RETROUT

Effectiveness of wetland system to retain nutrients: case study of Smiltele stream (Lithuania)

J. Petkuviene, M. Zilius, I. Vybernaite-Lubiene, T. Politi, A. Skersonas, N. Nika

Marine Research Institute, Klaipeda University, Lithuania

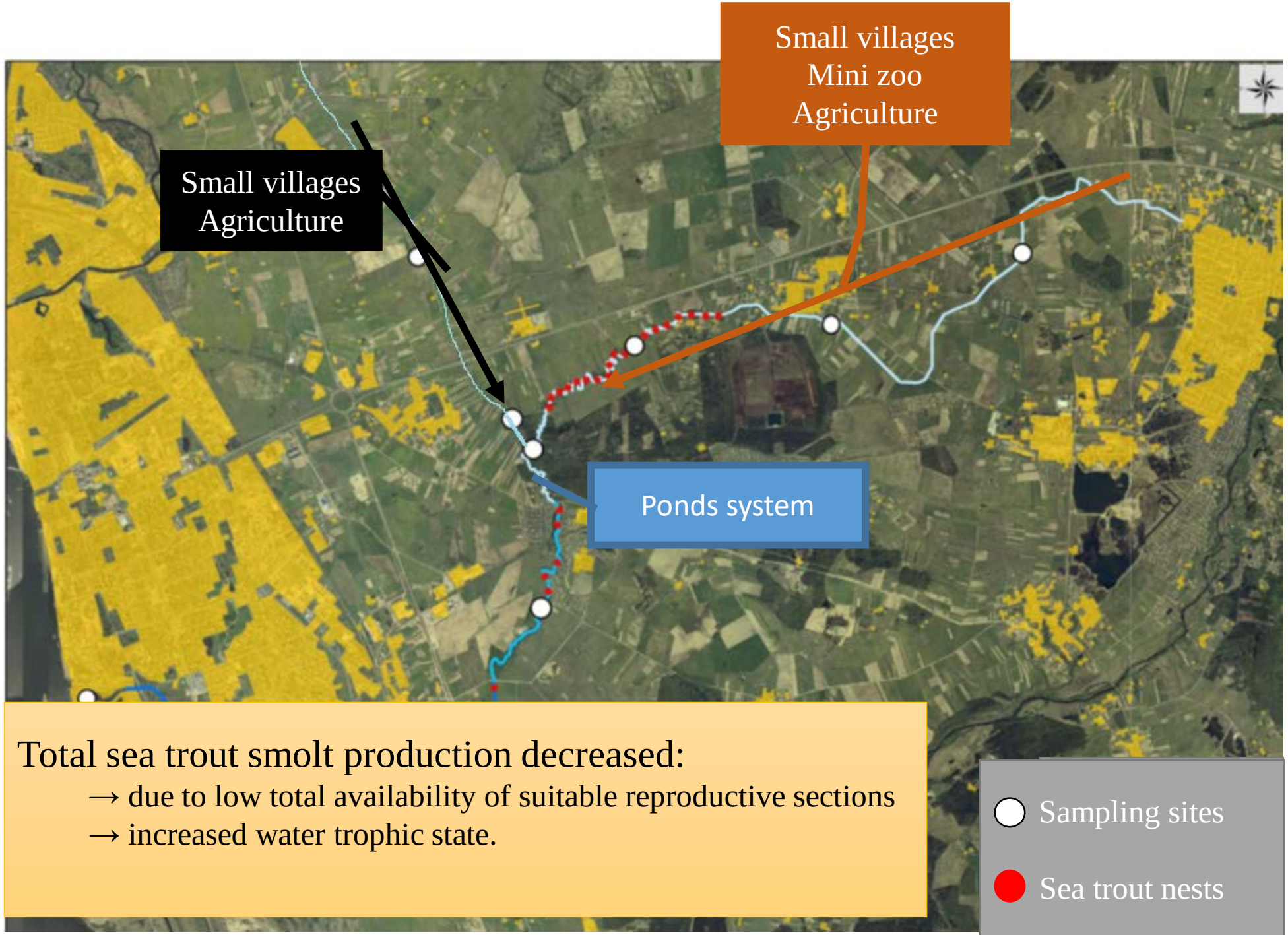
jolita.petkuviene@apc.ku.lt

Introduction: importance of habitat

Kazys et al. 2013

- The Smeltele → lowland stream → 22,8 km length and 124 km^2 catchment area.

- **Smeltele is important for sea trout migration.**



Total sea trout smolt production decreased:

→ due to low total availability of suitable reproductive sections

→ increased water trophic state.

Pond system

- In 1996 the first artificial wetland was constructed in Smeltele Stream (western Lithuania) consisting of six bioponds.
- 1st and 2nd ponds are deeper and act as sedimentation pots.
- 3rd, 4th and 5th ponds are shallow with denser vegetation cover (*Phragmites* and *Scirpus*). Removal of N and P under aerobic conditions.
- 6th pond – shallow, and its sediment should contain anaerobic conditions. Vegetated by *Typha sp.*
- The area of the ponds is sufficient to retain up to 10-15 % nitrogen and phosphorus load in the Smeltele. This is approximately 2,5-3,8 t N and 0,15- 0,23 t P per year.

After 22 years….

Pond sides overgrowth by bushes, trees and grass.

Sedimentation ponds accumulated mud (2→1 m);

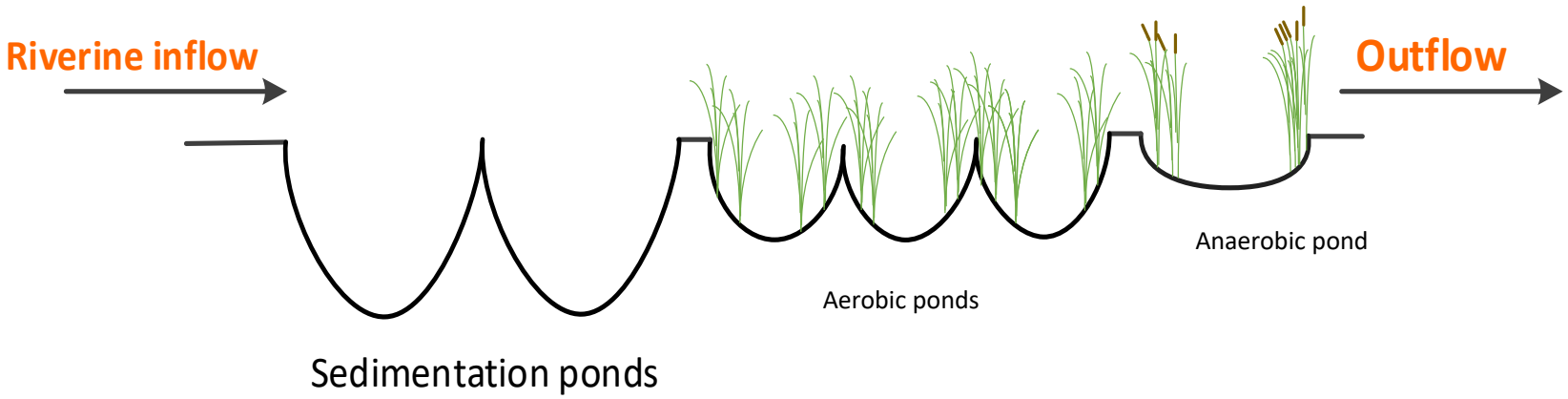
Incraesed macrophytes biodiversity within the ponds:

- Elodea canadensis
- Potamogeton natans
- Typha angustifolia
- Sparganium erectum
- Lemna minor
- Lemna trisulca
- Phragmites australis
- Myriophylum spicatum
- Sagittaria sagittifolia
- Nuphar lutea
- Equisetum spp.

