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Cluthia miocenica sp. nov. (Ostracoda) from the Middle Miocene of southern Poland (Central Paratethys)

JANINA SZCZECHURA
Zaklad Paleobiologii, Polska Akademia Nauk, 02-089 Warszawa, Al. Zwirki i Wigury 93, Poland

ABSTRACT—*Cluthia miocenica* sp. nov., the earliest known species of *Cluthia* Neale, 1973, is described from the upper part of the Middle Miocene (Upper Badenian) of south-east Poland. The occurrence of this species supports the hypothesis of climate cooling during Upper Badenian times in the Central Paratethys and suggests that this region was the birth place of the genus.

INTRODUCTION

The ostracod genus *Cluthia* Neale, 1973 has been hitherto represented by two species: *Cluthia cluthae* (Brady, Crosskey & Robertson, 1874) and *Cluthia keiji* Neale, 1985; both recorded from Recent and fossil sediments. They are represented by rare, small and thin-shelled individuals easily destroyed and which may be overlooked by micropalaeo- and microneontologists. This is presumably the main reason why *Cluthia* is only rarely recorded in Recent and fossil ostracod assemblages. Another reason for its rarity is due to its narrow environmental tolerance. *Cluthia* is regarded as a cold water taxon, preferring boreal and Arctic waters. Its presence in Late Tertiary and Quaternary sediments of the Mediterranean and central part of the eastern Atlantic areas has been explained by periodic migrations from northern seas (Peypouquet, 1971; Ruggieri, 1977; Llano, 1981; Carbonnel & Balesio, 1982). In the present paper, *Cluthia miocenica* sp. nov. is described from late Middle Miocene (Upper Badenian) deposits of southern Poland (northern periphery of the Central Paratethys). This oldest known occurrence supports my view point on the origin and migration of *Cluthia*.

The described material is housed in the Institute of Paleobiology, Polish Academy of Sciences, Warsaw (abbreviated ZPAL).

GEOGRAPHICAL DISTRIBUTION AND ENVIRONMENTAL TOLERANCE OF FOSSIL AND RECENT *CLUTHIA*

The Recent *Cluthia* includes two species which are represented by rare individuals but which occur in many regions of the Northern Hemisphere, in waters of different depth and temperature.

Norman (1891) found *Cluthia cluthae* in the Bog Fjord (E. Finnmark) at a depth of 40-60m while Scott (1899; see Neale, 1973) collected it from Franz Joseph Land at a depth of about 60m. Hazel (1970) also collected it from near Greenland at a depth of 13m and determining its amphiatlantic bathymetry and distribution as being between 20 and 300m. Benson *et al.* (1983), however, investigating the biofacies of the Newfoundland continental slope recorded *Cluthia cluthae* from a depth of 500m to over 1500m, from such different sediment substrates as silt, mud and sand.

C. cluthae has been described from the Bay of Biscay from a depth of 100m and 600m by Yassini (1969), and Neale (1975) described *C. keiji* from the eastern coast of Spain from a depth of 81m. Bonaduce *et al.* (1975) found this species in the Bay of Naples and the Adriatic Sea, where it occurs preferably at a depth of about 85m on a substrate varying from medium sand to sandy silt. Neale (1975) also mentioned the occurrence of *C. keiji* near the Algerian coast.

In the Quaternary, *C. cluthae* is recorded from the N.E. Atlantic shelf of Morocco (Llano, 1981), from the Bay of Biscay (Peypouquet, 1971) and from Malta (Neale, 1975). In the Pleistocene *C. cluthae* has been recorded from the N.W. coastal regions of the USSR (Neale, 1973), from S.W. Sweden (Lord, 1982) and from the Bay of Biscay (Moyes & Peypouquet, 1969). The oldest, so far, recorded occurrence of *Cluthia (C. keiji)* was described by Carbonnel & Ballesio (1982) from the Pliocene of south-east France and northern Italy.

According to Hazel (1970), the amphiatlantic temperature tolerance of Recent species of *Cluthia* is between 0°C (or even less) to 7°C+ and that its southern range is limited by summer temperatures (see also Neale, 1973). Neale estimates that it is a summer surface water temperature of 15°C that limits the southward distribution of Recent and Pleistocene species of *Cluthia* in the Atlantic.

