ONE OCEAN FOUNDATION

Ocean Disclosure Initiative

FISHING INDUSTRY REVIEW

SDA Bocconi SCHOOL OF MANAGEMENT
SUSTAINABILITY LAB

McKinsey & Company

CSIC
Consejo Superior de Investigaciones Científicas

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About One Ocean Foundation

This research is an initiative of the One Ocean Foundation, as part of its project Ocean Disclosure Initiative.

The mission of the Foundation is to accelerate solutions to Ocean issues by inspiring international leaders, institutions, companies, and people; promoting sustainable blue economy and enhancing ocean knowledge through ocean literacy.

Thanks to an international network of contacts (companies, institutions, entrepreneurs, sportsmen, yacht clubs, influencers, etc.) the One Ocean Foundation intends to develop a leading platform, bringing together and strengthening the voices speaking out on behalf of the ocean around the world, from a collaborative, not competitive, perspective.

The distinctive feature of One Ocean Foundation is its scientific scope and, at the same time, its strong educational drive, in order to increase awareness and establish constructive relationships between all stakeholders engaged in marine preservation at different levels.

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About the Ocean Disclosure Initiative

The Ocean Disclosure Initiative project is part of the multi-year research “Business for Ocean Sustainability” promoted by the One Ocean Foundation (OOF), in collaboration with SDA Bocconi School of Management Sustainability Lab, McKinsey & Company and CSIC (Consejo Superior de Investigaciones Científicas) and aimed at building knowledge about the relationship between the business and the ocean.

The project started in 2019 with the goal of investigating the role of companies in addressing ocean challenges, focusing on the pressures on marine ecosystems, the level of awareness within the business community and the main (technological and organizational) responses implemented.

The Ocean Disclosure Initiative has the ambition to be a science-based framework and methodology aimed at supporting businesses from all industries in taking action on ocean-related issues, promoting prevention and/or mitigation responses and favouring disclosure and reporting.

Introduction to the fishing industry

The fishing industry includes any industry or activity concerned with taking, processing, preserving, storing, transporting, marketing or selling fish or fish products. It is defined by the Food and Agriculture Organization (FAO) as including recreational, subsistence and commercial fishing, and the related harvesting and processing sectors[1].

The fishing industry is also notorious for the pressures it exerts on marine ecosystems, as such is one of the sector analysed in the framework of the Ocean Disclosure Initiative (ODI), by reviewing relevant material and sectoral publications on the environmental pressures of the industry, along with sustainability reports from the main stakeholders in the sector. The core objective of the analysis is to map and better understand the pressures exerted on marine ecosystems thus creating the basis for the industry-specific edition of the ODI tool dedicated to fishing. To this end, the following paragraphs introduce the industry and present its main pressures on the ocean.

Marine resources, especially seafood, are critical to human life. Beyond the nutritional and dietary values, the economic value of the fishing industry is paramount not only for communities living in coastal areas but also for those living inland. Moreover, marine biodiversity is a catalyst for the provision of various ecosystem services from the fishing sector linked to tourism, water transportation, erosion control and habitat provision.

Despite the well-demonstrated added value, marine ecosystems are severely exploited. In particular, the soaring demand and consumption of fish have increased the pressures exerted by the fishing industry on marine ecosystems. This trend has led to the development and employment of new fishing technologies, resulting in fish extraction on an unprecedented scale, often at unsustainable rates (overfishing).

THE FISHING INDUSTRY PLAYS AN ESSENTIAL ROLE FOR HUMAN POPULATION. HOWEVER, IT EXERTS SEVERAL PRESSURES ON THE HEALTH OF THE OCEAN THAT CAN LEAD TO LONG-TERM AND IRREVERSIBLE DAMAGES.