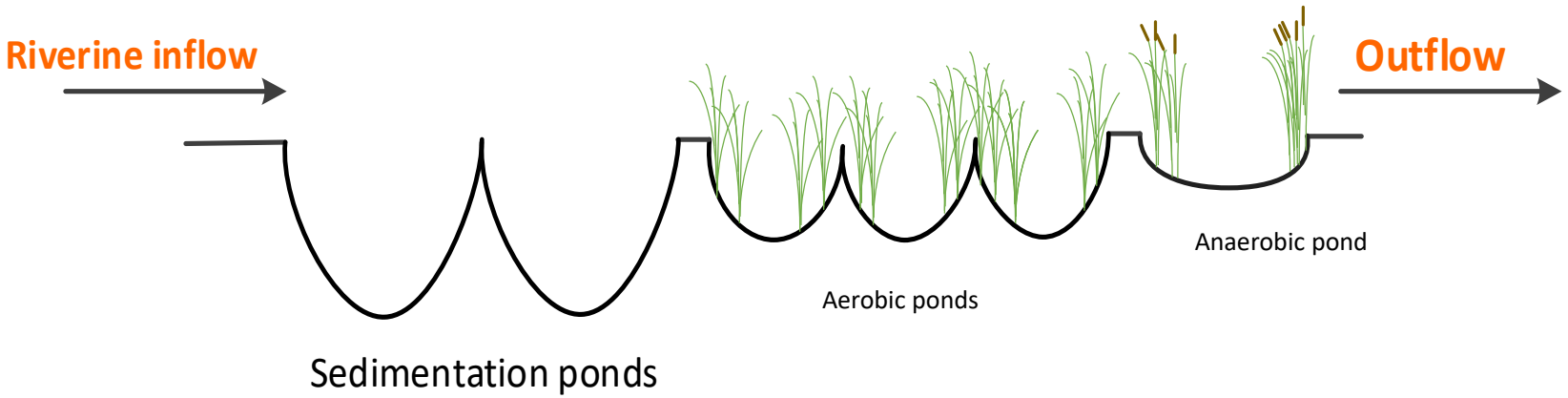
Due to **decrease of Sea trout smolt** within Interreg BSR RETROUT project pre-restoration surveys were conducted in **2017-2018 on nutrient pollution and biogeochemical cycling within stream ecosystem and in biopond system**.

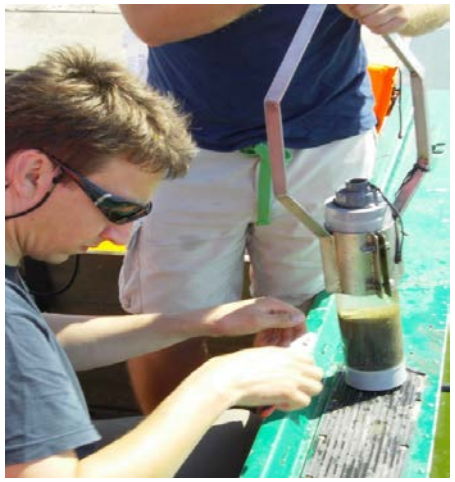
Aim of the study

- Evaluate the pond systems capability to retain/regenerate nutrients (phosphorus)



Material and Methods



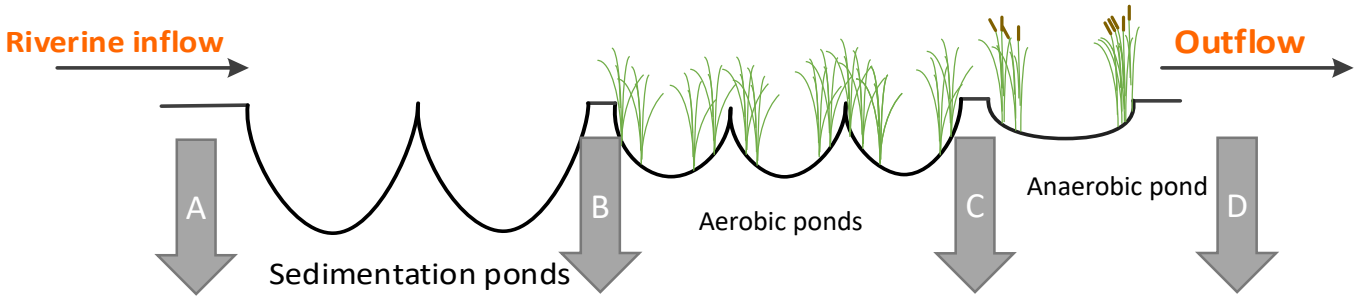


October 2017 – September 2018

Monthly/biweekly measurements:

- Water characteristics: water flow, temperature;
- Water sampling: DIP, DOP, TP
- Net fluxes of DIP at the sediment-water interface

Estimation of Phosphorus Retention



1) Retention at different pond section (B-A, C-B and D-C):

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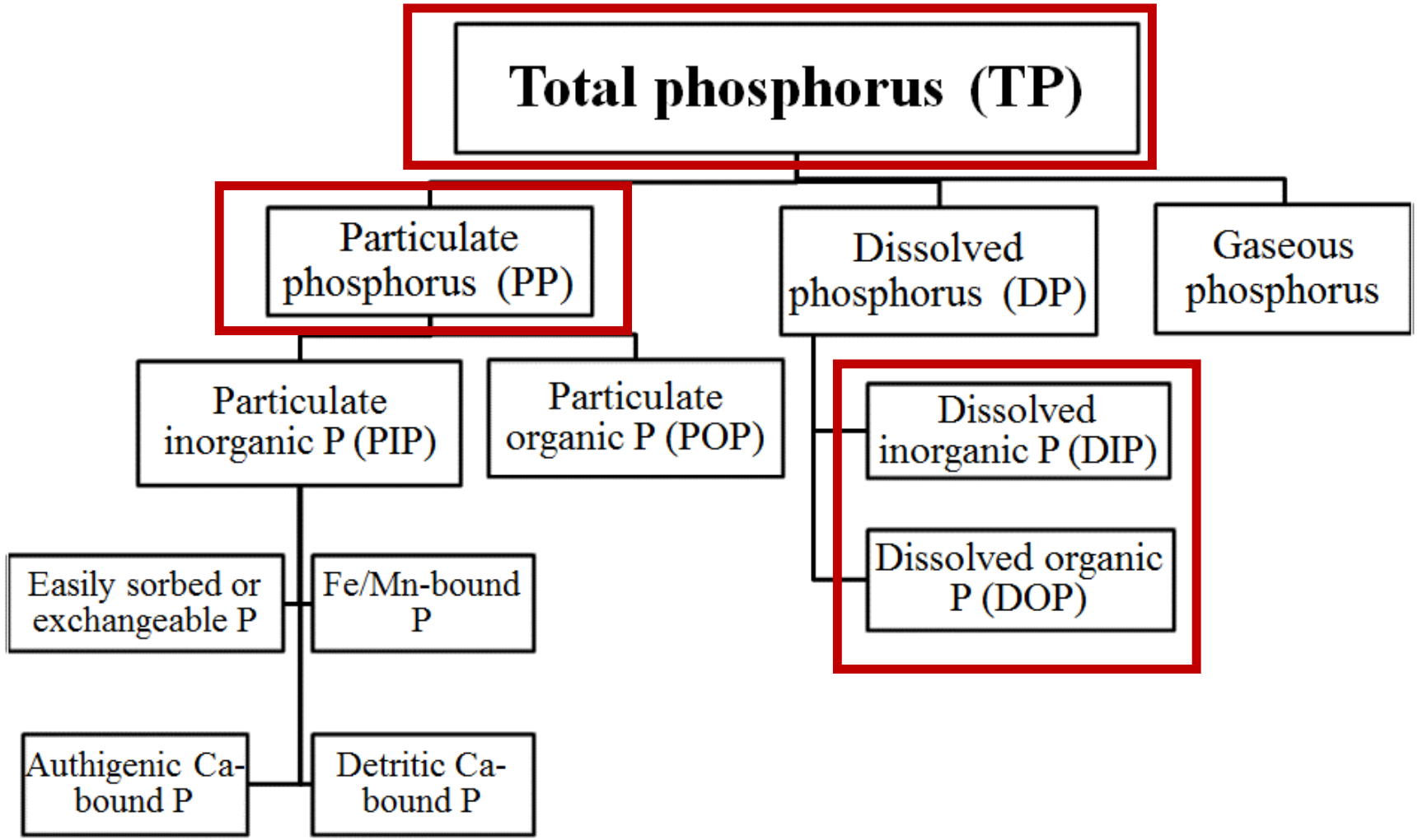
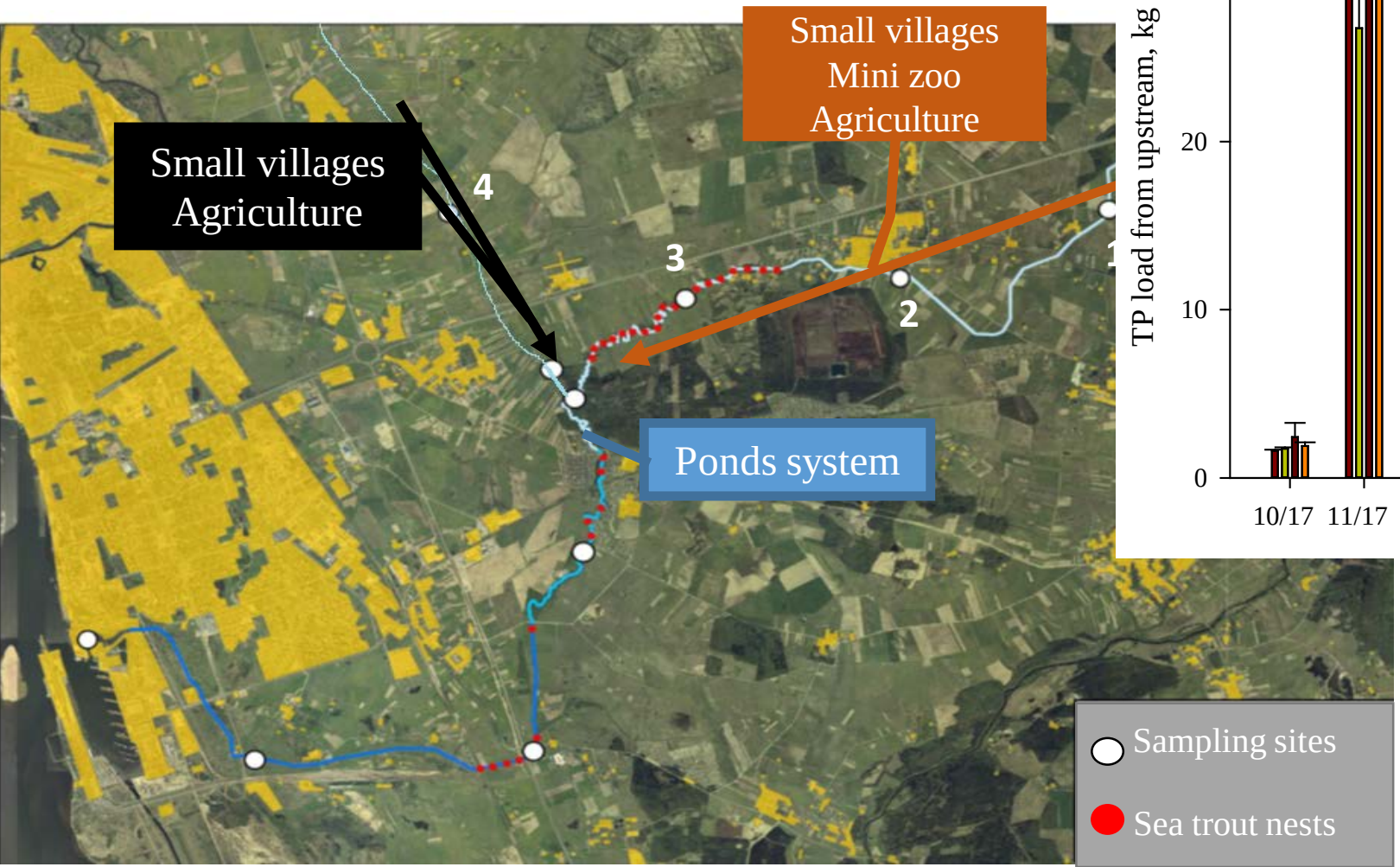
$$L = C * Q \qquad \Delta L = L_{out} - L_{in}$$

