Zitteliana

An International Journal
of Palaeontology and Geobiology

Series A / Reihe A
Mitteilungen der Bayerischen Staatssammlung
für Paläontologie und Geologie

45

München 2005

Zitteliana

An International Journal of Palaeontology and Geobiology

Series A/Reihe A

Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Geologie

45

CONTENTS/INHALT

Zitteliana	A 45	218 Seiten	München, 30.12.2005	ISSN 1612-412X

Editors-in-Chief/Herausgeber: Reinhold Leinfelder, Michael Krings
Production and Layout/Bildbearbeitung und Layout: Martine Focke, Lydia Geißler

Bayerische Staatssammlung für Paläontologie und Geologie
Richard-Wagner-Str. 10, D-80333 München, Deutschland
http://www.palaeo.de/zitteliana
email: zitteliana@lrz.uni-muenchen.de

ISSN 1612-412X
Druck: Gebr. Geiselberger GmbH, Altötting

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)

Zitteliana	A45	115-133	2 Textfigs, 3 Pls, 1 Tab.	München, 30.12.2005	ISSN 1612-412X

Ostracods of the Paratethyan Neogene Kılıç and Yalakdere Formations near Yalova (İzmit Province, Turkey)

By
Renate Matzke-Karasz [1*] & Wolfgang Witt[2]

[1]*Department für Geo- und Umweltwissenschaften der LMU München, Paläontologie, und GeoBio-Center^{LMU}, Richard-Wagner-Str. 10, 80333 München, Germany*
[2]*Hangstr. 16, D-84079 Gündlkofen, Germany*

Manuscript received July 1, 2005; revision accepted November 04, 2005.

Abstract

Following an extended biostratigraphical and environmental study of Gastropoda, Pelecypoda, Ostracoda, Otoliths and other fish remains of the Neogene Kılıç and Yalakdere Formations at Yalova (İzmit Province, Turkey), the present paper now fully documents the ostracods of these units resulting in the following taxonomical and palaeoecological interpretations. The fundamental difference between the ostracod faunas of the Kılıç and Yalakdere Formations is reflected by the fact, that out of a total of 21 species documented, both units only have 2 in common. Three different ostracod associations occur in the Kılıç clastics, characterizing a lagoon with seasonally varyiing salinities, a sand bar or a beach within a deltaic complex, and a low energy freshwater habitat. The ostracod associations of the coal bearing part of the Yalakdere Formation are less varied, indicating a shallow, low energy, freshwater habitat with seasonally fluctuating salinities, probably in the oligohaline range. The ostracod associations of the Kılıç Formation are Late Pannonian, or, in Eastern Paratethys terminology Khersonian, in age. The ostracod associations of the Yalakdere Formation only permit a wide age assignment of Pannonian to Pleistocene.

Key words: Biostratigraphy, Kılıç Formation, Ostracoda, Palaeoecology, Paratethys, Turkey, Yalakdere Formation

Kurzfassung

Im Anschluß an eine umfassende biostratigraphische und ökologische Untersuchung der Gastropoden, Pelecypoden, Ostracoden, Otolithen und anderer Fischreste der neogenen Kılıç- und Yalakdere-Formationen bei Yalova (İzmit Provinz, Türkei), beschränkt sich die vorliegende Arbeit auf die vollständige Dokumentation der Ostracoden obiger Formationen. Die Ostracodenfaunen gestatten folgende taxonomische und paläoökologische Interpretationen. Der grundlegende Unterschied zwischen den Ostracodenfaunen der Kılıç- und Yalakdere- Formation zeigt sich schon allein in der Tatsache, dass von insgesamt 21 dokumentierten Arten beide Formationen nur 2 Arten gemeinsam haben. In der Kılıç-Formation wurden 3 verschiedene Ostracodenvergesellschaftungen nachgewiesen, die eine Lagune mit jahreszeitlich wechselnden Salinitäten, eine Sandbank oder einen Strand im Deltabereich und ein lakustrines Süßwasserhabitat charakterisieren. Die Ostracodenfaunen des Kohleflöze führenden Teils der Yalakdere-Formation unterscheiden sich weniger und weisen auf einen flachen limnischen Stillwasserbereich mit jahreszeitlich fluktuierender Salinität hin, etwa ansteigend bis ins Oligohalinikum. Die Ostracodenvergesellschaftungen der Kılıç-Formation weisen auf Oberpannon, oder in der Terminologie der östlichen Paratethys, auf Kherson hin, während die der Yalakdere-Formation nur eine weitgefasste Zuordnung zum Pannon bis Pleistozän gestatten.

Schlüsselwörter: Biostratigraphie, Kılıç Formation, Ostracoden, Paläoökologie, Paratethys, Türkei, Yalakdere Formation

1. Introduction

In order to constrain the age of movements along the North Anatolian Fault Zone in the İzmit region, the (micro)fossils of six critical spot samples, three of the up to 400 m thick Kılıç Formation and three from the 150 m thick Yalakdere Formation, supplied by our Turkish colleagues were biostratigraphically evaluated. The results of the biostratigraphical and environmental implications of various biota (e.g. Gastropoda, Ostracoda, Otoliths) of the Kılıç and Yalakdere Formations at Yalova are to be published (Rückert-Ülkümen et al., subm.). The nature of the sampling only permitted a preliminary environmental interpretation. In this publication, only a

**Author for correspondence and reprint requests; E-mail: r.matzke@lrz.uni-muenchen.de*

species list of the ostracods and illustrations of only the most important species are given. The present paper is the complete systematic documentation of the ostracod faunas of the said formations.

The samples are derived from the southern shores of İzmit Bay (North-western Anatolia) near Yalova, where Neogene limnic-brackish clastics with a minor lignite seam (Kılıç Formation) are outcropping, overlain by carbonates and marls with intercalated lignite seams (Yalakdere Formation). A locality map is given in Textfig. 1, while Textfig. 2 presents a generalized section of the Neogene to Quaternary units at Yalova. Detailed data on the regional geology are already presented in Rückert-Ülkümen et al. (subm.).

The figured specimens and additional investigated material is deposited in the collection of the Bayerische Staatssammlung für Paläontologie und Geologie, München (BSP 1980 X 1274-1292, 1332-1352).

2. Material

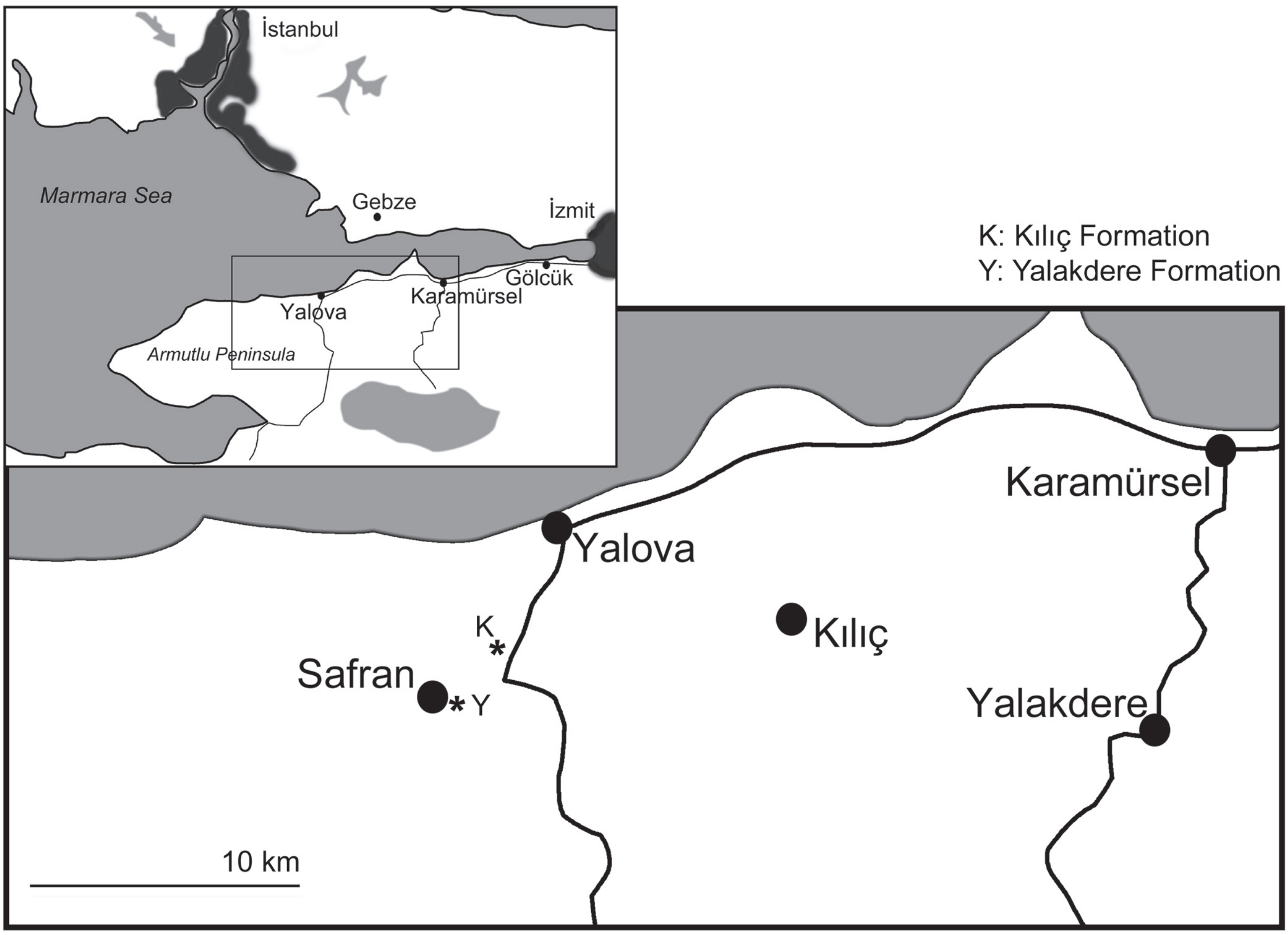
The Safran samples, labelled below and above main coal bed, and grey beds between the coal seams, are from the Yalakdere Formation, Yalova samples I/2, I/3 and I/5 from the Kılıç Formation. The material was collected by Prof. E. Yiğitbaş, Geological Department, Çanakkale University and Dr. N. Rückert-Ülkümen, Bayerische Staatssammlung für Paläontologie und Geologie, München, and washed and picked by Dr. N. Rückert-Ülkümen. The pickings are rich in well-preserved ostracods.

3. Ostracoda

The following ostracods have been encountered (Abbreviations: vr = very rare, r = rare, c = common, a = abundant):

Yalakdere Formation:

<u>Safran, above main coal bed</u>
Darwinula stevensoni (Brady & Robertson, 1870), c
Vestalenula cylindrica (Straub, 1952), r
Candona (C.) burdurensis Freels, 1980, incl. juv., a
Candona (C.) compressaeformis Mandelstam, 1963, vr
Candona (Neglecandona) decimai Freels, 1980, incl. juv., c
Pseudocandona cf. *compressa* (Koch, 1838), juv., r
Cyclocypris nitida Sieber, 1905, r
Ilyocypris sp., cf. *I.* sp. Janz, 1992, r
Heterocypris salina (Brady, 1868), incl. juv., c
Cyprideis torosa (Jones, 1850), incl. juv., a



Textfigure 1: Location map with indication of sampled sections.

Safran, below main coal bed
Darwinula stevensoni (Brady & Robertson, 1870), r
Vestalenula cylindrica (Straub, 1952), r
Candona (C.) burdurensis Freels, 1980, incl. juv., c
Candona (Neglecandona) decimai Freels, 1980, incl. juv., a
Pseudocandona cf. *compressa* (Koch, 1838), r
Cyclocypris cf. *laevis* (O. F. Müller, 1776), a
Heterocypris salina (Brady, 1868), incl. juv., c
Cyprideis torosa (Jones, 1850), incl. juv., a
Cyprideis sp. juv., vr

Safran, grey beds between coal seams
Vestalenula cylindrica (Straub, 1952), c
Pseudocandona cf. *compressa* (Koch, 1838), incl. juv., a
Candonopsis kingsleii (Brady & Robertson, 1870), r

Kılıç Formation:

Yalova sample I/2
Candona (Neglecandona) decimai (Freels, 1980), incl. juv., a
Heterocypris formalis (Mandelstam, 1963), c
Heterocypris ex gr. *gregaria* (Skoksberg, 1917), a
Leucocythere aff. *luculenta* (Livental, 1929), c
Cyprideis torosa (Jones, 1850), incl. juv., va
Cyprideis compacta turgida Bassiouni, 1979, r

Yalova sample I/3
Amplocypris aff. *tenuis* Zalányi, 1944, a
Candona (Neglecandona) sp. 1, r

Yalova sample I/5
Candona (Neglecandona) decimai Freels, 1980, incl. juv., a
Candona (Neglecandona) aff. *neglecta* Sars, 1887, r
Candona (Neglecandona) sp. 2, r

3.1 Systematic descriptions

The systematics follows Meisch (2000). Abbreviations: C = carapace(s), h = height, h_a = height, anterior, h_p = height posterior, l = length, L = left valve(s), R = right valve(s), V = valve(s), w = width.

