

Chondrichthyes species in deep waters of the Mediterranean Sea*

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SUMMARY: Data collected during the DESEAS survey carried out in three areas of the Mediterranean Sea (Balearic Sea, western and eastern Ionian Sea) were used to describe the distribution and abundance of chondrichthyes species at depths between 600 and 4000 m. A total of 8 chondrichthyes species were recorded, 5 of them in the Balearic Sea, 4 in the western Ionian and 6 in the eastern Ionian. A decrease in abundance with depth was observed in each species with the exception of *Centroscymnus coelolepis*. The most abundant species were *Galeus melastomus* and *Etmopterus spinax*. The depth range of some species was updated. *G. melastomus* was caught down to 1500 m, exhibiting a smaller-deeper pattern in females, while *E. spinax* was captured down to 2200 m with a bigger-deeper trend. Mature females of these two sharks were found between 600 and 1500 m. A wide size-range was shown in both species. *C. coelolepis* was only collected in the Balearic Sea down to 2800 m. The presence of pregnant female was sampled from a depth of 1500 m. The distribution of the species is discussed in the context of the present knowledge of the Mediterranean ichthyofauna.

Key words: Chondrichthyes, distribution, size structure, biology, Mediterranean Sea.

RESUMEN: ESPECIES DE CONDRICHTIOS EN AGUAS PROFUNDAS DEL MAR MEDITERRÁNEO. — Para describir la distribución y abundancia de las especies de condrichtios a profundidades entre 600 y 4000 m, se utilizaron muestras de la campaña DESEAS en tres áreas del Mediterráneo (mar Balear y Iónico oriental y occidental). Se registraron un total de 8 especies de condrichtios de las cuales 5 de ellas corresponden al mar Balear, 4 al Iónico occidental y 6 al Iónico oriental. En cada una de las especies se observó un descenso de abundancia con la profundidad a excepción de *Centroscymnus coelolepis*. Las especies más abundantes fueron *Galeus melastomus* y *Etmopterus spinax*. Se amplió el rango de distribución de algunas especies, *G. melastomus* fue capturado por debajo de 1500 m y las hembras redujeron su talla con la profundidad (smaller-deeper pattern), mientras que *E. spinax* que se capturó hasta 2200 m presentó una tendencia a aumentar su tamaño con la profundidad (bigger-deeper trend). Entre 600 y 1500 m se encontraron hembras maduras de estas dos especies. También ambas especies presentaron un amplio rango de tallas. *C. coelolepis* solo se encontró en el mar Balear a 2800 m de profundidad. De esta especie se encontró una hembra ovada a 1500 m. Finalmente se discute la distribución de estas especies en el marco de los conocimientos actuales de la ictiofauna mediterránea.

Palabras clave: Chondrichthyes, distribución, estructura de tallas, biología, Mediterráneo.

INTRODUCTION

The fish fauna in the Mediterranean Sea consists of 664 species, of which 86 are represented by chondrichthyes (Quignard and Tomasini, 2000). Most of

the cartilaginous species are distributed on the continental shelf and on the slope. Only 4 of them dwell exclusively below 1000 m and only 1 exclusively at depths greater than 2000 m (Fredj and Maurin, 1987).

In the past two decades studies on Mediterranean chondrichthyes have increased markedly, although

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they mostly regard species distributed from the continental shelf to the upper slope (Fredj and Maurin, 1987). National and international programmes of bottom trawl surveys carried out routinely since the early 1980s have mostly contributed to the knowledge on the distribution and abundance of demersal sharks, rays and skates (Allué *et al.*, 1985; Bertrand *et al.*, 2000; Relini *et al.*, 2000). Although cartilaginous fishes represent by-catch of the commercial fisheries in the Mediterranean, their importance as indicators of the “top down” effect in the food webs and overexploitation by fishery is currently under discussion for this basin (Serena *et al.*, 2002). Their position at the top of the marine food webs in addition to their life-history k-strategies make chondrichthyes more susceptible to overfishing and to man-induced environmental changes (e.g. Stevens *et al.*, 2000; Vacchi and Notarbartolo di Sciarra, 2000). In this respect, a specific international plan of action has recently been proposed for the conservation and management of Mediterranean cartilaginous fish (Serena *et al.*, 2002). The importance of such an action plan is linked to the awareness of the fragmentary knowledge on their biology and ecology, even for the more common species.

Even though the deep-sea exploration in the Mediterranean dates back to the end of the eighteenth century (Ryland, 2000), the main knowledge on the deep-sea cartilaginous fish of this basin concerns their taxonomy (Tortonese, 1956). Information on the occurrence, vertical distribution and abundance of chondrichthyes deeper than 1000 metres has been obtained in some areas of the western

Mediterranean (Grey, 1956; Carpine, 1970; Allué *et al.*, 1985; Albertelli *et al.*, 1992; Stefanescu *et al.*, 1992a, 1992b, 1993) and in some areas of the eastern basin (e.g. Isaacs and Schwartzlose, 1975; Gilat and Gelman, 1984; Golani, 1986-87; Klausewitz, 1989; Albertelli *et al.*, 1992; Galil and Goren, 1994; Goren and Galil, 1997; Priede and Bagley, 2000; Jones *et al.*, 2003). Feeding ecology and sex ratio by depth have only been investigated in deep water for *Galeus melastomus* and *Centroscymnus coelolepis* in the western Mediterranean (Carrassón *et al.*, 1992; Clò *et al.*, 2002).

