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RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

A checklist and some new records on the teuthofauna of Türkiye in the Northeastern Mediterranean Sea

Kuzeydoğu Akdeniz Türkiye teuthofaunası kontrol listesi ve bazı yeni kayıtlar

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Abstract: The cephalopod species observed in this study were caught during two concurrent projects on the demersal fisheries resources conducted along the coasts of Türkiye in the Northeastern Mediterranean Sea. The samples were collected by a bottom trawl at depths ranging from 50 to 800 meters, following the guidelines set by MEDITS (International Bottom Trawl Survey in the Mediterranean). Through the study, a total of 22 cephalopod species were determined. Among them, *Heteroteuthis dispar* (Rüppell, 1844), *Chiroteuthis veranii* (A. Férussac, 1834), *Onychoteuthis banksii* (Leach, 1817), *Octopus salutii* Vérany, 1839 are being reported first time in the Mediterranean coasts of Türkiye.

Keywords: Cephalopoda, distribution, Eastern Mediterranean, Turkish coasts

Öz: Bu çalışmada incelenen sefalopod türleri Akdeniz'in kuzeydoğusunda Türkiye'nin kıyılarındaki demersal balıkçılık kaynaklarına yönelik yapılan iki çalışmada yakalanmıştır. Örnekler, MEDITS (Akdeniz'de Uluslararası Dip Trolü Araştırmaları) tarafından belirlenen yönergeler izlenerek 50 ila 800 metre arasında değişen derinliklerde dip trolü ile toplanmıştır. Bu çalışmada 22 sefalopod türü tespit edilmiş olup bunlardan *Heteroteuthis dispar* (Rüppell, 1844), *Chiroteuthis veranii* (A. Férussac, 1834), *Onychoteuthis banksii* (Leach, 1817), *Octopus salutii* Vérany, 1839 Türkiye'nin Akdeniz kıyıları için ilk kez rapor edilmektedir.

Anahtar kelimeler: Cephalopoda, dağılım, Doğu Akdeniz, Türkiye kıyıları

INTRODUCTION

Cephalopods are one of the most preferred seafood by humans due to either their high-level nutritive characteristics or their tastes. Increasing populations of the countries are led to the import of seafood from abroad, and they are also placed in Turkish fish markets, both fresh and frozen. As per the data from FAO (2022), in 2014, humans captured nearly 5 million tonnes of cephalopods, which plays a role in the food web of the ocean ecosystem. Moreover, the importance of cephalopods in the marine food web is overmuch than being human food, and Clarke (1996) stated that the expected annual consumption of cephalopods by only cetaceans, except for the other known predators, such as fishes, seabirds, and seals, was between 120 and 320 million tonnes.

Cephalopod fauna of the Mediterranean Sea occupied 10% of the known species in the world, and most of the species were reported from the surrounding seas of Türkiye, excluding the Black Sea, in different studies (Katagan et al., 1993; Salman et al., 2002; Salman, 2015; 2016). Although taxonomic studies on the group are comparatively diverse in Turkish seas, studies on their stocks and fisheries productivity are limited. (Salman et al., 1997; Salman and Katagan, 2004; Dereli et al., 2021). Until now, faunistic observations on cephalopods were generally taken into fisheries studies using demersal trawl, a preferred sampling gear for many benthic and demersal cephalopod species (D'Onghia et al., 1992; Belcari and Sartor, 1993; Salman et al., 1997; Salman and Katagan, 2004; Dereli et al., 2021). To determine the pelagic cephalopod species and their paralarvae, however, Isaacs-Kidd Midwater Trawl (IKMT) (Roper, 1974), which has a mouth opening of 2-3 m or Hamburg Plankton Net (HPN) was mainly used (Salman et al., 2003).

Because some cephalopod species are difficult to catch through fishing operations or other sampling methods mentioned above, their ecological roles in the ecosystem are inferred from the feeding habits of their natural predators. Understanding the distribution of cephalopod species is crucial,

and one way to gain insight is by analyzing the beaks found in the stomachs of predator fishes or cetaceans. However, this data may not always be entirely accurate due to the prolonged stability of the beaks in the stomach from a few weeks to several months and the predator's ability speed to migrate (Xavier et al., 2011).

