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Nuri BAŞUSTA
Çetin KESKİN
Fabrizio SERENA
Bernard SERET

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Fax: + 90 216 424 07 71
Web: www.tudav.org
e-mail: tudav@superonline.com

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PREFACE

The International Workshop on Mediterranean Cartilaginous Fish with Emphasis on Southern and Eastern Mediterranean was held in Ataköy Marina, Istanbul, Turkey on 15-16 October 2005. The previous day, 14 October, was dedicated to deepen in the Turkish national component of the same subject, gathering the national experts on the matter. It was a meeting organized by Turkish Marine Research Foundation (TÜDAV) with RAC/SPA support, within the framework of the Action Plan for the Conservation of Cartilaginous Fishes (Chondrichthyans) in the Mediterranean Sea (UNEP-MAP-RAC/SPA). This was the first meeting ever intended to understand the problems on conservation and fisheries management of cartilaginous fish in the Southern and Eastern Mediterranean.

The aim of the workshop was to exchange information among scientists and experts especially in the developing Mediterranean countries. This meeting focused on by-catch and discard as a serious threat on the cartilaginous fish and their stocks, information retrieval for standard protocols and a database to be used in the whole Mediterranean region, critical habitats such as nursery areas, collaboration and coordination among all the countries along the Mediterranean.

We hope that the results of this workshop will help better understand the cartilaginous fish species in the Mediterranean Sea for their protection.

We thank Ataköy Marina for kindly hosting the meeting. Also our special thanks are due to Dr. E. Mümtaz TİRAŞİN for his valuable comments on the drafts of the proceedings as well as to the Ministry of Environment and Forestry for their support.

Daniel CEBRIAN
Programme Officer
UNEP-MAP
Regional Activity Centre for
Specially Protected Areas (RAC/SPA)

Bayram ÖZTÜRK
Director
Turkish Marine Research Foundation

POPULATION PARAMETERS OF SPINY DOGFISH, *Squalus acanthias* FROM THE TURKISH BLACK SEA COAST AND ITS COMMERCIAL EXPLOITATION IN TURKEY

Ertuğ DÜZGÜNEŞ[1], İbrahim OKUMUŞ[1], Muzaffer FEYZİOĞLU[1] and Nüket SİVRİ[2]

[1]K.T.U. Faculty of Marine Sciences, Dept. of Fisheries, 61530 Camburnu/ Trabzon, Turkey
[2]University of Istanbul, Faculty of Engineering, Dep. of Env. Eng, 34320 Avcılar/Istanbul, Turkey

Abstract

Spiny dogfish *Squalus acanthias* is one of the most widespread shark species in the world's oceans. It is also the only shark species inhabiting the brackish water of the Black Sea. The Black Sea stock is not commercially exploited and studies on this species are rare. In this preliminary study, we aimed to examine the population structure along the south-eastern Black Sea coast of Turkey. A total of 267 (85 male and 182 female) specimens were collected and size (length and weight) distribution, sex ratio, gutted weight, liver weight and weight of dorsal fin as edible body parts, and the relationships between various parameters were determined. Size in length and weight varied between 36.5 and 141.5 cm, and 135 and 16140 g. The mean (±se) length and weight were 88.25±2.157 cm and 3319±204 g for males, and 92.55±1.73 cm and 4387±217.6 g for females. Sex ratio was estimated as 68 % females and 32 % males. The length-weight relationship for the stock was derived as $W=0.009*L^{3.3423}$ (r^2= 0.9607). Mean gutted body, liver and first dorsal fin weights were 1888±317.1, 605.87±129.5 and 117±44.8 g, respectively.

Total landings of spiny dogfish peaked in 1974 at 11,126 metric tonnes, followed by fluctuations during the 1980s and continued to decline after early 1990s. The vast majority (70 %-98 %) of the catch comes from the Black Sea. Spiny dogfish are caught primarily with trawls, gill nets and purse seines as by-catch. Spiny dogfish has been exported as fresh/chilled into Greece, Italy, Norway and Spain. This species is used in the popular "fish and chips" meals as well as marketed for its oil and as fish meal.

Key words: Spiny dogfish, Black Sea, population parameters, landings.

Introduction

The spiny dogfish *Squalus acanthias* is abundant throughout the north temperate waters of the Pacific and Atlantic Oceans, the Mediterranean Sea, the Aegean Sea and the Black Sea. The species is found in cold and warm temperate oceans at temperatures between 6 and 30°C. It is tolerant to a wide range of salinities and can be found in brackish waters like the Black Sea, however, it prefers full-strength seawater and does not enter freshwater habitats. Spiny dogfish occur epibenthically, however they move through the water column, up to surface water. They are found in inshore and offshore waters over the continental shelf to depths of 900 m (URL-1; 2).

Annual catch in Turkey was around 2115 t (0.4 % of total marine fishes production) (FILIZ and TOGULGA, 2002) and limited with by-catch. Thus few studies of growth and meat yield have been conducted in the surrounding seas of Turkey. The main aim of this paper is to present the results of a study on stock structure of the spiny dogfish conducted in the north-eastern part of the Black Sea. In addition commercial exploitation of the species is also evaluated.

Materials and Methods

Between November 1994 and March 1995, 267 specimens of dogfish were collected from by-catches of commercial purse seine and gill net fishing along the North-eastern Black Sea coast of Turkey (Fig. 1). Total length (TL) and fork length (FL) were taken according to COMPAGNO (1984). Body weight (TW), gutted, liver and dorsal fins were measured to nearest 1 g.

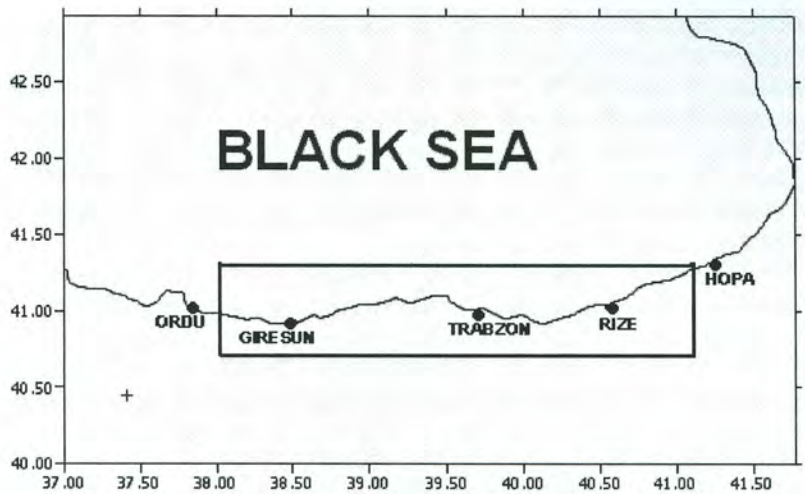

Figure 1. Sampling area

Weight–length relationships were estimated by fitting an exponential curve, $W = aL^b$, to the data (RICKER, 1973; 1975). Parameters a and b of the exponential curve were estimated by linear regression analysis over log-transformed data ($\log W = \log a + b \log L$), where W is the total weight (g), L the total length (cm), a the intercept and b the slope. Although a only corresponds to a condition factor when b (the allometry coefficient) equals 3, different authors refer to a as the relative condition factor (ANDERSON and GUTREUTER, 1983) or the allometric condition factor

(RICKER, 1975) when b ≠ 3. The parameter a is then used as a proxy of the condition factor. The degree of association between the variables W and L (or log W and log L) was evaluated by the coefficient of determination (r^2).

Percentage ratio of liver weight, total weight, gutted weight and first dorsal fin to total body weight were calculated, and sex ratio was estimated.

The catch statistics gathered and published by State Statistics Institute (SSI, 1971-2004) are used, while export figures obtained both from the SSI and the Under Secretariat of Foreign Trade.

Results and Discussion

The sample was composed of 85 males (32 %) and 182 (68 %) females. The average size of the spiny dogfish was 91.18±1.368 (35.3-141.5 cm) with males ranging from 36.5-114 cm and females from 35.3-141.5 cm in length (Table 1). Just over 25% of the specimen fall in size range 95-105 cm (Fig. 2). Females reach mean weight of 4.387±217.6 kg, with a maximum recorded weight of 16.140 kg, while mean and maximum weights for males were 3.318±204.1 and 6.6 kg, respectively. Females attain a greater size than males ($P<0.05$) (Table 1).

Table 1. Total length, fork length and total weight (mean, standard deviation, range) of spiny dogfish caught in the south-eastern Black Sea coast

Variables	N	Mean±s.e.	N	Female	N	Male
Total length (cm)	267	91.18±1.368 (35.3-141.5)	182	92.56±1.730 (35.3-141.5)	85	88.25±2.157 (36.5-114)
Fork length (cm)	267	82.43±1.269	182	83.97±1589	85	79.14±2.043
Total weight (g)	267	4047±164.1 (135-16410)	182	4387±217.6 (135-16140)	85	3318±204.1 (195-6600)

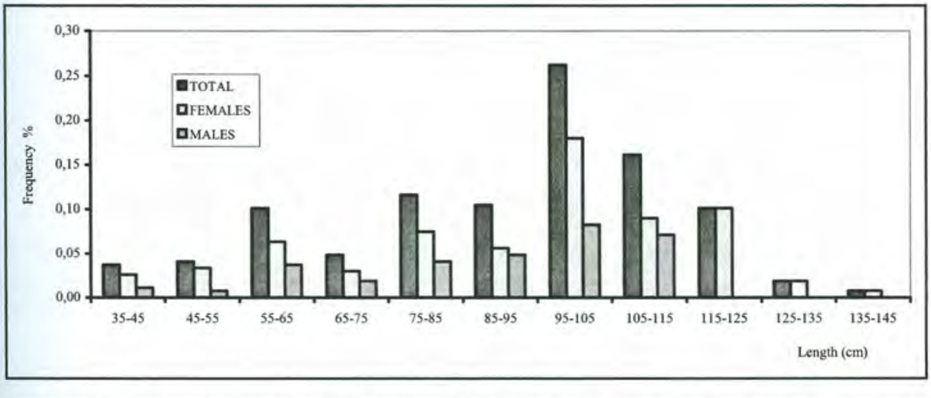

Figure 2. Length - frequency distribution of spiny dogfish specimens sampled from the South-eastern Black Sea

The relationships of length (TL) to weight (BW) were derived as: $W_A = 0.0009*L^{3.3423}$ (r=0.9802, N=276) for both sexes combined, $W_F = 0.0014*L^{3.542}$ (r=0.9607, N=182) for females and $W_M = 0.001*L^{3.3148}$ (r=0.9898, N=85) for males (Fig. 3).

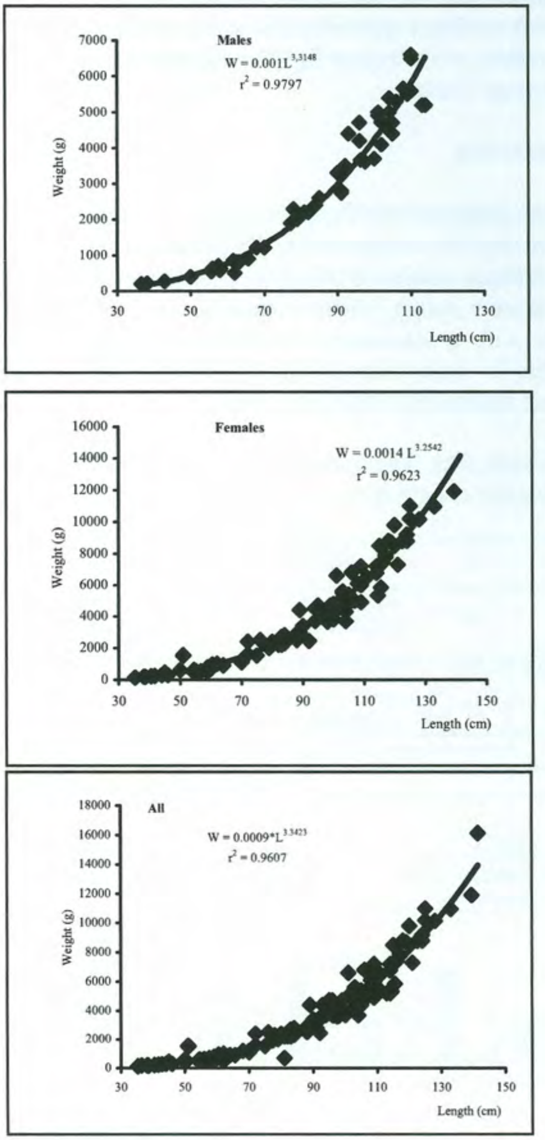

Figure 3. Length – weight relationships for all specimens, males and females.

In addition highly significant linear relationship was observed between measures total and fork length values: FL = 0.9194*TL – 1.1347 (r = 0.9882).

Females outnumbered (68 % versus 32 %) males in the current. The similar results were reported by SAMSUN *et al.* (1995). SHEPHERD *et al.* (2002) reported that in the Bay of Fundy and Scotian Shelf, Canada, dogfish sex was affected by habitat associations. Males were found to occupy bottom water of significantly higher salinities and depths than that occupied by females. Length also significantly affected habitat associations. Smaller dogfish occupied relatively deep, high salinity bottom water compared with larger dogfish. This fact may also valid for the vertical distribution of spiny dogfish in the Black Sea.

Size range of specimens was similar to that reported by SAMSUN *et al.* (1995) earlier in the Black Sea. However, mean total length values were higher than those found in above mentioned study. Mean weight of females is very similar to that determined by SAMSUN *et al.* (1995). Average length of the Black Sea dogfish is much higher than that of the Northern Aegean Sea population according to figures (male: 47.81±2.87; 38.5 – 56.5 cm and female: 59.47±6.03; 27.0 – 70.5 cm) given in FILIZ and MATER (2002). Elsewhere in the world SHEPHERD *et al.* (2002) reported the average weight of female and male dogfish as 1.36 and 1.42 kg respectively, while the mean total length values were 66.0 cm for females and 69.9 cm for males in the Bay of Fundy and Scotian Shelf, Canada. SAUNDERS and MCFARLANE (1993) estimated size range of females as 40 – 122 cm in the Strait of Georgia, British Columbia. This limited comparison indicates that the current Black Sea spiny dogfish population attain higher sizes than both that of other Turkish seas and those in other parts of the world. The main reasons may be the commercial exploitation rate (almost none in the Black Sea, except for bycatch) and environmental factors.

The length-weight relationship parameters of spiny dogfish from the South-eastern Black Sea are similar to the estimates given by SAMSUN *et al.* (1995) for the central Black Sea (a = 0.0022, b = 3.1413), KUTAYGIL and BILECIK (1998) for South-western Black Sea (a= 0.027, b=3.02), FILIZ and MATER (2002) for the Northern Aegean population (a = 0.0031, b = 3.1056). However there seems to be differences regarding the a and b values between the current study and earlier studies in the same area by AVSAR (1996; 2001), who estimated these values as a= 0.0040 and b = 2.95. According to the author this was due to due to differences in sampling times. Similar findings have also been reported in other parts of the world, for example; JONES and GEEN (1977) for the Strait of Georgia, British Columbia (a= 0.0017 and b= 3.47).

Some organ weights and ratios from dissected samples, namely liver, internal organs, first dorsal fin and gutted weights are presented in Table 2. Liver weight consisted of 14.39 % total weight and did not differ between sexes, while gutted and internal organ weights as percentage of total weight showed significant differences between sexes, former in favour of males and later females. The mean first dorsal fin weight consisted of 4.12 % and 4.46 % of total weights of females and males, respectively.

Table 2. Some organ weights and ratios from dissected samples (LW: Liver weight (g), TW: Total weight (g), VW: viscera weight (g), DFW: dorsal fin weight (g), GW: gutted weight (g)).

Parameters	LW	GW	1st DFW	VW	LW/TW %	GW/TW %	LW/VW %	DFW/TW %	VW/TW %	WI/GW %	DFW/GW %
						ALL					
Mean	606	1888	117	1241	14.39	66.52	44.11	4.25	33.45	54.60	6.41
N	51	47	47	47	51	47	47	47	47	47	47
Min	10	90	5	35	6.65	32.73	14.49	1.14	19.63	24.42	2.02
Max	3670	8970	2115	7170	34.92	80.37	89.19	23.20	67.27	55.6	32.74
SE	129.5	317.1	44.8	243.8	0.882	1.447	2.207	0.570	1.450	4.534	0.861
						FEMALE					
Mean	767	2318	155	1622	14.56	65.64	42.86	4.12	34.36	55.88	6.33
N	32	29	29	29	32	29	29	29	29	29	29
Min	10	100	5	35	6.65	43.20	14.49	1.14	19.63	24.42	2.02
Max	3670	8970	2115	7170	33.99	80.37	81.56	19.28	56.80	31.48	32.74
SE	190.9	475.0	71.9	367.3	1.107	1.815	2.642	0.612	1.815	4.627	1.046
						MALE					
Mean	334	1196	56	627	14.11	67.93	46.13	4.46	31.97	52.55	6.54
N	19	18	18	18	19	18	18	18	18	18	18
Min	15	90	5	45	7.14	32.73	17.30	1.48	21.30	27.06	2.41
Max	1980	3450	210	2220	34.92	78.70	89.19	23.20	67.27	55.6	31.11
SE	113.1	257.2	11.9	161.6	1.494	2.421	3.939	1.138	2.430	9.382	1.528

Commercial Exploitation in Turkey

The spiny dogfish is not a major commercial species, but it has been caught as by-catch by purse seines used for pelagic fishes like anchovies, sardines and horse mackerels. There is no domestic consumption and all the meat and fins are exported. Maximum catch was 11,126 tons in 1979 and 98 % of the total was obtained from the Black Sea (Fig. 4). 97 % had been caught from the Eastern Black Sea. The abundance of the dogfish has also showed similar fluctuations as commercial fish species, mainly pelagics which were heavily affected by overfishing and invasive Ctenophora species *Mnemiopsis leidyi* during 199s (Fig. 5). The recent production has occured around 650 metric tons for Turkey, and 430 metric tons for the Black Sea (Fig. 4). According to the latest catch data the share of the Black Sea and Eastern Black Sea has decreased to 67 % and 62 %, respectively (Fig. 4).

Dogfish are exported to some Mediterranean countries, namely Greece, Italy and Spain as fresh/chilled product (Table 3; 4).

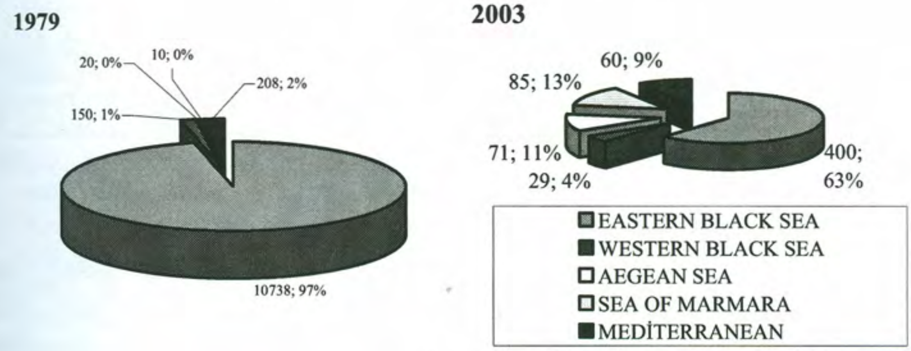

Figure 4. Changes of the share of dogfish catch among regions from 1979 to 2003 (SSI).

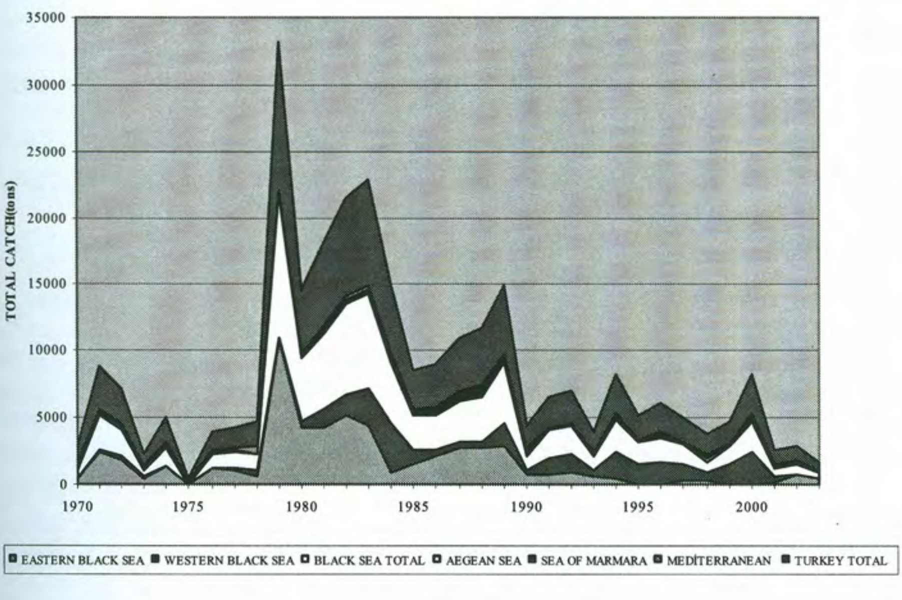

Figure 5. Additive area chart of dogfish catch by years.

Table 3. Export quantities and values (US $) of dogfish from Turkey (All species) (Under secretariat of Foreign Trade, 2005)

	2000		2001		2002		2003		2004	
Country	kg	$	kg	$	kg	$	kg	$	kg	$
France	1851	5054								
Netherlands	8	25								
Germany	540	1340								
Italy	35498	98218	4790	19440	3646	7924	16030	66079	1589	9688
Greece	65434	189231	144677	387641	124670	350251	32811	125037	60069	281243
Spain									8327	9901
Norway	10360	60770	5690	35123						
Austria	20	81								
Bulgaria							1465	696		
Canada			19	70						
Hong Kong	1220	7232								
Istanbul Free Zones	10	50								
Total	114941	362.001	155176	442.274	128316	358.175	50306	191.812	69985	300.832

Table 4. Export of spiny dogfish as fresh/chilled from Turkey (Under secretariat of Foreign Trade, 2005)

Years	kg	$	Years	kg	$	Years	kg	$
1996	607	2171	1999	100	332	2002	25161	62177
1997	3691	8826	2000	540	1949	2003	7717	26159
1998	1025	2484	2001	2017		2004	4936	23218

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SEASONAL VARIATION OF *Hysterothylacium aduncum* INFECTION IN THE COMMON GUITARFISH, *Rhinobatos rhinobatos* IN ISKENDERUN BAY (NORTH-EASTHERN MEDITERRANEAN SEA) TURKEY

Ercument GENÇ[1], Yasemin B. YILDIRIM[1], Nuri BAŞUSTA[2] and Mustafa ÇEKİÇ[3]

[1]Programme of Fish Diseases, Faculty of Fisheries and Aquaculture, Mustafa Kemal University, Tayfur Sokmen Campus 31034, Antakya/ Hatay, Turkey. E-mail: ercumentgenc@yahoo.com
[2] ATA Aquaculture and Fisheries Research Centre, Harran University, Sanliurfa, Turkey
[3]Cukurova Unıversity, Yumurtalik Vocatinal School, 01680,Yumurtalik/Adana, Turkey

Abstract

A total of 244 individuals of the common guitarfish, *Rhinobatos rhinobatos* (*TL* range: 31-144 cm), were obtained between March 2003 and February 2005 from commercial fishing vessels in Iskenderun Bay, North-eastern Mediterranean Sea, Turkey and examined for the presence of an anisakid nematode *Hysterothylacium aduncum* (Rudolphi) in the digestive tract. The parasites (fourth-stage larvae, L4s) were found in spiral valve (Infected samples, *Ni*: 88, *TLi* range: 31-127 cm) of common guitarfish. Seasonal *H. aduncum* intensity (*MI*: mean±SD) and prevalence (*P*: %) values were determined. Throughout the research, the highest *MI* and *P* values were found in May-June 2004 (7.67±2.16 %) and March-April 2003 (78.57 %). The lowest *MI* and *P* values were found in March-April 2003 (3.91±1.97) and November-December 2003 (7.69 %), respectively. During the research period, seasonal changes of *MI*, *P*, and *A* (abundance: mean±SD) values were given in detail.

***Key words: Mediterranean Sea,* Rhinobatos rhinobatos, *parasites, nematoda,* Hysterothylacium aduncum.**

Introduction

Within the marine ecosystem, elasmobranchs play an important role at or near the top of the food web (ABELLA and SERENA, 2005). The elasmobranch species are among the most studied fish (KNOFF *et al.*, 2001; HENDERSON *et al.*, 2002; KLIMPEL *et al.*, 2003). It is known that the top of the food web's species (predator fish) serve as intermediate and paratenic hosts for parasitic diseases. However, despite the large volume of biological information available for the elasmobranchs (HENDERSON *et al.*, 2002) dedicated parasitology studies including common guitarfish are very few especially in the Mediterranean Sea. In Turkey, guitarfish are readily sold in markets as food for human consumption. It is critically important for sustainable fisheries and aquaculture activities and human health to have reliable information about potentially pathogenic organisms that may be present in their region. Helminth infections are seriously taken to consideration for cultured (BERLAND, 1987; SUNDERS, 2003) and wild marine fish (GENC, 2002). Nematodes are one of the most important agents for financial losses in marketing value of fishes. The nematode problem is known as anisakidosis (ABOLLO *et al.*, 2001).

Transmission of species of Anisakidae family is dependent upon water and usually involves aquatic invertebrates and fish as intermediate or paratenic hosts. The species of *Hysterothylacium* in the adult stage are normally found in the guts of fishes (ANDERSON, 2000). They are cosmopolitan and non zoonotical anisakid species (CARVAJAL *et al.*, 1995; GONZALEZ, 1998). Although, WILLIAMS and JONES (1976) document cases of human infection (eosinophilic granulomata) by larvae of *H. aduncum*.

According to SÁNCHEZ (1998), the adults are found in the alimentary canal of marine teleosts and, occasionally, in the stomach; several marine invertebrates act as intermediate hosts. Third-stage larvae have been found encapsulated in the mesentery and viscera of a wide range of fish that act as transport hosts (BERLAND, 1961; PETTER and MAILLARD, 1988; KØIE, 1993). *H. aduncum* is usually found in inshore, benthic hosts. This parasite probably only occurs in offshore fishes that acquire them from eating inshore fishes. In Europe it is the most common larval roundworm encysted in inshore fishes, occurring in almost every fish in some areas (WILLIAMS and BUNKLEY-WILLIAMS, 1996). In the literature, larvae and adults have frequently been refereed to *Contracaecum* and *Tynascaris* but DEARDORFF and OVERSTREET (1980) have distinguished *Hysterothylacium* and *Contracaecum*.

Previous research pointed out *H. aduncum* infection all around the world including the Mediterranean Sea (ANDERSON, 2000; HENDERSON *et al.*, 2002; FERNÁNDEZ *et al.*, 2005; MARQUES *et al.*, 2005). Furthermore, anisakid infections were reported in several fish, except chondrichthyans in the Iskenderun Bay (the north-east Mediterranean Sea). This study was designed to investigate the condition of common guitarfish as a representative of chondrichthyans with regards to *H. aduncum* infections in the Iskenderun Bay, Turkey.

Materials and Methods

A total of 244 individuals of the common guitarfish, *R. rhinobatos* were caught during the period from March 2003 to February 2005 in an area of the North-eastern Mediterranean Sea (Iskenderun Bay) located at 35°54'09"E-36°30'05"N, 35°54'09"E-36°25'04"N (Fig. 1). Total length of each fish was measured. After the abdominal dissection, internal organs especially intestinal tract was directly examined for the presence of parasitic nematode *H. aduncum*. When encountered for each specimen the nematode were counted and identified according to their morphologic features using a light microscope (DEARDORFF and OVERSTREET, 1980; KØIE, 1993; BERLAND, 1998; ANDERSON, 2000). The prevalence (*P*), the mean intensity (*MI*) and the abundance (*A*) of *H. aduncum* were calculated as defined by BUSH *et al.* (1997).

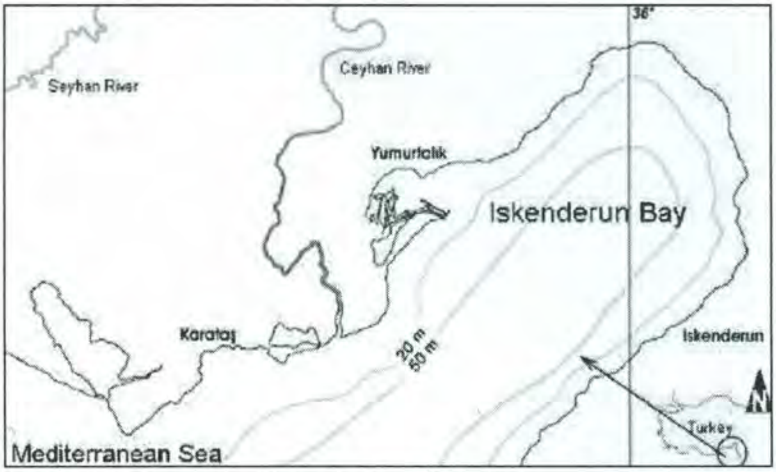

Figure 1. Sampling area.

Results

Common guitarfish *R. rhinobatos* specimens examined for anisakid nematodes ranged in length from 31 to 144 cm. Only one internal parasite species was found in spiral valves of fish and identified as *Hysterothylacium aduncum* (Rudolphi). Number of *H. aduncum* worms (fourth-stage larvae, L4s) per fish was ranged in 1-12. The overall Prevalence (*P*), mean intensity (*MI*) and mean abundance (*A*) are listed in Table 1.

Table 1. Sample of common guitarfish examined for anisakid, *H. aduncum*.

	Sampling Month	*N*	*TL*	*Ni*	*TLi*	*Nn*	*P*	*MI*	*A*
	March- Apr.	14	52.36±18.04 (31-78)	11	50.27±18.11 (31-78)	43	78.57	3.91±1.97	3.07±2.40
	May- June	18	60.33±14.93 (36-87)	9	60.25±16.58 (36-83)	40	50.0	4.44±1.81	2.22±2.60
2003	July- Aug.	21	55.76±10.13 (32-66)	7	58.0±8.81 (44-66)	35	33.33	5.0±2.58	1.67±2.80
	Sept.- Oct.	18	63.77±15.15 (41-90)	ND	ND	ND	ND	ND	ND
	Nov.- Dec.	13	73.77±13.44 (51-103)	1	82	9	7.69	ND	ND
	Jan.- Feb.	23	61.87±14.51 (38-82)	2	64.5±7.78 (59-70)	10	8.70	5.0±2.83	0.44±1.56
	March- Apr.	37	72.97±21.98 (44-119)	17	80.47±24.21 (48-119)	106	45.95	6.23±2.39	2.87±3.53
	May- June	16	88±23.99 (53-144)	6	91.67±19.64 (72-127)	46	25.0	7.67±2.16	2.88±4.03
2004	July- Aug.	23	69.09±15.76 (37-108)	5	66.8±16.18 (44-84)	31	21.74	6.20±2.28	1.35±2.79
	Sept.- Oct.	27	67.37±12.37 (48-88)	8	67.38±12.47 (47-80)	61	29.63	7.63±2.33	2.26±3.75
	Nov.- Dec.	19	77.47±21.35 (41-102)	13	76.46±18.23 (53-99)	85	68.42	6.54±3.73	4.47±4.36
2005	Jan.- Feb.	25	77.04±28.15 (33-127)	9	68.56±30.30 (36-113)	69	36.0	7.66±1.93	2.76±3.92
2003-2004		**244**	**68.32±10.17 (31-144)**	**88**	**69.67±12.0 (31-127)**	**535**	**36.07**	**6.03±1.39**	**2.40±1.09**

Sample size (*N*), Total body length (*TL*: mean± SD; range), Infected samples (*Ni*), Total body length of infected fish (*TLi*: mean±SD; range), Total number of nematode (*Nn*) Prevalence (*P*: %), Mean intensity (*MI*: mean± SD), Abundance (*A*: mean± SD), Not detected (*ND*)

The data showed seasonal variations with the highest prevalence in spring seasons (Fig. 2). There was a positive relationship between warm seasons and the prevalence values of nematodes in the common guitarfish. Seasonal changes of basic parameters were found as follows; *P* values were Spring> Summer> Fall> Winter, *MI* values were Fall> Winter> Summer> Spring and, *A* values were Spring> Fall> Summer> Winter.

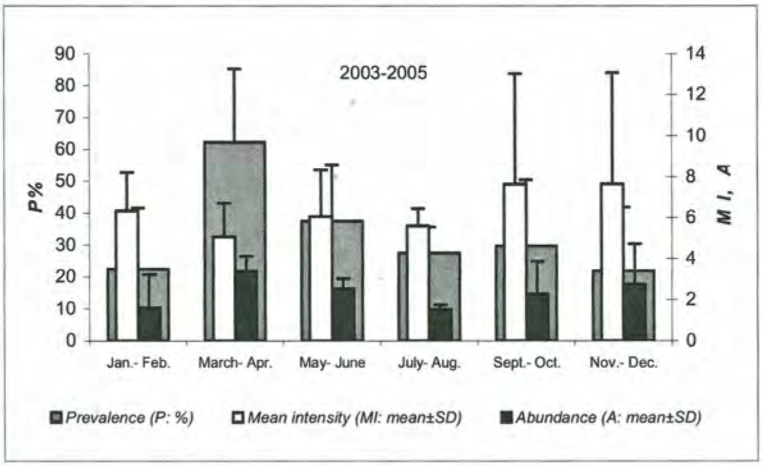

Figure 2. Seasonal changes of parasitic nematodes.

Discussion

Anisakinea are parasites mainly infesting the marine mammals, turtles, piscivorous birds and elasmobranches (ANDERSON, 2000). Anisakidae characteristically occur in deep waters in meso- or benthopelagic species and are typically found in predators. Natural transmission also occurs in specific habitats and in relation to characteristic host diets (CANNON, 1977; ABOLLO *et al.*, 2001; ÁLVAREZ *et al.*, 2002). According to a previous study on teleosts helminth parasites, *Hysterothylacium* sp. was found in sparid fish (Sparidae) with 1.74% prevalence level (GENC, 2002). In the present study, we only detected the same Anisakidae, *H. aduncum* in *R. rhinobatos.* This is not surprising considering the same sampling area. ABOLLO *et al.* (2001) note that in temperate waters, anisakid parasites are a natural part of the trophic web of marine ecosystems. Furthermore, many authors claimed that *H. aduncum* is not very host-specific in either its adult stage or its larval stages. Many parasites, especially helminthes, possess complex life cycles involving trophic transmission from one host to the next by consumption of infected intermediate hosts (CANNON, 1977; ANDERSON, 2000; ABOLLO *et al.*, 2001; ÁLVAREZ *et al.*, 2002). SMITH (1983) reported that seasonality might not be expected because anisakids eggs are shed by the final hosts, possibly throughout the year, and they may develop and hatch at any time.

AMUNDSEN *et al.* (2003) indicated that parasite carrying capacity might be higher in predator hosts. Beside that, more than 100 species of invertebrates in seven phyla have been reported as intermediate hosts. This wide range of hosts may help to explain the great abundance and broad distribution of *Hysterothylacium aduncum* (WILLIAMS and BUNKLEY-WILLIAMS, 1996). Since the common guitarfish is a predator, the prevalence of infestations in elasmobranchs is worth being taken into account. These prevalence's were consistent with AMUNDSEN *et al.* (2003)'s notion, excluding of the prevalence's of nematode infections in wild fish.

Results of the present study indicated that highest *MI* and *P* values were found in May-June 2004 (7.67±2.16 %) and March-April 2003 (78.57 %). The lowest *MI* and *P* values were found in March-April 2003 (3.91±1.97) and November-December 2003 (7.69%). In conclusion, the present study is the first report on the presence of anisakid nematodes in the common guitarfish, *R. rhinobatos* in Iskenderun Bay. Since *H. aduncum* could be a serious threat to common guitarfish. Future studies are planed to determine the transmission pathways molecular biology methods.

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SOME BIOLOGICAL ASPECTS OF THE LESSER SPOTTED DOGFISH *Scyliorhinus canicula* (Linnaeus, 1758) IN EDREMIT BAY (THE NORTHERN AEGEAN SEA) TURKEY

Dilek TÜRKER ÇAKIR, Hatice TORCU KOÇ and Zeliha ERDOĞAN

Balikesir University, Faculty of Science and Art, Department of Biology, 10100 Balikesir, Turkey

Abstract

Length-weight relationship, reproduction, sex ratio, sexual maturity, hepatosomatic index and stomach contents of 291 lesser spotted dogfish *Scyliorhinus canicula* (Linnaeus, 1758) were examined. These fish were collected from trawl hauls made in Edremit Bay, the northern Aegean Sea, in 1998. Total lengths of sampled fish ranged from 27.0-78.6 cm in males and 24.6-70.0 cm in females. Weight increased allometrically for both sexes together with b=2.93. Reproduction activities continued in all seasons with a relatively high rate of oogenesis in the summer. The overall sex ratio (females and males) was 0.29:1. The mature females spawned successively two eggs in each batch. It is found that differences between liver weights of males and females were not significant (P>0.05). The food of dogfish was mainly composed of fishes and decapod crustaceans.

Key words: Aegean Sea,* Scyliorhinus canicula, *biological parameters.

Introduction

The dogfish *Scyliorhinus canicula* (Linnaeus, 1758) is a very common small shark inhabiting particularly over sandy, coralline, algal, gravel or muddy bottoms at about 30-110 m depth. It is distributed in the Mediterranean and the Atlantic from Portugal to Morocco and Canaries. It is oviparous, with a single egg laid per oviduct at a time (WHITEHEAD *et al.*, 1984; AKŞİRAY, 1987; COMPAGNO, 1999). It feeds on molluscs and crustaceans, small cephalopods, polychaeta worms, and small bony fishes (ELLIS and SHACKLEY, 1997; OLASO *et al.*, 1998) RODRIQUEZ-CABELLO and SANCHEZ (2005) estimated mortality rates of *S. canicula* in the Cantabrian Sea.

Although the more recent list of elasmobranch species from the seas of Turkey (TORCU and AKA, 2000; TORCU-KOÇ *et al.*, 2005; KABASAKAL, 2002) has included a total of 28 confirmed species from the Turkish coast of the Aegean Sea, the information on the distribution, bio-ecological aspects and population structures of nearly all of these 28 species is still scarce, The lesser spotted dogfish is the most abundant shark in Turkey (the Northern Aegean Sea). Despite its abundance, *S.canicula* has never had a high commercial value in Turkey (CİHANGİR *et al.*, 1997; KABASAKAL and KABASAKAL, 2004). It is caught as by-catch in demersal fisheries and is mainly used for bait for crab and whelk fisheries (CLARKE, 1999). Many sharks are commonly present as by-catch in commercial fisheries. It is now well known that by-catch is of great concern both ecologically and in terms of fishery management, particularly in shrimp fisheries (HALL, 1996; CEDROLA *et al.*, 2005).

In previous studies from the Turkish coasts on, GELDİAY (1969), AKŞİRAY (1987), CİHANGİR *et al.* (1997), and AKA-ERDOĞAN *et al.* (2004) gave the maximum lengths. KABASAKAL (2001) and AKA-ERDOĞAN *et al.* (2004) noted the feeding habits of lesser spotted dogfish from the Turkish Seas.

The aim of the present study is to provide information on some biological features of the lesser spotted dogfish in Edremit Bay.

Materials and Methods

A total of 291 specimens were collected with trawl at monthly intervals, in 1998. Sampling location was in Edremit Bay (the Northern Aegean coast of Turkey) between Altınoluk and Bozburun (Fig. 1). This bay occupies an area of 34.5 km from east to west, 25.5 km from north to south between 39°17' and 39°34'N, 26°57' and 26°34'E.

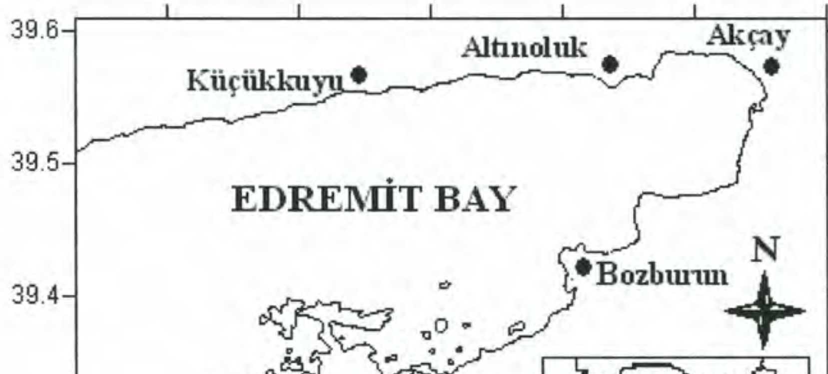

Figure 1. Sampling area in Edremit Bay.

Trawling was done only during daytime at depths ranging from 45 to 60 m. Duration of hauls was about 2 hours with a speed of 2 miles per hour. The trawl was equipped with a 22 mm stretched mesh size at the cod-end.

Total length (TL) of each fish was measured to the nearest 0.5 cm. After the total weight measurements, dissected parts (liver, stomach, somatic, and gonad weight) weighed to the nearest 0.01 g. The gonads were macroscopically examined to determine the sex and reproductive stage. The five-point maturity scale employed here was a simplified version of PINTO and ANDREU (1957) maturity scale (stage I-virgin or resting; II-maturing stage; III-premature stage; IV-spawning; V-post spawning stage).

For length frequency distribution 0.5 cm class interval (RICKER, 1975). The length-weight relationship was estimated by the equation: $W=a*L^b$, where W is the weight in grams, TL the total length in cm, b the growth exponent factor, and a is a constant (y-intercept). The hypothesis of Allometric growth (RICKER, 1975) was tested using a t-test.

Spawning period was determined by analyzing the monthly percentages of mature individuals (on the basis of macroscopic classification). Sex ratio was analyzed monthly (on the basis of macroscopic classification). Deviations from 1:1 null hypothesis were statistically tested by (χ^2) analysis (SOKAL and ROHLF, 1994).

Livers of all individuals were removed and weighted. Hepatosomatic index (HSI %), the ratio of liver weight to somatic weight was estimated.

The stomachs were removed and preserved in 4% formaldehyde or 70% alcohol solution for later analysis. Where possible, prey items were identified to species or the nearest possible taxonomic level, and counted under binocular microscope (HYSLOP, 1980; LABROPOULOU *et al.*, 1998; CORTES, 1999). Generally, results of dietary analyses include one or more of indices: by weight (W) and percentage frequency occurrence (FO): W%: the ratio of total weights of a particular prey type to the total weight of all stomach items, FO%: the ratio of the number of stomachs containing a given type of prey to the total number of stomach examined; vacuity index, $V= Ev*100/N$; with N: the number of fish examined, Ev: the number of fish with empty stomach. Chi-square (χ^2) was done according to vacuity index in variations of total length and seasons. (TUSET *et al.*, 1996; CORTES, 1999).

Results

Length and Weight Frequency Distribution by Sex

Males ranged from 270 to 786 mm, whilst the range of for females 246-700 mm TL and 246-786 mm for all fish (Table I). The most of the individuals in our samples ranged from 440 to 470 mm (67 %) (Fig. 2A).

Males ranged from 63.67-2424 g, whilst the range for females 75.14-1682 g W and 63.67 - 2424 g for all fish (Table I). The majority of the sampled fish ranged from 302 to 394 g (72 %) (Fig. 2B).

Differences in the mean length values were statistically significant between sexes, but not in the mean weight values.

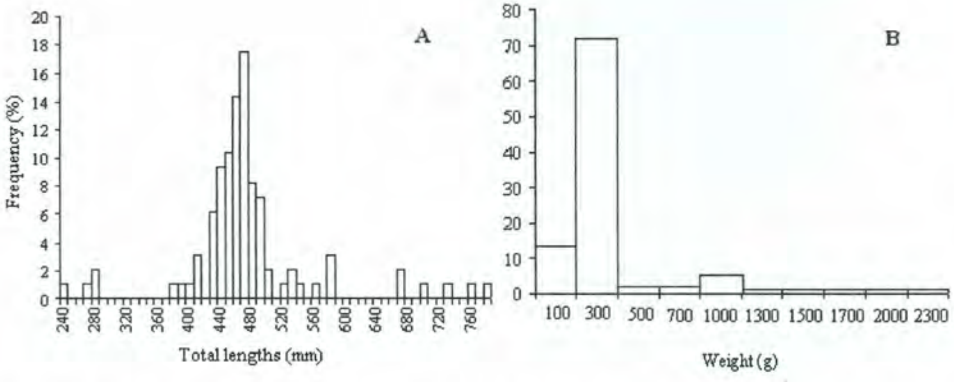

Figure 2. A-B. Total Length (A) and Weight (B) frequency distribution of male and female *S. canicula.*

Table 1. Total length (mm), weight (g) values (SE: Standard error) by sex

	Female		Male		t test	All fish	
	Min-Max	Mean ± SE	Min-Max	Mean ± SE		Min-Max	Mean ± SE
W	75.14-1682	558.90±55.071	63.67-2424	465.52±26.767	>0.05	63.67-2424	486.695±24.235
TL	246-700	477.5±13.916	270-786	479.24±5.001	<0.05	246-786	478.845±4.977

Length-weight relationship

Allometric growth was observed for all fish. Regression parameters for all individuals are presented in Table 2. No significant difference in b values was found between males and females (t-test, $t < t_{0.05,\ n > 200} = 1.65$). Length growth is faster than weight growth.

Table 2. All fish; parameters of the lenght-weight relationship ($W = a*L^b$) (a: Intercept, b: Slope, SE: Standard error, N: Number of specimens, r^2: Determination coefficient)

	N	a	B	SE (b)	r^2	t-test
All fish	291	$6*10^{-7}$	2.9276	182.8578	0.8266	-3.958

(t-test, $t_s > t_{0.05,n>200} = 1.96$)

Sex ratio

The samples contained 66 females and 225 males. The overall ratio of females to males was (F:M) 1:3.41, the males were significantly more abundant ($\chi^2 = 86.87$, $p<0.05$).

According to macroscopic identification, lesser-spotted dogfish reproduce through out the year. It was seen that the mature females spawned successively two eggs in each batch.

Hepatosomatic index (HSI %)

Differences rates of liver weights of males and females to total body weight (1.3 % and in 1.14 %, respectively) were not statistically significant according to min, max, and mean HIS (%) values (ANOVA=1.328, p>0.05) (Fig. 3). The smallest observed HSI (%) value was in Autumn with 1.493 and the highest HSI (%) value was in Spring with (10.726) for females.

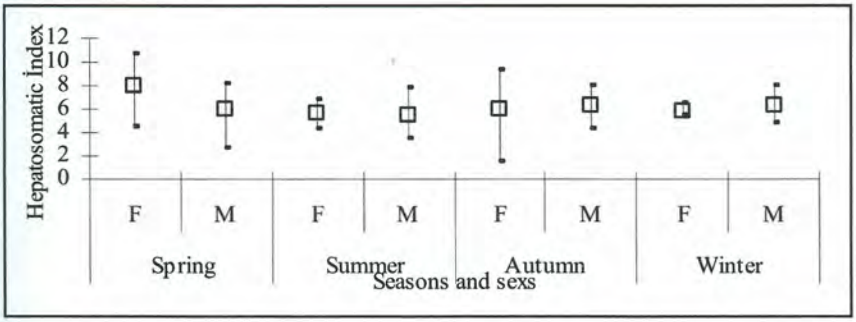

Figure 3. Variations in values of hepatosomatic index by sex and seasons.

Feeding

Variations of ratios of the number of fish with empty stomach by length groups and seasons are given in Fig. 4. Winter is excluded since no fish with empty stomach was found in this period. Seasons affected the vacuity index, the ratio of feeding increased in summer and autumn (χ^2 test, $p<0.05$). But, the influence of length on vacuity index is not statistically significant (χ^2 test, $p>0.05$)

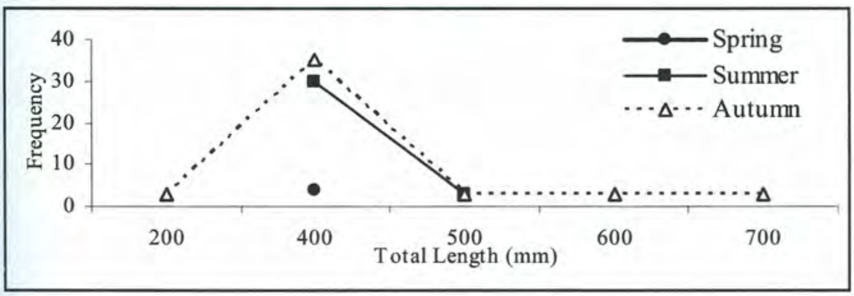

Figure 4. Vacuity index values according to total length and seasons.

The food was primarily consisted of teleosts and crustaceans. For lesser-spotted dogfish of 450 mm, indeterminated material was the most with 67.4%. Percentage frequency of occurrence (FO %) by length groups and sexes are given in Fig. 5. The reason why that is the most of samples caught couldn't be stored for a long time in the summer, food content was mostly digested. Percentage frequency of occurrence (FO %) by length groups and sexes is given in Fig. 5.

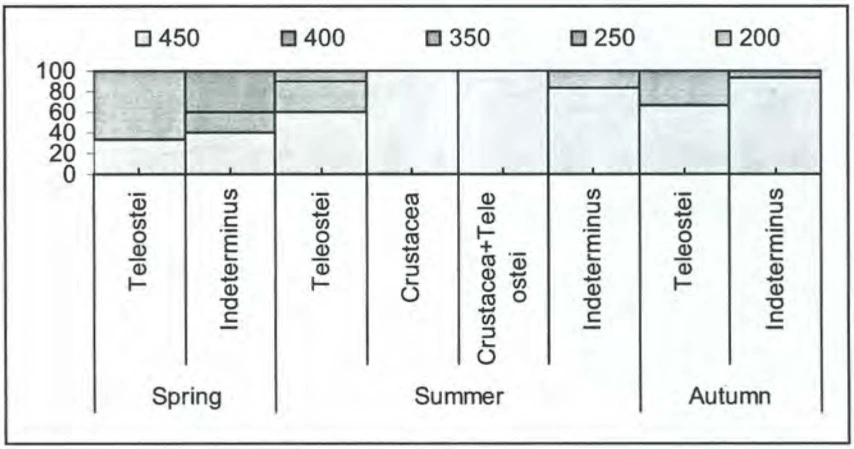

Figure 5. Variations stomach contents of *S. canicula* to length groups and seasons.

As seen in Fig. 5, stomach contents of *S. canicula* of >400-450 mm were determined. A list of identified food organisms was presented without indeterminated material (Table 3). Values of W (%) in Table 3 were also estimated with no indeterminated material.

Table 3. Composition of the food of *S. canicula* in Edremit Bay in terms of W (%)

Prey category groups	Total Length		
	<250	*400*	450<
Crustacea			2.15
Decapoda			5.03
Caridea			12.96
Teleostei		73.32	59.73
Sardina pilchardus		26.68	13.07
Merluccius merluccius and *S. pilchardus*	100		
Caridea and Teleostei			7.05

*The higher taxonomic groups include organisms which could not determine to species level.

Discussion

S. canicula is considered as a common species in the northern Aegean Sea (PAPACONSTANTINOU and TSIMENIDES, 1979; BENLİ *et al.*, 2000; KABASAKAL 2002; KABASAKAL and KABASAKAL, 2004).

There were significantly more males than females observed, due to the dominance of males in 1998. Females are known to predominate in July in the Cantabrian Sea (RODRIQUEZ *et al.*, 1998); in January and June in the Bristol Channel (ELLIS and SHACKLEY, 1997); in Summer from the northern Aegean Sea of Turkey (CİHANGİR *et al.*, 1997). The apparent monthly differences in the sex ratio may be the result of unisexual shoaling and not geographical segregation. The values of some biological aspects of *S. canicula* in the studies were showed in Table 4. CAPAPE (1977) noted that the males and females mature at lengths of 40 and 45 cm, respectively along the Tunisian coast. CAPAPE *et al.* (1991) noted maximum length 55 cm for males, 51 cm for females from the gulf of Lion, while SÁNCHEZ *et al.* (1995) presented maximum length 65 cm for all individuals from Galicia and Cantábrico. JARDAS (1979) stated that the males and females mature at lengths of approximately 33 and 40 cm, respectively from the Adriatic Sea. ELLIS and SHACKLEY (1995) suggested that the males and females mature at lengths of approximately 52 and 55 cm. RODRIQUEZ-CABELLO *et al.* (1998) reported that the females attained first sexual maturity at length of 54.2 cm, while IVORY *et al.* (2002; 2004) stated that the males and females mature at lengths of 53.5-57.0 cm, respectively. As the previous studies carried out along Turkish coasts, GELDİAY (1969) and AKŞİRAY (1987) established that maximum lengths were 80 cm and 150 cm, respectively. CİHANGİR *et al.* (1997) noted total lengths of 54.6 cm for males and 51.7 cm for females. The findings of our study are nearly in agreement with the previous assessments.

Egg lying occurs throughout the year, except for a break during the autumn (MELLINGER, 1983; CAPAPE *et al.*, 1991; ELLIS and SHACKLEY, 1995; CİHANGİR *et al.*, 1997). MELLINGER (1983) reported that egg laying rates of 44 eggs in 187 days, 20 in 148 days and 24 in 144 days for three Mediterranean specimens. CAPAPE *et al.* (1991) pointed out that females lay 17 eggs. The 10 mature female fish maintained in captivity from June to December laid a combined total of 177 eggs over 214 days from British Channel (ELLIS and SHACKLEY, 1995), while CİHANGİR *et al.* (1997) found that one egg in each oviduct canal of a female from the northern Aegean Sea. RODRIQUEZ-CABELLO *et al.* (1998) reported that at least one in six adult female dogfish carried egg-capsules from the Cantabrian Sea during 1994-1995. Our findings confirm that of CİHANGİR *et al.* (1997).

CRAIK (1978) mentioned that liver weights of females were more than liver weights of males in pre and during vitellogenesis. CRAIK (1978) pointed out that HSI values were higher in females than males and varied in two sexes according to seasons, while CİHANGİR *et al.* (1997) reported that no difference was determined between sexes, except for Spring. Even if this study is in agreement with that of CİHANGİR *et al.* (1997), differences rates of liver weights of males and females to total body weight are not statistically significant in seasons.

It has been reported that *S. canicula* feeds on decapods crustaceans, molluscs, and teleosts (LYLE, 1983; ELLIS and SHACKLEY, 1995; ELLIS and SHACKLEY, 1996; OLASO *et al*., 1998). LYLE (1983) studied feeding habits of *S. canicula* in the Isle of Man. And found that diet composed of molluscs with (20-48 %). According to KABASAKAL (2001), *S. canicula* feeds on fishes, crustaceans, and cephalopods. Our findings confirm the relevant literature, except for LYLE (1983).

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Table 4. The values of some biological aspects of *S. canicula*.

References	Year	Locality	W (g)			N	TL (cm)			L-W relationship			HSI		Food
			Femal e	Male	All Fish		Fema le	Male	All Fish	a	b	r^2	Female	Male	All Fish
Macpherson 1979	1976-1978	Balearic Sea													zoobethos
Jardas 1979			16.0-32.12	22.33-26.0			214-235	193-206					2.53	2.67	crustacea
Dorel 1985		Bay of Biscay				285			20-30	0.0036	2.779				
Dorel 1985		EastandWest Channel				376			37-103	0.0031	3.029				
Gibson and Erzini 1987	1975-1976	UK.Scotland													zoobenthos
Wetherbee *et al.*,1990		Spain													teleost
Kaiser and Spencer 1993		UK.Englan													benthic crustaceans
Sánchez *et al.*, 1995	1991-93	Galiciaand Cantábrico							650						
Ellis and Shackley 1995		Bristol Channel					520-650	490-550	490-650	-	-	-	7.07-14.09	2.72-6.64	
Ellis *et al.*, 1996	1981-1985	Northeaster Atlantic													zoobenthos
Cihangir *et al.*, 1997		Northern Aegean Sea					517	546	-	0.001	3.21	0.919			teleost, decapod crustaceans
Merella *et al.*, 1997	1995-1996	Balearic Islands				262			75-421	0.0016	3.160	0.997			
Ivory *et al.*, 2004		Northwest Atlantic					103-700	104-710							
This study			75.14-1682	63.67-2424	63.67-2424	291	246-700	270-786	246-786	6.10^{-7}	2.93	0.83	1.493-10.726	2.62-8.149	teleost

DIFFICULTIES IN AGE READINGS FROM DORSAL SPINES OF SPINY DOGFISH *Squalus acanthias* L., 1758

Sefa Ayhan DEMİRHAN[1], Hamdi ÖĞÜT[2], Semih ENGİN[3], Nuri BAŞUSTA[4] and Ercüment GENÇ[1]

[1] Mustafa Kemal University, Faculty of Fisheries, 31040 Serinyol, Antakya/Hatay, Turkey
[2]Karadeniz Technical University, Surmene Faculty of Marine Sciences, 61530 Surmene/Trabzon, Turkey
[3]Black Sea Technical University, Faculty of Fisheries, Rize, Turkey
[4]Harran University, Ata Fisheries Research and Application Center, Sanliurfa, Turkey
E-mail:nbasusta@hotmail.com

Abstract

The structural problems of using spines for determining the age of spiny dogfish *Squalus acanthias* L., 1758 were examined. The main problems connected with this method were: the occurrence of spines with wiped surfaces (18 % of first and 12 % of second spines), broken spines (8 % of first and 6 % of second spines), both broken and wiped surfaces (20 % of first and 12 % of second spines), and spines with complicated surfaces (31 % of first and 31 % of second spines). While these problems sometimes made age readings impossible (70 % of first and 37 % of second spines), other spines were used successfully to determine age despite the problems. The frequency of these problems was different between first and second dorsal spines.

Key words: Spiny dogfish, Black Sea, spiny age determination.

Introduction

The spiny dogfish *Squalus acanthias* L., 1758 is a common shark in the North Atlantic and North Pacific. As the spiny dogfish grows slowly and has a low reproduction potential (COLVOCORESSES and MUSICK, 1980), it of importance to carefully monitorpopulation for a sustainable fishery. Stock assessment of any fish species requires estimates of growth rates, maximum age, cohort structure and age of maturity, all of which rely on accurate estimates of age. Age determination of all elasmobranchs is a difficult process because of lack of calcified otholits and scales. Reading annuli externally from the second dorsal spine is the most preferred method for determining the age of spiny dogfish populations (HOLDEN and MEADOWS, 1962; KETCHEN, 1975; SOLDAT, 1982; NAMMACK, 1985; POLAT and GUMUS, 1995). The spine consists of an outer enamel layer, a pigment layer, three layers of dentine, and a central pulp cavity. The annulus is formed as the dentine layers do not grow at the same rate as the upward growth of spine in different seasons. When spine growth is reduced, pigments are concentrated and the enamel layer thickens, producing an annulus (MCFARLANE and BEAMISH, 1987). Annual formation of annuli has not been validated through direct methods, but several indirect methods have been used. Length-

frequency analysis was used by BONHAM *et al.* (1949), HOLDEN and MEADOWS (1962) and KETCHEN (1975). Monthly variation in colour of the basal band (HOLDEN and MEADOWS, 1962), mercury accumulation (KETCHEN, 1975), differences in length at known stages of pregnancy (BONHAM *et al.*, 1949; KETCHEN, 1975), and tagging studies (BONHAM *et al.*, 1949) have also been used. JONES and GEEN (1977) measured variations in elemental composition within vertebrae with an X-ray spectrometric technique and found them to correspond nearly identically with dorsal spine annulus. MCFARLANE and BEAMISH (1987) have identified these bands to be annual with oxytetracycline (OTC) injections.
In this study, the difficulties associated with the most preferred method for determining the age of spiny dogfish were studied.

Materials and Methods

This study was conducted in the Southern Black Sea (Fig. 1) between 2000 and 2003. A total of 118 dogfish were captured by longline (DEMİRHAN *et al.*, 2004) and commercial purse seiners and gill-netters.