At present a comprehensive picture of the geographic and vertical distribution of deep-sea cartilaginous fish in the Mediterranean is lacking. Considering the broad area covered by the Mediterranean below 1500 m and the several technical limitations for sampling bathyal and abyssal fish species (Merrett and Haedrich, 1997), specific research programmes are required in order to gather scientific information on the species living in the various basins.

The DESEAS project, financed by the EC, gave the opportunity to investigate three different areas (the Balearic Sea, the western Ionian and the eastern Ionian) of the Mediterranean Sea down to 4000 m. This paper presents the results of deep-sea chondrichthyes species collected during this research. In particular, the abundance of each species is reported as well as the depth-size trends, size structure and biological aspects on the three most abundant species: *Galeus melastomus*, *Centroscymnus coelolepis* and *Etmopterus spinax*.

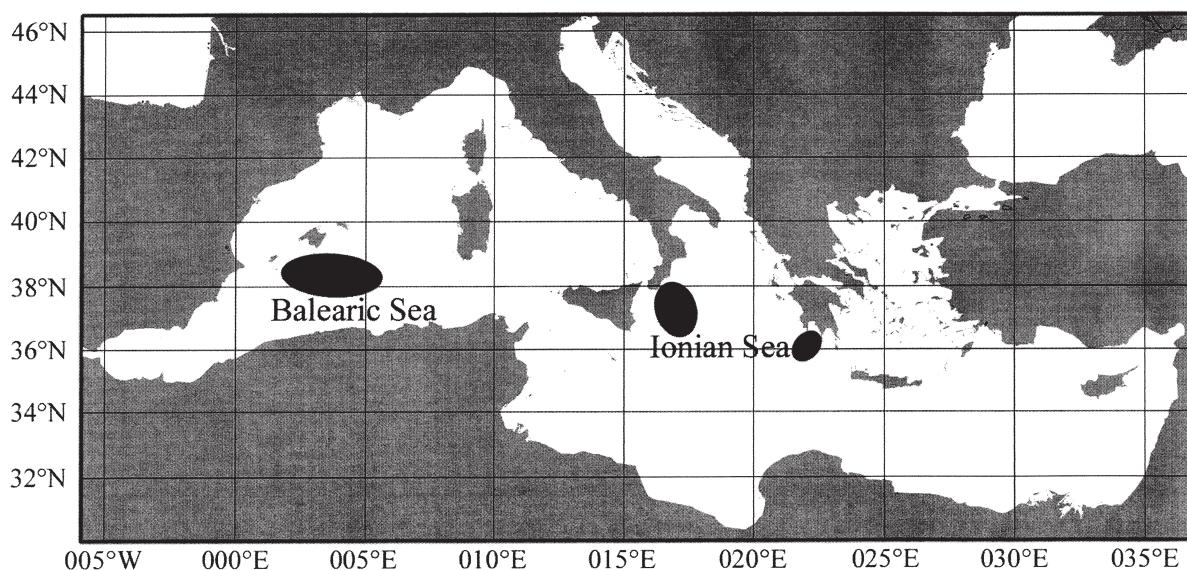


FIG. 1. – Map of the Mediterranean Sea with indication of the study areas during the DESEAS survey.

TABLE 1. – Number of hauls by depth strata carried out in the Balearic Sea, in the western and eastern Ionian Sea during the DESEAS survey.

Depth stratum (m)	Balearic area	Western Ionian Sea	Eastern Ionian Sea
500 - 999	2	2	4
1000 - 1499	2	2	2
1500 - 1999	1	3	1
2000 - 2499	-	1	1
2500 - 2999	2	-	1
3000 - 3499	-	1	-
3500 - 3999	-	-	-
4000 - 4499	-	1	-
Total hauls	7	10	9

MATERIALS AND METHODS

The deep-sea research cruise was carried during June 2001 in three areas of the Mediterranean Sea (Fig. 1). The area in the Balearic Sea extends from 38°04'06"N 1°44'18"E to 40°48'18"N 5°34'36"E, the western Ionian area from 35°41'04"N 16°24'48"E to 38°18'30"N 17°47'00"E, and the eastern Ionian area from 36°19'31"N 21°54'23"E to 36°51'24"N 22°14'54"E.

The sampling was conducted with the otter trawl Maireta System (OTMS) using the R/V *García del Cid* (38 m long; 1500 HP). The OTMS (vertical opening 1.8-2 m; wing spread 14 m) was trawled by a single warp and operated with a pair of rectangular iron otter boards (1.20 x 2.0 m; 450 kg). A detailed description of the net can be found in Sardà *et al.* (1998). The initial and final tow time were measured using a SCANMAR sonar system down to 1500 m, and the same parameters were assumed below 1500 m. The vessel speed and geographic

position were measured using differential GPS. The trawling was carried out during daylight hours. The number of hauls carried out in each area, with the indication of the depth, is reported in Table 1. Tow duration ranged from 1 to 3 hours, but data were standardised to one hour of trawling. The results obtained in number were also standardised to one km² for subsequent numerical processing.

