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Fisheries Resources in the Deep Waters of the Eastern Mediterranean (Greek Ionian Sea)

by

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Abstract

The deep waters of the Greek seas are unexploited, since trawling is carried out mainly down to 400 m. In the present work, the fisheries resources of the deep waters (300-900 m) of the Greek Ionian Sea are studied in spring, summer and autumn 2000 by means of experimental trawl surveys. The results showed that in the zone 300-500 m, fish composed 73-83% by number or 89-92% by weight of the catch depending on the season, crustaceans 16-25% by number or 6% by weight and cephalopods 1-2% by number or 3-5% by weight. In the zone 500-700 m, crustaceans composed 28-41% by numbers or 67-80% by weight of the catch, whereas the proportion of cephalopods was less than 1% by number and about 1% by weight. In the deepest zone (700-900 m), the proportion of cephalopods remained negligible, whereas the proportion of fish increased and was about equal in numbers with that of crustaceans, whereas in weight it ranged from 81 to 86%. The CPUE of commercial fish was 23-59 kg/h in the first depth stratum, 7-25 kg/h in the second one and 2-10 kg/h in the third one, depending on the season. Concerning the commercial crustaceans, their CPUE was 3-6.5 kg/h in the shallowest zone, 6-8.5 kg/h in the middle one and 2-4 kg/h in the deepest one. The commercial part of cephalopods ranged from 1 to 7 kg/h in the zone 300-500 m, whereas deeper it was negligible. As long as it concerns the commercial/total ratio by weight of the whole catch, it took the highest values in the stratum 500-700 m (0.60-0.78), whereas in the other zones it was generally lower than 0.50.

Introduction

The commercial fishery in Greece is carried out mainly down to 400 m of depth. The geomorphology of the Greek continental margin, and particularly that of the Ionian Sea, is characterised by steep bottoms and narrow continental shelf. As a result of the above, large marine grounds remain unexploited, while the stocks of a narrow area along the coast suffer from overexploitation (Stergiou *et al*. 1997).

The pristine condition of the Greek deep waters gave a great opportunity to the scientists to explore their fishing resources in order to determine their distribution and abundance, study their biology and dynamics and plan a reasonable management design. This kind of research started recently in the framework of larger projects (MEDITS projects 1995-2001) or in restricted areas of the Ionian Sea (Anon. 1997, Anon. 2001) and Cretan Sea (Kallianiotis *et al*. 2000). The present study is carried out in an extended area of the Ionian Sea in the framework of the project INTERREG Italy-Greece. In this paper, the results concerning the fisheries resources of the deep waters of the Greek Ionian Sea for different depth strata and seasons are presented.

Materials and Methods

Sampling took place in depths from 300 to 900 m of the Greek Ionian Sea during spring, summer and autumn 2000 (fig. 1) using a chartered commercial trawler. The gear used was a bottom trawl with a cod end mesh size of 20 mm (side). The random stratified sampling design was applied using depth for the stratification of the study area. Three depth zones were defined, 300-500 m, 500-700 m and 700-900 m. A total of 107 hauls were carried out. After each haul, catches were identified to species level. Species abundance in number and weight were recorded on board, whereas other biological measures were also taken. The catch per unit effort (CPUE) in weight per fishing hour was estimated as follows for each depth zone:

$$CPUE=SWn/Stn$$

where SWn=sum of weights of a species or category in the n hauls carried out in the depth zone and Stn=sum of fishing time of the n hauls in the depth zone. Consequently, the commercial/total (C/T) ratio was calculated for each fishing category and for the total catch. The separation between commercial and non commercial species is shown in Table 1.

Results

Catch composition

Fish was the main component of the catch by weight independently of depth and season, whereas in terms of numbers fish dominated in the catch only in the first stratum (fig.2,3). Crustaceans ranked second, after fish, in weight in all cases. However, in terms of numbers crustaceans were dominant in the 500-700 m depth zone during all seasons and almost equal to fish in the deepest zone. Finally, cephalopods always composed a low proportion of the catch (0.1-5.1 % by weight and 0.2-2% by number) being more important in the first stratum (300-500 m).

A list of species of each category caught per depth stratum and season is given in Table 1.

CPUE

The total CPUE ranged from 14 kg/h to 150 kg/h depending on the depth stratum and the season (Table 2). Concerning the CPUE variation with depth, during all seasons, it was highest in the first stratum (300-500 m), and it decreased gradually reaching its minimum in the deepest stratum (700-900 m). Concerning the seasonal variation, it took the lowest values in all depths during spring.

