Europe's seas and coasts

Multiple pressures and their combined effects in Europe’s seas

Europe’s seas are overexploited. Most of Europe’s marine area (93 %) is under multiple pressures from human activities, which have reached the most remote areas. The EU’s maritime economy will not be sustainable unless it is confined to the current ecological limits of marine ecosystems. That means decoupling human activities on land and sea from the degradation and depletion of marine ecosystem capital. This briefing summarises a spatial assessment of the multiple pressures on Europe’s seas (ETC/ICM, 2019a).

Key messages

The target of achieving good environmental status of European marine waters by 2020 will not be met in relation to key pressures such as contaminants, eutrophication, invasive alien species, commercial fish and marine litter.

The most extensive combined pressure effects were detected in the coastal and shelf areas of the North Sea, parts of the Baltic Sea, the Adriatic Sea and the western Mediterranean Sea. All of these areas are under several anthropogenic pressures from pollution, physical loss and disturbance due to intensive fishery and coastal activities. Major data gaps in the assessment were identified in the Mediterranean and Black Seas.

The combined effects of multiple pressures on marine species and habitats reduce the overall resilience of marine ecosystems. This is aggravated by climate change-related systemic changes that further erode marine ecosystems' resilience.

Regional cooperation to reduce specific pressures has been implemented consistently in some places and has worked, for example, by decreasing levels of nutrients and selected contaminants or limiting introductions of new non-indigenous species.

Sources: EEA (2019a); ETC/ICM (2019a)

This briefing summarises the first spatial assessment of multiple pressures from human activities and their combined effects at the scale of Europe's seas: the North-East Atlantic Ocean, the Baltic Sea, the Mediterranean Sea and the Black Sea. The assessment, by the EEA and its European Topic Centre on Inland, Coastal and Marine Waters (ETC/ICM), uses the indicative list of ecosystem elements and human activities and their associated anthropogenic pressures in Annex III of the Marine Strategy Framework Directive (MSFD; EU, 2008a), which is the main EU legislation for marine environmental protection.

The pressures assessed include the extraction of living and non-living materials; pollution by nutrients, chemicals, underwater noise and litter; sea floor disturbance; and introduction of non-indigenous species. In addition, climate change-related impacts, including ocean warming and acidification and oxygen depletion, are addressed, as these impacts erode marine ecosystems'

resilience and increase the sensitivity of ecosystems to other pressures (EEA, 2019a; ETC/ICM, 2019a).

The assessment of the cumulative effects from (all) human activities at sea and on land is a requirement of the MSFD. This knowledge is needed to build a solid base for managing human activities in the marine environment and achieving the MSFD's 'good environmental status' objective. This knowledge is also needed for decision-making in the context of the spatial planning of human activities at sea in accordance with the EU Maritime Spatial Planning Directive (MSPD; EU, 2014; EEA, 2019a; ETC/ICM 2019a).

To achieve sustainability, human activities in the marine environment should be managed from an ecosystem-based perspective (Box 1). This would also support the European Green Deal's (EC, 2019) aim of making the EU's economy sustainable — among other things, climate neutral. The focus of the Green Deal includes combating climate change; the conservation and restoration of biodiversity; making farming, fishing and aquaculture sustainable; and achieving a toxin-free environment, through the zero-pollution ambition, improved chemical regulation, and a circular economy (EC, 2019).

For more details, see EEA, 2019a and ETC ICM, 2019a.

Box 1 Ecosystem-based management in Europe's seas

Ecosystem-based management is an integrated approach to management that considers the entire ecosystem, including humans as part of it. The goal is to maintain ecosystems in a healthy, clean, non-toxic, productive and resilient condition, so that they can continue to provide humans with the services and benefits upon which we depend, and to ensure the protection of these ecosystems. It is a spatial approach that builds on (1) acknowledging connections, (2) combined effects, and (3) multiple objectives, rather than a traditional approach that addresses single concerns, e.g. species, habitats, sectors, activities and individual national interests.

