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LONG AND SHORT-TERM TRENDS OF MEDITERRANEAN FISHERY RESOURCES

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GENERAL FISHERIES COUNCIL FOR THE MEDITERRANEAN

LONG AND SHORT-TERM TRENDS OF MEDITERRANEAN FISHERY RESOURCES

by

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PREPARATION OF THIS DOCUMENT

The document contains an analysis of long-term landing trends in the West and East Mediterranean, based on, and summarizing, two separate informal documents submitted to the General Fisheries Council for the Mediterranean Eighth Technical Consultation on Stock Assessment in the Western Mediterranean held in Casablanca (Morocco), 14-17 October 1997; and to the GFCM First Technical Consultation on Stock Assessment in the Central and Eastern Mediterranean held in Nicosia (Cyprus), 9-12 December 1996. The document is intended to provide a factual basis for further studies of the interrelationships between fisheries in the Mediterranean, as other relevant trends and data sources.

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Long and short-term trends of Mediterranean fishery resources.
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ABSTRACT

This study makes use of the recently published (FAO 1995) 45 year time series (1950-1994) of landings now available from FAO through the program FISHSTAT-PC (Version 5094/96 of March 1996) to analyse long-term trends and separate them automatically in a number of categories using an expert system for data analysis. Landing time series of the most important commercial species and group of species of both West (148 species) and East (137 species) Mediterranean have been processed with this program written in Pascal, in order to analyse and categorize long and short-term trends in these fisheries. Species trends have been categorized following a description of the different stages a fishery could pass through in time (new, rising, stable, declining, recovering and collapsed fisheries). Species have been also arranged into ecological or biological categories (estuarine, benthic and coastal, pelagic, large pelagic, demersal and slope resources), and differences between West and East Mediterranean trends were sought for the same and different species. A ranking of the most important commercial species using 1992 catches, as well as by 1992 total value of landings, have been carried out, and a comparison between West and East Mediterranean fisheries has been provided.

TABLE OF CONTENTS

1. INTRODUCTION

Time series of fishery landings can provide important indications of changes in a fishery, or changes to the underlying environment. Often, as in the case of Mediterranean fisheries, this is essential in the absence of complete or independent information such as on the fishing intensity or fishing mortality affecting the stock. Then, fishery landing trends can provide the only indication that important changes have occurred in the past.

It must be recognized however that this type of analysis does not of itself, provide an adequate information base for fisheries management decisions. If used in the absence of stock assessments or surveys, it can lead to excessive optimism, since a resource which supported a significant fishery in 1992 may already have been decimated in some parts of its range by the time the trend analysis is reported. One further qualification on the following type of analysis is that it does not take into account the status of individual stocks: landings from individual resources may be combined such that declining stock trends in one subarea may be hidden by increases in landings from another. Finally, trends influenced by environmental or ecosystem changes cannot be distinguished from those caused by fishing. Despite this qualifications, analysis of historical trends for many resources can provide useful indication of the general "state of health" of fisheries in the region.

The present document summarises and compares 2 separate informal documents submitted to the GFCM Eighth Technical Consultation on Stock Assessment in the Western Mediterranean (Casablanca, Morocco, 14-17 October 1997) and to the GFCM First Technical Consultation on Stock Assessment in the Central and Eastern Mediterranean (Nicosia, Cyprus 9-12 December 1996), and makes use of the recently published (FAO 1995) 45 year time series (1950-1994) of landings now available from FAO through the program FISHSTAT-PC. (Version 5094/96 of March 1996).

Evidently, the early years of this long-term time series from 1950-1994 preceded the separation of Mediterranean fisheries statistics into subareas, as is the case for more recent data. It has therefore been necessary for these early years, in representing the trends in landings of species in the West and East Mediterranean, to restrict our analysis to time series of grouped national landings reported from a restricted number of countries or territories.

The two series of combined national data are for:

A/ West Mediterranean
Algeria, France, Gibraltar, Italy (*Adriatic and Ionian excluded*), Monaco, Morocco, Spain and Tunisia (*Ionian excluded*).

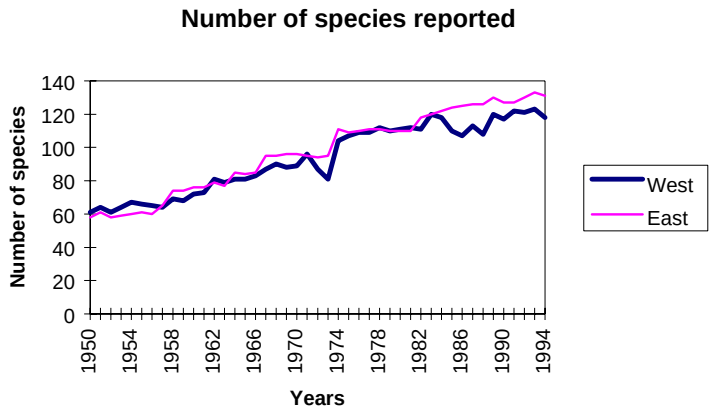
B/ East Mediterranean
Albania, Croatia, Cyprus, Egypt, Greece, Israel, Italy (*Adriatic and Ionian included*), Lebanon, Libya, Malta, Slovenia, Syria, Tunisia (*Ionian included*), Turkey (*Black Sea excluded, Sea of Marmara included*), Yugoslavia SFR, and Yugoslavia FR (*i.e. States of the former Yugoslavia*).

