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REGIONAL STUDY ON SMALL TUNAS IN THE MEDITERRANEAN INCLUDING THE BLACK SEA

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GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

REGIONAL STUDY ON SMALL TUNAS IN THE MEDITERRANEAN INCLUDING THE BLACK SEA

by

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PREPARATION OF THIS DOCUMENT

During its thirty-second session, the General Fisheries Commission for the Mediterranean (GFCM) requested to its Scientific Advisory Committee (SAC) to undertake a regional study on small tunas fisheries in the Mediterranean and the Black Seas with the perspective to prepare the eighth meeting of the joint GFCM/ICCAT Working Group on Large pelagic, held in Spain (May, 2008).

The study reverses the widespread perception that these fishing activities were almost irrelevant either in terms of catches or revenues. The fleet catching small tunas is scarcely defined or not identified in most of the countries studied, but it is generally known that thousands of small and medium-sized vessels, engaged in small-scale, artisanal or recreational fisheries, are carrying out activities that also target small tuna species. In addition, catches are also obtained as a bycatch in other fisheries.

This document, related to the above mentioned study, summarizes and makes analysis of the available information and data about the small tuna species in the Mediterranean Sea and the Black Sea, notably on their biology and ecology, their exploitation, including the fishery statistics by species, and the socio-economic aspects of these fisheries. It was elaborated with the financial support of the Japanese project titled “Supporting and strengthening function and coordination among regional fisheries bodies (RFBs)/Regional fisheries management organizations (RFMOs)”quoted GCP/INT/069/JPN.

This document was prepared by Mr Abdellah Srour (GFCM Deputy Executive Secretary) and five (5) consultants namely: Mr A. Di Natale, Mr A. Hattour, Ms Ç. Keskin, Mr M’Hamed Idrissi and Ms L.O.Relini.

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ABSTRACT

This study, undertaken upon request by the General Fisheries Commission for the Mediteranean (GFCM), summarizes the available information about the small tuna species in the Mediterranean Sea and the Black Sea. It provides data on their biology and ecology, their exploitation, including the fishery statistics by species, and the socio-economic aspects of these fisheries.

The study reverses the widespread perception that these fishing activities were almost irrelevant either in terms of catches or revenues. Indeed it was commonly believed that these fisheries were mostly subsistence activities. On the contrary, important production levels can be achieved. The fleet catching small tunas is scarcely defined or not identified in most of the countries studied, but it is generally known that thousands of small- and medium-sized vessels, engaged in small-scale, artisanal or recreational fisheries, are carrying out activities that also target small tuna species. In addition, catches are also obtained as a bycatch in other fisheries.

Many Mediterranean and Black Sea countries are not reporting any catches, or, in the case of a few countries, only a small number of landings are declared. Nevertheless, fishery production data related to the small tuna species show a total official reported landing of 83 386 tonnes in 2005. The under-reporting is believed to be significant because landing sites are scattered all along the coastline and the islands – where many thousands of small and medium-sized vessels operate – and the catches are often directly marketed. Moreover, catches from recreational fishery in many countries are seldomly reported. Under such circumstances, the total landings could possibly be estimated at a minimum of about 150 000 tonnes. Considering only the total official production for the four most relevant species, it is likely that the estimation of the real production might reach about 300 millions euros in the best years.

A specific problem can be noted in relation to the small tuna species fishery in the Marmara Sea and in the Black Sea. Apart from Turkey, no recent data are present in any of the databases used for this study. The level of catches reported by Turkey in that area is, however, important.

A secondary difficulty is the lack of data on fleet segmentation targeting these species, on catch per unit effort (CPUE) and on socio-economic parameters.

RÉSUMÉ

Cette étude, réalisée sur demande de la Commission générale des pêches pour la Méditerranée, offre un résumé des informations disponibles concernant les petits thonidés en Méditerranée et dans la mer Noire. Elle fournit des données sur leur biologie et écologie ainsi que sur leur exploitation, y compris les statistiques des pêches par espèces et les aspects socioéconomiques de ces pêcheries.

Cette étude renverse l'idée reçue selon laquelle ces activités halieutiques étaient peu pertinentes en terme de prises ou de revenus. En effet, on croit généralement que ces pêcheries sont avant tout des activités de subsistance, alors qu'au contraire, elles peuvent atteindre d'importants niveaux de production. Dans la plupart des pays étudiés, la flotte capturant les petits thonidés est mal définie ou non identifiée, mais on sait que généralement des milliers de navires de petite ou moyenne taille, opérant dans la pêche artisanale ou récréative, exercent des activités visant également les petits thonidés. De surcroît il existe des prises accessoires dans d'autres pêcheries.

De nombreux pays de la Méditerranée et de la mer Noire ne font pas rapport de leurs captures ou, dans le cas de quelques pays, seulement un nombre limité de débarquements sont déclarés. Néanmoins les données de la production halieutique relative aux petits thonidés s'élèvent à 83 386 tonnes en 2005. On pense que cette estimation à la baisse est importante car les sites de débarquement sont disséminés le long des côtes et des îles – où opèrent plusieurs milliers de navires de petite et moyenne taille – et que les prises sont directement commercialisées. De surcroît, les prises provenant de la pêche récréative dans de nombreux pays sont rarement comptabilisées. Dans de telles circonstances, l'ensemble des débarquements pourrait être estimé à un minumum d'approximativement 150 000 tonnes. En considérant seulement la production officielle totale pour les quatre espèces les plus pertinentes, il est probable que l'évaluation de la production réelle atteigne 300 millions d'euros pour les années fructueuses.

Il existe un problème spécifique lié aux petits thonidés en mer de Marmara et en mer Noire. À l'exception de la Turquie, aucune donnée récente ne figure dans les bases de données utilisées dans le cadre de cette étude. Le niveau des captures dont la Turquie fait état dans la région est cependant notable.

Une deuxième question concerne le manque de données relatives à la segmentation des flottiles ciblant ces espèces, la capture pas unité d'effort (CPUE) ainsi que les paramètres socioéconomiques.

CONTENTS

1. GENERAL INTRODUCTION

During its thirty-first session (Rome, 9–12 January 2007), the General Fisheries Commission for the Mediterranean (GFCM) reiterated its interest for strengthened cooperation with the International Commission for the Conservation of Atlantic Tunas (ICCAT) and agreed that in the short term, priority should be given to the improvement of knowledge on the sustainable exploitation of small tuna fisheries, including their biological and socio-economic aspects.

As a result, follow-up will be ensured on the Recommendations of the seventh session of the Joint GFCM/ICCAT Ad Hoc Working Group concerning small tunas, especially in relation to the compilation of statistics and the implementation of scientific research programmes.

The general project for this study was presented during the 2007 ICCAT/Scientific Committee on Research and Statistics (SCRS) meeting (Srour and Di Natale, 2007).

The presence of several species of small tunas and the related fisheries have been well known in the Mediterranean Sea since historical times. Indeed small tunas are quite common in several artisanal or small scale fisheries throughout the area studied, however catches are only sometimes recorded in the national statistics systems or are not considered relevant because many catches are often sold on local markets or for subsistence.

According to the ICCAT database on catch statistics, it is clear that the small tunas are quite important in the Mediterranean Sea (including the Black Sea), reaching a total of about 80 000 tonnes in the year 2005. It is reasonable to estimate that catches of all small tuna species combined in the Mediterranean and in the Black Sea might reach a total of about 150 000 tonnes in some years, which should result in a quantity much larger than all the other tuna species in the same area. It is believed that the under-estimation of the landings is one of the explanations for the inaccurate reporting of the small tuna catches in some countries or fisheries. Even without full statistical evidence at the moment, it can be reasonably assumed that the small tuna fisheries are highly significant from a social and economic point of view, particularly for the coastal communities in both the Mediterranean and the Black Seas. Furthermore, these species are certainly very important from an ecological point of view, due to their relevance in the local food chain, either as predators or prey.

This study on small tuna species in the Mediterranean and in the Black Sea (Table 1) takes into account six species. Three of them are common to almost all countries in this area: the Atlantic bonito *Sarda sarda* (BON), the bullet tuna *Auxis rochei* (BLT)[1] and the little tunny *Euthynnus alletteratus* (LTA); the skipjack *Katsuwonus pelamis* (SKJ) appears, more or less regularly in seven of them; the plain bonito *Orcynopsis unicolor* (BOP) appears only in the statistics of Mediterranean Morocco, Algeria, Tunisia, Libyan Arab Jamahiriya and Portugal (for the few longline vessels fishing in the Mediterranean Sea); the narrow-barred Spanish mackerel *Scomberomorus commerson* (COM), a lessepsian migrant, has a role in the fishery of the countries of the Levant Sea, namely Egypt, Israel, Lebanon, but specimens have been found in other countries.

Three species, the Wahoo (*Acanthocybium solandri),* the West African Spanish mackerel (*Scomberomorus tritor)* and the Indian mackerel *(Rastrelliger kanagurta)* have been rarely found in Mediterranean and Black Sea waters and the few specimens recorded can be considered vagrant.

Other species, like the black skipjack, the dogtooth tuna and the king mackerel have been mentioned in some fishery statistics in the area, possibly due to a misidentification and no specimens are included in any Mediterranean collection.

For the main species it was possible to collect a lot of data, while for the others there is very scarce scientific information about several of the biological and ecological parameters.

This report took also advantage of the latest available information about several aspects of the small tuna fisheries and biology, which was provided during the Joint GFCM/ICCAT Meeting on Small Tuna Species in the Mediterranean (Malaga, Spain, 5–9 May 2008). A preliminary summary of

[1] According to this report, the catches of *Auxis thazard* (FRI) reported in several statistics have been considered as a mis-identification of the species. The problem is more extensively examined in Section 3.2.

information about the content of this report was also presented at the same meeting (Srour *et al*., 2008).

The structure of this report includes a first part about the biological and ecological information by species, a second part concerning the fishery and exploitation, a third part concerning the economic aspects of these fisheries and finally some management considerations.

A bibliography is included under each section, to facilitate the identification of specific references.

Table 1 – Species or entities of small tunas reported in the Mediterranean and in the Black Sea

ICCAT CODE	Species name	English	French	Spanish
BLT	*Auxis rochei*	Bullet tuna	Bonitou	Melva
FRI	*Auxis thazard*	Frigate tuna	Auxidae	Melva
FRZ	*Auxis thazard* & *Auxis rochei*	Frigate and bullet tunas	Auxidae and Bonitou	Melva
LTA	*Euthynnus alletteratus*	Little tunny	Thonine commune	Bacoreta
SKJ	*Katsuwonus pelamis*	Skipjack tuna	Listao	Listado
BOP	*Orcynopsis unicolor*	Plain bonito	Palomette	Tasarte
COM	*Scomberomorus commerson*	Narrow-barred Spanish makerel	Thazard rayé Indo-Pacifique	Carite estriado Indo-Pacifico
BON	*Sarda sarda*	Atlantic bonito	Bonite à dos rayé	Bonito del Atlántico
TUN	Thunnini	Tunas nei Young tunas	Thonidés nca Jeunes thonidés	Atunes nep Atunes jóvenes
Vagrant species				
WAH	*Acanthocybium solandri*	Wahoo	Thazard-bâtard	Peto
RAG	*Rastrelliger kanagurta*	Indian mackerel	Maquereau des Indes	Caballa de la India
MAW	*Scomberomorus tritor*	West African Spanish mackerel	Thazard blanc	Carite lusitánico
Uncertain presence, possibly due to misidentification in fishery statistics				
BKJ	*Euthynnus lineatus*	Black skipjack	Thonine noire	Barrilete negro
KGM	*Scomberomorus cavalla*	King mackerel	Thazard barré	Carite lucio
DOT	*Gymnosarda unicolor*	Dogtooth tuna	Bonite à gros yeux	Casarte ojón

1.1 Bibliography consulted

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2. BIOLOGY AND ECOLOGY OF SMALL TUNAS IN THE MEDITERRANEAN AND THE BLACK SEAS

This section of the report includes the available information on the life history of the main species of small tunas present in the Mediterranean Sea and in the Black Sea, according to various scientific sources, with particular attention to the biological parameters useful for stock assessment.

As far as the biology is concerned, it was decided only to take into account the specific features reported for the study area, substituting them with worldwide references if the local information was not available. Length frequencies have been collected by several fisheries and they have been summarized herein by species.

2.1 *Sarda sarda* (Block, 1793)

The Atlantic bonito, *Sarda sarda* (Block, 1793) (ICCAT code BON) is an epi-pelagic neritic schooling species which lives in a large range of water temperatures (12–27°) and salinities (14–39‰), sometimes reported entering estuaries (Collette and Nauen, 1983).

Its **distribution** is in tropical and temperate waters of the Atlantic and Mediterranean, including the Black Sea. On the East side of Atlantic the distribution appears uninterrupted from Scandinavia to South Africa; on the West side, it presents interruptions in the Caribbean Sea and South of the Amazon River to Northern Argentina.

The **maximum size** in the Atlantic is 91.4 cm (Collette and Nauen, 1983), in the Mediterranean it is 96 cm (Ionian Sea, De Metrio *et al*., 1998) and in the Black Sea it is 90 cm (Kara, 1979).

The **diagnostic features** are well known (Collette and Nauen, 1983): upper jaw teeth 16 to 26; lower jaw teeth 12 to 24; gillrakers 16 to 23 on first arch. Dorsal fin 20–23 spines; dorsal finlets usually 8; anal fin 14–17 rays; anal finlets usually 7; pectoral fin 23–26 rays. Vertebrae: 26–28 precaudal plus 23–27 caudal.

The meristics of dorsal fin and vertebrae are higher than the other three species of Sarda [*S. australis* (Macleay, 1880), *S. chiliensis* (Cuvier, 1831), *S. orientalis* (Temminck and Schlegel, 1844).

More detailed information about biometric and meristic characteristics can be found in Demir (1964) and Franicevic *et al.* (2005).

2.1.1 Migrations

In the Western and Central Mediterranean Atlantic bonitos are mainly fished in coastal waters, but large specimens (60–85 cm FL) are also present offshore; observations made while studying the swordfish fishery in the Italian waters ascertained a distance from the coast of about 15 nm, at a depth of more than 2 000 m in the Ligurian Sea and a large distribution offshore, even over very deep bottoms in the Central and Southern Tyrrhenian Sea.

In the Eastern Mediterranean migrations from the Black Sea to the Aegean Sea and viceversa have been studied since the fifties by tagging techniques (Demir, 1957). The water temperatures possibly influencing fish movements were also recorded (Acara, 1957). There are large spawning grounds in the Black Sea, which give huge quantities of young fish not only moving along the Southern coast of the same sea, but also migrating in autumn to the Marmara Sea and in part to the North Aegean. Where the Black Sea is concerned Atlantic bonito moves to the southern Black Sea coast in May–July, forming shoals and staying in the same area from the autumn/winter period until the beginning of March. Individuals of age 1 probably migrate to the same region for feeding. All these locations represent fishery areas of the Turkish fleet (Oray, Karakulak and Zengin, 1997).

During the spring, with a reverse migration, adult fish reach the spawning areas of the Black Sea; restrictions have been enforced on fishery from April to September to protect the spawning season. Each year class strongly influences the production and can trigger oscillations within a period of several years. In the seventies severe environmental decay occurred in the Black Sea and since then large migratory species such as bluefin, swordfish, little tunny and bluefish have disappeared. The Atlantic bonito is no longer available throughout the area, but is apparently limited mainly to the southern part of this sea.

Atlantic bonitos tagged on the Spanish Mediterranean coast (Rey, Alot and Ramos, 1984) have shown that: 1) the fish can move along the coast in both South and North directions; 2) a specimen covered about 370 nm in less than 4 months, travelling towards Gibraltar from Castellon to Estepona (Rey and Cort, 1978).

A consistent fraction of fish tagged at the tuna trap of Ceuta was recovered in the Atlantic, both South and North of the Straits, from Morocco to Portugal (Rey and Cort, 1981). According to these scientific data, the distribution of the local population of *S. sarda* would not seem to be strictly confined to the Mediterranean Sea, but it is so far not known if Atlantic specimens (which have their spawning grounds along the Atlantic coast of Morocco (Dardignac, 1962) also move across the Strait toward the Mediterranean.

It is likely that, from a management point of view, the Mediterranean and Black Sea stock can be considered as separate management units from the Atlantic stock, even if the exchange rate between the Atlantic Ocean and the Mediterranean and between the Mediterranean and the Black Sea are not known. The boundaries of this stock along the eastern Atlantic coast outside Gibraltar are yet to be defined. According to the data presented in this report, sub-stocks might be distinguished in the Western-Central and Eastern side of the Mediterranean Sea including the Black Sea.

2.1.2 Biological characteristics

Many studies on the fishery biology of *Sarda sarda* have been carried out in the Eastern area (Zusser, 1954; Nümann, 1955; Slastenenko, 1956; Demir, 1957, 1963, 1964; Krotov, 1957; Mayorova and Tkacheva, 1959; Porumb and Porumb, 1959; Nikolov, 1960; Demir and Demir, 1961; Kutaygil, 1965).

Recent data on the biological characteristics of this species, with implications for its management, have been studied both in the Eastern and Western Mediterranean and allow for the comparison of potentially different population units. According to a recent summary of information about Atlantic bonito of the Western and Central Mediterranean, a possible stock unit on the basis of genetic difference (Viñas, Alvarado Bremer and Pla, 2004) might be present in these areas (Orsi Relini *et al*., 2005).

The **length/weight** relationships were studied by several scientists and the published findings are shown in Table 2 and in Figure 1. It is known that more recent data have been collected by some EC countries thanks to the EC-DCR national programmes, but these results have not been published yet.

Table 2 – Length/weight relationships in *Sarda sarda* in the Mediterranean and Black Seas

Function	N	Range FL (cm)	Range W (g)	Author	Area	Notes
$W=0.01486LF^{2.9719}$	165	40–55.5		Rodriguez-Roda, 1966	Gibraltar	–
$W=0.02361LF^{2.8703}$	1608	14–90	80–7500	Kara, 1979	Aegean, Marmara, Black Sea	
$W=0.00724LF^{3.1644}$	878	19–72	200–5500	Rey, A lot and Ramos, 1984	Gibraltar (Med-Atl)	M+F+Indet.
$W=0.00653LF^{3.1865}$	242	33–65.2	436–4040	Rey, A lot and Ramos, 1984	Mediterranean Atlantic	M
$W=0.00844LF^{3.1218}$	229	33–70.5	460–4866	Rey, A lot and Ramos, 1984	Mediterranean Atlantic	F
$W=0.0252LF^{2.83}$	845	–	–	Giacchetta *et al*., 1995	Gulf of Taranto	M+F
$W=0.0039LF^{3.3263}$	–	21.8–70.5	110–5000	Oray, Karakulak and Zengin, 2004	Turkey	–
$W=0.0038LF^{3.3414}$	285	35–67	–	Franicevic *et al*., 2005	Adriatic Sea	M
$W=0.0056LF^{3.2364}$	353	33–64.5	–	Franicevic *et al*., 2005	Adriatic Sea	F
$W=0.0085LF^{3.1230}$	665	33–67	–	Franicevic *et al*., 2005	Adriatic Sea	M+F
$W=0.03LF^{2.8323}$	240	35–82	700–7050	Di Natale *et al*., 2006	Tyrrhenian Sea	–
$W=0.4LF^{2.1813}$	109	35–67	800–4000	Di Natale *et al*., 2006	Strait of Sicily	–
$W=0.0094632LF^{3.1011}$	–	–	–	Macias *et al*., 2006	Spanish Mediterranean Traps	–

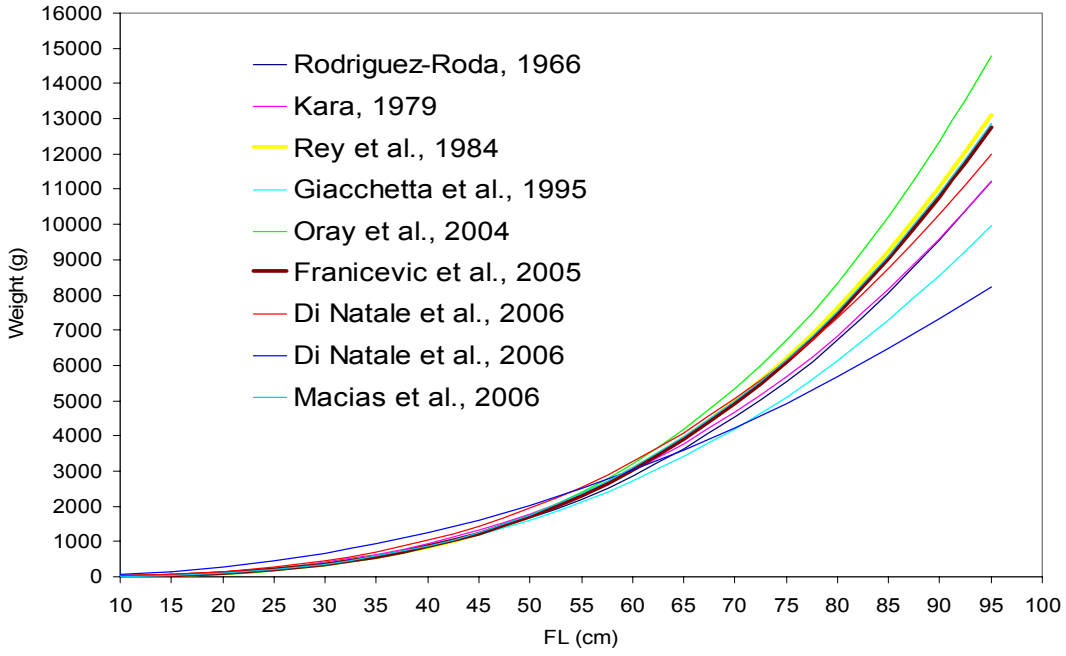

Figure 1 – Length/weight relationships of *Sarda sarda* in the Mediterranean Sea

The **reproductive season** shows a remarkable variability, according to several authors. It is likely that it occurs largely from May to July in most of the Mediterranean Sea, with some yearly variation in March or April according to the areas, concentration or oceanographic features. It the Black Sea reproduction takes place in the second part of the spring, sometimes extending up to July. The optimal water temperature for spawning in the Black Sea is 18 °C (Majorova and Tkecheva, 1960).

Table 3 – Spawning periods and grounds of *Sarda sarda* in the Mediterranean and Black Sea

AREA	**PERIOD**	**AUTHOR**
Sicily	May 20 – June 30	Sanzo, 1932
Algerian coasts	March – May	Dieuzeide, 1955
Gibraltar	May – July	Rodriguez-Roda, 1966
Black Sea	May to mid June	Demir, 1957
Black Sea	June to mid July	Mayorova and Tchaceva, 1959
Mediterranean and Atlantic Morocco	June – July	Rey *et al.*, 1984
Catalan coast	May to July	Sabates and Recasens, 2001
Southern Tyrrhenian Sea	May to July	Di Natale (pers.com.)
Straits of Sicily	April to June	Di Natale (pers.com.)
Ligurian Sea	May to July	Orsi Relini (pers.com.)

When describing basic characteristics of *S. sarda*, the most difficult subject is **growth**. Reading of **age** on skeletal pieces is difficult and seems to produce different results compared to the study of length/frequency distributions (cfr. Table 4). The latter are very important in this species because the reproductive season is short (Table 3) and therefore, in length/frequency distributions, the cohorts are clearly identified.

Samples obtained by longlines and drifnets in offshore waters generally have a limited component of young fish. Coastal traps for tuna, such as those of Spain and Italy, represent important opportunities for the study of the young classes. Turkey's unique geographical position provided by the Straits of Bosphorus offers a privileged observation area for young bonitos.

Table 4 – Length at age, in centimetres, of *Sarda sarda*

	Age group						
Author	**0**	**1**	**2**	**3**	**4**	**Method**	**Area**
Nümann (1955)	–	38–41	53–57	60–64	–	l/f distributions	Turkish waters
Kutaygil (1965)	–	–	58	64.8	68	otoliths	Turkish waters
Rodriguez-Roda (1966)	–	43.48	51.46	62	–	l/f distributions	Gibraltar
Rodriguez-Roda (1981)	42.59	50.51	60.50	64.00	–	vertebrae	Gibraltar
Rey *et al.* (1984)	46.0	51.71	57.04	63.15	–	–	Gibraltar
Rey *et al.* (1986)	37.03	51.71	57.04	63.15	71.00	otoliths, vertebrae, fin rays	Gibraltar
Santamaria *et al.*, (1998)	34.8	50.9	57.5	64.8	70.4	Fin rays, vertebrae	Ionian Sea
Oray *et al.* (2004) quoting Nümann	–	41	52–57	61–64	–	–	Turkish waters
Di Natale and Mangano (in press)	38.63	54.40	56.50	64		Fin rays	Tyrrhenian Sea 2002
idem	40.80	50.92	61.40	71		Fin rays	Tyrrhenian Sea 2003
idem	38.83	45.69	57.80			Fin rays	Tyrrhenian Sea 2005
idem	39.50	50.25	59	66		Fin rays	Tyrrhenian Sea 2006
idem	40.50	49.65	59.43			Fin rays	Straits of Sicily 2006
Santamaria *et al.*, (2005)	Juvenile growth 10.5–39.8 FL in 18–110 days					otoliths	Southern Italian seas

The Von Bertalanffy growth functions reported so far for the Mediterranean Sea are the following:

Rey *et al.*, 1986 L inf = 80.87; K = 0.35; t0 = -1.70

Santamaria *et al.*, l998 L inf = 80.60; K = 0.36; t0 = -1.37

Many studies were available for *Sarda sarda* from the Black Sea, including contrasting "slow" growth series of length at age with a longevity of 9 years (74–85 cm at age 9 according to Zusser, 1954) and fast growth performances, e.g. 67 cm, at age 4 (Nikolov, 1960).

Kara (1979), measuring large quantities of bonitos in the fish market of Istanbul, gave a perfect description of juvenile growth, from 20–25 cm in July to about 38–41 cm in June, based on twelve monthly l/f distributions. He also placed large fish, which locally have a different name from the young, in the range 50–90 cm LF (Figure 2).

The length distribution series (Figure 2) also shows the effect of temperature on growth: indeed from January to May (cold season) the sizes of young fish remain very similar and rapidly change from June onward. This effect is also clear in the second year of life.

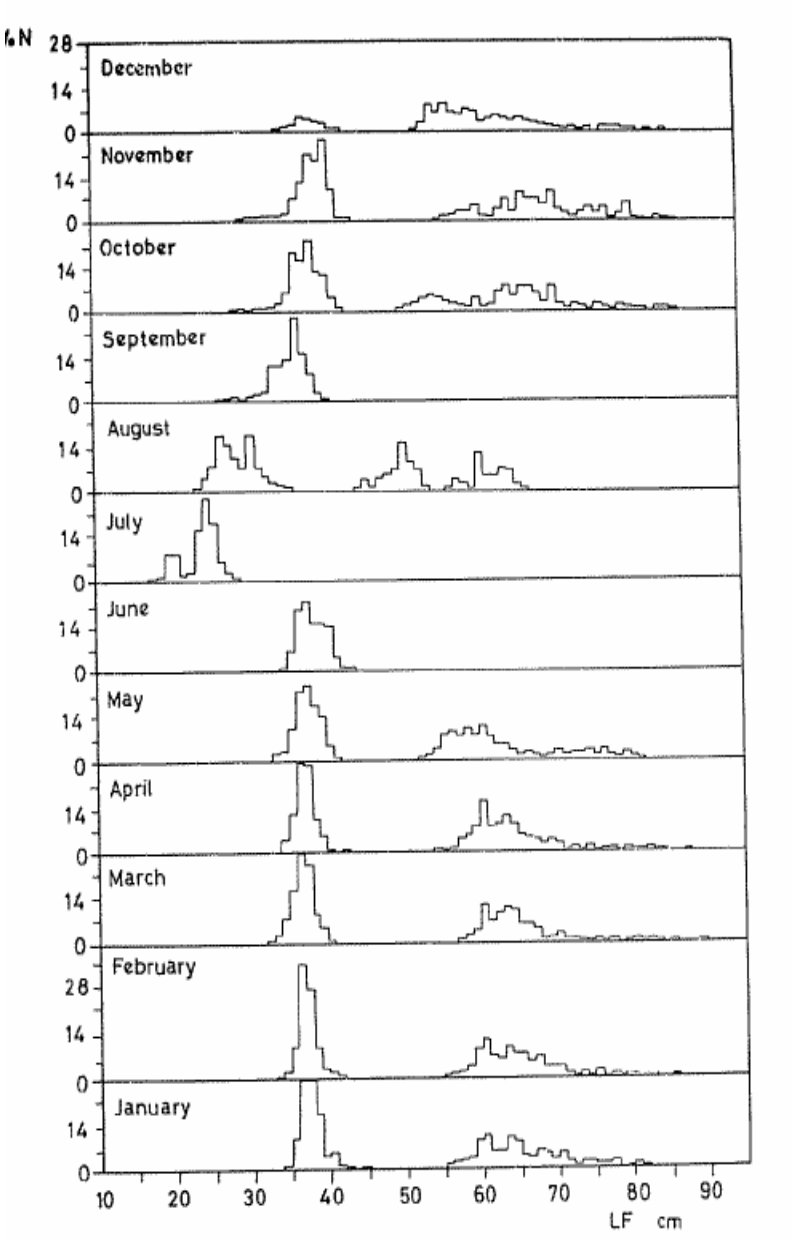

Figure 2 – Serial length/frequency distributions of *Sarda sarda* obtained during the year 1968 in the fish market of Istanbul (Kara, 1979). The set described includes 9 162 specimens

It is interesting to note that Rey *et al*. (1984) described the growth of 1982 cohort in the same way, on the basis of l/f distributions obtained in the tuna trap of Tarifa and Barbate, from 28 cm in September 1982 to about 40 cm FL in May and 44 cm in June 1983 (Figure 3). However, these authors overlooked this datum in respect of age reading by skeletal pieces (Table 3).

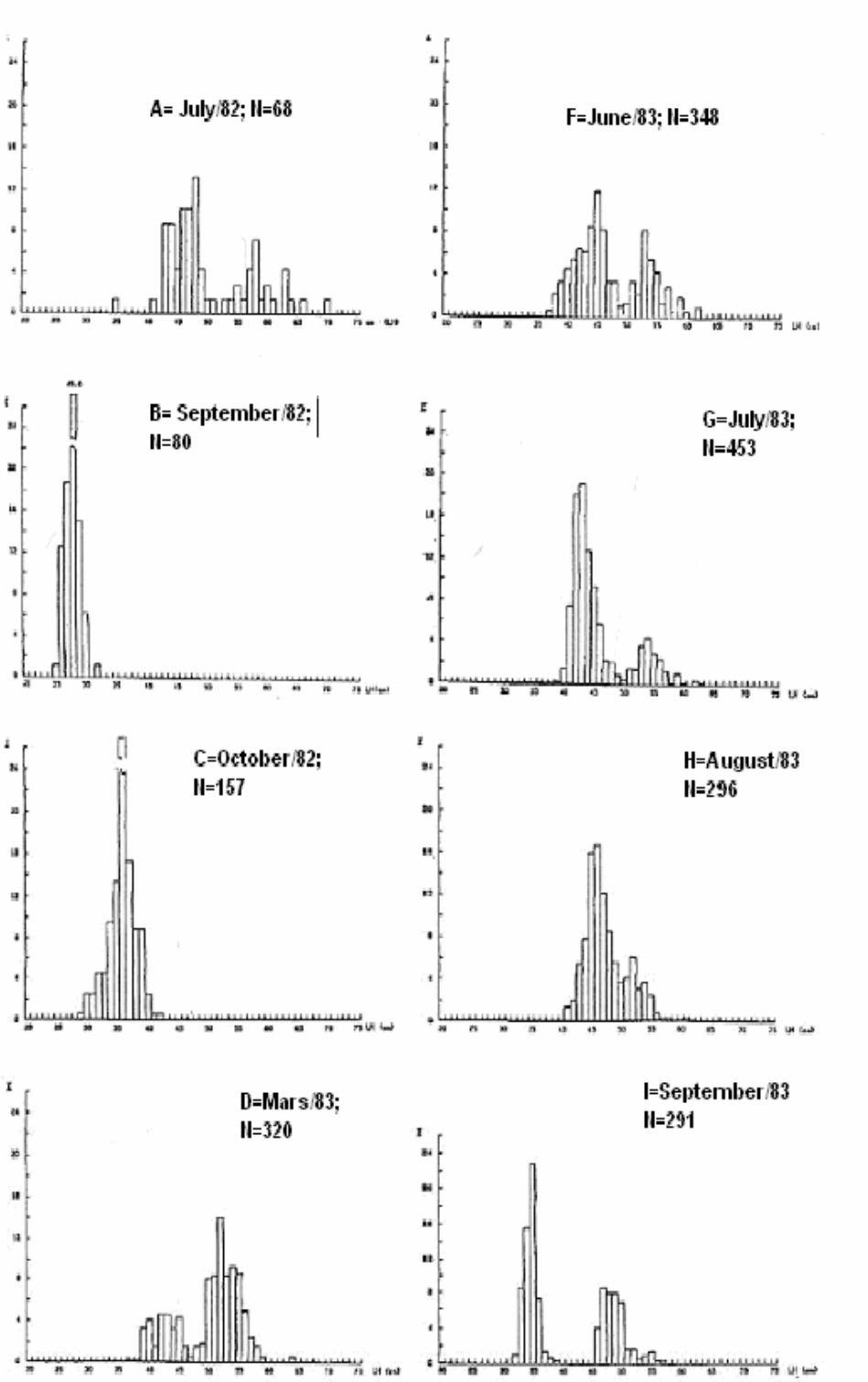

Figure 3 – Monthly length/frequency distributions of S. sarda in Spanish waters in 1982–83 (Rey, A lot and Ramos, 1984)

In the Western Mediterranean the range of sizes and, possibly, age groups derived by length/frequency distributions by means of material obtained in tuna traps, have recently been reported by Macias *et al*. (2006) (Figure 4) and Relini *et al*. (2007) (Figure 5).

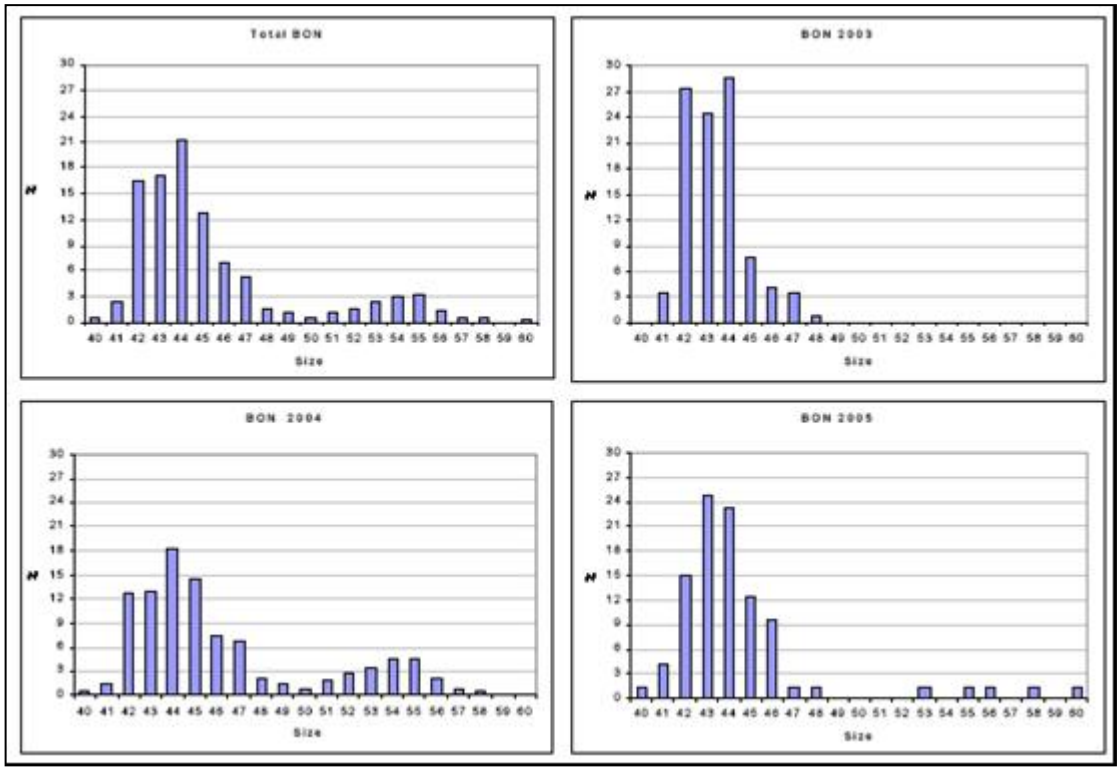

Figure 4 – Length/frequency distribution of *Sarda sarda* obtained in a tuna trap in Murcia (from Macias *et al*., 2006)

In Figure 4 the sizes were in the range 40.3–60 cm FL, with modal size at 44 cm in a first age group and 54–55 cm in a possible second age group. In the Ligurian sea a temporal series of size frequency distributions was derived from the small tuna trap of Camogli. The latter is a "tonnarella" i.e. a type of trap which some centuries ago was used in the Liguro-Provencal basin to target young bluefin of one to four years and is typical to this basin; this trap, the last surviving in the NW Mediterranean, is active from April to September and at present catches several coastal species but not bluefin tunas. Length/frequency distributions of bonitos show large fish in April, 51 cm FL and above, which in May disappear and are replaced by a younger fraction, 41–48 cm FL modal size. These grow during the summer months to 47–54 cm in September, i.e. becoming the group which in April of the following year will form the "large fish"; so the series describes the growth from age 1 to age 2.

It is interesting to note the analogies in size structures recorded in Murcia and in the Liguria Sea (Figures 4 and 5). They suggest common characteristics in the Western Mediterranean, reinforcing the hypothesis of a stock unit in this basin (Viñas, Alvarado Bremer and Pla, 2004; Orsi Relini *et al*., 2005), while a distinct stock unit might characterize the Aegean-Eastern Mediterranean. Indeed size at age 1 is larger in the Western (44 cm) than in the Eastern Mediterranean (41 cm), indicating a larger fish as well as the maximum sizes already reported in paragraph 2.1.0.

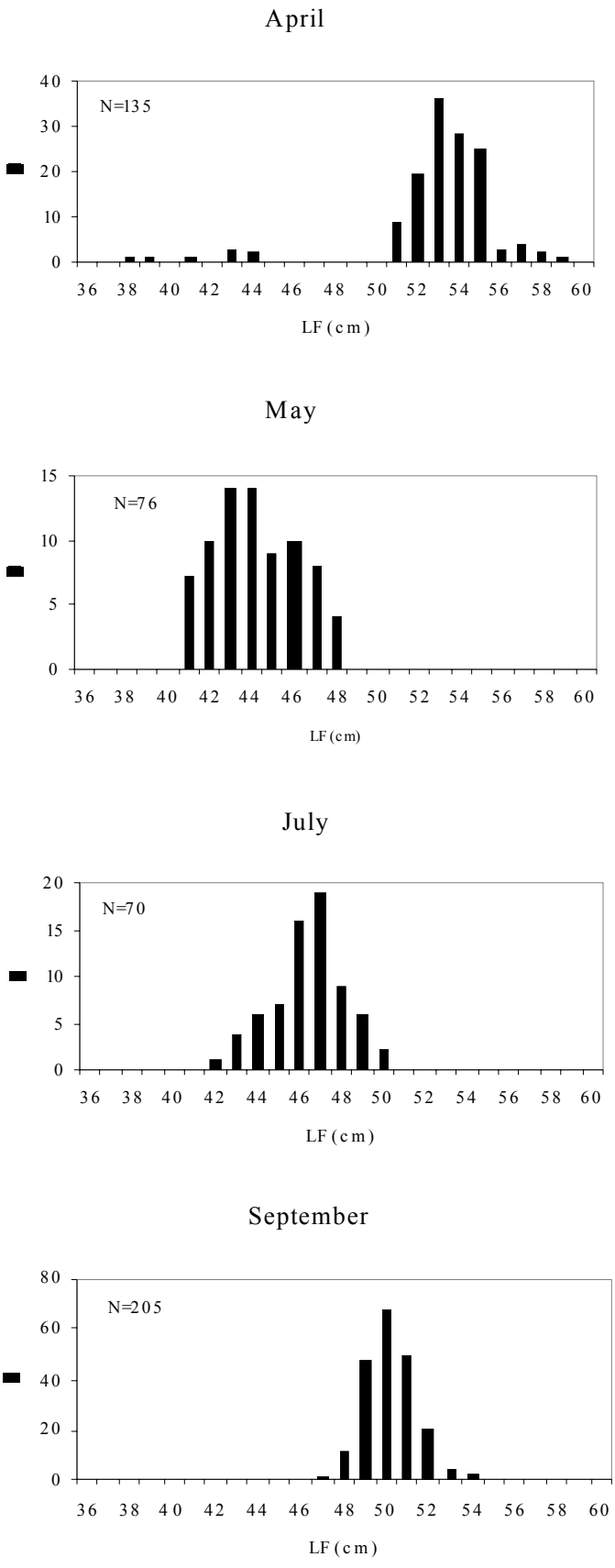

Figure 5 – Serial length/frequency distributions of *Sarda sarda* from the tuna trap of Camogli, Ligurian Sea (Relini, Calandri and Orsi Relini, 2007)

The range of sizes of Atantic bonito in the Adriatic is shown by the previously mentioned study on biometric characteristics (Franicevic *et al.*, 2005): such sizes do not have any time-frame indication. Among the 665 specimens obtained in the Croatian waters, 353 were females (53.08 percent), 285 were males (42.86 percent) and 27 (4.06 percent) were of undetermined sex. Fork lengths ranged between 33.0–67.0 cm with a mean of 42.2±6.077 cm and mode of 38.0 cm. Fork length in males ranged between 35.0–67.0 cm with a mean of 43.2±6.269 cm and mode of 40.0 cm. Fork length in females ranged between 33.0–64.5 cm with a mean of 41.8±5.889 cm and mode of 38.0 cm. The two dominant length groups were 38.5 cm and 39.0 cm. Males were more abundant in the 40.0 cm length group and females in the 38.0 cm length group (Figure 6).

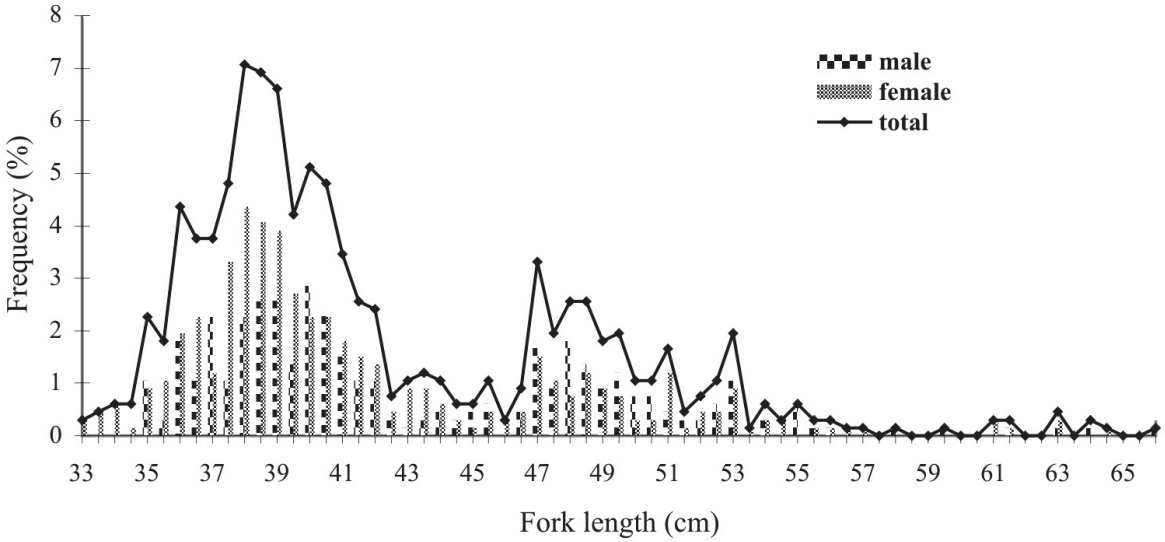

Figure 6 – Total lengths of Atlantic bonito, *Sarda sarda*, from the eastern mid Adriatic Sea (Franicevic *et al.*, 2005)

Somewhat different from the previous areas are the frequencies obtained by the hand line and gillnet fisheries in the Southern Tyrrhenian Sea and in the Straits of Sicily, where the statistical data have been collected thanks to the Italian programmes until 2000 and to the EC-DCR from 2001.

In the Southern Tyrrhenian Sea, where this fishery is mostly conducted by gillnets in spring-summer and troll lines and hand lines in spring and autumn, the main mode was the following: 34–37.9 cm in 1994, 38–39.9 cm in 1995, 40–41.9 in 1998, 38–41.9 in 1999, 52–53.9 in 2000, 40–41.9 in 2001, 50–51.9 in 2002, 48–49.9 in 2004, 40–41.9 in 2005, 52–53.9 in 2006 and 38–39.9 in 2007 (Figure 7, Di Natale and Mangano, in press).

The data collection from the southern Tyrrhenian Sea is one of the most extensive available in the Mediterranean Sea. The largest annual group (1999) was split in monthly graphs (Figure 8) and a modal progression is visible from August to November, while the winter and spring months show similar sizes; the apparent reduction of sizes in July and September may suggest movements of a subcohort of younger fish in the area. These figures can show more normal distribution when grouped bimonthly, showing a progressive increase of the mode by size over the year.

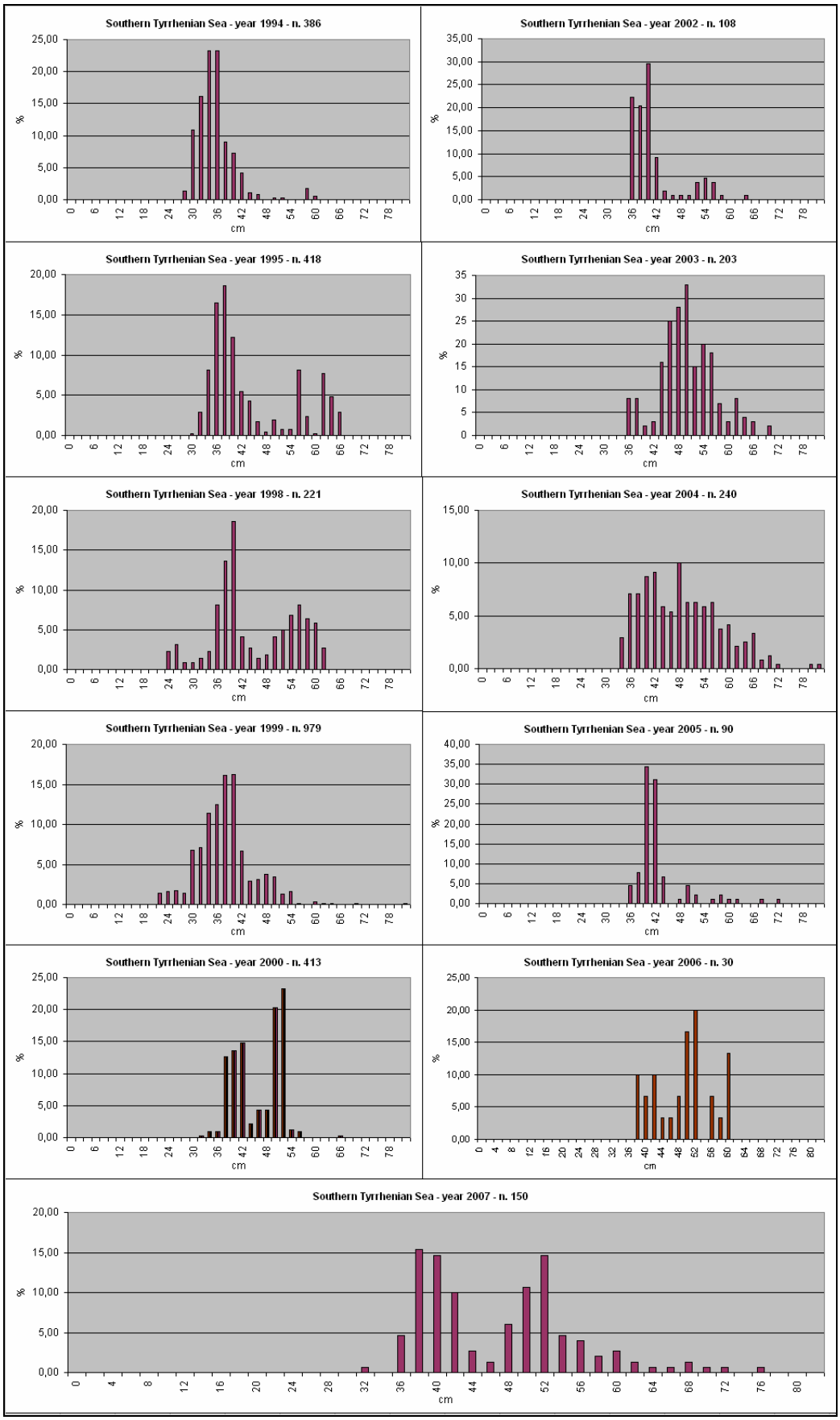

Figure 7 – Length/frequency distributions of *Sarda sarda* from the southern Tyrrhenian Sea from 1994 to 2007 (Di Natale and Mangano, in press)

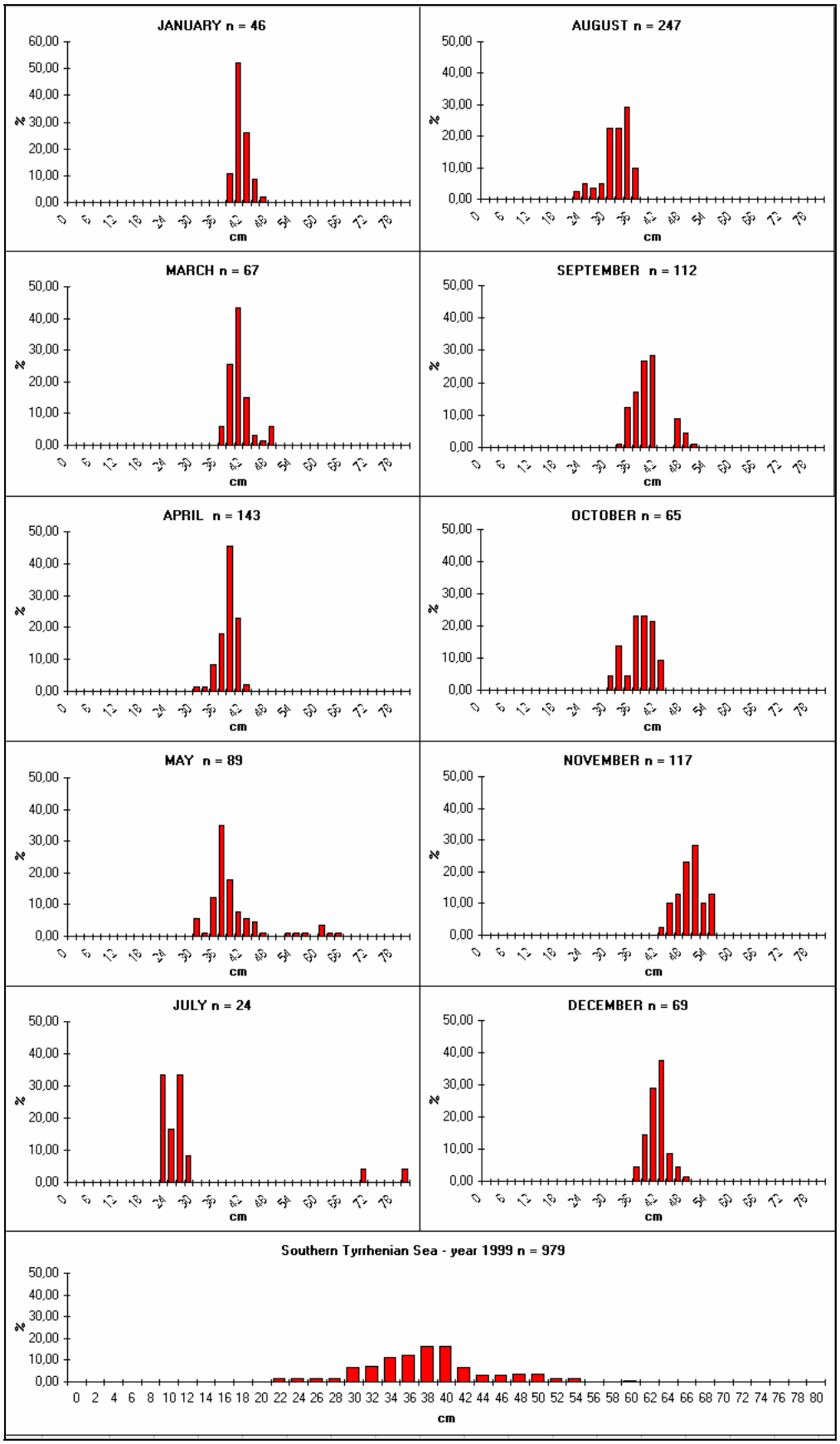

Figure 8 – Serial length/frequency distributions of *Sarda sarda* from southern Tyrrhenian Sea in 1999 (Di Natale and Mangano, in press)

In the Straits of Sicily, where this fishery is mostly conducted by troll lines and hand lines, the main annual mode was in the length class 46–47.9 cm in 2003, in the class 44–45.9 cm in 2004, in the classes 42–45.9 cm in 2005 and in the class 52–53.9 cm in 2006 (Figure 9, Di Natale and Mangano, in press). The polymodal structure in some years can be correlated to difference in time or presence. It is remarkable that the mode in 2004 was the same as reported in the tuna trap of Murcia, even though the length distribution was different.

