

Marine Protected Areas in Focus – The MGF Projects Are Coming to an End

For six years, the two projects “MGF-Nordsee” and “MGF-Ostsee” have intensively investigated how mobile



bottom-contact fishing (in German *mobile grundberührende Fischerei* = MGF) and its exclusion affect marine protected areas (MPAs) in the North Sea and the Baltic Sea. The projects will conclude on 28th February 2026 as part of the research mission sustainMare. During this time, we collected and analyzed numerous samples, gaining fascinating insights into our protected areas.

Within MGF-Nordsee, we spent three years establishing a baseline for the Dogger Bank (DB), Borkum Reef Ground (BRG), and Sylt Outer Reef – Eastern German Bight (SOR). We found that all three MPAs differ significantly in their abiotic and biotic characteristics. From hydrodynamics to fish communities, each protected area is unique and contributes in its own way to the overall functioning of the North Sea ecosystem. The DB is a relatively stable, offshore area with only minor seasonal variability. Benthic biodiversity there is lower than in the other two North Sea MPAs. Despite its important role as a transition, nursery, and feeding



ground, the DB has been strongly influenced by human pressures such as climate change and, until recently, MGF. The

SOR is the largest and most structurally diverse protected area. The variety in habitats results in stronger seasonal environmental variability and overall high biodiversity. The BRG is the smallest and most coastal MPA and is characterized by particularly high benthic biodiversity. It is also the only area where active restoration measures through the reintroduction of the European oyster are taking place. Traces of MGF were found in all protected areas during Phase I, but additional human pressures such as shipping routes, cable corridors, sand extraction sites, and surrounding offshore wind farms also affect the MPAs.

Phase II of the project began in March 2023, coinciding with the implementation of MGF management measures in the BRG and SOR. Since then, MGF has been fully excluded from the entire BRG. In contrast, MGF measures in the SOR are spatially heterogeneous; however, the Amrum Bank within the SOR represents the only area where fishing is completely prohibited. In

Phase II, we investigated first effects of MGF exclusion and intensively tested new, non-invasive monitoring methods. In the epifaunal communities of the Amrum Bank, initial effects of fishing exclusion became apparent: biodiversity remained stable in closed areas, while it declined in areas that continued to be fished.

allow the first observed changes in benthic communities to be evaluated. The coming years will be especially important, as parts of the investigations will be continued within new projects.

Recording entire benthic communities in the protected areas – from microorganisms to demersal fish – has resulted in one of the



Figure 1: Confocal laser scanning microscopy images of the three described species (different scales), dorsal, lateral, and ventral views. Left: new genus and species *Monopenicillus anke* (George et al. 2023). Center: *Enhydrosoma sarsi* (Kunze et al., in revision). Right: *Huntemannia jadensis* (image source: Larissa Brkan).

Non-invasive monitoring approaches such as biodiversity assessment using eDNA and imaging techniques proved to be promising alternatives for long-term monitoring. However, they cannot fully replace conventional methods, making continued methodological comparison necessary.

At the same time, MGF-Ostsee focused on the specific challenges and communities of the Baltic Sea MPAs Fehmarn Belt and Pomeranian Bay–Rønne Bank. While fishing continued in the study areas until November 2024, we were able to carry out essential baseline work and achieve methodological advances. Because the EU decision to exclude bottom-contact fishing in parts of these MPAs only came into force in autumn 2024, surveys conducted in 2025 were particularly exciting. Comparisons with similar reference areas outside the MPAs

most comprehensive pictures of benthic biodiversity ever achieved for the Baltic Sea. For microorganisms such as bacteria, protists, and meiofauna, these were in some cases the first studies conducted in these areas, leading to the description of numerous new taxa and ecological functions. The combination of molecular techniques and morphological approaches was crucial. For protists (heterotrophic flagellates, ciliates, amoebae), the development of a distinct brackish-water community was demonstrated. For meiofauna, it became possible to identify even morphologically difficult specimens, and the first comprehensive morphological–genetic reference library for Baltic Sea harpacticoid copepods was established. In addition, 25 harpacticoid species were added to international reference databases, and one new genus and

one new species (*Monopenicillus anke*) were described (Fig. 1). For sediment bacterial communities, it was shown, among other things, how key functions such as sulfate reduction develop across different sediment types and salinity regimes. This knowledge is essential for assessing the impacts of seabed disturbance caused by bottom trawling.

Further development of non-invasive monitoring methods (underwater video, eDNA) also produced promising results in the Baltic Sea. For example, eDNA analyses enabled a qualitative assessment of fish communities that closely matched results from conventional fishing methods. Whether these approaches can also be used for quantitative assessments in the future is currently being discussed in a joint working group involving both MGF projects.

