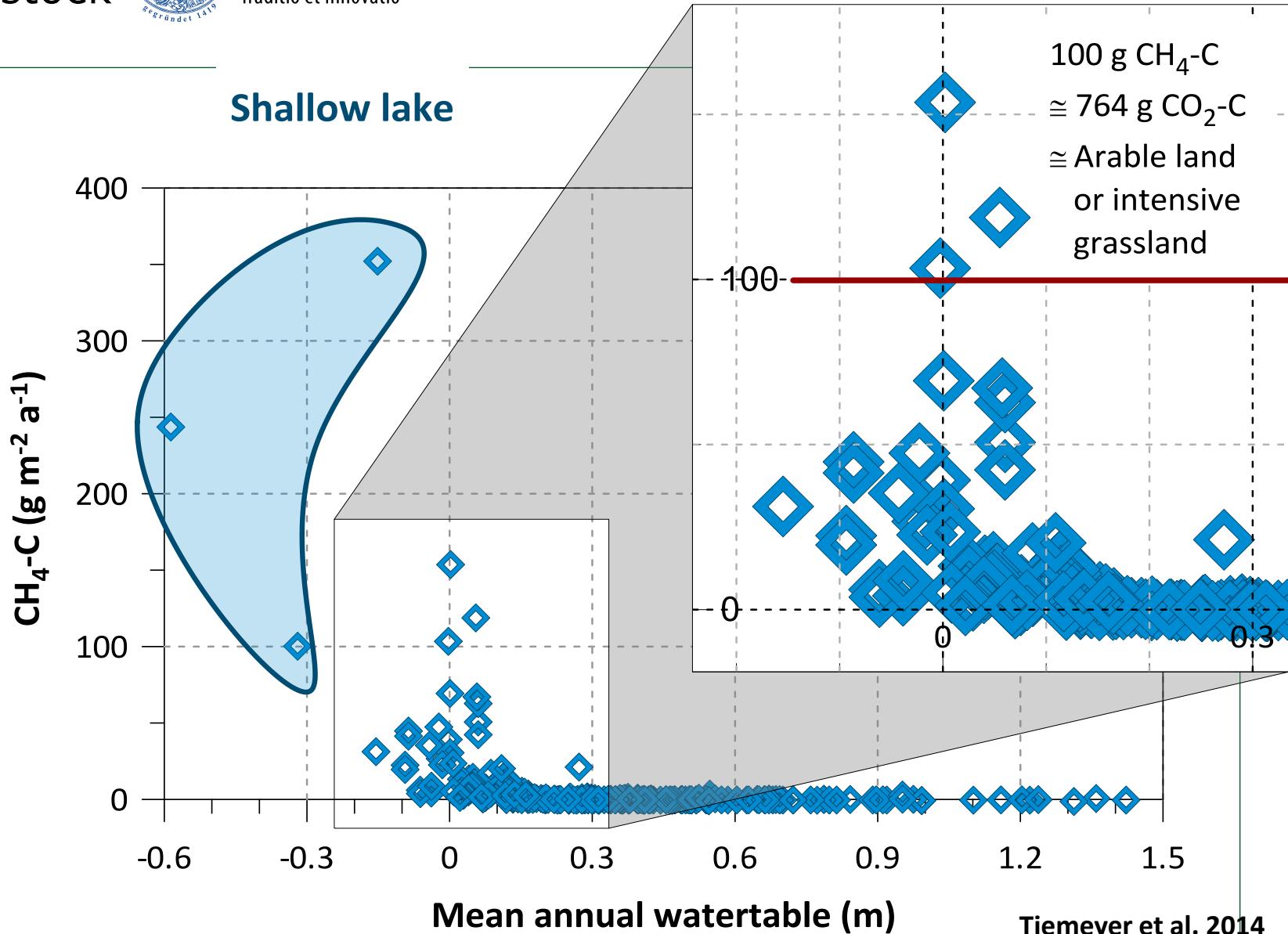


**Inundated fens  
due to  
top soil removal**

„Shallow lake“ with underlain  
less decomposed peat

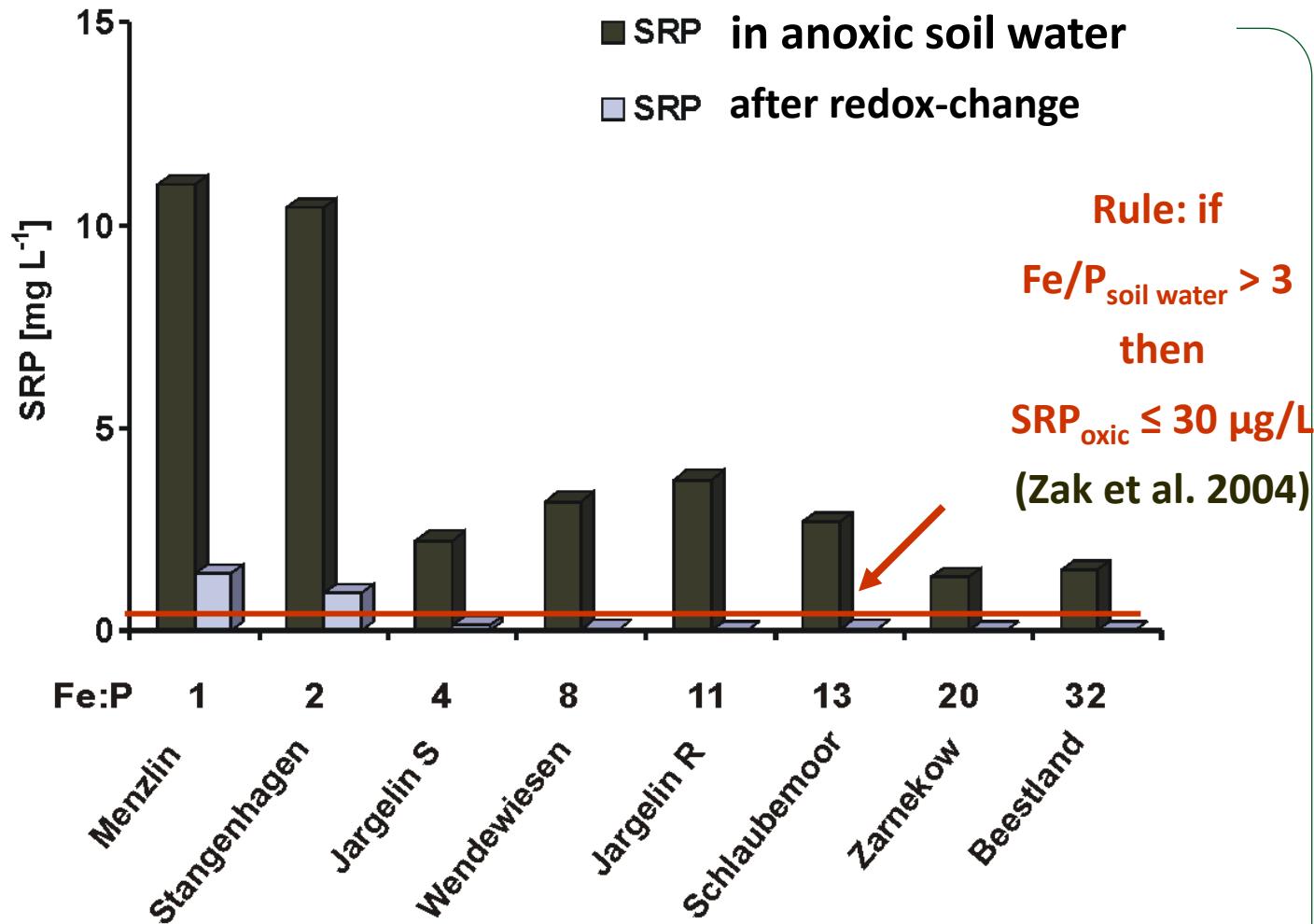


# 1) Managing the water table



# 1) Managing the water table for P?

All  
were  
inun-  
dated!



P dissolved in anoxic soil water and after 'aeration' and precipitation of Fe(III)-P hydroxides



# „What is the contribution of single plant species for P-C-fluxes?“



A fast vegetation shift over 20 years rewetting, but also depending on water table!

