

## RESEARCH ARTICLE

# Two new records paralarva in the Eastern Mediterranean (Cephalopods: Mollusca)

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### Abstract

In this study, cephalopod paralarvae from the Aegean Sea and eastern Mediterranean Sea were examined. Hamburg Plankton Net and zooplankton net (model WP-2) were used for sampling. Fourteen species were identified from 119 paralarval individuals; two of them (*Loligo vulgaris*, and *Octopus macropus*) are recorded for the first time from the Aegean Sea and eastern Mediterranean Sea. Comprising results of earlier relevant studies, number of paralarval and early juvenile stage of cephalopod species recorded in the Levant basin and Aegean Sea is now 23.

**Keywords:** Cephalopoda, paralarvae, distribution, Aegean Sea, Eastern Mediterranean

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### Introduction

Pelagic regions of the Aegean Sea and eastern Mediterranean are often regarded as “deserts”, because they are characterized by low primary productivity and low standing stock of zooplankton and nekton (Kocataş and Bilecik 1992). However, there are various seamounts and islands in this region which may provide productive environments with appropriate condition for all trophic levels of the marine food chain (Kocataş and Bilecik 1992). However, the Eastern Mediterranean is in a continuous dynamic of change with respect to the migrating species as a result of its connection to the Red Sea and Indian Ocean (Galil 2000).

Little is known about the paralarval cephalopods distribution in the eastern Mediterranean, although these active pelagic predators are a major nektonic group occurring in all pelagic system in the Mediterranean. They are essential elements of pelagic food chains (Piatkowski *et al.* 2001) and their distribution closely related to hydrographic conditions (Diekmann and Piatkowski 2002). The existing studies in the eastern Mediterranean in last hundred years (Degner 1925; Lefkadiou *et al.* 1999; Salman *et al.* 2003, Lefkadiou *et al.* 2005) are

quite limited. Therefore, both their paralarval lifestyles and their geographic and vertical distributions are very important for ecology of the species. Paralarval life types of cephalopods give information on both their ecology and related distribution of species (Boletzky 2003).

Early life-history dynamics of cephalopods in coastal systems are not clearly understood in the Aegean Sea and in the eastern Mediterranean. For example, mature individuals of *Scaevurgus unicolor* are found throughout the Mediterranean, however, larval form of the species was first reported from the Adriatic Sea and other parts of the Mediterranean by Bello (2004). This proved the lack of information on the distribution and developmental stages of cephalopod paralarvae and their early juveniles in the Mediterranean. Although there is some information given about the oceanic and pelagic species from Levantine Basin, the larval behavior of neritic species living in this region is not known exactly.

## **Materials and Methods**

Samples were collected by two different methods during R/V K. Piri Reis cruise. One of them was a series of pelagic samplings, carried on in Saros Bay in the northern Aegean Sea and Gökova Bay in the southern Aegean Sea within the framework of “An Investigation of Pelagic Ecosystems of Aegean Sea” project. Hamburg Plankton Net (HPN: Isaac-Kid, modified from mid-water trawl, Hydrobios) with 500 $\mu$  mesh size was used for the samplings, operating at 100, 300 and 600 m depths with oblique hauls. The depths were measured by Simrad Net Sounder depth sensor.

Paralarvae of several species were collected by another sampling method using vertical zooplankton net with vertical hauls at different dates between 1996 and 2004 in Aegean Sea and in the Mediterranean. Model WP-2 standard zooplankton net with 300  $\mu$  mesh size and 57 cm mouth opening was used between 1998 and 2004 (Figure 1).

Sampled materials were fixed in 4% formalin and after separation of species, measured micrometrically under a stereomicroscope, Olympus Model SZ61. Diagnostic features of the species were determined from drawings using taken photographs.

Samples were identified following Naef, (1923), Sweeney *et al.* (1992), Vecchione *et al.* (2001) and Diekman *et al.* (2002).

