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Abstract

The aim of this paper is to give a description of the Mediterranean fisheries, and its level of exploitation and to address the main questions dealing with its management. The Mediterranean is a semi-enclosed marine area with generally narrow continental shelves. The primary production of the Mediterranean is among the lowest in the world (26-50g C m-2 y-1). The Mediterranean fisheries can be broken down into three main categories: small scale fisheries, trawling and seining fisheries, which operated on demersal, small pelagic and large pelagic resources. After a general description of the state of the resources in the different areas of the Mediterranean it is concluded that (a) the overall pictures from the western to the eastern Mediterranean are not considerably different, (b) the total landings in the Mediterranean have been increased the last decades, and (c) from the perspective of stock assessment, the very few available time series data show stable yield levels. In general fisheries management in the Mediterranean is at a relatively early stage of development, judging by the criteria of North Atlantic fisheries. Quota systems are generally not applied, mesh-size regulations usually are set at low levels relative to scientific advice, and effort limitation is not usually applied or, if it is, is not always based on a formal resource assessment. The conservation/management measures applied by the Mediterranean countries can be broadly separated into two major categories: those aiming to keep the fishing effort under control and those aiming to make the exploitation pattern more rational. The most acute problems in the management of the Mediterranean resources are the multispecificity of the catches and the lack of reliable official statistics.

Keywords: Mediterranean, Fishery, Biological Resources.

Introduction

The Mediterranean is a semi-enclosed marine area with generally narrow continental shelves. With the exception of the Adriatic Sea, the Gulfs of Lion and Gabes, in the rest of the areas the levels of biological production is considered low. The area is connected with the Atlantic Ocean and the Black and Red Sea through narrow straits or channels that limit the exchange of water among the bodies of water they interconnect. The Mediterranean Sea is divided into a western and an eastern basin by a sill at a depth of about 400m extending from Sicily to the north African coast.

Nutrient-poor, but well oxygenated surface waters enters from the Atlantic across a narrow sill through the Straits of Gibraltar. This water is replaced by Levantine intermediate water and Mediterranean deep water flowing from east to west and spilling over the sill of Gibraltar into the deep Atlantic. The Mediterranean Sea as a whole has been referred to as an "evaporation basin", since surface evaporation, particularly in the Levantine region, accounts for this net inflow, and more than compensates for the inflow of lower salinity water from the Black Sea rivers and other freshwater inflows dominated by the discharges, principally of the rivers Po, Rhone, Nile and Ebro. The surface salinity of the Mediterranean range from about 36.2‰ in the western to about 39.2‰ in the eastern part of the Sea. The Mediterranean lacks, in general, the strong currents and good vertical mixing that renews the nutrients in the surface waters. Instead, the water masses show a marked vertical stratification which is one of the reasons for the low biological production.

The biological productivity of the Mediterranean is among the lowest in the world. Average primary production in the western basin corresponds to an assimilation of 50g Cm^{-2} y^{-1} (MARGALEF, 1985) whilst in the eastern basin the primary production amounts to about 26g Cm^{-2} y^{-1} (DUGDALE & WILKERSON, 1988). Primary productivity can, however, be unusually high at the mouths of the rivers and at urban centres. Concerning the eutrophication, the Mediterranean is well adapted to avoid eutrophication (MARGALEF, 1985). However, it is well known that a significant degree of eutrophication occurred in several coastal areas in the Mediterranean, due, mainly, to the development of the agriculture and to run off of anthropogenic nutrient materials (UNESCO, 1988). In particular, sewage discharge and nutrient run off, directly or via river systems, at high intensity, have local negative impacts on coastal fisheries, and are disastrous for coastal tourism and marine recreation. This has some significant impact on the local faunas and fisheries. Also, upwelling may occur, mainly during winter, in certain areas along the European coast, enriching and renewing the surface waters with nutrient salts accumulated in lower water layers. In contrast to the above picture of the oligotrophic Mediterranean, many coastal lagoons have high productivity, due, mainly, to the high level of eutrophication.

The addition of moderate levels of nutrients to a nutrient-limited system can be positive for fisheries, although concern is often expressed about its long-term implications, given the long retention time of Mediterranean water masses. This effect appears to have been responsible for high yields of fish from some sewage-contaminated lagoons, and is at least partially responsible for the dramatic increases in biomass of small pelagics that began in the 1970s in the Black Sea, although, in this water body, an accompanying decline of other valuable resources, such as turbot and of most pelagic predators, has also occurred (CADDY, 1990).

