

Ocean INSTITUTE

Marine protected areas

*When the sea is effectively
protected, nature returns*

■ ANALYSIS



Foreword

Denmark's sea area is home to a unique biodiversity. However, the marine environment is under pressure and far from the stable, good environmental status that Denmark is obliged to restore under EU legislation.^{1,2}

The sea is not an inexhaustible resource, but a living ecosystem on which we humans are deeply dependent and share the responsibility to protect.

International research shows that Marine Protected Areas (henceforth MPAs) that are effectively protected, can have significant positive effects on the marine environment. They can lead to larger and more fish, more life in the sea, help restore marine ecosystems and increase their resilience to climate change.

The purpose of this analysis is to provide an overview of the level of protection in the Danish sea area and highlight the positive effects of effective protection of the marine environment.

As an extension of this analysis, the Ocean Institute, together with a large group of its members, has produced a separate publication with 10 recommendations and an action plan to strengthen the level of protection. The aim is for Denmark to have an ecologically connected and representative network of 30% effectively protected MPAs, including 10% strictly protected MPAs.

The upcoming Law on Nature and Biodiversity could be a crucial tool in ensuring this and setting an ambitious course for more life in our ocean.

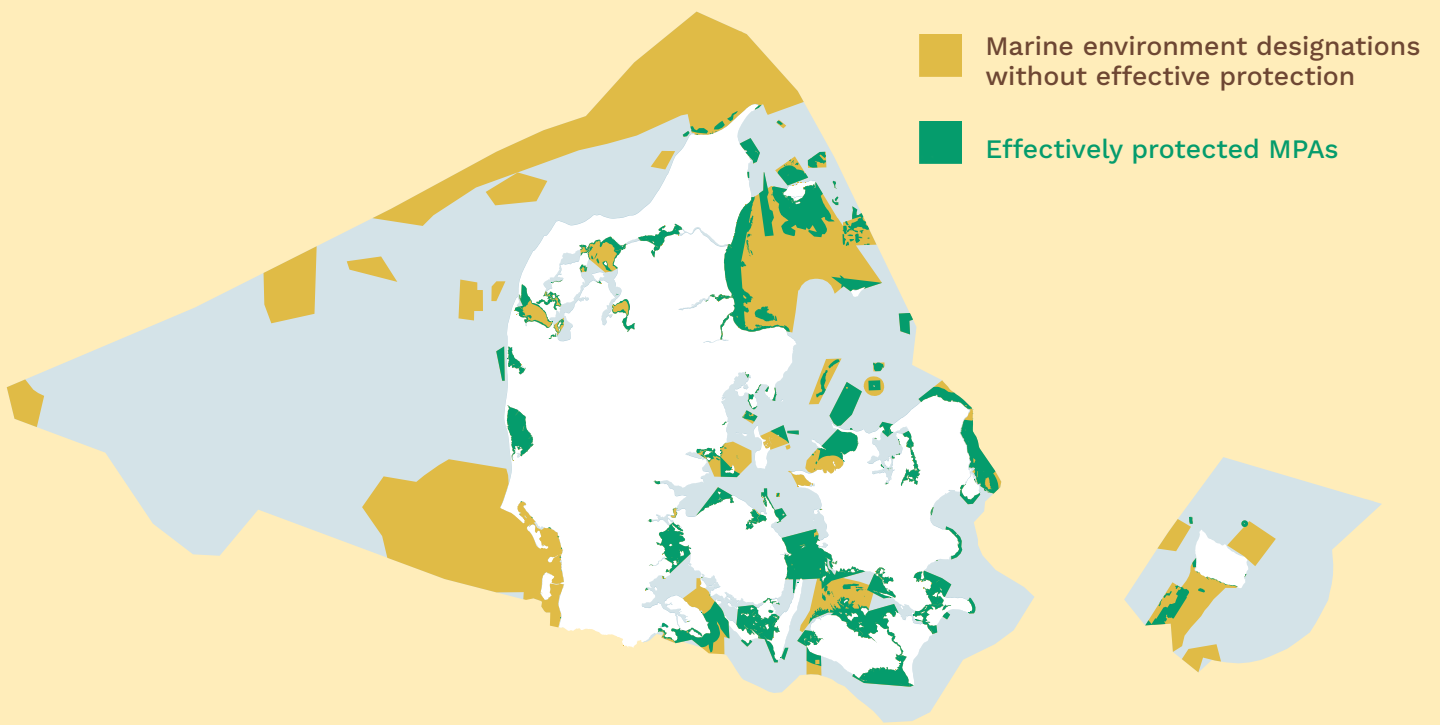
Please find the Ocean Institute's recommendations and action plan at www.taenketankenhav.dk/english

Enjoy the read.



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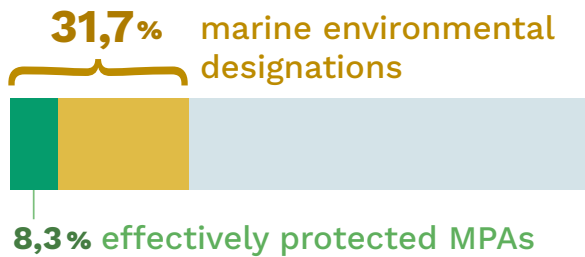
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Most of Denmark's MPAs are not effectively protected

In **three quarters** of the marine environment designations, it is either permitted or planned to **fish with bottom-towed fishing gear**, practice **aquaculture**, extract raw materials such as **sand, gravel, oil or gas**, **dumping polluted sediment**, **storage of CO2 underground** and construction of new **infrastructure projects** or offshore wind farms.

Status on protection of the marine environment in Denmark:



The Danish authorities report that 31.7% of Denmark's Sea area has been designated as MPAs.³ The Ocean Institute has calculated that roughly one quarter of these — corresponding to a maximum of 8.3% of the marine area — is effectively and long term protected. In the remaining areas, activities that are not compatible with real nature protection are either currently allowed or planned.

There are plans in several political agreements to introduce further bans on fishing with bottom-towed fishing gear. When these bans come into force, the area of effectively protected MPAs will constitute 15.3% of the Danish marine area.

International research shows that designating marine areas for environmental protection does not in itself benefit biodiversity. Only areas with effective protection, effective enforcement and long-term management deliver documented benefits for the marine environment and marine life.

Although it may seem that MPAs make up a large area of the Danish sea, in practice, there is a lack of effective protection, enforcement and management in multiple areas. These areas therefore do not meet the objectives they were intended to achieve.^{4,5}

This conclusion is supported by the European Court of Auditors (ECA), who in 2020 published a special report titled "Marine environment: EU protection is wide but not deep".⁶ The report describes how Europe's MPAs play a limited role in protecting marine biodiversity, as there is a "lack of an effective, well-managed and well-connected network of MPAs."

In the rest of this analysis, the MPAs in the Danish sea area are generally referred to as "marine environmental designations" in order to distinguish between effectively protected MPAs and marine areas that have been designated for environmental protection.

Calculation the extent of effectively protected MPAs

Marine environmental designations are included as effectively protected MPAs if they meet the following terms:

- A formal ban on fishing with bottom-towed fishing gear.
- Not designed as a development zone in the maritime spatial plan for oil/gas, carbon capture and storage, aquaculture, offshore wind, raw material extraction or new transportation infrastructure, among other things.
- Not affected by a specific land reclamation project.
- Not designed as an existing dumping site or navigation channel.

One must consider that the estimation of 8.3 % could be overestimated as data from fishery with pelagic trawl and passive fishing gear, together with cables and pipelines etc. are not included in the estimate.

Including these pressures will show activity in some areas that appear to be effectively protected. Furthermore, land-based emissions such as nutrient pollution and environmentally hazardous substances are not included.

Nature protection does not provide representative coverage of the marine habitat types

According to the EU Marine Strategy Framework Directive, Denmark must ensure good environmental status in the Danish Sea area. This must be achieved, in part, by creating and managing an ecologically coherent and representative network of MPAs that covers the diversity of marine ecosystems.

In addition, the entire sea area must be managed based on an ecosystem-based approach that ensures the overall pressure on the sea is compatible with achieving good environmental status⁶.

Hard-bottom habitats such as stone reefs create structural complexity that provides shelter and food for many species, thereby promoting high biodiversity. Deep soft-bottom habitats play a central role in nutrient cycling and serve as a food source for benthic and pelagic species. Shallow coastal areas are important nursery and feeding grounds for fish and invertebrates, including species of great ecological and commercial importance.

Each of the different marine habitats supports important parts of the ecosystem, all of which have their own adapted species associated with them. The interaction contributes to resilient ecosystems and stable food webs^{7,8}.

In 2024, the Danish Ministry of Environment and Gender Equality assessed that the existing marine environmental designations did not meet the requirements for a coherent and representative network. This was partly due to the identification of multiple habitat types and species that were not sufficiently protected by the existing network⁹. This assessment has not been updated. The Ocean Institute assesses that the habitat types circalittoral (the deeper part of the seabed) and offshore stone and biogenic reefs, as well as circalittoral and offshore mud bottoms are particularly underrepresented in the network of effectively protected MPAs.

Multiple pressures in marine environmental designations

EXAMPLE: SKAGERRAK

Skagerrak contains large Natura 2000 designations for the protection of porpoises, reefs, sandbanks and seabirds. It is the largest coherent marine environmental designation in Denmark. With an area of 7,839 km², it accounts for approximately one quarter of Danish marine environmental designations. Based on data from DTU Aqua¹⁰, the Ocean Institute has estimated that 96% of the area has been fished with bottom trawling gear between 2017 and 2022. In addition, pelagic fishing is not shown on the map. The maritime spatial plan also designates an area for underground carbon capture and storage (CCS), partly overlapping with the area.

