Investigating the combined effects of climate change on ecophysiological response of offshore wind farm fouling fauna

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In the past decades, the Belgian part of the North Sea (BPNS) has been affected by a mixture of local and global pressures. Locally, an increasing trend to install offshore wind farms results in the introduction of artificial hard substrates and an increase in potentially non-indigenous fouling fauna. Plans to use these concession areas for aquacultural activities will further affect the food web structure and aggravate the emission of nitrous oxide (N_2O), a potent greenhouse gas. On a global scale, the International Panel for Climate Change (IPCC) 'business-as-usual' climate change scenario predicts a rise of ocean temperature by 3°C and a drop in oceanic pH of 0.3 by the end of this century.

The overall objective of the PERSUADE project (Experimental approaches towards future sustainable use of North Sea artificial hard substrates) is to investigate the impact of these combined pressures on food web interactions and nutrient cycling of coastal ecosystems and integrate the dynamics of the water column and the sediment while doing so.

This presentation reports on the experiments done with blue mussel (*Mytilus edulis*), the dominant species of the intertidal fouling community on the artificial hard substrate structures of the Belgian offshore wind farms. Additionally, blue mussel is also the target species for the aquaculture industry. To gain insight into respiration, nutrient exchange and survival of this species under current environmental conditions and the aforementioned future climate settings, a fully crossed laboratory experiment was set up. Incubations ran for six weeks in four different environmental treatments: 'CTRL' (control settings – ambient temperature of 12°C and current pH), 'pH' (ambient temperature of 12°C and pH lowered by 0.3), 'TEMP' (elevated temperature of 15°C and current pH) and 'CC' (climate change scenario – elevated temperature of 15°C and pH lowered by 0.3).

Under each of these environmental settings, different ecophysiological parameters were tested in the third and sixth week of incubation. Survival of blue mussels was significantly lower in the climate change scenario ($p = 0.044$) compared to the control settings, while the differences in condition index between the environmental treatments were not significant. Mixed effects modelling reported highly significant effects of time (week 3 and 6 of incubation), pH (current or lowered) and temperature (ambient or elevated) on both respiration rate and clearance rate, which were higher in the 'PH' and 'TEMP' treatments and showed a synergistic response in the 'CC' treatment.

These changes in ecophysiological response across the environmental treatments suggest that climate change will affect both the survival of blue mussel and the physiology of the survival individuals, which in turn will affect the local offshore wind farm ecosystem.

Keywords: climate change; ocean acidification; fouling fauna, ecophysiology; *Mytilus edulis*