Individuals were identified on board following the nomenclature reported in Whitehead *et al.* (1984). For each species the relationships between abundance (N km⁻²) and depth were computed. Total length (TL) of each individual was measured to the nearest cm and weight to the nearest g. Sex and the maturity stage of the gonads were determined macroscopically according to Stehmann (1998).

The relationship between size and depth was evaluated for *G. melastomus*, *C. coelolepis* and *E. spinax* by means of regression analysis. The population structure by depth was performed for these species. The length-frequency distribution by maturity stage was computed for *G. melastomus*.

RESULTS

Species composition, abundance and biomass

During the DESEAS survey a total of 8 chondrichthyes species belonging to 5 families were collected between 600 and 2800 m depth. The depth range and the number of hauls in which the species were found together with the total number of the individuals caught and their total biomass are reported in Table 2. *G. melastomus*, *Dalatias licha* and *E. spinax* were caught in all three areas. In addition,

TABLE 2. – Chondrichthyes species collected in the Balearic Sea, in the western and eastern Ionian Sea during the DESEAS survey, with indication of depth range, number of hauls in which the species were caught (n.), total number (N h⁻¹) and total biomass (kg h⁻¹).

Family / Species	Balearic Sea				Western Ionian Sea				Eastern Ionian Sea			
	Depth range (m)	n. hauls	N	kg	Depth range (m)	n. hauls	N	kg	Depth range (m)	n. hauls	N	kg
Hexanchidae												
<i>Hexanchus griseus</i>												
Scyliorhinidae												
<i>Galeus melastomus</i>	650-1500	5	65	25.24	600-1500	5	63	10.75	600-1300	6	62	13.42
Oxynotidae												
<i>Oxynotus centrina</i>					800	1	1	0.07				
Squalidae												
<i>Centrophorus granulosus</i>												
<i>Centroscymnus coelolepis</i>	1500-2800	3	14	14.56					1100	1	1	2.37
<i>Dalatias licha</i>	802-1200	2	2	6.24	1200	1	6	8.29	800	2	2	3.08
<i>Etomopterus spinax</i>	802-1200	3	10	2.65	600-1500	4	13	0.50	600-2200	8	15	1.74
Chimaeridae												
<i>Chimaera monstrosa</i>	650	1	1	0.02					800	2	2	0.02

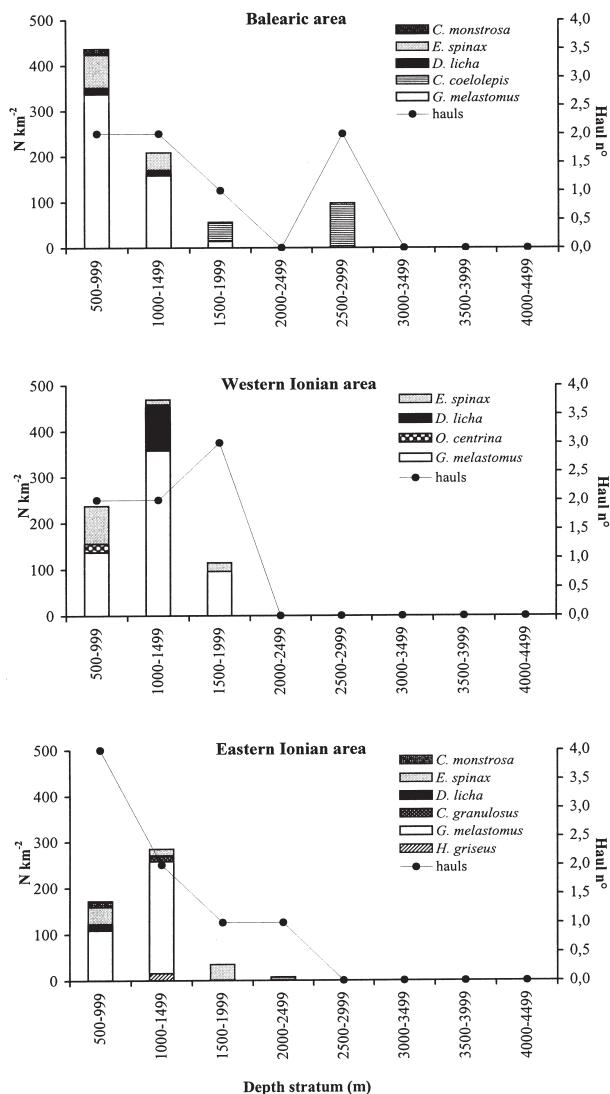


FIG. 2. – Relationship between abundance ($N \text{ km}^{-2}$) and depth of chondrichthyes species collected in the three study areas during the DESEAS survey. (The number of hauls where the species were collected is indicated).

one species was collected exclusively in the Balearic Sea (*C. coelolepis*), one in the western Ionian (*Oxynotus centrina*) and two in the eastern Ionian (*Hexanchus griseus* and *Centrophorus granulosus*). In all three study areas the Scyliorhinidae and Squalidae families represented about 74 and 24% respectively of the chondrichthyes collected.

The most abundant species were *G. melastomus* and *E. spinax*. The former was caught down to depths of 1500 m, with the highest biomass in Balearic waters. *E. spinax* showed the widest vertical distribution in the eastern Ionian Sea (down to 2200 m) and the greatest biomass in Spanish waters. *C. coelolepis* showed the deepest distribution (from 1500 to 2800 m) and was only caught in the Balearic Sea.

