



## Pontian aged *Loxoconcha* (Ostracoda) species from eastern Black Sea Region of Turkey

*Türkiye'nin Doğu Karadeniz Bölgesi'nin Ponsiyen yaşlı Loxoconcha (Ostrakod) türleri*

**Cemal TUNOĞLU**

Hacettepe University, Faculty of Engineering, Department of Geological Engineering, 06532 Beytepe, ANKARA

### ABSTRACT

In this study, Neogene aged ostracod fauna of the Eastern Black Sea Region was investigated and 86 ostracod species were determined. In this ostracod fauna, one new, seven known, three taxa belongs to open nomenclature, totally eleven *Loxoconcha* species were described. These are; *Loxoconcha arakliensis* n.sp., *Loxoconcha petasus* Livaltal, *L. ornata* Schneider, *L. laeta* Stancheva, *L. valiente* Stancheva, *L. gibboides* Livaltal *L. eichwaldi* Livaltal, *Loxoconcha* cf. *hastata* Reuss, *Loxoconcha* sp.1, *Loxoconcha* sp. 2, *Loxoconcha* sp. 3. All of the *Loxoconcha* association was observed and described from the Araklı, east of Değirmendere (Trabzon), Boztepe (Trabzon) and Bafra (Samsun) regions. The age of this association is Middle-Late Pontian. According to environmental properties of *Loxoconcha* and the other associated ostracoda fauna, it can be concluded that shallow marine, littoral and transitional facies conditions were continuously dominant during this period. This ostracoda association indicated that the Black Sea Coast of Anatolia during Pontian was affected from the Paratethys bioprovince (especially Euxinic and Caspic Basins)

**Key words:** *Loxoconcha*, Ostracoda, Paratethys, Pontian, Turkey.

### ÖZ

*Bu çalışmada, Doğu Karadeniz Bölgesinin Neojen yaşlı ostrakod topluluğu araştırılmış ve 86 ostrakod türü tanımlanmıştır. Bu topluluğun 11 adedi Loxoconcha cinsine ait olup, bunların biri yeni tür olarak önerilirken, yedi adedi bilinen türdür ve üç adedi ise isimlendirilmeye açık olarak bırakılmıştır. Bunlar sırasıyla; Loxoconcha arakliensis n.sp., Loxoconcha petasus Livaltal, L. ornata Schneider, L. laeta Stancheva, L. valiente Stancheva, L. gibboides Livaltal Loxoconcha. eichwaldi Livaltal, Loxoconcha cf. hastata Reuss, Loxoconcha sp.1, Loxoconcha sp.2, Loxoconcha sp.3 türleridir. Tüm Loxoconcha türleri Araklı, Değirmendere doğusu (Trabzon), Boztepe (Trabzon) ve Bafra (Samsun) bölgesinde gözlenmiş ve tanımlanmıştır. Bu türler, kronostratigrafik olarak Orta-Geç Ponsiyen kütüne aittir. Saptanmış olan Loxoconcha türlerinin yanısıra, belirlenen diğer ostrakod topluluğu; inceleme alanındaki ortamsal özelliklerin siğ denizel-litoral ve geçiş ortamı niteliğini yansıttığını göstermektedir. Mevcut ostrakod faunası, Ponsiyen boyunca Doğu Karadeniz kıyılarının tamamen Paratetis biyoprovensinin etkisi altında (özellikle Öksinik ve Kaspik havza koşulları) olduğunu işaret etmektedir.*

**Anahtar kelimeler:** *Loxoconcha*, Ostrakod, Paratetis, Ponsiyen, Türkiye.

### INTRODUCTION

Species of *Loxoconcha* genus were common in the Tethys and Paratethys bioprovince especially during Neogene period. *Loxoconcha* is known as brackish and shallow marine genus in the ecology of ostracod assemblages (Moore,

1961; Morkhoven, 1962, 1963). Furthermore, this genus was very important in the brackish Paratethys basins and abundant characteristic species during the Sarmatian-Pontian interval.

One of the important publication about the *Loxoconcha* was written by Krstic (1972) from the

Paratethys bioprovince of Congerian beds in Bulgaria. Some of the articles about *Loxoconcha* are as follows: Krstic (1975a, b; 1989), Stancheva (1963, 1989), Agalarova (1967), Carbonnel (1978), Tunoğlu (1984), Tunoğlu and Gökçen (1985, 1991, 1997), Rundic (1993) and Tunoğlu et al. (1998) and Tunoğlu (2001). This genus were also found from the brackish and coastal (littoral) assemblages in the Tethys (Mediterranean) bioprovince (Montenegro et al., 1998) during Pliocene-Recent (Morkhoven, 1963; Bonaduce et al., 1975; Aranki, 1987; Tunoğlu, 1999).

The main aim of this paper is to describe the species of *Loxoconcha* genus of Pontian stages from Eastern Black Sea Region of Anatolia. This study is a part of a detailed investigation, in which totally 86 Ostracoda species of different genera were determined.

## GEOLOGIC SETTING

In this study, ostracod fauna of Eastern Black Sea Coast was examined from 250 samples obtained from five different localities along the Eastern Black Sea coast (Figure 1-3). The lithological characteristics of Trabzon and Araklı Sections are generally weakly cemented sandstone, laminated grey marl, sandy clay and yellow shelly sandstone (Tables 1-3), but Gümüşyaprak Section (Samsun) consists of limestone, marl and sandy marl lithologies (Table 4).

Following publications could be pronounced as previous paleontological studies in the Black Sea Coast of Turkey. Early paleontologic studies were carried out between Sinop and Trabzon by Özsayar (1977a, b; 1980, 1983 a, b and 1984) and Tarchanian, Chockrakian, Karaganiyan and Sarmatian Paratethys stages (lower, middle upper Miocene local stages) were determined based on the foraminifera and Mollusca fauna. Meanwhile, the first detailed ostracoda investigation was conducted by Tunoğlu (1984), Tunoğlu and Gökçen (1985, 1991, 1995 and 1997) in the Sinop Peninsula.

## SYSTEMATIC DESCRIPTION

In this study, eleven *Loxoconcha* species of Pontian stage were identified. The ostracoda fauna of these regions include one new species, seven known and three taxa belongs to open

nomenclature. Hartmann and Puri's (1974) classification was used for the systematic description of the species, and Moore (1961), Morkhoven (1962, 1963) and the "Catalogue of Ostracoda" of Ellis and Messina's (1953-1985) were also utilized for determinations. The materials described in this study are stored at the Geological Engineering Department of Hacettepe University.

**Family : LOXOCONCHIDAE** Sars

**Genus: *Loxoconcha*** Sars

**Type-species: *Cythere rhomboidea*** Fischer

**Stratigraphic distribution:** Paleocene-Recent (Morkhoven, 1963)

**Environment:** Littoral, mesohaline salinity conditions ( Moore, 1961)

***Loxoconcha petasus*** Livaltal, 1929

pl. 1 figs. 1-3

1929. *Loxoconcha petasus* Livaltal, p. 33, pl. 1, figs. 39-41.

1956. *Loxoconcha petasus* Livaltal, Agalarova: p. 98, pl. 8, figs. 18a, b, c; pl. 9, figs. 25 a, b.

1967. *Loxoconcha ex.gr. petasus* Livaltal, Agalarova: p. 110, pl. 19, fig. 1a.

1984. *Loxoconcha petasus* Livaltal, Tunoğlu: p. 102, pl.7, figs. 13-15.

1997. *Loxoconcha petasus* Livaltal, Tunoğlu and Gökçen: p. 356, pl. 2, fig. 11.

1998. *Loxoconcha petasus* Livaltal, Tunoğlu et al., p. 75, pl. 5, figs.1-3.

