Analysis of economic activities in the Mediterranean: Fishery and aquaculture sectors

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About the author

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About this edition

Didier Sauzade, who is on a temporary secondment from Ifremer as Plan Bleu's Sea Programme Officer, produced the terms of reference for this study and has revised it at various stages. This work is part of the Plan Bleu project to analyse the sustainability of maritime economic activities in the Mediterranean (MedSEA project). The final edition of this report was produced by Sandra Dulbecco (Plan Bleu).

Legal notices

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Main acronyms

GFCM: General Fisheries Commission for the Mediterranean

CIHEAM: International Centre for Advanced Mediterranean Agronomic Studies

FAO: Food and Agriculture Organization of the United Nations

FAO Copemed: FAO Coordination to Support Fisheries Management in the Western and Central Mediterranean.

FAO Adriamed: FAO Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea

FAO Eastmed: FAO Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean"

FAO MEDFISys: Project for Fisheries Statistics and information System in the Mediterranean

FAO GSA: Geographical Sub Area

ICCAT: International Commission for the Conservation of Atlantic Tunas

FAO-NASO: FAO National Aquaculture Sector Overview

OECD: Organization for Economic Co-operation and Development

UNEP: United Nations Environment Programme

MAP: Mediterranean Action Plan

EU: European Union

I. Introduction

In the general context of the implementation of an ecosystems approach in the Mediterranean, Plan Bleu has undertaken a regional study to estimate the value of the sustainable profits that can be drawn from Mediterranean marine ecosystems.

Among the maritime activities that use the marine environment, fisheries and aquaculture significantly modify Mediterranean coastal ecosystems. The biological and socio-economic status of marine and aquaculture resources in the Mediterranean needs to be characterised so that the socio-economic consequences of this impact can be assessed.

This report first gives a description of the geographical context of the Mediterranean Basin and then details and analyses the various sectors of the fishing and aquaculture industries in Mediterranean countries, examining their socio-economic characteristics, on the basis of a literature survey and various sources of data gathered over a period of several decades.

This analysis, which is limited to the Mediterranean Basin from the Straits of Gibraltar to the Dardanelles, aims to distinguish as far as possible between the various production practices, while excluding from its scope all non-commercial (recreational and subsistence) fishing.

As a conclusion, various recommendations are suggested with regard to management and public policy.

II. Background

1. Geographical context

The Mediterranean Sea has a volume of 3.7 million km^3 and covers a surface area of 2.5 million km^2, with a mean depth of 1,500 m which can go down to 5,000 m in certain areas. The Mediterranean is bordered by 23 countries (including Gibraltar and the Palestinian Territories). There are 69 rivers that flow into the Mediterranean, the largest being the Po, the Rhone, the Nile and the Ebro.

The following marine areas are generally recognised, moving from coast to open sea:

- lagoons, estuaries and intertidal zones,
- coasts,
- continental shelf,
- continental slope and rise,
- ocean.

While aquaculture is currently mainly confined to lagoons and coastlines, fishing is practiced in all these areas.

Table 1 - Estimates of the main geographical characteristics of the countries with a Mediterranean coastline

COUNTRY	Length of Mediterranean coastline (km) (*)	Surface area of Mediterranean continental shelf from 0 to 200 m depth (km^2) (*)	Surface area of Mediterranean coastal regions (km^2) (***)	% of national surface area (***)
Albania	427	6,076	12,149	42%
Algeria	1,280	13,700	42,899	2%
Bosnia and Herzegovina	20	14	10	0.0%
Cyprus	796	2,960	9,251	100%
Croatia	6,168	44,850	17,297	35%
Egypt	1,050	(**) 30,475	260,912	28%
Spain	2,372	58,225	95,553	19%
France	1,703	16,240	34,379	6%
Gibraltar	12	-	7	100%
Greece	13,676	94,340	92,547	70%
Israel	205	3,207	7,398	36%
Italy	7,600	110,750	165,112	18%
Lebanon	294	1,169	6,074	60%
Libya	1,970	63,695	348,833	20%
Malta	197	1,800	316	100%
Morocco	512	5,460	17,757	4%
Monaco	4	-	2	100%
Montenegro	293	3,079	1,591	12%
Palestine – Gaza Strip	41	386	360	100%
Slovenia	46	194	1,044	5%
Syria	183	900	4,189	2%
Tunisia	1,298	65,347	45,410	29%
Turkey	5,191	18,614	119,288	15%
Total (rounded values)	45,500	525,600	1,283,000	17 %

Source: * FAO Country profile. Note: Length of coastline and continental shelf surface area are for Mediterranean areas only.
** Sea Around Us
*** World Bank and national statistics. Other source consulted: CIA The World Factbook [1]

[1] https://www.cia.gov/library/publications/the-world-factbook/geos/

The geographical data given above (Table 1), and used for the analyses, is taken from the following sources:

- for country surface areas: mainly World Bank[2] sources;
- for coastline lengths and estimated surface areas of continental shelves, fact sheets from the FAO or associated programmes (such as CopeMed, AdriaMed, EastMed and MedFisis).

It should be noted that other data sources are available online, in particular those of the Sea Around Us[3] project and the World Resources Institute, which sometimes have minor or significant differences in the values depending on the geodesic calculation methods used.

1.1. Mediterranean coastlines

While 54% of the coastlines are rocky, 46% are sedimentary and include important sensitive ecosystems such as beaches, dunes, reefs, lagoons, wetlands, estuaries or deltas (UNEP/MAP-Plan Bleu, 2009). The length of the Mediterranean perimeter, estimated here on the basis of FAO data (FAO Country Profiles) is slightly lower than the value of 46,000 km commonly cited in the literature. This discrepancy is largely due to the way island geography has been taken into account, especially for Croatia (Duplančić Leder *et al.*, 2004) and Greece. Taken together, Greece, Italy, Croatia and Turkey account for 71% of the coastline (Figure 1).

1.2. Continental shelves

According to the definition in the United Nations Convention on the Law of the Sea[4]: *"The continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance."*

However, the continental shelf is often considered as just the continental margin between the coast and a depth of 200 metres, especially when analysing fisheries.

It should be noted that the Mediterranean continental shelves of each country are not precisely known, given the difficulties in positioning the edges of the margins and 200-metre soundings. In different sources, the total surface area varies between 520,000 km² (Inshore Fishing Area, Sea Around Us) and 730,000 km² (Breuil, 1997). In this study, we have mainly chosen to base our figures on data supplied by the FAO and its various Mediterranean programmes (such as CopeMed, AdriaMed, EastMed, MedFisis and MedSuMed), with the exception of the Egyptian continental shelf where the value used for the Mediterranean coastline is the one estimated by Sea Around Us.

The surface area of all continental shelves from the coast to 200-metre depth has thus been estimated at approximately 541,500 km², of which 50% belongs to three countries: Italy, Greece and Tunisia (Figure 2).

1.3. Surface areas of "coastal regions"

A reliable representation of the Mediterranean coastal plain can be obtained by aggregating the administrative "regions" located on the coastline; these "regions" are equivalent to Level 3 of the Nomenclature of Units for Territorial Statistics (NUTS3)[5] and correspond to French *départements*, Italian provinces, Tunisian governorates or Libyan *shabiyat,* (Attané and Courbage, 2001) (Figure 3).

[1] http://www.worldbank.org/
[3] http://www.seaaroundus.org/
[4] http://www.un.org/french/law/los/unclos/part6.htm (art.76).
[5] Regulation (EC) No. 1059/2003 http://europa.eu/legislation_summaries/regional_policy/management/g24218_en.htm

The surface areas of these coastal regions, taken from each country's national statistics, add up to approximately 1,283,000 km², i.e. 17% of the total surface area of the Mediterranean countries, with Libya, Egypt, Italy and Turkey accounting for 70% of this area.

1.4. Islands

In the Mediterranean, there are approximately 4,000 islands with a surface area of less than 10 km², and 162 islands with a surface area greater than or equal to 10 km². Of these, nine Mediterranean islands are larger than 1,000 km² (Sicily, Sardinia, Cyprus, Corsica, Crete, Euboea, Majorca, Lesbos and Rhodes) and represent 6% of the surface area and population of the Mediterranean coastal plain[6].

1.5. Population of Mediterranean countries

In 2008, the total population of the Mediterranean countries was 464 million, with four countries accounting for 60% of this total: Egypt, Turkey, France and Italy.

In 2008 again, the population of the coastal regions was approximately 157.3 million, i.e. 34% of the total national population of the Mediterranean countries. Italy, Egypt, Spain and Turkey account for 62% of this total (Table 2).

Table 2 - Mediterranean coastal populations, coastal-region and national population densities, and activity rate (*), by country in 2008

COUNTRY	Coastal population (x1000)	Coastal density (people per km²)	National density (people per km²)	Activity rate (%) (*)	References
Albania	1,880	155	109	46.2%	INSTAT
Algeria	13,489	314	14	49.4%	ONS
Bosnia and Herzegovina		0	0	61.1%	FBS
Cyprus	862	93	94	57.5%	CYSTAT
Croatia	1,413	82	78	45.9%	DZS
Egypt	26,504	102	81	43.2%	CAPMAS
Spain	18,908	198	90	48.6%	INE
France	6,859	200	113	47.9%	INSEE
Gibraltar	29	4,320	4,320	n/a	INTUTE; GPS
Greece	9,855	106	85	48.6%	ELSTAT
Israel	4,026	544	352	50.5%	CBS
Italy	33,304	202	203	43.6%	ISTAT
Lebanon	2,490	410	417	45.9%	CAS
Libya	4,979	14	4	48.6%	(**); (***)
Malta	412	1,304	1,287	50.5%	NSO
Morocco	2,866	161	708	46.1%	HCP
Monaco	31	15,500	15,500		MC, (**)
Montenegro	149	94	45	49.9%	SOM
Palestine – Gaza Strip	1,551	4,308	4,308	43.7%	PCBS; (**)
Slovenia	106	102	100	59.4%	SORS
Syria	1,711	408	111	44.8%	CBS
Tunisia	7,202	159	66	41%	INS
Turkey	18,661	156	94	42.3%	TURKSTAT
Total (rounded values)	157,300	123	58		

* World Bank – ratio of economically active population to total population for each country
** Wikipedia: http://en.wikipedia.org/wiki/
*** Statoids: http://statoids.com/uly.html

[6] http://www.uicnmed.org

Excluding the exceptional case of Monaco (15,500 people per km²), the highest population densities are found on Gibraltar (4,328 people per km²), in the Gaza Strip (4,308 people per km²), on Malta (1,287 people per km²), in Lebanon (409 people per km²) and in Israel (338 people per km²).

2. Country scope

Among the 23 Mediterranean countries, six also have coastlines on other seas (Spain, France, Turkey, Egypt, Israel and Morocco). As this analysis focuses on the Mediterranean Sea, the specifically Mediterranean activities of these countries have been distinguished as far as possible from their national activities, especially with regard to fisheries. This was not always possible for aquacultural activities which, unless otherwise specified, concern the whole country.

Monaco, Gibraltar and Bosnia-Herzegovina have not been taken into account in the analyses in this study, due to the small size of their fishing and aquaculture industries. The Palestinian Territories were taken into account wherever possible, as there is a sizable fishing industry in the Gaza Strip.

3. Economic scope

The Mediterranean fishing and aquacultural industries have been broken down into Geographical Sub-Areas (GSAs) using FAO and GFCM statistical divisions. As the Black Sea GSA was excluded from the scope of this study, only those activities performed between the Straits of Gibraltar and the Dardanelles were taken into account (Table 3).

Table 3 - FAO-GFCM statistical divisions and geographical sub-areas (GSAs)

FAO SUBAREA	FAO STATISTICAL DIVISIONS	GSA	
WESTERN	1.1 Balearic	Northern Alboran sea	1
		Alboran Island	2
		South Alboran sea	3
		Algeria	4
		Balearic Island	5
		Northern Spain	6
	1.2 Gulf of Lions	Gulf of Lions	7
	1.3 Sardinia	Corsica Island	8
		Ligurian and North Tirrenian sea	9
		South & Central Tirrenian sea	10
		Sardinia	11
		Northern Tunisia	12
CENTRAL	1;4 Adriatic	Northern Adriatic	17
		Southern Adriatic	18
	2.2 Ionian	Gulf of Hammamet	13
		Gulf of Gabes	14
		Malta Island	15
		South Sicilian sea	16
		Western Ionian sea	19
		eastern Ionian sea	20
		Southern Ionian sea	21
EASTERN	3.1 Aegean	Aegean sea	22
		Crete Island	23
	3.2 Levant	North Levant	24
		Cyprus Island	25
		South Levant	26
		Levant	27
BLACK SEA	4.1 Marmara	Marmara sea	28
	4.2 Black sea	Black sea	29
	4.3 Azov sea	Azov sea	30

Source: FAO-CGPM

III. Marine fisheries

1. Fishing vessels and fishing gear

1.1. Main characteristics

A fleet's overall production capacity is characterised by the number of fishing vessels, their fishing capacity expressed as power (kW) or tonnage (GT), their fishing practices, the activity category (see below) and crew numbers.

Number of vessels. The number of registered vessels is generally the number of units that may be involved in fishing in a given year; the number of vessels actually active during that year is often lower for various reasons (such as repairs or change of ownership). While the former is more representative of the fleet's economic potential (capital investment), the latter is more representative of the fishing effort (capacity x number of days fishing).

Fishing capacity. This indicator expresses the potential of the whole fishing fleet. It is generally expressed as the sum of the fleet's engine powers or tonnages. These indicators are more representative than a simple count of fishing vessels. They are currently measured in kW or GT (Gross Tonnage), which presents an initial difficulty, as historical data was generally expressed in horsepower (approximately 0.732 kW) and Gross Register Tonnage (GRT), for which the conversion depends on the length of the vessel, a parameter which is generally unavailable in aggregate data.

Fishing practices are identified via the species targeted and the fishing techniques used. Over 45 different fishing techniques are practised in the Mediterranean. On the basis of the FAO's fishing gear classification (Nédelec, 1990), these **fishing techniques** can be grouped into three main categories:

- towing techniques (trawling and dredging), targeting bottom-dwelling (demersal or benthic) species or surface-dwelling (pelagic) species, whether fish or invertebrates,
- encircling nets, designed for catching pelagic species,
- passive gear (longlines, hoop nets, baskets and other fish trap practices), used to catch large pelagic species (drift nets, drifting longlines and tunny nets) or various demersal species (trammel nets, bottom longlines and fish traps).

The designation of activity category has always been the subject of debate, in particular on the distinction between "artisanal fishing" and "industrial fishing".

Here, we have chosen to make a distinction not via the type of fishing gear used but via the main market for the catch: local market or "export" market. These two types of market have an indirect effect on the levels of capital investment, and on the way fishing vessels and gear are managed and made available.

On the basis and classification of Lleonart *et al.* (1998), Mediterranean fishing fleets can be broken down into three main types: industrial, semi-industrial and small-scale artisanal fishing.

- **Industrial fleets.** These fleets are often described as ocean-going or long-distance fishing fleets; they go out for several days at a time and use large vessels, generally over 500 GT, to transport the catch and accommodate the crew (Folsom *et al.*, 1993). They target large catches of certain species (such as tunas, sardines, anchovies, large gadidae, squid or prawns) for the international fresh or frozen markets and especially for processing. This implies large investments, both in fishing vessels and gear (ship-owners) and processing (factories and fattening units), and is only possible for industrial or financial groups.
- **Semi-industrial fleets.** While these are also driven by demand in domestic or international markets, they differ from the previous by the artisanal management of their vessels, with the fishing skipper on board, the owner of the means of production (vessel and fishing gear). His relationship with the market is either via auctions or a contract with a fishing association (such as cooperatives, producer bodies and Spanish "*cofradias*"). Like industrial fleets, in order to respond effectively to the demand in terms of

species and quantity, these fleets have had to specialise and use fishing gear suitable for large catches. In the Mediterranean, they mainly comprise trawlers, sardine seiners and vessels using equipment such as mechanical drag nets, certain long-lines and trammel nets. They generally land their catches daily and mainly operate on the continental shelf and around the continental slope.

- **Small-scale artisanal fishing fleets.** These fleets mostly target the local market for fresh, varied produce, mainly sold directly to consumers. However, some of them may make a significant contribution to the export market (eel and octopus fisheries etc.). They generally operate on lagoons and the coastal fringe of the continental shelf, less than 2 hours away from their landing points. They mainly use low-tonnage boats with small or no engines, generally no more than 12 m long. They comprise small-scale fisheries, made up of vessels that require low levels of investment. Boat length is not an absolute criterion, as in certain countries, polyvalent (i.e. multipurpose) vessels longer than 12 m, generally specialising in longline and gillnet fishing, can be considered as practising artisanal fishing. To meet the highly-varied consumer demand, artisanal fleets use a wide variety of fishing techniques (45 types of fishing gear have been identified in the Mediterranean), generally orientated towards catching around a hundred different demersal species and a smaller proportion of medium-sized pelagic species. They employ a variable number of fishermen, depending on the practices of the various geographical areas, generally with 1 or 2 registered fishermen per vessel and 1 or 2 "seasonal" hands.

It is important to stress that, in this study, the term "artisanal" designates a fishery management system, which does not directly correspond to a vessel-size category or a level of specialisation in fishing practice. It is common to find small-scale Mediterranean fishing fleets comprised of small boats (less than 12 m long), specialising in a form of trawling or encircling-net fishing, as in Egypt, Lebanon or Palestine.

Any fishery-management project that is to be established on the basis of this distinction must therefore be carefully analysed on a case-by-case basis, taking into account the specifics of each sector's fishery.

Fleet management systems and in particular the logging of the fleet's entry-exit regime, is based on various characteristics, with procedures specific to each country. **Fleet segmentation** can thus be established on the basis of fishing practice (trawlers, seiners), activity category (polyvalent, exclusive license), the length or type of vessel (e.g. *luzzu, kajjik, firilla*, Maltese) or, frequently, a combination of these various criteria.

Crews. The various techniques each require a crew, whose size may vary for the different fishing operations, ranging from operating the vessel and its fishing gear to landing the catch. These actions require a range of skills (captain, mechanic etc.) of varying levels, remunerated according to the type of fishery and the individual's role. Remuneration is either based on a fixed salary or on a shares system, calculated on the basis of sales made and vessel running costs. This latter system of remuneration is the most widespread.

1.2. Data

There is no recognised database that provides exhaustive information about all Mediterranean fleets and their characteristics.

The European Commission (EC) maintains a statistical database EUROSTAT[7], which only gives the number of vessels and their length, power and tonnage for EU countries, with no indication of fishing practices. However, in the context of its Multi-Annual Guidance Programme, since 1983 (MAGP 1983-1986) the EC has annually published a country-by-country listing of capacity and number of vessels registered by type of fishing practice, defined using a single set of criteria. This information, supplied by national ministries responsible for fisheries, does not always accurately reflect the complexities of the fishing industry in each country. In particular, the set of criteria adopted by the EC does not always correspond to local fishing practices and is poor at taking into account polyvalence, which is a major feature of

[7] http://ec.europa.eu/fisheries/fleet/

Mediterranean fisheries. The segmentation used by certain countries is not always easy to convert to that of the EC, and this conversion may lead to oversimplification.

The Organization for the Economic Co-operation and Development (OECD) also provides online statistics on member-state fisheries for the years 1995-2001. In the Mediterranean, this covers Spain, France, Greece, Italy, Israel and Turkey. From these figures, information can be extracted on landing volumes and values, employment and fishing fleet capacities. In 2005, the OECD also published general information on the fisheries of member states (Regulatory Management System Country Notes[8]).

The Food and Agriculture Organization for the United Nations (FAO) published annual statistics reports on world fishing fleets from 1970 to 1995. To our knowledge, they have not been published since (FAO, 1998). Furthermore, the FAO compiles a certain amount of information on fishing fleets and practices, supplied by member states, as Fishery Country Profiles. These profiles have been published in two different periods (1993-1995 and 2004-2010). These profiles were the main source of data for producing the country-by-country descriptions given in the appendix to this report.

The General Fisheries Commission for the Mediterranean (GFCM) produces a compilation of national reports from each member state in each SAC Report it issues following a meeting of its Scientific Advisory Committee (SAC). Unfortunately, this information is published only sporadically and is rarely updated. Occasionally, some of these country reports have the advantage of giving a comprehensive account of the status of national fisheries with a chronological summary of their activities. Since 2008, these country reports are no longer summarised in the appendix to the SAC reports, but they are published in full on the GFCM's website.

GFCM Task 1. Since 2007, GFCM has standardised its data gathering processes for statistics on the activities and yields of member-state fishing fleets[9]. The main objective is to have joint management of the fishing effort by **Operational Units**, which also gives a clearer idea of the spatial distribution of actual fleet activity and their catches[10]. Although it is in operation, this database is not currently comprehensive. The quality of the records depends on the ability of each country to ensure regular monitoring of its fleet. This monitoring should be improved by the gradual roll-out of a GFCM (electronic) log-book and Vessel Monitoring System (VMS) for all vessels over 12 m in length. Information on vessels is structured using a different breakdown than that used by the EC, one that is more suitable for the polyvalence of Mediterranean fleets.

National statistics records. These records are theoretically published annually by the various ministries responsible for fisheries, and are the official and, in principle, the most reliable sources on the state of the fishing fleet in each country. Occasionally, recent data is available online; older data was published as annual statistics reports that can only be obtained via a request to the relevant ministry. The level of detail in the published figures depends on the importance of the fishing industry to the national economy. As this sector is often combined with agriculture, the data supplied may, in some cases, boil down to just a few economic indicators. As yet, certain countries do not have a regular system for registering operating vessels. This is one of the priority subjects for the FAO's regional programmes in the Mediterranean (such as CopeMed, AdriaMed, EastMed and MedFisis).

Finally, a certain amount of relevant, detailed information, extracted from specific works on fisheries and cited in the bibliography, has helped us to fill in some of the missing data. In particular, works published by the FAO (e.g. Breuil, 1997, Caddy and Oliver, 1996), the International Centre for Advanced Mediterranean Agronomic Studies, CIHEAM (e.g. Oliver and Franquesa, 2005, Franquesa *et al.*, 2008) or studies funded by the EU were used.

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[8] http://www.oecd.org/statisticsdata/

[9] Resolution GFCM/31/2007; http://www.gfcm.org/gfcm/topic/16164/en.

[10] "*Within the context of managing fishing effort by Geographical Sub-Area(s), an Operational Unit is a group of fishing vessels which are engaged in the same type of fishing operation within the same GSA, targeting the same species or group of species and belonging to the same economic segment. Fishing vessels may belong to more than one Operational Unit and the composition of Operational Units is subject to change over time.*"

Among these, the paper "Recent historical study of the European Commission in European countries' demersal fisheries" (EVOMED, 2001) gives an analysis concerning Greek, Spanish Catalan and Italian demersal fishing fleets, on the basis of statistical documents from the last 100 years and interviews with fishermen. This study gives the state of play of Mediterranean demersal fisheries, based especially on an analysis of the changes in vessel numbers and capacities (tonnage and power), as well as the volume and composition of landings.

Crews and their size per fishing-practice group. The availability of data on crew numbers depends mainly on the existence of public bodies responsible for monitoring the registration of fishing crews for social-security, safety or economic purposes. The registration of a fisherman on a vessel's crew roster often depends on the vessel's activity. During down times (repairs, wintering) or at certain seasons, part of the crew may be "landed". Thus, the employment rate is variable and not always known, in particular for small-scale fishing and certain trawler and seiner fleets, where the use of unregistered seasonal hands is common.

When they are not given by the national fisheries body (e.g. Spain) or specialist statistics bodies (e.g. IREPA, Italy), data on crews can be gathered from national statistics records. However, even when not completely absent, such data is often aggregated with that of other activities such as aquacultural and agricultural production.

Furthermore, in addition to these official sources, the analysis of data on crews and their distribution by fishing-practice group has generally been supplemented by the descriptions of fleets given in the literature (cf. Appendix II, country-by-country description).

1.3. Analysis

An examination of how the fisheries for each country are operated gives greater insight into the characteristics of the various segments defined above.

The industrial segment. Among the Mediterranean countries, the registers for Italy, Greece, Malta, Cyprus and Turkey include fleets of trawlers and ocean-going tuna seiners that operate mainly in the Atlantic or Indian Oceans. Where they can be identified, their numbers and capacities should be subtracted from the fleet registers to leave only those vessels that operate exclusively in the Mediterranean.

The Mediterranean has a wide variety of species and no large single-species demersal "stocks" like those found in the North Atlantic. This means that its industrial fishing is mainly accounted for by bluefin tuna fishing practised by large tuna-seiners and with tunny nets (*madragues*), which still exist in certain countries such as Spain, Italy, Morocco and Tunisia (Farrugio *et al.*, 1993; Lleonart *et al.*, 1998).

The semi-industrial and small-scale fishing segments. These are the categories which most of this analysis of trends in Mediterranean fisheries focuses on. Detailed examination of country-by-country descriptions highlights the difficulty of classifying fishing fleets without adding other criteria, such as their degree of polyvalence or mean vessel size. Indeed, while a 20-metre-long polyvalent trawler/seiner is undeniably a semi-industrial vessel, a coral diver belongs to the category of small-scale artisanal fishing, despite the technical, specialised nature of this fishing practice.

In the absence of more specific data on vessels and gear, we have chosen to arbitrarily distinguish five groups of fishing practice:

- Trawlers and dredgers, specially designed for "towing" techniques,
- Seiners specialised for using encircling nets, including vessels longer than 12 m that target small pelagic species (such as sardines) or bluefin tuna,
- Polyvalent vessels longer than 12 m, specialising in longline fishing and coastal-water or open-sea net fishing,
- Small-scale artisanal fishing fleets, highly polyvalent or specialised in low-investment fishing practices, operating with vessels less than 12 m long, with or without engines. Shellfish gatherers are included in this category.

- Tunny nets used to catch bluefin tuna, whose management system, levels of investment and marketing methods are more industrial than artisanal, even though based on traditional practices.

By using all the sources of information described above, the state of the Mediterranean fleets is presented for two years selected in a period for which we have maximum reliable data for all the countries: 1995 and 2008.

Study of the long-term changes for the five chosen groups required filling in missing values over short periods, by using a moving average between two declared values and maintaining an identical proportion between the various groups. It was not possible to establish the distribution of capacities (tonnage and power) by fishing-fleet group, since this information is not always documented (or recorded) in the sources examined.

Breakdown of crews by fishing-practice group. Given all the uncertainties described above, it is extremely difficult to reliably estimate crew sizes for all Mediterranean countries with the current state of available knowledge. To make an approximation, the following assumptions had to be used:

- the total number of fishermen declared by each country is considered reliable and has not been readjusted,
- each registered fisherman is considered to be part of a fishing fleet,
- each vessel declared in a particular year is considered to have been active during that year,
- where the crew breakdown between fishing practices is not given in national annual statistics, it was calculated on the principle that, year-on-year, each fishing practice requires the same size crew, on the basis of vessel size and the socio-economic factors affecting employment for each country. For example, a French 20 m trawler employs between 4 and 7 fishermen (including the skipper); similarly a large sardine seiner takes a crew of 12 to 20, while a small "*lamparo*" (lamplight fishing boat) may manage with a crew of 5 to 7. The table below (Table 4) summarises the mean crew sizes assigned to the various main fishing-practice groups.

The crew sizes for tuna seiners and tunny net (*madrague*) installations are both highly variable and, in the absence of more precise data, mean values of 16 fishermen for a tuna seiner and 60 per tunny net have been used.

Table 4 - Estimated mean number of fishermen aboard active vessels by fishing-practice group and by country

COUNTRY	TRWL	PS	PLV	ART	PST	MAD
Albania	4	5		2		
Algeria	8	20		5	16	
Croatia	5	14	4	2	16	
Cyprus	6	12	4	1		
Egypt	8	20	7	3		
Spain	4	8	4	1	16	60
France	4	10	4	1	16	
Greece	6	9		1	16	
Israel	8	21		2		
Italy	3	6	4	2	16	
Lebanon				3		
Libya	4	8		1	16	
Malta	4		4	1.5	16	
Morocco	15	26	14	4		60
Montenegro	4	8		2		
Palestine	5	10		4		
Slovenia	5	12	4	2		
Syria	12	20	6	3		
Tunisia	14	15	6	4	16	
Turkey	5	20	5	2	16	

Source: Author's evaluation

TRWL: trawlers and dredgers; PS: small-pelagic seiners; PLV: polyvalent vessels longer than 12 m; ART: small-scale artisanal fishing vessels; PST: tuna seiners; MAD: tunny nets).

