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**MALACOFAUNA OF THE LATE VISTULIAN AND EARLY HOLOCENE  
LACUSTRINE CHALK FROM ROZTOKI NEAR JASŁO  
(JASŁO—SANOK DEPRESSION)**

**Malakofauna kredy jeziornej późnego Vistulianu i wczesnego holocenu z Roztok  
koło Jasła (Doły Jasielsko-Sanockie)**

**ABSTRACT.** The lacustrine chalk from Roztoki comprise a sequence of three molluscan assemblages, characterizing the changes of paleogeographical conditions during the uppermost part of Vistulian and the beginning of Holocene. The first of these assemblages can be compared with a zone of arctic molluscs. It pass upwards into the transitional one, while the thirds contain species typical of the temperate climatic zone.

**INTRODUCTION**

In the vicinity of Krosno and Jasło the Late Glacial and Early Holocene lacustrine sediments are known in several localities. There are silts and sandy silts with a low content of calcium carbonate passing upwards into lacustrine chalk intercalated by peat or calcareous gyttja and covered by peat and loam. Calcareous sediments abound with shells of molluscs, both bivalves and water gastropods, locally shells of land snails can be found. Molluscan assemblages were described from Miejsce Piastowe and Łężany near Krosno (Alexandrowicz & Stworzewicz 1980, Alexandrowicz 1981a, b) and from Roztoki near Jasło (Urbański 1935, 1948, Alexandrowicz 1981c, 1986). The occurrence of subfossil malacofauna was also noted in some other localities of this region (Fig. 1).

**ASSEMBLAGES OF MOLLUSCS**

Malacological analysis of the lacustrine chalk from Roztoki was carried out at first by Urbański (1935, 1948) and in the last few years by the author (Alexandrowicz 1981c, 1986). As a result two molluscan assemblages were

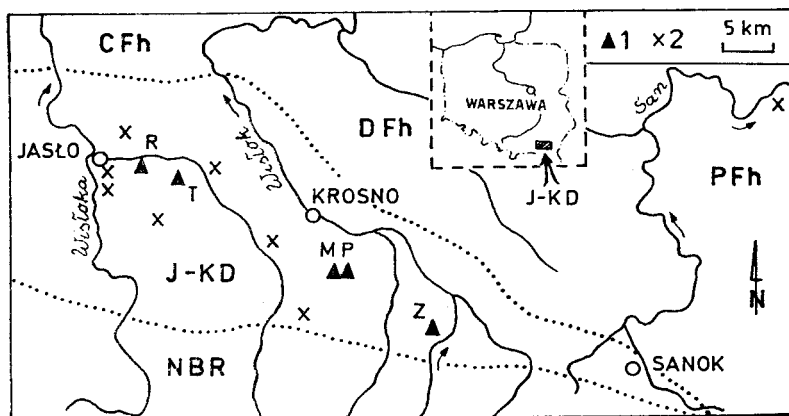


Fig. 1. The occurrence of the Late Vistulian and Early Holocene lacustrine chalk in the Polish Carpathians. 1 — localities with the Malacofauna described: R — Roztoki, T — Tarnowiec, MP — Miejsce Piastowe — Łężany, Z — Zapowiedź, 2 — other localities, NBR — Niski Beskid Range, J-K-D — Jasło—Krosno Depression, CFh — Cieżkowice Foothill, DFh — Dynów Foothill, PFh — Przemyśl Foothill

distinguished: one of them characterized by numerous shells of *Planorbidae* and the other one — with a lot of shells and opercula of *Bithynia*. New series of analysed samples derives from three profiles — a, b and c, described in detail by Wójcik (1987) as well as from the profile f situated about 200 m eastwards from the point b (Wójcik 1987 — Fig. 2). Numerous shells of snails and bivalves were found in all the samples taken from the lacustrine chalk and from the lowermost part of the peat covering the calcareous sediments. Three types of molluscan assemblages including some sub-types can be distinguished in the mentioned profiles. They are denominated according to the nomenclature used by Ložek (1964, 1976, 1982), Fuhrmann (1973) and other authors and can be regarded as assemblages characterizing particular stages of the sedimentation of the lacustrine chalk (Table 1).

