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OSTRACODS OF THE MEDITERRANEAN (THE GULF OF ANTALYA) AND THE AEGEAN SEA (AYVALIK AND KUŞADASI) AND THEIR BIOGEOGRAPHICAL DISTRIBUTIONS

Derya PARLAK[a] and Atike NAZİK[b*]

[a]*Çukurova Univ., Fac. of Sci., Dept. of Geol. Eng., 01330, Sarıçam, Adana, TURKEY*
[b]*Çukurova Univ., Fac. of Eng. and Arch., Dept. of Geol. Eng., 01330, Sarıçam, Adana, TURKEY*

Research Article

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Ostracod, Geological Time, Biogeography, Mediterranean, Aegean Sea.

ABSTRACT

The aim of this study is taxonomic investigation and environmental distribution of ostracoda association from the bottom sediments of the Mediterranean (The Gulf of Antalya) and Aegean Sea (Alibey and Maden islands/Ayvalık and Kuşadası) and identification of species surviving up to present. Twenty genera and 26 species are determined by examining the ostracoda contents of the 197 samples from the bottom sediments from 5 to 30 m depth in the Antalya Bay (Mediterranean). 24 genera and 34 species in 84 samples belonging to 4 cores around Alibey and Maden islands to the north of Ayvalık in Aegean Sea have been determined. Also, 23 genera and 29 species from the 45 samples at the depth of 8,5-22.3 m around Kuşadası have been determined. According to carapace morphology and depth of water, shallow marine group genera are belonging to subfamilies Trachyleberidae and Hemicytheridae which have well-developed hinge, branching marginal-pore canals, clear eye-spots and more ornamentation, are relatively abundant specimens. The ostracoda association defined in this study is correlated with previous studies in Mediterranean, Aegean islands, Adriatic Sea, Algeria, Aegean and Marmara Sea of Turkey. The well-known ostracoda species such as *Aurila convexa, Jugosocythereis prava, Carinocythereis antiquata, Carinocythereis carinata, Costa batei, Semicytherura inversa, Loxoconcha rhomboidea, Sahnia fasciata, Cushmanidea elongata* from Atlantic and Mediterranean and *Neonesidea formosa, Triebelina raripila, Cytherella (Cytherelloidea) beckmanni, Cytherelloidea sordida, Aurila arborescens, Carinocythereis rhombica, Hiltermannicythere rubra, Hiltermannicythere turbida, Cytheretta adriatica, Cytheretta judaea, Callistocythere intricatoides, Urocythereis crenulosa, Acanthocythereis hystrix, Paracytheridea depressa, Xestoleberis communis, Xestoleberis dispar* and *Pontocypris acuminata* from in Mediterranean are wide-spread.

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1. Introduction

The study area covers The Gulf of Antalya (Mediterranean) and Ayvalık-Kuşadası (Aegean Sea) regions (Figure 1). In various regions of the Aegean Sea and the Mediterranean, the ostracod and foraminiferal distributions and their systematical studies close to the subject of this research were carried out (Altınsaçlı and Kubanç, 1990; Kubanç and Altınsaçlı, 1990; Nazik, 1994; Şafak, 1999, 2008; Tunoğlu, 2001; Kubanç, 1995; 2005; 2006; Çulha and Tunoğlu, 2008, 2009; Ertekin and Tunoğlu, 2008; Meriç et al., 2002; Meriç et al., 2008*a, b, c, d, e*; Meriç et al., 2009*a,b*; Perçin-Paçal, 2011; Meriç et al., 2012*a, b, c;* Meriç et al., 2014; Parlak and Nazik, 2014).

The bottom sediments collected from different stations in The Gulf of Antalya, which they have different environmental conditions, the core studies carried out within sea bottom sediments around Ayvalık (Alibey and Maden islands) in the Aegean Sea, and samples possessing different characteristics taken from the vicinity of mineral water springs in the Gulf of Kuşadası were investigated. The purpose of the study is; a) to examine taxonomically, b) to observe the effects of the environmental conditions, c) to determine living species through geological time to present, and d) to compare species determined in this study with previous studies carried out in the Atlantic and Mediterranean and to establish their biogeographical distributions benefiting from the similarities and differences of genera and species of the ostracod assemblage found in bottom sediments of Mediterranean and Aegean Sea .

**Corresponding author: Atike Nazik, anazik@cu.edu.tr*
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Figure 1- Location map of study areas (Parlak and Nazik, 2014).

2. Material and Method

The main material of the study is formed by 106 samples taken from bottom sediments at depths of 5-30 meters in the Gulf of Antalya, 84 samples belonging to 4 cores taken from the vicinities of Alibey and Maden islands located in northwestern Ayvalık and 45 samples collected from Kuşadası region at depths of 8.5-22.3 meters in the Aegean Sea.

Samples from the Gulf of Antalya (Mediterranean) were taken by the member of Bosphorus University Diving Club within scope of "Ecological Regional Scale Protection and Responsible Tourism on Lycian Coasts Project, Marine Biodiversity Research, 2002" by the World Wildlife Fund (WWF-Turkey).

Samples belonging to 11 cores in the Aegean Sea were taken by Meriç et al. (2009*c*) in 4 areas (3 locations in northern part of the Alibey Island and 1 location in east of the Maden Island). The material of this research consist of total 84 samples of each core selected in 4 localities and their ostracod content was studies. The depths at which the samples were taken vary between 0.80-8.00 meters. The coordinates of the points, where the cores were taken, and the length of cores are given in table 1.

The samples taken from Pamucak Bay at northwest of Kuşadası in Aydın province covers samples collected from the vicinity of a mineral water spring which is 200 meters away from the shore at 12.40 m depth, at 19.6 °C temperature. 45 actual sediment samples were collected in 2007 autumn by free diving

Table 1- Lengths, coordinates and water depths of cores taken from Ayvalık region (Meriç et al., 2009*c*)

Core name	Latitude	Longitude	Water Depth (m)	Core Length (cm)
1 c	39°22.548'	26°38.552'	-1,5	45
2 c	39°23.427'	26°36.029'	-8	42
3 a	39°22.394'	26°36.929'	-2,7	45
4 b	39°22.220'	26°37.499'	-0,8	52

method; one of them being at the center, and the others being at 5-100 m in east, 5-45 m in west, 5-50 m in north and 5-50 m south directions horizontally, with depths varying between 8.5-20.2 meters (Meriç et al., 2009*b*). The horizontal distance, direction, water depth and water temperature estimations of these samples with respect to source area are given in table 2.

All samples used in this study were supplied by Prof. Engin Meriç as a research material.

The identification of genera and species of ostracods were examined under binocular microscope. Both the external and internal views of carapace and valves of ostracods were studied. In determining genera and species, Van Morkhoven (1963), Hartmann and Puri (1974), Bonaduce et al. (1975), Breman (1975), Yassinsi (1979), Guillaume et al. (1985), Athersuch et al. (1989), Zangger and Malz, (1989), Mostafawi and Matzke-Karasz (2006), Joachim and Langer (2008) and "MarBEF Data System" (http://www.marbef.org/data/) were used.

Ostracod images of the Antalya samples were taken in Scanning Electron Microscope (SEM) of Şişecam Group,Turkey and as for the images of Ayvalık and Kuşadası samples SEM images were taken in the laboratory of the Advanced Technology Education, Research and Application Center (METİAM), Mersin University. SEM images of ostracod species are given in plates 1-3.