The various physicochemical conditions and ecology of the seas surrounding Türkiye led to notable differences in the distribution of cephalopod species. Furthermore, the scarcity of studies on cephalopod fauna and stock structures is one of the main reasons for the present uncertainty regarding their taxonomy and biology in the Turkish seas. This study aims to provide a clear understanding of the current state of the cephalopod fauna living on the Mediterranean coast of Türkiye.

MATERIALS AND METHODS

The cephalopod specimens were collected using a bottom trawl at 41 stations chosen between the locations of 36°25'85"N - 30°31'03"E and 36°40'20"N - 36°10'99"E on the Turkish Mediterranean coast (Figure 1). Approximately 450 trawl operations were succeeded at these stations with depths ranging from 50 to 800 m by *R/V Akdeniz Araştırma 1* between 2015 and 2022. All trawl haulings were performed according to the MEDITS (International Bottom Trawl Survey in the Mediterranean) (Anonymous, 2016; 2017)

Trawl operations were carried out only during the daytime, starting 30 minutes after sunrise and ending 30 minutes before sunset. The hauling duration was limited to 30 min at depths shallower than 200 m and extended to one hour at depths deeper than 200 m. Before each sampling, whether the bottom structure was suitable for the trawling operation was checked with Simrad EK 60 scientific echo-sounder. Simrad PX II sensors were used to monitor crucial information such as trawling depth and trawl mouth opening throughout every trawling process. Cephalopod specimens were fixed in a 10% formalin solution, according to Roper and Sweeney (1983). Identification of the cephalopod species belonging to Sepiolida, Teuthida and Octopoda orders in the study was made according to Jereb and Roper (2005), Jereb and Roper (2010) and Jereb et al. (2016) respectively. After identification, their mantle lengths were measured by a fish measuring board to the nearest 0.1 mm and relatively rare species were recorded at the ESFM (Ege University Faculty of Fisheries Museum) in the international coding system.

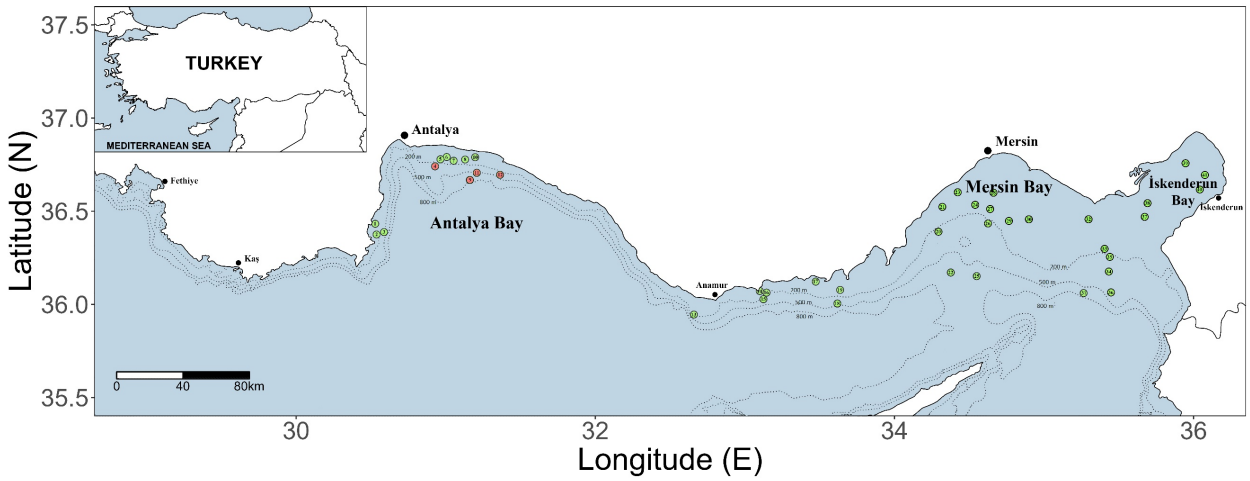

Figure 1. Trawling stations along the Mediterranean coast of Türkiye in the study- (The red colour stations in Antalya Bay indicated the locations for *Heteroteuthis dispar* (Sta. 4 and 11), *Chiroteuthis veranii* (Sta. 9), *Onychoteuthis banksii* (Sta. 11) and *Octopus salutii* (Sta. 12)).