Other authors, (Moyes & Peypouquet, 1971; Carbonel, 1980; Llano, 1981; Carbonnel & Ballesio, 1982) consider *Cluthia* not only to be a cold water form but also nearshore in habit, and as such is an indicator of the palaeocoast in fossil forms. Peypouquet (1971) also considers the temperature tolerance of Recent *Cluthia* to be the factor limiting its geographical distribution. This author, investigating Recent and subfossil ostracod assemblages from the shelf sediments of the Bay of Biscay, included specimens of *Cluthia* into the palaeothanatocoenosis which resulted from the biocoenosis living during the last glaciation. Similarly Llano (1981), who analysed Quaternary ostracod assemblages from the Moroccan coast, considered the specimens of *Cluthia* in his material to be representatives of northeastern Atlantic forms from the Norwegian Province, and to be indicative of a cold water palaeothanatocoenosis. One may add here that Quaternary biocoenoses with *Cluthia* also contain other cold-water ostracod species.

Carbonnel & Ballesio (1982), regarding *Cluthia* to be a cold-water ostracod having a very short stratigraphical range in the Pliocene deposits in France and Italy, used it for correlation as well as for designating a zone indicating Middle Pliocene cooling in the Mediterranean basin. In the light of these interpretations of the age and palaeotemperature conditions of *Cluthia*, one has doubts about the findings of *Cluthia* in the Recent Mediterranean Sea (Italy, Algeria, Spain and Yugoslavia coasts).

CLUTHIA MIOCENICA SP. NOV. FROM THE MIDDLE MIOCENE OF S.E. POLAND

Cluthia miocenica sp. nov. has been found in the Middle Miocene (Upper Badenian) deposits of southeast Poland, in Roztocze region. Roztocze, which is a southern margin of the Lublin Upland, forms, together with other Polish Uplands, the northern margin of the Fore-Carpathian Depression. In the Miocene, Roztocze constituted a marginal part of the Central Paratethys and, therefore, deposits of this age represent a shallow water, nearshore zone of sedimentation. The most common sediments are intercalating sands, marls and limestones.

A few specimens of *Cluthia* have been found in outcrops of Upper Badenian age in the northwest part of Roztocze at Weglin and Trzesiny. At Weglin (cf. Szczechura & Pisera, in press, fig. 2) it has been found in marls overlying lithothamnian limestones and in marly clay from the higher part of the section. In the marls, *Cluthia miocenica* is accompanied by relatively abundant *Aurila* cf. *A. opaca*, *Aurila* sp., and *Semicytherura* spp., and very rare *Pterygocythereis jonesii, Bairdia* sp., *Kangarina abyssicola*, *Cytheropteron* sp., *Krithe* sp., *Pseudocythere* cf. *P. caudata*, *?Argilloecia* sp., *Occultocythereis bituberculata* and *Cythereida acuminata*. In the clays, *Cluthia* and *Cythereidea acuminata* only occur.

Diversity, taxonomic composition of ostracod assemblages accompanying *Cluthia*, density and population structure as well as analysis of the whole microfauna from Weglin (except from the topmost part of the section; cf. Szczechura & Pisera, in press) are indicative of a non-stable environment, with fluctuating bathymetry (deepening). At least outer infralittoral (*sensu* Carbonel, 1980) conditions existed during sedimentation of the lower part of the section.

At Trzesiny (cf. Szczechura, 1982, fig. 3) *Cluthia* occurs in a clay layer (in a sample almost corresponding to sample no. 7), a marly limestone (sample no. 10) and sandstone (sample no. 11). In the clays *Cluthia* is accompanied by abundant *Callistocythere* spp., *Aurila* spp., *Semicytherura* spp., and *Cytheridea acuminata*; less common or rare are *Loxoconcha* sp., *Cytheropteron* sp., *Parakrithe dactylomorpha*, *P. crystallina*, *Hemicytherura videns*, *Paracytheridea triquetra*, *Cnestocythere* sp., *Xestoleberis* sp., *Kangarina abyssicola*, and *Henryhowella asperima*. These forms are indicative of an at least circalittoral environment. In limestones the dominant ostracods are *Callistocythere* spp., *Cytheridea acuminata*, *Loxoconcha* spp., *Aurila* spp., with rare *Pterygocythereis jonesii, Paracythereidea triquetra* and

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Explanation of Plate 1
Cluthia miocenica sp. nov.
All figures × approx. 250 unless stated otherwise.

