A GIS-BASED TOOL TO EVALUATE MUSSEL CULTIVATION IN EUROPEAN OFFSHORE WATERS

AN ASSESSMENT FOR MULTI-USE WITH THE WIND INDUSTRY

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INTRODUCTION

The rapid expansion of the offshore wind industry can be seen as a threat to fisheries, leisure, and aquaculture, but also as **an opportunity for multi-use**! Co-locating aquaculture with the offshore wind industry would allow better maritime space management as well as tackling food and energy demand at the same time. Also, implementing mussel farms offshore would potentially reduce the risks of toxic algae contamination.

Spatial multi-criteria evaluation (SMCE) can help decision-making and policy development for mussel farms offshore.

OBJECTIVE

(1) Assess if European offshore waters are suitable for the blue mussel growth for aquaculture.
(2) Identify if constructed or planned offshore wind farms overlap suitable areas for *Mytilus edulis* development.
(3) Study the suitability of future offshore wind sites by 2050 [1].

METHODOLOGY

Data for factors such as sea surface temperature (SST), Chlorophyll-a (CHL), sea surface salinity (SSS), suspended particulate matter (SPM), and significant wave height (Hs) were downloaded from Copernicus Marine Service from 2019 to 2023 and averaged over this period (Fig 1a).
Mathematical functions that represented *Mytilus spp.* development regarding SST, CHL, SSS, and SPM were found in the literature (Fig 1b)[2].