For the West Mediterranean, the data consisted of 380 separate time series, and for the East Mediterranean 580 separate time series of species or species groups.

The following specific comments may be relevant:

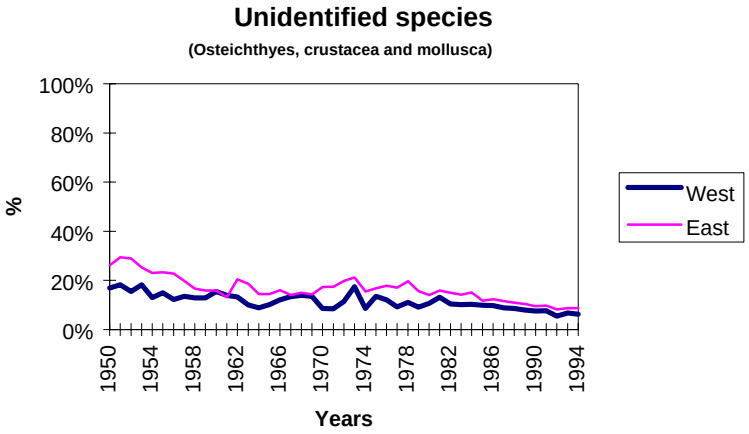
The GFCM statistical data base contained in FISHSTAT-PC from year 1972 onwards, was used to separate landings for Italy and Tunisia between the West Mediterranean (Sardinia) and the East Mediterranean (Adriatic and Ionian), and to separate Turkish data between Mediterranean and Black Sea.

As must be evident, the data series of landings incorporate an unknown degree of error in reporting, and some changes in reported values might even reflect changes in national data collecting and reporting procedures rather than just real fishery trends. This possibility cannot be commented on in detail here. It seems likely however that where similar trends are shown by 2 or more countries over the same period (and is illustrated in the comparisons shown later, and by the general similarity of West and East Mediterranean trends for the same species), there is good justification for considering that they reflect real trends, or at least merit further more specific investigation by the countries reporting. It would seem that there has been an improved discrimination of species recorded by countries since early years of reporting (see figure 1 and figure 2) and a slow reduction in unidentified catch. It is not certain however what these two data trends tell us about the change in overall accuracy of reporting, or about the change in underreporting with time. Note however most of the new species reported are minor in quantity, and probably were previously included in an undifferentiated category.



This figure shows how the number of species or group of species, from the point of view of reporting of landings, has increased with time in West and East Mediterranean. Landings in 1950 were recorded only for 60 species, and nowadays for more than 100.

Figure 1



This figure shows that the percentage of total landings recorded as taxonomically undifferentiated groups (like Osteichthyes, unespecified Crustacea and Molluscs), has decreased with time. In 1950, 17% of West and 30% of East landings were included in such undifferentiated groups, while nowadays this percentage has been reduced to 6% and 9% respectively.

Figure 2

2. METHODOLOGY

2.1 Discrimination of long-term trends

Categorizing data trends in a large number of time series is a difficult task, and one that requires an approach that combines biological intuition and knowledge of the fisheries in question, with an objective approach to statistical analysis. The approach outlined below is only one way of addressing this task, and is only partial, although we have provided categorizations both in terms of short and long-term trends. We have not attempted to provide a definitive explanation of what these statistical categorizations mean in biological terms. This is for the reader to decide, but it is felt that such an automatic categorization can help to point to one or more possible hypotheses explaining the trends observed, and draw attention to similar trends between species which may, or may not, be obvious from simple ecological considerations.

The simple statistical categorization or "technical analysis" reported here has the merit of minimizing the importance of human judgement in classifying the voluminous data analysed, which would otherwise be difficult to tackle. It does of course have the associated difficulty that interpretation of the trends is not automatically evident.

One possible unifying hypothesis for looking at the long-term data is proposed in figure 3, which draws upon the observation (e.g. Caddy 1984) that fisheries typically pass through a series of peaks and troughs which may represent one or more of at least three types of factors:

a) A sequence of development stages in the fishery from a new fishery to full exploitation, overexploitation, decay of the fishing effort in response to a depleted stock size, possibly followed by a recovery.

b) Periods of natural increases or decreases in abundance, carrying capacity and/or availability of the resource, may be followed by a reversal, and subsequently natural decline or recovery

