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Deep-water decapod crustacean fauna of the Eastern Ionian Sea

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ABSTRACT. Knowledge on the decapod crustacean fauna of the E. Ionian Sea was enriched by a recent research program, carried out in deep waters (300-1200 m) of its northern part. The data were collected from a total of 148 hauls towed during four experimental trawl surveys from September 1999 to September 2000.

Thirty nine decapod species were identified, of which eight were Dendrobranchiata and 31 Pleocyemata (17 Caridea, 9 Brachyura, 3 Anomura, 1 Astacideum and 1 Palinurum). Concerning their depth distribution, 30 species were found in the depth zone 300-500 m, with *Parapenaeus longirostris* being the most abundant species. *Plesionika heterocarpus* and *P. antigai* followed in terms of abundance. Of the 27 species caught in the zone 500-700 m, *Aristaeomorpha foliacea* and *Plesionika martia* were the most abundant. In the zone 700-900 m, 19 species were found and *Aristaeomorpha foliacea* with *Aristeus antennatus* were the most numerous. Finally, the 18 decapod species encountered in the zone 900-1200 m showed low abundance, and *Sergia robusta* with *Polycheles typhlops* predominated in numbers.

From the identified decapods, *Acanthephyra eximia*, *Philoceras echinulatus* and *Pontophilus norvegicus* were mentioned for the first time in the E. Ionian Sea. Some other species, such as *Acanthephyra pelagica*, *Geryon longipes, Munida tenuimana, Paromola cuvieri, Parthenope macrochelos, Pasiphaea multidentata, Plesionika narval, Polycheles typhlops, Sergestes arachnipodus* and *Sergestes arcticus* have been reported for the area only in the gray literature. Additionally, new depth distribution records for the Mediterranean were obtained for some species.

KEY WORDS : Decapoda, deep-water, Ionian See, Mediterranean.

INTRODUCTION

The literature on the decapod crustacean fauna of the Eastern Ionian Sea (Greece) is limited comparing to that referring to other Greek seas and more specifically to the Aegean Sea (e.g. THESSALOU-LEGAKIS & ZENETOS, 1985 ; THESSALOU-LEGAKIS, 1986 ; D'UDEKEM D'ACOZ, 1995). The systematic investigation of the decapod fauna of the Greek waters in the Ionian Sea has started quite recently in the framework of larger projects (MEDITS projects 1994-2001) or in restricted areas of the Ionian Sea, always at depths not exceeding 800 m ("Deep Water Fisheries" and RESHIO projects). Some information, obtained during the MEDITS project, is given by POLITOU et al. (1998, 2000).

The aim of the present work is to enrich the knowledge on the decapod crustacean fauna of the Eastern Ionian Sea with information obtained in the framework of the project INTERREG Italy-Greece, which was carried out in deep waters (300-1200 m) of its northern part. This information concerns the decapod faunistic composition, the species depth distribution, their frequency of occurrence and abundance.

MATERIALS AND METHODS

Sampling took place in depths from 300 to 1200 m of the Greek Ionian Sea during four experimental trawl surveys carried out from September 1999 to September 2000 (Fig. 1) using two chartered commercial trawlers. The gear used was a commercial bottom trawl with a cod end mesh size of 20 mm (side). The vertical and horizontal opening of the trawl were estimated, using a remote acoustic sensing system attached to the gear, as 1.5 m and 17 m respectively at a towing speed of 2.4 knots. 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. Some additional experimental hauls were carried out in the depth zone 900-1200 m. A total of 148 hauls were carried out. The tow duration was 30 minutes for depths <500 m and one hour for depths >500 m. After each haul, catches were identified to species level. Species abundance was recorded on board. The mean abundance in number of individuals per fishing hour (CPUE) was estimated for each depth zone as :

$$CPUE=\Sigma Nn/\Sigma tn$$

where ΣNn=sum of individuals of a species in the n hauls carried out in the depth zone and Σtn=sum of fishing time of the n hauls in the depth zone.

RESULTS

Thirty nine decapod species were identified in total in the study area. Of them eight were Dendrobranchiata and 31 Pleocyemata (17 Caridea, 9 Brachyura, 3 Anomura, 1 Astacideum and 1 Palinurum) (Table 1).