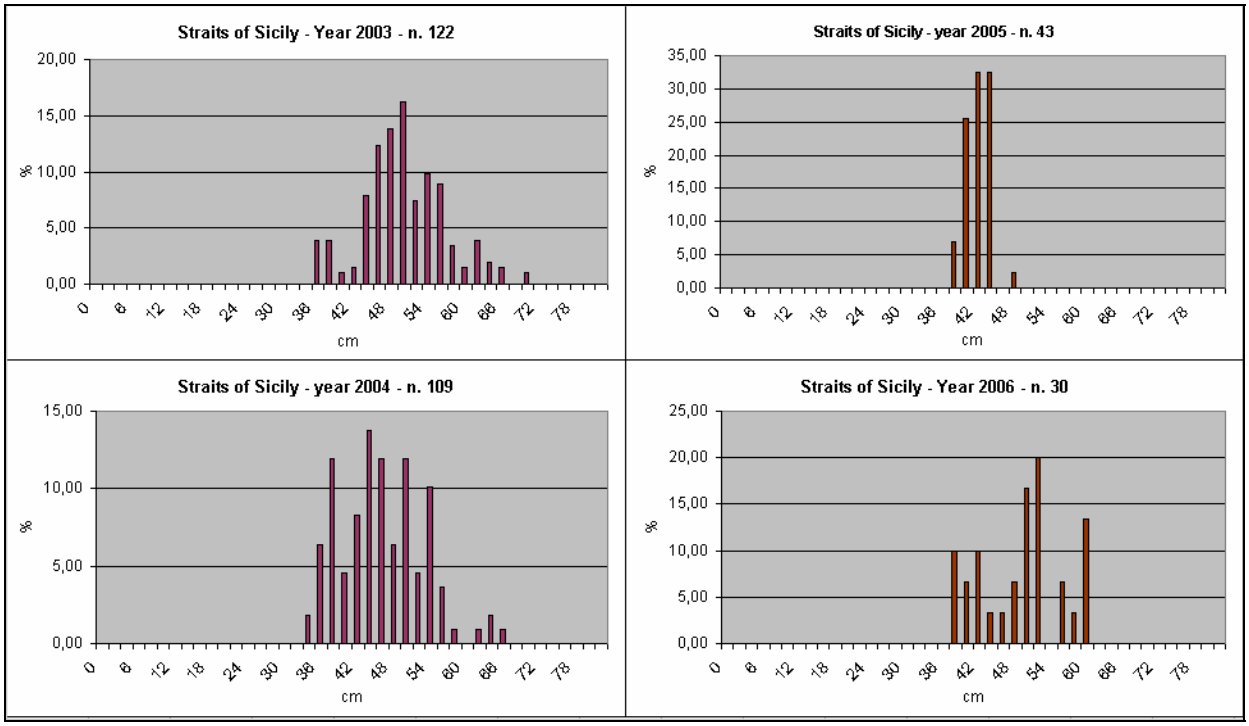

Figure 9 – Length/frequency distributions of *Sarda sarda* from the Straits of Sicily from 2003 to 2006 (Di Natale and Mangano, in press)

Some length data from the same area are reported for the southern part (Tunisian waters) by Hattour (2000). The size of these fish varies from 15 to 50 cm, with a mode at 36–38 cm class; this modal class represents 40.1 percent of the total sample (Figure 10).

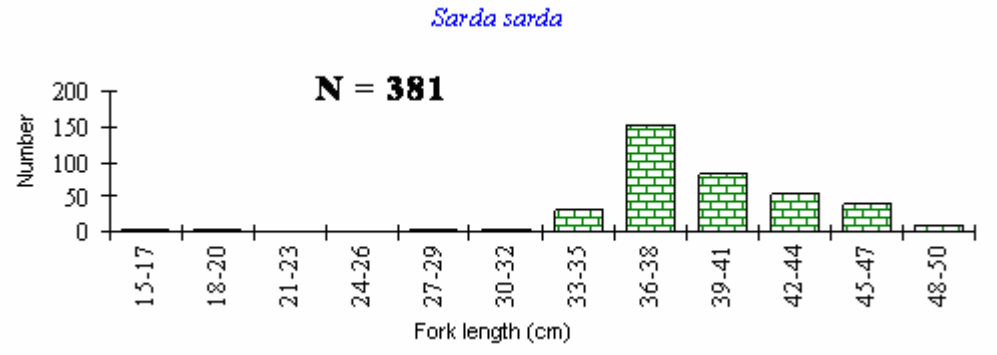

Figure 10 – Size distributions of Atlantic bonito in Tunisian water (Hattour, 2000)

Length data are also available from the Turkish areas (autumn-winter fishery). The length classes of the landed bonitos during the fishing seasons 2000 to 2002 were between 15.5 and 46.0 (28 ± 2.61, n=492) to 15.1–47.5 (31.2 ± 3.33, n=198) cm respectively. Two peak points in this group were observed; namely 26.4 ± 3.68 and 35.4 ± 3.57 cm respectively (Figure 11).

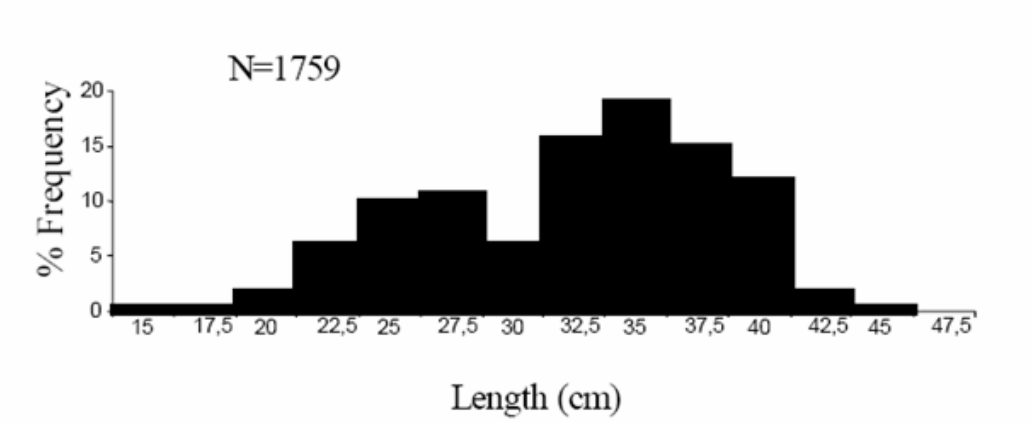

Figure 11 – Length frequency of *Sarda sarda* migrating to South Black Sea (Zengin, Karakulak and Oray, 2005)

The length distribution of Turkish catches by month in the fishing seasons 2000/01 and 2001/02 (August-February) is shown in Figure 12.

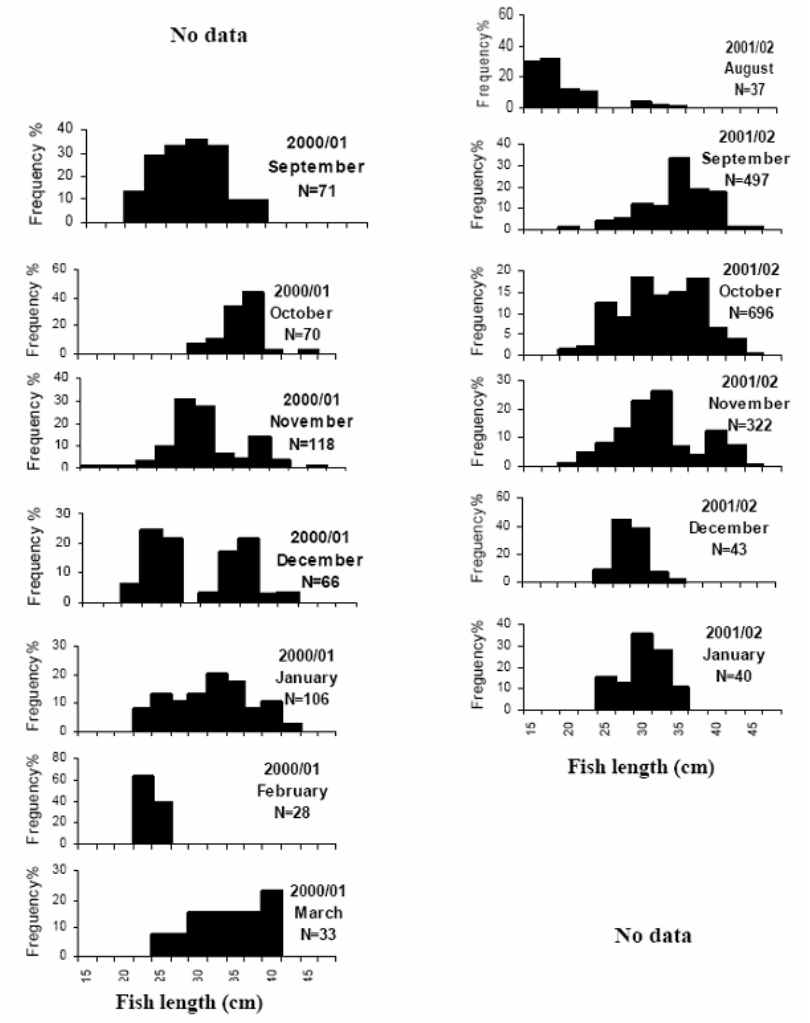

Figure12 – Length of *Sarda sarda* landed in Turkey in 2000/01 and 2001/02 (Zengin, Karakulak and Oray, 2005)

It is important to remark that, according to Rodriguez Roda (1966), the size distribution is similar by sex (see Figure 50b).

Where the **size at maturity and description of maturation** is concerned, Rey *et al.* (1984) described the maturation of *Sarda sarda* in terms of macroanatomy (Table 5).

Table 5 – Stages of maturity and related description of gonads (Rey *et al.*, 1984)

Stage of maturity	**Morphology of gonads**
Stage 1: undetermined	Gonads pinkish, in the shape of a narrow ribbon.
Stage 2: immature	Gonads thin but it is possible to determine sex. Female with enlarged and subcilindrical gonads; pinkish colour. Male with thin gonads in shape of ribbon; pinkish colour. **Testicular arteries easily visible in the median portion.**
Stage 3: beginning of maturation or recovering	Female have subcilindrical gonads, from dark pink to light red. Oocytes aren't yet visible. **Male with whitish gonads, with bigger size than in the female. Testicular arteries visible.**
Stage 4: maturation	Female with developed gonads; yellow orange colour. Oocytes visible. **Male with very developed gonads; whitish colour. It is possible to observe some spermatic fluids after incision.**
Stage 5: mature fishes – spawning	**Female with gonads at maximun developement, filling all the abdominal cavity. The oocytes, very large and translucent, are detached by simple pressure on the abdomen. Male with gonads at maximun development; it is possible to observe few red spots on the gonads surface. Seminal fluid spouts by simple pressure.**
Stage 6: post spawning	**Female gonadal aspect is different according to more or less recent deposition (ovary empty, very vascularized or contracted). Male have soft gonads, with the presence of scarce seminal fluid, owing recent deposition. Pinkish colour at the end of the deposition, whitish onward.**

Recently the female gonad maturation process has been described by Macias *et al.* (2005) on the basis of Gonadosomatic Indices and observations about the histological structure of the ovaries. Observed mature fishes were in the length range 41 to 47 cm FL.

Five different stages of ovarian activity are reported here:

a) Inactive females: the histological analysis indicates that the ovary contains no yolked oocytes and no atresic structures.

b) Active females: females were classified as active when the ovary contained yolked oocytes and there was no atresia or only minor atresia can be found. Active females were further classified into other stages according to additional criteria.

c) Ripening females (Maturing): Those females showing signs of sexual maturity (Yolked oocytes) but not signs of imminent spawn or signs of past spawns batches.

d) Pre-spawning females (Ripe): Those females showing signs of an imminent spawning like hydrated or nuclear migration phase oocytes but not postovulatory follicles or extended atresia. High density of oocytes in the ovary can be seen.

e) Spawning females: Those females whose ovaries present postovulatory follicles or imminent spawning signs like hydrated or migratory-nucleus oocytes. The histological analysis shows signs of past spawning (postovulatory follicles) and enough vitellogenic oocytes to complete more spawning.

f) Post-spawning females: Those females showing signs of past spawning (postovulatory follicles) but which do not have enough vitellogenic oocytes to complete more spawning. Extended atresia in vitellogenic oocytes. Low oocyte density in the ovary.

Rey *et al.* (1984) reported the **fecundity** of female *Sarda sarda* in the range of 47–71 cm FL, which showed between 220 000 to 1 500 000 eggs, while Macias *et al.* (2005) also provided **fecundity** estimates of six individuals in the range of 43–44 cm FL.

The **age of first maturity** in *Sarda sarda* in the Mediterranen Sea and Atlantic Morocco is reported at 38 cm in males and 39 cm in females (Rey *et a*l., 1984). In the Black Sea *Sarda sarda* reach first sexual maturity at the end of the first year (average length 39.0 cm) (Ivanov and Beverton 1985).

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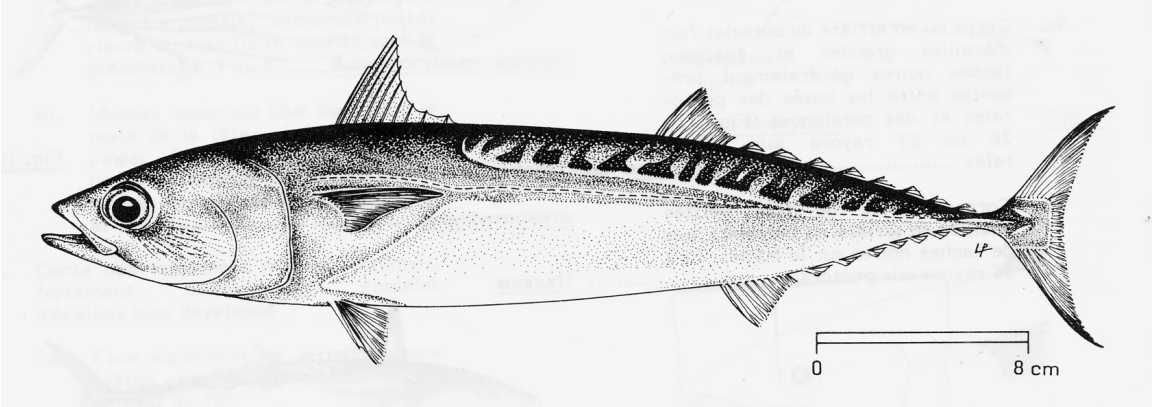
2.2 *Auxis rochei* (Risso, 1810)



The bullet tuna, *Auxis rochei* (Risso, 1810) (ICCAT code BLT), is an epipelagic neritic as well as an oceanic species (Collette and Nauen, 1983), cosmopolitan in warm waters. Its distribution is not completely clarified due to confusion with a second cosmopolitan species, the frigate tuna, *Auxis thazard* (Lacepede, 1800) (ICCAT code FRI), which many European ichthyologists had considered non-valid for a long time. In the belief that there was a single worlwide species of *Auxis*, they used the name *A. thazard*, which was the first name to appear in literature, for the Mediterranean fish. A monographic study (Yoshida, 1983) and a worldwide re-examination of collections (Collette and Aadland, 1996) described the peculiar characteristics of the two species of *Auxis*. Moreover, the second paper divided them into subspecies, with the identification of two new taxonomic units in Californian waters, *A. rochei eudorax* and *A. thazard brachydorax*; in the same study 43 specimens belonging to 23 Mediterranean collections from France, Italy (Ligurian, Tyrrhenian, Ionian and Adriatic Seas), Austria, Lebanon, Israel, were defined as *A. rochei rochei*. The detailed distribution of *Auxis* ascertained by the study of Collette and Aadland is shown in Figure 13.

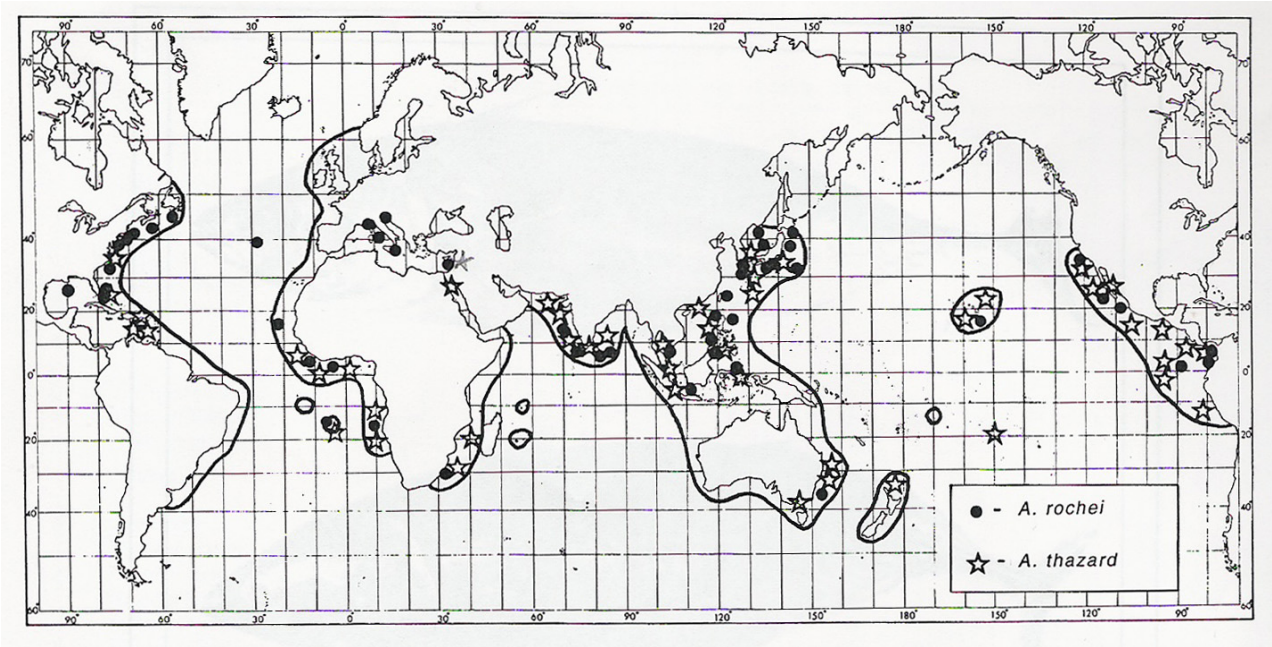


Figure 13 – Distribution of *Auxis rochei* and *A. thazard* according to Collette and Aadland (1996). Solid lines show approximate limits of distribution; symbols indicate localities of the specimens examined by the authors

Due to a persistent confusion between the two main species, either in some scientific reports or in statistics from the Mediterranean and the Black Seas, it is relevant to define the description of the species which is currently believed to be the only one distributed in the study area. *Auxis rochei* at present is described as follows:

"the body is robust, elongated and rounded in the transversal section. Two dorsal fins, the first with 9–11 spines, the second with 11–13 rays separated by a long interspace: the second fin followed by 7–8 finlets; anal fin followed by 6–7 finlets. Interpelvic process is single and large. Caudal peduncle with a strong central keel between two smaller keels. Body naked except for the corselet, which laterally presents a caudal extension surpassing the second dorsal fin. At the origin of this fin, the corsalet is formed by six or more rows of scales".

The reported maximum **fork length** is 50 cm derived from one specimen caught in Tunisian waters (Hattour, 2008).

The **diagnostic features,** provided by Collette and Aadland (1996), to distinguish this species from *A. thazard* are the following:

1) a corselet six or more scales wide under the second dorsal fin origin (five or less in *A. thazard*);

2) anterior margin of the scaleless area above the corselet not reaching the tip of the pectoral fin (surpassing the tip of pectoral fin in *A. thazard*);
3) in the scaleless area above the lateral line the colour pattern consists of 15 or more fairly broad, nearly vertical dark bars (bars or wavy lines, oblique to nearly horizontal in *A. thazard*).

These diagnostic features have been adopted in several FAO and ICCAT manuals and catalogues; however it is not clear to what extent they can be applied to the Mediterranean *Auxis*. For this reason a specific study, combining morphology and genetics was carried out recently (Orsi Relini *et al.*, 2008a and b)

It is almost certain that criteria 2 and 3 are not valid for the totality of fish from the West and Central Mediterranean Sea (Tortonese, 1963; Cefali e Cavallaro, 1983, Cavallaro 1996) and also criterium 1 is not valid for all specimens (Rodriguez Roda, 1980) and illegible in specimens less than 30 cm FL (Orsi Relini *et al*., 2008). The variable pattern of dark bars in the naked dorsal skin is the most eye-catching characteristic of the Mediterranean fish: it frequently includes spots surrounded by half-circles or circles.

In conclusion, at present the body proportions seem to be the most reliable characteristic to distinguish the two species: in fact *A. thazard* has a more compressed silhouette profile of the transversal section, with greater body height than *A. rochei*. However, the problem of identification could be of little importance in the Mediterranean, where only two specimens of *A. thazard* have been found in a fish market so far, and these were of uncertain origin.

Although the zoological problem will be probably soon be clarified for the Mediterranean and the Black Seas, there is still the statistical one due to the fact that several statistics report one or the other species for the same area which could create confusion. The uncertain classification in several areas brought about the decision to have a further statistical entity from ICCAT, called FRZ, which includes unclassified *Auxis* spp., as well as the category "Auxids" mentioned in the index of this report.

2.2.1 Migrations

Little is known about the displacement of *Auxis rochei rochei*. Sabates and Recasens (2001) hypothesized spawning migrations from Gibraltar to the Catalan coast on the basis of time of occurrence of maximum landings in the Spanish Mediterranean waters. This hypothesis is clearly suggested by the reproductive behaviour of bluefin tuna; however, while bluefin tuna has distinct spawning grounds in the Mediterranean (i.e.: Balearic Sea, Sicily, South Tyrrhenian, Crete, Cyprus, South Mediterranean), fluent *A. rochei* and their eggs and larvae have been found everywhere acconding to detailed reports (Piccinetti and Manfrin, 1993; Piccinetti *et al*., 1996; Oray and Karakoulak, 2005; Garcia *et al.*, 2008)

2.2.2 Biological characteristics

The main biological parameters of *Auxix rochei* in the Mediterranean Sea are summarized in Tables 6 to 8.

Table 6 – Length/weight relationships of *A. rochei*

Function	N	Range FL (cm)	Range W (g)	Author	Area	Notes
$W=0.00001005LF^{3.12987}$	744	34–45	–	Rodriguez-Roda (1966)	Gibraltar strait	M+F
$W=0.00166LF^{3.64257}$	515	21–48	–	Ramos *et al*. (1985)	Mediterranean and Spanish Atlantic	–
$W=0.000019037LF^{2.98}$	1100	33–47	650–1750	Santamaria *et al*. (1996)	Gulf of Taranto	–
731.44 (508–1550)	354	28–44	515–1550	Bok and Oray (1995)	Turkish Aegean	–
$W=0.076LF^{3.24291}$	936	–	350–1750	Bok and Oray (2000)	Aegen and Mediterranean sea	–
$W=0.0088LF^{3.17}$	24	36.7–45.3	781.25–1464.14	Sinovcic *et al*. (2004)	Adriatic Sea	M+F

Function	N	Range FL (cm)	Range W (g)	Author	Area	Notes
$W=0.00559LF^{3.29}$	458	25.9–47	–	Macias *et al*. (2006)	Western Mediterranean	M+F
$W=0.0014LF^{3.6746}$	83	27–46.5	282–1820	Palandri *et al.* (2008)	Ligurian Sea	M+F

Table 7 – Spawning periods and grounds of *A. rochei*

Area	Period	Author
Sicily	June, July and after	Sanzo, 1908
Mediterranean Sea	June to September	Ehrenbaum (1924)
30 larval cruises in the Mediterranean	April to September	Piccinetti and Piccinetti Manfrin (1993), Piccinetti *et al*., (1996)
Ionian Sea	Mainly June and July (studied period April–July)	Santamaria *et al*. (1996)
Balearic Sea	June to September	Alemany (1997)
Ionian Sea	May to August (derived by ageing young fish)	Santamaria *et al*. (2000)
Aegen Sea and Eastern Mediterranean	March to September	Bok and Oray (2000)
SE Spanish Mediterranean	June to September	Macias et al. (2006)
Ligurian sea	May to September	Palandri *et al*. (2008)

The length of the spawning period (Table 7) and the small size of this species make the identification of cohorts in l/f distributions quite difficult: data on young fish are scarce. Data on juvenile growth are reported by Cefali (1981) and Santamaria *et al*. (2000). Growth studies on juveniles, fished in large quantities in the Saharian Atlantic waters, gave a very different interpretation of growth (Grudtsev, 1992) from the Mediterranean studies. The results of the latter only seem homogeneous for advanced ages (Table 8).

Table 8 – Length at age and growth function (in cm) of *A. rochei*

	Age group								
Authors	0	1	2	3	4	5	6	7	**Method**
Rodriguez-Roda 1983	-	25	33.1	37.4	41.2	-	-	-	vertebrae
Santamaria *et al.* 1996	-	34.4	37.6	40.5	42.9	-	-	-	fin rays
Bok and Oray 2001	-	30.7	34.43	38.7	41.1	42.88	-	-	fin rays, otoliths
Santamaria *et al.* 2000	Juvenile growth 9 to 25 cm FL in the age range 20-75 days								otoliths
Palandri *et al.* 2008	0.3	23.1	34.4	39.9	42.6	43.9	44.6	44.9	fin rays

Authors	Von Bertalanffy growth function	
Bok and Oray 2001	$L=45.26292[1-e^{0.39722(t-(-1.0044)}]$	Females
Bok and Oray 2001	$L=45.08422[1-e^{0.33988(t-(-1.5984)}]$	Males
Bok and Oray 2001	$L=47.76151[1-e^{0.29235(t-(-2.3649)}]$	Total samples
Santamaria *et al.* 2000	L=29.74; K=10; t0=0.018	Total samples
Palandri *et al*. 2008	$L=45.21[1-e^{0.71(t-(-0.01)}]$	Total samples

There are not so many data on the length frequencies of *Auxis rochei* from the Mediterranean Sea, in spite of the large distribution of this species and its constant presence in several fisheries. This could be considered an indication that managers, scientists and fishermen do not regard this species as being particularly significant.

A total of 458 bullet tunas were measured and weighed during three scientific surveys carried out in 2003–2005, in "La Azohía" trap (Murcia) in the Spanish South Western Mediterranean coast (Macias *et al*., 2006a).

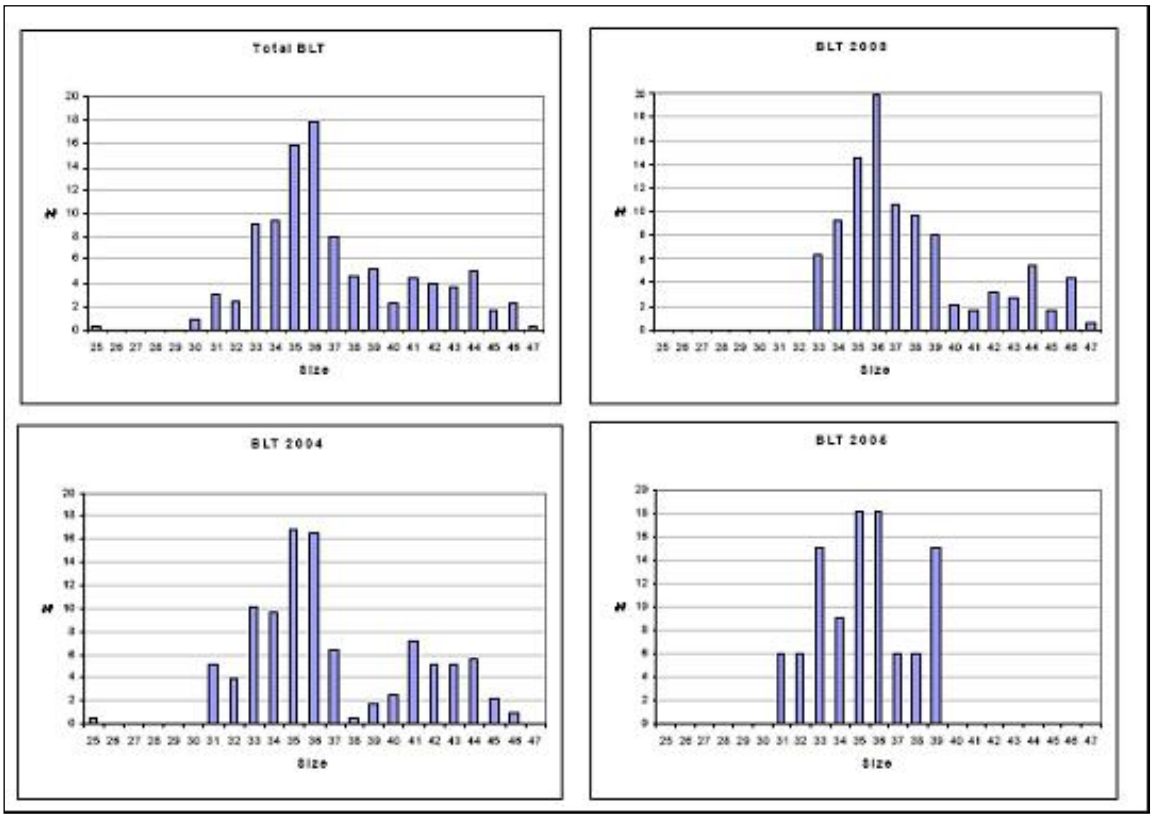


Figure 14 – Annual size distributions and the combined size distribution for the whole study period of *Auxis rochei* in the tuna trap of La Azohía, Spain (Macias *et al*., 2006a)

Generally, the annual distributions appeared plurimodal (Figure 14) in this Spanish trap. The highest modal value corresponds approximately to first maturity size: 35–36 cm (age 2). The second (minor) modal value was around 44 cm (age 3 and older specimens) except for the last year studied, in which this modal value cannot be found (all sampled fish were around 2 years old). These results agree with those reported in previous papers about size at first maturity and also indicate that the bullet tuna reproductive stock mainly consists of individuals aged 2. The second modal value can include the age 3 class and older specimens (Macias *et al*., 2006a).

Other length data are available for the Tunisian waters (Hattour, 2000), where the measured specimens ranged from 20 to 46 cm (Figure 15). A large specimen of 50 cm was reported in the same paper.

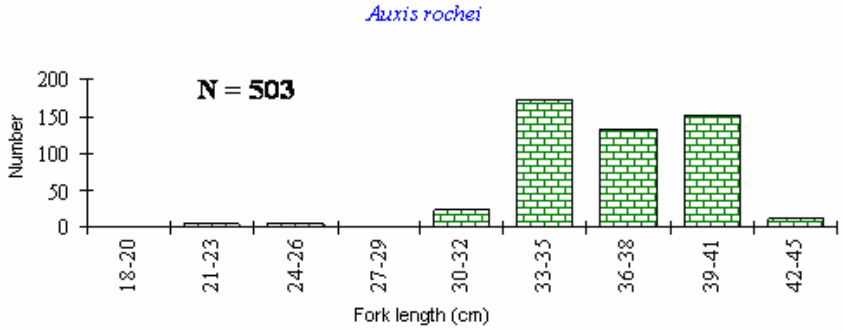


Figure 15 – Size distributions of bullet tuna in Tunisian water (Hattour, 2000)

Other data are available from the Eastern Mediterranean, thanks to samples taken along the Turkish coasts. A total of 354 individuals of bullet tuna were sampled in the Turkish Mediterranean Sea from January to May 1994, showing a the fork length between 28 to 44 cm, with weight ranging between 515 to 1550 g (Figures 16 and 17, Bök and Oray, 1995)

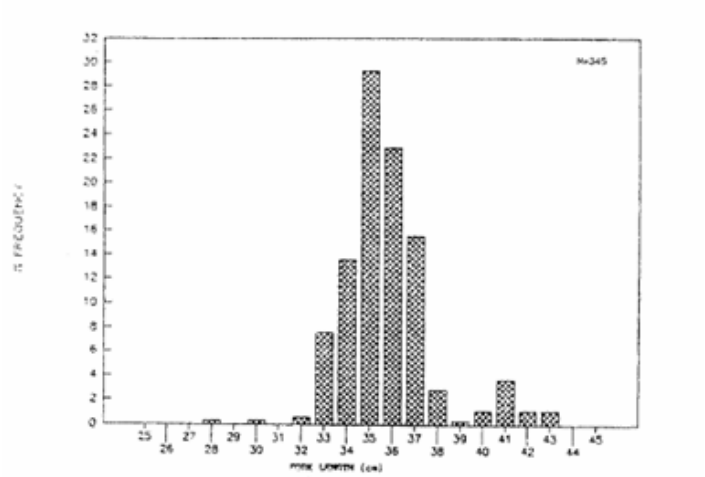


Figure 16 – Fork length frequencies of bullet tuna caught by the purse seine fishery in the Mediterranean Turkish water in 1994 (Bok, and Oray, 1995)

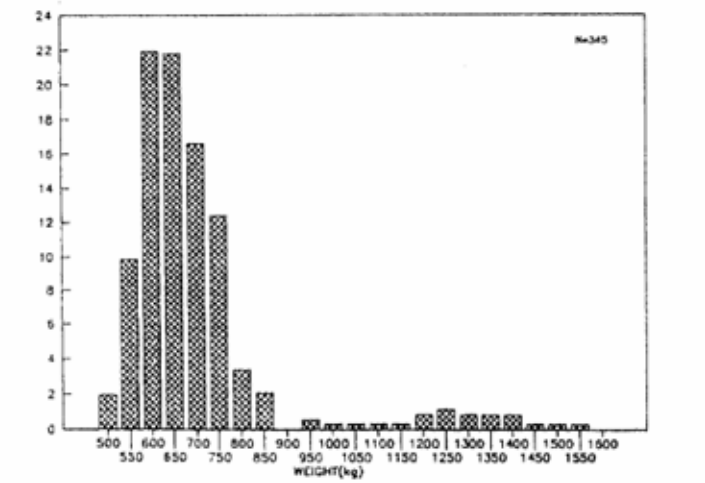
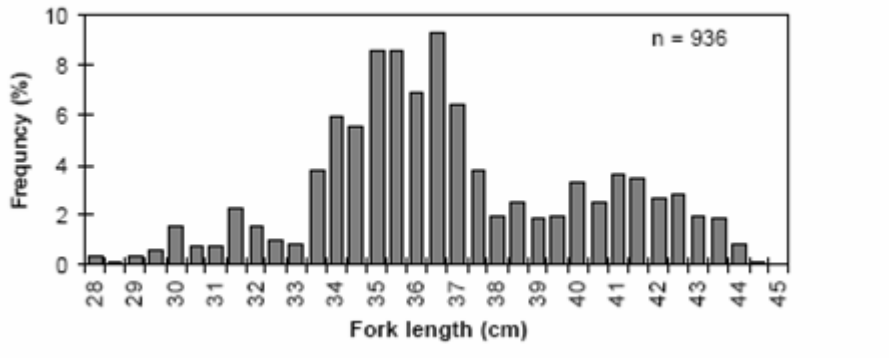


Figure 17 – Weight frequencies (in gr, not in kg) of bullet tuna caught by the purse seine fishery in the Mediterranean Turkish water in 1994 (from Bok and Oray, 1995)

More data were made available by Bok and Oray (2001), when a total sample of 936 bullet tuna was examined. The length ranged from 28.5 cm to 44.5 cm, with several modal patterns (Figure 18). The weight ranged from 350 g to 1 750 g, showing two main peaks at 650 and 1 300 g respectively (Figure 19).



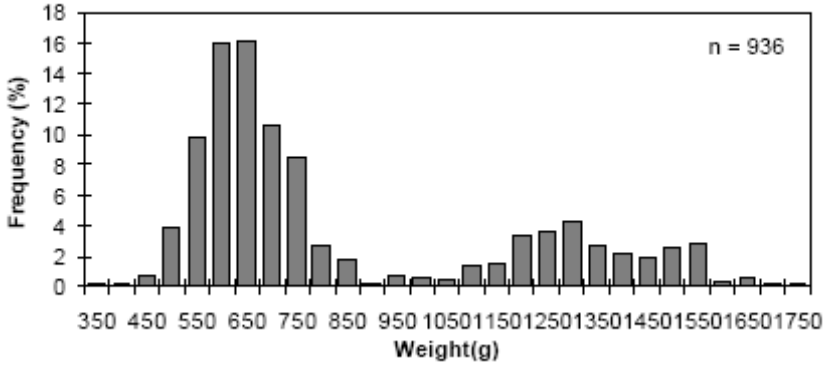


Figure 18 – Fork length (high) and weight frequencies of bullet tuna caught by the purse seine fishery in the Mediterranean Turkish water in 1994–1996 (Bok, and Oray, 2001)

The small tuna trap of Camogli (Ligurian Sea) shows a shift of sizes during its fishing seasons which are analogous to that described for *Sarda sarda* (Figure 19), with the presence of large fish in April at the beginning of the fishing season and the arrival of smaller individuals in the following months. Mature fish were found in the complete range of sizes shown in Figure 19 (Relini *et al.*, 2007).

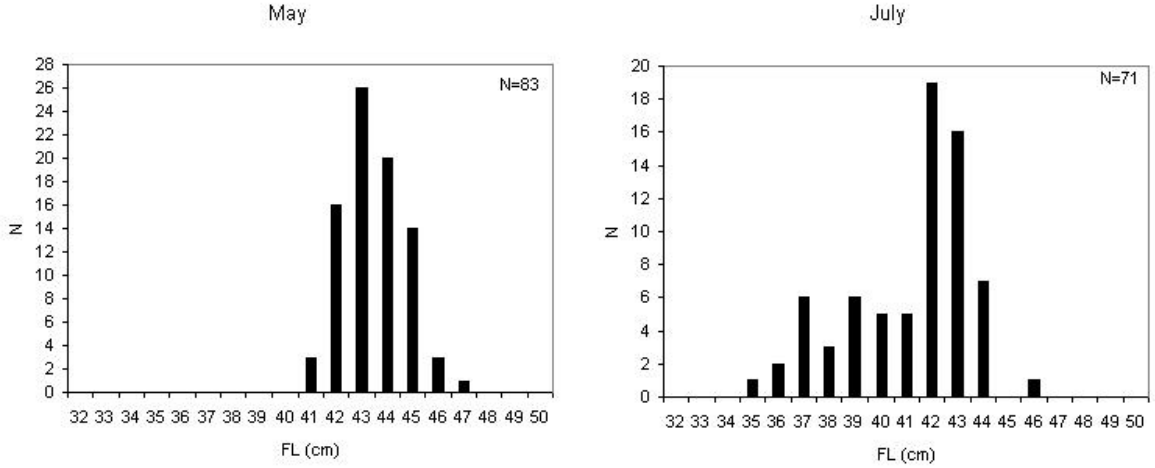


Figure 19 – Fork length frequencies of bullet tuna caught by the tuna trap in Camogli, Ligurian Sea (Relini *et al*. 2007)

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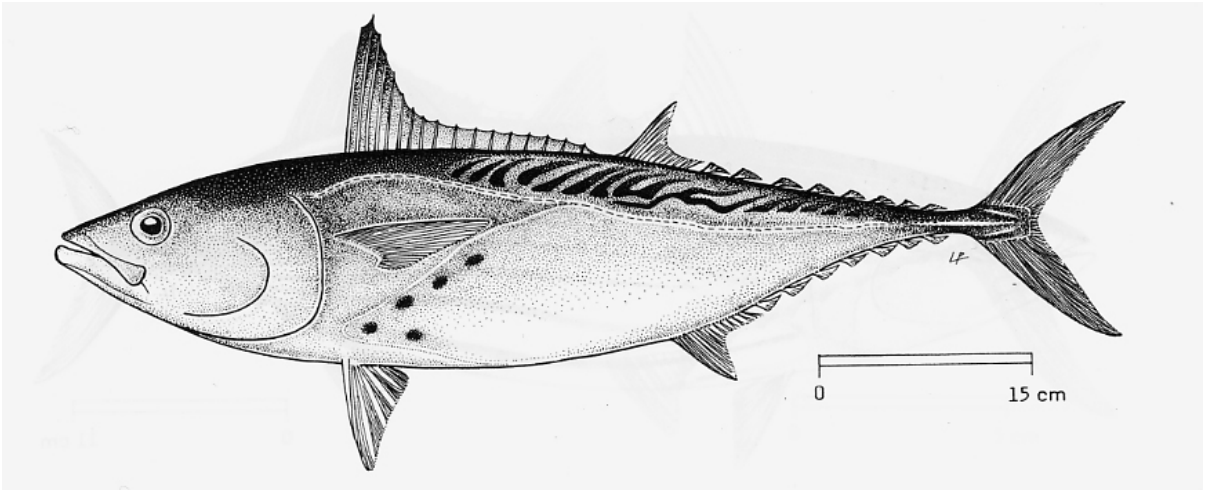
2.3 *Euthynnus alletteratus* (Rafinesque, 1810)



The Atlantic little tunny, *Euthynnus alletteratus* (Rafinesque, 1810) (ICCAT code LTA) is a medium-sized species. It is an epipelagic coastal species, typically occurring in inshore waters of the Atlantic and Mediterranean (Collette and Nauen, 1983), but also occasionally found in offshore waters.

The **maximum size** is 122 cm TL in the Atlantic, while in the Mediterranean about 100 cm FL (110 cm FL) and 12 kg weight have been reported.

The **diagnostic features** are: fusiform body; two dorsal fins, very close to each other, with 15–16 spines and 11–13 rays respectively, followed by 7 dorsal finlets. Short pectoral fin , with 26–27 rays. Anal fin with 11–15 rays, followed by 7 finlets. Gillrakers 37–45 on first arch. Caudal puduncle with a prominent median keel, between smaller keels. 39 Vertebrae. Interpelvic process small and bifid. Colour: back dark blue; lower side silvery white; in the naked dorsal areas oblique to horizontal dark bars; several round spots above the pelvic fins.

The **Geographical distribution** is continuous in the East Atlantic from the North Sea to South Africa including the Mediterranean and, in the past, also the Black Sea; the distribution seems to be lower in the West Atlantic.

2.3.1 Migrations

The migration patterns of *Euthynnus alletteratus* are not well known and very poorly studied in the Mediterranean and the Black Seas. At the beginning of the eighties 244 specimens were tagged in the area of Gibraltar, with seven recaptures (Rey and Cort, 1981): five fish in the Mediterranean and two in the Gulf of Cadiz. The longest path was to Blida, Algeria, 390 nm from the releasing point; in this case the fish was recaptured after 45 days.

2.3.2 Biological characteristics

The main biological parameters of *Euthynnus alletteratus* in the Mediterranean Sea are summarized in Tables 9 to 11, according to the scientific knowledge available in the study area.

Table 9 – Length/weight relationships of *Euthynnus alletteratus* in the Mediterranean Sea

Function	N	Range FL (cm)	Range W (g)	Author	Area
$W=0.02218LF^{2.91487}$		34–45	–	Rodriguez-Roda (1966)	Gibraltar strait
$W=0.0163LF^{3}$	100	47–101		Hattour (1984)	Tunisia
$W=0.01769*SL^{2.903}$	630			Andaloro *et al* (1998)	Sicily seas
$W=0.0476LF^{2.72562}$	1454	52–97.5	–	Kahraman and Oray (2001)	Eastern Mediterranean sea

Function	N	Range FL (cm)	Range W (g)	Author	Area
$W=0.0575LF^{2.69693}$	145	55–85	–	Kahraman and Oray (2001)	Aegen sea
$W=0.04098LF^{2.7549}$	217	–	–	Macias *et al.* (2006)	Western Mediterranean
$W=0.0381LF^{2.77}$	96	43–87	1215–8930	Kahraman and Alicli (2007)	Levantin basin

*SL= Standard Length

The **spawning season** of *Euthynnus alletteratus* in the Mediterranean Sea seems to be quite long (Table 10). In the Levantine basin, larvae were found in June together with those of *Thunnus thynnus* and *Auxis rochei*.

Table 10 – Spawning periods and grounds of *Euthynnus alletteratus*

Area	Period	Author
Tunisia		Hattour (1984)
South Tyrrhenian and Sicily Strait	May–August	Andaloro *et al* (1998)
Aegean- East Mediterranean	April.May 4 stages of maturation	Kahraman and Oray (2001)
East Mediterranean, near Cyprus	June, larvae	Oray and Karakulak (2005)
Southern Italian seas	July–August on the basis of juvenile daily growth analysis	Santamaria *et al*. (2005)

Table 11 – Length (FL) at age, in cm, of *Euthynnus alletteratus*

Author	0	1	2	3	4	5	6	7	8	9	Method	Von Bertalanffy growth function
Landau (1965) Mediterranean sea	–	35.84	53.91	63.72	70.19	75.5	80.15	81	–	–	vertebrae	–
Rodriguez-Roda (1979) Gibraltar strait	–	46.2	58.1	67.9	76.2	86	–	–	–	–	vertebrae	$L=114.59425[1-e^{0.190518(t-(-1.71229))}]$
Kahraman and Oray (2001) Aegean Sea	–	53.87	61.27	67.93	73.92	79.31	84.16	–	–	–	fin rays	$L= 127.5[1-e^{0.106(t-(-4.18)}]$
Kahraman and Oray (2001) Mediterranean Sea	–	56.57	64.53	71.52	77.69	83.12	87.9	92.12	95.83	99.09	fin rays	$L=123.229[1-e^{0.127(t-(-3.839)}]$
Santamaria *et al*. (2005) S. Italian seas	Juvenile growth from 7.5 to 25.2 cm in 18–69 days										otoliths	
Hattour (2008) Tunisian waters	–	33.2	46.6	59.6	64	72	79	82	–	–	vertebrae	$L=106[1-e^{0.255(t-(-0.765)}]$
Hattour (2008) Tunisian waters		32.8	41	50.1	56.7	63.5	69.9	73.6	–	–	fin rays	$L=117[1-e^{0.192(t-(-1.127)}]$

The length/weight relationships are also reported in Figure 20, while the Von Bertalanffy growth functions are shown in Figure 21.

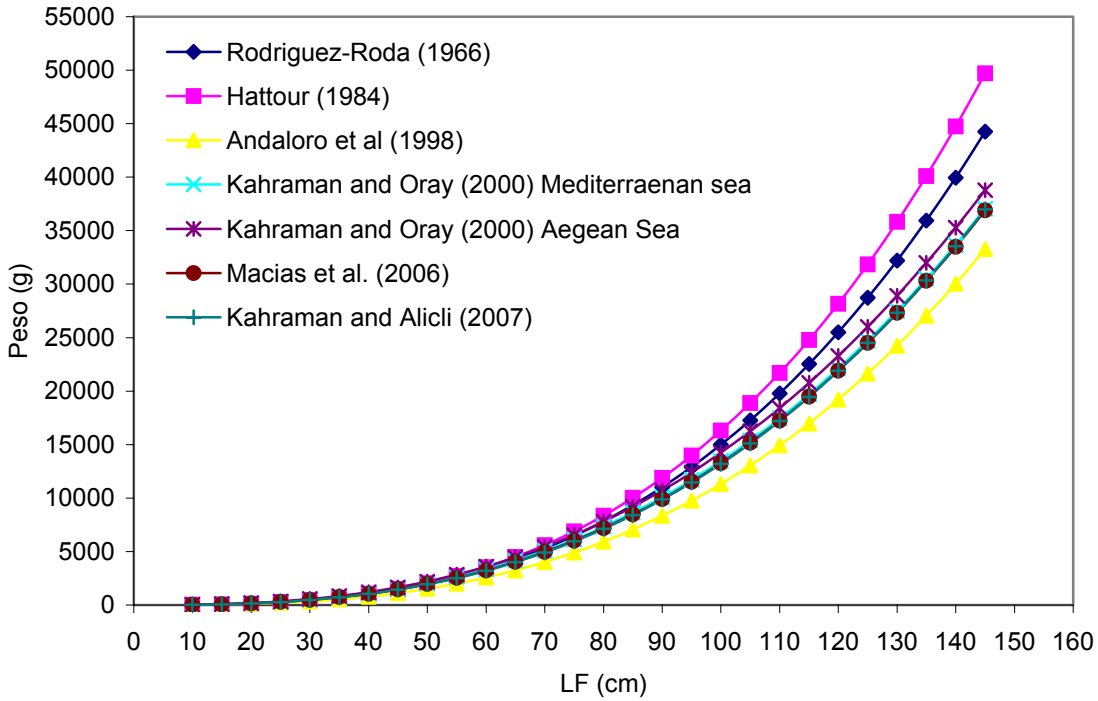


Figure 20 – Length/weight relationships of *E. alletteratus*

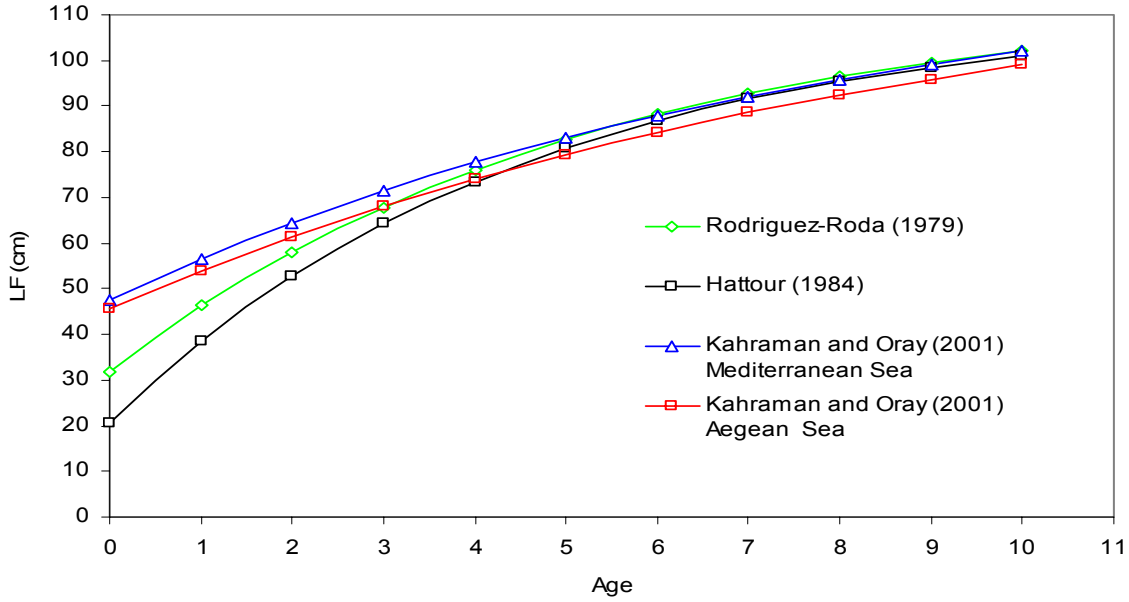


Figure 21 – Von Bertalanffy growth curves of *E. alletteratus*

The length frequency distribution in the South Western Spanish waters were reported by Rodriguez-Roda (1979) on the basis of the catches of tuna traps in Barbate and Tarifa (Figure 22).

