DNASense

From gene to landscapes: development of environmental impact assessment tools for marine biodiversity monitoring using eDNA and remote sensing techniques

DURATION
1/04/2024 – 30/06/2027

BUDGET
211 740 €

PROJECT DESCRIPTION

Over the last few decades, biodiversity has decreased across most ecosystems. Human activities can impact around 40% of marine habitats , and regional coastal ecosystems are rapidly losing populations, species, or entire functional groups. The continuous loss of marine biodiversity has detrimental consequences for ecosystem functioning, as it increases the rate of resource collapse and reduces the stability and the recovery potential of ecosystems. Long-term monitoring programs are essential to detect and understand trends, dynamics, and causes of biodiversity loss; and to predict where, when, and how biodiversity may change in the future. This understanding of the status and trends of biodiversity is critical for evidence-based resource management and conservation. This is, however, a complex task as ecological communities are spatially and temporally dynamic, with the different dimensions of biodiversity (taxonomic, genetic or functional) often being impacted by multiple anthropogenic pressures such as overexploitation, eutrophication, pollution and species introductions. Traditional methods to monitor marine biodiversity based on morphological and observational surveys have been necessary for this task, but often carry important limitations to reliably assess biodiversity trends and achieve effective management strategies. One of the most obvious challenges of traditional approaches is assessing the diversity of most microscopic communities on a relevant spatial and temporal scale. Thus, many marine monitoring programs today assess changes in biodiversity while ignoring their most diverse communities. Additionally, such methods are associated with high costs and time-consuming methods that constrain upscaling to large spatial and temporal scales and can limit the potential to detect responses to perturbations.

The primary aim of this research project is to develop a DNA-based method to identify microscopic animals present in the seafloor (the meiofauna). The goal is to construct a library of reference DNA sequences for meiofaunal organisms and use this to efficiently determine and assess the biodiversity of meiofauna. The DNASense project thus realizes practical applications from new technologies such as sequencing of environmental DNA (eDNA), but other technologies, such as satellite data will also be applied by our partners. An additional goal is to initiate overarching eDNA analyses of seabed samples from different European seas (the North Sea, Baltic Sea and Mediterranean Sea) to eventually estimate the impact of human activities on seabed biodiversity, also based on the new methods. Finally, we aim to use this information to develop novel indicators for biodiversity assessment and integrate them into existing environmental tools of use for stakeholders in environmental management and biodiversity conservation.
To achieve these aims, we will first collect reference organisms from the most common meiofauna species of the North Sea, Baltic Sea and Mediterranean Sea. Sequences of those organisms will be deposited in an international reference database of DNA sequences. Subsequently, we examine to which extent the biodiversity patterns of the meiofauna community can already be described from an artificial and from a real (complete) seabed sample using these identification tools. In the overarching analysis, we will use pre-existing eDNA datasets and associated metadata to distinguish influences of human activity on seafloor life via bioinformatics and statistical analysis.

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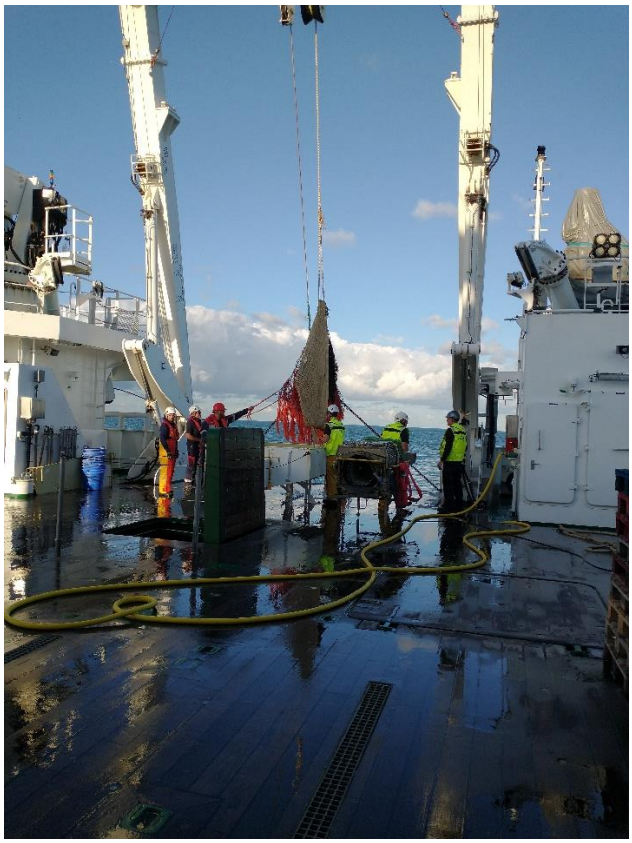
DNASense will integrate and harmonize new technologies in biodiversity assessment tools with the aim of working towards a healthy marine environment. The goals of our project in terms of policy at a global level will contribute predominantly to the UN Convention on Biodiversity. The UN has declared 2021-2030 as the Decade of Ocean Science for Sustainable Development, which highlights the importance of the outcomes of this project. By providing greater taxonomic coverage and spatial and temporal resolution of benthic monitoring data, our project will also facilitate the establishment of new indicators and develop assessment tools that will help EU member states to fulfil their Marine Strategy Framework Directive (MSFD) and Water Framework Directive (WFD) requirements. The incorporation and harmonization of eDNA protocols to monitoring also links directly to the overarching objective of the MFSD to promote regional harmonization of monitoring methods and the use of temporal and spatial data of microorganisms to assess marine environmental health.
Our project will result in important novel outcomes: 1) Mechanistic understanding of spatio-temporal trends of benthic biodiversity using eDNA data. 2) Development and evaluation of new PCR-free eDNA-based methods and standardized guidelines to monitor benthic biodiversity; 3) Establishment of new indicators for biodiversity assessment that will integrate and harmonize benthic eDNA data for microorganisms and identify ecological thresholds; 4) Integration of such indicators into BEAT, a biodiversity assessment tool used by stakeholders in the context of the MSFD and HELCOM, to obtain holistic assessments of biodiversity.



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LINKS

https://www.biodiversa.eu/2024/04/15/dnasense/