1.4. Results

1.4.1. Number of vessels and trends

In 2008, the number of declared vessels was approximately 82,000 according to our estimates, including 68,200 small-scale artisanal fishing boats, which accounted for 83% of the fleet in the Mediterranean from the Straits of Gibraltar to the Dardanelles (Table 5).

However, our estimate does not take into account the number of rowing or sailing boats practising coastal or lagoon fishing, mainly along the southern and eastern Mediterranean coastlines. The size of these fleets, which are only sporadically counted in national statistics records, may be estimated at several tens of thousands of boats.

Table 5 - Breakdown of fishing vessels by fishing-practice groups and country for 2008

Vessels 2008	TRWL	PS	PLV	ART	PST	Country total
Albania	180	22		67		269
Algeria	487	1,039		2,908	7	4,441
Croatia	800	400		2,600	23	3,823
Cyprus	8	1	28	628	1	666
Egypt	1,095	238		1,791		3,124
Spain	840	277	168	2,052	6	3,343
France	111	24	27	1,079	32	1,273
Greece	311	281	511	16,250	2	17,355
Israel	31	19		388		438
Italy	3,520	305	292	9,258	46	13,421
Lebanon		70		2,590		2,660
Libya	140	165		4,695	29	5,029
Malta	17		114	1,018	3	1,152
Morocco	119	150	112	2,974	3	3,358
Montenegro	30	18		170		218
Palestine	18	67		632		717
Slovenia	20	9		152		181
Syria	21	5	30	1,157		1,213
Tunisia	399	360	227	10,316	24	11,326
Turkey	300	167	33	7,406	86	7,992
Total (rounded values)	8,450	3,600	1,540	68,100	262	82,000

Source: FAO Aquaculture and Fisheries profiles by country; national statistics and author's data
(rounded totals; TRWL: trawlers and dredgers; PS: small-pelagic seiners; PLV: polyvalent vessels longer than 12 m; ART: small-scale artisanal fishing vessels; PST : tuna seiners; MAD: tunny nets).

In addition to these fleets, there are eight active tunny nets for bluefin tuna fishing, one in Spain, another in Morocco and six more in Italy.

In 2008, Greece had the largest fishing fleet. This fleet plus those of Italy, Turkey and Tunisia accounted for 61% of Mediterranean fishing vessels (excluding the Black Sea and Marmara Sea, cf. Figure 4). These four countries also had the largest artisanal fleets, with 63% of the total number of boats. With regard to semi-industrial fleets, nearly 41% of Mediterranean trawlers and dredgers (TRWL) were Italian, while Algeria alone accounted for 29% of sardine seiners (PS). Finally, in 2008, Turkey had the largest fleet of tuna seiners (33%), followed by Italy (18%) and France (12%).

In 2008, the combined fleets of the Southern Mediterranean countries only accounted for 38% of all Mediterranean vessels, and 42% of artisanal boats. Trawlers, dredgers, seiners, tuna seiners and "polyvalent vessels longer than 12 m" accounted for nearly 13,800 vessels (16%). EU countries owned 58% of trawlers and 34% of tuna seiners. In contrast, the combined pelagic-seiner fleets of the Southern Mediterranean countries accounted for 58% of the total.

Fleet trends. On the basis of the available data and the assumptions described above, and excluding tuna vessels, we have attempted to outline changes in the fleets over the last 20 years.

By comparing the results obtained with those given in earlier studies, it is observed that the total numbers are slightly lower than those given by Breuil (Breuil, 1997), if we exclude tuna and service vessels. For the period 1992-1995 and for the same countries, Breuil estimated a total of 84,100 fishing vessels, including 71,780 artisanal fishing boats (85.4%). Franquesa *et al.* (2008) estimated that 170,000 fishing vessels were sailing under Mediterranean country flags in 2005, a figure that includes vessels sailing from the Atlantic and Black Sea coastlines or operating on other seas.

Although our estimates are slightly higher than his, they confirm the trend identified by Breuil of a gradual reduction in the total number of fishing vessels. This reduction began in the late 1980s, dropping from around 100,000 vessels to just under 83,000 in 2008 (Figure 5).

This trend towards a reduction in numbers generally concerns small-scale fishing but, since 2000, has also strongly affected the trawler sector (Figure 6 to Figure 9). In particular, this latter point is explained by the EU's fleet reduction programme, as can be seen on the next diagram.

In contrast, the fleets of Middle Eastern and North African (MENA) countries with a Mediterranean coastline (for which the term "Southern Mediterranean countries" is used throughout this document) have tended to grow, in line with the development policies of these countries. Nevertheless, these fleets remain less numerous than those of the current EU countries.

Tuna fleets. From the 1960s, a specialisation focusing bluefin tuna and other large pelagic species has developed among the seiner fleets and the larger artisanal vessels, with three main groups: tuna seiners, pelagic longline vessels and vessels using nets such as trammel nets. Driven by the Japanese market for sashimi, purse-seiner tuna fishing developed significantly in the 1990s to become the main technique for catching bluefin tuna.

In 2008, 1,120 licences were granted for bluefin tuna fishing in the Atlantic and Mediterranean, including, for Mediterranean fleets, 262 for seiners, 476 for longline vessels, 17 for trawlers, 8 for tunny nets and approximately 40 for various artisanal fishing practices (Figure 27). These licences were not exclusive, except for the French tuna seiners; most of the other vessels also used other fishing practices or targeted other species, such as small pelagic species in the case of trawlers and seiners less than 24 m long, or large pelagic species, such as swordfish and albacore tuna for longline vessels.

In the Mediterranean, out of a total of 316 seiners with a "bluefin tuna" licence, 262 can be considered as tuna seiners exploiting bluefin tuna full time. To these vessels should be added approximately thirty support vessels (cage tugs, fishing support vessels) which increase the real capacity of this fleet.

Shrimp fleets. From the 1980s, part of the Mediterranean trawler fleet has started to focus on fishing crustaceans on the continental slope (prawns, shrimp and scampi). This focus, which has required the use of specific gear for deep-water fishing (high-capacity winch, deep-sea sounding apparatus), has led to the development of more powerful and efficient vessels. Some of these are specialised in deep-sea fishing, others alternate seasonally between fishing for demersal fish on the continental shelf and fishing for deep-sea crustaceans.

It is currently very difficult to distinguish between these two categories within the trawler fleets or to determine the amount of time devoted to each activity. The EVOMED study (EVOMED, 2011) gives a mean activity ratio of 50% for deep-sea crustacean fishing, with wide variation among fleets, from less than 10% for the Italian fleet from Trapani to over 70% for Spanish trawlers from Palma.

1.4.2. Trends in capacity

The number of vessels only gives an approximate idea of the fishing capacity of the fleets, because it does not take into account technological developments or changes in regulatory measures that affect the technical catch potential of the vessels in various ways, depending on fishing practice, regional development and the history of the fishery. While the number of vessels has been decreasing since 1980, especially in EU countries under the effect of the EU fleet reduction programme, it is nevertheless unlikely that this decrease has been accompanied by an equivalent decrease in effective fishing capacity, since capacity has been underestimated in recent years (EVOMED 2011).

In 2009, the EU Multi-Annual Guidance Programme estimated that technical efficiency was increasing at a rate of 3% per annum, despite a reduction in the number of vessels in European fleets (Figure 40) (des Clers, 2009).

Engine power (in kW or hp), tonnage (in GT or GRT) and length (in LOA) are the most frequently used indicators for describing potential fishing capacity.

Indeed, although the number of fishing vessels may be stable or declining, changes to engines or the replacement of old vessels with more powerful ones, generally leads to a rapid increase in fishing capacity, as shown by the examples given in the final EVOMED Report (2011) for the Greek trawler fleet (Figure 12) and the Italian fleet (Figure 13). According to that report, effective power has also increased between 5-fold and 8-fold since the 1950s.

Measuring fleet capacity using installed engine power

Unfortunately, fishing capacity values are often under-declared and underestimated in national statistics records, in particular when the technical characteristics of the vessels, notably their engine power, are subject to regulations, whether for the purposes of management (EU fleet reduction programme), navigational safety or social security for registered fishermen.

The examples of the Greek and Catalan trawler fleets (Figure 14) serve to illustrate this point by showing an increase in installed power, currently limited to approximately 400 hp (300 kW) for Greek vessels and 300 hp (200 kW) for Catalan trawlers; in reality, engine powers have continued to increase and seem to have reached even higher levels.

Such underestimates also affect the French trawler segment, which has declared mean engine powers below 316 kW ever since 1994, when national regulation was implemented limiting installed power to this value. Private sources tell us that, in reality, the mean values are much higher, of the order of 600 kW (800 hp).

Table 6 - Estimated values of mean engine power by fishing-practice group and country

2008	TRWL	PS	PLV	ART
Albania	280	200	-	80
Algeria	280	110	-	30
Croatia	400	200	-	70
Cyprus	630	270	190	70
Egypt	400	110	50	40
Spain	190	180	80	40
France	310	320	150	70
Greece	300	190	430	40
Israel	240	90	-	30
Italy	650	280	330	200
Lebanon	-	-	-	50
Libya	270	120	-	30
Malta	430	260	70	60
Morocco	230	180	0	30
Montenegro	170	140	0	40
Palestine	240	80	0	30
Slovenia	780	150	0	40
Syria	240	80	50	20
Tunisia	400	110	50	20
Turkey	400	200	80	50

Source: Aquaculture and Fisheries profiles by country; national statistics and author's data

With a few exceptions, such data is rarely available for non-European Mediterranean countries and is only occasionally found in the literature (FAO Fishery Country Profiles, with references to fleet descriptions). On the basis of these documents and various pieces of private correspondence regarding the state of fisheries, an estimate of the mean engine power values of vessels has been produced for 2008 (Table 6),

showing significant differences both between fishing-practice groups and between the various Mediterranean fleets in the same segment.

This can be explained both by the importance of engine power for the particular fishing practice and by differences in investment capacities or equipment distribution networks. In this respect, European fleets have been able to take advantage of the free-trade mechanisms provided by the EU, while Southern and Eastern Mediterranean counties have found it more difficult to source more efficient fishing gear and to benefit from technical assistance for their equipment.

On the basis of the vessel numbers previously listed for 2008 (Table 6), the fishing capacities in kW of each country's fleet can be estimated (Table 7).

Table 7 - Estimated fishing capacities (in thousands of kW) by country in 2008 (rounded values).

COUNTRY	TRWL	PS	PLV	ART	Country total
Albania	51	4		5	60
Algeria	140	110		82	330
Croatia	320	80		180	580
Cyprus	5	0	5	39	50
Egypt	440	25	27	45	540
Spain	160	50	13	65	290
France	34	8	4	66	120
Greece	91	53	220	530	890
Israel	8	2		11	21
Italy	670	84	52	310	1,200
Lebanon				150	150
Libya	37	20		120	170
Malta	10	2	15	61	87
Morocco	28	22		78	140
Montenegro	5	3		6	14
Palestine	4	5		16	26
Slovenia	5	1		5	11
Syria	5	0	1	24	30
Tunisia	160	38	11	210	420
Turkey	120	34	3	380	530
Total by fishing-practice group	2,300	550	350	2,400	5,600

Source: Aquaculture and Fisheries profiles by country; national statistics and author's data

The calculated values are only approximations, which underestimate the declared powers of EU vessels and probably overestimate those of other countries; nevertheless, they give an indication of the distribution of fishing capacities in the Mediterranean.

Tow fishing (TRWL: trawlers and dredgers) accounts for approximately 40% of the engine power of the Mediterranean fishing fleet of the 20 selected countries.

Given the number of vessels, the small-scale artisanal fishing sector (ART) remains slightly larger (43%) despite the low engine power of the individual boats.

Table 8 - Comparison of fishing-fleet capacities between Southern Mediterranean, Northern Mediterranean and EU countries (in kW)

2008	TRWL	PS	PLV	ART	Total
SOUTHERN	660,000	190,000	28,000	510,000	1,400,000
NORTHERN	1,700,000	360,000	320,000	1,900,000	4,200,000
EU	970,000	200,000	310,000	1,100,000	2,600,000

Source: Aquaculture and Fisheries profiles by country; national statistics and author's data

If these values are grouped together into larger regions (Table 8), it can be seen that Southern Mediterranean countries only account for 25% of this capacity, while EU countries account for 46%. This is

explained by the fact that many artisanal boats in the Southern Mediterranean countries have small or no engines, in contrast to those of the EU.

Finally, the tow fishing (trawlers and dredgers) practices of Northern Mediterranean countries alone accounts for 74% of the total power in this segment.

Another measure of fishing capacity

An analysis of fleet tonnages could also be performed in the same way, on condition that the necessary tonnage data is available. It would have the advantage of more accurately taking into account the variations in the artisanal fishing boat and seiner fleets. Indeed, while engine power is the major indicator of capacity for tow fishing, tonnage is a better indicator of load and crew capacity, which are relevant for purse seine and artisanal fishing.

The only capacity indicators that are regulated – number of fishing vessels, engine power and tonnage – give an inadequate indication of the actual fishing capacity of each vessel, even when not falsified due to the effects of the regulations. Indeed, engine power and tonnage do not take into account all the technical progress from which fishing vessels have benefited, in particular the mechanisation of fishing gear (such as winches and net lifters) and in navigational aids and sensors (such as GPS, sounding apparatus and sonar).

The development of onboard electronics and hydraulics, and more powerful or cheaper fishing gear (large-opening midwater trawls; artisanal-fishing gillnets from the Far East), has contributed to an unsupervised increase in the capacity of semi-industrial and artisanal fishing fleets.

Changes in investment costs, where known, are the only way to give a more accurate indicator of this 'technology creep'.

This increase in the capacity of fishing fleets is, of course, happening at different paces between the Northern and Southern (or Eastern and Western) Mediterranean, depending on the ability of each country to invest in the fisheries sector and benefit from new technologies.

Again, the semi-industrial fishing vessels of EU and Northern Mediterranean countries have been the main beneficiaries, ahead of the Southern and Eastern Mediterranean countries.

1.4.3. Crew numbers

By compiling the various sources cited, the number of fishermen employed in 2008 can be estimated at 250,000. Their distribution by country (Table 9) shows that four countries (Tunisia, Algeria, Italy and Greece) accounted for 56% of total numbers, with only 27% in EU countries compared with 58% in Southern Mediterranean countries and 42% for Morocco, Algeria and Tunisia together.

Small-scale "artisanal" fishing (ART) employs the largest numbers of fishermen (55%), followed by small-pelagic seiners (PS: 22%) and tow fishing (trawlers and dredgers).

However, this distribution underestimates small-scale fishing numbers to the extent than national statistics do not generally count fishermen without boats, or with non-powered boats, or the significant numbers of undeclared part-time fishermen, who have other main occupations (such as seasonal tourism and agricultural workers).

This distribution, if examined over the period 1990 to 2008 (Figure 8) shows an overall trend of falling artisanal fishing numbers, with different trends between Southern Mediterranean countries and Northern ones, which are mainly EU countries. This difference was even more pronounced between Eastern and Western Mediterranean (Figure 9)

This reduction is due both to the effects of the EU fleet reduction programme and to an increasing loss of interest in small-scale fishing in these countries. It should be noted that a number of semi-industrial fleets on both sides of the Mediterranean use an increasing number of "seasonal" workers from non-Mediterranean countries (Africa and South-East Asia).

Table 9 - Number of registered fishermen by fishing-practice group and by country

Fishermen by fishing-practice group, 2008	TRWL	PS	PLV	ART	PST	MAD	Country total (rounded)
Albania	729	97		158			990
Algeria	4,480	20,780		13,480	112		38,500
Croatia	4,000	5,600		5,200			14,800
Cyprus	48	12	112	754			930
Egypt	8,760	4,760		4,478			18,000
Spain	3,675	2,206	647	2,152	96	70	8,800
France	455	240	95	1,101	512		2,400
Greece	1,866	2,529	1,789	15,138	32		21,400
Israel	248	399		776			1,420
Italy	10,965	2,277	1,153	14,953	736	420	30,500
Lebanon		8,40		8,194			9,100
Libya	560	1,320		5,313	464		7,660
Malta	68		460	1,527	48		2,100
Morocco	1,785	3,900	1,568	8,922		70	16,200
Montenegro	120	135		255			510
Palestine	90	670		2,528			3,290
Slovenia	100	108		228			440
Syria	252	100	165	3,471			3,990
Tunisia	5,426	5,508	1,249	36,106	384		48,670
Turkey	1,500	3,340	149	12,590	1,376		18,950
Total (rounded)	45,100	55,000	7,400	136,900	3,800	600	250,000

Source: Aquaculture and Fisheries profiles by country; national statistics and author's data
Key: TRWL: trawlers and dredgers; PS: small-pelagic seiners; PLV: polyvalent vessels longer than 12 m; ART: small-scale artisanal fishing; PST: tuna seiners; MAD: tunny nets).

2. Mediterranean marine fishery yields

Marine fisheries generally involve commercial catches of marine fish species, crustaceans, molluscs and other edible invertebrates (such as sea urchins and tunicates).

2.1. Data

Data is available over a series of years mainly for landings of fishery products brought to market, which are regularly logged by the administrative services of the countries involved, then compiled and forwarded to relevant national and international bodies.

Consequently, these do not take into account "throwbacks", illegal catches, direct sales to consumers or home consumption. These quantities are generally not declared and, by definition, difficult to assess, although some broad estimates have been made.

Despite the gaps mentioned above, the FAO's fishery yield database (FISHSTAT) is considered to be relatively reliable. It has the advantage of having annual data for the years 1950 to 2008 (the last year available when this study was produced) for each country and geographical sub-area (GSA).

Since the FISHSTAT database can group data by group of species, marine produce yields from 1970 to 2008 have been extracted and separated into demersal and pelagic species.

Yield values (in Euros or dollars) are only rarely given in national fishery statistics and are only available for certain fisheries that have been analysed in specific economic studies.

2.2. Analysis

The objective of the analysis described here is to give the most up-to-date possible snapshot of trends in marine fishery yields in the Mediterranean over the last thirty years, attempting to highlight the major periods for each country, for each large geographical region and for the Mediterranean as a whole.

On the basis of the FISHSTAT database, and by using the categories from the International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP), we took into consideration landings of benthic and demersal species (fish, crustaceans and cephalopods) and pelagic fish (small and medium pelagic species).

To make the analysis easier, certain species were not taken into account, including large pelagic species, whose fisheries extend beyond the area of operation of artisanal and semi-industrial Mediterranean fleets; inedible invertebrates (sponges and red coral); and oysters and mussels, whose origin is not always certain (mariculture or dredging).

2.3. Results

The data from the FISHSTAT database shows that while coastal demersal fish dominate over other demersal species, small pelagic species (sardines, anchovies and sardinellas) comprise the majority of pelagic landings (Figure 15).

Table 10 - Commercial marine fishery yields by country and by species group, for Mediterranean landings in 2008

Marine fishery yield (t)	Small pelagic species	Medium pelagic species	Large pelagic species	Sharks and rays	Crustaceans and molluscs	Demersal fish	Country total
Albania	125	280	55	193	470	2,013	3,135
Algeria	66,712	35,396	4,009	568	3,839	28,296	138,820
Cyprus	13	10	433	7	181	1,345	1,989
Croatia	34,323	385	864	78	1,422	11,872	48,944
Egypt MED	22,254	2,504	3,397	3,039	20,562	37,126	88,882
Spain MED	29,723	19,191	8,870	931	13,180	33,213	105,108
France MED	10,916	1,214	2,721	88	1,920	5,044	21,903
Greece	27,084	5,946	2,920	941	10,001	36,072	82,964
Israel MED	259	784	130	169	390	813	2,545
Italy	57,954	10,738	11,544	1,515	80,896	59,008	221,656
Lebanon	580	993	389	58	107	1,414	3,541
Libya	19,518	12,939	1,318		1,171	12,699	47,645
Malta	7	290	588	46	112	237	1,281
Morocco MED	8,743	11,892	2,857	100	3,682	8,528	35,802
Montenegro	97	60	86	13	44	235	535
Palestine	1,983	207	165	14	313	204	2,886
Slovenia	510	9		2	49	112	681
Syria	360	692	472	90	223	1,375	3,212
Tunisia	36,373	13,906	7,798	1,945	10,487	26,542	97,051
Turkey MED	19,764	9,738	9,831	315	6,887	14,993	61,528
Total MED (rounded values)	337,300	127,170	58,450	10,110	155,940	281,140	970,110

Source: FAO FISHSTAT

In 2008, the total fishery yield of Mediterranean fleets is estimated at 970,110 tonnes of edible marine produce (i.e. excluding corals, sea urchins, sponges and turtles), (Table 10). This figure does not take into account yields from areas other than the Mediterranean coastline (i.e. Atlantic, Red Sea, Black Sea or the Sea of Marmara) in the relevant countries. Also, only declared yields are taken into account (often only what is put on the market) excluding "throwbacks" and, apparently, most of the yields from small-scale artisanal fishing where the produce is sold direct to the consumer.

2.3.1. Country-by-country analysis

EU countries account for 45% of total declared landings, while Southern Mediterranean countries account for 43%.

All demersal species (fish, sharks, rays, crustaceans and molluscs) account for 46% of landings, of which 48% is accounted for by EU fleets; these species represent 56% of EU yields in the Mediterranean, compared with 42% for Southern Mediterranean countries.

Morocco, Algeria and Tunisia together accounted for 33% of Mediterranean small pelagic yields in 2008 and this represented 41% of the overall yield for these countries.

The catch trends based on the categories chosen above, demersal species excluding oysters and mussels and pelagic species excluding tunas, differ slightly between the two groups (Figure 16**Erreur ! Source du renvoi introuvable.**):

- Demersal species yields have been constantly declining since 1994 with a slight rebound in landings in 2005,
- Pelagic species yields, dominated by small pelagic species, were constantly growing until 1981. Since then there has been a long period of stability at around 50% of total yield until 2004 when yields started to grow again, reaching 80% of total Mediterranean marine fishery yields in 2007. According to GFCM estimates, excluding the Western Mediterranean sardine stocks (GSA 06) which are considered overexploited, the small-pelagic stocks studied are generally fully exploited (Alboran Sea) or moderately exploited, (GFCM-SAC, 2010).

Comparison of Northern Mediterranean countries with Southern ones shows that yields have been declining in the former since the mid-1990s and are currently at the same level as those of the Southern countries, whose yields have been regularly increasing since the early 1950s (Figure 17).

Examination of trends by country (Figure 18 to Figure 23) shows that, in 2008, four countries accounted for 54% of Mediterranean landings: Algeria, Spain, Tunisia and Egypt. Furthermore, significant differences are observed that depend both on the fishing effort and fluctuations in the resources exploited. These fluctuations are particularly large when small pelagic species dominate the catch. Countries whose yields are stable or increasing (Algeria, Libya, Syria, Lebanon and Southern Mediterranean countries in general) can be distinguished from those where a continuous drop in yields is observed (Israel, Cyprus, Turkey and EU countries).

In the particular case of former-Yugoslav countries, it can be seen that aggregate yields for the various countries have returned to their peak level (of 1986) after the collapse that followed the independence of the various states of the Federation (Figure 23).

2.3.2. Analysis by sub-region

Three large geographical zones dominate Mediterranean yields: the Balearic zone, the Ionian Sea and to a lesser extent the Adriatic. They account for over 60% of declared marine fishery yields over the last 40 years, and for over 70% of pelagic yields (Figure 24). It can be observed that while Balearic fisheries are characterised by dominant and increasing pelagic yields, those of the Ionian Sea are characterised by landings mainly comprised of demersal species, whose volume has been decreasing gradually since 1994.

It can be assumed that the majority of Mediterranean marine resources are located around the continental shelves. Over time, these resources have been exploited at different rates, in particular depending on the ability of each country's fleets to access them and catch as much as possible.

This ability is, of course, related to each fleet's capacity, which depends chiefly on its level of technology. In many cases, poorly-managed development has led to building a capacity greater than the resource could support.

2.3.3. Analysis of catch rates per unit surface area

Several approaches have been developed to analyse the sustainability of a fleet's exploitation of a fishery resource.

The Maximum Sustainable Yield (MSY) approach, using Schaefer and Fox models, can be sufficiently reliable if differences in efficiency between fishing vessels and the effects of technological development can be taken into account. The number of fishing vessels is not therefore sufficient for this analysis, since engine power (for tow fishing) and tonnage (for seiners and passive fishing vessels) are the most appropriate indicators for taking technological development into account. Unfortunately, this information is only available for certain EU countries, often with insufficient detail, and is entirely lacking for most Mediterranean North African and Middle Eastern countries.

Another approach was suggested by Caddy and Oliver (1996), which analyses resource catch rates calculated from declared landings for each fleet per km² of continental shelf (up to a depth of 200 m). Analysis of mature fisheries shows that catch volume generally increases over time up to a peak and then declines. It can be assumed that this maximum is close to the optimum yield. This analysis is based on the assumption that, at some point in time, the fleets will cover the maximum extent of their fishing zone, in this case the whole continental shelf, which is true for most Mediterranean fleets.

This method is similar to the one used by Garcia (2009) for the World Bank, to examine the state of national fisheries worldwide. It relies on the use of a fishery development cycle, based on the assumption that trends in landings are mainly a reflection of the impact of fishing fleets on the resources. This method has recently been used in a study of the long-term trends for Mediterranean small-pelagic and demersal fisheries (Garcia, 2011), commissioned by Plan Bleu.

By limiting this analysis to demersal species (Table 11), which are more closely associated with the physical characteristics of the continental shelf than pelagic species, it can be seen that – with the exception of Egypt, Algeria, and Malta – the values obtained in 2008 are lower than the peak levels obtained in the past, with a mean of 0.83 t/km² (ratio of total landings to the total surface area of the continental shelves).

Table 11 - Estimated catch rates for demersal species: tonnes landed per km² of continental shelf, by year and by country (MED=Mediterranean area)

Catch rate t/km² of demersal species	1979	1989	1999	2008	Max rate
Albania	0,98	0,72	0,29	0,44	1,01 (1981)
Algeria	0,67	1,27	1,23	2,39	2,39 (2008)
Cyprus	0,39	0,80	0,70	0,52	0,86 (1992)
Croatia	-	-	0,09	0,30	0,30 (2008)
Egypt	0,42	0,89	1,34	1,99	1,99 (2008)
Spain (MED)	1,13	0,87	0,90	0,81	1,28 (1982)
France (MED)	0,78	0,84	0,61	0,43	1,60 (1972)
Greece	0,43	0,68	0,52	0,50	0,96 (1994)
Israël (MED)	1,00	0,84	0,86	0,43	1,66 (1978)
Italy	1,65	1,83	1,30	1,28	2,54 (1984)
Libya	0,04	0,21	0,33	0,22	0,43 (2003)
Lebanon	0,70	0,60	1,49	1,35	1,49 (1999)
Malta	0,23	0,21	0,11	0,22	0,95 (1999)
Morocco (MED)	1,48	1,03	1,76	2,25	2,60 (2006)
Montenegro	-	-	-	0,09	0,09 (2006)
Syria	0,82	1,05	1,53	1,88	2,25 (2005)
Former Yougoslavia	0,13	0,21	-	-	0,21 (1989)
Slovenia	-	-	0,37	0,83	1,39 (2001)
Tunisia	0,58	0,96	0,82	0,60	1,03 (1988)
Turkey (MED)	0,49	2,44	2,00	1,19	2,97 (1988)

Source: FAO FISHSTAT, adjustments by the author; continental shelf estimated surfaces: Aquaculture and Fisheries profiles by country and related programmes CGPM (Copemed, Adriamed, Eastmed, Medfysis)

These results overlap with those from the study cited (Garcia, 2011), which identified, for each country and GSA, periods of growth, stagnation and decline. Garcia's diagnosis is as follows "*an overall stagnation of aggregate production, with relative stability of pelagic species compared with the continuous decline of demersal species from 1990*". Furthermore, he stresses the "*existence of a more advanced stage of development and, unfortunately, of decline in the Western and Northern Mediterranean than in its Southern and Eastern parts*".

