

# Deep-water fish fauna in the Eastern Ionian Sea

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**ABSTRACT.** Existing information on the ichthyofauna of the Eastern Ionian Sea (Greece) was enriched by a recent research project carried out in its northern part at depths ranging from 300 to 1200 m. The frequency of occurrence of the identified fish species and their abundance were examined. In total, 101 fish species were identified. Their number and abundance decreased significantly with depth. *Argentina sphyraena* presented the highest frequency of occurrence and *Chlorophthalmus agassizi* the highest abundance at depths ranging between 300 and 500 m. In the depth zone 500-700 m, *Chlorophthalmus agassizi* predominated in abundance and *Phycis blennoides* in frequency of occurrence. In the zone 700-900 m, *Galeus melastomus* and *Nezumia sclerorhynchus* showed both the highest abundance and frequency of occurrence. These two species were also the most abundant at depths 900-1200 m, whereas *Lampanyctus crocodilus* was the most frequently encountered. Four species (*Benthocometes robustus*, *Micrroichthys coccoi*, *Nemichthys scolopaceus* and *Epigonus constanciae*) are reported for the first time in Greek waters, and twenty species are reported for the first time in the Greek Ionian Sea. Moreover, one specimen of *Caelorinchus mediterraneus* IWAMOTO & UNGARO, 2002, a species that has only recently been described for the Mediterranean Sea, was also identified.

**KEY WORDS :** deep sea, fish fauna, Eastern Ionian Sea, Greece

## INTRODUCTION

The ichthyofauna of the Eastern Ionian Sea (Greece) consists of Atlantic-Mediterranean and cosmopolitan species. Few studies exist, most of which concern the fish fauna of the continental shelf and the upper slope (KASPIRIS, 1973; PAPACONSTANTINO, 1986; PAPACONSTANTINO et al., 1987). The previously available data on the fish fauna of the deep waters of the Eastern Ionian Sea were derived from the research expeditions "Dana" and "Thor" (TANING, 1918; 1923; EGE, 1930; 1934; 1948; 1953). No recent published data appear in the literature, although unpublished data for depths down to 800 m of the central and southern part of the Greek Ionian Sea exist from research projects carried out in recent years.

The present work provides information on the qualitative and quantitative fish species composition of the Eastern Ionian Sea for depths ranging between 300 and 1200 m.

## MATERIALS AND METHODS

Sampling was carried out in the deep waters of the northern part of the Eastern Ionian Sea (Fig. 1) during four experimental surveys (September 1999, April 2000, July 2000 and September 2000). Two hired commercial trawlers equipped with trawls of 40 mm (stretched) mesh size in the cod-end were used for sampling. The study area included between the 300 and 900 m isobaths, and was divided into three depth strata (300-500, 500-700, 700-900 m). A random stratified design was applied for the sampling, taking into account the depth and the sur-

face of each stratum (COCHRAN, 1977). However, for experimental purposes, sampling was also extended to depths 900-1200 m with some additional stations. In total, 148 hauls were carried out during the four surveys (Fig. 1), three hauls of which were not considered valid. The duration of the hauls was 30 min for depths <500 m and one hour for depths >500 m. Catches were identified to species level and the abundance of each species was recorded on board.

The number of species and their total abundance per fishing hour in each haul were examined and the relation of their logarithms to depth was tested using linear regression. Moreover, the frequency of occurrence (F) and the mean abundance (A) in terms of number per fishing hour per species for each depth stratum were estimated as follows :

$$F = \sum hn * 100 / \sum h,$$

where  $\sum hn$  = sum of the number of the n hauls where a species was present in a depth stratum, and  $\sum h$  = sum of the number of all the hauls carried out in that depth stratum, and

$$A = \sum Nn / \sum tn,$$

where  $\sum Nn$  = sum of the numbers of a species in the n hauls carried out in a depth stratum and  $\sum tn$  = sum of the fishing time of the n hauls in that depth stratum.

