7 When marine sanctuaries benefit biodiversity

> Marine protected areas (MPAs) are regarded as a key tool in combating overexploitation and species extinction in the oceans. Their purpose is to protect marine organisms and their habitats by prohibiting or regulating certain human activities. Their number has increased significantly in recent years, and yet in many places, success remains elusive, for all too often, the planned conservation measures are implemented and monitored half-heartedly or not at all.

Setting up marine protected areas: Doing it right

> The vast majority of marine protected areas around the world are currently missing their conservation targets and failing to effectively protect local marine organisms and habitats. This lack of success has prompted experts to look more closely at the conditions that must be in place for ocean life to benefit from protected zones. The findings are clear: jointly developed conservation plans and a wealth of scientific knowledge, as well as funding, human resources and regular monitoring of outcomes, are needed in order to halt species decline in these marine regions.

The Dominican Republic: Leading the way

The government of the Dominican Republic had some good news for the international community on 11 April 2024, when it announced that it was granting protected status to 54,795 square kilometres of ocean on the Beata Ridge sea mount off the country's south coast, effective immediately.

This area of the ocean plays a vital role for many species in the Caribbean Sea, particularly as a migration route and feeding ground for sperm whales *(Physeter macrocephalus)*, hawksbill sea turtles *(Eretmochelys imbricata)*, sharks, various species of dolphin, and seabirds, including the now rare black-capped petrel *(Pterodroma hasitata)*. Many of them also give birth to their young here.

In addition, the government announced plans to enlarge the area of the Marine Mammal Sanctuary of Silver and Navidad Banks in the north of the Dominican Republic, where North Atlantic humpback whales birth their calves. The sanctuary now covers more than 64,500 square kilometres and has almost doubled in size.

With two marine protected areas (MPAs) of this scale, the Dominican Republic is one of more than 30 coastal states worldwide (as of October 2024) that have placed at least 30 per cent of their territorial waters under protection – the target agreed by the parties to the Convention on Biological Diversity (CBD). In their decision on the Kunming–Montreal Global Biodiversity Framework, adopted in December 2022, they made a joint commitment to ensure that at least 30 per cent of the world's terrestrial and inland water areas, and of marine and coastal areas, are effectively conserved and managed by 2030 (the "30 x 30" target).

One marine protected area is not like another

Protected areas are intended to shield marine organisms and their habitats from man-made impacts by prohibiting or regulating certain human activities. The granting of protected status to marine and coastal areas is regarded as a key tool in combating marine species extinction, which humans have caused in a multitude of ways. Sanctuaries can help to increase local biological diversity, restore food webs, protect threatened species and sensitive habitats, and bolster fishing in adjacent areas – to mention just a few of the benefits.

Precisely when an area of the ocean can genuinely be characterized as a protected area or operates as such is difficult to pinpoint, however. States apply different rules when granting protected status, and the terminology that they use also varies to some extent. Protected areas consequently come in all shapes and sizes, with different conservation standards and objectives. In "no-take zones", for example, all forms of resource extraction – of fish, oil, gas, sand, gravel, etc. – are prohibited. In multiple-use protected areas, by contrast, all conservation measures are aimed at preserving specific resources or services that the ocean provides, such as fish stocks for the fishing industry, or reefs, kelp and mangrove forests for tourism. This means that in these protected zones, certain human activities and uses are regulated and permitted as long as they have no adverse impact on conservation objectives.

According to the Kunming–Montreal Global Biodiversity Framework, the extraction of organisms or raw materials should be prohibited entirely in one third of the 30 per cent of protected coastal and marine areas. In line with this target, ten per cent of the ocean would be designated as no-take zones from 2030.

7.1 > A safe nursery for Atlantic humpback whales *(Megaptera novaeangliae)*: in April 2024, the government of the Dominican Republic announced the enlargement of the Silver Bank Marine Mammal Sanctuary off the country's north coast.

The European Union has embedded this target in its Biodiversity Strategy for 2030. It plans to expand upon the existing marine protected areas and supplement them with further national protected areas, with strict protection guaranteed for areas of very high biodiversity and climate value. In parallel, by 2030, one fifth of marine regions in the EU should be ecologically upgraded through the restoration of degraded habitats, according to a supplementary EU Regulation on Nature Restoration. The EU Birds Directive, Habitats Directive and Marine Strategy Framework Directive provide the relevant legal basis for action here.

Core objective:
To preserve species, habitats and their functions

Marine protected areas are established by various institutions and pursue a variety of goals. Their designation is therefore always a political decision and, as such, is rarely uncontested. Furthermore, various approaches can be used to classify a marine region as a protected area.

Although there have been calls for the establishment of marine protected areas under the United Nations for decades, the international community was unable to reach agreement on a definition of the term "marine protected area" until 2023, when it was achieved within the framework of the new UN High Seas Treaty. Therefore, in the debate about marine protected areas, the definition adopted by the International Union for Conservation of Nature (IUCN) was and is often used.

According to the IUCN's definition, a protected area – whether terrestrial or marine – is a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. In line with this IUCN definition, marine areas in which fishing, mining

or other extractive activities take place on a scale that causes harm do not qualify as marine protected areas. The same applies to marine regions in which only one species is protected or only one harmful fishing practice is prohibited. The reason is that at sites such as these, the core objective of a marine protected area – namely the long-term protection and conservation of the diversity of marine organisms and their habitats – cannot be guaranteed.

Marine protected areas, according to the IUCN, must meet six basic standards. They should:

1. focus on conservation of nature as the priority,
2. pursue defined goals which reflect these nature conservation objectives,
3. have a suitable size, location and design that will genuinely enable conservation of nature and habitats,
4. have a defined and agreed-upon boundary,
5. have a management plan which enables the conservation goals and objectives to be achieved, and
6. have been initiated by individuals or institutions with sufficient resources and capacity to implement the management plan.

If human activities are still permitted within the marine protected area, they must in all cases have a low ecological impact and be sustainable. Furthermore, all activities must be clearly regulated, and compliance with the regulations must be monitored, the IUCN stresses.

7.2 > IUCN experts assign terrestrial and marine protected areas to distinct categories depending on their conservation objectives and associated management plan.

The seven IUCN protected area management categories

Management category	Designation of protected area The name of a protected area has no bearing on the IUCN management category to which it is assigned.	Conservation objectives and measures
Category Ia	**Strict nature reserve** The only IUCN management category with a comprehensive ban on extractive activities – no-take zone.	Strictly protected for biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are controlled and limited. Research may be permitted if the studies concerned cannot be conducted elsewhere.
Category Ib	**Wilderness area** Large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation.	Areas that are managed mainly for research purposes or to preserve large unspoiled wildness areas.
Category II	**National park** Large natural or near-natural areas protecting large-scale ecological processes with characteristic species and ecosystems.	Areas that are managed mainly for the conservation of ecosystems and for recreational purposes.
Category III	**Natural monument or feature**	Areas that are set aside mainly to protect a specific natural monument or feature (sea mount, marine cavern, etc.).
Category IV	**Habitat/species management area** Areas to protect particular species or habitats.	Areas that are managed through targeted interventions.
Category V	**Protected landscape or seascape** Areas where the interaction of people and nature over time has produced a distinct character with significant ecological, biological, cultural and scenic value.	Areas that are managed mainly to protect a landscape or seascape and serve recreational purposes.
Category VI	**Protected area with sustainable use of natural resources**	Protected areas with sustainable use of natural ecosystems and habitats.

