New species of *Mediocytherideis* (Ostracoda, Mediocytherideidae) in the brackish Messinian of Italy

Silvia LIGIOS, Alessandro BOSSIO & Elsa GLOZZI

ABSTRACT - The genus *Mediocytherideis* Mandelstam, 1956 with its subgenera *Mediocytherideis* s.s. and *M.* (Sylvestra) Doruk, 1973 are here revisited and the emended diagnosis of the two subgenera are given. Six new species have been introduced: *Mediocytherideis* (Sylvestra) etrusca nov. sp., *Mediocytherideis* (Sylvestra) fossata nov. sp., *Mediocytherideis* (Sylvestra) ornata nov. sp., *Mediocytherideis* (Sylvestra) punctata nov. sp., *Mediocytherideis* (Sylvestra) sulcata nov. sp. and *Mediocytherideis* (Sylvestra) tetrafoveolata nov. sp., coming from the Messinian brackish sediments of the Volterra-Radicondoli and Velona basins (Tuscany, central Italy). Three more taxa are described, left in open nomenclature, coming from the Messinian brackish sediments of the Velona Basin, the Taranta Peligna cemetery section (Majella Mt., central Italy) and the Trave Section (Ancona, central Italy).

An overview of the known Mediocytherideis s.l. species is given and the stratigraphic distribution and palaeobiogeography of this genus is discussed. The database shows that both *Mediocytherideis* s.s. and *M.* (Sylvestra) appear more or less at the same time, either in the Mediterranean and in the Paratethys regions during Serravallian, a time interval in which these two palaeodomains were not yet divided. After the closure of the Mediterranean-Paratethys connection, occurred during the late Serravallian, *Mediocytherideis* s.l. continued to spread in each bioprovince: in the Paratethys it is characteristic of brackish environments or, at least at the very beginning of its evolutive history, of shallow stressed marine environment; in the Mediterranean, on the contrary, since its appearance the genus gave rise to different species adapted to shallow marine environment or brackish environment. Unfortunately the too much-fragmented knowledge on *Mediocytherideis* s.l. species prevents the recognition of the centre of origin of the genus. Similarly, it is impossible to establish whether the brackish Mediterranean *Mediocytherideis* s.l. evolved from a Mediterranean stock or from Paratethyan brackish species migrated westwards by passive dispersal.

KEY WORDS - Mediocytherideidae (Ostracoda), Taxonomy, Central Italy, Mediterranean, Paratethys.

INTRODUCTION

1956, and *Minicythere* Ornellas, 1974. Tribe Tanellini seems confined to the Pliocene-Recent of the Indo-Pacific region and to the South America Atlantic coast, while Tribe Mediocytherideiini includes mainly Miocene to Recent genera from Paratethys, Mediterranean, Red Sea and Atlantic Morocco areas, except for *Ishizakiella*, which is signalled from the Plio-Pleistocene of Indonesia (Krstić & McKenzie, 1991).

In several papers dealing with the Upper Miocene brackish deposits of Italy, genera *Mediocytherideis, Sylvestra* and *Chartocythere* have been reported, without any specific identification (Bossio et al., 1994a, b, 1996; Krstić & Bossio, 1992; Testa, 1995; Ghiotti et al., 2002). In this paper we revise this material, giving the description of several new species and the emended diagnoses for genera and subgenera. At the moment, only genus *Mediocytherideis* and its two subgenera (*Mediocytherideis* s.s. and *Sylvestra*) are retained as valid, while genus *Chartocythere* is probably a preoccupied taxon. *Chartocythere* has been arisen by Buryndina (1969), who used the name *Chartocythere* proposed by Livental (1956, p. 38), never described or preoccupied taxon. Buryndina (1969) did not give a generic diagnosis but described it indirectly on her material of *Buryndina* (1969, Pl. II, Figs. 7-9) neither the crenulated posterior sulcus nor the ventral expansion of the inner lamella are correspondent elements. The inner lamella is developed 3-4 denticles. The hinge of the left valve shows the posterior portion there is a sulcus, crenulated in the inner carapace with maximum height in the posterior third. Smooth surface covered by opaque spots, corresponding to the marginal pore canals. Hinge of the right valve made of a crenulated bar in the antero-median portion. In the posterior portion there is a sulcus, crenulated in the inner part. On the postero-dorsal angle there is a stout bar with 3-4 denticles. The hinge of the left valve shows the correspondent elements. The inner lamella is developed all along the free margin. It reaches its greater width in the ventral part and this is a characteristic of this species and for this Livental assigned this species to the genus *Chartocythere*, which has been described..." Unfortunately in the good pictures given by Buryndina (1969, Pl. II, Figs. 7-9) neither the crenulated posterior sulcus nor the ventral expansion of the inner lamella are evident. Krstić & McKenzie (1991) gave an emended diagnosis of genus *Chartocythere*, underlining the crenulated posterior sulcus/bar of the hinge, but in the SEM pictures of the right and left hinges of *Chartocythere franzii* Krstić & McKenzie, 1991, Pl. 4, Figs. 1, 3), the "crenulated" sulcus/bar seems smooth. Looking at the ventral inner lamella of the *Chartocythere* species illustrated by Krstić & McKenzie (1991) it is possible to observe an angular expansion (which could be the expansion mentioned in Buryndina, 1969 and not illustrated by her) but this angular shape is present also in subgenera *Mediocytherideis* and *Sylvestra*, thus it cannot be considered a typical generic character of *Chartocythere*. For all these reasons, at the moment *Chartocythere* cannot be considered a valid genus, unless new good illustrations of the Buryndina specimens will clarify its diagnostic characters. In any case, none of the Mediocytherideisinae specimens revised in this paper shows a crenulated posterior sulcus/bar in the median element.

GEOLOGICAL SETTING AND SAMPLE LOCATION

The Mediocytherideisinae studied in the present paper were collected in two different Tuscan "central" basins (sensu Martini & Sager, 1994), the Radicondoli area of the Volterra-Radicondoli Basin and the Velona Basin, and in the post-evaporitic Messinian successions of Taranta Peligna cemetery (Majella Mt., central Italy) and Trave (Marche, central Italy).

