IS THERE A FUTURE FOR ARTISANAL FISHERIES IN THE WESTERN MEDITERRANEAN?

Cover illustration from an old photograph of artisanal fishermen in Malaga by Luis Bellon. Courtesy of the Instituto Español de Oceanografía (IEO) of Malaga.

COORDINACIÓN PESQUERA MEDITERRÁNEA (COPEMED)

IS THERE A FUTURE FOR ARTISANAL FISHERIES IN THE WESTERN MEDITERRANEAN?

by

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PREPARATION OF THIS DOCUMENT

In 1996, the Government of Spain requested the Food and Agriculture Organization of the United Nations (FAO) to implement a regional project aimed at promoting regional cooperation and co-ordination between fishery administrations of countries in the western and central Mediterranean, particularly in the fields of fishery science and fishery resources assessment. This project, formally entitled “Advice, Technical Support and Establishment of Cooperation Networks to Facilitate Co-ordination to Support Fisheries Management in the Western and Central Mediterranean”, is referred to less formally as COPEMED (**CO**ordinación **PE**squera **MED**iterránea); it became operational in 1996.

The main objective of COPEMED is to widen scientific knowledge and regional cooperation for the sustainable management of the Mediterranean fisheries. COPEMED was also designed to facilitate as far as possible the research on shared stocks, which is being promoted by the FAO's General Fisheries Commission for the Mediterranean (GFCM). One of the main COPEMED activities was the Artisanal Fisheries Programme which included many objectives and tasks and has obtained important results, both for the countries involved and for the GFCM itself.

This Artisanal Fisheries Programme was established at the first meeting of the Project's Steering Committee (Tangier, 1997), attended by scientific representatives and managers from the fishery administrations of each of the Project's participating countries, backed by experts from the Fisheries Department of FAO. Following this decision, a working group was created to: (i) elaborate clear and general criteria; (ii) compile all available data (from national fishery offices, research centres, and existing documentation, etc.); and, to complete it, (iii) carry out field studies in all the countries, port by port, beach by beach, using previously agreed reporting forms.

As a result of this wide-ranging and complicated exercise, and for the first time in the region, a preliminary version of an “Inventory of the Artisanal Fishery Communities in the Western and Central Mediterranean”, both in hard copy and on CD–ROM, was presented to the 25th session of the GFCM in 2000; it has been progressively updated with new information from the countries concerned, and the latest version, updated to 2005, has been published in the GFCM Studies and Reviews No. 77.

An important complement to all the hard work done so far would be to bring the corresponding information to the greatest possible number of members of the Mediterranean fisheries community. To this end it was decided that, in addition to the CD–ROM, it was desirable to undertake the publication of a book with an easily understood content and, above all, written in an easy-to-understand style as free as possible from specialist technicalities.

This book has, thus, been conceived to expose to a wide public the problems of the artisanal fisheries, the obstacles to their development, and some possible avenues for such development. Also, artisanal fisheries are dispersed widely along all the region's coasts, strongly obliging them to act in an uncoordinated manner, without effective associations to represent them and to make known their real problems as an important coastal community. This community should enjoy strong institutional support, since it is a socially important sector and, even economically speaking, could be profitable.

A copy of the CD-ROM and the document titled *Inventory of the Artisanal Fishery Communities in the Western and Central Mediterranean* and a copy of the CD-ROM titled *Encyclopedia of Living Marine Resources of the Mediterranean* can be requested directly to CopeMed project (www.faocopemed.org).

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PREFACE

Artisanal fishing, as any other human activity, is subject to continual change which, depending on the circumstances, may be positive or negative. Although artisanal fishing is a prevalent activity in many Mediterranean countries, it has, in the past half century, been relegated to a marginal role, from a socio-economic point of view, manifested as a steady erosion of a longstanding tradition. And this in a period in which the demand for high-quality, fresh fish and shellfish has grown enormously while the state of the fish stocks has, overall, become greatly weakened by overfishing, especially by the industrial fisheries, and by environmental degradation due to human activities on land and in the coastal zone.

However, consideration of the rehabilitation of the artisanal fishery sector in the Mediterranean has been lost in the wider discussion on the future status of fisheries in general in the region, so has not been given more attention than in the past. Artisanal fishing, apart from its peculiarities, is the weakest element when large-scale management issues are being discussed, and the interaction between such fishing and the many other types of activity in the same area – essentially the coastal zone – calls for special attention.

First of all, more knowledge is needed to assess the observed changes carefully, so as to direct artisanal fishing and fisheries towards a more modern management framework, respectful of the fish stocks and their environment, etc. This need has been stressed for a very long time, not only with respect to the North African coast but also the European side. There is general agreement that only effective management of these fisheries – and the resources they exploit – as well as other socio-economic components in the same area of influence, could ensure a more modern and effective management of the coastal zone.

The artisanal fisheries sector concerns many countries and encompasses many kinds of social groups, fishing gear and fishing methods. Its resources, shared by various countries, often move from one part of the region to another, and the size of the fish catch varies from country to country, as does the number of people dedicated to fishing and the economic value of the catch. In the Mediterranean, artisanal fisheries have never been seriously considered as a regional priority, although the United Nations Conference on Environment and Development (UNCED) had already addressed this issue, in 1992, under its Agenda 21: Programme of Action for Sustainable Development; chapter 17: the Protection of the Ocean and All Kinds of Seas, including Enclosed and Semi-enclosed Seas, and Coastal Areas and their Protection, Rational Use and Development of their Living Resources.

We and many others strongly believe that the future of the artisanal fisheries in the Mediterranean requires the formulation of new strategies for the rational management of the coastal zone and its resources, provided that they cover all the zone's stakeholder communities that interact directly or indirectly with artisanal fisheries and take into account the interactions, conflicting or otherwise, and synergies amongst these communities. However, at present, no innovative and courageous measures are in sight, nor are there regulatory and managerial tools to give effect to such measures to renew the artisanal fisheries of the region in the context of a drastic but necessary policy of conservation of the resources and their environment. With this in mind, the FAO–COPEMED Project decided to make an inventory of all the artisanal fishery communities in the western Mediterranean, aimed at assessing their actual state and at promoting a debate that could bring the artisanal fisheries to the fore in the context of national and regional development.

Today, after several years of difficult and hard work, in which many colleagues on both sides – north and south – of the region have collaborated in the publication of the regional inventory and the completion of two pilot studies – in the Cilento area (in Italy) and in the Nador Lagoon (in Morocco) – we have considered it useful also to prepare a book for as wide a readership as possible and broader than the interests of the specialists working in the field of fishery research in the Mediterranean. It will, we think, also be of use to those in possession of the published CD–ROM which contains precise information (not included in the present book), by country, port, fishery or fishing gear, among many other aspects.

Through this book we are trying to render comprehensible and popularize the world of artisanal fisheries to those who wish, for the first time, to know more about them. We also want to reach those social and cultural groupings that were not taken into consideration as being possibly interested when the CD–ROM (*Inventory of the Artisanal Fishery Communities in the Western and Central*

Mediterranean) was undertaken. We therefore wanted the readership to include not only the artisanal fisheries community in the strict sense (fishermen and their families, their cooperatives and associations plus the fishery administrators) but also the local, regional and national persons and entities which, through their professional activities – social services, teachers, doctors, sociologists, psychologists, historians, statistical services, etc. – are in contact with the fishermen, whether artisanal or not. The book is also aimed at all those – persons and organizations – that work in or take initiatives in the coastal zone (tourism, industry, coastal-zone managers and conservationists, NGOs, etc.) or whose responsibilities or activities in some way interact with artisanal fishing. And, obviously, the book is aimed at all non-artisanal fishermen, who often see the artisanal fishermen as poor brothers or even as close competitors. And if, after all, this book reaches schools, training centres and universities, it will have covered the whole spectrum of possible readers that have come to mind during the many discussions leading up to its drafting.

We have tried to make the book as readable as possible without sacrificing the necessary precision, and to make the book as easy to use as possible; in any case, no technical background is needed for reading it. We also think that books have a great advantage: they may be left anywhere or even lost without forfeiting the chance to be picked up and read by someone who might thus discover an interest in artisanal fishing.

In this way, the COPEMED Project has been able to contribute to a better understanding of this sector that is so frequently referred to but always, finally, forgotten. We believe that, inevitably, it must be taken into account if the sustainable management of Mediterranean fisheries is to be publicly recognized as an important objective in the region's overall socio-economic development. In this way, we hope that the work done on the artisanal fisheries will be found useful for achieving similar objectives in the eastern Mediterranean.

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CONTENTS

INTRODUCTION

This book concerns the artisanal fisheries in the western part of the Mediterranean bound approximately by the coasts of (in clockwise direction from the Strait of Gibraltar) Spain, France (and Monaco, as well as Corsica), Italy (as well as Sardinia and Sicily, but excluding the Adriatic), Malta, Tunisia, Algeria and Morocco). Since Libyan Arab Jamahiriya is a participant in COPEMED, it is also included.

We have understood artisanal fisheries, herein, as referring only to the marine kind, including, nevertheless, those conducted in coastal lagoons and river estuaries. And we have used the term "fisherman" to mean a person engaged in catching fish in the sea. The main reason this word is preferred to, say, "fishers" or "fisherfolk", now sometimes used to avoid a gender reference, is that "fisherman/men" is a traditional term, reflecting the fact that women are not usually involved in fishing itself, even today, in the Mediterranean, although they are often involved in the complementary shoreside manipulation of the catch. The word "fisher" is archaic and "fisherfolk" is a recent "social scientific" invention with, however, a slightly patronizing tone.

When you try to define an artisanal fisherman, it seems initially straightforward. Originally, it meant someone who made his own fishing gear and perhaps even built his own boat, and fished to feed his immediate family, possibly with some excess catch to sell or barter in his community. Although taking advantage of mechanical devices (oars in the boat being the primary example), artisanal fishing was originally unmotorized: wind and muscles were the source of power – to get to the fishing place, cast the net or line, haul it in, then return home. In more recent decades, and especially since World War II – from which the Mediterranean was not spared, by a long way – motorization in the form mainly of outboard motors was progressively adopted, though at different rates and/or at different periods, from country to country or even from place to place. In more recent decades some fairly simple motorization of net or line hauling has become more common. Otherwise, artisanal fisheries have always been characterized by the modest quantities of their catch per fisherman or per fishing boat. Their catch does not, as a rule, go to industrial fish-processing plants which usually require large and sustained quantities of fish to justify such processing.

Artisanal fisheries range from men standing on a pier with a handline catching a few fish a day, to a couple of men in a small boat with oars or, at best, an outboard motor, landing their catch on a pebble beach of difficult access from the landside, to a rather well mechanized boat several metres long, with a small crew, setting a net or a longline many hundreds of metres long, if not more, and landing their catch in a formal port – all of them for themselves and their families and for the local food trade (especially fish shops and restaurants). Some of these fisheries are pursued all year round or just for two or three months of the year – their "season".

The term "artisanal fishery" has no fixed meaning for all regions, times and places. Sometimes, terms such as traditional or subsistence fisheries are used here and there, but this does not clarify the desired definition. In view of the wide variety of gears, ports and target species, it is feasible, and even desirable, to define many artisanal fisheries in the region of interest. Also, many artisanal fisheries are, practically speaking, "personal" fisheries. Although three types of gear (gillnets, trammel nets and longlines) constitute 80% of the artisanal gears used, this does not imply that 80% of all artisanal fishermen use one or other of these three types; a large proportion use handlines, pots, dredges and other "personal" devices to catch small quantities of fish or shellfish.

This complexity notwithstanding, COPEMED felt it important and necessary to define what an artisanal fishery is. In practice, it was only able, like its predecessors, to define what an artisanal fishery is not: that is, neither semi-industrial nor industrial. So, for practical purposes, artisanal fisheries exclude fisheries using: large trawlnets (bottom and midwater trawls, whether towed by one fishing vessel or two); large seines for small-pelagic species (mostly sardines and anchovies), other than those using lampara nets; gear (purse seines, longlines, drift nets, stationary uncovered pound nets, often known as madragues, tuna-fishing rods, troll lines) targeting large-pelagic species (especially tunas and related species), hydraulic mollusc dredges, and very long gillnets and surface longlines.

In spite of adopting this "exclusive" definition (what artisanal fisheries are not), COPEMED noted that three criteria are always implicit in the term "artisanal fishery": boat length; tonnage and fishing

gear; and target species. COPEMED also summarized the technical and socio-economic features of these fisheries:

Boats and fishing gear

- Low boat tonnage (≤10 gross registered tons)
- Low power (<100HP)
- With or without outboard motor
- Limited autonomy (<24 h)
- Minimal or non-existent safety equipment
- Use of various types of fishery gear determined by:
  - the presence of target species, in space and time
  - the nature of the sea bed
  - the existence of specific regulations
  - high level of knowledge of target species and their behaviour
  - accessibility of "noble" (i.e. high-demand/high-value) species
  - socio-economic status of the artisanal fishermen

Socio-economic factors

- Boat is owned by the fisherman or his family
- The fishermen have other professional activities
- Crews are small (1–5 fishermen)
- Weak hierarchy in the work at sea
- High level of employment relative to investment
- Direct sale of most of the catch to fish shops, restaurants or the general public
- Individual catches of low tonnage but high value

We should also briefly mention here that the important lampara fishery for small-pelagic species is practised sometimes from large vessels (notably in Italy and Spain), sometimes using accessory boats, but also often by artisanal fishermen, sometimes only one man to a boat. Since it is, at present, not feasible to distinguish these two levels in the landings, all lampara fisheries are tentatively classified as artisanal, in spite of the difficulty this causes, especially in Spain, where the vessels fish lampara nets in the Mediterranean for half the year, and other gears, elsewhere, for the other half.

Although Mediterranean artisanal fisheries are not fundamentally different from such fisheries elsewhere, they have acquired some distinctive characteristics. The artisanal fishing boats are very diverse but are grouped around small fishing communities based on small ports or beaches. These fisheries target a wide variety of species, so they use various types of fishing gear at different times of the year, depending on the local availability of the target species; this availability in turn tends to reflect the differences in life-histories amongst the key species – spawning migrations and seasons, feeding migrations etc. The involvement of families in the artisanal fisheries – from the making and repair of the gear to the handling and sale of the catches – is also typical and traditional. Some artisanal fisheries are also pursued in coastal lagoons, sometimes illegally.

It is often convenient to consider artisanal fisheries in terms of a "métier" (French for, among other things, trade, profession, business, craft). In the present context it is basically a method of fishing defined by the target species, the fishing gear/method itself, the base port or landing place of the catch, and the season of operation. Even so, there is a certain arbitrariness with respect to, for example, fishing boat size and variety of fishing gear. In Spain alone, there are about 135 métiers, around 50 varieties of trammel net and over 35 varieties of longline; and even more if the small dimensional differences are considered. These varieties represent adaptations to local circumstances:

- ecological (e.g. water depth, nature of the sea bed);
- biological (e.g. the target species, its behaviour and its availability to the fishermen at any given time);

- economic (e.g. the possibilities of the fishermen to acquire and maintain specific qualities and quantities of gear, up-to-date boats and boat equipment).

The foregoing information also brings out another important underlying fact: that the industrial and semi-industrial fisheries are much less constrained by (hence less adapted to) specific local circumstances.

But the question remains: Why, in a generally well developed region like the Mediterranean, are artisanal fisheries still so important, in spite of their modest level of technological development? The answer may be, in no particular order, that:

- ecologically, there is a high diversity of fish species in the Mediterranean coastal zone;
- technically, artisanal fishing gear is usually species-selective and size-selective, unlike industrial trawl fishing;
- economically, artisanal fisheries contribute to the local food supply and to the income of a part of the local population;
- socially, artisanal fisheries contribute to the social fabric of the coastal population, in particular, and to the national life, in general;
- culturally, they contribute to the local and national tradition and cohesion through the promulgation of cultural diversity and community heritage.

There are also several reasons for their historical existence, lying in the geological, ecological and cultural history of the region, which we discuss further here below.

Although we are concerned here mainly with the western Mediterranean, these various factors apply generally to the whole basin. Moreover, in spite of a definite geological division into eastern and western basins, there are strong oceanographic and biological connexions between the two.

The physical context

The geological and ecological history of the Mediterranean Sea (see p. 4) goes a long way in explaining the Mediterranean marine environment and its resources. It comprises two main basins connected principally by the Strait of Sicily. The western basin, covering an area (at the sea surface) of some 0.85 million km^2, has a secondary basin: the Tyrrhenian Sea.

Figure 1-1
Map of the Mediterranean showing the main geographical features – mountain ranges, major rivers, major cities
(The basic bathymetrical features are shown in Fig. 1-2, below)

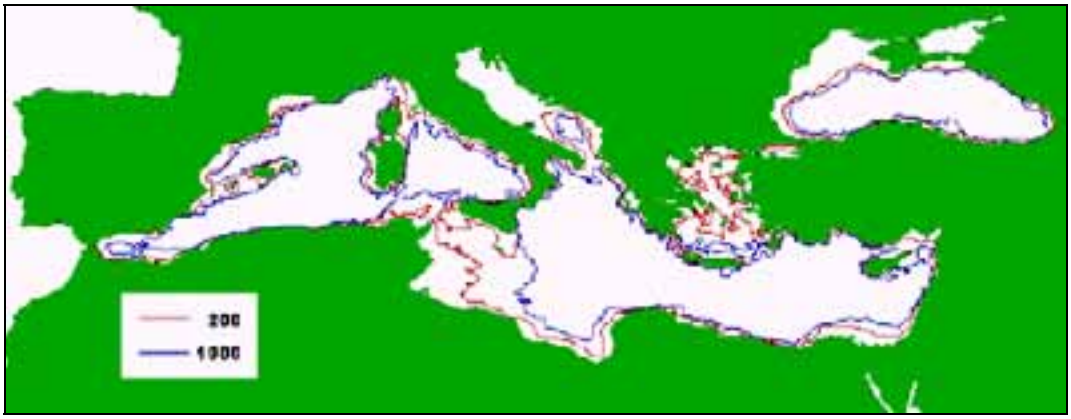


Figure 1-2
Map showing the 200- and 1 000-m isobaths. *(From Oliver, 2002)*

The Mediterranean is almost an enclosed sea, but it is connected to the Atlantic Ocean by the Strait of Gibraltar, which has a sill 15 km wide and a maximum depth of 350 m, and to the Sea of Marmara (and thus the Black Sea) by the Dardanelles Strait, which has a width between 1.3 km and 7 km and an average depth of 55 m. Since the late-nineteenth century, it has also been connected to the Red Sea by the Suez Canal (120 m wide and 12 m deep).

The Mediterranean Sea is essentially a relic of the once great Tethys Sea that largely separated the northern tectonic or crustal plate (European continent) from the southern plate (African continent), some 200 million years ago. The Tethys Sea linked what is now the North Atlantic Ocean with what is now the Indian Ocean. The eastward, then northward, movement of the African plate gradually enclosed a part of

the Tethys Sea. The Mediterranean Sea, however, was not established until the passage to the Indian Ocean was closed off, some 16 million years ago, then the passage to the Atlantic Ocean, with the closure of the Betis Channel (along the south coast of Iberian Peninsula), between 7 and 6.6 million years ago, and the closure of the el-Rif pass (off the North African coast) some 6.3 million years ago. But, even so, the newly formed enclosed sea had to undergo the so-called Messinian crisis, some 5.6 million years ago, which opened the Strait of Gibraltar, before the Mediterranean Sea proper could come into being much as we know it today.

These plate tectonics, together with climate changes, have played a major role in determining the biodiversity of the Mediterranean. (See the next chapter on The species, their habitats and the fisheries).

The main physical results of the clash between the African plate and the Eurasian plate (the subduction of the African plate under the European one) are:

1. the creation of a virtually enclosed sea;
2. the elevation of mountain ranges all along the northern side – the Sierra Nevada (Spain); the Pyrenees (Spain–France); the Alps (France–Switzerland–Austria–Italy–Slovenia); the Apennines (Italy); the Dinaric Alps (Croatia/Bosnia and Herzgovina); the Taurus (Turkey) – and, on the southern side, the Atlas mountains in north-western Africa;
3. the area of land (~3.5 million km²) that drains into the Mediterranean Sea forms a relatively small part of the total drainage basin area (~6 million km² – land plus sea surface), thus constituting a relatively narrow rim around the Mediterranean Sea itself;
4. the comparatively narrow continental shelf (Fig. 1-2; in the western Mediterranean, the Balearic Islands plateau and the Gulf of Gabès are notable but limited exceptions);
5. the creation of marine basins of considerable maximum depth (>4 000 m);
6. the high level of volcanic and seismic activity;
7. the much damped tidal regime;
8. the specific wind regime.

The consequences of these eight features may be quickly indicated.

Being a semi-enclosed sea (1) means a slow replacement of the sea water from the Atlantic and, to a much lesser extent, from the Black Sea, hence the means for the Mediterranean region to leave a very strong "imprint" on its sea water (very high salinity, for example, due to high evaporation), which can be traced at depth (between about 500 and 1 000 m depth) throughout the central Atlantic Ocean after having exited over the Gibraltar sill below the incoming Atlantic surface water. The Mediterranean would have a quite different marine regime if, for example, the Atlantic Ocean water entered at the bottom of the Strait of Gibraltar.

The mountain ranges (2) have important effects on the weather, especially the rainfall and wind regimes (see here below). It should also be noted that, between Tunisia and the Near East, there is a vast mountainless desert, which is also of considerable relevance to the present-day marine and coastal environment.

The small land drainage-basin area (excluding the Nile valley upstream of the Aswan dam) relative to the total basin area (3) is due to the fact that the coastal mountains slope steeply into the sea, creating: a very narrow littoral zone (enhanced also by factor 7); a narrow continental shelf (4) which leads to a low volume of shelf sea water, hence a limited amount of marine resources, living and non-living, within easy reach of the human populations on land; a generally limited natural freshwater supply; and, until relatively recently, a certain isolation of coastal populations around ports and landing places themselves isolated by the same mountains. This isolation has disappeared, superficially at least, as a result of modern transport and communication systems, but remains ingrained in the culture of coastal populations which have traditionally shown considerable independence, hence resistance to co-ordination on a regional basis, but also a disposition to regional trade.

Having deep basins (5) is essentially an obstacle to nature in the renewal of the sea water in these basin depths, and to the human population in the exploitation of the deep-sea resources, as well as being an encouragement to the use of such basins as a place to dump, in one way or another, human waste (especially litter and garbage).

High volcanic and seismic activities (6) speak for themselves, representing, especially in the eastern Mediterranean, an ever present risk to the human population and to the natural resources of the region.

The damped tidal regime (7) generally favours coastal stability, but reduces coastal faunal and floral diversity; it favours maritime trade and fishery, but slows the degradation and spread of floating or suspended marine pollutants such as oil.

The specific wind regime (8), comprising strong but local winds, tends to act against maritime trade and fishing. This regime is due mainly to the fact that the northern mountain ranges present significant barriers to air movement which is channelled by the mountains, leading to strong local wind systems; of these, the most notable are: the *tramontane* or *cers*, channelling air south-eastwards across the Languedoc region in south-western France north of the Pyrenees; the *mistral*, channelling air southwards down the Rhone valley; the *bora*, likewise, at the head of the Adriatic Sea; and the *meltemi* wind at the head of the Aegean Sea. These are essentially venting systems imposed by the local topography but related to the major high/low pressure fields competing over the European continent; these strong winds are of comparatively short duration, as well as being seasonal, mainly spring and summer. They impede all types of fishing.

On the other hand, the *scirocco* or the *khamsin* wind blows more persistently and northwards from the African or Arabian subcontinents bringing hot desert air (subsequently humidified while traversing the Mediterranean) and desert dust to the northern side of the region.

The same mountains play a major role in the rainfall patterns of the Mediterranean Sea, the northern side being subject to seasonally heavy rains in spring and autumn, the southern side, to annual rainfall of <200 mm in certain regions, mainly in the winter. The mountains also ensure a rapid and sometimes disastrous run-off leading from time to time to heavy flooding in the main river plains and deltas, notably those of the Rhone and Po.

Only five river basins in the region exceed an area of 50×10^6 km^2. Nevertheless, nearly 60% of the land area of the Mediterranean basin is occupied by river valleys of less than 10^4 km^2 individual area. The broken geomorphology of the Mediterranean basin, especially in its northern, south-western and eastern parts, ensures relatively rapid riverine run-off.

The climate change now considered to be in progress is due principally to the "greenhouse" effect which is raising the Earth's mean temperature; this can be expected to have a significant impact on, *inter alia*, the marine environment and the adjacent coastal zone in the coming decades, most likely leading to changes in: wind systems; air–sea interaction (evaporation, precipitation, the exchange of gases – notably carbon dioxide and oxygen – and of salt); mean sea level; and marine currents.

A detailed study of the period 1992–2001 has shown that there has been a strong warming trend in the Alboran Sea on the continental shelf off Málaga. The rate of increase is about 0.01°C per year, which is greater than that observed in the deep water of the Mediterranean. Whether this trend is attributable to climate change or rather to changes in circulation is not clear, however. Nevertheless, the number of species of "Mauritanian" origin has been increasing as well. The abundance of the gilt sardine, *Sardinella aurita*, has also increased in the last decade, mainly in the Levantine and Spanish Tramontana regions.

We consider briefly the probable role of climate change in the future of artisanal fisheries in the western Mediterranean in the chapter on this future.

The ecological context

Given the technical and economic difficulties of fishing the continental slope, the bulk of the readily available living marine resources are found and exploited on the continental shelf (depth less than about 200 m) or in the upper 100 m of the open sea. Some trawling is done on the continental slope, but catches are rarely taken below 300–400 m depth, although modern trawlers can now fish down to about 800 m depth.

The species living on or close to the sea bed are referred to as *benthic*. Those that swim above the sea bed over the continental shelf are referred to as *neritic*, and those that swim in the body of the sea, not normally near the sea bed, are referred to as *pelagic*. In practice, pelagic species are only fishable if they form schools (examples: sardine, anchovy) or are individually large enough to justify the fishing effort

required to capture them (examples: tuna, sharks). A general fishery term, *demersal*, is used for species caught just above the sea bed.

Because of its high temperature and high salinity, especially in the eastern basin, its rapid freshwater run-off (which does not allow the water to build up a high mineral content), and its deep basins with their relatively slow replenishment times, the Mediterranean has always been considered *oligotrophic*; that is, not allowing a generally high primary production (by the microscopic green algae that mainly constitute the phytoplankton), hence not a generally high food supply for the other marine organisms. Thus it imposes on its marine organisms a relatively severe set of living conditions, biologically and physically, except in sheltered bays.

Under difficult ecological conditions, there is a tendency for only a comparatively few species to survive, whereas, under easy ecological conditions (known as *eutrophic*) a comparatively large number of species can survive.

Where does the Mediterranean stand in this respect? In its bulk – open sea, deep basins – it is oligotrophic. Inshore, close to the land, it is more nearly eutrophic. The discharge of excess fertilizers and animal wastes from coastal agriculture and, nowadays, intensive horticulture, which has been a feature of the Mediterranean environment in recent decades, has promoted this coastal eutrophication, occasionally to excess, so that the frequency of harmful algal blooms has also considerably increased inshore, often to the detriment of marine fishery resources, whether artisanal or industrial. Thus, the dilemma of the River Po, for example, is essentially whether it is socio-economically more beneficial to the overall economy and the regional environment to raise animals for food in the Po valley (and almost inevitably to dump much of the waste into the Po River system) than to harvest shrimp and other sea food off the Po delta (otherwise adversely affected by the poor ecological conditions caused by the Po discharge), or vice-versa. Similar arguments can be put forward for the other major (and indeed many minor) river basins and for other activities (e.g. siting of power plants and other industries on river banks or in the coastal zone; and, notably for the Nile, the effect of the establishment, at Aswan, of a major hydroelectric dam on the sediment discharge to the coastal area – with a good deal of agricultural wastes as well).

Upwelling is a relevant feature of the western Mediterranean; it has two causes: the more important is due to the wind stress on coastal water, mainly along the south-facing coasts in the northern part, which forces surface water offshore and subsurface water to well up into the surface layer to replace the surface water driven offshore. The other is less drastic and steadier, arising from the basically cyclonic (anti-clockwise) circulation of the low-density Atlantic Ocean surface water. The water near the centre of the gyre – a "spinning wheel" of water – created by this circulation is, initially, higher (relative to the mean sea height) at the centre than at the edges, producing a centrifugal flow (from the centre outwards), which induces replacement by the upwelling of deeper water at the centre. At the edge of the main gyre, the "opposition" of the coast induces numerous secondary, anticyclonic (clockwise) gyres in which the opposite occurs, the average flow being centripetal circulation (towards the centre of each small coastal gyre and tending to produce upwelling inshore). Since upwelled water brings nutrient-rich water into the well lit surface-water layer, primary production is enhanced and eventually is a benefit to the artisanal fisheries.

We shall also look briefly at the possible role of biodiversity changes in the future development of the artisanal fisheries of the region. This biodiversity, as a measure of the variety of genes, species and species assemblages (ecosystems), is of value because we cannot be sure of the impact of removal of any component (e.g. variety, species or group of species) from a given ecosystem, owing to our weak understanding of how ecosystems function. It is therefore, in principle, important to preserve a high biodiversity, so as to confer upon an ecosystem the greatest possibility for resistance or adaptation to environmental change.

Most of these physical and biological factors affect the marine living resources and therefore the fisheries on them; whether the effects are positive or negative depends somewhat upon your point of view, but, in any case, that is the only Mediterranean we have, and whether it can be improved or not also depends on your point of view.

The cultural context

The species that evolved in the Mediterranean, or invaded it whenever geological opportunities to do so arose, have not marked and moulded the Mediterranean basin so much as human populations have.

Many of the world's major civilizations have been established or have flourished there: Egyptian, Minoan, Greek (Mycenaean, Hellenic), Etruscan, Phoenician, Roman, Arab, Ottoman, for example. And likewise, major religions (in historical order of appearance): Judaism, Christianity, Islam.

These various civilizations, many based on empire, have considerably modified the pristine environment by the same means, practically speaking, as those used today: the growth of cities and ports, agriculture, water exploitation, industry and recreation, if not tourism as well. They have also bequeathed us a major architectural wealth, now part of the World Heritage established under the auspices of UNESCO, and a history whose influence is still with us and will perhaps remain with us for many centuries to come.

Thus, culturally, there is a longstanding tradition, involving whole families, specific social or ethnic groups and communities, centred on areas, such as protected bays, environmentally favourable to artisanal fisheries and allowing the possibility to fish many different species, often with different gears, in different seasons. Artisanal fisheries meet a fundamental and immediate need – the need for food – but, as noted above, the artisanal fishing communities, through their particular way of life, contribute to the local and national cultural diversity and community heritage. There is no doubt, however, that the socio-cultural diversity, of which the artisanal fishery communities are an important part, is being reduced steadily as other forms of economic activity (notably tourism and coastal-zone urbanization) become opened up and the mass media promote "uniformization" of the population.

Two other considerations

(a) A cautionary word should be said about the concept of season, because this can be determined by several factors that do not all apply everywhere at all times. For this reason we have not emphasized this aspect, although, locally, it is quite important. These factors are:

- the availability of the target species to the fishermen (as a result of, for example, onshore–offshore migration or vertical migration of the fish, size of fish, which is particularly important with respect to gillnet mesh size, and to hook size in longlines and hand lines)
- the demand for the species, hence the market price, which is particularly influenced not only by the physical condition of a species – notably with respect to spawning or feeding periods – but also by the affluence of piscivorous tourists in summer
- the availability of alternative forms of seasonal employment that may be more economically rewarding
- fishery management/conservation measures in force (e.g. obligatory closed seasons or fishing areas)

(b) This book is not a suitable place to consider in any detail the legislative context, which is very complex and variable not only from country to country, but also from one government level to another. However, artisanal fisheries cannot expect to operate and develop outside it (even small-scale mining, where the problems are often analogous, is being progressively brought within the corresponding legislative framework), so we shall try to give a broad outline, at least on the regional level, in the section on the future of artisanal fisheries.

About this book

Its purpose is to describe as briefly but as clearly as possible the artisanal fisheries of the western Mediterranean for an informed though not specifically expert readership, based on the enquiries made as part of the FAO Project, financed by Spain, on "Advice, Technical Support and Establishment of Cooperation Networks to Facilitate Coordination to Support Fisheries Management in the Western and Central Mediterranean", known more easily, and herebelow, as COPEMED (**CO**ordinación **PE**squera **MED**iterránea), and as a part of this project's contribution to the knowledge and understanding of the region's fisheries.

In describing the artisanal fisheries, we decided to start with the original reason for them: the species. From the need to capture them for food came the development of fishing gear and methods,

then the necessary onshore infrastructure, however modest, to service the fishermen. Primary interest lies with the target species – those that each type of fishery is seeking preferentially to capture. Obviously, some other species get caught at the same time; they are known as accessory species, and some of these may be target species in other types of artisanal fishery in the same vicinity. There are about 175 target and closely associated accessory species; we give most attention to the target species, without ignoring the accessory species.

One great difficulty that we have had to face is that of fish names. As far as our information allows us, we have used the local names of the key species pursued and captured by the region's artisanal fisheries. Local names in Arabic have, however, been transliterated into English or French, depending on the most familiar foreign language used in each country: French in Algeria, Morocco and Tunisia; English in Libyan Arab Jamahiriya, or both these foreign languages, if appropriate; it should also be noted that many names used in the Arabic-speaking countries have been simply adapted from the relevant European language. Names in Maltese or Italian are retained as are. However, the common names may vary from region to region even within one country and even in the same language, and one common name may be used for more than one type or species of fish. Also, a common name may apply to several species within a family, usually being qualified by an adjective (e.g. *common*, *red*, *striped*) depending on the species. In spite of our wish to limit the use of technical jargon, as far as possible, we decided also to give the biological (taxonomic) names (in Latin or latinized words), since this provides some assurance that a fish can be correctly ascribed to a given species (and that the related fishery data and statistics can be protected from confounding). Our main authority in this matter is the *Species Identification Sheets for Fishery Purposes* published by FAO (Rome, Italy); FAO has adopted specific (and widely used) common names in English, French and Spanish for each species. Other authoritative sources we have relied on are the national fishery experts and the UNESCO publication *Fishes of the North-eastern Atlantic and the Mediterranean* (in three volumes) which is largely compatible with the FAO Sheets. The *Società Italiana di Biologia Marina* recommended the Italian common names of the principal species.

To describe all the varieties of fishing gear and methods used by the artisanal fisheries of the western Mediterranean goes beyond the scope and intention of the present book. Such details may be found on the FAO and COPEMED Web sites: www.fao.org and www.faocopemed.org, respectively; and CDs containing the relevant data bases may be obtained from FAO, 00153 Rome, Italy. Here we content ourselves with a brief description of all the main types of fishing gear, stressing those used particularly in artisanal fisheries.

While it is not possible here to go into the detail of the history of artisanal fisheries in the western and central Mediterranean, this past is discussed in general terms in the chapter "Is there a future for artisanal fisheries in the western Mediterranean?".

Since, at the same time and in the same chapter, we discuss in some detail the present technical, ecological and socio-economic circumstances in which the artisanal fisheries are operating, we give the reader some idea of the situation of artisanal fisheries in the western Mediterranean today and of the problems they are facing and may face in the future. This future will certainly require, or be determined by, important changes – culturally, technically and economically – if survival is to be ensured, and even more so, if successful artisanal fisheries are to be sustained in the Mediterranean basin, western and eastern.

THE SPECIES, THEIR HABITAT AND THE FISHERIES

Introduction

We should first provide some background to the biodiversity of the Mediterranean with particular regard to fishes. This biodiversity was, like so many other aspects of this region, strongly shaped by the geological and climatic history of the basin. This history has resulted in a very complex Mediterranean biota, with species of diverse origin and survival paths.

As we mentioned earlier, the Mediterranean originated from the Tethys Sea which, during the Tertiary Period (65–2 million years before the present), enabled communication among the "pre-Atlantic Ocean", the Tethys Sea and the "pre-Indian Ocean", which allowed subtropical species to mix with temperate species, thus constituting the *palaeo-mediterranean component*. During the Pliocene Epoch (at the end of the Tertiary, 5.1–2 million years before the present), communication with the Indio-Pacific region closed, thus allowing some of the *palaeo-mediterranean* species to evolve as the *endemic component*. As the Mediterranean became more temperate, species that made up the *Atlantic–Mediterranean component* could become established in the "pre-Mediterranean", and they have survived largely until today. Towards the end of the Pliocene and during the Calabrienses glacial period, boreal species settled in the Mediterranean, constituting the *septentrional component*. Successive invasions and extinctions of boreal species took place during the successive interglacial periods and ice ages, respectively, and this facilitated the introduction of species of West African origin, the *Senegalese* component.

These five different components, as just defined, constitute the fauna that now occupies the Mediterranean basin. The *Atlantic–Mediterranean* and the *endemic components* are, however, predominant.

Although the Strait of Gibraltar is a natural barrier (its maximum sill depth is about 350 m), some Atlantic species are brought in with the Atlantic Ocean surface current over the Gibraltar sill. Atlantic deep-water species can also enter the Mediterranean by means of their nocturnal vertical migrations in the water column, which many bathypelagic species undertake. However, not every species has the capacity to adapt to the Mediterranean marine environment; among other reasons, many species become introduced while still in their larval phase and cannot complete their development in this new environment.

The so-called Mediterranean endemic species had different origins**:** some remained after the "destruction" of the Tethys Sea by the plate tectonics; others are survivors in the Mediterranean after having been extinguished in other parts of their distribution by adverse climatic changes; and some arose in the Mediterranean during its isolation (for 5–6 million years) at the end of the Pliocene Epoch and the beginning of the Quaternary Period. It seems likely that the pteropod mollusc (sea butterfly), *Cavolina gibbosa gibbosa*, which is confined to the eastern Mediterranean, and the sea grass, *Posidonia oceanica*, are representatives of the original Tethys fauna. A few fishes also form part of the endemic component: the blotched picarel, *Spicara maena*, the picarels, *S. smaris* and *S. flexuosa* (or *Smaris chryselis*), the Maltese brown ray, *Raja melitensis*, and the speckled ray, *R. polystigma*.

One of the examples of a Lessepsian species (Indo-Pacific species entering the Mediterranean via the Suez Canal) is the sea grass *Halophila stipulacea*, which is distributed throughout the Greek islands. Others are the bivalve molluscs: the rayed pearl oyster, *Pinctada radiata*; the straight hammer oyster, *Malleus regular*; and the Red Sea mussel *Brachidontes pharaonis* (this is the most recent nomenclature, replacing *Brachydontes variabilis*); all are widely distributed throughout the eastern Mediterranean.

Some species of boreal origin have persisted since the Pleistocene Epoch (first 2 million years of the Quaternary Period), having resisted the interglacial warming in the Mediterranean, and are found in areas such as the northern Adriatic Sea. Examples are: the chaetognath, *Sagitta setosa*; the copepod crustacea, *Pareuchaeta norvegica* and *Pseudocalanus elongatus*; the periwinkle, *Littorina saxatilis*, in the upper Adriatic and in the Gulf of Gabès; and the brown seaweed, *Fucus spiralis*, which is limited to the Adriatic Sea.

