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Abstract

A new genus and species of ground-hornbill are described from the Late Tertiary (Late Miocene) fluviative deposits in Hadzhidimovo (Hadzhidimovo-1, or Hadzhidimovo-Girizite locality), in southwestern Bulgaria. The cranial half of a scapula and the distal third of a femur have been recovered. The morphology distinguishes the specimen from the recent species of *Bucorvus*, the closest genus. Most interesting is the morphology of the scapula (the holotype), which differs considerably from the ground-hornbills in some structures (e.g. the clavicular joint) while being surprisingly similar in other structures (e.g. the humeral articular joint). The last peculiarity may indicate that the fossil species was a more primitive form having relatively poorer flying capacity in comparison to other ground-hornbills. This first record of Bucerotidae in Europe proves the occurrence of the family in the Tertiary of the western parts of the Eurasian continent. It came from the richest Bulgarian locality of the Hipparion fauna, from which ca. 36 species of large mammals and birds are now known.

Résumé

Un nouveau genre et une nouvelle espèce de bucorvinés sont décrits du Miocène supérieur d'un gisement fluviatile près de la ville de Hadjidimovo (localité Hadjidimovo-1, ou Hadjidimovo-Girizite), au Sud-Ouest de la Bulgarie. Le nouveau taxon est représenté par une partie craniale de scapula et une partie distale de fémur. La morphologie distingue le spécimen fossile des espèces récentes de *Bucorvus*, qui est le genre le plus proche. La morphologie du scapula (holotype) est spécialement indicative. Par certaines structures (exemple de l'articulation claviculaire) elle diffère considérablement du genre nouveau des bucorvinés récents. Par ailleurs, un nombre de ces structures (exemple de l'articulation humérale) sont très proches morphologiquement de *Bucorvus*. Le dernier caractère est une indication probable d'un vol relativement plus limité. Cette première trouvaille de bucorvinés en Europe confirme l'occurrence de ce groupe dans le Tertiaire de l'Occident de l'Eurasie. Son origine est liée au gisement qui présente la plus riche faune à hipparion en Bulgarie, d'où 36 espèces de grands mammifères et d'oiseaux sont connues.

Keywords: Late Miocene; Bulgaria; Aves; Bucerotidae; Ground-hornbills

Mots clés : Miocène supérieur ; Bulgarie ; Aves ; Bucerotidae ; Bucorvinés

1. Introduction

Hornbills are currently distributed through the Paleotropics (Fig. 1). Fifty-four recent species are known (Kemp, 2001). The

