Ecophysiology and survival of the Blue mussel (*Mytilus edulis*) as offshore wind farm fouling and aquaculture key species, is adversely affected by a changing marine climate

Voet Helena[1,2], Van Colen Carl[2] and Vanaverbeke Jan[1,2]

[1] Koninklijk Belgisch Instituut voor Natuurwetenschappen: Operationele Directie Natuurlijk Milieu (IRScNB/KBIN-OD Natuur), Vautierstraat 29, 1000 Brussel, Belgium
E-mail: hvoet@naturalsciences.be
[2] Universiteit Gent: Onderzoeksgroep Mariene Biologie (UGent-MARBIOL), Campus De Sterre S8, Krijgslaan 281, 9000 Gent, Belgium

For decades, a combination of global changes and local anthropogenic stressors have put a strain on the marine environment. The International Panel for Climate Change (IPCC) predicts a global rise in ocean temperature of 3°C and a drop in oceanic pH of 0.3 by the end of this century, according to its 'business-as-usual' climate scenario. In addition to these global changes, human activities can affect the marine ecosystem locally. In the Belgian Part of the North Sea (BPNS), the area used for or allocated to the construction of offshore wind farms (OWFs) is increasing and with it, large quantities of potentially non-indigenous fouling fauna can now settle on these artificial hard substrates.

The Blue mussel (*Mytilus edulis*) is both a key species in these fouling fauna communities and the prime candidate for extensive aquaculture projects planned inside the OWF concession areas. The presence of this species undoubtedly affects the local food web structure and the biogeochemistry of the surrounding environment. Partly on account of its shell biofilm, the habitation and cultivation of Blue mussels could also aggravate the local emission of nitrous oxide (N_2O), a potent greenhouse gas (Heisterkamp et al. 2013).

A total of 900 Blue mussels were equally and randomly distributed across four different environmental treatments. These manipulated climate conditions were designed as a fully crossed experiment with varying sea water temperature and pH: CTRL (control setting with ambient 20°C and current pH), PH (acidified setting with 20°C and pH lowered by 0.3), TEMP (ocean warming scenario with 23°C and current pH) and CC (climate change scenario with combination of 23°C and pH lowered by 0.3). For six weeks, several ecophysiological parameters were monitored or tested and the differential effects of the climatic conditions were analysed. Proportional survival and mussel growth in three dimensions were monitored closely during the 42 days of incubation. Weekly experiments were set up to gain insight into the respiration, as a proxy for metabolic rate, as well as the nutrient exchange and the production of N_2O. Additionally, the potential changes in microbial composition and oxygen microprofile of the shell biofilm were characterised weekly. Considering the aquacultural value of this species, changes in mussel tissue quality were also assessed.

This presentation reports on the combined effects of these climate conditions on the survival and growth of the Blue mussel, as well as on the oxygen consumption by both the mussel itself and the associated shell biofilm. All manipulated treatments had a lower proportional survival compared to the current climate control setting, with the lowest survival rate in the climate change scenario (66.67%). Sea water temperature and pH had opposite effects on mussel growth, where the stimulating effect of an increased temperature was trumped by the adverse effect of a lowered pH when combined in the climate change treatment. The environmental manipulations had an amplifying synergistic effect on the metabolic rate, with the highest respiration rates in the climate change setting, and affected the oxygen consumption, thickness and patchiness of the associated shell biofilm.

Reference

- Heisterkamp IN, Schramm A, Larsen LH, Svenningsen NB, Lavik G, de Beer D and Stief P (2013). *Shell biofilm-associated nitrous oxide production in marine molluscs: processes, precursors and relative importance*. Environmental Microbiology 15(7), 1943–1955.

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