Regarding the comparatively recent introduction of species into the Mediterranean by human beings, the first are attributable to the pharaonic era, when canals were first dug to link the Red and the Mediterranean Seas, but it is impossible to specify particular species. The Portuguese oyster, *Crassostrea angulata*, could correspond to the introduction of the Japanese oyster, *Crassostrea gigas*, from the Far East in the sixteenth century, since the genetic difference between them is very small. A similar case could be made for the coral *Oculina patagonica* which was introduced into Spain from the Atlantic coast of South America also in the sixteenth century.

The opening of the Suez Canal in 1869 led to the introduction of between 200 and 300 species, including the largest contingent of macrophytes (plant-like seaweeds, such as wrack) ever introduced into the Mediterranean Sea.

Returning to the artisanal fisheries, there are at least 175 target and closely associated accessory species in the western and central Mediterranean. For each of the seventy species considered most important from the fishery standpoint – commercially important and fished in most, if not all, the countries of the western Mediterranean – we give:

- its scientific name;
- its common names in English (E), French (F), Spanish (S), in accordance with the FAO Species Identification Sheets for Fishery Purposes, and, if available, Arabic (A, discriminated, if necessary, by [A/A] Algerian, [A/L] Libyan, [A/M] Moroccan, [A/T] Tunisian), Italian (I) and Maltese (M), for species recognized in national fishery statistics for these countries' respective artisanal fisheries; the Italian common names were recommended by the Società Italiana di Biologia Marina;
- its distribution in the marine environment and in the Mediterranean as a whole;
- its individual sizes (in centimetres) usually found in the sea (the largest sizes being very rare in the catches);
- the types of fishery exploiting it in the Mediterranean (including the semi-industrial and industrial fisheries, since the artisanal fisheries do not operate in a vacuum);
- the types of gear that may be used (not only in the artisanal fishery);
- the usual products or uses of the landed species;
- the countries of the western Mediterranean in which they are artisanal fishery target species.[1]

For the remainder, we just provide a list, with scientific and common names only, for the species that may be considered "moderately important" (widely caught but not of high commercial importance) and "not important" (sometimes taken in the artisanal fisheries); the choice is based, however, mainly on the publication "Clasificación científica e indentificación de nombres vernáculos existentes en la base de datos de seguimiento informático de recursos naturales oceánicos" (Scientific classification and identification of common names in the data base on computerized monitoring of living ocean resources) by J. Crespo, J. Gajate and R. Ponce, Instituto Español de Oceanografía, 2001 (ISBN: 84-931926-0-0).

Since the family is the principal grouping for fish of a similar type in FAO statistics, it may be useful to recall that animals, such as fish, and other "kingdoms" of living creatures, are grouped, more or less conveniently, into the following categories in descending order of precision: phylum (e.g. Pisces, for fishes), class (e.g. Osteichthyes, for bony fishes), order (e.g. Scombroidei, for tuna-like fishes), family (e.g. Scombridae, for tunas and bonitos), genus (e.g. *Thunnus*, always in italics, for tuna), species (e.g. *Thunnus thynnus*, always in italics, for bluefin tuna) and subspecies (e.g. *Thunnus thynnus thynnus*, always in italics, for northern bluefin tuna).

We should also stress the fact that, at the species and subspecies levels, the specialists – ichthyologists and taxonomists – still argue about some cases, so that the current species names may have provisional scientific names, although this is not the case with the target species we are

[1] In some cases, the species are closely related and often physically similar fishes are reported only as, for example, Mullus spp. Or by family, as, for example, Mullidae, Scorpaenidae, Sparidae. The “failure” to mention a country for a particular species does not therefore necessary mean that the species is not fished at all in the country

concerned with (except possibly *Auxis rochei* [=*Auxis thazard*?] bullet tuna [=frigate mackerel], and this is more problematic elsewhere than in the Mediterranean).

We have not specified the particular ports or landing places at which each target species may be landed. In some cases these are formal ports with modern installations, and the artisanal fishermen may even provisionally deposit their fish in cold-storage facilities. In other cases, the landing place is simply a beach (possibly of difficult access from the land side) or a pier. There are several hundred such landing places in the western Mediterranean.

The Table in Annex I is intended to enable the reader to identify fishes of interest by their common names in any of the languages retained, and to relate it easily to the corresponding scientific name, notably for the "important species", in the present chapter.

Important species

Fishes

Scientific name: ***Anguilla anguilla***

Common names: **E**: European eel: **F**: anguille d'Europe; **S**: anguila europea; **A(A)**: anguille; **A(L)**: anguilla; **A(T)**: hanncha; **M**: sallura; **I**: anguilla

Distribution in sea: coastal and migratory; all coastal waters and rivers (catadromous)

Distribution in region: whole of Mediterranean; Black Sea

Common size (cm): 30–40 (male) 20–80 (fem.)

Type of fishery: semi-industrial, artisanal, sport

Type of gear: hoop nets, traps, barriers, trawls, gillnets, bottom longlines, handlines

Product/use: fresh, frozen, salt-dried, smoked, marinated, tinned

Countries: Morocco, Spain

by Zienert, S.

Scientific name: ***Auxis rochei***

Common names: **E**: bullet tuna (frigate mackerel); **F**: bonitou; **S**: melva; **A (A)**: melva; **A(L)**: matseti; **A(T)**: melva; **M**: tumbrell; **I**: biso

Distribution in sea: epipelagic, oceanic and neritic

Distribution in region: whole of Mediterranean; Sea of Marmara

Common size (cm): 20–40

Type of fishery: semi-industrial (Sicily), artisanal, sport

Type of gear: beach and purse seines, lampara nets, bottom and pelagic gillnets, handlines, drifting longlines, barriers, trolls

Product/use: fresh, tinned, salted (Greece)

Countries: Algeria, Malta, Morocco, Spain

by Randall, J.E

Common names: **E**: English; **F**: French; **S**: Spanish; **A(A)**: Arabic (Algeria); **A(L)**: Arabic (Libyan Arab Jamahiriya); **A(M)**: Arabic (Morocco); **A(T)**: Arabic (Tunisia); **M**: Maltese; **I**: Italian

Scientific name: ***Conger conger***

Common names: **E**: European conger; **F**: congre d'Europe; **S**: congrio común; **A(A)**: conger; **A(L)**: grango; **A(T)**: gringo; **M**: gringu; **I**: gronco

Distribution in sea: continental shelf, demersal

Distribution in region: whole of Mediterranean (except Baleares, Malta); SW Black Sea

Common size (cm): 60–150

Type of fishery: semi-industrial (Spain), artisanal, sport

Type of gear: beach seines, bottom trawls, gillnets and longlines, traps, handlines

Product/use: fresh

Countries: Algeria, France, Morocco, Spain, Tunisia

by Cambraia Duarte, P.M.N.

Scientific name: ***Coryphaena hippurus***

Common names: **E**: common dolphinfish; **F**: coryphène; **S**: lampuga; **A(A)**: coryphene; **A(L)**: lambuka; **A(T)**: lambouka; **M**: lampuka; **I**: lampuga, sgombro dorato

Distribution in sea: pelagic, offshore and coastal

Distribution in region: whole Mediterranean (except Adriatic)

Common size (cm): 50–100

Type of fishery: artisanal, sport

Type of gear: surrounding net without purse line; troll, handline

Product/use: fresh, dried

Countries: Libyan Arab Jamahiriya, Malta, Spain

by Cenaim

Scientific name: ***Dicentrarchus labrax***

Common names: **E**: European seabass; **F**: bar européen; **S**: lubina; **A(A)**: bar européen; **A(L)**: garous; **A(T)**: karouss; **M**: spnotta; **I**: spigola, branzino

Distribution in sea: continental shelf, coastal and brackish water

Distribution in region: whole of Mediterranean; Black Sea

Common size (cm): 20–55

Type of fishery: artisanal, sport

Type of gear: beach and purse seines, bottom and midwater trawls, bottom gillnets and longlines, drifting longlines, handlines, trolls

Product/use: fresh

Countries: France, Morocco, Spain, Tunisia

by Ticina, V.

Scientific name: ***Diplodus sargus sargus***

Common names: **E**: white seabream; **F**: sar commun; **S**: sargo; **A(A)**: sar; **A(L)**: garagous; **M**: sargi; **I**: sarago maggiore

Distribution in sea: coastal, demersal

Distribution in region: whole of Mediterranean (except Baleares); Sea of Marmara; Black Sea

Common size (cm): 15–30

Type of fishery: semi-industrial fisheries (Sicily, Morocco), artisanal, sport

Type of gear: beach seines; bottom trawls, gillnets and longlines; pelagic longlines; traps; handlines

Countries: Spain, Tunisia

by Patzner, R.

Scientific name: ***Engraulis encrasicolus***

Common names: **E**: European anchovy; **F**: anchois commun; **S**: boquerón; **A(A)**: anchouwa; **A(L)**: anshoga; **A(M)**: chtoun; **A(T)**: anchouwa; **M**: incova; **I**: acciuga, alice

Distribution in sea: coastal (euryhaline), pelagic

Distribution in region: whole of Mediterranean Sea; Black Sea

Common size (cm): 7–15

Type of fishery: industrial, semi-industrial, artisanal

Type of gear: beach and purse seines; trawls; lampara nets; barriers; traps

Product/use: fresh, frozen, salted, salt-dried, smoked, marinated, tinned; fishmeal; bait

Countries: Algeria, Malta, Spain, Tunisia

by Dammous, S.

Scientific name: ***Epinephelus guaza***

Common names: **E**: dusky grouper; **F**: mérou noir; **S**: mero; **A(L)**: farouj; **M**: cerna; **I**: cernia

Distribution in sea: coastal, continental shelf, demersal

Distribution in region: whole of Mediterranean (except Baleares, Malta)

Common size (cm): 20–80

Type of fishery: incidental in semi-industrial fisheries (Sicily), artisanal, sport

Type of gear: bottom trawls, gillnets and longlines, traps, handlines, barriers, harpoons

Product/use: fresh, refrigated, frozen

Countries: Algeria, Libyan Arab Jamahiriya

by Minguell, C.

Scientific name: ***Helicolenus dactylopterus***

Common names: **E**: rockfish; **F**: rascasse de fond; **S**: gallineta; **A(A)**: rascasse; **A(L)**: shkorfo; **A(T)**: boukacha; **M**: skorfna; **I**: scorfano di fondale

Distribution in sea: coastal, continental shelf and upper slope, demersal

Distribution in region: whole Mediterranean, except northern half of the Adriatic

Common size (cm): 15–25

Type of fishery: semi-industrial (Spain, Adriatic, Sicily, Cyprus), artisanal

Type of gear: beach seines, bottom trawls

Product/use: fresh, refrigated, frozen

Countries: Spain

by Cambraia Duarte, P.M.N.

Scientific name: ***Isurus oxyrinchus***

Common names: **E**: shortfin mako; **F**: taupe bleue; **S**: marrajo dientuso; **A(A)**: taupe bleu; **A(L)**: zergaya; **A(M)**: lkars; **M**: pixxitondu; **I**: squalo mako

Distribution in sea: oceanic, coastal, epipelagic

Distribution in region: whole of Mediterranean (except N Aegean)

Common size (cm): 150–200

Type of fishery: incidental in semi-industrial fisheries (Sicily, for swordfish, and Cyprus), artisanal

Type of gear: bottom trawls and gillnets, bottom and drifting longlines, trolls, handlines

Product/use: fresh, refrigated, frozen; liver oil; bait

Countries: Spain

by Randall, J.E.

Scientific name: ***Lamna nasus***

Common names: **E**: porbeagle; **F**: taupe commune; **S**: marrajo sardinero; **A(A)**: taupe commune; **A(L)**: zergaya; **A(M)**: lkars **M**: pixxiplamtu; **I**: smeriglio

Distribution in sea: oceanic, coastal, epipelagic, down to 370 m

Distribution in region: whole of Mediterranean

Common size (cm): 90–260

Type of fishery: occasional, artisanal

Type of gear: bottom trawls and trammel nets, bottom and drifting longlines, trolls, traps

Product/use: fresh, refrigerated, frozen (Tyrrhenian Sea); bait (Morocco); liver oil

Countries: Malta

FAO

Scientific name: ***Lepidopus caudatus***

Common names: **E**: silver scabbardfish; **F**: sabre argenté; **S**: pez cinto; **A(A)**: sabre argente; **A(L)**: semta; **A(T)**: sibtta; **M**: fjamma; **I**: pesce sciabola

Distribution in sea: coastal and continental shelf, benthopelagic

Distribution in region: W Mediterranean up to Egypt; S Adriatic; Aegean Sea

Common size (cm): 50–150

Type of fishery: semi-industrial (Spain, Sicily), artisanal, sport

Type of gear: purse seines, lampara nets, bottom trawls and longlines

Product/use: fresh, refrigated

Countries: Morocco, Spain

by Cambraia Duarte, P.M.N.

Scientific name: ***Lithognathus mormyrus***

Common names: **E**: striped seabream; **F**: marbré; **S**: herrera; **A(A)**: menkous; **A(L)**: mankus; **A(M)**: rmouli; **A(T)**: menkous; **M**: mingus; **I**: marmora

Distribution in sea: coastal, demersal

Distribution in region: whole of Mediterranean (except Baleares, Malta); Sea of Marmara

Common size (cm): 15–30

Type of fishery: semi-industrial fisheries (Adriatic, Egypt), artisanal, sport

Type of gear: beach and purse seines; bottom and pelagic trawls; bottom gillnets and longlines; trammel nets; cast nets (Tunisia); traps; handlines; cherfa cherfa (Tunisia)

Product/use: fresh, refrigated

Countries: France, Spain, Tunisia

by Freitas, R.

Scientific name: ***Lophius budegassa***

Common names: **E**: black-bellied angler; **F**: baudroie rousse; **S**: rape negro; **A(A)**: baudroie; **A(L)**: boshkara; **A(T)**: bichi chkara; **M**: petrica zghira; **I**: budego, rospo coda tripla

Distribution in sea: coastal, continental shelf and upper slope, benthic

Distribution in region: whole of Mediterranean

Common size (cm): 20–40

Type of fishery: semi-industrial fisheries

Type of gear: bottom trawls, gillnets and longlines

Product/use: fresh, refrigated, frozen

Countries: France

by Neto, G.

Scientific name: ***Lophius piscatorius***

Common names: **E**: angler; **F**: baudroie commune; **S**: rape; **A(A)**: baudroie; **A (L)**: boshkara; **A(T)**: bichi chkara; **M**: petrici; **I**: rana pescatrice

Distribution in sea: coastal, continental shelf and upper slope, benthic

Distribution in region: whole of Mediterranean

Common size (cm): 20–100

Type of fishery: semi-industrial (Spain, Cyprus), artisanal

Type of gear: bottom trawls, gillnets and longlines

Product/use: fresh, refrigated, frozen

Countries: France, Italy, Morocco, Spain, Tunisia

by Svensen, E.

Scientific name: ***Merluccius merluccius***

Common names: **E**: European hake; **F**: merlu commun; **S**: merluza europea; **A(A)**: nasalli; **A(L)**: marlutso; **A(T)**: nazalli; **M**: merluzz; **I**: nasello, merluzzo

Distribution in sea: continental shelf and slope, demersal, bathypelagic

Distribution in region: whole of Mediterranean; Sea of Marmara

Common size (cm): 12–60

Type of fishery: semi-industrial, artisanal

Type of gear: bottom and pelagic trawls, bottom gillnets and longlines, purse seines, handlines

Product/use: fresh, refrigated, frozen, salt-dried, potted

Countries: Algeria, France, Malta, Spain

by Svensen, R.

Scientific name: ***Mullus barbatus***

Common names: **E**: red mullet; **F**: rouget-barbet de vase; **S**: salmonete de fango; **A(A)**: rouget; **A(L)**: trelia bayda; **A(T)**: trilia bidha; **M**: trilja tal-quawwi; **I**: triglia di fango

Distribution in sea: continental shelf, demersal

Distribution in region: whole of Mediterranean; Black Sea

Common size (cm): 10–20

Type of fishery: semi-industrial, artisanal, sport

Type of gear: beach seines, bottom trawls and gillnets, hoop nets, handlines, harpoons

Product/use: fresh, refrigated, frozen, salted

Countries: Algeria, Malta

by Svensen, R.

Scientific name: ***Mullus surmuletus***

Common names: **E**: surmullet; **F**: rouget-barbet de roche; **S**: salmonete de roca; **A(A)**: rouget; **A(L)**: trelia; **A(T)**: trilia hamra; **M**: trilja tal-hawa; **I**: triglia di scoglio

Distribution in sea: continental slope and upper shelf, demersal, coastal

Distribution in region: whole of Mediterranean (except Baleares; Black Sea

Common size (cm): 10–25

Type of fishery: semi-industrial, artisanal, sport

Type of gear: beach and purse seine, bottom trawls, gillnets and longlines, hoop nets, harpoons, handlines

Product/use: fresh, refrigated

Countries: Algeria, France, Libyan Arab Jamahiriya, Malta, Spain

by Patzner, R.

Scientific name: ***Pagellus acarne***

Common names: **E**: axillary seabream; **F**: pageot acarné; **S**: aligote; besugo; **A(A)**: morjane; **A(L)**: bazoka; **A(M)**: pageot; **A(T)**: morjane; **M**: bazuga; **I**: pagello bastardo

Distribution in sea: coastal, continental shelf, demersal

Distribution in region: whole of Mediterranean (except Baleares)

Common size (cm): 10–25

Type of fishery: semi-industrial fisheries (Sicily, Adriatic, Cyprus), artisanal, sport

Type of gear: beach and purse seines, bottom and pelagic trawls, bottom gillnets and longlines, handlines, traps

Product/use: fresh, refrigated

Countries: France, Italy, Morocco, Spain

by Hernández-González, C.L.

Scientific name: ***Pagellus bellottii bellottii***

Common names: **E**: red pandora; **F**: pageot à tache rouge; **S**: breca chata; **I**: pagello maculato

Distribution in sea: coastal, continental shelf, demersal

Distribution in region: Morocco, Algeria

Common size (cm): 15–25

Type of fishery: artisanal

Type of gear: beach and purse seines, bottom gillnets and longlines, handlines

Product/use: fresh

Countries: Morocco

by Dammous, S.

Scientific name: ***Pagellus bogaraveo***

Common names: **E**: blackspot seabream; **F**: dorade rose; **S**: besugo; **A(A)**: morjane; **A(L)**: bazoka; **A(M)**: pageot; **A(T)**: morjane; **M**: bazuga; **I**: occhione

Distribution in sea: coastal, continental shelf and upper slope, demersal

Distribution in region: W Mediterranean (except Baleares); Adriatic, Ionian and Aegean Seas

Common size (cm): 15–50

Type of fishery: semi-industrial fisheries (Spain, Sicily), artisanal , sport

Type of gear: bottom trawls, gillnets and longlines, handlines

Product/use: fresh

Countries: France, Italy, Morocco, Spain

by Cambraia Duarte, P.M.N.

Scientific name: ***Pagellus erythrinus***

Common names: **E**: common pandora; **F**: pageot commun; **S**: breca; **A(A)**: morgen; **A(L)**: morjan; **A(M)**: pageot rouge; **A(T)**: morjane horr; **M**: pagella hamra; **I**: pagello fragolino

Distribution in sea: coastal, continental shelf and upper slope, demersal

Distribution in region: whole of Mediterranean (except Baleares); Sea of Marmara; SW Black Sea

Common size (cm): 10–30

Type of fishery: semi-industrial fisheries (Spain, Sicily, Cyprus), artisanal, sport

Type of gear: beach and purse seines; bottom trawls; gillnets and longlines; trammel nets; handlines; traps; gargoulettes (Tunisia)

Product/use: fresh, refrigated, frozen

Countries: Algeria, France, Morocco, Spain, Tunisia

by Hernández-González, C.L.

Scientific name: ***Pagrus pagrus pagrus***

Common names: **E**: common seabream; **F**: pagre commun; **S**: pargo; **A(A)**: pagre; **A(L)**: bagro; **A(M)**: pagrus pagrus; **A(T)**: pagre; **M**: pagru; **I**: pagro

Distribution in sea: coastal, continental shelf, demersal

Distribution in region: whole of Mediterranean (except Baleares, Malta)

Common size (cm): 20–60

Type of fishery: semi-industrial fisheries (Spain, Sicily, Egypt, Cyprus), artisanal, sport

Type of gear: beach seines; bottom trawls, gillnets and longlines; pelagic longlines; handlines; traps

Product/use: fresh, refrigated

Countries: Algeria, Libyan Arab Jamahiriya, Malta, Tunisia

by Patzner, R.

Scientific name: ***Phycis blennoides***

Common names: **E**: greater forkbeard; **F**: phycis de fond; **S**: brótola de fango; **A(A)**: mostia kabirah; **A(L)**: deeb; **A(M)**: bartola; **A(T)**: mostia kabirah; **M**: lipp abjad; **I**: mostella

Distribution in sea: continental shelf and slope, demersal

Distribution in region: whole of Mediterranean (except S Turkey, Cyprus, W Egypt, E Libyan Arab Jamahiriya)

Common size (cm): 20–40

Type of fishery: semi-industrial, artisanal

Type of gear: beach seines; bottom trawls, gillnets and longlines; handlines; traps

Product/use: fresh, occasionally fish-meal (Sicily)

Countries: Malta

by Luquet, D.

Scientific name: ***Phycis phycis***

Common names: **E**: forkbeard; **F**: phycis de roche; **S**: brótola de roca; **A(A)**: mostia saghirah; **A(L)**: deeb; **A(T)**: mostia saghirah; **M**: lipp tal-qawwi; **I**: musdea bianca

Distribution in sea: continental shelf and slope, demersal

Distribution in region: whole of Mediterranean (except S Turkey, Cyprus, W Egypt, Libyan Arab Jamahiriya)

Common size (cm): 10–40

Type of fishery: semi-industrial (Spain), artisanal

Type of gear: trawls, gillnets, bottom longlines, traps, handlines

Product/use: fresh

Countries: France, Spain

by Cambraia Duarte, P.M.N.

Scientific name: ***Prionace glauca***

Common names: **E**: blue shark; **F**: peau bleue; **S**: tiburón azúl; **A(A)**: bou menqar; **A(L)**: ergaya; **(M)**: huta kahla; **A(T)**: bou menqar; **M**: huta kahla; **I**: verdesca

Distribution in sea: coastal, oceanic, pelagic

Distribution in region: whole of Mediterranean

Common size (cm): 180–300

Type of fishery: incidental in semi-industrial fishery for swordfish (Sicily), artisanal, sport

Type of gear: bottom and pelagic trawls, gillnets, trammel nets, drifting longlines, handlines, trolls

Product/use: fresh

Countries: Malta

by Carvalho Filho, A.

Scientific name: ***Sarda sarda***

Common names: **E**: Atlantic bonito; **F**: bonite à dos rayé; **S**: bonito atlántico; **A(A)**: bonite; **A(L)**: mghatat; **A(M)**: cerda; **A(T)**: toumbrel; **M**: plamtu; **I**: palamita

Distribution in sea: mainly coastal epipelagic

Distribution in region: whole of Mediterranean; Black Sea

Common size (cm): 25–65

Type of fishery: semi-industrial (Spain, Turkey, Black Sea), artisanal

Type of gear: beach and purse seines; lampara nets; bottom and pelagic gillnets; handlines; trolls; traps; barriers

Product/use: fresh, salted, smoked, tinned

Countries: Algeria, France, Morocco, Spain, Tunisia

by Cambraia Duarte, P.M.N.

Scientific name: ***Sardina pilchardus***

Common names: **E**: European pilchard; **F**: sardine commune; **S**: sardine; **A(A)**: sardine; **A(L)**: sardin mabroum; **A(M)**: sardina; **A(T)**: sardina; **M**: sardin kahla; **I**: sardina

Distribution in sea: coastal, pelagic

Distribution in region: whole of Mediterranean; (except Cyprus, S Turkey, W Egypt, E Libyan Arab Jamahiriya); Sea of Marmara; Black Sea

Common size (cm): 15–20

Type of fishery: industrial, semi-industrial, artisanal

Type of gear: beach and purse seines; lampara nets; bottom and pelagic trawls; pelagic gillnets; barriers

Product/use: fresh, refrigated, salted, smoked, marinated, tinned; fishmeal and oil; bait

Countries: Algeria, Malta, Spain, Tunisia

by Dammous, S.

Scientific name: ***Sardinella aurita***

Common names: **E:** round sardinella; **F:** allache; **S:** alacha; **A(A):** latchah; **A(L):** sardinah; **A(M):** latcha; **A(T):** latchah; **M:** lacca tal-faxx; **I:** alaccia

Distribution in sea: coastal, pelagic

Distribution in region: whole of Mediterranean; Black Sea

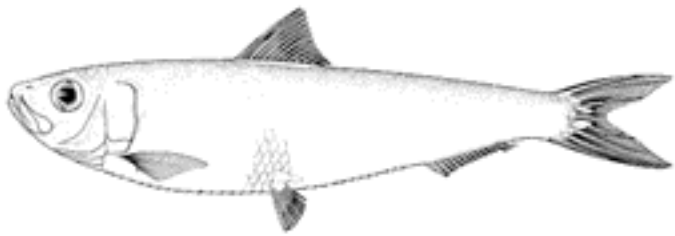
Common size (cm): 15–25

Type of fishery: semi-industrial (Spain, Tunisia, Morocco, Cyprus), artisanal

Type of gear: beach and purse seines, lampara nets, bottom and pelagic trawls, bottom gillnets, barriers

Product/use: fresh, frozen, salted, tinned; fishmeal and oil; bait

Countries: Algeria, Libyan Arab Jamahiriya



FAO

Scientific name: ***Scomber japonicus***

Common names: **E**: chub mackerel; **F**: maquereau espagnol; **S**: estornino; **A(A)**: sqoumri; **A(L)**: cawalli; **A(M)**: kabaila; **A(T)**: scombri bou inne; **M**: kavall; **I**: lanzardo

Distribution in sea: epipelagic or mesodemersal

Distribution in region: whole of Mediterranean; Sea of Marmara; occasionally SW Black Sea

Common size (cm): 15–30

Type of fishery: semi-industrial (Spain, Sicily, Italy, Morocco, Israel, Adriatic Sea); artisanal

Type of gear: beach and purse seines, lampara nets, bottom and pelagic trawls and gillnets, bottom and drifting longlines, handlines, trolls, barriers

Product/use: fresh, refrigated, frozen, salted, salt-dried, smoked, tinned; bait

Countries: Malta

by Cambraia Duarte, P.M.N.

Scientific name: ***Scomber scombrus***

Common names: **E:** Atlantic mackerel; **F:** maquereau commun; **S:** caballa del Atlántico; **A(A):** sqoumri; **A(L):** cawalli; **A(M):** kabaila; **A(T):** scombri bou richa: **M:** pizzintun; **I:** sgombro

Distribution in sea: epipelagic or mesodemersal

Distribution in region: whole of Mediterranean; S Black Sea

Common size (cm): 18–30

Type of fishery: semi-industrial (Spain, Sicily, Morocco, Cyprus, Turkey, Tyrrhenian and Adriatic Seas); artisanal

Type of gear: beach and purse seines; lampara nets; bottom and pelagic trawls, gillnets and longlines; handlines; trolls; barriers

Product/use: fresh, salted, salt-dried, smoked, marinated, tinned; bait

Countries: Malta, Tunisia

by Ueberschaer, B.

Scientific name: ***Scorpæna notata***

Common names: **E**: small red scorpionfish; **F**: petite rascasse; **S**: scorpora; **A(A)**: rascasse; **A(L)**: shkorfo aswad; **A(T)**: boukachech sghir; **M**: skorfnott; **I**: scorfanotto

Distribution in sea: coastal, continental shelf and upper slope, benthic

Distribution in region: whole of Mediterranean (except Baleares, Sardinia, most of Libyan Arab Jamahiriya and Egypt, S Turkey); E and W Black Sea

Common size (cm): 10–15

Type of fishery: semi-industrial (Adriatic, Sicily, Cyprus), artisanal

Type of gear: beach seines, bottom trawls, gillnets and longlines, handlines

Product/use: fresh, refrigated

Countries: France, Italy

by Patzner, R.

Scientific name: ***Scorpæna porcus***

Common names: **E**: black scorpionfish; **F**: rascasse brune; **S**: rascacio; **A(A)**: rascasse; **A(L)**: shkorfo aswad; **A(T)**: boukachech akhel; **M**: skorfna sewda; **I**: scorfano nero

Distribution in sea: coastal, demersal

Distribution in region: whole of Mediterranean; Sea of Marmara; Black Sea

Common size (cm): 10–20 (Med.)

7–13 (Black Sea)

Type of fishery: semi-industrial (Spain, Cyprus), artisanal

Type of gear: bottom trawls and gillnets, dredges, traps, beach seines, handlines

Product/use: fresh, refrigated

Countries: Spain

by Hernández-González, C.

Scientific name: ***Scorpæna scrofa***

Common names: **E:** red scorpionfish; **F:** rascasse rouge; **S:** cabracho; **A(A):** rascasse; **A(L):** shkorfo; **A(T):** boukachech ahmer; **M:** cipullazza; **I:** scorfano rosso

Distribution in sea: coastal, continental shelf, demersal

Distribution in region: whole of Mediterranean

Common size (cm): 20–30

Type of fishery: semi-industrial (Sicily, Cyprus), artisanal

Type of gear: bottom trawls, gillnets and longlines, beach seines, traps, handlines

Product/use: fresh, refrigated, frozen

Countries: Italy, Morocco, Spain, Tunisia

by Hernández-González, C.

Scientific name: ***Scyliorhinus canicula***

Common names: **E**: smallspotted catshark; **F**: petite roussette; **S**: pintarroja; **A(A)**: ktat; **A(L)**: gtat; **A(M)**: gata; **A(T)**: ktat; **M**: gattarel; **I**: gattuccio

Distribution in sea: coastal, demersal

Distribution in region: whole of Mediterranean; Sea of Marmara

Common size (cm): 20–50

Type of fishery: semi-industrial, artisanal

Type of gear: bottom trawls, gillnets, longlines, traps, handlines

Product/use: fresh

Countries: Algeria

by Aquarium Kiel

Scientific name: ***Seriola dumerili***

Common names: **E**: great amberjack; **F**: sériole couronnée; **S**: pez de limón; **A(A)**: poisson limon; **A(L)**: shoal; **A(M)**: seriole; **A(T)**: safraia bichi limouni; **M**: accola; **I**: ricciola

Distribution in sea: coastal, epibenthic, pelagic

Distribution in region: whole of Mediterranean

Common size (cm): 30–50

Type of fishery: semi-industrial, artisanal, sport

Type of gear: beach and purse seines, bottom and pelagic gillnets, handlines, trolls, bottom and drifting longlines, bottom trawls, barriers

Product/use: fresh, refrigated, frozen

Countries: Libyan Arab Jamahiriya, Spain

by Pontes, M.

Scientific name: ***Solea vulgaris***

Common names: **E:** common sole; **F:** sole commune; **S:** lenguado; **A(A):** sole; **A(L):** mdas; **A(T):** mdess; **M:** ingwata; **I:** sogliola comune

Distribution in sea: coastal, demersal

Distribution in region: whole of Mediterranean (except S Cyprus); Sea of Marmara; SW Black Sea

Common size (cm): 15–45

Type of fishery: semi-industrial, artisanal

Type of gear: beach seines, bottom trawls and gillnets

Product/use: fresh, frozen fillets

Countries: France, Spain

by Canosa, C. & B.F. Souto

Scientific name: ***Sparus aurata***

Common names: **E**: gilthead seabream; **F**: dorade royale; **S**: dorada; **A(A)**: ourata; **A(L)**: kerraf; **A(M)**: daurade; **A(T)**: ourata; **M**: awrata; **I**: orata

Distribution in sea: coastal, demersal

Distribution in region: whole of Mediterranean (except Cyprus); Sea of Marmara

Common size (cm): 20–50

Type of fishery: semi-industrial fisheries (Sicily, Israel, Egypt), artisanal, sport

Type of gear: beach and purse seines; bottom trawls, gillnets and longlines; trammel nets

Product/use: fresh, refrigated, frozen; aquaculture (mainly Italy, Sicily, France, Spain)

Countries: France, Malta, Spain, Tunisia

by JJPhoto

Scientific name: ***Thunnus alalunga***

Common names: **E**: albacore; **F**: germon; **S**: atún blanco; **A(A)**: ghzel; **A(L)**: albacore; **A(M)**: germon; **A(T)**: ghzel; **I**: tonno alalonga

Distribution in sea: oceanic, epipelagic, mesopelagic

Distribution in region: N Mediterranean; Egyptian waters (except Nile delta), Israel; Aegean Sea; Sea of Marmara

Common size (cm): 50–80

Type of fishery: semi-industrial (Spain, Egypt, Tyrrhenian and Adriatic Seas), artisanal, sport

Type of gear: beach and purse seines; bottom and pelagic gillnets; drifting longlines; trolls; barriers

Product/use: fresh, salted, tinned

Countries: Tunisia

by Hofinger, E.

Scientific name: ***Thunnus thynnus thynnus***

Common names: **E**: northern bluefin tuna; **F**: thon rouge; **S**: atún; **A(A)**: toun ahmar; **A(L)**: tun; **A(M)**: thone; **A(T)**: toun ahmar; **M**: tonn; **I**: tonno rosso

Distribution in sea: oceanic (migratory), epipelagic, mesopelagic

Distribution in region: whole of Mediterranean; Black Sea

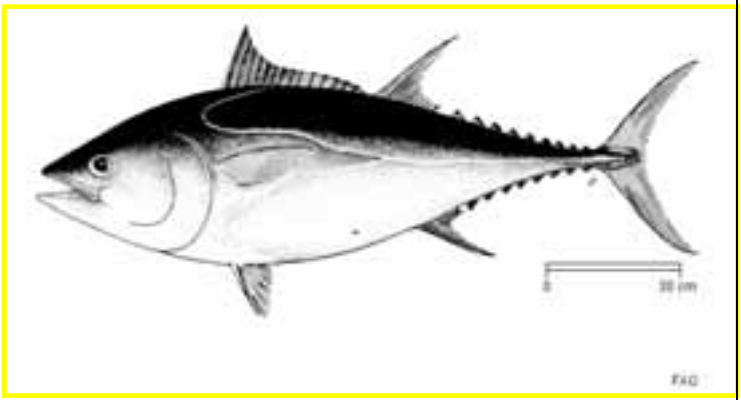
Common size (cm): 50–150

Type of fishery: semi-industrial (Spain, Sicily, Morocco, Tyrrhenian and Adriatic Seas), artisanal, sport

Type of gear: beach and purse seines; pelagic trawls and gillnets; drifting longlines; handlines; trolls; barriers

Product/use: fresh, refrigated, frozen, smoked, tinned

Countries: Algeria, Malta, Morocco, Spain, Tunisia



Scientific name: ***Trachurus mediterraneus***

Common names: **E**: Mediterranean horse mackerel; **F**: chinchard à queue jaune; **S**: jurel mediterráneo; **A(A)**: chourou farasi; **A(L)**: saurou aswad; **A(M)**: chren; **A(T)**: chourou asfer; **M**: sawrella; **I**: sugarello maggiore

Distribution in sea: oceanic, epipelagic, mesopelagic

Distribution in region: migratory; whole of Mediterranean; Black Sea

Common size (cm): 10–50

Type of fishery: industrial, semi-industrial, artisanal, sport

Type of gear: beach and purse seines, lampara nets, bottom and pelagic trawls, bottom gillnets and longlines, handlines, barriers

Product/use: fresh, refrigated, frozen, salted, dried, smoked, breaded, tinned; fishmeal; bait

Countries: Malta

by Meyer, T.

Scientific name: ***Trachurus trachurus***

Common names: **E**: Atlantic horse mackerel; **F**: chinchard d'Europe; **S**: jurel; **A(A)**: chourou europi; **A(L)**: saurou; **A(M)**: chrene; **A(T)**: chourou; **M**: sawrella kahla; **I**: suro

Distribution in sea: coastal, epibenthic, pelagic

Distribution in region: whole of Mediterranean; occasionally Black Sea

Common size (cm): 15–30

Type of fishery: industrial, semi-industrial, artisanal, sport

Type of gear: beach and purse seines; lampara nets; bottom and pelagic trawls; bottom gillnets and longlines; handlines; barriers

Product/use: fresh, refrigerated, salted; bait

Countries: Malta, Spain, Tunisia

by JJPhoto

Scientific name: ***Chelidonichthys (ex-Trigla) lucerna***

Common names: **E**: tub gurnard; **F**: grondin-perlon; **S**: bejel; **A(A)**: galinette; **A(L)**: djaj; **A(T)**: djej; **M**: gallinetta; **I**: capone, gallinella

Distribution in sea: coastal, continental shelf and upper slope, benthic

Distribution in region: whole of Mediterranean; Sea of Marmara; Black Sea

Common size (cm): 20–40

Type of fishery: semi-industrial (Spain, Sicily, Cyprus, Egypt), artisanal

Type of gear: bottom trawls, gillnets and longlines, handlines, beach seines

Product/use: fresh, refrigated, frozen

Countries: France

by Stergiou, K.I.

Scientific name: ***Xiphias gladius***

Common names: **E**: swordfish; **F**: espadon; **S**: pez espada; **A(A)**: bou sif; **A(L)**: aboucet; **A(T)**: bou sif; **M**: pixxispad; **I**: pesce spada

Distribution in sea: oceanic, epi- and meso-pelagic

Distribution in region: whole of Mediterranean; Black Sea

Common size (cm): 80–220

Type of fishery: semi-industrial (Spain, Cyprus), artisanal, sport

Type of gear: beach and purse seines; bottom and pelagic trawls, gillnets and longlines; handlines; harpoons; trolls

Product/use: fresh, refrigated, frozen and potted

Countries: Algeria, Libyan Arab Jamahiriya, Malta, Spain, Tunisia

by Cambraia Duarte, P.M.N.