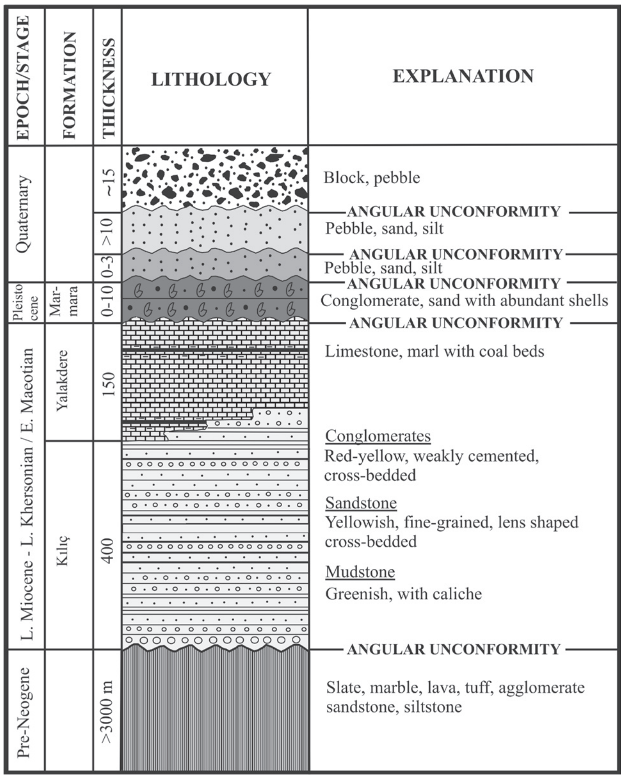
Synonyms and listings of other occurrences are generally restricted to Greece, the Aegean and Aegean Islands and Turkey and, where found appropriate, to the Balkans. For those species covered by Witt (2003), the reader is referred to the synonyms in that paper. Only additional synonyms are given here.

Superfamily Darwinuloidea Brady & Norman, 1889
Family Darwinulidae Brady & Norman, 1889

Genus *Darwinula* Brady & Robertson, 1885

Darwinula stevensoni (Brady & Robertson, 1870)

1994 *Darwinula stevensoni* (Brady & Robertson, 1870) – Danatsas: 128, pl. 15, fig. 9.
v 2003 *Darwinula stevensoni* (Brady & Robertson, 1870) – Witt: 95, pl. 1, fig. 1. (Further synonyms).



Textfigure 2: Generalized stratigraphical section showing the Neogene – Quaternary units of the Yalova region.

Material: Safran, above main coal bed (partly measured): 4 R, 5 L, 2 V juv.; Safran, below main coal bed: 1R, 1 L.

Measurements (mm):
R: l = 0.676-0.691, h = 0.285-0.291; l/h = 2.372-2.375
L: l = 0.669-0.711, h = 0.262-0.273; l/h = 2.553-2.604

Other regional occurrences: Greek islands and mainland: In the Upper Serravallian and/or Lower Tortonian of Crete (Mostafawi 1989b), in the Upper Pontian of the Thessaloniki region (Mostafawi 1996), in the Upper Pliocene and Upper Pleistocene of Kos (Mostafawi 1988), in the Upper Pliocene of Evia (Mostafawi 1994), and in the Pleistocene of the Peloponnesus (Danatsas 1994). Turkey: Widely spread from the Upper Miocene to the Lower Pleistocene of Anatolia (Freels 1980), in the upper Middle to Upper Miocene of Southwestern Anatolia (Gökçen 1979a,b), in the Upper Miocene to Lower Pliocene of Western Anatolia (Witt 2003), and in the Pliocene of the Adana area (Nazik et al. 1992).

Ecology: The Recent *D. stevensoni* is tolerant of salinities up to 15‰. The species prefers ponds, lakes and slow streams and occurs on both muddy and sandy substrates (Neale 1988: fig. 2; Meisch 2000: 51). Detailed characterization: Thermoeuryplastic, oligorheophilic, and mesohalophilic (Meisch 2000: 52).

Genus *Vestalenula* ROSSETTI & MARTENS, 1998

Vestalenula cylindrica (STRAUB, 1952)
Pl. 1, Fig. 1

1989b *Darwinula cylindrica* STRAUB, 1952 – MOSTAFAWI: fig. 4/16.
1992 *Darwinula cylindrica* STRAUB – NAZIK et al.: pl. 1, figs 1-2.
1994 *Darwinula cylindrica* STRAUB, 1952 – DANATSAS: 128, pl. 15, figs 7-8.
1994 *Darwinula cylindrica* STRAUB, 1952 – MOSTAFAWI: fig. 6/7.
2001 *Vestalenula cylindrica* (STRAUB, 1952) – JANZ et al.: 185, pl. 3, figs 22-26.

Material: Safran, above main coal bed (measured): 1 C, 1 R, 1 L; Safran, below main coal bed: 1 R, 1 L; Safran, grey beds between coal seams: 8 V.

Measurements (mm):
C: l = 0.509, w = 0.223; l/w = 2.283
R: l = 0.504, h = 0.222, w = 0.100; l/h = 2.270
L: l = 0.493, h = 0.229; l/h = 2.153

Relations: GROSS' (2004: 62) opinion is followed in considering *D. cylindrica* in FREELS (1980: 14, pl. 1, figs 1-6) and MOSTAFAWI (1988: 182, pl. 2, fig. 13) to be *V. pagliolii* PINTO & KOTZIAN, 1961, since they are more stubby than *D. cylindrica* with l/h-ratios of 2.066, 2.106 and 2.078 respectively.

Other regional occurrences: Greek mainland and islands: In the Upper Serravallian and/or Lower Tortonian of Crete (MOSTAFAWI 1989b), in the Upper Pliocene of Evia (MOSTAFAWI 1994), and in the Pleistocene of the Peloponnesus (DANATSAS 1994). In the Pliocene of the Adana region, Turkey (NAZIK et al. 1992). In the Holocene of Iran (JANZ et al. 2001).

Remarks: The diagnostic features to distinguish *Vestalenula* from *Darwinula* is the presence of a posteroventral keel on the exterior of the right valve (see Pl. 1, Fig. 1) and a knob-like anteroventral tooth in the interior of the left valve (ROSSETTI & MARTENS 1998: 65)

Palaeoecology: *Vestalenula cylindrica* occured in ponds and in the littoral of lakes. Limnic, possibly tolerating mesohaline conditions (GROSS 2004: 62).

Superfamily Cypridoidea BAIRD, 1845
Family Candonidae KAUFMANN, 1900
Subfamily Candoninae KAUFMANN, 1900

Genus *Candona* BAIRD, 1845
Subgenus *Candona* BAIRD, 1845

Candona (Candona) burdurensis FREELS, 1980
Pl. 1, Fig. 2

*1980 *Candona burdurensis* n. sp. – FREELS: 101, pl. 17, figs 15-23.
non 1992 *Candona burdurensis* FREELS – NAZIK et al.: pl. 2, figs 4-5.
1994 *Candona* cf. *burdurensis* FREELS, 1980 – DANATSAS: 124, pl. 13, figs 20-22.
non 1995 *Candona burdurensis* (FREELS) – GÜLEN et al.: pl. 3, fig. 6a-c.

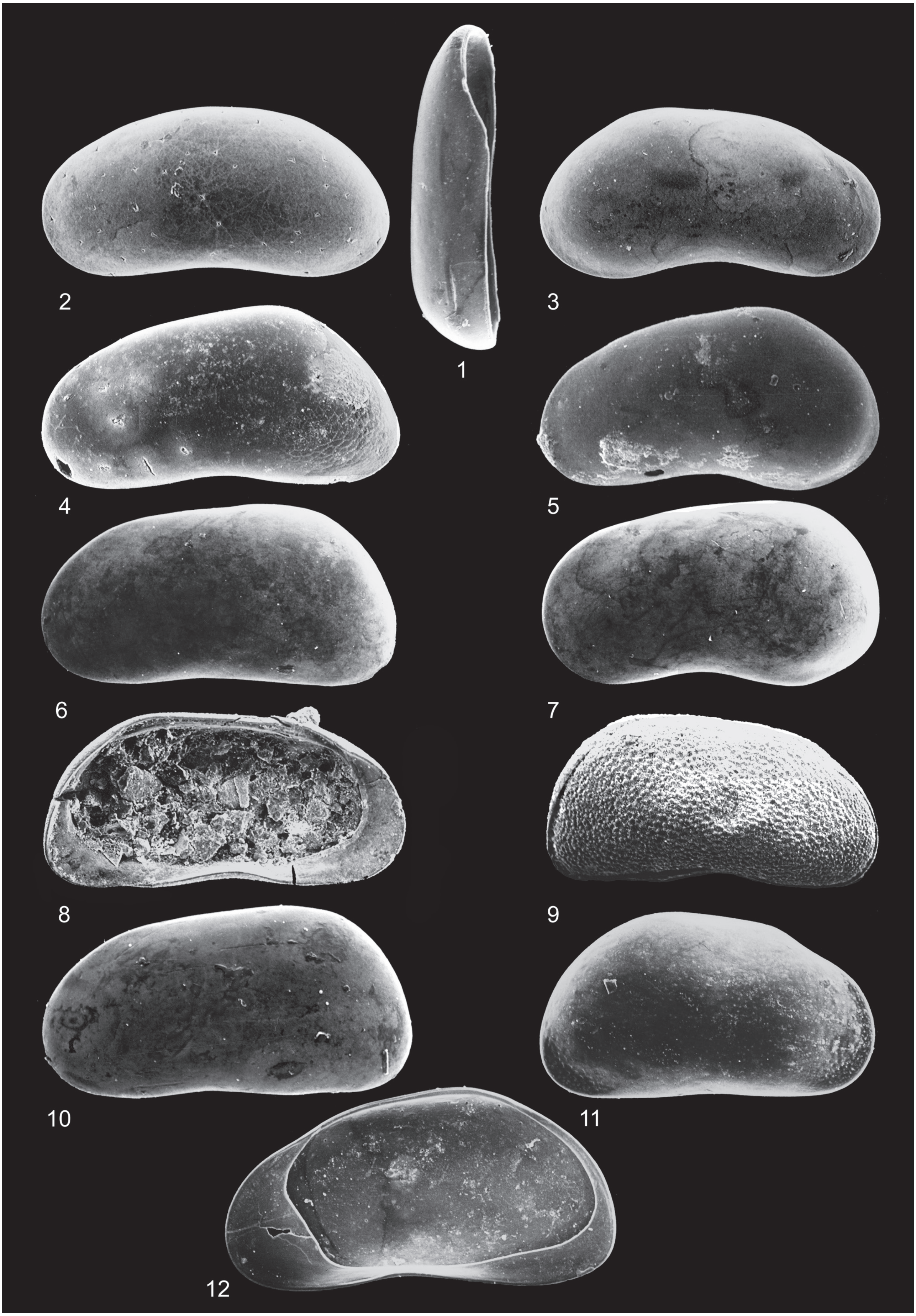
Material: Safran, above main coal bed (partly measured): ♂: L, 1 L damaged; a-1: 1 L; a-2: 13 R, 4 L; a-3: 5 R; Safran, below main coal bed (partly measured): ♀: 1 R; numerous V juv.

Measurements (mm):
L♂: l = 1.065-1.082, h = 0.531-0.527; l/h = 2.006-2.053
R♀: l = 0.982, h = 0.476; l/h = 2.063

Plate 1

Images were digitally processed to compensate for the distortion produced by the SEM. Figs 1-5, 11, 12: Yalakdere Formation. Figs 1-4: Safran, above main coal seam. Fig. 5: Safran, below main coal seam. Figs 11, 12: Safran, grey beds between coal seams. Figs 6-10: Kılıç Formation. Figs 6, 7, 10: Yalova, sample I/5. Figs 8, 9: Yalova, sample I/3.

Fig. 1: *Vestalenula cylindrica* (STRAUB, 1952). R (l = 0.504, w = 0.100 mm), ventral view with typical keel, ca. x 123; BSP 1980 X 1337.
Fig. 2: *Candona (C.) burdurensis* FREELS, 1980. L♂ (l = 1.082, h = 0.527 mm), external view, ca. x 60; BSP 1980 X 1287.
Fig. 3: *Candona (C.) compressaeformis* MANDELSTAM, 1963. R♂ (l = 0.982, h = 0.491 mm), external view, ca. x 65; BSP 1980 X 1286.
Figs 4, 5: *Candona (Neglecandona) decimai* FREELS, 1980.
Fig. 4: L♀ (l = 1.200, h = 0.618mm), external view, ca. x 52; BSP 1980 X 1338.
Fig. 5: L♂ (l = 1.258, h = 0.672 mm), external view, ca. x 50; BSP 1980 X 1339.
Figs 6, 7: *Candona (Neglecandona)* aff. *neglecta* SARS, 1887.
Fig. 6: L♀ (l = 1.127, h = 0.596 mm), external view, ca. x 60; BSP 1980 X 1284.
Fig. 7: L♂ (l = 1.036, h = 0.600 mm), external view, ca. x 60; BSP 1980 X 1285.
Figs 8, 9: *Candona (Neglecandona)* sp. 1
Fig. 8: L (l = 1.462, h = 0.745 mm), internal view, ca. x 46; BSP 1980 X 1275.
Fig. 9: C from right (l = 1.527, h = 0.800 mm), external view, ca. x 41; BSP 1980 X 1274.
Fig. 10: *Candona (Neglecandona)* sp. 2. L♀(l = 1.224, h = 0.655 mm), external view, ca. x 57; BSP 1980 X 1288.
Fig. 11: *Pseudocandona* cf. *compressa* (KOCH, 1838). R (l = 0.805, h = 0.451 mm), external view, ca. x 78; BSP 1980 X 1340.
Fig. 12: *Candonopsis kingsleii* (BRADY & ROBERTSON, 1870). R (l = 0.982, h = 0.505 mm), internal view, ca. x 74; BSP 1980 X 1341.


1
2
3
4
5
6
7
8
9
10
11
12

L A-1: l = 0.876, h = 0.424; l/h = 2.066
R A-2: l = 0.751, h = 0.364; l/h = 2.063
L A-2: l = 0.782, h = 0.384; l/h = 2.036
R A-3: l = 0.589, h = 0.293; l/h = 2.010

Other regional occurrences: In the Upper Pleistocene and questionable in the (Upper Miocene? to) Pliocene to Lower Pleistocene of Anatolia (FREELS 1980). In the Pleistocene of North-western and Northern Peloponnesus (DANATSAS 1994).