The IUCN's seven protected area management categories

Depending on the conservation objectives and the associated management plan, the IUCN experts assign marine protected areas to one of seven management categories, ranging from strictly protected areas with a ban on all extractive activities (no-take zones), to areas that continue to be fully available for human use subject to certain conditions. The higher the management category, the stricter the limits on human intervention and use of the ecosystems concerned.

How much of the world's ocean is protected, and where?

The number of marine protected areas has increased substantially since the 1960s. Designated zones now exist in every ocean region – mostly in national territorial waters, varying in size and with various forms of protection status. For many countries and experts, a further ambition is to establish a network of marine protected areas covering a range of ecosystems and biodiversity hotspots, ensuring that a representative share is protected and that species can migrate between the individual protected areas. This exchange of organisms from diverse populations is essential for the conservation of marine biodiversity worldwide at all levels – from genes and populations to individual species, biological communities and ecosystems.

Due to the variety of definitions of the term "protected area" and related standards, however, there is not one set of protected area statistics for the oceans, but several. So when figures are mentioned, it is always important to consider who compiled the statistics and which selection criteria they are based on. The two best-known databases for marine protected areas are the Marine Protection Atlas (MPAtlas) and the World Database on Protected Areas (WDPA). The former is operated by a marine conservation organization (Marine Conservation Institute), while the latter is a joint project between the IUCN and the United Nations Environment Programme (UNEP). However, the two databases use different protection categories.

OECMs: Where nature conservation is a secondary outcome

Human communities often utilize areas of the sea for purposes which are not primarily aimed at nature conservation, but which may in some circumstances have a positive and reinforcing effect on ecosystems. Examples are:

- Areas with common fisheries management;
- Marine and coastal regions that are managed for tourism;
- Wind farms and oil rigs, which contribute in various ways to increasing biodiversity around subsea infrastructures;
- Marine and coastal areas that are reserved for other purposes but may also support nature conservation, e.g. military training areas, coastal defences, protected channels for communications cables and pipelines, and areas of the sea in which, due to their significance for marine life, special regulations apply to shipping;
- Large ocean regions (e.g. the Northeast Atlantic or Baltic Sea region) in which certain species are legally protected on a transboundary basis.

If these forms of use of the oceans strengthen local ecosystems, they are known as „Other Effective Area-Based Conservation Measures" (OECMs). Less than one per cent of the world's terrestrial and freshwater environments and less than 0.1 per cent of marine areas are currently designated as OECMs. However, now that the international community has embraced the target of protecting and conserving ecosystems in at least 30 per cent of the ocean by 2030 and only using them sustainably, OECMs are becoming more important as a management tool – for as experience shows, marine protected areas alone will not suffice to end the climate and biodiversity crisis affecting the ocean.

According to the Marine Protection Atlas, only three per cent of the world's ocean fell into the fully or highly protected categories in February 2025. At that point in time, the Atlas listed only 220 marine areas in which fishing and other forms of resource extraction or destructive activities were prohibited entirely or on a large scale. The two largest were located in the Southern Ocean (Ross Sea Region Marine Protected Area) and off the northwest coast of Hawaii (Papahānaumokuākea Marine National Monument). Many smaller protected areas with fishing bans were sited in tropical and subtropical waters – mostly where there is particularly high species diversity.

7.3 > Protected area status does not shield ocean regions from floating marine litter. Here, national park employees are removing a fishing net that had become entangled in a coral reef in the Papahānaumokuākea marine sanctuary northwest of Hawaii.

In addition, according to information from the World Database on Protected Areas (WDPA), there were more than 16,300 protected areas around the world in which fishing and extraction of other resources were permitted to some extent. These "less protected" zones included the marine protected areas in the German North Sea and Baltic Sea. In February 2025, according to the WDPA, a total of 8.34 per cent of the world's oceans was protected to some degree. This equated to a total area of 30.26 million square kilometres – roughly three times the size of the United States.

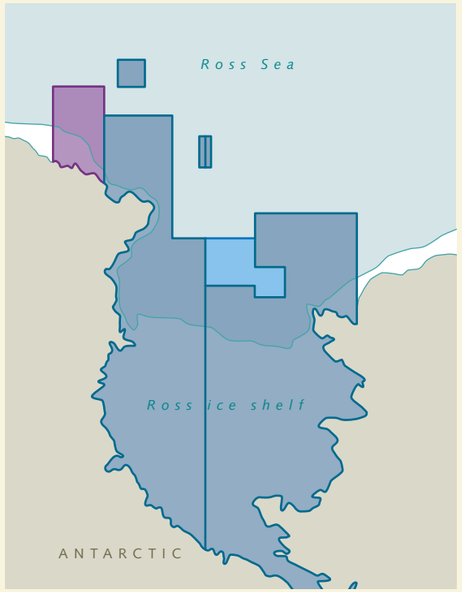
In order to achieve the conservation target of 30 per cent of the world's ocean, however, a further 78.3 million square kilometres of coastal and marine waters must be added – in less than five years and ideally in the form of large, representative protected area networks. For this, designation of new marine protected areas would have to proceed at a much faster pace.

Little more than greenwashing?

As there is a long way to go to reach the 30 per cent target, some experts argue that the public debate should not focus exclusively on how much of the total ocean area is protected, an issue agreed at political level. Instead, there needs to be far more serious discussion of whether the areas that are important for biodiversity are indeed being protected and whether conservation regimes are being implemented and monitored effectively in all protected areas. In 2023, researchers investigated how effectively the 100 largest marine protected areas are safeguarding the living organisms that inhabit them. They found that in these areas, which cover 90 per cent of protected marine waters:

- Only one third offered a level of protection that is likely to contribute to the conservation of marine organisms and habitats;

Marine protected areas in the Ross Sea Region



	Zones	Area (km²)*	% of site
Implemented or actively managed	**5**	**2,041,330**	**100**
Fully protected	1	325,237	16
Highly protected	3	1,606,529	79
Minimally protected/ incompatible	1	109,564	5.4
Total assessed	**5**	**2,041,330**	**100**

*Zones may contribute less than their total area if they are covered by zones with higher protection levels.