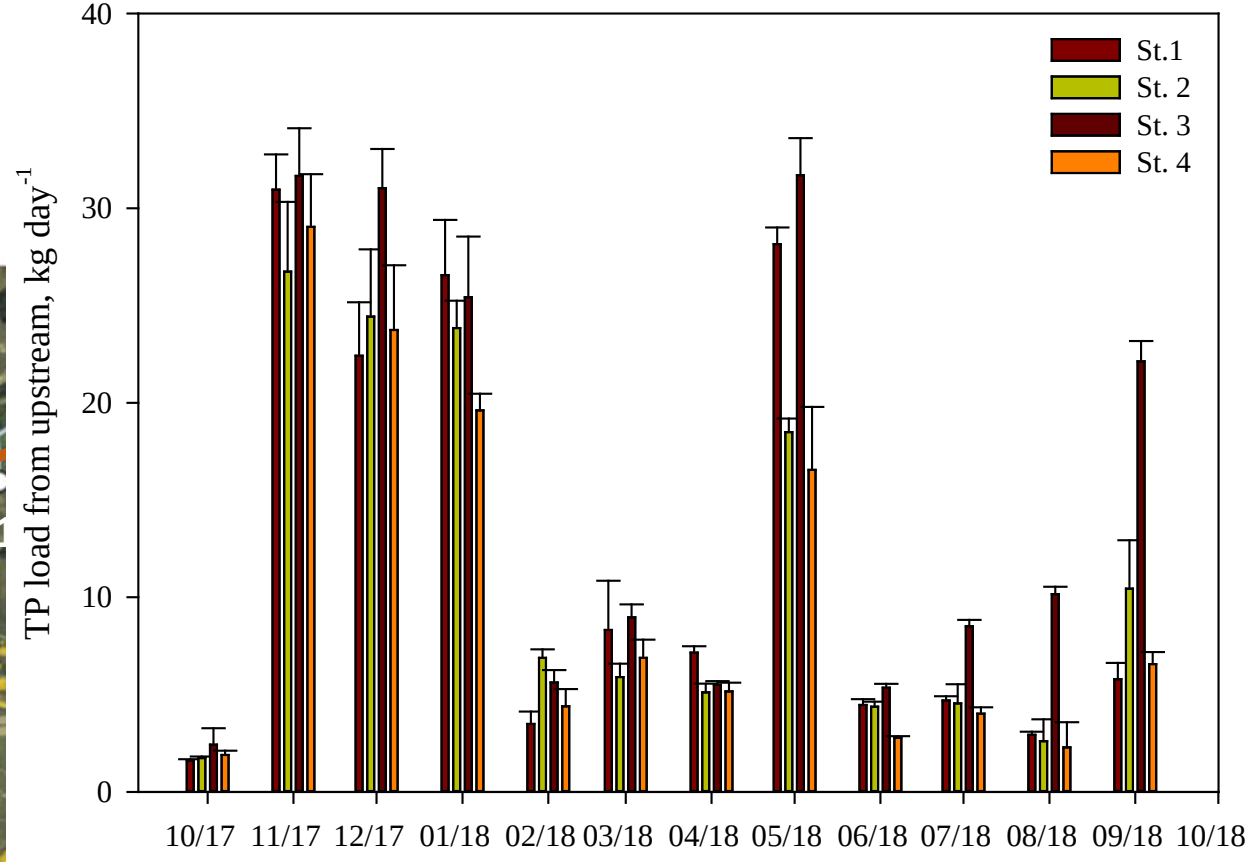
2) Annual retention of whole system:


Total phosphorus (TP)
Particulate phosphorus (PP)
Dissolved phosphorus (DP)
Gaseous phosphorus
Particulate inorganic P (PIP)
Particulate organic P (POP)
Dissolved inorganic P (DIP)
Dissolved organic P (DOP)
Easily sorbed or exchangeable P
Fe/Mn-bound P
Authigenic Ca-bound P
Detritic Ca-bound P

