Late Miocene Mammals from Kocherinovo, Southwestern Bulgaria

Latinka Hristova 1, Denis Geraads 2, Georgi N. Markov 1 and Nikolai Spassov 1

1 National Museum of Natural History, BAS – Tsar Osvoboditel 1 -1000 Sofia, Bulgaria; E-mails: lhristova@nmnhs.com, markov@nmnhs.com, nspassov@nmnhs.com
2 CNRS, UMR 7207, Département Histoire de la Terre - CP 38, Muséum National d’Histoire Naturelle, 57 rue Cuvier, F-75231 PARIS Cedex 05, France. and Max Planck Institute for Evolutionary Anthropology, Department of Human Evolution, Deutscher Platz 6 - D-04103 Leipzig, Germany; E-mail: geraads@mnhn.fr

Abstract: The fauna from the late Miocene localities of Kocherinovo (KCH), SW Bulgaria, is briefly described. Their faunal features and geologic situation suggest that all of these localities (KCH-1, KCH-2, KCH-3) are roughly contemporaneous. The evolutionary stages of several taxa (Choerolophodon, Microstonyx, Palaeoreas) the presence of an archaic aardvark, as well as the presence of C. cf. macedonicum are features indicative of an earlier age than the other Bulgarian Turolian localities, suggesting an early Turolian age. Hipparions, Gazella and spiral-horned bovids (especially Palaeoreas sp.) make up the bulk of the bone sample, a faunal assemblage that is typical, from a palaeoecological point of view, for the Turolian palaeocoenoses of Southern Bulgaria. This indicates that open woodland and shrubland represented the dominant landscape in the region, and shows that it was present in the area as early as the early Turolian. The zoogeographic relationships of the fauna are similar to those of other Turolian localities of Bulgaria, although individuals identified as “? Samotherium” and the aardwark tentatively referred to Amphiorycteropus cf. browni attest to an eastern influence.

Key words: Bulgaria, Kocherinovo, Mammalia, Late Miocene, biochronology

Introduction


The present study of the fauna from the Kocherinovo localities follows these field investigations. Three fossiliferous spots, which we called Kocherinovo 1-3, are now recorded in the Miocene continental deposits of Middle Struma, in the area of Gradishtero (Kamarata) Hill between Mursalevo and Kocherinovo villages. The first (Kocherinovo-1, KCH-1: Spassov et al. 2006) was found by I. Nikolov in the early 1970s. His unpublished notes list the following taxa: Indarctos sp., Proboscidea indet., Hipparion mediterraneum, Dicerorhinus sp., Microstonyx major, Helladotherium sp., Gazella sp.
Most of the material is unavailable (probably stored in the collections of the Palaeontological museum of the Sofia University “St. Kl. Ohridski”). Only some fossils were described recently (Spassov et al. 2005a, 2006). The exact location of the site was lost after Nikolov’s death. After several surveys by N. Spassov and T. Tzankov, a new locality, KCH-2, was discovered in 2001 immediately to the north of the Gradishte Hill by N. Spassov and D. Geraads. The presence of the same green alluvial sandy clays indicates that this locality must be stratigraphically close to KCH-1, a conclusion supported by the biochronology of its fauna. It is located between the villages of Kocherinovo and Mursalevo and a preliminary faunal list was given, without description, by Tzankov et al. (2005) and Spassov et al. (2005b). In 2010, another fossiliferous spot (Kocherinovo-3, KCH-3) was discovered by N. Spassov and J. Prieto, during a survey organized by N. Spassov with a team from the University of Tübingen. This locality is situated about 30 meters to the west of KCH-2 and a few meters below it. The description of the fauna from KCH-2 and KCH-3 with a revision of the one from KCH-1 is the scope of this paper. All the material from KCH-2 and KCH-3 is stored in the National Museum of Natural History, Sofia (NMNHS) and the indications and numbers follow the official nomenclature of the fossil collections of the museum.