1. Canary grass  
(*Phalaris arundinacea*)



2. Hornwort  
(*Ceratophyllum demersum*)



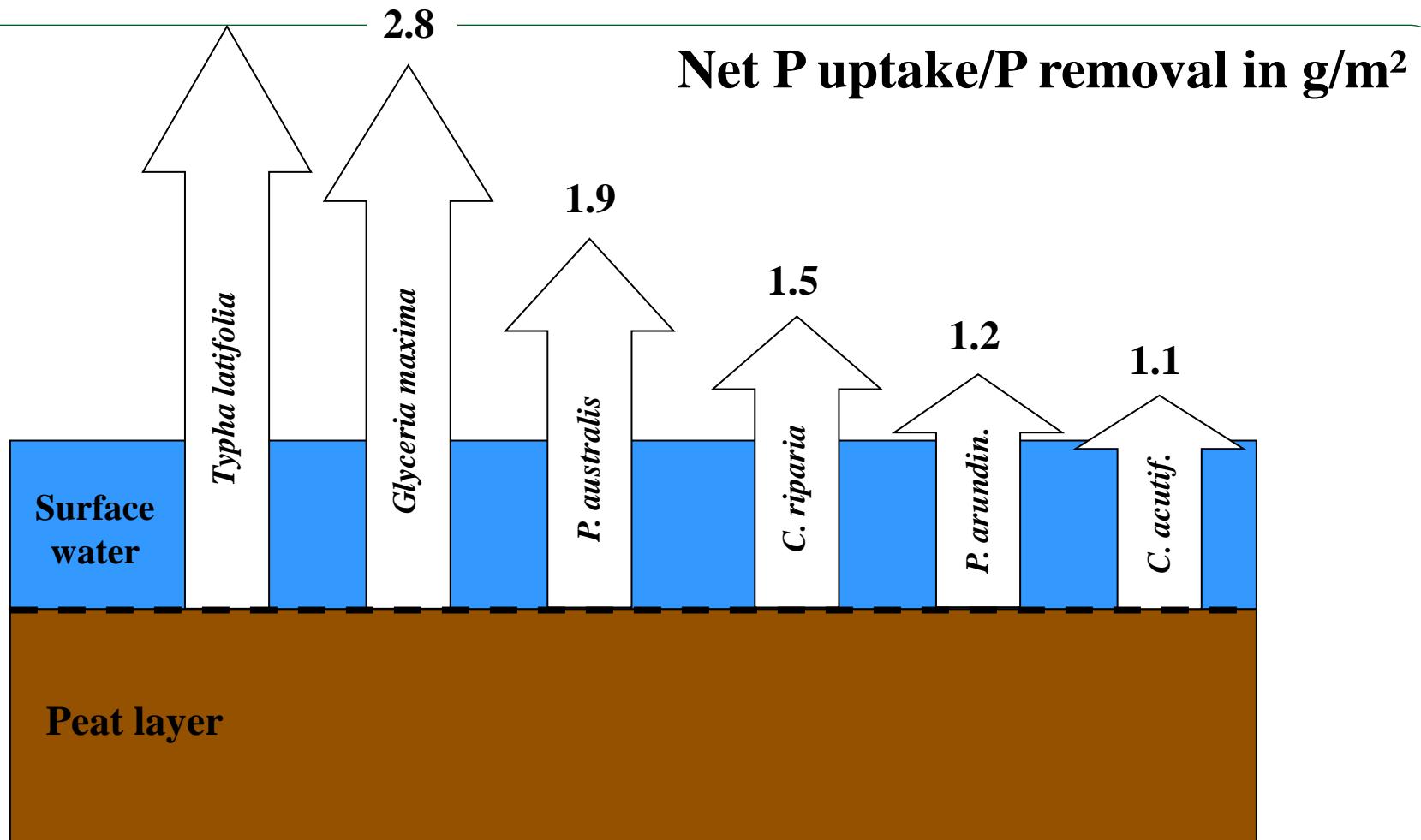
3. Cattail  
(*Typha latifolia*)



