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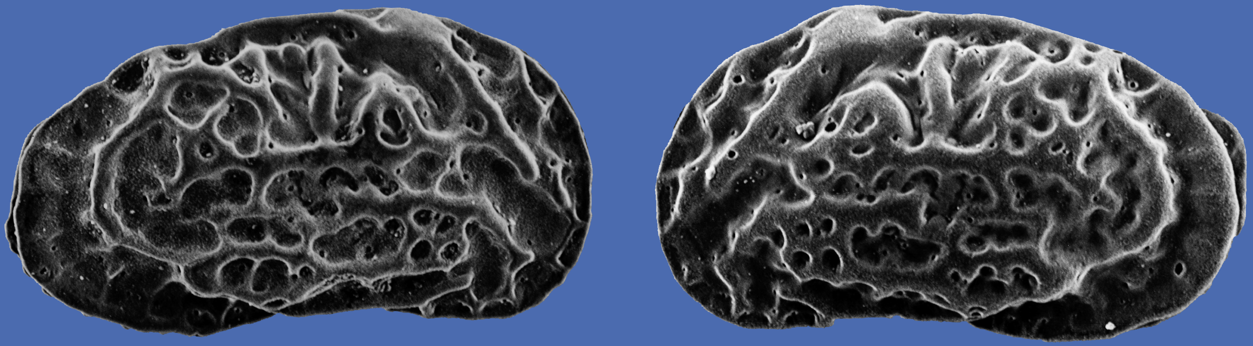

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Cover illustration: Ostracod *Callistocythere intricatoides* (Ruggieri, 1953) from the Thyrrenian of Altinova (Turkey). Left: Right valve, external view, BSPG 1980 X 1313 (length 0.640 mm). Right: Left valve, external view, BSPG 1980 X 1314 (length 0.646 mm). SEM Photograph: R. Matzke-Karasz (LMU München, Department für Geo- und Umweltwissenschaften, Sektion Paläontologie)

Umschlagbild: Ostrakode *Callistocythere intricatoides* (Ruggieri, 1953) aus dem Thyrrenium von Altinova (Türkei). Links: Rechte Klappe, Außenansicht, BSPG 1980 X 1313 (Länge 0,640 mm). Rechts: Linke Klappe, Außenansicht, BSPG 1980 X 1314 (Länge 0,646 mm). REM-Foto: R. Matzke-Karasz (LMU München, Department für Geo- und Umweltwissenschaften, Sektion Paläontologie)

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Ostracods and bivalves from an Upper Pleistocene (Tyrrhenian) marine terrace near Altinova (İzmit Province, Turkey)

By
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Abstract

Ostracods and bivalves from two samples collected near Altinova (İzmit Province, Turkey) are studied. The sample sediment consists of coarse to fine grained sands and comes from the oldest part of the Marmara Formation, a succession of Late Pleistocene marine terraces. The composition of the ostracod fauna corroborates the Tyrrhenian radiometric age of the succession. The ostracod associations are composed predominantly of heavily calcified and ornamented genera, which indicate a nearshore, inner neritic depositional environment. The bivalve assemblages, containing byssate and cementing epifaunal and infaunal taxa, suggest a combination of rocky coastal environment and shallow marine clastic deposits. Faunal composition and shell dimensions of the bivalves are indicative of reduced salinity.

Key words: Ostracods, Bivalves, Pleistocene, Tyrrhenian, Turkey.

Kurzfassung

Ostrakoden und Bivalven zweier Proben aus der Nähe von Altinova (İzmit Provinz, Türkei) werden untersucht. Das beprobte Sediment besteht aus grob- bis feinkörnigen Sanden und stammt aus der ältesten einer Abfolge Spät-Pleistozäner mariner Terrassen, der Marmara Formation. Das radiometrisch ermittelte Tyrrhenische Alter wird von der Ostracodenfauna gestützt. Die Ostrakoden-Vergesellschaftungen von überwiegend dickschaligen und stark ornamentierten Genera weisen auf ein strandnahes, innerneritisches Ablagerungsmilieu hin. Die Bivalven-Ansammlungen, zusammengesetzt sowohl aus byssater und zementierender Epifauna, als auch aus infaunalen Taxa, deuten auf eine Kombination von felsigen Küsten-Abschnitten und flachmarinen sandigen Ablagerungsbereichen hin. Die Faunen-Zusammensetzung und die Schalengrößen der Bivalven zeigen reduzierte Salinität an.

Schlüsselwörter: Ostrakoden, Bivalven, Pleistozän, Tyrrhenium, Türkei, Salinität.

1. Introduction

On the southern shoreline of İzmit Bay (Northwest Anatolia), at Subaşı near Altinova, some 12.5 km west of Karamürsel (Textfig. 1), shell-rich coarse clastics occur in the form of three Late Pleistocene marine terraces. The coarse sands are being dug up in sand pits. For the present study, two samples from the oldest terrace were investigated. The first sampled level, Subaşı 1, is positioned just above the unconformity at the base of the unit; the second, Subaşı 2, is positioned higher up in the section.

Since the 1860s, these sediments, comprising the Marmara Formation, have been documented from several localities around the Marmara Sea, the Dardanelles region, the Bosphorus, and İzmit Bay under a variety of names (e.g., Tchihatcheff 1867, 1869a, 1869b; Calvert & Neumayr 1880; English 1904; Penck 1917; Pfannenstiel 1944; Taner 1983; Erol 1985; Bargu & Sakinç 1989; Sakinç & Bargu 1989). Sakinç & Yaltirak (1997) eventually assigned the term Marmara Formation to all marine sediments of Pleistocene age that occur in the vicinity of the Marmara Sea.

From İzmit Bay, only Early Pleistocene ostracods (Gülen et al. 1995) and a few molluscs from the Upper Pleistocene (e.g., Erol & Nuttall 1973; Taner 1995) have been studied to date, and thus omit extensive paleoecological considerations. The present paper provides a modern description of the Late Pleistocene fauna and an evaluation of its paleoecological significance based on material from two selected levels. Several small bivalve taxa are recorded for the first time from the Pleistocene in this area. The sample locality is within the reach of the North Anatolian Fault Zone and belongs to an area that linked the Black Sea with the Mediterranean Sea. As a result, part of the history of this connection is expressed in the here presented fauna.

2. Material and Methods

The samples Subaşı 1 and 2 come from an Upper Pleistocene marine terrace that is located at the northern foothills of the

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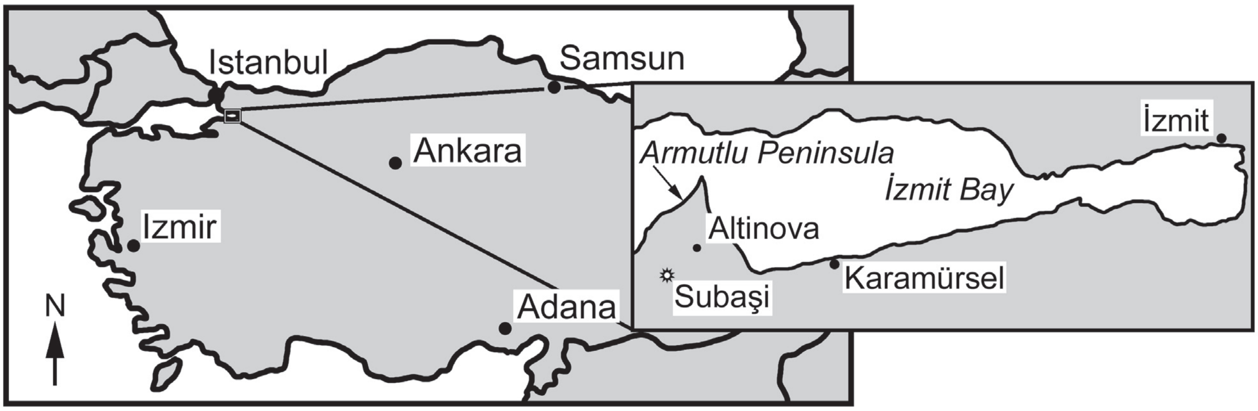
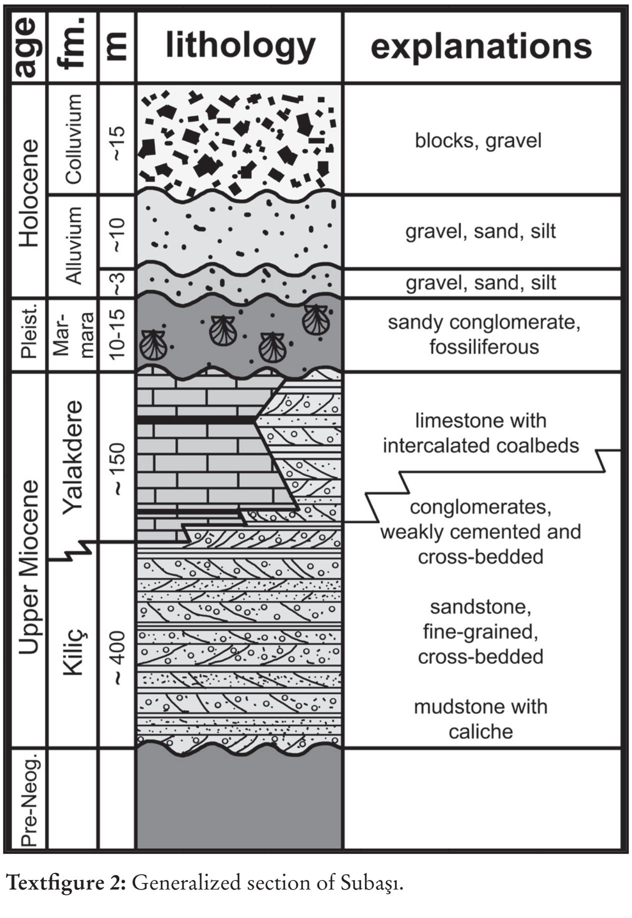


Textfigure 1: Geographic overview showing the sample locality.

Armutlu peninsula (Textfig. 1). This terrace belongs to the Marmara Formation. The sediments of the Marmara Formation are composed predominantly of fossiliferous sandstones, mudstones, and conglomerates. Tilting and faulting visible in the Marmara Formation are interpreted as results of tectonic activity, which occured after deposition, and was induced by the North Anatolian Fault Zone (Sakinç & Bargu 1989; Görür et al. 1997; Oktay et al. 2002).

The three Pleistocene marine terraces (*sensu* Emre et al. 1998: 126) crop out on different morphological levels. They have been dated radiometrically (U/Th and ^{14}C) as 260.000, 130.000, and 40.000 years B.P. (Paluska et al. 1989; Emre et al. 1998). The oldest terrace corresponds in age to the Early Tyrrhenian, and starts transgressively on Eocene flysch deposits and associated volcanics and/or Neogene strata. At Subaşı, the oldest terrace is exposed approximatly 60 m above the present day sea level, and rests unconformably on the Late Miocene Kılıç Formation, which is vertically and laterally toothed with the Yalakdere Formation (Textfig. 2; Rückert-Ülkümen et al., submitted).



Textfigure 2: Generalized section of Subaşı.

The samples were collected, washed, and picked. The pickings of microsamples yielded an abundance of well-preserved ostracods. Calcareous benthic foraminifera, bryozoan fragments, gastropods, bivalves, and echinoid spines occur in low numbers in the washed residue. Minor sediment components are glauconite, idiomorphic quartz, and undifferentiated heavy minerals. The macrosamples contain a relatively diverse mollusc fauna, composed of bivalves and a few gastropods.

The ostracods were sputter-coated with gold and documented by SEM (Leitz). The material illustrated in Plates 1-3 is housed in the collection of the Bayerische Staatssammlung für Paläontologie und Geologie, Munich, Germany, under accession numbers 1980 X 1302 through 1980 X 1335.

3. Systematic Palaeontology

3.1 Ostracoda (W. Witt)

The systematic treatment of the ostracods follows Hartmann & Puri (1974), simplified.

Abbreviations:

C = carapace(s)
V = valve(s)
R = right valve(s)
L = left valve(s)

l = length
h = height
w = width

The listing of synonyms is restricted to reports from the Adriatic Sea, mainland Greece, the Aegean Islands, the Aegean Sea, and Turkey. Comments on other regional occurrences focus on the Aegean region, omitting the Adriatic Sea.

Superfamily Cytheroidea Baird, 1850
Family Leptocytheridae Hanai, 1957

Genus *Leptocythere* Sars, 1925

Leptocythere multipunctata (Seguenza, 1884)
Pl. 1, Fig. 1

1972b *Leptocythere multipunctata multipunctata* (Seguenza) – Sissingh: 91, pl. 5, fig. 9.
1975 *Leptocythere multipunctata* (Seguenza, 1884) – Bonaduce et al.: 33, pl. 17, figs 4-7.
1980 *Leptocythere multipunctata* (Seguenza, 1884) – Doruk: 151-154.
1985 *Leptocythere multipunctata* (Seguenza, 1884) – Stambolidis: 188, pl. 1, fig. 8.

Material: Subaşı 2: ♀: 1R; ♂: 1R.

Measurements (mm):
R♀: l = 0.531, h = 0.273; l/h = 1.945
R♂: l = 0.442, h = 0.235; l/h = 1.881

Other regional occurrences: Greek islands: Upper Pliocene and Lower Pleistocene of Rhodes (Sissingh 1972b), and Recent in the northern Aegean Sea (Stambolidis 1985). Southern Turkey: Upper Pliocene to Pleistocene in subsurface Iskenderun Bay (Doruk 1980). Central and eastern Mediterranean Basin: Upper Pliocene to Holocene (Sissingh 1982: tab. 1).

Ecology: Stambolidis (1985: 167) found the species in 3.5-31 m deep water. Doruk (1980: 151) presumes a shallow marine habitat for this species.

Remark: The smaller males exhibit a forward-sloping posterior margin.

Leptocythere peterseni Mostafawi, 1989
Pl. 1, Fig. 2

1981 *Leptocythere* sp. B – Mostafawi: 138, pl. 3, figs 5-8.
1989a *Leptocythere aegaea* n. sp. – Mostafawi: 126, pl. 1, figs 19-21.
* 1989b *Leptocythere peterseni* n. nom. – Mostafawi: 201.
1994a *Leptocythere peterseni* Mostafawi 1989 – Danatsas: 112, pl. 8, figs 4-5.
2002 *Leptocythere* sp. – Tunoğlu: pl. 3, fig. 1.

Material: Subaşı 2: ♀: 1C; ♂: 1R.

Measurements (mm):
R♀: l = 0.429, h = 0.213; l/h = 2.014
C♂: l = 0.402, h = 0.204; l/h = 1.971

Other regional occurrences: Greek mainland and islands: Upper Pliocene of Northwest and northern Peloponnesus (Danatsas 1994a) and Rhodes (Mostafawi 1989a), and Upper Pliocene and Upper Pleistocene of Kos (Mostafawi 1981). Recent in the northern exit of the Bosphorus (Tunoğlu 2002).

Relations: The similar *Leptocythere multipunctata* (Seguenza, 1884) displays an almost regularly rounded anterior margin.

Palaeoecology: The species has been encountered in a shallow marine ostracod association that also contains *Cyprideis torosa*, which indicates a tendency towards brackish water (Mostafawi 1989a: 142).

Genus *Callistocythere* Ruggieri, 1953

Callistocythere intricatoides (Ruggieri, 1953)
Pl. 1, Figs 3-4

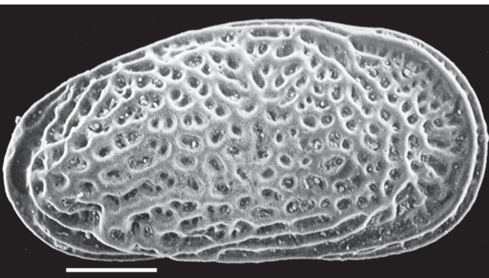
1966 *Leptocythere (Callistocythere) flavidofusca intricatoides* Ruggieri – Schornikov: 46, fig. 10.
1972 *Callistocythere flavidofusca intricatoides* (Ruggieri 1953) – Uffenorde: 67, pl. 7, fig. 1.
1975 *Callistocythere intricatoides* Ruggieri, 1953 – Bonaduce et al.: 38, pl. 12, figs 1-5.
1976 *Callistocythere intricatoides* (Ruggieri) – Tsapralis: pl. 1, fig. 5.
1981 *Callistocythere intricatoides* (Ruggieri, 1953) – Mostafawi: 142, pl. 4, figs 1-4.
1985 *Callistocythere intricatoides* (Ruggieri, 1953) – Stambolidis: 191, pl. 1, figs 6-7.
1990 *Callistocythere intricatoides* (Ruggieri 1953) – Mostafawi: pl.1, fig. 10.
1994a *Callistocythere intricatoides* (Ruggieri 1953) – Danatsas: 114, pl. 9, figs 1-3.
2002 *Callistocythere* sp. – Tunoğlu: pl. 3, fig. 8.