## RESULTS

In total, 101 fish species were caught in the study area, of which 81 were osteichthyes and 20 were chondrichthyes (Table 1). The relationships of the number of species and their total abundance with depth were statisti-

cally significant with decreasing trend ( $b = -0.001$ ,  $r = 0.65$ ,  $DF = 144$ ,  $P < 0.05$  and  $b = -0.006$ ,  $r = 0.79$ ,  $DF = 144$ ,  $P < 0.05$ , respectively) (Figs. 2, 3). Similar results were obtained from the analysis of the number of osteichthyes ( $b = -0.009$ ,  $r = 0.57$ ,  $DF = 144$ ,  $P < 0.05$ ) and

their total abundance ( $b = -0.0069$ ,  $DF = 144$ ,  $P < 0.05$ ) with depth as well as for the number of chondrichthyes ( $b = -0.002$ ,  $DF = 141$ ,  $r = 0.61$ ,  $P < 0.05$ ) and their total abundance with depth ( $b = -0.002$ ,  $DF = 141$ ,  $r = 0.40$ ,  $P < 0.05$ ).

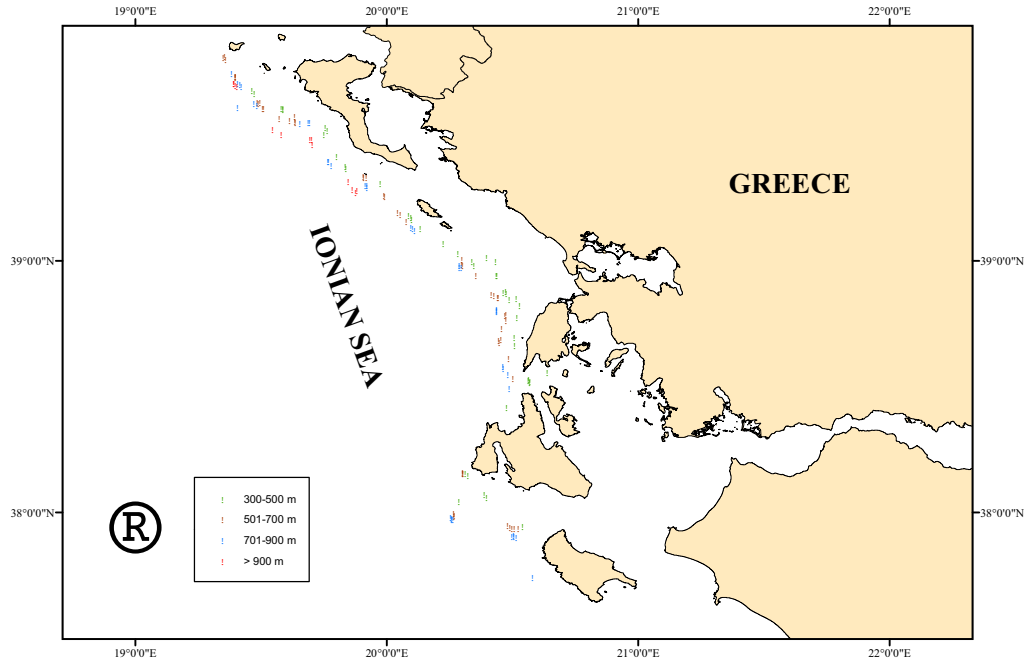


Fig. 1. – Map of the study area showing sampling stations.

TABLE 1

List of fish species collected in the E. Ionian Sea with species depth range, frequency of occurrence (%) and abundance (N/h) per depth stratum. Species names are given according to FishBase. (\* species for the first time in the Greek ionian Sea)