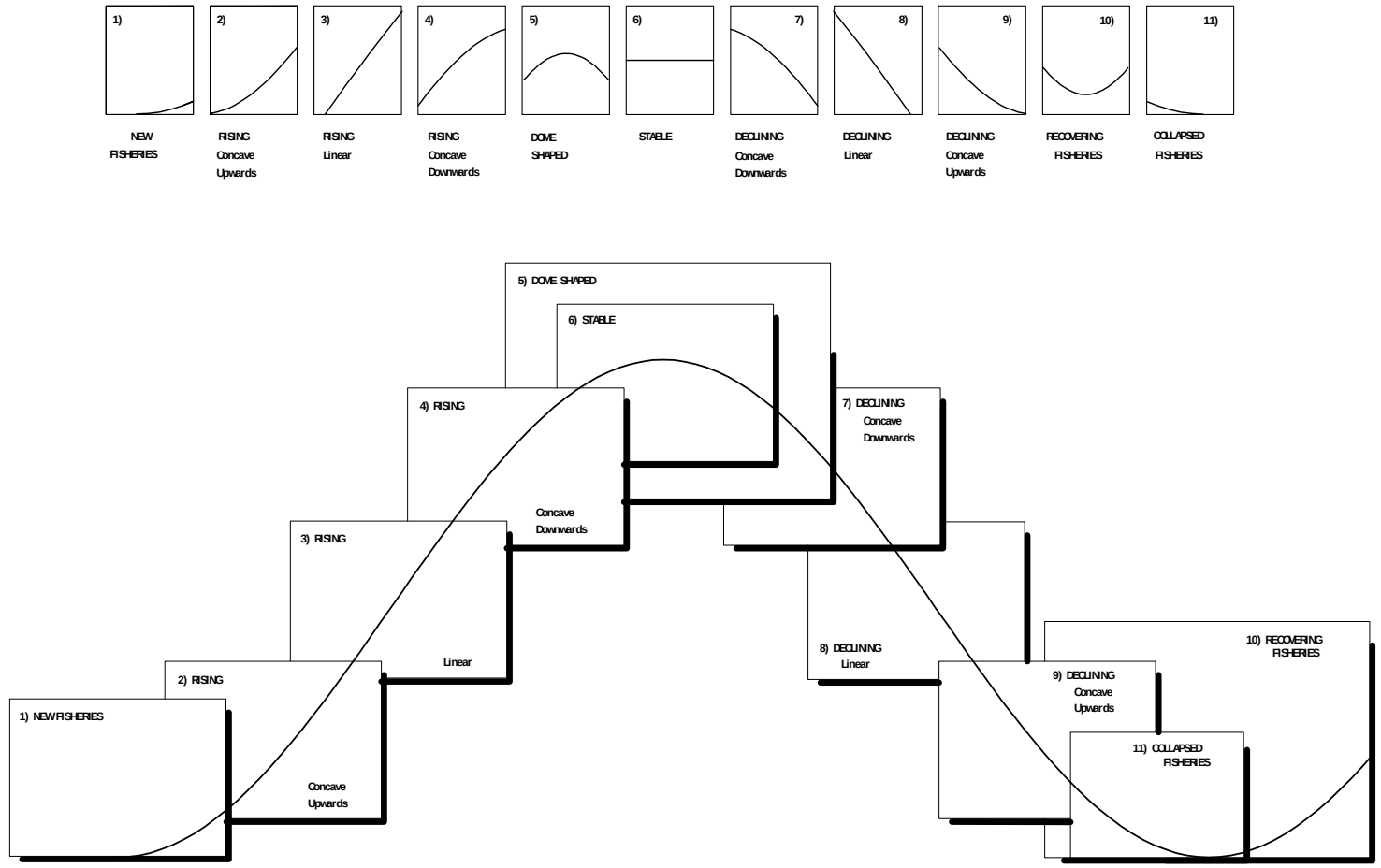


Figure 3. One conception of how the different fittings of the individual time series could fit into an overall model of growth, decay and recovery of a fishery

of the stock. In this case a "dome shaped" landing trend could have been due either to overfishing, or subsequent change in environment, from favourable to unfavourable during the period covered by the data series.

c) A similar cycle of events may be due in part, to changing market demand.

In practice of course, all three factors are likely to be operating simultaneously, and the approach used here does not depend on which, or give independent confirmation of their relative importance. It requires that the reader distinguish between them.

2.2 Tables

Having sorted the time series into the above categories using the automatic procedures described in the technical annex the numbers in each category are then summarized in figures 4 and 5. These histograms show the number of long-term trends by category and (shaded areas) proportion of time series with rises and declines over the last five years.

The technical annex also includes the tables and the figures for both parts of the Mediterranean Sea produced by the Pascal program written ad-hoc by the senior author to perform the subsequent analysis. This approach may be regarded as analogous to creating an "expert" system that frees the authors from the accusation of making judgements in particular cases.

