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Potential impacts of finfish aquaculture on eelgrass (*Zostera marina*) beds and possible monitoring metrics for management: a case study in Atlantic Canada

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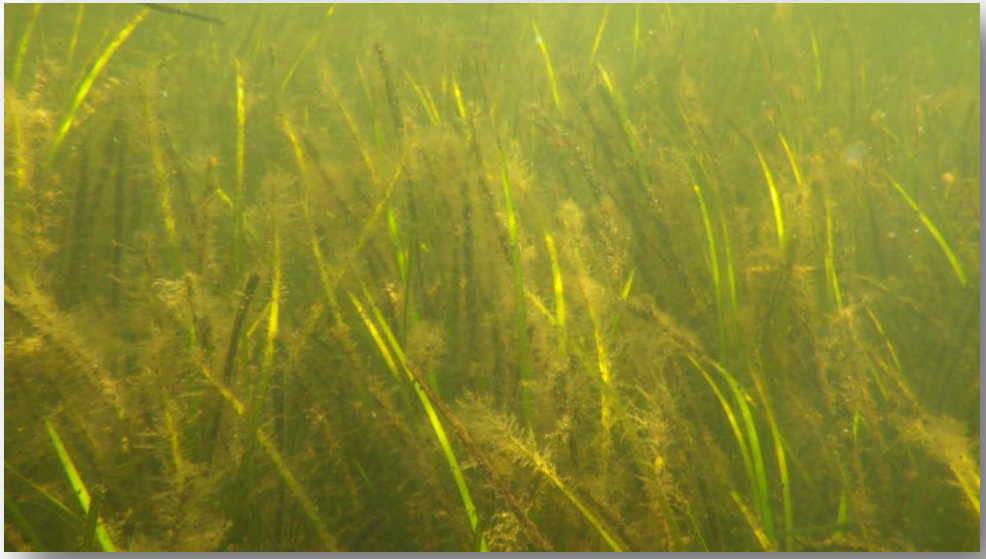
Eelgrass Impacts and Aquaculture

Background

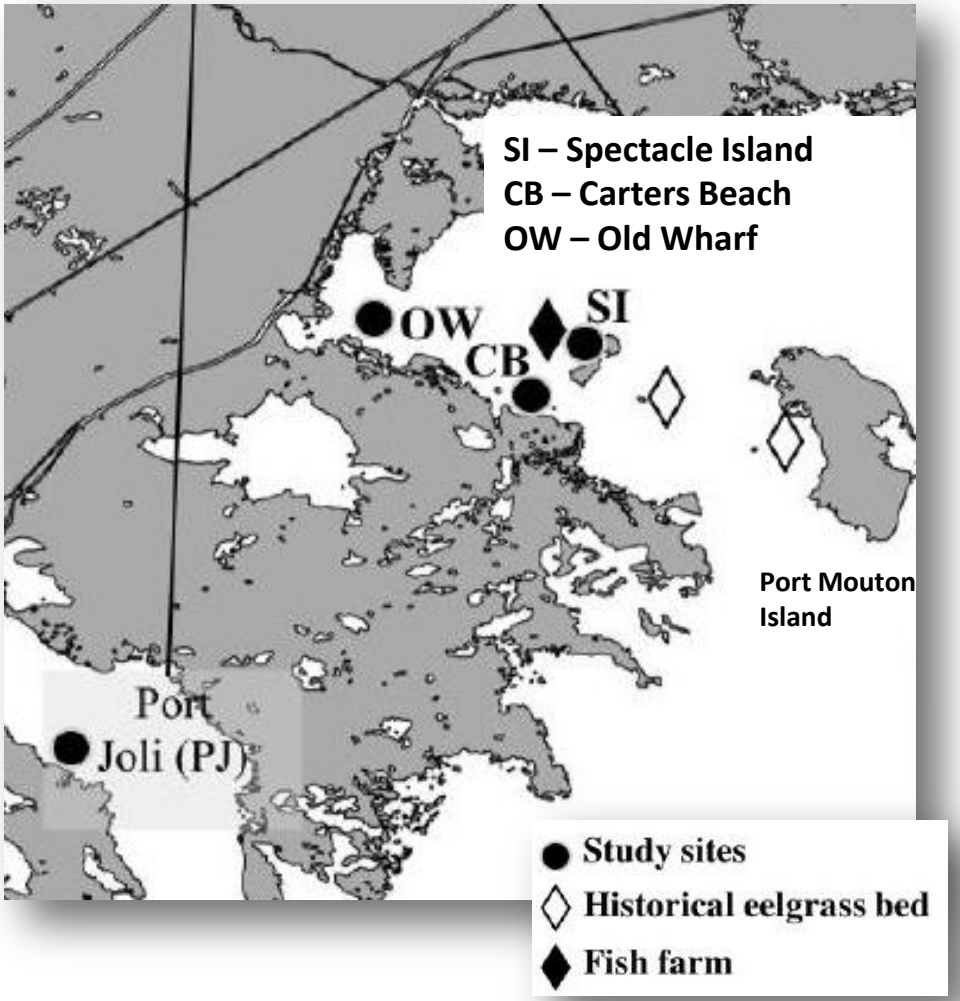
- **Seagrasses, like eelgrass, are among the most productive and diverse ecosystems on the planet.**
- **Eelgrass has been designated an Ecologically Significant Species by DFO because it provides an essential habitat for many commercial and non-commercial species, and it plays a role in nutrient cycling, carbon storage, and helps to reduce wave action on shorelines.**
- **Eelgrass habitat can be impacted by nutrient and organic waste loading from human sources such as municipal waste, fish processing plants, and sea-cage fish farms.**