Fig. 1 Paratype, ZPAL 0.XXIX/1, car., L side, Trzesiny.

Fig. 2. Paratype, ZPAL 0.XXIX/2, car., dorsal view of posterodorsal area, Weglin (× approx. 150).

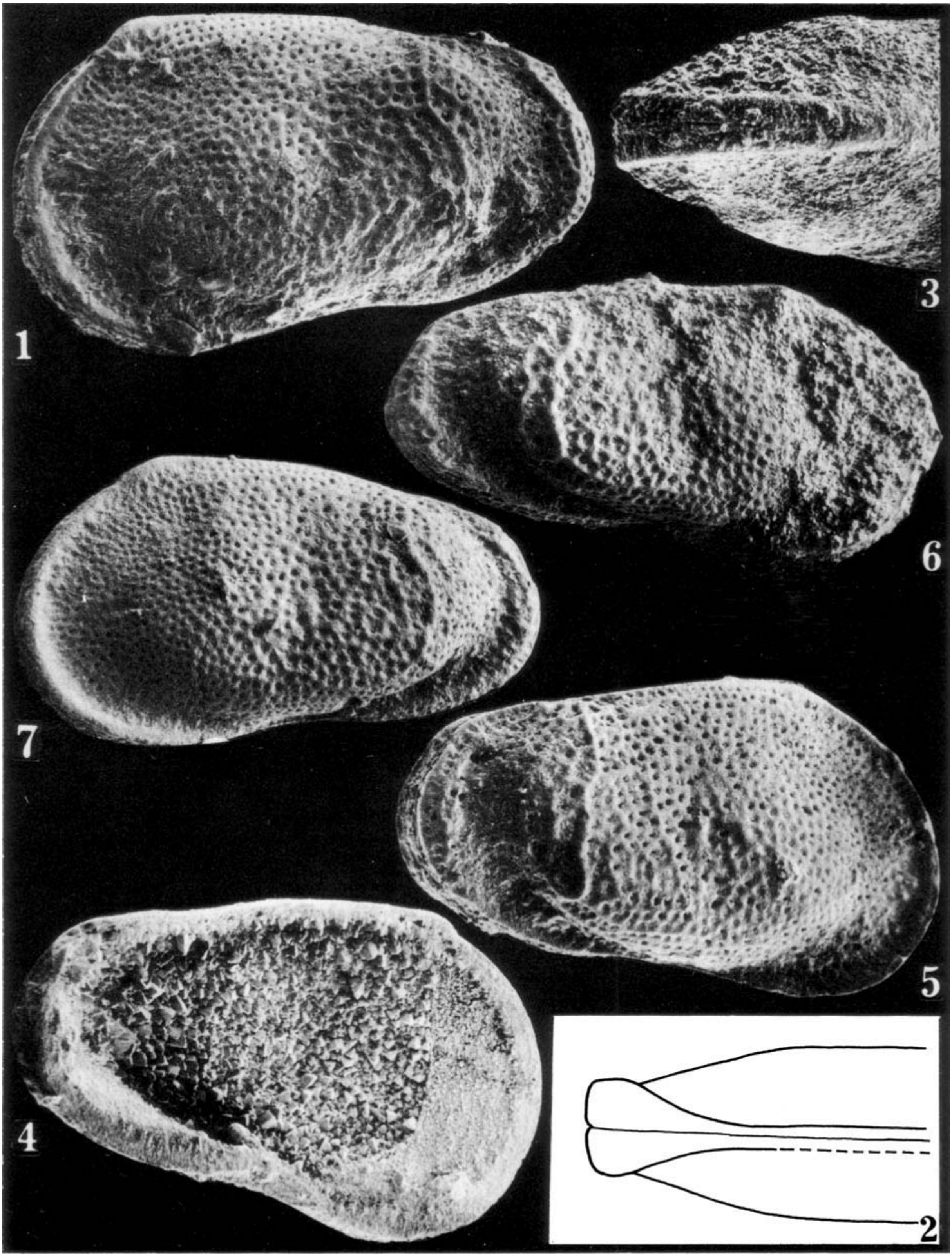
Fig. 3. Paratype, ZPAL 0.XXIX/3, car., dorsal view of anterodorsal area, Trzesiny.

