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# A MOLLUSC THANATOCENOSIS IN THE NILE RIVER VALLEY NEAR WADI HALFA (N SUDAN)

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ABSTRACT: A mollusc thanatocenosis found in the Nile Valley on the shore of the Naser Lake contains several thousand specimens representing five species; shells of aquatic snails dominate. The coarse fraction is composed mainly of *Cleopatra bulimoides* (Olivier); the fine fraction – of *Valvata nilotica* Jickeli. Substantial differences between the mean size of mollusc shells and mineral grains in the thanatocenoses, reflected by the displacement index (DI), depend of the density (unit weight) of these components. Death assemblages deposited recently during floods resemble subfossil assemblages from Holocene deposits of the Fayum Depression (Egypt), thus testifying to the stability of the mollusc fauna inhabiting the Nile Valley during the last ten thousand years.

KEY WORDS: thanatocenosis, mollusc assemblages, flood sediments, Nile Valley, Sudan

## INTRODUCTION

Relatively rich mollusc assemblages composed mainly of aquatic snails and bivalves have been reported from the Nile Valley in Egypt and Sudan. Many of them are found in Quaternary deposits during archaeological and geological field work. Three sites can be indicated as the most interesting and important. The first is situated within the Fayum Depression, ca. 100 km S of Cairo. Its fauna from Holocene lacustrine chalk and sandy silts, composed of several species of water molluscs, was described in detail (SMITH 1908, GARDNER 1932, 1935, ALEXANDROWICZ 1986, 1990). Mollusc-bearing lake deposits of the Late Vistulian age were found in Sodiri in Sudan (second site; 400 km SW of Khartum) (HUCKRIEDE & VENZLAFF 1962, HUCKRIEDE 1972). Late Vistulian and Holocene mollusc-bearing deposits in the third locality, with seventeen species of water snails and bivalves (MARTIN 1968), were uncovered during archaeological excavations along the Nile Valley in the vicinity of Wadi Halfa (Northern Sudan).

The recent mollusc fauna of Egypt and Sudan is known from both the Nile Valley and the oases within the surrounding deserts. It has been mentioned and described by several authors (JICKELI 1874, HÄGG 1904, PALLARY 1909, 1924, GERMAIN 1909, 1929, HAAS 1936, BROWN 1979, 1980). Aquatic snails are the main component of all assemblages, composed usually of few taxa represented by numerous specimens. A few species (*Melanoides tuberculata* (O. F. Müller), *Cleopatra bulimoides* (Olivier), *Bulinus truncatus* (Audouin), *Lymnaea natalensis* Krauss), known from numerous localities, reach a high constancy.

Mollusc thanatocenoses of Africa have not been studied to date, although specimens accumulated on river banks and shores of water bodies form a considerable part of collections presented by various authors. Fossil (subfossil) shells and the "modern fauna" were sampled separately by MARTIN (1968) close to the Second Nile Cataract. The material described by this author is till now the only source of information about death assemblages of snails and bivalves, accumulated in the Nile Valley during floods.

## MATERIAL AND METHODS

A very rich mollusc thanatocenosis was sampled during the Nile Valley expedition organised fifteen years ago by students of the Jagiellonian University. Participants of this expedition found a sediment looking like white, coarse sand composed nearly exclusively of empty shells of snails and bivalves. It was deposited on the eastern side of the valley, in the distal part of the Naser Lake, between Wadi Halfa and Akasha, ca. 40 km S of the Egypt–Sudan frontier, upstream of the submerged Second Nile Cataract. The thanatocenosis was accumulated along the shoreline, on sandbanks, during temporary fluctuations of water level. The sample, of 1 kg weight, contains mainly mollusc shells with an admixture of mineral grains. It was delivered to the author by Dr. hab. ANDRZEJ FALNIOWSKI; the material is a part of the collection of the Zoological Museum, Jagiellonian University.