Mediterranean fisheries offer a great variability according to their location, their production methods as well as the adjustment of human communities to the environmental conditions. With an average production around 1.2 million tons for the most recent years (LEVI & TROADEC, 1974). These figures are known to be underestimated since, in several countries, statistics are usually obtained directly from fishermen for tax collection purposes or at selected official marketing points where not all of the fish landed pass through. Mediterranean fishing production represents a limited proportion of the world production, which is about 100 million tons. But, on the other hand, the average price of the products of this activity, intended almost exclusively to be consumed when fresh, are five to ten times higher than those in most other regions of the world. Besides, from the European point of view, Mediterranean fishing is far from being

marginal, since it represents nearly 20% by weight and 35% by the value of the Community's fishery production. In addition, aquaculture in cages or in coastal or brackish waters are very promising in the Mediterranean; which should be taken into consideration when assessing the economic importance of the fish resources in the area.

The aim of this paper is to give a brief updated description of the Mediterranean fisheries, and of its level of exploitation and to address the main questions dealing with its management.

The fleet

The Mediterranean fisheries can be broken down into three main categories: small scale fisheries, trawling and seining fisheries.

The term "small-scale fisheries", attempting to integrate aspects of the "coastal" and "artisanal" fisheries and to avoid the vagueness, inconsistencies and differences of previous definitions, is virtually absent from the official terminology of the most Mediterranean countries. This term was introduced at first in 1990 by the European Commission, when the Commission presented a proposal (COM(90) 358 final of 7 September 1990) to amend Regulation 4028/86 on measures to improve and adapt structures in the fisheries and aquaculture sector (Anonymous, 1990). Official statistics of 1989-1990 for the small-scale fisheries suggests that in the EU countries operate 41900 units, of which 46%, 39%, 8% and 7% are registered to Greece, Italy, Spain and France respectively (FARRUGIO, 1996).

Most of the trawlers could be considered as semi-industrial or industrial vessels, taking into account the international practice. Trawls are widely used in the Mediterranean and there are two main types: (a) bottom, and (b) pelagic trawlers.

Seine nets (purse seines) are one of the main types of fishing gear used in the Mediterranean. The purse-seiners are distinguished into two major types: purse-seiners operating during the day and purse-seines operating at night. There are no significant differences between the two types as far as equipment and vessel construction are concerned. The difference is that they employ a different fishing methodology, and their activities focus on different species. Concerning the number of the "semi-industrial" fishing vessels, mostly trawlers and purse-seiners, operating in the EU ports, it has been estimated to be about 4300 vessels of which 45%, 32%, 17% and 6% are registered to Italy, Spain, Greece and France respectively (FARRUGIO, 1996).

Description of the mediterranean living resources

Demersal resources

Demersal resources consist of those organisms which live and feed close to the seabed. Most commercial species belong to this group. A number of these species are clearly coastal, i.e. grey mullets, sea breams, sea bass, some shrimps (*Grangon crangon*), and many molluscs. The exploited depth range is usually from 10 to 800m, but mainly up to 400m. The upper zones of the continental shelf are inhabited by the following species, i.e. red mullets (*Mullus barbatus, Mullus surmuletus*), sole (*Solea solea*), gurnards (*Trigla* sp.), poor cod (*Trisopterus minutus capelanus*), Black Sea whiting (*Merlangius melrangus euxinus*), common spiny lobster (*Palinurus elephas*) and the triple-grooved shrimp (*Penaeus kerathurus*). On the continental slope there are many fish species of great economic interest. Thus in the upper part of the slope (200 and 400m) there are hake (*Merluccius merluccius*), flatfishes (*Lepidorhombus boscii, Citharus linguatula*), Norway lobster (*Nephrops norvegicus*) etc and various shrimps (e.g *Peneus longirostris*). In deeper waters, from 400 to 600m, the dominant species are the greater forkbread (*Phycis blennoides*), the blue whiting (*Micromesistius poutassou*) and the red

shrimps (*Aristeus antennatus, Aristaemorpha foliacea*). The vertical distribution of the hake (*Merluccius merluccius*) and *Lophius* sp. that presented specimens of different age groups that are distributed from 30 to almost 800m is quite interesting. Many different gears are used to exploit these species, including bottom trawlers, gill-nets, trammel nets, traps, bottom longlines and a variety of drags.

On the basis of the available data most of the demersal stocks are either fully exploited, or overexploited. The available models can only lead to foretell a passage to a state of overfishing, in the best case, if the general tendency to a growing effort of the various fishing activities was carried on according to the pattern prevailing during the recent past.

In most of the cases a decreasing trend in individual lengths of the fish caught and in the catches per unit of effort of the trawlers can be observed. In general, the juveniles are under the most important fishing pressure. This results essentially from the fact that the sizes at first catch are very often similar to those at which fishes appear in the fisheries (recruitment). The artisanal fleets affect more the adult population, even though there is some degree of overlap.

An evolution can be noted in the general production statistics of the demersal fisheries; it seems that the general fish production of the Mediterranean is increasing, and perhaps more than we can deduce from the official statistics. Recent data show that the general production of the Mediterranean has increased about 50% from 1977 up to now. This increase seems to be due partly to some corrections on catch statistics; it could also be due to a movement away from the original oligotrophic condition of the Mediterranean to a more mesotrophic productive condition.