Sources: Adapted from McLeod and Leslie (2009), EEA (2015) and EEA (2019a).

Assessing the pressures and their effects

The assessment of multiple pressures and their combined effects in Europe's seas is based on an analysis of the spatial distribution of human activities on land and at sea and of the pressures they cause (Box 2). The analysis uses data from the period 2011-2016 (ETC ICM, 2019a).

Box 2 Method for assessing multiple pressures and their combined effects on Europe's seas

The combined effects of multiple marine pressures assessed here represent their **potential** combined effects, as the actual realised impacts are often defined by local characteristics and are very dynamic in time. The approach chosen indicates the relative pressure risk in the marine areas assessed and should not be a substitute for state assessments of those areas.

The combined effects assessment method consists of (1) mapping human activities, (2) describing their pressures in a spatial context, (3) mapping ecological elements, i.e. species and habitats, (4) describing their sensitivity to the set of pressures, and (5) combining the information to establish the connections needed to inform management. The assessment method is described in full in ETC/ICM (2019a).

We stress that one of the steps in assessing cumulative effects — the term used in Article 8 of the Marine Strategy Framework Directive — is to study the synergistic and antagonistic effects from different pressures. Current knowledge of synergistic and antagonistic effects is still incomplete at the level of Europe's seas, and it has not been feasible to assess these effects so far. This is why our assessment uses the term **combined effects** instead of **cumulative effect**.

Sources: ETC/ICM (2019a); Halpern et al. (2008); de Vries et al. (2011); Coll et al. (2012); Korpinen et al. (2012); Andersen et al. (2013); Micheli et al. (2013); van der Wal and Tamis (2014).

The assessment of the combined effects of multiple pressures in Europe's seas from (all) human activities (Figure 1), from activities on land (Figure 2) and from activities at sea (Figure 3) shows the following.

Pressures from human activities are widespread across Europe's marine area (Figure 1, top) and there is hardly any part of Europe's marine area that is not affected by at least two anthropogenic pressures (ETC/ICM, 2019a) . The most widespread pressures identified in the assessment relate to (1) pollution by contaminants, (2) fishing (including extraction, bycatch and sea floor damage), and (3) underwater noise, nutrient enrichment and non-indigenous species (Figure 1, bottom left). Climate change-related impacts, including ocean warming and acidification and oxygen depletion, were addressed, as these impacts erode marine ecosystems' resilience and increase the sensitivity of entire marine ecosystems to other pressures, but were not included in the ranking of pressures (EEA, 2019a; ETC/ICM, 2019a).

There are differences in the intensity of pressures, depending on the distance from shore, because coastal areas and the continental shelf are generally under much greater pressure than offshore areas due to pressures from activities on land (Figure 2) and at sea (Figure 3). The most extensive combined pressure effects were detected in the coastal and shelf areas of the North Sea and in parts of the Baltic and Adriatic Seas (Box 3). Spatially less extensive but also high combined effects were found in the narrow shelf areas of the western Mediterranean Sea (EEA, 2019a; ETC/ICM, 2019a).

The potentially worst affected ecosystem elements are fish and marine mammals (Figure 1, bottom right). Seabed habitats are affected by a wide range of targeted activities (e.g. bottom trawling or extraction of minerals) and indirectly by other fishing practices. Abrasion by shipping and other human activities in shallow water areas also cause seabed disturbance. In addition, climate change-related systemic changes further erode marine ecosystems' resilience. (For more details, see ETC/ICM, 2019b)

There are gaps in the data needed to assess all the pressures, especially in the Mediterranean and Black Seas, but despite that the assessment provides a robust overview of the pressures in Europe's marine areas (ETC/ICM, 2019a).