The commercial/total (C/T) ratio by weight of the whole catch took the highest values in the stratum 500-700 m (0.60-0.78). In the other zones, it was generally lower than 0.50, and it ranged from 0.29 to 0.48 in the zone 300-500 m and from 0.35 to 0.45 in the zone 700-900 m.

a) **Fish**

The CPUE of fish ranged from 11.5 kg/h (700-900 m, spring) to 133 kg/h (300-500 m, autumn), and its variation with depth and season followed the same pattern with that of the total CPUE (Table 3).

In the shallower zone, the ratio C/T (commercial/total catch in weight) for fish was generally low (0.25-0.44), and the commercial part of fish showed a CPUE ranging from 23 kg/h (spring) to 59 kg/h (autumn). 60 fish species were caught in total in this zone. The most important of these, caught constantly in high quantities was *Chlorophthalmus agassizii* (25.5-47.7 kg/h) (Table 1). Another important species was *Squalus blainvillei* (3-10.3 kg/h). *Merluccius merluccius* and *Galeus melastomus* were constantly present in the shallowest depth zone with CPUE ranging from 1.5 kg/h (spring) to 9.2 kg/h (autumn) and from 1.4 kg/h (spring) to 4.1 kg/h (autumn), respectively. *Gadiculus argenteus* and *Scyliorinus canicula* were also found constantly in this stratum with a peak of 12.4 kg/h and 6 kg/h respectively in autumn. The CPUE of *Argentina sphyraena* was also important (2.6-5.8 kg/h). *Micromesistius poutassou* showed a high CPUE in autumn (17.3 kg/h). Finally, the CPUE of *Lepidorhombus boscii* ranged from 2 kg/h (spring) to 6.8 kg/h (autumn).

The stratum 500-700 m showed the highest C/T ratios for fish (0.49-0.73), and the CPUE of commercial fish ranged from 7 kg/h (spring) to 25 kg/h (autumn). The most important of the 43 fish species of this zone were *Helicolenus dactylopterus* with CPUE ranging from 4.1 kg/h (spring) to 7.9 kg/h (summer) and *Galeus melastomus* with CPUE ranging from 2.9 kg/h (spring) to 5.7 kg/h (summer). *Hoplostethus mediterraneus* and *Chlorophthalmus agassizii* were also found constantly with CPUE ranging from 1 to 3.7 kg/h and from 1.1 to 3.9 kg/h, respectively. *Phycis blennoides* was found in this zone with CPUE ranging between 0.6 kg/h and 2.2 kg/h. Other worth mentioning species were *Lophius piscatorius* found in summer and autumn (3.4-3.6 kg/h), *Squalus blainvillei* with maximum CPUE during autumn (5 kg/h) and *Merluccius merluccius* with maximum CPUE also in autumn (2 kg/h).

In the zone 700-900 m, the C/T ratio of fish was low (0.21-0.37) with the CPUE of the commercial part ranging from 2 kg/h (spring) to 10 kg/h (summer). 37 fish species were found in this depth zone. *Galeus melastomus* was dominant (4.4-8.7 kg/h) with *Mora moro* (1.4-3 kg/h) and *Helicolenus dactylopterus* (1.4-2.5 kg/h) following. *Hoplostethus mediterraneus* was caught in lower quantities (0.8-1.8 kg/h), whereas *Lophius piscatorius* and *L. budegassa* were found in relatively high quantities in summer (4.3 and 1.8 kg/h, respectively).

b) **Crustaceans**

The CPUE of crustaceans ranged from 2.5 kg/h (700-900 m, autumn) to 9.5 kg/h (300-500 m, autumn) (Table 3). It took its highest values in the middle stratum (spring, summer) or the first stratum (autumn) and the lowest ones in the deepest stratum during all seasons. The C/T ratio was always high (0.69-0.98).

In the shallower stratum, the C/T ratio of crustaceans showed lower values (0.69-0.85) comparing to the deeper zones, and the CPUE of the commercial catch ranged from 3 kg/h (spring) to 6.5 kg/h (autumn). 16 crustacean species were found in total in this depth zone, and *Parapenaeus longirostris* was the dominant species during all seasons (2.4-6.1 kg/h). Also *Plesionika heterocarpus* had a constant presence in the catch of this depth zone with a worth mentioning CPUE in autumn (2.8 kg/h).

The middle zone displayed the maximum CPUE of commercial crustaceans (6-8.5 kg/h) with C/T always higher than 0.9. From the 15 species caught, *Aristaeomorpha foliacea* (4.3-5.8 kg/h) followed by *Plesionika martia* (1.3-1.8 kg/h) were the most important species. *Aristaeus antennatus* was also found constantly in low quantities (0.4-0.65 kg/h).

In the deeper zone, a decrease in the catch of crustaceans was observed and although the C/T ratio remained high (>0.95), the CPUE of the commercial part ranged between 2 and 4 kg/h. From the 11 species found in that zone, *Aristaeomorpha foliacea* (1.2-2.8 kg/h) was the main species caught with *Aristaeus antennatus* (0.3-1.1 kg/h) ranking second.

c) **Cephalopods**

The total CPUE of cephalopods ranged from 0.03 kg/h (700-900 m, autumn) to 7.7 kg/h (300-500 m, autumn) and it showed an important decrease with depth during all the cruises (Table 3).

