Does seagrass stimulate the bioavailability of mercury in contaminated sediments in a brackish fjord in Norway?

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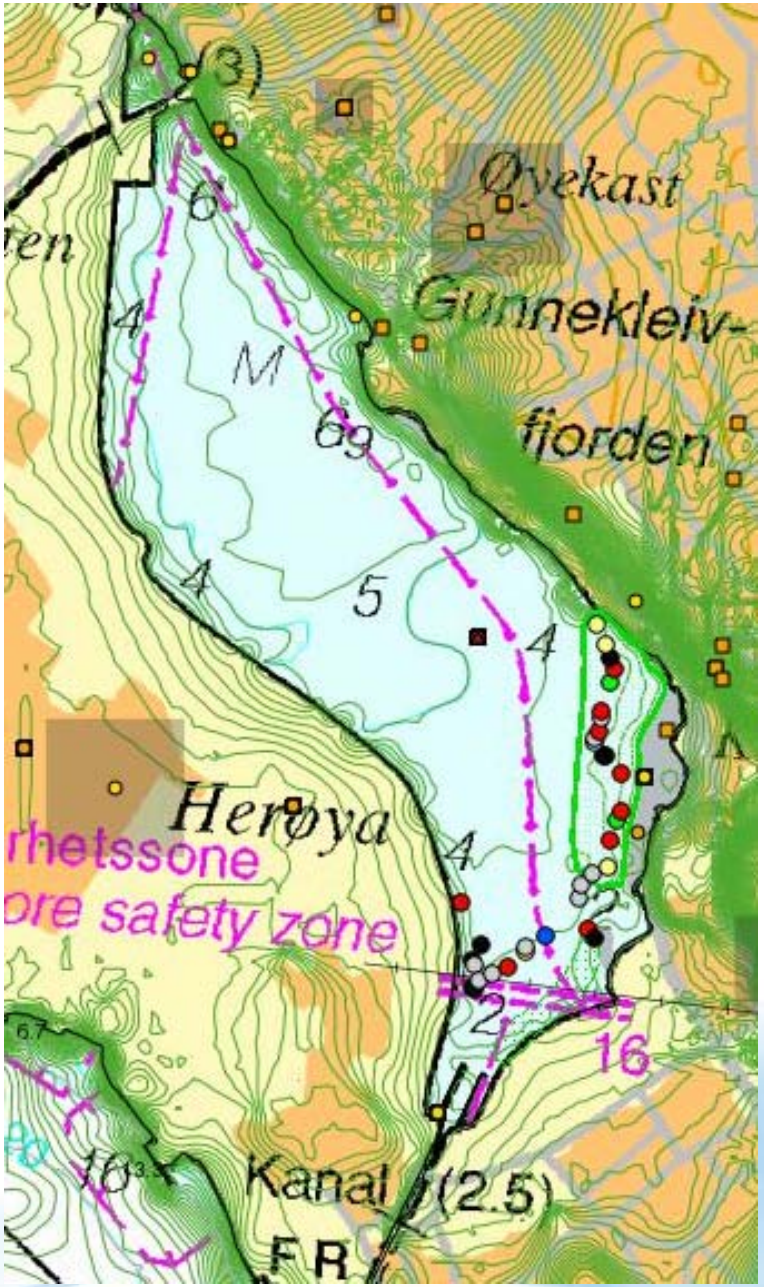
Special Session: Relationship between sediments and biota in transitional water ecosystems and harbours
8th International SedNet Conference
07.November 2013, Lisbon, Portugal

…..and what happens if we cap the sediments and the seagrass?