Small pelagic stocks

Most of the small pelagic species are in general distributed close to the coast, over the continental platform. The majority of these species undertake rather well defined seasonal migrations, which explains the seasonal character of their fisheries. Sardine, anchovy, mackerel and horse mackerel move close to the coast during the summer months, which corresponds to the main fishing period of these species for the Mediterranean. All the above species during the winter are moving away from the coast and shift to more or less deeper waters.

Large-scale fluctuations in stock size occur for small pelagic resources which are as yet unexplained by science. It is presumed from the general similarity of such changes in several areas that they are environmentally driven, although the decline of some anchovy fisheries may suggest that this highly sought species is also subjected to excessive fishing. For most other small pelagic species, including the sardine, the existing assessments indicate that they do not seem to be fully exploited everywhere (this situation is likely to be related to difficulties in achieving effective utilisation and marketing).

Large pelagic stocks

This category is comprised of large fish which live near the surface, and which are migratory and gregarious. Swordfish, tuna, and pelagic sharks are included in this group. Regarding the large pelagic species, the Mediterranean provided on an average, from 1983 to 1992, 65000 tons of tunas and billfishes, i.e. 8% of the overall Mediterranean yearly catches. Among these stocks, bluefin tuna is considered as fully exploited and juveniles of this species are submitted to a heavy fishing pressure. The Mediterranean is an important spawning area from several tuna species, and bluefin tuna in particular. A main problem about the stock structure of this species is to estimate the migration rates between the Mediterranean and the Atlantic, but the available data are

insufficient to quantitatively estimates the migratory rates. It seems that the Mediterranean swordfish and albacore constitute two stocks which are relatively isolated from the northern Atlantic ones.

The evaluation of the state of the tuna and the associated species in the Mediterranean have principally been carried out on the bluefin tuna, since no other species can be analysed at the present time, due to the lack of ad hoc biological and statistical data. Concerning the bluefin tuna, the increasing trend of the catches, observed during the last thirty years, is mainly the result of a constantly increased fishing effort. As for the demersal catches, a better submission of catch statistics is also partly a cause for this trend. The statistics also show the existence of massive and systematic catches of juvenile bluefin tuna which are extremely negative for the stock productivity. Despite this "alarming" situation and the almost total absence of rational management measures, the relatively satisfactory health of the Mediterranean bluefin tuna resources constitutes a surprising paradox and is not well explained by the scientists.

The state of the resources

Periodical updating of the research activities dealing mainly with demersal and small pelagic Mediterranean living resources and fisheries have been realised by GFCM (General Fisheries Council for the Mediterranean) since 1970, during working group occasions and technical consultations at a regional level. OLIVER (1983) reviewed the fisheries resources and activities in the Western Mediterranean giving information on the state of the stocks, the production, the landings etc. The scientific knowledge of large pelagic stocks and fisheries is annually updated for more than 20 years by ICCAT (International Commission for the Conservation of Atlantic Tunas). Furthermore, a detailed review has been prepared for the EU Diplomatic Conference on Fisheries Management, held in Crete in 1994 (CADDY, 1996) and in Venice two years later, in 1996 (FARRUGIO, 1996; TSIMENIDES, 1997), as well as in the meeting held in Crete for the Coordination of Fishery Research to the Eastern Mediterranean (OLIVER *et al.*, 1997). On the other hand, the FAO fisheries statistics database has been now updated until 1994 (FAO, 1995). All this allow to draw a fairly complete panoramic synthesis of the situation.

Time series of fishery landings can provide important indications for changes in a fishery, or changes to the underlying environment (CADDY, 1990). Often, as in the case of Mediterranean fisheries, this is essential in the absence of complete or independent information such as on the fishing intensity or fishing mortality affecting the stock. LLEONART (1997) describing the fisheries assessment methodology applied in the Mediterranean, concluded that the most fisheries research projects have a local contingency. The only exemption is the MEDITS programme (BERTRAND *et al.*, 1997), funded from EU and carried out by France, Greece, Italy and Spain, extended along the north coasts of the Mediterranean Sea since 1994. Fishery landings trends can provide the only indication about important changes that might have occurred in the past.

Based on different documents that have been submitted to the GFCM Technical Consultation, as well as on the 45 year time series of landings in the Mediterranean, some general observations can be reached for the West and East Mediterranean (FIORENTINI *et al*., 1997); (a) Despite some significant differences, the overall pictures from the West and the East Mediterranean are not strikingly different, (b) From the study of the trends, it is clear that a high proportion of species or species groups in both the West and East Mediterranean have shown increases in landings over the whole time period; either if these increases were linear, or concave upwards or concave, downwards, and (c) From the perspective of

Table 1
Comparison between percentage of resources in West and East Mediterranean showing different trends in landings (FIORENTINI *et al.*, 1997).

