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SHORTER CONTRIBUTION

Distribution of Cumacea in the deep Mediterranean*

DANIEL REYSS†

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Abstract—Cumacean Crustacea are an important faunal component of the deep-sea benthos of the Mediterranean. Thirty-three species have been collected from bathyal and abyssal depths and eight of these were new.

Faunal composition is closely related to the North Atlantic cumacean fauna, especially to that of the Bay of Biscay. Mediterranean endemism is found for species occurring at depths of more than 2000 m. Trophic conditions and species diversity in the deep Mediterranean (2000–3000 m) are similar to those occurring in the North Atlantic between 4000 and 5000 m depth.

INTRODUCTION

RECENT studies on the distribution of Cumacea in the deep Atlantic (JONES and SANDERS, 1972) have demonstrated that they are a numerically significant and more diverse deep-sea group than had been previously thought, perhaps almost as important as are the isopods.

Here, we present the findings for Cumacea collected during two Mediterranean cruises:

POLYMÈDE I, May–June 1970, Western Basin (REYSS, 1972)

POLYMÈDE II, April–May 1972, Ionian, Aegean and Alboran Seas (REYSS, in press).

All the deep-sea benthic samples were collected with an epibenthic sled (mesh-size: 0·5 mm).

Using the same format, the same kinds of analyses and interpretation, this study is complementary to the recent publication on the distribution of Cumacea in the deep Atlantic by JONES and SANDERS (1972).

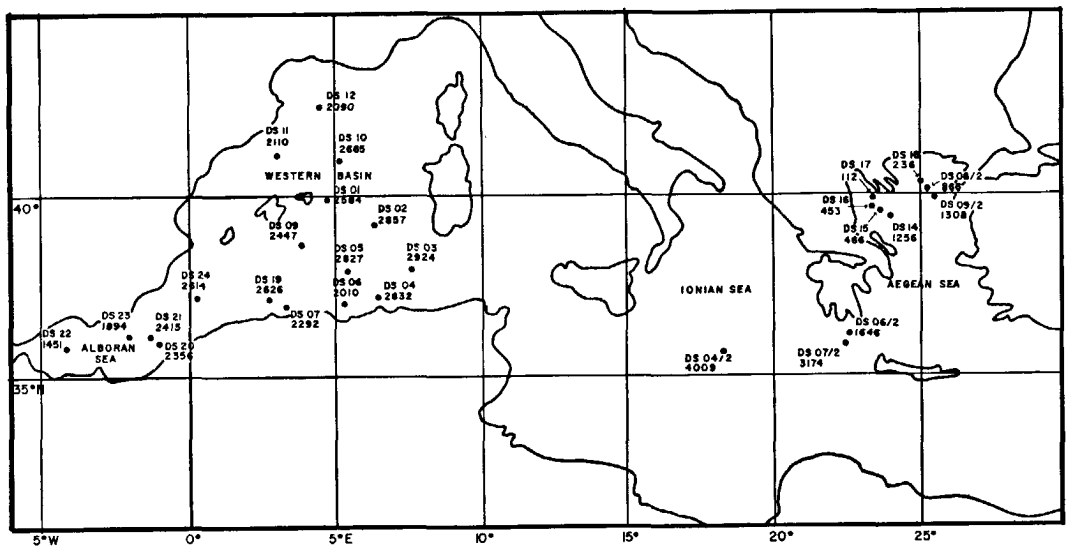

Fig. 1. Chart of the Mediterranean Sea showing the location, the number (upper line) and depth (lower line) of the benthic stations.
Western basin: POLYMÈDE Cruise I (May–June 1970).
Aegean, Ionian and Alboran seas: POLYMÈDE Cruise II (April–May 1972).

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†Centre Océanologique de Bretagne, B.P. no. 337, 29273 Brest, France.