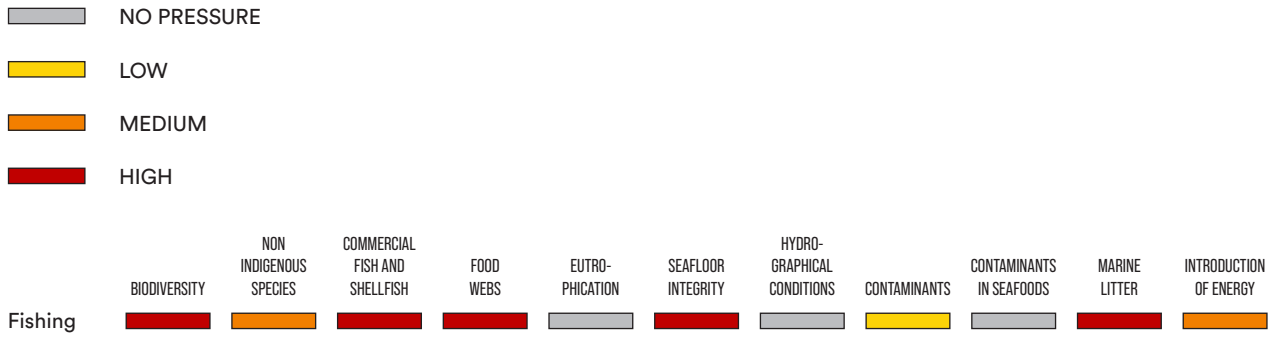
1. FAO Fisheries Section: Glossary: Fishing industry.

As such, fish populations struggle or fail to replenish themselves, in order to satisfy the needs of the growing global population. For these reasons, overfishing has traditionally been considered to be the major environmental pressure exerted by fisheries. However, fishing operations at large are responsible for a plethora of environmental pressures which need to be prevented or otherwise managed, mitigated, and ideally remediated.

The scientific review conducted, as shown in figure 1, verified that the most significant pressures for ocean health concern:

— Loss or reduction of biodiversity
— Depletion of stocks of commercial fish and shellfish
— Alteration of food webs
— Deterioration of seawater and seabed physical integrity
— Introduction of marine litter

FIGURE 1: Review of the negative pressures of the fishing industry*



Source: Ocean Disclosure Initiative, One Ocean Foundation, 2021

* Pressures exerted on the eleven Good Environmental Status descriptors (GES) of EU marine waters, listed in the figure as identified in the Marine Strategy Framework Directive of the European Union. https://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm

The main pressures exerted by the fishing industry

Overfishing, use of potentially unsustainable fishing techniques (including Fish Aggregating Devices – FADs), bycatch of vulnerable species and discarding or loss of ghost nets represent just some of the key issues that can contribute to altering the functioning and structure of the marine ecosystem, leading to long-term and irreversible damages.

The main pressures exerted by the fishing sector on the marine environment are listed below:

1. Exploitation of commercial fish stock and consequences on food webs

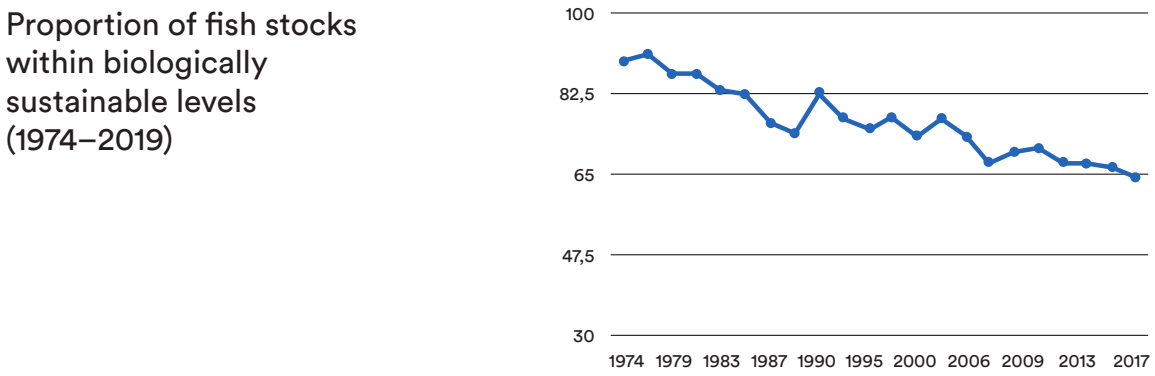
Commercially exploited fish and shellfish are all living marine resources targeted for economic profit. To avoid endangering marine ecosystems, fish stocks should (i) be exploited sustainably (ii) ensure full reproductive capacity to maintain stock biomass, and (iii) maintain (or preferably increase) the proportion of older and larger fish/shellfish, which represents an indicator of a healthy stock[2]. Despite these conditions which need to be respected, the increasing demand for seafood at the global level has led to an escalation of the overfishing phenomenon.