Crustaceans

Scientific name: ***Maja squinado***

Common names: **E**: spinous spider crab; **F**: araignée de mer; **S**: centolla; **I**: granseola

Distribution in sea: demersal, over rocky bottoms or sandy bottoms covered with algae, sublittoral, down to 150 m, even 500 m

Distribution in region: whole Mediterranean, except southern Turkey

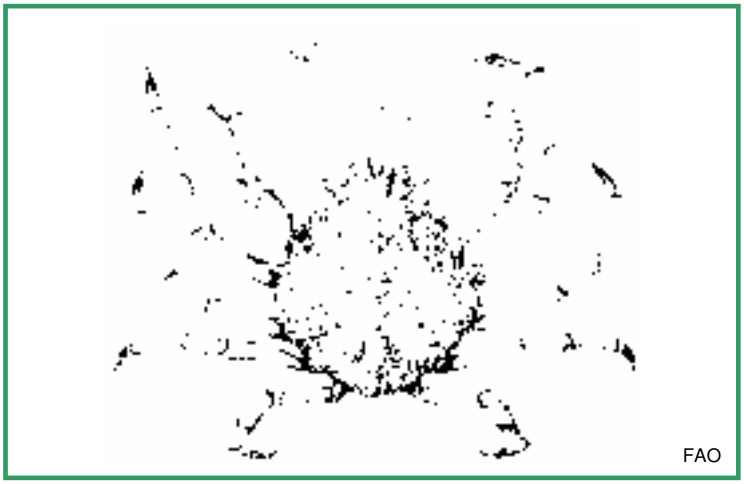
Common size (cm): 10 (carapace width)

Type of fishery: artisanal

Type of gear: bottom trawls, beach seines, trammel nets, by hand or tongs (divers)

Product/use: fresh

Countries: Morocco


FAO

Scientific name: ***Homarus gammarus***

Common names: **E:** European lobster; **F:** homard européen; **S:** bogavante; **I:** astice

Distribution in sea: demersal over rocky bottoms, 0–150 m

Distribution in region: whole Mediterranean, except Malta and the Levant

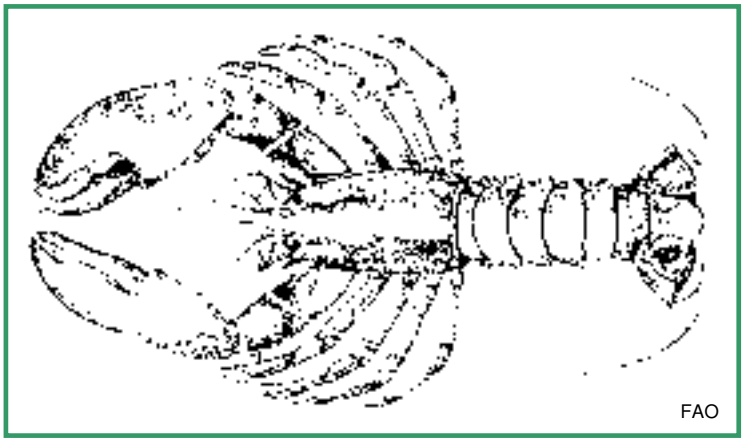
Common size (cm): 23–50

Type of fishery: semi-industrial, artisanal

Type of gear: pots, bottom trammel nets, handlines, by hand

Product/use: fresh, frozen

Countries: Italy


FAO

Scientific name: ***Nephrops norvegicus***

Common names: **E**: Norway lobster; **F**: langoustine; **S**: cigala; **M**: skampu; **I**: scampo

Distribution in sea: demersal over muddy or sandy-muddy bottoms, 20–800 m (common at 100–300 m)

Distribution in region: whole Mediterranean, except in Levant

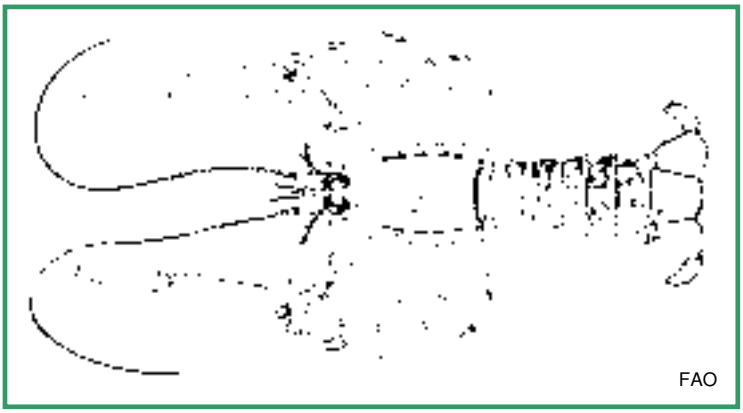
Common size (cm): 10–19

Type of fishery: semi-industrial, artisanal

Type of gear: bottom trawls, pots

Product/use: fresh, refrigerated, frozen

Countries: Algeria, Italy, Spain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Scientific name: ***Palinurus elephas***

Common names: **E**: common spiny lobster; **F**: langouste rouge; **S**: langosta común; **M**: awwista; **I**: aragosta mediterranea

Distribution in sea: demersal, rocky bottoms, 15–160 m

Distribution in region: whole Mediterranean except Levant, Egypt, eastern Libyan Arab Jamahiriya

Common size (cm): 20–40

Type of fishery: artisanal, semi-industrial (Ligurian Sea, Sicily)

Type of gear: traps, trawls, bottom gillnets, handlines, by hand

Product/use: fresh, refrigerated, frozen

Countries: Algeria, France, Malta, Morocco, Spain


FAO

Scientific name: ***Scyllarides latus***

Common names: **E**: Mediterranean slipper lobster; **F**: grande cigale; **S**: cigarra; **A(L)**: shcala; **I**: cicala di mare

Distribution in sea: demersal over rocky and sandy bottoms, 4–100 m

Distribution in region: whole Mediterranean except northern Adriatic and Malta

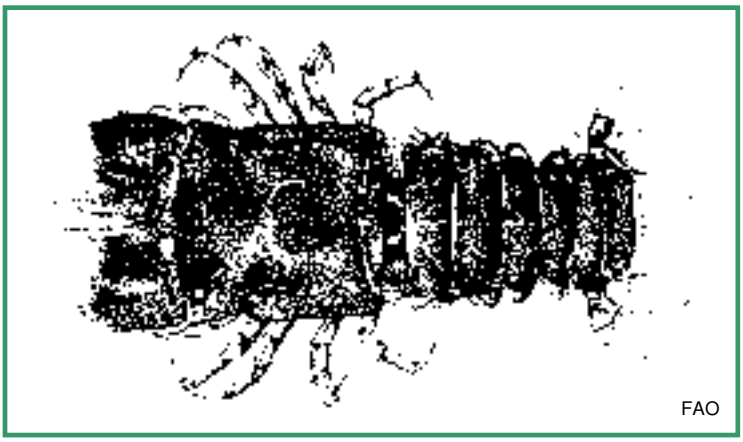
Common size (cm): 5–36

Type of fishery: artisanal or incidental in semi-industrial fisheries

Type of gear: bottom trawls and gillnets

Product/use: fresh, refrigerated, frozen

Countries: Libyan Arab Jamahiriya


FAO

Scientific name: ***Aristæomorpha foliacea***

Common names: **E**: giant red shrimp; **F**: gambon rouge; **S**: langostino moruno; **I**: gambero rosso

Distribution in sea: demersal over muddy bottoms, 120–300 m, down to 700 m

Distribution in region: whole Mediterranean, except north and central Adriatic, northern Aegean

Common size (cm): 13–14 (males); 17–20 (females)

Type of fishery: artisanal, semi-industrial

Type of gear: bottom trawls

Product/use: fresh, refrigerated, frozen

Countries: Spain


FAO

Scientific name: ***Aristeus antennatus***

Common names: **E**: blue and red shrimp; **F**: crevette rouge; **S**: gamba rosada; **M**: gamblu homor; **I**: gambero imperiale

Distribution in sea: demersal, muddy bottoms, 80–1 400 m

Distribution in region: whole Mediterranean except Adriatic Sea, eastern Aegean Sea, western Turkey

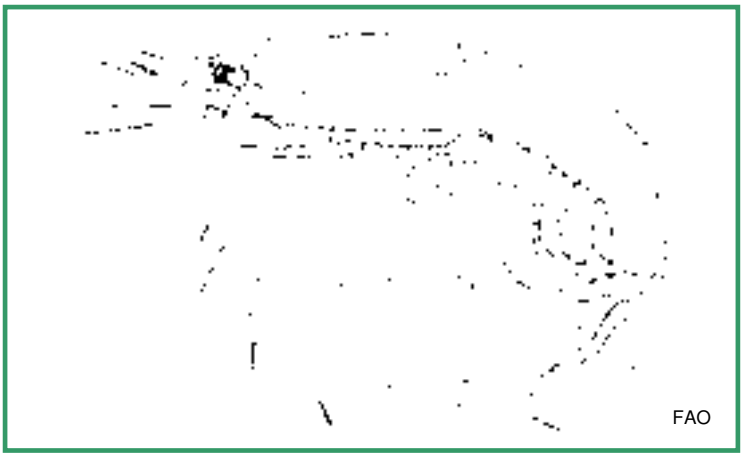
Common size (cm): 10–18

Type of fishery: artisanal, semi-industrial

Type of gear: trawls

Product/use: fresh, refrigerated, frozen

Countries: Malta, Spain



Scientific name: ***Crangon crangon***

Common names: **E**: common shrimp; **F**: crevette grise; **S**: quisquilla; **I**: gambero grigio

Distribution in sea: demersal over muddy or muddy-sandy bottoms or seagrass beds, 0–20 m, lagoons and estuaries

Distribution in region: whole Mediterranean, except Malta

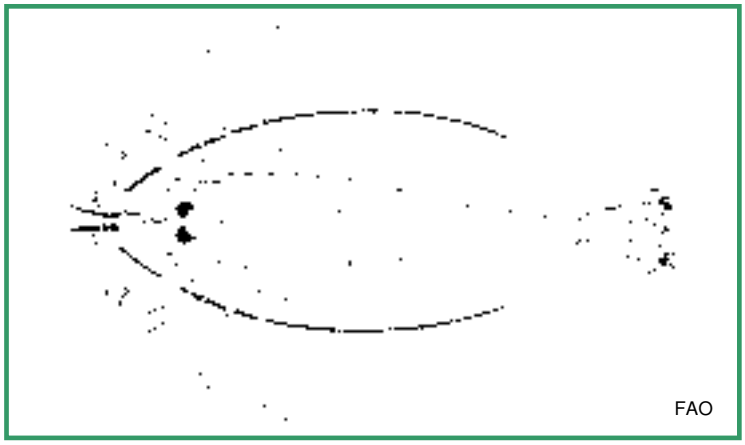
Common size (cm): 5–8

Type of fishery: artisanal

Type of gear: bottom trawls (ganguis), dredges, beach seines, barriers, pots and bags

Product/use: fresh; bait

Countries: Spain



Scientific name: ***Parapenæus longirostris***

Common names: **E**: deepwater rose shrimp; **F**: crevette rose du large; **S**: gamba de altura; **M**: gamblu bojot; **I**: gambero rosa mediterraneo

Distribution in sea: demersal, muddy/sandy bottoms, 20–700 m

Distribution in region: whole Mediterranean except N. Adriatic Sea

Common size (cm): 8–14 (males) 12–16 (females)

Type of fishery: artisanal, semi-industrial

Type of gear: trawls, palanzas (Morocco)

Product/use: fresh, refrigerated, frozen, tinned

Countries: Malta, Morocco

Scientific name: ***Penæus kerathurus***

Common names: **E**: caramote prawn; **F**: caramote; **S**: langostino; **A(L)**: gamberi kebir; **I**: mazzacolla, gambero imperiale

Distribution in sea: demersal, coastal zone, estuaries (young), muddy/sandy bottoms, 50–90 m

Distribution in region: whole Mediterranean

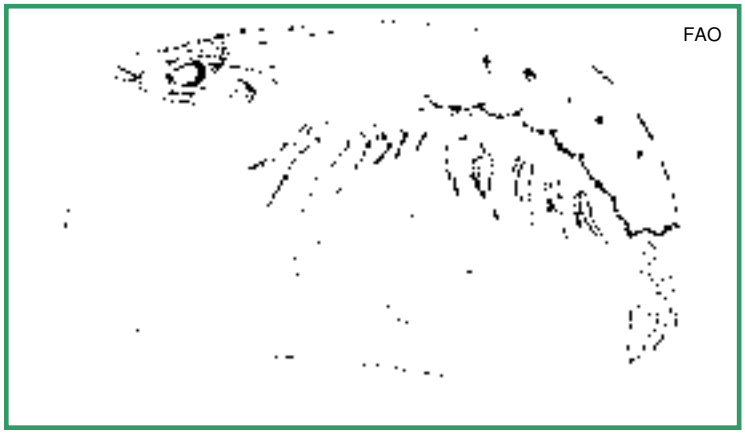
Common size (cm): 8–14 (males), 17 (females)

Type of fishery: artisanal, semi-industrial

Type of gear: trawls; beach seines (occasionally); trammel nets; traps (palanzas for young shrimp, Morocco); barriers

Product/use: fresh, refrigerated, frozen

Countries: Libyan Arab Jamahiriya, Morocco, Spain, Tunisia



Scientific name: ***Plesionika martia***

Common names: **E:** golden shrimp; **F:** crevette dorée; **S:** camarón marcial; **I:** gobbetto liscio, gobbetto dorato

Distribution in sea: demersal, muddy bottoms, 180–1 200 m

Distribution in region: whole of W. Mediterranean, S. Adriatic Sea, Ionian Sea, W. Aegean Sea, N. Crete; Nile delta

Common size (cm): 7–12

Type of fishery: artisanal, semi-industrial

Type of gear: bottom trawls, traps, longlines

Product/use: fresh, refrigerated, frozen

Countries: Malta, Spain

Scientific name: ***Plesionika edwardsii***

Common names: **E**: striped soldier shrimp; **F**: crevette Edward; **S**: camarón soldado; **I**: gobbetto striato

Distribution in sea: demersal, muddy bottoms, coral bottoms, 110–680 m (usually 250–380 m)

Distribution in region: whole of W. Mediterranean, S. Adriatic Sea, Ionian Sea, W. Aegean Sea, Crete, S. Turkey; Nile delta

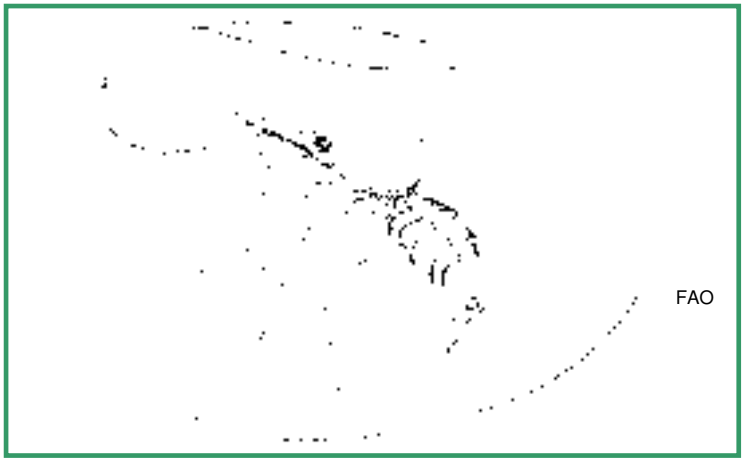
Common size (cm): 8–12

Type of fishery: artisanal, semi-industrial

Type of gear: bottom trawls, traps, longlines

Product/use: fresh, refrigerated, frozen, conserves

Countries: Malta, Spain



Scientific name: ***Squilla mantis***

Common names: **E**: spottail mantis squillid; **F**: squille ocellé; **S**: galera ocelada; **I**: pannocchia, canocchia

Distribution in sea: demersal over muddy bottoms, sublittoral, usually 50 m, down to 200 m

Distribution in region: whole Mediterranean

Common size (cm): 12–18

Type of fishery: semi-industrial, artisanal

Type of gear: bottom trawls, trammel nets, traps, dredges, beach seines

Product/use: fresh

Countries: Italy, Spain

FAO

Molluscs

Scientific name: ***Acanthocardia tuberculata***

Common names: **E**: tuberculate cockle; **F**: bucarde tuberculée; **S**: corruco; **I**: cuore rosso

Distribution in sea: benthic, sandy, sandy-muddy, gravelly bottoms (down to 80 m) in the littoral zone

Distribution in region: whole Mediterranean (except Malta)

Common size (cm): 5–7

Type of fishery: artisanal, occasionally semi-industrial

Type of gear: bottom trawls, drags/dredges, bottom gillnets and trammel nets, rakes, by hand (diving)

Product/use: fresh or tinned

Countries: Spain

FAO

Scientific name: ***Chamelea gallina***

Common names: **E**: striped venus; **F**: petite praire; **S**: chiurla; **I**: vongola comune

Distribution in sea: benthic, sandy or sandy/muddy bottoms

Distribution in region: whole Mediterranean

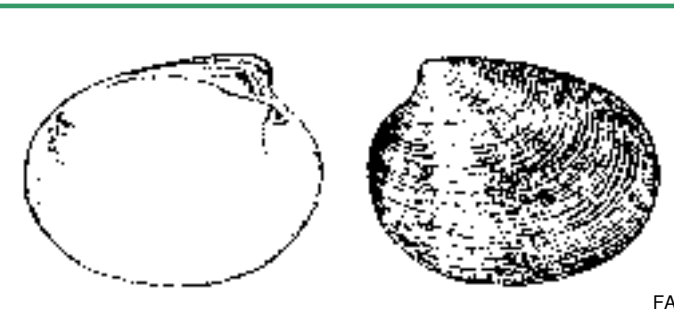
Common size (cm): 2.5–3.5

Type of fishery: artisanal, industrial, semi-industrial, aquaculture

Type of gear: dredges, rakes, by hand

Product/use: fresh, frozen, marinated, tinned

Countries: Morocco, Spain



FAO

Scientific name: ***Donax trunculus***

Common names: **E**: truncate donax; **F**: flion tronqué; **S**: coquina; **I**: tellina, arsella

Distribution in sea: demersal, sandy bottoms, 0–15 m

Distribution in region: whole Mediterranean except Malta

Common size (cm): 2.5–3.5

Type of fishery: artisanal, semi-industrial

Type of gear: bottom trawls, dredges, rakes, by hand

Product/use: fresh

Countries: Spain

FAO

Scientific name: ***Mytilus galloprovincialis***

Common names: **E**: Mediterranean mussel; **F**: moule méditerranéenne; **S**: mejillón mediterráneo; **I**: mitilo comune

Distribution in sea: intertidal rocks

Distribution in region: whole Mediterranean, except Malta

Common size (cm): 5–8

Type of fishery: culture (semi-industrial), artisanal, occasional, semi-industrial (Sicily)

Type of gear: rakes, by hand but now almost all by mariculture

Product/use: fresh, refrigerated, frozen, tinned; as bait

Countries: Spain

FAO

Scientific name: ***Pecten jacobæus***

Common names: **E**: great Mediterranean scallop; **F**: coquille St-Jacques de Méditerranée; **S**: concha de peregrino del Mediterráneo; **I**: cappasanta comune

Distribution in sea: inshore (various bottom types), offshore zone (detritic bottom type)

Distribution in region: whole Mediterranean except Malta

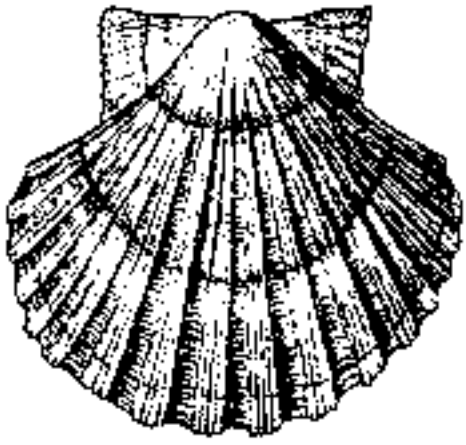
Common size (cm): 8–10

Type of fishery: artisanal, industrial

Type of gear: bottom trawls, dredges, occasionally beach seines, by hand

Product/use: fresh, refrigerated, tinned

Countries: Spain



FAO

Scientific name: ***Ruditapes decussatus***

Common names: **E**: grooved carpetshell; **F**: palourde croisée d'Europe; **S**: almeja fina; **I**: vongola verace

Distribution in sea: benthic, inshore, muddy sandy/gravelly bottoms or compact muddy bottoms, coastal lagoons

Distribution in region: whole Mediterranean except Cyprus

Common size (cm): 4–5

Type of fishery: artisanal, industrial, semi-industrial, aquaculture

Type of gear: dredges, rakes, occasionally bottom trawls

Product/use: fresh, marinated, tinned

Countries: Spain


FAO

Scientific name: ***Eledone cirrhosa***

Common names: **E**: horned octopus; **F**: poulpe blanc; **S**: pulpo blanco; **I**: moscardino bianco

Distribution in sea: benthic, sandy and muddy bottoms, 30–500 m, especially 60–150 m

Distribution in region: western Mediterranean, west of Libyan Arab Jamahiriya and Aegean Sea, sometimes in Crete, Cyprus and Nile delta

Common size (cm): 12 (female, mantle length), 8 (male, mantle length)

Type of fishery: artisanal, incidental in industrial and semi-industrial fisheries

Type of gear: bottom trawls

Product/use: fresh, refrigerated, frozen

Countries: Italy, Tunisia


FAO

Scientific name: ***Eledone moschata***

Common names: **E**: musky octopus; **F**: élédone ou poulpe musquée; **S**: pulpo almizclado; **I**: moscardino bianco

Distribution in sea: benthic, sandy and muddy bottoms, 150–90 m, down to 300 m

Distribution in region: whole Mediterranean

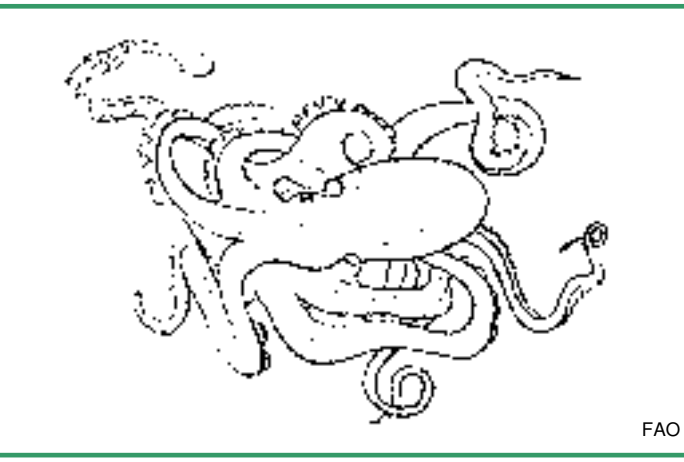
Common size (cm): 11 (mantle length)

Type of fishery: artisanal, incidental in industrial and semi-industrial fisheries

Type of gear: bottom trawls, bottom gillnets, trammel nets

Product/use: fresh, refrigerated, frozen, dried

Countries: Italy, Tunisia


FAO

Scientific name: ***Illex coindetii***

Common names: **E**: broadtail shortfin squid; **F**: encornet rouge; **S**: pota voladora; **I**: totano

Distribution in sea: pelagic, semi-demersal, 0–600 m

Distribution in region: whole Mediterranean

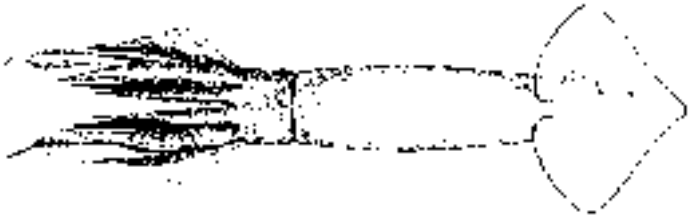
Common size (cm): 15–22

Type of fishery: incidental in industrial, semi-industrial and artisanal fisheries

Type of gear: bottom trawls, midwater trawls, handlines

Product/use: fresh, refrigerated, frozen

Countries: France, Italy



FAO

Scientific name: ***Octopus vulgaris***

Common names: **E**: common octopus; **F**: pieuvre; **S**: pulpo común; **A(L)**; garnet; **M**: garnita; **I**: polpo comune

Distribution in sea: benthic; coastal zone, to 100 m, rocky/sandy bottoms

Distribution in region: whole Mediterranean

Common size (cm): 10–20 (mantle)

Type of fishery: artisanal; incidental catch in industrial and semi-industrial fisheries

Type of gear: bottom trawls; trammel nets; handlines; traps; pots; beach seines; gargoulettes (Tunisia; A/T: drina); by hand

Product/use: fresh, refrigerated, frozen, dried

Countries: Libyan Arab Jamahiriya, Malta, Morocco, Spain, Tunisia

FAO

Scientific name: ***Sepia officinalis***

Common names: **E**: common cuttlefish; **F**: seiche commune; **S**: choco; **A(L)**: sebia; **M**: sicca; **I**: seppia comune

Distribution in sea: demersal, neritic, 0–150 m; muddy or sandy bottoms, seagrass beds

Distribution in region: whole Mediterranean

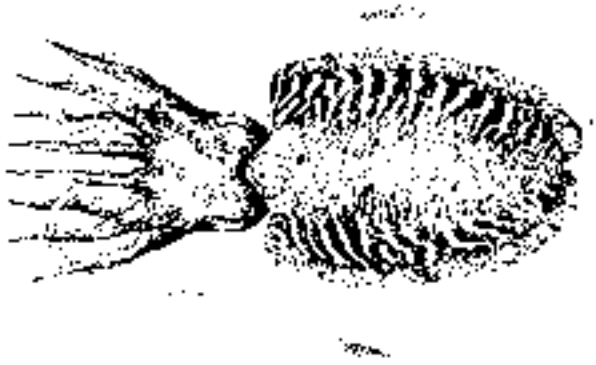
Common size (cm): 15–25 (mantle)

Type of fishery: artisanal, industrial, semi-industrial

Type of gear: bottom trawls and gillnets; trammel nets; pots and traps; handlines; barriers; cherfa cherfa (Tunisia)

Product/use: fresh, refrigerated, frozen, salt-dried; bait

Countries: Algeria, France, Libyan Arab Jamahiriya, Malta, Morocco, Spain, Tunisia



FAO

Scientific name: ***Todarodes sagittatus***

Common names: **E**: European flying squid; **F**: toutenon commun; **S**: pota europea; **M**: totlu; **I**: totano viola

Distribution in sea: semidemersal, 0–800 m

Distribution in region: whole Mediterranean, coastal and offshore

Common size (cm): 20–25

Type of fishery: artisanal, incidental catch in industrial, semi-industrial fisheries

Type of gear: bottom trawls, handlines (turluttes)

Product/use: fresh, refrigerated, frozen; bait

Countries: Italy, Malta

FAO

Moderately important species

Scientific name	Common names
Fishes	
Aphia minuta	**E:** transparent goby, **F:** nonnat, **S:** chanquete, **I:** rossetto
Atherina boyeri	**E:** bigscale sand smelt, **F:** joël, **S:** pejerrey, **I:** latterino capoccione
Boops boops	**E:** bogue, **F:** bogue, **S:** boga, **A(L):** bougah, **M:** vopa, **I:** boga
Brama brama	**E:** Atlantic pomfret, **F:** grande castagnole, **S:** japuta, **I:** pesce castagna
Centrophorus granulosus	**E:** gulper shark, **F:** squale-chagrin commun, **S:** quelvacho, **M:** zaghrun, **I:** centroforo comune
Cheilopogon heterurus	**E:** Mediterranean flyingfish, **F:** exocet méditerranéen , **S:** juriola, **I:** rondone di mare
Chelidonichthys (ex-Aspitrigla) cuculus	**E:** red gurnard, **F:** grondin rouge, **S:** arete, **I:** capone coccio
Dasyatis pastinaca	**E:** common stingray, **F:** pastenague commune, **S:** raya látigo común, **A(L):** bugrah bahar, **I:** pastinaca
Dentex dentex	**E:** common dentex, **F:** denté commun, **S:** dentón, **A(L):** dendichi, **M:** dentici, **I:** dentice
Dicentrarchus punctatus	**E:** spotted seabass, **F:** bar tacheté, **S:** baila, **I:** spigola macchiata
Diplodus annularis	**E:** annular seabream, **F:** sparaillon commun, **S:** raspalión, **A(L):** sbarus, **I:** sarago sparaglione
Diplodus vulgaris	**E:** common two-banded seabream, **F:** sar à tête noire, **S:** sargo mojarra, **A(L):** garagous mwashim, **I:** sarago fasciato
Euthynnus alleteratus	**E:** little tunny (tuna), **F:** thonine commune, **S:** bacoreta, **A(L):** rzam, **M:** kubrita, **I:** tonnetto
Gaidropsarus mediterraneanus	**E:** shore rockling, **F:** motelle de Méditerrannée, **S:** bertorella, **I:** motella mediterranea
Gaidropsarus vulgaris	**E:** three-bearded rockling, **F:** motelle commune, **S:** lota, **I:** motella maculata
Gymnammodytes cicerellus	**E:** Mediterranean sand eel, **F:** cicerelle, **S:** barrinaire, **I:** cicerello
Heptranchias perlo	**E:** sharpnose seven-gill shark, **F:** requin perlon, **S:** cañabota bocadulce, **M:** murruna, **I:** squalo manzo
Hexanchus griseus	**E:** bluntnose six-gill shark, **F:** requin-griset, **S:** cañabota gris, **M:** murruna, **I:** squalo capopiatto
Labrus merula	**E:** brown wrasse, **F:** merle, **S:** merlo, **A(L):** abukheder, **I:** tordo nero
Liza aurata	**E:** golden grey mullet, **F:** mulet doré, **S:** galupe, **I:** cefalo dorato, cefalo lotregano
Liza ramada	**E:** thinlip mullet, **F:** mulet porc, **S:** morragute, **I:** cefalo calamita
Merlangius merlangus euxinus	**E:** whiting, **F:** merlan, **S:** plegonero, **I:** merlano, molo
Mugil cephalus	**E:** flathead grey mullet, **F:** mulet à grosse tête, **S:** pardete, **A(L):** buri, **I:** cefalo comune
Mustelus mustelus	**E:** smoothhound, **F:** émissole lisse, **S:** musola, **I:** palombo comune
Oblada melanura	**E:** saddled seabream, **F:** oblade, **S:** oblada, **A(L):** kahla, **M:** kahlija, **I:** occhiato
Polyprion americanus	**E:** wreckfish, **F:** cernier commun, **S:** cherna, **M:** dott, hanzir, **I:** cernia di fondale
Pomatomus saltatrix	**E:** bluefish, **F:** tassergal, **S:** anjova, **A(L):** magres, **I:** pesce serra
Psetta maxima	**E:** turbot, **F:** turbot, **S:** rodaballo, **I:** rombo chiodato
Raja alba	**E:** white skate, **F:** raie blanche, **S:** raya bramante, **I:** razza bianca
Raja asterias	**E:** starry ray, **F:** raie étoilée, **S:** raya estrellada, **I:** razza stellata
Scophthalmus rhombus	**E:** brill, **F:** barbue, **S:** rémol, **I:** rombo liscio
Scyliorhinus stellaris	**E:** nursehound, **F:** grande roussette, **S:** alitán, **I:** gattopardo

Solea senegalensis	**E:** Senegalese sole, **F:** sole du Sénégal, **S:** lenguado senegalés, **I:** sogliola del Senegal
Sphyræna sphyræna	**E:** European barracuda, **F:** bécune européenne, **S:** espetón, **I:** luccio marino, barracuda
Sphyræna viridensis	**E:** yellowmouth barracuda, **F:** bécune bouche jaune, **S:** espetón boca amarilla, **A(L):** mughzel asfar, **I:** barracuda bocca gialla, luccio boccagialla
Sphyrna zygæna	**E:** smooth hammerhead, **F:** requin-marteau commun, **S:** cornuda cruz, **M:** kurazza, **I:** pesce martello
Spicara smaris	**E:** picarel, **F:** picarel, **S:** caramel, **M:** arznella, **I:** zerro
Spondyliosoma cantharus	**E:** black seabream, **F:** dorade grise, **S:** chopa, **A(L):** tannut, **I:** tanuta
Squalus acanthias	**E:** piked dogfish, **F:** aiguillat commun, **S:** mielga, **A(L):** abushoka, **M:** mazzola, **I:** spinarolo
Squatina squatina	**E:** angelshark, **F:** ange de mer commun, **S:** angelote, **A(L):** sfen, **I:** squadro
Trachinus draco	**E:** greater weever, **F:** grande vive, **S:** escorpión, **I:** tragina drago
Trigla (ex-Eutrigla) gurnardus	**E:** grey gurnard, **F:** grondin gris, **S:** borracho, **M:** gallina, **I:** capone corno
Trisopterus minutus capelanus	**E:** poor cod, **F:** capelan, **S:** capellán, **I:** merluzzetto
Umbrina canariensis	**E:** canary drum, **F:** ombrine bronze, **S:** verrugato de fango, **I:** ombrina delle Canarie
Umbrina cirrosa	**E:** shi drum, **F:** ombrine côtière, **S:** verrugato fusco, **A(L):** baghlah, **I:** ombrina
Uranoscopus scaber	**E:** stargazer, **F:** uranoscope, **S:** miracielo, **I:** pesce prete
Xyrichthys novacula	**E:** pearly razorfish, **F:** donzelle lame, **S:** rao, **I:** pesce pettine
Zeus faber	**E:** John dory, **F:** Saint-Pierre, **S:** pez de San Pedro, **M:** pixxi San Pietru, **I:** pesce San Pietro

Crustaceans

Carcinus æstuarii	**E:** Mediterranean shore crab, **F:** crabe vert de la Méditerranée, **S:** cangrejo mediterráneo, **I:** granchio comune, granchio ripario, moleca

Molluscs

Bolinus brandaris	**E:** purple dye murex, **F:** murex-droite épine, **S:** canaille, **I:** murice spinoso
Callista chione	**E:** smooth callista, **F:** vernis fauve, **S:** almejón, **I:** fasolaro
Loligo vulgaris	**E:** European squid, **F:** encornet, **S:** calamar, **M:** klamaru, **I:** calamaro comune
Mytilus edulis	**E:** common mussel, **F:** moule commune, **S:** mejillón, **I:** mitilo atlantico
Nassarius mutabilis	**E:** changeable nassa, **F:** nasse-ceinture, **S:** mugarida lisa, **I:** lumachina di mare
Phyllonotus trunculus	**E:** banded murex, **F:** murex tuberculé, **S:** busano, **I:** murice troncato
Venerupis aurea	**E:** golden carpetshell, **F:** clovisse (palourde) jaune, **S:** almeja dorada, **I:** vongola gialla
Venerupis rhomboides	**E:** banded carpetshell, **F:** palourde rose, **S:** almeja rubia, **I:** vongola rombo
Venus verrucosa	**E:** warty venus, **F:** praire commune, **S:** escupiña grabada, **I:** tartufo

Not important species

Scientific name	Common names
Fishes	
Alosa alosa	**E:** allis shad, **F:** alose vraie, **S:** sábalo común, **M:** lacca, **I:** alosa
Atherina hepsetus	**E:** Mediterranean sand smelt, **F:** sauclet, **S:** chucleto, **I:** latterino
Balistes carolinensis	**E:** grey triggerfish, **F:** baliste-cabri, **S:** pez ballesta, **A(L):** hallouf, **I:** pesce balestra
Belone belone gracilis	**E:** garfish, **F:** orphie, **S:** aguja, **A(L):** yebrah, **I:** aguglia
Belone belone euxini	**E:** garfish, **F:** orphie, **S:** aguja, **A(L):** yebrah, **I:** aguglia
Caranx crysos	**E:** blue runner, **F:** carangue coubali, **S:** jurel azúl, **A(L):** sawro imbriali, **I:** carango mediterraneo
Caranx rhonchus	**E:** false scad, **F:** comète coussut, **S:** jurel real, **A(L):** sawro asfar, **I:** carango ronco
Carcharhinus brevipinna	**E:** spinner shark, **F:** requin-tisserand, **S:** tiburón aleta negra, **I:** squalo tessitore
Carcharhinus falciformis	**E:** silky shark, **F:** requin soyeux, **S:** tiburón jaquetón
Carcharhinus obscurus	**E:** dusky shark, **F:** requin sombre, **S:** tiburón arenero, **I:** squalo scuro
Carcharhinus plumbeus	**E:** sandbar shark, **F:** requin gris, **S:** tiburón trozo, **I:** squalo grigio
Dentex gibbosus	**E:** pink dentex, **F:** gros denté rose, **S:** sama de pluma, **A(L):** joghali, **I:** dentice corazziere
Epinephelus æneus	**E:** white grouper, **F:** mérou blanc, **S:** cherna de ley, **A(L):** mennani, **I:** cernia bianca
Epinephelus alexandrinus	**E:** golden grouper, **F:** mérou badèche, **S:** falso abadejo, **M:** dott, **I:** cernia dorata
Epinephelus caninus	**E:** dogtooth grouper, **F:** mérou gris, **S:** cherna dentón, **A(L):** khanzirah, **I:** cernia nera
Muræna helena	**E:** Mediterranean moray, **F:** murène de la Méditerrannée, **S:** morena, **A(L):** zemrina, **M:** morina, **I:** murena
Mustelus asterias	**E:** starry smooth-hound, **F:** émissole tachetée, **S:** musola coronada, **I:** palombo stellato
Mustelus punctulatus	**E:** blackspotted smoothhound, **F:** émissole pointillé, **S:** musola punteada, **I:** palombo punteggiato
Mycteroperca rubra	**E:** comb grouper, **F:** mérou royal, **S:** gitano, **A(L):** dooth yahudi, **I:** cernia rossa
Naucrates ductor	**E:** pilot fish, **F:** poisson-pilote, **S:** pez piloto, **A(L):** lalaja, **M:** fanfru, **I:** pesce pilota
Platichthys flesus flesus	**E:** flounder, **F:** flet, **S:** platija, **I:** passera nera
Pleuronectes platessa	**E:** plaice, **F:** plie, **S:** solla, **I:** passera
Raja batis	**E:** skate, **F:** pocheteau gris, **S:** noriega, **I:** razza bavosa
Raja brachyura	**E:** blonde ray, **F:** raie lisse, **S:** raya boca de rosa, **I:** razza a coda corta
Raja clavata	**E:** thornback ray, **F:** raie bouclée, **S:** raya de clavos, **I:** razza chiodata
Raja fullonica	**E:** shagreen ray, **F:** raie chardon, **S:** raya cardadora, **I:** razza spinosa
Raja miraletus	**E:** brown ray, **F:** raie-miroir, **S:** raya de espejos, **I:** razza quattrocchi
Raja montagui	**E:** spotted ray, **F:** raie douce, **S:** raya pintada, **I:** razza maculata
Raja naevus	**E:** cuckoo ray, **F:** raie fleurie, **S:** raya santiguesa, **I:** razza cucolo
Raja oxyrinchus	**E:** longnosed skate, **F:** pocheteau noir, **S:** picón, **I:** razza monaca
Raja polystigma	**E:** speckled ray, **F:** raie tachetée, **S:** raya manchada, **I:** razza polistimma
Raja radula	**E:** rough ray, **F:** raie-râpe, **S:** raya áspera, **I:** razza scuffina
Raja undulata	**E:** undulate ray, **F:** raie brunette, **S:** raya mosaico, **I:** razza ondulata
Sarpa salpa	**E:** salema, **F:** saupe, **S:** salema, **A(L):** shelba, **M:** xilpa, **I:** salpa
Sciæna umbra	**E:** brown meagre, **F:** corb commun, **S:** corvallo, **A(L):** ghrab, **I:** corvina

Scomberomorus commerson	**E:** narrow-barred Spanish mackerel, **F:** thazard rayé, **S:** carite estriado del Indo-Pacífico, **A(L):** palamet yamani, **I:** sgombro striato
Serranus cabrilla	**E:** comber, **F:** serran-chèvre, **S:** cabrilla, **A(L):** serran, **M:** sirrana, **I:** perchia
Serranus hepatus	**E:** brown comber, **F:** serran-tambour, **S:** merillo, **I:** sacchetto
Serranus scriba	**E:** painted comber, **F:** serran-écriture, **S:** serrano, **I:** sciarrano
Siganus luridus	**E:** dusky spinefoot, **F:** sigan sombre, **S:** sigano nebuloso, **A(L):** batata, **I:** sigano scuro
Solea ægyptiaca	**E:** Egyptian sole, **F:** sole égyptienne, **S:** suela egipcia, **I:** sogliola egiziana
Sparisoma cretense	**E:** parrotfish, **F:** perroquet-vieillard, **S:** vieja colorada, **A(L):** ghazla, **I:** scaro

Others

Corallium rubrum	**E:** Sardinia coral, **F:** corail Sardaigne, **S:** coral Cerdaña, **I:** corallo rosso
Hippospongia communis	**E:** honey comb, **F:** éponge commun, **S:** esponja común, **A(L):** sfenj, **I:** spugna da cavallo, spugna cavallina
Paracentrotus lividus	**E:** stony sea urchin, **F:** oursin-pierre, **S:** erizo de mar, **I:** riccio di mare di roccia, arbacia
Nereis spp.	**E:** sandworms, **F:** néréide commune, pelouse; **S:** gusana
Microcosmus sabatier	**E:** sea fig, **F:** figue de mer, **S:** provecho, **I:** microcosmo gigante, limone di mare polimorfo

THE FISHING GEAR

Although this book is about marine, estuarine and lagunar artisanal fisheries in the western Mediterranean, we think it useful to describe briefly the main types of fishing gear in current use here and in many other parts of the world, so as to provide a context for our later considerations. We indicate those that are or are not normally present in artisanal fisheries. Then we indicate those types used in the region we are concerned with, pointing out local varieties of each in the various countries covered. We basically follow the FAO Fishing Gear Classification (FAO Fisheries Technical Paper 222 rev 1, 1990). We should stress that all the types of gear mentioned occur in an enormous variety, each variety being determined by local circumstances, such as target species, availability of the materials (at acceptable cost) for making the gear, sea bottom, usual sea state, nature of the coastline, fishing-boat requirements, level of mechanization etc. We cannot pretend to give more than a small selection of examples, and we omit very special cases, such as simple coshes for stunning fish forced into very shallow water.