3. Research Findings

The study was conducted with the ostracod investigation of samples taken from the Gulf of Antalya and Ayvalık-Kuşadası (Aegean Sea). 26 species in Mediterranean, 34 species in Ayvalık region) and 29 species in Kuşadası region in the Aegean Sea were identified. The graphic of family percentage distribution for ostracods in the study was prepared (Figure 2). When the ostracod assemblage is numerically assessed, and the carapace morphology and depth are taken into consideration, it is observed that genera of Trachyleberidae and Hemicytheridae families, which have very ornamentation with distinctive shallow marine characteristics, with developed hinge, distinct eye spots and branched margin-pore canals, are relatively more than the number of individuals.

As a result of this study, the information about the ostracod assemblage of both regions was given below in detail.

Table 2-Direction, distance, depth and water temperature of samples taken from the vicinity of Kuşadası Spring.

Sample Number		Horizontal distance	Direction	Depth	Water
CB 001	A	From Spring	From Spring	12,4 m	19,6
CB 002	A	5 m	South	11,1 m	17,5
CB 003	A	10 m	South	9,7 m	17,5
CB 004	A	15 m	South	9,2 m	17,5
CB 005	A	20 m	South	9,5 m	17,5
CB 006	A	25 m	South	10,5 m	17,5
CB 007	A	30 m	South	11,3 m	17,5
CB 008	A	35 m	South	12,3 m	17,5
CB 009	A	40 m	South	12,5 m	17,5
CB 010	A	45 m	South	13,7 m	17,5
CB 011	A	50 m	South	14,9 m	17,5
CB 012	A	5 m	North	8,9 m	17,5
CB 013	A	10 m	North	8,5 m	17,5
CB 014	A	15 m	North	8,7 m	17,5
CB 015	A	20 m	North	9,0 m	17,5
CB 016	A	25 m	North	10,1 m	17,5
CB 017	A	30 m	North	10,9 m	17,5
CB 018	A	35 m	North	12 m	17,5
CB 019	A	40 m	North	13,1 m	17,5
CB 020	A	45 m	North	14,2 m	17,5
CB 021	A	50 m	North	20,1 m	17,5
CB 022	A	5 m	West	9,1 m	17,5
CB 023	A	10 m	West	9,3 m	17,5
CB 024	A	15 m	West	11,3 m	17,5
CB 025	A	20 m	West	12,8 m	17,5
CB 026	A	25 m	West	14,7 m	17,5
CB 027	A	30 m	West	17,3 m	17,5
CB 028	A	35 m	West	17,9 m	17,5
CB 029	A	40 m	West	18,2 m	17,5
CB 030	A	45 m	West	22,3 m	17,5
CB 031	A	5 m	East	12,8 m	17,5
CB 032	A	10 m	East	11,9 m	17,5
CB 033	A	15 m	East	12,1 m	17,5
CB 034	A	20 m	East	11,5 m	17,5
CB 035	A	25 m	East	14,4 m	17,5
CB 036	A	30 m	East	15,3 m	17,5
CB 037	A	35 m	East	15,9 m	17,5
CB 038	A	40 m	East	18,1 m	17,5
CB 039	A	45 m	East	19,1 m	17,5
CB 040	A	50 m	East	19,5 m	17,5
CB 041	A	60 m	East	19,4 m	17,5
CB 042	A	70 m	East	19,1 m	17,5
CB 043	A	80 m	East	20,2 m	17,5
CB 044	A	90 m	East	20,1 m	17,5
CB 045	A	100 m	East	20,2 m	17,5

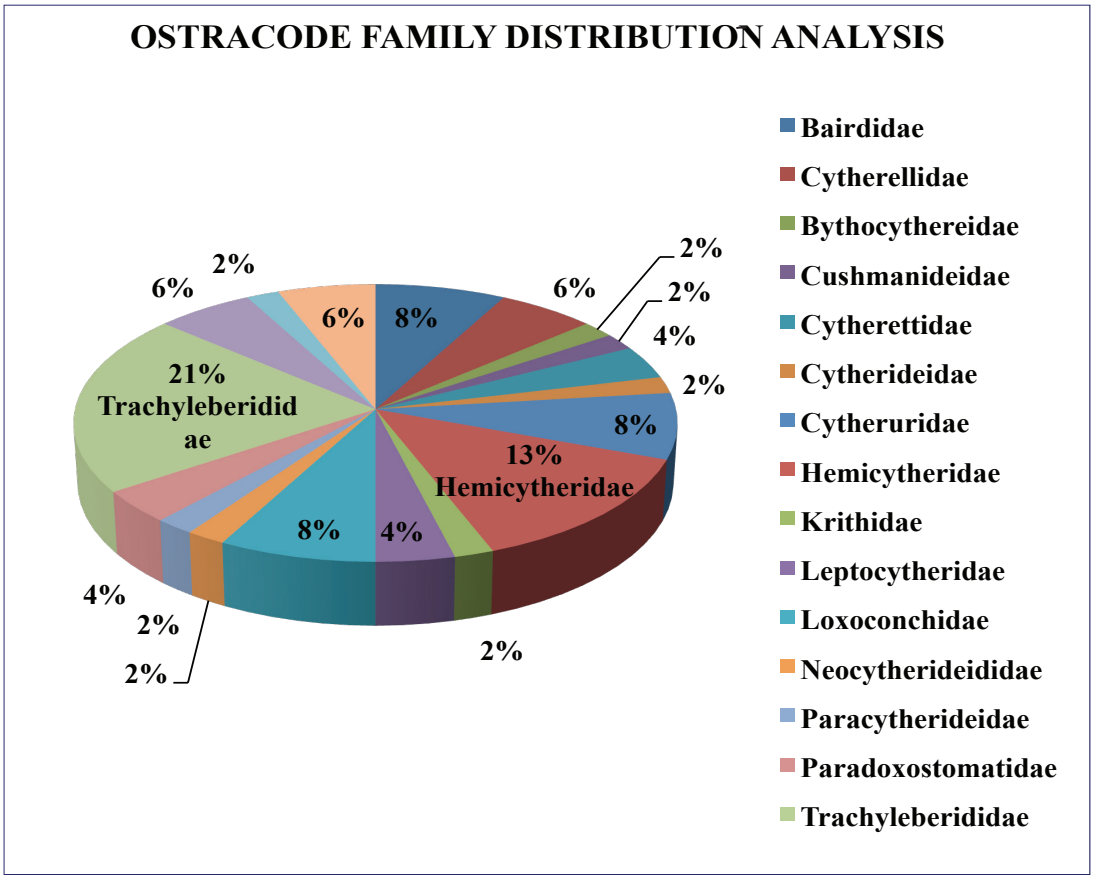

Figure 2- The percentage distribution of ostracod families in the study.

3.1. The Gulf of Antalya Ostracod Assemblage

The ostracod content of 197 samples taken from bottom sediments at depths of 5-30 meters in Antalya Bay was investigated, and 20 genera and 26 species were identified (Table 3a, b).

Genera of *Xestoleberis, Loxoconcha*, *Neonesidea*, *Urocythereis*, *Aurila*, *Jugosocythereis* from the the Gulf of Antalya ostracod assemblage were widely observed. According to recent ostracod studies carried out among widespread genera, it is known that *Neonesidea* lives at depths of 5-40 m, in sandy silty layers; *Jugosocythereis* at depths of 12-120 m in layers with *Posidonia,* calcerous algals and in sands with *Amphioxus*; *Loxoconcha* generally at depths below 30-40 m; *Urocythereis* at depths of 0-30 m in sandy layers and *Aurila* lives at depths of 0-128 m in sandy layers (Van Morkhoven, 1963; Breman, 1975; Bonaduce et al., 1975; Yassini, 1979). The genera of *Pterygocythereis*, *Henryhowella* and *Propontocypris*, which generally live in bathyal environment but rarely observed in littoral environment, were identified in a couple of stations. Besides; the ostracod assemblage with genera less than 2 were encountered in stations 8/12m, 10/8m, 25/A1 S10, 35/14-15m, 51/14m, 69/12-24m, 86/15m, 100/12-24m, 106/12m, 107/24m, 112/12m, 114/24m, 115/24m, 116/20m, 135/10 m.