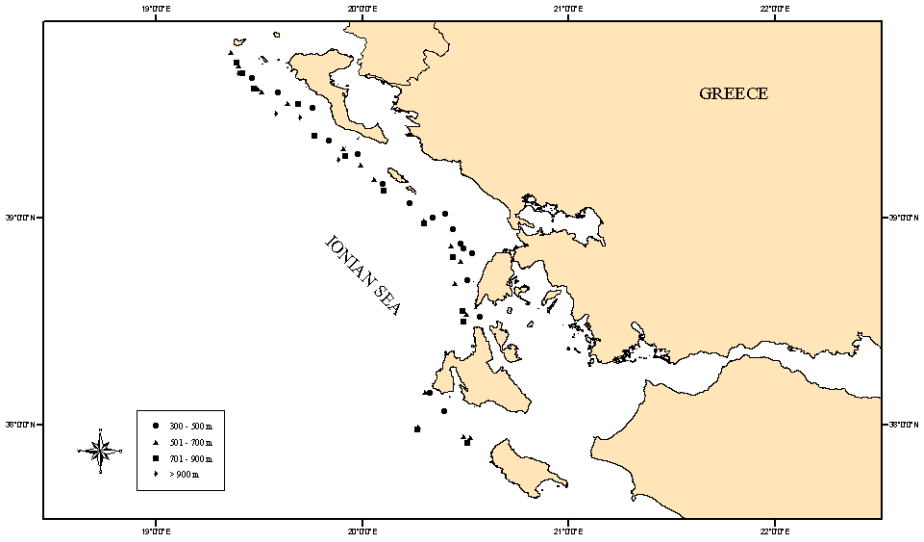

Fig. 1. – Map of the study area showing the sampling stations.

Thirty species were found in the depth zone 300-500 m (6 Dendrobranchiata and 24 Pleocyemata : 14 Caridea, 6 Brachyura, 2 Anomura, 1 Astacideum and 1 Palinurum). *Parapenaeus longirostris* was the most important species, since it presented a remarkably high frequency of occurrence and abundance (Fig. 2). Although different species, such as *Plesionika antigai, P. gigliolii, P. heterocarpus, Nephrops norvegicus, Munida rutllanti, P. edwardsii* and *Chlorotocus crassicornis,* were also found frequently, only *P. heterocarpus, P. antigai* and *P. edwardsii* were worth a mention in terms of their abundance.

Of the 27 species caught in the zone 500-700 m, six were Dendrobranchiata and 21 Pleocyemata : 9 Caridea, 7 Brachyura, 3 Anomura, 1 Astacideum and 1 Palinurum. *P. martia* was present in all stations, whereas other highly occurring species were, in order of importance, *Polycheles typhlops, Aristaeomorpha foliacea, P. acanthonotus, P. gigliolii, P. longirostris, N. norvegicus* and *P. antigai. Aristaeomorpha foliacea* and *Plesionika martia* were dominant in terms of abundance.

In the zone 700-900 m, 19 species were found (7 Dendrobranchiata and 12 Pleocyemata : 7 Caridea, 3 Brachyura, 1 Astacideum and 1 Palinurum). Many species, such as *A. foliacea, Polycheles typhlops, Aristeus antennatus, P. martia, Sergia robusta* and *P. acanthonotus,* showed high frequency of occurrence. However, their abundance was generally low with *A. foliacea* followed by *Aristeus antennatus* being the most numerous.

Finally, of the 18 decapod species encountered in the zone 900-1200 m, six were Dendrobranchiata and 12 Pleocyemata : 7 Caridea, 4 Brachyura and 1 Palinurum. *S. robusta* was the most frequently occurring species followed by *A. antennatus, P. typhlops, Acanthephyra pelagica, Pasiphaea multidentata, Sergestes arachnipodus, Acanthephyra eximia* and *P. acanthonotus.* Although, *Sergia robusta* and *Polycheles typhlops* predominated in numbers, their abundance was remarkably low.