Abbreviations:

- DTK – Dytiko, Greece
- GR – Grebeniki, Ukraine
- HD – Hadjidimovo, SW Bulgaria
- FM – Fossil Mammal collection, NMNHS
- KAL – Kalimantsi, SW Bulgaria
- KCH-1, KCH-2, KCH-3 – Kocherinovo 1, 2 and 3, SW Bulgaria
- KTD – Kemiklitepe D, Turkey
- LGPUT – Laboratory of Geology and Palaeontology, Aristotle University of Thessaloniki, Greece
- MNHN – Muséum National d’Histoire Naturelle, Paris
- NHM – Natural History Museum, London
- NIK 1, 2 – Nikiti 1, 2, Greece
- NMNHAs – Palaeontological Museum (Branch of NMNHS), Assenovgrad.

Geology and stratigraphy

The localities of Kocherinovo are situated in the uppermost green sandy clays of the Gradishte Benchmark Group of strata (Spassov et al. 2006) (Fig. 1). This stratigraphic unit is represented by a bundle of mostly grey-green to olive green, rarely yellow-brown clays with various thickness, up to 10-15 m (rarely more). The lower boundary is transitional with the rocks of the Slatino Genetic Lithocomplex. The upper boundary is also transitional with the lower parts of the Strumyani Genetic Lithocomplex. According to Tzankov et al. (2005), the Gradishte Benchmark Group outcrops as big spots or short bands in the area of Dzherman (south of Dupnitsa), from Mursalevo through Elenov Vrah peak as far as the Gradishteto peak (the type area of this genetic lithocomplex), in the area of Blagoevgrad and Sandanski, and of the villages of Novo Delchevo, Spathovo, Hotovo, Harsovo, Kalimantsi and Katuntsi. This unit consists of lacustrine-marshy or fluvial deposits formed by braided rivers (Tzankov et al. 2005). All Kocherinovo localities belong to this unit and are probably roughly contemporaneous.

Systematic palaeontology

Order Proboscidea Illiger, 1811

Suborder Elephantiformes Tassy, 1988
Superfamily Elephantoidea Gray, 1821
Family Choerolophodontidae Gaziry, 1976
Genus Choerolophodon Schlesinger, 1917
Choerolophodon sp. “KTD-type”

The only identifiable proboscidean fossils from Kocherinovo are four choerolophodont teeth, one from KCH-2, discovered in 2002, and three from KCH-3, in 2010:
Late Miocene Mammals from Kocherinovo, Southwestern Bulgaria

FM1986, left dp3, KCH-2 (Fig. 2A). The specimen, briefly mentioned by Markov (2004) and Spassov et al. (2006), preserves its entire crown and parts of its two roots. Consisting of two lophids and a postcingulum, the tooth is almost entirely unworn: dentine is only slightly exposed on the first posttrite. Strongly wrinkled enamel with cement deposits. The narrow first lophid has two cusps of which the posttrite is posteriorly displaced. This, as well as the cross-contact in the interlophid involving the posterior posttrite conule of the first and the anterior pretrite conule of the second lophid, are typically choerolophodont characters: Tassy (2005). The second lophid is transversally enlarged; the posterior cingulum is prominent but there is no entoflexus separating it from the lophid. In this aspect, as well as in its dimensions, FM1986 is very close to the left dp3 in the KTD66 mandible from the lower level of Kemiklitepe (KTD, MN11) described by Tassy (1994, Fig. 2B) as Ch. pentelici ssp. indet. L: 46; W: 29.7; H: 22.

At KCH-3, three teeth were found in close proximity to each other and probably belong to one individual:
FM2861, right DP3. (Fig. 2B). With a crown posteriorly damaged, the tooth has two lophs and two roots. The enamel is strongly wrinkled, with deposits of cement. Dentine is only slightly exposed on the first posttrite, otherwise the tooth is practically unworn. The anterior cingulum is separated from the first loph. The second pretrite cusp is strongly displaced anteriorly in relation to the posttrite, blocking the interloph. Although the crown is damaged, just enough is preserved to demonstrate the absence of a second entoflexus behind the second loph. In this aspect, FM2861 differs from typical *Ch. pentelici* and is close in shape to the DP3 from Yassiören (see *Tassy* 1994, Fig. 3). Larger than the latter, it is very close to a DP3 from Kayadibi (*Gaziry* 1976; *Sanders* 2003). L: 72; W: 32/37e/40; H: 29

FM2863, anterior fragment (2 lophids) of a right lower tooth germ. Higher and wider than FM2862, this is either a dp4 of another individual, or a first molar. L: > 53 (ca. 80e); W: > 38.5; H: > 33.5

