

Biological and environmental drivers of deep-sea benthic ecosystem functioning in Canada's Laurentian Channel Area of Interest (AOI)

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Background

Ongoing environmental changes and accelerating biodiversity loss raise concern about the role environmental factors and biodiversity play in marine ecosystem functioning. Past studies suggest that multiple abiotic and biotic factors influence organic matter remineralization. However, many studies base findings on controlled laboratory experiments, which simplify complex natural processes. As a consequence, understanding the main drivers of functioning in marine natural systems remains a major challenge. In some environments, sea pens (soft corals order *Pennatulacea*) are hypothesized to be keystone species able to increase oxygen penetration in sediments through their burrowing behaviour, thereby enhancing biochemical processes and infaunal biodiversity. Sea pens are one of the primary reasons for efforts to create a Marine Protected Area in Laurentian Channel in eastern Canada.

Objectives

- (1) To identify the role of benthic organisms (e.g., macrofauna, prokaryotes) and environmental parameters (e.g., depth, temperature, sediment characteristics) in determining ecosystem functioning (organic matter and nutrients remineralization) within different sedimentary habitats in the Laurentian Channel Area of Interest (AOI);
- (2) To identify the role of sea pens as a potential keystone species enhancing local benthic biodiversity and functioning in the area;
- (3) To evaluate the design and monitoring strategies proposed for the Laurentian Channel MPA.

Methods

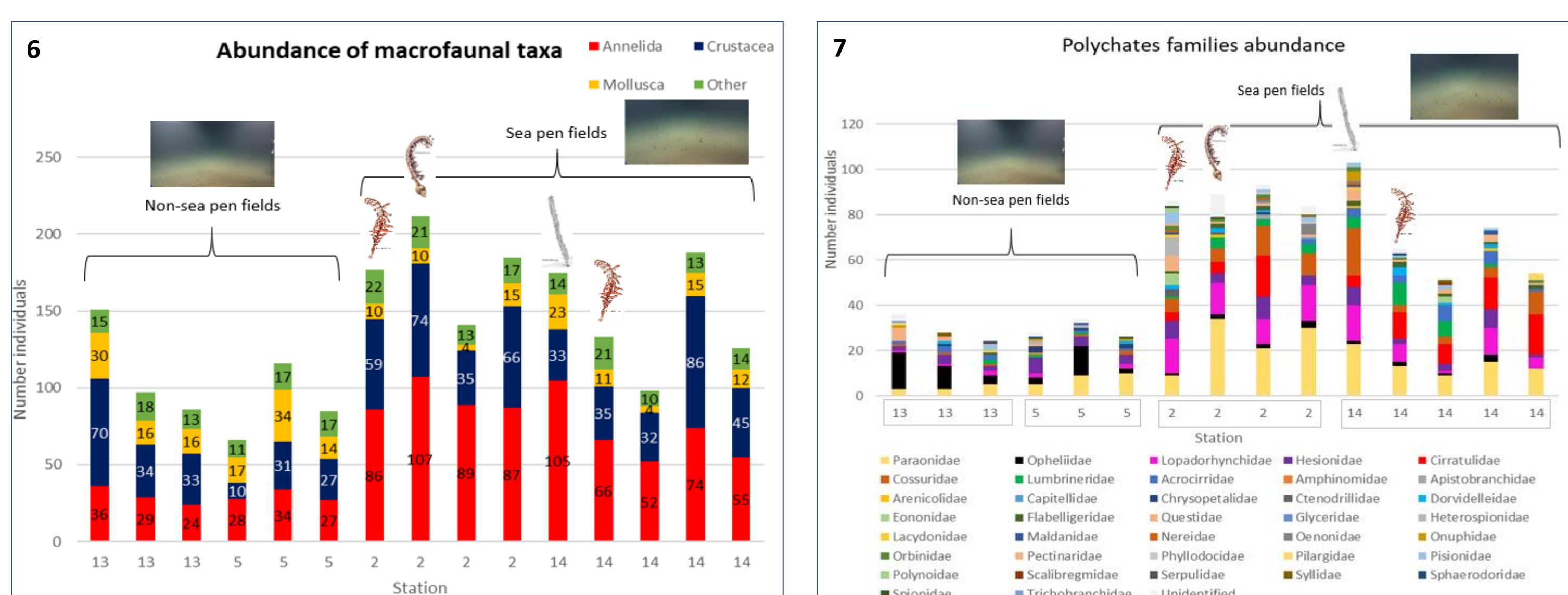
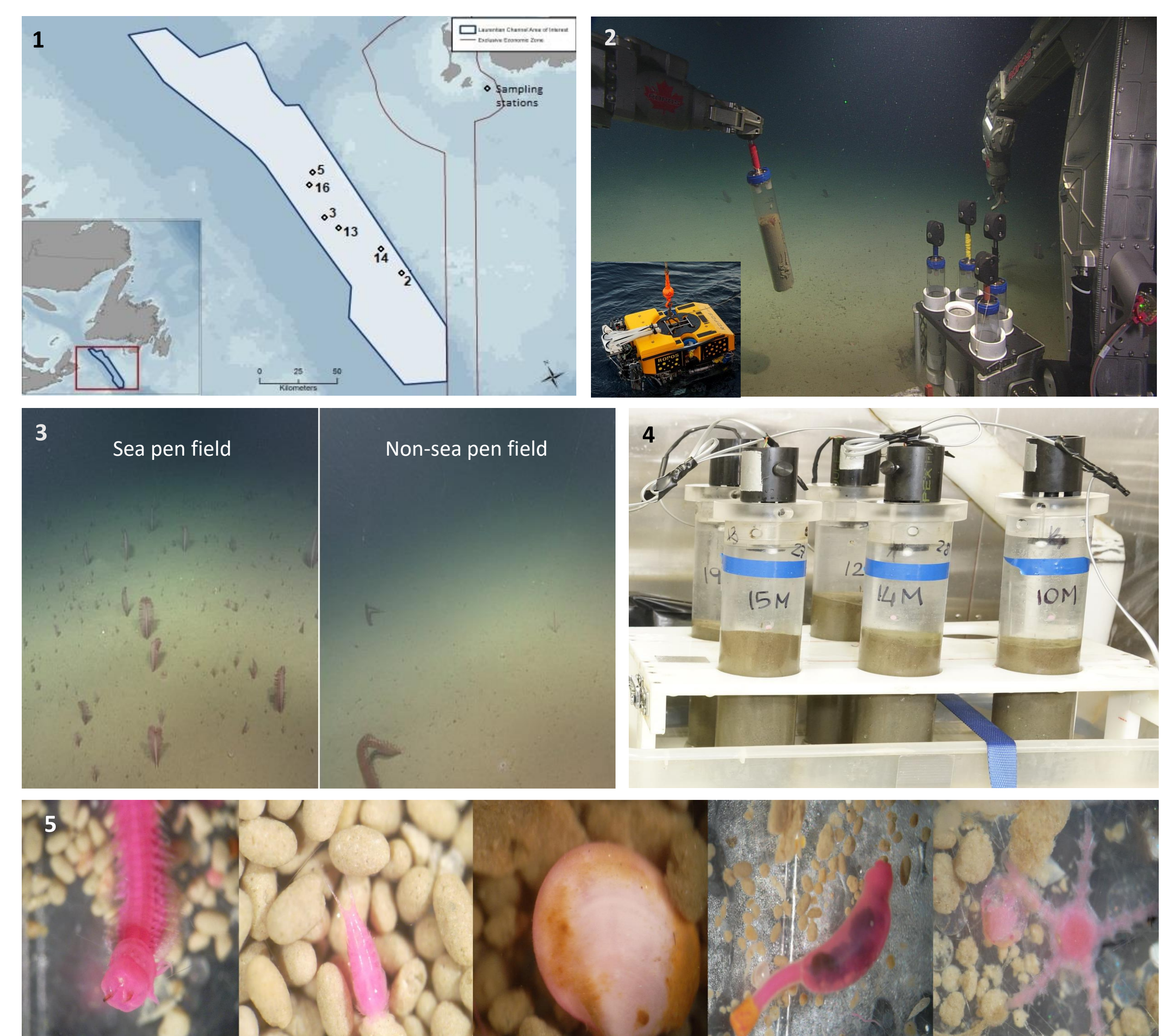
During a cruise in the Laurentian Channel AOI (**Fig. 1**) onboard the CCGS Martha L. Black in September 2017 we collected sediment cores using the ROV ROPOS (**Fig. 2**). We collected sediment samples from 6 different stations inside the AOI (depth 338-445 m), in areas characterized by a different abundance and diversity of sea pens and other megafauna (**Fig. 3**).

