



A new vertebrate fossil locality on the Scythian Platform, Vaslui County, Romania

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Abstract

Although previously understudied, the Bârlad Sud outcrop has yielded significant paleontological material through sustained monitoring and collecting efforts. Similar to the fossil vertebrate assemblages from the sites at Zorleni and Simila, the fossil record here comprises two distinct components: a Miocene assemblage, characterised by heavy transport-related abrasion and fragmentation, and a Pleistocene assemblage, distinguished by a comparatively high degree of preservation. The Pleistocene mammal fauna indicates an Upper Pleistocene age (Weichsel/Würm glaciation), and includes taxa such as *Bos primigenius*, *Megaloceros* sp. and *Mammuthus* sp., whose presence reflects open steppe and semi-open habitat conditions associated with the climatic oscillations of this interval. These findings offer valuable insights into the paleoenvironmental evolution of the region and the adaptive strategies of large herbivores during the Late Pleistocene.

Keywords: Upper Pleistocene, *Bos primigenius*, *Megaloceros* sp., *Mammuthus* sp., Weichsel/Würm glaciation.

1. INTRODUCTION

Within the Bârlad Valley, the Pleistocene strata are mainly preserved in the river terraces. The most significant sites are found in Vaslui County, near the town of Bârlad: Zorleni (on Bour Hill – Dealul Bour) and Simila, where open sand quarries reveal fluvial deposits. Fossil material

from Zorleni was first documented by Simionescu (1903), who described *Hipparion gracile* teeth and, shortly thereafter, an antelope skull later assigned to *Gazella brevicornis* (Simionescu, 1904). Subsequently, Codrea et al. (2011) recorded additional taxa, most notably *Canis lupus*

and *Megaloceros giganteus*, collected from sandy-gravelly channel fills.

Another significant outcrop in the region is Simila, situated near the homonymous village. Over the years, it has been the subject of detailed investigations: Codrea et al. (2013) emphasised the importance of the fossil assemblages collected here, which include reworked Late Miocene material (fossil wood,

molluscs, and vertebrates), as well as Pleistocene taxa such as *Elephantidae* indet., *Stephanorhinus hemitoechus*, and *Megaloceros giganteus*.

The Bârlad Sud outcrop lies in the southwestern part of the city of Bârlad (Fig. 1 and Fig. 2), at the foot of Ivești Hill, close to the intersection between the Tecuci Road and National Road DN11A (46°12'22.67"N; 27°38'33.57"E).



Fig. 1 The Bârlad Sud outcrop, located near the town of Bârlad. General overview of the outcrop.

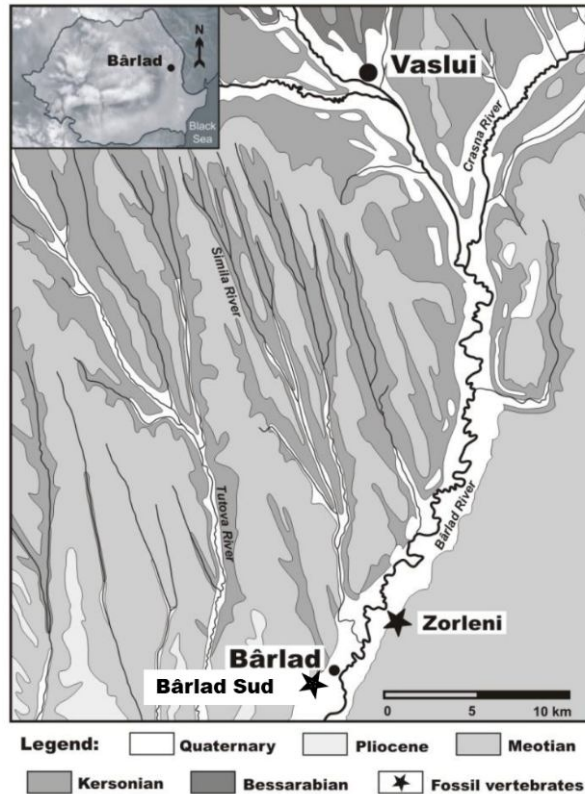


Fig. 2 Geological map and location of outcrops around the town of Bârlad (Vaslui County) (modified after Codrea et al., 2011).

