Impacts of fishing and climate change on life below water: what challenges for the future?

Close to 3.3 billion people depend on aquatic resources for sustenance. (1) Fish products account for almost 20% of the overall amount of animal protein consumed across the world and are a major issue as far as food security is concerned, especially in the many developing countries. (1) The fishing sector is also crucial from an economic and social point of view. The Food and Agriculture Organization of the United Nations (FAO) estimates that close to 39 million people were employed in the sector in 2018, while the total number of fishing boats of all sizes was close to 4.6 million. (1)

At the same time, the exploitation of fish stocks – in particular their over-exploitation – compounded by the growing impact of climate change is threatening marine biodiversity and the populations that depend on it. In a world of limited resources, how do we maximize the environmental, social and economic usefulness of the fish we pull out of the sea?

Summary of policy recommendations

- **Encourage sustainable fishing practices that respect fish stocks and protect ecosystems,** while at the same time encouraging a high standard of environmental exigency beyond that of the current management model of maximum sustainable yield (MSY).
- **Intensify efforts to eradicate illegal, unreported and unregulated fishing** (IUU fishing) and eliminate subsidies that contribute to overfishing.
- **Set up and enforce an ecosystem approach to fisheries which respects biodiversity and is socially and economically fair**, in order to strengthen the resilience of marine ecosystems and fishing activities as they deal with the impacts of climate change.

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EXPLOITATION AND OVER-EXPLOITATION OF FISHERIES

The exploitation of the living resources of the sea has, particularly since the middle of the nineteenth century, intensified relentlessly, driven by technical developments and the industrialization of fishing practices. A study published in 2018 in the journal Science estimates that more than 55% of the sea is subject to industrial fishing, amounting to some 70,000 registered vessels. (2) Exploiting the sea in this manner has increased catches, making no little impact on the abundance of the stocks fished. In 2018 global fishing production reached 179 million tonnes, of which 84.4 million tonnes were attributed solely to sea fisheries. (1) And yet, since 1996, declared catches worldwide have been decreasing, the cause being diminishing fish populations. On a global scale, fishing has reduced the total biomass of exploitable species by a factor of two, perhaps as much as two and a half, impacting all the food webs of the sea and the capacity for the most exploited marine populations to reproduce and maintain their numbers. (3) In the fisheries sector, an increase in the means of production does not equate to a growth in production. On the contrary, the over-exploitation of fish stocks is characterized by an overly large fishing fleet. Beyond a certain threshold the pressure exerted on fish stocks leads to a reduction in production. This has been observed on a global scale since the 1980s. (3)

To tackle overfishing, the United Nations adopted in 1955 the idea of a maximum sustainable yield (MSY) as a standard for good fishing management. This standard is included in the United Nations 1982 Convention on the Law of the Sea which gives States the right and the duty to use the MSY model to manage the marine living resources in their exclusive economic zone. (3) The MSY corresponds to the largest quantity of biomass that can be extracted from a species' stock, overall and over the long term, in specific environmental conditions and for specific exploitation characteristics (fishing devices and mesh sizes). In 2017 a total of 65.8% of the world's fish stocks were exploited up to their maximum yield. (1) However, despite the progress made in terms of fishery management in certain industrialized countries, the proportion of species subject to overfishing has continued to increase in global terms over the last few decades. In 2020 the FAO highlighted the fact that 34% of marine fish stocks were being exploited at biologically unsustainable levels. (1) In addition to the pressure of intensive legal fishing is the question of illegal, unreported and unregulated fishing which, in 2011, accounted for up to a third of the world's catch. (4)

It is to be noted that the concept of MSY as a fisheries management strategy came from the monospecific models developed by scientists in the 1950s. MSY aims to maximize the yield (or catch) over the long term rather than protect fish stocks. The absence of over-exploitation does in no way equate with an absence of impact, quite the contrary. Population renewal is ensured, which means that the youngest of the age categories are always abundant; however this situation can predominate even when the oldest age categories, those which contain the biggest fish and create the biggest biomass, are greatly affected. As a result, for each fish population exploited to its maximum sustainable yield, the biomass left in the sea amounts to no more than about 35% of what it would have been if there had been no fishing at all. Impact is, therefore, very high and has an obvious chain of repercussions on the prey, predators and competitors of the exploited species. Over time this spreads through the food webs to all parts of a given ecosystem. Also, the MSY management model does not take into account the effect fishing devices have on habitats nor the possible genetic drift or reduction in genetic diversity subsequent to a fishing mortality rate that is higher than the natural mortality rate. In other words, the MSY management model focuses on maximizing the exploitation and the survival of each of the exploited species, as if species did not interact with each other. It in no way guarantees the sustainability of ecosystems.