Gunneklevfjorden
Telemark,
Norway

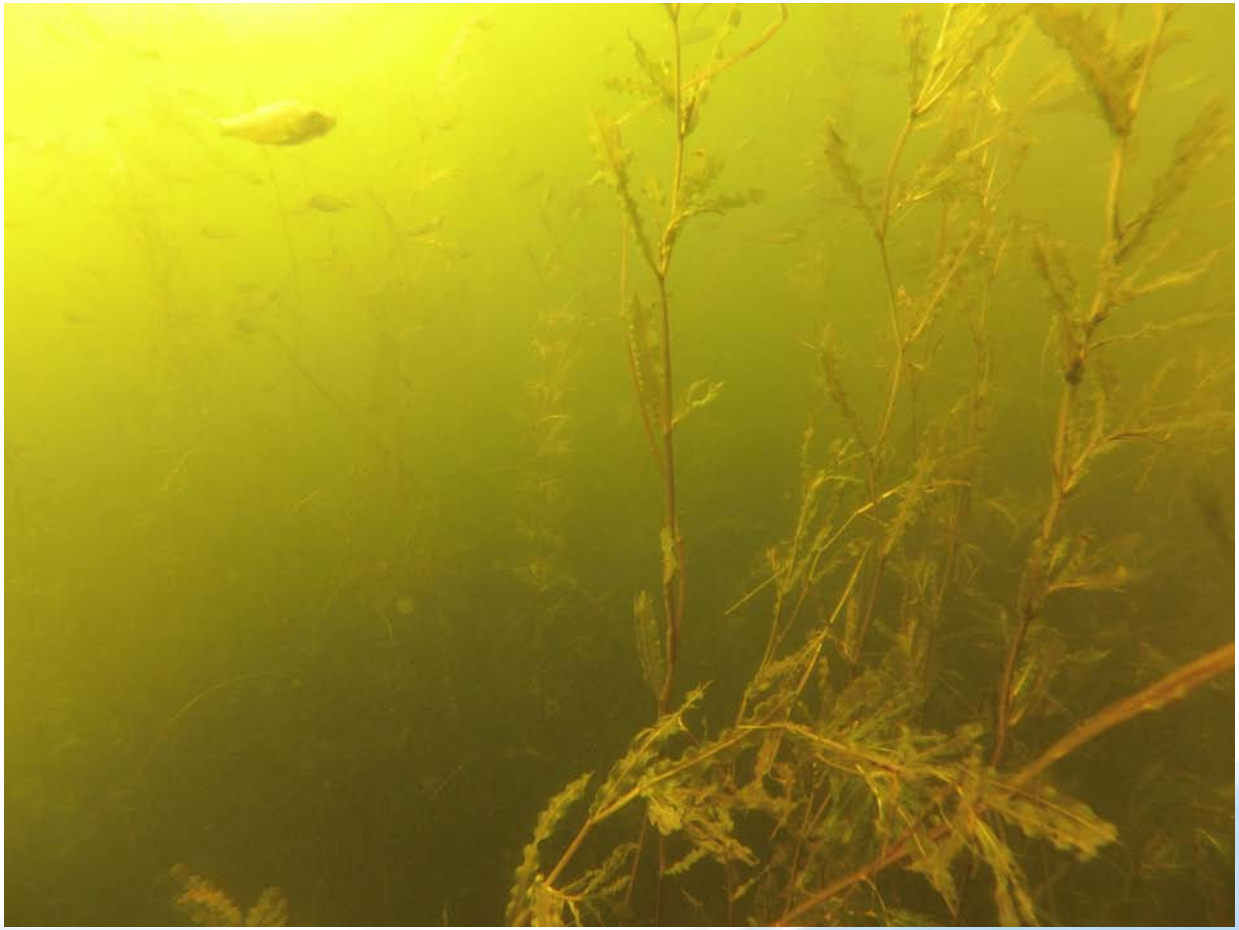


Area of fjord: 750 000 m^2 (after landfill: 500 000 m^2)
Area of seagrass: 70 000 m^2

Dominated by
Pondweed
Potamogeton crispus

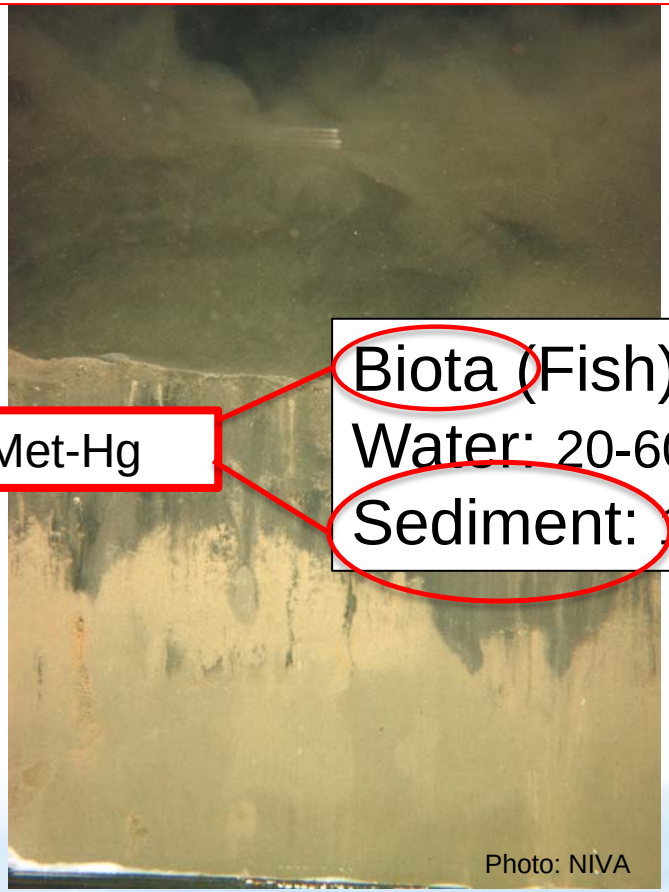
Watermilfoil
Myriophyllum sp.

