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Abstract

The present study concerns faunal composition and distribution of cephalopods in the southern Aegean Sea (35° 13' 19''- 37° 55' 25'' N, 23° 00' 15'' - 28° 15' 37'' E). Samples were collected from 708 hauls, obtained by an experimental bottom trawl net during eight surveys carried out in the summers of the years 1994-2001, as well as by commercial trawl net during four surveys carried out in September 1995, December 1995, May and September 1996. The hauls were performed at depths ranging from 16 to 778 m.

A total of 34 species of cephalopod in 12 families were identified, including 11 oegopsid squid, 3 myopsid squid, 7 octopod, 3 cuttlefish and 10 sepiolid.

Trawling with the experimental net resulted in the capturing of some uncommon pelagic species, such as Ctenopteryx sicula and Octopoteuthis sicula, which were recorded for the first time in the Aegean Sea.

Most of the species showed a wide depth and geographical range. The species: Sepia officinalis, Sepietta neglecta, Sepietta obscura and Sepiola rondeleti were caught only on the continental shelf, whereas the Ancistroteuthis lichtensteini, Bathypolypous sponsalis, Brachioteuthis riisei, Chiroteuthis veranyi, Ctenopteryx sicula, Heteroteuthis dispar, Histioteuthis reversa, Neorossia caroli and Pyroteuthis margaritifera were found only on the slope. The rest of the species extended in both continental shelf and slope.

The spatial distribution of different species groups is discussed in relation to the hydrology and topography of the study area and the species ecology.

Keywords: Cephalopoda, Eastern Mediterranean.

Introduction

Cephalopods constitute increasingly important resources for human consumption and a principal food for many top predators (CLARKE, 1983).The knowledge of their abundance and distribution is fundamental, not only for fisheries, but also for the understanding of their significance in energy and material flow in marine ecosystems (PIATKOWSKI *et al.*, 2001).

The earliest available scientific literature on the cephalopod fauna of the Aegean Sea comes from the Danish Oceanographical

Expeditions to the Mediterranean and adjacent seas in 1910 (DEGNER, 1926). Nevertheless prior to the 1990s references to cephalopods are scanty (STERGIOU *et al.*, 1997) and only within the last decade their distribution has been regularly monitored, based mainly on trawl surveys carried out in the northern and eastern part of the Aegean Sea (D' ONGHIA *et al.*, 1991, 1996; SALMAN *et al.*, 1997, 2002).

This is a preliminary study on the species composition and distribution of cephalopods in the southern Aegean Sea.

Material and Methods

The data analyzed come from bottom trawl surveys carried out in summer during 1994-2001 in the framework of the "International Bottom Trawl Survey in the Mediterranean (MEDITS)" and from four surveys carried out in September 1995, December 1995, May and September 1996 in the context of a national project for the "Stock Assessment of Commercially Important Demersal Species in the southern Aegean Sea". The area investigated and the sampling stations for each one of the projects are shown in Figure 1.

During the eight MEDITS surveys 582 hauls in total were performed, in depths ranging between 34 and 778 m. The experimental trawl net used had a mesh size of 10 mm at the cod end and its horizontal and vertical net opening, measured by means of a SCANMAR sonar system, ranged between 13-18.8 m and 1.9-2.8 m respectively.

During the 4 surveys of the national project 161 hauls were carried out by a commercial trawl net having a cod end of 16 mm mesh size, horizontal net opening 11.2-18.2 m and vertical net opening 1.1-1.3 m. The minimum and