Material: Subaşı 1 (partly measured): 1 C, 13 R, 11 L, 2 V juv.; Subaşı 2 (partly measured): 8 R, 2 L, 1 V juv.

Measurements (mm):
R: l = 0.618-0.640, h = 0.324-0.347; l/h = 1.907-1.844
L: l = 0.636-0.655, h = 0.336-0.364; l/h = 1.893-1.799

Other regional occurrences: Greek mainland and islands: Upper Miocene to Pliocene of Crete (Sissingh 1972b; Tsapralis 1976), Upper Pliocene of Karpathos, Rhodes (Sissingh 1972b), Northwest and northern Peloponnesus (Danatsas 1994a), and Kithira (Mostafawi 1990), Lower Pleistocene of the Isthmus of Corinth (Römmelt-Doll 1990), and Upper Pleistocene of Kos (Mostafawi 1981). Recent in the northern Aegean Sea (Stambolidis 1985), the Black Sea, the Sea of Azov (Schornikov 1966), and the northern exit of the Bosphorus (Tunoğlu 2002). Central and eastern Mediterranean Basin: Upper Miocene to Upper Pleistocene (Sissingh 1982: tab. 1). Italy: Sicilian to Recent (Ruggieri 1980: 131).

Ecology: *Callistocythere intricatoides* is a marine infralittoral species. Stambolidis (1985: 168, 192) reports this form from the northern Aegean Sea on muddy substrate between 3.5 and 17 m depth. Schornikov (1966: 46) found the species in the Black Sea in 15-100 m with an optimum at 20-30 m water depth.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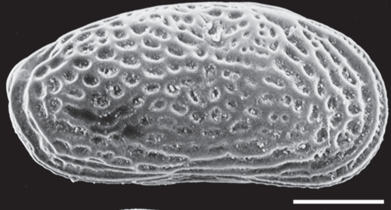
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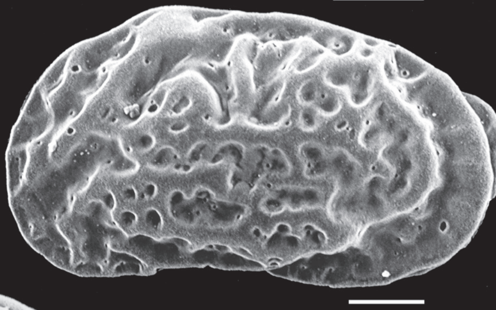
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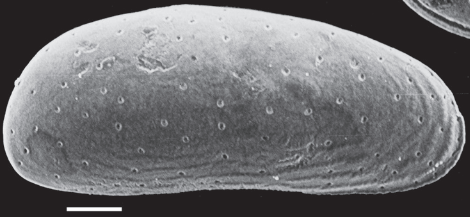
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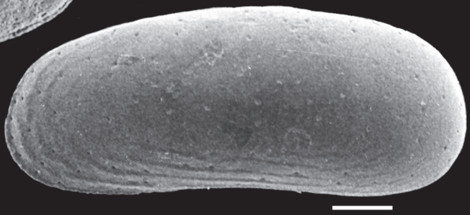
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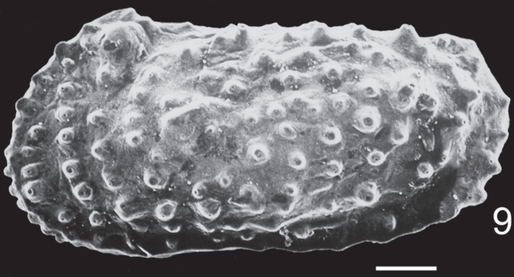
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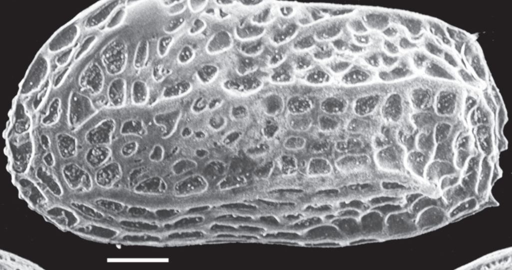
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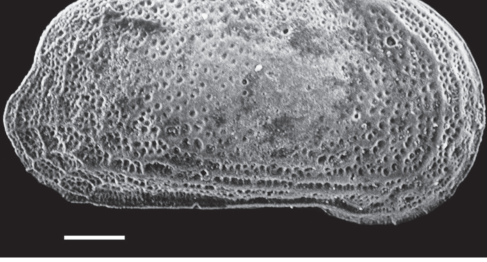
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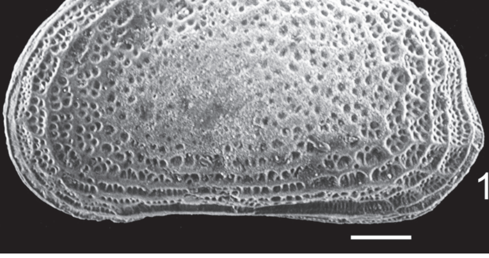
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Remark: Sissingh (1972a: 14) considers *Callistocythere intricatoides* a junior synonym of *C. crispata* (Brady, 1868). Athersuch & Whittaker (1980), Mostafawi (1981: pl. 4, figs 8-9), and Malz & Jellinek (1984: 125 & pl. 1, fig. 5) demonstrate that the smaller *C. crispata* is different in ornamentation.

Family Cytherideidae Sars, 1925
Subfamily Cytherideinae Sars, 1925

Genus *Neocyprideis* Apostolescu, 1956

Neocyprideis sp.
Pl. 1, Fig. 5

Material: Subaşı 1: 1 C

Measurements (mm):
l = 0.745, h = 0.456; l/h = 1.634

Stratigraphic range: The genus is known from the Eocene to Miocene (Moore 1961: 277) or Paleocene to Miocene (? Recent) (van Morkhoven 1963: 293). Jiříček & Říha (1993) give a range of Paleocene to Oligocene for *Neocyprideis (Neocyprideis).*

Palaeoecology: The genus predominantly occurs in brackish (meso-polyhaline) environments (van Morkhoven 1963: 294).

Remarks: The generic determination is based exclusively on the shape of the carapace, its length of approximately 0.75 mm, and the absence of denticulations (Kollmann 1960: 177; van Morkhoven 1963: 295). This complement of features does not permit assignment to the genus *Miocyprideis* Kollmann, 1960. However, Jiříček & Říha (1993) consider *Miocyprideis* a subgenus of *Neocyprideis*. The single specimen is probably reworked.

Family Cushmanideidae Puri, 1973

Genus *Pontocythere* Dubowsky, 1939

Pontocythere turbida (G. W. Müller, 1894)
Pl. 1, Figs 6-7

1878 *Argillaecia ? lithodomoides,* Terq. – Terquem: 88, pl. 10, fig. 3a-d.
1969 *Pontocythere turbida* (G. W. Müller 1894) – Gramann: 508, pl. 33, fig. 10.
1975 *Pontocythere turbida* (G. W. Müller, 1894) – Bonaduce et al.: 61, pl. 35, figs1-5.
1981 *Cushmanidea elongata* (Brady, 1868) – Mostafawi: 144, pl. 5, figs 4-7.
1989a *Pontocythere turbida* (G. W. Müller 1894) – Mostafawi: 127, pl. 2, fig. 25.
1989 *Pontocythere turbida* (G. W. Müller 1894) – Zangger & Malz: pl. 3, fig.4.
1994a *Pontocythere turbida* (G. W. Müller 1894) – Danatsas: 98, pl. 1, figs 8-10.
1996 *Pontocythere* sp. – Mostafawi: pl. 1, fig. 8.
1996 *Pontocythere elongata* (Brady) – Nazik: 218, pl. 2, fig. 6.

Material: Subaşı 1: ♂ & ♀: 27 V; 14 V juv.; Subaşı 2 (partly measured): ♂: 2 R, 4 L; ♀: 1 C, 4 R, 3 L; juv.: 4 V.

Measurements (mm):
R♂: l = 0.818-0.824, h = 0.309-0.318; l/h = 2.647-2.667
L♂: l = 0.798-0.815, h = 0.318-0.328, l/h = 2.509-2.477
R♀: l = 0.735-0.785, h = 0.300-0.327; l/h = 2.379-2.401
L♀: l = 0.764-0.785, h = 0.318-0.327; l/h = 2.403-2.401

Other regional occurrences: Greek mainland and islands: Upper Pontian of the Strimon Basin and the Thessaloniki area (Gramann 1969; Mostafawi 1996), Upper Pliocene of Northwest and northern Peloponnesus (Danatsas 1994a), Upper Pliocene to Lower Pleistocene of Rhodes (Terquem 1878; Mostafawi 1989a), and Kos (Mostafawi 1981), Upper Pleistocene of the Isthmus of Corinth (Römmelt-Doll 1990), and the Gulf of Argos (Zangger & Malz 1989). Turkey: Pliocene of the Adana region (Nazik 1996). Central and eastern Mediterranean Basin: Lower Pleistocene to Holocene (Sissingh 1982: tab. 1).

Ecology: The following data refer to *Pontocythere* elon-

Plate 1

Fig. 1: *Leptocythere multipunctata* (Seguenza, 1884). R♀ (l = 0.531, h = 0.345 mm), external view, ca. x 125; BSPG 1980 X 1311.
Fig. 2: *Leptocythere peterseni* Mostafawi, 1989. C♂ from right (l = 0.429, h = 0.213 mm), external view, ca. x 120; BSPG 1980 X 1312.
Figs 3 & 4: *Callistocythere intricatoides* (Ruggieri, 1953). Fig. 3: R (l = 0.640, h = 0.347 mm), external view, ca. x 105; BSPG 1980 X 1313; Fig. 4: L (l = 0.644, h = 0.362 mm), external view, ca. x 105; BSPG 1980 X 1314.
Fig. 5: *Neocyprideis* sp. C from right (l = 0.745, h = 0.456 mm), ca. x 80; BSPG 1980 X 1315
Figs 6 & 7: *Pontocythere turbida* (G. W. Müller, 1894). Fig. 6: R♀ (l = 0.764, h = 0.309 mm), external view, ca. x 80; BSPG 1980 X 1316; Fig. 7: L♀ (l = 0.767, h = 0.318 mm), external view, ca. x 80; BSPG 1980 X 1317.
Figs 8 & 9: *Carinocythereis rhombica* Stambolidis, 1985. Fig. 8: R♂ (l = 0.836, h = 0.404 mm), external view, ca. x 80; BSPG 1980 X 1318; Fig. 9: L♀ (l = 0.832, h = 0.427 mm), external view, ca. x 80; BSPG 1980 X 1319.
Fig. 10: *Hiltermannicythere rubra* (G. W. Müller, 1894). L (l = 0.849, h = 0.473 mm), external view, ca. x 80; BSPG 1980 X 1320.
Fig. 11 & 12: *Aurila arborescens* (Brady, 1865). Fig. 11: R (l = 0.798, h = 0.436 mm), external view, ca. x 85; BSPG 1980 X 1321; Fig. 12: C from left (l = 0.800, h = 0.437 mm), external view, ca. x 85; BSPG 1980 X 1322.

Length of bars: 0.1 mm

gata, because several authors, including Stambolidis (1985: 195), regard *P. turbida* as conspecific with *P. elongata*. Stambolidis (1985: 168, 196) collected a few specimens on a sandy substrate in the northern Aegean Sea in 31-33 m water depth. According to Breman (1975: 133), *P. elongata* is a widely distributed marine infralittoral species that prefers sandy substrates and reaches a maximum distribution in 45 m deep water.

Remarks: Wouters (1974: 8) places *Argillaecia? lithodomoides* Terquem, 1878 in the synonymy of *Pontocythere turbida*. Kruit (1955: 484-485 & pl. 6, figs 1a-d, 2a-d) describes and illustrates the differences between *P. turbida* and *P. elongata* (Brady, 1868) = *P. rubra* (G. W. Müller, 1894). In dorsal view, *Pontocythere turbida* displays a more truncate posterior end and a more compressed carapace with parallel sides. The left valve of *C. elongata* shows a narrower posteroventral curvature than *C. turbida*. Towards the dorsal margin, the posterior margin of *C. elongata* is less steeply inclined (~57° according to Wagner 1957: pl. 15, fig. 5) than that seen in *C. turbida* (~83° according to Mostafawi 1989a: pl. 2, fig. 25). In side view, the posterior half of the valve of *C. elongata* is higher than the anterior half, whereas in *C. turbida* this difference is less apparent. Athersuch (1982: 238) also discusses the difference between *C. elongata* and *C. turbida*, and states that the latter is posteriorly truncated, and "the selvage in the posteroventral region of the right valve cuts sharply inwards and runs away from the outer margin …". Bonaduce et al. (1975: 61) indicate the length of *P. turbida* with 0.77-0.81 mm, whereas *P. elongata* = *P. rubra* measures 0.85-0.89 mm. Mostafawi (1981: 144) reports a length range from 0.714 to 0.891 mm, and thus, based on this feature exclusively, both species could be present in his material. The specimens illustrated in this paper are males based on their size.

Family Trachyleberididae Sylvester-Bradley, 1948

Subfamily Trachyleberidinae Sylvester-Bradley, 1948

Genus *Carinocythereis* Ruggieri, 1956

Carinocythereis rhombica Stambolidis, 1985

Pl. 1, Figs 8-9

* 1985 *Carinocythereis rhombica* n. sp. – Stambolidis: 200, pl. 2, figs 10-13.
1986 *Carinocythereis willmanni* n. sp. – Mostafawi: 288, pl. 2, figs 24-27; text-fig. 5.
1989 *Carinocythereis rhombica* Stambolidis 1985 – Zangger & Malz: pl. 4, figs 2-6.

Material: Subaşı 1: ♂: 1 R, ♀: 1 L.

Measurements (mm):
R♂: l = 0.836, h = 0.404; l/h = 2.069
L♀: l = 0.832, h = 0.427; l/h = 1.948

Other regional occurrences: Greek mainland and island: Upper Pleistocene of the Gulf of Argos (Zangger & Malz 1989) and Kos (Mostafawi 1986). Recent in the Sea of Marmara and the northern Aegean Sea (Stambolidis 1985).

Ecology: Stambolidis (1985: 168) collected the species in water depths of 0.2-31 m. *Carinocythereis rhombica* occurs most frequently in 9 m water depth.

Remarks: Zangger & Malz (1989: 174) regard *Carinocythereis willmanni* as a synonym of *C. rhombica*. The ventrolateral rib of the Turkish specimens, which appear to be corroded, is short and not conspicuous.

Genus *Hiltermannicythere* Bassiouni, 1970

Hiltermannicythere rubra (G. W. Müller, 1894)

Pl. 1, Fig. 10

1969 *Falunia capsula* n. sp. – Uliczny: 91, pl. 7, fig. 5; pl. 8, fig. 1; pl. 17, figs 2-3.
1969 *Falunia retifastigata* (Jones 1856) – Uliczny: 98, pl. 5, fig. 9.
1969 *Carinocythereis rubra* (G. W. Müller, 1894) – Schornikov: 191, pl. 18, fig.1.
1971 *Carinocythereis* sp. – Barbeito-Gonzales: 281, pl. 14, fig. 1c-3c; pl. 47, figs 1-4.
1972 *Falunia (Hiltermannicythere) turbida* (G. W. Müller 1894) – Uffenorde: 73, pl. 7, fig. 10.
1972b *Falunia (Hiltermannicythere) retifastigata* (Jones) – Sissingh: 106, pl. 7, fig. 18.
1975 *Hiltermannicythere* aff. *H. turbida* (G. W. Müller, 1894) – Bonaduce et al.: 49, pl. 28, figs 1-5.
1976 *Falunia (Hiltermannicythere)* sp. – Gökçen: pl. 1, fig. 26-27, ?28.
1981 *Hiltermannicythere capsula* (Uliczny) – Mostafawi: 148, pl. 7, figs 8-10.
1984 *Hiltermannicythere turbida* (G. W. Müller 1894), tota species – Malz & Jellinek: 138, pl. 4. fig. 31.
1985 *Hiltermannicythere rubra* (G. W. Müller) – Athersuch & Horne: 45-48.
1985 *Hiltermannicythere turbida* (Müller, 1894) – Stambolidis: 205, pl. 4, fig. 1.
1985 *Hiltermannicythere retifastigata* (Jones, 1856) – Stambolidis: 206, pl. 4, fig. 2.
1989 *Hiltermannicythere turbida* sensu Stambolidis 1985 – Zangger & Malz: pl. 2, fig. 10.
1989a *Hiltermannicythere rubra* (G. W. Müller 1894) – Mostafawi: 137, pl. 5, fig. 101.
1990 *Hiltermannicythere rubra* (G. W. Müller 1894) – Mostafawi: pl. 2, fig. 27.
1990 *Hiltermannicythere capsula* (Uliczny 1969) – Römmelt-Doll: pl. 1, fig. 10.
1994a *Hiltermannicythere capsula* (Uliczny 1969) – Danatsas: 120, pl. 12, fig. 1.
1996 *Hiltermannicythere emaciata* (Brady) – Nazik: 219, pl. 3, fig. 5.
2002 *Hiltermannicythere rubra* (G. W. Müller 1894) – Mostafawi: 321, pl. 2, fig. 4; pl. 3, figs 2-3.
2002 *Falunia (Hiltermannicythere)* sp. 1 – Tunoğlu: pl. 5, fig. 2.
2003 *Hiltermannicythere turbida* (Müller, G., 1894) – Guernet et al.: 84, pl. 2, fig. 6.

