An early record of the genus *Cytheridella* Day, 1905 (Ostracoda, Limnocytheridae, Timiriaseviinae) from the Upper Cretaceous of Mali, West Africa: palaeobiogeographical and palaeoecological considerations

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ABSTRACT – The limnic ostracod genus *Cytheridella* Day, 1905 (Limnocytheridae, Timiriaseviinae), previously only known from Plio–Pleistocene sediments and Recent lacustrine environments of South and Central America, the Caribbean Islands, Florida and Equatorial Africa, and from earliest Eocene to Early Oligocene Eurasian localities, is found for the first time in the Upper Cretaceous (undifferentiated Campanian–Early Maastrichtian) of northern Mali, West Africa, suggesting an African origin for the genus. The association with the brackish-water ostracod genus *Sarlatina* suggests a mixo- or oligohaline environment for the Cretaceous species of *Cytheridella*. *J. Micropalaeontol.* 16(1): 91–95, May 1991.

INTRODUCTION

The limnic ostracod genus *Cytheridella* Day, 1905 (Cytheracea, Limnocytheridae, Timiriaseviinae, Cytheridellini) is represented by several Plio–Pleistocene and Recent species geographically restricted to South and Central America, the Caribbean Islands, Florida and Equatorial Africa (Pinto & Sanguinetti, 1962; McKenzie, 1971; Purper, 1974; Colin & Danielopol, 1980; Martens & Behen, 1997). In Australia, *Cytheridella* is replaced by the genus Gomphodella De Deckker, 1981 which is morphologically very close.

Until recently, pre-Pliocene Pleistocene representatives of this genus were known only from few Eurasian localities of earliest Eocene to Early Oligocene age (Fig. 1):

- Earliest Eocene (Ilerdian) of southern France, Montagne Noire: *Cytheridella audensis* Tambareau et al., 1991 (= *Cytheridella* n. sp. in Tambareau et al., 1989);
- Early Eocene of India (Ypresian?): *Cytheridella strangulata* (Jones, 1905) and *Cytheridella gujeratensis* Bhandari, 1993 (*nom. nudum*) (= *Cytheridella* sp. in Bhandari et al., 1991);
- Middle Eocene (Lutetian) of southern France, Fontaine de Grabels near Montpellier: *Cytheridella* sp. (Y. Tambareau collection, unpublished);
- Late Eocene (Bartonian) of Hungary: *Cytheridella gantensis* Monostori, 1977;
- Eocene of Slovenia: *Cytheridella buseri* Monostori, 1993;
- Early Oligocene (Melanienot) of northern Germany: *Cytheridella ritzkowskiana* Carbonnel & Ritzkowski, 1969.

![Fig. 1. Stratigraphical and geographical distribution of fossil and recent species of *Cytheridella.*](image-url)
Other fossil species assigned to the genus *Cytheridella* by various authors have been removed from it by Purper (1974: pp. 655-656). The oldest species previously included in this genus, *Cytheridella? barnstorfensis* Martin, 1957 (*in* Martin & Weiler, 1957), from the Late Jurassic of Germany, has been recently reattributed to the genus *Marslatourella* (*Marslatourella?) Malz, by Schudack (1994). It is also possible that 'Gomphocythere' sp. L 234 Grékoff, 1958 from the Tertiary (Eocene, 'Grès Polymorphes') of Central Zaire, lacking the lateral ventral ridge on both valves typical of most species of the genus *Gomphocythere* Sars, 1924, belongs to the genus *Cytheridella*, as already suggested by Pinto & Sanguinetti (1962).

**THE GENUS CYTHERIDELLA IN THE UPPER CRETACEOUS OF MALI**

**Stratigraphic framework**

Recent study of material from northern Mali, West Africa (Fig. 2), led to the discovery of rare specimens of a new species of *Cytheridella* in sediments of Upper Cretaceous age (Colin et al., 1996). The level which has yielded this species, in the borehole Talack, contains also the ostracod genera *Virgatocypris*, *Zonocypris*, *Cypria*, *Darwinula* and *Sarlatina*, as well as charophyte oogonia of *Platychara caudata* Grambast and *Porochara globosa* Grambast. It is located below the first well-dated Late Maastrichtian marine beds (previously dated as Danian by Berggren, 1974) containing the foraminifera *Laffiteina bibensis* Marie and the ammonite *Lybicoceras ismaeli* Zittel (Krasheninnikov & Trofimov, 1969). According to Bellion et al. (1990), the age of this horizon is not very clear but is probably Campanian to Early Maastrichtian on the basis of molluscs faunas. Charophyte oogonia suggest a Campanian age, although a Maastrichtian age cannot be discounted (M. Feist, pers. comm.)