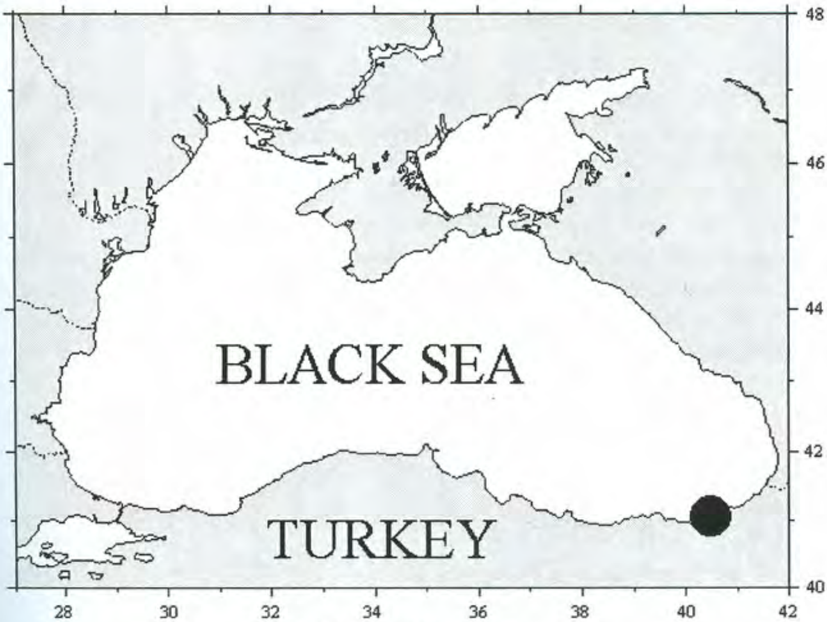
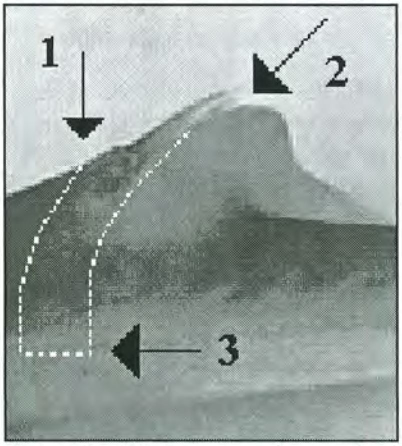


Figure 1. Sampling area

The first and second dorsal spine was removed by placing the knife posterior to the spine. A cut was made parallel to the base of the spine down into the muscle tissue. A second cut was made anterior to the spine until reaching the first cut (Fig. 2a and b). The spines were placed into a labelled envelope, and frozen until laboratuary analysis.

Spines were examined by using the Photoshop 7.0™ program on computer after having been photographed digitally by using a Sony 5.0 megapixel™ digital camera.



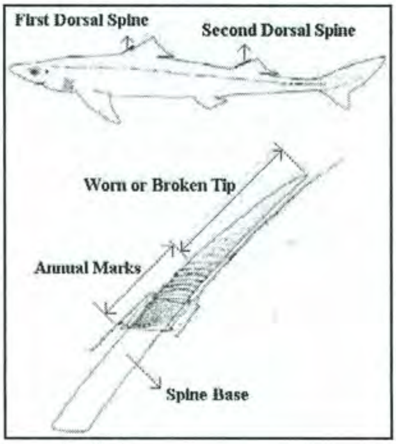


Figure 2. a) Spine removing method b) Spine

Results and Discussion

The age of 118 specimens was read by using the spine reading method. The age of 9 specimens were read by using only the first spine, and 50 specimens were read by using only second spine. The age of 59 specimens was read by using both spines.

Age readings are given in Fig. 3. The reasons for difficulties encountered while determining age were (in order of importance) (1) spines with wiped surfaces (lack of a pigment layer and annual rings on the spine surfaces), (2) broken spines (the tip of the spines were broken or eroded), (3) spines with both broken and wiped surfaces, and (4) spines with complicated surfaces (the surfaces of the spines had collapsed/corrupted the annual ring on the spine base or surface) (Fig. 4).

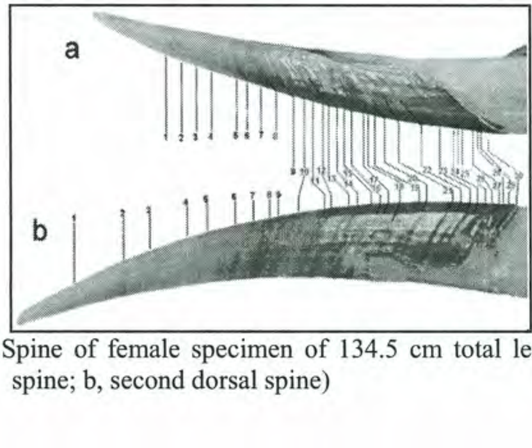
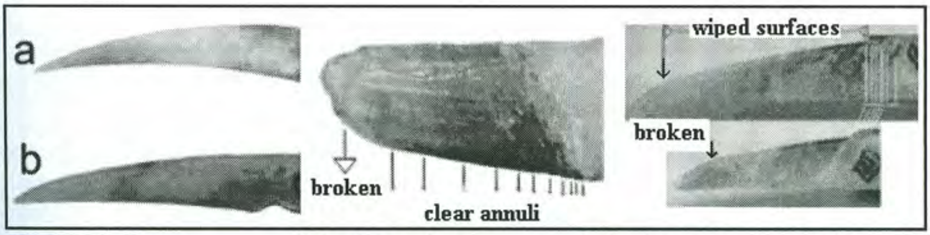
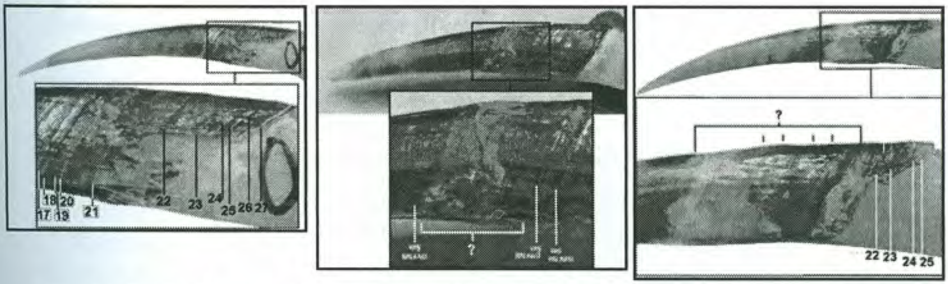


Figure 3. Spine of female specimen of 134.5 cm total length (a, first dorsal spine; b, second dorsal spine)



1) wiped surfaces (a) 1st spine (b) 2nd spine 2) broken spine 3) broken and wiped spines



1) wiped spine base 2) complicated spine surfaces 3) complicated spine surfaces

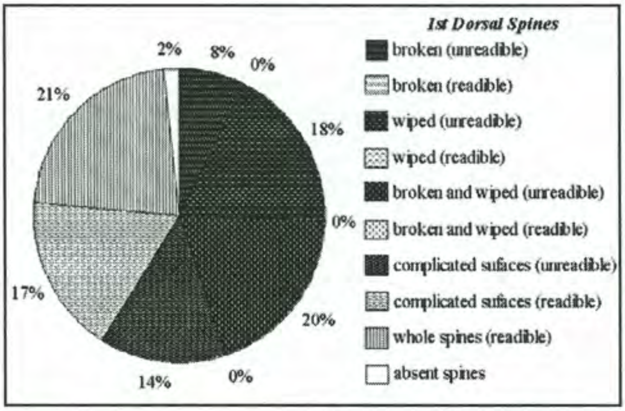
Figure 4. Main problems faced with age readings

Two criteria were used for ageing studies; the age readings had to be validated for accuracy (1) and the age readings had to be repeated by using validated methods (2) (CAMPANA, 2001). Also, the importance of using both spines together (1), as well as counting all dark bands and ridges occurring on the enameled surfaces together (2) was not ignored. Annual marks on the spine surface (dark bands and ridges) was different between first and second dorsal spines (Table 1).

Both spines were used to determine the age of 59 out of 118 specimens. Both dark bands and ridges were used to determine age using the first 24 spines and 22 of the second spines of a total of 59 spines. The age of 14 % of 118 specimens were determined by using the two above mentioned criteria (the use of both spines together and both dark bands and ridges that occur on enameled surfaces). All the first dorsal spines were shorter than the second dorsal spines, and the annual bands were more closely pressed together at the base of the first spines. Generally, first dorsal spines were broken and had eroded and wiped surfaces. It was therefore difficult to read the first dorsal spines. On the other hand, the annual bands were separated from each other on the surfaces of the second dorsal spines, and this made readings easier (Fig. 5).

Table 1. Evaluation of spines in age readings

First Spine	Number	Second Spine	Number
Age readings from only first dorsal spines	9	**Age readings from only second dorsal spines**	50
Only pigment band readings	2	Only pigment band readings	21
Only ridge readings	4	Only ridge readings	17
Both pigment band and ridge readings	3	Both pigment band and ridge readings	12
Readings from both of spines	59	**Readings from both of spines**	59
Only pigment band readings	23	Only pigment band readings	24
Only ridge readings	12	Only ridge readings	13
Both pigment band and ridge readings	24	Both pigment band and ridge readings	22



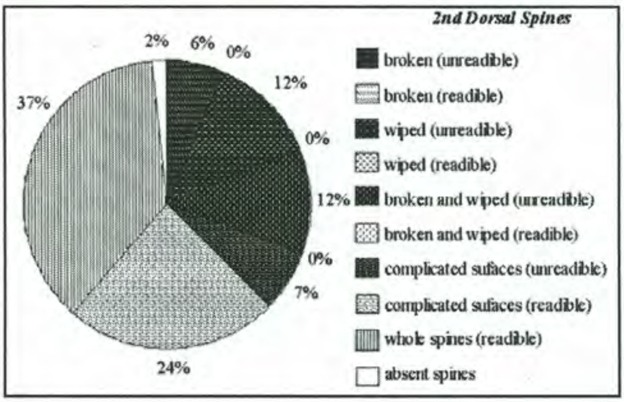


Figure 5. Use of spines and structures

KETCHEN (1975), JONES and GEEN (1977), BEAMISH and MCFARLANE (1985), MCFARLANE and BEAMISH (1987) stated that readings from second dorsal spines were reliable. It can be said that age readings from just second dorsal spines (50 specimens) and both of the spines (59 specimens) were reliable in this study. Thus 92 % of age readings (109 of 118 specimens) were considered as reliable.

There are several advantages to the method for determining age using dorsal spines in this study. The spines were examined by using high resolution photos. The images could be filtered by using the PhotoShop 7.0™ program. This made it easier to identify and count annual growth bands. Lighting could be used to expose annual ridges on the spine surface. Electronic records can be saved indefinitely without compromising the samples. This method allows sensitive measurements on spine dimensions and supplies a standardization on readings.

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SEDIMENT STRUCTURE AND OCCURRENCE OF SKATES AND RAYS INHABITING IN BABADILLIMANI BIGHT LOCATED IN NORTHEASTERN MEDITERRANEAN

Hacer YELDAN and Dursun AVŞAR

Cukurova University, Faculty of Fisheries, 01330 Balcalı/Adana, Turkey. E-mail: hacyel@cu.edu.tr

Abstract

This study was carried out between May 1999 and May 2000 in Babadılimanı Bight located in Northeastern Mediterranean coast of Turkey. *Raja clavata*, *Raja radula* and *Raja asterias* were the most common skates in the region while the most common rays of the territorial area were *Dasyatis pastinaca* and *Gymnura altavela.* In addition, for the identification of sediment composition of the sea bottom where these species distributed along the Northeastern Mediterranean, Grain Size Analysis was carried out by using the samples taken from 3 depth ranges in the Babadıllimanı Bight. In terms of the habitat selection, it was found that skates preferred highly silty bottom while rays were more densely distributed along the shallower areas and sandy silts.

Key words: Mediterranean Sea, sediment, continental shelf, skates and rays.

Introduction

Although approximately 700 000 tonnes of skates and rays are caught in the world in a year on average (BONFIL, 1994; FRISK *et al.*, 2001); according to State Institute of Statistics Prime Ministry Republic of Turkey's 1995 to 2002 statistics the mean landing values in Turkey are rather low, varying between 340 and 1575 tonnes per year, and the annual statistics for these groups in Turkey are not given separately (DIE, 1995-2001).

Although elasmobranchs have become important fishery resources worldwide, yet many aspects of their ecology suggest that they may susceptible to over exploitation (HOLDEN 1974; 1977). In Turkey, skates and rays are considered as by-catch in demersal fisheries, and some species eg. *Raja clavata* and *Dasyatis pastinaca* are landed for consumption in some European countries (Italy and France). Geographic distribution abundance, feeding habits and reproductive data for skates and rays in the Northeastern Atlantic and the Mediterranean (WHEELER, 1969; NOTTAGE and PERKINS, 1980; WHITEHEAD *et al.*, 1986; FISCHER *et al.*, 1987; ESCHMEYER, 1999; DULCIC *et al.*, 2003) and extended seas located along the Turkish coast (ANONYMOUS, 1984; AKSIRAY, 1987; BASUSTA *et al.*, 1998; GUCU and BINGEL, 1994; KABASAKAL, 1994; BINGEL *et al.*, 1996; BASUSTA and ERDEM, 2000; ISMEN, 2002; FILIZ and TOGULGA, 2002; FILIZ and MATER, 2002; MATER *et al.*, 2003) are mostly based on systematic, comprehensive biology, distribution and the identification characteristic of these groups, while data about the occurrence, ecology and sediment structure of their habitat are rare. This study, in relation to others apart from general biology, deals with sediment structure of their habitat and occurrence of skates and rays in the Northeastern Mediterranean. Therefore this study contributes to the increased knowledge of the ecology of skates and rays.

Materials and Methods

A total of 307 individuals were captured by deep-trawl net between May 1999 to May 2000 in Babadıllimanı Bight located in the Northeastern Mediterranean coast of Turkey. In order to determine the sediment structure of Babadıllimanı Bight (33^0 23' 36" - 33^0 32' 57" N; 36^0 07" 00" - 36^0 09' 39" E), the study region of this research, only one sampling was carried out in May 2000. The samples were collected from three different stations located at 0-50, 50-100 and >100m depth ranges by using dredge (Fig. 1). Samples were transferred to the laboratory in plastic bags in order to make Grain Size Analysis. The analyses were carried out according to the Wentworth Scale. Sieves with 2, 1, 0.5 and 0.25 mm (in diameter) holes were used to shift the samples (RICHARD and DAVIS, 1972). Afterwards, the samples were classified according to the particle sizes. The particles between 2-1 mm in diameter were classified as gravels, and those between 1-0.25 mm were sand and silt, while those smaller than 0.25 mm were clay.

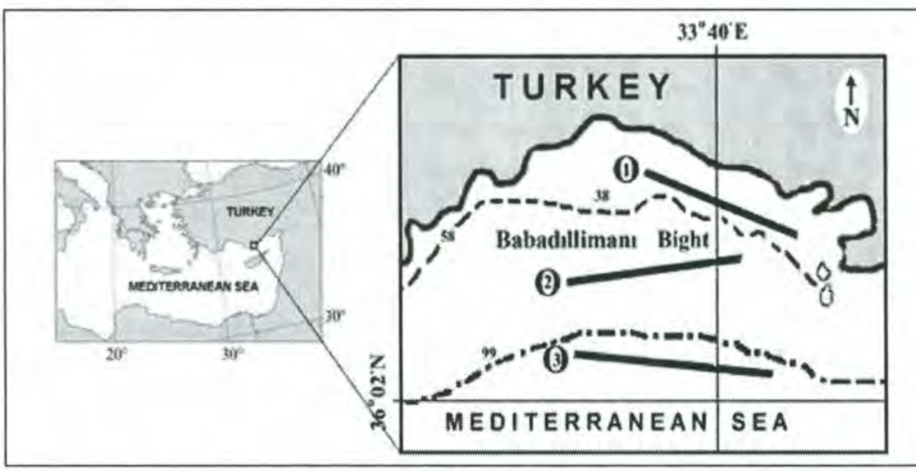

Figure 1. The study area and the sampling stations.

Results

General Features of the Babadıllimanı Bight

In the Northeastern Mediterranean, the largest continental shelf area is located between Iskenderun and Silifke. There are also some small areas in the western entrance of this section. Among them Babadıllimanı Bight is the largest area of the region subject to the fishing along the northeastern Mediterranean coast of Turkey. The bottom structure of Mersin and Iskenderun Bays located in the region are mostly covered by sand, silt, clay or mud; and therefore have a dynamic substratum structure. Due to this formation, the bottoms of both bays are convenient for deep trawling, but the rest of the region has a slopy, highly steep bottom.

The section where Babadıllimanı Bight lays is of typical Mediterranean characteristics: it has a highly narrow continental shelf and is surrounded by very steep mountains lying parallel to the coastline. Nearby inshore is mostly covered by rocks and crags. Only the area of 6 miles length and 2-3 nautical miles width between Beşparmak Island and Kızılliman Cape has a partly even floor, and its bottom is mostly covered by clay and silt (OZYURT, 2003).

Sediment Structure

The results obtained from the sediment samples taken from the stations located into the depth ranges of 0-50 m, 50-100 m and >100 m in Babadıllimanı Bight are given in Fig. 2.

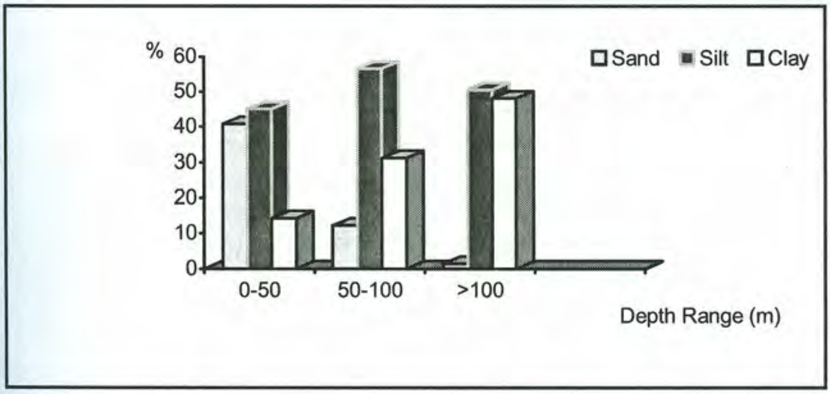

Figure 2. The sediment structure of Babadıllimanı Bight (%).

It seems that the 0-50 m depth range representing coastal region of Babadıllimanı Bight is mostly covered by silt, and it is followed by sand and then, by clay (Fig. 2). It is clearly seen that within the depth ranges, silt formation has uttermost importance in 50-100 m depth range, but the silt percentage is higher compared to the 0-50 m depth range. Clay comes after the silt, and sand is lesser than the other two sediment types in the region. Within the depth ranges silt structure is the main component of the sediment in the area deeper than 100 m while clay follows this, and sand constitutes the smallest proportion (Fig. 2).

Moving from the shallow coastal region to the deeper offshore, it seems that the bottom is mostly covered with silt in all depth ranges, and the sand is also significant in the sediment composition of coastal bottom structure, but it becomes less and less noteworthy advancing towards the deeper waters. On the other hand, clay becomes the second significant component after silt advancing to deeper bottoms, while it is insignificant in the sediment structure of coastal bottoms (Fig. 2).

Distribution of Skates and Rays in the Region

The proportional distribution of skates and rays caught from Babadıllimanı Bight and obtained results in this study considering depth ranges are given in Table 1.

Table 1. The proportional distribution of skates and rays in terms of depth ranges and along the Babadıllimanı Bight

	Depth ranges			
Species	**0-50m**	**50-100m**	**>100m**	Total
Raja clavata	4.10	4.40	0.65	9.15
Raja radula	24.10	36.10	1.05	61.25
Raja asterias	3.00	4.20	0.30	7.50
Dasyatis pastinaca	5.10	2.10	-	7.20
Gymnura altavela	13.70	1.20	-	14.90
Total	50.00	48.00	2.00	100.00

As seen in Table 1, although the thornback ray (*Raja clavata*) is found in each of three depth ranges, since it is more common in the first two depth ranges, and these places mostly consist of silt while including sand to some extent. Therefore, it could be claimed that this species prefer silty-sandy bottoms in the Northeastern Mediterranean. However, the fact that this species exist proportionally more within 50-100 m depth range than that of 0-50 m indicates that this species prefers silty regions within silty-sandy areas more. *R. radula* seems to prefer the bottoms of 0-50 m and 50-100 m depth ranges which are close to the coast and of sandy and silty formation, more than that of >100 m depth range. Within these areas it chiefly prefers mostly silty regions, just as *R. clavata* and *R. asterias* individuals do. (Table 1; Fig. 2).

Although the skates (*R. clavata*, *R. radula* and *R. asterias)* obtained during the sampling period mostly prefer silty regions, it was found that the rays (*D. pastinaca* and *G. altavela*) prefer shallower and sandy-silty regions -where two sediment types exist nearly equally-compared to the other species. (Table 1; Fig. 2).

Discussion

The species related to this study are demersal and widely distributed in the waters of Northeastern Mediterranean, and they prefer the sediment formation of sand, silt and clay for habitation. In the study, although *R. clavata* and *R. radula* individuals occurred within all of the three depth ranges, they were only extensively found within 0-50 and 50-100 m depth ranges.

It was also found that *R. asterias* preferred the same substratum as *R. clavata* and *R. radula* inhabited, whereas *Dasyatis pastinaca* and *Gymnura altavela* individuals were scattered within different environments. Although *D. pastinaca* individuals were found within three depth ranges (0-50 m; 50-100 m; >100 m), *G. altavela* were distributed abundantly within 0-50m depth range, but seldom within 50-100 m, and they were not encountered at the substratum deeper than 100m. In literature, other studies have only given some information about the geographical regions these species exist in and the strata in which they distribute. Among them, WHEELER (1969), AKSIRAY (1987), FISCHER *et al.* (1987), WHITEHEAD *et al.* (1986), BASUSTA *et al.* (1998; 2000), HAMLETT (1999) and MATER *et al.* (2003) state that these species are found in nearly all the coastal waters: from hot seas to the warm and very cold seas of Northern and Southern Hemisphere; and from very shallow areas to the depth of 200 m and even up to 3000 m.

Additionally, considering their general distribution, it is stated that from skates and rays individuals live on sandy-muddy benthic areas of all the Turkish coastal waters (BASUSTA *et al.*, 1998; MATER *et al.*, 2003; FROSE *et al.*, 2004). Consequently, it seems that the structures of the substrata, considering the species examined in this study are in harmony with those reported by other researchers.

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SAVE THE SANDBAR SHARKS OF BONCUK BAY, TURKEY

Bayram ÖZTÜRK

Faculty of Fisheries, Istanbul University
Turkish Marine Research Foundation
Istanbul, Turkey

Abstract

Sandbar shark *Carcharhinus plumbeus* (Nardo, 1827) is found in Boncuk Bay, Marmaris, on the southern Aegean coast of Turkey. The present study shows that this bay is one of the critical habitats for this species and at least 2 nm (nautical miles) areas should be protected for this vulnerable species in the Mediterranean Sea. Fisheries and other anthropogenic factors should also be eliminated in the bay using the fisheries law 1380 to protect this species. Total of 23 fish species, 21 invertebrate species, and 4 marine mammal species were identified in Boncuk Bay.

Key words: **Carcharhinus plumbeus,** ***Aegean Sea, critical habitat.***

Introduction

The sandbar shark *Carcharhinus plumbeus* (Nardo, 1827) is a large, slow growing and low fecundity coastal species (Fig. 1). It occurs in offshore and inshore waters in subtropical and warm temperate regions in world wide. It is found commonly in continental shelf areas, shallow sandy or muddy bottoms in bays, or harbours, river mouths, although it is found very rarely on sandy beaches and in the surface zone, coral reefs and rough bottom, and the surface (COMPAGNO, 1984). Their long migration cycle along the Western North Adriatic is well known. It migrates to south for winter and north for summer. Main causes of these migrations are seasonal temperate changes, current patterns, and local upwellings. Sandbar sharks prefer temperate waters in shallow bays and estuaries as a nursery area of the east-central USA in the Western North Atlantic (COMPAGNO, 1984). Atlantic population of the sandbar sharks was over exploited, and this population declined very sharply in the last few decades (10-15 % survives) (URL_1). Today, this species is very rare, and the IUCN Red List classifies sandbar sharks as *Lower Risk/Near Threatened* at the world level (SHARK SPECIALIST GROUP, 2000)

Data on sandbar sharks in the Mediterranean are very few. Nowadays, this species is captured rarely in the Mediterranean. Boncuk Bay is the only known nursery area in the Turkish coast in the Mediterranean (URL_1; URL_2; CLO and SABATA, 2004). This bay has been known as a nursery area of the sandbar shark at least since 1990.

CLO and SABATA (2004) stated that dozens sandbar sharks come in this bay for reproduction every year in early summer (May and June). They have identified over 100 individuals in Boncuk Bay since 2001. They observed that mature females are majority of the population in this bay (URL_1, CLO and SABATA, 2004).

The aim of this paper is to describe the marine fauna of Boncuk Bay, and to provide scientific data to the relevant authorities in case of the protection of Boncuk Bay as a critical habitat for the sandbar shark.

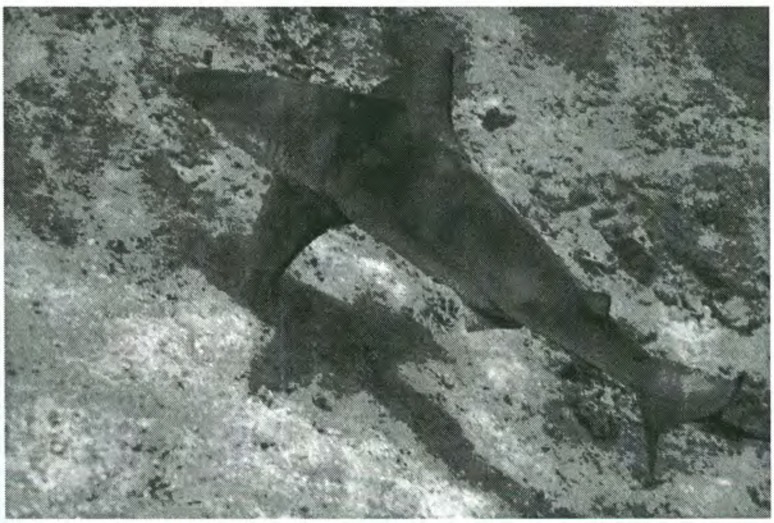

Figure 1. *Carcharhinus plumbeus*

Materials and Methods

Boncuk Bay is located in Gökova Gulf, just next to the Sedir Island (Fig. 2). The bay is situated in Marmaris, which is one of the resort areas of Turkey.

All the investigation were carried out with scuba diving and snorkelling in early summer (May, June and July, 2003 and 2004). Fish, invertebrates and mammals were identified visually at depth range 0-10 m.

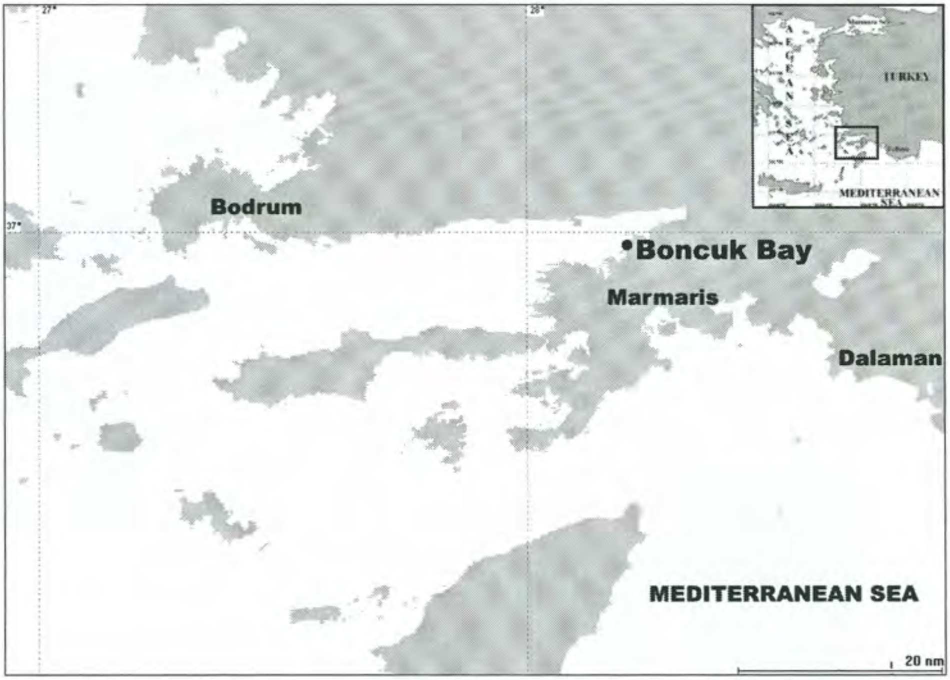

Figure 2. Boncuk Bay

Results and Discussion

Total 21 invertebrate species belonging to 20 families were identified. Among them, 8 sponge, 3 coelenterate, 3 crustacean, 2 mollusc, 5 echinoderm species were determined. List of the invertebrates in the bay is shown in Table 1.

Table 1. List of the invertebrate species observed in Boncuk Bay, Marmaris.

Phylum	Famillies	Species
Porifera	Agelasidae	*Agelas oroides* (Schmidt, 1864)
	Aplysinidae	*Aplysina aerophoba* Nardo, 1843
	Axinellidae	*Axinella verrucosa* (Esper, 1794)
	Spongiidae	*Hippospongia communis* (Lamarck, 1814)
	Irciniidae	*Sarcotragus muscarum* Schmidt, 1862
	Petrosiidae	*Petrosia ficiformis* (Poiret, 1798)
	Chondrillidae	*Chondrilla nucula* Schmidt, 1862
		Chondrosia reniformis Nardo, 1847
Cnidaria	Actiniidae	*Actinia equina* (Linnaeus, 1758)
Annelida	Serpulidae	*Protula tubularia* (Montagu, 1803)
	Amphinomidae	*Hermodice carunculata* (Pallas, 1776)
Arthropoda	Squillidae	*Squilla mantis* (Linnaeus, 1758)

Table 1. (Cont.)

	Penaeidae	*Melicertus kerathurus* (Forskål, 1775)
	Scyllaridae	*Scyllarides latus* (Latreille, 1803)
Mollusca	Patellidae	*Patella caerulea* Linné, 1758
	Pinnidae	*Pinna nobilis* Linné, 1758
Echinodermata	Echinasteridae	*Echinaster (Echinaster) sepositus* (Retzius, 1783)
	Echinidae	*Paracentrotus lividus* (de Lamarck, 1816)
	Toxopneustidae	*Sphaerechinus granularis* (de Lamarck, 1816)
	Holothuriidae	*Holothuria (Platyperona) sanctori* Delle Chiaje, 1823
	Synaptidae	*Synaptula reciprocans* (Forskal, 1775)

Total 23 fish species belonging to 14 families were determined in Boncuk Bay (Table 2). The species number was the highest to the family Sparidae. *Sardina pilchardus, Dicentrarchus Labrax, Mugil cephalus, Mullus surmuletus, Epinephelus costea, Diplodus vulgaris, D. puntazzo, Oblada melanura, Boops boops, Sarpa salpa* and *Scorpaena porcus* are economically important species.

Table 2. List of the fish species observed in Boncuk Bay, Marmaris.

Families	**Species**
Carcharhinidae	*Carcharhinus plumbeus* (Nardo, 1827)
Atherinidae	*Atherina sp.*
Clupeidae	*Sardina pilchardus* (Walbaum, 1792)
Congridae	*Conger conger* Linnaeus, 1758
Holocentridae	*Sargocentron rubrum* (Forsskål, 1775)
Labridae	*Coris julis* (Linnaeus, 1758)
	Thalassoma pavo (Linnaeus, 1758)
Moranidae	*Dicentrarchus labrax* (Linnaeus, 1758)
Mugilidae	*Mugil cephalus* Linnaeus, 1758
Mullidae	*Mullus surmuletus* Linnaeus, 1758
Muraenidae	*Mureana helena* Linnaeus, 1758
Pomacentridae	*Chromis chromis* (Linnaeus, 1758)
Scorpaenidae	*Scorpaena porcus* Linnaeus, 1758
Serranidae	*Epinephelus costae* (Steindachner, 1878)
	Serranus scriba (Linnaeus, 1758)
Sparidae	*Boops boops* (Linnaeus, 1758)
	Diplodus annularis (Linnaeus, 1758)
	Diplodus puntazzo (Cetti, 1777)
	Diplodus vulgaris (E. Geoffrey Saint-Hilaire, 1817)
	Oblada melanura (Linnaeus, 1758)
	Sparus aurata Linnaeus, 1758
	Salpa salpa (Linnaeus, 1758)

As marine mammals, *Delphinus delphis* (Linnaeus, 1758), *Stenella coeruleoalba* (Meyer, 1833), *Tursiops truncatus* (Montagu, 1821) and *Monachus monachus* Hermann 1779 were observed in Boncuk Bay.

Total 23 fish species, 21 invertebrates and 4 marine mammals were determined in Boncuk Bay. Among them *Sargocentron rubrum* and *Synaptula reciprocens* were exotic species originally from the Red Sea.

During this study, *C. plumbeus* was observed very frequently in May and June. Maximum number of individuals observed at a time was 11, but generally 1 or 2 individuals are seen at a time, rarely exceeding 4. This species preferred mostly 3-5 m depths in the bay in early summer. The sandbar shark had been known to occur there at least in the last three decades by divers, fishermen and local boat owners. Over 100 sandbar shark individuals have been identified in this bay since 2001 by CLO and SABATA (2004). Also, the same authors recorded the birth of a shark in 2004 in the same area (CLO and SABATA, 2004). This is an evident that this bay is a nursery area for sandbar sharks in the Mediterranean.

Conclusions

1. Boncuk Bay is one of the most quiet resort areas in Gökova Gulf. Relatively small tourism activity and being next to the Sedir Island, which is protected due to its famous Cleopatra beach, are advantages for the habitat protection, but the tourism activities can be a threat in the future.

2. Purse seining, long lining, gill netting are main fisheries activities in the bay, except for August. Massive fishing activities are the main threat for the sandbar shark population in the bay.

Boncuk Bay is the only known nursery area for the sandbar shark *Carcharhinus plumbeus* in the Mediterranean Sea. This area, threfore, should be protected for the survival of the sandbar shark population.

It is not known where these fish migrate for the rest of the year since this species is observed in the bay mostly in May and June, and very rarely in July. A monitoring study by tagging should be performed to understand their movement. Besides, the sandbar shark has also been observed in Mandalya Bay in 1990 and a detailed study is also needed for some other areas.

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SEXUAL DIMORPHISM IN THE HEAD, MOUTH AND BODY MORPHOLOGY OF THE LESSER-SPOTTED DOGFISH, *Scyliorhinus canicula*, FROM TURKEY

Halit FİLİZ and Ertan TAŞKAVAK

Ege University, Faculty of Fisheries, Department of Basic Sciences, 35100 Bornova/ Izmir, Turkey
E-mail: ertan.taskavak@ege.edu.tr

Abstract

Males of *Scyliorhinus canicula* have a longer and narrower mouth than females resulting in pronounced sexual dimorphism with respect to the mouth length/mouth width ratio (0.55 and 0.50, respectively). Significant sexual differences related to head measurements (i.e., snout to spiracle and snout to pectoral) were recorded. Some body measurements, i.e. pelvic to anal, pectoral inner edge, pelvic to median tip and upper caudal as well as total body length differentiated males from females. Reasons for these differences are discussed.

Key words: **Scyliorhinus canicula,** ***Elasmobranchii, sexual dimorphism, meristic.***

Introduction

The lesser spotted dogfish, *Scyliorhinus canicula* Linnaeus, 1758(Family: Scyliorhinidae), is an Atlanto-Mediterranean demersal species, inhabiting continental shelves and uppermost slopes, found on sandy, coralline, algal, gravel or muddy bottoms between 3-400 meters depth (HUREAU and MONOD, 1973; CAPAPE, 1977; JARDAS, 1979; WHITEHEAD *et al.*, 1984; FROESE and PAULY, 2004). The species is common in the Mediterranean (CAPAPE, 1977; JARDAS, 1979; CIHANGIR *et al.*, 1997; BERTRAND *et al.*, 2000; BAINO and SERENA, 2000) and widespread in the Northeast Atlantic (WHITEHEAD *et al.*, 1984).

Differences in the selective pressures experienced by the sexes can ultimately result in the evolution of sexual dimorphism of morphological traits (CASSELMAN and SCHULTE-HOSTEDDE, 2004). Sexual dimorphism with respect to body size appears more common among shark species where females have viviparous and ovoviviparous reproductive modes (SIMS, 2003). ELLIS and SHACKLEY (1995) and ERDOGAN *et al.* (2004), however, have demonstrated that sexual dimorphism can occur in oviparous sharks as *S. canicula*.

Morphological and dental differences are two useful criteria for the taxonomy of elasmobranch fish (ELLIS and SHACKLEY, 1995). However, intraspecific variation, due to growth, sexual dimorphism and geographical and individual differences, has been little studied (STEFFENS and D'AUBREY, 1967; TANIUCHI, 1970;

BASS, 1973; SIQUEIROS-BELTRONES, 1990; KAJIURA and TRICAS, 1996; KAJIURA, 2001).

BROUGH (1937) noted that the head and mouth were narrower and the intermandibular separation less in male *S. canicula*. He correlated changes in the lower jaw structure to sexual maturity and observed that these sexual dimorphic characters were more pronounced in the breeding season and were not present in sexually immature specimens. Sexual dimorphism in the mouth length/mouth width ratio of *S. canicula* has also been described briefly (ARTHUR, 1950). It is considered that this sexual dimorphism occurs relatively suddenly at the onset of maturity (BROUGH, 1937). Morphometric studies of *S. canicula* from the Mediterranean have shown negative allometric growth of the head (BAS, 1964), and JARDAS (1979) and ERDOGAN *et al.* (2004) reported that males had longer heads than females.

The purpose of the present study was to determine the extent of sexual variation in the head morphometrics of *S. canicula* and to assess its possible functional significance.

Materials and Methods

On September and November 2002, we collected the specimens from Foca Trawl Area (Izmir Bay, Aegean Sea, Turkey) in depths between 40 and 120 meters, with two bottom trawls materialized by commercial vessel (Fig. 1). A total of 296 *Scyliorhinus canicula* specimens were sampled. The sex, total length (TL), mouth length (MoL) and mouth width (MoW) of 123 females and 173 males were recorded to the nearest mm. For analyses, we followed the methodology described by ELLIS and SHACKLEY (1995). Significant differences of the mouth length (%TL), mouth width (%TL) and mouth length/mouth width ratio (MoL/MoW) between the sexes were calculated from a *t*-test of the differences between two means (SOKHAL and ROHLF, 1981). The data were further divided into six TL groups (<275, 275-324, 325-374, 375-424, 425-474 and >475 mm) with similar tests used to determine any significance between the various TL groups within each sex, and between the same TL groups of each sex.

Eight morphometric measurements of the head region and eighteen morphometric measurements of the body (according to BASS *et al.*, 1975) were also examined to determine the differences between sexes (Fig. 2). These dimensions were measured to the nearest mm and converted to % TL for statistical analysis.

Results

Males possessed a significantly longer (4.02 and 3.75 % respectively; $P<0.0001$) and narrower mouth (7.42 and 7.51 % respectively; $P<0.0001$) than females (Table 1). These differences result in a significant sexual dimorphism with respect to MoL/MoW (0.55 and 0.50 for males and females respectively; $P<0.0001$). MoL/MoW was almost constant in the length groups 1, 2 and 3, and decreased significantly after the length group 4, whereas this ratio increased significantly with length in male fish (Fig. 3).

Comparing the sexual differences in these measurements for each size group (Table 2) indicated that sexual dimorphism occurred only in the TL groups larger than 374 mm. Other size groups smaller than 375 mm showed no significant differences. For fish 375-424 mm, although MoL was found to be significantly different, MoW and MoL/MoW were not significantly different. For fish 425-474, MoL and MoL/MoW were significantly differentiated between sexes. All fish larger than 475 mm groups showed significant differences for all three variables.

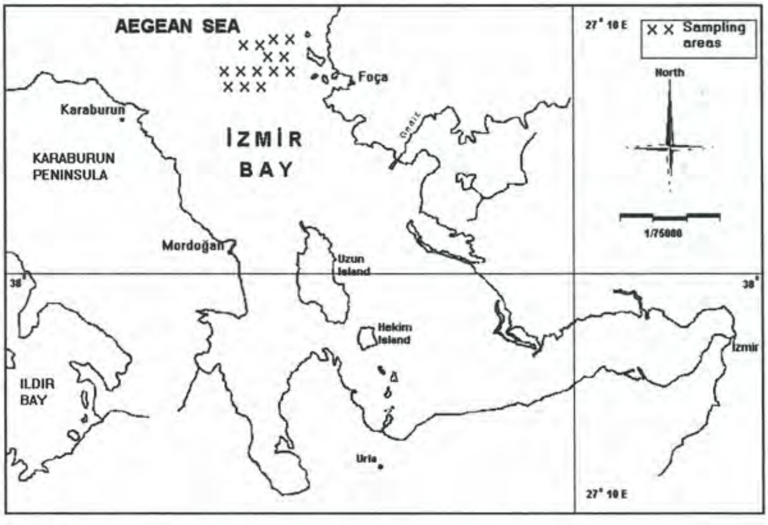

Figure 1. Localities where the *Scyliorhinus canicula* specimens were sampled.

Significant size-based differences were observed for both sexes, although more so for male fish. MoL/MoW in males increased from 0.49 (<275 mm TL) to 0.61 (>475 mm TL) (Table 1) with significant differences occurring between fish smaller than 275mm TL and the three larger size groups (375-424, 425-475 and >475 mm; P=0.0005, 0.0004 and 0.0001, respectively). This difference in MoL/MoW can be attributed to an increase in the MoL and a relative decrease in MoW as male fish grew. MoL of fish <275, 275-324 and 325-374 mm were significantly different from three of the larger TL groups (P<0.005 for all). Significant differences in MoW occurred between fish <275 mm and the other five TL groups (P<0.005 for all). MoL and MoW changed very little in female fish (Table 2).

Both MoL and MoW were positively correlated with TL in males and females (Fig. 4). The linear relationships are described by the following equations;

Females: MoL= 0.035 T.L + 0.738 (r^2 = 71.99, n = 123)
MoW= 0.074 T.L + 0.452 (r^2 = 79.26, n = 123)

Males: MoL= 0.047 T.L – 2.505 (r^2 = 76.99, n = 173)
MoW= 0.060 T.L + 5.174 (r^2 = 79.26, n = 173)

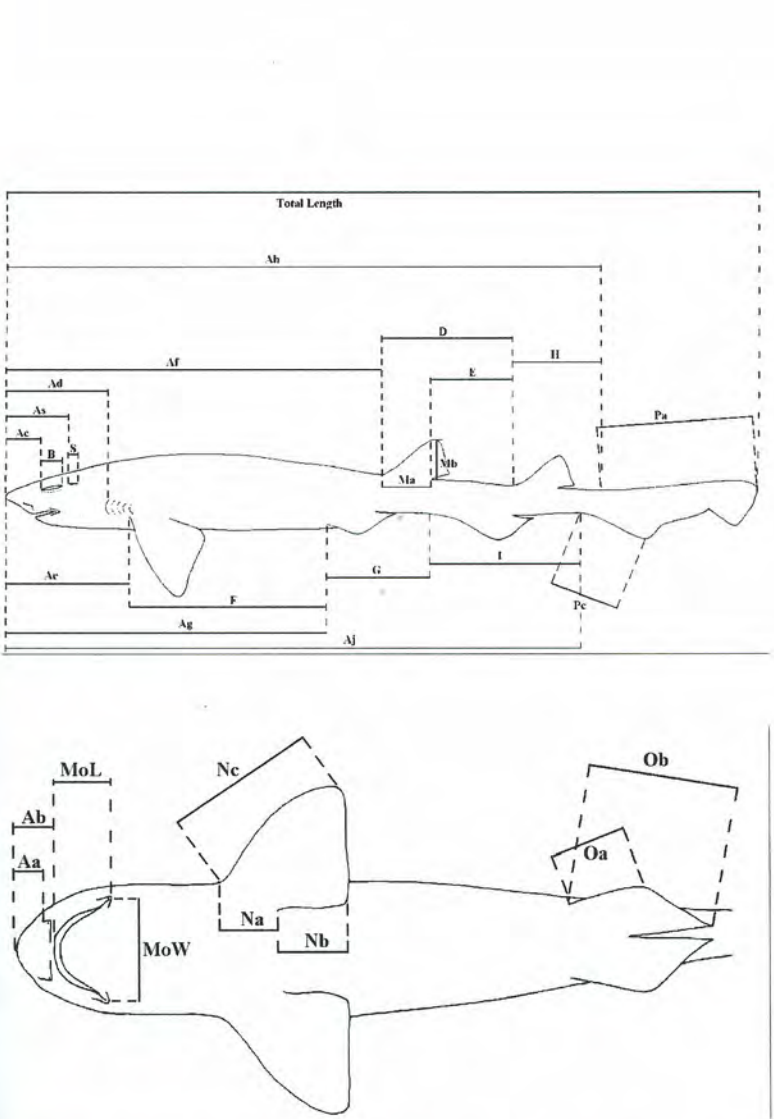

Figure 2. Measurements taken in the present study. **Aa:** snout to nostrils; **Ab:** snout to mouth; **Ac:** snout to eye; **Ad:** snout to first gill-slit; **Ae:** snout to pectoral; **Af**: snout to first dorsal; **Ag**: snout to pelvic; **Ah**: standard length (snout to upper caudal); **As**: snout to spiracle; **B**: eye diameter; **D:** first to second dorsa; **E:** between dorsal bases; **F:** pectoral to pelvic; **G:** pelvic to anal; **H**: second dorsal to upper caudal; **I**: anal to lower caudal; **MoL:** mouth length; **MoW:** mouth width; **Na**: pectoral base; **Nb:** pectoral inner edge; **Nc:** pectoral length; **Oa:** pelvic to lateral lobe; **Ob:** pelvic to median tip; **Pa:** upper caudal; **Pc:** lower caudal; **S:** spiracle length (According to Bass *et al.*, 1975).

Distances from snout to spiracle and from snout to pectoral were significantly different between males and females (P=0.037 and 0.026, respectively, Table 3). Males have longer snout to spiracle and snout to pectoral lengths than those of females. Snout to first gill-slit length tended to be shorter in female fish, although these measurements were not statistically significant (P=0.057). Similarly, when we also compared the measurements take from other parts of the body, except for head region, a set of five characters (total body length, pelvic to anal, pectoral inner edge, pelvic to median tip and upper caudal) differentiated males from females (Table 4).

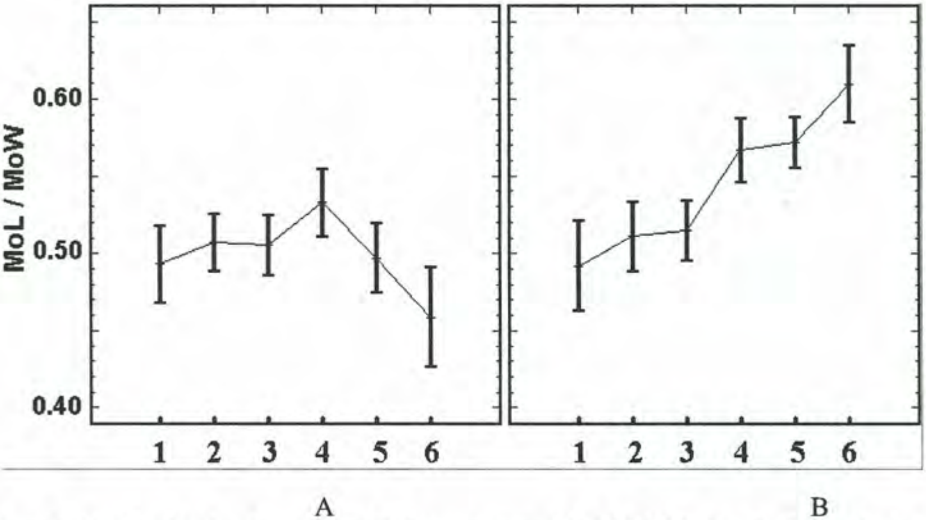

Figure 3. Graphs showing the relationship between mean MoL/MoW (± Standard deviation) and size group in (A) female and (B) male *Scyliorhinus canicula* (**1**: <275, **2**: 275-324, **3**: 325-374, **4**: 375-424, **5**: 425-474 and **6**: >475).

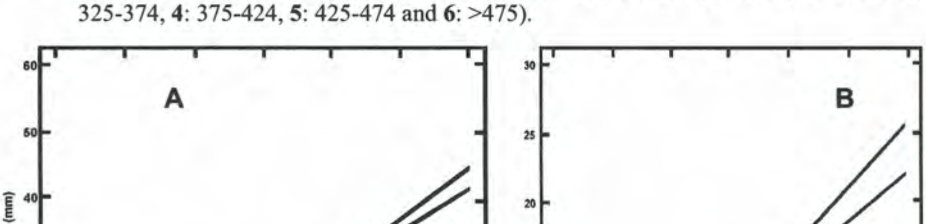

Figure 4. Graphs showing the linear relationships between mouth width and total length, and mouth length and total length for male (A) and female (B) *Scyliorhinus canicula.*

Table 1. Differences for male and female *Scyliorhinus canicula* specimens in mouth morphometries by TL (Values given are the mean ± SD and range in parenthesis).

	MALES				FEMALES			
TL	**N**	**MoL/MoW**	**MoL (%)**	**MoW(%)**	**N**	**MoL/MoW**	**MoL(%)**	**MoW(%)**
<275	15	0.49±0.12 [0.25-0.74]	3.85±0.59 [3.11-5.60]	8.16±1.91 [5.83-14.20]	16	0.49±0.07 [0.38-0.63]	3.69±0.42 [2.78-4.48]	7.60±1.11 [4.63-9.85]
275-324	26	0.51±0.07 [0.34-0.65]	3.81±0.39 [2.97-4.55]	7.50±0.57 [6.67-9.02]	29	0.51±0.09 [0.36-0.85]	3.84±0.69 [2.67-5.97]	7.59±0.73 [5.87-9.09]
325-374	35	0.51±0.06 [0.40-0.65]	3.84±0.37 [3.22-4.86]	7.51±0.59 [5.48-8.49]	28	0.51±0.07 [0.36-0.70]	3.75±0.38 [3.06-4.51	7.51±0.83 [5.03-8.82]
375-424	30	0.57±0.11 [0.32-0.90]	4.19±0.65 [3.21-6.31]	7.50±1.12 [5.98-12.59]	21	0.53±0.05 [0.44-0.67]	3.85±0.38 [3.05-4.45]	7.25±0.76 [5.94-8.32]
425-474	46	0.57±0.06 [0.44-0.84]	4.17±0.48 [3.32-6.24]	7.30±0.49 [6.28-8.94]	20	0.50±0.05 [0.39-0.63]	3.68±0.38 [3.12-4.42]	7.42±0.64 [6.17-8.37]
>475	21	0.61±0.07 [0.49-0.77]	4.12±0.32 [3.59-4.84]	6.80±0.65 [5.46-7.80]	9	0.46±0.05 [0.41-0.55]	3.59±0.37 [3.04-4.17]	7.85±0.48 [6.84-8.42]
Σ	173	0.55±0.09 [0.25-0.90]	4.02±0.50 [2.97-6.31]	7.42±0.92 [5.46-14.20]	123	0.50±0.07 [0.36-0.85]	3.75±0.47 [2.67-5.97]	7.51±0.79 [4.63-9.85]

Table 2. Probability values showing the statistical differences of MoL/MoW, MoL% and MoW% (using t-test) between males and females of entire *Scyliorhinus canicula* specimens.

	MoL/MoW	**MoL%**	**MoW%**
<275	0.975	0.382	0.317
275-324	0.850	0.880	0.628
325-374	0.573	0.317	0.992
375-424	0.175	0.033*	0.374
425-474	0.000*	0.001*	0.403
>475	0.000*	0.000*	0.001*
∑	0.000*	0.000*	0.417

(* indicates significant differences)

Table 3. Descriptive statistic of eight metric measurements of the head region of males (n=173) and females (n=123) (Values given are the mean ± SD and range in parenthesis).

	Male	Female	
Measurements	Mean±SD	Mean±SD	P
Snout to nostrils (Aa)	2.44±0.39 [1.79-3.73]	2.46±0.40 [1.70-4.71]	0.653
Snout to mouth (Ab)	3.91±0.37 [2.33-5.48]	3.96±0.37 [2.54-5.16]	0.298
Snout to eye (Ac)	5.68±0.50 [3.15-7.80]	5.60±0.56 [3.28-7.19]	0.113
Snout to spiracle (As)	9.50±0.55 [7.22-13.40]	9.33±0.83 [3.92-11.11]	0.037*
Snout to first gill-slit (Ad)	12.48±0.89 [10.17-18.40]	12.25±1.18 [9.94-21.82]	0.057
Snout to pectoral (Ae)	16.55±1.47 [7.39-24.00]	16.20±1.13 [13.70-20.06]	0.026*
Eye diameter (B)	3.68±0.75 [0.96-6.58]	3.65±0.65 [2.18-5.24]	0.744
Spiracle length (S)	0.85±0.15 [0.53-1.40]	0.84±0.17 [0.42-1.48]	0.824

(* indicates significant differences)

Table 4. Descriptive statistic of eighteen metric measurements of the body of males (n=173) and females (n=123) (Values given are the mean ± SD and range in parenthesis).

	MALE	FEMALE	
Measurements	**Mean±SD**	**Mean±SD**	**P**
Total Length (TL)	385.83±73.70 [210.00-525.00	357.89±72.59 [210.00-508.00]	0.001*
Snout to first dorsal (Af)	49.51±2.14 [45.46-70.00]	49.32±3.10 [45.20-76.27]	0.533
Snout to pelvic (Ag)	39.29±2.08 [27.65-56.00]	39.81±3.02 [35.00-58.68]	0.083
Standard length (Ah)	79.90±3.64 [68.66-114.00]	79.54±2.02 [76.09-93.14]	0.311
Snout to lower caudal lope (Aj)	78.06±3.03 [68.00-110.00]	77.98±3.22 [72.36-102.63]	0.820
First to second dorsal (D)	18.20±1.19 [15.09-26.80]	18.14±1.01 [14.88-21.57]	0.648
Between dorsal bases (E)	12.78±1.05 [10.50-19.20]	12.90±0.99 [10.79-17.11]	0.338
Pectoral to pelvic (F)	23.54±1.73 [18.52-36.00]	23.79±1.46 [20.00-27.78]	0.193
Pelvic to anal (G)	19.30±1.27 [16.67-26.00]	18.91±1.42 [15.24-23.26]	0.013*
Second dorsal to upper caudal (H)	12.44±1.02 [10.19-16.80]	12.62±1.26 [9.36-16.67]	0.176
Anal to lower caudal (I)	20.17±1.25 [16.67-29.20]	20.26±1.24 [17.05-24.00]	0.576
Pectoral base (Na)	5.20±0.60 [3.88-8.00]	5.24±0.59 [3.68-7.46]	0.571
Pectoral inner edge (Nb)	5.95±0.71 [4.00-8.22]	6.18±0.80 [4.32-9.47]	0.008*
Pectoral length (Nc)	12.13±0.98 [9.33-15.71]	12.19±0.84 [10.29-15.03]	0.576
Pelvic to lateral lobe (Oa)	5.97±0.64 [4.27-8.40]	5.97±0.61 [4.14-8.37]	0.966
Pelvic to median tip (Ob)	12.63±1.23 [9.43-17.20]	10.76±0.81 [8.24-12.67]	0.000*
Upper caudal (Pa)	20.49±1.43 [16.81-28.00]	21.11±2.06 [17.78-34.72]	0.003*
Lower caudal (Pc)	9.32±1.29 [4.67-14.80]	9.39±1.15 [4.12-11.63]	0.619

(* indicates significant differences)

Discussion

Sexual dimorphism with respect to body size appears more common among shark species where females have viviparous and ovoviviparous reproductive modes (SIMS, 2003). Although *S. canicula* is a oviparous shark species, previous studies (BROUGH, 1937; ARTHUR, 1950; BAS, 1964; JARDAS, 1979; ELLIS and SHACKLEY, 1995; ERDOGAN *et al.*, 2004) have shown that this kind of dimorphism can occur in the lesser spotted dogfish and our findings support previous ones.

The MoL/MoW values of 0.55 and 0.50 (males and females, respectively) calculated for the present study coincide with the values (0.59 and 0.53 for males and females, respectively) given by ARTHUR (1950) and (0.67 and 0.57 for males and females, respectively) reported by ERDOGAN *et al.* (2004) for *S. canicula*, thus this sexual dimorphism in MoL/MoW has been confirmed statistically in the present study. However, although these values correspond to the upper limit of the ranges recorded, those values given by ARTHUR (1950) and ERDOGAN et al (2004) were significantly different to the mean values of 0.49 and 0.43 calculated by ELLIS and SHACKLEY (1995). ELLIS and SHACKLEY (1997) claimed that that might be because ARTHUR (1950) had used a small sample size. However, sample size used in the present study is bigger than that used by ELLIS and SHACKLEY (1995). This sexual dimorphism in MoL/MoW was due to an increase in %MoL and decrease in %MoW of male fish. Changes in mouth morphology, if correlated with reproductive changes, may be considered as secondary sexual characteristics (ELLIS and SHACKLEY, 1995). In the present study, MoL/MoW was significantly different between sexes for only the larger size groups and not for those fish <375 mm (Table 2). Differences in intermandibular separation have been related previously to sexual maturity (BROUGH, 1937). FORD (1921) computed that both sexes of *S. canicula* attained maturity at 57-60 cm. However, more recent data suggest that males and females mature at lengths of approximately 52 and 55cm respectively (ELLIS and SHACKLEY, 1997; maturity assessed by clasper length, nidamental gland width and weight and appearance of gonads). ELLIS and SHACKLEY (1995) considered that the changes in mouth morphology of male fish and the subsequent sexual dimorphism in MoL/MoW was related to sexual maturity, as those fish <500 mm were immature, 500-549 mm maturing and fish within the larger size groups were mature. GOSZTONYI (1973) studied sexual dimorphism in the mouth shape of *Schroederichthys bivius* (Smith) and determined that the MoL/MoW was 0.50 in females and juvenile males and 0.80 in mature males.

MoL and MoW were both positively correlated with TL in both sexes (Fig. 4), however, the present study lacks information on specimens below 210mm (size group <275) and above 525 (size group >475). BASS (1973), who studies on the relationship between MoL and TL, reported an initial decrease and subsequent increase in MoL for larger fish in a sample of 119 male and female *Carcharhinus leucas*. ELLIS and SHACKLEY (1995) suggested that that initial decrease in MoL after birth was probably due to the head region being better developed in proportion to the rest of the body at birth.

According to ELLIS and SHACKLEY (1995), possible explanations as to why the mouth dimensions in male *S. canicula* change during maturation, and fact that males have longer teeth than females, included differential feeding habits and adaptations for reproductive behavior. The diet of *S. canicula* is composed primarily of decapod crustaceans, molluscs and teleosts (FORD, 1921; LYLE, 1983). LYLE (1983) found no significant sexual difference in the diet of *S. canicula* in Isle of Man waters. Both precopulatory behavior and copulation in scyliorhinids may involve the male biting the fins and body of the female (CASTRO *et al.,* 1988) and so the mouth of the male may have adapted for this function by changes in shape and dentition (ELLIS and SHACKLEY, 1995).

We could not determine any statistical difference between pre-oral lengths (snout to mouth in Table 3; P= 0.298) of male and female *S. canicula* specimens. However, ELLIS and SHACKLEY (1995) and ERDOGAN *et al.* (2004) found that pre-oral length was significantly shorter in males and they claimed that it was a probable result of the increased mouth length. Similarly, they claimed that the significant differences in the measurements of pre-branchial length, head length and head girth might be contributed to sexual differences in the pattern of growth of the whole head region. Our finding on the measurement of snout to spiracle almost coincides with the result given by ELLIS and SHACKLEY (1995). Although no statistical difference was computed between pre-branchial lengths of male and female, the distance from snout to fist gill-slit was relatively longer in males (P= 0.057). We also found that the distance snout to pectoral was longer in males than this in females.

Regarding body measurements, except for head, the distances from pelvic to anal and pelvic to median tip were longer in males than those in females, whereas, lengths of pectoral inner edge and upper caudal were shorter in males. ELLIS and SHACKLEY (1995) recorded total body length of 586 and 555 mm for males and females respectively, and this sexual dimorphism in total body length has been confirmed in our study. However, the mean values given by ELLIS and SHACKLEY (1995) for male and female *S. canicula* are significantly different to the mean values of 385 and 357 mm calculated for the present study. It is obvious that Aegean population of *S. canicula* is much smaller than those collected from Swansea and Oxwich Bays in the Bristol Channel and from the Irish Sea. By taking into consideration length range and sexual maturity length, CIHANGIR *et al.* (1997), who studied some biological characteristics and distribution of *S. canicula* from North Aegean Sea, claimed that growth of Mediterranean dogfish is slower than Atlantic ones, and they reach sexual maturity in relatively smaller length than those from Atlantic. LITVINOV (2003), who studied sexual dimorphism as an index of the isolation of West African populations of *S. canicula*, noted significant morphological differences between West African cat sharks and West European and Mediterranean cat sharks against the background of spatial disintegration and isolation. According to him, comparative morphological studies on West African, West European, and Mediterranean sharks are needed to solve the issue of distinguishing West African cat shark as an independent species or subspecies.