2. GEOLOGICAL FRAMEWORK

Geologically, the Bârlad Sud outcrop and its surrounding area are geologically situated on the Scythian Platform (Săndulescu, 1984), where the crystalline basement is overlain by a succession of four major sedimentary megacycles: Devonian; Permian-Triassic; Jurassic-Cretaceous-Eocene; and Middle Miocene (Late Badenian) – Pliocene (Romanian) (Ionesi, 1994). Of these, only the deposits of the youngest megacycle are exposed at the surface, forming the foundation for the overlying Pleistocene and Holocene

sediments. This distribution corresponds to Săndulescu's (1984) characterisation of the final sedimentary megasequence on the Scythian Platform, which spans from the Upper Badenian (Middle Miocene) through the Pleistocene, a chronology later refined and detailed by Ionesi (1994).

In the area northeast of Bârlad, continental sequences of the Upper Miocene are exposed, arranged in a monocline that tilts northwest-southeast. Overlying them are Pleistocene and Holocene deposits, represented by loess, gravels and river-terrace sands.

The Pleistocene lithological sequence (Fig. 3 and Fig. 4) from the Bârlad Sud outcrop, from base to top, is composed of:

I – fine sand levels and fine- to medium-grained gravels exhibiting cross-stratification;

II – gravels associated with erosional basal surfaces, displaying a strongly lenticular geometry and enclosed within predominantly sandy deposits;

III – intercalations of fine- and coarse-grained sands;

IV – clay and loess.

Similar to other Pleistocene outcrops, the recovered palaeontological assemblage represents material reworked before its final deposition. Alongside the remains of Pleistocene vertebrates, noteworthy is the occurrence of mollusc remains, encompassing both freshwater and terrestrial taxa.

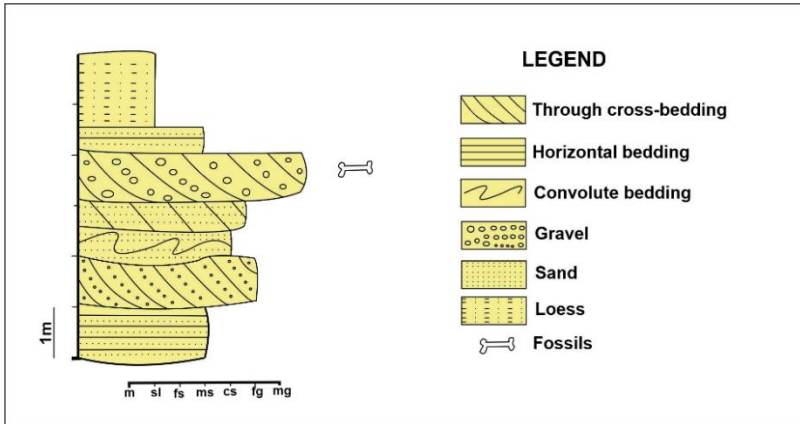


Fig. 3 Lithostratigraphic log of the Bârlad Sud outcrop.



Fig. 4 The lithostratigraphic sequence of Pleistocene deposits at Bârlad Sud.

3. MATERIALS AND METHODS

The bovid fossil material of Bârlad Sud was measured according to the methodologies suggested by von den Driesch (1976), and, when possible, it was compared with the corresponding anatomical parts of fossil aurochs.

For the description of the *Megaloceros* sp. antler, the morphological framework proposed by Gustafson (2015) and Azanza et al. (2013) was employed. Measurements follow the standards of von den Driesch (1976), Vislobokova (1990), and Croitor (2018), and are expressed in millimetres.