An extensive list of synonyms, covering 1894-1999, can be found in Mostafawi (2002).

Material: Subaşı 1 (measured): ♀: 1 C, 2 L; Subaşı 2: ♀: 1 C.

Measurements (mm):
C♀: l = 0.820, w = 0.360; l/w = 2.278
L♀: l = 0.844-0.849, h = 0.458-0.473; l/h = 1.843-1.795

Other regional occurrences: Greek mainland and islands: Pliocene to Lower Pleistocene of the South Aegean Island Arc (Sissingh 1972b), Upper Pliocene of Kithira (Mostafawi 1990) and northwestern and northern Peloponnesus (Danatsas 1994a), Upper Pliocene to Lower Pleistocene of Rhodes (Mostafawi 1989a), Upper Pliocene and Upper Pleistocene (Tyrrhenian) of Cephalonia (Uliczny 1969), Lower Pleistocene of the Isthmus of Corinth (Römmelt-Doll 1990), Peloponnesus (Malz & Jellinek 1984) and Kos (Mostafawi 1981), Upper Pleistocene of the Gulf of Corinth (Guernet et al. 2003), and the Gulf of Argos (Zangger & Malz 1989). Recent and subfossil in the northern Aegean Sea (Stambolidis 1985). Turkey: Pliocene of the Adana region (Nazik 1996), and Holocene of the northwestern coast of Turkey (Gökçen 1976). Recent off Naxos (Barbeito-Gonzales 1971) and Cyprus (Athersuch & Horne 1985), in the Black Sea and the Sea of Azov (Schornikov 1969; Tunoğlu 2002). Generally in the eastern Mediterranean from Pliocene to Recent (Mostafawi 2002: 322).

Ecology: Occurring in water depths from 1 to 63 m, predominantly in sandy biotopes (Mostafawi 2002: 322).

Remark: The specimens presented here are females. Males are characterized by l/h-values of approximately 2 (Malz & Jellinek 1984: 138).

Family Hemicytheridae Puri, 1953
Subfamily Hemicytherinae Puri, 1953

Genus *Aurila* Pokorny, 1955

Aurila arborescens (Brady, 1865)
Pl. 1, Figs 11-12

1971 *Aurila woodwardi* (Brady, 1868) – Barbeito-Gonzales: 276, pl. 11, figs 1a-3a; pl. 46, figs 1-2.
1972 *Aurila woodwardii* (Brady 1868) – Uffenorde: 77, pl. 8, fig. 7.
1975 *Aurila woodwardi* (Brady, 1868) – Bonaduce et al.: 44, pl. 20, figs 8-11.
1980 *Aurila woodwardii* (Brady, 1868) – Athersuch: 45-52.
1985 *Aurila woodwardi* (Brady,1868) – Stambolidis: 212, pl. 5, fig. 2.
1985 *Aurila arborescens* (Brady, 1865) – Athersuch et al.: 156; pl. 1, figs 5-8; pl. 2, figs 1-4.
1994a *Aurila woodwardii* (Brady1868) – Danatsas: 107, pl. 6, figs 7-8.

Material: Subaşı 1: 1 C, 4 R, 2 L, 2 V juv.; Subaşı 2 (partly measured): 1 C, 3 R, 4 L, 2 V juv.

Measurements (mm):
C: l = 0.800, h = 0.437; l/h = 1.831
R: l = 0.798-0.800, h = 0.436-0.440; l/h = 1.830-1.818
L: l = 0.807, h = 0.444; l/h = 1.818

Other regional occurrences: Greece: Upper Pliocene of Northwest and northern Peloponnesus (Danatsas 1994a), and Lower Pleistocene of the Isthmus of Corinth (Römmelt-Doll 1990). Subfossil in the northern Aegean Sea (Stambolidis 1985), Recent off Naxos (Barbeito-Gonzales 1971), Cyprus (Athersuch 1980; Athersuch et al.1985), Latakia, Syria (Brady 1868/1869; Sissingh 1972a), and Jaffa, Israel (Brady 1868/1869; Sissingh 1972a). Central and eastern Mediterranean Basin: In the Upper Pleistocene to Holocene (Sissingh 1982: tab. 1). Italy: Lower Pleistocene to Recent, particularily frequent in the Crotonian (Ruggieri 1980: 130).

Ecology: Barbeito-Gonzales (1971: tab. 2) reports the species off Naxos from a water depth of up to 4 m, and Stambolidis (1985: 213) from the northern Aegean Sea in 3.5 m water depth.

Remark: Athersuch et al. (1985: 156) demonstrate that *Aurila woodwardii* is a junior synonym of *A. arborescens* (Brady, 1865). In dorsal view, the prominent ridges running parallel to the anterior and posterior margins of *A. arborescens* are well recognizable from the specimens illustrated by Barbeito-Gonzales (1971: pl. 11, fig. 3a) and Athersuch (1980: 48, fig. 3a-b). Bonaduce's et al. (1975: pl. 20, fig. 9) figure does not show this feature, which is also not discernible in our material. Benson's (1976: 154) observation is probably pertinent here: "...taxonomic certainty at the species level decreases rapidly, the shallower the marine ostracode faunas become. This is evident, for example, in the large number of species of *Aurila*.... The shells of these ostracodes become more massive, that is, thicker and less distinctive in the ornament used for identification."

Subfamily Urocythereidinae Hartmann & Puri, 1974

Genus *Urocythereis* Ruggieri, 1950

Urocythereis crenulosa (Terquem, 1878)
Pl. 2, Fig. 1

* 1878 *Cythere crenulosa* Terq. – Terquem: 104, pl. 11, fig. 18a-c.
v 1969 *Urocythereis margaritifera alba* n. ssp. – Uliczny: 65, pl. 15, fig. 9.
1972 *Urocythereis margaritifera alba* Uliczny 1969 – Uffenorde: 79, pl. 8, fig. 9.
1972b *Urocythereis margaritifera margaritifera* (Mueller) – Sissingh: 128, pl. 10, fig. 8.
1989a *Urocythereis crenulosa* (Terquem 1878) – Mostafawi: 137, pl. 5, fig. 105.
1992 *Urocythereis margaritifera* (Mueller) – Nazik et al.: pl. 5, fig. 2.
1994 *Urocythereis* sp. – Mostafawi: 107, fig. 7/6.
non 1994a *Urocythereis crenulosa* (Terquem 1878) – Danatsas: 112, pl. 7, fig. 18.

Material: Subaşı 1 (partly measured): 1 C, 21 R, 19 L, 46 V juv.; Subaşı 2: 9 R, 9 L, 20 V juv.

Measurements (mm):
C♀: l = 0.984, w = 0.515; l/w = 1.911
R♀: l = 0.945-0.971, h = 0.473-0.487; l/h = 1.998-1.994
L♀: l = 0.964-0.976, h = 0.484-0.489; l/h = 1.992-1.996
R♂: l = 1.015-1.073, h = 0.491-0.509; l/h = 2.067-2.108
L♂: l = 1.018-1.078, h = 0.500-0.518; l/h = 2.036-2.081

Other regional occurrences: Greek mainland and islands: Upper Pliocene of Crete and Karpathos (Sissingh 1972b), Upper Pliocene to Lower Pleistocene of Rhodes (Terquem 1878; Sissingh 1972b; Mostafawi 1989a), Upper Pliocene and Upper Pleistocene (Tyrrhenian) of Cephalonia (Uliczny 1969), and Upper Pleistocene of the northern Peloponnesus (Mostafawi 1994). Turkey: Pliocene of the Adana region (Nazik et al. 1992). Recent in the Aegean Sea (Uliczny 1969). Central and eastern Mediterranean Basin: Upper Pliocene to Holocene (Sissingh 1982: tab. 1).

Ecology: Dead specimens were found in the northern Adriatic Sea nearshore on slightly sandy silt down to 32 m, and on coarse sand in 18 m depth (Uffenorde 1972: 79). Thick, heavy, highly ornamented, large carapaces of genera like *Urocythereis* characterize nearshore coarse-grained sediments (Puri 1966: 463).

Remarks: Athersuch (1977a: 250) groups together *Urocythereis britannica* Athersuch, 1977, *U. distinguenda* (Neviani, 1928), *U. margaritifera* (G. W. Müller, 1894), *U. favosa* (Roemer, 1838), and *U. neopolitana* Athersuch, 1977 based on the distribution of their fossae. *Urocythereis crenulosa* is related to *U. favosa*, and hence also belongs to this group. However, the latter shows a lower number of fossae, indicating the position of a possible further subdivision in their undulating outline. *Urocythereis crenulosa* (cf. Danatsas 1994a) differs from *U. crenulosa* (Terquem 1878) from the type-area (cf. Mostafawi 1989a) by possessing longitudinally running ribs in the upper half of the valve that seperate rows of fossae instead of an irregular arrangement.

Family Loxoconchidae Sars, 1925

Genus *Loxoconcha* Sars, 1866

Loxoconcha gibberosa Terquem, 1878

Pl. 2, Fig. 2

* 1878 *Loxoconcha gibberosa* Terq. – Terquem: 95, pl. 10, fig. 20a-e.
1975 *Loxoconcha gibberosa* Terquem, 1878 – Bonaduce et al.: 108, pl. 64, figs 1-7.
1986 *Loxoconcha gibberosa* Terquem 1878 – Mostafawi: pl. 2, fig. 22.
1995 *Loxoconcha gibberosa* Terquem – Gülen et al.: pl. 2, fig. 5a-b.
1998 *Loxoconcha gibberosa* Terquem 1878 – Hajjaji et al.: pl. 2, fig. 9.

Material: Subaşı 1 (partly measured): ♂: 1 C, 1 R, 1 L; ♀: 1 R, 1 L; juv.: 1 C; Subaşı 2 (partly measured): ♂: 1 C, 2 R, 1 L; ♀: 1 C, 1 R, 3 L; juv.: 4 V.

Measurements (mm):
C♂: l = 0.673, w = 0.320; l/w = 2.103
R♂: l = 0.636-0.640, h = 0.422-0.420; l/h = 1.507-1.523
L♂: l = 0.640-0.673, h = 0.396-0.398, l/h = 1.616-1.691
C♀: l = 0.600, w = 0.327; l/w = 1.835
R♀: l = 0.582, h = 0.384; l/h = 1.516
L♀: l = 0.600-0.622, h = 0.393-0.416; l/h = 1.527-1.495

Other regional occurrences: Greek islands: Upper Pliocene to Lower Pleistocene of Rhodes (Terquem 1878; Hajjiji et al. 1998), and Upper Pleistocene of Kos (Mostafawi 1986). Turkey: Lower Pleistocene of İzmit Bay (Gülen et al. 1995).

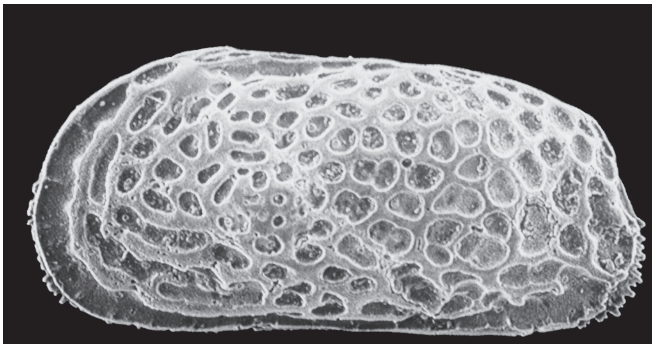
Ecology: In the Adriatic Sea, the species was found in the nearshore to 125 m water depth with a maximum distribution in 70 m water depth; more frequently on medium to fine sands than on very sandy to sandy pelites and sandy silts (Bonaduce et al. 1975: 108).

Remarks: Based on the revision of the similar *Loxoconcha rhomboidea* (Fischer, 1855) in Athersuch & Whittaker (1976), the following differences are noted. The female specimens of *L. gibberosa* are dorsally less arched than seen in *L.*

Plate 2

Fig.1: *Urocythereis crenulosa* (Terquem, 1878). L♂ (l = 1.018, h = 0.500 mm), external view, ca. x 80; BSPG 1980 X 1323.
Fig. 2: *Loxoconcha gibberosa* Terquem, 1878. L♂ (l = 0.673, h = 0.398 mm), external view, ca. x 80; BSPG 1980 X 1324.
Figs 3 & 4: *Loxoconcha stellifera* G. W. Müller, 1894. Fig. 3: R♂ (l = 0.727, h = 0.447 mm), external view, ca. x 80; BSPG 1980 X 1325; Fig. 4: L♀ (l = 0.598, h = 0.400 mm), internal view, ca. x 80; BSPG 1980 X 1326.
Figs 5 & 6: *Paracytheridea* aff. *depressa* G. W. Müller, 1894. Fig. 5: R♂ (l = 0.590, h = 0.258 mm), external view, ca. x 80; BSPG 1980 X 1327; Fig. 6: R♀ (l = 0.590, w = 0.200 mm), dorsal view, ca. x 80; BSPG 1980 X 1328.
Figs 7 & 8: *Paracytheridea parallia* Barbeito-Gonzales, 1971. Fig. 7: L♀ (l = 0.662, h = 0.313 mm), external view, ca. x 80; BSPG 1980 X 1329; Fig. 8: R♂ (l = 0.700, w = 0.209 mm), dorsal view, ca. x 80; BSPG 1980 X 1330.
Figs 9 & 10: *Pseudocytherura calcarata* (Seguenza, 1880). Fig. 9: L♂ (l = 0.876, h = 0.445 mm), external view, ca. x 80; BSPG 1980 X 1331; Fig. 10: R♂ (l = 0.855, w = 0.247 mm), dorsal view, ca. x 80; BSPG 1980 X 1332.
Fig. 11: *Xestoleberis dispar* G. W. Müller, 1894. R (l = 0.664, h = 0.352 mm), external view, ca. x 80; BSPG 1980 X 1333.
Fig. 12: *Xestoleberis* cf. *dispar* G. W. Müller, 1894. C from right (l = 0.751, h = 0.409 mm), ca. x 80; BSPG 1980 X 1334.
Fig. 13: *Xestoleberis* cf. *margaritea* (Brady, 1866). L (l = 0.558, h = 0.316 mm), external view, ca. x 80; BSPG 1980 X 1335.
Fig. 14: *Xestoleberis* sp. Typ B Danatsas, 1994. R (l = 0.484, h = 0.255 mm), external view, ca. x 80; specimen lost.

