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Marine Mollusk Fauna of Kastamonu and Sinop Provinces: A Compiled list of Black Sea Mollusks of Turkey

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ABSTRACT

The study was carried out to determine Mollusca fauna of Kastamonu and Sinop coasts. A seasonal sampling procedure was performed in the area from a variety of biotops in 0-0.5 and 5m depths at 4 stations between July 2007 and May 2008. A total of 11 species and 16823 specimens belonging to Bivalvia; 15 species and 5482 specimens belonging to Gastropoda and 1 species and 1 specimens belonging to Polyplacophora classes were encountered during the study.

The presence of the cosmopolitan Bivalve, Pholas dactylus Linnaeus, 1758 was remarked for the first time in this study. Also, in this context, a list of Mollusca fauna of the Black Sea coasts of Turkey is compiled based on various studies carried out in Turkish coasts of the Black Sea.

KEYWORDS : Turkey coast, Central Black Sea (Kastamonu, Sinop), Marine Mollusca, Distribution

Introduction

The Black Sea, 420 000 km^2 in area and 2200 m deep, is the largest enclosed sea in the world (Zenkevich, 1963; Ross, 1977). The distinguishing features of the Black Sea is the shallow (150-200 m deep), oxic and biologically active top layer. The remaining 90% of its 5.37 km^3 volume is anoxic (Küçüksezgin, 1999). Also, although the Black Sea is a deep sea, it has limitations for deep sea organisms due to the hydrogen sulfide (H_2S) that emerges below the depths of 150-200m (Bakan and Buyukgungor, 2000; Zenkevicth, 1963).

Since the littoral zone along the Black Sea is very narrow, benthic living areas are very limited. Therefore, biodiversity, particularly of benthic species, is low in the Black Sea. However, the Mollusk phylum is the second largest group among all the animal groups following Arthropods, and the largest among marine organisms as regards species richness. Besides its species richness, it includes many commercially important species (Da Ros *et al*., 2003, Karayucel *et al*., 2003 and Sequeira *et al*., 2008).

The biodiversity of the Black Sea ecosystem includes some 2,050 species of animals including Arthropoda (over 590 species), Molluscs (206), Echinodermata (14), Fish (184) and Mammals (4 species) (Zaitsev, 2006). Approximately 2,700 invertebrate species are known within the Turkish seas, 57 of which have economic value. The largest number of commercial invertebrate species (48) was recorded from the Mediterranean and Aegean Sea coasts of Turkey (Dogan *et al*., 2007).

There have been many studies on Mollusca in the Black sea. Some of these, 206 (2 Loricata, 90 Bivalvia, 113 Gastropoda, 1 Scaphopoda) by Mordukhai and Boltovski (1969); 210 (3 Loricata, 88 Bivalvia, 118 Gastropoda ve 1 Scaphopoda) by Ivanov (1985) and 207 species by Kocataş *et al.* (2000) were reported from the Black Sea (Demirci, 2005). Also, 109 (41 Gastropoda, 68 Bivalvia) by Zaitsev and Alexandrow (1998) from the Black Sea coasts of the Ukraine; 42 (19 Gastropoda, 23 Bivalvia) by Komakhidze and Mazmanidi (1998) from the Black Sea coasts of the Georgia; 91 (2 Loricata, 43 Gastropoda, 46 Bivalvia) by Konsulov and Konsulova (2008) from the Black Sea coasts of the Bulgaria; 149 species (2 Polyplacophora, 80 Gastropoda, 66 Bivalvia, 1 Scaphopoda) by Micu (2004) from the Black Sea coasts of the Romania were reported.

As far as Turkey is concerned, investigations on the Black Sea Mollusk biodiversity are quite scanty and limited to information depth of finding and other details, except for Russian, Ukraine and Romania, some another countries coasts of the Black Sea. Also, There have been some studies on Mollusca in Turkish coasts of the Black Sea. These studies have begun since years of 1960'. 11 by Caspers (1968); 49 by Bacescu *et al.* (1971), 37 by Fisher *et al.* (1987), 37 by Mutlu *et al.* (1993), 49 by Kocatas *et al.* (2000), 108 by Ozturk (1998), 50 by Ozturk and Cevik (2000), 16 by Culha *et al.* (2000), 99 by Demir (2003), 23 by Demirci and Katagan (2004), 28 by Culha (2004), 8 species by Luth (2004), 26 by Ozturk *et al.* (2004), 33 by Demirci (2005), 14 by Culha *et al.* (2007), 15 species by Culha *et al.* (2007) were reported. As a result of the studies in Turkish coasts of the Black Sea carried out up to now, 183 Mollusca species have been identified.

Regarding all these knowledge, representatives of this phylum should be investigated from all aspects. The present study was carried out to determine Mollusca fauna (biodiversity) of Kastamonu and Sinop coasts located at the upper-infralittoral zone of the Southern Black Sea coasts.

Materials and Methods

Collection and evaluation of the study material

Mollusk specimens were obtained by sampling during July 2007 and May 2008 at 4 stations (2 stations from Sinop [Ayancık, Türkeli] and 2 stations from Kastamonu [Abana, Çatalzeytin] chosen at the Middle Black Sea, Abana: 41°58'51"N, 34°00'01"E; Çatalzeytin: 41°57'20"N, 34°11'58"E; Türkeli: 41°56'59"N, 34°20'37"E; Ayancık: 41°56'46"N, 34°34'41"E (Figure 1). A total of 32 (16 x 2 replicate) samplings were performed with 4 samplings for seasonaly.