Eelgrass Impacts and Aquaculture

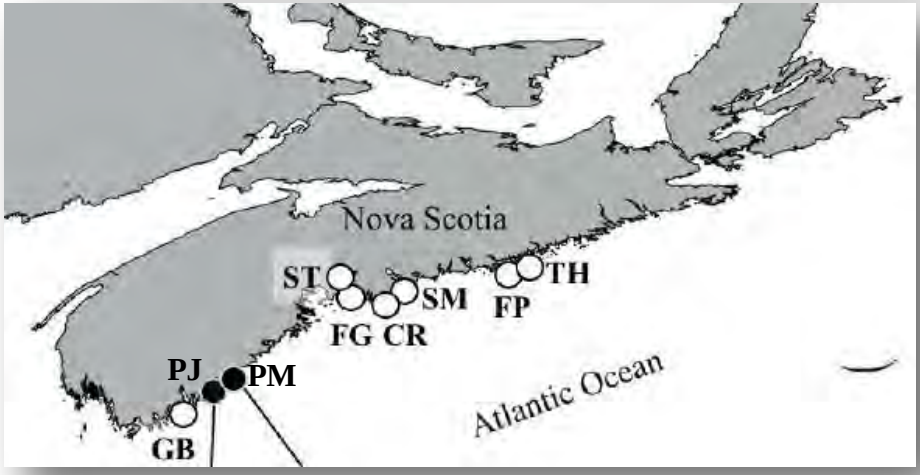
Port Mouton Bay

- **Historic eelgrass beds near Jackie's and Port Mouton Islands that were healthy in 2014, had become degraded and largely disappeared in 2015.**
- **Studies on the potential impacts of sea-cage fish farms on seagrasses have been done extensively in the Mediterranean Sea for more than two decades.**
- **No studies on the potential impacts of fish farms on eelgrass habitat have been done in Atlantic Canada.**
- **We did a study in 2015 to examine the potential changes in eelgrass beds at various distances from the Port Mouton Bay fish farm compared to eelgrass beds in Port Joli and other eelgrass sites along the southwest and eastern shore of Nova Scotia without fish farms.**



