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MOLLUSCAN ASSEMBLAGES FROM A LOESS PROFILE AT ODONÓW (MAŁOPOLSKA UPLAND)

Abstract

Molluscan assemblages with *Pupilla*, *Columella*, *Lymnaea* and *Succinea* have been found in a loess profile at Odonów. Their composition and sequence correspond to the successive changes in palaeogeographical environment during the Warta glaciastadial and the last glaciation.

INTRODUCTION

Studies of loess malacofauna are well advanced in many countries. Owing to this, it is possible to follow the climatic changes that occurred in Europe during glacial periods, as well as to reconstruct the ecological environments that existed in zones of deposition of dust sediments. The methodological foundations of malacologic analysis were largely laid by V. LOŽEK (1955, 1964). On the basis of many years' detailed studies, this author recognized variations in molluscan assemblages in the successive stages of Pleistocene climatic cycles, and his scheme is largely based on the analysis of loess profiles exposed near Prague and in other regions of Czechoslovakia (V. LOŽEK, 1965, 1976; KUKLA, V. LOŽEK, 1961). Investigations of loess malacofauna were also carried out in Alsace (PUISSEUR, 1978), in the European part of the USSR (KUNICA 1961; VEKLIČ, 1961; SOKOLOVSKII, 1961; MOTUZ, 1961) and in Hungary (WAGNER, 1966, 1979a, b).

No systematic studies of this kind have been made as yet in Poland, but data on the occurrence of some snail species and characteristic assemblages of loess fauna can be found in the papers of several authors (URBAŃSKI, 1955; PIECHOCKI, 1977; ALEXANDROWICZ, 1983). The studies undertaken by the present author aimed to determine the composition of malacofaunal assemblages and their variation in different genetic types of loesses and in the basic profiles of loess series of southern Poland. An interesting profile of loess sediments is located at Odonów near Kazimierza Wielka (Małopolska Upland), about 45 km NE of Cracow.

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The profile of loess series of a thickness of 16 m is exposed in two outcrops in a brick-yard at Odonów (Fig. 1-St). It was described by J. JERSAK (1975, 1976) and mentioned by H. MARUSZCZAK (1980). The profile contains a few horizons of fossil soil, with two soil complexes, corresponding to the interstadial period within the Middle-Polish glaciation and to the last interglacial period, being particularly well developed. Within the loess series JERSAK (1976) distinguished lower older loess (Odra glacistadial, Fig. 1-O), the "Tomaszów" soil complex (Lublin interstadial – T), upper older loess (Warta glacistadial – W), the "Nietulisko" soil complex (Eemian interglacial period – N) and younger loess (Vistulian glaciation – V) separated by the poorly marked "Komorniki" soil. The loesses rest on boulder clay of the Cracow glaciation (Fig. 1-M) and on Upper Miocene clay (K).