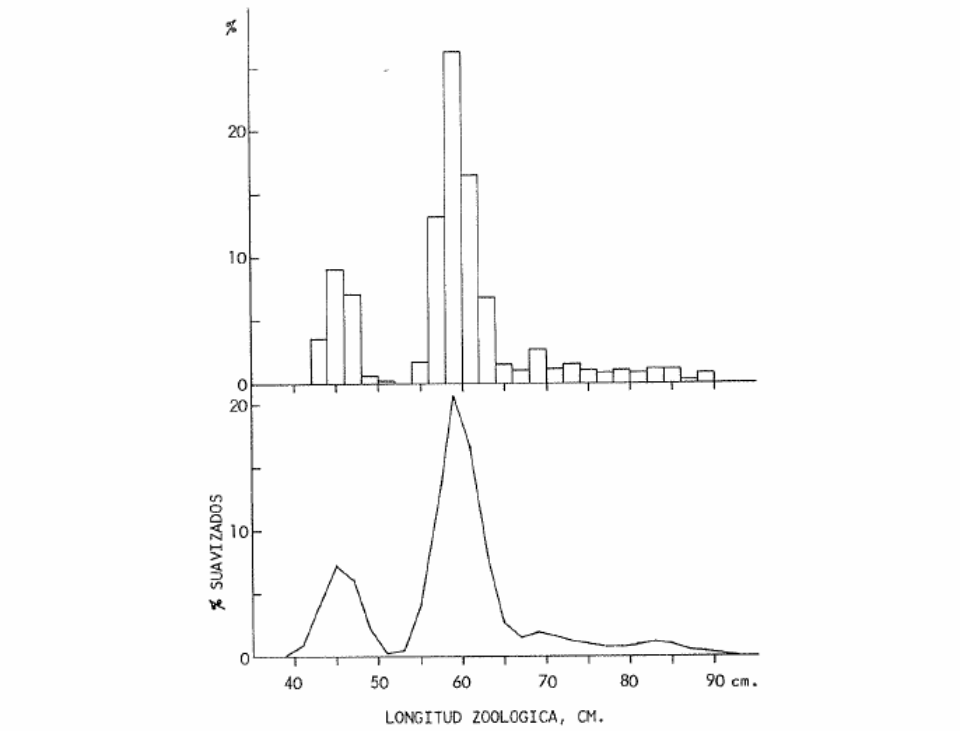


FIG. 1. — Frecuencias de tallas de 415 bacoretas capturadas por las almadrabas de Barbate y Tarifa en los años 1963 y 1964 durante los meses de mayo, junio y julio.

Figure 22 – Length/frequency distributions of *E. alletteratus* from Rodriguez-Roda (1979)

More recently, 217 Atlantic little tunny were measured and weighed during three scientific surveys carried out from 2003 to 2005 in the "La Azohía" trap (Murcia) in the Spanish South Western Mediterranean coast (Macias and al., 2006a) (Figure 23).

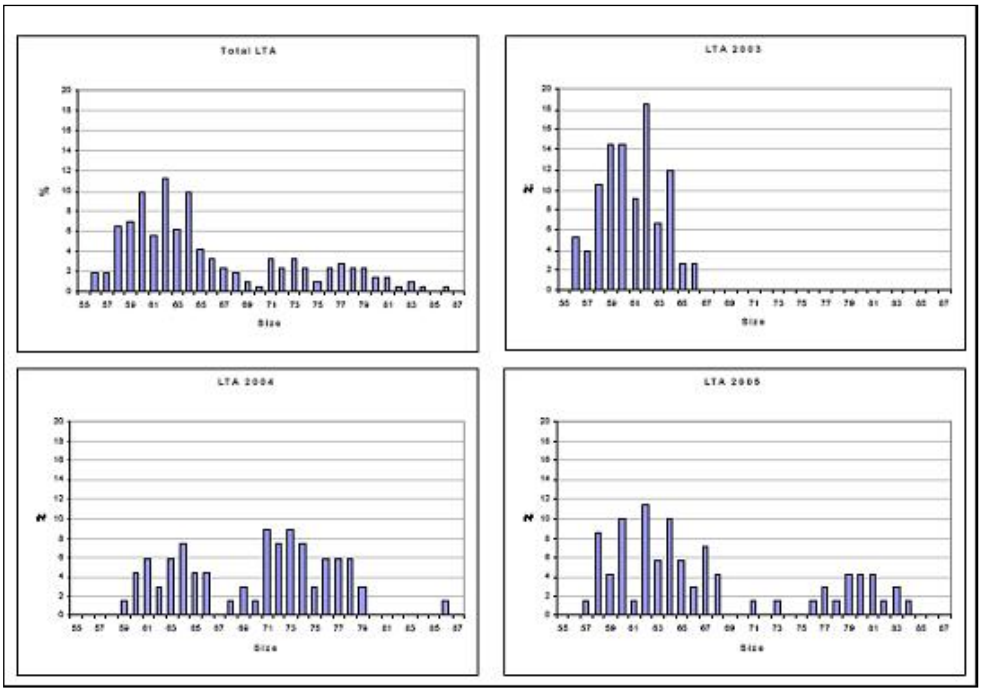


Figure 23 – Size distributions (annual and total) of Atlantic little tunny (Macias *et al.*, 2006a)

The size distribution of *Euthynnus alletteratus* shows multiple modal values. The first mode, around 62–63 cm, was the only found in 2003 sampling. In 2004 this year-class was found less abundantly than the second one (around 71 cm in fork length). A third modal value can be found in 2004 around

74 cm and a fourth one around 79 cm. According to previous papers (Rodriguez-Roda, 1979, Landau 1965) the first mode corresponds to age 3. The second modal value in 2004 (71cm) should corresponds to age 4, the third mode to age 5 (75 cm) and the last one to age 6. It is important to note that these measurements were made using the fork length, while the previous ones using the total length. In 2005 the first mode (age 3) was the most abundant in catches. The second mode corresponds to the older fishes, around 79–81 cm (more than 6 years).

Additional length frequencies from 989 specimens of *Euthynnus alletteratus* are available for the Tunisian waters, where it was possible to measure fish caught in the traps of Sidi Daoud and Monastir (Hattour, 2000) (Figure 24).

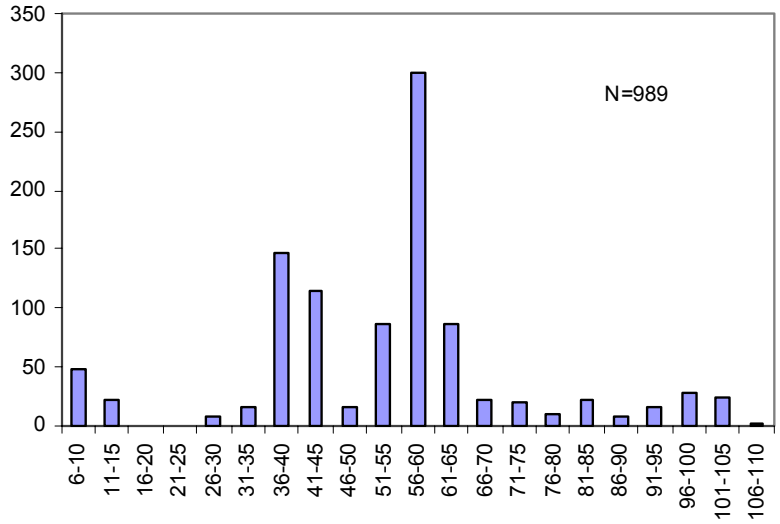


Figure 24 – Length/frequency distribution of *E. alletteratus* in Tunisian traps (Hattour, 2000)

Kahraman and Oray (2001), studied *Euthynnus alletteratus* fished in Turkish waters between 1994 and 1998 (Figures 25, 26, 27 and 28), maintaining a distinction between the Aegean Sea and the Eastern Mediterranean, both showing a bimodal pattern at 59 and 74 cm; the composition by age of the two groups is given in Table 11.

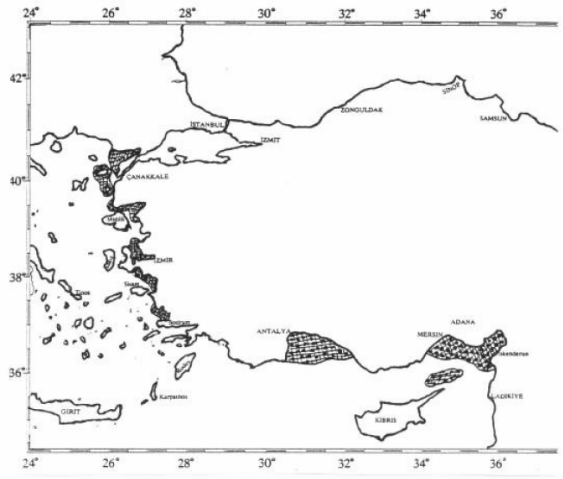


Figure 25 – The fishing areas for *Euthynnus alletteratus* in Turkish waters (Kahraman, 2005)

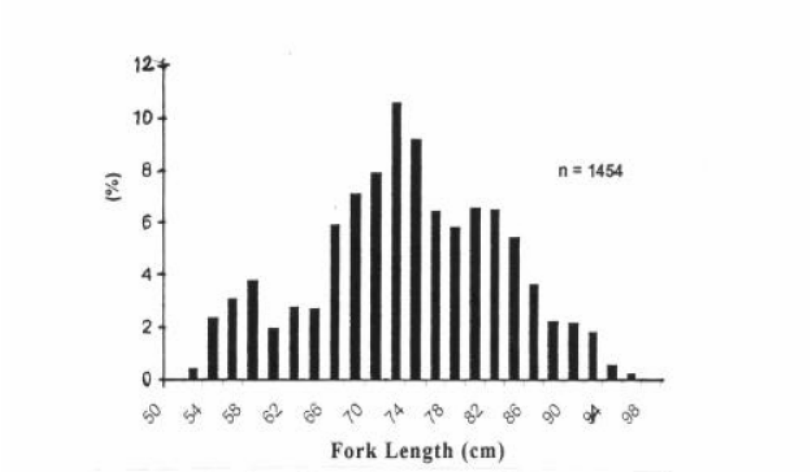


Figure 26 – Length frequency distribution of *E. alletteratus* in the Eastern Mediterranean (Kahraman and Oray, 2001)

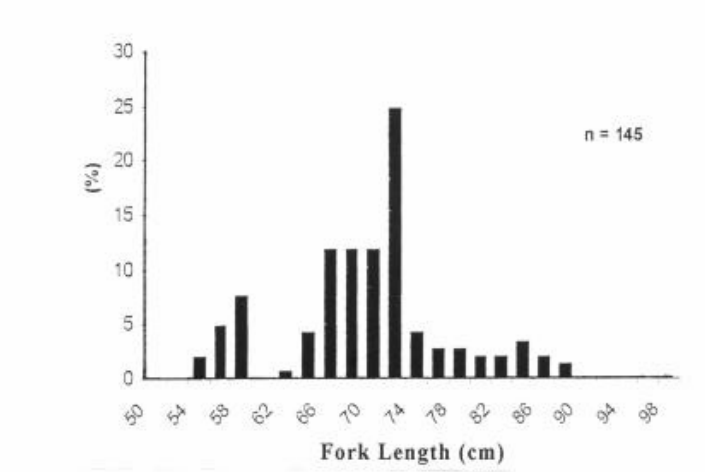


Figure 27 – Length frequency distribution of *E. alletteratus* in the Aegean Sea (Kahraman and Oray, 2001)

More recent data were also collected in Turkish waters in 2003–2004 (Kahraman, 2005), again showing a bimodal pattern at 61 and 74 cm (Figure 28).

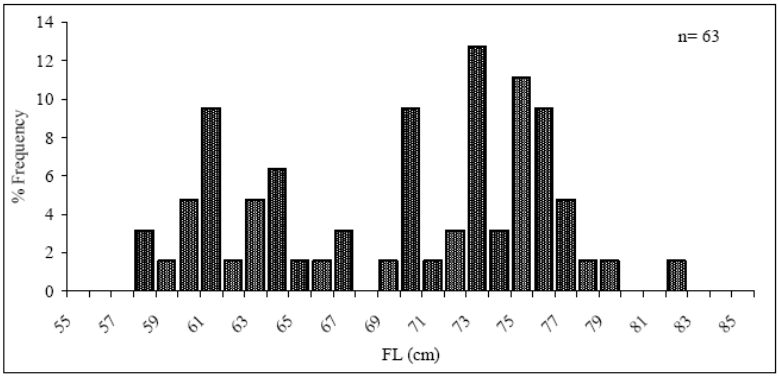


Figure 28 – Length frequency distribution of *E. alletteratus* in Turkish waters (Kahraman, 2005)

Some information about the **feeding ecology** are also available. The feeding habits (diet) per size have recently been analysed by sampling 187 stomach contents in the South Tyrrhenian (Falautano et al., 2007). The diet was made up of small pelagic fish (*Engraulis*, *Sardina*, *Sardinella*, *Maurolicus*,

Myctophum ecc.), fish larvae, crustaceans (anphipods, decapods, larvae) and molluscs (cephalopods and pelagic gastropods).

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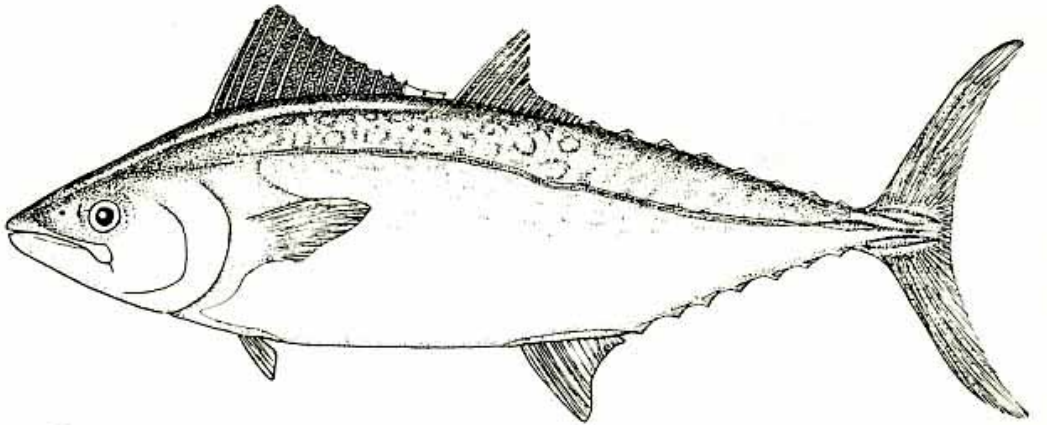
2.4 *Orcynopsis unicolor* (Geoffroy Saint-Hilarie, 1817)



The plain bonito *Orcynopsis unicolor* (Geoffroy Saint-Hilarie, 1817) (ICCAT code BOP), is an epipelagic neritic species mainly distributed in the Eastern Atlantic from 13°S to 60°N, from Norway to the Gulf of Guinea and then in the Mediterranean (Muus, B., Dahlström P., 1978, 1989; Sanches, 1989; Schneider, 1990; Robins *et al*. 1991; Collette, 1996; Kullander, 1999: Muus and Nielsen, 1999). It is mainly concentrated in an arch along the North African Atlantic coast, from about 15° N to the Straits of Gibraltar and from this Strait to the Southern Mediterranean Sea and Levant basin (Economidis, 1973; Swaby and Potts, 1990; Costa, 1991; Hureau, 1991; Lanfranco, 1993; Quignard and Tomasini, 2000; Fricke, 2007; Plejic, 2007). In the North-Western Mediterranean Sea (e.g. France, Italy) its presence is very infrequent. The presence of this species in the Black Sea is not well defined, even though catches are reported close to the Straits of Bosphorus (Stanciou, 1987; Bilecenoglu *et al*., 2002).

The **diagnostic features** of the plain bonito can be summarized as follows: body fusiform, strongly compressed, with maximum height between the dorsal fins, which are close together. First dorsal fin with 12–14 spines; second dorsal fin with 12–15 rays followed by 7–9 finlets. Anal fin with 14–16 rays followed by 6–8 finlets. Pectoral short with 21–23 rays. Interpelvic process small and bifid. Scaled skin forms a corselet and patches at the bases of the fins. Caudal peduncle with a well developed lateral keel, between two smaller keels. Vertebrae 37–39.

The **colour** of the back is dark blue or black, while the lower side is silvery. A faint mottled pattern on the dorsal and upper lateral surfaces. First dorsal fin is black, except a small rear part.

The maximum reported size is 130 cm, while the maximum size in the Mediterranean is 110 cm FL, commonly reported within the range 40–60 cm.

2.4.1 Migrations

No information is available about the migratory pattern of the plain bonito in the Mediterranean Sea and its possible correlation with the Atlantic ones.

2.4.2 Biological characteristics

The recent data on this species are those from Hattour (2000) and are releted to specimens caught in the Tunisian waters.

The size frequency distribution of catches is presented in Figure 29: except for some individuals accidentally captured by bottom trawlers, where size is between 8.5 and 11.5cm, the size of plain bonito varies from 31.5 cm to 79 cm. The main mode is the class 41–45 cm, which represents 25 percent of the total number of sampled fish, but others modes are in the classes 8–15 cm and 61–65 cm (Figure 29).

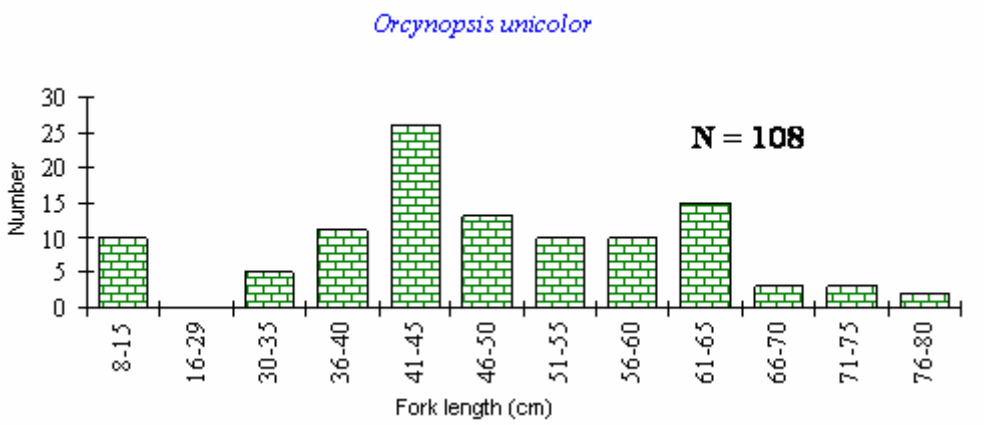


Figure 29 – Size distributions of plain bonito in Tunisian waters (Hattour, 2000)

The length weight relationships are the following:

whole fish (RW)	gutted fish (GW)
Males : $Wm = 0.00971*FL^{3.0809}$	$Wm = 0.035718*FL^{2.8094}$
Females: $Wf = 0.024172*FL^{2.9042}$	$Wf = 0.024172*FL^{2.9042}$
Males + Females: $We = 0.005388*FL^{3.2648}$	$We = 0.005388*FL^{3.2648}$

The growth, calculated by otolith readings, corresponds to the following Von Bertalanffy function:
$Lt = 93\ [1 - e^{0.386(t + 0.376)}]$
The size at first maturity is equal to 44.3 cm FL for the total of males and females; distinguishing the fish by sex, it is 45 cm FL in males and 43.5 cm FL in females.

The reproductive season, studied by means of gonadosomatic index, spans the period from April to September.

Where the **feeding ecology**is concerned, the plain bonito feeds on small fishes, especially sardines, anchovies, jacks, mackerel, bogue and others (Collette, 1986). Hattour (2008) also lists cephalopods such as squids, sepiolids and octopods.

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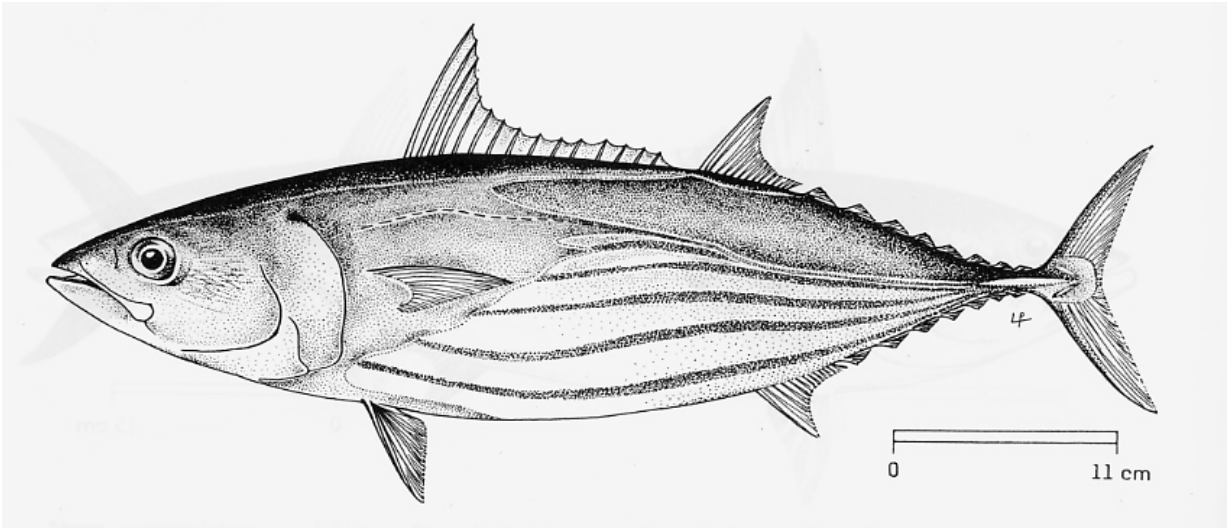
2.5 *Katsuwonus pelamis* (Linnaeus, 1758)



The skipjack tuna, *Katsuwonus pelamis* (Linnaeus, 1758) (ICCAT code SKJ), is an epipelagic oceanic species, cosmopolitan in warm and temperate waters (Collette and Nauen, 1983), having a worldwide distribution (Figure 30) including to some extent the Mediterranean Sea but not the Black Sea. Its distribution in the Mediterranean needs much more detailed studies.

The **diagnostic features** of the skipjack tuna can be summarized as follows: body fusiform, two dorsal fins separated by a small interspace (about equal to eye diameter), the first with 14–16 spines, the second with 14–15 rays; 7–9 dorsal finlets; pectoral fin with 26–27 rays; 14–15 anal soft rays; interpelvic process small and bifid; 7–8 ventral finlets. Skin scaleless except for the corselet and lateral line. Caudal peduncle with a strong lateral keel and two smaller keels. 41 Vertebrae. Swimbladder absent. 53–63 Gillrakers on the first arch.

The **colour** of the back is dark blue, while the lower sides and belly are silvery with 4–6 longitudinal dark bands.

The **maximum size** is 108 cm FL and about 34 kg. Common size is 80 cm FL and about 10 kg. The first maturity is achieved at 45 cm FL.

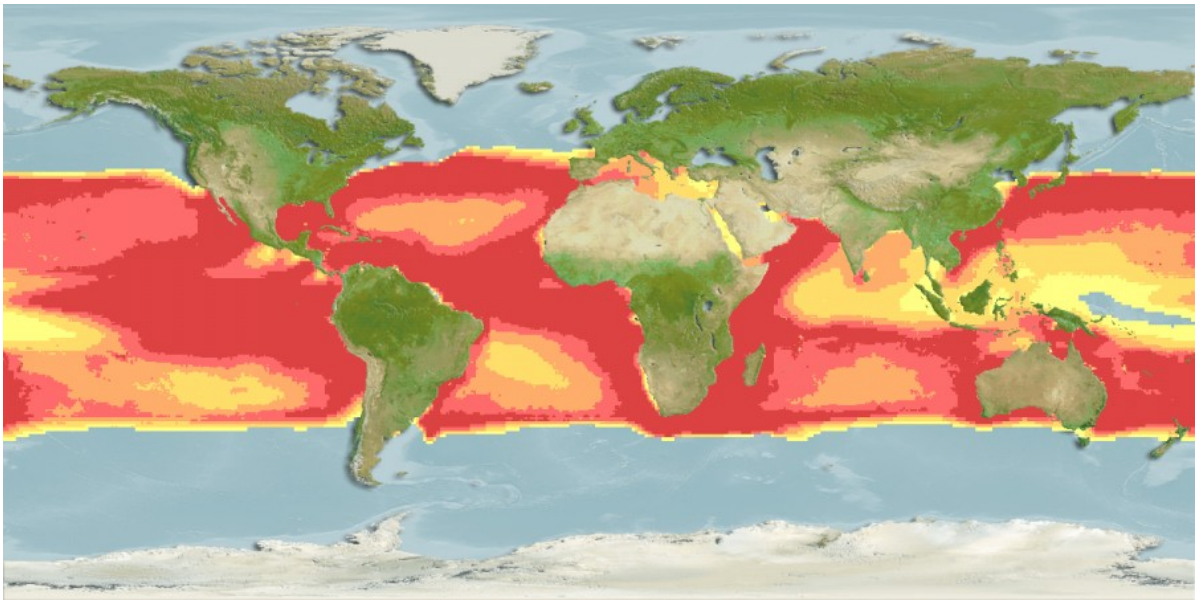


Figure 30 – Distribution of *Katsuwonus pelamis* according to Fishbase

2.5.1 Migrations

Information on the migratory pattern of the skipjack tuna in the Mediterranean Sea and the possible correlation with the Atlantic ones is lacking at the moment. Migrations in other oceans are much better known, due to the relevance of this species for fishery.

2.5.2 Biological characteristics

In oceanic waters this species is found in the 15–30 °C temperature range, with spawning seasons more or less extended according to latitude, and almost continuing into equatorial waters. According to ICCAT SCRS, one of the characteristics of skipjack is that from its first year of life it spawns opportunistically throughout the year and in vast sectors of the ocean, its growth varying according to the latitude. In the Atlantic Ocean the fecundity in the range 41–87 cm FL was typically calculated at 80 000–2 000 000 eggs.

Nothing is known about the **reproductive biology** of this species in the Mediterranean Sea.

2.5.3 Bibliography

The literature is rich for oceanic populations (Pacific, Indian, Western and Eastern Atlantic) but, in the Mediterranean it seems limited to the description of the species or a very few reports concerning the fishery.

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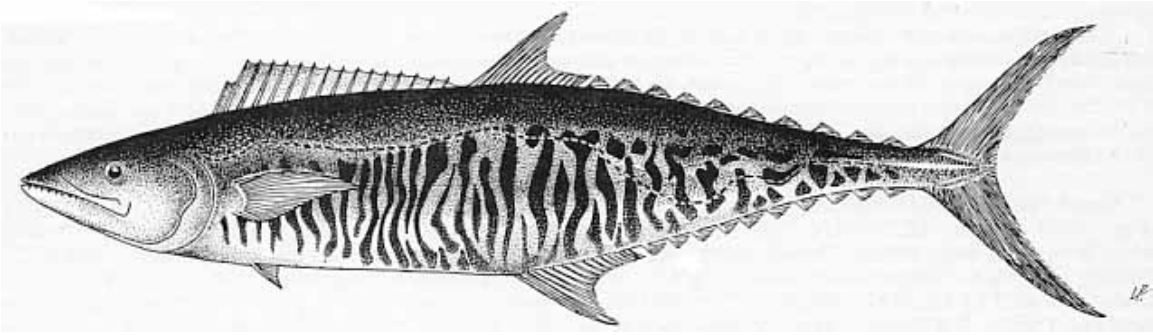
2.6 *Scomberomorus commerson* (Lacepède, 1800)



The narrow-barred Spanish mackerel, *Scomberomorus commerson* (Lacepede, 1800) (ICCAT code COM) is an epipelagic, neritic species, known to undertake lengthy coastal migrations (Collette and Nauen, 1983). Widespread throughout the Indo-West Pacific, during the 1930s, this species entered the Mediterranean where it was first recorded in Palestine in 1935 (Hornell, 1935). In the following years the species was recorded in Lebanon (George and Athanassiou, 1965), Turkey (since 1981, in Gucu *et al*., 1994), Egypt (El Tayeb, 1994) and Aegean Sea (Buhan *et al.,* 1997) (Golani *et al*., 2002). At present, fishery statistics show commercial quantities in Israel, Lebanon, Egypt and Algeria, commercial quantities are reported also for the Libyan Arab Jamahiriya (Shakman and Kinzelbach, 2007; Di Natale, pers. comm.) but catch data are not available in the statistics, while in only Tunisia does the presence of the species seem to be recorded (Golani *et al*., updating of CIESM Fish Atlas, on line); a few specimens have been also recorded in Sicily.

The **diagnostic features** can be summarized as follows: the body is fusiform, elongated and compressed. Two dorsal fins close to each other, the first with 15–18 spines and the second with 15–20 rays; 8–10 dorsal finlets; anal fin with 16–21 rays followed by 7–12 finlets; pectoral fin with 21–24 rays; caudal peduncle with a lateral keel between two smaller keels. Wavy lateral line with a marked bend in the caudal segment. A few gill rakers on the first arch, 1–8 total. Vertebrae 42–46.

The **colour** is grey to silvery on the belly, with vertical bars of a darker grey extending from the flanks to the ventral surfaces. Bars are irregular, in part wavy and broken in spots, which is an exclusive characteristic of this species (*S. tritor* recorded in the Mediterranean as an Atlantic vagrant has only spots, more or less round, on the flanks). Young fish differ from adults in that they have bars in a more dorsal position and the first dorsal fin with a black anterior segment followed by a white one.

The maximum fork length is 240 cm, and is commonly recorded at around 90 cm; the maximum recorded weight is 70 kg. The maximum length in the Mediterranean was recorded in Turkish waters: 113 cm FL. First maturation in male and female is at 65 and 70 cm FL respectively (Pacific, Fiji).

2.6.1 Migrations

No information exists at present about the migratory pattern of the narrow-barred Spanish mackerel in the Mediterranean Sea and the possible correlation with other oceans.

2.6.2 Biological characteristics

The only information existing in the Mediterranean is related to data collected in Turkish waters. According to this information the minimum, maximum and mean values of the TL and TW were 520 mm, 870 mm, 618 mm and 1 050 g, 3 300 g, 1 553g, respectively in Güllük Bay and Gökova Bay (Turkey, South Aegean Sea) in November and December 1994. One large specimen (not included in the graph), with a FL of 113 cm, was collected in the Güllük Bay (Öğretmen *et al.*, 2005) (Figure 31 and Table 12).

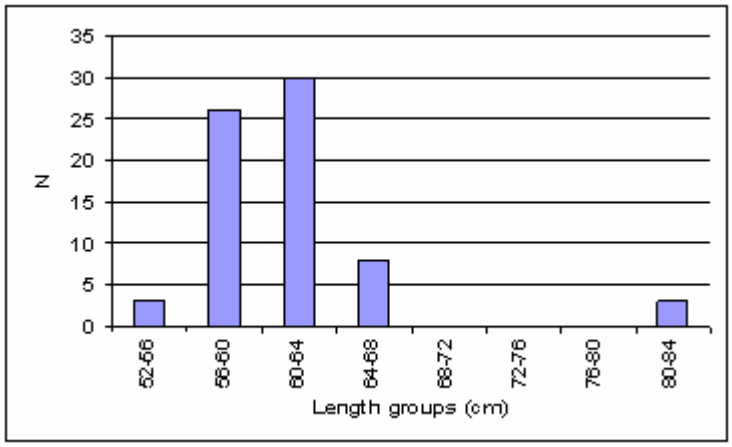


Figure 31 – Length frequency distribution of *Scomberomorus commerson* in Güllük and Gökova Bays in November and December 1994 (Buhan *et al*., 1997)

Table 12 – Morphomertic characters of *Scomberomorus commerson* in Güllük and Gökova Bays in November and December 1994 (Buhan *et al*., 1997)

TL (cm)	± (percent)	Mean length (cm) ± GS (95 percent)	Mean weight (g) ± GS (95 percent)	P	K
52 – 56	3(4.3%)	52.90±1.94	1180±293		0.8
56 – 60	26 (37.1%)	58.38±0.70	1356±41	p<0.05	0.68
69 – 64	30 (42.9%)	62.11 ±0.49	1491±33	p<0.05	0.62
64 – 68	8(11.4%)	66.00±0.81	1937±134	p<0.05	0.67
68 – 72					
72 – 76					
76 – 80					
80 – 84					
84 – 88	3 (4.3%)	86.67±1.43	3233±189	p<0.05	0.5
Mean		L=61.83±1.44	W=1553±74		K=0.65

The **length/weight** relationship is the following: $W = 0.1567FL^{2.2231}$ (Buhan *et al*., 1997). The growth parameters are only available for the areas where the narrow-barred Spanish mackerel has its original distribution. In NE Australian waters the growth of *Scomberomorus commerson* was studied by otolith reading. A tagging programme, with significant recaptures, allowed for the comparison of the growth functions, derived for male and female respectively, with segments of growth registered in the wild (Figure 32 and Table 13 provide these data) (McPherson G.E., 1992).

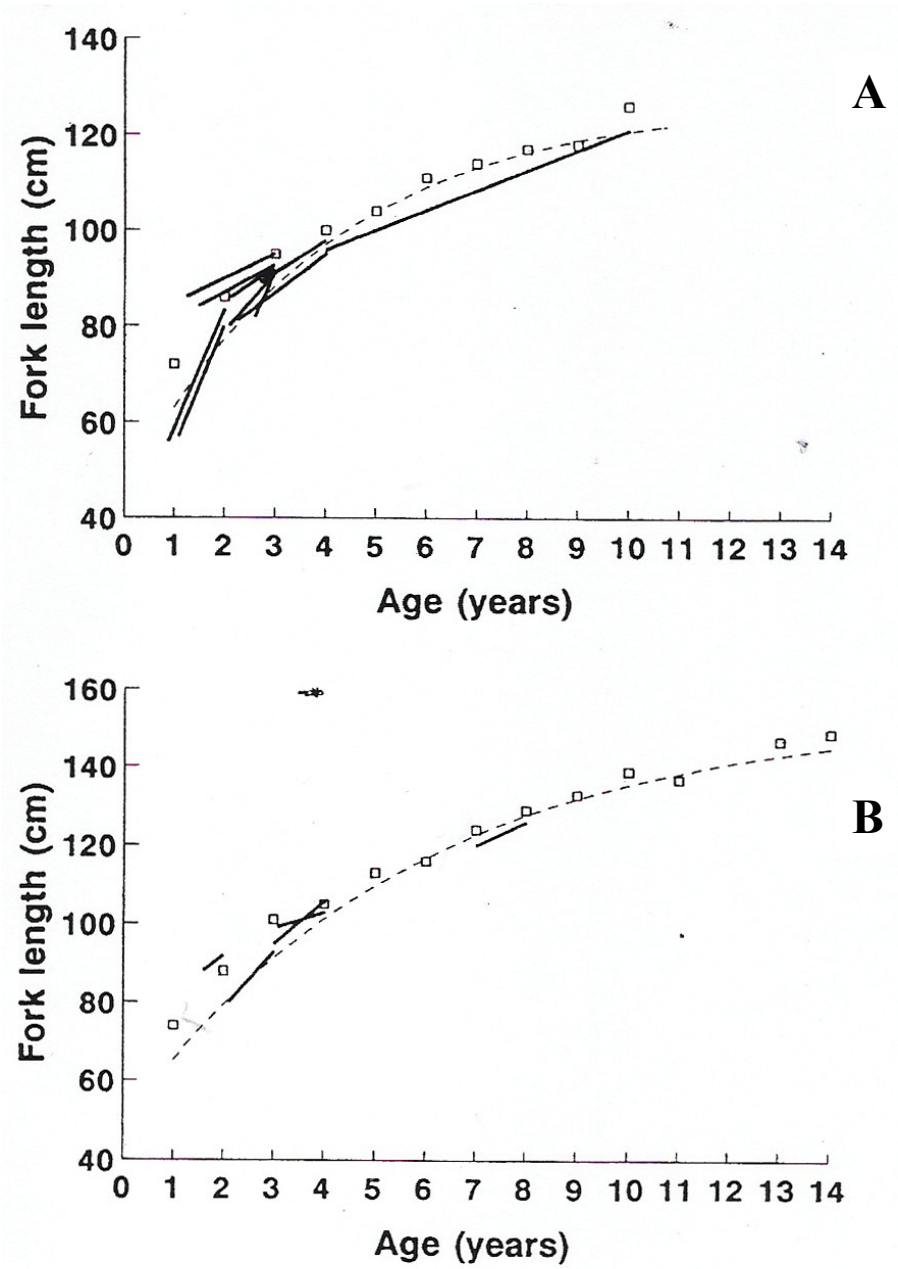


Figure 32 – Growth increments from tagging (solid lines) for known-age males (A) and females (B) of *Scomberomorus commerson*, compared with the Von Bertalanffy growth curve (dashed line) and mean observed length at age data (squares)

Table 13 – Von Bertalanffy growth parameters describing growth in North-East Australian stock of *Scomberomorus commerson*

Parameter	Males	Females
L_∞	127·5	155·0
(s.e.)	(5·7)	(5·8)
(95% C.I.)	(114, 141)	(142, 168)
K	0·25	0·17
(s.e.)	(0·05)	(0·03)
(95% C.I.)	(0·07, 0·43)	(0·10, 0·24)
t_0	−1·72	−2·22
(s.e.)	(0·54)	(0·50)
(95% C.I.)	(−3·0, −0·5)	(−3·3, −1·1)
r^2	0·98	0·98

2.6.3 Bibliography consulted

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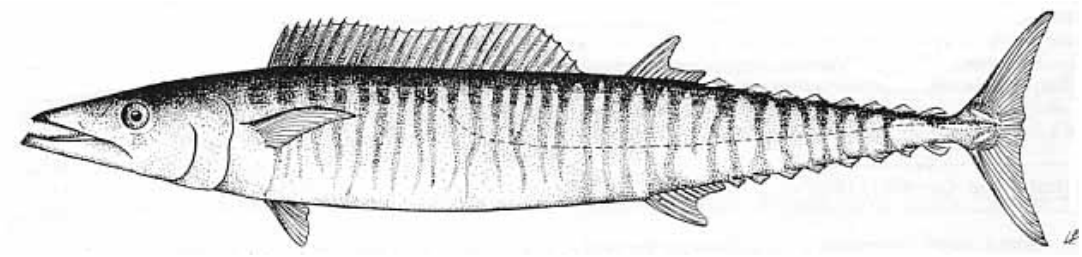
2.7 Other small tuna species observed in the Mediterranean Sea and Black Sea

As reported previously, several other small tuna species have been reported so far in the Mediterranean Sea or in the Black Sea. These species are considered incidental or extremely occasional and their presence could be explained by occasional movements of individual specimens. They can be lessepsian immigrants, entering into the Mediterranean Sea by the Suez Canal, or species entering into the Mediterranean Sea through the Strait of Gibraltar. Some of them are occasionally reported in some fishery statistics, but their presence might be linked to a misidentification or mistakes in reporting the catches.

This report lists them with the sole purpose of providing the most complete list of species possible, but the information is limited to a general description. Their relevance to the Mediterranean fishery is actually negligible, they have a mostly scientific interest due to the ecological implications of the expansion of their distribution range.

2.7.1. Vagrant species

***Acanthocybium solandri* (Cuvier, 1832)**



The wahoo, *Acanthocybium solandri* (Cuvier, 1832) has a large distribution worldwide in equatorial, tropical and temperate waters. Its distribution covers the Red Sea, the Indian Ocean, the Pacific Ocean, the Atlantic Ocean, from 46°N to 37°S.

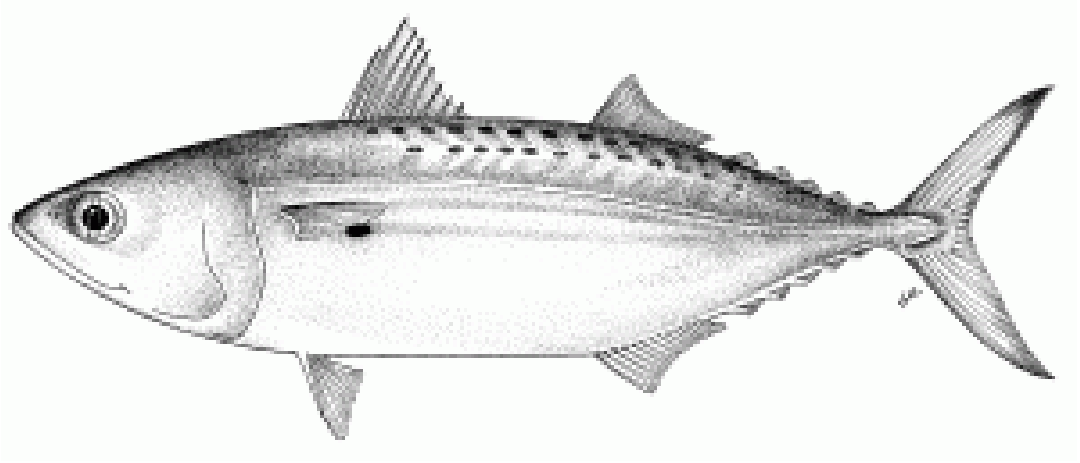
It has also been found also in the Mediterranean Sea, around Sicily (Romeo *et al*., 2005), where it possibly immigrated either through the Straits of Gibraltar or the Suez Canal. Usually pelagic and oceanodromus, it usually swims in the upper stratum of the sea.

The diagnostic features are the followings: the body is covered with small scales, no anterior corselet developed. The back is iridescent bluish green; the sides silvery with 24 to 30 cobalt blue vertical bars which extend to below the lateral line. Swim bladder present. Dorsal spines (total) 23–27; Dorsal soft rays (total) 12–16; Anal spines 0; Anal soft rays 12–14; Vertebrae 62 – 64. Mouth large with strong, triangular, compressed and finely serrated teeth. Snout about as long as the rest of the head. Posterior part of maxilla completely concealed under preorbital bone. Gill rakers absent. Interpelvic process small and bifid.

The maximum reported length is 250 cm FL; maximum. Published weight: 83 kg.

The wahoo feeds primarily on fishes and squids.

***Rastrelliger kanagurta* (Cuvier, 1816)**



The Indian mackerel, *Rastrelliger kanagurta* (Cuvier, 1816) is a mostly Indo-Pacific species, with a prevalent equatorial and tropical distribution, from the Red Sea, to East Africa, Madagascar and Indonesia, north to the Ryukyu Islands and China, south to Northern Australia, Melanesia and Samoa. Only two specimens have been reported so far from the Mediterranean Sea, along the coast of Israel (Collette, 1970). It is considered an occasional Lessepsian migrant.

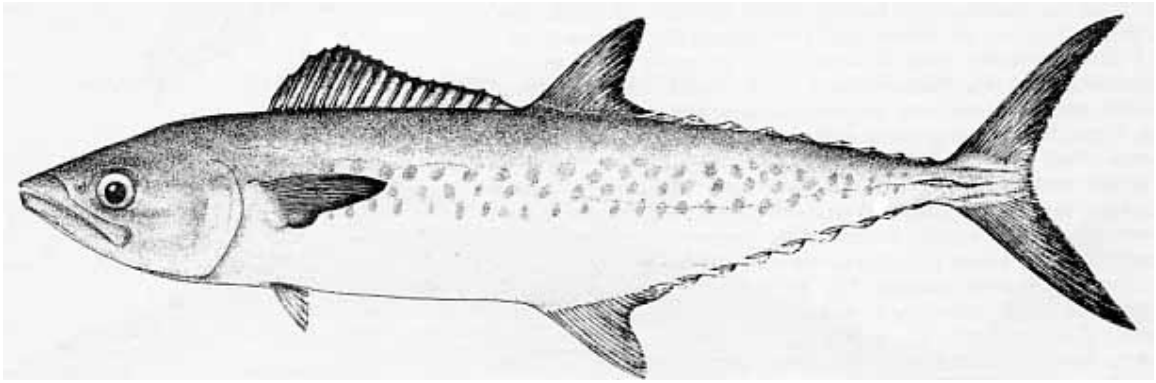
The body is elongated and fusiform, moderately compressed. The colour is blue-green back with several black spots, flanks and belly silvery-white with 2 or 3 faint longitudinal stripes and a black dot under the lower margin of the pectoral fin. Two well-separated dorsal fins, each depressible into a groove. Second dorsal fin opposite anal fins, both followed by five finlets. Caudal fin forked with two small horizontal keels on its base. Pectoral and pelvic fins are small. Head longer than body depth.

Large mouth, maxilla extending beyond posterior margin of eye. Small conical teeth in both jaws, absent from palatine and vomer. Very long gill rakers visible when mouth closed, some of them bearing fine bristles. Eye covered by an eyelid. Entire body covered with scales.

The maximum reported length is 35 cm, commonly 20–25 cm. The maximum reported age is 4.

The Indian mackerel is a pelagic species, often found in coastal bays, harbours and deep lagoons, usually in turbid, plankton-rich waters. It is a schooling species, often observed swimming through plankton patches with an open mout, because it feeds on phytoplankton, zooplankton, shrimps and fish.

***Scomberomorus tritor* (Cuvier, 1832)**



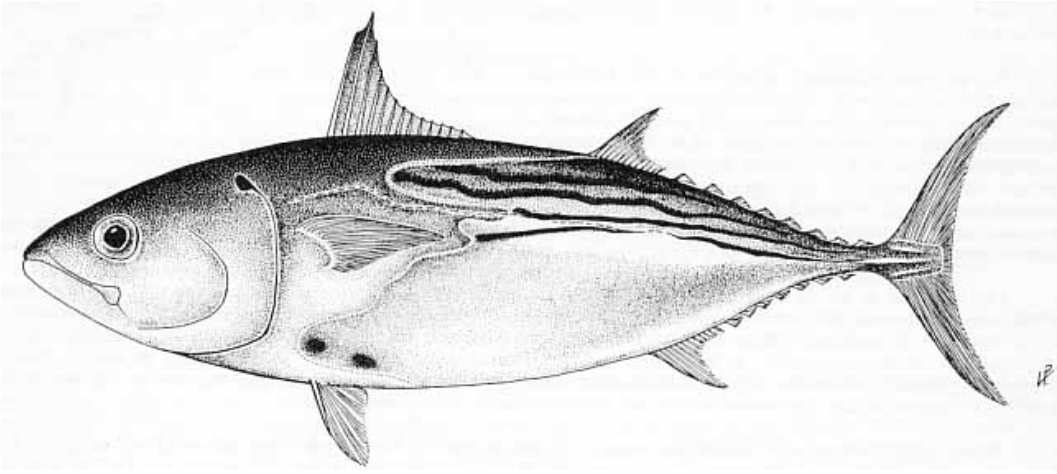
The West African Spanish mackerel, *Scomeromorus tritor* (Cuvier, 1832), is a tropical species, distributed in the Eastern Atlantic from the Canary Islands and Senegal to the Gulf of Guinea and Baía dos Tigres in Angola. Rarely found in the northern Mediterranean Sea, along the coasts of France and Italy. It is an occasional migrant through the Gibraltar Strait.

The body is covered with small scales. Lateral line gradually curving down towards caudal peduncle. Swim bladder absent. Some large individuals have thin vertical bars. Anterior half of first dorsal fin and margin of posterior half of first fin black. Dorsal spines (total): 15–18; Dorsal soft rays (total): 0–0; Anal soft rays: 17–20; Vertebrae: 46–47. Reproduction occcurs in July and August.

The maximum reported size is 100 cm TL for males and 98 cm FL for females; the maximum published weight is 6 kg and the maximum reported age is 5 years. The West African Spanish mackerel is a pelagic species, which sometimes forms school close to the shore or enters coastal lagoons. It feeds on clupeids.

2.7.2. Species having an uncertain presence in the Mediterranean, possibly due to misidentification in fishery statistics

***Euthynnus lineatus* (Kishinouye, 1920)**

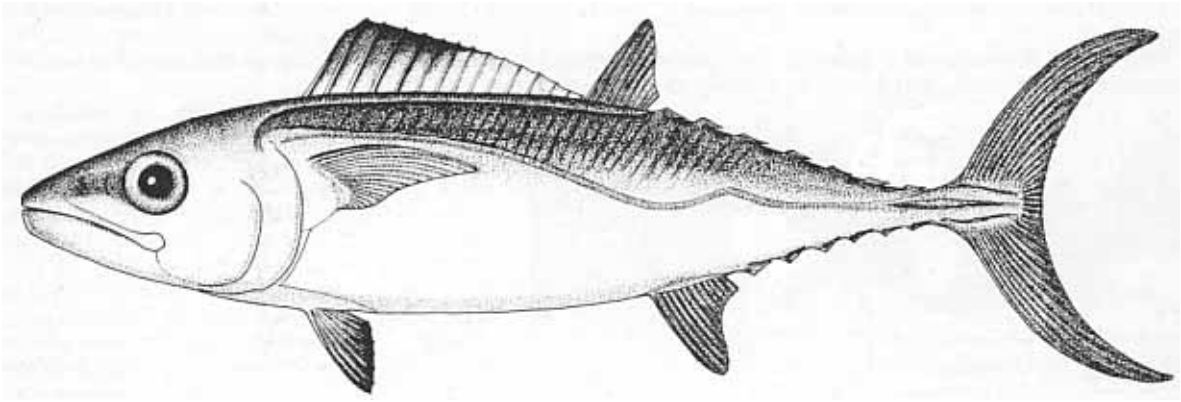


The black skipjack, *Euthynnus lineatus*, Kishinouye (1920) has a distribution limited to the tropical Eastern Pacific Ocean, from California to North Peru and Galapagos, with a few specimens found in the Hawaii area. Its presence in the Mediterranean Sea is quite questionable but it appears in some fishery statistics, possibly due to misidentification or confusion with other species on the market.

The diagnostic features are the followings: the body is naked except for corselet and lateral line. Swim bladder absent. Large rounded protuberances on 31st and 32nd vertebrae. Colour is generally iridescent blue with black dorsal markings composed of 3 to 5 horizontal stripes, also with variable black or dark grey spots above the pelvic fins. Occasionally with extensive longitudinal stripes of light grey on the belly; some individuals have few or no belly markings. Dorsal spines (total): 10–15; Anal soft rays: 11–12; Vertebrae: 37. Anterior spines of first dorsal fin much higher than those mid-way, giving the fin a strongly concave outline. Interpelvic process small and bifid.

The maximum reported length is 84 cm FL; maximum published weight is 9.12 kg. It usually forms schools with other small tuna species, sharing the same feeding ground.

***Gymnosarda unicolor* (Rüppell, 1836)**

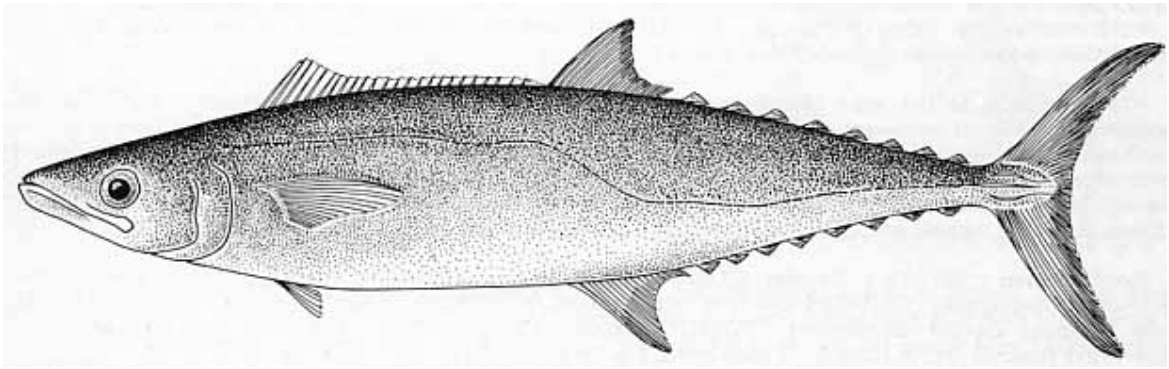


The dogtooth tuna, *Gymnosarda unicolor* (Rüppel, 1836) is a typical tropical species, mostly distributed in the Indo-Pacific Ocean, from the Red Sea and East Africa to French Polynesia, north to Japan, south to Australia. Its presence in the Mediterranean Sea is quite questionable but it appears in some fishery statistics, possibly due to misidentification or confusion in common names.

The diagnostic features are the following: the body is naked from posterior to corselet. Swim bladder large, spleen visible in ventral view on the right side of the body. The back and upper sides are brilliant blue-black, lower sides and belly silvery; no lines, spots or other markings on the body. The lateral line is strongly undulating. Dorsal spines (total): 13–15; dorsal soft rays (total): 12–14; anal spines: 0; anal soft rays: 12–13; vertebrae: 38. Mouth fairly large, upper jaw reaching to middle of eye. Laminae of olfactory rosette 48 to 56. Interpelvic process large and single.

The maximum reported length is 248 cm, with a maximum weight of 131 kg. The Dogtooth tuna is an oceanodromous species, often reef-associated. It is a solitary species, which forms small groups of a few individuals. It feed on fish and squids.

***Scomberomorus cavalla* (Cuvier, 1829)**



The King mackerel, *Scomberomorus cavalla* (Cuvier, 1829) is a tropical species, mostly distributed in the Western Atlantic Ocean, from Canada to Massachusetts and south to Brazil. In the Eastern Central Atlantic it is reported in St. Paul's Rocks. Large schools have been found to migrate over considerable distances along the Atlantic US coast. Its presence in the Mediterranean Sea is quite questionable but it appears in some fishery statistics, possibly due to misidentification or confusion with other species on the market.