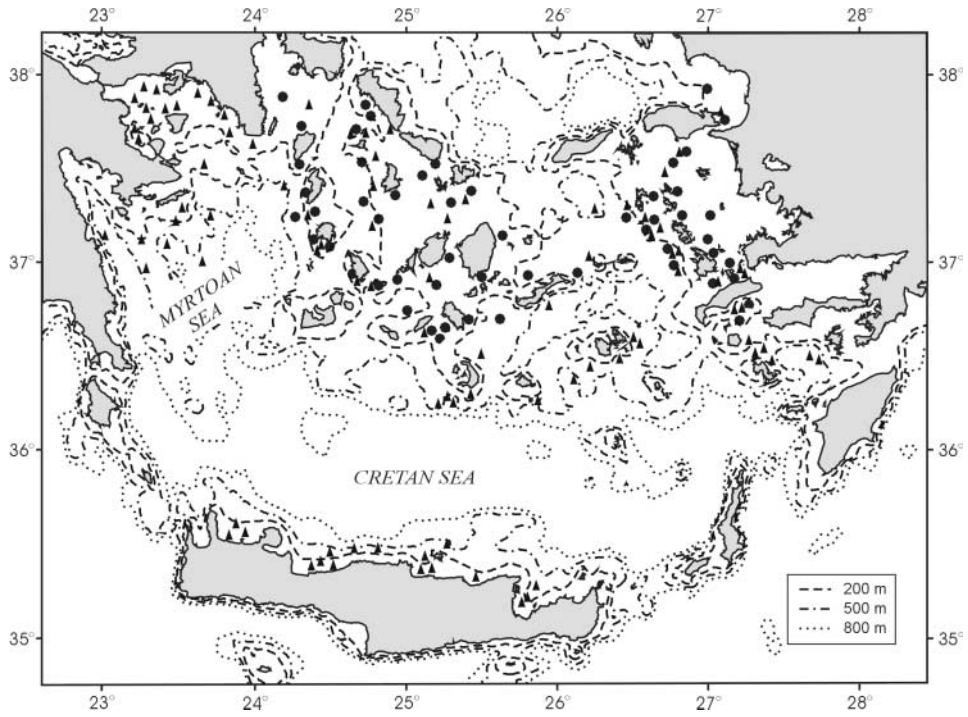

Fig. 1: Map of the southern Aegean Sea showing the position of the hauls performed during the trawl surveys of "MEDITS" (s) and the national project (l).

maximum investigated depths were 30 and 635 m respectively.

The species were identified following the keys in MAGNOLD & BOLETZKY (1987) and Bello (1995). Preliminary analysis of the composition and distribution of the cephalopod catches in the southern Aegean Sea was carried out.

Results and Discussion

Cephalopods were collected in 645 of the 708 valid hauls. A total of 34 species of cephalopod were identified, including 11 oegopsid squid, 3 myopsid squid, 7 octopod, 3 cuttlefishe and 10 sepiolid. Remains of female shells of *Argonauta argo* were also recorded. The frequencies of the species appearance in the catches of the different trawl nets are listed in Table 1, where indications of the depth range and the geographical rectangle of capture for each species are included. Previous records of cephalopod species in the southern and the northern Aegean Sea are also reported in Table 1.

A total of 25 species have been known from the southern Aegean Sea (Table 1). Among the 34 species recorded during our surveys, 16 are new findings for the studied area (Table 1) and two of them, *Ctenopteryx sicula* and *Octopoteuthis sicula*, have been caught for the first time in the Aegean Sea. Thus with this study the cephalopod fauna has increased to 49 species for the Aegean Sea and 41 for the southern part, reaching 96% and 80% respectively of the eastern Mediterranean fauna which is represented by 51 species (SALMAN *et al.*, 2002).

The nine species previously recorded in the southern Aegean Sea but not found during these surveys (Table I), include a species of the littoral zone, *Octopus macropus*, the epipelagic *Thysanoteuthis rhombus, Ocythoe tuberculata, Tremoctopus violaceus* and the mesopelagic species *Abraliopsis pfefferi, Ancistrocheirus lesueuri, Ommastrephes bartrami and Onychoteuthis banksii.* Such pelagic species are very rarely caught by conventional fishing gear although they form a considerable part in the diet of marine mammals, sharks and large pelagic fish (CLARKE, 1983; ORSI-RELINI *et al.*, 1994; BELLO, 1996).