The relationships of abundance ($N \text{ km}^{-2}$) with depth of each species are shown in Figure 2. In the Balearic Sea, the abundance of *G. melastomus*, *D. licha* and *E. spinax* decreased with depth while *C. coelolepis* showed the highest density between 2500 and 2999 m. In the western Ionian Sea both *G. melastomus* and *D. licha* were found to be more abundant between 1000 and 1499 m, while *E. spinax* was mostly captured at depths between 500 and 999 m. In the eastern Ionian Sea *G. melastomus* exhibited the highest abundance in the 1000-1499 m depth stratum, whereas *D. licha* and *E. spinax* were mainly found in the shallower depths. The latter species also showed noteworthy density values between 1500 and 1999 m in both the western and eastern Ionian Sea.

Biological aspects of the most abundant species

Galeus melastomus Rafinesque, 1810

Both small and large individuals were found across the vertical gradient surveyed. Significant variations in the depth-size trend were only observed in all three areas for females (Fig. 3). The size composition of males and size by maturity stage of gonads in females are presented in Figure 4. The broadest size range was shown in the Balearic waters, with the females up to 62 cm and males up to 55 cm. In this area the most abundant specimens were between 50 and 60 cm TL. A flat distribution with a greater number of small individuals was found in the western Ionian Sea. The largest female and male measured 55 cm and 52 cm respectively. In the eastern Ionian Sea the maximum sizes were 51 cm in females and 48 cm in males. Here the specimens were mostly distributed around the size classes of 40-48 cm.

Immature and maturing females (stages I and II), mature females (stages III and IV) and females with egg capsules (stages V and VI) were caught in all three areas (Fig. 4). Females bearing egg capsules were caught from 800 to 1500 m and were between 44 and 55 cm in the Balearic Sea; they were collected from 800 to 1500 m and between 44 and 55 cm in the western Ionian Sea; 2 females with egg capsules of 45 and 50 cm TL were sampled at a depth of 600 m in the eastern Ionian Sea.

Centroscymnus coelolepis Bocage Capello, 1864

For *Centroscymnus coelolepis*, the relationship between size and depth is shown in Figure 5. The

