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SEABASED MEASURES IN
BALTIC SEA NUTRIENT MANAGEMENT

WP T4: Binding phosphorous into sediment

Nils Ekeroth, NIRAS
26.01.2021

Laboratory tests

- The sorbent is made by treating of marl/limestone residue with heat
- Laboratory results show that heat treatment greatly improves phosphorus (P) sorption capacity
- The laboratory work was mainly carried out at the cement manufacturer Cementa's plant in Slite on the island of Gotland, Sweden
- The raw material originates from Gotland and was provided by the limestone producer Nordkalk AB

Small scale experiments:

- Controlled experiments with focus on certain details such as P-sorption efficiency and stability of the sorbent and its effects on sediment biogeochemical variables.

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Whole-bay field trials:

- Spreading of the sorbent over the entire sediment area impacted by oxygen depletion with the aim of lowering P-bioavailability in the bays.

The Kyrkviken Bay and Kolkka Bay

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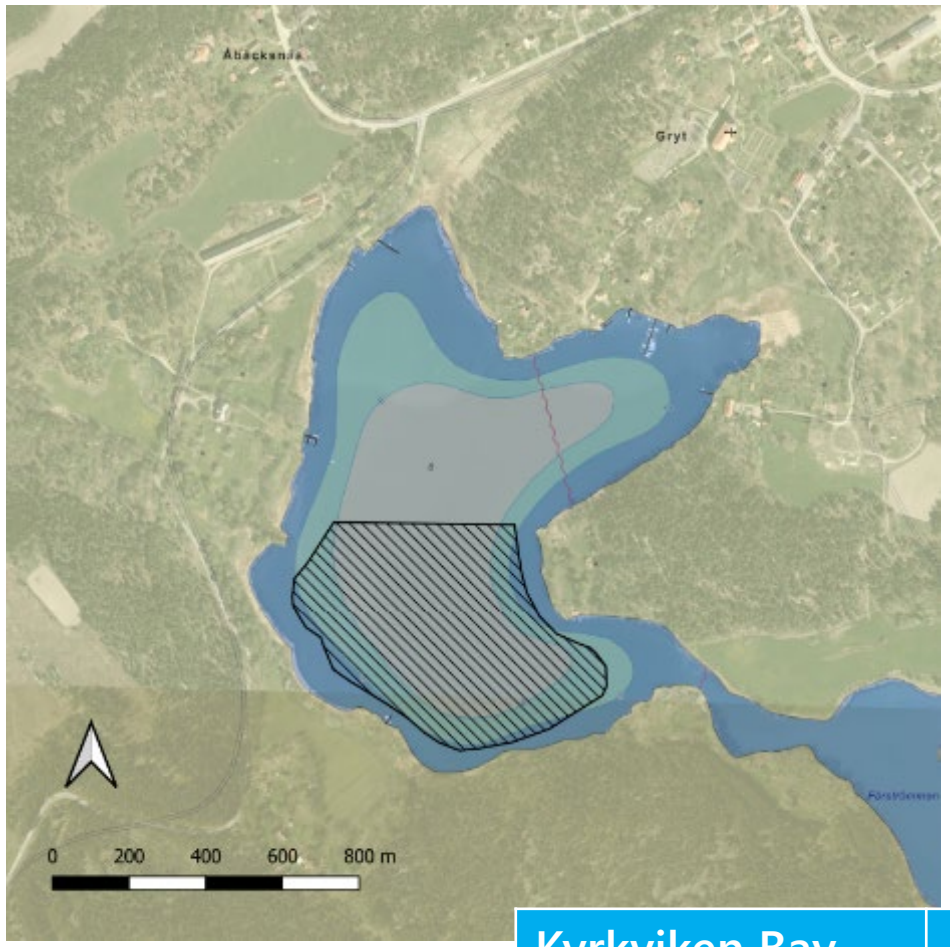
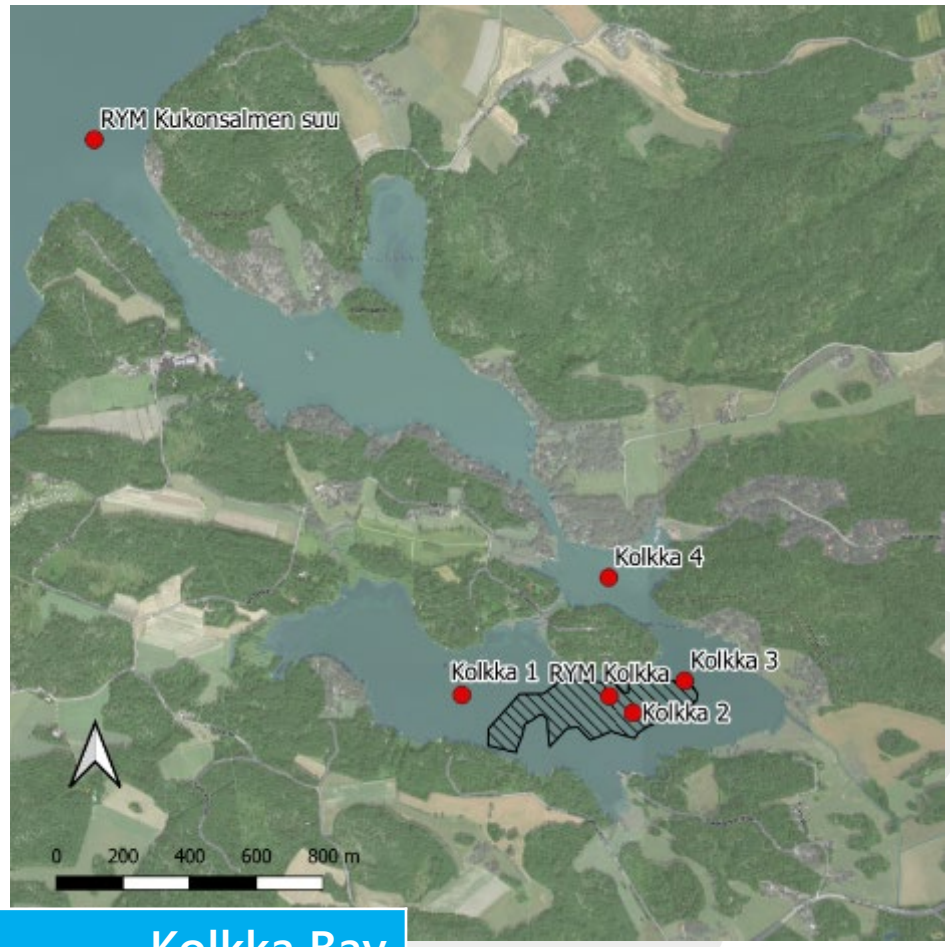
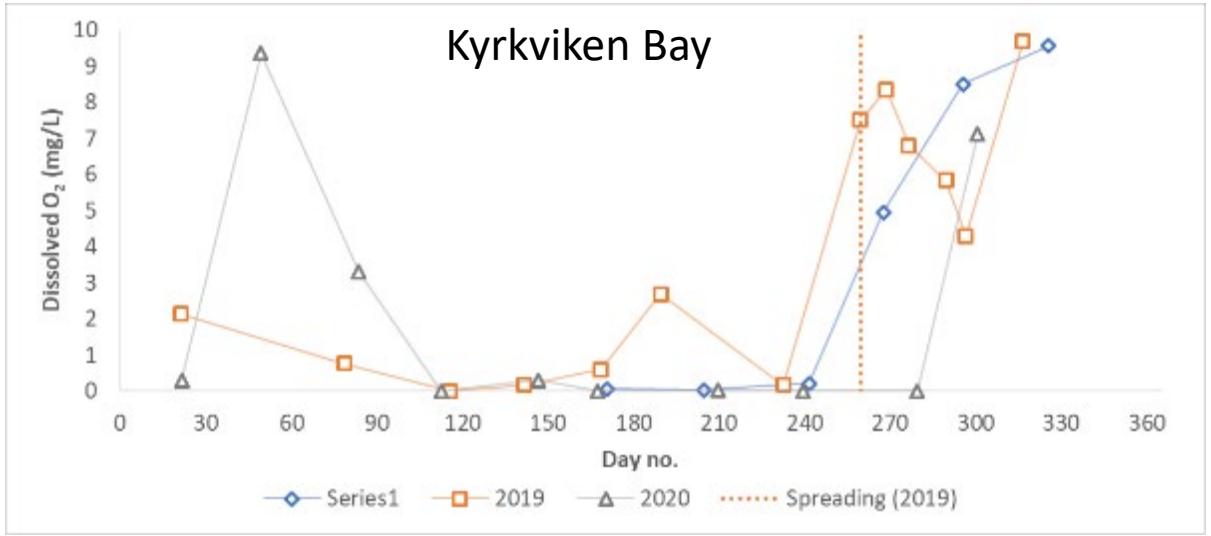
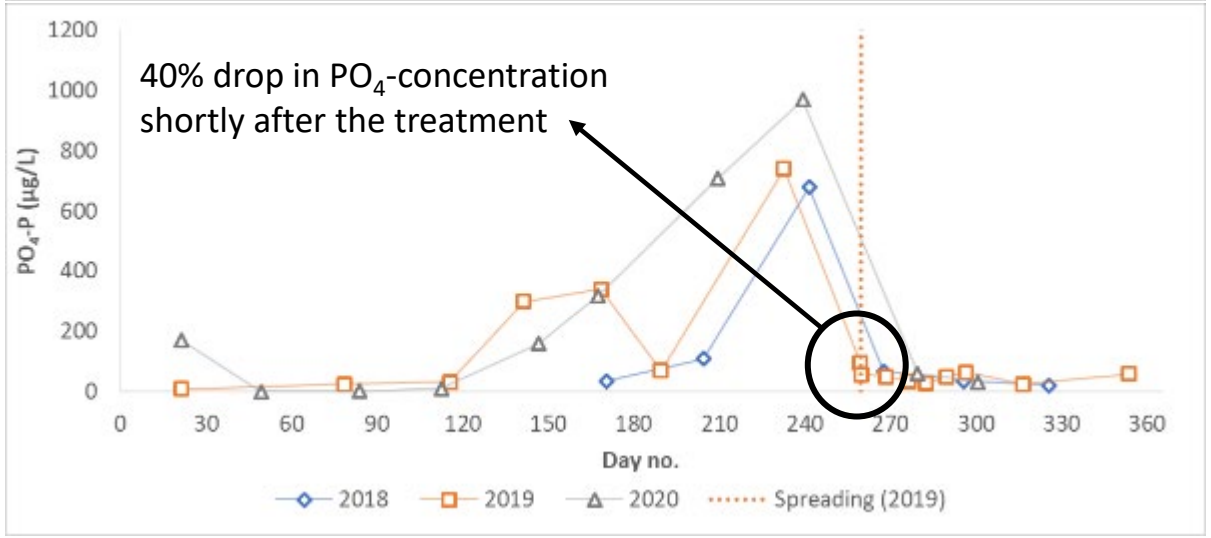