Nets

Taking for granted the limitations of size imposed by the nature of artisanal fisheries, the following types of nets may be used by such fisheries: gillnets, tangle nets, trammel nets, beach seines, lampara nets, [small] purse seines, [small] bottom [shallow-water] trawlnets, lift nets, dip nets and cast nets.

Gillnets are normally rectangular, being much longer than high, with a float (or cork) line along the upper edge and a lead (weight) line along the lower edge.

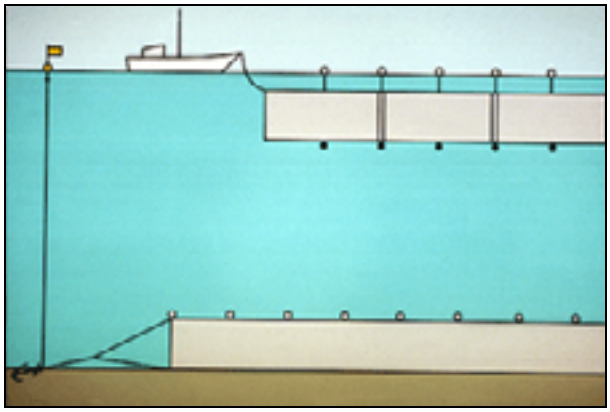


Figure 3-1
Diagram showing a drifting (floating) gillnet (top) and a set gillnet (bottom);
gillnets may also be set in mid-water or allowed to drift freely

They are designed to be set vertically in the water. Fish do not apparently see them or, at least, are not deterred by them; they force their head through a mesh as far as it will go, only to find, in most cases, that their body is deeper than their head. When they try to back out, the gillnet twine passes under their gill cover (or *operculum*), thus trapping them. Fish without opercula (as sharks) or with bodies of uniform width (as eels) are less likely to be trapped. And some fish with spines, barbels or similar organs at the front end of their body may simply become snared. Sometimes, marine turtles, birds and mammals (as seals, dolphins) are trapped if the mesh gets behind fins, wings or shell protrusions. Often these "higher" animals may just die of fright and drowning. Modern large-scale drifting gillnets may be several tens of kilometres long, but those used in artisanal fisheries are only, at most, a few hundreds of metres long.

Gillnets may also be fixed, by anchors or stakes, to the sea bed (as in tidal bays and inshore water), towed by the setter boat (sometimes encircling the target fish) or, as just noted, allowed to float freely in a vertical plane. They may be set at mid-depths though anchored to the sea bed. In shallow water, they may occupy the whole water column.

What they capture is determined by the net's mesh size relative to the sizes of individual fish in the fishing area. The conversion from natural fibres (as cotton) to synthetic monofilament (as nylon) for netmaking has greatly enhanced the effectiveness and durability of gillnets as well as other types of net gears.

Gillnets come in many versions in the artisanal fisheries of the Mediterranean. The main characteristics are the size of the panels (of netting), the number of panels constituting the gear (hence the overall dimensions), the mesh size (adapted to that of the target species, obviously) and the filament used (commonly nylon or a similar plastic, normally as monofilament) and its thread diameter, hence its "visibility" to target species and its resistance to a fish's effort to escape from the net. Panels may also differ in their construction to catch more than one target species according to their habitual depth in the water column. (See also combined gillnet–trammelnet gears, here below).

Tangle nets are similar to gillnets but are more loosely set, usually on the sea bed. They are aimed at entangling such prey as spiny lobsters and spider crabs, the spines of which make it almost impossible for them to detach themselves once caught. The role of the netting quality in terms of mesh size and material (e.g. whether monofilament or braided) is also relevant here.

Trammel nets, although they resemble gillnets, operate on a different principle. They are in fact two or three nets in one: one net with a fine mesh made of fine flexible (usually braided) twine is laid against another, or sandwiched between two others, of larger mesh and stronger thread. A fish, in attempting to pass through the larger mesh, pushes the fine-mesh net (which is also much less stretched than the larger-mesh net) through the larger mesh forming a bag on the other side in which the fish is entrapped. Like gillnets, they are made up of several or many panels, but are usually set to touch the bottom and may, also like gillnets, occupy the whole water column in shallow water, even if they are set far more slackly. When set over rocky or "dirty" bottoms, a heavy-mesh skirt may be attached to the leadline to prevent the gear from snarling on rocks or to pick up the debris while saving the main netting from becoming filled up with this debris.

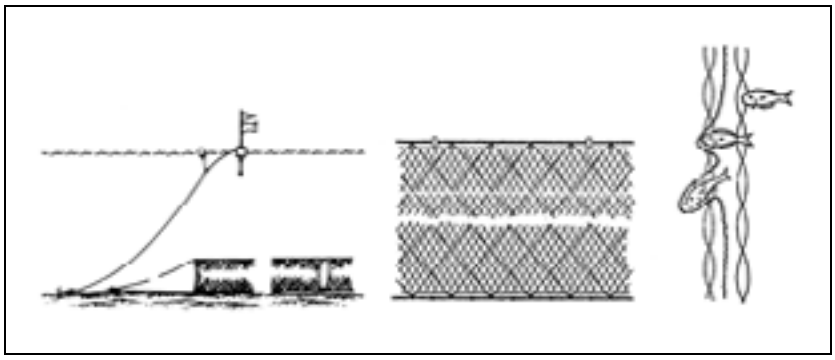


Figure 3-2
Diagram showing: on the left, the usual way a trammel net is set on the sea bed; in the middle, a frontal view; and, on the right, an end-on view showing how the fish become trapped (successive stages, top to bottom)

Trammel nets are some times combined with gillnets, to extend the variety of target species catchable at one time and place with one gear. Usually, the gillnet occupies the upper part of the combined gear, and the trammel net, the lower part, which normally rests on the sea bed. Such combination gears are nevertheless generally more difficult to operate, so are comparatively uncommon in the western Mediterranean.

Seines are designed to surround schooling fish; they are of four general types. The first two now briefly described may be used in artisanal fisheries. The last two are generally too large to be operated successfully by artisanal fishermen.

(i) The **beach seine** consists essentially of a bag (a sort of large cod-end) with a long rectangular and relatively narrow panel of netting (known as a wing) attached to the bag on either side of the "mouth", with corkline and leadline to keep it vertical in the water; for fishing, it is usually staked at one end (of a wing) to the beach, then, from a boat, set around a school of fish. The other wing is then hauled onto the beach, leadline first, and the captured fish school removed from the bag.

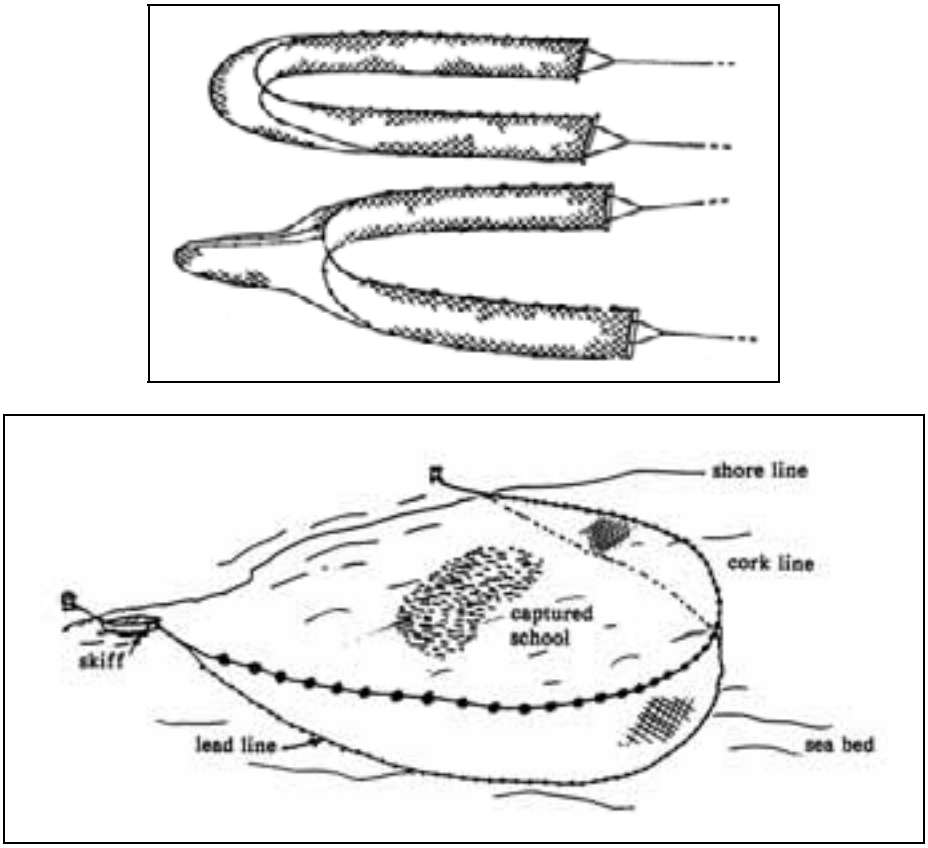


Figure 3-3
Diagrams of a beach seine, a lampara net (top) and
a schematic representation of a typical beach seine operation (bottom)

(ii) The **lampara net** is a relatively loose and open net bag with two wings, somewhere between a Danish seine (see below) and a beach seine in conception; it is fished from small boats or along the beach to catch schooling fish, and, like the beach seine, it is hauled leadline first. Large lampara nets are also operated from large fishing vessels.

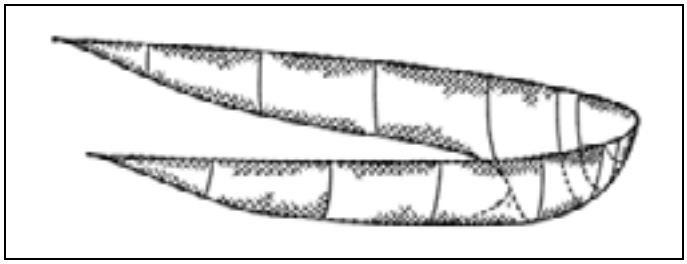


Figure 3-4
Diagram of a Danish seine

(iii) The **Danish seine** is similar to a trawl, a big net bag with two wings, though fished in a different way (it is used to catch fish living just over the bottom); it is operated from a fishing boat.

(iv) The **purse seine** is basically a rectangular encircling net, with a float line and with metal rings attached to its footrope and "threaded" onto the "purse string". It is set around a school of fish, usually offshore and off-bottom (i.e. it avoids touching the sea bed), and the purse line is drawn in to close the net at the footrope, thus trapping the school. Generally, the fish are taken aboard by **dip** (or **brail**) **net** while the purse seine remains in the water.

Small purse seines may be operated from a beach, rather like a sophisticated beach seine. Sometimes, this gear is used in combination with night lights which encourage schooling fishes to congregate and become more accessible to a fishery. (See also the section on Fish-attracting devices, here below)

Trawlnets vary greatly in size according to the local fishing situation, but, generally speaking, are not used in artisanal fisheries, since, to be effective, they are normally large and therefore require powerful vessels to tow them. The low-powered artisanal fishing boats cannot tow them fast enough to be effective. Whatever the size of the net, the bag itself has a more or less rectangular mouth and tapers towards the bottom or end of the bag; a second, detachable, smaller-mesh bag, at the tapered end and known as a cod-end, constitutes the actual end of the main bag; it greatly facilitates the emptying of the trawl.

Usually the bag also has two "wings", one attached to each side of the mouth. These wings are attached to the towing ropes (warps). Usually, a more or less rectangular board (otter board) is attached between the wing and the tow rope proper. The board, by resisting the water during towing, forces the wings to open as far as possible. The net mouth is also maintained open by means of floats on the top rope (headline) and by weights on the bottom or ground rope (leadline). Such trawls are called **otter trawls**.

The maximum horizontal opening can also be achieved by using two boats to tow the net, one for each wing, the boats themselves maintaining the tension by appropriate manoeuvring. Such trawls are called **pair trawls**.

In some fisheries, two trawlnets are attached to each other and hauled by one vessel; these are known as **twin trawls**.

Trawlnets can be towed along the bottom (provided it is smooth and soft enough not to snag the net), just above the bottom, depending on the behaviour of the species of interest to the fishermen. Those that are dragged along the bottom (generically called **bottom trawls**) have a low mouth and are usually fitted with a tickler chain between the wings and just in advance of the net-mouth leadline. This chain has the effect of forcing the typical target species – shrimp and flatfish – upwards and into the net mouth, thus improving catches.

Some smaller bottom trawls are fitted with a metal or wooden beam rather than a cork line and are called **beam trawls** which are often preferred for catching demersal flatfish and shrimp, particularly closer to shore; the towing warps are attached to the beam (at its ends).

Trawls can also be towed in mid-water to catch pelagic species (as sardines, anchovies, sprats) and are called therefore **midwater trawls.**

Trawlnets may be towed from the side of the fishing boat, and usually still are in artisanal (small-scale) trawl fisheries, but the introduction of powerful mechanical net-hauling devices (power blocks) in the early 1960s led to a preference for stern trawling, in which the net is shot over the stern, which in turn is designed in the form of a ramp, with a so-called "A" frame above it, to facilitate net handling.

Fishermen have always found ingenious ways to adapt their trawls to the local fishing circumstances, so it is not practical here to describe all the different varieties. The size of the mouth opening is one important point of variation. The latest and largest mid-water pair trawls have a "gape" just about big enough to "swallow" the Statue of Liberty, which welcomes immigrant and visiting humans to New York, or even the Arc de Triomphe in Paris – hardly the gear for artisanal fisheries.

Lift nets are usually set more or less flat on the bottom, particularly in tidal areas in which the passage or aggregation of fish is predictable. They are attached to a lifting mechanism which is normally operated physically, by human muscle power, at the appropriate time to catch the fish directly over the net or in the water column above it (obviously, this water column must be shallow in relation to the speed

with which the net can be hauled, so as to avoid escape by the fish). Such nets are common along the banks of river estuaries in some parts of the world. The relatively low catching power of lift nets usually limits them to use in artisanal fisheries. In some places, however, mechanical devices are used to haul lift nets rapidly and even automatically at a given time. Lift nets may also be operated from boats or can be portable and set and hauled by hand. Sometimes, as with purse seines, this gear is used in combination with night lights, for similar reasons. (See also the section on Fish-attracting devices, here below).

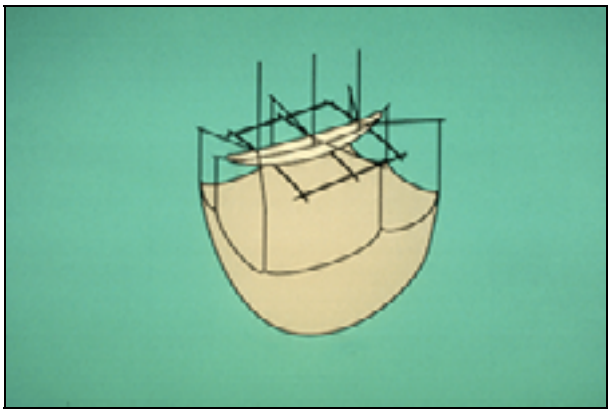


Figure 3-5
Diagram of a lift net

Dip nets may be hand held and used to catch fish, such as salmon and trout, in shallow and narrow waterways where such fish are often concentrated. They are exclusively artisanal fishing gear.

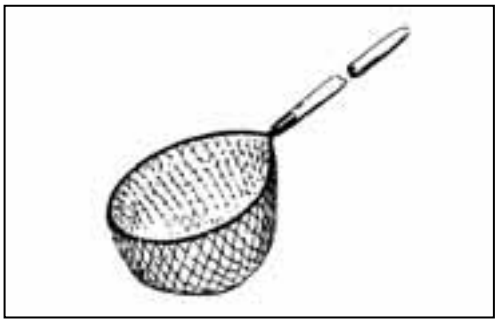


Figure 3-6
Diagram of a dip net

Throw or **cast nets** are also exclusively artisanal gear. Usually circular in design, they are thrown, with considerable skill, over a fish school in very shallow water. The fish are trapped on the bottom and can be retained in the net as it is taken from the water by the fisherman.

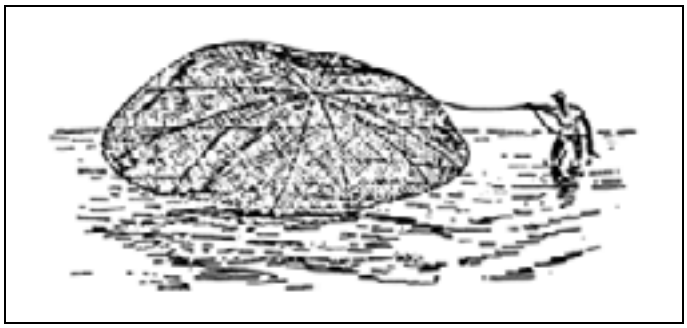


Figure 3-7
Drawing of a cast net being cast by an artisanal fisherman

Dredges

Dredges are usually in the form of a metallic frame or cage or a cage to which a strong netting is attached. The dredge is dragged over a soft sea bed where bivalve molluscs (such as scallops and clams) live in the surface mud. The cage has a "mouth" (a rectangular opening) which is presented to the sea-bed surface during fishing. Often, welded to the lower "jaw" – usually a metal bar – are "teeth", usually from 9 to 15 cm long, depending on the target species. These teeth "harrow" the sea bed to disturb the target species, usually molluscs. Since it may be dragged at some speed by a boat, the molluscs, which are essentially immobile organisms, are trapped in the rear end of the dredge or the net attached to it, which, when judged to be full, is hauled aboard.

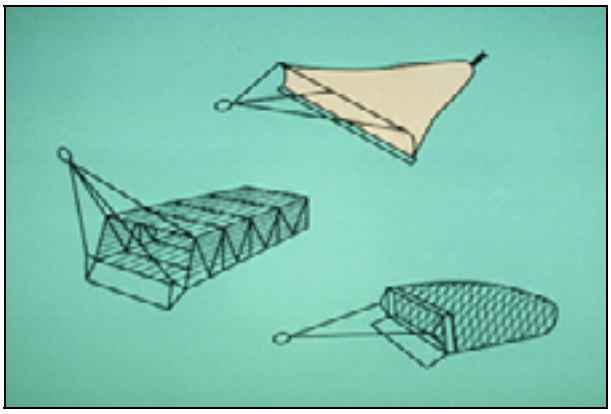


Figure 3-8
Diagram showing three kinds of bottom dredge;
the teeth that are often welded to the lower "jaw" are not shown here

A modern form of dredge, designed particularly to exploit small clams, is supplied with a forced air system fitted to the leading edge of the dredge, as well as "teeth" on the lower "jaw". The teeth and the forced air disturb the top twenty or so centimetres of the sea bed, virtually launching the clams into the mouth of the dredge. Some of these dredges are also designed specifically to force the clams through selector meshes so that the clams, when brought aboard, are already sorted into two or three size groups each of which is processed for a different purpose (e.g., canning, fresh consumption in restaurants, canned soup). This form of dredge is too sophisticated to be considered an artisanal fishing gear.

Rakes and **scrapers** (next paragraph) are considered as special, elementary forms of a dredge. Rakes are like the garden tool but adapted to raking soft sea bottom, usually in the intertidal zone, to gather clams and other bivalves. Since they are handheld, they are usually used only for subsistence and artisanal fishing.

Figure 3-9
Drawing showing four types of rake commonly used by individual artisanal fishermen

Scrapers are similar to rakes, but more usually used to scrape rock surfaces on which sessile or semi-sessile organisms, such as mussels, oysters and limpets, are attached.

Traps

Pots usually take the form of a rectangular box or a vertical, flattish cylinder or a horizontal half-cylinder, the flat side being on the sea bed. Although usually made of netting (wire, nylon), pots may be made of wooden slats, rattan and other natural materials. The netting is usually attached to a solid frame made of metal or wood.

They all have a conical entrance funnel that narrows towards the interior of the pot; some may have two or more such entrances. They all have a door (often occupying one side of the pot) that can be opened to retrieve the catch. When set on the sea bed, their position may be marked with a surface float attached to the pot by a line, although in some situations, where there is a likelihood of poaching, floats may be subsurface and set to pop up to the surface at about the time of retrieval by the fishermen. In some artisanal fisheries, many such pots are attached at intervals to a longline, which facilitates the setting and retrieval of the gear.

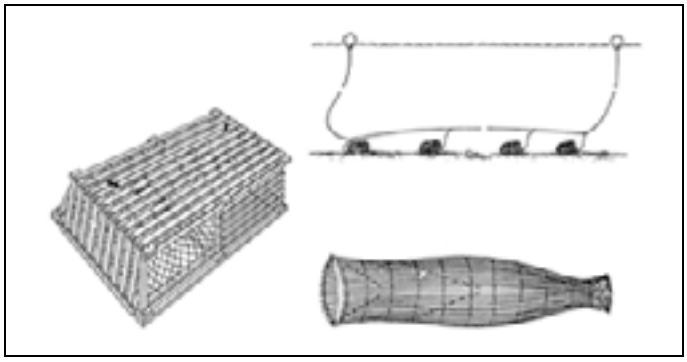


Figure 3-10
Drawings of two varieties of pot (left and lower drawings)
and (upper drawing) a line of pots set on the bottom

Their design is adapted to the target species, taking into account its form and behaviour; however, most species that are disposed to entering the larger opening of the entrance funnel do not seem to be able to escape by returning through the narrow, inner part of the entrance funnel, and so remain trapped. Likewise, the time of day (or week or month or year, even) at which pots are set and hauled takes the target species' behaviour into account. For example, in some species, several specimens caught in a trap may attack each other. In other traps, the captured specimens may die relatively quickly and start to decay if left too long in the pot. Since some species are territorial, as soon as one occupies a pot, it may prevent others from entering the trap, thus limiting the pots' effectiveness, from the fisherman's point of view; but fishermen know this and how to deal with it.

Sometimes, a pot will be baited to encourage a target species to enter it.

Since the catch rate (numbers caught per day) is relatively low, and pots are an artisanal method (worked by only one or a very small group of fishermen), the species sought are usually of high economic value (e.g., lobster, prawn, crayfish, crab, snapper).

A special kind of trap may be used to catch octopuses and cuttlefishes (which may also be induced into ordinary pots, however). It consists of a line to which is attached an object to which such species are attracted. The object may be a cylinder to which hooks are attached, or a ceramic pot – rather like a small classical amphora – which is often ballasted by cement in the pot's bottom. These special gears are in common use along the Spanish Mediterranean coast and called "cadups" or "cadufs".

Figure 3-11
Photo of a cadup (or caduf)

Octopuses can also be caught in a piece of a car tyre. The octopus uses the tyre as a hide and will not attempt to leave it even after it has been hauled out of the water, by which time it is too late. Often, many such tyre pieces (commonly a quarter of a tyre) are attached at intervals to a longline, to facilitate setting and retrieval. This method is not, apparently, used in the western Mediterranean, however.

Traps are usually bigger than pots, although the word trap may used for pots as just described. However, traps (and similar structures called barriers, fences, weirs, corrals etc.) are usually large, elaborate nets or wooden structures often fixed to the sea bed, particularly in shallow or inshore sites, where the top of the structure extends above the water surface, and placed taking into account the behaviour (especially local tidal migrations) of the target species. The fish are induced to enter the trap through an entrance that likewise diminishes in size towards the interior of the trap. Since the depth of the trap may be several metres and allow some fish the possibility of finding their way out, two or three such entrances may be arranged in sequence, occasionally with fairly elaborate "cul-de-sacs" to one side or the other or both.

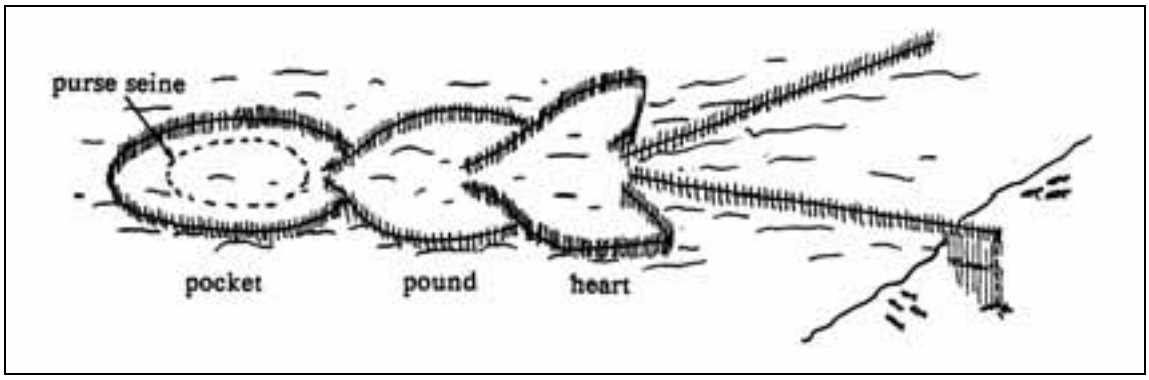


Figure 3-12
Drawing of a fish trap

Such traps are often placed in the entrance to coastal lagoons, the lagoon itself becoming a large natural trap concentrating fish that may be taken by other fishing gears. Sometimes, all the fisherman does is block the lagoon entrance with a net or other barrier after fish have entered with the incoming sea water.

A common type of trap is staked to the sea bed and perpendicularly to the shore; it extends several tens of metres (or even more) out to sea, ending in one (downstream of the coastal current, as a rule) or two (one upstream and the other downstream) curved (semicircular) barriers from which the fish seem unable to escape.

In some circumstances, a trap, like a pot, may be baited to attract species of interest. Special set nets are used as traps; the commonest are fyke nets, stow nets, pound nets and aerial traps.

Fyke nets are set in shallow water, particularly in a tidal zone; they are in the form of a cone with one or more staggered conical apertures of (necessarily) decreasing size inside the trap. The trap is staked or anchored to the sea bed. Often a wing is attached to each side of the net to guide the fish towards the entrance. The first aperture is normally about a metre in circumference, whereas the last, if there are, say, three in all, may be only about 30 centimetres across.

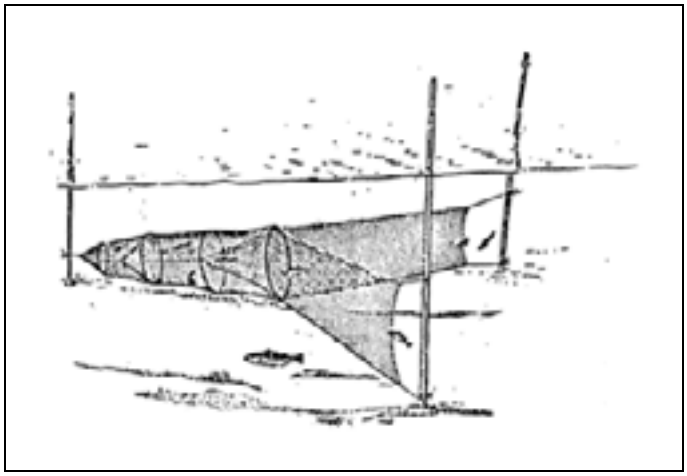


Figure 3-13
Drawing of a fyke net set on the sea bed in shallow water

Pound nets are usually quite elaborate structures staked to the sea bed in shallow water. One part of the pound net guides the fish into the main pound, which often has a bottom netting as well and one or more cul-de-sacs to deter the fish from finding a way back out of the pound net.

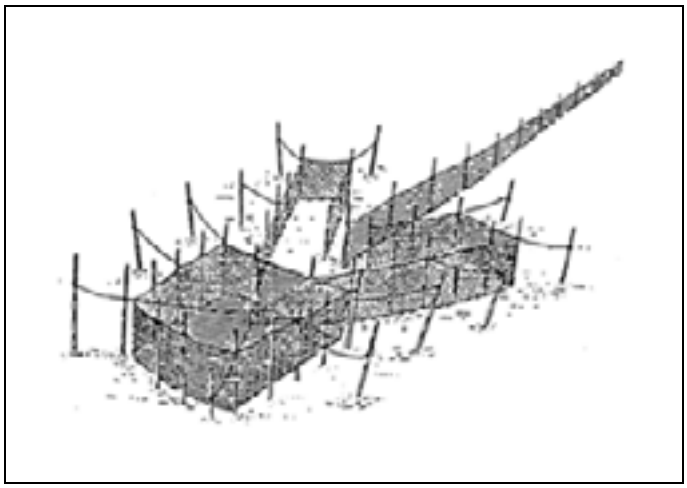


Figure 3-14
Drawing of a stationary uncovered pound net

Stow nets are usually in the form of an elongate cone or pyramid, with mouth held open by a frame which is staked to the sea bed or supported by a boat near the water surface. Such nets, or traps, are often grouped and placed with the mouth across the current in rivers or estuaries.

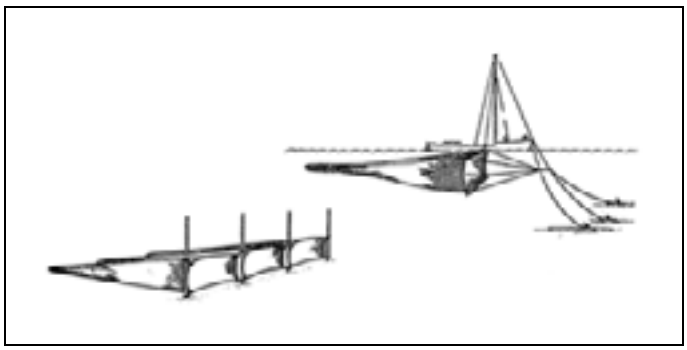


Figure 3-15
Drawing of stow nets set on the sea bed (left)
or retained by a fishing boat at the sea surface (right)

Aerial nets are a special form of barrier set in shallow water between bottom and surface; they are designed to catch jumping fish (e.g. mullets) or flying fish. The fish are diverted by the net "wall" and leap over the net into a horizontally set piece of netting (or boxes) on the other side of the "wall".

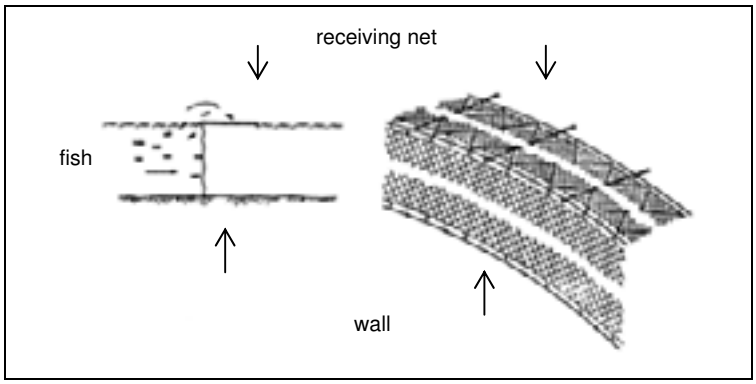


Figure 3-16
Drawing of an aerial net, in profile (left) and in frontal view (right)

Hooks

Although the hook is a simple and ancient fishing gear, the means of deploying hooks for fishing are numerous. Generally speaking, hook gear may be fished in rocky areas, as well as in the open sea.

Handlines are normally lengths of line to which one or more barbed hooks is attached. A weight is usually attached to the outward end of the line which is cast into the water; the hooks may be baited. Handlines may also be allowed to rest on the bottom, with the hooks baited, or they may be fished at mid-water depth, often with an artificial bait (jig). The line is hauled in (either by hand or by a mechanical device) and recast at regular intervals, depending on the nature of the target species. Sometimes the line may be cast from a moving boat and hauled in mechanically.

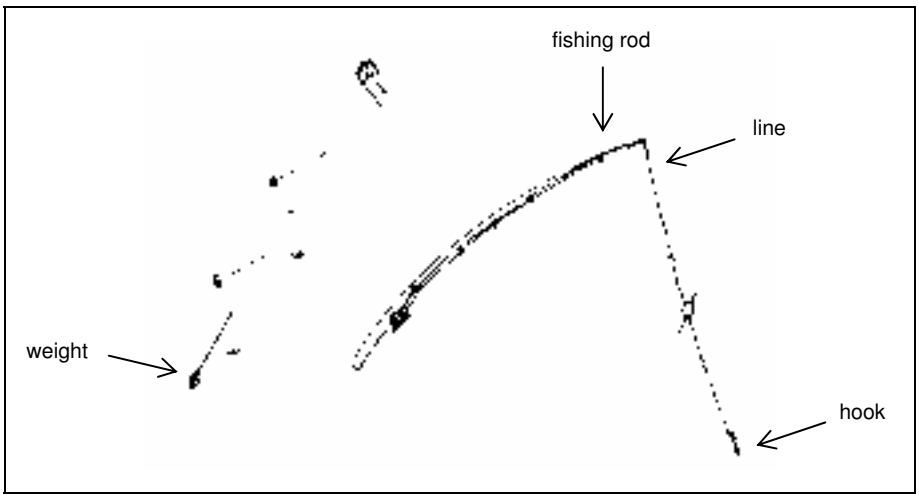


Figure 3-17
Drawing of a multi-hook handline (left) and a rod-and-line (right)

Angling is a specialized form of hand line; it is used normally for sport or subsistence fishing, rather than for artisanal fishing. A baited hook or a hook with an artificial bait (spinner) may be used, as in trolling (see below).

Longlines used in commercial/industrial fisheries may be several kilometres long; smaller varieties, a few hundred metres long, are used in artisanal fisheries. They may be floated horizontally, usually at subsurface depths. At intervals along them, hooklines, or snoods, are attached, the hooks hanging more or less vertically in the water column when the gear is being fished. Usually, the hooks are baited.

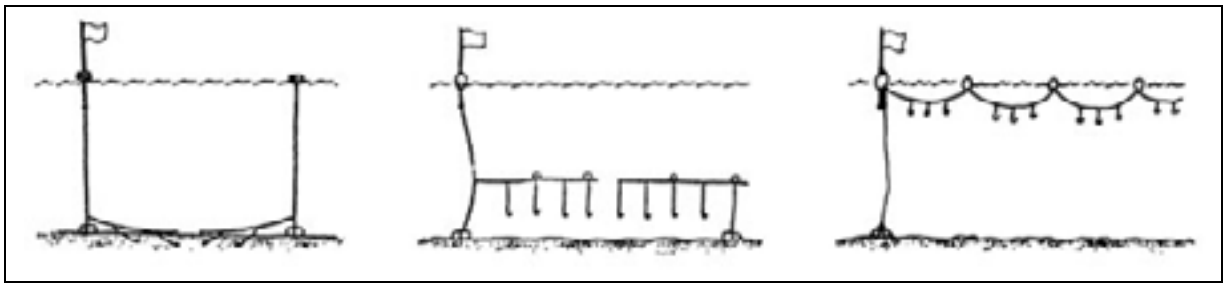


Figure 3-18
Diagrams showing a bottom set longline (left),
a mid-water longline (middle), and a floating set longline (right)

The longline is fished (often being allowed to drift freely) for several hours, or more, before being hauled aboard the fishing vessel, normally mechanically, but also by hand if they are light (short) enough. Swordfish, marlins, tunas, sabrefish, sharks and other species are the principal targets; however, sharks may have come to attack the other hooked fish just mentioned and be caught incidentally.

Longlines may also be laid on the bottom if demersal fish, such as hake, are the target species. And sometimes, by a careful combination of floats and weights on the mainline, the gear can be set in a zig-zag fashion to cover a wide range of depth and target more than one species.

Trolls are hook lines dragged through the water, at appreciable speed, to catch such species as swordfish, marlin, tunas, dolphinfish and other high-speed swimmers. The hook usually forms part of an artificial bait (a spinner) that, by intermittently reflecting the light while it spins, attracts these predatory fishes; it must therefore be used in relatively transparent water. This gear is used for sport-fishing and sometimes for commercial fishing, but since the catch rate is relatively low, it is aimed at high-valued fish. Trolling can be used in artisanal fisheries as well although very unusual in the western Mediterranean.

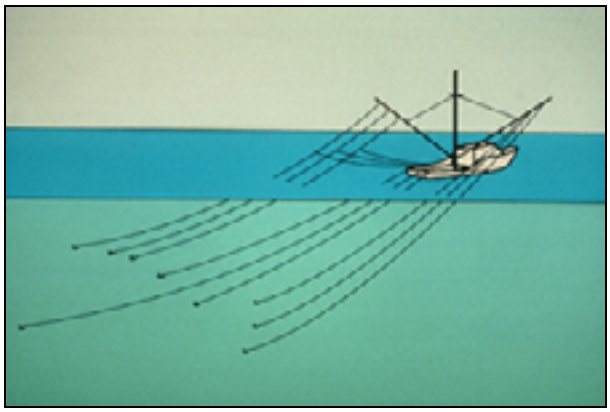


Figure 3-19
Diagram of a fishing boat trolling nine lines

Harpoons

Harpoons are a specialized form of spear, usually with a barb; the point is normally fitted to a stock which may be lanced by the fisherman directly into the target species; although not commonly targeted in the Mediterranean by this gear, whales, porpoises, seals (often while basking), sharks and other fishes are otherwise common target species.