Activities: ■ ■ ■ ■

EXAMPLE: CENTRAL KATTEGAT

In the central Kattegat, there are areas designated for habitat protection, bird protection and marine strategy framework directive areas (henceforth: MSFD areas), and nature and wildlife reserves. The area includes designations for sea sediment dumping and raw material extraction. Data for fisheries other than fisheries with bottom-towed fishing gear are not shown on the map, but pelagic trawl and gillnetting take place in the area. Fisheries with bottom-towed fishing gear rarely take place, but the area is not officially protected against this.

Activities: ■ ■ ■ ■

- Bottom-towed fishing
- New infrastructure etc.
- Navigation channels
- Raw materials extraction
- Carbon Capture Storage
- Oil and gas
- Aquaculture
- Dumping (of sediments)
- Offshore wind farms

EXAMPLE: THE DANISH WADDEN SEA

The area around the Wadden Sea has a wide range of international and national protections: Natura 2000, RAMSAR, nature and wildlife reserve, conservation area, UNESCO World Heritage Site, national park and particularly sensitive sea area (PSSA). Despite this, beam trawl fishing for shrimp takes place in approximately half of the area¹⁰ – In some places up to 78 times a year.¹¹ Large parts of the area have been designated for raw material extraction and offshore wind farms, and five areas are used for dumping.

Activities: ■ ■ ■ ■ ■

EXAMPLE: THE GREAT BELT

The Great Belt has been designated for habitat protection and bird protection and serves as an important biological corridor between Kattegat and the Baltic Sea. Here, raw material extraction, offshore wind and dumping of sediments pressures the area, and there is intensive marine traffic. Bottom-towed fishing was banned in 2025, but fishing continues with other gear such as gillnets (not shown on the map).

Activities: ■ ■ ■ ■ ■

Danish marine environmental designations are affected by multiple pressures

Below is a brief description of the pressures shown on the previous map to the left. In addition to these pressures, the Danish marine environment is affected by nutrient pollution and pollution with environmentally hazardous substances, as well as activities such as fishing with pelagic trawls, purse seine fishing and passive fishing gear, vessel traffic, pipelines and cables, harbours and recreational activities.

Climate change simultaneously affects and amplifies many of these pressures and is already considered one of the most significant threats to the marine environment – a threat that is expected to increase significantly in the coming



BOTTOM-TOWED FISHING

Degrades marine biodiversity by flattening seabed structures and removing animals from the seabed, such as fish, mussels and corals.



AQUACULTURE

Releases nutrients, organic material and medicine residues, which can lead to nutrient pollution, oxygen depletion and degradation of nature in nearby fjords and coastal areas.



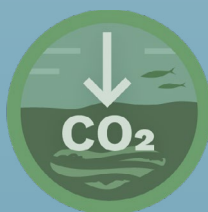
OFFSHORE WIND

Offshore wind farms cause underwater sound pollution and alter seabed habitats and currents. Offshore wind farms can also displace bird habitats.



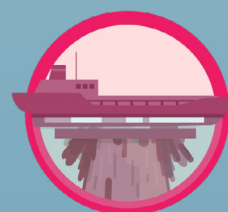
OIL AND GAS

Involves the risk of oil spills, pollution with environmentally hazardous substances and underwater sound pollution. The physical installations can also damage the seabed habitats.



CARBON CAPTURE AND STORAGE

Leads to sound pollution and vibrations caused by, e.g. drilling activities, which can affect marine mammals and fish. Furthermore, it can lead to pollution with environmentally hazardous substances from, e.g., drilling fluids and unintended spills.



DUMPING OF SEDIMENT

Releases potentially polluted sediments with environmentally hazardous substances. Re-suspends particles, decreasing water quality and light penetration, covering bottom fauna and flora.



RAW MATERIAL EXTRACTION

Leads to direct loss of seabed, habitats and seabed animals. In addition, extraction causes suspension of sediment, reducing light. The suspended sediment can eventually cover organisms and worsen conditions for algae and fish.



NEW INFRA-STRUCTURE ETC.

Bridges, tunnels, harbour expansions and new artificial islands result in the loss of habitats and create altered current conditions, underwater noise and pollution. Land reclamation results in the loss of coastal habitats.



NAVIGATION CHANNELS

Excavation of navigational channels causes recurring disturbance of the seabed and can result in loss of habitats. Suspended sediment reduces visibility, covers plants and animals, and can release environmentally hazardous substances.

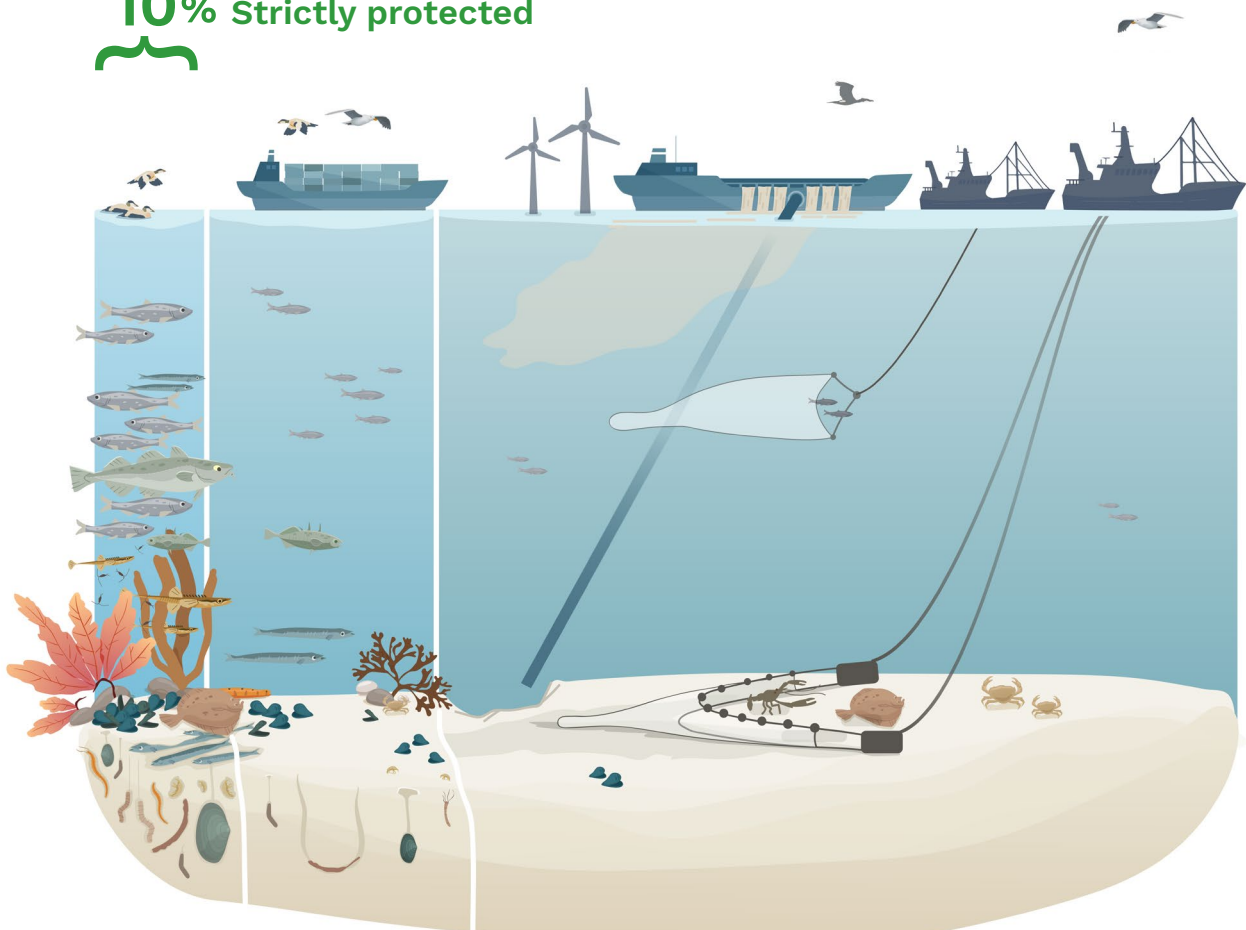
Targets and obligations for marine environmental protection

To turn biodiversity loss into growth, the EU and the UN have established several commitments and targets, which Denmark has signed up to.

100% of the Danish Sea area:
Ecosystem-based management and good environmental state

30% Effectively protected

10% Strictly protected



Biodiversity targets in the EU and UN

The EU’s biodiversity strategy from 2022 aims to ensure that biodiversity will be moving towards recovery by 2030.¹²

The strategy states that the EU’s current network of legally protected areas, including strictly protected areas, is not sufficient to secure biodiversity. Therefore, the strategy sets targets, including that at least 30% of the sea area within the EU should be protected. At least one third of the protected areas (10%) should be strictly protected. Member States are responsible for designating these areas, and clearly defined conservation objectives and conservation measures must be in place for all protected areas. In addition, the areas must be monitored appropriately.¹²

The UN Kunming-Montreal Agreement of 2022 includes targets that at least 30% of the world’s seas must be effectively protected and managed through ecologically representative and coherent networks of MPAs and other effective area-based conservation measures (OECMs), and that 30% of degraded ecosystems must be restored by 2030.¹³

The European Commission’s 2024 Action Plan for “Protecting and restoring marine ecosystems for sustainable and resilient fisheries” calls on all EU Member States to phase out mobile bottom fishing in all MPAs by 2030.¹⁴

EU Nature Restoration Regulation

According to the EU’s Nature Restoration Regulation from 2024, effective and area-based restoration measures must be introduced for all marine ecosystems that need to be restored by 2050.