Status and taxonomy of the late Miocene choerolophodonts of the Mediterranean, and more specifically of the Vallesian and early Turolian forms, are debatable. *Gaziry* (1976) referred Vallesian as well as Turolian choerolophodonts to *Ch. pentelici*, the type species of the genus. A similar approach was adopted by e.g. *Tassy et al.* (1989) and *Tassy* (1994) who, however, accepted separate subspecific status for earlier (pre-Pikermian) choerolophodonts. *Sanders* (2003) regarded *Ch. pentelici* as a strictly Turolian (MN12-MN13) species, referring Vallesian and early Turolian choerolophodonts (including the KTD material) to *Ch. anatolicus* (*Ozansoy* 1965). *Markov* (2008), while accepting the separate status of the Vallesian species, disagreed with the attribution of KTD to *Ch. anatolicus*, regarding it as an early form of *Ch. pentelici* s. str. In a recent study, *Konidar* and *Koufos* (2013) restricted *Ch. anatolicus* to MN9, referring not only KTD (MN11) but also late Vallesian material to *Ch. pentelici*. As a result, views on material from KTD and the Turkish locality Kayadibi (from both of which specimens directly comparable to the Kocherinovo finds are known), vary: Both KTD and Kayadibi were included in *Ch. anatolicus* by *Sanders* (2003) as late (MN11) examples of the species’ occurrence, for *Tassy* (1994) KTD and the earlier Yassiören material apparently represented the same, primitive subspecies of *Ch. pentelici*. As said, KTD was regarded as an early form of *Ch. pentelici*.
by Markov (2008) and Konidaris, Koufos (2013); while not explicitly discussing the age of Kayadibi, Konidaris, Koufos (2013) referred its choerolophodonts to Ch. anatolicus (a strictly MN9 species, according to them). It is possible that the Kayadibi fauna is of mixed age (see Sickenberg et al. 1975), with at least part of the proboscidean material being not earlier than MN10, probably even MN11, considering the large size of deinotheres' teeth from this locality (Sanders 2003; Markov 2008; Garevski, Markov 2011) and of some Kayadibi choerolophodonts like the DP3 figured by Gaziry (1976, Pl. 9, Fig. 5). It is worth noting that the latter specimen was not included in Ch. anatolicus by Konidaris, Koufos (2013) — although it appears on the diagram, Fig. 6, apparently by mistake (G. Konidaris, pers. comm. to GM 2012), — nor in Ch. pentelici, staying in a kind of taxonomic limbo.

Fig. 3. Hipparion skull specimens from Kocherinovo 2: A: Hippotherium brachypus, FM2611. B: Hippotherium brachypus, FM 2547. C: Cremohipparion cf. macedonicum, FM2229. Scale bar: 4 cm
Late Miocene Mammals from Kocherinovo, Southwestern Bulgaria

In summary, the Kocherinovo choerolophodonts belong to a form present at KTD and, possibly, Kayadibi, the status of which is doubtful: it could be either a late form of *Ch. anatolicus*, or an early stage of *Ch. pentelici* s. str. (A third possibility would involve co-occurrence, and even possible hybridization, of *Ch. anatolicus* and *Ch. pentelici* around the Vallesian / Turolian boundary: a scenario similar to that proposed for European mammoths by LISTER et al. 2005). Obviously, this problem could only be solved by the (nearly miraculous) discovery of well dated, associated adult mandible (permitting observations on the symphyseal shape; ideally with a skull published by GAZIRY 1976) and deciduous teeth (permitting observations on the morphology of dp3/DP3; again, ideally, with a mandible). In any case, what can be said about the Kocherinovo material is that its size and morphology indicate an age definitely earlier than Pikermi (MN12) and most probably later than Yassiören (MN9), the type localities of *Ch. pentelici* and *Ch. anatolicus*, respectively. An allocation of the Kocherinovo choerolophodonts to *Ch. pentelici* ssp. KTD type (based on size) or to *Ch. cf. anatolicus* (based on morphology, and the diagnoses of the two species as provided by KONIDARIS, KOUFOS 2013) would be equally valid, for this reason we refer them to *Choerolophodon* sp. “KTD-type”.