THE NUMBER OF SPECIES AND DISTRIBUTION

Of 27 samples, only five produced more than 100 specimens, the greatest number being 358 (DS 09), and the greatest number of species in a single haul was 15 (DS 09). These five samples were at depths between 2000 and 2660 m. The comparison (Table 1) between the Sanders' stations in the Atlantic Ocean (JONES and SANDERS, 1972) and ours is significant, since collecting gear were the same in the two studies.

Table 1. Mean numbers of species and specimens of cumaceans per haul.

Depth (m)	Mediterranean			Atlantic		
	No. of stations	*No. of species*	*No. of specimens*	*No. of stations*	*No. of species*	*No. of specimens*
100–1000	5	6	28	21	15	288
1000–2000	5	5	15	18	18	243
2000–3000	15* (see below)	8	87	26	13	214
3000–4000	2	1	2	7	13	187
4000–5000				11	4	54

*On these 15 stations, 5 yielded more than 100 specimens and 10 less than 100. Thus, mean numbers for these two groups are:

5	12	182
10	5	20

Numbers of species and specimens are clearly lower in the Mediterranean, especially in the 100–1000 m and 1000–2000 m ranges, but one can observe that, for the five richest stations, mean numbers may be compared with mean numbers of Atlantic stations for the same depth (2000–3000 m).

Of the seven families of Cumacea, five are represented in the deep Mediterranean and two are missing; the Bodotriidae, with four genera and four species, the Leuconidae, with two genera and six species, the Nannastacidae, with three genera and twelve species (including seven species of *Campylaspis*), the Lampropidae, with two genera and two species and the Diastylidae, with four genera and nine species. The Pseudocumidae, occurring in the Mediterranean and the Black Sea, are from littoral waters and are not found there in depths of more than 100 m. The Ceratocumidae are not known in this sea. Thirty-three species and 1505 specimens were collected; of this total number of species, 8 were new: the latter is a significant proportion (24%) of the total number.

Fourteen species (43%), representing 16% of the total number of specimens, have not yet been found outside the Mediterranean. Nineteen species (57%), representing 84% of the specimens, are also found in the Atlantic (Table 2).

Table 2. Distribution of the nineteen species occurring both in the Atlantic and the Mediterranean.

Species	*Mediterranean*	*Bay of Biscay*	*Bermuda transect*	*Canary Islands*	*Dakar–Recife transect*
Leucon longirostris	+	+	+	+	+
Bathycuma brevirostris	+	+	+	+	+
Procampylaspis armata	+	+	+	+	
Makrokylindrus longipes	+		+	+	+
Cyclaspis longicaudata	+	+	+	+	
Leucon siphonatus	+	+	+		
Diastyloides serrata	+	+	+		
Campylaspis glabra	+	+	+		
Campylaspis vitrea	+	+	+		
Platysympus typicus	+	+	+		+
Campylaspis verrucosa	+	+	+		
Campylaspis horridoides	+	+	+		
Eudorella truncatula	+	+			
Campylaspis macrophthalma	+	+			
Vauthompsonia cristata	+	+			
Hemilamprops normani	+	+			
Cumellopsis puritani	+	+			
Leptostylis macrura	+		+		
Campylaspis spinosa	+			+	+

REGIONAL DISTRIBUTION

Of the species found in the Mediterranean, 57% are found in the Atlantic; among them, 48% occur in the Bay of Biscay, but only 28% of the species occurring in the Bay of Biscay are also found in the Mediterranean.

Of the Mediterranean species, 39% are found on the Gay Head–Bermuda transect, but only 13% of the Gay Head–Bermuda transect species occur in the Mediterranean.

Of the species found in the Mediterranean, 18% are also found near the Canary Islands, but only 13% of the Canary species occur in the Mediterranean.

Of the species occurring in the Mediterranean, 15% are also found on the Dakar–Recife transect, but only 5% of these transect species occur in the Mediterranean.

Of these 57%, some occur in one or several regions of the Atlantic (Fig. 2).