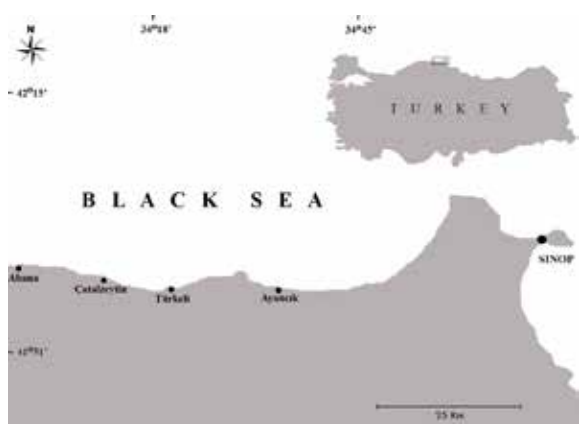

Figure 1. The position of four selected stations at Kastamonu and Sinop coasts.

Sampling at the 4 stations was conducted seasonally at various biotopes at depths of 0.5m – 5m. A spatula or shovel was used to collect specimens from a 20X20 cm area using a quadrate sampling methodology. The area of 400 cm^2 is suggested as being representative of the community structure (Kocataş, 1978). Sampling was carried out by free or scuba diving. Additionally, the physico-chemical parameters of the sampling stations were measured seasonally from the surface to ~1-2m depth using a WTW 340i multi Set water quality meter. The collected material was fixed in 4% formalin solution to be examined in the laboratory. Material was washed through a sieve with 0.5mm

and 1mm mesh size with the help of pressurized water and was then taken stored under 70% alcohol. Specimens were classified into groups using a stereo microscope and species were identified. Identification was performed according to shell characteristics and several reference sources, including Nordsieck (1968), Cachia *et al*. (1996, 2001), Graham (1971), Barash and Danin (1992), Butakov *et al*. (1997), Culha (2004), Dogan (2005). Sabelli *et al*. (1990, 1992) and Clemam (2008) were followed for the systematic index of the species.

Some information regarding the study area is presented in Table 1.

Table 1 Some data on the study stations (Rocky, *Ulva rigida* **+** *Enteromorpha* **sp.,** *Cystoseira* **spp.,** Sandy, Mudy)

Station No	Date	Depth (m)	Biotope	Sampling device	Latitude-Longitude
1 st. (Ayanck)	July 2007 Oct 2007 Jan 2008 Apr 2008	0-0.5&5	Ulv.+Ent., Cysto., R, S,	Quadrat, Spatula	41°56'48.97"N 34°34'46.63"E
2 st. (Türkeli)	July 2007 Oct 2007 Jan 2008 Apr 2008	0-0.5&5	R, S, M	Quadrat, Spatula	41°56'59.22"N 34°20'36.17"E
3 st. (Çatalzeytin)	July 2007 Oct 2007 Jan 2008 Apr 2008	0-0.5&5	R, S, M	Quadrat, Spatula	41°57'23.53"N 34°12'15.67"E
4 st. (Abana)	July 2007 Oct 2007 Jan 2008 Apr 2008	0-0.5&5	R, S, Cysto.	Quadrat, Spatula	41°58'46.40"N 34° 01'15.13"E

Results

Samples were collected between July 2007- May 2008, from four stations within the upper infralittoral zone of the Kastamonu and Sinop coasts of the Central Black Sea Region. Classification of the samples showed 27 species: 1 species of the class *Polyplacophora;* 15 *Gastropoda* and 11 species of *Bivalvia*. The present study also presents the results of previous studies carried out in Black Sea coasts on the phylum *Mollusca* (Table 2). In addition, there may be other species which prefer various depths and biotopes (pebbly, rocky, sandy etc). Previous studies indicated that, as a result of marine activities (waves, currents and storms etc), some species were carried to different biotopes and were sampled from these environments. For example, *Rapana venosa* Valenciennes 1846 which is an exotic species (India-Pacific Ocean) has been an increasingly dominant species within the Black Sea ecosystem. Some species (*Chamelea gallina*, *Donax trunculus*, *Mactra stultorum* etc.) generally prefer sandy biotopes. Similarly, *Lentidium mediterraneum* is one of the pollution indicator species that prefer sandy biotopes (Öztürk *et al*., 2004).

Anadara inaequivalvis is an exotic (India-Pacific) species that was observed in previous studies carried out in sandy areas of the Black Sea (Demirci, 2005), but which was not found in rocky environments of the present study. Mollusk studies carried out by different researchers in similar areas indicate different species. The distribution of species shows natural variation, due to different substratum preferences.

Mytilus galloprovincialis, which is common in the Black Sea region, was present at almost every station. This species was present in both algal and facies form. This species is generally present with *Mytilaster lineatus.* Demirci (*2005) stated that Mytilus galloprovincialis*, *Mytilaster lineatus*, *Lepidochitona caprearum, Gibbula adansonii, Tricolia pullus, Cerithiopsis minima,C.tubercularis, Rissoa splendida, Setia valvatoides, Ammonicera fischeriana, Chrysallida sp. Odostomia sp.* and *Abra sp.*. are dominant in rocky substrates. Table 2 lists the species mentioned in previous studies and in the present study; It should be noted that relatively few studies have been conducted in this field within the Black Sea coasts of Turkey. The fact that synonym species were included in previous studies (e.g. Demir, 2003) carried out in Black Sea coasts (including the straits system) causes some confusion in classification (Ozturk, 2005).