The Volterra-Radicondoli Basin is located west of the Mid Tuscan Ridge (Fig. 1); during the Late Miocene sedimentation, four main palaeoenvironments can be recognized: a brackish one, spanning from the late Tortonian to the early Messinian, corresponding to the "*Serie Lignitifera*" Auct., a marine littoral one, corresponding to the "*Argille a Pseudonotta*" Auct., an evaporitic environment, corresponding to the onset of the Messinian Salinity Crisis and, again, a brackish environment linked to the post-evaporitic Messinian *Lago-Mare* facies. The Volterra-Radicondoli Basin has been extensively studied by several authors (Bossio et al., 1978, 1981, 1994a, b, 1996; Sarti & Testa, 1994; Testa, 1995) and it is included in the new geological maps 1:50,000, recently published by the Servizio Geologico d'Italia (2002) Sheets N° 285 Volterra, N° 295 Pomerance and N° 296 Siena (in press). The Radicondoli area represents the southeastern portion of the Volterra-Radicondoli Basin and the samples studied in the present paper were collected in the following Upper Miocene formations (Lazzarotto et al., 2002): "*Argille del Torrente Fosci*" Fm. (upper Tortonian-lower Messinian), "*Torrente Raquese*" Fm. (lower Messinian) and "*Argille e gessi del Fiume Era Morta*" Fm. (evaporitic and post-evaporitic upper Messinian). In particular, the Mediocytherideisinae studied here were collected from massive grey clays with fine sandy intercalations referable to the lower Messinian portion of the "*Argille del Torrente Fosci*" Fm.: samples RA II 262, 263, 264, 265 in a section located near Podere Olli (43°15'01" N, 1°26’1" W), samples RA II 256, 259 in a section located along the Vallone Ameli (43°16’52" N, 1°28’20" W), sample RA 160 in a section located near Casa Orta (43°18’7” N, 1°27’50” W) and sample RA 137 in a section 300 m E of Casa Mandria (43°18’24” N, 1°26’45” W). From the same formation also the scattered samples RA 114 and RA 145 were collected; samples RA 32, 41 in a section near Pian di Cecina (43°17’30” N, 1°28’10” W), made of grey or beige clayey-sandy sediments referable to the "*Torrente Raquese*" Fm. (lower Messinian); samples RA II 82, 81, in a section near Casa Colombia (43°15’51” N, 1°24’44” W), made of clays and silty-marly clays with intercalations of gypsum lenses referable to the "*Argille e gessi del Fiume Era Morta*" Fm. (upper Messinian..."
Lago-Mare); the scattered samples RA II 86 and 166 were collected from the same formations.

The Velona Basin is located east of the Mid Tuscan Ridge (Fig. 1) and, during the Messinian, underwent a brackish continental sedimentation, referred by Ghetti et al. (2002) to two different synthems (Lower Synthem, lower Messinian and Upper Synthem, upper Messinian-?Early Pliocene). The Lower Synthem was divided into six concordant sub-units. The samples studied in the present paper were collected in two sections both referable to the sub-unit B, made of thick lacustrine sediments composed of a fining-upward succession of conglomerates, sands, and clays: samples VE 6, 8, 16, 36, 53, 57, 59 and 65 come from Fosso Casotto Section (43°00'08" N, 11°33'05" E), while sample OW2/1, OW2/4 and OW2/5 come from Orcia Ovest 2 section, around 300 m N of the previous section (Rook & Ghetti, 1997; Ghetti et al., 2002).

The Trave succession belongs to the central sector of the present-day foredeep basin and foreland ramp of the outer northern Apennine fold and thrust belt and is located along the sea-cliff between Monte dei Corvi

---

Fig. 1 - Location of the Volterra-Radicondoli and Velona basins within the structural frame of the Tuscan Neogene basins (modified from Martini & Sagri, 1993).
and Mezzavalle, south of Ancona (Marche, central Italy). The analysed samples TRA 63, 69 were collected from the upper portion of the succession, made of coarse-grained sandstone bodies rhythmically alternated to thick laminated mudstones. Two laminated micritic limestones (‘colombacci’), up to 1 m thick, are also intercalated. According to Roveri et al. (2006) and Iaccarino et al. (in press) this portion of succession must be referred to the late Messinian post-evaporitic phase of the Messinian Lago-Mare biofacies.

The Taranta Peligna cemetery section is located along the southeastern margin of the Majella Mt. (Abruzzi, central Italy) and belongs to the Adriatic foreland domain. The 40 m-thick succession is made of clays and silty clays with thin conglomeratic and sandy intercalations, which conformably overlie resedimented gypsarenites deposited during the post-evaporitic Messinian. In a nearby correlatable section (Fonte dei Pulcini section), the upper portion of the clays and silty clays crops out, conformably overlain by Lower Pliocene clays and conglomerates (Cipollari et al., 2002; Cosentino et al., 2005). Thus, the sample MAJ 144 collected in the Taranta Peligna cemetery section can be ascribed to the post-evaporitic Messinian (Lago-Mare biofacies).

TAXONOMY

The described material is stored in the Gliozzi Ostracod Collection (GOC) at the Dipartimento di Scienze Geologiche, Università degli Studi Roma Tre.

Suborder CYTHEROCOPINA Gründel, 1967
Superfamily CYTHEROIDEA Baird, 1850
Family LEPTOCYTHERIDAE Hanai, 1957
Subfamily MEDIOCYTHERIDEISINAE Mandelstam, 1960

Genus Mediocytherideis Mandelstam, 1952

Type species - Cytherideis apatoica Schweyer, 1949 by original designation.

Enlarged and partially emended diagnosis - Small to middle-sized Leptocytheridae with thick and elongate carapace. Maximum height sometimes in the anterior portion. Slightly inequivalve carapace, with the right valve generally more elongate. In left lateral view, infracurved anterior margin, which can or not encompass the ventral margin. Dorsal margin convex to various degrees. Rectilinear or rounded and tapered short posterior margin. Ventral margin from straight to sinuous. Ornamentation from absent or with feeble punctuations to heavily reticulated. Presence of anterior ribs, which can be arranged concentrically and subparallel to the anterior margin; sometimes they may run subparallel to the anterior portion of the ventral margin. Posterior rib weakly or strongly developed, sometimes with a remarkable posterior pouch. Hinge of the right valve with an anterior elongate lamellar and crenulated tooth, a median element made of a smooth bar and a posterior cube-like or lobate tooth. Hinge of the left valve made of opposite elements. Sometimes in front of the median groove a toothlet is present. Snap-pit and snap-knob present in the middle of the inner ventral margin. Postero-ventral inner angularity present. Muscle scars typical of the Family. Few long and polifurcate marginal pore canals. Very small vestibule. Sexual dimorphism evident, with males with a smaller but proportionally more elongate carapace.