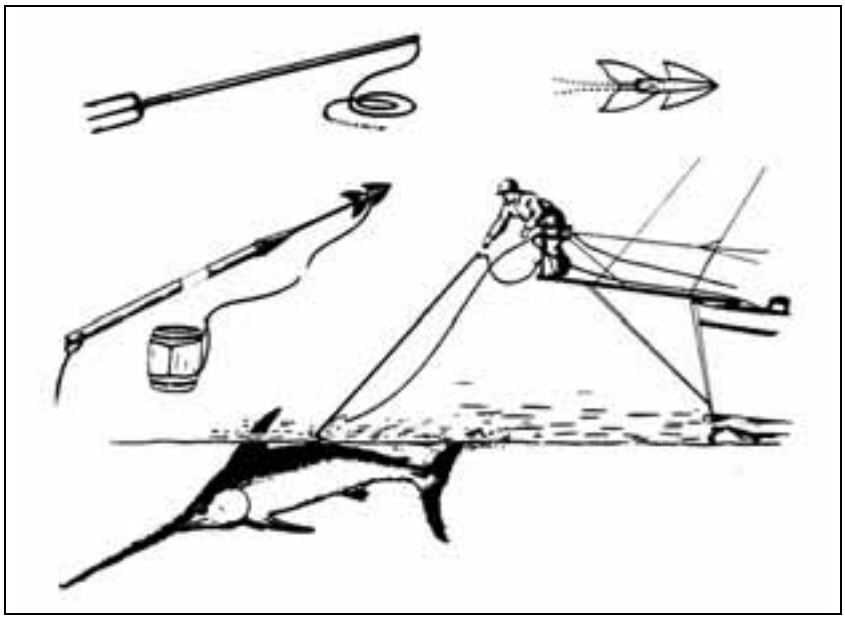


Figure 3-20
Drawings of harpoons

To prevent the prey from escaping, harpoon and all, a rope is attached to the harpoon and tied to a heavy or immovable object such as the fishing boat.

Handheld harpoons, as well as harpoon guns (usually based on the crossbow or catapult principle), are used by scuba divers for sport-fishing or subsistence fishing, but may also be used in artisanal fisheries.

Tongs

Tongs are used locally for taking shellfish, crabs etc. from the shore or in shallow water.

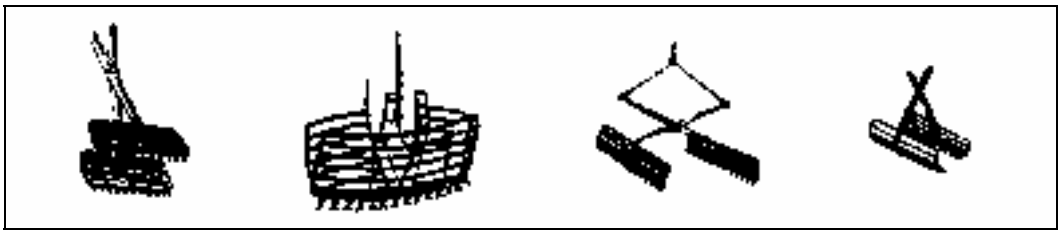


Figure 3-21
Drawing of four different types of shellfish tongs; the handles may be up to 5 metres long and be used from small fishing boats to take shellfish off the sea bottom

Other tricks

There are other fishing gears or methods that do not fit appropriately into any of the aforementioned categories. One of these, not however applicable in the Mediterranean, is the trapping of fish in tide gates at high tide, often with a retaining net to keep the fish as the tide goes out. At least two others are considered indefensible as legitimate fishing methods, but may be used by unscrupulous artisanal fishermen.

Explosives may be used in the sea to kill or stun fish (and other organisms), which float to the surface and are collected by the fishermen. This method is obviously totally unselective, so that species, sometimes the majority, of no interest to the fishermen are left to decay or be eaten by scavengers later.

Poison may be used in a similar way; it is also more or less unselective, although affecting some species more readily than others.

Fish-attracting devices (FADs)

These devices may be used in association with several fishing methods, but are not, in themselves, fishing gear; they may greatly facilitate the use of such gear. The best known, and which may be used by artisanal fishermen, are:

Lights. Used at night, powerful lamps set at the water surface or immersed in it attract a variety of marine organisms, particularly schooling fishes which can then be taken by a suitable fishing gear, such as a lift net or a purse seine, as mentioned earlier.

Floats, particularly logs of wood, small rafts, etc., have a similar effect, perhaps less pronounced than night lights, but still able to offer acceptable fishing opportunities, especially for schooling fishes, such as tuna and other large pelagic species and small pelagics (e.g. sardine, anchovy).

Artificial reefs, as the name suggests, are man-made structures set on the sea bed, usually in inshore waters. They may be dumps of wrecked car bodies or used tyres or building rubble, but an increasing effort is being made to design and manufacture them from modular parts such as concrete blocks and to assemble them in reef parks. In some cases the modular structures are designed to provide niches for fish and large crustaceans to hide in and/or lay eggs in. There is a fish-aggregating effect and there may be, in some cases, a real enhancement of the biomass in the region. Again, the target species (e.g. fish, octopuses, squid, lobsters, etc.) may be caught on or over the reef by conventional methods, though some adaptation to the physical mass of the reef may be necessary.

Pumps are really a sort of vacuum cleaner that can catch densely schooling fish species at the sea surface (often attracted by powerful lights at night); they are obviously energy-intensive, so the economic value of the target species, the efficacy of the pump and the value of the catch play determinant roles in the rentability of this type of gear.

"Ghost" fishing

This is one kind of fishing that no one does! Yet it is not ecologically or economically negligible. Netting is sometimes lost by fishermen by accident (in bad weather or by snagging on rocks, forcing the fishermen to cut loose part of their gear) and sometimes on purpose (dumping of old netting in the sea or on a beach whence it may be washed into the sea). This netting, drifting with the currents, continues to catch fish and snare marine mammals, birds and reptiles, but it may also cause maritime accidents or nuisance. This so-called ghost fishing has so far been very poorly quantified, but its importance is growing and thus is being increasingly taken into account in marine ecological terms.

IS THERE A FUTURE FOR ARTISANAL FISHERIES IN THE WESTERN MEDITERRANEAN?

Introduction

For a human activity to have a future, it must have a present, but also, almost inevitably, a past or at least a precedent. The artisanal fisheries of the Mediterranean clearly have all three: a past, a present and – under certain conditions – a future. Once started, the future at any particular time has not only been determined by the socio-economic, cultural, and biological context, but also by the past – the experience – in the business of artisanal fishing.

Our purpose here is to say what we think will be needed to achieve sustainable artisanal fisheries in the western Mediterranean and, by inference, possibly also in the rest of the Mediterranean basin. We must assume a reasonable evolution of human socio-economic affairs and of probable ecological change in the region, based, also reasonably, on the past experience of the Mediterranean, at least. We try to take into account the various factors, "tangible" (e.g. the state of the artisanal fisheries themselves, economic trends, social trends) and the "intangible" (e.g. many aspects of marine pollution, probable climate change, loss of biodiversity) and their effects – immediate and long-term. We hope to be more right than wrong with respect to the next thirty years.

The probable impact of climate change in the Mediterranean has been carefully evaluated in two volumes on *Climate Change and the Mediterranean*, published by the UN Environment Programme; the first volume was edited by L. Jeftic, J.D. Milliman and G. Sestini (1992); the second, by L. Jeftic, S. Keckes and J. Pernetta (1996). However, climate change is slow, thus allowing adaptation, so its practical effects on artisanal fisheries will not be strongly felt year to year. On the other hand, some of the possible effects are hard, if not impossible, to separate from the ordinary decennial or centennial time-scale variations in ocean circulation which have a strong oscillatory influence on marine resources. A book by Bruno Voituriez, titled "The Changing Ocean: Its Effects on Climate and Living Resources", published by UNESCO in 2003, provides several relevant examples. It is also interesting to note that the translation of the global changes to the Mediterranean Sea is manifested by a warming trend in the seawater temperature, affecting the continental shelf, the species diversity and resilience of the ecosystems concerned. The increasing salinity and temperature in the Alborán Sea at the end of the twentieth century could affect the biodiversity, with the appearance of new tropical species in the region. The highest water temperature also has a negative impact, producing mass mortality of gorgonians in the north-western Mediterranean, as was recently shown, resulting in important changes in the ecosystem.

We suggest some possible consequences of climate change and analogous phenomena for artisanal fisheries in the Mediterranean basin, although these changes are most likely to affect the ecosystems on which the artisanal fisheries depend rather than the artisanal fishermen directly.

The past

Needless to say, in the past, fisheries were perforce artisanal mainly for technological reasons: the means of building technically sophisticated fishing gear and boats were not available; moreover, the fish were probably more abundant and perhaps closer to the shore than they are today, so artisanal forms of fishing were adequate.

We may wonder why there are artisanal fisheries at all. Why would human beings ever try to obtain some or all of their food from the sea rather than from the more familiar, drier, more stable and probably more predictable land? The most obvious reasons might have been the following.

(i) Food was very hard to obtain on the land (in some places), even if it is generally easier to get food from the land than from the sea (other than by simple shell-gathering along the beach). The social forces acting to overcome such a major difficulty might have included the following.

- For various *ecological* reasons (droughts and floods, for example), an adequate food supply from the land was not available all year round, year in, year out. Or the food available from the land was generally of low nutritional value (e.g. low protein content), compromising the health of the local population.

- For local *geological* reasons (mountainous or arid hinterland, for example), an adequate food supply was not available from the land all year round, year in, year out.
- For local *social* reasons, obtaining food from the land was difficult because of the local pattern of land ownership, such as to make it possible for a land owner to demand too high a tribute, financially or socially, from a landless part of the population.

(ii) The alternative of fishing in the sea must have seemed valid, particularly since the sea was not, normally, privately owned and was little regulated by local authorities (in many ways, this circumstance remains largely true today).

(iii) Then there was a more general reason for the development of coastal marine fishing: the growth of human civilization. Civilization is a process by which human beings organize their socio-economic, political and cultural activities in society and which requires the exploration, understanding and mastery of the natural world in which the civilization takes place. This process leads to and depends on a search for new experiences, not least in the variety of foods that may be safely or even advantageously consumed. Fish flesh (including, as we said earlier, shellfish and crustacea, among other things) once tried and found to be delicate, tasty and nutritious, would be eaten and perhaps considered a privilege (of the rich and powerful, customarily).

However, fish are, like many things in the experiment called civilization, also a matter of fashion. The Atlantic Ocean salmon, the caviar of sturgeons and tuna are good examples. The Romans had a food dressing known as *garum* which was based on fish meat (predominantly tuna) and fish offal extract and rare herbs and usually reserved for the wealthy Romans. Today, tuna is widely consumed in the Mediterranean and elsewhere. Salmon and caviar were both initially regarded as best fit for poor people, but they became rarer and then a delicacy of the well-to-do. Today, with intensive fishery and intensive aquaculture, salmon, at least, has again become a rather cheap and "popular" fish, a feature of the diet of the now not so rich in the western world. Caviar may also be following suit, as sturgeon aquaculture increases (e.g. in the Gironde estuary on the Atlantic coast of France and in the region of the Guadalquivir in Spain).

Once firmly established, an artisanal fishery would have helped create the sense of a marine community, not only due to living on the coast, but also, probably, to the marketing of the catch, and to solidarity in the face of adversity – ecological, geographical or socio-economic. And the creation of a community very strongly implies the development of corresponding laws and rules of conduct, hence to the development of a culture, based not only on the business of making and repairing fishing gear and boats, but also on the means of recovery from the recurrent physical and mental effort of fishing, the celebration of successful fishing, and the search for fortitude in the face of unsuccessful fishing.

Indeed, the "marketing" of the artisanal fishery catches has been, and still is, very similar all over the Mediterranean. Historically, the artisanal fisheries were the main source of fish food for the region's nomadic peoples at a time when these were adopting a more stable and "anchored" life based on agriculture. This has proved a socially cohesive force at the local level, in the region

In this past, many or even all of these notions were a fact, at some times and in some places. The ancient art of the Mediterranean bequeathed to us by the old civilizations, and notably the mosaics of Roman times, show us the great interest taken in hunting and fishing. Seeing them today (the Bardo Museum in Tunis has a splendid collection of Roman mosaics, especially from that region – ancient Carthage), we have no great difficulty to recognize the preferred species of that time, which are often those still preferred today, and some of the fishing gears used then and still used today, improved only – though fundamentally – by the use of steel in the place of wood for net and dredge frames, and for hooks, instead of bone, iron or bronze; and nylon mesh in the place of natural fibres for the netting. The bait used and even some boat designs have certainly not changed at all!

All these factors gave a certain importance to artisanal fisheries in the past, but this importance was rather suddenly reduced in the late nineteenth century by the introduction from northern Europe of modern motors which were installed in fishing vessels and greatly increased the fishing power: vessels had to be bigger to accommodate such equipment and to answer the need for far larger quantities of fish to feed the growing populations of the countries of the Mediterranean, especially on its northern side, and of Europe in general. Such a development rather quickly reduced the economic and even social importance of artisanal fisheries. Indeed, the term "artisanal" was not in general use

with respect to fisheries before this major change occurred, which may be assigned to the early 1960s.

The present

Introduction

So, in what context are the artisanal fisheries of the western Mediterranean currently operating? This question requires a full answer, not only to provide a baseline for assessing the future, but also because the artisanal fishermen themselves may not, in their everyday lives, always be aware of the forces acting upon them today.

The geological nature of the Mediterranean basin remains unchanged, essentially, so fisheries are, for the most part, confined to the relatively narrow coastal/continental shelf area (with the exception of the Gulf of Gabès and the Balearic Islands plateau). This confinement to coastal waters is inevitably true for artisanal fisheries, for mechanical and economic reasons.

Nowadays, artisanal fishery communities may feel the need to defend their interests and socio-economic status vis-à-vis other community groups, including industrial and semi-industrial fishermen, in the pursuit of assurance of viability – of the community, if not of life itself. These other communities are, principally: coastal city dwellers; tourists and the tourist industry; coastal industry (including the petroleum transformation and pumping stations); farmers and market-gardeners (including winemakers); marine mining; shipping; the industrial fishing industry; mariculturists; and even the military in some places.

It is therefore of considerable importance to indicate how the artisanal fisheries relate to, and are affected by, the large number and variety of human activities in the western and central Mediterranean (and indeed in the eastern Mediterranean). In doing so, we hope to provide a reasonable basis for consideration of the future of artisanal fisheries. However, we decided to deal separately with marine pollution, in view of its situation as a sort of bridge between environmental/ecological aspects and the socio-economic aspects.

Fishery statistics and management

Although modern fishery management is now increasingly taking into account other important factors, its basis is fishery data and their analysis; in short, fishery statistics. The key data relate to the amount of fishing effort, the corresponding catch, the landings (which are not necessarily the same, since the catches may include bycatch discarded at sea, which is an important ecological and fishery consideration), the fishing season and, later, the data arising from the scientific study of the catch composition by species, individual size, sexual maturity, fish growth in length and weight, and other characteristics. The other important factors, mentioned above, relate to the ecological and environmental aspects.

At present, and to the practical extent possible, the fishermen themselves generate some of these data by, for example, recording their fishing activity in logbooks which are submitted to the relevant fishery-management authority for the purpose of data acquisition and control. Some of the required data are obtained by fishery inspectors interviewing fishermen and sampling catches at random.

These activities have led to the creation of national fishery-statistical offices and, more recently, to the creation of national, regional and, in some cases, international fishery data and information bases.

For the most part, however, fishermen meet their responsibilities in this sense only under constraint of law (or governmental regulation). Only in the best cases do they cooperate enthusiastically. There remains, therefore, a need to develop mechanisms for generating reliable fishery data and information that manifest a clear advantage to the fisherman themselves. The case of artisanal fishermen is rendered more difficult by their dispersion along the coasts, the precariousness of their situation, sometimes by their low level of education, and their characteristic mistrust of "outsiders", not to speak of the possibility that the information they might give could be used for "other purposes", such as tax assessment, or by rival fishing groups.

At present, while it is comparatively easy to control fixed coastal-zone mariculture, with respect to data and information acquisition, the rapid development of "tuna farming", consisting of seining tuna schools offshore then towing them inshore for "fattening", is pursued with a significant lack of control from the fishery statistical point of view.

In spite of the appreciable advances made in recent years, fishery statistics in general are inadequate as to quality and coverage by area and in time to enable high-quality assessment of fish stocks and of the state of the fisheries. Fishery management has therefore remained generally inadequate.

The General Fisheries Commission for the Mediterranean (GFCM), which organizes the scientific monitoring of the fisheries in the region, among other things, and the International Commission for the Conservation of Atlantic Tunas (ICCAT) which follows the tunas, notably the bluefin tuna and tuna-like species, and the swordfish, both make fishery management recommendations to their respective member states, and these recommendations are being increasingly, though slowly, implemented.

The European Commission has recently proposed a Community project on fishery management in the Mediterranean with a view to establishing the sustainable exploitation of the resources. This management would include:

- an increase in allowable fishing-net mesh size (from 40 mm to 60 mm over a period of six years) or a possible change from diamond mesh to square mesh;
- the banning of trawl and dredge fishing within 1.5 nautical miles of the coast and over seagrass beds, so as to protect coastal-zone nursery and juvenile-fish havens;
- the creation of national and Community marine protected areas in which some kinds of fishing activity will be forbidden;
- the establishment of minimum landing sizes for more than 20 species, although some established previously (i.e. for hake) have since been reduced;
- an improvement in the monitoring and the sharing of management responsibility between the EU and the member countries.

The Commission has, in effect, recently proposed that the management of the coastal-zone fisheries exploiting unshared stocks be largely entrusted to the member countries. However, given the multispecific nature of the Mediterranean fisheries and the interactions amongst the fishing practices, the European Commission has also proposed fishery management plans appropriate to the Community or to the countries themselves, with a view to allowing the combination of the various technical measures (with specific derogations if necessary, a fact that would no doubt give rise to grievances which may impede the acceptance of established standards whatever they may be). Another objective of the EU plan of action is to conduct a debate on the possible extension of the jurisdiction of the member countries in the field of fisheries (fishery protection zones, already existing in some cases), if necessary in the framework of a multilateral initiative involving other coastal States.

Although we could accept all the positive aspects of this new proposal of a Community regulation concerning the Mediterranean, we make the following general observations on it:

- First there is a need for a critical analysis of the working of the previous regulation, with its numerous derogations which ended up diluting its effectiveness; it led to an unequal treatment among the countries and sectors concerned and hence undermined the perception and working of a real Common Fishery Policy in the Mediterranean.
- It gave little support to the technical proposals presented and revealed a lack of reference to the scientific and technical studies that were carried out to justify any new proposals put forward. This aspect was particularly surprising, since in many cases the studies were co-financed by the European Commission; there was, for example, no analysis or consideration of the effect of the change from diamond mesh to square mesh, nor of the special devices for increasing catch selectivity as an alternative to a change to a 60-mm mesh, which would be difficult to apply.
- The mention of marine protected areas as a complementary management mechanism is approached in a very restrictive manner and there is no specific mention of closed fishing areas or seasons as a management method traditionally used in the Mediterranean.

- It is also strange that there is no mention of the socio-economic effect of the proposed measures. Nor is anything said of the problems arising from the trade under flags of convenience (control of landings from such vessels in Community ports), nor of the necessity of an effective supervision of sanitary quality.

Human activities and their ecological impacts on the coastal waters

Introduction

The Mediterranean, as a semi-enclosed sea, is particularly affected by human activities, but their impact depends on: (i) the nature and amount of the direct coastal terrestrial, riverine and atmospheric inputs relative to the rate of flushing to the Atlantic Ocean; (ii) the size (and density) of the human population living along the coast and within the catchment basin; (iii) the level of human activities and the land-use and water-use practices; (iv) the catchment area and its rainfall relative to the area of the sea itself; (v) the extent to which sills or basins modify the exchange of water with the Atlantic Ocean and within the Mediterranean itself; (vi) the depth and consequently, to a significant extent, the temperature stratification of the water mass.

The Mediterranean, with an average flushing time of some 80 years and perhaps much longer for deep-basin water, allows nutrients and toxic materials to accumulate, which, with other factors such as overfishing, is most likely to lead to a decline in ecosystem diversity and to progressive dominance of the biological production system by short-lived, especially pelagic, species, such as sardines and anchovies, which have constituted roughly 30% of the total Mediterranean fish landings since the early 1970s. The Black Sea, which is in a catastrophic ecological condition, also has a small but not negligible effect on the Mediterranean.

We turn now to the human activities of most concern at present in the context of the artisanal fisheries.

Coastal-zone use, urbanization and construction

Urbanization grows more or less proportionally to population growth. Generally speaking, in the Mediterranean, especially in the western basin, the population has always been constrained in its physical expansion by its mountainous terrain, except for a few major river basins and, along the North African coast, by desert. Human settlements have historically been concentrated in ports, either because of the difficulties of exploiting nearby mountainous terrain or because of the need to transport (and trade) the products of the hinterland (river basin) to other countries or quasi-landlocked towns and cities elsewhere along the coast. Major urban centres have therefore grown around the original coastal settlements and ports. This underlying factor, and the persistent downward trend in the agricultural population, observed in all industrial and post-industrial economies, and the corresponding, though upward, trend in the urban population, has contributed to continuing urbanization of the coastal area, with the subsequent pressures on natural living and non-living resources of the coastal zone.

The demands of urbanization on the coastal environment, like those attributable to population growth, hence to economic activity in the Mediterranean region, are essentially as follows: (i) the use of land that was previously rural and/or agricultural; (ii) the use of land that is otherwise needed to ensure the conservation of coastal resources and species of economic, ecological or social importance; (iii) the use of land to provide sporting and other facilities for tourists; (iv) the use of ground and river water to ensure an adequate and continuous supply of water for human use and consumption.

The demands on the environment, the natural resources and the ecosystems into which such resources are normally organized substantially modify the coast itself, displacing and reducing local flora and fauna, including fish, to ever-shrinking suitable habitat, and probably obliging artisanal fishermen to exploit ever-decreasing resources. For example, sand-dune systems are also being destroyed by occupation or use for the construction of seaside residences, as well as by too dense bathing populations.

It now seems likely that, between Málaga, in southern Spain, and Naples, in southern Italy, well over half the coastline is occupied by various forms of coastal urbanization and construction (including industrial installations). This certainly has a significant impact on the local marine ecosystems, particularly by altering the drainage and sedimentation pattern in the coastal zone. Urbanization also means covering substantial areas with impermeable concrete (for roads, building bases etc.) thus preventing rain water from permeating the soil (and filling natural subterranean water systems) and thus greatly speeding run-

off into rivers (themselves sometimes with concrete banks to channel discharge), leading to increased incidence of flooding on land and local dilution of coastal waters. These changes in drainage and siltation may force the fishermen to change their gear/methods and target species accordingly.

Coastal-zone urbanization has two more negative consequences for the environment: (i) the roads, motorways and seafronts running parallel to the shore between coastal cities and urban areas have reduced the contribution of terrestrial sediment to the shoreline and act as a damn, hindering the movement of fauna to the seashore; and (ii) the creation of artificial beaches, and conservation programmes using sea-bed sand, modify the bottom ecosystems and the natural coastal movements of sediment and coastal regeneration.

Fishermen stand to benefit from the correspondingly increased demand for their catches from the increased human population due to coastal urbanization and construction, as well as tourism (see next section). However, the traditional practice, in many coastal countries, of landing fish directly on the beach and selling the catch directly to the public and to the seaside restaurants is being significantly modified, depending on local circumstances, as a result of this urbanization and construction, as well as of new national legislation. So, paradoxically, while coastal construction may improve the capacity of seaside resorts to receive visitors or new residents, it may also make it harder and/or more costly to feed them, as far as the sea-food component of their diet is concerned.

Tourism and recreation

The Mediterranean basin offers a wide variety of possibilities for recreation, from skiing (mainly in the Alps and the Pyrenees), via mountaineering and rambling, tennis and golf, to the customary "water" sports: swimming/sunbathing, surfing, water-skiing, snorkelling and submarine diving (whether for spear-hunting or for amateur archæology), yachting/sailing, marine angling (from the beach or from pleasure cruisers offshore).

Tourism and recreation are a forcing factor in coastal development, notably through the construction of hotels, restaurants, shopping centres, sport facilities, marinas, public services and buildings. The populations of many coastal resorts are multiplied several times during the holiday season. If the authorities do not provide facilities or services especially to deal with the increased waste, the coastal sea is relied upon to handle the waste that cannot be treated. While the sea's capacity to accept this waste may be considerable, it is far from infinite and may depend quite heavily on the rate at which the local sea is changed (flushed) by local currents.

Tourism and recreation in all their forms either involve significant environmental degradation or costly arrangements by the "tourist-importing" countries to limit such degradation; the aquatic activities inevitably prevent the pursuit of artisanal fisheries in inshore waters in many places that were once valuable fishing grounds.

An important direct impact of tourism and recreation is due to the litter left on beaches or thrown directly into the sea along the beach. Although certain plastic or metal objects (bottles, cans, containers etc.) on the sea bed may, at a relatively low density, serve as niches for certain kinds of marine organisms, at a higher density they may simply act as a bar to such organisms because of overcrowding. And the destruction of sand-dune systems by too dense bathing populations or by occupation or use for the construction of seaside residences was mentioned above.

Discharge of domestic and industrial solid, liquid and energy waste

The dumping of industrial and urban wastes is an important use of the sea in the Mediterranean basin. The main routes to the sea are direct discharge, normally through coastal outfalls, indirect discharge via rivers, themselves discharging to the sea, and via the atmosphere, from which wastes, especially particulates, are deposited dry on the sea surface or washed out of the atmosphere by rain onto the sea surface.

Industrial wastes usually contain compounds (e.g. heavy-metal residues) or materials (e.g. sludges) that are harmful to fish in coastal waters. Sometimes, the waste products of chemical processes are simply dumped (e.g. the voluminous deposits of phosphogypsum waste on the Sfax seashore in Tunisia).

Those industries, especially power-generating plants, preferring the coastal zone as a location generally do so because of their strong demand for water for cooling or for receiving wastes created by

the industrial processes involved, and sometimes because the inland rivers and water bodies are already over-used or over-protected (for their flora and fauna) or with too low a capacity to dilute and transport away the generated heat or waste quickly enough. The heat from the cooling of turbines and condensation towers of power plants, for example, is dumped with the cooling water back into the water body from which the cooling water originally came, creating a local environmental nuisance, modifying the pre-existing aquatic ecosystem, usually, though not always, for the worse. Moreover, the effluents of thermal power plants may contain toxic substances (used to keep piping free of mineral deposits or encrusting organisms) that contaminate natural water bodies receiving these effluents.

Urban solid wastes comprise, basically, organic matter (e.g., food debris), paper, glass, wood, textiles, plastics and metals. The solid wastes (mainly garbage) of human habitation and socio-economic activity are either used for land fill or, sometimes, dumped into the sea, although there is a growing recycling industry (producing, for example, paper and packaging materials, insulation materials, glass and scrap metal); such recycling, however, only slows down the eventual discharge of some solid waste to the land or sea environments. Untreated sewage can lead to the risk of viral contamination of shellfish and, if eaten insufficiently cooked, consequent human illness. The artisanal fisheries sometimes "pay" for the "bad reputation" such illness causes in the public mind.

Direct domestic and industrial waste discharges to the sea are generally dispersed relatively quickly, mainly by the sedimentation of solid wastes and the dilution of liquid wastes, usually within only a few tens of kilometres of the point of discharge. Nevertheless, the flora and fauna are usually severely affected within this area. Estuaries and deltas often serve not only as "sediment traps" for toxic wastes, but also as spawning and nursery areas for many species of invertebrates and fishes, so the early-life stages of these species can be severely prejudiced. Industrial and urban wastes therefore have a definite adverse effect on artisanal fisheries, although this is not always obvious.

Coastal and hinterland agriculture

The principal economic aim of agriculture in the Mediterranean drainage basin is to meet the food demand of the resident and the international market and, as necessary, the tourist populations. In this respect it resembles the Mediterranean fisheries. In recent decades, there has also been a steady growth of covered or semi-covered horticulture which occupies space (agricultural and periurban). The present percentage of agriculture in the Gross Domestic Product of the basin as a whole is under 20% (and even much less in the developed countries) and food supply from domestic agriculture is falling behind population growth in the basin; this offers a chance for artisanal fisheries to increase their share of the regional food supply.

Agriculture has (with deforestation and overgrazing, as well as urbanization and industry) contributed to a loss of the specialized flora (e.g. garrigue, grassland and forests) and the associated fauna that went a long way to preventing soil erosion in the Mediterranean basin, since several types of agricultural crop (e.g. sugar beet) are planted, grown and removed annually, which prevents the creation of a soil structure resistant to erosion by wind and rain.

Soil erosion increases sediment loading of rivers and changes the seasonal cycle and amount of freshwater run-off to coastal seas. High riverine sediment loads adversely affect:

- the coastal sea, by increasing water turbidity – which reduces the light penetration, hence the primary production, then the secondary and tertiary biological production, including fish – and the sedimentation;
- species, such as salmon, tilapia, sea and river lampreys, shad and sturgeon, which go up-river to spawn (anadromous);
- species, such as eels, which go down-river to the sea to spawn (catadromous);
- estuarine organisms such as oysters;
- aquatic vegetation (e.g. seagrass beds) which is often of key importance as fish habitat in the coastal zone;
- by implication, the fisheries.

Forests stabilize soil distribution and conserve genetic resources, and agriculture, as it has become more intensive, has abandoned marginally exploitable land to reforestation in some places, particularly on the northern side of the Mediterranean, thus counteracting soil erosion. Nevertheless, the consequences

of soil erosion and changed sedimentation pattern continue to constitute a serious factor with respect to inshore artisanal fisheries.

Pesticides and fertilizers, both of which are often over-applied in agriculture in the hinterland, as well as in the coastal zone itself, may be washed by rain from the cultivated land surface directly into the sea, or indirectly via rivers debouching into the sea, with sometimes adverse affects on the coastal marine fauna and species of fishery interest. The effect of fertilizers in coastal waters is discussed in more detail in the section on marine pollution, here below.

Marine mining

The narrow continental shelf in the Mediterranean limits the possibilities for sea-bed mining. However, the three main forms (drilling offshore for oil and gas; dredging inshore for gravel and sand; salt extraction by evaporation in coastal salt beds) have definite adverse effects on the coastal marine environment and the artisanal fisheries.

At present, the extraction of oil and gas, for energy and for chemical transformation, is the most important submarine mining activity in the western Mediterranean; it takes place off the eastern coast of Spain, in the Gulf of Taranto, off southern Sicily, off eastern Tunisia and eastern Algeria and, in the central Mediterranean, off Libyan Arab Jamahiriya.

Oil drilling produces dirty waste water, drilling sludge and waste oil which are often dumped into rivers and, in the case of offshore drilling, directly into the sea. The main effects of oil on marine water bodies are due to direct discharge, intentionally or accidentally, leading to such now familiar problems as the tarring of marine animals, notably sea birds and mammals, and of fishing gear, the degradation of beach quality, if the oil comes ashore, and the tainting of seafood. The fishermen, again, often "pay" for such tainting as the public "goes off" seafood consumption because of it.

Coastal sea-bed dredging for gravel and sand greatly disturbs the sea bed, thus adversely affecting the demersal and benthic fish resources, in particular, but also pelagic resources as a result of the increased general environmental disturbance and increased water turbidity. Moreover, in some places, artificial-beach replenishment has a major environmental impact, not least on the living marine resources.

Even land mining often involves the dumping of mine tailings (for example, coal slag heaps) and ore slurry to the land, to rivers (hence to the sea) or to the sea directly. Such slurry is not only a physical factor of marine environmental degradation, but also a chemical factor to the extent that the mining and processing of ore mobilize toxic substances (e.g. cyanide and/or mercury from gold processing).

Shipping

The Mediterranean is a relatively busy shipping area. Ships entering the Mediterranean via the Suez Canal are mostly bound for European ports. A smaller proportion is bound for Atlantic Ocean ports. Similar arguments apply, more or less in reverse, for the shipping entering the Mediterranean via the Strait of Gibraltar. There is a possibility of conflict between merchant shipping and local inshore fisheries in areas such as straits (Gibraltar, Sicily) or major ports, where the density of shipping is high.

Oil tankers, freighters and pleasure craft contribute to the deterioration of the marine environment, shorelines and ports, by the discharge of garbage and hazardous substances, notably dirty bilge water and toxic components of antifouling and anticorrosion paints. Occasionally, fishing vessels dump old fishing gear (especially netting) into the sea, or lose it while fishing; such netting may float away and passively capture fish ("ghost" fishing), as we described briefly in the chapter on the fishing gear.

Fishing and mariculture

Although we are concerned with the impact of all the foregoing human activities on artisanal fisheries, we must bear in mind that fishing of all kinds, and mariculture, are themselves important activities in the coastal zone and, because they are based mainly on fishing ports and communities (or specific coastal sites, in the case of mariculture), contribute significantly to the cultural, as well as the economic and ecological aspects of life in the coastal zone. The fisheries depend above all on the state of the fish stocks, hence on the factors that affect these stocks.

Hitherto, the great variety of fish (and shellfish) species taken in the Mediterranean fisheries, and the considerable dispersion of the small-scale, artisanal fisheries, makes reliable assessments of the state of the stocks difficult. Most of these stocks also overlap national jurisdictions, and international cooperation in

the collection and analysis of relevant data is still not adequate to allow effective assessments to be made of the whole stock of each species; at present, only local partial (and possibly misleading) assessments are feasible.

During the last two decades, competition among the various types of fishery (industrial, semi-industrial and artisanal) has become more severe and industrial fishing practices have changed. New fishing technology now allows the exploitation of all the fishery resources down to a depth of at least 800 metres. As a result, there has been a very strong growth overall in the fishing effort (in terms of increased vessel-engine power), an increase of about 20% in the number of fishing vessels, between 1980 et 1992, and an even higher percentage in the case of trawlers. Although this has led to a certain increase in the total catch, this increase has gone hand in hand with a continuous reduction in the yield in terms of catch per unit of fishing effort, which is a significant indicator of a decline in the fish stocks. In the most productive zones, the Adriatic and the Strait of Sicily, the catch per unit of fishing effort for certain species has declined 60% in the last 20 years. This indicates the poor state of a number of fish stocks and the consequently low level of the abundance of fish of reproductive age. Few or no fisheries in this situation are covering their investments (nor, sometimes, even their expenses) from their own financial resources, and continue under governmental subvention.

Bearing in mind the necessary caution with respect to the reliability of the available data, of a total of 84 100 Mediterranean fishing vessels, 71 800 are engaged in inshore fishing (mostly artisanal fisheries). EU member countries own about 57% of the industrial fishing fleet, and sport-fishing boats, numerically and according to the few data available, probably represent about 10% of the total fleet. A significant proportion (how much?) of the artisanal fishing boats is not motorized, and many of the fishermen have more than one job besides artisanal fishing. The contribution of coastal artisanal fisheries to the national catches varies greatly, but does not normally exceed about 40% in the western Mediterranean.

Evidently, recruitment, mortality and growth of a fish stock are affected by the impacts of other users of the aquatic habitat and its catchment area; such impacts arise potentially from all upstream economic activities, such as industry, agriculture and hydraulic engineering, as well as from fishing.

While artisanal fisheries are considered to have only a minor impact on the coastal marine environment and its ecosystems, some forms of mariculture (or marine aquaculture) often do have an impact. Most mariculture is still carried out in coastal lagoons and small, well protected bays not already ceded to sailing and other water sports or to infilling for the construction of resident and tourist accommodation, or worse, to industrial and/or domestic waste discharge.

Many of the species preferred for mariculture are also target species for the artisanal fisheries; for example: the Mediterranean mussel (*Mytilus galloprovincialis*); flathead grey mullet (*Mugil cephalus*); carpet shells (*Tapes* spp.); gilthead seabream (*Sparus aurata*); seabass (*Dicentrarchus labrax*); and the European eel (*Anguilla anguilla*).

The extensive or semi-intensive production of fish based on the natural productivity of the marine environment is growing (from about 232 000 tonnes en 1994 to over 400 000 tonnes in 2003, with 260 000 tonnes of shellfish, notably mussels, but also grey mullets, seabass, seabreams and eels). Even greater growth rates are being achieved by intensive marine mariculture (in pens, cages or tanks), especially of seabass and seabreams.

Tuna farming has increased rapidly in the last few years. It is a form of mariculture based on the capture of a tuna school by purse seine; the catch is then dragged slowly shorewards and the fish are kept in the net or transferred to pens where they fatten quickly for the market. It is possible that this form of fish-farming will prove to have a significant environmental impact, but it will also compete with artisanal fisheries not only for space but also for some small pelagic species used to feed the small tuna in the pens.

Intensive mariculture uses certain substances (e.g. hormones) to increase the production of sperm in the hatcheries, to promote growth (e.g. food additives, such as colorants, vaccines, and immunostimulants), to control pathogenic organisms and diseases (e.g. antibiotics, antibacterial agents, pesticides) and to reduce stress (e.g. anaesthetics). And equipment upkeep involves the use of plastics, antioxydants, fungicides, disinfectants and antifouling products. The chemical products deposited in the sea-floor sediments beneath the cages can be detected in the marine organisms in the immediate vicinity of the production site. There is also often eutrophication and other forms of degradation of the sea floor (e.g. disappearance of seagrass beds) beneath the fish cages, due mainly

to the discharge of excess nitrogen and phosphorus. Such impacts have not, however, yet been adequately evaluated.

Mariculture may sometimes have a negative impact on local capture fisheries, whether artisanal or industrial, as a result of the loss or the dispersion of local wild stocks, due to the occupation of specific coastal areas. Intensive mariculture, if not properly managed, may itself also be a source of over-fertilization of bays and lagoons that have a limited exchange of water with the open sea.

The mariculture production of the Mediterranean coastal zone has grown rapidly in the last two to three decades. The total value of the production in 1998 was about $960 million and exceeded $1 200 million by the end of 2003. This growth was possible mainly as a result of: the mastery of the artificial reproduction of the seabass and the seabream; the transfer of technology; the favourable temperature of the Mediterranean for the raising of these species; the availability of suitable sites in certain countries for cage aquaculture; and the high demand mentioned above.

Mariculture is therefore providing a solution to the shortage of certain high-priced species in high demand, which can no longer be supplied in sufficient amounts by traditional capture fisheries; this has important implications for the artisanal fisheries.