In the first stratum, the C/T ratio was high (0.58-0.88) and the commercial cephalopod catch had a CPUE range from 1 kg/h (spring) to 7 kg/h (autumn). 16 cephalopod species were caught in this zone. From these, *Loligo forbesi* was the most important species found during all seasons with CPUE ranging from 0.5kg/h (spring) to 2.1 kg/h (autumn). *Todarodes sagittatus* was found in relatively high quantities in autumn (3.3 kg/h). *Illex coindetii* was also important in autumn (1.1 kg/h). Finally, *Pteroctopus tetracirrhus* was present in low quantities (<1 kg/h) in all cruises, but during autumn its CPUE was negligible.

In the second stratum, the CPUE of cephalopods ranged from to 0.2 kg/h (spring) to 0.6 kg/h (autumn). From the 7 species caught, the most worth mentioning species was *Todarodes sagittatus*, which contributed in the catch in autumn and summer with low CPUE (<1 kg/h).

In the third stratum, the CPUE of cephalopods was always lower than 0.1 kg/h. 5 species were found in that depth stratum.

Discussion

The prevailing role of depth, with a secondary seasonal influence, on the demersal fish and megafaunal changes in the Greek waters has already been documented for different regions (Kallianiotis *et al*. 2000, Labropoulou and Papaconstantinou 2000). Our results showed a general pattern where fish were highly dominant (in number or weight) in depths 300-500 m with crustaceans and cephalopods ranking second and third respectively, independently of season. The importance of crustaceans increased in higher depths (500-900 m) and mainly in the zone 500-700 m, although fish remained dominant in terms of weight. On the contrary, the presence of cephalopods was dramatically reduced with depth.

Although the marketable total catch and the commercial catch of fish and cephalopods was higher in the shallower stratum (300-500 m) during all seasons, the commercial catch of crustaceans was higher in the second stratum (500-700).

The most abundant and of high value species of the shallower stratum were *Merluccius merluccius*, *Parapenaeus longirostris*, *Squalus blainvillei* and *Lepidorhombus boscii*. However, this depth zone was characterised by a particularly high abundance of the non-commercial species *Chlorophthalmus agassizii*, as well as of the importance of other non- commercial species such as *Gadiculus argenteus* and *Argentina sphyraena*. The C/T ratio of this zone was generally low (<0.5), and even though the marketable catch of this zone was higher comparing to deeper waters the discarded part of the catch was even higher. A factor which may reduce the ratio of commercial / non-commercial species is an extended in time increasing fishing pressure (Overholtz and Tyler 1985). In the Greek Ionian Sea, fishing activity is carried out mainly down to 400 m and most of the stocks were found overexploited (Stergiou *et al*. 1997) until this depth. Consequently, apart from other factors related to the geomorphology and oceanography of the study area, fishery may have affected the species composition of the 300-500 m depth zone.

The two deeper zones can be considered as unexploited and in pristine state, since fishing activities do not reach these depths. The most important species for fisheries found in the middle stratum were *Helicolenus dactylopterus*, red shrimps, mainly *Aristaeomorpha foliacea*, *Merluccius merluccius* and *Squalus blainvillei*. *Helicolenus dactylopterus*, although found in all the examined depth zones, showed its maximum of abundance in the 500-700 m zone during all seasons. Also *Aristaeomorpha foliacea*, which was caught in the two deeper strata, was more abundant in the middle zone. Despite the decrease of the total catch in this depth zone, it must be noted that the CPUE of non-commercial species was reduced in this depth zone and the C/T ratio was generally high. Finally, in the deeper zone, both the catch and the C/T ratio were low. However, species of considerable value, such as *Aristaeomorpha foliacea*, *Aristeus antennatus*, *Helicolenus dactylopterus* and *Lophius spp* were found in non-negligible quantities.

A seasonal trend in the CPUE was observed in all depths with a minimum in spring and a maximum in autumn in the shallower or in summer in the deeper. This phenomenon may be attributed to the yearly recruits and to species movements. However, in the shallower zone, the influence of fishing activities on the catches' seasonal variability could also be considered. The observed minimum CPUE in spring coincides with the end of the trawl-fishing period, whereas the maximum CPUE of autumn observed in this stratum coincides with the end of the closed season for trawling (1^{st} June to 30^{th} September).