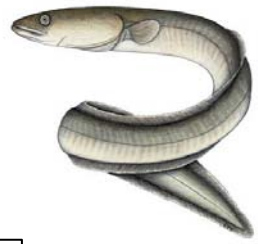
Max depth 10 m
Salinity: ~ 3 - 5 ‰



Known mercury contamination in the fjord

Norsk Hydro: total discharges of 80 tonnes Hg (1947-1988)





Met-Hg

Biota (Fish): - 1,55 µg Hg/g ww (1989)
Water: 20-60 ng Hg/l (1988)
Sediment: 1,6 - 72 mg Hg/kg (1997)

> 0,5 ppm
Class V
Class V

Scope of new project

- Bioavailability of Hg
- Bioaccumulation of Hg
- Biomagnification of Hg
- Remediation strategy

- Bioavailability and bioaccumulation of dioxins
- Analysis of stabile isotops in foodweb
- Flux in-situ and in box-cores
- Contamination of new sedimenting material
- Relative contribution from vegetated/non-vegetated areas
- Effect of different capping materials

? Stimulation of mercury methylation within seagrass area ?

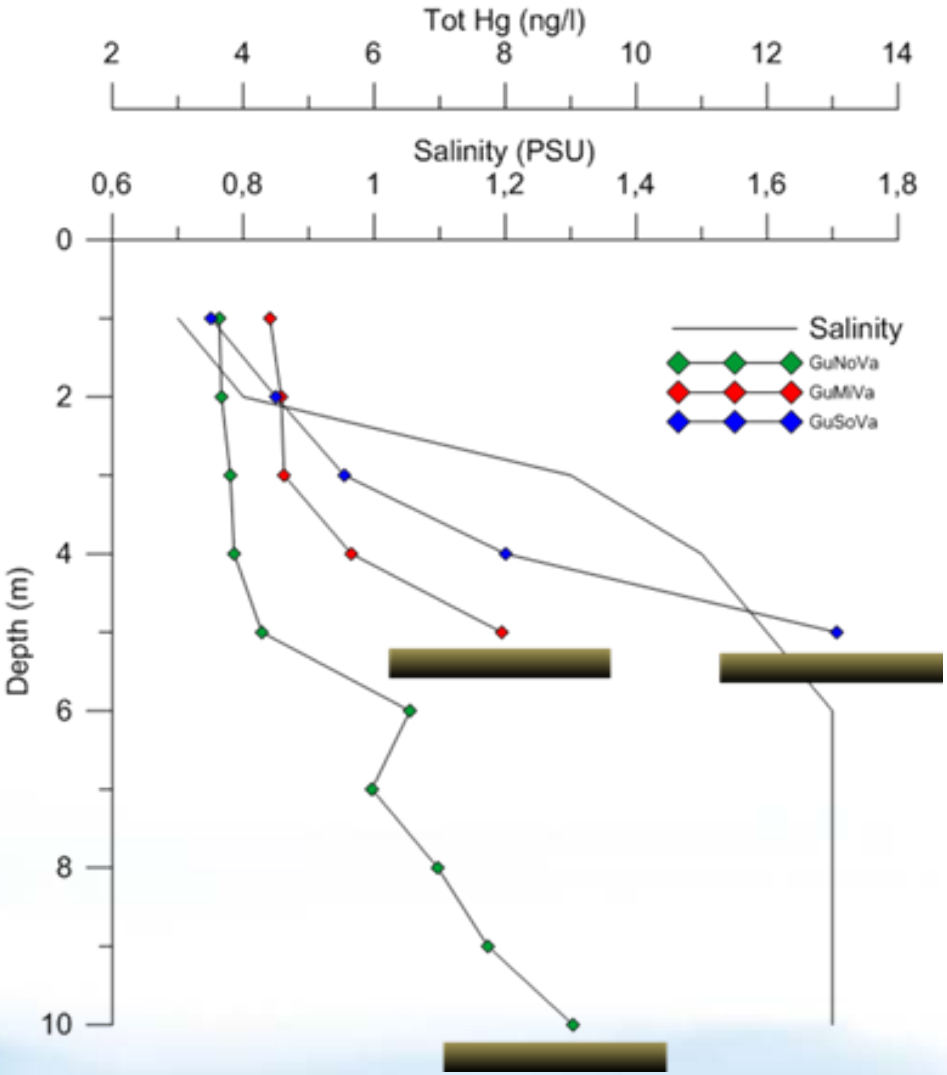
? Capping enhance methylation?