Results

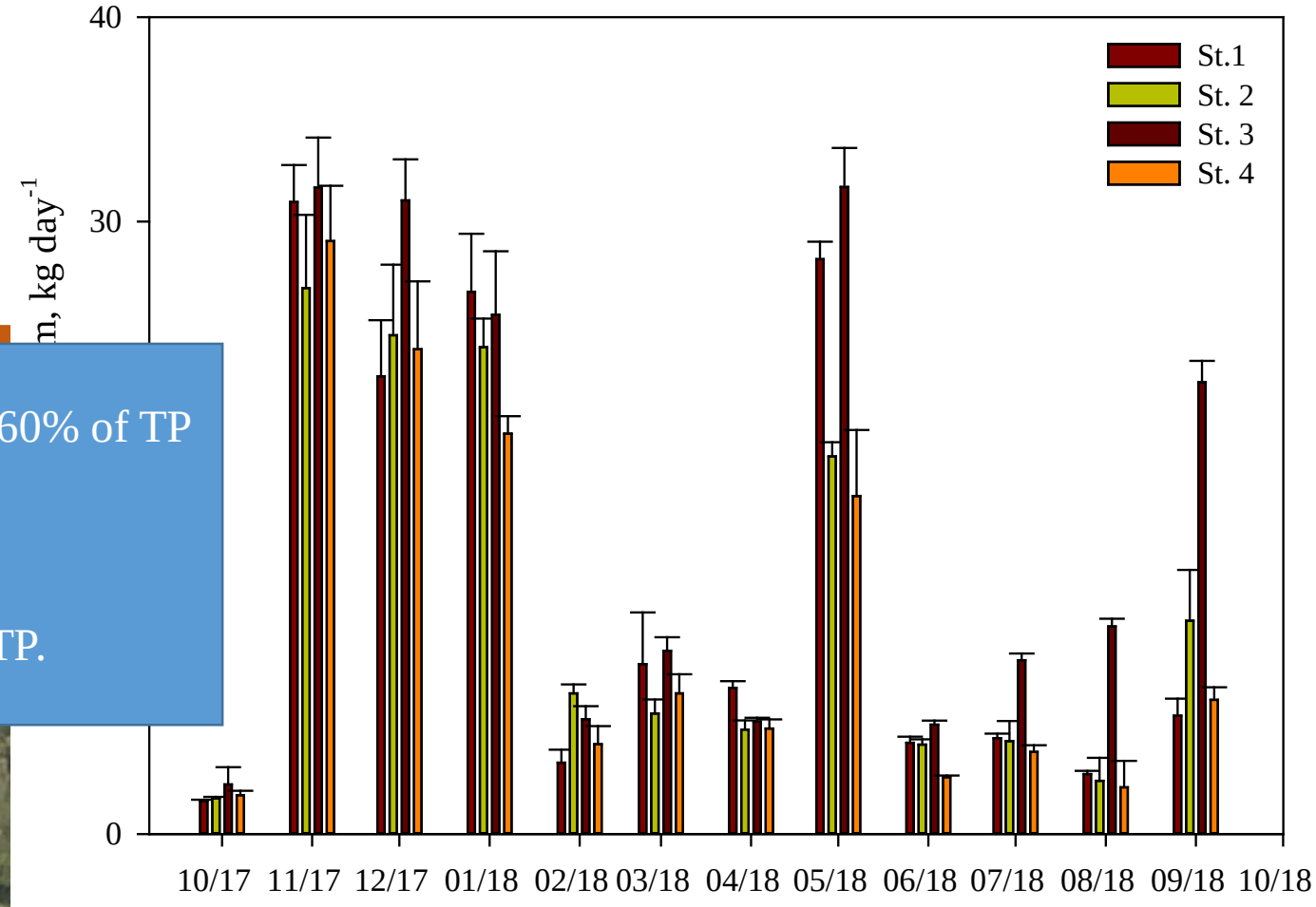
Loads of TP from upstream





- Loads of TP varied seasonally.
- Highest input from station No. 3

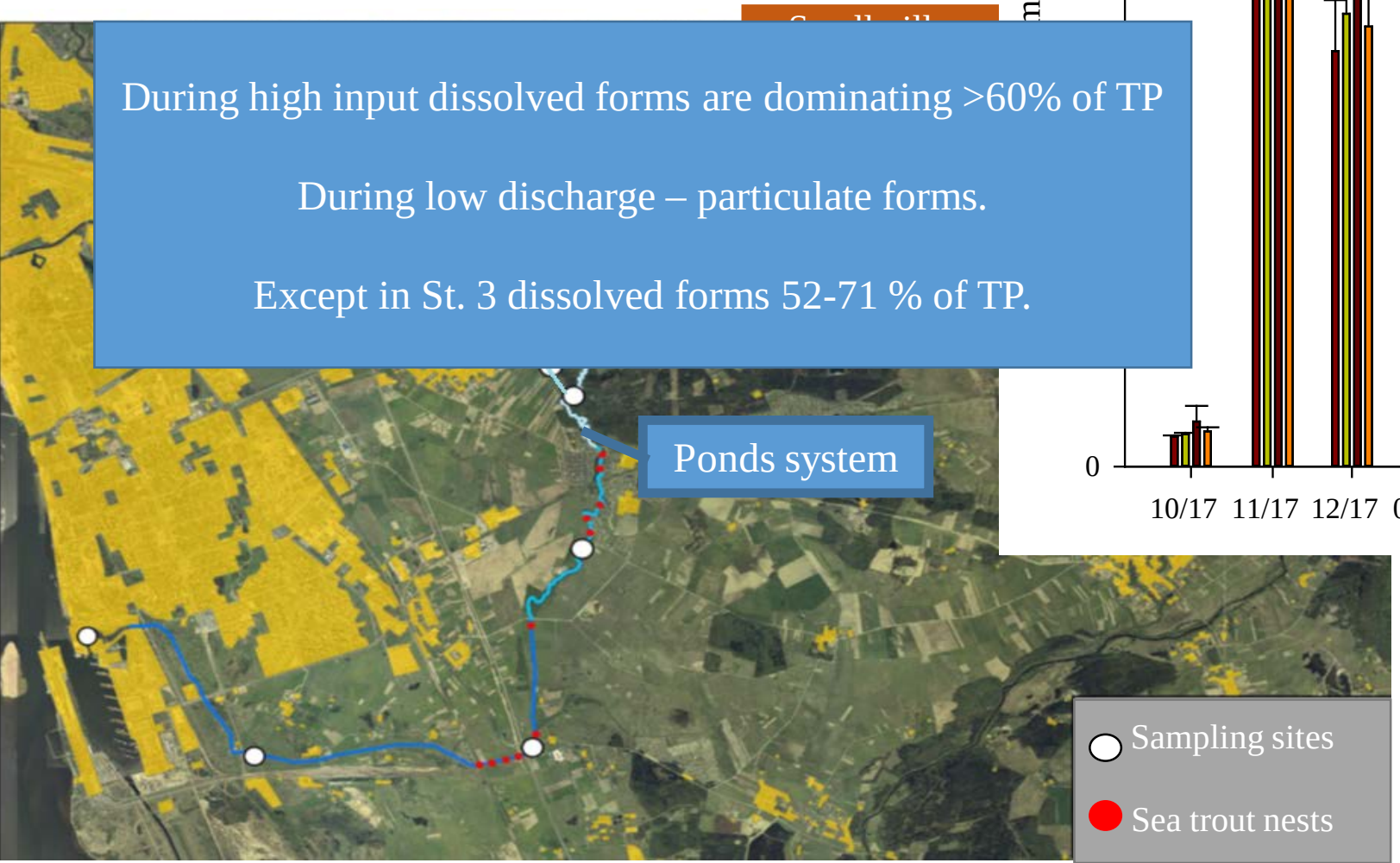
Loads of TP from upstream



During high input dissolved forms are dominating >60% of TP

During low discharge – particulate forms.

Except in St. 3 dissolved forms 52-71 % of TP.