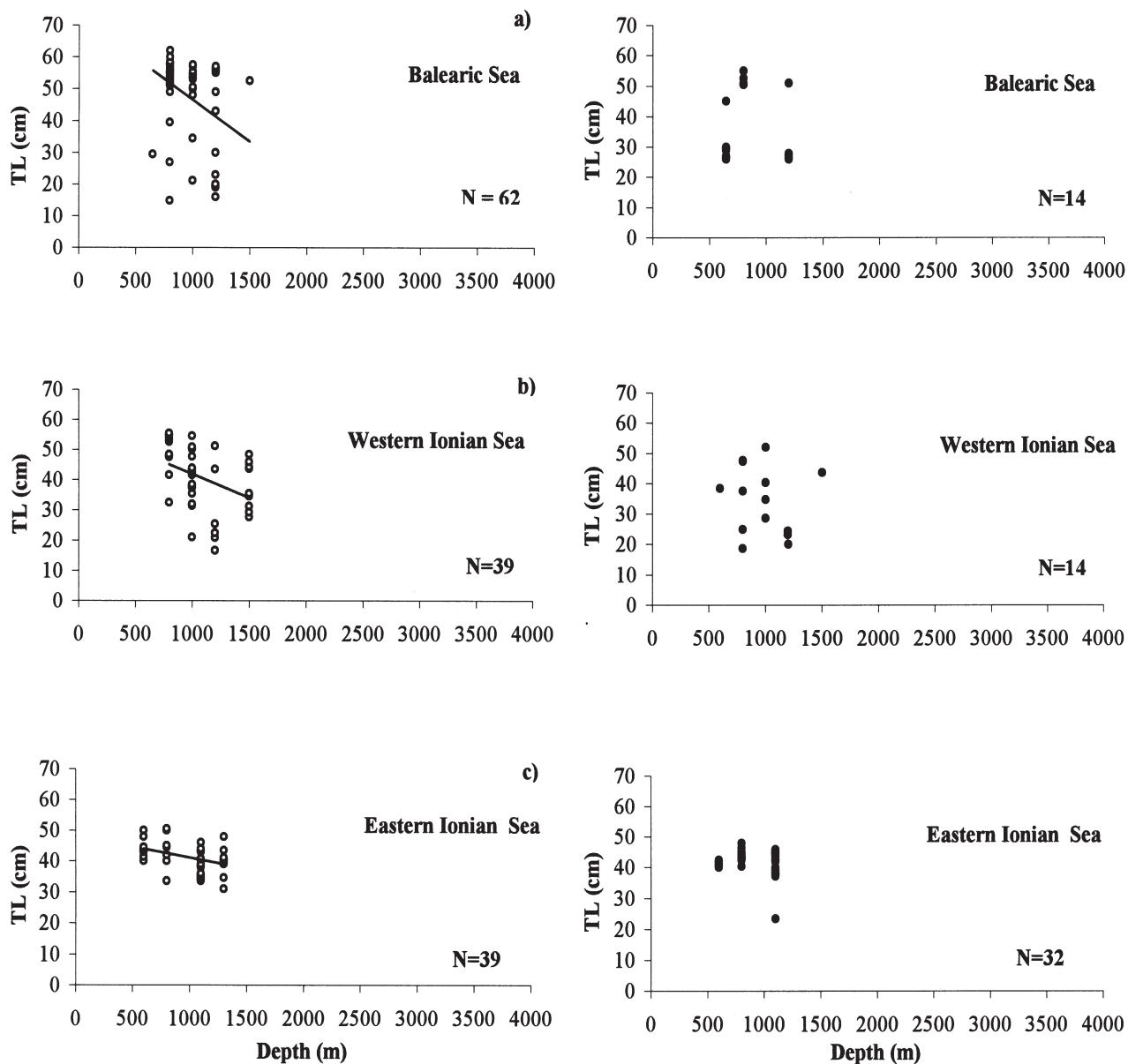


FIG. 3. – Bathymetric distribution by size of *Galeus melastomus* collected in the Balearic Sea, in the western and eastern Ionian Sea during the DESEAS survey. ○, Females; ●, Males. a) TL = - 0.0261 depth + 72.68; $r^2 = 0.13$; $p < 0.05$; b) TL = - 0.0158 depth + 57.64; $r^2 = 0.14$; $p < 0.05$; c) TL = - 0.007 depth + 48.11; $r^2 = 0.13$; $p < 0.05$.

two smallest individuals were caught in shallower waters. The size structure of this shark showed a wide range, with females and males that measured 27 to 64 cm and 49 to 54 cm respectively (Fig. 6).

The percentage of immature and maturing females was about 68%. The remaining percentage consisted of 4 females at the “candle” stage (with unsegmented yolk content) and one pregnant female. The former were caught from 2500 to 2800 m depth and were between 59 and 64 cm TL. The gravid female was found at a depth of 1500 m. It was 60 cm TL and contained 8 embryos that measured between 15 and 18 cm and weighed between 47 and 55 g.

Etmopterus spinax (Linnaeus, 1758)

The depth-size trend of *E. spinax* was analysed for the whole sampled population since a low number of individuals was caught in each area. A significant increase in size with depth was only shown in males ($p < 0.05$) (Fig. 7). The largest specimens were caught off the Balearic Islands (34-48 cm) and the youngest individuals (10-32 cm TL) in the western Ionian. In the eastern Ionian the size-range was 11-40 cm TL (Fig. 8). The females were found to be larger than the males. In the Balearic Sea eight mature females were collected between 800 and

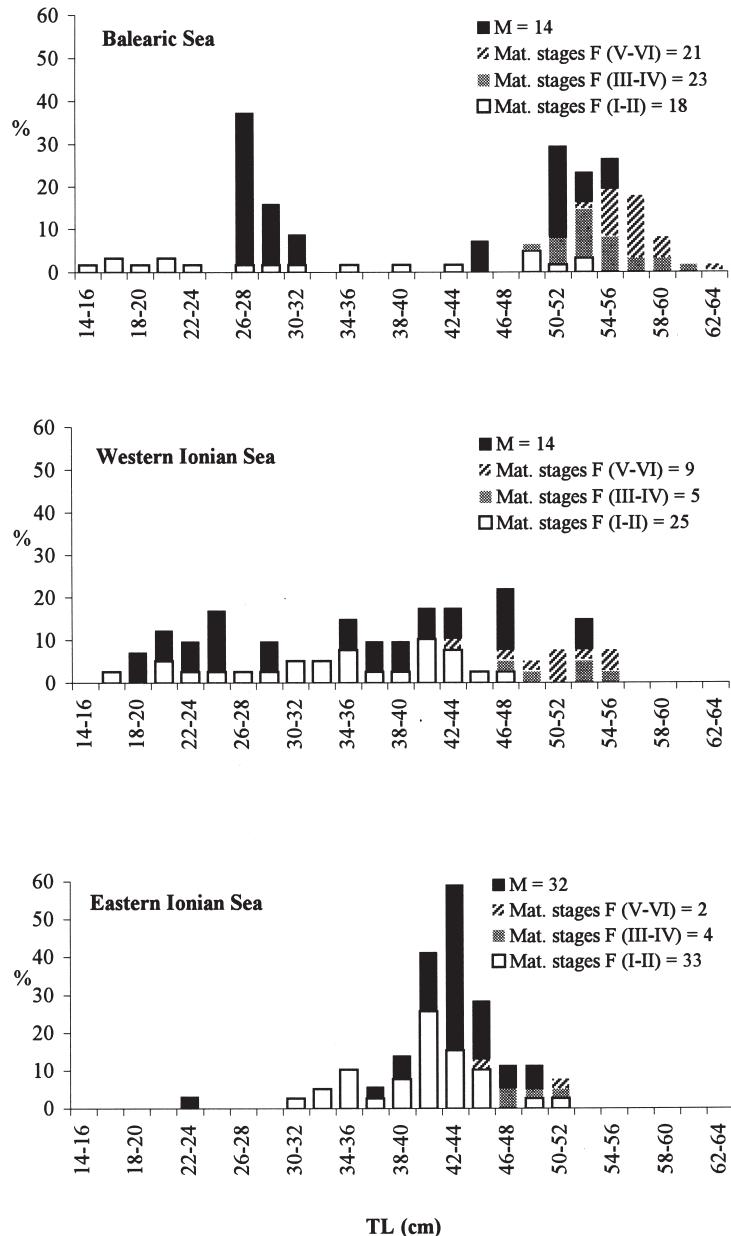


FIG. 4. – Length-frequency distribution of males and females by maturity stage of *Galeus melastomus* collected in the Balearic Sea and in the western and eastern Ionian Sea during the DESEAS survey.