The Gulf of Antalya ostracod assemblage was compared with ostracod assemblages found in studies carried out in Aegean Islands (Sissing, 1972; Adriatic Sea (Bonaduce et al., 1975; Breman, 1975), Algeria (Yassini, 1979), Gökçeada-Bozcaada-Çanakkale (Şafak, 1999; Meriç et al., 2002; Meriç et al., 2009*a*; Öner et al., 2013), Sea of Marmara (Tunoğlu, 1999; Nazik, 2001; Kubanç, C. 2002; Kubanç, N. 2005; Kırcı-Elmas et al., 2007), western Black Sea (Kılıç, 2001; Ongan et al., 2009;), Izmir (Meriç et al., 2011; 2012*b*), Edremit Bay (Meriç, 2012*c*), and in Mediterranean (Nazik, 1994; Şafak, 2003, 2008; Ertekin and Tunoğlu, 2008); so big similarities in genera and species were identified. It was also determined that *Aurila convexa*, *Loxoconcha rhomboidea*, *Cytheridea neapolitana*, *Xestoleberis communis*, *Xestoleberis dispar*, *Jugosocythereis prava*, *Neonesidea corpulenta* and *Urocythereis margaritifera* species were also widespread.

Table 3a- The distribution of ostracod species in samples of Antalya Bay (modified from Meriç et al., 2008*b*).

OSTRACODA	SAMPLING STATIONS																																																
	5/5,12 m	7/14 m	8/12 m	10/8 m	12/20 m	14/12, 24 m	15/14 m	17/7, 17 m	19/12 m	20/6, 12 m	21/12,24 m	23/14,24 m	24/22 m	25/A1 S 10 m	26/18, 25 m	27/16 m	30/14, 24 m	31/16,24 m	32/12,20,22 m	33/13 m	34/6, 13 m	35/14, 15 m	37/15 m	39/14, 23, 24	41/6, 12 m	42/3, 9 m	43/6, 21, 24 m	44/6, 20, 22 m	45/6, 19 m	47/12,24 m	48/12 m	49/8,14, 24 m	50/14 m	51/14 m	52/7, 14 m	53/16, 24 m	54/15, 16, 23	55/14, 24 m	56/6, 13 m	57/15 m	58/7, 14, 24 m	59/7, 24 m	60/14, 21 m	61/5, 12 m	63/12, 24 m	64/12,24 m	65/6,16,24	68/16 m	69/12, 24 m
Cytherella (Cytherelloidea) beckmanni																																																	
Cytherelloidea sordida																																										*							
Neonesidea corpulenta	*					*		*			*	*			*				*	*	*		*	*		*	*	*	*	*		*			*		*	*			*	*	*	*	*		*	*	
Neonesidea formosa					*											*	*							*	*		*					*				*		*					*		*		*		
Triebelina raripila																				*																						*							
Cushmanidea elongata	*	*									*	*	*	*		*				*				*					*	*		*	*										*		*				
Microcytherura fulva									*																		*									*	*	*									*		
Aurila convexa	*	*				*				*		*				*	*	*		*		*		*	*		*	*	*	*	*	*			*	*	*	*	*	*	*	*	*		*	*			
Aurila arborescens																																				*													
Jugosocythereis prava	*					*						*			*	*	*	*	*		*			*		*		*				*	*		*	*	*	*				*	*		*		*	*	
Urocythereis margaritifera		*						*		*	*	*	*		*				*				*	*	*		*	*		*		*		*	*	*											*		
Urocythereis oblonga	*																																																
Callistocythere intricatoides						*	*																																										
Loxoconcha rhomboidea	*	*		*	*	*		*	*		*	*		*	*	*	*		*	*	*	*		*	*	*	*	*	*	*		*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Sahnia fasciata																																																	
Cytherois sp.		*																									*			*																			
Carinocythereis carinata																																																	
Costa batei																																																	
Hiltermannicythere rubra																									*																								
Hiltermannicythere turbida																																			*														
Henryhowella sp.																																						*											
Pterygocythereis ceratoptera																																				*													
Xestoleberis communis	*	*	*					*	*	*	*	*	*		*	*	*	*	*	*	*		*	*	*	*	*	*	*	*		*	*		*	*	*	*		*	*	*	*		*		*		
Xestoleberis dispar			*					*					*		*	*	*		*	*	*		*	*	*		*	*	*	*		*	*		*	*	*	*	*	*		*	*		*	*	*		*
Xestoleberis depressa								*											*																*				*				*			*	*		
Ekpontocypris pirifera																																																	

Table 3b- The distribution of ostracod species in samples of Antalya Bay (modified from Meriç et al., 2008*b*) (Cont.).

OSTRACODA	SAMPLINGSTATIONS																																																							
	71/8, 15 m	72/12, 24 m	73/8, 12, 21 m	74/6, 12, 23 m	76/15, 24 m	77/6, 12 m	78/6, 24 m	79/12, 24 m	80/6, 15, 19 m	81/8, 12, 15, 24 m	82/5, 26 m	83/6, 24 m	84/3, 10,12, 14, 20	85/12, 23 m	86/15 m	87/14,5 m	88/5, 13 m	89/6, 12, 24 m	90/6, 12, 24 m	91/6, 24 m	92/6, 12, 24 m	93/12, 24 m	94/24 m	95/12, 24 m	96/12, 24 m	97/12 m	98/24m	99/12, 24 m	100/12, 24 m	101/15, 18 m	102/12, 24 m	103/12, 24 m	106/12 m	107/24 m	108a/12, 24 m	108b/24 m	109/12, 24 m	111/13 m	112/12 m	114/24 m	115/24 m	116/20 m	117/16, 19 m	119/12, 24 m	120/12, 24 m	122/12, 15, 30 m	123/12, 20 m	124/20, 27 m	125/12, 18 m	127/18, 21 m	128/17, 20 m	129/15 m	130/20 m	131/12, 19 m	132/6 m	134/6 m	135/10 m
Cytherella (Cytherelloidea) beckmanni																		*																																							
Cytherelloidea sordida													*															*																										*			
Neonesidea corpulenta	*	*		*	*			*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*			*	*	*		*				*	*		*					*	*	*	*		*	*	*	*	*	*	*		*	
Neonesidea formosa		*	*					*		*												*	*				*				*				*											*	*	*		*	*					*	
Triebelina raripila																							*																							*		*	*									*
Cushmanidea elongata						*			*	*		*	*					*	*	*	*	*	*			*		*			*			*											*	*		*									
Microcytherura fulva			*																			*									*																*	*									
Aurila convexa	*		*	*		*		*	*				*	*			*	*		*	*	*				*		*		*	*	*			*		*				*	*		*	*	*	*			*	*	*	*	*	*	*	
Aurila arborescens							*					*		*						*																																					
Jugosocythereis prava				*	*				*	*	*			*		*	*		*	*	*			*				*		*	*	*	*												*			*		*	*	*						
Urocythereis margaritifera	*								*	*			*			*		*	*		*		*	*				*		*	*			*			*								*		*	*	*		*	*		*		*	
Urocythereis oblonga											*																																													
Callistocythere intricatoides																												*																													
Loxoconcha rhomboidea	*		*	*	*				*	*	*	*	*	*			*	*	*		*	*	*	*	*	*		*	*		*	*				*	*		*	*					*	*	*	*	*				*		*		*
Sahnia fasciata																																																						*		
Cytherois sp.				*																					*																															
Carinocythereis carinata																												*																										*		*	
Costa batei																												*																													
Hiltermannicythere rubra																		*													*																							*			
Hiltermannicythere turbida																															*																										
Henryhowella sp.																																														*											
Pterygocythereis ceratoptera																						*						*																*							*						
Xestoleberis communis	*	*		*		*	*	*		*	*		*				*											*																													
Xestoleberis dispar	*		*	*		*	*		*									*		*	*		*	*	*	*		*		*	*	*			*		*						*		*	*	*	*	*	*	*	*		*	*	*	
Xestoleberis depressa										*	*		*	*		*				*	*			*	*			*				*				*						*			*	*	*	*	*	*	*	*		*	*		
Ekpontocypris pirifera							*		*	*			*				*											*																*	*									*			