Subgenus Mediocytherideis s.s.

Emended diagnosis - In lateral view, elongate carapace with subparallel dorsal and ventral margins, infracurved anterior margin that does not encompass the ventral margin and ventral margin straight. External surface of the valves partially smooth or covered by small pits. Anterior ribs concentric, posterior rib very feeble or absent. Postero-ventral pouch not evident.

Subgenus Sylvestra (Doruk, 1973)

Type species - Sylvestra posterobursa Doruk, 1973 by original designation.

Emended diagnosis - In lateral view, the infracurvature anterior margin encompasses the ventral margin giving to the valve a reniform shape. Sinuous ventral margin.

EXPLANATION OF PLATE 1

figs. 1-2 - Mediocytherideis (Mediocytherideis) sp. A
1 - Female LV, lateral external view, sample VE 6.
2 - Female LV, lateral inner view, sample VE 6.

figs. 3-9 Mediocytherideis (Sylvestra) etrusca nov. sp.,
3 - Holotype, female LV, lateral external view, sample RA II 263.
4 - Paratype, female carapace, dorsal view, sample RA II 263.
5 - Paratype, female RV, lateral external view, sample RA II 263.
6 - Paratype, female RV, lateral inner view, sample RA II 263.
7 - Paratype, female LV, lateral external view, sample RA II 263.
8 - Female RV, lateral inner view, sample RA 114.
9 - Paratype, female carapace in left external view, sample RA II 263.

Scale bar = 0.1 mm.
Generally strongly ornamented but, in some cases, with small pits or rather smooth. Anterior ribs present with no evident concentrical arrangement. Posterior rib present. Postero-ventral pouch or tubercle present.

Mediocytherideis (Sylvestra) etrusca nov. sp. (Pl. 1, figs. 3-9)

Derivatio nominis - From Latin etruscus, -a, -um, relative to the ancient Italic population who inhabited the Etruria, a region located between the northern Latium and the central-southern Tuscany, where this species was collected.

Holotype - Left valve GOC M80/2/12; size: L = 0.55 mm; h = 0.28 mm.

Paratypes - 5 adult and 2 juvenile carapaces, 3 left female valves, 3 female right valves, 1 male right valve, 3 left A-1 valves.

Locus typicus - Radicondoli area (southern sector of the Volterra-Radicondoli Basin).

Stratum typicum - Sample RA II 263, upper portion of the “Argille del Torrente Fosci” Fm. from the section near Podere Olli.

Age - Early Messinian.

Diagnosis - Medium-sized Mediocytherideis (Sylvestra) with a heavy carapace. In dorsal view the female carapace is inflated with an anterior sulcus, underlining a more inflated posterior zone. In lateral outer view dorsal border feebly arched, anterior margin infracurved with a parallel strong rib. Ventral margin sinuous, posterior border slightly rounded. Very strong ornamentation with evident thick, vertical, rounded, dendritic ribs. Very pronounced posterior rib that borders an evident postero-ventral pouch. Hinge typical of the genus, with a posterior 4-lobate tooth. Instars are strongly ornamented. In males the ornamentation shows thinner vertical ribs and a more evident reticulation.

Size -
Female left valve  L = 0.54-0.57 mm  h = 0.28-0.30 mm
Female right valve  L = 0.55-0.56 mm  h = 0.27-0.30 mm
Male right valve  L = 0.56 mm  h = 0.29 mm

Studied material - Sample RA 145 (Radicondoli area, upper portion of the “Argille del Torrente Fosci” Fm. from the section 500 m E of Casa Pietrasanta, along the road from Poggio Macignano to Monteguidi, early Messinian): 2 female carapaces, 1 left female valve, 8 instars.
Sample RA 114 (Radicondoli area, upper portion of the “Argille del Torrente Fosci” Fm. from the section near Poggio Macignano on the road to Monteguidi, early Messinian): 1 juvenile valve.
Sample RA 137 (Radicondoli area, upper portion of the “Argille del Torrente Fosci” Fm. from the section 300 m E of Casa Mandria, early Messinian): 1 right A-1 male valve, 1 juvenile carapace.

Geographic and stratigraphic distribution - Early Messinian of the Radicondoli area.

Mediocytherideis (Sylvestra) fossata nov. sp. (Pl. 2, figs. 1-10)

Derivatio nominis - From Latin fossa, -a, -um for the large and deep pits characteristic of the ornamentation.

Holotype - Left female valve GOC M80/1/6; size: L = 0.62 mm; h = 0.31 mm.

Paratypes - 8 female, 3 male and 9 juvenile carapaces, 3 left female valves, 1 female right valve.

Locus typicus - Radicondoli area (southern sector of the Volterra-Radicondoli Basin).

Stratum typicum - Sample RA II 263, upper portion of the “Argille del Torrente Fosci” Fm. from the section near Podere Olli.

EXPLANATION OF PLATE 2

figs. 1-10 - Mediocytherideis (Sylvestra) fossata nov. sp.
1 - Holotype, female LV, lateral external view, sample RA II 263.
2 - Paratype, female LV, lateral external view, sample RA II 263.
3 - Paratype, female carapace in right lateral view, sample RA II 263.
4 - Male RV, lateral external view, sample RA 32.
5 - Paratype, female RV, lateral external view, sample RA II 263.
6 - Paratype, female carapace, dorsal view, sample RA II 263.
7 - Paratype, male carapace, dorsal view, sample RA II 263.
8 - Paratype, female carapace in left external view, sample RA II 263.
9 - Female RV, lateral inner view, sample RA 75.
10 - Male carapace, ventral view, sample RA 32.

Scale bar = 0.1 mm.
Age - Early Messinian.

Diagnosis - Medium-sized *Mediocytherideis* (*Sylvestra*). In lateral outer view dorsal border arched, anterior margin strongly incurved with two or more ribs. Ventral margin sinuous, posterior border sub-quadrate in the females and almost pointed in the males. Surface of the female valve rather inflated posteriorly behind a remarkable antero-dorsal *sulcus*. Ornamentation consists in sub-rounded meshes with thick muri. The *sulcus* zone is underlined by some elongate and inclined pits. A posteroverentral rib limits the *bursa*. Hinge typical of the genus with a posterior 4-lobate tooth.