A lateral line abruptly curves downwards below the second dorsal fin. Adults have no black area on the anterior part of the first dorsal fin; juveniles have bronze spots in 5 or 6 irregular rows. Body entirely covered with scales; swim bladder absent; dorsal spines (total): 12–18; dorsal soft rays (total): 15–18; anal spines: 0; anal soft rays: 16–20; vertebrae: 41–43. Interpelvic process small and bifid.

The maximum reported size is 184 cm TL; the maximum published weight is 45 kg and the maximum reported age is 14 years It is an oceanodromous species, often reef-associated; it feeds primarily on fishe and also on penaeid shrimps and squids.

A revision of the fishery statistics where these three species are present seems necessary.

2.7.3 References

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3. SMALL TUNA FISHERIES IN THE MEDITERRANEAN AND BLACK SEAS

This chapter aims to present a concise assessment of changes in small tuna fisheries of the Mediterranean Sea and Black Sea area. The various fishing methods used in the region and the main small tuna target species exploited in the study zone are described by country, along with the catch trends available from the FAO relative to the region. The last part of the current chapter of this report summarizes the most relevant legislation existing in each country in relation to small tuna fisheries.

Is it to be noted that the only source for the fishery data analysed in this chapter is the FAO database (FAO Fisheries and Aquaculture Information and Statistics Service). The use of a single source avoided difficulties due to discrepancies, as already observed, among the most relevant statistics services available (FAO, ICCAT and EUROSTAT) for some species. This issue will be discussed in the final part of this report, following the socio-economic section of this study.

The information reported in this chapter was mostly obtained from official sources and published scientific papers, but it has also been possible to check the details thanks to the kind assistance of the scientific community in the Mediterranean and the Black Seas. Several contacts were established with many of the national administrations in the region, in order to check the existing regulations.

Knowledge on the status of the small tuna stocks in the Mediterranean and Black Seas and the relative fisheries is poor and often unavailable. Several factors combine to cause this, such as the low economic importance perceived by the professionals of the sector and the administrations in relation to these species (brought about in many cases by a lack of proper knowledge), and in particular by the genuine difficulties in monitoring landings which take place all along the coasts often by the small-scale fisheriessector . Indeed, the small tuna species are exploited by a very large number of vessels, as target or bycatch, and the majority of the fleet is small-scale, although purse seiners, lamparo vessels, pelagic trawlers and other large vessels also catch these species.

In addition to the difficulties in properly monitoring and assessing the landings of small tuna species, there is the issue of the correct identification of the various species (i.e. *Auxis* spp., *Katsuwonus pelamis*, etc.) and the failure to differentiate between several species. This can affect the fishery statistics either in terms of total catch by species or in the quality of the basic data, thus leading to the existing discrepancies among the various data sets on these species at the FAO (GFCM), ICCAT or EUROSTAT.

The accuracy of declared landings by Mediterranean countries is uncertain for several reasons, including misidentification of the species at landing or on the market, mixed catches, incomplete declaration of catches (i.e. bycatch), under-declaration of landings or non-reported landings.

These uncertainties could theoretically influence trends in catches of individual species, creating problems in understanding fluctuations in catches.

3.1 Main fishing techniques

The geographical position of the Mediterranean Sea, its mild climate, the temperate sea water, the well established communication with the Atlantic Ocean, make its water an ideal habitat, reproduction and transit area for a great number of fish species of economic importance. Tuna and tuna-like species (including small tunas) rank among the most significant. This has also been true for centuries for the Black Sea, even though the environmental conditions there are rather different and several dramatic changes have happened in recent decades. The fisheries targeting tuna and tuna-like species have provided subsistence and a way of life for millions of inhabitants of the Mediterranean area since very early ages.

Schools of various species of tunas appear at many locations along the Mediterranean in accordance with partially predictable time schedules. During March to June/July, a huge number of tunas pass through the Strait of Gibraltar into the Mediterranean or leave the deep waters and come near to the shore or in surface layers or traverse the Strait of Gibraltar into the Mediterranean to spawn. In the late summer or at the beginning of autumn some tuna species migrate from the Mediterranean to the Atlantic Ocean or from the surface to deeper waters. In spring, many small tuna (mostly bonito and bullet tuna) traverse the Dardanelles, the Sea of Marmara and the Bosphorus to the Black Sea, where they spawn from June to July. In September, bonitos appear again in the Sea of Marmara, apparently migrating back to the Aegean Sea.

These biological and ethological features have directly influenced the fishery of these species for centuries. A huge number of small vessels were always ready to go to sea, close to the shore, to catch feeding or spawning aggregations of small tunas whenever they showed up in suitable areas. In recent decades, after World War II, with the introduction of engines on board the opportunities to extend the fishing range were dramatically improved, allowing fishermen to increase the potential of their activities. More recent technology has resulted in the further strengthening of fishing capacity.It is important to remark, however, that the fishery of small tunas remains, with a very few exceptions, a typical artisanal activity.

Important landings occur at the time of concentration of those species; an example is provided by the bullet tuna fishery. Certain areas in the Mediterranean Sea have already been identified among

possible spawning grounds for *Auxis* spp.: Greece and the Gulf of Catania (Bellot, 1954), the Balearic Islands (Duclerc *et al*., 1974), Tunisian and Algerian waters (Postel, 1964) and off the Eastern Spanish Mediterranean coast (Macías *et al*., 2004), but the list is certainly incomplete. According to the spawning period in the basin, which has been reported to occur mainly from June to September (Ehrenbaum, 1924; Piccinetti *et al*., 1996; Alemany, 1997; Macías *et al*., 2006), most of the catches are reported in this timeframe by several fleets. Yearly variation of the spawning period, according to oceanographic features or climatic effects, have direct effects on this fishery, as well as for the distribution of the related trophic chain and the presence/absence of feeding or spawning aggregations close to various coasts.

In the Mediterranean and Black Seas, various gears, such as purse seines, small surrounding nets, trap nets, driftnets, gillnets and a variety of lines, including troll-lines, pole-lines, surface and mid-water longlines, and hand lines (Yesaki and Arce, 1984) are used to catch small tunas. Pelagic trawls, light fishing (lamparo) and fish aggregating devices (FADs) are also used to catch these species. The main fishing techniques used in Mediterranean and Black seas for the exploitation of small tunas are described in the following sections of the report.

3.1.1 Hooks and lines

This category includes a huge variety of gears, which havein common the fact that the fish is attracted by natural or artificial (lures) bait, placed on a hook fixed at the end of a line, on which they get caught. Hook and line units may be used singly or in large numbers. These gears are hauled by hand in small-scale fisheries while bigger vessels are usually provided with powered line haulers and automatic hook handling and baiting systems.

Pole and line or baitboats

A pole and line consists of a hooked line attached to a pole. This method is common to sport fisheries but is also used in commercial fisheries. Fishing rods/poles are made of wood (including bamboo) and increasingly of fibreglass. The technique has been described by several authors (Gobert, 1983; Portais, 1986). Fishing tunas by pole and line or baitboats consists of attracting and retaining the fish from a school with the aid of live bait thrown at sea, but this technique is not used in the Mediterranean or in the Black Sea for small tunas, while it was used in the past for albacore (*Thunnus alalunga*).

Pole and lines may be hand-operated or mechanized. They are used by commercial or sport fishing from any type of vessel and at all distances from the coast and at any depth.

Trolling lines

A trolling line consists of a line with natural or artificial baited hooks and is trailed by a vessel near the surface or at a certain depth. Several lines are often towed at the same time, by using outriggers to keep the lines away from the wake of the vessel. Each line can have one or more hooks, although it is usually one. The line is hauled by hand or with small winches.

Hauling trolling lines might be mechanized. Outriggers (made from wood or metal) should be light and reasonably flexible.

A number of lures or baited hooks are towed astern at an adequate speed, the fish being hooked after snapping at the lure and held by the mouth until they can be brought aboard as the line is hauled in. These lines are used either by professionals or recreational fishermen to catch small tunas and other pelagic species.

Handlines

This category includes a large variety of single lines equipped with various types of hooks, according to the target species, commonly used by small-scale or artisanal fishery, but also by recreational fishermen. In the case of the small tuna fisheries, hand lines are equipped with robust hooks, with natural or artificial bait. They can be used from an anchored vessel, from a drifting one (“dead lines”) or from a slowly moving vessel.

Longlines

Long-lining gets its name from the length of the lines that are commonly used. Longline fishing consists of mooring a main line in open water, kept near the surface or at a certain depth by means of regularly spaced floats and with relatively long snoods or branches with baited hooks, equally spaced on the mainline (Suzuki and Kume, 1982). Drifting longlines may be of considerable length. Some drifting longlines are set vertically, each line hanging from a float at the surface. The technique is also described by Woo Il Choo (1976), and Weeb (1973).

A longline for pelagic fishing is traditionally stored in pieces, in a series of baskets. More modern solutions have been developed to store the longline on a drum, to use spools for keeping buoy lines, etc. The baiting of hooks may be manual or by a baiting machine. Shooting machines are often used, but only for large tunas or swordfish. Longlines are set and retrieved every day. Longlines used to catch albacore or swordfish are reported to have a potential bycatch of several species of small tunas.

Longlines used to target small tunas (mostly bonito) are not very long and equipped with robust small-medium hooks, using sardines or anchovies as bait. They are used in areas not very distant from the coast.

3.1.2 Nets

Beach seines

A beach seine is a net operated from the shore. The gear is composed of a bunt and long wings lengthened with long ropes for towing the seine to the beach. The beach seine can be with or without a bag. The headrope with floats is on the surface, the footrope is usually in permanent contact with the bottom and the seine is therefore a barrier which prevents the fish from escaping from the area enclosed by the net. Demersal and pelagic species including small tuna are targeted by the beach seine. In past times it was used to catch various tuna species close to the coast, but now this gear is only rarely used for small tunas.

Because beach seining is used in waters close to the shore (in areas which are often spawning and nursery grounds), or over *Posidonia* meadows and lead frequently to the capture of juveniles, the use of beach seine in a number of countries is regulated, restricted or prohibited.

Encircling gillnets

They are gillnets set vertically in shallow waters, encircling fish. After the fish have been encircled by the net, noise or other means are used to force them to gill or entangle themselves in the netting. It is a technology commonly used by groups of small-scale fishermen. These nets are rarely used for small tunas.

Lampara nets

The lampara net is a surrounding net, with two lateral wings and a central bunt with small meshes to retain the catch. The leadline is much shorter than the floatline.

The net is usually used by a single, relatively small vessel. Once the shoal of fish has been surrounded the two wings are hauled up at the same time.

The principal impact produced by this net may be occasional bycatch/discards (undersize specimens, non-marketable specimens, non-target species, etc.), in particular when the lampara is used in association with aggregating devices (FADs). It is sometimes used for small tunas, particularly in the southern part of the Mediterranean.

Ring nets

The ring net is a surrounding net and its form is an intermediate hybrid between a purse seine and a lampara net: like a purse seine, rings at the lower edge of the net allow the use of a purse line to close it under the fish (pursing) and like a lampara net, there is a central bunt (with smaller mesh) where the capture concentrates as the two wings are hauled together.

Most ring net vessels work in cooperation with another vessel and this procedure helps to tow the net. When a suitable shoal of fish is located and both vessels are ready, the first vessel drops its marker light over the side and proceeds round one side of the shoal, setting out bridles and net. After the aggregated fish have been surrounded, the purse line is hauled for pursing/closing the bottom of the net. Then, the two wings are pulled on board at the same time and the fish concentrate in the central bunt. Finally, the catch is taken from the bunt, alongside the boat, by using a scoop net.

Vessels using ring nets are usually small and simple in relation to the equipment, and their length ranges between 12 to 24 meters length. All small/medium pelagic fish are targeted by this gear.

The potential negative impact may come from occasional bycatch/discards effects (undersize specimens, non-marketable specimens, non-target species, etc

Surrounding nets

A surrounding net has large netting walls set for surrounding aggregated fish, both from the sides and from underneath, thus preventing them from escaping by diving downwards. Apart from a few exceptions, these are surface nets. The netting wall is framed by lines: a floatline top and leadline at the bottom.

According to the type of surrounding net gear, specific equipment may be required, the main requirement being some facility for manoeuvring large to very large nets.

Vessels using surrounding nets can be included in the size ranging from <12 to >45 meters length.

Surrounding nets are the most important and most effective gears to catch aggregated pelagic species, including small tunas.

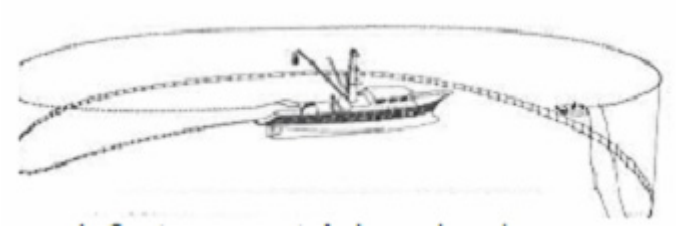
The increasing practice of encircling floating objects, including FADs, increases the capture of juvenile and immature fish aggregating around such devices.

Purse seines

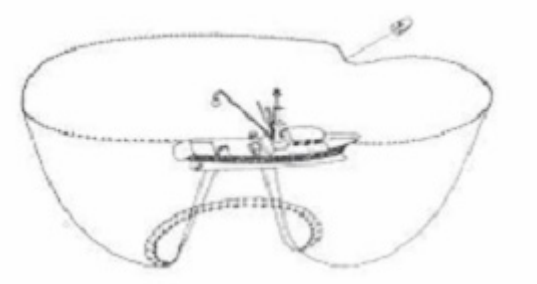
The purse seine fishing consists of encircling the school of fish located with a closing net which can be progressively reduced in volume. This technique was described by Neely (1962). The purse seines have a length between 800 m to over 1400 m and a drop of 60m to more than 200 m. The purse seines are made with a large single-panel multi-mesh size net, with a float rope and a foot rope. The foot rope has a steel wire running through the pursing rings, by means of which the bottom of the net is closed. The purse seiners used to catch tuna and tuna-like species are vessels with a length ranging from 15 to more than 40m and have a storage capacity between 18 and more than 350 tons. The power of their diesel engines varies from 300 to more than 2 000 hp. Vessels are equipped with a hydraulic crane with a multi-articulated and telescopic arm for loading the nets. A power block motor pulley is also installed on the crane.

The purse seiner circles the school of fish and eventually returns to the position of the skiff where it is recovered at the extremity of the net. Once circled, the purse line is hauled and this closes the net. The purse seine then forms an immense pocket with the bottom situated at around 70 – 90 m in depth. The skiff keeps the vessel outside of the net during its recovery and then fish concentrated in the pocked are loaded.

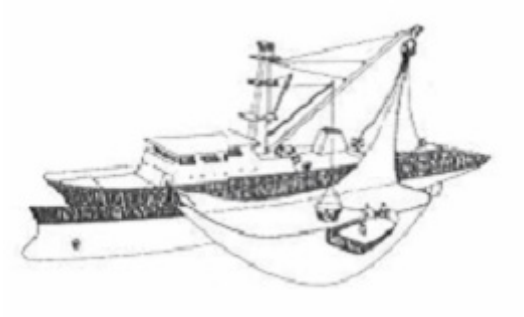
Purse seine fishery is the most diffused technique for catching tuna and it is used also for small tunas in some areas.



a – Launching the skiff and encirclement of the school



b – Closing the net and formation of the purse



c – Loading the content

Figure 33 – Various phases in the deployment of a purse seine

Pelagic trawl

The pelagic trawl (or midwater trawl) is a sort of long cone-shaped net, with a central bunt and two lateral wings, trawled by a powerful vessel in mid-water, at various depths. This net can be towed by one vessel or by two vessels working together (pair trawl).

Information about this fishery targeting small tunas in the Mediterranean and in the Black Sea is very limited. The small tunas are among the target catches of the pelagic trawling, which is mostly directed to schooling pelagic species (i.e.: mackerels, clupeids, etc.).

Trap nets

A relevant fishing method for tuna and tuna-like species, used since ancient times by the Phoenicians, Greeks, Romans and other ethnic groups, lies in the construction and operation of tuna traps. The first Mediterranean traps appear around 3 000–4 000 years ago (Fromentin *et al*, 2000) and, since the XV century, the most favourable locations along the migration routes of tuna have been well exploited throughout the Mediterranean Sea.

A tuna trap is a fixed passive gear that intercepts tuna and tuna-like species when swimming towards spawning or feeding grounds. Each surface net is provided with a float rope and heavily anchored by means of rope of about three times in length the bottom depth. The foot rope is equipped with lead, stones or iron chains, or various anchors attached along the lower edge of the net, thus maintaining ground contact. It is a net barrier going from close to the shore to off-shore at sea, sometimes for several miles. In the middle a succession of nets allowing the fish to concentrate in the last one called "chamber of death" or "copo". This chamber differs from the others because it has a horizontal net floor. The size of the mesh varies according to different parts of the trap net, it is about 50 cm for the land-side net and decreases progressively to reach 20 cm or less in the last chamber.

Dieuzeide and Novella (1953), defined the trap as follows: "if one does not take into account all its accessories, the trap-net looks like a massive box without bottom and cover. The upper part appears on the surface of the sea level and the lower part adapts to sea bottom. The sides are formed by vertical nets. The box is divided by transversal nets placed vertically in a certain number of compartments and chambers with different name in which the tuna is retained".

The trap is an obstacle for the tuna swimming along their course, they try to avoid it and get entrapped in the chambers. When there are enough fish in the last chambers, the fishers erect the dam, circle the fish and lead it towards the chamber of death. When all the fish are supposed to be in this last chamber, the upper bolt rope of the net is lifted and the bottom of the net is slowly lifted by fishermen. Once the bottom is almost on the surface the "Mattanza" (or "Matanza" in Spanish) takes place. It consists of loading, manually or with the aid of long-poled hooks, the fish on board the vessels set around the last chamber. The hauling is repeated once there is a suitable number of fish again and good weather conditions.

From an ecological point of view, the trap-net is an excellent example of an ecological fishing method for the following reasons:

1) it is a passive gear which does not increase its fishing effort over time;
2) it works in a limited period, 2 to 6 months;
3) its efficiency depends strongly on the weather conditions;
4) it has very low impact on bycatch species;
5) it allows the operators to release undesired species alive;
6) it allows for scientific tagging experiments on fish of various sizes;
7) it has a very limited environmental impact on the sea-bed.

In historical times there were hundreds of tuna traps set annually along all the Mediterranean coasts and even in the Black Sea. In Sicily alone there were more than 50 coastal tuna traps. Now the number of tuna traps has dramatically decreased, reaching its minimum level in the last centuries with a total of only thirteen active plants: one in Spain, one in Morocco, five in Italy, four in the Libyan Arab Jamahiriya and two in Turkey. The replacement of trap-nets by other techniques such as purse seine, longlines, etc. which are a less expensive method and which require a much smaller crew have probably contributed to the decline of the traps (Farrugio, 1981; Addis *et al*., 1997; Doumenge, 1998; Hattour, 2004, 2005). The increase in coastal traffic and pollution have certainly decreased the traps' efficiency.

Some of the remaining tuna traps mostly catch bluefin tuna, while a few are specialized in catching small tunas and other pelagic fish species. Among these the most famous is the tuna trap ("tonnarella") of Camogli, in the Ligurian Sea.

In **Spain** four traps are located in the Atlantic area in the south west part of the Iberian peninsula (Conil, Barbate, Zahara and Tarifa). All these traps target both bluefin and tuna-like species during their genetic migration towards spawning grounds. Only one trap (Ceuta) is located in the Mediterranean Sea. Only the traps located in Barbate and Ceuta catch tuna and tuna-like fish during feeding migration. In **Morocco,** fifteen traps are still set along the two maritime coasts (ICCAT, 2007). Fourteen are in the Atlantic and one is in the Mediterranean (Principé). These traps deal with different phases in the migration of tunas, the Atlantic traps are drawn from April to June, targeting genetic tunas, while Mediterranean one targets fish during both genetic and trophic migration; it is drawn during a more extended period, from April to October. In **Tunisia**, where trap-net fishing has been practiced since Phoenician times (Plusquellec, 1956), there are no more active plants. The last two traps (Sidi Daud and Kuriat) ceased fishing in 2002. In t**he Libyan Arab Jamahiriya**, there are the last four trap-nets (Gazira, Zreg, Zeletin and Garbulli), and they mostly target large tunas. In **Italy**, five trap-nets are still active: Isola Piana, Cala Vinagra, Porto Paglia, Favignana and Camogli; the last one only targets fish species other than bluefin tuna.

The tuna traps along the Mediterranean coasts catch several species other than the bluefin tuna, particularly swordfish and small tunas, like little tunny (*Euthynnus alletteratus*), Atlantic bonito (*Sarda sarda*) and frigate tuna (*Auxis rochei*), among others of minor importance.

Drifting gillnets

Drifting gillnets or driftnets consist of a string of gillnets kept more or less vertical by floats on the upper line (head-rope) and weights on the lower line (ground-rope); the hanging ratio is variable, depending on the target species. These nets drift with the currents, usually near the surface or in mid-water; sometimes linked to the operating vessel by a rope. Mesh size, thickness and material

(polyamide multifilament or nylon monofilament) of the net tissue also depends on the target species. The method of capture is by gilling or entangling (Figure 34) and driftnets are considered highly size-selective for the target species. The most frequently reported length range is from 500 to more than 8 000 m; the drop is between 12 and 30 m.

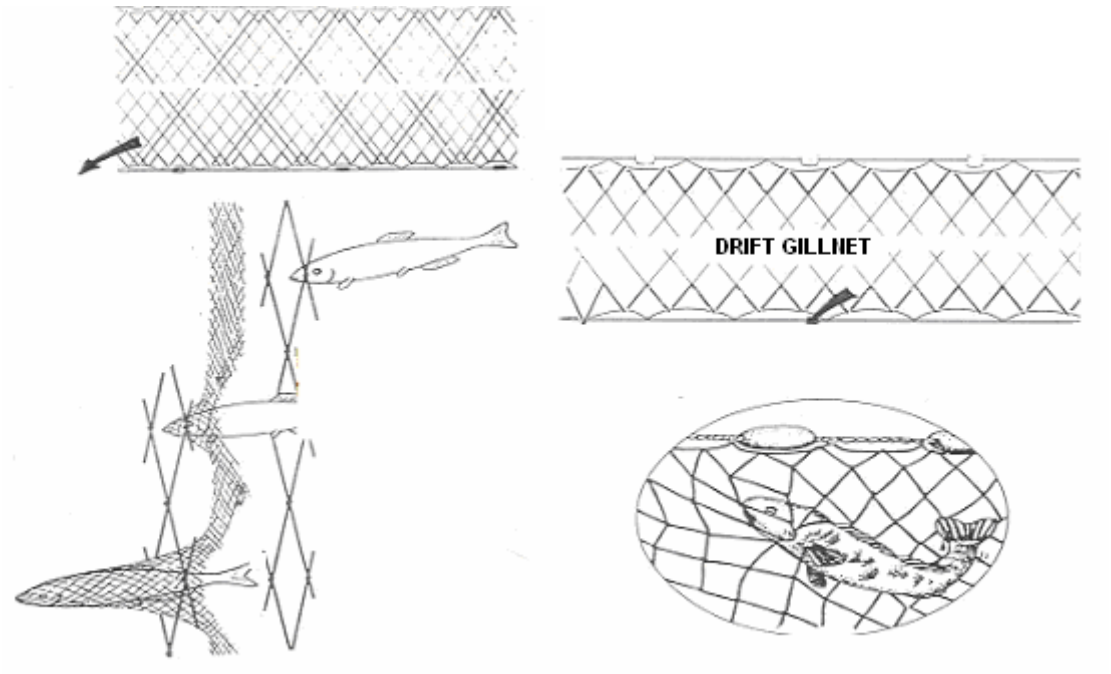
Net haulers are usually employed for setting and hauling driftnets. The drifter capstan on the forepart of the vessel is typical for driftnet vessels. In some countries mostnets are usually hauled by hand.

The driftnets are generally deployed at night, so that catch can be gathered early in the morning; twilight and sun rise are the ideal moments for a good catch. These nets are set up in a zig-zag manner, in the direction of the wind, taking into account the main direction of the current. This drifting barrier is invisible at night for most of the marine animals and this is why catches decrease according to the intensity of the moonlight. The CPUE depends upon the moon phase, the currents, the weather conditions, the main target species, and the ability of the fishers.

In the Mediterranean, as in the other areas, this fishing gear targets pelagic fish. Various types of drifting nets target small pelagic fish (mackerels, bogues, sardines, etc.), small tuna species (i.e.: *Auxis* spp., *Sarda sarda*, *Euthynnus alletteratus*) or specifically swordfish or albacore. The traditional driftnet fishing activity for large and medium pelagic species usually takes place from late April to the first part of August, but other driftnet fisheries are active for a longer period of the year and particularly in autumn for the small tunas.

The major problem for the use of this gear in the Mediterranean has been caused by the bycatch of some protected species (marine mammals and turtles) in the driftnet fishery for swordfish. As a consequence, several regulations have been issued by the competent authorities (EC, ICCAT, GFCM and coastal States), banning this fishery for almost the all of the Mediterranean and Black Sea countries.

The very large number of driftnet vessels existing in the eighties and nineties were gradually dismissed or converted to other fishing activities. In spite of the existing legislation, several hundred driftnet vessels are still active in the Mediterranean Sea (RAC/SPA, 2003), illegally targeting mostly swordfish but also small tuna species.



Trammel Net Drift net

Figure 34 – Trammel and driftnet tecnique to catch a fish. The driftnets are also eble to entangle the fish, due to the type of tissue and the setting strategies

3.2 The exploitation of small tunas in the Mediterranean and the Black Sea

3.2.1 Introduction

The small tunas (little tunny, Atlantic bonito, bullet tuna, etc.) are essentially exploited by the small scale fisheries but also by bigger vessels or tuna traps. For the purpose of this chapter it was decided only to use the fishery statistics provided by the FAO for all the Mediterranean and Black Sea Countries. This choice is motivated by the fact that not all the Countries are members of the ICCAT or of GFCM and therefore it is supposed that the FAO statistics should cover the whole area. The recent data from Lebanon have been provided directly for this report.

Of course, it is well known that some discrepancies already exist among the various databases (FAO, GFCM, ICCAT, EUROSTAT), as reported in paragraph 4.0, but this fact cannot be solved or analysed in a short time, because it was in all probability caused by various factors and for some of them the solution not immediate.

The main problem is related to the confusion existing with the common names in some countries, where some of them refer to several species together, while others have the same name in different countries, but refer to different species. Furthermore, several species are sometimes landed or marketed together, making it extremely difficult to isolate the landing or catch data for each species.

This is the rationale behind the category “small tunas” or Thunnini (TUN) in some statistics; the problems which exist for *Auxis rochei* and *Auxis thazard* is another point and the ICCAT had issued the category FRZ for the two species combined or for catches belonging to the genus *Auxis* but without a clear classification.

3.2.2 Catch data and trends

The historical landings of small tuna are given in Tables 14 and 15, and in Figures 35 and 36. The reported total landings of all species combined increased from about 15 000 tonnes in 1950 to nearly 55 000 tonnes in 1957. Reported landings remained very variable until 1972 followed by a decline until 1978 then growth remained relatively stable at a mean value of approximately 25 000 tonnes.

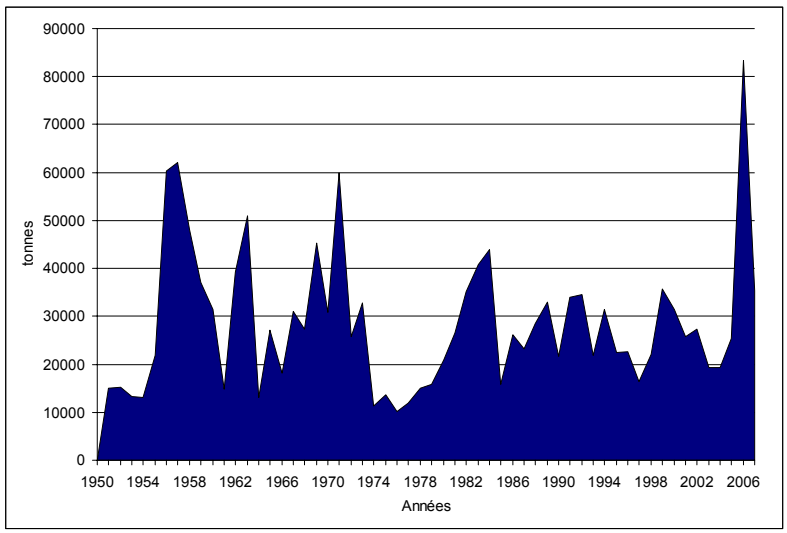


Figure 35 – Declared catches of small tunas combined in the study area from 1950 to 2006

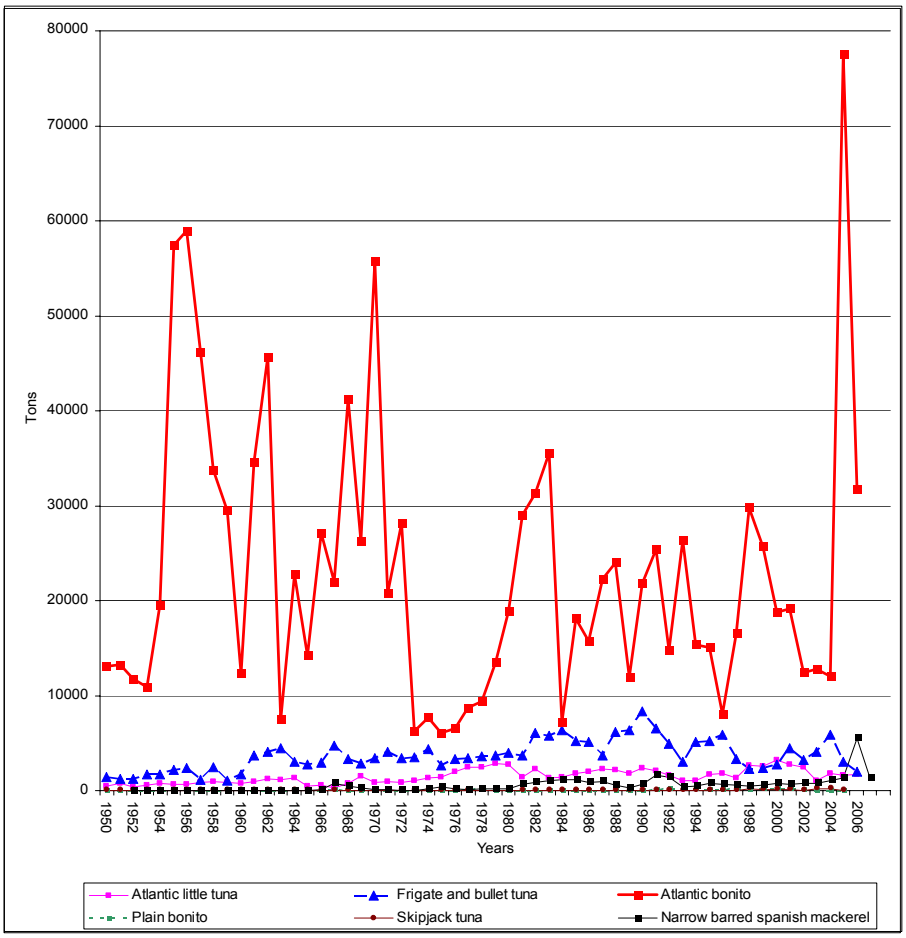


Figure 36 – Declared catches of small tunas by species in the study area from 1950 to 2006 (source FAO)

An exceptional landing was observed in 2005, due to an important declaration of catch data by Turkey. This resulted in a total declared catch of 83 386 tonnes in 2005, which is the highest value reported since 1950. Taking into account the fact than several countries are not reporting their catches and that the under-declaration is a logical consequence of scattered landings and the great difficulties in collecting good statistics, it is reasonable to suppose that total catches might be at a level of about 150 000 tons in some years.

The relative importance of those small tuna fisheries in the Mediterranean Sea officially accounts for about 25 percent of total reported catches of tuna and tuna-like species. Nevertheless, it is repeatedly noted by ICCAT/SCRS that uncertainties remain regarding the accuracy of reported landings in all Mediterranean and Black Sea countries.

Along with the uncertainties in total landings, as has already been mentioned in this study, further confusion exists for the species which make up these catches.

According to reported catches, the Atlantic bonito (*Sarda sarda*) constitutes the most important species landed by the Mediterranean and Black Sea countries with a percentage that varies between 55 percent and 96.5 percent of all small tunas combined. The bullet tuna, *Auxis rochei*, (together with catches reported as frigate tuna, *Auxis thazard*) is the second most important "species", showing a proportion varying from 2 percent to 32.7 percent of total catches. It should be noted that catches of *Auxis* spp. are known to occur in all Mediterranean countries, either as a target species for artisanal or recreational fishermen or as bycatch in several fisheries; as a consequence, it is reasonable to assume that the reported catches of *Auxis* spp. are greatly underestimated.

Table 14 – Catches of small tunas declared by country in the Mediterranean and in the Black Seas from 1950 to 2006. Catches in 2006 are incomplete (Source FAO)

	Euthynnys alletteratus	*Auxis rochei* & *Auxis thazard*	*Sarda sarda*	*Orcynopsis unicolor*	*Katsuwonus pelamis*	Thunnini	
	Little tunny	Bullet tuna & Frigate tuna	Atlantic bonito	Dogtooth tuna	Skipjack tuna	Other tunas	
Year	LTA	FRZ	BON	DOT	SKJ	TUN	TOTAL
1950	456	1451	13083	0	0	0	14990
1951	751	1224	13313	0	0	0	15288
1952	414	1212	11727	0	0	0	13353
1953	544	1694	10895	0	0	0	13133
1954	730	1689	19536	0	0	0	21955
1955	656	2172	57407	0	0	0	60235
1956	694	2392	58978	0	0	0	62064
1957	822	1132	46127	0	0	0	48081
1958	947	2500	33722	0	0	0	37169
1959	811	1072	29522	0	0	0	31405
1960	713	1723	12330	0	0	0	14766
1961	924	3703	34559	0	0	0	39186
1962	1231	4090	45710	0	0	0	51031
1963	1118	4490	7526	0	0	0	13134
1964	1348	2994	22735	0	0	100	27177
1965	442	2791	14188	1	0	800	18222
1966	527	2932	27101	1	0	500	31061
1967	238	4761	22012	48	0	300	27359
1968	768	3278	41206	4	1	100	45357
1969	1535	2886	26268	3	0	100	30792
1970	899	3366	55712	3	0	0	59980
1971	918	4095	20738	7	2	31	25791
1972	881	3445	28182	6	0	222	32736
1973	1061	3549	6282	3	0	343	11238
1974	1304	4388	7710	7	0	183	13592
1975	1386	2644	6038	0	6	140	10214
1976	2028	3290	6499	0	0	143	11960
1977	2499	3409	8699	135	1	236	14979
1978	2497	3567	9419	153	0	210	15846
1979	2870	3707	13486	28	11	690	20792
1980	2774	3952	18870	0	0	879	26475
1981	1446	3678	29019	0	0	1067	35210
1982	2281	6043	31242	0	0	1152	40718
1983	1361	5820	35545	0	2	1167	43895
1984	1450	6337	7222	0	10	880	15899
1985	1840	5240	18128	9	13	912	26142
1986	1966	5077	15719	1	2	527	23292
1987	2244	3740	22320	26	13	256	28599
1988	2205	6126	23987	8	0	681	33007
1989	1835	6387	11954	7	0	1577	21760
1990	2417	8360	21786	37	0	1393	33993
1991	2123	6571	25436	101	0	405	34636
1992	1566	4901	14793	176	0	463	21899
1993	1066	3027	26345	252	2	770	31462
1994	1005	5123	15382	176	0	688	22374
1995	1694	5205	15071	115	43	536	22664
1996	1838	5909	8054	132	9	480	16422
1997	1349	3324	16521	227	4	551	21976
1998	2623	2297	29763	130	176	738	35727
1999	2586	2334	25655	217	53	645	31490
2000	3228	2763	18760	145	90	745	25731
2001	2753	4473	19154	154	77	724	27335
2002	2445	3222	12393	137	37	1015	19249
2003	1078	4038	12826	23	157	1288	19410
2004	1764	5832	12031	8	181	5540	25356
2005	1567	3029	77460	5	29	1296	83386
2006	1660	1960	31651				35271

As indicated by the proportion of reported catches, the little tunny, *Euthynnus alletteratus*, accounts for catches varying from 0.5 percent to 17.16 percent of the total. The plain bonito (*Orcynopsis unicolor*) and the skipjack tuna (*Katsuwonus pelamis*) each represent from 0 to about 1 percent of the total catches declared to FAO; for these last two species, it would be worthwhile to analyse the quality of the data in greater depth, in order to understand how far a possible misidentification of catches in some areas might affect the statistics.

Other small tuna species such as the Wahoo (*Acanthocybium solandri*), the West African Spanish mackerel (*Scomberomorus tritor*), but also the improbable king mackerel (*Scomberomorus cavalla*), the Dogtooth tuna *(Gymnosarda unicolor)* and the black skipjack (*Euthynnus lineatus*) are mentioned in Mediterranean and Black Sea waters among the small tunas and tuna-like fishes. No information related to landings is available for this study.

The narrow-barred Spanish mackerel (*Scomberomorus commerson)* is a Lessepsian fish. Four countries, Egypt, Israel, Lebanon and Algeria, have declared some landings of this species to FAO since 1964.

Atlantic bonito, *Sarda sarda*

The reported catches in the Mediterranean and Black Seas for the period 1950 to 2005 fluctuated between a minimum of 6 083 to a maximum of 77 460 metric tons per year. 2005 catches were exceptionally high, reaching almost 77 460 tonnes, mostly related to the catches reported by Turkey, which alone account for 70 797 tonnes, obtained from the Eastern Mediterranean and the Black Seas combined (FAO, 2007) (Figure 37 and Table 14).

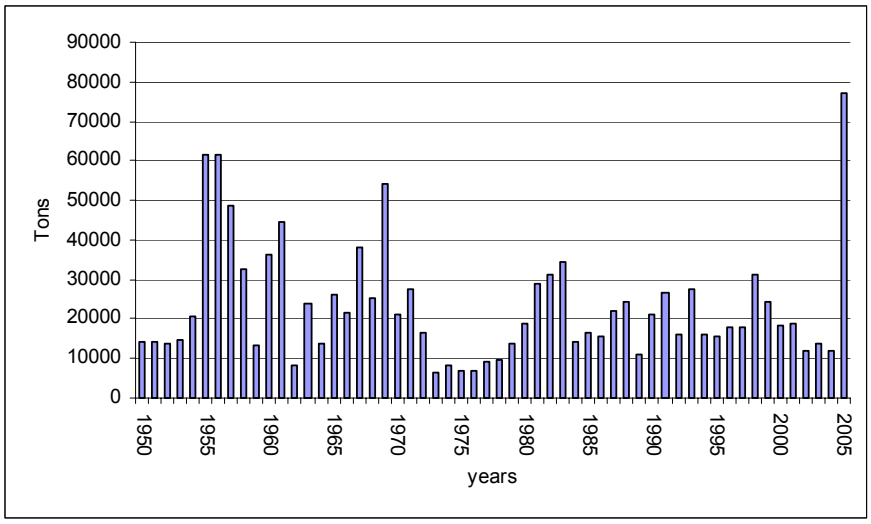


Figure 37 – Declared catches of bonito in the study area from 1950 to 2005 (source FAO)

According to the data, it would appear possible to identify periodic cycles for the fishery of this species over the last 55 years. A detailed analysis is necessary to define and understand these cycles better, and how they are linked to natural (environmental) factors or to other possible variables (fishery factors), or to several factors combined.

According to the catch data in the Mediterranean and Black Seas in the last decade, Turkey is the most important producer of Atlantic bonito with about 17 500 tonnes (96.5 percent in Black Sea), followed by Italy (1 907 tonnes), Greece (1 550 tonnes) and Morocco (1 500 tonnes) (Figure 38, Table 16).

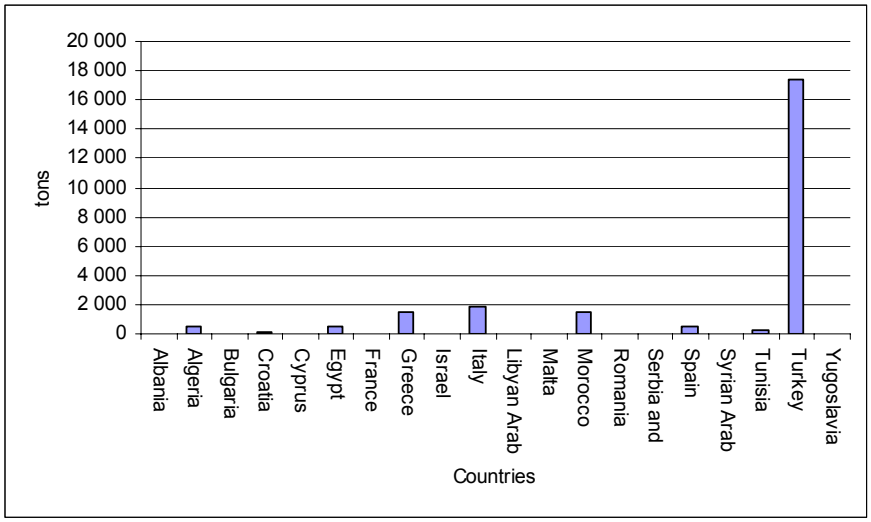


Figure 38 – Mean declared catches of Atlantic bonito by country in the study area from 1996 to 2005 (source FAO)

Auxids (bullet tuna and frigate tuna), *Auxis rochei* and *Auxis thazard*

The catch of Auxidae reported to FAO, taking into account the caution and the uncertainties mentioned in paragraph 3.2.2, is in the order of 1 000 to 2 000 tonnes per year from 1950 to 1960, after which it increased, reaching about 9 500 tonnes in 1990. Since then, the catch statistics show a decreasing tendency, reaching an average of about 4 000 tonnes. Only the catches in the year 2004 constitute an exception, with total nominal catches of about 11 000 tonnes, because of the reported Egyptian catches (Figure 39).

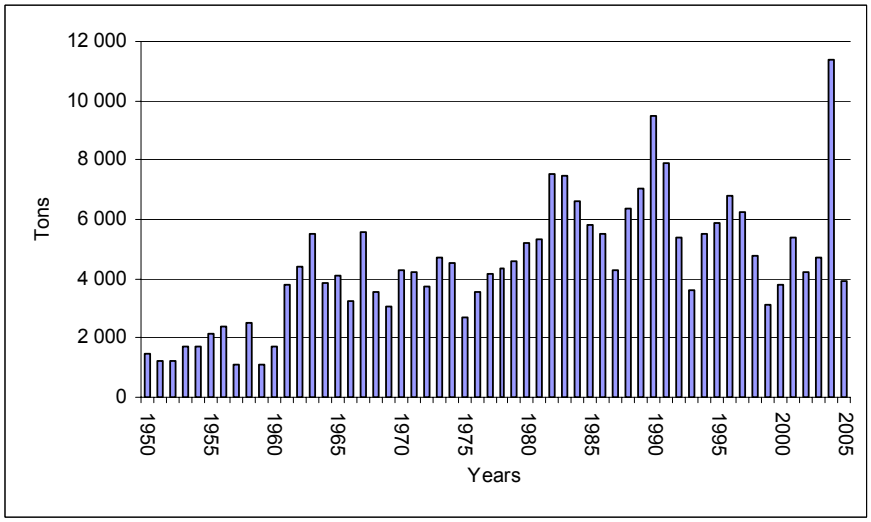


Figure 39 – Declared catches of frigate and bullet tuna in the study area from 1950 to 2005 (source FAO)

From the available data the identification of periodic cycles for the fishery of these species over the last 55 years would also seem possible.

According to the catch data from the Mediterranean and the Black Seas in the last decade, Morocco is the most important producer with approximately 1 433 tonnes, followed by Spain (829 tonnes), Egypt (802) and then Italy and Tunisia (with slightly more than 600 tonnes each) (Table 17, Figure 40).

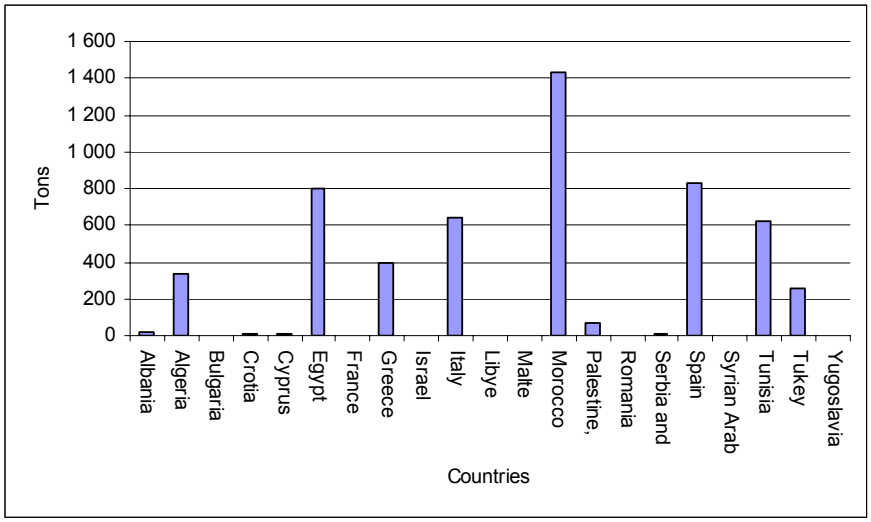


Figure 40 – Mean declared catches of frigate and bullet tuna combined by country in the study area from 1996 to 2005 (source FAO)

Little tunny, *Euthynnus alletteratus*

During the historical period considered (1950 to 2006), the reported catches of little tunny varied enormously (Table 14). There are three main phases: (i) 1950–1975 with a maximum of 1 250 tonnes and an average of 625 tonnes; (ii) 1975–1995 with a maximum of 2 250 tonnes and an average of 1 100 tonnes and (iii) 1995–2005 with a maximum of 5 500 tonnes and an average of 2 500 tonnes. (Figure 41).

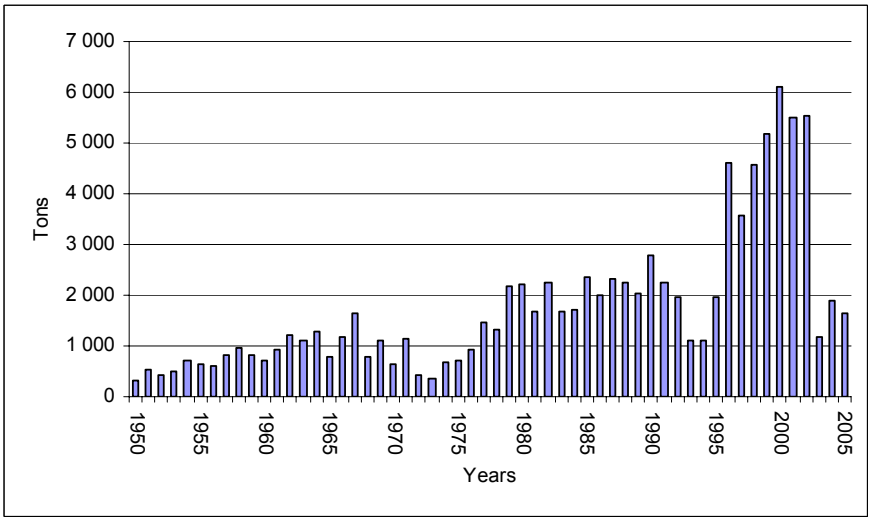


Figure 41 – Declared catches of Atlantic little tuna in the study area from 1950 to 2005 (source FAO)

According to the data, as with the species mentioned in the previous paragraphs, it seems that it should be possible to identify periodic cycles for the fishery of this species over the last 55 years, which is longer than for other small tuna species.

According to the catch averages in the Mediterranean and the Black Seas in the last decade, the largest catches have been declared by EC-France (1 636 tonnes), followed by Tunisia (835 tonnes), Turkey (457 tonnes) and Algeria (327 tonnes) (Table 18, Figure 42). These catches need to be investigated in greater depth, due to the possible misidentification of species, particularly in the Southern Mediterranean countries.

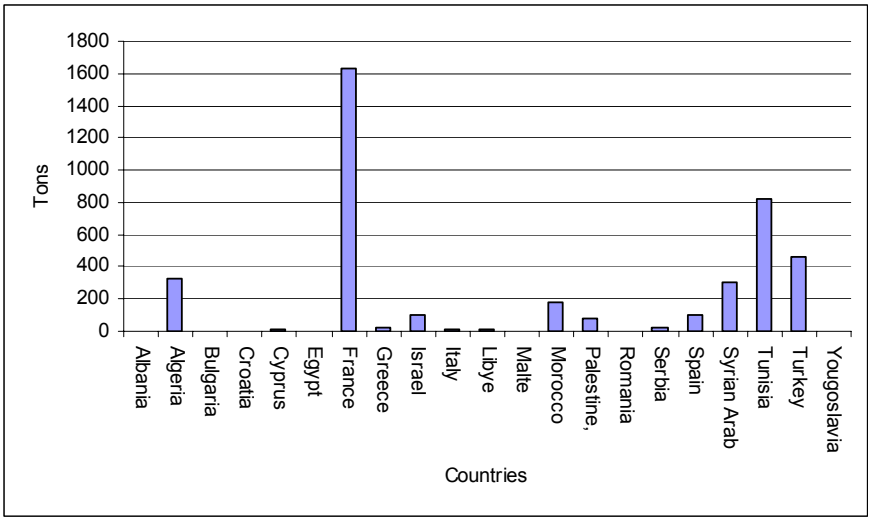


Figure 42 – Mean declared catches of little tunny by country in the study area from 1996 to 2005 (source FAO)

Narrow-barred Spanish mackerel, *Scomberomorus commerson*

During the historical period considered (1950 to 2006), the reported catches of narrow-barred Spanish mackerel varied from 31 to 1 340 tonnes with an increasing trend (Figure 43).

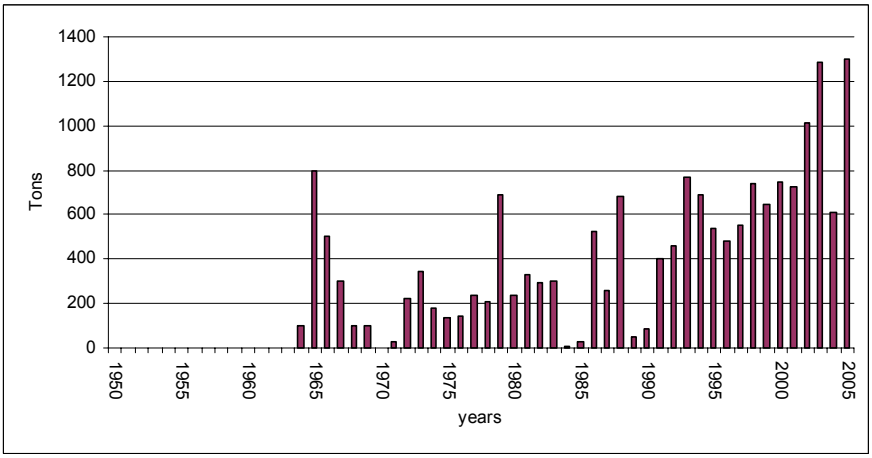


Figure 43 – Declared catches of narrow-barred Spanish mackerel in the study area from 1950 to 2005 (Source FAO)

Among all Mediterranean countries, only three declare their catches of this species (Algeria, Egypt, and Israel). New, unpublished information from Lebanon, provided for the purposes of this report, gives a rough idea about the catch of this species, with about 30 tonnes declared in 2007.

According to the catch averages in the Mediterranean in the last decade, the largest catches have been declared by Algeria (499 tonnes), followed by Egypt with (309 tonnes). Israel has not declared any catch since 1992. (Table 19, Figure 44).

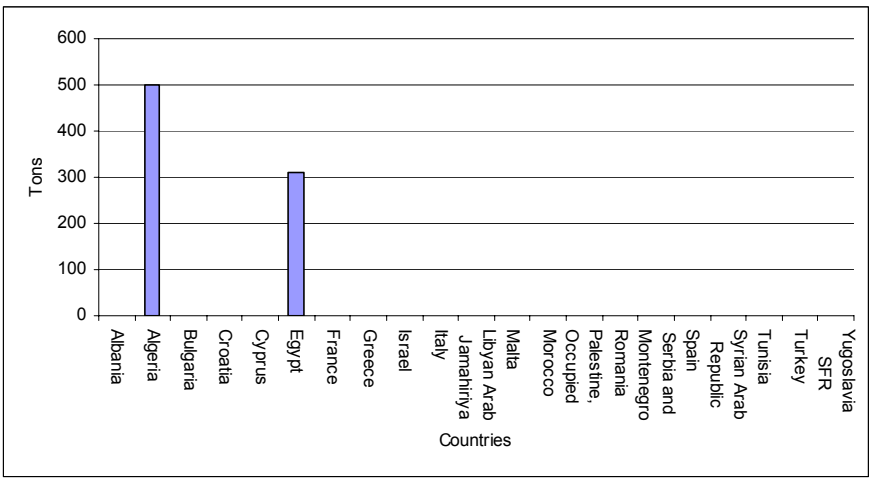


Figure 44 – Mean declared catches of narrow-barred Spanish mackerel by country in the study area from 1996 to 2005 (source FAO)

Plain bonito, *Orcynopsis unicolor*

On the basis of the available information, it seems there is no fishery directly targeting this species. Some catches are taken incidentally in Morocco, Algeria and Tunisia (Figure 46). The estimated Mediterranean catch from 1965 (first declared catch) to 2005 fluctuated between 1 and 252 tonnes (Table 20, Figure 45).