Box 3 Areas under highest potential combined effects

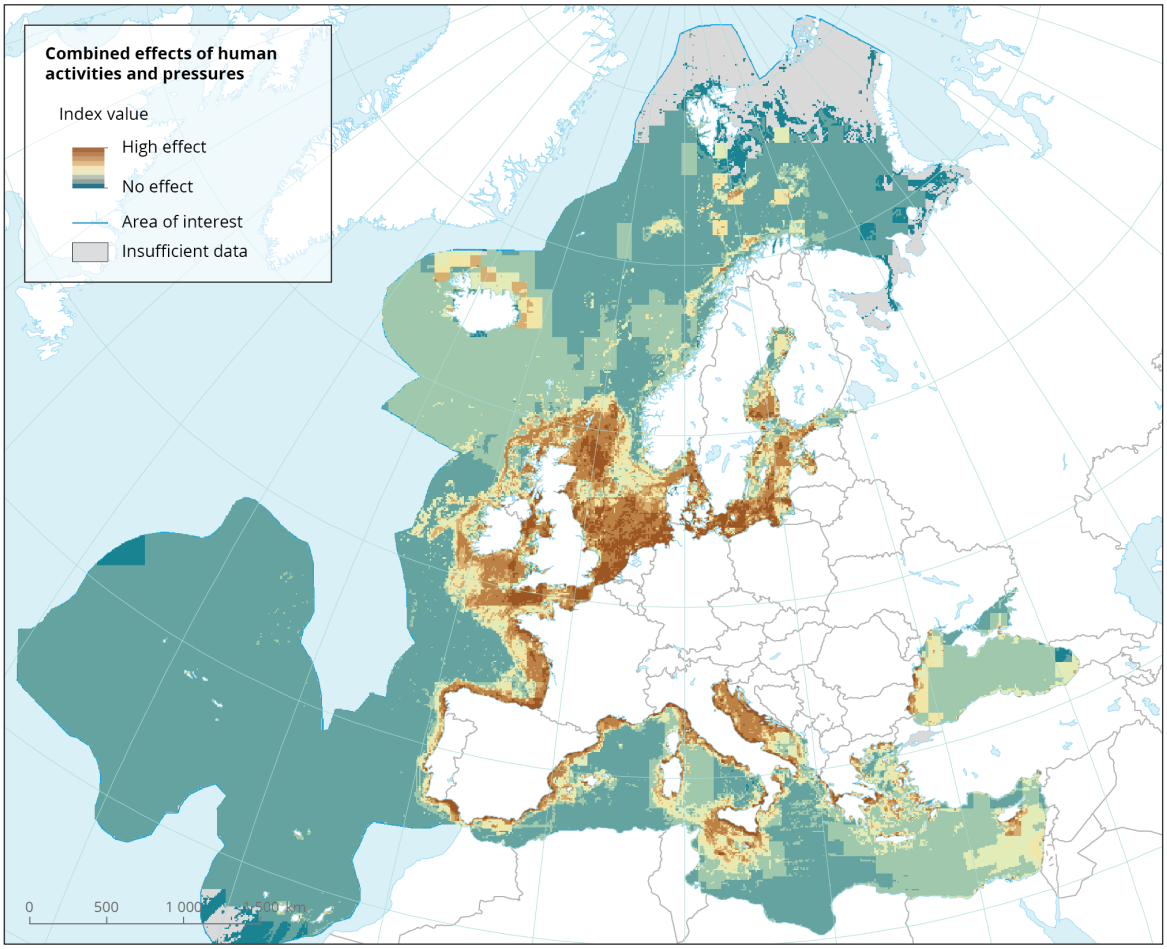
The wide spatial scale of the assessment presented here may mask the fact that the greatest combined effects from multiple pressures are in coastal waters. Many offshore species use coastal waters in some phases of their life cycles. Hence, assessment may underestimate the adverse effects of pressures in coastal areas in relation to the wider assessment area. For example, herring stocks are mainly fished from offshore areas, but their reproduction depends on shallow water gravel or vegetation. Turtles crawl onshore to lay their eggs; seabirds use cliffs, reefs or wetlands to nest; and whales bring their calves to feed in shallow waters. The assessment here suggests that habitat space for these species and their behaviours is becoming more and more limited.

