Policy Brief

Baltic Sea Centre

Stockholm University

Safeguard ecosystem function and carbon storage capacity in deep soft bottoms

Deep soft bottoms are of vital importance for the functioning of the whole marine ecosystem and for long-term carbon storage. These functions may be reduced when the bottoms are trawled for commercial fishing and during seabed mining. Still, these habitats are often overlooked when outlining marine protected areas and restricting fisheries and exploitation. EU Member States must better protect deep soft bottoms in the Baltic and North Sea.

POLICY RECOMMENDATIONS

- Member States must better protect deep soft bottom areas in the Baltic and North Sea as they are important for the functioning of the whole marine ecosystem and for carbon storage.
- There is a need for clear legal guidance on the Member States' possibilities to adopt fisheries regulations to protect the seafloor, both within and outside marine protected areas within the exclusive economic zones.
- Member States should develop methods to assess and predict the impacts of deep-sea mining on ecosystem function and carbon storage to be able to better regulate these industries. Any allowed activity and method should minimise disturbances.

Hardly anyone has seen them, the muddy seafloors that lie at depths with permanent darkness. These constitute a large part of the Baltic and North Sea ecosystems and they are not considered particularly valuable by humans. Nowadays, a large proportion are labelled dead, or rather anoxic (oxygen-free), with bacteria as the only sign of life. But regardless of this, these dark habitats, in this policy brief referred to as deep soft bottoms, should be recognised for providing important ecosystem services.

The role of benthic ecosystems for marine life

Benthic ecosystems are the ones based in and on the seafloor. They constitute an important link between the overlying water and the sediment and most species in the water column are in one way or the other reliant on the functioning of these systems. Besides being important food sources for several commercial species like flatfish and cod, benthic fauna and microorganisms metabolise organic matter, breaking it down into smaller components and releasing carbon dioxide and nutrients to the water. This service fuels the whole marine ecosystem and plays a crucial role in carbon and nutrient recycling. Larger sessile (immobile) species stabilise the seafloor. Sediment-living fauna create tubes and burrows, and increase the habitat's structural variation, which is linked to higher biodiversity in general. Burrowing, feeding or motion in the sediment, also moves particles and substances such as oxygen, nitrate, ammonium, phosphate, oxidised iron and manganese minerals around in the seafloor. This mixing enhances the exposure of organic matter to oxidation and increases organic carbon degradation. In addition, calcifying seafloor fauna such as bivalves leave behind carbonate particles in the sediment after they die. These can dissolve and provide calcium and magnesium that are essential for the formation of new shells and skeletons for marine organisms, including fish, molluscs and crustaceans.

Deep soft bottoms of the North Sea harbour fascinating species such as brittle stars and sea pens.

Photo: Volker Brüchert

WHAT ARE DEEP SOFT BOTTOMS?

Aphotic soft bottoms, in this brief referred to as deep soft bottoms, are areas below the depth to which light can reach and are covered by fine-grained sediments - silt and clay. In the Baltic and North Sea, these sediments have been deposited since the last glacial period 12 000 years ago and cover an area of approximately 37 per cent of the Baltic Sea and about 19 per cent of the North Sea. The sediments have mainly been deposited in the deeper basins, where water movements from currents are relatively low. These sediments are characterised by high organic carbon concentrations, 1.5-2 per cent organic carbon by weight.

The deep soft bottoms, in orange, cover a vast area of the North Sea and Baltic Sea. Map information is based on EUSeaMap 2023 Broad-Scale Predictive Habitat Map for Europe, by EMODnet Seabed Habitats.

The role of deep soft sediment in the carbon cycle

Marine sediments are the world's largest reservoirs of organic carbon and an important component of the carbon cycle. The top metre of sediments globally harbours a carbon stock of 2322 gigatonnes which equals nearly twice that of terrestrial soils. In shallow and warmer soft bottoms, most of the carbon is quickly degraded by microorganisms. But in places where sedimentation and burial rates are faster than mixing and degradation rates, soft sediments are long-term sinks for carbon. Degradation rate and fate varies depending on location, oxygen content and sediment type. In the presence of oxygen, organic matter is generally oxidised to dissolved carbon dioxide that leaves the sediment, becomes consumed by phytoplankton and returns back into the food web. However, in deeper layers under anoxic conditions and in bottoms covered by anoxic waters, where species numbers and diversity are low, permanent carbon storage is high.

Although organic carbon can be microbially converted to methane under anoxic conditions, only a fraction of this is normally released as gas bubbles from deep waters to the seawater and atmosphere. In the Baltic Sea, 90 per cent of the soft bottom deposits are covered by anoxic bottom waters, which makes them a substantial marine carbon sink. In the North Sea, around 40 per cent of the deep soft bottoms are anoxic.

