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RESEARCH ARTICLE

First records of two macrobenthic invertebrate species in the Black Sea: *Marmara musculata* (Cnidaria: Anthozoa) and *Hydroides dianthus* (Annelida: Polychaeta)

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Abstract

The present study reports on two macrobenthic invertebrate species found along the Turkish coast of the Black Sea. An anthozoan species, *Marmara musculata*, was first encountered among hard-bottom materials collected in 2017 off Kıyıköy and then widely found among benthic materials collected at several locations at depths of 19-41 m along the Turkish Black Sea coast in 2022 and 2024. An invasive alien serpulid species, *Hydroides dianthus*, was determined on artificial substratum in and around harbour environments at 0.1-0.5 m in Samsun and on plastic surface at 28 m in Rize. Among the species, *M. musculata* is a new record for the Black Sea and *H. dianthus* for the Black Sea coast of Türkiye.

Keywords: Polychaetes, anthozoans, alien species, fouling species, Türkiye

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Introduction

The Black Sea is a semi-closed sea and it is the largest (a volume of 547000 km^3) permanently stratified marine basin in the world (Zaitsev *et al.* 2002). It is characterized by brackish waters with a salinity of 18 PSU which limits the transport of euhaline forms via the İstanbul Strait. Its ecosystem structure differs from that of the neighbouring Mediterranean Sea: the species diversity is lower

and the dominant organism groups are different. However, the abundance, total biomass and productivity of the Black Sea are much higher than those in the Mediterranean Sea (Zaitsev and Alexandrov 1998). Macrobenthic animals inhabiting the Black Sea have been relatively well studied in different parts of the region (Czerniavsky 1880, 1881, 1882; Băcescu *et al.* 1971; Andriescu 1977; Marinov 1977; Băcescu 1977; Kiseleva 1981, 1988; Stokyov and Ouzounova 1998; Todorova and Konsulova 2000; Revkov *et al.* 2002; Losovskaya *et al.* 2004; Grintsov *et al.* 2005; Boltachova *et al.* 2006, 2011; Begun *et al.* 2010; Lisitskaya *et al.* 2010; Surugiu *et al.* 2010; Filimon *et al.* 2016; Dumitrache *et al.* 2024; Teacă *et al.* 2025; author's database) but their compositions and distributions on habitats have been rarely a subject of the study along the Turkish Black Sea coast (Sezgin *et al.* 2001; Çinar and Gönlügür-Demirci 2005; Sezgin and Katağan 2007; Gözler *et al.* 2009, 2010; Kuş and Kurt-Şahin 2016; Kurt-Sahin *et al.* 2017a, 2017b, 2019; Kuş *et al.* 2021; Çinar and Erdoğan-Dereli 2023). Zoobenthic community structures in the Black Sea have considerably changed over the years. The species influx from the Aegean Sea and the Sea of Marmara, a process known as the "Mediterranization" of the Black Sea has increased with the ongoing climate change (Oğuz and Öztürk 2011; Kurt-Şahin *et al.* 2019; Çinar *et al.* 2024a; Bat *et al.* 2024). The introduction of species primarily driven by dense shipping traffic is another factor affecting biodiversity in the area. A total of 65 alien zoobenthic species are known to exist in the region and this number is increasing over time (Çinar *et al.* 2021; Shalovenkov 2022). In addition, several species new to science were described in recent studies conducted along the Turkish Black Sea coast (Kuş *et al.* 2021; Çinar and Erdoğan-Dereli 2023). This clearly indicates that the zoobenthic diversity in the Black Sea has been underestimated and that more detailed research is needed to elucidate the region's true benthic animal diversity.

This study presents the first reports of two macrobenthic invertebrate species collected from the Turkish coast of the Black Sea within various research projects: *Hydroides dianthus* (Verrill 1873) and *Marmara musculata* Ocaña and Çinar 2018. Among the species the anthozoan *M. musculata* was originally described from the Sea of Marmara among hard bottom materials at 10-50 m depths and has not been reported outside the region so far (Ocaña and Çinar 2018). The serpulid polychaete *H. dianthus* was originally described from the Atlantic coast of North America by Verill (1878) and it is considered as an invasive alien species for the coast of Türkiye (Çinar *et al.* 2021, 2024a). It is known from the Sea of Marmara, Aegean Sea and Levantine Sea (Çinar *et al.* 2024a). This species was reported for the Black Sea from the coast of Sevastapol (Crimea) on oysters (*Magallana gigas* (Thunberg 1793) as *Crassostrea gigas*) shells and stones at depths of 0.1-5 m by Boltachova *et al.* (2011). Recently Sun *et al.* (2017) use barcoding gene cytochrome c oxidase I (COI) sequences to assess the genetic divergence among *H. dianthus* populations and examined individuals sampled from 17 different localities worldwide including the Black Sea samples from Sevastopol.

This study reports these two species along the Black Sea coast of Türkiye and describes them based on the material collected at stations.

Materials and Methods

Specimens of *Marmara musculata* and *Hydroides dianthus* were collected at nine stations along the southern part of the Turkish Black Sea coast (Figure 1). A Van Veen grab (at stations KYK, TRK1, TRK10, TRK13, TRK25, TRK28) or bottom trawl (at stations ST1 and ST2) were used to take soft bottom samples at stations. In harbour environment (station KSLS) fouling communities on artificial substrata were collected by using a spatula. The locality sampling depth habitat and date for each station are presented in Table 1.