Species	Depth range (m)	Depth strata (m)								
		300-500		500-700		700-900		900-1200		
	No. of hauls	44	52	36	13					
		%	N/h	%	N/h	%	N/h	%	N/h	
<b>CHONDRICHTHYES</b>										
<i>Centrophorus granulosus</i> (Bloch & Schneider, 1801)	512-823			7.7	0.2	10.5	0.1			
<i>Chimaera monstrosa</i> Linnaeus, 1758 *	514-1171			7.7	0.1	7.9	0.1	15.4	0.2	
<i>Dalatias licha</i> (Bonnaterre, 1788)	655-764			3.8	0.1	15.8	0.2			
<i>Dipturus batis</i> (Linnaeus, 1758) *	700					2.6	0.1			
<i>Galeus melastomus</i> Rafinesque, 1810	305-1171	55.6	60.8	98.1	54.6	94.7	36.1	92.3	18.4	
<i>Heptranchias perlo</i> (Bonnaterre, 1788) *	388-501	4.4	0.2	1.9	0.1					
<i>Hexanchus griseus</i> (Linnaeus, 1758) *	700					2.6	0.1			
<i>Leucoraja circularis</i> (Couch, 1838)	463-676	2.2	0.1	7.7	0.1					
<i>Mustelus mustelus</i> (Linnaeus, 1758) *	624			1.9	0.1					
<i>Oxynotus centrina</i> (Linnaeus, 1758) *	549-777			3.8	0.1	7.9	0.1			
<i>Raja asterias</i> Delaroche, 1809	333-343	6.7	0.3							
<i>Raja clavata</i> Linnaeus, 1758	300-577	44.4	3.1	3.8	0.1					
<i>Raja miraletus</i> Linnaeus, 1758	462	2.2	0.1							
<i>Raja montagui</i> Fowler 1910 *	318-345	11.1	0.3							
<i>Raja oxyrinchus</i> Linnaeus, 1758	288-640	77.8	3.9	15.4	0.2					
<i>Raja polystigma</i> Regan, 1923	328	2.2	0.1							
<i>Raja sp.</i>	462-473	4.4	0.3							
<i>Scyliorhinus canicula</i> (Linnaeus, 1758)	288-780	88.9	25.1	7.7	0.1	2.6	0.1			
<i>Squalus blainville</i> (Risso, 1827)	300-780	77.8	20.1	17.3	0.5	15.8	0.2			
<i>Torpedo marmorata</i> Risso, 1810	317-368	6.7	0.2							
<i>Torpedo nobiliana</i> Bonaparte, 1835 *	300-388	4.4	0.1							
<b>OSTEICHTHYES</b>										
<i>Acantholabrus palloni</i> (Risso, 1810)	351	2.2	0.1							
<i>Argentina sphyraena</i> Linnaeus, 1758	288-700	95.6	760.6	28.8	2.9					
<i>Argyropelecus hemigymnus</i> Cocco, 1829	460-1082	4.4	0.2	32.7	0.7	15.8	0.2	23.1	0.3	
<i>Arnoglossus rueppelli</i> (Cocco, 1844) *	288-897	73.3	26.0	5.8	0.1	5.3	0.1			
<i>Bathypterois dubius</i> Vaillant, 1888 *	700-1171					34.2	1.1	84.6	4.6	
<i>Bellottia apoda</i> Giglioli, 1883	460-569	2.2	0.1	3.8	0.1					
<i>Benthocometes robustus</i> (Goode & Bean, 1886)	503			1.9	0.1					
<i>Benthosema glaciale</i> (Reinhardt, 1837)	541-1085			9.6	0.4	2.6	0.1	7.7	0.1	

