

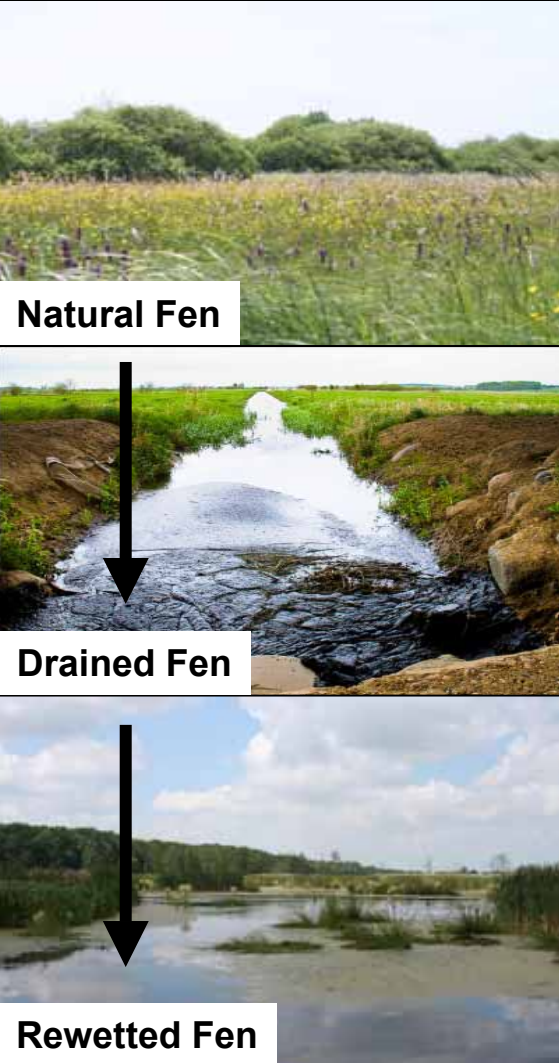


# The dynamics of phosphorus and carbon in degraded rewetted peatlands of the River Peene valley - governing factors and management options

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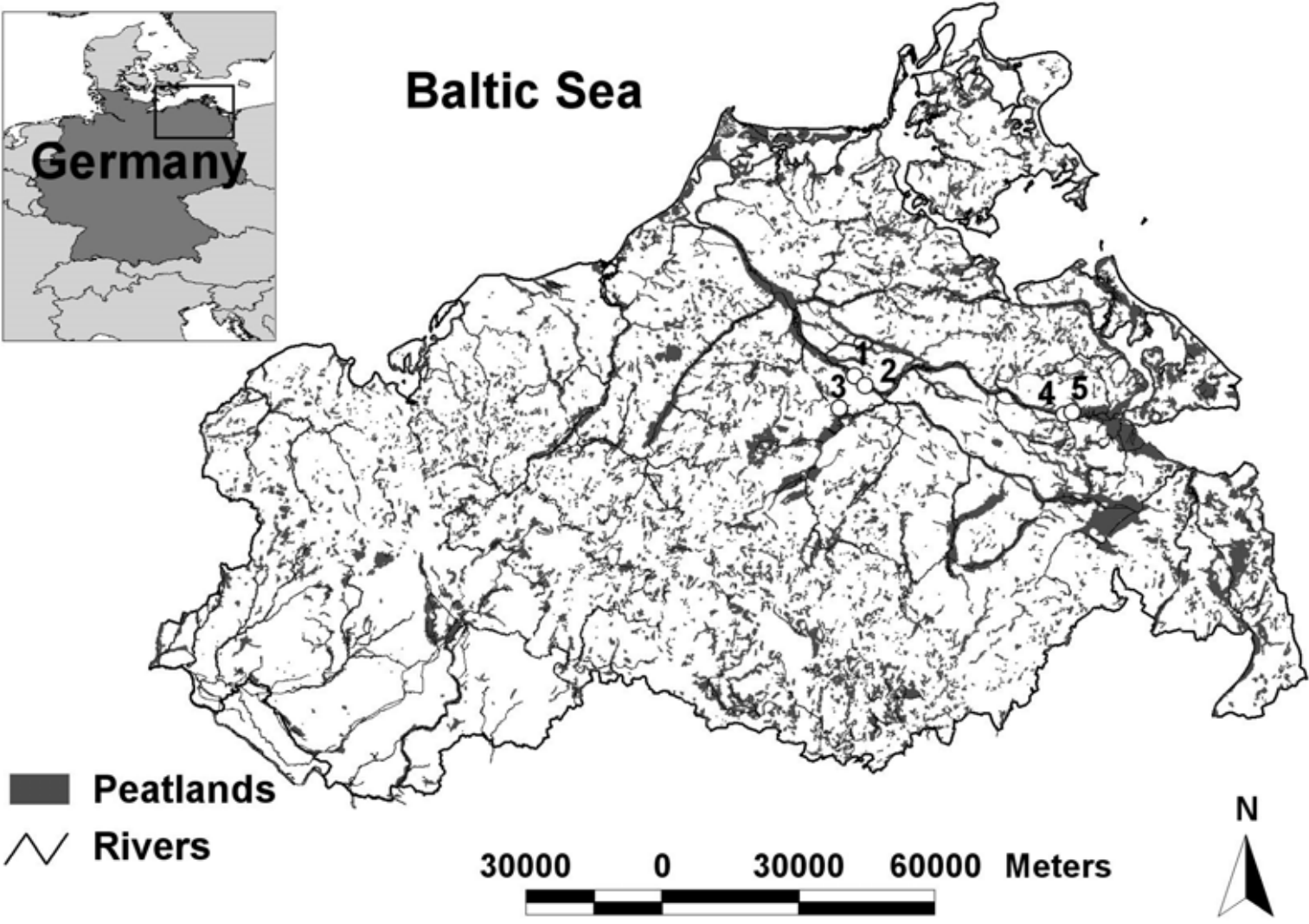


?

# 500 years ago we had many wetlands to clear water!



- INTRO
- METHODS
- RESULTS
- CONCLUSIONS



Fens along water courses in Mecklenburg-Vorpommern (~ 13%)

# Zooming into the fen sites ...

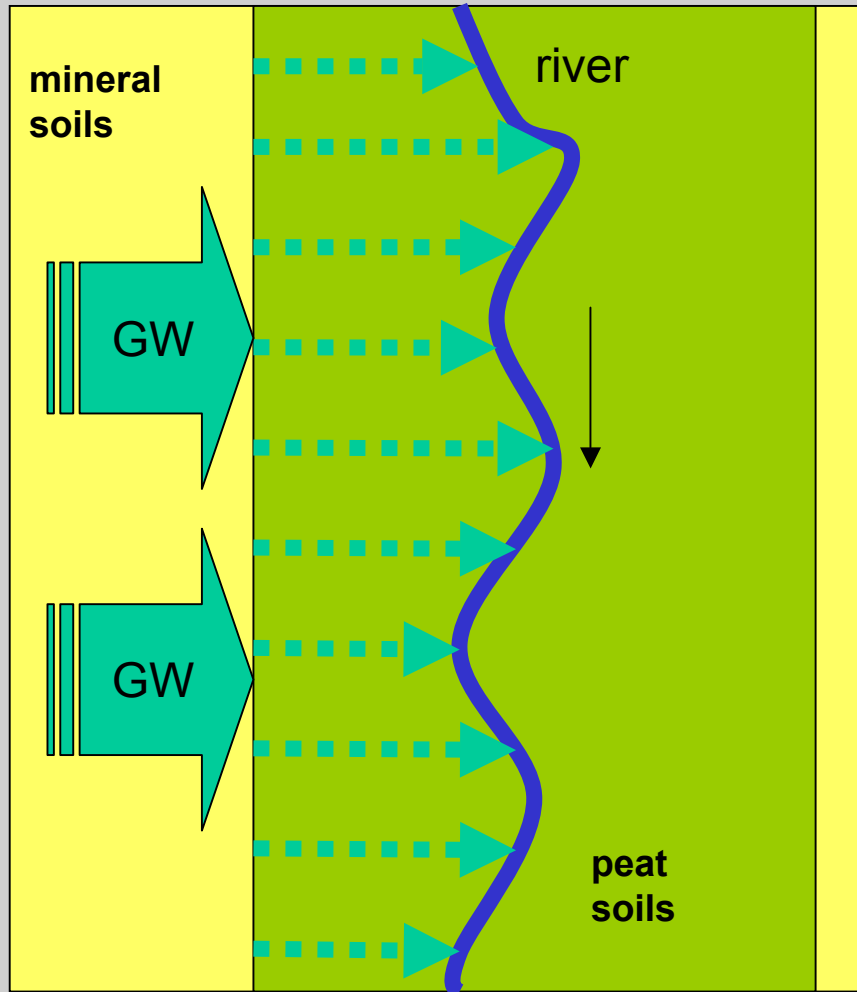


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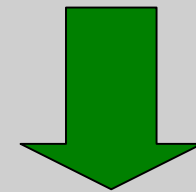
RESULTS