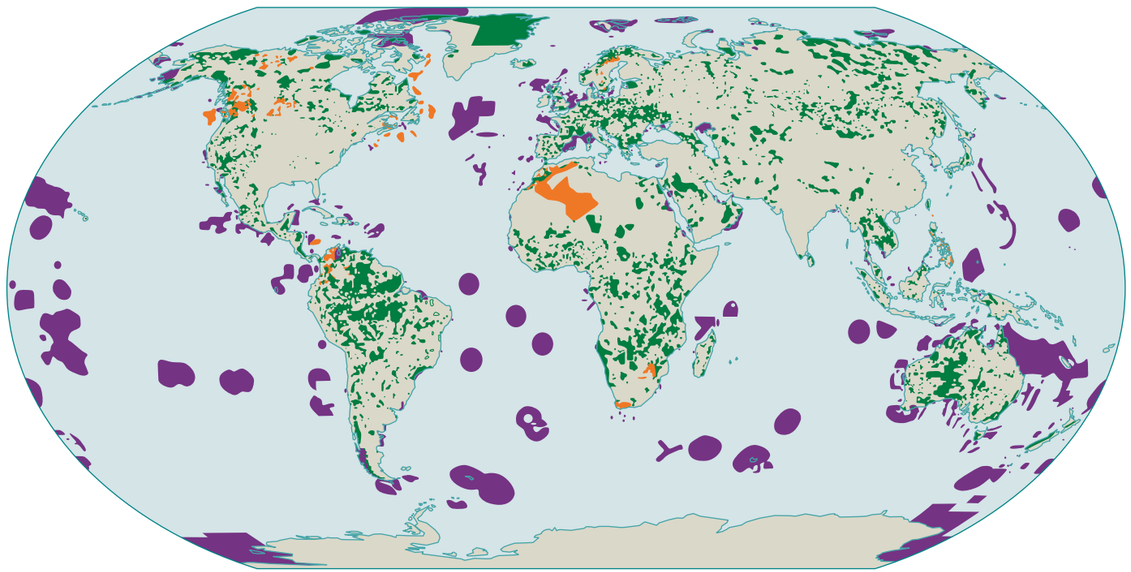
7.4 > The Ross Sea Region contains what is currently the world's largest marine protected area, covering more than two million square kilometres. But even here, there are some zones with minimal protection.

- A quarter of these protected areas (a total of 6.7 million square kilometres) were not in operation at all. In other words, the promised conservation measures had not yet been implemented and the areas were not being managed in accordance with the conservation plans. In these circumstances, protected areas offer no benefits whatsoever for flora, fauna and habitats;
- Industrial or other highly destructive activities were permitted in more than one third of the protected areas. This primarily includes industrial fishing which, along with the impacts of climate change, is the main cause of marine biodiversity loss. For the IUCN, the existence of industrial fishing operations within an area is a reason to withhold protected status;
- The majority of large-scale fully or highly protected marine areas were not located anywhere near the nations supposedly responsible for them. Instead, they are sited in far-flung overseas regions. Areas designated by the United Kingdom and USA are examples of this.

These findings, the researchers point out, indicate that the current methods being used to survey marine protected areas and assess and report on their effectiveness are overestimating the scope and quality of the protection provided. This produces a distorted picture of human impacts on the ocean and of our progress on marine conservation – especially if protected areas which in reality have not yet been operationalized are included in current protected area statistics. Moreover, based on this and other analyses, there is reason to doubt whether increasing the coverage of marine protected areas to 30 per cent of the world's oceans will genuinely offer the marine environment the level of protection that marine life requires for its recovery. At present, marine biodiversity is declining overall – despite the conservation measures already taken and the benefits that such measures, when fully implemented, are capable of achieving.

7.5 > On the online platform protected planet.net, the IUCN and UNEP publish a regularly updated map showing all the world's protected areas, both terrestrial and marine, as well as areas where nature conservation should be achieved as a secondary outcome (OECMs).

Protected areas and other effective area-based conservation measures (OECMs) (as of May 2025)



Where should the ocean be protected?

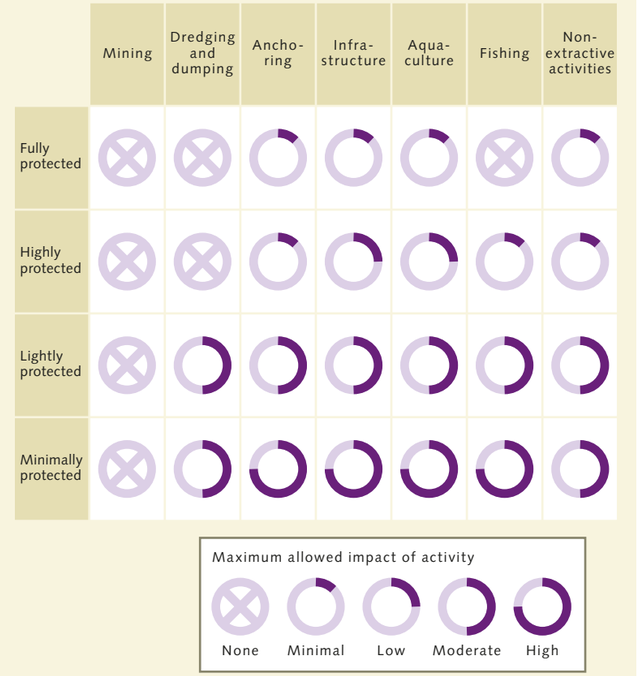
In the debate about the 30 per cent conservation target, experts have investigated, in various ways, which marine regions should be fully protected in order to yield the greatest benefits for ocean biodiversity. Politically, the most important initiative here is a process for the designation of Ecologically or Biologically Significant Marine Areas (EBSAs) within the framework of the Convention on Biological Diversity (CBD).

In this process, international marine scientists meet in regional workshops in order to assess, on the basis of current scientific, technical, indigenous and local knowledge, which areas within a given marine region are particularly worth protecting. The term "ecologically or biologically significant" applies to areas which, in the experts' view, meet the following seven EBSA criteria:

1. They are biologically or ecologically unique or rare: this means that they contain unique, rare or endemic species, populations, communities, habitats or ecosystems – or unique geomorphological or oceanographic features.
2. They have special importance for the survival of species.
3. They are critical for threatened, endangered or declining species and/or habitats.
4. They contain a high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.
5. They contain species, populations or communities with comparatively high natural biological productivity.
6. They contain high diversity of ecosystems, habitats, communities or species, or are notable for their high genetic diversity.
7. They have a comparatively high degree of naturalness, meaning that they show a lack of or a low level of human-induced disturbance or degradation.

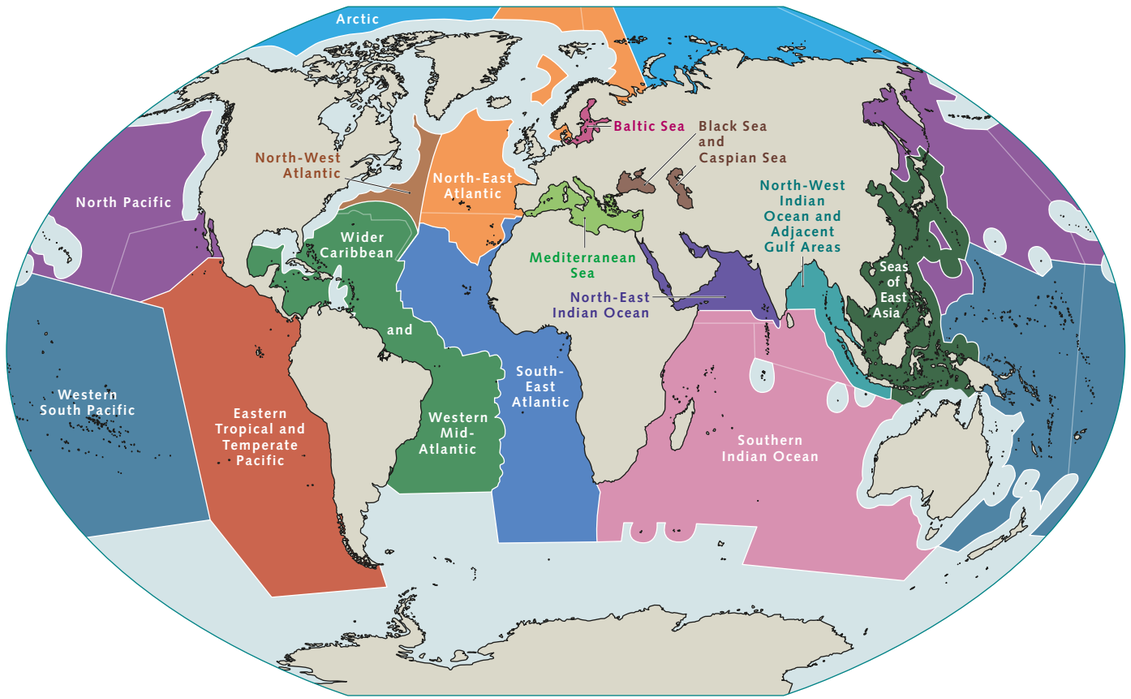
Marine areas which fulfil these criteria and are classed by the experts as worth protecting are then recognized as EBSAs by the bodies of the Convention on Biological Diversity and added to the EBSA database. It is a matter for policy-makers to decide whether the sites that are worth protecting are subsequently designated as marine protected areas as well. However, since they have been recognized as EBSAs, they are the first choice if a state,