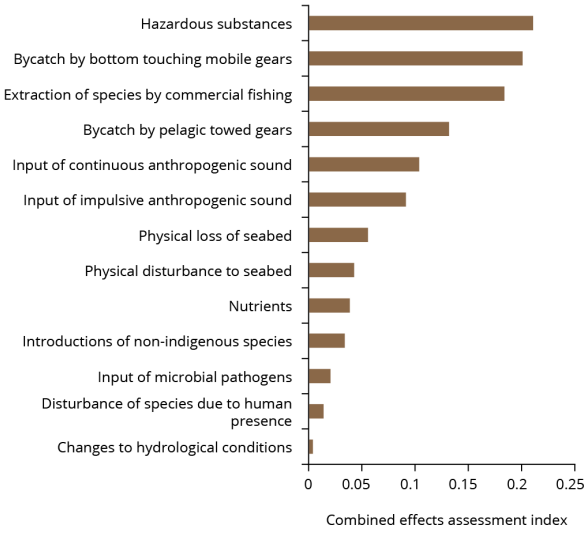
Source: ETC ICM (2019a).

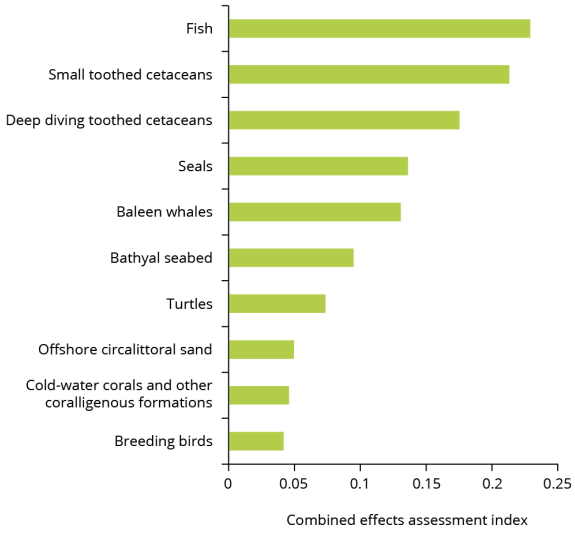
These results indicate that, despite a strong EU marine policy, the use of Europe's seas does not yet appear to be sustainable (EEA, 2019a). The target of achieving good environmental status of European marine waters by 2020 will not be achieved in relation to key pressures such as contaminants, eutrophication, invasive alien species, commercial fish and marine litter (EEA, 2019a). Overexploitation and pollution of Europe's seas, with the added threat of anthropogenic climate change acting as an additional pressure and leading to increased water temperature, ocean acidification and loss of oxygen, can result in abrupt changes to less desirable states for both the seas and people (Möllmann et al., 2011; IPCC, 2018; EEA, 2019a; IRP, 2019).

Combined effects of human activities (all, figure 1), land based (figure 2) and sea-based (figure 3) and their associated multiple pressures.