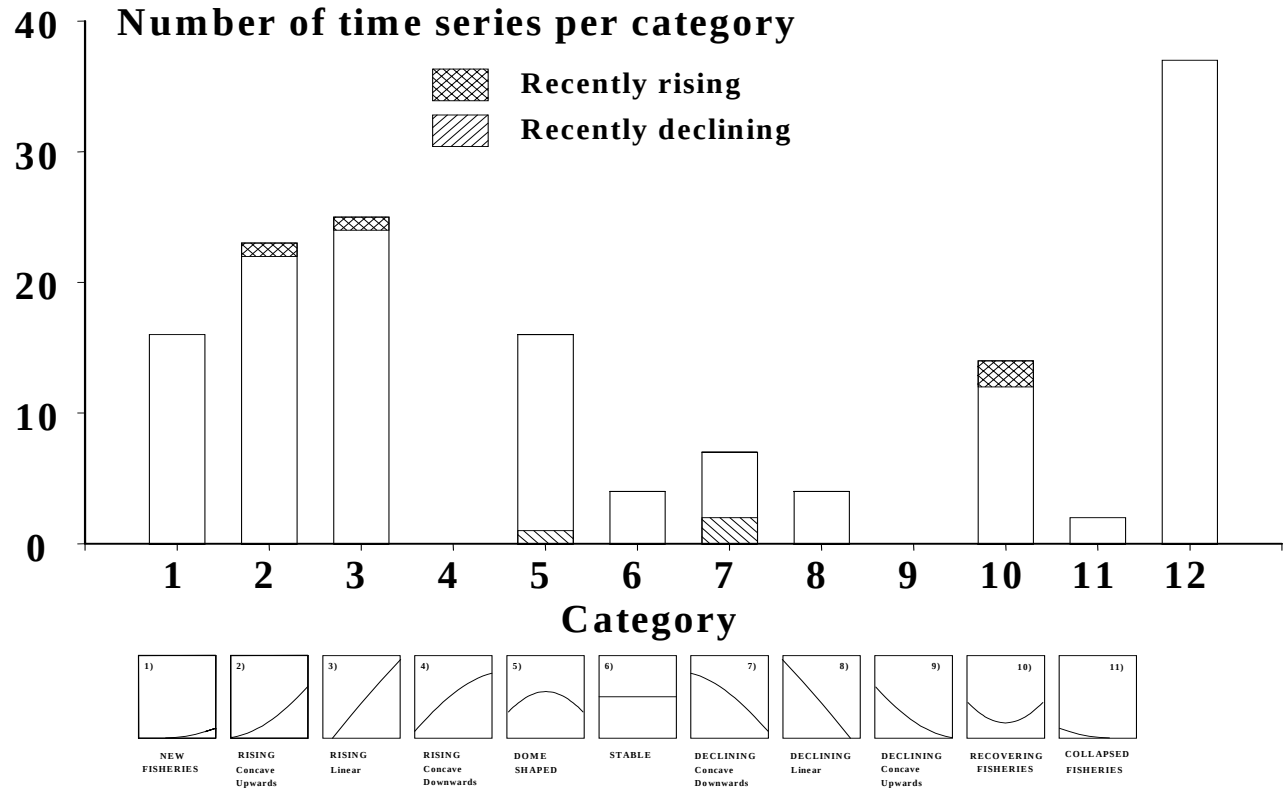


Figure 4. Histogram of trend type: West Mediterranean

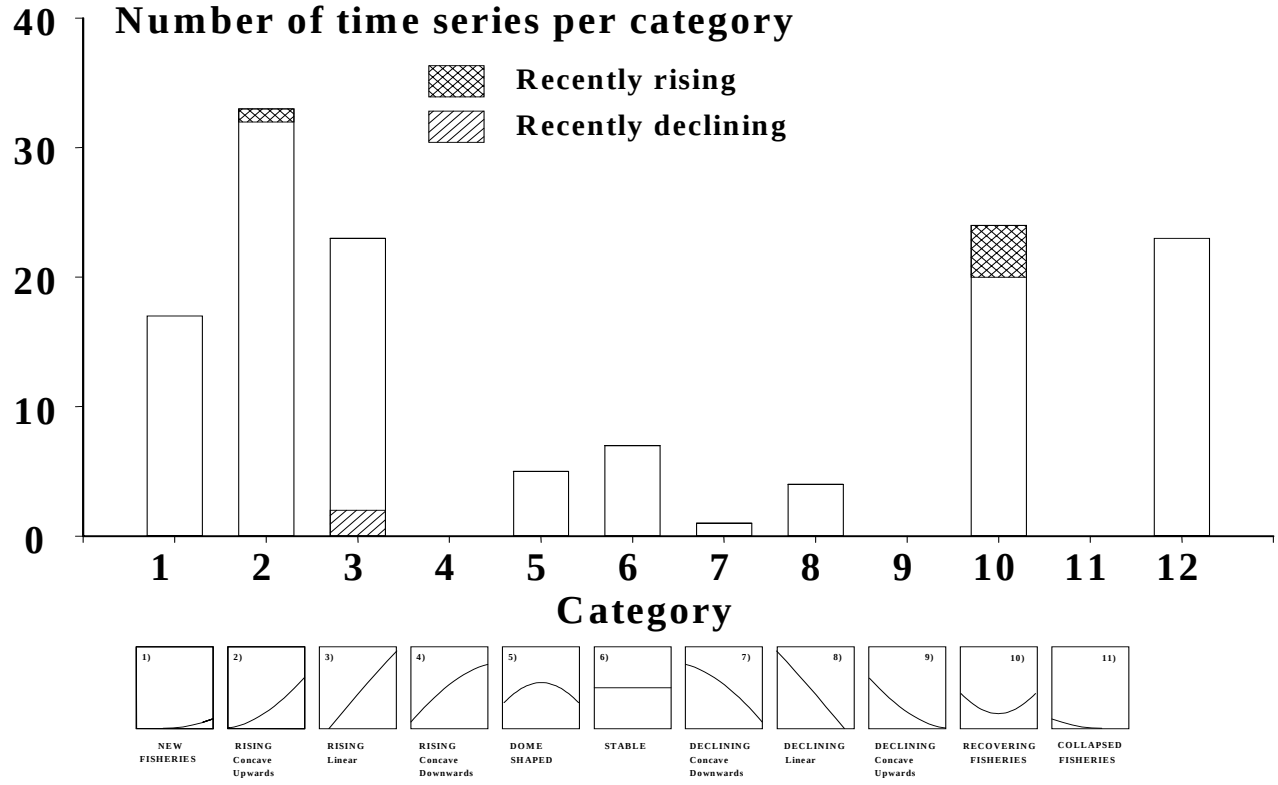


Figure 5. Histogram of trend type: East Mediterranean

3. RESULTS OF THE ANALYSIS

3.1 Interpretation

The following general observations on the whole data set can be made:

1) Despite some significant differences, noted later, the overall pictures for the West and East Mediterranean are not strikingly different.

