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**RESEARCH ARTICLE**

# Contribution to the knowledge on the zooplankton fauna of the Finike Seamounts, the eastern Mediterranean Sea

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**Abstract**

In this study, the zooplankton diversity in the Finike Seamounts, which has been declared as a Special Environmental Protection Area, was investigated. In total, 42 species were identified, of which *Pontella atlantica*, *Euchaeta spinosa, Phronima sedentaria*, *Oxycephalus piscator*, *Vibilia propinqua* and *Streetsia challengeri* were new records for the Turkish coast. The numbers of species identified in shallower coastal water was higher than those in the deeper offshore waters.

**Keywords:** Seamounts, Türkiye, zooplankton, Mediterranean

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## Introduction

Seamounts in the eastern Mediterranean are quite isolated from world oceans and are located in a region with extremely high temperatures in the deep water layers. The salinity and temperature of the deep-water layers in the Mediterranean increase from west to east because of the semi-enclosed nature, being in an arid region, high evaporation rate and little freshwater inflow (Hofrichter 2002). Minor nutrient input from rivers or the atmosphere, as well as the counter-estuary water body circulation, lead to reduction in productivity from the Strait of Gibraltar in the west to the coast of Asia Minor in the east (Turley 1999). The phytoplankton production in the east is three times lower than in the western basin (Turley *et al.* 2000). The eastern Mediterranean is extremely nutrient-poor and is considered an oligo- or ultraoligotrophic region (Powley *et al*. 2017). In this setting, deep Mediterranean waters are also poor in zooplankton abundance and diversity compared to the open ocean (Scotto di Carlo *et al*. 1991).

The Finike Seamounts, also known as the Anaximander Mountains, are the seabed elevations surrounded by the deep Rhodes Basin in the west, the outer part of the Antalya Basin in the east, and the Mediterranean Ridge in the south. From west to east, they consist of three elevations: Anaximander Mountain (*sensu stricto*), Anaximenes Mountain and Anaxagoras Mountain (Aksu *et al*. 2009). Of this region, 35 $km^2$ is within the 12-nautical miles territorial waters of Türkiye, and the rest is within the outer borders of the continental shelf. As this region hosts a special ecosystem due to the benthic and pelagic species it contains, it is important to study both the benthic and pelagic organisms to protect the biodiversity of the area. This region was declared as the "Finike Seamounts Special Environmental Protection Area" on 16 August 2013 by the Turkish government.

In a study conducted in the pelagic region above the Finike Seamounts, it was revealed that the zooplankton abundance and biomass were at a low level as in the open waters of the eastern Mediterranean, and the local increase of zooplankton biomass and abundance generally seen around seamounts was not observed in the region (Denda and Christiansen 2011).

Apart from those mentioned above, other studies, albeit limited in number, have been carried out in the research area. While the majority of these studies are on geological oceanography, tectonic and petrography, the region has also been examined from a biological point of view (Lampadariou *et al.* 2009; Öztürk 2009; Öztürk *et al.* 2010; Shank *et al.* 2011). Studies on zooplankton, however, are negligible.

Our main goal here was to improve our knowledge of the biodiversity of zooplankton in the area.

## Materials and Methods

Plankton samplings were carried out in the pelagic zone by RV YUNUS-S (Faculty of Aquatic Sciences, Istanbul University) in May and September 2021. Samples PKI-1 to PKI-10 and PKII-2 to PKII-5 were obtained from the surface with a plankton net, samples FKI-1, FKI-2, FKI-3, FKII-2, FKII-3 were obtained by vertical grabbing of the pelagic net and at a station coded with BT-2 a beam trawl was used (Figure 1 and Table 1). All stations were qualitatively sampled. Sampling durations were variable and the vertical plankton samples were collected from near bottom to surface. The plankton net had a mesh size of 300μ, 133cm in diameter and 280cm in length. The pelagic net consisted of two layers. The outer layer had a 1 cm mesh size, used to support the inner mesh. The inner mesh, on the other hand, had a very small mesh opening, called the zero mesh. Sampling dates, coordinates and depths are given in Table 1. The obtained samples were fixed with 40% formaldehyde solution and placed in plastic containers. In the laboratory, the samples were washed with tap water and stored in 70% ethanol after the examination.