The fossil material was stabilised with acrylic copolymer B-72, applied as 2-4% solutions for surface protection and 5-10% for consolidation, depending on porosity and fragility. Restoration employed cyanoacrylate for small to medium-sized pieces and Paraloid B-72 (15-20% in acetone) for porous materials. Photographs were taken using a Canon EOS 4000D+ (18-55 mm lens) and then edited in Adobe Photoshop CC.

The material is housed in the Museum of Original Paleontological Collections of the Faculty of Geography and Geology, „Alexandru Ioan Cuza” University of Iași. It includes several Late Pleistocene large mammals remains from the Bârlad Sud locality, catalogued under inventory numbers 8246–8251. The studied specimens comprise a right antler fragment attributed to *Megaloceros* sp. (8246), several teeth belonging to the same taxa (8247 a–b), a right hemimandible and postcranial

elements of *Bos primigenius* (8248–8250), including a proximal metacarpal end and a third phalanx, and the tip of a tusk assigned to *Mammuthus* sp. (8251).

4. PALAEONTOLOGY

Class Reptilia LAURENTI, 1768
Order Testudines BATSCH, 1788
Suborder Cryptodira COPE, 1868
Family Testudinidae BATSCH, 1788
Testudinidae indet.
(Fig. 5a)

The only piece of this family from Bârlad Sud is a fragment of a marginal carapace plate. It is sub-rectangular, gently curved, with a concave lower margin and a relatively flat upper margin. The small size could suggest either a juvenile individual or a small-bodied taxon.

Measurements: length = 22 mm; width = 13.5 mm; maximum thickness = 10 mm.

Pérez-García et al. (2022) described a new species of *Testudo* from Crețești 1, based on complete specimens. From the Simila open pit, Codrea et al. (2013) reported several fragments of Testudinidae, which are reworked in a Pleistocene fluvial environment.

Family Cervidae GRAY, 1821
Subfamily Cervinae GRAY, 1821
Tribe Megacerini VIRET, 1961
Subtribe Megacerina VIRET, 1961
Genus *Megaloceros* BROOKES, 1828
Megaloceros sp.
(Fig. 5 b-i)

Material: right antler.

From these deposits, the most significant piece of *Megaloceros* is a shed antler. The proximal segment is relatively well



Fig. 5 Upper Pleistocene vertebrates from Bârlad Sud

Testudinidae indet. fragment (a); scale bar: 3 cm

Megaloceros sp. shed antler: b – medial view; c – posterior view; d – lateral view; e – basal view; scale bar: 10 cm;

m3, m2: f, g – buccal view; h, i – occlusal view; j, k – lingual view; scale bar: 5 cm;

Bos primigenius: hemimandible; l – buccal view, m – lingual view; scale bar: 10 cm

Metacarpal: n – anterior view; o – posterior view; p – proximal view; scale bar: 10 cm

Phalanx: q – dorsal view; r – lateral view; scale bar: 5 cm

Mammuthus sp.: tusk tip; s, t – lateral view; scale bar: 5 cm

preserved, retaining an intact rosette with a somewhat rounded basal outline. During the process of recovery from the sediment, the brow tine was still attached near the rosette; however, due to its poor state of preservation, it subsequently detached, and has been conserved separately.

Despite its fragmentary and degraded condition, the brow tine still shows diagnostic features: the flattened morphology is evident, with rounded margins, and the flattening begins immediately next to the point of insertion. This trait, together with the close insertion at the base of the rosette (observable in Fig. 5b), is characteristic to the species.

The distal portion of the antler is absent, preventing further morphological observations. The fact that only the beam is conserved lends support to the hypothesis that the antler underwent transport and fragmentation before deposition.

Measurements (mm) of the *Megaloceros* sp. right antler.