Member States must ensure a continuous positive trend in ecosystems in good ecological status until the targets set for 2025 are achieved, while preventing significant degradation in areas that have already achieved good ecological status.¹⁵

EU Marine Strategy Framework Directive

According to the EU Marine Strategy Framework Directive (MSFD) of 2008, the Danish Sea area must be managed with an ecosystem-based approach aimed at achieving good environmental status and ensuring the sustainable use of marine resources. This goal should have been achieved by 2020, and Denmark therefore has an ongoing obligation to implement measures that are sufficient to achieve the goal as quickly as possible. At the same time, the MSFD requires Denmark to create and manage an ecologically coherent and representative network of MPAs covering the diversity of each marine ecosystem.⁵ As part of the MSFD, threshold values are set for impacts on the sea, e.g. for loss and disturbance of the seabed.¹

EU Habitats and Birds Directives

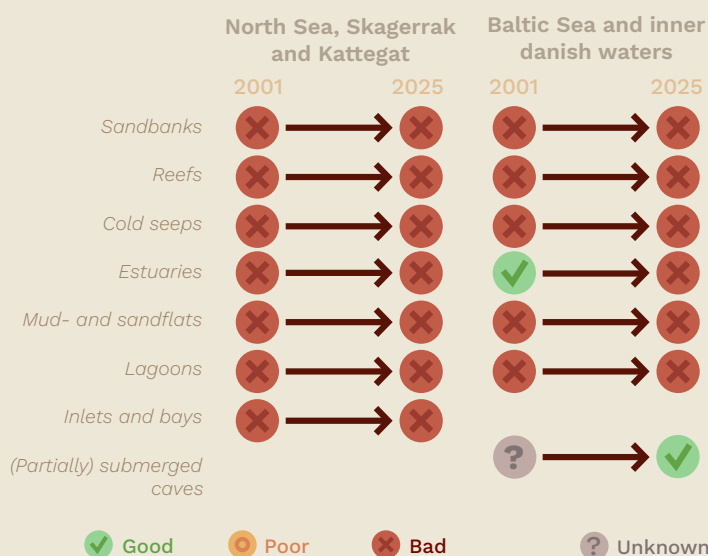
Under the EU’s 1992 Habitats Directive, Denmark has the obligation to achieve or maintain good conservation status for selected marine habitats and species.¹⁶ At the same time, Denmark is obliged, through the implementation of the 1979 Birds Directive to adopt measures aimed at ensuring the conservation of the national populations of birds covered by the Directive.¹⁷ As part of this, Natura 2000 sites must be designated where the species or habitat type for which the site is designated must be protected.

No improvement in 25 years

The EU’s Habitats Directive requires Member States to report every six years on the conservation status of selected habitats and species.

The assessments are based on four sub-elements: distribution area, occurrence area, structure/ function and future prospects. The Danish national monitoring programme for water and nature (NOVANA) provides the technical data basis.

Since the first assessment in 2007 (covering the period 2001-2006), almost all marine habitats have had a bad conservation status. This is primarily because structure and function (i.e. ecological condition and species richness) are not good, despite generally stable areas.



Source: Article 17 reports from Denmark (2007, 2013, 2019, 2025)



Denmark's approach to marine environmental protection





















































































The Danish approach to protecting marine environmental designations varies from area to area, as new categories of 'designations' have been introduced over the years. Some areas are designated for a specific species or habitat type, while others are designated for the entire marine ecosystem in the area.

Overall, there are six types of marine environmental designations in Denmark, with differing targets and management of activities:

- Strictly protected MSFD areas
- Standard-level protected MSFD areas
- Special Areas of Conservation (SACs) (Natura 2000)
- Special Protection Areas (SPAs) and RAMSAR sites (Natura 2000)
- Conservation areas
- Nature- and wildlife reserves

Common to most of these designations is that multiple activities are not officially prohibited but can be allowed after a specific assessment of the activity's accordance with the purpose of the area's designation.¹⁸

This is illustrated by the table on the following page.

	STRICTLY PROTECTED MSFD area	STANDARD LEVEL PROTECTED MSFD area	SARs (Natura 2000)	SPAs AND RAMSAR (Natura 2000)	CONSERVATION AREA	NATURE AND WILDLIFE RESERVE
Fishery with bottom-towed fishing gear (beam trawl, bottom trawl, dredging and seine fishing)	 PROTECTED	 PROTECTED	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Fishery with stationary gear and pelagic trawl etc.	 PROTECTED	 NO PROTECTION	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Aquaculture	 PROTECTED	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Seismic activities	 PROTECTED	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
New transportation infrastructure (bridges, tunnels etc.)	 PROTECTED	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
New artificial islands, beach parks, harbours etc.	 PROTECTED	 NO PROTECTION	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Offshore wind farms and energy islands	 PROTECTED	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Extraction of raw materials	 PROTECTED	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Oil and gas activities	 PROTECTED	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Dumping of polluted seabed sediments and CO2-waste	 PROTECTED	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Recreational activities (angling, anchoring, hunting, underwater hunting and traffic)	 NO PROTECTION	 NO PROTECTION	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Commercial shipping and maritime transport (incl. cleaning and excavation of navigation channels, anchoring and disposal of wastewater)	 NO PROTECTION	 NO PROTECTION	 NO PROTECTION	 NO PROTECTION	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Pipelines and cables	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT
Military activities (planned test denotations, sonar etc.)	 NO PROTECTION	 NO PROTECTION	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT	 SPECIFIC ASSESSMENT

Examples from Denmark

Denmark has no strong tradition of researching effects of MPAs, as there have been limited MPAs from which to gather data and research. There is therefore no comprehensive documentation of the effect of these in Denmark. Here, two Danish examples are presented where protection has been gradually developed into more integrated measures to strengthen biodiversity.

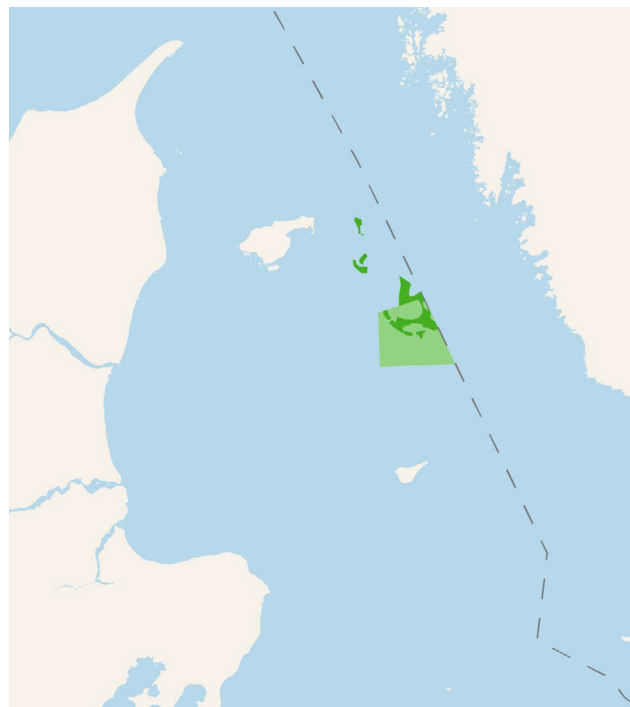
Kattegat

“Kim’s Top and the Great Wall of China” is the name of a habitat area in the central Kattegat, consisting of stone reefs in shallow water intersected by deep channels with muddy bottoms. The soft seabed and its habitats play a crucial role in the ecosystem, including maintaining biodiversity in the overall ecosystem. The area was designated a special area of conservation in 1998 because of porpoises, stone reefs, cold seeps and sandbanks.²² Studies by OCEANA in 2013 showed a rich biodiversity in the seabed fauna in the area, including haploids communities, mussel beds and the coral animals’ sea pens. On this basis, they recommended establishing a large MPA with a range of protective measures.³¹

As part of the MSC certification of fishing for Norway Lobster in Kattegat, Danish fishermen entered a voluntary agreement in 2016 to stop bottom trawling in small, selected areas with sensitive habitats in the area around Kim’s Top.

Later in 2016, the government designated six new MSFD areas in Kattegat to protect the deep soft, muddy seabed. The designation was part of an effort to improve the environmental status of Kattegat and meet the requirements of the Marine Strategy Framework Directive for a coherent and representative network of MPAs.³² The aim was to protect vulnerable species on the deep soft seabed from physical disturbance such as fishing with bottom-towed fishing gear, raw material extraction and dumping of sediment.^{32,33} The designation was based on seabed mapping and biological seabed surveys from 2015^{32,33,34} and on consultation with stakeholders, taking fishing interests into account in order to limit the economic consequences of the designations.^{31,33,35}

Some of the new MSFD areas were located at Kim’s Top. They were small, but studies conducted in connection with the designation showed that the areas contained a high diversity of seabed fauna.³² However, the results have generally not been communicated to the public – not even after the protection came into force.