Taxonomic Findings

This study was conducted in order to determine the mollusk species at the upper infralittoral zone distributed in Sinop and Kastamonu coasts. At the end of the study, the identified species and the systematic category of those species were given. Previous studies of various authors concernig the Black Sea coasts were also given in the Table 2.

Tablo 2. List of the Mollusk species reported in the Black Sea coasts of Turkey (S: species found on this study, N: New Records of the Black Sea coasts of Turkey, 1–9: see references)

SPECIES	1	2	3	4	5	6	7	8	9	S	St1	St2	St3	St4	AM	E	B	IP	C	N
M O L L U S C A																				
POLYPLACOPHORA																				
Lepidochitona caprearum (Scacchi,1836)					+				+											
Chiton sp.	+																			
Acanthochitona fascicularis (Linné,1767)				+	+				+	+	+				+					
G a s t r o p o d a																				
Patella caerulea Linné, 1758	+	+				+				+	+			+	+					
Patella ulyssiponensis Gmelin, 1791				+											+					
Theodoxus danubialis (Pfeiffer, 1828)				+																
Theodoxus fluviatilis (Linné, 1758)				+																
Diodora graeca (Linné, 1758)	+			+											+					
Emarginula rosea Bell T., 1824				+											+					
Scisurella laevigata d'Orbigny, 1824	+														+					
Jujubinus exasperatus (Pennant, 1777)	+														+					
Gibbula adansonii (Payraudeau, 1826)	+	+	+	+	+	+			+	+	+	+	+	+		+				

Gibbula adriatica (Philippi, 1844)						**				+	+	+	+			+				**
Gibbula albida Gmelin, 1791	+			+		+										+				
Gibbula deversa Milaschewitsch, 1916	+															+				
Gibbula divaricata (Linné, 1758)	+			+		+									+					
Gibbula sp.			+																	
Calliostoma granulatum (Von Born, 1778)				+											+					
Tricolia pullus (Linné, 1758)				+	+	+			+	+	+	+	+	+		+				
Cerithium rupestre Risso, 1826	+														+					
Cerithium vulgatum Bruguière, 1789	+		+	+		+				+	+	+	+		+					
Bittium reticulatum (Da Costa, 1778)	+	+	+			+			+	+	+	+	+	+	+					
Bittium scabrum (Olivi, 1792)					+	+			+							+				
Cerithidium submamillatum (De Rayneval & Ponzi, 1854)				+	+	+			+	+	+	+	+	+		+				
Bittium sp.					+				+											
Turritella communis Risso, 1826	+			+											+					
Monophorus perversus (Linné, 1758)				+		+									+					
Cerithiopsis minima (Brusina, 1865)					+	+			+	+	+				+					
Cerithiopsis tubercularis (Montagu, 1803)				+	+	+			+	+	+	+		+	+					
Epitonium commune (Lamarck, 1822)				+		+									+					
Eulima glabra (Da Costa, 1778)	+														+					
Rissoa euxinica Milaschewitsch, 1909			+													?				
Rissoa labiosa (Montagu, 1803)				+		+				+	+	+	+	+	+					
Rissoa splendida Eichwald, 1830				+	+	+			+	+	+		+	+		+				
Rissoa variabilis (Von Mühlfeldt, 1824)					+				+							+				
Rissoa ventricosa Desmarest, 1814					+				+							+				
Pusillina dolium (Nyst, 1845)	+															?				
Pusillina inconspicula (Alder, 1844)				+											+					
Pusillina lineolata (Michaud, 1832)				+	+	+			+	+	+		+	+	+					
Pusillina parva (da Costa, 1778)		+		+													+			
Pusillina radiata (Philippi, 1836)									*							+				*
Setia valvatoides (Milaschewitsch,1909: Rissoa)					+				+						+					
Setia pulcherrima (Jeffreys, 1848)						+				+	+		+	+	+					
Alvania cimex (Linné, 1758)	+															+				
Caecum armoricum (de Folin, 1869)				+											+					
Caecum trachea (Montagu, 1803)				+		+									+					
Hydrobia acuta (Draparnaud, 1805)						**									+					**
Hydrobia sp.							+													
Ventrosia ventrosa (Montagu, 1803)	+	+				+											+			
Heleobia stagnarum (Gmelin, 1791)									*								+			*
Truncatella subcylindrica (Linné, 1767)				+											+					
Apporhais pespelecani (Linné, 1758)	+														+					
Calyptraea chinensis (Linné, 1758)	+	+	+	+		+			+						+					
Natica stercusmuscarum (Gmelin, 1791)				+											+					
Euspira fusca (de Blainville, 1825)	+			+											+					

