LIVING LAB - ATLANTIC

Objective 2.6 - Linking modelled and empirical freshwater nutrient loads to estuarine eutrophication dynamics

The main goal of this component was to refine estuarine ecosystem models used at DFO to provide realistic simulations of the effects of excessive nutrient loading coming from the watersheds.

Partners

Agriculture and Agri-Food Canada

Yefang Jiang and team

Objective 2.1: Co-demonstrate and model the effects of selected nutrient reduction BMPs on water quality at watershed and field scales

Data exchange & Model coupling

Dalhousie University

Prof. Ramón Filgueira with help from Laura Steeves
supervising 2MSc students: **Keryn Winterburn & Jasmine Talevi**

Experimental work

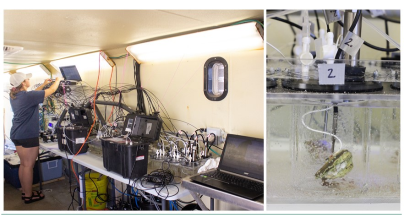
Fisheries and Oceans Canada

Mike Coffin & Thomas Guyondet with support from:
André Nadeau, John Davidson, Tessa Craig, Tim Bernard, Luke Poirier & Jeff Clements

Coordination, Field work & Modelling

Methodology

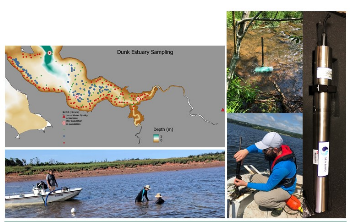
Experimental and field work gathered new data to inform and further develop an existing estuarine ecosystem model.



Experimental work

Bivalves, wild and cultivated, can play an important part in estuary functioning and in particular nitrogen cycling.

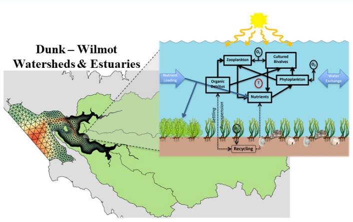
Experiments were conducted in laboratory and *in situ* settings through two MSc student projects to provide quantitative physiological data about the response of the main PEI estuary bivalve species to extreme conditions of low oxygen and high water temperature generated by eutrophication and climate change.



Field work

Followed the main water column variables (T, S, O2, nitrate and phytoplankton) over a whole productive season through water sampling and multiparameter probe deployments.

Distribution and biomass of eelgrass and sea lettuce the main benthic vegetation components were also surveyed, as well as the distribution and biomass of the main bivalve species.



Modelling work

Both development of new modules simulating eelgrass and sea lettuce and validation of the fully coupled model on the Wheatley and Dunk estuaries were required.

The complete model simulates the nitrogen cycle through the main pelagic and benthic components and provides a spatially explicit depiction of the key pools and fluxes that control the nitrogen dynamics along the land-ocean continuum.

Results - Experimental

Winterburn et al. submitted

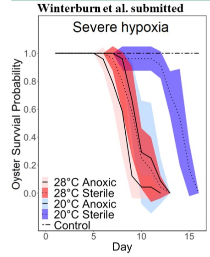


Figure 1. Oyster cumulative mortality

Talevi et al. submitted

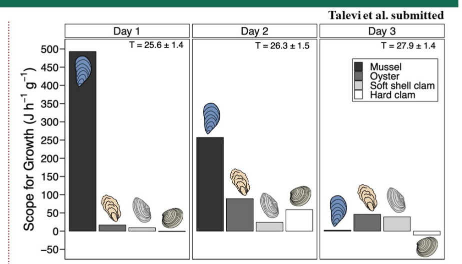


Figure 2. Energy available for growth in 4 bivalve species

- The first MSc student work conducted in controlled laboratory conditions showed that strong interaction exists between hypoxia and high temperature to explain observed oyster mortality. Although the temperature effect dominates, mortality also increases in presence of anoxic sediment and associated bacteria.
- The second MSc student measured several physiological rates such as filtration and respiration of the 4 most abundant bivalve species under *in situ* low oxygen and heatwave conditions. In these stressful conditions, only oysters and softshell clams acquired enough energy to maintain a positive scope for growth.

Results - Field

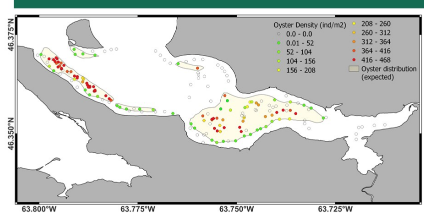


Figure 3. Oyster density distribution in the Dunk

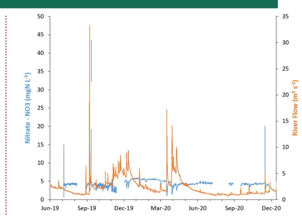


Figure 4. Dunk river discharge and NO3 concentration in 2019-20

Field data were collected to support model forcing and validation. Up to three years of stream nitrate concentration were gathered at the head of tide in the Dunk. Other parameter time series covered the biologically productive season of 2019. That same year surveys were conducted to estimate the density and biomass distribution of sea lettuce and of the most abundant bivalve species.

Results - Model

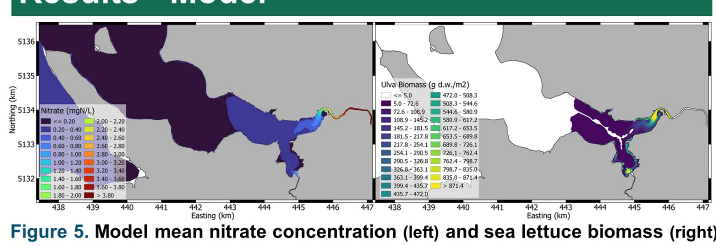


Figure 5. Model mean nitrate concentration (left) and sea lettuce biomass (right)

Model validation is still underway but already shows promising results in terms of nitrate concentration spatial and temporal patterns as well as sea lettuce biomass and distribution in the Dunk estuary.