	NEW	RECOVERING	RISING	DOME-SHAPED	STABLE	DECLINING	INTERMITTED	COLLAPSED
WEST	11%	9%	33%	11%	3%	8%	25%	1%
EAST	12%	18%	41%	4%	5%	4%	17%	0%

stock assessment, very few time series show stable yield levels, suggesting a considerable dynamism caused by environmental and/or trophic or fishery-related impacts in the fisheries of the sub-region. Despite the long-term upward trends, the short- term trends over the last 5 years tell a different story. Roughly the same proportion has shown short-term declines and short-term increases over the last five years of the data series. One tentative deduction from this is that multispecies landings may now be approaching a peak for the Mediterranean as a whole; with new increases (especially in the South and East Mediterranean) being balanced by recent declines; especially in the West and North.

A comparison between West and East mediterranean fisheries

FIORENTINI *et al.*, (1997) based on trends in landings, have classified (Table 1) the long-term trends of different resources, species or group of species, in the two basins of the Mediterranean Sea (148 in the West and 137 in the East Mediterranean). As noted, this comparison suggests that these trends are in general fairly similar, and differences in percentages by category of trends between West and East trends rarely exceed 9%.

The following observation can be made:

(a) *New fisheries*: A number of species classified to the "new fisheries" in the above table are in fact a result of a more accurate division of former broader categories. Other "new" fisheries (like the clam *Donax* sp) have always been fished, but were only recently recorded separately from other shelfish in the statistics. Thus, few real "new fisheries" are identified in the period since 1950, and this is hardly surprising as the Mediterranean has been actively fished for centuries with a wide variety of gears.

(b) *Recovering fisheries*: Most species fall into this category in the East Mediterranean than in the West.

(c) "*Dome shaped*" and "*Intermittent*" *fisheries*: There is a greater proportion of resource trends in the West than in the East for these categories.

(d) *Rising fisheries*: This is the more frequent category in both parts of the Mediterranean, but it seems that the percentage is higher in the East.

(e) *Declining fisheries*: These only account for a small percentage, as judged from long-term trends, and are slightly more common in the West than in the East.

(f) *Collapsed fisheries*: No data sets fitted into this category in the Eastern Mediterranean, and only one species in the West, the Wedge sole (*Dicogologlosa cuneata*).

Coastal laggons and extensive Aquaculture

The increased fish production possibly due to a moderate degree of eutrophication of coastal lagoons has already been documented (KAPETSY, 1984), with eutrophic coastal lagoons supporting production figures of 400 or more kg/ha/yr, in contradiction to the "background" figure of 100-200/Kg/ha/yr, considered typical of non-nutrified coastal lagoons. We may therefore

expect that, while the 25000-30000 t/yr produced from lagoon fisheries (figures mainly from Greece, Italy, France, Spain, Tunisia and Turkey) might arise from nutrient inflows, there is also the potential and actual loss of productive coastal lagoons due to landfill, to excessive input of nutrients, and to overfishing.

Sectorial appraisal by GFCM divisions

The following sections on subregional fisheries are necessarily very brief, and depend heavily on FAO sources and data since 1991; CADDY & OLIVER (1996) describe in general the fishery production in the Mediterranean as follows:

(a) The general decline from west to east in production/shelf area is clear, with the notable exception of the Adriatic, where local nutrient runoff enriches nutrient-poor Mediterranean waters, which become progressively poorer to the east (MURDOCH & ONUF, 1972).

(b) Overall production trends have been upward in all areas, with the notable unexplained exception of the Sardinian Division, where a decline has been noted over the past three decades.

Balearic area *(Western Mediterranean GFCM Division 1.1)*

This division which includes Moroccan, Algerian and Spanish fisheries (Fig. 1), is an area of relatively high productivity, where purse-seiners and trawlers predominate. The small-scale inshore fishery is also well developed.

Assessments for demersal fishes and invertebrates have been reported at the GFCM and other regional fisheries bodies for most of the resources; including direct trawl and acoustic surveys, plus egg and larval surveys, and estimates based on catch sampling for size and age data (OLIVER, 1983). Time series of commercial catch and data effort are also available for a few species, and some production model estimates have been made. The available data suggest that the demersal stocks are fully or overexploited throughout the Balearic region.

Concerning the small pelagic, annual acoustic surveys have been carried out since 1982 on the Spanish continental shelf, and the Virtual Population Analysis was applied to sardine stocks. At least in the northern part of the division an underexploitation is observed on the stock of sardine, probably due to low market demand, and an increase in the species' biomass. On the contrary, with the exception of the Algerian shelf there has been a gradual intensification of exploitation of stocks of anchovy, which have shown some decline, resulting to an over exploitation trend.