Fig. 4. Paratype, ZPAL 0.XXIX/4, LV, int. lat., Weglin.

Fig. 5. Paratype, ZPAL 0.XXIX/5, RV, ext. lat., Weglin.

Fig. 6. Paratype, ZPAL 0.XXIX/6, car., R side, Trzesiny.

Fig. 7. Holotype, ZPAL 0.XXIX/7, LV, ext. lat., Trzesiny.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Semicytherura sp. This assemblage seems to characterise an inner littoral, phytal environment.

Sands contain a similar assemblage of ostracods although their frequency is lower than in the limestones and ostracods occur mostly as adult carapaces indicating a high rate of sedimentation.

Analysis of ostracod and forminifera distribution in the whole Trzesiny section suggests changing bathymetry and energy environment in a shallowing upward sequence.

Especially important seems to be the fact that although in all samples from Roztocze, *Cluthia* represents various environmental conditions regarding depth, character of substrate and hydrodynamic energy, it seems to represent rather uniform temperate temperature conditions.

Differences existing between the Early and Late Badenian in the Central Paratethys, concern among others, microfauna distribution and are expressed by the disappearance of termophilic small planktonic and large benthic foraminifera in the Late Badenian. Based on this, I have designated (Szczechura, 1982, 1984) *Globigerinoides* and *Globigerina* ecozones which represent respectively, a tropical climate in the Early Badenian and a temperate climate in the Late Badenian. In this biostratigraphical zonation, *Cluthia* belongs to the *Globigerina* ecozone. Of importance here seems to be the fact that deposits of the *Globigerina* ecozone are impoverished with regard to the numerous ostracod species present in deposits of the *Globigerinoides* ecozone (Szczechura & Pisera, in press).

According to earlier investigations, presented above, the occurrence of *Cluthia* in Poland probably records the drop in temperature of the shallow surface waters of the Late Badenian of the Central Paratethys. The presence of *Cluthia* in deposits of the Middle Miocene of the Central Paratethys also has other consequences in that it allows for the origin of *Cluthia* and the direction of migration to be different from that previously postulated.

ORIGIN AND MIGRATION PATHS OF *CLUTHIA*

Evaluating the so far known geographical and stratigraphical distribution of *Cluthia* (Fig. 1) there is no doubt that it appeared in the Middle Miocene (Late Badenian) of the Central Paratethys presumably during climate cooling. Later, in the Pliocene, it spread into the Tethys (France and Italy) and around its periphery. Northern seas were colonised by *Cluthia* only in the Quaternary, so they cannot be regarded as provinces of origin of this genus.

The existence of a communication between the Paratethys and the Tethys in the Late Middle Miocene (Late Badenian) (Carbonnel & Jiřiček, 1977; Jiřiček, 1983) allowed *Cluthia* to migrate from the Paratethys into the Tethys and, as a consequence, into the eastern and northern Atlantic. At Roztocze, in deposits which are stratigraphical equivalents of those with *Cluthia*, both *Carinocythereis carinata* and *Cyamocytheridea dertonensis* occur. These two species also occur in time-equivalent strata in Italy, and thus permit a correlation