In addition to time-series observations in the MPAs, a large-scale, three-week field experiment was conducted off Kühlungsborn in July 2024 to better understand the immediate and short-term effects of bottom trawling on sediments and benthic communities. Led by the IOW, four research vessels – Alkor (GEOMAR, Kiel), Clupea (Thünen Institute of Baltic Sea Fisheries), Limanda (University of Rostock), and Elisabeth Mann Borgese (IOW) –

participated in the experiment (Fig. 2). During a trawling operation by the Clupea, sediment resuspension was sampled and quantified using various methods.

The effects on benthic communities and biogeochemical processes were monitored for approximately three weeks, allowing potential regeneration processes to be observed. For the first time, research divers were able to specifically sample trawl-induced changes in seabed morphology such as trawl marks. Initial results show that various biogeochemical processes and material fluxes are altered in the impacted area and that the vertical structure of sediment communities changes. Such experiments are an important complement to MPA monitoring, as they capture effects that might otherwise be overlooked, including sediment redistribution, release of substances from sediments, and short-term damage to benthic organisms.

A detailed overview of all results and findings from the MGF-Nordsee and MGF-Ostsee projects will be presented at the final conference held from 14th to 15th January 2026 in Bremerhaven. However, although the MGF projects are coming to an end, management measures and developments in the MPAs will continue.



Figure 2: Schematic illustration of the trawling experiment conducted in July 2024 to investigate acute and short-term impacts of bottom-contact fishing. The four participating research vessels and their respective roles are shown: from right to left, Clupea (Thünen Institute of Baltic Sea Fisheries), Elisabeth Mann Borgese (IOW), Alkor (GEOMAR, Kiel), and Limanda (University of Rostock). (Image source: Thünen Institute, A. Schütz)

For example, MGF regulations for the Dogger Bank only entered into force in November 2025. We are eager to see how North Sea and Baltic Sea ecosystems will develop in the future and are confident that marine protected areas will continue to play a central role in future research projects.

Since fishing activities have been restricted in Germany's marine protected areas like the Sylt Outer Reef (southern North Sea), scientific monitoring must also rely on less invasive methods to replace the traditional bottom contacting fishing techniques. In spite of the challenging imaging conditions at the Sylt Outer Reef (SOR), excellent results have been achieved for automatic detection of *Asterias rubens* using a standard YOLOv8 model fine-tuned to domain-specific data.

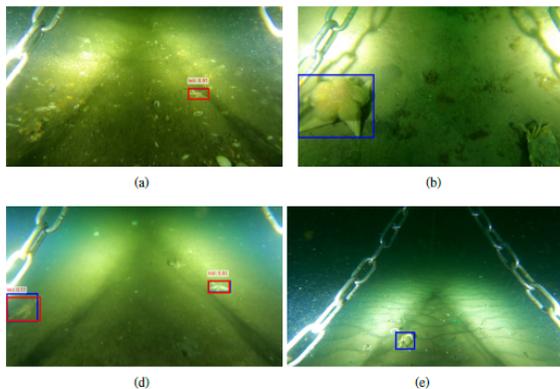


Figure 3. Example detections (from the test folds) of the SOR-922-AR-4CV dataset. The first column (a,d) contains correct detections (TP) of *Asterias rubens*. GT bounding box in blue and predicted bounding box in red) with intersection over union (IoU) values, the second column (b,e) missing detections (FN, blue GT).

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iSeal: Pathways Toward Unified Fish Monitoring in the Wadden Sea

A recent expert workshop organized by the iSeal project of the German Marine Research Alliance (DAM) has brought together specialists from Denmark, Germany, and the Netherlands to explore ways to harmonize fish-monitoring programs across the entire Wadden Sea region. Held at the "Seeburg" of Kiel University (CAU) on 6 and 7 November 2025, the meeting gathered around 25 experts from research institutions, governmental agencies, and nature conservation organizations. Their primary goal was to systematically compare existing monitoring approaches and develop perspectives for better coordination. Currently, national programs differ significantly in methodology, spatial coverage, and institutional frameworks, which complicates joint assessments and conservation measures.