**Order Tubulidentata HUXLEY, 1872**

Family Orycteropodidae GRAY, 1821

Genus Amphiorictopus LEHMANN, 2009

*Amphiorictopus cf. browni* (COLBERT, 1933)

An aardwark skull from KCH-1 was determined as *Orycteropus cf. browni* (SPASSOV et al. 2006). The species *O. browni* COLBERT, 1933 is known from the Siwaliks, where it is best known from the first half of the late Miocene, but a skull tentatively dated at 7.9 Ma could be younger and its age corresponds to the early Turolian (BARRY et al. 2002). The species was recently referred, together with several other late Miocene forms, such as *O. gaudryi*, *O. mauritanicus* and probably *O. pottiari*, to the genus *Amphiorictopus* LEHMANN (LEHMANN 2009). Identification is hampered by the fact that only photos of the skull are available, but they display several features of *Amphiorictopus* (e.g. post-palatine torus). In any case, the skull demonstrates, in the strength of the temporal lines that almost meet caudally, and in the morphology of its M3, less 8-shaped than in later forms, some more archaic features than the typical middle Turolian *A. gaudryi* (SPASSOV et al. 2006), and indicates an older age.

**Order Perissodactyla OWEN, 1848**

Suborder Hipparion Wood, 1937

Family Equidae GRAY, 1821

Hipparion finds from the localities are several cranial and mandibular remains, some of them badly preserved. There are also postcranial materials, some of them in good preservation. Most of the materials are from KCH-2, but a few tarsals and metatarsal fragments from a small to medium-sized hipparion included in bone breccia are from KCH-1. A single, unworn molar is from KCH-3. The only fossils that could be identified are from KCH-2.

Genus Hippotherium KAUP, 1833

*Hippotherium brachypus* (HENSEL, 1862)

Four skull fragments, two mandibles and some postcranial bones can be assigned to this species.

The skull fragments are from juvenile and adult individuals. The cranial fragment FM2611 (Fig. 3A) is from an adult male individual. The preorbital bar is not preserved, but it seems to be wide – the posterior border of the preorbital fossa is above the middle of M2. The preorbital fossa is deep (about 20 mm), with well delineated borders, anteroventrally oriented. The posterior pocket is shallow, about 5 mm deep. The preorbital fossa is located high above the facial crest (m36 = 33.5 mm), which ends above the anterior end of M1. The nasal notch ends above the anterior part of P2. The muzzle is short (m1 = 116 mm) and wide (m15 = 53 mm). The tooth row is 143.6 mm; the premolar length is 78.5 and the molars – 66.5 mm. The enamel plication is moderate – 17-23 plis, the pli caballin is complex. The hypoconal groove is deep, the lingual one is well developed on M3, but rudimentary on the other cheek teeth. The protocone is lingually flattened – labially rounded, with spur on P2.

The other adult skull fragment (FM2955) preserves M1-M3. The enamel plication is rich (26-31 plis), with thin enamel and deep folds. The hypoconal groove is deep; on M3 the hypocone is angular, with deep lingual groove. The posterior wall of the tooth is also plicated. The protocone is lingually flattened – labially rounded.

The specimen FM2547 (Fig. 3B) is from a juvenile individual, with dp1-dp4 and M1 in the process of eruption, only about 5 mm of which are visible
outside the bone. The preorbital bar is wide (m32 = 40.5 mm), with lacrimal placed on more than the half of the bar length. The preorbital fossa is large, well outlined, anteroventrally oriented. There is a moderate posterior pocket. The anterior border is well delineated, and anteriorly to it is a shallow depression. The foramen is close to the anteroventral border of the fossa. The preorbital fossa is close to the facial crest (m36 = 18 mm), which ends above the anterior end of dP4. The nasal notch seems to end above the anterior part of dP2. The muzzle is long, about 130 mm, and narrow (42 mm). The enamel is richly plicated, the pli caballin is complex, the protocone is plicated, the pli caballinid is rudimentary on all molars. The metaconid is rounded, the metastylid is quadrangular, and the pli caballinid is rudimentary on all molars as well of the preserved posterior half of p4. The linguaflexid of m1 and m2 separate the metaconid and metastylid, but not on m3. There is a protostylid on m1. The linguaflexid is deep and v-shaped.