Criteria determining the level of protection in the Marine Protection Atlas

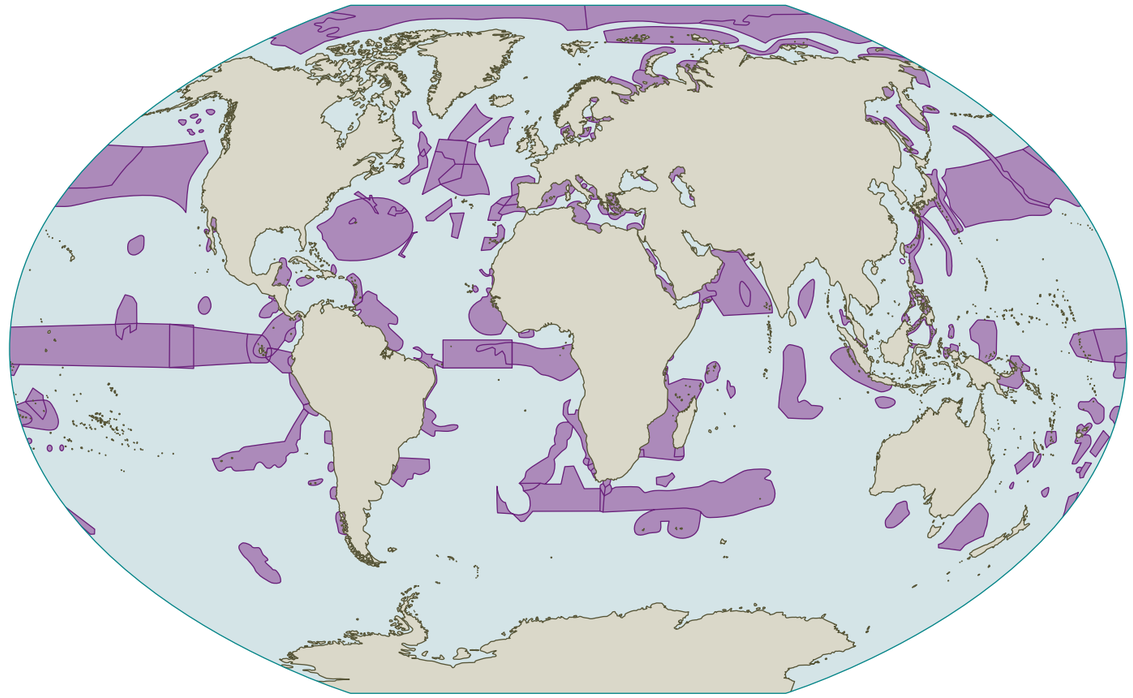


7.6 > In contrast to the IUCN, the experts working on the Marine Protection Atlas (mpatlas.org) differentiate between four management categories that permit different levels of human activity, from minimal to high.

Marine areas whose significance for species conservation has been assessed by expert workshops (as of 2021)



EBSAs around the world (as of 2025)



7.7 > The Secretariat of the Convention on Biological Diversity (CBD) has, to date, convened 15 regional workshops in which experts from various sectors discuss which areas of a particular region of the ocean meet the EBSA criteria and are thus deemed to be worth protecting.

group of states or intergovernmental body is considering designating new marine protected areas, particularly in international waters.

Marine regions that have been recognized as EBSAs currently represent around 20 per cent of the world's oceans. The smallest covers an area of just 0.95 square kilometres (in the Black Sea). The largest, in the northern Pacific, extends for 11.14 million square kilometres. Almost half of the sites are located in waters less than 200 metres deep. Others reach down to the sea floor in the deep sea. EBSAs encompass a broad array of species, habitats and oceanographic features. Some are of seasonal significance for marine organisms, while others are important all year round. The sites include submarine mountains, hydrothermal vents, coral reefs, migration corridors, seasonal fish spawning grounds and coastal upwelling areas, as well as many other types of ecosystem. There are large EBSAs in the North Atlantic, off the southern tip of Africa, in the Arctic Ocean, in the central and northern Pacific, in the tropical waters of Southeast Asia and Central America, off the east coasts of Australia and the United States, and elsewhere.

The challenges facing marine protected areas in international waters

Most marine protected areas are currently located in national waters, for it is here that coastal states can decide independently on the granting of protected status and the related conservation objectives, as laid down in the United Nations Convention on the Law of the Sea. Protected zones in international waters (the high seas) – remote from any national coast – can only be designated on the basis of international agreements which cover these areas of the ocean. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and the OSPAR Commission are examples.

The first MPA in international waters was established by CCAMLR on the South Orkney Islands Southern Shelf in 2009. This was followed in 2016 by the world's largest marine protected area, covering 1.55 million square kilometres of the Ross Sea in the Antarctic. The OSPAR MPAs in the Northeast Atlantic cover around 460,000 square kilometres and are hence larger than Germany and Austria combined. It must be kept in mind, however, that these protected areas in international waters are recognized only by states that are members of CCAMLR and OSPAR. States that are not party to these agreements are not bound by the protected area rules. It is hoped, however, that future marine protected areas that are located in international waters and are designated by the United Nations under the new High Seas Treaty (Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction – BBNJ) will be applicable to all, or at least the majority, of nations within the international community.

The establishment of marine protected areas in international waters is often hampered by a lack of rules and an absence of legal bases. The new UN High Seas Treaty is intended to remedy this situation. But will the Treaty genuinely have an effect? Only time will tell.

The monitoring of marine protected areas in international waters poses a further challenge because these

7.8 > Site proposals that are approved by the Conference of the Parties (COP) to the Convention on Biological Diversity are immediately recognized as EBSAs and are added to the official EBSA map. However, this does not confer protected status.

areas are located in remote parts of the high seas. Successful protection therefore depends on whether all the stakeholders concerned are able to reach agreement on how and when the implementation of conservation measures is monitored and by whom, which scientific studies are used to document this process, and to what extent and on which scale the conservation objectives are being achieved and the protected status has a positive effect on ecosystems.

