ACTA ZOOLOGICA BULGARICA
Acta zool. bulg., 65 (2), 2013: 233-250

Seasonal Variations and Structure of the Molluscan Assemblage in the Canakkale Strait (Turkey)

***Herdem Aslan-Cihangir*[1], *Panayotis Ovalis*[2]**

[1] Canakkale Onsekiz Mart University, Gokceada School of Applied Sciences, PO Box 8 - 17760 Gokceada, Canakkale- Turkey. Email: ssherdem@comu.edu.tr, asherdem@gmail.com
[2] Panayotis Ovalis, Agisilaou 37-39, Tzitzifies / Kallithea, 176 74, Athens, Greece

Abstract: The molluscan assemblage of the Canakkale Strait (Turkish Strait System) was studied at depths ranging from 10 to 22 m, by means of the van Veen grab seasonally during 2006 and also at 7 stations, that are located in the middle part of the Canakkale Strait, at depths ranging from 40 to 83 m by means of box-core, van Veen grab and dredge during the summer of 2007. A total of 283 species were found in the strait. *Krachia cylindrata* (Jeffreys, 1885) was newly recorded in the East of the Mediterranean Sea and a total of 5 species [*Cerithiopsis scalaris* (Locard, 1892), *Melanella monterosatoi* (Monterosato, 1890), *Bela fuscata* (Deshayes, 1835), *Mangelia melitensis* Cachia and Mifsud, 2008 and *Cylichnina laevisculpta* (Granata-Grillo, 1877)] were newly recorded in the Turkish Seas. Furthermore, 37 mollusc species were newly recorded in the Turkish Strait System and 140 more species were recorded for the first time from the Canakkale Strait. *Bittium reticulatum* (da Costa, 1778) and *Mytilus galloprovincialis* Lamarck, 1819, were the most important species, representing 52% of the total 37024 specimens. No seasonal differences were found, while hydrodynamic conditions seem to be the factor controlling Mollusca recruitment in the Canakkale Strait.

Keywords: Dardanelles, Turkish Strait System, Mollusca, Biodiversity.

Introduction

The Mollusca fauna of the Mediterranean Sea consists of 2113 species (nine Caudofoveata, 29 Solenogastres, 31 Polyplacophora, one Monoplacophora, 1564 Gastropoda, 400 Bivalvia, 14 Scaphopoda and 65 Cephalopoda) (Coll *et al.* 2010). Ozturk, Cevik (2000) compiled the data on 745 Mollusca species distributed in the Turkish Seas. The Canakkale Strait is one of the most poorly studied areas regarding the Mollusca fauna in the Mediterranean Sea. According to Ozturk, Cevik (2000), 148 mollusc species were reported from the Canakkale Strait based on the literature of Colombo (1885), Marion (1898) and Pallary (1917). Following them, 12 new Mollusca species were reported by Palaz, Berber (2005), and 3 by Palaz, Colakoglu (2009) in the same area.

The Canakkale Strait, one of the two straits in the Turkish Straits System, constitutes a pathway between the Aegean basin of the Mediterranean Sea and the Marmara Sea that further communicates with the Black Sea through the Istanbul Strait at its other extremity. The Straits also play an important role as a biological corridor and barrier between the Mediterranean Sea and the Black Sea (Ozturk, Ozturk 1996).

The objectives of the present study were: 1) to investigate the biodiversity of the benthic Mollusca communities, and 2) to characterize the seasonal dynamics of the Mollusca fauna in the Canakkale Strait.

Materials and Methods

Study area

Fieldwork was carried out along the southern part of the Canakkale Strait, connecting the Sea of Marmara to the Aegean Sea (Turkey) (Fig. 1). It

has an approximate length of 70 km and an average width and depth of 3.5 km and 55 m respectively. The Strait has a well-defined two-layer stratification associated with a two-layer pattern of water exchange. The brackish Black Sea waters flow southward through the Canakkale Strait at the surface layer, while the more saline and dense waters of the Aegean Sea flow deeper in the opposite direction (Oğuz, Sur 1989, Stashchuk, Hutter 2001). The surface water outflow and bottom water inflow fluxes vary seasonally, as they depend upon wind stress and density differences above and below the pycnocline (Poulos *et al.* 1997).

Sampling

Bottom samples were obtained seasonally during 2006 by means of a 0.1 m^2 van Veen grab at 11 stations; six of them were located along the European shelf and the remaining five stations were in the Asian shelf. Samples were collected from depths between 7 and 26 m utilizing R/V Bilim 1 (Fig. 1a). At each station, three replicates were taken for benthic analysis. During the study, it was impossible to take grab samples at station CB in autumn due to the presence of *Mytilus galloprovincialis* facies. In addition, seven more stations located in the middle line of the Canakkale Strait were sampled by means of the van Veen grab, dredge and box-corer stationed on R/V K. Piri Reis from depths between 40-83 m on 22.06.2007 (Fig. 1b). Because of the high water hydrodynamism, the sampling gear's capacity was very low. Moreover, maritime traffic did not permit a long stay at each station. Therefore, a total of twelve samples were taken, but they cannot be considered as replicates and have been used in this study only for qualitative analyses. However, it must be noted that the present study was the first attempt to obtain benthic samples from this area. Coordinates, depth, sampling gear used, as well as sediment types are given in Table 1.

All benthic samples were sieved through a 0.5 mm mesh size sieve and then the retained fauna was fixed with a 4% formaldehyde-seawater solution. In the laboratory, the molluscs were separated under a stereomicroscope and preserved in 70% ethanol. The specimens were identified at the highest taxonomic level and counted as live and dead. The taxonomy used is that of Clemam (2011).

Data analysis

Univariate analyses were applied to characterise the community in terms of relative abundance and diversity. Margalef richness index (d), Pielou's evenness index (J') and Shannon-Wiener's diversity index (log_2 base) (H') were calculated at each station for each season. The frequency of species occurrence (Ci) was calculated to identify the most representative species; accordingly, each species was evaluated either as constant ($1 \geq Ci \geq 0.5$), or common ($0.5 > Ci \geq 0.25$), or rare ($Ci < 0.25$) (SOYER, 1970).

The numerical abundance data were analyzed by means of cluster and multidimensional scaling (MDS) techniques based on the Bray Curtis similarity using the PRIMER package ver. 5.0 (Clarke, Warwick, 2001). The cluster analyses were based on $log_{10}(x+1)$ transformation. The one-way ANOSIM permutation test was used to assess the significant differences between pre-defined groups of sample sites in the cluster analyses. SIMPER analysis was performed to identify the percentage contribution of each species to the overall similarity/dissimilarity within each species to the groups identified from the cluster analysis.

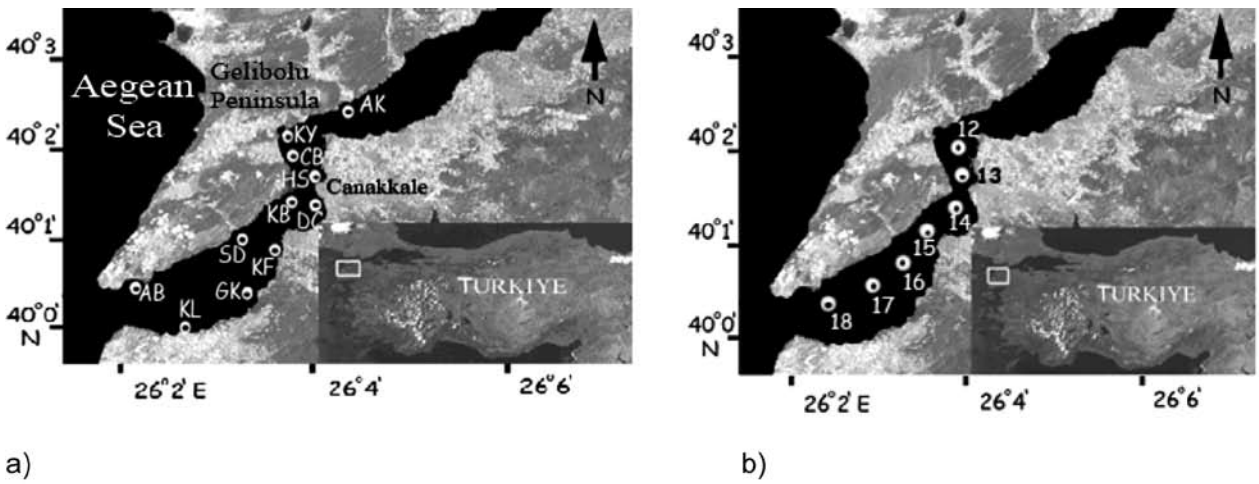

Fig. 1. Map of sites sampled in Canakkale Strait, a) coastal sites (seasonal samplings), b) mid-line area (sampled in June 2007). (from Aslan-Cihangir & Pancucci-Papadopolou 2011a).

