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Baseline

Copper in the sediment and sea surface microlayer near a fallowed, open-net fish farm

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Copper Pollution and Aquaculture

Background

- Copper (Cu) is added to fish feed as a nutritional supplement and used in antifouling chemicals on nets
- High Cu concentrations have been reported in sediments around fish farms
- Copper is most toxic to algae, molluscs and crustaceans such as lobster larvae
- Copper and other pollutants such as oils and pesticides, as well as haddock and cod eggs and lobster larvae, can be found in the sea surface microlayer, the upper millimeter of surface water.
- No studies have been done to examine copper levels in the sea surface microlayer around fish farms



Copper pollution and Aquaculture

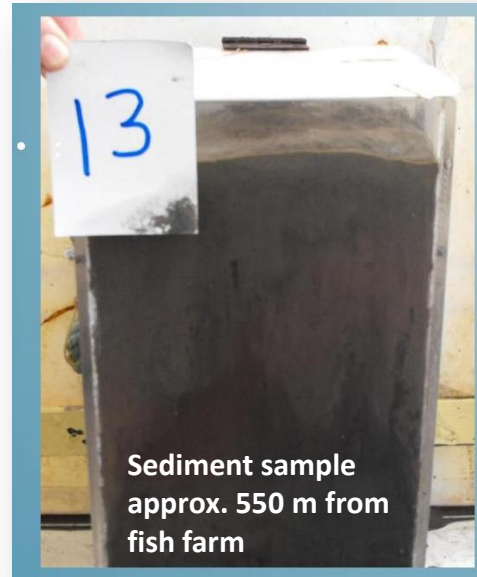
Port Mouton Bay Fish Farm

- Copper from sediments can be transferred to the sea surface from fish feed oils or sulphide gas bubbles released from decomposing fish feces/feed
- An aerial photograph revealed a slick on the sea surface (red arrows) around the Port Mouton Bay fish farm in 2009
- A study to examine the copper levels in sediments and the sea surface microlayer began in 2010



How the study was done

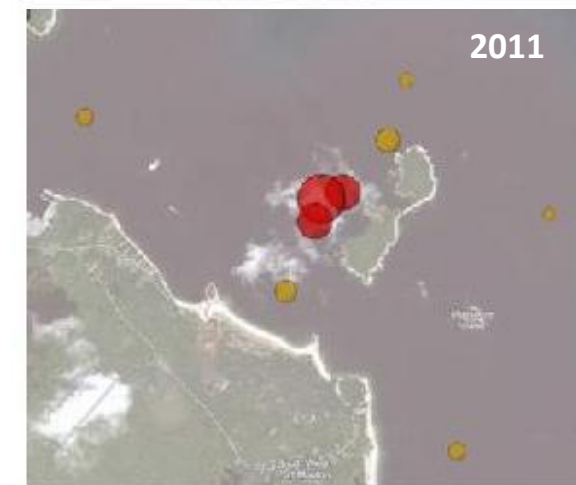
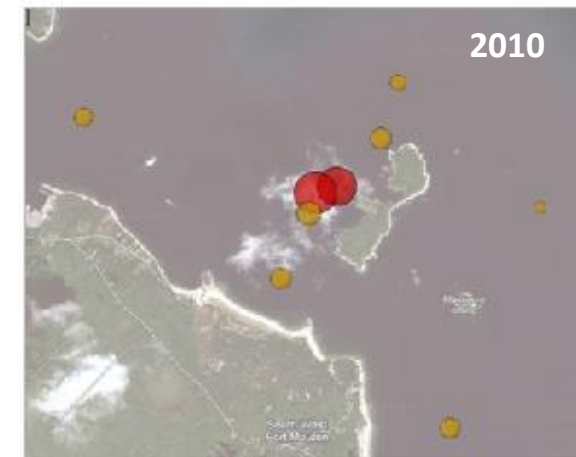
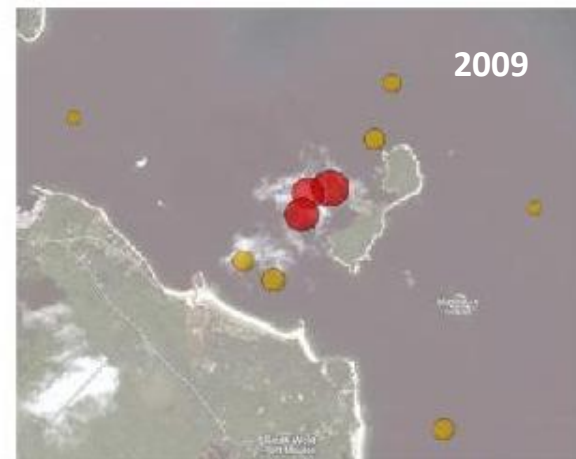
- Sediment samples were collected in 2009, 2010 and 2011 at various distances around the fish farm and analyzed for copper levels
- Seawater and sea surface water were collected and analysed for copper at various distances from the fish farm 13, 18, 25 and 27 months after the farm was fallowed