Size -

<table>
<thead>
<tr>
<th></th>
<th>Female left valve</th>
<th>Female right valve</th>
<th>Male left valve</th>
<th>Male right valve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L = 0.62-0.70 mm</td>
<td>h = 0.31-0.37 mm</td>
<td>L = 0.63-0.66 mm</td>
<td>h = 0.31-0.36 mm</td>
</tr>
<tr>
<td></td>
<td>L = 0.60-0.64 mm</td>
<td>h = 0.30-0.33 mm</td>
<td>L = 0.57-0.67 mm</td>
<td>h = 0.30-0.33 mm</td>
</tr>
</tbody>
</table>

Studied material - Sample RA II 86 (Radicondoli area, “Argille e Geschi del F. Era Morta” Fm. from the section near 200 m S of Casa La Colombaia, late Messinian): 1 A-1 female carapace, 1 A-1 female right valve.

Sample RA 160 (Radicondoli area, upper portion of the “Argille del Torrente Fosci” Fm. from the section near Casa Ortali, early Messinian): 6 female carapaces, 2 male carapaces, 3 left female valves, 2 right female valves, 1 left male valve, 1 right male valve, 1 A-1 left valve, 14 instars.

Sample RA II 265 (Radicondoli area, upper portion of the “Argille del Torrente Fosci” Fm. from the section near Podere Olli, early Messinian): 1 A-1 male carapace, 1 instar.

Sample RA 32 (Radicondoli area, “Torrente Raquese” Fm. from the section near Pian di Cecina locality, early Messinian): 1 left female valve, 1 right female valve, 1 male left valve, 6 male right valves, 2 A-1 male valves, 14 instars.

Geographic and stratigraphic distribution - Early-late Messinian of the Radicondoli area.

Comparisons - In the general outline and dimensions *M. (Sylvestra) fossata* nov. sp. is similar to the marine *M. (Sylvestra) posterobursa* Doruk from the Tortonian-early Messinian of the Mediterranean area. It differs from the marine species for a less inflated and ventrally protruding *bursa*, for a deeper mid-dorsal *sulcus* and for the different pattern of the stronger reticulation.

*Mediocytherideis* (*Sylvestra*) *ornata* nov. sp.

2002 *Sylvestra* sp. - *GHETTI ET AL.* p. 8, Tab. 2 (*parum*).

Derivatio nominis - From Latin *ornatus*, -a, -um = ornate.

Holotype - Left female valve, GOC M122/1/8; size: L = 0.67 mm; h = 0.35 mm.

Locus typicus - Velona Basin (Tuscany).

Stratum typicum - Sample OW2/1, Orcia Ovest 2 section, subunit B of the Lower Synthem.

Age - Early Messinian.

Diagnosis - Medium-sized *Mediocytherideis* (*Sylvestra*). In lateral outer view dorsal border slightly arched, anterior margin incurved with two or three thin ribs. Ventral margin sinuous, posterior border sub-quadrate. The surface is reticulated and the roundish meshes include clusters of two or more pits. One irregular sinuous ridge runs across the median and the posterior portion of the valve and its termination draws the ventral pouch. Hinge typical of the genus with a posterior 4-lobate tooth.

Size -

<table>
<thead>
<tr>
<th></th>
<th>Female left valve</th>
<th>Male left valve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L = 0.63-0.67 mm</td>
<td>L = 0.66 mm</td>
</tr>
<tr>
<td></td>
<td>h = 0.32-0.35 mm</td>
<td>h = 0.33 mm</td>
</tr>
</tbody>
</table>

Studied material - Sample VE 16 (Velona Basin, Fosso Casotto Section, subunit B of the Lower Synthem, early Messinian): 1 left female valve.

Sample VE 59 (Velona Basin, Fosso Casotto Section, subunit B of the Lower Synthem, early Messinian): 1 A-1 left female valve.

Sample VE 53 (Velona Basin, Fosso Casotto Section, subunit B of the Lower Synthem, early Messinian): 1 left ?male valve.

EXPLANATION OF PLATE 3

figs. 1-8 - *Mediocytherideis* (*Sylvestra*) *ornata* nov. sp.

1. Holotype, female LV, lateral external view, sample OW2/1.
2. Female LV, lateral external view, sample VE 16.
3. Holotype, female LV, lateral inner view, sample OW2/1.
5. Detail of the LV hinge of fig. 6, sample VE 16.
6. Female LV, lateral inner view, sample VE 16.
7. Female LV, lateral external view, sample VE 53.
8. Male LV, lateral external view, sample VE 53.

Scale bar = 0.1 mm.
Sample OW2/4 (Velona Basin, Orcia Ovest Section, subunit B of the Lower Synthem, early Messinian): 1 A-1 left female valve.

**Geographic and stratigraphic distribution** - Early Messinian of the Velona Basin.

*Mediocytherideis* (Sylvestra) punctata nov. sp.  
(Pl. 4, figs. 1-10; Pl. 5, figs. 1-2)

**Derivatio nominis** - From Latin punctum = little hole.

**Holotype** - Left female valve, GOC M80/2/1; size: L = 0.60 mm; h = 0.30 mm.

**Paratypes** - 5 female carapaces, 1 A-1 female left valve, 4 right female valves, 2 right male valves, and 3 instars.

**Locus typicus** - Radicondoli area (southern sector of the Volterra-Radicondoli Basin).

**Stratum typicum** - Sample RA II 81, “Argille e Gessi del F. Era Morta” Fm. from the section 250 m E of Casa la Colombaia.

**Age** - Late Messinian.

**Diagnosis** - Medium-sized *Mediocytherideis* (Sylvestra). In lateral outer view dorsal border feebly arched, anterior margin infracurved with two or more ribs. Ventral margin slightly sinuous, posterior border rounded. The whole surface is pitted; pits are rather large and rare in the anterior surface and small and denser in the posterior. Some ventral ribs are present in the anterior portion. The bursa is evident and underlined by a protruding ridge. Hinge typical of the genus with a posterior 4-lobate tooth.

**Size** -
- Female left valve: L = 0.60-0.63 mm, h = 0.30-0.33 mm
- Female right valve: L = 0.55-0.59 mm, h = 0.28-0.29 mm
- Male left valve: L = 0.56-0.61 mm, h = 0.26-0.29 mm
- Male right valve: L = 0.51-0.64 mm, h = 0.23-0.31 mm

**Studied material** - Sample RA II 82 (Radicondoli area, “Argille e Gessi del F. Era Morta” Fm. from the section 250 m E of Casa la Colombaia, late Messinian): 1 female and 1 male carapaces, 3 instar carapaces.