RESULTS

A checklist of the cephalopods in the present study is given in Table 1. The columns about fish and cetaceans' stomachs could be considered a prediction of the species in the area due to the abovementioned reasons. During the present study, 22 cephalopod species were identified from the trawl compositions. From them, *Heteroteuthis dispar*, *Chiroteuthis veranii*, *Onychoteuthis banksii* and *Octopus salutii* were reported for the first time here with body morphological traits of the whole specimens, and all were caught in Antalya Bay (Figure 1).

The following species were recorded at the ESFM museum because of their rarity and obtaining difficulties;

Order: SEPIOLIDA

Family: SEPIOLIDAE

Heteroteuthis dispar (Rüppell, 1844)

Two specimens were recorded in Antalya Bay in 2017. One of them was sampled at 300 m depth (36°44'N-30°53'E) has a mantle length of 11 mm (ESFM-CEP-2017-006), and the other specimen from 560 m depth (36°39'N-31°13'E) has 19 mm mantle length (Figure 1; Sta. 4 and 11).

Table 1. Checklist of cephalopods in the Northeastern Mediterranean off Turkish coasts (T: Trawl; P: Plankton; ST-F: Stomach content of fishes; ST-M: Stomach content of mammals).

	Species	T	P	ST-F	ST-M
SEPIIDA					
Sepiidae	*Sepia officinalis* Linnaeus, 1758	2,5,6,8,**17**			
	Sepia elegans Blainville, 1827	5,6,8,**17**			
	Sepia orbignyana Férussac, 1826	6,**17**			
SEPIOLIDA					
Sepiolidae	*Heteroteuthis dispar* (Rüppell, 1844)	**17**		9,10	7,12
	Sepiola steenstrupiana Lévy, 1912	6			
	Rondeletiola minor (Naef, 1912)	6			
	Sepietta oweniana (d'Orbigny, 1841)	6,**17**			
	Sepietta neglecta Naef, 1916	6			
	Rossia macrosoma (Delle Chiaje, 1830)	6,**17**			
TEUTHIDA					
Loliginidae	*Loligo vulgaris* Lamarck, 1798	2,5,6,8,**17**	11		
	Loligo forbesii Steenstrup, 1856	6,**17**			
	Alloteuthis media (Linnaeus, 1758)	6,**17**			
	Alloteuthis subulata (Lamack, 1798)	6			
	Sepioteuthis lessoniana d'Orbigny, 1826	4			
Ancistrocheiridae	*Ancistrocheirus lesueurii* (d'Orbigny, 1842)			9	7,15,15
Brachioteuthidae	*Brachioteuthis riisei* (Steenstrup, 1882)				7,12,15
Chiroteuthidae	*Chiroteuthis veranii* (A. Férussac, 1834)	**17**		10	7,12,15
Chtenopterygidae	*Chtenopteryx sicula* (Vérany, 1851)			9	7,12
Enoploteuthidae	*Abralia veranyi* (Rüppell, 1844)	6, **17**			7,12
Histioteuthidae	*Histioteuthis bonnellii* (A. Férussac, 1835)				7,12,15
	Histioteuthis reversa (A. E. Verrill, 1880)	14,16,**17**		10	7,15
Octopoteuthidae	*Octopoteuthis sicula* Rüppell, 1844	13,**17**		10	7,12,15
Ommastrephidae	*Illex coindetii* (Vérany, 1839)	6,8,**17**		9	
	Todaropsis eblanae (Ball, 1841)	6,**17**		9	
	Todarodes sagittatus (Lamarck, 1798)	6,**17**		9,10	7
	Ommastrephes bartramii (Lesueur, 1821)	1		10	7
Onychoteuthidae	*Onychoteuthis banksii* (Leach, 1817)	**17**		9,10	7,12
	Ancistroteuthis lichtensteinii (A. Férussac [in A. Férussac & d'Orbigny], 1835)			10	12,15
Pyroteuthidae	*Pyroteuthis margaritifera* (Rüppell, 1844)	6, **17**		10	7,12,15
	Pterygioteuthis giardi H. Fischer, 1896			10	12
OCTOPODA					
Octopodidae	*Octopus vulgaris* Cuvier, 1797	2,5,6,8,**17**			
	Octopus salutii Vérany, 1839	**17**			
	Amphioctopus cf. aegina/kagoshimensis (Gray, 1849)	3,5,6			
	Callistoctopus macropus (Risso, 1826)	6,8			
	Macrotritopus defilippi (Vérany, 1851)	5,6			
	Pteroctopus tetracirrhus (Delle Chiaje, 1830)	6			
	Scaeurgus unicirrhus (Delle Chiaje [in Férussac & d'Orbigny], 1841)	6,**17**		10	
	Eledone cirrhosa (Lamarck, 1798)	8		10	
	Eledone moschata (Lamarck, 1798)	2,5,6,8,**17**			
Argonautidae	*Argonauta argo* Linnaeus, 1758			9,10	
Tremoctopodidae	*Tremoctopus violaceus* delle Chiaje, 1830			9,10	7
Total number of species by different sampling methods		**33**	**1**	**18**	**16**