A further difficulty is that the lifespan of marine protected areas in international waters is time-limited in some cases. The decisive factor here is the international convention under which the protected status was granted. The Ross Sea Region Marine Protected Area within the CCAMLR framework, for example, has a lifespan of 35 years. An extension will likely be considered only if there is scientific evidence that the biocoenoses in the Ross Sea have clearly benefited from protected status. For this reason too, clear rules on the monitoring and evaluation of protected areas have a key role to play.

Do marine protected areas safeguard life in the ocean?

The successes achieved by a protected area can only be measured with reference to its conservation objectives – and they often vary. In contrast, the list of environmental hazards against which MPAs provide little or no protection is quite clear. This is due to the fact that ocean and air currents transport heat, water and air, and all that they contain, to the farthest corners of the seas. It follows that marine protected areas do not protect organisms from rising water temperatures, oxygen deficiency and increasing acidification or from eutrophication, pollution, diseases, sea-level rise or non-indigenous invasive species.

There are some marine regions, however, which are and will be impacted by climate change and other environmental hazards at a later stage than others. Protected areas in these regions provide havens, refuges and niches. Furthermore, researchers assume that biocoenoses and species that are not exposed to human-induced pressure from extractive activities or degradation have better prospects of adapting to the impacts of climate change than those that are highly stressed.

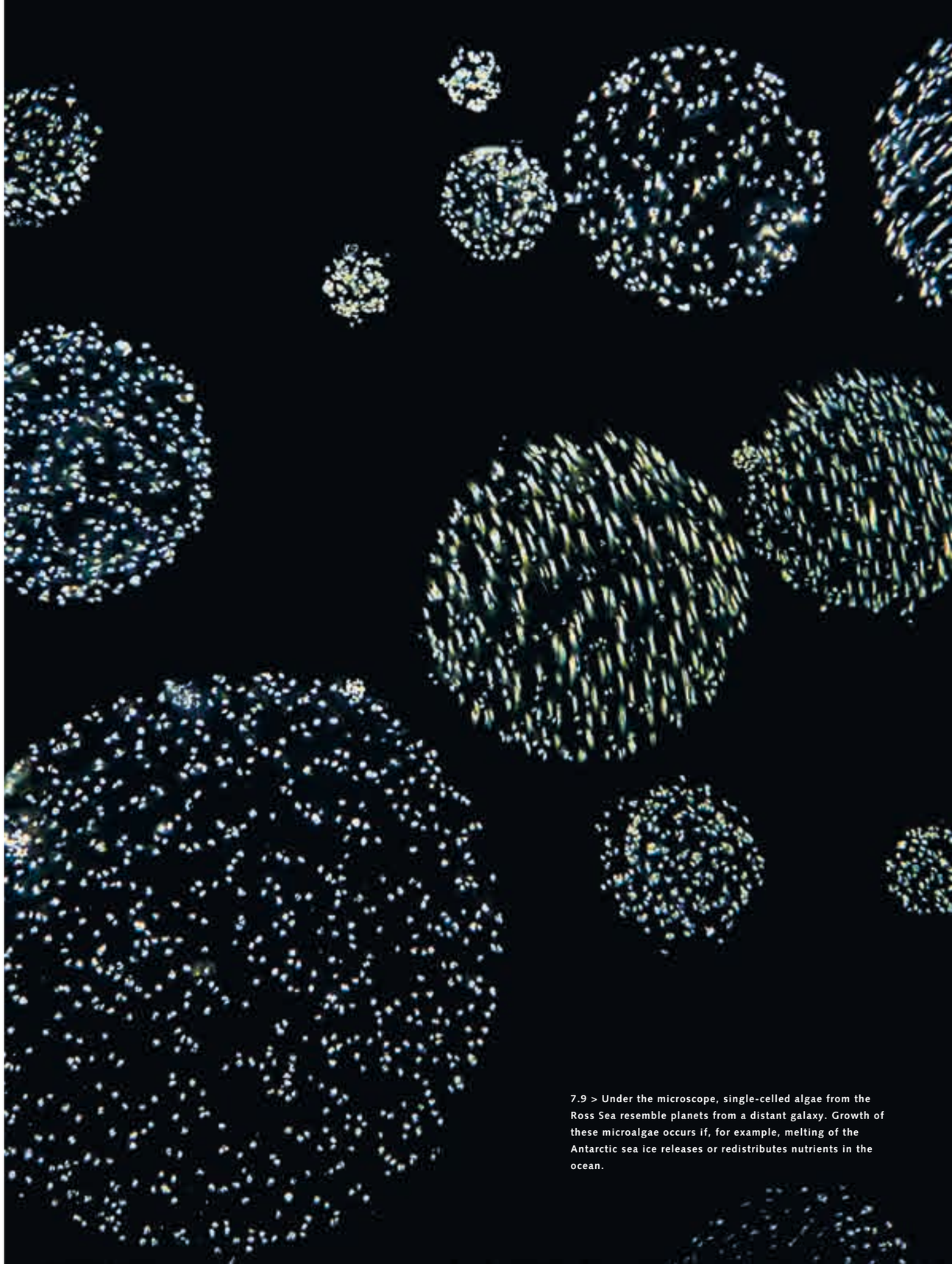
The UN High Seas Treaty: More marine conservation in international waters

Around 64 per cent of the world's ocean is not managed by individual states but forms part of the high seas, far away from any coastline. Previously, human interventions were largely unregulated in many areas of these international waters, with the result that rules on marine conservation were poorly implemented. However, the United Nations High Seas Treaty (full title: the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity in Areas Beyond National Jurisdiction – BBNJ Agreement), adopted in June 2023, is intended to remedy this situation.

The Treaty enters into force on 17 January 2026 and allows states parties to create marine protected areas in international waters. It also makes provision for the granting of protected status in situations in which no consensus is reached – through a vote by the UN member states, a three-fourths majority of the parties present and voting being sufficient. It is hoped that in this manner it will be possible to protect and ensure the sustainable use of at least 30 per cent of the ocean by means of protected areas and other measures by 2030.

In order to implement the Treaty, however, many more detailed consultations are required, particularly with the regional fisheries management organizations (RFMOs) and representatives of the regional seas conventions. If a newly planned protected area is to be located in an area of the high seas for which regional fisheries management or marine conservation agreements exist, both institutions' approval of the new protected area is required. Substantial funding will also be needed: according to one estimate, proper planning, implementation and monitoring of marine protected areas in 30 per cent of the high seas will cost around seven billion US dollars – plus a further one billion US dollars in annual operating costs. Currently, less than one per cent of international waters are protected.

It is interesting to note that in the High Seas Treaty, the UN member states have agreed on a common definition of "marine protected area" for the first time. It states: *"'Marine protected area' means a geographically defined marine area that is designated and managed to achieve specific long-term biological diversity conservation objectives and may allow, where appropriate, sustainable use provided it is consistent with the conservation objectives."*



7.9 > Under the microscope, single-celled algae from the Ross Sea resemble planets from a distant galaxy. Growth of these microalgae occurs if, for example, melting of the Antarctic sea ice releases or redistributes nutrients in the ocean.

The effectiveness of protected areas also depends on the extent to which the proposed conservation measures are actually implemented. If a marine protected area misses its conservation targets because none of the previously announced restrictions or measures were actioned, it is said to be a "paper park" – one which exists solely on paper. Experts currently estimate that the large majority of existing marine protected areas – more than 70 per cent – are failing to meet some or all of their conservation targets. Indeed, in Europe, according to a new study, this applies to 80 per cent of the marine protected areas currently in existence.

