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Interstitial and Phytal Harpacticoid (Copepoda, Harpacticoida) Fauna of the Mediolittoral Zone of the Biga Peninsula (Çanakkale, Turkey)

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Abstract

In this study, interstitial and phytal harpacticoid copepods distributed along the mediolittoral zone of the Biga Peninsula were investigated. The samplings were made from 26 different stations seasonally between April - 2016, February - 2017. As a result, 73 species and subspecies belonging to 46 genera within 17 families were identified. In addition, 4 genera (*Troglophonte, Psammastacus, Stereoxiphos and Pteropsyllus*) and 20 species/subspecies (*Ameira divagans, Ameira reducta, Filexilia intermedia, Nitokra sewelli, Noodtiella enertha, Noodtiella intermedia, Noodtiella wellsi, Glabrotelson* sp., *Asellopsis intermedia, Echinolaophonte minuta, Heterolaophonte brevipes, Klieonychocamptus klei confluens, Troglophonte* sp., *Psammastacus confluens, Stereoxiphos operculatus, Schizopera minuta, Emertonia constricta orotavae, Thalestrella* sp., *Phyllopodopsyllus berrieri* and *Pteropsyllus plebeius furcatus*) are new records for the Turkish fauna. Besides, all identified taxa are new records for the Biga Peninsula.

Keywords: New record; Biodiversity; Meiofauna; Aegean Sea; Sea of Marmara.

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Biga Yarımadası (Çanakkale, Türkiye) Mediolitoral Bölgesinin Kumiçi ve Fital Harpacticoid (Copepoda, Harpacticoida) Faunası

Öz

Bu çalışmada, Biga Yarımadası'nın mediolitoral bölgesinde yayılış gösteren kumiçi ve fital harpaktikoid kopepodlar incelenmiştir. Örneklemeler Nisan – 2016, Şubat – 2017 tarihleri arasında 26 farklı istasyondan mevsimsel olarak yapılmıştır. Bu çalışma sonucunda 17 familya içerisinde 46 cinse ait 73 tür ve alttür tespit edilmiştir. Ek olarak 4 cins (*Troglophonte*, *Psammastacus*, *Stereoxiphos* ve *Pteropsyllus*) ve 20 tür/alttür (*Ameira divagans, Ameira reducta, Filexilia intermedia, Nitokra sewelli, Noodtiella enertha, Noodtiella intermedia, Noodtiella wellsi, Glabrotelson* sp.*, Asellopsis intermedia, Echinolaophonte minuta, Heterolaophonte brevipes, Klieonychocamptus klei confluens, Troglophonte* sp., *Psammastacus confluens, Stereoxiphos operculatus, Schizopera minuta, Emertonia constricta orotavae, Thalestrella* sp.*, Phyllopodopsyllus berrieri* ve *Pteropsyllus plebeius furcatus*) Türkiye faunası için yeni kayıttır. Ayrıca tespit edilen tüm taksonlar Biga Yarımadası için de yeni kayıt niteliğindedir.

Anahtar Kelimeler: Yeni Kayıt; Biyoçeşitlilik; Meiofauna; Ege Denizi; Marmara Denizi.

1. Introduction

The purpose of classification is to reveal biodiversity on the Earth [1]. The term biodiversity is used for many levels, e.g., genetic variations in populations, species variation in ecosystems. Taxonomic studies involve discovery, description, and analysis of the collected data [2]. The results of taxonomic studies are of great importance to understand of the biodiversity and the relationship between living things that are critical for conservation action [3].

Harpacticoida is one of the 10 orders of the subclass Copepoda [4, 5]. The biodiversity of the order is quite high; Wells [6] reported 58 families, 671 genera and approximately 4400 species except for the parasitic forms in his identification key. Later, Ahyong et al. [7] reported approximately 6000 harpacticoid species in 645 genera, which assigned to 59 families. Harpacticoid copepods are mainly marine, with merely one-tenth of species being freshwater. Most are benthic, a few are planktonic or are symbiotic with invertebrates and vertebrates [8 - 10]. Harpacticoids are also distributed on macroalgae and have great diversity [11].

The first record of harpacticoid copepods for Turkish fauna was given by Noodt [12], 52 species/subspecies belonging to 19 families were reported from the littoral zone of the Sea of