DISCUSSION

Including results from the present study, the number of known decapods from the Ionian Sea has now reached 82 species. Of the identified decapods, *Acanthephyra eximia*, *Philoceras echinulatus* and *Pontophilus norvegicus* are reported for the first time in the E. Ionian Sea. *Acanthephyra eximia* was found in waters deeper than 800 m, which were not investigated earlier. Only one specimen of *Philoceras echinulatus* was caught in a single station. Finally, only one specimen of *Pontophilus norvegicus* was found in a deep station (965 m). Some other species, such as *Acanthephyra pelagica*, *Geryon longipes, Munida tenuimana, Paromola cuvieri, Parthenope macrochelos, Pasiphaea multidentata, Plesionika narval, Polycheles typhlops, Sergestes arachnipodus* and *Sergestes arcticus,* have been reported for the area only in the gray literature (Deep Water Fisheries technical report, unpublished data ; D'ONGHIA et al., 2001 ; POLITOU et al., 2001). Most of them are also uncommon species or mainly found in the two deepest strata. The two commercial deep-water shrimps *Aristaeomorpha foliacea* and *Aristeus antennatus* that were absent from the list of POLITOU *et al*. (1998) were found during the surveys of the Deep Water Fisheries project and later in the framework of the MEDITS project (KAPIRIS *et al.,* 1999 ; KAPIRIS & THESSALOU-LEGAKI, 2001 ; PAPAKONSTANTINOU & KAPIRIS, 2001 ; CAU *et al.*, 2002). Most of the decapod species found in the present study, with the exception of *Acanthephyra eximia*, *Aegaeon lacazei, Munida rutllanti, Paromola cuvieri, Philoceras echinulatus, Plesionika edwardsii, Plesionika narval* and *Pontophilus norvegicus,* were also found in the SE Adriatic Sea, which is adjacent to the E. Ionian (VASO & GJIKNURI, 1993 ; UNGARO et al., 1999 ; MARSAN *et al*., 2000). Comparing data from the rest of the Greek waters (Aegean and Cretan Sea) reveals that all the species found in the present study, with the exception of *Pontophilus norvegicus* and *Sergestes arachnipodus,* have been reported in the existing literature for these areas (KOUKOURAS et al., 1992, 1997, 1998, 2000 ; KALLIANIOTIS et al., 2000).

TABLE 1

List of decapod species collected in the E. Ionian Sea with species depth range and frequency of occurrence (%) per depth stratum.

		Depth strata (m)			
	Depth range (m)	**300-500**	**500-700**	**700-900**	**900-1200**
No. of hauls		**45**	**52**	**38**	**13**
Dendrobranchiata					
Aristaeomorpha foliacea (Risso, 1827)	388-1047	2.2	88.5	94.7	15.4
Aristeus antennatus (Risso, 1816)	480-1171	2.2	53.8	89.5	76.9
Gennadas elegans (Smith,1882)	1082-1192				15.4
*Para*penae*us longirostris* (Lucas, 1846)	288-840	93.3	57.7	10.5	
Sergestes arcticus Kröyer, 1855	700-1192			2.6	23.1
Sergestes arachnipodus (Cocco, 1832)	318-1171	2.2	5.8	10.5	46.2
Sergia robusta (S.I. Smith, 1882)	480-1192	2.2	23.1	63.2	84.6
Solenocera membranacea (Risso, 1816)	322-823	6.7	1.9	2.6	
Pleocyemata					
Anomura					
Munida intermedia A. Milne Edwards & Bouvier, 1899	328-503	11.1	1.9		
Munida rutllanti Zariquiey Alvarez, 1952	300-533	37.8	3.8		
Munida tenuimana G.O. Sars, 1872	518-518		1.9		
Astacidea					
Nephrops norvegicus (Linnaeus, 1758)	317-700	42.2	57.7	2.6	
Brachyura					
Bathynectes longipes (Risso, 1816)	620		1.9		
Bathynectes maravigna (Prestandrea, 1839)	322-1003	6.7	23.1	13.2	15.4
Calappa granulata (Linnaeus, 1758)	302-553	8.9	1.9		
Geryon longipes A. Milne Edwards, 1881	644-965		1.9	7.9	7.7
Macropipus tuberculatus (Roux, 1830)	343-462	11.1			
Macropodia longipes A. Milne Edwards & Bouvier, 1899	340-1003	2.2			7.7
Monodaeus couchii (Couch, 1851)	460-965	2.2	1.9		7.7
Paromola cuvieri (Risso, 1816)	597-742		7.7	2.6	
Parthenope macrochelos (Herbst, 1790)	302-582	11.1	1.9		
Caridea					
Acanthephyra eximia S.I. Smith, 1886	897-1047			2.6	38.5
Acanthephyra pelagica (Risso, 1816)	480-1192	2.2		15.8	61.5
Aegaeon lacazei (Gourret, 1887)	340-464	17.8			
Alpheus glaber (Olivi, 1792)	373	2.2			
Chlorotocus crassicornis (Costa, 1871)	300-614	35.6	3.8		
Pasiphaea multidentata Esmark, 1866	518-1171		9.6	28.9	53.8
Pasiphaea sivado (Risso, 1816)	377-1082	6.7	23.1	10.5	7.7
Philoceras echinulatus (M. Sars, 1861)	407	2.2			
Plesionika acanthonotus (Smith, 1882)	317-1047	13.3	86.5	44.7	30.8
Plesionika antigai Zariquiey Alvarez, 1955	288-700	77.8	34.6		
Plesionika edwardsii (Brandt, 1851)	305-700	35.6	23.1	2.6	
Plesionika gigliolii (Senna, 1903)	300-700	75.6	61.5		
Plesionika heterocarpus (Costa, 1871)	300-676	64.4	23.1		
Plesionika martia (A. Milne Edwards, 1883)	317-1085	15.6	100	65.8	15.4
Plesionika narval (Fabricius, 1787)	356	2.2			
Pontophilus norvegicus (M. Sars, 1861)	965				7.7
Pontophilus spinosus (Leach, 1815)	322-460	8.9			
Palinura					
Polycheles typhlops Heller, 1862	328-1171	17.8	98.1	92.1	76.9