Table 1. Sampling locations, dates, coordinates, depth and substrate types of stations

Code	Station Location	Date	Depth (m)	Coordinates		Substrate
				Latitude	Longitude	
TRK 1	İğneada	09.07.2024	19	41°52′12.07″ N	28°03′33.48″ E	Sand with shell fragments
TRK 10	Sakarya River	10.07.2024	24	41°08′45.85″ N	30°37′39.18″ E	Mud
TRK 13	Zonguldak	12.07.2024	20	41°27′36.18″ N	31°46′24.78″ E	Black sandy mud
TRK 25	Sinop 2	14.07.2024	20	42°03′49.25″ N	34°55′04.69″ E	Mud
TRK 28	Sinop 1	14.07.2024	25	42°00′57.24″ N	35°09′28.51″ E	Coarse sand with shell fragments
ST1	Rize	10.03.2022	28	41°04′27.01″ N	40°35′20.00″ E	Plastic debris
ST2	Rize	09.03.2022	41	41°11′22.99″ N	40°44′24.00″ E	Plastic debris

In the field the specimens were fixed with 4% formaldehyde solution and transferred to the jars. In the laboratory the benthic material was washed with tap water and sorted. The specimens were preserved in 70% ethanol. All specimens of *Hydroides* were identified to species using taxonomic characters such as operculum, chaetae, tubes. The operculum of serpulids is a structure with particularly important characters for the identification of the species. The operculum shape, as well as the number and arrangement of chitinous or calcareous ornamentations, are useful for the diagnosis of species. Tube ornamentations and collar chaetae are also used in combination with the operculum (Bastida-Zavala and ten Hove 2002). Anthozoa specimens were identified according to Ocaña and Çinar (2018). Photographs of the general view of the specimen were taken by a digital camera attached to a stereomicroscope (Nikon SMZ745-T) and the chaetal images were taken by a digital camera (Nikon1 J5) equipped on a compound upright microscope with phase contrast attachment (Nikon Eclipse Ci-L).

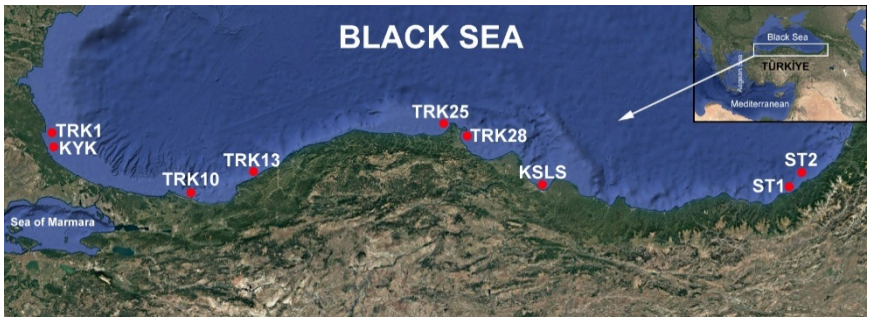

Figure 1. Sampling stations

The specimens were deposited at the Marine Biology Laboratory of Department of Biology, Faculty of Arts and Sciences, Sinop University and Benthology Laboratory of Department of Hydrobiology, Faculty of Fisheries, Ege University in Türkiye.

Results and Discussion

Hydroides dianthus (Verrill 1873)

Serpula dianthus Verrill 1873: 620.
Hydroides dianthus Zibrowius 1971: 697-705; Bastida-Zavala and Salazar-Vallejo 2000: 845 Figure 1m-u; Bastida-Zavala and ten Hove 2002: 143-146 figs 23A-M 24A-K 28; Çinar *et al.* 2008: 5-11; Link *et al.* 2009: 1-6 figs 1a-g 2; Otani and Yamanishi 2010: 63-64 figs 3a-g; Ben-Eliahu and ten Hove 2011: 14-16; Boltachova *et al.* 2011: 34-38; Bastida-Zavala *et al.* 2017: 25-28 figs 4C-5; Sun *et al.* 2017: 1-12; Çinar *et al.* 2020: 9.

Material examined: 04.07.2021, KSLS, Samsun, 41°18'14"N 36°20'42"E, 0.5 m, on rubber tire, 5 specimens; 18.07.2024, KSLS, Samsun, 41°18'14"N 36°20'42.00"E, 0.3 m, dock, 12 specimens; 10.03.2022, Rize, ST1, 41°04′27.01″N 40°35′20.00″E, 28 m, on plastic debris, 1 specimen.

Description: Tubes white with two longitudinal ridges (Figure 2E); internal diameter 1.4 mm external diameter 1.6 mm. Specimen complete 23.1 mm long. Both thorax and abdomen pale yellow in preserved specimens (Figure 2A). Branchial crown 2.1 mm long with 16-18 radioles. Length of operculum with peduncule 1.9 mm; funnel with 33 radii; verticil with 9-10 yellow spines without external spinule and wings all curved ventrally with pointed tips (Figures 2C, D); dorsal spines larger than ventral ones; spines with one basal internal spinule. The verticil lacked a central tooth. Collar chaetae including 1-2 bayonet and 4-5 hooded capillary chaetae (Figure 2B); bayonet chaetae with two blunt-rounded distal blades smooth 215 µm long. The thoracic membrane well developed. Seven thoracic segments six of which with capillary notochaetae. The abdomen with 95

segments. Thoracic and abdominal uncini saw-shaped. Neurochaetae of the posterior abdominal segments with long capillary chaetae.

