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

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Introduction: The brackish land locked fjord Gunneklevfjorden in Telemark, Norway, has received substantial amounts of contaminants since early 1900, due to discharges from industrial activities. Between 1947 and 1988 the chloralkaliplant of Norsk Hydro released approximately 80 tonnes of mercury [1]
The most recent investigations of the sediments [2] show values reaching 72 mg Hg/kg. Samples of fish muscle tissue from 1989 were all above the limit for commercial sale (0.5 ppm Hg), and the highest concentration reported was 1.55 µg Hg g^{-1} ww for one specimen of Eel (*Anquilla anquilla*). Despite the heavy contamination, the fjord is hosting a large area of seagrass, important to the biological diversity in the fjord and rated to be of national value. The ongoing project is investigating the bioavailability and bioaccumulation of mercury in the fjord, and has proposed a possible stimulation of methylation of mercury within the seagrass area. In connection with the development of a plan for remediation of the contaminated sediments, it is relevant to discuss if the area of seagrass should be protected as a valuable biological area, or treated to reduce the bioavailability of mercury with potentially fatal consequences for the seagrass habitat.

Methods: The fjord was investigated by monthly sampling of water to monitor concentrations of mercury in the water column. The seagrass area was surveyed by cameras and video. Bioavailability will be investigated by sampling sediment cores for mercury analysis, and the conditions for methylation will be assessed by measures of redox-potential and sulfide in the sediments, as well as analysis of nitrate and oxygen. The sediment cores will be sampled inside and outside the seagrass area. For bioaccumulation fish and benthic invertebrates have been sampled inside and outside the seagrass area. The biota will be analyzed for stabile isotopes to define trophic levels, in addition to mercury.

Results: The seagrass area is covering approximately 70 000 m^2, and is dominated by curly-leaf pondweed (*Potamogeton crispus*) and Watermilfoil (*Myriophyllum sp.*). Benthic organisms found in the seagrass area are representatives of the Amfipoda, Diptera, Gastropoda, Mesogastropoda, Annelida and Arachnida. Fishing has resulted in vast catches of Perch (*Perca fluviatilis*) and Pike (*Esox Lucius*), and a few specimens of Flounder (*Platichthys flesus*), Eel (*Anquilla anquilla*) and Common rudd (*Scardinius erythrophtalmus*).
So far only water has been analyzed for mercury. Preliminary results from mercury analysis of the water column have shown total mercury between 2 and 11 ng L^{-1}, with the highest concentrations found close to the seabed. Total mercury concentration in pore water has been found to reach 11 700 ng L^{-1}. Methyl mercury has been found both in the water column and in pore water, reaching 0,11 ng L^{-1} and 33,9 ng L^{-1} respectively. Sediment has been sampled during October and will be analyzed together with biota during the following months.

Discussion:
The preliminary results of mercury in the water column and in the pore water indicates flux of mercury from sediment to water. The role of live vegetation in sediment methyl mercury production has been examined by Windham-Myers et al [3] and their experiment demonstrated that the presence of live plants enhanced microbial rates of mercury methylation by 20 to 669% compared to de-vegetated plots. Major investigation end-points such as enhanced mercury concentrations in sediments within the seagrass compared to outside, as well as higher methyl mercury to total mercury ratios and increasing concentrations of mercury with trophic levels of the food chain, are used to test the hypothesis of stimulated methylation within the seagrass habitat.

References:
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