In conclusion, the above results show the existence of important fisheries resources in the deep waters of the Greek Ionian Sea. Species such as *Aristaeomorpha foliacea*, *Aristeus antennatus* and *Helicolenus dactylopterus*, which are unknown in most Greek fish markets, are extensively exploited in the Western and Central Mediterranean by deep water trawling down to 1000 m (Ragonese and Reale 1992, Ragonese *et al*. 1994, Sardà and Cartes 1994). The extension of the Greek bottom trawling to deeper waters is expected to lead up to a reduction of the fishing pressure in the shallows and provide new products to the market. However, a better knowledge of the deep-water species and ecosystems is required in order to formulate an effective management scheme for deep-water resources and regulate their exploitation in a sustainable way.

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Table 1. List of species caught with CPUE (kg/h) per depth stratum and season. In bold are shown the commercial or possibly commercial species.

Species	300-500 m			500-700 m			700-900 m		
	SPR	SUM	AUT	SPR	SUM	AUT	SPR	SUM	AUT
FISH									
Argentina sphyraena	2.99	5.83	2.55	0.01	0.04	0.03			0.04
Arnoglossus rueppelli	0.15	0.10	0.01						
Aspitrigla cuculus	**0.32**	**0.28**							
Capros aper	0.60	4.25	0.11						
Centracanthus cirrus	**0.03**								
Centrolophus niger					0.41			0.78	
Centrophorus granulosus				**0.19**		**2.34**	**0.41**		**0.73**
Chauliodus sloani		0.03		0.01	0.01		0.01	0.03	0.01
Chimaera monstrosa				0.07			0.15	0.11	
Chlorophthalmus agassizii	25.50	42.28	47.70	1.55	3.91	1.14		0.04	0.25
Coelorhynchus coelorhynchus	0.96	1.47	1.16	0.08	0.24	0.16		0.01	0.03
Conger conger	**0.11**	**0.10**	**0.45**	**0.21**		**0.09**	**0.43**	**0.02**	**0.43**
Dalatias licha				0.04	0.02		0.62	1.04	0.49
Deltentosteus quadrimaculatus		0.01							
Diaphus metopoclampus						0.01			
Epigonus constanciae					0.02				
Epigonus telescopus	0.05				0.04		0.17		
Etmopterus spinax	0.02			0.11	0.30	0.12	0.12	0.26	0.34
Eutrigla gurnardus			**0.03**						
Gadella maraldi							0.02		
Gadiculus argenteus argenteus	1.11	4.53	12.41						
Galeus melastomus	**1.42**	**3.46**	**4.14**	**2.93**	**5.69**	**4.16**	**4.37**	**8.67**	**4.62**
Gnathophis mystax							0.03		
Helicolenus dactylopterus	**2.06**	**1.03**	**0.38**	**4.13**	**7.90**	**7.13**	**1.39**	**2.54**	**1.79**
Heptranchias perlo		0.53							
Hexanchus griseus									1.33
Hoplostethus mediterraneus		0.13		1.00	3.74	1.84	0.75	1.81	0.87
Hymenocephalus italicus	0.55	3.41	2.00	0.19	0.34	0.21	0.01	0.02	0.03
Lampanyctus crocodilus		0.03		0.11	0.19	0.08	0.17	0.29	0.17
Lepidopus caudatus	**0.01**	**0.22**		**0.04**	**0.02**	**0.12**			
Lepidorhombus boscii	**2.04**	**3.40**	**6.75**	**0.13**	**1.01**	**1.20**			**0.11**
Lepidorhombus whiffiagonis	**1.24**	**0.79**	**0.75**		**0.27**	**0.65**			**0.11**
Lepidotrigla dieuzeidei	0.81	0.82	0.19		0.01				
Lophius budegassa	**1.16**	**2.23**	**1.24**	**0.42**	**0.48**	**0.24**		**1.82**	**0.02**
Lophius piscatorius	**2.19**				**3.36**	**3.60**		**4.32**	
Maurolicus muelleri		0.04							
Merluccius merluccius	**1.45**	**6.21**	**9.23**	**0.18**	**0.53**	**2.02**	**0.03**	**0.10**	**0.43**
Micromesistius poutassou poutassou	**0.39**	**1.44**	**17.29**	**0.18**	**0.18**	**0.33**			
Molva dipterygia macrophthalma	0.08	0.23		0.04	0.26	0.11		0.10	0.04
Mora moro				0.03	0.09	0.10	1.75	2.96	1.44
Mullus barbatus	**0.01**								
Mullus surmuletus	**0.60**								
Mustelus mustelus					**0.80**				
Nettastoma melanurum	0.02	0.08	0.13	0.11	0.27	0.12	0.41	0.59	0.42
Nezumia sclerorhynchus		0.03		0.28	0.50	0.54	0.38	0.58	0.37

Table 1. Continued.