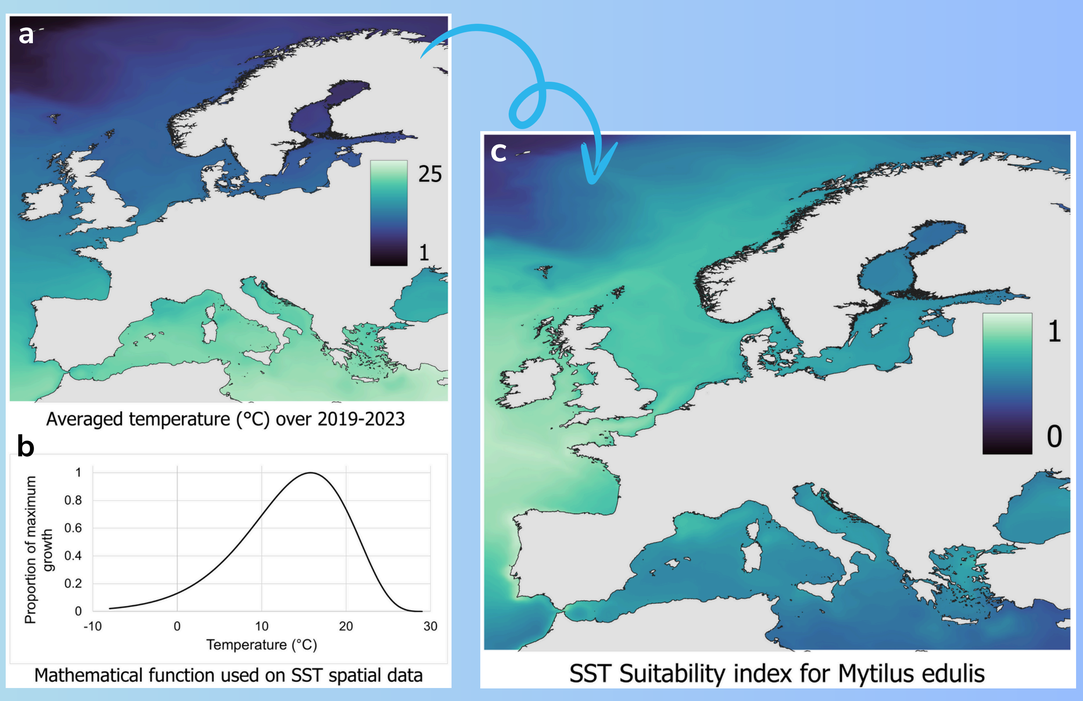


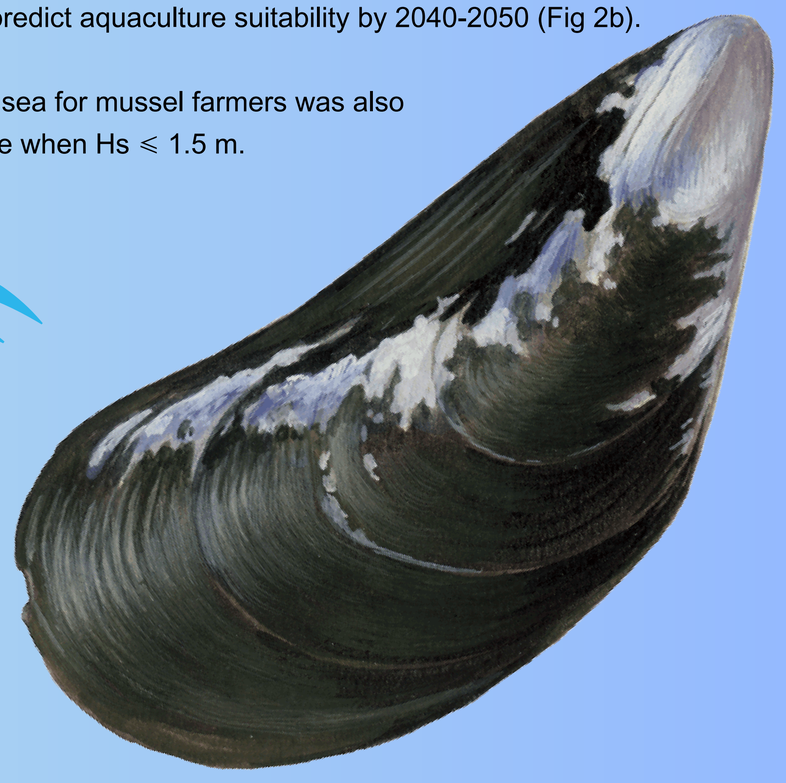
Figure 1: Graphical example of SST factor suitability index.

A SMCE was conducted by fitting each mathematical function into the corresponding dataset leading to a **0 to 1 suitability index for each factor** (Fig 1c). Weights were given to each factor by carrying out an analytical hierarchy process. Finally, factors were combined together using this equation:

Suitability index = 0.45 x SST* + 0.30 x CHL + 0.16 x SSS + 0.09 x SPM

*SST was also replaced by SSP 8.5 acquired from climate model runs (https://www.bio-oracle.org/) to predict aquaculture suitability by 2040-2050 (Fig 2b).

The relative accessibility time at sea for mussel farmers was also studied as the percentage of time when Hs ⩽ 1.5 m.



RESULTS & DISCUSSION

M. edulis aquaculture seemed to be very highly suitable in the southern part of the North Sea, the Irish Sea, and the west coasts of France and Portugal (Fig 2a). The Mediterranean region presented a low suitability due to high SST during the summer. Most of the sheltered and coastline areas presented are highly accessible by boat (Fig 3).
By 2040-2050, some parts of the North Sea will be extremely suitable for growing mussels (Fig 2b). Also, more than half of the predicted wind farms will be in high-suitability zones.