THE OVERFISHING PHENOMENON, TRIGGERED BY THE INCREASING DEMAND FOR SEAFOOD, IS LEADING TO DEPLETION OF FISH STOCKS AND DAMAGES TO THE MARINE ECOSYSTEMS.

2. EU Costal and marine policy, Good environmental status
https://ec.europa.eu/environment/marine/good-environmental-status/descriptor-3/index_en.htm

Specifically, as shown in figure 2, based on FAO's assessment, the proportion of fishery stocks sitting within biologically sustainable levels fell to 64.6% in 2019, a decrease of 1.2% compared to 2017, but a staggering 25.4% lower than the 90% reported in 1974.

FIGURE 2: Proportion of fish stocks within biologically sustainable levels



Source: FAO. 2022. Indicators. In: Sustainable Development Goals.

Common fishing methods that, if not well managed, could result in major impacts on fish stocks' abundance include, among others, the purse seining technique, which consists of an enormous net that encircles schools of fish, and the pelagic pair trawl technique, which uses a trawler net suspended mid-water to catch pelagic species.

Best practices. To avoid the exploitation of commercial fish stock and the related consequences on food webs, best practices include the use of less environmentally damaging techniques and the strengthening of fishery management measures with respect to national and international regulations and guidelines. For instance, harvest strategies, and in particular the Harvest Control Rules – HCRs, represent a useful tool to regulate fishing activities and to improve fishery management towards a more sustainable use of resources; indeed, they provide a pre-agreed framework to make managerial decisions on fishery in a long-term perspective, based on scientific advice, monitoring programmes, indicators on fish status, target reference points, management objectives and assessment methodologies that aim both to safeguard the health of fish stock and to guarantee the fishing sector activities.

Finally, special attention needs to be paid to the issue of illegal, unreported and unregulated (IUU) fishing, in violation of both national and international fishing regulations, which is still considered one of the main threats to the marine ecosystem.

2. Fishing practices detrimental to seafloor integrity

Damage to seafloor integrity refers to alterations to the structure and function of seabed habitats and their communities, often associated with harmful practices implemented by the fishing industry. Indeed, it is proven that the use of specific gears towed on the seabed, considered harmful and not selective such as trawlers and dredgers, negatively affect the ecological status of the ocean bottom, causing the destruction of entire marine ecosystems and associated living biota. Moreover, mobile demersal fishing gears[3] can affect sediment properties such as structure, granulometry and topography[4].

THE IMPROPER USE OF CERTAIN FISHING TECHNIQUES, MOSTLY THOSE INVOLVING DEMERSAL FISHING GEARS, COULD RESULT IN DAMAGES TO THE INTEGRITY OF THE SEAFLOOR AND TO THE ASSOCIATED BIODIVERSITY.

The magnitude of the impact exerted by these fishing practices on the seafloor depends not only on the selected fishing method and gear, but also on the characteristics of the area, including the type of sediment and the presence of sensitive species such as deep-sea corals. It is quite common that hard, stable, and highly structured habitats, like biogenic reefs and seagrass meadows, experience long-term damage and greater disturbance from harmful fishing practices compared to other habitats like highly dynamic and soft bottoms that tend to be less severely impacted even though affected by heavy dredges[5] (including hydraulic ones). Literature reports that around five million km^2 of seabed is trawled each year[6] and that the same bottom areas can be targeted more than once[7].

3. Demersal fisheries incorporate all different fishing methods to catch fish and shellfish both directly on and close to the seabed.
4. Epstein, G., Middelburg, J. J., Hawkins, J. P., Norris, C. R., & Roberts, C. M. (2022). The impact of mobile demersal fishing on carbon storage in seabed sediments. Global Change Biology, 28(9), 2875-2894.
5. FAO, Fisheries impact on the ecosystem https://www.fao.org/3/y4773e/y4773e05.htm
6. Sala, E., Mayorga, J., Bradley, D., Cabral, R. B., Atwood, T. B., Auber, A., ... & Lubchenco, J. (2021). Protecting the global ocean for biodiversity, food and climate. Nature, 592(7854), 397-402.
7. Hilborn, R., & Hilborn, U. (2019). Ocean Recovery: A sustainable future for global fisheries? Oxford University Press.