Sample RA II 86 (Radicondoli area, “Argille e Gessi del F. Era Morta” Fm. from the section 250 m S of Casa la Colombaia, late Messinian): 1 female carapace, 1 instar carapace.

RA II 263 (Radicondoli area, upper portion of the “Argille del Torrente Fosci” Fm. from near Podere Olli, early Messinian): 1 female carapace, 1 instar carapace, 2 left and 1 right juvenile valves.

Sample RA 41 (Radicondoli area, “Torrente Raquese” Fm. from the section near Pian di Cecina locality, early Messinian): 40 female, 3 male and 1 instar carapaces, and 1 female right valve.

Sample RA 32 (Radicondoli area, “Torrente Raquese” Fm. from the section near Pian di Cecina locality, early Messinian): 1 female carapace, 1 instar carapace.

RA II 264 (Radicondoli area, upper portion of the “Argille del Torrente Fosci” Fm. from near Podere Olli, early Messinian): 12 deformed carapaces.

Sample RA II 166 (Radicondoli area, “Argille e Gessi del F. Era Morta” Fm. from the section 300 m E of Podere Gatteresi, late Messinian): 9 deformed carapaces.

**Geographic and stratigraphic distribution** - Early-late Messinian of the Radicondoli area.

*Mediocytherideis* (Sylvestra) sulcata nov. sp.  
(Pl. 5, figs. 3-9)

**Derivatio nominis** - From Latin sulcus = groove.

**Holotype** - Left female valve, GOC M47/3/1; size: L = 0.67 mm; h = 0.34 mm.

**Locus typicus** - Velona Basin.

**Stratum typicum** - Sample VE 53, Fosso Casotto section, subunit B of the Lower Synthem.

---

**EXPLANATION OF PLATE 4**

figs. 1-10 - *Mediocytherideis* (Sylvestra) punctata nov. sp.
1. Holotype, female LV, lateral external view, sample RA II 81.
2. Holotype, female LV, lateral inner view, sample RA II 81.
3. Holotype, detail of the ventral angularity of the inner margin, sample RA II 81.
4. Female carapace, dorsal view, sample RA 41.
5. Holotype, detail of the muscle scars, sample RA II 81.
6. Paratype, female carapace in lateral right view, sample RA II 81.
7. Female carapace, ventral view, sample RA 41.
8. Holotype, particular of the left hinge, sample RA II 81.
9. Paratype, female carapace in lateral left view, sample RA II 81.
10. Male LV, lateral external view, sample RA 41.

Scale bar = 0.1 mm.
**Age** - Early Messinian.

**Diagnosis** - Medium-sized *Mediocytherideis* (*Sylvestra*). In lateral outer view dorsal border slightly arched, anterior margin feebly infracurved with one rib. Anterior and posterior margins flattened. Ventral margin sinuous. The surface of the valve is rather inflated and the anterior and posterior areas are divided by a remarkable dorsal sulcus. The *bursa* is evident, underlined by a ridge only in male valves. The surface is ornate with rare pits located mainly anteriorly and around the *sulcus*. Posteriorly the inflated area is rather smooth or with few isolated pits. Males are more pitted all over the surface. The inner ventral angularity is very feeble. Hinge typical of the genus with a posterior lobate tooth and with a median toothlet in the left valve.

**Size** -

<table>
<thead>
<tr>
<th>Sex</th>
<th>Valve Type</th>
<th>Length (L)</th>
<th>Height (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Left</td>
<td>0.60–0.67 mm</td>
<td>0.31–0.35 mm</td>
</tr>
<tr>
<td>Male</td>
<td>Right</td>
<td>0.74 mm</td>
<td>0.36 mm</td>
</tr>
</tbody>
</table>

**Studied material** -

- Sample VE 18 (Velona Basin, Fosso Casotto Section, subunit B of the Lower Synthem, early Messinian): 1 female left valve.
- Sample VE 65 (Velona Basin, Fosso Casotto section, subunit B of the Lower Synthem, early Messinian): 1 male right valve.
- Sample OW2/4 (Velona Basin, Orcia Ovest 2 section, subunit B of the Lower Synthem, early Messinian): 1 female left valve, 1 A-1 male right valve.
- Sample OW2/5 (Velona Basin, Orcia Ovest 2 section, subunit B of the Lower Synthem, early Messinian): 1 female left valve.

**Geographic and stratigraphic distribution** - Early Messinian of the Velona Basin.

**Comparisons** - *Mediocytherideis* (*Sylvestra*) *sulcata* nov. sp. is similar to *Sylvestra* *gravida* Bonaduce, Russo & Barra from the early Messinian of the Gulf of Gabes (Bonaduce et al., 1990) for the presence of a remarkable dorsal *sulcus* and for the faint pitted ornamentation; it differs from this species for the general shape, that is less sub-rectangular, the presence of one anterior ridge instead of two, a less infracurved anterior margin, a more tapered posterior border and the greater size. It is also similar to *M. (Sylvestra) maximus* Olteanu from the middle Pontian (early Messinian) of Romania (Pannonian Basin) (Olteanu, 1989), from which differs for a more deep mid-dorsal *sulcus*, the more elongate shape, a more straight ventral border and the slightly larger size.

**Mediocytherideis (Sylvestra) tetratwoveolata** nov. sp. (Pl. 6, figs. 1-7)

2002 *Sylvestra* sp. - Ghetti et al., p. 8, Tab. 2 (partim).

**Derivatio nominis** - From Greek τετρα and Latin foveolatus, -a, -um = four pits.

**Holotype** - Right female valve GOC M47/2/4; size: L = 0.55 mm; h = 0.29 mm.

**Paratypes** - 1 left female valve, 3 right female valves (one broken and one lost).

**Locus typicus** - Velona Basin.

**Stratum typicum** - Sample VE 57, Fosso Casotto Section, subunit B of the Lower Synthem.

**Age** - Early Messinian.

**Diagnosis** - Medium-sized *Mediocytherideis* (*Sylvestra*) with a sub-rectangular shape. In lateral outer view dorsal border feebly arched, anterior margin infracurved with two ribs. Ventral margin slightly sinuous, posterior border slightly squared. Postero-dorsal angle underlined by a thick rim. Strong reticulated ornamentation with 4 (or more) pits clustered into a large mesh. Near the feeble postero-ventral ridge the meshes are arranged in slightly arched dorso-ventral rows. A rounded keel underlines the ventral pouch. Hinge typical of the genus, with a posterior 5-lobate tooth.