Length of bars: 0.1 mm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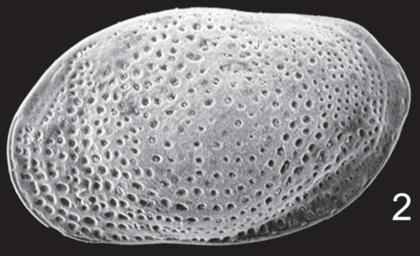
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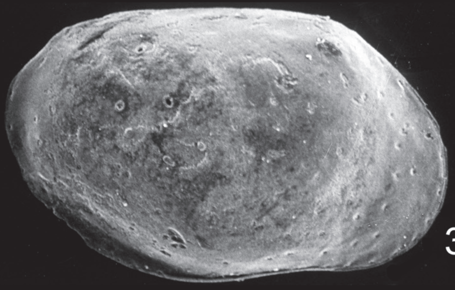
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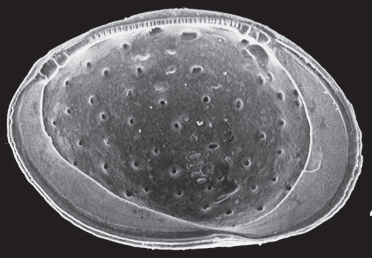
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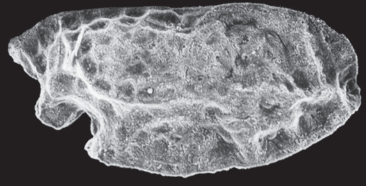
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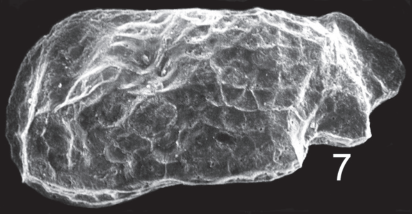
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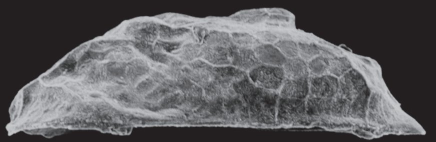
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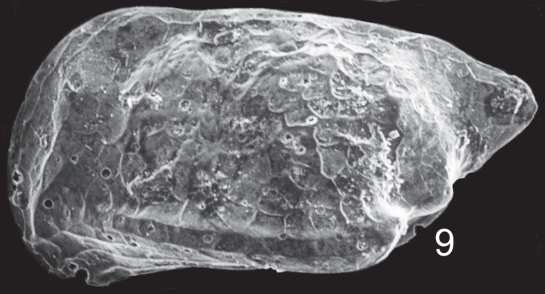
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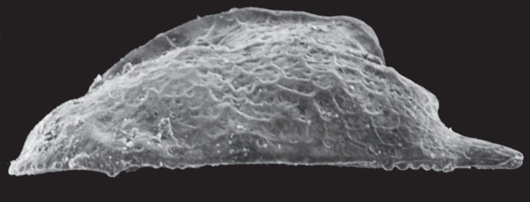
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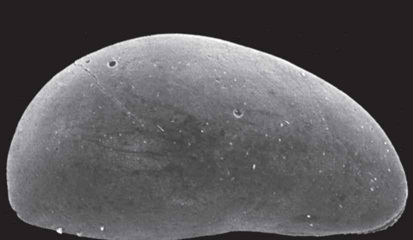
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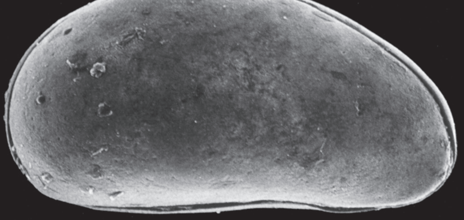
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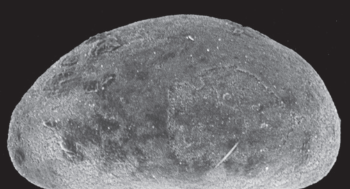
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14

rhomboidea. Furthermore, the pitted surface extends along the anterior margin onto the depressed area and is well developed in *L. gibberosa* in contrast to *L. rhomboidea*. In the latter form, the dorsal pits, if present at all, are much smaller than those on the lateral surface.

Loxoconcha stellifera G. W. MÜLLER, 1894

Pl. 2, Figs 3-4

1971	*Loxoconcha stellifera* G. W. MÜLLER 1894 – BARBEITO-GONZALES: 307, pl. 31, figs 1c-4c.
1972	*Loxoconcha stellifera* G. W. MÜLLER 1894 – UFFENORDE: 85, pl. 9, fig. 6.
1975	*Loxoconcha stellifera* G. W. MÜLLER, 1894 – BONADUCE et al.: 110, pl. 64, figs 8-13.
1977b	*Loxoconcha stellifera* G. W. MÜLLER – ATHERSUCH: 107-114.
1981	*Loxoconcha stellifera* G. W. MÜLLER 1894 – MOSTAFAWI: 164, pl. 13, figs 7-10.
1985	*Loxoconcha stellifera* MÜLLER, 1894 – STAMBOLIDIS: 223, pl. 7, figs 12-14.
1989a	*Loxoconcha "stellifera"* G. W. MÜLLER 1894 – MOSTAFAWI: 129, pl. 2, fig. 35.
1990	*Loxoconcha stellifera* G. W. MÜLLER 1894 – RÖMMELT-DOLL: pl. 2, fig. 30.
1994a	*Loxoconcha stellifera* G. W. MÜLLER 1894 – DANATSAS: 116, pl. 10, fig. 11.

Material: Subaşı (partly measured): ♂: 2 R, 2 L; ♀: 6 R, 7 L; juv.: 1 V; Subaşı 2 (partly measured): ♂: 2 C, 3 R, 1 L; ♀: 2 C, 7 R, 12 L; juv.: 2 V.

Measurements (mm):
C♂: l = 0.669, w = 0.327; l/w = 2.046
R♂: l = 0.684-0.727, h = 0.418-0.447; l/h = 1.636-1.626
L♂: l = 0.691-0.727, h = 0.435-0.447, l/h = 1.589-1.626
C♀: l = 0.582, w = 0.309; l/w = 1.883
R♀: l = 0.602-0.636, h = 0.400-0.436; l/h = 1.505-1.459
L♀: l = 0.598-0.618, h = 0.400-0.440; l/h = 1.495-1.405

Other regional occurrences: Greek mainland and islands: Lower Pliocene of Crete (SISSINGH 1972b), Upper Pliocene of Northwest and northern Peloponnesus (DANATSAS 1994a), Upper Pliocene of Karpathos, Lower Pleistocene of Rhodes (SISSINGH 1972b), Upper Pliocene to Lower Pleistocene of Kos (MOSTAFAWI 1981), Lower Pleistocene of Rhodes (MOSTAFAWI 1989a) and Isthmus of Corinth (RÖMMELT-DOLL 1990). Recent off Naxos, Cyprus, and in the Aegean Sea (BARBEITO-GONZALES 1971; ATHERSUCH 1977b; STAMBOLIDIS 1985).

Ecology: BARBEITO-GONZALES (1971: tab. 2) discovered *Loxoconcha stellifera* in up to 4 m water depth, STAMBOLIDIS (1985: 223) found it in 3.5-33 m on a muddy and sandy substrate.

Family Paracytherideidae PURI, 1957

Genus *Paracytheridea* G. W. MÜLLER, 1894

Paracytheridea aff. *depressa* G. W. MÜLLER, 1894

Pl. 2, Figs 5-6

1971	*Paracytheridea* sp. 8 – BARBEITO-GONZALES: 306, pl. 30, figs 1e-2e.
1971	*Paracytheridea* sp. 9 – BARBEITO-GONZALES: 306, pl. 30, figs 1d-2d.
1972	*Paracytheridea* aff. *P. depressa* G. W. MÜLLER 1894 – UFFENORDE: 86, pl. 9, fig. 8; pl. 12, fig. 8.
1975	*Paracytheridea* sp. 8 – BONADUCE et al.: 89, pl. 50, figs 1, 3-6.
1976	*Paracytheridea* sp. – GÖKÇEN: pl. 1, figs 3-5.
1981	*Paracytheridea depressa* G. W. MÜLLER, 1894 – MOSTAFAWI: 165, pl. 14, figs 1-2.
1984	*Paracytheridea* cf. *depressa* G. W. MÜLLER 1894 – MALZ & JELLINEK: 128, pl. 2, fig. 14.
1989	*Paracytheridea* sp., aff. *P. depressa* G. W. MÜLLER 1894 – ZANGGER & MALZ: pl. 2, fig. 3.
1994a	*Paracytheridea* cf. *depressa* G. W. MÜLLER 1894 – DANATSAS: 118, pl. 11, figs 1-2.

Material: Subaşı 1 (measured): ♂: 1 R; 1 L, damaged; ♀: 1 R; Subaşı 2: ♀: 1 R; juv.: 1 L.

Measurements (mm):
R♂: l = 0.607, h = 0.236; l/h = 2.572
L♂: l = 0.633
R♀: l = 0.590, h = 0.258, w = 0.200; l/h = 2.287

Other regional occurrences: Greek mainland and islands: Upper Pliocene of Northwest and northern Peloponnesus (DANATSAS 1994a), Upper Pliocene to Lower Pleistocene of Kos (MOSTAFAWI 1981), Lower Pleistocene of Peloponnesus (MALZ & JELLINEK 1984), Upper Pleistocene of the Gulf of Argos (ZANGGER & MALZ 1989), Recent off Naxos (BARBEITO-GONZALES 1971). Turkey: Holocene of the northwestern coast (GÖKÇEN 1976).

Ecology: BARBEITO-GONZALES (1971: tab. 2) found this species off Naxos in a water depth of up to 50 m. In the Adriatic Sea, UFFENORDE (1972: 86) found living specimens on coarse sand in a depth of 18 m and dead specimens on slightly sandy silt in 6-34 m and on coarse sand in 12 m. BONADUCE et al. (1975: 89) reported the species throughout the sampled area, but not deeper than 135 m, with a maximum distribution in 71-121 m water depth, common on medium to fine sands, more rarely on sandy pelite.

Remarks: The species displays some variability in ornamentation, including with regard to the degree of intercostal reticulation, e.g., specimen with prominent reticulation in the upper part of the posterior half of the valve (BONADUCE et al. 1975: pl. 50, figs 1, 3; MOSTAFAWI 1981: pl. 14, fig. 2; MALZ & JELLINEK 1984: pl. 2, fig.14; ZANGGER & MALZ 1989: pl. 2, fig. 3) vs. lack of reticulation between the main costae (MOSTAFAWI 1981: pl. 14, fig. 1).

As documented by SCHORNIKOV (1969: pl. 29, fig. 1) based on extant material from the Black Sea (i.e. *Paracytheridea* *pauli* Dubowsky, 1939), the female clearly shows the end of the ventral rib and the secondary smaller process between this end and the caudal process in dorsal view, whereas the male only displays minor indications of these features. Adding to these differences the variation in orientation of the valves for drawing or SEM-photography, the recognition of a plethora of related species is inevitable. This is well-illustrated by Barbeito-Gonzales (1971), who distinguishes 10 species from offshore Naxos.

Paracytheridea parallia Barbeito-Gonzales, 1971
Pl. 2, Figs 7-8

* 1971 *Paracytheridea parallia* n. sp. – Barbeito-Gonzales: 303, pl. 28, figs 1c-6c.
1985 *Paracytheridea parallia* Barbeito-Gonzales, 1971 – Stambolidis: 224, pl. 8, fig. 5.
1994a *Paracytheridea parallia* Barbeito-Gonzales 1971 – Danatsas: 118, pl. 11, figs 5-7.
1995 *Paracytheridea parallia* (Barbeito-Gonzales) – Gülen et al.: pl. 2, figs 7a-b.

Material: Subaşı 1 (partly measured): ♂: 1 R, 1 L; ♀: 2 L; juv.: 1 V; Subaşı 2 (partly measured): ♂: 3 L; ♀: 6 R, 6 L; juv.: 1 V.

Measurements (mm):
R♂: l = 0.664, h = 0.296, w = 0.216; l/h = 2.243
L♂: l = 0.689-0.693, h = 0.309-0.316, w = 0.200; l/h = 2.230-2.193
R♀: l = 0.656-0.700 = 0.324-0.327, w = 0.209; l/h = 2.025-2.141
L♀: l = 0.640-0.676, h = 0.309-0.344, w = 0.215; l/h = 2.071-1.965

Other regional occurrences: Greek mainland and island: Upper Pliocene of Northwest and northern Peloponnesus (Danatsas 1994a), Recent off Naxos (Barbeito-Gonzales 1971) and in the northern Aegean Sea (Stambolidis 1985). Turkey: Lower Pleistocene and Holocene of İzmit Bay (Gülen et al. 1995).

Ecology: Barbeito-Gonzales (1971: tab. 2) reports this species off Naxos in a water depth of up to 4 m. Stambolidis (1985: 224) records it for the Northern Aegean Sea in mud at 3.5-5.3 m.

Family Cytheruridae G. W. Müller, 1894
Subfamily Cytherurinae G. W. Müller, 1894

Genus *Pseudocytherura* Dubowsky, 1939

Pseudocytherura calcarata (Seguenza, 1880)
Pl. 2, Figs 9-10

1971 *Pseudocytherura calcarata* (Seguenza, 1880) – Barbeito-Gonzales: 302, pl. 27, figs 1c-3c.
1972 *Pseudocytherura calcarata* (Seguenza 1880) – Uffenorde: 88, pl. 10, fig. 2.
1972b *Pseudocytherura calcarata* (Seguenza) – Sissingh: 144, pl. 12, fig. 11.
1984 *Pseudocytherura calcarata* (Seguenza 1880) – Malz & Jellinek: 129, pl. 2, fig. 15.
1986 *Pseudocytherura calcarata* (Seguenza 1880) – Mostafawi: pl. 3, fig. 46.
1995 *Pseudocytherura calcarata* (Seguenza) – Gülen et al.: pl. 3, fig. 1a-b.
2002 *Pseudocytherura calcarata* (Seguenza 1880) – Tunoğlu: pl. 1, figs 14-15.

Material: Subaşı 1: ♂: 4 L; ♀: 2 R, 2 L; juv.: 2 V; Subaşı 2 (partly measured): ♂: 2 R, 3 L; ♀: 1 R, 2 L; juv.: 3 V.

Measurements (mm):
R♂: l = 0.875, h = 0.418; l/h = 2.093
R♂: l = 0.855, w = 0.247; l/w = 3.462
L♂: l = 0.876-0.926, h = 0.445-0.480, l/h = 1.969-1.929
L♂: l = 0.855, w = 0.273; l/w = 3.132
R♀: l = 0.805, h = 0.415; l/h = 1.940
L♀: l = 0.822-0.836, h = 0.416-0.418; l/h = 1.976-2.000

Other regional occurrences: Greek mainland and islands: Lower Pliocene of Crete, Upper Pliocene of Karpathos and Rhodes (Sissingh 1972b), Lower Pleistocene of the Southeast Peloponnesus (Malz & Jellinek 1984) and Rhodes (Sissingh 1972b), Upper Pleistocene of Kos (Mostafawi 1986), and Recent off Naxos (Barbeito-Gonzales 1971). Turkey: Lower Pleistocene of İzmit Bay (Gülen et al. 1995). Recent in the southern Black Sea (Tunoğlu 2002). Central and eastern Mediterranean Basin: Lower Pliocene to Holocene (Sissingh 1982: tab. 1).

Ecology: Barbeito-Gonzales (1971: tab. 2) reports a few specimens of this species off Naxos down to 50 m. Uffenorde (1972: 88) discovered dead specimens on coarse sand in 18 m water depth.

Family Xestoleberididae Sars, 1928

Genus *Xestoleberis* Sars, 1866

Xestoleberis dispar G. W. Müller, 1894
Pl. 2, Fig. 11

1975 *Xestoleberis dispar* G. W. Müller, 1894 – Bonaduce et al.: 124, pl. 73, figs 1-3.
1976 *Xestoleberis dispar* Müller – Athersuch: 297, pl. 15, fig. 2.
1986 *Xestoleberis* sp. – Mostafawi: pl. 3, fig. 33.
1994 *Xestoleberis dispar* G. W. Müller 1894 – Mostafawi: 110, figs 8/4-8/5
1994a *Xestoleberis dispar* G. W. Müller 1894 – Danatsas: 123, pl. 12, figs 20-22.
2003 *Xestoleberis* cf. *dispar* Müller, G., 1894 – Guernet et al.: 88, pl. 3, figs 1-2, 4.

Material: Subaşı 1 (partly measured): 6 R, 1 L; Subaşı 2: 2 R, 2 L.

Measurements (mm):
R: l = 0.664, h = 0.352; l/h = 1.886
L: l = 0.662, h = 0.382; l/h = 1.733

Other regional occurrences: Greek mainland and islands: Upper Pliocene of Northwest and northern Peloponnesus (Danatsas 1994a), Upper Pleistocene of Kos (Mostafawi 1986) and northern Peloponnesus (Mostafawi 1994), and Holocene of the Gulf of Corinth (Guernet et al. 2003).