CONCLUSIONS



**Natural Fen acting as filter for ground water (GW)**

**in addition they balanced the water budget of landscape like a sponge**

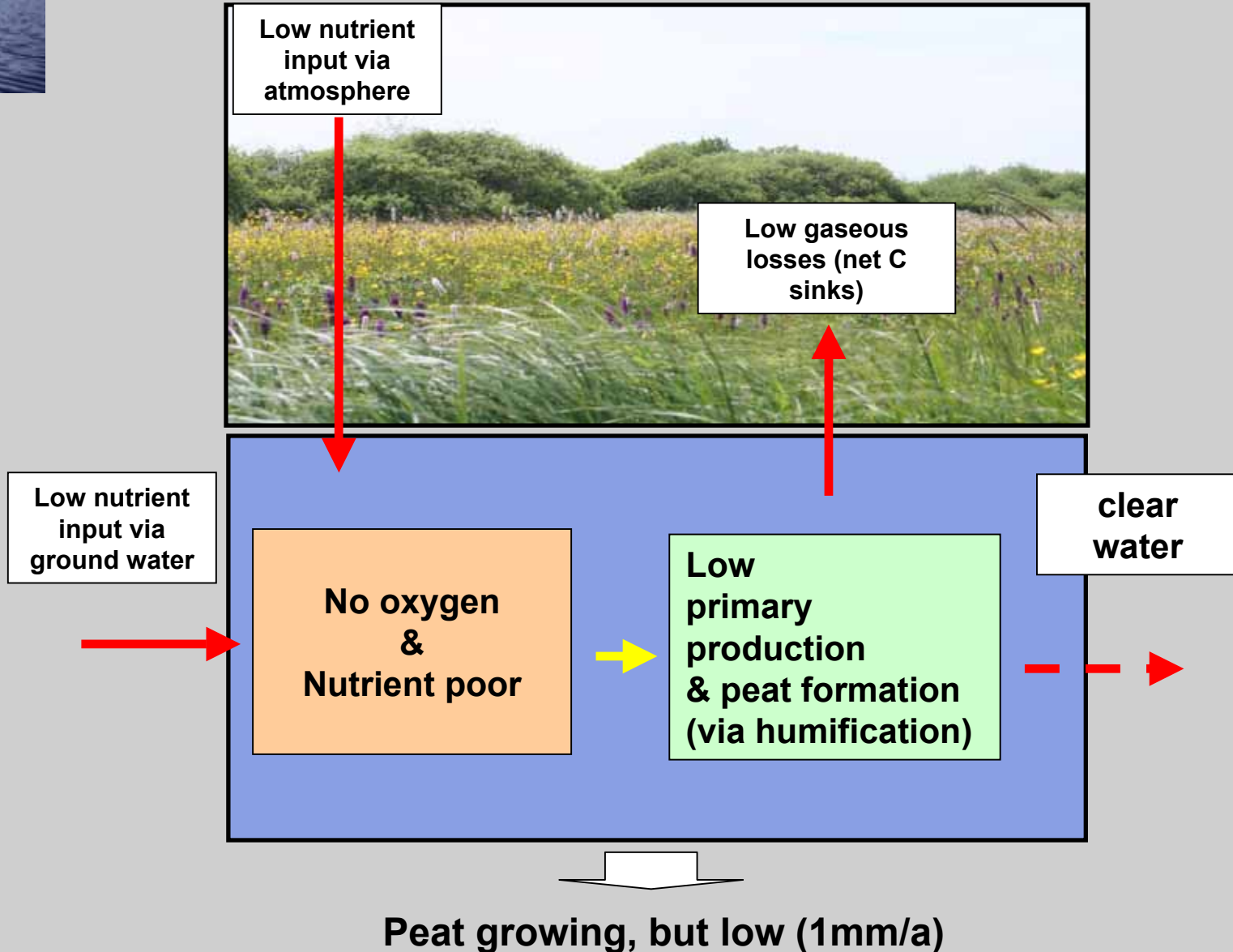


**„Kidneys of the landscape“**

# Zooming into the soils - how wetlands clear water?



- INTRO
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- RESULTS
- CONCLUSIONS



# Today nearly all "filters" are bypassed (> 90%)

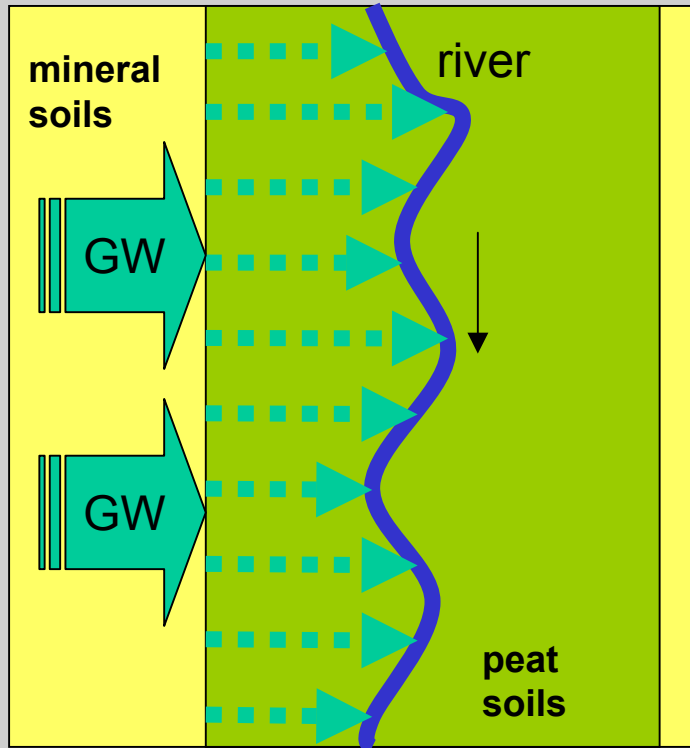


INTRO

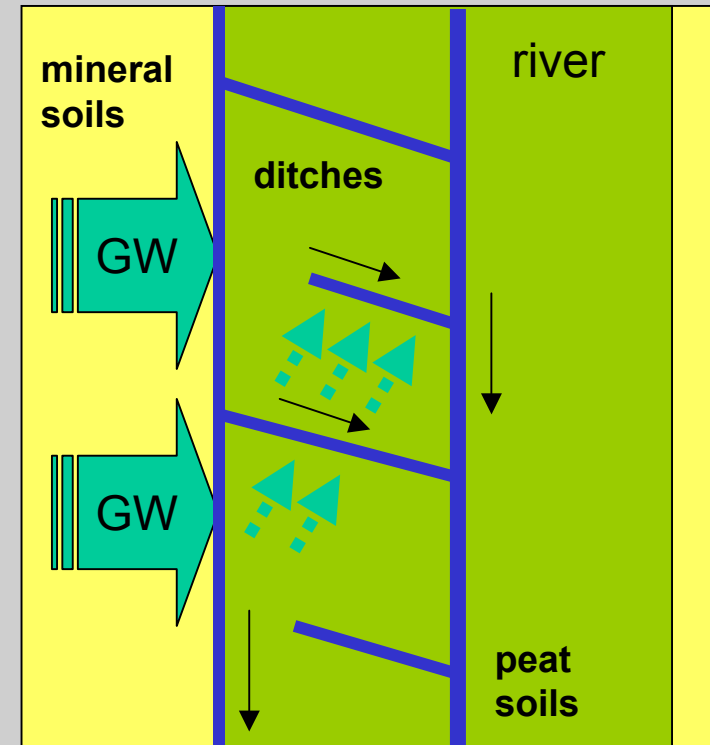
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**Natural Fen acting as filter for ground water (GW)**