Gulf of Lions *(Western Mediterranean GFCM Division 1.2)*

The Gulf of Lions (Fig. 1) is one of the areas with highest productivity in the Mediterranean, essentially exploited by the Spanish and French semi-industrial fleets (mainly trawlers, but also longliners and gillnetters). These fleets have reached approximately their present size at least a decade ago. Despite a limitation on number of licenses, fishing power continues to grow as technical innovations are introduced.

The available scientific data on the trawl fishery for most demersal species suggest that MSY conditions have exceeded the maximum values since 1991 (CADDY, 1990).

A highly developed small-scale fishery fishing inshore waters and lagoons takes a significant proportion of catches, and, a rare phenomenon in the Mediterranean region, has been investigated by biologists and socio-economists, and it has been proved to be a major component of the fishery in this region.

There has been a gradual intensification of exploitation by means of purse seiners and trawlers and a spectacular increase in

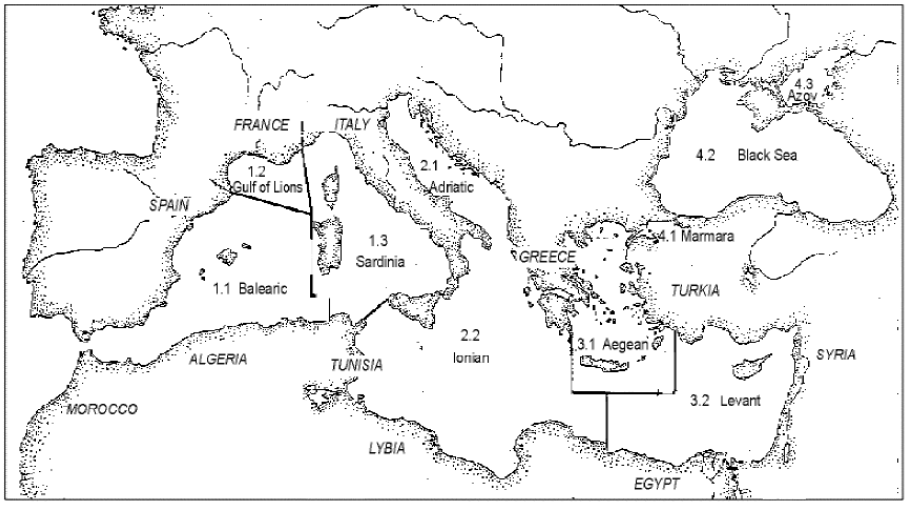

Fig. 1: GFCM's fishing divisions of the Mediterranean.

the anchovy catch from 300 tons in 1980 to 8000 tons in 1989; landings then fell to about 2000 tons in 1993.

Sardinia *(Western Mediterranean GFCM Division 1.3)*

This zone is characterised by water masses of generally low productivity (Fig. 1). Concerning the fish species, the area is mainly dominated by rocky bottom fish. The main activity of the Italian fleet in the area is located in the Tirrenian Sea, largely in the northern part. The small scale fleet represents more than 75% in number of vessels. The inshore fishery resources of the rocky northern Tunisian coast are fished by small scale vessels, and are considered by national authorities to be somewhat underexploited. The Tunisian authorities want to develop an offshore trawl fishery in the area.

A number of demersal resources have been assessed in the Ligurian and Tyrrhenian Seas, showing that the stocks of several important commercial species of fishes (hake, mullet, blue whiting etc) and crustaceans (Norway lobster, red shrimps) are at least fully exploited. The exploitation of small pelagic stocks is not important in this sector. The sardine and anchovy are the most important exploited species in the area, although no assessments have been made to determine their state of exploitation.

Adriatic Sea *(Western Mediterranean GFCM Division 2.1)*

This area (Fig. 1) consists of flat bottom covered by mud and sand and is extremely productive, due to strong nutrient outflow from incoming rivers, and from agricultural/ industrial and dense coastal populations, as well as receiving nutrient inflows of an apparently periodic nature from the Mediterranean itself. This combination occasionally leads to anoxic die-offs of demersal and benthic resources in the northern and western Adriatic, and is conductive to high productivity of molluscan shellfish and of small commercial invertebrates and fish of high commercial value.

The area is exploited by different fishing gears: trawls (pelagic and bottom), purse-seines, static nets and dredge fishery for clams in Italian waters. Up to 46% of the overall Italian trawling fleet was operating in the Adriatic Sea in 1986. Along the eastern part of Adriatic, the exploitation of the fishery resources has increased after 1990.

Assessment of demersal resources has

been carried out on most species of fishes using mainly trawl surveys and confirming that in late 1980's, the demersal resources were fully overfished. The clam fishery is or was, perhaps the most valuable fishery in the Mediterranean in terms of landed values, but it has suffered, in recent years, collapses of the key species apparently due to overfishing.