This is even truer and particularly relevant today as fish stocks, which are already to a large extent impacted by overfishing, are equally and very directly threatened by certain consequences of climate change, such as the warming, deoxygenation and acidification of the sea.

FISHING AND CLIMATE CHANGE: A DUAL CHALLENGE

In 2019 the Intergovernmental Panel on Climate Change (IPCC) published a special report on the oceans and the cryosphere in the context of climate change. Raising the alarm on the future of oceanic species, the report estimates that the warming of the world's oceans and changes to primary production in the latter part of the twentieth century have resulted in an overall reduction in the capacity of fish stocks to renew themselves by approximately 3% per decade. (5) Faced with rising sea temperatures, numerous mobile marine species are modifying their native range in search of oceanic environments to which they are acclimatized. (5) This spatial redistribution, generally in the direction of the poles and the deep sea, encourages the tropicalization of species assemblages, in other words, the shift of warm-water species to higher latitudes. (6)

According to FAO figures, changes in the distribution of fish linked to ocean warming could lead to an overall reduction in the catch potential. This reduction could be even more marked because warmer waters lead to less efficient transfers of energy within food webs. (7) The impact of water acidification on phytoplankton and coral reefs also drives changes in marine ecosystems and food webs.

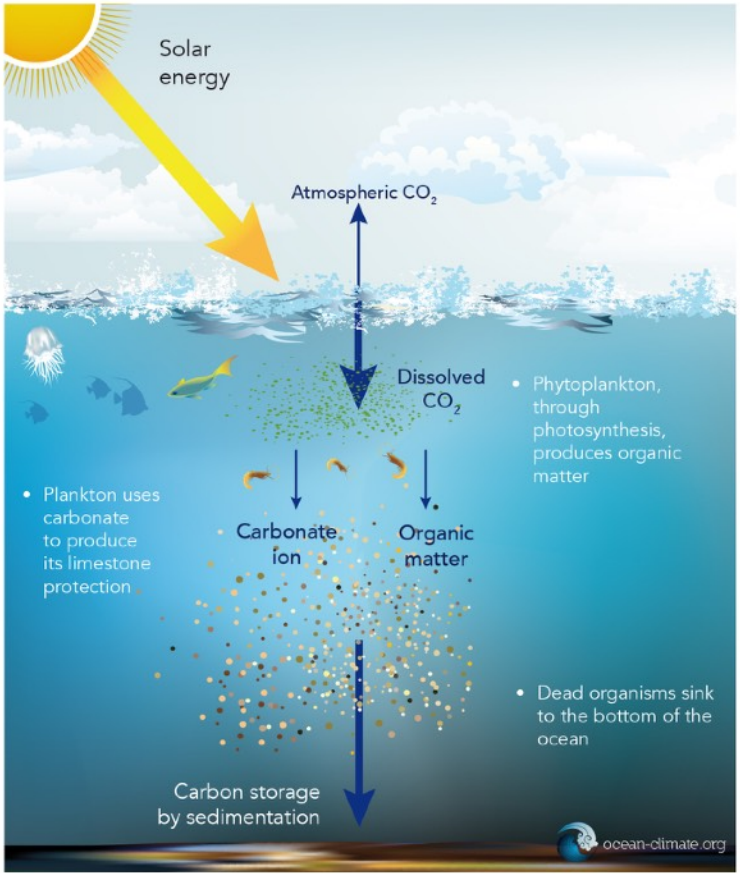
In short, the FAO estimates that the catch potential in exclusive economic zones (EEZ) across the world could fall by 2.8–5.3% by 2050 (compared to 2000) in the most favourable pathway (RCP2.6) and 7–12.1% for the 'business as usual' pathway (RCP8.5). (8) By the year 2100 the IPCC expects to see a fall in catch potential of 20% to 24% in the most pessimistic of the pathways (5), the fall being as much as 40% in the tropical regions. Unfortunately, such a scenario could have dramatic consequences for those regions of the world where numerous populations are dependent on fisheries for food security.