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Species	Depth range (m)	Depth strata (m)							
		300-500		500-700		700-900		900-1200	
No. of hauls		44		52		36		13	
		%	N/h	%	N/h	%	N/h	%	N/h
<i>Caelorinchus caelorinchus</i> (Risso, 1810)	305-710	51.1	175.7	65.4	22.5	7.9	0.2		
<i>Caelorinchus mediterraneus</i> Iwamoto & Ungaro, 2002	1032							7.7	0.1
<i>Capros aper</i> (Linnaeus, 1758)	288-700	68.9	283.1	3.8	0.1				
<i>Centracanthus cirrus</i> Rafinesque, 1810	327-464	13.3	1.6						
<i>Centrolophus niger</i> (Gmelin 1789) *	624-770			1.9	0.1	2.6	0.1		
<i>Ceratoscopelus maderensis</i> (Lowe, 1839)	460-1082	2.2	0.1	1.9	0.1	2.6	0.1	7.7	0.2
<i>Chauliodus sloani</i> Bloch & Schneider, 1801	473-1192	2.2	0.3	32.7	0.9	39.5	0.6	30.8	0.9
<i>Chelidonichthys cuculus</i> (Linnaeus, 1758)	288-356	22.2	3.8						
<i>Chelidonichthys gurnardus</i> (Linnaeus, 1758)	340	2.2	0.1						
<i>Chelidonichthys lucerna</i> (Linnaeus, 1758)	318	2.2	0.1						
<i>Chlorophthalmus agassizi</i> Bonaparte, 1840	300-897	88.9	3958.2	78.8	165.7	5.3	1.0		
<i>Conger conger</i> (Linnaeus, 1758)	305-1171	24.4	1.1	23.1	0.9	26.3	0.5	23.1	0.4
<i>Deltentosteus quadrimaculatus</i> (Valenciennes, 1837)	333	2.2	0.8						
<i>Diaphus holti</i> Tåning, 1918	300-777	4.4	0.1	3.8	0.1	5.3	0.1		
<i>Diaphus metopoclampus</i> (Cocco, 1829)	518-1085			5.8	0.2	7.9	0.1	7.7	0.1
<i>Diaphus rafinesquii</i> (Cocco, 1838)	616-660			3.8	0.1				
<i>Electrona risso</i> (Cocco, 1829)	614			1.9	0.1				
<i>Epigonus constanciae</i> (Giglioli, 1880)	351-742	2.2	1.1	15.4	0.3	2.6	0.1		
<i>Epigonus denticulatus</i> Dieuzeidei, 1950 *	351-660	2.2	0.1	5.8	0.1				
<i>Epigonus spp</i>	620			1.9	0.1				
<i>Epigonus telescopus</i> (Risso, 1810)	351-780	4.4	0.1	1.9	0.1	5.3	0.1		
<i>Etmopterus spinax</i> (Linnaeus, 1758)	327-1171	4.4	0.1	40.4	3.2	65.8	2.0	69.2	1.4
<i>Gadella maraldi</i> (Risso, 1810)	368-748	2.2	0.1	7.7	0.1	2.6	0.1		
<i>Gadiculus argenteus argenteus</i> Guichenot, 1850	300-518	66.7	647.0	1.9	0.4				
<i>Gaidropsarus biscayensis</i> (Collette, 1890) *	549			1.9	0.1				
<i>Gnathophis mystax</i> (Delaroche, 1809)	700					2.6	0.1		
<i>Gonostoma denudatum</i> Rafinesque, 1810	531			1.9	0.1				
<i>Helicolenus dactylopterus</i> (Delaroche, 1809)	288-852	91.1	35.0	94.2	53.6	78.9	8.8		
<i>Hoplostethus mediterraneus</i> Cuvier, 1829	388-897	6.7	1.1	94.2	47.6	73.7	10.5		
<i>Hymenocephalus italicus</i> Giglioli, 1884	305-897	53.3	321.5	96.2	70.1	47.4	2.1		
<i>Ichthyococcus ovatus</i> (Cocco, 1838)	614			1.9	0.1				
<i>Lampanyctus crocodilus</i> (Risso, 1810)	318-1192	4.4	0.1	71.2	11.2	92.1	14.4	100.1	6.4
<i>Lepidopus caudatus</i> (Euphrasen, 1788)	333-620	8.9	0.2	9.6	0.1				
<i>Lepidorhombus boscii</i> (Risso, 1810) *	300-700	51.1	18.0	80.8	10.1	2.6	0.1		
<i>Lepidorhombus whiffiagonis</i> (Walbaum, 1792) *	288-700	55.6	3.7	40.4	1.2	2.6	0.1		