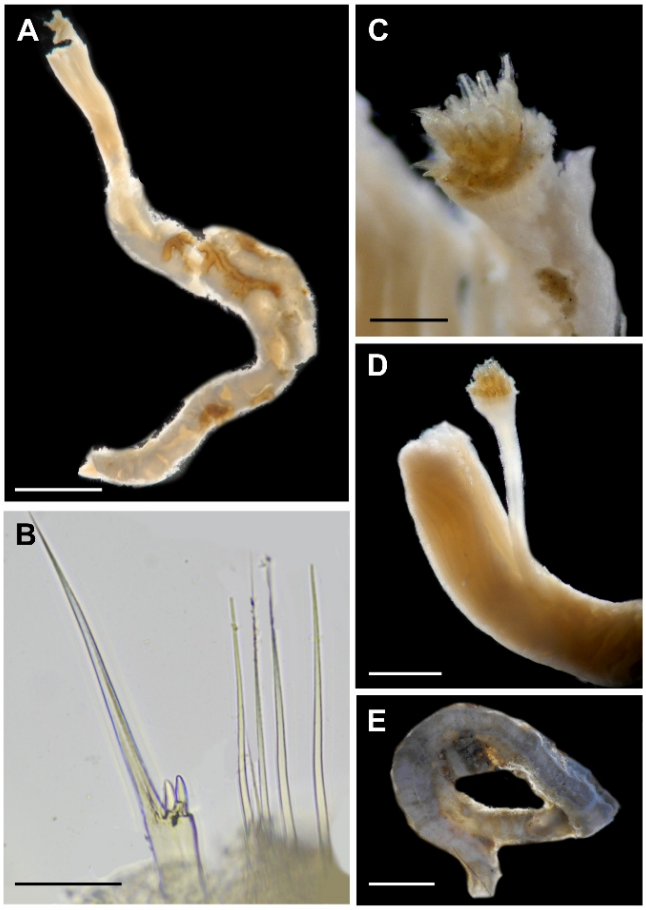

Figure 2. *Hydroides dianthus* A. General view;
B. Bayonet collar chaeta and capillary chaetae; C-D. Operculum; E. Tube
(Scale bar A: 500 µm; B: 100 µm; C: 100 µm; D. 200 µm; E. 500 µm)

***Marmara musculata* Ocaña and Çinar 2018 (Figure 3)**

Marmara musculata Ocaña and Çinar 2018: 2246-2252.

Material examined: 04.04.2017, Kıyıköy, 41°39'1.92"N 28°6'41.40"E, 27 m, on muddy sand with shell fragments, 1 specimen; 09.03.2022, ST2, Rize, 41°11′22.99″N 40°44′24.00″E, 41 m, on plastic debris, 2 specimens; 10.03.2022, Rize, ST1, 41°04′27.01″N 40°35′20.00″E, 28 m, on plastic debris, 4 specimens; 09.07.2024, TRK1, İğneada, 41°52′12.07″N 28°03′33.48″E, 19 m, on sand with

shell fragments, 1 specimen; 10.07.2024, TRK10, Sakarya River, 41°08′45.85″N 30°37′39.18″E, 24 m on mud with shell fragments 1 specimen; 12.07.2024, TRK13, Zonguldak, 41°27′36.18″N 131°46′24.78″E, 20 m, black sandy mud, 1 specimen; 14.07.2024, TRK25, Sinop, 42°3′49.25″N 34° 55′ 4.69"E, 21 m, on mud with shell fragments, 18 specimens; 14.07.2024, TRK28, Sinop, 42°0′ 5724″N 35°9′2851"E, 25 m, coarse sand with shell fragments, 2 specimens.