Remarks: Both the course of the inner margin and the width of the inner lamella of *C. burdurensis* in NAZIK et al. (1992) are fundamentally different from the ones shown in FREELS' figures. NAZIK's et al. (1992) specimens are rather *Candonopsis kingsleii* (BRADY & ROBERTSON, 1870).

Candona burdurensis in GÜLEN et al. (1995) is characterized by a pointed posterior end and therefore belongs to the genus *Caspiolla* MANDELSTAM, 1960 and a different species.

Palaeoecology: *Candona burdurensis* has been described from Late Pleistocene lake deposits in Turkey (FREELS 1980: 102).

Candona (Candona) compressaeformis MANDELSTAM, 1963
Pl. 1, Fig. 3

*1963 *Candona compressaeformis* MANDELSTAM sp. n. – MANDELSTAM & SCHNEIDER: 146, pl. 21, fig. 13; pl. 23, fig. 9.
1980 *Candona (Candona)* 1 n. sp. – FREELS: 97, pl. 17, figs 1-3.
1995 *Candona rostrata* BRADY & NORMAN – GÜLEN et al.: pl. 3, fig. 7.
1998 *Candona* (*Candona*) sp. 1 – PIPÍK: pl. 1, fig. 2.

Material: Safran, above main coal bed: ♂: 1 R.

Measurements (mm):
R♂: l = 0.982, h = 0.491; l/h = 2.000

Other regional occurrences: In the Pannonian of the Danube Basin, Slovakia (PIPÍK 1998). In the Upper Pliocene (Akchagylian) of the Caspian Basin of Western Kazakhstan (MANDELSTAM & SCHNEIDER 1963). In the Pliocene to Lower Pleistocene of Eastern Turkey (FREELS 1980) and in the Pleistocene of İzmit Bay (GÜLEN et al. 1995).

Remarks: *Candona (C.)* 1 n. sp. in FREELS (1980) is slightly smaller, ♂R: l = 0.936, h = 0.488 mm, l/h = 1.919 (FREELS 1980: 98). The dimensions given in MANDELSTAM & SCHNEIDER (1963: 146) l = 0.99, h = 0.50 mm, resulting in l/h = 1.98 concur well with those of the Turkish specimen.

The present specimen is in better accordance with the one of pl. 23, fig. 9 than the one of pl. 21, fig. 13 in MANDELSTAM & SCHNEIDER (1963), the latter being the holotype (FREELS 1980: 98).

Palaeoecology: *Candona (C.)* sp. 1 in PIPÍK has been encountered in a freshwater faunal association (PIPÍK 1998: 168).

Subgenus *Neglecandona* KRSTIĆ, 1993
Candona (Neglecandona) decimai FREELS, 1980
Pl. 1, Figs 4-5

v 2003 *Candona decimai* FREELS, 1980 – WITT: 95, pl. 1, figs 2-7. (Further synonyms).

Material: Safran, above main coal bed (partly measured): ♀: 4 R, 4 L; 10 V juv.; Safran, below main coal bed (partly measured): ♀: 3 R, 3 L, ♂: 1 L; 4 C juv., numerous V juv.; Yalova, sample I/2: ♀: 1 L; ♂: 1 L; abundant V juv.; Yalova, sample I/5: ♀: 8 R, 4 L; abundant V juv.

Measurements (mm):
R♀: l = 1.042-1.109, h = 0.513-0.533; l/h = 2.031-2.081
L♀: l = 1.102-1.200, h = 0.567-0.618; l/h = 1.944-1.942
L♂: l = 1.258, h = 0.672; l/h = 1.872

Other regional occurrences: In the Upper Miocene (Khersonian) of the Euxinic Basin in North-Western and Northern Bulgaria (STANCHEVA 1963). Greek mainland and islands: In the Upper Pontian of Greek Macedonia (GRAMANN 1969), in the Upper Pliocene and Upper Pleistocene of Kos (MOSTAFAWI 1981; 1988), and in the Upper Pliocene of Rhodes (MOSTAFAWI 1989a). Widely found from the Upper Miocene to the Lower Pleistocene in Anatolia (FREELS 1980), in the Upper Miocene to Lower Pliocene of Western Anatolia (WITT 2003), in the Pliocene of the Kayseri (ŞAFAK et al. 1992) and Adana areas, Turkey (NAZIK et al. 1992).

Palaeoecology: *Candona decimai* is a limnic species, possibly also of slightly brackish waters (FREELS 1980: 120).

Candona (Neglecandona) aff. *neglecta* SARS, 1887
Pl. 1, Figs 6-7

2001b *Candona neglecta* SARS, 1888 – TUNOĞLU & ÜNAL: 176, pl. 3, fig. 1.
2001b *Candona candida* MÜLLER, 1776 – TUNOĞLU & ÜNAL: 177, pl. 3, fig. 7.
2001b Candona parallela pannonica ZALANYI, 1959 – TUNOĞLU & ÜNAL: 177, pl. 3, figs 2-4.

Material: Yalova sample I/5: ♀: 1 C, 3 L; ♂: 1 L.

Measurements (mm):
L♀: l = 1.127-1.145, h = 0.596-0.618; l/h = 1.853-1.891
L♂: l = 1.036, h = 0.600; l/h = 1.727

Relations: MEISCH (2000: 77) gives for female left valves of Recent *C. neglecta* h/l-ratios of 0.49-0.52, sometimes up to 0.54, corresponding to l/h-ratios of 2.041-1.923 and sometimes down to 1.852. This means that the Yalova specimens are higher in comparison with the Recent *C. neglecta*.

Remarks: TUNOĞLU & ÜNAL's *C. neglecta* is a male specimen characterized by its posteroventral convexity. Their *C. candida* (O. F. MÜLLER, 1776) belongs rather to the *neglecta*-group, missing the arched dorsal margin of *C. candida* (O. F. MÜLLER, 1776).

C. parallela pannonica in TUNOĞLU & ÜNAL (2001b: 177, pl. 3, figs 2-4) are juveniles (written comm. Dr. N. KRSTIĆ, 8.3.2005).

Other regional occurrence: In the Pannonian to Pontian of Thrace (TUNOĞLU & ÜNAL 2001b).

Ecology: *C. neglecta* is reported from a wide range of aquatic habitats ranging from springs to lakes occupying the shallow littoral to the profundal. It occurs also in slightly salty inland and coastal waters within a salinity range of 0.5-16‰. Detailed characterisation: Oligothermophilic, mesorheophilic, titanoeuryplastic, mesohalophilic (MEISCH 2000: 80).

Candona (Neglecandona) sp. 1
Pl. 1, Figs 8-9

Material: Yalova sample I/3: 5 C, 1 L.

Measurements (mm):
C: l = 1.418-1.527, h = 0.718-0.800; l/h = 1.909-1.975; w = 0.638
Averages: l = 1.467, h = 0.754; l/h = 1.962
L: l = 1.462, h = 0.745; l/h = 1.962

Remarks: The outline of this ornamented species is the one of the Candoninae (written comm. Dr. N. KRSTIĆ, 5. 3. 2005) and more specifically of the subgenus *Neglecandona* (written comm. Dr. N. KRSTIĆ, 7. 4. 2005), the slight antero-dorsal concavity of the right valve being a typical character. This determination is supported by the occurrence of a roundish depression at the outer central valve surface, suggesting a candonine central muscle field. Since the only valve available is filled with sediment, the central muscle field can not be observed.

KRSTIĆ & GUAN SHAO-ZENG (2001: 31) discuss the ornamentation of Candoninae. Not all members of this subfamily, whose carapaces are primarily smooth, develop an ornamentation in salty waters. The type of ornamentation in salty lakes or caspibrackish sea-lakes is genetically controlled, but the degree of ornamentation is depending on environmental conditions, generally more pronounced with increasing salinities, and therefore phenotypic. HARTMANN (1975: 615) points to the fact that reduced salinity results in a reduced calcification of ostracod valves, which manifests itself in thinner shells and reduced ornamentation.

Examples of ornamented candonids of the *neglecta*-group or the subgenus *Neglecandona*, respectively, are the Lower Pleistocene to Recent *Candona angulata* G. W. MÜLLER, 1900, and its Upper Miocene to Lower Pleistocene predecessor *Candona decimai* FREELS, 1980. Both are characterized by a reticulation of the posterior quarter. Moreover, large specimens of *C. decimai* show this pattern on the whole valve with exception of the central und dorsal fields (FREELS 1980: 95).

The heavily calcified *Candona (Neglecandona)* sp. 1 is finely reticulated with the reticulum passing into minuscule spines. The heavy calcification manifests itself also by strong bars bordering the groove of the adont hinge of the left valve (Pl. 1, Fig. 8).

Palaeoecology: The unusual ornamentation of this species points to caspibrackish conditions, which exhibits (after POKORNÝ 1952: 364) salinities of some 3-8‰. A high energy depositional environment can be also inferred from the strong calcification of this species.

Candona (Neglecandona) sp. 2
Pl. 1, Fig. 10

Material: Yalova sample I/5: ♀: 1 L, ♂?: 1 L.

Measurements (mm):
L♀: l = 1.224, h = 0.655; l/h = 1.869
L♂?: l = 1.327, h = 0.709; l/h = 1.872

Relations: This form reminiscent of *Candona* cf. *natronphila* PETKOVSKI, 1969 as illustrated by KRSTIĆ (1973a: figs 14-17; pl. 1, fig. 6) lacks, however, in lateral view the second minor concavity between the centro-ventral concavity and the posterior end. The feature is also missing in the similar *Candona (Neglecandona)* aff. *neglecta* from the same sample, which is moreover smaller.

Palaeoecology: Smooth representatives of the subgenus *Neglecandona* occur in the Early Badenian "Serbian Lake", in freshened embayments of the Pannonian Basin in the Pannonian - Pontian Congeria Beds (written comm. Dr. N. KRSTIĆ, 24.4.2005) and in the Early Pleistocene palustrine and lacustrine Paludinian Beds of Serbia (KRSTIĆ 1993: 124). Summarizing, smooth *Neglecandona* species occur in fresh and in slightly brackish waters.

Genus *Pseudocandona* KAUFMANN, 1900

Pseudocandona cf. *compressa* (KOCH, 1838)
Pl. 1, Fig. 11

1994 *Candona compressa* (KOCH, 1837) – DANATSAS: 124, pl. 14, figs 1-2.
1995 *Candona* (*Pseudocandona*) *compressa* (KOCH, 1837) – TUNOĞLU et al.: pl. 2, figs 7-9.
v 2003 *Pseudocandona* cf. *compressa* (KOCH, 1838) – WITT: 97, pl. 2, fig. 8. (Further synonyms).

Material: Safran, below main coal bed (partly measured): 1 L 4 V juv.; Safran, grey beds between coal seams: numerous V incl. juv.

Measurements (mm):
R: l = 0.805, h = 0.451, l/h = 1.785
L: I = 0.976, h = 0.545, l/h = 1.791

Relations: The identity of *P. compressa* (KOCH, 1838) sensu BRADY, 1868 with *P. steinheimensis* (SIEBER, 1905) as suggested by FREELS (1980: 64) is questionable (JANZ 1992: 14).

Other regional occurrences: Greek islands and mainland: In the upper Serravallian to Lower Tortonian of

Kithira (MOSTAFAWI 1990), in the Upper Pontian of the Thessaloniki region (MOSTAFAWI 1996), in the Upper Pliocene of Evia (MOSTAFAWI 1994) and Kos (MOSTAFAWI 1988), and in the Pleistocene of the Peloponnesus (DANATSAS 1994). Widely known from the Middle Miocene to the Upper Pleistocene from many regions of Anatolia (FREELS 1980), in the Upper Miocene to Lower Pliocene of Western Anatolia (WITT 2003) and in the Pliocene of Central Anatolia (TUNOĞLU et al. 1995).

Ecology: The Recent *P. compressa* is a freshwater species, occurring also in slightly salty (oligo- to mesohaline) coastal and inland waters. The species prefers the shallow littoral of lakes and is reported from a maximum depth of 8 m. Detailed characterization: Mesothermophilic, meso- to polytitanophilic, oligorheophilic and oligo- to mesohalophilic (MEISCH 2000: 180).

Genus *Candonopsis* VÁVRA, 1891

Candonopsis kingsleii (BRADY & ROBERTSON, 1870)
Pl. 1, Fig. 12

1985 *Candonopsis* cf. *kingsleii* (BRADY & ROBERTSON) – KRSTIĆ: pl. 4, figs 1-2.
1989b *Candonopsis* sp. – MOSTAFAWI: fig. 4/7.
1992 *Candona (Candona) burdurensis* FREELS – NAZIK et al.: pl. 2, figs 4-5.
1992 *Heterocypris salina salina* (Brady) – NAZIK et al.: pl. 3, fig. 4.
1994 *Candonopsis* aff. *kingsleii* (BRADY & ROBERTSON ,1870) – DANATSAS: 126, pl. 14, fig. 19.
1995 *Candonopsis* n. sp. – KRSTIĆ: 389, pl. 2, fig. 7; pl. 9, fig. 9.

Material: Safran, grey beds between coal seams: 1 R, 2 L.

Measurements (mm):
R: l = 0.982; h = 0.505; l/h = 1.945
L: l = 0.945-0.967; h = 0.513; l/h = 1.842-1.885

Remarks: The present form differs from the Recent *C. kingsleii* illustrated in MEISCH (2000: fig. 89) by a somewhat narrower posteroventral inner lamella.

Candonopsis sp. in MOSTAFAWI (1989b) is in size and the l/h-ratio of the illustrated R very similar to *C. kingsleii*, and so is *Candonopsis* n. sp. in KRSTIĆ (1995). The shape of the inner lamella of *Candona (C.) burdurensis* and *Heterocypris salina salina* in NAZIK et al. (1992) clearly indicates that these specimens are *C. kingsleii*.