2.3.4. Bluefin tuna and other large pelagic species

Yields of these migratory species can be broken down into four main groups: bluefin tuna; swordfish and other billfish; albacore tuna; bonitos and other associated species (Figure 25 and Figure 26). It should be noted that fisheries for these species are managed at the regional level by the International Commission for the Conservation of Atlantic Tunas (ICCAT), which is the main source of data for this part of the report.

Bluefin tuna. Bluefin tuna yields had been constantly increasing since the 1960s, with an acceleration in the early 1990s, driven by the Japanese sashimi market, reaching almost 35,000 tonnes in 1994. After a similarly large fall, landings stabilised. Following a drastic reduction in quotas, landings of bluefin tuna caught by Mediterranean countries in the Mediterranean were down to 15,628 tonnes in 2008, compared with 24,830 tonnes in 2005. Of the 13 countries involved, Tunisia, France and Spain accounted for 50% of the Mediterranean catch. In 2008, Southern Mediterranean countries accounted for 38% of the Mediterranean yield of this species compared with 52% for EU countries. Purse-seine fishing accounted for 78% of catches compared with 14% for drifting longlines.

The presence of two distinct reproductive zones, one in the Gulf of Mexico and the other in the Mediterranean seems to argue for bluefin tuna to be considered as two distinct stocks. However, migration of large individuals between the two Atlantic coasts shows that these two stocks are interdependent.

ICCAT's Scientific Advisory Committee (SAC) estimates the quantity of bluefin tuna catches in the whole of the East Atlantic and Mediterranean Basin to have been between 50,000 and 60,000 tonnes per annum over a decade, i.e. two to three times the stock's current optimum yield. This intense overfishing is mainly due to the development of the floating-cage tuna fattening industry, which is mainly based on catching large brood-stock fish, thus putting the existence of this species in danger.

Consequently, ICCAT's "recovery plan for Eastern bluefin tuna" was adopted in 2006 (in Dubrovnik) for the years 2007-2022, in particular planning bluefin tuna management via quotas, an increase in the minimum size in catches and an overall reduction of the fishing effort and catch capacities.

Swordfish. During 2008, nearly 12,000 tonnes of swordfish and other billfish were landed in the Mediterranean, 98% of which was swordfish. Italy has the largest landings of swordfish, with 38% of the catch, followed by Spain at 17%. EU countries account for approximately 66% of the catch, while Southern Mediterranean countries declare 31%.

Fishing for swordfish started to grow mainly from the 1980s. Over the last 15 years, annual Mediterranean catches have fluctuated between 12,000 tonnes and 16,000 tonnes without showing any particular trend. According to the ICCAT's SAC 2010-2011 report, these relatively high values could be the consequence of high recruitment levels, effective reproductive strategies (spawning areas that are larger than the stock distribution zone), and few large pelagic predators (such as sharks) (ICCAT, 2011).

Albacore tuna. Albacore fishing has developed since the early 1980s with the development of longline fishing. In 2008, landings of albacore caught in the Mediterranean and declared by Mediterranean countries were 2975 tonnes. Italy had the largest landings, accounting for 71% of the yield. Most catches come from longline fisheries. Insufficient data and a lack of statistical information mean that a reliable diagnostic on the state of this resource cannot be produced. Consequently, there are no ICCAT regulations aiming to manage Mediterranean albacore stocks.

Bonitos, little tunny and other tunas. A range of small coastal tuna species are caught, mainly by small-scale artisanal fishing nets and lines, and a few seiners. These seasonal fisheries land 24,460 tonnes annually for the whole Mediterranean. Turkey declares the largest landings at 34%, while Southern Mediterranean countries account for 35% and EU countries 30%.

IV. Inland fisheries in Mediterranean countries

Although the scope of this study is limited to marine activities, it is important to briefly summarise the characteristics of activities which were historically a major source of fishery yields, and remain so in some Mediterranean countries. These activities include professional fisheries on the lakes, rivers and estuaries of Mediterranean countries. While this was significant in the past, it is currently marginal or declining. It mainly concerns cyprinids, salmonids and brackish water species.

While associated with recreational angling, in certain countries (such as Egypt and Lebanon) it provides a significant food supply and source of revenue. For example, Montenegro supplies 1.5% of rainbow trout for the European market. Egypt is the country where this activity is most significant, with an estimated yield of 300,000 tonnes and nearly 40,000 fishermen employed in this activity, mainly using sailing or rowing boats (Table 12).

These yields are the result of professional fishing that generally uses artisanal methods (fish traps, gillnets, hoop nets or fish weirs) but more productive fishing methods are also used in some places, such as encircling nets (e.g. Sea of Galilee).

Table 12 - Freshwater fishery yields and primary employment figures

FRESHWATER FISHERY	Yield (t)	Primary employment	Reference year
Albania	2,000	2,000	2006
Algeria	11	?	2007
Cyprus	-	-	
Croatia	45	?	2006
Egypt	295,000	~40,000	2001
Spain	2,862	?	2006
France	700	?	2006
Greece	21,000	?	2006
Israel	75	130	2007
Italy	3,295	400	2008
Lebanon	365	?	2005
Libya	-	-	-
Malta	-	-	-
Morocco	?	?	?
Montenegro	520	400	2007
Palestine	-	-	-
Slovenia	333	?	2007
Syria	5,000	2,500	2005
Tunisia	-	-	-
Turkey	41,011	7,670	2008

Source: FAO Fishery and Aquaculture Country Profiles, adjustments by author

V. Aquaculture in Mediterranean countries

Aquaculture covers on-shore aquaculture including freshwater fish farming, and marine aquaculture, which includes both seawater and brackish water fish farming and shellfish farming. Aquaculture yields in Mediterranean countries come from both on-shore waters (rivers, lakes, ponds and reservoirs or other artificial bodies of water) and marine and lagoon waters on the Mediterranean or other coastlines (Red Sea, Black Sea, Sea of Marmara and Atlantic).

It thus produces a wide variety of freshwater, brackish water or marine fish, mollusc and crustacean species.

Modern aquaculture in Mediterranean countries started to develop around 1950, with the development of shellfish farming in lagoons. It grew rapidly from 1986, with the development of freshwater and marine fish farming. It is mainly built around taking mollusc larvae (oysters, mussels), fish larvae (sea bass, sea bream) or young fish (bluefin tuna) and raising and fattening them. For bluefin tuna, it can also involve their reproduction.

Aquacultural operations can take various forms from an artisanal family business to more industrial set ups, right up to large groups drawing on foreign investment.

1. Data

As for fisheries, the most reliable source of data for aquaculture is the FAO's FISHSTAT database. The FISHSTAT database gives access to country-by-country yields (in tonnes and in value), with distinctions between species, farming type (freshwater, brackish water or marine) and geographical area (Mediterranean and Black Sea, on-shore waters etc.).

Additional information on the production systems used and the importance of aquaculture in the economy of each country can be found in the FAO country profiles. Data on aquaculture employment in the Mediterranean is not well documented and, where available, is often incomplete or varies between sources.

Mediterranean aquaculture and its specific issues have been studied in several reports and documents published by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) and the GFCM's Aquaculture Committee.

2. Analysis

An analysis of the trends for the various sources of production has been performed on the basis of data from the FISHSTAT database for the period 1950 to 2008. The relative importance of these various sources has been studied for the year 2008, taking into account the fact that on-shore freshwater and brackish water yields are declared at the national level without distinguishing coastline. Therefore, these are aquaculture yields for Mediterranean countries and not yields specific to the Mediterranean basin as such. The difference is significant for countries such as Spain, France, Turkey and Egypt.

Analysis of this data can run into several difficulties, in particular for certain marine (sea bass and sea bream) and diadromous species (eel) or bivalves, which can be produced in a variety of farming environments (freshwater, marine or brackish water) depending on the country.

3. Yields

National yields

In 2008, aquaculture in Mediterranean countries produced yields of 1,663 thousand tonnes, an increase of 89% compared with 1995 (Table 13).

Among those countries practising aquaculture, Egypt (42%), Spain, France, Italy, Greece and Turkey accounted for 96% of yields for Mediterranean countries.

Taking advantage of favourable conditions, Egypt is the country that has had the strongest growth, with the development of semi-intensive aquaculture for mullet (world's leading producer), tilapia (second producer worldwide) and carp in the Nile delta (FAO Fisheries Country Profile). Turkish, Greek, Tunisian and Croatian aquaculture has also benefited from significant growth, as can be seen by comparing yields for 1995 and 2008. In contrast, French and Italian yields have declined (by 15% for France and 31% for Italy).

Table 13 - National aquaculture yields for Mediterranean countries: for the years 1995 and 2008, including bluefin tuna

National aquaculture yields	1995 (t)	2008 (t)
Albania	340	1,858
Algeria	369	2,780
Bosnia and Herzegovina	0	7,620
Cyprus	452	3,403
Croatia	4,007	12,017
Egypt	71,815	693,815
Spain	223,965	249,074
France	280,786	238,512
Greece	32,644	114,888
Israel	16,180	20,017
Italy	214,725	148,977
Lebanon	300	803
Libya	100	240
Malta	904	1,692
Morocco	2,072	1,399
Montenegro	0	669
Palestine	0	65
Slovenia	789	1,315
Syria	5,857	8,595
Tunisia	960	3,328
Turkey	21,607	152,260
Total (rounded numbers)	878,000	1,663,000

Sources: FISHSTAT, FAO Fishery and Aquaculture Country Profiles and national statistics

Yield by environment

It is helpful to analyse aquaculture yields by environment (freshwater, brackish water, marine) and by country (Table 14).

Generally, brackish water yields (mainly tilapias and other cichlids, but also sea bass, sea bream and bivalves) represent 50% of Mediterranean aquacultural production in tonnage and 38% by value.

These brackish water yields grew strongly in the early 1990s, overtaking marine aquaculture yields in 1998 and freshwater yields in the early 2000s (see Figure 28 Left).

For France, Spain, Malta, Cyprus and Libya, aquaculture is mainly performed in marine environments, while Algerian, Bosnian, Israeli, Lebanese, Moroccan and Syrian aquacultural production is mainly in freshwater environments. Egypt, Montenegro and Tunisia chiefly focus on brackish water production (inland salt lakes and coastal lagoons).

Aquacultural production in Southern Mediterranean countries is thus largely freshwater and brackish water based, while that of EU countries is more diversified.

Table 14 - Percentage of aquaculture yields by environment for Mediterranean countries in 2008

National aquaculture yields 2008	Freshwater		Brackish water		Marine	
	Quantity (t)	*Value ($)*	Quantity (t)	*Value ($)*	Quantity (t)	*Value ($)*
Albania	30%	*51%*	51%	*14%*	19%	*36%*
Algeria	80%	*76%*	20%	*24%*		
Bosnia and Herzegovina	97%	*92%*			3%	*8%*
Cyprus	2%	*1%*			98%	*99%*
Croatia	37%	*28%*			63%	*72%*
Egypt	14%	*17%*	86%	*83%*		
Spain	9%	*19%*	1%	*3%*	90%	*77%*
France	17%	*19%*			83%	*81%*
Greece	3%	*4%*	1%	*1%*	96%	*95%*
Israel	89%	*78%*	1%	*1%*	10%	*21%*
Italy	22%	*19%*	39%	*55%*	39%	*27%*
Lebanon	100%	*100%*				
Libya	4%	*2%*			96%	*98%*
Malta					100%	*100%*
Morocco	97%	*95%*			3%	*5%*
Montenegro			82%	*97%*	18%	*3%*
Slovenia	79%	*74%*			21%	*26%*
Syria	100%	*100%*				
Tunisia	34%	*11%*	61%	*81%*	6%	*8%*
Turkey	44%	*31%*			56%	*69%*
Overall	24%	*24%*	50%	*38%*	26%	*38%*

Source: FAO FISHSTAT

Mediterranean lagoon and marine yields

Excluding on-shore yields and those from other coastlines (Red Sea, Atlantic, Black Sea and Sea of Marmara), it can be considered than brackish water and marine yields account for all Mediterranean lagoon and marine aquaculture yields, involving strictly marine species and diadromous species such as eels.

This "Mediterranean" aquacultural production has risen from 4,336 tonnes in the early 1950s to around 415,000 tonnes in 2007-2008, with a value of approximately $2 billion (Figure 28 Right).

Mediterranean marine-species yields

Production strictly marine species include crustaceans, shellfish and marine fish and 26% in tonnage and 38% of the value of aquaculture production in Mediterranean countries, the remainder consisting of species of brackish water and freshwater.

In 1995, it was dominated by shellfish farming (oysters, mussels and other bivalves) which accounted for nearly 80% of yields, while fish farming still only accounted for 21%. By 2008, the situation had switched with 60% of marine aquaculture yields coming from fish farming, mainly demersal species such as sea bass and sea bream (Table 15).

In 1970, aquacultural production represented just 3% of all Mediterranean yields from catches and farming. By 2008, aquaculture accounted for 31% of this total, approaching the levels from marine fisheries for demersal species (34%) and pelagic species (35% excluding tuna), (see Figure 29 Left).

The most rapid growth took place from the late 1980s, mainly due to a strong growth in marine fish farming (nearly 30% per annum between 1988 and 2000), which overtook traditional bivalve mollusc production in 2004 (Figure 29 Right).

Over the last 5 years this growth has slowed, with a slight decrease in the production of diadromous fish (trout) and a plateau in mussel, oyster and clam yields since the early 2000s (Figure 28 and Figure 29).

Table 15 - Aquaculture yields (in thousands of tonnes) for Mediterranean marine species in 1995 and 2008

Marine aquaculture yields (x1000 tonnes)	Crustaceans		Molluscs		Marine fish		Bluefin tuna		Country total	
	1995	2008	1995	2008	1995	2008	1995	2008	1995	2008
Albania		0.0	0.3	1.0		0.3			0.3	1.3
Algeria			0.0	0.0	0.0	0.0			0.0	0.0
Cyprus					0.3	2.7		0.6	0.3	3.3
Croatia			0.2	3.0	0.3	4.5		0.1	0.6	7.6
Egypt MED										
Spain MED	0.1	0.0	0.0	4.1	3.2	23.0	0.0	0.3	3	27
France MED			29.0	22.5	3.7	3.4		0.3	33	26
Greece			10.9	21.1	19.4	89.4			30	111
Israel MED					0.9	2.3			1	2
Italy		0.0	144.0	95.9	9.8	13.3		0.3	154	110
Lebanon										
Libya						0.2				0
Malta					0.9	1.7		0.6	0.9	2
Morocco MED	0.0		0.0	0.0	1.1	0.0			1.2	0
Montenegro				0.2		0.1				0
Slovenia			0.0	0.2	0.0	0.1			0.1	0
Syria										
Tunisia			0.1	0.1	0.4	1.9		0.2	0.5	2
Turkey MED	0.0		0.2	0.2	7.6	82.7		0.1	8	83
Total x1000 tonnes	0.1	0.1	185	148	48	226	0.0	2	233	376

Sources: FISHSTAT, FAO Fish and Aquaculture Country Profile, and national statistics

Despite several attempts at its development, Mediterranean crustacean aquaculture remains insignificant. Mediterranean marine aquaculture was largely accounted for by bivalve farming in 1995 (80%), whereas by 2008 it was dominated by marine fish farming (60%). Greece, Spain, Croatia and Cyprus focus their aquacultural activities on marine fish farming, whereas over 75% of Italian, French, Slovenian, Albanian and Montenegrin aquaculture is shellfish farming.

Generally, EU countries dominate marine aquaculture production (74%), whereas Southern Mediterranean countries only account for 1%; the remaining 25% is mainly produced by Turkey and Croatia.

Employment

Like the fishing industry, aquaculture provides a wide variety of full-time, part-time and seasonal employment, whether in production units or in support activities (fish-meal production, product processing, equipment manufacture and installation), distribution (transport, wholesale, retail etc.) or technical and administrative support (consultancy, product hygiene or administrative services).

However, the data cited in the literature regarding employment in aquaculture is often inextricably combined with that for fisheries and is quoted in a variety of different ways, such as by number of families (for traditional aquaculture), by number of individuals (all sectors combined) or as full-time equivalents (FTE).

Nevertheless, employment in Mediterranean aquacultural production and related activities has been estimated, from FAO-NASO (National Aquaculture Sector Overview) Reports and some data drawn from the literature, at approximately 123,000 permanent jobs for 2005 to 2010 (Table 16).

Table 16 - Farms and total number of employers in the Mediterranean aquaculture

AQUACULTURE	Farms Number	Total number of employers	Year reference	References
Albania	*50*	2,500	2009	NASO2006-2012
Algeria	10	100	2006	NASO2006-2012
Cyprus	20	250	2009	NASO2006-2012
Croatia	335	1,670	2010	NASO2005-2012
Egypt	6,000	68,000	2009	NASO2003-2012
Spain MED	200	3,060	2008	ESTATISCAS, 2010 OESA, 2010
France MED	620	1,660	2008	MAAPA2009
Greece	1,500	9,880	2008	ELASTAT2009
Israël	60	600	2006	NASO2006-2012
Italy	907	7,770	2006	Barazi-Yeroulanos, 2010 Cataudella, 2005
Lebanon	200	800	2005	NASO2005-2012
Libya	10	140	2006	NASO2006-2012
Malta	9	964	2009	NASO2005-2012
Morocco MED	2	40	2005	NASO2006-2012
Montenegro	42	170	2009	NASO2009-2012
Palestine				
Slovenia	277	230	2009	NASO2005-2012
Syria	2,060	12,000	2006	NASO2008-2012
Tunisia	54	1,000	2006	CTA/NASO2006-2012
Turkey	356	12,000	2010	NASO2005-2012
TOTAL (rounded values)	12,700	123,000		

Sources: NASO : FAO National Aquaculture Sector Overview. http://www.fao.org/fishery/countrysector
OSEA : Observatoire de l'agriculture (Espagne) http://www.fundacionoesa.es/la-fundacion/
MARM : Ministère en charge de la Pêche (Espagne) http://www.mapa.es
MAAPA: Ministère en charge de la Pêche (France) http://agriculture.gouv.fr/
ELASTAT: Office statistique (Grèce) http://www.statistics.gr
CTA : Centre Technique d'Aquaculture (Tunisie) : http ://www.ctaquaculture.tn/

Egypt accounts for approximately half of aquacultural businesses and permanent jobs. Outside Egypt, aquacultural installations in Southern Mediterranean countries only account for approximately 20% of sites and permanent jobs according to the sources consulted, while EU countries account for 28% of installations and 18% of jobs.

Aquacultural products are destined either for home consumption and local markets, especially for freshwater and brackish water fish-farm yields, such as in Egypt, Israel and Albania, or for export (e.g. Greece and Tunisia).

Bluefin tuna aquaculture. Tuna-fattening farms first appeared in the South of Spain in the mid-1990s. The purpose of these facilities is to meet the demand of the Japanese market for bluefin tuna with high fat content, to produce the best sashimi. Each farm employs between 50 and 90 people, depending on season and intake. After transferring live tuna from the tuna seine to a floating cage, the cage is towed to the fattening farm where the tuna are fattened over a period of a few months to two years. It takes 15 to 20 kg of forage fish (mainly small pelagic species) to produce 1 kg of tuna, which corresponds to an intake of 40 to 50 tonnes a day for a 6-cage farm.

The ICCAT Record of Bluefin Tuna Farming Facilities (FFB No.) includes 67 facilities with a total capacity of 60,000 tonnes[11]. The majority of these are located in EU countries. It should be noted that of the 42 farms in the EU that had received an authorisation, only 16 (with a total capacity of 16,000 tonnes) were active in 2008: 5 in Italy, 5 on Malta, 3 in Spain, 2 on Cyprus and 1 in Greece (ECORYS Nederland BV, 2010). The other farms are located in Turkish, Croatian, Tunisian and Libyan waters.

[11] http://www.iccat.int/en/ffb.asp.

This technique is currently controversial, and in particular criticised by ecological bodies, because it blurs yield counts and indirectly increases pressure on juvenile bluefin tuna as well as on small pelagic species, as can be seen with the development of sardine seiner fleets.

Currently, research efforts are underway in Spain, Greece and France to try and develop a complete farming system, aiming to manage bluefin tuna spawning in captivity, larvae farming and the production of juveniles, as well as developing suitable feedstuffs, independent of fishery yields.

VI. Fisheries and aquaculture in the economy

1. Consumption

Buyers potentially have three sources of supply for fish products: local catch yields, aquacultural produce and imports, whether this is for direct consumption (fresh, chilled or frozen) or for processing for later human consumption. Subtracting exports from these three sources gives the fish supply, also called the apparent consumption; in this study, this figure is expressed in kg per person per year.

1.1. Data

The FAOSTAT[12] database gives access to annual data from 1961 to 2007 on fish supply per country and per type, in particular making such distinctions as "fish and shellfish, marine fish and other fish, pelagic species, freshwater fish", which means that indicators such as total fish supply or total fish supply per capita can be extracted.

The values for 2008 were calculated on the basis of FISHSTAT data for fishery and aquaculture yields, quantities imported/exported and population figures for the chosen countries from the World Bank database. For countries with other coastlines (Morocco, Spain, France, Egypt, Turkey and Israel), consumption levels specifically associated with Mediterranean regions cannot be distinguished from total national consumption levels. It should be noted that the market value of this fish supply was not estimated.

1.2. Analysis

We chose to analyse the apparent consumption per capita, firstly making a distinction between freshwater and marine species for all Mediterranean countries, then taking the mean consumption values for each country and region for pelagic and demersal species.

1.3. Results

Across all Mediterranean countries, apparent consumption per capita for all freshwater and marine fish products has been growing since 1961, as shown by the mean quantity for each country, rising from an initial 7.7 kg per capita to 19 kg per capita in 2007 (Figure 30).

As can be seen, the consumption of marine products dominates substantially, with demersal species being the most common (61% in 2007). After a period of slight decline from the 1960s to the 1980s, the proportion of pelagic species among marine species consumed has since increased (almost 39% in 2007). Two reasons seem to explain this last trend: an increase in price of demersal species and increased marketing of "medium and large" pelagic species (corphaenas, bonitos and tunas), associated with the development of pelagic fishing practices (encircling nets, semi-pelagic trawling gear and longlines).

The large proportion of demersal species in consumption is associated with the dietary habits of Mediterranean populations and, in particular, their taste for fresh fish, combined with a certain distrust of small pelagic species (anchovies, sardines and sardinellas) which can quickly spoil and for this reason are generally destined for the canned/preserved food market. With improving standards of living and the development of tourism in the Mediterranean, it can be assumed that this tendency will accentuate, making demersal-species consumption increasingly dependent on imports, given the continual decline of this group of species in catches.

[12] http://faostat.fao.org/site/609/default.aspx#ancor

Table 17 - Comparison of apparent consumption of aquatic produce (pelagic, demersal and freshwater species) and total yields (from fisheries and aquaculture) by Mediterranean country in 2008

Country	Population 2008	Per capita consumption 2007	Total estimated consumption 2008	Total aquatic produce yield 2008	Yield to consumption ratio 2008
	(x1000)	kg per capita	t	t	%
Albania	3,144	5	15,720	6,815	43%
Algeria	34,374	5	171,870	141,611	82%
Cyprus	870	15	13,050	5,392	41%
Croatia	4,440	23	102,120	61,006	60%
Egypt NAT	81,530	17	1,386,010	1,498,183	108%
Spain NAT	45,600	40	1,824,000	1,130,766	62%
France NAT	62,300	35	2,180,500	692,919	32%
Greece	11,240	21	236,040	218,852	93%
Israel NAT	7,310	10	73,100	21,838	30%
Italy	59,900	24	1,437,600	366,504	25%
Lebanon	4,194	10	41,940	4,709	11%
Libya	6,295	10	62,950	47,885	76%
Malta	412	30	12,360	2,973	24%
Morocco NAT	31,606	10	316,060	990,341	313%
Montenegro	623	9	5,607	1,760	31%
Palestine	1,500	9	13,500	2,886	21%
Slovenia	2,022	5	10,110	2,329	23%
Syria	20,582	2	41,164	16,807	41%
Tunisia	10,328	13	134,264	99,262	74%
Turkey NAT	73,920	7	517,440	577,176	112%
Total	462,190	18.6	8,595,400	5,890,000	69%

Sources: FAOSTAT and the World Bank

In 2008, the mean consumption of aquatic produce in Mediterranean countries was 18.6 kg per capita. Six countries were above this average: Spain (40 kg per capita), France (35 kg per capita), Malta (30 kg per capita), Italy (24 kg per capita), Croatia (23 kg per capita) and Greece (21 kg per capita), (see Table 17).

The highest levels of aquatic produce consumption, with a mean of 22 kg per capita, are found in EU countries, while Southern Mediterranean countries only consume 9 kg per capita (Figure 33 and Figure 35).

Analysis per type of produce (Table 18) shows that the relative share of pelagic and demersal species in this consumption varies between countries: while Turkey, Algeria, Syria and Morocco are strong consumers of pelagic fish, EU countries like Spain, France and Italy consume more demersal species.

The increase in consumption in EU countries slowed in the late 1980s and consumption started to decline in the early 2000s, while in certain Southern Mediterranean countries, such as Algeria and Libya, consumption continues to increase.

The availability of marine produce can be affected by external events which may either prevent fishing or limit trade (such as for former-Yugoslav countries, Palestine, Israel and Syria).

Finally, with the exception of Morocco, Egypt and Turkey, no Mediterranean country covers its aquatic produce consumption by its aquacultural and fishing yields, which makes them highly dependent on imports (Table 17). Mediterranean countries as a whole produce approximately 70% of their consumption. EU countries only produce 42% of their consumption from their aquaculture and fisheries, with the largest deficit probably affecting demersal species.

Table 18 - Consumption rates for various aquatic species (in kg per capita), by country in 2007

Country	Freshwater species	Pelagic species	Demersal species	All species
Albania	1	3	2	5
Algeria	-	4	1	5
Cyprus	2	6	15	23
Croatia	1	8	5	15
Egypt	7	3	7	17
Spain	3	10	28	40
France	4	8	23	35
Greece	2	3	17	21
Israel	4	4	13	21
Italy	2	5	17	24
Lebanon	1	3	5	9
Libya	-	5	5	10
Malta	2	15	13	30
Morocco	-	5	4	10
Slovenia	1	3	6	9
Syria	1	1	-	2
Tunisia	-	9	4	13
Turkey	1	4	2	7

Source: FAOSTAT

2. Markets

The market for marine produce in Mediterranean countries involves not only Mediterranean yields but also trade with neighbouring countries and bordering regions or other parts of the world, as well as the yields of Mediterranean fleets operating on other seas (such as the Atlantic or the Black Sea). Trade is hard to monitor, as many Mediterranean commercial hubs serve as transit zones for other destinations in or outside the Mediterranean region (for shrimp, cod, shark etc).

2.1. Data

The quantities of fish exported or imported in tonnage and dollar value have been from the FAO's FISHSTAT database. They originate in the customs records of the various countries. They cover all imports and exports with no distinction by regional origin or destination of the produce.

All commercialised marine origin produce has been selected, excluding tunas and inedible products (such as sponges and corals).

2.2. Analysis and Results

Import and export data for the selected produce for 2008 shows a trade deficit of $11.4m for Mediterranean countries as a whole, corresponding to a deficit of 2.1 million tonnes (Table 19).

Among the countries studied, only Morocco, Turkey, Tunisia and Libya have a trade surplus, mainly because of the price advantage enjoyed by their exports.

Morocco's trade surplus is highly dependent on the volume of its Atlantic production.

The countries with the largest trade deficits are Italy, Spain and France, responsible for 75% of the deficit on marine produce in the Mediterranean (in dollars). It should be noted that these countries are also major exporters (Figure 37 and Figure 38).

Indeed, the main exporting countries in order of importance are Spain, Morocco, France, Greece and Italy, both in terms of quantity (together they account for 93%) and value (91%). The fleets of these five countries account for 48% of vessels (all coastlines together), but less than 20% of registered fishermen.

The main importing countries are Spain, France, Italy and Greece, both in terms of quantity (together they account for 82% of imports to Mediterranean countries) and value (92%). The national populations of these four countries account for 39% of the total population of Mediterranean countries.