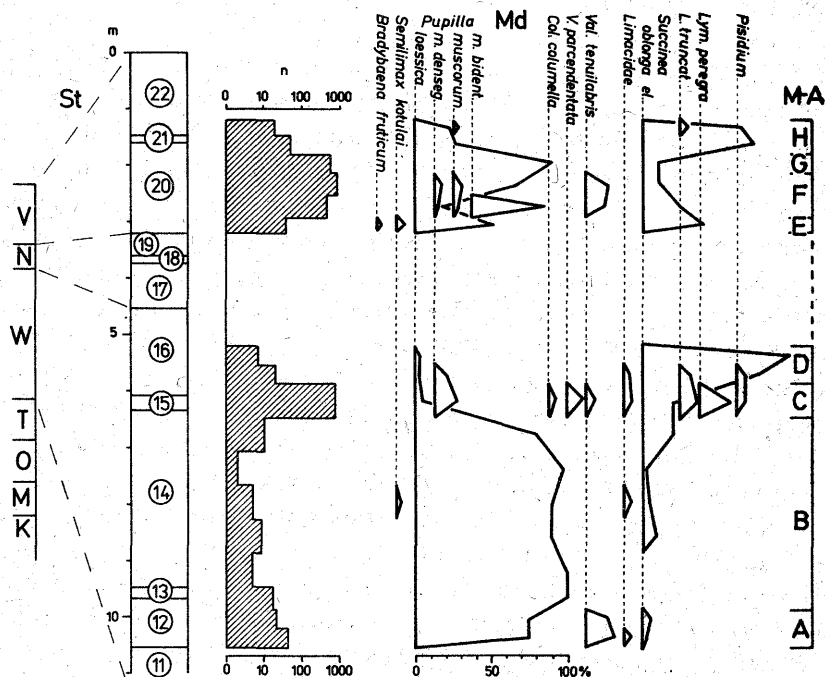


Fig. 1. Malacofaunal assemblages in the profile of loess series at Odonów

St – stratigraphic profile (acc. to JERSAK, 1976); K – Upper Miocene clay; M – boulder clay of the Cracow glaciation; O – loess, Odra glacistadial; T – Tomaszów soil complex, Lublin Interstadial; W – loess, Warta glacistadial; N – Nietulisko soil complex, Eemian interglacial period; V – loess, Vistulian glaciation; 11–22: bed numbers (acc. to JERSAK, 1976); n – number of mollusc shells in samples (logarithmic scale); Md – ranges and percentages of determined species in the loess series; M-A – letter symbols for malacofaunal assemblages (A–H)

The loesses in question contain snail shells, which are abundant in the middle and upper parts of the profile. The preliminary studies of malacofauna were made by M. JASTRZEBSKA-MAMELKO (1975), who found assemblages with *Succinea*, *Pupilla*, *Vallonia* and aquatic molluscs in three samples collected from the beds abounding in mollusc shells. This differentiation in malacofaunal assemblages suggested the expediency of carrying out detailed studies throughout the profile. Such studies were made by the present author in the old outcrop of the brick-yard (Odonów II, JERSAK, 1975). Samples 1 – 2 dcm³ in size were taken at intervals of 20 cm, and in beds particularly abounding in mollusc shells – at intervals of 10 cm. The total number of samples was 96, 54 of which contained fossils. To determine the number of specimens, the composition of assemblages and their variation, 17 samples representative of all the beds were selected. The number of shells in each sample is presented in logarithmic scale (Fig. 1-n) and the content of assemblage components in per cent (Fig. 1-Md). The numbering of beds (Fig. 1-St) was taken from the paper of JERSAK (1976).

Snail shells were found in loesses between the two cited horizons of fossil soil, in the sediments of the Warta glacistadial, and above the soil of the Eemian interglacial period, in loesses representing the last glaciation. The number of shells in respective samples is variable. In the lower part of the profile (upper older loess – Warta glaciation) there are not more than several dozen shells, and the bed 14 contains only a few specimens. An exception is an insert of calcareous loess, recognized as the bed 15, in which the number of shells is as high as 1000 in each sample. In younger loesses (bed 20), except for the lowermost layer containing poor fauna, more than 500 shells can be found in each sample. The number of shells decreases markedly in the bed 22, whereupon fauna disappears altogether (Fig. 1-n).

The occurrence of mollusc shells is partly associated with the content of calcium carbonate in the sediments. Calcareous loesses contain abundant or fairly abundant malacofauna whereas calcium-free loesses are devoid of molluscs or nearly so. In the top part of the profile, loesses abounding in calcareous tubes or concretions and showing a high CaCO₃ content do not contain snail shells. This fact may be accounted for by the activity of secondary diagenetic processes, and specifically by the dissolution of calcium carbonate (also of mollusc shells) present in the sediment and its precipitation in the immediate vicinity amidst plant roots and round crystallization centres.

DESCRIPTION OF SPECIES

Ten units of classification of land snails and two species of aquatic snails were identified in the profile in question. Moreover, shells of slugs and pelecypods (Fig. 1-Md) and eggs of snails were found, exhibiting features identical to the

forms described by H. BINDER (1972) from loesses of the Riss glaciation in lower Austria.

The richest component of the assemblages studied is the genus *Pupilla*. It is represented by *P. loessica* (LOŽEK), *P. muscorum* (LINNAEUS), *P. muscorum bidentata* (PFEIFFER) and *P. muscorum densegyrata* (LOŽEK).