Table 1. General characteristics of the study sites (from Aslan-Cihangir & Pancucci-Papadopolou 2011).

Station	Lat. (°N)	Long. (°E)	Depth (m)	Gear used	Sediment type
AK	40 13 605	26 25 735	19	van Veen Grab	sandy+muddy+stone
KY	40 12 094	26 22 005	12	van Veen Grab	sandy + detritus (shell)
CB	40 10 395	26 22 082	15	van Veen Grab	*Mytilus galloprovincialis*+sand
KB	40 08 296	2622 436	10	van Veen Grab	sandy + detritus (shell)
SD	40 05 923	26 19 004	15	van Veen Grab	sandy + *Posidonia oceanica*
AB	40 02 960	26 12 544	13	van Veen Grab	sandy + *Posidonia oceanica*
KL	40 00 252	26 14 884	22	van Veen Grab	muddy + *Caulerpa racemosa*
GK	40 02 409	26 20 011	20	van Veen Grab	muddy
KF	40 04 988	26 21 490	18	van Veen Grab	muddy
DC	40 07 783	26 23 786	19	van Veen Grab	sandy
HS	40 09 500	26 24 000	21	van Veen Grab	sandy + stone
12	40 11 603	26 23 366	60	van Veen Grab, dredge	stone
13	40 10 026	26 23 548	83	van Veen Grab	gravel
14	40 07 663	26 23 145	81	van Veen Grab	sandy
15	40 06 065	26 20 000	40	Box corer, dredge	sandy
16	40 04 333	26 18 668	60	Box corer	muddy
17	40 03 593	26 16 614	69	Box corer	muddy
18	40 01 749	26 13 342	83	Box corer	muddy

Results

A total of 283 Mollusca species were obtained from the entire study area. Gastropoda are the dominating species in number (191 species), followed by Bivalvia (80 species) and Polyplacophora and Scaphopoda (6 species). *Krachia cylindrata* was newly recorded in the East of the Mediterranean Sea, while *Cerithiopsis scalaris*, *Melanella monterosatoi*, *Bela fuscata*, *Mangelia melitensis*, and *Cylichnina laevisculpta* were newly recorded in the Turkish Seas. Furthermore, 37 mollusc species were newly recorded in the Turkish Strait System and 140 more species were recorded for the first time in the Canakkale Strait (Table 2).

The total number of species that were obtained from the middle line was 50 and 14 of them (*C. jussei, K. cylindrata, C. tubercularis, A. lactea, A. cf. punctura, N. lima, M olivoidea, E. ventricosa, O.cf. lukisi, A. tetragona, P. cf. scabrum, D. exolata, G. effosa and D. politus*) were identified only in the middle line (Fig. 1b). *J. exasperatus, B. lacteum, M. adversa, O. cf. lukisi, R. utriculus* and *D. politus* were not obtained as live specimens from the middle line. The maximum number of species was identified at station number 12 (30 species), while the minimum number of species was obtained from stations 15 and 18 (two species) (Fig. 2).

The remaining 269 species were identified in the shallow water. Examination of the collected living material unveils a total of 37027 ind./m^2 belonging to 236 mollusc species in the Canakkale Strait (Fig. 1a). The most important and characteristic species in the taxocoenosis were *B. reticulatum* and *M. galloprovincialis* representing 52% of the total number of specimens. The analysis of the frequency index revealed five common species ($0.50 > Ci \geq 0.25$) (*B. reticulatum*, *C. gibba*, *B. latreillii*, *A. cimex* and *P. rudis*) for the studied area while no constant species (≥ 0.50) was found. The other 231 species were rare species ($Ci < 0.25$).

Number of species based on temporal variation of living mollusc species (S), abundance (N), richness (d), diversity (H') and evenness (J) values at all stations are presented in Fig. 3. The highest number of total living species was found in winter (148 species), followed by spring (133 species) and then summer (123 species), while the lowest number of species (100 species) was found in autumn. Station KY showed the highest total number of live species (58) in the winter. The maximum abundance of living molluscs was obtained in winter (11997 ind./m^2), and it gradually decreased to 11837 ind./m^2 in spring, to 11119 ind./m^2 in summer and to 2074 ind./m^2 in autumn. Station KY showed the highest abundance of 15934 ind./m^2 (8137 ind./m^2 of it due to *B. reticulatum*). The highest diversity (H') and richness (d) values were observed in spring at station AB (1.4 and 7.6 respectively). The highest evenness (J) values (1) were observed at stations KL and KF in winter, at station GK in summer

Table 2. List of molluscs collected from Canakkale Strait and their abundance (ind m^{-2}), Numbers in the parentheses (x) indicate only the samples collected as shell. Ni: total abundance of living molluscs. α: new records for Turkish Seas, β: new records of for Turkish Strait System; γ: new records for the Canakkale Strait

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
POLYPLACOPHORA													
LEPTOCHITONIDAE													
Lepidopleurus cajetanus (Poli, 1791)$^{\beta}$		7										7	
Leptochiton africanus (Nierstraz, 1906)$^{\beta}$									3			3	
Leptochiton cimicoides (Monterosato, 1879)$^{\beta}$						7					20	27	
CHITONIDAE													
Chiton olivaceus Spengler, 1797					3						3	6	
ACANTOCHITONIDAE													
Acanthochitona fascicularis (Linne, 1767)$^{\gamma}$		12	8		7						10	37	
Acanthochitona crinita (Pennant, 1777)$^{\gamma}$		20									3	23	
GASTROPODA													
FISSURELLIDAE													
Diodora graeca (Linne, 1758)		15		(3)		(3)						15	
Diodora gibberula (Lamarck, 1822)		22		3			(3)				3	28	+
Diodora sp.									(3)			0	
TROCHIDAE													
Jujubinus striatus (Linne, 1758)				(47)37	(3)	(7)10	(10)7	(3)	(3)3			57	
Jujubinus exasperatus (Pennant, 1777)$^{\gamma}$		10		(7)7	(3)7	(6)10	(10)3	(23)10	(53)3			50	+
Jujubinus montagui (Wood, 1828)$^{\gamma}$						3					3	6	
Clanculus corallinus (Gmelin, 1791)		(10)		(3)								0	
Clanculus cruciatus (Linne, 1758)$^{\gamma}$	3	(25)98	10	(3)20	7	(3)	(3)				3	141	
Clanculus jussieui (Payraudeau, 1826)$^{\gamma}$												0	+
Gibbula divaricata (Linne, 1758)$^{\gamma}$		(10)5			3							8	
Gibbula albida (Gmelin, 1791)		50		3						(10)	7	60	
Gibbula adansonii (Payraudeau, 1826)	3	(3)37	5	(3)	(7)50						3	98	
Gibbula ardens (Salis, 1793)$^{\gamma}$		10		7	(3)7		3			(3)	3	30	
Gibbula turbinoides (Deshayes, 1835)$^{\beta}$			(17)3						(10)10			13	
Gibbula guttadauri (Phlippi, 1836)$^{\gamma}$		(20)		3		3						6	
Gibbula varia (Linne, 1758)		3									3	6	
Gibbula spratti (Forbes, 1844)$^{\beta}$				(7)	(7)7	7	(10)	3				17	
Gibbula racketti (Payraudeau, 126)					3	(3)						3	
Gibbula magus (Linne, 1758)					(3)							0	
Gibbula rarilineata (Michaud, 1829)$^{\beta}$								3				3	
Gibbula umbilicaris (Linne, 1758)									(3)			0	