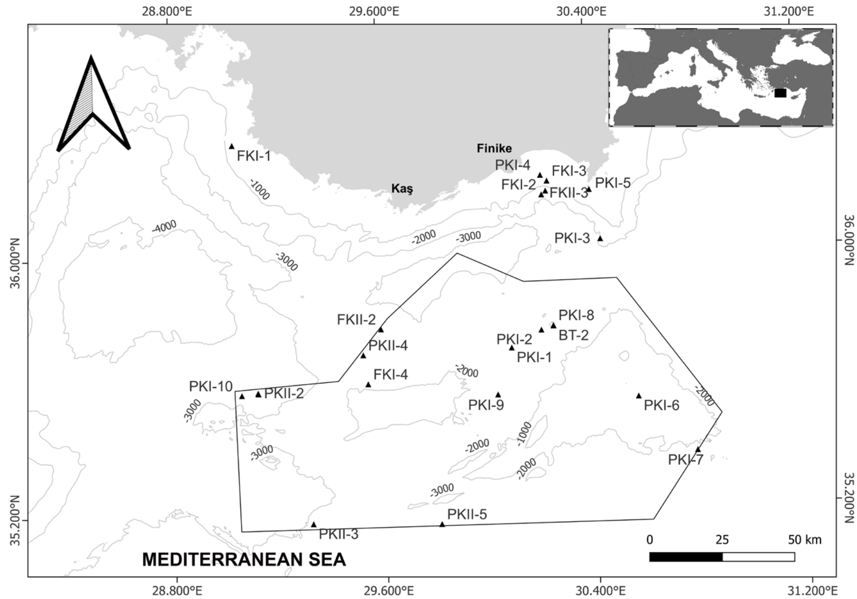


**Figure 1.** Sampling stations (Numbers are stations; Black line is Special Environmental Protection Area)

**Table 1.** List of the sampling stations

| Date | Stations | Coordinates | | Depth (m) |
|---|---|---|---|---|
| 14.05.2021 | PKI-1 | 35°42'17.34"N | 30°5'30.36"E | 2112 |
| 14.05.2021 | PKI-2 | 35°45'27.06"N | 30°12'24.96"E | 2102 |
| 14.05.2021 | PKI-3 | 36°2'6.90"N | 30°26'35.04"E | 1884 |
| 15.05.2021 | PKI-4 | 36°14'18.84"N | 30°13'14.46"E | 249 |
| 16.05.2021 | PKI-5 | 36°11'22.14"N | 30°24'23.04"E | 56 |
| 19.05.2021 | PKI-6 | 35°32'32.40"N | 30°34'8.40"E | 1422 |
| 19.05.2021 | PKI-7 | 35°22'8.40"N | 30°47'9.72"E | 2063 |
| 20.05.2021 | PKI-8 | 35°46'14.40"N | 30°15'12.60"E | 2029 |
| 24.05.2021 | PKI-9 | 35°33'37.08"N | 30°2'3.42"E | 2046 |
| 25.05.2021 | PKI-10 | 35°34'32.04"N | 29°3'33.39"E | 3399 |
| 18.09.2021 | PKII-2 | 35°34'47.39"N | 29°7'22.43"E | 3277 |
| 25.09.2021 | PKII-3 | 35°10'19.98"N | 29°19'15.60"E | 2960 |
| 25.09.2021 | PKII-4 | 35°41'37.40"N | 29°31'30.21"E | 2363 |
| 26.09.2021 | PKII-5 | 35°9'45.06"N | 29°48'27.12"E | 2701 |
| 11.05.2021 | FKI-1 | 36°21'14.40"N | 29°2'23.88"E | 625 |
| 12.05.2021 | FKI-2 | 36°10'39.78"N | 30°13'23.04"E | 1678 |
| 15.05.2021 | FKI-3 | 36°13'11.64"N | 30°14'43.02"E | 514 |
| 25.09.2021 | FKII-2 | 35°46'22.38"N | 29°35'42.06"E | 2736 |
| 28.09.2021 | FKII-3 | 36°11'20.40"N | 30°14'20.10"E | 1305 |
| 19.05.2021 | BT-2 | 35°46'8.52"N | 30°15'12.72"E | 1800 |