Species	300-500 m			500-700 m			700-900 m		
	SPR	SUM	AUT	SPR	SUM	AUT	SPR	SUM	AUT
Notacanthus bonapartei							0.01		
Oxynotus centrina						0.38		0.01	0.03
Pagellus acarne	**0.47**	**0.05**							
Pagellus bogaraveo	**0.55**	**1.42**	**3.75**	**0.34**	**0.56**	**0.11**			**0.15**
Peristedion cataphractum	1.79	3.28	0.90	0.13	0.07	0.07	0.01		0.03
Phycis blennoides	**0.91**	**1.68**	**2.19**	**0.63**	**1.38**	**2.23**	**0.14**	**0.99**	**0.50**
Polyprion americanus					**0.28**	**0.16**			
Raja asterias		0.14	0.32						
Raja clavata	**1.26**	**0.50**	**1.47**						
Raja miraletus			0.75						
Raja montagui	**0.15**	**0.55**							
Raja oxyrinchus	3.01	2.11	0.60	0.03	0.16	0.21			
Raja polystigma	0.03								
Scorpaena elongata	**0.55**	**0.38**		**0.04**					
Scyliorhinus canicula	**1.33**	**1.78**	**6.02**	**0.03**			**0.01**		**0.03**
Spicara smaris	**0.01**								
Squalus blainvillei	**6.70**	**3.02**	**10.28**	**0.04**	**0.13**	**4.97**	**0.01**	**0.56**	**0.29**
Stomias boa		0.01		0.01	0.04	0.01		0.03	0.01
Synchiropus phaeton	0.02	0.03			0.01				
Torpedo marmorata	0.03								
Torpedo nobiliana	0.37								
Trachurus picturatus	**0.13**								
Trachurus trachurus	**0.24**	**0.18**							
Trachyrhynchus trachyrhynchus	0.02						0.16	0.17	0.17
Trigla lucerna		**0.22**							
Trigla lyra	**0.66**	**0.30**	**0.30**	**0.02**	**0.01**	**0.07**			
Trisopterus minutus capelanus		**0.02**							
Zeus faber	**0.02**								
CRUSTACEANS									
Aegaeon lacazei			0.01						
Aristaeomorpha foliacea		**0.01**		**4.29**	**5.71**	**5.84**	**1.79**	**2.81**	**1.23**
Aristeus antennatus				**0.53**	**0.65**	**0.39**	**0.74**	**1.07**	**0.29**
Bathynectes longipes						0.01			
Bathynectes maravigna		0.01			0.01				
Calappa granulata	**0.04**								
Chlorotocus gracicornis		0.01							
Geryon longipes							0.01		
Macropipus tuberculatus			0.01						
Munida iris	0.07	0.01							
Munida perarmata									
Nephrops norvegicus	**0.19**	**0.40**	**0.41**	**0.17**	**0.21**	**0.07**		**0.01**	**0.05**
Parapenaeus longirostris	**2.44**	**4.69**	**6.13**	**0.03**	**0.18**	**0.07**		**0.01**	**0.01**
Paromola cuvieri					0.05	0.02		0.03	0.04
Parthenope macrochelos	0.01								
Pasiphaea multidentata								0.01	0.01

Table 1. Continued.

Species	300-500 m			500-700 m			700-900 m		
	SPR	SUM	AUT	SPR	SUM	AUT	SPR	SUM	AUT
Pasiphaea sivado				0.01	0.25	0.01			
Plesionika acanthonotus	0.01			0.04	0.01	0.01			
Plesionika antigai	0.16	0.10	0.04		0.01				
Plesionika edwardsii	**0.52**	**0.07**		**0.04**	**0.05**	**0.07**			**0.83**
Plesionika gigliolii	0.03	0.08	0.04	0.02	0.01				
Plesionika heterocarpus	**0.30**	**0.97**	**2.81**		**0.01**				
Plesionika martia	**0.12**			**1.32**	**1.79**	**1.57**	**0.01**	**0.04**	**0.02**
Polycheles typhlops				0.06	0.06	0.07	0.04	0.04	0.03
Sergestes robustus							0.01	0.01	0.01
CEPHALOPODS									
Alloteuthis media		0.01	0.01						
Ancistroteuthis lichtensteini	0.01	0.01							
Eledone cirrhosa	**0.01**	**0.02**	**0.10**						
Illex coindetii	**0.13**		**1.13**			**0.05**			
Loligo forbesi	**0.51**	**1.57**	**2.05**		**0.06**	**0.12**			
Neorossia caroli				0.05	0.05	0.04		0.02	
Octopus salutii	0.01		0.03						
Octopus vulgaris						**0.03**			
Pteroctopus tetracirrhus	0.47	0.85	0.01	0.13	0.03	0.02	0.04		
Rondeletiola minor	0.02	0.03	0.03						
Rossia macrosoma	0.05	0.11	0.24			0.02			
Scaeurgus unicirrhus	0.04	0.02	0.03				0.03		
Sepia elegans	0.03	0.07							
Sepia orbignyana	**0.09**	**0.05**	**0.05**						
Sepietta oweniana	0.13	0.21	0.51						
Sepiola ligulata		0.02							
Todarodes sagittatus		**0.58**	**3.30**		**0.16**	**0.34**		**0.05**	**0.02**
Todaropsis eblanae	**0.49**	**0.05**	**0.21**				**0.01**		

Table 2. CPUE (Kg/h) of the total, commercial (CO) and non commercial (NC) catch per depth zone and season. The ratio of the commercial to the total catch (C/T) is also presented.