**Material:** 3 carapaces, 35 valves.

**Dimensions:**

Length: (♂) 0.57-0.59 mm (♀) 0.67-0.69 mm

Height: 0.35-0.37 mm 0.37-0.39 mm

Width: 0.30-0.38 mm 0.32-0.36 mm

**Stratigraphic and geographic distribution:**

Azerbaijan and Turkmenistan: Pontian-Pliocene (Livaltal, 1929; Agalarova, 1956, 1967); Turkey, Sinop Neogene Basin, Pontian (Tunoğlu, 1984; Tunoğlu and Gökçen, 1997); Araklı (Trabzon), Pontian (Tunoğlu et al., 1998).

***Loxoconcha ornata*** Schneider, 1939

lev.1 fig. 4

1939. *Loxoconcha ornata* Schneider, p. 187, pl. 3, figs. 5,6.

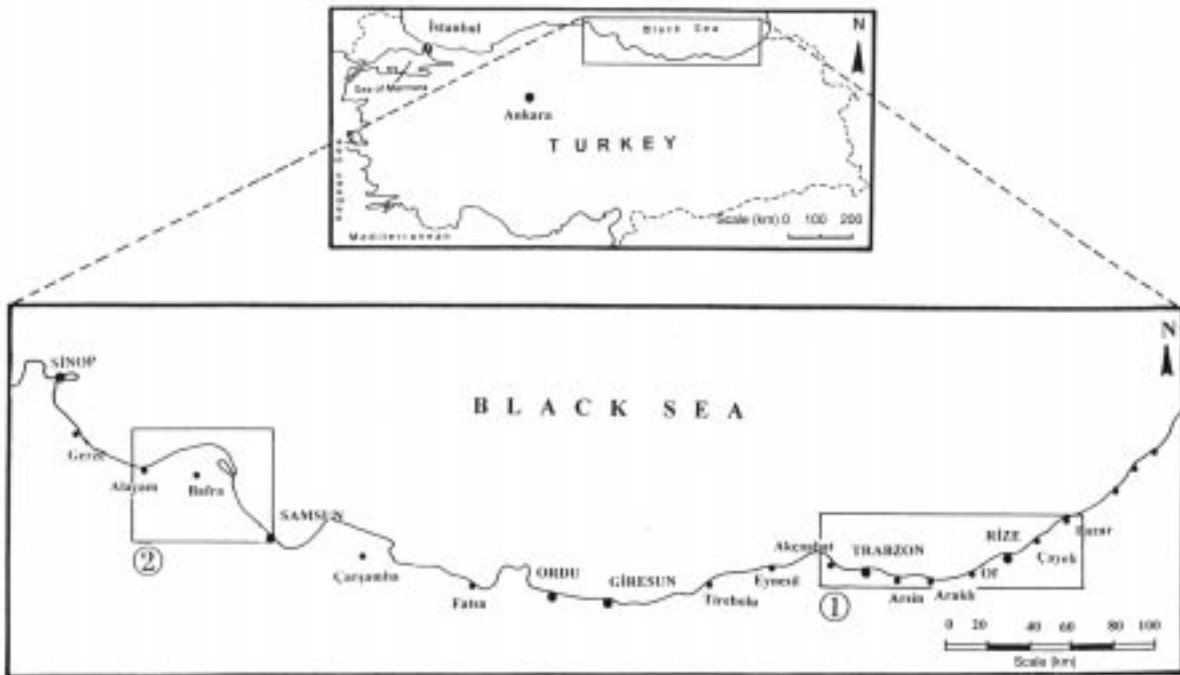


Figure 1. Location map of the investigated region and subareas.  
 Şekil 1. İnceleme bölgesinin ve altalanların yerbulduru haritası.

1963. *Loxoconcha ornata* Schneider, Stancheva, p. 32, pl. 6, fig. 10.  
 1998. *Loxoconcha ornata* Schneider, Tunoğlu et al., p. 76, pl. 5, fig. 4

**Material:** 3 carapaces, 11 valves.  
**Dimensions:** Length: 0.55-0.57 mm  
 Height: 0.38-0.41 mm  
 Width: 0.36-0.44 mm

**Stratigraphic and geographic distribution:** Azerbaijan and Turkmenistan, Sarmatian (Schneider, 1939); Bulgaria, Sarmatian (Stancheva, 1963); east side of Değirmendere River (Trabzon/Turkey), Pontian (Tunoğlu et al., 1998).

***Loxoconcha valiente*** Stancheva, 1963  
 pl. 1 fig. 5

1963. *Loxoconcha valiente* Stancheva, p. 49, 59; pl. 6, fig. 1.  
 1998. *Loxoconcha valiente* Stancheva, Tunoğlu, et al., p. 76, pl. 5, fig. 5.

**Material:** 2 carapaces, 17 valves.  
**Dimensions:** Length: 0.55-0.57 mm  
 Height: 0.36-0.39 mm  
 Width: 0.38-0.42 mm

**Stratigraphic and geographic distribution:** Bulgaria, Middle Sarmatian (Stancheva, 1963);

- Gümüşyaprak Village (Bafra/Samsun), Pontian (Tunoğlu et al., 1998).

***Loxoconcha laeta*** Stancheva, 1963  
 pl. 1 fig.6

1963. *Loxoconcha laeta*, Stancheva, p. 58, pl. 6, fig. 9.  
 1998. *Loxoconcha laeta*, Stancheva, Tunoğlu, et al., p. 76, pl. 5, fig. 6.

**Material:** 16 valves.  
**Dimensions:** Length: 0.69-0.71 mm  
 Height: 0.42-0.44 mm  
 Width: 0.44-0.48 mm

**Stratigraphic and geographic distribution:** Bulgaria, Early Sarmatian (Stancheva, 1963). Gümüşyaprak Village (Bafra/Samsun), Pontian (Tunoğlu et al., 1998).

***Loxoconcha gibboides*** Livental, 1929  
 pl. 1 figs. 7-10

- 1929 *Loxoconcha gibboides* Livental, p. 31, pl.1, figs. 32-34.  
 1961 *Loxoconcha gibboides* Livental, Mandelstam et al., p.176, pl. 28, fig. 3.  
 1989 *Loxoconcha gibboides* Livental, Stancheva, p. 33, pl. 9, figs. 5, 6.

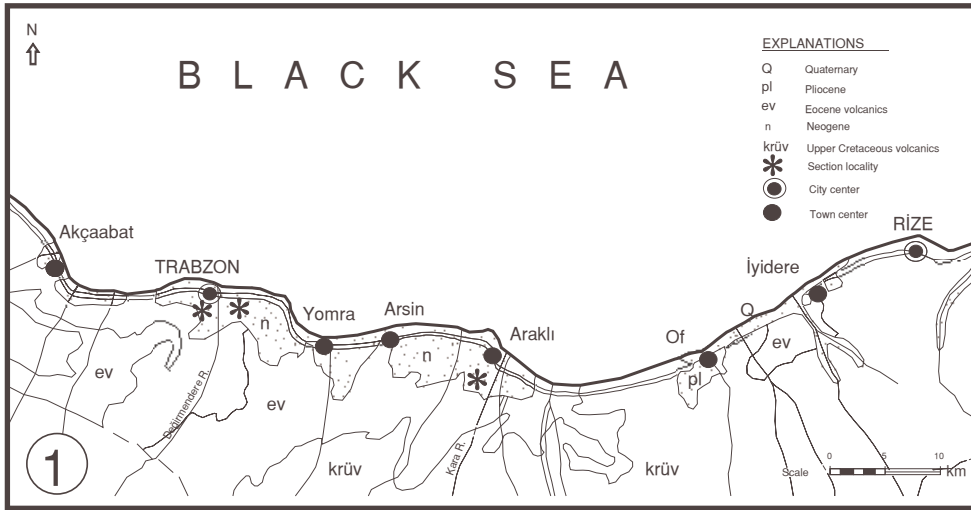


Figure 2. Geological map and section localities of Trabzon-Rize subarea (simplified from the 1/500000 scaled geological map of Turkey).