Ecology: In the Adriatic Sea, nearshore to 125 m, common in depths <50-60 m; more frequent on medium and fine sands (Bondaduce et al. 1975: 124).

Remarks: The arrangement of the central muscle scars is illustrated in van Morkhoven (1963: 442, fig. 747). The relatively pronounced convex posterior part of the ventral margin suggests that the illustrated specimen is a female. A single carapace from Subaşı 2 differs from *Xestoleberis dispar* (I = 0.751, h = 0.409, w = 0.431; l/h = 1.816) in its larger dimensions, and is consequently considered *X.* cf. *dispar* (pl. 2, fig. 12). In outline it is reminiscent of *Xestoleberis sexmaculata* Athersuch, 1976, a small species with dimensions (R: l = 0.545, h = 0.298 mm, l/h = 1.829) calculated based on Athersuch's pl. 12, fig. 1.

Xestoleberis cf. *margaritea* (Brady, 1866)

Pl. 2, Fig. 13

cf. 1866 *Cytheridea margaritea* n. sp. – Brady: 370, pl. 58, fig. 6a-d.
1971 *Xestoleberis* cf. *margaritea* (Brady, 1866) – Barbeito-Gonzales: 317, pl. 39, figs 1c-4c.
cf. 1976 *Xestoleberis margaritea* (Brady) – Athersuch: 294, pl. 11, figs 1-3; text-fig. 9b.

Material: Subaşı 1: 1 L, 1 R damaged.

Measurements (mm):
L: l = 0.558, h = 0.316; l/h = 1.766
R: I = 0.579

Other regional occurrence: Greek islands: Recent off Naxos (Barbeito-Gonzales 1971).

Remarks: The inner lamella of *Xestoleberis margaritea* shown in Athersuch's (1976) pl. 11, fig. 3 is much wider posteriorly than those seen in Barbeito-Gonzales' specimens and the specimens at hand. The male specimen of *X. margaritea* figured in Ruggieri (1953: pl. 5, fig. 41) shows a broader inner lamella in contrast to the female. Brady's (1866: 370, pl. 58; fig. 6a-d) specimen is much higher. The dimensions calculated based on Athersuch's pl. 11, fig. 3 are L: l = 0.639, h = 0.402 mm, l/h = 1.590.

Xestoleberis sp. Typ B Danatsas, 1994

Pl. 2, Fig. 14

1994a *Xestoleberis* sp. Typ B – Danatsas: 124, pl. 13, figs 9-12.

Material: Subaşı 1 (measured): 1 R; Subaşı 2 (measured): 2 L.

Measurements (mm):
R: l = 0.484, h = 0.255; l/h = 1.898
L: I = 0.471-0.484, h = 0.256-0.267; l/h = 1.840-1.813

Other regional occurrence: Greek mainland: Upper Pliocene of Northwest and northern Peloponnesus (Danatsas 1994a).

Remark: A small X*estoleberis*, characterized by an almost bilaterally symmetrical outline and wide anterior and posterior vestibula.

3.2 Bivalvia (S. Schneider)

The systematic treatment of the bivalves follows the current version of the Checklist of European Marine Mollusca (CLEMAM) database of the Muséum National d'Histoire Naturelle, Department of Systematics and Evolution, Paris, edited and permanently updated by LeRenard (2004).

Abbreviations:
C = complete articulated specimen with closed valves
R = right valve(s) l = length
L = left valve(s) h = height

For each species, only a selection of synonyms from the Pleistocene of Turkey is given here since the described species are well-known and common in the Mediterranean.

Subclass Pteriomorphia Beurlen, 1944
Order Mytiloida De Férussac, 1822
Family Mytilidae Rafinesque, 1815

Genus *Mytilus* Linné, 1758

Mytilus galloprovincialis Lamarck, 1819

Pl. 3, Figs 1-2

1904 *Mytilus edulis* – English: 269, 270.
1904 *Mytilus edulis*, Linnaeus – Newton: 278/279.
1957 *Mytilus galloprovincialis* Lmk. – Chaput: 133.
1973 *Mytilus edulis* Linné – Erol & Nuttall: tab. 1.
1989 *Mytilus galloprovincialis* – Sakinç & Bargu: 55.
1989 *Mytilus edulis* – Sakinç & Bargu: 55.
2003 *Mytilus edulis* – Elmas: fig. 5j.

Material: Subaşı 1: 1 R; 2 L, one fragmentary; Subaşı 2: 17 R; 13 L, all fragmentary.

Measurements (mm): l = 2.1-approximately about 80; h = 3.5-approximately about 120

Ecology: *Mytilus galloprovincialis* is a common species along rocky shores. It lives byssally attached to hard substrate, and forms dense colonies from the intertidal zone down to a depth of 40 meters.

Remarks: The occurrence of *Mytilus edulis* LINNÉ, 1758 in the Mediterranean has to be regarded as questionable. There is still discussion about the confusion of *M. edulis* with *M. galloprovincialis* since the shell forms are very similar, and about their respective distributions. TEBBLE (1966) reports specimens of *M. galloprovincialis* from the British coast. POPPE & GOTO (1993), who are not sure of the species status of *M. galloprovincialis*, report shells of this form from deeper waters in Brittany. From the Mediterranean, these authors do not mention *M. edulis* sensu stricto, while PARENZAN (1974) figures *M. edulis* from the Mediterranean and mentions specimens from the central Adriatic. Although *M. edulis* might have migrated from Atlantic realms into the Mediterranean, its occurrence in the easternmost part can largely be excluded. Accordingly, I place reports of *M. edulis* from the Turkish Pleistocene in the synonymy of *M. galloprovincialis*. Our material contains three juvenile specimens from Subaşı 1, and 30 shell fragments from Subaşı 2. It is interesting to note that these fragments all belong to specimens that reached a height of 70-80 mm. Since intertidal specimens of the extant *M. galloprovincialis* only reach some 60 mm high (POPPE & GOTO 1993), these specimens probably lived at greater depths.

Genus *Mytilaster* MONTEROSATO, 1883

Mytilaster lineatus (GMELIN, 1791)

1956	*Mytilaster* sp. – ERINÇ: 188.

Material: Subaşı 1: 34 R; 39 L; 4 C; Subaşı 2: 32 R; 41 L; 11 C.

Measurements (mm): l = 0.36-5.4; h = 0.48-10.0

Ecology: This is a small mytilid that thrives in the intertidal area, byssally attached to rocks and usually occurring in high densities.

Remarks: The origin of *Mytilaster lineatus* is the Mediterranean. However, the species has today extended its range into the Black Sea. I suggest that *Mytilaster* sp., mentioned by ERINÇ (1956), should be placed here.

Superfamily Pterioida NEWELL, 1965
Family Anomiidae RAFINESQUE, 1815

Anomiidae indet.

Material: Subaşı 1: 2 L

Measurements (mm): l = 0.68-1.8; h = 0.63-1.53

Ecology: Anomiids are byssally attached to rocks or other mollusc shells. The byssus reaches out through a byssal window in the right valve and ancors on hard surfaces by producing a calcified byssal notch. The valves are thin and display sculptural patterns of the substrate.

Remarks: The preservation of both shells is too poor to distinguish the muscle scars that are required for accurate determination. Based on overall shell morphology, the fossils at hand seem to belong to the common *Anomia ephippium* LINNE, 1758, which has already been recorded by NEWTON (1904). This species is also listed in CHAPUT (1957: 133) under the name *Anomya ephippium* L. var. *membranacea* LMK., but incorrectly assigned to the gastropods.

Order Ostreoida DE FÉRUSSAC, 1822
Family Ostreidae RAFINESQUE, 1815

Genus *Ostrea* LINNÉ, 1758

Ostrea edulis LINNÉ, 1758
Pl. 3, Fig. 3

1904	*Ostrea edulis* – ENGLISH: 269/270.
1904	*Ostrea edulis*, LINNAEUS – NEWTON: 278/279.
1956	*Ostrea edulis* LINNÉ var. *adriatica* LAMARCK – ERINÇ: 188.
1957	*Ostrea edulis* LIN. var. *boblayei* DESH. – CHAPUT: 131.
1968	*Ostrea edulis* LIN. var. *boblayei* DESH. – AKARTUNA: 67.
1968	*Ostrea edulis* LIN. – AKARTUNA: 67.
1968	*Ostrea edulis* LIN. var. *lamellosa* BROC. – AKARTUNA: 67.
1973	*Ostrea edulis* LINNÉ – EROL & NUTTALL: tab. 1.

Material: Subaşı 1: 1 R; Subaşı 2: 13 R; 13 L; 2 C.

Measurements (mm): l = 4.31-88.7; h = 4.5-96.7

Ecology: The only cementing species found at Subaşı is *Ostrea edulis*. It is fixed to hardgrounds, but also to somewhat stabilized mud or gravel bottoms, by its left valve. TEBBLE (1966) reports this form from around the British Isles in depths of about 25 to 80 meters. POPPE & GOTO (1993) report it from “shallow water down to 90 m on all types of bottoms”. In Croatia, I have found fresh dead specimens attached to rocks even at a depth of about two meters. *Ostrea edulis* is known to tolerate brackish conditions and frequently cultivated for food in estuarine habitats, especially along the Atlantic coast.

Remarks: Except for a single juvenile specimen from Subaşı 1, this species is only present in sample Subaşı 2. The more or less adult specimens found in this sample display the normal, regular shell form. This suggests that they grew without restrictions in space. Shells from rocky grounds or oyster thickets often develop irregular shapes due to space limitation. A large number of synonyms and subspecies have been introduced that refer to these intraspecific variations.

Subclass Heterodonta NEUMAYR, 1884
Order Veneroida ADAMS, H. & A., 1857
Family Lucinidae FLEMING, 1828

Genus *Loripes* Poli, 1791

Loripes lacteus (Linné, 1758)

1880 *Lucina leucoma* Turt. – Calvert & Neumayr: 366.
1904 *Loripes lacteus* – English: 269/270.
1904 *Loripes lacteus* (Poli) – Newton: 278.
1957 *Loripes lacteus* L. – Chaput: 133.
1968 *Lucina desmaresti* Pay. – Akartuna: 67.
1973 *Loripes lacteus* Linné – Erol & Nuttall: tab. 1.
1989 *Loripes lacteus* – Sakinç & Bargu: 55.

Material: Subaşı 1: 1 R; 2 L; Subaşı 2: 6 R; 3 L.

Measurements (mm): l = 4.5-14.7; h = 4.1-14.2

Ecology: This bivalve burrows in fine sand or gravel and occurs from the intertidal zone down to some 150 meters. I have found this species in lagoons with reduced salinity on Sardinia where it co-occurred with several *Abra* species.

Genus *Lucinella* Monterosato, 1883

Lucinella divaricata (Linné, 1758)

Material: Subaşı 1: 16 R; 27 L; 1 C; Subaşı 2: 20 R; 13 L; 3 C.

Measurements (mm): l = 0.85-6.0; h = 0.8-5.8

Ecology: The species lives in fine sand or mud, from the intertidal zone down to a depth of about 60 meters.

Family Ungulinidae

Genus *Diplodonta* Bronn, 1831

Diplodonta rotundata (Montagu, 1803)

1880 *Diplodonta rotundata* Mtg. – Calvert & Neumayr: 366.

Material: Subaşı 2: 2 R; 1 L.

Measurements (mm): l = 8.0 -17.0; h = 7.4-15.7

Ecology: *Diplodonta rotundata* occurs in the intertidal zone down to about 100 meters, burrowing in gravel or muddy sand.

Family Lasaeidae Gray, 1847

Genus *Lasaea* Brown, 1827 ex Leach ms.

Lasaea rubra (Montagu, 1803)

Material: Subaşı 1: 8 R; 5 L; 1 C; Subaşı 2: 3 R; 4 L; 2 C.

Measurements (mm): l = 0.79-2.15; h = 0.66-1.83

Ecology: This intertidal species lives byssally attached in small holes and crevices. It prefers the tufted thalli of *Lichina pygmaea* (Lightf.) C. Agardh, a lichen that grows on rocks in the intertidal zone. The species is known to tolerate reduced salinity (Bouchet et al. 1979; Poppe & Goto 1993).

Family Montacutidae Clark, W., 1855

Genus *Mysella* Angas, 1877

Mysella bidentata (Montagu, 1803)

Material: Subaşı 1: 3 L.

Measurements (mm): l = 1.05-1.68; h = 0.83-1.35

Ecology: The depth range of this small species is extraordinary. It lives in small holes and crevices from the intertidal zone down to a depth of 2.500 meters.

Family Cardiidae Lamarck, 1809

Genus *Parvicardium* Monterosato, 1884

Parvicardium exiguum (Gmelin, 1791)

Material: Subaşı 1: 61 R; 57 L; 4 C; Subaşı 2: 55 R; 38 L; 1 C.

Measurements (mm): l = 1.1-10.0; h = 0.94-9.0

Ecology: This shallow burrowing cardiid is recorded for fully marine and brackish waters down to a salinity of 17‰ (Tebble 1966); the shell form varies with salinity (Van Aartsen et al. 1984). The species occurs from the intertidal area down to approximately 55 meters.

Genus *Cerastoderma* Poli, 1795

Cerastoderma glaucum (Poiret, 1789)

Pl. 3, Figs 4-5

1880 *Cardium edule* L. – Calvert & Neumayr: 366.
1904 *Cerastoderma edule* – English: 269/270.
1904 *Cerastoderma edule* (Linnaeus) – Newton: 278.
1956 *Cardium edule* Linné – Erinç: 188.
1957 *Cardium (Cerastoderma) edule* L. var. *lamarcki* Reeve – Chaput: 133.
1973 *Cardium (Cerastoderma) edule* Linné – Erol & Nuttall: tab. 1.
1989 *Cerastoderma edule* Gmelin – Sakinç & Bargu: 55.

Material: Subaşı 1: 132 R; 139 L; 41 C; Subaşı 2: 63 R; 60 L.

Measurements (mm): l = 1.0-52.7; h = 0.85-47.6

Ecology: This species typically lives in reduced salinity environments. It burrows a few millimeters deep and lives in a water depth of up to 10 meters in sand, mud or gravel (TEBBLE 1966; VOSKUIL 1989; POPPE & GOTO 1993).

Remarks: *Cerastoderma edule* (LINNÉ, 1758) is of Atlantic origin. Occurences in the Mediterranean are restricted to the westernmost part (VOSKUIL 1989). The species has often been confused with *Cerastoderma glaucum* (POIRET, 1789), which is widely distributed in the Mediterranean since the Miocene.

Family Mactridae LAMARCK, 1809

Genus *Spisula* GRAY, 1837

Spisula subtruncata (DA COSTA, 1778)

1880	*Mactra triangula* REN. – CALVERT & NEUMAYR: 366.
1968	*Mactra subtruncata* DA COS. – AKARTUNA: 67.
1968	*Mactra subtruncata* DA COS. cf. var. *triangula* REN. – AKARTUNA: 67.
1973	*Spisula subtruncata* (DA COSTA) – EROL & NUTTALL: tab. 1.

Material: Subaşı 1: 14 R; 12 L; 1 C; Subaşı 2: 10 R; 9 L.

Measurements (mm): l = 1.28-6.1; h = 1.1-5.0

Ecology: This bivalve is common in muddy and sandy bottoms, ranging from the intertidal zone to a depth of approximately 200 meters.

Remarks: *Spisula subtruncata* is variable in shell geometry, and several subspecies and varieties have been described. Among these is *Spisula subtruncata triangula*, which was incorrectly named *Mactra subtruncata* DA COS. cf. var. *triangula* REN. by AKARTUNA (1968). This name is often assigned to a sharp-angled form of nearly triangular outline.

Family Mesodesmatidae GRAY, 1840

Genus *Donacilla* LAMARCK,1819

Donacilla cornea (POLI, 1791)

1880	*Mesodesma donacilla* LAM. – CALVERT & NEUMAYR: 366.
1957	*Donacilla cornea* POLLI – CHAPUT: 133.
1973	*Donacilla cornea* (POLI) – EROL & NUTTALL: tab. 1.

Material: Subaşı 1: 1 R; 1 L.

Measurements (mm): l = 1.53-3.6; h = 1.16-2.2

Ecology: This species lives burrowed in coarse sand in the intertidal zone.

Remark: The two specimens picked from our samples are juveniles.

Family Pharidae ADAMS, H. & A., 1857
Pharidae indet.

Material: Subaşı 1: 1 fragment; not measured; Subaşı 2: 2 fragments; not measured.