2) From the histograms of trend type (figures 4 and 5) and from table 1, it is clear that a high proportion of species or species groups in both West and East Mediterranean have shown increases in landings over the whole time period; whether the increases were linear, concave upwards or concave downwards. If we include new and recovering fisheries in this group, some 53% in the West and 71% in the East of all species and species groups were rising during the second half of the time series.

3) Also of note from the perspective of stock assessment, is the fact that very few time series show stable yield levels, suggesting a considerable dynamism caused by environmental and/or trophic or fishery-related impacts underway in the fisheries of the sub-region.

Despite the long-term upward trends, the short-term trends over the last 5 years of the series tell a different story. *Roughly the same proportion have shown short-term declines and short-term increases over the last five years of the data series.* One tentative deduction from this is that multispecies landings may now be approaching a peak for the Mediterranean as a

whole; with new increases (especially in the South and East Mediterranean) being balanced by recent declines; especially in the West and North.

Table 1: Comparison between percentage of resources in West and East showing different trends in landings

	New	Recovering	Rising	Dome-shaped	Stable	Declining	Intermittent	Collapsed
West	**11%**	**9%**	**33%**	**11%**	**3%**	**8%**	**25%**	**1%**
East	**12%**	**18%**	**41%**	**4%**	**5%**	**4%**	**17%**	**0%**

3.2 A comparison between West and East Mediterranean fisheries

Table 1 looks at the classification of long-term trends for the species or group of species used for the analysis (148 in the West, and 137 in the East). As noted, this comparison suggests that these trends are basically fairly similar, and differences in percentages by category of trends between West and East trends rarely exceed 9%.

The following observations can be made:

a) New fisheries: A number of species classified as "new fisheries" in this table are in fact a result of a more accurate division of former broader categories (e.g. *Mullus spp* was formerly use to include not new, but landings of both striped and red mullet, which were later separated into two species). Other "new" fisheries (like the clam *Donax sp*) have always been fished, but were only recently recorded separately from other shellfish in the statistics. Thus, few real "new fisheries" are identified in the period since 1950, and this is hardly surprising as the Mediterranean has been actively fished for centuries with a wide variety of gears.

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

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

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

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

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

An alternative approach is adopted below, which is considering trends by species or group of species by predominant ecological or biological category of resources. We have arranged almost all species (141 in the West and 131 In the East) into five categories of resources: estuarine, benthic and coastal, demersal, slope, pelagic and highly migratory (annex 1). We have then compared percentages for West and East of time series falling into each category. The main differences (only differences equal to, or higher than 10% are recorded), are as follows:

Table 2: Comparison between percentage of resources in West and East by biological category

ESTUARINE	West	East
Recovering	0%	50%
Rising	20%	50%
Dome shaped	40%	0%
Intermittent	40%	0%

DEMERSAL	West	East
Recovering	5%	20%
Rising	30%	47%
Dome shaped	16%	2%
Intermittent	26%	15%

PELAGIC	West	East
Rising	28%	52%
Declining	11%	0%

BENTHIC	West	East
Recovering	11%	33%
Rising	30%	20%
Declining	14%	0%

SLOPE	West	East
New	0%	36%
Rising	54%	27%

HIGHLY MIGRATORY	West	East
New	0%	10%
Recovering	10%	0%
Rising	50%	60%
Dome-shaped	10%	0%
Stable	10%	0%
Declining	0%	10%

From the perspective of stock assessment, it would seem precautionary to look first at those species showing strong short-term declines and those (7, 8, 9 and 11 in figures 3-5) which have been showing long-term declines. These "long-term declining species" and those which may have surpassed their theoretical maximum production would seem to merit more attention from a formal assessment process, if a precautionary approach were to be adopted. Species mentioned in this category in the Western and in the Central and Eastern Mediterranean Technical Consultations on stock assessment were:

West Mediterranean:
.- anchovy, picarels, little tunny, albacore, scombrids;
.- common pandora, large eye dentex and wreckfish;
.- gobys, seabreams and groupers;
.- sharks and rays;
.- lobsters and spinous spider crab;
.- carpet shell and murex;
.- sponges, Sardinia coral and grooved sea squirt.

East Mediterranean:
.- large demersal species (Serranids, Sciaenids);
.- whiting;
.- common eel;
.- some Carangids;
.- dolphin fish;
.- mackerels;
.- demersal and pelagic sharks and other squaliforms.

In addition, these Technical Consultations have pointed out some species that have shown a very rapid increase in their landings over the last decade. These species are:

West Mediterranean:
.- demersal species: European hake;
.- pelagic species: bluefin tuna and swordfish

East Mediterranean:
.- demersal species: Sparidae and Mullidae,blue whiting;
.- pelagic species: silversides, anchovy, sardines, horse mackerels, sardinellas, Seriola and Pomatomus;
.- crustaceans: shrimp and Norway lobster;
.- molluscs: octopus, clams, oysters and mussels;
.- estuarine: grey mullet.

If these rapid increases are due to a corresponding increase in exploitation, we again may have grounds for concern.