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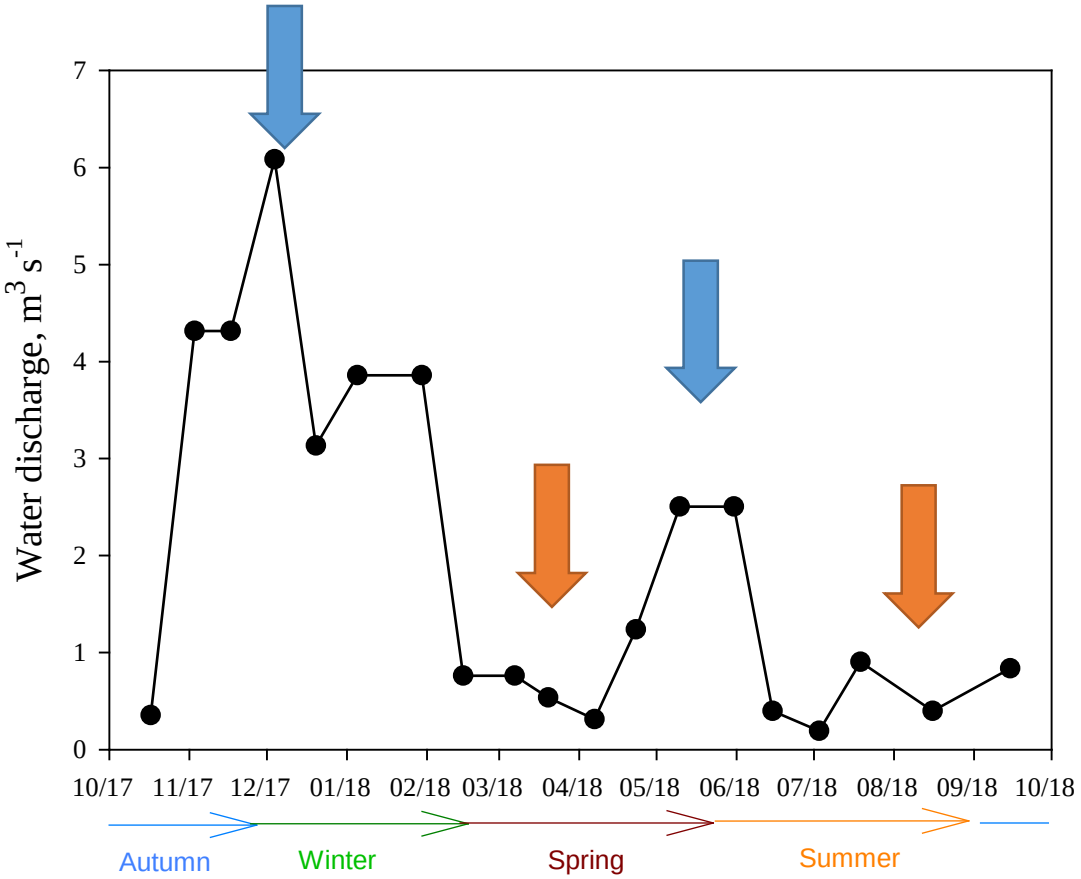
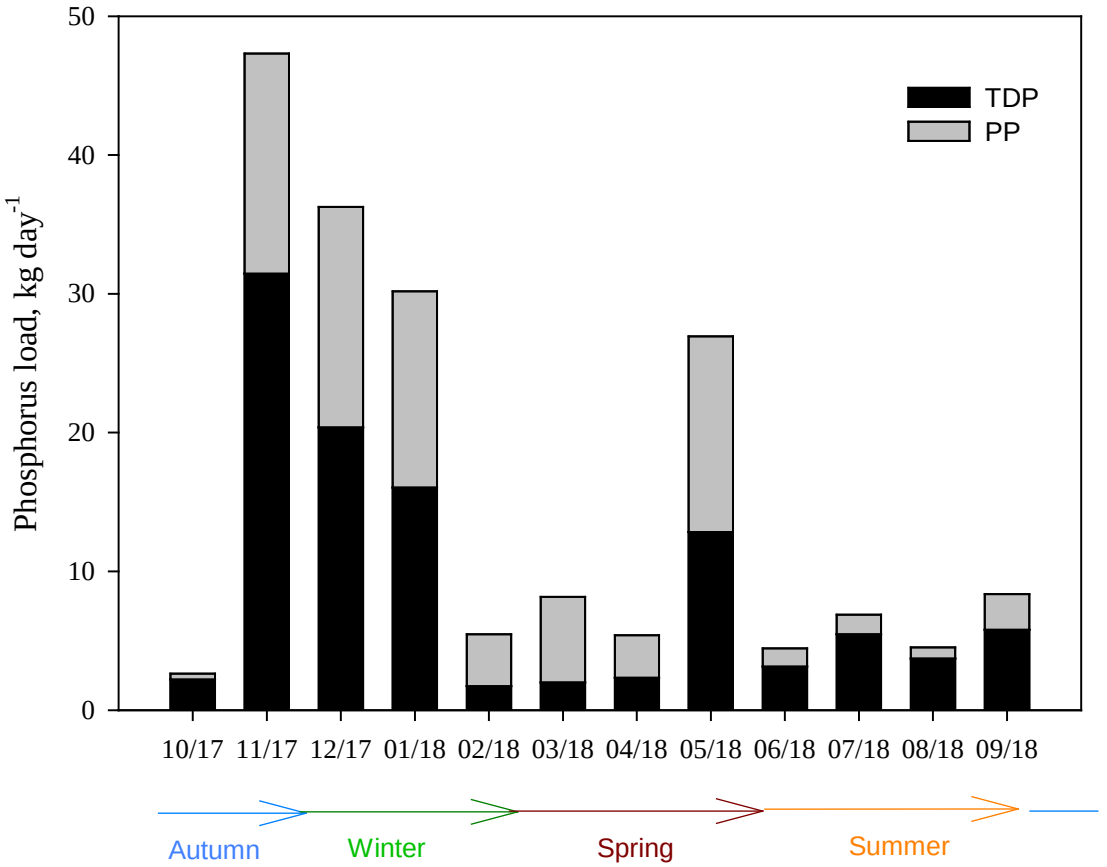
Water load into the pond system



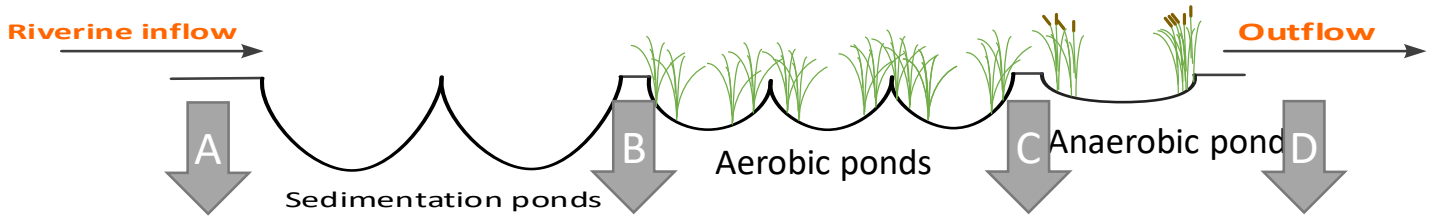
- High water inflow during late autumn-winter and late spring;
- Dry period during spring and summer.
- The same pattern in outflow with 5-10% lower discharge as inflow.