The ban on bottom trawling did not formally come into force until 2022 and included the new MSFD areas and the stone reefs in the SARs.^{33,35}

In 2025, a new fisheries agreement was reached, planning to further extend the ban on bottom trawling at Kim’s Top, thereby bringing several of the smaller areas together.³⁶

Kim’s Top is an example of how an area was designated to protect specific ecosystems, habitat types and associated species, and where environmental assessments, voluntary agreements and stakeholder involvement were all part of the process. At the same time, protective measures were not implemented until six years later and there has been no communication of environmental protection to the public. The area therefore illustrates both progress and challenges in creating effectively protected MPAs.

Øresund (The Sound)

Since 1932, the Sound has been a trawl-free area because of a Danish-Swedish agreement¹⁹, and therefore functions as a biological reference area.²⁰ However, actual marine environmental designations in the Sound only came later and in smaller fractions.

The coastal areas at Amager Beach Park and Southern Amager were protected between 1939 and 1993. In 1994, the areas at Saltholm and Western Amager were designated as SPAs for birds²¹, and as SACs in 1998²² and several areas were designated as nature- and wildlife reserves aimed at protecting birds between 1999 and 2014. The northern part of the Sound was designated as an additional MSFD area in 2017, simultaneously with the decision to phase out raw material extraction in that area. In 2024, two smaller areas near Christiansfeld and Saltholm were designated as strictly protected MSFD areas.¹⁸

The Sound is therefore an example of how a ban on bottom trawling came first, followed by the gradual designation of smaller areas focusing on selected species and habitats, without focusing on the area as a whole site. The Sound is also an example of what can happen in an area where a ban on bottom trawling is implemented, but where other pressures are still permitted.

The area is located in one of Scandinavia's most densely populated regions and is affected by extensive human activities, including shipping traffic, urban development, land reclamation, harbour expansions, dumping of sediment, wastewater, raw material extraction, offshore wind farms, fishing with gillnets and traps, recreational fishing, water sports and sailing.^{23,24}



The exclusion of bottom trawling has allowed for the preservation of complex seabed habitats and contributed to relatively high biodiversity compared to other parts of Kattegat and the Belt Seas.^{23,25,26} For cod, the exclusion of bottom trawl has led to stock improvements, but new, yet unpublished analyses also show that selective gillnet fishing and recreational fishing may have pressured the stock, contributing to reduced growth and fewer large individuals of cod, poorer condition and earlier sexual maturation.²⁷⁻³⁰ The Sound thus illustrates the limitations of partially protected MPAs: even long-term protection from bottom trawling is not sufficient to ensure the health of specific fish stocks if other pressures continue to affect them, as well as the overall condition of the ecosystem.



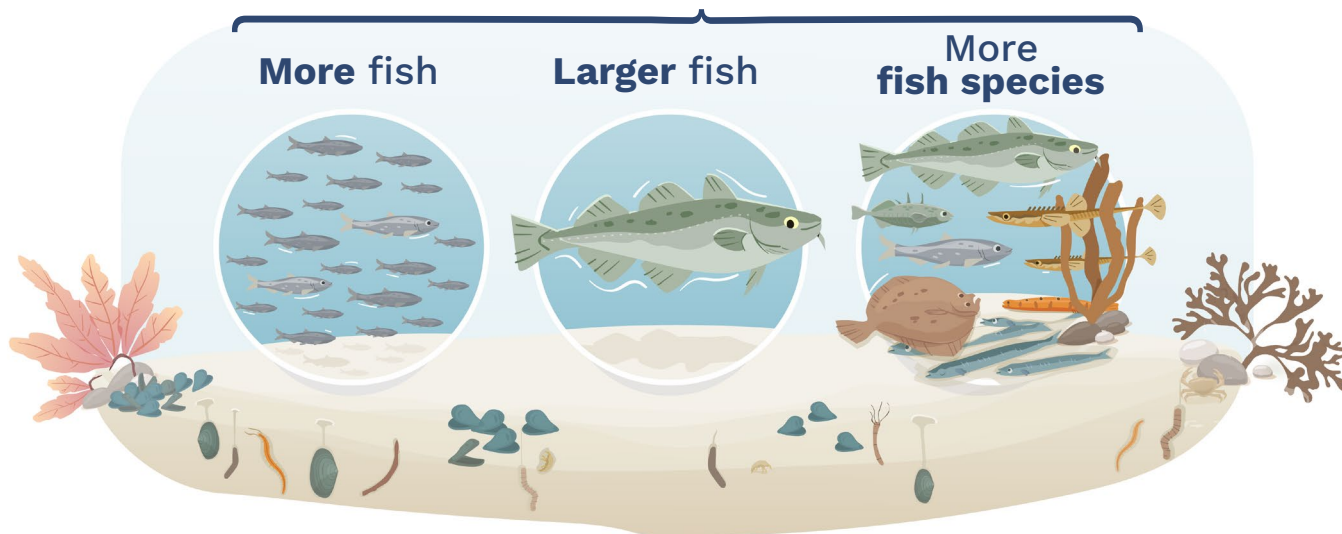


Benefits of effective marine environmental protection

Effectively protected MPAs increase biodiversity and biomass, strengthen fish stocks, restore ecosystems and increase their resilience towards pressures.

- Up to 450-670% greater biomass of fish in strictly protected MPAs compared to areas with no protection, and approx. 340% greater in partially protected MPAs.^{37,38}
- 100% higher number of large fish species and older individuals, where large female fish can produce several times the number of eggs and more viable eggs than smaller female fish.³⁹⁻⁴¹
- 1300% greater biomass of sharks.⁴¹
- Increased species richness and abundance with significantly more fish species and invertebrates such as lobster, crabs, snails and mussels, compared to areas with no protection.^{42,43}
- The stricter and more effective the protection is, the greater the positive benefits are.^{41,43,44}
- Restoration of the marine food web, creating balance between predator and prey organism.⁴¹
- Spillover effects, where both eggs, larvae and adult individuals spread beyond the boundaries of the MPA and benefit the fisheries in the surrounding area.^{40,45,47}

Healthy, resilient ecosystems with higher biodiversity



Effectively protected MPAs are one of the most well-documented tools for restoring biodiversity and ecosystem functions in the ocean.^{37,41,44} The stricter the protection, the greater the positive effects compared to both unprotected and partially protected MPAs.³⁷ The greatest positive effects are seen in MPAs that are strictly protected, large, old (older than 10 years), effectively enforced and isolated with a long distance to human influences. The more of these characteristics an MPA has, the greater the positive biological effects.⁴¹

Global scientific reviews show that strictly protected MPAs can significantly increase fish biomass in these areas – up to 450-670% greater than in adjacent unprotected areas, and 340% greater than in partially protected MPAs.^{37,38} Research also shows that the density, size and species richness of fish and sharks increase significantly compared to MPAs that are open for fisheries.³⁸ Recent meta-analyses confirm that strictly protected MPAs provide significantly greater biological benefits than partially protected MPAs.^{43,44}

When individuals grow larger in strictly protected MPAs, they are more successful at reproducing, and in addition, a large female fish can produce significantly more viable eggs than a small female.^{39,40} Thus, MPAs actually function as “biological banks” where the reproduction of populations is strengthened and where the effects can spread throughout the entire food web.⁴¹

Effectively protected MPAs also contribute to restoring balance in ecosystems. Restoring populations of large predatory fish is often crucial to maintaining a natural balance in the food chain. Predatory fish regulate populations of smaller prey fish that feed on zooplankton. When prey fish populations decline, zooplankton populations increase, which can reduce the risk of algal blooms and generally create more balance in the food chain and thereby the ecosystem. A balanced ecosystem will also be more resilient towards external influences such as the invasion of invasive species or climate change.^{41,48,49}

SILLOVER EFFECTS

The most common mechanism is egg and larvae dispersal, where fish and shellfish within MPAs produce more eggs and larvae, which are carried by the current to fished areas. This larvae spillover can contribute to recruitment up to 30 km away from the MPA.⁵⁰

Studies show that larvae from populations in MPAs often constitute a significant part of recruitment in the surrounding fished areas.⁶²⁻⁶⁴

In addition, adult spillover occurs when the density of individuals increases within the MPA and competition causes fish and shellfish to disperse out of the MPA into nearby fished areas. This can increase catch rates close to the border of MPAs, especially for species with limited

mobility such as lobsters and flatfish.^{40,45,47}

However, the effectiveness of spillover depends on the MPA's size, age and degree of protection. Experience from, for example, Lyme Bay and Kattegat shows that even though biomass and individual size increase significantly within the MPAs, the spillover effect is often limited by intensive fishing along the borders of the MPAs.

Overall, research indicates that spillover effects can support sustainable fishing, but only if the MPAs are sufficiently large, permanently protected and part of a coherent network where ocean currents and species dispersal patterns are incorporated into the design.

International inspiration

Effectively protected international MPAs provide documentation on clear benefits and positive effects on biodiversity, fisheries and society.

International experience shows that effectively protected MPAs not only conserve nature – they can actively strengthen ecosystems, help fish populations recover and create more sustainable fisheries.

The following pages showcase four international examples of inspiration: Lyme Bay in England, Kattegat and the Baltic Sea in Sweden, Skagerrak in Norway and the Channel Islands in the United States.

Each example demonstrates how targeted protection, long-term management and local involvement can lead to significant and long-lasting improvements: biomass and species richness increase significantly, seabed habitats are restored, larger individuals dominate the populations, and the ecosystems' resilience to pressures such as invasive species is strengthened. At the same time, the examples show how the benefits can spread from the MPAs via spillover effects.





Lyme Bay (England)

Lyme Bay in south-west England is one of Europe's most notable examples of effectively protected MPAs. Since the area was closed to bottom trawling, biodiversity has increased significantly.