Ecology: Pharidae are inhabitants of shallow water sandy bottoms.

Remarks: There are just three poorly preserved fragments without any diagnostic features.

Genus *Ensis*

Ensis sp.

Material: Subaşı 1: 1 fragment; not measured.

Ecology: *Ensis* usually occurs in sandy bottoms at low depth.

Remarks: The preservation of the fragment is too poor for an exact determination.

Family Tellinidae DE BLAINVILLE, 1814

Genus *Tellina* LINNÉ, 1758

Tellina tenuis DA COSTA 1778

Material: Subaşı 1: 6 R; 8 L; Subaşı 2: 2 R

Measurements (mm): l = 1.13-12.1; h = 0.84-8.4

Ecology: This bivalve is reported from sandy bottoms down to a depth of up to 10 meters.

Tellina donacina LINNÉ, 1758

Material: Subaşı 1: 9 R; 6 L; Subaşı 2: 2 R; 4 L.

Measurements (mm): l = 2.2-7.5; h = 1.38-4.3

Ecology: This species lives in sand, mud or gravel from the low tide line down to a depth of approximately 200 meters.

Tellina pygmaea LOVEN, 1846

Material: Subaşı 2: 2 L.

Measurements (mm): l = 1.03-1.65; h = 0.75-1.13

Ecology: Burrowing in mud or sand, the habitat of this bivalve ranges from the intertidal zone down to a depth of about 100 meters.

Genus *Gastrana* Schumacher, 1817

Gastrana fragilis (Linné, 1758)
Pl. 3, Figs 8-9

1880	*Tellina fragilis* L. – Calvert & Neumayr: 366.
1904	*Gastrana fragilis* – English: 270.
1904	*Gastrana fragilis* (Linnaeus) – Newton: 278.
1957	*Gastrana fragilis* L. – Chaput: 133.
1973	*Gastrana fragilis* (Linné) – Erol & Nuttall: tab. 1.
2003	*Gastrana fragilis* – Elmas: fig. 5j.

Material: Subaşı 1: 2 R; Subaşı 2: 6 C; 4 R, 5 L.

Measurements (mm): l = 7.2-30.5; h = 5.2-22.0

Ecology: *Gastrana fragilis* lives in the intertidal area, burrowed in muddy bottoms. It frequently occurs in waters with reduced salinity (Van Aartsen et al. 1984).

Family Donacidae Fleming, 1828

Genus *Donax* Linné, 1758

Donax trunculus Linné, 1758

Material: Subaşı 1: 1 L.

Measurements (mm): l = 6.6; h = 4.2

Ecology: This species is burrowing in sand at a depth of only a few meters.

Remarks: There is only a single small valve of this species in our samples. In fully marine habitats, this form frequently occurs in dense populations, reaching a length of about 40 mm.

Family Semelidae Stoliczka, 1870

Genus *Abra* Lamarck, 1818

Abra segmentum (Récluz, 1843)

Material: Subaşı 1: 2 R; 3 L; 1 C.

Measurements (mm): l = 1.35-14.2; h = 1.1-10.6

Ecology: Like several *Abra* species, *A. segmentum* is a common brackish-water bivalve that lives in sandy mud in the infralittoral zone (Poppe & Goto 1993).

Family Veneridae Rafinesque, 1815

Genus *Chamelea* Mørch, 1853

Chamelea gallina (Linné,1758)

1904	*Chione gallina* – English: 270.
1904	*Chione gallina* (Linnaeus) – Newton: 279.
1973	*Venus gallina* Linné – Erol & Nuttall: tab. 1.

Material: Subaşı 1: 129 R; 120 L; 9 C; Subaşı 2: 106 R; 101 L; 21 C

Measurements (mm): l = 0.49-9.2; h = 0.46-8.4

Ecology: This bivalve lives in mud or sand at a depth of 5 to 20 meters.

Remarks: This is a typical Mediterranean and Black Sea species, which does not occur in the Atlantic. The Atlantic sister-taxon *Chamelea striatula* (Da Costa, 1778) is often regarded as a subspecies (e.g., Van Aartsen et al. 1984).

Genus *Gouldia* Adams, C. B., 1847

Gouldia minima (Montagu, 1803)

Material: Subaşı 1: 14 R; 18 L; 8 C; Subaşı 2: 20 R; 9 L; 6 C

Measurements (mm): l = 0.54-2.48; h = 0.49-2.13

Ecology: Burrowing in sand, mud or fine gravel. This species occurs between the low tide line down to more than 200 meters.

Plate 3

Figs 1 & 2: *Mytilus galloprovincialis* Lamarck, 1819. Fig. 1: R fragment (l = 36.2 mm, h = 56.0 mm), external view; BSPG 1980 X 1309; Fig. 2: L fragment (l = 45.6 mm, h = 53.0 mm), external view; BSPG 1980 X 1308.

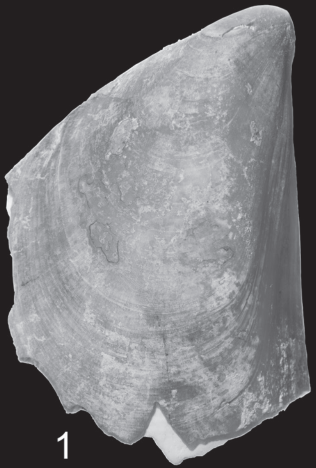
Fig. 3: *Ostrea edulis* Linne, 1758. C from left (l = 88.7 mm, h = 96.7 mm); BSPG 1980 X 1310

Figs 4 & 5: *Cerastoderma glaucum* (Poiret, 1789). Fig. 4: L (l = 43.3 mm, h = 41.0 mm), external view; BSPG 1980 X 1302; Fig. 5: R (l = 42.2 mm, h = 37.3 mm), internal view; BSPG 1980 X 1303.

Figs 6 & 7: *Venerupis aurea* (Gmelin, 1791). Fig. 6: L (l = 54.7 mm, h = 44.5 mm), internal view; BSPG 1980 X 1305; Fig. 7: R (l = 57.3 mm, h = 45.4 mm), external view; BSPG 1980 X 1304.

Figs 8 & 9: *Gastrana fragilis* (Linné, 1758). Fig. 8: L (l = 22.8 mm, h = 17.8 mm), internal view; BSPG 1980 X 1307; Fig. 9: R (l = 29.9 mm, h = 20.6 mm), external view; BSPG 1980 X 1306.

Length of bars: 10 mm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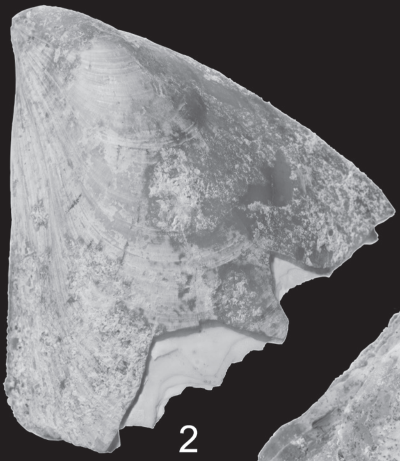
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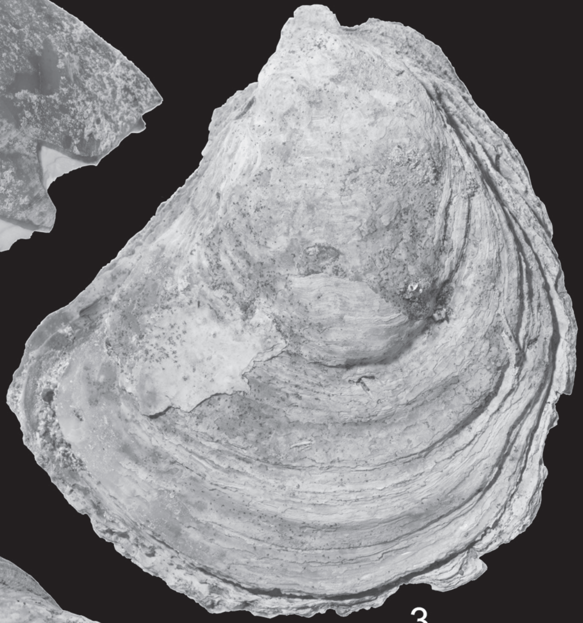
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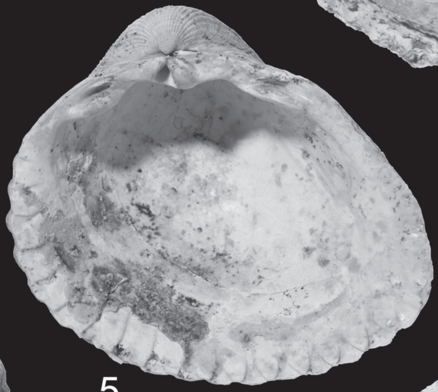
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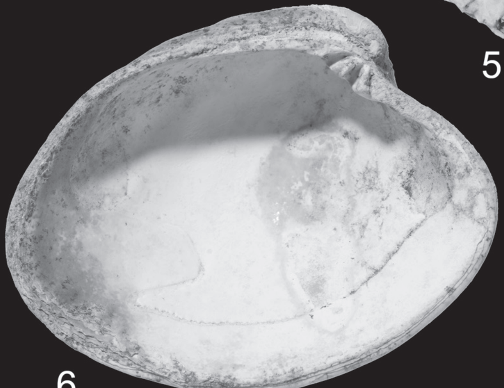
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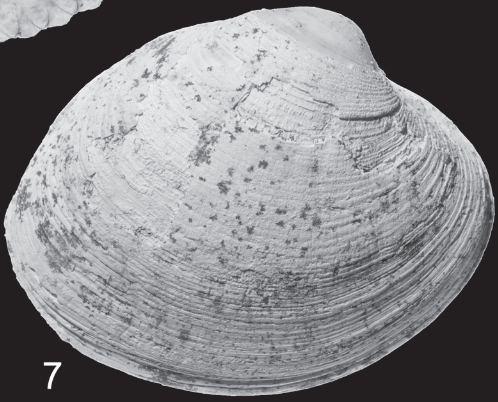
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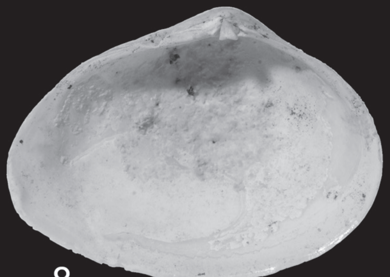
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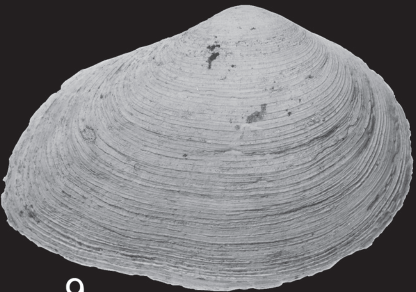
9

Genus *Venerupis* LAMARCK, 1818

Venerupis aurea (GMELIN, 1791)

Pl. 3, Figs 6-7

1880	*Tapes aurea* MTG. – CALVERT & NEUMAYR: 366.
1880	*Tapes* cf. *Dianae* REQ. – CALVERT & NEUMAYR: 366; tab. 2, figs 7, 8.
1904	*Tapes* cf. *Dianae* – ENGLISH: 269/270.
1904	*Tapes Calverti*, sp. nov. (= *Tapes* cf. *Dianae*, LOCARD) – NEWTON: 278.
1956	*Tapes diaene* REQ (*Tapes calverti* NEWT.) – ERINÇ: 188.
1957	*Tapes calverti* NEWT. – CHAPUT: 133.
1973	*Venerupis (Polititapes) aurea diane* (REQUIEN) – EROL & NUTTALL: tab. 1.
1989	*Venerupis (aurea)* cf. var. *calverti* (NEWTON) – SAKINÇ & BARGU: 55.
2003	*Tapes calverti* – ELMAS: fig. 5j.

Material: Subaşı 1: 53 R; 46 L; 1 C; partly fragmentary; Subaşı 2: 34 R; 37 L; 10 C.

Measurements (mm): l = 2.31-67.1; h = 1.94-45.7

Ecology: This bivalve lives burrowed in sand, mud or gravel from the low tide line down to about 40 meters.

Remarks: The name *Tapes calverti* was introduced by NEWTON (1904), because he regarded the Turkish specimens as a new species, which differs from *Tapes dianae*. However, this author did not provide a description or figure of the shell. As a result, *T. calverti* is a nomen nudum. EROL & NUTTALL (1973) already discussed the identity of the shells from the Turkish Pleistocene, and proposed the name *Venerupis (Polititapes) aurea dianae* (REQUIEN), following, in general, the argumentation of GIGNOUX (1913, 1950). I hold the opinion that *V. aurea dianae* is a synonym of *V. aurea*. However, I admit that the general form of most Pleistocene specimens (also that of the specimen figured by GIGNOUX 1913) is somewhat higher and more angular than that of the common form of extant Mediterranean specimens. Nevertheless, I have found angular shells of extant *V. aurea* in Croatia. This form was also described by POPPE & GOTO (1993) as forma *lucens* (LOCARD, 1886). On the other hand, the Subaşı samples also contain specimens with a more round outline. The intraspecific shell shape variability has been documented by PARENZAN (1976: fig. 259a-f). I assume that shell form in *V. aurea* is related to salinity to a certain extent. The angular and thick-shelled specimens that I have collected in Croatia from slightly reduced salinity conditions are very similar to the Pleistocene shells from Subaşı.

Family Petricolidae DESHAYES, 1839

Genus *Petricola* LAMARCK, 1801

Petricola lithophaga (PHILIPPSON, 1788)

1904	*Petricola lithophaga* – ENGLISH: 269.
1904	*Petricola lithophaga* (RETZIUS) – NEWTON: 278.

Material: Subaşı 2: 1 R.

Measurements (mm): l = 12.5; h = 9.8

Ecology: This species is boring in sedimentary rocks (BOUCHET et al. 1979) from the intertidal zone down to a depth of approximately 100 meters. The shape of the shells varies to a certain extent depending on the crevices that the animals live in.

Order Myoida STOLICZKA, 1870
Family Corbulidae LAMARCK, 1818

Genus *Corbula* BRUGUIÈRE, 1797

Corbula gibba (OLIVI, 1792)

Material: Subaşı 1: 2 R; 2 L; Subaşı 2: 1 R; 1 L.

Measurements (mm): R: l = 2.16-7.2; h = 1.76-5.7; L: l = 2.93-5.6; h = 2.13-4.3. *C. gibba* is an inequivalve species. Therefore, right and left valves have been measured seperately.

Ecology: *Corbula gibba* lives on silty sand and mud, fixed by a byssus. It can be found just below the tide line down to several hundred meters water depth.

Remarks: *Corbula gibba* is one of the most common shells of muddy substrates in the European Neogene.

Subclass Anomalodesmata DALL, 1889
Order Pholadomyoida NEWELL, 1965
Family Thraciidae STOLICZKA, 1870

Genus *Thracia* LEACH in DE BLAINVILLE, 1824

Thracia papyracea (POLI, 1791)

Material: Subaşı 1: 2 R; Subaşı 2: 1 L.

Measurements (mm): l = 2.2-23.6; h = 1.7-13.3

Ecology: Lives in fine sand, mud or gravel from the intertidal zone down to approximately 50 meters.

Thracia sp.

Material: Subaşı 1: 11 R; 12 L; 3 C; Subaşı 2: 13 R; 17 L; 2 C.

Measurements (mm): l = 0.69-2.5; h = 0.53-1.65

Remarks: In both samples, numerous juvenile shells of *Thracia* sp. are present. I could not find illustrations of juvenile *Thracia* shells, except for a single drawing of a Miocene specimen (JANSSEN 1984). Accordingly, I am not able to identify these shells down to species level.

4. Synopsis of Results

The composition, stratigraphic range, and ecological data of the ostracod and bivalve communities from Subaşı 1 and 2 are summarized in Tables 1-3. The samples yielded 21 ostracod taxa (Tab. 1). Only 16 taxa are interpreted as autochthonous, while the remaining 5 fresh or brackish water taxa are considered to be reworked. All 28 bivalve taxa are interpreted to be more or less autochthonous. The depth range and prefered substrate of the ostracod and bivalve species indicate a shallow sandy environment next to a rocky coastline (Tabs 2, 3). The composition of the bivalve association (Tab. 3) suggests brackish water conditions for Subaşı.