Standard methods of malacological analysis (ALEXANDROWICZ 1987, 1999) and grain size analysis (GRADZIŃSKI et al. 1986, MYCIELSKA-DOWGIAŁŁO & RUTKOWSKI 1995) were applied in this study. The whole material was sieved to divide it into fractions according to the logarithmic Wentworth Phi scale (KRUMBEIN 1934). The intervals of the scale correspond to the following grain diameters: ∅ –3 = 8 mm, ∅ –2 = 4 mm, ∅ –1 = 2 mm, ∅ 0 = 1 mm, ∅ +1 = 0.50 mm, ∅ +2 = 0.25 mm, ∅ +3 = 0.125 mm, ∅ +4 = 0.063 mm. The list of species, the number of specimens, malacological spectra of specimens (MSI) as well as the quantitative relation between the shells and mineral components were established for each fraction. Additionally, indices of species diversity were calculated to characterise the compared assemblages. An analytical balance of accuracy of 0.01 g facilitated the estimation of the number of shells and the content of quartz grains.

## RESULTS AND DISCUSION

The described thanatocenosis comprises about 28 thousand shells, representing only five taxa of water molluscs known from several localities in N Africa. Two of them (*Cleopatra bulimoides* (Olivier), *Valvata nilotica* Jickeli) constitute 82% of the assemblage while the remaining species are subordinate or even accessory components.

***Valvata nilotica*** Jickeli, 1874. Shells of this snail correspond closely with the original description (JICKELI 1874) and descriptions presented by other authors (GARDNER 1932, BROWN 1980). The largest ones reach 3–4 mm in diameter but most are much smaller, so that the mean size of specimens in the whole sample is only ca. 1.2 mm. The distribution range of the species includes NE Africa, mainly Egypt and Sudan. It is similar to *Valvata tilhoi* Germain, reported from Algeria and Chad (GERMAIN 1909). Both are known also from Late Quaternary sediments of these regions (GARDNER 1932, MARTIN 1968, ALEXANDROWICZ 1986, 1998).

***Melanoides tuberculata*** (O. F. Müller, 1774). It is widely distributed in Australia, Asia and Africa, introduced also in greenhouses of Europe (FLASAR & KROUPOVÁ 1976, BROWN 1980, ALEXANDROWICZ 1993). Shells in the described thanatocenosis are relatively small, up to 17 mm in height (H), but most are only 8–12 mm high (mean 10.51±0.75 mm). Specimens from extant populations are usually twice larger.

***Cleopatra bulimoides*** (Olivier, 1804) is an African species living mainly in the eastern part of the continent in Egypt, Sudan, Somalia and Ethiopia as well as in Chad, Nigeria and Niger (BROWN 1980). Shells accumulated by the Nile River are variously preserved, the first whorl being usually broken. The shell size (H) is much varied. Adult specimens constitute a fourth of the population reaching the height (H) of up to 16 mm (mean 13.85±0.32 mm) while the mean size of shells in the whole thanatocenosis is 3.89±0.16 mm.

***Bulinus truncatus*** (Audouin, 1827). Shells of this snail are relatively small and variable in shape, a part of them being poorly preserved. The largest specimens are 6–9 mm high (H) but the mean size in the sample is 4.05±0.14 mm. The species is widespread around the Mediterranean Sea and in North Africa but it has a disjunct distribution range (BROWN 1980, ALEXANDROWICZ 1993).

***Corbicula consobrina*** (Cailliaud, 1823). Small shells of this species described mainly from the Nile River Valley in Egypt and Sudan are a subordinate component of the assemblage in question.

Two granulometric fractions (∅ –3 and ∅ –2) dominate in the mentioned thanatocenosis; accordingly 76% of the sediment is within the grain size interval 2.83–8 mm (Fig. 1A). The remaining part is composed of material corresponding to coarse, medium and fine sand and representing grain size intervals 0.06–2.83 mm (fractions ∅ –1 – ∅ +4). Mollusc shells are the dominant component of the sediment, reaching 88%, while mineral grains constitute only 12% (Fig. 1B). The latter are mainly a part of medium and fine fractions (∅ +1 – +4).