EU countries account for 77% of trade tonnage and 83% of trade value.

Comparison of changes in tonnage imports and exports for the Mediterranean as a whole shows a regular increase since the 1970s, with a gradual increase in the deficit (Figure 34). The increase in the value of imports since 2004 is striking.

Apart from Morocco, all countries import more than they export in tonnage terms. However, the trends in balance of trade (Figure 35 to Figure 39) vary from country to country: some have a large trade deficit (e.g. Cyprus, Italy, Egypt, Israel) often with a rapid increase from 2002-2006 (e.g. Egypt and France), others are relatively balanced (e.g. Croatia, Greece, Malta and Turkey).

Table 19 - Quantities and values for imports and exports of marine produce per country, with corresponding balance of trade

2008	Exports		Imports		Exports - Imports	
Units	(x1000 t)	(x1000 $)	(x1000 t)	(x1000 $)	(x1000 t)	(x1000 $)
Albania	0.334	2.2	9.2	24.3	-8.9	-22
Algeria	2.1	10.7	12.8	22	-11	-11
Cyprus	1.4	12.2	22.4	69.4	-21	-57
Croatia	25.6	86.6	48.3	102	-23	-15
Egypt	6.6	10.3	178	276	-170	-270
Spain	591	2,090	1,120	5,230	-530	-3,100
France	226	1,160	697	3,600	-470	-2,400
Greece	104	588	216	637	-110	-49
Israel	1.2	19.1	43.5	159	-42	-140
Italy	102	470	643	3,470	-540	-3
Lebanon	0.1	891	17	57	-17	-56
Libya	3	11.7	3.6	11.1	-0.5	0.6
Malta	1	58	23.4	34.6	-22	-29
Morocco	474	1,650	64.3	55.6	409	1,590
Montenegro	0.03	0.3	3.5	11	-3.5	-11
Palestine	-	-	-	-	-	-
Slovenia	3.3	14.5	12.4	50.1	-9.1	-36
Syria	0.03	0.2	14.6	34.8	-15	-35
Tunisia	18.2	135	27.2	39.4	-8.9	95.4
Turkey	53.4	254	118	148	-64	106
Total	2,320	7,200	4,440	18,600	2,100	11,400

Source: FISHSTAT

3. Employment

Employment in industries related to marine produce from fisheries and aquaculture can be analysed with reference to the three broad sectors of the economy[13]:

- Primary-sector employment corresponds to activities associated with extracting natural resources, notably fishing fleets and aquaculture facilities.
- Secondary-sector employment corresponds to activities associated with the processing of raw materials from the primary sector. This includes shipyards and equipment manufacturers, which supply the fishing and aquaculture industries, and processing industries and wholesaling, which are supplied by them.

[13] http://www.insee.fr/en/methodes/default.asp?page=definitions

- Tertiary-sector employment, i.e. all service industries with some connection to the sector, includes administrative services for management, public and private technical assistance, the banking sector and tourism.

3.1. Data

For Mediterranean countries, **primary-sector employment** is generally poorly documented in national statistics or is often inextricably combined with Agriculture. The quality of information that can be gathered depends on the existence of reliable systems for recording employment data, but these have only been partially implemented in Mediterranean countries. Where data is available, it is often to be treated with caution. Indeed, employment in fisheries and aquaculture is often seasonal or shared with other business sectors. FAO Fishery and Aquaculture Country Profiles generally give information on primary- and secondary-sector employment, and rarely on tertiary-sector employment. The data can be quite old (more than 5 years). For countries with more than one coastline, the Mediterranean is not generally distinguished from national data. Primary-sector employment in fisheries depends on the active periods for fishing vessels. Seasonal recruitment and the widespread lack of employment contracts mean that in extended periods of bad weather, during breakdowns or when fishing practices change, crews are often "landed". During these periods of inactivity, fishermen may work elsewhere (such as in the port, agriculture, industry or tourism).

Secondary-sector employment, with the exception of marine produce processing and wholesaling, is less specific to fishing and can serve other economic sectors. For example, shipyards and equipment manufacturers also serve the yachting sector.

For **tertiary-sector employment,** data gathering is also affected by difficulties in assessing the employment generated in sectors such as restaurants, retail and transport. Even where given, the criteria for assessing indirect employment from aquatic production are often subjective and vary between countries.

3.2. Analysis and Results

According to our estimates based on various sources (World Bank, national statistics offices), in 2008, in the administrative regions (or equivalent) bordering the Mediterranean there was a total population of 157 million (Table 2) with an economically active population of almost 72 million, which corresponds to a ratio of economically active population to total population of 0.46 (Table 20).

On the basis of the data gathered, and with an awareness of the multiple limitations mentioned above on the quality of this data, this study estimates that in 2008, less than 587 000 people were employed in the primary and secondary sectors of Mediterranean fisheries and aquaculture. This represents approximately 0.5% of the economically active population in Mediterranean regions.

As far as possible, fisheries and aquaculture have been distinguished within the primary sector, where fisheries accounted for 43% of the employment in 2008, compared with 21% for aquaculture.

Egypt is the country where fisheries and aquaculture provide the largest number of jobs (22% of the Mediterranean Basin total), followed by Tunisia (16%), Italy (11%) and Algeria (10%).

Southern countries (excluding Egypt) cover 43% of this number reported being employed in the Mediterranean fisheries and aquaculture, including nearly half by the three Maghreb countries, in comparison, EU member countries n 'possess only 27%.

All secondary-sector employment account for 37% for without distinction. The relatively low rates of secondary-sector employment stem from the weakness of the Mediterranean processing industry, which only accounts for 14% of total employment in the marine produce industry (European Communities, 2006). The canning sector has considerably declined in the Mediterranean since the early 1970s. Mediterranean demand, with a preference for fresh fish, has remained limited to sardine and anchovy canning in countries with low labour costs (Morocco, Algeria and Tunisia). The employment is often seasonal, dependent on the quantities landed for processing and in many cases unreported.

The shipyards and equipment manufacturers that supply the industry, largely rely on trawling and encircling-net fishing, and have also been affected by the increased fuel costs and falling stocks, and have largely had to turn to other sectors such as yachting.

Table 20 - Distribution of employment by sector and by country in 2008

Countries	Primary Employment fishing	Primary Employment aquaculture	Secondary Employment fishing & aquaculture	(E)Total employment fishing &aquaculture	(A) Coastal Labor force 2008	Ratio E/A
Albania	990	2,500	1,600	5,090	868,600	0,59%
Algeria	39,000	100	19,200	58,300	6,663,600	0,87%
Cyprus	930	250	150	1,330	495,700	0,27%
Croatia	15,000	1,670	8,000	24,670	648,600	3,80%
Egypt MED	18,000	68,000	45,000	131,000	11,449,700	1,14%
Spain MED	8,900	3,060	5,700	17,660	9,525,400	0,19%
France MED	2,500	1,660	800	4,960	3,231,900	0,15%
Greece	21,400	9,880	3,200	34,480	5,230,200	0,66%
Israel	1,500	600	2,300	4,400	2,029,100	0,22%
Italy	30,500	7,770	29,400	67,670	13,462,600	0,50%
Lebanon	8,500	800	3,200	12,500	1,142,900	1,09%
Libya	7,700	140	3,500	11,340	2,419,800	0,47%
Malta	2,100	960	1,200	4,260	208,100	2,05%
Morocco MED	16,250	30	15,000	31,280	1,354,500	2,31%
Montenegro	510	170	300	980	74,400	1,32%
Palestine	3,300		1,100	4,400	677,800	0,65%
Slovenia	440	230	100	770	63,000	1,22%
Syria	4,000	12,000	18,600	34,600	766,500	4,51%
Tunisia	49,000	1,000	46,000	96,000	2,952,800	3,25%
Turkey MED	19,000	12,000	9,900	40,900	9,095,700	0,45%
Total (rounded values)	250,000	123,000	214,000	587,000	72,361,000	0,81%

Legend: (rounded values); primary-sector employment (registered fishermen for fisheries); secondary-sector employment in fisheries and aquaculture; (E) = primary-sector employment + primary-sector employment in aquaculture + total secondary-sector employment; (A) = economically active population in coastal regions in 2008; ratio E/A = percentage of the Mediterranean coastal-region economically active population employed in the sector.

Sources: FCP (Fishery Country Profile); MPRH (Algerian Ministry for Fisheries); MCMH (Slovenian Ministry of Culture and Health); TURKSTAT (Turkish Statistical Institute); Eurostat; HCP (Moroccan High Planning Commission); INSTAT (Albanian National Statistics Office).

Note: For Egypt: the value of 300,000 secondary-sector jobs given in FCP 2001 seems to be an overestimate; the value given here was calculated from the mean ratio of secondary-sector employment to total employment given for other countries. Economically active population numbers were calculated on the basis of NUTS2-level ratios of economically-active population to total population for Albania (Instat), the EU (Eurostat), Morocco (HCP), Turkey (TURKSTAT), and from national statistics for other countries (World Bank) multiplied by the populations of the Mediterranean coastal regions (Table 2).

Total employment in the whole industry accounts for approximately 0.82% of the economically active population in Mediterranean countries (Table 20).

Most Mediterranean countries have a ratio of direct employment in fisheries and aquaculture to the economically active population in coastal regions of less than 4%, the exception being Syria (4,5%). This ratio is however more important for Southern Mediterranean countries (1.4% without Egypt) and especially the Maghreb countries (1.7%) than in EU countries (0.5%).

Assuming the existence of around 20,000 small-scale artisanal fishermen not counted in national statistics, to which could be added a certain number of non-declared jobs in aquaculture and around 30,000 seasonal jobs in the secondary sector, the total number of jobs created by fisheries and aquaculture may reach 700,000, i.e. approximately 10% of the economically active population in Mediterranean coastal regions. It should be noted that indirect employment created by the marine produce industry, i.e. jobs created indirectly in the wider economy due to these activities, has not been taken into account.

4. Economic value of fisheries and aquaculture

4.1. Data

Gross sales of produce to the initial buyer can be an adequate indicator of the economic importance of fisheries and aquaculture, since it provides a direct measure of the revenue from the production activities (Franquesa, 2008). Unfortunately, while the FISHSTAT database supplies the value of yields for aquaculture by country, it does not do the same for fisheries, which require that all available sources of information (such as national statistics offices, ministries responsible for fisheries and monographs) be researched.

The contribution these sectors make to a country's GDP is an indicator that only takes the added value of production into account, i.e. output less intermediate consumption. However, to calculate this it is necessary to have access to data on profits and costs which affect the whole industry (salaries, fuel costs, various other operating costs and depreciation), as well as sales volumes and the value of any aid and subsidies that may be allocated. This information is supplied by national statistics offices, but is often aggregated with agricultural production with no specific information for fisheries and aquaculture.

Finally, the ratio of added value or earnings to and labour provides an indicator for comparing the economic performance of different categories of activity. However, in order to take into account that much work in fisheries and aquaculture is part time, employment must be expressed as Full-Time Equivalent (FTE) or as Annual Work Units (AWU)[14]. It is rarely possible to estimate earnings to labour, either because employment estimates are poor, as in most countries where a significant amount of the work is part-time, or because the various operating costs cannot be assessed.

4.2. Results

On the basis of the various sources consulted, the gross value of marine produce from lagoon and marine fishing and aquaculture in Mediterranean countries is estimated at $6,259m for 2008 (Table 21).

Italy, Greece and Turkey together generated 57% of this value. EU countries accounted for 64% of total sales value of Mediterranean marine yields, while Southern Mediterranean countries only accounted for 34%.

In 2008, marine- and lagoon-species aquaculture accounted for 26% of the total sales of marine yields (by value), with gross revenue of $1,652m.

Although there is no sufficiently reliable data available on the value of yields prior to 2008, it can be assumed that the rapid development of marine fish farming has significantly contributed to an increase in combined revenues from Mediterranean fisheries and aquaculture, despite the tail off in catches in recent years.

[14] AWU is the unit of labour adopted in the EU system for national accounts (SEC95), http://circa.europa.eu/irc/dsis/nfaccount/info/data/index

Table 21 - Value of marine and lagoon fisheries and aquaculture produce for the Mediterranean coastlines of the main Mediterranean countries

FISHERIES & AQUACULTURE 2008	MED fisheries 2008	MED aquaculture 2008	Total yields 2008	Aqua. / Total yield values	Sources
Gross values	(millions of dollars)			%	
Albania	13.8	3.1	16.9	18%	FAO FCP-NASO; INSTAT
Algeria	548.0	0.1	548.1	0%	FAO-NASO; MPRH
Bosnia and Herzegovina		1.8			FAO FCP-NASO; INSTAT
Cyprus	64.8	38.4	103.2	37%	FAO-FCP –NASO; MANRE
Croatia	419.5	29.8	449.3	7%	FAO FCP –NASO; CBS Fredotovic, Misura, 2002
Egypt		0.0	0.0		GAFRD Rahman El Gamal, 2010
Spain MED	354.0	149.0	503.0	30%	FAO-NASO; MMAMRM
France MED	322.8	102.0	424.8	24%	DPMA Agrimer
Greece	577.0	522.3	1,099.3	48%	FAO-NASO; ELSTAT
Israel	16.7	16.6	33.3	50%	FAO-NASO; MOAGV
Italy	1,565.0	307.2	1,872.2	16%	FAO-NASO; IREPA
Lebanon	No estimate	0.0			FAO-NASO
Libya	136.9	1.1	138.0	1%	FAO-NASO; PANAPRESS; MBC 2007
Malta	12.6	9.9	22.5	44%	FAO-NASO; NSO; EC; MRRA
Morocco MED	21.2	0.3	21.5	1%	FAO-NASO; MADRPM
Montenegro	5.9	0.9	6.8	13%	FAO-NASO; MAFWM
Palestine	No estimate	0.0			
Slovenia	2.2	1.3	3.5	38%	FAO-NASO; MCMH
Syria	241.9	0.0	241.9	0%	FAO-NASO; CBS
Tunisia	150.6	18.9	169.5	11%	FAO-NASO; MARH
Turkey MED	156.0	449.4	605.4	74%	FAO-NASO; TURKSTAT
Total MED	4,609	1,652	6,259	26%	

Sources: FAO NASO for Total yields; FAO FCP 2008; national statistics offices and ministries responsible for fisheries (see Appendix I); (*) = estimated values.

4.3. Added Value and contribution to GDP

Not all countries provide data regarding the Added Value generated by fisheries and aquaculture. Data is available for EU countries and members of the OECD, which provides additional information for Israel and Turkey, and a few other countries such as Morocco and Albania (see FAO-FCP and national statistics). This data can be used to estimate the direct contribution of these sectors to the GDP of the countries. For the cases mentioned, this contribution is small (generally less than 1% and, at best, 2.5% of GDP in the case of Morocco). Generally, this estimate does not take into account induced and indirect economic impacts (such as the impact on regional mechanical industries and restaurants). This would require specific research that few countries in the region have yet undertaken.

The small size of this contribution should not lead to the significance of fisheries being underestimated, in particular for isolated coastal communities where it is often the only major socio-economic activity. Indeed, it is acknowledged that GDP is an inadequate measure of wealth, to the extent that it excludes from its measurement a number of non-commercial aspects that are essential to social and individual well-being, such as the cultural and social value of food production.

Added Value is also of interest for assessing the economic performance of the sector and, in particular, the income generated by these activities. However, for this, it would be necessary to estimate other key factors such as labour costs and subsidies, which are even more difficult to assess outside EU and OECD countries.

4.4. Comparison of the economic performance of the various practices

Given the difficulties encountered in performing a comprehensive analysis of the significance of fishing in the Mediterranean economy, we have decided to limit ourselves here to presenting case studies for two countries with significant economic weight, Spain and Italy.

4.4.1. Spain

In its two-yearly fisheries and aquaculture report, the Spanish Ministry for the Rural and Marine Environment (MARM) publishes a set of detailed statistics on the revenues and profits (i.e. the value of yields less allowable costs) for various fishing practices.

An analysis of the data for 2008 for the Spanish fishing fleet operating in the Mediterranean shows that the rate of return, expressed as the ratio of revenue to Annual Work Units (AWU), for large seiners (over 24 m long) is four times higher than for other categories, which have similar performances. This difference could be explained by the fact that this category seems to include vessels practising seasonal bluefin tuna seine-net fishing and, generally, more ocean-going fishing than other sectors (Table 22).

It should be noted that small-scale artisanal fishing, although penalised by its low productivity, has a rate of return similar to that of semi-industrial fisheries.

The trawler fleet performs least well, due to rising fuel costs and an apparent drop in yields.

Table 22 - Economic performance of the Spanish fishing fleet operating in the Mediterranean by fishing-practice group for 2008

Spain MED 2008	Number of vessels	Total revenue (x1000 €)	Number of fishermen	AWU	Revenue per AWU (x1000 €)
Trawlers	838	49,530	3,480	3,687	13.4
Seiners	233	25,394	1,938	1,586	16
Seiners > 24 m	20	10,301	244	149	69.1
Polyvalent vessels > 12 m	256	11,859	906	814	14.6
Small-scale artisanal fishing	1,549	17,270	1,852	1,210	14.3
Total	2,896	114,355	8,420	7,446	15.4

Source: Spanish Ministry for the Rural and Marine Environment (MARM)

4.4.2. Italy

The Italian Institute for Economic Research in Fisheries and Aquaculture (IREPA) also publishes an annual report on the socio-economic status of Italian fisheries at the national and regional levels. Its presentation of the economic performance of the various fishing practices is different from the Spanish assessment and based on estimating Added Value and profits (Table 23).

For 2008, the per-vessel calculation for these indicators shows that midwater pelagic trawlers and longliners produced the highest gross-profits. On the other hand, hydraulic dredgers and longliners produced the highest profits per fisherman onboard.

Table 23 - Mean economic performances for Italian fishing-practice groups, calculated per vessel for 2008

Italy 2008	No. of vessels	No. of fisher-men	Per-vessel yield (t)	Reve-nue (x1000 €)	Interm. costs (x1000 €)	Added Value (x1000 €)	Labour costs (x1000 €)	Gross profit (x1000 €)
Small-scale fishing	8,831	2	4	29.1	10	19	8	10
Passive polyvalent vessels	427	2.9	12.4	92.4	31	62	24	38
Trawlers	2,667	3.3	30.3	204.9	117	88	44	43
Midwater trawlers	155	4.6	227.5	329.6	168	162	83	79
Hydraulic dredgers	698	2.0	38.4	93.2	28	65	28	36
Seiners	305	7.5	97.0	227.0	104	123	61	62
Longliners	233	4.0	24.0	196.7	85	112	34	78
Polyvalent vessels > 12 m	59	3.7	7.9	52.2	35	18	10	8

Source: IREPA 2008

VII. Conclusion and recommendations

As a contribution to Plan Bleu's programme on the sustainability of Mediterranean marine economic activities, the primary objective of this study was to perform a diachronic analysis of the Mediterranean fishery and aquaculture sectors, examining their socio-economic and environmental characteristics. Through this analysis, sustainable-development indicators have been identified and recommendations for public policy proposed.

As the main indicators of trends in these two activities are their yields and the quantity of human and material resources used, annual data series were compiled from the FAO's FISHSTAT database, Eurostat, national statistics for each country and private sources of information. Furthermore, to allow comparison between each type of practice and each country, data for 1995 and 2008 was taken as benchmark values.

However, this data compilation task was impeded by the inaccuracy of some official data sources, in particular regarding fleet capacities, the origin of catches by fishing practice and the extent to which small-scale artisanal fishing was covered in the statistics. These gaps highlight both the usefulness and scale of the task undertaken by the GFCM and the FAO's Mediterranean regional programmes (such as CopeMed, AdriaMed, MedSuMed and EastMed) on the implementation of a standardised system for gathering statistics from each geographical sub-area (GSA).

The year-on-year analyses given here describe trends for fishery landings and aquaculture yields, by species group and environment type, over more than fifty years and trends for the number of vessels and fishermen per fishing-practice group over more than fifteen years.

Marine fisheries in the Mediterranean. Analysis of trends on yield data shows a certain consistency in the distribution between pelagic and demersal species, which each account for approximately half the yield. However, a downturn in landings of demersal species has begun to be observed over the last 15 years. This trend is confirmed by changes in the demersal catch rates per unit surface area of continental shelf, which has peaked in many national fisheries, in particular for North-Western Mediterranean countries.

Among pelagic species, increases in landings of small pelagic species (sardines, anchovies and sardinellas), which are the largest component, do not seem to be slowing, excluding the year-on-year fluctuations inherent to these species. As the country-by-country analysis shows, small pelagic species represent a large and increasing share of the yields for Southern Mediterranean countries, in particular Morocco, Algeria and Tunisia where these species currently account for over 40% of their marine fishery landings. In contrast, yields of small pelagic species for EU fleets, which represent about 30% of landings, show the same declining trend as for demersal species. The conjunction of the respective trends in landings of these two groups of species has led to a stagnation of the whole Mediterranean production, since its maximum of 1 million tonnes achieved in the mid 90s.

Country-by-country trends in fleet numbers, analysed as an indicator of their fishing capacity, show a slight but persistent increase in the number of vessels for all segments in Southern Mediterranean countries. The significant increase in the number of small-pelagic seiners highlights the size and dynamism of this sector in the fishery economies of Southern Mediterranean countries in general, and Morocco, Algeria, Tunisia in particular.

In contrast, the number of fishing vessels in EU countries fell rapidly from the early 1990s, under the dual effect of the European fleet reduction programme implemented in 1992[15] and the declining interest in small-scale artisanal fishing. This sector, which has seen numbers decline by 30%, has not benefited from the almost 50% reduction in the EU trawler and seiner fleets since the late 1980s.

As for all small-scale Mediterranean fisheries, the reasons that can be cited for the lack of growth are both structural and economic. The small vessels of these fleets, with small engines, practise their polyvalent

[15] EU Multi-Annual Guidance Programme III (1992-1996), cf.: http://www.europarl.europa.eu/factsheets/4_2_3_fr.htm

operations along a relatively narrow coastal strip (less than 20 nautical miles wide), often in competition with other maritime activities such as transport and yachting.

To date, small-scale artisanal fishing fleets have rarely been taken into account in development policies and benefited little from the technological progress enjoyed by semi-industrial fisheries. However, the recent development of "polyvalent vessels longer than 12 m" should be noted. These are often longliners specialising in high-value pelagic species on the continental slope, and their numbers doubled in the Mediterranean between 1990 and 2008, rising to approximately 1,550 vessels. In addition, individual landings from small-scale fishing, with high diversity and low quantity, fail to meet the criteria of a market mainly developed around the mass yields from trawlers and seiners.

In all events, given these issues and the GFCM's diagnostics, it can be assumed that marine fishing is currently in a crisis situation which leaves no hope for an increase in yields for many years, having apparently exceeded the optimum capacity for most stocks.

On-shore fisheries in Mediterranean countries. Although less important than in the past, professional on-shore fisheries still represent a non-negligible share of aquatic production for Mediterranean countries. This is particularly true for Egypt, Greece and Turkey, where yields are probably higher than 740,000 tonnes, mainly tilapia, carp, trout, eel and other diadromous species. It is practised on rivers, estuaries, reservoirs and various other bodies of water, but remains limited due to environmental and water-quality problems in particular.

Freshwater and marine aquaculture in Mediterranean countries. After developing out of traditional shellfish farming and freshwater and brackish water fish farming, aquaculture is the activity that has grown most strongly from the 1990s, with the rapid development of marine fish farming, whose production has caught up with that of freshwater farming in recent years. In 2008, aquaculture produced more than 1,100 thousand tonnes, of which 20% was marine fish. It is strongly dominated by the freshwater and brackish water aquaculture of Eastern Mediterranean countries (Egypt, Syria and Israel) and certain Balkan countries, such as Slovenia, Montenegro and Albania.

Marine aquaculture, three-quarters of which is accounted for by EU countries, currently supplies 45% of total demersal species production, exceeding shellfish yields in tonnage terms.

The differences in the trends in this sector between Southern Mediterranean and European countries is explained by the history of aquacultural development in these regions, as reconstructed from the FAO's Fishery Country Profiles. Although it started with the development of small family farms requiring little capital and using traditional skills, aquaculture has gradually industrialised with the development of intensive marine fish farming, using increasingly sophisticated techniques that require qualified staff. While the former system is still characteristic of the traditional freshwater and brackish water aquaculture of the South-Eastern Mediterranean, the latter more profitable form is increasingly being developed in these regions.

Supply and demand. Currently, fisheries and aquaculture yields only cover 70% of the aquatic-produce requirements of Mediterranean countries. With constant growth in the consumption of aquatic produce and no increase in production, most countries are becoming increasingly dependent on imports.

This dependence is likely to increase over the coming years, with the need to reduce current exploitation levels and with the development of tourism, which generates demand. This dependence is especially marked for high-value species (in particular crustaceans), where aquaculture has not yet provided a satisfactory answer.

Contribution to the economy. Estimates of the contribution of fisheries and aquaculture to the Mediterranean economy can be summarised by the following statistics: employment in the sector represents approximately 0.5% of the economically active population of Mediterranean regions, it generates turnover of more than $7bn, there is a trade deficit for aquatic produce, and the sector's Added Value is thought to account for less than 1% of the GDP of Mediterranean countries.

However, estimates are difficult, partly because the activities are practised over a geographical area that is larger than the Mediterranean region and partly because they are closely associated, both socially and physically, with other maritime and agricultural sectors.

Marine fisheries and aquaculture have economic impacts on other industries, such as the boating industry, tourism, trade in coastal towns and urban development of coastal areas in general. Such impacts should be measured more precisely (Dyck and Sumaila, 2010, Hishamunda *et al.*, 2011). Furthermore, small-scale artisanal fishing plays a significant role in slowing the exodus from rural coastal areas to large urban centres.

The sustainability of fisheries and aquaculture. The question of sustainability, as expressed in the Brundtland Report (1987) and applied to Mediterranean fisheries and aquaculture, assumes that the consequences of operating methods on the resources and ecosystems exploited can be estimated, along with their contribution to employment and the economy.

First of all, one of the main findings of this study is to highlight the gradual decline affecting Mediterranean resource exploitation, confirming various scientific diagnoses alerting decision-makers to a tendency to widespread over-fishing of demersal stocks over the past thirty years (Oliver, 1983; GFCM, 1984, 1988; Charbonnier, 1990; Farrugio *et al.*, 1993; Lleonart *et al.*, 1998; Lleonart, 2008; Garcia, 2009, 2011, etc.).

Indeed, various bottom-dwelling species are fished at the juvenile stage without having the time to reproduce. Overfishing of brood-stock fish compounds this growth overfishing, and will have more severe consequences for the survival of the stocks. This situation is currently in a state where it can be considered that nearly half of estimated stocks are fished outside safe biological limits, (Garcia, 2011).

While small pelagic resources can be considered as moderately exploited, according to recent GFCM estimates (2011), the level of this exploitation still needs to be better managed, given the high variability of their stocks, associated with variations in environmental conditions.

The situation is more critical for large pelagic species, bluefin tuna in particular. Various ICCAT assessments have shown that bluefin tuna brood-stock populations are at risk of collapse. Swordfish fisheries also have a problem with significant catches of juveniles, which must be reduced as soon as possible.

The main cause of demersal overfishing is the sustained increase in the fishing effort on these species by all fleets. This growth, which began in the 1980s, gradually extended to the continental slope and rise, and intensified because of major technological advances until the early 1990s, the period when demersal landings peaked in the Mediterranean.

The decline in demersal resources – and subsequent changes in economic conditions for exploiting them (increased operating costs and competition with imports) – led to the development of new units which specialised in pelagic fishing (tuna seiners, pelagic trawlers and sardine seiners), in particular in the Gulf of Lion. This strategy, which was encouraged and financially supported by the EU, national governments and regional authorities, has now placed the French Mediterranean fleet in a situation of dangerous overcapacity for resources that are either in a precarious situation (demersal and tuna species) or are too variable in quantity (small pelagic species).

While aquaculture has gradually offset the falling yields of certain high-value demersal species or has met specific, local needs, it is increasingly limited by economic and environmental constraints that can only be faced via significant research efforts and which mean that short-term profits cannot be envisaged.

The development of a more sophisticated version of aquaculture that focuses on production for export can only be made with significant capital investment, often from outside the operating regions (Poynton, 2006).