**The loss of filter function due to fen drainage**

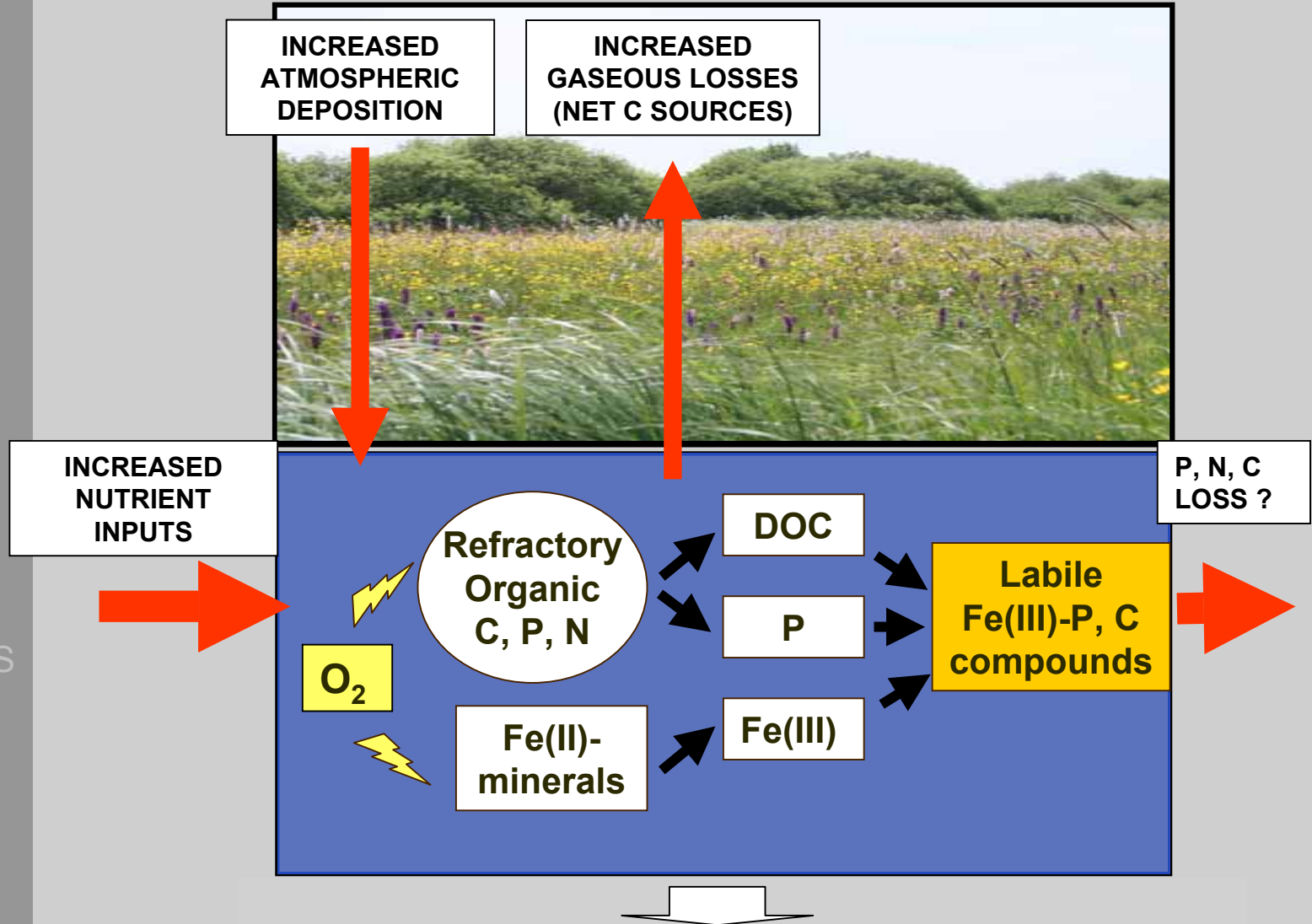
# What is changed during the time of drainage?

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Peat loss & shrinkage (~10-20 mm/a)

# Can a non-expert see these changes?



**The change from slightly decomposed peat to ,muck soils' (highly decomposed) due to peat mineralization**



**Highly decomposed peat or muck soils (0-0.3 m)**

**Moderately decomposed peat (0.3-1 m)**

**Slightly decomposed peat (1-10 m)**

**Drained polder Zarnekow before re-wetting**

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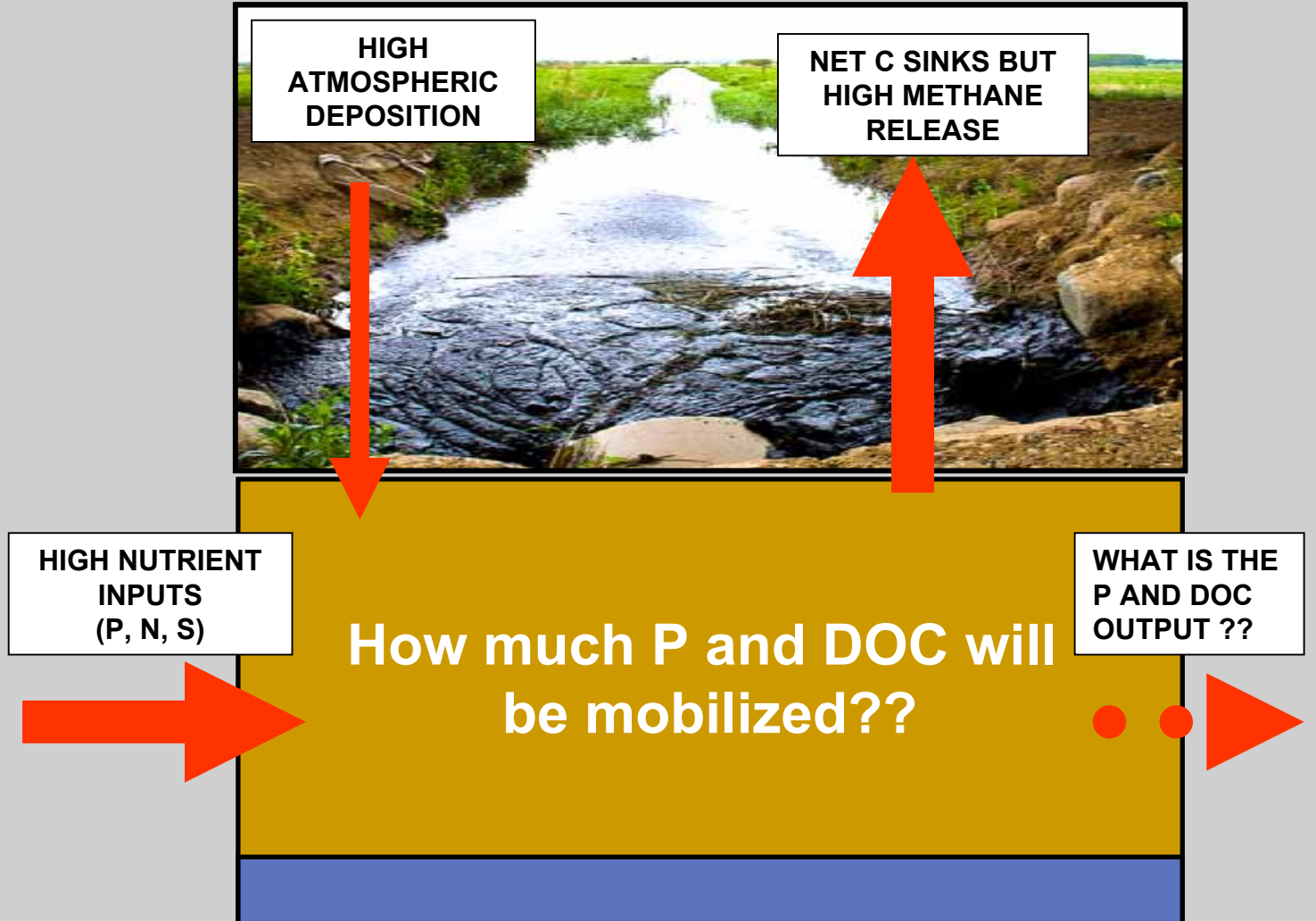
# What happens after rewetting of fens?

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# SIX QUESTIONS OUT OF THE PRACTICE

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1. Do rewetted fens release always more P and DOC than natural fens?
2. Which peat layer release P and DOC after fen rewetting?
3. Can we predict the magnitude of P and DOC release in rewetted fens?
4. Which portion of released P and DOC will enter adjacent water courses?
5. How long we can expect a high P mobilization in rewetted fens?
6. Can we minimize the mobilization of P and DOC after fen rewetting?