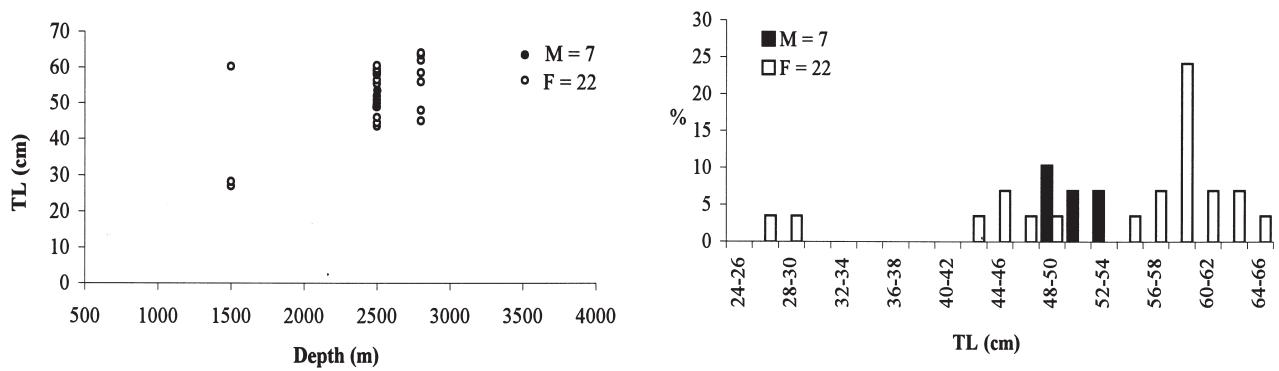


FIG. 5. – Bathymetric distribution by size of *Centroscymnus coelolepis* collected in the Balearic Sea during DESEAS survey.

FIG. 6. – Size-frequency distribution by sex of *Centroscymnus coelolepis* collected in the Balearic Sea during the DESEAS survey.
M, males; F, females.

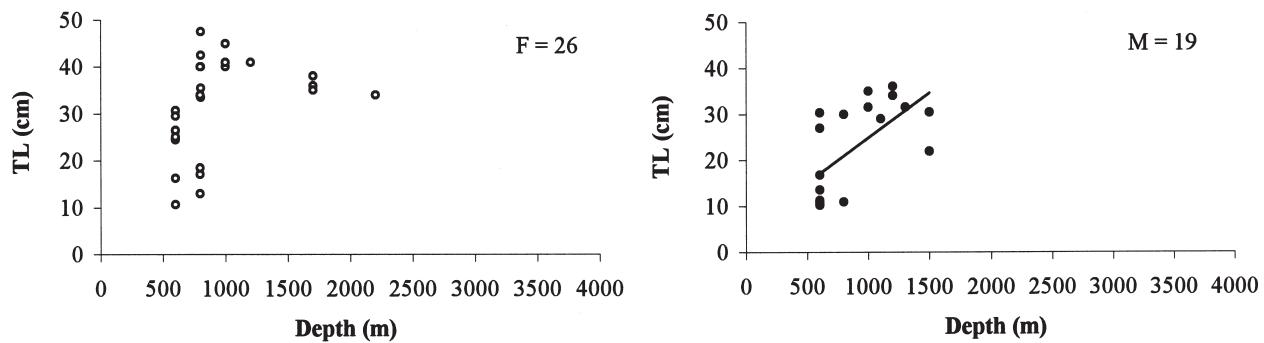


FIG. 7. – Bathymetric distribution by size of *Etmopterus spinax* collected in the whole study area during the DESEAS survey (F, females; M, males). Males: $TL = 0.0194 \text{ depth} + 5.6273$; $r^2 = 0.40$; $p < 0.05$.