Şekil 2. Trabzon-Rize altalanının jeolojik haritası ve kesit yerleri (1/500000 ölçekli Türkiye jeoloji haritasından alınmış ve basitleştirilmiştir).

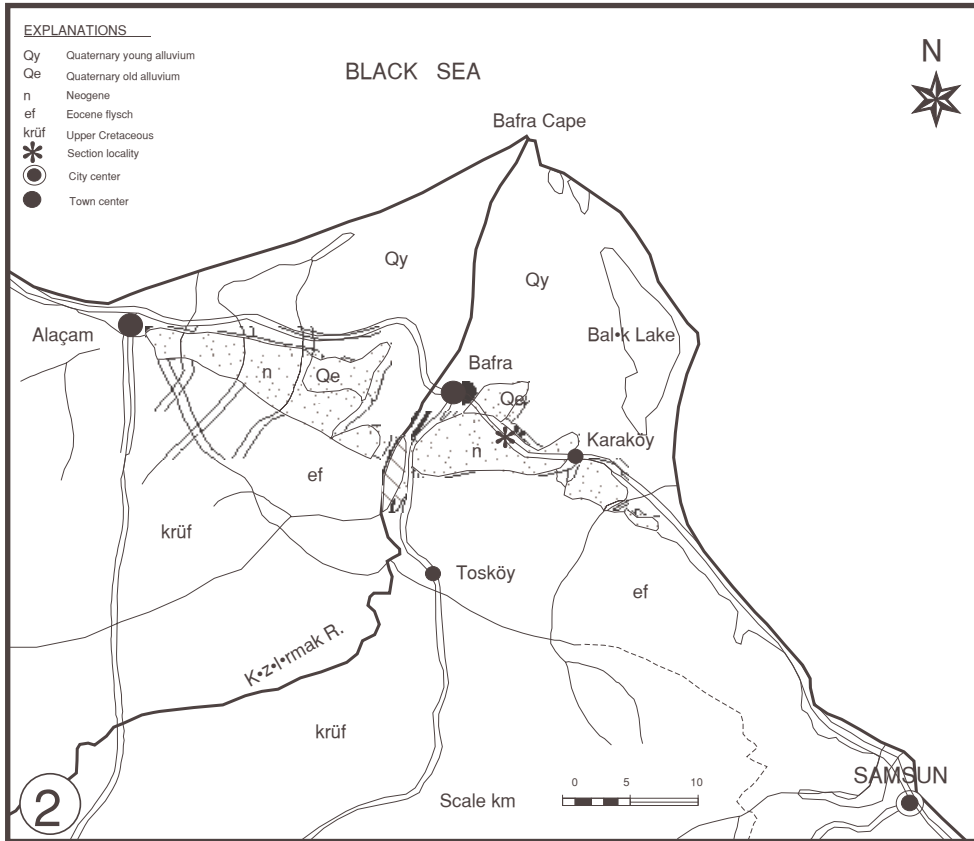


Figure 3. Geological map and section locality of Samsun subarea. (simplified from the 1/500000 scaled geological map of Turkey).

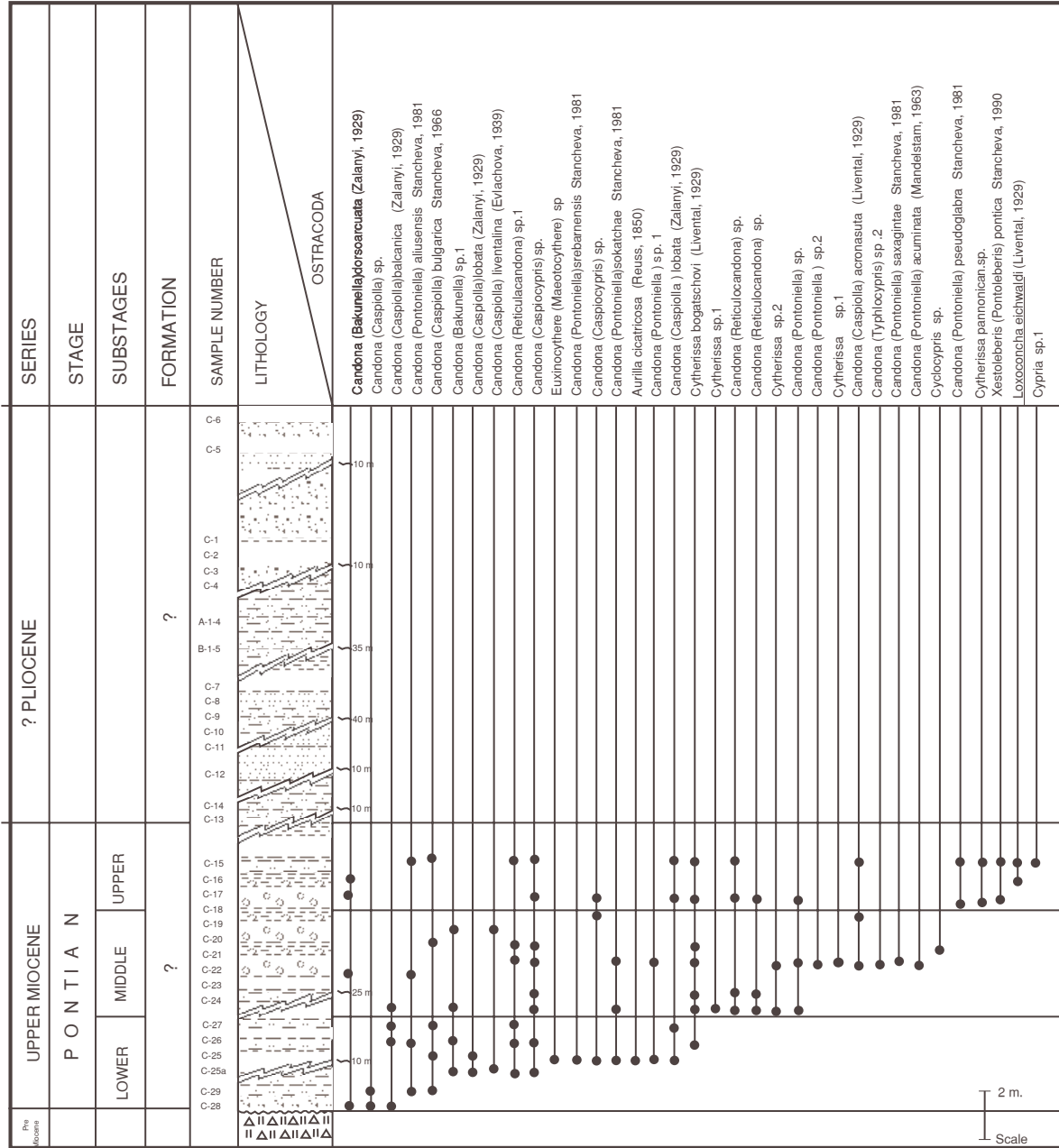
Şekil 3. Samsun altalanının jeolojik haritası ve kesit yeri (1/500000 ölçekli Türkiye jeoloji haritasından alınmış ve basitleştirilmiştir).

Table 1. Stratigraphic distribution of the *Loxoconcha* species and the other ostracoda assemblages of the Araklı Section (Trabzon).Çizelge 1. *Loxoconcha* türlerinin ve diğer ostrakod topluluğunun Araklı Kesiti'nde (Trabzon) stratigrafik yayılımı.