<i>Lepidotrigla dieuzeidei</i> Blanc & Hureau, 1973	288-596	55.6	73.0	1.9	0.1				
<i>Lestidiops sphyrenoides</i> (Risso, 1820)	518			1.9	0.1				
<i>Lesueurigobius suerii</i> (Risso, 1810) *	322-337	6.7	0.3						
<i>Lobianchia dofleini</i> (Zugmayer, 1911)	318	2.2	0.2						
<i>Lophius budegassa</i> Spinola, 1807	300-1013	42.2	2.8	32.7	0.5	10.5	0.1	7.7	0.1
<i>Lophius piscatorius</i> Linnaeus, 1758	370-770	2.2	0.1	5.8	0.1	7.9	0.1		
<i>Macroramphosus scolopax</i> (Linnaeus, 1758)	322-342	4.4	0.2						
<i>Maurolicus muelleri</i> (Gmelin, 1789) *	318-351	6.7	4.8						
<i>Merluccius merluccius</i> (Linnaeus, 1758)	288-764	86.7	35.3	50.1	2.8	13.2	0.1		
<i>Microichthys coccoi</i> Rüppell, 1852	549			1.9	0.1				
<i>Micromesistius poutassou</i> (Risso, 1827)	305-676	26.7	14.1	44.2	1.1				
<i>Molva macrophthalma</i> (Rafinesque, 1810)	388-754	4.4	0.3	26.9	0.4	7.9	0.1		
<i>Mora moro</i> (Risso, 1810)	512-1171			28.8	3.5	92.1	9.3	92.3	13.3
<i>Mullus barbatus</i> Linnaeus, 1758	328	2.2	0.2						
<i>Mullus surmuletus</i> Linnaeus, 1758	305-409	22.2	2.8						
<i>Myctophidae</i>	754-1082					5.3	0.1	7.7	0.2
<i>Myctophum punctatum</i> Rafinesque, 1810 *	549			1.9	0.2				
<i>Nemichthys scolopaceus</i> Richardson, 1848	390-1079	2.2	0.1	1.9	0.1			7.7	0.1
<i>Nettastoma melanurum</i> Rafinesque, 1810	305-1171	11.1	0.3	84.6	3.5	89.5	9.1	76.9	4.8
<i>Nezumia sclerorhynchus</i> (Valenciennes, 1838)	388-1171	2.2	0.2	98.1	46.5	94.7	35.1	92.3	18.5
<i>Notacanthus bonaparte</i> Risso, 1840	487-1034			1.9	0.1	13.2	0.2	15.4	0.2
<i>Pagellus acarne</i> (Risso, 1827)	302-318	6.7	3.0						
<i>Pagellus bogaraveo</i> (Brünnich, 1768)	305-700	37.8	8.6	50.1	2.1				
<i>Paralepis coregonoides</i> Risso, 1820	1032							7.7	0.1
<i>Paralepis speciosa</i> Bellotti, 1878	660			1.9	0.1				
<i>Peristedion cataphractum</i> (Linnaeus, 1758)	288-848	91.1	141.9	42.3	2.1	2.6	0.1		
<i>Phycis blennoides</i> (Brünnich, 1768)	300-1047	75.6	10.6	100.1	29.0	92.1	7.3	61.5	0.8
<i>Polyprion americanus</i> (Bloch & Schneider, 1801)	503-577			3.8	0.1				
<i>Scorpaena elongata</i> Cadenat, 1943	300-710	31.1	0.9	1.9	0.1	2.6	0.1		
<i>Spicara smaris</i> (Linnaeus, 1758)	328	2.2	0.1						
<i>Stomias boa</i> (Risso, 1810)	473-1032	2.2	0.2	28.8	1.5	26.3	0.8	7.7	0.1
<i>Symphurus ligulatus</i> (Cocco, 1844) *	531-761			15.4	0.4	7.9	0.1		
<i>Symphurus nigrescens</i> Rafinesque, 1810	533-601			7.7	0.2				
<i>Synchiropus phaeton</i> (Günther, 1861)	302-848	31.1	3.3	17.3	0.5	2.6	0.1		
<i>Trachurus picturatus</i> (Bowdich, 1825)	305-368	8.9	0.3						
<i>Trachurus trachurus</i> (Linnaeus, 1758)	300-318	6.7	0.3						
<i>Trachyrincus scabrus</i> (Rafinesque, 1810) *	480-1171	2.2	0.1			15.8	0.9	46.2	0.7
<i>Trigla lyra</i> Linnaeus, 1758	288-620	57.8	5.4	9.6	0.1				
<i>Trisopterus minutus</i> (Linnaeus, 1758)	333	2.2	0.4						
<i>Zeus faber</i> Linnaeus, 1758	328	2.2	0.1						