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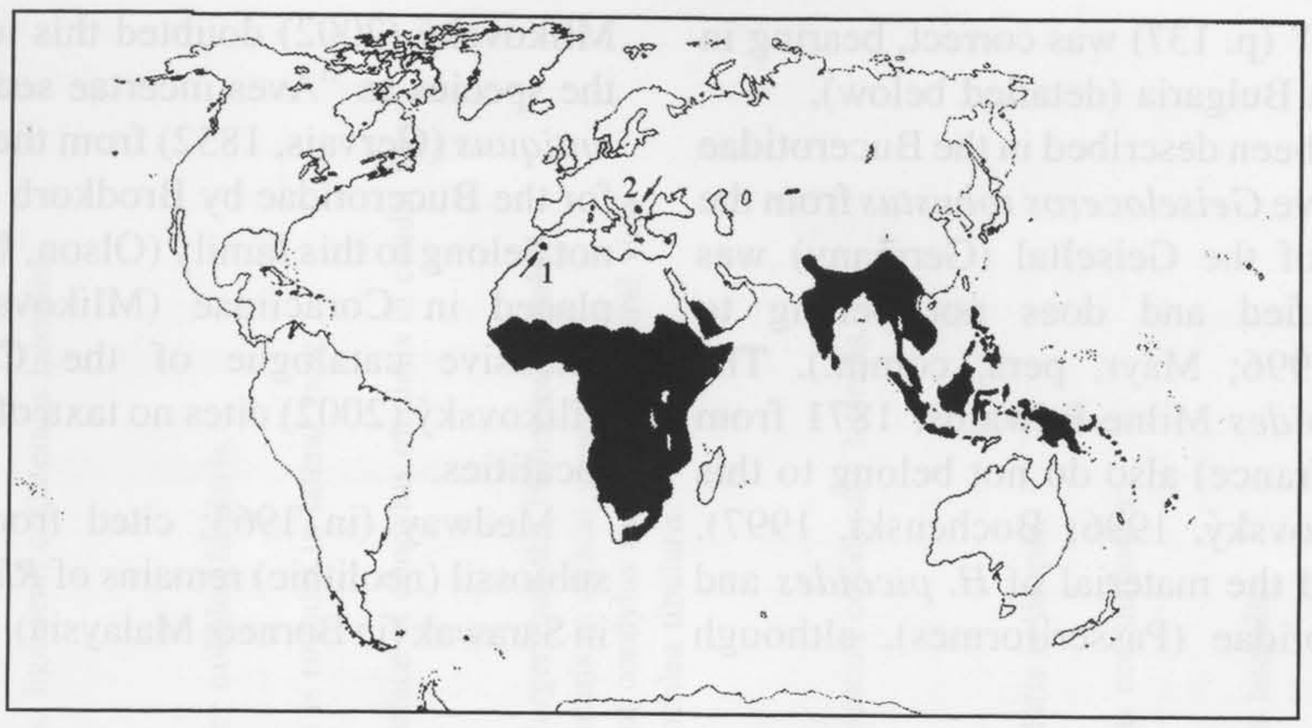
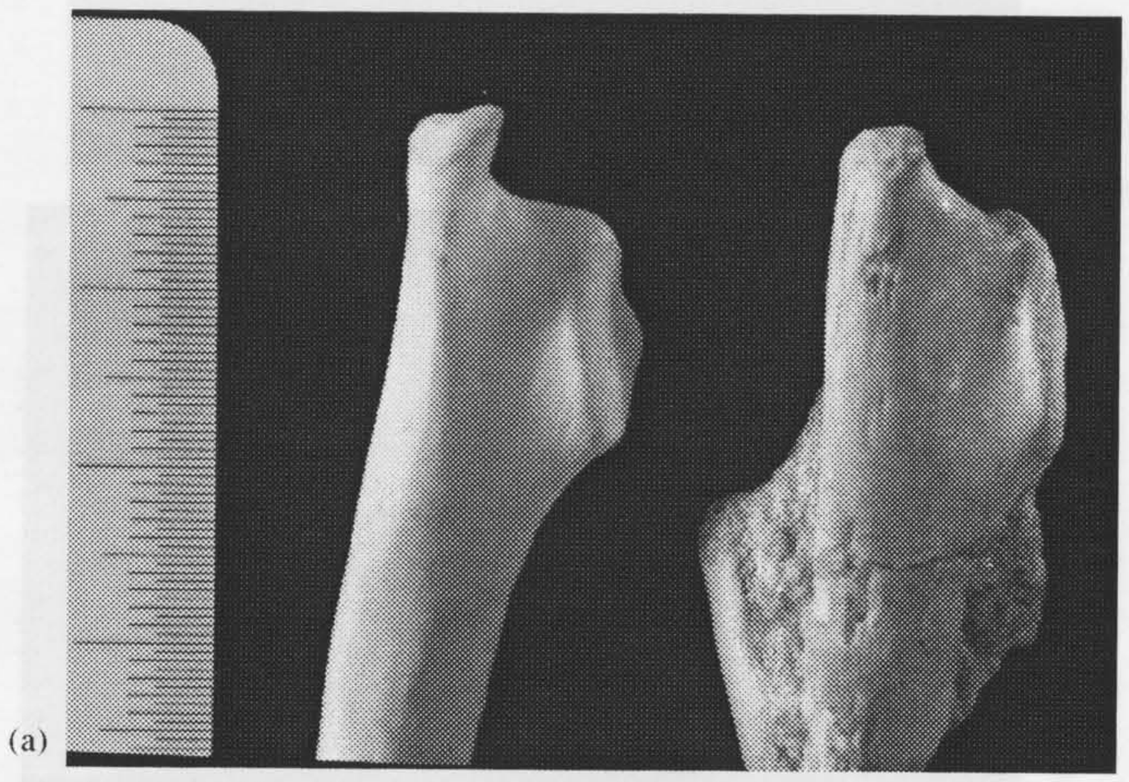


Fig. 1. Present range of Bucerotidae (after Kemp, 2001) and the localities of its fossil (Tertiary) record: Beni-Mellal, Late Miocene, Morocco (Brunet, 1971) (**1**) and Hadzhidimovo, Late Miocene, Bulgaria (present paper) (**2**) (Drawing: Vera Hristova).