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Currently, national programs differ significantly in methodology, spatial coverage, and institutional frameworks, which complicates joint assessments and conservation measures. According to co-organizer Dr. Katja Heubel, head of the Coastal Ecology Group at the Research and Technology Center West Coast (FTZ), stronger harmonization of sampling and analytical methods would greatly improve the reliability of long-term ecological assessments and evaluations of fish-community status in the Wadden Sea. The workshop therefore focused on identifying how existing datasets can be used more effectively to develop indicators and metrics relevant for ecosystem management and species protection. At the same time, participants sought to detect knowledge gaps and discussed how future monitoring and research efforts can better address the needs of applied conservation.

Co-organizer Dr. Claudia Günther of FTZ Büsum emphasized that the workshop not only strengthened dialogue between science and practice but also strived to identify concrete steps that can enhance the protection of the Wadden Sea and its ecosystems. The group will develop science-

based recommendations for unifying methodological standards and improving data integration, along with proposals for intensified international cooperation.



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The workshop is one of two expert-workshops on the Wadden Sea fish community in the iSeal project, which is part of the sustainMare research mission of DAM, funded by the Federal Ministry for Research, Technology, and Space as well as five northern German federal states. iSeal examines how climate change, fisheries, and invasive species impact coastal ecosystems in the three Wadden Sea national parks. A core element of the project is knowledge transfer, promoting exchange among researchers, policymakers, and conservation practitioners.

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CONMAR: On board of the RV Alkor: Searching for traces of dumped marine munition in the Baltic Sea

From 14 to 29 October 2025, a further munitions research expedition was conducted with the research vessel Alkor (AL642). During the first stage, the northeast Bornholm dumping area for chemical munitions was investigated. The two AUVs, "Abyss" and "Albert", were used to map large parts of the officially designated dumping area. As the seabed here consists of homogeneous soft sediment, 'hard' structures could be clearly identified in the backscatter data.

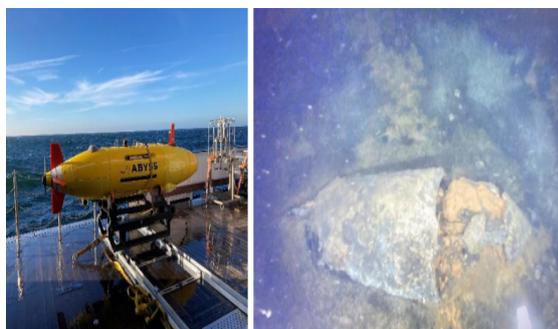


Fig. 4: AUV Abyss on the deck of the ALKOR (left) and chemical warfare agent in the Bornholm Basin (right)

This was confirmed by ROV dives, which revealed that the detected objects were bombs, some of which were heavily corroded. Often, only the tail fins of 250 kg bombs are visible, along with yellowish/orange chunks of encapsulated warfare agents such as mustard gas.

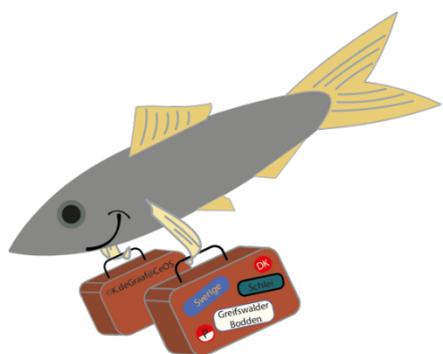
But isn't mustard gas dangerous? Yes, of course – it is a chemical warfare agent – but mustard gas quickly breaks down into non-toxic substances once released (half-life of 15 min).

After four successful days, the ALKOR had to seek shelter in Rønne on Bornholm. The reason was that a storm front passed over the work area, making it impossible to work with AUVs and ROVs on deck. Once the storm had passed, the AUV 'Abyss' was deployed for another 20-hour overnight dive, during which a CTD grid was sampled across the entire Bornholm Basin to evaluate potential contamination with TNT and other explosives. The AUV 'Luise' then used photogrammetry to explore clusters of bombs. At the same time, 'Luise' used magnetic surveys to investigate whether larger munitions were buried in the sediment. Initial viewing of the photos shows heavily corroded munitions. These images are currently being processed into a photomosaic and a DTM (digital terrain model). On the way back, there was a brief stop at the Nord Stream 1 pipeline blast site. The environmental conditions on site were documented there, three years after the blast. During the second week, the impact of the pilot clearances in August this year on the marine environment was investigated in the Bay of Lübeck.