---

**EXPLANATION OF PLATE 5**

figs. 1-2 - *Mediocytherideis* (*Sylvestra*) *punctata* nov. sp.

1 - Female carapace in lateral right view, sample RA 41.
2 - Female carapace in lateral left view, sample RA 41.

figs. 3-9 - *Mediocytherideis* (*Sylvestra*) *sulcata* nov. sp.

3 - Holotype, female LV, lateral external view, sample VE 53.
4 - Holotype, female LV, lateral inner view, sample VE 53.
5 - Female LV, lateral external view, sample VE 18.
6 - Female LV, lateral inner view, sample VE 18.
7 - Male RV, lateral external view in transmitted light, sample OW2/4.
8 - Female LV, lateral external view in transmitted light, sample OW2/4.
9 - Particular of the left hinge of the female valve illustrated in fig. 6, sample VE 18.

Scale bar = 0.1 mm.
Size -
Female right valve  \( L = 0.55-0.67 \) mm  \( h = 0.29-0.34 \) mm

**Studied material** - Sample VE 36 (Velona Basin, Fosso Casotto section, subunit B of the Lower Synthem, early Messinian): 1 female right valve.
Sample VE 16 (Velona Basin, Fosso Casotto section, subunit B of the Lower Synthem, early Messinian): 1 female right valve (broken).

**Geographic and stratigraphic distribution** - Early Messinian of the Velona Basin.

**Comparisons** - *M. (Sylvestra) tetrafoveolata* nov. sp. is similar in the general outline to the marine *M. (Sylvestra) intermedia* Bonaduce, Russo & Barra from the Recent of the Gulf of Aqaba, from which differs for the greater size and the ornamentation pattern: the anterior concentric ridges are less inclined, the posterior meshes are arranged in gently arched rows and the posterior flattened margin is narrower.

For the posterior meshes arranged in gently arched row, *M. (Sylvestra) tetrafoveolata* nov. sp. resembles *M. (Sylvestra) franzii* (Krstić), and "*Chartocythere*" sp. Krstić (Krstić & McKenzie, 1991) but the outline is different and less elongate.

**Mediocytherideisinae species left in open nomenclature**

Some other valves referable to Mediocytherideisinae species have been found both in Tuscany and in other Italian localities, but the remains are scarce or not well preserved, preventing the possibility to arise other new species. A brief description of each taxon is here provided, together with its age and the locality where it has been recovered.

**Mediocytherideis** (Mediocytherideis) sp. A (Pl. 1, figs. 1-2): medium sized, *Mediocytherideis* (L = 0.57 mm; h = 0.23-0.25 mm). In lateral outer view dorsal and ventral margins straight and subparallel, anterior margin infracurved with one parallel rib. Posterior border strongly arched. The posterior rib feeble but present. The whole surface of the valve densely pitted with small rounded pits. Velona Basin, Fosso Casotto section, sample VE 6, sub-unit B of the Lower Synthem, early Messinian.

**Mediocytherideis** (Mediocytherideis) sp. B (Pl. 6, figs. 9-10): medium sized, *Mediocytherideis* (L = 0.62 mm; h = 0.27 mm) with elongate carapace sub-rectangular in shape, slightly inflated, particularly in the posterior portion. Feeble ornamentation, with several small pits and three evident anterior and antero-ventral concentric ribs. Velona Basin, Fosso Casotto section, sample VE 8, sub-unit B of the Lower Synthem, early Messinian.

**Mediocytherideis** (Sylvestra) sp. C (Pl. 6, fig. 8): elongate A-1 male carapace, characterised by a sinuous ventral margin, underlined by a strongly infracurved anterior margin. Strong reticulated ornamentation, with flattened anterior and posterior areas. Two concentric ribs are visible anteriorly and one posteriorly. In front of the posterior rib, a small node is sometimes developed along the ventral margin. Taranta Peligna cemetery (Majella Mt., central Italy), sample MAJ 144; Trave section (Ancona, central Italy), samples TRA 63, TRA 69, late Messinian.

**DISCUSSION**

**Palaeoecology and age of the Mediocytherideis s.l. new species**

The *Mediocytherideis* s.l. species discussed in the present paper have been collected in brackish environments, associated with different species.

In the samples from the Radicondoli and Velona Basins *Mediocytherideis* (Mediocytherideis) spp. and *Mediocytherideis* (Sylvestra) spp. are always associated with Cyprideis spp. and sometimes with *Loxoconchissa velonae* Faranda, Ligios & Gliozzi, *Loxoconchissa* (Loxocapsia) *cosentinoi* Faranda, Ligios & Gliozzi, *Loxoconchissa* (Loxocapsia) *punctata* Faranda, Ligios & Gliozzi, *Loxoconchissa* (Loxocapsia) *reticulata* Faranda, Ligios & Gliozzi, *Loxoconchissa* (Loxocapsia) *velonae* Faranda, Ligios...

---

**EXPLANATION OF PLATE 6**

figs. 1-7 - *Mediocytherideis* (Sylvestra) *tetrafoveolata* nov. sp.
1 - Holotype, female RV, lateral external view, sample VE 57.
2 - Paratype, female RV, lateral external view, sample VE 57.
3 - Paratype, particular of the reticulated ornamentation in a right valve, sample VE 57.
4 - Female RV, lateral inner view, sample VE 36.
5 - Particular of the ventral angularity of the inner margin of the female RV illustrated in fig. 4, sample VE 36.
6 - Paratype, particular of the posterior tooth in a female RV, sample VE 57.
7 - Female RV, lateral external view, sample VE 36.

fig. 8 - *Mediocytherideis* (Sylvestra) sp. C, A-1 male LV, lateral external view, sample MAJ 144.

figs. 9-10 - *Mediocytherideis* (Mediocytherideis) sp. B
9 - Female RV, lateral inner view, sample VE 8.
10 - Female RV, lateral external view, sample VE 8.