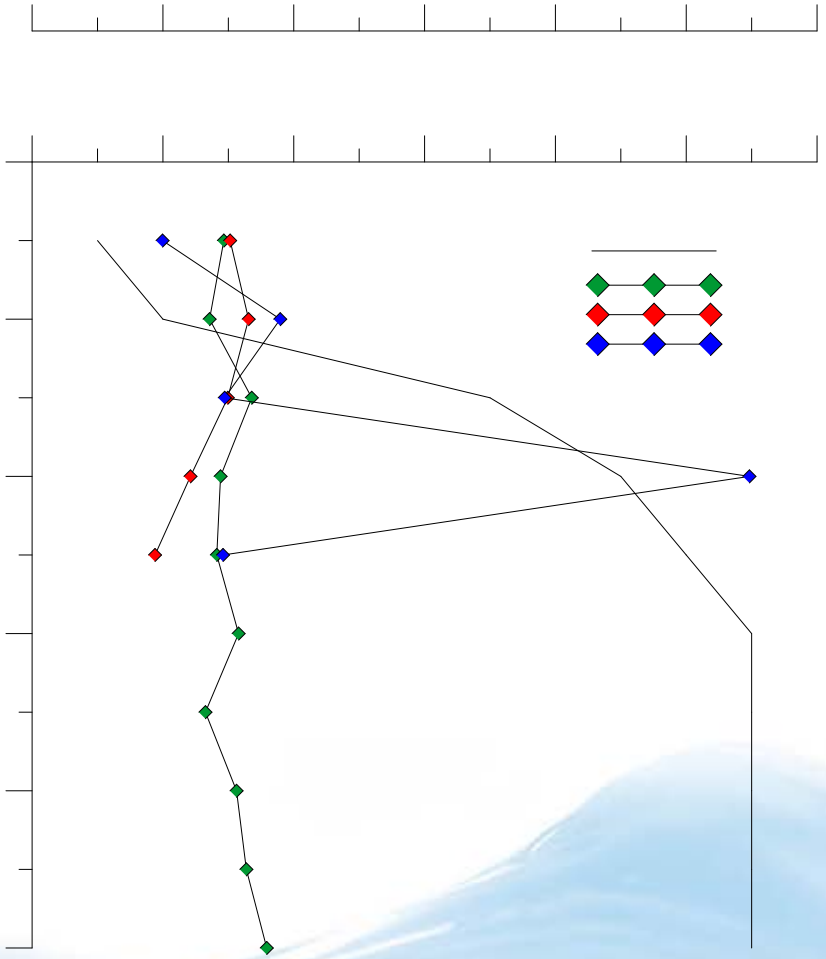
? Remediation or not in seagrass area?