Other regional occurrences: In the Upper Serravallian and/or Lower Tortonian of Crete (MOSTAFAWI 1989b), in the Pannonian and Dacian (Lower Paludinian Beds) of the Pannonian Basin of Serbia (KRSTIĆ 1985, 1995), in the Pliocene of the Adana region, Turkey (NAZIK et al. 1992), and in the Pleistocene of the North-western and Northern Peloponnesus (DANATSAS 1994).

Ecology: The Recent *C. kingsleii* prefers the littoral zone of freshwater lakes and small permanent water bodies. The species is recorded from a maximum depth of 12 m. Detailed characterization: Thermoeuryplastic, oligorheophilic, titanoeuryplastic and oligohalophilic (MEISCH 2000: 209, 211).

Subfamily Cyclocypridinae KAUFMANN, 1900

Genus *Cyclocypris* BRADY & NORMAN, 1889

Cyclocypris cf. *laevis* (O. F. MÜLLER, 1776)
Pl. 2, Figs 1-2

Plate 2

Figs 1-7: Yalakdere Formation. Figs 1, 2: Safran, below main coal seam. Figs 3-7: Safran, above main coal seam. Figs 8-13: Kılıç Formation. Figs 8-11: Yalova, sample I/3. Figs 12, 13: Yalova, sample I/2.

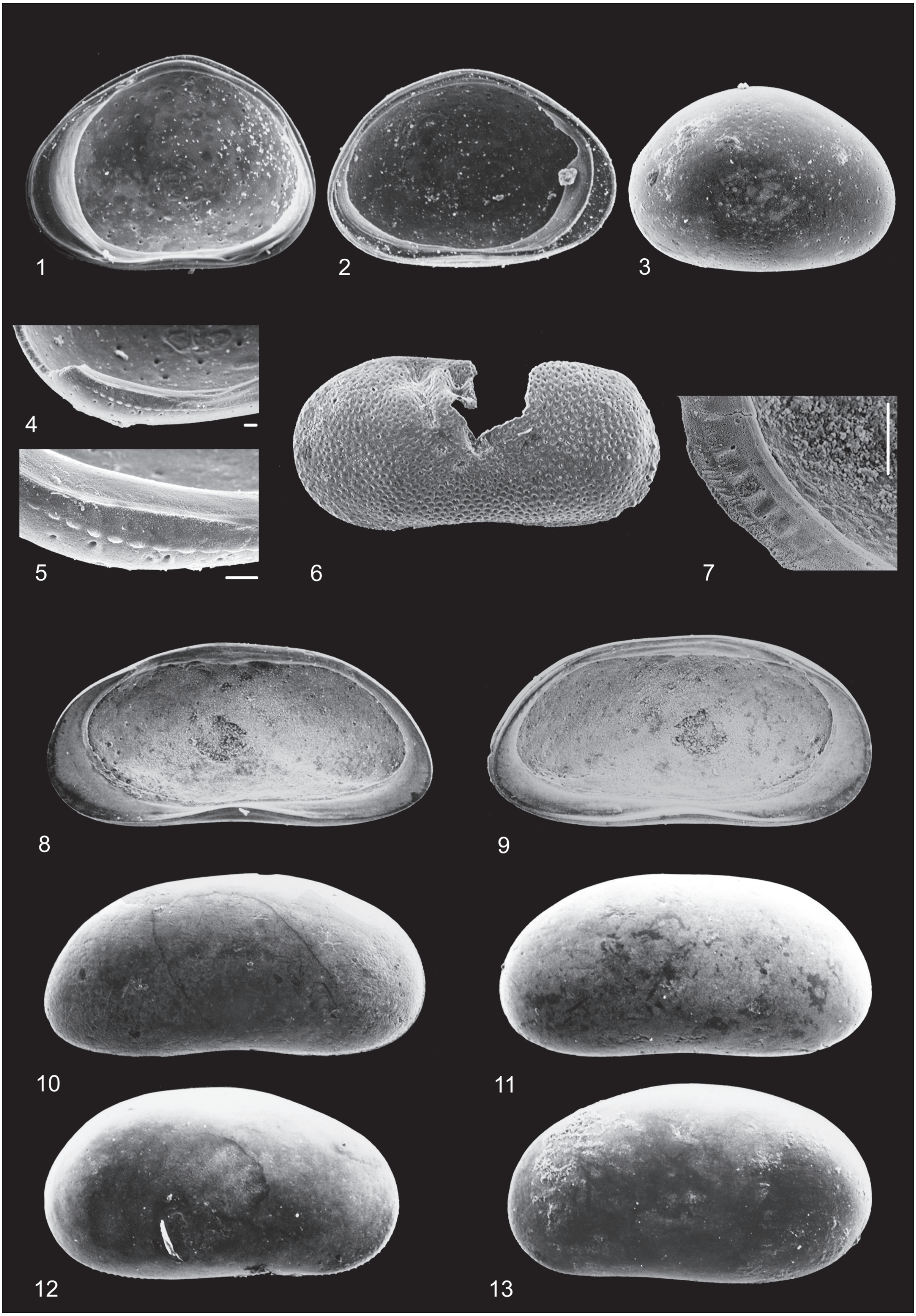
Figs 1, 2: *Cyclocypris* cf. *laevis* (O. F. MÜLLER, 1776).
Fig. 1: R (l = 0.455 , h = 0.337 mm), internal view, ca. x 118; BSP 1980 X 1291.
Fig. 2: L (l = 0.455 , h = 0.317 mm), internal view, ca. x 118; BSP 1980 X 1292.

Figs 3-5: *Cyclocypris nitida* SIEBER, 1905.
Fig. 3: R (l = 0.435, h = 0.307 mm), external view, ca. x 115; BSP 1980 X 1289.
Fig. 4: L posterio-ventral part of internal view, scale 10 μm ; BSP 1980 X 1290.
Fig. 5: L, detail of fig. 4, scale 10 μm.

Figs 6, 7: *Ilyocypris* sp., cf. *Ilyocypris* sp. JANZ, 1992.
Fig. 6: L (l = 1.173, h = 0.584 mm), external view, ca. x 59; BSP 1980 X 1342.
Fig. 7: L internal view, marginal ribs; scale 100 μm; BSP 1980 X 1342.

Figs 8-11: *Amplocypris* aff. *tenuis* ZALÁNYI, 1944.
Fig. 8: R (l = 1.355, h = 0.645 mm), internal view, ca. x 53; BSP 1980 X 1277.
Fig. 9: L (h = 1.373, h = 0.684 mm), internal view, ca. x 52; BSP 1980 X 1343.
Fig. 10: R (l = 1.238, h = 0.587 mm), external view, ca. x 58; BSP 1980 X 1344.
Fig. 11: L (h = 1.324, h = 0.651mm), external view, ca. x 53; BSP 1980 X 1276.

Figs 12, 13: *Heterocypris formalis* (MANDELSTAM, 1963).
Fig. 12: R♂ (l = 0.818, h = 0.455 mm), external view, ca. x 81; BSP 1980 X 1282.
Fig. 13: L (l = 0.862, h = 0.484 mm), external view, ca. x 79; BSP 1980 X 1345.


1
2
3
4
5
6
7
8
9
10
11
12
13

v 1996 *Cyclocypris* sp. – MOSTAFAWI: pl. 3, fig. 46.

Material: Safran, below main coal bed (partly measured): 11 C, 27 L, 22 R, 1R damaged.

Measurements (mm):
C: l = 0.436-0.455; w = 0.317-0.356
R: l = 0.428-0.455; h = 0.307-0.337; l/h = 1.333-1.484
L: l = 0.436-0.455; h = 0.307-0.337; l/h = 1.323-1.484

Relations: A small *Cyclocypris* with L overlapping R. The present form differs from *C. laevis* by its smaller size (*C. laevis*: 0.48-0.52 mm). Since all other valve characters are congruent with those of the Recent *C. laevis*, and no separating characters could be determined, the present material can so far only be identified as *C.* cf. *laevis*.

The left valve illustrated by MOSTAFAWI (1996) is somewhat larger, l = 0.48, h = 0.35, resulting in an l/h-ratio of 1.371.

Other regional occurrences: Although this form has also been found in the Upper Pontian of the Thessaloniki area, Greece (MOSTAFAWI 1996), it appears premature to restrict its stratigraphical distribution to this time interval in view of the ranges of the associated ostracod fauna.

Ecology: The Recent *C. laevis* is a common, holarctic species, occurring in a wide range of freshwater bodies. Detailed characterization: euryplastic for temperature and pH, mesorheophilic, mesohalophilic, polytitanophilic (MEISCH 2000: 237).

Cyclocypris nitida SIEBER, 1905
Pl. 2, Figs 3-5

*1905 *Cyclocypris nitida* n. sp. – SIEBER: 333, textfig. 5.
v 1965 *Cyclocypris nitida* SIEBER, 1905 – LUTZ: 295, fig. 15.
v 1992 *Cyclocypris nitida* SIEBER, 1905 – JANZ: 20, pl. 3, figs 1-6; textfig. 4c,f.
v 2000 *Cyclocypris nitida* SIEBER, 1905 – WITT: 125, pl. 2, fig. 6.

Material: Safran, above main coal bed: 3 L, 3 R, 1 L damaged.

Measurements (mm):
R: l =0.436-0.455, h = 0.297-0.317; l/h = 1.419-1.467
L: l = 0.436, h = 0.307-0.327; l/h = 1.333-1.419

Remarks: A small *Cyclocypris* with R overlapping L. *C. nitida* is similar to *C. ovum*; however, the mean carapace length of *C. nitida* represents the lower end of the size range given for *C. ovum* (usually 0.45-0.52; MEISCH 2000: 238). The outline of the carapace of *C. nitida* does not show any specific differences compared to *C. ovum*; particularly as the carapace shape in *C. ovum* has been proved to show a high variability without specific variability in soft parts (MATZKE-KARASZ 1996). However, as a clear separating character, LUTZ (1965) and JANZ (1992) described a denticulation at the posteroventral margin of the left valve in *C. nitida*; the present material also shows this character (pl. 2, figs. 4-5).

C. nitida has originally been described from the Steinheim Basin, a Miocene meteorite crater lake in Southern Germany, radiometrically dated about 15 Ma. (HEIZMANN & REIFF 2002: 72). *C. nitida* occurs here most abundantly in the *trochiformis*-beds, a phase of regression and very low water level (JANZ 1992: 66).

WITT (2000: tab. 4) reported *C. nitida* from the upper Lower to Middle Miocene of the Molasse Basin of Southern Germany. *C. nitida* has to be added to a number of freshwater species common to the Southern German Molasse Basin including adjacent areas and to Anatolian Neogene Basins (FREELS 1980: 118; WITT 2000: 138). Since the regression of the sea from Anatolia occurred only in Middle Miocene times (FREELS 1980: 121), these freshwater species appeared later in Anatolia than in Southern Germany (WITT 2000: 138).

Ecology: Given the close morphological relationship between *C. nitida* and *C. ovum*, the ecological requirements of the Recent *C. ovum* may give an impression of the possible habitat of *C. nitida*. *C. ovum*, a good swimmer like most species of the genus, typically inhabits littoral zones of inland water bodies with rich vegetation. The high abundance of *C. nitida* in the phases of very low water levels of the Steinheim crater lake supports this ecological assessment. Furthermore, *C. ovum* is characterized as euryplastic for temperature, current, and pH and as mesohalophilic (MEISCH 2000: 239).

Family Ilyocyprididae KAUFMANN, 1900
Subfamily Ilyocypridinae KAUFMANN, 1900

Genus *Ilyocypris* BRADY & NORMAN, 1889

Ilyocypris sp., cf. *Ilyocypris* sp. JANZ, 1992
Pl. 2, Figs 6-7

cf. 1992 *Ilyocypris* sp. – JANZ: 30, pl. 6, figs 1-5; textfig. 10; tab. 9.
cf. 1994 *Ilyocypris* sp. – JANZ: 6, pl. 3, fig. 4; textfig. 2h.
cf. 1997 *Ilyocypris* sp. – JANZ : 15, pl. 2, figs 1-3.

Material: Safran, above main coal bed: 1 L; 5 V damaged.

Measurements (mm):
L: l = 1.173, h = 0.584; l/h = 2.009

Relations: The present form is considerably larger than *Ilyocypris* sp. JANZ 1992 (L: l = 0.846, h = 0.479 mm) and differs from *Ilyocypris* sp. JANZ 1992 by a less distinctly sloping dorsal margin, furthermore by the amount and shape of the median situated marginal ripplets. There are six broad ones, which in section are rounded. Distally there are numerous small ones, which also appear in the upper part between and beyond the large marginal ripplets.

Remark: *Ilyocypris* sp. JANZ 1992 has been found in the Middle Miocene of the Steinheim Basin in Southern Germany.

E c o l o g y : *Ilyocypris* sp. JANZ, 1992 belongs to the *I. gibba*-group (JANZ 1997: 16). The Recent *I. gibba* prefers small and permanent freshwater bodies, and is also recorded from slightly salty (oligohaline) waters (MEISCH 2000: 246).

Family Cyprididae BAIRD, 1845

Subfamily Herpetocypridinae KAUFMANN, 1900

Genus *Amplocypris* ZALÁNYI, 1944

Amplocypris aff. *tenuis* ZALÁNYI, 1944
Pl. 2, Figs 8-11

aff. *1944 *Amplocypris tenuis* sp. nov. – ZALÁNYI, 41, fig. 19.

M a t e r i a l : Yalova sample I/3 (partly measured): 20 C, 9 R, 8 L.

M e a s u r e m e n t s (mm):
R: l = 1.238-1.355, h = 0.587-0.645; l/h = 2.109-2.101
L: l = 1.324-1.373, h = 0.651-0.684; l/h = 2.007-2.034

R e l a t i o n s : The Yalova specimens differ from *A. tenuis* by their slighty convex upper posterior margins, the one of *A. tenuis* being straight, resulting in a more pronounced posterior cardinal angle. The posterior lower third is narrower rounded in *A. tenuis* than in the Yalova specimens.