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Phorcus richardi (Payraudeau, 1826)			(3)									0	
CALLIOSTOMATIDAE													
Calliostoma laugieri (Payraudeau, 1826)$^{\beta}$				(20)	7	(47)3	(17)10	(7)	7			27	
Calliostoma conulus (Linne, 1758)$^{\gamma}$											(3)7	7	
Calliostoma granulatum (Born, 1778)$^{\gamma}$						3						3	+
Calliostoma zizyphinum (Linne, 1758)				(13)					3			3	+
TURBINIDAE													
Bolma rugosa (Linne, 1767)								(10)				0	
PHASIANELLIDAE													
Tricolia speciosa (Megerle von Mühlfeld, 1824)$^{\gamma}$				37		(27)	(3)		(13)	(3)	(7)	37	
Tricolia tenuis (Michaud, 1829)$^{\gamma}$				(3)	(3)		(3)		(13)			0	
Tricolia pullus pullus (Linne, 1758)	(3)	(3)23		(43)3	(7)3	(40)	(3)	(10)	(57)	(3)		29	
Tricolia sp.				(13)								0	
NERITIDAE													
Smaragdia viridis (Linne, 1758)$^{\beta}$											3	3	
CERITHIIDAE													
Cerithium vulgatum Bruguière, 1792		(17)42		(3)3	(3)	(3)		(3)	3	7	3	58	
Cerithium sp.				(3)3								3	
Bittium latreillii (Payraudeau, 1826)	(10)50	1182	27	(37) 323	97	(23) 273	(3)90	(7)20	(17)3	(10)60	27	2152	
Bittium lacteum (Philippi, 1836)$^{\beta}$		117		(13)17	(67)	(173)	(110)			(40)		134	+
Bittium submamillatum (de Rayneval & Ponzi, 1854)$^{\gamma}$		7		(3)	(23)							7	
Bittium reticulatum (da Costa, 1778)	(33) 2080	(1000)8137	(13) 860	(20) 1170	(100) 577	(43) 107	(3) 33	73	(17)	(27) 263	(7)897	14197	
TURRITELLIDAE													
Turritella communis Risso, 1826	(70)10			(3)3		(1140)300	(793)3	(123) 17	(293)7	(86)	(3)	340	+
Turritella turbona Monterosato, 1877$^{\gamma}$						90			(157)			90	+
TRIPHORIDAE													
Marshallora adversa (Montagu, 1803)$^{\beta}$		43		(10)3		(17)7			3		3	59	+
Monophorus perversus (Linne, 1758)		(35)68		(7)37	3	10		(3)			13	131	
Monophorus sp.		(20)										0	
CERITHIOPSIDAE													
Dizoniopsis coppolae (Aradas, 1870)$^{\gamma}$							(3)					0	

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Krachia cylindrata (Jeffreys, 1885)[α]												0	+
Cerithiopsis tubercularis (Montagu, 1803)[γ]												0	+
Cerithiopsis scalaris Locard, 1892[α]		(5)		3			(3)					3	
Cerithiopsis sp.		3										3	
EPITONIIDAE													
Epitonium pulchellum (Bivona Ant. 1832)[γ]							(3)					0	
Epitonium cantrainei (Weinkauff, 1866)[γ]	3					(3)3		3				9	
Epitonium clathrus (Linne, 1758)[γ]	(10)3	(20)		(3)	7	(7)293	(7)	(7)	(23)	(7)	(3)	303	
Epitonium algerianum (Weinkauff, 1866)[γ]											5	5	
Epitonium turtonis (Turton, 1819)[γ]	7	35				(7)3						45	
EULIMIDAE													
Melanella polita (Linne, 1758)[γ]						3		(3)				3	
Melanella monterosatoi (Monterosato, 1890)[α]								3	3			6	
Eulima glabra (da Costa, 1778)[γ]	3			3		53	(7)	(3)10	3			72	
Eulima bilineata Alder, 1848[γ]				3		7	(3)3	3				16	
Eulima sp.						3						3	
Curveulima sp.						(3)						0	
RISSOIDAE													
Alvania geryonia (Nardo, 1847)[γ]					(3)13	7						20	+
Alvania cimex (Linne, 1758)	3	(13)707	(40)7	(137) 30	(27)97	(10) 127	(10)	(3)7	(13)		(3)13	991	+
Alvania testae (Aradas & Maggiore, 1844)[γ]											5	5	+
Alvania lactea (Michaud, 1830)[γ]												0	+
Alvania cimicoides (Forbes, 1844)[γ]				3								3	+
Alvania beanii (Hanley in Thorpe, 1844)[γ]						10		3			5	18	+
Alvania lineata Risso, 1826[β]						(3)					7	7	
Alvania cancellata (da Costa, 1778)[γ]				(3)		10					3	13	+
Alvania cf. punctura (Montagu, 1803)												0	+
Alvania sp.		5		(33)3						(13)		8	
Rissoa membranacea (Adams J., 1800)[γ]		23		(3)	(3)			(7)7	(7)17		(7)	47	
Rissoa ventricosa Desmarest, 1814		(1820)5			3			(10)10				18	
Rissoa splendida Eichwald, 1830	(10)90	(13) 103	(7)3	(73)10	(143) 147	(13)10	(3)		(13)	17	(10)30	410	+
Rissoa monodonta Philippi, 1836		(13)493		7						3		503	

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Rissoa similis Scacchi, 1836					3							3	
Rissoa auriscalpium (Linne, 1758)$^{\beta}$					(7)	(7)7	(13)	(3)3	(7)3			13	
Rissoa violacea Desmarest, 1814$^{\gamma}$		10				(10)13						23	
Rissoa guerinii Récluz, 1843$^{\gamma}$					3							3	
Rissoa sp.		(33)		(33)3								3	
Pusillina marginata (Michaud, 1830)$^{\beta}$	3	(2100)2003	(17)	(100)77	(7)	3			(37)	30	3	2119	
Pusillina inconspicua (Alder, 1844)$^{\gamma}$				(7)7		(17)33		(7)				40	
Pusillina radiata (Philippi, 1836)$^{\gamma}$	13	63		(13)50	3	(3)80		3			(7)23	235	
Pusillina lineolata (Michaud, 1830)$^{\beta}$	33	10		10	3	(3)3		(3)	7	3	(3)	69	
Pusillina philippi (Aradas & Maggiore, 1844)$^{\gamma}$				(3)3								3	
Pusillina sp.		23		(3)								23	
Manzonia crassa (Kanmacher,1798)$^{\gamma}$		(20)25		(20)40	3	(13)20	(10)7				13	108	+
Rissoina bruguieri (Payraudeau, 1826)$^{\gamma}$		(3)										0	
Obtusella sp.				(3)								0	
CAECIDAE													
Caecum trachea (Montagu, 1803)$^{\gamma}$		(13)8										8	
HYDROBIIDAE													
Peringia ulvae (Pennant, 1777)$^{\beta}$		(5)										0	
IRAVADIIDAE													
Hyala vitrea (Montagu, 1803)$^{\gamma}$						3	3					6	
TRUNCATELLIDAE													
Truncatella subcylindrica (Linne, 1758)			3									3	
APORRHAIDAE													
Aporrhais pespelecani (Linne, 1758)	(7)			3	(3)	(7)3	(3)3	(13)10	(20)			19	
CALYPTRAEIDAE													
Calyptraea chinensis (Linne, 1758)	(23)3	(8)13	3	(13)13	(10)	(23)3	(20)	(7)13	(13)3	3	(15)7	61	
Crepidula moulinsii Michaud, 1829$^{\gamma}$				3								3	
TRIVIIDAE													
Erato voluta (Montagu, 1803)						7						7	
NATICIDAE													
Euspira guillemini (Payraudeau, 1826)$^{\gamma}$						(7)				3		3	
Euspira pulchella (Risso, 1826)$^{\gamma}$	(7)3	5	3	(23)7	(203)13	(133)3	(123)7	(26)3	(130)7	(37)10	(33)5	66	+
Euspira cf. macilenta (Philippi, 1844)$^{\gamma}$		(3)										0	