Trawling with the experimental net resulted in the capture of 32 species, whereas 25 species were present in the commercial net catches (Table 1). *Bathypolypous sponsalis* and *Sepietta obscura* were the only caught species exclusively by the commercial trawl net. The higher number of species found in the catches of the experimental trawl net results from the capture of the pelagic species *Ancistroteuthis lichtensteini, Brachioteuthis riisei, Chiroteuthis veranyi, Ctenopteryx sicula, Heteroteuthis dispar, Histioteuthis reversa, Pyroteuthis margaritifera, Octopoteuthis sicula* and *Todarodes sagittatus*. These mesopelagic species carry out diel vertical migrations, remaining close to the bottom during the daytime (ROPER & YOUNG, 1975). The wider vertical opening of the experimental net seems to be more effective in capturing mesopelagic cephalopods, as suggested by MAIORANO *et al.* (1999).

Twenty-four and 29 species were recorded respectively at the continental shelf and slope, of which 20 were distributed in both depth zones (Table 1). Four species, *Sepia officinalis, Sepietta neglecta, Sepietta obscura* and *Sepiola rondeleti,* were caught only at depths shallower than 200 m, however other species typically distributed on the continental shelf, like *Eledone moschata, Octopus vulgaris, Sepiola intermedia* and *Loligo vulgaris* were fished down to 223, 270, 293 and 335 meters respectively. The species fished exclusively on the slope were the pelagic sepiolid *Heteroteuthis dispar*, the mesopelagic squids *Ancistroteuthis lichtensteini, Brachioteuthis riisei, Chiroteuthis veranyi, Ctenopteryx sicula, Histioteuthis reversa, Pyroteuthis margaritifera* and the bathy-benthic *Neorossia caroli* and *Bathypolypous sponsalis;* these latter fished very close to the shelf-break. *Pteroctopus tetracirrhus, Sepia orbignyana, Sepia elegans* and *Rondeletiola minor* were found

Table 1
Cephalopod species collected in the southern Aegean Sea by experimental and commercial trawl nets.