Pupilla loessica (LOŽEK). The shell is cylindrical with the arched apex and a delicate, closely-spaced, irregular sculpture. Whorls are slightly convex, the mouth-edge sharp or with a very thin lip. There is no external rib behind the outer lip and no teeth in the aperture (Fig. 2-1, 2). The height of shells is 3.1 – 3.2 mm

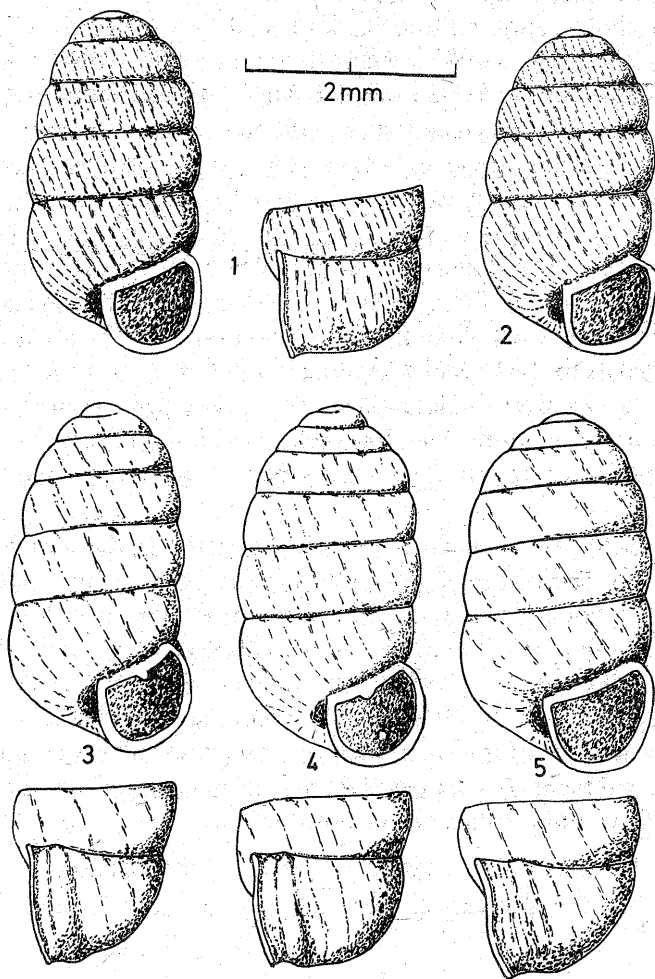


Fig. 2. Snails of the genus *Pupilla* in the Odonów loesses

1–2. *Pupilla loessica* (LOŽEK); 3. *Pupilla muscorum* (LINNAEUS); 4. *Pupilla muscorum bidentata* (PFEIFFER); 5. *Pupilla muscorum densegyrata* (LOŽEK)

and does not show variation in populations occurring in different beds of the profile. The species described is not known from the present-day faunal assemblages. In the Pleistocene it inhabited woodless zones of the severe and fairly dry subarctic climate, mainly steppes and steppe-tundra (LOŽEK, 1964, 1965).

Pupilla muscorum (LINNAEUS). The shell is cylindrical, tapering conically towards the short apex. Its surface shows a widely-spaced, obscure sculpture and sometimes is nearly smooth. Slightly convex whorls are marked off by slightly depressed sutures. The mouth is surrounded by a distinct, fairly thick lip with the white external rib behind it. One white parietal tooth is well visible in the aperture (Fig. 2-3). The height of shells is 3.3 – 3.8 mm. The species in question is Holarctic, typical open, dry and moderately wet environments. It inhabits steppes, insolated slopes and meadows. Today it is widespread up to 70° N latitude in Europe, Asia and North America.

Pupilla muscorum bidentata (PFEIFFER). The size and shape of shell correspond precisely to the nominal species and so do the lip and the rib behind the outer lip. Two teeth are well marked in the aperture: parietal – the larger one, and palatal which is smaller and distinctly receding (Fig. 2-4). This form differs from *Pupilla bigranata* (ROSSMÄSSLER) cited also as *Pupilla muscorum bigranata* ROSSMÄSSLER. The latter resembles *Pupilla triplicata* (STUDER) in shape and size. This similarity consists primarily in the deeply depressed sutures and low, convex whorls. In the material studied, shells with the features typical of *Pupilla muscorum* (LINNAEUS), showing the presence of two teeth, occur only in the bed 20, where they form a rich, well individualized population.