Other relevant "uses" of the coastal zone

Apart from pollution in the strict sense, which we deal with here below, other general uses are creating growing general problems: one is due to increased water withdrawals for human activities on land (e.g. irrigation, industrial-plant cooling systems, production of drinking water, waste treatment, aquaculture) and to the regulation of rivers for navigation and flood prevention; another is inappropriate land-use practices, which are still common in the Mediterranean, and which have an adverse effect on siltation of coastal and estuarine areas, hence on coastal habitats important to artisanal fishery resources. Overgrazing and uncontrolled deforestation, as well as the increasing intensification of agriculture, are examples of such inappropriate use. Specific areas in the coastal zone may be declared protected areas or reserved for military use. We give the marine protected areas some special consideration, in the next section, because we think they offer a useful prospect for the renewal of artisanal fisheries.

Marine protected areas

In the Mediterranean as a whole there are at present (2003) 102 marine protected areas. In the COPEMED countries only (see COPEMED Serie Informes y Estudios no. 11: Areas marinas protegidas como herramientas de gestión pesquera – área COPEMED – *www.faocopemed.org*), there are 66; they have diverse objectives. Of these 66, only a few have the specific objective of constituting a fishery protection area: six in Spain (see *www.mapya.es/rmarinas/index_rm.htm*) and another six in France (all in Corsica) are called fishery cantons or zones in which fishing has been prohibited for a duration of five years; this prohibition is subject to renewal if it is clear that the expected effects of the protection have not been achieved. Only a few Mediterranean MPAs do not have restocking as one of their objectives.

The original purpose of these MPAs – hence their usefulness in the renewal of artisanal fisheries – varies from place to place, mainly because their creation has been the prerogative of national provincial governmental bodies whose interests are varied and, sometimes, politically motivated (even if in the best sense of the term). Some MPAs are nature reserves, designed to protect species, ecosystems and biodiversity in general, and prohibiting most forms of human activity, not least, fishing. Some are parks in which limited tourism and some fishing (notably sports or "tourist" fishing, or artisanal fishing with approved gear types) may be allowed. A few have been established particularly to protect artisanal fisheries and their resources. Some are well run; others are hardly more than MPAs "on paper".

The MPAs in the region have generally been established in rocky coastal areas, so that the species that benefit from them are principally the large species of the Serranidae family (e.g. groupers of the genus *Epinephelus*) and the Sparidae family (e.g. seabreams of the genus *Pagrus*) and the large decapod crustaceans (e.g. Atlantic lobster and spiny lobster), which are predominantly target species of the artisanal fisheries. There are no reserves designed for the benefit of the target species of the trawler and purse-seine fisheries in the Mediterranean.

The fisheries allowed in MPAs are normally limited to a relatively small number with respect to the fishing gear types; also, the fishing methods are selective in terms of species caught, and are rotated as a function of the presence of the relevant species in the area.

Some MPAs have been shown to generate a higher-quality tourism, to the extent that they are better controlled and promote "tourist fishing" served by authorized artisanal fishermen. Since the Mediterranean is already a region of high biodiversity (with only 0.7% of the world's ocean surface but 7% of the known marine species), MPAs help to preserve this characteristic of the region. Even so, MPAs still only cover about three percent of the Mediterranean Sea's surface area.

The experience gained from fishery reserves, generally situated in areas close to the shore and of high biological value, shows that such reserves can constitute a good mechanism for resource management and for the artisanal fisheries carried out in the reserves. This control allows the demographic structure of the exploited fish populations to be improved and the traditions of artisanal fishing to be maintained to the extent that they do not impede the rational development of the fisheries desired by the fishermen. Moreover, the market for the species caught in the reserves is of high quality, and the sales contribute to improving the standard of living of the fishermen and their families.

Marine pollution

Introduction

Marine pollution is a consideration that links the socio-economic aspects to the ecological/environmental aspects, which is why we felt it more practical to deal with marine pollution separately. It is important to the present and the future of artisanal fisheries.

Although marine pollution is not as much front-page news as it was a few years ago, with the exception of major oil-tanker accidents, it is still a serious environmental problem in view of its largely land-based origin and the inevitable drainage of many pollutants from their sources directly or indirectly to the coastal sea. Such pollution inevitably reduces the quality of the aquatic environment which equally inevitably compromises the fish stocks, biologically, ecologically and physically. It is not always most dangerous where it is most easily seen or where it creates the strongest impression of "dirtiness", even if such aesthetic insults must be dealt with.

Often marine pollution is insidious, producing long-term gradual environmental degradation. It has been, and still is, either understated, sometimes out of industrial, commercial or political interest, but also out of ignorance of its mechanisms of action; or it is overstated, out of uncomprehended ecological factors and sometimes out of incomprehensible ecological motives. The artisanal fishermen cannot afford to over- or underestimate the importance of marine pollution to their activity.

In spite of the remarkable long-term efforts of the UN Environment Programme (UNEP), through its Mediterranean Action Plan, no comprehensive statement of the marine pollution of the Mediterranean is available (a full but general review – *The State of the Marine and Coastal Environment in the Mediterranean Region* – was published by UNEP in 1996; we have used this source generously here). UNEP has also published a *Mediterranean Regional Report: Regionally based assessment of persistent toxic substances* (UNEP, Athens, 2002). Therefore, quite a lot is known about certain pollutants, in general, or in certain places at certain times, but a comprehensive statement of knowledge and understanding of marine pollutants and pollution has yet to be achieved. Moreover, the state of the Mediterranean Sea changes in this respect.

Although the Mediterranean as a whole is not in as bad a state, environmentally, as was once thought, a few years ago, this does not mean at all that the marine pollution gives little cause for concern: quite the opposite, in fact. Pollutants damage organisms and their ecosystems, taint food, cause illnesses in fish and human beings alike. No scenario for the future of fisheries can afford to ignore the slow, cumulative effects, wherever the levels of key pollutants are higher than they should be to ensure the health of the Mediterranean ecosystems and the human populations.

In general terms, the majority of the socio-economic consequences of marine pollution are manifested as immediate or long-term effects on human health. In this context, the two main types of human exposure to pollutants in the marine environment are through direct contact with polluted sea water and/or beach sand, including ingestion of the water while swimming, and consumption of contaminated sea food, hence, as already noted, a concern for artisanal fisheries.

As with many of the economic and ecological factors mentioned above, the driving force is the population size, resident and seasonal. The pollution is largely generated by the many activities of this population. The effects of the pollution are, not surprisingly, on the population itself, on the animals and plants, directly, and on the ecosystems into which they are organized for their survival, and on which the human population, notably fishermen, depends for its own survival in the long run.

Pollution of the sea by persistent chemicals, such as heavy metals, organochlorine compounds and a number of other organic substances, creates a completely different hazard. Following their entry into the marine environment, some of these chemicals, as they pass through the marine food chain, accumulate in plants and animals, reaching their highest levels in filter-feeders, such as bivalve molluscs, and in large predatory fish, such as tuna and swordfish. Thus, chemical pollution may influence fish production in numerous ways; for example: reduction of stocks by mass mortalities; gradual decline, or changes in composition, of populations or entire ecosystems; defective reproduction; lowered growth rates; increased occurrence of diseases; deterioration of fish-food quality.

Here we briefly discuss the key pollutants and their main effects, as far as they are known, with particular stress on those that seem most relevant to the artisanal fisheries of the western and central Mediterranean. And, for convenience only, we also consider here the effects of compounds, substances and materials that, in themselves, are not pollutants, but which have a significant impact on the marine environment – sometimes favourable, sometimes not.

Even so, we decided not to deal with marine pathogenic organisms (bacteria and viruses, mainly), since they are not really examples of marine pollutants and are dealt with in quite other ways. Although they can have an unpleasant effect on human beings, they do not appear to have a serious negative impact on the marine environment itself; in fact, most of them do not survive for long in the sea. However, diseases affecting the gastrointestinal tract, with the exception of those associated with pathogens having a relatively low infective dose, are much more easily contracted by humans through the consumption of raw or partially cooked contaminated food, particularly shellfish. The number of epidemics and outbreaks of various diseases attributable to the consumption of contaminated shellfish is probably high in the Mediterranean, so of evident concern to the artisanal fisheries.

The adverse effects of marine pollutants can be viewed from more than one standpoint:

- the changes (in such factors as turbidity, oxygen depletion, chemical contamination) in the water that alter its value as a medium for living animals and for human recreation and other uses;
- the changes (in such factors as flocculation, oxygen depletion, chemical contamination) in the sediments on the sea bed that alter its value as a habitat for marine organisms, especially those of economic interest;
- the changes (in such factors as tainting, poisoning/toxicity, inhibition of growth/development) in marine organisms that are of economic or ecological value to the human population, especially artisanal fishermen;
- the changes in human health following the consumption of adulterated marine organisms, bathing in contaminated water, and breathing contaminated marine air.

Heavy, or trace, metals

These are metals with rather heavy atoms and which are normally only in trace amounts in riverine and marine environments, but which, in above-normal amounts, can have a disproportionately high impact on species, hence ecosystems. The most important are cadmium, mercury, lead, tin, copper and zinc, the latter two being considered as biologically necessary (at low concentrations) to organisms. Arsenic, which can form "metallic" compounds such as arsenic sulphide and "non-metallic" ones such as sodium arsenate, is bivalent but can be conveniently included here. Iron, although a heavy metal, is relatively abundant in the Mediterranean marine environment; it plays an important role in phytoplankton growth.

The main sources, uses and effects of these metals are summarized in Annex II.

Organohalogen compounds

These compounds are carbon-based molecules containing chlorine, bromine or fluorine atoms usually. The principal organohalogen contaminants in the Mediterranean marine and coastal environment are PCBs (polychlorinated biphenyls), DDT (dichloro-diphenyl-trichloroethane) and its breakdown products

(DDE and DDD), hexachlorohexanes (HCH, including lindane), hexachlorobenzene (HCB), heptachlor, and the agricultural pesticides aldrin, dieldrin and endrin.

Other agricultural pesticides in common use in the Mediterranean basin are: chlordane; endosulfan or thiodan; toxaphene or campheclor; mirex; captan; dicofol or kelthane, 2,4-D, pentachlorophenol, and dichlorophen; but they form only a small proportion of the total agricultural pesticides used. The commonest herbicides found in the Mediterranean Sea are atrazine, simazine, alachlor, metolachlor and molinate, all widely used in agriculture and horticulture. And triazines are used as biocide additives to marine antifouling paints.

Most of the organohalogen compounds used in agriculture and horticulture are eventually washed off the land into rivers, thence to the sea, or directly into the sea via coastal outfalls or run-off. However, most of these compounds appear not to persist in sea water or marine sediments. Nevertheless, they generally accumulate in fatty tissues in marine organisms. Most of them are, however, toxic to fish, and some have shown some degree of endocrine-disruption action, leading to defective reproduction. PCBs (there are over 200 possible varieties, including the industrial products Aroclor, Clophen and Phenoclor) inhibit plant growth; marine invertebrates and fishes are affected more at the juvenile stage than the adult. Herbicides may modify the structure of phytoplankton communities, and triazines have some adverse effect on phytoplankton photosynthesis.

The Mediterranean region, being the drainage basin of large agricultural areas, as those of the river plains of the Ebro, the Rhone, the Po and the Nile, among others, probably has important concentrations of these compounds, but no specific quantitative regional or subregional studies have been made of them.

Organophosphorus compounds

There are 60 such compounds and they have progressively replaced the persistent organochlorine pesticides. Their main uses are as insecticides, acaricides, nematicides, antihelminthic agents, fungicides and herbicides, and, industrially, as flame retardants, plasticizers, solvents, antifoaming agents, hydraulic fluids, lubricants, dispersants and detergents. It has proven difficult to assess their effect on fish stocks or the marine environment, but most environmental scientists believe that their effect is not negligible**.**

Organotin compounds

These comprise mono-, di-, tri- and tetrabutyl tin compounds and triphenyltin. Tributyl and triphenyltin compounds are mainly used in antifouling paints, hence very probably by artisanal fishermen and many other coastal zone stakeholders. The other compounds have a variety of industrial applications and as an antihelminthic (against schistosomiasis). Tributyltin tends to accumulate in marine organisms and may cause shell malformation in oysters, defective reproduction in marine snails and reduced resistance to infection in some fishes; it also impedes normal growth in lobster larvae.

Petroleum hydrocarbons and crude oil

These are normally only found in the marine environment as a result of accident or, sometimes, of illegal discharge. Obviously, as the maritime transportation of oil and oil products increases (as is still the case, especially with respect to refined products), the risk to the marine environment increases accordingly. They have little effect, other than locally, on phytoplankton communities, but may have significant effects on seashore communities (notably at times of oil spills); much depends upon the water mixing at a given time and place which would ensure dispersion of these compounds in the marine environment. In some cases, several years are needed to restore the seashore floral and faunal communities, although a few weeks usually suffice. The larval and juvenile forms of marine organisms tend to be more affected than the adult stages. Coastal-zone activities, such as tourism and artisanal fisheries, once hit by a major oil spill, also take a long time to recover from the immediate impacts, whether physical, economic or psychological.

Lubricating oils, although derived from oil, are highly processed products with a wide range of industrial and domestic uses. Their sources are much more dispersed than those of petroleum oils, but they are assumed to behave more or less similarly in respect of their effects on organisms and the marine environment.

Radioactivity

There are presently some 30 nuclear power stations and 2 nuclear-reprocessing plants in the Mediterranean basin; most are sited along the Ebro, Rhone and Po rivers. Barring serious accidents involving more or less direct discharge of radioactive substances into the coastal sea (happily, extremely rare), radioactivity poses no significant risk to the Mediterranean coastal marine resources and fisheries at present.

Man-made litter

The main components of coastal litter are, in approximate descending order of abundance: plastics (fragments, sheets, bags, containers), wood (driftwood, crates), metal (especially drink and food cans, spray cans), glass (bottles), styrofoam (a packaging material), rubber (but not rubber foam), and the rest (clothes, paper, cardboard, foodstuffs). Occasionally, pieces of lost fishing gear, and construction materials form part of marine litter. The sea-bed litter includes mainly metal, waterlogged wood, glass, fishing gear, and some plastics (sheets, bags, containers). The important thing to bear in mind is that, chemically and biologically, many of these materials are inert and have a potentially very long life (probably several hundred years). For the most part, they are broken down only physically by abrasion, thus returning to the natural, geological cycle, slightly but definitely modifying it.

Some marine organisms, especially seals, turtles and birds may become entrapped by certain components, such as rubber and plastic bands or rings, and fish netting, which pass over their head and become stuck, often eventually throttling them. Pieces of plastic in the sea are also mistaken for prey fish and are eaten; since they are indigestible, they block the alimentary canal and finally the digestion of food.

The Mediterranean basin, as a semi-enclosed sea, appears to have a higher level of marine litter than most open-sea regions. From time to time and place to place, artisanal fishermen have to cope with the inconvenience of marine litter.

Other possible contaminants/pollutants

There are large groups of industrial chemicals, products and by-products that certainly present some risk to the marine environment, but their pathways from source to sea are generally less direct than those used in agriculture and horticulture; and their persistence and toxicity to organisms are highly variable. The most important groups are the polycyclic aromatic hydrocarbons, phthalates and phenols.

There are significant leather industries in some western (as well as eastern) Mediterranean countries. Two of their main waste products are chrome salts and odours. They therefore represent some danger to the living resources in their vicinity and reduce the amenity value of the coastal-zone environment.

The pollutants mentioned above, do not, of course, constitute an exhaustive list.

Nutrients

Although nutrients (notably, nitrogen and phosphorus) are not pollutants, they are generated or mobilized extensively by human activities, agriculture being one of the most important in this respect, and they do have potentially important consequences for inshore fisheries.

Human activities are estimated to have caused an approximately five-fold increase in river inputs of nitrogen to the oceans and a four-fold increase in phosphorus; these relative increases probably hold true for the Mediterranean. It should also be kept in mind that, even after primary or secondary treatment, the nutrient impact of sewage outflows remains unchanged. The input of nitrogen to the Mediterranean Sea in this way contributes some ten percent "new" primary production (i.e. relative to the average).

Experience in the Mediterranean, which is basically an oligotrophic sea (i.e. characterized by low biomass and low availability of nutrients), suggests that moderate levels of enrichment of originally nutrient-limited marine systems may favour production and even suspension culture of some bivalve species; they may also lead to increased production of small pelagic fishes (e.g. sardines, anchovies), but this is usually at the expense of more valuable bottom-dwelling fishes (e.g. soles, turbots, seabreams, seabasses) and crustacea (e.g. prawns, spiny lobster). So artisanal fisheries have not benefited significantly from this environmental "improvement".

Eutrophication

The phytoplankton, as the sole source of primary production (i.e. creation of new living tissue based on photosynthesis), is the basis of the marine food chain, supporting primarily the zooplankton and, likewise in turn, small fishes, then larger fishes. However, nutrient enrichment inshore (known technically as eutrophication) may lead to unusual and dense phytoplanktonic blooms which, on death and decomposition, produce unæsthetic conditions close to the points of nutrient discharge, thus adversely affecting coastal activities such as tourism. Sometimes, in places inshore where flushing by water currents is weak, the over-abundance of the phytoplankton, spurred mainly by the abundance of nutrients, may, especially if accompanied by a high load of suspended sediments, lead to:

- reduced light penetration, thus adversely affecting the aquatic vegetation and food webs;
- fish kills, by asphyxiation due to the clogging of fish gills and to the increasing consumption of the oxygen dissolved in the sea water in the decomposition (by oxidation) of dead organic matter in the water;
- consequently, reduced success of fertilization of fish eggs or the survival of fish larvæ, or the displacement of older fish away from the usual fishing areas;
- the fouling of fishing nets and the clogging of engine cooling systems;
- the fouling or clogging of cages used in coastal aquaculture.

It may be that these various forms of clogging are due to polymers secreted into the water by the phytoplankters (especially dinoflagellates) involved; these polymers may also be responsible for the formation of slime and of surface foam (which dampens wave action and may even be a mechanism by which phytoplankton creates turbulence-free niches in the sea water that are useful for its own survival).

In any case, overall, eutrophication is most often very much to the artisanal fishermen's disadvantage.

There are also other, less well understood, but possibly serious, consequences of the over-abundance of the phytoplankton and its primary production, besides promoting the food chain dependent on it.

One is a substantial detrital "rain", a sort of sedimentation of organic materials from the sea surface to the sea bed, which promotes the activity of bacteria and flagellates in the water column; and this sometimes leads to seasonal or permanent anoxic zones in bottom water and sediments, with a corresponding adverse impact on the benthos and on demersal food webs. The other is, it is now believed, that coastal sediments on clean rocky, gravelly and sandy sea bottoms in areas affected by nutrient enrichment are being converted by eutrophication into organic mud or muddy sand. This would be an important ecological modification of the marine environment. It is not clear whether such modification would benefit the artisanal fisheries or not.

There is some reason to suppose that the conditions that favour eutrophication, and the adverse effects caused inshore, may be mitigated and then removed as the nutrient levels are reduced by turbulent mixing into deeper waters offshore where higher, but no longer excessive, concentrations may lead to an increase in productivity farther offshore. This may be the case in the northern Adriatic; however, this would be more beneficial to the industrial or semi-industrial than to artisanal (inshore) fisheries, since it would tend to favour small pelagics, such as sardines and anchovies.

It is also possible that eutrophication, by increasing the amount of food available, may cause "plagues" – sudden and spectacular outbreaks – of various kinds of organisms. The best-known examples are due to certain species of dinoflagellates (most frequently of the genera *Gymnodinium, Alexandrium, Noctiluca, Pyrodinium*) that produce what are known as "red tides" which are, in the Mediterranean, widespread, seasonal and often site-specific. Several species of dinoflagellates produce toxins that may severely affect fish ingesting them and, once accumulated in fish or shellfish, may severely affect human beings eating infected sea food, causing such disorders as diarrhoeic or paralytic shellfish poisoning. Human beings may also be affected by the respiration of certain toxic dinoflagellates in ærosols. Such serious negative effects on health often necessitate the temporary prohibition of the sale of affected fish products. Again, this is not usually to the advantage of the artisanal fisheries.

Another common plague, as many tourists have found to their considerable disappointment, consists of jellyfish, especially of the common species *Pelagia noctiluca*. However, there may well be other causes of such plagues than eutrophication.

Socio-economic and cultural circumstances

Although the themes of the two preceding sections are part of the socio-economic and cultural circumstances of the region's artisanal fisheries, some other factors are also part of these circumstances.

The point of fishing is to provide food, pay off the investment in gear and vessels, and make some profit. In this sense the cynical say that the fishermen are fishing for dollars. The success of the artisanal fisheries nevertheless depends greatly on the value of the fish they catch.

Although the fisheries in the Mediterranean satisfy only a small part of the demand for food products, they have an important role to play in terms of sustainable development in the region, with a high value in terms of Mediterranean identity (owing to the great diversity in their savoir-faire and fishing methods and in terms of employment).

The artisanal fishery sector in the Mediterranean, according to the available and probably incomplete data, represents at present over 400 000 jobs, of which, about 280 000 are fishermen. The average value of the landings is well above the world average.

Value is often a question of marketing: an "unpopular" species (as tuna once was) can be made a "popular" one (as tuna now is); and new products can be developed from "old" fish. At present, consumers in rich countries will pay the price of rare and desirable fish: a large and perfect specimen of bluefin tuna will always fetch more than $50 000 in the Japanese domestic fresh-fish auctions; in 2001, one splendid 200 kg specimen was auctioned for $165 000. Top-rate caviar fetches $1 000–$2 000 per kilogram in Western Europe, depending on the species and other quality criteria.

Although some fisheries are carried on year round (often with a change in the target species and/or the fishing gear deployed), the present artisanal fisheries are mainly seasonal, rapidly subject to changes in the economic climate, hence precarious. Many artisanal fishermen are active only on a part-time basis, depending largely on the seasonal availability of other, easier, more-remunerative work and on the seasonal availability of many fish species. This inherent precariousness has always impeded investment and development. And the widespread failure of the general population and governments to recognize the artisanal fishery community as a specific socio-economic entity – a valuable stakeholder in the coastal zone – has also put a brake on investment.

This brake on investment may also be promoted by the growing reluctance of artisanal fishermen to see their sons follow them into the fishery (as it now is), as well as the sons' ambitions to be something "better", both of which affect the recruitment of new artisanal fishermen. Most of the replacements nowadays are immigrants who become artisanal fishermen for want of a better work opportunity; many of them come from far-away countries and vastly different cultures and have no greater commitment to artisanal fishing than to have food to eat and to earn a small wage. Some have no onshore abode and live and sleep on the boat they fish from. Some "recruits" are local men who have retired from active economic life and therefore have a relatively short life as artisanal fishermen. The future is unsure, for the fisherman and the fisheries, and, as a result, for potential investors, whether financial or social.

In spite of the poorly understood importance of biological diversity to artisanal fisheries, it is clear that some human activities diminish the number of wild animals and species that might be valuable to artisanal fisheries. However, in some parts of the coast of Spain, for example, seagrass beds have been much affected by pollution, trawling and coastal degradation, and the artisanal fisheries there have adapted remarkably well to the changes, but this will not always be feasible.

Although the introduction, deliberately or accidentally by human beings, of species from one part of the world to another has immediate ecological impacts through changes in interspecific competition and predation, many of these alien species do not appear to have played an important role in the Mediterranean artisanal fisheries, generally having an ecological nuisance value. However, certain exotic or alien species are now caught and sold; for example, roving grey mullet (*Liza carinata*), obtuse barracuda (*Sphyræna chrysotænia*), Senegalese sole (*Solea senegalensis*) in the western Mediterranean, and others in the eastern Mediterranean. As we said, many of the species favoured in Roman times remain favoured today.

On the other hand, it is widely believed in the marine scientific community that the removal of even one species from a given ecosystem causes a drastic modification of this system. In the Mediterranean, several species are considered to be endangered (i.e. likely to disappear from the Mediterranean if nothing is done to protect them), and it is virtually certain that, if any of these species

is lost, there will be some significant effect on fisheries, whether artisanal or industrial. The species presently considered to be endangered are listed in Annex III.

Regarding jurisdictional aspects, we think it useful here to indicate the international legislative context in which artisanal fisheries are, formally speaking, operating. We are not in a position to consider national legislation of fisheries specifically in this book; however, generally speaking, harmonization of artisanal fishery legislation is presently non-existent in the Mediterranean. To address this problem, COPEMED has organized (in 2001, 2002 and 2003) three workshops on fishery regulations in the area in order to try to make an analytical comparison of the participating countries, as a first step to the eventual harmonization of such regulations.

The most important legal instrument applicable to the Mediterranean Sea is the UN Convention on the Law of the Sea which came into force in 1994. Its definition of a semi-enclosed sea, such as the Mediterranean, incorporates several key ideas:

- the potential effect of land on the marine system;
- the direct involvement of two or more States;
- a connection with another sea or ocean through a strait;
- the division of the sea area into territorial seas and/or Exclusive Economic Zones.

The UN Convention, while it is not specific with respect to artisanal fisheries, charges States with co-operating to ensure sustainable management of shared marine resources. In this regard, States are charged with using an existing fishery commission, or to set up such a body for this purpose. The only regional international body concerned exclusively with Mediterranean fisheries is FAO's General Fisheries Commission for the Mediterranean (GFCM). Moreover the GFCM, together with the International Commission for the Conservation of Atlantic Tunas (ICCAT), also promotes stock assessment of key shared tuna stocks. Hovever in spite of souch institutional framework, little has been done in the large pelagic sector of the artisanal fisheries.

Under the Convention, jurisdiction over shelf resources lies with the coastal States, except for limited areas of shelf beyond 200 miles. In the Mediterranean Sea itself, States are generally reluctant to establish Exclusive Economic Zone under the Convention, mainly because of the considerable difficulties in the delimitation of such zones, combined with the widespread need to preserve freedom of navigation and access to natural resources, living and non-living. Although Morocco has formally declared an EEZ, it has not yet negotiated its offshore boundary with its neighbours and, by this fact, does not formally give effect to the zone in the Mediterranean. France and Spain have declared EEZs but have declared that the relevant legislation does not apply in the Mediterranean.

Algeria, Malta, Spain and Tunisia have claimed fishing protection zones in the Mediterranean. These zones extend beyond their territorial waters, as follows: Algeria (in 1994, an "exclusive fishing zone" from 32 nautical miles from the coast, on its western side, to 52 nautical miles, on its eastern side, meeting at the longitude of Ras Ténés); Malta (in 1978, an "exclusive fishing zone" of 25 nautical miles, as far as possible); Spain (in 1997, a "fisheries protection zone" of 49 nautical miles in the Mediterranean, except the Alborán Sea); and Tunisia (in 1951, an "exclusive fishing zone" based mainly on the 50-m depth contour, which lies between about 25 and 75 nautical miles from the Tunisian coastline). The European Union advocates the creation of fishery protection zones in the Mediterranean as a means of improving fishery management and particularly to fight against illegal, unreported and unregulated (IUU) fishing.

These fishery protection zones will not affect jurisdiction over the other ordinary uses of the Mediterranean waters (e.g. seabed mining, navigation). In effect, therefore, almost all fishing activity, except that within territorial seas and these exclusive fishery areas, is conducted under a much-reduced open-access regime.

The UN Convention, by stipulating the rights and obligations of coastal States in extending their jurisdiction over fisheries, also removed the free and open access which the distant-water fleets formerly operated under within 200 miles of the coast. Even so, in the Mediterranean, perhaps partly owing to the non-existence of EEZs, distant-water fleets (e.g. of Japan, China, South Korea) operate regularly in the basin.

With respect to the problem of effort control, the GFCM has recently decided to use it as the main management tool for the management of the Mediterranean fisheries. Nevertheless, many coastal

States have internalized it by allowing an increase in fishing effort through fleet modernization or under the free and open-access conditions prevailing within national maritime jurisdictions. This occurred because no specific rights (e.g. Territorial User Rights of Fishermen–TURFs) were assigned to national harvesters and, in many cases, through excessive use of inappropriate subsidy schemes; all of which have led to excessive fishing effort and further deterioration of the natural-resource base.

The UN Convention on the Law of the Sea has also led to a number of voluntary "subjuridical" international agreements relevant to fisheries: one is the FAO Code of Conduct for Responsible Fishing; another is the FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas**;** and another is the relevant decisions of the UN Conference on Straddling Fish Stocks and Highly Migratory Species They have no force of law, but serve to orient attitudes to fishery development on a sustainable basis.

With respect to the marine and coastal-zone environmental aspects, the so-called Barcelona Convention is certainly relevant to the development of artisanal fisheries. (The Convention came into force in 1978 as the Convention for the Protection of the Mediterranean Sea against Pollution, but it was amended in 1994 and the name was changed to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, mainly to bring it into line with the tenets of the UN Conference on Environment and Development).

We may also point out that, formally, the European Commission's Common Fisheries Policy (CFP) only applies to the present seven Mediterranean member countries (Cyprus, France, Greece, Italy, Malta, Slovenia and Spain). However, hitherto, this CFP was not applied in the Mediterranean, nor did the European Commission have a Mediterranean common resources policy. Nevertheless, a new EC regulation on the management of fishery resources, applicable to the seven Mediterranean member countries, came into force in 2004.

The future

To the question "Is there a future for artisanal fisheries in the western Mediterranean?" we have, a priori, suggested that the answer is "Yes, provided that..."

What form it will take is much harder to say. The main factors (outlined above) in this future are part of the present and will continue to operate for a long time to come. Nevertheless, a number of conditions will need to be met, and not by the artisanal fishery communities alone. And even long-standing customs will almost certainly have to change. We may consider them under the following headings: *the fishery resources*; *fishery management*; *technological development*; *coastal-zone changes*; *coastal-zone management*; *marine protected areas*; *socio-economic and cultural developments*; *sustainable development*.

The fishery resources

There can be no fishery without fish, to start with. At present, practically all the currently popular species are heavily fished and some of them are clearly overfished (declining mean fish size in the catches, declining catch per unit of fishing effort etc.). Until appropriate and effective fishery management reverses this trend, these resources will remain underproductive. Nor is there any clear-cut evidence that there are abundant species in the Mediterranean Sea that, for one reason or another, are not being exploited but which could be in the future. However, as a result of market forces (demand for fish, product promotion etc.), presently unpopular species will become more popular. And because of marine environmental changes, possibly due to global warming, some Atlantic Ocean (so-called *Mauritanian*) species may become more abundant, at least in the Alborán Sea, for example. Likewise, new Lessepsian species (as we mentioned earlier) may also become fully established (especially in the eastern Mediterranean) and become exploitable (this has already occurred to some extent).

The deep water of the western Mediterranean basin (maximum depth in excess of 4 000 m) is not exploited; nevertheless, some developed countries are fishing in the region, trawling for crustaceans below 800 m depth and in even deeper water with bottom longlines. The development of fisheries in deeper water is possible in the foreseeable future, but such a development would not benefit artisanal fisheries, except possibly to reduce industrial trawling inshore.

Fishery management

The so-called bottom line is the availability and catchability of saleable fish. So things may change significantly only if serious attention is paid, now and in the future, to the state of the stocks in a sustainable-development context (see section thereon, here below), which means rational fishery management free of "exceptions" from the underlying obligations that such management involves.

Reliable fish-stock assessment will therefore continue to be a keystone of fishery management; apart from the fishing data and information, a part of these assessments will very probably require some forms of direct observation by such methods as regular hydroacoustic and underwater television surveys of already fished stocks and potentially fishable stocks, supported where appropriate by scientific experimental fishing and by deeper theoretical studies on indicators of true fish abundance as it evolves in response to changes in fishing pressure and environmental degradation. In some cases, direct observation by scuba-divers can provide information useful in stock assessment. Such direct observation may prove particularly useful in marine protected areas.

However, since most fish stocks, and not least the highly migratory resources, lie across national maritime boundaries or between territorial seas and international waters, the prospects for joint management of each stock are particularly problematical, given that a unit stock must be managed in a co-ordinated fashion based on information on catches and fishing effort, and other relevant information, throughout its range.

Even so, two important factors are now operating, and will increasingly operate, that artisanal fisheries will have to take into account and to respond positively to. First, to manage the stocks of all fishery species in a much more effective and precise way, fishermen will have to keep quite detailed records of their fishing (times, places, catches and landings, for example); this is being partially, but not adequately, achieved now with industrial fisheries landing their catch in major ports. Such a development will require all fishermen to co-operate with fishery administrations and catch samplers. Second, to meet the ever increasing demands of the public for safe fish, whether fresh or processed, fishermen, and not least artisanal fishermen, will have to devote a significantly greater proportion of their "fishing effort" to ensuring the greatest possible freshness of their catches upon landing and sale; this will, for the artisanal fishermen, almost certainly imply increased mechanization of their vessels and of their landing facilities.

It should be noted, in the present context, that the use of technical measures (e.g. obligatory mesh sizes) and fish-catch quotas for a given fish stock, as a policy for limiting fishing pressure with a view to allowing over-exploited stocks to recover, does not allow regulation of catching capacities and even encourages increases in catching capacity through excessive investment in more, and more efficient, fishing vessels and gear. Although, at present, fish-catch quotas are not applicable in the Mediterranean (except for large pelagics in the Mediterranean countries members of the International Commission for the Conservation of Atlantic Tunas (ICCAT); all the countries of the western Mediterranean are currently members), such a measure might be adopted in the future, even if, in practice, it would appear to be inapplicable to artisanal fisheries for the foreseeable future. However, today, tunas caught by artisanal fishing methods (handlines or traps) are monitored under the ICCAT membership agreement. And we may expect that tuna caught and brought under inshore fish-farming will also become increasingly more carefully controlled.

Technological development

So can artisanal fisheries develop by increasing mechanization and electronics? Yes, possibly; but such technological development will lead eventually to highly mechanized boats, powered gear-hauling devices, fish-detecting devices, and so on, so the present fairly clear difference between the artisanal fisheries and the non-artisanal fisheries, in spite of our difficulty in drawing up a definition, will become much vaguer and probably disappear. The future of artisanal fisheries would thus become embodied in the future of all coastal fisheries in the Mediterranean.

Two factors must be borne in mind: first, there is not much room on small-scale artisanal fishing boats for electronic and mechanical gear beside the fishing gear and the crew, although increasing miniaturization of electronic equipment can be anticipated; second, electronic and mechanical equipment, such as GPS, depth sounders etc., is subject to degradation in the humid salty air of the Mediterranean, in spite of modern protective technology, so maintenance, repair and replacement are always important factors in the adoption of such equipment by artisanal fishermen. Technological sophistication is a

probable evolution, though one largely conditioned by the efficacy of the hi-tech equipment and by the investment climate (see section on socio-economic and cultural developments, here below).

It is possible, and perhaps even likely, that, in the future, as the need to manage maritime navigation grows, to control maritime traffic and illegal maritime activities, possibly including illegal fishing, all vessels will be fitted with a signal emitter to allow the detection of vessel tracks by GPS satellites and of a vessel's flag identification. This, in itself, will not affect fishing adversely, and may even be useful in directing fishing vessels to currently good fishing areas. Although this would not advantage artisanal fisheries as much as industrial fisheries, it would be a development that artisanal fishermen should keep themselves informed of.

In any pursuit of sustainable development of fisheries, however, the amount of fish caught as a strict consequence of technological development in fishing boats, gear and methods must, fundamentally, cover the investment and indeed also yield a profit, either to pursue investment in new gear and methods or to raise the social status of the artisanal fishery communities. But it must finally also cover the cost of any environmental degradation and rehabilitation as a result of fishing. In the end, it is the amount and the market value of fish landed that must cover such investment and the basic costs of fishing.

Coastal-zone changes

Of the factors already discussed above in the present chapter, some will continue to modify the coastal marine environment to varying degrees. As long as many species of interest are overfished, whether by industrial or artisanal fisheries, or become progressively less abundant as their preferred habitats are either occupied or degraded, or fishery-management measures are introduced to reduce fishing effort and/or catch, to preserve fish stocks, the artisanal fishermen may have to contend with the possibility of having to make more effort to catch less fish, unless and until efforts to preserve habitat or restore stocks bear fruit.

Any attempt anywhere in the future to occupy natural habitat for human activities other than fishing must be, if not vigorously opposed, at least weighed in the balance of any effort of coastal-zone management. Wetlands, lagoons, coastal salt marshes, estuaries and deltas, for example, are essential to the protection of many fish stocks. The use of rivers for anything but "natural" purposes also compromises other stocks, especially those that either ascend rivers from the sea or descend rivers to the sea to breed or feed and grow; therefore, such use will also have to be considered with extreme care.

Inland hydraulic engineering (e.g. dam-building and agricultural irrigation schemes), although having natural limits, is likely to continue to grow in the next three decades. And artificial beach replenishment may do likewise, to meet the growing tourist demand. Both will continually alter the dynamics of coastal erosion, sedimentation and natural beach replenishment, in some places.

Climate change (notably that due to global warming) will probably have a significant impact on, among other things, the marine environment and the adjacent coastal zone in the coming decades, principally through changes in: wind systems, air–sea interaction (evaporation, precipitation, gas and salt exchange); mean sea level; and marine currents. These changes could have several fundamental impacts on the Mediterranean environment, including the coastal seas, and therefore on the artisanal fishery resources; we may briefly analyse them.

If there were significant changes in the wind systems, especially the ventilation of the European continent via the Rhône valley (the *mistral* wind), the northern Adriatic Sea (the *bora* wind) and the Aegean Sea (the *meltemi* wind), it would certainly affect the main marine currents and the formation of the main water masses in the Mediterranean, hence the distribution of fish species.

Changes in the air–sea interaction (exchange of heat, mechanical energy, water and salt) would significantly affect the water-mass formation and could either act synergistically with, or antagonistically to, the impact of the changes in the wind systems. If mean sea level increased – and this question cannot be answered without reference to the region's plate tectonics (Italy, for example, is sinking relative to the local reference geoid, so the mean sea level may not change as might be expected there) – coastal wetlands, estuaries, ports are likely to be changed significantly, and coastal erosion would be noticeably altered.

All these climate-change impacts would obviously affect the ecology, fish distribution, feeding, spawning and nursery areas, not to mention the possibilities of mariculture, land-based waste discharge – almost everything, in one way or another.

However, even if such changes are easily imaginable, they are not easily quantifiable, either individually or collectively (i.e. taking into account their interactions). And, moreover, the impacts will develop over a long period of time, allowing, to a considerable degree, a progressive adaptation to them. They will, therefore, be of far less significance for the immediate future of the Mediterranean artisanal fisheries than the impact of most of the current, and still increasing, human activities in the Mediterranean coastal zone and its hinterland.

Although eventual climate changes will add to the natural variations inherent in all ecosystems, and although the effects of such changes on fisheries and aquaculture are difficult to forecast, they are not expected to change overall fish production in a major way, because the biomass-support capacity of the Mediterranean Sea is largely determined by its geomorphology: the bulk of the exploitable biomass will always be found in the upper 100 m of the sea and mainly over the rather narrow continental shelf.