It is also worth noting that the seafloor constitutes an important carbon storage system and the negative impacts from bottom trawling activities may have consequences on the storage capacity of marine sediments.

Indeed, physical disturbance of the seafloor due to mobile fishing gears may generate a source of 'underwater carbon dioxide emission' through mixing, resuspension and smothering of sediments, thus, contributing to the release of the organic carbon content buried over time[8] and eventually affecting the global amount of CO_2.

Best practices. Adoption of innovative and more selective fishing methods and the implementation of modified gears could limit the impact on the seabed, as well as the avoidance of sensitive areas that include fragile habitats and the presence of protected and vulnerable marine species. Moreover, best practices also include the application of vessel codes of conduct, the enaction of fishery regulations related to coastal and offshore fishing areas, and the respect of the boundaries and the limits of established fishing zones (FAO Major Fishing Areas)[9].

3. Marine litter and waste, including bio-waste

The fishing industry generates considerable amounts of waste and discards that can easily enter the marine environment, especially when produced onboard during fishing operations. The most abundant material is plastic, today considered a major cause of ocean pollution. Plastic material mechanically fragments into smaller pieces known as micro and nano plastics which could be contaminated by chemical substances present in the water column and have the potential to enter food webs and accumulate through trophic levels, from plankton to marine mammals and top predators, eventually also affecting commercial seafood.

8. Epstein, G., Middelburg, J. J., Hawkins, J. P., Norris, C. R., & Roberts, C. M. (2022). The impact of mobile demersal fishing on carbon storage in seabed sediments. Global Change Biology, 28(9), 2875-2894.
9. FAO Major Fishing Areas, https://www.fao.org/fishery/en/area/search

Such particles are formed and can be released over time from gears and materials accidentally dispersed in the sea, including fish boxes in polystyrene foam (Styrofoam) and nets usually made by nylon and synthetic fibres. In this regard, lost or abandoned fishing gears represent a critical risk for the health of the marine environment. In fact discarded nets, including entangling FADs, can often become ghost nets. These are huge, tangled nets that can float and travel great distances in the ocean further trapping ropes, fishing rods and hooks while at the same time catching fish indefinitely, often affecting vulnerable and non-commercial species, such as sea turtles and marine mammals, which remain entangled.

These nets account for 46% to 70% of surface floating macro plastics (by weight) in the ocean[10] and it is estimated that they represent between 500,000 and 1 million tonnes of fishing gear abandoned in the ocean every year[11]. Ghost nets not only trap marine species, but also contribute to damaging sensitive marine habitats, like coral reefs, even in the most remote areas of the ocean, as indicated by images and data from deep sea explorations[12]. Sources of waste from fishing operations may also include bycatch discards and commercial fish discards (bio-waste).

The bycatch phenomenon refers to the accidental capture and mortality of non-target marine species, such as dolphins, sea turtles and sea birds, which do not have commercial value and are consequently discarded after being caught in the fishing process. Bycatch represents a serious threat to the marine ecosystem, contributing to the decrease in species abundance and depletion of marine stock; animals that are discarded are usually dead – or if not, often die soon after – and cannot reproduce.

On the contrary, the reasons that force fishermen to discard commercial fish, or parts of it, are multiple, including target species that do not reach commercial size, being too small, fish that are not edible and/or damaged or the exceeding of fish quotas: if catches are over the limit set by quotas, operators are required to throw the redundant fish volumes back into the ocean. According to FAO, the magnitude of annual discards in global marine capture fisheries was estimated at 9.1 million tonnes, which represented 10.8% of the annual average catch between 2010 and 2014[13].

PLASTIC, POLYSTYRENE FOAM AND ABANDONED NETS ARE THE MOST PRODUCED WASTE BY THE FISHING INDUSTRY. IF NOT WELL MANAGED, THEY COULD REPRESENT A SERIOUS RISK FOR THE MARINE ENVIRONMENT.

