▶Project *brief*

Determining and predicting the sensitivity of marine habitats to anthropogenic stressors

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- **The B-USEFUL project provides user-oriented solutions to protect marine diversity in all European marine areas in the long term against the background of climate change and other human influences**
- **73 monitoring datasets of bottom-dwelling fish and benthic fauna from the Mediterranean to the Arctic were standardised for regionalised modelling**
- **By developing overarching sensitivity indices and hotspot analyses, uniform recommendations for the establishment of marine protected areas can be derived**

Background and objectives

The B-USEFUL project creates a link between EU maritime policy with the EU Green Deal, Biodiversity Strategy 2030 and diversity research. It thus supports European regulations through a uniform framework for regional investigations. The prerequisite for such a working approach is the standardization and harmonization of all data sets and all evaluations. Sensitivity indicators coordinated with users show the temporal and spatial dynamics in the marine areas to date. They also serve to assess future developments under different climate changescenarios and different protective measures.

Approach

In order to be able to use a comparable data base in all marine areas, we have standardised all monitoring time series (Fig. 1). For this purpose, comparable data models were created for all data sets, so that all original data can be merged via corresponding attribute tables. Taxonomic information has been harmonised in order to provide comparable information, e.g., diversity and the number of species. Diversity is represented with indicators that had previously been developed with different user groups.

In addition to climate change, we have also identified fisheries as an overarching anthropogenic pollution parameter, as well as local pollution variables such as offshore wind turbines and existing land use zoning.

In addition to regional and local species numbers and species distribution, overarching biological characteristics were also recorded and calculated as indices of climate sensitivity and fisheries sensitivity for all communities. Environmental parameters and topography were extracted from the environmental databases and climate models. One focus of our analyses was on the German Wadden Sea and the shelf coast of East Greenland.
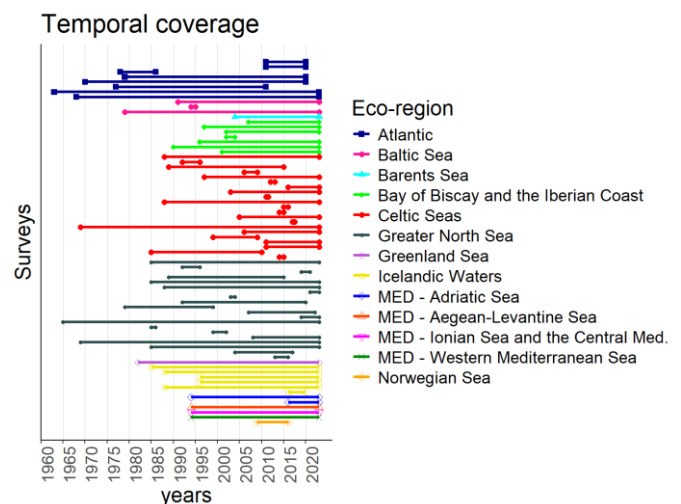

Figure 1: Overview of the time series used for bottom-dwelling fish and benthos in different marine areas (Source: Fock et al., 2025).

Results

Sensitivities can be determined both for the respective species and in aggregate form for communities.

For the sublittoral of the Wadden Sea, i.e., the permanently flooded zone in front of the tidal flats, we recorded the sensitivities to fishing and the natural dynamics of the tidal flats for 52 bottom-dwelling species. This showed a linear relationship between sensitivity to natural disturbances and that to fishing. This relationship is further modified by habitat properties, in this case sediment composition. If this influence is eliminated, a significant relationship ($p < 0.001$) between sensitivity to fishing and natural dynamics remains. This means that the better the adaptation to a dynamic environment, the better the adaptation to fishing (Fig. 2).
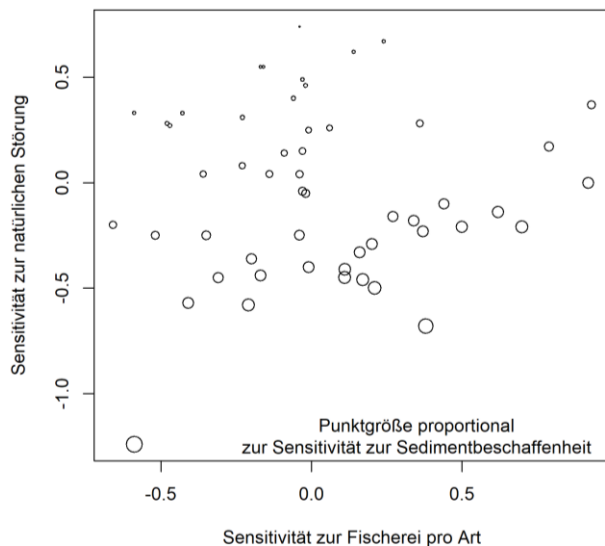
Figure 2: Sensitivity to fishing and natural habitat dynamics for 52 benthic species, German Wadden Sea (Source: Fock et al., 2025).

Conclusions

Standardization and harmonization of data are central requirements to make spatio-temporal data sets on biodiversity and its pressures interchangeable. Standardization creates consistency at the measurement level, including consistency checks within a data set. Harmonization means the standardization of data sets at the level of attribute information and metadata associated with the observations. The analysis focuses on two main drivers of diversity change: the risks of climate change and the risks of fishing pressure, as well as the associated physical disturbances of the seafloor. Both are almost ubiquitous pressures in Europe's regional seas.

We conducted a comprehensive analysis of how fishing pressure and climate change cause changes in biodiversity and community vulnerability. For marine habitats, a framework has been developed and tested to assess habitat sensitivity to climate change and fishing pressures.

At Community level, the sensitivity indices can be mapped spatially and temporally. The bottom-dwelling fish of East Greenland show a clear response to climate change. While in the period 1993-2001 subarctic species predominated ($S_{cc} < 0.5$; SCC = *sensitivity towards climate change*), species that responded positively to climate change dominated in the period 2003-2021 (SCC > 0.5). This increase was limited to certain habitats of the shelf area (Fig. 3).
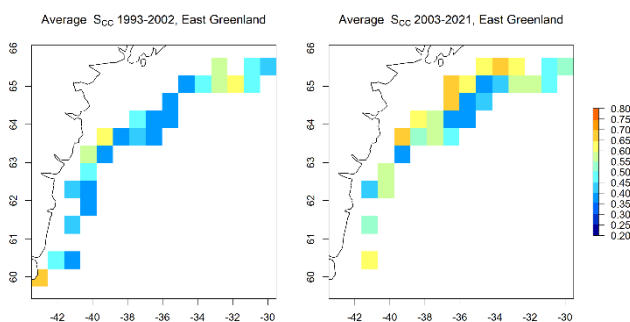
Figure 3: Changes in the climate sensitivity of the bottom-dwelling fish of East Greenland compared to the periods 1993-2002 and 2003-2021 (S_{cc} = *sensitivity towards climate change*) - (Source: Rozemeijer et al. 2025).

Further information