Aquaculture remains the only possibility for increasing yields but it must find answers to the problem of its current dependence on wild stocks, both for its supply of fish larvae and for providing the farms with foodstuffs. It is also confronted by the issues of sharing the coastline with other maritime activities and preserving water-quality in surrounding waters.

Recreational and subsistence fishing. To promote the development of tourism around the Mediterranean, various fishing practices have been developed for recreational purposes or as a

supplementary food supply. These fishing practices, which may or may not use boats, do not involve the sale or trade of catches but are often of major socio-economic importance for the Mediterranean economy, as shown by several studies (Gaudin *et al.,* 2007; Pawson *et al.*, 2007; Morales-Nin B. *et al.,* 2005; Cacaud, 2005; Camiñas J.A. *et al.,* 2011; Gordoa, 2004; Unal *et al.,* 2010). Their growing importance means that they have attracted sustained interest from the scientific community over the last few years (GFCM, 2010), in particular because of their interaction with commercial fisheries and the environment, but also via the alternatives that they could offer to small-scale fishing, such as 'angling tourism'.

Recommendations

The analysis presented in this study shows that the current operating methods for Mediterranean fisheries and aquaculture do not provide optimum sustainability for these sectors or the environments they exploit. On the basis of this observation, and the author's expertise in Mediterranean fisheries and aquaculture, certain recommendations can be formulated.

The management policies that have been implemented to date, in particular for European countries, have not achieved the anticipated results and certain measures have even aggravated fleet overcapacity and overexploitation of resources. This observation was made in the European Commission Green Paper on EU fisheries (2009).

Given the earlier gaps and errors, the new EU Common Fisheries Policy (CFP), which should come into force in 2013, has changed its strategy, in particular through the development of long-term management plans for each fishery.

These management plans should:

- take into account the marine ecosystems as a whole (habitats, birds, non-targeted species etc.) and not just commercial fish stocks;
- adjust fishing capacity to the biological potential of the stocks and the environment;
- curb the chronic decline in employment in the primary and secondary sectors of this industry, by making fishing and aquaculture more attractive and encouraging those who work in these sectors to remain on the coast.

To achieve these objectives, the management plans must use a certain number of existing tools to modify catches, whether these be catch limitation measures (quotas, minimum fish size in catches), access to the resource (licences, concessions, closed seasons, restricted fishing areas), fleet-capacity and fishing-effort reduction measures or financial incentives using the European Fisheries Fund (EFF). New measures are also planned, such as effort quotas and the introduction of Transferable Fishing Concessions (TFC) for vessels over 12 m long.

Given that Mediterranean fisheries only differ from European fisheries by their greater diversity and the lower proportion of single-species industrial production as practised in the Atlantic, it can be considered that the strategies chosen for the new CFP, as announced, could be applicable to the Mediterranean context. It should be noted that certain management measures suggested by the CFP have already been the subject of recommendations adopted by the GFCM (2011).

Furthermore, since marine fisheries and aquaculture are, perhaps more strongly in the Mediterranean than elsewhere, associated with coastline management and preservation, the management plans applied to the Mediterranean should take into account, in an integrated fashion, all interactions with coastal ecosystems, other users of the coastline and the economies of the coastal regions.

Finally, if fisheries have a future in the Mediterranean, small-scale artisanal fishing must take a central role. The modernisation of its fishing vessels to focus on high-value produce, as has already begun in some countries, must be further supported. In particular, it should profit from the creation of short distribution channels at the regional level, which provide better opportunities for the sale of high-value produce and indirectly promote the development of fleets of "polyvalent vessels longer than 12 m" for this type of catch.

Nevertheless, in Europe as in the Mediterranean as a whole, the success of any management policy is dependent on the applicability of the measures imposed, i.e.:

- effective monitoring and tracking systems, in particular based on relevant criteria for measuring capacity and fishing effort.
- the acceptance of guidelines by those who work in the sector, both by improving the quality of dialogue between them and scientific experts and by placing them at the heart of the management system. This is what the European Commission has started to do with the establishment of Regional Advisory Councils (RAC), forums for decision-making support and advice, which Mediterranean countries could use as an inspiration to create management dynamics, for example at the sub-regional scale of the GFCM's GSAs (Alboran Sea, South Tyrrhenian Sea etc.).

Finally, the reliability of operational biological indicators needs to be increased, in order to improve the consultancy capacity of scientists and the quality of dialogue between experts and those who work in the sector, which means that scientists must move forward in their understanding of how the ecosystems involved operate.

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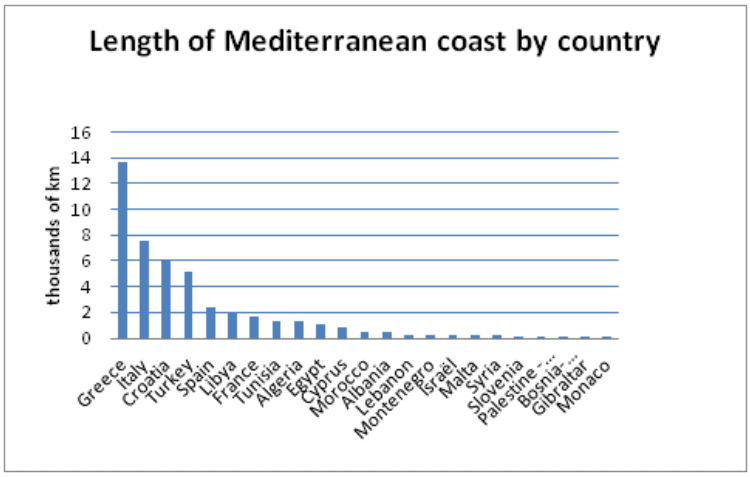
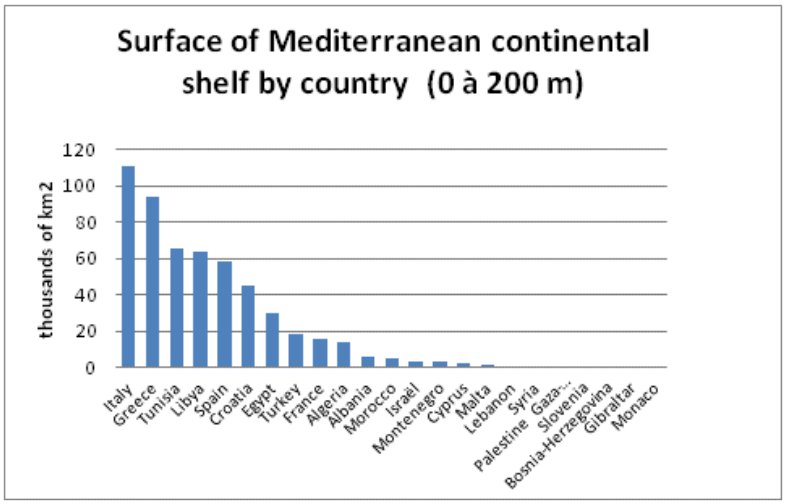
IX. Figures

Figure 1 – Length of Mediterranean coast by country (in km)



Source: FAO Aquaculture and Fisheries profiles by country

Figure 2 - Surface area of Mediterranean continental shelf per country (km²)

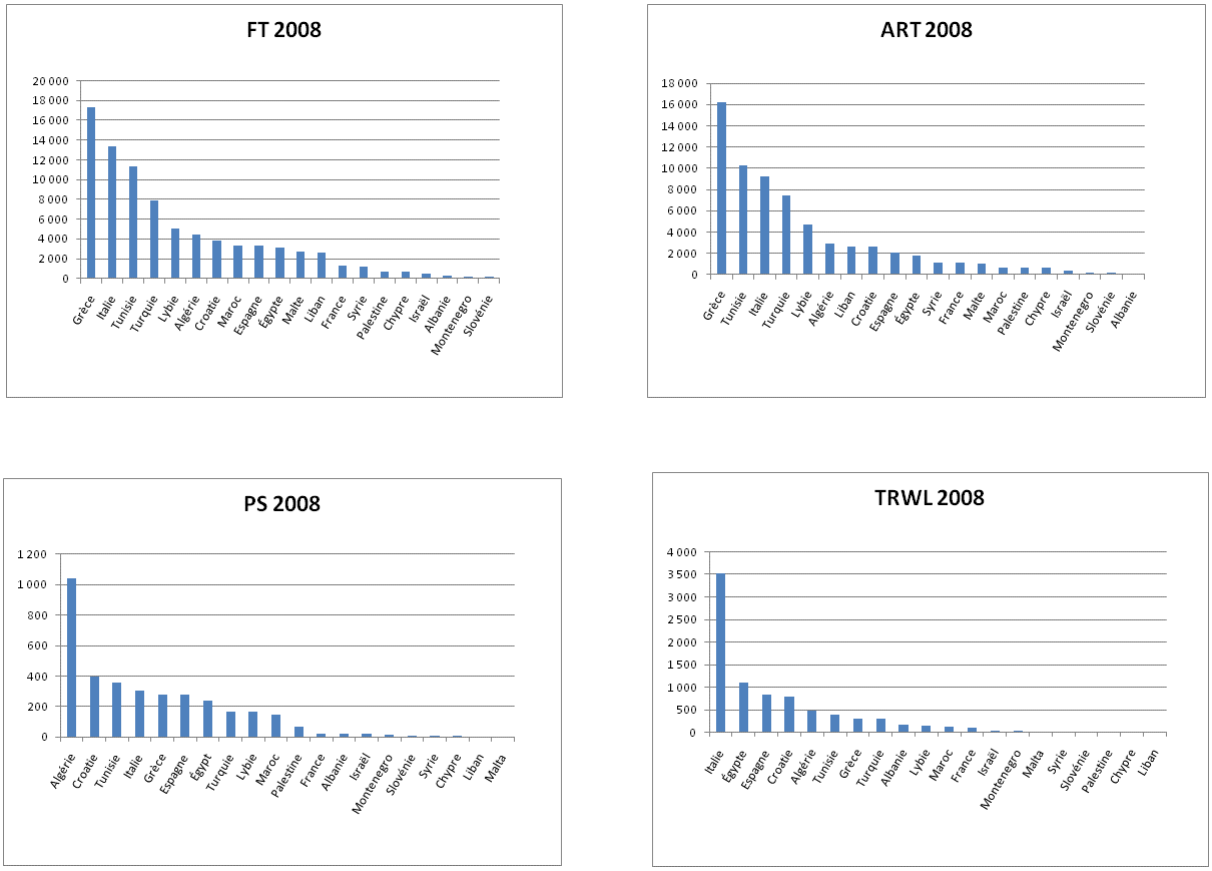


Source: FAO various sources

Figure 3 - Mediterranean coastal regions

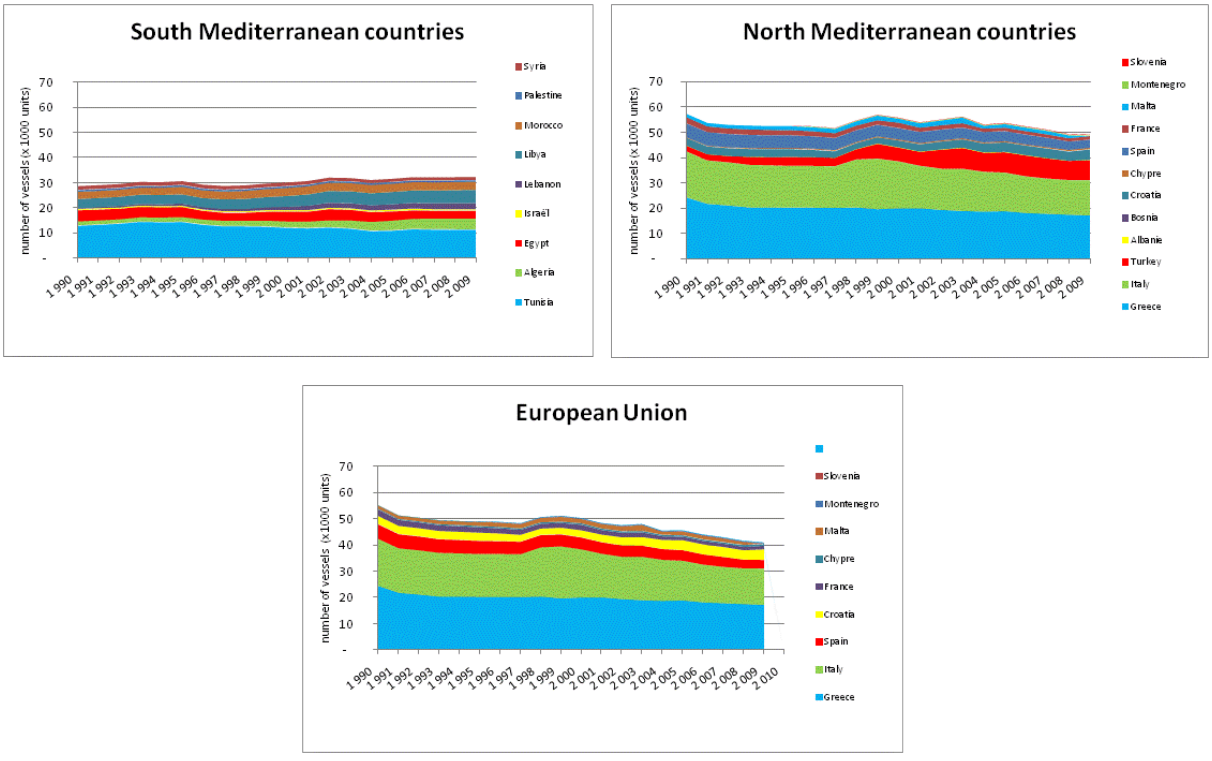
Source: Plan Bleu, 2012

Figure 4 - Distribution of the number of fishing vessels in 2008 (FT = total number; ART: small-scale artisanal fishing fleets; PS: small-pelagic seiner fleets; TRWL: towing fleets (trawlers and dredgers)



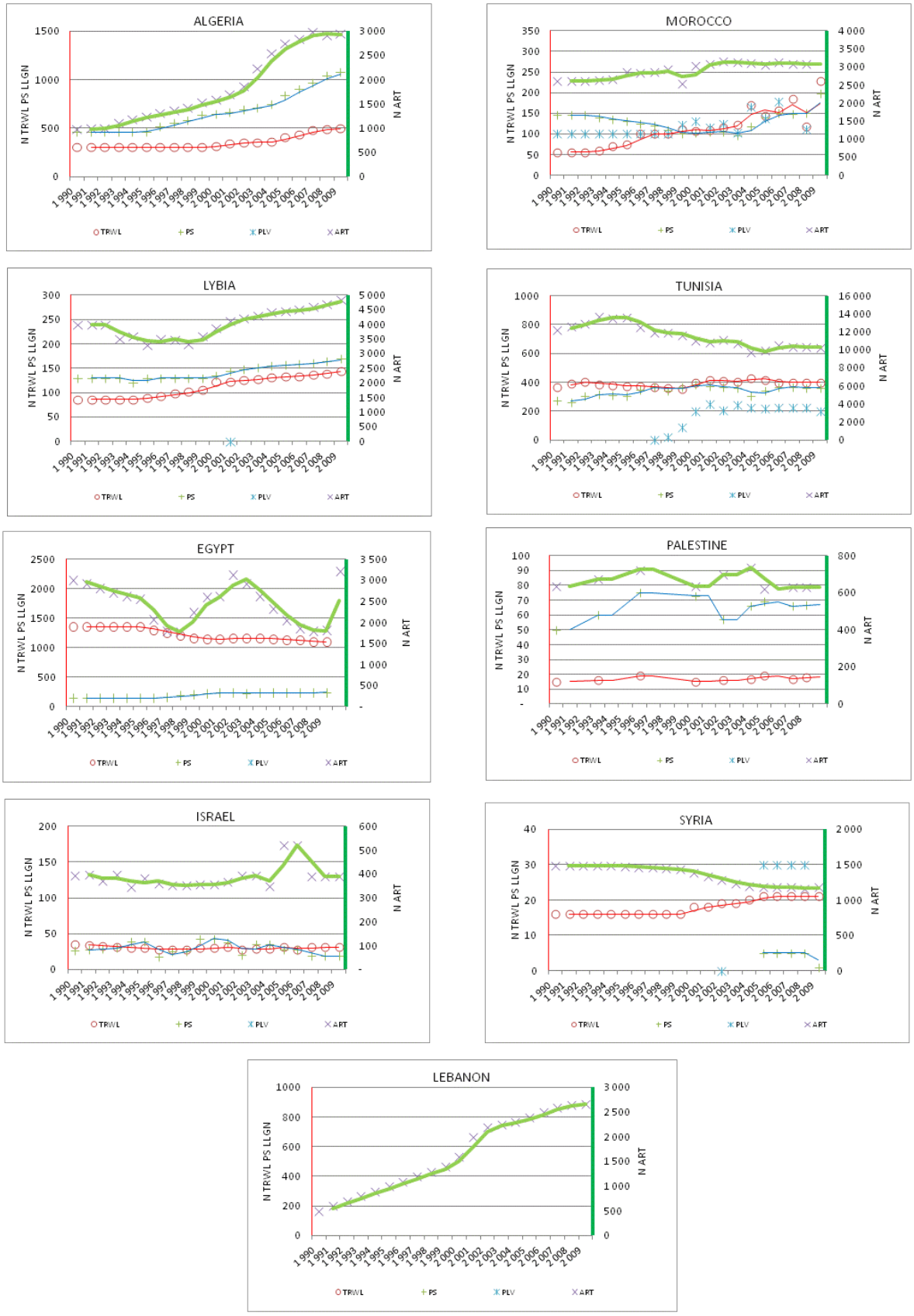
Source : FAO Aquaculture and Fisheries profiles by country; national statistics and author's data

Figure 5 - Changes in the number of fishing vessels from 1990 to 2009



TOP: South and North Mediterranean countries. BOTTOM: countries of the European Union.
Source: FAO Aquaculture and Fisheries profiles by country; national statistics and author's data

Figure 6 - Fleet distribution by groups of fishing practice and by country (South Mediterranean countries); TRWL: trawlers and dredgers; PS: sardine seiners; PLV: polyvalent vessels longer than 12 m; ART: small-scale artisanal vessels

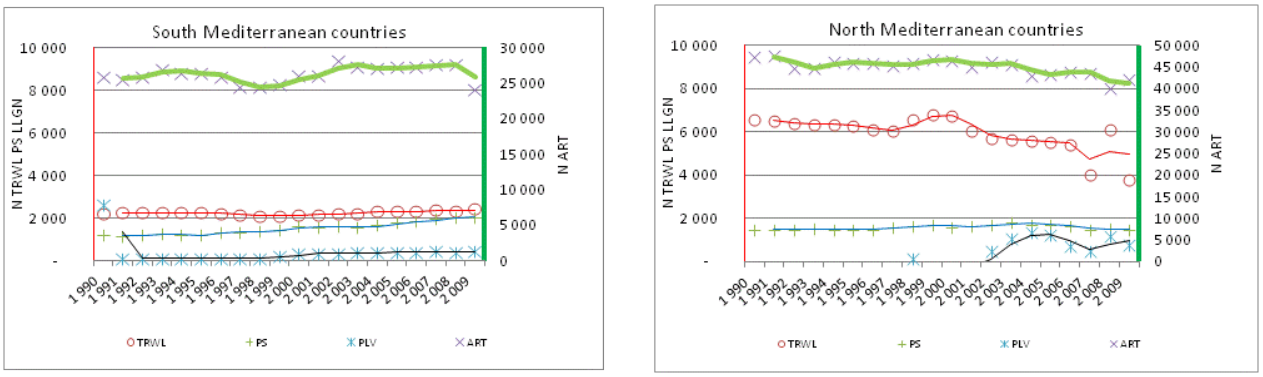


TRWL: chalutiers et draguiers ; PS : senneurs sardiniers ; PLV : navires polyvalents de plus de 12 m ; ART : navires de petite pêche
Source: FAO Aquaculture and Fisheries profiles by country; national statistics and author's data

Figure 7 - Fishing fleet distribution by groups of fishing practice and by country

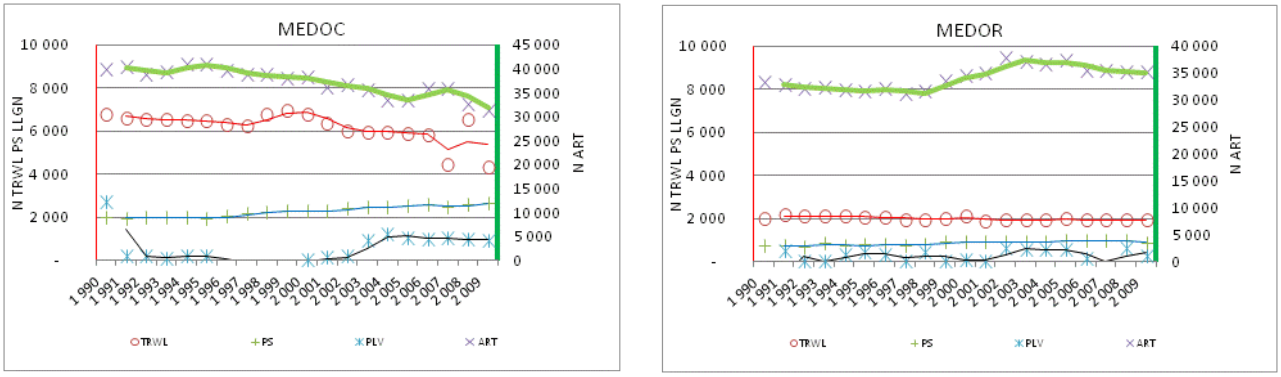
(North Mediterranean countries); TRWL: trawlers and dredgers; PS: sardine seiners; PLV: polyvalent vessels longer than 12 m; ART: small-scale artisanal vessels.

Figure 8 - Comparison of fleet distributions by fishing-practice groups between Southern and Northern Mediterranean countries



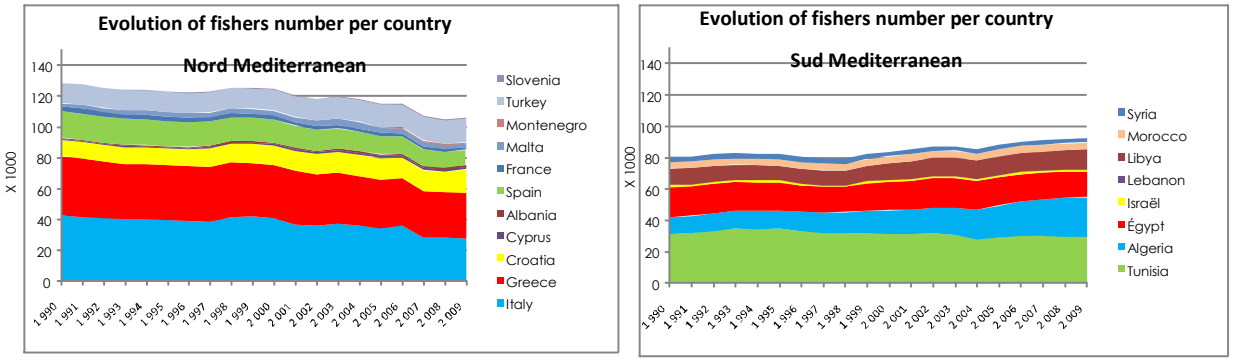
Source: FAO Aquaculture and Fisheries profiles by country; national statistics and author's data

Figure 9 - Comparison of fleet distributions by fishing-practice groups between Western Mediterranean (MEDOC) and Eastern Mediterranean (MEDOR)



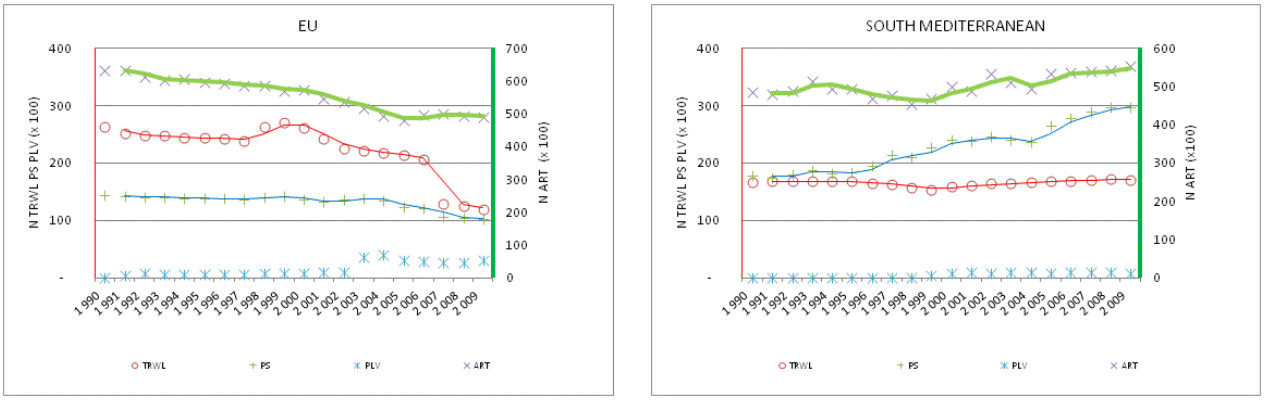
Source: FAO Aquaculture and Fisheries profiles by country; national statistics and author's data

Figure 10 - Changes in the numbers of registered fishermen between 1990 and 2009 in Northern and Southern Mediterranean countries



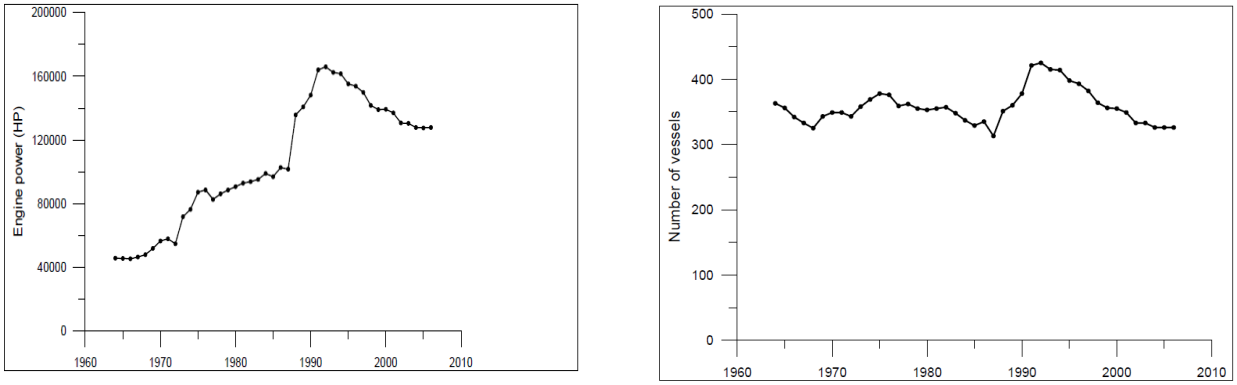
Source: FAO Aquaculture and Fisheries profiles by country; national statistics and author's data

Figure 11 - Comparison of changes in the number of fishermen in EU and Southern Mediterranean countries from 1990 to 2009



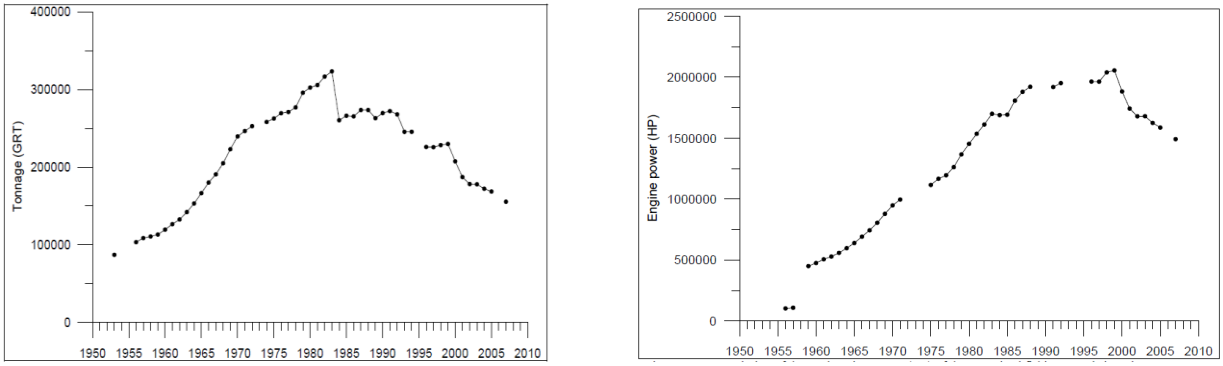
Source: FAO Aquaculture and Fisheries profiles by country; national statistics and author's data

