

Fishery Resources in the Mediterranean

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The fishery tradition in the Mediterranean is today experiencing a very precarious situation as a result of overexploitation of resources in the last few decades. The difficulties of management shared between different countries which have territorial waters in the basin, along with the ever growing demand for caught species, reveal the inefficiency of the current fishery model. Other factors contribute to the depletion of resources, such as the degradation of ecosystems, the advance of climate change or the price competition resulting from globalisation. This means that the future of fishery relies on a set of decisions that guarantee the preservation of species and put an end to policies for attaining short-term economic profits.

Introduction

Fishery in the Mediterranean has a centuries-long tradition. Greek and Latin writers make many references to it, and fish, or transformed products such as the *garum*, were often consumed. Technological progress and new techniques developed over centuries have gradually increased the fishery capacity of coastal peoples. However, the expansion in the use of the engine, around one hundred years ago, and the new materials that have more recently appeared meant that the 20th century saw a significant increase in fishery pressure, with serious consequences for the state of resources.

The Mediterranean is characterised, in comparison to the adjacent Atlantic, by its productive poverty and the narrowness of its continental shelves. With the exception of the large pelagic fish, such as the bluefin tuna or

swordfish, most fishery is carried out on the continental shelf (up to 200 metres deep) or on the upper part of the continental slope (up to 500 metres, exceptionally 800). The Mediterranean only has wide shelves in the Northern Adriatic, the Gulf of Gabès in Tunisia's east coast and, to a lesser extent, in the Gulf of Lions, the south of Sicily and the central area of the Iberian Peninsula.

If we compare the Mediterranean with the Black Sea, we realise that both seas have diverse juridical systems. In the former, the coastal countries have territorial waters up to 12 nautical miles from the baseline (6 in the Aegean Sea) although some countries have established areas of fishery or ecological protection (Spain, France, Algeria, Croatia, Libya and Malta) or even claimed exclusive economic zones (Morocco, Tunisia, Egypt, Cyprus and Syria). Nevertheless, we can say that in the Mediterranean

there is still an important area of international waters or high seas. In contrast, the Black Sea is completely shared into exclusive economic zones between riparian countries and there are no international waters.

In 2009, Mediterranean and Black Sea landings represented 1.7% of world fishery.¹ This rate has gradually decreased since 1950 – the first year with data available –, when it reached 3.8%. In any case, the total annual catches reported rose from 700,000 tonnes in 1950 to around 1.5 million tonnes in 2000. There was a peak in the 1980s, with 2 million, mainly due to the large catches in the Black Sea which later collapsed because of an invasive species, as we will see later on.²

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For an overall perspective approach to Mediterranean fishery, we will classify fisheries into three main groups: large pelagic fish, small pelagic fish, and demersal.

Large Pelagic Fish

Large pelagic fisheries target a few large-scale and highly migratory species, mainly the bluefin tuna and swordfish, but also some sharks, dolphinfish and some smaller tuna-like fish. This fishery is heavily industrialised and internationalised. Most of the catch occurs in international waters, beyond the 12 miles of territorial waters. In addition to the fleets of coastal states, fleets of distant countries and

with flags of convenience also fish them, hence IUU (illegal, unreported and unregulated) fishing is significant.

Bluefin tuna fishery traditionally used Mediterranean tuna traps and hook-and-lines. During the 20th century, Mediterranean tuna traps began to have economic problems and many disappeared. Today only a few remain in Sardinia, Sicily, Tunisia, and the Atlantic side of southern Spain. At the end of the century, purse seine started to be introduced, providing access to sections of the population of bluefin tuna, generally small-sized, which were not fished with traditional methods. Later, the technique of fattening up tuna in cages was introduced. Tuna caught by purse seine are kept alive in the water and transported towards the coast, housed in cages and fed with fresh or frozen fish. The objective is for them to attain the right level of fat and slaughter them when market conditions dictate. These techniques have made possible a supply of fresh tuna out of season, so that the market has expanded, above all in Japan, where the price of this species is particularly high. All this has resulted in increased fishery pressure on the tuna that has placed the population at very worrying overexploitation levels.

Fishery of large pelagics is also carried out with surface longlines and driftnets. Although the latter are prohibited in the Mediterranean, they are still used in some zones, often under traditional names. The main objective of these methods, longlines and driftnets, are swordfish and large pelagic sharks, but they have a great incidental impact on species of no commercial interest and very often protected, such as turtles, marine mammals and birds.

1. Capture Production 1950-2009 Database and FishSTAT Plus – Universal software for fishery statistical time series, Food and Agriculture Organization of the United Nations (FAO), <http://www.fao.org/fishery/statistics/software/fishstat/en>.