5. Discussion

5.1. Stratigraphy

5.1.1 Mediterranean Pleistocene Stratigraphy

The stages of the marine Mediterranean Pleistocene stratigraphy have been established in Italy. A Global Stratotype Section and Point (GSSP) for the base of the Pleistocene were defined by Aguirre & Pasini (1985) at Vrica in Calabria. The early Early Pleistocene Calabrian stage had been abandoned at this time, because it appeared that the type locality of the Calabrian was younger than Vrica, and hence of Sicilian age. As a result, the latter stage has priority (Ruggieri 1980). The Calabrian has been replaced by the Santernian and the subsequent Emilian, which directly underlies the Sicilian (Ruggieri & Sprovieri 1977: fig. 2). Consequently, Sissingh's (1973a) paper on the ostracods of the Calabrian type section at Santa Maria di Catanzaro (southern Italy) concerns a fauna of Sicilian age. The three stages, Santernian, Emilian, and Sicilian constitute the Early Pleistocene, meanwhile termed Calabrian, and comprise the time span between 1.806 and 0.781 My.B.P. This subdivision has later been applied for the Aegean region by Thomsen et al. (2001).

Ruggieri (1980) has further advanced this scheme into the Middle and Late Pleistocene. The Middle Pleistocene (Ionian), approximately 1.1-0.5, a continental unit, includes the Roman Regression. The Late Pleistocene, approximately 0.5-0.01 Ma., is characterized by marine terraces, and has been subdivided into the Crotonian, Tyrrhenian, and Versilian (Ruggieri 1980). The Crotonian unit precedes the invasion of the *Strombus bubonius*-fauna, and replaces the Milazzian because the Milazzian type-locality belongs to the Tyrrhenian. This has been demonstrated by the occurrence of the above mentioned gastropod. The Mediterranean subdivision that will be followed in this paper contrasts with the astronomically calibrated global timescale of Gradstein et al. (2004), which defines a time span of approximately 0.781-0.126 Ma for the Middle Pleistocene based on sediment cores from the North Sea area.

Fossiliferous Pleistocene marine terraces are widely distributed in the Mediterranean, including the Iberian Peninsula (e.g., Lozano-Francisco et al. 2004; Vera-Paláez et al 2004), Mallorca (e.g., Cuerda Barceló 1987; Cornu et al. 1993; Cuerda Barceló et al. 1993), Italy (e.g., Raffi 1986; Mazzini et al. 1999; Dominici 2001), Tunisia (e.g., Herm et al. 1980; Cornu et al. 1993), Greece (e.g., Krstić & Dermitzakis 1981; Kowalczyk et al. 1992; Danatsas 1994b; Mostafawi 1994; Guernet et al. 2003), and Turkey (e.g., Görür et al. 1997; Sakinç & Yaltirak 1997; Oktay et al. 2002). For comparison of the ostracod faunas from Subaşı (Tab. 1), we focus on the eastern Mediterranean localities listed in the caption of Tab.1, including several outcrops of earlier Pleistocene stages.

5.1.2 Stratigraphical Considerations

Ostracods. – Dating marine Pleistocene sediments based on ostracods is an order of magnitude less detailed in comparison to dating based on calcareous nannoplankton. Thomsen et al. (2001: fig. 6-7) demonstrated that datum events of ostracods, foraminifers, and calcareous nannoplankton are diachronous, except for the foraminifer *Hyalinea baltica* (Schröter, 1789). Zangger & Malz (1989: 166) observed in the Gulf of Argos that the Late Pleistocene marine ostracod assemblages show a general decrease in diversity towards the Holocene.

The ostracod associations of Subaşı 1 and 2 (Tab. 1) correspond to a certain degree with the Late Pleistocene age based on radiometric dating (Paluska et al. 1989). Of the 16 ostracod species recorded for Subaşı, nine are included in Guernet's distribution chart (2005) and indicate an age ranging from Early Pleistocene to Recent.

The associations are fulfilling Sissingh's (1982: 310) criteria of the Pleistocene-Holocene infralittoral *Aurila speyeri speyeri* community because they contain *Pontocythere turbida*, *Leptocythere multipunctata*, and *Xestoleberis* spp. (e.g., *X. dispar*, *X.* cf. *margaritea*, *X.* sp. Typ B, Danatsas, 1994) out of 8 characteristic taxa. This supports an age younger than Pliocene for our samples. Furthermore, *Aurila arborescens* characterizes Sissingh's (1976: 291) Late Pleistocene *Sclerochilus contortus* Zone. Another important diagnostic feature is the absence of the Neogene genera *Carinovalva*, *Cletocythereis*, *Graptocythere*, *Incongruellina*, *Flexus*, *Miocyprideis*, *Mutilus*, *Pachycaudites*, *Protocytheretta*, and *Ruggieria* at Subaşı.

Pontocythere turbida and *Loxoconcha gibberosa* have not been recorded to date from the wider Aegean region for strata younger than Late Pleistocene. However, the latter two species also occur in Recent Mediterranean sediments, e.g., in the Adriatic Sea (Bonaduce et al. 1975).

From the type-locality of the Tyrrhenian, Ruggieri (1973: 228) lists *Hiltermannicythere rubra*, *Aurila arborescens*, *Loxoconcha stellifera*, and *Paracytheridea* cf. *depressa*.

Of the ostracod fauna that has been reported from the type locality of the Sicilian (Sissingh 1973b), only *Leptocythere multipunctata* and *Xestoleberis dispar* also occur in our samples. Hence, already the suggested water depth of 100 to 300 m (Sissingh 1973b: 345) that was based on the predominance of representatives of the genera *Bosquetina, Cytherella, Henryhowella, Krithe, Pterygocythereis*, and *Cytheropteron*, precludes a similarity. Sissingh (1973b) recognized a number of ostracods that dislodged from their habitat in shallow depth and relocated to the deeper water: *Leptocythere multipunctata* and *Xestoleberis dispar* belong to this group.

The ostracod fauna of the type locality of the Calabrian (Sissingh 1973a: tab.1), now Santernian-Emilian, contains

Callistocythere intricatoides, *Pontocythere turbida*, *Hiltermannicythere rubra*, *Urocythereis crenulosa*, *Loxoconcha stellifera*, and *Pseudocytherura calcarata*, all of which also occur at Subaşı. These species have also been recognized in the Early Pleistocene of the Aegean region (Tab. 1).

With the Santernian-Emilian of the Vrica section in Calabria, only *Leptocythere multipunctata*, *Pseudocytherura calcarata*, and *Xestoleberis dispar* are in common. These shallow marine species are considered to have been displaced into deeper marine environments that are characterized by genera like *Henryhowella*, *Cytheropteron*, and *Pedicythere* (Colalongo & Pasini 1980; Pasini & Colalongo 1994).

In Subaşı 1, a few reworked fresh to brackish-water ostracods have been detected, including *Darwinula stevensoni* (Brady & Robertson, 1870), juveniles of *Candona* sp., *Heterocypris salina* (Brady, 1868), *Zonocypris membranae* (Livental, 1929), and *Neocyprideis* sp. These forms probably come from the underlying fresh to brackish-water Neogene sediments. *Darwinula stevensoni* and *H. salina* are known from the Mid/Late Miocene to Recent, *Z. membranae* from the Late Miocene to the Mid Pleistocene, and the genus *Neocyprideis* from the Paleocene to the Oligocene, perhaps also the Miocene.

Bivalves. – Apart from a few exceptions, evolutionary changes in bivalves progress slowly, and hence their stratigraphic value is low. As a result, it is not possible to date the sediments of Subaşı based on the bivalves. As shown in the third column of Tab. 3, the recorded species (except for *Abra segmentum*; its range is uncertain) are known from the Pliocene (or even Miocene) to Recent Mediterranean area (Monegatti & Raffi 2001). This was already shown by Nuttall (in Erol & Nuttall 1973) for several Pleistocene outcrops in the Dardanelles region. This author lists 18 bivalve taxa. Applying correct taxonomic terms, nine of these taxa also occur at Subaşı. *Mytilus edulis* and *Cerastoderma edule* are species of Atlantic origin. Their occurrence in the eastern Mediterranean can largely be excluded (see remarks in section 3.2). As a result, these forms should be considered as *Mytilus galloprovincialis* and *Cerastoderma glaucum*. *Venerupis (Polititapes) aurea diane* (Requien) is a synonym of *Venerupis aurea* (Gmelin, 1791) (see remarks in section 3.2). The remaining 9 taxa from Nuttal's list are of little to no stratigraphical value.

Erol & Nuttall (1973) incorporated in their faunal list portions of several older publications dealing with mollusc faunas from Pleistocene deposits in the Marmara Sea area. However, for comparison these authors only selected those taxa that were also found by them. We have briefly considered these works (Calvert & Neumayr 1880; English 1904; Newton 1904; Chaput 1957) in the systematic section (part 3.2). Calvert & Neumayr (1880) provided a first list of the recorded bivalve taxa. English (1904) refers on the distribution of faunal elements thgroughout the described sections. His bivalve samples are listed and partly described by Newton (1904). Chaput (1957) once more published a faunal list.

Sakınç & Bargu (1989: 55) list 13 bivalve taxa. However, some of their identifications are incorrect and require correction: *Ostrea edulis* (Linné) cf. var. *adriatica* Lamarck and *Ostrea edulis* (Linné) cf. var. *lamellosa* (Brocchi) are invalid combinations. *Ostrea adriatica* Lamarck, 1819 is a synonym of *Ostrea edulis* Linné, 1758 (correctly without brackets, because the species was assigned to a valid genus by Linné; e.g., Poppe & Goto 1993). *Ostrea lamellosa* Brocchi, 1814 is a valid species of Miocene origin, reaching up to the Pleistocene (e.g., Monegatti & Raffi 2001). If this were the correct determination for part of the *Ostrea* specimens discovered by Sakınç & Bargu (1989), this would indicate an age not younger than Pleistocene (Monegatti & Raffi 2001). The valid name for *Venerupis (aurea)* cf. var. *calverti* (Newton) is *Venerupis aurea* (Gmelin, 1791) (see remarks in section 3.2). Nine species are in common with our samples. The Late Pleistocene age, proposed by Sakınç & Bargu (1989), is not validated by the bivalve assemblage.

Elmas (2003: fig. 5j) lists the shallow marine pelecypods *Ostrea edulis*, *Mytilus edulis*, *Venus verracesa*, *Tapes calverti*, and *Gastrana fragilis*, and regards the fauna as indicative of the Late Pleistocene; as stated in section 3.2, the correct names for *Mytilus edulis* and *Tapes calverti* are regarded as *Mytilus galloprovincialis* and *Venerupis aurea*. The above listed species, with the exception of *Venus verrucosa* (correct spelling), have also been recorded for Subaşı. There is no stratigraphic evidence in this assemblage indicating a Late Pleistocene age. All species are reported from the Mediterranean Pliocene to Recent (Monegatti & Raffi 2001).

Taner (1995) describes molluscs from Pleistocene and Holocene sediments sampled from a series of drill cores in the Gulf of İzmit. Taner's determination of nearly all bivalves figured on her plates 1-3 is questionable, and requires rectifications. For instance, pl. 2, fig. 1, described as *Divaricella (L.) divaricata* (Linné), shows a left valve of a lucinid bivalve, perhaps *Lucinoma borealis* (Linné), but definitly not *Lucinella divaricata* (Linné), because a divaricate sculpture pattern is missing. Plate 2, fig. 2 was identified as *Parvicardium exiguum* Gmelin, and pl. 2, fig. 3 as *Monodacna caspia tamanica* Nevesskaja (both Family: Cardiidae). However, both figures display left valves of *Timoclea ovata* (Pennant, 1777) (Family: Veneridae). Even after rectification, the figured taxa do not represent good stratigraphic indices, since they occur throughout the Pliocene and Pleistocene into the Recent (Monegatti & Raffi 2001).

5.2 Paleoecology

In most regions around the Mediterranean Sea, Tyrrhenian shallow marine deposits can easily be identified by a single character fossil, i.e. the gastropod *Strombus bubonius* (Lamarck, 1822) (e.g., Herm et al. 1980; Cuerda Barceló 1987; Kowalczyk et al. 1992; Cornu et al. 1993). From Subaşı, however, this taxon has not been recorded to date. This suggests that Subaşı may be different from other Tyrrhenian Mediterranean deposits.

In order to more fully interpret these differences, it is worth looking at the bivalves. Because bivalves are predominantly living infaunally or are firmly attached, they are directly related to the substrate. Therefore, they represent excellent sedimentological and ecological markers. The composition of bivalve communities is significant in characterizing the depositional environment and ecological frame of the sampled levels.

At Subaşı, the shells are relatively well-preserved; dissolution or heavy erosion might be neglected. The 28 taxa documented are interpreted as representing a fairly complete bivalve fauna. Hence, the diversity is quite low for a shallow marine habitat. For example from Mallorca's Pleistocene, CUERDA BARCELÓ (1987) described more than 80 bivalve taxa.

Of twelve taxa, less than five specimens have been discovered in our samples. The remaining 16 taxa, represented in our samples by more than ten specimens, are further considered with regard to ecology. They can be divided into two groups based on their life strategies.

The first group is comprised of epifaunal forms. *Mytilus galloprovincialis* and *Mytilaster lineatus* are attached to hard substrates by byssus. *Ostrea edulis* is cemented to rocks or hardgrounds. *Lasaea rubra* lives in small crevices in the intertidal area where it is attached to its substrate by byssus. The preservation of specimens with attached valves, especially of *Lasaea rubra*, is indicative of a more or less autochthonous deposition close to the coastline.

The second group of bivalves consists of shallow burrowing infaunal forms, which inhabit sand, mud or gravel bottoms. Some of these bivalves (e.g., *Cerastoderma glaucum, Venerupis aurea, Chamelea gallina*) are preserved with attached valves. Thus, these forms must also be regarded as representing an authochthonous fauna.

Based on the preceding considerations, we suggest that the bivalve assemblage from Subaşı originated from a rocky shoreline and from different shallow marine clastic bottoms. Especially *Cerastoderma glaucum*, frequently preserved in situ in sample Subaşı 1, indicates that deposition occured at a depth of not more than 10 m. Sample Subaşı 2 also contains more than 120 shells of *C. glaucum*, but none of these specimens shows attached valves. Other differences between both samples include the frequent occurrence of *Mytilus galloprovincialis*, *Ostrea edulis*, and attached *Venerupis aurea* at Subaşı 2. These aspects suggest a somewhat deeper depositional environment that was surrounded by a greater variety of habitats than that of Subaşı 1.

Comparable substrate and bathymetrical information are accessible for several extant ostracod taxa (Tab. 2); only the common or abundant species are considered. The predominance of heavily calcified and ornamented ostracod genera (e.g., *Urocythereis*) indicates a shallow marine, higher energy depositional environment. The ecological characterization is based on the information listed for the individual species in section 3.1.

Several of the bivalves from Subaşı are euryhaline species, known also to occur in estuarine habitats and brackish water; these include *Mytilus galloprovincialis, Ostrea edulis, Loripes lecteus, Lasaea rubra, Parvicardium exiguum, Cerastoderma glaucum, Gastrana fragilis*, and *Abra segmentum* (see section 3.2 for references). The shells of these forms grow to the usual dimensions. However, the shells of some other species that are less tolerant to lowered salinity are remarkably smaller than usual, e.g., *Mytilaster lineatus, Spisula subtruncata, Tellina tenuis*, *Tellina donacina, Gouldia minima*, and *Chamelea gallina*. These forms attain only 50% (*Mytilaster lineatus, Tellina tenuis*, *Tellina donacina*) or only 20% (*Spisula subtruncata*, *Gouldia minima*, *Chamelea gallina*) of their normal length. Especially in *Chamelea gallina* stunting can be observed by narrow standing growth lines and concentric ribs, suggesting the adulthood of the examined specimens. Stunting of shells indicates environmental stress (e.g., TASCH 1953; HALLAM 1965). We interpret that, at Subaşı, stress is caused by reduced salinity.

Our observations are supported by the low diversity of gastropods (EROL & NUTTALL 1973; SAKINÇ & BARGU 1989; ELMAS 2003). The gastropods from our samples have not been investigated in detail for this study. Nevertheless, only a few euryhalinic forms have been observed, including *Bittium reticulatum* and *Retusa* sp.