## Results and Discussion

As a result of the examination of the collected samples, 42 planktonic species were identified (Table 2). Most of the species belong to the orders Amphipoda and Calanoida. Decapoda, Cnidaria and Stomatopoda orders were represented by several species (Figure 2). However, this was not a surprising result because these two groups, Amphipoda and Calanoida, are generally the dominant groups in studies conducted in the eastern Mediterranean Sea (Kovalev *et al.* 2001; Nowaczyk *et al.* 2011; Kurt and Polat 2013; Heneash 2015; Terbıyık Kurt and Polat 2015). Nowaczyk *et al.* (2011) found that copepods accounted for 90% of the total abundance, and stated that especially four taxa, namely *Clausocalanus* / *Paracalanus* spp., *Oithona* spp., *Oncaea* spp. and *Macrosetella* / *Microsetella* spp., make up 80% of the copepod population in the eastern Mediterranean. Heneash (2015) stated in his study in El Dekhaila Harbour in Egypt that copepods constitute 46% of the total zooplankton population, and Calanoida comes in the third place after Cyclopoida and Harpacticoida. However, in our study, Calanoida was the most dominant group in the copepod community (Figures 3 and 4). Denda and Christiansen (2011) also reported that the Calanoida group includes the most abundant species in the entire water column in the Finike Seamounts area.

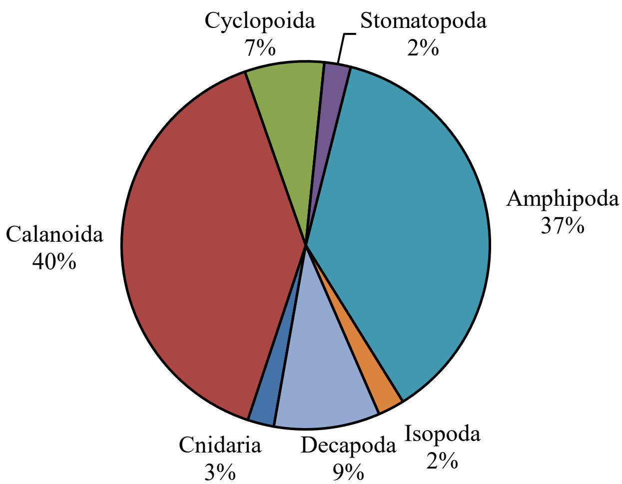


**Figure 2.** The proportions of taxa identified in the Finike Seamounts area

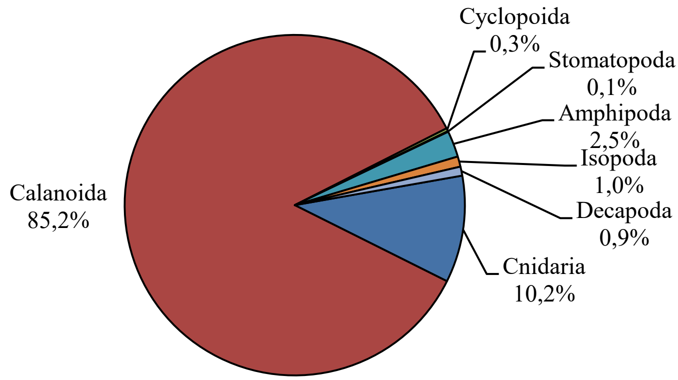


**Figure 3.** The proportions of number of individuals identified as each taxon group in the Finike Seamounts area

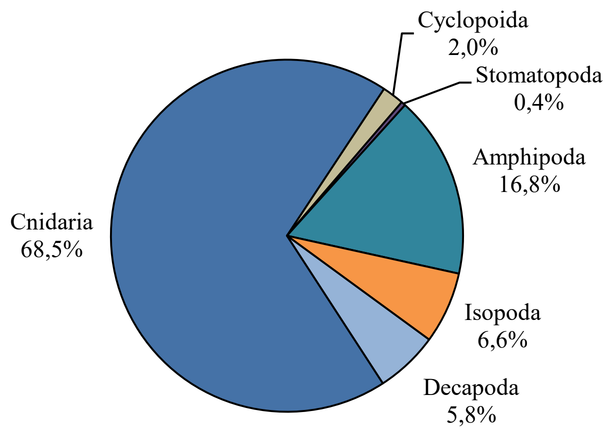


**Figure 4.** The proportions of number of individuals identified as each taxon group except for Calanoida in the Finike Seamounts area