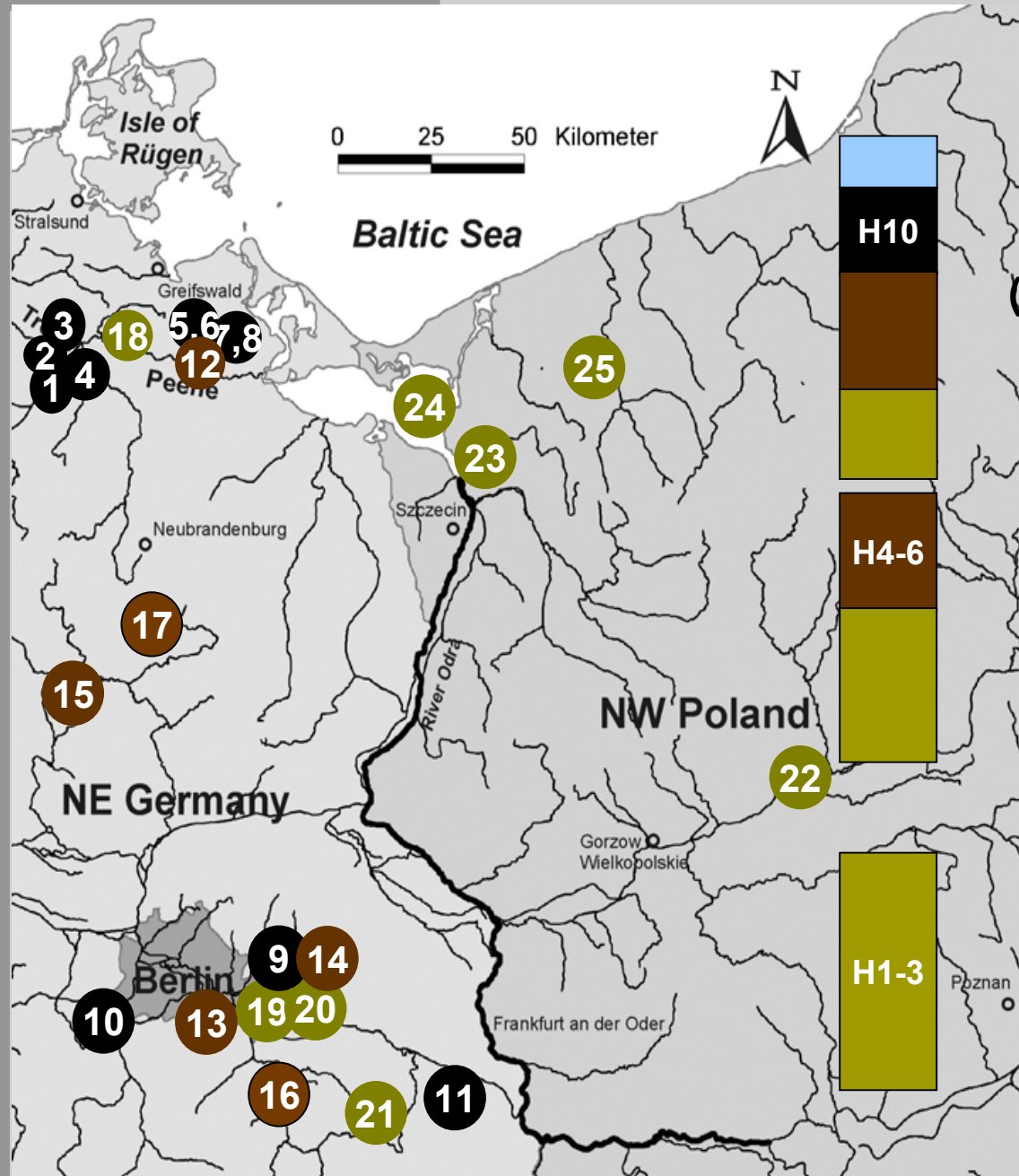
# Sampling sites (25 minerotrophic peatlands)

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„Heavily drained“  
rewetted fens  
(= highly degraded  
fens)

„Moderately  
drained“  
rewetted fens  
(= degraded fens)

„Non-drained“  
natural fens  
(= reference fens)

# Sampling methods – a brief overview

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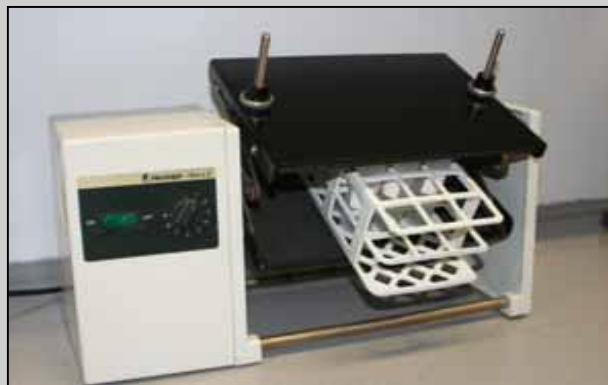
CONCLUSION



**Field sampling with dialysis samplers to investigate spatial and temporal changes of P and DOC concentrations in soil waters (depth 0-60 cm) of fens (e.g. Zak et al. 2004)**



**Lab experiments to identify the controlling factors of P and DOC dynamics in fens like peat decomposition, water quality, temperature (e.g. Zak et al. 2010)**



**Soil extractions to assess the mobilization potential of P, DOC etc. in rewetted fens (e.g. Zak et al. 2008)**

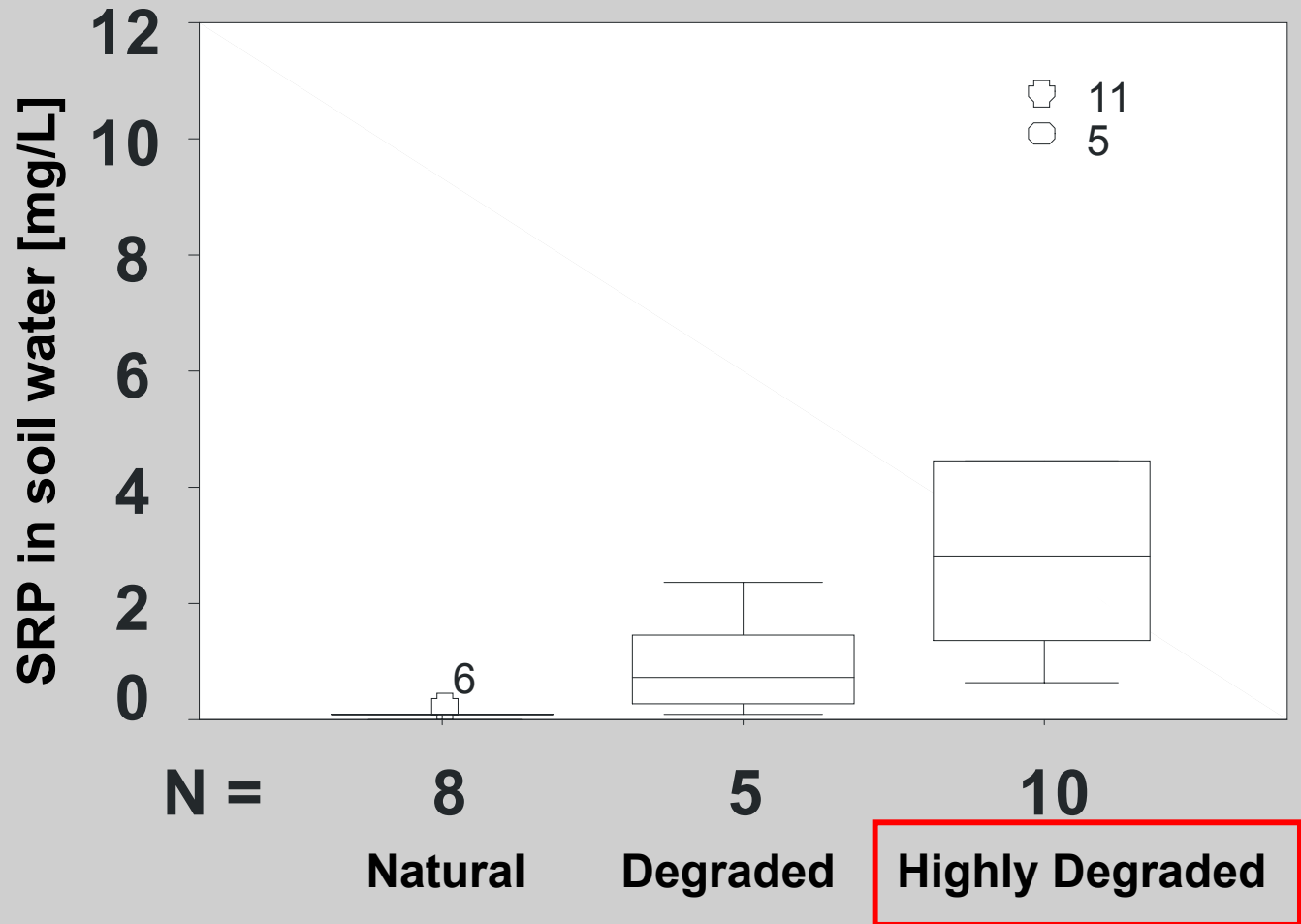
# Do rewetted tens release always more P?