The size distribution of the shells and mineral grains was analysed separately since patterns of both components are quite different. The bulk of the shell material corresponds to coarse fractions while min-

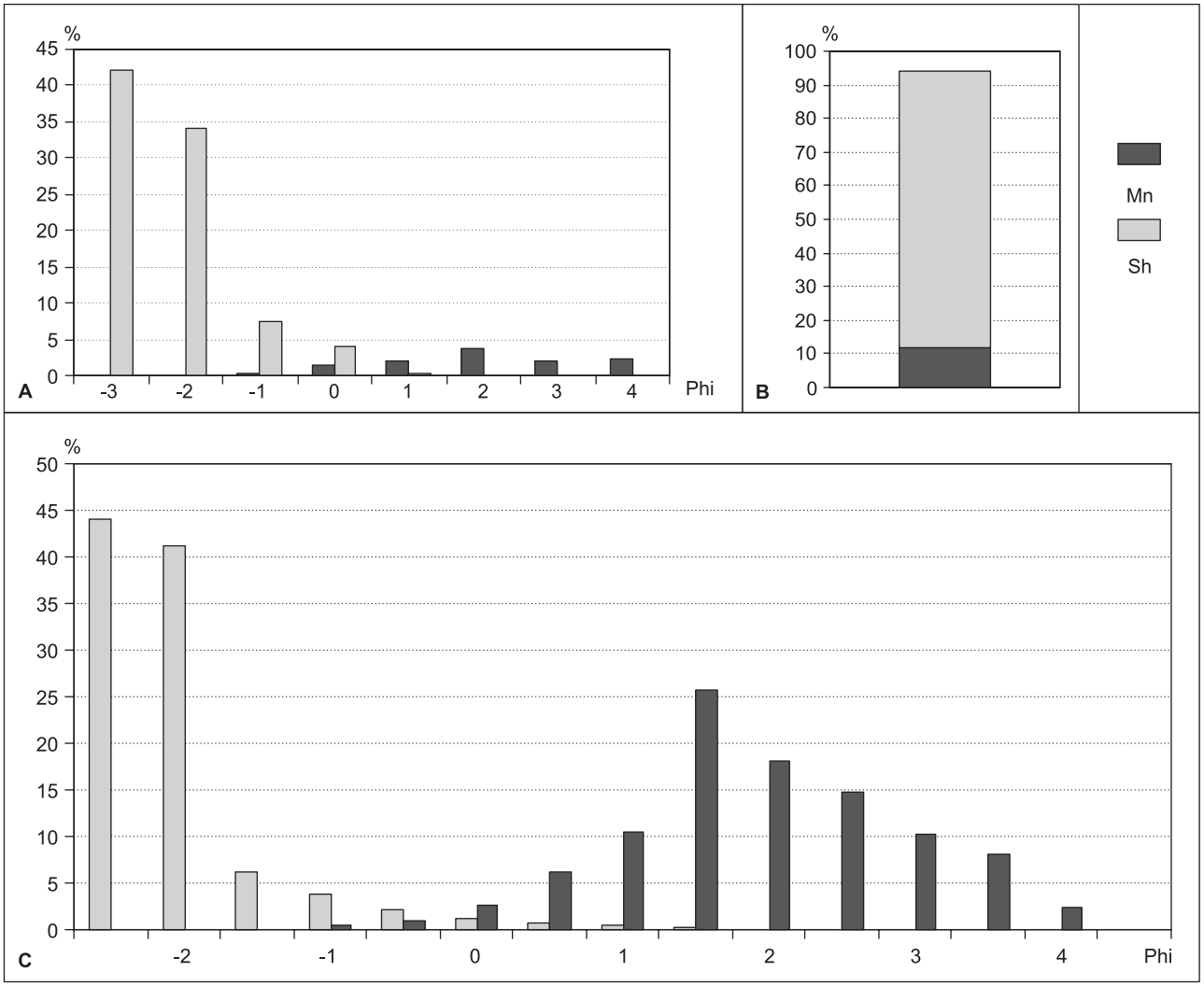


Fig. 1. Grain size distribution of thanatocenosis from the Nile Valley near Wadi Halfa. A – Whole sample, B – Relation between mollusc shells and mineral grains, C – Grain size distributions of shells and mineral components. Sh – mollusc shells, Mn – mineral grains, –3 – 4 – granulation intervals of the Phi-scale

eral grains belong nearly exclusively to fine fractions. The modal values are ∅ = –2.5 and ∅ = +1.5, respectively (Fig. 1C), resulting in the difference value 4 in the Phi scale. In carpological thanatocenoses and taphocenoses, described in detail by CABAJ (1993) from fluvial sedimentary environments, the corresponding difference between plant and mineral components is usually nearly the same.