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Neverita josephinia Risso, 1826					3							3	
Payraudeautica intricata (Donovan,1804)		(40)		(7)3	(3)3		3	(7)				9	
Notocochlis dillwynii (Payraudeau, 1826)$^{\beta}$						3	(63)	(37)	(57)		17	20	
MURICIDAE													
Bolinus brandaris (Linne, 1758)$^{\gamma}$				3					(3)3			6	
Hexaplex trunculus (Linne, 1758)	3				3	3						9	
Ocinebrina edwardsii (Payraudeau, 1826)			23		(7)17							40	
Ocinebrina aciculata (Lamarck, 1822)	7	(13)12			3	13		(3)33	(10)		13	81	
Ocinebrina sp.	3											3	
Muricopsis cristata (Brocchi, 1814)		3		(3)	10		3		(3)			16	
Trophonopsis muricatus (Montagu, 1803)$^{\gamma}$		8										8	
Granulina occulta (Monterosato, 1869)$^{\gamma}$							(3)					0	
Granulina marginata (Bivona Ant., 1832)$^{\gamma}$				(17)27		(3)7	(20)		3			37	
CYSTISCIDAE													
Gibberula cf. miliaria (Linne, 1758)$^{\beta}$				3								3	
CASTELLARIDAE													
Vexillum ebenus (Lamarck, 1811)$^{\beta}$				3								3	
BUCCINIDAE													
Euthria cornea (Linne, 1758)				(3)				(3)				0	
Engina leucozona (Philippi, 1843)		8										8	
Pollia dorbignyi (Payraudeau, 1826)$^{\gamma}$											3	3	
Chauvetia mamillata (Risso, 1826)$^{\beta}$						3	3					6	
NASSARIIDAE													
Nassarius nitidus (Jeffreys, 1867)$^{\gamma}$	(40)67	(13)20	(13)3	(3)	(20)3		3			(3)10	10	116	
Nassarius lima (Dillwyni, 1817)$^{\beta}$												0	+
Nassarius pygmaeus (Lamarck, 1822)$^{\gamma}$	(27)3	(5)62			(10)	(10)27	(73)3	(10)10	(10)	7		112	
Nassarus incrassatus (Ström, 1768)	(3)7	(17)20	(63)50	(17)7	(87)87	(3)30	(110)3	(13)	(33)3		37	244	
Nassarius cuvierii (Payraudeau, 1826)$^{\beta}$					3							3	
Cyclope neritea (Linne, 1758)			(3)7							10	3	20	
FASCIOLARIIDAE													
Fusinus pulchellus (Philippi, 1844)							(3)	(3)	(3)3			3	+
CONIDAE													
Mitromorpha olivoidea (Cantraine, 1835)$^{\gamma}$												0	+

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Bela menkhorsti van Aartsen, 1988[γ]				20	7	10	(7)	7	(10)			44	
Bela brachystoma (Philippi, 1844)[γ]	10	80		(3)	7	(7)30	(13)10	13	(7)7	17		174	+
Bela nebula (Montagu, 1803)[γ]	10	40		3	7	3			(7)	3		66	
Bela cf zonata (Locard, 1892)		5				10						15	
Bela fuscata (Deshayes, 1835)[α]		(200)			13	(13)20		3	(20)3	7		46	
Bela cycladensis (Reeve, 1845)[β]					(3)10							10	
Bela zenetouae (van Aartsen, 1988)[β]						3						3	
Bela taprurensis (Pallary, 1904)[β]					3							3	
Mangelia attenuata (Montagu, 1803)[γ]		(5)20	3	(3)		(3)13	3		3			42	+
Mangelia brusinae van Aartsen & Fehr-de Wal, 1978[γ]										3		3	
Mangelia melitensis Cachia & Mifsud, 2008[α]				3	3	3						9	
Mangelia costulata Risso, 1876[γ]	40	(100)160	7	(3)7	3	37	(30)	3	(3)7	17	3	284	
Mangelia costata (Pennant, 1777)[γ]	7											7	
*Mangelia unifasciata (*Deshayes, 1835)[γ]		(20)163	(13)3	(3)17	(3)7	(3)20	(3)			3	3	216	+
Mangelia barashi (van Aartsen & Fehr-de Wal, 1978)[β]				3								3	
Mangelia nuperrima (Tiberi, 1855)[γ]					3							3	
Mangelia scabrida Monterosato, 1890[γ]					(3)3			10				13	
Mangelia bertrandi (Payraudeau, 1826)[γ]		40				7		17		3		67	
Mangelia paciniana (Calcara, 1839)[γ]		3			3							6	
Mangelia cf. sicula Reeve, 1846[β]						3						3	
Mangelia stossiciana Brusina, 1869[γ]						3						3	
Mangelia sp.		(7)127					(3)		3			130	
Raphitoma linearis (Montagu, 1803)[γ]				7	13	(13)30	(7)3	3	10			66	
Raphitoma aequalis (Jeffreys, 1867)[γ]						3		3				6	
Raphitoma sp.					7			3				10	
Conus mediterraneus Hwass in Bruguière, 1792[γ]											(7)	0	
Comarmondia gracilis (Montagu, 1803)[γ]					(3)			3			5	8	
PYRAMIDELLIDAE													
Chrysallida suturalis (Philippi, 1844)[β]										3		3	
Chrysallida emaciata (Brusina, 1866)[γ]										3		3	
Chrysallida interstincta (Adams J. 1797)[γ]						3						3	
Chrysallida excavata (Philippi, 1836)[γ]						3						3	

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Chrysallida intermixta (Monterosato, 1884)$^{\gamma}$				(3)					(3)			0	
Turbonilla delicata (Monterosato, 1874)$^{\gamma}$		(250)		(7)7	(3)7	(13)77	3	13	(40)	(3)	(3)	107	
Turbonilla rufa (Philippi, 1836)$^{\gamma}$	(3)3	(5)30	(3)3	(3)7	(27)20	(7)7	(3)					70	
Turbonilla lactea (Linne, 1758)$^{\gamma}$		(15)52		(3)13	3	(13)	(13)			(3)	3	71	
Turbonilla pusilla (Philippi, 1844)$^{\gamma}$				3					3			6	
Turbonilla striatula (Linne, 1758)$^{\beta}$					3		(3)					3	
Turbonilla gradata Bucquoy Dautzenberg & Dollfus, 1883$^{\beta}$		7		3		(3)3						13	
Turbonilla sp.		(10)110		7		3						120	
Eulimella ventricosa (Forbes, 1844)$^{\gamma}$												0	+
Odostomia cf. plicata (Montagu, 1803)$^{\gamma}$		(10)5										5	+
Odostomia cf. lukisi Jeffreys, 1859$^{\beta}$					(3)							0	+
Odostomia striolata Thompson, 1850$^{\beta}$						3						3	
Odostomia cf. acuta Jeffreys, 1848$^{\gamma}$					3							3	
Odostomia eulimoides Hanley, 1844$^{\gamma}$			3				(3)					3	
Odostomia conoidea Brocchi, 1814$^{\gamma}$		(5)		3			(3)		(10)		3	6	
Odostomia scalaris Mac Gillivray, 1843$^{\gamma}$			20									20	
Odostomia sp.		(10)			3							3	
ACTEONIDAE													
Acteon tornatilis (Linne, 1758)$^{\gamma}$	(7)13					(10)3		3		(3)3		22	
RETUSIDAE													
Retusa truncatula (Bruguière, 1792)$^{\gamma}$				(3)		(3)3						3	
Cylichnina umbilicata (Montagu, 1803$^{\gamma}$				(3)		7						7	
Cylichnina laevisculpta(Granata-Grillo, 1877)$^{\alpha}$						3						3	
Cylichnina sp.						(3)						0	
Pyrunculus hoernesii (Weinkauff, 1866)$^{\beta}$						(167)10	(10)	(10)	(13)3			13	
Volvulella acuminata (Bruguière, 1792)$^{\gamma}$						(3)						0	
RINGICULIDAE													
Ringicula auriculata (Ménard de la Groye, 1811)					117	(10)3		(3)13		3		136	
Ringicula conformis Monterosato, 1877$^{\gamma}$						(90)	10		(10)7			17	+
Ringicula sp.						(3)						0	
BULLIDAE													
Bulla striata Bruguière, 1792$^{\beta}$						(7)						0	