Total catches of anchovy, mainly fished in the Italian part, have fluctuated quite widely during the last decades. This species can be considered as at least fully exploited, but recent scientific studies, based mainly on biomass estimates and stock assessment, show a positive trend in the stock recovery. Regarding the sardine stocks all available evidence indicates that there have been no serious trends in level of stock biomass over the last 15 years.

Ionian Sea *(Central Mediterranean GFCM Division 2.2)*

This area can be considered as the most fishery productive of the Mediterranean after the Adriatic (Fig. 1). The continental shelf off Tunisia and the Sicily Channel support an important trawl fishery, predominated by industrial scale Italian vessels. In the northern shelf waters of Tunisia, exploitation of demersal resources by multipurpose vessels is believed to be below MSY levels, but the very intensive fishery in the southern waters of the Gulf of Gabes is clearly overexploiting key resources.

Assessment of the demersal resources has been carried out on the most commercial species, using mainly trawl surveys. The results of this research suggest a general state of full to over exploitation for several species, such as hake, rockfish, red mullet etc. An intense trawl effort in the Gulf of Gabes and other southern waters is aimed principally at shrimp (*Penaeus kerathurus*), but it is clear from production modelling that levels of effort corresponding to MSY were passed in 1988, by some 20%. Attempts, up to now, to divert effort towards less easily trawlable grounds off northern Tunisia, where some slight increases in effort could be supported, have been frustrated by various factors.

A significant increase in exploitation effort on the stocks of clams (*Tapes sp*.) has doubled production between 1979 and 1993 as new grounds continue to be found. Resources of red coral are found off the north coast of Tunisia but their abundance is declining. Sponge grounds are also exploited by divers in the southern waters, however the stocks of this species have shown dramatic collapses, as well as in the eastern and southern Mediterranean, due to an epidemy, with some recent evidence of recovery.

Small pelagic stocks in the northern Ionian Sea are smaller than in more productive Adriatic waters. In the southern waters the small pelagic biomass estimates were above landings; this may be due to an overestimate of biomass, although the current low levels of landings could also be due to a lack of an adequate market. Undoubtedly problems of marketing exists in Tunisia, where the same situation occurs in the highly productive waters of the Gulf of Gabes.

Aegean Sea *(Eastern Mediterranean GFCM Division 3.1)*

The Aegean area (Fig. 1) is characterised by complex bathymetry, narrow continental shelf, except of its northern part off the Thraki coasts, and many small islands; it was formerly considered as an area of low biological productivity. In the recent years the catches of north Aegean Sea have increased. Many reasons could contribute to these changes, among which are the nutrient inflows from the Black Sea, and from incoming rivers to the north and Northwest Aegean Sea. Moreover, the increasing entrophication in some close gulfs, such as Saronic and Thermaikos etc, have also increased their productivity. On the other

hand, there is an increasing fishing effort in the Aegean Sea, which does not comply with the above observations. Eutrophication, as well as certain biases that could arise from catch statistics data, could contribute to the creation of the above contradiction. In any case, almost the 90% of the Greek catches are derived from the Aegean Sea area, while the respective Turkish catches do not exceed the 20% of the total Turkish production. The Greek fleet consists of about 20,000 small scale fishery vessels, equipped by trammel nets, gill-nets, long lines (surface or bottom), traps and beach seines. There is also a fleet of trawls and seines reaching a total number of about 650 vessels. Most of the trawls operate in the north, central and south Aegean Sea, whilst only about 8% of this fleet operate in the Ionian Sea.

Assessment of the most important commercial demersal resources has been carried out by the Greek scientists during the last years based mainly on experimental trawl surveys. A cohort analysis has been attempted for the hake stock in the north Aegean, as well as yield per recruit analyses have been carried out for different species e.g. hake, red mullet. From these studies a high exploitation rate has been calculated for the most commercial species, reinforcing the view that the stocks in the area are in a general state of full to overexploitation for several species. However, the geomorphology of the Aegean sea and the applied fisheries management measures, which are based mainly on the closed areas and seasons, contribute to the different exploitation status of the species stock in the area.

Concerning the small pelagic fishery it makes up a significant proportion of the catches along the coast of the North Aegean and in Saronikos Gulf. The only fishing gear operated is the purse seine. Mesopelagic trawl is prohibited in the area. Assessments of small pelagic resources have been carried out the last years by acoustic methods and eggs and larvae mainly in the North Aegean Sea. A sharp decline of the anchovy stock has been noted in recent years in the Greek waters, whilst for the sardina stock there is no any overfishing evidence.