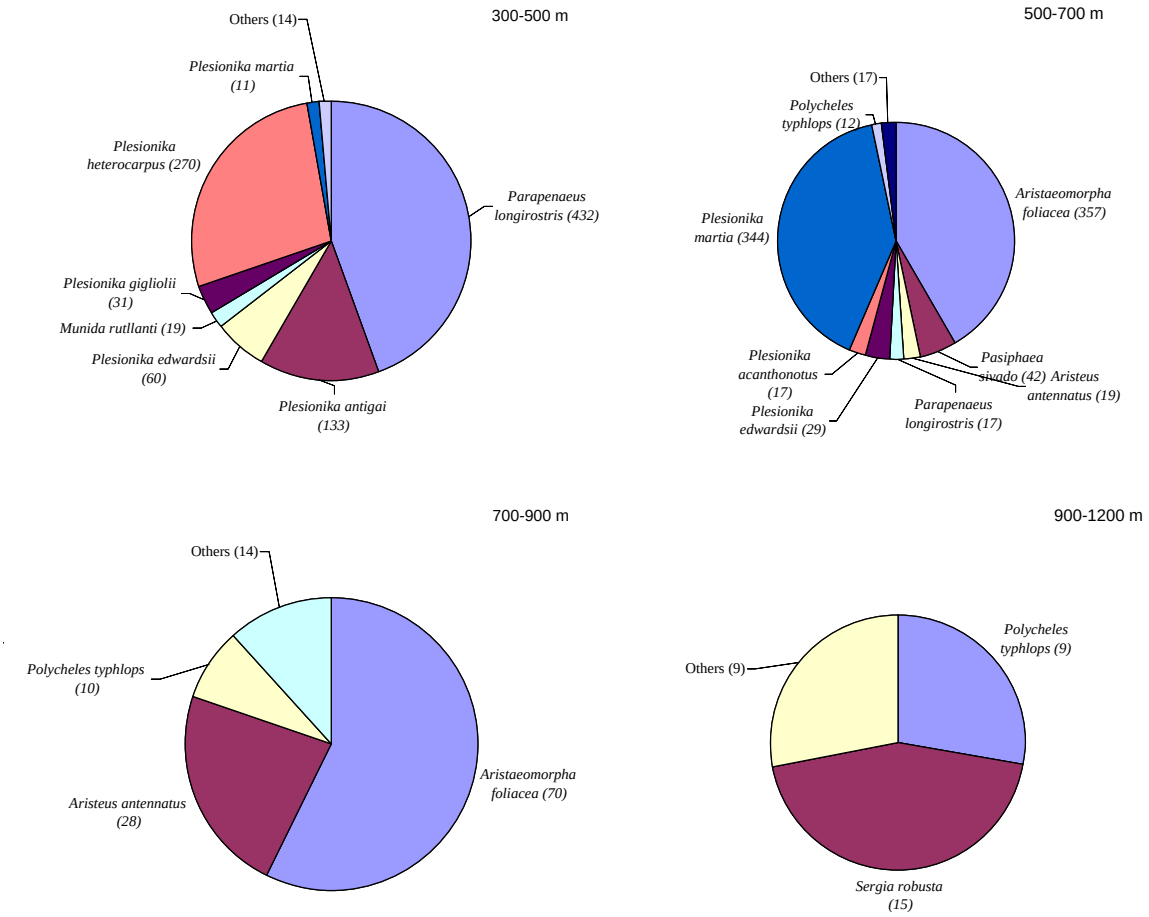

Fig. 2. – Relative abundance of decapod species per depth stratum in the E. Ionian Sea. In parenthesis the mean number of specimens caught per hour (CPUE) is given.

Although comparison of abundance with other studies is difficult, because of the different types of gear and methods used, the general fauna distribution is quite similar to that found in other Mediterranean areas (ABELLO et al., 1988 ; CARTES & SARDA, 1992, 1993 ; CARTES et al., 1994 ; UNGARO et al., 1999 ; ABELLO et al., 2002). A dominance of shrimps in all depth strata observed in the present study was mentioned also by POLITOU *et al.* (1998) for the slope of the region. In relation to the western Mediterranean, our results are more comparable with those of ABELLO et al. (1988), whose samples were collected with a commercial trawl. A high presence of small species, such as *Calocaris macandreae* Bell, 1864 and *Processa nouveli* Al-Adhub & Williamson, 1975, was mentioned by some authors (CARTES & SARDA, 1992 ; CARTES et al., 1994) for these depths in the Catalan Sea. These species were not found in the present study. This discrepancy can be explained by the smaller cod-end mesh size of the experimental trawl used in the former studies. Furthermore, although the species depth distribution observed in the present study was generally within the ranges given in the literature for the Mediterranean, in some cases new depth records were obtained (Table 2). More specifically, the distribution of the species *Aristaeomorpha foliacea, Bathynectes maravigna, Monodaeus couchii, Parapenaeus longirostris, Pasiphaea sivado, Plesionika antigai, Plesionika edwardsii* and *Plesionika martia* was extended into waters deeper than those reported for the Mediteranean. Concerning *Bathynectes longipes,* it is considered a scarce species (ABELLO et al., 2001) and no depth distribution ranges are given for it.