Season		Depth zone		
		300-500m	500-700m	700-900m
Spring	CO	27.28	12.99	4.98
	NC	42.70	7.08	9.25
	Total	69.98	20.07	14.23
	C/T	0.39	0.65	0.35
Summer	CO	31.87	25.72	14.34
	NC	77.15	16.86	17.63
	Total	109.02	42.58	31.97
	C/T	0.29	0.60	0.45
Autumn	CO	71.97	33.81	7.06
	NC	78.32	9.52	10.80
	Total	150.29	43.33	17.86
	C/T	0.48	0.78	0.40

Table 3. CPUE (Kg/h) of the total, commercial (CO) and non commercial (NC) fish (F), crustacean (C) and cephalopod (M) catch per depth zone and season. The ratio of the commercial to the total catch (C/T) is also presented.

Season		Depth zone		
		300-500 m	500-700 m	700-900 m
Spring	FCO	22.84	6.59	2.43
	FNC	41.27	6.75	9.12
	Total	64.11	13.34	11.55
	C/T	0.36	0.49	0.21
	CCO	3.30	6.39	2.54
	CNC	0.59	0.14	0.06
	Total	3.89	6.53	2.60
	C/T	0.85	0.98	0.98
	MCO	1.14	0.00	0.01
	MNC	0.84	0.19	0.06
	Total	1.98	0.19	0.07
	C/T	0.58	0.00	0.14
Summer	FCO	24.48	16.92	10.36
	FNC	74.60	16.37	17.52
	Total	99.08	33.29	27.88
	C/T	0.25	0.51	0.37
	CCO	5.17	8.58	3.94
	CNC	1.19	0.41	0.09
	Total	6.36	8.99	4.03
	C/T	0.81	0.95	0.98
	MCO	2.22	0.22	0.05
	MNC	1.37	0.09	0.02
	Total	3.59	0.31	0.07
	C/T	0.62	0.71	0.71
Autumn	FCO	58.64	25.27	4.61
	FNC	74.51	9.29	10.69
	Total	133.15	34.56	15.30
	C/T	0.44	0.73	0.30
	CCO	6.54	8.01	2.43
	CNC	2.90	0.13	0.09
	Total	9.44	8.14	2.52
	C/T	0.69	0.98	0.96
	MCO	6.79	0.54	0.02
	MNC	0.91	0.09	0.01
	Total	7.70	0.63	0.03
	C/T	0.88	0.86	0.67