4. Reed and sedges  
(*Phragmites australis* and e.g. *Carex riparia*)



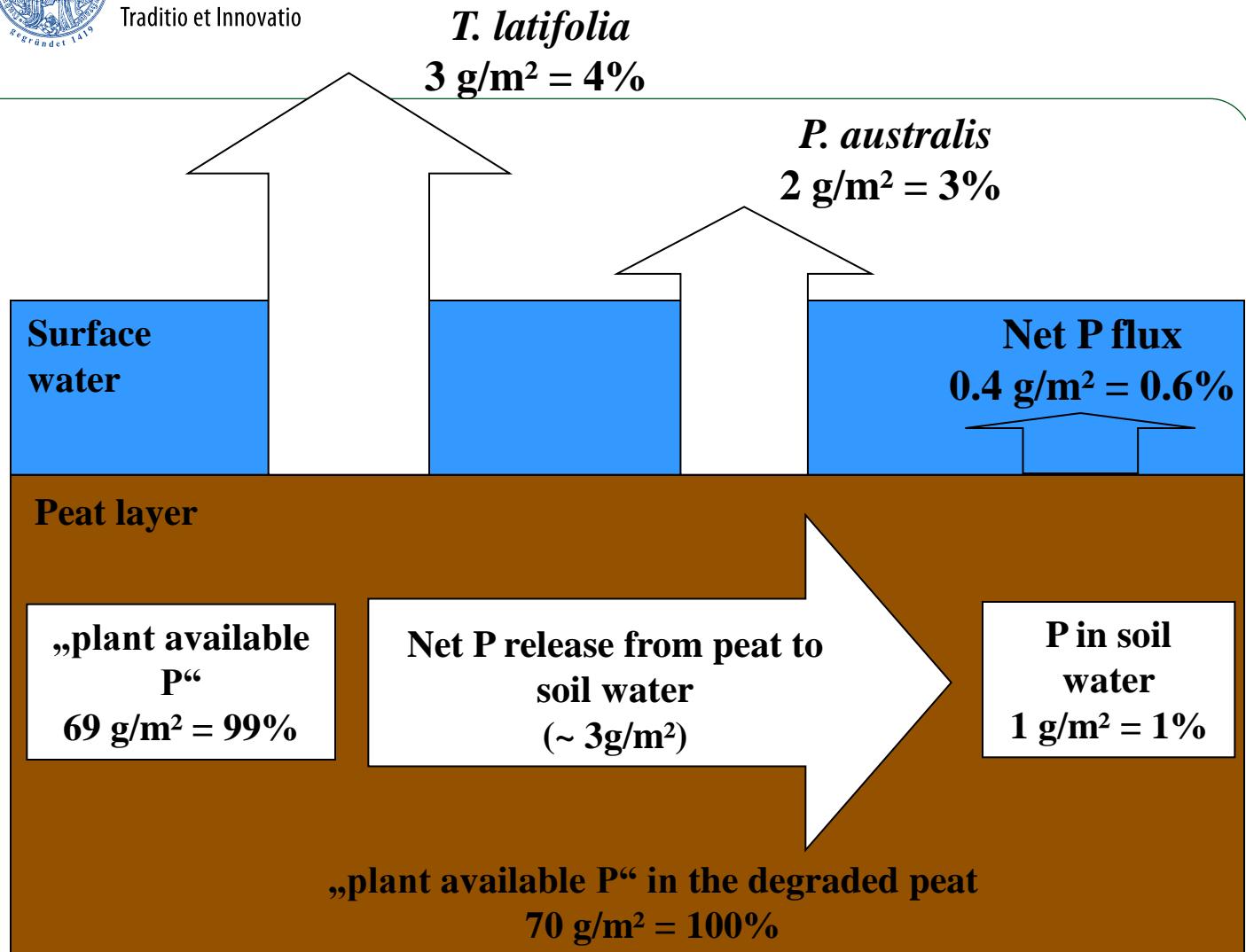
## „2. Harvesting effects on P“



Net P uptake by helophytes during growing season (150 d) in rewetted fens (mean, n = 24-48)