Burr circumference: 210.00 mm

Antler base circumference: 180.00 mm

Anteroposterior burr diameter: 66.45 mm

Lateromedial burr diameter: 59.40 mm

Anteroposterior diameter of antler base above the burr: 55.00 mm

Lateromedial diameter of antler base above the burr: 52.10 mm

Comparisons: Based on comparison with published data (as seen in Table 1) and considering the relatively small size of the burr and antler base, the specimen from Bârlad Sud does not correspond to the large and robust antlers typical of fully mature *M. giganteus* individuals from Ukraine, Moldova, or the Caucasus. It most

likely represents a subadult individual or one with incompletely-developed antlers. Local morphological variation or the existence of a regionally smaller subspecies cannot be excluded, although such an interpretation remains speculative in the absence of additional diagnostic features (such as palmation, complete beam structure, or tine morphology). Given the lack of palmation fragments and other key morphological elements, the specimen cannot be designated as a typical representative of the large-sized form; it is, therefore, more appropriately referred to as *Megaloceros* sp.

Material: m2, m3; heavily-worn, which limits the possibility of providing a detailed morphological description.

Discussion: *Megaloceros* is a representative genus of the Late Pleistocene, as is frequently recorded within the faunal assemblages of Western Europe. Regarded as an adaptable genus, it flourished in a variety of environments, particularly during interglacial periods, when vegetation was abundant and environmental conditions were favourable (Vislobokova, 2012). High-quality forage and milder climates supported the substantial nutritional requirements associated with the annual growth and renewal of antlers (Geist, 1999). However, this reliance on specific ecological factors constrained the distribution of the genus, in comparison with other Pleistocene fauna.

In Romania, fossil remains of *Megaloceros*, along with those of precursor species, have been documented across the entire territory. In Moldavia region, the giant deer is most frequently

Tab. 1 Measurements (in mm) of the studied material of *Megaloceros* sp. from the Bârlad Sud outcrop, compared with published records. Measurements between parentheses represent estimated values, inferred from incomplete or partially-preserved specimens, rather than obtained directly from complete elements.

	Romania		Northern Caucasus		Ukraine	Moldova	
Source	Păun (2025)	Codrea et al. (2011)	Titov and Shvyreva (2016)		Croitor et al. (2014)		
Measured parameters (mm)	<i>Megaloceros</i> sp. Bârlad Sud	<i>M. giganteus</i> Zorleni	<i>M. giganteus</i> Zorleni	<i>M. stavropolensis</i> , Georgievsk sand pit, holotype SMZ, 31306/6, dex	<i>Megaloceros</i> sp., Tsimbal sand pit, specimen ZIN, no. 26003, dex, subad.	<i>M. giganteus</i> ssp. from Hadikfalva = Dornesti) P-0002	<i>M. giganteus</i> ssp. AM 70/552 (AMIA) from Mezyn (Ukraine)
Burr circumference	210	275	340	270			
Antler base circumference	180	198		250		232	
Anteroposterior burr diameter	66.45	83.7	94	84.5	(51.30)	116.8	100.6
Lateromedial burr diameter	59.4	82	-	88	(38.7)	106.3	97.9
Anteroposterior diameter of antler base above the burr	55	60.15		76		112	98.1
Lateromedial diameter of antler base above the burr	52.1	57.45		60.7		90.5	76.3

identified on river terraces and in loess deposits. Beyond these areas, a mandible from Seleuş (Mureş) was reported by Codrea and Solomon (2011), while Codrea et al. (2011) recorded the genus at the Zorleni quarry. Subsequently, Codrea et al. (2013) described the lithology of the Simila quarry, which yielded numerous fossil remains, including a partial antler.

In eastern Romania, this large herbivore has been documented from several localities, all dating to the last glacial period – notably Ripiceni Izvor (Botoşani County), Iaşi (Iaşi County), and Hulubăţ (Vaslui County) (Simionescu, 1990, and references therein). No evidence indicates the persistence of this species into the Holocene, either in Moldavia or elsewhere in Romania. This pattern of extinction during the Late Pleistocene is consistent with the broader trend observed across Europe. In contrast, populations from Asia appear to have survived for a longer interval, as evidenced by the findings of Stuart et al. (2004).