The following tables, for the West (table 3) and the East (table 4), show Mediterranean species arranged according to their landings in 1992. We can see in these tables that the same four species are most important but occur with different order in both basins. Among the top ten landings by species, six are the same in the West and in the East. We can deduce from comparing these tables, that from the point of view of relative importance or ranking in the total landings the two parts of the Mediterranean do not differ greatly.

Table 3. West Mediterranean top 15 species ranked with respect to 1992 catches

SPECIES	1992 LANDINGS IN METRIC TONS	WEST RANKING	EAST RANKING
Sardina pilchardus	151630	1	2
Engraulis encrasicolus	45547	2	4
Mytilus galloprovincialis	38861	3	1
Osteichthyes (unspecified)	21281	4	3
Crassostrea angulata	14456	5	-
Merluccius merluccius	13993	6	6
Trachurus spp	13608	7	25
Thunnus thynnus	12146	8	41
Boops boops	9990	9	13
Mullus spp.	6950	10	8
Sardinella spp	6445	11	10
Xiphias gladius	5787	12	38
Octopodidae	5778	13	73
Micromesistius poutassou	5159	14	20
Scomber scombrus	5105	15	45

Table 4. East Mediterranean top 15 species ranked with respect to 1992 catches

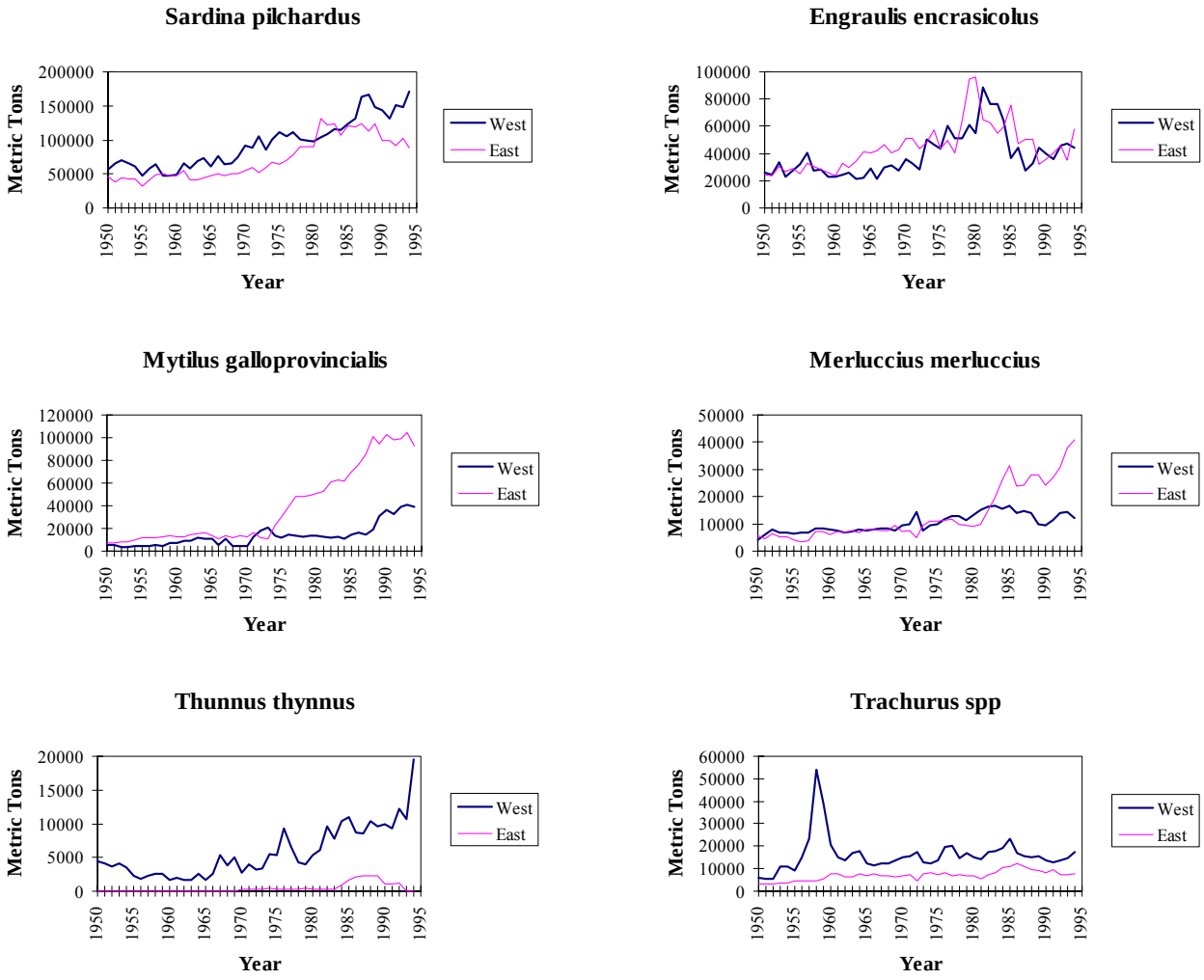
SPECIES	1992 LANDINGS IN METRIC TONS	EAST RANKING	WEST RANKING
Mytilus galloprovincialis	98761	1	3
Sardina pilchardus	92010	2	1
Osteichthyes	56794	3	4
Engraulis encrasicolus	45430	4	2
Venus(=Chamelea) gallina	37591	5	23
Merluccius merluccius	30532	6	6
Tapes spp	26400	7	-
Mullus spp	24952	8	10
Natantia	22555	9	31
Sardinella spp	20687	10	11
Octopus vulgaris	19414	11	18
Scomber japonicus	18422	12	17
Boops boops	18240	13	9
Sepia officinalis	15739	14	25
Mugilidae	15695	15	16