When the numbers of species and individuals in the samples were examined, it appeared that there were differences between stations (Figure 5). The number of species in stations with shallower depths and closer to the shore (such as Stations PKI-3, PKI-5, and FKI-1) is higher than in other stations. This is in contrast with the findings of Denda and Christiansen (2011) who revealed that the topographic structure of the Finike Seamounts does not affect the distribution of the zooplankton community in the Levantine Basin. On the other hand, in some stations, the increase in the number of individuals is noteworthy. In a study on copepods, it is known that the average annual abundance decreased from the coastal zone to the shelf and the offshore zone (Zakaria *et al.* 2016).

**Table 2.** List of species and individual numbers at sampling stations in the Finike Seamouts area (*new records for Turkish seas)

| | Stations | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PKI-1 | PKI-2 | PKI-3 | PKI-4 | PKI-5 | PKI-6 | PKI-7 | PKI-8 | PKI-9 | PKI-10 | PKII-3 | PKII-2 | PKII-5 | PKII-4 | FKI-1 | FKI-3 | FKI-2 | FKII-2 | FKII-3 | BT-2 |
| **CNIDARIA** | | | | | | | | | | | | | | | | | | | | |
| Cnidaria (sp.) | | | 3 | | 270 | | | | | | | | | | 57 | 13 | | | | |
| **CALANOIDA** | | | | | | | | | | | | | | | | | | | | |
| *Temora stylifera* (Dana, 1849) | | 3 | 1356 | 8 | 216 | | | | | | | | | 13 | | | | | | |
| *Centropages furcatus* (Dana, 1849) | | 1 | | | 1 | | | | | | | | 1 | 2 | | | | | | |
| *Centropages kroyeri* Giesbrecht, 1893 | | | | 1 | 5 | | | | | | | | | | | | | | | |
| *Centropages violaceus* (Claus, 1863) | | | 3 | | | | | | | | | | | | | | | | | |
| *Pleuromamma abdominalis* (Lubbock, 1856) | | | | | | | | | | | | | | | | | 1 | | | |
| *Candacia ethiopica* (Dana, 1849) | | 1 | | | 1 | | | | | | | | | | | | | | | |
| *Euchaeta marina* (Prestandrea, 1833) | | | | | | 1 | | | | | | | | | | | 3 | | | |
| *Euchaeta spinosa* Giesbrecht, 1893* | | | | | | | | | | | | | | | | | 1 | | 1 | |
| *Arietellus setosus* Giesbrecht, 1893 | | | | | | | | | | | | | | | 1 | | | | | |
| *Pontellina plumata* (Dana, 1849) | | | 2 | | | | | | | | | | | | | | | | | |
| *Euchirella messienensis* (Claus, 1863) | | | | | | | | | | | | | | | | | 4 | 1 | 2 | |