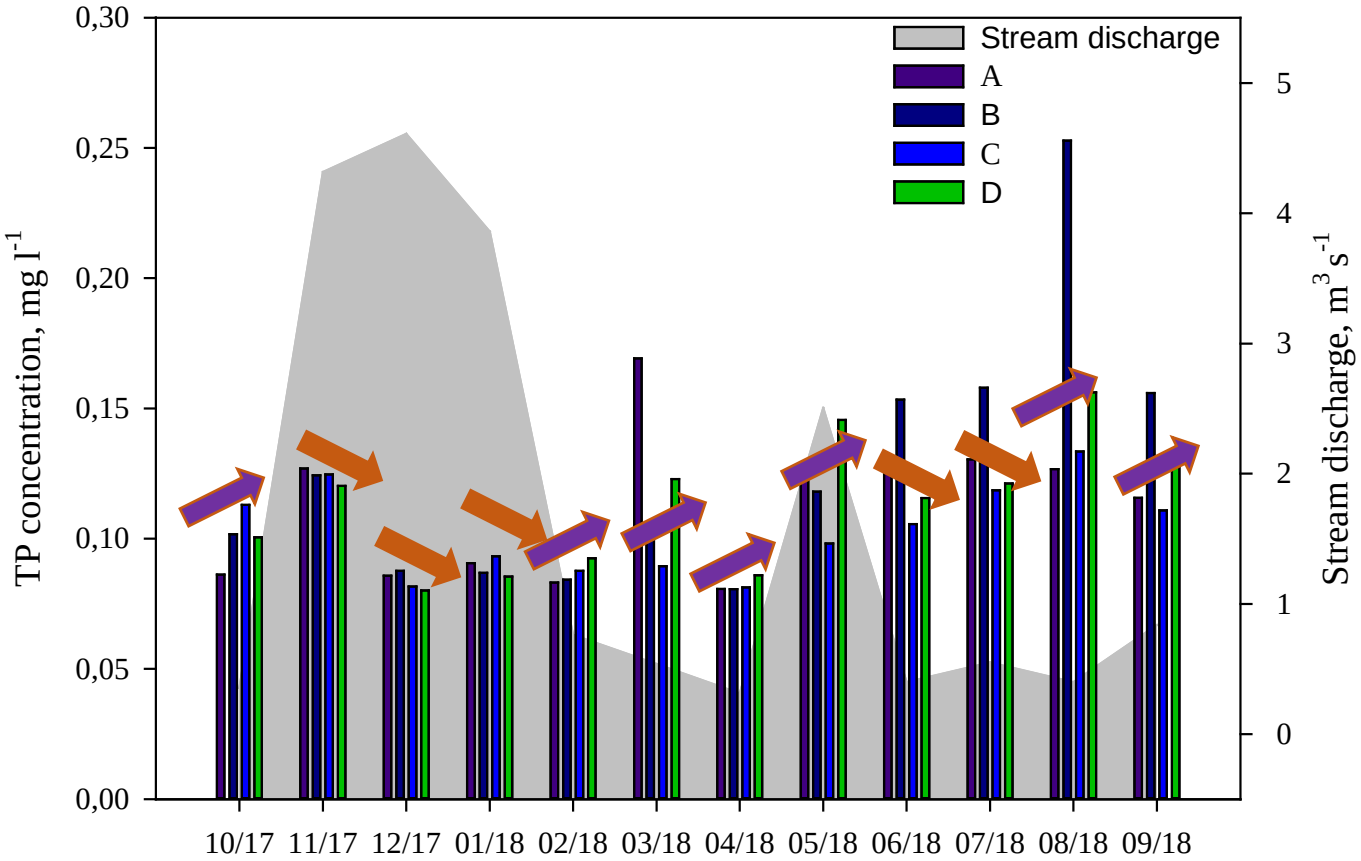
Phosphorus load into the pond system



- During high discharge entered 53-83% dissolved P of TP.
- During low – 52-75% contained particulate P, except during summer where dissolved P forms dominated.

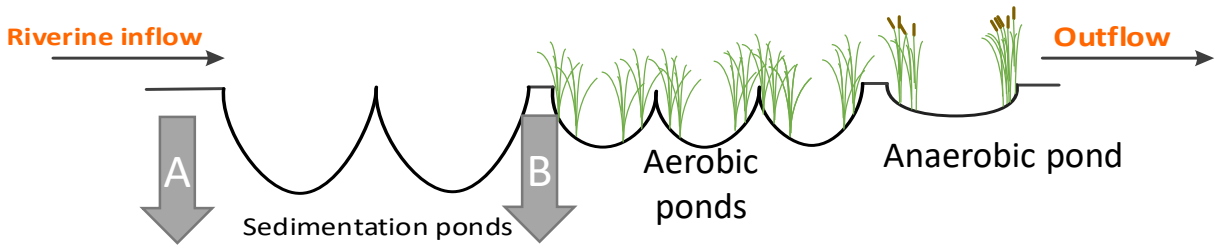
Phosphorus changes along ponds

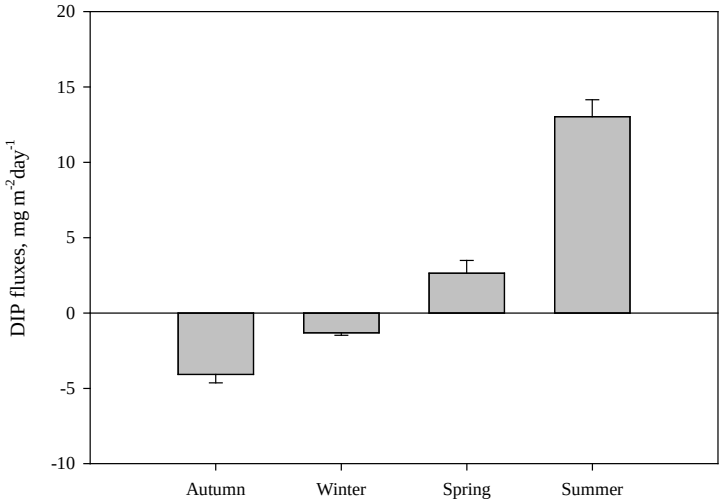


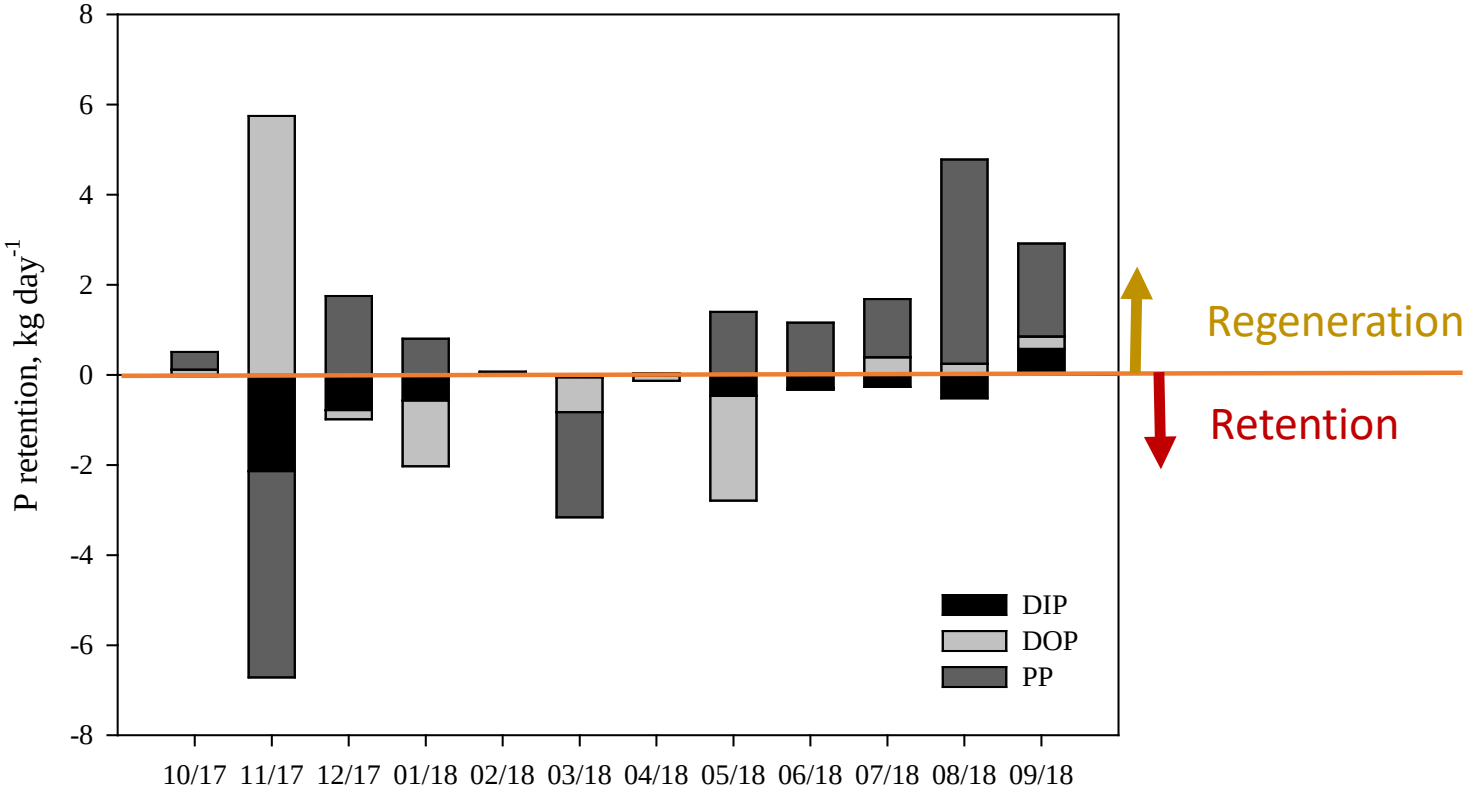


- During high discharge TP concentration decreased on the way of ponds.
- During low discharge TP is regenerated within the system and concentration increased in the outflow of ponds.