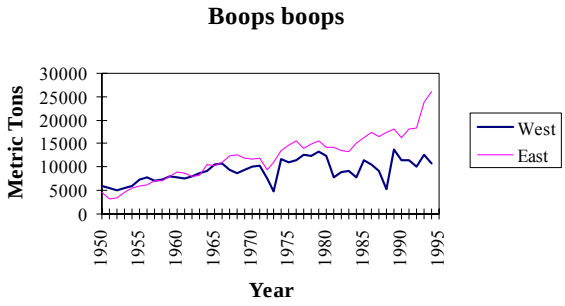
In the following we show the landings for the top ten species from 1950 to 1994, in order to compare trends in the West and East Mediterranean. We have not represented groups like

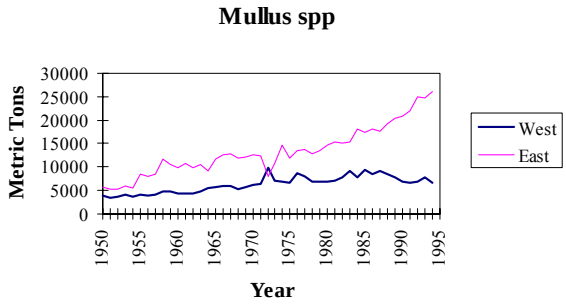
"unspecified Osteichthyes" and "Natantia" since their composition is not well defined; nor have we represented *Crassostrea angulata* and *Tapes spp* since we have no records for both Mediterranean basins. Some of these trends are very similar for both sides of the Mediterranean (anchovy, sardine swordfish). Also between different species in the same areas some of these trends seem to be surprisingly similar: for instance small pelagics like anchovy and European pilchard (=sardine) and highly migratory species like swordfish; although we do no enter into detail with respect to interpretation, this may suggest a possible trophic linkage between a forage fish and a pelagic predator?

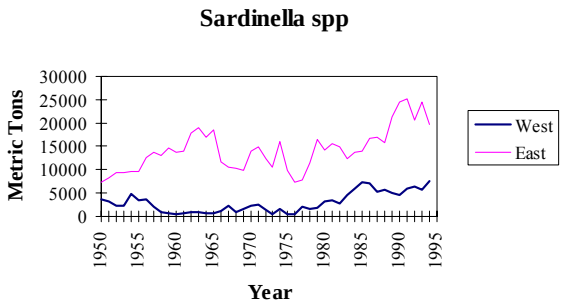
Other species like European hake show a very similar trend until the 1980's, when their trends diverge. Some species show a completely different trend such as bluefin tuna.

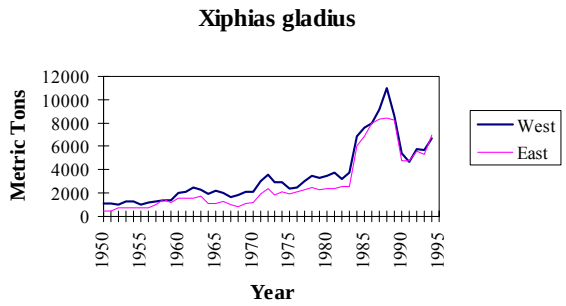
We have to be cautious with trends for tuna and tuna-like fishes because theses species are not separated by subareas in the GFCM data base as for the other species. For this reason, 50% of Italian and Tunisian landings have been assigned to respective sides of the Sicilian Channel. In the case of swordfish, the dominance of Italian fisheries in the West and East may offer one reason for the similarity in trend.

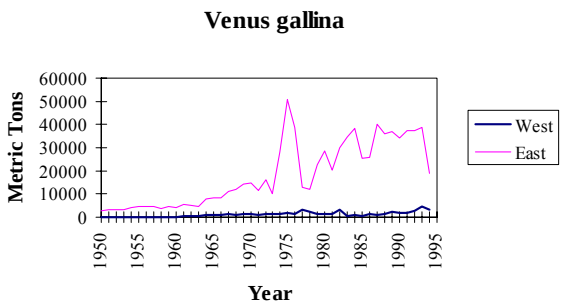


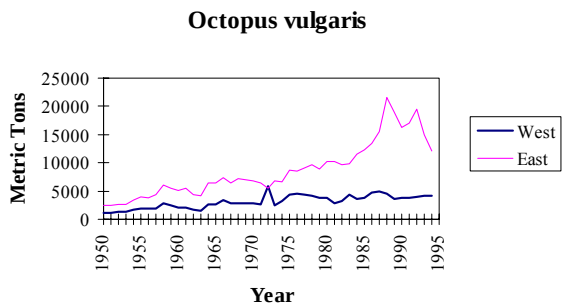


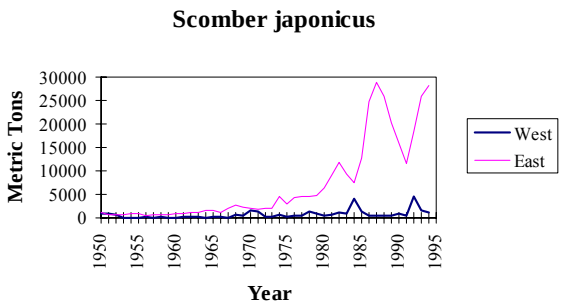












3.3 A tentative ranking of species by total value of landings

Although prices differ widely throughout the region, it was felt useful to attempt to determine the approximate order of importance of species in the two areas considered, using the extensive data on commercial landed prices from the Italian market. This last analysis of course needs further refinement, but shows some interesting features, named the high economic importance of invertebrate and large pelagics landings in the Mediterranean region.