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
HAMINOEIDAE													
Atys jeffreysi (Weinkauff, 1866)[γ]						3						3	
Haminoea navicula (da Costa, 1778)[γ]		3										3	
Haminoea sp.								(3)				0	
PHILINIDAE													
Philine aperta Linne, 1767[γ]				7					3			10	
Philine catena (Montagu,1803)[γ]									7			7	
CYLICHNIDAE													
Cylichna cylindracae (Pennant, 1777)[γ]				(3)	(3)	(3)	(3)			(3)		0	
Roxania utriculus (Brocchi, 1814)[γ]							(10)	(3)	(3)			0	
ELLOBIIDAE													
Myosotella myosotis Draparnaud, 1801[γ]			3									3	
BIVALVIA													
NUCULIDAE													
Nucula nucleus (Linne, 1758)	(3)	3		3			(3)3	(3)17	(3)3			29	
Nucula hanleyi Winckworth, 1931[β]			3						13			16	
Nucula sulcata Bronn, 1831[γ]						3	3	10	(10)10		3	29	+
Nucula nitidosa Winckworth, 1930[γ]		10							17			27	+
Ennucula aegeensis (Forbes, 1844)[γ]	3	5						37	(3)			45	+
NUCULANIDAE													
Nuculana pella (Linne, 1767)[γ]		(3)5		3			(10)7	3	17	3		38	
Saccella commutata (Philippi, 1844)[γ]								3				3	
ARCIDAE													
Arca tetragona Poli, 1795													+
Anadara corbuloides (Monterosato, 1880)			3									3	
NOETIIDAE													
Striarca lactea (Linne, 1758)		5										5	+
GLYCYMERIDIDAE													
Glycymeris glycymeris (Linne, 1758)[γ]				3								3	
MYTILIDAE													
Mytilus galloprovincialis Lamarck, 1819	(3)17	88	2450	(3)43	1737	13		3			3	4354	
Mytilaster lineatus (Gmelin, 1791)[γ]		3										3	
Mytilaster minimus (Poli, 1795)[γ]		10										10	

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Musculus costulatus (Risso, 1826)$^{\gamma}$	13	8		3		23						47	
Modiolus barbatus (Linne, 1758)	20	17	17	3	3						3	63	
Modiolus adriaticus (Lamarck, 1819)$^{\gamma}$		53		33	10	7				3	7	113	
Modiolarca subpicta (Centraine, 1835)	100	15	7	10	7	3						142	
Modiolula phaseolina (Philippi, 1844)$^{\gamma}$					10							10	
Lithophaga lithophaga (Linne, 1758)$^{\gamma}$					10	3						13	
Dacrydium hyalinum (Monterosato, 1875)$^{\beta}$						3						3	
PECTINIDAE													
Flexopecten glaber (Linne, 1758)		3						(3)				3	
Flexopecten flexuosus (Poli, 1795)	10											10	
Mimachlamys varia (Linne, 1758)	3	12										15	+
ANOMIIDAE													
Anomia ephippium Linne, 1758	(3)3		5		3	3		7				21	
Heteranomia squamula (Linne, 1758)$^{\gamma}$						7						7	
LIMIDAE													
Limaria hians (Gmelin, 1791)		10		3							3	16	
Limea loscombii (Sowerby G.B.I 1824)							3	7	3		3	16	
OSTREIDAE													
Ostrea edulis Linne, 1758	7		5					(3)7				19	
LUCINIDAE													
Anodontia fragilis (Philippi, 1836)$^{\gamma}$		3										3	
Ctena decussata (Costa, O.G. 1829)		(5)										0	
Loripes lacteus (Linne, 1758)	580	7	10	20	17	7			13	3	23	680	
Lucinella divaricata (Linne, 1758)$^{\gamma}$	140	45		7	13					17	3	225	
Myrtea spinifera (Montagu, 1803)	7			3		23	(3)10	30	33			106	
THYASIRIDAE													
Thyasira flexuosa (Montagu, 1803)$^{\gamma}$							10		7			17	
KELLIDAE													
Kellia suborbicularis (Montagu, 1803)$^{\gamma}$						3				13		16	
MONTACUTIDAE													
Tellimya ferruginosa (Montagu, 1808)$^{\gamma}$	3						3					6	
Kurtiella bidentata (Montagu, 1803)$^{\gamma}$	3	3				3				3		12	
ASTARTIDAE													

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Astarte sulcata (da Costa, 1778)[γ]				7		3						10	
CARDIDAE													
Acanthocardia tuberculata (Linne, 1758)									(3)	(3)		0	
Papillicardium papillosum (Poli, 1791)	3	67	3	(10)63	(3)10	(3)33		13	(3)43	10	5	250	
Parvicardium cf. scabrum (Philippi, 1844)[γ]												0	+
Parvicardium exiguum (Gmelin, 791)		5										5	
Laevicardium crassum (Gmelin, 1791)[γ]								3			3	6	
MACTRIDAE													
Spisula subtruncata (da Costa, 1778)	7	7	453	83	577	17	37	3		(3)60		1244	
PHARIDAE													
Ensis siliqua (Linne, 1758)[γ]									7			7	
Pharus legumen (Linne, 1758)									3			3	
TELLINIDAE													
Tellina nitida Poli, 1791[γ]	(3)	5										5	
Tellina serrata Brocchi, 1814							10					10	
Tellina pulchella Lamarck, 1818									(3)			0	
Tellina donacina Linne, 1758[γ]	(3)33	32		3	10	3	3	17	(3)30	(7)	3	194	
Tellina tenuis da Costa, 1778[γ]		5										5	
Tellina sp.											3	3	
Arcopagia balaustina (Linne, 1758)[γ]									3			3	
Gastrana fragilis (Linne, 1758)		5										5	
DONACIDAE													
Capsella variegata (Gmelin, 1791)[γ]								(3)				0	
SEMELIDAE													
Abra alba (Wood W., 1802)	3	62					13	10	(3)13		3	104	
Abra longicallus (Scacchi, 1835)[γ]										3		3	
Abra prismatica (Montagu, 1808)[γ]								7	3			10	
PSAMMOBIDAE													
Gari fervensis (Gmelin, 1791)[γ]				7								7	
Gari depressa (Pennant, 1777)		5			3							8	
Gari costulata (Turton, 1822)		8		10						3	7	28	
VENERIDAE													
Venus verrucosa Linne, 1758						3		3				6	

Table 2. Continued.

SPECIES/ STATIONS	AK	KY	CB	KB	SD	AB	KL	GK	KF	DC	HS	Ni	Middle line
Chamelea gallina (Linne, 1758)	(3)7		7									14	
Chamelea striatula (da Costa, 1778)$^{\gamma}$				(3)								0	
Clausinella fasciata (da Costa, 1778)	17		17	3		10		3			7	57	+
Timoclea ovata (Pennant, 1777)				3			3				3	9	+
Gouldia minima (Montagu, 1803)		168	10	(3)50	(3)	20	7		3	3	7	268	
Pitar mediterraneus (Aradas & Benoit, 1872)$^{\gamma}$				3							7	10	
Pitar rudis (Poli, 1795)	(3)47	77	97	97	3	33	7	(3)7	(3)13	(3)3	20	404	
Dosinia exoleta (Linne, 1758)$^{\gamma}$												0	+
Globivenus effossa (Philippi, 1836)$^{\gamma}$												0	+
Venerupis aurea (Gmelin, 1791)		20										20	
CORBULIDAE													
Corbula gibba (Olivi, 1792)	73	18		(3)80	30	100	470	140	(3)120	7	7	1045	
GASRTROCHAENIDAE													
Gastrochaena dubia (Pennant, 1771)		547		3	63			3			7	623	
HIATELLIDAE													
Hiatella arctica (Linne, 1758)	13	122			23	7		3			(3)25	193	+
Hiatella rugosa (Linne, 1758)$^{\gamma}$	7		57	63	137	10				(3)	27	301	
THRACIIDAE													
Thracia papyracea Polli, 1791$^{\gamma}$		10		20								30	
Thracia pubescens (Pulteney, 1799)$^{\gamma}$								(3)		17		17	
CUSPIDARIIDAE													
Cuspidaria rostrata (Spengler, 1793)$^{\gamma}$ **SCAPHOPODA**								3				3	
DENTALIIDAE													
Dentalium sp.		43		3	3	(3)	(3)					49	
Antalis inaequicostata (Dautzenberg, 1891)$^{\gamma}$	3	(23)				(7)		(7)10	(3)	(3)		13	
Antalis vulgaris (da Costa, 1778)$^{\gamma}$		(103)3			(20)3			(7)				6	
Antalis rossati (Caprotti, 1966)$^{\beta}$							(3)					0	
FUSTIARIIDAE													
Fustiaria rubescens (Deshayes, 1825)$^{\gamma}$		(3)				3						3	
GADILIDAE													
Dischides politus (Wood s., 1842)$^{\beta}$												0	+
Number of specimens m^{-2}	3605	15.934	4201	2809	4125	2295	808	690	510	639	1415	37.027	