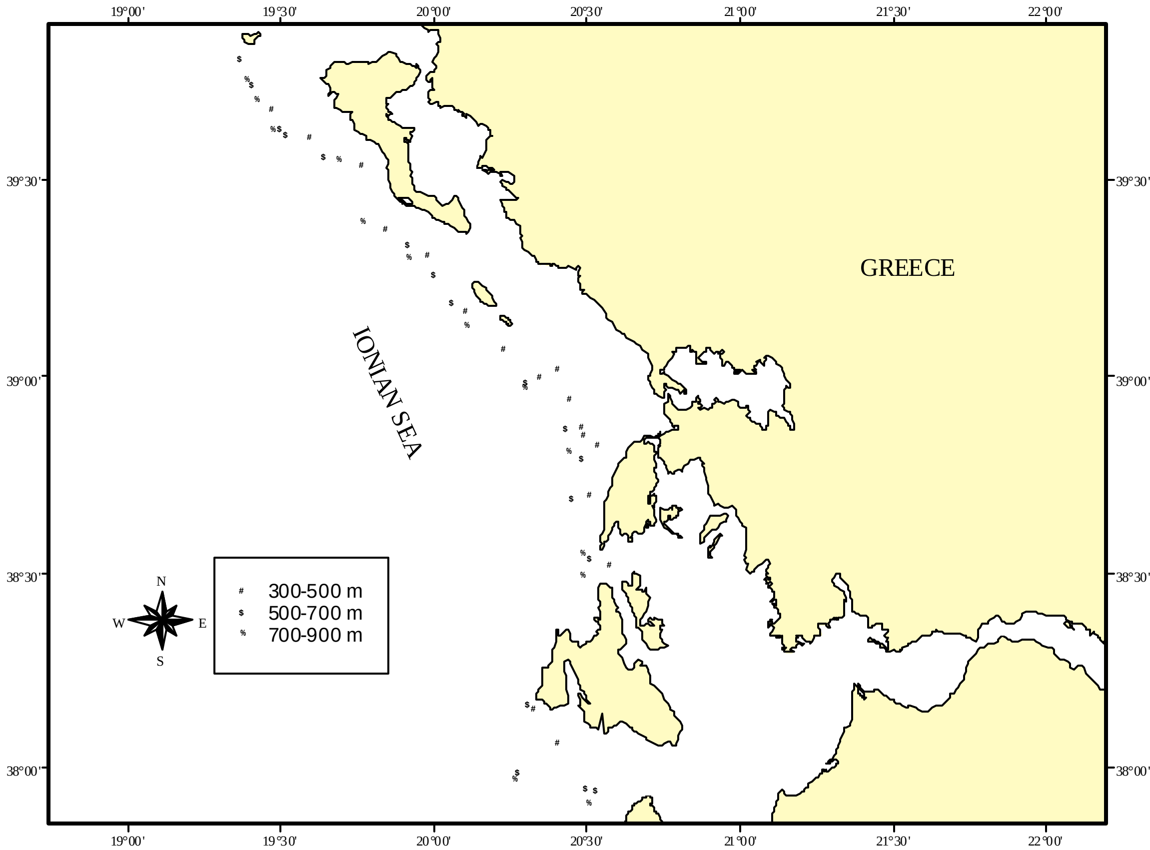

Fig. 1. Map of the study area showing the sampling stations.