Amplocypris cf. *tenuis* in KRSTIĆ (1973b: 110, pl. 13, figs 1-3) differs from both, the Hungarian and the Turkish specimens, by a very narrowly rounded transition between the ventral and the posterior margin of the left valve and a pointed one of the right valve, both situated at the base of the posterior margin.

R e m a r k s : The dimensions of *A. tenuis* in ZALÁNYI (1944: 41) are l = 1.82, h = 0.80 mm, resulting in a l/h-ratio of 2.275. Based on fig. 19 the l/h ratio is 2.189. The dimensions given in ZALÁNYI's paper are generally too high, compared e. g. to those presented in KRSTIĆ (1973b: 110): L: l = 1.54, h = 0.76; R: l = 1.57, h = 0.75 mm, resulting in l/h-ratios of 2.026 and 2.093.

R e g i o n a l o c c u r r e n c e : *A. tenuis* has been described and illustrated from the Upper Sarmatian of Hungary (ZALÁNYI 1944). However, strata with *A. sinuosa* ZALÁNYI, 1944 and with the association of *Amplocypris* and *Hungarocypris* characterize the Maeotian and the Khersonian to Bessarabian of Hungary respectively (SZÉLES in JÁMBOR et al. 1987: fig. 8), which corresponds to Lower Pontian to Pannonian of the Central Paratethys (POPOV et al. 2004).

P a l a e o e c o l o g y : *Amplocypris* is known from the Paratethys, where it occurs in sandy and brackish facies of Caspian origin (PIPÍK 2001: 217).

Subfamily Cyprinotinae BRONSHTEIN, 1947

Genus *Heterocypris* CLAUS, 1892

Heterocypris formalis (MANDELSTAM, 1963)
Pl. 2, Figs 12-13

*1963 *Cyprinotus formalis* MANDELSTAM sp. n. – MANDELSTAM & SCHNEIDER: 202, pl. 20, fig. 9a-b.
1995 *Cyprinotus* ex gr. *formalis* (MANDELSTAM) – KRSTIĆ: 402, pl. 9, fig. 1.

M a t e r i a l : Yalova, sample I/2 (partly measured): 5 R, 2 L.

M e a s u r e m e n t s (mm):
R♂: l = 0.818, h = 0.455; l/h = 1.798
L: l = 0.862, h = 0.484; l/h = 1.781

R e m a r k s : The Turkish specimens are some 5% shorter and lower than the ones from Middle Asia in MANDELSTAM & SCHNEIDER (1963) and from Serbia in KRSTIĆ (1995). The l/h-ratio based on measurements given in MANDELSTAM & SCHNEIDER (1963: 202) is 1.882, whereas the one based on measurements taken from pl. 20, fig. 9a amounts to 1.762. The l/h-ratio of the specimen illustrated by KRSTIĆ (1995) is 1.830.

O t h e r r e g i o n a l o c c u r r e n c e s : In the Miocene - Pliocene of Dzungaria (MANDELSTAM & SCHNEIDER 1963) and in the Pliocene (Dacian) of Serbia (KRSTIĆ 1995).

P a l a e o e c o l o g y : *H. formalis* has been described from freshwater deposits (MANDELSTAM & SCHNEIDER 1963: 203).

Heterocypris ex gr. *gregaria* (SKOKSBERG, 1917)
Pl. 3, Figs 1-3

1980 *Heterocypris* ex gr. *gregaria* (SKOKSBERG, 1917) – FREELS: 26, pl. 2, figs 14-20.

M a t e r i a l : Yalova Pr. I/2 (partly measured): ♀: 9 R, 7 L; ♂: 2 R, 4 L; unspecified: 7 R, 6 L; 4 V juv.

M e a s u r e m e n t s (mm):
R♀: l = 0.871-0.905, h = 0.473-0.529; l/h = 1.701-1.841
L♀: l = 0.925-0.964, h = 0.524-0.529; l/h = 1.765-1.822
R♂: l = 0.800-0.936, h = 0.447-0.518; l/h = 1.790-1.807
L♂: l = 0.804-0.927, h = 0.458-0.527; l/h = 1.755-1.759

R e m a r k s : The Upper Miocene specimens from Yalova in Western Turkey and the Lower Pliocene ones from Elbistan in Eastern Turkey agree well in outline, in the presence of tiny pustules anteriorly and posteriorly along the outer margin of the right valve, and in the males generally being smaller than the females. The Upper Miocene specimens from Yalova are generally smaller than the Lower Pliocene ones from Elbistan.

Unfortunately there are neither data on dimensions of FREELS' (1980) Upper Miocene specimens from the Afyon area in Western Turkey nor are they illustrated.

Other regional occurrences: In the Upper Miocene of Western and in the Lower Pliocene of Eastern Turkey (FREELS 1980).

Palaeoecology: FREELS (1980: 120) considers *H.* ex gr. *gregaria* a species characteristic for limnic, eventually also slightly brackish environments.

Heterocypris salina (BRADY, 1868)
Pl. 3, Fig. 4

v 2003*Heterocypris salina* (BRADY, 1868) – WITT: 100, pl. 1, figs 14-16. (Further synonyms).

Material: Safran, above main coal bed (partly measured): 2 R, 4 L, 11 V juv; Safran, below main coal bed: 4 R, 3 L, 6 V juv.

Measurements (mm):
R: l = 0.945-0.955, h = 0.564-0.591; l/h = 1.676-1.616
L: l = 0.964-1.109, h = 0.593-0.709; l/h = 1.626-1.564
L juv.: l = 0.818, h = 0.491; l/h = 1.666

Other regional occurrences: In the Upper Miocene of Slovakia (PIPÍK 2001). In the Pliocene of Romania (HANGANU 1966) and Bulgaria (STANCHEVA 1966), Dacian Basin. Greek islands: In the Upper Pliocene and Upper Pleistocene of Kos (MOSTAFAWI 1981, 1988), in the Upper Pliocene of Evia (MOSTAFAWI 1994). Widely known from the Upper Miocene to the Pleistocene of Anatolia (FREELS 1980), and in the Upper Miocene to Lower Pliocene of Western Anatolia (WITT 2003). In the Holocene of Iran (JANZ et al. 2001).

Remark: *Heterocypris salina salina* in NAZIK et al. (1992: pl. 3, fig. 4) is based on the features of the inner lamella and is actually a *Candonopsis kingsleii* (BRADY & ROBERTSON, 1870).

Ecology: The species is considered as euryhaline. JANZ et al. (2001: 188) state that the occurrence of Recent *H. salina* points to a high salt content in lacustrine waters, however, it also occurs abundantly in brackish waters. MEISCH (2000: 355) considers this species as being mesohalophilic, occurring in waters with salinities ranging from ±5-±18‰ in contrast to PIPÍK (2001: 161), who indicates 5-9‰. NEALE (1988: fig. 2) gives a range of 0.4-20‰.

Summarizing, the species is found in both small and slightly salty coastal and inland water bodies, where it often coexists with other halophilic ostracods, however, it also occurs in pure freshwater habitats. Temperature of 15° C combined with a salinity of 5-10‰ offers optimum conditions for the species (MEISCH 2000: 355).

Superfamily Cytheroidea BAIRD, 1850
Family Limnocytheridae KLIE, 1938
Subfamily Limnocytherinae KLIE, 1938

Genus *Leucocythere* KAUFMANN, 1892

Leucocythere aff. *luculenta* (LIVENTAL, 1929)
Pl. 3, Fig. 5

1963 *Leucocythere* aff. *luculenta* (Livental) – STANCHEVA: 10, pl. 1, fig. 7.

Material: Yalova, sample I/2: 5 R, 2 L.

Measurements (mm):
R: l = 0.644-0.709, h = 0.327-373; l/h = 1.899-1.969; w = 0.127
L: l = 0.693-0.709, h = 0.382; l/h = 1.814-1.856

Other regional occurrences: In the Upper Sarmatian of the Euxinic Basin, North-Western Bulgaria (STANCHEVA 1963). The Upper Sarmatian of the Eastern Paratethys equals the Khersonian (STANCHEVA 1990), which corresponds with the Upper Pannonian of the Central Paratethys (POPOV 2004).

Palaeoecology: No palaeoecological data are available on this species. It appears conceivable to accept the ecological characterisation of the type-species of this genus, *L. mirabilis* KAUFMANN, 1892. This species seems to prefer the sublittoral and profundal zones of cold oligotrophic lakes and is also known from slightly brackish habitats (MEISCH 2000: 448).

Family Cytherideidae SARS, 1925

Genus *Cyprideis* JONES, 1857

Cyprideis compacta turgida BASSIOUNI, 1979
Pl. 3, Figs 6-7

*1979 *Cyprideis (Cyprideis) compacta turgida* n. ssp. – BASSIOUNI: 94, pl. 16, figs 5-8.
2001b *Cyprideis* cf. *seminulum* (Reuss, 1850) – TUNOĞLU & ÜNAL: 174, pl. 2, figs 6-7.

Material: Yalova, sample I/2: ♀: 2 C.

Measurements (mm):
C♀: l = 0.896-0.969, h = 0.565-0.582; l/h = 1.586-1.665; w = 0.565-0.582

Relations: *Cyprideis karacasuensis* BASSIOUNI, 1979 from the Upper Miocene of South-Western Anatolia differs by its extreme width of the posterior half of female specimens (BASSIOUNI 1979: pl. 8, fig. 5: 0.750 mm).

C. ruggierii DECIMA, 1964 from the Upper Tortonian and basal Messinian shows a similar dorsal outline (pl. 11, figs 1b, 2b), however, the lateral outline is characterized by a posteriorly sloping dorsal margin comparable to the one of *C. torosa* (JONES, 1850). Moreover, *C. ruggierii* is less high.

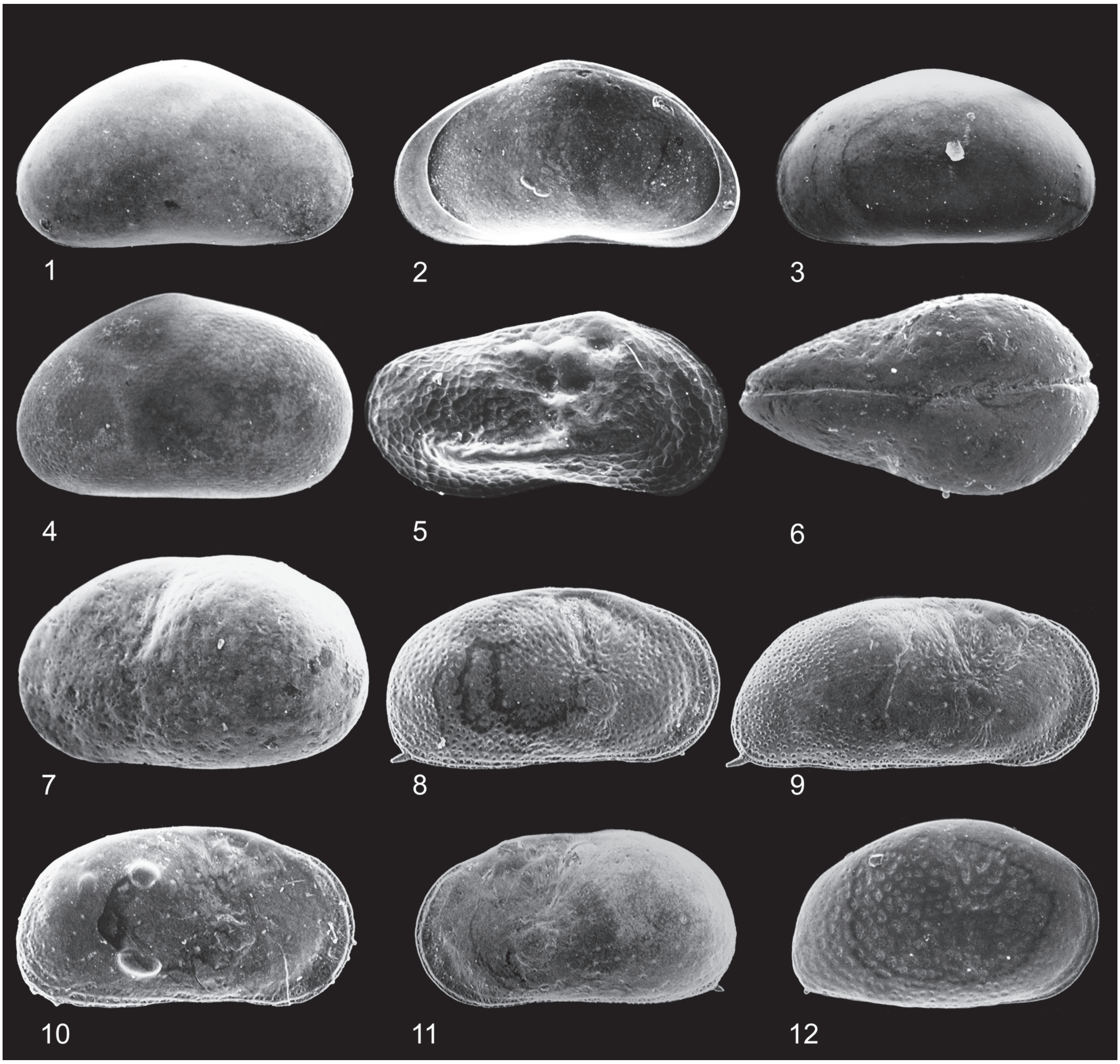


Plate 3

Images were digitally processed to compensate for the distortion produced by the SEM. Figs 1-3, 5-7: Kılıç Formation. Yalova, sample I/2. Figs 4, 8-12: Yalakdere Formation. Figs 4, 8-11: Safran, above main coal seam. Fig. 12: Safran, below main coal seam.