3.2. Ostracod Assemblage

Alibey and Maden islands, Ayvalık and Kuşadası regions were studied in the Aegean Sea. Detailed information related to the ostracod assemblage of these two regions is given below.

3.2.1. Ayvalık (Alibey and Maden Islands) Ostracod Assemblage

For each 4 cores performed in the vicinity of Alibey and Maden islands in northwest Ayvalık, 21 samples were collected from core 4b at a water depth of 0.80 m, from core 1c at 1.5 m, from core 3a at 2.70 m and from core 2c at 8.00 m The distribution of ostracod species according to cores is given in table 4. As a result of studies carried out in these samples, 3 species from Bairdiidae family, 2 species from Cytherellidae family, 5 species from Hemicytheridae family, 8 species from Trachyleberidae family, 2 species from Cytherettidae family, 2 species from Leptocytheridae family, 1 species from Cytheruridae family, 1 species from Paracytheridae family, 3 species from Loxoconchidae family, 1 species from Cytherideidae family, 1 speces from Neocytherideidae family, 1 species from Cushmanidae family, 1 species from Candonidae family, 1 species from Pontocytheridae family and 1 species from Cyprididae family were determined.

Ostracods were compared with studies carried out by Yassini (1979); Guillaume et al. (1985), Nazik (1994), Gülen et al. (1995), Oertli (1985), Szcechura (1998), Tunoğlu (1999), Şafak (1999), Meriç et al. (2005), Schneider et al. (2005). Among these species, *Carinocythereis*, *Xestoleberis*, *Loxoconcha*, *Urocythereis*, *Cytheretta*, *Aurila* and *Cytherelloidea* genera were identified also in 4 cores taken in the study area. It was observed that the number of ostracod genera and species increased based on water depth. These genera generally constitute epineritic (0-100 m) assemblage. Considering the carapace morphology and depth, it was observed that genera of Trachyleberidae and Hemicytheridae families, which have very ornamentation with distinctive shallow marine characteristics, with developed hinge, distinct eye spots and branched margin-pore canals, were relatively more than the number of individuals.

In the study, ostracod species known in the Atlantic and the Mediterranean such as; *Neonesidea corpulenta, Aurila convexa, Jugosocythereis prava*, *Carinocythereis antiquata*, *Carinocythereis carinata*, *Costa batei*, *Semicytherura inversa*, *Loxoconcha rhomboidea, Sahnia fasciata*, *Cuhmanidea elongata*, *Urocythereis oblonga* and ostracod species known in the Mediterranean such as; *Neonesidea formosa*, *Triebelina raripila*, *Cytherella (Cytherelloidea) beckmanni*, *Cytherelloidea sordida*, *Aurila arborescens*, *Carinocythereis rhombica*, *Hiltermannicythere rubra*, *Hiltermannicythere turbida*, *Cytheretta adriatica*, *Cytheretta judaea*, *Callistocythere intricatoides*, *Urocythereis crenulosa*, *Acanthocythereis hystrix*, *Paracytheridea depressa*, *Loxoconcha stellifera*, *Xestoleberis communis*, *Xestoleberis dispar*, *Pontocypris mytiloides*, *Caudites calceolatus* were determined.

Table 4- Ostracod species in cores of the Ayvalık region.

OSTRACODA	Ayvalık 1c	Ayvalık 2c	Ayvalık 3a	Ayvalık 4b
Neonesidea corpulenta	*	*	*	
Neonesidea formosa	*	*		
Triebelina raripila		*		
Cytherella (Cytherelloidea) beckmanni	*	*		*
Cytherelloidea sordida	*	*	*	*
Aurila arborescens	*	*	*	*
Aurila convexa	*	*	*	*
Caudites calceolatus		*		
Jugosocythereis prava	*	*	*	
Carinocythereis antiquata		*	*	
Carinocythereis carinata	*	*	*	
Carinocythereis rhombica		*	*	
Hiltermannicythere rubra	*	*	*	
Hiltermannicythere turbida	*	*	*	
Cytheretta adriatica	*	*	*	*
Cytheretta judaea		*		
Costa batei	*	*	*	
Callistocythere intricatoides	*	*	*	
Leptocythere sp.	*			
Urocythereis crenulosa		*	*	
Urocythereis oblonga	*	*	*	*
Acanthocythereis hystrix		*	*	
Semicytherura inversa	*	*	*	
Paracytheridea depressa	*	*	*	
Loxoconcha rhomboidea	*	*	*	*
Loxoconcha stellifera		*	*	
Cyprideis torosa		*		
Sahnia fasciata		*		
Cushmanidea elongata	*	*		
Xestoleberis communis	*	*	*	
Xestoleberis depressa	*	*	*	
Xestoleberis dispar	*	*	*	*
Pontocypris mytiloides		*	*	
Heterocypris salina		*		

3.2.2. Kuşadası Region Ostracod Assemblage

In the Pamucak Bay, NW Kuşadası of Aydın Province, total of 23 genera and 29 species were identified in 45 samples collected at depths of 8.5-22.3 meters at a distance of 200 meters from the coast (Table 5).

When the ostracod distribution is studied in Kuşadası samples, *Neonesidea corpulenta, Neonesidea formosa* from Bairdiidae family*; Aurila convexa*, *Jugosocythereis prava* from Hemicytheridae family*; Loxoconcha bairdi*, *Loxoconcha gibberosa from* Loxoconchidae family; *Xestoleberis communis*, *Xestoleberis dispar from* Xestoleberididae family and *Macropyxis adriatica* from Macrocyprididae family were widely observed. Whereas; genera such as; *Carinocythereis*, *Callistocythereis*, *Acantocythereis*, *Bosquetina*, *Hiltermannicythere*, which are generally known in the Mediterranean, were found in very few samples. Genera of *Cytheretta*, *Carinocythereis*, *Cytherella* and *Hiltermannicythere* were observed in east of the sampling station in samples taken from deeper parts.

In sampling, it was also investigated whether hot water springs have effects on the life of organisms. When ostracod individuals were examined, there was not observed any physical and chemical differences such as; the shape failure on carapace, color change. Accordingly; there is not any negative effect of hot waters on the ostracods.

Besides; *Urocythereis* and *Pterygocythereis* genera have never been observed in Kuşadası samples.

4. Stratigraphical and Biogeographical Distribution of Ostracods

The stratigraphical and biogeographical distribution of samples, which are the main subject of this study, were studied through geological time to present (Table 6). Besides; the original distribution of identified ostracods was given in table 7, as well. In this study, Van Morkhoven (1963), Sissing (1972), Bonaduce et al. (1975), Breman (1975), Yassinsi (1979), Athersuch et al. (1989), Meisch (2000), Schneider et al. (2005) and http://www.marinespecies.org/ostracoda/ site were mainly used.