- 430% Increase in commercially fished fish species within vs. outside the MPA.
- 370% higher abundance of commercially fished fish species within vs. outside the MPA.
- Restored reef habitats and increased physical complexity of the seabed.
- Better conditions for vulnerable seabed animals such as sponges, sea anemones and mussels.
- Increase in commercially fished fish species, also in surrounding areas of the MPA (spillover effects).
- The ecosystem reached a stable state approx. five years after the ban on fishing with bottom-towed fishing gear within the MPA was implemented, however, improvements continue over time.

A holistic approach

Lyme Bay was protected in 2008, when an area of 206 km² was closed to fisheries with bottom towed fishing gear, but more environmentally friendly methods such as pelagic trawling, gillnets and recreational fishing is still permitted.^{42,51,52} In 2011, the area was designated a Natura 2000 habitat area.⁵¹

The purpose of protecting Lyme Bay was to attempt a holistic and ecosystem-based approach that protects a larger area with different bottom habitats to preserve and restore reef structures and bottom-dwelling species such as corals and bryozoans, while allowing sustainable fishing to continue.^{42,51}

From voluntary closures to long-term protection

Management evolved from voluntary closures in 2001 and 2006 to legally binding regulation in 2008. Protection has been followed by a long-term, integrated monitoring programme of both ecological and socio-economic effects, with local stakeholder involvement.^{42,51}

Significant ecological wins

Over the span of 11 years, the total species diversity and abundance of commercially exploited fish species has increased significantly, with 430% more fish species and 370% greater abundance of fish within the area.⁵¹ Benthic fauna and reef habitats show significant recovery, while commercially exploited invertebrates such as lobsters and crabs do not show a corresponding increase, possibly due to increased use of traps within the protected area.^{42,51}

In control areas outside the protected area, the abundance of commercial fish species has also slightly increased over time, which may indicate spillover effects from the protected area.⁴²

Recovery of vulnerable reefs and seabed communities

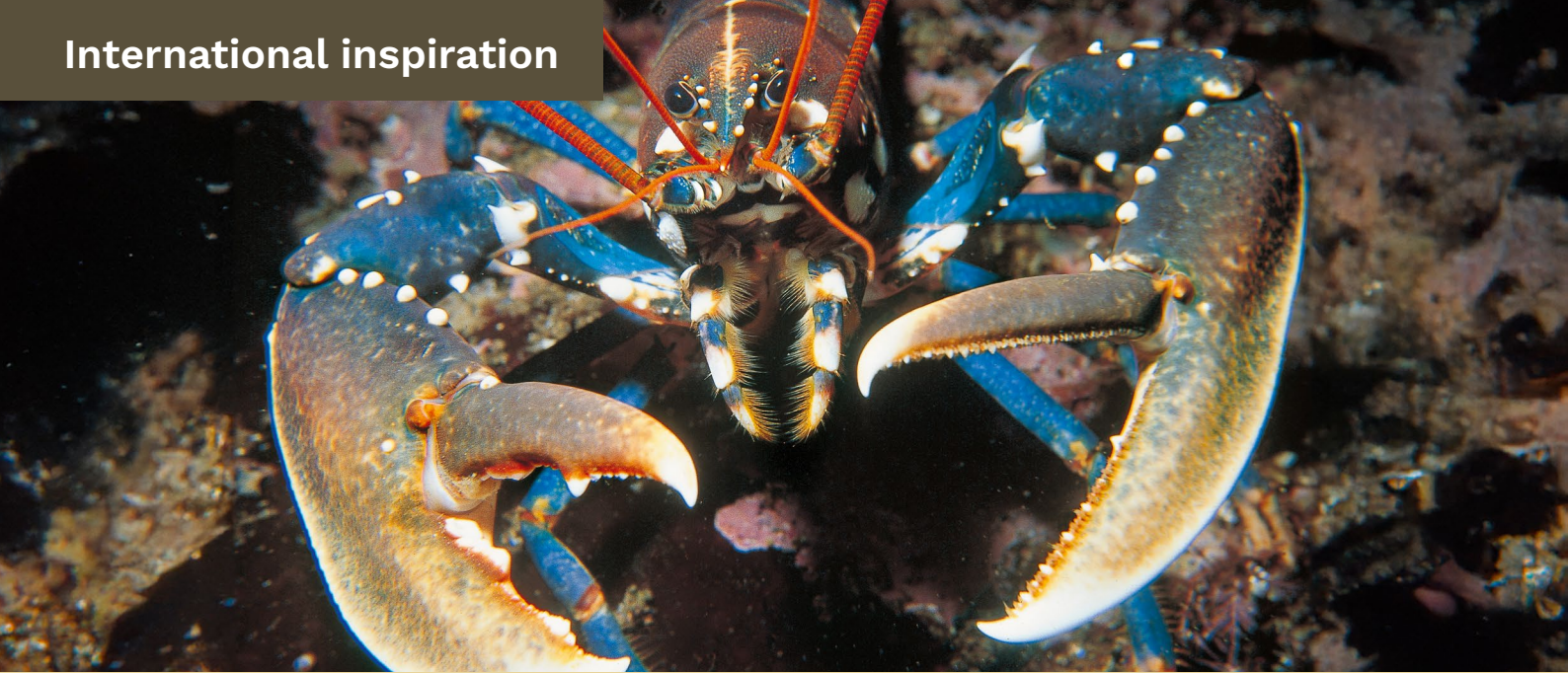
The protected area shows positive effects for vulnerable, sessile, bottom-dwelling species and reef structures, which are often among the first to be affected by fisheries with bottom towed fishing gear and other physical disturbance. This includes sponges, sea anemones, mussels and snails, as well as hard bottom structures such as rocky reefs and biogenic reefs. These organisms increase the physical complexity of the seabed and create habitats, shelter and foraging areas for mobile fish and crustaceans. Therefore, the restoration of seabed communities and reefs can help strengthen ecological functions and support larger populations of mobile species.⁵¹

The most significant ecological changes occurred in the first five years after protection, after which the ecosystem stabilised. Long-term studies show continued increases in diversity and recovery, but full recovery is estimated to take decades.^{51,53}

An international inspiration

The MPA in Lyme Bay demonstrates that a holistic approach with local anchoring can improve both biodiversity and fishing opportunities, and the literature confirms that it can serve as inspiration for marine protection.^{42,51}





Skagerrak (Norway)

Along the southern coast of Norway is a well-established network of MPAs for European Lobster. Monitoring shows a clear positive impact on lobsters in the area. In addition, the initiative has created new local support for nature protection, while inspiring others to establish more MPAs.

- 245% increase in catch of lobster per trap in scientific fishing projects few years after establishment of MPA.
- 92% increase in population density of labrids within the MPAs.
- 15% increase in body size of lobsters and higher abundance.
- Larger individuals of Atlantic cod within the MPAs.
- Positive progress detectable 4-5 years after establishment of the MPAs.
- Stable state populations with an increase in large individuals after 10-15 years.
- Larger lobsters emigrate from MPAs and increase catch in adjacent areas (spillover).

Establishment and purpose

The MPAs were established gradually between 2006 and 2020, stretching from the Swedish border in the south to Sognefjorden in the north, covering just above 2% of the coastal area (0–60 metres depth). Currently, the area consists of more than 70 lobster reserves. All fishing, including traps and gillnets, is prohibited to protect European lobster, while recreational fishing is still allowed. One area (Flødevigen) is strictly protected with a ban on all fishing.^{54,55} The areas have been established to restore heavily overfished lobster populations and strengthen biodiversity in the coastal habitats.⁵⁴

Local anchoring

Management is based on a bottom-up approach, involving local fishermen, municipalities and stakeholder organisations. Designation is based on good lobster habitats and local support, while annual monitoring, research and active local education and outreach takes place.

Rapid and positive effects

After just a few years, standardised scientific fishing projects have shown that the lobster catch per trap has increased by 245%, lobsters are 15% larger, and there is a higher abundance within the MPAs.

Outside the MPAs, lobsters have grown 1% larger during the same period. Positive impacts on cod and labrids have also been observed. For labrids, a 92% higher population density was found within the MPAs.^{38,54,56,57}

Long-term population growth

4–5 years after establishment of the MPAs, population density and biomass increased significantly. After 10–15 years, populations stabilised with an increase in large individuals.⁵⁴