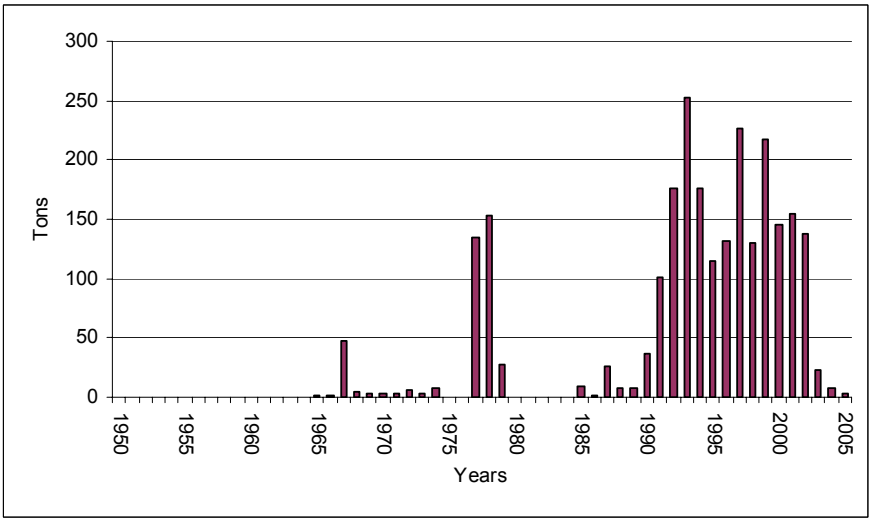


Figure 45 – Declared catches of plain bonito in the study area from 1950 to 2005 (source FAO)

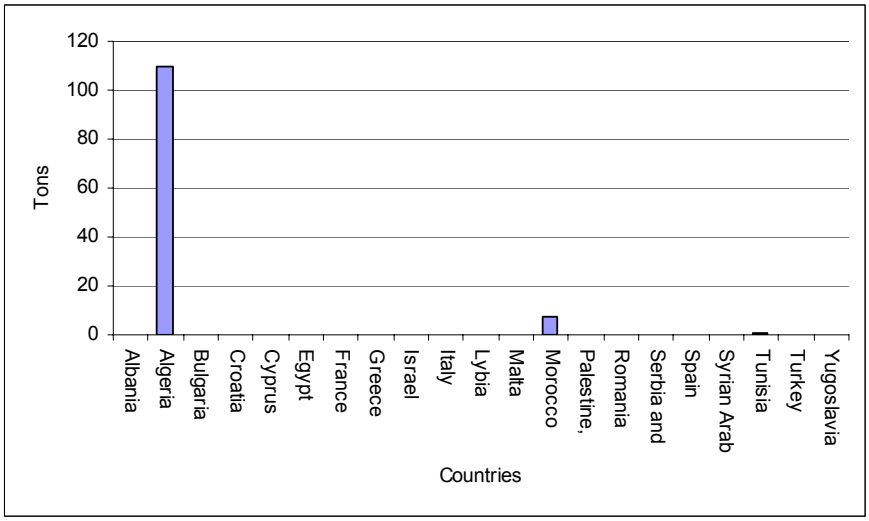


Figure 46 – Mean declared catches of plain bonito by country in the study area from 1996 to 2005 (source FAO)

Skipjack tuna, *Katsuwonus pelamis*

The FAO catch statistics for skipjack tuna in the Mediterranean and Black Sea area have only existed since 1968 (Table 14). The catches were in the order of 1 to 13 tonnes until 1994, then they increased abruptly from 40 to 181.5 tonnes until 2005 (Figure 47).

According to the catch averages in the Mediterranean in the last decade, the largest catches have been declared by Algeria (38 tonnes), followed by EC-Greece (20 tonnes), Italy (8 tonnes), EC-France (7 tonnes) and then EC-Spain and Morocco (with about 4 tonnes each) (Table 21, Figure 48).

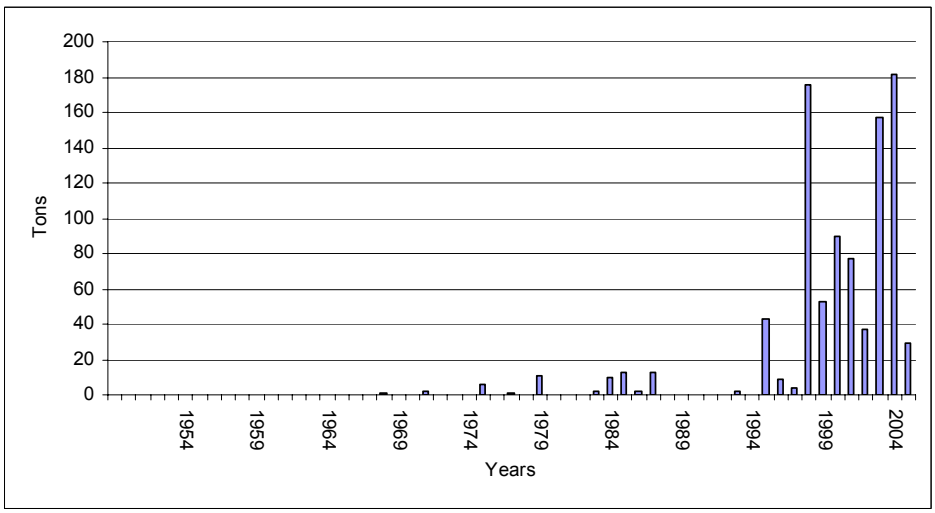


Figure 47 – Declared catches of skipjack tuna in the study area from 1950 to 2005 (source FAO)

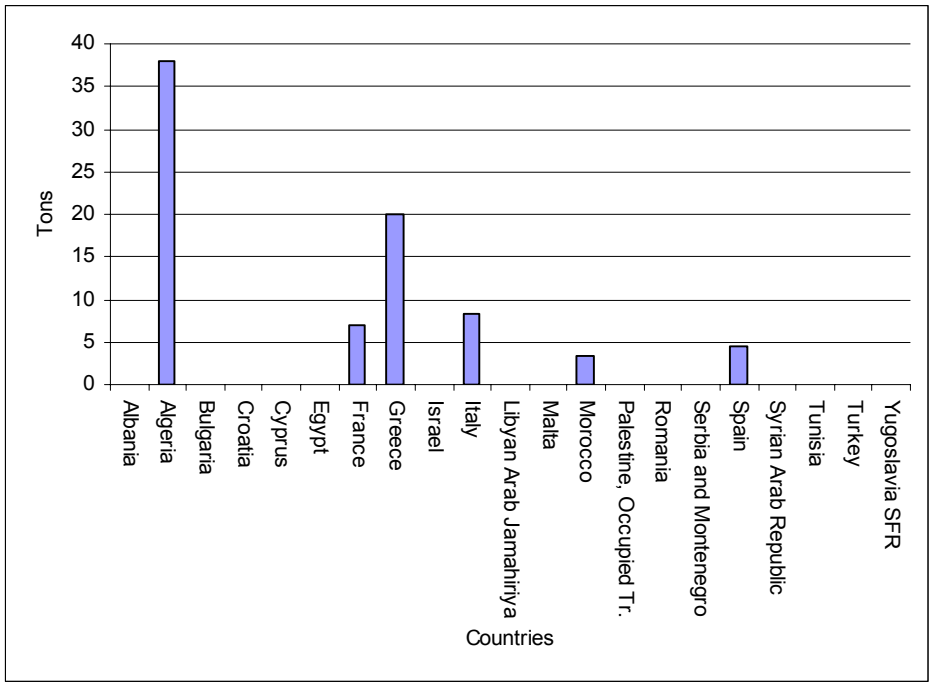


Figure 48 – Mean declared catches of skipjack tuna by country in the study area from 1996 to 2005 (source FAO)

Discussion on catches of small tunas in the Mediterranean and Black Seas

Small tuna catches in the Mediterranean and Black Seas show strong interannual variations, with some periodic cycles, for all the interval covered by the FAO statistics (1950–2005). Their average landings (31 600 tonnes) for the most recent period 2000–2005, in which statistics are almost complete, represent 2.1 percent of the halieutic production in the Mediterranean and Black Seas for the same period (1 478 630 tonnes). For the whole time series, landings vary from about 11 000 tonnes to 83 000 tonnes. Efforts to improve the quality of statistics have been strongly recommended by the scientific committees of the ICCAT (SCRS) and the GFCM (SAC).

Among all the species reported in the Mediterranean and Black Seas, namely little tunny (*Euthynnus alletteratus*), Atlantic bonito (*Sarda sarda*), bullet tuna (*Auxis rochei*), frigate tuna (*Auxis thazard*), plain bonito (*Orcynopsis unicolor*), wahoo (*Acanthocybium solandri*), West African Spanish mackerel *(Scomberomorus tritor*), and narrow-barred Spanish mackerel *(Scomberomorus commerson*), some species constitute the bulk of the reported catches, namely the Atlantic bonito, the little tunny and the bullet tuna, taking into consideration the questionable catches of what is declared as frigate tuna.

Three species are vagrant and they are sometimes reported in the Mediterranean: wahoo (*Acanthocybium solandri*), West African Spanish mackerel *(Scomberomorus tritor*), and narrow-barred Spanish mackerel (*Scomberomorus commerson*). Some other species appears in some fishery statistics, but their very uncertain presence might be due to misidentification: king mackerel *(Scomberomorus cavalla)*; dogtooth tuna *(Gymnosarda unicolor*), and black skipjack (*Euthynnus lineatus*).

The scientific community should intensify its efforts either to improve the existing statistics or the precise classification by species while also trying to obtain reliable correction factors to disentangle the category of "unidentified small tunas" which features in several data records.

Better statistics are necessary to understand the real situation in the Mediterranean and the Black Seas, in order to read the graphs more accurately and detect possible periodic cycles for each species. The lack of catch declaration in some countries is a problem that should be specifically addressed in the short term, because it is reasonable to assume that catches of small tunas take place in all the countries in the study area.

Table 15 – FAO catch statistics of small tunas declared by country in the Mediterranean and Black Seas from 1985 to 2006

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Albania	0	0	0	0	0	0	0	0	0	0	1	2	0	12	30	25	30	24	4	2	23
Algeria	880	459	203	625	1528	1307	1044	1305	1512	1336	1380	1187	1208	1493	1469	1348	1209	1354	1434	1158	1238
Bulgaria	1	0	13	0	0	17	15	12	8	0	25	33	16	51	20	35	49	0	23	18	56
Croatia	0	0	0	0	0	0	0	152	284	107	217	194	196	186	120	120	54	28	30	32	102
Cyprus	32	13	25	41	20	23	25	21	11	23	10	19	30	19	16	33	13	10	10	6	4
Egypt	62	68	35	17	358	598	574	518	640	648	697	985	725	724	1442	1128	1072	1416	784	706	963
France	0	0	0	10	0	1	18	9	6	0	1	0	0	0	0	0	28	49	47	35	8
Greece	2740	2427	3248	2654	3934	3934	4090	4090	4090	2981	3516	3178	2985	945	2135	2110	1675	1672	1886	1646	1682
Israel	259	284	273	135	124	129	108	126	119	119	215	119	103	73	90	113	70	40	76	189	89
Italy	2781	2781	3054	2851	1878	1738	1519	1593	2041	2359	2947	2462	5079	2375	2053	1331	1381	1215	3607	3900	2273
Libyan Arab Jamahiriya	0	0	0	0	0	0	0	111	110	0	0	0	45	52	0	5	4	4	0	0	0
Malta	1	13	5	8	18	21	28	12	18	9	10	8	16	8	5	2	7	4	5	9	9
Morocco	127	229	344	939	1212	2574	1372	1676	211	1842	725	1762	615	1200	821	889	270	695	353	413	99
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serbia and Montenegro	0	0	0	0	0	0	0	12	31	23	43	38	36	38	39	41	42	40	47	42	42
Spain	3104	2289	682	3636	3190	3697	2912	1438	848	1468	2119	3004	1241	835	1102	1374	1292	996	1039	1348	897
Syrian Arab Republic	95	73	121	99	121	127	110	156	161	156	155	270	350	417	390	370	370	330	280	114	114
Tunisia	2290	2632	2909	3096	2648	3586	2633	1342	1054	522	1123	397	970	2061	2147	2996	4519	3004	2497	3645	2166
Turkey	12809	11426	17333	18133	5008	14737	19645	8863	19548	10093	8944	10284	7810	24500	18966	13066	14526	7352	5999	6553	72324
The former Yugoslav Republic of Macedonia	49	71	78	82	144	111	138	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Small tuna	25230	22765	28323	32326	20183	32600	34231	21436	30692	21686	22128	23545	21425	34989	30845	24986	26611	18233	18121	19816	82089
Narrow-barred Spanish mackerel	32	527	256	681	49	86	405	463	770	688	536	480	551	738	645	745	724	1015	1288	609	1296
Total ST	25262	23292	28579	33007	20232	32686	34636	21899	31462	22374	22664	24025	21976	35727	31490	25731	27335	19248	19409	20425	83385

Table 16 – FAO catch statistics of Atlantic bonito (*Sarda sarda*) declared by country in the Mediterranean and Black Seas from 1985 to 2006

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Albania	0	0	0	0	0	0	0	0	0	0	1	2	0	12	30	25	30	24	4	2	23
Algeria	880	459	203	625	1 528	1 307	261	315	471	418	506	277	357	511	475	405	350	597	839	609	575
Bulgaria	1	2	13	0	3	17	15	12	8	0	25	33	16	51	20	35	49	0	23	18	56
Croatia	0	0	0	0	0	0	0	128	230	70	182	159	171	158	120	120	54	28	30	32	102
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0
Egypt	62	68	35	17	358	598	574	518	640	648	697	985	725	724	1 442	1 128	1 072	1 416	784	706	963
France	0	0 *0*	0 *0*	10	0	1	10	5	6	0	0	0	0	0	0	0	28	27	22	15	6
Greece	1321	1027	1848	1258	2534	2534	2690	2690	2690	1581	2116	1752	1559	945	2135	1914	1550	1420	1539	1321	1390
Israel	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	1437	1437	2148	2242	1369	1244	1087	1288	1662	1828	1512	2233	4580	2121	1614	1116	1006	944	2091	2009	1356
Libyan Arab Jamahiriya	0	0	0	0	0	0	0	71	70	0	0	0	0	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	2	7	2	2	1	1	0	0	1	1
Morocco	325	302	368	697	594	561	863	1099	1271	677	736	961	1304	1596	1510	2278	1705	2080	1013	1067	1449
Romania	32	92	3	255	136	8	212	84	0	0	0	0	0	0	0	0	0	0	0	0	0
Serbia and Montenegro	0	0	0	0	0	0	0	1	3	2	6	10	12	12	14	17	17	16	18	16	16
Spain	1 045	729	51	962	609	712	686	228	200	344	632	690	628	333	433	342	349	461	544	272	471
Syrian Arab Republic																					
Tunisia	482	504	500	600	422	488	305	643	792	305	413	560	611	855	1 350	1 528	1 183	1 112	848	1 251	1 666
Turkey	12809	11426	17333	18133	5008	14737	19645	8863	19548	10093	8944	10284	7810	24000	17900	12000	13460	6286	5999	5701	70797
The former Yugoslav Republic of Macedonia	34	38	62	36	98	79	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	16603	15580	22064	24235	11131	20979	26442	15945	27591	15966	15770	17948	17780	31320	24253	18267	18599	11883	13754	11769	77205

Table 17 – FAO catch statistics of bullet tuna and frigate tuna (*Auxis rochei* and *Auxis thazard*) declared by country in the Mediterranean and Black Seas from 1985 to 2006

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Albania	0	0	0	0	0	0	0	0	0	0	1	2	0	12	30	25	30	24	4	2	23
Algeria	0	0	0	0	0	0	174	270	348	306	230	237	179	299	173	225	230	481	588	391	547
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crotia	0	0	0	0	0	0	0	21	52	22	28	26	16	12	0 *0*	0	0	0	0	0	0
Cyprus	32	13	25	41	20	23	25	21	11	23	10	19	30	19	16	19	13	10	10	6	4
Egypt	32	68	53	16	49	86	144	112	299	270	30	203	194	227	170	340	374	418	449	4931	721
France	0	0	0	0	0	0	8	4	0	0	1	0	0	0	0	0	0	0	0	0	0
Greece	1419	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1426	1426	0	0	196	125	120	246	226	180
Israel	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	1344	1344	906	609	509	494	432	305	379	531	1435	229	499	254	439	215	375	251	1463	1819	866
Libyan Arab Jamahiriya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malte	1	13	5	8	18	21	20	11	10	1	2	3	6	6	3	1	1	0 *0*	2	8	4
Morocco	472	477	643	1005	1776	3497	2420	1976	444	1848	1266	2216	3176	3277	1176	1345	674	1062	430	868	111
Palestine	0	0	0	0	0	0	0	0	0	0	0	90	59	61	70	70	70	129	38	57	93
Romania	0	51	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serbia and Montenegro	0	0	0	0	0	0	0	1	0 *0*	0 *0*	2	6	6	6	7	8	9	8	9	9	9
Spain	2047	1555	631	2669	2581	2985	2226	1210	648	1124	1472	2296	604	487	669	1024	861	493	495	1009	352
Syrian Arab Republic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tunisia	367	538	606	588	660	985	985	35	20	13	14	13	26	93	45	15	2300	932	989	1760	1
Tukey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	316	316	316	316	0	284	1020
The former Yugoslav Republic of Macedonia	14	32	14	41	42	23	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5828	5491	4298	6377	7055	9514	7871	5366	3611	5538	5891	6766	6221	4753	3114	3799	5378	4244	4723	11370	3931

Table 18 – FAO catch statistics of little tunny (*Euthynnus alletteratus*) declared by country in the Mediterranean and Black Sea zone from 1985 to 2006

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algeria	0	0	0	0	0	0	522	585	495	459	552	554	448	384	562	494	407	148	7	158	116
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia	0	0	0	0	0	0	0	3	2	15	7	9	9	16	0	0	0	0	0	0	0
Cyprus	32	13	25	41	20	23	25	21	11	23	10	19	30	19	16	19	13	10	10	6	4
Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	0	0	0	0	195	0	74	13	8	54	59	2109	1981	1731	2438	2702	2681	2684	0	10	27
Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	132	0	0	112
Israel	335	284	273	135	124	129	108	126	119	119	215	119	103	73	90	113	70	40	76	189	89
Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	24	38	34
Libyan Arab Jamahiriya	0	0	0	0	0	0	0	0	0	0	0	0	45	52	0	5	4	4	0	0	0
Malte	0	0	0	0	0	0	8	1	8	8	8	3	3	0	0	0	5	4	3	0	4
Morocco	447	47	108	61	14	383	57	370	44	43	231	588	196	203	75	101	87	311	77	91	42
Palestine	0	0	0	0	0	0	0	0	0	0	0	90	59	61	70	70	70	129	38	57	93
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serbia montenegro	0	0	0	0	0	0	0	10	28	21	35	22	18	20	18	16	16	16	20	17	17
Spain	12	5	0	5	0	0	0	0	0	0	15	18	9	15	0	8	82	32	0	41	65
Syrian Arab Republic	95	73	121	99	121	127	110	156	161	156	155	270	350	417	390	370	370	330	280	114	114
Tunisia	1441	1590	1803	1908	1566	2113	1343	664	242	204	696	824	333	1113	752	1453	1036	960	657	633	496
Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	500	750	750	750	750	0	568	507
The former Yugoslav Republic of Macedonia	1	1	2	5	4	9	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2363	2013	2332	2254	2044	2784	2254	1949	1118	1102	1983	4625	3584	4604	5161	6101	5591	5566	1192	1922	1720

Table 19 – FAO catch statistics of narrow-barred Spanish mackerel (*Scomberomorus commersonii*) declared by country in the Mediterranean and Black Seas from 1985 to 2006

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algeria	880	459	203	625	1 528	1 307	261	315	471	418	506	277	357	511	475	405	350	597	839	609	575
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Egypt	32	68	53	16	49	86	144	112	299	270	30	203	194	227	170	340	374	418	449	4 931	721
France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Israel	0	0	0	40	0	0	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Libyan Arab Jamahiriya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morocco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Palestine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serbia and Montenegro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syrian Arab Republic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tunisia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
The former Yugoslav Republic of Macedonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand total	32	527	256	681	49	86	405	463	770	688	536	480	551	738	645	745	724	1015	1288	609	1296

Table 20 – FAO catch statistics of plain bonito (*Orcynopsis unicolor*) declared by country in the Mediterranean and Black Seas from 1985 to 2006

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algeria	0	0	0	0	0	0	87	135	198	153	92	119	224	128	216	135	145	128	0	0	0
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Israel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Libyan Arab Jamahiriya	0	0	0	0	0	0	0	40	40	0	0	0	0	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morocco	9	1	26	8	7	37	14	1	14	23	23	13	3	2	1	10	9	9	20	7	1
Palestine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serbia and Montenegro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Syrian Arab Republic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tunisia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3
Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
The former Yugoslav Republic of Macedonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand total	9	1	26	8	7	37	101	176	252	176	115	132	227	130	217	145	154	137	23	8	4

Table 21 – FAO catch statistics of skipjack (*Katsuwonus pelamis*) declared by country in the Mediterranean and Black Seas from 1985 to 2006

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algeria	0	0	0	0	0	0	0	0	0	0	0	0	0	171	43	89	77	0	0	0	0
Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyprus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	25	20	2
Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	99	0
Israel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	29	34	17
Libyan Arab Jamahiriya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morocco	13	2	13	0	0	0	0	0	2	0	43	9	4	5	10	1	0	1	1	2	1
Palestine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serbia and Montenegro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	26	9
Syrian Arab Republic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tunisia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
The former Yugoslav Republic of Macedonia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	13	2	13	0	0	0	0	0	2	0	43	9	4	176	53	90	77	37	157	181	29

3.2.3. Small tunas fishery characteristics by country in the Mediterranean and Black Seas.

This section of the report is limited to the small tuna fisheries for which there is information available by country, according to published reports, available grey literature or personal information provided by several scientists based in various countries.

Algeria

Generalities

At national level, the development strategy for the fishing of tuna-like species is based on the results of a national study carried out in the sector which has shown: (1) this fishery has existed since ancient times, (2) the predominance of the artisanal fishing method, and (3) the important social consequences of this activity. It is to be noted that the study was comprehensive for this sector, including the more relevant bluefin tuna fishery.

This study also resulted in an acknowledgement of the limits of this type of fishing, in particular the loss of profit in relation to the export of these products and to the socio-economic impact of modern fishing methods.

It should be noted that, in the past, the systems used for the collection of statistical data did not distinguish between tunas and other species. This did not facilitate the work of the scientists and researchers in monitoring and analyzing the results related to these fishery resources and has possibly resulted in biases in catch statistics provided to the regional fisheries management organizations (RFMOs) concerned. Changes that have been made to this general scheme are aimed at improving the reliability of the statistical data according to the recommendations of specialized regional and international organizations (FAO, ICCAT, GFCM, etc.).

Fleets and fishing methods

The catches of tuna and tuna-like species are obtained by a fleet composed of:

- 106 artisanal longliners (1 specialized tuna vessel)[2];
- 80 purse seiners (2 specialized tuna vessels)
- 11 trawlers.

There are many other non-specialized vessels, measuring from 6 to 24 m in length, equipped with engines from 9 to 500 hp. No distinction is made between vessels only fishing for tuna and those catching small tunas, besides the vessels >24 m listed in the ICCAT register.

Croatia

No data are available on the small tuna fishery in Croatia, while data on stock composition of Atlantic bonito in Croatian waters are included in chapter 3.1.2.

EC Bulgaria

No data are available on the characteristics of small tuna fishery.

EC Cyprus

Generalities

According to official statistics from Cyprus, the small tuna fishery mostly targets the Atlantic bonito and the Atlantic black skipjack. The correct identification of this species should be further investigated.

Fleet and fishing methods

The fishing is mainly carried out by trolling.

Fishing zones and seasons

The inshore fishery for small tunas takes place within the territorial waters of Cyprus. No more detailed data are available.

[2] There are also 12 chartered tuna longliners measuring 45 m.

Species caught

The small tuna species which occur in the waters of Cyprus were collectively reported as "tuna-like species" in the log records until 2002. Since 2003, they have been reported separately. According to some information, even Albacore (*Thunnus alalunga*) was sometimes included in the statistics before 2002.

EC France

No data are available on the characteristics of small tuna fishery, but these species are caught along the Mediterranean coast and in Corsica by a fleet of driftnets, called "thonaille".

EC Greece

Generalities

A national regulation specific to these species enforces a 3-month ban for all purse seiners (daylight and night).

Fleet and fishing methods

Small tunas in Greece are mainly caught by "daylight purse seiners" and secondly by certain types of gillnets (small-scale fisheries); hand lines are also used by small boats. As all or most of these vessels are multi-licensed (they can use several types of gears) and small tunas are fished opportunistically, the fleet is difficult to identify.

The small tuna fishery targets mostly *Auxis rochei*, *Sarda sarda* and *Euthynnus alleteratus* but catch statistics appears very weak, due to the difficulty in monitoring the landings.

Fishing zones and seasons

The main catch usually takes place in spring in Greek waters and concerns two species, *Sarda sarda* and *Auxis rochei*, caught by purse seiners and gillnets. Incidental catches of *Euthynnus alleteratus* in artisanal fisheries are reported in autumn.

Species in the Greek fishery

Bullet tuna is the main small tuna species marketed in Greece, followed by the bonito and then the little tunny. The real composition of the *Auxis* spp. landings is confused, because statistics sometimes include both *Auxis thazard* and *Auxis rochei* but it is strongly suspected that only one species is present. *Auxis* spp. is the bulk of small tuna catches of the daylight purse seiners, also caught incidentally by certain types of gillnets in small quantities. Generally, with the exception of Atlantic bonito, most of the small tunas are marketed together, making it difficult to estimate their catches by species. Existing estimates are based on self-reporting without any quality-control system.

EC Italy

Generalities

The small tuna fisheries in the Italian Seas are usually considered as marginal and the catches have sometimes been mixed-up together, making it difficult to discriminate among species and follow stable trends. Nevertheless, in several Italian areas this is a traditional fishery, particularly in the southern and eastern Mediterranean targeting the Atlantic bonito.

Auxis rochei and *Sarda sarda* are target species in several fisheries. Other catches, which might also be relevant in some cases, are obtained as bycatch from other fisheries, mostly in the swordfish and the albacore fisheries.

Fleet and fishing methods

The fleet directly targeting the small tunas is not well defined, because it includes small vessels for the most part (below 10 m length), which are not registered according to Italian regulations, and usually fall into the category "multipurpose". Furthermore, most of these vessels belong to recreational fishermen who seldom report their catches. The total number is estimated to be over 4 000 vessels.

The most relevant small tuna species in the Italian fishery, particularly *Auxis rochei* and *Sarda sarda*, are caught as bycatch in the swordfish and albacore fisheries, by driftnets and longlines.

The gears used are the following:

- for *Auxis* spp: hand lines, troll lines (including recreational fishery), pelagic gillnets (bycatch in pelagic longlines for albacore and swordfish as well as in driftnets);
- for *Sarda sarda*: pelagic gillnets, hand lines, troll lines also in sport fishery (bycatch in pelagic longlines for albacore and swordfish as well as in driftnets);
- for *Euthynnus alletteratus*: troll lines also in sport fishery (occasional bycatch in pelagic longlines for albacore and swordfish as well as in driftnets).

Other species can be unintentionally caught by several gears.

Fishing zones and seasons

In Italy the small tuna species fishery is distributed in all seas, with a higher concentration in the southern areas (southern Tyrrhenian Sea, Strait of Sicily, Ionian Sea, southern Adriatic Sea), mostly due to tradition. Atlantic bonito fishery is also an opportunistic activity; catches of Atlantic bonito are apparently more common in the southern areas, (central and southern Tyrrhenian Sea, Straits of Sicily), but relevant catches are also reported from the northern Tyrrhenian Sea, while minor catches are reported everywhere.

Catches of *Euthynnus alletteratus* are mostly concentrated in late spring and the beginning of summer (May, June, July), as bycatch of the swordfish fishery offshore; catches of *Auxis rochei* are usually in late summer and autumn (July, August, September, October) but they are also in the bycatch of other fisheries from April to July. *Sarda sarda* is usually taken in winter and spring (September–November and February–May), but its presence is quite variable and specimens are also caught in summer and, more generally, all the year round. *Sarda sarda* and *Auxis rochei* are often found in coastal waters, particularly in bays or where the continental shelf is narrow.

Most of the catches are obtained by small-scale and artisanal fisheries, with landings scattered all along the coastline, around small islands and in harbours. This increases the difficulties in getting precise landing statistics.

Due to the high mobility of the Italian fleet carrying out large pelagic fishery, where small tunas are a bycatch, it is quite difficult to identify the areas more precisely, besides those in national waters.

Species in the Italian fishery

The small tuna species reported in the Italian fishery are *Sarda sarda*, *Auxis rochei* (but reported catches of *Auxis thazard* do also exist, possibly due to a problem of misidentification), *Euthynnus alletteratus* and *Katsuwonus pelamis. Scomberomorus commerson* and maybe some specimens of other lessepsian migrants are occasionally present.

The occurrence and amount of the main species are reported in the previous sections 2.1.0. to 2.7.0.

Where the Tyrrhenian Sea and the Strait of Sicily are concerned, some catches were reported by Di Natale *et al*. (1992, 1995a, 1995b, 2001), while more detailed data for *Sarda sarda* were provided by Di Natale *et al*. in 2005. According to these data, the Atlantic bonito stock seems to be evenly distributed with small differences in size composition in these two large areas. The good catches reported in most of the Italian seas might imply a growing importance of this species, possibly correlated to favourable environmental conditions, where and when they occur.

Small tuna as associated species

The fishery exploiting multispecies concentrations of small pelagic fish, predominately of clupeids, generate a bycatch of small tunas and other pelagic species in the Mediterranean (Santamaria *et al*., 2005). The annual incidental catches of small tunas never exceed 5 percent of the total purse seine catches in the southern Italian seas. The species composition of small tuna bycatch showed that the Atlantic bonito*, S. sarda*, the little tunny*, E. alletteratus*, and the bullet tuna, *A. rochei,* represented the main species.

Observers' surveys on drifnets and surface longlines (Di Natale *et al*., 1992 and DCR 2004) confirmed the presence of these species as bycatch in swordfish and albacore fisheries.

EC Malta

No data are available on the small tuna fishery characteristics.

EC Portugal

No data are available on the small tuna fishery characteristics. The reported catches to ICCAT are taken as a bycatch in the surface longline fishery carried out by a few vessels in the Mediterranean waters.

EC Romania

No data are available on the small tuna fishery characteristics. During the period 1954–1960, *Sarda sarda* was the main species in offshore fishing in the Romanian Black Sea waters (99.8 percent in 1954 and 1955; 96.0 percent in 1956). In 1954, a total of 34 tons were caught in front of Sulina-St.Gheorghe branches; in 1955 and 1956 from June to August, the total amount reached 150 tons in the Portita-Constanta zone. In the following years the pollution in the Marmara Sea and in the Black Sea, together with possible overfishing, were the conditions which brought about a dramatic decrease of *Sarda sarda* in the Black Sea and in the Romanian fishery. No recent data are available.

EC Slovenia

No data are available on the small tuna fishery characteristics.

EC Spain

Generalities

Bullet tuna (*Auxis rochei*), little tunny (*Euthynnus alletteratus*) and Atlantic bonito (*Sarda sarda*) are the most abundant small tuna species along Spanish Mediterranean coasts. These species are commercially exploited by traditional fisheries and particularly by the small scale fishery (Sabatés and Recasens, 2001; Demir, 1963).

Fleet and fishing methods

Small tunas have traditionally been caught by Spanish seasonal coastal fisheries using several fishing gears as traps and other minor fixed gears, purse-seine and hand-lines (Uchida, 1981; Rey *et al*., 1984). Even small driftnets were used in Southern Spain to catch small tunas (Di Natale *et al*., 1992). No more detailed data on the fleet targeting the small tunas are available.

Fishing zones and seasons

Catches of *A. rochei* can be seasonally relevant, with maximum values in the warmest months (June to September), which is also the spawning period. In summer adults of this species migrate from the Atlantic to the Western Mediterranean, including the Catalan Sea, to spawn, making them available for fishery, but they cannot be found in the Catalan Sea during the colder months. Catches are usually low between November and June (below 5 tonnes) and indeed between January to March the species is not usually caught at all.

Sarda sarda is fished throughout the year by the Spanish fleet, although the main catches are still seasonal. The highest values are usually recorded in autumn and winter (September to March), values fall to minimum levels in spring and summer (April–July). This trend is specially marked in the northern part of the Spanish Mediterranean coast.

In the western and central Mediterranean the Atlantic bonito is mainly fished in coastal waters, but large specimens (60–85 cm FL) are sporadically present offshore. *Sarda sarda* is present all year round in the Catalan Sea, with the maximum catches from September to March and the minimum levels during the spawning period (May to July). According to the results of tagging programmes (Rey and Cort, 1978, 1981), it is clear that *Sarda sarda* moves across the Straits of Gibraltar, and this might be one of the reasons for catches of this species taking place year round in the area, possibly due to the mixing of two different stocks (Atlantic and Mediterranean) and to different spawning seasons in the two areas (Dardignac, 1962; and paragraph 3.2.0 of this report).

Species in the Spanish fishery

FAO fishery statistics include only three species of small tunas in the Spanish Mediterranean fishery.

According to Postel, (1973), the bullet tuna (*Auxis rochei*) is one of the most abundant small tuna species in the Spanish Mediterranean Sea, where it has been commercially exploited by seasonal artisanal fisheries for many years (Sabatés and Recasens, 2001). This species is abundant in the Strait of Gibraltar, along the Northern African coast and along the Spanish Mediterranean coast. In Spain, and is caught traditionally by seasonal coastal fisheries.

The Atlantic bonito (*Sarda sarda*) is present all along the Spanish Mediterranean coast and in the Balearic Sea, where there is one of the known spawning grounds for this species. It forms large mixed schools with other tuna species near the surface (Collete and Nauen, 1983).

The catches of this species have been studied for many years. Interesting data were provided by Rodriguez Roda (1966), studying the tuna trap fishery; these data, together with those already reported in the previous section 3.1.0., provide a good overview of the size distribution of the catch of *Sarda sarda* in the Spanish Mediterranean fishery, which also shows a similar distribution by sex (Figure 49).

The little tunny (*Euthynnus alletteratus*) also has a wide distribution and is caught in several Spanish Mediterranean fisheries.

Small tunas as associated species

Summary data are available about some Spanish fisheries which have a bycatch of small tuna species in the Mediterranean Sea. These data, related only to bluefin tuna and swordfish fisheries in the year 2000, were collected through the IEO Information and Sampling Network within the project FAO-COPEMED/2000, and are shown on Table 22.

Table 22 – Associated species to the Spanish fisheries of Bluefin tuna

Target species	Fishing gear	Associated species
Bluefin tuna (BFT)	Trap	*Sarda sarda* *Euthynnus alletteratus* *Auxis* spp. *Xiphias gladius*
Bluefin tuna (BFT)	Hand Bait boat Purse seine	*Sarda sarda* *Euthynnus alletteratus* *Auxis* spp. *Xiphias gladius*
Swordfish (SWO)	Longline hand boat	*Prionace glauca* *Isurus oxirynchus* *Sphyraena* spp. *Alopias* spp.

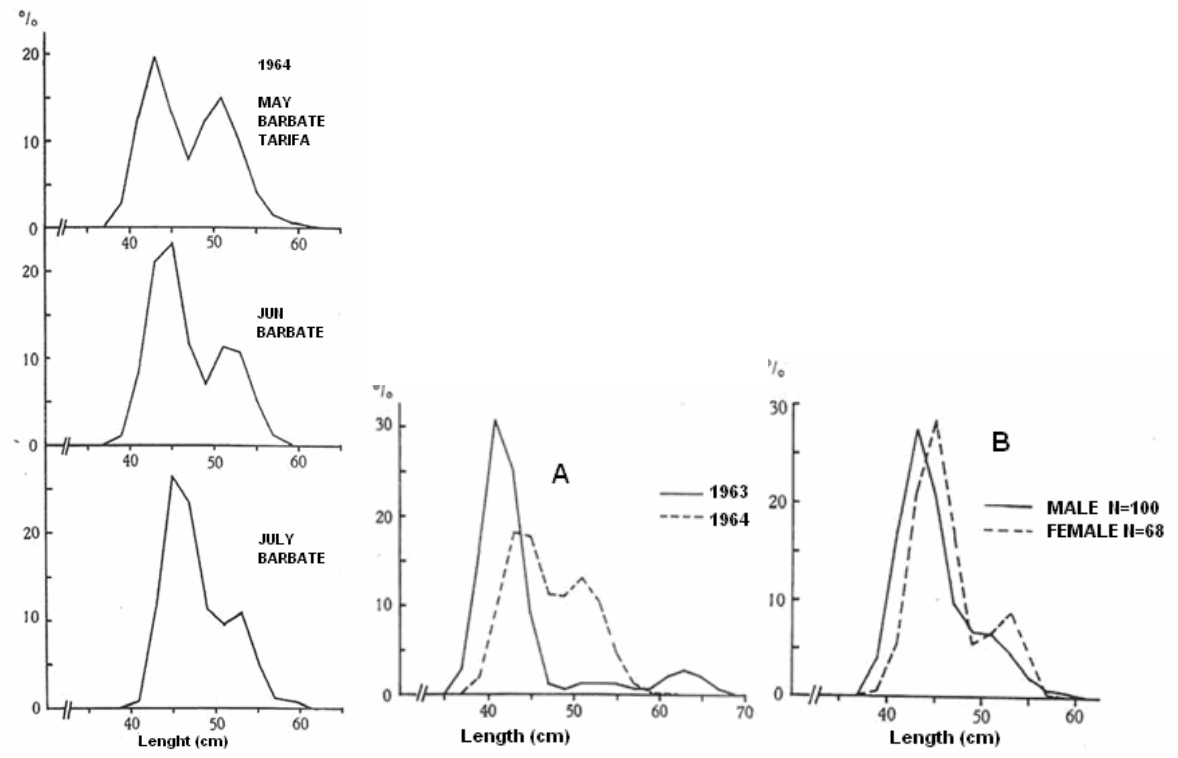


Figure 49 – Length/frequency distributions of *Sarda sarda* in Spanish waters in the tuna trap fishery in 1964 (left) and mode distribution by year and sex (centre A and right B) (Rodriguez-Roda 1966)

EC United Kingdom (Gibraltar)

No data are available on the small tuna fishery characteristics, if any exists.

Egypt

No data are available on the small tuna fishery characteristics.

Israel

No data are available on the small tuna fishery characteristics.

Japan

No data are available on the small tuna fishery characteristics. Some catches are reported to ICCAT, taken as a bycatch in the surface longline fishery targeting bluefin tuna in the Mediterranean Sea.

Lebanon

Few data on small tunas are present in the fishery statistics for Lebanon. Some more detailed data were provided for this report about the catches of *Sarda sarda*, *Euthynnus alletteratus* and *Scomberomorus commerson* in 2005, 2006 and 2007.

The level of unofficially reported catches is reported in Table 24, but more detailed studies are necessary to define quality and quantities better.

Table 24 – Unofficial catches of small tuna species in Lebanon

Species	ICCAT code	2005 tonnes	2006 tonnes	2007 tonnes
Sarda sarda	BON	59.7	51.3	233.4
Euthynnus alletteratus	LTA	0	136.7	61.1
Scomberomorus commerson	COM	0	6.2	30.2

Libyan Arab Jamahiriya

Generalities

Tuna and tuna-like species, including small tunas have been important components of the Libyan fishery since historical times and they represented a well-established tradition, particularly along the western coast during late spring and early summer (El-Tawil and Gashti, 1998) until a few years ago. These species are caught when large schools swim close to the coast, travelling eastward up to Misurata, during their movements related to migration or spawning behaviour during late spring and early summer (El-Tawil and Gashti, 1998) (Anon, 1976; Zupanovic and Mujahid, 1983; Secor *et al*., 1997).

The tradition to catch tuna and tuna-like species is also linked to the use of tuna traps, that were quite frequent along the Libyan coast, reaching a maximum of twenty in the 1930s. (Anon 1976; Piccinetti and Omiccioli 1998). The last tuna trap, also able to catch *Euthynnus alletteratus*, was in Zreg and it was closed down in 2001.

Fleet and fishing methods

Small tunas were traditionally caught by tuna traps in the Libyan Arab Jamahiriyan, but the last one ceased to be operational a few years ago. At the moment, according to unofficial information available, catches are obtained mostly by the small-scale fishery, using hand lines and occasionally gillnets. There is no information available about the characteristics of the fleet.

Fishing zones and seasons

The bulk of the small tuna catches is obtained along the western Libyan coast, particularly in spring and Summer. No more detailed data are available.

Species in the Libyan fisheries

Three species of small tunas seem mostly present in the Libyan fishery: *Euthynnus alletteratus*, *Sarda sarda* and *Orcynopsis unicolor*, even if other species, including some lessepsian migrants, are known to occur occasionally. *Scomberomorus commerson* is also frequently caught.

Some interesting statistics are available for *Euthynnus alletteratus* caught by the tuna trap in Zreg from 1930 to 1999: the catches showed an increasing trend from 1930 up to 1970 (Table 23 and Figure 50), with the best production period from 1960 to 1970. Then, a decreasing trend is quite evident until the last available data.

Table 23 – Historical catch of *Euthynnus alletteratus* from Zreg tuna trap (Libyan Arab Jamahiriyan)

Year	No. of fish	Year	No. of fish
1930	250	1965	8 628
1931	4200	1966	9 729
1932	358	1967	3 669
1933	6000	1968	12 508
1934	8239	1969	7 068
1935	2700	1970	12 210

Year	No. of fish	Year	No. of fish
1936	4000	1971	1 622
1937	11200	1972	8 579
1938	5670	1973	7 568
1939	7521	1974	3 460
1940	12620	1975	5 715
1941	3600	1976	6 675
1942	5780	1977	8 682
1943	9337	1978	2 429
1944	13605	1979	4 559
1945	–	1980	3 600
1946	–	1981	4 239
1947	9216	1982	2 314
1948	7654	1983	4 520
1949	10286	1984	2 877
1950	3728	1985	1 510
1951	16720	1986	1 492
1952	5680	1987	3 215
1953	8359	1988	2 970
1954	4382	1989	4 729
1955	8756	1990	2 575
1956	12210	1991	1 815
1957	11560	1992	2 300
1958	4567	1993	1 250
1959	9423	1994	2 500
1960	2920	1995	3 120
1961	9340	1996	900
1962	6973	1997	1 600
1963	15207	1998	1 920
1964	11216	1999	2 179

Small tuna as associated species

The only available information for the Libyan fishery concerns, once more, the tuna trap. According to the historical data reported so far, 8.6 percent of the catch was related to small tuna species.

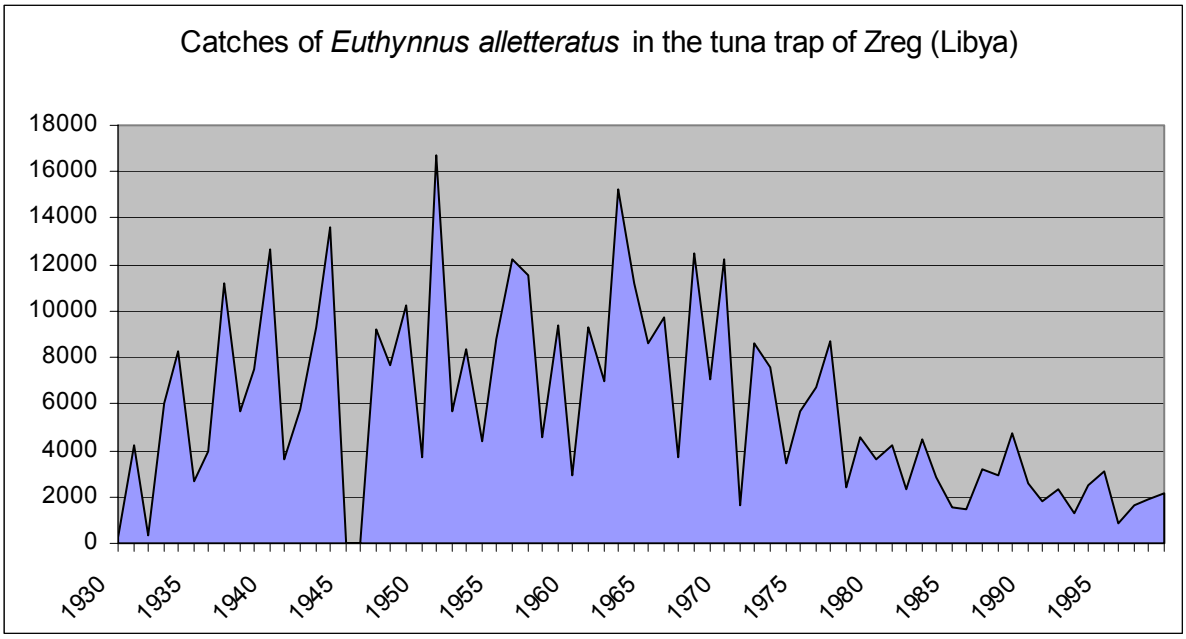


Figure 50 – Catches (in number of fish) of *Euthynnus alletteratus* in the tuna trap of Zreg in the Libyan Arab Jamahiriyan from 1930 to 1999

Monaco

No data are available on the small tuna fishery characteristics.

Montenegro

No data are available on the small tuna fishery characteristics. Previous catches (BON, LTA and FRI) were reported as the former Serbia and Montenegro.

Morocco

Generalities

The Moroccan maritime fishing sector is very active and continues to contribute towards financing the national economy. Tuna and tuna-like fishing is an important component of this sector due to the volume of investments, its development (mostly related to the bluefin tuna fishery), is monitored by the authorities and constitutes a multi-disciplinary activity that starts with artisanal fishing and extends to industrial activities.

Moreover, Morocco's geographic and climatic characteristics make it an area where pelagic species must pass should they migrate between the Atlantic and Mediterranean and where fish movements are always noteworthy.

Fleet and fishing methods

Small tunas are caught by small boats along with other tuna species, mainly by artisanal vessels and coastal longliners. Small tunas are found in the landings of the artisanal and coastal fishing vessels at all the ports of the Kingdom of Morocco.

Tunas and tuna-like species are mainly caught by four fishing methods:

a. Trap: one trap is set in national waters in the Mediterranean, it is not permanently operative. This gear targets mainly bluefin tuna and small tunas.
b. Hand line: this gear is used primarily by an important community of artisanal fishers that have a fleet of hundreds of artisanal vessels (less than 7 m length and < 2 t GRT). This fishing activity targets large-size bluefin tuna but catches of small tuna species are also reported.
c. Purse seine: this fishing technique is mostly directed towards species other than tunas, but the bycatch of small tuna species is not rare, even if these are not target species.
d. Drifnet: this fishing gear usually targets swordfish, but bycatch of small tunas is not uncommon. The fleet using this gear consists mostly of "longliners" (due to the shape of the vessel and to the fact that they can also use longlines) and the majority of these are small-medium size vessels (14–16 m LOA).

Fishing zones and seasons

Small tunas (Atlantic bonito, bullet tuna and skipjack tuna) are usually fished off the Mediterranean coast of Morocco. The major landing ports of tuna and tuna-like species are Tangier, M'diq, El Hoceima, Nador and Ras Kebdana in the Mediterranean

The hand line fishery is carried out practically the entire year round, except for a few months, while traps are active from April to July.

Species in the Moroccan fishery

The major small tuna species caught by Moroccan fishers are skipjack, Atlantic bonito and frigate tuna, while other species can incidentally appears in the fishery.

Small tuna as associated species

The only available information concerns the Moroccan swordfish fisheries with drift gillnets in the port of Tanger. These data show that the bycatch in this fishery consists mainly of small tunas, such as the bullet tuna (*Auxis rochei*), skipjack tuna (*Katsuwonus pelamis*), Atlantic bonito (*Sarda sarda*), little tunny (*Euthynnus alletteratus*) and plain bonito (*Orcynopsis unicolor*) (FAO/COPEMED/2000). The less abundant species are included as "other" in Table 25.

Table 25 – Bycatch in swordfish fishery with drift gillnet in Tanger, Morocco (year 2000)

Month	SKJ	BON	LTA	FRI	BUM	BFT	Others
1				0	0	0	252
2		192		0	0	18	461
3			247	1820	0		2210
4			140	290	0		5604
5			0	1625	360		6450
6			0	240	1122	70	2729
7			415	0	702		5025
8	700		0	0	10454		12144
9			830	885	24152		9550
10			640	0	9148		9756
11			370	0	2100		4339
12			454	0	44		861
Total	700	192	3096	4860	48082	88	59381

Palestine

No data are available on the small tuna fishery characteristics.

Russian Federation

No data are available on the small tuna fishery characteristics. Some catches of small tuna species were previously reported for the Black Sea as the former U.S.S.R.

Syrian Arab Republic

No data are available on the small tuna fishery characteristics.

Tunisia

Generalities

The tuna and tuna-like species fisheries are among the most important species fished along the Tunisian coast. They occupy an important place in the economy and have a high market value and tunas constitute a preferential product for the export market.

Four species of small tunas are fished throughout the year, with peaks of landings during the hot season. These species are also favoured by the Tunisian consumers. The plain bonito and the Atlantic bonito are the most sought after and their commercial value is up to four times those of the bullet tuna and the little tunny.

Fleet and fishing methods

In Tunisia the fishing gears used to catch small tuna species are mainly purse seine and surface longline. Small tunas can be taken as occasional catch or as a bycatch by gillnets, lampara, pelagic trawls and longlines. The traps, which were the major gear for catching bluefin tuna and small tunas, have been abandoned since 2003.

No data are available on the fleet concerned by the small tuna fishery.

Fishing zones and seasons

In Tunisia purse seiners target mainly bluefin tuna, but small tuna species are a secondary target in this fishery all along the Tunisian coast. Purse seine vessels are active from March to October off the Tunisian coast, mainly in the gulf of Gabès and close to the Tunisian-Libyan border.

Species in the Tunisian fishery

The most important small tuna species caught by Tunisian fishers are the little tunny (*Euthynnus alletteratus*), the bullet tuna (*Auxis rochei*), the Atlantic bonito (*Sarda sarda*) and the plain bonito (*Orcynopsis unicolor*). Other minor species are caught incidentally, including lessepsian migrants.

Besides the data reported in the previous sections 2.1.0. to 2.7.0, additional information is available for an improved definition of the catches of some species.

Where *Euthynnus alletteratus* is concerned, it should be noted that the large specimens caught in the past (FL of 110 cm, the maximum in the Mediterranean Sea) are becoming progressively rarer. This might be the effect of a prolonged, significant fishing effort, particularly during the genetic migration (Hattour, 2000). Looking at the catch data by age classes in the two tuna traps of Sidi Daoud and Monastir over the period 1950–1997 (Table 26 and Figures 51 and 52), the reduction of older specimens is quite apparent.