Assemblage with *Gyraulus laevis* ("laevis-fauna") comprise about 10 species. The nominal taxon — *Gyraulus laevis* is represented by a considerable number of specimens and can be regarded as a dominant component of this fauna. As subordinate components a few species of *Planorbidae* and *Lymnaeidea* such as *Armiger crista nautilus*, *Hippeutis complanatus* and *Lymnaea peregra* can be mentioned. These species are found in most samples but in a scarce number of shells. Some other species like *Bathyomphalus contortus*, *Lymnaea palustris* and *Lymnaea truncatula* occur sporadically, only in single samples. Numerous specimens of *Pisidium* are another significant component of the assemblage in question. There are: *Pisidium lillieborgi*, *P. stewarti* and *P. obtusale lapponicum* as well as *P. milium*, *P. casertanum* and *P. nitidum*. In some samples shells of land snails are found, representing such species as: *Columella columella*, *Vertigo genesii*, *Vallonia tenuilabris*, *Pupilla muscorum*, *Euconulus fulvus*, *Succinea elegans* and *S. oblonga elongata* (Fig. 2 — L). The described fauna is

Table 1

Molluscs of the lacustrine chalk from Roztoki. C — constance index: I — 0—20%, II — 20—40%, III — 40—60%, IV — 60—80%, V — 80—100%, D — dominance index: I — 0—1%, II — 1—5%, III — 5—10%, IV — 10—20%, V — 20—100%

Taxon	Laevis-fauna		Peregra-fauna		Tentaculata-fauna	
	C	D	C	D	C	D
1. <i>Valvata cristata</i> Müller			V	III	II	I
2. <i>Valvata piscinalis</i> (Müller)	I	I				
3. <i>Bithynia tentaculata</i> (Linnaeus)			I	I	V	V
4. <i>Bithynia operculum</i>			II	I	V	V
5. <i>Physa fontinalis</i> (Linnaeus)			IV	II	I	I
6. <i>Lymnaea stagnalis</i> (Linnaeus)	III	I	IV	II	III	I
7. <i>Lymnaea palustris</i> (Müller)	I	I	II	I	II	I
8. <i>Lymnaea truncatula</i> (Müller)	I	I	I	I	I	I
9. <i>Lymnaea peregra peregra</i> (Müller)	IV	II	V	V	V	II
10. <i>Lymnaea peregra ovata</i> (Draparnaud)	II	I	IV	III	II	I
11. <i>Planorbis planorbis</i> (Linnaeus)					III	III
12. <i>Anisus leucostomus</i> (Millet)					I	I
13. <i>Bathyomphalus contortus</i> (Linnaeus)	III	I	IV	II	IV	II
14. <i>Gyraulus riparius</i> (Westerlund)					II	I
15. <i>Gyraulus laevis</i> (Alder)	V	V	III	II	I	I
16. <i>Armiger crista</i> (Linnaeus)	IV	II	IV	III	III	III
17. <i>Hippeutis complanatus</i> (Linnaeus)	III	I	IV	I	III	I
18. <i>Pisidium milium</i> Held	IV	II	V	II	IV	II
19. <i>Pisidium subtruncatum</i> Malm			I	I	I	I
20. <i>Pisidium nitidum</i> Jenyns	IV	II	V	V	V	IV
21. <i>Pisidium lillieborgi</i> Clessin	V	V	II	I		
22. <i>Pisidium casertanum</i> (Poli)	II	I	I	I		
23. <i>Pisidium obtusale</i> (Lamarck)			II	II	III	II
24. <i>Pisidium obt. lapponicum</i> Clessin	IV	III				
25. <i>Pisidium stewarti</i> Preston	IV	III				
26. <i>Columella columella</i> (Martens)	I	I				
27. <i>Vertigo antivertigo</i> (Draparnaud)			I	I	I	I
28. <i>Vertigo genesii</i> (Gredler)	I	I				
29. <i>Pupilla muscorum</i> (Linnaeus)	I	I				
30. <i>Vallonia tenuilabris</i> (Braun)	I	I				
31. <i>Succinea oblonga elongata</i> Sandberg.	I	I				
32. <i>Succinea elegans</i> (Risso)					I	I
33. <i>Euconulus fulvus</i> (Müller)	I	I			I	I
34. <i>Limacidae</i>			I	I	I	I

differentiated due to the percentage of the principal components and the occurrence of land snails. Beside the nominal sub-type of the assemblage, characterized by the predominance of *Gyraulus laevis*, another sub-type with *Pisidium stewarti*, *P. lillieborgi* and *P. obtusale lapponicum* can be distinguished. The third sub-type comprises an admixture of shells of land snails typical of open habitats and moist environments.