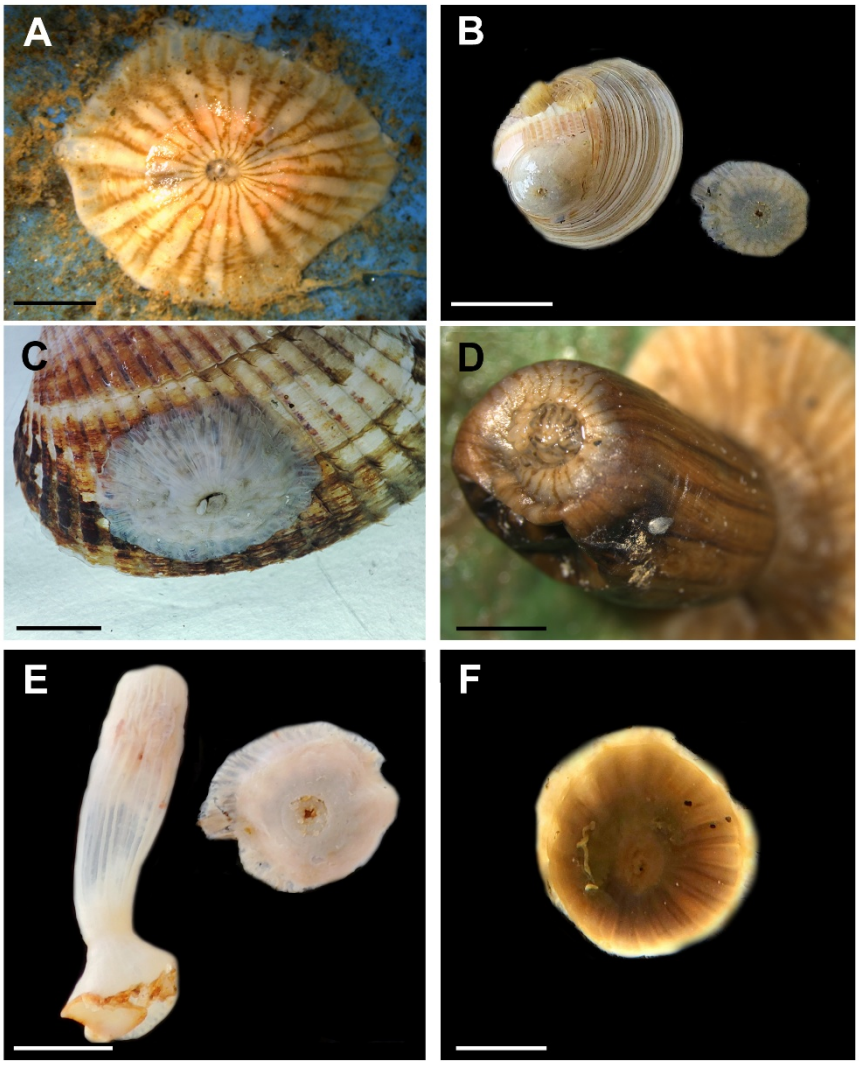

Figure 3. General view of *Marmara musculata* specimens.
A-D. on plastic debris; B. on *Chamelea gallina*; C. on *Anadara kagoshimensis*;
E-F. Retracted and protruded fixed specimens
(Scale A: 2 mm B: 10 mm C: 4 mm D: 2 mm E: 5 mm F: 3 mm)

Diagnosis: Specimens pinky or orange-like colour with white stripes; white stripes more obvious from capitulum till base; upper part of column and capitulum with lines of orange or reddish colour; brownish colour with same stripe and line patterns described above (Figure 3). Dimension in strongly retracted specimens: 0.4–1.1 cm × 0.3–0.8 cm; in expanded specimens 1.1-1.5 cm long. In expanded condition body with two differentiated areas: upper part with tentacles and pharynx concentrated in a budlike structure; rest of column till base constituting a thin cord-like structure; in strongly retracted specimens pedal disc enlarged and attached to stones or shell fragments (Figure 3). Conspicuous muscular belts of endodermic musculature present along column and capitulum. No scapulus. Tentacles retracted in some specimens.

The Black Sea is a region that remains insufficiently studied in terms of its macrozoobenthic diversity and there is significant potential for the discovery of new species and records. The current status of marine animal diversity along the Turkish Black Sea coast and in all seas surrounding Türkiye was recently presented in a special issue of the Turkish Journal of Zoology in 2024 entitled "*Marine Animal Diversity of Türkiye*". The relevant articles (Bakir *et al.* 2024; Çinar *et al.* 2024a, b, c; Evcen and Topaloğlu 2024; Koçak and Aydın 2024; Öztürk *et al.* 2024) in the special issue reported approximately 1172 invertebrate species from the Black Sea coast of Türkiye most of which were benthic organisms. Among these Çinar *et al.* (2024a) reported 209 polychaete species and Çinar *et al.* (2024b) reported 7 anthozoan species from the region. To date four alien polychaete species [*Capitellethus dispar* (Ehlers 1907), *Polydora cornuta* Bosc 1802, *Prionospio pulchra* Imajima 1990 and *Ficopomatus enigmaticus* (Fauvel 1923)] have been reported on the Turkish Black Sea coast (Çinar *et al.* 2014, 2024a). While *C. dispar* was previously considered an alien species in the area (Kurt-Şahin and Çinar 2012; Çinar *et al.* 2014; Bat *et al.* 2024) Çinar *et al.* (2024a) questioned this classification.

The invasive serpulid species *Hydroides dianthus* which was originally described by Verill (1878) from the Atlantic coast of North America (Great Egg Harbour to New Haven and Cape Cod New Jersey to Massachusetts United States) as *Serpula dianthus* has been previously recorded from the Gulf of Mexico, Mexican Caribbean, Mediterranean Sea, Aegean Sea, Sea of Marmara, European Atlantic, Senegal, Japan, China, Brazil, and Black Sea (Quatrefages 1865; Zibrowius 1971; Sun and Yang 2000; Bastida-Zavala and ten Hove 2002; Zenetos *et al.* 2005; Otani and Yamanishi 2007, 2010; Çinar *et al.* 2008; Link *et al.* 2009; Boltachova *et al.* 2011; Sun *et al.* 2017; Çinar *et al.* 2020). Zibrowius (1971, 1973, 1978) concluded that *H. dianthus* was distributed in the Mediterranean in ancient times and established itself in ports and lagoons. After examining various museum collections, he stated that the oldest *H. dianthus* collections date from before 1865 in the eastern Mediterranean basin (İzmir) after 1874 in the Adriatic (Gulf of Trieste) and after 1888 in Naples (Zibrowius 1971). The first report from the Turkish coast of *H. dianthus* was from İzmir (Aegean Sea) by Quatrefages (1865).

Then Çinar *et al.* (2008) reported the species as an alien species for the Mediterranean from İzmir Bay (Aegean Sea) and Çinar *et al.* (2020) from the Sea of Marmara. The present record is the first for the Turkish coast of the Black Sea although it was previously reported for the Black Sea fauna in 2011 from Sevastapol (Crimea Ukraine) by Boltachova *et al.* (2011).