Figure 12 - Changes in number of vessels and total engine power for the Greek trawler fleet in the Mediterranean



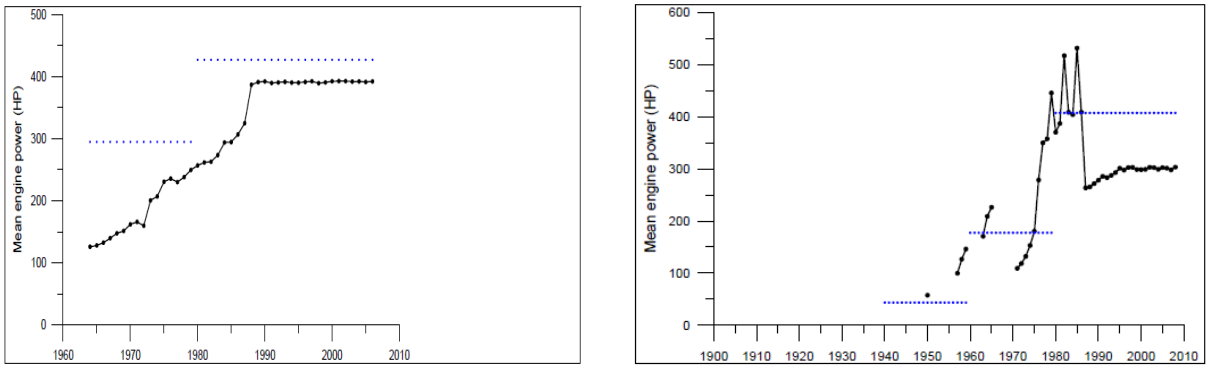
Source: EVOMED 2011

Figure 13 - Changes in number of vessels and total engine power for the whole Italian trawler fleet in the Mediterranean



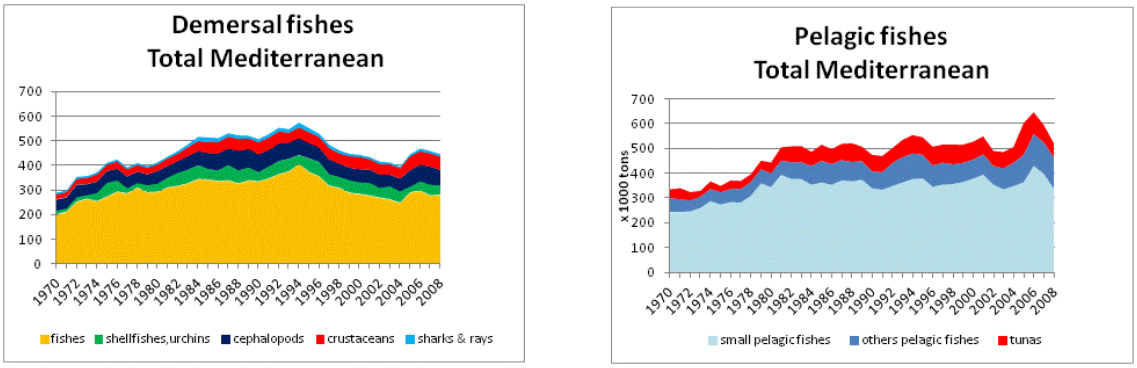
Source: EVOMED 2011

Figure 14 - Changes in mean engine power for the Greek and Catalan trawler fleets in the Mediterranean



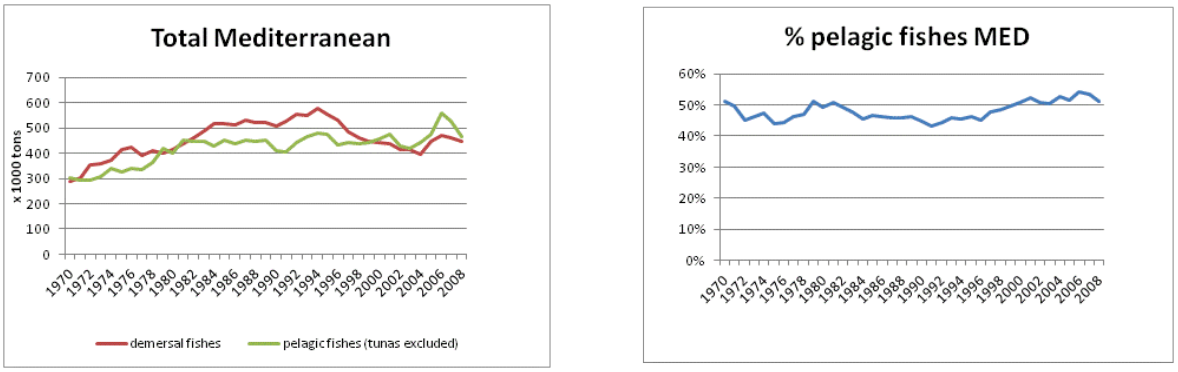
Source: EVOMED 2011

Figure 15 - Changes in the fishing yields for demersal and pelagic species for all 20 Mediterranean countries combined



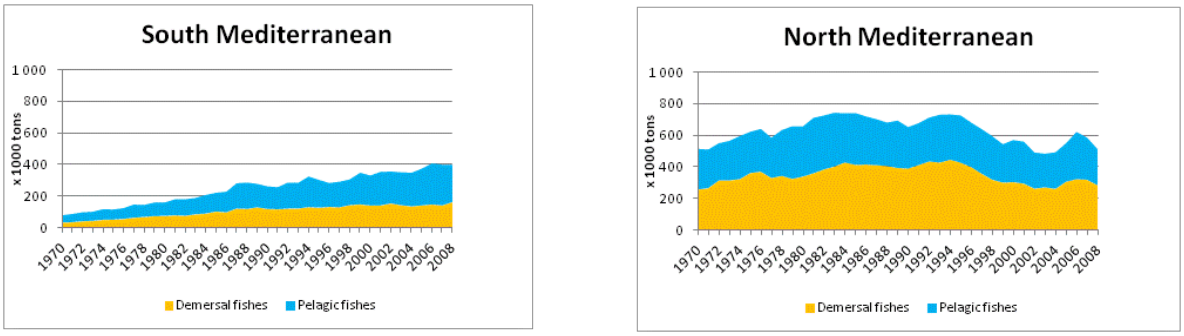
Source FAO – FISHSTAT

Figure 16 - Comparison of changes in yields for demersal and pelagic species in total landings for all 20 Mediterranean countries combined



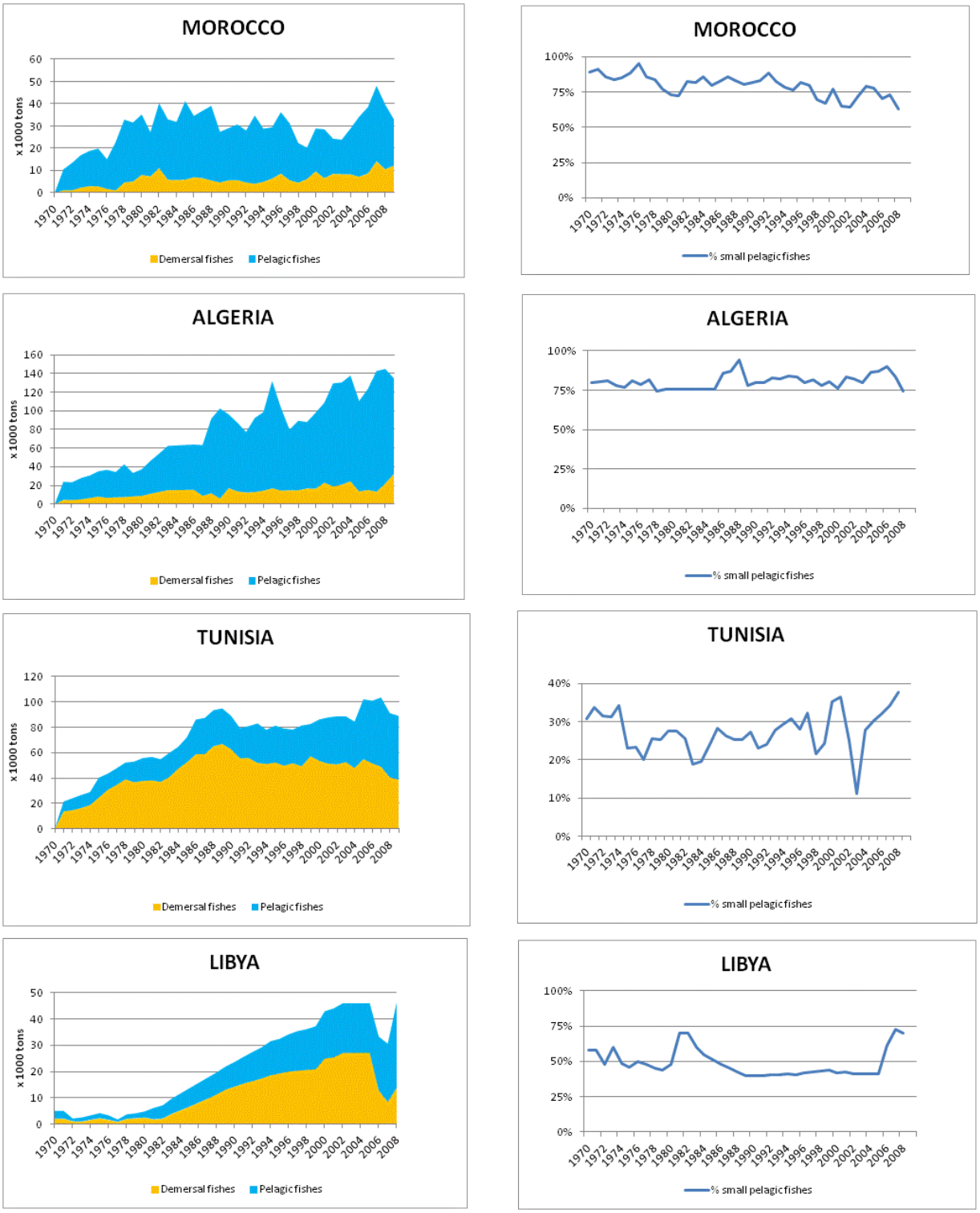
Source FAO – FISHSTAT

Figure 17 - Comparison of changes in yields of demersal and pelagic species between Southern and Northern Mediterranean countries



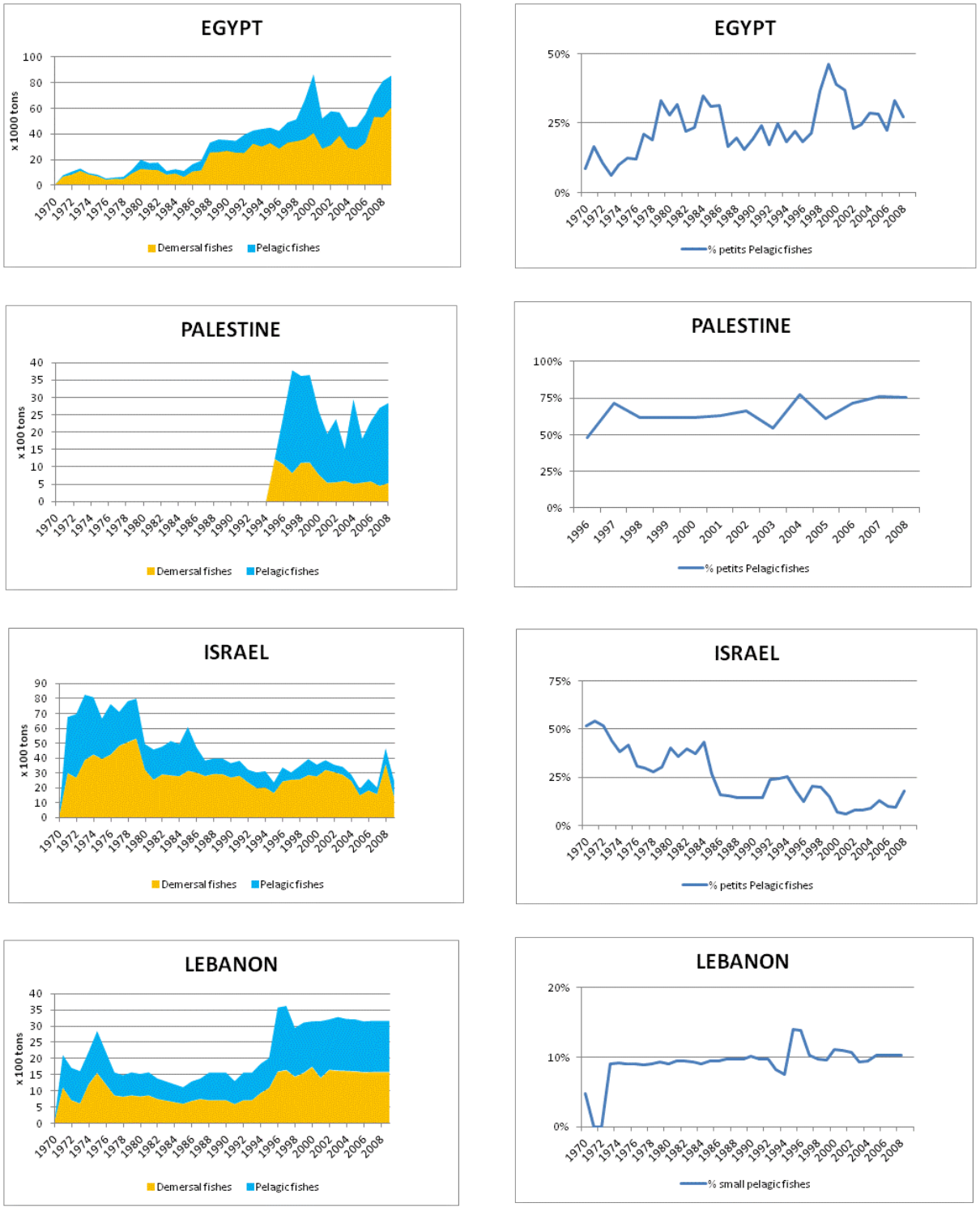
Source FAO – FISHSTAT

Figure 18 - Changes in fishing yields for demersal and pelagic species and the proportion of small pelagic species by country – Morocco, Algeria, Tunisia and Libya



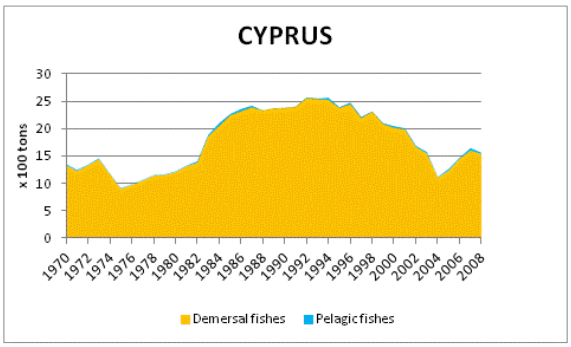
Source FAO – FISHSTAT

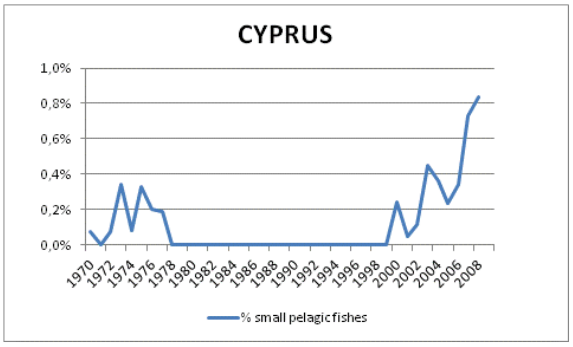
Figure 19 - Changes in fishing yields for demersal and pelagic species and the proportion of small pelagic species by country – Egypt, Palestine (Gaza Strip), Israel and Lebanon

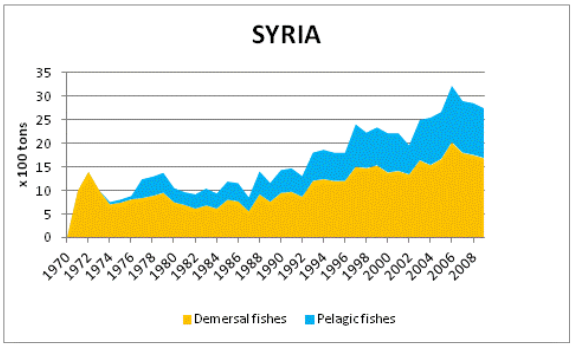


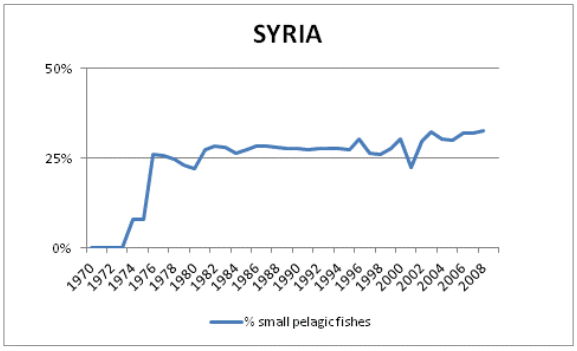
Source FAO – FISHSTAT

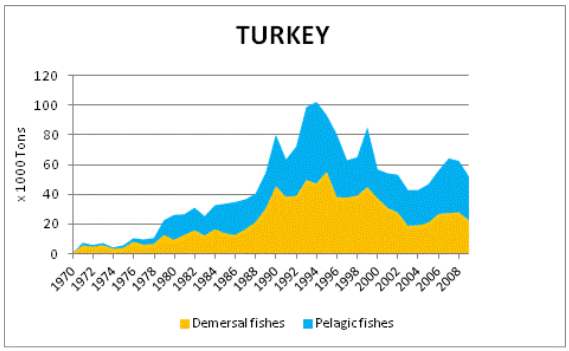
Figure 20 - Changes in fishing yields for demersal and pelagic species and the proportion of small pelagic species by country – Cyprus, Syria, Turkey, Greece

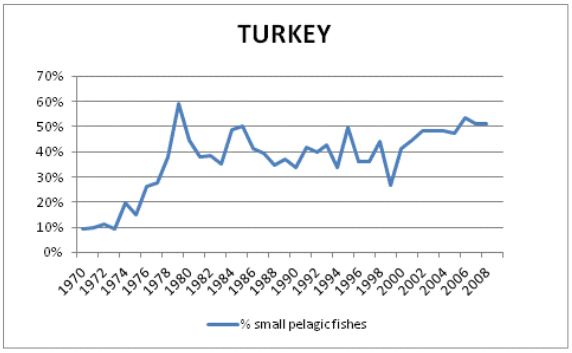


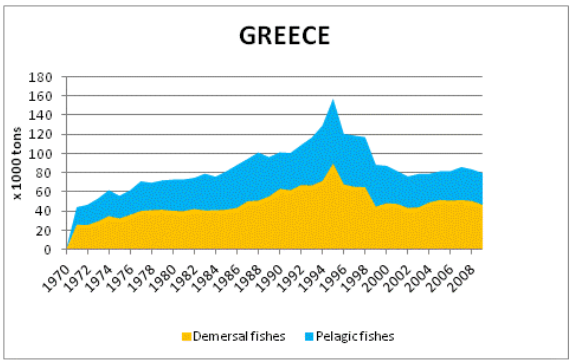


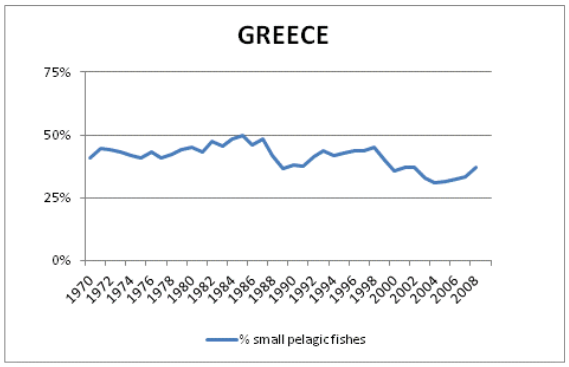






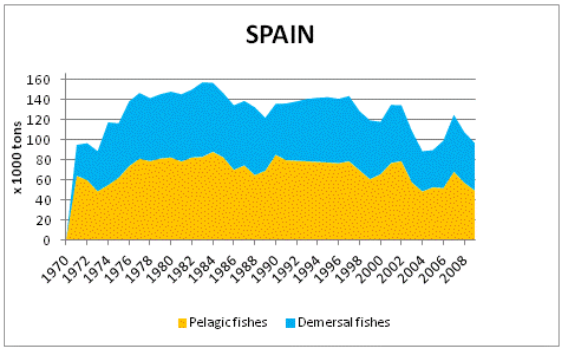


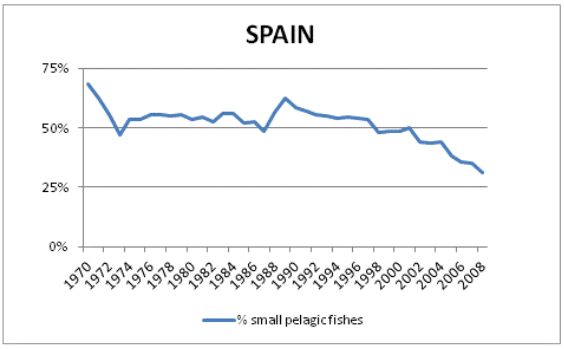


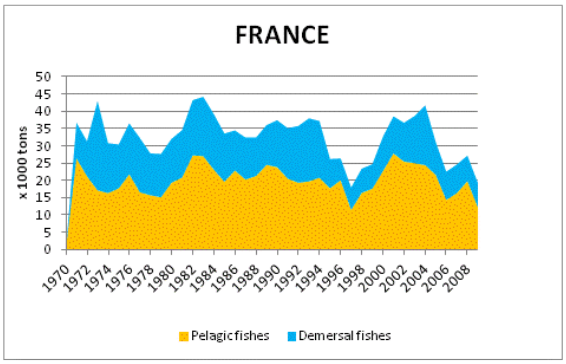


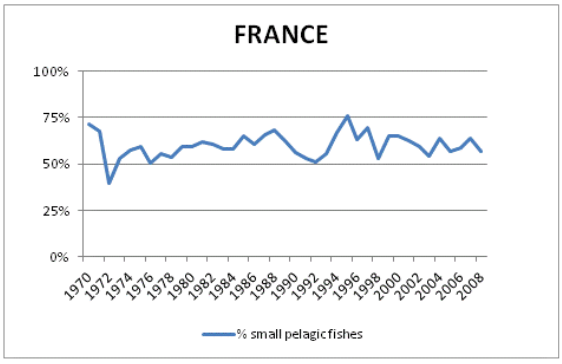
Source FAO – FISHSTAT

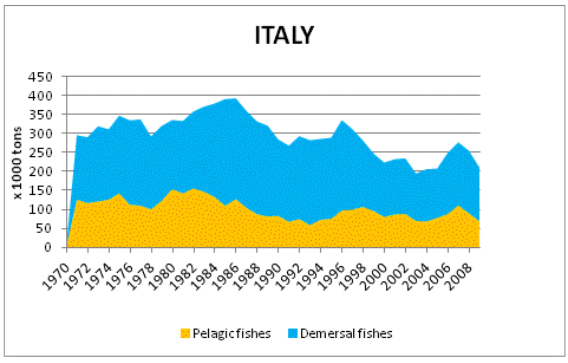
Figure 21 - Changes in fishing yields for demersal and pelagic species and the proportion of small pelagic species by country – Spain, France, Italy and Malta

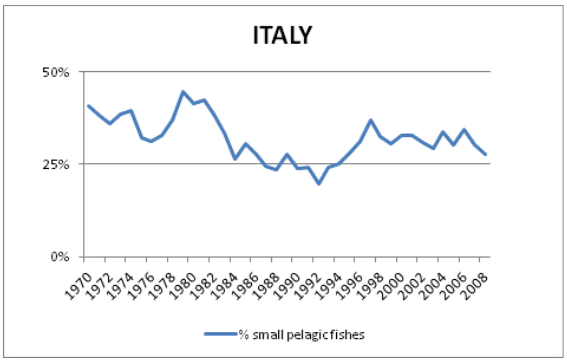


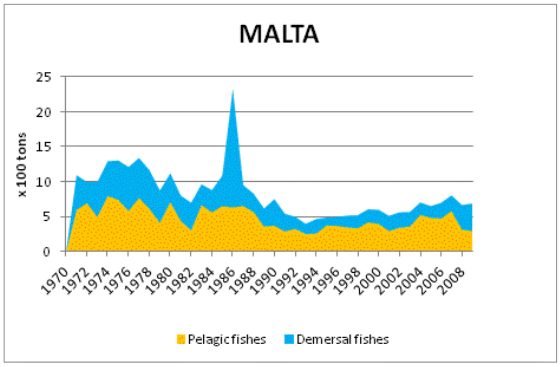


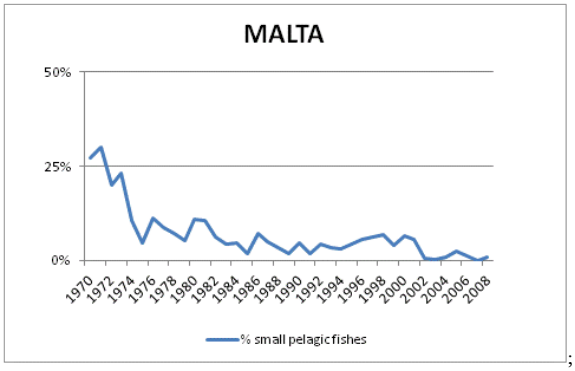












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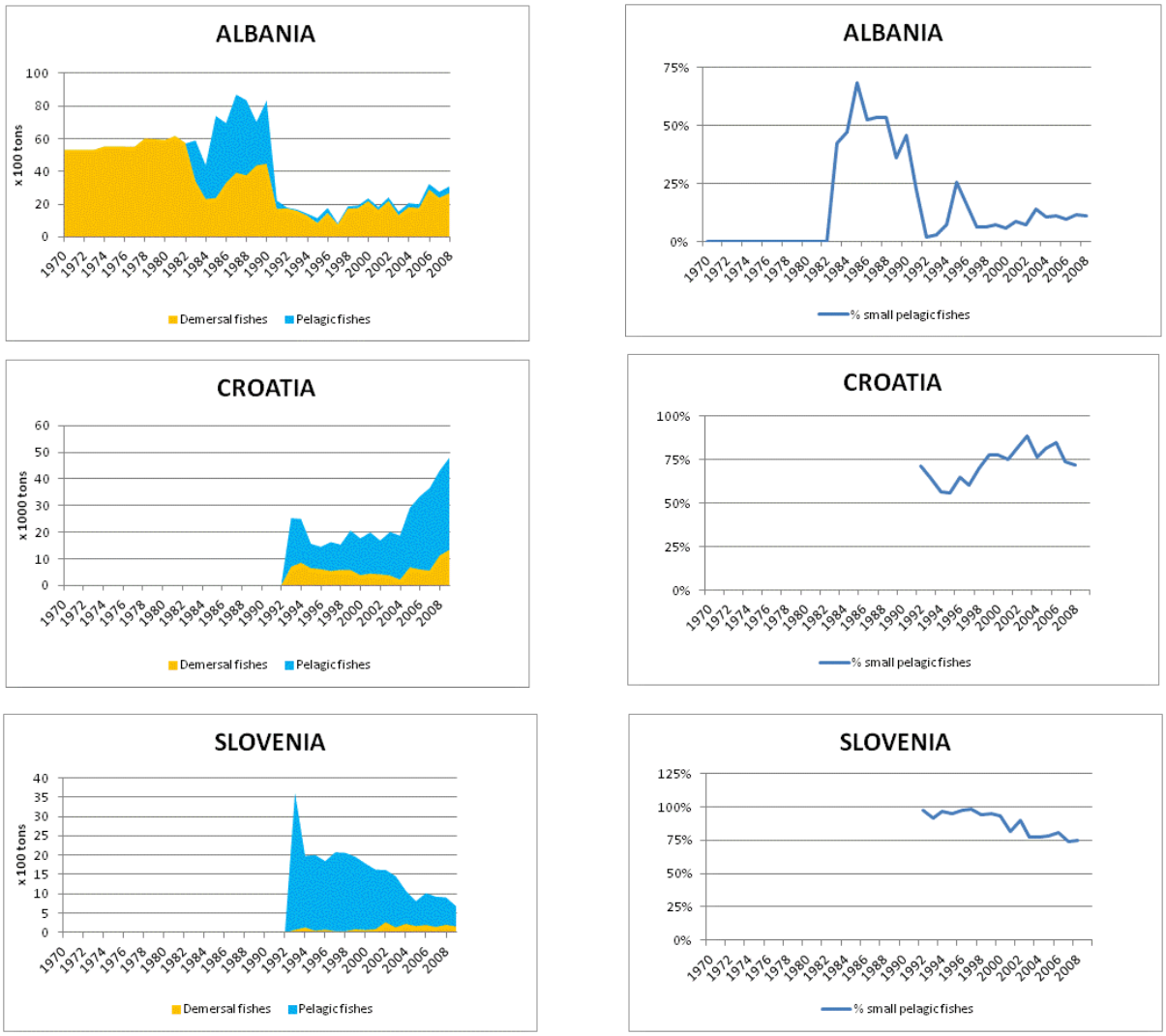
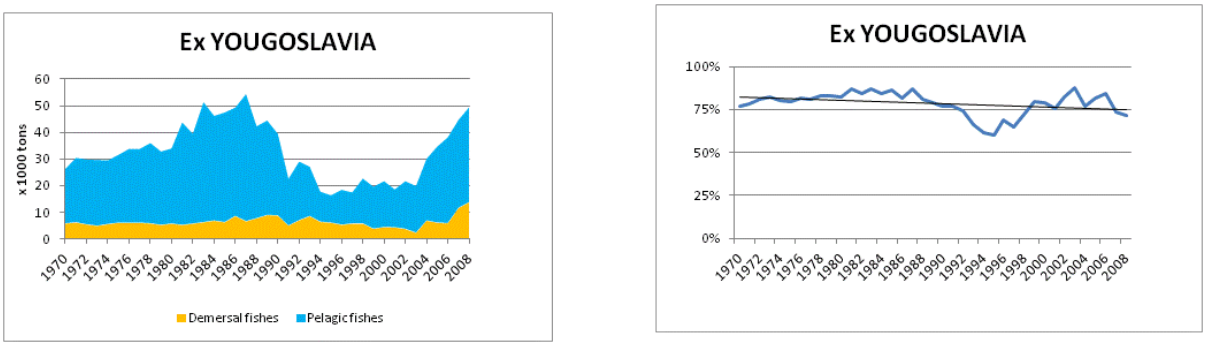
Source FAO – FISHSTAT