In response to the effects of overfishing and the initial impacts of climate change, fishers are having to look for resources further and further from the shore and use ever more powerful fishing devices. This dynamic translates foremost into an increase in the sector's carbon emissions. According to FAO figures from 2012, carbon dioxide emissions from both coastal and deep-sea fishing vessels amounted to 172.3 megatonnes, which is equivalent to 0.5% of the year's total emissions. (8) A study published in the journal Nature also estimates that emissions from the world's fishing sector increased by 28% in the period 1990–2011 while production stagnated, even declined, which is characteristic of a system suffering productivity loss. (9) So not only is the fishing sector vulnerable to the growing effects of climate change, it is also contributing to the climate crisis. Given that ocean food webs and marine ecosystems play a key role in the natural ocean carbon cycle (10), by destabilizing them, overfishing degrades the oceans' capacity to regulate the climate.

Use more energy to catch fewer fish? This is exactly the effect the consequences of climate change and the over-exploitation of fish stocks are having on the fishing sector. In the light of the above, the establishment of more effective controls for the sector appears to be indispensable if we are to promote sustainable fishing practices that take into account ecosystems so as to protect both the resources and the populations that depend upon them.

Focus: The role of marine ecosystems in the biological carbon pump

Over the course of recent decades the oceans have slowed down the rate of human-induced climate change by absorbing close to 30% of the carbon dioxide emitted by human activities. The ocean carbon cycle relies not only on physico-chemical processes but also on biological processes wherein phytoplankton, zooplankton and more generally marine ecosystems play a leading role. (10) In a study published in Frontiers in Marine Science (11), scientists argue that putting an end to overfishing would increase the oceans' resilience in the face of climate change. By capturing and storing carbon that would otherwise enter the atmosphere and contribute to climate change, healthy fish populations and marine ecosystems can contribute to mitigating global warming, thus protecting the oceans and making marine life more resistant through a cycle of positive feedback.



Biological carbon pump - OCEAN AND CLIMATE, 2016 – Fact sheets, Second Edition.

RE-ESTABLISH SUSTAINABLE FISHING TO PROTECT ECOSYSTEMS AND THE CLIMATE

Mobilize international political will to champion sustainable fishing

If we are to tackle the impacts fishing and climate change have on the oceans and the resources they contain, fishing activities must be managed and controlled at international level. On the whole, this is what the European Union is attempting to do today. But for deep-sea resources, the model has for the most part yet to be built. We need to aim for a collaborative and multilateral model which is both inclusive and adaptable.

Any fisheries management must be founded on scientific opinion so that catches can be tailored to what the ecosystems can sustainably produce. To do this, numerous tools for assessing fish stocks exist; however their application on a global scale is still far from systematic. Above all, numerous political decisions continue to ignore scientific recommendations. For instance 48% of fishing quotas fixed by the European Union in 2020 for the North-East Atlantic are higher than those recommended by scientists. (12 & 13)

More generally, acknowledging the true value of the benefits provided by healthy ecosystems must be indispensable to the emergence of a common and ambitious political resolve founded on sustainability. According to a study by the New Economics Foundation, the climate and ecosystem services engendered by the demise of overfishing in Europe would produce food for 89 million European citizens, generate an annual revenue of 1.6 billion euros, and create 20,000 new jobs. (12) In addition to a reassessment of ecosystem benefits, the notion of the fishing sector's resilience must be central to any management strategy. It can be promoted through the use of international certification systems and sustainable fishing quality labels, such as the Marine Stewardship Council (MSC), which advocate multiple sustainable development goals at the heart of their certification. Systems for certifying sustainable fishing and labelling sustainable fishing products encourage those actively involved in the fishing sector to implement improvements, in particular by increasing international collaboration between politicians, scientists and fishers. (16)

Lastly, and perhaps above all, the notion of marine ecosystem resilience is crucial in the context of climate change and should inspire all fisheries management policies. It involves restoring ecosystems to good health by preserving habitats and marine biodiversity in all its specific, genetic and functional components. It guarantees, in fact, the very resilience of the fishing sector itself. This approach requires putting an end to overfishing permanently, promoting ecosystem-based fisheries management, and placing the Sustainable Development Goals (SDGs) at the heart of the sector's governance.