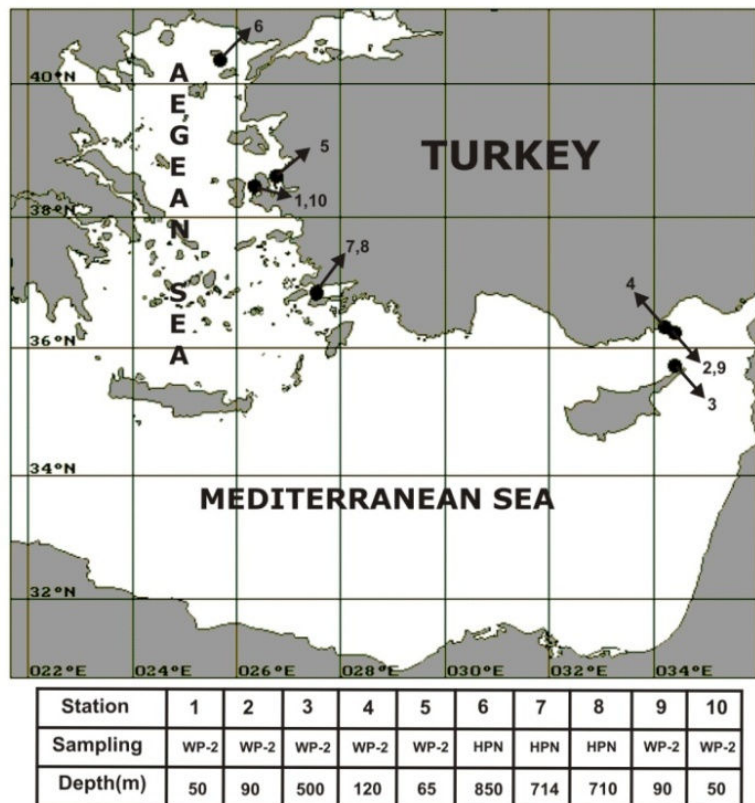


Figure 1. Sampling stations (WP-2: Zooplankton net HPN: Hamburg Plankton Net).

## Results

A total of 119 paralarval and juvenile individuals of cephalopods belonging to 14 species were found. Two of them (*Loligo vulgaris* and *Octopus macropus*) were reported for the first time from the Aegean Sea and eastern Mediterranean Sea (Table 1). Remarks on each species are given below following the systematic order of Sweeney and Roper (1998).

**Table 1.** The distribution of the early stage cephalopods in the eastern Mediterranean (S.M: Sea of Marmara; A.S: Aegean Sea; L.S: Levant Sea; C.M: Central Mediterranean).

Species		S.M	A.S.	L.S	C.M
<b>SEPIOLIDA</b>					
Sepiolidae	<i>Heteroteuthis dispar</i> (Rüppell, 1844)		1,2,3,5	1,5	1,4
	<i>Neorossia caroli</i> (Joubin, 1902)				4
<b>TEUTHIDA</b>					
Loliginidae	<i>Loligo vulgaris</i> Lamarck, 1798		5	5	
	<i>Loligo forbesi</i> Steenstrup, 1856				4
Enoploteuthidae	<i>Abraliopsis pfefferi</i> Joubin, 1896		1,5		1
	<i>Ancistrocheirus lesueurii</i> (Orbigny, 1839)		2,3		
	<i>Pyroteuthis margaritifera</i> (Rüppell, 1844)		2,3,4,5	1,5	1
Enoploteuthidae	<i>Pterygioteuthis giardi</i> Fischer, 1896				1