Marmara. Later, Bacesco [13] recorded *Leptastacus laticaudatus* Nicholls, 1935 and *Psammopsyllus operculatus* Nicholls, 1945 from the Bosporus side of the Black Sea. Gündüz [14] reported *Mesochra aesturaii* Gurney, 1921 from Bafra Lake (Samsun), which is a brackish lake. In the early 2000s, Toklu and Sarıhan [15] recorded a pelagic form of *Euterpina acutifrons* Veal, 1852, from the Gulf of Iskenderun. *Taurocletodes tumenae* Karaytuğ and Huys, 2004; *Delamarella obscura* Huys, et al., 2005 and *Psammopsyllus ertunci* Karaytuğ and Sak, 2005 were described from the Black Sea coast of Turkey [16]. Karaytuğ and Sak [17] recorded 37 species and 1 subspecies belonging to 21 families from the Aegean and Sea of Marmara coasts of Balıkesir province. *Psammoleptastcus barani* Sak et al., 2008 was described from the Black Sea coast (Sahilköy/Istanbul) [18]. Sak et al. [19] reported the first record of *Pseudoleptomesochrella halophila* (Noodt, 1955) in Turkey from the coasts of Bartın and Kastamonu and presented the redescription of the genus *Pseudoleptomesochrella*. Sak et al. [20] established the genus *Ciplakastacus* within the family Leptastacidae to place *C. mersinensis*, a new species collected from the Mediterranean coast of Turkey. Pulat et al. [21] reported 6 phytal harpacticoid species belonging to 3 families from mediolittoral rocky biotopes on the coasts of Gümüldür (İzmir). Alper et al. [22] reported 49 species belonging to 18 families from Datça and Bozburun Peninsulas, 34 of these are new records for the Turkish coasts. Karaytuğ et al. [23] reported *Odaginiceps korykosensis* Karaytuğ et al., 2010 from Kızkalesi (Mersin). Kaymak et al. [24] recorded 8 species and subspecies belonging to the family Laophontidae from the Black Sea coasts of Turkey, 4 of these are new records for Turkey. Sönmez et al. [25] recorded 9 species belonging to the family Ectinosomatidae from the mediolittoral region of the Mediterranean coast of Turkey. On the other hand, Sönmez et al. [26] identified miraciid specimens, collected from the mediolittoral zone of the Aegean, Mediterranean and Black Sea coasts of Turkey and reported 18 species and subspecies. *Leptocaris emekdasi* Köroğlu et al. 2014; *Schizopera karanovici* Sönmez et al. 2014; *Diarthrodella ergeneae* Sönmez et al. 2015 were described in several studies which conducted on the Mediterranean and Aegean coasts [27 - 29]. Alper et al. [30] recorded 78 species and subspecies in 18 families from coast of Dilek Peninsula (Aydın), all the taxa reported herein are new records for the studied region, and more importantly 25 species and subspecies were also new records for the Turkish coasts. *Karaytugia aydini* (Kuru and Karaytuğ, 2015) described from Kızkalesi (Mersin) [31]. Karaytuğ and Koçak [32] recorded 24 species belonging to 20 genera from the Aegean and Mediterranean Sea of Turkey, and the northern coasts of Cyprus. Yıldız and Karaytuğ [33] reported 23 species belonging to 20 genera from the beaches of three islands in Bodrum. *Enhydrosoma serdarsaki* Sönmez et al., 2019 and *Pseudoameiropsis suphankaraytugi* Sönmez, 2019 were identified from the Mediterranean and Black Sea coasts of Turkey respectively [34, 35]. Two new louriniid species were described by Karaytuğ et al. [36]

from Mediterranean coast of Turkey. A total of 66 species/subspecies, 19 of which were new records for Turkey, were reported in a study conducted on the Sarımsaklı beach (Balıkesir) [37]. Another faunistic study conducted in Saros Bay, a total of 72 species/subspecies, 16 of these recorded for the first time from Turkish seas were identified [38]. According to the literature summarized above the total number of harpacticoid species reported from Turkish seas are reached to 232. All of these researches conducted on Harpacticoid fauna of the Turkish shores were carried out in the last two decade.

Despite all these studies there is not any research on harpacticoid copepods on the shores of Biga Peninsula (Çanakkale) which is located western part of Turkey and it has surrounded by Sea of Marmara and Aegean Sea. This study was aimed to reveal Harpacticoida fauna of the Biga Peninsula.

2. Materials and Methods

Biga Peninsula is located in the northwestern part of Turkey (Fig.) which is bounded by the Dardanelles Strait and the southwest coast of the Sea of Marmara to the north, Aegean Sea to the west and the Edremit gulf to the South. In general, it constitutes a transition between the Black Sea and Mediterranean climates. The Mediterranean climate is hot and dry during the summer season, and the Black Sea climate is cold and rainy in winters. It receives the most precipitation occurs in the autumn and winter seasons, and the summers are mostly dry [39].

Harpacticoid copepods were collected from 26 stations (Fig.; Table) from the shores of Biga Peninsula between April 2016 and February 2017. Of the sampling shore stations, 11 stations were located near the Aegean Sea, 8 stations were located on the shore of the Dardanelles, and 7 stations were located on the shores of the Sea of Marmara. Interstitial samples obtained from mediolittoral zone using Karaman – Chappius method [40]. Macroalgae were collected by bare hand from splash zone of shores where available. Collected samples were placed in polypropylene containers and then fixed with formalin solution (4% v/v) in situ. Harpacticoid copepods were extracted from detritus using PHYWE SMZ stereomicroscope in the laboratory and were next placed in concave slides by the stations. Specimens were mounted using lactophenol medium. Broken coverslip glass fibers were placed between slide and coverslip to prevent samples from being compressed or crushed. This method also allows to rotate specimen and facilitates to examine them from different angles [17]. The specimens were examined and identified using Olympus BX-50 equipped with DIC (differential interference contrast) attachment and CX-21 light microscopes. Descriptive terminology is adapted from Huys and Boxshall [4] and Huys et al. [41]. Lang [42, 43], Huys et al. [41], Wells [6] and other relevant literature were used for

identifications. Specimens were deposited in the collection of Balıkesir University, Faculty of Arts and Sciences, Department of Biology, in Turkey.