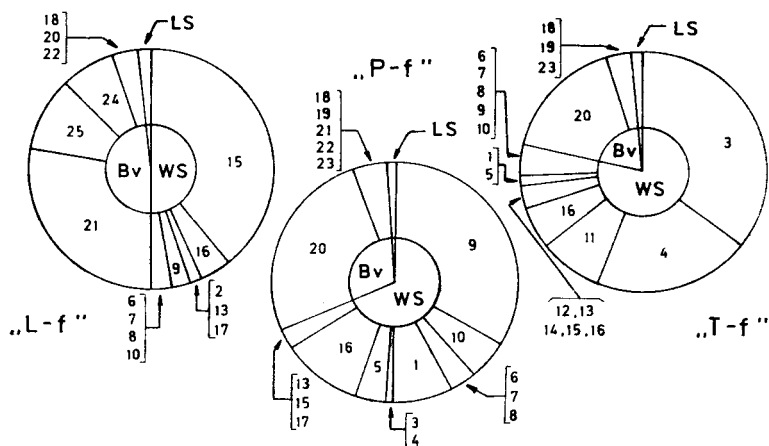


Fig. 2. Malacological spectra of the assemblages from the lacustrine chalk at Roztoki. L-f — laevis-fauna, P-f — peregra-fauna, T-f — tentaculata-fauna, WS — water snails, LS — land snails, Bv — bivalves, 1—25 — numbers of species according to Table 1

Assemblage with *Lymnaea peregra* ("peregra-fauna") is more rich as the previously described one. The nominal species prevail and is represented by two forms: *Lymnaea peregra peregra* and *Lymnaea peregra ovata*. The other species of *Lymnaeidae*: *L. stagnalis*, *L. palustris* and *L. truncatula* reach a low number of specimens. *Planorbidae* are found in each sample, there are mainly: *Armiger crista nautileus*, *Hippeutis complanatus*, *Bathyomphalus contortus* and *Gyraulus laevis*. Only the first mentioned is an important component of the assemblage, while the others are noted just as single shells. The occurrence of a considerable number of two other taxa: *Valvata cristata* and *Physa fontinalis* is notheworthy. Land snails are found sporadically. Shells of bivalves reach about 25% of all the specimens. The most numerous is *Pisidium nitidum*, accompanied by scarce shells of *P. milium*, *P. casertanum*, *P. obtusale* and *P. subtruncatum* (Fig. 2 — P). The differentiation of the described fauna is not clearly expressed, but one sub-type — with *Lymnaea peregra peregra*, and the other — with *Lymnaea peregra ovata* can be distinguished.

Assemblage with *Bithynia tentaculata* ("tentaculata-fauna") comprise about 20 taxa of molluscs with the predominance of shells and opercula of *Bithynia tentaculata*. Numerous specimens of *Planorbidae* and *Lymnaeidae* are found in each sample. The first mentioned is represented by: *Planorbis planorbis*, *Bathyomphalus contortus*, *Armiger crista nautileus*, *A. crista cristatus*, *Hippeutis complanatus*, *Gyraulus laevis* and *G. riparius*, while the second one by: *Lymnaea peregra*, *L. stagnalis*, *L. palustris* and *L. truncatula*. Some specimens of *Valvata cristata* and *Physa fontinalis* are found, too. Shells of bivalves are an important component of the fauna in question. There are mainly: *Pisidium nitidum*, *P. milium* and *P. obtusale*, accompanied by *P. subtruncatum* and *P. casertanum*. In a few samples shells of land snails occur, such as: *Vertigo antivertigo*, *Euconulus fulvus*,

*Succinea elegans* and *Carychium minimum* (Fig. 2 — T). The assemblage is less differentiated, but in some samples shells of *Bithynia tentaculata* dominate distinctly, while in other samples the number of opercula (*Bithynia-operculum*) considerably exceed the number of shells.

The described assemblages form a sequence observed in all the mentioned profiles. A similar sequence was also reported by Urbański (1948). The most typical are the "laevis-fauna" and the "tentaculata-fauna", while the "peregrina-fauna" can be regarded as an assemblage intermediate between the two cited above. The occurrence of some species known in present-day malacocenoses from different climatic conditions can be used for stratigraphic and paleogeographic interpretations. There are following snails and bivalves:

*Gyraulus laevis* (Alder) — an holarctic species known from North-Europe and North Asia and reported also from Middle Europe, a.o. from Poland (Piechocki 1979). It is one of the most typical taxon of the late glacial lacustrine sediments, occurring commonly in chalk and gyttja in the deglaciated areas.

*Planorbis planorbis* (Linnaeus) is widespread in Middle and South Europe reaching 62°N in Scandinavia. It prefers small, permanent or temporary water bodies of the temperate climatic zone and is known from different types of Holocene sediments.