## „2. The effect on P pools“



**Comparison of P fluxes in rewetted fens (calculations are based on the length of the growing season of 150 d)**



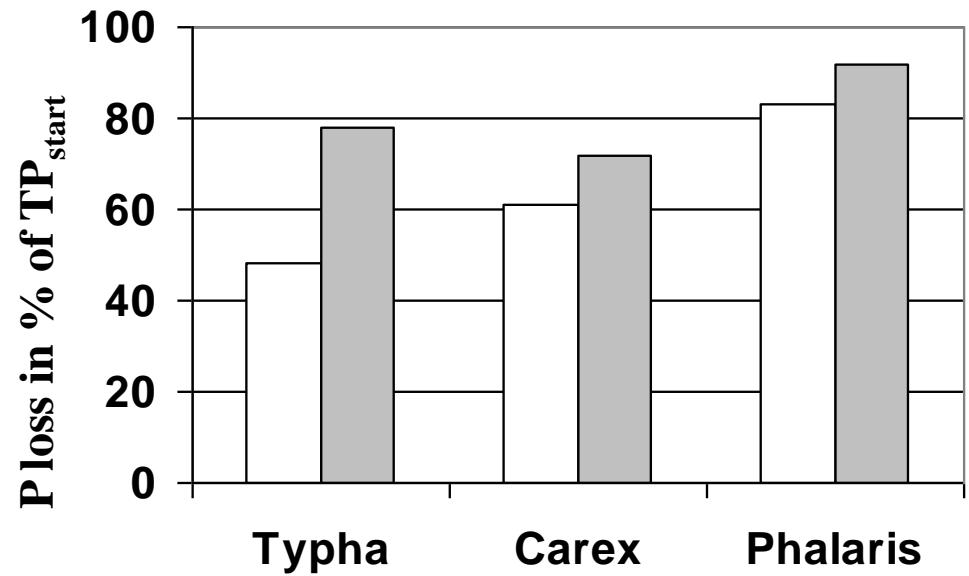
## „2. No harvesting: P recycling!“



Menzlin (July)



Menzlin (November)



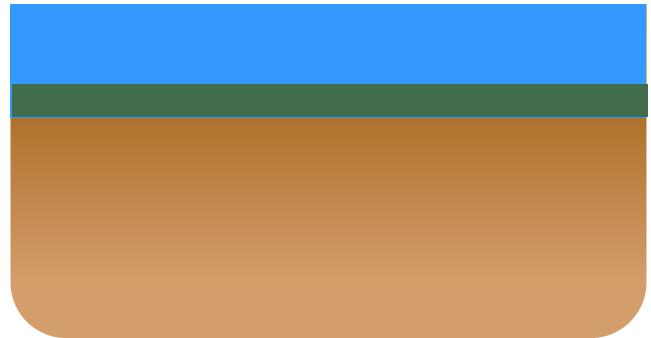
Leaching (1 d)

Decomposition (150 d)

P loss of plant litter due to leaching and subsequent anaerobic decomposition (MW, n = 3) (Zak et al. 2014)