Table: Co-ordinates and sampling dates of stations

Station number	Locality	Sampling Habitats	Coordinates	Sampling Dates			
				I	II	III	IV
St.1	Küçükkuyu	Interstitial	39.53995° N 26.57687° E				
St.2	Assos Otel	Interstitial/Phytal	39.52196° N 26.46817° E				
St.3	Kadırga Bay	Interstitial	39.48644° N 26.36880° E				
St.4	Sokakağzı	Interstitial	39.46890° N 26.21017° E				
St.5	Akliman	Interstitial	39.51918° N 26.08333° E				
S.t6	Gürpınar Beach	Interstitial	39.56645° N 26.10018° E				
St.7	Kavaklı Pier	Interstitial	39.65297° N 26.16035° E				
St.8	Ezine Beach	Interstitial	39.68654° N 26.16309° E				
St.9	Geyikli Beach	Interstitial	39.81913° N 26.16342° E				
St.10	Kumburun	Interstitial	39.87059° N 26.15126° E				
St.11	Yeniköy, Papaz Beach	Interstitial	39.91868° N 26.15511° E				
St.12	Güzelyalı Beach	Interstitial/Phytal	40.04484° N 26.34361° E	09.04.2016 – 11.04.2016	22.08.2016 – 23.08.2016	03.12.2016 – 05.12.2016	18.02.2017 – 20.02.2017
St.13	Dardanos Beach	Interstitial/Phytal	40.08096° N 26.36374° E				
St.14	Kepez Beach	Interstitial	40.10338° N 26.37427° E				
St.15	Yapıldak Altı Beach	Interstitial/Phytal	40.23373° N 26.54126° E				
St.16	Azmak Beach	Interstitial	40.27839° N 26.57071° E				
St.17	Suluca Village Beach	Interstitial/Phytal	40.29814° N 26.62553° E				
St.18	East of Lapseki	Interstitial/Phytal	40.36568° N 26.69161° E				
St.19	Çardaklı, Kumada Beach	Interstitial/Phytal	40.38310° N 26.71025° E				
St.20	Şevketiye	Interstitial/Phytal	40.39755° N 26.87440° E				
St.21	Kemer	Interstitial/Phytal	40.41533° N 27.06399° E				
St.22	Aksaz Beach	Interstitial/Phytal	40.44004° N 27.17658° E				
St.23	Biga, Kaleler Beach	Interstitial/Phytal	40.40735° N 27.31225° E				
St.24	Denizatı Beach	Interstitial	40.34784° N 27.37550° E				
St.25	Kumkent Beach	Interstitial	40.32112° N 27.44261° E				
St.26	Çanakkale-Balıkesir Province Border	Interstitial	40.30364° N 27.51508° E				

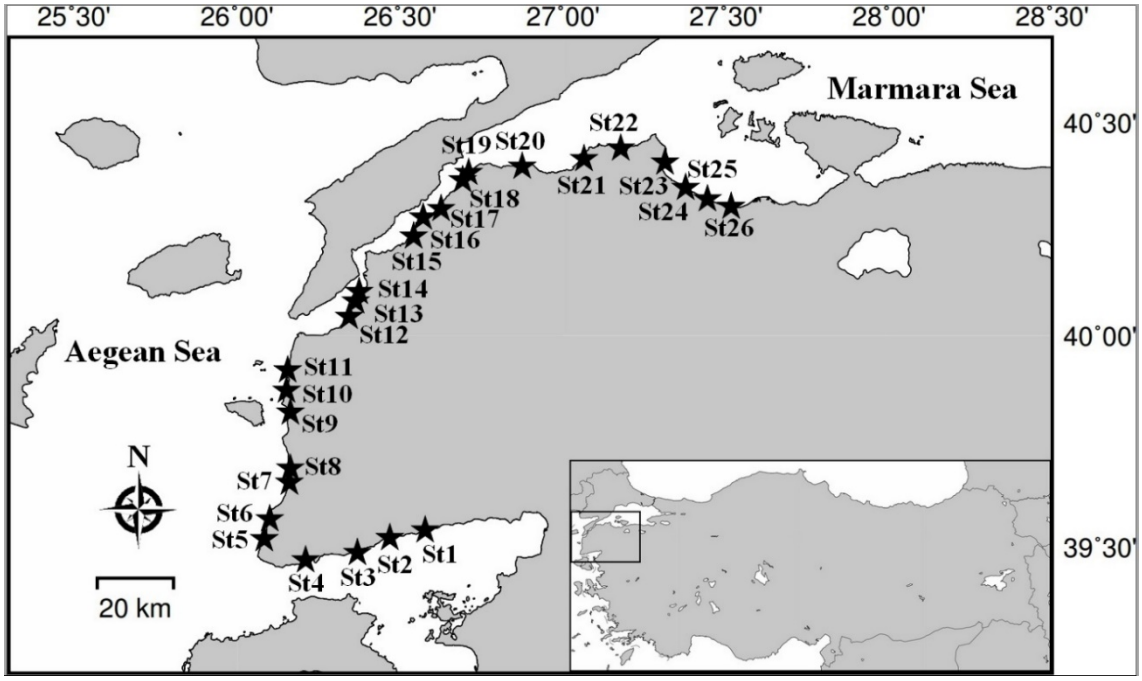

Figure: The sampling stations and study area

3. Results

A total of 73 species and subspecies belonging to 46 genera within 17 families were identified. Identified taxa are listed as follows:

Order: HARPACTICOIDA Sars, 1903

Family: AMEIRIDAE Boeck, 1865

Ameira atlantica mediterranea Kunz,1975

Material examined: (II) St.4 (8♀♀, 1 ♂), St.21 (16 ♀♀, 2 ♂♂); (III) St.6 (5♀♀); (IV) St.1 (1♀), St.2 (3♀♀, 1♂)

Distribution in Turkey: Aegean Sea [38]

Ameira divagans Nicholls, 1939

Material examined: (III) St.21 (31♀♀, 5♂♂)

Distribution in Turkey: New Record.