BOTTOM TRAWLING IN THE BALTIC AND NORTH SEA

The Western Baltic and the North Sea are among the most trawling intense areas of the world. Assessments conclude that the regional swept area ratios were among the top 6 of 24 global sea areas assessed for the years 2010-2013. In these basins, around half of the trawled areas were also trawled more than once a year, some as often as 10 times a year (along the edge of the Norwegian trench in the northern North Sea and Skagerrak-Kattegat). The North Sea is mainly bottom trawled for Norway lobster, shrimp, saithe and haddock but also for sand eel and Norway pout for the fish meal and oil industry. In the Baltic Sea, target species are mainly flatfish, as trawling for cod is currently banned to protect the endangered population.

Impacts of bottom trawling on marine life ...

Bottom trawling directly impacts benthic species as the fishing gear physically harms the organisms, removes biomass and disrupts habitats. This is detrimental to large, sessile, long-lived species. Over time bottom trawling favours small, short-lived, opportunistic species or mobile species and deep burrowers that can avoid the fishing gear. Bottom trawling also displaces, mixes, and suspends sediments and changes the physical properties of the seabed, for instance by disrupting its three-dimensional structures and changing grain size and water content of the sediment. The suspended sediment can spread kilometres away and stay in the water column for days. When the sediment settles again it can bury or suffocate filter-feeding species such as sponges and mussels and potentially impair reproduction of fish species. Overall, changes in species composition can affect interactions between organisms and sediment and thus the seabed's ability to recirculate carbon and nutrients to the whole ecosystem is reduced.

... as well as on carbon storage and climate gas release

Repeated bottom trawling disturbance and re-suspension of sediments re-exposes organic carbon to degradation by microorganisms, which likely disrupts long-term carbon storage. But although rapid changes in the sediment and nutrient release to the water have been observed within hours to days after bottom trawling, potential long-term impacts on climate-active gas release are not well understood and will depend on the frequency and type of fishing, how deep the gear penetrates the sediment, the type of sediment (e.g. muddy or sandy), type of carbon material (e.g. carbonate shell fragments or freshly deposited spring bloom material), environmental conditions, and season (e.g. oxygen content, current speed, pelagic primary productivity, sediment deposition rates). It is also uncertain how much of the carbon dioxide released from the bottoms will actually reach the atmosphere. Early regional and global estimates of fisheries-induced impacts on carbon storage and degradation have not accounted for these uncertainties and have likely overestimated the risk for large-scale release of climate gas release due to bottom trawling. Still, given that such large areas are exposed to bottom trawling, it is important that the risk for carbon and climate gas release from this fishery is considered in fisheries management. That requires further research to improve the knowledge of these processes at appropriate temporal and spatial scales.

Seabed mining – a new threat

Seabed mining involves removing or disturbing the upper layers of sediment to extract minerals such as polymetallic nodules. In light of the growing demand for rare earth elements, seabed mining could become a major industry. The effects on benthic organisms are similar to those experienced and documented by bottom trawling. As with bottom trawling, these physical effects also disrupt essential biogeochemical gradients, and potentially reduce the sediment's role as a carbon sink. Because of its potentially far-reaching impacts, there is a need for robust methods to assess and predict effects of deep-sea mining on ecosystem function and carbon storage before scaling up. Member States must balance the need for metals with the risk of undermining marine ecosystems. If it is to be allowed, methods need to be developed to minimise effects.

Is the recovery of anoxic bottoms a climate risk?

Anoxic conditions in the seabed promote carbon storage - does this mean that the restoration of these bottoms carries a risk of unwanted greenhouse gas emissions from the sea into the atmosphere? There is little research on how carbon dioxide emissions are affected when deep soft sediments become oxic, but the global impact is likely to be small due to the small area of anoxic seabeds worldwide. Their current contribution to total sediment carbon sequestration is estimated to be less than 5 per cent. The risk of increased local and temporal release of carbon dioxide must be weighed against the huge benefits for biodiversity and ecosystem function, such as opening up habitats for threatened species, improving feeding grounds for fish, and enabling efficient circulation of nutrients between sediment, pore water and fauna.