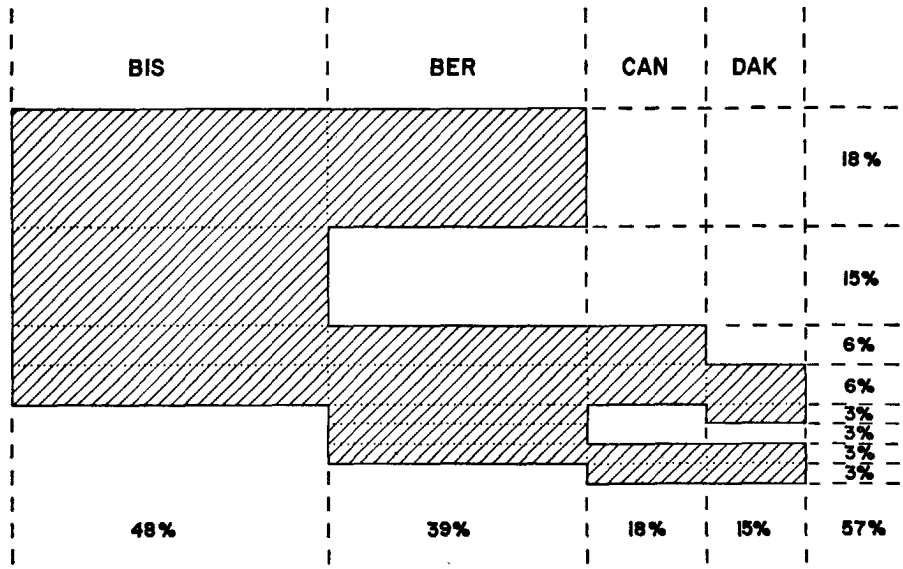

Fig. 2. Diagram showing the proportional distribution of the species occurring in the Mediterranean and in the Atlantic.
BIS: Bay of Biscay BER: Gay Head–Bermuda transect
CAN: Canary Islands DAK: Dakar–Recife transect.
Percentages along the abscissa mean that 48% of the species found in the Mediterranean occur also in the Bay of Biscay, 39% of the species found in the Mediterranean occur also on the Gay Head–Bermuda transect, etc., and 57% of the species found in the Mediterranean are also found in one or several regions of the Atlantic.
Percentages along the ordinate mean that of these 57%, 18% occur both in the Bay of Biscay and in the Gay Head–Bermuda transect, 15% occur only in the Biscay area, etc.

The cumacean fauna of the Mediterranean (Fig. 2) is fairly closely related to that of the Bay of Biscay area. An affinity with the fauna of the three other regions is shown by a small number of widely ranging species with a whole Atlantic distribution.

Thus, the five species shared between the Mediterranean and the Dakar–Recife transect occur on the Brazilian side (and only one occurs on the African side) but four are also found in the Canary area.

VERTICAL DISTRIBUTION (TABLE 3)

Of the 30 species of Cumacea previously known to extend to depths greater than 200 m in the Mediterranean (JONES, 1969) 23 are represented in the present collections. Of the seven species not found, four are confined to the continental shelf and upper slope (not exceeding 400 m) and three were known from more than 1000 m depth: *Diastylis cornuta, Diastylis vemae* and *Makrokylindrus gibraltariensis.*

Of three groups of species (Table 3):

(1) The first (from *Makrokylindrus aegaeus* to *Bodotria scorpioides*), does not exceed 1500 m depth and occurs in the Aegean Sea.

(2) The second (from *Procampylaspis bacescoi* to *Diastyloides carpinei*) occurs between 500 and 2500 m, and is composed largely of possibly endemic forms.

(3) The third is formed by widely ranging species and with a broad geographical distribution. It is numerically dominant in the Mediterranean Sea, where the cumacean faunal composition does not change continuously with increasing depth as in the Atlantic Ocean. There is a superimposition, at depths exceeding 2000 m, of a typical deep Mediterranean fauna upon an eurybathic fauna (200 or 500–3000 m and more), the latter almost always also occurring in the Atlantic.