Hydroides dianthus forms dense populations especially in harbour environments (Bianchi and Moori 2001; Toonen and Pawlik 2001; Çinar *et al.* 2008). The species inhabits subtropical to tropical marine and brackish waters with salinity levels of 1-51.7‰ and temperatures of 3-30°C (Zibrowius 1971; Haines and Maurer 1980; Bianchi and Morri 2001). It occurs from the intertidal to the sublittoral zone (0-189 m). *Hydroides dianthus* colonizes a great variety of natural and artificial hard substrates including oyster shells (*Crassostrea* spp.), mussel beds (*Mytilus galloprovincialis* Lamarck 1819), other mollusk shells, corals, seagrasses (*Posidonia oceanica* (L.) Delile), macroalgae, sponges, bryozoan nodules, vermetid-covered fort walls, ascidians, rocks, wooden dock pilings, and other artificial structures (Zibrowius 1971; Bastida-Zavala and Salazar-Vallejo 2000; Bastida-Zavala and ten Hove 2002; Çinar *et al.* 2008, 2020; Link *et al.* 2009; Ben-Eliahu and ten Hove 2011).

While the debate about whether *H. dianthus* is a cryptogenic or an alien species (Zenetos *et al.* 2017) continues, a recent study based on the molecular genetic analysis of mtDNA COI sequences from 17 locations around the world revealed the existence of two previously unknown species lineages (Sun *et al.* 2017). The study suggests that the species may have originated in the Mediterranean and that the Black Sea populations of *H. dianthus* were introduced directly from an American population. Following Sun's study this species was regarded as native to the Mediterranean Sea. Since Grosse *et al.* (2021) reported that an alleged native lineage and a Caribbean-origin lineage as described by Sun *et al.* (2017) coexisted in a harbour of the Mediterranean, Langaneck *et al.* (2024) suggested that *H. dianthus* should be precautionarily considered cryptogenic in the Mediterranean. This recent finding coupled with the fact that the species is strictly associated with harbour environments and artificial substrata has led to its reclassification as an invasive alien species in the region (Çinar *et al*. 2024a).

The anthozoan *Marmara musculata,* originally described from the Sea of Marmara (Ocaña and Çinar 2018), which gave it its genus name, was first discovered along the entire Black Sea coast in the present study. It was found on muddy sand bottoms with its base attached to stones or shell fragments at depths ranging from 10 to 50 m in the type locality. In the present study we found specimens between 19-41 m depths on the shells of *Anadara kagoshimensis* (Tokunaga 1906) and *Chamelea gallina* (Linnaeus 1758) living on sand and mud with shell fragments and on plastic debris. The morphological and taxonomic features of the Black Sea specimens are consistent with the original description of those from the Sea of Marmara. This tiny anthozoan initially known only from

the Sea of Marmara is now frequently encountered along the Turkish Black Sea coast prompting debate over whether it is native or alien status.

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Author contributions: G.K. and M.E.Ç. planned the study. G.K., M.E.Ç. and Ü.A. collected the samples. G.K. and M.E.Ç. performed the laboratory work and conducted data analysis. G.K. and M.E.Ç. wrote the original manuscript draft with input from all the authors. All authors contributed to the article and approved the submitted version.

Karadeniz'de iki makrobentik omurgasız türünün yeni kayıtları: *Marmara musculata* (Cnidaria: Anthozoa) ve *Hydroides dianthus* (Annelida: Polychaeta)

Öz

Bu çalışma, Karadeniz'in Türk kıyıları boyunca bulunan iki makrobentik omurgasız türü hakkında bilgi vermektedir. Anthozoan *Marmara musculata*, ilk olarak 2017 yılında Kıyıköy açıklarından toplanan sert substratum materyalleri arasında tespit edilmiş ve daha sonra 2022 ve 2024 yıllarında Türkiye Karadeniz kıyıları boyunca 19-41 m derinliklerde çeşitli lokasyonlardan toplanan bentik materyaller arasında yaygın olarak bulunmuştur. İstilacı yabancı serpulid türü *Hydroides dianthus* ise Samsun'da 0,1-0,5 m derinlikteki liman ortamlarında ve çevresindeki yapay substratumlarda ve Rize'de 28 m derinlikteki plastik yüzeylerde tespit edilmiştir. Türler arasında *M. musculata* Karadeniz için, *H. dianthus* ise Türkiye Karadeniz kıyıları için yeni kayıttır.

Anahtar kelimeler: Poliketler, anthozoanlar, yabancı türler, fouling türler, Türkiye

References

Andriescu, I. (1977) Le zoobenthos de l'ecosysteme des fonds rocheux de la côte Roumaine de la Mer Noire. *Biologie des eaux saumatres de la Mer Noire* 1: 117-127.

Băcescu, M. (1977) Les biocenoses benthiques de la Mer Noire. *Biologie des eaux saumatres de la Mer Noire Premiere partie*: 128-134.

Băcescu, M., Müller G.I., Gomoiu M.T. (1971) Benthic ecology research in the Black Sea Quantitative qualitative and comparative analysis of the Pontic benthic fauna. *Marine Ecology* 4: 357.

Bakir, A.K., Aker H., Özgen Ö., Durucan, F. (2024) Diversity of Marine Arthropoda along the coasts of Türkiye. *Turkish Journal of Zoology* 48(6): 446-530.

Bastida-Zavala, J.R., Salazar-Vallejo, S.I. (2000) Serpúlidos (Polychaeta: Serpulidae) del Caribe noroccidental: *Hydroides* y *Serpula*. *Revista de Biología Tropical* 48: 841-858.

Bastida-Zavala, J.R., McCann, L.D., Keppel, E., Ruiz, G.M. (2017) The fouling serpulids (Polychaeta: Serpulidae) from United States coastal waters: an overview. *European Journal of Taxonomy* 344: 1-76.