CARBON STORAGE AND EFFECTS OF SEAFLOOR DISTURBANCE

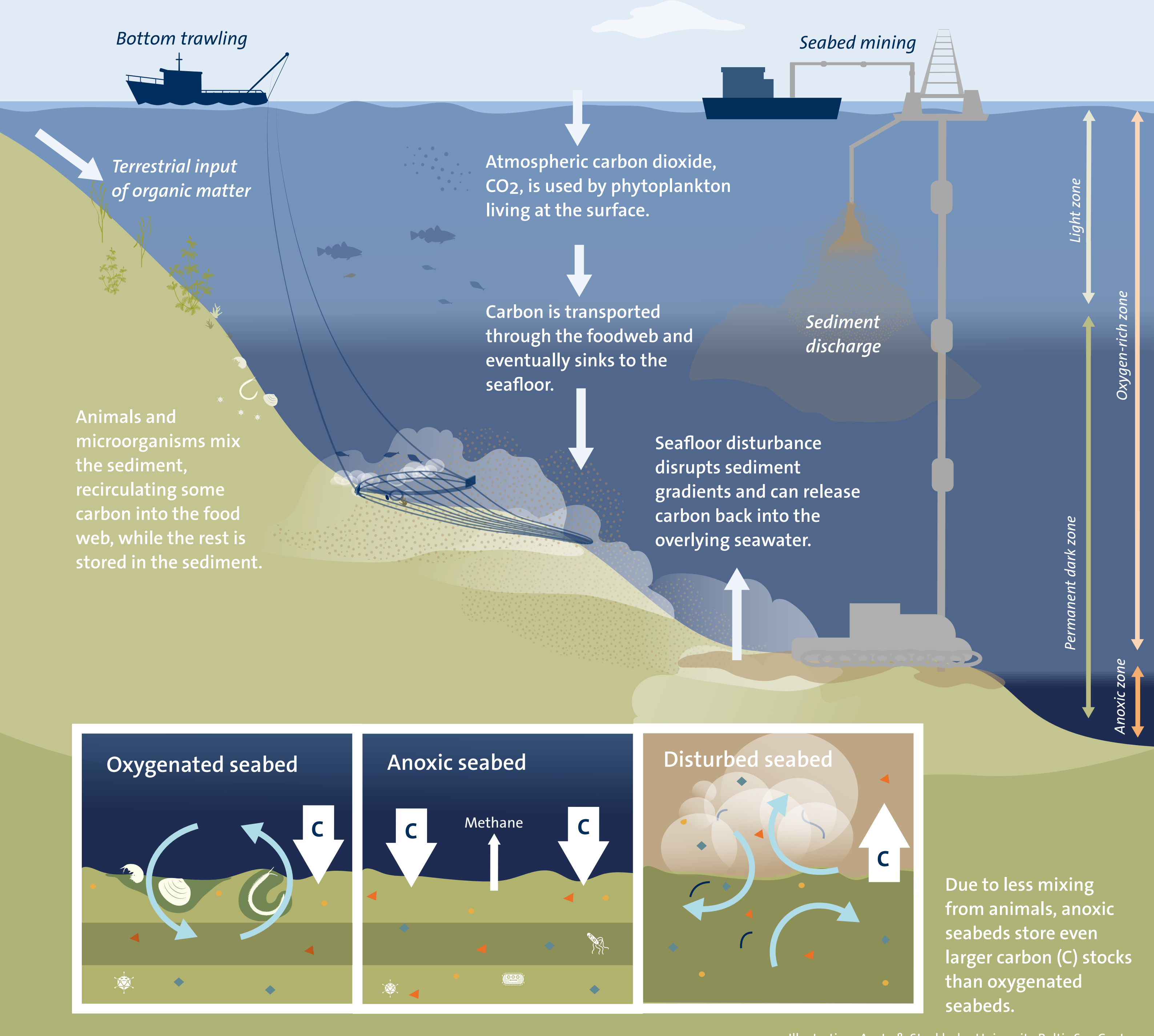


Illustration: Azote & Stockholm University Baltic Sea Centre

The legal protection of deep soft bottoms

The EU Marine Strategy Framework Directive

The need to protect ecological functions of marine habitats is recognised in the EU Marine Strategy Framework Directive, which requires Member States to keep seafloor integrity at a level that safeguards the structure and functions of the ecosystems (in order to achieve good environmental status, GES). The agreed guidelines stipulate that no more than 25 per cent of any bottom habitat should be adversely affected by human activities, with irreversible losses limited to 2 per cent. To achieve GES, Member States must adopt programs of measures which shall also include spatial protection measures (article 13.4). The directive does not exclude measures related to fish stocks and fisheries. However, the directive leaves considerable room for Member States to decide what measures to adopt.