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FOOD OF LESSER SPOTTED DOGFISH, *Scyliorhinus canicula* (Linnaeus, 1758), IN FOCA (THE NORTHEAST AEGEAN SEA, TURKEY) IN AUTUMN 2002

Halit FİLİZ and Ertan TAŞKAVAK

Ege University, Faculty of Fisheries, Department of Basic Sciences, 35100 Bornova/ Izmir, Turkey,
E-mail: halit.filiz@ege.edu.tr

Abstract

In the present study, stomach contents of 146 lesser-spotted dogfish, *Scyliorhinus canicula* (78 male, 240-502 mm TL and 68 female, 215-508 mm TL), were examined. Fish and crustaceans were found to be most important prey groups (MIP; IRI≥352, and % IRI = 52.00 and % IRI = 42.07, respectively) in the diet. Polychaetes and Cephalopods constituted the secondary prey groups (SP; 352>IRI>39; % IRI = 3.29 and 2.44, respectively). Sipunculida (% IRI = 0.20) were an occasional prey group (OP; IRI≤39).

Key Words: **Scyliorhinus canicula,** ***feeding habits, stomach content, Aegean Sea.***

Introduction

Sharks play an important role in aquatic food webs throughout their evolutionary history (CORTES, 1999). While it is widely recognized that many extant species of sharks are top or apex predators in marine communities, surprisingly little quantitative information is available on their diets (CORTES, 1999). The feeding habits of sharks, in particular, determine their role in the exchange of energy between upper trophic levels of the marine environment (GELSLEICHTER *et al.*, 1999).

The lesser-spotted dogfish are small bottom-living sharks which occur on a wide variety of seabed types but are most commonly encountered on sand or gravel at depths between 3 and 400 m (CAPAPE, 1977; JARDAS, 1979; FROESE and PAULY, 2003). The species is common in the Mediterranean (CAPAPE, 1977; JARDAS, 1979; CIHANGIR *et al.*, 1997) and widespread in the Northeast Atlantic (OLASO *et al.*, 2002; FROESE and PAULY, 2003).

Various studies about feeding of this species are available (ELLIS *et al.*, 1996; SIMS *et al.*, 1996; OLASO *et al.*, 1998; VELASCO *et al.*, 2001; OLASO *et al.*, 2002), however, similar studies from Turkey's coasts are scarce (etc., CIHANGIR *et al.*, 1997; KABASAKAL, 2001; 2002). Such information is necessary to understand the role that this species plays in the trophic structure of coastal marine communities (GELSLEICHTER *et al.*, 1999). Thus, this study presents data on the food habits of lesser spotted dogfish from the Northeast Aegean Sea.

Materials and Methods

Data Collection

All specimens caught by bottom trawls were taken from commercial fishermen in Foça (the Northeast Aegean Sea) (Fig. 1). Trawl surveys were carried out between September and November 2002 in depths between 40 and 120 meters. A total of 296 *Scyliorhinus canicula* specimens were sampled. The fish were stored in ice until returned to the laboratory, where the length and weight measurements were taken. Of them, stomachs of 146 lesser spotted dogfish (78 male, 240-502 mm TL and 68 female, 215-508 mm TL) were chosen randomly. Stomachs of the individuals were excised from the esophageal region. The stomach samples were fixed in a 250 cc polyethylene container using 4% buffered formalin. A label contains information as date, locality and number of sample was placed in each container. In order to determine stomach condition, five categories were used; empty, full (F), ¼ F, ½ F, and Vomited. In order to designate condition of stomach content, a scale proposed by ALBERT (1995) was applied (Table 1). The items were carefully separated, weighed (nearest to the 0.01 g) and identified to the possible lowest taxonomic level. The individuals of each identified taxon were counted. Whenever fragments were found, the number of individuals was taken as the smallest possible number of individuals from which fragments could have originated.

Diet Analysis

Diet composition was evaluated using three measures described in HYSLOP (1980): the numerical index (% N); the gravimetric index (% W), and frequency of occurrence (% O). Each of these indices provides different insight into feeding habits of a predator: numerical abundance is informative regarding feeding behaviour, volume or weight indices reflect dietary nutritional value, and occurrence represents population-wide food habits (CORTES, 1997). One of the most widely used compound indices in fish diet studies is the index of relative importance (IRI; PINKAS *et al.*, 1971). In this method, the percent frequency of occurrence of each prey category is multiplied by the sum of the percentage volume (or weight) and percentage number [IRI = (% N+% W)x % O]. By incorporating bulk, amount, and occurrence into a single measure it appears to provide a more accurate description of dietary importance and is also intended to facilitate comparative studies (CORTES, 1997). It is therefore suggested that IRI be expressed on a percent basis (CORTES, 1997), such that %IRI for a specific food category i (IRI_i) becomes;

$$\%\,IRI_i = 100\,IRI_i \,/\, \sum_{i=1}^{n} IRI_i$$

where n is the total number of food categories considered at a given taxonomic level.

Therefore, food items were grouped into categories of preference using the method proposed by MORATO *et al.* (1998). The categories were measured according to the equations:

$IRI \geq 30 \times (0.15 \times \sum\%O)$	- main important prey (MIP)
$30 \times (0.15 \times \sum\%O) > IRI > 10 \times (0.05 \times \sum\%O)$	- secondary prey (SP)
$IRI \leq 10 \times (0.05 \times \sum\%O)$	- occasional prey (OP)

Graphical representation of diet analysis has been used as an alternative to summary tables and included measures mentioned above. CORTES (1997) proposed a method, which uses %O, %N and %W (or %V) in a three-dimensional graphical representation of population-level stomach content data. Each point on the graph represents the percent occurrence and abundance (in weight or volume and numbers) for a prey category (Fig. 2).

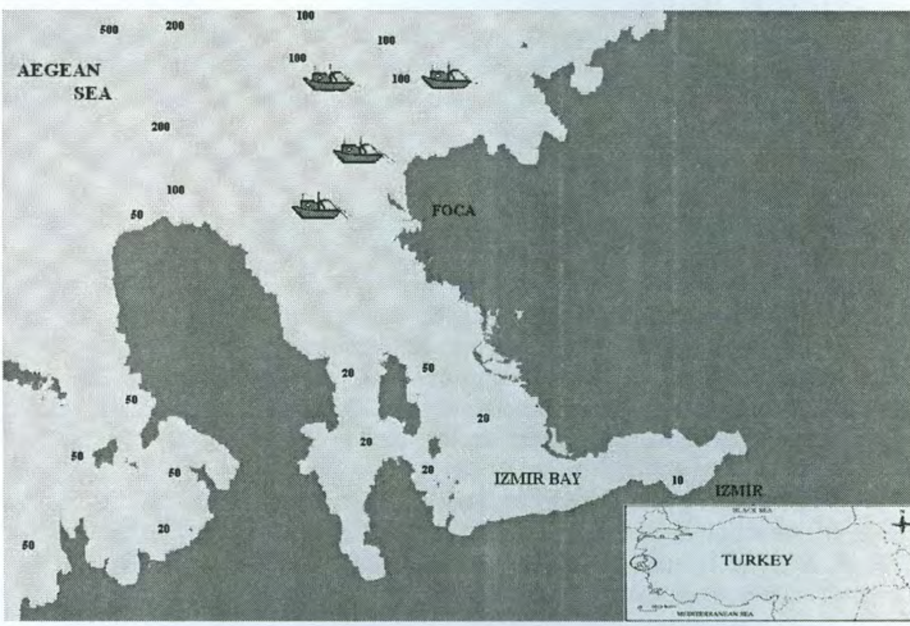

Figure 1. Study area.

Table 1. Definition of digestion status of prey (ALBERT, 1995)

Status	Definition
I	Fresh; prey without signs of digestion.
II	Digestion just started; prey intact except for the more delicate parts
III	Moderately digested; prey clearly affected by digestion
IV	Severely digested; prey highly fragmented
V	Digestion almost complete; unidentifiable remains or indigestible parts only
VI	Digestion complete; stomach empty

Results

In this study, stomach contents of 146 *S. canicula* (78 male, 240-502 mm TL and 68 female, 215-508 mm TL) were investigated. From the stomach examined 115 had food (78.8 %), 29 had empty (19.9 %). Only 2 (1.3 %) individuals were determined as vomited.

According to stomach content's digestion scale (Table 1), 2 stomachs (1.4 %) placed into category II, 4 (2.78 %) placed into category III, 39 (27.08 %) into category IV, 70 (48.61 %) into category V, and 29 (20.14 %) into category VI. No stomach was found into category I. Since majority of the stomach contents was in category V, it is difficult to determine the prey items to lower taxon.

As a result of the analysis, fishes and crustaceans were found to be main important prey groups (MIP; IRI≥352). From these MIP groups, fishes were the most important prey in lesser spotted dogfish diet (% IRI = 52.00), while crustaceans made up the second important group (% IRI = 42.07). Polychaetes and Cephalopods constituted secondary prey groups (SP; 352>IRI>39; % IRI = 3.29 and 2.44, respectively). Sipunculids (% IRI = 0.20) were considered as occasional prey group (OP; IRI≤39) (Table 2).

Among the fishes, *Engraulis encrasicolus* was principal fish prey (% IRI = 5.26), followed by *Gobius niger* (% IRI = 1.35), *Serranus hepatus* (% IRI = 0.70), *Scyliorhinus canicula* (% IRI = 0.27), *Scorpaena* sp. (% IRI = 0.20) and *Cepola rubescens* (% IRI = 0.19). Unidentified fishes constituted 43.94 % of the diet (Table 2).

Natantia were the principal group (% IRI = 35.95) among the crustaceans, followed by *Squilla mantis* (% IRI = 4.67), Brachyurans (% IRI = 0.91), Copepods (% IRI = 0.05) and Isopods (% IRI = 0.04). Unidentified crustaceans constituted of 0.45% of the diet (Table 2).

Regarding the polychaetes, except for unidentified polychaetes (% IRI = 3.21), *Hermione hystrix* formed 0.08 % of the diet (Table 2).

Loligo vulgaris was principal cephalopod species (% IRI = 1.10), followed by Octopoda (% IRI = 1.03). Unidentified cephalopods composed 0.31 % of the diet (Table 2).

Three-dimensional graphical representation of diet

Use of CORTES (1997) three-dimensional graphical method permitted simple and rapid characterization of the feeding styles of the species studied (Fig. 2). The diet of lesser spotted dogfish demonstrated greater heterogeneity and appeared more generalized. Fish and crustaceans were consumed by nearly half of the individuals, but fish represented a larger component of prey gravimetrically. Cephalopods, polychaetes and sipunculids were rare preys.

Discussion

The ratio of empty stomachs was found as 19.9 %. This is somewhat higher than that found by OLASO *et al.* (2002) who computed as 14 %. Both the ratio of empty stomachs and majority of the stomach contents in category V may be affected by long trawl hauls since the specimens were obtained from commercial trawl boats, and time interval passed from the field to the laboratory. In our study, we determined that the 2 vomited individuals. The function of vomiting behavior in lesser spotted dogfish is probably a protective reflex for the expulsion of indigestible matter in their natural diet and for the avoidance of toxic food (ANDREWS *et al.*, 1998).

The variety of prey items found in this study implies that lesser spotted dogfish is a broad generalist. Lesser spotted dogfish prey on a wide range of items (polychaetes, sipunculids, crustaceans, cephalopods, fish), although fishes and crustaceans are their main food (Table 2). This kind of general, opportunistic and scavenger feeding has been described by OLASO *et al.*, 1998. They noted dogfish fed on damaged or dead animals from the fishing operations or on other scavengers attracted to the trawled area.

The dominance of fishes in the diet of lesser spotted dogfish agrees with previous studies. MACPHERSON (1979) reported that 55.4 % of the diet of lesser spotted dogfish was constituted by fishes and 35.1 % by crustaceans in the Balearic Sea. CIHANGIR *et al.* (1997) recorded, in the order of importance, fishes, decapods crustaceans and polychaetes for the North Aegean Sea. OLASO *et al.* (1998) who studied in Cantabrian Sea, found the diet composition of lesser spotted dogfish as 54.6 % fish, 31.5 % crustaceans, 6.7 % molluscs, 4.2% polychaetes and 0.9 % sipunculids. KABASAKAL (2001) noted that the diet of lesser spotted dogfish was composed of 71% teleosts, 32 % crustaceans, 21 % cephalopods and 15% polychaetes in the North Aegean Sea. STERGIOU and KARPOUZI (2002) documented the components of the diet as 41 % fishes (mainly *Micromesistius poutassou* and *Gadiculus argenteus argenteus*), 26 % decapods, 7 % molluscs and 26 % other groups in the Mediterranean Sea.

Table 2. Percent number (% N), percent weight (% W), frequency of occurrence (% O), Index of Relative Importance (IRI) and percent Index of Relative Importance (% IRI) calculated for each prey item found in the stomachs of lesser spotted dogfish *S. canicula*

Items			%N	%W	%O	IRI	%IRI
Polychaeta (Total)			10.63	3.07	6.09	63.47	3.29
	Errantia						
		Hermione hystrix	0.88	0.97	0.87	1.61	0.08
	Polychaeta(Unidentified)		9.75	2.10	5.22	61.86	3.21
Sipunculida (Total)			1.77	0.47	1.74	3.90	0.20
		Sipuneulusnudus	1.77	0.47	1.74	3.90	0.20
Crustacea (Total)			39.81	29.90	30.44	810.62	42.07
	Copepoda		0.88	0.17	0.87	0.91	0.05
	Isopoda		0.88	0.02	0.87	0.78	0.04
	Natantia		23.89	18.05	16.52	692.85	35.95
	Brachyura		3.54	1.14	3.48	16.29	0.85
		Gonopelax rhomboides	0.88	0.50	0.87	1.20	0.06
	Stomotopoda						
		Squilla mantis	6.20	8.56	6.09	89.89	4.67
	Crustacea (Unidentified)		3.54	1.46	1.74	8.70	0.45
Cephalopoda (Total)			8.85	8.37	7.83	46.94	2.44
	Decapoda						
		Loligo vulgaris	3.54	4.59	2.61	21.22	1.10
	Octopoda		3.54	2.15	3.48	19.80	1.03
	Cephalopoda (Unidentified)		1.77	1.63	1.74	5.92	0.31
Fishes (Total)			38.94	58.19	32.18	1001.83	52.00
	Elasmobranchii						
		Scyliorhinus canicula	0.88	5.09	0.87	5.19	0.27
	Teleostei						
		Engraulis encrasicolus	8.86	7.77	6.09	101.28	5.26
		Serranus hepatus	1.77	6.00	1.74	13.52	0.70
		Cepola rubescens	0.88	3.31	0.87	3.65	0.19
		Gobius niger	2.66	7.33	2.61	26.07	1.35
		Gobiidae	1.77	0.12	0.87	1.64	0.09
		Scorpaena sp.	0.88	3.44	0.87	3.76	0.20
	Teleostei (Unidentified)		21.24	25.13	18.26	846.72	43.94
Total			100	100	78.28	1926.76	100

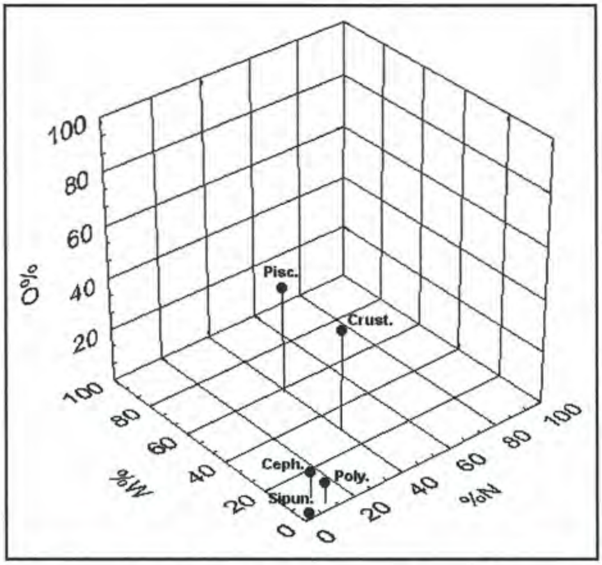

Figure 2. The three-dimensional graphical representation of stomach content data for *S. canicula* (Pisc.: Fishes; Crust.: Crustaceans; Ceph.: Cephalopods; Poly.: Polychaetes; Sipun.: Sipunculida).

However, JARDAS (1979) recorded that the diet in the Adriatic Sea, was constituted by 43.8 % crustaceans, 29.4 % fishes, 21 % polychaetes and 5.8 % cephalopods, in the order of importance. GIBSON and EZZI (1987) found that diet consisted of 44.3 % polychaetes, 37.7 % crustaceans and 12.9 % fish in Scotland. ELLIS and SHACKLEY (1995) suggested that the diet of lesser spotted dogfish is composed primarily of decapod crustaceans, molluscs and teleosts in the Northeast Atlantic. ELLIS et al (1996) recorded in the Northeast Atlantic that diet included 51.6% crustaceans, 15.9 % teleost, 15.3 % annelids and 14.7 % molluscs. CORTES (1999), found that diet comprised 42.3 % crustaceans, 17.3 % fish and 4.2 % cephalopods. Such differences may reflect size-specific and region-specific feeding preferences.

Consequently, this study indicates that lesser spotted dogfish has a relatively generalized diet. However, it is an interesting finding that among fishes eaten by *S. canicula*, *E. encrasicolus* (anchovy), a pelagic species, is the most dominant. However, KABASAKAL (2001) stated that many elasmobranchs grow to a large size and have the ability to prey on both pelagic and benthic communities. Furthermore, there is an intensive purse seine fishery on anchovy in the sampling area, thus, this may support that lesser spotted dogfish also feeds on wounded or dead animals in the fishing zone as an opportunist or scavengers. In addition, we found a little lesser spotted dogfish in the stomach of a male (465 mm TL). Similarly, OLASO *et al.* (1998) claimed that cannibalism occurred in lesser spotted dogfish longer than 50 cm TL. (0.1 % of the stomach volume).

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PRELIMINARY RESULTS ON DEPTH DISTRIBUTION OF CARTILAGINOUS FISH IN THE NORTH AEGEAN SEA AND THEIR FISHING POTENTIAL IN SUMMER 2001

Çetin KESKİN and F. Saadet KARAKULAK

Istanbul University, Fisheries Faculty, Ordu St. No: 200, 34470 Laleli/ İstanbul, Turkey,
E-mail: seahorse@istanbul.edu.tr

Abstract

The aim of this study was to determine the depth distribution of cartilaginous fish in the North Aegean Sea in August, 2001. Samplings were carried out using bottom trawl at 13 stations ranging from the depth of 40 m to 500 m (total trawling time was 8.6 h). A total of 29223 fish specimens (total weight: 621.2 kg) were recorded. The total number of cartilaginous specimens (3 % of total specimens) were 863; 114.3 kg in weight (18 % of total weight). The most abundant cartilaginous fish species was *Scyliorhinus canicula* (total mean biomass: 2850.6 kg/nm^2 (kilogram/nautical mile square)), and it was caught in all depths. *Torpedo marmorata*, *Raja radula* and *Dipturus oxyrinchus* were sampled rarely.

Key Words: North Aegean Sea, elasmobranchs, depth distribution.

Introduction

Elasmobranch fish are common but unspecified by-catch in many fisheries all over the world, particularly those using bottom trawls, long-lines, or gill nets (STEVENS *et al.*, 2000). Serious declines have been documented for a number of shark and ray populations in recent years. Over human exploitation and habitat degredation are main threats to elasmobranch populations (CORTES, 2000; ELLIS *et al.*, 2002; HEESSEN, 2002; PRINCE, 2002). It is reported that there have been havested more than 700000 t cartilaginous fish annually worldwide (BONFIL, 1994; FRISK *et al.*, 2001). BILECENOĞLU *et al.* (2002) reported that 64 elasmobranch species were found in the Turkey's seas. Among them 38 are important economical species (FİLİZ and TOGULGA, 2002). Total havesting amount in Turkey is 965 t in 2003 (DIE, 2003).

A number of investigations have been carried out on the distribution, taxonomy and biology of elasmobranch fish in Turkey's seas (BENLİ *et al.*, 1993; UYSAL *et al.*, 1996; CIHANGIR *et al.* 1997; KABASAKAL and ÜNSAL, 1999; KABASAKAL, 1998$_{a,\ b}$; 1999; 2001, 2002, 2003, 2004; ERYILMAZ, 2000; AVSAR, 2001; FİLİZ and MATER, 2002; ISMEN, 2003). BENLİ *et al.*(1999) investigated on the some demersal fisheries researches in the Aegean Sea. Fisheries management of economical elasmobranch species in Turkish sea was reported by FİLİZ and TOGULGA (2002).

The aim of this study was to determine the depth distribution and fisheries potential of elasmobranchs in the North Aegean Sea.

Materials and Methods

This study was conducted in the North Aegean Sea from 03.08.2001 to 11.08.2001. Samples were collected by bottom trawl at 13 stations (depth range: 40 to 500 m) (Figure 1). The head-rope length of the trawl net was 21,6 m and the cod-end mesh size was 20 mm (bar lenght). The trawling speed was 2.2-2.6 nm/h (nautical mile/hour). The duration of each haul, and the trawling areas are showed in Table 1.

Fish species were identified according to WHITEHEAD *et al.* (1984), and the number of individuals and the total weight of each species were determined, and biomass was estimated based on the swept area method (SPARRE and VENEMA, 1992). The mean biomass per unit area (b) was calculated by using the formula:

$$b = (cw/a)/X_1 \ (kg/nm^2)$$

where cw is the catch in weight of a haul, X_1 is the fraction of the biomass in the effective path swept by the trawl (X_1=1 was used), and "a" is swept area, which can be estimated from; $a= D{*}h{*}X_2$, $D= v{*}t$ (h is the length of the head-rope, "t" is the time spent trawling, X_2 is that fraction of the head-rope length (X_2=0.5 was used))

Samples were taken over a wide depth range and divided into four depth strata for analysis: (A) between 40 and 50 m; (B) between 80 and 105 m; (C) between 200 and 300 m; and (D) between 300 and 500 m. Mean biomass values were calculated for all four depth strata.

The frequency degree of species for each strata was calculated as follows:

$$F=(N_a/N){*}100$$

Where N_a is sampling number of species a. N is total sampling of each strata.

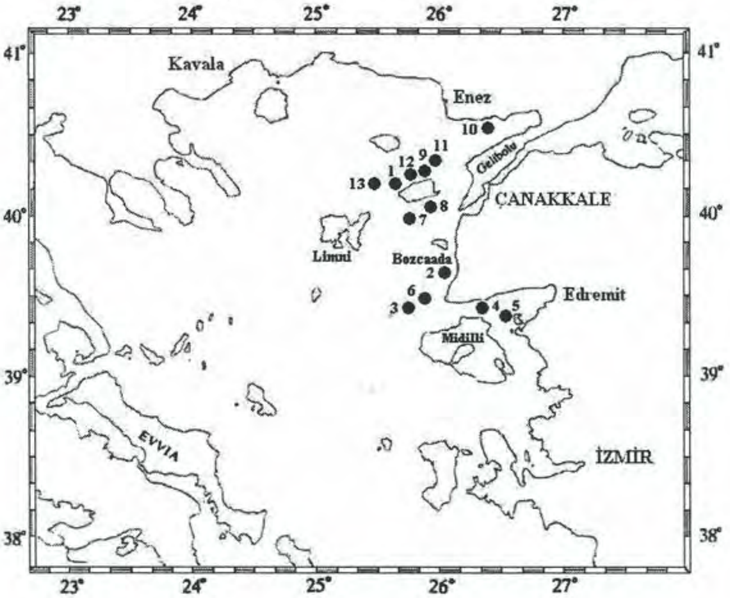


Figure 1. Sampling stations in the North Aegean Sea.

Table 1. Towed area and duration of hauls per depth strata in the study area

Stations	Coordinates		Depth (m)	Total Time (h)	Surface (nm^2)
1	40°14'35"N - 25°41'39"E	40°13'57"N – 25°40'18"E	314-447	0.5	0.006
2	39°39'26"N - 26°06'26"E	39°38'29"N – 26°05'34"E	40-45	0.5	0.006
3	39°28'02"N - 25°52'00"E	39°26'11"N – 25°50'52"E	300-310	1	0.012
4	39°27'30"N - 26°19'00"E	39°27'24"N – 26°21'30"E	105	0.5	0.006
5	39°24'42"N - 26°30'16"E	39°25'29"N – 26°31'12"E	99	0.5	0.006
6	39°31'07"N – 25°4' 42"E	39°29'06"N – 25°54'35"E	266-300	1	0.012
7	39°59'04"N - 25°48'59"E	39°58'43"N – 25°47'37"E	83	0.5	0.007
8	40°05'35"N - 25°55'52"E	40°04'59"N – 25°54'40"E	43-49	0.5	0.007
9	40°17'16"N - 25°55'11"E	40°16'14"N – 25°52'25"E	200-280	1	0.015
10	40°33'51"N - 26°22'25"E	40°34' 09"N- 26°20'41"E	80	0.5	0.007
11	40°19'20"N - 25°57'32"E	40°17'51"N – 25°56'37"E	490-350	0.7	0.007
12	40°16'37"N - 25°54'03"E	40°15'40"N – 25°51'19"E	226	0.5	0.007
13	40°12'44"N - 25°32'06"E	40°12'52"N – 25°29'33"E	486	1	0.012

Results

A total of 11 elasmobranch species belonging to 5 families were caught in the North Aegean Sea. While *Scyliorhinus canicula, Rostraraja alba, Raja clavata* and *Raja asterias* were caught at all four depth strata, *Galeus melastomus*, *Raja radula*, *Dipturus oxyrinchus* and *Torpedo marmorata* were caught very rarely (Table 2).

Table 2. List of elasmobranchs, frequency degree (f) and distribution in the various depth strata

Family	Species	f	40-50 m	f	80-105 m	f	200-300 m	f	300-500 m
Scyliorhinidae	*Scyliorhinus canicula*	50	+	100	+	100	+	100	+
	Galeus melastomus		-		-		-	75	+
Squalidae	*Squalus blainvillei*		-		-	33.3	+	25	+
Dalatiidae	*Etmopterus spinax*		-		-	33.3	+	75	+
Rajidae	*Rostraraja alba*	100	+	50	+	33.3	+	25	+
	Raja miraletus	100	+		-	33.3	+	25	+
	Raja clavata	100	+	100	+	66.3	+	25	+
	Raja asterias	50	+	50	+	33.3	+	25	+
	Raja radula		-	25	+		-		-
	Dipturus oxyrinchus		-		-		-	25	+
Torpedinidae	*Torpedo marmorata*	50	+		-		-		-

Total catch composition: Commercial, discard and elasmobranchs

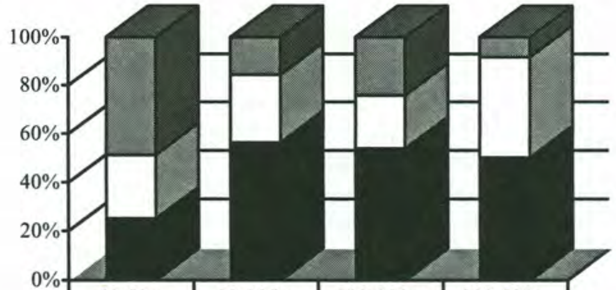
A total of 29233 fish (621.4 kg) were collected by 13 trawl hauls, during 8,6 hours, ranging from 40 m to 500 m. A total number of fish representing 11 elasmobranch species were 863 individuals (3 % of total fish number); 114.3 kg (18 % of total fish weight). The total weight of commercial species was 285.7 kg (46 % of the total fish weight), discard weight was 221.3 kg (36 %) (Table 3).

Depth variations in mean biomass of elasmobranchs, commercial and discard fish

Mean biomass of elasmobranchs was the lowest value (8.3 % of the mean total biomass) in the 300-500 m, although the highest value was observed in the 40-50 m (48.7 %) (Fig. 2). Mean biomass of commercial fishes was higher in the 80-105 m (56.3 %), 200-300 m (53.8 %) and 300-500 m (50.1 %), respectively, than in the 40-50 m (25.3 %). Mean biomass value of discard fish was lower in the 200-300 m (22 %), 40-50 m (26 %), and 80-105 m (27.9 %), respectively, than in the 300-500 m (41.6 %) (Fig. 2).

Table 3. General summary of the hauls analyzed (A: 40-50 m; B: 80-105m; C: 200-300 m; D: 300-500 m)

Stations	Min- max depth (m)	Duration (h)	Trawled area (nm^2)	Commercial (kg)	Discard (kg)	Elasmobranchs (kg)	Total catch (kg)
2/A	40 - 45	0.5	0.006	8.2	15.4	22.6	46.2
8/A	43 - 49	0.5	0.007	11.5	4.9	15.2	31.6
10/B	80	0.5	0.007	24.2	11.1	5.1	40.3
7/B	83	0.5	0.007	17.5	5.9	8.3	31.7
5/B	99	0.5	0.006	8.2	3.7	4.5	16.4
4/B	105	0.5	0.006	21.5	14.7	2.5	38.6
12/C	226	0.5	0.007	31.4	2.3	7.5	41.2
6/C	266 - 300	1	0.012	17.1	33.9	20.0	71.0
9/C	200 - 280	1	0.015	30.6	6.5	6.1	43.2
3/D	300 - 310	1	0.012	22.8	37.4	5.4	65.6
1/D	314 - 447	0.5	0.006	59.5	16.8	3.4	79.6
11/D	490 - 350	0.6	0.007	10.4	24.8	9.0	44.2
13/D	486	1	0.012	23.0	44.0	4.8	71.8
Totals				285.7	221.3	114.3	621.4



	40-50m	80-105m	200-300m	300-500m
Elasmobranchs	2898,0	769,7	1292,1	592,0
Discard	1559,1	1376,7	1171,2	2961,1
Commercial	1493,8	2776,8	2871,0	3566,8

Figure 2. Percentages of mean biomass, and mean biomasses (kg/nm^2) of commercial, discard and elasmobranch fish in the four depth strata.

S. canicula was the most abundant elasmobranch species (total mean biomass: 2855.1 kg/nm^2). In terms of depth strata, the most abundant species was *S. canicula* in the 40-50 m (1634.3 kg/nm^2) and 200-300 m (904.2 kg/nm^2); *R. clavata* (444.8 kg/nm^2) was in the 80-105 m; and *G. melastomus* (340 kg/nm^2) was in the 300-500 m (Table 4).

Table 4. Mean biomasses (kg/nm^2) of commercial, discard and elasmobranch fish species in the four depth strata

	40-50m		80-105m		200-300m		300-500m		Total (kg/nm^2)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Commercial	1493.8	312.1	2689.6	978.3	2871	1490	3569.6	4117.3	10624	6897.7
Discard	1559.1	1180.2	1348.7	796.6	1171.2	1042.2	2967.6	337.1	7046.6	3356.1
S. canicula	**1634.3**	2247.9	252.8	215.1	**904.2**	350.2	63.8	50.6	**2855.1**	2863.8
G.melastomus							**340**	402.8	340	402.8
S. blainville					1.9	2.6	1.6	3.1	3.5	5.7
E. spinax			15.4	30.9	251.3	351.4	68.8	68.7	335.5	451
R. alba	865	1117.5	12.8	22.1	26	36.7	44.8	89.6	948.6	1265.9
R. miraletus	103.6	91.8			0.3	0.4	11.7	23.4	115.6	115.6
R. clavata	257.3	184.4	**444.8**	392.3	99.1	70.4	58.5	116.9	859.7	764
R. asterias	5.2	7.4	42.9	56.6	9.4	13.2	0.9	1.8	58.4	79
R. radula			1	2					1	2
D. oxyrinchus							1.9	3.9	1.9	3.9
T. marmorata	32.6	46.1							32.6	46.1
Total (kg/nm^2)	5950.9	5187.3	4808	2493.9	5334.3	3357.2	7129.2	5215.3	23222.4	16253.7

Discussion and Conclusion

The number of elasmobranch species living in Turkish seas according to different authors is showed in Table 5. A total of 11 elasmobranch species were caught in this study. All these species were benthic forms; 4 species were sharks, and 7 species were rays. The present study was carried out only in one season (summer) and only by bottom trawl. For this reason, the number of species captured in this study was much lower than that of the total identified elasmobranch species (57 species) in the Aegean Sea, given in Checklist of the Marine Fishes of Turkey (BİLECENOĞLU *et al.*, 2002).

Table 5. The number of elasmobranch fish species in Turkish seas according to different authors

	Black Sea	Sea of Marmara	Aegean Sea	Mediterranean	Turkey
KOCATAŞ *et al.* (1987)					43
KOCATAŞ *et al.* (1993)		12			
MERİÇ and MATER (1996)	7	22	52	50	54
ERYILMAZ (2000)		13			
ERYILMAZ and MERİÇ (2005)		31			
BİLECENOĞLU *et al.* (2002)	8	33	57	61	64

It was determined that *S. canicula* was the most abundant species during the research period. According to WHITEHEAD *et al.* (1984), this species has a wide distribution range extending a wide bathymetric range and spatial area in the Northeast Atlantic and the Mediterranean Sea. Also, CARRASSON *et al.* (1992) and MORANTA *et al.* (1998) indicated that this species was found abundantly in 150 m depth and that the distribution ranges extended to 500 m. In this study, *S. canicula* was mostly caught at 40-50 m depth (1635.3 kg/nm^2). In the trawl surveys carried out by JICA (1993) in the North Aegean Sea and by CARNOBELL *et al.* (2003) in the Mediterranean Sea (Baleric Islands), it was determined that *S. canicula* was found as the most abundant species only in the Summer period. These results confirmed by our findings.

CARRASSON *et al.* (1992) and MORANTO *et al.* (1998) stated that *G. melastomus* is the most abundant demersal shark on the upper and middle slope down to about 1400 m in depth in the western Mediterranean. It is clear from the study carried out by CARNOBELL *et al.* (2003) that *E. spinax* and *G. melastomus* were caught in the western Mediterranean Sea at waters deeper than 150 m and that the biomasses of the two species are more than that of *S. canicula*. In this study, *E. spinax* and *G. melastomus* were caught at deeper waters than 200 m, and these two species were more abundant than the other species.

It was estimated that the value of total biomass in the Summer 1994 in the North Aegean Sea was 16,9*10^3 t (BENLİ *et al.*, 1999). The ratio of teleost fish in the total biomass was 50 %, and the proportion of sharks and rays was 45 %, the rest part of total biomass (5 %) was formed by ahtapods, squids, shrimps and lobsters. It was reported in the same study that the ratio of *S. canicula* in total elasmobranchs was 80 %. In this study, the mean portion of sharks and rays in the total biomass is 31 %, and the ratio of *S. canicula* in the total elasmobranchs is 51 %. This difference between results of these two studies can be a sing to the declining of stocks.

Unfortunately, there are not any statistical records for elasmobranch species caught in Turkey. According to DIE (2003), the total production of elasmobranchs was 965 t. It was determined that this amount was composed of three groups, sharks (400 t), angel sharks (25 t), and rays (540 t). Of all elasmobranch species, *Squalus acanthias* (piked dogfish), *Scyliorhinus* spp (spotted dogfish), and *Raja* spp (rays) are the most commercially valuable species in Turkey. According to the export registers, they are exported as fresh, frozen, and fillet. Turkey made 305039 $ by exporting the products of 82,8 t (DIE, 2003).

The elasmobranchs, considered as commercial species, are generally caught by bottom trawl as by-catch in the Mediterranean Sea (BONFIL, 1994; BERTRAND *et al.*, 2000). Because of the higher rates of population increase and shorter generation times, small coastal sharks, such as scyliorhinids may be able to sustain commercial fisheries with careful conservation and management in contrast to deep-water shark species, which are generally considered to be more vulnerable to exploitation (CAMHI *et al.*, 1998; WALKER, 1998).

This preliminary study shows that there may be an important fishing potential of some elasmobranchs, such as *S. canicula* and *Raja* spp in the North Aegean Sea. For this reason, it is vital to determine the commercial elasmobranchs stocks, and to study their biological aspects. It is also important to develop an appropriate fisheries management plan for these species from the point of view of the conservation of the ecosystem and sustainable fisheries.

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THE PRODUCTION AND ECONOMIC IMPORTANCE OF SHARKS IN TURKEY

Kadir DOĞAN

Istanbul University Faculty of Fisheries, Aquaculture Department, Ordu St. No: 200, 34470 Laleli/ Istanbul, Turkey. E-mail: kadogan@istanbul.edu.tr

Abstract

The production and economic values of sharks in Turkey have been analysed for the last 34 years. Along these years, the maximum catch level was recorded in 1979 as 11.125 t. A significant decrease observed after 1989 and it reached to the minimum level of 400 t in 2003.

In spite of its rare consumption in internal market, sharks fishery contributes to Turkey's economy as an export product. They were exported to the other countries as fresh/chilled, frozen, topeshark fillets, dried, salted or in brine products. Total sale was US$ 738.080 in 1993 with the exports of 309.461 kg and US$ 211.879 in 2003 with the exports of 52.394 kg.

Key words: Cartilaginous trade, economic importance of shark.

Introduction

As it was pointed out by SPAGNOLO (1999), shark landings show a decreasing trend and therefore increasing attention is being paid to the state of stocks. However, sharks have been little studied in Turkey, except for a few works SLASTENENKO (1956), KUTAYLIGIL and BILECIK (1998). Around 470 true shark species have been recorded around the world and only 63 of those species live in Turkey KENCE and BILGIN (1996). The phenomenon is hard to monitor since there is very little experience of shark fisheries in the world SPAGNOLO (1999).

The aim of this paper is to provide data on production of sharks and on their economic value in Turkey.

Materials and Methods

The main source of the present report will be compiled with the national and international studies. During the 1970 to 2003, the total Sharks production which was obtained by hunting, its distribution according to the region, and amount of the exports have been evaluated using the Turkish Statistical Institute, Fishery Statistics. Only true sharks data was used in this study, other species, like rays, were not included.

To understand economical value of the shark production to the Turkish economy, several studies e.g. ACARA (1992, 1996), ACARA *et al.* (1993, 1998), SENEL *et al.* (1999, 2000, 2001, 2002), GOZGOZOGLU *et al.* (2004, 2005) have been used.

Results and Discussion

Production of Sharks

The production of sharks in the world did not vary considerably for the period of 1994 and 2003 (Fig. 1). Sharks do not take an important place in the world total fish production. It accounted for only 0.7 % of the total production.

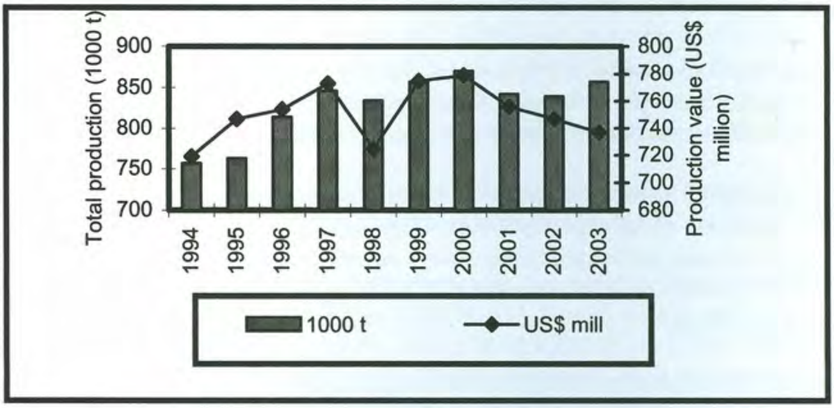


Figure 1. World shark production and production value in 1994-2003 (Source: URL_1).

On the other hand, shark production showed big fluctuations among the years in Turkey. The total production of sharks was 1198 t in 1970 and reached to the last 34 years' maximum (11.125 t) in 1979. After that, the production showed a dramatic decrease and only 400 t was caught in 2003. The production of sharks in Turkish waters is shown in Table 1 and Figure 2.

Table 1. The production of sharks in Turkish waters between 1970 and 2003 (t)

Year	East Black Sea	West Black Sea	Marmara Sea	Aegean Sea	Mediterranean Sea	Total Shark Production
1970	400	122	415	106	156	1.199
1971	2.373	212	242	2	257	3.085
1972	1.876	206	236	1	293	2.559
1973	418	25	160	11	105	719
1974	1.305	41	389	22	45	1.803
1975	-	-	62	181	16	159
1976	1.178	-	113	51	52	1.395
1977	1.098	115	177	59	44	1.494
1978	672	456	23	31	609	1.791
1979	10.738	150	10	20	208	11.125

Table 2 (Cont.)

Year	East Black Sea	West Black Sea	Marmara Sea	Aegean Sea	Mediterranean Sea	Total Shark Production
1980	4.210	492	133	33	122	4.990
1981	4.202	1.400	218	101	352	6.273
1982	5.113	1.637	255	118	211	7.334
1983	4.375	2.786	269	35	357	7.822
1984	854	3.734	348	45	254	5.235
1985	1.537	1.061	203	128	62	2.911
1986	2.195	386	470	71	81	3.203
1987	2.670	469	572	86	98	3.895
1988	2.790	471	670	136	148	4.215
1989	2.922	1.636	229	76	277	5.140
1990	797	262	345	103	208	1.715
1991	740	1.277	18	106	151	2.292
1992	857	1.363	25	101	58	2.404
1993	533	522	-	112	269	1.436
1994	463	1.969	79	129	240	2.880
1995	49	1.513	45	83	93	1.783
1996	70	1.678	205	65	140	2.158
1997	278	1.232	64	34	112	1.720
1998	302	553	225	242	128	1.450
1999	17	1.461	29	40	78	1.625
2000	60	2.330	269	103	118	2.880
2001	129	447	137	188	99	1.000
2002	49	267	146	121	103	686
2003	29	155	85	71	60	400

Source : 1970-2003 Fishery Statistics, Turkish Statistical Institute.

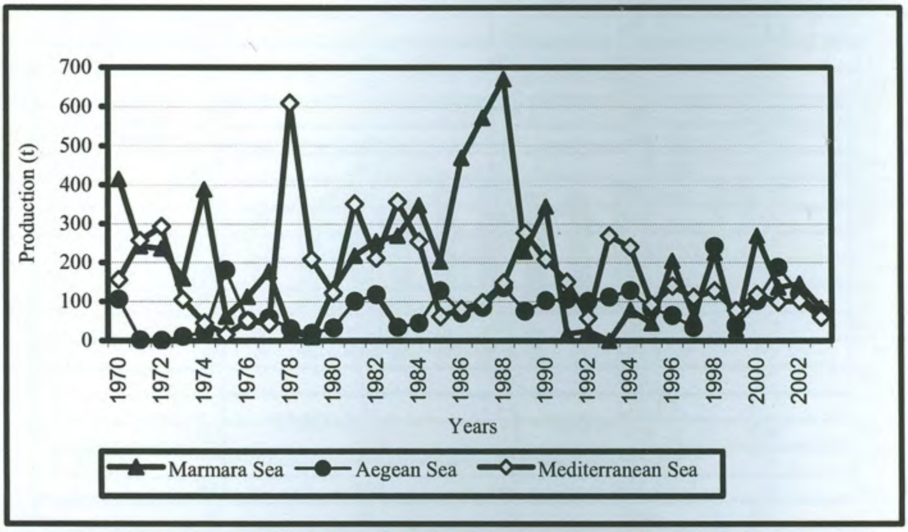
As it can be seen in Fig. 2, the shark production varies between the seas and fluctuates distinctively among the years. Most of the sharks have been caught in the Black Sea KABASAKAL (2003) and it accounted for 84 % of the total production of last 34 years fıshery statıstıcs (DIE, 1970-2003). 54 % of catch is from the Eastern Black Sea, 30 % from Western Black Sea, 7 % from the Marmara Sea, 6 % from the Mediterranean Sea and 3 % from the Aegean Sea.

Sharks are caught by long lines, gill-nets and deep trawls. Although, their production is based on generally by-catches of deep trawling, anchovy and turbot fisheries in Turkey KABASAKAL (1998).

Economical Importance

Sharks are consumed in many countries. Especially, fins are one of the most expensive products of fish in the world. The market of the sharks fins present in especially Asia, Hong Kong, Singapur, Taivan, China (SENGOR, 2005). Sharks fins are not consumed in Turkey, therefore most of them are exported to other countries with or without processing (KABASAKAL and KABASAKAL, 2004). Sharks are sold to the other countries as fresh/chilled *Scyliorhinus* spp; Dogfish frozen and fillets, Topeshark fillets, dried, salted or brine. In Table 4 shows the amount and values of exported sharks products from Turkey.

According to the fishery statistics, the average price of sharks was 1.3 $/kg in 2003 while it was 0.8 $/kg in 2000 and 1.0 $/kg. in 1994 fishery statıstıcs (DIE, 1970-2003).



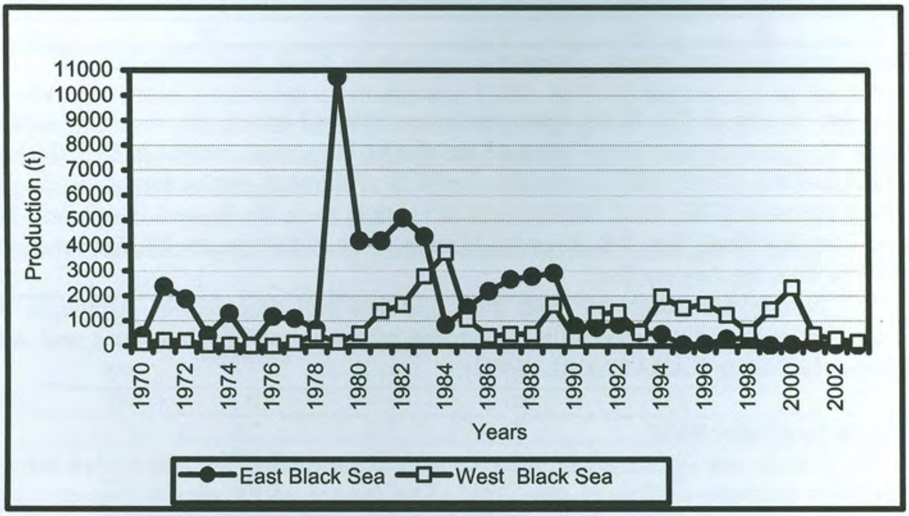


Figure 2. The annual production of sharks in Marmara, Aegean and Mediterranean Sea (Upper panel) and East and West Black Sea (Lower panel).

In 2003 the average sales price of sharks per kg was 1.3 $ in the Eastern Black Sea, 1.2 $ in Western Black Sea, 1 $ Marmara Sea, 1.4 $ Aegean Sea, and Mediterranean Sea and it provided 535.406 $ supplementary budget to the country economy with the average sales price of 1.3 $ per kg. The increasing economical value of sharks in Turkey is given in Table 2 and Fig. 3. As it is seen from the table, the value was 1.055.373 $ in 1985 while it was 1.733.779 $ in 1990 and 2.308.787 $ in 2000. This ratio accounts for the 1 % of the total fish production in Turkey ACARA (1992), ACARA *et al.* (1993), SENEL *et al.* (2000), GOZGOZOGLU *et al.* (2004), GOZGOZOGLU *et al.* (2005).

The exportation of sharks in the world showed an increasing trend in recent years. In 1995, US$ 42,546 billion of revenue was achieved with the exported products of 17,956 t (URL_1). This value was US$ 41,130 with 16,130 t in 1999. On the other hand, the export quantity was 309.461 kg in Turkey in 1993 and decreased to the 52.394 kg with the revenue of US$ 211.879 in 2003 (Table 3 and Fig. 4).

Table 2. The positive effect of sharks to the country economy according to the regions in 1985-2003 ($) (ACARA, 1992, 1996; ACARA *et al.*, 1993, 1998; SENEL *et al.*, 1999, 2000, 2001, 2002; GOZGOZOGLU *et al.*, 2004, 2005)

Year	Eeatern Black Sea	Western Black Sea	Marmara Sea	Aegean Sea	Mediterranean Sea	Total Shark production	Total marine fish production
1985	250.820	613.544	117.692	73.317	-	1.055.373	296.380.474
1986	1.006.872	403.346	491.485	74.694	-	1.976.397	442.455.931
1987	2.950.801	548.089	668.459	100.503	-	4.267.852	509.142.223
1988	1.963.682	331.503	471.565	95.721	-	2.862.471	539.452.421
1989	2.249.623	771.407	107.978	53.753	-	3.182.761	392.931.440
1990	916.935	301.427	396.917	118.500	-	1.733.779	767.293.297
1991	709.849	1.224.969	17.267	101.681	-	2.053.766	813.436.773
1992	68.385	1.978.947	36.298	146.642	-	2.230.272	956.500.036
1995	107.283	3.126.430	98.525	181.725	101.810	3.615.773	1.383.943.096
1996	56.460	1.820.084	220.735	82.187	136.045	2.315.511	918.363.824
1997	169.505	821.283	37.496	38.625	125.729	1.192.638	704.912.395
1998	215.613	492.201	186.237	330.111	58.314	1.282.476	796.808.015
1999	14.995	1.165.114	22.584	38.938	73.449	1.315.080	596.764.734
2000	48.098	1.861.819	210.943	93.495	94.432	2.308.787	510.167.483
2001	71.057	307.816	86.091	131.983	55.895	652.842	344.701.308
2002	28.348	83.456	126.780	107.641	91.302	437.527	348.147.993
2003	38.446	194.572	113.949	104.665	83.774	535.406	462.059.560

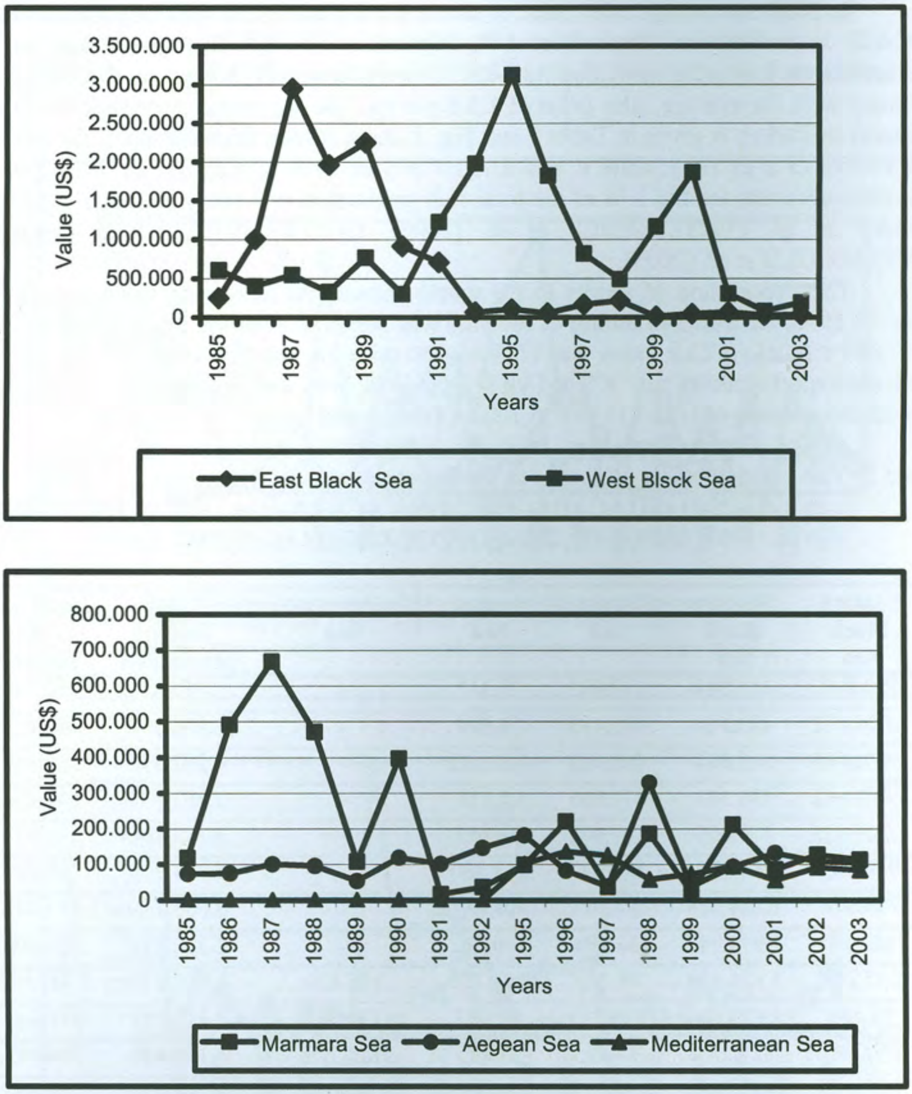


Figure 3. Total income of shark production in East and West Black Sea (upper panel) and Marmara, Aegean and Mediterranean Seas (lower panel).

Table 3. Exported sharks production of Turkey, 1993-2003

	Quantity (Kg)	Value (US$)
1993	309.461	738.080
1994	180.058	365.826
1995	194.647	498.929
1996	92.851	243.327
1997	155.428	434.449
1998	156.633	429.010
1999	58.721	174.074
2000	115.426	363.207
2001	156.976	447.062
2002	133.591	383.881
2003	52.394	211.879

Source :1993-2003 Fishery Statistics, Turkish Statistics Institute.

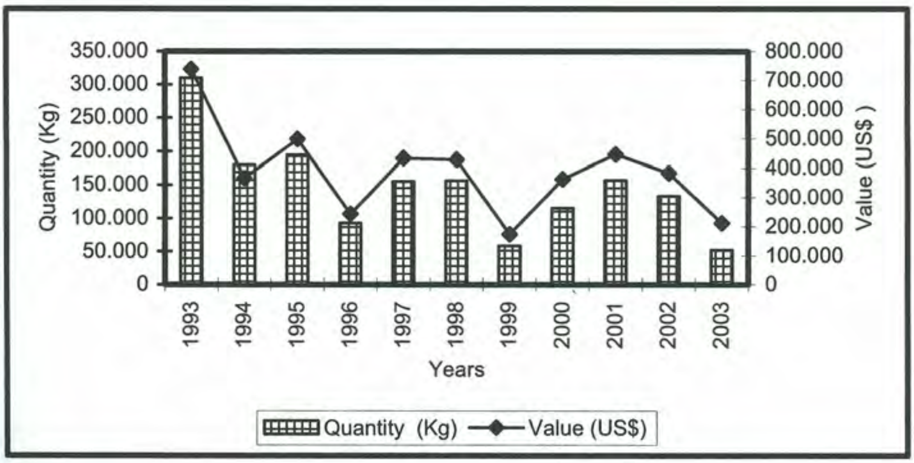


Figure 4. The quantity and economical value of exported sharks in Turkey.

The production of sharks in Turkey is variable, but it provides relatively important income as most of it is exported. SPAGNOLO (1999) stated that sharks have a wide range of uses and the Mediterranean markets are the most important in absolute terms. He also pointed out that shark liver is used as a raw material for the production of pharmaceutical products and the cartilage is used by the same industry for its curative properties.

In conclusion, it is worthwhile to point out that the main fishing areas in Turkey for the sharks are the Black Sea and North Aegean Sea. Although sharks are weakly consumed in Turkey, there are some potentialities to develop internal markets, pending on stock assessments are undertaken.

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Iago omanensis, A DEEP-SEA SHARK UNDER THE STRESS OF FISHERIES IN THE GULF OF AQABA (NORTHERN RED SEA)

Albert BARANES

Interuniversity Institute of Marine Sciences,
P.O.Box 469, 88000 - Eilat, Israel

Abstract

Iago omanensis, is caught in the Gulf of Aqaba by hook-and-line, mostly by artisanal fisheries. It is now obvious that commercial fishery on deep-sea fish of the Gulf of Aqaba, without a proper management program, will endanger the population of *Iago omanensis.* The fisheries in the Gulf of Aqaba harvest mostly females while in the Red Sea proper, the fisheries impacts mostly on large males.

Key words: Red Sea,* Iago omanensis*, critical habitat, ecology.

Introduction

In Israel, sharks are "protected animals" by law and it is forbidden to catch or sell them; also it is "non-Kosher" fish and is not consumed by religious Jewish people. When illegally caught, in the Mediterranean Sea, sharks are smuggled to the Gaza stripe; therefore obtaining any fisheries statistic is impossible.

The principal and most pressing problem is that none of the countries bordering the Red Sea has any kind of control in the form of management measures. Furthermore, there is a general lack of knowledge of how many species of sharks are found in the region, and neither what is their ecology.

Iago omanensis, among other species, is caught in the Gulf of Aqaba by hook-and-line, mostly by artisanal fisheries. In Jordan, *Iago* is a commercial fish consumed as fresh food. Although, commercial fishing in Jordan is of little significance, a gradual decline of commercial fish production has been observed during the last few years. Jordan fishermen operate approximately 100 medium and small boats, using hand lines, traps and gillnets as fishing gears (KHALAF, pers. comm.).

The Egyptian fishermen are operating, in the Gulf of Aqaba, mostly in shallow coastal water and then do not land *I. omanensis.*

In the Red Sea proper, small-scale fishing boats are commonly used but in some places larger fishing vessels with long-range capabilities also take part in the fishery. Trawlers for shrimps usually harvest *Iago* population and it is commercialized as by-catch.

The Red Sea presents a very peculiar pattern of circulation, warm surface waters (28-30°C) entering the Straits of Bab el Mandeb, are transported to the northern Red Sea where they cool and become saltier; the thermohaline circulation causes the bottom waters to eventually exit the Red Sea system back to the Indian Ocean (GOLDSHMIDT *et al.*, 1996).

BARANES and GOLANI (1993) showed that the ichthyofauna inhabiting the deep-waters of the aphotic zone of the Gulf of Aqaba (and the Red Sea) is primarily a coral reef fauna that migrated to deeper waters, presenting similar abiotic characteristics (warm and constant temperature) and provided with a sustainable food web.

Within the frame of a regional research and monitoring project (The Red Sea Peace Park Program), between 2000 and 2003, a joint team of Israeli and Jordanian Ichthyologists developed a method for monitoring Coral Reef Fishes. It very soon appeared that about 83 % of the fish caught by fishermen in the northern Red Sea are coral reef fishes, mostly not edible.

Our recommendation was to move the coastal fisheries to deeper waters, in order to protect the coral reef ecosystem and to land more valuable commercial fishes.

According to KHALAF (pers.comm.), one of the side impacts on these new fisheries grounds was the reduction of the number of a deep-sea shark, *I. omanensis*, in the catches.

Materials and Methods

The hound shark, *Iago*, belongs to the Order Carcharhiniformes, Family Triakidae, Genus *Iago* COMPAGNO and SPRINGER, 1971.

Only two species in this genus are known today: *Iago omanensis* (NORMAN, 1939), known from the Red Sea and the Gulf of Aden (Fig. 1 and Fig. 2), and *I. garricki* FOURMANOIR and RIVATON (1979) from the New Hebrides.

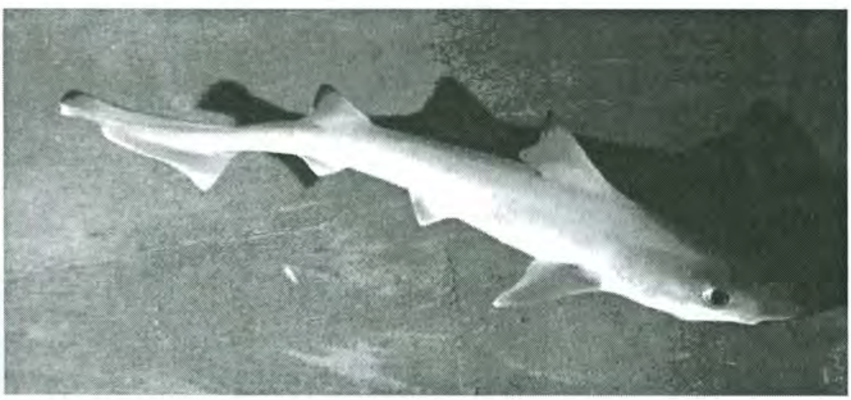

Figure 1. A live specimen of *Iago omanensis*, 510 mm TL.

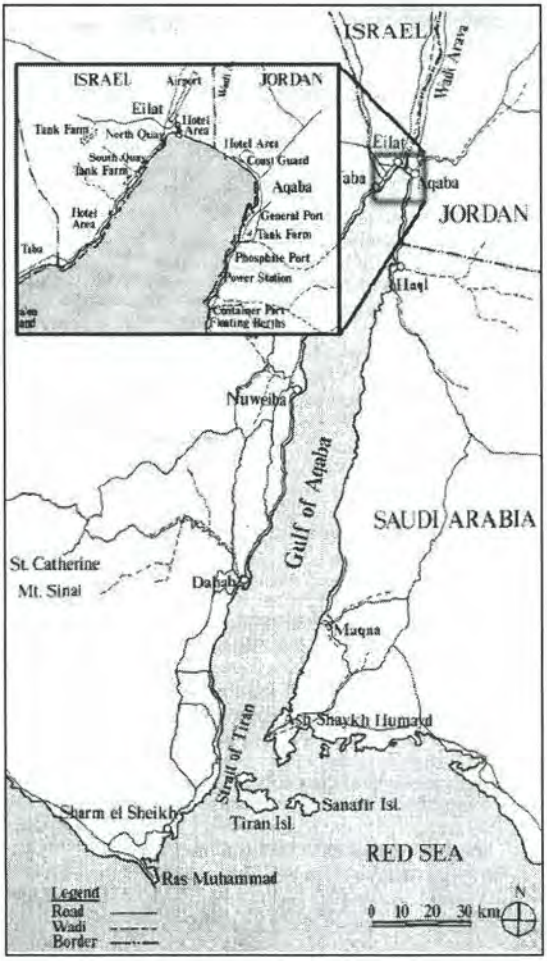

Figure 2. Map of the Gulf of Aqaba, northern part enlarged.