Family	Species	Frequency of occurrence in		Haul depth (m)		Latitude		Longitude		Previous references	
		Commercial trawl	MEDITS trawl	min	max	min	max	min	max	S. Aegean	N. Aegean
Brachioteuthidae	Brachioteuthis riisei(Steenstrup,1882)		0,3	756	758	37° 08' 42"	37° 39' 15"	23° 00' 15"	23° 14' 51"	14	
Chiroteuthidae	Chiroteuthis veranyi (Ferussac, 1835)		0,3	404	758	37° 08' 48"	37° 39' 17"	23° 00' 15"	23° 15' 39"		13
Ctenopterygidae	Ctenopteryx sicula (Verany, 1851)		0,2	404	409	37° 36' 52"	37° 39' 17"	23° 13' 48"	23° 5' 39"		
Enoploteuthidae	Abralia veranyi (Ruppell, 1844)	1,9	3,6	88	720	35° 23' 44"	36° 18' 54"	24° 47' 39"	25° 17' 54"		4, 10,11
	Abraliopsis pfefferi (Verany, 1837)									1	
	Ancistrocheirus lesueuri (Orbigny, 1839)									15	13, 15
	Pyroteuthis margaritifera (Ruppell, 1848)		0,2	756	758	37° 08' 48"	37° 11' 22"	23° 00' 15"	23° 00' 35"		10, 13
Histioteuthidae	Histioteuthis bonnellii (Ferussac, 1835)									11	13
	Histioteuthis reversa (Verrill,1880)		1,2	561	694	36° 30' 04"	36° 58' 55"	23° 40' 58"	27° 45' 37"		13
Loliginidae	Alloteuthis media (Linnaeus, 1758)	68,9	37,4	30	585	35° 14' 07"	37° 55' 25"	23° 10' 23"	27° 14' 58"	3, 9, 11, 15	3, 4, 10, 11
	Alloteuthis subulata (Lamarck, 1798)										4, 10, 11
	Loligo forbesi (Steenstrup, 1856)	14,9	7,4	35	549	35° 19' 29"	37° 27' 30"	23° 15' 23"	27° 04' 41"	11	4, 10, 11
	Loligo vulgaris (Lamarck, 1798)	29,8	18,9	16	335	35° 14' 26"	37° 51' 21"	23° 19' 27"	27° 14' 49"	11	4, 10, 11
Octopoteuthidae	Octopoteuthis sicula(Ruppel, 1844)		0,5	707	778	37° 02' 19"	37° 08' 05"	23° 00' 31"	23° 26' 38"		
Ommastrephidae	Illex coindetii (Verany, 1839)	60,9	47,6	37	766	35° 14' 07"	37° 55' 25"	23° 10' 23"	27° 16' 43"	9, 11	11
	Todarodes sagittatus (Lamarck, 1798)	8,8	40	770		35° 14' 07"	37° 51' 33"	23° 00' 31"	27° 45' 37"	3, 9	3, 4, 10, 11
	Todaropsis eblanae (Ball, 1841)	7,5	6,2	110	766	36° 31' 05"	37° 53' 49"	23° 11' 20"	26° 59' 35"		4,10,11
	Ommastrephes bartramii (Leueur, 1821)									6	
Onychoteuthidae	Ancistroteuthis lichtensteini (Orbigny, 1839)		1,2	257	770	37° 57' 37"	37° 09' 04"	23° 00' 31"	23° 42' 37"	14	15
	Onychoteuthis banksi (Leach, 1817)									1	
Thysanoteuthidae	Thysanoteuthis rhombus (Troschel, 1857)									5	
Argonautidae	Argonauta argo (Linnaeus, 1758)		*	131	139	37° 36' 01"	37° 36' 16"	23° 59' 01"	23° 59' 53"		11
Octopodidae	Bathypolypous sponsalis(Fischer, 1892)	0,6		211	494	36° 42' 16"	37° 32' 50"	24° 17' 00"	26° 04' 32"		4, 10, 11
	Eledone cirrhosa (Lamarck, 1798)	20,5	33,8	44	548	35° 14' 16"	37° 55' 25"	23° 10' 23"	27° 25' 11"	9, 11	4, 10, 11
	Eledone moschata (Lamarck, 1798)	58,4	25,0	16	223	35° 18' 58"	37° 55' 25"	23° 10' 23"	27° 14' 58"	2, 9, 11	4, 10, 11
	Octopus macropus (Risso, 1826)									2, 9, 11	
	Octopus salutii (Verany, 1839)	3,1	1,9	135	520	35° 17' 02"	37° 53' 24"	23° 15' 05"	26° 59' 35"	11	4, 10, 11, 13
	Octopus vulgaris (Cuvier, 1798)	36,0	19,1	16	270	35° 14' 55"	37° 53' 22"	23° 19' 21"	27° 14' 58"	2, 9, 11	4, 10, 11, 13
	Pteroctopus tetracirrhus (Delle Chiaje, 1830)	5,6	4,0	88	706	35° 17' 02"	37° 52' 11"	23° 15' 48"	27° 25' 22"	9, 11	4, 10
	Scaeurgus unicirrhus (Orbigny, 1840)	28,0	15,0	97	549	35° 14' 29"	37° 54' 12"	23° 15' 07"	27° 16' 43"	11	4, 10