Ameira parvula (Claus, 1866)

Material examined: (III) St.15 Phytal (3♀♀, 1♂), St.18 Phytal (7♀♀, 22♂♂); (IV) St.21 Pyhtal (3♀♀), St.23 Phytal (5♀♀), St.23 (5♀♀, 2♂♂)

Distribution in Turkey: Aegean Sea [17, 22, 30, 37, 38]

Ameira reducta Petkovski, 1954

Material examined: (I) St.2 (10♀♀, 6♂♂), St.3 (3♀♀), St.16 (16♀♀, 2♂♂), St.23 (7♀♀, 4♂♂), St. 24 (35♀♀, 5♂♂), St. 25 (8♀♀, 3♂♂), St.26 (20♀♀, 3♂♂); (II) St.2 (2♀♀, 3♂♂), St.16 (24♀♀, 8♂♂), St.17 (24♀♀, 8♂♂).

Distribution in Turkey: New Record.

Filexilia brevipes (Kunz, 1954)

Material examined: (II) St.21 (14♀♀, 1♂), St.22 (14♀♀, 2♂♂); (III) St.8 (19♀♀, 2♂♂); (IV) St.21 (10♀♀, 3♂♂), St.22 (6♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [37, 38]

Filexilia intermedia (Galhano, 1970)

Material examined: (I) St.22 (36♀♀, 2♂♂).

Distribution in Turkey: New Record.

Filexilia marinovi Conroy-Dalton and Huys, 1997

Material examined: (II) St.6 (8♀♀, 1♂); (III) St.12 (17♀♀, 10♂♂), St.13 (5♀♀, 2♂♂), St.14 (28♀♀, 5♂♂).

Distribution in Turkey: Aegean Sea [30, 37, 38].

Nitokra affinis Gurney, 1927

Material examined: (III) St.23 (10♀♀, 4♂♂).

Distribution in Turkey: Aegean Sea [22, 38].

Nitokra cari Petkovski, 1954

Material examined: (I) St.14 (7♀♀, 6♂♂).

Distribution in Turkey: Aegean Sea [37]

Nitokra sewelli Gurney, 1927

Material examined: (III) St.3 (2♀♀, 1♂).

Distribution in Turkey: New Record.

Nitokra typica Boeck, 1865

Material examined: (I) St.8 (10♀♀, 2♂♂), St.20 (7♀♀, 1♂); (II) St.15 (2♀♀), St.20 (4♀♀, 1♂); (IV) St.25 (1♀, 3♂♂).

Distribution in Turkey: Aegean Sea [30, 37, 38].

Pseudameira breviseta Klie, 1950

Material examined: (III) St.3 (13♀♀, 2♂♂).

Distribution in Turkey: Mediterranean Sea [33].

Pseudoleptomesochrella halophila (Noodt, 1952)

Material examined: (I) St.14 (6♀♀, 2♂♂); (II) St.14 (11♀♀, 2♂♂), St.24 (18♀♀, 3♂♂); (III) St.5 (6♀♀).

Distribution in Turkey: Aegean Sea [37, 38], Black Sea [20].

Psyllocamptus eridani Ceccherelli, 1988

Material examined: (II) St.15 (1♀, 1♂), St.23 (7♀♀, 1♂); (III) St.2 (22♀♀, 3♂♂), St.23 (10♀♀, 5♂♂).

Distribution in Turkey: Aegean Sea [30, 38], Mediterranean Sea [33].

Family: ARENOPONTIIDAE Martínez Arbizu Moura, 1994

Arenopontia nesaie Cottarelli, 1975

Material examined: (I) St.5 (21♀♀, 3♂♂), St.11 (5♀♀), St.17 (1♀, ♂), St.19 (16♀♀, 5♂♂); (II) St.5 (5♀♀, 5♂♂), St.6 (1♂), St.11 (2♀♀), St.17 (12♀♀); (III) St.2 (1♀), St.11 (9♀♀, 5♂♂), St.23 (1♀), St.25 (8♀♀, 2♂♂), St.26 (4♀♀, 1♂); (IV) St.10 (6♀♀, 3♂♂), St.11 (9♀♀, 1♂), St.22 (4♀♀).

Distribution in Turkey: Aegean Sea [30, 37, 38], The Black Sea [18].

Neoleptastacus acanthus Chappuis, 1954

Material examined: (II) St.4 (4♀♀, 1♂).

Distribution in Turkey: Aegean Sea [22, 30].

Psammoleptastacus barani Sak, Huys and Karaytuğ, 2008

Material examined: (I) St.7 (2♀♀, 1♂), St.21 (2♀♀), St.23 (2♀♀); (III) St.24 (5♀♀, 10♂♂).

Distribution in Turkey: The Black Sea [20], Aegean Sea [30, 38].

Family: CANTHOCAMPTIDAE Brady, 1880

Mesochra pygmaea (Claus, 1863)

Material examined: (III) St.24 (1♀).

Distribution in Turkey: Sea of Marmara [12], Aegean Sea [38].