Combined effects of human activities and pressures







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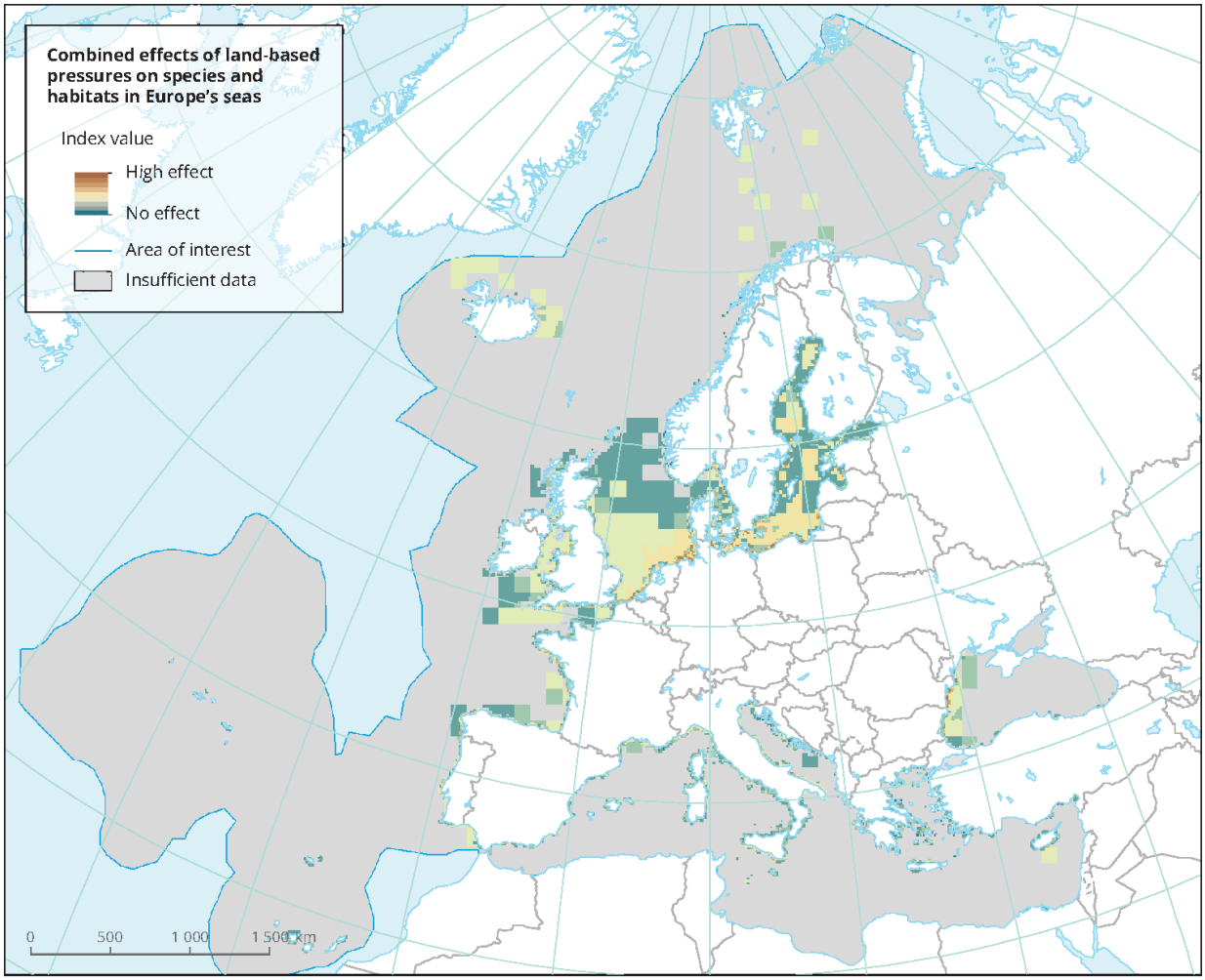
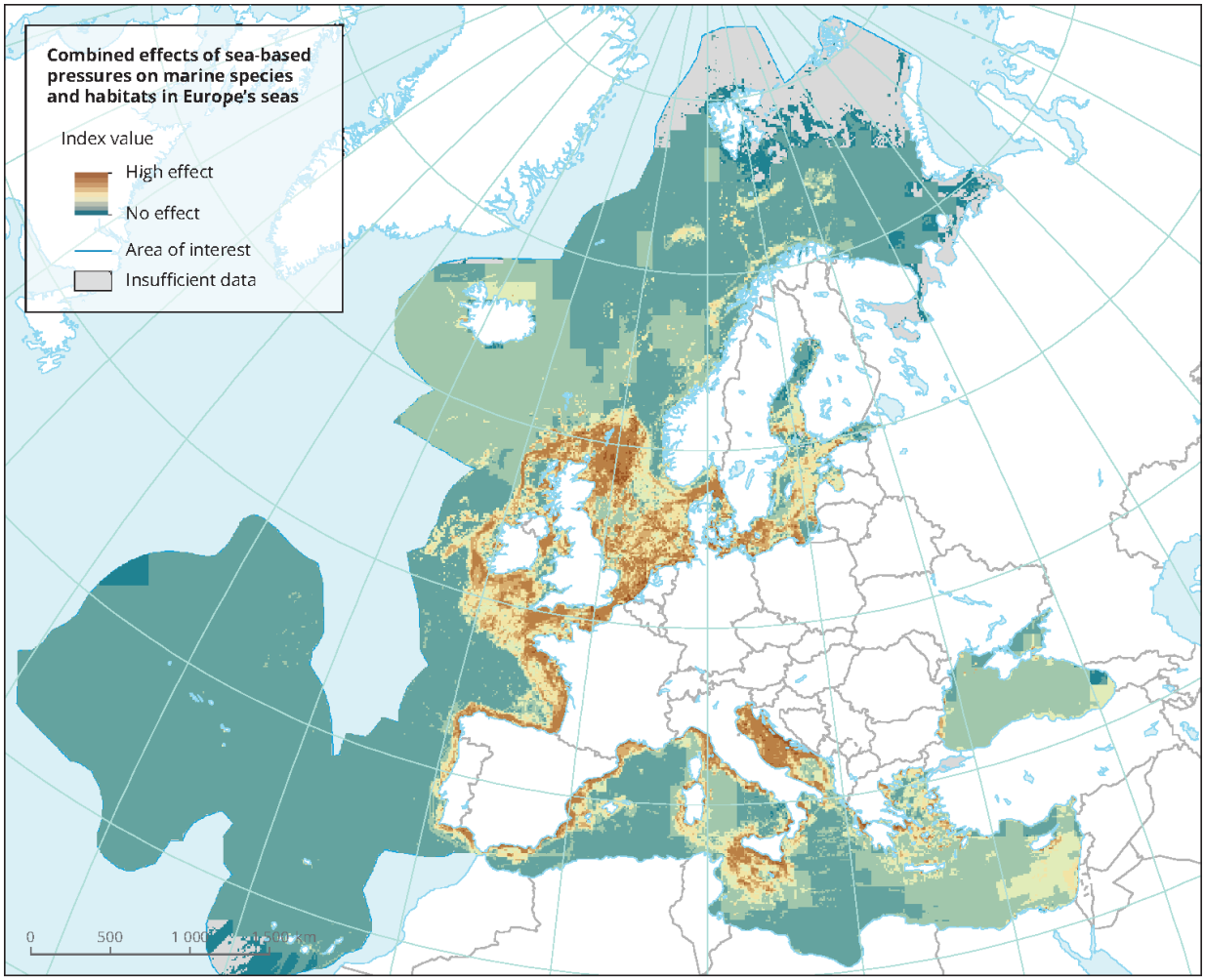