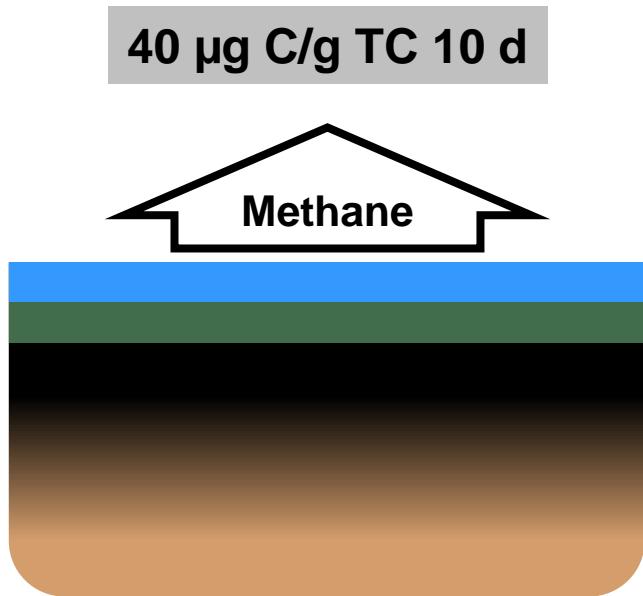


## „3. Top soil removal“



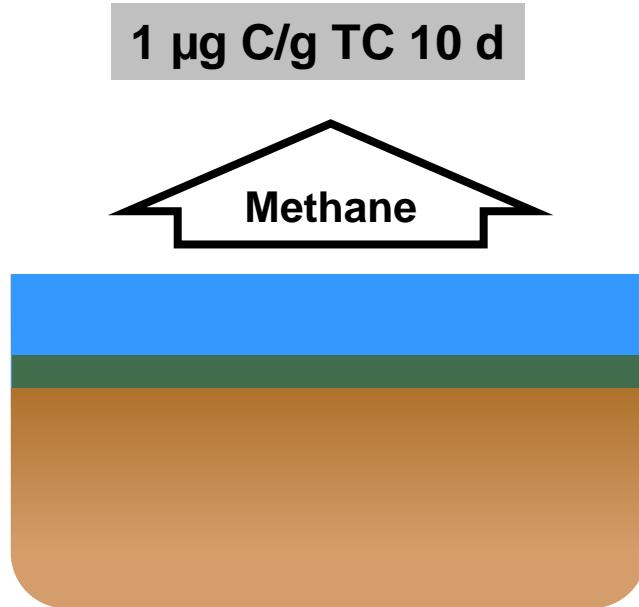


## „3. Effect of TSR on methane flux“



Rewetted fen without  
TopSoilRemoval

> 40 x



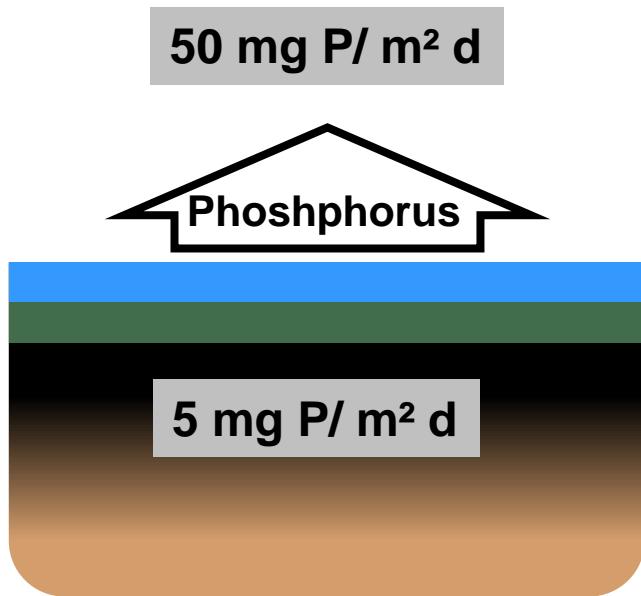
Rewetted fen with  
TopSoilRemoval

**Methane release potential at 15 °C**

(Zak et al. 2017)