Figs 1-3 : *Heterocypris* ex gr. *gregaria* (Skogsberg, 1917).
Fig. 1: R♂ (l = 0.936, h = 0.518 mm), external view, ca. x 54; BSP 1980 X 1281.
Fig. 2: R♀ (l = 0.900, h = 0.529 mm), internal view, ca. x 58; BSP 1980 X 1280.
Fig. 3: L♀ (l = 0.964, h = 0.529 mm), external view, ca. x 50; BSP 1980 X 1346.

Fig. 4: *Heterocypris salina* (Brady, 1868). L (l = 0.964, h = 0.595 mm), external view, ca. x 53; BSP 1980 X 1347.

Fig. 5: *Leucocythere* aff. *luculenta* (Liventál, 1929). L (l = 0.709, h = 0.382 mm) external view, ca. x 77; BSP 1980 X 1283.

Figs 6, 7: *Cyprideis compacta turgida* Bassiouni, 1979.
Fig. 6: C♀ (l = 0.969, b = 0.565 mm), dorsal view, ca. x 57; BSP 1980 X 1278.
Fig. 7: C♀ (l = 0.896, h = 0.565 mm), external view, ca. x 60; BSP 1980 X 1278.

Figs 8-11: *Cyprideis torosa* (Jones, 1850).
Fig. 8: R♀ (l = 0.849, h = 0.462 mm), external view, ca. x 67; BSP 1980 X 1349.
Fig. 9: R♂ (l = 1.036, h = 0.495 mm), external view, ca. x 49; BSP 1980 X 1348.
Fig. 10: R♀ (l = 0.905, h = 0.491 mm), external view, ca. x 55; BSP 1980 X 1351.
Fig. 11: L♀ (l = 0.971, h = 0.491 mm), external view, ca. x 53; BSP 1980 X 1350.

Fig. 12: *Cyprideis* sp. juv. R, juv. (l = 0.691, h = 0.433 mm), external view, ca. x 69; BSP 1980 X 1352

R e m a r k s : One of the Yalova specimens (Pl. 3, Fig. 6) shows a dorsal outline like the one in BASSIOUNI (1979: pl. 16, fig. 12). The other Yalova specimen, as well as TUNOĞLU & ÜNAL's specimen, show a more pronounced concavity at mid-length in dorsal view than the one illustrated by BASSIOUNI (1979).

TUNOĞLU & ÜNAL's *Cyprideis* cf. *seminulum* (REUSS, 1850) is *C. compacta turgida* BASSIOUNI, 1979 based on dimensions, the lateral outline of the illustrated valve and the concavity at mid length of the carapace in dorsal view. The latter feature is not apparent in *C. compacta compacta* BASSIOUNI, 1979.

O t h e r r e g i o n a l o c c u r r e n c e s : In the Middle Miocene of Central Anatolia (BASSIOUNI 1979) and in the Middle to Late Pannonian of Thrace (TUNOĞLU & ÜNAL 2001b).

P a l a e o e c o l o g y : *Cyprideis compacta turgida* is considered to have been a brackish water species (BASSIOUNI 1979: 38).

Cyprideis torosa (JONES, 1850)
Pl. 3, Figs 8-11

1976 *Cyprideis torosa* (JONES) – GUERNET et al.: 66, pl. 1, figs 16-17.
1979 *Cyprideis torosa* (JONES, 1850) – BASSIOUNI: 100, pl. 5, figs 14-15.
1981 *Cyprideis torosa* (JONES, 1850) – MOSTAFAWI: 142, pl. 4, figs 7, 16. (Further synonyms).
1989 *Cyprideis torosa* (JONES, 1850) – ZANGGER & MALZ: pl. 3, figs 11-12.
1994 *Cyprideis torosa* (JONES, 1850) – MOSTAFAWI: fig. 5/3.
1995 *Cyprideis torosa* JONES, 1850 – TUNOĞLU et al.: pl. 1, figs 1-5.
1995 *Cyprideis torosa* (JONES) – GÜLEN et al.: pl. 1, fig. 4a-b.
1998 *Cyprideis torosa* (JONES, 1857) – HAJJAJI et al.: pl.1, fig. 16.
2003 *Cyprideis torosa* (JONES, 1850) – GUERNET et al.: 81, pl. 1, fig. 19.

M a t e r i a l : Safran, above main coal bed (partly measured): ♂: 2 R; ♀: 1 C, 24 R, 11 L; numerous V juv.; Safran, below main coal bed: ♂: 1 R, 3 L; ♀: 3 R, 1 L; 22 V juv.; Yalova, sample I/2: ♀: > 50; ♂: > 50; > 50 V juv.

M e a s u r e m e n t s (mm):
R♂: l = 1.033-1.036, h = 0.487-0.495; l/h = 2.121-2.093
R♀: l = 0.849-0.922, h = 0.462-0.491; l/h = 1.838-1.878
L♀: l = 0.891-0.960, h = 0.491-0.509; l/h = 1.815-1.886

R e l a t i o n s : Upper Miocene related species are *C. bendai bendai* BASSIOUNI, 1979, described from the Upper Miocene of Turkey and *C. mehesi* SISSINGH, 1972, known from Lower Pannonian of Austria, Hungary and Moravia, the Lower and Middle Pannonian and Lower Pontian of Romania, and from the Upper Miocene of Turkey (BASSIOUNI 1979: 103). The first one is identical in outline and l/h-ratio, but there is often a thickening along the posterior margin, as shown in BASSIOUNI (1979: pl. 4, figs 16, 18). This feature is, however, not an integral part of the diagnosis. BASSIOUNI (1979: 102) considers the smaller *C. mehesi* being the stem species of *C. torosa.*

R e m a r k s : The *Cyprideis* associations comprise right valves with one posteroventral spine (pl. 3, fig. 9), which is in accordance with the definition of *C. torosa* in MEISCH (2000: 459). However, KOLLMANN (1960: pl. 12, figs 10-11) shows Recent carapaces of *C. torosa* with right valves having anteriorly marginal denticulations additionally to the single posteroventral spine. DECIMA (1964: 117) includes specimens with additional anterior spines and specimens without spines in the description of the species. Furthermore GUERNET et al. (1976: pl. 1, figs 16-17) depict a female right valve of *C. torosa* with anterior marginal denticulations from the Pliocene of Kos.

In the present material there are right valves with additional anterior marginal denticulation (Pl. 3, Fig. 8), left valves with one posteroventral spine (Pl. 3, Fig. 11) and right valves with more than one posteroventral spine and anterior marginal denticulations (Pl. 3, Fig. 10). Few juveniles possess 2 posteroventral spines on the right valve.

Although the listing below suggests *C. torosa* occurring since the Pliocene, the fossil record of the species is Miocene to Recent (MEISCH 2000: 463).

O t h e r r e g i o n a l o c c u r r e n c e s : Greek mainland and islands: In the Upper Pliocene of Evia (MOSTAFAWI 1994) and Rhodes (SISSINGH 1972), in the Upper Pliocene and Upper Pleistocene of Kos (GUERNET et al. 1976; MOSTAFAWI 1981), in the Pleistocene of the Gulf of Argos (ZANGGER & MALZ 1989), in the Upper Pliocene to Lower Pleistocene of Rhodes (MOSTAFAWI 1989a; HAJJAJI et al. 1998) and in the Upper Pleistocene to Holocene in the Gulf of Corinth (GUERNET et al. 2003). In the Pliocene of Central Anatolia (TUNOĞLU et al. 1995), in the Plio-Pleistocene of Turkey (BASSIOUNI 1979) and in the Pleistocene to Holocene of İzmit Bay (GÜLEN et al. 1995).

E c o l o g y : The Recent *C. torosa* is found very commonly in brackish coastal waters with fluctuating salinitiy (MEISCH 2000: 463) in localities ranging from Kola Peninsula as the northernmost to South Africa as the southernmost locality (WOUTERS 2003). According to VAN MORKHOVEN (1963: 290) most *Cyprideis* species are found in brackish (meso-polyhaline) habitats, which correspond to ±3-±30‰ salt content. NEALE (1988: fig. 2) gives a range of 0.4-75‰. The optimal population development is found at salinities of 2-16.5‰ (MEISCH 2000: 463).

The species prefers mud or a sandy mud substrate. On soft mud with organic detritus mass development can occur. *C. torosa* occurs in coastal ponds, lakes, lagoons, estuaries, deltas, salt marshes and other marginal marine environments, down to a depth of 30 m (MEISCH 2000: 463).

Since unnoded specimens predominate in the present samples, salinities are estimated to be higher than approximately 5‰ (MEISCH 2000: 462).

Cyprideis sp. juv.
Pl. 3, Fig. 12

M a t e r i a l : Safran, below main coal bed: 1R juv.

M e a s u r e m e n t s (mm):
R juv.: l = 0.691, h = 0.433, l/h = 1.596

R e m a r k s : The specimen belongs to the *C. brevis*-group, characterized by high valves in relation to their length (KRSTIĆ 1968: 156).

R e l a t i o n s : The lateral outline compares well with the one of the juvenile *C. maxima* CARBONNEL, 1969 (pl. 12, fig. 24) from the Pliocene of the Rhône Basin. The Turkish specimen is characterized by an arrangement of medium sized pits following the ventral and posterior margin. Towards the anterior end the size of the pits is reduced. The juvenile *C. maxima* shows an irregular arrangement of large pits, which increase in size towards the anterior end.

Certain features of this juvenile form are also comparable with those of *C. fusus* KRSTIĆ, 1968. The l/h-ratio of a juvenile left valve (KRSTIĆ 1968: pl. 4, fig. 9) is comparable with the one of the present form. Furthermore, the position of the highest point in the anterior half, and the ornamentation, medium sized pits, are in common. *C. fusus* occurs in the Upper Miocene to Lower Pliocene *Congeria*-Beds of the Pannonian Basin (KRSTIĆ 1968). It has also been proven in the Pontian of Eastern Serbia (SOKAČ 1989: 691; KRSTIĆ & STANCHEVA 1989: pl. 9, fig. 1).

E c o l o g y : The genus generally occurs in meso- to polyhaline brackish waters (±3-±30‰ salt content) (VAN MORKHOVEN 1963: 290).

3.2 Palaeoecological and Stratigraphical Evaluation (Tab. 1)

Table 1 summarizes the stratigraphical distribution and the (palaeo-)ecological information, the latter as given for individual species in section 3.1 “Systematic Descriptions”. Ranges are mainly based on regional literature: Greece, the Aegean and its islands and Turkey and, where appropriate, to the Balkans.

3.2.1 Palaeoecology

The palaeoecological interpretations are merely preliminary point observations and do not cover all possible depositional environments of a lacustrine and fluviatile deltaic setting, since ostracod bearing sample density compared with the thickness of both formations is too low.

However, considering all biota and lithological characteristics, the following interpretation is presented in RÜCKERT-ÜLKÜMEN et al. (subm.): While the Kılıç Formation comprises sediments of fluviatile deltaic systems, connected to lagoons with partly reduced water energy, the Yalakdere Formation exemplifies a freshwater habitat, including stagnant water bodies with a seasonally slightly varying salinity and, at most, moderately flowing rivers.

The following interpretations are, however, solely considering the evidence provided by the ostracod associations.

3.2.1.1 Yalakdere Formation

The ostracod associations of both Safran samples of the Yalakdere Formation do not differ significantly, the main deviation being the greater number of *Cyclocypris* species in the sample below main coal bed.

The associations show a co-occurrence of species characteristic for higher salinities, the major faunal elements *Cyprideis torosa* associated with *Heterocypris salina*, and those of limnic to oligo/mesohaline waters, dominated by *Candona (Neglecandona) decimai* and *Candona (C.) burdurensis*, and in small numbers, *Darwinula stevensoni*, *Pseudocandona* cf. *compressa*, and *Vestalenula cylindrica*. *Cyclocypris nitida* and *Ilyocypris* sp., both rare in the sample above, and *Cyclocypris* cf. *laevis*, abundant in the sample below main coal bed, generally characterize freshwater habitats.

Abundant *Cyprideis torosa*, however, can also be indicative of sediments rich in organic detritus (MEISCH 2000: 463), and, indeed, both Safran samples were taken in the immediate vicinity of coal (lignite). Rich plant life is shown by the abundance of *Cyclocypris* in the sample below main coal bed.

These euryhaline associations probably reflect seasonal rainfall. Freshwater conditions prevailed in the cool rainy season and probably oligohaline ones in the warm dry season. Data on depth distribution indicate shallow water. Low water energy is indicated by the co-occurrence of adult and juvenile specimens.

The uniformity of preservation of the ostracod specimens precludes mixing of faunas from habitats different in salinities.

Summarizing, the ostracod associations of the coal-bearing part of the Yalakdere Formation indicate a shallow, low energy, freshwater habitat with seasonally fluctuating salinities, probably in the oligohaline range.

3.2.1.2 Kılıç Formation

Each of the three Yalova samples of the Kılıç Formation contains a different ostracod association and hence indicates a different depositional environment.

Yalova sample I/2 contains fresh and brackish water species. *Candona (Neglecandona) decimai* and *Heterocypris* ex gr. *gregaria*, *Heterocypris formalis* and *Leucocythere* aff. *luculenta* basically indicate freshwater conditions, very abundant *Cyprideis torosa* and rare *Cyprideis compacta turgida* point to brackish water, probably in the range above 5‰. The presence of juveniles of *Cyprideis torosa* proves a low energy environment and *Leucocythere* aff. *luculenta* marks deeper water.

Summarizing, this association is interpreted to indicate a lagoon with variable salinities. The co-occurrence of fresh and brackish water species is probably due to a seasonal change of precipitation resulting in salinity changes.