Figure 22 - Changes in fishing yields for demersal and pelagic species and the proportion of small pelagic species by country – Albania, Croatia and Slovenia



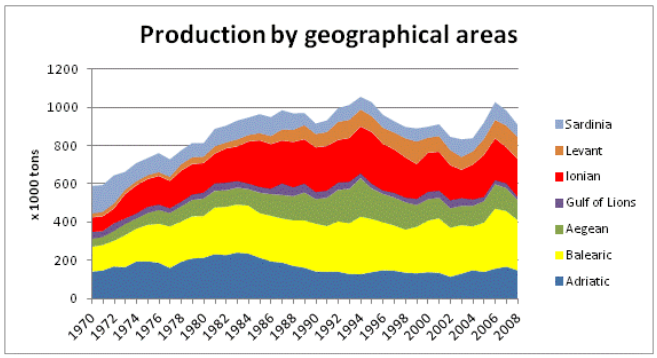
Source: FAO – FISHSTAT

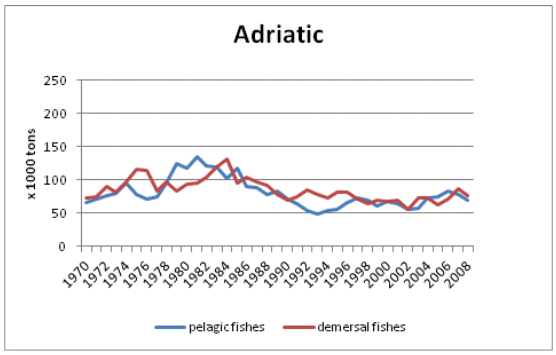
Figure 23 - Changes in fishing yields for demersal and pelagic species and the proportion of small pelagic species for the main countries of the former Yugoslavia (Croatia, Slovenia and Montenegro)

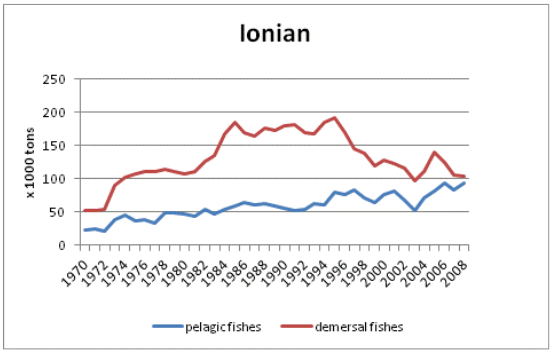


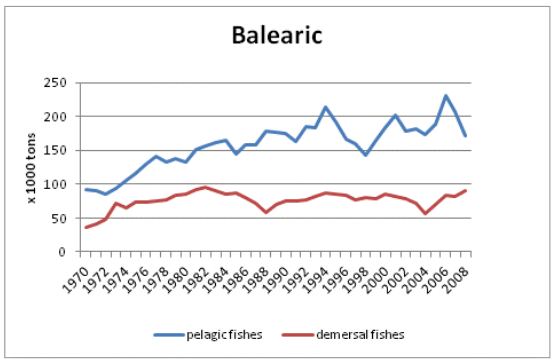
Source: FAO – FISHSTAT

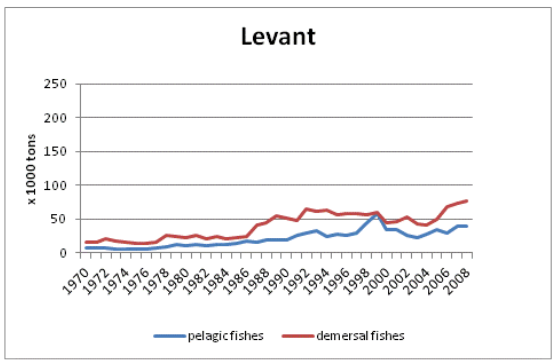
Figure 24 - Changes in landings by geographical area

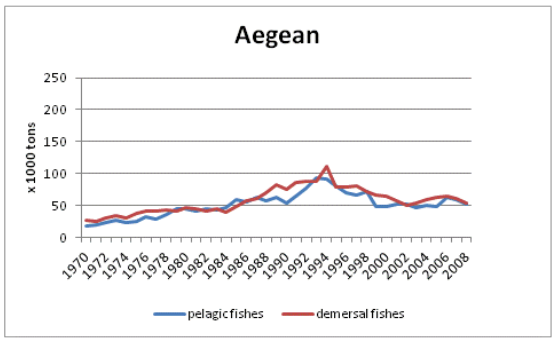


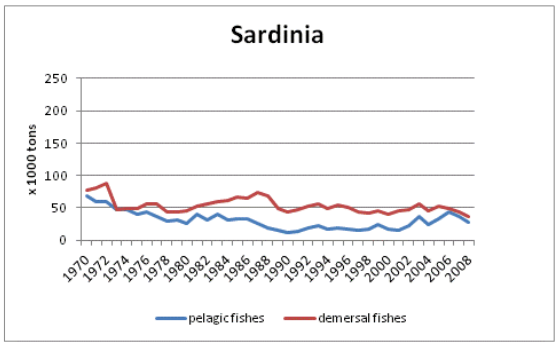






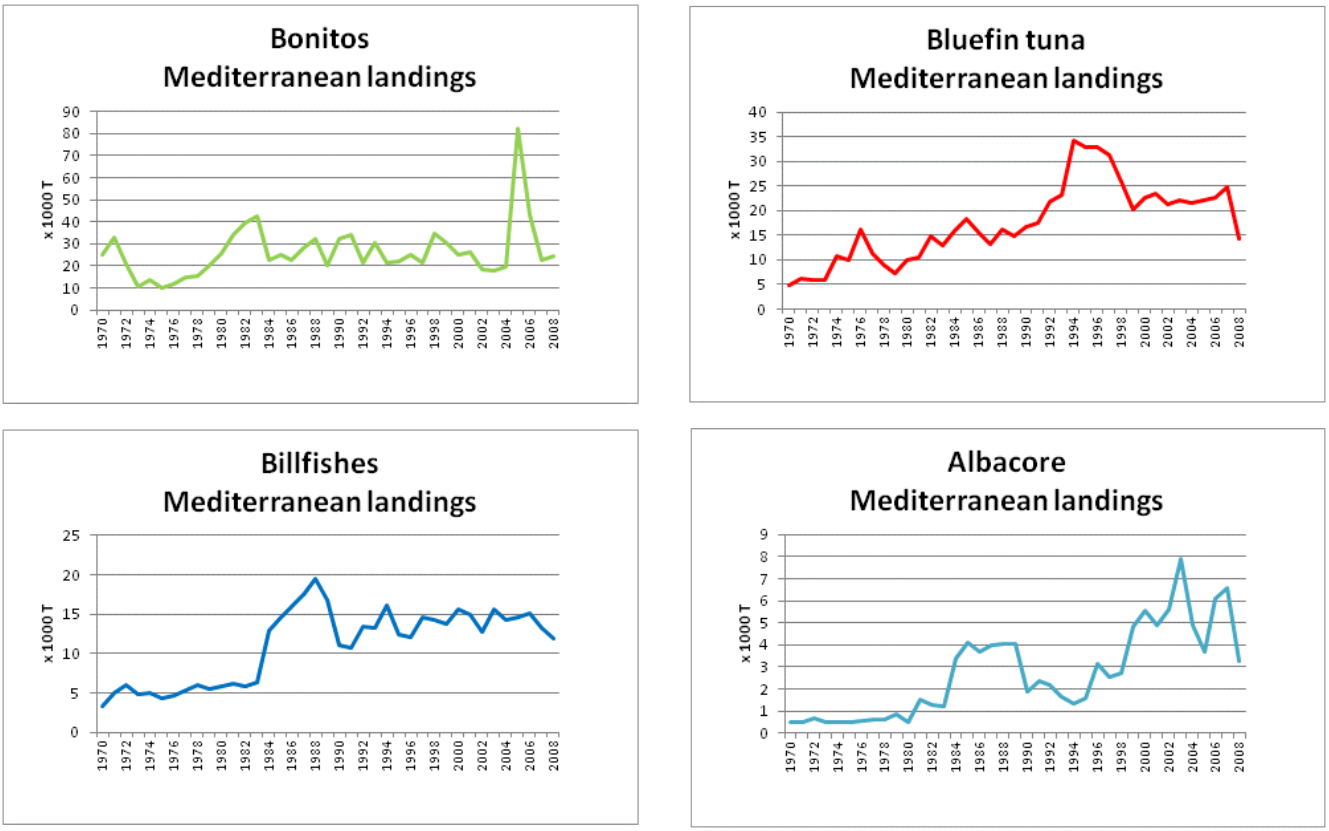






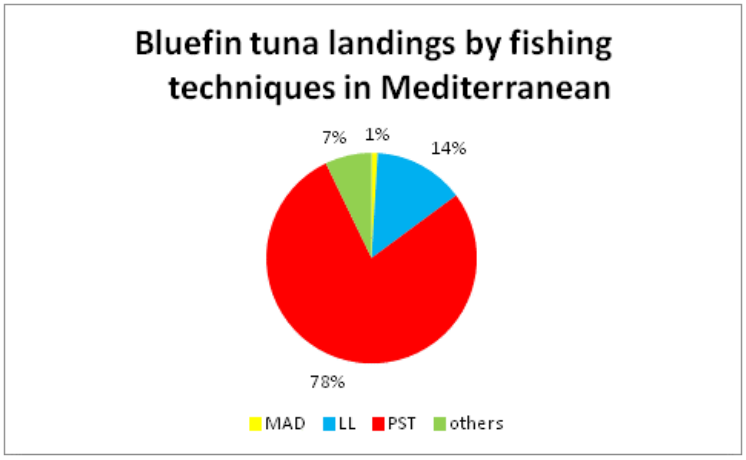
Source: FAO FISHSTAT

Figure 25 - Mediterranean yields of tunas and associated species: TOP LEFT: Bonitos; TOP RIGHT: Bluefin tuna; BOTTOM LEFT: Swordfish and other billfish; BOTTOM RIGHT: Albacore tuna



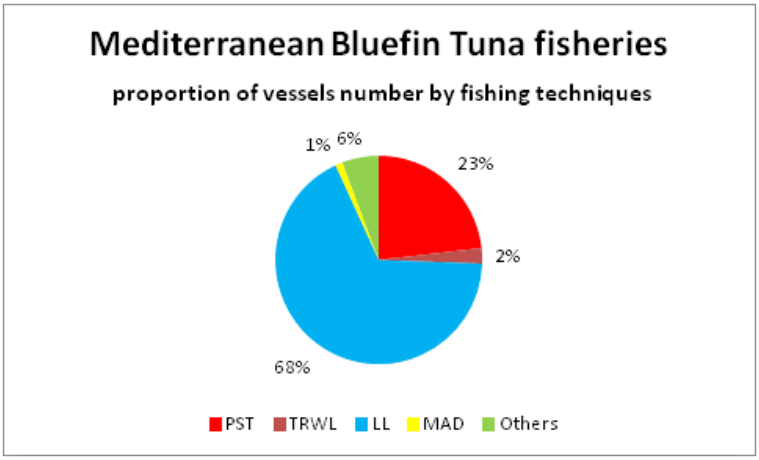
Source FAO – FISHSTAT

Figure 26 - Distribution of bluefin tuna catches by fishing practice in the Mediterranean



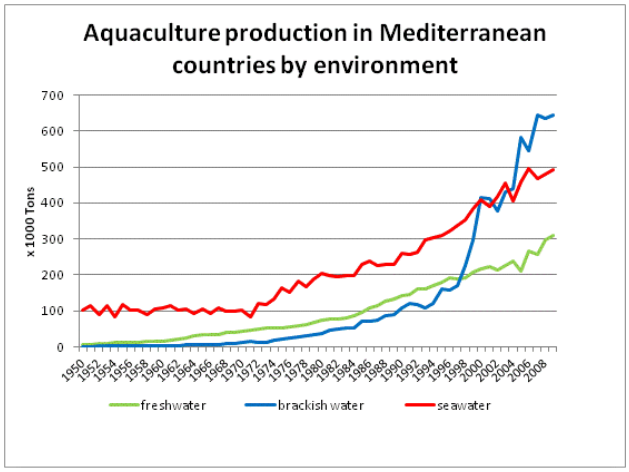
Source: FAO – FISHSTAT

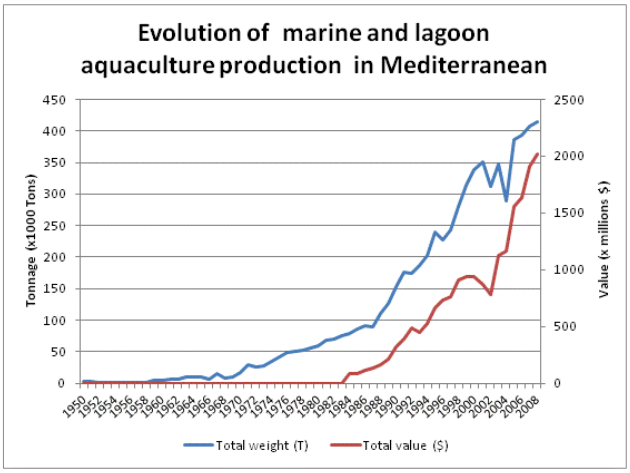
Figure 27 - Distribution of vessels authorised to catch bluefin tuna by fishing practice



Source: ICCAT statistical database

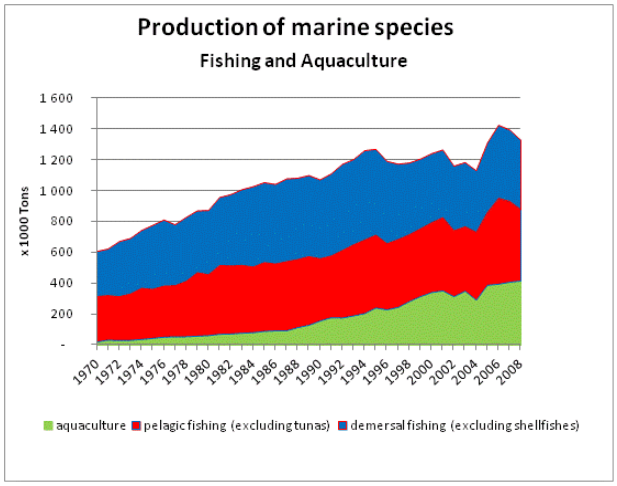
Figure 28 - Left: Comparative changes in national aquaculture yields by environment type; Right: Changes in Mediterranean marine and lagoon yields in tonnage and value

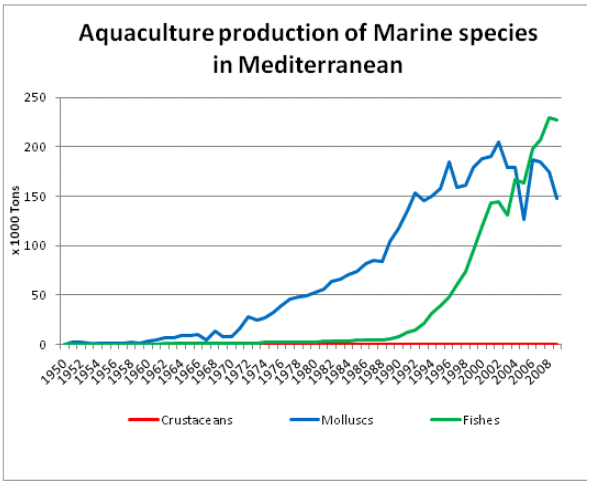




Source FAO – FISHSTAT

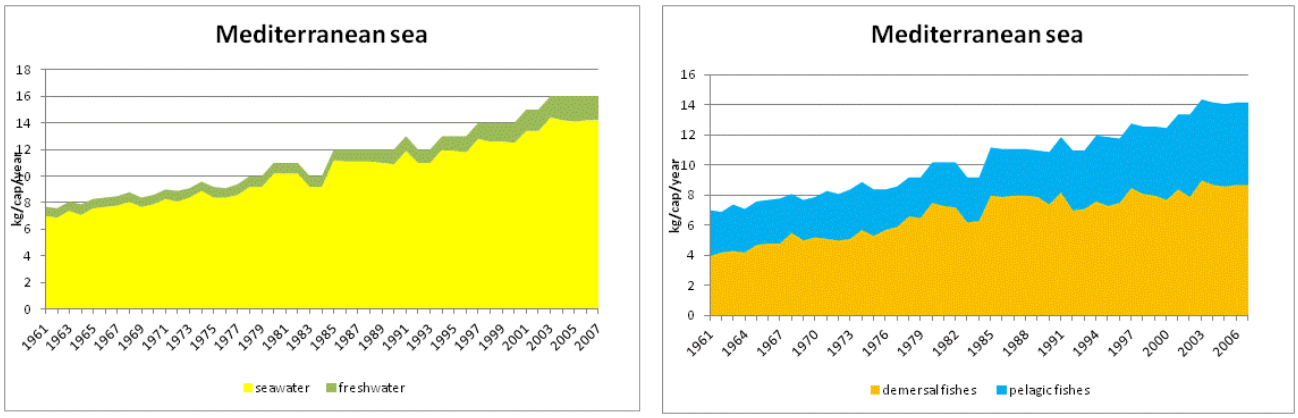
Figure 29 - Left: Comparative changes in aquaculture yields and marine species catches in tonnes. Right: Comparative changes in yield in tonnes for crustaceans, bivalves and marine fish





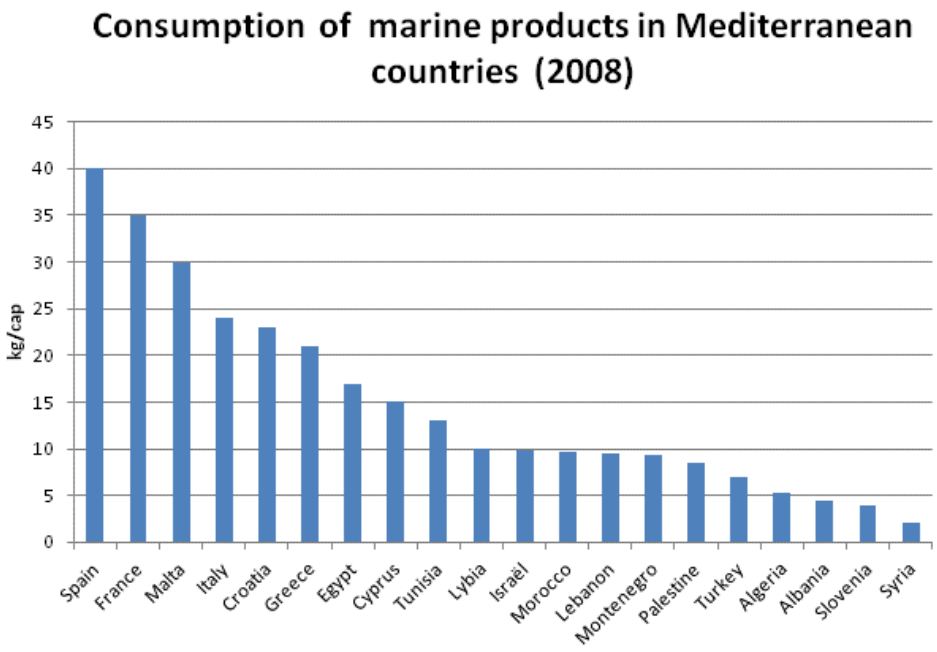
Source: FAO – FISHSTAT

Figure 30 - Changes in mean apparent consumption for freshwater and marine species in the Mediterranean



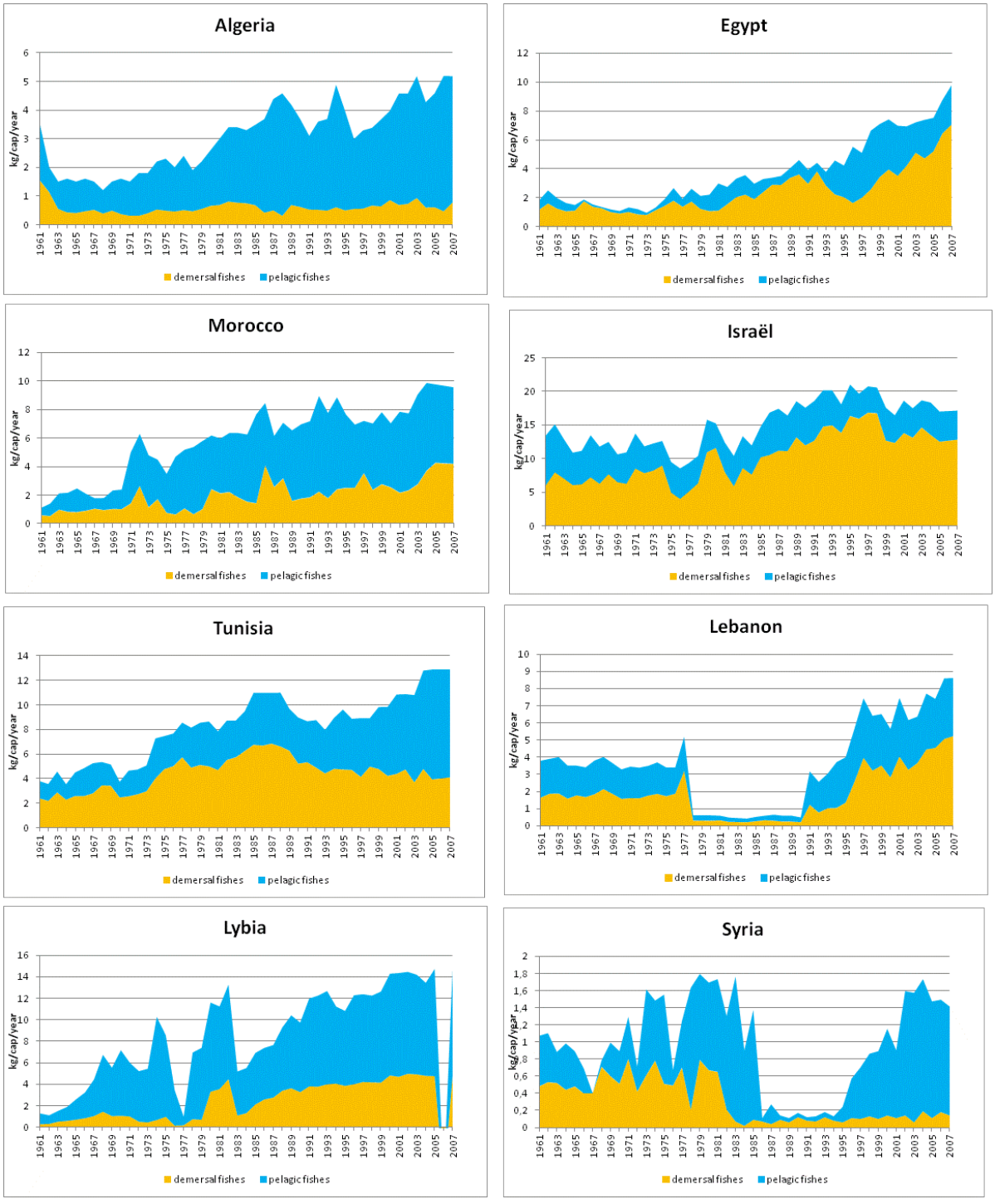
Source: FAOSTAT

Figure 31 - Marine product consumption rates for Mediterranean countries



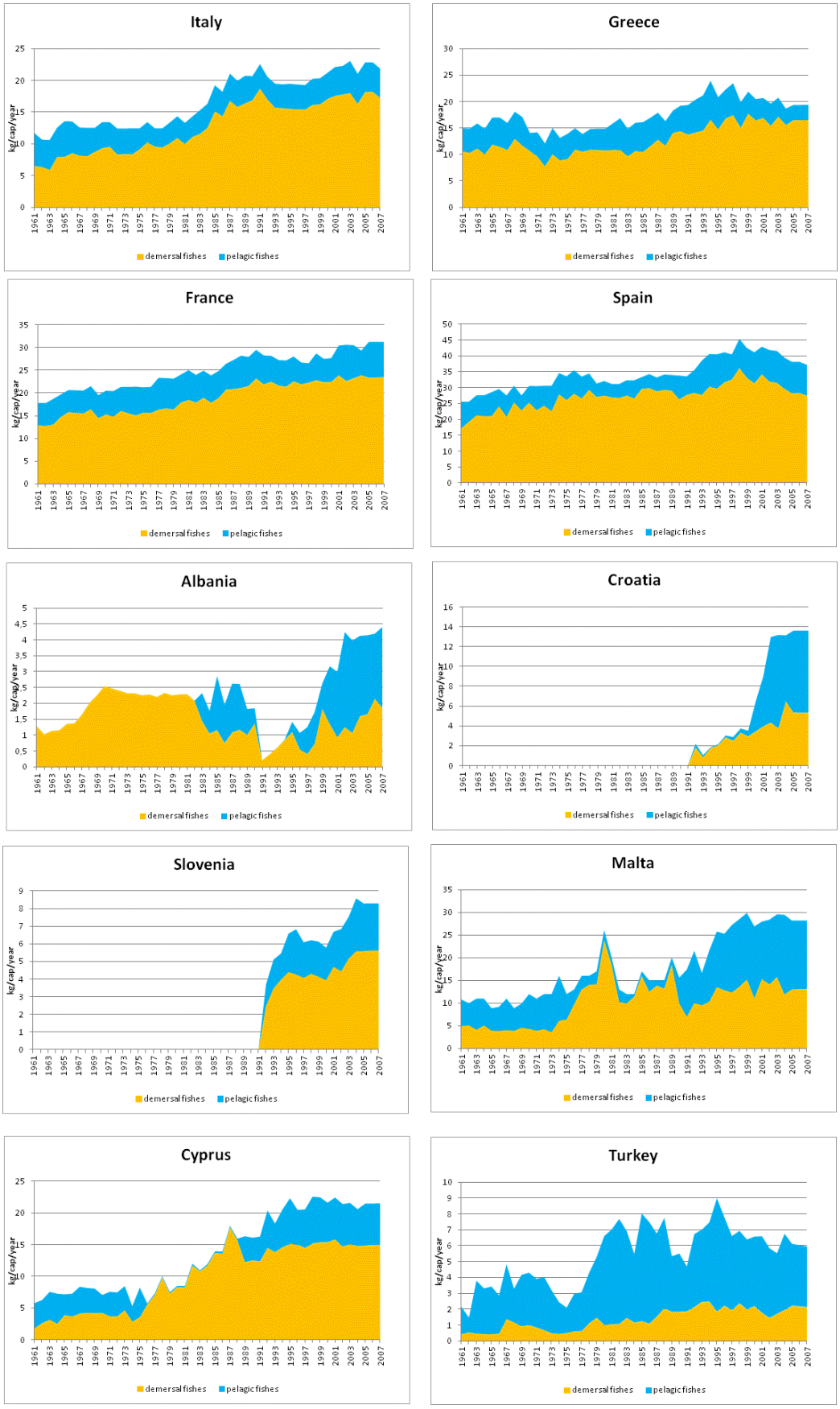
Sources: FAO FISHSTAT and World Bank

Figure 32 - Apparent consumption of demersal and pelagic species (in kg per capita per year) for the main Southern Mediterranean countries