A remarkable difference between the Greek Ionian Sea and the westernmost areas of the Mediterranean is the high abundance of *A. foliacea* in the former area and its absence or scarcity in the latter ones. This difference may be explained by the vulnerability of this species to overfishing (ORSI RELINI & RELINI, 1985 ; MATARRESE et al., 1997) in combination with the fishing pressure exercised in the deep waters of the westernmost areas. Such pressure is negligible in the Greek Seas. Furthermore, different hydrological conditions (i.e. salinity and temperature) between areas are reported as factors affecting the distribution of the species along the Mediterranean (RELINI & ORSI RELINI, 1987 ; MURENU et al., 1994). *A. foliacea* is considered to prefer waters of relatively high salinity and temperature such as those of the E. Ionian Sea in comparison to the westernmost Mediterranean areas (THEOCHARIS et al., 1993 ; HOPKINS, 1985).

A decline in the number of decapod species and of their abundance with depth was evident in the Ionian Sea. This pattern was observed also in the western Mediterranean (CARTES & SARDA, 1992, 1993 ; CARTES, 1993). The upper part of the slope (300-700 m) was characterized by a relatively high number of species found in abundance. *Parapenaeus longirostris, Aristaeomorpha foliacea, Ple-*

sionika martia, P. heterocarpus, P. antigai and *P. edwardsii* were the species that displayed the highest abundance values, and most of them are of important commercial value. Below 700 m of depth, the number of species and mainly their abundance decreased sharply, although red shrimps (mainly *A. foliacea* and secondarily *A. antennatus*) were found in non negligible quantities in the zone 700-900 m. Given the relatively constant environmental conditions in these depths and the high oligotrophy of the area (STERGIOU et al., 1997), the main factor determining this reduction with depth seems to be the low trophic resource availability.