Family: DARCYTHOMPSONIIDAE Lang, 1936

Leptocaris biscayensis (Noodt, 1955)

Material examined: (I) St.5 (1♂), St.21 (1♀), St.25 (2♀♀); (II) St.5 (8♀♀, 6♂♂), St.8 (1♀); (III) St.2 (1♀, 1♂), St.22 (10♀♀, 1♂); (IV) St.4 (8♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [27, 30, 37, 38].

Family: ECTINOSOMATIDAE Sars G.O., 1903

Arenosetella germanica Kunz, 1937

Material examined: (I) St.7 (25♀♀, 2♂♂), St.8 (19♀♀, 2♂♂), St.12 (8♀♀, 2♂♂), St.16 (1♀), St.17 (6♀♀), St.21 (8♀♀, 2♂♂); (II) St.9 (4♀♀), St.11 (1♀); (III) St.9 (4♀♀), St.12 (2♀♀), St.17 (30♀♀, 4♂♂), St.24 (10♀♀, 2♂♂), St.25 (8♀♀, 2♂♂); (IV) St.12 (12♀♀, 1♂), St.14 (1♀), St.16 (13♀♀), St.17 (5♀♀, 1♂).

Distribution in Turkey: Aegean Sea [17, 22, 37, 38], Mediterranean Sea [25].

Arenosetella lanceorostrata Sönmez, Sak and Karaytuğ, 2016

Material examined: (I) St.2 (1♀), St.7 (7♀♀, 1♂), St.22 (1♀, 1♂); (II) St.4 (4♀♀, 1♂), St.7 (4♀♀); (III) St.2 (3♀♀), St.4 (2♀♀), St.5 (2♀♀), St.8 (3♀♀); (IV) St.4 (11♀♀, 2♂♂), St.5 (1♀), St.7 (3♀♀), St.17 (5♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [37], Mediterranean Sea [44].

Ectinosoma melaniceps Boeck, 1865

Material examined: (II) St.25 (5♀♀), St.2 Phytal (7♀♀, 2♂♂), St.15 Phytal (18♀♀, 2♂♂); (III) St.8 (8♀♀, 2♂♂).

Distribution in Turkey: Sea of Marmara [12], Aegean Sea [17, 37, 38], Mediterranean Sea [25].

Ectinosoma reductum Bozic, 1955

Material examined: (II) St.20 Phytal (20♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [30, 38], Mediterranean Sea [25].

Ectinosoma soyeri Apostolov, 1975

Material examined: (I) St.1 (1♀, 1♂), St.23 (5♀♀, 1♂), St.25 (13♀♀, 2♂♂), St.26 (21♀♀, 3♂♂); (II) St.17 (2♀♀, 1♂), St.20 (12♀♀, 2♂♂); (IV) St.20 (16♀♀, 2♂♂), St.25 (9♀♀, 2♂♂), St.26 (25♀♀, 5♂♂).

Distribution in Turkey: Aegean Sea [22, 30, 37, 38], Mediterranean Sea [25].

Glabrotelson sp.

Material examined: (I) St.21 (2♀, 1♀ dissected in 6 slides, 3♂♂)

Distribution in Turkey: New Record.

Microsetella norvegica (Boeck, 1865)

Material examined: (I) St.3 (1♀), St.4 (7♀♀), St.5 (5♀♀); (II) St.2 (2♀♀, 3♂♂), St.6 (1♀), St.7 (10♀♀, 1♂), St.8 (7♀♀, 1♂), St.9 (6♀♀); (III) St.4 (2♀♀, 1♂), St.11 (3♀♀), St.12 (1♀); (IV) St.1 (1♀), St.3 (2♀♀), St.7 (3♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [22, 30, 32, 37], Mediterranean Sea [22].

Microsetella rosea (Dana, 1847)

Material examined: (III) St.13 (6♀♀, 4♂♂).

Distribution in Turkey: Aegean Sea [38], Mediterranean Sea [25].

Noodtiella enertha Lindgren, 1975

Material examined: (II) St.17 (2♀♀, 1♂); (III) St.11 (8♀♀, 1♂), St.25 (5♀♀, 1♂); (IV) St.9 (2♀♀).

Distribution in Turkey: New Record.

Noodtiella intermedia Wells, 1967

Material examined: (II) St.11 (2♂).

Distribution in Turkey: New Record.

Noodtiella wellsi Apostolov, 1974

Material examined: (I) St.21 (1♀).

Distribution in Turkey: New Record.

Family: HARPACTICIDAE Dana, 1846

Harpacticus compsonyx Monard, 1926

Material examined: (I) St. 15 Phytal (10♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [22].

Harpacticus littoralis Sars G.O., 1910

Material examined: (I) St.17 Phytal (10♀♀, 2♂♂); (II) St.20 Phytal (15♀♀, 3♂♂); (III) St.20 Phytal (9♀♀, 2♂♂); (IV) St.13 Phytal (20♀♀, 5♂♂), St.15 Phytal (11♀♀), St.17 Phytal (24♀♀, 1♂), St.18 Phytal (8♀♀, 1♂), St. 19 Phytal (9♀♀, 3♂♂), St.21 Phytal (5♀♀).

Distribution in Turkey: Aegean Sea [22, 30].

