

Subtidal mussel reefs: A feasible nature-based approach for coastal protection along the Belgian coast?

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Subtidal mussel reefs, formed by blue mussels *Mytilus edulis* and other benthic organisms, provide a range of ecosystem services. Empirical studies have shown that mussel reefs attenuate wave energy and stabilize sediments, leading to a significant reduction in sand and beach erosion. Additionally, these reefs provide a habitat for a variety of marine species, including fish, invertebrates, and plants, and can improve water quality by filtering out excess nutrients and suspended particles and by stabilizing sediments. Subtidal mussel reefs could therefore offer a sustainable, cost-effective, and environmentally friendly solution for protecting coastal areas from sand erosion while providing additional ecological benefits.

The sandy beaches along the Belgian coast suffer from extensive and frequent sand and beach erosion, and protective mussel reefs do not naturally occur here. In the Coastbusters 2.0 project, a habitat suitability model using fuzzy logic has been developed to identify potential locations where mussel reefs could thrive. Nine environmental parameters were included in the model, covering the biotic, abiotic, and hydrodynamic aspects of the environment. These parameters may interact in complex and sometimes conflicting ways. Using a fuzzy logic approach allowed us to model these complex relationships and produce predictions that take multiple factors into account simultaneously. Also, it enabled modelling gradations of suitability rather than a binary 'suitable' or 'unsuitable' classification, allowing for more nuanced predictions. This model supports the identification of favorable growth sites of mussel reefs as a nature-based solution for mitigating sand erosion in the region.

Keywords

Biogenic Reef; Blue Mussel; Sustainable Coastal Management; Habitat Suitability Model