Euspira guillemini (Payraudeau, 1826)				+											+					
Payraudeautia intricata (Donovan, 1804)	+														+					
Ocenebra erinaceus (Linné, 1758)	+														+					
Trophonopsis breviatus (Jeffreys, 1882)	+			+		+	+									+				
Trophonopsis muricatus (Montagu, 1803)	+	+		+												+				
Rapana venosa (Valenciennes, 1846)	+	+		+		+			+	+	+			+				+		
Coralliophila squamosa (Bivona Ant. in Bivona And., 1838)				+											+					
Nassarius incrassatus (Ström, 1768)	+			+											+					
Nassarius reticulatus (Linné, 1758)	+		+	+		+											+			
Cyclope neritea (Linné, 1758)	+	+	+	+	+	+			+	+	+		+	+	+					
Mitrella scripta (Linné, 1758)	+														+					
Bela nebula (Montagu, 1803)				+		+									+					
Mangelia pontica Milaschewitsch, 1908				+												+				
Mangelia costata (Donovan, 1804)						**									+					**
Ammonicera fischeriana (Monterosato, 1869)					+				+							+				
Chrysallida emaciata (Brusina, 1866)				+												+				
Chrysallida incerta (Milaschewitch, 1916)				+											+					
Chrysallida indistincta (Montagu, 1808)		+													+					
Chrysallida interstincta (Adams J., 1797)		+		+											+					
Chrysallida terebellum (Phillippi, 1844)	+			+											+					
Chrysallida sp.1					+				+											
Chrysallida sp.2									+											
Eulimella acicula (Philippi, 1836)				+											+					
Odostomia eulimoides Hanley, 1844				+													+			
Odostomia rissoides Hanley, 1844	+														?					
Odostomia scalaris MacGillivray,1843		+													+					
Odostomia sp.1					+				+											
Odostomia sp.2									+											
Turbonilla delicata Monterosato, 1874				+											+					
Retusa truncatula (Bruguière, 1792)	+	+		+			+								+					
Retusa sp.									+											
Cylichna cylindracea (Pennant,1777)	+														+					
Cylichnina umbilicata (Montagu,1803)	+	+													+					
Philine aperta (Linné, 1767)	+														+					
Aplysia depilans Gmelin, 1791	+															+				
Doto pontica Swennen, 1961	+														?					
Calmella cavolini (Vérany, 1846)	+															+				
Pontohedyle milatschevitchi (Kowalewsky 1901 : Hedyle)	+														?					
Turricaspia dybowskii Milachevitch, 1909	+														?					
Opisthobranchia spp.					+				+											
Bivalvia																				
Nucula nucleus (Linné, 1758)	+			+											+					

Nucula sulcata Bronn, 1831	+														+					
Nuculana commutata (Philippi, 1844)				+											+					
Arca noae Linné, 1758	+														+					
Arca tetragona Poli, 1795	+														+					
Anadara diluvii (Lamarck, 1805)	+														+					
Scapharca inaequivalvis (Bruguière, 1789)		+		+				+										+		
Striarca lactea (Linné, 1758)	+	+		+					+						+					
Mytilus galloprovincialis Lamarck, 1819	+	+	+	+	+		+	+	+	+	+	+	+	+	+					
Mytilaster lineatus (Gmelin, 1791)	+	+		+	+			+	+	+	+	+	+	+		+				
Mytilaster sp.								+												
Musculus marmoratus (Forbes, 1838)	+														?					
Modiolus barbatus (Linné, 1758)	+	+		+						+	+		+	+	+					
Modiolus adriaticus (Lamarck, 1819)	+	+						+		+	+				+					
Modiolula phaseolina (Philippi, 1844)	+	+		+			+	+							+					
Pinna rudis Linné, 1758	+	+													+					
Pecten jacobeus (Linné, 1758)	+														+					
Pseudamussium clavatum (Poli, 1795)				+											+					
Chlamys clavatus (Poli,1791)	+														+					
Chlamys varia (Linné, 1758)	+	+		+											+					
Chlamys flexuosa (Poli, 1795)		+													+					
Chlamys glabra (Linné, 1758)	+			+											+					
Chlamys sp.			+																	
Anomia ephippium (Linné, 1758)	+			+											+					
Pododesmus patelliformis (Linné, 1761)	+			+											+					
Ostrea edulis Linné, 1758	+	+		+					+	+	+			+	+					
Loripes lacteus (Linné, 1758)	+	+		+				+							+					
Lucinella divaricata (Linné, 1758)	+	+		+				+							+					
Myrtea spinifera (Montagu, 1803)			+	+											+					
Thyasira flexuosa (Montagu, 1803)	+														+					
Diplodonta rotundata (Montagu, 1803)				+											+					
Kellia suborbicularis (Montagu, 1803)	+	+																	+	
Hemilepton nitidum (Turton,1822)								***									+			***
Mysella bidentata (Montagu, 1803)	+	+		+											+					
Cardium sp.							+													
Acanthocardia echinata (Linné,1758)								+							+					
Acanthocardia paucicostata (Sowerby, G.B. II, 1841)	+	+		+				+							+					
Acanthocardia tuberculata (Linné,1758)	+	+		+											+					
Parvicardium exiguum (Gmelin, 1791)	+	+	+	+	+			+	+	+	+		+	+	+					
Plagiocardium papillosum (Poli,1795)	+	+	+												+					
Plagicardium simile (Milachevitch, 1909)							+								+					
Cerastoderma glaucum (Poiret, 1789)	+			+											+					
Mactra stultorum (Linné, 1758)	+	+		+											+					
Spisula solida (Linné, 1758)		+													+					
Spisula subtruncata (Da Costa, 1778)	+	+		+				+		+	+			+	+					