Transport and deposition of mollusc shells, seeds, fruits and mineral grains depend on their size and density (unit weight) as well as on the flow competence. As a result of the sorting effect the mean size of organic remains in thanatocenoses considerably exceeds that of mineral grains. This feature of flood sediments can be expressed by the displacement index, calculated as the difference between the mean values of grain size (arithmetic mean, median, modal value) or between the size distributions of the two mentioned components. Values of this index characterising relations: seeds/fruits versus mineral grains (CABAJ 1993) and molluc shells versus mineral grains (the case of the thanatocenosis in question) are similar, reaching the value of ca. 4 in the Phi-scale. This means that both seeds/fruits and mollusc shells are 10–15 times larger than grains of quartz or other minerals. Consequently the presence, absence and abundance of particular taxa in sediment accumulated by flowing or moving water is also controlled by the sorting effect according to their size.

The number and percentage of specimens representing particular species in five fractions of the described thanatocenosis, as illustrated by the MSI spectrum, are quite different (Fig. 2A). The coarse fraction (∅ –3, > 6 mm) consists almost exclusively of shells of *Cleopatra bulimoides*, accompanied by single shells of *Melanoides tuberculata*, *Bulinus truncatus* and *Corbicula consobrina*. The next fraction – ∅ –2 (2.83 – 6 mm) is characterised by a similar composition but the admixture of the three accompanying species increases to 9%, plus a few shells of *Valvata nilotica*. In

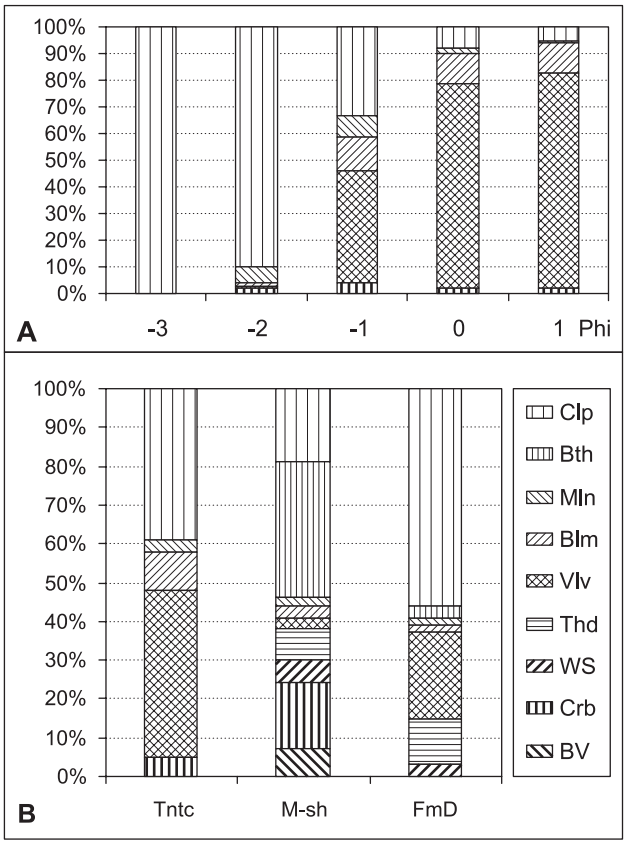


Fig. 2. Malacospectra of specimens (MSI) of mollusc assemblages from the Nile River Valley. A – Thanatocenosis from Wadi Halfa divided in five classes (∅ –3 – +1) according to the grain size distribution. B – spectra of three selected assemblages: Tntc – thanatocenosis from Wadi Halfa, M-sh – "modern fauna" from the Second Nile Cataract (MARTIN 1968), FmD – subfossil assemblage from Holocene deposits in the Fayum Depression (ALEXANDROWICZ 1986). Components of assemblages: Clp –*Cleopatra*, Bth – *Bithynia*, Mln – *Melanoides*, Blm – *Bulimus*, Vlv – *Valvata*, Thd – *Theodoxus*, Ws – other water snails, Crb – *Corbicula*, BV – other bivalves

fraction ∅ –1 (1.41 – 2.83 mm) the proportion of two dominant species: *Valvata nilotica* and *Cleopatra bulinoides* is nearly equal (42 and 33%) while other components constitute a fourth of the assemblage. The finest two fractions (∅ 0 and ∅ +1, < 1.41 mm) contain about 80% of *Valvata nilotica* with a considerable admixture of *Bulinus truncatus* (11%). No determinable shells have been found in the material finer than 0.4 mm.