Iago omanensis was reported on the basis of photographs taken at 740 m deep in the central Red Sea by KLAUSEWITZ and THIEL (1982). BARANES and BEN-TUVIA (1979) recorded *I. omanensis* as a rare carcharhinid from the Gulf of Aqaba. Since then it appears that *I. omanensis* is a common inhabitant of the deep waters of the Gulf of Aqaba and numerous works were conducted on its ecology and life history.

BARANES and GOLANI (1993) reported *I. omanensis* from all depths sampled in the aphotic zone (150-1500 m).

BARANES (1986) described the reproduction of *I. omanensis* as a viviparous development, forming a yolk sac-placenta. The males reach maturity at the size of 310-320 mm TL, females at about 400 mm. There are 2 to 6 embryos in each litter. Young are born at about 160 mm. TL. Females get pregnant 6 months after parturition. The gestation period is about 10-12 months. A female is gravid twice in two years. No seasonality was found in the mating of this species. The sex ratio of embryos was 1:1 in more than 1000 gravid females observed. HAMLETT *et al.* (2002) showed that females are able to retain sperm, for a long period and without affecting its quality.

WALLER and BARANES (1991) investigated the morphology of *I. omanensis* and stated that there is no sexual dimorphism in the anatomy of the skull and the jaw fixation, therefore males and females can eat the same food items.

In a study conducted between 1989 and 1990, WALLER and BARANES (1994) collected in trammel nets 630 specimens of *I. omanensis* for stomach contents analyses. They concluded that there was no sexual difference in the diet of 630 *Iago omanensis* examined. In *I. omanensis* stomachs examined, 7.5 % were empty. Cephalopods were the most numerous prey items in the diet, with fish intermediate and crustaceans, gastropods and polychaetes of minor importance. Mud was present in 96.7 % of non-empty stomachs (probably for buffering the stomach pH or the neutralization of cephalopod toxins). Offal (vegetables, animal bones, feathers) was recorded in 44 % of non-empty stomachs. Detritus (plastic, rubber, string, nylon) was present in 9.8 % of non-empty stomachs.

GOLDSHMIDT *et al.* (1996) reported the bathyal distribution of *I. omanensis* in the Gulf of Aqaba and showed that two distinct groups exist within the population (Fig. 3).

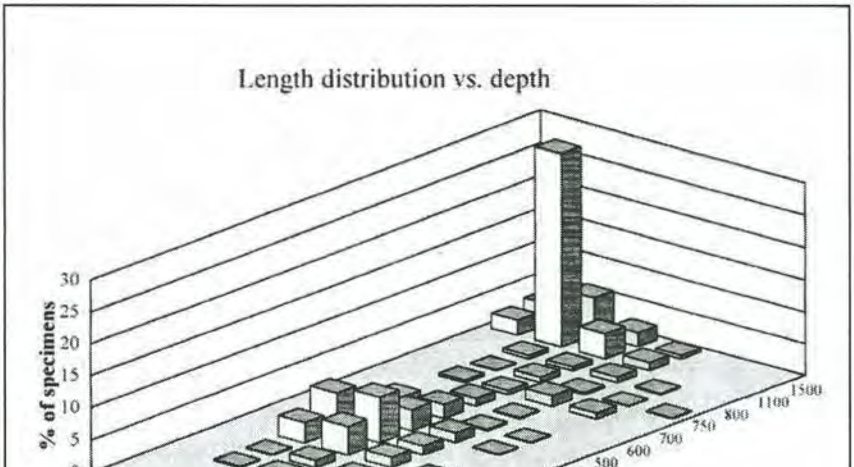

Figure 3. Bathymetric distribution of *Iago omanensis* (from GOLDSHMIDT *et al.*, 1996).

When plotting the males and females separately, it appears that most of the males inhabit the deeper waters, while the females prefer shallower areas (Fig. 4).

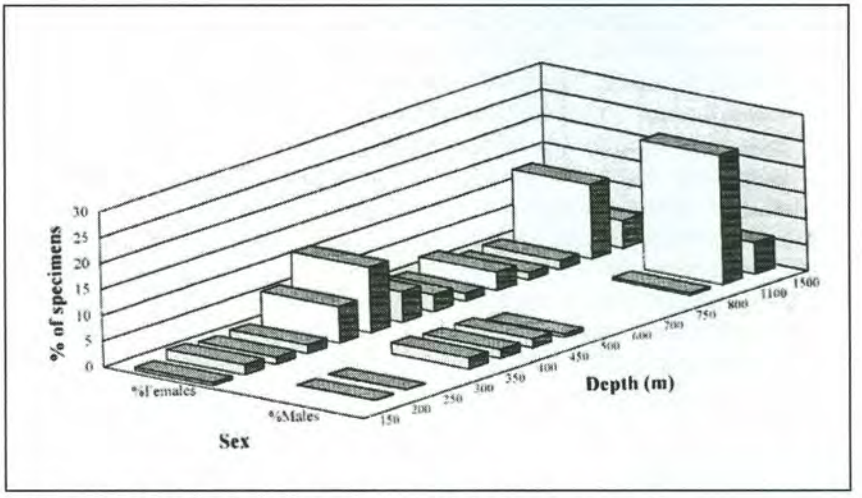

Figure 4. Distribution of sexes vs. depth in *Iago omanensis*.

The authors also confirmed the fact described in previous works that females are found to outnumber males in catches. The overall sex ratio is usually 8 females: 1 male (Fig. 5)

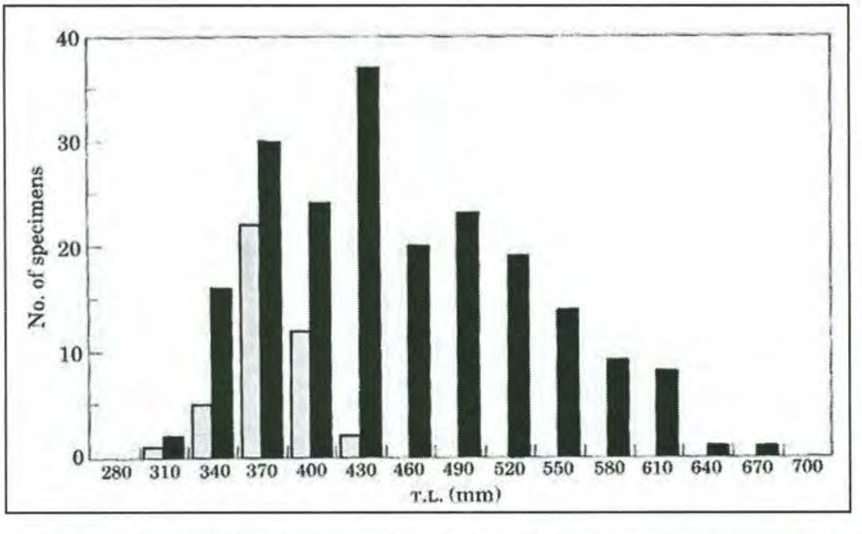

Figure 5. Total length frequency n= 246 of *Iago omanensis* in the Gulf of Aqaba (black: females, white: males).

GOLDSHMIDT *et al.* (1996) described the food web in the aphotic zone of the Gulf of Aqaba, using qualitative analyses of the stomach contents and the stable carbon isotopic composition ($\delta^{13}C$) in the tissue of collected organisms. They concluded that the highest trophic level comprising *Muraenesox cinereus* and *Carcharhinus plumbeus*, is above that of *I. omanensis*, indicating that the former two species feed on the *Iago* population. The authors stated that the low proportions of males in catches were independent of depth of sampling and geographical locality of collection; no evidence of cannibalism was observed in *I. omanensis* and remains of only males were not found ingested by other sharks feeding in the deep reef zone; probably the smaller size of males makes them vulnerable to higher predation pressure than females.

Sharks species often segregate by sex (SPRINGER, 1967) and the males are probably in other areas, or in deeper water. The confirmation of this hypothesis was obtained when we collected 87 *I. omanensis* in the Dahlak Archipelago (Eritrea, central Red Sea), 57 males (250-451 mm) and 30 females (267-459 mm) at a depth of 1570 m. (BARANES, GOLANI and GOREN, personal communication).

Conclusions

Although fishery statistics are inexistent in the area, it is now obvious that commercial fishery on deep-sea fish of the Gulf of Aqaba, without a proper management program, will endanger the population of *I. omanensis*. The fisheries in the Gulf of Aqaba harvests mostly females while in the Red Sea proper, the fisheries impacts mostly on large males.

The balance between shark exploitation in fisheries and shark preservation must be carefully and continuously monitored. It is of higher importance for sustaining shark population to learn their life history, their reproductive cycle and their food habits. Nursery grounds must be declared protected areas. When learning the bathymetrical distribution of each and every species we shall be able to protect selected areas from fisheries during mating, spawning and parturition periods.

The need of further investigation on sharks is crucial, and since most of the species are presenting large territories, regional, multinational, joint fishery management program are to be developed with full partnership.

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CARTILAGINOUS FISHES OF THE MEDITERRANEAN COAST OF ISRAEL

Daniel GOLANI

Department of Evolution, Systematics and Ecology
The Hebrew University of Jerusalem
91904 Jerusalem, Israel

Abstract

The Mediterranean ichthyofauna of Israel numbers a total of 57 cartilaginous species: 31 sharks, 25 skates and rays and only a single Chimaera species. Only one species *Himantura uarnak* (Forsskål, 1775) is of Red Sea origin (Lessepsian migrant). The west-east gradient of species number, known throughout the entire Mediterranean ichthyofauna, is echoed in cartilaginous species, where only 65.5 % of the Mediterranean ichthyofauna is found in Israel. The annual catch of cartilaginous species in the last few decades ranges between 28-111 tons, constituting only 0.9-2.8 % of the total catch. Due to their low catch and low commercial value in Israel, there are very few local studies of the biology and ecology of these species. However their importance in the well-being of the ecosystem justifies more intensive studies of cartilaginous fishes, in order to formulate effective conservation and management policies.

Key words: Israel coast, Levantine basin, Lessepsian migration.

Cartilaginous fish constitute an important component in all marine ecosystems. Since some cartilaginous fish are target species of commercial fishery, it is essential to study their biology, ecology and the impact of fishery and other anthropogenic factors on their exploited stocks.

Conservation of cartilaginous species is an acute issue worldwide. The high demand for shark fins in the markets of the Far East, as well as their low reproductive rate, places many sharks in the list of endangered species.

In order to further understand the global distribution and population dynamics of cartilaginous fish, regional studies must be conducted. Therefore, a primary research priority is the compilation of an inventory list of the cartilaginous species of the Mediterranean coast of Israel and comparing this list with that of the entire Mediterranean. For the purposes of this compilation, the work of QUIGNARD and TOMASINI (2000) was used regarding cartilaginous fishes of the entire Mediterranean and that of GOLANI (2005) regarding the coast of Israel.

When one examines the ichthyofauna of the entire Mediterranean, one sees a clear west-east gradient of the number of species; 664 fish species have been recorded in the Mediterranean, of which only 402 (60.5 %) are in the Israeli coast. However, this rate is misleading and is actually more moderate, due to the influx of Lessepsian migrants that entered the Mediterranean via the Suez Canal. To date, there are 62 Lessepsian fish species occupying the eastern Mediterranean basin (GOLANI and SONIN, in press). As for indigenous Mediterranean fish species, only 52.2% are found also in the eastern basin (see Table 1).

This west-east gradient of number of species is echoed in Cartilaginous species; out of 87 Mediterranean species, 57 (65.5 %) are found in the Israeli coast and out of 55 shark species, 31 (56.4 %) are found in the eastern basin. However, this value may be an overestimation, since QUIGNARD and TOMASINI (2000) included in their list several doubtful and questionable records (including *Carcharhinus melanopterus*, *Sphyrna tudes*, *Centrophorus uyato*, etc.). As for Batoidea, 25 (83.3 %) species are found in Israel out of 30 in the entire Mediterranean. The single Chimaera species (*Chimaera monstrasa*) is distributed throughout the Mediterranean.

Table 1. Number of fish species in the Mediterranean coast of Israel as compared to that of the entire Mediterranean

	Entire Mediterranean	**Coast of Israel**	**%**
All fish species	664	402	60.5
Med. Indigenous only	664	340	51.2
Cartilaginous	87	57	65.5
Sharks	55	31	56.4
Skates and Rays	30	25	83.3
Chimaera	1	1	100.0

Very little is known about the abundance of cartilaginous species, for two main reasons. Firstly, there is some confusion as to the taxonomy of these species. Secondly, the catch of all cartilaginous species is lumped together in fishery statistics which are the main source of information on these species.

The paucity of biological studies of cartilaginous fish in Israel is due to a certain extent to the low esteem and therefore the low price given them in local markets. The low demand for cartilaginous fish in Israel stems mainly from the fact that their consumption is forbidden for observant Jews, since these fish are not kosher. According to the Jewish religion, only fish with scales are kosher or ritually permitted for eating. Despite the fact that sharks have scales, the definition of scales by Jewish religious authorities differs from that of ichthyologists. The laws of Kashrut or keeping kosher provide that a fish scale must be big enough to be discernible by the naked eye and also should be easily detachable. The placoid scales of sharks do not meet these criteria. Therefore, most of the sharks, skates and rays caught along the Israeli Mediterranean coast are sold to non-Jewish communities at a rather low price.

Cartilaginous fishes are considered to be a by-catch by local Israeli fishermen who catch them mainly by trawl and bottom long-line and, to a lesser extent, in purse seine and trammel nets. The total annual catch of Mediterranean cartilaginous species in

Israel for the years 1980-2004 varied greatly between 28 to 111 tons, constituting only 0.9-2.8 % of the total catch (DEPARTMENT OF FISHERIES, 1981-2005).

Table 2 reveals the list of the cartilaginous fish of the Mediterranean coast of Israel with a general classification of each species' abundance.

Table 2. List of cartilaginous species from the Mediterranean coast of Israel. R – Rare; P—Prevalent; C—Common

SELACHII		
HEXANCHIDAE	*Heptranchias perlo* (Bonnaterre, 1788)	P
	Hexanchus griseus (Bonnaterre, 1788)	P
ODONTASPIDIDAE	*Carcharias taurus* Rafinesque, 1810	R
	Odontaspis ferox (Risso, 1810)	R
LAMNIDAE	*Carcharodon carcharias* (Linnaeus, 1758)	R
	Isurus oxyrinchus Rafinesque, 1810	P/R
	Lamna nasus (Bonnaterre, 1788)	R
CETORHINIDAE	*Cetorhinus maximus* (Günnerus, 1765)	R
ALOPIIDAE	*Alopias superciliosus* (Lowe, 1839)	P
	Alopias vulpinus (Bonnaterre, 1788)	R
SCYLIORHINIDAE	*Galeus melastomus* Rafinesque, 1810	C
	Scyliorhinus canicula (Linnaeus, 1758)	C
TRIAKIDAE	*Mustelus asterias* Cloquet, 1821	R
	Mustelus mustelus (Linnaeus, 1758)	C
CARCHARHINIDAE	*Carcharhinus altimus* (Springer, 1950)	R
	Carcharhinus brevipinna (Müller and Henle, 1839)	P
	Carcharhinus limbatus (Valenciennes, in Müller and Henle, 1839)	R
	Carcharhinus obscurus (Lesueur, 1818)	C
	Carcharhinus plumbeus (Nardo, 1827)	C
	Prionace glauca (Linnaeus, 1758)	R
SPHYRNIDAE	*Sphyrna zygaena* (Linnaeus, 1758)	P
DALATIIDAE	*Etmopterus spinax* (Linnaeus, 1758)	C
	Dalatias licha (Bonnaterre, 1788)	R
OXYNOTIDAE	*Oxynotus centrina* (Linnaeus, 1758)	C/P
CENTROPHORIDAE	*Centrophorus granulosus* (Bloch and Schneider, 1801)	C
SQUALIDAE	*Squalus acanthias* Linnaeus, 1758	C
	Squalus blainvillei (Risso, 1826)	P
SQUATINIDAE	*Squatina aculeata* Dumeril in Cuvier, 1817	R
	Squatina oculata Bonaparte, 1840	P
	Squatina squatina (Linnaeus, 1758)	R
BATOIDAE		
PRISTIDAE	*Pristis pectinata* Latham, 1794	R
TORPEDINIDAE	*Torpedo marmorata* Risso, 1810	C
	Torpedo nobiliana Bonaparte, 1835	R
	Torpedo torpedo (Linnaeus, 1758)	C
RHINOBATIDAE	*Rhinobatos cemiculus* Geoffroy Saint-Hilaire, 1817	P

Tablo 2. (Cont.)

	Rhinobatos rhinobatos (Linnaeus, 1758)	C
RAJIDAE	*Dipturus oxyrinchus* (Linnaeus, 1758)	C
	Raja asterias Delaroche, 1809	R
	Raja clavata Linnaeus, 1758	C
	Raja miraletus Linnaeus, 1758	C
	Raja montagui Fowler, 1910	R
	Raja radula Delaroche, 1809	R
	Raja undulata Lacépède, 1802	R
DASYATIDAE	*Dasyatis centroura* (Mitchill, 1815)	R
	Dasyatis chrysonota (Smith, 1828)	C/P
	Dasyatis pastinaca (Linnaeus, 1758)	C
	Dasyatis tortonesei Capapé, 1975	P
	Himantura uarnak (Forsskål, 1775)	P
	Pteroplatytrygon violacea (Bonaparte, 1832)	R/P
	Taeniura grabata (Geoffroy St-Hilaire, 1817)	C/P
GYMNURIDAE	*Gymnura altavela* (Linnaeus, 1758)	P
MYLIOBATIDAE	*Myliobatis aquila* (Linnaeus, 1758)	C/P
	Pteromylaeus bovinus (Geoffroy St-Hilaire, 1817)	C/P
RHINOPTERIDAE	*Rhinoptera marginata* (Geoffroy St-Hilaire, 1817)	C
MOBULIDAE	*Mobula mobular* (Bonnaterre, 1788)	R
HOLOCEPHALI		
CHIMAERIDAE	*Chimaera monstrosa* Linnaeus, 1758	C

Knowledge of the biology and ecology of cartilaginous fish along the coast of Israel is partial. There have been a few studies of *Centrophorus granulosus* and other deep-water species (GILAT and GELMAN, 1984; PISANTY and GOLANI, 1995; GOLANI and PISANTY, 2000) and several taxonomical studies (BARANES, 1973; GOLANI and CAPAPÉ, 2004). PISANTY and GOLANI (1995) and GOLANI and PISANTY (2000) showed that *C. granulosus* is the most abundant shark at depths of 200-400 m, with a sex ratio of 1 male to 4.5 females. At depths of 500-800 m males dominate while juveniles inhabit depths of 1400-1500 m with an equal ratio of males to females. The most abundant shark species at these depths was found to be *Galeus melastomus* with females overwhelming males by a ratio of 1 male to 21 females (GOLANI, unpublished data). BEN-TUVIA (1977) reported large catches of two shark species *Carcharhinus plumbeus* and *C. obscurus* outside the openings connecting the Bardawil Lagoon (northern Sinai) to the Mediterranean; in this lagoon, these sharks are abundant particularly in winter, when their primary fish prey species *Dicentrarchus labrax* and *Sparus aurata* commence spawning in November and December and return to the lagoon in March and April.

Regarding cartilaginous Lessepsian migrants, only a single such species has been recorded: the Spotted or Forsskål's stingray *Himantura uarnak.* The presence of another Indo-Pacific shark, *Carcharhinus melanopterus*, in the Mediterranean has been recorded by TORTONESE (1951). But it should be noted that this record originated in

Egypt, where the source of the specimens could be from the Red Sea; in addition, no specimens were preserved for confirmation. Furthermore, *C. melanopterus* bears a superficial resemblance, especially its black fin tips, to the indigenous *Carcharhinus brevipinna*. However, the occurrence of *C. melanopterus* in the Mediterranean has been repeatedly cited in major works. BEN-TUVIA (1978) erroneously reported *Carcharhinus brevipinna* as a Lessepsian migrant despite its being an indigenous Mediterranean species.

Further studies of cartilaginous fish in the Levant are of prime importance. The question remains, whether the apparent low abundance of these fish in the eastern Mediterranean is due to the fact that data has been obtained from fishery statistics or whether this is a true case of scarcity. Only direct studies on the abundance of these species in the Levant will reveal a more accurate picture, when complemented by studies on such biological aspects as growth rate, feeding habits and reproduction, etc. These studies will provide tools to aid in making rational decisions as to conservation of cartilaginous species in the Levant.

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ELASMOBRANCH RESEARCH IN SLOVENIA: STATE OF THE ART

Borut MAVRIČ[1], Robert TURK[2] and Lovrenc LIPEJ[1]

[1]Marine Biology Station Piran, NIB, Slovenia
[2]Institute of Republic of Slovenia for Nature Conservation Piran, Slovenia

Abstract

In the Slovenian part of the Adriatic Sea elasmobranch research is almost totally neglected in favour of the study of commercially more important bony fishes (e.g. swordfish). Elasmobranch research is more or less connected to an individual interest of a small number of ichthyologists and marine biology enthusiasts rather than to organized research interest. Up to date, 34 elasmobranch species (20 sharks and 14 Batoids) have been recorded in the Slovenian coastal sea. However, among them only few are rather common in the area. In recent years research in Slovenia has been focused on different topics such as: feeding ecology of *Mustelus punctulatus* and *M. mustelus*, increased occurrence of basking sharks (*Cetorhinus maximus*) and occurrence of juvenile sandbar shark specimens (*Carcharhinus plumbeus*) in the area, ecology and feeding habits of violet stingray (*Pteroplatytrigon violacea*) and others.

Key words: North Adriatic Sea, Slovenian coast.

Introduction

In the Adriatic area, elasmobranch research is almost totally neglected in favour of the study of commercially more important bony fishes. This is true for Slovenia, as well, where there is still a huge lack in all aspects of elasmobranch research. This is more or less connected to an individual interest of a small number of ichthyologists and marine biology enthusiasts rather than to organized research interest. The knowledge on sharks and rays is still more or less connected with occasional captures by fishermen.

The sea of Slovenia covers the southern part of the Gulf of Trieste, which is the northernmost part of both the Adriatic and the Mediterranean seas. It is a shallow semi-enclosed gulf with a maximum depth of ca. 33 m in waters off Piran. Slovenian coastline is approximately 46 km long. The area is characterized by the greatest tidal differences (semidiurnal amplitudes approach 30 cm) and the lowest winter temperatures (below 10°C) in the Mediterranean Sea (BOICOURT *et al.*, 1999).

Up to date, 34 elasmobranch species (20 sharks and 14 batoids) have been recorded in the Slovenian coastal sea (LIPEJ *et al.*, 2004). However, among them only few are rather common in the area. Five species of sharks: nursehound (*Scyliorhinus stellaris*), lesser spotted cat shark (*Scyliorhinus canicula*), piked dogfish (*Squalus acanthias*), smooth-hound (*Mustelus mustelus)* and black-spotted smooth-hound *(Mustelus punctulatus)*, and seven ray and skate species: marbled electric ray (*Torpedo marmorata*), common stingray (*Dasyatis pastinaca*), common eagle-ray (*Myliobatis *aquila*), bull ray (*Pteromylaeus bovinus*), starry ray (*Raja asterias*), thornback ray (*Raja clavata*) and brown ray (*Raja miraletus*) should be considered as frequent in the area. Some other species are only occasionally visiting the area, whereas the majority of species were only rarely sighted or captured in waters off Slovenia (LIPEJ *et al.*, 2004).

Materials and Methods

Highlights of research

The most common shark species in the Slovenian coastal area are *M. punctulatus* and *M. mustelus*. A recent research on the ecology of those species revealed that they are both occurring in mixed schools (Fig. 1). Additionally, the analysis of their stomach content showed that they are feeding on the same assemblage of benthic invertebrates, mainly bivalves, clupeids and mantis shrimps (*Squilla mantis*). Due to such results, certain doubts are arising on the validity of the status of *M. punctulatus* as a distinct species.

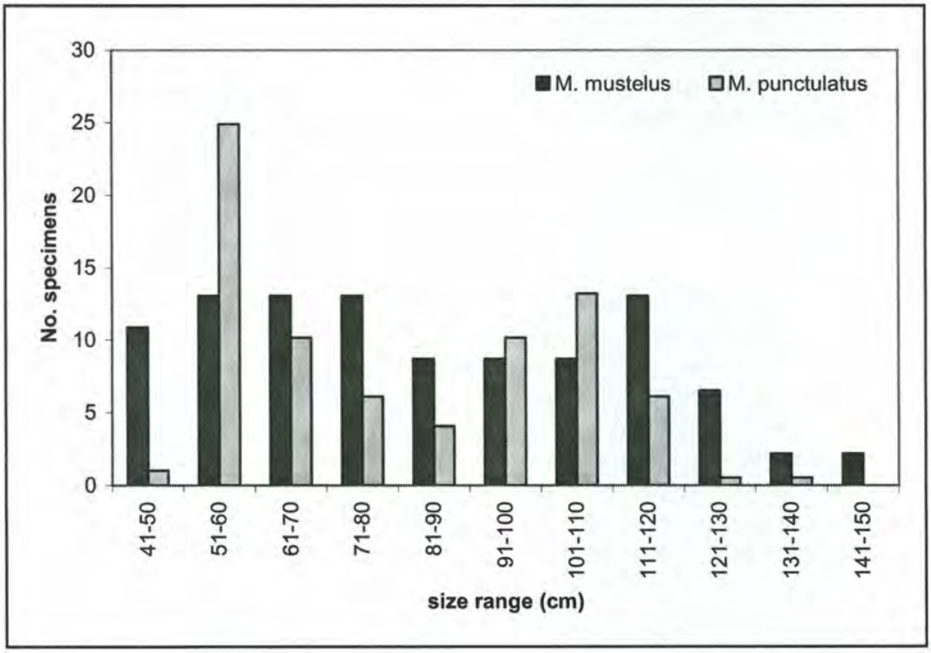

Figure 1. Size range distribution of two mustelid shark species, caught in the Slovenian coastal waters in 2003-2004.

The basking shark (*Cetorhinus maximus*) occurrence in the Slovenian coastal sea deserves a proper attention. During last decades, the frequency of sightings (and captures) of basking sharks in the Adriatic Sea with particular emphasis at the northernmost part drastically increased. In the Slovenian coastal sea two juvenile basking sharks were accidentally caught in the waters off Piran in 2000 (LIPEJ *et al.*, 2000_a). The first one has been entrapped in the special net for small sharks (e.g. smooth hounds), whereas the other was entangled in the bottom net for flatfish. In the very next year, a group of ten sharks were monitored while grazing in the Slovenian coastal sea over a month in spring. There are evidences of huge specimens, almost 9.50 m in length, but also cases of some very small specimens, measuring below 3 m and even below 2.5 m (LIPEJ *et al.*, 2004).

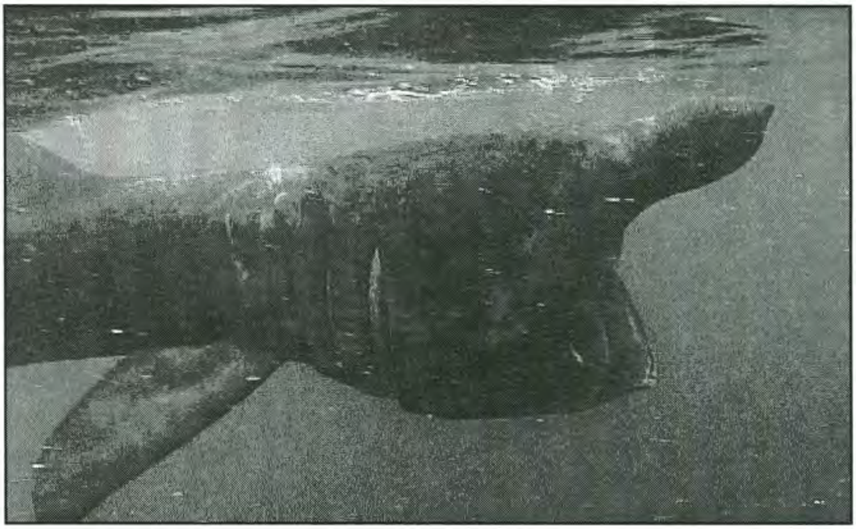

Figure 2. Grazing basking shark from a group of ten individuals observed off Slovenian coast during a month long period in 2000 (Photo: C. Mlinar).

It is not yet clear, what is the main reason of a sudden increase of evidence. Certain authors such as ZUFFA *et al.* (2001) postulated three possible explanations for the unusual occurrence of basking sharks in northern and central Adriatic Sea. According to them, this event could be explained by climate changes, changes in zooplankton abundance or some unknown aspects of basking sharks metabolism and/or behaviour.

Recently, we witnessed the increased abundance of another elasmobranch species, the violet stingray (*Pteroplatytrigon violacea*). The very first record of this species has been reported by MAVRIČ *et al.* (2004) for the waters of Slovenia. Since then, the pelagic stingray has been regularly caught by fishermen. The preliminary research on its feeding habits revealed a diverse food spectrum, consisting mainly on *Cepola rubescens* and clupeids (Fig. 3) (MAVRIČ *et al.*, 2004). The increasing number of pelagic stingrays in the area offers the possibility to investigate this species more accurately, in order to get more precise data on its diet and role in the food web. At the very same time, the feeding habits of the eagle ray (*Myliobatis aquila*) and the bull ray are investigated. Both species are regularly occurring in the area in high numbers.

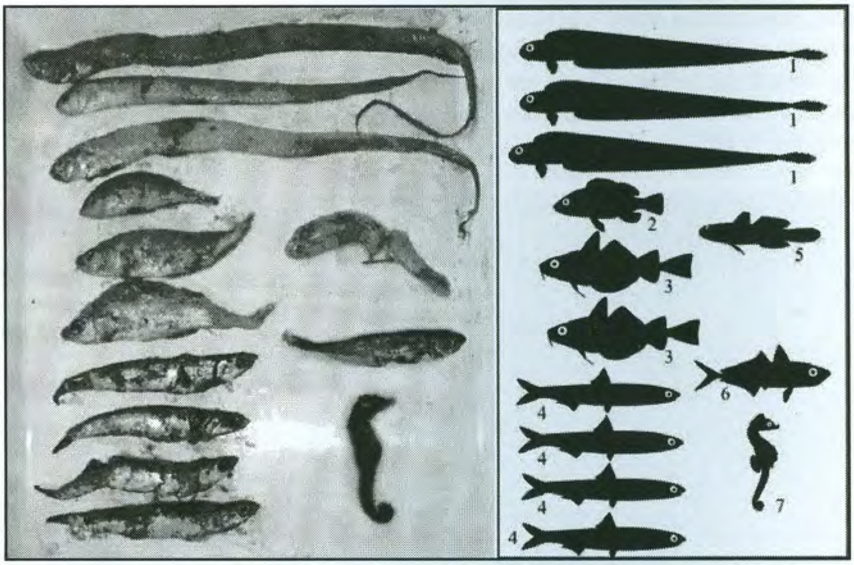

Figure 3. Prey items found in stomachs of pelagic stingray (Figure by T. Makovec).

Beside the previously mentioned juvenile basking sharks there were another two distinct juvenile elasmobranch specimens of *Carcharhinus plumbeus* caught in Slovenian area in 2000. In October 2000 a specimen of sandbar shark has been caught in gillnet called »*cagnara*«, a fishing gear for small cartilaginous fish. This was the first ever record of this species in Slovene coastal waters. The second specimen was caught 10 days later in the trammel net called »*passarela*« used for fishing flatfish (LIPEJ *et al.*, 2000_b). These juveniles together with a record of some neonatal specimens caught in northern Adriatic imply that northern Adriatic might be a nursery area for this rather rare (or neglected) shark species in the Adriatic Sea.

Threats

Since elasmobranches are more vulnerable to fishery than other fishes high measure of caution should be taken when exploiting them. Elasmobranches in Slovenian waters are usually not exposed to targeted fishery. Fishing effort is dedicated only to smooth-hounds (*Mustelus* spp.) and piked dogfish (*S. acanthias*). According to some fishermen, less than 5 tonnes of those shark species are caught per year. Elasmobranches are thus having a rather negligible relative importance in Slovenian fisheries. Unplanned capture known as by-catch represents one of the most damaging impact on elasmobranch populations in Slovenian coastal waters. Thresher sharks (*Alopias vulpinus*) are occasionally caught by fishermen and in certain cases juvenile specimens of basking shark were captured in bottom nets, as previously mentioned. The same is true for many stingrays, eagle rays and bull rays, which are regularly caught in pelagic trawls and discarded at sea by fishermen.

Although the Slovenian sea covers only a small portion of the Adriatic Sea, the big game is practiced in the area, as well. This impact seems to be a serious threat to certain shark species such as the Thresher shark and Blue shark (*Prionace glauca*). This is even more concerning as the northern Adriatic represents a nursery area for both species.

During last decade many cases of illegal trading with shark jaws are known in Slovenia. Generally, confiscated jaws belonged to several tropic shark species. There is a good cooperation between Marine Biology Station and the Ministry of Environment, who is involved in CITES.

Conservation

The decline in the number of elasmobranches calls for urgent investigation into their status. Despite only small portion of the Adriatic Sea belongs to Slovenia, a relatively high number of elasmobranchs have been till now reported for the area. This shows importance of Slovenian area in elasmobranch research and conservation. As there are still some cases of captures of shark species, listed in the IUCN list of endangered animals, such as the basking shark and the great white shark (*Carcharodon carcharias*), some conservation measures should be put into practice. There is also a critical need, prior to conservation, for biological information on the life history of many elasmobranch species in order to better assess the impact of fisheries on these top predators. Their role in structuring biodiversity should as well be assessed and this cannot be done without a basic knowledge on elasmobranch biology and ecology.

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THE GULF OF GABÈS: A SPOT FOR THE MEDITERRANEAN ELASMOBRANCHS

Mohamed Nejmeddine BRADAÏ[1], Bechir SAIDÏ[1],
Samira ENAJJAR[1] and Abderrahmen BOUAIN[2]

[1] Institut national des sciences et technologies de la mer, Centre de Sfax, BP 1035, 3018 Sfax, Tunisia.
E-mail : mednejmeddine.bradai@instm.rnrt.tn
[2] Faculté des Sciences de Sfax, BP 802, 3018 Sfax, Tunisia.

Abstract

Among the Mediterranean elasmobranchs, 62 species occurred along the Tunisian coasts. The elasmobranchs fauna of Tunisia included 33 sharks and 29 rays representing about 19 % of Tunisian ichthyofauna. Twenty-three sharks and 21 rays are recorded in the gulf of Gabès, the most important fishing area.

In Tunisia, elasmobranchs constitute about 2 % (2000 Tones/an) of national fish production. They are captured mainly by the bottom trawl, gillnets and longlines. The most abundant fishing zone is the gulf of Gabès from which about 70 % of Tunisian production is landed. Mainly 5 sharks and 7 rays are landed throughout the year and have an economic value. Several other species are landed along the year as by-catch of fisheries. Pelagic species (*Isurus oxyrinchus*, *Alopias vulpinus* and *Carcharodon carcharias*) were frequently captured by tuna trap.

Literature and new investigations along the Tunisian coasts, mainly in the gulf of Gabès, suggest that many species found favorable environmental conditions to develop and reproduce in the area, which constitutes nursery for some of them.

Key words: Tunisia, gulf of Gabès, elasmobranchs, nurseries.

Introduction

The Mediterranean elasmobranchs consist of about 1/10 of the total number of species in the world and they are represented with 84 species (SERENA, 2005). They are found in various habitats, from the coastal lagoons to the abyssal grounds. Although, elasmobranchs border various habitats, they migrate to rather specific places when they give birth or lay eggs (SPRINGER, 1967). These areas are geographically discrete parts where the gravid females deliver their young or deposit their eggs and where their young spend their first weeks, months or years. These areas are usually located in shallow, energy rich coastal zones where the young find abundant food and have little predation by large sharks (CASTRO, 1993).

The present paper deals with the status of elasmobranch species off Tunisian coasts and mainly off gulf of Gabès coasts.

Materials and Methods

This work is based on (1) the analysis of the ichthyological knowledge available for the Tunisian elasmobranchs (QUIGNARD and CAPAPE, 1971, 1972; CAPAPE, 1975; 1987; CAPAPE *et al.*, 1979; CHAKROUN, 1966; NAJAI, 1980), (2) surveying campaigns (using the INSTM's oceanographic vessel and commercial fishing fleet) and (3) visits to main landing points mainly in the gulf of Gabès (Fig. 1).

As sampling has various goals, it includes species and sex determination, measurements (TL mm and claspers length for males) and weighing. Several specimens of both sexes were dissected to examine the genital tract for maturity stages. The oocytes, the embryos and the fully developed fetuses were removed from the ovaries and the uteri of female genital tracts and then measured and weighted.

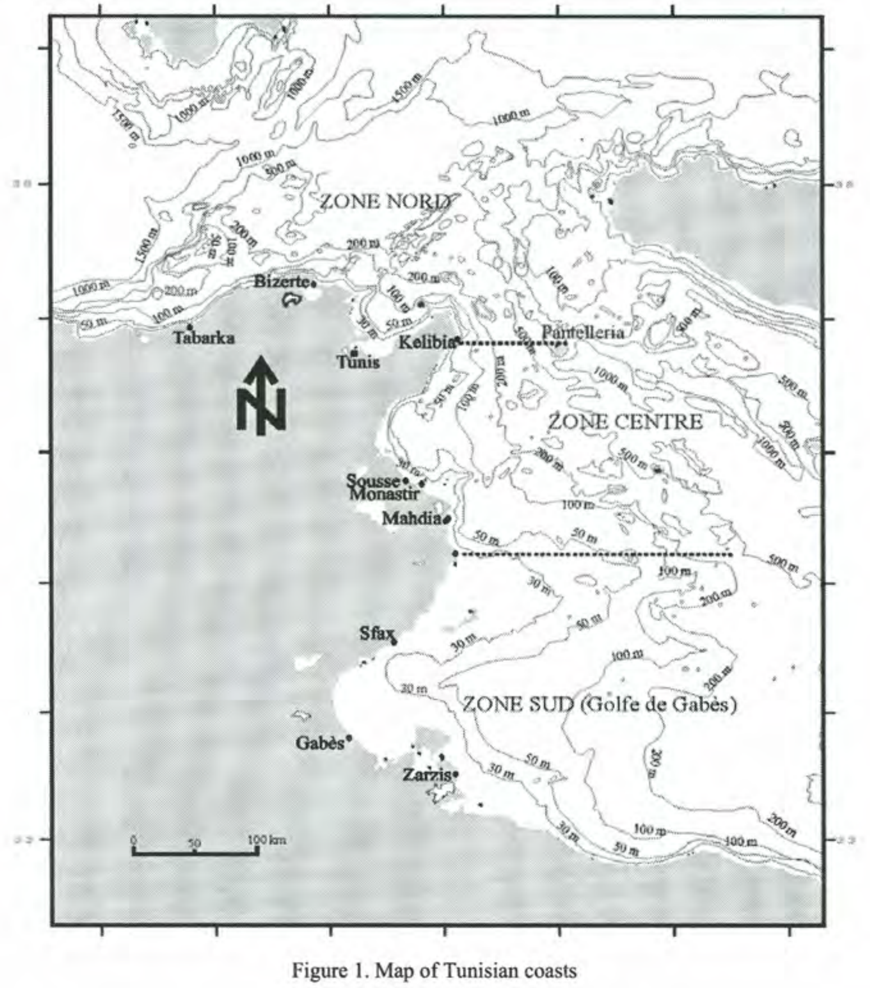

Figure 1. Map of Tunisian coasts

Results

Diversity

The Mediterranean basin is known as one of the world-wide marine regions where biodiversity is high. Its ichthyofauna includes 664 species of fish of which 84 are elasmobranchs (SERENA, 2005). These elasmobranchs fauna compound endemic, Atlantic, cosmopolitan and Lessepsian migrants'species. Mediterranean elasmobranchs are mainly coastal (80%). Among the Mediterranean elasmobranchs, 62 species occurred along the Tunisian coasts (BRADAI *et al*., 2002; BRADAI *et al*., 2004). The elasmobranchs fauna of Tunisia included 33 sharks and 29 rays representing about 19% of Tunisian ichthyofauna (BRADAI *et al*., 2004). Among the 33 sharks, 23 species are recorded in the gulf of Gabès (BRADAI *et al*., 2002). Among the 29 rays, 21 species occurred along the gulf of Gabès. Of the 33 sharks cited along the Tunisian coasts, we observed 27 species from which three are recorded only one time during our investigations. Six sharks are cited in literature and not observed during last decade (Table 1). Among the 29 rays, we observed only 21 species since 1990 (Table 2).

Table 1. Sharks recorded in Tunisian coasts

Species		Species	
Heptranchias perlo	*	*Carcharias taurus*	-
Hexanchus griseus	*	*Odontaspis ferox*	-
Squalus blainvellei	*	*Scyliorhinus canicula*	*
Squalus acanthias	-	*Scyliorhinus stellaris*	*
Dalatias licha	-	*Galeus melastomus*	*
Etmopterus spinax	*	*Galeorhinus galeus*	*
Oxynotus centrina	*	*Mustelus asterias*	*
Centrophorus granulosus	*	*Mustelus mustelus*	*
Squatina aculeata	*	*Mustelus punctulatus*	*
Squatina oculata	*	*Carcharhinus brevipinna*	*
Squatina squatina	*	*Carcharhinus melanopterus*	*
Alopias vulpinus	*	*Carcharhinus plumbeus*	*
Cetorhinus maximus	*	*Carcharhinus falciformis*	**
Carcharodon carcharias	*	*Carcharhinus limbatus*	**
Isurus oxyrhinchus	*	*Carcharhinus obscurus*	**
Lamna nasus	-	*Prionace glauca*	*
Sphyrna zygaena	-		

*Regularly observed, ** Observed only one time, - Cited in literature and not observed.

Table 2. Rays recorded in Tunisian waters.

Species		Species	
Dasyatis pastinaca	*	*Raja clavata*	*
Dasyatis tortonesei	*	*Raja radula*	*
Dasyatis centroura	*	*Raja miraletus*	*
Dasyatis chrysonota	*	*Raja asterias*	*
Peroplatytrygon violacea	*	*Raja montagui*	-
Taeniura grabata	*	*Raja brachyura*	-
Torpedo marmorata	*	*Raja polystigma*	*
Torpedo torpedo	*	*Raja africana*	-
Torpedo nobiliana	-	*Dipturus oxyrinchus*	*
Rhinobatos rhinobatos	*	*Leucoraja fullonica*	-
Rhinobatos cemiculus	*	*Leucoraja circularis*	-
Myliobatis aquila	*	*Leucoraja naevus*	-
Pteromylaeus bovinus	*	*Leucoraja melitensis*	*
Mobula mobular	*	*Rostroraja alba*	*
Gymnura altavela	*		

* Regularly observed, ** Observed only one time, - Cited in literature and not observed

Landing

In Tunisia, elasmobranchs constitute about 2 % (2000 Tones/an) of national fish production (ANONYMOUS, 2004). The most abundant fishing zone is the gulf of Gabès from which about 70% of Tunisian production is landed (Fig. 2). Mainly 5 sharks and 7 rays are landed throughout the year and have an economic value (Sharks: *Mustelus mustelus*, *M. punctulatus*, *Carcharhinus plumbeus, Squalus blainvillei* and *Scyliorhinus canicula*; Rays: *Rhinobatos cemiculus*, *R. rhinobatos*, *Dasyatis pastinaca*, *D. tortonesei*, *Pteromylaeus bovinus, Torpedo torpedo* and *Raja clavata*).

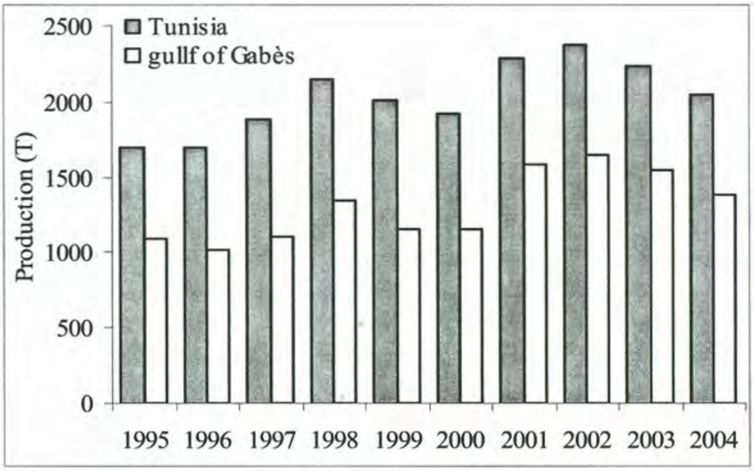

Figure 2. Elasmobranch landings in Tunisia and gulf of Gabès during the period 1995-2004.

In the Gabès gulf, the targeted species are *M. mustelus*, *M. punctulatus*, *C. plumbeus*, *R. cemiculus* and *R. rhinobatos*. Several other species are landed along the year in important quantities such as Dasyatids, *S. blainvillei*, *P. bovinus*, Scyliorhinids but constitute the by-catch of fisheries.

Commercial catches of targeted species such as *C. plumbeus* and *Mustelus* spp in the gulf of Gabès are seasonal; they peak in spring-summer when these species move to shallow water (Fig. 3, 4). Our investigation shows that inshore moving is a regular annual event, and it is probably linked with annual reproductive cycle.

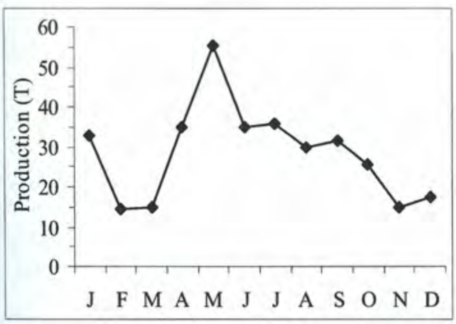

Figure 3. Monthly landing of *C. plumbeus*.

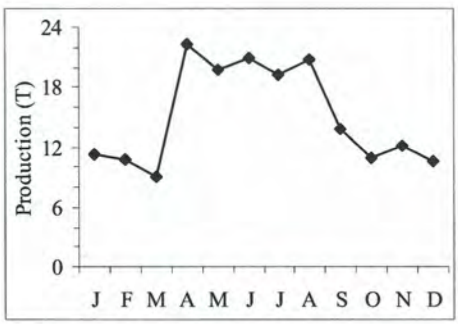

Figure 4. Monthly landing of *Mustelus* spp.

Fishing gears in the gulf of Gabès

Along the Tunisian coast, elasmobranchs are mainly caught with bottom trawls, gillnets and longlines.

The bottom trawlnets, with a cod end of 20 mm stretched mesh, were used to capture shrimps and demersal fishes at depths of 30-100 m. Elasmobranchs were by-catch species. Sandbar sharks were targeted March-July between Djerba Island and Zarzis by gillnets in polyamide monofilament with a stretched mesh size of 300-400 mm. Gillnets were 1000-3000 m long, set on the sea floor at depths of 10-25 m, and checked and cleared of catch, or pulled and reset, daily. These special gillnets "Garracia", was used only to capture *C. plumbeus* or Rhinobatids. *C. plumbeus* were also captured by pelagic and bottom longlines. Pelagic longlines, used in June-August, consist of a heavy nylon monofilament mainline, 7-28 km long, connected to buoys by a 10 m buoy line. Twenty-five large hooks (hook size: 00-01) are suspended about every kilometer, at depths of 30-100 m. Bottom longlines, used in August-October, consist of a heavy nylon monofilament (1.5-3 km long) with small hooks, generally 200 (hook size: 04-05) suspended every kilometer and a single hook per light stick. For both types of longlines, the hooks were baited with pieces of teleosts such as pilchard and mackerel or cephalopods such as cuttlefish.
The Smooth-hounds were targeted by special gillnets "Gattatia" from February to June along the gulf of Gabès coasts. This gillnets was constructed of polyamide monofilament netting with a stretched mesh size of 120-160 mm. Gillnets were 500-1500 m long, set on the sea floor at depths of 10-40 m, and checked and cleared of catch, or pulled and reset, daily.

By-catch

Several species of sharks and rays of different size, but mainly the juvenile, are captured incidentally as by-catch in costal fisheries. These categories include mainly Triakids, Dasyatids, *P. bovinus* and juveniles of Carcharhinids. Individuals of *Cetorhinus maximus* are mainly caught as by-catch along the Tunisian coasts (CAPAPE *et al.*, 2003; MANCUSI *et al.*, 2005).

The deep fisheries (trawls and longlines) captured incidentally several sharks. *Scyliorhinus canicula*, *Galeus melastomus*, *S. blainvillei*, *Centrophorus granulosus*, *Mustelus* spp and some rays are common in the catches. Species without commercial values, such Rajids, are discarded at sea.

Pelagic sharks (*Isurus oxyrinchus*, *Prionace glauca*) represent the main by-catch of high-sea fisheries targeting tuna and swordfish.

The pelagic species were also frequently captured by tuna trap. Recent observations and data available in literature show that three large shark species are episodically caught in tuna traps: *I. oxyrinchus*, *Alopias vulpinus* and *Carcharodon carcharias*. From 27 records of *C. carcharias* along the Tunisian coast, 15 were registered in the tuna trap of Sidi Daoud.

Critical habitats

Mediterranean Sea offers divers habitats from coastal lagoons to abyssal grounds. However, little information is known about the presence of nursery area in Mediterranean Sea. It is possible that parturition occurred in remote areas; for exemple, neonates of *C. plumbeus* are captured in Adriatic Sea (COSTANTINI and AFFRONTE,

2003) and gravid females off Turkish coast (SIMON CLÒ, pers. comm.). Northern Tyrrhenian Sea and Southern Ligurian Sea are hypothesized to be nurseries for *R. clavata*, *S. canicula* and *G. melastomus* (BAINO and SERENA, 2000). However, the mere presence of gravid females bearing term pups and neonates in an area is not sufficient to determine a nursery area (CASTRO, 1993). In general, shark nurseries are areas where gravid females give birth or lay eggs, and where the young spend their first weeks, months or years (SPRINGER, 1967).
Literature and new investigations along the Tunisian coasts mainly in the gulf of Gabès suggest that many species found favorable environmental conditions to develop and reproduce in the area which constitutes nursery for some of them.

***The sandbar shark,* Carcharhinus plumbeus**

The sandbar shark, *C. plumbeus*, is a medium-sized coastal carcharhinid with a worldwide distribution in temperate and tropical region of the Atlantic, Indian, Pacific Oceans and all the Mediterranean Sea (COMPAGNO, 1984).

Along the Tunisian coasts, *C. plumbeus* is captured through the year mainly in summer particularly along the southern-east coast (gulf of Gabès) where it finds the favorite condition to reproduce (SAIDI *et al.*, 2005_a).The sandbar shark is the most commonly landed carcharhinids, especially at fishing sites in the gulf of Gabès (Fig. 5).

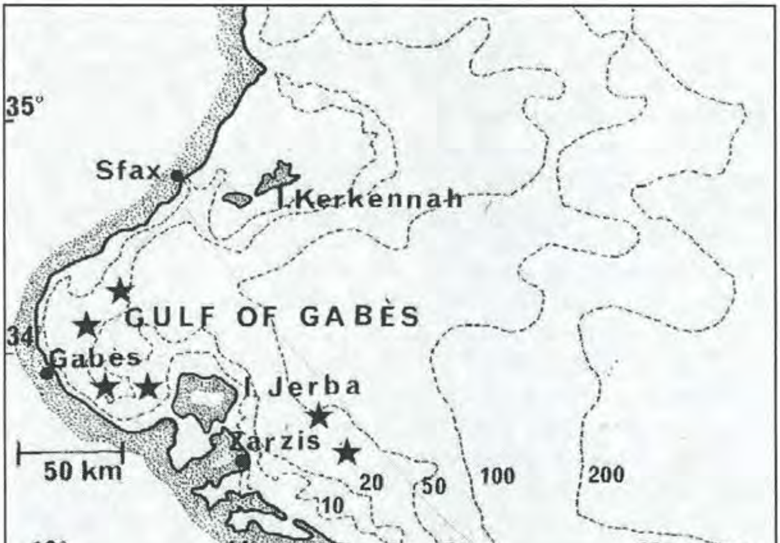

Figure 5. *C. plumbeus* capture sites (black stars).

Commercial landings of this species increased from 250 t in 2000 to about 400 t in 2004 (Fig. 6). Males and females are mature at 1600 and 1720 mm TL (SAIDI *et al.*, 2005_a). Pregnant females were observed between March and July, and then at the end of July, they disappeared from landing. These pregnant females were captured by demersal gillnets at depths between 10 and 20 m from March to May, and at depths lesser than 10 m from June to July, on sandy-muddy bottoms. These females were caught by special gillnets "Kallabia". Soon after, neonates exhibiting an unhealed umbilical scar on the ventral surface and post-partum females were captured from July to October. Neonates are captured at depths between 10 and 50 m, especially on sandy bottoms. Juveniles are captured along the year. These observations suggested that the gulf of Gabès is a nursery area for this shark (BRADAI *et al.*, in press).

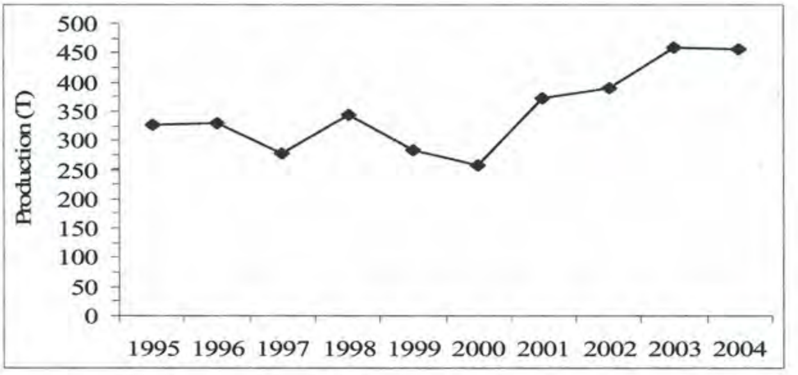

Figure 6. Sandbar shark catches in gulf of Gabès.

***White shark,* Carcharodon carcharias**

The white shark *C. carcharias* has been repeatedly documented from the Mediterranean sea since Antiquity (FERGUSSON, 2002). Since POSTEL (1958), 27 captures of *C. carcharias* were reported off the Tunisian coast from which there is one neonates and tow pregnant females. Of the 27 records, 11 were reported from the gulf of Gabès. In 1992, first pregnant female carrying two embryos was captured off Cape Bon (Tunisia northeastern) (FERGUSSON, 2002). On 26 February 2004, a second pregnant female was caught off the Tunisian coast, in the gulf of Gabès (southern Tunisia) (SAIDI *et al.*, 2005_b). FERGUSSON (2002) noted that along the Sicilian Canal, coastal records of immature specimens (< 250 cm TL) were primarily of Tunisian origin, coming from longlines and gillnets fisheries operating in the southeast of the country (gulf of Gabès). These observations suggest that the species find favorable environmental conditions to develop and reproduce in the area. FERGUSSON (2002) stated that 41 % of white shark records in Mediterranean Sea are reported from the Sicilian Channel and its adjoining environs suggesting that this zone is a reproductive and nursery area for this Shark.

Beside the White shark and the Sandbar shark, other species seem to have also nursery in the gulf of Gabès.

The smooth-hound, **Mustelus mustelus**

M. mustelus is landed along the year as a targeted or as by-catch species (Figure 4). Our investigation shows that the pregnant females were captured at depths between 10 and 20 ms from February to April, on sandy-muddy bottoms. From the earlier May to the end of June, neonates exhibiting an unhealed umbilical scar on the ventral surface and post-partum females were captured. On July females with encapsulated eggs are captured at depth about 50 m. Neonates are captured at depths between 10 and 30 m, especially on sandy bottoms. Juveniles are captured along the year. These observations suggested that smooth-hound shark find in the Gulf of Gabès the condition to reproduce and develop which could be considered as a nursery area for the species.

The blackchin guitarfish, **Rhinobatos cemiculus**

R. cemiculus is targeted mainly between April and August by gillnets (Figure 7). On June-July females with encapsulated eggs are captured at depth about 20 m. Neonates are captured at depths between 10 and 20 m, especially on sandy bottoms. Juveniles are captured along the year in bottom trawlers. The presence of all size classes of the Blackchin guitarfish in the southern east region of Gabès gulf (Zarzis, Djerba) suggested that this ray find in the area the condition to reproduce and develop which could be considered as a nursery area for the species.

Figure 7. Monthly landings of *Rhinobatos cemiculus* in Southeast of gulf of Gabès (Zarzis).

Conclusion

This review of literature data and the new observations show that Tunisian coasts and mainly the gulf of Gabès are very important places for the elasmobranch fauna in the Mediterranean ; many species found favorable conditions to reproduce and to develop. Nevertheless, precise information and data on distribution, biologic and fishing parameters should be needed to ovoid over-exploitation and determine particular areas to be protected. On other hand national action plan should be elaborate to maintain catch at level of sustainable yield and to reduce incidental mortality due to fishing in the frame of the implementation of the action plan for the conservation of cartilaginous fishes (Chondrichtyans) in the Mediterranean sea adopted by Tunisia.

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THE MEDLEM DATABASE APPLICATION: A TOOL FOR STORING AND SHARING THE LARGE SHARK'S DATA COLLECTED IN THE MEDITERRANEAN COUNTRIES

Fabrizio SERENA[1], Monica BARONE[1], Celilia MANCUSI[1], Glauco MAGNELLI[1] and Marino VACCHI[2]

[1] Agenzia Regionale per la Protezione Ambientale della Toscana
Via Marradi 114 57100 Livorno, Italy. E-mail: f.serena@arpat.toscana.it
[2] ICRAM c/o MNA-Università di Genova

Abstract

The MedLem Database Application is a user-friendly computerized system designed to facilitate sharing of large cartilaginous fish data between participants in the MedLem programme. Main objectives of the MedLem Database Application are an implementation of data collection, the standardization of the data entry procedures and a free access for the participants to the site www.arpat.toscana.it/xxx/medlem.htlm. Furthermore, the MedLem Database provides an updated source of information on large cartilaginous fishes for national and international organizations involved in the management and the conservation of these marine vertebrates in the Mediterranean Sea. The application allows the data entry of catch, sighting, stranding or bibliographic reference, or a search for species, country and gear. An example of the practical use of these data stored in the MedLem database is presented.

Key words: Large elasmobranchs, Mediterranean Sea, information system, open source software.

Introduction

The MedLem Database Application is a computerized system, based on Open Source software, designed as a simple tool to store and share the available data collected in the framework of the MedLem programme. As one of the major intention of the MedLem programme were to collect and share data following a common protocol, the idea was to design an user-friendly application that would allow all participants to insert new data and making search easily through a free accessible site (www.arpat.toscana.it/xxxx/medlem.htlm). In addition a new data sheet, which fields are standardized with the MEDLEM Database Application, is presented (Fig. 1).

In all the seas of the world, the cartilaginous fish species are exploited for their fins, skin, jaws or meat. Sometimes they are directly targeted in commercial and recreational fisheries while in other cases they are caught incidentally as by-catch. In many areas of the world a decline in cartilaginous fish species landings has been observed while fishing effort has generally increased. This especially applies to the fisheries that target shark fins. Moreover, most countries report statistics related to sharks without making a distinction between species or, in worse still, they are not recorded at all. As a result, it is impossible to recognize the species in multi-specific fishery. Due to an inadequate collection of statistics on landings, it is difficult to estimate and monitor fishing mortality (SERENA, 2005).

Background information on MedLem programme

MedLem is a monitoring programme on the captures and sightings of the large cartilaginous fishes occurring in the Mediterranean Sea. This programme directly links up with the FAO IPOA-SHARKS and it has been submitted to the discussion of the SAC Sub-Committee on Marine Environment and Ecosystems (SCMEE) of the GFCM (Barcelona, 6-9 May 2002) as "subproject Basking shark" (FAO, 2002_a; 2002_b).

During the meeting of the SCMEE held in Spain (Malaga, 10-12 May 2004) a common protocol to collect field data were proposed and many Mediterranean countries showed a willingness to cooperate on this initiative and to conform in the collection of data (Table 1) (FAO, 2004). In The seventh session of the General Fisheries Commission for the Mediterranean (GFCM) Scientific Advisory Committee (SAC), held in Italy (Rome, 19-22 October 2004), SCMEE reiterated the importance of a wider use of the MedLem protocols and information system already adopted by a number of regional bodies to favour timely exchange of information on Large Elasmobranchs (FAO, 2005). Up to now, an updating of information on incidental catches of protected species and on by catch of large migratory sharks in the commercial fisheries is still done.