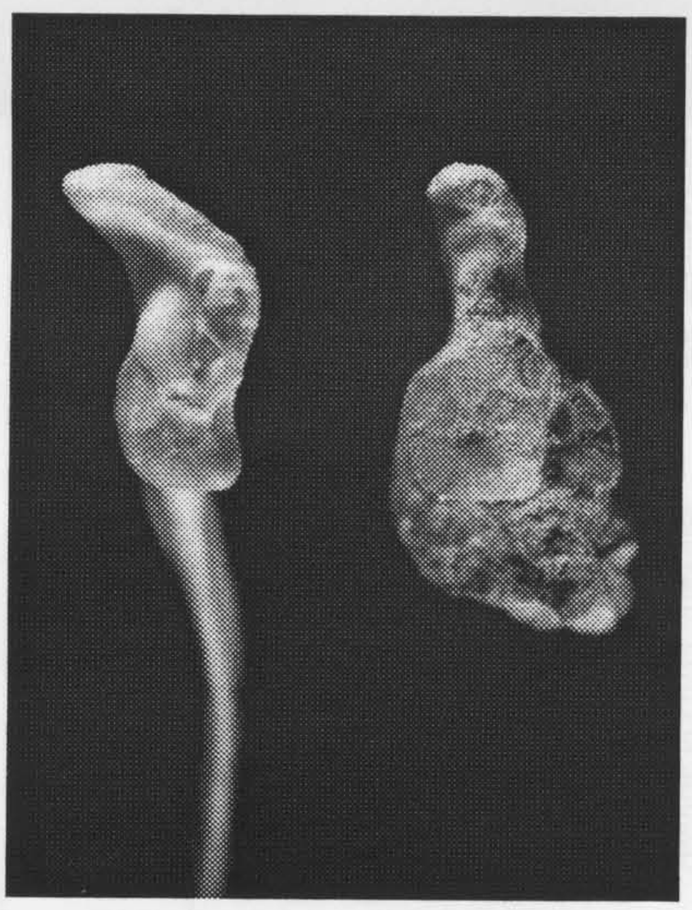
ground-hornbills (Bucorvinae) include two recent and one fossil species (Brunet, 1971; Kemp, 2001).

The fossil record of Bucerotidae is surprisingly scanty and in fact only two papers contain data on the fossil history of this family. Brunet (1971) reports on a distal tarsometatarsus from the Late Miocene locality of Beni-Mellal in the northern parts of the Atlas Mountains (N Morocco), described as *Bucorvus brailloni* Brunet, 1971. This record has been confirmed and accepted by Olson (1985), whose suggestion that "... bucerotids should be looked for in the Tertiary deposits of



(a)

(b)



(c)

Fig. 2. *Euroceros bulgaricus* gen. nov., sp. nov.: scapula dex. prox., NMNHS 12353 on the right, compared with *Bucorvus leadbeateri*, on the left: (**a**), dorsal view; (**b**), ventral view; (**c**), cranial view (Photographs: Boris Andreev).

the modern Palearctic region" (p. 137) was correct, bearing in mind the recent discovery in Bulgaria (detailed below).

Three taxa have formerly been described in the Bucerotidae (Brodkorb, 1971). The putative *Geiseloceros robustus* from the Lutetian (Middle Eocene) of the Geiseltal (Germany) was almost certainly misidentified and does not belong to Bucerotidae (Mlíkovský, 1996; Mayr, pers. comm.). The remains of *Homalopus picoides* Milne-Edwards, 1871 from the Astaracian of Sansan (France) also do not belong to this family (Olson, 1985; Mlíkovský, 1996; Bochenski, 1997). Cheneval (2000) has revised the material of *H. picoides* and referred it to Dendrocolaptidae (Passeriformes), although Mlíkovský (2002) doubted this identification and referred to the species as "Aves incertae sedis". In addition, *Cryptornis antiquus* (Gervais, 1852) from the Paris basin in France, listed for the Bucerotidae by Brodkorb (1971), also apparently does not belong to this family (Olson, 1985). Provisionally, it can be placed in Coraciidae (Mlíkovský, 2002). Finally in his extensive catalogue of the Cenozoic birds of Europe, Mlíkovský (2002) cites no taxa of Bucerotidae from European localities.