The comparison with other hipparions shows greatest resemblance with *Hippotherium* (Bernor et al. 1988, 1997, Koufos 1987a, b, 2000, Vlachou and Koufos 2002, 2009). Although the skull fragments are not well preserved, the similarity is expressed in: the relatively long deciduous and permanent tooth rows, moderately to highly plicated enamel on the deciduous and permanent teeth. The anterior border of the preorbital fossa, which is not so well delineated as in *H. primigenium*, the deeper nasal notch which ends above P2 (instead of between P2 and C in *H. primigenium*), and the shallow pocket, distinguish the specimens from Kocherinovo from *H. primigenium* and relate them to *H. brachypus*. This species is widespread during the early and middle Turolian in the Balkan Peninsula (Hadjidimovo, Pikeri, Kalimantsi, numerous localities from the Republic of Macedonia) and perhaps also includes *H. giganteum* from the Northern Black Sea (Grebeniki). The relatively deep preorbital fossa, the deeper posterior pocket and well delineated anterior border on the specimens from Kocherinovo show greater similarity with earlier populations of *H. brachypus* from Hadjidimovo and Grebeniki.

The proportions of the mandible are close to those of some *Hippotherium* species. The rostral part length, its width at the incisors and the length of the symphysis are about the size of *H. primigenium* from Nikiti1, while depths of the horizontal ramus are close to the mean value for *H. brachypus* of Hadjidimovo and Pikeri. The dimensions and enamel features definitely distinguish the mandible from the other hipparion genera, such as *Hipparion* and *Cremohipparion*.

The comparison of a large astragalus (FM2231) shows affinities to *Hippotherium* from different localities and *C. proboscidium* from Vozarci (Republic of Macedonia). With no data showing the presence of *C. proboscidium* at KCH, the astragalus could also be assigned to *H. brachypus*.

Genus *Cremohipparion* Qiu, Huang et Guo, 1987

*Cremohipparion* cf. *Cremohipparion macedonicum* Koufos, 1984

The specimen FM2229 (Fig. 3C) is a young individual, preserving part of the skull with deciduous teeth only. The muzzle is short and narrow (m1 = 88, m15 = 45.5), with not much curved incisor row. The length DP2-DP4 is 78 mm, there is a DP1. The
Late Miocene Mammals from Kocherinovo, Southwestern Bulgaria

enamel plication is simple, the pli caballin is single; the protocone is elliptical to lingually flattened – labially rounded. The hypoconal groove is deep, on DP3 and DP4 it is confluent with the postfossette. It is difficult to use that specimen for comparison because of its bad preservation and young age. The muzzle length and width would be larger in an adult individual, and together with features such as elliptical to lingually flattened – labially rounded protocone and straighter incisor line, the specimen seems to be closer in its features to C. macedonicum than to C. matthewi (Koufos 1987c, 1988a, b, c, 2000, Vlachou and Koufos 2006, 2009).

The mandibular fragment FM2485 is of a small hipparion with preserved p2-m2. Its enamel is slightly crenulated and plicated, the metaconid rounded to elongated on p3, and the metastylid is rounded. The premolar ectoflexid does not separate metaconid and metastylid, while the molar ectoflexid penetrates the isthmus and reaches the linguaflexid. The pli caballin is rudimentary on p3, 4. The linguaflexid is V-shaped on the molars and U-shaped on the molars. There is protostylid on p3-m3. The premolar length is 67.7 mm, close to the size of C. macedonicum from PER. The other two measurements (m11 and m12) are close to the samples of C. macedonicum from NIK-1, RZO and VTK, as well as of C. matthewi from DTK. Despite the length tooth row, slightly too long for C. macedonicum, the crenulated enamel on the flexids shows greater similarity with this species than with C. matthewi. (Koufos 1984, 1987c, 1988b, Vlachou, Koufos 2006, 2009).

Two small metacarpals from KCH-2 could possibly be added to this sample. Only one of them is well preserved, FM2488. Its length is close to those of C. macedonicum from NKT2 and PER, but is more robust. It is close but is slightly longer and has larger distal dimensions.

“Hipparion” sp., medium-sized

The skull fragment (FM2951) is of a juvenile specimen of a medium-size species; M1 is slightly worn, M2 is just erupted and only its tips are visible from the alveolus. The area of the preorbital bar is deformed, but seems to be wide. The DP2-DP4 tooth row is about 86 mm long, with moderately plicated enamel, and a double pli caballin.