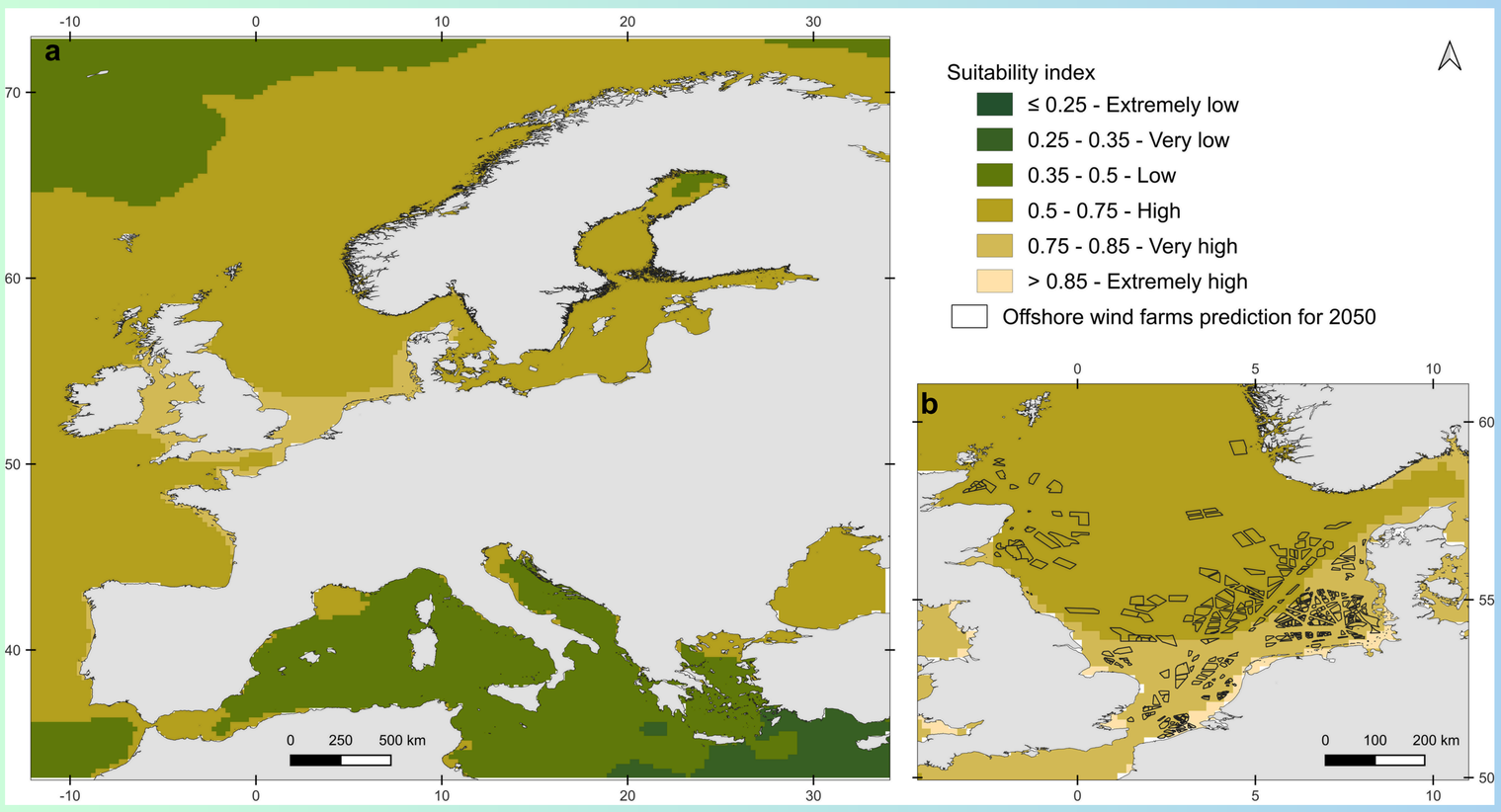


Figure 2: (a) Suitability index for growing the blue mussel in Europe (2019-2023).
(b) Suitability index for growing the blue mussel in the North Sea (2040-2050).

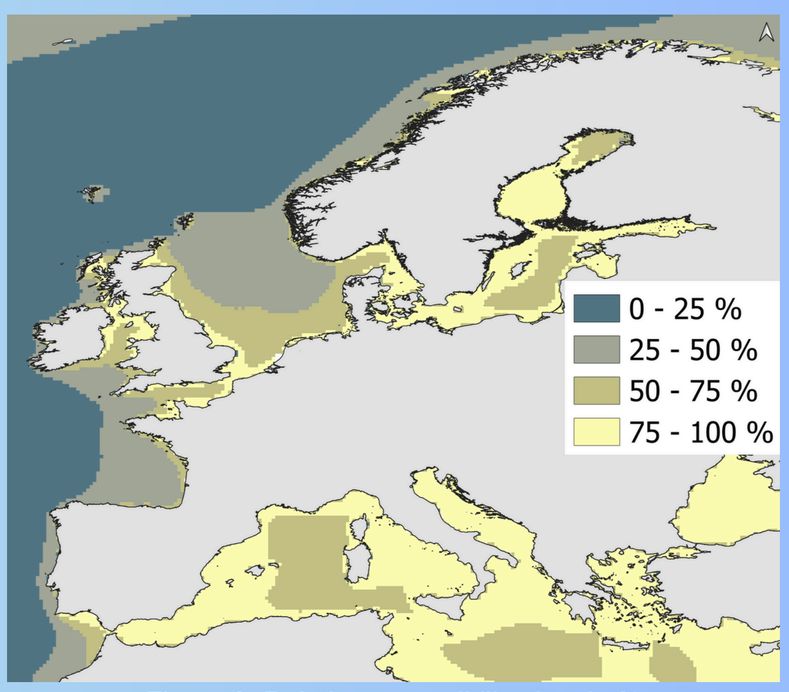


Figure 3: Relative accessibility time in %
(significant wave height ⩽ 1.5 m).

CONCLUSION & RECOMMENDATIONS

Multi-use of *Mytilus edulis* aquaculture with offshore wind farms can allow better space management at sea. This study showed that blue mussel cultivation is possible offshore, even by the horizon of 2040-2050. In the future, the North Sea might look even more promising for co-location between *M. edulis* aquaculture and the offshore wind industry. The potential yield for a mussel farm implemented within an offshore wind farm still needs to be predicted more precisely to assess its economic viability.

LITERATURE

[1] Waldman, S., Munro, P., & Forster, R. (2023). Plausible 2050 offshore wind locations in the North Sea (Version 2) [Data set] Zenodo.
[2] Lauzon-Guay, J. S., Barbeau, M. A., Watmough, J., & Hamilton, D. J. (2006). Model for growth and survival of mussels Mytilus edulis reared in Prince Edward Island. Marine Ecology Progress Series, 323, 171-183.