Experts therefore argue that when it comes to marine conservation, what matters is not only the size or number of protected zones (quantity), but how well marine protected areas genuinely fulfil their conservation mission and how compliance with conservation measures is monitored (quality). Another factor which plays a role is whether protected areas exist to preserve local habitats – above all, sedentary or territorial species (coral reefs, seagrass beds, submarine mountains, kelp forests, etc.) – or are intended to protect migratory/mobile species (e.g. fish, sharks, whales). Depending on the conservation objective, the effectiveness of protected areas can vary considerably here.

The effectiveness of protected areas is also influenced by what happens near their boundaries. Since the construction of five new wind farms in the German North Sea, for example, seabirds have been avoiding large areas of the Eastern German Bight Special Protection Area (SPA) that was created for them. One of the wind farms was even constructed within the protected area. As a new study now shows, the birds are keeping their distance – as much as ten to 16 kilometres – from the wind turbines. As a result, their usable habitat within the protected area has shrunk by around half. The greatest habitat losses have been recorded for red-throated loons *(Gavia stellata)* and black-throated loons *(Gavia arctica)*, but massive impacts have been documented for other breeding species on the island of Heligoland as well. The loons are now concentrated mainly in the areas farthest away from the wind farms and avoid the rest of the protected area. The experts involved in the study have therefore issued an urgent warning: constructing offshore wind farms in or near a bird sanctuary runs the risk that its core functions as a resting area and hunting ground will be lost and its original conservation objectives can no longer be fulfilled.

7.10 > Black-throated loons *(Gavia arctica)* are among the bird species facing habitat loss following the construction of new wind farms in the North Sea.

Before/after, inside/out:
How researchers measure the protective effect

To be able to assess the benefits of a marine protected area on the basis of the data, researchers must first capture the baseline condition (as-is state) of the biocoenoses, so that they can then investigate which biological parameters change over the short and long term as a result of the granting of protection. They look primarily at the distribution and population density of selected species, their biomass, age and size structure, and the biodiversity of the ecosystems within the planning area.

When monitoring performance, researchers also refer to data from comparable unprotected marine areas further afield in order to identify specific protective effects. However, the unprotected areas used for comparison must, as far as possible, display identical environmental conditions (e.g. depth, currents, sediment composition) to those of the protected areas so that any consequent – and possibly confounding – differences in the findings are avoided. The ongoing challenge when measuring performance is being able to exclude other factors that may influence the findings, such as climate change or increasing marine pollution. Both these factors can cancel out potential protective effects or partly or fully distort the results of the before/after comparison.

A meta-analysis on the effectiveness of marine protected areas where bans on extractive activities are in place has revealed an overall improvement of biological indicators – albeit, in many cases, only within the protected zones and by no means equally for all species studied. Furthermore, the successes achieved differ considerably from one protected area to another, which raises a question: why are some better at protecting marine life than others?

As a general rule, the larger the protected area and the longer it has enjoyed protected status, the more consistent the enforcement and monitoring of all prohibitions and the greater the distance from fishing grounds, the stronger the recovery of its inhabitants will be, particularly if bans on fishing and the extraction of gravel and other resources are in operation. At present, however, very few studies focus on changes in the ecosystem as a whole or look beyond individual key species (of edible fish). As a result, information is lacking on how the granting of protected status impacts the full range of ecosystem services in the protected area and which effects can be observed within the food web.

One question which arises, for example, is how an ecosystem changes if a predator fish species at the apex of the food web is no longer fished and its numbers therefore increase over time. Marine research has a role to play here, by developing new approaches that offer clearer insights into ecosystem dynamics and marine biodiversity networks and thus enhance our overall understanding. Both are needed for a more precise appraisal of the effectiveness of marine protected areas and for better and more targeted planning of new protected zones.

The controversy over the protection of fish stocks

According to figures from the Food and Agriculture Organization (FAO), more than 37 per cent of monitored global fish stocks are overfished. Experts are therefore urgently seeking solutions that would enable the recovery of endangered fish stocks. Some are in favour of an extensive network of protected areas with a total ban on fishing, as research findings show that in protected areas with fishing bans, fish abundance increases and biocoenoses on the sea floor recover – particularly mussels,

CCAMLR & OSPAR
CCAMLR stands for the Commission for the Conservation of Antarctic Marine Living Resources, whose Contracting Parties (currently 26 states and the European Union) agreed in October 2016 to designate the Ross Sea Region as a marine protected area. The OSPAR Convention is a regional marine conservation agreement for the North Sea and the Northeast Atlantic. Its Contracting Parties are 15 European countries and the European Union.

7.11 > If offshore wind farms are constructed adjacent to or in protected areas, they can impact the areas' effectiveness – not least because seabirds keep their distance from the wind turbines.

corals, sponges and other sedentary organisms previously damaged by bottom trawl nets.

Other experts, in turn, do not consider no-fishing zones to be expedient; instead, they favour comprehensive regulation of fishing, including strict fishing quotas, seasonally limited fishing periods and a ban on fishing technology that is destructive, or results in a high level of bycatch, in areas with particularly sensitive biocoenoses. In their view, a fishing ban would encourage fishermen impacted by the ban to switch to neighbouring areas, increasing the risks to the marine environment in the latter. They note that it is unlikely that fishing would be reduced overall.

Based on this argument, the governments of China and Russia have blocked the designation of further marine protected areas in the Antarctic for many years. According to environmentalists, however, these governments ignore the fact that while measures to restrict fishing can ensure that stocks of target species are not overexploited, they do not guarantee protection for the ecosystem as a whole. Restrictions on fishing merely regulate the Total Allowable Catch for selected target species and possibly bycatch. However, the governments of China and Russia disregard the other impacts of fishing, the environmentalists say. In the Antarctic, for example, how would the ecosystems of the Southern Ocean be affected if hundreds of tonnes of Antarctic toothfish *(Dissostichus mawsoni)* – an apex predator – were extracted from a relatively small area of the sea or if many thousands of tonnes of krill were harvested locally?

Marine research has provided arguments for both sides of the controversy, but has yet to do so on other issues: model calculations indicate, for example, that a protected area can boost fish abundance and catches beyond its boundaries – but only if fish stocks in this region were already heavily overexploited and fishing pressure is very high outside the new protected area. In such regions with little or no regulated fishing, a network of multiple no-fishing zones can support the recovery of biocoenoses in the water column and on the sea floor.

A point yet to be fully clarified, however, is whether the fish stock in a marine area increases if only parts of it are protected, and in which circumstances this occurs. Another unknown variable is whether undisturbed fish spawning within a protected area has the long-term effect of increasing fish abundance outside the protected area as well. However, researchers have been able to prove that amateur anglers often land fish of seemingly record-breaking size closer to marine protected areas than further afield. The chances of landing a big catch also increase along with the age of the protected area. Evidence for the positive effects of protected areas is also available from tropical coral reefs. Without the existing protected zones, according to some calculations, the number of reef fish would be around ten per cent lower than it is today.