Ocythoidae	Ocythoe tuberculata (Rafinesque, 1814)									8	3
Tremoctopidae	Tremoctopus violaceus(Delle Chiaje, 1829)									7	15
Sepiidae	Sepia elegans (Blainville, 1827)	62,7	27,1	31	585	35° 14' 29"	37° 55' 25"	23° 10' 23"	27° 27' 55"	3, 9, 11	4, 10, 11
	Sepia officinalis (Linnaeus, 1726)	39,8	12,8	16	179	35° 14' 26"	37° 53' 22"	23° 19' 40"	27° 14' 58"	9, 11	4, 10, 11
	Sepia orbignyana (Ferussac, 1826)	42,2	44,2	30	585	35° 14' 16"	37° 55' 25"	23° 15' 16"	28° 15' 37"	3, 9, 11	4, 10, 11
Sepiolidae	Heteroteuthis dispar (Ruppell, 1844)		1,9	332	735	35° 28' 57"	37° 09' 32"	23° 00' 31"	27° 27' 55"	1	3, 11
	Neorossia caroli (Joubin, 1902)	3,1	1,4	207	567	36° 56' 38"	37° 53' 02"	23° 16' 53"	27° 01' 05"	4, 10, 11	
	Rondeletiola minor (Naef, 1912)	16,8	23,9	55	766	35° 13' 19"	37° 54' 34"	23° 11' 20"	27° 25' 22"	3, 11	4, 10, 11
	Rossia macrosoma (Delle Chiaje, 1830)	13,7	10,2	167	567	35° 17' 02"	37° 53' 24"	23° 15' 07"	27° 45' 37"	15	4, 10, 11
	Sepietta neglecta (Naef, 1916)	0,6	0,5	88	163	37° 33' 14"	37° 50' 10"	23° 30' 06"	26° 52' 44"	11, 12	
	Sepietta obscura (Naef, 1916)	0,6		31	31	37° 33' 14"	37° 34' 37"	26° 52' 34"	26° 52' 44"	15	
	Sepietta oweniana (Pfeffer, 1908)	23,0	21,6	47	715	35° 13' 19"	37° 55' 25"	23° 11' 20"	27° 04' 46"	3, 4 ,10, 11	
	Sepiola affinis (Naef, 1912)										4, 10
	Sepiola intermedia (Naef, 1912)	5,6	1,6	60	293	36° 56' 25"	37° 34' 37"	23° 29' 04"	27° 02' 07"		10, 11
	Sepiola ligulata (Naef, 1912)	0,6	1,6	84	216	37° 13' 28"	37° 52' 09"	23° 11' 20"	27° 01' 55"		4, 10
	Sepiola robusta (Naef, 1912)										11
	Sepiola rondeleti (Steenstrup, 1856)	3,1	0,5	75	104	36° 53' 16"	37° 35' 06"	23° 29' 15"	26° 53' 16"		4, 10, 11

1 - Degner, 1926; 2 - Barash and Danin (1988); 3 - Katagan and Kocatas (1990), 4 -D'Onghia *et al.* (1991); 5 -Vardala - Theodorou et al., (1991); 6 - Katagan *et al.* (1992); 7 - Vardala - Theodorou (1994); 8 - Corsini and Lefkaditou (1995); 9 - Kallianiotis *et al.* (1995); 10 - D'Onghia *et al.* (1996); 11 - Salman *et al.* (1997); 12 - Lefkaditou and Kaspiris (1998); 13 – Lefkaditou *et al.* (1999); 14 - Lefkaditou et al. (2000); 15 - Salman *et al.* (2002).

shallower than previously reported in the Aegean Sea (D' ONGHIA *et al.*, 1991,1996; KALLIANIOTIS *et al.*, 1995; SALMAN *et al.*, 1997). The narrow continental shelf and the generally steep waters of the southern Aegean Sea probably favour the wide depth range observed for most of the species.

Concerning the geographical range, the species caught frequently (f>5 %) by trawl net presented a wide longitudinal and latitudinal range (Table 1). The capture of some uncommon pelagic squids, like *Ancistroteuthis lichtensteini, Brachioteuthis riisei, Chiroteuthis veranyi, Ctenopteryx sicula, Pyroteuthis margaritifera* and *Octopoteuthis sicula* was limited at the westernmost part of the study area (TABLE 1). The strong anticyclone appearing in the Myrtoan deep water basin during winter (NITTIS & LASCARATOS, 1993) may result in high biological productivity along the abrupt coasts of eastern Peloponnisos, which could be the reason for a higher abundance of such species known to be usually associated with hydrographic regimes (COELHO, 1985).

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