Preliminary results

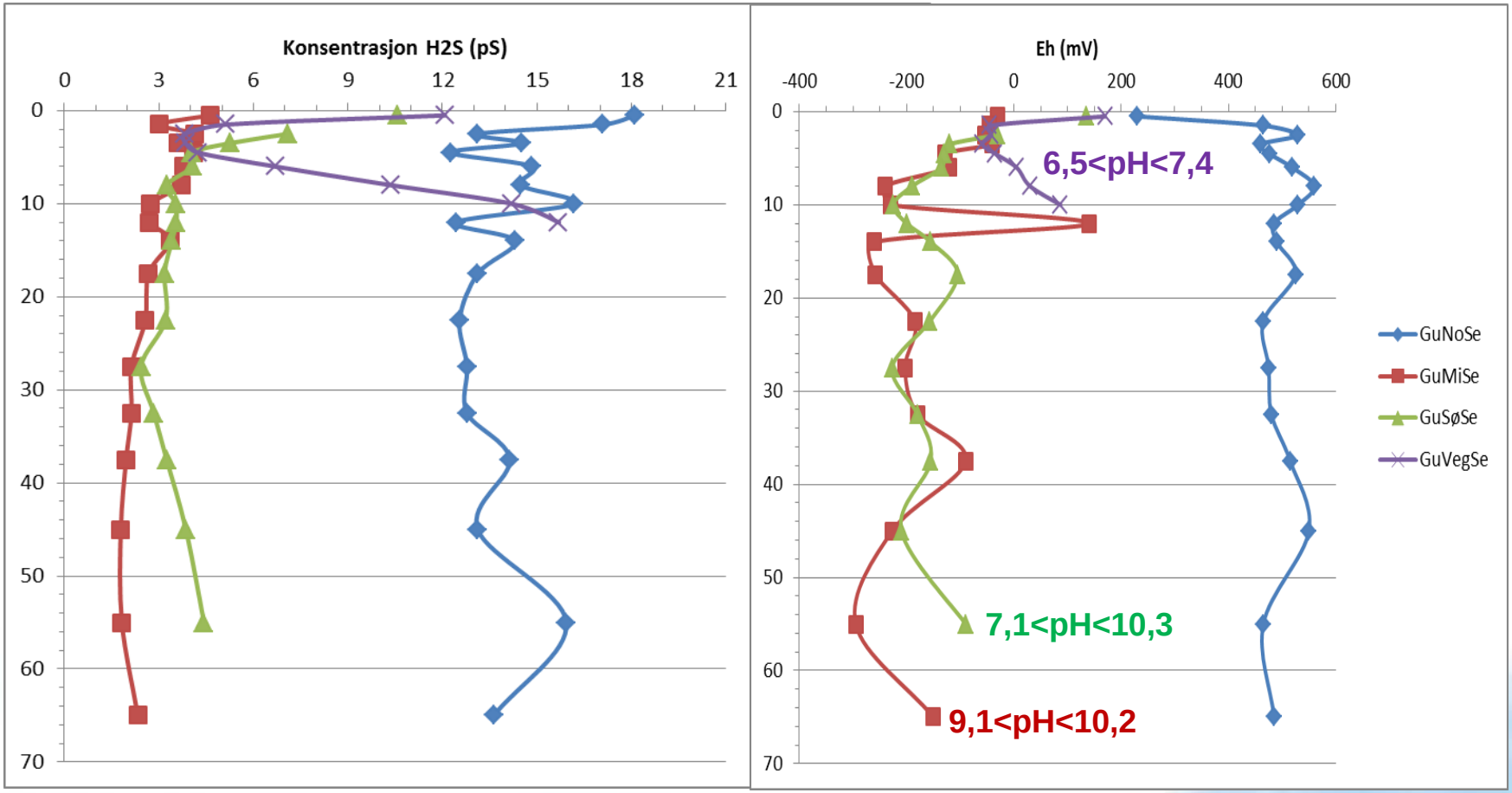
	Tot-Hg ng L^{-1}	**Met-Hg** ng L^{-1}
Water, surface	1,7 – 6,1	0,02 – 0,06
Water, bottom	2,2 – 13,1	0,02 – 0,1
Porewater, outside seagrass	2 537 – 11 740	2,3 – 33,9
Porewater, inside seagrass	To be continued….	
Sediment concentrations and flux	To be continued….	
Biota/Foodweb concentrations	To be continued….	
Effects of capping	To be continued….	

Water profiles





H_2S and Eh profiles in sediment cores:



Preliminary indications:

- Tot-Hg gradient in water indicates mercury flux from sediment to water
- No Met-Hg gradient indicates low flux of MetHg from sediments to water (??)
- Low values of MetHg in water indicates little methylation in water column (outside seagrass area)
- Redox gradient in sediments in seagrass area and not outside might indicate favorable conditions for methylation in seagrass area
- High H_2S at «root-depth» in sediments indicates high rates of bacterial activity; conditions for methylation

The seagrass area a major source?