**Taxonomic comments**

Subclass **Ostracoda** Latreille, 1806  
Order **Podocopida** G. W. Müller, 1894  
Suborder **Podocopa** Sars, 1866  
Superfamily **Cytheracea** Baird, 1850  
Family **Limnocytheridae** Klie, 1938  
Subfamily **Timiriaseviinae** Mandelstam, 1960  
Tribe **Cytheridellini** Danielopol & Martens, 1989 emend Martens, 1993  
Genus **Cytheridella** Daday, 1905  
(= *Onychocythere* Tressler, 1939)  
*Cytheridella* sp.  
(Fig. 3)

**Fig. 2.** Location map of the studied area (Mali).

**Fig. 3.** *Cytheridella* sp., borehole In Talack, Mali, sample N2. (1) Female, dorsal view; (2) male left lateral view; (3) male dorsal view. All figures × 80.
An early record of the genus *Cytheridella*

Remarks. In 1978, Colin & Danielopol separated the genus *Cytheridella* from the Timiriaseviinae and included it in the subfamily Limnocytherinae. In 1989, Danielopol & Martens (in Danielopol et al., 1989) erected the tribe Cytheridellini including the genera *Cytheridella*, *Gomphocythere* and *Gomphodella*. Recently, Martens (1993) emended the Cytheridellini diagnosis. According to K. Martens (pers. comm.) the tribe Cytheridellini belongs to the Timiriaseviinae and not to the Limnocytherinae.

Diagnosis. The Malian Upper Cretaceous species has a typical *Cytheridella* external morphology characterized by:
- a deep and narrow dorso-median vertical sulcus extending about two-thirds of the way down the valves;
- a broad, smooth and compressed anterior margin;
- an ornamentation formed by numerous small and deep polygonal pits;
- a very pronounced sexual dimorphism with the females developing a distinct brooding cavity.

Unfortunately, since only closed carapaces were found, the internal characters could not be observed.

Affinities and differences. By its outline, this species is closer to the Recent south American type-species *Cytheridella ilosvayi* Daday, 1905 (= *Cytheridella ometepensis* Swain & Gilby, 1965), and to Plio–Pleistocene species from the Upper Amazon Basin of Brazil and Colombia *Cytheridella danielopoli* Purper and *Cytheridella postornata* Sheppard & Bate, than to the Eocene species of Hungary and Slovenia, respectively *Cytheridella gantensis* Monostori and *Cytheridella buseri* Monostori which are more elongate. Besides minor details of the outline, the Malian Upper Cretaceous species differs from other known species of the genus by its strong ornamentation formed by numerous small and deep polygonal pits.

Dimensions.

\[ L = 0.73 \text{ mm (female)} - 0.92 \text{ mm (male)} \]
\[ h = 0.43 \text{ mm (male)} \]
\[ w = 0.62 \text{ mm (female)} - 0.40 \text{ mm (male)} \]

Palaeoenvironmental considerations

According to Purper (1974) all the recent species of *Cytheridella* live in fresh-water (maximum salinity 2.5%), permanent (eggs cannot withstand desiccation, as with all members of the Cytheridellini – Martens, 1993), warm (temperature between 16 and 30°C), shallow limnic environments with well developed aquatic vegetation. They are always observed in association with other freshwater genera such as *Candona, Darwinula, Eucypris, Cypris, Candonopsis, Gomphocythere, Potamocypris, Chlamydotheca* ... For Keyser (1977), *Cytheridella alta* (Tressler, 1939), which according to Purper (1974) is a junior synonym of *Cytheridella ilosvayi* Daday, 1905, observed in Florida is a 'true limnic species which, however, is often washed into the oligohaline zone' where it occurs with *Cyprideis*.

In Australia, the closely related genus *Gomphodella* is considered to be a 'freshwater species which can withstand a slight amount of dissolved solid in water, with its highest salinity recorded at 2.3%' (De Deckker, 1981). The other related African genus *Gomphocythere* can also occur in slightly saline conditions (K. Martens, pers. comm.) and highly alkaline waters, up to > 30 meq$^{-1}$ (Cohen et al., 1983).

Fossil species are also often found in strictly freshwater environments, as in the Middle Eocene of Grabels near Montpellier (southern France), where *Cytheridella* is associated with *Frambocythere* and mammals. However, in several cases, *Cytheridella* is known to occur in mixohaline environments:
- Pleistocene and Holocene of Argentina (Zabert & Herbst, 1986; Bertels & Martinez, 1990), in which *Cytheridella ilosvayi* and *Cytheridella aff. ilosvayi* occur with truly limnic ostracods and the brackish-water species *Cyprideis salebrosa* van den Bold.
- Sub-recent and Pleistocene of Venezuela and Plio–Pleistocene of the Dominican Republic and Trinidad (van den Bold, 1971, 1986), in which *Cytheridella boldii* Purper, 1974 is found with the brackish-water genus *Cyprideis*. For these levels van den Bold (1971, p. 459) suggests a rather high alkalinity.
- Plio–Pleistocene from the Upper Amazon Basin, Colombia and Brazil (Pebas Fm.), in which *Cytheridella danielopoli* Purper, 1979 (= *Cytheridella sp. A* Purper, 1977) and *Cytheridella postornata* Sheppard & Bate, 1980, are found either in monospecific assemblages or with the brackish-water genera *Cyprideis, Proparaecytheridea, Perissocytheridea* and the truly marine genera *Pacamboocythere* and *Rhadinoocythera*.
- Eocene of Hungary in which *Cytheridella gantensis* is associated with lagoonal molluscs and dasycladacean algae (Monostori, 1977, 1993).
- Early Eocene of India in which *Cytheridella gujratensis* is found with the brackish-water genus *Neocyprideis* and rare arenaceous foraminifera (Bhandari, 1993).
- Earliest Eocene (Ilerdian) of southern France in which *Cytheridella audensis* occurring with the limnic ostracod *Frambocythere, Cypris, Candona* and *Virgatocypris* can also be associated with the brackish-water genus *Neocyprideis* (Tambareau et al., 1991).