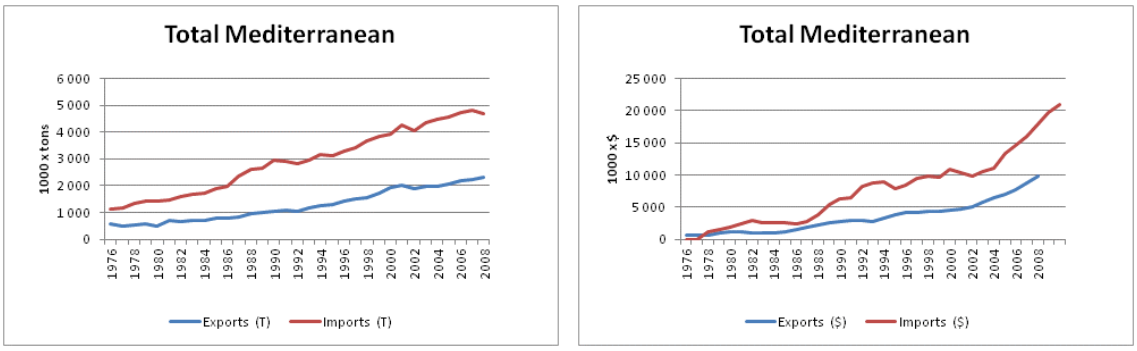
Source FAOSTAT

Figure 33 - Apparent consumption of demersal and pelagic species (in kg per capita per year) for the main Northern Mediterranean countries



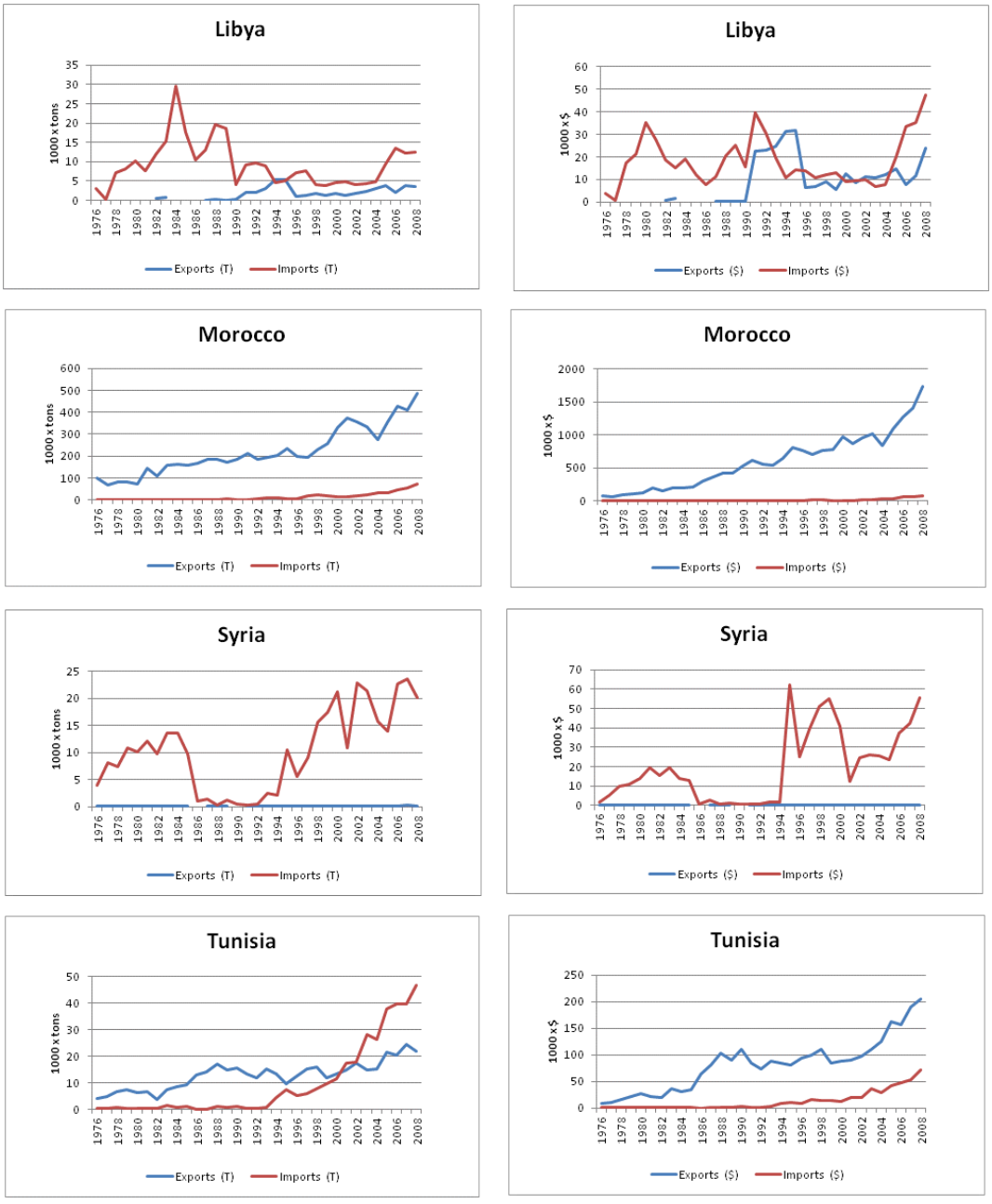
Source FAOSTAT

Figure 34 - Changes in the value of marine produce imports and exports in the Mediterranean



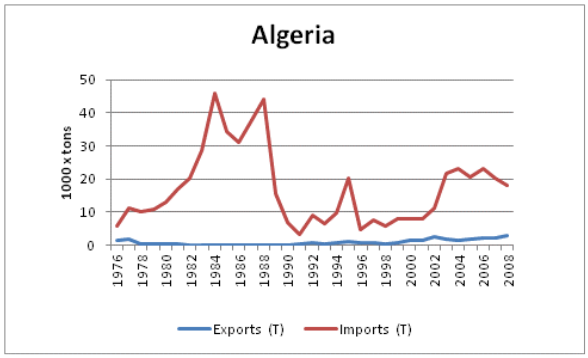
Source FAOSTAT

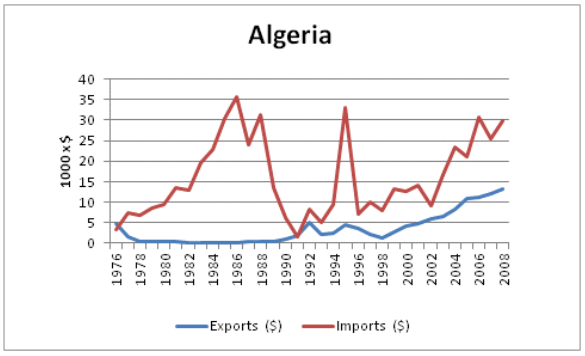
Figure 35 - Changes in the quantities (RIGHT) and value (LEFT) of marine produce imports and exports in certain Southern Mediterranean countries (Morocco, Syria and Tunisia)

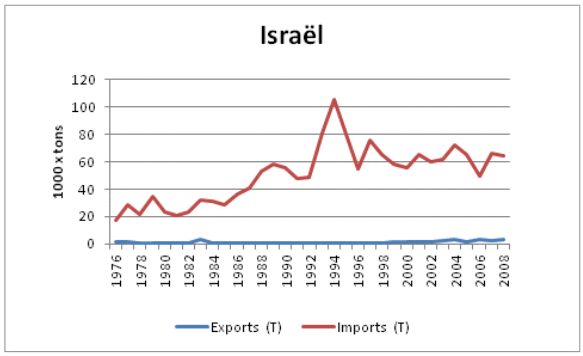


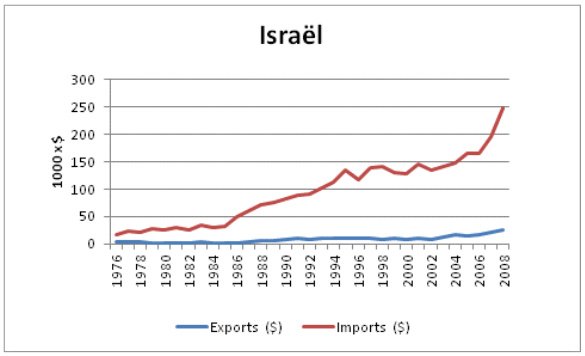
Source FAOSTAT

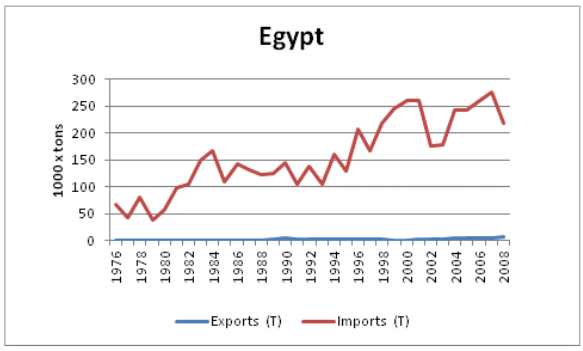
Figure 36 - Changes in the quantities (RIGHT) and value (LEFT) of marine produce imports and exports in certain Southern Mediterranean countries (Algeria, Egypt, Israel and Lebanon)

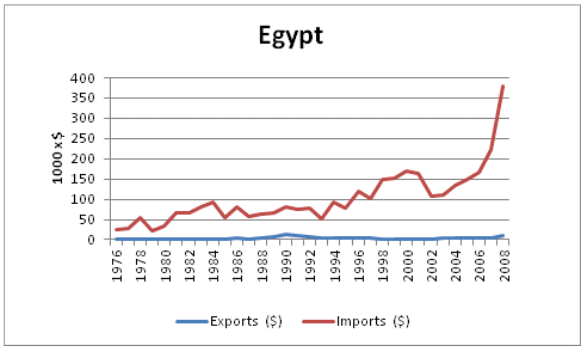


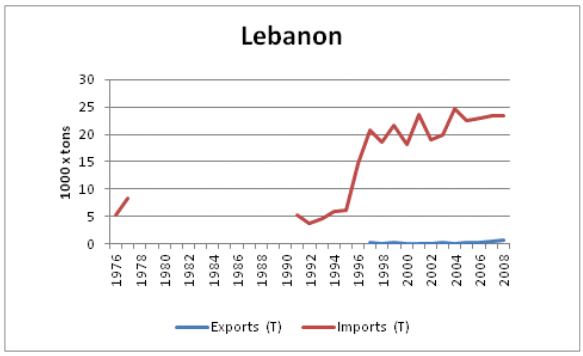


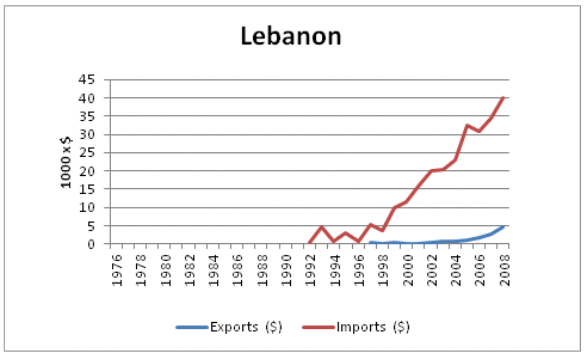






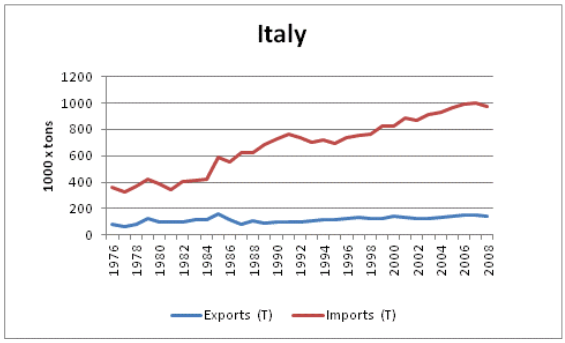


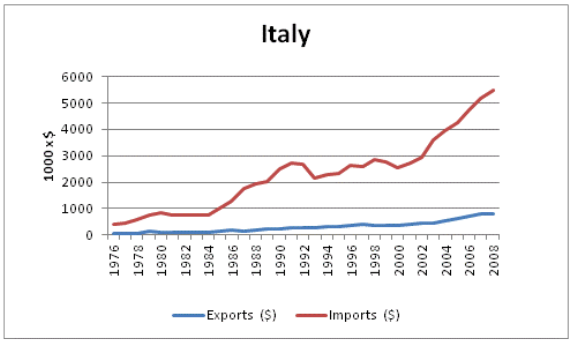


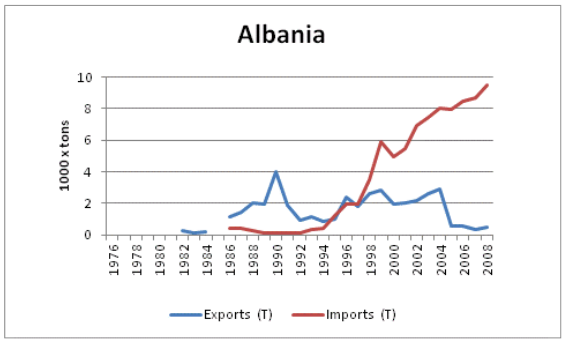


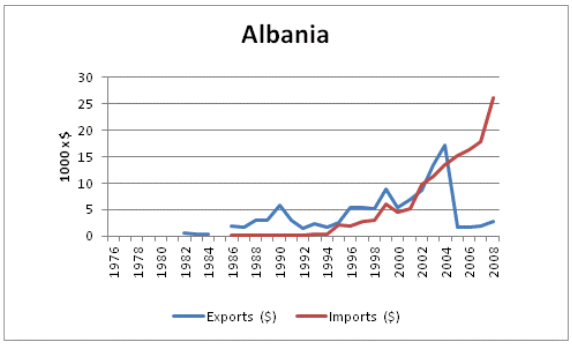
Source FAOSTAT

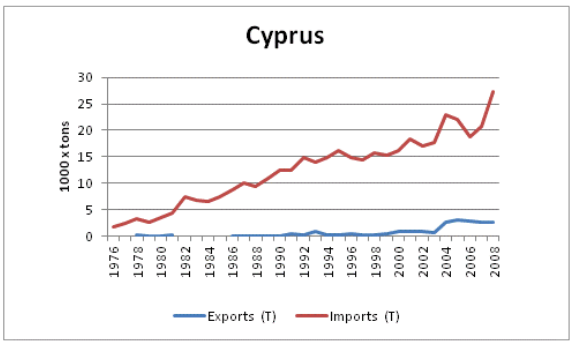
Figure 37 - Changes in the quantities (RIGHT) and value (LEFT) of marine produce imports and exports in certain Northern Mediterranean countries (Italy, Albania, Cyprus and Croatia

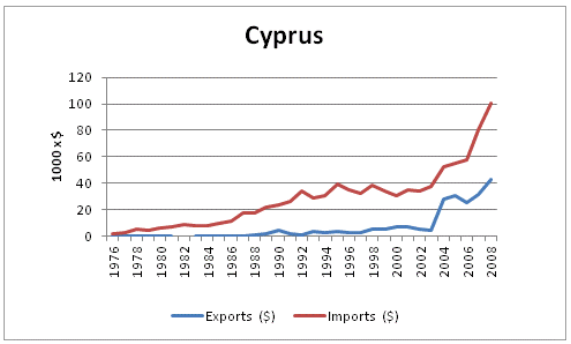


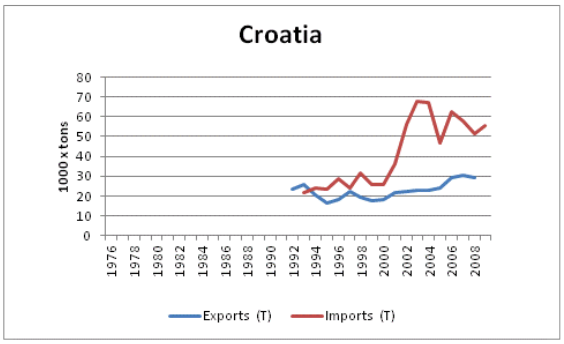


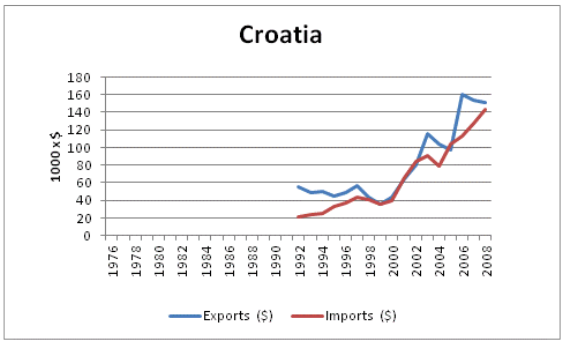






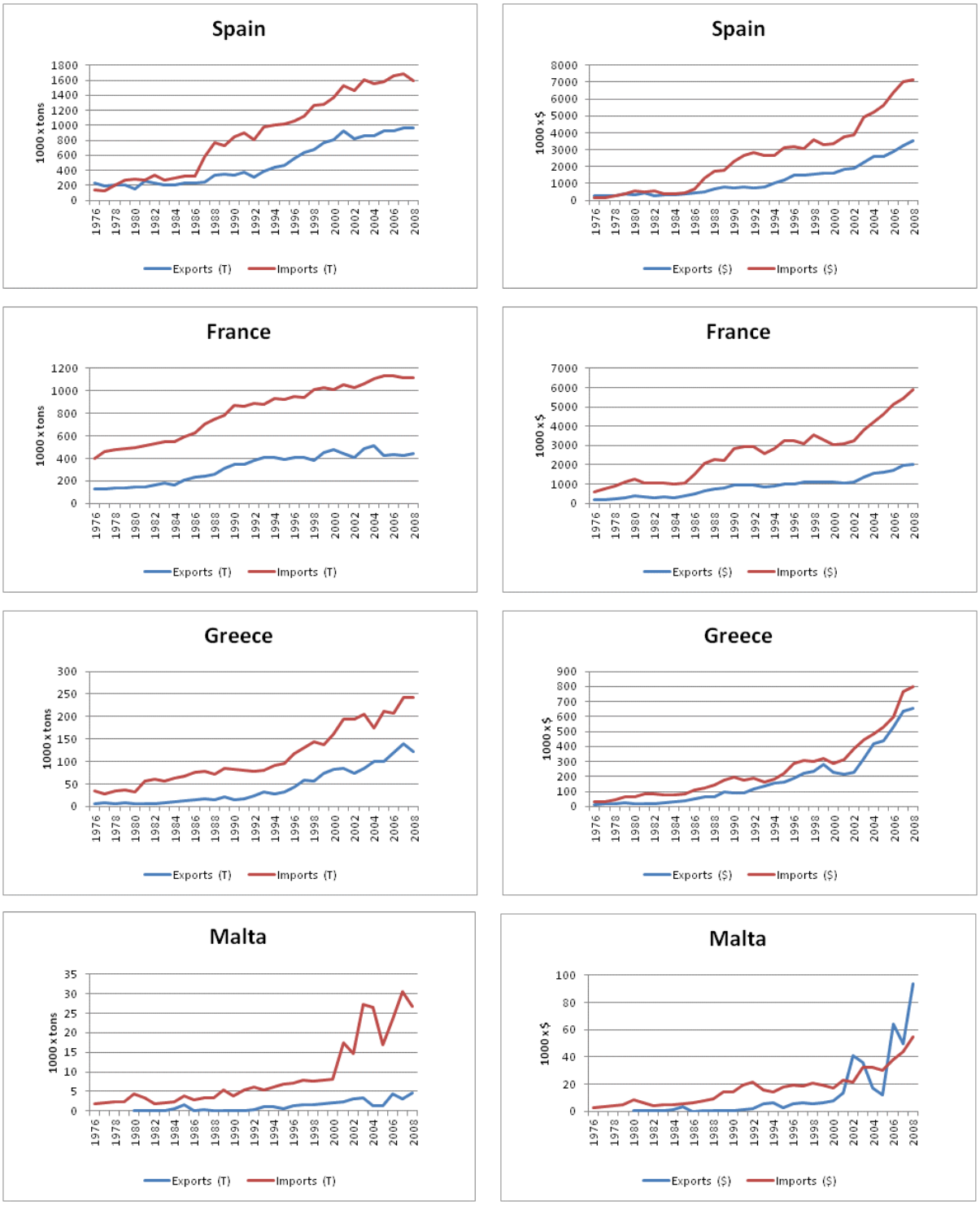






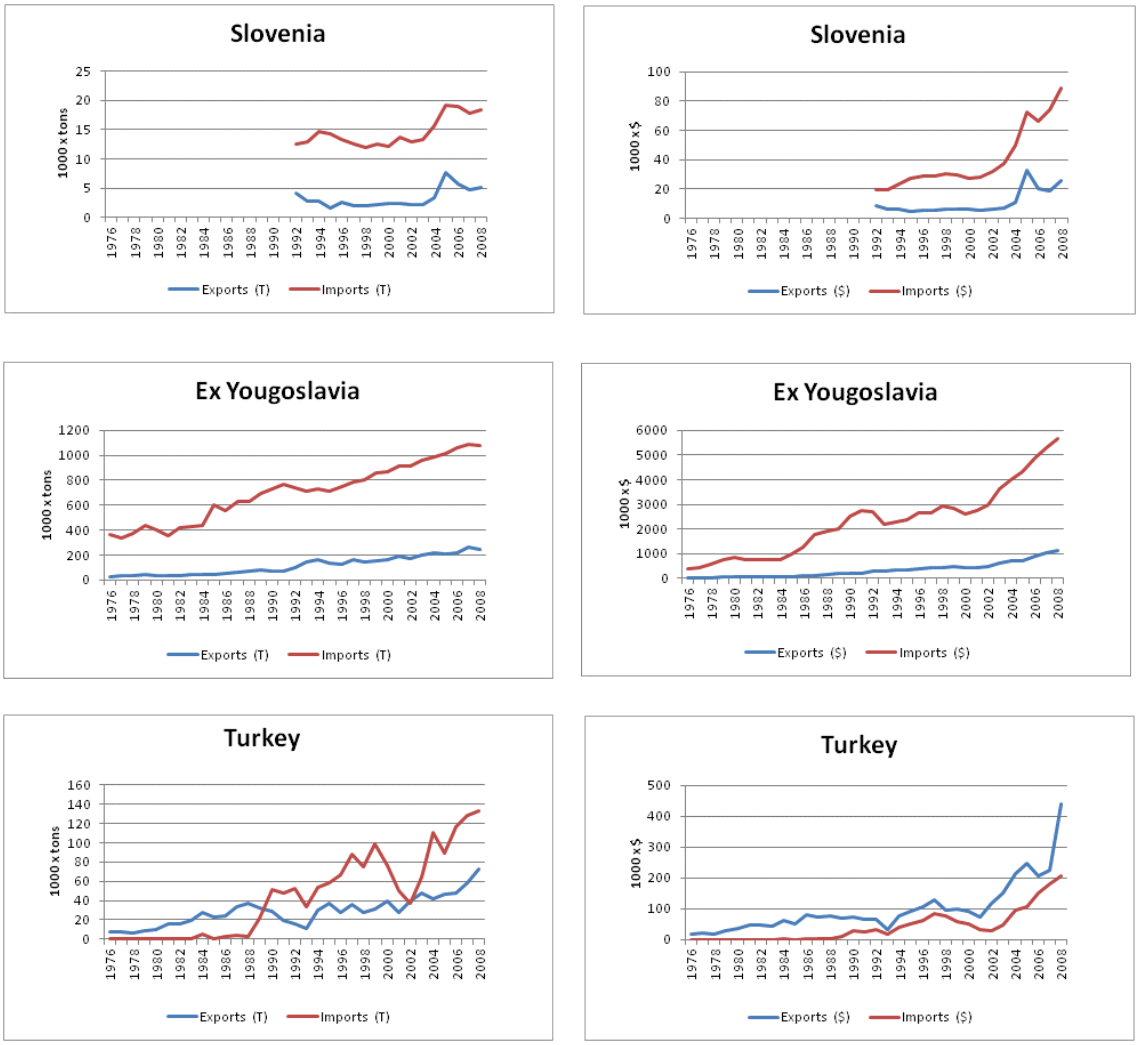
Source FAOSTAT

Figure 38 - Changes in the quantity (RIGHT) and value (LEFT) of marine produce imports and exports in certain Northern Mediterranean countries (Spain, France, Greece and Malta



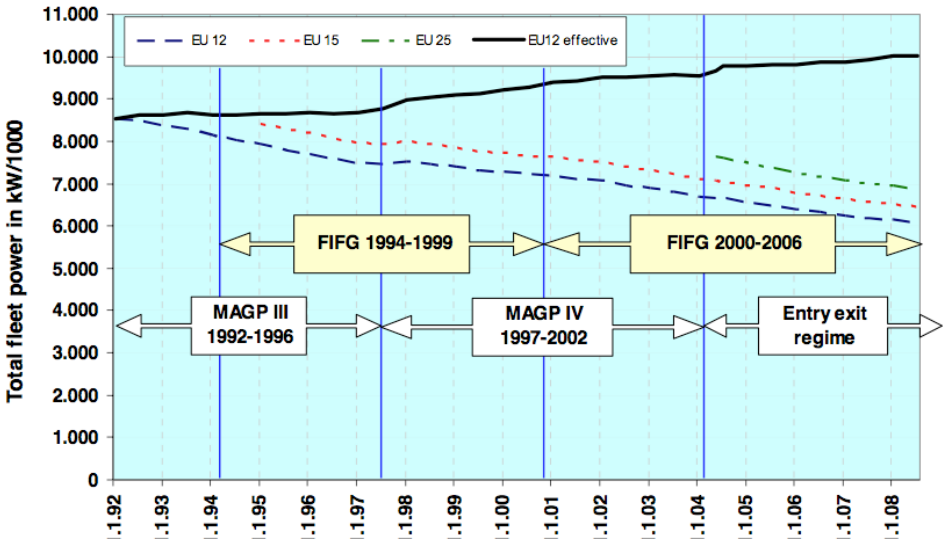
Source FAOSTAT

Figure 39 - Changes in the quantities (RIGHT) and value (LEFT) of marine produce imports and exports in certain Northern Mediterranean countries (Slovenia, former-Yugoslav countries and Turkey



Source FAOSTAT

Figure 40 - Changes in the total power of the European fishing fleet



Source: des Clers, 2009 EU Multi-Annual Guidance Programme).

X. Table of illustrations

Figures

Tables