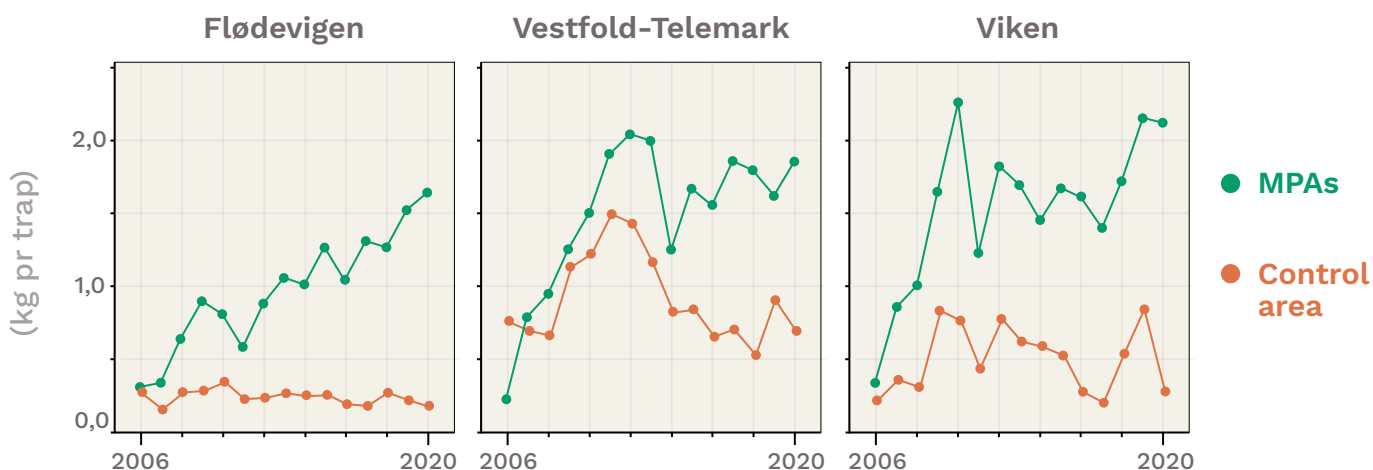
Spillover to adjacent areas

Scientific tagging studies show that lobsters emigrate from the MPAs. Thereby, protection has increased catches of lobster in adjacent areas and has not led to a reduction in overall catch of fisheries.⁵⁴

Key lessons

The impact of the MPAs in Skagerrak show that even small, strategically placed and locally anchored MPAs can deliver rapid and quantifiable benefits for both biodiversity and fisheries through cooperation, monitoring, information and outreach.⁵⁶ This is particularly true for less mobile species such as lobsters.

Increased abundance of lobsters in MPAs



The figure illustrates how catches of lobster in scientific fishing projects increases significantly in multiple MPAs after 2006 while catches outside remain largely unchanged. This shows how protection has had a rapid positive effect on lobster population growth rates.⁵⁴



Kattegat and the Baltic Sea (Sweden)

Along the Swedish coast in Kattegat and the Baltic Sea, some of the most comprehensive marine protection in the Nordic region has been established. Here, the effects of several strictly protected MPAs with a total ban on fishing have been studied. The results are clear; catch volumes increased, fish and shellfish grew larger, benthic fauna returned, and ecosystems became more stable.

- 280% increase in catch rates in scientific fishing projects after six years.
- Significant increase in large and older individuals of lobster and flatfish.
- Limited increase in cod abundance, expected due to bycatch outside the MPAs and predation.
- Recovery of benthic fauna and a more balanced ecosystem.
- Limited spillover effect of larvae and adults to adjacent areas, possibly due to intensified fishing at the edge of the MPAs and the MPAs being too small to protect cod effectively.
- Positive effects quickly disappeared when fishing was reintroduced, even though the MPAs are still protected during the spawning season.

Establishment of MPAs

The strictly protected MPAs were established in two phases (1979-2006 and 2009-2011). All but one area had a total ban on fishing. Two areas were later partially reopened, but with continued protection during the spawning season. The size of the areas varied from 1.7 to 426 km², reflecting different management objectives and scales.⁵⁸

Protection of target species

The MPAs were established to restore stocks of commercial fish species and protect them during their spawning periods, with a special focus on cod, turbot, plaice, flounder, perch, pike, burbot and lobster. Location and size were adapted to the movement ecology of the species and covered both coastal and offshore environments.^{58,59}

The Cod-box

In 2009, the ‘Cod-box’ was introduced across Danish and Swedish waters in the southern Kattegat to reduce targeted fishing and bycatch of cod within their spawning grounds.^{58,60} All fishing by Danish and Swedish vessels is prohibited in the area, as well as in three smaller adjacent areas with seasonal bans on fisheries with bottom-towed fishing gear.⁵⁸ German fishing vessels are not subject to restrictions in the area.

Studies from the area show that several fish species, such as flatfish and Norway lobster, increased in abundance and biomass within the Cod-box compared to areas outside of it. An increase in the number of cod was also observed within the area, but not outside it. The effect was thus not sufficient to boost the overall cod stock in Kattegat, which continues to be under pressure from low recruitment and high bycatch rates in the surrounding fisheries targeting Norway lobster.⁶¹

Collaboration and buffer zones

The designation was made collaboratively between authorities, fishermen, and environmental organisations. All MPAs were established as strictly protected, and buffer zones with seasonal closures were created around them.^{58,60,61}

Increased catch rates

Three years after establishment, scientific fishing projects showed that the catch rate was 160% higher in the strictly protected MPAs, and 280% higher after six years.⁵⁸ The size and age structure changed significantly, with an increase in large and older individuals.⁵⁸ In the Cod-box, the biomass of flatfish and lobster increased, and the benthic fauna showed signs of recovery after bottom-towed fishing was banned.^{58,61} For cod, an increase in abundance was seen within, but not outside, the area, probably due to continued high bycatch mortality.^{58,60,62}

Changes in benthic fauna

The composition of benthic fauna changed significantly over 12 years, with an increase of some species and a decline of others. The changes suggest that the ban on bottom-towed fishing created a more stable and dynamic benthic community, where the increased presence of predatory fish altered predation and contributed to a more balanced ecosystem.⁵⁸

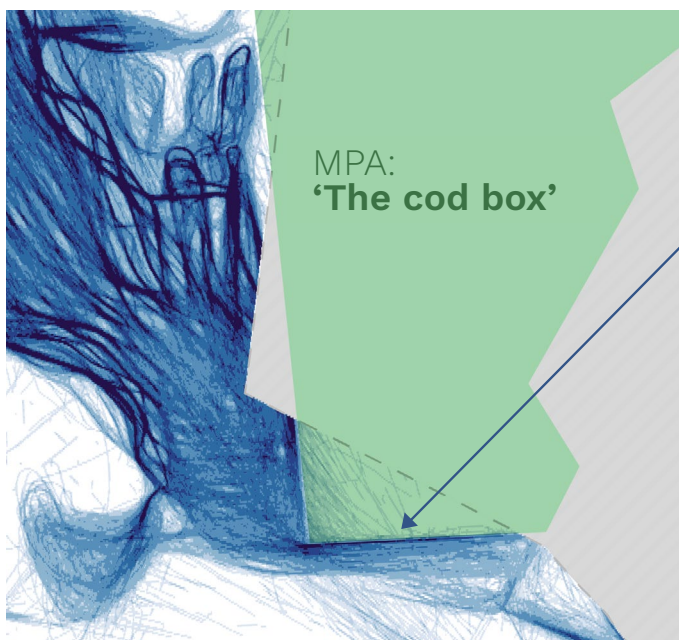
Long-term effects

After five years, increased abundance and body size was observed for most fish species. Long-term data showed continued increases within MPAs, while species in reopened areas declined.^{58,60}

There are indications of limited spillover effects for species such as Norway lobster. As multiple species disperse over large distances, the individual MPAs are considered too small to create significant spillover effects, and a network of MPAs is considered necessary to enhance the resilience of the population.⁵⁸

Permanent protection is the most efficient

The experiences from these Swedish MPAs show that benefits start to show after five years and keep growing over time. Strictly protected MPAs have a greater positive impact than seasonal closures. Buffer zones can reduce the edge effects of potentially increased fishing along the edges of strictly protected MPAs.^{58,63}



The green area shows the Danish-Swedish MPA commonly called ‘The Cod-box’.

The blue gradient shows the intensity of Danish fisheries with bottom-towed fishing gear.¹⁰

As illustrated, the fishing intensity near the borders of the MPA is very high.

The dashed line marks the border between Danish and Swedish waters. The Ocean Institute does not have access to data for fishing activities here.



Northern Channel Islands (USA)

The Channel Islands in the Pacific Ocean off the coast of California are a pioneering example of how MPAs can work on a large scale. Here, a network of 11 MPAs was established in 2003 to protect kelp forests and rocky reefs. The results are striking: fish have grown faster, lobsters have become larger, and the resilience of ecosystems has been significantly strengthened.

- Four times faster increase in biomass of commercial fish within MPAs compared to outside MPAs.
- Key fish species have grown significantly.
- Significant increase in both abundance and size of lobster catches within MPAs.
- Significant increase after five years in the density and biomass of commercial species.
- Long-term protection has stabilised the ecosystem and increased resilience to invasive species due to restored predator-prey interactions.
- Fish and lobsters have emigrated and supplied fisheries outside the MPAs (spillover).