Some postcranial remains could belong to this species. The three metatarsal fragments, two proximal (FM2492, FM2493) and one distal (FM2230), by their size and proportions, as well as two astragal of medium size (FM2490, FM2499) and three medium-sized first phalanges (FM2491, FM2828A, FM2952) could be assigned to a slender-legged hipparion species of Cremohipparion or Hipparion.

Family Rhinocerotidae Gray, 1821

? Acerorhinus sp.

FM2959 (KCH3) is a mandibular fragment with p4-m3 (m1-m3 c. 124; mandibular depth below m1 and m3 = 92 and 104 mm respectively; width at the bases of the i2 alveolus is c. 93). Although the front part is missing, it is clear than the corpus was not tapering forwards, in contrast to that of horned rhinos, and the symphysis as well as the i2 alveolar bases (which are preserved) must have been rather broad, as in Acerorhinus and Chilotherium.

Order Artiodactyla Owen, 1848

Family Suidae Gray, 1821

cf. Microstonyx sp.

Suids are represented by a distal tibia FM 2232 (KCH-2) (TD = 49.0; APD = 44.5) (the size of a specimen from the late Miocene of Hadjidimovo is TD = 44.5; APD = 39.5;) as well as by a tooth, a P3 FM2958 (KCH-3), remarkable by its large size (L = 20, W = 18.7), slightly larger than all Microstonyx major / erymanthius P3s that we could measure. The difference is not great but, together with the large size of the tibia, it is perhaps indicative of an age somewhat different from that of the bulk of later Miocene sites of the Balkano-Iranian province. The Vallesian Hippopotamodon antiquus is larger, but the evolution of these forms is still too poorly understood, in spite of their abundance, to draw reliable conclusions from a single tooth.

Family Giraffidae Gray, 1821

? Samotherium sp.

A juvenile mandible with dp3-m1 FM2879 (KCH-2) (Lm1 = 35; Wm1 = 21.5, H of unworn m1 = 25.5) (fig. 4 A1, A2), half a lower molar FM2532 (KCH- 2) (W = 22), and a proximal metacarpal FM2960 (KCH- 2) (proximal TD = 80) belong to a larger giraffid, probably a medium-sized giraffid of the Palaeotragus / Samotherium group; larger and more hypsodont than Bohlinia attica. (Fig. 4). Samotherium has not been recorded from the late Miocene of Bulgaria but is known from the Southern Balkans, pointing to eastern influences in the Turolian faunas (Geraads 1978; Kostopoulos et al. 1996).
Family Bovidae Gray, 1821

Tragoportax sp.

FM2024 (KCH-1) is a skull fragment of a relatively large bovid (width over pedicles = 92) but the horn-cores themselves are quite small (28 x 19). Spassov et al. (2005a) assigned it to a female Tragoportax, of which it is one of the few known examples (perhaps including some specimens reported as Graecoryx). This skull is associated with a few teeth, including m2 and m3, but no other fossil from Kocherinovo can be referred to this taxon.

Miotragocerus (Pikermicerus) sp.

A maxilla FM2884 (KCH-2) and both sides of a mandible FM2482 (KCH-2) (fig. 4 E1, E2) belong to a small Boselaphini. The lower molars are similar to those of Tragoportax, but are much smaller. They must belong to the small genus (or subgenus) reported from many other localities, but the absence of horn-cores prevents any precise identification.

A few phalanges are too large for Palaeoreas or Prostrepsiceros, and could also belong here.

Palaeoreas lindermayeri?

The most common bovid at Kocherinovo is a small form represented by several upper and lower tooth-rows (Fig. 4 B1, B2, D1, D2). Although the molars are about as long as those of Prostrepsiceros rotundicornis, the premolars are distinctly shorter (compare Table 2 with Kostopoulos 2005, table 9). Instead, they are of the right size and morphology for Palaeoreas lindermayeri, a species well-known in Bulgaria, especially at Kalimantsi and Hadjidimovo (Geraads et al. 2003). More specifically, they are more or less intermediate in size between the fossils from this latter site and those from Pikermi, but there are too few specimens for inferring an age estimate from this observation.