Results

Sediment copper

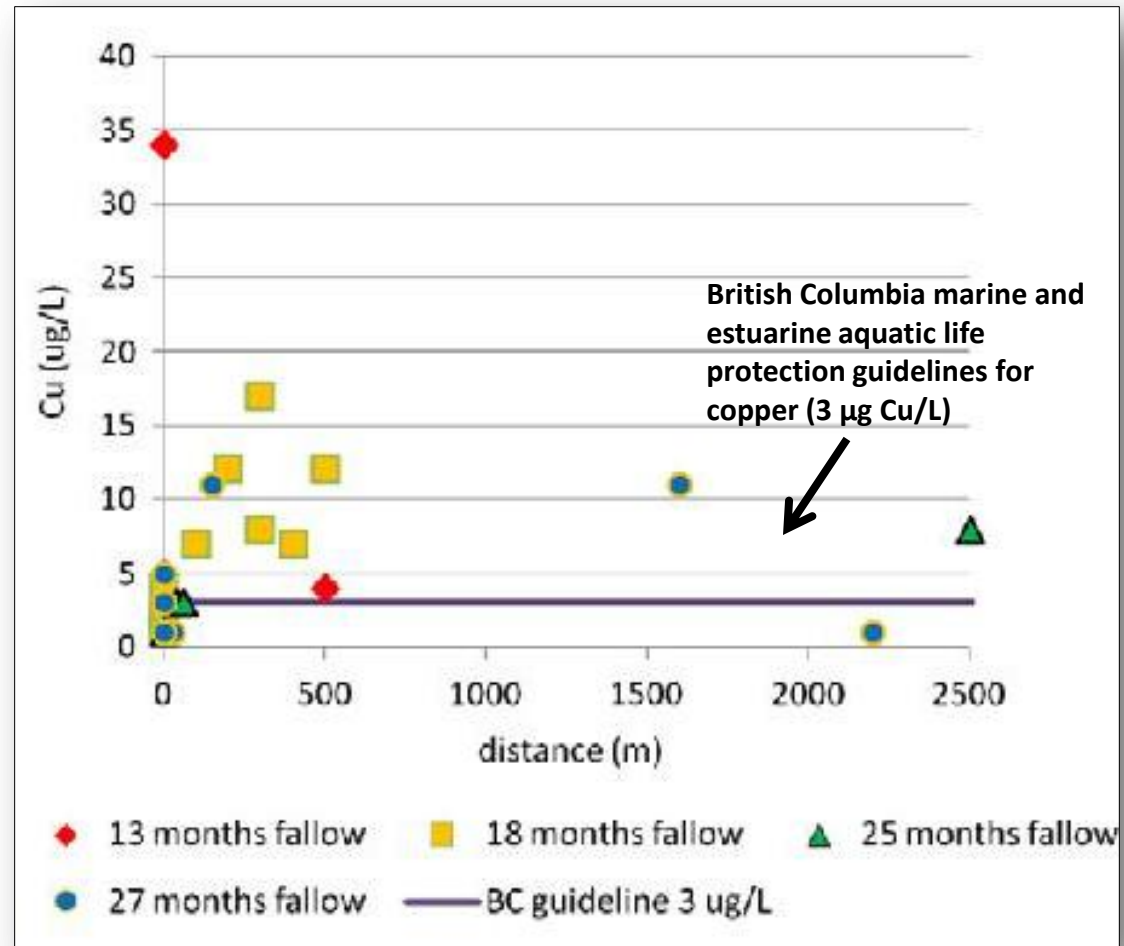
- Canadian Council of Ministers for the Environment (CCME) have set a copper sediment guideline (18.7 mg Cu/L) to protect marine life
- Highest sediment copper concentrations (32-42 mg Cu/L) were measured consistently near fish farm (**red circles**)
- Moderate copper levels (12-17 mg Cu/L) were found 400-2000 m from fish farm (medium-sized **yellow circles**)
- Low copper levels (6-7 mg Cu/L) are represented by the smallest **yellow circles**



Results:

Sea surface microlayer

- More than 2 years after fallowing, copper levels in the sea surface microlayer were several times higher than BC marine life protection guidelines ($3 \mu\text{g Cu/L}$)
- Copper levels of $0.5 \mu\text{g Cu/L}$ has been recommended for the protection of decapod species such as lobster and crab (Mariño-Balsa et al. 2000)



Conclusion

- Copper, and likely other contaminants associated with aquaculture, can be transferred from the sea bottom to the sea surface where they are concentrated and move horizontally for 1 km or more
- The potential toxic effects of copper and other contaminants in the sea surface microlayer on marine life need to be further examined and regulated

Thank you

- Friends of Port Mouton Bay for their financial support of this project
- Fisher and citizen volunteers for their assistance with field work