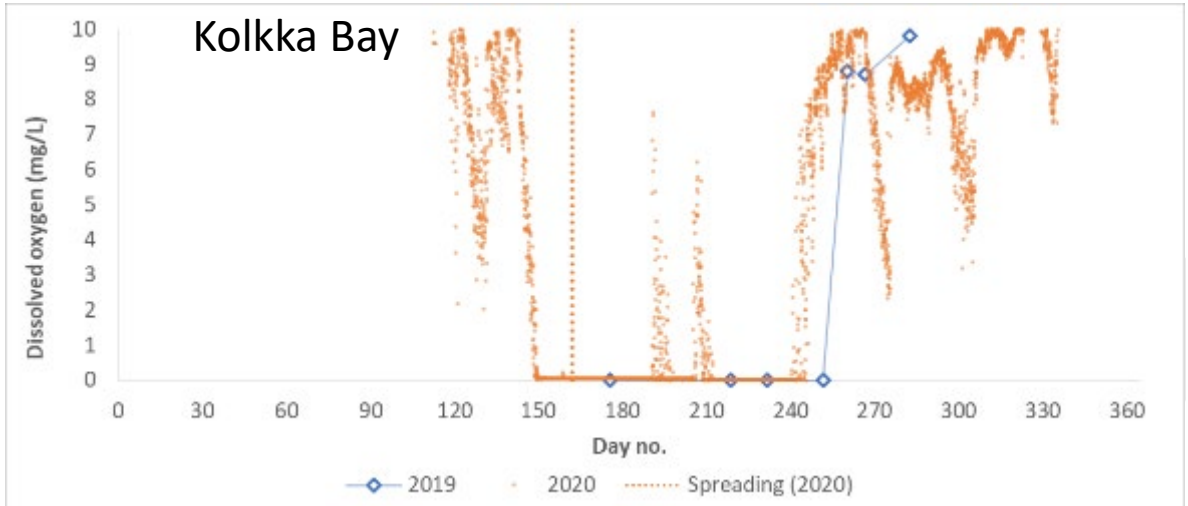


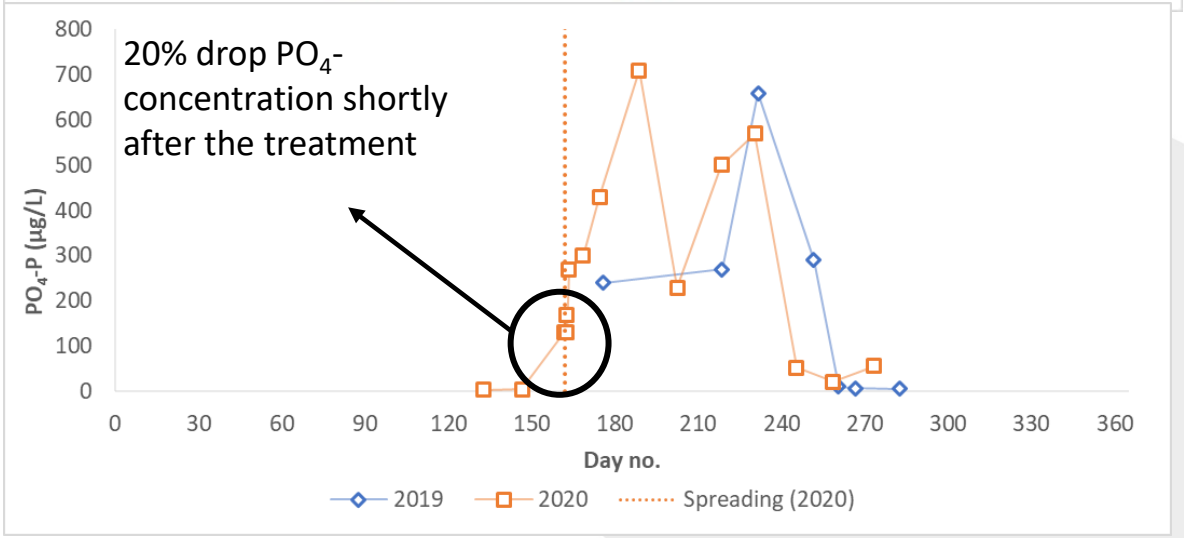
Kyrkviken Bay		Kolkka Bay
90000	Treatment area (m^2)	80000
12000 (139 g/m^2)	Amount of sorbent (kg)	8000 (100 g/m^2)
June 2018	Start monitoring program	June 2019
Sept. 2019	Spreading of the sorbent	June 2020

Bottom water – short term changes but no signs of lowered P-concentrations on longer term









The Djuröfladen Bay

Aim:

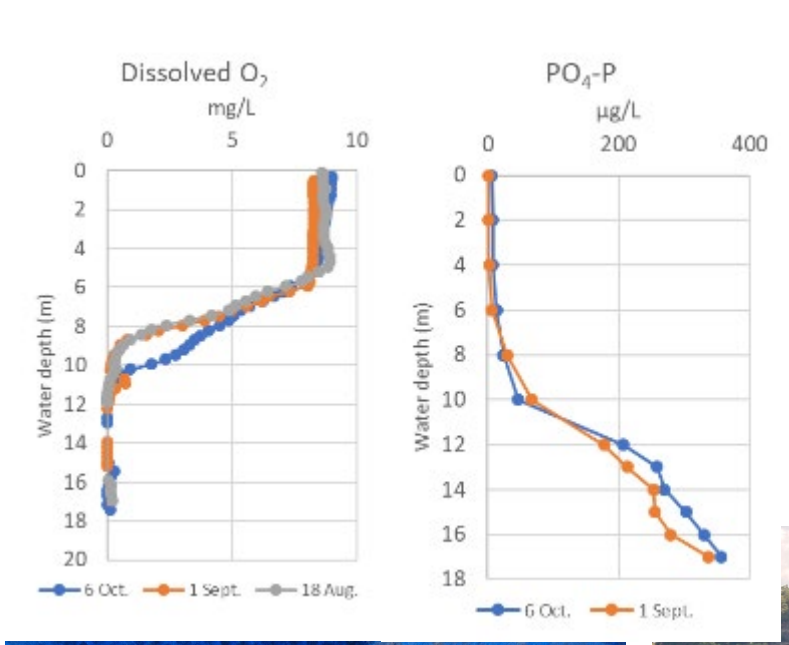
- Measure changes in physicochemical variables in the sediment by marl sorbent addition