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P concentrations in soil water (0-60 cm) obtained by dialysis samplers (data source: Zak et al. 2010)

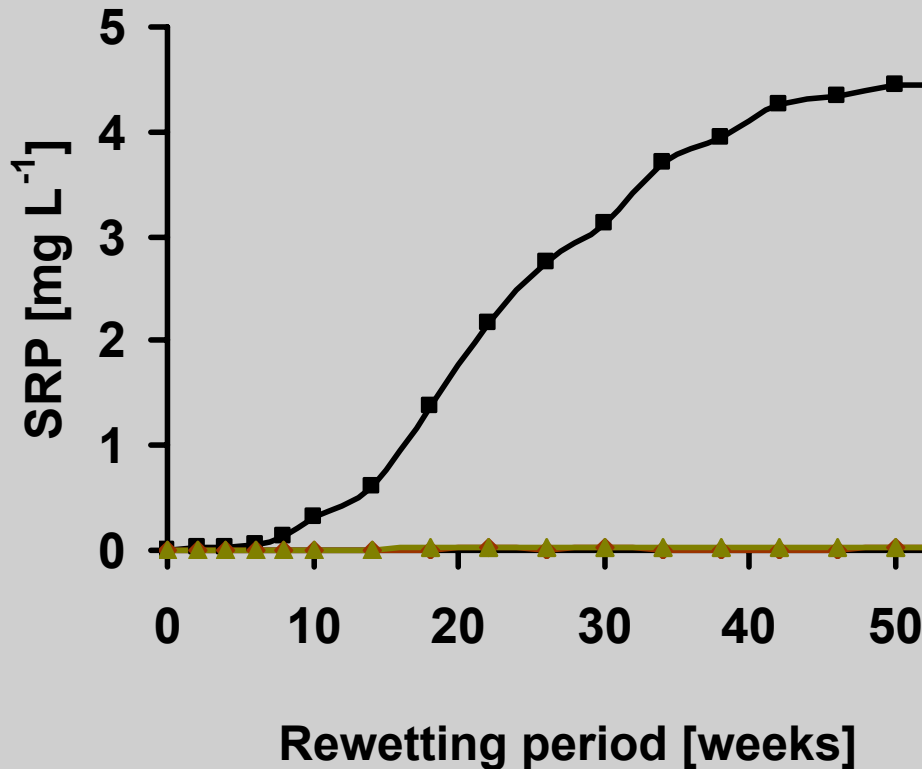
# Which soil layer release P?



Highly decomposed peat or muck soils (0-0.3 m)

Moderately decomposed peat (0.3-1 m)

Slightly decomposed peat (1-10 m)



Course of P in soil water of re-wetted mesocosms with different decomposed peat (mean  $\pm$  SD, n =3).

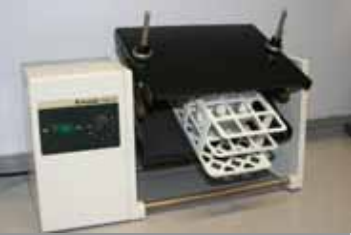
(Zak & Gelbrecht 2007)

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# Can we predict P mobilization?

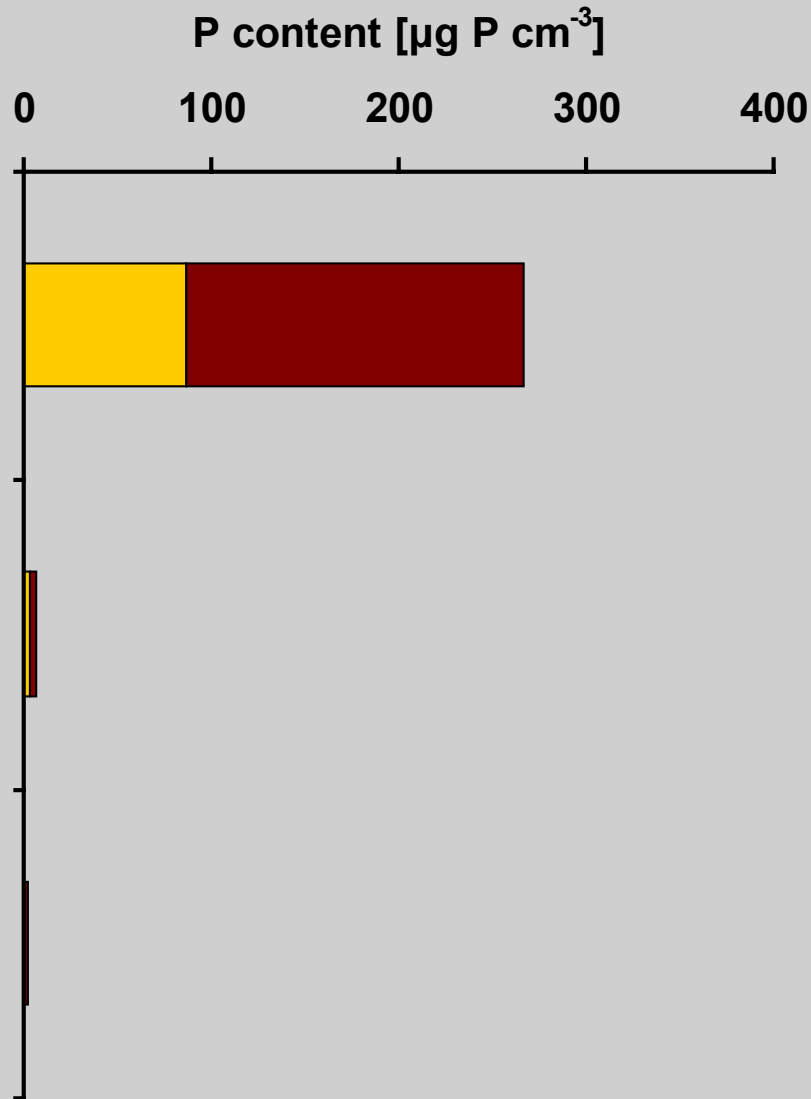


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Highly decomposed peat or muck soils (0-0.3 m)

Moderately decomposed peat (0.3-1 m)

Slightly decomposed peat (1-10 m)

P mobilisable under anoxic (■) and acidic (■) conditions in different decomposed peat (Median, n = 6-18).