Among the principal aims of the programme are:

- Contribute to the knowledge and conservation of the sharks following a common protocol to collect data about the specimens sighted, stranded or accidentally captured in the Mediterranean Basin.
- The collection of scientific papers related to elasmobranches in the Mediterranean area.

Main objectives of the MedLem Database Application

The creation of the MedLem application allowed for

- Implementation of data collection;
- Standardization of the data entry procedures;
- Effective data sharing among the participating countries.
- Free access for the participants to the site www.arpat.toscana.it/xxx/medlem.htlm

Materials and Methods

Cartilaginous fish data

In relation to this project "**large cartilaginous fish**" is defined as an elasmobranch of more than 100 cm Total Length or a batoid fish with a Disc Width more than 100 cm or Total Length more than 150 cm. The size of the monitored cartilaginous fishes is established on the basis of the maximum size reached from the different species. For this reason the species to be considered in the project belong to the families reported in Table 2.

However, in the list of the species recorded in the frame of the MedLem project are present also some "small" specimens, not considered "large cartilaginous fishes", like *Galeorhinus galeus, Mustelus punctulatus, Mustelus* sp.. This is due to the fact that these species are very rare in some Mediterranean areas, in Italian seas for example, and we thought of interest to report their accidental caught. Some other species can be rather common in the southern part of the Mediterranean basin, present also in the commercial landings (e.g. *Rhinobatos cemiculus* and *R. rhinobatos*) and never registered or very rare in other parts of the region.

Application characteristics

The MedLem Database Application use Open Source software. The advantages of Open Source model are:

- **Simplified license management:** obtain the software once and install it as many times and in as many locations as you need.
- **Lower software costs:** Open source solutions generally require no licensing fees.
- **Lower hardware costs:** in general, Linux and open source solutions are elegantly compact and portable, and the result is you can get by with less expensive or older hardware.
- **Ample support:** support is available for open source, often superior to proprietary solutions. First, open source support is freely available and accessible through the online community via the Internet. And second, many tech companies are now supporting open source with free online and multiple levels of paid support.
- **Quality software:** evidence and research indicate that open source software is good stuff. The peer review process and community standards, plus the fact that source code is out there for the world to see, tend to drive excellence in design and efficiency in coding.

Open source software used by MedLem Database Application (Fig. 2):

- **Perl:** Perl is a stable, cross platform programming language created by Larry Wall. It is used for mission critical projects in the public and private sectors. Perl is Open Source software, licensed under its Artistic License, or the GNU General Public License (GPL).
- **Apache:** The Apache HTTP Server Project is an effort to develop and maintain an opensource HTTP server for modern operating systems including UNIX and Windows NT. The goal of this project is to provide a secure, efficient and

extensible server that provides HTTP services in sync with the current HTTP standards.

- **Linux:** Linux is a free Unixtype operating system originally created by Linus Torvalds with the assistance of developers around the world. Developed under the GNU General Public License, the source code for Linux is freely available to everyone.
- **MySQL:** The MySQL database has become the world's most popular open source database because of its consistent fast performance, high reliability and ease of use.
- **CGI:** The Common Gateway Interface (CGI) is a standard for interfacing external applications with information servers, such as HTTP or Web servers.
- **DBI:** The DBI is the standard database interface module for Perl. It defines a set of methods, variables and conventions that provide a consistent database interface independent of the actual database being used.

Database organization

In Figure 3 a flowchart to follow during the start up of the application is given. As to access to MedLem application username and password are needed, each user will be required to compile a registration form; then username, password and instructions will be sent by e-mail only to users belonging to institutions or organizations involved in the project. Once users access to the application, they can choose both to entry data on catch, sighting, stranding or bibliographic reference inherent large cartilaginous fish (Fig. 4), or to do a search for species, country and gear (Fig. 5). As the data entry procedure is based on the previous compilation of the data collection field sheet, users who have properly compiled the data sheet will be advantageous.

The data are stored into six main tables: DATA, BIOLOGY, SPECIES, BIBLIOGRAPHY, GEAR, PERSON IN CHARGE (Fig. 6). Users are not allowed to see or manage these tables but the knowledge of the fields required by the system is essential to understand the application performance properly.

Results

Thanks to the collaboration with several research institutes, military authorities and with professional and recreational fishermen, MedLem programme allowed the acquisition of valuable information on catch, sighting and stranding of large cartilaginous fish, starting from 1795. As the most part of event recorded into the MedLem database concern *Cetorhinus maximus* (Gunnerus, 1765) (Table 3), an example of the practical use of these data is presented by MANCUSI *et al* (2005) in figures 7, 8 and 9 presence and distribution of basking shark in the Mediterranean, the major fishing gears responsible for the by-catch of basking sharks and the frequency of accidental catches are showed.

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Table 1. List of the institutions or organizations and their referent involved in the project

ARPAT, Livorno (Italy)	Fabrizio Serena
ICRAM, Roma (Italy)	Marino Vacchi
IEO, Malaga (Spain)	Luis Jil de Sola
IMEDEA, Spain	Gabriel Morey
INSTM, Tunisia	Mohamed Nejmeddline Bradai
N.AG.RE.F, Greece	Argiris Kallianotis
Institute of Oceanography and	Alen Soldo
USTHB, Algeria	Farid Hemida
National & Kapodistrian University of	Persefoni Megalofonou
Marine Sciences laboratory, Fac. of	Adib Ali Saad
Malta Centre for Fisheries Science	Matthew Camilleri
IUCN-SSG	
European Elasmobranchs Association	
Societa Italiana Biologia Marina (Italy)	

Table 2. List of the families to be considered in the MedLem project.

HEXANCHIDAE
ECHINORHINIDAE
SQUATINIDAE
PRISTIDAE
RHINOBATIDAE
RAIJDAE
DASYATIDAE
GYMNURIDAE
MYLIOBATIDAE
RHINOPTERIDAE
MOBULIDAE
ODONTASPIDIDAE
ALOPIIDAE
CETORHINIDAE
LAMNIDAE
CARCHARHINIDAE
SPHYRNIDAE

Table 3. Number of species present in the MedLem database up to now

Scientific name	**n°**
Alopias vulpinus (Bonnaterre, 1788)	26
Carcharhinus brachyurus (Günther, 1870)	1
Carcharhinus plumbeus (Nardo, 1827)	1
Carcharodon carcharias (Linnaeus, 1758)	9
Cetorhinus maximus (Gunnerus, 1765)	610
Dalatias licha (Bonnaterre, 1788)	1
Galeocerdo cuvier (Péron and Lesueur, *in* Lesueur 1822)	1
Galeorhinus galeus (Linnaeus, 1758)	2
Hexanchus griseus (Bonnaterre, 1788)	18
Isurus oxyrinchus Rafinesque, 1810	2
Lamna nasus (Bonnaterre, 1788)	4
Mobula mobular (Bonnaterre, 1788)	19
Mustelus punctulatus (Risso, 1826)	6
Mustelus sp.	12
Oxinutus centrina (Linnaeus, 1758)	3
Prionace glauca (Linnaeus, 1758)	7
Pteromylaeus bovinus (Geoffroy St-Hilaire, 1817)	1
Sphyrna zygaena (Linnaeus, 1758)	3
Taeniura grabata (Geoffroy St-Hilaire, 1817)	1
Total	**743**

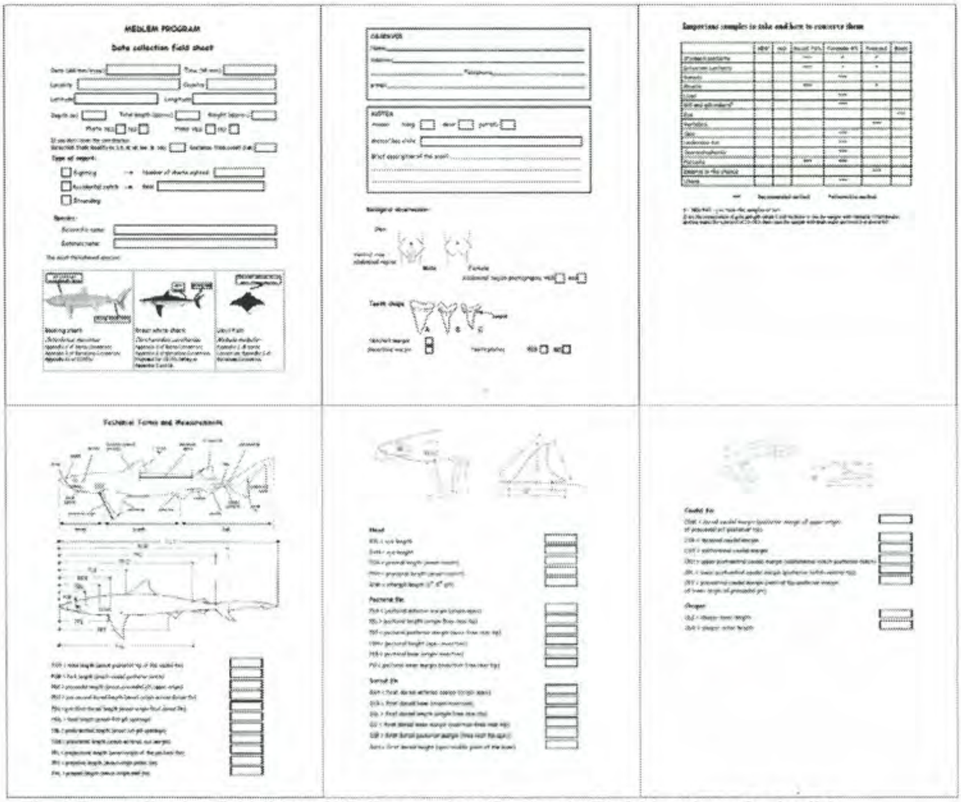

Fig. 1 Data collection field sheet of MedLem project (See Annex II of this volume for details).

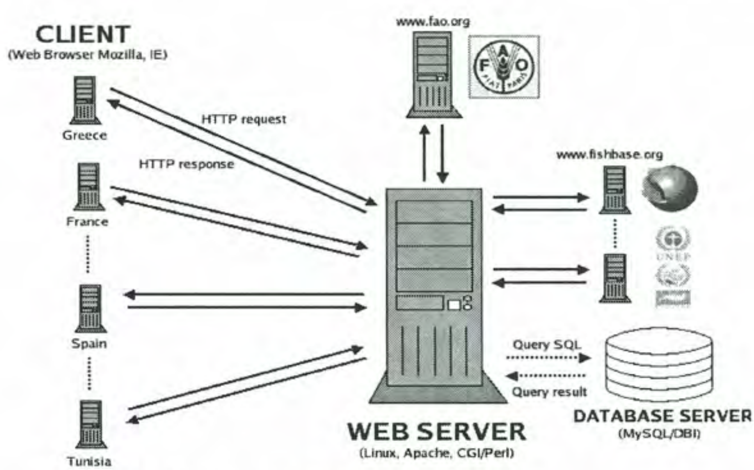

Figure 2. Architecture of the MedLem application

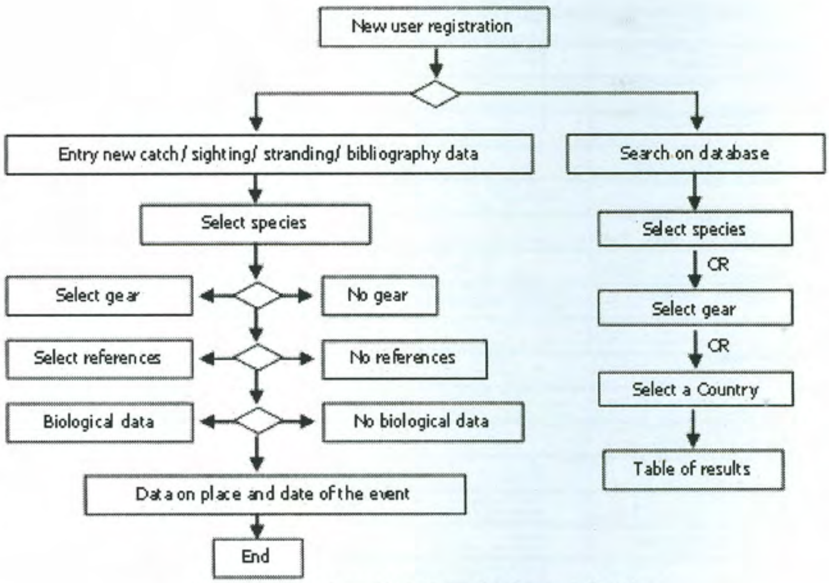

Figure 3. Flowchart of MedLem database application

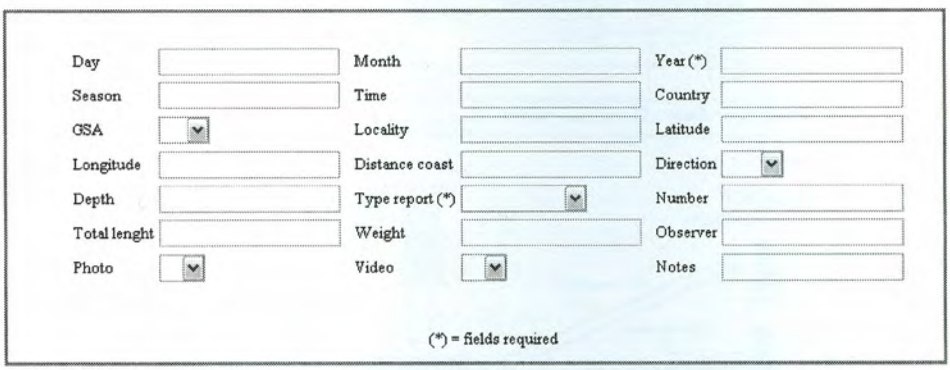

Figure 4. One of the pages of data entry in MedLem database application.

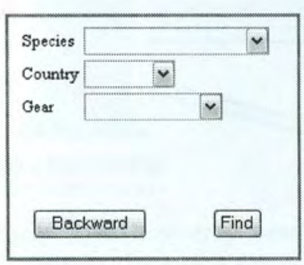

Figure 5. Page of search in MedLem database application.

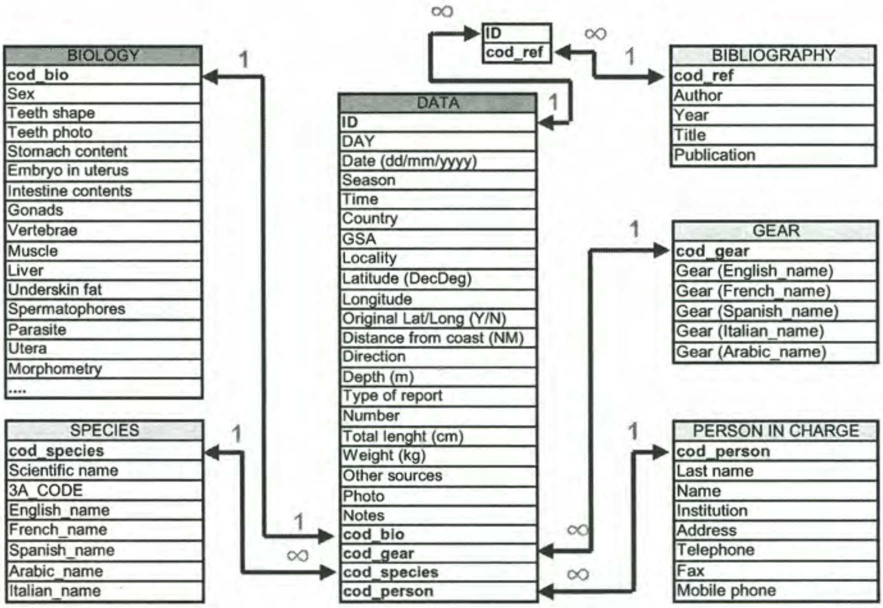

Figure 6. Table and relationship of MedLem database application.

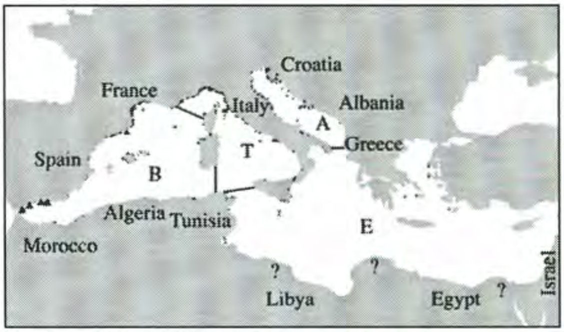

Figure 7. Geographical allocation of observations and captures of *Cetorhinus maximus* in the Mediterranean Sea (MANCUSI *et al.*, 2005).

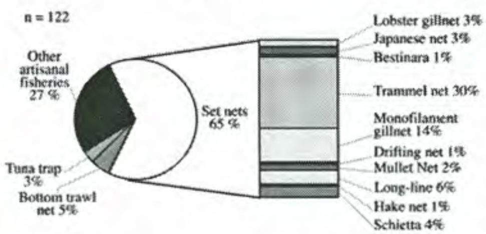

Figure 8. Incidental catches of *C. maximus* split by fishing gear (MANCUSI *et al.*, 2005).

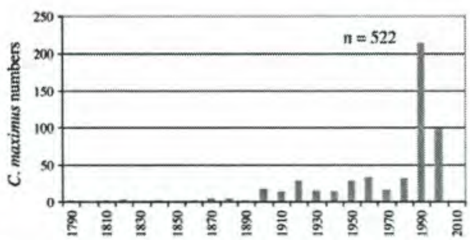

Figure 9. Frequency of incidental catches of *C. maximus* by year in the Mediterranean. (MANCUSI *et al.*, 2005).

STATUS OF THE SHARKS IN THE ADRIATIC

Alen SOLDO

Institute of Oceanography and Fisheries, Split, Croatia.

Abstract

Several authors have reported lists of shark species in the Adriatic. Recent list considered as unreliable some previously reported shark species for the Adriatic and considered the total of 28 species as confirmed. Most of the shark species are not target species in the Adriatic area but they were caught mainly as bycatch by various fishing gears. Shark targeted fisheries are only for dogfish and hound sharks, which are performed by gillnets designated exclusively for such fishery. This paper reports data on currently known status of shark species in the Adriatic and gives suggestions for ensuring conservation of shark populations and biodiversity of marine ecosystem of the Adriatic.

Key words: Adriatic Sea, sharks, conservation.

Introduction

Several authors have reported lists of cartilaginous fishes in the Adriatic (ŠOLJAN, 1948; MILIŠIĆ, 1994; JARDAS, 1996). Usually they were reporting around 54 different cartilaginous species, within this number 29 species were sharks, 24 batoids (skates and rays) and 1 species of chimaeroids. Some of those species were constantly present in the Adriatic, while some were reported only occasionally. MILIŠIĆ (1994) reported 31 species of sharks, containing two additional species: oceanic whitetip shark, *Carcharhinus longimanus*, and little gulper shark, *Centrophorus uyato*, but those data are very questionable and uncertain.

BELLO (1999) reported only 28 species with an exception of smalleye hammerhead, *Sphyrna tudes* (Valenciennes, 1822), whose occurrence in the Adriatic Sea, according to him, still needs to be confirmed. The same author also wanted to find the origin of the data regarding *S. tudes,* but he was unable to trace it. *Sphyrna tudes* is one of the most questionable shark species not only in the Adriatic, but in the whole Mediterranean as well. COMPAGNO (1984) has not considered the Mediterranean as the area of its distribution, QUERO (1984) reported several records in the Mediterranean (one in western Greek waters), while FISCHER *et al.* (1987), within the other Mediterranean records reported one record from the Southern Adriatic. Only 2 records, both from 19th century, have been reported in the Eastern Adriatic and they are based on data from KOLOMBATOVIĆ (1894) who had determined and reported several young specimens of smalleye hammerhead. Consequently, all succeeding lists of the Adriatic sharks, where *S. tudes* was listed, were based on that report (KOSIĆ, 1903; ŠOLJAN, 1948; MILIŠIĆ, 1994; JARDAS, 1996).

Based on findings of origin of the data on *S. tudes,* recent book on sharks (LIPEJ *et al.*, 2004) has not included this species in the list of Adriatic sharks, as according to the authors key for the determination of this species in 19th century was not certain. Therefore, this report was considered as unreliable and only 28 shark species have been considered as confirmed for the Adriatic area (Table 1).

Table 1. List of shark species reported in the Adriatic with English and Croatian names.

Order	Families	Species
HEXANCHIFORMES	HEXANCHIDAE	*Heptranchias perlo* (Bonnaterre, 1788). Sharpnose sevengill shark. Volonja sedmoškrgaš.
		Hexanchus griseus (Bonnaterre, 1788). Bluntnose sixgill shark. Glavonja šestoškrgaš.
SQUALIFORMES	ECHINORHINIDAE	*Echinorhinus brucus* (Bonnaterre, 1788). Bramble shark. Pas zvjezdaš.
	SQUALIDAE	*Squalus acanthias* Linnaeus, 1758. Piked dogfish. Kostelj.
		Squalus blainvillei (Risso, 1826). Longnose spurdog. Kostelj dugonosi.
	CENTROPHORIDAE	*Centrophorus granulosus* (Bloch & Schneider, 1801). Kostelj dubinac.
	ETMOPTERIDAE	*Etmopterus spinax* (Linnaeus, 1758). Velvet belly. Kostelj crnac.
	OXYNOTIDAE	*Oxynotus centrina* (Linnaeus, 1758). Angular roughshark. Prasac.
	DALATIIDAE	*Dalatias licha* (Bonnaterre, 1788). Kitefin shark. Drkovna.
SQUATINIFORMES	SQUATINIDAE	*Squatina oculata* Bonaparte, 1840. Smoothback angelshark. Sklat žutan.
		Squatina squatina (Linnaeus, 1758). Angelshark. Sklat sivac.
LAMNIFORMES	ODONTASPIDIDAE	*Carcharias taurus* Rafinesque, 1810. Sand tiger shark. Psina zmijozuba ružičasta.
		Odontaspis ferox (Risso, 1810). Smalltooth sand tiger. Psina zmijozuba.
	ALOPIIDAE	*Alopias vulpinus* (Bonnaterre, 1788). Thresher shark. Lisica.
	CETORHINIDAE	*Cetorhinus maximus* (Gunnerus, 1765). Basking shark. Gorostasna psina.
	LAMNIDAE	*Carcharodon carcharias* (Linnaeus, 1758). Great white shark. Velika bijela psina.
		Isurus oxyrinchus Rafinesque, 1810. Shortfin mako. Psina dugonosa.

Table 1 (Cont.)		
		Lamna nasus (Bonnaterre, 1788). Porbeagle shark. Atlantska psina.
CARCHARHINIFORMES	SCYLIORHINIDAE	*Galeus melastomus* Rafinesque, 1810. Blackmouth catshark. Mačka crnousta.
		Scyliorhinus canicula (Linnaeus, 1758). Smallspotted catshark. Mačka bljedica.
		Scyliorhinus stellaris (Linnaeus, 1758). Nursehound. Mačka mrkulja.
	TRIAKIDAE	*Galeorhinus galeus* (Linnaeus, 1758). Tope shark. Butor.
		Mustelus asterias Cloquet, 1821. Starry smoothhound. Pas mekuš.
		Mustelus mustelus (Linnaeus, 1758). Smoothhound. Pas čukov.
		Mustelus punctulatus Risso, 1826. Blackspot smoothhound. Pas mekuš piknjavac.
	CARCHARHINIDAE	*Carcharhinus plumbeus* (Nardo, 1827). Sandbar shark. Pas tupan.
		Prionace glauca (Linnaeus, 1758). Blue shark. Modrulj.
	SPHYRNIDAE	*Sphyrna zygaena* (Linnaeus, 1758). Smooth hammerhead. Mlat.

Most of the shark species are not target species in the Adriatic Sea but they are caught mainly as bycatch by longlines, driftnets and other fishing gear used in tuna, small pelagic fish and swordfish fisheries. Smaller shark species are also often bycatch of trawls. In certain areas during some seasons dogfish and hound sharks are targeted with gillnets, but only few fishermen are involved in this fishery.

Current Croatian legislation does not have any regulations for shark conservation and management, so shark catches and bycatch are not reported in the eastern Adriatic.

Materials and Methods

Data presented in this paper were collected from scientific and popular literature and by unpublished data from personal research. All common names of sharks used in this paper follow FAO nomenclature (COMPAGNO, 1984).

Results and Discussion

Due to lack of any fishery statistics, members of Institute of Oceanography and Fisheries - Split started and conducted monitoring of large sharks in 1999 on a voluntary basis and collaboration with fisherman, journalists, marine police, harbor offices, private citizens, etc.

This monitoring allowed to collect data on several large shark species. From 1868 to 2000, a total of 62 records on occurrence of the great white shark, *C. carcharias* in the Eastern Adriatic Sea have been collected. The records showed a distribution of the great white throughout whole eastern coast of Adriatic, mainly in the northern Adriatic, especially in the area of Kvarner Bay and adjacent islands.

SOLDO and JARDAS (2002) related the presence of the great white shark in coastal waters of the eastern Adriatic with high abundance of tuna in these waters during 19th century and first half of 20th century, which were their major prey. The start of intensive tuna fishing in open waters of the Adriatic, especially during the 70's, caused the disappearance of tuna in coastal waters of the eastern Adriatic, and as a consequence the disappearing of the great white shark records in these waters. Same authors also presumed that any future records of the great white shark in the Eastern Adriatic would be, probably, only accidental entering from the Mediterranean. New record, and first since 1974, confirmed such speculation on 24-25. June 2003, a female was caught in tuna purse seine 15 Nm southwest off Jabuka island (SOLDO and DULČIĆ, 2005).

Data on shortfin mako (*I. oxyrinchus)* have showed even more severe. Fourty-Three records out of total 48, were reported during 19th century and since 1972 there were no more records of this species in the Eastern Adriatic. However, it is possible that shortfin mako still occurs in open waters of the Adriatic where it is misidentified by fisherman as blue shark (*P. glauca)*, or some other shark species. Unconfirmed data pointing that this species could be bycatch of pelagic longlines and driftnets used in the southern Adriatic.

Porbeagle shark *(L. nasus)* has been reported 11 times in the eastern Adriatic, most in the 20th century. All records were reported in open waters of the Adriatic what is in accordance with its description as an offshore and epipelagic shark. As in the case of shortfin mako (misidentification and inadequate fishing gear), it is possible that occurrence of the porbeagle is even higher than reported (SOLDO and JARDAS, 2002). Recent records (1999, 2002, 2005) prove they are reported accidentally as bycatch of big game fishing, activity that rapidly grow up in the eastern Adriatic area in recent years.

The basking sharks (*Cetorhinus maximus)* and hammerhead sharks (*Sphyrna* spp). are rather rare in this area, although the evidence (by comparing records in the 19th century with the 20th century) suggests that they have been more abundant in the past. However, in the case of the basking sharks there has been a notable increase in records reported in the eastern Adriatic since 2000, especially during 2001 (ZUFFA *et al*., 2001). This unusual phenomenon is related to changes in zooplankton abundance, mainly of copepod species, with particular emphasis on *Calanus helgolandicus*, on which basking shark prey.

Particular problems are regarding other large species of sharks, whose populations with smaller or higher number of specimens exist in the eastern Adriatic, but these species are often misidentified, so their records are not reported.

The bluntnose sixgill shark (*H. griseus)* and sharpnose sevengill shark (*H. perlo)* are often caught as bycatch in trawls and by deep bottom longlines, but their current status in the Adriatic is unknown. Similar case is of the sandtiger shark (*C. taurus)* and the smalltooth sand tiger (*O. ferox)*, that were previously reported often, but in recent years there are no records of them. The thresher shark (*A. vulpinus)*, was common in the eastern Adriatic and was caught, as bycatch, in purse seines and by tuna longlines, like the blue shark (*P. glauca*), the most common species of large sharks in the Adriatic. Big game fishing regularly targeted these two species, so fishermen involved in that activity have observed rapid decline of those species in their catches during last few years.

Recently, the Adriatic was supposed to be nursery and spawning areas for many large shark species. For *C. plumbeus* (CONSTANTINI and AFFRONTE, 2003) and *A.vulpinus* (NOTARBARTOLO DI SCIARA and BIANCHI, 1998) in the northern part, for *P. glauca* and *O. centrina* in the middle part, and for *L. nasus* in the southern Adriatic (SOLDO, unpublished data) (Fig. 1).

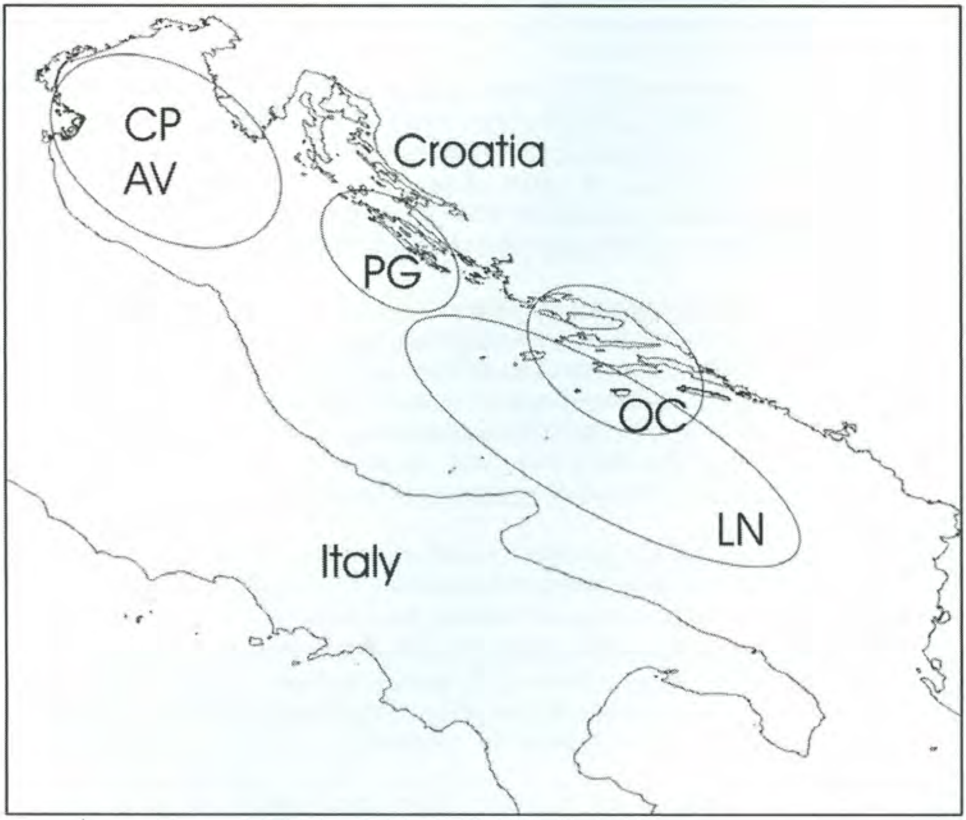

Figure 1. Possible nursery areas in the Adriatic for *Carcharhinus plumbeus* (CP), *Alopias vulpinus* (AV), *Prionace glauca* (PG), *Oxynotus centrina* (OC), and *Lamna nasus* (LN).

It is of great importance to identify critical habitats, namely mating areas, spawning and nursery grounds of all shark species in the Adriatic. Furthermore, it is necessary to develop management programmes that would ensure acurate fisheries statistics of catches and landings by species. Although there are no proper fishery statistics, comparison of catches of chondrichthyan fishes caught by trawls in 1948-49 during research expedition "HVAR" with the data from "MEDITS" program in 1997-98 shows considerable decline in abundance of 26 species of chondrichthyans, as well as major reductions of their distribution. The Hypotremata group showed the greatest decline, as their biomass percentage decline from 20 % during HVAR research to 7 % in MEDITS (JUKIĆ-PELADIĆ *et al.*, 2001). Hence, the thornback ray, *Raja clavata* in 1948-49 had high abundance and widespread distribution throughout the Adriatic Sea, while was restricted to a small area with low abundance in 1997-98 (SOLDO, 2002).

Therefore, more thorough investigations are necessary to lead to the implementation of a management plan for the Adriatic Sea, to prevent overexploitation and preserve the biodiversity in this region. Shark management programmes in the Mediterranean, followed by local ones (Adriatic) should respect the principles of sustainability, precautionary principle and conservation measures as defined in the FAO Code of Conduct for Responsible Fisheries and in the International Plan of Action for the Conservation and Management of Sharks.

Such approach is urgently needed, as any delays can have severe consequences on conservation of shark populations and biodiversity of marine ecosystem of the Adriatic, as well as in the Mediterranean Sea.

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USE OF SCIENTIFIC CAMPAIGNS (TRAWL SURVEYS) FOR THE KNOWLEDGE OF THE SENSITIVE HABITATS. A REVIEW OF THE MEDITS, GRUND AND APHIA DATA WITH SPECIAL ATTENTION TO THE ITALIAN SEAS

Fabrizio SERENA[1] and Giulio RELINI[2]

[1]ARPAT Via Marradi 114 - 57100 Livorno, Italy. E-mail: f.serena@arpat.toscana.it
[2]DIP.TE.RIS. Università di Genova Viale Benedetto XV, 3 -16132 Genova, Italy

Abstract

National and international trawl surveys have been carried on in the Mediterranean since 1985. The analysis of abundance indexes and size structure of the chondrichthyan populations is important to identify and delimitate the nursery areas and the juveniles concentrations. Some examples for elasmobrachs and rays are reported for the southern Ligurian and North Tyrrhenian Sea.

Keywords: Trawl survey, nursery area, Mediterranean Sea.

Introduction

In the Mediterranean and Black Sea about 84 chondrichthyan species of potential interest for fishery have been identified (SERENA, 2005). These species show different distribution patterns in the basin. In the Greek waters, 62 species of elasmobranchs have been listed within a total of 447 fish species (PAPAKONSTANTINOU, 1988). The situation is quite similar in the Catalan Sea with 62 elasmobranch species for a total of 454 fish species (LLORIS *et al.*, 1984; STEFANESCU *et al.* 1992). In the Italian seas 490 fish species were recorded and among these 74 are represented by cartilaginous fishes (1 Chimaeriformes, 43 Squaliformes, 30 Rajiformes) (AMORI *et al.*, 1993). Demersal scientific campaigns in the Mediterranean Sea have been carried out at national and international level as MEDITS and GRUND projects (BERTRAND *et al.*, 1997; RELINI, 1998). These surveys produced a lot of information on a large number of species occurring on the shelves and on the upper slopes and represent an opportunity to improve the knowledges on a great number of species. The list of cartilaginous fishes caught during national trawl surveys (1985-1998) within the GRUND project in all the Italian seas, reports 44 demersal species (1 Rabbit fish, 17 sharks, 26 rays) (RELINI *et al.*, 2000). Different studies on the distribution of fishes, including elasmobranchs, in the Mediterranean basin are also available (GIL DE SOLA SIMARRO, 1994). Also some local or regional projects represent very important tools to collect information about the distribution, biology and ecology of this group of fishes (ABELLA *et al.*, 1997; Catalano *et al.*, 2003). In some cases, trends in abundance and diversity of these species have been described (ALDEBERT, 1997; FERRETTI *et al*., 2005; SERENA *et al*., 2005).

In the Mediterranean-Black Sea region the distribution of cartilaginous fishes show two particular situations: in the Adriatic Sea, the abundance of chondrichthyan species is scarce especially in the northern part perhaps due to the hydrological characteristics of this area that may limit biodiversity; infact the deeper currents do not reach this area. A total of 52 species of cartilaginous fish have been recorded and only 10 of them are widely distributed. Some bathyal species of the group inhabit exclusively the central and southern parts of this sea (JARDAS, 1984; JUKIC-PELADIC *et al*., 2001). The number of cartilaginous fish species is very low in the Black Sea too: only 12 chondrichthyans species are assumed to occur in this basin (TORTONESE, 1956; BAUCHOT, 1987; ROUX, 1984; McEACHRAN and CAPAPÉ, *In*: Whitehead *et al*., 1984; FREDJ and MAURIN, 1987). BİLECENOGLU *et al*. (2002) consider only 8 elasmobranchs along the Turkey coast of the Black Sea.

The goal of this paper is to provide some general indications on the diversity and distribution of chondrichthyans in the Mediterranean using data collected with the trawl surveys and to underline the importance of these projects in order to indicate the areas where juveniles specimens are concentrated. In some cases, the identification of breading and feeding areas are important as well.

Materials and Methods

The data used for this review were issued from standardized bottom trawl surveys carried out in the Mediterranean especially in the Italian seas from 1985 to 2004. We consider here the MEDITS and GRUND trawl surveys and others demersal scientific campaigns as APHIA for *Aphia minuta* stock assessment (BERTRAND *et al*., 1997; RELINI *et al*., 1998; ABELLA *et al*., 1997) and RAIA TAG project, a tag and release survey on juveniles of *Raja asterias* (CATALANO *et al*., 2003) (Table 1). The MEDITS and GRUND surveys covered all the trawlable areas from the Straits of Gibraltar to the Aegean Sea at depths between 10 to 800 meters (Fig. 1). They were conducted each year between the end of spring and the middle of summer (MEDITS project) and in autumn season (GRUND project). During each of the MEDITS surveys, a total of about one thousand hauls were carried out. Each tow lasted 30 minutes at depths of less than 200 meters. Below this limit the tows length was double. About 59% of the total 6336 studied stations during the 11 surveys carried on from 1994 to 2004 were positioned over the continental shelves from 10 to 200 meters while the others were allocated on the upper slope. The hauls were conducted in the same geographical position during every yearly survey. Even though the surveys were managed aboard different vessels with as similar as possible structural characteristics, all the involved teams applied the same sampling methodology, including the characteristics of the gear, its handling and the observations on the samples. The gear used for these surveys had a small codend (20 mm, 40 mm stretched mesh for MEDITS and GRUND respectively) and between 2 and 2.5 meters of vertical opening (BERTRAND *et al*., 1997; RELINI, 1998). APHIA project was carried out monthly from 1994 to 1997 and the gear used had a smallest codend (3 mm, stretched mesh) (ABELLA *et al.*, 1997). For the RAIA TAG project a trawl net with 20 mm, 40 mm stretched cod end mesh size was used and two sampling campaigns were performed in July- August 2001 and March-May 2002 (CATALANO *et al.*, 2003).

Estimates of abundance indices were based on stratified random sampling (COCHRAN, 1977), applying the stratification scheme defined for the MEDITS programme and a swept area method. When the areas have been aggregated, the limit between the western and eastern basins has been arbitrary fixed at the south-eastern end of Sicily. The chondrichthyans reported in table 2 were named referring to the recent FAO taxonomy (SERENA, 2005).

The geo-referenced information proceeding from the trawl surveys was analysed with a geographic information system Arcview (ESRI, 1996) and maps representing areas with different levels of density were drawn through interpolation techniques. This more detailed analysis, however, refers only to the area between Southern Ligurian and Northern Tyrrhenian Sea.

Moreover, the analysis of time series of the data of abundance and biomass for some species has been carried out by the min/max autocorrelation factor analysis (MAFA) (SHAPIRO and SWITZER, 1989), a statistical method to extract common trend from multiple time series performed using the software package Brodgar 2.3.7 (www.brodgar.com).

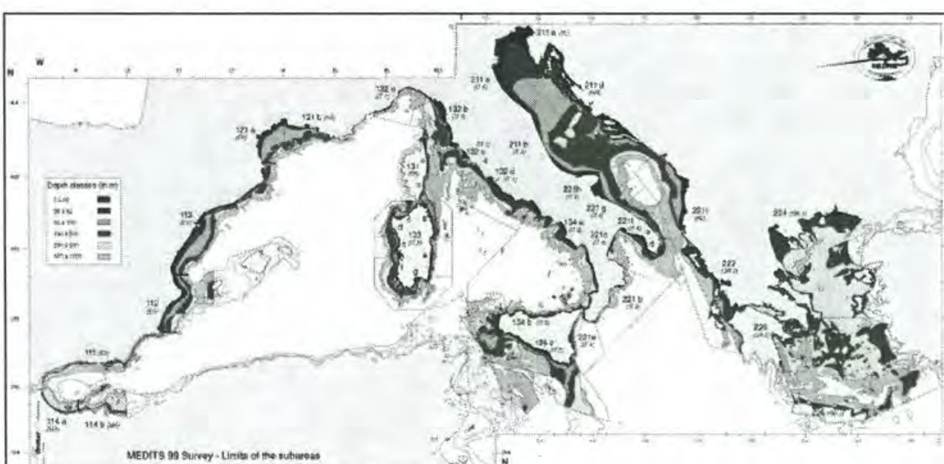


Figure 1. Bottom grounds up to 800 m depth investigated by MEDITS trawl surveys and GRUND surveys in the Italian seas.

Table 1. Origin of the data used in the analysis.

Project	Period	Frequency	Number of cruises	Number of stations	Geographical areas explored	Depth range sampled (m)
GRUND	1985-2004	Every year in autumn	30	870	South Ligurian and North Tyrrhenian Sea	10-800
MEDITS	1994-2004	Every year in spring	11	6336	Euro Mediterranean Basin	10-800
APHIA	1994-1997	Every month	25	125	South Ligurian Sea	0-50
RAJATAG	2001&2002	July-August & March-April	2	47	South Ligurian Sea	0-20

Results

From 1994 to 2004, 11 surveys and 6336 MEDITS tows were performed and 45 demersal chondrichthyan species were identified in the catch: 18 sharks, 2 angelsharks, 4 stingrays, 3 skates, 14 rays, 3 electric rays and 1 rabbitfish (Table 2). Indeed, *R. montagui* is probably the same species as *R. polystigma*; *D. tortonesey* is equal *D. pastinaca* and *R. rondeleti* = *R. fullonica* (Serena, 2005). Single or sporadic captures were recorded for *Dasyatis centroura, Pteroplatytrigon violacea*, *Galeus atlanticus*, *Hexanchus griseus*, *H. vitulus*, *Mustelus asterias*, *M. punctulatus*, *Rostroraja alba*, *Dipturus batis*, *Raja brachiura*, *Leucoraja circularis*, *Leucoraja fullonica*, *Raja undulata*, *Rhinoptera marginata*, *Squatina aculeata* and *S. squatina*. For some species, these figures reflect a true rarity (e.g. *R. marginata*) or possibly a depletion of the populations (e.g. *Squatina* spp.) but in other cases such *G. atlanticus* some misidentification problems cannot be excluded. *Mobula mobular* and *H. nakamurai* are occasional captures (BAINO *et al.*, 2001; BERTRAND *et al.*, 2000).

Table 2. Ranked list of the chondrichthyans caught in the MEDITS, Italian GRUND surveys and in the Northern Tuscany GRUND surveys.

Species	Frequency of occurrence			ranks		
	MEDITS (% hauls)	GRUND Italy (% surveys)	GRUND Tuscany (% hauls)	MEDITS	GRUND Italy	GRUND Tuscany
Scyliorhinus canicula (Linnaeus, 1758)	27,8%	83,9%	64,8%	1	2	1
Galeus melastomus Rafinesque, 1810	26,9%	84,3%	32,1%	2	1	2
Etmopterus spinax (Linnaeus, 1758)	18,5%	77,3%	16,1%	3	3	5
Raja clavata Linnaeus, 1758	15,8%	57,9%	31,8%	4	5	3
Chimaera monstrosa Linnaeus, 1758	8,3%	60,7%	12,0%	5	4	6
Raja miraletus Linnaeus, 1758	6,7%	50,4%	17,0%	6	7	4
Torpedo (Torpedo) marmorata Risso, 1810	5,0%	49,2%	11,4%	8	8	7
Raja asterias Delaroche, 1809	4,0%	57,8%	10,3%	10	6	8
Dipturus oxyrinchus Linnaeus, 1758	4,8%	37,6%	6,3%	9	9	10
Squalus acanthias Linnaeus, 1758	5,2%	26,4%	2,9%	7	12	12
Dalatias licha (Bonnaterre, 1788)	2,4%	31,8%	2,4%	13	11	13
Squalus blainvillei (Risso, 1826)	3,1%	20,6%	2,3%	11	16	14
Raja polystigma Regan, 1923	2,7%	9,9%	10,1%	12	22	9
Centrophorus granulosus (Bloch & Schneider, 1801)	1,8%	22,3%	1,1%	14	13	17
Raja montagui cfr polystigma Regan, 1923	1,7%	33,9%	0,7%	16	10	21
Torpedo (Torpedo) torpedo (Linnaeus, 1758)	0,4%	20,6%	4,5%	23	17	11
Myliobatis aquila (Linnaeus, 1758)	0,6%	21,9%	1,0%	20	15	18
Scyliorhinus stellaris (Linnaeus, 1758)	0,5%	19,4%	1,5%	22	18	15
Mustelus mustelus (Linnaeus, 1758)	1,8%	21,9%		15	14	27
Torpedo (Tetronarce) nobiliana Bonaparte, 1835	1,2%	16,1%	0,2%	17	19	24
Dasyatis pastinaca (Linnaeus, 1758)	0,8%	14,1%	0,3%	18	20	22
Oxynotus centrina (Linnaeus, 1758)	0,6%		0,8%	21	23	19
Leucoraja circularis Couch, 1838	0,2%	13,6%	0,7%	30	21	20
Heptranchias perlo (Bonnaterre, 1788)	0,2%	6,2%		28	26	28
Leucoraja naevus Müller & Henle, 1841	0,7%	2,1%		19	35	29
Leucoraja melitensis Clark, 1926	0,3%	5,4%		26	29	30
Rostroraja alba Lacépède, 1803	0,1%	7,9%		31	25	31
Raja radula Delaroche, 1809	0,3%	3,3%		25	32	32
Raja brachyura Lafont, 1783	0,3%	2,9%		24	33	33
Hexanchus griseus Bonnaterre, 1788)	0,2%	5,0%		29	30	34
Dipturus batis Linnaeus, 1758	0,0%	9,5%		38	24	35
Mustelus asterias Cloquet, 1821	0,1%	6,2%		35	27	36
Leucoraja fullonica Linnaeus, 1758	0,1%	3,7%		32	31	37
Centrophorus uyato (Rafinesque, 1810)	0,3%	0,8%		27	37	38
Raja rondeleti = Leucoraja fullonica Linnaues, 1758		0,8%	1,3%	47	39	16
Pteroplatytrygon violacea (Bonaparte, 1832)	0,0%	6,2%		37	28	39
Mustelus punctulatus Risso, 1826	0,0%	2,5%	0,1%	44	34	26
Dasyatis centroura (Mitchill, 1815)	0,0%	0,8%	0,1%	41	38	25
Pteromylaeus bovinus (Geoffroy St-Hilaire, 1817)		1,7%	0,2%	46	36	23
Raja undulata Lacépède, 1802	0,1%	0,8%		33	40	40
Galeorhinus galeus (Linnaeus, 1758)	0,1%	0,1%		34	43	41
Dasyatis tortonesei = pastinaca (Linnaeus, 1758)	0,0%	0,1%		36	44	42
Squatina squatina (Linnaeus, 1758)	0,0%	0,4%		40	42	43
Rhinoptera marginata (Geoffroy Saint-Hilaire, 1817)	0,0%			39	45	44
Galeus atlanticus (Vaillant, 1888)	0,0%			42	46	45
Mobula mobular (Bonnaterre, 1788)		0,8%		48	41	46
Hexanchus nakamurai Teng, 1962	0,0%			43	47	47
Squatina aculeata Cuvier, 1829	0,0%			45	48	48

Only a reduced number of species have abundance levels of some commercial interest, and only some of them are actually marketed. Most of these species are represented by sharks of small or medium size, with an opportunistic behaviour (i.e. the scavenger *G. melastomus*) or show a bathimetric distribution that extends to deeper waters over the depth interval covered by MEDITS surveys (i.e., *G. melastomus* or *Etmopterus spinax*). On the contrary, the high-priced and large-sized species (such as *Mustelus* spp and *Squalus* spp.) show signs of depletion although some zones of relatively high density were evidenced (likely in dangerous grounds usually not explored by fishermen) (FERRETTI *et al*., 2005).

Some of the most common and abundant species, *Scyliorhinus canicula, Raja clavata, Galeus melastomus* and *Squalus acanthias,* showed high frequency of occurrence (>5% of the hauls) and abundance (> 10 kg/km^2 or > 10 % of relative biomass); the first three species also display the wider geographical distribution.

Based on the species depth distribution, MEDITS data suggest the identification of three faunistic groups: *a)* the group of species more or less well represented on all depths such as *R. clavata* and *S. canicula*; *b)* the group of species showing a preference for the shelf such as *D. pastinaca* and *M. mustelus* and *c)* the group of species showing a preference for the slope such as *C. granulosus* and *E. Spina*x (BAINO *et al*., 2001).

From the geographical point of view, some species are abundant in all areas *(S. canicula, R. clavata, Torpedo marmorata, R. asterias, Chimaera monstrosa),* while others are most common in the west (*Torpedo nobiliana, R. alba, Oxynotus centrina*) or in the east *(S. acanthias*, *R. radula, L. naevus, R brachyura*) sector of the Mediterranean basin; some species are localised into restricted areas (*H. griseus* and *R. miraletus* in the Tyrrhenian, *M. mustelus* in the Adriatic Sea, or *R. brachyura* and *R. undulata* in the Aegean Sea). The eastern basins (Adriatic and Aegean Seas) show quite high standing stocks biomass, mainly due to the presence of a wider continental shelf, while densities (kg/km^2) are higher in the western basins.

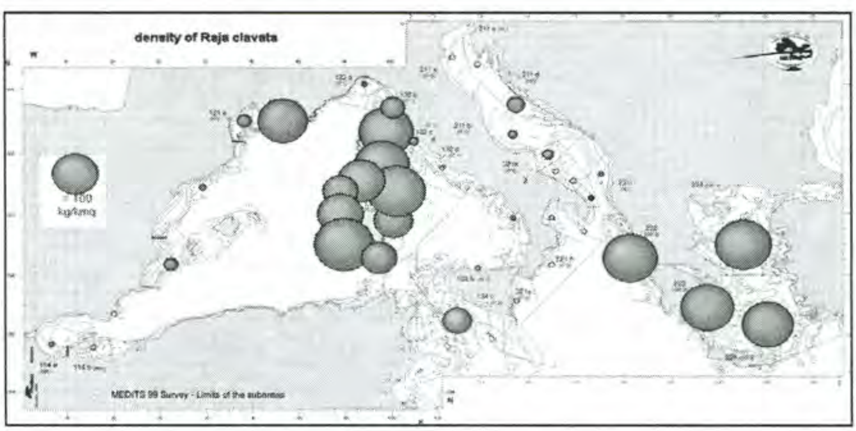


Figure 2. Geographical distribution of *Raja clavata* in the Northern Mediterranean

The skate *R. clavata* is still abundant despite its high vulnerability to the trawl net. The persistence of good rate of catches for this species, in fact, seems to reflect a higher ecological performance than a true resilience to exploitation. The higher biomass concentrations (up to 100 kg/km^2) are found only locally in the Gulf of Lion, Corsica, Sardinia and Greece waters. Up 64 % of the total Mediterranean biomass is located in the Aegean Sea, where trawling deeper than 400 m is inexistent (Fig. 2). Considering the size at first maturity calculated for all the Mediterranean area (Mean Weight = 300 g and Total Length = 37 cm), the Ionian Sea seems to be the most important area where the juvenile specimens are concentrated (Table 3).

Table 3. Density, biomass and nursery location of *Raja clavata* in the Northern Mediterranean

Area =	111a	112a	113a	114a	114b	121a	121b	131a	131b	132a	132b	132c	132d	133a	133b	133c	133d	133e	133f	133g	134a	134b	134c	211a	211b	211c	211d	221a	221b	221c	221d	221e	221f	221g	221h	221i	222a	223a	224a	225a
Raja clavata	Alboran Sea	Alicante sector	Catalan Sea	W Morocco	E Morocco	W Gulf of Lions	E Gulf of Lions	NE Corsica	SE Corsica	N Ligurian Sea	E Ligurian Sea	N Tyrrhenian Sea	Centr. Tyrrhenian	SE Sardinia	NE Sardinia	N Sardinia	NW Sardinia	W Sardinia	SW Sardinia	S Sardinia	SE Tyrrhenian	SW Tyrrhenian	Sicilian Channel	N Adriatic Sea	Central Adriatic	N Adriatic-Slov.	NE Adriatic-Croat	E Sicily	NW Ionian Sea	N Ionian Sea	N Ionian Sea	SW Adriatic Sea	SW Adriatic Sea	SW Adriatic Sea	SW Adriatic Sea	SE Adriatic-Alban	E Ionian Sea	Argosaronikos	N Aegean Sea	S Aegean Sea
Kg/kmq																																								
0-50	0	0	1	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	7	3	11	2
50-100	0	0	0	0	0	7	3	78	101	0	4	1	0	0	33	0	11	1	15	0	0	0	23	0	2	0	8	0	0	0	0	0	0	0	0	1	52	43	84	17
100-200	0	10	2	0	0	0	28	11	36	0	15	5	1	50	67	58	19	73	111	22	0	0	10	0	0	0	5	0	0	0	0	1	0	0	0	0	95	49	57	66
200-500	0	1	0	0	0	2	57	54	6	2	7	0	0	17	55	49	22	22	38	42	2	1	9	0	3	0	5	0	0	0	0	0	0	0	8	0	17	27	18	26
500-800	0	0	0	1	0	3	24	0	1	0	3	0	0	0	1	0	0	3	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	2	4

limiti = 10 - 30 - 100 - kg/kmq

Biomass in tons

Area =	111a	112a	113a	114a	114b	121a	121b	131a	131b	132a	132b	132c	132d	133a	133b	133c	133d	133e	133f	133g	134a	134b	134c	211a	211b	211c	211d	221a	221b	221c	221d	221e	221f	221g	221h	221i	222a	223a	224a	225a
0-50	0	0	3	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	3	0	0	6	0	0	0	0	0	0	0	0	1	20	7	92	10
50-100	0	0	0	6	0	29	8	39	53	0	6	1	0	0	82	0	6	1	15	0	0	0	[illegible]	0	23	0	[illegible]	0	0	0	0	0	0	0	0	2	[illegible]	25	107	69
100-200	0	34	7	0	0	0	48	3	5	0	47	14	3	19	56	30	16	67	[illegible]	17	0	0	[illegible]	0	0	0	38	0	0	0	0	2	0	0	0	0	[illegible]	350	908	665
200-500	0	6	0	0	0	1	37	50	2	4	17	0	0	10	45	24	15	9	53	44	5	1	[illegible]	0	12	0	1	0	0	0	0	0	0	0	8	0	54	[illegible]	353	645
500-800	0	0	0	1	0	2	14	0	1	0	3	0	0	0	1	0	0	1	1	1	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	2	90	36	91

limiti = 50 - 100 - 300 - tons

Nursey (milions of individuals with stratum average MW<300g ML<37 cm)

Area =	111a	112a	113a	114a	114b	121a	121b	131a	131b	132a	132b	132c	132d	133a	133b	133c	133d	133e	133f	133g	134a	134b	134c	211a	211b	211c	211d	221a	221b	221c	221d	221e	221f	221g	221h	221i	222a	223a	224a	225a
0-50																											0,0													0,0
50-100																0,0																					1,1			
100-200																																								
200-500												0,0			0,2																									
500-800								0,0		0,0										0,0																				

limiti = 0,5 - 1 - 5 milion ind

This MEDITS project extends the information gathered during the GRUND national surveys confirming the presence of juveniles in specific areas and also allows the comparison between the different explored areas. For example, *S. canicula* nursery area in the northern Tyrrhenian Sea can be compared with that off the central-eastern Adriatic coasts (Fig. 3a, 3b). In both areas the juveniles of this species are concentrated at about 200 m of depth (PICCINETTI pers. com.; BAINO and SERENA, 2000).

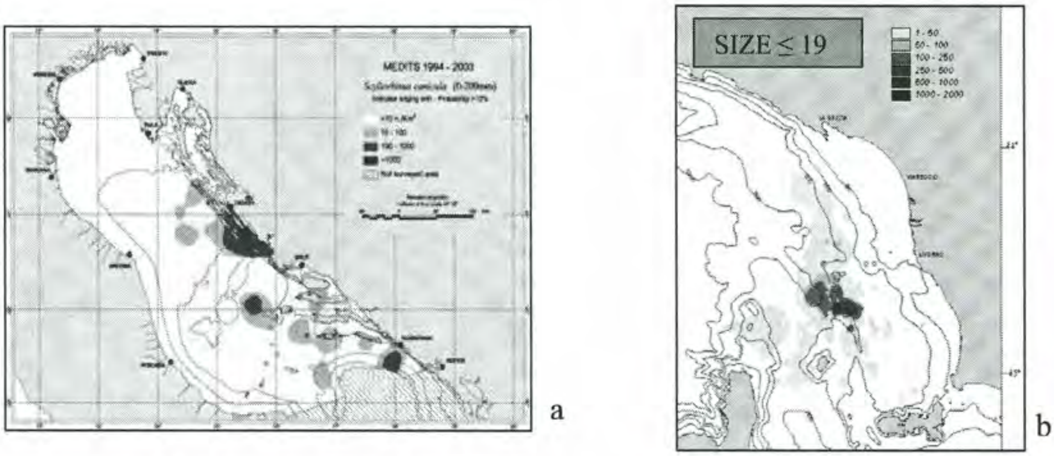


Figure 3. *Scyliorhinus. canicula* nursery area along the central-eastern Adriatic coasts (a) and in the northern Tyrrhenian Sea (b).

During the 30 GRUND campaigns 870 hauls were carried out from 1985 to 2004 in the Tuscany area, 26 chondrichthyans species were caught, 1 chimaera, 10 sharks and 15 and rays skates. The species that show the higher values in number and in weight are *G. melastomus*, *S. canicula* and *R. clavata*; in some cases their catches reach 100 kg/h in yield. Besides the important information gathered regarding the biology of the species, this project allowed to identify, for some of them, nursery and feeding grounds. A study on the historical series of the rays catches in the northern part of the western Mediterranean basin allowed identifying the presence of juveniles in specific areas and depths.

In the north Tyrrhenian and south Ligurian Sea *R. miraletus* is distributed between 13 and 439 meters of depth, but it is mainly concentrated between 50-150 m (Fig. 4). Unlike other species, *R. miraletus* lives on bottoms with different characteristics, from the muddy substratum to *Posidonia oceanica* seabed. The population size structure obtained from the GRUND data give a figure of an important mode on 40 cm TL but the size range is between 11-48 cm TL. The biomass and density indices time series trend, for both GRUND and MEDITS project, show a discrepancy between BI and DI. The exceptional captures of juvenile specimens are underlined by the density index (DI) pick in 1999 (Fig. 5) (SERENA *et al.*, 2005).

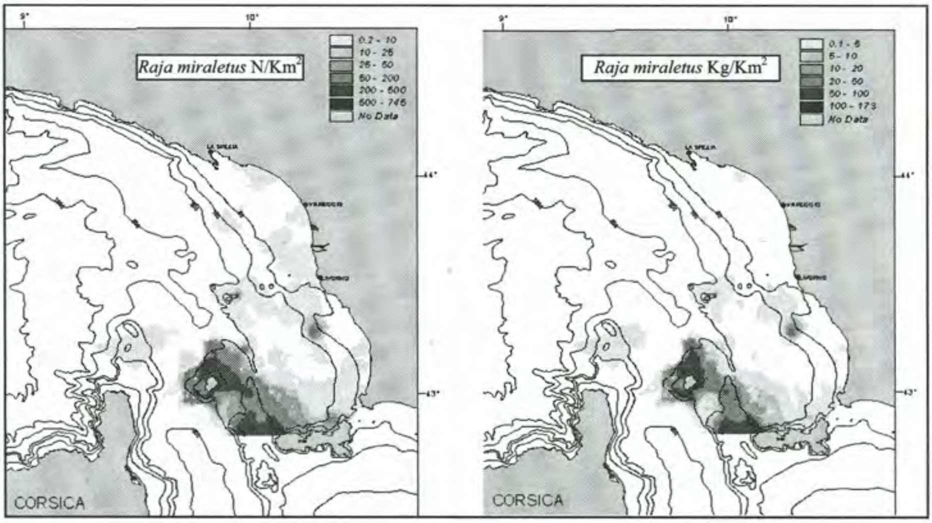
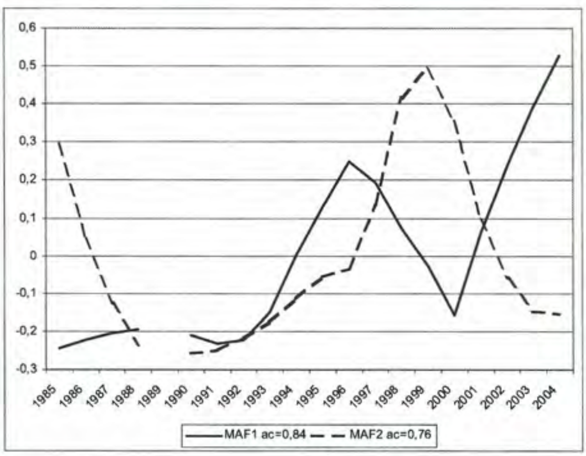


Figure 4. Spatial distribution in number and biomass per km^2 of *Raja miraletus* in the south Ligurian and North Tyrrhenian Sea.