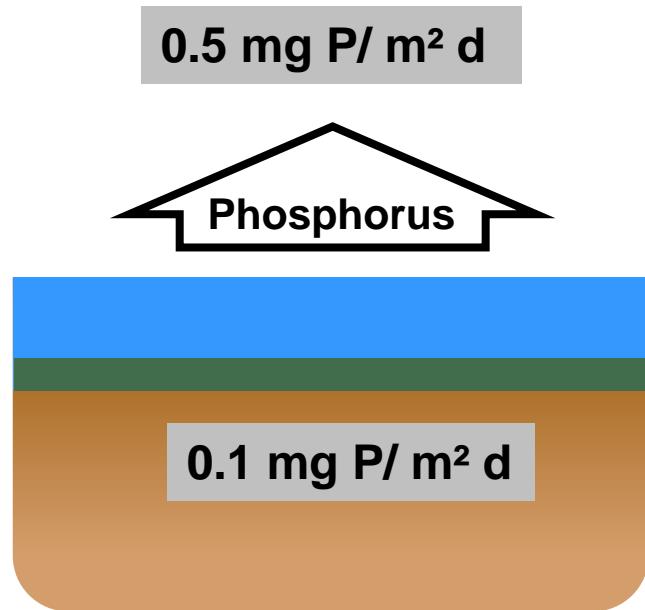


## „3. Organic mud amplify P release!“



Rewetted fen without  
TopSoilRemoval

> 40 x



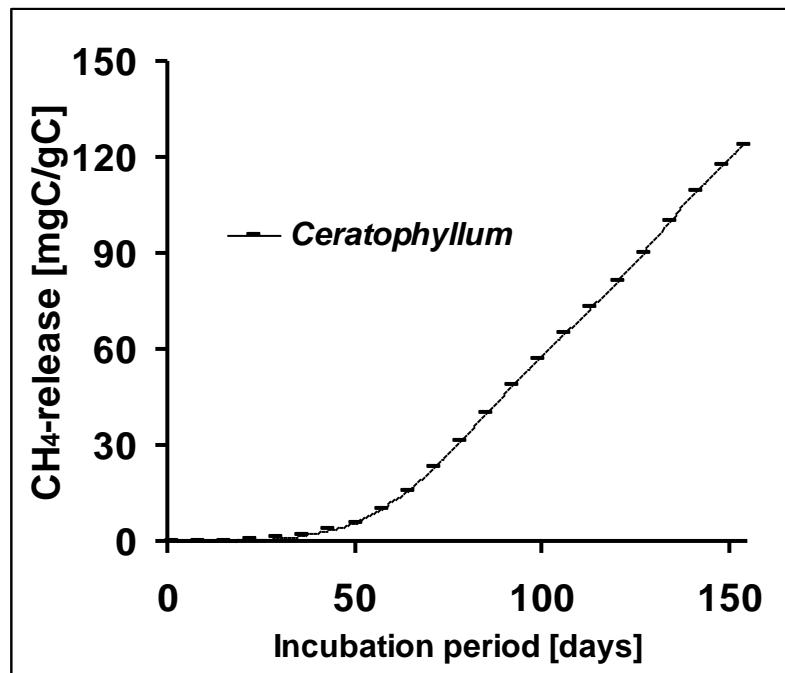
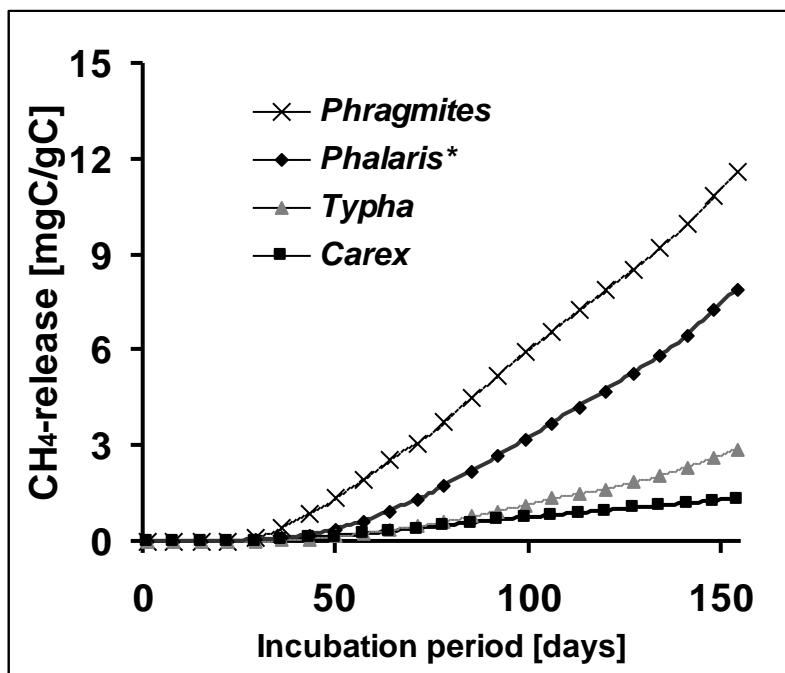
Rewetted fen with  
TopSoilRemoval

P fluxes in different soil substrates

(Zak et al. 2017)



