Phosphorus and particle retention in wetlands constructed on arable land – a catchment comparison

K.M. Johannesson[1], P. Kynkäänniemi[2], B. Ulén[2] and K.S. Tonderski[1]

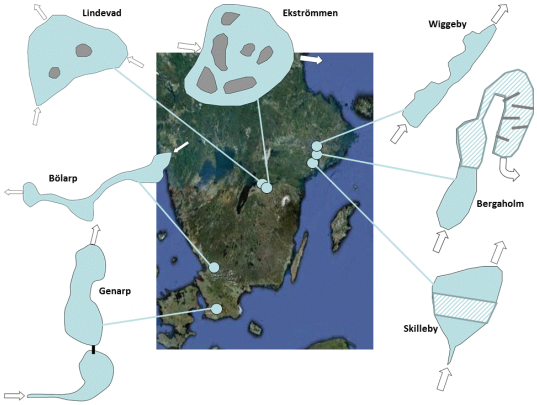
[1]Linköping University [2]Swedish University of Agricultural Sciences
karin.johannesson@liu.se

Aims

- Quantify the net settling of P and particles in Swedish constructed wetlands (CWs) receiving arable field runoff
- Investigate if theoretical P load and wetland shape were correlated with P retention

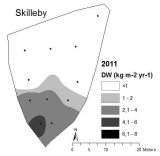
Introduction

Seven constructed wetlands (CWs) were investigated for annual phosphorus (P) and particle retention. All wetlands were situated in catchments dominated by agricultural land and with a variable proportion of clay soils. The wetlands varied in design, size , and hydraulic and P load.



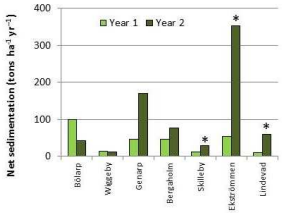
Materials and methods

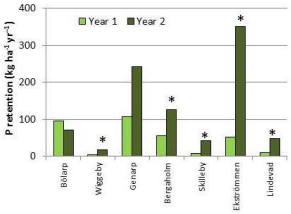
- Sedimentation plates, sampled once a year
- Sediment was analysed for particle and tot-P amount
- ArcGIS interpolation tool (IDW) → estimation of the total particle and P retention in kg ha^{-1} yr^{-1}
- Theoretical P load was estimated based on leakage from arable land using the ICECREAM model



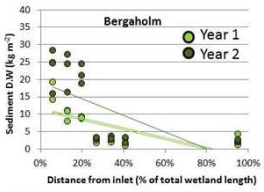
Results and discussion

There was a large difference in particle and P retention, both between wetlands and years. P retention was higher the second year in most of the CWs even though the hydraulic load was slightly higher in the first year for most of the wetlands.

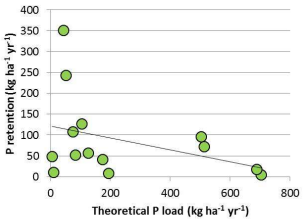




Two of the CWs with long and narrow shape had a clear gradient from inlet to outlet, with decreasing sedimentation closer to the outlet (e.g. Bergaholm).



There was a weak pattern for a decrease in P retention with increasing theoretical load. However, P load was estimated based on large leakage regions, which may not be transferable on the small catchments in this study.



Previous investigations on P retention in Swedish CWs, based on water quality and discharge data, may have underestimated the potential of CWs as P sinks.

Sampling strategy	Minimum retention	Maximum retention
	(kg ha^{-1} yr^{-1})	
Sediment plates	5	351
Water quality*	1	58

Future analyses: Statistical relationships between particle and P retention and different catchment characteristics will be investigated.

Conclusions

- All CWs functioned as net sinks for particle-associated P (from 25 to 200 kg ha^{-1} yr^{-1} on average)
- The difference in particle and P retention was larger between wetlands than between years
- Theoretical P load did not explain P retention
- A long and narrow wetland shape may enhance net settling, but design alone cannot explain P retention differences

Financial support was obtained by
- The Swedish Research Council Formas
- The Swedish Board of Agriculture
- The Swedish Farmers' Foundation for Agricultural Research

* Johannesson 2011 Analysis of phosphorus retention variations in constructed wetlands receiving variable loads from arable land. LiU-TEK-LIC 2011:21