We estimated organic matter remineralization through measurements of oxygen and nutrient fluxes at the sediment-water interface (**Fig. 4**) during 48-hours onboard incubations, and determined key environmental parameters (e.g., temperature, oxygen concentration, inorganic nutrient levels, sediment organic content) from onboard measurements and laboratory analysis.

After processing the cores, we evaluated the abundance and diversity of the predominant macrofaunal taxa (**Fig. 5**) and the polychaetes biodiversity at the family level of 15 of the 36 sediment samples we incubated.

Preliminary results

- Environmental variables differ among stations.
- Oxygen consumption and inorganic nutrients fluxes varied substantially among replicates and we found no significant differences among the stations or clear relationships with the environmental variables so far analyzed.
- In some of the stations the presence of sea pens inside the cores appeared to enhance nitrate (NO_3^-) fluxes.



Next steps

- (1) Determine pigments, proteins, carbohydrates and Biopolymeric Carbon (BPC) content of sediment and its grain size;
- (2) Complete the analysis of macrofaunal biodiversity of all the samples to the lowest practical taxonomic level and evaluate functional diversity based on different traits (behaviour, morphology);
- (3) Determine prokaryotic abundances and biomass in sediments;
- (4) Determine the relationships between ecosystem functioning and all the biotic and abiotic factors considered.

- The abundance and composition of macrofaunal communities (**Fig. 6**) and the composition and abundance of polychaetes at the family level (**Fig. 7**) differed significantly (PERMANOVA, $p < 0.001$) between stations and between sea pen VS non-sea pen fields.
- The presence of sea pens inside the cores had no significant effect on macrofaunal and polychaete biodiversity in the samples considered.

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