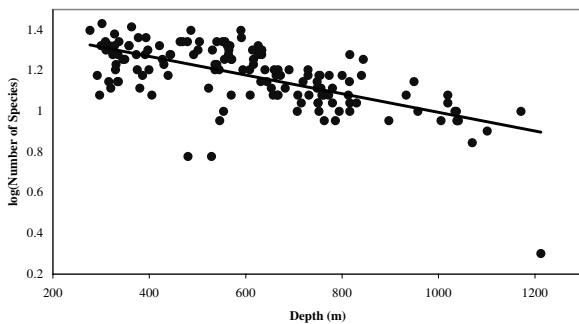


Fig. 2. – Relationship of the number of species with depth.

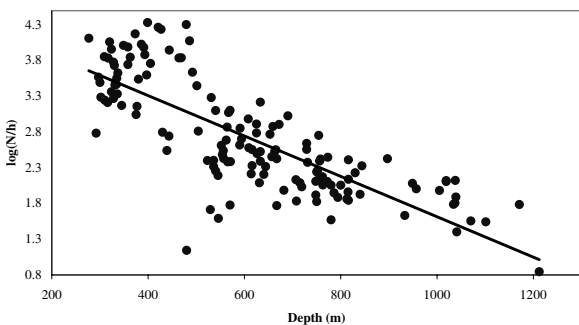


Fig. 3. – Relationship of the total abundance (N/h) with depth.

In the depth zone 300–500 m, 72 species were found (59 osteichthyes and 13 chondrichthyes). *Argentina sphyraena*, *Peristedion cataphractum*, *Helicolenus dactylopterus*, *Chlorophthalmus agassizi*, *Scyliorhinus canicula* and *Merluccius merluccius* presented high frequency of occurrence (Table 1). *Chlorophthalmus agassizi* was dominant in terms of abundance (Table 1). Most of the chondrichthyes caught in this zone belonged to species of the genus *Raja*.

In the zone 500–700 m, 70 fish species were identified (58 osteichthyes and 12 chondrichthyes) (Table 1). *Chlorophthalmus agassizi* still predominated in terms of abundance (Table 1). *Phycis blennoides* was present at all stations (100% frequency of occurrence). *Galeus melastomus*, *Nezumia sclerorhynchus*, *Hymenocephalus italicus*, *Helicolenus dactylopterus* and *Hoplostethus mediterraneus* were also found in high frequency of occurrence (Table 1).

From the 47 species (38 osteichthyes and 9 chondrichthyes) caught in the depth zone 700–900 m and from the 22 species (20 osteichthyes and 2 chondrichthyes) caught in the zone 900–1200 m, *Galeus melastomus* and *Nezumia sclerorhynchus* were the most abundant in both zones (Table 1). *Galeus melastomus*, *Nezumia sclerorhynchus*, *Lampanyctus crocodilus* and *Mora moro* were the most frequent in the zone 700–900 m (Table 1). Their order of importance in terms of frequency of occurrence changed in the deeper zone as follows: *Lampanyctus crocodilus*, *Galeus melastomus*, *Nezumia sclerorhynchus* and *Mora moro*. Furthermore, *Phycis blennoides* was also frequently present in the depth zone 700–900 m, but less so in deeper waters (Table 1).

## DISCUSSION

From the 101 species identified in the present work, one fish was identified as the new Mediterranean macrurid species, *Caelorinchus mediterraneus* IWAMOTO & UNGARO, 2002 (Table 1). It was caught at a depth of 1032 m, which is within the depth range reported in the literature for the species (IWAMOTO & UNGARO, 2002). This species has been recently described from specimens collected in the Catalan, Ligurian and Adriatic Seas (IWAMOTO & UNGARO, 2002) but it has not been reported so far from the Ionian Sea.

Four species are recorded for the first time in Greek waters: *Benthocometes robustus*, *Microichthys coccoi*, *Nemichthys scolopaceus* and *Epigonus constanciae*. The first two were found only in one station at depths 500–700 m. The third one was encountered in three depth zones (300–500, 500–700 and 900–1200 m) in very low frequencies and abundances (Table 1). Finally, *Epigonus constanciae* was caught at depths between 351 and 742 m, with higher occurrence at depths 500–700 m (Table 1). According to the literature, *Benthocometes robustus* has been rarely found in the Mediterranean Sea and *Microichthys coccoi* is reported only from the Strait of Messina (Italy) (WHITEHEAD et al., 1989). *Nemichthys scolopaceus* is recorded for the first time for all the Ionian Sea, although it is known in the western Mediterranean and the Atlantic (WHITEHEAD et al., 1989). *Epigonus constanciae* has also been found in the western Mediterranean and eastern Atlantic off West Africa with a maximum of occurrence between 200 and 400 m (WHITEHEAD et al., 1989).

