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Estimating nitrogen loading and far-field dispersal potential from background sources and coastal finfish aquaculture: A simple framework and case study in Atlantic Canada

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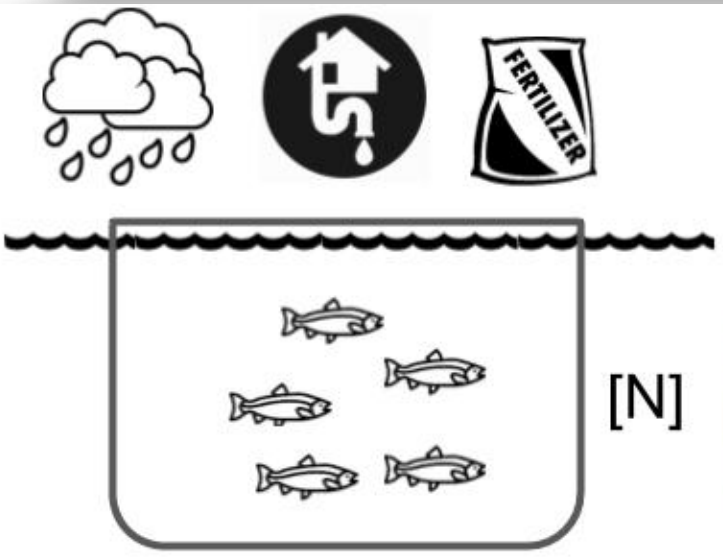
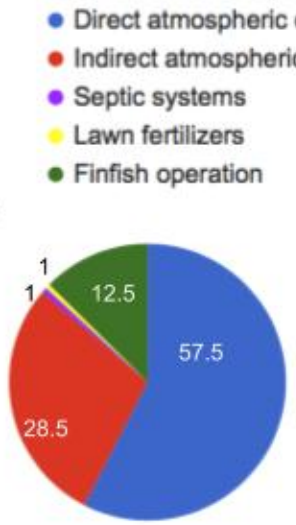
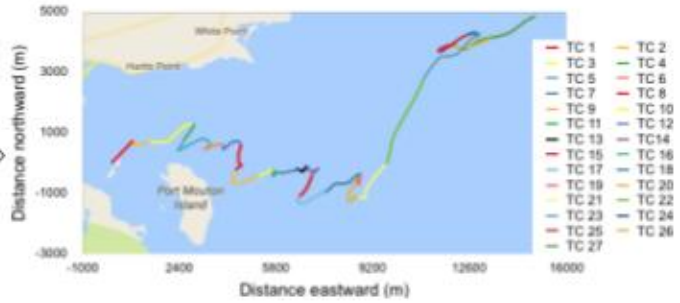


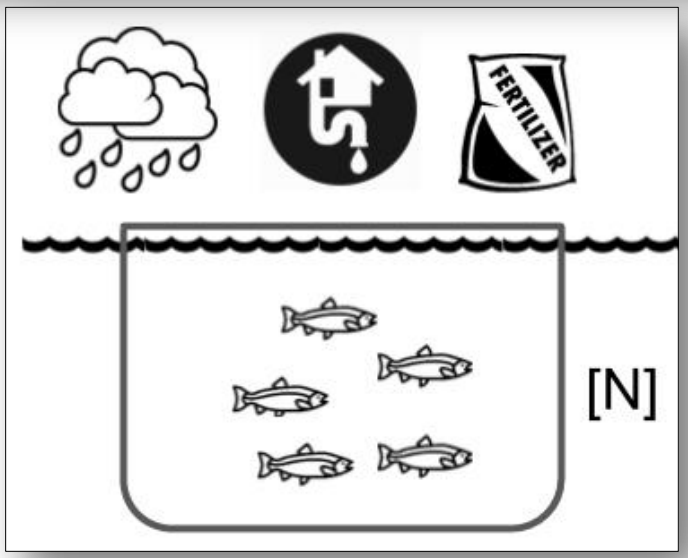




Nutrient Pollution and Aquaculture

Background

- **Nutrients are a class of pollutants and, in the marine environment, too much nutrients or nitrogen (N) loading can cause problems in the ecosystem**
- **Nutrients are quickly converted to increased plant production such as microalgae (e.g. phytoplankton) and macroalgae (e.g. seaweeds)**
- **Common and visible symptoms of too much nutrient loading include the growth of nuisance algae (e.g. brilliant green and slimy brown annual algae), increasingly murky or turbid waters, and smothering or disappearance of eelgrass or rockweed by green algae**
- **Sources of human-generated nitrogen to marine ecosystems include point sources (e.g. sewage and septic systems, fish plants and finfish netpens) and non-point sources (e.g. atmospheric deposition of nitrogen oxide, a greenhouses gas and air pollutant, and fertilizer runoff from lawns and farms)**