Upper Miocene	? Pliocene	SERIES
Pontian		STAGE
Middle-Upper		SUBSTAGE
?	?	FORMATION
Y-33 Y-32 Y-31 Y-30 Y-29 Y-28 Y-27 Y-26 Y-25 Y-24 Y-23 Y-22 Y-21 Y-20 Y-19 Y-18 Y-17 Y-16 Y-15 Y-14 Y-13 Y-12 Y-11 Y-10		SAMPLE NUMBER
		LITHOLOGY
		OSTRACODA
<p style="text-align: center;">U N F O S S I L I F E R O U S  Z O N E</p>		<p>Amplocypris odessaensis Il'nitskaya, 1962  Tyrrhenocythere batmani Tunoğlu, 2001  Tyrrhenocythere araklensis Tunoğlu, 2001  Candona (Pontoniella) sp.2  Candona (Caspiolla) sp.  Candona (Pontoniella) acuminata Mandelstam, 1963  Aurila cicatricosa (Reuss, 1850)  Cytherissapannonica n. sp.  Candona (Caspiolla) bulgarica Stancheva, 1966  Candona (Candona) parallela pannonica (Zalanyi, 1929)  Candona (Caspiocypris) sp.  Candona (Lineocypris) sp.  Cyprideis sp.1  Loxoconcha gibboides (Livaltal, 1929)  Euxinocythere (Maeotocythere) pontica n.sp.  Loxoconcha sp.  Loxoconcha petasus (Livaltal, 1929)  Xestoleberis (Xestoleberis) sp.  Xestoleberis (Xestoleberis) ovulum (Reuss, 1850)  Xestoleberis (Pontoleberis) pontica Stancheva, 1990  Candona (Caspiolla) balcanica (Zalanyi, 1929)  Candona (Caspiolla) lobata (Zalanyi, 1929)  Candona (Bakunella) dorsoarcuata (Zalanyi, 1929)  Candona (Bakunella) sp.1  Tyrrhenocythere turcica Tunoğlu, 2001  Tyrrhenocythere alatum Tunoğlu, 2001  Tyrrhenocythere alatum reticulata Tunoğlu, 2001  Tyrrhenocythere trabzonensis Tunoğlu, 2001  Cytherissa bogatschovi (Livaltal, 1929)  Cyprideiskrstici n.sp.  Candona (Pontoniella) sokachavae Stancheva, 1981  Candona sp.1  Candona sp.2  Candona (Pontoniella) sp.3  Candona (Pontoniella) sp.4  Tyrrhenocythere sp.2  Candona (Pontoniella) pseudoglabra Stancheva, 1981  Euxinocythere (Maeotocythere) krstici n. sp.  Tyrrhenocythere goekcenaе Tunoğlu  Cytherissa sp.1  Cytherissa sp.2  Tyrrhenocythere filipesculi (Hanganu, 1962)  Tyrrhenocythere agalarovae n.sp.  Tyrrhenocythere pontica (Livaltal, 1929)  Tyrrhenocythere sp.1  Candona (Caspiolla) acronasuta (Livaltal, 1929)  Euxinocythere (Maeotocythere) bosqueti (Livaltal, 1929)  Leptocythere (Amnicocythere) multituberculata (Livaltal, 1929)  Cypria dorsoconcava Krstic, 1975  Cypria sp.1  Cypria sp.2  Leptocythere (Amnicocythere) sp.  Leptocythere (Leptocythere) cymbula (Livaltal, 1929)  Candona (Candona) sp.  Candona (subgenus indet) sp.</p>
<p>Scale 5m</p>		

Table 2. Stratigraphic distribution of the *Loxoconcha* species and the other ostracoda assemblages of west of the Değirmendere Section/Boztepe(Trabzon).

Çizelge 2. *Loxoconcha* türlerinin ve diğer ostrakod topluluğunun Değirmendere batısı/Boztepe (Trabzon) Kesitinde stratigrafik yayılımı.



1998 *Loxoconcha gibboides* Livental, Tunoğlu et al., p. 76,77, pl. 5, figs. 7-10; pl. 13, figs. 1,2.

**Material:** 11 carapaces, 56 valves.

**Dimensions:** Length: 0.64-0.66 mm  
Height: 0.42-0.44 mm  
Width: 0.44-0.48 mm

**Stratigraphic and geographic distribution:** Azerbaijan, old Euxinian and Bakunian, Turkmenistan, North Caucasia, Southern Volga (Livental, 1929; Mandelstam, 1960); Bulgaria, Western Black Sea Shelf, Pleistocene (Stancheva, 1989); Araklı (Trabzon/ Turkey), Pontian (Tunoğlu et al., 1998).

Table 3. Stratigraphic distribution of the *Loxococoncha* species and the other ostracoda assemblages of the east of Değirmendere (Trabzon).  
Çizelge 3. *Loxococoncha* türlerinin ve diğer ostrakod topluluğunun Değirmendere doğusu (Trabzon) Kesitinde stratigrafik yayılımı

Pre-Miocene	UPPER MIOCENE		? PLIOCENE		SERIES	
	PONTIAN				STAGE	
	LOWER	MIDDLE	LATE		SUBSTAGE	
					FORMATION	
					SAMPLE NUMBER	
					LITHOLOGY	
						OSTRACODA
						Candona (Caspioypris) sp.
						Candona (Reticulocandona) stanchevae n. sp.
						Candona (Reticulocandona) sp.
						Candona (Caspioella) liventalina (Evlachova, 1939)
						Candona (Caspioella) bulgarica (Zalanyi, 1929)
						Candona (Metacondana) sp.
						Candona (Pontoniella) acuminata (Mandelstam, 1963)
						Candona (Pontoniella) aliensis Stancheva, 1981
						Candona (Typhlocypris) sp. 1
						Candona (Bakunella) dorsocruata (Zalanyi, 1929)
						Candona (Caspioella) ataensis n.sp.
						Candona (Pontoniella) sokachavae Stancheva, 1981
						Candona (Bakunella) sp.1
						Candona (Pontoniella) saxajintae Stancheva, 1981
						Candona (Pontoniella) srbarmensis Stancheva, 1981
						Candona (Typhlocypris) sp. 2
						<u>Loxococoncha</u> sp.2
						<u>Loxococoncha</u> eichwaldi (Livental, 1929)
						Candona (Caspioypris) araxica Freis, 1980
						Xestolebris (Pontolebris) pontica Stancheva, 1990
						Candona (Trabzoniella) turica n.sp.
						Candona (Pontoniella) sp.3
						Candona (Pontoniella) sp.4
						Candona (Pontoniella) pseudoglabra Stancheva, 1981
						<u>Loxococoncha</u> sp.1
						<u>Loxococoncha</u> ornata (Schneider, 1939)

***Loxococoncha arakliensis* n.sp.**

pl. 1 figs. 11-12

**Derivation of name:** Araklı town of Trabzon city.

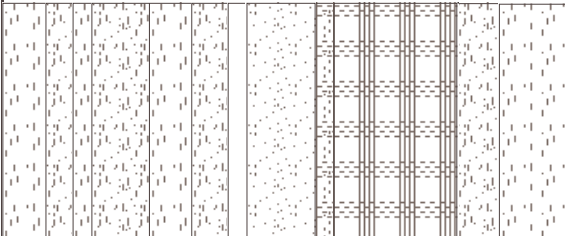
**Holotype:** Left valve.

**Paratype:** 4 carapaces, 42 valves.

**Type locality:** Araklı (Trabzon), factory of brick-tile kilns.

Table 4. Stratigraphic distribution of the *Loxoconcha* species and the other ostracoda assemblages of Bafra-Gümüşyaprak Section (Samsun).

Çizelge 4. *Loxoconcha* türlerinin ve diğer ostrakod topluluğunun Bafra-Gümüşyaprak Kesitinde (Samsun) stratigrafik yayılımı.