Medway (in 1963; cited from Brunet, 1971) reports on subfossil (neolithic) remains of *Rhinoplax vigil* from Niah Cave in Sarawak (in Borneo; Malaysia). Our still unpublished material

Fig. 3. *Euroceros bulgaricus* gen. nov., sp. nov.: femur sin. dist., NMNHS 12352, on the right, compared with *Bucorvus leadbeateri*, on the left: (**a**), cranial view; (**b**), medial view; (**c**), lateral view; (**d**), caudal view; (**e**), distal view (Photographs: Boris Andreev).

Table 1
Morphological comparison of the fossils of *Euroceros bulgaricus* sp. nov. and the recent hornbills

N	Recent species	*Euroceros bulgaricus* gen. nov., sp. nov.	
		Scapula dextra proximalis NMNHS 12533	Femur sinistra distalis NMNHS 12532
1	Red-billed hornbill *Tockus erythrorhynchus*	Much larger. Has sharper middle part of the ventral edge of the facies articularis humeralis and has a longitudinal protruding ridge on the facies medialis on the first half of corpus scapulae.	Much larger. Less caudally situated impressio ligamenti collateralis on the lateral side of the condylus lateralis.
2	African Grey hornbill *Tockus nasutus*	Much larger. The cranial part of the scapula is sharp, instead of almost right, angle towards facies articularis humeralis in lateral view.	Much larger. Sulcus intercondylaris less shallow.
3	Piping hornbill *Bycanistes fistulator*	Much larger. Has triangle-like, rather than pear-like shape of facies articularis humeralis.	Much larger. Lacks deep impressio ligamenti collateralis lateralis.
4	Trumpeter hornbill *Bycanistes bucinator*	Much larger. Has triangle-like, rather than pear-like shape of facies articularis humeralis.	–
5	Indian Pied hornbill *Anthracoceros coronatus*	Much larger. Lacks a thickness on the lateral side of corpus scapulae in the second quarter of its length.	Much larger. Has a relatively wider trochlea fibularis.
6	Wrinkled hornbill *Aceros corrugatus*	Larger. The cranial part of its scapula is of almost sharp, instead of right, angle towards facies articularis humeralis in lateral view.	Much larger. Its condylus lateralis is rounder in lateral view.
7	Plain-pouched hornbill *Rhyticeros subruficollis*	Larger. Has a relatively narrower cranial part and smaller acromion and lacks a thickness of corpus scapulae in the second quarter of its length.	Larger. Has relatively narrower surface of condylus medialis in caudal view.
8	Helmeted hornbill *Rhinoplax vigil*	Relatively narrower cranial part of scapula and the shorter facies articularis clavicularis	The NMNHS 12532 specimen is larger than the Helmeted Hornbill and has asymmetrical trochlea fibularis in caudal view.
9	Great hornbill *Buceros bicornis*	Has a shorter and thinner acromion (measurement "c"), straight shaft of the corpus scapulae, lacks a thickness of corpus scapulae in the second quarter of its length (Fig. 4A), and has thinner medial part of corpus scapulae, blunter acromion and more angular shape of facies articularis humeralis.	Much larger. Has rounder profile of condylus medialis in ventral view and considerable asymmetry of trochlea tibularis.
10	Rhinoceros hornbill *Buceros rhinoceros*	Considerably shorter and thicker acromion.	Larger. Has shallower impressio musculi collateralis lateralis.
11	Rufous hornbill *Buceros hydrocorax*	Much larger. Ils facies articularis humeralis is triangular, rather than oval.	Much larger.
12	Bushy-crested hornbill *Anorrhinus galeritus*	Much larger. Lacks clearly developed dorsal edge in the second quarter of the bone length.	Much larger. Ils sulcus intercondylaris is deeper.
13	Black-casqued hornbill *Ceratogymna atrata*	Much larger. Lacks clearly developed dorsal edge in the second quarter of the bone length, and the facies articularis humeralis laks a deep cranio-medial cutting.	Much larger. Its trochlea fibularis is not shallower.
14	Black hornbill *Anthracoceros malayanus*		Much larger. Has rounder condylus lateralis.
15	Oriental Pied hornbill *Anthracoceros albirostris*	Much larger and has relatively shorter facies articularis clavicularis.	Much larger. Its trochlea fibularis is not shallower.
16	Wreathed hornbill *Rhyticeros undulatus*	Has cranial part of sharp, instead of almost right, angle towards facies articularis humeralis in lateral view. Its corpus scapulae is right, instead of slightly medially bent in the second quarter of the bone length.	Much larger. Less asymmetrical impressio lig. cruciati cranialis in caudal view.
17	Mindanao Tarictic hornbill *Penelopides affinis*	Much larger.	Much larger. Has less deep impressio ligamenti collateralis lateralis.