The association of Yalova sample I/3 contains only two species: Abundant adult *Amplocypris* aff. *tenuis* and rare adult *Candona (Neglecandona)* sp. 1, both large, thick shelled species, the latter strongly ornamented. *Amplocypris* is known from the Paratethys, where it occurs in sandy and brackish facies of Caspian origin (PIPÍK 2001: 217). The solid shells of both species probably indicate their habitat being rather sandy than muddy. Lack of juveniles and other smaller species point to further sorting by water movements or currents, meaning the remaining large specimens have undergone a winnowing process. Therefore this association derived from a semi-consolidated sand sample is interpreted to represent a sand bar,

Yalakdere Formation - Safran samples, above and below main coal bed		
Darwinula stevensoni (Brady & Robertson, 1870) Middle/Late Miocene to Late Pleistocene	c / r	In habitats up to 15 ‰ salinity (Neale 1988: fig. 2; Meisch 2000: 51).
Vestalenula cylindrica (Straub, 1952) Middle/Late Miocene to Holocene	r / r	In lakes and brackish waters (Janz et al. 2001: 186).
Candona (C.) burdurensis Freels, 1980, incl. juv. (Late Miocene? to) Pliocene?, Pleistocene	a / c	Lake deposits (Freels 1980: 102).
Candona (C.) compressaeformis Mandelstam, 1963 Pannonian to Pleistocene	vr / -	Freshwater (Pipík 1998: 168).
Candona (Neglecandona) decimai Freels, 1980, incl. juv. Late Miocene to Late Pleistocene	c /a	Limnic, possibly also slightly brackish (Freels 1980: 120).
Pseudocandona cf. *compressa* (Koch, 1838) Middle Miocene to Late Pleistocene	r / r	Fresh- and oligo-mesohalophilic, inland and coastal waters. Prefers the shallow littoral, max. 8 m (Meisch 2000: 180).
Cyclocypris cf. *laevis* (O. F. Müller, 1776) Late Miocene and ?younger	- / a	In wide range of freshwater bodies, eurythermophilic and mesohalophilic (Meisch 2000: 237).
Cyclocypris nitida Sieber, 1905 Middle Miocene and ?younger	r / -	In the littoral of inland waters, richly vegetated. Euryplastic for temperature and current, mesohalophilic (Meisch 2000: 239 for *C. ovum* Jurine, 1820).
Ilyocypris sp., cf. *Ilyocypris* sp. Janz, 1992 Oligocene to Recent (genus)	r / -	Small permanent freshwater bodies, also oligohalophilic (Meisch 2000: 246).
Heterocypris salina (Brady, 1868), incl. juv. Late Miocene to Recent	c / c	Mesohalophilic, also in pure fresh-water. Opt. conditions: 15° C and salinity of 5-10 ‰ (Meisch 2000: 355).
Cyprideis torosa (Jones, 1850), incl. juv. Late Miocene to Recent	a / a	Commonly down to 30 m in brackish coastal waters with fluctuating salinity. At 2-16.5 ‰ greatest development. Predom. unnoded specimens in salinities > ca. 5 ‰ (Meisch 2000: 462-463).
Kılıç Formation - Yalova sample I/2		
Candona (Neglecandona) decimai Freels, 1980, incl. juv As above	a	As above
Heterocypris ex gr. *gregaria* (Skogsberg, 1917) Late Miocene to Early Pliocene	a	Limnic, possibly also slightly brackish (Freels 1980: 120).
Heterocypris formalis (Mandelstam, 1963) Miocene to Pliocene	c	Freshwater deposits (Mandelstam & Schneider 1963: 203).
Leucocythere aff. *luculenta* (Livental, 1929) Late Pannonian (Khersonian)	c	Type-species of genus in the sublittoral and profundal of cold oligotrophic lakes (Meisch 2000: 448).
Cyprideis compacta turgida Bassiouni, 1979 Middle Miocene to Late Pannonian	r	Brackish water (Bassiouni 1979: 38).
Cyprideis torosa (Jones, 1850) incl. juv. As above	va	As above
Kılıç Formation - Yalova sample I/3		
Candona (Neglecandona) sp. 1 Late Miocene to Recent (subgenus)	r	Caspibrackish (3-8 ‰), high energy.
Amplocypris aff. *tenuis* Zalányi, 1944 Pannonian	a	Genus in sandy and brackish facies (Pipík 2001: 217).
Kılıç Formation - Yalova sample I/5		
Candona (Neglecandona) decimai Freels, 1980, incl. juv. As above	a	As above
Candona (Neglecandona) aff. *neglecta* Sars, 1887 Pannonia to Pontian	r	In lakes from shallow littoral to profundal. Also in slightly salty inland and coastal waters (Meisch 2000: 80).
Candona (Neglecandona) sp. 2 Late Miocene to Recent (subgenus)	r	Fresh and slightly brackish waters.

Table 1: Stratigraphical distribution and (palaeo-)ecological data for ostracods of the Yalakdere and Kılıç Formations. The middle column shows species abundance, left for sample above and right for sample below main coal bed. Abbreviations: vr = very rare, r = rare, c = common, a = abundant, va = very abundant.

or a beach within a deltaic area.

The third association of Yalova sample I/5 is dominated by limnic *Candona (Neglecandona) decimai* and contains furthermore rare *Candona (Neglecandona)* aff. *neglecta* and *Candona (Neglecandona)* sp. 2. This association of candonids is considered to be derived from a low energy, probably lacustrine freshwater habitat.

3.2.2 Faunal Relations

There is a fundamental difference between the ostracod associations of the Safran and Yalova samples and the typical Pontian ones from the Turkish Black Sea coast (TUNOĞLU & GÖKÇEN 1997) and the Pontian at Karamürsel (GILLET et al. 1978: 60), only some 30 km east of Yalova.

The following Paratethyan Pontian brackish water ostracod species have been proven at Karamürsel (GILLET et al. 1978: 60): *Tyrrhenocythere* cf. *pignattii* RUGGIERI, 1955, *Candona (Caspiocypris)* cf. *pontica* SOKAČ, 1972, *Candona (Lineocypris) trapezoidea* (ZALÁNYI, 1929), *Loxoconcha* cf. *rhombovalis* POKORNÝ, 1952 and *Leptocythere (Amnicythere)* cf. *andrusovi* (LIVENTAL, 1929). None of these species have been encountered in the Safran and Yalova samples, thus supporting negative evidence for a Pannonian age of these samples. The above cited association points to a salinity of 3-8‰, typical for brackish waters of the Pannonian, Euxinian and Caspian Basins (POKORNÝ 1952: 364).

Faunal relations are well developed with the Neogene Basins of Anatolia, Thrace, mainland Greece and Greek Islands and for a number of species, viz. *Darwinula stevensoni*, *Candona (C.) compressaeformis*, *Candona (Neglecandona) decimai*, *Amplocypris* aff. *tenuis*, *Heterocypris formalis*, *Heterocypris salina*, and *Leucocythere* aff. *luculenta* with the Paratethyan basins. A different taxonomy of authors working in different countries precludes a better comparison.

Still, with the brackish and lagoonal Pannonian to Pontian sequence of the adjacent Gelibolu Basin of Thrace, showing connections with the Euxinic and Pannonian Basins, there are 3 species in common, *Candona (Neglecandona)* aff. *neglecta*, *Heterocypris salina* and *Cyprideis torosa*. This association can be best accomodated in the Late Pannonian *Cyprideis tuberculata* (=*C. mehesi*)/*Heterocypris salina* - Zone of TUNOĞLU & ÜNAL (2001a, b).

3.2.3 Age of the Yalakdere and Kılıç Formations

EMRE's et al. (1998: fig. 4) and ELMAS' (2003: fig. 5) representative stratigraphical sections indicate a Late Miocene to Early Pliocene age for the Kılıç Formation grading laterally and vertically into the Yalakdere Formation. RÜCKERT-ÜLKÜMEN et al. (subm.) prove both units being Late Miocene in age.

3.2.3.1 Yalakdere Formation

The *Cyprideis* and *Candona* associations of the Yalakdere Formation, not containing Paratethyan brackish water ostracods in major numbers, indicate a Late Miocene to Pleistocene age. The single specimen of *Candona (C.) compressaeformis* constrains this interpretation to Pannonian to Pleistocene.

Most *Cyprideis* and *Candona* s. str. associations characterize any one of the Neogene low salinity stages (KRISTIĆ & STANCHEVA 1989: 759). KRSTIĆ (1971: 391) statement "in the Pont the caspibrackish regime became predominant in the whole Paratethys" rather points to an age other than Pontian.

3.2.3.2 Kılıç Formation

The assemblage of *Cyprideis torosa, Candona (Neglecandona) decimai, Heterocypris* ex gr. *gregaria*, and *H. formalis* permits only a broad age assignment, Late Miocene to Early Pliocene.

Leucocythere aff. *luculenta* has been proven in the Euxinic Basin, in the Upper Sarmatian of North-western Bulgaria (STANCHEVA 1963). The Upper Sarmatian of the Eastern Paratethys, the Khersonian, corresponds with the Late Pannonian of the Central Paratethys (POPOV 2004: fig.), thus constraining the age of this assemblage to the Khersonian. *Cyprideis compacta turgida* occurring in the Middle to Late Pannonian Gelibolu Basin of Thrace (TUNOĞLU & ÜNAL 2001a) is supporting evidence.

Summarizing, the ostracod associations of the Kılıç clastics at Yalova are Late Pannonian, or in Eastern Paratethys terminology, Khersonian, in age.

Acknowledgements

N. RÜCKERT-ÜLKÜMEN (Munich, Germany) provided the material, washed residues and slides with picked ostracods. E. YIĞITBAŞ (Çanakkale, Turkey), prepared the regional columnar section. M. BÖHME (Munich, Germany) provided Russian literature and helped with the translation of Russian and Bulgarian texts. N. KRSTIĆ (Belgrade, Serbia) supplied Yugoslavian publications and gave many helpful advice concerning taxonomic questions. D. HORNE (London, Great Britain) and N. MOSTAFAWI (Kiel, Germany) critically read an earlier version of the manuscript and provided helpful suggestions for improvement. We sincerely wish to thank all of them.

4. References

BASSIOUNI, M. A. (1979): Brackische und marine Ostrakoden (Cytherideinae, Hemicytherinae, Trachyleberidinae) aus dem Oligozän und Neogen der Türkei. – Geologisches Jahrbuch, **B31:** 3-195.

CARBONNEL, G. (1969): Les ostracodes du Miocène Rhodanien. – Documents des Laboratoires de Géologie de la Faculté des Sciences de Lyon, **32:** 1-469.

DANATSAS, I. (1994): Jungneogene Ostrakoden aus der NW- und N-Peloponnes (Griechenland). – Münstersche Forschungen zur Geologie und Paläontologie, **76:** 97-167.

DECIMA, A. (1964): Ostracodi di Gen. *Cyprideis* JONES del Neogene e del Quaternario italiani. – Palaeontographica Italica, **57:** 81-134.

ELMAS, A. (2003): Late Cenozoic tectonics and stratigraphy of northwestern Anatolia. - International Journal of Earth Sciences (Geologische Rundschau), **92:** 380-396.

EMRE, Ö., ERKEL, T., TCHEPALYGA, A., KAZANCI, N., KEÇER, M. & ÜNAY, E. (1998): Neogene-Quaternary evolution of the eastern Marmara region. – Bulletin of the Mineral Research and Exploration Institute of Turkey (Foreign Edition), **120:** 119-145.

FREELS, D. (1980): Limnische Ostrakoden aus dem Jungtertiär und Quartär der Türkei. – Geologisches Jahrbuch, **B39:** 3-169.

GILLET, S., GRAMANN, F. & STEFFENS, P. (1978): Neue biostratigraphische Ergebnisse aus dem brackischen Neogen an Dardanellen und Marmara-Meer (Türkei). – Newsletter on Stratigraphy, **7:** 53-64.

GÖKÇEN, N. (1979a): Denizli - Muğla çevresi Neojen istifinin stratigrafisi ve paleontolojisi. (Neogene stratigraphy and paleontology of Denizli – Muğla area (SW Anatolia)) – Doçentlik Tezi; Ankara (Hacettepe Üniversitesi Ankara), 154 pp. [in Turkish].

GÖKÇEN, N. (1979b): Stratigraphy and Paleogeography of the Neogene Sequences of the Denizli – Mugla Region (SW Anatolia) – 7th International Congress on Mediterranean Neogene. – Annales Géologiques des Pays Helléniques, Tome hors série, fasc. 1, 467-474.

GRAMANN, F. (1969): Das Neogen im Strimon-Becken (Griechisch-Ostmazedonien). Teil II Ostracoden und Foraminiferen aus dem Neogen des Strimon-Beckens. – Geologisches Jahrbuch, **87:** 485-528.

GROSS, M. (2004): Zur Ostracodenfauna (Crustacea), Paläoökologie und Stratigrafie der Tongrube Mataschen (Unter-Pannonium, Steirisches Becken; Österreich). – Joannea Geologie und Paläontologie, **5:** 49-129.

GÜLEN, D., KUBANÇ, C. & ALTINSAÇLI, S. (1995): İzmit Körfezi (Hersek Burun - Kaba Burun) Kuvaterner İstifinin Ostrakod faunası (Ostracoda fauna of the Quaternary sequence in the Gulf of İzmit (Hersek Burun - Kaba Burun). – In: MERSIÇ, E. (Ed.), İzmit Körfezi Kuvaterner İstifi (Quaternary sequence in the Gulf of İzmit); İzmit (Military College Printing House), 153-171. [in Turkish]

GUERNET, C., KERAUDREN, B & SAUVAGE, J. (1976): La série «Levantine» du Cap Phocas (Île de Kos, Dodécanèse, Grèce): Stratigraphie, palynologie et paléoécologie. – Revue de Micropaléontologie, **19:** 61-73.

GUERNET,C., LEMEILLE, F., SOREL, D., BOURDILLON, C., BERGE-THIERRY, C. & MANAKOU, M. (2003): Les Ostracodes et le Quaternaire d'Aigion (Golfe de Corinthe, Grèce). – Revue de Micropaléontologie, **46:** 73-93.