10. OOF (2021), “Ocean Disclosure Initiative”
11. WWF (2020), Ghost Gear Report
12. Ibidem
13. FAO (2019), A third assessment of global marine fisheries discards, Technical Paper n.663

Waste and bio-waste may also be produced by (near) shore and land fishing operations occurring in processing plants. These activities are usually related to the handling and transformation of raw fish into a final commercial product for the fishery market and may entail the release of waste, in particular bio-waste and wastewater, which can end up in the marine environment, and lead to harmful consequences such as proliferation of algal blooms and oxygen depletion (anoxia). Bio-waste mainly includes floating and suspended residuals of organic nature such as fish oils, fat and by-products rich in nutrients (nitrogen and phosphorous) that can end up in the ocean, together with a mixture of other contaminants (chemicals compounds, disinfectants, etc.) from the seafood production chain[14]. This mechanism can work as a catalyst for the eutrophication of marine waters. Despite being organic substances, discharges of bio-waste could contribute to the alteration of several chemical and physical parameters of waters, including pH, salinity, temperature, amount of oxygen, and the overall abundance of organisms[15].

Best practices. The implementation of waste management plans both on board and on land, including correct procedures for the disposal, treatment and recovery of plastic materials, solid waste, bio-waste discards and wastewater, is necessary to limit the possibility of polluting the marine environment. Discards can be recycled and used as fertilisers, a source of food, energy and industrial feedstock (biodiesel); for example, fish protein and oils, rich in amino acids, are suitable for human consumption and can be used to produce margarine and omega-3 fatty acids.

Other best practices include the adoption of specific and improved fishing gears designed to avoid bycatch and to be more selective with regard to target and commercial species; for example, size and shape of nets and mesh designed to trap only adult fish while avoiding juveniles and smaller individuals, or gears that include “escape routes” for non-target species like sea turtles – Turtle Excluder Devices (TED), or even the introduction of innovative fishing gears that include a GPS to track discarded or lost ghost nets.

Finally, the inclusion of Marine Fauna Observer and qualified personnel on board vessels is considered an effective way to ensure the protection of non-target and vulnerable marine species.

14. Tay, J. H., Show, K. Y., & Hung, Y. T. (2004). Seafood processing wastewater treatment. In Handbook of industrial and hazardous wastes treatment (pp. 706-749). CRC Press.
15. Barnett, M. (2019). The Effects of Fish Processing Bio-Waste on the Ocean’s Organisms and Nutrients. ScienceBuzz. URL https://www. sciencebuzz.com/the-effects-of-fish-processing-bio-waste-on-the-oceans-organisms-and-nutrients/ (accessed on 5.10.20).

4. GHG emissions and air pollution

Seafood is a protein with a much lower carbon footprint in comparison with protein sourced from meat. Nevertheless, fisheries remain energy-intensive operations that produce most of their emissions directly from the fossil fuels used for vessel propulsion and onboard equipment such as refrigerants: according to the IMO, the GHG emissions of the global fishing fleet accounted for 40 million tonnes of CO_2 in 2018[16]. Clearly, emissions from fishing fleets vary considerably across and within fleets that use different amounts and types of fuel. Nevertheless, not all fishing techniques are equal. Demersal fisheries are highly fuel inefficient and produce most of the fishing industry's direct greenhouse gas emissions. The latter is also the result of the aforementioned disturbance of carbon stored in seabed sediments[17].

GHG EMISSIONS LINKED TO THE FISHING INDUSTRY ARE MAINLY CAUSED BY FISHING VESSEL PROPULSION AND ONBOARD EQUIPMENT. DEMERSAL FISHERIES REPRESENT THE MOST FUEL INEFFICIENT TECHNIQUE.

Overall, emissions from the industry have progressively increased over the years for various reasons[18]. Some of these include longer routes for fishing vessels as a result of fish stock depletion and fishing operations in deeper waters, which require the use of heavier gears and higher fuel consumption[19].

Other sources of GHG emissions for this sector can be found in the use of raw materials, packaging, and other supply chain components, as well as distribution and logistics management operations (onboard processing, refrigeration and freezing).