**Table 2.** Continued

| | Stations | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PKI-1 | PKI-2 | PKI-3 | PKI-4 | PKI-5 | PKI-6 | PKI-7 | PKI-8 | PKI-9 | PKI-10 | PKII-3 | PKII-2 | PKII-5 | PKII-4 | FKI-1 | FKI-3 | FKI-2 | FKII-2 | FKII-3 | BT-2 |
| *Pontella atlantica* (Milne Edwards, 1840) * | | 3 | 17 | 1 | | | | | 1 | | | | | 1 | | | | | | |
| *Pontella mediterranea* (Claus, 1863) | | 61 | 100 | 22 | | 209 | | 36 | 15 | 3 | 3 | 8 | 35 | 17 | 37 | | | | | |
| *Pontellopsis villosa* Brady, 1883 | | 7 | 17 | 2 | | 8 | 1 | 1 | 4 | | | 2 | 3 | 2 | 3 | | | | | |
| *Pontellopsis regalis* (Dana, 1849) | | | 3 | | | | | | | | | | | | | | | | | |
| *Labidocera pavo* Giesbrecht, 1889 | | | | | | | | | | | 1 | 2 | 7 | 610 | | | | | | |
| *Calanopia elliptica* (Dana, 1849) | | | | | | | | | | | | | | 7 | | | | | | |
| **CYCLOPOIDA** | | | | | | | | | | | | | | | | | | | | |
| *Corycaeus clausi* Dahl F., 1894 | | | | | 1 | | | | | | | | 1 | 5 | | | | | | |
| *Agetus flaccus* (Giesbrecht, 1891) | | | | | 2 | | | | | | | | | | | | | | | |
| *Sapphirina metallina* Dana, 1849 | | | | | 1 | | | | | | | | | | | | | | | |
| **STOMATOPODA** | | | | | | | | | | | | | | | | | | | | |
| Stomatopod (sp.) | | | 2 | | | | | | | | | | | | | | | | | |
| **AMPHIPODA** | | | | | | | | | | | | | | | | | | | | |
| *Anchylomera blossevillei* H. Milne Edwrads, 1830 | 2 | | 1 | | 3 | 1 | | | | | | | | | 3 | | 2 | | 10 | |
| *Phronima sedentaria* (Forskal, 1775) * | | | | | | | | | | | | | | | 7 | 3 | | 2 | | |

**Table 2.** Continued

| | Stations | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PKI-1 | PKI-2 | PKI-3 | PKI-4 | PKI-5 | PKI-6 | PKI-7 | PKI-8 | PKI-9 | PKI-10 | PKII-3 | PKII-2 | PKII-5 | PKII-4 | FKI-1 | FKI-3 | FKI-2 | FKII-2 | FKII-3 | BT-2 |
| *Phrosina semilunata* Risso, 1822 | | | | | 18 | | | | | | | | | | 1 | 3 | | 1 | 1 | |
| *Paraphronima crassipes* Claus, 1879 | | | | | | | | | | | | | | | | 1 | | | | |
| *Platyscelus ovoides* (Risso, 1816) | | | | | | | | | | | | | | | 1 | 4 | | | | |
| *Platyscelus serratulus* Stebbing, 1888 | | | | | 2 | | | | | | | | | | | | | | | |
| *Lycaeopsis themistoides* Claus, 1879 | | | | | 8 | | | | | | | | | | | | | | | |
| *Primno latreillei* Stebbing, 1888 | | | | | 3 | | | | | | | | | | | | | | | |
| *Lycaea pulex* Marion, 1874 | | | | | 1 | | | | | | | | | | | | | | | |
| *Paralycaea gracilis* Claus, 1879 | | | | | | | | | | | | | | | 1 | | | | | |
| *Brachyscelus crusculum* Spence Bate, 1861 | | | | | | | | | | | | | | | | | | | 1 | |
| *Oxycephalus piscator* H. Milne Edwards, 1830* | | | | | | | | | | | | | | | 1 | | | | | |
| *Vibilia propinqua* Stebbing, 1888* | 1 | | | | | | | | | | | | | | | | | | | |
| *Streetsia challengeri* Stebbing, 1888* | | | | | | | | | | | | | | | | | | | | 1 |
| *Scina* sp. | | | | | | | | | | | | | | | | | 1 | | | |

**Table 2.** Continued

| | Stations | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PKI-1 | PKI-2 | PKI-3 | PKI-4 | PKI-5 | PKI-6 | PKI-7 | PKI-8 | PKI-9 | PKI-10 | PKII-3 | PKII-2 | PKII-5 | PKII-4 | FKI-1 | FKI-3 | FKI-2 | FKII-2 | FKII-3 | BT-2 |
| **ISOPODA** | | | | | | | | | | | | | | | | | | | | |
| *Idotea metallica* Bosc, 1802 | | 1 | 23 | | | | 3 | 2 | 1 | 1 | | | | | 2 | | | | | |
| **DECAPODA** | | | | | | | | | | | | | | | | | | | | |
| *Lucifer typus* H. Milne Edwards, 1837 | | | | | 7 | | | | | | | | | | | | 2 | | | |
| Natantia (sp.) | | | | | 1 | | | | | | 1 | | | | | 2 | | | | |
| Brachyura (sp.) | | | 1 | | | 1 | | | | | | | | 13 | | | | | | |
| Pyllosoma (sp.) | | | | | | | | | | | | | | | | | 1 | | | |