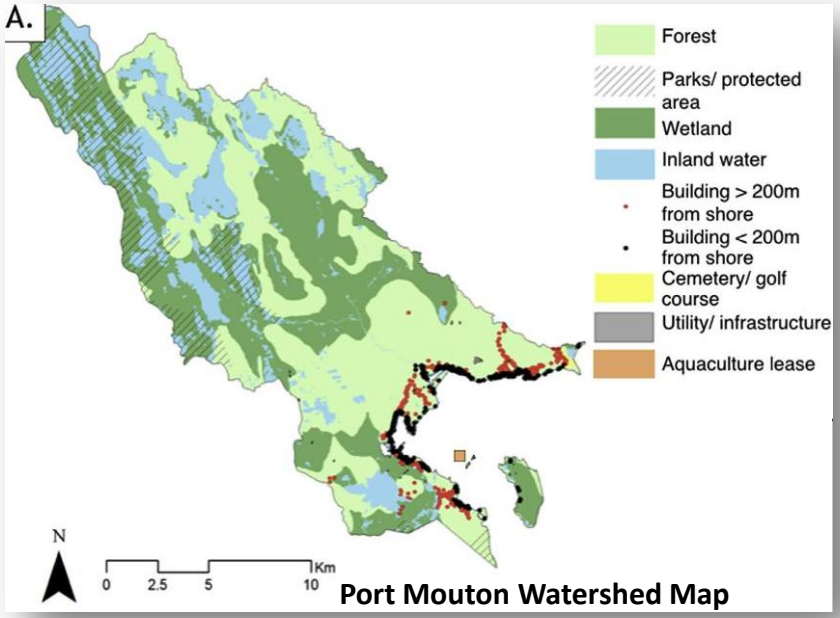
Nutrient Pollution and Aquaculture

Port Mouton Bay

- **Residents and fishermen had observed increased occurrence of green algae on beaches and rocks, loss of eelgrass beds, and slimy algae on lobster traps in the vicinity of the finfish netpen farm in Port Mouton Bay**
- **We did a study to estimate the amount of nitrogen being released from the fish farm compared to other human-generated sources into Port Mouton Bay**
- **We also examined the potential spread of algae (phytoplankton and nuisance algae) resulting from the release of nutrients from the fish farm**

How the study was done

- The amount of nitrogen from point and non-point sources from the Port Mouton Bay watershed was calculated
- The amount and concentration of nitrogen from the fish farm were also estimated
- Current meter data was used to create progressive vector diagrams (PVDs) that show the potential spread of nutrients or resulting algae from the Port Mouton Bay fish farm over a 2-week period

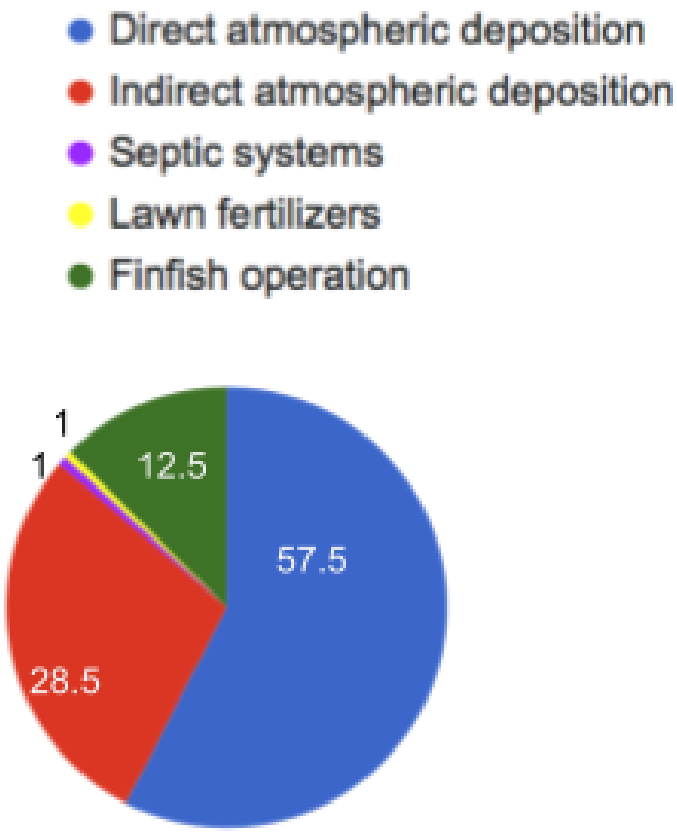


Port Mouton Watershed Map

Results:

Amount of Nutrients

- **Annual estimated amount of nitrogen from all land and atmospheric sources is 211,703 mt**
- **Atmospheric deposition (208,796 mt) in the form of nitrogen oxides is the largest source of nitrogen to the Bay**
- **At an estimated annual stocking level of ~ 400,000 rainbow trout, the fish farm is the second largest contributor of nitrogen (30,400 mt) to the Bay and represents an *additional* 14.4% compared to the amount estimated from other sources**
- **Nutrients levels at the cage edge were estimated to be double the background levels estimated for Port Mouton Bay**