Migratory marine organisms: Genuine protection at the right time of life

Protecting migratory marine organisms is even more challenging than preserving static marine habitats such as reefs, sandbanks or seagrass beds. These migratory species primarily include whales, seals, sharks, rays, seabirds and turtles, as well as many popular species of edible fish such as tuna. The animals travel thousands of kilometres on their migrations in some cases and are therefore often found outside protected zones. Nevertheless, smaller and medium-sized marine protected areas can support their conservation. This applies particularly if the protected zones are located in areas to which the animals return at particularly significant times in their lives – to mate, to lay their eggs or to give birth and rear their young. In the case of fish, it is also essential to protect regions that eggs and larvae drift into or to which juveniles migrate.

The effectiveness of conservation measures also depends on the extent to which there is cooperation among states whose coastal waters are traversed by these animals during their migrations. In a best-case scenario, the coastal states form a network of marine protected areas, with corridors that enable the animals to migrate undisturbed from one region to another.

However, even under the most favourable conditions, a protected area can never do justice to all the various

7.12 > A member of the environmental organization Greenpeace attaches a notice with the words "Marine Protected Area" to a navigation buoy in the North Sea. By taking this action, the activists aim to protect fish stocks.

Stepping stones
"Stepping stones" are small areas or patches of habitat that are used as stopovers by species during their climate-related outward migrations from an area. They are essential in enabling organisms to reach new habitats further afield. Stepping stones therefore count as habitats of high conservation interest.

species simultaneously – their migration patterns differ too much for that. For this reason too, opponents of protected areas with fishing bans argue that fish stocks would be better protected if strict fishing regulations were implemented effectively everywhere in the ocean, not only in geographically limited protected areas. This kind of sustainable fishing would ease the pressure on the marine environment while also safeguarding the supply of edible fish and shellfish for the long term, so the argument goes.

Migratory edible fish species are covered by the United Nations Fish Stocks Agreement. It entered into force on 11 December 2001 and aims to ensure the long-term conservation and sustainable use of straddling and highly migratory fish stocks. For example, the Agreement spells out the duties of flag states related to registration and records of vessels, authorizations, monitoring and enforcement in respect of their fishing fleets. It also obliges states whose waters host migrating schools of fish, or whose fishing fleets target these species, to engage in common fisheries management.

Marine protected areas can fuel conflicts

A marine protected area is always associated with restrictions on human activity. Fishing, for example, may be limited, permissible only at specific times, or prohibited altogether. Navigation, lying at anchor and diving are also banned in some cases, ruling out any tourism use. Local communities whose livelihoods depend on the services provided by the sea therefore find themselves at a disadvantage if one of the areas used by them (in some cases for generations) is suddenly no longer accessible in the customary way.

This can give rise to conflicts of use in which the public interest in protecting the sea clashes with the individual interest in livelihood security. Often, numerous families' livelihoods depend on access to the sea. The designation of a protected area therefore has not only an environmental and an economic component but often social impacts as well. For every protected area, the question which arises is whether the benefits for marine and species conservation outweigh the disadvantages for affected communities and how these disadvantages can be mitigated.

Planning and implementing marine protected areas: Doing it right

Conflicts of interest exist in every marine region, particularly in intensively used coastal waters. If marine protected areas are to be established successfully, the diverse claims must be considered from the outset and affected communities must be involved in planning. Unless this happens, conservation efforts are very likely to fail.

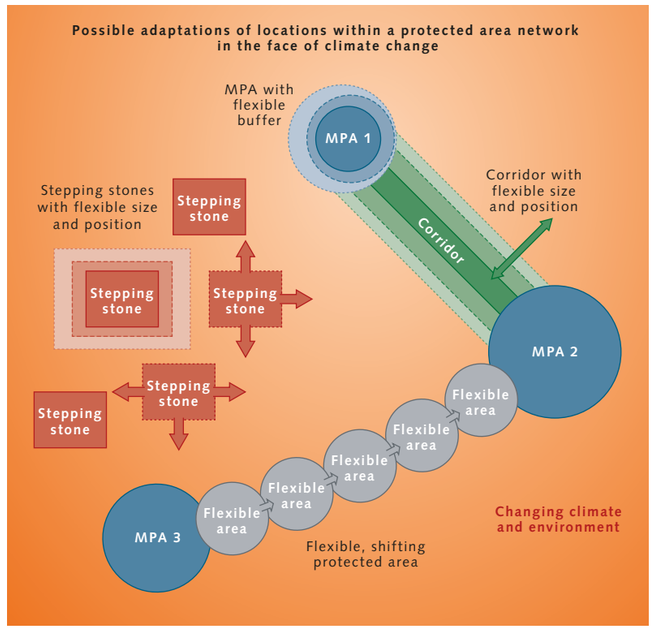
Strategies, solutions and success factors
Various approaches have proved their worth here. In the planning of smaller marine protected areas in coastal

7.13 > To safeguard its extraordinarily well-preserved coral reefs and shark populations, the Marshall Islands designated some 48,000 square kilometres of ocean as a protected area in January 2025. It covers the waters around the two northernmost islands in the archipelago.

waters, there may be many benefits in having local people working with experts to reach a joint decision on which areas should be protected and to what extent, in order to achieve the best possible outcomes for the marine environment and human communities. Local fishing families are often the best source of knowledge about local resources and traditional forms of management and use. There is also more community buy-in for compliance with the rules if local people are involved in decision-making and understand the goals being pursued.

With larger protected areas in international waters, by contrast, a fruitful approach is for one or more governments to take the lead and progress transboundary cooperation under the international agreement applicable to the marine region in question. Here too, the parties to these agreements must ensure that all stakeholder groups affected by the future protected area are involved in the planning and decision-making process and can genuinely have a say. Otherwise, communities are unlikely to comply with the new rules or support their enforcement.

7.14 > In the face of ocean warming, some marine species are shifting polewards or into deeper waters. To ensure that these species continue to be safeguarded, protected areas must move with them. This can be achieved if dynamic and flexible areas, stepping stones and corridors are factored into planning from the outset.



Experts have now identified a range of success factors for the planning and implementation of marine protected areas. They include the following:

- Involve all stakeholder groups in the planning of the protected area at an early stage.
- Ensure transparency in all discussions and decision-making.
- Identify alternative sources of income and resources for the local community.
- Offer training, upskilling and technical and financial support so that affected communities have access to alternative income sources.
- Align the planning process and conservation strategy with local conditions.

Adhering to these guidelines helps to avoid a situation in which new marine protected areas reinforce social inequalities and add to the pressure on already disadvantaged groups.

Being mindful of all the impacts of protected areas means that new scientific methods are required to analyze the interactions between the marine environment, its direct users and other stakeholders within society. Initial approaches already exist, including social-ecological network analysis, which is used primarily by experts who work on an interdisciplinary basis, enabling them to better predict and assess the impacts of economic restrictions on the various user groups and the marine environment. In addition, new remote sensing methods (satellites, drones, etc.) are useful for monitoring marine protected areas; they enable illegal fishing in MPAs or overexploitation of mangrove forests, for example, to be detected with greater accuracy.

Planning for climate impacts and adaptation

A further factor that will be decisive for the future of marine protected areas is to what extent they are able to migrate with the organisms they are intended to protect. As one of the impacts of climate change, major shifts in community composition are already being observed in the oceans. If highly endangered flora and fauna are to continue to be safeguarded, the protected areas established for this purpose must be planned and monitored flexibly and their position must shift to keep pace with species migration.