	Baltic Sea	Black Sea	Mediterranean	NE Atlantic
Eutrophication	87 %	52 %	16 %	13 %
Nutrients	98 %	31 %	42 %	6 %
Direct effects	97 %	92 %	7 %	6 %
Indirect effects	69 %	48 %	10 %	1 %
Hazardous substances	96 %	91 %	87 %	75 %
Water	94 %	79 %	98 %	95 %
Biota	77 %	58 %	32 %	43 %
Sediment	89 %	99 %	89 %	92 %
Hydrographic alterations	16 %	3 %	14 %	6 %
Species disturbance	40 %	22 %	38 %	26 %



	Coastal strip	Shelf	Beyond shelf
Continuous noise	86 %	97 %	96 %
Physical disturbance	79 %	43 %	3 %
Non-indigenous	53 %	22 %	4 %
Extraction of fish	27 %	37 %	4 %
Bycatch demersal	26 %	35 %	3 %
Bycatch pelagic	18 %	20 %	3 %
Physical loss	23 %	2 %	0 %
Impulsive noise	11 %	17 %	3 %

Note: The assessment method is described in full in ETC/ICM (2019a).

Sources: EEA (2019a); ETC/ICM (2019a).

Human activities at sea

Human activities at sea are driven by our requirements for continuous extraction of living and non-living materials and space for transport and energy production. In addition, the oceans are expected to absorb the undesirable outputs from these and other human activities, such as polluting emissions, atmospheric deposition, wastes and energy (e.g. sound, heat) as well as to buffer anthropogenic climate change.

Human activities at sea include traditional sectors, such as fishing, shipping, tourism, aquaculture and extracting non-living resources. New and emerging sectors are also increasing, such as producing offshore renewable energy, desalination, blue biotechnology (EC, 2012) and extracting mineral resources specifically in the deep sea (DG MARE, 2019). Each of these activities exerts several pressures on the marine environment and its ecosystems, and these pressures often overlap.

Pressures from human activities cause biological and other impacts on marine ecosystems, degrading their state and eroding their resilience. Maritime activities depend on the **natural** capital held in Europe's seas, i.e. the biotic and abiotic resources and space. It is therefore vital that they **all** use this capital sustainably to maintain its biotic component, on which a subset of these activities depends in the long-term. This is a key concern, as living resources depend on good environmental and ecosystem states, while activities using non-living resources cause pressures on marine ecosystems but are mostly independent of their state and of the general state of the sea (DG MARE, 2019, 2020; EEA, 2019a; ETC/ICM, 2019a)**.**

Towards the sustainable use of Europe's seas

The EU maritime economy has been increasing and is anticipated to further increase over at least the next 10 years (DG MARE, 2019, 2020; ETC/ICM, 2019a), which will lead to a further increase in competition for marine **natural** capital. To be sustainable, current and future human activities at sea and on land need to be decoupled from the degradation and depletion of marine **ecosystem** capital and take place within the current ecological limits of marine ecosystems.

Many ready-to-deploy solutions to achieve the sustainable use of Europe's seas exist already. A good, powerful example is spatial protection measures, such as temporary closures, zoning and **no-take areas**. It is time to join up efforts and implement all our knowledge to use marine resources and space in a sustainable way. This will require profound changes — a break-through in the way we use Europe's seas, including making ecosystem-based management a reality. It will also need an unprecedented level of socio-economic adaptation and taking responsibility, including at the individual level (EEA 2019a; ETC/ICM, 2019a).

For more information, see EEA (2019a, 2019b); ETC ICM (2019b).

Some signs of improvement in terms of reduced pressure in Europe's seas

Reductions in pressure are feasible. The ever-increasing trends in **certain** pressures across Europe's seas seem to have been reversed as a consequence of implementing relevant policy and legislation (e.g. MSFD, MSPD, EU Water Framework Directive (EU, 2000) and common fisheries policy (e.g. EU, 2008b, 2019). This has happened typically in areas where there has been regional cooperation to do so.

There have been significant reductions in fishing pressure in the North-East Atlantic Ocean and the Baltic Sea, leading to some recovery of commercial fish and shellfish stocks. The same is true of tuna stocks in the North and Mediterranean Seas (EEA, 2019a, 2019c). The inputs of nutrients and contaminants have, likewise, decreased over the years, and this is so in all of Europe's seas (EEA, 2018, 2019d; EEA and UNEP/MAP, 2020; UNEP/MAP and Plan Bleu, 2020).

The numbers of non-indigenous species are still increasing in Europe's seas, but the rate of new introductions is slowing down (EEA, 2019c; ETC/ICM, 2019a). Although the improvements may become visible only after some time, the trend is for these pressures to be reduced in many areas. To maintain and achieve further reductions in pressure, it is important to maintain and further improve management, given that society's requirements will keep increasing in the future (DG MARE, 2019, 2020).

For more information, see EEA (2019a, 2019b); ETC/ICM (2019b).

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