Donacilla cornea (Poli, 1795)	+			+				+							+					
Solen marginatus Pulteney, 1799	+	+		+											+					
Ensis ensis (Linné, 1758)	+																		+	
Tellina fabula Gmelin, 1791				+				+								+				
Tellina serrata Brocchi, 1814				+											+					
Tellina tenuis Da Costa, 1778	+	+		+				+							+					
Gastrana fragilis (Linné, 1758)		+		+				+							+					
Donax venustus Poli, 1795	+	+		+											+					
Donax trunculus Linné, 1758	+		+	+				+		+	+		+	+	+					
Abra nitida (Mueller,O.F., 1776)	+			+			+								+					
Abra prismatica (Montagu, 1808)	+	+						+							+					
Abra alba Wood, 1802	+	+	+	+				+							+					
Abra segmentum (Récluz,1843)								**							+					**
Abra sp.					+				+											
Solecurtus strigilatus (Linné, 1758)	+														+					
Glossus humanus (Linné, 1758)	+														+					
Venus casina Linné, 1758	+	+													+					
Chamelea gallina (Linné, 1758)	+	+	+	+				+		+		+	+	+	+					
Clausinella fasciata (Da Costa, 1778)	+														+					
Clausinella brongniartii (Payraudeau, 1826)				+												+				
Timoclea ovata (Pennant, 1777)				+											+					
Gafrarium minimum (Montagu, 1803)	+																	+		
Gouldia minima (Montagu, 1803)		+						+							+					
Dosinia exoleta (Linné, 1758)				+											+					
Pitar mediterranea (Dautzenberg, 1891)	+														+					
Pitar rudis (Poli, 1795)	+	+		+				+		+				+	+					
Irus irus (Linné ,1758)				+											+					
Paphia aurea (Gmelin, 1791)	+	+		+				+							+					
Petricola lithophaga (Philippson, 1788)				+											+					
Mya arenaria Linné, 1758	+	+															+			
Corbula gibba (Olivi, 1792)	+			+											+					
Lentidium mediterraneum (Costa O.G.,1829: Tellina)				+				+	+							+				
Gastrochaena dubia (Pennant, 1777)	+			+											+					
Hiatella arctica (Linné, 1767)	+			+															+	
Pholas dactylus Linné, 1758	+	+								+	+								+	
Barnea candida (Linné, 1758)	+	+		+											+					
Teredo navalis Linné, 1758	+														+					
Teredo utriculus Gmelin, 1791	+														+					
Nototeredo norvegica (Spengler, 1792)	+														+					
Hypanis plicata (Eichwald, 1829)	+														?					
Monodacna colorata (Eichwald, 1829)	+														?					
Monodacna caspia (Eichwald, 1829)				+											?					
Scaphopoda																				
Antalis inaequicostata (Dautzenberg,1891:Dentalium)	+															+				
TOTAL	102	50	16	95	23	28	8	26	33	27										

(*) and (**): New records, (***): New to the Turkish Mollusca Fauna

( ) Absent, (**+**) Present, **?** Questionable ; **St.1:** Ayancık, **St.2:** Türkeli, **St.3:** Çatalzeytin, **St.4:** Abana

AM: Atlanto-Mediterranean, E: Endemic, B: Boreal, IP: Indo-Pacific, C: Cosmopolitan

Ecological Findings

As a result of the evaluations for the collected samples, a total of 11 species and 16823 specimens belonging to Bivalvia; 15 species and 5482 specimens belonging to Gastropoda and 1 species and 1 specimens belonging to Polyplacophora classes were encountered during the study. Also, the presence of the cosmopolitan Bivalve, *Pholas dactylus* Linnaeus, 1758 was remarked for the first time in this study.

The seasonal distribution of the physicochemical parameters measured on site as in-situ. In addition to, analytical procedure and minimum and maximum ranges with (Mean±SD) are shown in Table 3.

Table 3. Minimum and maximum range and Mean ± SD from selected stations, of physicochemical parameters of sea water of Sinop and Kastamonu coasts and analytical procedure during the period July 2007 and May 2008

				St1			St2			St3			St4		
Variables	Abbreviations	Units	Analytical method	Mean ±SD	Min-Max		Mean ±SD	Min-Max		Mean ±SD	Min-Max		Mean ±SD	Min-Max	
Temperature	Temp	°C	WTW Multi 340i / SET handheld meter	15.67 ± 7,27	7.13	24.73	15.36 ± 6.66	7.72	23.54	14.72 ± 6.22	7.65	22.51	15.69 ± 6.32	9.26	24.19
Salinity	Saline	‰ (ppt)	WTW Multi 340i / SET handheld meter	17.35 ± 0.80	16.21	18.10	17.56 ± 0.82	16.80	18.45	18.40 ± 0.65	17.52	19.02	17.56 ± 1.32	16.09	19.22
pH	pH	µS cm-1	WTW Multi 340i / SET handheld meter	7.58 ± 1.04	6.14	8.57	8.13 ± 0.73	7.15	8.91	7.85 ± 0.73	6.79	8.46	8.03 ± 0.70	7.09	8.73
Dissolved Oxygen	DO	mg l^{-1}	WTW Multi 340i / SET handheld meter	6.39 ± 0.64	5.59	7.02	6.12 ± 0.53	5.43	6.71	6.38 ± 0.39	6.00	6.89	6.43 ± 0.62	6.01	7.35
Conductivity	EC	µS cm-1	WTW Multi 340i / SET handheld meter	24.55 ± 0.75	23.72	25.50	24.54 ± 1.07	23.17	25.62	24.00 ± 1.26	22.86	25.41	24.33 ± 0.85	23.12	25.00