Pupilla muscorum densegyrata (LOŽEK). The shape, size and sculpture of shell are similar to those in the nominal species, while the external rib behind the outer lip is not so well marked. There are no teeth in the aperture (Fig. 2-5). This form usually coexists with *Pupilla loessica* LOŽEK and, like the latter, thrives in cold climate, in slightly wet environments (LOŽEK, 1964, 1965).

Succinea oblonga elongata SANDBERGER is abundant in the malacofaunal assemblages from the loess profile at Odonów. This snail was widespread in the periglacial zones of deposition of dust material. It had a preference for open, moderately wet habitats of the Boreal and Subarctic zones and today is one of the commonest components of loess malacofauna.

Columella columella (MARTENS) lives today mainly in high mountains (e.g. the Tatra Mts and the Alps) and on the Scandinavian peninsula between 60 and 70° N latitude. It is a typical representative of subarctic steppe and tundra fauna.

Vertigo parcedentata (BRAUN). The taxon has a range and ecological requirements similar to the one described above.

Vallonia tenuilabris (BRAUN) lives today mainly in Asia, in steppes of a severe

continental climate as far as the tundra boundary. In the Pleistocene it was a common species inhabiting the periglacial zones of loess deposition.

Semilimax kotulai (WESTERLUND) is a mountain species reported, for example, from the Alps and the Tatra Mts. It thrives in a severe but fairly humid climate. In the last glacial period it was wide spread throughout the uplands of Central Europe, but today it only forms isolated relic populations there.

Bradybaena fruticum (MÜLLER) is a European snail occurring in partly shaded and moderately wet environments of the temperate and Boreal climate. Its present-day range reaches as far as the polar circle.

Lymnaea peregra (MÜLLER) — a widespread aquatic snail with a geographical range extending as far as Arctic regions. The nominal form of this species (*L. peregra peregra*), found at Odonów in the Warta glacistadial loesses, shows high resistance to desiccation. It usually inhabits small, intermittent water basins and can also be adapted to the amphibiotic mode of life.

Lymnaea truncatula (MÜLLER) is a species well adapted to the life in small water basins, episodic pools and floodplains, or even in marshes and intermittently flooded meadows. It lives in Europe, Asia and North America, reaching as far as the Arctic zone above the polar circle. It has been reported on frequent occasions from loesses.

The list of taxa is complemented by shells of slugs determined conventionally as *Limacidae* which are present as an accessory component in the Warta glacistadial loesses, and by single pelecypod shells belonging in the genus *Pisidium*, found in the beds 15 and 16.

MALACOFAUNAL ASSEMBLAGES

Eight malacofaunal assemblages can be distinguished in the profile of the Odonów loess series. From the bottom upwards, they have been designated as A-H (Fig. 2-MA).

A. The assemblage with *Pupilla loessica* and *Vallonia tenuilabris* (bed 12) shows the predominance of the former species, the content of which is 75%. Sporadically *Succinea oblonga elongata* and small shells of slugs can also be found. The number of specimens in the sample varies from 20 to 50. This assemblage points to a cold, slightly humid climate which permitted, however, certain differentiation in habitats.

B. The assemblage with *Pupilla loessica* (bed 14) is very poor and little differentiated. It consists almost entirely of the index taxon, and the number of shells in individual samples is not more than 10. In the middle part of the bed 14 single shells of *Semilimax kotulai* and *Limacidae* and scarce *Succinea oblonga elongata* have been found. The period of deposition of this bed was unfavourable

to the development of molluscs because of the subarctic, cold and dry climate and the poor diversity of habitats.

C. The assemblage with *Lymnaea* (bed 15) occurs in an insert of grey-yellowish gley loess abounding in mollusc shells (JERSAK, 1976). The number of specimens is more than 500 in each sample. The content of *Pupilla loessica* is insignificant while *Pupilla muscorum densegyrata* is fairly abundant. Besides the common species *Succinea oblonga elongata*, worth noting is the presence of *Columella columella* and *Vertigo parcedentata*. Aquatic molluscs make up about 35% of the assemblage, the shells of *Lymnaea peregra* — the nominal form of this species — being most abundant. The association in question points to a cold, subarctic climate of fairly high humidity. At that time, in the zone of tundra or steppe-tundra, there were small water basins in which loesses accumulated.