2. J. Lleonart, B5 – Mediterranean and Black Sea, FAO statistical area 37 (table D5), "Review of the state of the world marine fishery resources", *FAO Fisheries Technical Paper*, No. 457, Rome, Marine Resources Service, Fishery Resources Division, FAO, 2005, pp. 49-64 and 220-221.

Small Pelagic Fish

Small pelagic fish is a group of species that live more or less close to the surface with no relation to the seabed, small, non-migratory and distributed mostly not far from the coast. They are the main fishery resource of the Mediterranean in quantity of catches, sustained basically by three species: the sardine, anchovy and round sardinella. The three produce around 40% of the reported landings,³ the sardine being the main one. The round sardinella is a species of tropical distribution and is caught mainly on the southern shore of the Mediterranean. In the Black Sea, the small pelagic fish are even more important, with two main species: the anchovy and the sprat. Small pelagic fish are mainly caught with pelagic trawling, a technique prohibited in some countries, and purse seine. If we add the medium-size pelagic fish, mainly mackerel and horse mackerel, the importance of the pelagic group increases to more than half of the total catch in both seas.

Demersal Fish

Demersal species inhabit the seabed or live in close relation to it. The number of species of this group is high and its market value is highly varied according to species and zone. Moreover, the techniques used to fish it are extraordinarily varied and diverse, and include bottom trawling, gillnets, trammel nets, bottom longlines, dredges, traps, and so on. The importance of demersal species is due to the amounts caught (around 50% of the total in the Mediterranean), but also their price. Half of the demersal catch is made up of fish. The most significant resource is hake, a highly appreciated species

throughout the Mediterranean basin, followed by the red mullet. The bogue is a very important resource in the eastern Mediterranean – but not in the western –, both in terms of catch and price. Other demersal fish species with an important role in some regions or throughout the Mediterranean are the common pandora, picarels, blue whiting, gilthead seabream and flatfish, particularly sole. Worthy of note in the Black Sea are whiting, a species also partly fished in the Adriatic, and turbot, whose price makes it an important resource although it does not account for big catches.

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Molluscs account for around 10% of total catch, the double if we only take into consideration demersal fish. Among bivalves, the striped venus is the most caught species, particularly in the Adriatic, where it is fished with hydraulic dredges, a technique not allowed in other areas. The octopus and other cephalopods, such as cuttlefish and squid, are also very important: their catch represents 6% of the total, but some species fetch a good price.

Regarding crustaceans, normally their catches oscillate at around 6% of the total, but their prices are usually high, and for fishermen they are a good source of income. We must mention the blue and red shrimp, a species with a very high price, but also the deep-water rose shrimp, Norway lobster and camarote prawn. Other crustaceans, such as crabs or spottail mantis squillids, are abundant but fetch a lower price. Crustaceans, especially the blue

3. GFCM capture production 1970-2008 Database and FishSTAT Plus – Universal software for fishery statistical time series, FAO, <http://www.fao.org/fishery/statistics/software/fishstat/en>.

and red shrimp, are species fished at the deepest levels of the Mediterranean: some trawlers manage to fish at a depth of 800 metres in the western basin.

Fishery in the Mediterranean is largely destined to direct human consumption, often fresh. There is no significant production of fishmeal and oil. Part of the catch of small pelagic fish is to feed caged tunas. Some low price species are used as bait for longline fishing, although in both cases frozen fish is also imported from other parts of the world.

Fishing in a Changing World

In the Mediterranean, we must mention that it has been, and is being, colonised by invasive species; that is, organisms from other places of the world that arrive in a new habitat where they did not previously exist, colonise it and live in it. Normally the transport is anthropogenic, voluntary or involuntary as a result of other activities. The most usual systems of introducing species are aquaculture, aquarology, biofouling and ballast water. In the Mediterranean, the Suez Canal is a channel of introduction of many species from the Red Sea, known as Lessepsian, which have profoundly changed the biocoenosis of the eastern Mediterranean. In 2000, 60 species were recorded of Indo-Pacific origin in the eastern basin of the Mediterranean^{4,5} which produced very significant changes in fishery in the Levantine basin.

One of the species introduced that has caused many problems is the *Mnemiopsis leidyi*, a comb jellyfish which moved from the western Atlantic to the Black Sea through ballast water. This organism is a predator of

eggs and larvae of small pelagic fish and was the cause of the collapse of the anchovy in the Black Sea in the late 1980s. The anchovy catch fell from 600,000 to 100,000 tonnes, and for sprat, from 100,000 to under 20,000 tonnes, with very serious consequences for fishery activity. Later, this predator was detected in the Aegean and has recently been found in the western Mediterranean, near the Ebro river delta.