In Mali, although typical freshwater genera occur in the assemblage (*Virgatocypris, Cypris, Darvinula and Zonocypris*), a lagoonal oligohaline environment is suggested by the presence in the sample of a great number of the cytherid genus *Sarlatina* which represents more than 50% of the fauna (Fig. 4), and whose ecological requirement was probably very close to that of *Cyprideis* (Babinot & Colin, 1976).

Whether *Cytheridella* actually lived in the lagoonal environ-

![Fig. 4. Qualitative and quantitative composition of the level with *Cytheridella* in the borehole In Talack.](image-url)
ment or was transported into it, as suggested by Monostori (1993) for the Eocene of Hungary and by Keyser (1977) for recent environments of southern Florida, cannot be proved. However, the fact that in Mali the specimens found are closed carapaces does not favour a transportation hypothesis. The high percentage of closed carapaces observed in *Gomphodella maia* De Deckker, 1981 in sub-Recent sediments of Tasmania, southern Australia, has been explained (De Deckker, 1981, 1982) by the supposition that this species could burrow in the sediment to withstand short periods of desiccation.

Concerning *Cytheridella postornata* from the Plio-Pleistocene of Colombia, Sheppard & Bate (1980) argue that 'Although a large species, the shell is thin and delicate and no extensive transport of the material is envisaged'.

Similar problems concerning the salinity tolerance and transportation into marine environments of the Mesozoic related genera *Timiriasevia* and *Theriosyneecum* have been discussed by various authors (see synthesis in Carbonel et al., 1988, pp. 443–447).

In conclusion it can be said that Recent species of *Cytheridella* are present in various types of permanent limnic environments, from truly lacustrine (*Cytheridella chariessa* Rome, 1977 (in Rome & De Deckker, 1977) in Lake Kivu in Zaire), to marginal environments (for example *Cytheridella aloxa* in Florida (Keyser, 1977)). It is assumed that fossil species had the same ecological requirements.

Palaeobiogeographical considerations (Fig. 5)

This species of *Cytheridella* of Campanian–Early Maastrichtian age is the oldest known representative of the genus, the previously known oldest species being of earliest Eocene age (*Cytheridella audensis* Tambareau et al., 1991). Its presence in Mali during this period suggests that the genus, like other members of the Timiriasevinae such as *Frambocythere*, recently reported from the Alban of Zaire (Colin, 1993), probably originated in Africa during the Cretaceous.

During the Early Tertiary (earliest Eocene to Early Oligocene), it spread over Europe and India from which it subsequently disappeared, probably as the result of climatic deterioration (cooling). In fact, the major change in lacustrine ostracod fauna and the appearance of *Cytheridella* in southern France occur during the Middle Ilerdian (earliest Eocene) and is associated with a marked climatic warming event well documented by subtropical to tropical florras (Tambareau et al., 1991).

Until now, despite a great number of studies, no Miocene representative of the genus has been reported. The only Miocene species formerly assigned to *Cytheridella*, *Cytheridella mediterranea* Zaiani, 1913 from the Miocene of Hungary, being coarsely reticulate and lacking the distinctive vertical sulcus, certainly does not belong to the genus, as already suggested by Purper (1974).

In the Plio-Pleistocene, the genus is only known from few South American localities (Brazil, Colombia and Venezuela) and its present day distribution is limited to Equatorial Africa (Cameroon and Zaire), South America (Argentina, Paraguay, Brazil, Venezuela and Chile), Central America (Nicaragua), the Caribbean Islands (Dominican Republic, Cuba and Trinidad), and the southern United States (Florida). The absence of

**CONCLUSION**

The early occurrence of the limnic ostracod genus *Cytheridella* in the Campanian–Early Maastrichtian of Mali, suggests that this genus, which had a strictly Eurasian distribution during the Eocene–Oligocene and since the Plio–Pleistocene has been geographically restricted to South and Central America, the Caribbean Islands, Florida and Equatorial Africa, probably originated in West Africa during the Late Cretaceous. The association with other freshwater ostracods and the brackish-water genus *Sarlatina* supports a mixo- or oligohaline environment for the Cretaceous species.

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