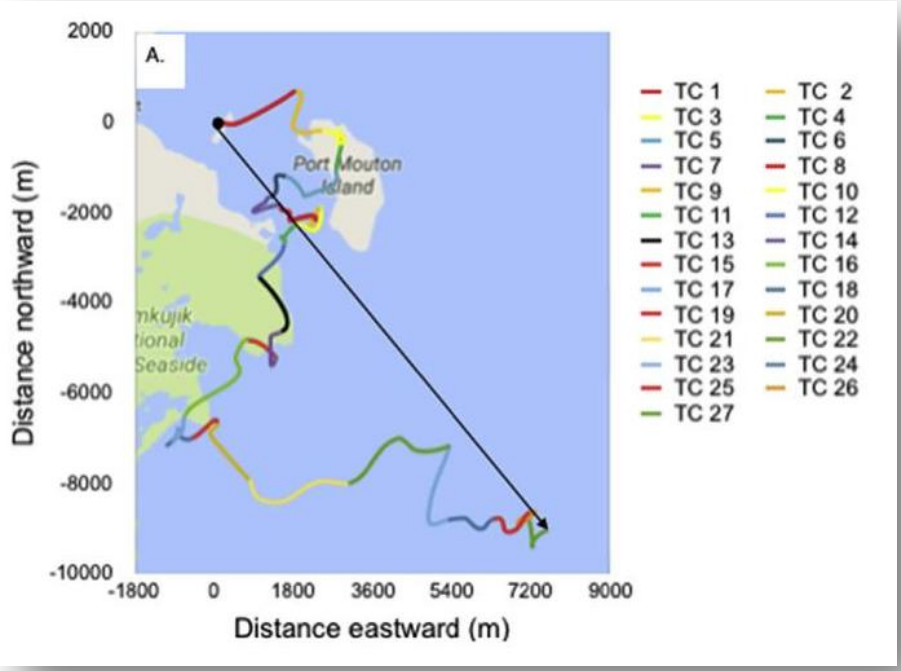


Percent of total nutrient loading to Port Mouton Bay by source

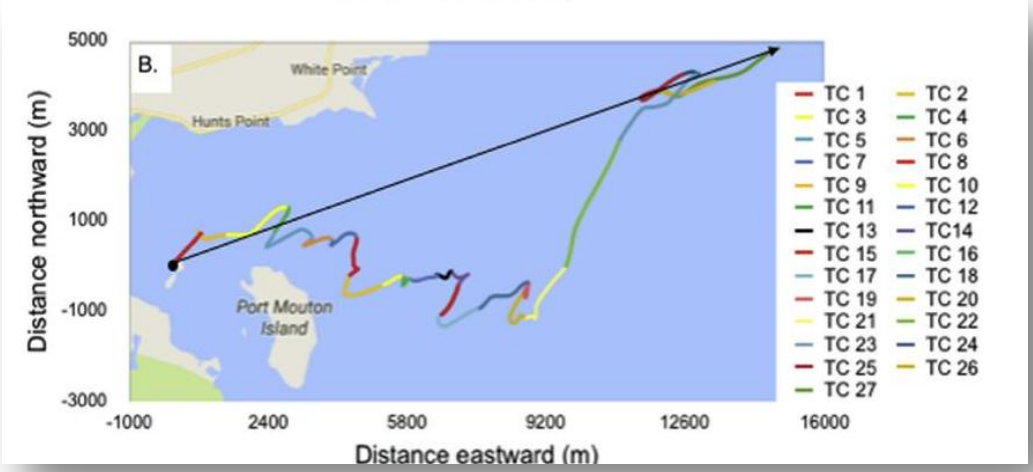
Results:

Spread of nutrients or plant production from the fish farm

- Progressive vector diagrams show that surface current speeds are low (1 cm/sec) and, over a 2-week period, nutrients or algae could spread ~ 11 km southeast of the fish farm
- Why some lines cross over coastal land is because vector diagrams show direction and distance of a parcel of water but do not take into account landforms
- Bottom or lower level currents are also slow (1 cm/sec) and, over a 2-week period, nutrients or algae could travel 15 km east northeast



Potential spread based on surface currents (0-4 m deep)



Potential spread based on bottom currents (4-8 m deep)

Conclusion

- Nitrogen loading from the fish farm in Port Mouton Bay is significant compared to other land-based sources of nutrient pollution
- Slow current speeds around the fish farm could affect the flushing and dilution of nutrient waste and contribute to increased phytoplankton and nuisance algae production
- More effective site assessment and monitoring methods need to be developed and implemented to avoid potential impacts from finfish aquaculture on habitat and water quality

Thank you

- Fishers and Friends of Port Mouton Bay
- Elizabeth Nagel, Dalhousie University
- OceanCanada Partnership