Levant Sea *(Eastern Mediterranean GFCM Division 3.2)*

This area is characterised by a narrow continental shelf (Fig. 1), high depth and a low level of biological productivity due to the low nutrient composition of the water. In the past, the river Nile provided seasonal inflows of sediment and nutrients which were drastically reduced after the construction of the Aswan dam, with immediate impacts on the small pelagic resources whose landings dropped significantly in the area. Some subsequent recovery of these resources appears to be associated with high nutrient outflows of drainage water from the Nile Delta. The last few decades have seen a significant number of Red Sea species entering in the Eastern Mediterranean (Lessepsian immigrants), increasing the biodiversity of the area and changing the fishery status in the Egypt and Israel.

Small scale and medium size vessels exploiting inshore grounds dominate the fleets of Cyprus, Israel, Lebanon, Syria, Egypt and Turkey, with some larger trawls and purse-seines in the last two countries.

Stock assessment studies have been performed for the Cyprus demersal resources which show a generally overfished condition, but there is a very poor scientific knowledge on stock status and exploitation levels for the main small pelagic fishery and demersal resources off the Nile Delta.

Management

Fishing not only reduces the abundance of the target species but also affects biodiversity. The Mediterranean is a sea with a high level of biodiversity that is concentrated mainly between 0 and 50m depth, whereas at a depth below 1000 meters there is only 9% of

the total amount of the species. The impact of the fishing activities is very important in the littoral zone, and the result of the decreasing biodiversity is evident not only in the sense of the disappearance of species, but also on the diminution of effective habitats. Furthermore, the survival rate of the majority of the discards is very low. Several fishing gears can damage the seabed. The benthos, the seagrass beds, the rocky and coral bottoms can be severely damaged and can lead to sediment erosion by waves and currents which makes it difficult for species to re-establish.

In general fisheries management in the Mediterranean is at a relatively early stage of development, judging by the criteria of North Atlantic fisheries. Quota systems are generally not applied, mesh-size regulations usually are set at low levels relative to scientific advice, and effort limitation is not usually applied or, if it is, is not always based on a formal resource assessment. Despite this, there has been some progress towards management by means of closed seasons and areas, which has provided positive results.

The fisheries legislation of the different Mediterranean countries contains a great variety of conservation/management measures which can be broadly separated into two major categories: those aiming to keep the fishing effort under control and those aiming to make the exploitation patterns more rational. The first set of measures is based on restrictions imposed on the number or fishing capacity of the vessels, rather than on catch limits and control of discards and by-catches, upon which the fisheries policy in the Atlantic mostly relies. Among these measures, some aim at preventing the expansion of the number of fishing vessels through a licensing system, and can be characterised as direct, while other measures aim at placing upper limits on the fishing capacity of individual vessels, through engine power and tonnage limitations, and can be characterised as indirect.

The second set of measures is based on provisions concerning gear specification, gear deployment, fishing practices or techniques, fishing seasons or areas, and resource exploitation patterns, which are commonly known as technical measures. However, in the absence of satisfactory results from scientific investigations on spawning or nursery grounds, first maturity sizes, mesh selectivity studies etc, the adequacy, effectiveness and suitability of many measures have yet to be verified .

Apart from the main target of a management policy, which is the conservation of fisheries resources, the establishment of a common fisheries policy in the Mediterranean should also take into account the political and socio-economic aspects of the Mediterranean nations that share in the exploitation of these resources. A number of technical measures has already been woven into the national laws of all FAO/GFCM Member States (TSIMENIDES, 1994). These measures include:

- limited entry to fisheries (vessel licensing)
- limitation of fisheries in certain areas and during certain time periods.
- use of a specific minimum mesh size
- limitation on the use of some gear during certain time periods and/or in certain areas.
- limitation on the horsepower and length of fishing vessels,
- limitation on the minimum size and weight of certain species.

The GFCM has attempted to harmonise, on a Mediterranean level, some of those technical measures. One of its efforts concerns the establishment of the 40mm mesh size for the bottom trawls. This measure has been adopted by most of the Mediterranean countries, but its implementation has been less successful in others. However, the need for a reduction in overall fishing effort, particularly in inshore waters, remains the main priority for management action. So far, few Mediterranean countries have taken management action to control increases in fishing effort, in spite of repeated recommendations by the GFCM. For the Mediterranean

countries, members of the EU, a limitation in total fleet capacity and horsepower are in effect.

Even in cases where management can be done entirely at local or national levels, the setting up of common rules and the harmonisation of management policies (particularly as regards technical measures) would be desirable, given the advantages that can result from the exchange of experiences in the implementation and enforcement of management actions. Some progress in this way was made at a "Seminar on analysing technical measures for the management of shared stocks in the Mediterranean", organised in 1993 by the Commission of the European Communities in Palma de Mallorca (Spain) with the participation of most of the Mediterranean coastal States and the GFCM Secretariat.

Regarding Mediterranean fishing effort control, it has been suggested that it may be achieved through shares in the total number of standard effort units exerted on a common stock. This implies a common approach at a regional level, when the key demersal resources are straddling stocks lying across the boundaries between territorial seas and international waters where open access conditions apply.