**Table 1 Continued.**

	<b>Species</b>	<b>S.M</b>	<b>A.S.</b>	<b>L.S</b>	<b>C.M</b>
Octopoteuthidae	<i>Octopoteuthis sicula</i> Rüppell, 1844			1	
Onychoteuthidae	<i>Onychoteuthis banksii</i> (Leach, 1817)		3,5	1	1
Histiototeuthidae	<i>Histiototeuthis bonnellii</i> (Férussac, 1835)		2,3		
	<i>Histiototeuthis reversa</i> (Veril, 1880)		2,3		
Chtenopterygidae	<i>Chtenopteryx sicula</i> (Verany, 1851)		3,5	1	1
Brachioteuthidae	<i>Brachioteuthis riisei</i> (Steenstrup, 1882)		3,5		
Ommastrephidae	<i>Illex coindetii</i> (Verany, 1839)		3,4,5		4
Thysanoteuthidae	<i>Thysanoteuthis rhombus</i> Troschel, 1857		3		1
Chiroteuthidae	<i>Chiroteuthis veranii</i> (Férussac, 1835)		2,3,5		1
Cranchiidae	<i>Galiteuthis armata</i> Joubin, 1898			1	1
<b>OCTOPODA</b>					
Octopodidae	<i>Octopus vulgaris</i> Cuvier, 1797	1	2,3,4,5		4
	<i>Octopus defilippi</i> Verany, 1851		5		
	<i>Octopus macropus</i> Risso, 1826		5		
	<i>Octopus salutii</i> Verany, 1839		2		
	<i>Pteroctopus tetracirrhus</i> (Dele Chiaje, 1830)		4		
	<i>Scaevargus unicolor</i> (Orbigny, 1834)		1,4,5		1
	<i>Eledone cirrhosa</i> (Lamarck, 1798)		1,3,4		1
Argonautidae	<i>Argonauta argo</i> Linnaeus, 1758		3	5	1

1: Degner (1925); 2: Lefkaditou *et al.* (1999); 3: Salman *et al.* (2003); 4: Lefkaditou *et al.* (2005); 5: Present study

### Order SEPIOLIDAE

#### Family SEPIOLIDAE

#### Sub Family SEPIOLINAE

#### *Sepietta sp.*

Two specimens (St.1, 5.3 mm ML; St.10, 1.5 mm ML) were found at 50 m in the Aegean Sea.

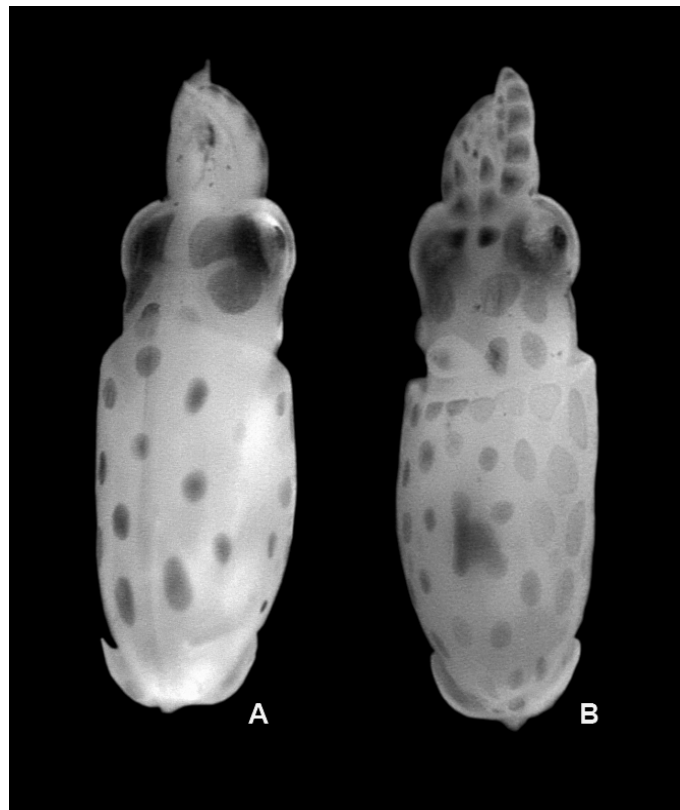
### Order TEUTHIDA

#### Suborder MYOPSINA

#### Family LOLIGINIDAE

#### *Loligo vulgaris* Lamarck, 1798

Two specimens of this species, one from the Aegean Sea (St. 8a. 2.3 mm ML), and two from (St.9, 2.8 mm ML) the eastern Mediterranean Sea coast of Turkey were found. A juvenile specimen of this species is being reported for the first time from the Aegean Sea and eastern Mediterranean (Figure 2).