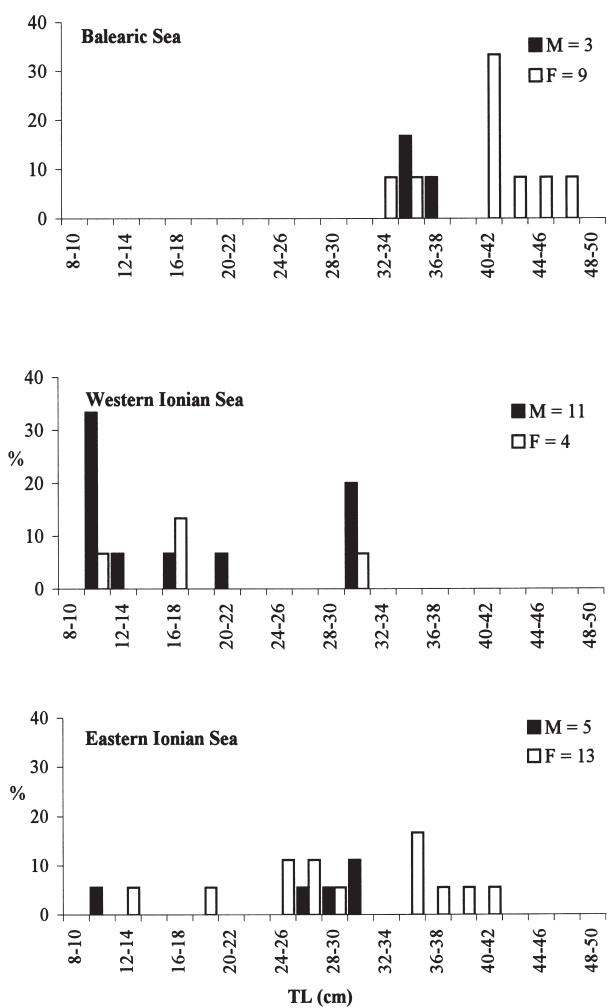


FIG. 8. – Size-frequency distribution by sex of *Etmopterus spinax* collected in the Balearic Sea and in the western and eastern Ionian Sea during the DESEAS survey. M, males; F, females.

1000 m. In the eastern Ionian Sea one mature female was captured at a depth of 800 m and two ripe males were found at depths of 1100 and 1300 m. No mature individuals were caught in the western Ionian Sea.

DISCUSSION

The DESEAS survey represents the first recent investigation on deep-sea chondrichthyes species carried out in three areas of the Mediterranean Sea with the same gear and during the same period. All the species caught in the three study areas are typically demersal species living over sandy and muddy bottoms (Fischer *et al.*, 1987). Although a different number of species was collected in the three study transects, it is not possible to draw definite conclusions on the species diversity differences between the three Mediterranean areas from the present results. All the species collected are known in both the western and eastern Mediterranean (Compagno, 1984; Whitehead *et al.*, 1984; Golani, 1986-87; Fischer *et al.*, 1987; Stefanescu *et al.*, 1992a; Relini *et al.*, 2000; Goren and Galil, 2002; Jones *et al.*, 2003). The differences observed in the presence-absence between the study areas might be due to the different number of hauls carried out by depth and area and/or to the occasional findings depending on the gear used. In addition, the number of species in each area could have been increased by employing other sampling techniques with different selectivity for the cartilaginous fishes. However, the number of species collected during this study is even higher than that captured in the western Mediterranean using three types of gear with a higher number of stations (OTSB, Agassiz trawl, longline) (Stefanescu *et al.*, 1992a).

Three species (*G. melastomus*, *E. spinax* and *D. licha*) were found in all three areas. Their distribution throughout the Mediterranean basin is well known even in deep waters (Whitehead *et al.*, 1984; Tortonese, 1956; Stefanescu *et al.*, 1992a; Golani, 1986-87; Jones *et al.*, 2003). Although during this research *C. monstrosa* was not sampled in the western Ionian Sea, its occurrence has frequently been

recorded along the southeastern Italian coasts (Matarrese *et al.*, 1996; Relini *et al.*, 2000). *C. coelolepis* was only caught in the Balearic Sea, confirming its wide vertical distribution in the western Mediterranean. In this area it was caught as far as the maximum depth of 2863 m (Grey, 1956) and recently down to 2853 m (Clò *et al.*, 2002). In the Catalan Sea, it was previously found from about 1400 to 2300 m (Carrassón *et al.*, 1992; Stefanescu *et al.*, 1992b) and off the Balearic Islands down to 1800 m (Moranta *et al.*, 1998). The occurrence of *C. coelolepis* in the eastern Mediterranean was recorded using lander platforms equipped with baited cameras: between 1500 and 2500 m in the Cretan Sea and between 2300 and 3850 m in the Rhodes Basin (Priede and Bagley, 2000).

C. granulosus and *H. griseus* were only collected in Greek waters, though their occurrence throughout the Mediterranean has long been known (e.g. Fischer *et al.*, 1987). The former was captured by longline from a depth of 1400 m off the coast of Israel (Golani, 1986-87). The presence of both species in the eastern Mediterranean has also been recorded in underwater photographic surveys (Gilat and Gelman, 1984; Priede and Bagley, 2000; Jones *et al.*, 2003). Gilat and Gelman (1984) recorded *C. granulosus* from 280 to 1490 m, with a density peak at 1080 m, and *H. griseus* from a depth of 750 m. Jones (Priede and Bagley, 2000; Jones *et al.*, 2003) reported the occurrence of both sharks between 1500 and 2500 m in the Cretan Sea and between 2300 and 3850 m in the Rhodes Basin.

The overall highest abundance of the chondrichthyes considered during the DESEAS cruise was observed at less than 1500 m. The abrupt decrease in abundance below this depth might reflect the reduction of food availability as reported for deep-sea fish assemblages studied in the western Mediterranean Sea (Stefanescu *et al.*, 1993; Moranta *et al.*, 1998). In fact, the trophic resources between the upper and middle slope benthic boundary would be mostly based on the energetic transfer system due to mesopelagic organisms, as reported in the Atlantic ocean (e.g. Gordon, 1979; Merrett and Haedrich, 1997). In this respect, *G. melastomus* has a diet based on epibenthic (mainly *Calocaris macandreae*) and benthopelagic species (euphausiids, ommastrephidae, *Pasiphaea multidentata*, mesopelagic fishes), while *C. coelolepis* almost exclusively consumes cephalopods and, unlike the Atlantic populations (Mauchline and Gordon, 1983), the Mediterranean ones do not show strong

scavenger habits (Carrassón *et al.*, 1992). The diet of *E. spinax* is mainly based on cephalopods (Wurtz and Vacchi, 1978).