Bastida-Zavala J.R., ten Hove H.A. (2002) Revision of *Hydroides* Gunnerus, 1768 (Polychaeta: Serpulidae) from the Western Atlantic Region. *Beaufortia* 52(9): 103-178.

Bat, L., Kurt, G., Mülayim, A., Çağlar, S., Öztekin, A. (2024) Long-term changes and causes of biota assemblages in the southern Black Sea coasts. *Marine Biology Research* 20(7-8): 251-265.

Begun, T., Teacă, A., Gomoiu, M.T. (2010) State of the macrobenthos within *Modiolus phaseolinus* biocoenosis from Romanian Black Sea continental shelf. *Geo-Eco-Marina* 16: 5-18.

Ben-Eliahu, M.N., ten Hove, H.A. (2011) Serpulidae (Annelida: Polychaeta) from the Suez Canal-From a Lessepsian migration perspective. *Zootaxa* 2848: 1-147.

Bianchi, C.N., Morri, C. (2001) The battle is not to the strong: serpulid reefs in the lagoon of Orbetello (Tuscany Italy). *Estuarine Coastal and Shelf Science* 53: 215-220.

Boltachova, N.A., Lisitskaya, E.V., Lebedovskaya, M.V. (2011) New record of *Hydroides dianthus* (Verrill, 1873) (Polychaeta: Serpulidae) from the coastal waters of Crimea (the Black Sea). *Marine Ecological Journal* 10(2): 34-38. (in Russian)

Boltachova, N.A., Mazlumyan, S.A., Kolesnikova, E.A., Makarov, M.V. (2006) Long-term changes of the shallow sea benthos near Sevastopol (The Black Sea). *Ekologiya Morya* 72: 5-13. (in Russian)

Czerniavsky, V. (1880) Materialia ad zoographiam Ponticam comparatam. Fasc. 3. Subordo Vermes. II. Polychaeta. *Bulletin de la Société Impériale des Naturalistes de Moscou* 55: 213-363.

Czerniavsky, V. (1881) Materialiaad zoographiam Ponticam comparatam. Fasc. 3. Subordo Vermes II. Polychaeta. *Bulletin de la Société Impériale des Naturalistes de Moscou* 56: 338-420.

Czerniavsky, V. (1882) Materialia ad zoographiam Ponticam comparatam. Fasc. 3. Vermes II. Polychaeta. *Bulletin de la Société Impériale des Naturalistes de Moscou* 57: 146-198.

Çinar, M.E., Açik, Ş., Aker, H.V. (2024b) Diversity of Cnidaria and Ctenophora from the coasts of Türkiye. *Turkish Journal of Zoology* 48(6): 356-378.

Çinar, M.E., Açik Ş., Kurt G., Erdoğan-Dereli, D. (2024a) Diversity of Annelida from the coasts of Türkiye. *Turkish Journal of Zoology* 48(6): 413-445.

Çinar, M.E., Bakir, K., Öztürk, B., Doğan, A., Açik, S., Kirkim, F., Dağli, E., Kurt, G., Evcen, A., Koçak, F., Bitlis, B. (2020) Spatial distribution pattern of macroinvertebrates associated with the black mussel *Mytilus galloprovincialis* (Mollusca: Bivalvia) in the Sea of Marmara. *Journal of Marine Systems* 211: 103402.

Çinar, M.E., Bilecenoğlu, M., Yokeş, M.B., Öztürk, B., Taşkin, E., Bakir, K., Doğan, A., Açik, Ş. (2021) Current status (as of end of 2020) of marine alien species in Turkey. *PloS One* 16(5): e0251086.

Çinar, M.E., Dağli, E., Kurt Şahin, G. (2014) Checklist of Annelida from the coasts of Turkey. *Turkish Journal of Zoology* 38: 734-764.

Çinar, M.E., Erdoğan-Dereli, D. (2023) Polychaetes (Annelida: Polychaeta) off Kıyıköy (Black Sea, Türkiye) with descriptions of three new species. *Zootaxa* 5383: 537-560.

Çinar, M.E., Gönlügür-Demirci, G. (2005) Polychaete assemblage on shallow-water benthic habitats along the Sinop Peninsula (Black Sea, Turkey). *Cahiers de Biologie Marine* 46: 253-263.

Çinar, M.E., Katagan, T., Koçak, F., Öztürk, B., Ergen, Z., Kocatas, A., Önen, M., Kirkim, F., Bakir, K., Kurt, G., Dağli, E., Açik, S., Doğan, A., Özcan, T. (2008) Faunal assemblages of the mussel *Mytilus galloprovincialis* in and around Alsancak Harbour (Izmir Bay, eastern Mediterranean) with special emphasis on alien species. *Journal of Marine Systems* 71: 1-17.

Çinar, M.E., Ürkmez, D., Yokeş, M.B. (2024c) Diversity of Platyhelminthes, Xenacoelomorpha, Nematoda, Acanthocephala, Brachiopoda, Kinorhyncha, Nemertea, Chaetognatha, Tardigrada, Gastrotricha, Rotifera, Phoronida, Echinodermata and Chordata (Tunicata, Cephalochordata, and Hemichordata) from the coasts of Türkiye. *Turkish Journal of Zoology* 48(6): 379-412.

Dumitrache, C., Tănase, M.C., Filimon, A., Marin, O., Abaza, V. (2024) Current status of zoobenthic fauna associated with macroalgae fields from the southern Romanian Black Sea coast. *Cercetări Marine - Recherches Marines* 54: 56-69.

Evcen, A., Topaloğlu, B. (2024) Diversity of porifera along the coasts of Türkiye. *Turkish Journal of Zoology* 48(6): 341-355.