Bosquetina carinella and *Pterygocythereis ceratoptera* from Eocene to Recent were first identified on European coast and is recently known in the Mediterranean.

Acanthocythereis hystrix, *Aurila convexa*, *Callistocythere intricatoides*, *Carinocythereis carinata*, *Cushmanidea elongata*, *Cyprideis torosa*, *Cytheretta adriatica*, *Heterocypris salina*, *Hiltermannicythere rubra*, *Hiltermannicythere turbida*, *Semicytherura inversa*, *Triebelina raripila*, *Xestoleberis communis*, *Caudites calceolatus* are genera from Miocene to Recent.

Costa batei, *Jugosocythereis prava*, *Loxoconcha gibberosa*, *Loxoconcha stellifera*, *Macropyxis adriatica*, *Neonesidea corpulenta*, *Neonesidea formosa*, *Pseudopsammocythere reniformis*, *Semicytherura acuticostata*, *Urocythereis crenulosa*, *Urocythereis margaritifera*, *Xestoleberis dispar* are living genera from Pliocene to Recent.

Carinocythereis rhombica, *Cytherella (Cytherelloidea) beckmanni*, *Loxoconcha bairdi*, *Sahnia fasciata* are genera from Pleistocene to Recent.

Cytherella alvearium, *Cytherelloidea sordida*, *Ekpontocypris pirifera*, *Microcytherura fulva*, *Neonesidea formosa*, *Paracytheridea depressa*, *Paradoxostoma tenuissimum*, *Pontocypris acuminata*, *Urocythereis oblonga*, *Xestoleberis depressa* are genera described as Recent.

5. Results

The study was conducted by the ostracod examination of samples collected from the the Gulf of Antalya, Ayvalık-Kuşadası (Aegean Sea), and results obtained were given below.

The number of species identified in this study and their locations are as follows; 26 species in the Mediterranean, 34 species Ayvalık region and 29 species in Kuşadası in the Aegean Sea. 2 species from Eocene, 14 species from Miocene, 15 species from Pliocene and 6 species from Pleistocene have continued till Recent. Nine species are known in the Recent.

When the ostracod assemblage was numerically assessed, and the shell morphology and depth were taken into consideration, it was observed that genera of Trachyleberidae and Hemicytheridae families, which have very ornamented with distinctive shallow marine characteristics, with developed hinge, distinct eye spots and branched marginal pore canals, were relatively more than the number of individuals.

Table 5- The distribution of ostracod species in Kuşadası samples.

OSTRACODA	SAMPLING STATIONS																																												
	South											North										West									East														
	1/12,4 m	2/11,1 m	3/9,7 m	4/9,2 m	5/9,5 m	6/10,5 m	7/11,3 m	8/12,3 m	9/12,5 m	10/13,7 m	11/14,9 m	12/8,9 m	13/8,5 m	14/8,7 m	15/9 m	16/10,1 m	17/10,9 m	18/12 m	19/13,1 m	20/14,2 m	21/20,1 m	22/9,1 m	23/9,3 m	24/11,3 m	25/12,8 m	26/14,7 m	27/17,3 m	28/17,9 m	29/18,2 m	30/22,3 m	31/12,8 m	32/11,9 m	33/12,1 m	34/11,5 m	35/14,4 m	36/15,3 m	37/15,9 m	38/18,1 m	39/19,1 m	40/19,5 m	41/19,4 m	42/19,1 m	43/20,2 m	44/20,01 m	45/ 20,2 m
Neonesidea corpulenta			*			*	*	*	*	*		*	*		*	*	*	*	*	*	*			*	*		*	*	*	*					*	*		*	*		*			*	
Neonesidea formosa				*	*	*	*	*	*		*			*		*	*	*	*	*	*		*	*	*	*		*	*		*			*	*			*				*			*
Triebelina raripila																							*																						
Cytherella alvearium																																											*	*	*
Aurila convexa	*		*		*	*	*	*		*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				*	*	*	*	*	*		*	*	*			*	*	*	
Caudites calceolatus			*			*		*																							*														
Jugosocythereis prava	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*
Bosquetina carinella							*										*			*																									*
Carinocythereis carinata																																											*		*
Hiltermannicythere rubra																																													*
Hiltermannicythere turbida																																						*						*	*
Cytheretta judaea																																													*
Callistocythere intricatoides							*			*											*				*				*								*					*	*	*	*
Paradoxostoma acuminatum			*									*				*		*					*									*		*											
Cytherois sp.																		*		*																									
Acanthocythereis hystrix																														*															
Semicytherura acuticostata					*																			*	*	*			*			*		*		*			*	*				*	*
Semicytherura inversa						*		*				*			*	*	*		*	*	*							*			*				*		*			*		*	*	*	
Semicytherura paradoxa																	*																												
Paracytheridea depressa										*																	*				*							*			*	*	*		
Loxoconcha bairdi	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Loxoconcha gibberosa		*			*			*			*	*	*			*	*	*	*	*			*	*	*	*	*		*	*	*	*				*		*	*	*	*			*	
Sclerochilus contortus								*	*			*											*															*							
Pseudopsammocythere reniformis					*						*									*				*					*			*							*						
Xestoleberis communis	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Xestoleberis dispar	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Macropyxis adriatica							*		*				*			*		*	*		*			*	*	*				*		*			*		*								
Pontocypris acuminata																			*																										
Ekpontocypris prifera								*						*					*												*								*		*		*		

Table 6-The stratigraphical and biogeographical distributions of ostracod species in the study.

OSTRACODA	Eocene/Oligocene	Miocene	Pliocene	Pleistocene	Holocene
Bosquetina carinella	Ec	Ec, Ew, Mt	Ec, Ew, Mt	Mt	Mt
Pterygocythereis ceratoptera	Ecw	Ecw, Mt	Mt	Mt	Mt, Ew
Acanthocythereis hystrix		Ec, Mt	Mt	Mt	Mt
Aurila convexa		Ew	Mt, Ew	Mt, Ew	Mt, Ew
Callistocythere intricatoides		Mg	Mt	Mt	Mt, B
Carinocythereis carinata		Mt	Mt	Mt	Mt, B
Caudites calceolatus		Mg	Mg	Mg	Mt
Cushmanidea elongata		Mt	Mt	Mt, Ew	Mt, Ew, A
Cyprideis torosa		W	W	W	W
Cytheretta adriatica		Mt	Mt	Mt	Mt
Heterocypris salina		W	W	W	W
Hiltermannicythere rubra		Mt	Mt	Mt	Mt, B
Hiltermannicythere turbida		Mt	Mt	Mt	Mt, B
Semicytherura inversa		Ew	Ew, Mt	Ew, Mt	Mt
Triebelina raripila		Mt	Mt	Mt	Mt
Xestoleberis communis		Mg	Mt	Mt	Mt
Aurila arborescens			Mt	Mt	Mt
Carinocythereis antiquata			Mt	Mt	Mt, Ew
Costa batei			Mi	Mi	Mi,
Jugosocythereis prava			Mt	Mt	Mt, B
Loxoconcha gibberosa			Mg	Mg	Mg, Ag
Loxoconcha stellifera			Mg	Mt	Mt
Macropyxis adriatica			Mi	Ew	Ew
Neonesidea corpulenta			Mg	Mt	Mt, Ew
Neonesidea formosa			Mt	Mt	Mt
Pseudopsammocythere reniformis			Mi	Mi	Mt
Semicytherura acuticostata			Mt	Mt	Mt
Semicytherura paradoxa			Mt	Mt	Mt
Urocythereis crenulosa			Mt	Mt	Mt
Urocythereis margaritifera			Mg	Mt	Mt, Ew
Xestoleberis dispar			Mg	Mt	Mt
Carinocythereis rhombica				Mg	Mg, Ag
Cytherella (Cytherelloidea) beckmanni				Mt	Mt
Cytheretta judaea				Mi	Mt
Loxoconcha bairdi				Mi	Mt
Sahnia fasciata				Mi	Mt, Ew
Sclerochilus contortus				Mt, Ew	Mt, Ew
Cytherella alvearium					Mt
Cytherelloidea sordida					Mt
Ekpontocypris pirifera					Mt, Ew
Loxoconcha rhomboidea					Mt
Microcytherura fulva					Ma
Paracytheridea depressa					Mt, Ew
Paradoxostoma acuminatum					Ew
Pontocypris acuminata					Mt, Ew
Pontocypris mytiloides					Mt, Ew
Mt= Whole Mediterranean		Ec= Central Europe			
Mi= Italian coasts		Ew=Atlantic coast of Europe			
Ma=Adriatic		A=Atlantic coasts of Central America			
Mg= Greek coasts		W= Worldwide			
B= Black Sea		Ag= Aegean Sea			