# „Who ist the hot methane emitter?“



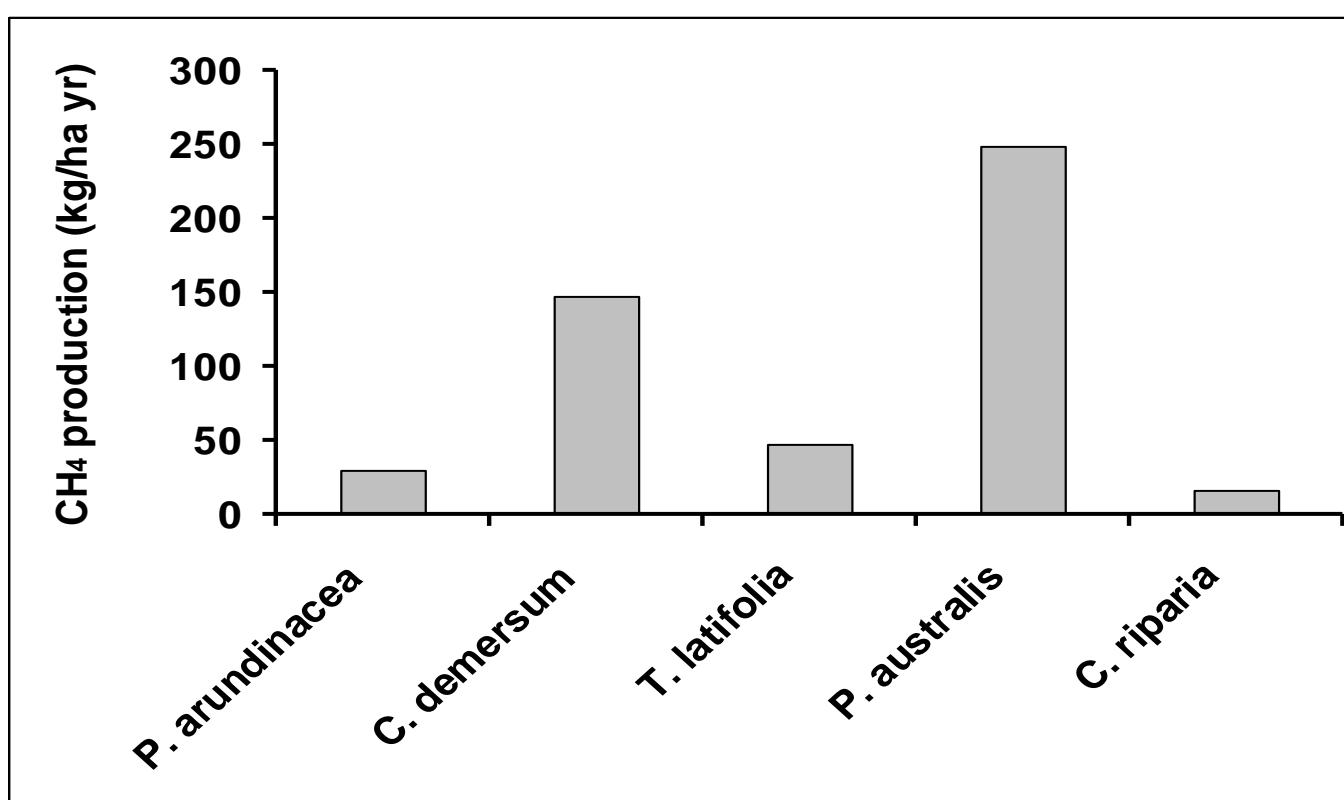
Cumulative release of CH<sub>4</sub> from different incubated plant material under submerged conditions over an incubation period of 154 d

*Ceratophyllum demersum* had the highest methane production potential followed by *Phragmites australis* and the lowest *Carex riparia*.

Zak et al. 2015



# „Translating lab results to the field“



Assessment of annual CH<sub>4</sub> production due to the decomposition of aboveground plant litter of different wetland plants taking biomass into account

Due to high biomass formation the decomposition of *P. australis* might produce more methane than *C. demersum* (17 vs. 1 t/ha yr)



- 1. Management can be helpful to lower the matter mobilisation with some unpleasent side effects!?**
  
- 2. The costs of harvesting might be compensated at the beginning but the yield might go down sooner or later!?**
  
- 3. Can we do something meaningful with heavily degraded peat?**



# „Peat under Water“ Workshop May 2018 MV, Germany

## „Relax or Read?“



Contents lists available at [ScienceDirect](#)

Ecological Engineering

journal homepage: [www.elsevier.com/locate/ecoleng](http://www.elsevier.com/locate/ecoleng)

How helophytes influence the phosphorus cycle in degraded inundated peat soils – Implications for fen restoration

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Martin Barth <sup>c</sup>, Alvaro Cabezas <sup>a</sup>, Peggy Steffenhagen <sup>d</sup>

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Biogeosciences



Changes of the CO<sub>2</sub> and CH<sub>4</sub> production potential of rewetted fens  
in the perspective of temporal vegetation shifts

D. Zak<sup>1</sup>, H. Reuter<sup>1</sup>, J. Augustin<sup>2</sup>, T. Shatwell<sup>1</sup>, M. Barth<sup>1</sup>, J. Gelbrecht<sup>1</sup>, and R. J. McInnes<sup>3</sup>

STANDARD PAPER

Journal of Applied Ecology

Top soil removal reduces water pollution from phosphorus and dissolved organic matter and lowers methane emissions from rewetted peatlands

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