Filimon, A., Abaza, V., Marin, O., Dumitrache, C. (2016) Community structure of zoobenthos associated with *Cystoseira barbata* facies from the southern Romanian Black Sea coast. *Journal of Environmental Protection and Ecology* 3: 942-949.

Gözler, A.M., Ağırbaş, E., Şahin, C. (2009) Spatial and temporal distribution of Nereidae (Polychaeta: Annelida) along the coast of Turkish eastern Black Sea in the upper-infralittoral zone. *Journal of Animal and Veterinary Advances* 8: 229-234.

Gözler, A.M., Kopuz, U., Ağırbaş, E. (2010) Seasonal changes of invertebrate fauna associated with among algae *Cystoseira barbata* facies of Southeastern Black Sea coast. *African Journal of Biotechnology* 9: 8852-8859.

Grintsov, V.A., Murina, V.V., Evstigneeva, I.K. (2005) Biodiversity and structure of fouling community on the hard substrata of Karadag natural reservation (the Black Sea). *Marine Ecological Journal* 4: 37-47. (in Russian)

Grosse, M., Pérez, R., Juan-Amengual, M., Pons, J., Capa, M. (2021) The elephant in the room: first record of invasive gregarious species of serpulids (calcareous tube annelids) in Majorca (western Mediterranean). *Scientia Marina* 85: 15-28.

Haines, J.L., Maurer, D. (1980) Benthic invertebrates associated with a serpulid polychaete assemblage in a temperate estuary. *Internationale Revue der Gesamten Hydrobiologie* 65(5): 643-656.

Kiseleva, M.I. (1981) Benthos of the Soft Bottoms of the Black Sea. Naukova Dumka Kiev, 168. (in Russian)

Kiseleva, M.I. (1988) A characteristic of benthos changes of many years in the littoral zone of the area of Sevastopol. *Marine Ecological Journal* 28: 26-32. (in Russian)

Koçak, F., Aydin, S. (2024) Diversity of Bryozoa along the coasts of Türkiye. *Turkish Journal of Zoology* 48(6): 572-588.

Kurt Şahin, G., Çinar, M.E. (2012) A check-list of polychaete species (Annelida: Polychaeta) from the Black Sea. *Journal of the Black Sea/Mediterranean Environment* 18: 10-48.

Kurt-Sahin, G., Çinar, M.E., Dagli, E. (2019) New records of polychaetes (Annelida) from the Black Sea. *Cahiers de Biologie Marine* 60: 153-165.

Kurt Şahin, G., Dağlı, E., Sezgin, M. (2017a) Spatial and temporal variations of soft bottom polychaetes of Sinop Peninsula (southern Black Sea) with new records *Turkish Journal of Zoology* 41(1): 89-101.

Kurt-Şahin, G., Sezgin, M., Ünlüer, F., Öztürk, B., Cavdar, E., Dağlı, E. (2017b) Macrozoobenthic community structure of İğneada region in Turkey (the southwestern Black Sea). *Oceanological and Hydrobiological Studies* 46: 340-349.

Kuş, S., Kurt, G., Çinar M.E. (2021) Nephtyidae (Annelida: Polychaeta) from the Sea of Marmara and Black Sea with descriptions of two new species. *Zootaxa* 5060: 183-214.

Kuş, S., Kurt-Şahin, G. (2016) Temporal Changes in the Polychaeta (Annelida) Community Associated with *Cystoseira* Beds of Sinop Peninsula (Southern Black Sea). *Turkish Journal of Fisheries and Aquatic Sciences* 16: 61-68.

Langeneck, J., Putignano, M., Dimichele, D., Giangrande, A., Bilan, M., Toso, A., Musco, L. (2024) Non-indigenous polychaetes along the Salento Peninsula: new records and first molecular data. *Mediterranean Marine Science* 25: 184-203.

Link, H., Nishi, E., Tanaka, K., Bastida-Zavala, R., Kupriyanova, E.K., Yamakita, T. (2009) *Hydroides dianthus* (Polychaeta: Serpulidae) an alien species introduced into Tokyo Bay Japan. *Biodiversity Records* 6430: 1-6.

Lisitskaya, E.V., Boltacheva, N.A., Lebedovskaya, M.V. (2010) New Ukranian fauna species *Polydora websteri* (Hartman, 1943) (Polychaeta: Spionidae) from the coastal waters of Crimea (Black Sea). *Marine Ecological Journal* 9: 74-80. (in Russian)

Losovskaya, G.V., Sinegub, I.A., Rybalko, A.A. (2004) Comparison of species composition and quantative development of polychaetes in fouling and benthos of Odessa port. *Marine Ecological Journal* 51-58. (in Russian)

Marinov, T. (1977) Fauna of Bulgaria. In: BristleWorms (Polychaeta). Vol. 6. Bulgarskata Akademijana Naukite Sofia, 258. (in Bulgarian)

Ocaña, O., Çinar, M.E. (2018) Descriptions of two new genera six new species and three new records of Anthozoa (Cnidaria) from the Sea of Marmara. *Journal of Natural History* 52(35-36): 2243-2282.

Oğuz, T., Öztürk, B. (2011) Mechanisms impeding natural Mediterranization process of Black Sea fauna. *Journal of the Black Sea / Mediterranean Environment* 17(3): 234-253.