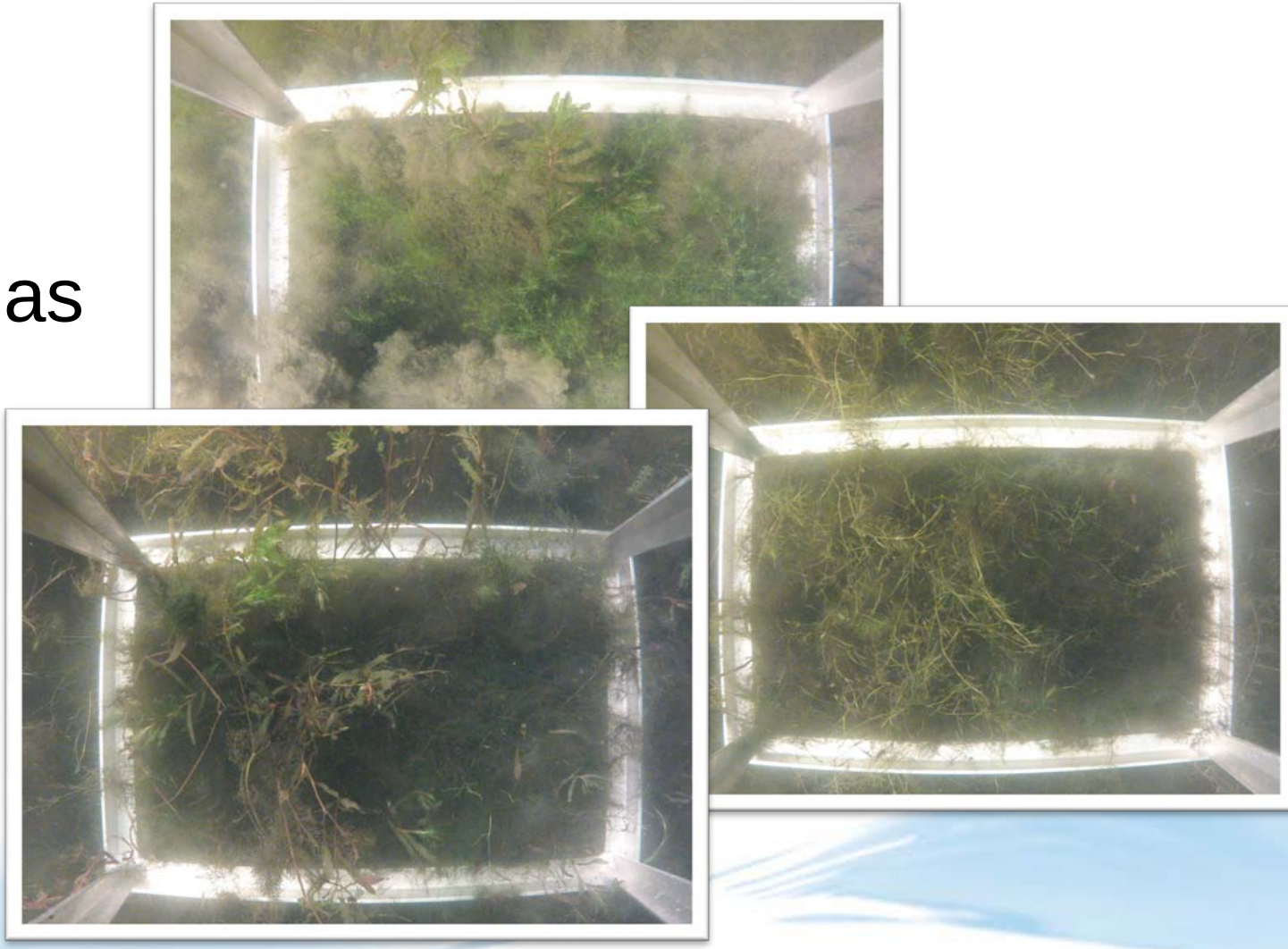
«..presence of live plants enhanced microbial rates of mercury methylation by 20 – 669% compared to de-vegetated plots.»

Windham-Myers, L., Marvin-DiPasquale, M., Stricker, C.A., Agee, J.L. Kieu, L. and Kakouros E.

Mercury cycling in agricultural and managed wetlands, Yolo Bypass, California: experimental evidence of vegetation-driven changes in sediment biogeochemistry and methylmercury production. Sci Total Environ (2013). In press.

Ecological value of seagrass area

Biotop classified as area of national value



Ecological consequences of capping?

Capping might enhance methylation??

"*Since placement of an in-situ cap will induce anaerobic conditions that are known to be favorable for the growth of sulfate reducing bacteria, there is justifiable concern that capping could increase mercury methylation in underlying sediments*."

Nathan William Johnson, University of Minnesota

Management implications

Scenarios:

Capping entire fjord:

Reducing flux of mercury
or
Enhance methylation by capping?

Destroying national value seagrass area
- Restitution time?

Capping non-vegetated area only:

Reducing flux of mercury in parts of fjord

Protect national value seagrass area
(..and keeping major methyl mecury source for foodweb uptake..?)

….to be continued……..

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Financing:

Norsk Hydro

Thank you!

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