Family: LAOPHONTIDAE Scott T., 1904

Afrolaophonte pori Masry, 1970

Material examined: (I) St.4 (11♀♀, 2♂♂), St.8 (1♀); (II) St.4 (18♀♀, 1♂), St. 7 (1♀), St.8 (28♀♀, 6♂♂); (III) St.4 (12♀♀, 8♂♂); (IV) St.8 (15♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [22, 30, 37, 38].

Asellopsis intermedia (Scott T., 1895)

Material examined: (I) St.13 Phytal (15♀♀, 3♂♂).

Distribution in Turkey: New Record.

Echinolaophonte minuta Cottarelli and Forniz, 1991

Material examined: (II) St.2 Phytal (1♀, 1♂); (III) St.8 (4♀♀, 6♂♂).

Distribution in Turkey: New Record.

Heterolaophonte brevipes Roe, 1958

Material examined: (II) St.15 Phytal (5♀♀, 2♂♂).

Distribution in Turkey: New Record.

Heterolaophonte uncinata (Czerniavski, 1868)

Material examined: (II) St.2 Phytal (7♀♀, 6♂♂), St.15 Phytal (3♀♀), St.18 Phytal (14♀♀, 9♂♂); (III) St.12 Phytal (5♀♀); (IV) St.13 Phytal (6♀♀, 2♂♂), St.21 Phytal (7♀♀, 1♂), St.22 Phytal (8♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [22], The Black Sea [24].

Klieonychocamptus kliei adriaticus (Petkovski, 1954)

Material examined: (III) St.8 (2♀♀, 1♂); (IV) St.19 (3♀♀, 1♂), St.21 (1♂)

Distribution in Turkey: Aegean Sea [22], The Black Sea [24].

Klieonychocamptus kliei confluens Noodt, 1958

Material examined: (I) St.3 (6♀♀, 2♂♂).

Distribution in Turkey: New Record.

Klieonychocamptus ponticus (Serban and Plesa, 1957)

Material examined: (II) St.15 (10♀♀, 7♂♂), St.16 (3♀♀, 1♂), St.20 (14♀♀, 5♂♂), St.25 (8♀♀, 6♂♂), St.26 (27♀♀, 7♂♂); (III) St.5 (2♀♀, 4♂♂), St.16 (8♀♀, 2♂♂), St.17 (1♀, 1♂), St.20 (6♀♀, 5♂♂), St.21 (6♀♀).

Distribution in Turkey: Aegean Sea [30, 37, 38, The Black Sea [24].

Laophonte inornata Scott A., 1902

Material examined: (IV) St.18 Phytal (7♀♀, 2♂♂).

Distribution in Turkey: Sea of Marmara [12], The Black Sea [17].

Laophonte lignosa Hicks, 1988

Material examined: (I) St.15 Phytal (5♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [30].

Laophonte setosa Boeck, 1865

Material examined: (III) St.17 Phytal (2♀♀, 1♂); (IV) St.17 Phytal (2♀♀, 1♂), St.23 Phytal (25♀♀, 5♂♂).

Distribution in Turkey: Sea of Marmara [12], The Black Sea [24].

Lipomelum adriaticum (Petkovski, 1955)

Material examined: (I) St.3 (7♀♀, 2♂♂), St.5 (1♀); (II) St.3 (9♀♀, 5♂♂); (III) St.3 (15♀♀, 8♂♂), St.4 (3♀♀, 4♂♂); (IV) St.3 (2♀♀), St.4 (4♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [30, 33, 38].

Paralaophonte brevirostris (Claus, 1863)

Material examined: (III) St.17 Phytal (2♀♀, 1♂); (IV) St.17 Phytal (5♀♀, 2♂♂), St.23 Phytal (25♀♀, 5♂♂).

Distribution in Turkey: Sea of Marmara [12], Aegean Sea [21, 22, 30, 38].

Troglophonte sp.

Material examined: (IV) St.19 (4♀♀, 1♀ dissected in 6 slides; 2 ♂♂, 1 ♂ dissected in 6 slides).

Distribution in Turkey: New Record.

Family: LATIREMIDAE Bŏzić, 1969

Delamarella obscura Huys, Karaytuğ and Cottarelli, 2005

Material examined: (I) St.3 (1♀, 1♂), St.4 (1♀), St.7 (4♀♀), St.8 (5♀♀, 1♂), St.19 (2♀♀, 2♂♂), St.21 (1♀), St.22 (1♀), St.25 (6♀♀), St.26 (10♀♀, 2♂♂); (II) St.6 (4♀♀, 1♂), St.8 (1♀); (III) St.2 (2♀♀), St.3 (7♀♀, 1♂), St.4 (9♀♀, 2♂♂), St.21 (2♀♀), St.22 (3♀♀, 5♂♂), St.25 (22♀♀, 4♂♂), St.26 (24♀♀, 20♂♂); (IV) St.4 (2♀♀, 4♂♂), St.5 (1♀).

Distribution in Turkey: The Black Sea [45], Aegean Sea [17, 22, 37, 38].

Family: LEPTASTACIDAE Lang, 1948

Ciplakastacus mersinensis Sak, Karaytuğ and Huys, 2008

Material examined: (II) St.11 (8♀♀, 4♂♂).

Distribution in Turkey: Mediterranean Sea [19].

Minervella baccettii Cottarelli and Venanzetti, 1989

Material examined: (III) St.11 (1♂).

Distribution in Turkey: Aegean Sea [37].

Psammastacus confluens Nicholls, 1935

Material examined: (II) St.13 (2♀♀).