Variable	MAF1	MAF2
Biom (Kg/K m^2)	0,6846	0,7289
Abund (N/Km^2)	ns	0,9094

95% CI=+- 0,45

Figure 5. First and second MAFA axes for *Raja miraletus*. Canonical correlations between the variables and the MAFA axes are also shown; ac = autocorrelation of MAFA axis with time lag 1.

Following *R. clavata* and *R. miraletus, Raja polystigma* is the third most abundant species in the trawl-surveys catches for the north Tyrrhenian Sea. It occupies a very wide depth range (20-633 m), preferring the depths of 100-400 m, but concentrating between 300-400 m (Fig. 6). Important captures of juvenile specimens were registered between 1997 and 2000 for MEDITS and GRUND trawl surveys data (Fig. 7) (SERENA *et al.*, 2005).

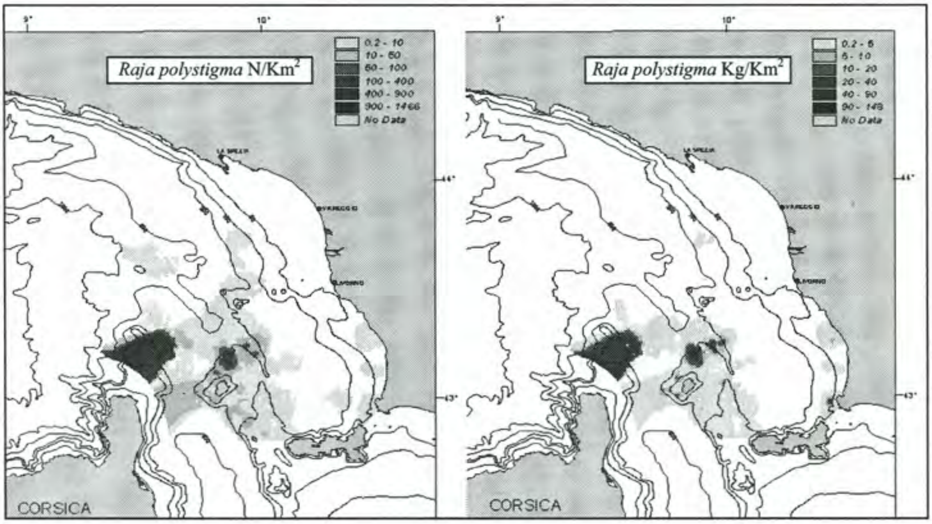
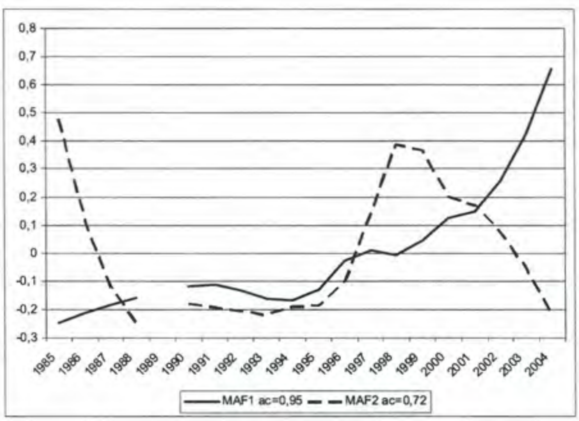


Figure 6. Spatial distribution in number and biomass per km^2 of *Raja polystigma* in the South Ligurian and North Tyrrhenian Sea.



Variable	MAF1	MAF2
Biom (Kg/K m^2)	0,8763	ns
Abund (N/Km^2)	0,9819	ns

95% CI=+- 0,45

Figure 7. First and second MAFA axes for *Raja polystigma*. Canonical correlations between the variables and the MAFA axes are also shown; ac = autocorrelation of MAFA axis with time lag 1.

Along a very restricted coastal zone of the south Ligurian and north Tyrrhenian Sea, trawl surveys aimed at the Gobidae *Aphia minuta* stock assessment allowed to identify and monitor important nursery, reproduction and spawning areas of *R. asterias* ranging between 5-50 metres of depth (ABELLA *et al.*, 1997). The juveniles are concentrated in this area especially in the January-March and July-September months (Fig. 8). On the muddy bottoms, at about 40 m of depth, the egg cases are laid all around the year especially in spring season. After hatching, juvenile specimens quickly reach the shore (3-7 meters of depth) (BARONE *et al.*, in press). The RAIA TAG project thanks to tag and release experiments of juveniles of this species made possible to demonstrate the migration of *R. asterias* northwards to open sea areas and to deeper bottoms as individuals increase their size (BONO *et al.*, 2003; CATALANO *et al.*, 2003).

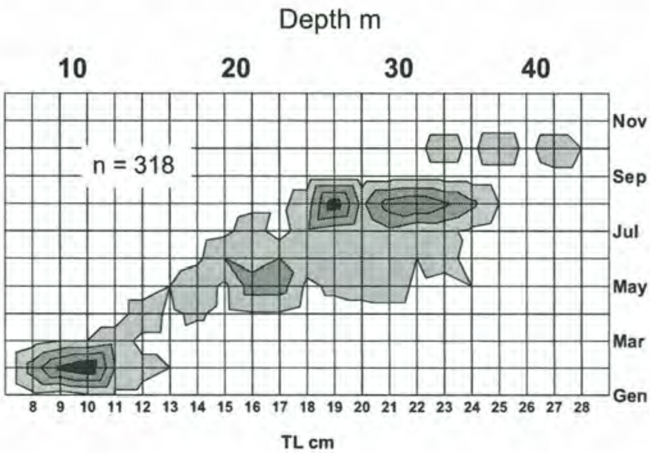


Figure 8. *Raja asterias* juveniles size distribution by month in the coastal studied area (0-50 m of depth).

Discussion

The knowledge of many biological characteristics of the cartilaginous species (distribution, growth rates, migrations, reproduction), of their demographic structures as well as the fisheries catching these species are very important when it is necessary to give advice as regards management measures aimed at the reduction of the by-catch or to protect sensible habitats and the biodiversity. In fact, the management measures useful for the reduction of the by-catch of the cartilaginous fishes are directed to the reduction of undesired catches of these species or alternatively to release at sea the juveniles specimens or the adults with no commercial value when they are still in life, but above all to avoid the fishing activities in the nurseries, breading or the spawning areas, in the cases of ovoviviparous species, in order to preserve sensible habitat.

The preliminary results presented herein are only a first step toward the implementation of a future assessment aimed at a sound management of the Mediterranean cartilaginous fish stocks. Nevertheless, a preliminary analysis of MEDITS data evidences clear signs of suffering for most of sharks and rays and the risk of local extinction for some species that in the past were considered common (such as *Squatina* spp.). The importance of the present results mainly relays to the fact that for the first time data were collected using a common gear and methodology, a condition necessary although not sufficient to implement a proper assessment program for this important component of the marine ecosystem on a wide spatial scale.

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BY-CATCH OF SHARKS IN THE MEDITERRANEAN SEA: AVAILABLE MITIGATION TOOLS

Francesco FERRETTI and Ransom A. MYERS

Biology Department. Dalhousie University. 1355 Oxford St. Halifax, NS, B3H 4J1, Canada.
E-mail: ferretti@mathstat.dal.ca

Abstract

The Mediterranean elasmobranch community is thought to suffer strong depletion in many sectors of the basin because of fishing. The reduction of their catches is felt as a priority. This paper reviews some example of by-catch mitigation tools available world wide that would be effective for elasmobranch, and specifically, in the Mediterranean basin. We talked about their potential, limitation, and finally priorities that would be necessary to address for a better conservation of elasmobranchs in the Mediterranean Sea.

Key words: Mediterranean Sea, by-catch, mitigation tools, legislation tools.

Introduction

The definition of by-catch is quite controversial in the scientific literature. By-catch can refer to the portion of the capture not directly targeted by the fishers (KELLEHER, 2005). This can be retained or discarded at sea, depending on the regulation of the fishery, and personal choice of the fishers. Usually the discarded portion is what causes many controversies. In fact, it has a negative connotation for fishers and environmentalists, since it burdens the fishery with a high economic, social, and moral cost.

Elasmobranchs constitute a by-catch fraction of many fisheries around the world (BONFIL, 1994). The low quality of their meat and the unfortunate reputation that labels the group as man eaters, make fishers to discard these catches for more valuable prey. However, as target fish decline in abundance and fisheries start to show signs of sufferance in terms of production, it seems that elasmobranch fish represent compensation for such lost. In recent years, new markets trading elasmobranch products raised in importance (WALKER, 2004), leading many fisheries to actively pursue many chondrichthyan stocks with catastrophic effect for the status of their populations (WALKER, 1999).

The conservation of elasmobranchs is now a priority for the scientific community (FAO, 1999). Many populations around the world show strong depletion after years of fishing pressure (BAUM *et al.*, 2003; BAUM and MYERS, 2004; STEVENS *et al.*, 2000; GRAHAM *et al.*, 2001) . Limiting shark by-catch is one of the goals of many fishery managers, who are accepting the fact that shark extirpation could bring negative effects on the marine ecosystem, in spite of a long period of resource exploitation.

This paper discusses the shark by-catch present in the Mediterranean Sea, the available tools to limit its incidence worldwide and suggestion for future research to cope with this problem.

The Mediterranean situation

In the Mediterranean Sea elasmobranchs constitute by-catch and target fish in relation to the sector, type of fishery, considered species and location (MACHIAS *et al.*, 2001; CARBONELL *et al.*, 2003; ANONYMOUS, 2003). What can be regarded as by-catch in more developed countries could be a vital resource in southern and eastern countries where sharks represent a cheap fish meal. Generally there are really few discarded species. In trawl fisheries about 46 species of demersal elasmobranchs are commercially used (ANONYMOUS, 2003). At least 10 species of large pelagic sharks (*Prionace glauca, Alopias* spp., *Isurus oxyrhincus, Lamna nasus, Sphyrna zygaena, Carcharodon carcharias, Galeorhinus galueus, Cetorhinus maximus, Carcharhinus* spp., *Pteroplatytrygon violacea*) are regularly caught by fisheries using long lines and driftnets (DI NATALE, 1995, 1997; MEGALOFONOU *et al.*, 2000; TUDELA *et al.*, 2005), even though the effect of drifnets probably declined after its use was restricted by the European Community in 2001 (ANONYMOUS, 2003). Thresher sharks (*Alopias vulpinus*), basking sharks (*Cetorhinus. maximus*), blue sharks (*Prionace glauca*) and pelagic stingrays are also occasionally caught by pelagic trawlers and purse seiners (ANONYMOUS, 2003; FROMENTIN and FARRUGIO, 2005; TUDELA, 2004). Despite this information, it is very difficult to quantify the magnitude of shark by-catch in the Mediterranean Sea. Elasmobranch catches are not regulated in any fisheries. There have been few monitoring programs specifically addressing by-catch species of any kind and even less addressing elasmobranchs. The available data are scattered in time and space. Data on directed shark fisheries are difficult to retrieve because these fisheries are all artisanal and at the present time located in countries that even have trouble in developing efficient fishery management programmes for target fishes.

FAO reports 9.332 tons of shark landing for the year 2003 in the whole Mediterranean Sea (Fig. 1) (Data extracted form Fishstat PC database). This is probably a gross underestimation due to the discarded portion of the catches and the unmonitored fisheries in the basin. However, by looking at the temporal trend of the landings, it is worrying to see the sharp decline these have undergone in the last 10 years. It is likely that the Mediterranean elasmobranch community is experiencing high levels of over-exploitation. In some of its sectors, the coastal elasmobranch diversity have dropped by more than 50 % over 50 years of fishing exploitation (ALDEBERT, 1997; JUKIC-PELADIC *et al.*, 2001; FERRETTI *et al.*, 2005). In some of these areas, elasmobranchs showed signs of stock depletion as far back as the beginning of the last century, even before the industrialized fishery began in the basin (FERRETTI *et al.*, 2005). Therefore in recent periods the attention of the scientific community has been raising to develop conservative action in their regard. One of these would be limiting the by-catch fraction associated with different fisheries in the basin (FAO, 1999).

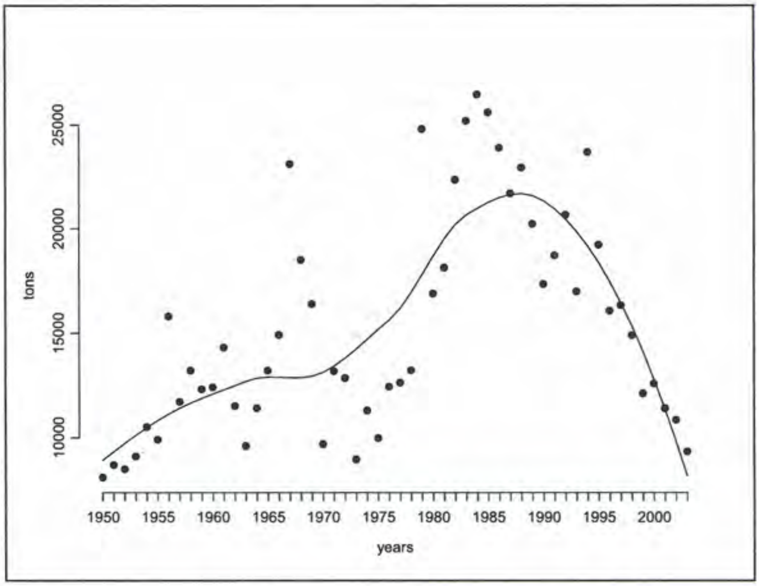

Figure 1. Mediterranean elasmobranch production according to FAO statistics. Dots represent annual landings of elasmobranchs in the basin in tons. The line is a local regression fitted on the data to show a smooth temporal trend of the catches.

By-catch mitigation

There is very little research on avoiding shark by-catch. Most of the by-catch mitigation tools have been studied for turtles, birds, marine mammals and fisheries where the amount of discards represented a clamorous portion of the production (KELLEHER, 2005; HALL *et al.*, 2000; HALL and MAINPRIZE, 2005). Elasmobranchs constitute mainly undervalued species and are of little concern to the public. This resulted in a significant lack of information with respect to their ecology, biology and potential mechanisms to reduce their extraction from the sea. Until a few years ago their status and rate of decline in abundance in the ocean were not really evident and so there was no perceived problem to resolve.

However, many of these mechanisms studied for other animals, or measures traditionally applied to manage target stocks, can be applied as well to reduce shark by-catch. These can be classified into three large groups:

- Technological methods: modification of the fishing gear framework thought to increase its selectivity to target fish and reduce the catchability of the unwanted portion of the catches; actions addressed to reduce the availability of unwanted fish stocks by the fisheries;

- Legislative regulations: all the regulations made to reduce the wastage of productions, and all the conservative deliberations to protect endangered species.
- Social approaches: actions addressed to improve and enhance the applicability and the effectiveness of the first two, by working with fishers to accustom them to these kinds of constrains in their work.

Technological mitigation tools

Some technological mitigation tools adopted world-wide could also be applied to the most important fisheries in the Mediterranean Sea where elasmobranchs constitute a significant portion of by-catch.

The shrimp trawl fishery is one of the most wasteful extractive practices in the oceans. Target fish usually represent less than 20 % of the total catch and a big portion of the by-catch is systematically discarded at sea. In the Italian waters, about 13 elasmobranch species are being taken with this practice; constituting 20 % of the total catches (ANONYMOUS, 2003). Technological modifications of this kind of gear, to reduce the by-catch fraction of the production, are particularly widespread around the world. In the federal water of the Gulf of Mexico and the south Atlantic States of the US, the production of commercial shrimp amounts to about 13 % of total production. Most of by-catch consists of finfish, but turtles, sharks and shellfish are abundantly caught too. The large impact that this fishery would have on the ecosystem, pushed the US government to adopt mandatory BRDs on shrimp trawl nets. Theses devices are components added to the trawl net to avoid the catch of unwanted species ore facilitate their escapement once these are inside the net. Usually a strong metal grid is placed at the beginning of the codend to avoid catches of turtle: TEDs (Turtle Exclusion Devices). Turtles are avoided to enter the sack and an auxiliary door beside the grid helps them to escape from the gear. With the same principle, other sorting grids or modifications of gear netting are placed in other strategic sectors of the net. These prevent fishes and other marine animals from penetrating the final portion of the gear with its fine meshes, and help them to escape through large windows (Fig. 2). These gear modifications are also largely used in Northern Europe and Australia (Square mesh panels, Separator trawls, Nordmøre grids, etc) (BROADHURST *et al.*, 2002). Although these devices reduce the amount of by-catch of other species, sharks seems to barely benefit from them. Recent analyses performed by Shepherd and Myers in the Gulf of Mexico did not detected any mitigation in the rate of decline of many elasmobranchs affected by this practice after the use of these devices in recent years (SHEPHERD and MYERS, 2005).

Trawl fishing is one of the most important fisheries in the basin and many demersal elasmobranch species are caught with this technique, though few of them are discarded.

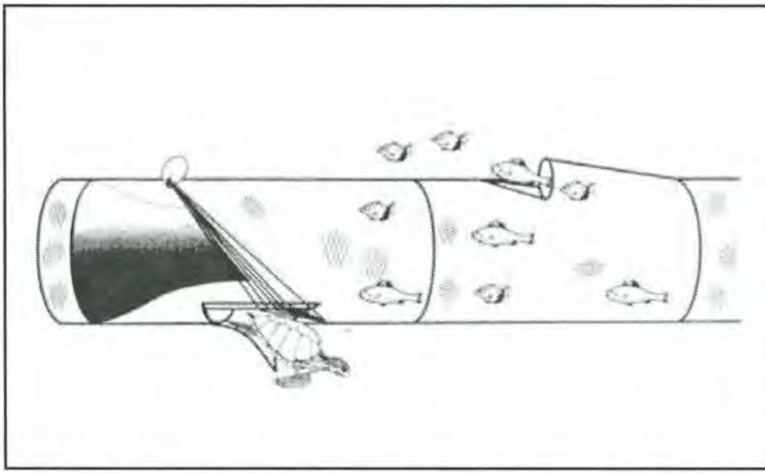

Figure 2. Example of by-catch reduction device applied to shrimp fisheries: Turtle Exclusion Device (on the left), escaping window for fishes (on the right). From TALAVERA, R.V. 1997.[1]

Modification of the net with different combinations of mesh sizes, footrope, head-rope, sinkers, buoys, bridles to connect the doors to the beginning of the fishing net can have a great influence on the catchability of different species. Although, developing an extremely selective net for target fish is very difficult. The modification of one component can increase the selectivity for a group of species with similar behavioural and morphological characteristics but different responses to fishing pressure. For example, to increase the selectivity of gear for flat fish the footrope can be placed ahead of the head rope. The upper panel would be composed by larger meshes in its initial portion. In this way, fishes that hover in the water column can easily escape above the net, over the head-rope, or through the large meshes of its upper panel. Alternatively, we can just reduce the vertical opening of the net. Such gears would surely be effective for flat fish such as pleuronectiformes, skates and rays, but would not discriminate between the two groups with certainly different sensibility to fishing pressure. Vice versa, skates and rays and other flat fishes could be avoided by using trawl net that don't have tight contact with the substrate, but this would exclude an important portion of commercial catches for Mediterranean trawlers represented by several species of soles.

By varying the dimension of the foot-rope we can influence its resistance in rocky bottoms. Rubber discs and covers of the bottom panel of the net can allow trawlers to exploit hard grounds by increasing the resistance of the net to its damaging action. Therefore limitation on the diameter of the rope and on the use of these protective devices can avoid the catch of species present in such environments.

[1] TALAVERA, R.V. 1997. Dispositivos excluidores the tortugas marinas. FAO Fisheries Technical Paper 372, FAO.

Midwater gears can be used instead of bottom otter trawl to force the fishers to trawl in easily accessible grounds and thus to limit the spectrum of environments that can be exploited in a given area (ANONYMOUS, 2004_b).

Traditionally, the most used tools to manage the by-catch of trawl fisheries remains the regulation of the net mesh size. This is the only gear regulation applied to the Mediterranean demersal trawl fisheries, mainly addressed to reduce the juvenile portion of the catches, which here constitute the bulk of the discard.

In longline fishing, by-catch of elasmobranch is relatively high (BONFIL, 1994). Most of the technical measures developed to reduce by-catch in this fishery are particularly effective for these fishes. There are several gear characteristics that can affect its selectivity: hook size, shape, soak time of the gear, depth of the hooks, material of the gangions, and the presence of swivels to attach the gangion to the main line. In the South Australian Shark Fishery it is prohibited the use of machines that automatically attach and remove the hooks form the main line (WALKER, 1999). This machine improved the efficiency of the longline fisheries around the world, by largely increasing the umber of hooks that could be deployed at sea each fishing trip. Prohibiting the use of these machines forced the fishers to reduce their effort and so the number of possible catches. Coelho and co-authors demonstrated that the elasmobranch by-catch was highly reduced in the Portuguese semi pelagic near bottom longline fishery if the hooks close to the bottom were removed from the line (COELHO *et al.*, 2003). This is a particular effective by-catch mitigation tool since in their experiment it did not decrease significantly the European hake catches, the target species for that fishery. Forbidding the use of steel wires and adopting only nylon for the gangions would be another improvement of longlines that would highly decrease the portion of elasmobranchs caught, since it gives more chances to larger specimens to bite off by cutting the line.

With gillnets, modifying mesh size can effectively reduce the portion of juvenile specimens that remain entangled in the net (CARLSON and CORTES, 2002). Buenquerpo and co-authors showed significant differences in the mean size of sharks caught by longlines and gillnets fishing in common areas. For several species of sharks, gillnets caught mainly bigger specimens than longlines did (BUENQUERPO *et al.*, 1998). Also by modifying the breaking strain of the webbing filament, large sharks could escape when entangled by breaking the net (WALKER, 2004). In the Bass Strait, a selection of the mesh size of about 15 cm in the *Mustelus antarticus* fishery allowed a sustainable use of this resource by ensuring escapement of small and large animals, and exploiting only middle sized specimens, which occur far from inshore areas where pregnant female and juveniles concentrates (WALKER, 1998).

The use of lights attached on driftnets can aid in gear recognition at night. Although the practice can bring gillnet fishery to extend its activity at 24 hours a day, the use of such lights can alternatively help fishers recognize their nets which will prevent leaving unattended gears for several days. There would be a reduction of shark wastage and spoilage due to fish and other animals, and there would be a reduction of ghost fishing since lost gears would be easily detected end removed from the sea.

Instead of improving the selectivity of the fishing gear, technological measures can be addressed to reduce the availability of sensible stocks to the fisheries. Marine protected areas would be efficient tools to manage elasmobranch fishes. These can constitute refuge for depleted stocks, which can use such portions of the ocean as recruitment zones for adjacent exploited regions, and thus allowing a longer exploitation of the resource. In the Italian coasts, zones such as the northern Tyrrhenian Sea and the Sicilian Channel are areas of high elasmobranch diversity, but also of high fishing pressure. However, this pressure is highly skewed toward the Italian portion of the sectors, leaving Corsica and Tunisia comparatively underexploited coasts. The closeness of the coasts, and the bathymetric contiguity of the seabed within each area, could have allowed the persistence of many elasmobranch species in the regions, as sharks could recruit from low fishing pressure grounds acting as natural marine protected areas. The utility of MPAs as fishery management tools still need to be tested properly, but there is evidences that these could be particularly beneficial for elasmobranchs, especially on the light of case studies showing persistence of shark species attributable to recruitment from unexploited fishing grounds (GRAHAM *et al.*, 2001; WALKER, 1998).

Temporary closure of fishing areas would be effective tools to reduce fishing pressure on critical stages of the life history of a given species, e.g. during spawning and mating season or in sectors where juvenile aggregate and growth before reaching their sexual maturity. Such measures can range from total closures and restriction of any fishing practice, to forbidding the use of some gear in some determinate period. They can range from day/night, monthly or seasonal closures, depending on the particular situation of the managed fishery. Estuarine environments have been recognized as preferential spawning ecosystem for many sharks. The closure of such sectors of the coast would prevent the disruption of critical ecosystems for elasmobranch fishes and prevent the exploitation of pregnant adult females and juvenile specimens. However these areas must be identified beforehand. The best way to do it is through the scientific campaigns of evaluation of the resources (SERENA and RELINI, in this volume)

Instead of area closures, a more dynamic approach could be developing a system of information sharing among fishers. Each time a vessel encounter a spot with an elevate proportion of by-catch, that would be communicated to other components of the fishery, and that area would be avoided in the immediate period. This practice is called hot-spot reporting. It has been undertaken by fishers of the Bering Sea. In this area, a private contractor gathers all the information coming from fishers and analyzes such data to provide an immediate estimate of the distribution of the catches per vessels in the fishery (HALL and MAINPRIZE, 2005).

Legislative tools

In some fishery the application of individual or collective quota has been a good response to limit by-catch. Individual quota limits the number of by-catch species that a particular vessel can report for each fishing trip or season. Collective quota enlarge such limit to the entire fishery, but can have the advantages to push fishers to limit their individual catches through a "peer" effect (pressure that other fishers exercise to the ones that produce the major portion of unwanted catches).

Some nations have adopted discard and by-catch bans. In Norway where size limitations exist, fishers are forced to keep all their catches, even if these are constituted by juvenile specimens. In this way the discard portion of the production can be recorded. Fishers can not sell their discard but this is being auctioned and the earnings can not be taken by the producing parts. In this way, there is surely an improvement of the estimation of fishing mortality, useful for several managerial purposes, but also there is an improvement on the fisher's acceptance of eventual fishing gear modifications to reduce by-catch. Similar policies have been adopted by other countries with bigger or lesser variation from the above described scheme. In Canada the landed by-catch counts against quota. In New Zealand and Iceland, the quota reduction produced by the landed by-catch portion is only 50 % (HALL and MAINPRIZE, 2005). Such measures could be particularly relevant for shark by-catches, especially where finning is practiced. The obligation to retain carcasses would amply reduce the amount of sharks killed each fishing trip given the space limitations of the boats.

Social work

It is implicit that all measures of by-catch mitigation are usually costly for fishers and for agencies. The application of gear regulation can largely affect the production of target fish. Marine protected areas and area closures reduce the overall effort that the fishery deploys in a zone and limits its spectrum of available resources. The collaboration of fishers would be extremely helpful for the success of these measures. By their responsible behaviour, they can avoid and buffer many of the drawbacks of current regulations. For example, the application of quotas or discard bans can really be effective in pushing fishers to adopt modifications that increase gear selectivity to target fish, and make them avoid hot spots of high by-catch. However, these can also produce a new-market for by-catch species, and push fishers to not record their catches. To be effective in reducing shark by-catch, the agencies need to put a great effort in training programs for resource users. These programs would be used to explain them the importance of conserving such species, the possible problems that their elimination could bring to the ecosystem and to the persistence of fishing activities.

One of the problems of shark conservation is the lack of detailed information about their extraction from the oceans. Fishers represent a continuous sampling force in the marine environment. The success of catch monitoring programs through the use of log-books requires a great deal of fisher's time, which, without their understanding of the utility of such practice, would be difficult to obtain. Fishery agencies must provide them all of instruments needed to register catches in the easiest and least time consuming manner. Laminated identification cards, posters, and any other easily usable format helping fishers to recognize the species with relative ease in fishing time condition, are preferable to cumbersome and complicated books.

Finally, the success of conservation programs comes after the public has taken a vested interest. Sharks, unfortunately, have a great handicap in this aspect due to their bad reputation, but it is the job of conservation and fishery agencies to find the best communicative tools to put sharks closer to the concerns of people and to let them understand the gravity of losing such important animals. Under the pressure of environmentalist and Non Governmental Organizations, a great effort has been made for dolphins and for turtles, even though these animals are not of great commercial value. Most of the researches on mitigation tools have been funded in that direction respect to the plight of elasmobranchs.

Problems and priorities

All of the above mentioned mitigation tools are expensive (both as direct costs and as loss of profit), and therefore worth careful consideration before implementation. This is particularly true for species, such as sharks and rays, which don't have a high market value. The loss of elasmobranch will not immediately affect revenue from fisheries, although the cost of the above mentioned mitigation tools will represent an immediate cost for fishermen. However, given their actual status, it is without doubt that sharks require conservation. Considering the economic and social cost this would bring, it is necessary to ensure all of the actions are extremely effective, and address the components, which most affect their resistance to extirpation. For this purpose, it is required an extensive amount of data on species distribution, abundance, movement, fishing mortality, interaction between species and sensitivity to fishing gears. For sharks, unfortunately this is not the case, especially in Mediterranean where the paucity of data is extremely evident.

At the present, the Mediterranean Sea requires a clear understanding of the status of its elasmobranch community. The basin it is still lacking a compendium showing the distribution of species in its different sectors, relative abundance between areas, and absolute abundance within areas in relation to fishing pressure. Some description have been done in the northern part of the basin from trawl and pelagic surveys (BERTRAND *et al.*, 2000; RELINI *et al.*, 2000; MEGALOFONOU *et al.*, 2000), but the southern and eastern part of the basin still remain unassessed. It is need to identify the characteristics of the pristine Mediterranean marine ecosystem, and analyze what has changed, why, and what the ultimate effects of such changes are in relation to our use of resources. There is a clear difference in elasmobranch diversity between the north-western and south-eastern part of the basin. In the north-western basin we find most of the elasmobranch population showing signs of depletion (ALDEBERT, 1997; JUKIC-PELADIC *et al.*, 2001; FERRETTI *et al.*, 2005) while in the south-eastern sector many populations are still in their pristine state (most will be shown in this volume). The influence of fishing is quite evident, since there is a clear gradient between the two zones, going from more exploited zones in the northwest, to almost no disturbed areas in the southeast. Environmental differences may be also pertinent, but more likely negligible by taking into account the relative small geographical scale of the basin and the much greater effects of fishing pressure. This, however, has to be tested and quantified, in order to identify the correct tools to manage the region.

At present, the best conservation tool to apply to elasmobranch populations would be data analysis. It is necessary for each country to cooperate in a regional management by developing a common database, where any kind of information regarding elasmobranch catches, fishery effort, biological, and ecological information would come from every sector of the basin, and be widely accessible to the whole scientific community. Fishery data need to be combined together by using all of the statistical tools available at the moment, to produce estimates of actual abundance and trends over time. This is needed to produce a research baseline on which will be possible to refer for future effective conservation actions. To obtain an accurate assessment of the historical condition in the Mediterranean, it is essential to enlarge the temporal and spatial scales of the present investigations. Most analyses to date are representative of very small regions over short period of time. By focusing on small sectors of the basin, these observation are constrained in their potential to explain general and more meaningful patterns. By combining data over regions and time, it would be possible to piece together the historical condition of the Mediterranean, and develop an understanding of the patterns of change. An historical approach will likely change the current outlook on the baseline abundance of many species.

With sound data analyses, unequivocally quantifying the reality of the situation, come conservation actions. The research performed by Baum and colleagues in the northwest Atlantic and Gulf of Mexico, on the status of elasmobranch populations occurring in these areas (BAUM *et al.*, 2003; BAUM and MYERS, 2004), has already resulted in conservation actions that will protect global shark populations, such as the listing of the oceanic white tip shark as "critically endangered" by the World Conservation Union (IUCN) (ANONYMOUS, 2004_a) and the recently announced ban of shark finning in international waters of the Atlantic (BURDEAU, 2004).

In Mediterranean Sea, 14 nations have so far ratified The Barcelona Convention, an international agreement for the protection of the Mediterranean sea against human induced degradation of the marine ecosystem. Within the convention, three species (*Carcharodon carcharias, Cetorhinus maximus* and *Mobula mobular*) are enlisted as endangered and threatened. These should receive full protection against killing, trade, transport and exposition of specimens and their product. It is likely that a broad scale analysis of shared information on elasmobranch extraction, coming from all the sector of the basin, could really lengthen this list and promote immediate conservation actions.

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CHONDRICHTHYES IN CYPRUS

Myroula HADJICHRISTOPHOROU

Senior Fisheries and Marine Research Officer, Department of Fisheries and Marine Research, Cyprus.
E-mail: andrecws@logos.cy.net

Abstract

In Cyprus 28 species of shark and dogfish and 17 species of skates and rays have been recorded. The paper lists these species with information on the area they were recorded in, as well as depth and frequency. The catches of these species from 1980 to 2004 are given, as are the relative impacts of the various fisheries on them. Indications on the state of the stocks of these fishes are also given where possible.

Key words: Cyprus coasts, fisheries, landings.

Introduction

In Cyprus there is little consumption of cartilaginous fishes. Only some skates and rays and some dogfishes are of commercial interest. These are mainly caught by the inshore fishery, with trammel nets and bottom-set long-lines and by the trawl fishery. These are not targeted for, in any fishery, but are by-catch. Sharks are not fished for either, but form a small by-catch of surface long-lining for swordfish. A few species are of some very limited commercial interest.

The study of these species on the island has so far been incidental to other fish studies. Some of the information on the species comes from the systematic catch sampling programme of the Department of Fisheries, in the inshore and trawl fisheries.

The main sources of statistical data on catches are the Annual Reports of the Department of Fisheries (DEMETROPOULOS, 1980-1989). These reports in fact extend back to 1967 and include detailed statistics on catches and fishing effort data. The Annual Reports of the Department were discontinued in 1990 but fishery statistics continued being collected and the Department has been compiling statistical reports on the Cyprus Fisheries since then (DEPARTMENT OF FISHERIES, 1990-2004).

Records of Chondrichthyes in Cyprus

The species of cartilaginous fishes recorded in Cyprus are presented in Table 1 and consist of 28 species of shark and dogfish and 17 species of skates and rays. These records cover the whole island. Some of the species listed need confirmation. Unconfirmed reports from local sources are marked with an asterisk (*).

The main sources of information are DEMETROPOULOS and NEOCLEOUS (1969), GILAT and GELMAN (1984), FISCHER *et al.* (1987), COMPAGNO ($1984_{a,\,b}$), MCEACHRAN and CAPAPÉ (1984) and (SERENA, 2005), with some unpublished information provided by A. Demetropoulos on one new species and in listing doubtful species (DEMETROPOULOS, pers. comm.). The CLOFNAM classification was used (HUREAU and MONOD, 1973).

Table 1. Records of Chondrichthyes in Cyprus

Species	Local name	Common English name	Area recorded	Freq.	Depth (m)
HEXANCHIDAE					
Heptranchias perlo (1)	Skyllopsaro	Sharpnose seven-gill shark	FB,MB	Occ.	50
Hexanchus griseus (1)	Bambakaris	Bluntnose six-gill shark	NC,WC	Com.	100-200
SQUALIDAE					
Squalus acanthias (1)	Acanthias	Piked dogfish	CW	Com.	80-500
Squalus blainville (5)	Skyllaki	Longnose spurdog			
CENTROPHORIDAE					
Centrophorus granulosus (2)		Gulper shark		Occ.	1490
ETMOPTERIDAE					
Etmopterus spinax (2)		Velvet belly lantern shark		Occ.	1490
OXYNOTIDAE					
Oxynotus centrina (3)		Angular roughshark		Rare	
SQUATINIDAE					
Squatina squatina (1)	Gatos	Angel shark	CW	Occ.	
Squatina oculata (5)	Gatos	Smoothback angelshark			
ODONTASPIDIDAE					
Carcharias taurus (1)*	Karcharias	Sand tiger shark	MB, NC	Rare	
Odontaspis ferox (1)*	Skyllopsaro	Fierce shark	NC	Rare	
ALOPIDAE					
Alopias vulpinus (1)	Aloupos	Thresher shark	NC	Rare	EP
LAMNIDAE					
Carcharodon carcharias (5)	Karcharias	Great white shark			
Isurus oxyrinchus (1)	Skyllopsaro	Shortfin Mako	NC,WC	Occ.	EP
Lamna nasus (1)	Skyllopsaro	Porbeagle	AB	Rare	EP
SCYLIORHINIDAE					
Galeus melastomus (1)		Blackmouth cat-shark	FB	Occ.	40
Scyliorhinus canicula (1)	Skyllaki	Small spotted cat-shark	CW	Com.	20-60
Scyliorhinus stellaris (4)		Nursehound			
TRIAKIDAE					
Galeorhinus galeus (4)	Galeos	Tope shark			
Mustelus asterias (1)	Drositis	Starry smooth-hound	WC	Occ.	20
Mustelus mustelus (1)	Galeos	Smooth-hound	EB	Occ.	60/80
Mustelus punctulatus (4)	Galeos	Blackspotted smooth-hound			

Table 1 (Cont.)					
CARCHARHINIDAE					
Carcharhinus brevipinna (4)	Skyllopsaro	Spinner shark			
Carcharhinus melanopterus (5)	Skyllopsaro	Black-tip reef shark			
Carcharhinus plumbeus (4)	Skyllopsaro	Sandbar shark			
Prionace glauca (1)	Karcharias	Blue shark	NC	Occ.	
SPHYRNIDAE					
Sphyrna zygaena (1)	Zygaena	Smooth hammerhead		Rare	EP
Sphyrna mokarran (4)	Zygaena	Great hammerhead			
Rhinobatus rhinobatus {1)	Viola	Common guitarfish	NC,LB	Occ.	15
Rhinobatos cemiculus (6)	Viola	Blackchin guitarfish			
TORPEDINIDAE					
Torpedo marmorata (1)	Moudiastra	Marbled electric ray	FB	Occ.	60/70
Torpedo nobiliana (1)	Moudiastra	Dark electric ray	FB	Occ.	60/70
Torpedo torpedo (1)*	Moudiastra	Electric ray			
RAJIDAE					
Dipturus oxyrinchus (1)	Vati	Long-nosed skate	MB	Occ.	400
Raja asterias (1)*	Vati	Starry ray			
Raja clavata (1)	Vati	Thornback ray	EB,FB, AB	Com.	150-300
Raja miraletus (1)	Vati	Brown ray	EB,FB, MB	Occ.	150-300
Raja radula (1)	Vati	Rough ray	EB,FB, MB	Occ.	100-220
DASYATIDAE					
Dasyatis centroura (6)	Vati	Roughtail stingray			
Dasyatis pastinaca (1)	Vati	Common stingray	CW	Com.	
Pteroplatytrygon violacea (1)*	Vati	Blue stingray			
GYMNURIDAE					
Gymnura altavella (1)	Vati	Spiny butterfly ray			
MYLIOBATIDAE					
Pteromylaeous bovines (1)	Aetopsaro	Bullnose ray	NC	Occ.	20
RHINOPTERIDAE					
Rhinoptera marginata (6)		Lusitanian cownose ray			
MOBULIDAE					
Mobula mobular (1)*		Manta ray			

Sources of identification/record: (1) Demetropoulos and Neocleous (1969), (2) Gilat and Gelman (1984), (3) Demetropoulos (pers. Comm.), (4) Compagno (1984) (part 1), (5) Compagno (1984) (part 2), (6) McEachran and Capapé (1984). Abbreviations: AB - Akrotiri Bay (Limassol Bay); CW - Cyprus Waters; EB-Episkopi Bay, FB - Famagusta Bay; MB - Morphou Bay; WC - West Coast; NC - North Coast; LB - Larnaca Bay; EP - Epipelagic

Fisheries

Table 2 and Figure 1 show catches in the area under the control of the government. Fishermen are required to report sharks and rays separately in their statistical returns in all fisheries.

The Swordfish Fishery

The annual catch of sharks in surface long-line fishing varies with a fluctuating fishing effort. At its peak in the late 1980s and early 1990s catches peaked at 34 tons in 1990 and dropped to about 10 tons p.a. since 1995. On average, sharks form about 10% of the total catch of the swordfish fishery. The figures for 2003 and 2004 show a practically zero catch and this is related to the drastic drop of fishing for swordfish, as the stocks of this fish are evidently very low and little fishing takes place. Annual catches may in fact have been higher, as many sharks, of some species at least, are discarded at sea, as they fetch very low prices or are not marketable at all, so in effect the figures in Table 2, reflect landings rather than catches. In Cyprus fish from the local fisheries is mainly sold fresh and the fact that shark meat cannot keep for any length of time (due to the presence of high levels of urea in the blood and its breakdown to ammonia which contaminates the meat,) make their marketing more of a problem.

The data for the swordfish fishery (i.e., for the sharks) are deemed to be more accurate than those of the inshore fishery though fluctuations and trends in fishing effort need to be linked to these data to make them more meaningful – and possibly reveal changes and trends in populations. This is currently being done.

The Inshore (artisanal) Fishery and the Trawl Fishery

These fisheries catch mainly dogfish, skates and rays. Catches of sharks are rare and often reach the newspapers and other media. The catches of skates, rays and some of the dogfishes, which are fished by the trawl and inshore fisheries, are in part at least marketed. Table 2 and Figure 1 show the landings of these species. The catches reflected in the statistics, of the inshore fishery in particular, vary considerably, with peaks up to 156 tons, in the period between 1985 and 1990. There is, however, some doubt as to the credibility of these data - especially of those in peak years - due to the sample boat system used to calculate the landings of the inshore fishery and the willingness of fishermen to report such catches. As there have not been any marked changes in fishing effort in the trawl fishery, at least during the period covered by the present study, and a steady (if rapid) increase in the inshore fishery, the main source of bias would be expected to come from statistical errors. Nonetheless, the dramatic changes in fishing effort in the immediately preceding period (i.e., 1975-1980, following the 1974 events in the country), are very likely to have impacted seriously the populations - and catch rates - of these species during the period under review. This is no doubt accentuated by the fact that the species concerned are long-living species, the populations of which are unable to recover quickly, even if they benefited from any of the conservation measures taken in 1981/82 and later (extension of the closed period for trawling, freezing of the capacity of the trawl fishery, etc). It needs to be noted here, that the trawl fishery in Cyprus waters is currently being reduced by a license buy-back programme and the fishery is now (in 2005) already operating at about 50 % of its capacity, with the vessels, whose licenses are withdrawn, being scrapped.

Table 2. Catches of Chondrichthyes in Cyprus

Year	Catches in Cyprus waters - in tons	
	Swordfish Fishery	**Inshore and Trawl Fisheries**
1980	6,5	19
1981	8,4	17,5
1982	17,5	16,2
1983	3,9	13,3
1984	9,3	18
1985	5,9	55,1
1986	12	137,7
1987	16,9	32,5
1988	18,3	90,2
1989	18,8	157,5
1990	33,8	9,4
1991	13,3	6,7
1992	9,7	23,6
1993	15,5	30
1994	24,6	16,4
1995	13,6	19,5
1996	8,4	13,4
1997	8	16,1
1998	10,6	9,8
1999	11,6	3
2000	8,8	13,2
2001	8	18,4
2002	8,7	8
2003	1,5	7,8
2004	0,6	5,4
Total	**294,2**	**757,7**
Average	**11,77**	**30,31**

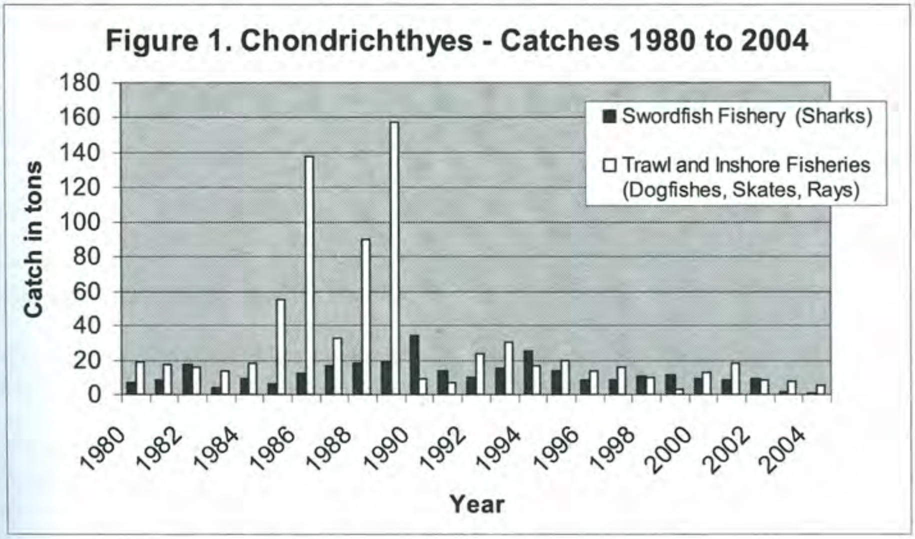

Figure 1. Catches of Chondrichthyes in Cyprus.

Discussion

The fishery statistics show a drop in catches of most Chondrichthyes in Cyprus waters over the last 25 years. The drop may be partly attributed to statistical inaccuracies, but most likely they reflect also a real drop in stocks. The state of individual species is even more difficult to assess. Nonetheless there are indications that the stocks of some non-commercial species, such as that of the bluntnose six gill shark, are little impacted. On the other hand shark species that form a regular by-catch of surface longlining are more at risk from intensive fishing and may well follow the fate of the swordfish stocks that are now in a near collapsed state. The recent drastic reduction of surface longlining for swordfish is likely to benefit the stocks of the sharks caught by this method. The drastic reduction of the trawl fishery is also expected to benefit the stocks of dogfishes, skates and rays, which are exploited by this fishery.

A more focused study of Chondrichthyes in Cyprus will no doubt provide insight into the state of these species and of the effects of the measures taken (reduction of the trawl fishery) and of the de facto drop in surface longlining.

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A SUMMARY OF SHARK BY-CATCH IN THE ITALIAN PELAGIC FISHERY

Fulvio GARIBALDI

University of Genoa, DIP.TE.RIS.,
C.so Europa 26, 16132 Genoa, Italy. E-mail: garibaldi.f@libero.it

Abstract

This paper is a review of the literature data on species caught as by-catch in the Italian pelagic fishery, mainly targeting the swordfish (*Xiphias gladius*), the bluefin (*Thunnus thynnus*) and the albacore (*Thunnus alalunga*). A significant pelagic shark by-catch is recorded only for 5 species, such as *Prionace glauca*, *Isurus oxyrinchus*, *Alopias vulpinus*, *Lamna nasus*, *Galeorhinus galeus* and *Pteroplatytrigon violacea*, but CPUE values are generally very low, also if compared to some areas of the adjacent Atlantic Ocean. There are few, scattered data sets available in literature and the majority of them are referred to the most abundant shark, *Prionace glauca*. The lack of information about biology, populations dynamics and migratory routes of pelagic species in the Mediterranean Sea is pointed out and discussed.

Key words: Pelagic fisheries, by-catch, sharks, Mediterranean.

Introduction

In Italian waters, as in the most part of the Mediterranean Sea, cartilaginous fish are a relevant by-catch of the professional pelagic fisheries. The traditional harpoon fishery in the Southern Tyrrhenian Sea and purse seine fishery targeting bluefin tuna show a really low shark by-catch, generally reduced to a few large specimens.

Fishing activities strictly related to pelagic cartilaginous species are:

1) Surface longline: it is probably the most common fishing gear targeting swordfish, tunas and other tuna like fish. In the Italian seas more than 1.000 fishing vessels are using this gear, but many of them are small multipurpose boats, operating at a small scale. Moreover, there are many different long line types: swordfish longline (SWO LL), American Type SWO LL, Bluefin tuna longline (BFT LL), Albacore longline (ALB LL), with different characteristics (nylon thickness, hook number and size, bait, etc) in order to be the most selective for each target species. Thus, it is really hard to standardize collect valuable data on the real and the real fishing effort.

2) Driftnets are officially banned from the E.U. countries from 2002, but in different ways they are still operating, in Southern Italian seas and in the South-West Mediterranean. At the moment it is not possible to have an estimate of the fishing effort

3) (total length of the nets and number of boats operating every night at sea), even if it is reduced in comparison with the last decade.

No pelagic fishery directly targeting shark exists in Italy and, except restricted areas, in the whole Mediterranean Sea.

Materials and Methods

Since the 80's, research programs on pelagic fishery have been carried out in Italy, funded by the Italian Ministry for the Agricultural Policy,and from EU: aim of these programs is a better understanding of the biology and population dynamics of the large pelagic species, mainly swordfish, albacore and bluefin tuna, for stock assessment and management. Italian seas were divided on the basis of different O.U., similar in extension to FAO's GSA, in order to have a complete coverage of the Italian coastline and ports. These programs are generally carried out monitoring catches at landings. This is a great difference with programs addressed to the study of demersal resources (cfr. MEDITS and GRUND programs), based on fishing surveys at sea. This is due to the fact that for pelagic fishery, fishing surveys at sea are more time and money expensive. In the framework of these programs, every year a part of the work was carried out by observers directly on board for each O.U., considering that the only way to collect biological samples (gonads, stomach contents, etc) because fish are gutted and dressed for the market at sea. Obviously all possible data on by-catch species, including sharks, were also collected.

Qualitative information about the presence of species come also from recreational fishing activities, but they are generally spotted records of occasional catches.

At present, some new programs funded by Italian Ministry and coordinated by SIBM (Italian Marine Biology Society) are going to start: they could be very useful tools considering that they it must be carried out with observers at sea.

Results

A significant shark by catch is recorded only for the 5 following species, as pointed out by many authors: *Prionace glauca*, *Isurus oxyrinchus*, *Alopias vulpinus*, *Lamna nasus*, *Galeorhinus galeus*, *Pteroplatytrigon violacea.* All but pelagic stingrays have a good commercial value. Many other cartilaginous fish are caught, including some protected (i.e. *Mobula mobular* and *Cetorhinus maximus*) or deepwater species (i.e. *Hexanchus griseus*), but numbers are generally low. Uncertainty remains about the real incidence on other pelagic sharks, also considering that for some families (i.e. Lamnidae, Sphyrnidae and Carcharhinidae) the correct species identification is sometimes very difficult.

Catch per unit of effort (CPUE) in number (number of individuals for 1000 hooks for longlines, and for 1000 m of net for driftnets) and mean weight are valuable tools trying to analyze trends in sharks abundance. Available literature data on elasmobranch by-catch from the past are summarized in the following tables: data sets are mainly referred to blue shark, *P. glauca*, which is the most common shark.

Table 1. Blue shark CPUE (n) and mean weight (kg) values in the Gulf of Taranto - Swordfish longline (combined data and modified from DE METRIO *et al.*, 1984 – FILANTI *et al.*, 1986).

Years	1978	1979	1980	1981	1982	1983	1984	1985
CPUE (N)	1,53	1,13	0,94	2,25	1,40	3,07	1,12	1,17
Mean weight (kg)	9,42	47,4	30,28	20,16	13,81	12,3	21	9,47

Table 2. Blue shark CPUE (n) and mean weight (kg) values in Southern Adriatic Sea - Swordfish longline (modified from DE ZIO *et al.*, 1998)

Years	1984	1985	1986	1987	1991	1992	1993	1994	1995	1996	1997	1998
CPUE (N)	0,71	0,76	1,71	0,97	0,89	2,38	1,51	0,55	1,12	0,69	1,13	1,87
Mean weight (kg)	16,3	17	15,9	11,6	14,2	8,4	10,1	9,8	11,8	11,7	10,7	10,8

Table 3. Blue shark CPUE (n) and mean weight (kg) values in the Ligurian Sea – Swordfish longline (from GARIBALDI and ORSI RELINI, 2000).

Years	1990	1991	1992	1993	1994	1995	1996	1997	1998
CPUE (N)	0,28	0,52	1,09	0,08	0,18	0,65	0,4	0,2	0,12
Mean weight (kg)	12,08	16,6	12,5	13,3	9,28	8,5	9,6	10,4	9,96

CPUE data for other species are rarely available; they are summarized in the following tables 4, 5 and 6.

Table 4. Shark CPUE in the Gulf of Taranto – Swordfish longline (from FILANTI *et al.*, 1986)

Species	1978	1979	1980	1981	1982	1983	1984	1985
M mobular	0,067	0,040	0,009	0,016	0,007	0,009	-	-
L nasus	0,220	0,184	0,218	0,016	0,013	-	-	-
S zygaena	0,043	0,044	0,007	-	-	-	0,03	0,003
A vulpinus	0,096	0,047	0,021	0,004	0,007	-	-	-
H griseus	-	0,004	-	-	-	-	-	0,003

Table 5. CPUE values for other sharks caught in Ligurian Sea - Swordfish longline (modified from ORSI RELINI *et al.*, 1999; GARIBALDI and ORSI RELINI, 2000).

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
A. vulpinus	-	0,013	-	-	-	-	0,009	-	0,007
I. oxyrinchus	0,047	-	-	0,012	-	-	0,018	-	0,065
C. plumbeus		0,013	0,022						
L. nasus	-	-	-	-	-	-	-	-	0,007

Table 6. CPUE values for elasmobranchii - Driftnet (from DI NATALE *et al.*, 1998)

Species	Ligurian Sea	Tyrrhenian Sea and Sicily Straits
P. glauca	0,009	0,358
A. vulpinus	0,005	-
I. oxyrinchus	-	0,051
S. zygaena	-	0,691
C. maximus	0,001	-
P. violacea	0,022	0,691
M. mobular	0,005	-

At a Mediterranean scale, recent researches were carried out by BUENCUERPO *et al.* (1998), on the Spanish fleet harvesting sharks in the Eastern Atlantic Ocean and Gibraltar Strait, and by TUDELA *et al.* (2003), on the Moroccan driftnet fishery in the Alboran Sea. These two studies covered a limited time period (only one year of observations): results are summarized in tables 7 and 8 respectively.

Table 7. CPUE (n) of sharks caught in the Eastern Atlantic and Gibraltar Strait (modified from BUENCUERPO *et al.*, 1998).

SWOLL	Sectors	*P. glauca*	*I. oxyrinchus*	*A. vulpinus*	*A. superciliosus*	*S. zygaena*	Total sharks
Eastern Atlantic	1	6,17	3,03	0,013	0,09	0,62	9,92
	2	14,53	3,09	0,002	0,5	0,07	18,19
	3	30,69	4,78	0,015	0,22	0,85	36,55
	4	33,69	3,9	0,032	0,15	0,03	37,8
Gibraltar Strait	5	21,98	1,94	0,007	0,02	0,28	24,23
DN							
Gibraltar Strait	5	0,32	0,54	0,05	0,22	0,08	1,22

Table 8. Estimated CPUE (n) of the Moroccan driftnet fishery in Alboran Sea (from TUDELA *et al.*, 2003)

	P. glauca	*I. oxyrinchus*	*A. vulpinus*
CPUE	0,117-0,121	0,059 - 0,145	0,092 - 0,117

The only program specifically dedicated to monitoring shark by-catch in pelagic fishery (Project funded by EC 97/50 DG XIV C1) was carried out in Greece, Southern Italy and Spain during 1998 and 1999 fishing seasons. Main results of this survey are reported in MEGALOFONOU *et al.* (2005): CPUE values in number for swordfish long line are here summarized in Table 10. As authors pointed out, the highest shark by-catch was found in the Alboran Sea, confirming results obtained by Buencuerpo *et al.*, 1998.

Table 9. CPUE (n) in different Mediterranean areas – Swordfish longline (from MEGALOFONOU *et al.*, 2005)

Area	*P. glauca*	*I. oxyrinchus*	*A. vulpinus*	*G. galeus*	Other species
Ionian	0,53	-	0,001	-	0,003
Levantine	0	-	-	0,14	-
Adriatic	1	-	0,004	-	-
Tyrrhenian	0,27	-	-	-	-
Straits of Sicily	0,06	-	0,02	0,02	0,11
Balearic	0,07	0,04	0,01	0,003	0,001
Alboran	3,59	0,19	0,008	0,007	0,004
Catalonian	0,17	0,004	0,004	0,004	0,004
Total	1,24	0,05	0,006	0,003	0,002

Discussion

In Italian Seas and throughout the whole Mediterranean, shark by-catches are generally low if compared with those obtained in the adjacent Atlantic waters (BUENCUERPO *et al.*, 1998; MEJUTO *et al.*, 2002; MEGALOFONOU *et al.*, 2005). Swordfish longline present the highest number of by-catches, but, except in the Alboran Sea, percentage of sharks caught in relation to the target species is very low.

Everywhere CPUE values show a great variability, depending on species, year, gear and fishing areas, but there is not a definite and clear trend. Data on cartilaginous fish by-catch are heterogeneous and in most cases not strictly related to a valuable measure of fishing effort, so standardization is quite impossible; in many cases data sets derive from restricted geographical subareas, covering a limited time period. Thus there is a general lack of information about catches, distribution, biology and consistence of Mediterranean elasmobranch populations. This is mainly due to the small number of research programs specifically targeted to large pelagic fishery by-catch and consequently to the scarcity of comparable scientific data. There is a need of long-term monitoring programs, mainly carried out by the means of on board observers, avoiding the possible bias due to specimens discarded at sea, especially those of protected or no commercial species (*M. mobular*, *C. maximus*, *P. violacea*). Analysis of published historical time series shows a generalized decline of the Mediterranean sharks; the mean size of blue shark is dramatically dropping from the '80; for the other species, catches are so low and scattered that it is impossible to establish a clear trend, but it seems that for all the species the majority of specimens caught are immature. In large pelagic bony fish, mainly swordfish and bluefin tuna, there is so far many studies on population structure, age, growth, reproduction, spawning areas etc., which are the starting point for a correct stock assessment and management.

The same requirements are also needed for cartilaginous fish, but the fragmentation (temporal and spatial) of available data sets makes the stock assessment in the Mediterranean really hard.. Some important questions remain unsolved: what is the meaning of the variations in CPUE values and size of sharks depending on year, season and fishing areas? Are the Mediterranean shark populations isolated from the Atlantic ones? Does the Gibraltar Strait represent a phylogeographic break? So far we ignore the migratory routes and the eventual mixing ratio between Mediterranean and Atlantic populations of sharks or nursery areas. Considering the high swimming potential of the individuals, in the case of these highly migratory species we have to proceed with great caution in the identification of critical habitats.

Finally, considering the high survival rates recorded for sharks caught with longlines (MEGALOFONOU *et al.*, 2005; pers. observations), it could be possible to mitigate the impact of these fishing gears releasing live sharks at sea.

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SHARK RESEARCH PROGRAMME IN LIBYA

Bernard SERET[1] and Abdallah BEN ABDALLAH[2]

[1]Muséum National d'Histoire Naturelle, Département Systématique et Evolution, UMS 602 « Taxonomie et Collections », Case postale n° 26, 43 rue Cuvier, 75231 Paris cedex 05, France. E-mail: seret@mnhn.fr
[2]Marine Biology Research Center (MBRC), P.O. Box 30830, Tajura/ Tripoli, Libya

Cartilaginous fishes have traditionally been consumed in Libya, mainly sharks, guitarfishes and some stingrays. However, very little is known about the Libyan cartilaginous fishes, and no particular study has been so far dedicated to these fishes. Also there is no quantitative fisheries data on the landings and catches of these fishes although they constitute important resources within Libyan fisheries. Because of these lacks, the Marine Biology Research Centre of Tripoli (MBRC) and the Environment General Authority of Libya (EGA) were willing to jointly undertake a research programme on the cartilaginous fishes of Libya. In this context, the Regional Centre for Specially Protected Areas in Tunis (RAC-SPA) supported an expertise mission in June 2005, in order to consider the conditions of the feasibility of such a study and to determine the content of an adapted research programme to be jointly carried out by MBRC and EGA. As a result of this expertise, a research programme on cartilaginous fishes of Libya has been proposed. It includes three parts: a systematic inventory of the chondrichthyan fishes of Libya, the biological study of some selected species and the record of fishery data. The programme should provide the basic information and data necessary to manage the shark and ray fisheries and to possibly monitor the conservation of some of their populations or species. The conditions to launch such a research programme in Libya are quite propitious because of the relatively high biodiversity of these fishes in Libyan waters and the apparently "good health" of their populations; also, the human and logistic capacities of both MBRC and RGA would contribute to the achievement of this programme, which should start in Spring 2005 for a period of two years. This programme could be considered as a pilot study in the frame of the implementation of the « Action Plan for the conservation of the cartilaginous fishes in the Mediterranean Sea » as defined by RAC –SPA in 2002.

CONSERVATION MANAGEMENT OF SHARKS AND RAYS (VERTEBRATA: CHONDRICHTHYES) IN THE MALTESE ISLANDS (CENTRAL MEDITERRANEAN) – A REVIEW OF STATUS AND TRENDS

Titian SCHEMBRI

University of Malta, Malta

Introduction

Although research on chondrichthyan fishes in the Mediterranean is sparse, enough information exists to suggest that most grow, mature and recruit very slowly when compared to the more commercially important groups of teleost fishes. This implies that chondrichthyans have a low resilience and are therefore more vulnerable to exploitation than most commercial fish species. Added to this, many species, especially sharks, are top predators and thus normally have low numerical abundances. Thus shark populations need careful monitoring to ensure that they survive the impact of human exploitation.

Located centrally in the Mediterranean Sea, close to the boundary between the western and eastern basins, the Maltese Islands afford a well placed sampling point for the region's ichthyofauna. From as early as the 18th Century, naturalists, fishers and enthusiasts have compiled lists of the fish fauna of the Maltese Islands (SCHEMBRI *et al.*, 2003). Unfortunately, while research on chondrichthyan biodiversity has improved our knowledge on which species are present in the Central Mediterranean, much remains to be discovered about population dynamics.