Distribution of species and specimens according to sampling stations;

As a result of the qualitative investigations on the species identified, station 1, with the greatest abundance, was found to be represented by 25 species whereas the second most abundant station was established to be station 4 with 21 species, respectively. As the stations were examined based on the number of specimens, the highest number of specimens (11,750) were found at station 1 followed by station 4 (4215 specimens) and station 3 (3250 specimens). Otherwise, the lowest number of specimens (3091) was found at station 2 (Figure 2). Figure 2

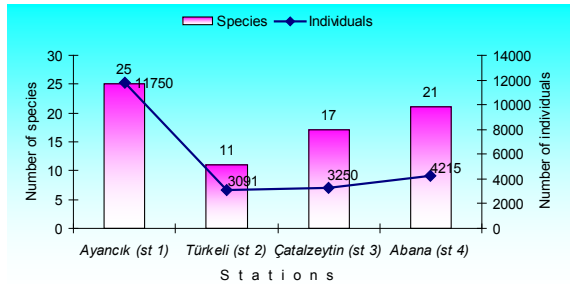

Figure 2. The distribution of species and specimens according to sampling stations.

*Seasonal distribution of species and specimens***;**

With regard to the seasonal distribution of the species found in study area, summer was the leading season with 27 species followed by spring with 24 species, autumn with 22 species and winter (17 species) with the lowest number of species. In the present seasonal study, the highest number of species and specimens were observed in summer, which provided warm waters and optimum environmental parameters (Figure 3, Table 3), whereas the lowest number of species and specimens were recorded in winter.

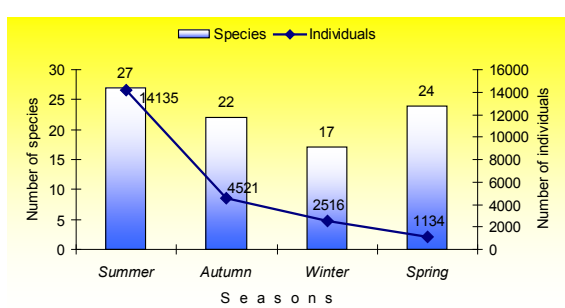

Figure 3. The seasonal distributions of the species and specimens found in the study area

*Distribution of the species and specimens belonging to biotops***;**

Five biotops were determined to the study area. These biotops were Rocky, *Ulva rigida* + *Enteromorpha* sp.., *Cystoseira* spp., Sandy and Mudy. When the number of species and individuals were examined based on their biotop distributions, the highest number of species in Rocky and *Cystoseira* spp. substratum were encountered with seven each species followed by in sandy substratum with six species, and finally the lowest number in *U. Rigida* & *Enteremorpha* sp. and mudy substratum with four each species (Figure 4).

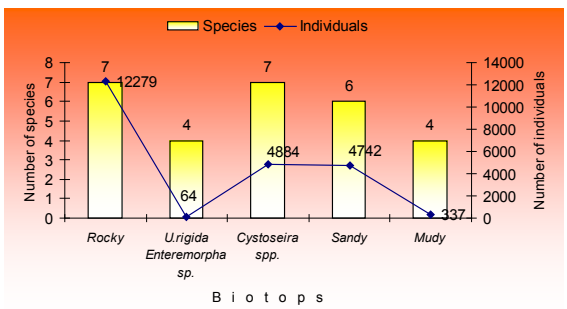

Figure 4. The distribution values of the species and specimens belonging to biotops.

Results and Discussion

The purpose of the present study was to determine the marine mollusk species within Kastamonu (Abana, Çatalzeytin) and Sinop (Ayancık, Türkeli) provinces. A total of 27 species were detected: 1 of these species belonged to the class *Polyplacophora*, 15 belonged to the class *Gastropoda* and 11 belonged to the class *Bivalvia*. In various previous studies, *Pusillina radiata* and *Heleobia stagnarum* (Demirci, 2005); *Gibbula adriatica*, *Hydrobia acuta* and *Mangelia costata* (Çulha, 2004), and; *Abra segmentum* (Öztürk *et al.,* 2004) were reported to be new records for the Black Sea coasts of Turkey. *Hemilepton nitidum* (Turton, 1822), on the other hand, is one of the new reported species of *Mollusca* within Turkey (Öztürk *et al.,* 2004). The present study and previous studies report a combined total of 183 species in the Black Sea coasts of Turkey. 3 of these species belonged to class *Polyplacophora*, 91 belonged to class *Gastropoda*, 88 belonged to class *Bivalvia* and 1 belonged to class *Scaphopoda*. A review of the literature indicated that previous studies in Sinop peninsula and neighbouring coasts analyzed different biotopes. Demirci G. and Katagan (2004), who mainly collected samples from rocky substrates, reported 23 species (19 *Gastrapoda*, 4 *Bivalvia*) in Ulva facies. The same species were also reported in other studies. Çulha *et al*. (2000) carried out studies in sandy biotopes in the same area, but reported 8 species (*Hinia reticulata, Myrtea spinifera, Rissoa euxinica, Monodonta sp., Parvicardium papillosum, Chamelea gallina, Donax trunculus, Chlamys sp.* that were not reported by Demirci (2005). Similarly, in a study carried out in Sinop peninsula and neighboring areas, Çulha (2004) reported 28 *Gastropoda*. Among these species, *Mangelia costata, Bela nebula, Nassarius reticulatus, Trophonopsis breviatus, Epitonium comune, Monophorus perversus, Ventrosia ventrosa, Caecum trachea, Setia pulcherrima, Rissoa labiosa, Gibbula divaricata, G. adriatica* and *G. Albida* were not reported in the study by Demirci (2005). In addition, there is a high probability that *Monodonta sp.,* the species detected in the study of Culha *et al*. (2000) belonged to the genus *Gibbula*. This is because the genus *Monodonta* is not present in the Black Sea coasts of Turkey. In a study by Öztürk *et al*. (2004) of sandy and hard substratum, 26 *Bivalvia* species were detected. In the study of Öztürk *et al.* (2004), the number of common species with other studies is quite low. In a deep water study carried out in Inebolu district (Central Black Sea), Luth (2004) detected 3 *Gastropoda* and 5 *Bivalvia* species. Some of the species detected in this study were *Plagicardium simile, Abra nitida milachewichi, Retusa truncatella, Trophonopsis breviata, Modiolus phaseolinus* (Demirci, 2005).