Scale bar = 0.1 mm.
& Gliozzi, Loxoconchissa (Loxocaspia) tuberculata Faranda, Ligios & Gliozzi, Tavanicythere palchra Bossio, Tavanicythere posteroalata Bossio, Gliozzi & Tassone, Tavanicythere varieomate Bossio, Gliozzi & Tassone, Tavanicythere julianii Bossio, Gliozzi & Tassone, Bullocypris robusta Devoto, Potamocypris cf. P. graciles (Sieber), Ilyocypris cf. A. gibba (Ramdohr), Ilyocypris sp., Candona sp. and several freshwater-brackish molluscs as Bithynia leachi (Sheppard), Planorbius sp., Planorbis cf. P. moquiini (Requien), Gyraulus cristins (Linnaeus), Pseudoamnicola sp., Orygoceras sp., Micromelania sp., and Melanopsis fallax Pantanelli (Ghieti et al., 2002).

At the Trave section Mediocytherideis (Sylvestra) sp. C is associated with typical late Messinian Lago-Mare ostracods such as Cyprideis agrigentina Decima, Loxocochna eichwaldi Liveental, Loxocochna mülleri (Mèhes), Loxocyclicula disfarariui (Schneider in Sazin, 1956), Tyrrhenocythere ruggieri Devoto, Amnicythere propinqua (Liveental), Amnicythere accicularia (Olteanu) and Amnicythere sp. D Miculan in Bassetti et al., 2003, while at the Taranta Peligna cemetery is accompanied by Tyrrhenocythere pontica Liveental in Agalarova et al., 1961 and Loxocochna sp. juv.

Thus it is possible to conclude that all the Mediocytherideis s.s. new species are characteristic of brackish environments, mainly in the mesohaline (or oligo-mesohaline) range.

All these new species have a Messinian stratigraphic distribution (Fig. 2).

**Palaeobiogeographic distribution of Mediocytherideis s.l.**

The genus Mediocytherideis s.l. shows a wide stratigraphical (Middle Miocene-Recent) and (palaeo)-geographical distribution (Mediterranean, Paratethys, Indian and Atlantic oceans). Tab. 1 lists several species referable to Mediocytherideis s.s. and M. (Sylvestra), including the new species and those quoted in literature, their provenance and their age. Compiling this database, made only by species checked on the basis of the published illustrations, a tentative is made to understand the spreading centre and the distribution pathways of genus Mediocytherideis.

The first representative of the genus could be M. (Sylvestra) inflata (Schneider, 1939) from the Karaganian (middle Badenian, early Serravallian) of Caucasus. This species is associated with Leptocythere stabilis Schneider, Leptocythere distincta Schneider, Cythereis declivis Schneider, Hirshmannia viridis (Muller), Palmoconcha laevata (Norman), Loxocochna trunca (Schneider) and Xesteoleberis sp. and with few continental ostracods: Darwinula stevensoni (Brady & Robertson) and Ilyocypris bavardyi (Sars) (Schneider, 1939). This assemblage could point to a littoral marine environment, but with few continental displaced ostracods or to a marginal marine environment characterised by brackish waters. During late Badenian (middle Serravallian) M. (Sylvestra) aff. M. (S.) posterobursa Doruk occurs in the Serbian area (Krstić & McKenzie, 1991), but its palaeoenvironment is unfortunately unknown. During Sarmatian (late Serravallian) several Mediocytherideis occur: M. (Mediocytherideis) cecensis Zelenka in the foredeep Carpathian basin of the Jamnica S-119 borehole (southern Poland) in a stressed shallow marine environment (Szczeczura, 2000), in the Styrarian Basin and in the Vienna Basin in shallow brackish water environments (Gross et al., 2007; Zelenka, 1990; Fordal & Zlinska, 1998); M. (Sylvestra) sp. in the foredeep Carpathian basin of the Jamnica S-119 borehole (southern Poland) in a stressed shallow marine environment (Szczeczura, 2000); M. (Mediocytherideis) inflata sensu Stancheva, 1963 (not M. inflata Schneider, 1939), in Bulgaria (Stancheva, 1963); M. (Sylvestra) spp. in the Atapuerca Basin (Spain) in a brackish water environment (Gliozzi et al., 2005). Although all these species seem adapted to shallow stressed marine environment or brackish water environments a further species, M. (Mediocytherideis) tripertita (Carbonnel), occurs in the Rhône Basin during the Serravallian in fully marine environment; this taxon is found associated with Cytheretta orthesensis Moyes, Bythocythere neerlandica vedenei Carbonnel, Cytheridea expansa Carbonnel, Cytheridea acuminata caumontensis Carbonnel, Costa batei batei (Brady), Falunia gr. F. plicatula (Reuss), Falunia sphaerulolitana (Jones), Callistocythere propocornuta Oertli, Loxocochna gr. acuminata Carbonnel, Cytherelloidea sp., Pseudoamnicocythere kollmanii Carbonnel, Cytheropteran ascellii Carbonnel, Leptocythere pentagonalis Carbonnel, Parakrithe...
<table>
<thead>
<tr>
<th>SPECIES</th>
<th>REFERENCES</th>
<th>PARATETHYS</th>
<th>MEDITERRANEAN</th>
<th>LOCALITY AND ENVIRONMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (Mediocyclididae) lipartia (Carboni)</td>
<td></td>
<td>Carboni, 1999</td>
<td>Terme Basin (Pannonia)</td>
<td>marine environment</td>
</tr>
<tr>
<td>M (Sylvestra) aff. M. (S.) postglacialis (Doruk)</td>
<td></td>
<td>Sarrazanii</td>
<td>Karakasian (Mediterranean)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
<tr>
<td>M (Sylvestra) aff. M. (S.) postglacialis (Doruk)</td>
<td></td>
<td>Late Badanian (mediterranean)</td>
<td>Karakasian (Mediterranean)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
<tr>
<td>M (Sylvestra) sp. Rodriguezi-Zabala et al</td>
<td></td>
<td>Sarmatian (late Sarmatian)</td>
<td>Sarmatian (late Sarmatian)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
<tr>
<td>M (Springtail) cephalica (Zelinka)</td>
<td></td>
<td>Sarmatian (late Sarmatian)</td>
<td>Sarmatian (late Sarmatian)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
<tr>
<td>M (Sylvestra) sp. Bacarachani</td>
<td></td>
<td>Sarmatian (late Sarmatian)</td>
<td>Sarmatian (late Sarmatian)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
<tr>
<td>M (Sylvestra) postglacialis (Doruk)</td>
<td></td>
<td>Sarmatian (late Sarmatian)</td>
<td>Sarmatian (late Sarmatian)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
<tr>
<td>M (Sylvestra) aff. M. (S.) postglacialis (Doruk)</td>
<td></td>
<td>Sarmatian (late Sarmatian)</td>
<td>Sarmatian (late Sarmatian)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
<tr>
<td>M (Springtail) cephalica (Zelinka)</td>
<td></td>
<td>Sarmatian (late Sarmatian)</td>
<td>Sarmatian (late Sarmatian)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
<tr>
<td>M (Sylvestra) sp. Bacarachani</td>
<td></td>
<td>Sarmatian (late Sarmatian)</td>
<td>Sarmatian (late Sarmatian)</td>
<td>Paratethysian region, stressed marine environment</td>
</tr>
</tbody>
</table>