Coastal-zone management

Introduction

It is beyond the scope and purpose of this book to propose possible ways forward in integrated coastal-zone management, even as far as artisanal fisheries are concerned. We understand coastal-zone management as an attempt to arrest, control and then rationally manage the factors mainly responsible for the coastal-zone changes described in the preceding section. It is also a possible means to better organize the multiple uses of the coastal zone by human beings, by reducing or eliminating, if possible, the competition and, sometimes, conflict amongst the main users (stakeholders).

All the Mediterranean coastal areas, in general, have a substantial potential for development, with multiple uses and stakeholder groups. Proper coastal development normally attracts entrepreneurs interested in investing in coastal activities. However, too fast an influx of capital in the absence of proper planning of the modalities of development may result in further degradation of the coastal area; such situations have arisen in some parts of the Mediterranean and may have actually provoked a loss in the value of the coastal zone.

Artisanal fishermen are, practically by definition, confined to inshore waters and therefore interact in many ways with other users of these waters, whether directly or indirectly. As an important coastal-zone stakeholder, the artisanal fisheries community must become actively involved in coastal-zone management. To be able to do so, it must be recognized as a specific socio-economic sector different from industrial fishermen and with a status comparable to that of the other coastal-zone stakeholder groups. It will be up to the artisanal fisheries community itself to gain such status, but also up to the national entities responsible for coastal-zone development, in general, and artisanal fishery development and management, in particular. In all cases, the administrations with coastal-zone management responsibilities are local, regional and national, and in countries of the European Union, the Union also has important competences in Community Interest Areas and in species protection. All these administrations *should take into consideration the artisanal fishermen and their organizations as useful and practical interlocutors in the management of the coastal zone*. But this is a key question for the future of the artisanal fisheries: Are they able to create and maintain such competent organizations and, accordingly, act jointly as a useful and practical interlocutor.

The principal factors to be managed were described in the section on "the present", here above. We now attempt to foresee how these same factors will evolve in the next thirty years, and which, we think, the artisanal fisheries community will also have to take very much into account if they are to enjoy any significant development, especially of the sustainable variety.

Coastal urbanization and construction

These will continue in the western Mediterranean, though now probably more along the southern coast than the northern coast where at least half the coastal-zone land has already been built on and a lot of the remainder is dedicated to agriculture and mariculture; wild land in the northern Mediterranean is now largely confined to nature reserves and protected cultural or archeological areas. Present and proposed efforts to improve and modernize all the European ports will surely continue to have a significant ecological impact. If coastal-zone urbanization and port development can be carefully controlled and the nearby coastal living marine resources taken into account, the artisanal fishermen are likely to be able to demonstrate their traditional capacity to adapt to such changes. In any case, future coastal-zone

construction should include appropriate physical facilities for the landing, processing and marketing of the artisanal fishery catches.

Tourism and recreation

These will also continue to grow, and, though having a generally positive impact on the economies of "tourist-importing" countries, they will put further pressure on land (for accommodation and other facilities), on water and food resources, on transport facilities, on coastal seas (for food and recreation), on historical and natural sites, and, culturally, on the resident population; pristine beaches are now extremely rare and, again, mainly in protected areas, in the northern Mediterranean. Tourism will, however, probably become more specialized and selective, so-called ecotourism being increasingly favoured and requiring the better preservation of sites of ecological interest, whether new-found or long-established in tourism's terms. And similarly for cultural tourism.

In response to the growth, not only in tourism and recreation, but in all the main human socio-economic activities, air and land transport will continue to grow and to have an increasing impact on resources, notably land and fuel, through the increased number and size of roads (hence vehicles) and airports (hence aircraft). Tourism will also increase maritime transport, the use of sport and pleasure boats, contamination, noise, and impact on protected species (notably sea mammals and sea turtles), but will also be a serious concern of the artisanal fishermen, because of the breakage of fixed and drifting fishing gear and the consequent reduction in catches.

Mediterranean tourism is demanding more and more fish products and to meet this demand the food and restaurant industry is importing fish products from outside the region. Such importation will continue to increase in parallel with the growth in tourism and could prejudice the Mediterranean artisanal fishermen by reducing the prices for the fresh fish and for other products of the Mediterranean fisheries.

Thus tourism and recreation will continue to be a mixed blessing for artisanal fisheries: on the one hand, an increased demand for fish as food; on the other, a reduced availability of fish from the sea. There is, however, a growing demand for "tourist fishing" – tourists pretending to be fishermen while on holiday – which could be met by artisanal fishermen.

Domestic and industrial waste disposal

These will not decrease in the foreseeable future, in spite of the declining rate of natural increase by births in the resident population, not only because of the likely continued growth of temporary residents (tourists etc.), but also because of continued human migration towards the coast. Even if such growth tails off on the northern side of the Mediterranean, it still has favourable prospects on the southern side. There will need to be a further evolution in the treatment and disposal of waste, the avoidance of direct dumping and of the waste of water, by the treatment of the urban and industrial waste materials (in appropriate plants), so as not to further limit the production of fish in the coastal sea.

To reduce the amount of waste, municipalities will have to introduce much more effective and efficient waste-treatment plant. Industry will have to make a much greater effort to replace inefficient industrial plant and processes. Greater reduction or exploitation of those wastes could be achieved by recycling or the manufacture of secondary products based on them. A second problem that industry will continue to bring is the waste products arising from the production and consumption of energy. Increasing demand and supply, mainly of fossil fuels, will continue to be a main factor in environmental pollution and other forms of environmental degradation. It may, however, be expected that environmentally friendly power sources, such as hydrogen fuel cells, currently being developed by the automobile industry, will provide the benefit and avoid the degradation. This alternative power source may prove to be a blessing for artisanal fisheries, as well as for other coastal-zone stakeholders. Until such a power source arrives, however, the artisanal fisheries community must press for waste reduction in any coastal-zone management scheme.

Agricultural production

This is expected to increase, particularly in the countries on the southern and eastern borders of the Mediterranean Sea. To avoid the negative impact on soil, through changes in its composition, nutrient content and texture, and on water quality, it will be necessary to improve irrigation systems. Otherwise, the reduced volume of discharged waste water, carrying a high load of excess agricultural chemicals and nutrients, will be to the disadvantage of the coastal artisanal fisheries. The horticulture in plastic-covered

"glasshouses", as a consequence of the urbanization, is modifying the land structure near the coast. This system reduces the infiltration of rain water into the ground, thus increasing the volume of rainwater that reaches the sea from the land, modifying the coastal ecosystems by changing the sea salinity and the concentration of nutrients.

Marine mining

This is likely to become more widespread and, especially if some of the industrial processing is done at sea, may become an even more important environmental factor because of the discharge of waste rock dust into the sea, which will create significantly increased turbidity or increased concentrations of elements that are normally rare in sea water but become toxic at higher concentrations. None of this will benefit the fish stocks, or the fisheries. It will therefore be necessary to modernize mining methods and ore-treatment, so as to reduce environmental degradation to the minimum possible.

In some countries, the reconstruction of eroded beaches will be increasingly pursued, using sand dredged off the sea bed near the coast and dumped on existing but eroded beaches; this will, in some places, increasingly affect seagrass meadows, the ecosystems these beds support and, therefore, the artisanal fisheries.

Shipping

This will also continue to grow. Not only are the European ports being developed to handle increased traffic, but the size and speed of cargo and container vessels, and oil tankers, are still tending to increase, although, in the Mediterranean context, there is still a natural limit imposed by the width and depth of the Suez Canal. We need not doubt, however, that the Canal would be enlarged if ever the traffic required it. With the Indian and Chinese economies growing rapidly, and Europe still providing a large market for their products, the Suez Canal and the Mediterranean still have many good days of maritime commerce before them. These developments will not always be to the advantage of the artisanal fisheries of the region. The possibility of satellite identification and tracking of vessels at sea was mentioned earlier as a useful technological advance.

Artisanal fisheries and mariculture

These are part of the scenario in which these activities have their future. First, the artisanal fisheries are likely to continue to be in competition with the industrial and high-seas fisheries, as well as mariculture, if not physically, at least economically and culturally. All these fisheries must, sooner rather than later (or too late), face up unitedly to the need to manage and exploit the fish stocks far more rationally than hitherto. If the fishermen depend on governments, whether national or supranational, they will get a political solution rather than a rational one. No one can "have their cake and eat it." The fish must be there, in the sea, able to reproduce and grow; the fishermen must catch them, land them and sell them at a cost the fishermen can afford and the consumer will pay.

Resolution of conflicting interests in the coastal zone

While recognizing that there will continue to be a need for mechanisms for managing the principal interactions amongst the main users of the coastal zone, we are not, as we said above, in a position to specify such mechanisms or precisely how they will work. We limit ourselves therefore to summarizing the main interactions amongst the coastal-zone stakeholder communities in a Table given in Annex IV. However, we must always keep in mind the great variety of artisanal fisheries; they vary in method, season, target species etc., from place to place, so the coastal-zone interactions between them and the other stakeholders are never as simple as we have been able, herein, to describe.

We discuss now, briefly, other factors that "pervade" the various aspects of coastal-zone degradation and the remedial coastal-zone development and management.

Marine protected areas

There are three main factors that suggest that Marine Protected Areas (MPAs) will be able to offer serious prospects for the renewal of the artisanal fisheries. First, the experience gained from them shows that they can constitute a good additional mechanism for resource management and for the artisanal fisheries carried out in them. Second, the application of classical measures to reduce fishing

pressure on depleted stocks (e.g. decrease in the overall fishing effort, by means of closed seasons and/or reduced number of fishing vessels or reduced vessel power, or by fixing lower total allowable catches) has been generally disappointing, largely because of the difficulty of applying such measures thoroughly along the whole coastline. And third, the present general legal context in which fisheries operate is far too complex to allow its specific application to the renewal of the artisanal fisheries, whereas the relative independence of the legislative context in which the MPAs operate offers some opportunity for promoting the sustainable development of some artisanal fisheries in the western Mediterranean. The FAO Code of Conduct on Responsible Fishing recommends MPAs as a form of "best practice" in the management and development of the artisanal fisheries.

We think that the establishment of many more marine protected areas for the primary purpose of ensuring use rights of artisanal fishermen, as a means of better controlling, managing and developing the artisanal fisheries, and of conserving the fishery resources concerned, is a real possibility and another key point for the future of artisanal fisheries. This development could be expected to provide a greater certainty in the future of these fisheries and possibly to reverse the negative trend in the artisanal fishery population due to the failure to retain the sons of artisanal fishermen in the fishery. However, the currently high level of replacement of traditional artisanal fishermen and their communities mainly by immigrants, who now have no particular long-term commitment to these fisheries and communities, may continue to affect the evolution of this sector of human socio-economic activity in this region. The creation and development of marine protected areas in favour of the region's artisanal fisheries can be expected to improve settlement of the fishermen in their own places of origin, thus facilitating the incorporation of young people into the fishing activities. The possible disadvantage of this system of management for the artisanal fisheries is the need for independent supervision, which will require meaningful investment by the concerned fishery administrations.

If the inherent uncertainty can be thus reduced, so as to ensure a sounder investment climate, it will speed up the adaptation of the artisanal fisheries accordingly. It must be particularly borne in mind, however, that the necessary changes we think will be needed cannot be decided and implemented rapidly. A future can never be based easily on the destruction of the present structure whatever its weaknesses.

There are, and will continue to be, some complementary advantages that the MPAs may be able to offer: better touristic or educational possibilities, probably involving some of the artisanal fishermen; and, if a much larger number and much more extensive MPAs were created, the region's role as a source of biodiversity would also be better protected.

Socio-economic and cultural developments

From the present situation, the socio-economic and cultural circumstances of the artisanal fisheries will certainly evolve, but it is hard to say how quickly and how profoundly for each of the main factors.

The reason for fishing (food, profit, investment) will not change, even if the fisheries will continue to depend largely on the value of the fish they catch and/or the economic climate. We mentioned above the possibility of marketing, converting "unpopular" species into "popular" ones, and the development of new products from "old" fish. In the future, we should also expect some "old" products, such as fish paste, which was once regarded as a low-grade inexpensive form of marketing otherwise non-descript fish meat etc., will be marketed anew as highly nutritious and relatively expensive savoury fare.

For the foreseeable future, there will be a luxury market for rare and desirable species of fish, but here too, the economic climate will play a big role; and tastes change, or can be induced to change, fairly regularly.

We may expect that the artisanal fishermen will seek to rid themselves of the traditional status of their community and the precariousness of their occupation, by a combination of enhanced fishing technology, thorough stock assessments, rational management of the stocks and the fisheries on them, and the maintenance of a clear demand for a wide variety of species. In trying to do so, they will arrest the current trend to a decline in their number (and increasing average age), due in part to their reluctance to see their sons follow them into the fishery (as it now is), as well as to the sons' ambitions to be something "better". This will be in the hope of creating year-round, full-time artisanal fisheries, even if artisanal fishing will become less and less a family affair. If they succeed, they will also gradually acquire an enhanced status within the coastal zone community of the western

Mediterranean. If they do not, perhaps there will be far fewer fishermen or a higher percentage of part-timers.

Although overall production will remain at a high level, the demand for marine fishery products in the Mediterranean countries will remain well above the supply (capture fisheries + aquaculture) and will accompany, among other things, notably on the southern (and eastern) side of the Mediterranean Sea, the population growth, the growth in tourism, the possible and desirable improvement in the diet, and the consequent drop in the price of aquaculture products.

The maintenance of high prices for seabass and seabreams by means of a concerted Mediterranean strategy for their production and promotion now seems unlikely. The major industrial aquacultural producers appear to be moving towards a policy of low prices with a view to enlarging the present market. And, to counter the scarcity of coastal-zone maricultural sites and the increasing conflicts of interest amongst the zone's stakeholders (notably, with tourism, industry and coastal-freighter shipping, for example), the new offshore production techniques (already being developed in Malta and Cyprus) will be more closely pursued.

Growth in production may, however, be very uneven, with recurrent crises of overproduction and of commercialization (market saturation, price drops, decline in product image and customer interest, etc.). This could call into question strategies that are insufficiently concerted and over-reliant on the quantitative aspects.

The risk of a decline in the stocks taken in the natural environment (e.g. bluefin tuna, grey mullets) will remain if this supplementary fishing pressure is not accompanied by an increased effort in the management of the fish stocks and the fisheries on them. Also, there may be serious losses from the fish cages used for fattening and from an increased level of disease. And genetic modifications in the long term are possible as a result of the mixing of fish that escape from the fish-farming installations and the wild stocks.

The general increase in the regional, subregional and local actions to deal with these various problems shows the development of an increased awareness of the possibility that other scenarios of fishery development than the current one are credible. What is actually at stake, and hence another key point for the future of artisanal fisheries, is the change from a fishery based primarily on competition amongst the fishermen, which has been exacerbated by the technical advances in the fishing and the lack of discrimination in the access to the resources, to a fishery based on the management of the ecosystem.

The future of artisanal fisheries will also have to take into account the main socio-cultural developments that will increasingly occupy the coastal-zone populations. These are the "green movement" and the pursuit of sustainable development. Although we have discussed, however briefly, most of the environmental concerns already expressed by the "green movement" – environmental protection, conservation of resources and biodiversity, for example – we expect it to continue to pursue its goals; we think such pursuit will be more successful the more truly ecological (and less political) the movement becomes.

In any case, for the foreseeable future, some environmental degradation will continue to occur as a result of human activities. We have only to think of the motives of those who deliberately start forest fires in high summer.

Regarding sustainable development (see following section), there will continue to be, for a long time to come, a real gap between its ideals and the possibility of achieving them. We believe that its ideals will prevail in the long run, but its achievement will take more than the thirty years of our horizon here.

The legal context is not likely to change much at the international level. A considerable evolution at the national level is very probable, but it will be a question of its scope and objectives; if these are strictly national, the artisanal fisheries might benefit in the short term, but not in the long term. Artisanal fishermen cannot be entirely protected by governments from such things as the negative effects of overfishing and the consequent weak state of their resources, and adverse market conditions.

The States, if they wish to ensure the sustainable management of the living marine resources in the Mediterranean Sea, will continue to work together through the General Fisheries Commission for the Mediterranean (GFCM) and, as appropriate, the International Commission for the Conservation of Atlantic

Tunas (ICCAT). We do not expect them to set up a new body for this purpose, and it will be generally beneficial to artisanal fishermen to cooperate as far as possible with the existing regional bodies.

We may expect to see, if not a generalized establishment of Exclusive Economic Zones in the Mediterranean (that would probably provoke too many disputes), a move towards a greater control by the Mediterranean States of the Sea's living marine resources (by the creation of fishery protection zones, for example). This would probably lead to the de facto exclusion of the distant-water fleets of nations from outside the Mediterranean region, which might be of some advantage to artisanal fisheries.

We also expect to see an increasingly greater implementation, in the region, of the UN Convention on the Law of the Sea and of the voluntary "subjurisdictional" international agreements relevant to fisheries it has engendered.

The continued implementation of the Barcelona Convention, insofar as it applies to fisheries, and the related UNEP Action Plans to protect species and marine habitats, may depend a lot on the evolution of the regional environment, but will continue to pursue the creation of marine protected areas in more countries, benefiting the artisanal fisheries as a result of the increase in the biomass of fishes reproducing in the marine reserve system.

We may also expect to see the European Commission provide more leadership and play an increasing role in fishery management in the Mediterranean, particularly through effective support to FAO regional cooperation projects, such as COPEMED, that would generally benefit the artisanal fishery sector.

Sustainable development

Sustainable development is an idea, even an ideal, rather than a fully attainable state. To achieve it will require a major change in public, and private, attitudes to socio-economic activity in relation to the natural resources, if not to all human activities. At present, the major users of the coastal zone are, in one way or another, in competition, at best, or conflict, at worst, even if some progress has been made in resolving the conflicts by the adoption of an integrated coastal-zone management policy. The problem remains the effective implementation of such a policy. To a considerable extent, this is because ecological criteria of choice in terms of space and objectives are unlikely to correspond to political criteria, in terms of jurisdiction and economics. Controlling coastal development and protecting natural habitats will require improved planning procedures, and will often involve social and political choices that will be painful in the making but rewarding to the coastal community as a whole, in the long run.

The concept of development, as still currently widely understood, embodies the idea of "progress", the motive force for technologically driven changes, and the idea of "stability", the ability of mankind to extract a constant level of benefits from an ecosystem over an indefinite period. The more limited notion – sustainable development – therefore embodies the notion of exploitation or harvesting of natural resources, but is constrained by the capacity of the exploited resource and its natural environment to resist the impact of exploitation.

The definition of sustainable development adopted by the World Commission on Environment and Development in 1987 (the Brundtland Report) is perhaps the simplest:

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

This definition recognizes that the value systems of society are continuously changing, as will the relative value currently assigned to a particular living resource. The latter idea is very important to the development of fisheries, whether artisanal or industrial, because investment is based largely on a forecast of the value of the resource to be exploited.

A more explicit definition of sustainable development for aquatic and terrestrial systems was adopted by the FAO Council in 1988:

Sustainable development is the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such development conserves land, water, plant and genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable.

We may suggest here the main objectives for the achievement of sustainable development in fisheries in the Mediterranean, to the extent that this is possible without also ensuring it in all the other fields of human activity. The main objectives could, we believe, be:

- development of an information and sampling system to allow accurate assessment of marine ecosystems, applying ecosystem limits and reference points;
- development of a much improved information base to allow accurate assessment of the state of the stocks and the optimum biological yield therefrom, applying limits and biological reference points;
- control of fleet size and of the introduction of technical advances in gear, vessels and navigational and fish-finding equipment, so as to adjust fishing effort rapidly to changes in stock size and biological yield;
- rational and equitable allocation of fishing areas and resources, so as to place responsibility for stock maintenance in the hands of those (not least, the fishermen themselves) to whom the resources have been so allocated, by the creation of subregional fishery advisory councils with the participation of fishermen and other coastal-zone stakeholders;
- the practical implementation of the FAO Code of Conduct for Responsible Fishing, the FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, and the relevant decisions of the UN Conference on Straddling Fish Stocks and Highly Migratory Species;
- the special protection of estuaries and associated nearshore areas from use prejudicial to the fishery resources, because of the biological importance of these land–water interfaces which are reproduction and nursery areas for many valuable species, areas where coastal marine systems are fertilized from the land, and on which marine resources harvested farther offshore depend;
- the establishment in all countries of regulated marine protected areas to preserve the coastal ecosystems and to protect many valuable species, especially of reproductive age;
- the development of legal, management and conservation mechanisms required for the management of the freshwater–seawater interface and the related resources;
- the rehabilitation of coastal ecosystems in which fishery resources once prospered;
- the real enhancement of regional cooperation among countries in the pursuit of such sustainable development;
- pursuit of full compliance with existing fishery laws and regulations (including those it is hoped to harmonize) at national and regional levels.

The probable implication for artisanal fisheries of pursuing these objectives is that more species of fish will be caught in smaller amounts each by fewer fishermen who will, however, have increasingly sophisticated boats and gear.

Mariculture is also important for sustainable development, through the wealth and the jobs it is capable of generating in numerous coastal areas, including some experiencing economic difficulties (notably islands). It may help to avoid the development of a "tourism-only" economic outlook and in some cases to allow out-of-work artisanal fishermen to engage in a new fishing activity. Moreover, most of the extensive and semi-intensive mariculture installations are advantageous to the environment, since they contribute in effect to the long-term maintenance of the wetlands and lagoons they exploit and they strengthen the fight against urban, agricultural and industrial pollution, as a condition of their own survival.

However, the mobilization of those most concerned (decision-makers, marine environmental scientists, social scientists, coastal-zone managers, etc.) and, of course, the fishermen themselves, is necessary to develop this type of action and must be effective at the various pertinent geographical scales (regional and subregional, for the shared stocks, and perhaps, most of all at the local scale, for the organization of responsible fishing). *Such mobilization must be based on the ecosystem hence on the local social system and on the recognition and strengthening of the knowledge and the rights of the local fishing communities, which thus become the guarantors of the respect of the community disciplines that will allow the conservation of the stocks*. Such cooperation would involve agreement on the areas to be reserved for the artisanal fisheries, on the necessary closed fishing seasons, and the desirable location and nature of marine protected areas.

If the sustained development of mariculture is to be achieved, especially if it involves habitat-enhancement measures, such as the construction of artificial reefs (even if these may have mainly a dissuasive purpose with respect to capture fisheries), centred on coastal waters, estuaries and lagoons, there will almost certainly have to be an allocation of exclusive rights to users over the area of operation, the promotion of environment-friendly mariculture, and the protection of maricultural standing crops against the harmful effects of other users of the environment.

Obviously, the part that artisanal fisheries will be able to play in overall sustainable development is, and always will be, modest, but that is not an argument for such fisheries and the communities that support them not to make every possible effort to ensure their own sustainability. They must look after their fish stocks just as a shepherd tends his sheep.

CONCLUSIONS

We can usefully end by summarizing what we think the artisanal fisheries communities, in particular, and others concerned with fishery development in the western Mediterranean, in general, may expect to have to do or to deal with in the coming decades to ensure the survival, at worst, and the sustainable development, at best, of these fisheries. We take the past and the present for granted – they are the experience on which the future is inevitably based; we have added our own, we hope reasonable, imagination of the future, which the artisanal fishermen, the others concerned with fishery development, and the general reader, may welcome or contest or improve upon. We have assumed that, in principle, there is no need to treat the artisanal fisheries on the northern and southern sides of the western Mediterranean differently, even if the timing of various future developments may not be the same everywhere.

Overall conclusions

There is a future for artisanal fisheries provided that enough effort is made to reduce their precariousness in terms of:

- the state of the fish stocks they exploit;
- reliable fish-stock assessment;
- the physical and commercial competition they face from the industrial fisheries;
- the harmonization of the artisanal and the industrial fisheries with respect to target species, fishing areas and seasons;
- the predictablility of the demand for, and the value of, their landings;
- the operational costs of artisanal fishing, including landing facilities and the delivery of catches to market;
- added value of the fishery products;
- the replacement of the old artisanal fishermen by new, committed and well trained artisanal fishermen;
- the status of the artisanal fishery community as a coastal-zone stakeholder;
- the opportunities for sound investment in boats, gear and technological aids to fishing;
- the possible conflicts of interest with other coastal-zone stakeholders;
- the possibility of their specific protection and development by associating them with dedicated marine protected areas.

We take these overall conclusions on the foregoing and related subjects in a little more detail under separate headings.

The fish stocks and their scientific assessment

Fisheries have probably reached a plateau in terms of what can be taken from the sea without driving the stocks to economic distinction, which normally precedes biological extinction, unless the public's willingness to pay the cost of capture remains inversely proportional to the availability of the catch. In some cases, this is regrettably true (e.g. bluefin tuna), and rational fishery management and development are severely compromised: the relevant measures, however necessary, will be hard to impose if money is to be made from fishing for high-value but increasingly rare species. Nevertheless, there will have to be a major improvement in the scientific assessment of the fish stock(s) in terms of reproduction, recruitment, abundance and optimum biological yield in the context of each fishery.

Since most of these stocks overlap national jurisdictions, regional cooperation in the collection and analysis of relevant data is, and will remain, essential if proper assessments are to be made of the whole

stock of each major target species. The present efforts to make local stock assessments and to manage fisheries mainly on a strictly national basis are almost certainly ineffective.

A part of stock assessment in the future will very probably require some forms of direct observation, such as regular hydroacoustic and underwater television surveys and, in some cases, by scuba-divers. Such direct observation may prove particularly useful in marine protected areas.

Another part of stock assessment is, and will remain, scientific experimental fishing and deeper theoretical studies of indicators of the true fish abundance as it evolves in response not only to the biological factors mentioned above, but also to changes in fishing pressure and environmental degradation.

While the principal responsibility for fish-stock assessment falls on national bodies (through the appropriate scientific institutions) responsible for fishery development, the artisanal fisheries communities will have to collaborate in such assessment, notably by providing reliable fishing information (see following section). This collaboration will have to be conditional upon the use of the information for the exclusive benefit of the artisanal fishery communities themselves.

Fishery management

There will also have to be a major improvement in the management of all the fisheries, artisanal, industrial and maricultural, on all the major target species. So all these fisheries will have to face up together to the need to manage and exploit the fish stocks far more rationally than hitherto and to co-operate in doing so.

Besides the more classical fishing restrictions (e.g. control of fishing gears and methods, fishing effort, hence of fleet size, fishing time and fishing power) and stock assessment, fishery management itself will also have to include such aspects as:

- the introduction of appropriate technical improvements in the fishing gear, vessels, fish-finding and navigational equipment;
- the proper resolution of any physical or commercial conflicts between the major types of fishery (artisanal, industrial and maricultural);
- the application of fishery ecological know-how;
- the conservation of the various fishery resources.

The long-term objective of rational fishery management will almost certainly have to be the development of the ability to adjust fishing pressure rapidly to changes in stock size and biological yield, in the economic context (fish processing, marketing, trade and investment climate) and in the ecological trends, locally and regionally, in which the fisheries have to operate.

To this end, there will have to be a change from a fishery based primarily on competition amongst the fishermen, which has been exacerbated by the technical advances in the fishing and the lack of discrimination in the access to the resources, to a fishery based on the management of the ecosystem.

Since, for many of the species, stock assessment and fishery management, to be effective, will almost certainly have finally to be on a Mediterranean-wide fish-population basis, the role of the General Fisheries Commission for the Mediterranean will be primordial. So GFCM should concentrate not only on shared stocks, but also on species targeted by the artisanal fisheries. In either case, this will require more and more-active regional cooperation, with an increasing participation of the artisanal, industrial and maricultural fishery communities and of the national bodies responsible for fishery development and management in meetings or specific dialogue fora involving all interested parties and in the work of this Commission. To this end, fishermen will have to keep quite detailed records of their fishing activities and provide the relevant data to relevant national and regional entities charged with fishery management. But, again, the fishermen will have to see their underlying interests served by this increased contribution of information.

At the same time, the Commission and the national fishery administrations will increasingly have to promote the harmonization of regulations of common interest to the industrial and artisanal fisheries in

terms of control of fishing pressure on stocks of specific target species and in the light of the ecological circumstances of each species.

Regional cooperation in the development of fishery management that includes the artisanal fisheries could be promoted initially through FAO regional projects (possibly with particular emphasis on marine protected areas) conducted by FAO (such activity falls within its commitment under Agenda 21 of the UN Conference on Environment and Development) and under the auspices of the GFCM. A proposal for practical action in the form of a specific pilot project is outlined at the end of the present chapter.

Socio-economic development

In spite of the difficulty in separating socio-economic development from other types of development, the following factors will continue to operate in the next three decades or more, so the artisanal fisheries community will have to pay close attention to:

- the evolution of the operational costs of artisanal fishing in terms of fish-finding, fishing gear and equipment replacement, and retraining, if necessary;
- the development of markets for their catches, even on a small scale, and the increasing requirement to devote much more of their "fishing effort" to ensuring the high quality of their landings, not only to maximize the price at time of sale, but also to meet the growing requirements of national and European food-safety regulations;
- the competition presented by mariculture, including the newly developed tuna farming, and the possibilities for some artisanal fishermen to convert to mariculture;
- the competition presented by the products of agriculture, bearing in mind, among other things, the possibility that agricultural as well as fishery products may be imported at lower cost from other parts of the world;
- the implications of the creation of marine protected areas for fishery-management purposes necessarily limited to a restricted number of artisanal fishermen, hence the exclusion of others outside such areas.

Socio-cultural developments

Although culture is often an expression of the socio-economic climate of a country or region, the artisanal fisheries community will have, in the coming decades, to deal with the following factors of a socio-cultural nature:

- The desirability of creating regional associations representing artisanal fishery interests generally may prove useful, even if, in the majority of western Mediterranean countries, national fishermen's cooperatives and associations already go some way to providing a common vehicle for community stakeholder action; the danger of having a multiplicity of such bodies each concerned with a particular area, species or type of fishery, for example, must be taken into account.
- The impediments to financial and social investment in, and development of, the artisanal fisheries, particularly the precariousness inherent in artisanal fisheries, as now practised and due principally to:
  - uncertainty in the future availability of the target species;
  - uncertainty in the market for the fish caught.
- The difficulty of replacing old, experienced fishermen by equally competent younger fishermen, given that the artisanal fishermen's sons are increasingly reluctant, for social and economic reasons, to follow their fathers into artisanal fishing (as it now is).
- The presently widespread failure of the general population and local, regional and national governments to recognize the artisanal fishery community as an important stakeholder and therefore as a specific socio-economic sector different from industrial fishermen and with a status comparable to that of the other coastal-zone stakeholder groups in the coastal zone.
- For artisanal fisheries to be able to grow and prosper the competing demands of the primary users of the Mediterranean Sea, and especially of the coastal zone, must be resolved rationally and fairly

and sooner rather than later, so the artisanal fisheries community must become actively involved in coastal-zone management.

- The main socio-cultural developments (based mainly on species conservation, reduced waste production, increased waste treatment, limiting the causes of climate change) pursued by the "green movement", to which, in some respects, the artisanal fishermen may need to adapt.
- The impacts of climate change and the move towards sustainable development, although less immediately important, cannot be ignored; they can be expected to develop over a relatively long period of time, allowing artisanal fisheries to adapt to their foreseeable consequences progressively.

Climate change is not expected to change overall fish production of the Mediterranean Sea, anyway, though it will probably change some of the ways, and the places where, artisanal fishing will be conducted.

To achieve sustainable development will require a major change in public, and private, attitudes to socio-economic activity, if not to all human activities. Even if some progress has been made in resolving the conflicts of interest in the coastal zone by the adoption of integrated coastal-zone management schemes, the problem remains the effective implementation of such schemes. Controlling coastal development and protecting natural habitats will require improved planning procedures, and will often involve social and political choices that will be painful in the making but rewarding to the coastal community as a whole, in the long run.

The part that artisanal fisheries can play in overall sustainable development is, and always will be, modest, but that is not an argument for such fisheries and the communities that pursue them not to make every possible effort to ensure their own sustainability.

Technological development

The chance to enhance the efficacy of artisanal fisheries by increasing the use of mechanical and electronic devices to find and catch fish will certainly be available, but such an evolution will also change the social and technical status of these fisheries, as well as the state of the resources on which they depend. The introduction of electronic and mechanical gear, beside the fishing gear and the crew, can be expected to drive an increase in the average size of artisanal fishing boats, which, in turn, may drive the demand for more formal landing facilities. Maintenance, repair and replacement of hi-tech equipment will become an important consideration in the cost of artisanal fishing, hence in the investment.

The artisanal fishery communities will need to ensure that the amount of fish caught as a possible consequence of technological development in fishing boats, gear and methods covers the investment that such development demands and the cost of any environmental degradation and rehabilitation due to their fishing, as well as yield a profit.

Coastal-zone management and the protection of the living marine resources

Since artisanal fisheries are, in practice, unavoidably linked with the coastal zone, their future will be closely linked with coastal-zone development and management decisions.

The implementation of integrated coastal-zone management (ICZM) policies, if successful, may improve the present environmental/ecological situation, but may not arrest such degradation entirely in the future. The problem remains, however, the effective implementation of such a policy. To a considerable extent, this is because ecological criteria of choice in terms of space and objectives are unlikely to correspond to political criteria, in terms of jurisdiction and economics.

The artisanal fishery communities will have to become actively involved in coastal-zone management in the future, to ensure the protection of living marine resources. The development of certain artisanal fisheries *will require, or at least benefit from, the following actions*:

- the creation of coastal marine protected areas for artisanal fishery management purposes and the direct involvement of artisanal fishermen in their protection;

- special protection (for example, by the creation of marine protected areas) of rivers, estuaries, deltas, wetlands, lagoons and coastal salt marshes from uses prejudicial to the fishery resources;
- the elaboration of legal, management and conservation mechanisms for the management of the freshwater–seawater interface and the related resources;
- the rehabilitation, to the greatest extent possible, of coastal ecosystems (coastal lagoons, for example) in which fishery resources once prospered.

The establishment of many more marine protected areas for the primary purpose of ensuring use rights of artisanal fishermen, as a means of better controlling, managing and developing the artisanal fisheries, and of conserving the fishery resources concerned, is a real possibility. Experience shows that marine protected areas as fishery reserves can constitute a good mechanism for resource management and for the artisanal fisheries carried out in them, by allowing the state of the exploited fish populations and the standard of living of the fishermen and their families to be improved, and the traditions of artisanal fishing to be maintained.

The artisanal fishermen should, as far as possible, become generally concerned with endangered species, even if they are not target species of their fisheries, given the strong impact that the loss of a major species is likely to have on the marine ecosystems in which it lives.

The artisanal fisheries community will have to participate effectively, and often in an adversary role, in any decision by local or national governmental entities to authorize any occupation of natural aquatic habitat for human activities other than fishing or mariculture. Accordingly, they should also, collectively, pay attention to developments, whether positive or negative, in:

- tourism;
- demand for "tourist fishing";
- sport fishing;
- coastal-zone urbanization and port development, including appropriate physical facilities for the landing, processing and marketing of their fish landings, where such facilities are needed;
- hinterland hydraulic engineering, with a view to better controlling coastal erosion and natural beach replenishment;
- the treatment and disposal of agricultural, industrial and domestic wastes;
- marine mining, in those areas where it may interfere with fishing;
- marine pollution in their fishing area, bearing in mind that they – the artisanal fishermen – "pay", through loss of sales, for any occurrence of seafood found to be tainted or contaminated by marine pollutants;
- discharge of waste by commercial shipping (and, indeed, fishing vessels) insofar as this affects the fishery resources or interferes with artisanal fishing.

Legislative development

Assuming no major political revolution (which is a risky assumption, we agree), the other factor that the artisanal fishery communities, national entities responsible for fisheries, and local, regional, and national governments must take into account is the legal context in which these fisheries must expect to operate and develop in the future.

Since no one Mediterranean country has, in practical quantitative terms, a species distributed exclusively within the waters under its sole jurisdiction, fishery management in the Mediterranean is, and will continue to be, obligatorily, an international affair. The key issue here is whether all those concerned with fisheries – the artisanal fishery community itself, national entities responsible for fisheries, and local, regional, and national governments – will seek to ensure effective compliance with the relevant legal instruments, as intended, or not.

Our conclusion is that, in the long run, far more is to be gained, at all levels (national, regional, international) by general compliance with the relevant legal instruments, even if local, short-term advantage may be achieved by non-compliance.

Such a conclusion would also be valid with respect to the application of: the FAO Code of Conduct for Responsible Fishing; the FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas; the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks; and, as appropriate, the Barcelona Convention for the Protection of the Mediterranean Marine Environment.

While we could not consider national legislation as it applies to fisheries in detail, we believe that such legislation should tend to:

- recognize the artisanal fisheries communities as a specific and essential stakeholder in future coastal-zone development and management;
- legitimize artisanal fisheries as a generally seasonal or intermittent activity with admissible alternative forms of employment open to the artisanal fishermen;
- recognize the use by bona fide artisanal fishermen of various types of fishing gear at different times of the year and for different species;
- facilitate the transfer of fishing boats and gear to descendants of bona fide artisanal fishermen;
- safeguard the confidentiality of fishery information (data on fishing areas, effort, catches, landings etc.) and restrict its use to legitimate purposes in the specific interest of the artisanal fisheries;
- confer the right to exploit, and the obligation to manage, a given specific fish stock, to bona fide fisherman, one possible solution, perhaps particularly applicable to artisanal fisheries, being the recognition of specific geographical rights to specified fishery areas, referred to as TURFs (Territorial User Rights of Fishermen);
- confer comparable rights on those pursuing mariculture (however, in our view, any such rights would better be granted in a Mediterranean regional framework);
- allow the development of artisanal fisheries in specific marine protected areas to be governed by the legislation directly applicable to such areas.

A proposal for pratical action

A specific pilot project

Our proposals for the future development and management of the artisanal fisheries of the western Mediterranean (and, in principle, the whole Mediterranean) are certainly not exhaustive, but nor is our capacity for foretelling the future. Nevertheless, while we have indicated so far what we think will be necessary to renew the artisanal fisheries in the western Mediterranean, in the hope that those concerned – the fishermen, their communities, national fishery administrations, other coastal-zone stakeholders etc. – will agree on the validity of our views and take the appropriate action, we believe that it would be unrealistic to expect that the variety of actions needed, nationally and/or regionally, could be planned and executed without careful preparation of a plan and a programme for each area of the western Mediterranean in which such renewal is clearly required. It would therefore not be unreasonable for the relevant regional entities, such as the General Fisheries Commission for the Mediterranean, of the Food and Agriculture Organization of the United Nations, to develop and execute a pilot project aimed at restoring the degraded human and physical capital as the basis for the renewal of the artisanal fisheries. We recognize that this process will take a long time to be implemented, to be effective and to be convincing. The fishermen must be able to see a real future in their activity, rather than simply live it for better or for worse.

