

PERSUADE

ExPERimental approaches towards Future Sustainable Use of North Sea Artificial hard substratEs



DURATION

1/01/2017 - 15/04/2021

BUDGET

824 442

PROJECT DESCRIPTION

CONTEXT

Coastal areas are increasingly affected by a combination of global and local pressures. At the global scale, climate change results in increasing sea-water temperature and ocean acidification (OA). At the local scale, important human activities include the installation of offshore wind farms (OWF) to meet the requirements for renewable energy sources, and marine aquaculture to meet the demands for food. Both climate change and human activities affect biodiversity and ecosystem functioning. Climate change results in alterations of food-web properties and biogeochemical cycling, similar effects are expected from the introduction of OWFs, in combination with aquaculture activities. OWFs are colonized by fouling species, resulting in alteration of food web structure. In addition, locally increased emissions of the greenhouse gas N₂O are expected, as a consequence of the presence of a specific microbial community on the shells of fouling fauna. Combining aquaculture with OWFs, as planned in Belgian water, can further affect the coastal ecosystem through similar pathways.

GENERAL OBJECTIVES

PERSUADE will investigate how both local and global stressors affect coastal ecosystem functioning. Focus will be on the effect of climate change (temperature increase and OA) in combination OWFs and mussel farming on ecosystem resilience and biogeochemical cycling.

METHODOLOGY

We will use a combination of ecosystem-wide and model-species experiments, modern genomic tools and modeling. Using large holding tanks (4 m³), we will incubate the dominant fouling communities above sediments, in current and 2 future scenarios. A first scenario will mimic the presence of OWFs in a coastal sea environment as predicted by IPCC, while the second scenario adds blue mussel farming to the predicted climate change setting.

We will investigate how the combined local and global pressures affect resilience and the production of N₂O. Resilience will be investigated through structural and functional food-web properties. This will be complemented with a quantitative assessment of C-flows to relate the structural and functional changes to secondary production, important for aquaculture activities. We will take into account both trophic and non-trophic interactions within the network as their relative importance is expected to change in future conditions.

We will conduct detailed experiments and genomic research that will allow for quantification and a mechanistic understanding of the effects of key fouling organisms (the blue mussel *Mytilus edulis*, the amphipod *Jassa herdmani* and the non-indigenous tunicate *Diplosoma listerianum* on the pelagic N-cycle. Along the same lines, the effect of climate change on the sedimentary N-cycle will be investigated. We will combine whole-community incubations with detailed investigations on behavioral responses of selected key species (the invasive clam *Ensis directus*, the bivalve *Abra alba*, and the tube-building polychaete *Lanice conchilega*) to quantify and understand the effect of climate change on the benthic N-cycle.

The integration of ecosystem-wide and species-specific experiments will be done through the development of an ecological model. This 2D-model will be a coupling of the biological models for the key species with a physical and biogeochemical pelagic model and a diagenetic benthic model. This will allow to predict how the coastal ecosystem will respond to the changes in the feedback links between organisms and their environment that are expected when cumulative pressures affect the ecosystem.



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INTERDISCIPLINARITY

PERSUADE will combine research on soft sediments, water column dynamics and ecosystem modeling, both from a biogeochemical perspective and from a food-web perspective. This will allow to link structural ecosystem characteristics to functional aspects such as resilience and nutrient cycling.

IMPACT OF RESEARCH ON SCIENCE, POLICY AND SOCIETY

The impact on the research community will be primarily through through papers in the peer-reviewed literature and contributions to symposia and conferences. In addition, we will construct the Artificial Hard Substrate Garden, an in-situ facility enabling future detailed experiments. This facility will be made available to the scientific community at large through EMBRC.

Our results will help policy through the provision of scientific knowledge of direct use to Descriptors 2,4 and 6 of the MSFD. Furthermore, Belgium allows the execution of aquaculture activities within the concession zones for wind mill farms, however there is no data on how this multiple use will affect the marine ecosystem, both on the global and local scale. Our data will directly inform policy makers about the chance and magnitude of risks on unwanted effects on the ecosystem. This will allow Belgium to maintain the principle of multiple use of OWF zones, or revise the marine spatial plan during adaptive management cycles.

PERSUADE will have a direct impact on society, as the final PERSUADE model will allow to estimate biomass yields of cultured blue mussels in future climate settings and aquaculture designs. Given the imminent plans of Belgian aquaculture consortia to start blue mussel farming pilot projects in an OWF setting, our results will be of local economic importance and serve as a basis for international developments on multiple use of off-shore wind farms.



CONTACT INFORMATION

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LINKS

<https://www.researchgate.net/project/PERSUADE-EXPERIMENTAL-approaches-towards-Future-Sustainable-Use-of-North-Sea-Artificial-HarD-SubstratEs>