In comparison to the much higher diversity of Recent fully marine associations, the only 16 ostracod species recorded for Subaşı also indicate reduced salinity, perhaps even brachyhaline conditions within the marine realm. From a locality in the northern Aegean Sea, STAMBOLIDIS (1985) described 98 extant ostracod species from a water depth down to 33 m. The salinity in this region depends on the depth and season and varies between 33 and 37‰ (STAMBOLIDIS 1985: 165). Offshore Naxos, BARBEITO-GONZALES (1971) distinguished more than 200 ostracod species in samples collected from a water depth down to 70 m. In contrast, GÜLEN et al. (1995) mention a total of 49 taxa from drillhole-sections in İzmit Bay, covering a time span from the uppermost Pliocene into the Holocene. In the region, this time interval is characterized by frequent changes in salinity.

5.3 Paleogeography

The bivalve fauna from Subaşı, although impoverished, is undoubtedly of Mediterranean origin. It is composed of taxa that are widespread in the Mediterranean since the Pliocene or Miocene (MONEGATTI & RAFFI 2001). The Black Sea area was not connected to the Mediterranean Sea during the Upper Pliocene Kujalnician period. Rather, it was linked with the Akchagilian Basin in the Caspian region, and inhabited by a strictly brackish bivalve fauna (TSHEPALYGA 1995; KHONDKARIAN et al. 2004) predominantly comprised of cardiids, mactrids, and dreissenids. None of these taxa or their modern relatives occurs in our samples. On the other hand, most of the species recorded for Subaşı are part of the modern Black Sea fauna (POUTIERS 1987).

The Pleistocene marine terraces in the study area display the connection between the Mediterranean Sea and the Black Sea via the Sea of Marmara, İzmit Bay, Lake Sapanca, and the lower reaches of the Sakarya River (PFANNENSTIEL 1944; MERIÇ 1995; TSHEPALYGA 1995; ELMAS 2003). Stable connections, leading to a "marine" Black Sea Basin, existed during the transgressive stages of the Middle and Late Pleistocene interglacials, the Chaudinian (0.8-0.5 Ma., several trans- and regressions), Ancient-Euxinian (0.45-0.35 Ma.), Uzunlarian = Tyrrhenian (0.30-0.20 Ma.), and Karangatian = Monastirian (0.15-0.08 Ma.) (TSHEPALYGA 1995). This concurs with the radiometric ages of both the terraces at Subaşı (0.26 Ma; EMRE et al. 1998), and around the Marmara Sea (0.21 Ma; YALTIRAK et al. 2002). Whether the time gap between these areas may be a result of tectonic processes and/or sea level fluctuations is beyond the scope of this article. The Recent connection via the Bosphorus opened during the Holocene, ca. 7.000-5.300 years B.P (ÇAĞATAY et al. 2000; MUDIE et al. 2001).

The average surface water saliny of the modern Black Sea ranges from <15 to 21‰. The surface water salinity of the modern Marmara Sea is approximately 21‰ (Aksu et al. 1995). Water exchange between the Mediterranean Sea and Black Sea occurs today in two layers: Mediterranean deep water with a salinity of 39 ‰ flows in, while Black Sea surface water of 20‰ flows out, and affects the surface water composition far into the Aegean Sea (Aksu et al. 1995, 1999).

Svitoch et al. (2000) provide an overview of the trans- and regressional phases in the Pleistocene and Holocene Black Sea, and the corresponding mollusc faunas. Mediterranean type faunas were first recorded from the Late Chaudinian. A second rise of Mediterranean molluscs in the Black Sea is reported from the Unzunlarian, which corresponds to the Tyrrhenian in Mediterranean Stages. Although the Tyrrhenian connection to the Black Sea via İzmit Bay is different from the Bosphorus of modern times, the processes of water exchange were probably identical, resulting in an equivalent faunal composition. The salinity of the Black Sea basin of between 17 and 19‰ for the Unzunlarian (Svitoch et al. 2000) corresponds well to the faunal composition of Subaşı. Following Remane & Schlieper (1971), the conditions in the Tyrrhenian İzmit Bay have to be assigned to the upper pliohaline (8-18‰) or the lowermost polyhaline (18-30‰) regime. As a result, the “marine terraces” of the Marmara Formation cannot be regarded as marine deposits sensu stricto.

6. Conclusions

The Tyrrhenian ostracod fauna from Subaşı is dominated by taxa living in shallow marine environments that are influenced by high water energy. The bivalve fauna is comprised of epifaunal species living in the intertidal space, and of shallow burrowing infaunal taxa. The occurrence of *Cerastoderma glaucum* in situ at Subaşı 1 confirms a water depth of not more than 10 m. Sample Subaşı 2 was probably deposited a few meters below, based on the occurence of *Venerupis aurea* preserved in situ and disarticulated *Cerastoderma glaucum* shells.

The low diversity of both ostracods and bivalves and the dominance of more or less euryhaline bivalve species indicate a salinity of approximately 20‰. This value is in good accordance with literature data about the Unzunlarian Black Sea basin, which is of similar age. Reduced salinity is also indicated by the occurrence of dwarf shells in several bivalve species.

The Subaşı fauna provides evidence of an ancient seaway that connected the Mediterranen Sea with the Black Sea via the İzmit Bay. Hence, the paleogeographic reconstruction based on tectonic studies is corroborated by the fossil record.

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			Rec. / Holoc.		Upper Pleistocene					Lower Pleistocene				
species/genera	**1/2**	**regional stratigraphical distribution**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
**Darwinula stevensoni* (Brady & Robertson, 1870)	r/-	-												
**Candona* sp., juv.	vr/-	-												
**Heterocypris salina* (BRADY, 1868)	r/-	-												
**Zonocypris membranae* (Livental, 1929)	r/-	-												
Leptocythere multipunctata (Seguenza, 1884)	-/r	Late Pliocene to Recent	x							x				
Leptocythere peterseni Mostafawi, 1989	-/r	Late Pliocene to Recent	x									x		
Callistocythere intricatoides (Ruggieri, 1953)	c/c	Late Miocene to Recent	x					x			x	x	x	
**Neocyprideis* sp.	vr/-	-												
Pontocythere turbida (G. W. Müller, 1894)	a/a	Late Miocene to Pleistocene				x	x			x		x		
Carinocythereis rhombica Stambolidis, 1985	r/-	Late Pleistocene to Recent	x		x	x								
Hiltermannicythere rubra (G. W. Müller, 1894)	r/vr	Early Pliocene to Recent	x	x		x			x	x	x	x	x	
Aurila arborescens (Brady, 1865)	c/c	Late Pliocene to Recent	x										x	
Urocythereis crenulosa (G. W. Müller, 1894)	a/a	Late Pliocene to Recent						x		x				
Loxoconcha gibberosa (Terquem, 1878)	c/c	Late Pliocene to late Pleistocene			x			x						x
Loxoconcha stellifera G. W. Müller, 1894	a/a	Early Pliocene to Recent	x							x		x	x	
Paracytheridea aff. *depressa* G. W. Müller, 1894	r/r	Late Pliocene to Recent	x	x		x					x	x		
Paracytheridea parallia Barbeito-Gonzales, 1971	c/a	Late Pliocene to Recent	x	x										x
Pseudocytherura calcarata (Seguenza, 1880)	c/c	Early Pliocene to Recent	x		x					x	x			x
Xestoleberis dispar G. W. Müller, 1894	c/c	Late Pliocene to Holocene		x	x			x						
Xestoleberis cf. *margaritea* (Brady, 1866)	vr/r	Recent	x											
Xestoleberis sp. Typ B Danatsas, 1994	vr/r	Late Pliocene												

Table 1: The ostracod associations from the Tyrrhenian terrace. *: Fresh- and brackish water ostracod species most probably reworked from the underlying Paratethyan Neogene. Only Neocyprideis sp. is considered here, the other species (except the juveniles of Candona sp.) are described and illustrated from Turkey in Freels (1980) and Witt (2003).The frequencies in the second column correspond to Subaşı 1 and Subaşı 2; abbreviations are a = abundant, c = common, r = rare, vr = very rare. The indicated ranges are based on regional literature (Mainland Greece, Aegean Islands, Turkey, Aegean and Black Seas, Sea of Azov) including revisions of ostracod faunas from Rhodes and Kos in Mostafawi (2002) and Guernet (2005).

A detailed comparison with Recent, Holocene, and Pleistocene associations of the Aegean region is shown in columns 1 to 12. The data sets are derived from: 1) Brady (1868/1869) & Sissingh (1972a): Eastern Mediterranean, Recent; Barbeito-Gonzales (1971): offshore Naxos, Recent; Stambolidis (1985): Northern Aegean Sea, Recent; Tunoğlu (2002): Northern Bosphorus and southern Black Sea, Recent; 2) Gökçen (1976): North-eastern Aegean coast of Turkey, Holocene; Gülen et al. (1995): İzmit Bay, Holocene; Guernet et al. (2003): Gulf of Corinth, Holocene; 3) Mostafawi (1986): Kos, Nikolaos Formation, Upper Pleistocene; 4) Zangger & Malz (1989): Gulf of Argos, Upper Pleistocene; 5) Römmelt-Doll (1990): Isthmus of Corinth, Cycles D-F, Tyrrhenian; 6) Mostafawi (1994): Northern Peloponnesus, Tyrrhenian; 7) Guernet et al. (2003): Gulf of Corinth, Tyrrhenian; 8) Sissingh (1972b), Mostafawi (1989a): Rhodes, Vasfi Formation, Emilian; 9) Malz & Jellinek (1984): Southeast Lakonia, Peloponnesus, Emilian; 10) Mostafawi (1981): Kos, Tafi Formation, Santernian-Sicilian; 11) Römmelt-Doll (1990): Isthmus of Corinth, Cycles N_2-C, Santernian-Sicilian; 12) Gülen et al. (1995): İzmit Bay, Santernian-Sicilian.

species/genera	1/2	depth (m)	substrate
**Darwinula stevensoni* (Brady & Robertson, 1870)	r/–	/	/
**Candona* sp., juv.	vr/–	/	/
**Heterocypris salina* (BRADY, 1868)	r/–	/	/
**Zonocypris membranae* (Livental, 1929)	r/–	/	/
Leptocythere multipunctata (Seguenza, 1884)	–/r		/
Leptocythere peterseni Mostafawi, 1989	–/r		/
Callistocythere intricatoides (Ruggieri, 1953)	c/c	3.5-17 (Stambolidis 1985); 15-100; opt. 20-30 (Schornikov 1966)	mud
**Neocyprideis* sp.	vr/–	/	/
Pontocythere turbida (G. W. Müller, 1894)	a/a	0-4 (Barbeito-Gonzales 1971); 31-33 (Stambolidis 1985); 0-45 (Breman 1975)	sand
Carinocythereis rhombica Stambolidis, 1985	r/–	/	/
Hiltermannicythere rubra (G. W. Müller, 1894)	r/vr	/	/
Aurila arborescens (Brady, 1865)	c/c	0-4 (Barbeito-Gonzales 1971); 3.5 (Stambolidis 1985)	/
Urocythereis crenulosa (G. W. Müller, 1894)	a/a	0-32 (Uffenorde 1972)	mud, sand
Loxoconcha gibberosa (Terquem, 1878)	c/c	0-125; opt. 70 (Bonaduce et al. 1975)	sand
Loxoconcha stellifera G. W. Müller, 1894	a/a	0-4 (Barbeito-Gonzales 1971); 3.5-33 (Stambolidis 1985)	mud, sand
Paracytheridea aff. *depressa* G. W. Müller, 1894	r/r	/	/
Paracytheridea parallia Barbeito-Gonzales, 1971	c/a	0-4 (Barbeito-Gonzales 1971); 3.5-5.3 (Stambolidis 1985)	mud
Pseudocytherura calcarata (Seguenza, 1880)	c/c	0-50 (Barbeito-Gonzales 1971); 18 (Uffenorde 1972)	coarse sand
Xestoleberis dispar G. W. Müller, 1894	c/c	0-125; common: 0-60 (Bondaduce et al. 1975)	sand
Xestoleberis cf. *margaritea* (Brady, 1866)	vr/r	/	/
Xestoleberis sp. Typ B Danatsas, 1994	vr/r	/	/

Table 2: Ecological data, mainly derived from the following studies on the distribution of extant marine ostracods: Offshore Naxos: Barbeito-Gonzales (1971); Northern Aegean Sea: Stambolidis (1985); Adriatic Sea: Bonaduce et al. (1975); Breman (1975); Northern Adriatic Sea: Uffenorde (1972); Black Sea: Schornikov (1966). Abbreviations in the second column: 1/2 refers to samples Subaşı 1/2; a = abundant; c = common.

species/genera	1/2	stratigraphic distribution	depth (m)	mode of life	substrate	brackish aff.
Mytilus galloprovincialis Lamarck, 1819	+/+	Early Pliocene to Recent	0-40	epifaunal-byssate	rock, hardground	++
Mytilaster lineatus (Gmelin, 1791)	+/+	Early Pliocene to Recent	intertidal zone	epifaunal-byssate	rock, hardground	+
Anomiidae indet.	+/–	/	/	epifaunal-byssate	rock, hardground	/
Ostrea edulis Linné, 1758	–/+	Miocene to Recent	0-90	epifaunal-cementin	rock, hardground	++
Loripes lacteus (Linne, 1758)	+/+	Miocene to Recent	0-150	shallow infaunal	sand, gravel	++
Lucinella divaricata (Linné, 1758)	+/+	Miocene to Recent	0-60	shallow infaunal	mud, sand	/
Diplodonta rotundata (Montagu, 1803)	–/+	Miocene to Recent	0-100	shallow infaunal	mud, sand, gravel	/
Lasaea rubra (Montagu, 1803)	+/+	Early Pliocene to Recent	intertidal zone	epifaunal-byssate	rock	++
Mysella bidentata (Montagu, 1803)	+/–	Early Pliocene to Recent	0-2500	in crevices	no preference	/
Parvicardium exiguum (Gmelin, 1791)	+/+	Early Pliocene to Recent	0-55	shallow infaunal	mud, sand, gravel	++
Cerastoderma glaucum (Poiret, 1789)	+/+	Miocene to Recent	0-10	shallow infaunal	mud, sand, gravel	++
Spisula subtruncata (Da Costa, 1778)	+/+	Miocene to Recent	0-200	shallow infaunal	mud, sand	+
Donacilla cornea (Poli, 1791)	+/–	Miocene to Recent	intertidal zone	shallow infaunal	sand	+
Pharidae indet.	+/+	/	/	shallow infaunal	sand	/
Ensis sp.	+/–	/	/	shallow infaunal	sand	/
Tellina tenuis Da Costa 1778	+/+	?Miocene to Recent	0-10	shallow infaunal	sand	+
Tellina donacina Linné, 1758	+/+	Miocene to Recent	0-200	shallow infaunal	mud, sand, gravel	+
Tellina pygmaea Loven, 1846	–/+	Miocene to Recent	0-100	shallow infaunal	mud, sand	/
Gastrana fragilis (Linné, 1758)	+/+	Miocene to Recent	intertidal zone	shallow infaunal	mud	++
Donax trunculus Linné, 1758	+/–	Early Pliocene to Recent	0-10	shallow infaunal	sand	+
Abra segmentum (Récluz, 1843)	+/+	?	0-10	shallow infaunal	mud, sand	++
Chamelea gallina (Linné,1758)	+/+	Miocene to Recent	5-20	shallow infaunal	mud, sand	+/–
Gouldia minima (Montagu, 1803)	+/+	Miocene to Recent	0-200	shallow infaunal	mud, sand, gravel	+/–
Venerupis aurea (Gmelin, 1791)	+/+	Early Pliocene to Recent	0-40	shallow infaunal	mud, sand, gravel	+
Petricola lithophaga (Philippson, 1788)	–/+	Early Pliocene to Recent	0-100	boring in rocks	sedimentary rock	/
Corbula gibba (Olivi, 1792)	+/+	Miocene to Recent	0-several 100	epifaunal-byssate	mud, sand	/
Thracia papyracea (Poli, 1791)	+/+	Miocene to Recent	0-50	deep infaunal	mud, sand, gravel	+/–
Thracia sp.	+/+	/	/	deep infaunal	mud, sand, gravel	/

Table 3: Bivalve taxa recorded from Subaşı 1 and Subaşı 2. The occurrence in either one or both levels is shown in the second column. The third column indicates the stratigraphic range (after Monegatti & Raffi (2001)). Columns 4 to 7 list ecological parameters (depth range, mode of life, prefered substrate and brackish water affinity) derived from Tebble (1966), Bouchet et al. (1979), Van Aartsen et al. (1984), Poutiers (1987), and Poppe & Goto (1993). Abbreviations in column 7 are: ++ = tolerates/prefers brackish conditions; + = tolerates moderately brackish conditions; +/– = tolerates slightly brackish conditions; / = no data.