UPPER MIOCENE		SERIES
PONTIAN		STAGE
UPPER		SUBSTAGE
?		FORMATION
G-10 G-9 G-8 G-7 G-6 G-5 G-3 G-2 G-1	SAMPLE NUMBER	
LITHOLOGY		OSTRACODA
		<p>Scale 2m</p> <ul style="list-style-type: none"> <li>● Ilyocypris sp.</li> <li>● Candona sp.</li> <li>● Candona (<i>Lineocypris</i>) <i>bafraensis</i> n.sp.</li> <li>● Candona (<i>Candona</i>) <i>candida</i> (O.F.Muller, 1776)</li> <li>● <i>L. Stancheva oxoconcha valiente</i>, 1963</li> <li>● <i>Loxoconcha eichwaldi</i> (Liventol, 1929)</li> <li>● <i>Cyprideis</i> sp.1</li> <li>● Candona (<i>Bakunella</i>) sp.2</li> <li>● Candona (<i>Caspiocypris</i>) <i>araxica</i> Freels, 1980</li> <li>● <i>Cytherissa bogatschovi</i> (Liventol, 1929)</li> <li>● <i>Cytherissa pannonica</i> n.sp.</li> <li>● Candona (<i>Caspiolla</i>) <i>balcanica</i> (Zalanyi, 1929)</li> <li>● <i>Cycloocypris</i> sp.</li> <li>● <i>Zonocypris membranae</i> (Liventol, 1929)</li> <li>● <i>Zonocypris</i> sp.</li> <li>● <i>Eucypris</i> sp.</li> <li>● <i>Pontocythere bayramensis</i> Tuno•lu, 1987</li> <li>● <i>Loxoconcha laeta</i> Stancheva, 1963</li> <li>● <i>Loxoconchahastata</i> cf(Reuss, 1950)</li> <li>● <i>Loxoconcha</i> sp.3</li> <li>● <i>Eucypris</i> sp.2</li> <li>● <i>Heterocypris salina salina</i> (Brady, 1868)</li> </ul>

**Type level:** Pontian.

**Diagnosis:** Ovate in the lateral view. Dorsal margin straight, anterior and posterior margin

well rounded but posterior margin broadly rounded than the anterior margin. Postero-ventral margin swollen. Valve surface covered with rec-



tangular and hexagonal reticulations. One or more cotes parallel to the ventral margin.

**Description:** Ovate in the lateral view. Dorsal margin is straight, antero-dorsal and postero-dorsal areas are angular ( $150^\circ$  and  $130^\circ$ ), anterior margin well rounded, posterior end oblique towards the postero-dorsal end and broadly rounded. Ventral margin is slightly sinusoidal and concave. Maximum length at the center of carapace, maximum height and width are between at the central area and posterior margin. Triangular and rectangular reticules are strong and arranged concentrically with margins. Reticules are larger at the center of the carapace. Muscle scars, hinge, marginal pore canals, marginal zone and vestibule are in genus character.

**Dimensions:** Length: 0.70-0.74 mm  
Height: 0.39-0.42 mm  
Width: 0.40-0.45 mm

**Remarks:** This species is similar to *Loxoconcha* (L.) *schweyeri* Suzin, but differs from it with small reticules, narrower postero-dorsal corner and more concave dorsal margin.

***Loxoconcha* sp.1**

pl. 1 fig.13

Carapace is trapezoidal in the lateral view. Dorsal margin is straight, angle of antero-dorsal is  $150^\circ$ , anterior margin is well rounded and dropped antero-ventral, ventral margin is convex, posterior end upwardly and well rounded, anterior end more tapering than the posterior end at the dorsal view. Maximum length and width are at the centre of valve, maximum height at the antero-central area. Surface of the valve is covered with small pits and reticules and observed tiny cotes which are parallel to ventral margin at the central ventral area. Eye spot is also encountered. Central muscle scars, marginal pore canals and hinge are in genus character. Marginal zone and vestibule are narrow at the anterior margin. Sexual dimorphism is not observed.

**Material:** 13 valves.

**Dimensions:** Length: 0.59-0.61 mm  
Height: 0.33-0.35 mm  
Width: 0.30-0.34 mm

**Remarks:** *Loxoconcha* sp.1 could be differentiated from the other species of *Loxoconcha* genus by having general valve shape and surface ornamentation. *Loxoconcha* sp.1 has tiny surface pits and tiny cotes at the anterior area of the valve surface and smooth concave ventral and posterior margin.

**Locality and stratigraphic level:** East side of Değirmendere River (Trabzon), T-11, T-15, Pontian.

***Loxoconcha eichwaldi* Livental, 1929**

pl. 1 figs.14,15

1929. *Loxoconcha* aff. *eichwaldi* Livental, p. 34, pl. 1, figs. 42, 43.

1963. *Loxoconcha* aff. *eichwaldi* Livental, Stancheva, p. 36-37, pl. 5, fig. 9.

1967. *Loxoconcha eichwaldi* Livental, Agalarova, pl. 20, figs. 3a,b.

1978. *Loxoconcha eichwaldi* Livental, Olteanu, p. 1020, pl. 7, fig. 2.

1989. *Loxoconcha eichwaldi* Livental, Stancheva, p. 32, pl. 8, fig. 7.

1998. *Loxoconcha eichwaldi* Livental, Tunoğlu et al., p. 78, pl. 5, figs. 14,15; pl. 13, figs. 9-11.

**Material:** 8 carapaces, 37 valves.

**Dimensions:** Length: 0.64-0.71 mm  
Height: 0.35-0.41 mm  
Width: 0.30-0.36 mm

**Stratigraphic and geographic distribution:**

NW Bulgaria, Sarmatian (Stancheva, 1963). West-Central Caucasus, Turkmenistan, Black Sea: Akçagilian and Apşeronian (Livental, 1929; Agalarova, 1967; Olteanu, 1978), Bulgaria (east of Varna and Samotina), Pleistocene, (Stancheva, 1989); Turkey: Gümüşyaprak village (Bafra/Samsun), East of Değirmendere River (Trabzon), Boztepe (Trabzon), (Tunoğlu et al., 1998); Pontian.

***Loxoconcha* sp. 2**

pl. 1 fig.16

**Definition:** Valve is trapezoidal shape in the lateral view. Dorsal margin is straight, antero-dorsal and postero-dorsal corners are angular ( $150^\circ$  and  $140^\circ$ ), anterior margin is well rounded and repressed towards ventral margin, ventral margin is convex, maximum height, length and width are at the centre. Anterior margin is more tapering than the posterior end at the dorsal view. Surface of the valve is covered with very thin and parallel cotes near the ventral margin. Eye tubercle is not visible. Marginal pore canals and hinge are in genus character. Marginal zone is in medium size. Vestibule is narrow at the anterior and posterior margins. Sexual dimorphism is not observed.

**Material:** 8 valves.

**Dimensions:** Length: 0.65-0.68 mm  
Height: 0.33-0.36 mm  
Width: 0.30-0.34 mm

**Remarks:** *Loxoconcha* sp. 2 differs from *Loxoconcha pseudoassimilata* Stancheva by having smaller reticulates and less tapering posterior margin.

**Locality and stratigraphic level:** Gümüşyaprak village (Bafra/Samsun), East of Değirmendere, Pontian.

*Loxoconcha* cf. *hastata* (Reuss, 1950)  
pl.1 fig.17

1869. *Loxoconcha hastate* Brady, p. 159, pl. 1, figs. 19, 20.

1963. *Loxoconcha hastata* (Reuss), Stancheva, p. 43, pl.6, fig. 5.

1998. *Loxoconcha* cf. *hastata* (Reuss) Tunoğlu et. al, p. 79, pl. 5, fig. 17.

**Material:** 2 carapaces, 11 valves.

**Dimensions:** Length: 0.55-0.57 mm  
Height: 0.35-0.37 mm  
Width: 0.34-0.38 mm

**Remarks:** *Loxoconcha* cf. *hastata* is similar to *Loxoconcha hastata* with surface ornamentations, but it differs from holotype by having U shaped posterior margin and absence of wing shaped postero-ventral area.