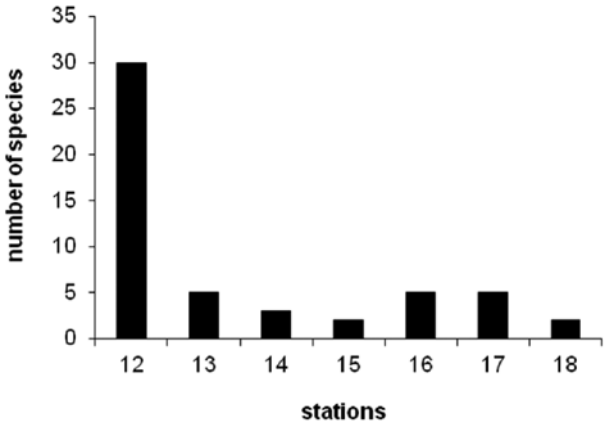

Fig. 2. Number of species from middle line.

and at stations AK and KB in autumn due to their paucity in abundance and species number.

The cluster analysis of species abundance for each station and season based on the Bray-Curtis similarity (Fig. 4) showed no clear seasonal patterns among stations, except the following: station KY in spring and summer (51% similarity level, common species of *B. reticulatum*), station AK in winter and spring (47% similarity level, common species of *Loripes lacteus*), autumn samples of stations AK and winter samples of stations KL (48% similarity level, common species of *B. brachystoma*), winter CB and summer SD (47% similarity level, common species of *M. galloprovincialis*), summer AB and winter HS (45% similarity level, common species of *B. reticulatum*)

According to the cluster analyses applied to the total abundance of living molluscs, four groups of stations were detected in the area (Fig. 5). Similarity values higher than 40% were calculated within the groups I (45%), II (44%), III (47%) and IV (45%). According to the SIMPER analysis, the species that contributed most to the similarity of these groups is *C. gibba* for group I (52.63) and II (24.27) and *B. reticulatum* for group III (80.22) and IV (64.04).

According to ANOSIM (Table 3), the rate of dissimilarity was not statistically significant among the groups ($p<0.05$).

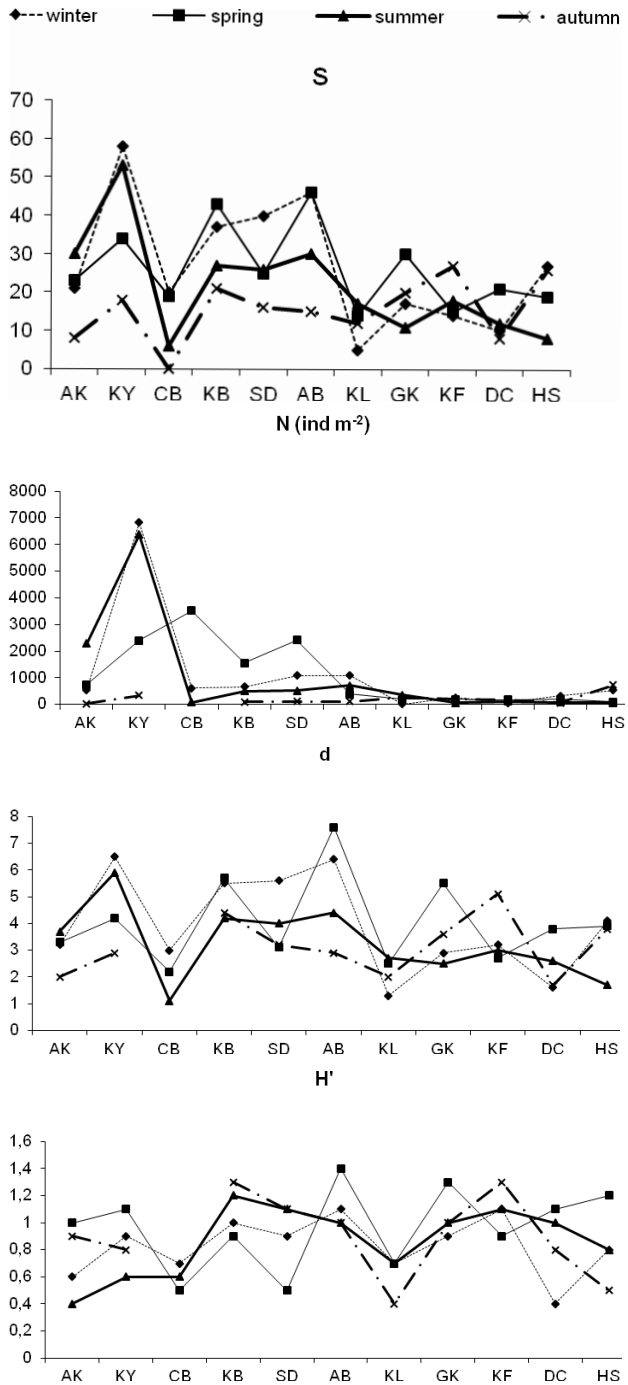

Fig. 3. Seasonal qualitative and quantitative distribution of mollusca fauna per station in Canakkale Strait.(S: Number of species, N: Number of individuals m-2 , d: Species richness, J: Evenness, H': Diversity).

Discussion

Considering the total number of collected species, we can conclude that the Canakkale Strait hosts a quite diverse mollusc fauna (283 species). This number is higher than that reported from other areas of the eastern Mediterranean where sampling was performed in a soft bottom (e.g. Koutsoubas *et al.* 1992 (Crete: 233 species); Koulouri *et al.* 2006 (Crete: 109 species); Aslan-Cihangir, Mutlu 2006 (Bozcaada Island: 127 species); Bitlis *et al.* 2010 (Sea of Marmara: 100 species); Antoniadou *et al.* 2005 (North Aegean Sea: 111 species)).

The result of the analysis of frequency, while showing no constant species, indicates only five common species (*B. reticulatum*, *B. latreillei*, *A. cimex*, *C. gibba* and *P. rudis*). 231 species were rare among the total of 236 living mollusc species. Boero (1994)

Table 3. Results of ANOSIM and SIMPER on the total data sets.

Groups	One-way ANOSIM		SIMPER		
	R value	P value	Average Dissimilarity (%)	Discriminating species	Contribution (%)
I vs II	1.0	0.33	69.65	*Corbula gibba* *Turitella communis*	13.04 7.2
I vs II	1.0	0.33	93.53	*Bittium reticulatum* *Mytilus galloprovincialis*	35.20 27.19
I vs IV	1.0	0.067	91.04	*Bittium reticulatum* *Mytilus galloprovincialis*	37.52 10.51
II vs III	1.0	0.33	88.81	*Bittium reticulatum* *Mytilus galloprovincialis*	30.36 24.75
II vs IV	0.679	0.067	83.65	*Bittium reticulatum* *Mytilus galloprovincialis*	33.3 9.83
III vs IV	0.5	0.133	62.69	*Bittium reticulatum* *Mytilus galloprovincialis*	26.49 24.23