DIVERSITY

To study species diversity, only samples that yielded 100 or more specimens were considered. With this limitation, five samples qualify. All are from the western basin, on a north–south line, along 5°E from the Golfe du Lion to the Algiers Basin.

For calculating species diversity, the Shannon–Wiener information function (Table 4) was used (SHANNON and WEAVER, 1949):

$$H(s) = -\sum_{r=1}^{s} P_r \log_2 p_r,$$

where s = total number of species and p_r = observed proportion of individuals that belongs to the rth species ($r = 1,2, \ldots, s$).

Diversity values obtained by Jones and Sanders on the Gay Head–Bermuda transect vary between 2·5 and 3·5 (11 samples), low values, less than 2·0, were restricted to three stations shallower than 500 m, two abyssal stations and one station on the Bermuda slope.

Diversity values obtained elsewhere in the Atlantic average somewhat higher. For comparison with the numbers found by Jones and Sanders, only Atlantic samples having a $H(s)$ comparable with the Mediterranean values are shown in Table 4.

Table 4. Atlantic–Mediterranean comparison: stations, depth, diversity value, number of species and number of individuals.

Atlantic Ocean					*Mediterranean Sea*				
Sample	*Depth*	*H(s)*	*No. spp*	*No. ind.*	*Sample*	*Depth*	*H(s)*	*No. spp*	*No. ind.*
103	2022	2·71	17	517	DS 12	2090	2·30	11	216
131	2178	2·70	19	753	DS 11	2110	2·53	11	104
76	2862	2·55	15	678	DS 19	2626	2·59	9	126
70	4680	2·57	10	190	DS 10	2665	2·60	13	307
84	4749	2·46	11	185	DS 09	2447	2·78	15	358

Two groups may be distinguished in the Atlantic samples: the three samples 103-131-76 and the deeper pair of samples 70-84.

The mean numbers for these two Atlantic groups and the Mediterranean group and variations from the Mediterranean mean are shown in Table 5.

Remarks. The five Atlantic samples (among the total samples shown in Jones and Sanders) having $H(s)$ comparable to the Mediterranean values are from the Gay Head–Bermuda transect. For similar depths (2000–3000 m), numbers of species and of specimens are considerably higher in the Atlantic,

Table 5. Comparison of mean numbers (depth, diversity value, number of species, number of individuals) between Mediterranean samples and Atlantic samples.

Group of samples	*Mean depth*		*Mean H(s)*		*Mean no. spp*		*Mean no. ind.*	
103-131-76	2350		2·65		17		649	
		−40		+0·09		+6		+427
MED-samples	2390		2·56		11		222	
		+2300		−0·05		−0		−35
70-84	4714		2·51		11		185	

Table 3. Numbers of specimens of the different species at each station. The stations are ordered for increasing depths.