The identification of the single horn-core from Kocherinovo, FM2531 (KCH-2) (fig. 4C1, C2), is less secure. It is the base of a left horn-core with clockwise torsion (i.e., heteronymous); it has a slightly compressed oval cross-section (38 x 32.7, but the horn-core is hard to orientate with precision) and is strongly spiralled (but only the first 3 cm are preserved). The lack of compression and lack of keel suggest affinities with Prostrepsiceros rotundicornis, but we consider this identification unlikely, as it would imply the less parsimonious hypothesis that teeth and horn-core belong to different taxa. Anyway, positive identification of such a small piece would be premature; we may note that the postero-lateral keel may be weak in Palaeoreas lindermayeri, but even the small specimens from Pikermi are larger than FM2531 (KCH-2) (Geraads et al. 2003).

Gazella sp.

It is not easy to separate the small Palaeoreas from large gazelles postcranials, but it seems that a number of postcranials (at least 4 individuals after the number of the radii) are of the right size for Gazella (see table 3).

Biochronology, Palaeoecology, and Palaeozoogeographic affinities

The mammalian fauna as a whole indicates a Turolian age. After their faunal composition, the localities of Kocherinovo are certainly the earliest Turolian localities from Bulgaria. Choerolophodont teeth from KCH-2 and KCH-3 show strong affinities with material from the localities KTD and Kayadibi in Turkey, suggesting a similar age, most probably MN11, for Kocherinovo.

The hipparions C. cf. macedonicum and H. brachypus from Kocherinovo, with morphology more archaic than that typical for MN12 and closer to the oldest samples of the species, such as Grebeniki and Hadjidimovo, also suggest an earlier (MN11) age. Palaeoreas, if correctly identified, is smaller than that from Pikermi, and the single Microstonyx tooth is larger than those from the middle Turolian of the Balkans. The aardvark from KCH-1 differs from O. gaudryi, known from the Turolian (mostly middle

<table>
<thead>
<tr>
<th>Table 1. Comparative check-list of the fauna from KCH 1-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kucherino 1</td>
</tr>
<tr>
<td>Choerolophodon sp.</td>
</tr>
<tr>
<td>Amphiorcieropus cf. browni</td>
</tr>
<tr>
<td>Acerorhinus sp.</td>
</tr>
<tr>
<td>Hippotherium brachypus</td>
</tr>
<tr>
<td>Cremohipparion cf. macedonicum</td>
</tr>
<tr>
<td>Hipparion sp.</td>
</tr>
<tr>
<td>Equinae indet. (hipparions)</td>
</tr>
<tr>
<td>cf. Microstonyx sp.</td>
</tr>
<tr>
<td>? Samotherium sp.</td>
</tr>
<tr>
<td>Tragoportax sp.</td>
</tr>
<tr>
<td>Miotragocerus (Pikermicerus) sp.</td>
</tr>
<tr>
<td>Palaeoreas lindermayeri</td>
</tr>
<tr>
<td>Gazella sp.</td>
</tr>
</tbody>
</table>
Late Miocene Mammals from Kocherinovo, Southwestern Bulgaria

Table 2. Measurements of bovid tooth rows, Kocherinovo 2

<table>
<thead>
<tr>
<th>Upper</th>
<th>P2-P4</th>
<th>M1-M3</th>
<th>P2-M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM2884 Miotragocerus sp.</td>
<td>37.2</td>
<td>47.8</td>
<td>-</td>
</tr>
<tr>
<td>FM2481 Palaeoreas lindermayeri?</td>
<td>28</td>
<td>38.3</td>
<td>67</td>
</tr>
<tr>
<td>Lower</td>
<td>p2-p4</td>
<td>m1-m3</td>
<td>p2-m3</td>
</tr>
<tr>
<td>FM2482 Miotragocerus sp.</td>
<td>37</td>
<td>51</td>
<td>87.8</td>
</tr>
<tr>
<td>FM293 Palaeoreas lindermayeri?</td>
<td>c. 24.5</td>
<td>41.3</td>
<td></td>
</tr>
<tr>
<td>FM2535 Palaeoreas lindermayeri?</td>
<td>27.2</td>
<td>39.3</td>
<td>65.5</td>
</tr>
<tr>
<td>FM2534 Palaeoreas lindermayeri?</td>
<td>-</td>
<td>42.7</td>
<td>-</td>
</tr>
<tr>
<td>FM2533 Palaeoreas lindermayeri?</td>
<td>25.3</td>
<td>41.2</td>
<td>66.8</td>
</tr>
</tbody>
</table>