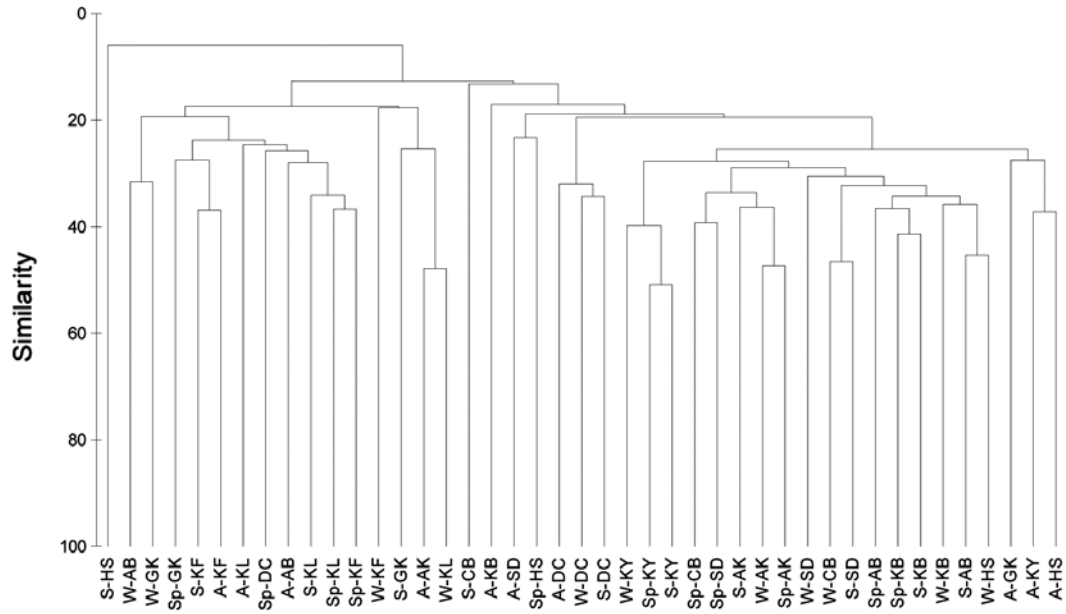

Fig. 4. Seasonal cluster analysis based on the total species abundance at each coastal station. A, autumn, Sp, spring, S, summer, W, winter.

reported that rare species can play a significant role in the description of the communities. These species can in fact represent an important source of diversity within the assemblage itself, thus allowing a certain number of adjustments in the assemblage composition in response to biotic and/or abiotic disturbance (Aslan-Cihangir, Pancucci- Papadopoulou 2011b).

The most abundant species were *B. reticulatum* (14197 ind.m^{-2}), *M. galloprovincialis* (4354 ind.m^{-2}), *B. latreillei* (2152 ind.m^{-2}), *P. marginata* (2119 ind.m^{-2}), *S. subtruntaca* (1244 ind.m^{-2}) and *C. gibba* (1045 ind.m^{-2}). Station KY had the highest abundance with 15934 ind.m^{-2} and 8137 ind.m^{-2} of this amount belonged only to *B. reticulatum* out of the total living 37024 specimens. Also, high amounts of dead shells (*B. reticulatum*: 1000 ind.m^{-2}, *P. marginata*: 2100 ind.m^{-2} and *R. ventricosa*: 1820 ind.m^{-2}) were obtained from the station KY. According to Aslan-Cihangir, Pancucci-Papadopoulou 2011a, station KY is rich in detritus and its gravel content is much higher than other studied stations. Also, high TOC and TN values in the sediment at this station could be caused by its location in a small bay that is characterized by low hydrodynamism and high levels of aquacultural activities (*M. galloprovincilis*, trout and sea bass) in the area for about a decade (1994-2005). Terlizzi *et al*. 2005 reported that the abundance of deposit-feeding gastropod species, namely *B. reticulatum* and *B. latreillei*, increased due to high sedimentation. Also *M. galloprovincialis* and *C. gibba* were reported as having tolerance to environmental disturbances or stress (Borja *et al.* 2000,

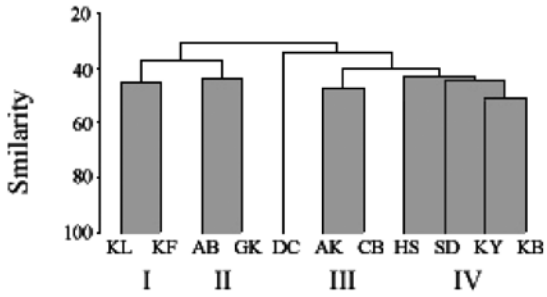

Fig. 5. Cluster analysis based on the total species abundance at each coastal station.

Simboura, Zenetos 2002, Chintiroglou *et al*. 2004.

Both number and abundance of living mollusc species were at a maximum in winter and they gradually decreased in the following seasons, but abundance had a sharp decrease from summer to autumn. This result is a contradiction to most other authors' results (Rueda *et al.* 2001, Reiss, Kroncke 2005, Koulouri *et al.* 2006, Rueda, Salas 2008, Moreira *et al.* 2010). According to Rueda *et al. (*2001) most of the mollusc species' recruitment events happen between spring and summer. In addition, Jensen (1990) reported the second recruitment period in autumn in Denmark. Rueda, Salas (2003) argued that inter-annual differences in recruitment of molluscan assemblages depict the pressure of some other environmental factors. While Russo *et al.* (1991) reported that the most important factors in mollusc distribution are water movement and depth. Sanches-Moyano *et al.* (2000) reported that the grain size of sediment and the percent of organic matter are affecting the aspects of mollusc fauna. According to the results of other studies about decapods and peracarid crustaceans, which were conducted at the same stations in the Canakkale Strait, the highest abundance of decapod crustaceans was recorded during winter (Aslan-Cihangir,Pancucci-Papadopoulou 2011b), while the abundance of peracarid crustaceans, which were not at the larval stage, was the lowest in winter (Aslan-Cihangir, Pancucci-Papadopoulou 2011a). Not being able to collect any samples from station CB in autumn might have contributed to this result. In addition, Aslan-Cihangir, Pancucci-Papadopoulou (2011a) reported that seasonal grain size analyses in the Canakkale Strait showed significant fluctuations at each station, with coarser sediments during winter and spring, due to sediment instability caused by winter winds, and the finest sediments in summer and autumn, as a result of lower wind and lower currents. Also they advocated that individual settlement was favoured in periods and areas with milder conditions and higher abundance in coarser sediment (winter).

Some mollusc species in the reported species list were problematic. *Buccinulum corneum* (Linnaeus, 1758) was reported from the Mediterranean Sea and the Canakkale Strait according to the checklist, which was prepared by Ozturk, Cevik (2000). But this species was identified as *Euthria cornea* in the study according to Gofas 2010. *Bela zenetouae* and *Bela taprurensis* were reported by Ozturk *et al*. 2008 as *Fehria zenetouae* van Aartsen, 1988 and *Fehria taprurensis* (Pallary, 1904) in response to Clemam (2008), but the same species were declared as belonging to the *Bela* genus (Clemam, 2011). The species *Mangelia coarctata,* which was reported by Ozturk *et al*. 2008, is evaluated as *M. costata* in this study based on the Clemam's taxonomy. Meanwhile JJ van Aartsen has been defending the argument that the species *M. costata* is found only in the Atlantic Ocean (Ozturk *et al.* 2008)

The present study constitutes the first baseline approach to the seasonal fluctuations of soft bottom molluscs at the Canakkale Strait covering the biogeographic area between the Black Sea and Mediterranean Sea. The results of this study revealed that the composition and distribution of Mollusca fauna in the seasonally varying sediment composition of Canakkale Strait are directly influenced by the high hydrodynamism and the two different current systems of the area. Further studies are still needed to understand some other factors such as recruitment, seasonal variations in food supply, predation, which established the distribution of molluscs and cause the seasonal changes in their abundance.

Acknowledgement: The authors would like to thank the staff of Bilim-1 R/V and K. Piri Reis R/V. They are also grateful to Dr. Marco Taviani, Maurizin Sosso and Kemal Geryan for checking some molluscs species and Dr. Bruno dell'Angelo for identifying *L. cimicoides*. Thanks are also due to Arnie Boyaci for correction of English grammar.

References

Antoniadou C., D. Koutsoubas, C. Chintiroglou 2005. Mollusca fauna from infralittoral hard substrate assemblages in the North Aegean Sea. – *Belgian Journal of Zoology,* **135** (2): 119-126

Aslan-Cihangir H., E. Mutlu 2006. Mollusca fauna of Bozcaada Island (NE Aegean Sea). International Seminar on Coastal Water Management and Sustainable Use of Marine Resources 14-16, November 2006, Dakar – Senegal, 221-234.

Aslan-Cihangir H., M. A. Pancucci-Papadopoulou 2011a. Spatial and temporal variation of soft-bottom peracarid (Crustacea: Peracarida) infauna in the Canakkale Strait (Turkey). – *Mediterranean Marine Science,* **12** (1): 153-182.