TABLE 2

Depth range of occurrence for decapod species in the Mediterranean updated with the results of the present study.

Species	Depth range (m)	
	Min	Max
Acanthephyra eximia	421 (ABELLO et al., 2002)	2261 (CARTES, 1993)
Acanthephyra pelagica	176 (ABELLO et al., 1988)	2261 (CARTES, 1993)
Aegaeon lacazei	13 (ABELLO et al., 1988)	1041 (CARTES, 1993)
Alpheus glaber	3 (ABELLO et al., 1988)	871 (ABELLO et al., 1988)
Aristaeomorpha foliacea	150 (MATARRESE et al., 1995)	1047 (present study)
Aristeus antennatus	150 (MATARRESE et al., 1995)	2200 (SARDÀ et al., 1994)
Bathynectes longipes	620 (present study)	
Bathynectes maravigna	245 (ABELLO et al., 2001)	1003 (present study)
Calappa granulata	25 (ABELLO et al., 2002)	712 (ABELLO et al., 2002)
Chlorotocus crassicornis	55 (ABELLO et al., 1988)	742 (PIPITONE & TUMBIOLO, 1993)
Gennadas elegans	250 (KOUKOURAS et al., 1997)	2261 (CARTES, 1993)
Geryon longipes	439 (ABELLO et al., 1988)	1895 (CARTES, 1993)
Macropipus tuberculatus	48 (ABELLO et al., 1988)	748 (ABELLO et al., 1988)
Macropodia longipes	18 (ABELLO et al., 1988)	748 (ABELLO et al., 1988)
Monodaeus couchii	44 (ABELLO et al., 2002)	965 (present study)
Munida intermedia	35 (ABELLO et al., 1988)	871 (ABELLO et al., 1988)
Munida rutllanti	40 (ABELLO et al., 2002)	587 (ABELLO et al., 2002)
Munida tenuimana	286 (ABELLO et al., 2002)	1899 (CARTES, 1993)
Nephrops norvegicus	58 (ABELLO et al., 2002)	871 (ABELLO et al., 1988)
Parapenaeus longirostris	26 (PIPITONE & TUMBIOLO, 1993)	840 (present study)
Paromola cuvieri	267 (PIPITONE & TUMBIOLO, 1993)	795 (PIPITONE & TUMBIOLO, 1993)
Parthenope macrochelos	20 (ABELLO et al., 1988)	655 (PIPITONE & TUMBIOLO, 1993)
Pasiphaea multidentata	128 (ABELLO et al., 1988)	2261 (CARTES, 1993)
Pasiphaea sivado	33 (ABELLO et al., 1988)	1082 (present study)
Philoceras echinulatus	55 (ABELLO et al., 1988)	871 (ABELLO et al., 1988)
Plesionika acanthonotus	141 (PIPITONE & TUMBIOLO, 1993)	1680 (CARTES, 1993)
Plesionika antigai	98 (ABELLO et al., 2002)	700 (present study)
Plesionika edwardsii	250 (GARCIA-RODRIGUEZ *et al*, 2000)	700 (present study)
Plesionika gigliolii	101 (ABELLO et al., 1988)	748 (ABELLO et al., 1988)
Plesionika heterocarpus	45 (ABELLO et al., 2002)	699 (ABELLO et al., 1988)
Plesionika martia	165 (ABELLO et al., 1998)	1085 (present study)
Plesionika narval	5 (THESSALOU-LEGAKI et al., 1989)	510 (POLITOU et al., 2000)
Polycheles typhlops	241 (ABELLO et al., 2002)	1927 (CARTES, 1993)
Pontophilus norvegicus	366 (ABELLO et al., 1998)	2261 (CARTES, 1993)
Pontophilus spinosus	69 (ABELLO et al., 2002)	871 (ABELLO et al., 1998)
Sergestes arachnipodus	279 (ABELLO et al., 2002)	1224 (CARTES, 1993)
Sergestes arcticus	160 (ABELLO et al., 2002)	2188 (CARTES, 1993)
Sergia robusta	220 (ABELLO et al., 1998)	2261 (CARTES, 1993)
Solenocera membranacea	3 (ABELLO et al., 1998)	871 (ABELLO et al., 1998)

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