Sedimentation ponds

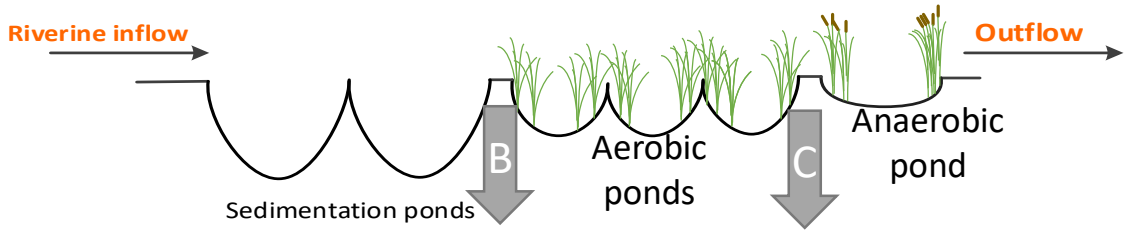


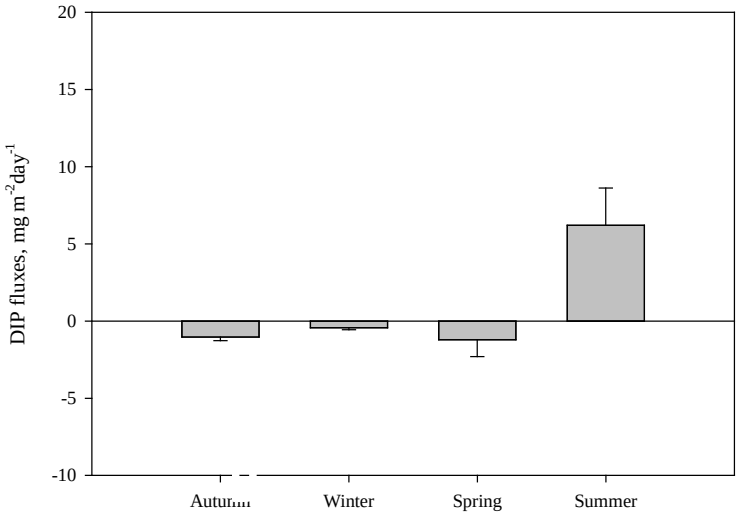


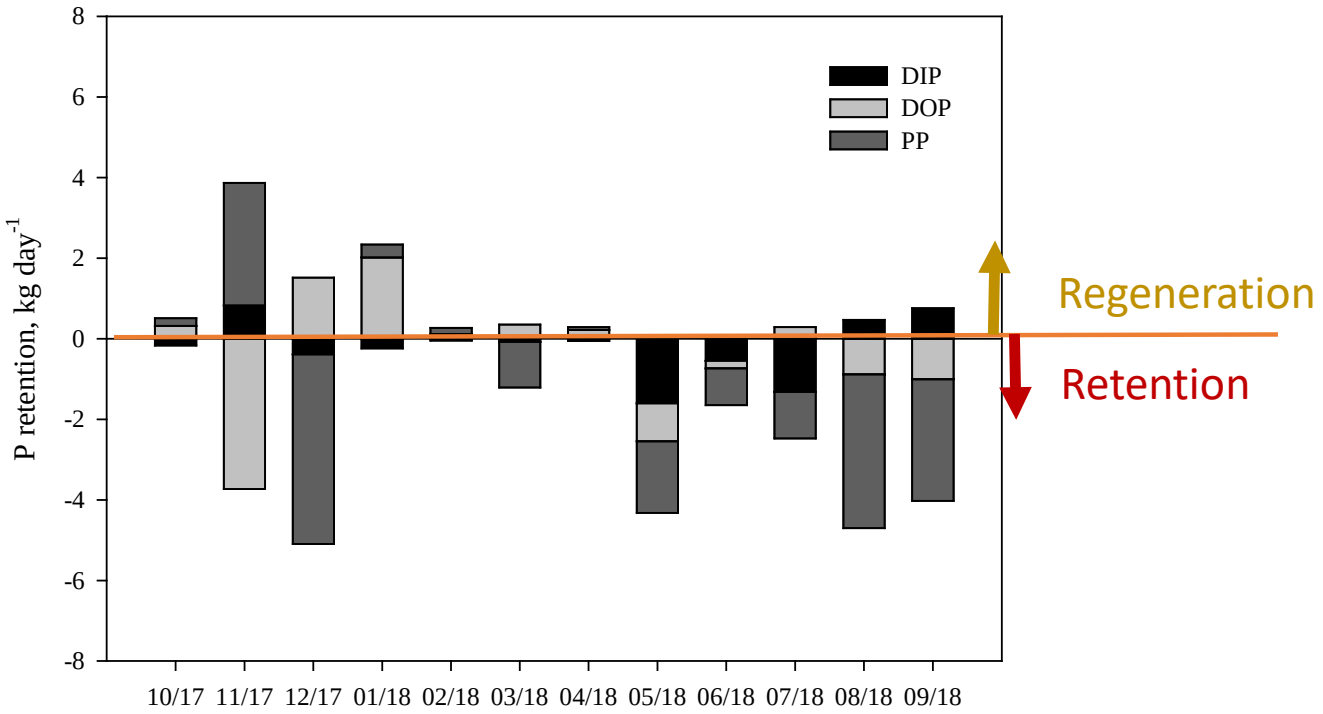


- Sedimentary ponds effectively retained dissolved P, except DOP ↑ in November.
- During summer ponds become a source of particulate P relation with low water flow and DIP release from sediments.