Family Bovidae GRAY, 1821
 Subfamily Bovinae GRAY, 1821
 Genus *Bos* LINNAEUS, 1758
Bos primigenius BOJANUS, 1825
 (Fig. 5, j-p)

Material: Right hemimandible.

The mandibular corpus, broad and spatulate in form, is only partially preserved. The foramen mentale is clearly visible. The diastema is, likewise, only partially preserved. The mandibular ramus comprises two components: the *pars molaris* (horizontal portion) and the *ramus mandibulae* (vertical portion). In the lateral

view, the mandible narrows anteriorly; near the corpus, a distinct foramen is present, corresponding to the exit of neurovascular structures and representing the inferior opening of the mandibular canal.

Measurements:

Mandible: Length of premolar row = 46.70 mm;

Mandibular height in front of *m1* = 53.90 mm;

Mandibular height in front of *p2* = 48.50 mm;

P2: width (*l*) = 9 mm, length (*L*) = 10 mm;

P3: width (*l*) = 9 mm, length (*L*) = 10 mm.

Material: third phalanx.

The third phalanx exhibits a conical shape, obliquely sectioned and laterally compressed, somewhat resembling half of an equine phalanx. Three main surfaces are distinguishable: (1) the anterior, or concentric, surface, marked by a groove and vascular foramina; (2) the superior articular surface, comprising two glenoid facets bounded cranially by a pyramidal eminence, at the base of which two vascular openings are visible, corresponding to the apertures of the semilunar sinus; and (3) the plantar surface, which lacks both the semilunar crest and plantar notches, displaying a smooth appearance instead.

Measurements:

(Greatest) diagonal length of the sole (DLS) = 97.40 mm;

Length of the dorsal surface (Ld) = 78 mm;

Middle breadth of the sole = breadth in the middle of the sole (MBS) = 39.70 mm.

Material: proximal end of a metacarpal.

Only the proximal extremity and part

of the shaft of the metacarpal are preserved. The articular region is transversely elongated, comprising two distinct condylar facets separated by an intercondylar crest. Posterior to the articular surfaces lies a deep fossa interpreted as the insertion area for ligaments. The extra-articular surface bears slight rugosities on the cranial side of the extremity, while laterally a small, roughened area is present, corresponding to the articulation with the rudimentary metacarpal. The shaft displays a smooth cranial surface, marked by a longitudinal suture groove, whereas the caudal surface is flat and slightly concave in its proximal third. Both the lateral and medial margins are concave along their vertical extent.

Measurements can only be carried out on the proximal portion.

(Greatest) breadth of the proximal end (Bp) = 74.5 mm;

(Greatest) depth of the proximal end (Gp) = 42.5 mm.

Discussion: *B. primigenius* is part of the aurochs group, considered an ancestor of modern domestic cattle, and among the largest herbivores of Pleistocene megafauna. Widespread and quite common, it thrived in the open grasslands that expanded during the cold Pliocene climate, which favoured the evolution of large grazers (van Vuure, 2005). The exact origin of the species is debated, with African or Asian roots having been suggested (Samartzidou et al., 2021).

As noted by van Vuure (2002), *B. primigenius* occupied habitats such as riparian forests, floodplains, and marshes situated along rivers and lakes. Its feeding ecology, broadly comparable to that of

extant bovids, together with palynological evidence provided by Zong (1984), indicates a predominantly grazing strategy, with a diet composed mainly of grasses supplemented by shrub twigs.

The occurrence of this species has been documented in Bacău County, at Prăjești, where successive collections from the fluvial terraces of the Siret River have yielded material attributable to this species. Furthermore, the area produced additional Pleistocene faunal elements, including fossil remains of *Bison priscus* (Saraiman and Țarălungă, 1978). Ilie (2005) reported a neurocranium of *B. primigenius* from the Rateș site (Galați County), which is part of the Tecuci Museum collection.

Order Proboscidea ILLIGER, 1811

Family Elephantidae GRAY, 1821

Subfamily Elephantinae GRAY, 1821

Genus *Mammuthus* BROOKES, 1828

Mammuthus sp.