The basis for such a management system are suggested to be:

· The cooperative setting up of a fishing effort control system, the basis requirement being to build a close to real-time database of information on fishing vessel operations, linked to some form of regularly updated vessel registration list, according to a proper fleet typology that allows to establish standardised fishing vessel lists, which have to be regularly upgraded.

· The development of cooperative research programmes to monitor the environment and resources and to manage the shared stocks on the basis of stock assessments, carried out in a standard form and regularly updated.

Following some preliminary assessment results, it has been suggested that a fishery aimed particularly at small fish may be sustainable if a small -but sufficient- proportion of spawners could survive. This suggests the inclusion on the yield-per-recruit analyses (that have been the basis of mesh size regulations in the past) of considerations related more to the stock size of mature fish left in the populations.

Fisheries management to lagoon fisheries

Well-executed lagoon management is based on a synergy of problems and objectives in order of precedence. The methods must correspond to the management objectives. A sufficient consensus between competitive uses helps to achieve a balanced allocation of wealth, which makes it possible to achieve the best potential benefits along with the greatest diversity of utilisation. The general management approach should be:

· Any planning of the use of lagoons must be multidisciplinary. Account must be taken of the fundamental role of socio-economics.

· The establishment of an integrated plan for management of the coast is an essential stage in the management process.

Finally the management measures proposed must take into account:

· the ecological potential of lagoons (ecological characteristics) and their biogenic capacities. Management of the watershed and of the channels to the sea makes it possible to maximise aquaculture potential.

· biological factors: biology of organisms, migra tion, recruitment, and trophic interaction.

· existing technologies: fish barriers with traps, brush-park fisheries, enclosure fisheries, Channel traps for shrimps, etc for better management of the production system and adjustment of exploitation to demand.

Tools for evaluation of the ecological potential and management of the fishery resources, which also usually include those of the sea, the assessment of which depends on the availability and reliability of catch and effort statistics.

About some acute problems in the management of the Mediterranean resources, (a) Fishery statistics and (b) multispecificity

All the Mediterranean research centers have scientific teams capable of studying the biological and dynamic parameters of the most important stocks as well as the fleets dynamics and interactions; however catch and effort statistics remain the main weak point. Official statistics are neither full nor accurate and so they are not reliable; in several countries suggestions have been made to improve those data, but the majority of the statistical data are still often very far from reflecting the reality. According to the cases, underestimation of catches (they are suspected to represent frequently not more than a third of the reality) is detected, as well as overestimation of some productions. This situation is directly linked to the fact that an important part of the Mediterranean production often eludes from the traditional circuits for the gathering of information (auctions, markets etc). Moreover, most statistical services are not tailored to deal with that problem with adequate sampling systems.

The lack of reliable official statistics is a considerable handicap for researchers who must devote a significant proportion of their resources to estimate the corrective factors to apply to official statistics.

As for the inventory of the fleets, it leaves much to be desired in most of the coastal countries. The statistics do not describe well the structure and capacity of the fleets, which depend on heterogeneous factors such as the depth of the fishing grounds, the type of fishing activity, the economic level of the fishermen, the shipbuilding, traditions etc. Particularly, as regards the small-scale fleets, the files available in the national administrations are generally quite incomplete. An underestimation of about 50% compared to the real figures is not rare and of course, can introduce important biases in the analyses.

To avoid this situation, the latest works in the area have focused on improving sampling and assessment strategies, essentially based on the installation of networks of samplers on the coasts, which particularly fit to the Mediterranean fisheries.

Moreover, some Mediterranean experiments on the use of remote sensing to obtain direct information on fishing and surface marine life activities in large survey areas or on geographical distribution of marine communities have been recently conducted.

Another important point is that, despite the apparent very complex situation which the multispecificity of the Mediterranean catches seems to show, some 'target species' can be identified as priority indicators of the status of composite stocks and thus there is a possibility of reducing the assessment tasks to a relative level very similar to what it is in other parts of the world. For example, as noted during the EU Meeting on Mediterranean Fisheries (Ancona, Italy, 1992) it can be defined, for the northwestern Mediterranean fisheries, a group of 13 species which constitute the "basic production". Even if imperfect, the landing statistics show that this group represents more or less 50% of the overall demersal production of the european fleets (Anonymous, 1992). It has to be noticed that these proportions would certainly increase, if it could be possible to know the real composition of the item "various species" of the official statistics, which include part of the catches of those species.

Quantitatively, such a situation is not far from what we can find in many Atlantic European fishing grounds. In fact during the last two decades, on a group of 20 species under EEC regulation in the Atlantic and North Sea, 8 of them do not reach 1% of the catches and 7 other species stand between 3% and 5%. The relative proportion of the 5 last species is around 12%, except for the cod which is 17% of the total catch.

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