Put an end to overfishing

During the reform of the Common Fisheries Policy (CFP) in 2013, the European Union set itself the goal of ending overfishing in its waters by 2020 at the latest. Progress has certainly been made in this direction. In its 2020 report the Scientific, Technical and Economic Committee for Fisheries (STECF) of the European Union highlighted improvements in the situation in the waters of the North-East Atlantic. (17) The pressure of fishing exerted in the zone has been almost halved over the last twenty years and stocks of the fish populations have increased by close to 50%. Nevertheless, with the baseline so low, such improvements are clearly insufficient. Nearly 40% of European stocks are still overexploited in the Atlantic and no improvements have been recorded in the Mediterranean where up to 90% of the stocks are overfished. The European Union's goal is still far from being achieved. Nevertheless developments observed in the Atlantic prove that it is possible to halt the destructive process of overexploiting resources for the benefit of marine ecosystems and the fishers themselves.

At an international level the targets 14.4 and 14.6 of SDG 14, which focuses on life below water, also requires that the over-exploitation of resources be brought to an end, it being a key step to driving the fishing sector towards a more sustainable model. Target 14.6 calls for all forms of subsidies that contribute to developing or maintaining overfishing to be banned. This is a decisive factor because subsidies are known to play a particularly harmful role, both on a global scale and at a European level. In 2005 the European Union banned subsidies for building fishing vessels. However a recent vote in the European Parliament seeks to reintroduce them. And it persists in applying a policy of fuel tax exemptions which are often considered a form of fishing subsidy… which benefit foremost the least ethical fishing devices, those which scour the sea floor and burn large amounts of diesel and emit large amounts of CO2.

Encourage an ecosystem approach to fisheries

Managing fisheries using maximum sustainable yield is now coming up against the model's many limits, notably because of its monospecific focus. Stopping overfishing is, therefore, insufficient and many scientists are calling for an ecosystem approach to fisheries as an integral part of a wider regulation of maritime activities based on ecosystems. The aim of this approach to fisheries management is to take into account the many vital interactions that occur between species living in the oceans. Its goal is to reconcile exploitation and conservation, and thus strengthen the resilience of ecosystems in the face of climate change.

Some scientists are calling for maximum sustainable yield (MSY) to be abandoned in favour of maximum economic yield (MEY). (15) In this model, fishing pressure is lower than for MSY. Production costs are similarly reduced and the economic profitability of fishing companies is optimized as a result. Equally, the reduction of fishing pressure helps maintain more abundant fish populations in the sea. A reduction in environmental impact goes hand in hand with an improvement in economic performance.

More generally, the targets in monospecific management and the objective of maximum sustainable yield must be reassessed so that they may take into account ecosystems and counterbalance the new issues generated by climate change. (3) New management targets should also take into account the question of conservation and integrate a minimum biomass threshold below which a population should never fall, or run the risk of the population no longer playing its role within the ecosystem. These thresholds still need to be determined for the most part; however as a conservative estimate some scientists have suggested a threshold equal to 50% of the unexploited biomass, which is markedly higher than the 35% obtained through the MSY management model. (7) And for forage species (i.e. small fish at the bottom of the food chain which are preyed upon by large predators), this threshold should be raised to 60%, even 70%.

These more careful management thresholds could be achieved while at the same time maintaining high catches, on condition of significantly increasing the mesh size of fishing devices and the minimum landing sizes. This would leave the youngest fish in the water, catching only the few large ones. Fishing devices such as trawl nets should be gradually replaced with devices that are less destructive to biodiversity and habitats. More generally, the smart management of each fishing fleet would limit the impacts of the fisheries by making the most ethical practices more attractive, by encouraging innovation, and by promoting small-scale fishing operations.

Lastly, an ecosystem approach to fishing must be compatible with the Sustainable Development Goals (SDGs) and sustainability science. It needs to encourage synergies and interactions between Sustainable Development Goals so that they provide a suitable response to the various issues relating to maintaining biodiversity, feeding populations, unequal access to resources, job stability, and climate action.

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