Aslan-Cihangir H., M. A. Pancucci-Papadopoulou 2011b. Aspects of Decapod Crustacean assemblages from soft bottoms submitted to strong hydrodynamic conditions: an example from Canakkale Strait (Turkish Strait System). – *Fresenius*

Environmental Bulletin, **20** (9a): 2400-2411.

Bitlis B., B. Ozturk, A. Doğan, M. Onen 2010. Systematic and Ecological features of some Mollusca Species distributed along the Marmara Sea coast. Symposium of Sea of Marmara 2010. 2-26 September 2010, Istanbul 253-265.

Boero F. 1994. Fluctuations and variations in coastal marine environments. *Marine Ecology*, **15** (1): 3-25.

Borja A., J. Franco, V. Perez 2000. A marine biotic index to establish the ecological quality of soft-bottom benthos within European Estuarine and coastal environments. – *Marine Pollution Bulletin*, **40**:1100-1114.

Chintiroglou C. C., P. Damianidis, C. Antoniadou, M. Lantzouni, D. Vafidis 2004. Macrofauna biodiversity of mussel bed assemblages in Thermaikos Gulf (northern Aegean Sea). – *Helgoland Marine Research*, **58**: 62-70.

Clarke K. R., R. M. Warwick 2001. Change in Marine Communities: an approach to statistical analysis and interpretation, 2nd ed. PRIMER-E, Plymouth.

Clemam 2011. Check List of European Marine Molluscs, Paris; http://www.somali.asso.fr/clemam/

Colombo A. 1885. Raccolte zoologiche Eseguite dal R. Piroscafo Washington Nella Campagna Abissale Talossodell'anno. *Riviste – Marittima*, 22-53.

Coll M., C. Piroddi, J. Steenbeek, K. Kaschner, F. B. R. Lasram, J. Aguzzi, E. Ballesteros, C. N. Bianchi, J. Corbera, T. Dailianis,R. Danovaro, M. Estrada, C. Froglia, S. Bella-Galil, J. M. Gasol, R. Gertwagen, J. Gil, F. Guilhaumon, K. Kesner-Reyes, M. S. Kitsos, A. Koukouras, N. Lampadariou, E. Laxamana, López-Fé, C. M. Cuadra, H. K. Lotze, D. Martin, D. Mouillot, D. Oro, S. Raicevich, J. Rius-Barile, J.L. Saiz-Salinas, S. San Vicente, S. Somot, J. Templado, X. Turon, D. Vafidis, R. Villanueva, E. Voult-Siadou 2010. The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats. *PLoSONE* **5** (8): e11842. doi:10.1371/journal.pone.0011842.

Gofas S. 2010. *Buccinulum corneum* (Linnaeus, 1758). – In: Bouchet, P.; Gofas, S.

Rosenberg G. 2010. World Marine Mollusca database. Accessed through: Costello, M.J.; Bouchet, P.; Boxshall, G.; Arvantidis, C.; Appeltans, W. (2010) European Register of Marine Species at http://www.marbef.org/data/aphia.php?p=taxdetailsandid=138856 on 2011-05-10

Jensen J. N. 1990. Increased abundance and growth of the suspension-feeding bivalve *Corbula gibba* in a shallow part of the eutrophic Limfjord, Denmark. – *Netherland Journal of Sea Research*, **27**: 101-108.

Koulouri P., C. Dounas, C. Arvanitidis, D. Koutsoubas, A. Eleftheriou 2006. Molluscan diversity along a Mediterranean soft bottom sublittoral ecotone. – *Scientia Marina,* **70** (4): 573-583.

Koutsoubas D., A. Koukouras, I. Karakassis, C. Dounas 1992. Contribution to the knowledge of Gastropoda and Bivalvia (Mollusca) of Crete Island (S.Aegean Sea). – *Bollettino Malacologico,* 1-4: 69-82.

Marion A. F. 1898. Notes sur la Faune des Dardanelles et du Bosphore. – *Annales du musée d'histoire naturelle de Marseille*, **2**: 163-182.

Moreira J., C. Aldea, J. S. Troncoso 2010. Temporal dynamics of gastropod fauna on subtidal sandy sediments of the Ensenada de Baiona (NW Iberian Peninsula). – *Helgolland Marine Research,* **64**: 311-320.

Oguz T., I. Sur 1989. A two-layer model of water exchange through the Dardanelles Strait. – *Oceanologica Acta*, **12** (1): 23-31.

Ozturk B., C. Cevik 2000. Molluscs fauna of Turkish seas. – *Club Conchylia Informationen,* **32** (1/3), 27-53.

Ozturk B., A. Dogan, B. Bitlis, M. Onen 2008. Taxonomical and Ecological features of *Bela*, *Fehria* and *Mangelia* (Gastropoda: Conidae) species distributed along the Turkish coast. 2nd National Malacology Congress, 8-10 October, 22-54. Adana, Turkey.

Ozturk B., A. Ozturk 1996. Biology of the Turkish Straits System. Dynamics of Mediterranean straits and channels. – *Bulletin Oceanograbhy*, **17**: 205-221.

Palaz M., S. Berber 2005. The bivalve species of the Dardanelles. – *Journal of the Marine Biological Association of the United Kingdom*, **85:** 357-358.

Palaz M., S. Colakoglu 2009. Macrobenthic diversity of the Dardanelles. – *Journal of Animal and Veterinary Advances,* **8** (11): 2311-2344.

Pallary P. 1917. Mollusques marins des Dardanelles collies par M. Claude Bravard. – *Journel de Conchyliologie*, **63** (2): 142-147.

Poulos S. E., P. G. Drakopoulos, M. B. Collins 1997. Seasonal variability in sea surface oceanograbhic conditions in the Aegean Sea (Eastern Mediterranean): an overview. – *Journal of Marine Systems*, **13**: 225-244.

Reiss H., I. Kroncke 2005. Seasonal variability of infaunal community structures in three areas of the North Sea under different environmental conditions. – *Estuarine Coastal Shelf Science,* **65** :253-274.

Rueda J. L., M. Fernandez-Casado, C. Salas, S. Gofas 2001. Seasonality in a taxocoenosis of molluscs from soft bottoms in the Bay of Cadiz (southern Spain). – *Journal of the Marine Biological Association of the United Kingdom*, **81**: 903-912.

Rueda J. L., C. Salas 2003. Temporal dynamics of molluscan assemblages from soft and bioclastic bottoms in the Strait of Gibraltar. – *Cahiers de Biologie Marine*, **44**: 237-248.

Rueda J. L., C. Salas 2008. Molluscs associated with a subtidal *Zostera marina* L. bed in southern Spain: Linking seasonal changes of fauna and environmental variables. – *Estuarine, Coastal and Shelf Science*, **79**: 157-167.

Russo G. F., L. A. Chessa, D. Vinci, E. Fresi 1991. Mollusc of *Posidonia oceanica* beds in the bay of Porto Conte (North-Western Sardinia): zonation pattern,seasonal variability and geograbhical comparision. – *Posidonia newsletter*, **4**: 5-14.

Sanches-Moyano J. E., F. J. Estacio, E. M. Garcia-Adiego, J. C. Garcia Gomez 2000. The molluscan epifauna of the alga *Halopteris scoparia* in southern Spain as a bioindicator of coastal environmental conditions. – *The Journal of Molluscan Studies*, **66**: 431-448.

Simboura N., A. Zenetos 2002. Benthic indicators to use in ecological quality classification of Mediterranean soft bottoms marine ecosystems, including a new biotic index. – *Mediterranean Marine Science*, **3/2:** 77-111.

Soyer J. 1970. Bionomie benthique du plateau continental de la côte catalana Française. III: Les peuplements de Copepodes Harpacticoides (Crustacea). – *Vie et Milieu*, **21**: 377-511, Banyuls-Sur-Mer.

Stashchuk N., K. Hutter 2001. Modelling of water Exchange through the Strait of the Dardanelles. – *Continental Shelf Research,* **21**: 1361-1382.

Terlizzi A., D. Scuderi, S. Fraschetti, M. . Anderson 2005. Quantifying effects of pollution on biodiversity: a case study of highly diverse molluscan assemblages in the Mediterranean. – *Marine Biology*, **148**: 293-305.

Received: 28.03.20112
Accepted: 05.02.2013