Table 3. Comparative measurements of Gazella metapodials from KCH-2, STR 1, 2 (middle Turolian, GerAads et al. 2011), HD (end of early Turolian) and the Villafranchian of South Europe (after De Giull, HeiNTZ 1974)

<table>
<thead>
<tr>
<th>Strumyani</th>
<th>L.</th>
<th>prox. TD</th>
<th>TD shaft</th>
<th>dist. TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt FM2249 (Str-1)</td>
<td>-</td>
<td>20.6</td>
<td>11.6</td>
<td></td>
</tr>
<tr>
<td>Mt FM2008 (Str-2)</td>
<td>148</td>
<td>16</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Mc FM2009 (Str-2)</td>
<td>144</td>
<td>17</td>
<td>10.2</td>
<td>18.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hadjidimovo (a complete skeleton)</th>
<th>L.</th>
<th>prox. TD</th>
<th>TD shaft</th>
<th>dist. TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt</td>
<td>21.1</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mc</td>
<td>21.2</td>
<td>22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kocherinovo 2</th>
<th>L.</th>
<th>prox. TD</th>
<th>TD shaft</th>
<th>dist. TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt FM2484</td>
<td>159(160)</td>
<td>18.4</td>
<td>10.3</td>
<td>20.0</td>
</tr>
<tr>
<td>Mt FM2963</td>
<td>-</td>
<td>10.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mc FM2961</td>
<td>-</td>
<td>-</td>
<td>19.0</td>
<td></td>
</tr>
<tr>
<td>Mc FM2962</td>
<td>-</td>
<td>17.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gazella borbonica (Villafranchian of France, Italy and Spain)</th>
<th>L.</th>
<th>prox. TD</th>
<th>TD shaft</th>
<th>dist. TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt (n=35)</td>
<td>16.2-19.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The relatively small bone sample (about 200 identifiable bones) consists mostly of hipparions, Gazella and spiral-horned bovids (especially Palaeoreas sp.), making up an assemblage typical of the Turolian palaeocoenoses of Southern Bulgaria. This indicates that the open woodland and shrublands represented the dominant landscape in the region, and that this rather common landscape during the middle Turolian of Bulgaria and the Balkans was already present in the area in the early Turolian. The zoogeographic aspect of the fauna is also characteristic for the Turolian of Bulgaria, although ? Samotherium and Amphioryceropus cf. browni possibly attest to eastern influences.

Acknowledgements: We are grateful to T. Tzankov and K. Stoyanov (Blagoevgrad N. Rilski University) for the help for the discovery and the support in the organization of the first excavations in Kocherinovo site (2002) as well as to J. Prieto (München) and the team of M. Böhme (Tübingen University) who helped us (NS) in the collecting of the material from Kocherinovo 3 (2010); to P. Tassy and C. Sagne (MNHN – Paris), G. Daxner-Höck (NHMW), A. Currant (NHM), E. Tsoukala and G. Koufos (AUT) for access to collections. We thank an anonymous reviewer for comments and suggestions which helped improve the manuscript. Visits to MNHN were funded by the exchange program between the Bulgarian Academy of Sciences and CNRS, Direction des Relations Internationales. Visits to NHMW and NHM were financed by the European Union (SYNTHESYS grants AT-TAF-2283 and GB-TAF-1678).

References


BOEV Z., N. SASSOV 2009. First Record of ostriches (Aves, Struthioniformes, Struthionidae) from the late Miocene of
Bulgaria with taxonomic and zoogeographic discussion. – Geodiversitas, 31 (3): 493-507.


HRISTOVA L. 2012. About the age of the Late Miocene localities of the Kalimantsi fossiliferous area on the basis of Creornhipparion (Perissodactyla, Equidae) skull morphology polymorphism. – Historia naturalis bulgarica, 20: 143-150.


MARKOV G. N. 2004. The fossil proboscideans of Bulgaria and
the importance of some Bulgarian finds – a brief review. – *Historia naturalis bulgarica*, 16: 139-150.


Received: 13.05.2013
Accepted: 17.08.2013