Establishment and protection

The network was established in 2003 and consists of both strictly protected MPAs, where all exploitation of living and non-living resources is prohibited, and partially protected MPAs, where limited fishing (pelagic fishing and fishing for lobster with traps) is permitted.⁶⁴

Aims and purpose

The aim is to protect biodiversity and restore ecosystems such as kelp forests, while creating spillover effects to adjacent areas and establishing 'living laboratories' for research into ecosystem development without pressure from fisheries.⁶⁴⁻⁶⁶

The design is based on ecological principles such as habitat representation and habitats for key species as well as broad involvement of fishermen, authorities and organisations.⁶⁴

Biomass and key species thrive in MPAs

The biomass of commercial fish species has increased four times faster within the MPAs after the area was established compared to outside the MPA, while non-commercial species showed no or less effect.^{48,66}

Two key fish species of the area, California sheephead and Kelp Bass, grew in biomass within the MPAs, while levels outside remained stable. Standardised scientific fishing project for lobster yielded significantly more (4.8 per trap) and larger lobsters within the MPAs compared to outside.⁶⁷

Protection strengthens resilience to invasive species

Protection has also strengthened the ecosystem's resilience to invasive species by restoring natural predator-prey interactions.^{48,49}

Results have shown how the spread of the invasive seaweed, *Sargassum horneri*, is limited in one of the older MPAs because protection has increased the number of predators preying on sea urchins. Fewer sea urchins reduce the predation pressure on natural algae, allowing them to grow densely and outcompete the invasive species.^{48,49} Outside the MPAs, the invasive seaweed is also limited, but here it is due to the abundance of sea urchins, as predators have been fished away. In a newer MPA, the invasive seaweed spread because the balance between predators, sea urchins, and algae had not yet been restored. Experience shows that long-term protection can stabilise the ecosystem and make it more resilient to invasive species.⁴⁹

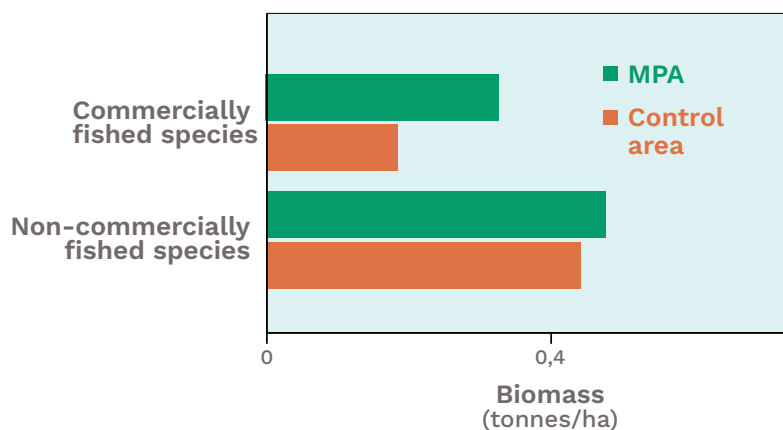
From science to sustainable fisheries

The Channel Islands network demonstrates that strategically placed and adaptively managed MPAs can deliver rapid ecological benefits while also benefiting surrounding fisheries through spillover effects.^{66,67}

The effects were detectable after one year, and after five years there were significantly higher densities (1.5x) and biomass (1.8x) of commercial species in the MPAs.⁴⁸ Over the period 2003–2012, the biomass of commercial species increased significantly faster within the MPAs compared to the control areas.⁶⁶

Scientific tagging experiments showed that lobsters captured near the boundaries of MPAs were often recaptured outside of them, and catch volumes increased with distance from the boundary towards the centre of the MPAs.⁶⁷ This suggests that MPAs may support fisheries outside the MPA.⁴⁸

Greater fish biomass within MPAs



The total biomass of commercially fished fish species is approximately twice as high within MPAs as outside. For non-commercial species, there is no significant difference.⁴⁸



Climate change and MPAs:

Resilient ecosystems can better withstand the effects of climate change

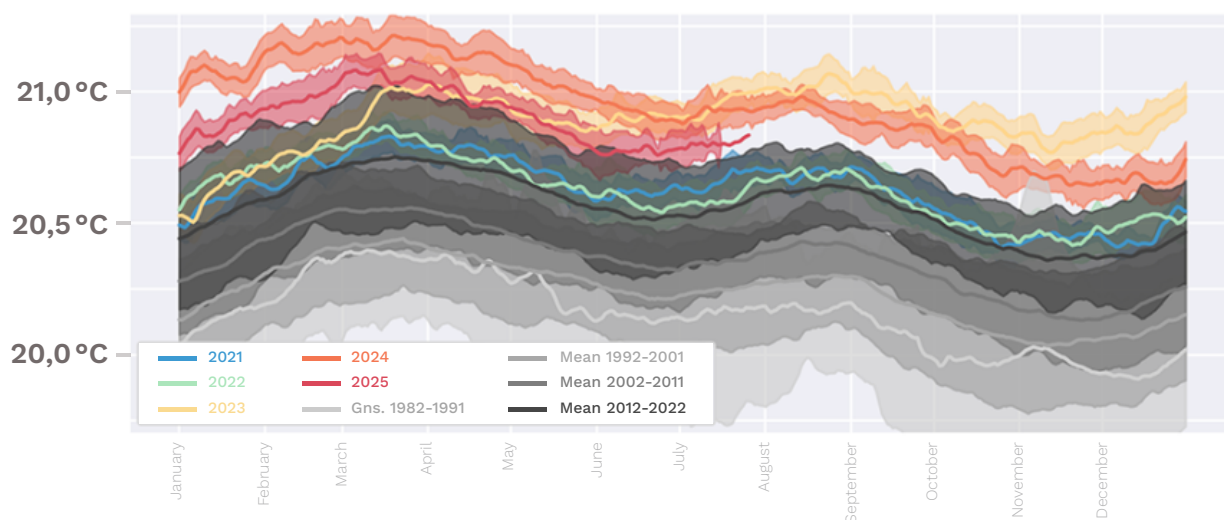
The global oceans are all affected by climate change, and the shallow coastal waters of Denmark are particularly vulnerable. The combination of climate change and other pressures is worsening conditions for vulnerable ecosystems, but MPAs can strengthen their resilience to the growing pressure.

- Climate change is altering the Danish marine environment, resulting in higher temperatures, more frequent oxygen depletion, changed precipitation patterns and hereby altered salinity in coastal waters, invasive species and more frequent extreme weather events.
- The combination of climate change and other pressures worsen conditions for vulnerable coastal ecosystems.
- MPAs can enhance ecosystem resilience to climate change and other human-induced pressures.
- Protecting carbon-rich ecosystems can maintain and increase carbon storage in the seabed.

Pressures on the marine environment

Climate change affects the marine environment through rising temperatures, among other things, and in recent years the average temperature of the global ocean has increased significantly.⁶⁸ This, combined with other factors, can lead to prolonged oxygen depletion, extreme weather events, altered plankton patterns and more invasive species.^{1,68} The effects are amplified with time and can alter ocean currents and create cascading effects throughout the food web. Shallow coastal waters and bottom-dwelling species are particularly vulnerable.^{69,70} Here, an altered environment can lead to habitat loss, displacement of species, reduced biodiversity and changes in the structure and function of the ecosystems.⁷⁰

Global mean sea surface temperature



The figure illustrates the mean sea surface temperature of the global ocean, both as 10-year averages from 1982 and per year averages for 2021-2025. For every decade, the mean temperature increased, and within the last three years, the mean temperature was significantly higher than earlier years.⁶⁸

Beneficial climate effects of MPAs

MPAs can reduce the risk of ecosystem collapse by reducing human-induced pressure.⁵¹ They show greater resilience and faster recovery after extreme events due to larger populations, higher genetic diversity and richer biodiversity.⁷¹⁻⁷³ After a severe, long-lasting storm at Lyme Bay, studies showed that the seabed recovered faster inside the MPAs compared to the reference area outside the MPAs.⁵¹

MPAs cannot, however, prevent the fundamental alterations to ecosystems caused by climate change⁷¹⁻⁷⁵, but they can strengthen the resilience and reduce pressures from other factors and thereby their combined effect.⁷³ Active nature restoration, such as re-establishing stone reefs and planting eelgrass in suitable areas, can further strengthen the resilience of ecosystems and create new habitats.⁷⁶

Carbon sequestration

The ocean absorbs CO₂ and regulates the climate through its high heating capacity. The ocean is therefore crucial in mitigating the effects of climate change globally.^{69,77}

Some of the CO₂ absorbed by the ocean is stored as organic carbon in eelgrass beds, salt marshes and other marine habitats. Physical disturbance of the seabed can release carbon, and the area will therefore act as a source of carbon rather than a sink.^{43,78,79} However, there are also opposing processes following disturbances of the seabed that, to a greater or lesser extent, counteract the negative impact on carbon storage. However, protecting carbon-rich areas will still help to reduce the release of carbon.^{79,80}

Climate change effects must be considered when establishing MPAs

Climate change inevitably affects the global network of MPAs.⁷⁴ Planning and managing future MPAs can therefore benefit from including areas that are either less affected by climate change or contain large carbon stocks.⁸⁰⁻⁸³ At the same time, an ecologically coherent network of MPAs will contribute to species dispersal and ecosystems resilience in a changing climate.^{72,84}



MPAs create both economic benefits and costs

The exact benefits and costs will vary from area to area, in part because the recreational activities allowed in each area differ. The literature on economic benefits and costs show that experiences vary from MPAs around the world.

- MPAs can bring economic benefits for commercial fisheries, tourism or recreational value in the local area. Conversely, MPAs can also entail economic costs, especially in the short term, because commercial or recreational activities may have to relocate or close within the MPAs.
- To achieve the best possible economic benefits from MPAs, it is essential that the MPAs are designed and established based on local conditions. For example, the exact effects on commercial fisheries depend on how the MPAs are managed and what types of fishing are still permitted in and around the MPAs.
- MPAs usually attract more tourism, likely beneficial to the local area. However, increased tourism often has an environmental and climate impact. It is therefore important to plan from the start, how to ensure that increased tourism does not negatively impact the MPAs.