**Figure 2.** *Loligo vulgaris* A:Dorsal view; B:Ventral view

Suborder OEGOPSINA

Family ENOPLOTEUTHIDAE

*Abraliopsis pfefferi* Joubin, 1896

One specimen (St.8c, 6.5 mm ML) was found at 650 m in the southern Aegean Sea. Two of the three photophores supposed to be in the ventral IV<sup>th</sup> arms of the species found were recognized very clearly (Figure 3).



**Figure 3.** Tip of arm IV photophores of *Abraliopsis pfefferi*

Family ONYCHOTEUTHIDAE

*Onychoteuthis banksii* (Leach, 1817)

Five specimens of this species were found in the southern Aegean Sea (St.8a, 3 indiv. 3.5-8.4 mm ML; St.8c, 2 indiv. 5.1-6.2 mm ML).

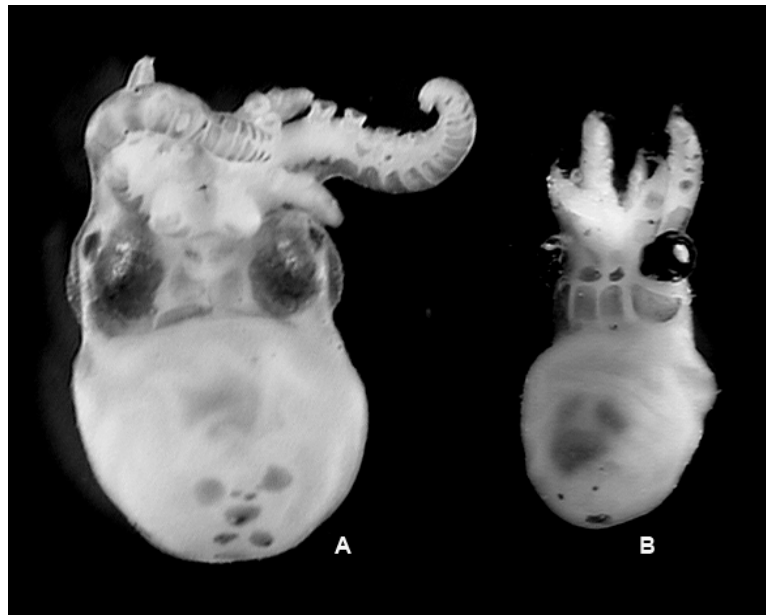
Order OCTOPODIDA

Suborder INCIRRINA

Family OCTOPODIDAE

*Octopus defilippi* (Verany, 1851)

Two specimens (St.8a, 3.0 mm ML; St 8b, 1 indiv 2.1 mm ML) were found at 100 and 300 m in the southern Aegean Sea; one with the mantle length of 2.1 mm and I,II,III, IV arms length were measured 0.5, 0.6, 1.1, 0.5 mm respectively. Another specimen was with 3.0 mm mantle length and I,II,III,IV arms measured as 0.6, 0.8, 1.3, 0.6 mm respectively (Figure 4).



**Figure 4.** *Octopus defilippi* A:Dorsal view 3 mm ML; B:Dorsal view 2.1 mm ML

*Octopus macropus* Risso,1826

Four specimens (St.8a, 2.9 mm ML; St.8b, 2 indiv.3.5-13.3 mm ML; St.8c, 16.7 mm ML) were found in the southern Aegean Sea. Paralarval and juvenile specimen of this species was reported for the first time from the Aegean Sea and Mediterranean. A total of seven longitudinal suckers were observed on the larvae of *O.macropus*. Dorsal and ventral chromatophore distributions on the larvae are shown in Figure 5 and Figure 6 shows the young individuals.



**Figure 5.** *Octopus macropus* A:Dorsal view; B:Ventral view.



**Figure 6.** Different view of *Octopus macropus* juvenile sampling.

*Scaeurghus uniccirrhus* (Orbigny, 1834)

Four specimens (St.7b, 2 indiv. 1.2-1.8 mm ML; St.8a, 1.7 mm ML; St.8b, 2.0 mm ML) were found in the Aegean Sea.

