Calibrating a Benthic Risk Assessment Model with Local Monitoring Data: Advancing Marine Spatial Planning in the Belgian Part of the North Sea

Lorré Dries[1], Vandamme Sara[2], Janssen Colin[2] and Asselman Jana[2]

[1] Blue Growth Research Lab, Ghent Univeristy
E-mail: dries.lorre@ugent.be
[2] Blue Growth Research Lab, Ghent University, Coupure Links 653, 9000 Gent, Belgium

Marine spatial planning (MSP) is crucial for balancing human activities with ecological preservation to ensure the provision of ecosystem services for future generations. The Belgian part of the North Sea (BPNS) hosts diverse marine activities—including shipping, fishing, tourism, offshore wind farms, dredging, and sand extraction—within a limited area, resulting in overlapping pressures. These pressures contribute to habitat degradation, biodiversity loss, and reduced ecosystem functioning, underscoring the need for effective risk assessment tools.

This study aims to develop a robust method for quantifying the risk of benthic habitat degradation resulting from human activities in a marine spatial context. Macrobenthos, which play a key role in ecosystem functioning, serve as sensitive indicators for assessing local impacts and evaluating these risks. The InVEST Habitat Risk Assessment (HRA) model is used to link human activities with ecological impacts. However, for its practical implementation, the model must be calibrated using high-quality local data.

To achieve this, long-term macrobenthos monitoring data from the BPNS is analyzed to derive stressor (human activity)–response (macrobenthos indicators) relationships. Indicators include species richness, total abundance, Shannon-Wiener diversity, functional richness, and shifts in community structure are used to capture the extent and nature of macrobenthic impacts. These stressor-response relationships are then used to calibrate the risk model. This is the first study to fully calibrate the HRA model using high-quality and local monitoring data, rather than relying on literature or expert-based values of stressor-response interactions. This approach ensures a highly calibrated model with greater relevance for local application.

The calibrated model will enable the quantitative evaluation of benthic habitat degradation risks under past marine management, the current (2020-2026) and proposed MSP (2026-2034). As such, it will serve as a scoping tool in the early planning process. Additionally, it will provide a visual tool for identifying high-risk areas, supporting adaptive management and sustainable spatial planning. By integrating the best available data, this research advances MSP strategies and offers a framework for managing ecological risks in complex marine environments like the BPNS. This approach will support decision-makers in designing effective mitigation strategies and ensuring compliance with conservation objectives.

Keywords
Risk Assessment, Macrobenthos, Marine Spatial Planning, Human Activities, InVEST Risk Model