1= Katagan et al. (1993); 2= Gücü and Bingel (1994); 3= Salman et al. (1999); 4= Salman (2002); 5= Duysak et al. (2004); 6= Salman and Katağan (2004); 7= Öztürk et al., (2007); 8= Duysak et al. (2008); 9= Karakulak et al. (2009); 10= Salman and Karakulak (2009); 11= Salman (2012); 12= Dede et al. (2016); 13= Jereb et al. (2016); 14= Gökoğlu et al. (2021); 15= Tonay et al. (2021); 16= Üstüner and Gökoğlu (2022); 17= Present study

Order: TEUTHIDA

Family: CHIROTEUTHIDAE

Chiroteuthis veranii (A. Férussac, 1834)

Two specimens were found in Antalya Bay (36°41'N-31°14'E) at 654 m depth in the Northeastern Mediterranean Sea during 2022 surveys. Only one has a whole body (ML= 64 mm) (ESFM-CEP-2022-001). Unfortunately, only the head of the second specimen was observed (Figure 1; Sta. 9)

Family: ENOPLOTEUTHIDAE

Abralia veranyi (Rüppell, 1844)

Five specimens were recorded in Antalya Bay (36°41'N-31°14'E) 2016 at 560 m depth. The mantle lengths of the specimens were between 45-52 mm (ESFM-CEP-2016-001). In addition, five juvenile specimens were observed in the same survey at 435 m depth (36°'42'N – 31°15'E) with mantle lengths between 11-25 mm. Also, in 2022, four specimens from Antalya Bay (36°41'N-31°14'E) were caught at 654 m depth mantle lengths ranging from 36 to 44 mm (ESFM-CEP-2022-002).

Family: HISTIOTEUTHIDAE

Histioteuthis reversa (A. E. Verrill, 1880)

Three specimens were recorded in 2015 and 2017. The first specimen Antalya Bay (36°41'N-31°07'E), at 600 m depth ML=89 mm (ESFM-CEP-2015-002), second specimen in Antalya Bay (36°39'N-31°05'E) at 560 m depth ML=27 mm (ESFM-CEP-2017-003) and last one from off Silifke coasts, in Mersin Bay (36°09'N-34°25'E) 620 m depth ML=26 mm (ESFM-CEP-2017-002)

Family: OCTOPOTEUTHIDAE

Octopoteuthis sicula Rüppell, 1844

One specimen was caught off Silifke coasts in Mersin Bay (36°09'N-34°23'E) at 650 m depth in the Northeastern Mediterranean Sea in 2017 (ML= 39 mm) (ESFM-CEP-2017-001).

Family: OMMASTREPHIDAE

Todaropsis eblanae (Ball, 1841)

One specimen was found in Antalya Bay (36°02'N-33°09'E) at 255 m depth in the northeastern Mediterranean Sea. (ML= 93 mm). No record number was given because the species already have specimens in EFSM.

Todarodes sagittatus (Lamarck, 1798)

Four specimens were found in Antalya Bay. Two of them (36°44'N-30°53'E) were caught at 440 m, has ML= 308-245 mm and others (36°39'N-31°05'E) were caught at 300 m has ML=227-229 mm. No record number was given because the species already have specimens in EFSM.