Table 7- The correlation of ostracod species in the study based on their regions and origins.

OSTRACODA	ANTALYA	AYVALIK	KUŞADASI	MEDITERRANEAN ORIGIN	MEDITERRANEAN-ATLANTIC ORIGIN
Acanthocythereis hystrix		*	*	●	
Aurila arborescens	*	*		●	
Aurila convexa	*	*	*		▲
Bosquetina carinella			*		▲
Callistocythere intricatoides	*	*	*	●	
Carinocythereis antiquata		*			▲
Carinocythereis carinata	*	*	*		▲
Carinocythereis rhombica		*		●	
Caudites calceolatus		*	*	●	
Costa batei	*	*			▲
Cushmanidea elongata	*	*			▲
Cyprideis torosa		*			▲
Cytherella (Cytherelloidea) beckmanni	*	*		●	
Cytherella alvearium			*	●	
Cytherelloidea sordida	*	*		●	
Cytheretta adriatica		*		●	
Cytheretta judaea		*	*	●	
Cytherois sp.	*		*		
Ekpontocypris pirifera	*		*		▲
Henryhowella sp.	*				
Heterocypris salina		*			▲
Hiltermannicythere rubra	*	*	*	●	
Hiltermannicythere turbida	*	*	*	●	
Jugosocythereis prava	*	*	*	●	
Leptocythere sp.		*			
Loxoconcha bairdi			*	●	
Loxoconcha gibberosa			*	●	
Loxoconcha rhomboidea	*	*		●	
Loxoconcha stellifera		*		●	
Macropyxis adriatica			*		▲
Microcytherura fulva	*			●	
Neonesidea corpulenta	*	*	*		▲
Neonesidea formosa	*	*	*	●	
Paracytheridea depressa		*	*		▲
Paradoxostoma acuminatum			*		▲
Pontocypris acuminata			*		▲
Pontocypris mytiloides		*	*		▲
Pseudopsammocythere reniformis			*	●	
Pterygocythereis ceratoptera	*				▲
Sahnia fasciata	*	*			▲
Sclerochilus contortus			*		▲
Semicytherura acuticostata			*	●	
Semicytherura inversa		*	*		▲
Semicytherura paradoxa			*	●	
Triebelina raripila	*	*	*	●	
Urocythereis crenulosa		*		●	
Urocythereis margaritifera	*				▲
Urocythereis oblonga	*	*			▲
Xestoleberis communis	*	*	*	●	
Xestoleberis depressa	*	*			▲
Xestoleberis dispar	*	*	*	●	
(● Endemik Akdeniz).	(▲Akdeniz-Atlantik)				

The ostracod assemblage found in this study were compared with previous studies carried out in the Mediterranean, the Aegean islands, the Adriatic Sea, Algeria, the Sea of Marmara and the Aegean Sea (Turkey). As a result; prevailing ostracod species such as; *Neonesidea corpulenta, Aurila convexa, Jugosocythereis prava, Carinocythereis antiquata, Carinocythereis carinata*, *Costa batei, Semicytherura inversa, Loxoconcha rhomboidea, Sahnia fasciata, Cushmanidea elongata* known in Atlantic and the Mediterranean, and species such as; *Neonesidea formosa, Triebelina raripila, Cytherella (Cytherelloidea) beckmanni, Cytherelloidea sordida, Aurila arborescens, Carinocythereis rhombica, Hiltermannicythere rubra, Hiltermannicythere turbida, Cytheretta adriatica, Cytheretta judaea, Callistocythere intricatoides, Urocythereis crenulosa, Acanthocythereis hystrix, Paracytheridea depressa, Xestoleberis communis, Xestoleberis dispar* and *Pontocypris acuminata* known in the Mediterranean were determined.

Besides; *Callistocythereis intricatoides*, *Carinocythereis carinata*, *Hiltermannicythere rubra*, *Hiltermannicythere turbida* and *Jugosocythereis prava* species, which are Mediterranean in origin, were found in studies carried out in Black Sea.

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PLATE

PLATE I

Figure 1. *Cytherella alvearium*, left valve side view, core Ayvalık 2c 0-2cm.

Figure 2. *Cytherella (Cytherelloidea) beckmanni*, left valve side view, core Ayvalık 2c 2-4cm.

Figure 3. *Cytherelloidea sordida*, left valve side view, ×63, Kekova-Antalya, Station 84/3m.

Figure 4. *Neonesidea corpulenta*, right valve side view, Kuşadası, Station 20.

Figure 5. *Neonesidea formosa*, left valve side view, Kuşadası, Station 24.

Figure 6. *Triebelina raripila*, right valve side view, Kuşadası, Station 23.

Figure 7. *Sclerochilus contortus*, left valve side view, Kuşadası, Station 38.

Figure 8. *Cushmanidea elongata*, right valve side view, core Ayvalık 2c 4-6 cm.

Figure 9. *Cytheretta adriatica*, left valve side view, core Ayvalık 4b 24-26 cm.

Figure 10. *Cytheretta judaea*, a. Left valve interor view, Kuşadası, Station 45, b. Right valve side view, Kuşadası, Station 38

Figure 11. *Cyprideis torosa*, left valve side view, core Ayvalık 2c 8-10 cm.

Figure 12. *Microcytherura fulva*, right valve side view, ×62, Kaş-Antalya, Station 43/21 m.

Figure 13. *Semicytherura acuticostata*, left valve side view, Kuşadası, Station 8.

Figure 14. *Semicytherura inversa*, right valve side view, Kuşadası, Station 42.

Figure 15. *Semicytherura paradoxa*, right valve side view, Kuşadası, Station 17.

Figure 16. *Aurila arborescens*, right valve side view, core Ayvalık 3a 40-42 cm.

Figure 17. *Aurila convexa*, left valve side view, ×64, Kekova-Antalya, Station 71/15m.