**Stratigraphic and geographic distribution:** Northwest Bulgaria (Dasic Basin), Tortonian (Stancheva, 1963), Gümüşyaprak village (Bafra/Samsun), Pontian (Tunoğlu et al., 1998).

*Loxoconcha* sp. 3  
pl. 1 fig.18

**Definition:** Carapace is trapezoidal shape in the lateral view. Dorsal margin is straight. Anterior margin is wide, well rounded and repressed towards to ventral margin. Posterior margin is upwardly and broadly rounded. Ventral margin is straight and/or slightly sinusoidal. Maximum length is at the centre of the valve, maximum height is at the antero-central and maximum width is at the postero-central area. Anterior and posterior ends are tapering at the dorsal view. Valve surface is covered with small and spherical reticules, which are bigger than the anterior surface area. There are thin cotes between reticules, Central muscle scars, hinge, marginal pore canals and marginal zone are in genus character. Sexual dimorphism is not observed.

**Material:** 19 valves.

**Dimensions:** Length: 0.55-0.57 mm  
Height: 0.31-0.34 mm  
Width: 0.30-0.34 mm

**Remarks:** *Loxoconcha* sp. 3 is similar to *Loxoconcha* sp.1 in this study, but it differs from *Loxoconcha* sp.1 by having large pits and reticules on the valve surface.

**Locality and stratigraphic level:** Gümüşyaprak Village (Bafra/Samsun), Pontian.

## RESULTS

The main results from this study are as follows:

1. Green marls, shales and sandstones were the main lithological units during the Pontian (see Tables 1-3). The Pontian ostracod fauna of this region contains totally 86 species of different genus, which eleven of this assemblage are *Loxoconcha* species.

2. Paleogeographic distribution of the described *Loxoconcha* species are summarized in Figure 4 which indicates that all of the *Loxoconcha* species are located from Bulgaria to Turkmenia (Dasic, Euxinic and Caspic Basins). Northern Anatolian coasts were southern boundary of Euxinic Basin during the Pontian age.

3. Stratigraphic levels of *Loxoconcha* and the other ostracod species in the areas are between Sarmatian-Plio-Quaternary stages (Table 5). Whereas, especially species of *Candona* indicate narrower stratigraphic range than the other ostracod species.

4. Transitional conditions were common in the bioprovince of the Paratethys during Pontian. Subsequently, minor open marine circulation and more fresh water income were dominant during Pontian.

5. Due to Ostracoda fauna, it can be concluded that only Paratethys bioprovince conditions (oligohaline and mesohaline; Remane, 1971) were prevailed in the region.

## ACKNOWLEDGMENTS

The author is grateful to TÜBİTAK (The Scientific and Technical Research Council of Turkey) for providing financial support during both the fi-

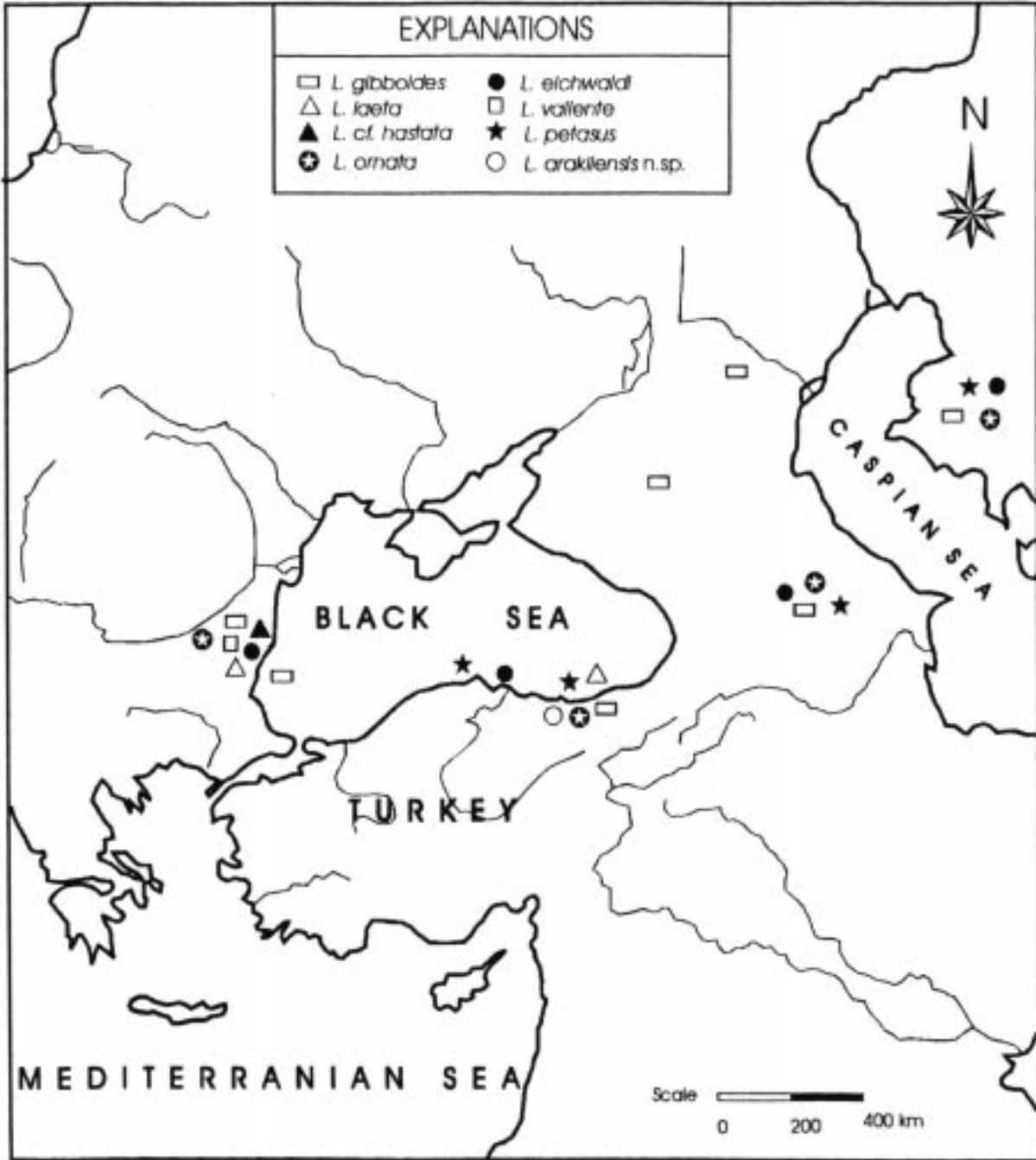


Figure 4. Paleogeographic distribution of the known *Loxoconcha* species in this study.  
 Şekil 4. Bu çalışmada saptanan bilinen *Loxoconcha* türlerinin paleocoğrafik yayılımı.

eld and laboratory studies (Project number: YDABÇAG-133). The author also thanks to Cüneyt BİLEN and Aziz ÜNAL for their help during the field studies. Special thanks are due to Dr. U. Kaan TEKİN (General Directorate of Mineral Research and Exploration) for his critical review of the manuscript and to Mr. Mehmet Ali SİYEZ

(Head of Department), Mr. Mehmet Ali YILMAN (Chemist Major) and Nebahat YURTSEVEN-SEM Operator) at the Ministry of Interior, Gendarmerie General Command, Head of Criminal Department and Narcotics Laboratory for SEM Analyses.

Table 5. General stratigraphic levels of the known *Loxoconcha* and the other ostracoda species in the studied localities.Çizelge 5. Bu çalışmada saptanmış, bilinen *Loxoconcha* ve diğer ostrakod türlerinin genel stratigrafik yayılımı.