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SpaCeParti: It's best at home – herring return to their birthplaces to spawn

In times of increasing human intervention in guaranteed. A study conducted as part of the SpaCeParti -1 project has now been published in the renowned journal Science Advances and, using a combination of otolith microchemistry – otoliths are calcareous



crystals in the inner ear of fish – and genetics, it has been shown for the first time that herring do not come to the coast indiscriminately to spawn in spring, but that 56–73% of them migrate back to the areas where they themselves hatched (natal homing). Stray individuals from other areas are ‘adopted’ by the shoals along the migration routes and ensure that the gene flow between the subpopulations is maintained, confirming the long-suspected metapopulation concept of Atlantic herring. In view of increasing anthropogenic influences, this study highlights the need for targeted coastal zone management to ensure productive ecosystems and thus sustainable fisheries in the future.

More information in the publication:
<https://doi.org/10.1126/sciadv.adz6746>

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Fishermen test sugar kelp cultivation – real-life experiment in Marina Wendtorf

One result of the vision workshop with stakeholders from the Stein-Wendtorf real-world laboratory is the real-life experiment ‘Marina Wendtorf Sea Garden’. The group's concerns were summarised in this project by combining the desire to do something positive for the ecology of the local waters of the Baltic Sea and to test other sources of income for local fishermen. After co-designing the experiment structure and its content and searching for project partnerships in spring and summer 2025, Kieler Meeresfarm was acquired as an experienced partner. At the end of November, on a cold winter's day, the first test field was laid out in Marina Wendtorf. Sugar kelp will grow on 150 metres of rope, which will hopefully be harvested with a good yield next April. Another part of the experiment is to test local applications and consumption options for the seaweed.



Fig. 5: Sugar kelp seedlings are transferred from a germination roller to a support rope that floats on buoys below the water surface.

Photos: K.deGraaf@CeOS

CREATE - Exchange with the BSH on the further development of the SeeSurface classification software

In the spirit of the transfer of scientific products, a meeting with several departments of the Federal Maritime and Hydrographic Agency (BSH) took place in September 2025, at which the AI-based classification and detection software *SeeSurface* developed in CREATE was presented.

During the event, which lasted several hours, the core functions of the software were demonstrated to a larger audience of experts for the first time and optimization approaches were discussed in concrete terms. *SeeSurface* enables the standardized and efficient evaluation of hydroacoustic area data – from pre-processing to classification algorithms to object recognition. In this way, the software addresses central requirements that are required of the responsible institutions, especially in the context of the MSFD-relevant monitoring tasks for seafloor mapping and assessment.

The feedback from the BSH was extremely constructive. Many responses related to very specific requirements from official practice, in particular the support of multi-level classification and the consideration of different data types. The ability to simultaneously evaluate multiple backscatter mosaics as well as bathymetry data and derived parameters has been integrated into the software since the meeting in

September and now represents a significant enhancement for use in monitoring and evaluation processes.



Fig. 6: Presentation of *SeeSurface* at BSH on 03.09.2025
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The event made it clear how important the close dialogue between science and the responsible planning and approval authorities is, especially when new tools are not only to be scientifically convincing, but also to be directly incorporated into official processes. By jointly discussing the possibilities, limitations and areas of application of *SeeSurface*, a basis was created to adapt the software precisely to the needs of the stakeholders and to further increase its future usability.

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Shaping Coastal Futures volume II: First Annual Meeting Held in Hamburg

From 24–26 November 2025, the partners of CoastalFutures Phase II, part of the DAM Research Mission “sustainMare”, met for their first annual meeting at the Hayloft Hamburg. The project consortium was joined by representatives of the **Project Management Agency Jülich (PtJ)** and associated partner institutions - **DAW, BSH, DDA, BfN, and BAW**.

Workshops and sessions addressed key topics for the future of coastal and marine management, including **OWF planning, underwater noise, cumulative effects, MPAs, legal frameworks, climate adaptation strategies, coastal and sediment transport, and fisheries** and their ecological interactions. Cross-cutting discussions focused on **model integration, scenarios, ecosystem services** and **data harmonisation**.



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The meeting highlighted the importance of close collaboration between science, authorities, practitioners and the funding agency to support sustainable and resilient development of Germany’s coastal regions.

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MGF-Ostsee & MGF-Nordsee Final Conference: 14th –15th January 2026

From the 14. to the 15. January, the two project partners, MGF- Nordsee and MGF- Ostsee attended their final Conference meeting in Bremerhaven. During the meeting, representatives of the work packages presented an overview of the main outcomes of their work from the Six-Year MGF projects, which investigate the effects of the exclusion of mobile bottom-contacting fisheries in Marine Protected Areas of the German EEZ of the North Sea and the Baltic Sea.

The sessions covered several work packages, including: **Sediments, Biogeochemistry, Microbiology, Meiofauna, Fish and Fisheries, Modelling, and New Monitoring Methods**.



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