Material: tusk tip.

Although the tusk tip is visibly fragmented and does not retain diagnostic anatomical features, the remaining portion preserves enough morphological information to confirm the taxonomic attribution and, thus, the presence of the genus in the deposits at Bârlad Sud.

Discussion: The genus has been previously recorded from several localities in the proximity of the present site. Particularly relevant are the remains described by Ursachi et al. (2018) from Movileni (Hreasa/Hreasca Creek ravine), Vaslui County, consisting of a comparable fragment. Further proboscidean material,

including small ivory fragments and a proximal ulna, was reported from Zorleni by Păun (2025).

Macarovici (1963) reported the occurrence of “*Elephas trogontherii*” from the Holboca locality (Izvorul Pândarului), near Iași, in a stratigraphic horizon containing both lithic artifacts and traces of fire. However, the description provided was rather limited, lacking key morphological and metric details, such as enamel thickness and lamellar frequency measurements. Ursachi and Codrea (2008) further noted that the material might in fact belong to *M. primigenius*, rather than *M. trogontherii*.

Several Late Pleistocene occurrences of *M. primigenius* have been reported from northeastern Romania, primarily within the terraces of the Prut, Siret, and Moldova rivers. Notably, *M. primigenius* is recorded from Stâncă Ripiceni and Ripiceni-Izvor (Botoșani County), the latter also yielding *Coelodonta antiquitatis*, *Cervus elaphus*, *C. capreolus*, *Rangifer tarandus*, and *B. primigenius* (Simionescu, 1990, and references therein). Additional findings attributed to the same species are documented at Holboca and Lunca Pașcani (Iași County), Hulubăț (Vaslui County), and in several terrace deposits along the Siret valley between Roman and Bacău, as well as at Icușești and north of Roman (Neamț County) (Simionescu, 1990, and references therein).

In Galați County, Codrea and Suster (2006) reported a fragmentary cranium belonging to a subadult or young adult individual of *M. primigenius*, retrieved from loessoid deposits within the Siret

riverbed following dredging operations near the city of Galați. The Rateș (Tecuci) fossil site has been the focus of dedicated studies on proboscideans, emphasising the biostratigraphic importance of Pleistocene remains from the region. Rateș remains a classic reference locality for discussions on the evolution and distribution of proboscideans in southern Moldavia. In a later re-evaluation of the Rateș material housed in the Tecuci Mixed Museum (Muzeul Mixt Tecuci), Ilie (2021) noted four molars attributed to *M. meridionalis*, ten molar fragments assigned to *M. trogontherii*, and two additional specimens designated as *M. primigenius*.

5. CONCLUSIONS

The Bârlad Sud outcrop has yielded significant palaeontological material through consistent monitoring. As in the case of Zorleni and Simila, two types of material are present within the outcrop: Miocene specimens, strongly transported and rounded, with a fragmentary character; and Pleistocene fauna, which is well-preserved. Among the latter are *B. primigenius*, *Megaloceros* sp., and *Mammuthus* sp.

The sedimentary deposits and fossil remains of *B. primigenius* indicate an open steppe environment, characterised by the climatic oscillations of the Pleistocene. As a large-bodied grazer, *B. primigenius* reflects explicit adaptations to pasture-dominated landscapes that characterised the region during this interval.

The occurrence of *Megaloceros* remains further indicates interspecific competition and ecological strategies

suites to semi-open habitats. The presence of *Mammuthus* sp. in the deposits at Bârlad Sud suggests the persistence of cold, steppe-tundra environments during the Late Pleistocene, shaped by pronounced climatic oscillations. As a highly cold-adapted megaherbivore, *Mammuthus* sp. reflects both morphological and ecological specialisation to open, grassy landscapes dominated by sparse vegetation and periglacial conditions (Codrea and Suster, 2006; Ilie, 2021). Analysed collectively, these faunal elements provide significant insight into palaeoenvironmental evolution and the adaptive responses of large herbivores to the climatic fluctuations of the Pleistocene.

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