OSTRACODA SPECIES	SARMATIAN			PANNON.	PONTIAN			PLIOCENE	QUATERNARY
	E	M	L		E	M	L		
<u>Loxoconcha laeta</u>	—								
<u>Loxoconcha valiente</u>		—							
<u>Loxoconcha ornata</u>		—							
<u>Loxoconcha eichwaldi</u>	—							—	
<u>Loxoconcha petasus</u>	—								
<i>Candona</i> ( <i>Caspiolla</i> ) <i>lobata</i>				—					
<i>Aurila</i> <i>cicatricosa</i>				—					
<i>Bakunella</i> <i>dorsoarcuata</i>				—					
<i>Amplocypris</i> <i>odessaensis</i>				—					
<i>Leptocythere</i> ( <i>Lep.</i> ) <i>cymbula</i>				—					
<i>Cytherissa</i> <i>bogatschovi</i>				—					
<i>Cypria</i> <i>dorsoconcava</i>				—					
<i>Xestoleberis</i> <i>ovulum</i>					—				
<i>Tyrrhenocythere</i> <i>filipesqui</i>					—				
<i>Pontocythere</i> <i>bayramensis</i>					—				
<i>Tyrrhenocythere</i> <i>pontica</i>					—				
<i>Candona</i> ( <i>Pont.</i> ) <i>acuminata</i>					—				
<i>Candona</i> ( <i>Casp.</i> ) <i>acronasuta</i>					—				
<i>Candona</i> ( <i>Casp.</i> ) <i>bulgarica</i>					—				
<i>Candona</i> ( <i>Pont.</i> ) <i>aliusensis</i>					—				
<i>Candona</i> ( <i>Pont.</i> ) <i>srebarnensis</i>					—				
<i>Candona</i> ( <i>Pont.</i> ) <i>sokactchae</i>					—				
<i>Candona</i> ( <i>Pont.</i> ) <i>saxagintae</i>					—				
<i>Candona</i> ( <i>Pont.</i> ) <i>pseudoglabra</i>					—				
<i>Xestoleberis</i> <i>pontica</i>					—				
<i>Candona</i> ( <i>Casp.</i> ) <i>araxica</i>					—				
<i>Candona</i> ( <i>Casp.</i> ) <i>balcanica</i>					—				
<i>Candona</i> ( <i>Candona</i> ) <i>candida</i>					—				
<i>Lept.</i> ( <i>Amni.</i> ) <i>multituberculata</i>					—				
<i>Eux.</i> ( <i>Maeoto.</i> ) <i>bosqueti</i>					—				
<i>Heterocypris</i> <i>salina salina</i>					—				
<i>Candona</i> ( <i>Can.</i> ) <i>par. liventalina</i>					—				
<i>Zonocypris</i> <i>membranae</i>					—				
<i>Candona</i> ( <i>Can.</i> ) <i>par. pannonica</i>					—				
<u>Loxoconcha gibboides</u>								—	

## REFERENCES

- Agalarova, D.A., 1956. Microfauna from productive Beds in Azerbaijan and Red Deposits in Turkmenistan. Turkmen SSR., Ylymlar Akademiiasy, Geol. Inst., Ashgabat, 190 pp.
- Agalarova, D.A., 1967. Microfauna der Ponthischen Ablagerungen Aserbeidschans und der angrenzenden Gebiete. Az NII po Dobyce Nefti, A204, 123 pp.
- Aranki, J.F., 1987. Marine Lower Pliocene Ostracoda of southern Spain with notes on the recent

- fauna. Publications from the palaeontological institution of the University of Upsala, 94 pp.
- Bonaduce, G., Ciampo, G., and Masoli, M., 1975. Distribution of Ostracoda in the Adriatic Sea, Pubblicazioni Della Stazione Zoologica di Napoli, 40, 154 pp.
- Brady, G. S., 1869. Les entomostraces de Hong-Kong. In: L. De Folin, L. Périer (eds.), Les Fonds de la Mer, Paris, Savy, 1, 159 pp.
- Carbonnel, G., 1978. La zone A *Loxococoncha djaffarovi* Schneider (Ostracoda, Miocène supérieur) ou le Mesinien de la vallée du Rhône, Revue de Micropaléontologie, 21, 3, 106-118
- Ellis and Messina, 1953-1985. catalogue of Ostracoda and their supplements. American Museum of Natural History, Newyork.
- Hartmann, G., Puri, H., 1974. Summary of neontological and paleontological classification of Ostracoda. Mitt Hamburg, Zool. Mus. Inst., 70, 7-73.
- Krstic, N., 1972. Ostracodi Kongeriskih Slojeva: 10, *Loxococoncha*, serie A, livte 27, 243-275.
- Krstic, N., 1975a. The Pliocene ostracods of Metohija: 3, Upper Pliocene of the locality cabrat (Dakovica), serie A, livre 30, 191-299.
- Krstic, N., 1975b. Les Ostracodes Pontiens dans la Serbie Orientale: 3, Cytherideidae, Annales Geologiques de la Peninsule Balkanique, vol. XXXIV, Belgrade, 209-222.
- Krstic, N., 1989. Il Mediterranean ostracode arrangement in South East part of Pannonian Basin. Proceedings of Geoinstitute, 23, 135-147.
- Livental, V.E., 1929. Ostracods of the Akchagly and Apsheron Stages along the Babazalan Profile. Izvestiy a Azerbaidzhanskogo Politeknicheskogo Instituta, 1-58.
- Mandelstam, M.I., 1960. Fundamentals of Paleontology. Arthropoda, Trilobita and Crustacea, 287-311.
- Montenegro, M., E., Pugl, N., Bonaduce, G., 1998. Shelf ostracods distribution in the Italian seas, What about ostracoda, Proceedings 3<sup>rd</sup> European Ostracodologist Meeting, S. Crasquin-Soleau, E. Braccini, F. Lethiers (eds.), 91-103.
- Moore, R.C., 1961. Teriatise on Invertebrate Paleontology, Q Arthropoda. 3. Ostracoda Geol. Soc. Amer. Univ. Kansas Press, 442 pp.
- Morkhoven, F.P.C.M. Van., 1962. Post Paleozoic Ostracoda. Elsevier, 1, 244 pp.
- Morkhoven, F.P.C.M. Van., 1963. Post Paleozoic Ostracoda, Elsevier, 2, 478 pp.
- Olteanu, R., 1978. Ostracoda from DSDP LEG 42B, Initial Reports of the Deep Sea Drilling Project, Volume XLII, Part 2, 379-381.
- Özsayar, T., 1977a. Karadeniz kıyı bölgesinde Neojen formasyonları ve bunların Mollusk faunasının incelenmesi. KTÜ Yayınları, 79, 80 pp.
- Özsayar, T., 1977b. Einige Besarbche Elphidien aus Sinop (Nord Anatolien). Giess. Geol. Schr., 12, 199-220.
- Özsayar, T., 1980. Pazar (Rize) yöresi Sarmasiyen Elphidiumları. TJK. Bült., 23, 87-92.
- Özsayar, T., 1983 a. Pazar (Rize) yöresi Sarmasiyen Miliola faunası, Hacettepe Üniversitesi, Yerbilimleri Uygulama ve Araştırma Merkezi Bülteni, 10, 17-34.
- Özsayar, T., 1983 b. Sarmasiyen katı üzerine notlar. Yeryuvarı ve İnsan, 8/2, 3-4, 3-5.
- Özsayar, T., 1984. Pazar (Rize) yöresi Sarmasiyen oluşuklarındaki Protelphidium türleri. KTÜ Yerbilimleri Dergisi, 3/1-2, 29-32.
- Remane, A., 1971. Ecology of Brackish Water. In: A. Remane and C. Schlieper (eds.): Biology of Brackish Water (2<sup>nd</sup> revised edition), Die Binnengewässer Einzeldarstellungen aus der limnologie und ihren Nachbargebieten, 25, part 1, 1-210 pp.
- Rundic, L., 1993. The Pontian Ostracodes from mala Mostanica (Belgrade). Proceedings of Geoinstitute, 24, 255-260, Belgrade.
- Schneider, G., 1939. Miocene ostracoda of the Crimea-Caucasian Region, Problems of Paleontology. Publ., Labor. of Paleontology, Moscow University, 5, 177-208.
- Stancheva, M., 1963. Ostracoda from the Neogene in North Western Bulgaria., II. Sarmatian Ostracoda. Trav. Géol Bulgaria, Sér. Paleont., 5, 5-74.
- Stancheva, M., 1989. Taxonomy and biostratigraphy of the Pleistocene ostracods of the Western Black Sea Shelf. Geologica Balcanica, 19.6, 3-39.
- Tunođlu, C., 1984. İncipınarı-Kurtkuyusu (Sinop batısı) yöresi Neojen'inin Ostrakod Biyostratigrafisi, Hacettepe Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Mühendislik Tezi, 173 pp (unpublished).
- Tunođlu, C., 1999. Recent Ostracoda association in the Sea of Marmara, NW Turkey. Yerbilimleri, Hacettepe Üniversitesi, Yerbilimleri Uygulama ve Araştırma Merkezi Bülteni, 21, 63-89.
- Tunođlu, C., 2001. New Pontian *Tyrrhenocythere* (Ostracoda) species from Araklı (Trabzon), Eastern Black sea region of Turkey. Yerbilimleri, Hacettepe Üniversitesi, Yerbilimleri