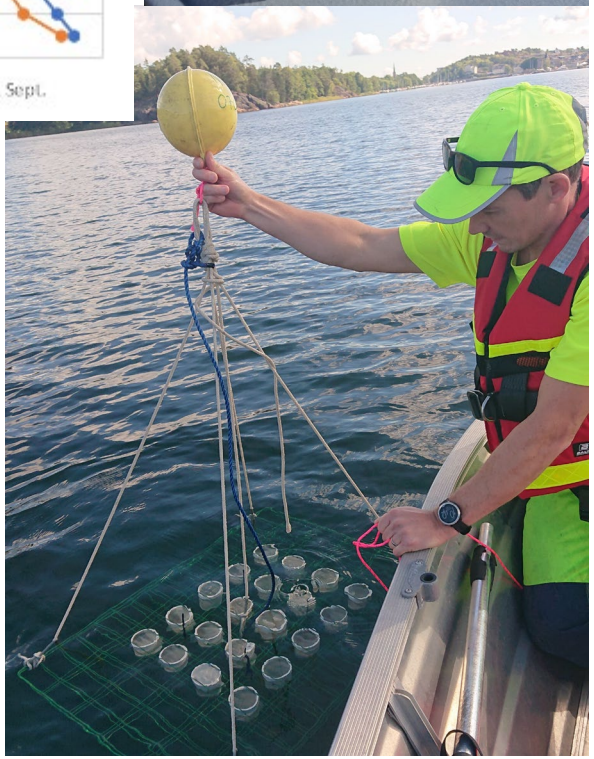
Hypothesis:

- Addition of marl sorbent will increase the P-content in the solid phase of the sediment lower pore water PO_4-concentrations
- Addition of marl sorbent will increase the Ca-content in the sediment and increase pH

Results:

- The marl sorbent increased pH and Ca but no effect on P





The Farstaviken Bay

Overall aim:

- Determine why the sorbent appears to have lower efficiency in field conditions than in laboratory studies

The Farstaviken Bay - Results

- One tenth of the sorbent was pulverised
- The fine grain material was clearly enriched in P (2-8 times higher P content than background level in sorbent)
- Still, lower P content than anticipated from lab studies

P binding efficiency (lab experiments)	P-concentration in fine grain sorbent from the field trial in the Farstaviken Bay
mg P/kg sorbent	mg P/kg dwt
10000-16800	186-350

Conclusions

- The sorbent has capacity to bind phosphorus, but the capacity is lower than anticipated
- The sorbent's relatively low capacity to sequester P likely explains the lack of long-term changes in P-availability in the Kyrkviken Bay and Kolkka Bay and why the sediment P-content the Djuröfladen Bay did not increase by treatment with the marl sorbent

Conclusions

- The sorbent's relatively low capacity to sequester P is likely related to the heat treatment

Production for lab-experiments

Large-scale production (30 000 kg) for field trials

Conclusions

- No harmful effects were observed due to spreading of marl (pH-effects, clouding, dusting)

Outlook

- Results show promising signs but more development work is needed
- In particular, the large scale production method needs to be optimised (planned for 2021)
- Controlled experiments on mesocosm-scale is recommended before additional full-scale field trials are carried out

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Thank you!

Contact: nils.ekeroth@niras.se

www.seabasedmeasures.eu

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CAB Östergötland- Project results