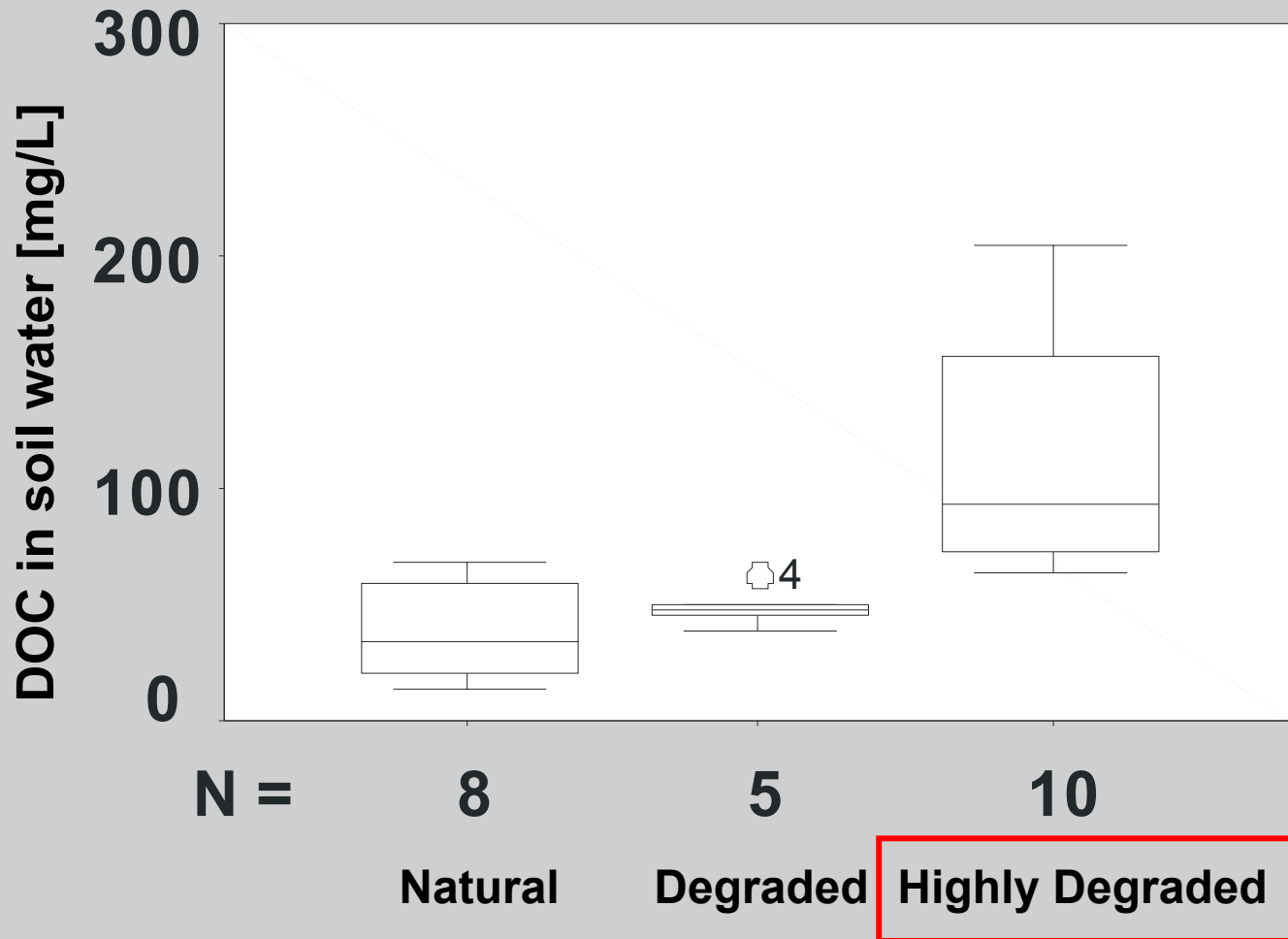
# Do rewetted fens release always more DOC?



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DOC concentrations in soil water (0-60 cm) obtained by dialysis samplers (data source: Zak et al. 2010)

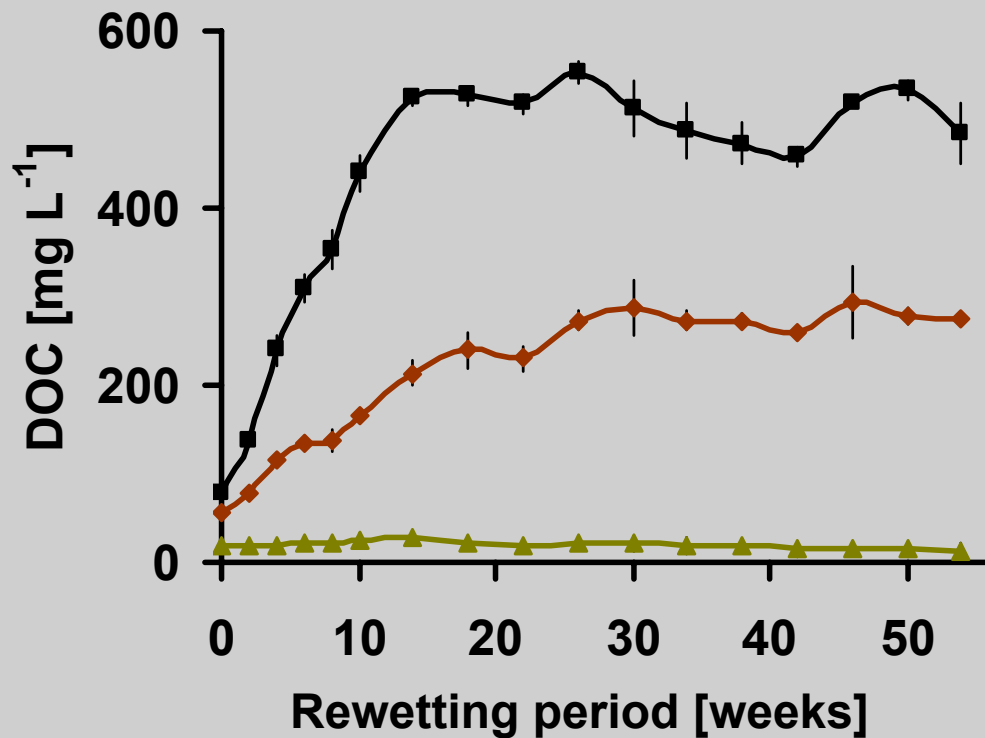
# Which soil layer release DOC?



Highly decomposed peat or muck soils (0-0.3 m)

Moderately decomposed peat (0.3-1 m)

Slightly decomposed peat (1-10 m)



Course of DOC in soil water of re-wetted mesocosms with different decomposed peat (mean  $\pm$  SD, n =3).

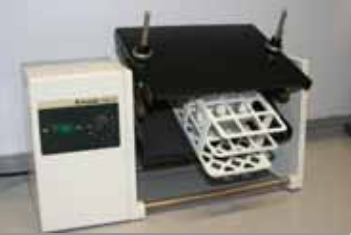
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# Can we predict C mobilization?