**Tab. 1 - List of the known Mediocytheridia s.l. species.** Legend: normal character - Mediterranean fossil species; bold character - Paratethyan fossil species; grey background - recent Atlantic and Red Sea species.
Dactylomorpha Ruggieri, Elofonella amberii Carbonnel and Sclerochilus aff. S. contortus (Norman) (Carbonnel, 1969). Since it is unknown to which part of the Serravallian the Rhône species must be referred, it is impossible to establish whether the origin of the genus is to be located in the Mediterranean or in the Paratethyan domain, but what is rather clear is that the adaptation to both the marine and brackish environment occurred in its early evolutive phases. Anyway, up to the end of middle Serravallian, several connections

<table>
<thead>
<tr>
<th>Ages</th>
<th>Eocene (Ma)</th>
<th>Epoch</th>
<th>Mediterranean</th>
<th>Western Paratethys</th>
<th>Eastern Paratethys</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N23</td>
<td>Lower</td>
<td>QUATERNARY</td>
<td>QUATERNARY</td>
<td>QUATERNARY</td>
</tr>
<tr>
<td>2</td>
<td>N22</td>
<td>Lower</td>
<td>PIACENZIAN</td>
<td>ROMANIAN</td>
<td>AKCHAGLIAN</td>
</tr>
<tr>
<td>3</td>
<td>N19</td>
<td>Lower</td>
<td>ZANCLEAN</td>
<td>DACIAN</td>
<td>KIMMERIAN</td>
</tr>
<tr>
<td>4</td>
<td>N20</td>
<td>Lower</td>
<td>MESSIAN</td>
<td>PONTIAN</td>
<td>PONTIAN</td>
</tr>
<tr>
<td>5</td>
<td>N16</td>
<td>Lower</td>
<td>TORTONIAN</td>
<td>PANNONIAN</td>
<td>MAEOTIAN</td>
</tr>
<tr>
<td>6</td>
<td>N17</td>
<td>Upper</td>
<td>MIDDLE</td>
<td>LANGHIAN</td>
<td>TSCHERBYSHEV</td>
</tr>
<tr>
<td>7</td>
<td>N14</td>
<td>Upper</td>
<td>MIDDLE</td>
<td>BADENIAN</td>
<td>KARAGANIANSI</td>
</tr>
<tr>
<td>8</td>
<td>N15</td>
<td>Upper</td>
<td>MIDDLE</td>
<td>LANGHIAN</td>
<td>TSCHERBYSHEV</td>
</tr>
<tr>
<td>9</td>
<td>N16</td>
<td>Upper</td>
<td>MIDDLE</td>
<td>BADENIAN</td>
<td>KARAGANIANSI</td>
</tr>
</tbody>
</table>

Fig. 3 - Different chronostratigraphic schemes of correlation between the Mediterranean and Paratethyan stages.
between the two domains are documented (Meulenkamp & Sissingh, 2003) and only during the late Serravallian the emersion of both the Carpathian and the Alpine foreland domains isolated the two areas, which, from this moment developed into two different bioprovinces (Marinescu & Papaianopol, 1990; Meulenkamp & Sissingh, 2003). From this moment, in the Paratethyan domain, both Mediocytherideis s.l. and M. (Sylvestra) spread with different species (Tab. 1) all adapted to brackish environments up to the Aphersonian (Quaternary) of the Caspian Basin (Turkmenistan, Uzbekistan, and Azerbaijan, Schwartz, 1949; Markova, 1960; Agalarova et al., 1961). On the contrary, in the Mediterranean, Mediocytherideis s.l. underwent an important adaptive radiation in the marine realm from the late Tortonian (M. (Sylvestra) bismathi Bonaduce, Russo & Barra in the Ashstart 1 well, Gulf of Gabes, Tunisia, Bonaduce et al., 1990, 1992) to the Late Pleistocene (OIS 5e, M. (Sylvestra) seminis Bonaduce, Masoli & Pugliese, Sarno Plain, southern Italy, Pugliese & Stanley, 1991). Only during Messinian several brackish species occurred in the Mediterranean: during the pre-evaporitic Messinian they were limited to the Tuscan basins with nine endemic species (Tab. 1), while, in the late Messinian Lago-Mare biofacies, Mediocytherideis s.l. seems widespread in a large portion of the Mediterranean, from Italy to Spain, associated with Paratethyan ostracods of the L. djafarof Zone (sensu Carbonnel, 1979).

The origin of these Messinian brackish taxa is unknown. Both the hypotheses of their derivation from the Tortonian Mediterranean marine Mediocytherideis s.l. species or from the Paratethyan brackish forms, eventually migrated westwards via passive dispersal, are not supported by data. Similarly, the morphologies of the Messinian brackish Tuscan species do not suggest their origin from a common ancestor, thus, for the moment, it is not possible to suppose a Tuscan brackish adaptive radiation.

ACKNOWLEDGEMENTS

We wish to thank J. Rodriguez-Lazaro and S. Trenkwalder who read the manuscript and helped us to improve it with their valuable suggestions, and Valentina Reveha, who, very kindly, helped us to read the Russian papers.

REFERENCES


Schweier A.V. (1949). On the Pliocene ostracoda of the northern Caucasus and lower Volga region with some new data on the systematics of fossil ostracods. Trudy Vsesoyuznogo Neftyanogo
Nauchno-Issledovatel’s Kogo Geologo-Razvedochnogo Instituta (VNGRI), nov. ser., 30: 7-68 [in Russian].


Manuscript received 11 January 2008
Revised manuscript accepted 23 May 2008