Maria Gustavsson & Kenneth Winroth

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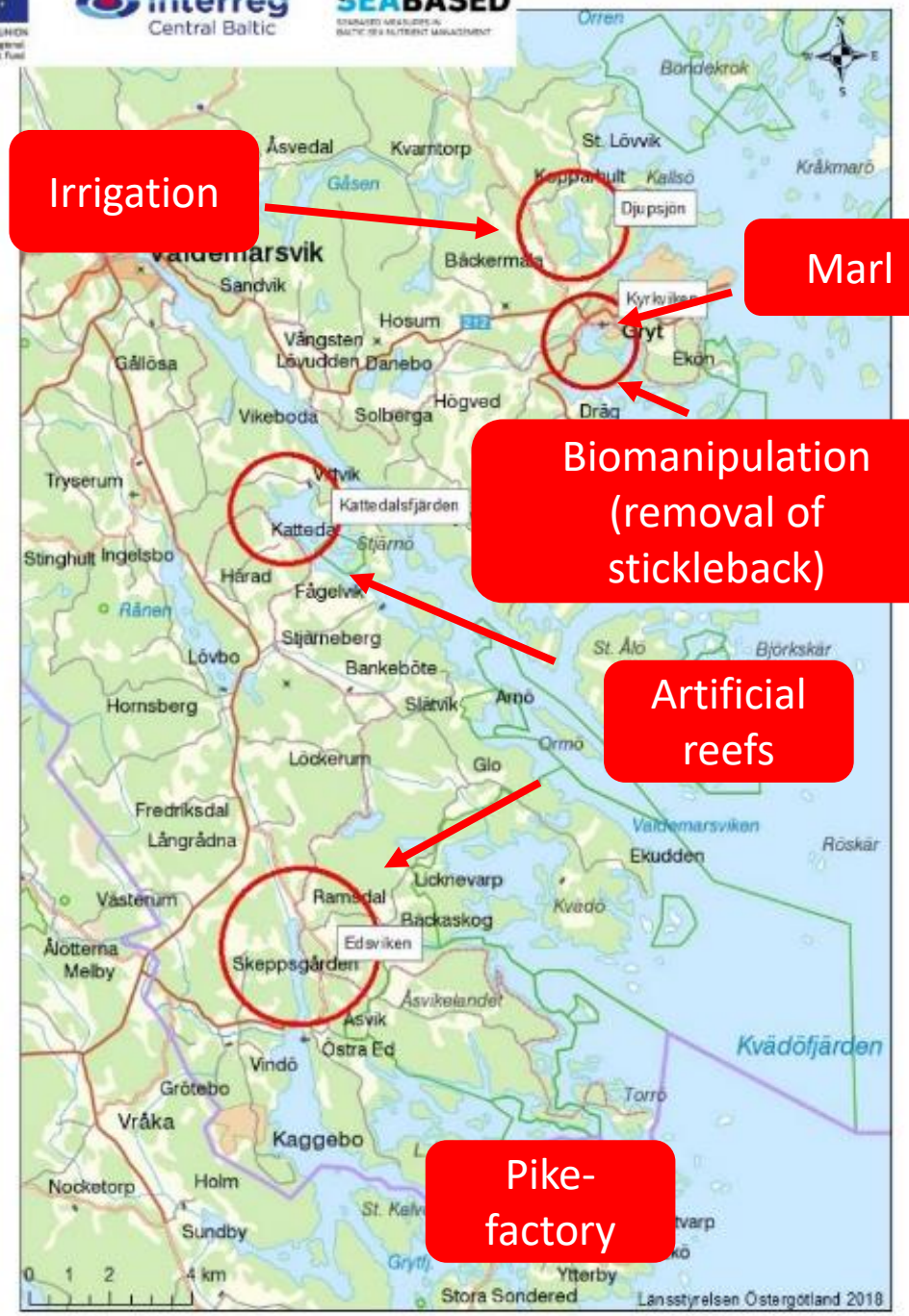
LÄNSSTYRELSEN
ÖSTERGÖTLAND

Pilot areas in Östergötland

- Kyrkviken *(SE580890-165500)*
- Djupsjön *(SE645330-155839)*
- Edsviken *(SE580250-164000)*
- Kattedalsfjärden *(SE580585-164720)*