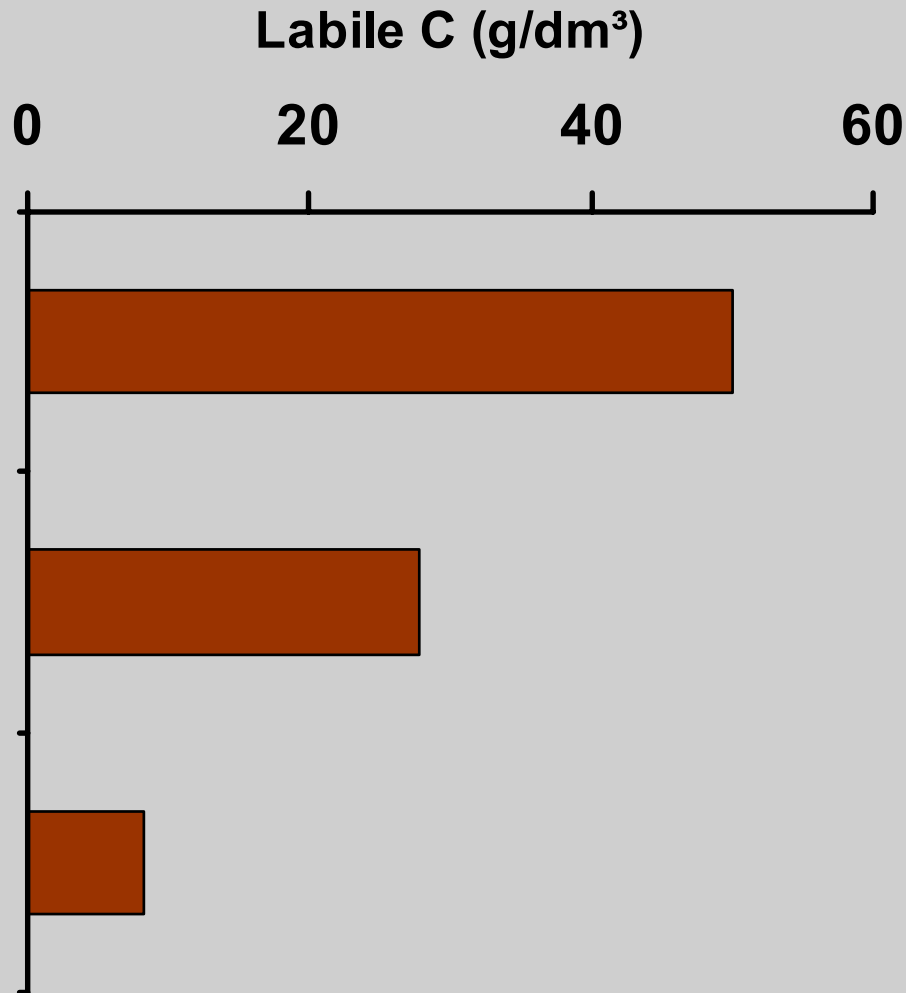


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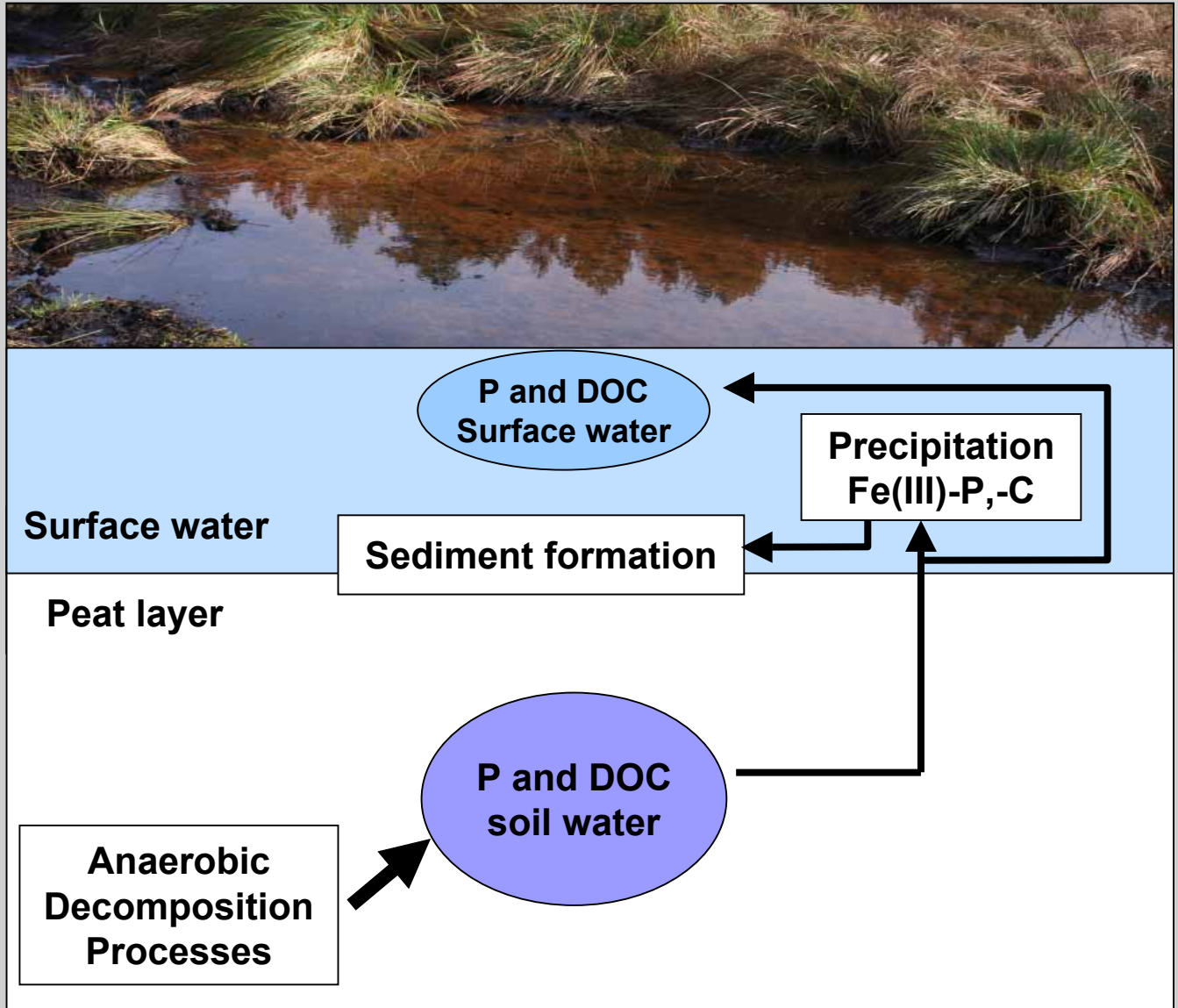
Highly decomposed peat or muck soils (0-0.3 m)

Moderately decomposed peat (0.3-1 m)

Slightly decomposed peat (1-10 m)

**C mobilisable by anaerobic decomposition processes in different decomposed peat (Median, n = 6-18).**

# How much P and C will enter adjacent water courses?



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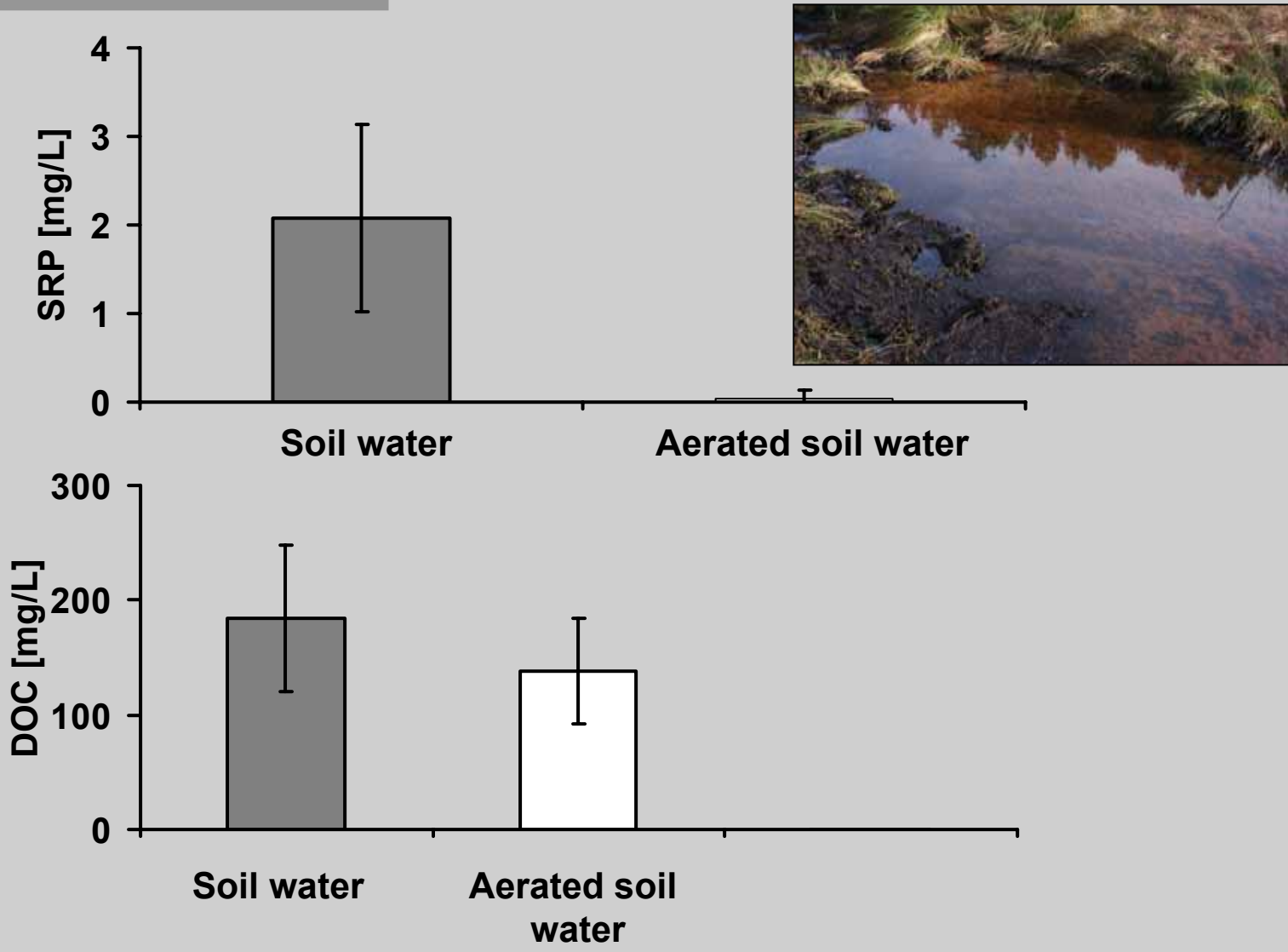
# How much P and C will enter adjacent water courses?