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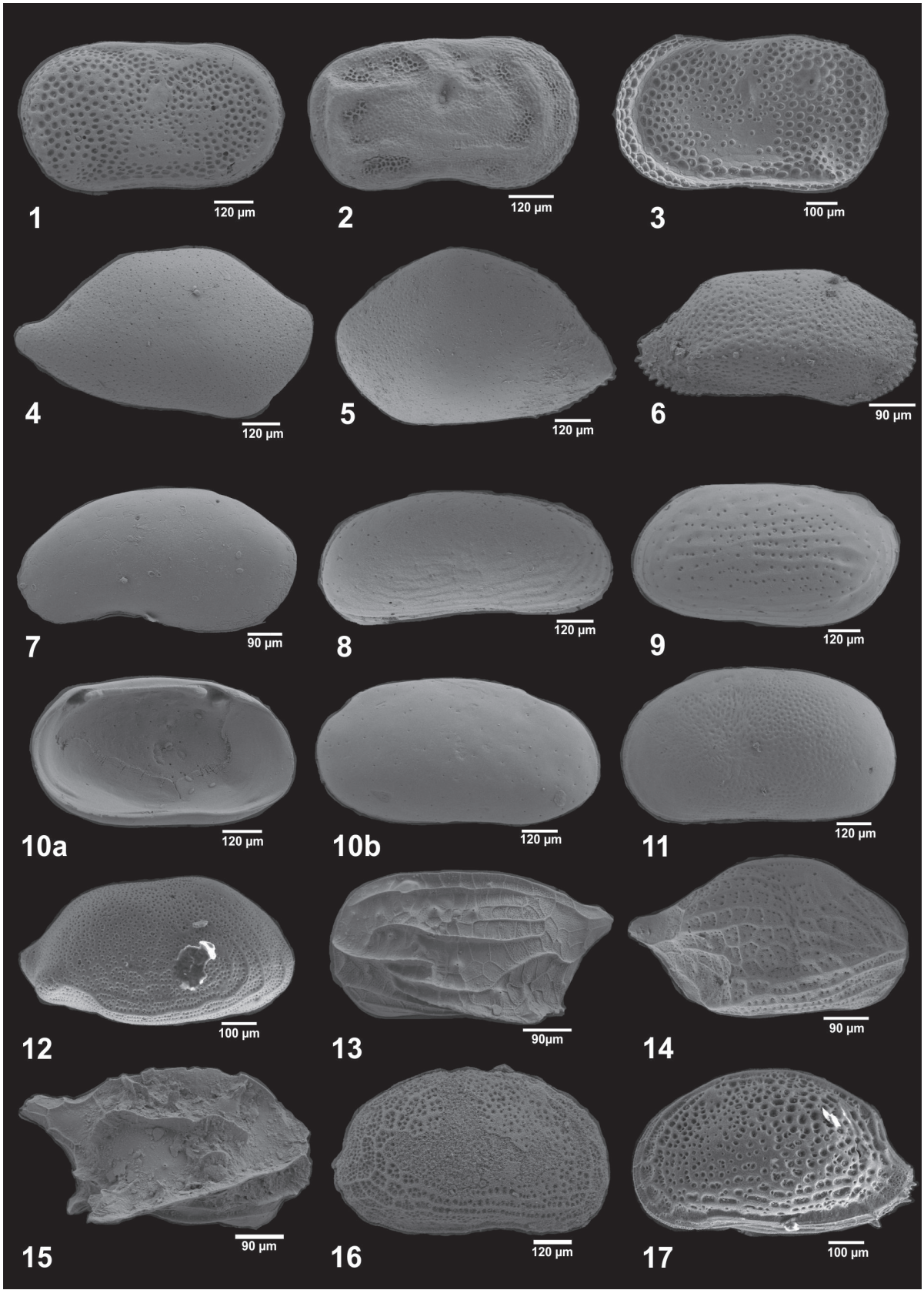
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PLATE II

Figure 1. *Caudites calceolatus*, left valve side view, Kuşadası, Station 3.

Figure 2. *Jugosocythereis prava*, right valve side view, Kaş-Antalya, Station 42/9 m.

Figure 3. *Urocythereis crenulosa*, right valve side view, core Ayvalık 2c 2-4 cm.

Figure 4. *Urocythereis margaritifera*, left valve side view, Üçadalar-Antalya, Station 128/20 m.

Figure 5. *Urocythereis oblonga*, right valve side view, Kalkan-Antalya, Station 5/5 m.

Figure 6. *Pseudopsammocythere reniformis*, a. Shell right external view, Kuşadası, Station 24; b. Right valve external view, Kuşadası, Station 29.

Figure 7. *Callistocythere intricatoides*, left valve external view, Kalkan-Antalya, Station 14/12 m.

Figure 8. *Loxoconcha bairdi*, left valve side view, Kuşadası, Station 34.

Figure 9. *Loxoconcha gibberosa*, left valve side view, Kuşadası, Station 18.

Figure 10. *Loxoconcha rhomboidea*, right valve side view ×86, Kekova-Antalya, Station 74/23m.

Figure 11. *Loxoconcha stellifera*, a. right valve side view, b. Left valve internal view, core Ayvalık 2c 14-16 cm.

Figure 12. *Sahnia fasciata*, a.left valve side view, core Ayvalık 2c 14-16 cm; b. Left valve internal view, core Ayvalık 2c 24-26 cm.

Figure 13. *Paracytheridea depressa*, left valve side view, Kuşadası, Station 38.

Figure 14. *Paradoxostoma acuminatum,* a. right valve side view, Kuşadası, Station 19; b. Right valve internal view, Kuşadası, Station 24.

PLATE II

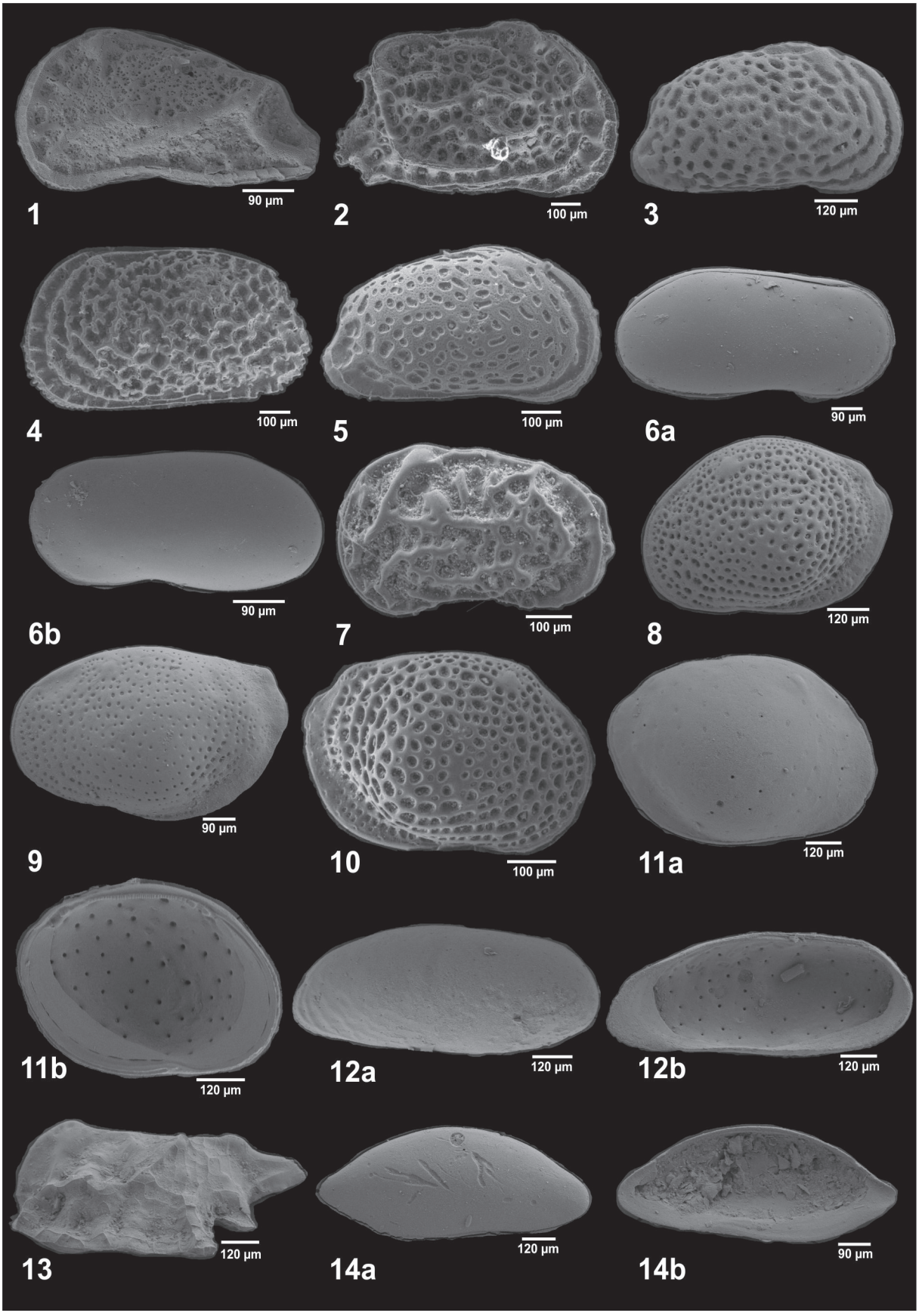
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PLATE III