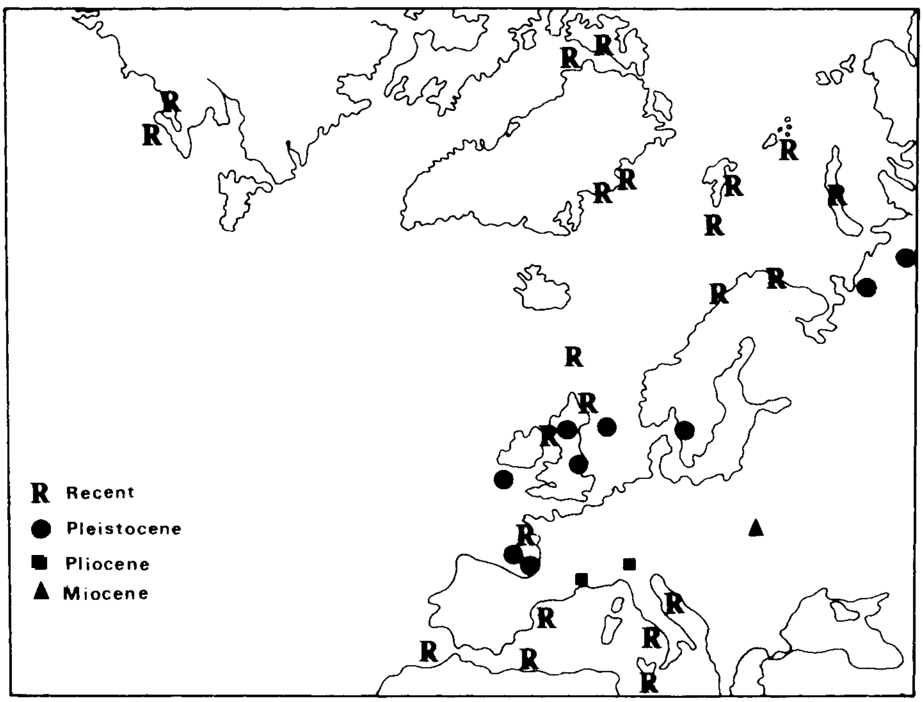

Fig. 1. Distribution of Recent and fossil *Cluthia* after Neale, 1973, and Szczechura, present paper.

of the upper part of the Middle Miocene of both the Tethys and the Paratethys (Carbonnel & Jiříček, 1977; Jiříček, 1983). The first of these two species lives today and has a wide disribution in the Mediterranean region and along the eastern coast of the Atlantic between lats. 25° and 60°N. Thus, it seems probable that the Paratethys, beginning in the Late Badenian, was the centre of origin of many marine ostracod species, known subsequently from the Late Miocene of the Tethys.

So far, the influence of the Paratethys on the Tethys, based on ostracods, was postulated to exist in the latest Middle Miocene i.e. in the Sarmatian.

In the light of the data presented above, *Cluthia* from the bottom sediments of the Mediterranean Sea is an element of a cool climatic paleothanatocoenosis or of a deep water (and so also cool-water) element of a Recent biocoenosis. However, to accept the living presence of *Cluthia* in the present day Mediterranean Sea, one needs to find it with soft parts preserved.

SYSTEMATIC DESCRIPTION

Family Leptocytheridae Hanai, 1957

Cluthia Neale, 1973

Cluthia miocenica sp. nov.

(Pl. 1, figs. 1–7)

Derivation of name. Latin, *miocenica* – occurring in the Miocene.

Holotype. ZPAL 0.XXIX/7; Pl. 1, fig. 7.

Paratypes. ZPAL 0.XXIX/1–6; pl. 1: 1–6.

Type horizon and locality. Upper Badenian (Middle Miocene), Weglin (Roztocze), Poland.

Material. Eight rather well preserved specimens.

Diagnosis. Non-tuberculate species of *Cluthia*, without posterodorsal, admarginal rib-like inflation.

Dimensions (mm)

	ZPAL 0.XXIX/1	0.XXIX/4,LV	0.XXIX/7,LV
Length	0.36	0.36	0.36
Height	0.20	0.20	0.20
Width	0.16		

Description. Valve small, thin, laterally compressed, with lateral outline typical of genus. Maximum height anteriorly, greatest width posteroventrally. Both valves very similar in size and shape. Dorsal margin straight, ventral margin concave in middle part. Anterior margin broadly and somewhat obliquely rounded, posterior margin less broadly rounded. Anterior cardinal angle better developed than posterior one, being more distinct in the left valve. Distinct lateral inflation best marked behind and below muscle-scar field; in its lower part it extends up to the ventral margin. Weak rib-like inflation runs closely to the posterior margin, in its upper part disappearing below and before the hinge margin, whereas in its lower part gently passing into the ventral margin. Marginal part of the anterior end slightly removed outside and generally thickened distally. Valve surface regularly and densely pitted, with weak and tiny, irregular striae bordering posteriorly the lateral inflation.

Duplicature wide anteriorly, narrow posteriorly, without a vestibule. Hinge margin straight; hinge elements unknown.

Variation. Weak variation concerning the size, length: height ratio and details of the valves ornamentation have been observed.

Remarks. The described species is very close to *Cluthia keiji* Neale, 1975, described as a Recent species from the Mediterranean region. In contrast to *C. keiji*, *C. miocenica* is larger and lacks the posterodorsal, admarginal, rib-like inflation.

Occurrence. Trzesiny and Weglin, Roztocze region, S.E. Poland, Upper Badenian (late Middle Miocene).

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