*Bithynia tentaculata* (Linnaeus) has a large ecological valency and occurs commonly both in present-day and in Holocene molluscan assemblages. In Middle and North Europe it is connected with a zone of a temperate climate occupied by mixed and deciduous forests.

*Pisidium stewarti* Preston — a species extinct in Middle Europe, known recently in North and Middle Asia, was reported from many localities of the Vistulian and Late Glacial lacustrine sediments (Schmierer 1947, Kuiper 1962) mainly in North Germany. It is a taxon typical of small water bodies of the periglacial zone.

*Pisidium obtusale lapponicum* Clessin is unknown from the present-day fauna but occurs commonly in lacustrine sediments of the Vistulian age, mainly in late glacial chalk and gyttja widespread in lowlands of the Middle Europe.

*Pisidium lillieborgi* Clessin live now in lakes of the Middle and North Europe and Asia. It was found in many localities in the Late Glacial and Early Holocene sediments of this area, together with molluscs typical of small water bodies of the cold climatic zone.

#### INTERPRETATION

Water molluscs are less characteristic indicators of paleoclimate as land snails, but it can be used for paleogeographic interpretations basing on the range of taxa living now in Europe. A detail study on the distribution of species and assemblages in several climatic and floristic zones of the Scandinavia was carried

out by Johansen (1904) and as a result a few types of malacofauna found in Vistulian and Holocene sediments of Northern Germany were distinguished by Menzel (1910). New data on the range of particular living and subfossil (Late Quaternary) snails and bivalves of Europe are given by Jaeckel (1962) and of Poland by Urbański (1947, 1957). The conclusions described by the mentioned authors can be adopted for the interpretation of molluscan succession from Roztoki.

The assemblage with *Gyraulus laevis* (laevis-fauna) can be compared with "zone of arctic molluscs" reported from Vistulian and Late Glacial sediments of North Germany (Menzel 1910). Beside water molluscs typical of this zone, such as the nominal taxon and the three described species of *Pisidium*, following land snails connected with the cold climatic zone occur: *Columella columella*, *Vertigo genesii*, *Vallonia tenuilabris* and *Succinea oblonga elongata*. The assemblage like this one, characterize a zone of tundra and subarctic steppe passing into the zone of birch forests.

In the peregrina-fauna some of the mentioned taxa, living in the peryglacial zone are lacking and species of a large ecological valency prevail. A few snails showing the limited range in North Scandinavia (a. o. *Valvata cristata* and *Physa fontinalis*) are present here. The occurrence of *Vertigo antivertigo* replacing land snails noted in the previously described assemblage is another important feature of the fauna in question. According to the scheme defined by Johansen (1904) the assemblage with *Lymnaea peregrina* seems to be an indicator of the cold-temperate zone with birch and pine-birch forests passing into the zone with mixed forests.

The assemblage with *Bithynia tentaculata* (tentaculata-fauna) correspond to the fauna described by Menzel (1910) from the "younger lacustrine chalk" of the North Germany. Species typical of the laevis fauna are absent or can be regarded as subordinate components of the assemblage. In contrast, snails living recently in the temperate climatic conditions, such as *Bithynia tentaculata* and *Planorbis planorbis*, abound here. The tentaculata-fauna is known mainly from present-day water bodies widespread in zones of mixed and deciduous forests of the Middle Europe as well as in corresponding areas deforested by the human activity.

Three molluscan assemblages described from Roztoki occurs as a sequence characterizing the changes of paleogeographic conditions during the accumulation of the lacustrine chalk. The basin filled with silts, calcareous sediments and finally by peat were formed in the late glacial time (Allerød — Younger Dryas) as a flat, shallow water body of the peryglacial zone, surrounding mainly by open, moist habitats. During the evolution of the basin in question the climate become slowly more mild, causing changes in vegetation and in molluscan fauna. The water body was gradually filled with sediments and overgrowth. In the final stage of this process, just in Early Holocene, the tentaculata-fauna developed. The dominance of shells of the nominal species characterize the litoral zone while the abundance of *Bithynia operculum* is typical of the zone of bulrush (Steen-

berg 1917). During the Lower Holocene the water body was transformed into peat bog and later — covered with silts and loams.

In the vicinity of Jasło and Krosno numerous ancient lakes and small water bodies developed in Late Vistulian — Early Holocene and filled with lacustrine chalk are known. Their origin, evolution and extinction were probably similar to the basin in Roztoki, but particular stages of these processes can be not synchronic.

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