Potamopyrgus jenkinsi (Smith, 1889), *Theodoxus danubialis* (Pfeiffer, 1828) and *Theodoxus fluviatilis* (Linnaeus, 1758) are species of fresh and brackish waters. For example, *T. fluviatilis* may occur in water basins characterized by brackish water connected with the Black Sea (Butakov *et al.,* 1997). The species at issue in Demir's article (2003) may have been found in estuaries or in lakes connected to seawater However, the fact that no explanatory information was given within the discussion section of the article, leads to the conclusion that these were marine species, which is impossible (Öztürk, 2005).

When the stations were evaluated from the perspective of the number of species and specimens, the Ayancık station demonstrated the highest species-specimen numbers. This result was explained by the rocky and stony nature of the Ayancık station which provided a more diverse habitat than the other sampling stations and also by its location, which was almost more sheltered against external environment effects such as currents, winds etc. than other stations.

Consequently, different results were obtained in previous studies which were carried out at different times and in various localities of the Central Black Sea Region. The most important reason for this variation is that the studies used different biotopes, different zones (Supralittoral, infralittoral, mediolittoral etc.), different sampling types/ material and methods (Grab, Dredge, Quatrad etc.) and different depths. In addition, the utilization of updated sources (Öztürk and Çevik, 2000; Clemam, 2008; Sabelli *et al*., 1990, 1992) by researchers working in this field will reduce potential errors that may arise.

As a result of this study, further relevant studies about marine biodiversity, especially on the Black Sea coasts of Turkey, must be investigated from all perspectives in the future. There is a need for future research to investigate different locations, habitats and depths. By means of carried out such a studies, I believe that marine biodiversity of the Black Sea will be better understanding.

Conclusion

Most of the patterns mentioned above have been documented in shallow and offshore areas of Mediterranean, Aegean, Marmara (inland sea in north-west Turkey connected to the Black Sea by the Bosporus and connected to the Aegean by the Dardanelles) and Western Black Sea coasts (including the straits system) of Turkey but there have been relatively few gradient studies of benthic ecosystem in shallow water areas of the Black Sea. Mutlu (1990) showed that the species number was higher in the shallow water than in the deep waters of the Black Sea. The present study was carried out on infra-littoral zones and I investigated the biological diversity in macrobenthic fauna (especially in Mollusks) along some of the central part of the Black Sea coasts (Ayancık, Türkeli, Çatalzeytin and Abana). Issues related to the Mollusk biodiversity, no previous investigation has been carried out at those areas.