Table 1 (*Continued*)

N	Recent species	*Euroceros bulgaricus* gen. nov., sp. nov.	
		Scapula dextra proximalis NMNHS 12533	Femur sinistra distalis NMNHS 12532
18	Northern ground-hornbill *Bucorvus abyssinicus*	Metrical identity. Complete similarity of the shape, position and orientation of facies articularis humeralis (Fig. 5B), identical position of linea intermuscularis on the dorsal side of corpus scapulae. Differences: narrower facies articularis clavicularis (measurement "c"), shorter and thinner acromion, thinner shaft (narrower corpus scapulae; measurement "d") (Fig. 5C). These differences are considerable and indicate distinguishing at generic level.	Of approximately the same size. Resembles by its rounder condylus medialis in ventral view; narrower crista tibiotibularis (1) (Fig. 5D) narrower impressio ligamenti cruciati cranialis (2) and the deeper medial (intercondylar) part of trochlea tibularis (3). The narrower trochlea fibularis is a distinguishing feature for *Bucorvus*. Il is similar in the fossil specimen, but the remaining features do not allow referring the fossil specimen to any of the known species of that genus.
19	Southern ground-hornbill *Bucorvus leadbeateri*	Metrical identity. Complete similarity of the shape, position and orientation of facies articularis humeralis (Fig. 5B), identical position of linea intermuscularis on the dorsal side of corpus scapulae. Differences: narrower facies articularis clavicularis (measurement "c"), shorter and thinner acromion, thinner shaft (narrower corpus scapulae; measurement "d") (Fig. 5C). These differences are considerable and indicate distinguishing at generic level.	Of approximately the same size. Resembles by its rounder condylus medialis in ventral view; narrower crista tibiotibularis (1) (Fig. 5D) narrower impressio ligamenti cruciati cranialis (2) and the deeper medial (intercondylar) part of trochlea fibularis (3). Has more caudally positioned impressio ligamenti collateralis lateralis on condylus medialis, rounder condylus medialis in ventral view, sharper condylus lateralis in ventral view and narrower sulcus intercondylaris. The narrower trochlea fibularis is a distinguishing feature for *Bucorvus*. It is similar in the fossil specimen, but the remaining features do not allow referring the fossil specimen to any of the known species of that genus.

from the Late Paleolithic deposits of Dieu Cave of Tonkin (N Vietnam) dated as 24,000 ± 1000 and 9400 ± 100 years B.P., contain remains of five taxa of Bucerotidae at least: *Anthracoceros albirostris*, *Rhinoplax vigil*, *Anorrhinus* sp. (?*A. tickelli*), *Buceros* sp. (*Buceros* cf. *bicornis*), and cf. *Rhyticeros undulatus*. *Anorrhinus* sp. (?*A. tickelli*) is also established in the Maxa I Cave near to Dieu Cave (same dating; Boev, unpublished data).

Thus, the fossil record of Bucerotidae comprises remains from five localities of four countries of the Old World: Morocco and Bulgaria (from the Tertiary) and Malaysia and Vietnam (from the Quaternary), spanning the last 17–15 million years.