Table 26 – Distribution of captures of *Euthynnus alletteratus* by age in Tunisian traps (Hattour, 2000)

		Age	I+	II+	III+	IV+	V+	VI+	>VII	Total
1950	Sidi Daoud	N	205	15278	3861	5188	4391	1858	0	30781
		%	0,7	49,6	12,5	16,9	14,3	6	0	100
1976	Sidi Daoud	N	2634	9708	1044	1447	1042	2041	5	17921
		%	14,7	54,2	5,8	8,1	5,8	11,4	0	100
	Monastir	N	0	2409	510	555	701	2740	0	6915
		%	0	34,8	7,4	8	10,1	39,6	0	100
1980	Sidi Daoud	N	54	4177	867	549	743	0	1396	7786
		%	0,7	53,6	11,1	7,1	9,5	0	17,9	100
	Monastir	N	594	373	120	250	2819	41	0	4197
		%	14,2	8,9	2,9	6	67,2	1	0	100
1988	Sidi Daoud	N	210	6487	22820	0	0	213	111	29841
		%	0,7	21,7	76,5	0	0	0,7	0,4	
	Monastir	N	580	188	7680	1059	0	0	0	9507
		%	6,1	2	80,8	11,1	0	0	0	100
1997	Sidi Daoud	N	7398	745	1802	0	0	0	0	9945
		%	74,4	7,5	18,1	0	0	0	0	100
	Monastir	N	369	110	92	0	0	0	0	571
		%	64,6	19,3	16,1	0	0	0	0	100

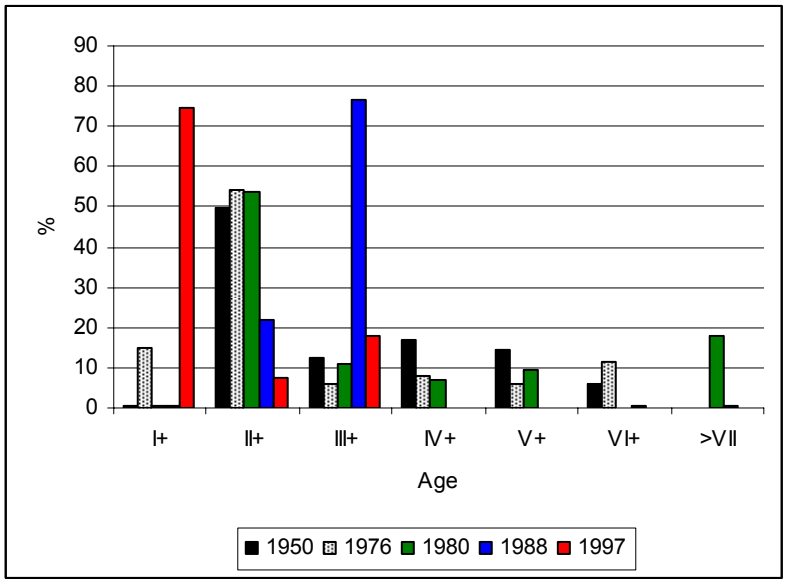


Figure 51 – Distribution of captures of *Euthynnus alletteratus* by age in the Tunisian trap of Sidi Daoud (Hattour, 2000)

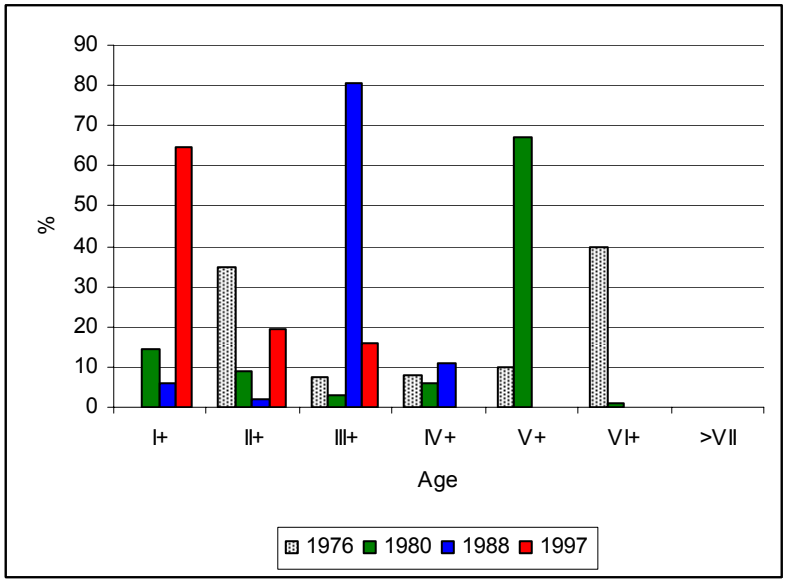


Figure 52 – Distribution of captures of *Euthynnus alletteratus* by age in the Tunisian trap of Monastir (Hattour, 2000)

This tendency is also confirmed by the variation of the annual mean weight average of the catches of little tunny in the same two traps (Figure 53). The two lines are quite similar (except in the years 1980–1985), providing additional evidence of this reduction, linked to the possible overfishing of this stock.

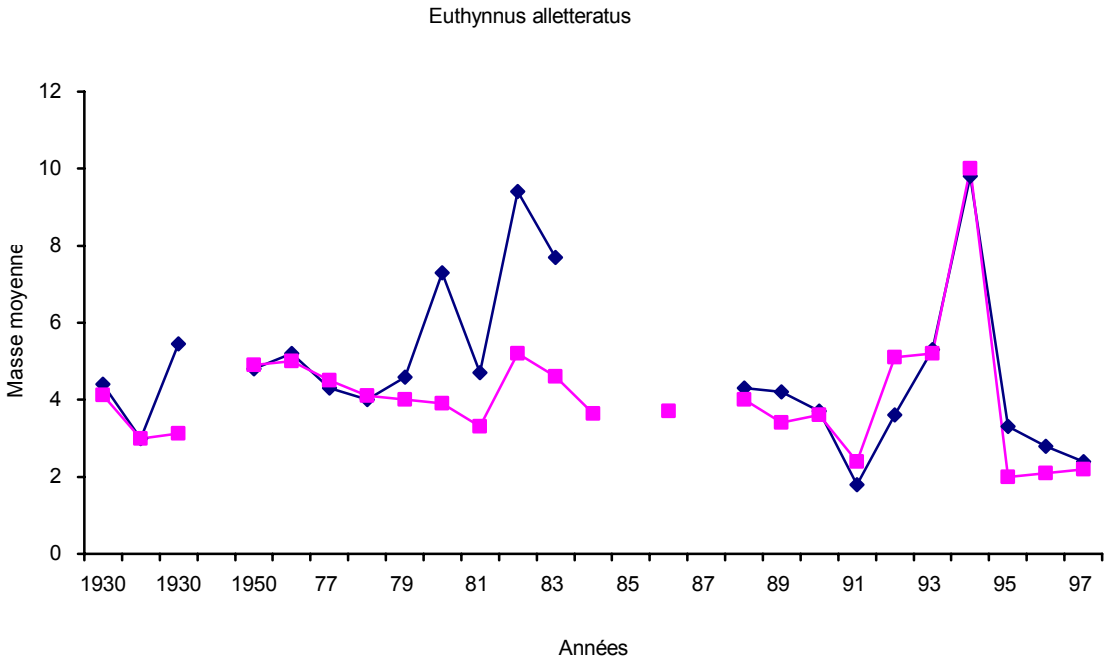


Figure 53 – Annual mean weight of *Euthynnus alletteratus* in the Tunisian traps of Sidi daoud and Monastir (Hattour, 2000)

Further information about the size distribution of the most relevant small tuna species in the Tunisian fisheries is provided by Table 27.

Table 27 - Distribution of sizes frequencies in number and percentages of *Orcynopsis unicolor, Euthynnus alletteratus, Auxis rochei* and *Sarda sarda,* in the Tunisian waters

Species / Fork length (cm)	*Orcynopsis unicolor*		*Euthynnus alletteratus*		Fork length (cm)	*Auxis rochei*		*Sarda sarda*	
	N	%	*N*	%		N	%	N	%
6–10	5	4,63	48	4,85	6–8	0	0	0	0
11–15	5	4,63	21	2,12	9–11	0	0	0	0
16–20	0	0	0	0	12–14	0	0	0	0
21–25	0	0	0	0	15–17	0	0	4	1,05
26–30	0	0	8	0,81	18–20	1	0,2	3	0,79
31–35	5	4,63	16	1,62	21–23	5	0,99	1	0,26
36–40	11	10,19	147	14,86	24–26	4	0,8	1	0,26
41–45	26	24,07	115	11,63	27–29	1	0,2	2	0,52
46–50	13	12,04	15	1,52	30–32	23	4,57	2	0,52
51–55	10	9,26	86	8,7	33–35	172	34,19	32	8,4
56–60	10	9,26	299	30,23	36–38	132	26,24	153	40,16
61–65	15	13,89	86	8,7	39–41	152	30,22	81	21,26
66–70	3	2,78	21	2,12	42–44	12	2,39	54	14,17
71–75	3	2,78	19	1,92	45–47	0	0	39	10,24
76–80	2	1,85	10	1,01	48–50	1	0,2	9	2,36
81–85			21	2,12	**Total**	**503**	**100**	**381**	**100**
86–90			8	0,81					
91–95			15	1,52					
96–100			29	2,93					
101–105			24	2,43					
106–110			1	0,1					
Total	**108**	**100**	**989**	**100**					

Small tunas as associated species

In addition to the main large pelagic species, such as bluefin tuna and the swordfish targeted by the Tunisian professionals, several small tunas are among the catches of the bluefin and swordfish fisheries in Tunisian waters, either as secondary target species or bycatch, particularly in the purse seine, traps and longline fishing.

Several small tuna species are captured in the surface longline fishery for swordfish, with a certain variability by year, as occurs in the other similar fisheries in the Mediterranean.

The catches obtained by the tuna trap in Sidi Daoud tell an interesting story of the changes which have happened in the Tunisian trap fishery over the two last decades.

In general, until the nineties, about 80 percent of the catches were related to bluefin tuna and the remaining part was mostly of bullet tuna (*Auxis rochei*), Atlantic bonito (*Sarda sarda*), little tunny (*Euthynnus alletteratus*) and plain bonito (*Orcynopsis unicolor*).

In the period between 2000 and 2003, the level of bluefin tuna in the catches of this trap decreased continuously, with an average of about 6 percent in the four years; at the same time, the catches of small tunas increased up to an average of about 94 percent and the little tunny become the dominant species (Figure 54 and Table 27).

Table 27 – Catches by species in the tuna trap of Sidi Daoud from 2000 to 2003 (Q = tonnes)

	2000			2001			2002			2003		
Species	Q	No.	%	Q	No.	%	Q	No.	%	Q	No.	%
Bluefin	6.50	87	2.36	3.96	75	3.09	9.26	205	8.14	4.64	76	3.17
Little tunny	262.67		95.18	116.29		90.85	93.96		82.56	127.32		86.95
Bonito	0.31		0.11	3.02		2.36	2.20		1.93	10.18		6.95
Dogfish	0.83		0.30	2.93		2.29	0.41		0.36	0.95		0.65
Swordfish	0.88		0.32	0.07		0.06	0.39		0.34	0.27		0.19
Various	4.79		1.74	1.73		1.35	7.59		6.67	3.07		2.10
TOTAL	275.98		100	127.99		100	113.81		100	146.43		100

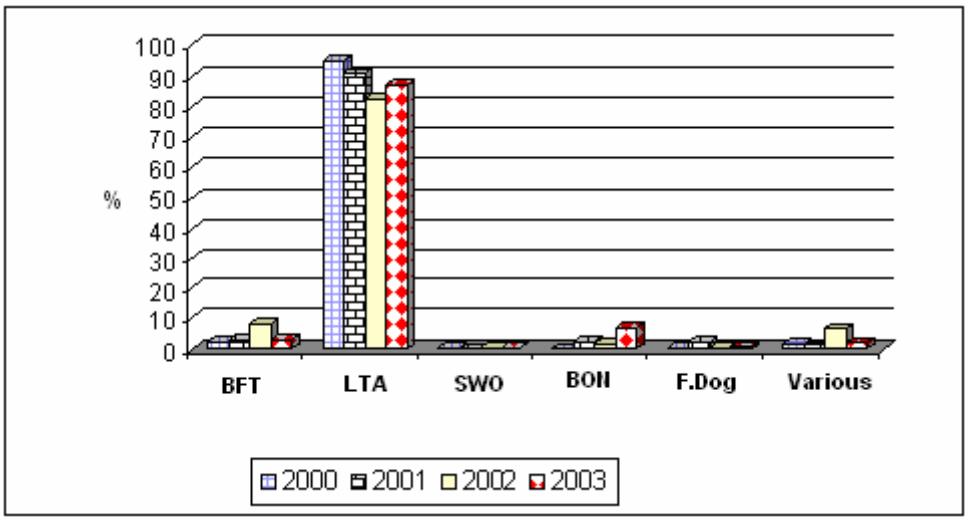
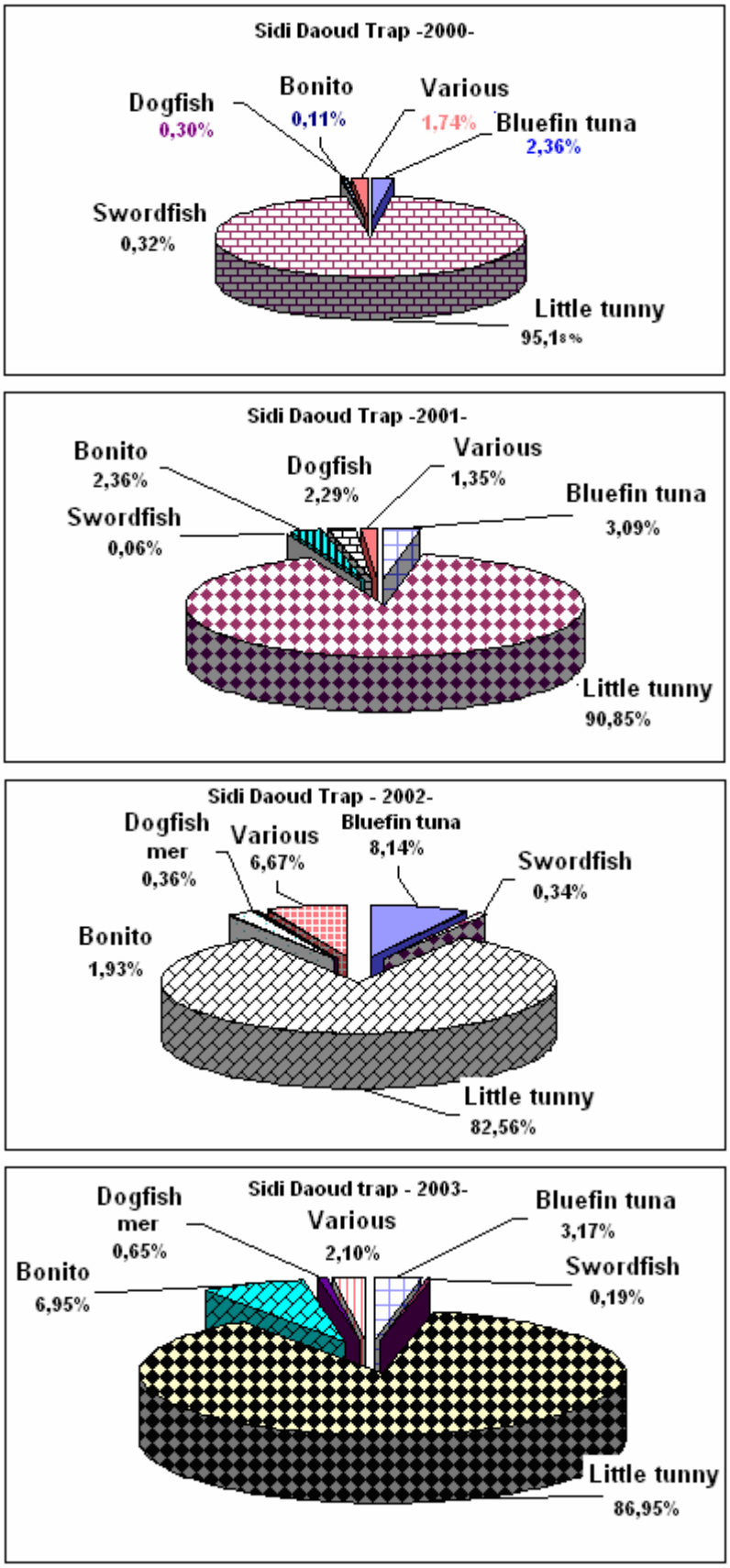


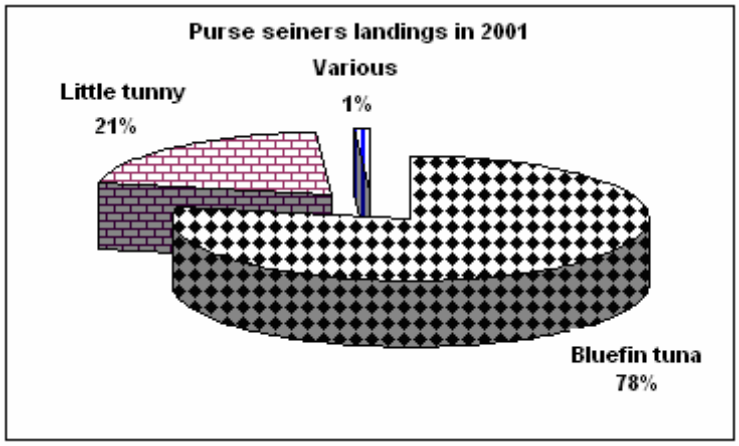
Figure 54 – Distribution of catches in the trap of Sidi Daoud from 2000 to 2004

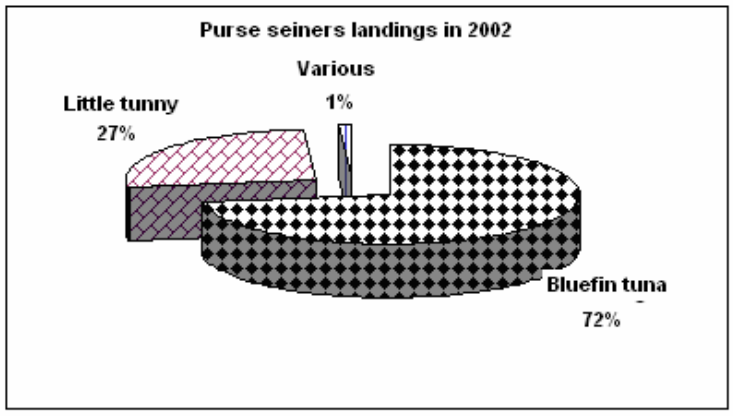
A more graphic overview of this interesting situation by year is provided by the following figures 55 to 58.

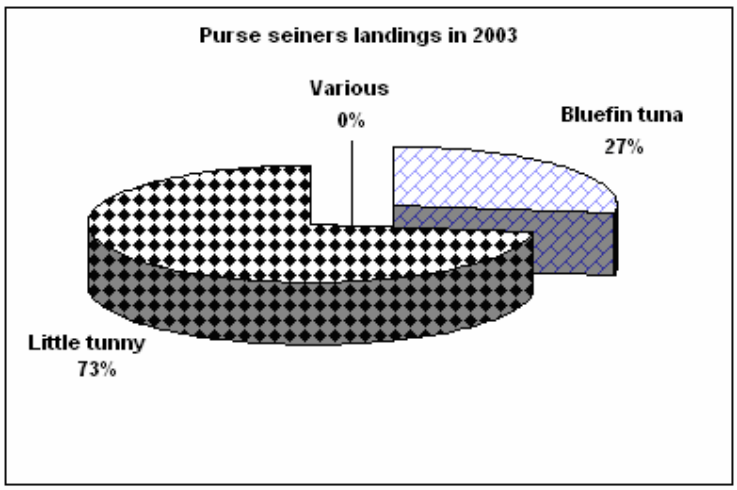


Figures 55–58 – Distribution of catches by species and by year in the tuna trap of Sidi Daoud between 2000 to 2003

The Tunisian purse seine fishery, targeting bluefin tuna, has the small tuna species as a secondary target. This is more evident when looking at the species composition of the catches between 2001 to 2003 (Hattour, 2001). Besides the bluefin tuna, the most abundant species is the little tunny (*Euthynnus alletteratus*), ranging from 21 to 27 percent. Occasional catches of Atlantic bonito (*Sarda sarda*), Bullet tuna (*Auxis rochei*) and plain bonito (*Orcynopsis unicolor*) are present among the other species caught in this fishery (Figures 59–61).







Figures 59–61 – Distribution of catches by species and by year in the Tunisian tuna purse seine fishery between 2001 to 2003

Turkey

Generalities

The Turkish fishery is characterized by artisanal and industrial types of fisheries. The quantity of marine fishery products (460 000 to 522 000 tonnes) is more or less stable over recent years. More than 70 percent of marine catches is from the black sea. Small tunas are relatively important and the Atlantic bonito represents from 1 to 3 percent of the total. Among the pelagic fish in the Black Sea, the bonito has the

highest economic value. The most important factor affecting the catch and the fishing intensity of the Atlantic bonito in the Black sea seems to be the change in the annual seawater temperatures.

Fleet and fishing methods

The fisheries of small tuna species in Turkey are more or less coastal, using trap nets, beach seines, surrounding gillnets, small purse seines, troll lines and pole-and-lines.

15.4 percent of the total Turkish catches of Atlantic bonito in the Black Sea are caught by gillnets and trammel nets on small wooden fishing boats with a mean length of 8,6 m (6,3–13,8 m) and mean engine power of 44.8 HP (8–135 HP). The CPUEs of these nets in September, October, November and December is almost stable, with an average value of 83.1 (0,6–967) kg/boat/trip (Zengin *et al.,* 2005).The gillnets and trammel nets (mesh sizes: between 16 and 45 mm) are used for various fish species, including small tunas.

A relevant part of the Atlantic bonito fishery (84,6 percent) is carried out by purse seining. Depending on the fishing season, purse seines are used intensively for bonito fishing from September to November. Bonito fishing by big boats is conducted around the eastern parts of the middle of the Black Sea. With vessels of 48 m and 1600 HP, bonito shoals are followed easily, operating 24 hours per day. During September, October and November when the bonito catches are at their peak, the CPUE of these vessels are reported to be 818.3, 601.7, and 156.5 kg boat/haul. (Zengin *et al*., 2005). In Turkey, a fleet of around 28 to 30 purse-seiners also catch *Euthynnus alletteratus* as bycatch (Kahraman 1999). This species is also caught by trolling by artisanal fishermen with small boats between 8–12 m.

Fishing zones and seasons

In Turkey small tuna species, along with other tuna species (bluefin tuna, albacore), are caught in the Gulf of Edremit, Ayvalýk, Ýzmir, Güllük, Fethiye, Antalya and Ýskenderun. (Bök and Oray, 2001). There is no permanent fishing activity for small tunas and some species are absent among the landings for some periods.

Fishing grounds of little tunny in Turkish waters are in the Bay of İskenderun, the Bay of Antalya, the area between the Bay of Güllük and Turgutreis, around Foça, Aliaga, Badem Islands, in the Bay of Edremit, between Cape Kadırga and Babakale, and around Gökçeada and Bozcaada Islands (Kahraman 1999). The fishing season is generally between February and June. In April and May, fishing is carried out intensively and mostly in Turkish waters, where Atlantic bonito is caught by purse-seiners as bycatch (Kahraman and Oray 2001).

Species in the Turkish fisheries

There are three main species of small tunas in the Turkish fisheries: the Atlantic bonito (*Sarda sarda*), the bullet tuna (*Auxis rochei*), the little tunny (*Euthynnus alletteratus*), but other species are sometimes caught as secondary targets, incidental catches or bycatch. Among these, there are also lessepsian species.

The Atlantic bonito shows significant fluctuations in the catches in Turkey. According to (Ivanov and Beverton, 1985), these fluctuations are caused by the varying strengths of the year classes and by variations in the proportion of fish which migrates into the Black Sea from the Aegean Sea and the Sea of Marmara. With decreasing water temperatures at the end of the summer in the Black Sea, Atlantic bonito migrates for reproduction and feeding from the end of April until mid-August from the Aegean Sea to the Sea of Marmara, and they return to the Aegean Sea mostly in November and December. Atlantic bonito stay in the thermocline layer throughout the winter (Kuntaygil 1979) and, according to Nümann (1954) and Artüz (1958), small numbers of the migrating bonitos stay in the Black Sea throughout the year.

There were four huge migrations of the bonito stocks in the periods 1910–13, 1922–23, 1934–41, and 1955–57 years (Artüz, 1958), which demonstrated that these huge migrations occur every 7.5 or 8 years. The landings decrease or increase with intervals of approximately 5 years, according to Artüz (1957; 1958), also confirmed by Zengin *et al*., (2005), who consider that a period of 5 to 6 years is necessary for the recovery of the stock. (Figure 62).

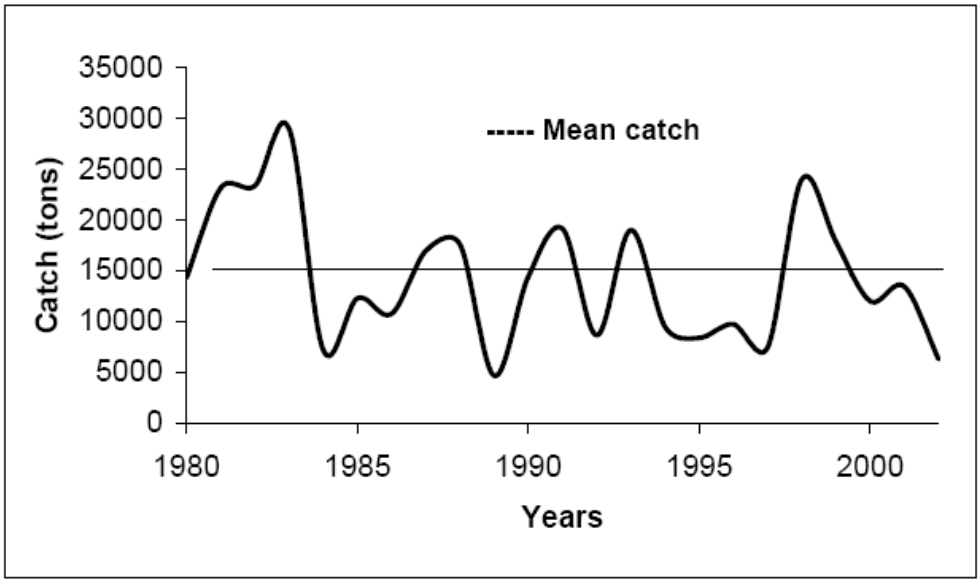


Figure 62 – Fluctuations of Atlantic bonito in the Turkish catches reported over the last 20 years (mean catch is taken as reference) (Zengin, *et al*., 2005)

One or more abundant year-classes, together with those of adjacent years, can aggregate in schools, most of which returns each year after their hibernation in the Sea of Marmara or in the Aegean Sea to the Black Sea, until the end of their life.

Due to these important movements, the Turkish fishery obtained abundant catch of Atlantic bonito in 1954. This increase probably resulted from recruitments at the age 0+, which were born in the Black Sea, who joined the stock in the Black Sea during the spring in 1954 (Artüz, 1958). Other important catches were obtained later. In 1956, the Turkish fishery reached a catch of about 55.5 $*10^3$ tonnes, and the USSR caught about 8.5 $*10^3$ tonnes in 1957. In Bulgaria, where the age group 1+ occurs only in autumn (September-December, mainly in October and November), the largest catch was obtained in 1954 (2 192 tonnes) (Ivanov and Beverton, 1985). The longest and most severe decline in the abundance of Atlantic bonito began in 1970 (Kocatas *et al*., 1993) and continued until 1975 (Ivanov and Beverton, 1985). The causes of this phenomenon are still not clear, even though it might be correlated to a corresponding decline in immigration of the adult stocks into the Black Sea from the Sea of Marmara and the Aegean Sea. An additional explanation is supported by Zaitsev (2000), who correlated this decline with the strong sound emitted by ships' propellers in the Boshporus, which produce an acoustic barrier. Another possible reason for the decline was the overfishing by international fleets in the Black Sea from 1970 to 1980 (Ivanov and Beverton, 1985). Nevertheless, the presence each year of small quantities of bonito in the Black Sea is likely to result in a future recovery of the stock (Ivanov and Beverton, 1985).

The catch of *Auxis rochei* (sometimes also reported as *Auxis thazard)* in Turkey does not show any stability. The average catch per day by the purse seiners in Turkey was 72.8 tonnes in 1990; 18.4 tonnes in 1991; 108.6 tonnes in 1992; 456 tonnes in 1993 and 148,5 tonnes in 1994 (Bök, and Oray– 1995).

The length structure of *Sarda sarda*, *Auxis rochei*, *Euthynnus alletteratus* and *Scomberomorus commerson* in the Turkish fisheries are reported in the previous chapter 3.0.

3.3 Fishery legislation

3.3.1 Governance of the Mediterranean and Black Sea

The Mediterranean and the Black Seas are two connected basins, surrounded by land and linked through the natural opening of the Straits of Gibraltar to the Atlantic Ocean and through the man-made Suez Canal to the Red Sea. The countries around this sea area have different traditions, stories, languages, cultures and state organizations, but they share among them an ancient link with the sea and with fishery. Finding the way to manage the shared resources together, at local or international level, (in practice, most of the existing species having halieutic interest) is a very difficult and complex exercise.

Much legislation has historical origins, but many laws were issued following the Second World War and as a consequence of political reorganization in the area. Specific international agencies were set up to deal with shared management issues under the UN umbrella.

The case of small tuna species is similar to many other pelagic species, which explains why in many cases specific legislation has not been designed, as these species are included with others having the same management.

Some information included in this report has been obtained from the recent IUCN compendium "Governance of the Mediterranean Sea. Outlook for the legal Regime" (Chevalier, 2005).

The Convention of Montego Bay, adopted on 10 December 1982 in Jamaica, stipulates that the sovereignty of any coastal State extends to an adjacent belt of sea, called the territorial sea, the breadth of which can extend up to a limit not exceeding 12 nautical miles. Most States in the Mediterranean and Black Seas have established a 12 nm territorial sea and only a few countries, namely Greece and Turkey in the Aegean Sea, still rely on narrower limits (6 nm).

Many treaties for a precise delimitation of the territorial sea in contiguous zones were endorsed between several Mediterranean and Black sea countries, such as Turkey and the former Union of the Soviet Socialist Republics (now Russian Federation) in 1973; France and Italy in 1986; Italy and Yugoslavia in 1975; Turkey and Bulgaria in 1997; Croatia and Bosnia and Herzegovina in 1999.

Since most Mediterranean states desire to preserve basin-wide access to fisheries, taking into account the presence of many islands and difficulties associated withdelimiting national waters which are still to be settled in this relatively narrow and complex sea, Mediterranean states have so far been reluctant to proclaim exclusive economic zones (EEZ)s. Nevertheless, in 1981, **Morocco** proclaimed a 200 nm EEZ, which in principle applies without distinction to both Atlantic and Mediterranean waters off the Moroccan coasts. However, Morocco has not yet enforced its EEZ legislation with regard to Mediterranean waters, partly due to the existence of some Spanish enclaves in the area. In 1983 **Egypt** declared that it "will exercise the rights attributed to it by the EEZ situated beyond and adjacent to its territorial sea in the Mediterranean and the Red Sea", it appears that the Egyptian declaration was followed by implementing legislation. **Spain** and **France** have proclaimed a 200 nm EEZ off their coasts, but have indicated that it is not applicable to Mediterranean waters. In 2004, **Cyprus** announced an EEZ in which rights and jurisdictions foreseen in the UNCLOS shall be exerted, and whose limit shall not extend beyond 200 nm from the baselines from which the breadth of the territorial sea is measured. The Maritime Code of **Croatia,** adopted in 1994, contains several provisions on the establishment of EEZ. However, such a zone has not been proclaimed and the Republic of Croatia has undertaken steps towards establishing a zone of ecological protection and fisheries. There is still an open discussion about the establishment of a sort of EEZ in **the Libyan Arab Jamahiriya** in 2005, going 62 nm beyond the national waters off the Gulf of Sirte and all the Libyan coast, which is considered valid by the Libyan authorities but not by some other states; indeed it is mostly considered as a Fisheries Protection Zone.

The Black Sea countries, on the contrary, have agreed EEZ for all relevant areas.

Where **international management** of fishery resources in the Mediterranean and the Black Seas is concerned, the tuna and tuna-like species are under the management responsibility of the International Commission for the Conservation of Atlantic Tuna (**ICCAT**). In 2008 ICCAT membership covered a total of 22 countries fishing in the area, including 2 non-bordering countries (EC Portugal and Japan). Other ICCAT members sometimes fish in the Mediterranean, but their catches are not reported separately eitherto ICCAT or to the GFCM.

The GFCM also has the responsibility of managing the fisheries in the area. In 2008 a total of 24 countries fishing in the Mediterranean or in the Black Sea were GFCM Members, including Japan. Five bordering countries or entities are not GFCM members.

The European Union (**EU**) is a supranational organization having the power to issue regulations on the fishery activities of its Member States which operate in the EU waters and on EU fleets. In 2008, a total of nine countries bordering the Mediterranean and the Black Sea were EU Members.

Fisheries protection zones

In the Mediterranean there are five countries, namely Algeria, Malta, Spain, Tunisia and the Libyan Arab Jamahiriya, that have claimed Fisheries Protection Zones (FPZ) extending beyond their territorial waters.

In 1951 **Tunisia** claimed an exclusive fishing zone that is bordered for about half of its length by the 50 m isobath. The Tunisian fishing zone encompasses the rich bank called "Mammellone" by the Italian fishermen, considered as high seas by Italy.

Malta has claimed a 25 nm exclusive fishing zone since 1978, now included in the EC waters, mostly for the management of FAD (cannizzati) fishery.

In 1994 **Algeria** claimed an exclusive fishing zone, beyond its territorial sea and adjacent to it, which extends 32 nm from the western maritime border to Ras Ténés and 52 nm from Ras Ténés to the eastern maritime border.

In 1997 **Spain** claimed a 37-mile wide fisheries protection zone calculated from the outer limit of the territorial sea eastward into the Mediterranean Sea. The fisheries protection zone is delimited according to the line which is equidistant (median line) from the opposite coast of Algeria and Italy and the adjacent coast of France. In the preamble of the Royal Decree it is argued that extension of jurisdiction over fisheries resources beyond territorial waters is a necessary step to ensure adequate and effective protection of fisheries resources, particularly in view of the increasing fishing intensity (bluefin tuna) in recent years by ships flying non-Mediterranean flags.

In the Spanish fishing zone:
(1) all ships flying non-EU flags are excluded (unless authorized);
(2) the Spanish regulation 1626/94 applies;
(3) control of fishing activities is exerted by Spanish authorities.

In 2005, **the Libyan Arab Jamahiriya** declared that the area to the north of Libyan territorial waters which extend up to 62 nm into the sea starting from the territorial sea line, represents a fishing area that falls under its jurisdiction and sovereignty.

Zones of ecological protection

In a 2002 document laying down a Community Action Plan for the conservation and sustainable exploitation of fisheries resources in the Mediterranean, the European Union advocated the declaration of fisheries protection zones of up to 200 nm to improve fisheries management in the Mediterranean. It stressed the fact that establishment of fisheries protection zones would facilitate control and would contribute significantly to the fight against illegal, unreported and unregulated (IUU) fishing. The document emphasized the need to build a consensus through wide consultation and involvement of all countries bordering the Mediterranean basin, if such an undertaking is to be successful and effective. To achieve this, a common approach should first be agreed upon by Community Member States and, subsequently, by all countries in the region.

In 2003 **France** created an Ecological Protection Zone in the Mediterranean, although France did not assert an Exclusive Economic Zone for international reasons (in particular related to fishing), the EPZ allows for measures to be taken to limit pollution by foreign vessels. According to this new law, in this area the French authorities will be able to apply the competences recognized by international law in the field of protection and safeguarding the marine environment including scientific research. The EPZ along the French coasts in the Mediterranean extends further than 100 km offshore.

In the same year (2003), **Croatia** declared an Ecological and Fisheries Protection Zone (EFPZ) in the Adriatic. It extends temporarily to the Croato-Italian median line of the continental shelf in the Adriatic This EFPZ will allow Croatian authorities to protect its vulnerable marine environment and ensure sustainable harvesting of the fishing resources.

The high seas in the Mediterranean

On the high seas, all States (whether coastal or landlocked) enjoy certain freedom of navigation and fishing; exercise of the latter is subject to some conditions. States which have the right for their nationals to engage in fishing on the high seas are subject to: (a) their treaty obligations; (b) the rights and duties as well as the interests of coastal States provided for in, amongst others, UNCLOS Article 63, paragraph 2, and Articles 64

to 67 and (c) obligations to conserve living resources of the high seas, to cooperate with other States in conserving and managing these resources, and to protect and correctly manage marine mammals.

For high seas law-enforcement, however, it is incumbent upon each State to apply international laws on matters within its jurisdiction.

The driftnet fishing ban falls, in many cases, under the High Seas Agreement. The resolutions 44/225 and 46/215 adopted in 1989 and 1991 by the United Nations recommended a moratorium on all the large pelagic driftnet fishery until June 30, 1992. In 1991, the United Nations banned the use of large-scale high seas driftnets having a length >2.5 km. Following this, European Regulation (EC) No. 345/92 prohibited driftnet fishing in the Mediterranean by nets exceeding a length of 2.5 km. A similar regulation was adopted in 1997 by the GFCM resolution 97/1. Finally, the adoption of European Regulation (EC) No. 1239/98 and later regulations totally banning the use of driftnets targeting swordfish, tuna and tuna-like species by EC fishing vessels within and outside EC waters from 1 January 2002. In 2004 the ICCAT adopted a driftnet ban for all the large pelagic fisheries in the Mediterranean Sea (Rec 03–04). The GFCM in 2005 decided to adopt the same ban (Rec. GFCM/2005/03).

No specific legislation is available for the small tuna species in the high seas, but they are always considered to be included among the large pelagic species.

National legislation related to small tunas fisheries

General rules are applied to all fisheries (including those associated with small tunas) in national legislations and it is not in the scope of this report to compile a comprehensive overview of the many existing regulations. This overview is thus limited to those rules which incorporate small tuna species fisheries.

Albania

Albanian fisheries legislation provides a wide range of conservation and management measures combining technical, input control and catch control measures. Albanian law establishes a licensing system which states that "every navigating vessel used for professional fishing, as well as any other entity exerting professional fishing without using any vessel, must have a licence". Holders of professional or sports fishing licences are required to report information on their fishing activities periodically. The captain of every commercial fishing boat, whether national or foreign, are required to keep a logbook in which all required information must be regularly and legibly recorded.

The catching and selling of immature fish is prohibited (article 48 of regulation No. 1 of 1997). Tuna and tuna-like species whose minimum size is regulated are the following:

Scientific names	Minimum legal size in cm
Sarda sarda	30
Thunnus thynnus	70
Thunnus alalunga	40
Euthynnus alletteratus	30
Xiphias gladius	100

Algeria

Algerian fisheries legislation combines a wide range of conservation and management measures.

The Legislative Decree No. 94–13 of 28 May 1994 establishes a licensing system applicable to all fishing activities taking place within waters under the national jurisdiction. It thus covers all forms of fishing whether or not a vessel is used. The Algerian fishery regulations in Executive Decree No. 95–38 of 28 January 1995 govern the fishing of highly migratory species by foreign fishing vessels in waters under national jurisdiction.

The Executive Decree No. 95–38 of 28 January 1995 rules that six species fall into the category of *highly migratory species,* namely: Bluefin tuna (*Thunnus thynnus)*, skipjack (*Katsuwonus pelamis*), Atlantic bonito (*Sarda sarda)*, little tunny (*Euthynnus alletteratus)*, frigate and bullet tuna (*Auxis* spp.) and swordfish (*Xiphias gladius*). Foreign fishing vessels are required to be properly licensed to participate in this fishery (article 3). Fishing for highly migratory species must be exercised beyond the six-nautical mile area measured from the baselines (article 4). Purse seining and longlining are the only two fishing methods that can legally be used to catch highly migratory species within waters under Algerian jurisdiction (article 5).

An individual quota system is established whereby no vessel can harvest more than 500 tonnes of highly migratory species annually (article 8). Fishing permits are valid for one fishing trip only (article 7). Two observers appointed by the fishery administration and the coast guards are placed on board foreign fishing vessels (article 13). The captain of the foreign fishing vessel must keep a logbook in which fishing information relating to, *inter alia*, date, place, species and quantity of catch are recorded daily (article 19). In addition, at the end of the fishing trip, the captain is required to report catch and scientific data as shown in the forms annexed to the Executive Decree (article 17).

Two ministerial Decrees set out the minimum marketable size of highly migratory species, fix the commercial sizes of large pelagic fishes and the dates on which the commercial fishing seasons of these species open and close. The minimum commercial sizes are stipulated as follows:

Scientific names	**Minimum legal (cm)**
Thunnus thynnus	70 (6.4 kg)
Thunnus alalunga	50
Euthynnus alletteratus	40
Euthynnus pelamis	30
Sarda sarda	30
Auxis rochei	22

From 1 June to 31 July of each year a biological rest is observed during which the fishing of these species is strictly prohibited

The Decree of November 4 1995 determines the monitoring methods for the assessment of the commercial fishing of large pelagic fishes by foreign vessels in Algerian waters and subjects these vessels to technical, medical and administrative inspection. Moreover, this regulation specifies the mission of the observers, who are responsible for checking the conformity of the fishing gear used, for recording the captures and for ensuring that the ship operates in the authorized fishing zones.

The fishery of large pelagic species is regulated by the Executive Decree no. 06–367 of 19 October 2006, which establishes the rules for releasing the permits for the commercial fishery of these species in the waters under Algerian jurisdiction. This Decree lists six species, including *Euthynnus alletteratus, Auxis rochei, Katsuwonus pelamis* and *Sarda sarda*. Only two gears are permitted for these fisheries: the purse seine and the longline. A closed season is also enforced within the national waters from the 1st June to the 31st December (both during the day and night) for the longliners and from the 1st July to the 31st December for the purse-seiners.

Bosnia and Herzegovina

No basic marine fisheries legislation has yet been issued in this country.

Croatia

Croatia has adopted basic fisheries legislation as well as a series of regulations governing various aspects of both artisanal and commercial fishing. The Marine Fisheries Act of 22 April 1997 establishes a permit system applicable to both commercial and artisanal fishing operations.

The ordinance of 5 June 1996 on the protection of fish and other aquatic species establishes the minimum legal size of various species of fish and other aquatic organisms and sets out closed seasons for certain species of fish. (No information related to small tunas is available).

European Union

Nine countries in the study area covered by this report, namely Bulgaria, Cyprus, France, Greece, Italy, Malta, Romania, Slovenia and Spain, are Member States of the European Union (EU). Where fisheries are concerned, guidance is provided by the Common Fishery Policy (CFP). It is therefore important to include a review of the relevant EC fisheries regulations in this study.

The EU has general competence in the field of fisheries, article 10 of Council Regulation (EEC) No. 3760/92 lays down the rules and measures for the conservation and management of fishery resources. It declares that Member States may adopt such measures in waters under their sovereignty or jurisdiction where:

- They involve strictly local stocks which are only of interest to fishermen from the Member State concerned, or they apply solely to the fishermen from the Member State concerned,

- They are compatible with the objectives of the Common Fisheries Policy (CFP) and are no less stringent than the measures governing the conditions of access to waters and resources and of the pursuit of exploitation activities adopted pursuant to Article 4.

The licensing system applies to all EC fishing vessels operating in the EC fishing waters, including the Mediterranean, or in the waters of a third country or on the high seas (article 5).

Regarding the fishing effort or the fishing capacity: Member States adopted a Multi-annual Guidance Programme aiming at ensuring a balance between resources and their exploitation through the restructuring of the EC fishing fleet (Council Decision No. 97/413/EC of 26 June 1997).

Where the technical measures are concerned, the most relevant for the conservation of fishery resources in the Mediterranean laid down in this Regulation, are summarized below and refer specifically to large pelagic fisheries:

- The use of encircling and towed nets set from a boat and operated from the shore (shore seines) must be prohibited as of 1 January 2002, unless it can be clearly established, on the basis of scientific data, that their use does not have a negative impact on the resources (article 2.3).
- The use of trawls, seines or similar nets is prohibited within three nautical miles of the coast or within the 50 m isobath, where that depth is reached at a shorter distance.
- Encircling nets (seines and *lampara* nets): the length of netting is restricted to 800 m and the drop to 120 m, except in the case of tuna seines.
- Minimum mesh size is 14 mm for encircling nets and 40 mm for towed nets (bottom trawls, surface trawls and anchored seines).
- Surface-set longline (floating): it is prohibited to have more than 60 km of longline on board and set per vessel.
- Supplementary measures: with the Council Regulation (EC) No. 1239/98, the Council agreed on a progressive driftnet ban, which came into effect fully as of 1 January 2002. The driftnet fishery is banned for a list of pelagic species, including all small tuna species and the landing of this species by driftnet vessels is prohibited. The Council Regulation (EC) No. 809/07 defined in details what a driftnet is from a technical point of view.
- Catch reporting: Council Regulation (EEC) No. 2847/93 of 12 October 1993 establishing a control system applicable to the Common Fisheries Policy requires that masters of Community fishing vessels exceeding 10 m in overall length keep a logbook of their operations, indicating in particular the quantities of each species caught and kept on board, the date and location of such catches and the type of gear used (article 6.1). In addition, the master of each such EC fishing vessel or his/her representative must, after each fishing trip and within 48 hours of landing, submit a declaration of catch to the competent authorities where the landing takes place (article 8.1).

Catches from a selected list of species, among the most representative in terms of landings by country, including those which are mandatory under the international obligation derived from GFCM or ICCAT, must be sampled a regular base according to a precise statistical scheme, under the Reg. (EC) 1543/2000 and further modifications. Some small tuna species are included in this list.

The EU fishery in the Mediterranean Sea is now regulated by Reg. (CE) no.1967/2006, which creates a legal framework for the sustainable management of fishery resources exploited by the EU fleets in the area. Under this regulation, which also governs other aspects of fisheries, several measures were adopted to improve the definition of the fishing gears.

EC Bulgaria

As a Member of the European Union, Bulgaria is subject to the CFP and EU fisheries regulations. There is a minimum size for the Atlantic bonito, set at 28 cm. Data on national legislation on fishery for small tunas are not available for this report.

EC Cyprus

As a Member of the European Union, Cyprus is subject to the CFP and EU fisheries regulations.

The Fisheries (Consolidation) Ordinance No. 2 of 1982 is the principal fisheries legislation in Cyprus. It dictates that no fishing vessel should engage in commercial fishing within the territorial waters of Cyprus without having obtained a licence. It also empowers the competent authority to impose conditions to the licence.

The Fisheries Regulation, 1991, determines the characteristics of nets (including mesh sizes), traps and longlines and regulates their conditions of use.

According to the Fisheries Law the Department of Fisheries and Marine Research is responsible for the collection and processing of fishery statistics, as well as their transmission to all international organizations and agencies. The collection of fishery statistics is based on the Fisheries Law, Chapter 135 and subsequent amendments of 1961 to 2000, as well as the Fisheries Regulations of 1990 to 2000, based on Article 6 of the Basic Law.

All trawlers and multi-purpose vessels are required by law to keep logbooks, while production data from the inshore fisheries are collected from a 10 percent sample of this fleet category. The collection of trawlers´ data is carried out by the daily return of logbook sheets, which all skippers are required to hand in prior to landing their catch. The logbook sheets of the multi-purpose fleet are handed to the fisheries inspectors of the Department of Fisheries after each trip and always within one month of their last report.

No minimum size regulation is adopted for small tuna species.

EC France

France is a Member State of the European Union and is therefore subject to the CFP and relevant EU regulations.

Vessels flying the French flag, whether operating within the waters under the sovereignty or jurisdiction of France or outside these waters, are required, in accordance with EU regulations, to be properly licensed. Where appropriate, the type of authorized gear and the maximum quantity of fish that may be caught may also be mentioned on the licence.

The Order of 11 April 1997 introducing management measures regulating the coastal fishing in the continental Mediterranean dictates that fishing vessels equipped for commercial fishing operations known as *petite pêche* may be subject to a licensing regime when using, among other gears, purse seines or drift gillnets.

Decree No. 90–95 of 1990 determines the types of nets, fishing practices and fishing methods that can be used in the Mediterranean Sea; among them: gillnets, seine nets, lines and others.

The Order of 19 December 1994 laying down technical measures for professional fishing in the continental Mediterranean regulates the technical characteristics of fishing gears and the conditions of their use.

Licences authorizing the use of purse seines may only be issued in respect of vessels whose length is greater than 6 m and less than 18 m (article 11). The holder of a licence permitting the use of seine nets for the capture of small pelagics may use light devices to attract these species. However, it is prohibited for each licensed vessel to use more than one supporting boat equipped with fishing lamps (article 12).

With regard to trawl nets, the tonnage of catch per hauling of species other than sardines, anchovies, mackerels, tuna species, horse mackerel and bogues must not exceed 10 percent of the total live weight, provided that 70 percent of the total live weight is made of sardines and/or anchovies (article 7). Where purse seines are concerned, the tonnage of catch per hauling of species other than small pelagic, large pelagic, horse mackerel and bogues must not exceed 10 percent of the total live weight (article 13).

The Decree No. 90–618 of 11 July 1990 as amended, which regulates recreational fishing activities, empowers the competent authorities within the limit of their jurisdiction, to take measures aiming at reducing the number or type of fishing gear that may be kept on board vessels used for recreational fishing; (article 5) and establishing the list and characteristics of authorized gear that can be used for underwater fishing or fishing alongside the shore, prohibiting the capture of certain species or restricting the quantity that can be caught.

EC Greece

As a Member of the European Union, Greece is subject to the CFP and EU fisheries regulations.

Data on national legislation on fishery for small tunas are not available for this report. No minimum size is adopted for small tuna species. A surface longline ban is enforced every year, from September to December.

EC Italy

As a Member State of the European Union, Italy is subject to the CFP and EU regulations applicable to the Mediterranean.

Most of the Italian fishery rules rely on the L. 14 luglio 1965 n° 963 and the subsequent modifications, including many Ministerial Decrees and Regional laws. The Law n. 963 is implemented according to the DPR 2 October 1968 n. 1639. The Ministerial Decree of 26 July 1995 lays down the rules governing the granting of fishing licences; a fishing licence is required for every vessel operating within Italian waters.

The minimum landing size for marine resources are set out in Presidential Decree No. 1639 of 2 October 1968 and where the small tuna species are concerned, two of them are listed: *Sarda sarda* (25 cm) and *Euthynnus alletteratus* (30 cm).

Several Ministerial Decrees in 1990, 1991 and 1992 were issued to regulate driftnet fishery, that was banned in 2002, thus enforcing the EC Regulation.

EC Malta

As a Member of the European Union, Malta is subject to the CFP and EU fisheries regulations. The Fish Industry Act of 1953 empowers the competent authority to issue fishing licences to all the skippers in charge of any class of fishing vessels and to regulate the use of fishing gears, including nets, lines, floats and lampara.

Use of seine nets (*tartarun*) is prohibited within bays and creeks. However, special temporary permits may be granted for the use of such nets within the prohibited areas for the purpose of catching migratory fish (sections 14 and 17). The mesh size of seine nets must not be less than 8,5 mm measured when the net is wet (section 13).

Trammel and gillnets are not allowed to be used from 15 February to 15 July each year in those areas where the use of seine nets is prohibited. However, special derogation permits for the use of these nets within the prohibited areas may be granted should shoals of mature anchovies, sardines, mackerels, Atlantic bonito or other pelagic fish appear.

EC Romania

As a Member of the European Union, Romania is subject to the CFP and EU fisheries regulations. According to the information available for this report, no specific Romanian fishery regulation is related to the small tuna species, except for the minimum sizes.

EC Slovenia

As a Member of the European Union, Slovenia is subject to the CFP and EU fisheries regulations. According to the information available for this report, no specific Slovenian fishery regulation is related to the small tuna species.

EC Spain

As a Member of the European Union, Spain is subject to the CFP and EU fisheries regulations.

The Royal Decree No. 681 of 28 March 1980 dictates that no Spanish fishing vessel is allowed to operate outside the waters under Spanish sovereignty or jurisdiction without having acquired a temporary fishing permit. This permit authorizes the vessel to carry out the fishery in specified area(s) and for a period not exceeding one year.

The Royal Decree No. 71 of 23 January 1998 requires that all fishing vessels flying the Spanish flag targeting tuna and similar species in the Mediterranean Sea, whether in waters under Spanish jurisdiction or sovereignty or on the high seas, be properly licensed (article 13).

The Royal Decree No. 71 of 23 January 1998 regulates the capture of tuna and tuna-like species by vessels flying the Spanish flag in the Mediterranean Sea. This decree was adopted pursuant to the recommendation formulated by ICCAT in 1994 which stipulates that Member States must take all necessary measures to ensure a 25 percent reduction in the production of tuna and tuna-like species in the Mediterranean by the end of 1998. Provisions of this Royal Decree apply to the fishery of five species of fish, namely *Thunnus thynnus* (Bluefin tuna), *Auxis* spp., *Sarda sarda*, *Thunnus alalunga*, *Euthynnus alleteratus* (article 2).