The Nature Restoration Regulation

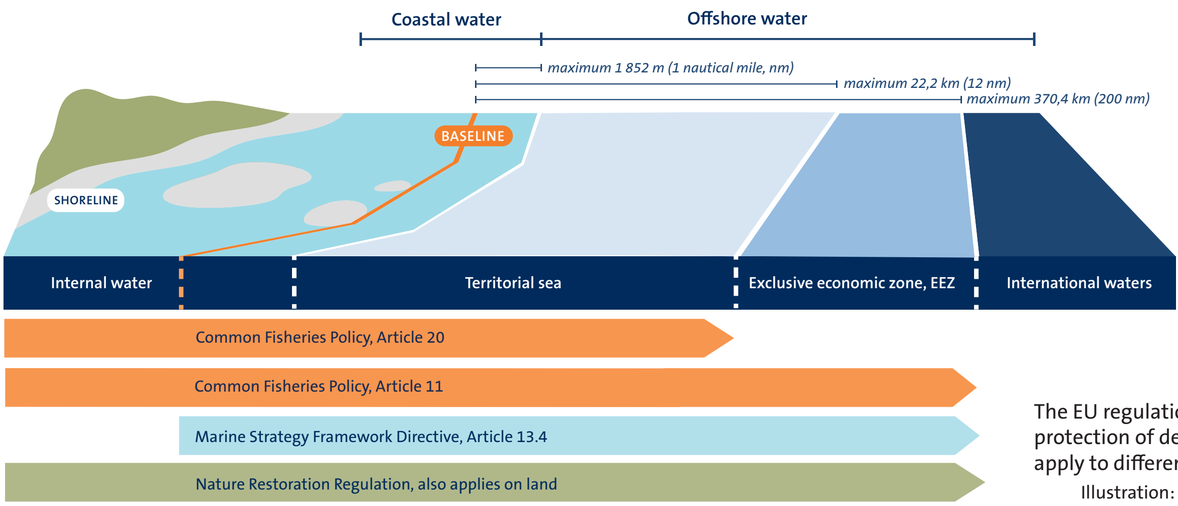
The new EU Restoration Regulation lays down rules to contribute to the long-term and sustained recovery of biodiversity and resilient ecosystems across Member States' land and sea areas through restoration of degraded ecosystems. It requires Members to develop national restoration plans and adopt measures to restore habitats, to a good condition, also in coastal and other marine waters. By 2030, restoration measures for coastal and marine waters shall be put in place, on at least 30 per cent of the total area of all listed habitat types (then 60 per cent by 2040 and 90 per cent by 2050). The plans should include a timeline for implementation, the financial resources needed as well as expected benefits for climate change adaptation and mitigation.

The Common Fisheries Policy

According to The Treaty on the Functioning of the European Union (TFEU), the EU has exclusive competence (i.e the legal power) when it comes to the management and conservation of marine biological resources under the common fisheries policy. However, some competence to regulate fisheries has been delegated back to Member States. Within 12 nautical miles from the baseline Member States are allowed to adopt fisheries measures to maintain or improve the conservation status of marine ecosystems, including prohibitions or restrictions on the use of certain fisheries techniques, such as bottom-trawling in territorial waters, under certain conditions (article 20, 1380/2013). When it comes to regulating fisheries in the exclusive economic zone, Member States are only allowed to adopt or initiate fisheries measures that are necessary to reach certain obligations following from nature conservation legislation. This also includes measures necessary to comply with the obligations to adopt spatial protection measures to ensure a coherent and representative (diverse) networks of marine protected areas (article 11, 1380/2013). Measures that impact other Member States' fisheries, must however be adopted by the Commission. One example of where the Commission has previously accepted and adopted a bottom trawling ban on soft bottoms in Member States' exclusive economic zones, is the Bratten area on the Swedish West Coast 2017. This was in order to fulfil obligations under the OSPAR convention.

Way forward for better protection

The protection of deep soft bottoms are essential to conserve marine biodiversity and enhance carbon sequestration efforts. As large areas of the seabeds are exposed to bottom trawling, it is important that fisheries management takes into account the risk of carbon and greenhouse gas releases. Similarly, because of its potentially far-reaching impacts, there is a need for better assessment and prediction of seabed mining effects on ecosystem function and carbon storage before it is scaled up. Recognising the ecological importance and carbon storage potential, as well as prioritising the conservation of these habitats will safeguard their ecological services, support climate change mitigation and contribute to the sustainable management of marine resources.



The EU regulations concerning protection of deep soft bottoms apply to different parts of the sea.
Illustration: Elsa Wikander/Azote

BRIDGING THE GAP BETWEEN SCIENCE AND POLICY

At the Baltic Sea Centre, scientists, policy analysts and communication experts work together to bridge the gap between science and policy.

We compile, analyse and synthesise scientific research on Baltic Sea related issues and communicate it at the right moment to the right actor.

This Policy Brief was published April 2025.

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