Family ARGONAUTIDAE

*Argonauta argo* Linnaeus, 1758

One specimen from the eastern Mediterranean (St.5, 0.7 mm ML).

## Discussion

In this study, paralarvae cephalopod species (*Loligo vulgaris* and *Octopus macropus*) are reported for the first time in the Aegean Sea and the eastern Mediterranean.

One of the two individuals of *Loligo vulgaris* was from the Aegean Coast with 2.3 mm ML, and the other from the Eastern Mediterranean coast with 2.8 mm ML. Recently, information on the early juvenile individuals of this species is very limited.

The average egg diameter in egg stalk of *L.vulgaris* was 2.7 mm and in newly hatched specimen mantle length measured 2.8 mm (unpublished data).

When mantle lengths and chromatophore patterns of newly hatched samples collected from the Aegean Sea and eastern Mediterranean were compared to the ones hatched in the laboratory (unpublished data) as part of our study, results showed similarities. This similarity was also observed by Sweeney *et al.* (1992).

In the present work, all the individuals of *Octopus macropus* were collected from the Southern Aegean Sea. Two individuals were at larval stage and the other two were at juvenile stage among the samples collected from the area. The individuals at the larval stage showed similarities in the ventral and dorsal chromatophore arrangement located on the mantle found also by Naef (1923; p 645, Fig 397) (Figure 6). Boletzky *et al.* (2001) reported that newly hatchlings are approximately 4.0 mm in size. The same researchers also mentioned that the size of the larvae may be less than 3.0 mm due to the preservation method applied such as formalin. In this study the juvenile individuals of 13.3 and 16.7 mm ML long were found at 300 and 500 m depths. They presented 11-13 outer demibranches. According to Mangold and Boletzky (1987), adults of *O. macropus* have 9-13 gill lamellas. According to Sweeney *et al.* (1992) *O. macropus* which has 15.0-20.0 mm dorsal mantle length can be found in the plankton (Figure 6). As a conclusion, findings of the present study on larvae and juveniles showed similarities to results found by other authors.

Degner (1925) reported Macrotritopus from the Ionian Sea as the larvae of *Scaevargus unicirrhus*. Later, Nesis and Nikitina (1981) found that the larvae of Macrotritopus belong to *Octopus defilippi*, not *S. unicirrhus*. After this report, Hanlon *et al.* (1985) reported that the species of *Octopus* generally known as macrotritopus, however, in reality, they belong to only one species of *Octopus* which is *O. defilippi*. In this case, the larvae mentioned as *S. unicirrhus* in Degner (1925) actually belonged to *O. defilippi*. In the present study, macrotritopus was identified as the larvae of *O. defilippi* for the first time in the Aegean Sea after 100 years (Figure 4).



As a conclusion, until now by the results of the studies on cephalopod larvae, a total of 26 species were determined in the eastern Mediterranean (Table 1). It is believed that more studies are needed to figure out the behavior of cephalopods early larval stages in the pelagic ecosystem of the Eastern Mediterranean, affected partially by the Red Sea.

## **Doğu Akdeniz için iki yeni kayıt paralarva (Mollusca: Cephalopod)**

### **Özet**

Bu çalışmada Ege Denizi ve Doğu Akdeniz'den cephalopodaya ait paralarvalar incelenmiştir. Örneklemelerde Hamburg Plankton kepçesi (HPN) ve WP-2 model zooplankton kepçesi kullanılmıştır. Örneklenen 119 adet bireye ait 14 adet tür tespit edilmiş olup, tespit edilen bu türler içerisinde *Loligo vulgaris*, ve *Octopus macropus* Ege Denizi ve Doğu Akdeniz'den ilk kez rapor edilmektedir. Sunulan bu çalışmanın sonuçlarını daha önceki çalışmalarla birleştirdiğimizde Ege Denizi ve Doğu Akdeniz'de bu güne kadar rapor edilen cephalopodalara ait paralarva ve erken juvenil safhaya ait tür sayısı 23 olarak tespit edilmiştir.

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