Differentiation of mollusc thanatocenoses in relation to the grain size distribution was described in two cases: one – death assemblages accumulated on shores of the Gardno Lake (N Poland) (ALEXANDROWICZ & FLOREK 1999), the other – rich accumulations of shell material deposited during the spring flood of the Warta River near Poznań (ALEXANDROWICZ 2000). In both cases the mollusc-bearing sediments were much more coarse-grained than the material collected on the Nile River bank.

The malacological spectrum of specimens characterising the whole assemblage reveals dominance of two components: *Valvata nilotica* (43%) and *Cleopatra bulimoides* (39%), and a considerable proportion of *Bulinus truncatus* (10%), while the remaining two species reach only 3–5% (Fig. 2B). It is quite similar to the spectrum of fraction ∅ –1.

The described thanatocenosis can be compared with the fauna mentioned by MARTIN (1968) as the "modern fauna", found in two localities situated ca. 12 km upstream of Wadi Halfa on the Second Nile Cataract, before it was submerged by the dam lake (Naser Lake). It contains shells of 14 species sampled on sandbanks that were accumulated on both banks of the river after temporary rising of the water level. Specimens of four taxa constitute most of the assemblage: *Bithynia neumanni* (Martens) – 35%, *Cleopatra bulimoides* (Olivier) – 19%, *Corbicula consobrina* (Cailliaud) – 17% and *Theodoxus niloticus* (Reeve) – 8%, while other taxa are subordinate components (Fig. 2B). The fauna collected by MARTIN (1968) includes the following species which are absent in the described thanatocenosis: *Theodoxus niloticus* (Reeve), *Bithynia neumanni* (Martens), *Gabbia* cf. *walleri* (Smith), *Gyraulus costulatus* (Krauss), *Ferrissia* sp., *Caelatura aegyptiaca* (Cailliaud), *Mutella* cf. *rostrata* (Rang), *Etheria elliptica* Lamarck and *Sphaerium hartmanni* cf. *mohasicum* Thiele. It is relatively rich and differentiated (differentiation index ADI = 0.624), like assemblages accumulated by streams and rivers (ALEXANDROWICZ 1999). On the other hand the described thanatocenosis derives from shores of the dam lake, where fluctuations of the water level and the dynamics of sedimentary environment are much less intense than on the river banks, particularly close to the rapids (the Cataract). In consequence it is well sorted and considerably less differentiated (differentiation index ADI = 0.446).

Thanatocenoses of the Nile River Valley found in Northern Sudan resemble the mollusc fauna described from Holocene lacustrine deposits of the Fayum Depression in Egypt (GARDNER 1932, ALEXANDROWICZ 1986). They are particularly similar to the subfossil assemblage of grey silts dated as 6,500–7,000 years BP. The assemblage is dominated by three taxa: *Cleopatra bulimoides*, *Valvata nilotica* and *Theodoxus niloticus*, while the following species are their subordinate components: *Melanoides tuberculata*, *Gyraulus ehrenbergi* (Beck), *Bithynia* sp. (operculum), *Segmentorbis angustus* (Jickeli), *Biomphalaria alexandrina* (Ehrenberg), *Bulinus truncatus*, *Lymnaea natalensis* Krauss and *Pisidium* sp. (Fig. 2B). It is relatively rich and differentiated (differentiation index ADI = 0.635), like those from the Second Nile Cataract. Holocene sediments containing the mentioned fauna have been deposited in the lake during floods. The presence of numerous shells of fluviatile snails (*Theodoxus niloticus*, *Cleopatra*

*bulimoides*) indicates a temporary penetration of the Fayum Depression by the Nile River at that time (ALEXANDROWICZ 1986).

The comparison of the three mentioned assemblages suggests that the mollusc fauna inhabiting the middle course of the Nile River remained relatively stable during the Holocene, including the historical period. The youngest thanatocenosis sampled after the construction of the Assuan Dam differs from the remaining two, since it was accumulated on the shore of the Naser Dam Lake, and thus under sedimentary conditions different from those occurring during floods of the big river.

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