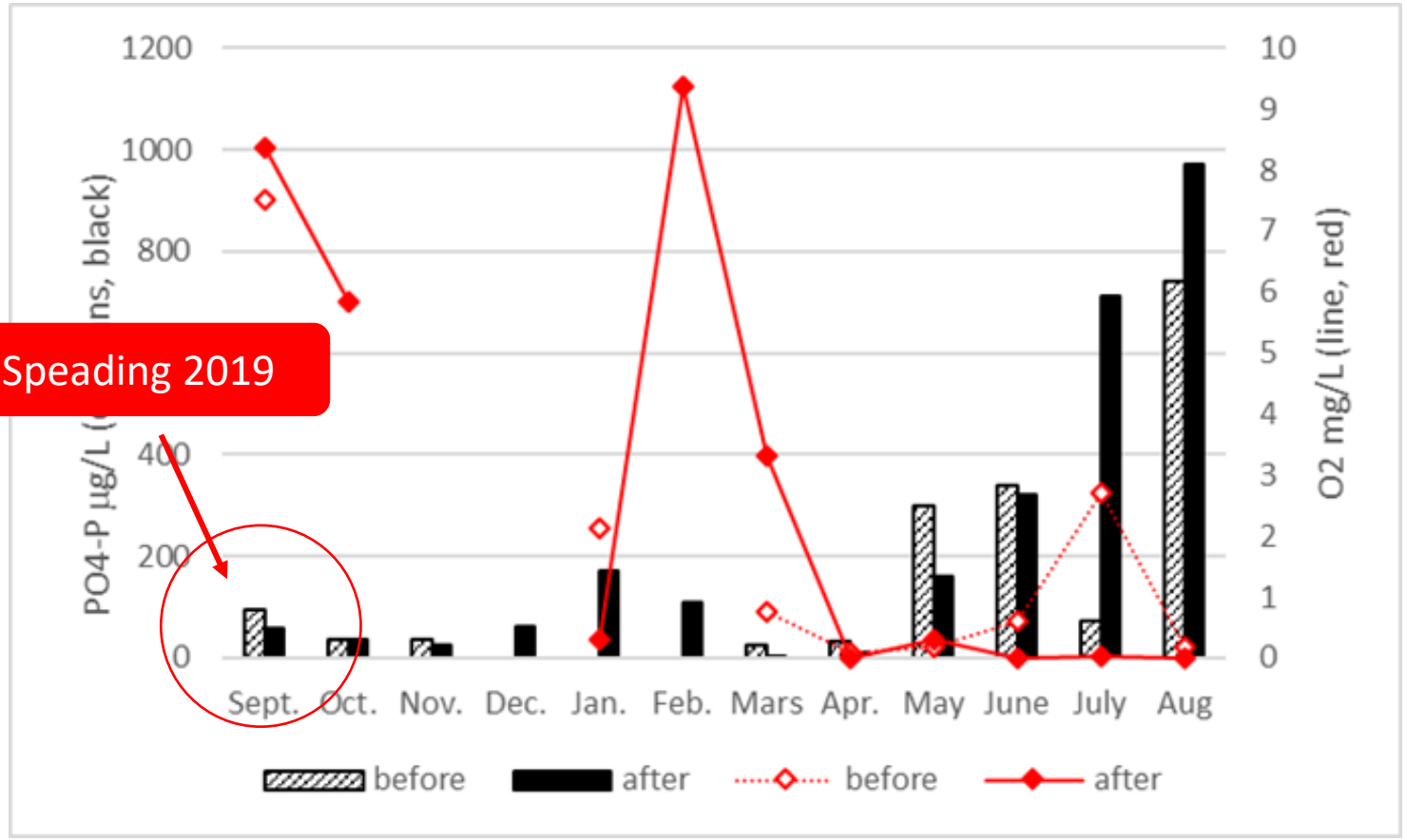


Results in Kyrkviken: Marl

13 ton/9 ha->
a little more than 100 g/m^2
Spread in the deepest area of the bay (6-8 m)

Results in Kyrkviken: Marl

PO4-P (µg/L) at 8–10 m depth before and after spreading of the sorbent (100 g/m²)



Speading 2019

Conclusion:
Effect directly after spreading (2019), but no lasting effect after 1 year

Results in Kyrkviken: Biomanipulation (Stickleback)

- Biomanipulation (removal of sticklebacks) was done in November 2019.
- Only a few sticklebacks caught, probably due to the season
- Side results: 8 tons of cyprinid fish was caught, mainly roach, bream and ide.
- Resulting in the removal of 60 kg of phosphorus and 200 kg of nitrogen.

Conclusion:
To catch stickleback in sheltered bays, it is important to do it during the right season and when they are closer to the shore.

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Contact:

Maria Gustavsson: maria.b.gustavsson@lansstyrelsen.se
Kenneth Winroth: kenneth.Winroth@lansstyrelsen.se

www.seabasedmeasures.eu