Station (DS):	17	18	15	16	08/2	14	09/2	22	06/2	23	06	12	11	07	20	21	09	01	24	19	04	10	05	02	03	07/2	04/2
Depth (m):	112	236	453	466	866	1256	1308	1491	1646	1894	2090	2090	2110	2292	2356	2415	2447	2584	2614	2626	2632	2665	2827	2857	2924	3174	4009
Number of specimens:	2	47	10	65	16	5	6	22	22	1	4	216	104	2	9	40	358	24	4	126	27	307	45	18	23	3	1
Number of species:	2	9	6	11	4	3	4	8	6	1	3	11	11	2	5	7	15	6	3	9	9	13	8	4	6	1	1
Makrokylindrus longipes		8					1	2	5			11	11				4			1	2	1					1
Bathycuma brevirostris								2	11			69	18		3	11	45	5		23		52	2	5	7	3	
Cyclaspis longicaudata									3		1	80	43				100	4		1		117	1	9	3		
Diastyloides serrata		7		5				8	1		2	4	3		2	6	4	1		34		4	4		1		
Procampylaspis armata		11						1	1				11		2	11	16	8	2	36	8	13	34	1	9		
Platysympus typicus			2	4				1				30	2		1		105	3	1			76		3	1		
Campylaspis spinosa																5					1	3			2		
Eudorella truncatula														1									1				
Leucon longirostris					7						1	1	7							1	1		1				
Campylaspis glabra		3	2	6		1			1			2	5				6				3	6	1				
Procampylaspis bacescoi			1	7		2															1		1				
Procampylaspis sp.																	10					7					
Campylaspis sp.									1						1	2	1			13		1					
Leptostylis gamoi																	1					1					
Leptostylis bacescoi													1				26					19					
Diastylis jonesi									1			13	2			1	33			9	2	4					
Procampylaspis bonnieri				1	3						1					4	4	3		8		4					
Campylaspis horridoides																	1										
Vaunthompsonia cristata												3					1										
Eudorella nana		4							6					1													
Eudorella sp.													1														
Cumellopsis puritani												1															
Diastyloides carpinei												1															
Makrokylindrus aegaeus			2	22			1																				
Diastylis charcoti			2	13	2		3																				
Campylaspis vitrea		4		3		2	1																				
Leucon mediterraneus	1	5	1		4																						
Campylaspis verrucosa				1																							
Campylaspis macrophthalma				1																							
Leucon siphonatus				4																							
Leptostylis macrura		1																									
Hemilamprops normani		4																									
Bodotria scorpioides	1																										

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and $H(s)$ is also higher. On the contrary, for deeper samples from the Atlantic (4700 m), mean numbers of species, of specimens and $H(s)$ are closely related to the Mediterranean means. Interpolated curves derived by the Hurlbert methodology for diversity measurement (HURLBERT, 1971) give the same results. Curves for Mediterranean samples (not drawn here) closely overlap curves for samples 70 and 84 from the Gay Head–Bermuda transect.

The significant resemblance between our 2000–3000 m hauls and the 4000–5000 m hauls from the Gay Head–Bermuda transect could be the result of trophic conditions. The amount of organic carbon in the deep Mediterranean (2500–3000 m) has not yet been calculated. A few values are known from depths not exceeding 1500 m (CARPINE, 1970) and are similar to those occurring for the same depths in the Atlantic.

In the Ionian Sea (Matapan Trench) the sediment is very poor in organic carbon; the amount of calcium carbonate is high (38–48%) (PAREYN, 1968). Biomasses calculated by SPÄRCK (1931) near Algiers and Naples and by CHUKHCHIN (1963) in the Ionian Sea and the Eastern Basin are very low; for 2000–3000 m depths they are similar to those calculated by KUZNETSOV (1960) in the deep Atlantic basins (4000–5000 m).

The total faunal composition (CHARDY, LAUBIER, REYSS and SIBUET, 1973) shows the absence in our samples of large species of Echinoderms, Mollusks, Polychaeta and Sponges; even in hauls with 1000 or more specimens of all zoological groups, the size of any animal rarely exceeds 0·5 cm. Thus, if we compare the Mediterranean to the northwest Atlantic (SOKOLOVA, 1972), the trophic conditions in the deep western basin of the Mediterranean are poorer than in the northwest Atlantic for the same depth, and more closely related to the trophic conditions prevailing at more than 4000 m in the Atlantic. The deep Mediterranean fauna is composed of small species as in the deep Atlantic.

Of 1500 specimens collected, 1000 (i.e. 66%) belong to four species (i.e. 12%): *Cyclaspis longicaudata*, *Bathycuma brevirostris*, *Platysympus typicus* and *Procampylaspis armata*. If we consider only the five samples that yielded 100 or more specimens, they represent 30% of the number of species and 72% of the specimens. These 4 species occur in the Atlantic and their distribution is very eurybathic: 300–4000 m and more, with, often, a maximum of occurrence between 500 and 1000 m. Moreover, they rarely occur together and they are never as numerically dominant as they are in the Mediterranean Sea. Their abundance in this sea seems to be related to the high temperature (13°C) of the deep favouring eurybathic species.

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