The occurrence of large mobile sharks at depths greater than 1500 m, revealed in the both western (e.g. Stefanescu *et al.*, 1992a; present study) and eastern Mediterranean basin (e.g. Jones in Priede and Bagley, 2000; Jones *et al.*, 2003; and in the present study), confirms the presence on the lower slope of a further trophic system based on food arriving from the upper layers of the water column, mostly represented by animals with migratory habits (Isaacs and Schwartzlose, 1975; Mahaut *et al.*, 1990).

The abundance recorded for *G. melastomus*, and to a lesser extent for *E. spinax*, confirms that these two species are the most abundant deep-sea demersal sharks in the Mediterranean Sea (e.g. Bertrand *et al.*, 2000; Relini *et al.*, 2000; Baino *et al.*, 2001). Both species are widespread in this basin, although the former is considered absent from the northern and central Adriatic. Moreover, both species were collected in deep waters of the western (Carrassón *et al.*, 1992; Stefanescu *et al.*, 1992b; Moranta *et al.*, 1998) and eastern Mediterranean basin (Galil and Goren, 1994; Goren and Galil, 1997; Jones *et al.*, 2003). The present finding of *E. spinax* down to 2200 m represents the greatest depth at which the species has been collected by trawling in the Mediterranean Sea. However, Jones *et al.* (2003) captured this shark in the Cretan Sea using baited traps as deep as 2230 m. Furthermore, Jones (Priede and Bagley, 2000) recorded the presence of *E. spinax*, together with *G. melastomus*, by means of baited cameras between 2300 and 3850 m in the Rhodes Basin.

Catches of *G. melastomus* in the Balearic and western Ionian Sea consisted of both small and large individuals, as reported by Ungaro *et al.* (2001) for the southern Adriatic Sea. In the eastern Ionian Sea the samples only consisted of medium-large specimens. Stefanescu *et al.* (1994) only collected large females at depths of 1200 m in the Catalan Sea. With regard to the size-related depth distribution, no trend was shown in males while a decreasing size with depth was detected in females. According to Carrassón *et al.* (1992), the occurrence of small specimens (< 20 cm) at depths greater than 1000 m was shown both in the Balearic Sea and the western Ionian Sea. However, considering that the bulk of the population on the edge of the continental shelf and on the upper slope of the western Ionian Sea consists of young individuals (Tursi *et al.*, 1993), the

spawning in this shark seems to occur over a wide depth range.

For *E. spinax*, Macpherson and Duarte (1991) indicated a general trend of increasing size with depth. Jones *et al.* (2003) did not find any clear depth-size trend in specimens measured photographically. In the present study a smaller-shallower pattern seems to be evident, since large individuals were captured over the whole depth range. Large specimens of *E. spinax* are also distributed in shallower waters than those investigated in this study (Sion *et al.*, 2000). In addition, since mature females were collected in the uppermost depths, the smaller-shallower trend might be the result of an inshore migration of adults during the spawning period.

An increase in size with depth was shown in *C. coelolepis*. However, no definitive conclusion can be drawn due to the small number of specimens collected. Only one pregnant female of this shark was found at 1500 m depth. In the northeast Atlantic, pregnant females were found almost exclusively in waters shallower than 1200 m (Girard and Du Buit, 1999; Clarke *et al.*, 2001). This would explain the fact that pregnant females can move to shallower bottoms to give birth. Embryo sizes are in the range reported in the literature for the Mediterranean Sea (Clò *et al.*, 2002) and much smaller than those observed by Girard and Du Buit (1999) for the Atlantic Ocean (around 30 cm). On the other hand, the maximum lengths usually recorded in the Mediterranean Sea are much smaller than those reported by these authors in the Atlantic Ocean (122 cm).

The distribution of the individuals in deep areas where trawling does not occur in the Mediterranean Sea makes the deep sharks less vulnerable to over-exploitation. In fact, the reduction in numbers of several selachian species, mostly on the continental shelf, seems to be related to the development of trawl fishing (Bertrand *et al.*, 2000; Relini *et al.*, 1999, 2000). According to Stevens *et al.* (2000), sharks are particularly vulnerable to overexploitation because of their slower growth, delayed maturity, low fecundity and in general k-selected life-history strategies. Indeed, several species of shark and skate that once were widespread and abundant are now uncommon and rare in Italian waters (Vacchi and Notarbartolo di Sciara, 2000). Some fishing activities targeting cartilaginous fishes, such as the deep-water fishery for bluntnose sixgill shark (*Hexanchus griseus*) in the Italian Ionian Sea, have almost disappeared. The fact that *G. melastomus* and

E. spinax are the most abundant shark species in the Mediterranean and show a stable size structure from trawl fishing catches might be related to their distribution at depths that are not exploited by trawling, thus making them less vulnerable to fishing.

Considering the deep distribution of *C. coelolepis*, the Mediterranean population of this shark could still be pristine, though its abundance in the whole basin is completely unknown. This could also be true for other deep-water sharks which are occasionally caught as by-catch during bottom trawls, or using longlines and driftnets, indicating that further data collection in deep-water using different sampling tools is required in order to improve our knowledge on the Mediterranean deep-sea ichthyofauna.

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