Twenty species (indicated in Table 1 by asterisk) are reported for the first time for the fish fauna of the Greek Ionian Sea. Most of them are species encountered mainly at depths >500 m, which have only recently been investigated.

The results of this study showed a general decrease in the number of fish species and of their abundance with depth. More specifically, the number of fish species decreased considerably in waters deeper than 700 m, whereas the species abundance declined sharply in waters deeper than 500 m. The decline in both number of species and abundance is also true for other Mediterranean areas as well as for other taxonomic groups (ABELLO et al., 1988; BIAGI et al., 1989; CARTES et al., 1994; STEFANESCU et al., 1994; ABELLA & SERENA, 1995; D'ONGHIA et al., 1998; 2002 KALLIANIOTIS et al., 2000).

The ichthyofauna in the Eastern Ionian Sea (Greece) is quite similar to that of the North-western Ionian Sea (Italy) (D'ONGHIA et al., 1998), a fact also mentioned by D'ONGHIA et al., (2002). However, important differences were detected concerning the abundance of various species. *Gadiculus argenteus argenteus* and *Hymenocephalus italicus* are the most abundant fish in the upper slope of the Italian Ionian (D'ONGHIA et al., 2002), whereas *Chlorophthalmus agassizi* was found to be the dominant species in the Greek Ionian with considerably higher abundance values. Moreover, abundance values were generally much higher in Greek than Italian Ionian Sea. Another remarkable discrepancy between the two neighbouring areas is the higher number of species and abundance of chondrichthyes in the upper slope of the Greek

Ionian than the Italian one. The higher abundance for many species, the dominance of few species and the greater number of species and specimens of chondrichthyes, characteristics found for the Eastern Ionian (Greece), could be explained by the environmental and fisheries conditions prevailing in each area. It must be underlined that fishing pressure is low at the Greek Ionian upper-slope bottoms, and fisheries activities are scarcely exercised at depths greater than 500 m in Greek waters, whereas the Italian waters are fished intensively down to 700 m by commercial trawlers. Fisheries exploitation affects species abundance and especially long-lived, large-sized species, and species generally positioned high in the food web (PAULY et al., 1998) such as chondrichthyes (STEVENS et al., 2000). However, some Chondrichthyes species such as *S. blannville* and *R. clavata* not found in the north-western Ionian (Italy) (MATARRESE et al., 1996; D'ONGHIA et al., 2002) are frequently found in the neighbouring Sicilian channel (RELINI et al., 2000). This indicates that the environmental conditions should also be considered in order to explain the differences in the fish fauna between the Greek and Italian Ionian Sea.