Otani, M., Yamanishi, R. (2007) Two newly recorded alien species *Rhithropanopeus harrisii* (Crustacea; Panopeidae) and *Hydroides dianthus* (Polychaeta; Serpulidae). *Sessile Organ* 24: 161. (in Japanese)

Otani, M., Yamanishi, R. (2010) Distribution of the alien species *Hydroides dianthus* (Verrill, 1873) (Polychaeta: Serpulidae) in Osaka Bay Japan with comments on the factors limiting its invasion. *Plankton and Benthos Research* 5(2): 62-68.

Öztürk, B., Bitlis, B., Türkçü, N. (2024) Diversity of mollusca along the coasts of Türkiye. *Turkish Journal of Zoology* 48(6): 531-571.

Quatrefages, A. (1865) *Histoire naturelle des Annéles marins et d'eau douce. Annélides et Géphyriens.* Paris: Librairie Encyclopédique de Roret 331.

Revkov, N.K., Boltacheva, N.A., Nikolaenko, T.V., Kolesnikova, E.A. (2002) Zoobenthos biodiversity over the soft bottom in the Crimean coastal zone of the Black Sea. *Marine Biology* 42: 561-571.

Sezgin, M., Kocataş, A., Katağan, T. (2001) Amphipod fauna of the Turkish central Black Sea fauna. *Turkish Journal of Zoology* 25: 57-61.

Sezgin, M., Katağan, T. (2007) An account of our knowledge of the amphipod fauna of the Black Sea. *Crustaceana* 80(1): 1-11.

Shalovenkov, N.N. (2022) Distribution of alien zoobenthic species on the Black Sea Shelf. *Russian Journal of Biological Invasions* 13: 23-139.

Stoykov, S., Ouzounova, S. (1998) Biodiversity of macrozoobenthos along Bulgarian coastal shelf zone in the period 1995-1997. International Conference on Marine Industry, Varna (ed. Bogdanov, P.A.) III, pp. 215-222.

Sun, R., Yang, D. (2000) Study on *Hydroides* (Polychaeta: Serpulidae) from waters off China. *I. Studia Marina Sinica* 42: 116-135.

Sun, Y., Wong, E., Keppel, E., Williamson, J.E., Kupriyanova, E.K. (2017) A global invader or a complex of regionally distributed species? Clarifying the status of an invasive calcareous tubeworm *Hydroides dianthus* (Verrill, 1873) (Polychaeta: Serpulidae) using DNA barcoding. *Marine Biodiversity* 164: 28.

Surugiu, V., Revkov, N., Todorova, V., Papageorgiou, N., Valavanis, V., Arvanitidis, C. (2010) Spatial patterns of biodiversity in the Black Sea: An assessment using benthic polychaetes. *Estuarine Coastal and Shelf Science* 88: 165-174.

Teacă, A., Begun, T., Mureşan, M., Menabit, S., Popa, A., Pavel, A.B. (2025) Unveiling the diversity of benthic habitats of the Romanian Black Sea coast: New records and an updated checklist. *Global Ecology and Conservation* 63: e03885.

Todorova, V., Konsulova, T. (2000) Long term changes and recent state of macrozoobenthic communities along the Bulgarian Black Sea coast. *Mediterranean Marine Science* 1: 123-131.

Toonen, R.J., Pawlik, J.R. (2001) Settlement of the gregarious tube worm *Hydroides dianthus* (Polychaeta: Serpulidae). I. Gregarious and nongregarious settlement. *Marine Ecology Progress Series* 224: 103-114.

Verrill, A.E. (1873) Report upon the Invertebrate Animals of Vineyard Sound and the Adjacent Waters with an Account of the Physical Characters of the Region. Report of the United States Commission for Fisheries 1871-72, pp. 295-778.

Zaitsev, Yu.P., Alexandrov, B.G. (1998) Black Sea Biological Diversity – Ukraine. Black Sea Environmental Series, 7, United Nations Publishing.

Zaitsev, Yu.P., Alexandrov, B.G., Berlinsky, N.A., Zenetos, A. (2002) Europe's Biodiversity - Biogeographical Regions and Seas: The Black Sea An Oxygen-

poor Sea. Environmental Issue Report, EEA (European Environment Agency), Copenhagen.

Zenetos, A., Çinar, M.E., Crocetta, F., Golani, D., Rosso, A., Servello, G., Shenkar, N., Turon, X., Verlaque, M. (2017) Uncertainties and validation of alien species catalogues: the Mediterranean as an example. *Estuarine Coastal and Shelf Science* 191: 171-187.

Zenetos, A., Çinar, M.E., Pancuci-Papadopoulou, M.A., Harmelin, J.G., Furnari, G., Andaloro, F., Bellou, N., Streftaris, N., Zibrowius H. (2005) Annotated list of marine alien species in the Mediterranean with records of the worst invasive species. *Mediterranean Marine Science* 6(2): 63-118.

Zibrowius, H. (1971) Les espèces méditerranéennes du genre *Hydroides* (Polychaeta: Serpulidae). Remarques sur le prétendu polymorphisme de *Hydroides uncinata*. *Téthys* 2: 691-745.

Zibrowius, H. (1973) Remarques sur trois espéces de Serpulidae acclimatées en Méditerranée: *Hydroides dianthus* (Verrill, 1873) *Hydroides dirampha* Morch, 1863 et *Hydroides elegans* (Haswell, 1883). *Rapport de la Commission Internationale de la Mer Mediterranee* 21: 683-686.

Zibrowius, H. (1978) Introduction du polychète Serpulidae japonaise *Hydroides ezoensis* sur la côte atlantique Française et remarques sur la repartition d'autres espèces de Serpulidae. *Téthys* 8: 141-150.