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Climate change and global warming are also relevant to these processes of alterations in the biodiversity. For example, the sprat, a species of northern distribution present in catches of the Mediterranean in the first half of the 20th century practically disappeared since then, and is currently only found in the Black Sea. In contrast, some species of tropical distribution, such as the round sardinella, have been increasing their presence towards the north of the Mediterranean, where they had been rare.

Overfishing and Management

Fishery overexploitation happens when more biomass than is generated through reproduction and growth is extracted from a fishery resource. Frequently, young animals are fished that are still growing and have not yet reproduced. Sometimes, the reproductive population

4. Y. Zaitsev and B. Öztürk, *Exotic Species in the Aegean, Marmara, Black, Azov and Caspian Seas*, No. 8, Istanbul, Turkish Marine Research Foundation, 2001.

5. D. Golani et al., *CIESM Atlas of Exotic Species in the Mediterranean: Fishes*, Vol. 1, Monaco, CIESM Publishers, 2002.

is reduced to very low levels, thus endangering the viability of the population. Although a resource with few reproducers can recover over time, it is very fragile in adverse environmental conditions and can collapse when there are unfavourable situations. In the history of fishery there are examples of resources that have not recovered after a collapse. Another kind of overexploitation is the degradation of the ecosystem, so that particularly sensitive or essential habitats in the life cycle of species are destroyed. This has happened in determined types of seabed, degraded by dredging or trawling.

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Two commissions carry out management of the resources in the Mediterranean at international level: the General Commission for Fishery in the Mediterranean (GFCM),⁶ responsible for managing fishery in the Mediterranean and the Black Sea, and the International Commission for the Conservation of Atlantic Tunas (ICCAT),⁷ responsible for large pelagic management. These commissions have scientific committees whose mission is to assess the resources and provide management recommendations to the Commission. Scientists and researchers form part of these committees but the scientific advice is rarely taken into account by the commissions, which frequently favour short-term economic interests under pressure

from national or business lobbies. These limitations on the process of assessing, advice and management, as well as a deficient mechanism of monitoring, control and surveillance, and a very limited data collection system, have taken the Mediterranean to a state of overexploitation of the resource generalised at almost all levels. Although a few resources cannot be considered generally overfished (for example, medium-sized pelagic fish, such as mackerel and horse mackerel) both the main demersal species (especially the hake) and the sardine, anchovy and bluefin tuna are in a worrying state of overexploitation. In contrast, there are no evaluations of many other demersal species, or of the other small pelagic fish or swordfish, so the level of exploitation to which they are subjected are not known.

In 1995, the United Nations Food and Agriculture Organization (FAO)⁸ adopted the Code of Conduct for Responsible Fisheries,⁹ a document whose objective is the practice of sustainable and responsible fishing with the aim of ensuring the conservation, management and development of marine resources. This document was endorsed by most countries, although its application is voluntary. In this context, for Mediterranean fishery management the application of two concepts promoted by the Code are particularly useful: the precautionary principle¹⁰ and the ecosystem approach to fisheries. The first establishes that the scarcity of scientific information must not be used as a reason for postponing or failing to take conservation and management measures, which happens all too frequently in the Mediterranean. For its part, the Ecosystem

6. <http://www.gfcm.org>.

7. <http://www.iccat.int>.

8. <http://www.fao.org/fi>.

9. *FAO Code of Conduct for Responsible Fisheries*, Rome, FAO, 1995, <http://www.fao.org/fishery/code/en>.

10. "Precautionary Approach to Capture Fisheries and Species Introductions", elaborated the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions), Lysekil, Sweden, 6-13 June 1995, *FAO Technical Guidelines for Responsible Fisheries*, No. 2, Rome, FAO, 1996.

Approach to Fisheries (EAF)^{11,12} consists of seeing fishery not only as a relation between a single-species resource and a fleet, following the classic approach, but also considering the ecosystem in which the resource lives and the socioeconomic environment of the fleet. The classic methods of assessment and management, developed for the big Atlantic single-species fisheries, are difficult to apply in the Mediterranean, which has numerous multi-species fisheries exploited with a variety of techniques and fragmented fleets. The use of TACs (total allowable catch) and quotas, the basis of the management of Atlantic fisheries, is not applicable to the Mediterranean (with the exception of the bluefin tuna). The weak fishery management in the Mediterranean is based on regulations, often not complied with, limiting the fishing effort and implementing technical measures, such as minimum mesh size or minimum legal sizes for some species. These, moreover, are almost always far below what would be recommended. The application of the ecosystem approach is, probably, the only possible option to adequately manage Mediterranean fishery, especially conservation of essential fish habitats and implementation of protected marine areas. This management, moreover, must be complemented by technical and economic measures that avoid subsidizing overfishing.