Figure 1. *Cytherois* sp., right valve internal view, Kuşadası, Station 20.

Figure 2. *Acanthocythereis hystrix*, right valve external view, Kuşadası, Station, 30.

Figure 3. *Bosquetina carinella*, right valve external view, Kuşadası, Station, 45.

Figure 4. *Carinocythereis antiquata*, left valve external view, core Ayvalık 3a 34-36 cm.

Figure 5. *Carinocythereis carinata*, left valve external view, core Ayvalık 2c 40-42 cm.

Figure 6. *Carinocythereis rhombica*, right valve external view, core Ayvalık 2c 24, 26 cm

Figure 7. *Costa batei*, right valve external view, ×61, Kekova-Antalya, Station 99/24 m.

Figure 8. *Henryhowella* sp., left valve external view, ×53, Üçadalar-Antalya, Station 122/30 m.

Figure 9. *Hiltermannicythere rubra*, left valve external view, Ayvalık 2c karotu 40-42 cm.

Figure 10. *Hiltermannicythere turbida*, right valve external view, ×57, Kekova/Antalya, Station 102/24 m.

Figure 11. *Pterygocythereis ceratoptera*, left valve external view, ×62, Kekova-Antalya, Station 99/12 m.

Figure12. *Xestoleberis communis*, left valve external view, ×83, Kaş-Antalya, Station 52/14 m.

Figure 13. *Xestoleberis depressa*, right valve external view, Kuşadası, Station 24.

Figure 14. *Xestoleberis dispar*, right valve external view, ×61, Kekova-Antalya, Station 94/24 m.

Figure 15. *Macropyxis adriatica*, a. left valve internal view, Kuşadası, Station 19; b. Right valve external view Kuşadası, Station 6.

Figure 16. *Pontocypris acuminata*, right valve external view, Kuşadası, Station 19.

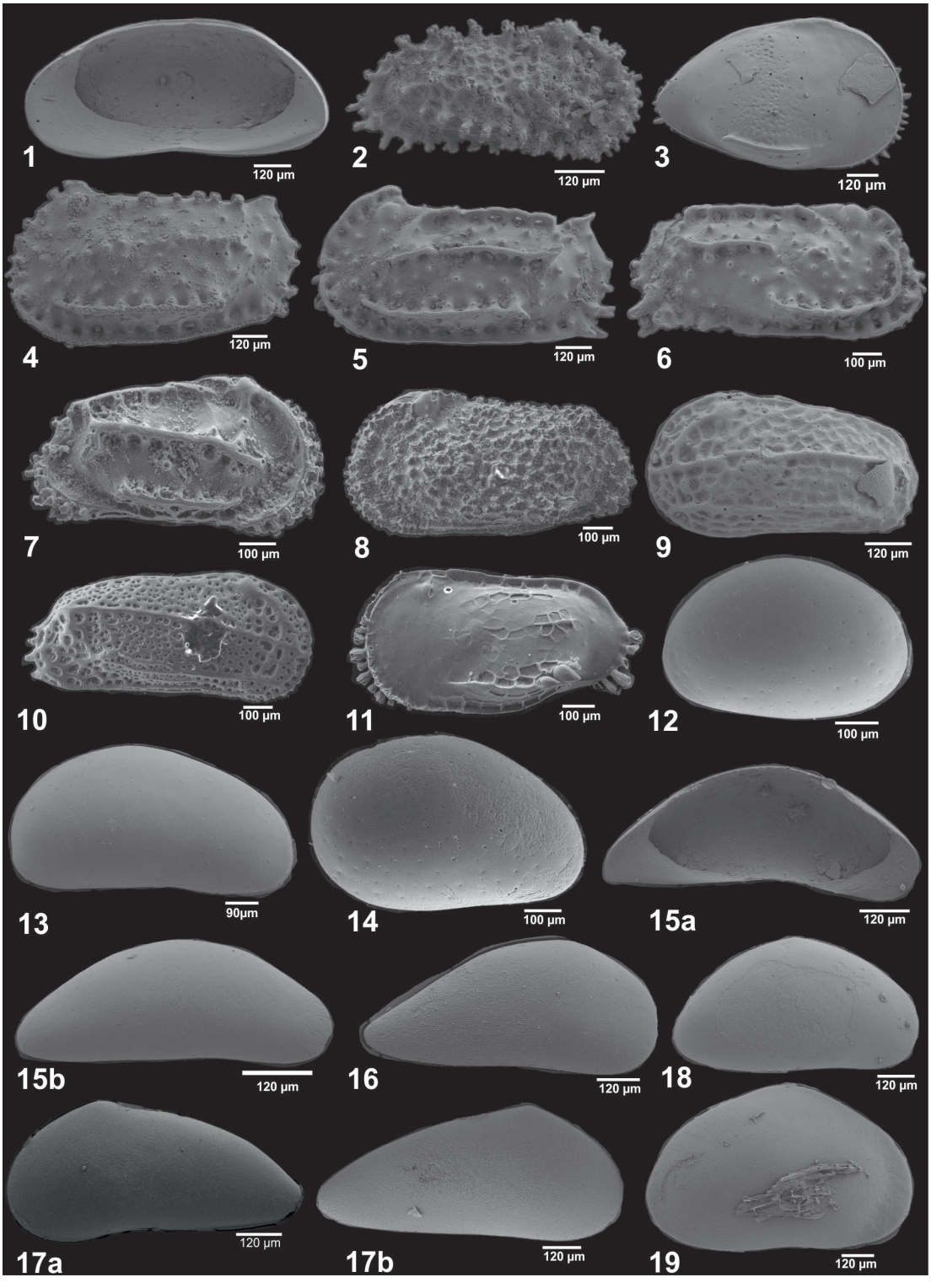
Figure 17. *Pontocypris mytiloides*, a. left valve external view, core Ayvalık 2c 2-4 cm;

b. Right valve external view, core Ayvalık 2c 24-26

Figure 18. *Ekpontocypris pirifera*, right valve external view, core Ayvalık 2c 40-42 cm.

Figure 19. *Heterocypris salina*, right valve external view, core Ayvalık 2c 30-32 cm.

PLATE III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