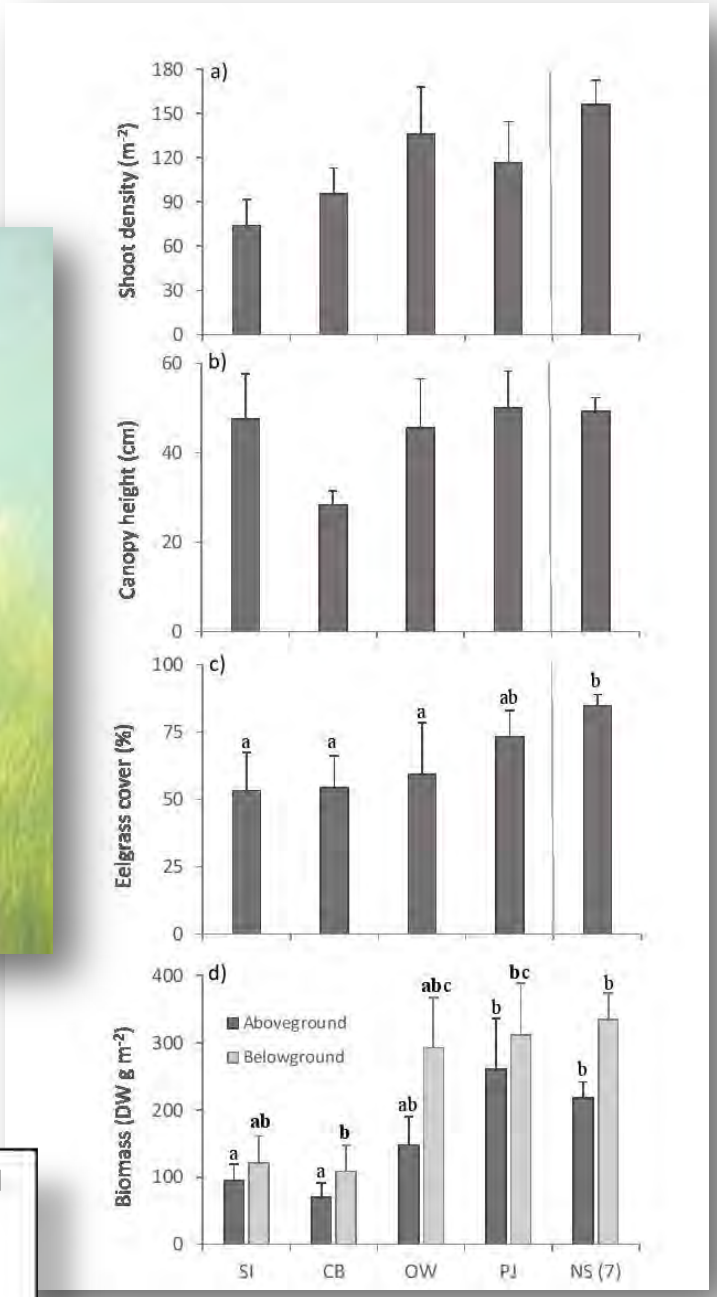
How the study was done

- Numerous features of eelgrass plants and the habitat they form were sampled such as plant height, shoot density, above and below ground biomass, tissue nitrogen content, percent cover of associated epiphytes and annual algae, organic content of sediments, and the identity, weight and number of animal species found in the sediments.
- Measurements were made at three sites in Port Mouton Bay (PM)(300, 700 and 3000 m from the fish farm) and one reference site in Port Joli (PJ).
- These measurements were compared to published data from seven other eelgrass sites along Nova Scotia's Atlantic coast without fish farms using various statistical methods.



Results

- Eelgrass sites closer to the fish farm (Spectacle Island and Carters Beach) had lower eelgrass biomass, cover, and shoot density compared to Port Joli and other sites in Nova Scotia without fish farms.
- Results also suggest higher tissue nutrient and lower biomass of animals in the sediments closer to the fish farm than at sites further away.



SI – Spectacle Island
CB – Carters Beach
OW – Old Wharf
PJ – Port Joli
NS – 7 other NS sites

Comparing eelgrass

Results

- Eelgrass at the Spectacle Island site had the highest epiphyte (mostly hydroid) load. Epiphytes are plants (e.g. brown slime algae) and animals (e.g. hydroids) that grow naturally on eelgrass leaves, but their amount can increase with higher nutrient and organic loading.
- Highest amount of organic matter in sediments was recorded closest to the fish farm.
- Opportunistic polychaete worms (e.g. *Capitella capitata)* are known indicators of polluted conditions, specifically organic waste, and were found in highest abundance close to the fish farm at Spectacle Island (SI). The Old Wharf site (OW) which has a history of pollution had half the abundance of *Capitella capitata* compared to the Spectacle Island site.


Epiphytes on eelgrass blades

Capitella capitata

Conclusions

- **Results reveal changes to eelgrass bed structure, their sediments and associated animal communities within Port Mouton Bay, particularly in closer proximity (<1 km) to the fish farm site.**
- **To protect eelgrass from nutrient and organic loading associated with finfish aquaculture, we recommend a suite of monitoring measures for eelgrass habitat such as sedimentation rates, sediment sulphide and organic content, prevalence of *Capitella capitata* worms, epiphyte load and composition, eelgrass bed structure (shoot density, percent cover, above-and belowground biomass), and tissue nitrogen content.**
- **The process for evaluating proposed finfish aquaculture operations should include comprehensive eelgrass habitat assessments and zoning criteria.**
- **As a precautionary measure, a setback of 1,000 m between eelgrass beds and open netpen finfish farms should be established to ensure the conservation and protection of this sensitive and ecologically important habitat.**

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