Distribution in Turkey: New Record.

Stereoxiphos operculatus (Masry, 1970)

Material examined: (I) St.11 (2♀♀, 1♂).

Distribution in Turkey: New Record.

Family: METIDAE Boeck, 1873

Metis ignea Philippi, 1843

Material examined: (I) St.15 (2♀♀, 1♂); (II) St.2 (1♀), St.18 Phytal (11♀♀), St.20 Phytal (10♀♀); (III) St.15 Phytal (5♀♀).

Distribution in Turkey: Aegean Sea [17].

Family: MIRACIIDAE Dana, 1846

Amphiascoides brevifurca (Czerniavsky, 1868)

Material examined: (IV) St.18 Phytal (5♀♀, 2♂♂).

Distribution in Turkey: Sea of Marmara [12], Aegean Sea [38]

Eoschizopera (Praeoschizopera) gligici (Petkovski, 1957)

Material examined: (I) St.5 (2♀♀), St.11 (1♀), St.14 (8♀♀, 5♂♂), St.22 (2♀♀), St.25 (3♀♀); (II) St.19 (1♀); (III) St.16 (17♀♀, 6♂♂), St.17 (5♀♀, 1♂).

Distribution in Turkey: Aegean Sea [17, 30, 37, 38], Mediterranean Sea [25].

Psammotopa vulgaris Pennak, 1942

Material examined: (I) St.14 (6♀♀, 4♂♂); (II) St.14 (6♀♀, 1♂); (III) St.11 (4♀♀, 1♂), St.14 (8♀♀,2♂♂); (IV) St.11 (14♀♀, 5♂♂), St.14 (10♀♀, 13♂♂).

Distribution in Turkey: Aegean Sea [26, 30, 38].

Pseudamphiascopsis attenuatus (Sars G.O., 1906)

Material examined: (I) St.2 (2♀♀, 1♂); (III) St.15 (1♀).

Distribution in Turkey: Aegean Sea [22, 37].

Sarsamphiascus minutus (Claus, 1863)

Material examined: (II) St.22 (3♀♀, 1♂).

Distribution in Turkey: Sea of Marmara [12, 17], Aegean Sea [22, 30, 38].

Schizopera brusinae Petkovski, 1954

Material examined: (I) St.4 (5♀♀, 1♂), St.8 (2♀♀).

Distribution in Turkey: Aegean Sea [17, 22, 30, 38].

Schizopera karanovici Sönmez, Sak and Karaytuğ, 2015

Material examined: (I) St.11 (2♀♀, 1♂).

Distribution in Turkey: Mediterranean Sea [28].

Schizopera minuta Noodt, 1955

Material examined: (I) St.12 (4♀♀, 1♂), St.17 (3♀♀), St. 19 (1♀).

Distribution in Turkey: New Record.

Family: ORTHOPSYLLIDAE Huys, 1990

Orthopsyllus linearis (Claus, 1866)

Material examined: (III) St.18 Phytal (5♀♀, 3♂♂).

Distribution in Turkey: Aegean Sea [17].

Family: PARAMESOCHRIDAE Lang, 1944

Apodopsyllus arenicolus (Chappuis, 1954)

Material examined: (I) St.14 (1♀, 1♂), St.16 (5♀♀); (II) St.16 (3♀♀, 3♂♂), St.19 (4♀♀), St.21 (9♀♀, 1♂); (III) St.10 (2♀♀, 5♂♂), St.16 (1♀, 2♂♂); (IV) St.16 (7♀♀, 2♂♂), St.17 (3♀♀).

Distribution in Turkey: Aegean Sea [38]

Emertonia constricta orotavae (Noodt, 1958)

Material examined: (I) St.17 (3♀♀); (II) St.17 (14♀♀, 9♂♂); (III) St.2 (2♀♀, 1♂), St.5 (1♀, 1♂), St.12 (2♀♀); (IV) St.10 (7♀♀, 1♂), St.12 (14♀♀, 1♂), St.16 (6♀♀), St.17 (15♀♀, 2♂♂), St.21 (8♀♀), St.25 (9♀♀, 2♂♂).

Distribution in Turkey: New Record.

Leptopsyllus punctatus Mielke, 1984

Material examined: (I) St.21 (11♀♀, 1♂); (II) (11♀♀, 1♂); (III) St.21 (14♀♀, 7♂♂).

Distribution in Turkey: Aegean Sea [22, 30, 37].

Family: PARASTENHELIIDAE Lang, 1936

Parastenhelia spinosa (Fischer, 1860)

Material examined: (II) St.17 Phytal (7♀♀, 7♂♂); (III) St.15 Phytal (10♀♀, 3♂♂).

Distribution in Turkey: Aegean Sea [22, 30], Mediterranean Sea [33].

Thalestrella sp.

Material examined: (IV) St.22 (9♀♀,1♀ dissected in 4 slides, 3♂♂).

Distribution in Turkey: New Record.

Family: PORCELLIDIIDAE Boeck, 1865

Porcellidium fimbriatum Claus, 1863

Material examined: (II) St.15 Phytal (5♀♀, 5♂♂); (III) St.12 Phytal (3♀♀, 2♂♂).

Distribution in Turkey: Aegean Sea [30].

Family: TETRAGONICIPITIDAE Lang, 1944

Phyllopodopsyllus berrieri Monard, 1936

Material examined: (III) St.16 (1♀, 1♂), St.22 (10♀♀, 12♂♂).