We describe here a new genus of hornbill from Hadzhidimovo, a locality in Bulgaria with a notably rich Hipparion fauna (i.e. large terrestrial mammalian fauna of the Late Miocene and the Pliocene, dominated in the forest-steppes (savannas) by a complex of herbivorous ungulates as bovids, girafids, cervids, rhinoceroses, also proboscideans, etc.).

2. Material and methods

The examined material consists of two bone fragments, one of partly within matrix, collected together in a piece of sandstone of whitish color by D. Kovachev. It is very likely that both fragments belong to an adult specimen. The locality lies in the vicinities of the town of Hadzhidimovo, ca. 2 km SE of the right bank of the River Mesta (SW Bulgaria). The finds came from the outcrop of the fossiliferous layer of one of the hills in the Girizite locality, known since the 1970s as the richest locality of the Hipparion fauna in Bulgaria.

Proximal part of right scapula NMNHS 12533 (Fig. 2). The preserved fragment is broken, but approximately the proximal two-fifths of the presumed length of the whole bone are almost completely preserved. This element is partly embedded in matrix (white sandstone).

Distal part of left femur NMNHS 12532 (Fig. 3). The distal epiphysis and the distal quarter of the diaphysis are preserved.

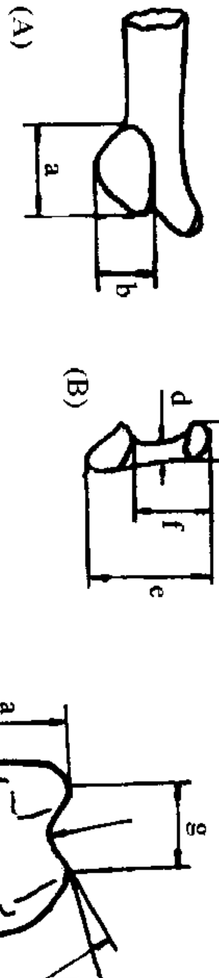


Fig. 4. Bone measurements: scapula: (**A**). Lateral view: a, length of facies articularis humeralis; b, width of facies articularis humeralis. (**B**). Cranial view: c, width of facies articularis clavicularis; d, minimum cranial thickness of corpus scapulae; e, maximum total cranial height of scapula; f, maximum cranial height between the dorsal edge of facies articularis humeralis and acromion scapulae (cranial height of scapula, excluding of facies articularis humeralis). (**C**). Dorsal view: g, dorsal thickness of the shaft at the middle of facies articularis humeralis (without reaching it). femur: (**D**). Distal view: a, width of condylus lateralis; b, width of crista tibiofibularis; c, width of condylus medialis; d, total width of distal epiphysis; e, width of trochlea fibularis; f, thickness of sulcus intercondylaris; g, intercondylar cranial width (between the most prominent points of condylus medialis and condylus lateralis).

The bone is broken and slightly flattened latero-medially due to the high degree of pneumatization of the femoral bones in Bucerotidae, and especially Bucorvinae. The cranial and caudal surfaces of the diaphysis are compressed and broken. The slight compression has caused a slight displacement of condylus lateralis latero-medially. The caudal surface of the diaphysis above the distal epiphysis is flattened and the cross section in this part has been altered from round to almost triangular. Besides damages of the bone, the inception of the lateral edge of the diagnostic for the Bucerotidae's femur fossa poplitea, is seen clearly (Fig. 3d).

The finds have been identified through reference to comparative bird collections of The Natural History Museum, former British Museum (Natural History), in Tring (BMNH), the Institute of Systematics and Evolution of Animals (Polish Academy of Sciences) in Krakow (ISEAC), and the National Museum of Natural History (Bulgarian Academy of Sciences) in Sofia (NMNHS) (Appendix A). The described material resides at the Fossil and Recent Birds Department of the NMNHS.

The taxonomy follows Kemp (2001). The osteological terminology is after Baumel and Witmer (1993) and Komarek (1979). All measurements are given in millimeters. All generic names of the binominals are given abbreviated in the text and in full in the tables. "Smaller", "much smaller", "larger" or "much larger" mean that the fossil specimen differs considerably in size from the specimens of the compared species, and thus their taxonomic identity is excluded.