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REFERENCES

Bacescu, M.C., Muller G.I. and Gomoiu, M.T. 1971. Ecologie Marina Cercetari de ecologie bentala in Marea Negra Analiza cantitativa calitativa si comparata a faunei bentale pontice, Romania, Vol: IV, 357 p. | Caspers, H. 1968. La macrofaune benthique du Bosphore et les problèmes de L'infiltration des éléments méditerranéens dans la mer Noire, Rapp. Comm. Int. Mer Médit., 19, 2, 107-117 pp. | Clemam, 2008. Unitas Malacologica Check List of European Marine Mollusca, Internet site (current URL:http://www.mnhn.fr/base/malaco.html), Réalisé par J. Le Renard, B.I.M.M., M.N.H.N, Paris. | 3Culha, M., Bat, L., Akbulut M. and Satılmış, H.H. 2000. A study on Some Macrobenthic Organisms of İçliman Region of Sinop Peninsula, Turkey. National Fisheries Symposium, 20-22 September 2000, Sinop, Turkey, 456-477 pp. | 6Culha, M. 2004.Taxonomical and Ecological Characteristics of Prosobranchia (Mollusca-Gastropoda) Species Distributed around Sinop, PhD thesis, Aegean University, Izmir, 150 p. | Culha, M., Bat, L., Culha S.T.and Gargacı, A. 2007. Some Mollusk Species on the Hard-Bottom of Sınop Penınsula (Central Black Sea). Turkish Journal of Aquatic Life, USG–2007 Congress, 5–8: 3/5, 242–250 pp. | Culha, M., Culha, T. S., Celik, M. Y., 2007, Mollusca Species Belonging to Some Facies in the Upper-Infralittoral Zone of Central Black Sea Coasts (Sinop Peninsula), Muğla Univ. XIV. National Fisheries Symposium, 4-7 september, Kötekli, Muğla, Turkey. | 4Demir, M. 2003. Shells of Mollusca collected from the seas of Turkey, Turk J. Zool., 27, 101-140 pp. | 5Demirci G. G. and Katağan, T. 2004. Qualitative and Quantitative investigations on Ulva rigida facies from the upper infralittoral zone along Sinop coast, Middle Black Sea, International Workshop on Black Sea Benthos, 19-23 April 2004, İstanbul, Turkey, 164-173 pp. | 9Demirci, G.G. 2005. Mollusca Fauna of Sinop Peninsula (Middle Black Sea), Science and Eng. J. of Fırat Univ., 17 (3), 565-572 pp. | Fischer, W., Schneider M. and Bauchot, M.L. 1987. Mediterranee et Mer Noire, Vol.1, FAO, Rome, 760 p. | Fredj, G., Bellan-Santini D. and Meinardi, M. 1992. Etat des connaissances sur la faune marine Méditerranéenne, Bull. Inst. Océanogr., 9, 133-145 pp. | Giannuzi-Savelli, R., Pusateri, F., Palmeri A. and Ebreo, C. 1994. Atlante delle conchiglie marine del mediterraneo, Vol.I, Edizioni de "La Conchiglia", Roma, 125 p. | Giannuzi-Savelli, R., Pusateri, F., Palmeri A. and Ebreo, C. 1997. Atlante delle conchiglie marine del mediterraneo,Vol.II, Edizioni de "La Conchiglia", Roma, 258 p. | Giannuzi-Savelli, R., Pusateri, F., Palmeri A. and Ebreo, C. 1999. Atlante delle conchiglie marine del mediterraneo, Vol.III, Evolver srl, Roma, 127p. | Ivanov, L. 1985. The Fisheries Resources of The Mediterranean, Part two: Black Sea, FAO, Rome, No:60, 136 p. | Komakhidze A. and Mazmanidi, N. 1998. Black Sea Environmental Series, Vol:8, New York, 167 p. | | Kocataş, A., Ergen, Z., Mater, S., Özel, I., Katağan, T., Koray, T., Önen, M., Kaya, M, Taşkavak E. and Mavili, S. 2000. Biological Diversity of the Turkey Seas., Aegean Univ., Journal of Fisheries and Aquatic Sciences, 17: 3-4, 223-230 pp. | Konsulov A. and Konsulova T. 2008. Biological Diversity of the Black Sea Zoobenthos and Zooplankton, http:// www.bsponline.org/ bsp/ publications/ europe/ bulgaria/ bulgaria10html, 1–36 pp. | 7Luth, U. 2004. The benthos of the oxic/anoxic interface in the western black sea: Comparative macro and meiofauna investigations on transects from the Ukrainian, Romanian and Turkish Shelf, International Workshop on Black Sea Benthos, 19-23 April 2004, İstanbul, Turkey, 9-74 pp. | Micu, D. 2004. Annotated checklist of the marine mollusca from the Romanian Black Sea, International Workshop on Black Sea Benthos, 19–23 April 2004, B. Öztürk, V.O. Mokievsky and B. Toplaoğlu (Editors), İstanbul, 89-152 pp. | Milachewitch, K.O. 1916. Faune de la Russie et des pays Limitrophe, Les mollusques de mers Russes, Tome I, Petrograd, 312 p. | Mordukhai-Boltovskoi, F.D. 1969. From Determination of the Fauna of the Black and Azov Seas, Vol: 1–3, Kiev, 340p. | Mutlu, E., Unsal M. and Bingel, F. 1993. Faunal community of soft-bottom mollusc of the Turkish Black Sea, Doğa, Tr. J. of Zoology, vol 17, 189–206 pp. | Mutlu, E. 1990. A preliminary study on macrobenthic mollusc and crustaceans along the Anatolian coast of the Black Sea. M.Sc. Middle East Technical University, Institute of Marine Sciences, 178 p. | 1Ozturk, B. 1998. Black sea biological Diversity ,Turkey, Black Sea Environmental Series, Vol:9, New York, 144p. | 2Ozturk B. and Cevik, C. 2000. Molluscs fauna of Turkish Seas, Club Conchylia Informationen, 32, (1/3), 27-53 pp. | 8Ozturk, B., Culha M. and Urkmez, D. 2004. 1st National Malacology Congress (with International Partipication), 1-3 September 2004, Izmir, Turkey, 71-80 pp. | Ozturk, B., 2005. Comments On: Shells of Mollusca Collected from the Seas of Turkey, Turk J Zool, 29,111-112 pp. | Sabelli, B., Giannuzi-Savelli R. and Bedulli, D. 1990. Catalogo Annotato dei Molluschi Marini del Mediterraneo, Libreria Naturalistica Bolognese, 1, 1-348 pp. | Sabelli, B., Giannuzi-Savelli R. and Bedulli, D. 1992. Catalogo Annotato dei Molluschi Marini del Mediterraneo, Libreria Naturalistica Bolognese, 2, 349-498 pp. | Zaitsev Yu. P. and Alexandrov, B.G. 1998. Black Sea Biological Diversity Ukraine, Vol: 7, New York, 191p. | Zaitsev Yu. P. 2006. Severo-zapadnaya chast' Chernogo morya: biologiya i ekologiya/ Red. i dr. K.: Naukova dumka press, 701 p. |