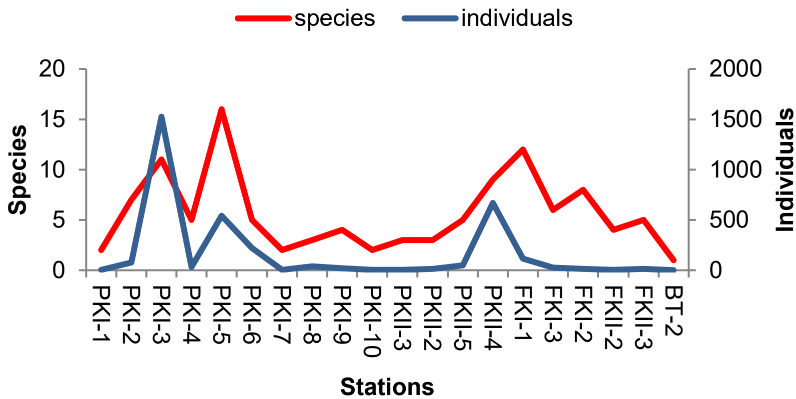


**Figure 5.** The variation of the number of species and individuals of the stations in the Finike Seamounts area

When the stations are examined in terms of similarity, grouping was observed (Figure 6). In the group, which is shown in green, the stations were 65% similar of each other due to the presence of *Pontella mediterranea*, *Pontellopsis villosa* and *Idotea metallica*. The group shown in orange also includes *Pontella mediterranea* and *Pontellopsis villosa*, but the major cause of separation from the other group is the existence of *Pontella atlantica* and *Temora stylifera*. The most important contribution to the formation of the group shown in blue is *Labidocera pavo* which was not found in other stations. The low similarity values of stations FKI-1, FKI-2, FKI-3, FKII-2, FKII-3 were due to the use of the pelagic net as a sampling tool at these points. In addition, the similarity of beam trawl station to other stations was 0%. This was because only one individual belonging to the genus *Scina* sp. was caught.

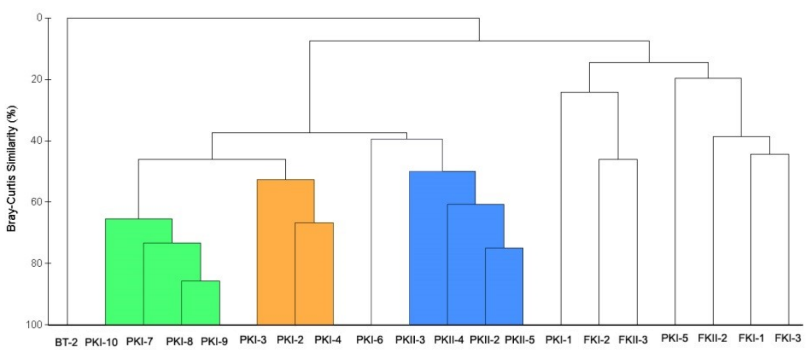


**Figure 6.** The dendrogram showed the Bray-Curtis similarity of the stations in terms of zooplankton diversity

The species identified in the study are generally known and previously reported from the waters of the eastern Mediterranean and Türkiye. However, *Pontella atlantica* and *Euchaeta spinosa*, which were previously detected in the studies performed in the Lebanese coasts in the eastern Mediterranean belonging to the order Calanoida (Lakkis 2011), are new records for the Turkish coasts. In addition, *Phronima sedentaria*, *Oxycephalus piscator*, *Vibilia propinqua* and *Streetsia challengeri* belonging to the order Amphipoda are also new records for Turkish seas (Figure 7). The biodiversity and plankton community of the Finike Seamounts will certainly be elucidated in a finer scale with vertical plankton sampling through the water column to be carried out in the future.