Aquaculture has acquired a growing importance in the Mediterranean and the Black Sea. In the 1960s, it barely represented 1% of total profit, while today it has exceeded 20%. 85% of aquaculture production corresponds to only three species: gilthead seabream, seabass and mussel, with more than 100,000 tonnes

of production each. The Japanese clam, with just over 30,000 tonnes per year, exceeds 8% of aquaculture production. Production of remaining species is much lower.

Some Final Reflections

In a world in crisis, the future of Mediterranean fishery is uncertain. Fishery is an activity involving nature and society. The resource exploited obeys certain laws, the laws of nature, to which man can do no more than adapt. Fishery is an economic activity and, therefore, is subject to social and economic laws in an environment, the sea, where the rights of states and of property are not as clear and as well established as on land, so there is great uncertainty in international legislation. Fishery is subject to a growing social demand, and an increasing demand for more products from the sea. According to the FAO, world fish consumption per person per year has gone from 9.9 kg in the 1960s to 17 kg in 2007.¹³

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Moreover, there is growing social awareness of respect for nature, which calls into question the use of some fishery techniques that, although efficient, or perhaps precisely because of this, are particularly aggressive with the environment, whether physical or biological. Drift nets have already been prohibited, and bottom trawling is being strongly questioned.

11. "FAO Fisheries Department. Fisheries management. 2. The ecosystem approach to fisheries", *FAO Technical Guidelines for Responsible Fisheries*, No. 4, Suppl. 2, Rome, FAO, 2003.

12. S.M. Garcia et al., "The ecosystem approach to fisheries: Issues, terminology, principles, institutional foundations, implementation and outlook", *FAO Fisheries Technical Paper*, No. 443, Rome, FAO, 2003.

13. FAO, *The State of World Fisheries and Aquaculture (SOFIA)*, 2010.

Overfishing, similarly to the general over-exploitation of other renewable resources, is a problem that generates inefficiency and waste, both of the resource and energy that must be used to extract it. And it is also a question about which society is showing a growing awareness. The depletion of fishery resources has been made clear by the FAO¹⁴ and some scientific works predict their collapse by the mid-21st century.¹⁵

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Climate change will also affect fishery. An acidification of the sea in the long term is expected with large-scale ecological changes owing to the disappearance of corals. As temperatures rise, populations of marine fish increase in areas of distribution near the poles and decrease in the tropical zone.¹⁶

Moreover, we must consider the problems of poor management of fishery, which are more pernicious than natural causes. The main problem derives from the objective of maximising short-term profits, thus compromising the future of the resource. A factor of special impact in this respect is subsidies. Public money could be useful to guide fishery towards a more rational and respectful activity, avoid overfishing and recover resources; however, it is usually used for contrary purposes and tends to enhance overexploitation, often in the guise of national interests. It should be noted here that European and Mediterranean fishery is heavily subsidised.

Moreover, globalisation, with its implications for international competition, also wors-

ens the situation and means that the Mediterranean product must compete with the rest of the world, in both fishery and aquaculture, which generates problems of prices. One of the consequences of this situation is that the wealthy regions take the fish from the poor regions, thus increasing inequalities between them.

There are doubts over whether aquaculture will substitute fishery, in the same way that stockbreeding substituted hunting in the Neolithic age. Although freshwater aquaculture generates proteins at a good price, marine aquaculture is aimed at expensive products and, with the exception of bivalve molluscs (mussels, etc.), must feed on fish and crustaceans, which are carnivores, with animal proteins that, in the form of fishmeal, come from capture fisheries. Moreover, some extensive forms have an enormous impact on the environment, such as the camarote prawn farming in tropical mangrove swamps.

There are tools to slow down this situation at the disposal of managers. In the Mediterranean, which has a complex fishery in number of species, fishery techniques, countries and cultures, the promotion of reserves and creation of protected areas is, probably, one of the best methods for endeavouring to recover resources by protecting the main commercial species. However, and although there have been some attempts to establish these areas, the political and economic obstacles to their implementation are enormous.

In short, fishery in general, and that of the Mediterranean in particular, is going through a very precarious situation. Its future depends on taking the right and, probably, painful decisions.

14. Ibid.

15. B. Worm et al., "Impacts of Biodiversity Loss on Ocean Ecosystem Services", *Science*, Vol. 314, 2006, p. 787.

16. K. Cochrane et al. (eds.), "Climate change implications for fisheries and aquaculture: Overview of current scientific knowledge", *FAO Fisheries and Aquaculture Technical Paper*, No. 530, Rome, FAO, 2009.