Shallow vegetated ponds



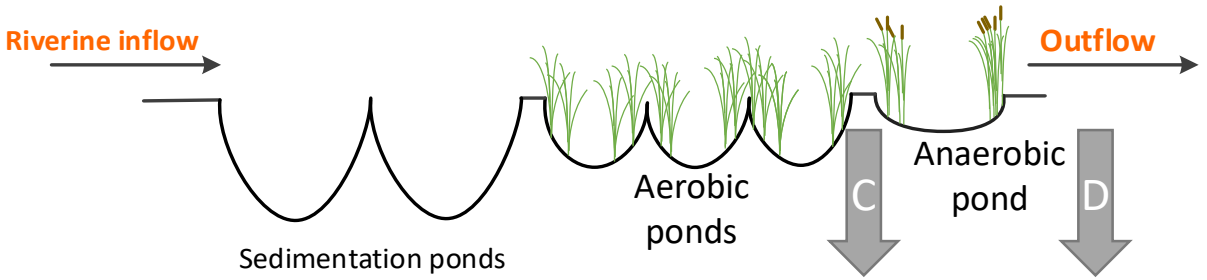


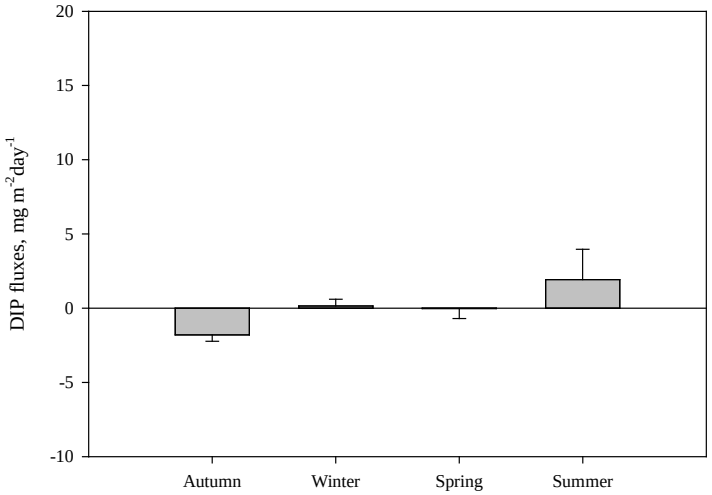


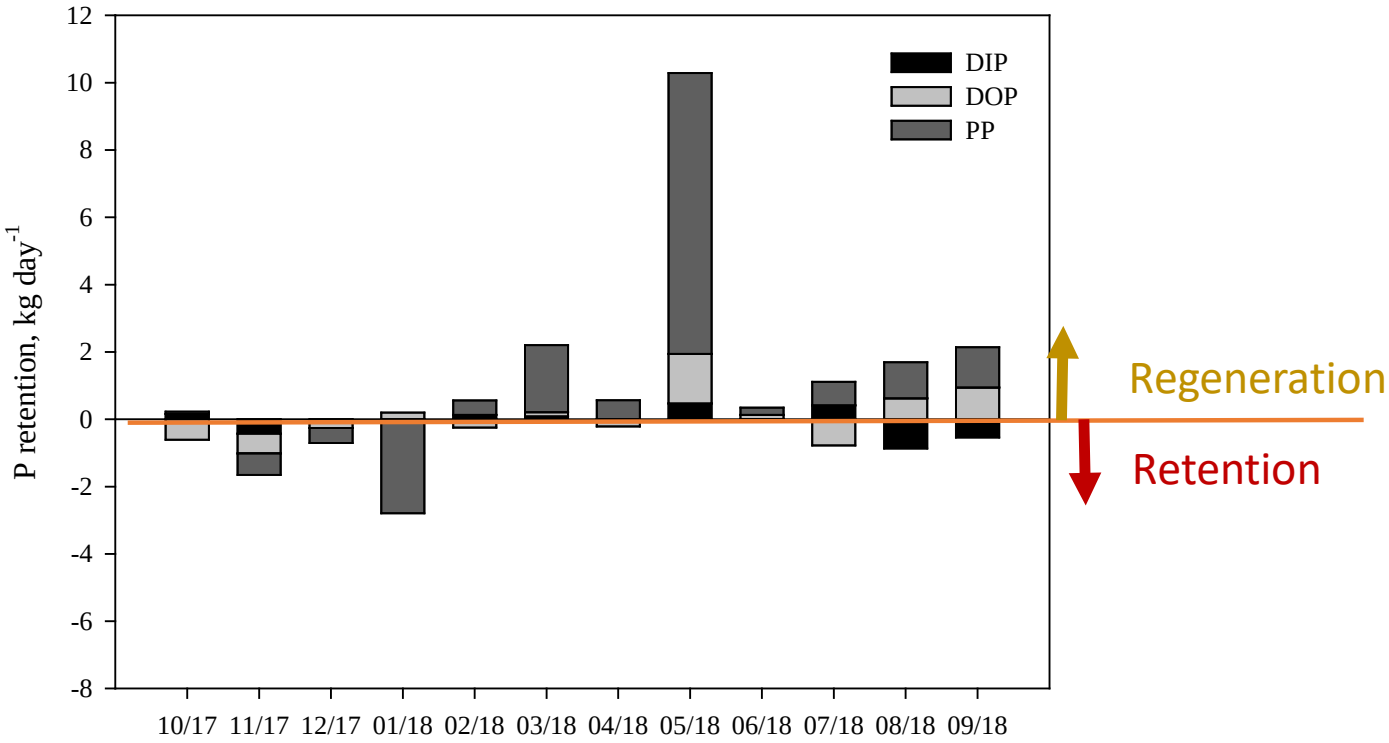
- Aerobic ponds were most effective for retaining P, only PP and DOP was regenerated in winter period.

- DIP was regenerated during the summer.

Anaerobic condition pond





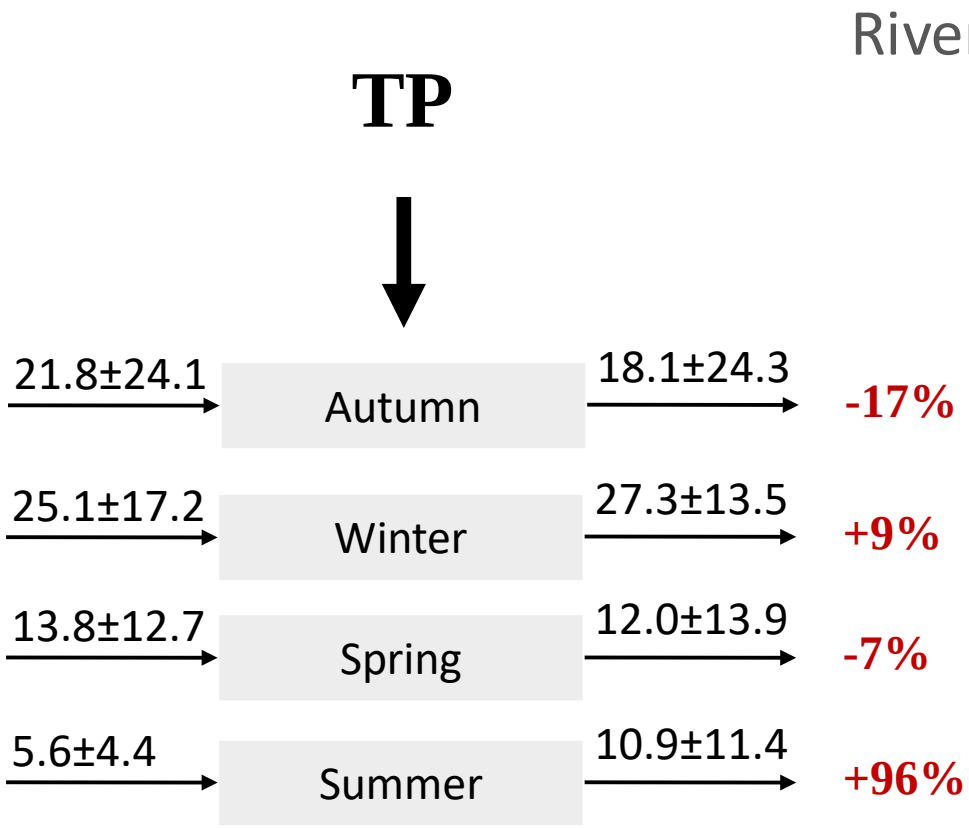


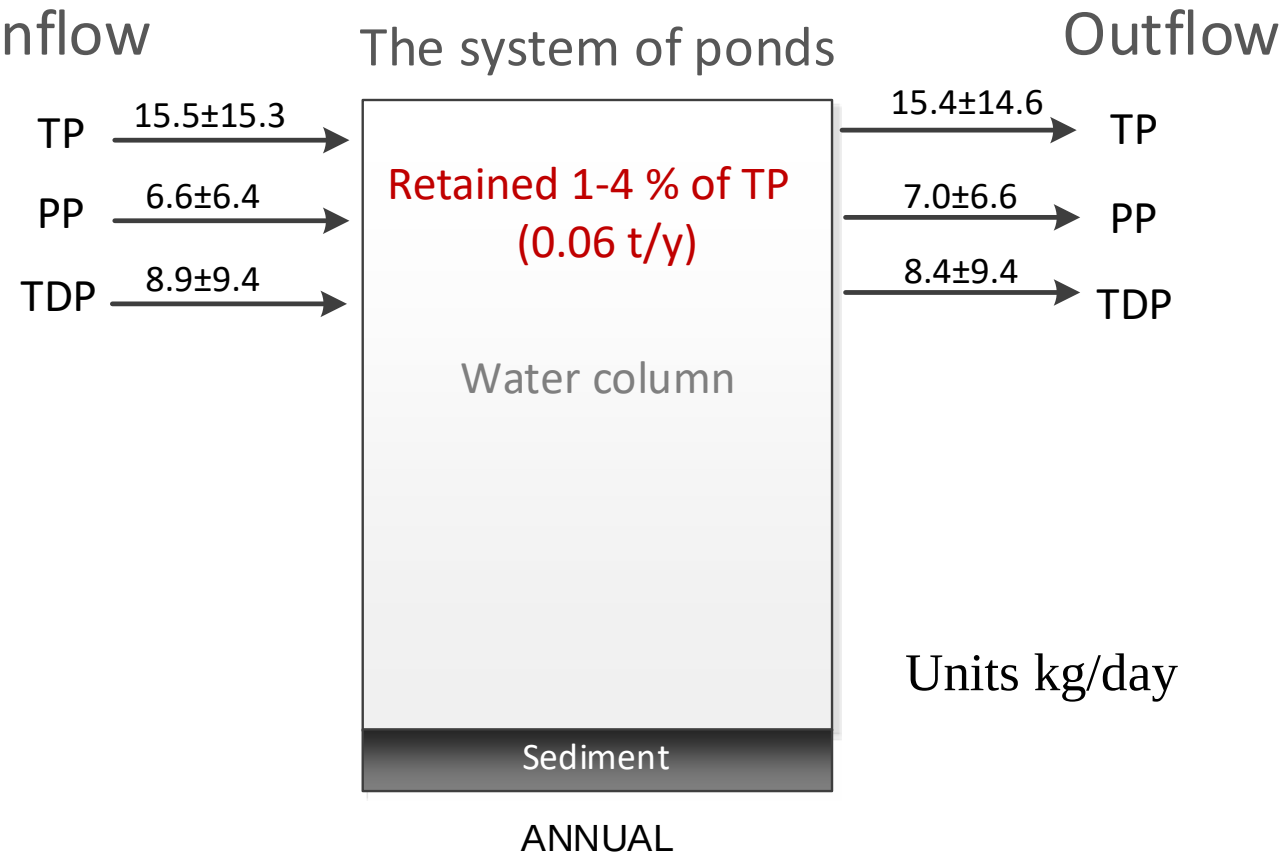
- Anaerobic pond was working well during autumn-winter period while spring and summer it regenerated PP and DOP.

- Sediments was working as a slight source of DIP in winter and summer.

TP retention in biopond system

Goal of bioponds were to retain **up to 10-15 %** nitrogen and **phosphorus load in** the Smeltete. This is approximately 2,5-3,8 t N and **0,15- 0,23 t P.**





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Thank You for you attention!