It contains technical and management measures:

- It establishes the list of fishing gears that can be legally used for catching these species: tuna traps and similar gears, gillnets, purse seines, and lines with hooks (article 3).
- The maximum length of gillnets is restricted to 2,500 m and their mesh size must not be less than 50 mm. It is prohibited to fish any *Xiphias gladius, Thunnus thynnus, Thunnus alalunga* or *Isurus oxyrinchus* with this type of net (article 5).
- No lines with hooks other than surface longline, handline, trolling line and pole-and-line with live bait can be used to catch the species listed in the Decree; the minimum hook sizes are regulated and set in relation to the target species (article 7).
- Tuna and tuna-like fishing is prohibited at depths less than 50 m, except by traps and similar gear (article 8).
- If necessary and after consultation with the competent scientific authority, the Minister responsible for fisheries may establish seasonal closures for this type of fishing (article 9).
- The Royal Decree empowers the competent authority to limit the fishing effort through the establishment of a day-at-sea programme, and if necessary set a TAC and determine individual fishing quotas (articles 11 and 12).
- Masters of fishing vessels participating in the tuna and tuna-like species fishery are required to submit information about their fishing activities to the fisheries management authority by the 15th of every month (article 16).

An Order of 8 March 1999 regulates the use of surface longlines by vessels flying the Spanish flag operating in the Mediterranean Sea, whether in waters under Spanish jurisdiction or sovereignty or on the high seas (article 1). The length of longlines and the number of hooks with which they can be fitted vary in relation to the targeted species as follows:

- Longlines used for the capture of palometa, melva (*Auxis* spp.), bonito (*Sarda sarda*), atun blanco and bacoreta (*Euthynnus alletteratus*) must not exceed 25 000 m in length and must not be equipped by more than 10 000 hooks;
- Longlines used to target swordfish and mako shark must not exceed 60 000 m in length and must not be equipped with more than 2 000 hooks (article 3).
- The sizes of hooks are also set in relation to the target species (article 4).
- It is prohibited for vessels authorized to fish by surface longlines to keep on board and use any other type of fishing gear simultaneously (article 5).
- The fishing effort is limited to a maximum of 20 days at sea per month and vessel (art. 9).

The Order of 22 October 1990, as amended, prohibited the use of driftnets in waters under the Spanish jurisdiction or sovereignty, except in the Mediterranean. In this area, the use of driftnets is subject to the following restrictions:

- The mesh size of driftnets used to catch melva (*Auxis* spp.), bonito (*Sarda sarda*) and similar species of small tunas must be not less than 150 mm;
- Driftnets must not exceed 1500 m in length (article 4).
- No gillnets of any type can be used to catch swordfish, tuna and mako shark (art. 5).

The use of driftnets was subsequently banned by the enforcement of the EC regulation in 2002.

The Royal Decree No. 2349 of 28 November 1984 regulates the use of surrounding nets throughout the waters under the jurisdiction or sovereignty of Spain.

A Royal Decree of 4 July 1924 lays down the technical measures for the use of tuna traps (*almadraba*) in the waters under the jurisdiction or sovereignty of Spain.

EC United Kingdom (Gibraltar)

As a Member of the European Union, the territory of Gibraltar (United Kingdom) is subject to the CFP and EU fisheries regulations. No information on any fishery regulation for small tuna species has been made available for this report.

Egypt

The main Egyptian fisheries legislation is Act No. 124 of 18 August 1983 on fishing, aquatic resources and fish farming. Since then it seems that no major fisheries regulations have been adopted to implement this Act.

The Egyptian legislation provides a variety of conservation and management measures; the above mentioned Act requires that all fishing vessels operating within Egyptian territorial waters be properly licensed. It empowers the Minister responsible for fisheries to define the number of fishing licences to be issued for every class of vessel and fishing area. A vessel should not be transferred from one fishing area to another without having been authorized to do so by the fisheries management authority. This measure is designed to control the level of fishing effort that can be sustained in each fishing area (Gulf of Suez, Red Sea, Mediterranean Sea).

Every individual fisherman or master of a fishing vessel is required to submit data relating to fishing activities.

A number of issues that were addressed in this main fisheries Act have not yet been implemented, as no regulation has been adopted so far. Apparently, no fishing gear specifications have yet been prescribed, thus fishing nets and other fishing gears are not subject to any length and/or mesh-size restrictions.

Georgia

No information on any fishery regulation for small tuna species in Georgia has been made available for this report.

Israel

The fisheries legislation in Israel is based on two main legal instruments, namely the Fisheries Ordinance of 1937 as amended, and its implementing regulations laid out in the Fisheries Rules of 1937, as amended.

As a general rule, fishing vessels not registered in an Israeli port or place are not eligible for a fishing licence to operate in the territorial waters. The licensing authority may restrict the use of a licence with respect to the area within which the vessel may fish, the fishing activity and gear that can be employed from each vessel. Vessels operating hand-lines for fishing are exempted from the requirement to obtain a licence (sections 8A and 9 of the Fisheries Rules of 1937 as amended).

The master of any fishing vessel operating within Israeli territorial waters is required to keep a logbook in which information about the fishing activities must be recorded.

It is prohibited to use surface longlines of more than 6 000 m in length. The minimum mesh sizes for the nets must be not less than 12 mm (knot to knot) when new or 11 mm (knot to knot) when used or 10 mm (knot to knot) in any condition for any nets other than trawl nets and entangling nets.

The minimum landing size is not specified for small tuna fish.

Finally, in order to control the fishing effort of their fleet, the fisheries management authority restricts the maximum number of fishing licences that may be issued each year.

Lebanon

According to the Lebanese basic fisheries legislation and regulations made available for this report, it seems that fishery conservation and management measures focus mainly on the use of sardine and *chinchilla* nets and dredges, listing only the full protection measures for marine turtles, whales and seals.

No information is available about specific rules to be applied for the small tuna species fisheries.

Libyan Arab Jamahiriya

The Law No. 14 of 1989 establishes a licence regime, this states that no fishing vessel, whether national or foreign, can operate within the Libyan territorial waters without having previously obtained a licence. Licences are issued for a 3-year period and are renewable.

Resolution No. 80 of 1991 laying down technical measures for the conservation and management of fishery resources defines the technical characteristics of fishing vessels, the list of authorized gear and equipment, the net specifications and the minimum landing sizes of commercial species of fish and other aquatic organisms, however no small tunas are listed.

Monaco

No information on any fishery regulation for small tuna species in Monaco has been made available for this report.

Montenegro

No information on any fishery regulation for small tuna species in Montenegro has been made available for this report.

Morocco

The basic fisheries legislation in Morocco establishes a licensing system applicable to every vessel, whether national or foreign, operating within waters under Moroccan sovereignty or jurisdiction. A fishing licence is valid for a maximum period of one year (article 2).

The Order of 23 April 1934 regulates the use of surrounding nets in the territorial waters of Morocco, setting out the maximum length and height of such nets:

- 200 m in length and 30 m in height when used to catch sardines;
- 260 m in length and 45 m in height (but no less than 30 m in height) for the catching Scombrids, including Atlantic bonito and mackerels (article 2).

This Order was modified by the Decree No. 2–58–848 of 16 July 1958, prohibiting the use of surrounding nets in Moroccan territorial waters by fishing vessels exceeding 40 GRT.

With regard to gillnets, it prohibits:

- the use of gillnets whose mesh size is less than 70 mm (wet net);
- the use of gillnets exceeding 200 m in length and 30 m in width;
- the setting of gillnets by vessels other than those specifically fitted for this type of fishing;
- the setting of gillnets at a distance less than 200 m from each other (parallel to the coast) and at a distance less than 100 m perpendicular to the coast.

The decree No. 2–92–1026 of 29 December 1992 dictates that holders of fishing licences are required to communicate information relating to the fishing activities of each vessel at least once a year (article 2).

The Order No. 1154–88 of 3 October 1988 sets the minimum landing size of commercial species of fish, crustaceans, shellfish and molluscs occurring within Moroccan waters. No size limitation exists for small tuna species.

Palestine

No information on any fishery regulation for small tuna species has been made available for this report.

Russian Federation

No information on any fishery regulation for small tuna species in the Russian Federation has been made available for this report.

Syrian Arab Republic

The main fisheries legislation in the Syrian Arab Republic is the Legislative Decree No. 30 of 1964 supplemented by the Resolution No. 460 of 29 March 1965, which indicate that any person who wishes to undertake in fishing in the Syrian territorial waters is required to obtain a fishing permit (article 4 of Resolution No. 460 of 1965).

Conservation and management measures are listed as area and time restrictions. The Resolution No. 460 of 1965 estabishes the list of authorized fishing gear (article 13). It includes fishing rods, hooks, spears, fishing traps and traps.

No particular measures concerning the small tuna species fishery is reported in the Legislation.

Tunisia

The main Tunisian legislation on fishery is the Law No. 94–13 of 31 January 1994 as amended, and it aims to manage fishing effort in the various Tunisian fishing zones, to rationalize the harvesting of living resources, to protect them and preserve their habitats. No fishing vessel is allowed to fish within the Tunisian waters without having previously obtained an authorization to do so. Foreign fishing vessels are not permitted to operate therein unless for research or educational purposes (article 4 of Law No. 94–13 of 1994). This Law empowers the competent authority to define the characteristics of authorized fishing gears and the limits for their use (article 8), it establishes the list of prohibited fishing gears (article 9), and determines the areas and the periods in which fishing is prohibited (article 7 as modified by Law No. 99–74 of 26 July 1999).

The number of authorizations for fishing is predetermined by the decision of the apposite authority for the protection of the Environment and it is related to the fishing potential in the various zones. With regard to the various gears able to catch, among other species, small tunas, the rules are the following:

- The mesh size for gillnets must be at least 30 mm (per side). For the trammel, the mesh size of the net side must be at least three times of that of the main net.
- The mesh of the trawling nets must measure at least 20 mm (per side).
- The surrounding nets used for small pelagic species must have a minimum mesh size of 12 mm (per side).
- The mesh of the surrounding nets used for fishing tuna and other related species must be at least 50 mm (per side). The use of surrounding nets is prohibited at depths of less than 20 m.
- There are no particular national rules for the surface longlines targeting small tuna species.

There is no minimum landing size for small tuna species.

Turkey

The Turkish Plan for the development of the Fishery is mainly focused on the sustainable exploitation of resources, institutional restructuring, strengthening of the institutional capacity and improvement of the necessary infrastructures, in view of the adoption of the Common Fisheries Policy.

As regards the limitations to be applied to the small tuna species fisheries, the following should be considered:

- Atlantic bonito (*Sarda sarda)*: fishery by fixed nets is prohibited in the Turkish territorial waters between 1 April to 31 August. The use of longlines for bonito is permitted between 15 and 31 August. In Black Sea the fishery targeting Atlantic bonito is only permitted in the moonlight with gillnets, outside the previous reported closure, in the territorial waters from Kerempe Cape to the Bulgarian border.
- Little tunny (*Euthynnus alletteratus*), plain bonito (*Orcynopsis unicolor*), leer fish and greater amberjack: their fishery is permitted in the territorial waters between Mıhlı Stream and the Syrian border between 1 May and 31 May. A permit (Appendix 1) is required for the fishing

vessels requesting derogation and it should be released by the Province administration. In the Aegean Sea, it is prohibited to fish these species in the territorial waters east of the line between the estuary of River Meriç and Boztepe Cape, Büyük Kemikli Cape, Bozcaada Batı Cape and Küçükkuyu Mıhlı Stream, from 15 April to 15 August.

- The art. 15 establishes the minimum size for the following tuna and tuna-like species: bluefin tuna (90 cm), swordfish (130 cm), Atlantic bonito (25 cm) and little tunny (45 cm), A 5 percent tolerance is allowed for these species.
- The art. 16 prohibits the harvesting of these species, among others, by surrounding nets in the following areas: a) in the Bosphorus Strait, b) in the Strais of Dardanelles; c) in the traffic navigation zone between the Bosphorus and the straits of Dardanelles; d) in the Istanbul Islands, e) in Muğla Province, Güllük Bay, the Tuzla Strait to the east of the line connecting Bombataşı Cape and Marata Cape, f) in the area to the north of the line connecting the southern end of the Büyük Ziraat Island and Zeytin Cape.
- Purse seining is prohibited a) in the Black Sea, Marmara Sea, the Bosphorus and the Straits of Dardanelles between 1 May to 31 August; b) in the Aegean Sea, in the territorial waters between the river Meriç and Mıhlı Stream from 15 April to 15 August, and in the territorial waters between Mıhlı Stream and Eşen Stream from 1 May to 31 August; c) in the Mediterranean Sea, in the territorial waters between the Eşen Stream and Anamur Cape from 1 May to 31 August, and in the territorial waters between Anamur Cape and the Syrian border from 1 May to 15 September.
- The purse seine fishery for little tunny, plain bonito, leer fish and amberjack is permitted between Mıhlı Stream and the Syrian border from 1st May to 31 May.
- The maximum depth of purse seines which can be used in the Marmara Sea is 165 m (90 fathom).
- Fishing with non-pursing cast nets is permitted during the year up to a depth of 22 m, with or without trammel net and without eyebolt and wire.
- Purse seining is prohibited in all Turkish territorial waters shallower than 18 m, while fishing with cast nets is prohibited in waters shallower than 11 m. However, purse seining in waters up to a depth of 11 m is permitted in the territorial waters in the Black sea between Köpekkaya Cape in Cide District of Kastamonu Province and the Bulgarian border, and in the Marmara Sea from 1st September to 1st December; fishing with cast nets is permitted in İzmir Bay up to a depth of 6 m. In the Mediterranean Sea, surrounding net fishery is prohibited in the territorial waters between the Seyhan River and Yumurtalık Shelter, in waters shallower than 10 fathom (18 m), in the area between the Kaladuvar Shelter and the Seyhan River, in waters shallower than 11 m, and in the territorial waters between Yumurtalık Shelter and Akıncı Cape, in waters shallower than 14 m.
- Art. 18 includes the rules for harvesting the fishery resources with seine nets, gillnets and other fishing nets. The following rules can also be applied to small tuna species.
- All sorts of seining with ığrıp (seine net usually employed as a beach seine in Aegean and Mediterranean regions), trata (haul net used in Aegean and Mediterranean regions), tarlakoz (a pair seine that is local to Ayvalık), manyat (lower type of beach seine, used in the Marmara Sea) and other beach seines, are prohibited in all the Turkish territorial waters; these seine nets and the equipment enabling their use are prohibited on board fishing vessels. However, fishing with manyat is permitted outside the period from 1st May to 30 September in the areas specified by the provincial administrations.
- Fishing with haul nets (trata) in the Aegean Sea is permitted in the area east of the line between ğribucak Cape to Babakale Cape, except from 1 April to 15 July. A permit is required.
- In cast net fishing areas specified by the provincial administrations, the harvesting with seine nets such as ığrıp (beach seine), manyat and tarlakoz (pair seine) and all types of gillnets is prohibited.

- In the Aegean and Mediterranean seas, all and any captures by shear legs are prohibited.
- All types of set nets and spearing are prohibited within 200 m of the coast line of Trabzon Province, of District, between Solaklı Stream to Hopa Port, from 1 April to 7 June.

Ukraina

No information on any fishery regulation for small tuna species in Ukraina has been made available for this report.

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4. SOCIO-ECONOMICAL ASPECTS OF THE SMALL TUNA SPECIES FISHERIES IN THE MEDITERRANEAN AND BLACK SEA

Many difficulties were encountered to get access to the proper databases in order to obtain the necessary data for the purposes of this report. Nevertheless, the few data collected allowed the construction of a preliminary analysis, which may be considered as a first step towards a better understanding of the relevance of these fisheries.

These species were and are under-considered, this is mainly due to the fact that most of the species are exploited as subsistence resources for many artisanal fishermen and local communities. A further consideration is that landings and catches are obtained by a great number of small vessels, mostly belonging to the small-scale segment of the fleets, landing everywhere and without actively directing the product towards a particular market. With a few exceptions (Turkey is one), the fisheries related to the small tuna species are not usually considered able to catch significant quantities or to activate productive economic

chains. However small quantities grouped together and a better knowledge of these fisheries reveal that this perception might be not entirely accurate.

This preliminary analysis was carried out on prices and total revenues (turnover) for the more abundant small tuna species caught in the Mediterranean Sea. More analyses should be undertaken concerning the socio-economic aspects of these fisheries through case studies and the identification of this gap is an output of this report.

The data related to employment, markets and socio-economic indicators are not currently available in most of the countries because data have never been collected specifically for the fleet segment carrying out these fisheries. However, some data were available, particularly in the case of Morocco.

The EUROSTAT database is the main source for the analysis carried out in this chapter. The Eurostat data are related to time-series and the evolution of price (euro or US$ per kilo), production (metric tonnes - MT), and total revenue (turn-over) of the main small tuna species.

The main species examined are:

- Atlantic bonito (*Sarda sarda*);
- Bullet tuna (*Auxis rochei* and *Auxis thazard*, due to the confusion existing in identifying and reporting the species);
- Little thunny (=Atl. black skipjack) (*Euthynnus alletteratus*);
- Plain bonito (*Orcynopsis unicolor*);
- Skipjack tuna (*Katsuwonus pelamis*).

It is to be taken into due account that catch (=landing) data in Eurostat are sometimes different from the data in the FAO or ICCAT databases and therefore discrepancies might appear. This problem is discussed in the final part of this report.

The information existing in the Eurostat database and some additional data obtained for this study for some countries have permitted this specific analysis to be carried out.

4.1 Overview of small tuna species landings in the Mediterranean Sea

The data existing for small tuna species in Eurostat are related to five main species, considering that the bullet tuna (*Auxis rochei*) and the frigate tuna (*Auxis thazard*) were considered as one species, although landings were sometimes reported for two separate species.

The catches of Atlantic bonito (*Sarda sarda*) show fluctuations over the last 30 years, with an average production of 18 000 tonnes per year for the last 10-year period. Catches of other species, namely Auxids tuna (*Auxis rochei* and *Auxis thazad*) (from here on conventionally named bullet tuna), little tunny (or Atlantic black skipjack) (*Euthynnus alletteratus*), plain bonito (*Orcynopsis unicolor*) and skipjack tuna (*Katsuwonus pelamis*), remained almost stable, with an average catch of 3 700 tonnes, 2 300 tonnes, 120 tonnes and 80 tonnes, respectively (Figure 63).

During the 1970s the total catch for these species was less than 15 000 tonnes; it increased up to a peak of 44 000 tonnes in 1983; since then the total quantity landed decreased until it stabilized around 25 000 tonnes[3] (Figure 63).

[3] The time series do not include the most recent year, when, according to FAO and ICCAT landings data, high catches were obtained, particularly for the Atlantic bonito.

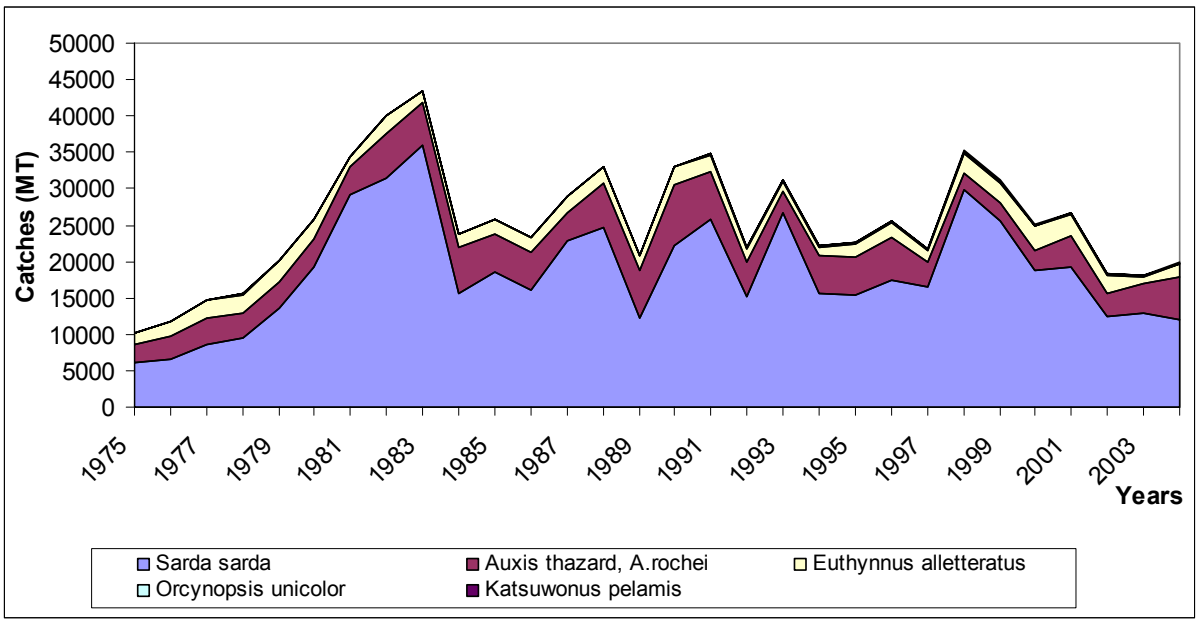

Figure 63 – Catches (metric tons) of small tunas in the Mediterranean; from 1975 to 2004

4.2 The economic relevance of small tuna fisheries.

As stated in the previous paragraph 4.0, it is difficult to find specific data or information about the economy linked to the fisheries of small tuna species. However, for the purpose of this report, it was possible to recover some useful data either from Eurostat or from the scientific community in the region, thus consenting the exploration of the situation in some countries.

4.2.1 EC France

The only species of small tunas reported to Eurostat by France in the Mediterranean is the skipjack; the maximum quantity recorded was 25 tonnes in 2003.

The price of skipjack showed an exponential increase; after a slight decease in 2005, the trend continues moving upwards. The average price recorded in the last five years is EUR3.7/kg (Figure 64).

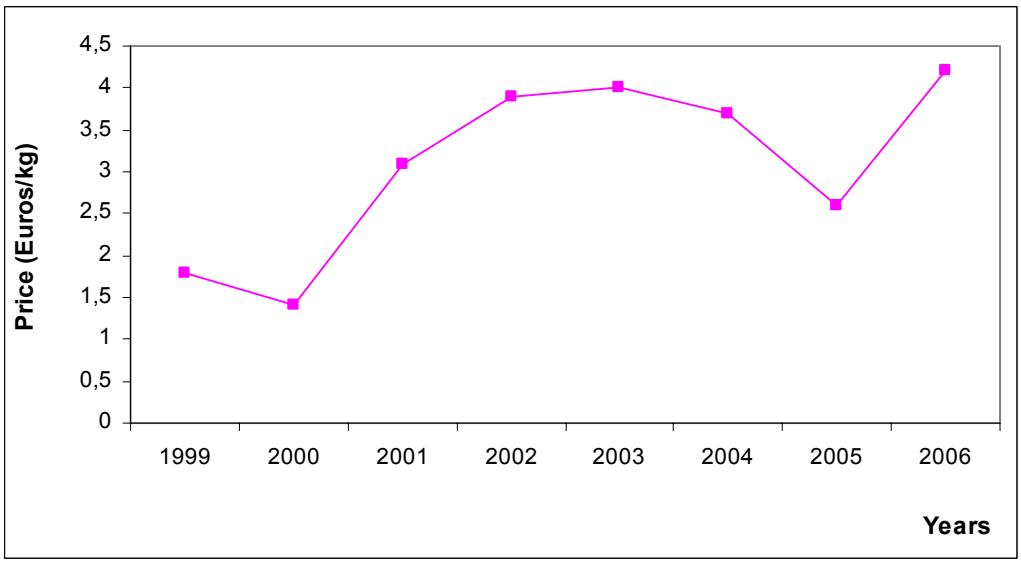

Figure 64 – Average price (EUR/kg) of skipjack in France from 1999 to 2006

4.2.2 EC Greece

According to the Eurostat database skipjack is the main species of small tunas caught in Greece. Its catch reached a maximum of about 2 100 tonnes in 1995. Since then the skipjack quantities decreased, reaching an average of about 1 300 tonnes per year over the last 5 years (Figure 65).

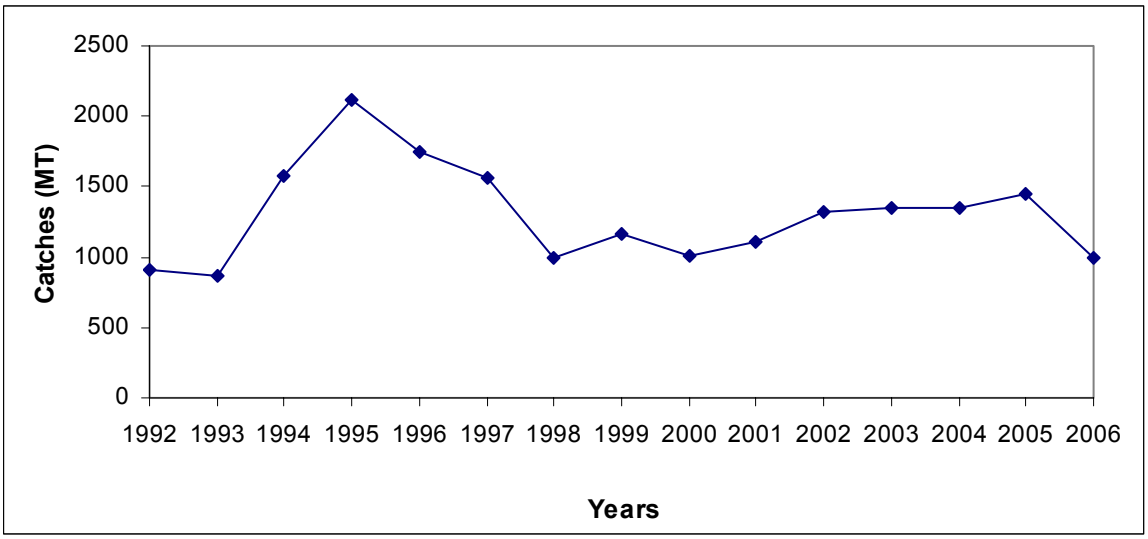

Figure 65 – Catches (metric tonnes) of skipjack in Greece from 1992 to 2006 (Eurostat)

The total revenue (turn-over) made by the Greek fleet targeting skipjack reached an total of about 7,5 million euros between 1995 and 1997. Since then it has decreased, stabilizing at around 5 million euros during the last 5 years (Figure 66).

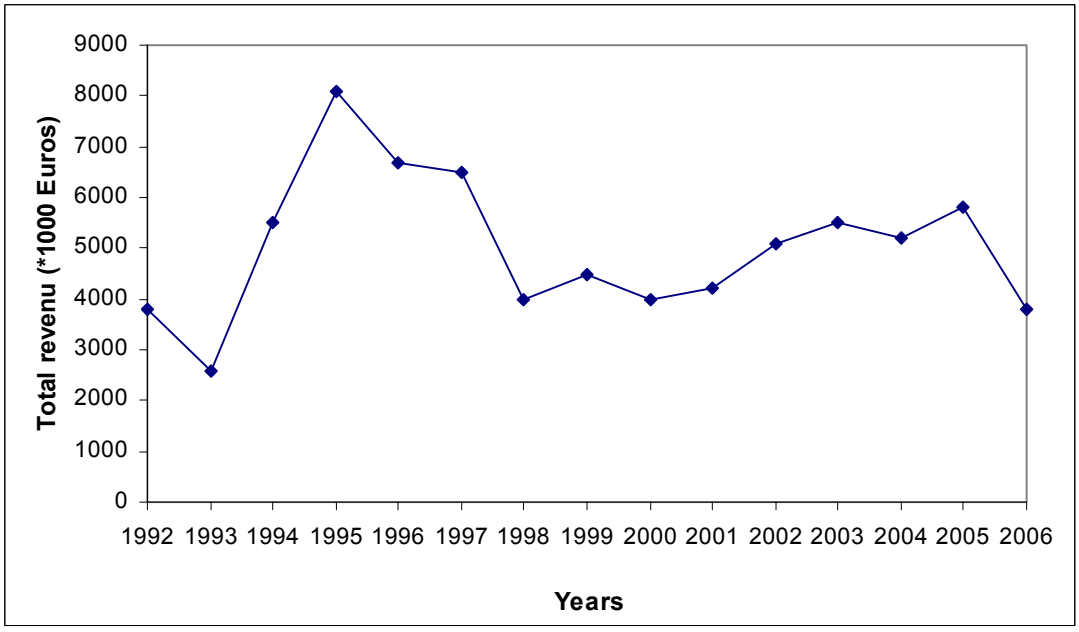

Figure 66 – Total revenue (turn-over, with values in 1 000 euros) made by the Greek fleet having targeted skipjack from 1992 to 2006 (Eurostat)

The average price per year of the skipjack landed in Greece did not show any remarkable fluctuation; it oscillated between EUR3 and 5/kg, with an average of EUR3.8/kg, with a higher average value in the last five years (Figure 67).

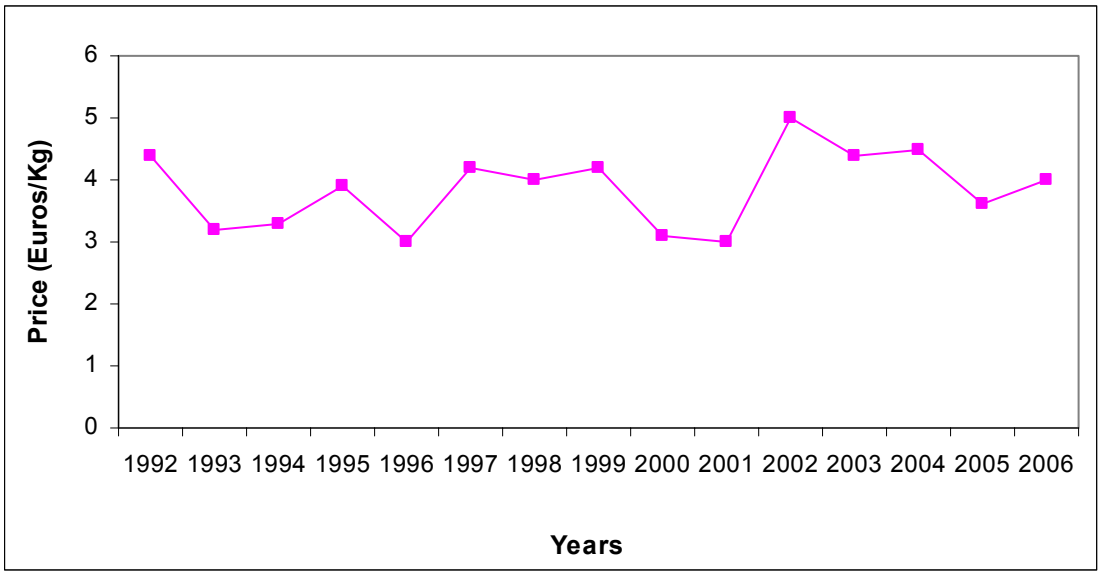

Figure 67 – Price of skipjack landed in Greece (EUR/kg) from 1992 to 2006

Figure 68 shows the trend of the mean price for the other three species of small tunas caught by the Greek fleet over the time period 1983–1997; these species are less important than skipjack in terms of quantities landed in Greece.

The price of bullet tuna is relatively low and remained stable between 1.1 to US$1.7/kg. The price of Atlantic bonito has recorded an upward trend with the highest level of US$6.7 /kg reached in 1985. The price of little tunny showed an upward trend too, but for a lower average price of US$2.9/kg per year (Figure 67).

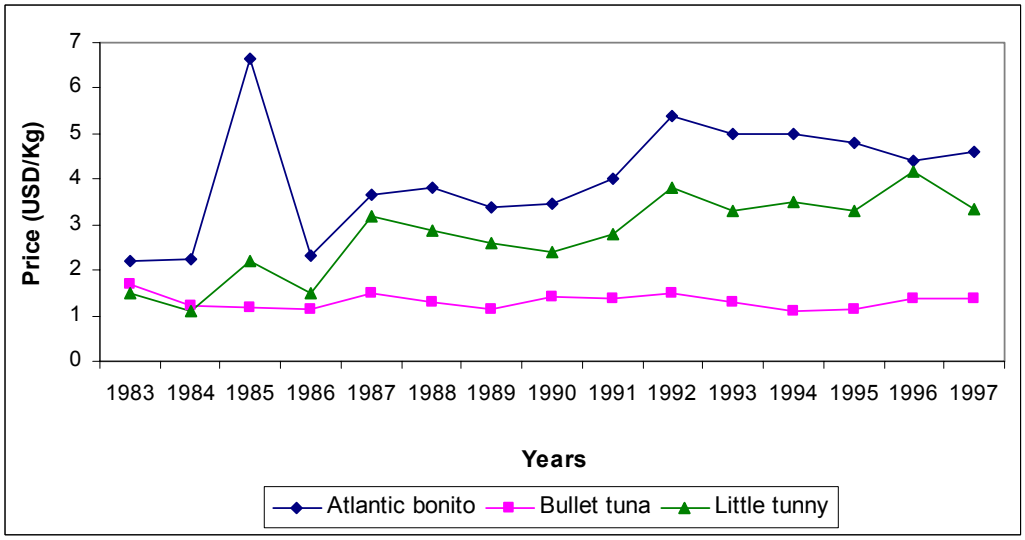

Figure 68 – Price of Atlantic bonito, bullet tuna and little tunny in Greece from 1983 to 1997

4.2.3 EC Italy

According to the Eurostat database, in comparison with other Mediterranean countries and without considering some recent catches reported in other data banks or the catches in the Black Sea, Italy has had on average the highest catches of small tunas. Italian production did not change over the time period 2004 to 2006, with an average of 7 500 tonnes per year (Figure 69).

Also according to Eurostat, the two main species of small tunas caught during the same period in Italy are skipjack and Atlantic bonito. They represent an average of 56 percent and 20 percent of the total catches respectively (Figure 69).

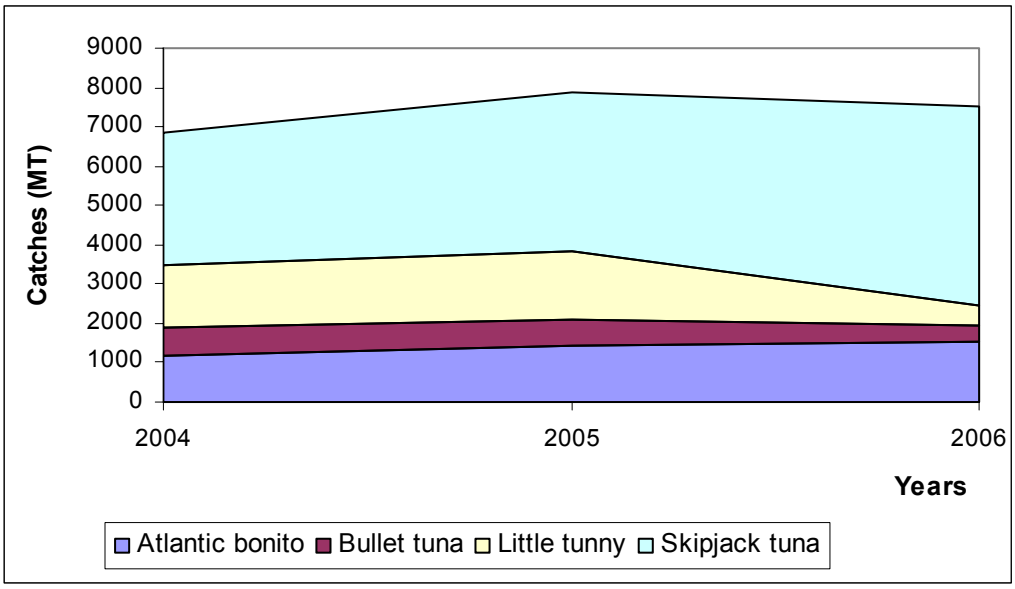

Figure 69 – Reported landings of the main species of small tunas in Italy from 2004 to 2006 (Eurostat)

In terms of total revenue (turn-over) there was a downward trend, from 11.3 million euros in 2004 to 10.1 million euros in 2006. The largest part of these revenues is due to the Atlantic bonito, with a share of 46 percent of the total; the remaining 54 percent was obtained by the landings of the three other species (bullet tuna, little tunny and skipjack) (Figure 70).

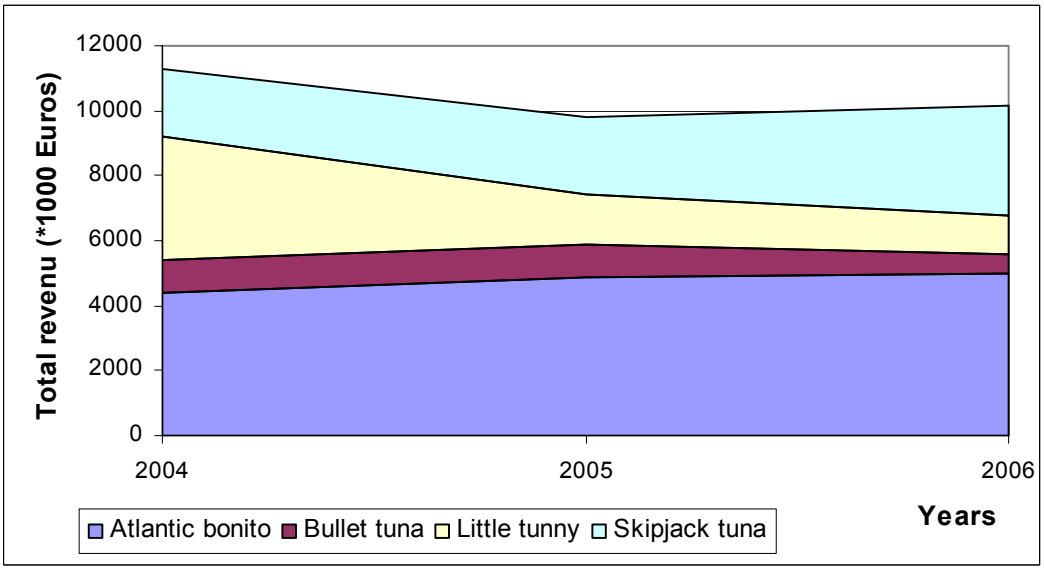

Figure 70 – Total revenue recorded for the four main species of small tunas in Italy (values in 1 000 euros), from 2004 to 2006

Examining the dynamic of prices in the last four years, the averages for the four species together remained almost stable, without noteworthy variations (source IREPA). For the Atlantic bonito the price is around EUR3.4/kg, for the little tunny the average is EUR2.3/kg, for bullet tuna it is EUR1.6/kg and, finally, the lowest price is reported for the skipjack, EUR0.7/kg (Figure 71).

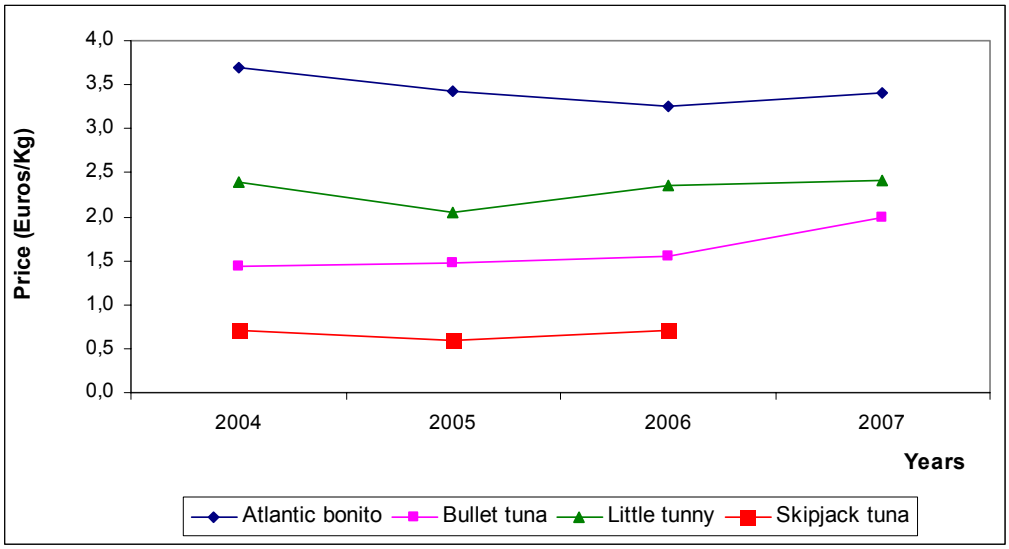

Figure 71 – Average price (EUR/kg) of the main small tunas species in Italy, from 2004 to 2007 (source IREPA). Frigate mackerel is the bullet tuna

4.2.4 EC Malta

The landings of small tunas in Malta from 2003 to 2006 are relatively low and they ranged from 5 to 10 tonnes per year. These quantities are related mainly to two species: the little tunny, accounting for between 4 and 6 tonnes per year and the bullet tuna, with quantities varying between 1 and 4 tonnes per year.

The total revenue (turn-over) has substantially increased during the last four years, varying from about 8 000 euros in the year 2003 to 12 000 euros in 2006 (Figure 72).

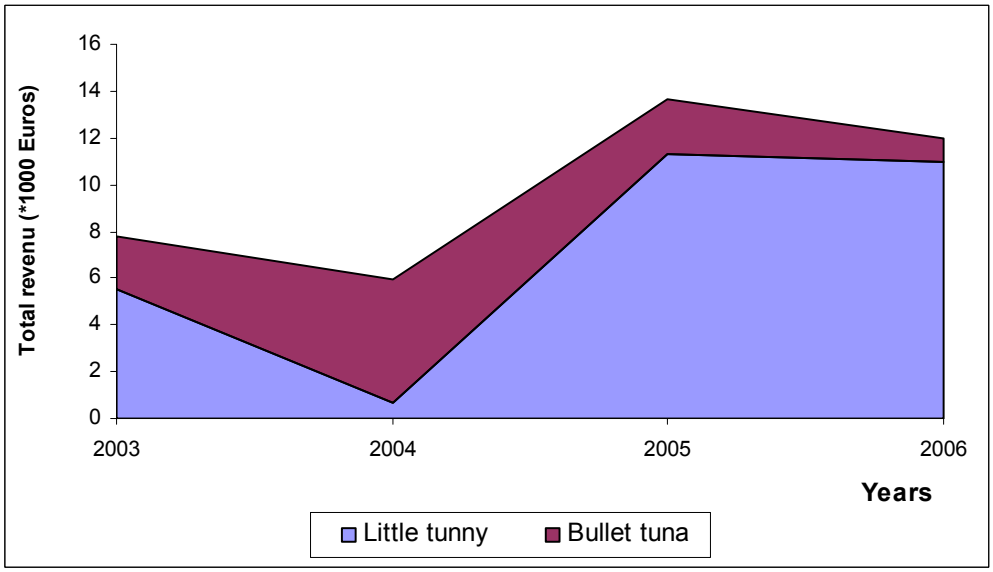

Figure 72 – Total revenue (turn-over, value in 1 000 euro) of the two main species of small tuna in Malta, from 2003 to 2006

The prices show two different trends between the two species in the same period (2003–2006). The price of bullet tuna price was almost steady around 1 euro/kg, with a slight increase in the last year, while the price of little tunny jumped from EUR1,5/kg to EUR2.5/kg from 2003 to 2006, with a peak of more than 3 euros in 2005 (Figure 73).

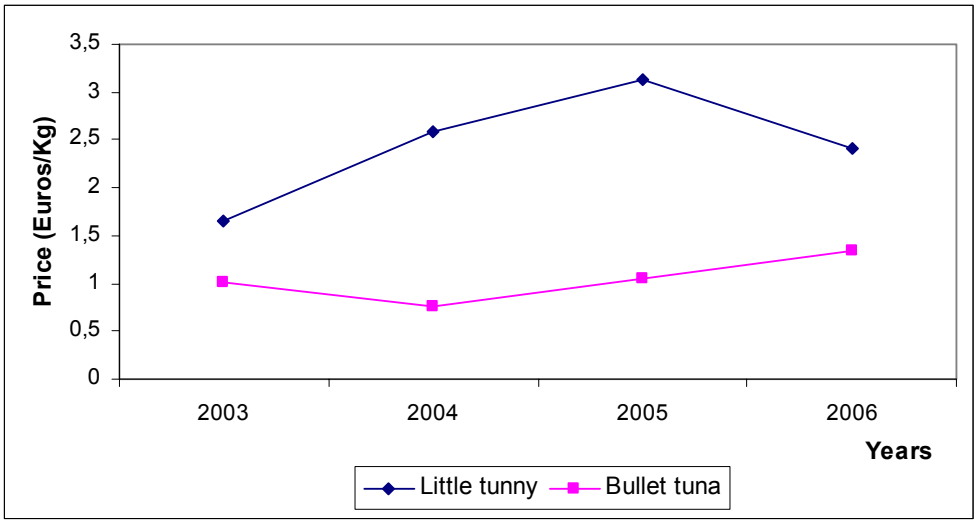

Figure 73 – Average price (EUR/kg) of the two main species of small tuna in Malta, from 2003 to 2006

4.2.5 EC Slovenia

According to Eurostat database, only 1 tonne of small tuna species was landed in Slovenia in 2006. No data are available on the total value of these fish or on their price.

4.2.6 EC Spain

A large proportion of the Spanish catches of small tunas is from the Atlantic Ocean fisheries; the quantities obtained in the Mediterranean are relatively low. The latter, according to Eurostat, showes a downward trend from 1996, followed by a stable catch from 1998 to 2003, with an increase in 2004. The average quantity landed by the Spanish Mediterranean fleet is around 1 400 tonnes per year over the whole time period (Figure 74).

The bullet tuna and Atlantic bonito are the most important species caught by Spanish Mediterranean fleet from 1996 to 2006 with respectively 870 tonnes and 480 tonnes. A very low quantity has been recorded for the little tunny with an average of about 40 tonnes per year for the same period (Figure 74).

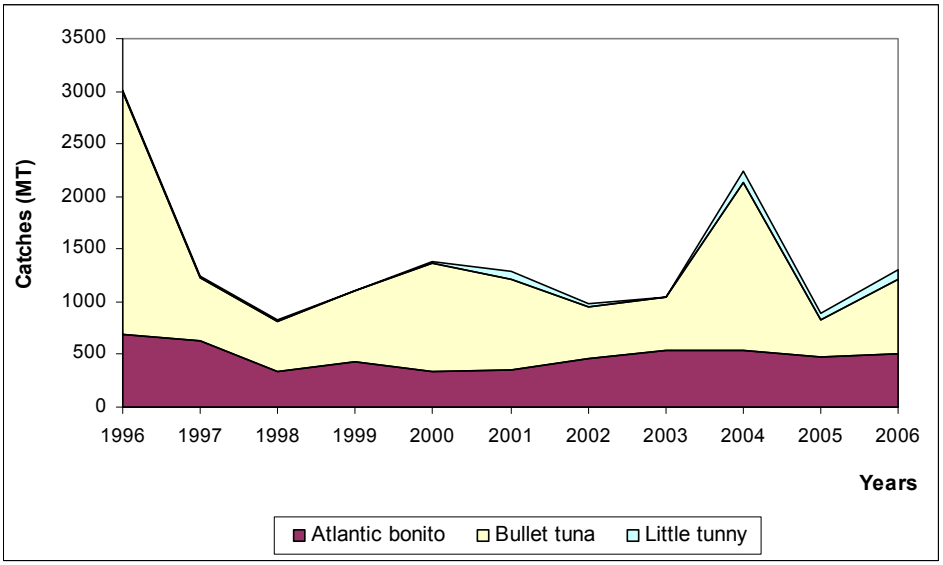

Figure 74 – Catches of the main species of small tunas in Spanish Mediterranean waters from 1996 to 2006 (source Eurostat)

The total revenue (turn-over) drawn from the catches of small tunas in Spain is about 2.8 million euros for the year 2006. This amount has decreased by 45 percent with respect to the quantity landed in 2004. Eighty percent (80 percent) of the 2006 total revenue is related to bullet tuna and Atlantic bonito, where they represent respectively 51 percent and 44 percent of this amount (the remaining is related to little tunny) (Figure 75).

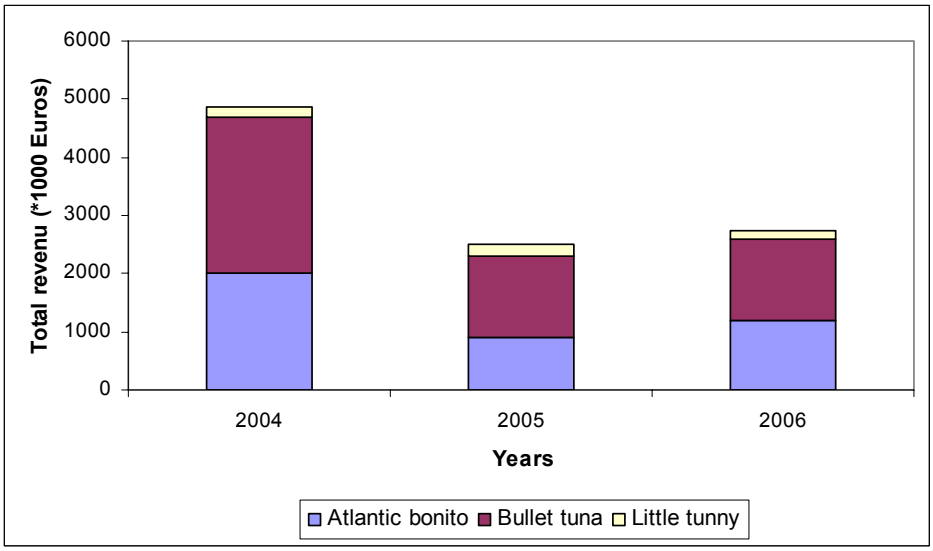

Figure 75 – Total revenue (values in 1 000 euros) attributed to the three main species of small tunas caught in the Spanish Mediterranean, from 2004 to 2006

In terms of price of the three main species of small tuna landed in the Spanish Mediterranean, this parameter does not show any clear annual trend for the time period considered. Therefore, it is important to note the direct correlation existing between the price of bullet tuna and that of little tunny, showing the same trend. On the contrary, the price of Atlantic bonito shows a different pattern; the average prices recorded for the last three years are: Atlantic bonito EUR2.7/kg, bullet tuna EUR2.5/kg and little tunny EUR1.8/kg (Figure 76).

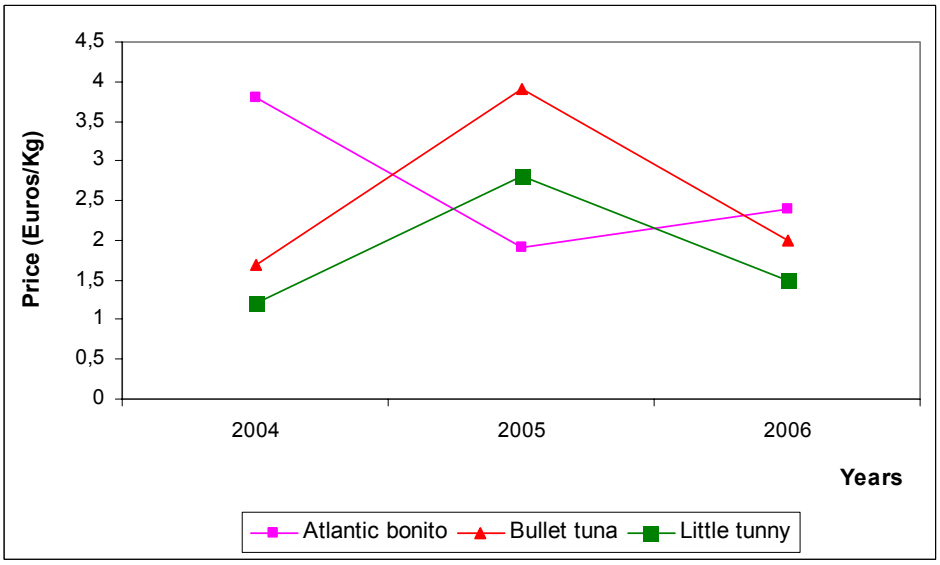

Figure 76 – Average price (EUR/kg) for the three main species of small tunas in Spain (Mediterranean coast) from 2004 to 2006

4.2.7 Lebanon

The catches of small tuna in Lebanon are mostly limited to two species; Atlantic bonito and little tunny. The total catches of these two species ranges from about 200 to 300 tons per year. From 2006 to 2007 the turn-over (total revenue) has increased five times in only one year, from 565 000 US$ in 2006 to 2,5 million US$ in 2007. The annual average price of Atlantic bonito for the time period 2005–2007 ranged from 6 to US$10/kg and that of little tunny was between US$1.3 to US$3/kg (Figure 77).