Biodiversity Studies

In a recent scientific review of records of sharks and rays from the Maltese Islands, SCHEMBRI *et al.* (2003) stressed the need for compiling an accurate inventory of the species that occur in a given region as the basis for the implementation of management initiatives, including conservation and food production. Most publications that mention the chondrichthyans of the Maltese Islands, however, are general descriptive accounts of Maltese fisheries, or reports on the economic status of these fisheries issued by the Maltese authorities or are of a primarily cultural nature; others, while more scientific, included outdated records that had not been substantiated by live specimens.

In order to address this problem, a long-term study of the fish fauna of the Maltese Islands was carried out in which the evaluation of previous records was sought by examining and accurately identifying specimens caught by fishers or seen by the authors, and those kept in museum collections. Photographs of caught specimens but which were not preserved were also considered. Out of 37 species of sharks and 26 species of rays previously recorded from Malta, 26 sharks and 14 rays were authenticated (SCHEMBRI *et al.*, 2003). Other records have yet to be validated.

Confirming certain species (for example, *Centrophorus uyato*) proved elusive mainly because these sharks are also caught from northwest of the Sicilian channel and thus specimens landed in Malta may originate from outside Maltese waters. Records of species such as the Basking shark (*Cetorhinus maximus*), while obviously valid, may be outdated as this species has not been observed in or around local waters since 1928 (DESPOTT, 1930).

What is certain is that determining the status of chondrichthyans from fisheries landings data is not always possible as data on individual species is not available in some cases.

Data Collection

Since to date no census has been carried out to determine the status of local chondrichthyan populations, data from Maltese waters depends entirely on the landing records collected by the Government's fisheries agency and the trends emerging from such data over several years. While the accuracy of the landing records collected has improved greatly over the past few years, these records are not yet reliable enough to be used as an accurate estimate of the status of local populations. Some of the current major problems are:

- Non-commercial species, and those species which inhabit regions not exploited by fishers, are not landed. Thus, referring to a particular species as "rare" simply because it is seldom landed is often misleading.
- Not all the species landed are recorded through the official channels. Some are sold or cut up before landing, others are thrown away[2].
- Some closely related species are lumped together in the official records, making it difficult to collect data on a particular species and/or populations.
- Trends showing an increase or decrease in landings do not always reflect a similar change in the overall population, as landings depend on a number of factors other than population abundance, namely the fishing effort, the commercial value of the species and market considerations (which are subject to variation) and the fishing gear/methodology (which may also vary with time).

Maltese Fisheries

Fishing in the Maltese Islands is mainly centred upon coastal or small-scale fisheries, which are largely seasonal. Several species of chondrichthyans are either landed as by-catch during the seasons involving the highly commercial landings or are targeted in their own right. The Bluefin tuna, *Thunnus thynnus thynnus* (May and July), and the Dolphin fish, *Coryphaena hippurus* (September to December), seasons are the most commercially important for the Maltese market, both because of the amount of fish caught and for the income generated by the catch. Other seasons that are less important but still provide a significant contribution to the catch and income include the

[2] An example of this is the Bigeye thresher shark (*Alopias superciliosus*). Since the flesh of this species is unmarketable, fishers are fined if it is present in their catch. It is thus thrown back if caught and there are no landing data for this species.

demersal species season (January to April), the Lampara season (March to July) and the Swordfish, *Xiphias gladius*, season (September to November; SCHEMBRI *et al.*, 1999)

The most widely used gear includes long-lines, which involves unravelling a long line of baited hooks. These are set adrift for pelagic species and close to the bottom for demersal species (SCHEMBRI *et al.*, 1999). This technique is mainly used for Bluefin tuna and Swordfish, while a deep-sea version (with the line just a few meters off the seabed) is used for species collectively termed 'Dogfish' (Hexanchidae, Squalidae, Scyliorhinidae and Triakidae), Stone bass, Grouper and Snappers (the larger species of Serranidae) and other demersal species. The larger boats that venture beyond 25 nautical miles and remain at sea for at least 5 days may set as many as 2000 hooks at any time, weather permitting. Smaller craft spend a maximum of three days at sea and set between 500 and 700 hooks per effort (SCHEMBRI *et al.*, 1999). During the Bluefin tuna and Swordfish season, large pelagic sharks are occasionally landed as by-catch. These generally include Mako sharks (*Isurus oxyrinchus*), Porbeagle sharks (*Lamna nasus*), Thresher sharks (*Alopias vulpinus*) and Blue sharks (*Prionace glauca*). A stronger version of the pelagic long-line is used specifically for large sharks such as Blue sharks (*P. glauca*), Thresher sharks (*A. vulpinus*), Requiem sharks (Carcharhinidae) and Mako sharks (*I. oxyrinchus*).

The 'Kannizzati' (used mainly for Dolphin fish) and 'Lampara' methods both involve encircling a given area where fish accumulate with nets, but the size of mesh and the materials used differ. Floating 'Fish Aggregating Devices', or FADs, are used to attract Dolphin fish as these fish seek shade. The Lampara method, which derives its name from the bright lamp used to attract mainly Bogue (*Boops boops*) and Mackerel (*Trachurus* spp., is not now much in use, mainly because other, more economical methods proved as effective. Sharks are seldom landed by the Lampara method.

Bottom trawling takes place in the winter months. Shallow coastal waters are trawled for demersal species in autumn/winter. Several species of rays and a number of the smaller 'dogfish' species (Squalidae, Scyliorhinidae) may be landed with this method.

Drift nets are used during May to August for specific pelagic species. Pelagic sharks are sometimes caught as by-catch.

Recent Trends In Fisheries Landings

Data on fish catches are compiled by the Government's fisheries agency, which at present is known as the Department of Fisheries and Aquaculture. Statistical data on fish landings are collected through the Wholesale Fishmarket in Valletta. The data presented in figures 1 and 2 only cover landings in Malta as there is still, to date, no equivalent market in the sister island of Gozo. Furthermore, a part of the catch is not recorded for various reasons that are beyond the control of the Department of Fisheries and Aquaculture (SCHEMBRI *et al.*, 2002). It is assumed that at least 25% of all catches goes unrecorded.

Figures 1 and 2 show the trends for all cartilaginous species as given in the Malta State of the Environment Report 2002 (SCHEMBRI *et al.*, 2002). The different species landed under the general category 'dogfish' include several species of the families Scyliorhinidae, Squalidae and Triakidae. Since data for separate species is not available, they are shown here as one group. Rays and skates are also grouped together. Torpedo rays (*Torpedo* spp.), Long-nosed skates (*Dipturus oxyrinchus*) and small rays (*Raja* spp.) are fairly common on the market, the most common by far being members of the family Rajidae (of which the main species landed are *D. oxyrinchus*, *Raja asterias*, *Raja miraletus*, *Raja montagui*, and *Raja radula*).

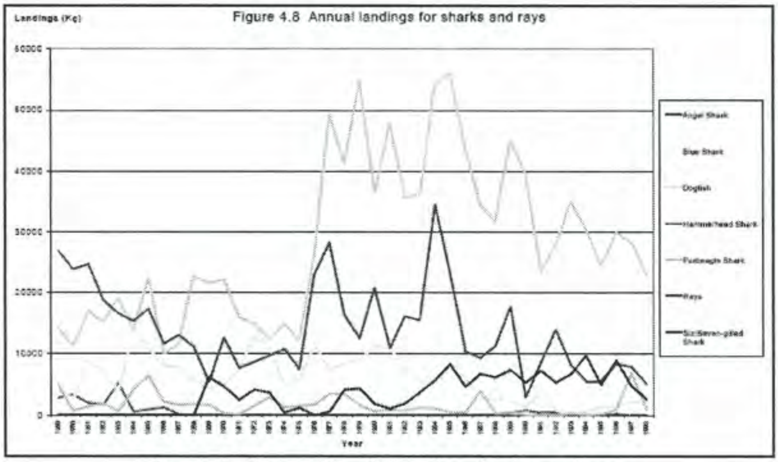

Figure 1. Annual landings for sharks and rays.

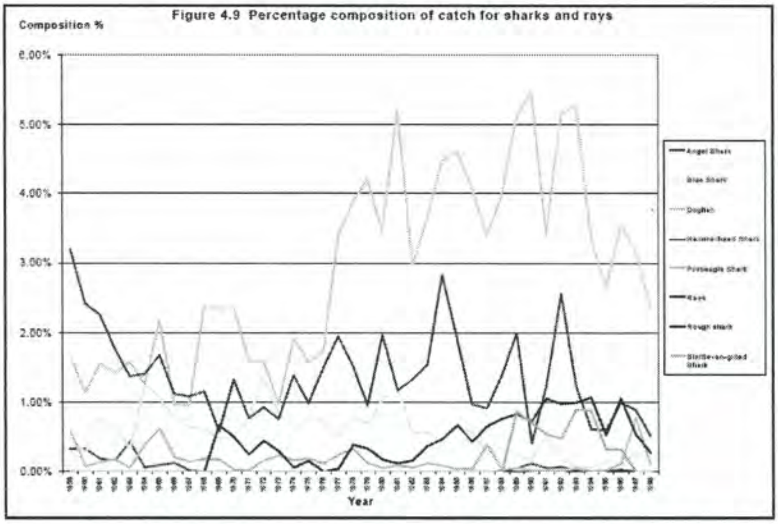

Figure 2. Percentage composition of catch for sharks and rays.

From Figures 1 and 2 the following trends are evident:

Angelsharks (*Squatina* spp.) disappeared from the records for a number of years. However, this does not mean that they were not caught. The amount landed yearly decreased to the point where records were grouped with those of other species, and were not reported separately. Whether this decline is due to a change in fishery practice or whether it reflects a change in abundance is not known but fishers comment that Angelsharks are not as common as they used to be (Various fishers in personal communication with the authors).

There is a slight increase in the catches of Blue Shark (*Prionace glauca*) but a decrease in those of the 'dogfish' species. Whether this is a reflection of changes in abundance or a decrease in fishing effort remains to be seen.

A slight increase in Porbeagle sharks (*I. oxyrinchus*, *L. nasus*, *Carcharondon carcharias*) in 1997 is countered by a severe dip in 1998.

Rough shark (*Oxynotus centrina*, *Centrophorus granulosus*, *C. uyato*) catches have also decreased while no recent data are available for the Six- and Seven-gilled sharks; since 1997, these species were merged with those in the 'Dogfish' or 'Other fish' categories.

The weight (in kg) of sharks and rays passing through the Valletta Wholesale Fishmarket for the period 1996-2001 are given in figures 3 to 7.

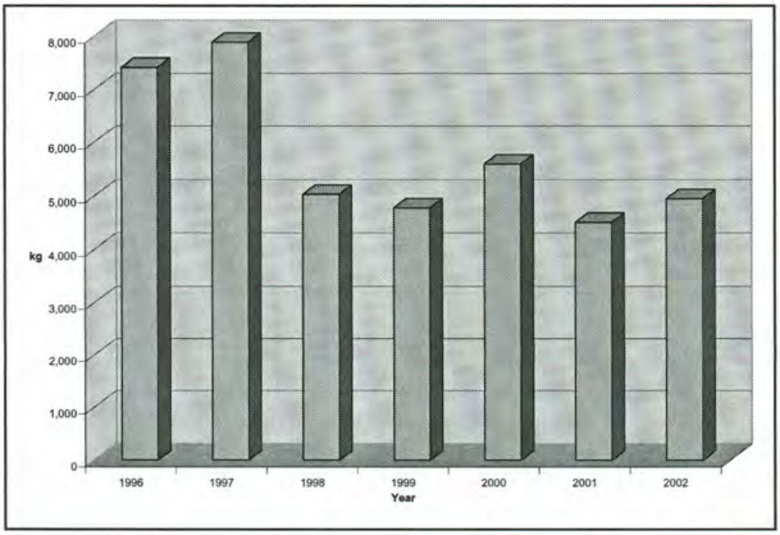

Figure 3. Annual landings for rays and skates.

Rays and Skates (Figure 3) – The graph shows a slight decline between 1996 and 2002. Rays and skates are landed throughout the year, but more commonly during the demersal season (i.e. January to April) and during spells of bad weather, when fishing is carried out closer to shore and bottom long lines are used. The most common species caught include members of the genera *Torpedo* and *Raja*.

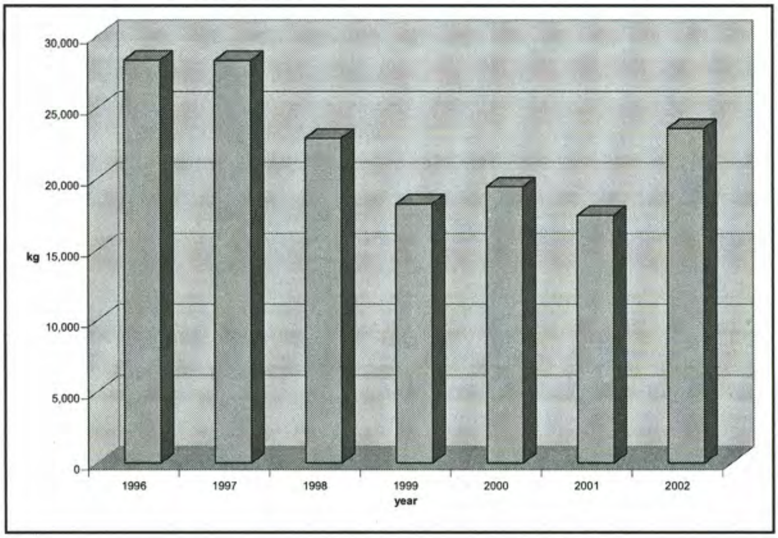

Figure 4. Annual landings for dogfish.

Dogfish (Figure 4) – The graph shows a decline from 1996 to 2001, followed by a slight increase in catch in 2002. Like the rays and skates, dogfish are landed mainly during the demersal season, but may be encountered in smaller numbers throughout the year. During the last few years the Six-gilled and Seven-gilled sharks (*Hexanchus griseus* and *Heptranchias perlo,* respectively) were included in this category, which explains their disappearance from the records after 1997 (Figures 1, 2).

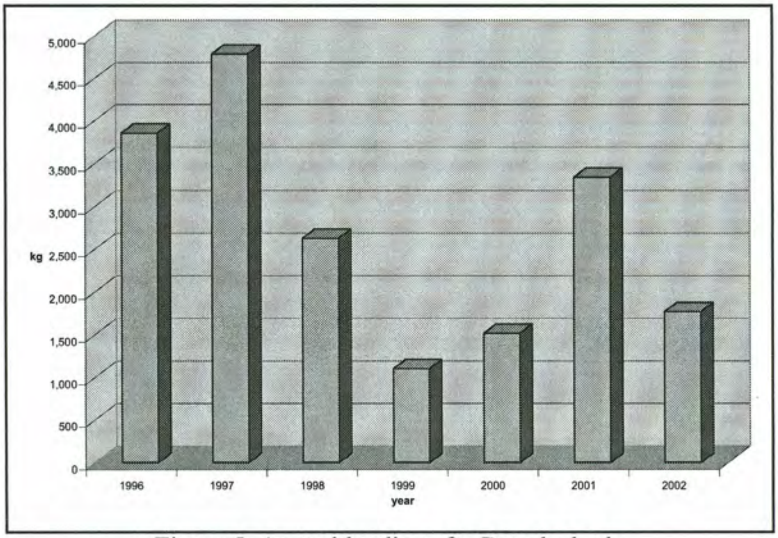

Figure 5. Annual landings for Rough shark.

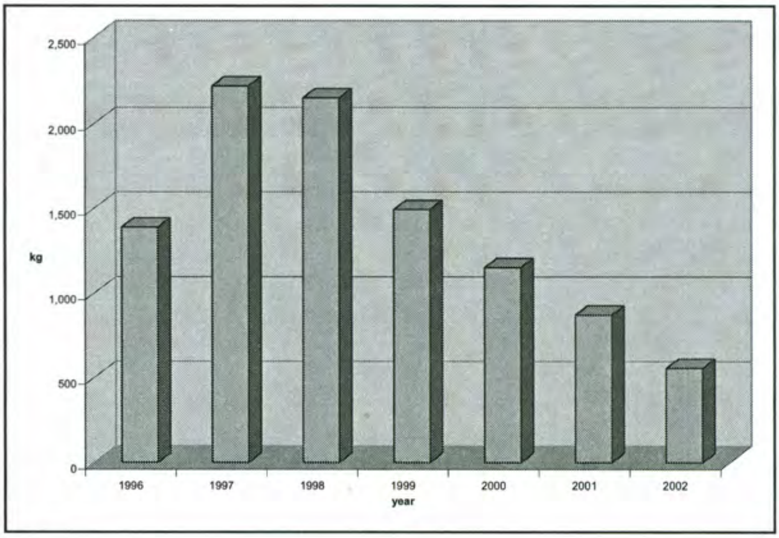

Figure 6. Annual landings for Blue shark.

Roughshark (Figure 5) – This graph shows a general decline between 1996 and 2002. "Roughshark" generally refers to Gulper sharks (*Centrophorus granulosus* and *C. uyato*), although occasional landings of other species of deep sea Squalidae and the Angular rough shark (*Oxynotus centrina*) may also be included.

Blue shark (Figure 6) – It is interesting to note the decreasing trend in Blue Shark landings after 1997, although the reason behind this decline remains to be ascertained.

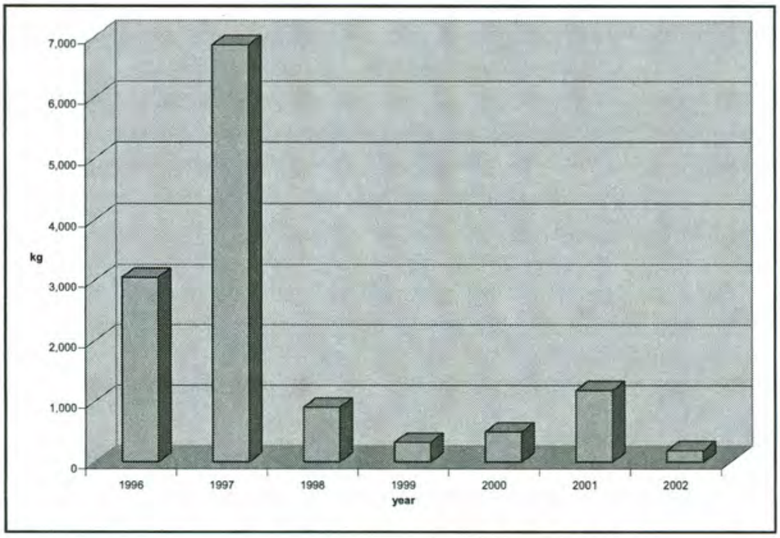

Figure 7. Annual landings for Rough shark.

Roughshark (Figure 7) – It is not clear whether this category includes all the species of the Lamnidae, or whether only the Mako shark (*I. oxyrinchus*) is caught in amounts significant enough to appear in the statistical reports[3]. A general decrease is also present in this category after 1997 (Figure 7), but the reasons for this are not yet known. Fishers comment that Makos (*I. oxyrinchus*) and Porbeagles (*L. nasus*), which share the Maltese vernacular "Pixxiplamtu" and are thus reported collectively under this name, decreased considerably (to the point of becoming scarce) in the last 20 years (Fishers, pers.comm.).

Current Legislation

Before the 1990s, national legislation concerning the protection and conservation of flora and fauna was rather limited in Malta (SCHEMBRI *et al.*, 2002).

A new Environment Protection Act (Act XX of 2001) was published on the 18th September 2001 (Chapter 435 of the Laws of Malta). This Act is essentially a framework law with various mandatory provisions granting the Minister responsible for the environment the possibility of issuing subsidiary legislation on various issues related to, amongst others, the protection of biological diversity, integrated pollution prevention and control, waste management, genetically-modified organisms and environmental audits. Many of the provisions at the time were novel issues in Maltese Law, and were first introduced into national legislation through this new act (SCHEMBRI *et al.*, 2002).

Legal Notice 257 of 2003 published under the Environment Protection Act issued a set of regulations called the Flora, Fauna and Natural Habitats Protection Regulations. *C. carcharias*, *C. maximus* and *Mobula mobular* are listed under Schedule V of these Regulations, which means that they are protected in Maltese waters and may not be disturbed or harmed in any way. Another 11 sharks and 3 rays are listed under Schedule VI, which lists those species whose exploitation may be subject to regulatory measures to ensure a favourable conservation status. Such measures include temporary prohibition of capture, regulation of fishing seasons and fishing methods, regulation of licences and landings quotas, and any other method deemed necessary. Table 1 lists a number of species that fall under Schedules IV and V of these regulations.

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[3] For example, several members of the Carcharhinidae (*Carcharhinus brevipinna*, *C. obscurus*, *C. limbatus*) and the Thresher shark (*Alopias vulpinus*) are certainly landed (Fishers, pers. com.), but do not appear anywhere in the statistics. Up to the time of writing, the author could not ascertain whether they are recorded under other names or simply not included, perhaps because the figures are too low.

Table 1. Shark and ray species listed under the Flora, Fauna and Natural Habitats Protection Regulations

Scientific name	Vernacular name (Malt.)	Vernacular name (Eng.)
Schedule V		
Carcharodon carcharias	Kelb il-Bahar	Great White Shark
Cetorhinus maximus	Pixxitonnu	Basking Shark
Mobula mobular	Baqra; Manta; Raja tal-Qrun	Devil Ray
Schedule VI		
Alopias vulpinus	Pixxivolpi	Thresher Shark
Carcharias Taurus	Tawru	Sandtiger Shark
Carcharhinus brevipinna	Kelb il-Bahar	Spinner Shark
Carcharhinus limbatus	Kelb il-Bahar	Blacktip Shark
Carcharhinus plumbeus	Kelb griz	Sandbar Shark
Galeorhinus galeus	Kelb il-Bahar	Tope Shark
Hexanchus griseus	Murruna ta' Sitt Gargi	Bluntnose Sixgill Shark
Isurus oxyrinchus	Pixxitondu	Shortfin Mako Shark
Lamna nasus	Pixxiplamtu	Porbeagle Shark
Prionace glauca	Huta Kahla	Blue Shark
Pristis pristis	Pixxisega; Pixxiserrieq; Sija	Common Sawfish
Rostroraja alba	Raja	White Skate
Leucoraja melitensis	Raja ta' Malta	Maltese Brown Ray
Squatina squatina	Xkatlu	Angel Shark

The Fisheries Conservation and Management Act (Act II of 2001), which replaced the Fish Industry Act (Act XII of 1953 as amended, Chapter 138 of the Laws of Malta), relates to the conservation, assessment and management of fish stocks, where 'fish' means "any aquatic animal, whether piscine or not, and includes shellfish, crustaceans, sponges, sea urchins, turtles, aquatic mammals and their young, fry, eggs or spawn and shells and parts thereof and fish meal".

By virtue of Article 38 of this Act, the Minister responsible for fisheries may make regulations, on, amongst others, the conservation, management and protection of fish resources including the establishment of closed areas and closed seasons, the establishment and management of marine areas for the preservation of fish stocks, including their means of sustenance; the control of the exploitation of coral and sponge resources, and the protection of turtles, dolphins "and other aquatic animals". These provisions overlap considerably with those of the Environment Protection Act.

Current Initiatives

Species Action Plan Programme

This programme, initiated by the Malta Environment and Planning Authority in 1998, involves specific management plans for the protection of endangered species and their habitats and eradication control plans for invasive alien species. This programme is being implemented in phases. Currently, the identification of endangered species requiring special conservation measures for their long-term survival is being carried out (SCHEMBRI *et al.*, 2002).

In 2003 a call for tenders for a National Biodiversity Database was issued by the Malta Environment and Planning Authority. Included among these was a call for a Biodiversity Database on fish, including chondrichthyans. This database is still under construction and should be complete by the end of 2006. The database will serve as a tool for identifying species in critical conservation status and as a reference tool for future research projects with conservation as their main aim.

Discussion

Although strategies for the conservation of a number of named species can be drafted and may eventually be implemented, ascertaining whether such strategies are having a significant effect on the status of a population or not, requires close monitoring. The conservation status of local populations of chondrichthyans is currently unknown, for the various reasons given above. Therefore the next step towards implementing measures to improve their conservation status around the Maltese Islands should be to carry out pilot surveys to identify which populations are in critical need of conservation management.

These surveys should be carried out while keeping disturbance levels to an acceptable minimum level. Once the factors having a detrimental effect on the populations are identified, realistic methods (such as regulations, landings quotas, etc.) for improving local stocks can be implemented. Other data to be collected include identification of nursery areas, chances of survival after release, and distribution.

Direct observation, tagging, capture-recapture, photographic recording, and interviews with local fishers and divers are all useful tools for collecting data about local chondrichthyan populations. Fishers should also be instructed on the detrimental effect of certain practices to help them understand why certain measures are necessary and to ensure their cooperation. Adequate compensation, should the release of certain species caught have an impact on the profit margin of local fishers, can only be negotiated and agreed through open dialogue between the parties involved. Volunteers (for example from local NGOs and divers' clubs) must also be trained in species identification. This can be achieved through short courses involving theory and practical exercises and/or field identification guide books.

Data collected through these means can then be used to augment the already-existing databases and to promote further research projects and implement legislation and regulations to improve local stocks.

Conclusion

It is evident that at present, data collected by the Fisheries Department, while sufficiently detailed as the basis for the statistical information published annually by the National Statistics Office, is not reliable enough to be used as a quantitative indicator of shark and ray population trends. Albeit in recent years a reorganisation of the system used to collect landings data has improved matters, many distantly related species are still lumped together. Also, some species belonging to the same family are recorded under the same vernacular name, thus limiting the use of landings data for population assessment.

Although a number of alarming trends emerge when the annually collected fisheries landings statistics are examined, most notably the decline in Blue shark, Hammerhead shark and Porbeagle shark landings, it is still not fully clear whether the population status of these species is in danger of becoming critical or not. Certainly fishers have noted a distinct decline in occurrence over the last twenty years and the trends seem to confirm this.

The extent and nature of the decline in landings must be ascertained as a first step towards compiling a strategic plan whereby sustainable fishing activities can continue while the conservation of local populations of sharks and rays remains a realistic goal. Now that a significant number of shark and ray species have been confirmed for the Maltese Islands (SCHEMBRI *et al.*, 2003), a quantitative study of the populations of these species is due.

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GENERAL OVERVIEW OF SHARKS LANDING AND RESEARCH PROGRAMME IN MOROCCO

Amina MOUMNI, Abdelhakim MESFIOUI and Said SEMMOUMY

Institut National de Recherche Halieutique 2, Rue de Tiznit/ Casablanca, Morocco

Abstract

In Morocco, sharks were not targeted due to the fact that their value is not so important. Nowadays, this fishery has undergone a great change and it gained some importance. Since 1980, annual catches of sharks in Morocco have increased in spite of the fact that the landings are generally dominated by-catch. In 2000, the catches were 3400 tons. Over 30 species are identified along Moroccan coasts. The important catches are realised at the Atlantic coast.

Pelagic sharks are caught primarily as by-catch in the swordfish and tuna longline fisheries; landings come primarily from a developing directed longline fishery. Benthic sharks are mostly catch by trawl.

Morocco has understood a shark research programme in 2001 focused on the study of the biology and ecology of the most dominates species in the capture.

Key words: Landing, assessment, IPOA-Sharks.

Introduction

In Morocco, sharks were not targeted due to the fact that their value is not so important. Nowadays, this fishery has undergone a great change and it gained some importance (KIFANI, 1999).

As regards the biology aspects, sharks remain largely under-studied fishes and their conservation status has not been fully assessed.

Sharks Landings in the Fishing Port

Since 1980, annual catches of sharks in Morocco have increased in spite of the fact that the landings are generally dominated by-catch. In 2000, the catches were 3400 tons (KIFANI, 1999).

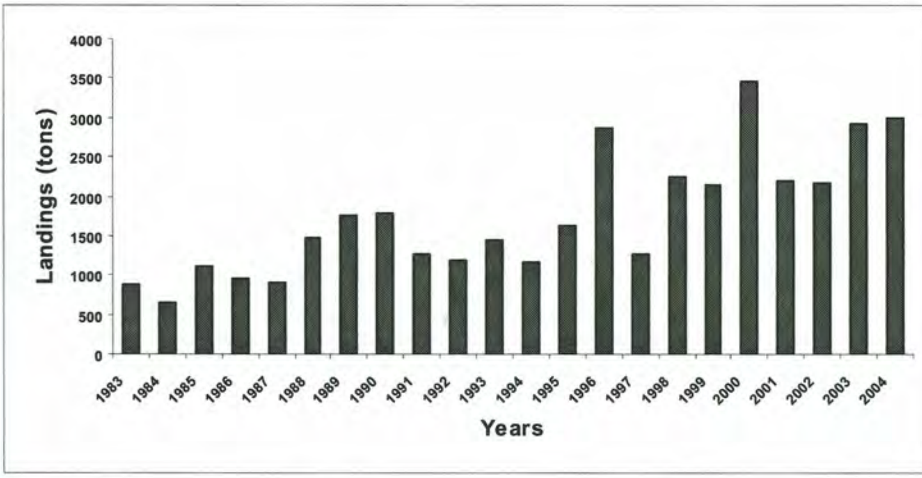

Figure 1. Annual landings of sharks in Morocco from 1983 to 2004 (Statistics ONP).

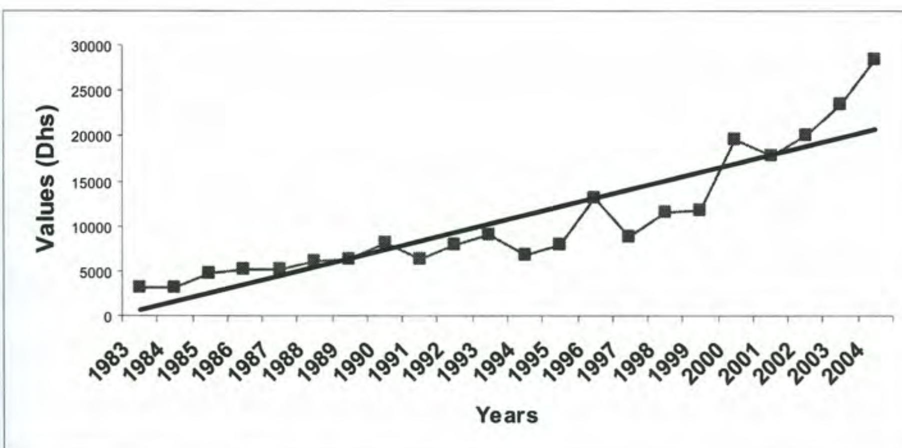

Figure 2. Annuals Values of landings in Morocco from 1983 to 2004 (Statistics of ONP).

The landings at the fishing port are given in figure 3. We can notice that the important catches are realised at the Atlantic coast. In the contrary, the catches at the Mediterranean region aren't very important by comparison to the Atlantic side.

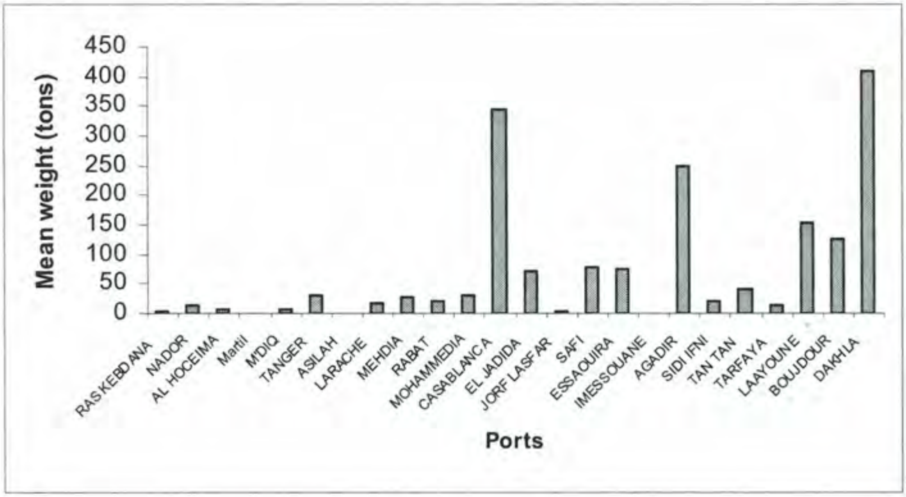

Figure 3. Mean weight (Tons) of shark landings in Moroccan fishing ports from the 1983 at 2004 (Statistics of ONP).

Moreover, the value of sharks at the fishing ports at the Mediterranean side is higher than the Atlantic side.

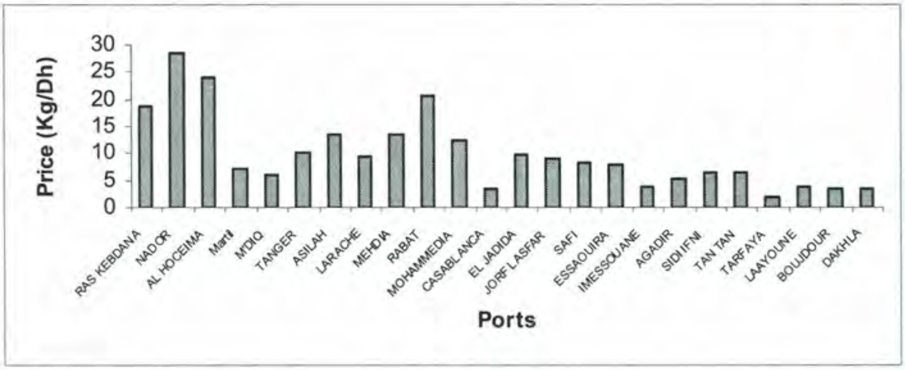

Figure 4. Mean price (Kg/Dh) of shark landings in Moroccan fishing ports: series 1983-2004 (Statistics ONP).

Specific composition of shark landings

Over 30 species are identified along Moroccan coasts (KIFANI, 1999) (Table 1).

Table 1. Some important species in Moroccan coasts

Scientific names	Common names	Ecological status
Alopias vulpinus (Bonnaterre, 1788)	Bigeye thresher	Pelagic
Carcharhinus altimus (Springer, 1950)	Bignose shark	Epipelagic
Carcharinus obscurus (Lesueur,1818)	Dasky shark	Benthopelagic
Cethorhinus maximus (Gunnerus,1765)	Basking shark	Pelagic
Centrophorus granulosus (Bloch and Schneider,1801)	Gulper shark	Benthic
Centrophorus uyato (Rafinesque,1810)	Little gulper shark	Benthic
Centrophorus squamosu (Bonnaterre, 1788)	Leafscale gulper shark	Benthic
Daenia calceus (Lowe,1839)	Birdbeak dogfish	Benthic
Dalatia lichia (Bonnaterre, 1788)	Kitefin shark	Benthic
Galeorhinus galeus (Linnaeus,1758)	Tope shark	Benthopelagic
Galeus melastomus Rafinesque,1810	Blackmouth catshark	Benthic
Heptranchias perlo (Bonnaterre, 1788)	Bluntnose sevengill shark	Benthic
Hexanchus griseus (Bonnaterre, 1788)	Bluntnose sixgill shark	Benthic
Isurus oxyrinchus Rafinesque, 1810	Shortfin mako	Epipelagic
Mustelus asterias Cloquet, 1821	Starry smoothhound	Benthic
Mustelus mustelus (Linnaeus,1758)	Smoothhound	Benthic
Prionace glauca (Linnaeus,1758)	Bleue shark	Pelagic
Scyliorhinus canicula (Linnaeus,1758)	Smallspotted catshark	Benthic
Sphyrna zygaena (Linnaeus,1758)	Smooth hammerhead	Pelagic
Squalus blainvillei (Risso,1826)	Longnose spurdog	Benthic

Fishing Gear

Pelagic sharks are caught primarily as by-catch in the swordfish and tuna longline fisheries; landings come primarily from a developing directed longline fishery. Benthic sharks are mostly catch by trawl (SROUR, 1986).

In the SW Mediterranean coast of Morocco (Alboran sea), TUDELA *et al.* (2005) undertake a study of the large-scale Moroccan driftnet fleet between December 2002 and September 2003; he attest that 498 blue sharks (*Prionace glauca*), 542 shortfin makos (*Isurus oxyrinchus*), and 464 thresher sharks (*Alopias vulpinus*) were caught during the sampling period, during the peak of the swordfish fishery.

We noted that sharks are mostly targeted by artisanal fisheries using line, longline and driftnet.

Research Program in Morocco

The International Plan of Action for Conservation and Management (IPA-Sharks) developed by FAO in 1998, engaged countries to elaborate National Plan

Action regarding the conservation and Management of the shark populations of Sharks (FAO, 1998).

In this context, Morocco by The National Institute of Marine Halieutic Research undertakes a shark research program in 2004, as a diagnostic. This program will be a basis of elaborates the National Plan Action.

Objectives of the programme

In terms of their biology, sharks remain largely under-studied fishes and their conservation status has not been fully assessed. In commercial terms, data on shark landings are mostly mixed with that of skates, rays and chimaeras and grouped in a rubric "Squalls". Therefore, the aims of this programme are the following:

- The improvement of biological and statistical data;
- The evaluation of the exploitable potential of resources;
- The estimation of the global impact of this fishery.

Methodological Approach used

There are steps in the process of implementing this program.

The methodological approach consists first on collecting information and data. It's based on:

- Sampling in the fishing port and in the vessel research, it consist on doing the specific composition, collecting biological material
- Investigation in the fishing ports: It concerns the fishing area, fleet, number of trips, bottom, nature of bottom

The second stage of this programme will focus on the study of the biology and ecology of the most dominates species in the capture.

On the basis of these parameters and statistics, we can estimate the exploitable potential of this fishery as well as the state of exploitation.
These components are essential for us to be able to elaborate the action plan for the management of this fishery.

Concerning this step, we started the study at Casablanca fishing port because it considered as the most important port in term of commercial activity. And then, we will consider prospecting other ports.

- Mediterranean side: Nador – Tanger
- Atlantic side: Laayoune – Dakhla

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ESTABLISHING AN INFORMATIVE (SAMPLING) NETWORK FOR THE ASSESSMENT OF THE STOCK STATUS OF SHARKS: A REVIEW

David MACÍAS and M. Jósé MELENDEZ

Instituto Español de Oceanografia (IEO), Spain.

The information about trends in the abundance of a determinate species population is one of the most important issues to assess the species status. Knowing the status and recent trends in the abundance of a given species is essential to manage and protect such species.

Planning programs, protocols and sampling forms to collect the information from the fisheries must be done taking into account the following factors:

- Source of information (Fishery-dependent sampling or fishery-independent data)
- Data type
- Fishing gear

Sources of Information

1. Fishery-Dependent Sampling

Fishery-dependent data collection is one of the most valuable tools available to fishery managers.

The management plans based on fishery-dependent sampling will only be as good as the data collected. It is critical to determine which one is the most important data to be collected and implement some system of data recording before overfishing occurs.

From a general point of view five methods are used in the collection of fisheries and biological data:

1. Fisheries observers
2. Shore and dockside sampling
3. Local fishery authorities data
4. Logbooks
5. Telephone and dockside surveys.

Each one has positive and negative aspects, and the decision to use one or other usually depends on the size of the vessels, the duration of the fishing trips, the type of data to be collected, and the fundings available to support the data gathering.

Usually a combination of two or more methods is required for adequate data gathering.

1. 1. Fisheries observers

Fisheries observer programs are used worldwide to collect high quality fisheries data including:

- biological data
- species composition
- discards

Observers can collect a variety of information, including:

- fishing location and depth
- time of sets and haul back
- oceanographic data (e.g., water temperature and salinity)
- type and amount of gear used
- effort data
- changes in the gear or fishing strategy
- species identification
- catch vitality
- discards quantification
- total catch data (Commercial plus discards)
- sex ratios
- lengths and weights
- maturity and biological samples
- Phothographic matherial
- Fishers awareness about fisheries management requirements

Observers are extremely beneficial to management programs because of the amount and accuracy of the information they collect. However, observer programs can be expensive, time consuming, and impractical if the boats in the fishery are too small (i.e., if they have space problems).

1. 2. Shoreside sampling

Shoreside sampling is very useful in fisheries where sharks are landed whole, such as recreational and some artisanal fisheries. However, sharks are often dressed at sea and are landed headed and gutted, which can give rise to significant problems for land based sampling since species identification, sex, fork and total length, reproductive sampling, as well as at-vessel vitality cannot be determined.

If sharks are landed intact, then a shore-based data collector can produce many of the same data as an onboard observer. These data are:

- commercial data
- accurate identification of commercial species
- sex ratios
- lengths and weights
- Maturity data

Additional data, such as fishing location and depth, type of gear used, etc. can be gathered by interviewing the fishers.

1. 3. Data from the local fishery authorities

The local authorities usually gather data about landing of each commercial species. This information usually consists of temporal series of total fleet landing of each commercial species.

The main problems of this kind of data are that they:

- Lack of data on discards
- Lack of data on by-catch of non commercial species
- Do not include data about fishing operations, gear and effort
- Errors in the identification of species.

1. 4. Logbooks

Logbooks are used in many fisheries, but data they gather are highly variable. Despite this, logbooks are commonly used in stock assessments and as the major data collection source in numerous fisheries. Fishers are required to fill out logbooks while at sea. The following data can be recorded in logbooks:

- species identification
- number caught
- sex ratios
- size
- disposition
- gear and amount used
- gear modifications
- location
- time of set and haul back
- depth and water temperature

It is widely recognized that fishers do not always record accurate data, as they under-report their catches, and frequently identify species incorrectly.

1. 5. Telephone and dockside sampling

Telephone or dockside surveys are often used to monitor recreational fishers and involve either calling or going to the docks and interviewing fishermen about their trips as they come back in. Surveyors usually ask questions about the species targeted and catch composition, type and amount of gear employed, gear modifications and lengths, and size of the vessel. This is a very basic type of data collection and there are real problems associated with the poor quality of the data.

As in logbook data, this type of data gathering is relatively inexpensive and provides a reasonable alternative to more expensive methodologies.

2. Fishery-Independent Sampling

Fishery-independent estimates of abundance are the cornerstone of many stock assessments for teleost and shellfish species. Fishery-independent surveys provide valuable measures of relative abundance, rates of population change, size and sex composition for a wide range of species. As these measures are obtained from experimental designs, they are less subject to uncertainty. For a variety of reasons, fishery-independent surveys for elasmobranchs are more difficult to interpret than surveys for teleosts.

There are two primary uses of fishery-independent surveys.

1) The first use is to generate an estimate of population abundance. Estimate relative density can be used to infer trends over time and calibrate numerical population models, but for this the target population and area must be well defined. Otherwise inferences are restricted to population available to area sampled.

2) The second use of fishery-independent surveys is to examine attributes of the sampled population (such as size frequency, maturity, sex ratios and age). These attributes help us to understand the basic biology of species and to define the developing life history of models (RAGO *et al.*, 1998).

Derived indicators of abundance are used to calibrate various population models for teleosts. However, these have less applicability for elasmobranchs for a number of reasons, as many of the characteristics of their life history can distort the interpretation of such data.

3. Type of Data

3. 1. Catch estimates

Several key factors are used to determine the status of a fishery. Among these factors are the catch estimates for both target species and any other bycatch involved in the fishery. Each individual fishery should maintain a continuous database that includes all reported catch, estimates of discard, and estimates of non-reported catches.

Catch estimates are used to:

- illustrate the species composition of individual fisheries
- set rates of each captured species
- monitoring quotas
- estimate fishing mortality
- calculate Catch Per Unit Effort (CPUE)

These estimates include all fishes retained or discarded.

Catch estimates allow managers to determine the current status of a fishery and can also be used to show historical trends in the fishery, and <u>estimate the population abundance</u>. These numbers can also be integrated into models to predict the outcome of future management plans or to estimate the effect current management will have on the stock. At-sea catch estimates often give a very different view of what is actually happening in a fishery as compared to landings (marketed catch) data. Bycatch is a common side effect of directed fisheries. Sharks are commonly caught as bycatch in a number of directed. The catch numbers, mortality, and <u>disposition</u> for all of these sharks must be recorded in the same manner as that of directed and multi-species fisheries.

3. 2. Fleet inventory

Data about the fleet that operates in a determinate fishing ground is another key factor affecting the fishery management. These data can be used to estimate the total effort that is being applied to a given fishing ground (fishing power).

This inventory consist of a list of all vessels that operate in this area, gathering together all the characteristics of each vessel: GRT, HP, Length, Base port, equipment, fishing gear, etc.

3. 3. Fishing effort (CPUE)

The "effort" usually refers to time spent or to a certain piece of the fishing gear deployed in the water.

Catch per unit effort (CPUE) is a ratio commonly used to eliminate temporal and regional trends in fish stock abundance. Many aspects of the fishery can be monitored using CPUE analysis, including trends in overall fishery catch rates, catch rates of target vs. bycatch species, etc. CPUE is a much more powerful tool than catch data alone. A decline in CPUE over a time period is usually a good indication that stocks are declining. However, changes or improvements in fishing gear, technology or abilities can influence CPUE trends.

Units of effort are dependent on the type of fishing gear used and can use such measures as the numbers of vessels, vessel-days, gillnet or longline sets, number of hook hours, and trawl or gillnet hours.

3. 4. Landings

Landings reports are one part of the process of estimating total catch and also are used to show how many individuals of each species of shark are brought to port for distribution or sale. There often is quite a difference between the number of sharks caught and the number of sharks actually landed. This is a biased assessment of the actual catch, because many sharks are discarded at sea. A well-designed management plan will consider both catch and landings data.

Problems associated with landings reports

- Species identification. A major shortcoming in using landings data is the common lack of species identification. In many shark fisheries, the sharks are dressed at sea in order to ensure high quality of the flesh.
- Carcassed landings also eliminate the ability to record the total size or weight of a shark (sex and reproductive maturity cannot be determined after the shark has been dressed)
- Quantification of bycatch is also lost using landing data, as it happens with the information on cryptic mortality (e.g., freshly-caught sharks used as bait at sea) and vitality (alive or dead) of captured sharks.

3. 5. Fishing mortality

Fishing mortality is a very important but sometimes underreported aspect of fishery-dependent monitoring. Individual species react differently to being hooked or ensnared in a net.

The condition, alive or dead, of every shark that is caught, whether targeted or taken as bycatch, should be recorded.

3. 6. Fishing area

Development of preferred fishing areas is dependent upon vessel size and cruising range, the availability of targeted species and size classes, weather, currents, and bottom configuration. Recording accurate fishing locations associated with catch data allows the fishery managers to:

- distinguish geographical variability in catch rates
- denote changes in the activities of the fishing fleet
- determine sub-population differences in life history parameters
- sense significant declines in regional catch rates (that should be examined carefully because such trends often are indicative of localized overfishing)

The most specific and preferred way to report fishing location is by recording the latitude and longitude of every set. Most commercial fishing vessels from developed nations have GPS or LORAN systems on board.

3. 7. Size

The sizes of all sharks in the catch should be consistently and accurately taken. This can be an arduous task and may be unrealistic for some fisheries. Such data is critical because many species of sharks show dramatic population declines when certain size/age classes are targeted.

Recorded weights of landed sharks are also used to show trends and shifts in the fishery. (Most fisheries measure the quantity of landed sharks as dressed weight metric tons (dw mt). Landing tonnages often are used as surrogate indicators of catch increases and decreases. This can be very misleading if the sizes and numbers of sharks being caught are not reported as well.

A variety of measurements are taken on sharks. The three most frequently used measurements are fork, total and precaudal length. When only a single measurement can be taken, fork length is the choice of most shark biologists because it provides a consistent measure of body length.

3. 8. Sex

Sexual segregation of sharks based on depth, season, area and sexual maturity is common in some species. Many fisheries operate at only certain times of the year or in selected locations and thus may have a propensity to target, intentionally or unintentionally, a certain sex or maturity stage. Other fisheries target sharks in the same location at different times of the year, resulting in catches of seasonally different sexual maturity groups.

The sex of a shark is easily identifiable by the presence of claspers in males and their absence in females. In addition, the following information should be recorded whenever possible: for males, clasper size and maturity; and, for females, uterine condition, average ovum diameter, and the sizes and sexes of embryos.Reproductive data collection on female sharks is much more time-consuming and time intensive.

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SHARK EXPLOITATION AND CONSERVATION IN SYRIA

Adib SAAD[1], Malek ALI[2] and Bernard SERET[3]

[1,2] Marine Sciences Laboratory, Fac. of Agr. Tishreen University, Lattakia, Syria.
E-mail: adibsaad@scs-net.org
[3]Lbortoire d'Ichthyologie, Museume d'Histoire Naturelle, Paris, France

Abstract

Sharks are vulnerable to over fishing because they are long-lived, take many years to mature, and only have a few youngs at a time. To provide protection and rebuild and maintain sustainable shark fisheries, the Laboratory of Marines Sciences at Tishreen University has been conducting since 2001 a research program on shark monitoring, distribution and exploitation off the Syrian coast.

Data collection programs, permitting and reporting requirements, identification of essential fish habitat, by-catch reduction of sharks in all fisheries, and promoting safety at sea for shark fishermen.

Thirty-nine cartilaginous fish species including 22 shark species have been recorded in the Mediterranean Syrian water. Some of these species are commercially important and have been exploited over the ages as target species or bycatch, while others are rare or very rare, and therefore have not been recorded on a regular basis. Due to the negative impact of irresponsible fisheries on sharks, a decline of some shark populations has been observed. The aim of this paper is to present the status of sharks in the Mediterranean coast of Syria and to propose some measures for their conservation and better management of their exploitation.

Key words: Sharks, exploitation, conservation, Mediterranean, Syria.

Introduction

Cartilaginous fishes off the Syrian coast have not been studied systematically as yet. Only one work was realized during the last century (GRUVEL, 1931) in which was reported the presence of 15 species of Chondrichthiyes in Syrian Coast . Recently ALI and SAAD (2003) reported 22 species, and SAAD *et. al* (2004) presented a commented list of 37 Chondrichiteyes species living in Syrian coast.

Despite the sharks and rays constitute important resources within Syrian fisheries, there is a lack of information on the landings and on the biology, distribution and abundance of their populations in Syrian waters.

As a result, the Marine Sciences Laboratory (MSL) at the Faculty of Agriculture, Tishreen University have undertaken a research programme on these fishes, its objectives are:

-Inventory of cartilaginous fish species living in the Syrian coast (Eastern Mediterraneansea)
- Identification and determination of catch composition of cartilaginous fish
- Study of exploitation level of shark fish
- Determination of threats to the cartilaginous fish stock

The purpose of this work is to present a preliminary field survey of the cartilaginous fish study and their exploitation state of the Syrian coast

Materials and Methods

The area investigated is situated between the border of Turkey (in North) and border of Lebanon (in south), to a depth of 25 to 1800 m; its about 180 x 20 = 3600 square km.

Samples were obtained by fishing with long- line and trawl (some time by beach seine) during 2001-2004 in the Syrian waters. The main line, firm braided nylon rope, 4.7 mm in diam., was held to the bottom by weights distributed along its length and anchored by a 30-50 kg iron sinker. Every 5-10 m a 1.2 mm diam., monofilament branch, 100-150 cm long, was attached to the main-line by a snap-on connector and swivel. The hooks were ringed no.6, 7 and 8 or Mustad tuna circle hooks no. 8 and 9, and were connected to the branches by 10 cm-long. 1 mm diam.stainless steel wire, in order to prevent sharks from cutting the branchline. The bait consisted primarily of Sparidae (*Boops boops, Diplodus* sp., *Pagellus* sp., *Lithognathus mormyrus* ect.)

Mesurments and counts follow COMPAGNO (1984), WHITEHEAD *et al.* 1984, FISCHER *et al.* (1987), GOLANI (1987), and NELSON (1994). All measurement and calculation refer to total length (TL). The following parameters were recorded in landing place or in laboratory (for the small specimens), for each individual of fish: total weight, total length, sex and stage of maturity. In particular the maturity of males can be easily and best defined from the state of development of the mixopterygia.

Maturity of females must be determined by internal examination. The described specimens have been deposited in the Laboratory of Marine Sciences- Faculty of Agriculture at Tishreen University, Fish collection (MLS).

Figure 1. Area of study on the Syrian coast: ■ = places of fish landing and sampling

Results and Discussion

At present, sharks and rays comprise 39 species in Mediterranean Syrian coast (Table1) and represent 14.9 % of total marine species number and 3.4% of total marine catch in weight (ALI, 2003), whereby most of them have a slow growth rate, late sexual maturity and a low number of eggs or offspring.

Such characteristics reflect a low increase in population size, combined with a strong susceptibility to every type of fishing. Managing their populations is thus indispensable, but unfortunately, the majority of the fisheries which have developed worldwide do not give this any consideration.

In addition, many of the large-sized shark and ray species demonstrate extensive migration behavior, making it just as imperative that national and international agreements are established to regulate their management.

Authorities concerned must give high priority to the management of sharks and rays because these animals with their slow population growth rates are very susceptible to overfishing and hence collapse of their populations (CASTRO *et al.*, 1999).

The data obtained in this study have discovered for first time the presence of *Torpedo* (*Torpedo*) *sinuspersici* Olfers, 1831 (SAAD *et al.*, 2004) and confirmed the presence of *Dalatias licha* in the eastern Mediterranean, as observed by GILAT and GELMAN (1984). However, in the present study, the use of long-lining scatter baits made them more accessible to smaller species.

Some other aspects, such as the presence of recruits both between 200 and 400 m and between 400 and 650 m, a greater percentage of mature individuals in the mesobathyal than in epibathyal and homoeothermic condition in the bathyal environment of Mediterranean, indicate, in our opinion, that the reproduction occurs at the lowest depths at which the species is found. In the first years of life, *Galeus melastomus* is distributed on a wide bathemtric bathyal slope, probably because of the different feeding requirements of the young compared to those of the adult (QUIGNARD and TOMASINI, 2000) and , successively, it moves to greater depths investigated, reproducing and concluding its life cycle.

Further studies and collection of fish in the bathyal of Syrian marine waters are necessary to increase our knowledge and understanding of the deep–water ichthyofauna in this region.

Table 1. List of Cartilaginous fish species recorded in the Syrian coast (present work) and reported by GRUVEL (1931).

Taxons	**Gruvel 1931**	**Present work**
Sharks		
HEXANCHIDAE		
Hexanchus griseus (Bonnaterre, 1788)		*
Heptranchias perlo (Bonnaterre, 1788)		*
SQUALIDAE		
Squalus acanthias Linnaeus, 1758	+	
Squalus blainvillei (Risso, 1826)		*
Squalus sp. cf. *megalops*		*
CENTROPHORIDAE		
Centrophorus granulosus (Bloch & Schn., 1801)	+	*
Centrophorus sp. cf. *uyato* (Rafinesque, 1809)		*
Centrophorus sp.		*
SOMNIOSIDAE		
Somniosus rostratus (Risso, 1810)		*
OXYNOTIDAE		
*Oxynotus centrina (*Linnaeus, 1758*)*		*
DALATIIDAE		
Dalatias licha (Bonnatere, 1788)		*
SQUATINIDAE		
Squatina aculeata Duméril in Cuvier, 1817		*

Table 1. (Cont.)		
Squatina oculata Bonaparte, 1840		*
Squatina squatina (Linnaeus, 1758)	+	*
ALOPIIDAE		
Alopias superciliosus (Lowe, 1839)		*
LAMNIDAE		
Isurus oxyrinchus Rafinesque, 1810		*
SCYLIORHINIDAE		
Galeus melastomus Rafinesque, 1810		*
Scyliorhinus canicula (Linnaeus, 1758)	+	*
Scyliorhinus stellaris (Linnaeus, 1758)	+	
TRIAKIDAE		
Mustelus mustelus (Linnaeus, 1758)	+	*
Mustelus punctulatus Risso, 1826		*
CARCHARHINIDAE		
Carcharhinus obscurus (Lesueur, 1818)		*
Carcharhinus plumbeus (Nardo, 1827)		*
SPHYRNIDAE		
Sphyrna zygaena (Linnaeus, 1758)	+	*
RYS		
PRISTIDAE		
Pristis pectinata Latham, 1794	+	
RHINOBATIDAE		
Rhinobatos cemiculus Geof. St Hilaire, 1817 G. St Hilaire, 1817		*
Rhinobatos rhinobatos (Linnaeus, 1758)		*
TORPEDINIDAE		
Torpedo (Tetronarce) nobiliana Bonaparte, 1835		*
Torpedo (Torpedo) marmorata Risso, 1810	+	*
Torpedo (Torpedo) sinuspersici Olfers, 1831		*
Torpedo (Torpedo) torpedo (Linnaeus, 1758)	+	
RAJIDAE		
Dipturus oxyrhynchus (Linnaeus, 1758)		*
Raja clavata Linnaeus, 1758	+	*
Raja miraletus Linnaeus, 1758	+	*
Raja montagui Fowler, 1910		
Raja radula Delaroche, 1809		*
DASYATIDAE		
Dasyatis pastinaca (Linaeus, 1758)	+	*
Dasyatis sp. cf. *tortonesei* Capapé, 1977		*
Pteroplatytrygon violacea (Bonaparte, 1832)		*
GYMNURIDAE		

Table 1. (Cont.)		
Gymnura altavela (Linnaeus, 1758)		*
MYLIOBATIDAE		
Myliobatis aquila (Linnaeus, 1758)	+	
Pteromylaeus bovinus (Geof. St Hilaire, 1817)		*
RHINOPTERIDAE		
Rhinoptera marginata (Geof. St. Hilaire, 1817)		*
MOBULIDAE		
Mobula mobular (Bonnatere, 1788)		*
CHIMERA		
CHIMAERIDAE		
Chimaera monstrosa Linnaeus, 1758	+	*
Total number of Shark species	**7**	**22**
Total nuber of Rays species	**7**	**16**
Total nuber of Chemera species	**1**	**1**
Total number of Condrichthias species	**15**	**39**

Exploitation

The Chondrichthyes species found at present in the Syrian marine waters can be divided to three groups according to its economical importance:

Very economically important species being caught in plentiful quantities and highly consumable: *Carcharhinus plumbeus, Mustelus mustelus Centrophorus uyato, Rhinobatos cemiculus, Hexanchus griseus, Squalus* sp.cf. *blanvllei,*

Moderate economically important species either for being caught in little quantities with high efforts in fishing, or for their little demand for human consumption, or may be both reasons: *Heptranchias perlo, Isurus oxyrinchus, Alopias superciliosus, Carcharhinus obscurus,Dalatias licha, Somniosus rostratus, Squatina squatina, Squatina oculata, Squatina aculata, Rhinobatos rhinobatos, Torpedo marmorata, torpedo nobiliana Raja oxyrinchus, Raja clavata,Raja radula, Dasyatias* sp. cf. *tortonesei, Dasyatis violacea, Centrophorus granulosus, Centrophorus moluccensis, Squalus megalops, Gymnura altavela, Pteromylaeus bovinus, Mobula mobular.*

Not economically important species with no demand for human consumption or caught in little quantities: *Galeus melastomus, Scyliorhinus canicula Oxynotus centrina, Torpedo* sp. cf. *sinuspersici ,Chimaera monstrosa,Centrophorus acus.*

The total fishing quantity of Chondrichthyes during 2002 amounted to 13020 fish, with a total weight of / 85.6 / Tons (ALI, 2003)

Further studies elasmobranches of Syrian marine water are necessary to evaluate with precision the commercial importance of sharks and rays in the marine fisheries and to propose the adequate methods for conservation.

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FISHING AND CARTILAGINOUS FISHES ON ADRIATIC AND IONIAN SEAS OF ALBANIA

Dritan ARAPI[1], Rigerta SADIKAJ[2] and Erida NELAJ[2]

[1] Fishery Development Project, Ministry of Environment, Forestry and Water Administration - Albania.
d_arapi@hotmail.com
[2] Agricultural University of Tirana, Department of Aquaculture - Albania.

Figure 1. Map of Albania

Abstract

This is a study done in 2004, in which results came from the specimens gathered by fisherman's catch. In our seas we have observed *Mobula mobular*, *Sphyrna zygaena*, *Squatina oculata* which are very rare now in most parts of the Mediterranean Sea.

Introduction

The Republic of Albania is situated in South Eastern Europe, in the western part of the Balkan Peninsula, facing the Adriatic and Ionian Sea to the west (Fig. 1). The Albanian coastline is 427 km long from which:

- 273 km is of the sandy Adriatic coast (70% of the coast - sandy)
- 154 km of the rocky Ionian Coast (30% of the coast - rocky).

It includes the southeastern and southernmost shores of the Adriatic Sea, then the eastern side of the Strait of Otranto connecting the Adriatic and Ionion seas, and the northernmost Ionian shores that is a shoreline of 472 km from the Bunë estuary at the Yugoslav frontier up to the Stilo cape in the Kékira (Corfu) channel at the Greek frontier.