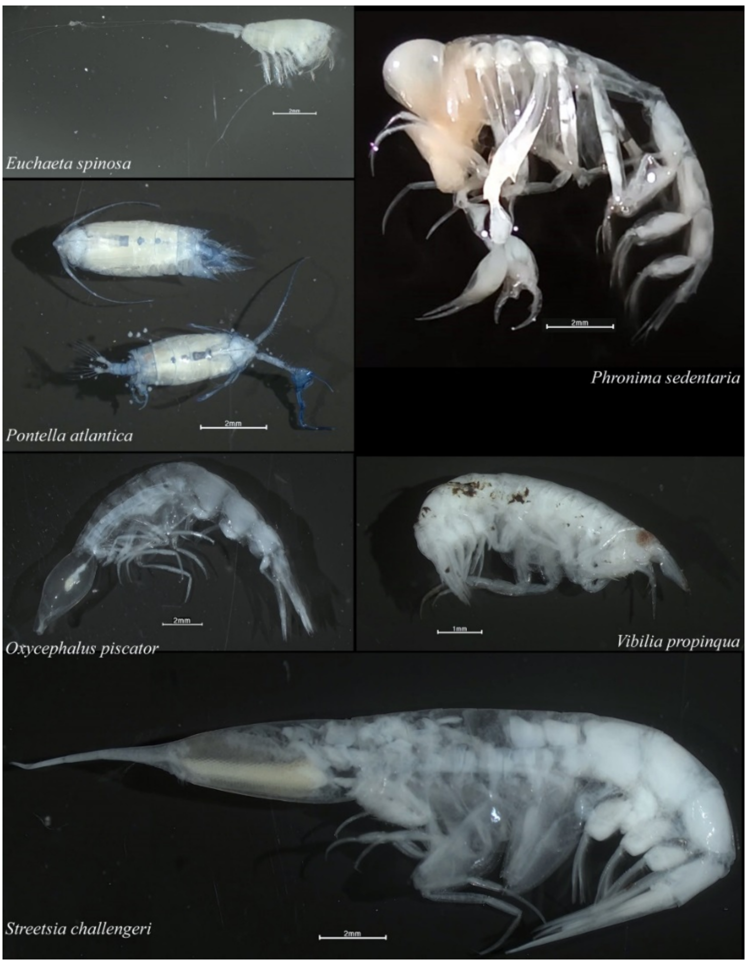


**Figure 7.** Photographs of the species recorded newly for Turkish seas

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# Finike Deniz Dağlarının zooplankton faunasına katkılar

**Öz**

Bu çalışmada, Özel Çevre Koruma Bölgesi olarak kabul edilen Finike Denizaltı Dağları (Doğu Akdeniz) civarındaki zooplankton çeşitliliği araştırılmıştır. Örneklerde 42 tür tespit edilmiştir. Bu türlerden *Pontella atlantica*, *Euchaeta spinosa*, *Phronima sedentaria*, *Oxycephalus piscator*, *Vibilia propinqua* ve *Streetsia challengeri* Türkiye kıyıları için yeni kayıtlardır. Daha sığ ve kıyıya yakın istasyonlarda tür sayısı diğer istasyonlara göre daha fazladır. Bölge faunasına katkı sağlamak için gelecekte daha detaylı örneklemelerin yapılması gerektiği sonucuna varılmıştır.

**Anahtar kelimeler:** Deniz dağları, Türkiye, zooplankton, Akdeniz

## References

Aksu, A.E., Hall, J., Yaltırak, C. (2009) Miocene–Recent evolution of Anaximander Mountains and Finike Basin at the junction of Hellenic and Cyprus Arcs, eastern Mediterranean. *Marine Geology* 258: 24-47.

Denda, A., Christiansen, B. (2011) Zooplankton at a seamount in the eastern Mediterranean: distribution and trophic interactions. *Journal of the Marine Biological Association of the United Kingdom* 91(1): 33-49.