- Uygulama ve Araştırma Merkezi Bülteni, 23,129-143.
- Tunoğlu, C. ve Gökçen, N., 1985. İncipınarı-Kurtkuyusu ( Sinop Batısı) Üst Miyosen İstifinde Yeni Ostrakoda Faunası, Yerbilimleri, Hacettepe Üniversitesi, Yerbilimleri Uygulama ve Araştırma Merkezi Bülteni, 12, 19-39.
- Tunoğlu, C. ve Gökçen, N., 1991. İncipınarı- Kurtkuyusu (Sinop Batısı) Üst Miyosen istifinin ostrakoda biyostratigrafisi. Türkiye Jeoloji Bülteni, 34/1, 37-43.
- Tunoğlu, C. and Gökçen, N., 1995. Tethys and Paratethys transition on the Black Sea Coast of Türkiye. EUG-8, European Union of Geosciences, Strasbourg, France, OS1 Paleontology, Stratigraphy and sedimentology, Abstracts, p. 262.
- Tunoğlu, C. and Gökçen N., 1997. Pontian Ostracodes of the Sinop Area, Black Sea Coast of Turkey. Revue de Micropaléontologie, 40, (4), 347-366.
- Tunoğlu, C., Ünal, A., Bilen, C., 1998. Doğu Karadeniz Kıyısı Boyunca Tetis-Paratetis geçişi ve Etki Alanlarının Araştırılması. TÜBİTAK, Proje No: YDABÇAG-133, 149pp (unpublished).

## PLATE 1

The scanning electron microscope (SEM) photomicrographs of *Loxoconcha* species.

Figure 1-3. *Loxoconcha petasus* (Livental, 1929) Araklı (Trabzon)/ factory of brick-tile kilns, sample number: Y-27, middle Pontian.

1. Right valve, external view, ♂

♀ Left valve, external view,

♂

3. Right valve, external view, ♀

Figure 4 *Loxoconcha ornata* (Schneider, 1939) east of Değirmendere (Trabzon), sample number: T-15, late Pontian. Right valve, external view.

Figure 5. *Loxoconcha valiente* Stancheva, 1963 Gümüşyaprak village (Bafra/Samsun), sample number: G-2, Pontian. Right valve, external view.

Figure 6. *Loxoconcha laeta* Stancheva, 1963 Gümüşyaprak village (Bafra/Samsun), sample number: G-2, Pontian. Left valve, external view.

Figure 7-10. *Loxoconcha gibboides* Livental, 1949 Araklı (Trabzon)/ factory of brick-tile kilns, sample number: Y-31, middle-late Pontian.

7. Right valve, external view.

8. Left valve, external view.

9. Left valve, internal view.

10. Left valve, dorsal view.

Figure 11, 12. *Loxoconcha arakliensis* n.sp. Araklı (Trabzon)/ factory of brick-tile kilns, sample number: Y-31, middle-late Pontian.

11. Right valve, external view.

12. Left valve, external view.

Figure 13. *Loxoconcha* sp. 1 east of Değirmendere, sample number: T-15, late Pontian. Left valve, external view.

Figure 14, 15. *Loxoconcha eichwaldi* Livental, Boztepe (Trabzon), sample number: C-15, middle-late Pontian.

14. Left valve, external view.

15. Right valve, external view, juvenile form.

Figure 16. *Loxoconcha* sp. 2 east of Değirmendere, sample number: T-8, middle-late Pontian Left valve, external view.

Figure 17. *Loxoconcha* cf. *hastata* (Reuss, 1950) Gümüşyaprak village (Bafra/Samsun), sample number: G-1, Pontian. Left valve, external view.

Figure 18. *Loxoconcha* sp. 3 Gümüşyaprak village (Bafra/Samsun), sample number: G-1, Pontian. Right valve, external view.

## LEVHA 1

*Loxoconcha* türlerinin electron mikroskop (SEM) görüntüleri.

Şekil 1-3. *Loxoconcha petasus* (Livental, 1929) Araklı (Trabzon)/tuğla-kiremit fab. ocakları, Y-27, orta Ponsiyen.

1. Sağ kapak, dış görünüm, ♂

♀ Sol kapak, dış görünüm, ♂

3. Sağ kapak, dış görünüm, ♀

Şekil 4. *Loxoconcha ornata* (Schneider, 1939) Tıp Fakültesi (Trabzon)/Değirmendere doğusu, T-15, geç Ponsiyen. Sağ kapak, dış görünüm.

Şekil 5. *Loxoconcha valiente* Stancheva, 1963 Gümüşyaprak Köyü (Bafra/Samsun), G-2, Ponsiyen. Sağ kapak, dış görünüm.

Şekil 6. *Loxoconcha laeta* Stancheva, 1963 Gümüşyaprak Köyü (Bafra/Samsun), G-2, Ponsiyen. Sol kapak, dış görünüm.

Şekil 7-10. *Loxoconcha gibboides* Livental, 1949 Araklı (Trabzon)/tuğla-kiremit fab. ocakları, Y-31, orta-geç Ponsiyen.

7. Sağ kapak, dış görünüm.

8. Sol kapak, dış görünüm.

9. Sol kapak, iç görünüm.

10. Sol kapak, sırt görünümü.

Şekil 11, 12. *Loxoconcha arakliensis* n.sp. Araklı (Trabzon)/tuğla-kiremit fab. ocakları, Y-31, orta-geç Ponsiyen.

11. Sağ kapak, dış görünüm.

12. Sol kapak, dış görünüm.

Şekil 13. *Loxoconcha* sp.1 Tıp Fakültesi (Trabzon)/Değirmendere doğusu, T-15, geç Ponsiyen. Sol kapak, dış görünüm.

Şekil 14, 15. *Loxoconcha eichwaldi* Livental, Boztepe (Trabzon), C-15, orta-geç Ponsiyen.

14. Sol kapak, dış görünüm.

15. Sağ kapak, dış görünüm, juvenil form.

Şekil 16. *Loxoconcha* sp.2 Tıp Fakültesi (Trabzon)/Değirmendere doğusu, T-8, orta-geç Ponsiyen. Sol kapak, dış görünüm.

Şekil 17. *Loxoconcha* cf. *hastata* (Reuss, 1950) Gümüşyaprak Köyü (Bafra/Samsun), G-1, Ponsiyen. Sol kapak, dış görünüm.

Şekil 18. *Loxoconcha* sp. 3 Gümüşyaprak Köyü (Bafra/Samsun), G-1, Ponsiyen. Sağ kapak, dış görünüm.

LEVHA 1 / PLATE 1