3. Systematic palaeontology

The general morphology of the scapula and femur indicates that the finds belong to the Bucerotidae. The general comparison with gen. *Bucorvus* (*B. leadbeateri*) (Figs. 2 and 3) shows that: lineae intermusculares completely corresponds each other, the shape of the facies articularis humeralis and the shape of the proximal third of the corpus scapulae in dorsal view are also very similar (Fig. 2). On the other hand, the interposition of condylus medialis and condylus lateralis, the position and the shape of the impressio ligamenti collateralis lateralis, the shape of the impressio ligamenti cruciati cranialis and the crista tibiofibularis (Fig. 3), indicate firm affiliation to that family.

Table 2
Measurements of scapula prox. of fossil and recent Bucerotidae (Ref. to Fig. 4)

Species	a	b	c	d	e	f	g
Fossil–Hadzhidimovo							
Euroceros bulgaricus gen. nov., sp. nov. NMNHS 12533	15.7	11.4	6.7	5.1	22.5	12.0	4.5
Recent							
Bucorvus leadbeateri NMNHS 228–1/1986	13.0	10.6	15.1	8.0	22.6	13.6	6.3
Bucorvus abyssinicus ISEAC A 3531/78	15.7	11.5	14.4	9.8	26.0	17.0	5.9
Bucorvus abyssinicus ISEAC A 1805/67	14.8	12.8	13.1	7.5	27.5	17.0	6.9
Bucorvus abyssinicus ISEAC A 1806/67	14.3	12.2	13.0	8.9	24.2	17.2	5.9
Bucorvus abyssinicus ISEAC A 3805/81	14.4	11.2	ca. 13.0	8.5	ca. 24.6	ca. 14.9	5.7
Bucorvus abyssinicus BMNH 1869.10.24.52	13.9	13.3	-	-	26.6	-	6.6
Bucorvus abyssinicus BMNH 1869.2.2.18	16.0	13.6	11.8	ca. 8.7	26.2	15.0	5.2
Bucorvus abyssinicus BMNH S/1952.2.553	15.2	11.8	11.6	ca. 6.1	ca. 19.1	ca. 15	6.0
Bucorvus abyssinicus BMNH S/1956.4.1	13.0	11.4	12.1	6.8	23.0	15.8	5.9
Bucorvus abyssinicus BMNH S/1956.4.2	13.3	10.8	13.1	7.9	25.1	16.4	4.8
Tockus erythrorhynchus ISEAC A 3187/76	4.2	3.6	2.4	1.9	7.2	4.6	1.3
Tockus erythrorhynchus BMNH S/1997.33.1	4.4	3.3	3.3	1.8	6.9	5.3	1.5
Tockus nasutus BMNH S/1989.2.1	6.2	4.0	3.8	1.8	9.8	6.3	1.6
Anorrhinus galeritus BMNH S/1969.1.50	10.6	6.7	6.5	4.0	16.0	12.8	2.7
Anthracoceros albirostris BMNH 1866.7.3.17	9.1	6.6	5.6	3.9	15.9	10.8	2.0
Anthracoceros coronatus BMNH 1868.12.22.3	9.4	8.1	5.8	4.0	16.7	11.2	2.3
Penelopides affinis BMNH 1878.5.20.91	6.0	5.6	3.5	-	11.3	7.7	2.0
Rhyticeros undulatus BMNH S/1961.9.1	11.0	7.4	7.0	3.7	17.1	11.3	3.3
Rhyticeros undulatus BMNH S/1972.1.96	11.9	11.0	7.0	-	21.4	12.9	4.5
Aceros corrugatus BMNH 1869.10.19.11	10.0	ca. 8.8	7.6	4.6	18.6	13.8	3.3
Rhyticeros subruficollis BMNH 1893.4.28.1	11.2	10.5	9.0	6.2	21.0	13.2	4.5
Rhyticeros plicatus BMNH 1859.9.6.204	15.0	10.8	9.4	-	23.6	13.6	6.7
Bycanistes fustilator BMNH 1865.5.9.13	6.6	5.5	4.9	3.3	11.9	8.2	2.4
Bycanistes bucinator BMNH S/1973.66.135	8.1	5.6	5.0	3.0	14.2	10.3	2.8
Ceratogymna atrata BMNH S/1955.5.38	ca. 10.6	8.2	6.5	-	6.4	ca. 10.8	4.3
Ceratogymna atrata BMNH S/1980.2.2	9.6	7.7	5.2	4.3	5.4	10.8	4.1
Buceros rhinoceros BMNH 1893.4.28.2	13.5	8.8	7.6	6.0	22.8	13.7	5.5
Buceros rhinoceros BMNH 1869.10.19.10	11.6	13.2	7.1	5.3	19.3	5.2	4.8
Buceros bicornis BMNH S/1956.20.1	13.6	ca. 9.8	7.4	7.8	21.6	ca. 12.2	5.0
Buceros bicornis BMNH 1896.2.16.22	ca. 16.3	10.2	9.1	7.4	22.5	ca. 13.5	5.2
Buceros bicornis BMNH S/1988.46.1	12.9	9.6	7.8	5.4	2.5	12.9	4.8
Buceros bicornis ISEAC A 2343/70	16.4	11.1	6.5	6.6	12.1	11.8	4.5
Buceros hydrocorax BMNH 1878.5.20.94	8.9	7.2	5.8	-	9.3	15.2	3.6
Rhinoplax vigil BMNH S/1952.2.550	13.5	10.3	9.8	6.6	21.8	14.3	4.3

