Ecotoxicological effects of chemical emissions from offshore wind farms: investigating physiological responses in the sediment-dwelling polychaete hediste diversicolor

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In the context of climate change and the environmental harm caused by fossil fuels, nations are increasingly prioritizing the transition to sustainable energy solutions, focusing on the expansion of renewable energies. Among them, offshore wind farms are particularly promising, as they contribute to reducing greenhouse gas emissions, exhibit declining costs, minimize the use of valuable land resources, and allow for multiuse applications, such as aquaculture. While offshore wind farms hold significant potential to facilitate a sustainable energy transition, their environmental impacts on marine ecosystems remain understudied, highlighting the need for further research despite recent advancements in this field. This research aims to investigate the ecotoxicological effects associated with corrosion protection systems used in offshore wind farms, such as galvanic anodes and antifouling paints. These systems may release heavy metals, such as Cd, In, Pb, Al, Zn, and Ga, alongside toxic chemical compounds, such as bisphenol derivatives, tributyltins, benzophenones, and per- and polyfluorinated substances, which may negatively affect marine organisms.

The experimental approach focuses on benthic organisms, using *Hediste diversicolor* as key bioindicator species. In the laboratory experiment, *H. diversicolor* are exposed to sediments collected from six sites located within and outside offshore wind farms in the North Sea, representing areas with varying levels of potential chemical exposure. Additionally, reference sediment obtained from the organism's sampling area in the Eastern Scheldt is assessed. For each sediment type, nine organisms are individually exposed to sieved sediments for 28 days, during which growth rate, mortality, and heavy metal bioaccumulation are measured. Preliminary results suggest differences in growth rates among the study sites, indicating that offshore wind farms may influence the physiological responses of the test species and other marine organisms.

This research will contribute to a deeper understanding of the potential environmental impacts of offshore wind farms, particularly their role as sources of chemical emissions and their effect on marine ecosystems. This is particularly significant given the rapid expansion and projected growth of the global offshore wind farm industry to meet ambitious renewable energy targets.

Keywords
Offshore Wind Farms; Chemical Emissions; Hediste Diversicolor; Marine Ecotoxicology