Even the pilot project we are suggesting will involve drastic changes concerning, among other things: the regulatory and normative framework, which remains incomplete; the establishment of a retraining programme which, starting from the fishing itself, should cover economic aspects (e.g. quality control, product certification and marketing), social and cultural studies. Such training and other forms of technical assistance should be given to the new generation of artisanal fishermen, including immigrants, with a view to granting them a regional licence, social-security coverage valid in all the countries of the region (as is in fact the practice in the European Union). In exchange, the fishermen should abandon the present custom of demanding and accepting day-to-day incentives that bring very little fresh air to the potential development of their way of life and standard of living in the future.

Cooperative easy-credit banking loans (as was done for the reconstruction of the European industry and the agriculture after the Second World War), improvement in the infrastructures (ports or landing places, fish markets, fish products), and improved safety at sea are much to be preferred, in the long run, to government subventions and subsidies.

The type of pilot project we propose could be fairly regarded as a pre-investment activity aimed at optimizing the utilization of coastal natural resources in two or three Mediterranean countries wishing to host the pilot project. Each such pilot project should comprise three phases. The first phase should cover the development of the methods of baseline analysis (an assessment of the present state of affairs). A second phase should cover the planning and test the methods developed in the first phase. The third phase should revise/improve the methods on the basis of the experience gained in their application, so as to guide additional investment in an increasingly large area of the coast.

This developmental approach would call for the concerted effort of all the principal coastal-zone stakeholder groups and lead to the *creation of stakeholder consortia* that could develop the relevant plans for their respective geographic areas. Working through such consortia would not only ensure a better participation in the planning by all those concerned, but also oblige the consortia to monitor and evaluate progress and to serve as vehicles for facilitating the marketing of the various products and services arising from these development activities.

Thanks to a new effort by the Spanish Agency for International Cooperation (AECI) to improve the living conditions of the Mediterranean fishermen, the establishment, under COPEMED II, of a pilot project on artisanal fisheries is foreseen which would fit into our general proposal and which should allow the institution of the consortia we are recommending, even if the primary objective of the AECI proposal is to seek to eradicate poverty among the artisanal fishermen of the Moroccan zone AECI is directly concerned with.

Artisanal fishing, aquaculture and tourism, as well as marketing and the creation of job opportunities, may be seen as major activities in the coastal development, and the proposed pilot project would pay special attention to them, though not at the expense of concern for such land-based activities as urbanization, agriculture and forestry.

A preferred mechanism for delivering technical assistance to the consortia could be to make centrally located experts available to guide each consortium in the development of the local planning.

A new institution dedicated to the artisanal fisheries of the Mediterranean

The foregoing leads us to consider the usefulness of establishing a Mediterranean body dedicated specifically to the development of the artisanal fisheries in the region. The data and information we have presented in this book illustrate the undeniable importance attached to this type of fisheries in the region (probably more than 80% of the whole fishing fleet); it also indicates the scarce, if not inexistent, representation of the artisanal fishermen in any kind of forum concerned with fishery development, whether at the national or international level.

We are sure that, in the Mediterranean countries themselves, in the European Union, in the regional fishery bodies involved (GFCM and ICCAT) and in the non-governmental organizations actively concerned with fishing in the region, there is a genuine interest in the proper development of artisanal fishing in the Mediterranean.

The creation of a body of this type would imply an important step forward, not only towards more-sustainable fisheries than the present ones, but also in the sense envisaged in the FAO Code of Conduct for Responsible Fishing.

The stimulus of the pilot project we have proposed could constitute the basis on which to establish appropriately the proposed regional body.

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ANNEX I

The common names of all the target species and principal accessory species of the artisanal fisheries of the western Mediterranean
(Within each category, the species are listed in alphabetical order of the scientific name; specifically Arabic names are transliterated into roman text)

Important species – fishes

Common names						Scientific name
Arabic[2]	English	French	Italian	Maltese	Spanish	
A(A): anguille **A(L):** anguilla **A(T):** hanncha	European eel	anguille d'Europe	anguilla	sallura	anguila europea	*Anguilla anguilla*
A(A): melva **A(L):** matseti **A(T):** melva	bullet tuna, frigate mackerel	bonitou	bonito	tumbrell	melva	*Auxis rochei* (=*A. thazard*?)
A(A): gallinette **A(L):** djaj **A(T):** djej	tub gurnard	grondin-perlon	capone, gallinella	gallinetta	bejel	*Chelidonichthys* (ex-*Trigla*) *lucerna*
A(A): conger **A(L):** grango **A(T):** gringo	European conger	congre d'Europe	gronco	gringu	congrio común	*Conger conger*
A(A): coryphene **A(L):** lambuka **A(T):** lambouka	common dolphinfish	coryphène	corifena	lampuka	lampuga	*Coryphaena hippurus*
A(A): bar européen **A(L):** garous **A(T):** karouss	European seabass	bar européen	spigola, branzino	spnotta	lubina	*Dicentrarchus labrax*
A(A): sar **A(L):** garagous **A(T):** karouss	white seabream	sar commun	sarago maggiore	–	sargo	*Diplodus sargus sargus*
A(A): anchouwa **A(L):** anshoga **A(M):** chtoun	European anchovy	anchois commun	acciuga	incova	boquerón; anchoa	*Engraulis encrasicolus*
A(L): farouj	dusky grouper	mérou noir	cernia	cerna	mero	*Epinephelus guaza*
A(A): rascasse **A(L):** shkorfo **A(T):** boukacha	rockfish	rascasse de fond	scorfano di fondale	skorfna	gallineta	*Helicolenus dactylopterus*
A(A): taupe bleue **A(L):** zergaya **A(M):** lkars	shortfin mako	taupe bleue	squalo mako	pixxitondu	marrajo dientuso	*Isurus oxyrinchus*
A(A): taupe commune **A(L):** zergaya **A(T):** lkars	porbeagle	taupe commune	smeriglio	pixxiplamtu	marrajo sardinero	*Lamna nasus*
A(A): sabre argente **A(L):** semta **A(T):** sibtta	silver scabbardfish	sabre argenté	pesce sciabola	fjamma	pez cinto	*Lepidopus caudatus*
A(A): chrab **A(L):** strelia **A(M):** liche **A(T):** ghrab	leerfish	liche né-bé	leccia	serra	palometón	*Lichia amia*
A(A): menkous	striped	marbré	marmora	mingus	herrera	*Lithognathus mormyrus*

[2] Arabic common names: **A(A)**: Arabic Algeria; **A(L)**: Arabic (Libyan Arab Jamahirya); **A(M)**: Arabic (Morocco); **A(T)**: Arabic (Tunisia).

A(L): mankus **A(M):** rmouli **A(T):** menkous	seabream					
A(A): baudroie **A(L):** boshkara **A(T):** bichi chkara	black-bellied angler	baudroie rousse	budego, rospo coda tripla	petrica zghira	rape negro	*Lophius budegassa*
A(A): baudroie **A(L):** boshkara **A(T):** bichi chkara	angler	baudroie commune	rana pescatrice	petrici	rape	*Lophius piscatorius*
A(A): nasali **A(L):** marlutso **A(T):** nazalli	European hake	merlu commun	nasello, merluzzo, argentato	merluzz	merluza europea	*Merluccius merluccius*
A(A): rouget **A(L):** trelia bayda **A(T):** trilia bidha	red mullet	rouget-barbet de vase	triglia di fango	trilja tal-quawwi	salmonete de fango	*Mullus barbatus*
A(A): rouget **A(L):** trelia **A(T):** trilia hamra	striped red mullet	rouget-barbet de roche	triglia di scoglio	trilja tal-hawa	salmonete de roca	*Mullus surmuletus*
A(A): morjane **A(L):** bazoka **A(M):** pageot **A(T):** morjane	axillary seabream	pageot acarné	pagello bastardo	bazuga	aligote	*Pagellus acarne*
–	red pandora	pageot à tache rouge	pagello maculato	–	breca chata	*Pagellus bellotti bellotti*
A(A): morjane **A(L):** bazoka **A(M):** pageot **A(T):** morjane	blackspot seabream	dorade rose	occhione	bazuga	besugo	*Pagellus bogaraveo*
A(A): morgen **A(L):** morjan **A(M):** pageot rouge **A(T):** morjane horr	common pandora	pageot commun	pagello fragolino	pagella hamra	breca	*Pagellus erythrinus*
A(A): pagre **A(L):** bagro **A(M):** pagrus pagrus **A(T):** pagre	common seabream	pagre commun	pagro	pagru	pargo	*Pagrus pagrus pagrus*
A(A): mostia kabirah **A(L):** deeb **A(M):** bartola **A(T):** mostia kabirah	greater fork-beard	phycis de fond	mustella	lipp abjad	brótola de fango	*Phycis blennoides*
A(A): mostia saghirah **A(L):** deeb **A(T):** mostia saghirah	forkbeard	phycis de roche	musdea bianca	lipp tal-qawwi	brótola de roca	*Phycis phycis*
A(A): bou menqar **A(L):** zergaya **A(M):** huta kahla **A(T):** bou menqar	blue shark	peau bleue	verdesca	huta kahla	tiburón azúl	*Prionace glauca*
A(A): bonite **A(L):** mghatat **A(M):** cerda **A(T):** toumbrel	Atlantic bonito	bonite à dos rayé	palamita	plamtu	bonito atlántico	*Sarda sarda*
A(A): sardine	European	sardine	sardina	sardin kahla	sardina	*Sardina pilchardus*

A(L): sardin mabroum **A(M):** sardina **A(T):** sardina	pilchard	commune				
A(A): latchah **A(L):** sardinah **A(M):** latcha **A(T):** latchah	round sardinella	allache	alaccia	lacca tal-faxx	alacha	*Sardinella aurita*
A(A): scoumri **A(L):** cawalli **A(M):** kabaila **A(T):** scombri bou inne	chub mackerel	maquereau espagnol	lanzardo	kavall	estornino	*Scomber japonicus*
A(A): scoumri **A(L):** cawalli **A(M):** kabaila **A(T):** scombri bou richa	Atlantic mackerel	maquereau commun	sgombro	pizzitun	caballa del Atlántico	*Scomber scombrus*
A(A): rascasse **A(L):** shkorfo aswad **A(T):** boukachech sghir	small red scorpionfish	petite rascasse	scorfanotto	skorfna tat-tebgha	escórpora	*Scorpæna notata*
A(A): rascasse **A(L):** shkorfo aswad **A(T):** boukachech akhel	black scorpionfish	rascasse brune	scorfano nero	skorfna sewda	rascacio	*Scorpæna porcus*
A(A): rascasse **A(L):** shkorfo **A(T):** boukachech ahmer	red scorpionfish	rascasse rouge	scorfano rosso	cipullazza	cabracho	*Scorpæna scrofa*
A(A): ktat **A(L):** gtat **A(M):** gata **A(T):** ktat	smallspotted catshark	petite roussette	gattuccio	gattarel	pintarroja	*Scyliorhinus canicula*
A(A): poisson limon **A(L):** shoal **A(M):** seriole **A(T):** safraia bichi limouni	great amberjack	sériole couronnée	ricciola	accola	pez limón	*Seriola dumerili*
A(A): sole **A(L):** mdas **A(T):** mdess	common sole	sole commune	sogliola comune	ingwata	lenguado	*Solea vulgaris*
A(A): ourata **A(L):** kerraf **A(M):** daurade **A(T):** ourata	gilthead seabream	dorade royale	orata	awrata	dorada	*Sparus aurata*
A(A): ghzel **A(L):** albacore **A(M):** germon **A(T):** ghzel	albacore	germon	tonno alalunga	–	atún blanco; bonito del Norte	*Thunnus alalunga*
A(A): – **A(L):** – **A(M):** thone **A(T):** toun ahmar	northern bluefin tuna	thon rouge	tonno rosso	tonn	atún rojo	*Thunnus thynnus thynnus*
A(A): chourou farasi **A(L):** saurou aswad **A(M):** chren **A(T):** chourou asfer	Mediterranean horse mackerel	chinchard à queue jaune	sugarello maggiore	sawrella	jurel mediterráneo	*Trachurus mediterraneanus*

A(A): chourou europi **A(L):** saurou **A(M):** chrene **A(T):** chourou	Atlantic horse mackerel	chinchard d'Europe	suro	sawrella kahla	jurel	*Trachurus trachurus*
A(A): bou sif **A(L):**aboucet **A(T):** bou sif	swordfish	espadon	pesce spada	pixxispad	pez espada; emperador	*Xiphias gladius*

Important species – <u>crustaceans</u>

Common names						Scientific name
Arabic	**English**	**French**	**Italian**	**Maltese**	**Spanish**	
–	giant red shrimp	gambon rouge	gambero rosso	–	langostino moruno	*Aristæomorpha foliacea*
–	blue and red shrimp	crevette rouge	gambero viola, gambero rosso	gamblu homor	gamba rosada	*Aristeus antennatus*
–	common shrimp	crevette grise	gambero grigio, canocchia	–	quisquilla	*Crangon crangon*
–	European lobster	homard européen	astice, lupicante	–	bogavante	*Homarus gammarus*
–	spinous spider crab	araignée de mer	granceola, granseola	–	centolla	*Maja squinado*
–	Norway obster	langoustine	scampo	skampu	cigala	*Nephrops norvegicus*
–	common spiny lobster	langouste rouge	aragosta mediterranea	awwista	langosta común	*Palinurus elephas*
–	deep-water pink shrimp	crevette rose du large	gambero rosa mediterraneo	gamblu bojot	gamba de altura	*Parapenæus longirostris*
A(L): gamberi kebir	camarote prawn	camarote	mazzancolla, gambero imperiale	–	langostino	*Penæus kerathurus*
–	striped soldier shrimp	crevette Edward	gobbetto striato	–	camarón soldado	*Plesionika edwardsii*
–	golden shrimp	crevette doré	gobbetto liscio, gobbetto dorato	–	camarón marcial	*Plesionika martia*
A(L): shcala	Mediterranean locust lobster	grande cigale	cicala grande, magnosa	–	cigarra	*Scyllarides latus*
–	spottail mantis shrimp	squille ocellé	pannocchia, cannocchia	–	galera ocelada	*Squilla mantis*

Important species – <u>molluscs</u>

Common names						Scientific name
Arabic	**English**	**French**	**Italian**	**Maltese**	**Spanish**	
–	tuberculate cockle	bucarde tuberculée	cuore rosso	–	corruco	*Acanthocardia tuberculat**a***
–	striped venus	petite praire	vongola comune	–	chirla	*Chamelea gallina*
–	truncate donax	flion tronqué	arsella troncata	–	coquina	*Donax trunculus*
–	horned octopus	poulpe blanc	moscardino bianco	–	pulpo blanco	*Eledone cirrhosa*
–	musky octopus	élédone, poulpe musquée	moscardino muschiato	–	pulpo almizclado	*Eledone moschata*
–	broadtail squid	encornet rouge	totano	–	pota voladora	*Illex coindetti*
–	Mediterranean mussel	Moule méditerranéenne	mitilo comune	–	mejillón mediterráneo	*Mytilus galloprovincialis*
A(L): garnet	common octopus	pieuvre	polpo comune	garnita	pulpo común	*Octopus vulgaris*

–	great Mediterranean scallop	coquille St-Jacques de Méditerranée	cappasanta comune	–	concha de peregrino del Mediterráneo	*Pecten jacobæus*
–	grooved carpetshell	clovisse, palourde croisé	vongola verace	–	almeja fina	*Ruditapes decussatus*

A(L): sebia	common cuttlefish	seiche commune	seppia comune	sicca	choco	*Sepia officinalis*
–	European flying squid	toutenon commun	totano viola	totlu	pota europea	*Todarodes sagittatus*

Moderately important species – fishes

Common names						Scientific name
Arabic	**English**	**French**	**Italian**	**Maltese**	**Spanish**	
–	transparent goby	nonnat	rossetto	–	chanquete	*Aphia minuta*
–	bigscale sand smelt	joël	latterino capoccione	–	pejerrey	*Atherina boyeri*
A(L): bougah	bogue	bogue	boga	vopa	boga	*Boops boops*
–	Atlantic pomfret	grande castagnole	pesce castagna	–	japuta	*Brama brama*
–	gulper shark, commun	squale-chagrin	centroforo comune	zaghrun	quelvacho	*Centrophorus granulosus*
–	Mediterranean flyingfish	exocet méditerranéen	rondone di mare	–	juriola	*Cheilopogon heterurus*
–	red gurnard	grondin rouge	capone coccio	–	arete	*Chelidonichthys* (ex-*Aspitrigla) cuculus*
A(L): bugrah bahar	common stingray	pastenague commune	pastinaca	–	raya látigo común	*Dasyatis pastinaca*
A(L): dendichi	common dentex	denté commun	dentice	dentici	dentón	*Dentex dentex*
–	spotted seabass	bar tacheté	spigola macchiata	–	baila	*Dicentrarchus punctatus*
A(L): sbarus	annular seabream	sparaillon commun	sarago sparaglione	–	raspallón	*Diplodus annularis*
–	common two-banded seabream	sar à tête noire	sarago fasciato	–	sargo mojarra	*Diplodus vulgaris*
A(L): rzam	little tunny (tuna)	thonine commune	tonnetto	kubrita	bacoreta	*Euthynnus alleteratus*
–	shore rockling	motelle de Méditerrannée	motella mediterranea	–	bertorella	*Gaidropsarus mediterraneanus*
–	three-bearded rockling	motelle commune	motella maculata	–	lota	*Gaidropsarus vulgaris*
–	Mediterranean sand eel	cicerelle	cicerello	–	barrinaire	*Gymnammodytes cicerellus*
–	sharpnose seven-gill shark	requin perlon	squalo manzo	–	cañabota bocadulce	*Heptranchias perlo*
–	bluntnose six-gill shark	requin-griset	squalo capopiatto	—	cañabota gris	*Hexanchus griseus*
A(L): abukheder	brown wrasse	merle	tordo nero	–	merlo	*Labrus merula*
–	golden grey mullet	mulet doré	cefalo dorato, cefalo lotregano	–	galupe	*Liza aurata*
–	thinlip mullet	mulet porc	cefalo calamita	–	morragute	*Liza ramada*
–	whiting	merlan	merlano, molo	–	plegonero	*Merlangius merlangus euxinus*

A(L): buri	flathead grey mullet	mulet à grosse tête	cefalo comune	–	pardete	*Mugil cephalus*
–	smoothhound	émissole lisse	palombo comune	–	musola	*Mustelus mustelus*
A(L): kahla	saddled seabream	oblade	occhiato	kahlija	oblada	*Oblada melanura*
–	wreckfish	cernier commun	cernia di fondale	dott, hanzir	cherna	*Polyprion americanus*
A(L): magres	bluefish	tassergal	pesce serra	–	anjova	*Pomatomus saltatrix*
–	turbot	turbot	rombo chiodato	–	rodaballo	*Psetta maxima*
–	white skate	raie blanche	razza bianca	–	raya bramante	*Raja alba*
–	starry ray	raie étoilée	razza stellata	–	raya estrellada	*Raja asterias*
–	brill	barbue	rombo liscio	–	rémol	*Scophthalmus rhombus*
–	nursehound	grande roussette	gattopardo	–	alitán	*Scyliorhinus stellaris*
–	Senegalese sole	sole du Sénégal	sogliola del Senegal	–	lenguado senegalés	*Solea senegalensis*
–	European barracuda	bécune européenne	luccio marino, barracuda	–	espetón	*Sphyræna sphyræna*
A(L): mughzel asfar	yellowmouth barracuda	bécune bouche jaune	barracuda bocca gialla, luccio boccagialla	–	espetón boca amarilla	*Sphyræna viridensis*
–	smooth hammerhead	requin-marteau commun	pesce martello	kurazza	cornuda cruz	*Sphyrna zygæna*
–	picarel	picarel	zerro	arznella	caramel	*Spicara smaris*
A(L): tannut	black seabream	dorade grise	tanuta	–	chopa	*Spondyliosoma cantharus*
A(L): abushoka	piked dogfish	aiguillat commun	spinarolo	mazzola	mielga	*Squalus acanthias*
A(L): sfen	angelshark	ange de mer commun	squadro	–	angelote	*Squatina squatina*
–	greater weever	grande vive	tragina drago	–	escorpión	*Trachinus draco*
–	grey gurnard	grondin gris	capone corno	gallina	borracho	*Trigla (ex-Eutrigla) gurnardus*
–	poor cod	capelan	merluzzetto	–	capellán	*Trisopterus minutus capelanus*
–	canary drum	ombrine bronze	ombrina delle Canarie	–	verrugato de fango	*Umbrina canariensis*
A(L): baghlah	shi drum	ombrine côtière	ombrina	–	verrugato fusco	*Umbrina cirrosa*
–	stargazer	uranoscope	pesce prete	–	miracielo	*Uranoscopus scaber*
–	pearly razorfish	donzelle lame	pesce pettine	–	raó	*Xyrichthys novacula*
–	John dory	Saint-Pierre	pesce San Pietro	pixxi San Pietru	pez de San Pedro	*Zeus faber*

Moderately important species – <u>crustaceans</u>

Common names						Scientific name
Arabic	**English**	**French**	**Italian**	**Maltese**	**Spanish**	
–	Mediterranean shore crab	crabe vert de la Méditerranée	granchio comune, granchio ripario, moleca	–	cangrejo mediterráneo	*Carcinus æstuarii*

Moderately important species – molluscs

Common names						Scientific name
Arabic	**English**	**French**	**Italian**	**Maltese**	**Spanish**	
–	purple dye murex	murex-droite épine	murice spinoso	–	cañailla	*Bolinus brandaris*
–	smooth callista	vernis fauve	fasolaro	–	almejón	*Callista chione*
–	European squid	encornet	calamaro comune	klamaru	calamar	*Loligo vulgaris*
–	common mussel	moule commune	mitilo atlantico	–	mejillón	*Mytilus edulis*
–	changeable nassa	nasse-ceinture	lumachina di mare	–	mugarida lisa	*Nassarius mutabilis*
–	banded murex	murex tuberculé	murice troncato	–	búsano	*Phyllonotus trunculus*
–	golden carpetshell	clovisse (palourde) jaune	vongola gialla	–	almeja dorada	*Venerupis aurea*
–	banded carpetshell	palourde rose	vongola rombo	–	almeja rubia	*Venerupis rhomboides*
–	warty venus	praire commune	tartufo	–	escupiña grabada	*Venus verrucosa*

Not important species – fishes

Common names						Scientific name
Arabic	**English**	**French**	**Italian**	**Maltese**	**Spanish**	
–	allis shad	alose vraie	alosa	lacca	sábalo común	*Alosa alosa*
–	Mediterranean sand smelt	sauclet	latterino	–	chucleto	*Atherina hepsetus*
A(L): hallouf	grey triggerfish	baliste-cabri	pesce balestra	–	pez ballesta	*Balistes carolinensis*
A(L): yebrah	garfish	orphie	aguglia	–	aguja	*Belone belone gracilis*
A(L): sawro imbriali	blue runner	carangue coubali	carango mediterraneo	–	jurel azúl	*Caranx crysos*
A(L): sawro asfar	false scad	comète coussut	carango ronco	–	jurel real	*Caranx rhonchus*
–	spinner shark	requin-tisserand	squalo tessitore	–	tiburón aleta negra	*Carcharhinus brevipinna*
–	silky shark	requin soyeux	–	–	tiburón jaquetón	*Carcharhinus falciformis*
–	dusky shark	requin sombre	squalo scuro	–	tiburón arenero	*Carcharhinus obscurus*
–	sandbar shark	requin gris	squalo grigio	–	tiburón trozo	*Carcharhinus plumbeus*
A(L): joghali	pink dentex	gros denté rose	dentice corazziere	–	sama de pluma	*Dentex gibbosus*
A(L): mennani	white grouper	mérou blanc	cernia bianca	–	cherna de ley	*Epinephelus æneus*
–	golden grouper	mérou badèche	cernia dorata	dott	falso abadejo	*Epinephelus alexandrinus*
A(L): khanzirah	dogtooth grouper	mérou gris	cernia nera	–	cherna dentón	*Epinephelus caninus*
A(L): zemrina	Mediterranean moray	murène de la Méditerrannée	murena	morina	morena	*Muræna helena*
–	starry smooth-hound	émissole tachetée	palombo stellato	–	musola coronada	*Mustelus asterias*
–	blackspotted smoothhound	émissole pointillé	palombo punteggiato	–	musola punteada	*Mustelus punctulatus*
A(L): dooth yahudi	comb grouper	mérou royal	cernia rossa	–	gitano	*Mycteroperca rubra*
A(L): lalaja	pilot fish	poisson-pilote	pesce pilota	fanfru	pez piloto	*Naucrates ductor*

–	flounder	flet	passera nera	–	platija	*Platichthys flesus flesus*
–	plaice	plie	passera	–	solla	*Pleuronectes platessa*
–	skate	pocheteau gris	razza bavosa	–	noriega	*Raja batis*
–	blonde ray	raie lisse	razza a coda corta	–	raya boca de rosa	*Raja brachyura*
–	thornback ray	raie bouclée	razza chiodata	–	raya de clavos	*Raja clavata*
–	shagreen ray	raie chardon	razza spinosa	–	raya cardadora	*Raja fullonica*
–	brown ray	raie-miroir	razza quattrocchi	–	raya de espejos	*Raja miraletus*
–	spotted ray	raie douce	razza maculata	–	raya pintada	*Raja montagui*
–	cuckoo ray	raie fleurie	razza cucolo	–	raya santiaguesa	*Raja naevus*
–	longnosed skate	pocheteau noir	razza monaca	–	picón	*Raja oxyrinchus*
–	speckled ray	raie tachetée	razza polistimma	–	raya manchada	*Raja polystigma*
–	rough ray	raie-râpe	razza scuffina	–	raya áspera	*Raja radula*
–	undulate ray	raie brunette	razza ondulata	–	raya mosaico	*Raja undulata*
A(L): shelba	salema	saupe	salpa	xilpa	salema	*Sarpa salpa*
A(L): ghrab	brown meagre	corb commun	corvina	–	corvallo	*Sciaena umbra*
A(L): palamet yamani	narrow-barred Spanish mackerel	thazard rayé	–	–	carite estriado del Indo-Pacífico	*Scomberomorus commerson*
A(L): serran	comber	serran-chèvre	perchia	sirrana	cabrilla	*Serranus cabrilla*
–	brown comber	serran-tambour	sacchetto	–	merillo	*Serranus hepatus*
–	painted comber	serran-écriture	sciarrano	–	serrano	*Serranus scriba*
A(L): batata	dusky spinefoot	sigan sombre	sigano scuro	–	sigano nebuloso	*Siganus luridus*
–	Egyptian sole	sole égyptienne	–	–	suela egipcia	*Solea ægyptiaca*
A(L): ghazla	parrotfish	perroquet-vieillard	scaro	–	vieja colorada	*Sparisoma cretense*

Not important species – <u>others</u>

Common names						Scientific name
Arabic	**English**	**French**	**Italian**	**Maltese**	**Spanish**	
–	Sardinia coral	corail Sardaigne	corallo rosso	–	coral de Cerdeña	*Corallium rubrum*
A(L): sfenj	honey comb	éponge commun	spugna da cavallo, spugna cavallina	–	esponja común	*Hippospongia communis*
–	sea fig	figue de mer	microcosmo gigante, limone di mare polimorfo	–	provecho	*Microcosmus sabatier*
–	sandworm	néréide commune, pelouse	–	–	gusana	*Nereis* spp.
–	stony sea urchin	oursin-pierre	riccio di mare di roccia, arbacia	–	erizo de mar	*Paracentrotus lividus*

ANNEX II

The principal heavy metals in the marine environment, their sources and their effects

Name	Sources to the environment	Effects/impacts
Cadmium	by-product of copper refining, lead processing and production of alloys, pigments and PCBs; electroplating; solders; batteries; sewage sludges	enters the human body mainly via the food (notably crustaceans and molluscs), but only about 5% is absorbed into the bloodstream; its main (adverse) effect is on the kidney and the liver; the principal effect of long-term cadmium contamination on marine organisms is growth inhibition/delayed development
Mercury	rocks (mainly as sulphide ores); degassing (of elemental mercury) from the Earth's crust and oceans; volcanoes; chlor-alkali plants; petrochemical industry; waste incineration and coal-burning; metal processing; sewage outfalls; inorganic mercury is also converted to methylmercury by micro-organisms	bioaccumulates with increasing age of an organism, but with strong variation among species; absorbed, especially in the methylated form, in the intestine and widely distributed in the tissues (brain and nervous system being the organs most affected); high concentrations in flesh of red mullet (*Mullus barbatus*) from the Tyrrhenian Sea, thus justifying concern from the human-health standpoint; tunas also have naturally high levels, but pose no significant health problems unless consumed abundantly and continually
Lead	mining; smelting; by-product of steel-making and production of alloys; batteries; pigments; leaded petrol	taken in mainly with food and water, but some is absorbed through the lungs; at effective concentrations in the tissues it causes anæmia and degrades brain and nervous-system function, especially in children; the gastrointestinal tract and the liver are also affected, and there may be some hormonal dysfunction; the effects on marine organisms are poorly known still
Tin	antifouling additive in marine paints; fungicides, acaricides, molluscicides, antihelminthics; wood and stone preservatives; disinfectants; stabilisers in PVC plastics; catalysts in the production of silicones, polyurethanes etc.; main pathway is leaching from treated cooling pipes and vessel (especially yacht) hulls into the ambient water	as triethyl-tin and trimethyl-tin it is a neurotoxin in human beings and may cause shell-thickening or other shell malformation in oysters
Copper	mining; alloys; metal plating; electricals; catalysts; jewellery; algicides; wood preservatives	appears to present no hazard to human beings or marine organisms, at least at the levels likely to be found in sea water or sea food
Zinc	smelting; alloys; by-product of steel-making; metal-plating and galvanizing; paints and dyes; batteries; production of organic chemicals and viscose-rayon; oil refining; fertilisers; paper pulp	little known of the effects of zinc on marine organisms
Arsenic	by-product or waste of non-ferrous metal processing (copper, zinc, lead, gold and cobalt), of fossil-fuel burning and the processing of phosphate rock and bauxite (for aluminium)	bioaccumulates only slowly and normally presents little risk to human consumers of sea food containing arsenic in small concentrations; it is somewhat toxic to phytoplankton, reducing the growth, in some species, and the productivity, leading to modification of the phytoplankton composition which may have a "knock-on" effect on the zooplankton community and on fish, such as sardines

ANNEX III

Endangered species in the context of the Mediterranean region

The species considered to be endangered differ somewhat from one piece of international legislation to another. The two texts of greatest relevance are the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES, 1973) and the Protocol on Specially Protected Areas and Biological Diversity of the Barcelona Convention for the Protection of the Mediterranean Sea against Pollution (1976, amended in 1995). A supplementary text, the European Union Habitats Directive, Annex II lists "Priority species". The principal relevant species with respect to the Mediterranean (though not limited to the western Mediterranean) in these lists are:

Group	Species and justification
Sea weeds	
	The brown sea weeds, *Cystoseira stricta* and *Cystoseira mediterranea*, which provide a living space suitable for several species of fish and shellfish, are highly susceptible to the discharge from sewage outfalls.
Sea grasses	
	Neptune grass, *Posidonia oceanica*, and eel-grass, *Zostera marina*, whose beds not only contribute to the primary production, but also provide important nursery areas for many species of fish and shellfish of commercial or ecological value; such beds are, in certain areas, greatly damaged by trawling, dredging (for benthic fish or shellfish or for sand for construction) and the anchoring of numerous pleasure craft outside established ports and marinas.
Molluscs	
	The European date mussel, *Lithophaga lithophaga*, is a much sought food item in the restaurant trade in some countries (e.g. Italy); since it is a rock borer, coastal rock formations are, in some places, badly degraded by the fishery for this species. The ferrous limpet, *Patella ferruginea*, although comparatively rare, is also sought as a human food item, which helps to make it an endangered species. The noble pen shell, *Pinna nobilis*, is eaten or used for bait and has been subject to overfishing for many years for these purposes.
Fishes	
	The Adriatic sturgeon, *Acipenser naccarii*, is very rare in the Adriatic Sea, and the sturgeon, *Acipenser sturio*, is heavily exploited for its flesh and caviar, especially since the environmental quality of the Black Sea has declined considerably in recent decades The basking shark, *Cetorhinus maximus*, has become increasingly fished in recent years and is now endangered. The sea horses, *Hippocampus hippocampus* and *H. ramulosus* are heavily exploited for the aquarium trade. The great white shark, *Carcharodon carcharias*, in common with other shark species, is being fished with great intensity for food (fins) and liver oil The fartet, *Aphanius iberus*, is a coastal-lagoon fish seriously threatened in lagoons along the French and Spanish Mediterranean coasts, as the human pressure on these biotopes (living spaces) grows relentlessly. The samarugo o samaruch, *Valencia hispanica*, is also a coastal-lagoon fish affected like *Aphanius iberus*.
Reptiles	
	The green turtle, *Chelonia mydas*, is endangered in the Mediterranean because it requires undisturbed beaches on which to lay its eggs then to allow them to incubate; at present, it nests only on beaches in southern Turkey and northern Cyprus. It is highly vulnerable to commercial fishing, often being taken incidentally or being the object of fishery itself for its flesh and carapace (tortoiseshell). It migrates extensively within the Mediterranean Sea. The loggerhead turtle, *Caretta c. caretta*, is likewise endangered in the Mediterranean; it currently nests on Greek, Turkish, Cypriot, Israeli, Egyptian, Libyan and Tunisian beaches and, like the green turtle, is highly vulnerable to commercial fishing, whether taken incidentally or for its flesh and carapace; it also migrates extensively within the Mediterranean Sea. The leatherback turtle, *Dermochelys coriacea* does not reproduce in the Mediterranean proper, but is endangered throughout its distribution in the Atlantic, including the Mediterranean, notably from fishing and habitat loss for reproduction.

Birds	
	The Audouin sea gull, *Larus audouinii*; the white pelican, *Pelecanus onocrotalus*; the Dalmatian pelican, *P. crispus*; the shag, *Phalacrocorax aristotelis*; the pygmy cormorant, *Phalacrocorax pygmaeus*; and the Yelkouan shearwater, *Puffinus yelkouan*; all are considered to be threatened within their European area of distribution, so the Mediterranean region has some responsibility for ensuring their survival.
Mammals	
	The monk seal, *Monachus monachus*, is particularly adversely affected by the loss, due to development, of the coastal habitat which it needs for resting, mating and rearing its young; it is also subject to accidental, if not also intentional, capture, and is adversely affected by marine litter in the form of plastics (bags and pieces of styrofoam) which are mistaken for food organisms and eaten, often blocking the oesophagus and stomach, and polyethylene or monofilament nylon cord (from fishing netting) which may throttle it (as it grows) or severely impede its movements. The fin whale, *Balænoptera physalus*, which is also much exploited outside the Mediterranean as well, is mainly adversely affected by intentional fishing; it is also adversely affected by large-scale commercial fishing on its prey species (small pelagic fishes and squids, and small crustaceans, in particular). And, like seals, it is also affected by the ingestion of plastics and ensnarement by remains of fish netting and plastic packaging. Marine noise (from pleasure craft and commercial vessels) is thought to hamper its sonic communication systems significantly. The common dolphin, *Delphinus delphis*, is adversely affected by accidental fishing (high susceptibility to capture by large purse seines used to catch tuna, with which dolphins are frequently associated); otherwise, it is adversely affected in much the same way as the fin whale The bottlenose dolphin, *Tursiops truncatus*, is also adversely affected by the ingestion of plastics, ensnarement by remains of fish netting and plastic packaging and by marine noise. The harbour porpoise, *Phocoena phocoena*, is affected in the same way as the bottlenose dolphin.

ANNEX IV

The principal interactions amongst the main users of the coastal zone

The socio-economic interactions (mostly negative) are indicated in the top-right part of the table, above the "diagonal", and best read from the column headings. The ecological interactions (which are mostly between the users, on one side, and the environment, on the other) are in the bottom-left part of the table, below the "diagonal", and best read from the row headings. In some cases, possible interactions within the user category itself are indicated (in italics) in these cells; in other cases, there is no evidently serious direct interaction (and this is marked by –).

Economic aspects ⇒ **Ecological aspects ⇓**	**Urban development**	**Tourism +recreation**	**Domestic and industrial waste disposal**	**Agriculture**	**Marine mining**	**Shipping**	**Fishery +mariculture**
Urban development	*Urban development may become self-defeating unless carefully managed*	Tourism and urban development compete for land	Waste disposal and urban development compete for land and discharge facilities	Agriculture and urban development compete for land	Marine mining may lead to amenity loss, to the detriment of urban development	Shipping and urban development compete for space (for or against port facilities)	Fisheries supply coastal population with food
Tourism +recreation	Habitat loss, degradation of coastal environment	*Tourism may become self-defeating unless carefully managed*	Waste disposal and tourism compete for land and discharge facilities	Agriculture and tourism compete for land	Marine mining may lead to amenity loss, to the detriment of tourism	Merchant ships and pleasure craft compete for berthing; amenity loss due to oil spills and antifouling paint	Fisheries and tourism compete for land for ports and for facilities; fisheries feed tourists
Domestic and industrial waste disposal	Habitat loss, degradation of coastal environment and sea bed	Habitat loss, degradation of coastal environment	*Urban and industrial waste disposal still mainly handled separately, therefore in competition for facilities*	Agriculture and waste disposal compete for land and waste-disposal facilities	–	–	Fisheries (including mariculture) may compete for coastal sites, or there may be undesirable proximity
Agriculture	Natural habitat loss, degradation of coastal environment	Natural habitat loss, degradation of coastal environment	Natural habitat loss, degradation of coastal and marine environment		–	–	Fisheries and agriculture compete for markets
Marine mining	Natural habitat loss, degradation of coastal and marine environment and sea bed	Natural habitat loss, degradation of coastal and marine environment	Natural habitat loss, degradation of coastal and marine environment	Natural habitat loss, degradation of coastal and marine environment		–	Fisheries and mining may compete for suitable seabed
Shipping	Natural habitat loss, degradation of coastal and marine environment	Natural habitat loss, degradation of coastal and marine environment	Natural habitat loss, degradation of coastal and marine environment	Natural habitat loss, degradation of coastal and marine environment	Natural habitat loss, degradation of coastal and marine environment	*Demand for berthing facilities leads to port development*	Fishing and merchant vessels may compete for berthing facilities and sea space
Fishery +mariculture	Natural habitat loss, degradation of coastal and marine environment and sea bed	Natural habitat loss, degradation of coastal and marine environment and sea bed	Untreated waste (excess pollutants etc.) may affect fish adversely	Agricultural waste may affect fish adversely (pesticides etc.) or positively (fertilizers)	Natural habitat loss, degradation of coastal and marine environment and sea bed	Natural habitat loss, degradation of coastal and marine environment	*Artisanal and industrial fisheries and mariculture may compete physically and economically*

Artisanal fisheries are found all along the coasts of the COPEMED region, strongly obliging them to act in an uncoordinated manner, without effective associations to represent them and to make known their real problems as an important coastal community. This book has been conceived to expose to a wide public the problems of the artisanal fisheries, the obstacles to their development, and some possible avenues for such development.