

## Burrowing activity of macrofauna in recent meandering river sediments (Dunajec River, SE Poland)

Paweł Mikuś<sup>1</sup>, Alfred Uchman<sup>2</sup>

<sup>1</sup> Institute of Nature Conservation, Polish Academy of Sciences, Kraków, Poland (mikus@iop.krakow.pl)

<sup>2</sup> Institute of Geological Sciences, Jagiellonian University, Kraków, Poland (alfred.uchman@uj.edu.pl)

Riverine ecosystem is a particular place for interactions of biosphere with the deposited sediment. It is characterized by large energy gradients in relatively short time, and therefore forces on its habitants special adaptation, recorded in bioturbation structures. For predators there are mainly residential burrows (ichnologically interpreted as *Domichnia*), and for saprofauns (especially earthworms) foraging trails (*Fodinichnia*). Understanding the relationships between organisms and the environment is an important prerequisite for understanding the functioning of modern and ancient flowing-water ecosystems.

It has been observed that in subsurface layers of natural levee, horizontally burrows of earthworms predominate. Vertical burrows of large earthworms, formed during a long period between two flooding events reaching over 2 m depth into the soil profile. Earthworms were often found in the vicinity of the European mole burrows, as well as along live and dead roots, going down with them in the deeper part of the sediment profile.

Observations of area surrounding our study reach has shown that fertile deposits of older terraces formed with many long-term interruptions in sedimentation processes, have a well-developed soil levels, more vulnerable to penetration than recently deposited sediments. In addition, older terrace deposits have completely disturbed layer boundaries by bioturbation processes and additionally characterized by a large degree of mixing in the individual layers. This is probably a result of moving up and down the fertile sediment by organisms, as well as mechanical leaching the sediment into the lower layers during subsequent floods or rainfalls. Such leaching processes can occur in a larger scale through the open burrows.

Sediments filling oxbow lakes are in the geological time scale very fast bioturbated and mixed by organisms which cause rapid penetration by blurring older by younger. On the scale of a few thousand years the final result is completely mixed sequence with visible bioturbation structures not older than a few decades. We are trying to compare such recent sediments, which deposited by the Dunajec River forming the nearby Pleistocene plains of higher terraces, built of river sands passing in eolian sands, locally with ferruginous nodules.

Bioturbation structures are not very abundant in the alluvial sediments. It is commonly recorded in the sediments of meandering systems than braided, especially in soil and subsoil layers. Such situation reflects better conditions to preserve the living activity traces in oxbow lakes and flood plains. In many cases there are thick sediment sequences without any bioturbation structures or with those restricted to certain layers. Distribution of organisms' penetration in the sediment is characterized as a function of the rate of sedimentation, energy of the environment and the amount of time between successive depositional episodes.

Active fluvial channels are known to be a medium or relatively high energy zones with rapid changes in the rate of sedimentation and erosion and coarse grain contrasting to the sediments deposited

in the neighbouring communities. Therefore, active channels represent stress environment for many organisms that makes the production and/or preservation of biogenic structures much more difficult. Burrows of fauna in the active fluvial channels are characterized by poorly differentiated sets of simple vertical penetration and escape traces.

In 2009-2012, on part of the study area (Dunajec valley in its lower course), we made some studies on the characteristics of ground beetle burrows (*Carabidae* family) and demonstrated their similarity to the ichnogenus *Macanopsis* known from continental deposits (Mikuś & Uchman, 2013a). It has also been proven an important role of flooding as an important factor controlling occurrence and distribution of fauna in the vertical horizontal alluvial deposits profile (Mikuś & Uchman, 2013b).

Although the typical geological literature is poor in the description of bioturbation structures of insects whose burrows are very numerous in sediment, entomological literature is a substantial set of knowledge about the biology, appearance of the burrows and environmental significance of this group. In addition to earthworms, our study area is rich in a large variety of fauna producing bioturbation structures, including centipedes (*Myriapoda*), a large group of beetles belonging to the ground beetles family (*Carabidae*), and the larvae of flying insects of the order *Diptera*, adults of the order *Hymenoptera* including *Andrenidae*.

The most common burrowing mammals are: European mole (*Talpa europaea*), fox (*Vulpes vulpes*), beaver (*Castor fiber*), shrews (*Soricidae*), European otter (*Lutra lutra*), several species of mice (*Muridae*) and voles (*Myodae*, *Microtae*). Special place in this species list occupies the only bird digging deep burrows in the natural levee sediments - swallow sand martin (*Riparia riparia*).

Among the amphibians, that would leave visible tropes on the floodplain sediment surface, here can be often found the gray toad (*Bufo bufo*), the water frog (*Rana esculenta*) and the common frog (*Rana temporaria*). Track mosaic on the surface of sediment supplements the footprints of birds: mallard duck (*Anas platyrhynchos*), terns (*Sterna hirundo*), black-headed gulls (*Larus ridibundus*), common gull (*Larus canus*), partridge (*Perdix perdix*), pheasant (*Phasianus colchicus*), white stork (*Ciconia ciconia*) and many other smaller species.

Such studies, involving impact of investigated organisms on recent alluvial sediment have not been carried out yet in relation to several different river environments. Knowledge about the bioturbation rate and grade also remains incomplete. Conducting each stage of the researches with adequate order and having appropriate geological knowledge, this project will significantly contribute to a better understanding of the burrowing behaviour and impact of fauna on alluvia deposited in recent riverine systems. This is also of great importance for the progress of sedimentology of river paleoenvironments.

Mikuś, P., Uchman A. (2013a): *Palaios*, 28: 403-413.