HAJJAJI, M., BODERGAT, A. M., MOISSETTE, P., PRIEUR, A. & RIO, M. (1998): Signification écologique des associations d'Ostracodes de la coupe de Kritika (Pliocène supérieur, Rhodes, Grèce). – Revue de Micropaléontologie, **41:** 211-233.

HANGANU, E. (1966): Studiul stratigrafic al Pliocenului dintre Teleajen şi Prahova (Regiunea Ploieşti). (Etude stratigraphique du Pliocène situé entre les vallées de Teleajen et de Prahova (Région de Ploieşti). – Comitetul de Stat Al Geologiei, Studii Technice Şi Economice Inst. Geol., **J2:** 1-127.

HARTMANN, G. (1975): Dr. H. G. Bronns Klassen und Ordnungen des Tierreichs. – In: H.-E. GRUNER, H. E. (Ed.), Fünfter Band: Arthropoda, 1. Abteilung Crustacea, 2. Buch, IV. Teil: Ostracoda, 4. Lieferung; Jena (Fischer), 569-786.

HEIZMANN, E. P. J. & REIFF, W. (2002): Der Steinheimer Meteorkrater; München (Pfeil), 160 pp.

JÁMBOR, A. & 26 co-authors (1987): General characteristics of Pannonian s. l. deposits in Hungary. – Proceedings of the VIIIth RCMNS Congress. – Annales Instituti Geologici Publici Hungarici, **70:** 155-167.

JANZ, H. (1992): Die miozänen Süßwasserostrakoden des Steinheimer Beckens (Schwäbische Alb, Süddeutschland). – Stuttgarter Beiträge zur Naturkunde, Serie B, **183:** 117 pp.

JANZ, H. (1994): Zur Bedeutung des Schalenmerkmals ‚Marginalrippen' der Gattung *Ilyocypris* (Ostracoda, Crustacea). – Stuttgarter Beiträge zur Naturkunde, Serie B, **206:** 19 pp.

JANZ, H. (1997): Die Ostrakoden der *kleini*-Schichten des miozänen Kratersees von Steinheim am Albuch (Süddeutschland). – Stuttgarter Beiträge zur Naturkunde, Serie B, **251:** 101 pp.

JANZ, H., JELLINEK, T. & HAMEDANI, A. (2001): Holozäne Süßwasser-Ostracoden aus dem Iran. – Senckenbergiana lethaea, **81:** 183-205.

KOLLMANN, K. (1960): Cytherideinae und Schulerideinae n. subfam. (Ostracoda) aus dem Neogen des östl. Oesterreich. – Mitteilungen der Geologischen Gesellschaft in Wien, **51:** 89-195.

KRSTIĆ, N. (1968): Ostracodes des Couches Congériennes: 3. *Cyprideis* II. – Bulletin du Muséum d'Histoire Naturelle (Beograd), Série A, **23:** 153-183.

KRSTIĆ, N. (1971): Ostracode biofacies in the Pannone. – In: OERTLI, H. J. (Ed.), Paléoécologie des Ostracodes Colloque Pau (1970) – Bulletin du Centre de Recherches de Pau-SNPA, **5** (supplement)**:** 391-397.

KRSTIĆ, N. (1973a): Pliocene ostracodes from Metohija: 1. Pontian of the Kruševo locality. – Bulletin du Muséum d'Histoire Naturelle (Beograd), Série A, **28:** 151-173.

KRSTIĆ, N. (1973b): Biostratigraphy of the Congerian Beds in the Belgrade region on the basis of ostracoda with a description of the species of the genus *Amplocypris*. – Institute for Geological and Mining Exploration and Investigation of Nuclear and other Minerals Raw Materials, Monographs 4; Beograd**,** 158 pp. [in Serbo-Croat with English summary]

KRSTIĆ, N. (1985): Ostracoden im Pannonien der Umgebung von Belgrad. – In: PAPP, A., JÁMBOR, Á., & STEININGER, F. F. (Eds), Chronostratigraphie und Neostratotypen, 7, Pannonien (Slavonien und Serbien); Budapest (Akadémiai Kiadó), 103-143.

KRSTIĆ, N. (1993): Some new taxons of the Plio-Quaternary ostracodes. – Annales Géologiques de la Peninsule Balkanique, **57:** 117-139.

KRSTIĆ, N. (1995): Ostracodes of Lower and Middle Paludinian Beds of Fruška Gora s. l. – In: Chronostratigraphy and Neostratotypen IX Dacien; Bucharest (Verlag Rumänische Akademie), 387-425.

KRSTIĆ, N. & GUAN SHAO-ZENG (2001): A proposal for the systematics of the subfamily Candoninae (Ostracodes) with the description of *Macedocandona*, new genus. – Geologica Macedonica, **14:** 25-48.

KRISTIĆ, N. & STANCHEVA, M. (1989): Ostracods of Eastern Serbia and Northern Bulgaria with notes on a Northern Turkish assemblage and some Mediterranean assemblages. – In: STEVANOVIĆ, P., NEVESSKAJA, L. A., MARINESCU, F., SOKAČ, A. & JÁMBOR, A. (Eds), Chronostratigraphie und Neostratotypen, 8, Pontien; Beograd (Jazu & Savu), 753-819.

LUTZ, A.-K. (1965): Jungtertiäre Süßwasser-Ostracoden aus Süddeutschland. – Geologisches Jahrbuch, **82:** 271-330.

MANDELSTAM, M. I. & SCHNEIDER, G. F. (1963): Iskopaemye ostrakody SSSR. Semejstvo Cyprididae. (The fossil Ostracoda of the U.S.S.R: Family Cyprididae.). – Trudy Vsesoyusnogo Nauchno-Issledovatelskogo Geologo-Razvedochnogo Neftyanogo Instituta (VNIGRI), **203:** 1-332. [in Russian]

MATZKE-KARASZ, R. (1996): Aktuelle Gattungs- und Artmerkmale bei *Scottia*, *Cyclocypris*, *Psychrodromus* und *Mesocypris* (Ostracoda). – Sonderveröffentlichungen des Geologischen Instituts der Universität zu Köln, **97:** 285 pp.

MEISCH, C. (2000): Freshwater Ostracoda of Western and Central Europe; Heidelberg, Berlin (Spektrum Akademischer Verlag), 552 pp.

MOSTAFAWI, N. (1981): Marine Ostracoden aus dem Oberpliozän im Mittelteil der Insel Kos (Griechenland). – Meyniana, **33:** 133-187.

MOSTAFAWI, N. (1988): Süßwasser-Ostracoden aus dem Plio-Pleistozän der Insel Kos (Griechenland). – Meyniana, **40:** 175-193.

MOSTAFAWI, N. (1989a): Limnische und marine Ostracoden aus dem Neogen der Insel Rhodos (Griechenland). – Courier Forschungsinstitut Senckenberg, **113:** 117-157.

MOSTAFAWI, N. (1989b): Neogene Ostracoden von Chersonisos und Vrysses (Kreta, Griechenland). – Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, **178:** 183-201.

MOSTAFAWI, N. (1990): Neogene Ostracoden von Kythira, Griechenland. – Courier Forschungsinstitut Senckenberg, **123:** 161-179.

MOSTAFAWI, N. (1994): Süßwasser-Ostracoden aus dem Ober-Pliozän von N-Euböa (Griechenland). – Neues Jahrbuch für Geologie und Paläontologie Monatshefte, **1994:** 309-319.

MOSTAFAWI, N. (1996): Neogene Ostracodenfaunen im Gebiet südlich von Thessaloniki (Nordgriechenland). – Senckenbergiana lethaea, **76:** 159-173.

NAZIK, A., ŞAFAK, Ü. & ŞENOL, M. (1992): Micropaleontological investigation (Ostracoda) of the Pliocene sequence of the Tufanbeyli (Adana) area. – Geosound, special issue, 1st International Symposium on Eastern Mediterranean Geology; Adana, 281-304.

NEALE, J. W. (1988): Ostracods and Palaeosalinity reconstruction. – In: DE DECKKER, P., COLIN, J.-P. & PEYPOUQUET, J.-P. (Eds), Ostracoda in the Earth Sciences; Amsterdam, Oxford, New York, Tokyo (Elsevier), 125-155.

PIPÍK, R. (1998): Salinity changes recorded by Ostracoda assemblages found in Pannonian sediments in the western margin of the Danube Basin. – Bulletin du Centre de recherches Elf exploration production, Mémoire, **20:** 167-177.

PIPÍK, R. (2001): Les ostracodes d'un lac ancien et ses paléobiotopes au Miocène supérieur: Le Bassin de Turiec (Slovaquie). – Thèse Université Claude Bernard Lyon I, 337 pp.

POKORNÝ, V. (1952): The Ostracods of the so-called Basal Horizon of the Subglobosa Beds at Hodonín (Pliocene, Inner Alpine Basin, Czechoslovakia). – Sborník Ústředního Ústavu Geologickéno, **19:** 229-396.

POPOV, S. V., RÖGL, F., ROZANOV, A. Y., STEININGER, F. F., SHCHERBA, I. G. & KOVAC, M. [Eds] (2004): Lithological - Paleogeographic maps of Paratethys - 10 Maps Late Eocene to Pliocene. – Courier Forschungsinstitut Senckenberg, **250:** 1-46.

ROSSETTI, G. & MARTENS, K. (1998): Taxonomic revision of the Recent and Holocene representatives of the Family Darwinulidae (Crustacea, Ostracoda), with a description of three new genera. – Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie, **68:** 55-110.

RÜCKERT-ÜLKÜMEN, N., KOWALKE, T., MATZKE-KARASZ, R., WITT, W. & YIĞITBAŞ, E. (Newsletters on Stratigraphy; in review): Biostratigraphy of the Paratethyan Neogene at Yalova (İzmit-Province, NW-Turkey).

ŞAFAK, Ü., NAZIK, A. & ŞENOL, M. (1992): Kayseri güneydoğusu (Sarız) Pliyosen ostrakod ve gastropod faunası (Pliocene Ostracoda and Gastropoda of Southeastern Kayseri (Sarız)). – Çukurova Üniversitesi, Mühendislik-Mimarlık Fakültesi Dergisi, **7:** 171-195. [in Turkish]

SIEBER, E. (1905): Fossile Süßwasser-Ostrakoden aus Württemberg. – Jahreshefte des Vereins Vaterländischer Naturkunde Württemberg, **61:** 321-346.

SISSINGH, W. (1972): Late Cenozoic Ostracoda of the South Aegean Island Arc. – Utrecht Micropaleontological Bulletins, **6:** 1-187.

SOKAČ, A. (1989): Pontian Ostracod fauna in the Pannonian Basin. – In: STEVANOVIĆ, P., NEVESSKAJA, L. A., MARINESCU, F., SOKAČ, A.. & JÁMBOR, A. (eds.): Chronostratigraphie und Neostratotypen, 8, Pontien; Beograd (Jazu & Savu), 672-721.

STANCHEVA, M. (1963): Ostracoda from the Neogene in North-Western Bulgaria. – Travaux de la Géologie de Bulgarie, Série Paléontologie, **5:** 5-71.

STANCHEVA, M. (1966): Notes on the stratigraphy and the ostracode fauna from the Pliocene and post-Pliocene of the district of Silistra. – Bulletin d'Institute de Géologie (Sofia), **15:** 205-229.

STANCHEVA, M. (1990): Upper Miocene Ostracods from Northern Bulgaria. – Geologica Balcanica, serie operum singulorum, **5:** 1-111.

TUNOĞLU, C. & GÖKÇEN, N. (1997): Pontian ostracoda of the Sinop area, Black Sea coast of Turkey. – Revue de Micropaléontologie, **40:** 347-366.

TUNOĞLU, C., TEMEL, A. & GENÇOĞLU, H. (1995): Pliocene Ostracoda association and environmental characteristics of Sivrihisar (Eskisehir) area, Central Anatolia, Turkey. – In: RÍHA, J. (Ed.), Ostracoda and Biostratigraphy. Proceedings of the 12th International Symposium on Ostracoda; Rotterdam (Balkema), 265-275.

TUNOĞLU, C. & ÜNAL, A. (2001a): Ostracoda biostratigraphy and chronostratigraphy of Pannonian-Pontian sequence of Gelibolu Peninsula, NW Turkey. – Geological Bulletin of Turkey, **44:** 15-25.

TUNOĞLU, C. & ÜNAL, A. (2001b): Pannonian-Pontian Ostracoda fauna of Gelibolu Neogene Basin (NW Turkey). – Yerbilimleri, **23:** 167-187.

VAN MORKHOVEN, F. P. C. M. (1963): Post-Palaeozoic Ostracoda. Vol. II. Generic Descriptions; Amsterdam London New York (Elsevier), 478 pp.

WITT, W. (2000): Süßwasserostracoden der miozänen Vorlandmolasse Süddeutschlands. – Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie, **40:** 109-151.

WITT, W. (2003): Freshwater Ostracods from Neogene deposits of Develiköy (Manisa, Turkey). – Zitteliana, **A43:** 97-108.

WOUTERS, Karel: New records of the genus *Cyprideis* (Crustacea, Ostracoda) from South Africa.– Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie, **73:** 161-165.

ZALÁNYI, B. (1944): Neogene Ostracoden in Ungarn. I. Teil. Die Beschreibung und stratigraphische Bewertung der neogenen Ostracodenfaunen von Tisztaberek. – Geologica Hungarica, Series Palaeontologica, **21:** 183 pp. [in Hungarian with German summary]

ZANGGER, E. & MALZ, H. (1989): Late Pleistocene, Holocene and Recent ostracods from the Gulf of Argos, Greece. – Courier Forschungsinstitut Senckenberg, **113:** 159-175.

Zeitschrift/Journal: Zitteliana Serie A

Jahr/Year: 2005

Band/Volume: 45

Autor(en)/Author(s): Matzke-Karasz Renate, Witt Wolfgang

Artikel/Article: Ostracods of the Paratethyan Neogene KÄ±lÄ±ç and Yalakdere Formations near Yalova (Ä°zmit Province, Turkey) 115-133