Commercial fishing

Commercial fisheries are expected to experience both positive and negative economic impacts. On the positive side, an MPA may lead to a larger quantity of fish – both more individuals and larger fish, which may have positive impacts on fisheries fishing in areas adjacent to the MPA.⁸⁵

On the other hand, commercial fisheries may be negatively affected, especially in the short term, as fishing will be restricted in specific areas.⁸⁶

However, the overall economic consequences depend on how costs of fisheries are affected by an MPA and the fishing pressure outside the area.⁸⁷

In Lyme Bay (UK), the value of landings in the area increased by up to 25% just under 10 years after the establishment of the MPA. The study looks exclusively at the value of landings, without examining how costs have developed over the same period, making it unclear whether profitability has increased or decreased overall. Fishermen who use static fishing gear report that they are experiencing an overall increase in value and wellbeing. Fishermen who use bottom-towed fishing gear report an overall loss of value and wellbeing, partly due to financial losses.⁸⁸

In Leigh Marine Reserve (New Zealand) there was no greater landing value around the MPA relative to other comparable areas approximately 35 years after the MPA was established.⁸⁸

In Tvedestrand (Norway) fishing pressure increased outside the MPA both commercially and recreationally. This shows an expectation of spillover effects to result in economic gains for the MPA.⁹⁰

In Mexico, the MPA Revillagigedo National Park has not negatively affected commercial fishery landings five years after establishment of the MPA.⁹¹

In Scotland, trawl vessels have been generally unaffected by the introduction of MPAs, since fishing in the area has adapted to the MPAs. However, trawl vessels that previously fished mainly within the MPAs have experienced a 12% decline in landings.⁹²

Tourism and recreational use

Tourism and recreational activities are expected to have both positive and negative impacts. On the positive side, tourism and recreational activities can lead to increased creation of value and employment locally.^{85,86} On the other hand, tourism and recreational activities in a given area can become so extensive that they diminish the value of the MPA or have negative impacts on the environment and climate.^{85,86}

On the Fernando de Noronha Islands in Brazil, increased tourism because of the establishment of an MPA has created challenges for the biological purposes of the MPA. This is due to tourists tending to eat large, more vulnerable fish species during their visits. The study points this out as an argument for limiting tourism.⁹³

In Scotland, MPAs are considered to have a positive impact on tourism, including marine tourism, and some companies use the MPAs as selling points in their marketing.⁹²

In Northern Norway, tourism is estimated to cause increased emissions of approximately 0.6 million tonnes of CO₂ annually, which in 2024 corresponded to approximately NOK 0.5 billion annually.^{94,95}

In Lundy (UK) the recreational value of the MPA is estimated to be at least DKK 4,000 to 6,400 per visit.⁹⁶

Non-use value

In addition to resources and ecosystem services, such as climate adaptation or carbon sequestration, many people also attribute an inherent value to the ocean.⁸⁵

In the UK, a study shows that British people are willing to pay an additional tax of between DKK 40 to DKK 330 annually for the protection of offshore marine nature far from the coast.⁹⁷

In Norway, a study shows that Norwegians are willing to pay an average of DKK 2,400 per person annually to protect their cold-water corals, even though this protection may have negative consequences for oil extraction and commercial fishing, among other things.⁹⁸

Other commercial use

Other commercial activities, such as offshore wind or raw material extraction, may experience costs because of exclusion from an MPA, or full or partial additional costs for mitigation measures.⁹⁹

In the Sound, it is estimated that the annual costs for the raw materials industry of a ban on raw material extraction could amount to DKK 40 million per year. An MPA is expected to entail similar costs for the raw materials industry, as the raw materials will have to be transported further or otherwise handled differently than today.¹⁰⁰

Climate change

Carbon sequestration, climate adaptation and other ecosystem services: MPAs can help in absorbing and sequestering CO₂ and adapt to rising sea levels, ocean acidification and rising temperatures.^{101,102}

Off the coast of Samsø, a stone reef has been established to protect the coast from erosion and create new habitats for marine animals. Active restoration in addition to MPAs could help to improve protection of the Danish coasts.⁷⁶



Without effective protection no positive effects

Many of the world's MPAs exist only on paper, while in practice, they protect neither species nor habitats. A lack of management, monitoring and enforcement means that pressures continue to affect ecosystems – and that both environmental and societal benefits are not realised.

- Many of the world's MPAs lack effective protection, management or enforcement.
- Up to 70% of the world's MPAs are failing, either completely or partially, in achieving their conservation goals.

Although MPAs are often highlighted as a key tool for conserving biodiversity and ensuring more sustainable use of marine resources, global analyses show that many MPAs are not delivering the expected results. This is partly because; the areas are not effectively protected from main pressures such as fishing, raw material extraction and pollution; the protection is too new for species and habitats to have recovered yet; the establishment of the areas has led to changes in human behaviour that counteracts the aim; or the MPAs selected are not interesting for human activities.^{43;103;104}

Experience shows that many of the world's protected marine areas exist primarily on paper – without sufficient management, monitoring,

enforcement or involvement of local stakeholders.¹⁰⁵ The most intense pressures, including commercial fishing, therefore continue to affect ecosystems.^{105;106} The result is that both the ecological gains, such as the restoration of stocks and habitats, and the socio-economic benefits that could strengthen the livelihood of local communities, are not being realised.⁴¹

MPAs that are not effectively protected are referred to as ineffective MPAs. They create a false sense of progress and undermine confidence in global marine protection.

Recent analyses show that up to 70% of the world's marine protected areas fail, either completely or partially, in achieving their conservation goals.¹⁰⁵

Conclusion

MPAs depend on effective protection

The Danish Sea is under pressure and far from the good environmental status (GES) required by EU legislation.

Many of the marine areas designated for environmental protection on paper are not actually protected in practice. They lack effective management, monitoring and enforcement.

The Ocean Institute's calculations show that a maximum of 8.3% of the total Danish sea area is effectively and long-term protected. This is far from the government authorities' estimate of 31.7%. The government authorities' figures are based on a combination of all marine environmental designations, without assessing the actual level of protection. In many of these areas, it is either still permitted or planned to permit fisheries with bottom-towed fishing gear, extraction of raw materials, dumping of marine sediment or establishment of new facilities. The government authorities' estimate therefore does not provide an accurate picture of the level of effectively protected MPAs in the Danish sea area.

At the same time, the current nature conservation of the Danish sea area is not representative of the Danish marine habitat types and biodiversity, which is a requirement in the EU's Marine Strategy Framework Directive (MSFD).

Effectively protected MPAs are one of the most well-documented tools for restoring biodiversity and ecosystem functions in the sea, given that protection is effectively implemented and the entire ecosystem is protected. International research shows that in such MPAs significant improvements can be achieved: more and larger fish, higher biodiversity and more resilient ecosystems. Restoration of predatory fish stocks can restore balance in food webs and increase ecosystem resilience towards disturbances and pressures such as climate change and invasive species. Effectively protected MPAs can also function as "biological banks" from which life can spill out to adjacent areas (spillover effect).

International research also shows that legal designation alone does not result in nature conservation. Without effective and long-term protection, the ecological benefits will not be realised. Effective nature conservation also depends on public support and the involvement of stakeholders who use the sea.

To meet the EU's targets and commitments on MPAs and good environmental status (GES), Denmark must establish an ecologically coherent and representative network of effectively protected MPAs covering at least 30% of the Danish sea area of which one third (10%) should be strictly protected MPAs. This must be done by 2030 at the latest.

Recommendations

The Ocean Institute, together with several of its members, has developed **10 recommendations** and an **action plan** to raise the level of protection in the Danish sea area.

The recommendations and action plan can be found at www.taenketanken.dk/english

Marine Protected Areas

When the sea is effectively
protected, nature returns.

Editing ended on the 28th of November 2025

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Photographs

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Shrimps (*Palaemon elegans*)

Photo: Sune Riis Sørensen

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Coastal landscape

Photo: Ihor Frolov

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Mussel beds (*Mytilus edulis*) in the Øresund

Photo: OCEANA/Enrique Talledo 2017

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Corals (*Eunicella verrucosa*) from Lyme Bay

Photo: Lin Baldock

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California sea lion (*Zalophus californianus*) from Channel Island

Photo: Robert Schwemmer/NOAA

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Red gurnard (*Chelidonichthys cuculus*) from Lyme Bay

Photo: Matt Doggett

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Small-spotted catshark (*Scyliorhinus caniculus*) — Photo: Lin Baldock

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European lobster (*Homarus gammarus*)

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Eelgrass (*Zostera marina*) and yellow-spotted goby (*Gobiusculus flavescens*) from Øresund Photo: Ulf Bergström

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California sheephead from Channel Island (*Bodianus pulcher*)

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Eelgrass (*Zostera marina*)

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Fishing vessel — Photo: Bjarne Christensen

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Sunset — Photo: Sebastian Voortman

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Graphic: The Ocean Institute, 2025 with data from Havplanen.dk and the Danish Environmental Protection Agency

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Pressures in marine environmental designations

Graphic: The Ocean Institute, 2025 with data from Havplanen.dk, the Danish Environmental Protection Agency and The seafloor footprint of Danish fishing, DTU Aqua, 2023 Pages 12-13: **Kattegat and the Sound** Graphic: The Ocean Institute, 2025

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Graphic: The Ocean Institute, 2025 with data from Knutsen et al. (2022): Lobster reserves as a management tool in coastal waters: Two decades of experience in Norway. Marine Policy, 136

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Graphic: The Ocean Institute, 2025 with data from The seafloor footprint of Danish fishing, DTU Aqua, 2023 and the Ministry of Food, Agriculture and Fisheries of Denmark 2023.

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Graphic: The Ocean Institute, 2025 with data from Hamilton et al. (2010): Incorporating biogeography into evaluations of the Channel Islands marine reserve network, PNAS, 107, 43

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Graphic: The Ocean Institute, 2025 with data from Atwood et al. (2023): Atmospheric CO₂ emissions and ocean acidification from bottom trawling. Front. Mar Sci., 10

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