Heneash, A.M.M. (2015) Zooplankton composition and distribution in a stressed environment (El Dekhaila Harbour), South-Eastern Mediterranean Sea, Egypt. *International Journal of Advanced Research in Biological Sciences* 2(11): 39-51.

Hofrichter, R. (2002) Das Mittelmeer: Fauna, Flora, Ökologie. Akademischer Verlag, Heidelberg and Berlin.

Kovalev, A., Mazzocchi, M., Toklu Alıçlı, B., Skryabın, V., Kıdeyş, A.E. (2001) Seasonal changes in the composition and abundance of zooplankton in the Seas of the Mediterranean Basin. *Mediterranean Marine Science* 2(1): 69-77.

Kurt, T.T., Polat, S. (2013) Seasonal distribution of coastal mesozooplankton community in relation to the environmental factors in Iskenderun Bay (north-east Levantine, Mediterranean Sea). *Journal of the Marine Biological Association of the United Kingdom* 93(5): 1163-1174.

Lakkis, S. (2011) Le Zooplancton Marin du Liban (Méditerranée orientale): Biologie, Biodiversité, Biogéographie. Publ. Université Libanaise, Beirut, Lebanon, No 23.

Lampadariou, N., Tselepides, A., Hatziyanni, E. (2009) Deep-sea meiofaunal and foraminiferal communities along a gradient of primary productivity in the eastern Mediterranean Sea. *Scientia Marina* 73(2): 337-345.

Nowaczyk, A., Carlotti, F., Thibault-Botha, D., Pagano, M. (2011) Distribution of epipelagic metazooplankton across the Mediterranean Sea during the summer BOUM cruise. *Biogeosciences* 8: 2159-2177.

Öztürk, B. (2009) Marine protected areas in the high seas of the Aegean and Eastern Mediterranean Seas, some proposals. *Journal of the Black Sea/Mediterranean Environment* 15: 69-82.

Öztürk, B., Topcu, E.N., Topaloglu, B. (2010) A preliminary study on two seamounts in the eastern Mediterranean Sea. *Rapports de la Commission Internationale pour L'Exploration Scientifique de la Mer Mediterranee* 39: 682.

Powley, H.R., Cappellen, P.V., Krom, M.D. (2017) Nutrient cycling in the Mediterranean Sea: the key to understanding how the unique marine ecosystem functions and responds to anthropogenic pressures. In: Mediterranean Identities - Environment, Society, Culture, (ed., Fuerst-Bjelis, B.), IntechOpen, London. https://doi.org/10.5772/66587

Scotto di Carlo, B., Ianora, A., Mazzochi, M.G., Scardi, M. (1991) Atlantis II Cruise: uniformity of deep copepod assemblages in the Mediterranean Sea. *Journal of Plankton Research* 13: 263-277.

Shank, T.M., Herrera, S., Cho, W., Roman, C.N., Bell, K.L.C. (2011) Exploration of the Anaximander mud volcanoes. In: New Frontiers in Ocean Exploration: The E/V Nautilus 2010 Field Season, (eds., Bell, K.L.C., Fuller, S.A.). *Oceanography* 24(1): 22-23.

Terbıyık Kurt, T., Polat, S. (2015) Zooplankton abundance, biomass, and size structure in the coastal waters of the northeastern Mediterranean Sea. *Turkish Journal of Zoology* 39(3): 378-387.

Turley, C.M. (1999) The changing Mediterranean Sea - a sensitive ecosystem? *Progress in Oceanography* 44: 387-400.

Turley, C.M., Bianchi, M., Christaki, U., Conan, P., Harris, J.R.W., Psarra, S., Ruddy, G., Stutt, E.D., Tselepides, A., Van Wambecke, F. (2000) Relationship between primary producers and bacteria in an oligotrophic sea - the

Mediterranean and biogeochemical implications. *Marine Ecology Progress Series* 193: 11-18.

Zakaria, H.Y., Hassan, A.M., Abo-Senna, F.M., El-Naggar, H.A. (2016) Abundance, distribution, diversity and zoogeography of epipelagic copepods off the Egyptian Coast (Mediterranean Sea). *Egyptian Journal of Aquatic Research* 42: 459-473.