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**P and DOC in anoxic soil water (0-60 cm) and after iron precipitation (aerated soil water) (Mean ± SD, N = 25-150)**

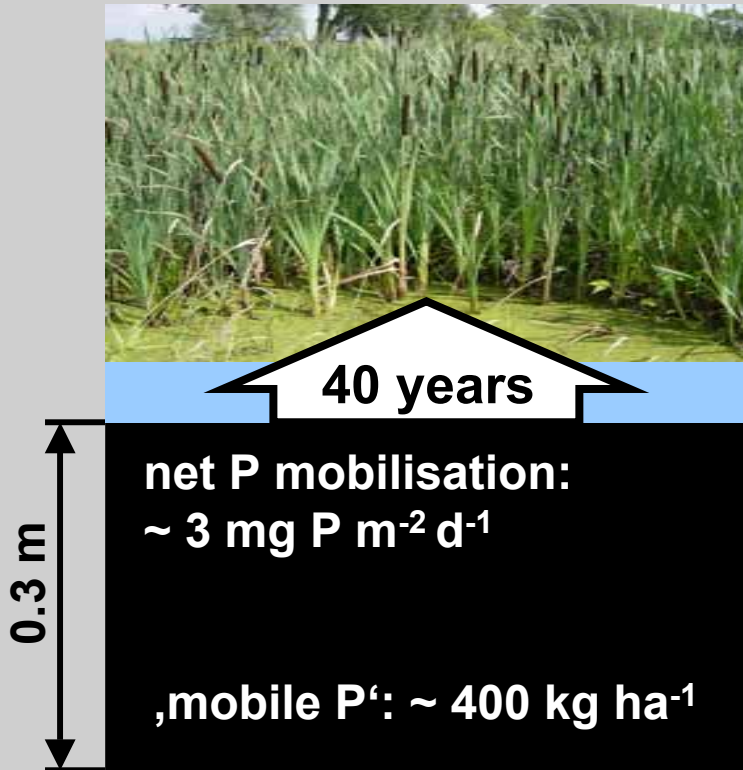
# How long a high P mobilisation is likely?

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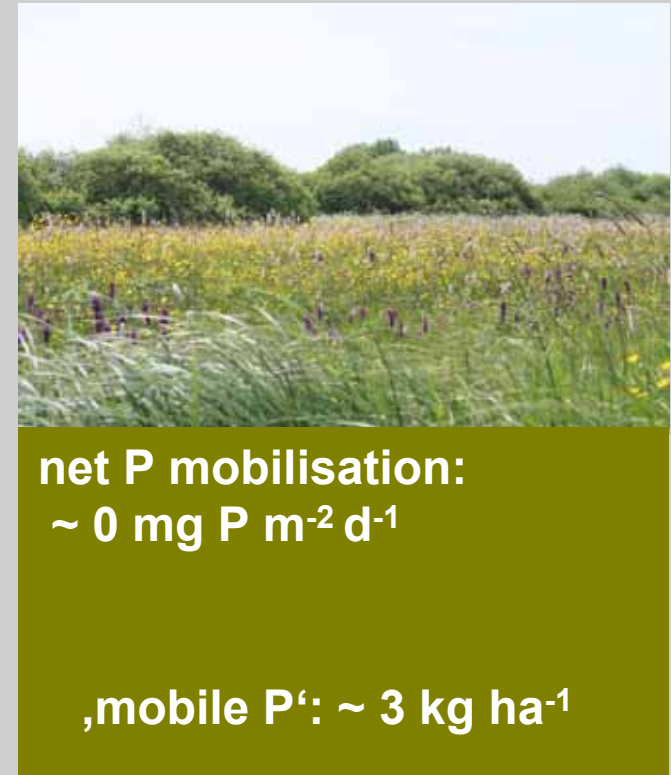
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Rewetted fen with highly decomposed peat in upper soil layer



Natural fen with slightly decomposed peat in upper soil layer

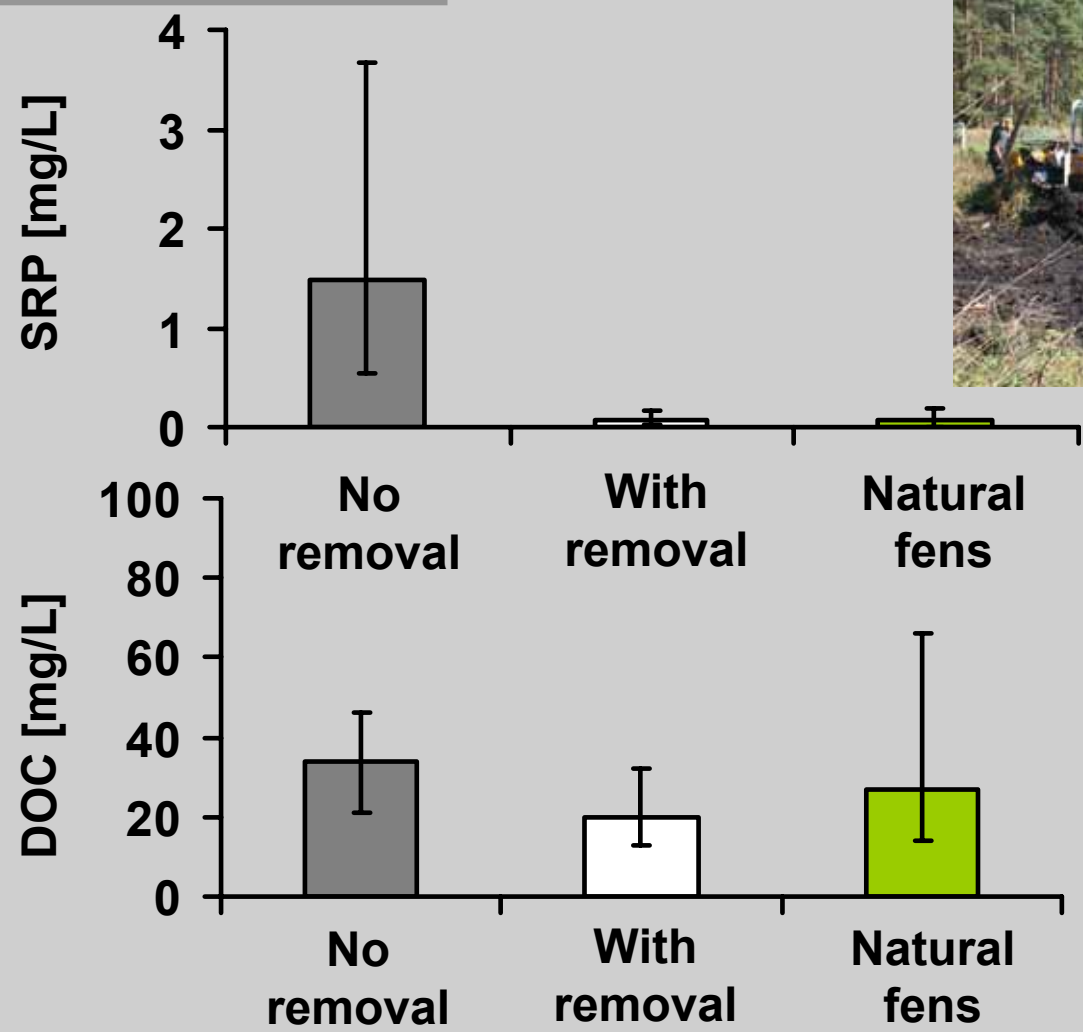
# Can we minimize P and DOC release in rewetted fens?

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P and DOC in soil water (0-60 cm depth) in a rewetted fen partially restored by top soil removal compared to natural fens (median and range, n = 3-12).

# CONCLUSIONS FOR FEN RESTORATION

1. Rewetting of fens is necessary to stop further peat mineralisation and to restore the important ecological function as nutrient filters in the long-term.
2. The restoration needs time (sometimes decades), pre-investigation help to predict the magnitude of P and C mobilization after rewetting.
3. To fasten up the fen restoration top soil removal is (mostly) a suitable measure.



**Apart from uncertainties regarding the restoration time, we still need much more knowledge to answer the QUESTION: How many fens should be rewetted to mitigate the high non-point pollution of water courses?**

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Many thanks to my brave colleagues and to the government  
of M-V for the subvention



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Thank you for  
attention!