The following tables (tables 5 and 6) show landings by species or group of species but this time arranged from the point of view of their relative landing value, as a percentage of the

value of each basin. One observation that is probably important, is that pelagic fish (large and small) are not as important in the East Mediterranean as they are in the West. Both in the West and in the East, a very high percentage of incomes generated by fisheries come from molluscs, including aquaculture production, but the important species are different: *Crassostrea angulata* and *Mytilus galloprovincialis* are important in the West and *Mytilus galloprovincialis, Tapes spp, and Ostrea edulis* in the East. It also seems that shellfish account for a higher percentage of the total value of landings in the West than in the East.

Table 5. West Mediterranean: top 15 species ranked with respect to 1992 percentage of total landings value

SPECIES	% of Total Value (1992)	WEST RANKING	EAST RANKING
Crassostrea angulata	13.65%	1	-
Engraulis encrasicolus	7.17%	2	10
Merluccius merluccius	6.61%	3	5
Mullus spp.	6.56%	4	1
Mytilus galloprovincialis	6.12%	5	4
Thunnus thynnus	5.74%	6	30
Sardina pilchardus	4.77%	7	21
Osteichthyes	3.35%	8	7
Crustacea	2.92%	9	35
Xiphias gladius	2.73%	10	24
Aristeus antennatus	2.71%	11	70
Parapenaeus longirostris	1.99%	12	42
Natantia	1.75%	13	2
Anguilla anguilla	1.45%	14	33
Nephrops norvegicus	1.41%	15	11

Table 6. East Mediterranean: top 15 species ranked with respect to 1992 percentage of total landings value

SPECIES	% of Total Value (1992)	EAST RANKING	WEST RANKING
Mullus spp	9.77%	1	4
Natantia	8.83%	2	13
Venus(=Chamelea) gallina	7.36%	3	18
Mytilus galloprovincialis	6.45%	4	5
Merluccius merluccius	5.98%	5	3
Tapes spp	5.17%	6	-
Osteichthyes	3.71%	7	8
Dicentrarchus labrax	3.28%	8	22
Sepia officinalis	3.08%	9	21
Engraulis encrasicolus	2.97%	10	2
Nephrops norvegicus	2.50%	11	15
Ostrea edulis	2.40%	12	91
Sparus aurata	2.11%	13	25
Mollusca	1.65%	14	30
Dentex dentex	1.56%	15	19

4. DISCUSSION

4.1 Trends in Mediterranean fisheries compared with fisheries of other semi-enclosed seas

Recent analyses of fisheries trends by FAO Statistical area (e.g. Grainger and Garcia 1996) have shown that the Mediterranean is almost unique in not showing a pronounced peak of landings earlier in the time series (generally this occurred in the 1970's and 80's, for example in the North Atlantic and North Pacific), and this diagnosis is confirmed in the present study. The Mediterranean is not unique however, when compared with other semi-enclosed seas: other seas such as the Black Sea, Baltic and Seto Inland Sea have shown sustained trends in production; in some cases e.g. the Black Sea followed by a precipitous collapse. The evidence (e.g. Caddy et al. 1995) seems to show that this trend is not just a result of previous underexploitation of resources (which would be highly unusual in the case of core or "inland" seas with long histories of exploitation and large riparian populations), but is due to an increasing nutrient contribution from the surrounding water basins under the influence of runoff of thousands of tons of nutrients annually; a feature which shows up in remote sensing imagery of these basins and may have played an influential role, especially for detritus and plankton feeders.

Evidently this trend is not an unmixed blessing; economically it has serious negative effects, even on fisheries, health, tourism, etc.; effects which are more pronounced close to shore. For semi-enclosed seas, the importance of integrating environmental and fishery management is clearly important, but extremely difficult to quantify or estimate its economic implications, and the risk of serious negative impacts such as have occurred in the Black Sea need to be taken seriously in the Mediterranean proper now and in the future.

We emphasize however that this hypothesis does not necessarily apply in many cases, for example, the dramatic rise in prices for some species such as bluefin tuna has certainly fuelled increases in exploitation; in others such as some molluscan shellfish, the spread of harvesting technology may have played a key role.

4.2 How to take long-term trends into account in fisheries management ?

If as seems likely, the standing stock has been increasing due to higher levels of primary production, this does not mean that the need to manage resources is removed. So far, although species collapses seem to be relatively few on a basin-wide basis, there is concern at the increases in effort in response to high and rising prices, and this may have resulted in the fishery sector attracting fishing effort levels that would be at or close to MSY levels for fisheries outside the Mediterranean. Further increases in fishing effort, therefore, are unlikely to result in increased long-term yield, at least for the high value species.

Unfortunately we have, few good data series that show how catch per unit of effort and fishing mortality rates are changing over the period, and together with the need for improved data trends on biomass, this points to the need to study these trends, together with those on spawning biomass and recruitment of the key commercial species.

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