For example, experts are proposing the establishment of flexible buffers, corridors and so-called protected "stepping stones" in order to facilitate safe migration of marine organisms to climatically suitable zones. However, this kind of systematic, climate-smart and often transboundary planning of marine conservation requires close cooperation among states, decision-makers, technical experts and affected local groups. One obstacle standing in the way of shifting protected areas is that other users of the ocean (e.g. the shipping or fishing industry) require clearly defined protected area boundaries in order to navigate safely and avoid these zones.

Furthermore, in view of the dramatic climatic changes that are occurring, the possibility that the conservation plans and objectives of a protected area may have to be adjusted cannot be ruled out. For example, plans for protected areas that were previously aimed at the conserva-

Successfully protecting marine regions: Some guidance

Successfully establishing a marine protected area involves a multi-stage process which consists of two distinct phases:

The first is the **planning phase**. It starts with a rough outline of the area to be protected (planning area) and a definition of the objectives. During this phase, all stakeholder groups share their aims, claims and expectations and set joint conservation targets.

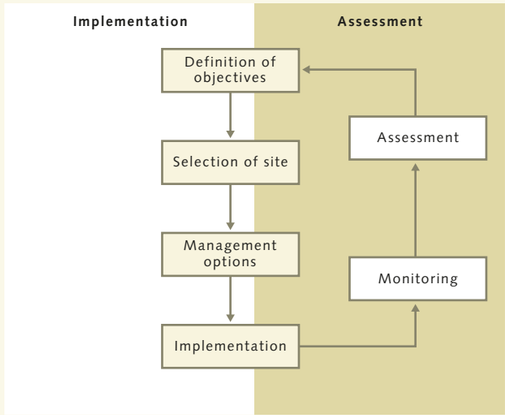
The next step is to identify an area of the sea in which the conservation objectives can be achieved through joint action. A detailed survey of the planning area is therefore carried out in order to document aspects such as the distribution of the species and ecosystems to be protected. Individual distribution maps are produced for all the collected data and indicators. In many cases, modelling is also used to assist the experts to produce a full site analysis based on the individual observations.

After that, the numerous maps are superimposed on one another and analysed with the aid of specialist software in order to identify the best location for the future protected area. This includes determining the position and size that would enable the conservation objectives to be fulfilled to the greatest possible extent while minimizing impacts on other forms of use such as fishing.

In addition, on the basis of the research results, various indicators and their baseline values are determined so that performance monitoring can be carried out at a later stage. The performance indicators generally include variables such as biomass and population size of specific target species, or population density on the sea floor. The stakeholders then draw up a joint catalogue of measures, including protection regimes and, if appropriate, a list of sanctions, solutions to potential economic and social conflicts, and proposals for funding, control and monitoring of all the various measures.

Once the marine protected area has been designated and all the regulations have been implemented, the second phase – namely **evaluation** – then follows. During this phase, experts regularly review the key indicators both within the protected area and outside and compare the trajectories (baseline condition) with the conservation objectives (target state).

If they identify any negative trends, it may be necessary to adjust the management plan or, in some circumstances, the position of the protected area accordingly.



7.15 > A protective effect is achieved solely in areas where conservation measures are implemented, evaluated and modified if necessary.

tion of selected species could be modified so that in future, the focus is on preserving all habitats within the protected zone. However, in order to determine whether these or other adaptations are necessary, the protected areas must be monitored on a regular and ongoing basis and any changes documented.

Growing challenges

Marine protected areas that are based on collaborative, climate-smart planning and are properly implemented will be an important and effective tool in biodiversity and marine conservation in future. Another crucial factor, however, is how sustainably we use the ocean outside the designated protected zones. In view of growing population numbers and increasing user claims on the oceans, holistic and, above all, sustainable strategies are required in order to protect and preserve marine biological diversity and ecosystems for the long term.

The option of designating the entire world ocean, or a large proportion thereof, as a marine protected area can be ruled out. Indeed, this is probably not a desirable step. Instead, humankind must learn to live with the ocean and see ourselves as part of nature. There is some evidence that the condition of marine habitats is at its best wherever the people who use them feel a close connection to their local ecosystems, are involved in all decision-making processes or, as fishing or coastal communities, are able to make their own decisions on the use of the sea.

The challenge, then, is to consider how we can implement conservation plans in marine protected areas more effectively and ensure more sustainable use of the marine environment in unprotected areas. This requires a fundamental recalibration of the way in which individuals, communities, industries and financial markets perceive the marine environment and interact with it. Rather than focusing solely on the monetary value of marine ecosystem services, as is currently the case, all stakeholders should consider the non-monetary services to a greater extent. Thus far, the international community has been unable to reach globally agreed targets for the conservation of biological and species diversity. This failure clearly shows that we must rethink the methods by which we seek to achieve our conservation goals.

7.16 > The entire Exclusive Economic Zone of the Cook Islands has been designated as a marine park. However, commercial fishing and marine mining are banned in selected areas only.

Conclusion

Marine protected areas: All too often ineffective

Marine protected areas (MPAs) are widely regarded as a key instrument in combating overexploitation of the oceans and associated species extinction. They are established in order to protect marine organisms and habitats from human impacts by prohibiting or regulating certain activities. Their number has increased significantly in recent years. However, MPAs' conservation objectives and management strategies vary considerably. One protected area is not like another. This makes it difficult to say for sure what percentage of the ocean is indeed protected effectively.

Consistently protecting marine regions helps to preserve local species and habitats. However, the benefits of protected areas beyond their boundaries are not always scientifically proven, often due to a failure to implement planned conservation measures (paper parks). Migratory species benefit from protected zones mainly when there is large-scale connectivity between these areas and they are located in regions where marine organisms breed or rear their young. Meeting the needs of all the inhabitants of a protected area simultaneously is challenging due to the often diverse behavioural patterns of the various species.

Protected areas address some of the challenges facing the marine environment, such as the risks to and destruction of local biocoenoses by overfishing, over-extraction of resources, or mass tourism. However, they do not guard against large-scale pollution (e.g. microplastics) or climate change impacts. They are, therefore, just one of many tools available to combat the climate and biodiversity crisis facing the oceans.

As more protected areas are designated, conflicts of interests increase – especially in areas with previously intensive human use, such as fishing. When planning a protected area, it is therefore absolutely vital that the interests of all user groups are genuinely considered. The prospects of success increase if protected areas are planned, implemented and monitored inclusively and transparently and user groups are offered alternative income sources.

In order to assess a protected area's trajectory and performance, scientific studies are required, which must be conducted regularly over extended periods. This research should aim to determine whether the original conservation objectives are being achieved, whether the granting of protected status has a positive effect on ecosystems, and which species benefit from the protected area. Methods that enable early identification and assessment of the benefits and disadvantages of protected status for people, the ocean and society should also be utilized more frequently. These forecasts can help encourage the diverse user groups to champion the area's protected status.

When planning, implementing and evaluating protected areas, the impacts of climate change on marine life will need to be given more consideration. New, flexible protected areas that are closely monitored and can be adapted and shifted in tandem with climate-induced species migration are required. Flexible buffers, corridors and protected stepping stones are essential to enable marine organisms to migrate into climatically suitable zones.