Unveiling offshore wind farms' impact on southern North Sea fisheries using ecological models: Exploring threads, opportunities and trade-offs

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Society today faces major global challenges, such as climate change, biodiversity loss and increasing demands for food. As a result, Europe has set clear but ambitious targets in its EU Green Deal to produce 120GW and 300GW of renewable offshore wind energy by 2030 and 2050 respectively to mitigate the effects of climate change. Offshore wind is widely regarded as one of the most credible sources for increasing renewable energy production. At the same time, the United Nations predicted we must produce 70% more food by 2050 to meet global food demands. Seafood will play an important role in meeting this demand, as it is a healthy source of protein and micronutrients, emits less CO2 and uses less water and land compared to conventional livestock. However, the increase in human activities at sea not only lead to competition for marine space, but may also impact our ecosystem as a whole and the biodiversity it holds. Yet, currently, the impacts of offshore wind farms towards marine food webs and fisheries remain poorly understood inserting huge uncertainty in the long-term sustainability of these developments. To address this knowledge gap, it is crucial to investigate how wind farms interact and impact marine food webs and commercial biomass, ensuring that the fishery sector is not put at risk. To this end our study will establish a spatial-temporal ecological model for the Southern North Sea. Ecopath with Ecosim (EwE) software, a well-established tool for investigating fisheries impacts on marine food webs, will serve as a foundational framework. Employing this ecological modelling, we aim to assess the impact of both existing offshore wind farms and anticipated developments on the fisheries sector. This involves exploring the effects on the Southern North Sea foodweb structure induced by offshore wind farms and how different commercial fishing fleets can operate in this changed system. One of the main tasks to do so, will be to implement the structural, biological and policy impacts induced by OWF developments into the spatial- temporal ecological model. The modelling approach additionally allows us to compare several development scenarios in terms of fishery impact and sustainability. Besides ecology, our study will investigate possible fishery options using the EwE platform. This exploration extends to the assessment of the economic impacts on the fisheries sector, providing valuable insights into the influence of offshore wind developments and how the fisheries sector can be guided though these changes in a sustainable manner ensuring both ecological balance and economic viability. By combining ecological and economic dimensions, our research aims to offer detailed insights of the threats, benefits and trade-offs the offshore wind sector might pose on the North Sea fisheries sector.

Keywords
Ecological Modelling; Fisheries; Offshore Wind Farms; Food Web; Marine Spatial Planning