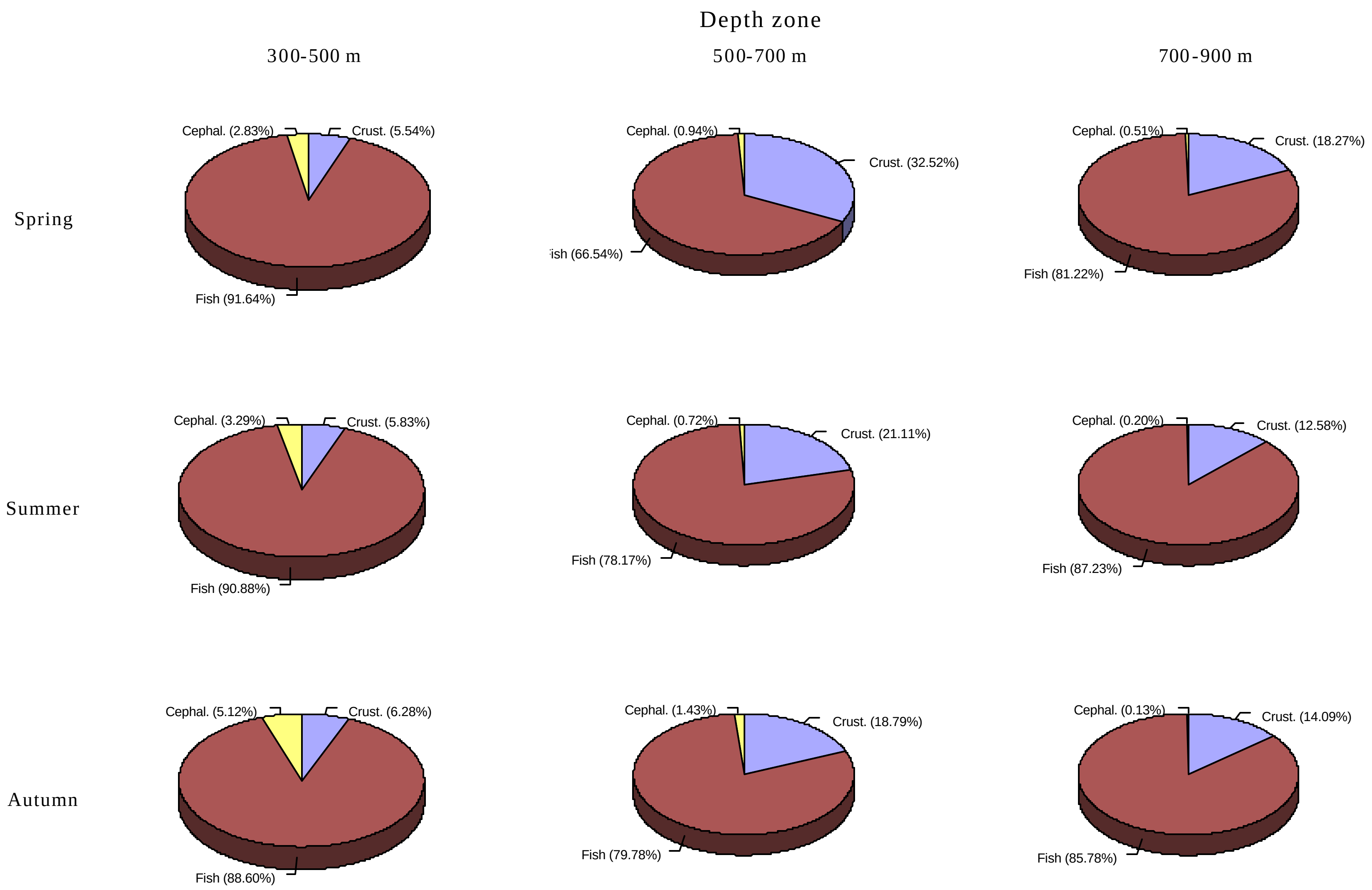

Fig. 2. Catch composition by weight per depth stratum and season.

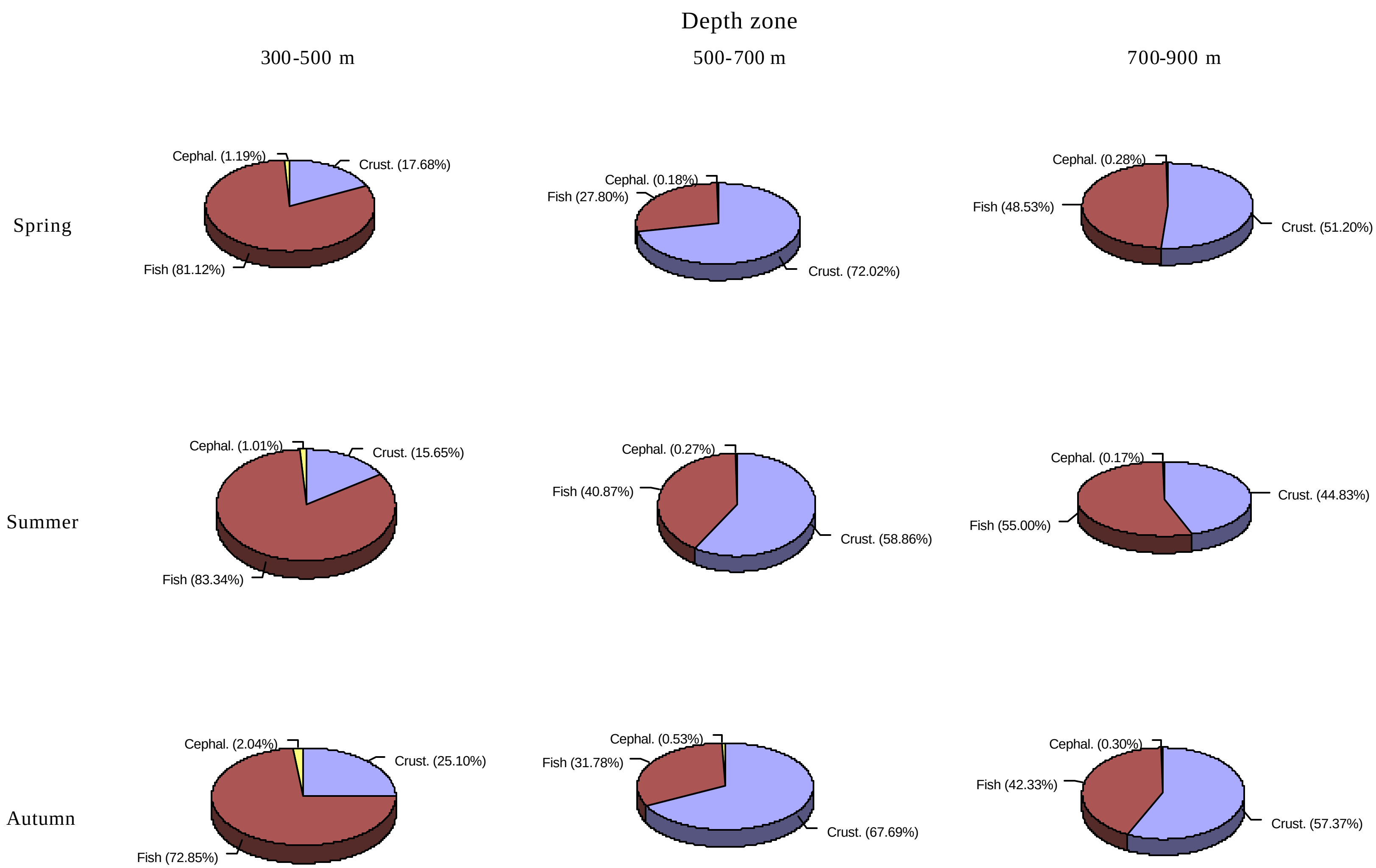

Fig. 3. Catch composition by number per depth stratum and season.