## REFERENCES

- ABELLO, P., F.J. VALLADARES & A. CASTELLON (1988). Analysis of the structure of decapod crustacean assemblages off the Catalan coast (North-West Mediterranean). *Mar. Biol.*, 98 : 39-49.
- ABELLA, A., & F. SERENA (1995). Definizione di assemblaggi demersali nell' alto Tirreno. *Biol. Mar. Medit.*, 2 : 451-453.
- BIAGI, F., S. DE RANIERI, M. MORI, P. SARTOR & M. SBRANA (1989). Preliminary analysis of demersal fish assemblages in the Northern Tyrrhenian Sea. *Nova Thalassia*, 10 (Suppl. 1) : 391-398.
- CARTES, J. E., J. B. COMPANY & F. MAYNOU (1994). Deep-water decapod crustacean communities in the Northwestern Mediterranean : influence of submarine canyons and season. *Mar. Biol.*, 120 : 221-229.
- COCHRAN, W. G. (1977). *Sampling techniques*. Third edition. John Wiley and Sons, New York, New York, USA.
- D'ONGHIA, G., A. TURSI, P. MAIORANO, A. MATARRESE & M. Panza (1998). Demersal fish assemblages from the bathyal grounds of the Ionian Sea (middle-eastern Mediterranean). *Ital. J. Zool.*, 65 (Suppl.) : 287-292.
- D'ONGHIA, G., C.-Y. POLITOU, F. MASTROTOTARO, CH. MYTILINEOU, & A. MATARRESE (2002). Biodiversity from the upper slope demersal community of the eastern Mediterranean : preliminary comparison between two areas with and without fishing impact. *J. Northw. Atl. Fish. Sci.*, Vol. 31 : 1-11.
- EGE, V. (1930). Sudidae (*Paralepis*). *Rep. Danish Oceanogr. Exped. Med., 1908-1910*, 2(10), A13 : 193p.
- EGE, V. (1934). The genus *Stomias* Cuv., taxonomy and biogeography. *Dana Rep.*, 5 : 58p.
- EGE, V. (1948). *Chauliodus* Schn., Bathypelagic genus of fishes. A systematic, phylogenetic and geographical study. *Dana Rep.*, 31 : 148p.
- EGE, V. (1953). Paralepididae I. (*Paralepis* and *Lestidium*). Taxonomy, ontogeny, phylogeny and distribution. *Dana Rep.*, 40 : 184p.
- IWAMOTO, T. & N. UNGARO (2002). A new grenadier (*Gadiformes*, *Macrouridae*) from the Mediterranean. *Cybium*, 26 (1) : 27-32.
- KALLIANIOTIS, A., K. SOPHRONIDIS, P. VIDORIS & A. TSELEPIDES (2000). Demersal fish and megafaunal assemblages on the Cretan continental shelf and slope (NE Mediterranean) : seasonal variation in species density, biomass and diversity. *Prog. in Oceanogr.*, 46 : 429-455.
- KASPIRIS, P. (1973). *Contribution on the study of Osteichthyes of the Korinthiakos and Patraikos Gulfs and Ionian Sea*. PhD. Thesis, University of Patras. (in Greek)
- MATARRESE A., G. D'ONGHIA, A. TURSI & M. BASANISI (1996). New information on the Ichthyofauna of the south-eastern Italian coasts (Ionian Sea). *Cybium*, 20(2) : 197-211.
- PAPACONSTANTINOU, C. (1986). The ichthyofauna of Korinthiakos, Patraikos Gulfs and Ionian Sea. *Biologia Gallo-Hellenika*, 12 : 229-236.
- PAPACONSTANTINOU, C., E. KARAGITSOU, K. STERGIU, V. VASSILOPOULOU, G. PETRAKIS, CH. MYTILINEOU & TH. PANOS (1987). Dynamics of the demersal fish populations in the Korinthiakos, Patraikos Gulfs and Ionian Sea. N.C.M.R. Spec. Publ. No 13 : 208p.
- PAULY, D., V. CHRISTENSEN, J. DALSGAARD, R. FROESE & F. C. TORRES JR (1998). Fishing down marine food webs. *Science*, 297 : 860-863.
- RELINI G., F. BIAGI, F. SERENA, A. BELLUSCIO, M. T. SPEDICATO, P. RINELLI, M. C. FOLLESA, C. PICCINETTI, N. UNGARO, L. SION & D. LEVI (2000). I Selaci pescati con lo strascico nei mari italiani. *Biol. Mar. Medit.*, (7)1 : 347-384.
- STEFANESCU, C., B. MORALES-NIN & F. PERRI (1994). Fish assemblages on the slope in the Catalan Sea (Western Mediterranean) : influence of a submarine canyon. *J. Mar. Biol. Ass. U.K.*, 74 : 499-512.
- STEVENS, J. D., R. BONFIL, N. K. DULVY & P. A. WALKER (2000). The effects of fishing on sharks, rays, and chimaeras (chondrichthyan), and the implications for marine ecosystem. *ICES J. Mar. Sci.*, 57 : 476-494.
- TANING, A.V. (1918). *Mediterranean Scopelidae*. *Rep. Danish Oceanogr. Exped. Med., 1908-1910*, 2(5), A(7) : 154p.
- TANING, A.V. (1923). *Lophius*. *Rep. Danish Oceanogr. Exped. Med., 1908-1910*, 2(7), A10 : 30p.
- WHITEHEAD, P.J. P., M.-L. BAUCHOT, J.-C. HUREAU & J. NIELSEN (1989). Fishes of the North-eastern Atlantic and the Mediterranean. UNESCO. Vols I to III.