To sum up, in addition to the emission of air pollutants, new research on the disruption of the seabed and the consequent release of the carbon stored in marine sediments due to trawl fishing indicates that the polluting impact of the fishing industry is greater than previously thought[20].

16. Fourth IMO GHG Study 2020.
17. Epstein, G., Middelburg, J. J., Hawkins, J. P., Norris, C. R., & Roberts, C. M. (2022). The impact of mobile demersal fishing on carbon storage in seabed sediments. Global Change Biology, 28(9), 2875-2894.
18. Parker, R. W., Blanchard, J. L., Gardner, C., Green, B. S., Hartmann, K., Tyedmers, P. H., & Watson, R. A. (2018). Fuel use and greenhouse gas emissions of world fisheries. Nature Climate Change, 8(4), 333-337
19. The carbon footprint of fisheries https://stecf.jrc.ec.europa.eu/c/document_library/get_file?uuid=924c1ba8-94af-440d-94cb-f9cb124d2d57&groupId=12762.
20. Sala, E., Mayorga, J., Bradley, D., Cabral, R. B., Atwood, T. B., Auber, A., ... & Lubchenco, J. (2021). Protecting the global ocean for biodiversity, food and climate. Nature, 592(7854), 397-402.

Best practices. Technological innovations (e.g., energy reduction in fishing practices and more efficient post-harvest and distribution systems) could improve the sector's sustainability, contributing to reducing its carbon footprint. Moreover, a change in fishing methods and gears can be promoted by removing environmentally harmful fuel subsidies and phasing out fuel tax exemption for fisheries, while at the same time providing financial and other incentives for alternative, less impactful fishing techniques.

Given that fishing activities rely on movement of vessels, the sector may contribute to the introduction of non-indigenous species (NIS) into the marine environment – through ballast waters and biofouling – as well as to ship strikes and possible collisions with marine megafauna.

POTENTIALLY POLLUTING CHEMICAL AND BIOLOGICAL COMPOUNDS COULD BE RELEASED INTO MARINE WATERS BY FISHING OPERATIONS.

Finally, the fishing industry can also contribute to the increase in the levels of contaminants present in marine waters. These substances include chemical and biological compounds with the potential to damage the marine environment. Contaminants are commonly present in wastewater discharges from fishing vessel operations or (near) shore fish processing operations. Routine maintenance of fishing boats, including painting, fuelling, repairing and greasing, produces considerable amounts of substances that can easily end up in the sea. In addition, water used for the cleaning of holding tanks or for storing fish products onboard can introduce contaminants such as disinfectants and detergents, and fish bio-waste and organic material respectively.

A specific case can be made for heavy metals. Elements like cadmium, mercury, lead, iron, naturally found in the Earth's crust at normal concentrations, can prove detrimental to aquatic organisms when excessively agglomerated due to fishing operations, especially considering their toxicity, persistency, bioaccumulation, and bio magnification properties[21].

21. Garai, P., Banerjee, P., Mondal, P., & Saha, N. C. (2021). Effect of heavy metals on fishes: Toxicity and bioaccumulation. J Clin Toxicol. S, 18.

Sustainability certification programmes

The fishing sector is benefitting from the existence of voluntary and fully independent certification programmes that strive to improve the sustainability and responsibility of seafood supply chains through raising awareness, driving the development of commitments and engagement in improvements. Fishing standards and certification schemes provide practical sustainability benchmarks that can help consumers to make more informed choices on sustainable production methods when it comes to buying seafood.

The main criteria that the most important certifications track with their checklists, standards and procedures include: i) impacts on critical and sensitive habitats (e.g. seabed, reefs, etc.) ii) bycatch of vulnerable and non-target species iii) overfishing of target fish stock iv) management of waste and discards v) compliance with social accountability and legal requirements. Legal requirements, in particular, include the avoidance of illegal, unreported and unregulated (IUU) fishery products, the respect of quotas and total allowable catches (TACs), together with the minimum fish size that can be fished, and limits related to fishing gears, such as the size of mesh and nets.

VOLUNTARY CERTIFICATION PROGRAMMES AND STANDARDS REPRESENT VALID TOOLS TO IMPROVE FISHING INDUSTRY'S PERFORMANCE AND MAKE IT MORE SUSTAINABLE.

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