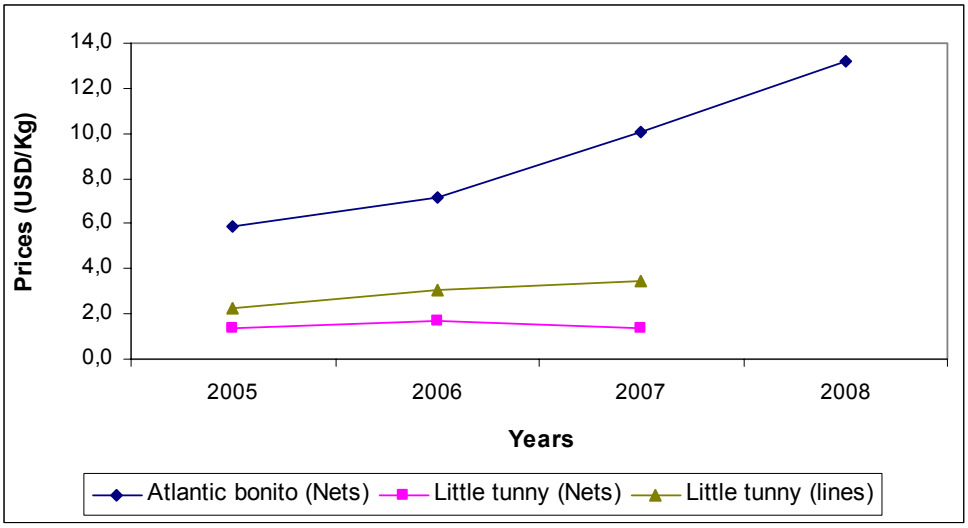

Figure 77 – Mean price per year (US$/kg) for Atlantic bonito and little tunny from 2005 to 2008 (first quarter) in Lebanon

The prices of both species are influenced by the fishing gear used. The Atlantic bonito caught by nets is sold 40 percent higher than that captured by hooks and lines, reaching an average price of US$9.1/kg for the first, against US$6.6/kg for the latter.

The opposite occurs with the little tunny, the individuals of this species when caught by lines are valued much more highly (100 percent) than the ones caught by nets. In terms of price, it reaches US$2.9/kg when catches are obtained by lines, against only US$1.4/kg when they are obtained by nets (Tables 28 and 29).

Table 28 — Catch (tonnes), price (US$/kg) and value (US$) of Atlantic bonito, caught in Lebanon from 2005 to 2008 (first quarter only)

Year	Catch (tonnes)	Price (US$/kg)	Value (US$)	Gear used
2005	60.0	5.9	352,645	Nets
2006	50.0	7.2	359,691	Nets
2006	1.0	6.0	7,689	Lines
2007	230.0	10.0	2,338,924	Nets
2007	0.3	7.2	1,877	Lines
2008	0.1	13.2	1,760	Nets

Table 29 – Catch (tonnes), price (US$/kg) and value (US$) of little tunny, caught in Lebanon from 2005 to 2008 (first quarter only)

Year	Catch (tonnes)	Price (US$/kg)	Value (US $)	Gear used
2006	122.0	1.3	164,214	Nets
2006	15.0	2.2	33,373	Lines
2007	58.0	1.7	100,630	Nets
2007	3.0	3.0	8,700	Lines
2008	2.0	1.3	2,507	Nets
2008	0.6	3.4	1,963	Lines

4.2.8 Morocco

In Morocco small tuna fishery is much more important along the Atlantic coast. In the Mediterranean Moroccan coast, however, there is fishing activity targeting mainly two species of small tunas: the bullet tuna and the Atlantic bonito. The average quantities landed over the time period 1996 – 2006 are respectively 590 tonnes and 70 tonnes. The little tunny is caught by small scale fishery.

In terms of price, the frigate mackerel showed an upward trend during the last ten years and a remarkable increase in 2006, with an average of about US$0.8/kg, whereas that of Atlantic bonito is almost stable in the period considered, with yearly variations, getting average price of US$1.2/kg (Figure 78).

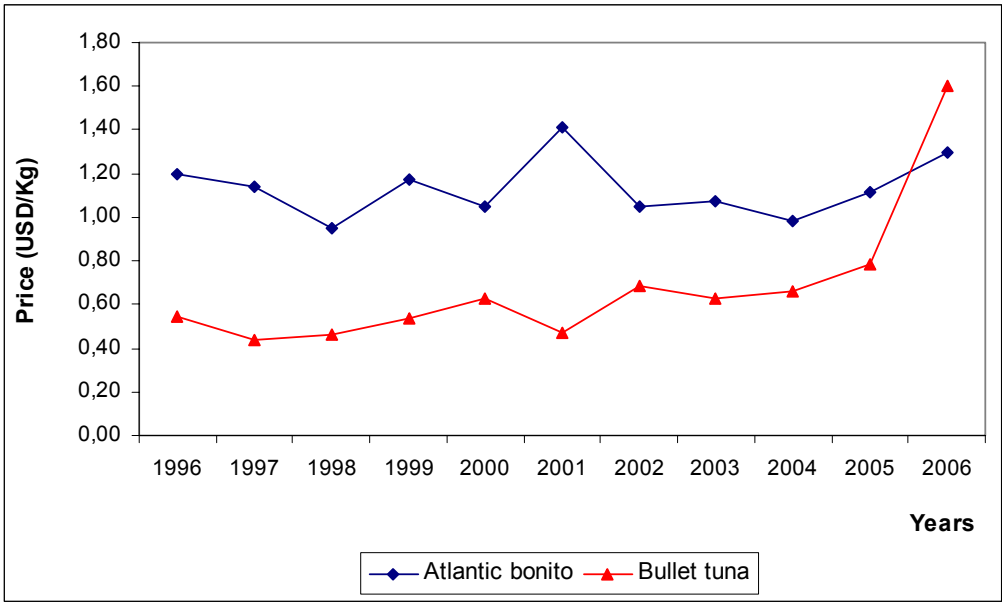

Figure 78 – Average price per year (US$/kg) of bullet tuna and Atlantic bonito, landed in Morocco, from 1996 to 2006

Along the Mediterranean coast of Morocco, small tunas are mainly targeted by a small-scale fishery of more than 1 000 small boats plus hundreds of longliners which operate seasonally. The majority of the fishing season lasts between 3 and 6 months per year. These fishing activities offer part-time employment to about 4 000 fishers.

The greatest part of the small tunas landed in Morocco is used by the canning industry at local level, providing raw products for factories based in the main coastal towns.

It is important, however, to emphasize that small tunas are not yet sufficiently valued by retailers and consumers, and this explains their low market values in comparison with other similar species. The small specimens are sometimes used as bait for longline or other line fisheries.

4.2.9 Turkey

The Atlantic bonito is the main species among all the various species of small tunas landed by Turkish fleet. The quantities of this species reached a remarkable amount of 70 000 tonnes in 2005 (Figure 79). However, the landings of little tunny and bullet tuna in the years 2004–2006, show respectively an average quantity of 770 tonnes and 780 tonnes.

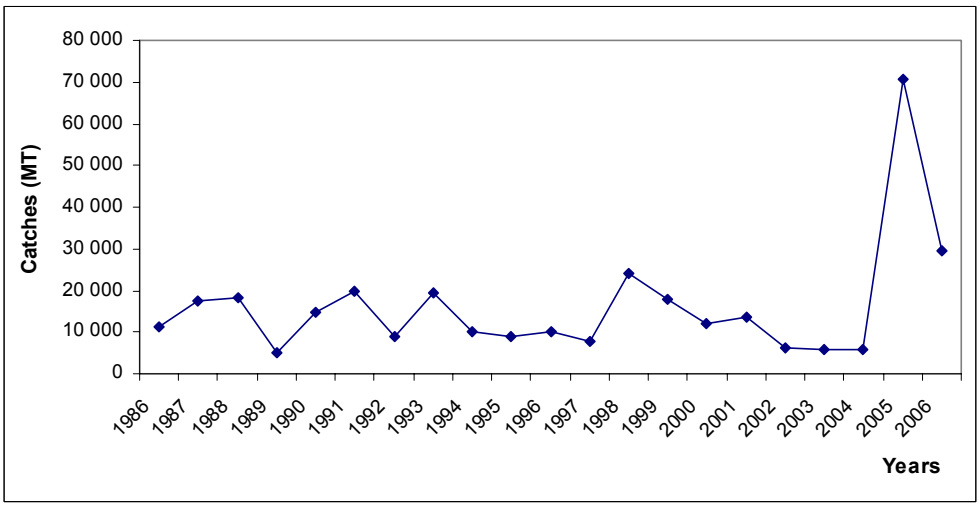

Figure 79 – Catches of the Atlantic bonito landed in Turkey from 1986 to 2006

No data are available for this very important fishery in terms of global value or on the prices in the various years.

4.3 An overall economic indicator for small tuna fisheries.

It is quite difficult to define the economic relevance of the fishery catching small tuna species in the Mediterranean and the Black Seas, due to the number of uncertainties that are pointed out in several paragraphs of this report.Using the available data on catches it is, however, possible to identify at least one indicator.

To achieve this, the total revenue is used; it is obtained from the four main species of small tunas landed by most of the Mediterranean and Black Sea countries. The calculation was done by using the average price of each species per year and the corresponding total catch reported by Eurostat for the whole Mediterranean and Black Sea region.

According to these inputs, the total revenue estimated for all the four species combined is about 42 million euros in 2004, 168 million euros in 2005 and 88 million euros in 2006.

Considering the most important species in the study area, the Atlantic bonito (*Sarda sarda*), the annual revenue is estimated at about 80 million euro in 2006; it was twice this amount in 2005 (160 million euros), and about 40 million euro in 2004 (Figure 80).

The same estimation provides values for the annual revenue concerning the other three species, bullet tuna (*Auxis rochei*, including *Auxis thazard*, as it is sometimes reported), skipjack (*Katsuwonus pelamis*) and little tunny (*Euthynnus alletteratus*). The dynamics of annual income from these catches show different trends among the single species, which are also quite different from the values obtained for the Atlantic bonito, with higher values on average in 2004 and then more or less stable lower values in 2005 and 2006 (Figure 81).

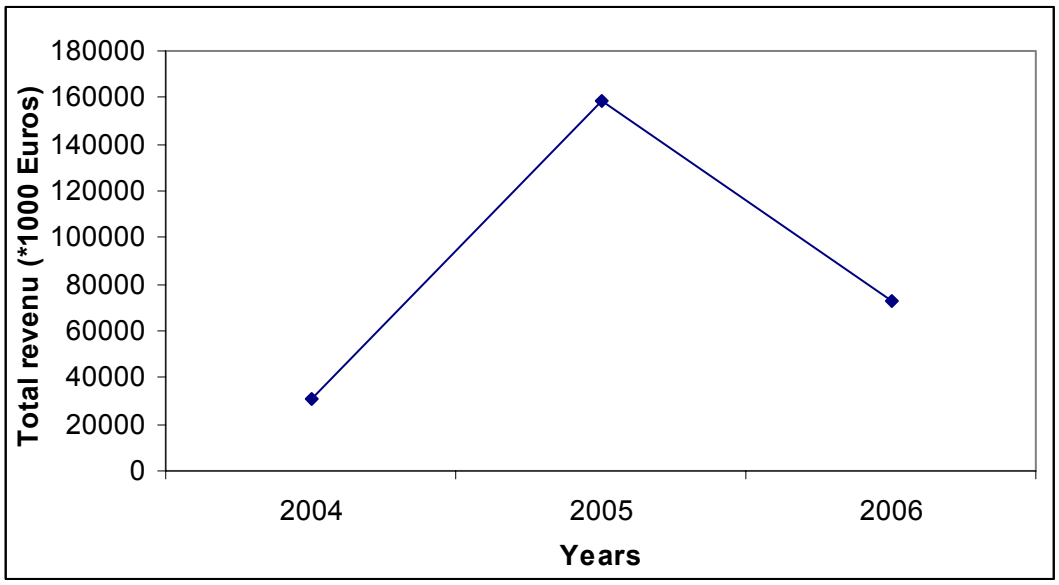

Figure 80 – Total revenue (values in 1 000 euros) estimated for Atlantic bonito in the Mediterranean and Black Sea area (all countries together), from 2004 to 2006

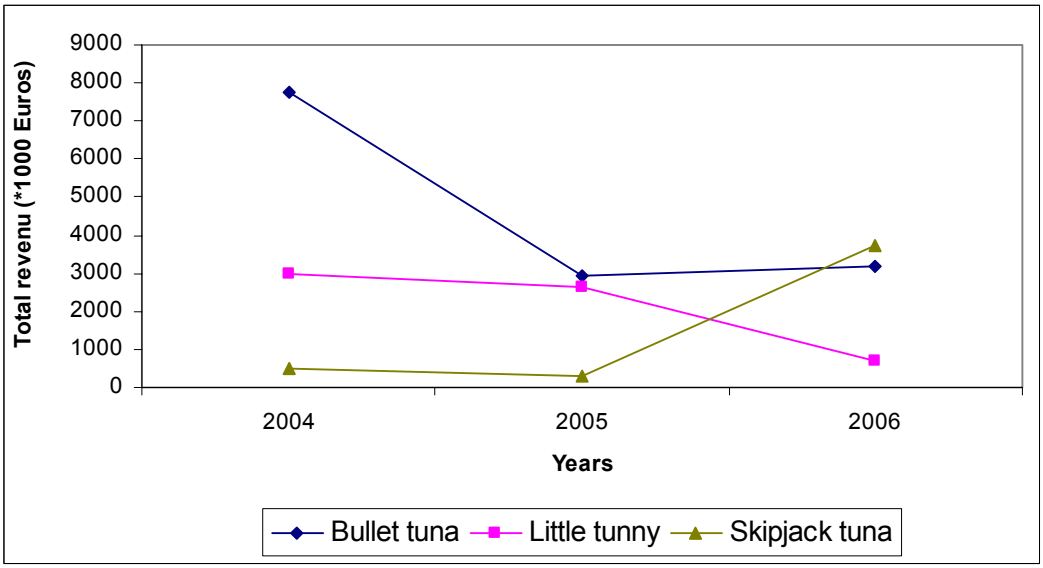

Figure 81 – Total revenue (values in 1 000 euros) estimated for bullet tuna, little tunny and skipjack – Mediterranean sea area (all countries together), from 2004 to 2006

The economic relevance of the small tuna species fisheries appears quite important from this first estimation exercise, taking into account that to the assessment should be considered a very prudential one, due to the many uncertainty factors which create an effective underestimation of the possible status of these fishing activities in the Mediterranean and Black Seas.

It is important to underline that, besides of the lack of several data and information, it appears quite clear that when combined these fisheries have high economic relevance for Mediterranean and Black Sea countries, certainly comparable with other much more well-known fisheries for other species.

4.4 Socio-economic indicators for small tuna fisheries

One of the preliminary goals of this report was to find some socio-economic indicators, able to define the relevance of these fisheries better. Despite the various efforts to obtain data useful for this exercise from both official sources and from the region's scientific community working in various research institutes in many Mediterranean countries, it has proved impossible to disentangle the existing information from the rest of the fisheries. Indeed the basic information, when and where it exists, is mixed up together with other components of the small scale fishery or with other segments of the fleets.

Only the future implementation of an approach to data collection by "métier" and related segments might allow for the improved identification of the data required to distinguish the various aspects of these fisheries.

The fact that these fisheries were considered for a long time as just a sort of traditional subsistence activity, able to partially support the needs of several coastal communities along the shores of the Mediterranean and Black Seas, alone substantiates the fact that these fisheries have a certain socio-economic relevance throughout the area.

More specific effort is needed to define these fisheries, including the economic and socio-economic aspects. Métier-based data collection approach, field surveys and dedicated pilot studies are useful tools to be used to improve the understanding of these fisheries immediately.

5. DISCUSSION

It is very clear, from what has been reported in the previous chapters, that much knowledge does not yet exist about the fishery of small tuna species in the Mediterranean and the Black Seas. While some situations are getting better and data are generally improving, others appear still undefined.

The landing data represent one of the points where an improvement is necessary. As has been pointed out several times in the report, there are a number of factors affecting the reliability of the landing data. It is certain that not all the countries are declaring their catches of small tuna species and it is strongly suspected that several others are under-estimating or under-reporting their catches. This is mostly due to the low consideration given to this fishing activity, which is not believed to be relevant in terms of production and

annual revenues. As we reported in the previous chapters, this is far from the reality and these fisheries are quite significant.

An overview of the species reported by countries to ICCAT is provided in Table 30.

Table 30 – Details of the Countries reporting catches of small tuna species from the Mediterranean and the Black Sea to ICCAT

COUNTRY	GFCM	ICCAT	reported catches to ICCAT						
	member	member	BON	LTA	FRI	BLT	SKJ	BOP	TUN
Albania	X	X							
Algeria	X	X							
EC-Bulgaria*	X	X							
Croatia	X	X							
EC-Cyprus*	X	X							
European Community	X	X							
Egypt	X	X							
EC-France*	X	X							
Georgia									
Gibraltar**									
EC-Greece*	X	X							
Israel	X								
EC-Italy	X	X							
Japan***	X	X							
Lebanon	X	X							
Libya	X	X							
EC-Malta	X	X							
Monaco	X								
Montenegro°	X								
Morocco	X	X							
Palestinian Territories									
EC-Portugal***		X							
EC-Romania	X	X							
Russia		X							
EC-Slovenia	X	X							
EC-Spain	X	X							
Syria	X	X							
Tunisia	X	X							
Turkey	X	X							
Ukraine									
NEI (unclassified)									
Former Countries									
Yugoslavia									
U.S.S.R.									

NOTES: *Represented in ICCAT by the EC; ** Belonging to UK (EC); ***Country fishing in the Mediterranean even if not coastal;° formerly Serbia and Montenegro .

Note: Libya = Libyan Arab Jamahiriya
Syria = Syrian Arab Republic
USSR = the former Union of Soviet Socialist Republics

According to ICCAT, five out of 29[4] countries or entities are not reporting any catch of small tunas. Among the others, six of them had sometimes reported catches in the past for a single species. Therefore 17 percent are not reporting catches and 21 percent had sometimes reported the catches of one species only; this result in 38 percent of the countries not reporting their catches of small tuna species, except for some years and for one species only. This is an important point to be taken into account when assessing the real situation of these fisheries.

Due to the fact that the FAO[5] statistics were used to describe the fishery of these species (chapter 3 of this report) and that EUROSTAT statistics were used to describe the economics of these fisheries, it is useful to complete the overview with the ICCAT statistics. Indeed the fishery of all these species must be reported to ICCAT by all member States (21[6] out of 29) and so it is quite relevant to show which data were provided by the statistical services of the various states to the well-established ICCAT data bank.

The total catches reported to ICCAT are shown in Figure 82. These include the reported catches of Atlantic bonito, bullet tuna, frigate tuna, little tunny, skipjack, plain bonito and undefined tunas including the small tuna species (*Thunnini*).

The average catch over the entire period of 57 years (1950–2006) is about 28,108 tons, quite a relevant amount when considering that they range from 653 to 78 037 tonnes per year.

Figures 83 and 84 show all catches one by one by species, as they are reported to ICCAT.

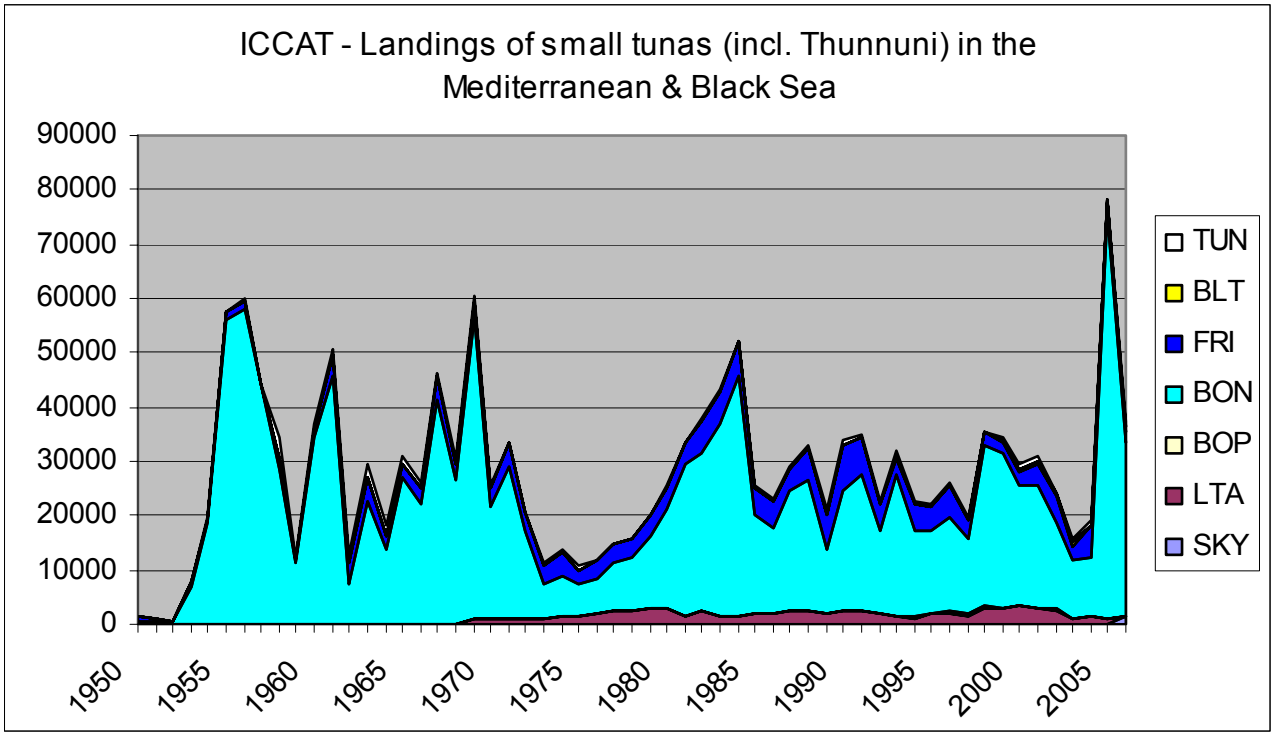

Figure 82 – Total cumulated catches by species in the Mediterranean and the Black Seas, as they are reported by the countries to ICCAT from 1950 to 2006

[4] The European Community is not taken into account in this calculation, because catches are individually reported by EU Countries.
[5] 24 out of 30 Countries or entities are members of the GFCM.
[6] Among them, 10 are EU Countries, plus Gibraltar.

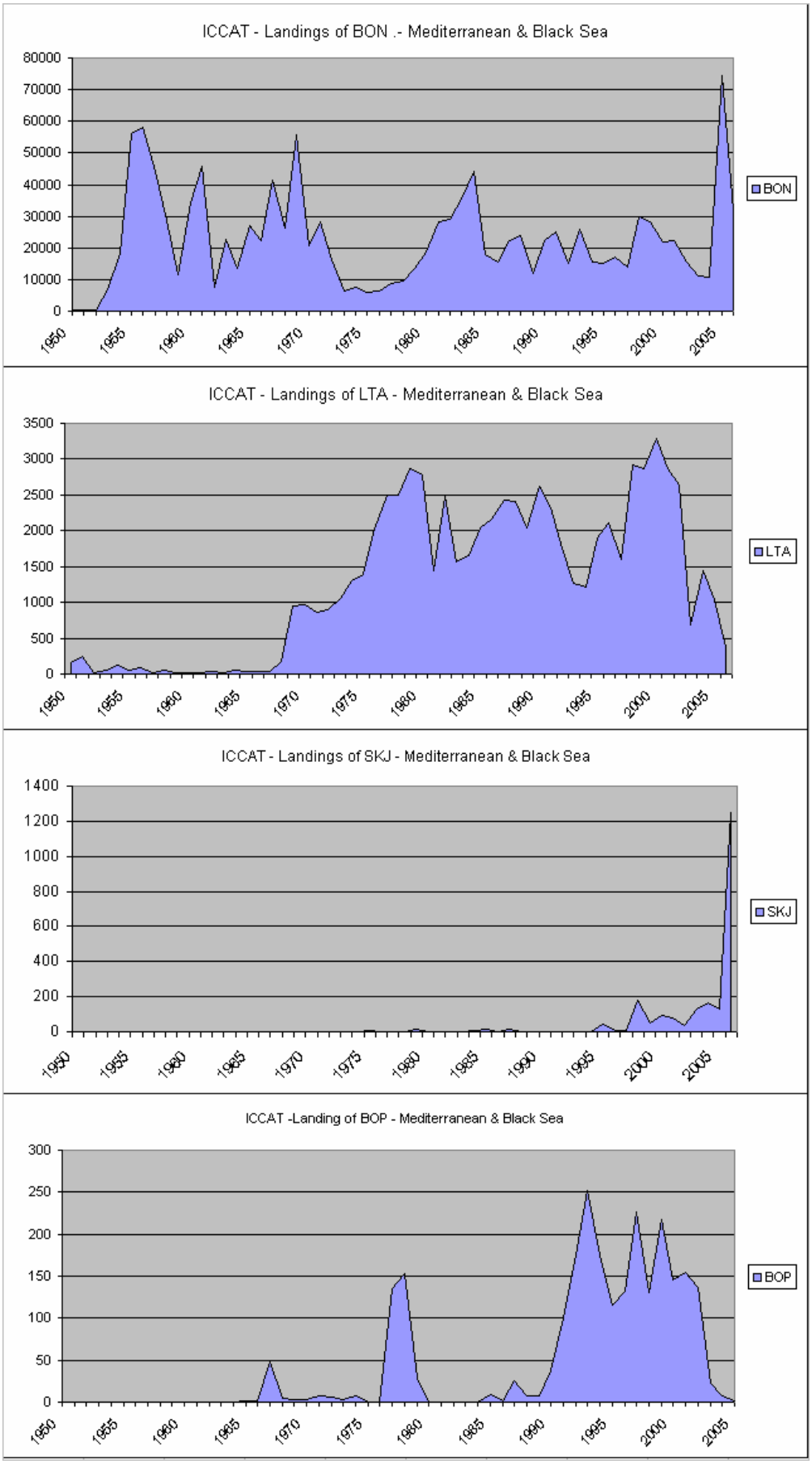

Figure 83 – Total catches of Atlantic bonito (BON), little tunny (LTA), skipjack (SKJ) and plain bonito (BOP) in the Mediterranean and the Black Seas, according to ICCAT from 1950 to 2006

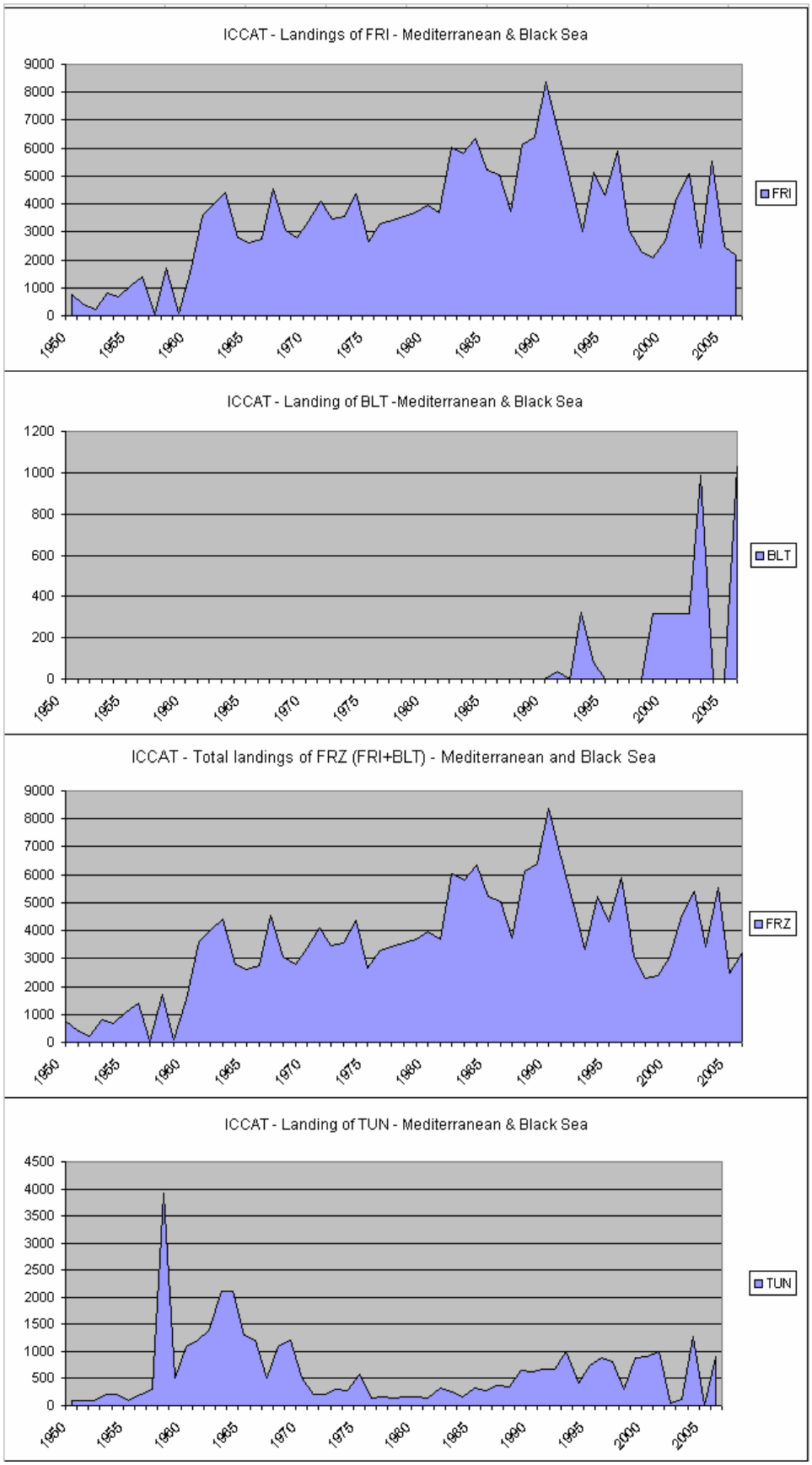

Figure 84 – Total catches of frigate tuna (FRI), bullet tuna (BLT), total *Auxis* spp. (FRZ) and thunnini (TUN) in the Mediterranean and the Black Seas, according to ICCAT from 1950 to 2006

The ICCAT database shows that the maximum average yearly catches over the period 1950–2006 are related to Atlantic bonito (*Sarda sarda*) with about 22,599 tonnes (range 327–74 375 tonnes), and then to frigate tuna (*Auxis thazard*) 3 461 tonnes (range 32–8 360 tonnes), little tunny (*Euthinnus alletteratus*) 1 271 tonnes (range 11–3 294 tonnes), thunnini (unidentified tunas) 629 tonnes (range 4–3 916 tonnes), bullet tuna (*Auxis rochei*) 65 tonnes (range 0–989 tonnes), plain bonito (*Orcynopsis unicolor*) 44 tonnes (range 0–252 tonnes) and finally skipjack (*Katsuwonus pelamis*) 39 tonnes (range 0–150 tonnes).

Whenever the identification problem of *Auxis* spp. is taken into account, then it should be better to join the two species of *Auxis* reported to ICCAT for the Mediterranean and the Black Sea, getting into the ICCAT code FRZ (able to include either *Auxis thazard* and *Auxis rochei*). The average over the period is about 3 526 tonnes (range 72–8 360 tonnes).

The ICCAT data show a lot of yearly variation in the fishery of each species and in some cases there are possible periodic cycles. It would be necessary to conduct more detailed analyses to improve definition and understanding of the combined effects of natural population cycles, fishery effort, fishing strategies, ecological factors, and so forth on these oscillations in catches.

Even where the ICCAT data are concerned, it is clear that it cannot be excluded that some small tuna catches might be reported with misidentification problems, as occurs in other databases (FAO and EUROSTAT). These problems can worsen when considering that some countries are reporting catches of one species to ICCAT and another species to a different organization.

It is interesting to make a comparison between different databases, trying to identify and understand any discrepancies better, at least for the most important species in terms of landed quantities. The first comparison is between the FAO and the ICCAT databases (Figures 85, 86 and 87), because a lot of work has been undertaken in the past to homogenize the databases and to try to reduce the discrepancies.

Where the Atlantic bonito is concerned, the data in the two databases are quite comparable, with some discrepancies from 1950 to 1960 and from 2000 to 2004 (Figure 85).

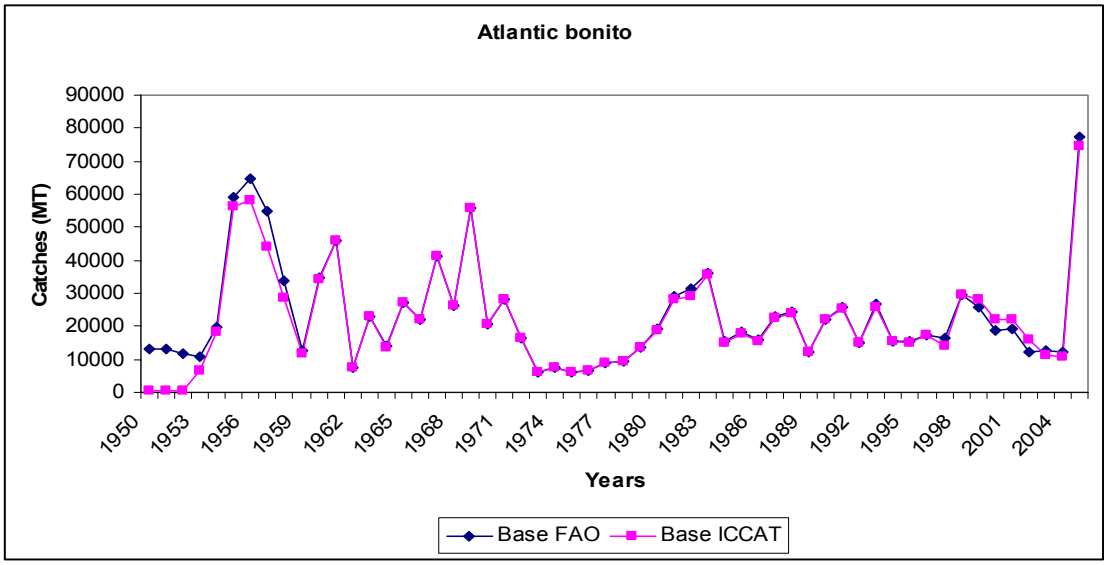

Figure 85 – Comparison of total declared catches for Atlantic bonito between FAO and ICCAT databases

A similar situation exists for the frigate tuna, which is possibly the bullet tuna, according to the most recent discussions about the classification of the Mediterranean specimens. The major discrepancies between the two databases are related to the early period (1950–1961) and again in the most recent years (2001–2004), with isolated years presenting small differences (Figure 86).

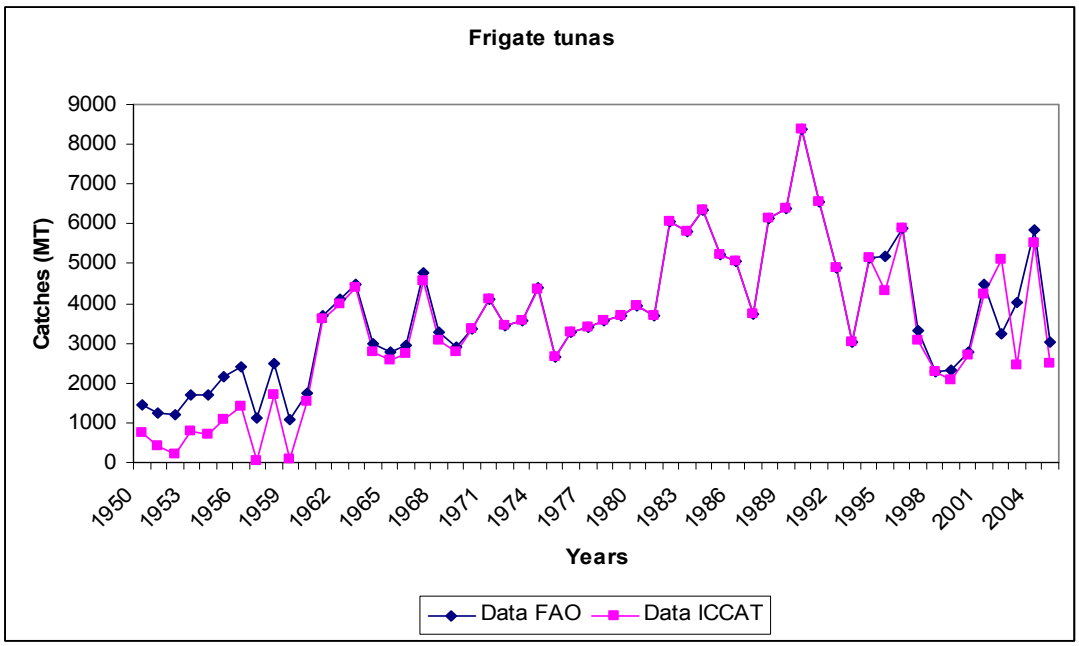

Figure 86 – Comparison of total declared catches for frigate tuna (possibly bullet tuna) between FAO and ICCAT databases

The discrepancies are more relevant in the comparison of the two databases for the little tunny. There is a significant difference in the declared landings from 1950 to 1970 and this might be caused by some countries not reporting data to ICCAT for these early periods. Other discrepancies exist in the last three years (Figure 87).

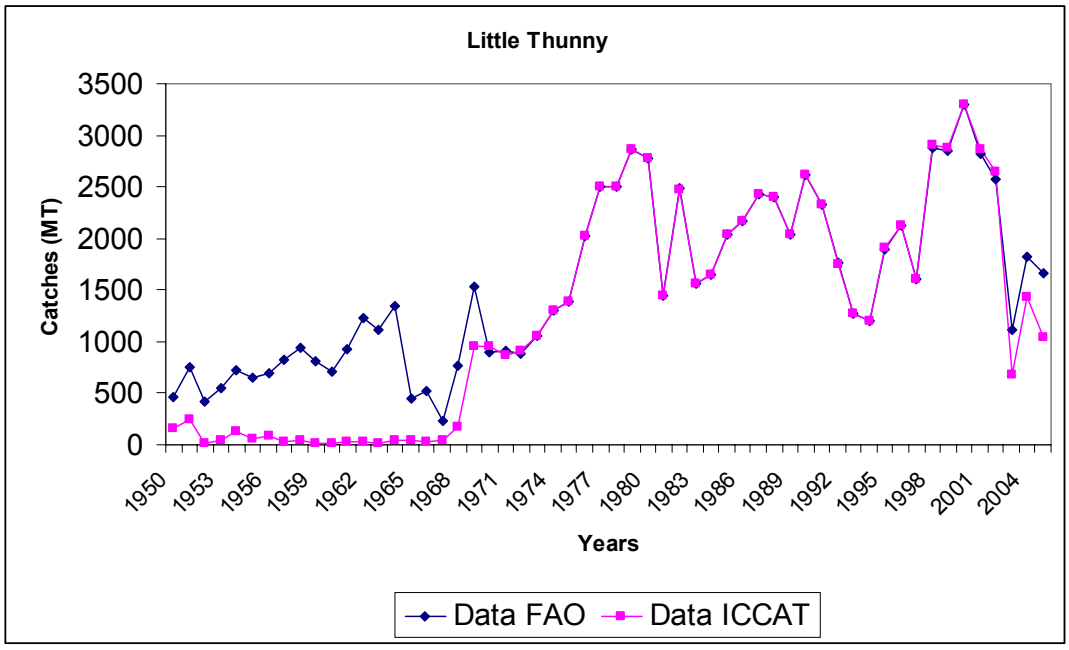

Figure 87 – Comparison of total declared catches for little tunny between FAO and ICCAT databases

The comparison between the ICCAT and EUROSTAT (with a smaller time series) databases shows that most of the problems are situated there and the two databases shows relevant discrepancies (Figures 88, 89 and 90).

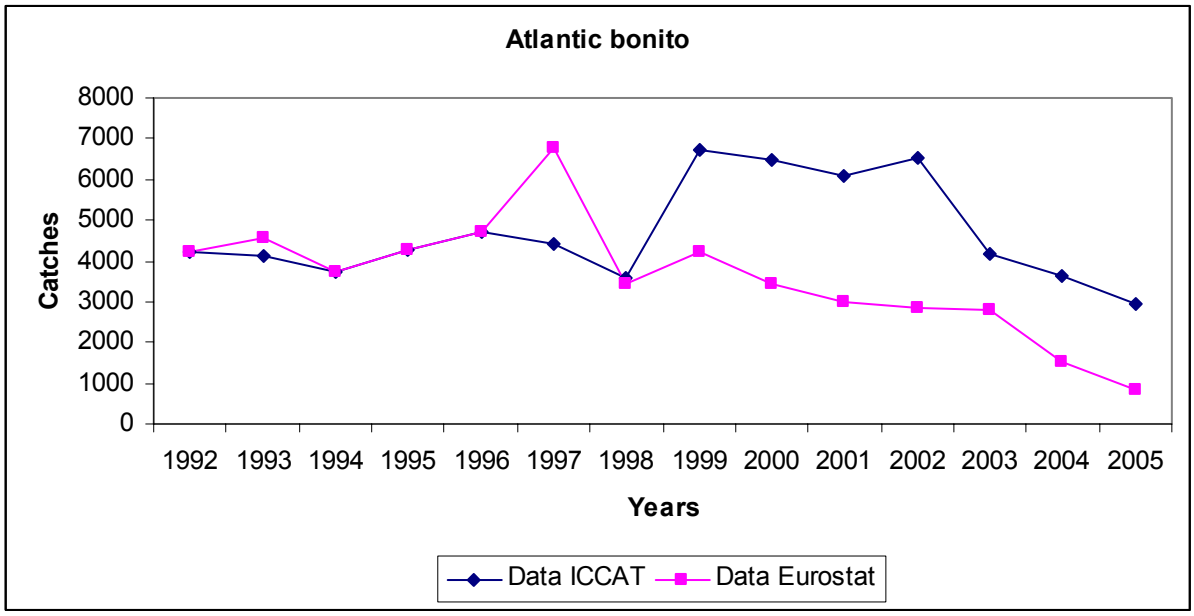

Figure 88 – Comparison of total declared catches for Atlantic bonito between ICCAT and EUROSTAT databases

Major problems exist for the reported landings of Atlantic bonito in the two databases (Figure 88). The discrepancies exist for all years except for 1992, 1994, 1995 and 1996, and they are quite relevant from 1998 onward.

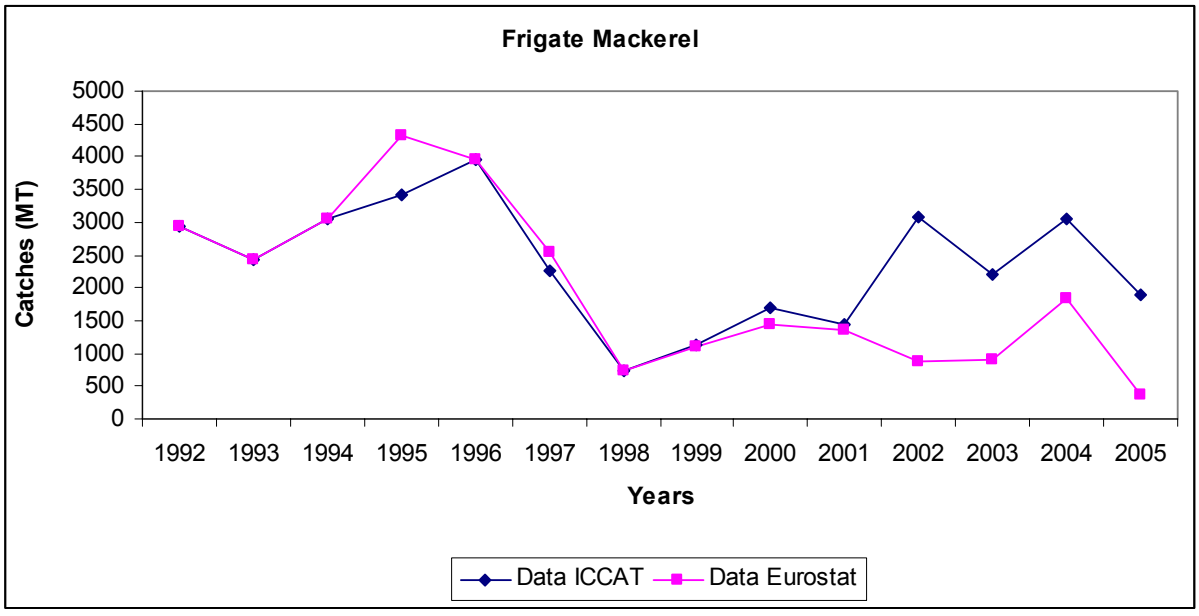

Figure 89 – Comparison of total declared catches for *Auxis* spp. (reported as frigate tuna but possibly being bullet tuna) between ICCAT and EUROSTAT databases

Similar problems exist for *Auxis* spp. (possibly bullet tuna and not frigate tuna), where data are more or less following the same trends until 2001, with some minor discrepancies except for a more relevant one in 1995, after which the two databases start to show major differences until the most recent years.

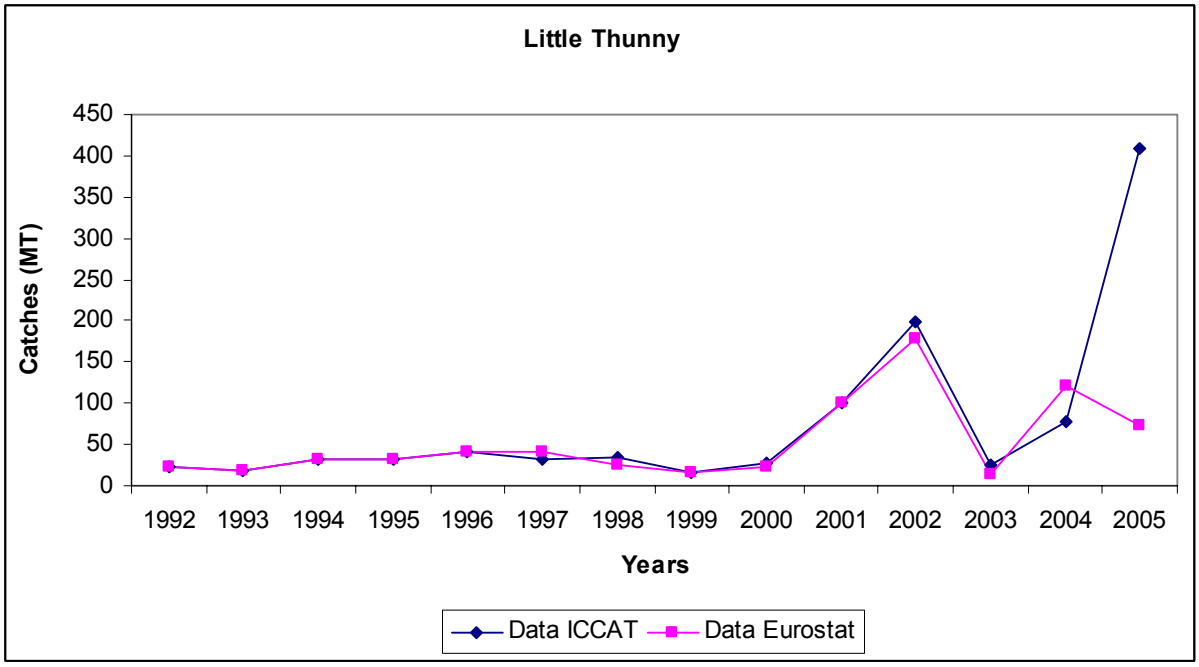

Figure 90 – Comparison of total declared catches for little thunny between ICCAT and EUROSTAT databases

A much better situation exists for the landing data on little tunny. In this case, the two databases show good comparability for most of the years, with very minor discrepancies until 2003. Following this something happened and data start to show discrepancies, which are particularly relevant in the last year.

Other inconsistencies exist for minor small tuna species in terms of reported landings, particularly for skipjack (*Katsuwonus pelamis*) in some countries and for some years.

Another important point, which has emerged from many parts of this report, is the correct classification of some species, either in terms of declaration of statistics or scientific identification according to the most updated zoological nomenclature.

As a matter of fact, it is clear that some discrepancies might be caused by catches declared, for instance, as one species to ICCAT or FAO and as another species to EUROSTAT. This is sometimes caused by two different offices manipulating the original data sets at national level, attributing different international codes to a particular vernacular name. This is likely to occur for small tuna species, because sometimes local vernacular names identify different species in the same way according to different geographical places. This issue needs to be put right, requesting the support of specialized scientific institutions.

A further problem is much more closely related to a scientific issue, already discussed in chapter 3.0. It concerns the classification of *Auxis* spp. in the Mediterranean (and possibly in the Black Sea if present) which, according to the latest scientific findings, should be correctly classified as *Auxis rochei* (bullet tuna – BLT). This is not to be underestimated, because currently most statistics concern *Auxis thazard* (frigate tuna – FRI) in all databases, while some catches of bullet tuna were also reported from time to time. This can create unwanted confusion in the statistics and needs to be solved by a correction to the data bank.

6. CONCLUSIONS

The history of small tuna fisheries in the Mediterranean and Black Seas after World War II appears rather unclear and complicated to define.

The common existing perception that these fishing activities are not particularly relevant either in terms of catches or revenues, is well established almost everywhere, with very few exceptions. This is also still affecting the importance given to the reporting of the catches. It is commonly believed that these fisheries are mostly subsistence activities, while, on the contrary, they are able to provide important production levels. The fleet catching small tunas is practically undefined or not identified in most of the countries, but it is generally known that thousands of small and medium size vessels, engaged in the small-scale, artisanal or

recreational fisheries, are carrying out activities targeting small tuna species, among others. Additional catches are obtained intermittently or as a bycatch in other fisheries.

Despite the fact that some Mediterranean and Black Sea countries are not reporting any catches (or some are only occasionally reporting a few catches), the fishery production related to all the small tuna species shows a total official reported landing of **83 386 tonnes in 2005**. The under-reporting is believed to be relevant, because of the landings which are scattered all along the coastline and the islands and among many thousands of small and medium size vessels; furthermore, the catches are sometimes passing directly from the fishers to consumers, without passing through the general markets. The majority of small vessels engaging in recreational fishery in many countries is not reporting the catches at all. As stated in chapter 4.0, the declared catches must be considered as the bare minimum of the real production, also taking into account that about 37 percent of the countries are not reporting catches (or sometimes reported a few catches of one species), while most of the small tuna species are distributed throughout the area, with different presence or concentrations. This implies that the total production might possibly reach about **150 000 tonnes** or more as a prudential estimate in the most productive years.

Considering that the total official production of only the four most relevant species was able to give an annual revenue of **168 million euros in 2005**, it is likely that the estimation of the real production might reach a level of about **300 million euros** in the best years. However, even considering only the official production and annual revenues, the value of these fisheries is quite relevant in the regional context.

A specific problem relates to the fishery targeting small tuna species in the Marmara Sea and in the Black Sea. Apart from Turkey, no recent data are present in any of the databases used for this study. The Black Sea had a very important and dramatic ecological crisis in the seventies and this certainly affected the the small tuna species fishery, but now the environmental situation is improving and the level of catches reported by Turkey in that area is extremely relevant. Special effort should be devoted to obtaining data from the countries having fleets in the Marmara Sea and in the Black Sea, even if some of them are not members or ICCAT of GFCM.

An additional problem resulting from the non-identification of the fleets targeting these species is the fact that it is not possible to get any data on the fleet segmentation, the CPUE, the socio-economic parameters, etc. This prevents a reliable analysis of the fleet characteristics and the socio-economic aspects of this particular sector.

Therefore, the following points need to be dealt with by the competent RFMO (ICCAT and GFCM) or further investigated:

1. Revision of the exiting fishery statistics, with the purpose of eliminating or clarifying the existing discrepancies among the FAO, ICCAT and EUROSTAT databases;
2. Critical revision of the existing statistics in order to clarify the declaration by species when a discrepancy exists between one database and another or when a reported species, believed to be uncommon, is reported with high quantities;
3. Improvement of the statistical reporting for small tuna species, including them in all countries' reporting systems and checking if the national statistical services are collecting data on these species;
4. A specific effort is required to improve the existing statistics with the catches from all the countries fishing in the Marmara Sea and in the Black Sea, possibly also including historical data;
5. Particular attention should be devoted to the data collection on the most abundant species, *Sarda sarda*, with in order to follow this fishery more closely and possibly define management approaches, including stock assessments;
6. Identification of the fleet segment concerned with the fishery of small tunas in all countries, following the "métier" approach for the data collection;
7. Pilot studies for the monitoring of catches of small tuna species obtained during recreational fishery or/and to estimate the bycatch of these species in other fishing activity concerned or/and to identify the various component in the mixed fisheries;
8. Pilot studies to define the economic and socio-economic aspects of fisheries targeting small tuna species, following a "métier" approach;

9. Detailed scientific investigations are needed to improve definition of several aspects of the biology of small tuna species in the various parts of the Mediterranean and the Black Seas; these studies should help in setting minimum size regulations when necessary;
10. A scientific study is needed at regional level to define the systematic situation of *Auxis*, getting proper samples from the various areas of the Mediterranean and the Black Sea and carrying out all the necessary studies to set a commonly accepted framework and a clear identification procedure if necessary;
11. General monitoring of the various species, including lessepsian migrants, would be quite useful to define the proportion in catches in all the various Mediterranean and Black Sea countries;
12. Periodic and regular joint meetings between ICCAT and GFCM are necessary to follow and monitor the small tuna fisheries appropriately over the years.