D. The assemblage with *Succinea oblonga elongata* (bed 16). This taxon is the principal component of the assemblage and the number of shells in the sample is small (up to 20 specimens). Single specimens of *Lymnaea truncatula* and *Pisidium* sp. have been found in the lower part of the bed. The malacofauna testifies to the disappearance of water basins and to a cold and humid climate showing evidence of slow warming up.

E. The assemblage with *Pupilla loessica* and *Succinea oblonga elongata* (bed 20) is characterized by the equal proportions of shells of the index taxa and by the presence of single specimens of *Semilimax kotulai* and *Bradybaena fruticum*. It points to a cold but humid climate and to the considerable diversity of habitats. Apart from mollusc shells, their number amounting to 25 specimens in the sample, scarce teeth of rodents have been found, determined by A. NADACHOWSKI as *Microtus* sp. and cf. *Dicrostonyx torquatus*.

F. The assemblage with *Pupilla* div. sp. and *Vallonia tenuilabris* (bed 29) is characterized by the large number of shells (400–600 in each sample) and a diversified composition. It contains snails representing the genus *Pupilla*: *P. loessica*, *P. muscorum densegyrata* and *P. muscorum bidentata*. The latter is the principal component of the assemblage in some samples. The list of species is complemented by *Vallonia tenuilabris* and *Succinea oblonga elongata*. Such malacofauna is typical of the steppe environment showing certain differentiation of habitats under the conditions of a rather cold and not very humid climate.

G. The assemblage with *Pupilla loessica* (bed 20) contains a large number of shells and shows the predominance of the index taxon. It points to a cold and fairly dry climate.

H. The assemblage with *Succinea oblonga elongata* (bed 20, 22) shows the gradual decrease in the number of shells. The principal component is the index taxon, accompanied by *Pupilla loessica* and single specimens of *Pupilla muscorum* and *Lymnaea truncatula*. The assemblage indicates that the climate was becoming warmer and more humid. It seems feasible that wet zones or even small, episodic water basins formed locally.

INTERPRETATION

The malacofaunal assemblages discussed make it possible to follow the environmental changes in loess deposition near Kazimierza Wielka. During the Warta glacistadial, the conditions of subarctic climate of very low humidity prevailed, and the cold steppe and steppe-tundra were inhabited by poor and little diversified malacofauna. The progressive increase in humidity in the descending phase of this glacistadial was responsible for the appearance of aquatic species, testifying to the existence of intermittent water basins. At the same time, the number of taxa thriving under the conditions of cold climate increased. Towards the close of the glacistadial the climate became mild, but the lack of fauna in the Eemian interglacial sediments make it impossible to fully reconstruct the changes in palaeogeographical environment in the period between the last two glaciations.

Younger loesses which overlie the "Nietulisko" fossil soil dated to the Eemian interglacial period and the ascending phase of the Vistulian (JERSAK, 1973), contain in their bottom part a malacofaunal assemblage consisting of species thriving under cold conditions, as well as a taxon typical of the temperate and Boreal zones. The successive stage is characterized by the presence of a few taxa of the genus *Pupilla*. Then the association becomes poorer and because of the abundance of shells of *Pupilla loessica*, can be regarded as an oligomictic assemblage. The whole episode in question corresponds to the period of cooling and the attendant development of subarctic steppe and steppe-tundra. In the upper part of the profile, the successive change in malacofaunal assemblage points to the increase in humidity and the progressive warming up of the climate.

The above variations in malacofaunal assemblages reflect the cyclic changes in conditions during the deposition of loesses. In both parts of the described profile of loess series, the phase of cold and dry climate can be traced, which was preceded and followed by phases of milder, more humid climate. This is reflected not only by the composition of the association and the appearance of certain snail species but also by the mutual proportion of the two most numerous taxa: *Pupilla loessica* and *Succinea oblonga elongata*. The dominant content of the former corresponds to the climatic pessimum which fell both in the Warta glacistadial (assemblage B) and in the last glaciation (assemblage G; Fig. 1: Md). The increase in the content of *Succinea oblonga elongata*, indicating that the climate became more humid and presumably also milder, took place in the final stages of deposition of older and younger loesses (assemblages E and H).

The results of detailed studies of the malacofaunal assemblages found in the loess profile at Odonów as well as in several loess outcrops in the Cracow and Miechów Uplands show the usefulness of malacologic analysis for the reconstruction of the ecological and palaeogeographical conditions of the periglacial environment.

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