Distribution in Turkey: New Record.

Phyllopodopsyllus briani Petkovski, 1955

Material examined: (I) St.3 (14♀♀, 15♂♂); (II) St.3 (18♀♀, 19♂♂); (III) St.2 (4♀♀, 1♂).

Distribution in Turkey: Aegean Sea [17], Mediterranean Sea [33].

Phyllopodopsyllus thiebaudi Petkovski, 1955

Material examined: (II) St.22 (1♀, 1♂), St.23 (11♀♀, 11♂♂), St.24 (2♂♂).

Distribution in Turkey: Aegean Sea [17], Mediterranean Sea [33].

Pteropsyllus plebeius furcatus Kunz, 1938

Material examined: (II) St.8 (3♀♀, 2♂♂).

Distribution in Turkey: New Record.

Family: TISBIDAE Stebbing, 1910

Scutellidium ligusticum (Brian, 1920)

Material examined: (II) St.17 Phytal (5♀♀, 2♂♂), St.20 Phytal (2♀♀, 1♂); (III) St.12 Phytal (4♀♀).

Distribution in Turkey: Aegean Sea [30].

Scutellidium longicaudum (Philippi, 1840)

Material examined: (II) St.18 Phytal (7♀♀, 2♂♂); (IV) St.17 Phytal (7♀♀, 1♂), St. 18 Phytal (7♀♀, 1♂).

Distribution in Turkey: Aegean Sea [30, 37].

4. Discussion

As a result of the study, 73 species/subspecies belonging to 46 genera in 17 families were identified from 26 stations. In terms of species richness, the families Laophontidae and Ameiridae ranked first with 14 species each, belonging to 9 and 6 genera respectively; these two families followed by Ectinosomatidae with 11 species in 5 genera, Miraciidae with 8 species in 6 genera, Leptastacidae with 4 species in 4 genera, Tetragonicipitidae with 4 species in 4 genera, Arenopontiidae with 3 species in 3 genera, Paramesochridae with 3 species in 3 genera, Harpacticidae, Parastenheliidae and Tisbidae with 2 species in 1 genus each, and the remaining families represented by one species each. *Delamarella obscura* identified from 20 different samplings and in all samplings was the most common species followed by *Ectinosoma soyeri* (found in 18 samplings), *Arenosetella germanica* (found in 17 samplings) and *Arenopontia nesaie* (found in 16 samplings). In contrast, some harpacticoids were determined to be unique to one station and are not found in any other stations studied (see Results, Material examined). For example, *Neoleptastacus acanthus* was identified only at station St.4 and, *Pteropsyllus plebeius furcatus* was identified only from station St. 8.

Considering the distribution of harpacticoid species sampled from the stations mentioned in the present study, it can be suggested that some harpacticoids are specific for the sampled regions. Eleven species (*Pseudameira breviseta, Nitokra sewelli, Lipomelum adriaticum, Echinolaophonte minuta, Paralaophonte brevirostris, Stereoxiphos operculatus, Ciplakastacus mersinensis, Minervella bacetti, Schizopera brusinae, Schizopera karanovici* and *Pteropsyllus plebeius furcatus)* were determined from the stations located on the Aegean Sea coast. Seven species (*Filexilia intermedia, Ameira divagens, Nitokra affinis, Noodtiella wellsi, Glabrotelson* sp.*, Sarsamphiascus minutus* and *Phyllopodopsyllus thiebaudi*) were determined from the stations

located from the shore of the Sea of Marmara. Six species (*Nitokra cari, Troglophonte* sp., *Psammastacus confluens, Schizopera minuta, Microsetella rosea* and *Phyllopodopsyllus berrieri*) were determined from the stations located along the Dardanelles Strait. On the contrary, fifteen species (*Ameira reducta, Nitokra typica, Psyllocamptus eridani, Pseudoleptomesochrella halophila, Arenopontia nesaei, Ectinosoma soyeri, Arenosetella lanceorostrata, Arenosetella germanica, Klieonychocamptus ponticus, Klieonychocamptus kliei, Klieonychocamptus adriaticus, Delameralla obscura, Eoschizopera (Praeoschizopera) gligici, Emertonia constricta orotavae* and *Apodopsyllus arenicolus*) were found widely distributed and determined from all three regions studied.

To date, 232 species of harpacticoid copepods have been reported from the Turkish coasts (See introduction). With the present study, additional 20 species/subspecies were recorded for the first time. Thus, the total number of harpacticoid copepod species determined from Turkish coasts has increased to 252.

Although faunistic studies on Turkish coasts have increased in the last two decades, they are still far from revealing the real harpacticoid diversity of Turkey. It is possible to speculate that one of the reasons for this situation is the faunistic results of almost all studies in Turkey were generally based on seasonal samplings that were carried out 3-4 times in a year. The most recent study were conducted by Alper [37] where, 9 stations on the mediolittoral zone of Sarımsaklı Beach (Balıkesir) were sampled 12 times in a year with monthly period. As a result of his examination, 66 species/subspecies were reported from a single beach. Apparently, the more sampling is conducted, the higher number of species can be identified. Another possible reason could be that only the mediolittoral regions were examined more intensively in the previous studies. Directing future studies to deeper regions, as well as examining symbiotic harpacticoids, will contribute to revealing the real biodiversity of Turkey's harpacticoid fauna.

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