The Adriatic coast is generally low with many lagoons and beaches. The process of accumulation is great because the rivers bring enormous quantities of solid materials and the Adriatic Sea is shallow. The coastline has continuously developed in seaward direction, especially during the last decades. This process has led to a rapid development of lagoons such as Velipoja, Kunea-Merxhani, Patok and Karavasta, formed in connection with the deltas of the rivers Buna, Drinit, Matit, Ishmit, Shkumbin, Seman and Vjosa.

The Ionian coast is high and dominated by cliffs, except for some zones around river mouths. Along the Ionian coast erosion prevails. This is why rugged cliffs and sometimes caves have developed, e.g at Karaburun, Dhermi and Himarë.

In May 1990, the government of Albania signed the Barcelona Convention and its four related protocols. Upon signing these documents, a number of activities were launched within the framework of the Albanian programme of participation in the Mediterranean Action Plan (MAP). At the meeting of the Scientific-Technical Committee of MAP held in 1991, the Albanian delegation proposed that Coastal Area Management Programme (CAMP) would be initiated in 1992. The proposal was approved by the Seventh Ordinary Meeting of the Contracting Parties to the Barcelona Convention and its Related Protocols in Cairo in 1991. In 1992 a draft agreement for the CAMP was co-signed by the Albanian Government and MAP at the end of 1992. The implementation of CAMPs thus pursues the task set as matter of priority at the Conference of the United Nations on the Environment and Development (UNCED) with its 'Agenda 21', which was held in Rio de Janeiro in 1992. The Ramsar Convention on protection of the habitats of migratory birds and the ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes have also been signed and ratified.

Regarding to the legal and regulatory framework in Albania there is a law (No. 7908, dated 5.4.1995) on fishing and aquatic life. In relation to this law, it is prohibited:
a) To fish in areas and periods of time prohibited, with sailing means, fixed or movable equipments prohibited, water organisms of prohibited species aiming at their protection; fish eggs, larva or offspring of any water organism species without necessary authorization or license based on by-laws for application of this law;
b) to use of explosive matters, of chemical or poisoning matters, of electrical energy capable of stun, paralyze or kill water organisms, as well as during the aquatic life activity.

In both seas, the Adriatic and Ionian seas, we can find a big number of cartilaginous fishes where the most common families are: Rajidae, Lamnidae, Triakidae, Oxynotidae, Scyliorhinidae, Sphyrhidae, Squalidae, Squatinidae, Torpenididae, Mobulidae, etc.

Results and Discussion

Fishing Boats

Fishing in open sea is spread all over the coastline including territorial water from 12 miles away till the international waters. The biggest part of the fishing boats are trawlers (39%) and trawl-sein (26%). The dynamic of fishing boats:

Fishing Boats	**Number of boats**	**%**
Trawler	60	39
Purse -seiner	11	7
Trawler-seiner	40	26
Lines -gill- nets	15	10
Gill net	19	12
Lines	10	6
Total	**155**	**100**

Total Fish Capture Estimates by Species (in kg), in 2004

Lamna nasus	17
Mobula mobular	3392
Mustelus mustelus	10293
Oxynotus centrina	20
Raja asterias	240
Raja clavata	10713
Raja miraletus	6
Raja montagui	555
Raja oxyrinchus	7
Raja polystigma	1120
Scyliorhinus canicula	670
Sphyraena sphyraena	43

Sphyrna zygaena	96
Squalus acanthias	1
Squatina oculata	4082
Torpedo torpedo	2059

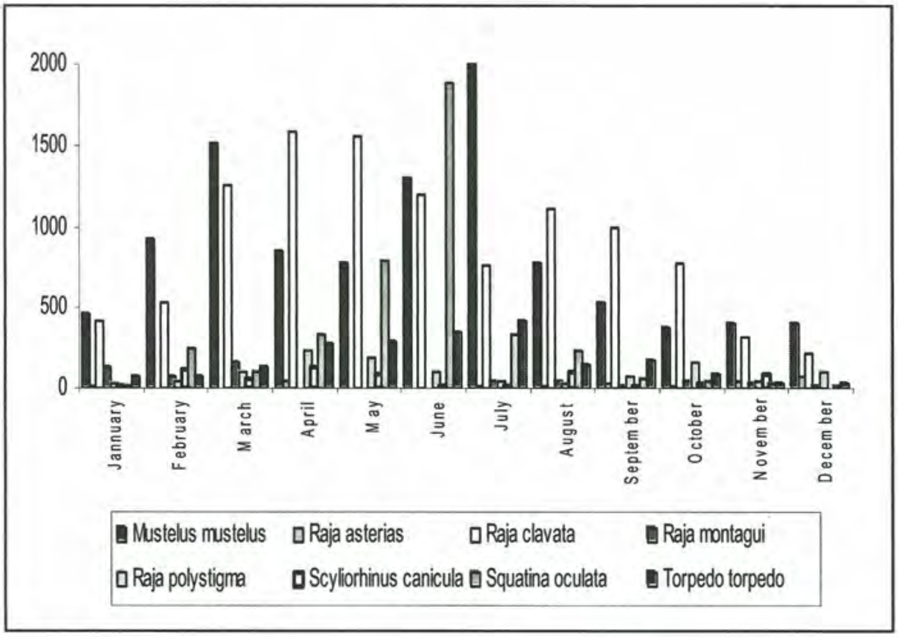

Figure 2. Capture Estimates by month for the most common species (in kg), 2004

As shown in Figure 2, the biggest captures are between March and September months, when the species that dominate are *Mustelus mustelus*, *Raja clavata* and also *Squatina oculata* (from May to July) which is very rare in the Mediterranean sea.

Rare species which are presented in Red Book of Albania

1. *Carcharodon carcharas* L., 1758

Spread: Muzhel, Durres
Status: K (insufficiently known)
Provisions: To know better this species

2. *Galeus melastomus* Rafinesque, 1810

Spread: Low seaside of Albania
Status: R (rare)
Provisions: To know better this species

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ANNEX I

CONCLUSIONS AND TECHNICAL ADVICE

Conclusions and technical advice from the Mediterranean meeting of experts on cartilaginous fish held at Istanbul on October 2005 within the framework of the Action Plan for the Conservation of Cartilaginous Fishes (Chondrichthyans) in the Mediterranean Sea (UNEP-MAP-RAC/SPA):

1. By-catch and Discard

Conclusions

For the entire Mediterranean Sea by-catch and associated discards constitute a serious threat for the elasmobranch species.

By catch reduction, while addressing that problem, helps also the efficiency of fisheries targeting other species.

There are already some existent tools to reduce by-catch of elasmobranches. Some of them show to be widely efficient (e.g. elimination of steel lines, trawler sorting-grids and escaping devices).

Chondrichthyans by-catch in determined age classes (i.e. aged females) has a sound effect on population depletion.

It is urgent to record elasmobranches capture amounts by species in order to allow their fishery assessment and management .

Several management tools can be adopted, but a present priority in the Mediterranean is to assess and specify which elasmobranch species are threatened.

Advice on actions

- The use of steel lines to attach the hooks should be abandoned in the Mediterranean region.
- Capacity building should benefit fishermen in order to adapt gears whenever recommended for environment protection purposes.
- Fishing in cartilaginous mating, spawning and nursery grounds should be avoided or regulated and monitored

- Legal commercial sizes for cartilaginous, according to their life history, has to be urgently defined in order to ensure sustainable exploited populations. Therefore, it is necessary to establish also for the cartilaginous fishes a list of the minimum capture sizes by species

- Discards should be released back to sea as soon as possible to ensure highest rates of survival

- Studies on selectivity of the gears and their improvement regarding the previous topic should be encouraged to reduce by-catch effects

- Logbooks, landing sites, surveys and fishery observer programmes have to record elasmobranches by species and assemble them in a common database set

2. Information retrieval and diffusion

Conclusions

Standard protocols to record catch, fishing effort, rare species, etc need to be used in the whole Mediterranean region.

There exists widespread confusion regarding local names of cartilaginous species in the fishermen communities. That problem affects proper record of data.

In spite that there are still many gaps regarding scientific knowledge of the biology of the elasmobranch fishes, specific funding to address them has not been prioritised.

A jointly shared Mediterranean database on elasmobranch fishes is a priority. This database should be freely consultable by the experts on the web .

Advice on actions

- Protocol prepared by RAC/SPA within the framework of the Action Plan should be used by all the coastal countries after being revised by experts from all the Mediterranean area

- The recommended reference book for cartilaginous taxonomy in the Mediterranean will be the one being prepared by FAO for 2006.

- A poster or plackets with pictures of the most rare as well as threatened species of Mediterranean cartilaginous species, intended for identification by fishermen, needs to be produced and distributed in each country.

- Educational packages on the elasmobranches problems addressed to fishermen and general public should be produced and widely distributed.

- Allocation of scholarships regarding elasmobranches ecology should be addressed by concerned funding institutions to improve expertise, especially in the developing Mediterranean countries.

- The database being prepared by RAC/SPA for the Mediterranean region and MEDLEM Database are both complementary and necessary. All the coastal countries should contribute with their data to them through their institutional bodies. The voluntary contribution of other experts should be, as reduced as possible, or filtered through national institutions.

3. Critical habitats

Conclusions

There exists initial information regarding the location of critical habitats for cartilaginous in the Mediterranean. Some of them are very detailed while other ones have less precise delimitations. That information is still limited and needs improvement.

Very specific populations of certain species use restricted habitats, but it is necessary to further evaluate this aspect in the Region by using genetic tools.

Biogeography and genetic parallel studies may allow discriminating between the elasmobranch Atlantic stocks and the Mediterranean ones.

Advice on actions

- Standardised criteria aimed to decide if an area is critical for Mediterranean species of cartilaginous fishes should be defined and agreed by the riparian countries.
- A standard list and a related map of critical habitats in the Mediterranean need to be settled, starting from this workshop results, and revised every few years.
- Monitoring the abundance and population structure of elasmobranchs, as well as the biodiversity in the critical habitats must be prioritised in relation to other areas.
- Genetic research on Mediterranean elasmobranches populations should be encouraged. For that purpose, the riparian countries should start to keep tissue samples of these species.

4. Coordination and collaboration

Conclusions

Regarding collaboration, no specific Mediterranean association addressing the conservation of sharks does exist so far. However, organisations such as IUCN and the European Elasmobranch Association are being active on this matter since years. At the same time Institutions such as GFCM and FAO play an important role regarding elasmobranches on the issue.

Nevertheless the Mediterranean sea is lacking a single associative body, involved on elasmobranch studies, embracing all the coastal countries.

Advice on actions

- It is kindly proposed to RAC/SPA to present the conclusions of the present meeting to the next meeting of the European Elasmobranch Association, to be held in Monaco on November 2005.

- At the same time, it is suggested to kindly propose to the EEA at that gathering the idea to allow membership to all the Mediterranean countries, including the southern and eastern ones, changing if possible and desired its name (not the acronym) to Euromediterranean Elasmobranch Association.

ANNEX II

Draft protocols proposed by RAC/SPA for monitoring commercial landings and discards by species, as well as for recording data on rarely observed, endangered and protected species

FAUNISTIC LIST 1
(COMMERCIAL)

VESSEL:

DATE:_____ CAST:__

TOTAL CAPTURE (kg)			CAPTURE SAMPLED (kg)	

		TOTAL C.		SAMPLE		TOTAL C.		SAMPLE			
SPECIES	CODE	w (gr)	Nº	W (gr)	Nº	SPECIES	CODE	w (gr)	Nº	W (gr)	Nº
FISHES						Dentex dentex					
Alopias superciliosus						Diplodus annularis					
Alopias vulpinus						Diplodus sp.					
Aphia minuta						Diplodus vulgaris					
Argentina sphyraena						**Dipturus batis**					
Arnoglossus laterna						**Dipturus oxyrinchus**					
Arnoglossus rueppelli						**Echinorhinus brucus**					
Arnoglossus spp						Engraulis encrasicolus					
Arnoglossus thori						Epigonus denticulatus					
Arnoglosus imperialis						**Etmopterus spinax**					
Aspitrigla obscura						Eutrigla gurnardus					
Bathysolea profundicola						Gadiculus argenteus					
Blennius ocellaris						Gaidropsarus spp.					
Boops boops						**Galeorhinus galeus**					
C. caelorinchus						**Galeus atlanticus**					
Callionymus maculatus						**Galeus melastomus**					
Capros aper						Gnathophis mystax					
Carcharhinus altimus						Gobius niger					
Carcharhinus branchyurus						Helicolenus dactylopterus					
Carcharhinus brevipinna						**Heptranchias perlo**					
Carcharhinus falciformis						**Hexanchus griseus**					
Carcharhinus limbatus						Hoplostethus mediterraneus					
Carcharhinus obscurus						**Isurus paucus**					
Carcharhinus plumbeus						**Lamna nasus**					
Carcharias taurus						Lepidopus caudatus					
Carcharodon carcharias						Lepidorhombus boscii					
Carharhinus melanopterus						Lepidotrigla cavillone					
Centrolophus niger						Lesueurigobius sanzoi					
Centrophorus granulosus						**Leucoraja circularis**					
Centrophorus ujato						**Leucoraja fullonica**					
Centroscymnus coelolepis						**Leucoraja melitensis**					
Cepola rubescens						**Leucoraje naevus**					
Cetorhinus maximus						**Leucoraje undulata**					
Citharus linguatula						Lophius budegassa					
Conger conger						Lophius piscatorius					
Chaulodius sloani						Lophius spp					
Chelidonichthys obscurus						Macroramphosus scolopax					
Chelidonichthys obscurus						Merluccius merluccius					
Chimaera monstrosa						Micromesistius poutassou					
Chlorophthalmus agassizi						**Mobula mobular**					
D. quadrimaculatus						**Mullus barbatus**					
Dalatias licha						Mullus surmuletus					
Dasyatis centroura						**Mustelus asterias**					
Dasyatis pastinaca						**Mustelus mustelus**					

Figure 1. Species list for observers (trawling and purse seine)

FAUNISTIC LIST 2 (COMMERCIAL)

VESSEL: DATE:____________ CAST:______

		TOTAL C.		SAMPLE				TOTAL C.		SAMPLE	
SPECIES	CODE	w (gr)	N°	W (gr)	N°	SPECIES	CODE	w (gr)	N°	W (gr)	N°
FISHES						**Sphyma zygaena**					
Mustelus punctulatus						**Sphyrna lewini**					
Myctophum punctatum						**Sphyrna mokarran**					
Myliobatis aquila						Spicara flexuosa					
Nezumia aequalis						Spicara maena					
Odontaspis ferox						Spicara smaris					
Ophidion barbatum						Spondyliosoma cantharus					
Oxynotus centrina						**Squalus acanthias**					
Pagellus acarne						**Squalus blainville**					
Pagellus bogaraveo						**Squatina aculeata**					
Pagellus erythrinus						**Squatina oculata**					
Pagrus pagrus						**Squatina squatina**					
Peristedion cataphractum						Stomias boa					
Phycis blennoides						Symphurus nigrescens					
Phycis phycis						T. trachurus					
Pomatoschistus spp.						**Torpedo marmorata**					
Prionace glauca						**Torpedo nobiliana**					
Pristis pectinata						**Torpedo torpedo**					
Pristis pristis						Trachinus draco					
Pteroplatytrygon violacea						Trachurus mediterraneus					
Raja asterias						Trachurus picturatus					
Raja branchyura						Trigla lucerna					
Raja clavata						Trigla lyra					
Raja miraletus						Trisopterus luscus					
Raja montagui						Uranoscopus scaber					
Raja naebo						Xiphias gladius					
Raja polystigma						Zeus faber					
Raja radula											
Raja rondeleti (of fullonica)											
Rhinobatos cemiculus											
Rhinobatos rhinobatos											
Rostroraja alba											
Sardina pilchardus											
Sardinella aurita											
Scomber japonicus											
Scomber scombrus											
Scorpaena sp.											
Scyliorhinus canicula											
Scyliorhinus stellaris											
Serranus cabrilla											
Serranus hepatus											
Solea vulgaris											
Somniosus rostratus											
Sphyma tudes											

Figure 2. Species list (Second part)

FAUNISTIC LIST 3 (COMMERCIAL)

VESSEL: DATE:____________ CAST:______

		TOTAL C.		SAMPLE				TOTAL C.		SAMPLE	
SPECIES	CODE	w (gr)	N°	W (gr)	N°	SPECIES	CODE	w (gr)	N°	W (gr)	N°
CRUSTACEAN						**MOLLUSKS**					
Alpheus glaber						Alloteuthis sp.					
Aristeus antennatus						Alloteuthis media					
Bathynectes maravigna						Alloteuthis subulata					
Calappa granulata						Eledone cirrhosa					
Dardanus arrosor						Eledone moschata					
Geryon longipes						Illex coindetti					
Goneplax rhomboides						Loligo vulgaris					
Homarus gammarus						Octopus salutii					
Liocarcinus depurator						Octopus vulgaris					
Macropodia longipes						Opistobranchia spp.					
Munida sp.						Pecten maximus					
Nephrops norvegicus						Sepia elegans					
Pagurus sp.						Sepia officinalis					
Parapenaeus longirostris						Sepia orbignyana					
Pasiphea sivado						Sepietta spp.					
Plesionika edwardsii						Sepiola spp.					
Plesionika giglioli						Todarodes spp.					
Plesionika heterocarpus						Cassidaria tyrrhena					
Plesionika martia						Sepia spp					
Plesionika sp.						Venus nux					
Pontocaris spp.						Todaropsis eblanae					
Solenocera membranacea											
Squilla mantis											
						OTHERS					
						Echinoidea					
						Asteroidea					
						Holothurioidea					
						Ophiuroidea					
						Without sorting					
						Plastic					
						Glass					
						Metal					
						Coal					
						Organic matter					
						Inorganic matter					
						Wood					

Figure 3. Species list (third part)

FAUNISTIC LIST 1 (DISCARDS)

VESSEL: DATE:____________ CAST:_______

TOTAL CAPTURE		**CAPTURE SAMPLED** (kg)	

		TOTAL C.		SAMPLE				TOTAL C.		SAMPLE	
SPECIES	CODE	w (gr)	Nº	W	Nº	SPECIES	COD	w (gr)	Nº	W	Nº
FISHES						Dentex dentex					
Alopias superciliosus						Diplodus annularis					
Alopias vulpinus						Diplodus sp.					
Aphia minuta						Diplodus vulgaris					
Argentina sphyraena						**Dipturus batis**					
Arnoglossus laterna						**Dipturus oxyrinchus**					
Arnoglossus rueppelli						**Echinorhinus brucus**					
Arnoglossus spp						Engraulis encrasicolus					
Arnoglossus thori						Epigonus denticulatus					
Arnoglosus imperialis						**Etmopterus spinax**					
Aspitrigla obscura						Eutrigla gurnardus					
Bathysolea profundicola						Gadiculus argenteus					
Blennius ocellaris						Gaidropsarus spp.					
Boops boops						**Galeorhinus galeus**					
C. caelorinchus						**Galeus atlanticus**					
Callionymus maculatus						**Galeus melastomus**					
Capros aper						Gnathophis mystax					
Carcharhinus altimus						Gobius niger					
Carcharhinus						Helicolenus dactylopterus					
Carcharhinus brevipinna						**Heptranchias perlo**					
Carcharhinus falciformis						**Hexanchus griseus**					
Carcharhinus limbatus						Hoplostethus mediterraneus					
Carcharhinus obscurus						**Isurus paucus**					
Carcharhinus plumbeus						**Lamna nasus**					
Carcharias taurus						Lepidopus caudatus					
Carcharodon carcharias						Lepidorhombus boscii					
Carharhinus						Lepidotrigla cavillone					
Centrolophus niger						Lesueurigobius sanzoi					
Centrophorus granulosus						**Leucoraja circularis**					
Centrophorus ujato						**Leucoraja fullonica**					
Centroscymnus						**Leucoraja melitensis**					
Cepola rubescens						**Leucoraje naevus**					
Cetorhinus maximus						**Leucoraje undulata**					
Citharus linguatula						Lophius budegassa					
Conger conger						Lophius piscatorius					
Chaulodius sloani						Lophius spp					
Chelidonichthys obscurus						Macroramphosus scolopax					
Chelidonichthys obscurus						Merluccius merluccius					
Chimaera monstrosa						Micromesistius poutassou					
Chlorophthalmus agassizi						**Mobula mobular**					
D. quadrimaculatus						**Mullus barbatus**					
Dalatias licha						Mullus surmuletus					
Dasyatis centroura						**Mustelus asterias**					
Dasyatis pastinaca						**Mustelus mustelus**					

Figure 4. Species discarded List for observers.

FAUNISTIC LIST 2 (DISCARDS)

VESSEL: DATE:___________ CAST:______

SPECIES	CODE	TOTAL C. w (gr)	TOTAL C. N°	SAMPLE W (gr)	SAMPLE N°
FISHES					
Mustelus punctulatus					
Myctophum punctatum					
Myliobatis aquila					
Nezumia aequalis					
Odontaspis ferox					
Ophidion barbatum					
Oxynotus centrina					
Pagellus acarne					
Pagellus bogaraveo					
Pagellus erythrinus					
Pagrus pagrus					
Peristedion cataphractum					
Phycis blennoides					
Phycis phycis					
Pomatoschistus spp.					
Prionace glauca					
Pristis pectinata					
Pristis pristis					
Pteroplatytrygon violacea					
Raja asterias					
Raja branchyura					
Raja clavata					
Raja miraletus					
Raja montagui					
Raja naebo					
Raja polystigma					
Raja radula					
Raja rondeleti (of fullonica)					
Rhinobatos cemiculus					
Rhinobatos rhinobatos					
Rostroraja alba					
Sardina pilchardus					
Sardinella aurita					
Scomber japonicus					
Scomber scombrus					
Scorpaena sp.					
Scyliorhinus canicula					
Scyliorhinus stellaris					
Serranus cabrilla					
Serranus hepatus					
Solea vulgaris					
Somniosus rostratus					
Sphyma tudes					

SPECIES	CODE	TOTAL C. w (gr)	TOTAL C. N°	SAMPLE W (gr)	SAMPLE N°
Sphyma zygaena					
Sphyrna lewini					
Sphyrna mokarran					
Spicara flexuosa					
Spicara maena					
Spicara smaris					
Spondyliosoma cantharus					
Squalus acanthias					
Squalus blainville					
Squatina aculeata					
Squatina oculata					
Squatina squatina					
Stomias boa					
Symphurus nigrescens					
T. trachurus					
Torpedo marmorata					
Torpedo nobiliana					
Torpedo torpedo					
Trachinus draco					
Trachurus mediterraneus					
Trachurus picturatus					
Trigla lucerna					
Trigla lyra					
Trisopterus luscus					
Uranoscopus scaber					
Xiphias gladius					
Zeus faber					

Figure 5. Species discarded list (second part)

FAUNISTIC LIST 3 (DISCARDS)

VESSEL: DATE:__________ CAST:_____

		TOTAL C.		SAMPLE				TOTAL C.		SAMPLE	
SPECIES	CODE	w (gr)	Nº	W (gr)	Nº	SPECIES	CODE	w (gr)	Nº	W (gr)	Nº
CRUSTACEAN						**MOLLUSKS**					
Alpheus glaber						Alloteuthis sp.					
Aristeus antennatus						Alloteuthis media					
Bathynectes maravigna						Alloteuthis subulata					
Calappa granulata						Eledone cirrhosa					
Dardanus arrosor						Eledone moschata					
Geryon longipes						Illex coindetti					
Goneplax rhomboides						Loligo vulgaris					
Homarus gammarus						Octopus salutii					
Liocarcinus depurator						Octopus vulgaris					
Macropodia longipes						Opistobranchia spp.					
Munida sp.						Pecten maximus					
Nephrops norvegicus						Sepia elegans					
Pagurus sp.						Sepia officinalis					
Parapenaeus longirostris						Sepia orbignyana					
Pasiphea sivado						Sepietta spp.					
Plesionika edwardsii						Sepiola spp.					
Plesionika giglioli						Todarodes spp.					
Plesionika heterocarpus						Cassidaria tyrrhena					
Plesionika martia						Sepia spp					
Plesionika sp.						Venus nux					
Pontocaris spp.						Todaropsis eblanae					
Solenocera membranacea											
Squilla mantis											
						OTHERS					
						Echinoidea					
						Asteroidea					
						Holothurioidea					
						Ophiuroidea					
						Without sorting					
						Plastic					
						Glass					
						Metal					
						Coal					
						Organic matter					
						Inorganic matter					
						Wood					

Figure 6. Discarded species list (third part)

BY-CATCH & DISCARDS

SIZE DISTRIBUTIONS **Vessel:...............................**

SET:	DATE:

Species:___	Species:________	Species:_________
Code: _	Code: _	Code: _____
Category: _	Category: __	Category: ___
Total weight: ___	Total weight: __	Total weight:
Sample weight: __	Sample weight:__	Sample weight: _____
Minimum size: ____	Minimum size:__	Minimum size: ______
Maximum size:	Maximum size:	Maximum size:

		cm			cm			cm
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		

Figure 7. Form for discards quantification in trawling and longline fisheries.

BY-CATCH & DISCARDS

SIZE DISTRIBUTIONS **Vessel:..............................**

SET:	**DATE:**

Species:______	Species:_______	Species:_____
Code: _____	Code: ______	Code: _____
Category: ___	Category: ____	Category: ____
Total weight: ___	Total weight: ___	Total weight: ___
Sample weight: ____	Sample weight: ____	Sample weight: ___
Minimum size: ____	Minimum size: ____	Minimum size:____
Maximum size: _____	Maximum size: _____	Maximum size:_____

		cm			cm			cm
0			0			0		
0,5			0,5			0,5		
1			1			1		
1,5			1,5			1,5		
2			2			2		
2,5			2,5			2,5		
3			3			3		
3,5			3,5			3,5		
4			4			4		
4,5			4,5			4,5		
5			5			5		
5,5			5,5			5,5		
6			6			6		
6,5			6,5			6,5		
7			7			7		
7,5			7,5			7,5		
8			8			8		
8,5			8,5			8,5		
9			9			9		
9,5			9,5			9,5		
0			0			0		
0,5			0,5			0,5		
1			1			1		
1,5			1,5			1,5		
2			2			2		
2,5			2,5			2,5		
3			3			3		
3,5			3,5			3,5		
4			4			4		
4,5			4,5			4,5		
5			5			5		

Figure 8. Form for discards quantification in purse seine fishery.

COMMERCIAL

SIZE DISTRIBUTIONS **Vessel:..............................**

SET:	**DATE:**	
Species:_______________	Species:_______________	Species:_______________
Code: ______	Code: ______	Code: ______
Category: ______	Category: ______	Category: ______
Total weight: ______	Total weight: ______	Total weight: ______
Sample weight: ______	Sample weight: ______	Sample weight: ______
Minimum size: ______	Minimum size: ______	Minimum size: ______
Maximum size: ______	Maximum size: ______	Maximum size: ______

		cm			cm			cm
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		

Figure 9. Form for lengths and weights quantification in trawling and longline fisheries.

COMMERCIAL

SIZE DISTRIBUTIONS **Vessel:...........................**

SET:	DATE:

Species:__________	Species:________	Species:__________
Code: ____	Code: _	Code: ______
Category: ___	Category: ______	Category: _____
Total weight: ____	Total weight: ______	Total weight: ______
Sample weight: _____	Sample weight:_____	Sample weight: _____
Minimum size: _____	Minimum size:______	Minimum size: _____
Maximum size: ____	Maximum size ____	Maximum size:_____

		cm			cm			cm
0			0			0		
0,5			0,5			0,5		
1			1			1		
1,5			1,5			1,5		
2			2			2		
2,5			2,5			2,5		
3			3			3		
3,5			3,5			3,5		
4			4			4		
4,5			4,5			4,5		
5			5			5		
5,5			5,5			5,5		
6			6			6		
6,5			6,5			6,5		
7			7			7		
7,5			7,5			7,5		
8			8			8		
8,5			8,5			8,5		
9			9			9		
9,5			9,5			9,5		
0			0			0		
0,5			0,5			0,5		
1			1			1		
1,5			1,5			1,5		
2			2			2		
2,5			2,5			2,5		
3			3			3		
3,5			3,5			3,5		
4			4			4		
4,5			4,5			4,5		
5			5			5		

Figure 10. Form for lengths and weights quantification in purse seine fishery (commercial species).

SIZE OF SPECIES CAPTURED (LOWESTcm)

	SWORDFISH	BLUEFIN TUNA	ALBACORE	BLUE SHARK	SHORTFIN MAKO	COMMON THRESHER	BIGEYE THRESHER	SPHYRNA SP.
	LJFL	FL	FL	FL/TL	FL/TL	FL/TL	FL/TL	FL/TL
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

COMMERCIAL CAPTURE

Species	Number of retained fishes	Weight retained	Number of discarded fishes
Swordfish			
Bluefin tuna			
Albacore			
Skipjack tuna			
Blue shark			
Shortfin Mako			
Common Thresher Shark			
Bigeye thresher shark			
Sphyrna zigaena			
Other			
Total			

H CAPTURE

Species	Number of specimens alive	Number of specimens dead
Total		

Figure 11. Form for lengths and weights data collection of target and by-catch species (Longline).

Fishing Data

Set Code:

Observer:	Departure date:
Vessel:	Landing date:
Base Port:	Landing port:

1. FISHING EFFORT

Fishing gear/Target species	Bait type (% of species)	Number of hooks (% sizes)
	Bait size:	Fluorescent baits (% and colour)

2. CAST SPECIFICATIONS

CAST	START	END	**TACK**	START	END
Situation			Situation		
Date			Date		
Time			Time		
Depth			Depth		
Temperature			Temperature		
Sea state			Sea state		
Wind strength			Wind strength		
Wind direction			Wind direction		
Lunar stage			Lunar stage		
Miles covered					
Distance to Coast			Distance to Coast		

Changes of direction			
Time:	Situation:	Time:	Situation:
Time:	Situation:	Time:	Situation:

Fishing incidents and other remarks

Figure 12. Fishing form for gathering data on longline fisheries.

I	Start time	End time	II	Start time	End time	III	Start time	End time
IV	Start time	End time	V	Start time	End time	VI	Start time	End time
VII	Start time	End time	VIII	Start time	End time	IX	Start time	End time
X	Start time	End time	XI	Start time	End time	XII	Start time	End time
XIII	Start time	End time	XIV	Start time	End time	XV	Start time	End time

Figure 13. Fishing form for gathering data on longline fisheries (catches by gear units).

ON BOARD OBSERVERS:::
SET FORM:;::: ::

VESSEL............. ......
FISHING GEAR.......
TYPE OF DOOR
WEIGHT DOOR

NUMBER OF SETS............

DATE (DAY/MONTH/YEAR) ____________________
CABLE LARGADO (m) ____________________
DISTANCE TO COASTLINE (m) ____________________

..........................Beginning..
....

TIME (hour, minutes).................. .. ____________________
LATITUDE (degree, minutes)......... ________ . ____________N
LONGITUDE (degree, minutes)...... ________ . ____________W
DEPTH (meters)............ .... ________________

..........................Finishing..
....

TIME (hour, minutes).................. .. ____________________
LATITUDE (degree, minutes)......... ________ . ____________N
LONGITUDE (degree, minutes)...... ________ . ____________W
DEPTH (meters)............ .... ________________

COURSE (degree) :
VELOCITY/SPEED (knot) :

GENERAL WEATHER CONDITIONS

CLOUDINESS (1/8 – 8/8):
RAINFALL:
WIND STRENGTH (calm, breeze, light, storm):
WIND DIRECTION:

SEA STATE

SEA STATE (calm, slight swell, swell, heavy swell):

o	LATITUDE									
o	LONGITUDE									
GPS	COURSE									
	TIME									
DEPTH FINDER	DEPTH									

Figure 14. Set form to be filled by observers on board of trawling vessels.

ON BOARD OBSERVERS .;;;
SET FORM:;;;

VESSEL.............. ......
FISHING GEAR.......

NUMBER OF SETS...........

DATE (DAY/MONTH/YEAR) ____________________
CABLE HAULED IN (m) ____________________
DISTANCE TO COASTLINE (m) ____________________

..........................Begining..
......

TIME (hour, minutes).................. .. ____________________
LATITUDE (degree, minutes)......... ________ . ____________N
LONGITUDE (degree, minutes)...... ________ . ____________W
DEPTH (meters)............ .... ____________

COURSE (degree) :
VELOCITY/SPEED (knot) :

GENERAL WEATHER CONDITIONS
CLOUDINESS (1/8 – 8/8):
RAINFALL:
WIND STRENGTH (calm, breeze, light, storm):
WIND DIRECTION:

SEA STATE
SEA STATE (calm, slight swell, swell, heavy swell):

º	LATITUDE									
º	LONGITUDE									
GPS	COURSE									
	TIME									
DEPTH FINDER	DEPTH									

Figure 15. Set form to be filled by observers on board of longline vessels.

PORT:______________________ DATE:__________________ LOCAL TIME:__________________

VESSEL	FISHING GROUND	FISHING TRIPS	NUMBER OF SETS	AVERAGE SETS DURATION	DEPTH	DURATION OF FISHING OPERATIONS	FISHING TRIPS (PREVIOUS MONTH)

Figure 16. Shoreside sampling form for trawling gear.

PORT :________________ DATE:__________ LOCAL TIME:____________

Vessel	Species/Category	Number of boxes	Total weight	Specimens number	Specimens weight

Figure 17. Shoreside sampling form for purse seine

PORT: ______________________
SPECIES: ______________________
REPORTER: ______________________
VESSEL: ______________________

BIOLOGICAL SAMPLINGS

SPECIES	ROUND WEIGHT	SEX MALE	FEMALE	INDET.	SIZE	TOTAL

TOTAL						

Figure 18. Accurate forms for bottom and surface longlines.

LANDING PORT:____________________

INFORMER:____________________________

DATE:______________ GEAR:________________ BASE:____________

VESSEL:________________

Days at sea :___________ SETS:_______ Hooks:__________ Bait:_____________

Miles: __________ Hours:_____________

POSITION SETS AREA NUMBER---WEIGHT

SHORTFIN MAKO:
BLUE SHARK:

BYCATCH SPECIES

	N	W		N	W
HAMMERHEAD SHARKS			WAHOO (Acanthocybium.)		
BLUE SHARK(TOTAL)			ALBACORE		
SHORTFIN MAKO			YELLOWFIN TUNA		
THRESHER SHARK			BIGEYE TUNA		
CARCHARINUS			WHITE MARLIN		
MEDITERRANEAN SPEARFISH					
BLUEFIN TUNA			ATLANTIC SAILFISH		

BYCATCH SPECIES

SPECIES

	sex	size	weight	sex	size	weight	sex	size	weight
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
TOTAL									

Figure 19. Forms for bottom and surface longlines

STATISTIC AND SAMPLING NET						REPORTER: PORT:			
Date	Vessel	Fishing gear	Fishing area	Species	Specimen nº	Total weight	Fishing days	Fishing Effort	Remarks

Figure 20. Form designed for gathering temporal series of total fleet landing of each commercial species.

OBSERVER - TRIP CODE **FISHING TRIPS DATA**

VESSEL	....
Number of sets	....
DEPARTURE DATE	....
ARRIVAL DATE	....
LANDING PORT	
SALE TYPE	....

SALE SPECIFICATIONS :

SPECIES	NUMBER	ROUND WEIGHT RW (kg)	DRESSED WEIGHT DW (kg)
Swordfish			
Bluefin tuna			
Albacore			
Blue shark			
Shortfin Mako			
Dolphin fish			
Pomfret			

IMPORTANT:
Please, when you note the weight, you must specify if it is round, dressed, gutted or trunk weight

Figure 21. Forms designed for gathering temporal series of total fleet landing of each commercial species

Vessel:______________________

Longline type:

Date:______/______/______

Longline characteristics: depth: ____________ Hook distance: _____________
Hook size: __________ Longline length: _____________ Bait:
Appelling Lights: yes ___ no ___ number _____

<table>
<tr><th>Situation at the beginning of fishing operation</th><th>Situation at the end of fishing operation</th><th>Number of hooks</th><th>Species</th><th>Number</th><th>Weight (average)</th><th>Individual weights: swordfish / bluefin tuna/ albacore</th></tr>
<tr><td></td><td></td><td></td><td>Swordfish</td><td></td><td></td><td rowspan="10"></td></tr>
<tr><td>Hours:</td><td>Fishing operation duration:</td><td></td><td>Bluefin tuna</td><td></td><td></td></tr>
<tr><td colspan="3">Temperature :
Sea stage:</td><td>Albacore</td><td></td><td></td></tr>
<tr><td colspan="3" rowspan="7">Observations:</td><td>Billfish</td><td></td><td></td></tr>
<tr><td>Blue shark</td><td></td><td></td></tr>
<tr><td>Shortfin Mako</td><td></td><td></td></tr>
<tr><td>Thresher shark</td><td></td><td></td></tr>
<tr><td>Heptranquias</td><td></td><td></td></tr>
<tr><td>Dasyatis spp.</td><td></td><td></td></tr>
<tr><td>Other species</td><td></td><td></td></tr>
</table>

Figure 22. Example of logbooks form.

24. In the event that my supervisor wishes to verify that I have been conducting interviews here today , may I have your name and phone number?

ANGLER´S NAME

D or N
PHONE # (___) ___ - ____ __ Name and phone number not given

25. UNAVAILABLE CATCH. Did you land any fish that are not here for me to look at? For example, any that you may have thrown back or use for bait? IF YES, COMPLETE TYPE 2 RECORD FOR THIS INDIVIDUAL ANGLER. NOT GROUP CATCH. NOTE : FILLETS ARE UNAVAILABLE CATCH.

DISPOSITION CODES FOR Q25

1. Thrown back alive/legal
2. Thrown back alive/not legal/legality refused
3. Eaten/plan to eat
4. Used for bait/plan to use for bait
5. Sold/plan to sell
6. Thrown back dead/plan to throw away
7. Some other purpose

TYPE 2 RECORDS: (INDIVIDUAL CATCH UNAVAILABLE IN WHOLE FORM)

	SPECIES CODE	# OF FISH	DISP
1. ______	__________	___	_
2. ______			
3. ______			
4. ______			
5. ______			
6. ______			
7. ______			

26. Did you catch any fish while you were fishing that I might be able to look at?

1 __ Yes
2 __ No – Code q. 27, 28, 29 as "8´s,"Not Applicable
3 __ Yes, BUT fish on another angler´s form- Fill interview # where fish are listed

__ __ -Code q. 27, 28, 29 as "8´s"Not Applicable

27. Did you catch these yourself or did someone else catch some of them?

1. __ All Caught by Angler – Code q. 28, 29, as "8´s"Not Applicable
2. __ Other Contributors 8. __ Not Applicable

28. Can you separate out your individual catch?

1. __ Yes _ Code 29 as "88"
2. __ No 8. __ Not Applicable

29. How many anglers including yourself have their catch here? Please de not include anyone who did not catch fish. Only count those who have their catch here.

__ __ No. Of Contributors 88__ Not Applicable

BOX C. If q. 11 is SH mode, code q. 30 as "88", and Code Box D as"8".

30. How many people fished on your boat today?

__ __ No. of People 88 __ Shore Mode

Box D. If response to q. 30 is 1, code as "8", Not Applicable. Otherwise, is this the first angler from this boat that I have interviewed?

1. __ Yes 8. __ Not Applicable
2. __ No -Record interview # of 1" angler in the fishing party

__ __

31. AVAILABLE CATCH. COMPLETE TYPE 3 RECORD BY ASKING: May I look at your fish? What do you plan to do with the MAJORITY of the (species)?

DISPOSITION CODES FOR Q31

3. Eaten/plan to eat
4. Used for bait/plan to use for bait
5. Sold/plan to sell
6. Thrown back dead/plan to thrown away
7. Some other purpose
8. Don´t know/Didn´t ask
9. Refused

TYPE 3 RECORDS: *(INDIVIDUAL CATCH AVAILABLE IN WHOLE FORM)*

	SPECIES CODE	# OF FISH	LENGTH (mm)	WEIGHT (kg)	DISP
1. ______	__________	___	____	___ . ___	_
2. ______	__________	___	____	___ . ___	_
3. ______	__________	___	____	___ . ___	_
4. ______	__________	___	____	___ . ___	_
5. ______	__________	___	____	___ . ___	_
6. ______	__________	___	____	___ . ___	_
7. ______	__________	___	____	___ . ___	_
8. ______	__________	___	____	___ . ___	_
9. ______	__________	___	____	___ . ___	_
10. ______	__________	___	____	___ . ___	_
11. ______	__________	___	____	___ . ___	_
12. ______	__________	___	____	___ . ___	_
13. ______	__________	___	____	___ . ___	_
14. ______	__________	___	____	___ . ___	_
15. ______	__________	___	____	___ . ___	_

Figure 23. Survey form.

List of main species rarely observed, endangered, and protected in the Mediterranean.
Dipturus batis
Squalus megalops
Squatina aculeata
Squatina oculata
Squatina squatina
Carcharias taurus
Odontaspis feroz
Cetorhinus maximus
Carcharodon carcharias
Pristis pectinata
Pristis pristis

Figure 24. Second part of the survey form shown in Figure 23.

Data Collection about rare or threatened species

Set	Hour	Species	FL	Tag Number	Condition	Remarks

Figure 25. Example of form to collect data about rare or threatened species.

Sightings of rare or threatened species

Position	Date	Time	Species	Specimen number	Remarks

Figure 26. Form to collect data about sightings of rare or threatened species.

Data collection in oceanographic cruises

Catch of main species

Date: ________________ **Depth:** ________________

Time: ________________ **Latitude:** ________________

Longitude: ________________

General weather conditions

Cloudiness (1/8 – 8/8):
Rainfall:
Wind strength (calm, breeze, light, storm):
Wind direction:

Sea state

Sea state (calm, slight swell, swell, heavy swell):

Vessel name:
Fishing gear:
Port:

Number of animals: ____________

State of the animals:

- Alive: ____ Nº: ____
- Dead: ____ Nº: ____
- In state of putrefaction: ____ Nº: ____
- In a very advanced state of putrefaction: ____ Nº: ____
- Fragmented: ____ Nº: ____

Figure 27. Form to use in fishing scientist surveys to collect general oceanographic data and general condition data of target species.

By-catch species

Date: ________________ **Depth:**__________________

Time:_________________ **Latitude:**________________

Longitude:_______________

General weather conditions

Cloudiness (1/8 – 8/8):
Rainfall:
Wind strength (calm, breeze, light, storm):
Wind direction:

Sea state

Sea state (calm, slight swell, swell, heavy swell):

Vessel name:
Fishing gear:
Port:

State of animals:

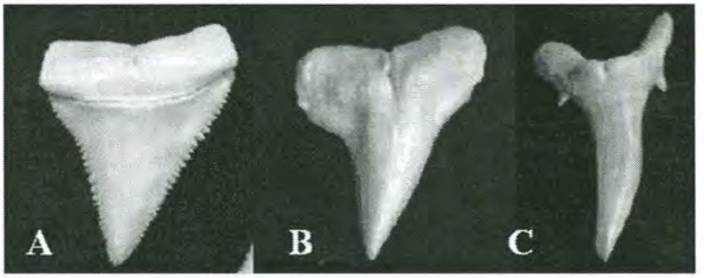
- Alive animals have been released ____ Nº: ____
- Dead animals have been released ____ Nº: ____
- Animals were already dead when caught ____ Nº: ____

Specie	Weight	Size	Sex

Photographs Yes:____ No:____

Figure 28. Form to use in fishing scientist surveys to collect general oceanographic data and general condition data of by-catch species.

Teeth shape



Notched margin _____
Smoothed margin _____
Teeth photos YES ____ NO ____

Other informations:

Stomach contents: **Yes:** _____ **No:** _____

Embryo in the uterus: **Yes:** _____ **No:** _____
(if possible conserve them frozen)

What kind of samples have you taken?

____
____
_____

Photographs **Yes:** _____ **No:** _____ **Video** **Yes:** _____ **No:** _____

NOTES:

____
____

OBSERVER:
Name:
Address:

Figure 29. Form to use in fishing scientist surveys to collect data about teeth shape, stomach contents, reproductive and other biological data.

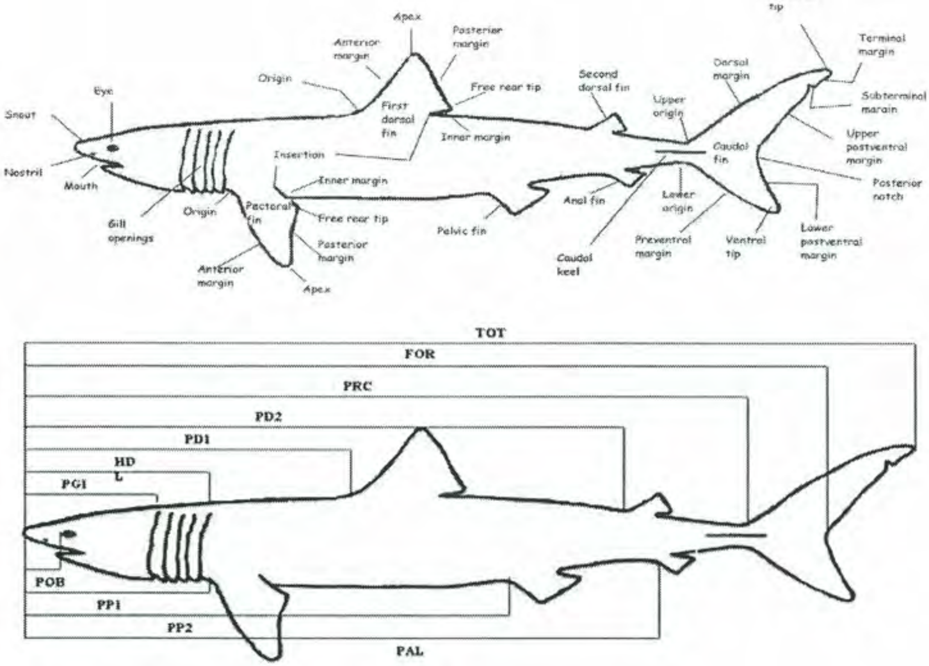
Important samples to take and how to conserve them

	Alcohol 70%	Formalin 4%	Frozen	Bouin
Stomach contents	***	*	*	
Intestine contents	***	*	*	
Gonads		***		
Muscle	***		*	
Liver		***		
Gill and gill-rakers[1]		***		
Eye				***
Vertebra			***	
Skin		***		
Underkin fat		***		
Spermatophores		***		
Parasite		***		
Utera	***	***		

*** Recommended method   * Alternative method

1: for the conservation of gills and gill-rakers it will be better to fix the sample with formalin 10% (formalin and sea water) for a period of 12-24 h; then rinse the sample with fresh water and store it in alcohol 80º.

Figure 30. Form to use in fishing scientist surveys to collect biological samples.



TOT = total length (snout-posterior tip of caudal fin) _____

FOR = fork length (snout-caudal posterior notch) _____

PRC = precaudal length (snout-precaudal pit, upper origin) _____

PD2 = pre-second dorsal length (snout-origin second dorsal fin) _____

PD1 = pre-first dorsal length (snout-origin first dorsal fin) _____

HDL = head length (snout-5th gill openings) _____

PGI = prebranchial length (snout-1st gill openings) _____

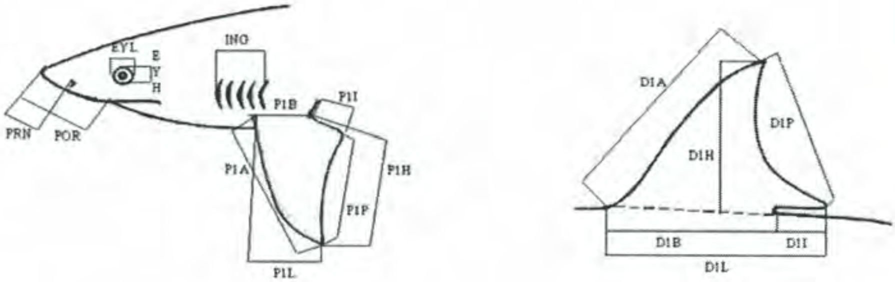
POB = preorbital length (snout-anterior eye margin) _____

PP1 = prepectoral length (snout-origin of the pectoral fin) _____

PP2 = prepelvic length (snout-origin pelvic fin) _____

PAL = preanal length (snout-origin anal fin) _____

Figure 31. Form to use in fishing scientist surveys to collect general length measurements in sharks.



Head

EYL = eye length
EYH = eye height
POR = preoral length (snout-mouth)
PRN = prenarial length (snout-nostril)
ING = intergill length (1^{st}-5^{th} gill)

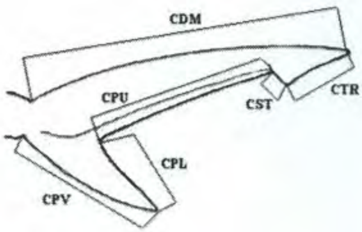
Pectoral fin

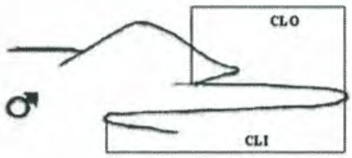
P1A = pectoral anterior margin (origin-apex)
P1L = pectoral length (origin-free rear tip)
P1P = pectoral posterior margin (apex-insertion)
P1H = pectoral height (apex-insertion)
P1B = pectoral base (origin-insertion)
P1I = pectoral inner margin (insertion-free rear tip)

Dorsal fin

D1A = first dorsal anterior margin (origin-apex)
D1B = first dorsal base (origin-insertion)
D1L = first dorsal length (origin-free rear tip)
D1I = first dorsal inner margin (insertion-free rear tip)
D1P = first dorsal posterior margin (free rear tip-apex)
D1H = first dorsal height (apex-middle point of the base)

Figure 32. Form to use in fishing scientist surveys to collect head and fin measurements.





Caudal fin

CDM = dorsal caudal margin (posterior margin of upper origin of precaudal pit-posterior tip) _____

CTR = terminal caudal margin _____

CST = subterminal caudal margin _____

CPU = upper postventral caudal margin (subterminal notch-posterior notch) _____

CPL = lower postventral caudal margin (posterior notch-ventral tip) _____

CPV = preventral caudal margin (ventral tip-posterior margin of lower origin of precaudal pit) _____

Clasper

CLI = clasper inner length _____

CLO = clasper outer length _____

Figure 33. Form to use in fishing scientist surveys to collect measurements of caudal fin and claspers.

FLEET FILE PORT:

MONTH:

YEAR:

VESSEL	LIST	AREA	HULL	REGISTRATION NUMBER	SHEET	GRT	HP	LENGTH	YEAR	BASE PORT	EQUIPMENT

Figure 34. Example of fleet data form.

Code of fishing gear: Date:

Target species:

Vessel: Length: GRT: HP: Base port:

Main line	Total length (mn)
	Number of hooks
	Material
	Gauge (Diameter)

Unit	Length
	Number of hooks

Branch line	Length
	Material
	Gauge (Diameter)

Stretch	Length
	Number of units
	Number of hooks

Hooks	Type
	Size
	Dimensions (mm)
	Hooks gaps

IMPORTANT: YOU MUST DRAW A GEAR SKETCH, NOTE ANY PARTICULAR CHANGE IN THE GEAR OR TERMINOLOGY.

Figure 35. Example of form to collect gear characteristics in longline fisheries.

NIMFS FISHERIES OBSERVER PROGRAM

GILLNET GEAR LOG

OBS/ TRIP ID	
DATE LAND (mm/yy)	

GEAR CODE | GEAR NUMBER(S) | NUMBER OF NETS

AVERAGE NET:
LENGTH ______FT
HEIGHT ______FT
MESH COUNT VERTICAL
HANGING RATIO
/
TWINE SIZE___A /E
STRANDS ____

NET MATERIAL
Unknown 0___
Nylon 1___
Other 9___

FLOATLINE MATERIAL
Unknown 0_
Floating (foam core) 1_
Twisted Polypropylene 2
Other 9

LEADLINE WEIGHT
______.______lbs / net

USED?	NO	YES	MEASUREMENTS
FLOATS	0___	1___	Dist Between ft
TIE DOWNS	0___	1___ 2___	Length ____. ft
SPACE(S) BETWEEN	0___	1___	Number _______
DROPLINES	0___	1___	Width ________ft
ADDTIONAL WTS	0___	1___	Lenght ________ft
ANCHOR(S)	0___	1___	Weight ________lbs
			Number ________
			Weight ________lbs (total)
			Actual 1___
			Estimated 2___
SECURING METHOD(S)		1___	None
		2___	Ocean Bottom
		3___	Vessel / Ocean Bottom
		4___	Vessel Only

MM DETERRENT DEVICES USD?

ACTIVE Brand ____________	0___	1___	Number _______ Frequency _______kHz
PASSIVE	0___	1___	Number _______

# OF NETS	MESH SIZE in	(CIRCLE ONE)
	.	A / E
	.	A / E
	.	A / E
	.	A / E
	.	A / E

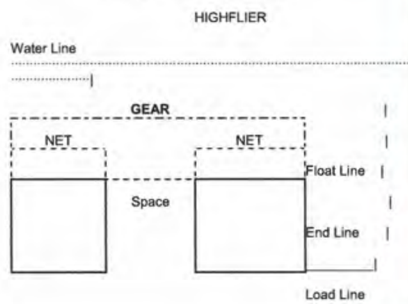
OR

MESH SIZE RANGE

____.____ - ____.____

COLOR
Unknow
00 Clear
White
02 Pink
Black
04 Green
Blue
06 Mukti-color
Red
08 Orange
Purple
10
Combination
98__ Other

(diagram for reference only)



COMMENTS

Page 1. Part___ Set # __ __ __ __ __ __ __
loc set mm yy

Vessel: ________________________ Date: In __________ Out _____________

Hooks:___________ Size:_______ Gear: Bottom ;Float Target:_______________Stow-away: in____ out____

Bait: ____

	Time	Air T°	H_2OT°	Location	Depth(ft)
Set First Hook In:					
Last Hook In:					
Haul First Hook Out:				Set Length: ______________	
Last Hook Out:				Haulback Direction: B -> E , E-> B	

Spec#	Species	A/D	Disp.	FL(cm)	TL(cm)	Misc. Measure	Sex	Notes	Notes
1.									
2.									
3.									
4.									

Figure 36. Form to collect sex data.

SIZE DISTRIBUTIONS VERS SEX 1/2 cm

Cruise:_______________ Specie:______________________________ CODE:_______________

CAST:	DEPTH:	RANGE:	CODE:	SECTOR:	DATE:	**PAGE Nº:**

	MALES				1//2	cm		**FEMALES**				1//2	cm	**INDET**	1//2	cm
	I	II	III	IV				I	II	III	IV					
0							0							0		
0,5							0,5							0,5		
1							1							1		
1,5							1,5							1,5		
2							2							2		
2,5							2,5							2,5		
3							3							3		
3,5							3,5							3,5		
4							4							4		
4,5							4,5							4,5		
5							5							5		
5,5							5,5							5,5		
6							6							6		
6,5							6,5							6,5		
7							7							7		
7,5							7,5							7,5		
8							8							8		
8,5							8,5							8,5		
9							9							9		
9,5							9,5							9,5		
0							0							0		
0,5							0,5							0,5		
1							1							1		
1,5							1,5							1,5		
2							2							2		
2,5							2,5							2,5		
3							3							3		
3,5							3,5							3,5		
4							4							4		
4,5							4,5							4,5		
5							5							5		
5,5							5,5							5,5		
6							6							6		
6,5							6,5							6,5		
7							7							7		
7,5							7,5							7,5		
8							8							8		
8,5							8,5							8,5		
9							9							9		
9,5							9,5							9,5		
0							0							0		

Number of specimen sampled: Males= Females= Undetermined=
Total number estimated: Males= Females= Undetermined=
Total weight of this specie:______________grs. Total specimen number (M+F+I):________
Weight sampled:___________grs.
Conversion coefficient: Initial size:_______ Initial size:________ Initial size:________
Final size: _______ Final size:________ Final size ________

Figure 37. Form to collect size data.

ANNEX III

INTERNATIONAL WORKSHOP ON MEDITERRANEAN CARTILAGINOUS FISH WITH EMPHASIS ON SOUTHERN AND EASTERN MEDITERRANEAN
14-16 October 2005 İstanbul/TURKEY

LIST OF PARTICIPANTS

SURNAME	NAME	INSTITUTION	NATION	E-MAIL
ALIÇLI	Zahit	İstanbul Univ.	Turkey	alilci@istanbul.edu.tr
ALTUĞ	Gülşen	İstanbul Univ.	Turkey	galtug@istanbul.edu.tr
ARAPI	Dritan	FDP	Albanıa	d_arapi@hotmail.com
BARANES	Albert-Avi	The inter University Institute for Marine Sciences	Israel	avib@vms.huji.ac.il
BAŞUSTA	Nuri	Harran Univ.	Turkey	nbasusta@hotmail.com
BEN-ABDALLAH	Abdallah	EGA	Libya	abdallalıbfish@yahoo.com
BİZSEL	K.Can	Dokuz Eylül Univ.	Turkey	can.bizsel@deu.edu.tr
BRADAI	M.Nejmeddine	INSTM	Tunisia	mednejmeddine.bradai@instm.rnrt.tn
CEBRIAN	Daniel	UNEP/MAP RAC/SPA	Tunisia	daniel.cebrian@rac-spa.org
CECAN	Haluk		Turkey	halukcecan@hotmail.com
CHATZISPYROU	Archontia	Univ. of Athens	Greece	a.chatzispyrou@mom.gr
ÇEKİÇ	Mustafa	Çukurova Univ.	Turkey	cekicm@cu.edu.tr
DAL	Tarık	Gaziosmanpaşa Univ.	Turkey	tdal@gop.edu.tr
DOĞAN	Kadir	İstanbul Univ.	Turkey	kadogan@istanbul.edu.tr
DÖKMECİBAŞI	Banu	Greenpeace	Turkey	bdokmecı@diala.greenpeace.org
ERSEMİZ	Barış	İstanbul Univ.	Turkey	sailor669tr@yahoo.com
FERRETTI	Francesco	Dalhousıe Univ.	Italy	ferretti@dal.ca
FEYZİOĞLU	Muzaffer	KTU	Turkey	muzaffer@ktu.edu.tr
FİLİZ	Halit	Ege Univ.	Turkey	halit.filiz@ege.edu.tr
GARIBALDI	Fulvio	University of Genova	Italy	garıbaldi.f@libero.it

GENÇ	Ercüment	MKÜ SUF	Turkey	egenc@mku.edu.tr
GOLANI	Daniel	The Hebrew University of Jerusalem	Israel	dgolani@cc.huji.ac.il
GÜÇLÜSOY	Harun	Dokuz Eylül Univ.	Turkey	harun.guclusoy@deu.edu.tr
HADJICHRISTOPHOROU	Myroula	Ministry of Agricalture	Cyprus	andrecws@logos.cy.net
KARAKULAK	Saadet	TÜDAV	Turkey	karakul@istanbul.edu.trt
KESKİN	Çetin	İstanbul Univ.	Turkey	seahorse@istanbul.edu.tr
KUPUSOVIC	Esena	Meteorological Institute	Bosnia-Herzegovina	ekupusov@utic.net.ba esena.kupusovic@heis.com.ba
MACIAS	David	IEO	Spain	david.macias@ma.ieo.es
MAVRIC	Borut	MBP National Institute of Biology	Slovenia	mavric@mbss.org
MOUMNI	Amina	INRH	Morocco	amoumni6@caramail.com
NADER	Manal	University of Balamand	Lebanon	manal.nader@balamand.edu.lb
ÖZGÜR	Elif	İstanbul Univ.	Turkey	eozgur@istanbul.edu.tr
ÖZTÜRK	Bayram	İstanbul Univ., TÜDAV	Turkey	ozturkb@istanbul.edu.tr tudav@superonline.com
PAYASLIOĞLU	Mutlu		Turkey	mutlup@yahoo.com
SAAD	Adib	Tishreen Univ.	Syria	adibsaad@scs-net.org
SCHEMBRI	Titian	University of Malta	Malta	titianpaul@camline.net.mt schembrinu@yahoo.com
SERENA	Fabrizio	ARPAT	Italy	f.serena@arpat.toscana.it
SERET	Bernard	IRD MNHN	France	seret@mnhn.fr
SOLDO	Alen	IOR	Croatia	soldo@izor.hr
SÜTÇÜOĞLU	Merve Pelin	İstanbul Univ.	Turkey	mervepelin@yahoo.com
TIRAŞIN	E. Mümtaz	Dokuz Eylül Univ.	Turkey	mumtaz.tirasin@deu.edu.tr
TONAY	Arda	TÜDAV	Turkey	atonay@istanbul.edu.tr
TURAN	Cemal	M.K.U.	Turkey	cturan@mku.edu.tr
TÜRKER ÇAKIR	Dilek	Balıkesir Univ.	Turkey	dilektürker@hotmail.com
YARDIMCI	Cumhur	İstanbul Univ.	Turkey	yardimci@istanbul.edu.tr
YELDAN	Hacer	Çukurova Univ.	Turkey	hacyel@yahoo.com
YOKEŞ	Baki	Boğaziçi Univ.	Turkey	yokesmeh@boun.edu.tr