Family: ONYCHOTEUTHIDAE

Onychoteuthis banksii (Leach, 1817)

Two juvenile specimens were found in Antalya Bay (36°39'N-31°13'E), the Northeastern Mediterranean Sea at 560 m. (ML= 21 and 33 mm) (ESFM-CEP-2017-005) (Figure 1; Sta. 11).

Family: PYROTEUTHIDAE

Pyroteuthis margaritifera (Rüppell, 1844)

One specimen was found (36°39'N-31°05'E) at 560 m depth in Antalya Bay in 2016 (ML= 23 mm) (ESFM-CEP-2016-003).

Order: OCTOPODA

Family: OCTOPODIDAE

Octopus salutii Vérany, 1839

One specimen was found in Antalya Bay (36°41'N-31°21'E) at 300 m in the Northeastern Mediterranean Sea. (ML= 71 mm). No record number was given because the species already have specimens in EFSM (Figure 1; Sta.12).

Scaeurgus unicirrhus (Delle Chiaje [in Férussac & d'Orbigny], 1841)

One specimen was caught in Antalya Bay (36°43'N-31°09'E) at 440 m in 2017 (ML= 22 mm) (ESFM-CEP-2017-007).

DISCUSSION

Although faunistic cephalopod studies were mainly based on trawling operations in Turkish seas (Gücü and Bingel, 1994; Salman and Katağan, 2004; Duysak et al., 2004, 2008), some additional records were identified from paralarva and juvenile specimens in plankton samples (Salman, 2012). Besides that, cephalopod beaks could be seen in the stomachs of predatory fishes (Karakulak et al., 2009; Salman and Karakulak, 2009) and cetaceans (Öztürk et al., 2007; Dede et al., 2016; Tonay et al., 2021). However, these beaks could remain undigested in the stomachs of predators for nearly a few months, leading to inaccurately identifying the species' origin (Xavier et al., 2011). For this reason, more robust results of the faunistic studies on cephalopods are only being enabled by identifying the species using body morphological traits from specimens in the whole condition.

If we combine 22 cephalopod species observed in the study and the remaining 11 species from the other studies on the Mediterranean coasts of Türkiye, we could say that 33 species are distributed in the area, and that is roughly half of the known 67 species (Salman, 2015) in the Mediterranean basin. That also indicates that the faunistic studies in the area have been insufficient until now. If we consider the cephalopod beaks found in stomachs to represent the exact location of the species, the number could potentially increase to 41 (Table 1). In this context, however, four species namely, *Heteroteuthis dispar*, *Chiroteuthis veranii*, *Onychoteuthis banksii* and *Octopus salutii* were reported from their remaining beaks in the

stomach contents of fishes or cetaceans incidentally or in planned studies in the Northeastern Mediterranean before the present study, they have reported by the first time here with body morphological traits of the whole specimens.

On the other hand, the occurrence of planktonic cephalopod paralarva randomly once from zooplankton sampling in the past (Table 1) clearly shows that the knowledge on the ontogeny of these species almost none, and there were no planned studies conducted on the subject up to now. Also, the origin of the rare cephalopod species, such as reported by Gökoğlu et al. (2021) and Üstüner and Gökoğlu (2022), obtained from incidental catches of commercial trawling operations is another sign of that. Moreover, faunistic studies on the pelagic cephalopods and paralarvae were started by Degner (1925) and were followed by Roper (1974) and Salman (2012).

Consequently, cephalopods are primarily consumed by top predators in marine ecosystems, but they also provide a significant food source for humans. Despite their ecological and commercial importance, research on cephalopods has been insufficient, and systematic research on cephalopod ontogeny, both in the pelagic and deep sea, is needed to fill these knowledge gaps. Moreover, it is also be accounted fishery management and sustainability studies on commercially important species should be improved.

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AUTHORSHIP CONTRIBUTIONS

The first author was responsible for identifying the species, designing the manuscript, and writing. The second and third authors contributed to collecting the specimens in the field studies and manuscript editing. The last author was involved in the field studies and manuscript editing.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ETHICAL APPROVAL

No specific ethical approval was required for this study.

DATA AVAILABILITY

All relevant data is inside the article.

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