Table 3
Measurements of femur dist. of fossil and recent Bucerotidae (Ref. to Fig. 4)

Species	a	b	c	d	e	f	g
Fossil–Hadzhidimovo							
Euroceros bulgaricus gen. nov., sp. nov. NMNHS 12532	ca. 18.4	ca. 17.5	ca. 19.6	ca. 23.5	8.2	ca. 13.4	10.6
Recent							
Bucorvus leadbeateri NMNHS 228 - 1/1986	19.0	20.0	22.6	24.7	8.6	12.9	11.5
Bucorvus abyssinicus ISEAC A 3531/78	19.5	18.9	21.8	24.7	9.0	14.4	10.8
Bucorvus abyssinicus ISEAC A 1805/67	20.8	21.2	23.5	27.3	9.0	14.6	12.2
Bucorvus abyssinicus ISEAC A 1806/67	19.8	21.1	23.4	25.2	8.7	13.9	11.8
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Bucorvus abyssinicus BMNH S/1952.2.553	19.8	21.5	23.0	25.9	9.5	12.2	10.1
Bucorvus abyssinicus BMNH S/1956.4.1	19.1	20.7	22.0	26.0	8.4	12.0	9.5
Bucorvus abyssinicus BMNH S/1956.4.2	20.4	21.0	22.4	28.6	8.8	11.9	11.0
Anorrhinus galeritus BMNH S/1969.1.50	9.4	10.7	11.4	13.8	5.0	7.8	5.1
Anthracoceros albirostris BMNH 1867.10.5.10	8.2	9.0	9.3	11.3	4.3	5.5	4.1
Anthracoceros albirostris BMNH 1866.7.3.17	9.9	9.8	10.6	13.7	5.2	7.0	5.2
Anthracoceros albirostris BMNH 1891.7.20.20	9.1	9.9	10.3	12.7	4.8	6.9	4.9
Anthracoceros coronatus BMNH 1868.12.22.3	10.2	11.5	12.5	14.9	4.6	7.6	6.0
Anthracoceros malayanus BMNH 1848.10.31.4	10.1	10.2	10.9	14.5	5.2	7.4	4.9
Tockus nasutus - BMNH S/1989.2.1	5.8	6.2	6.5	7.0	3.2	4.2	3.4
Tockus erythrorhynchus ISEAC A 3187/76	4.5	5.3	5.5	6.8	3.5	2.6	3.1
Tockus erythrorhynchus BMNH S/1997.33.1	4.8	5.3	5.4	6.3	2.3	3.2	2.7
Penelopides affinis BMNH 1878.5.20.91	7.2	8.2	8.6	10.4	3.8	5.5	4.1
Aceros corrugatus BMNH 1869.10.19.11	12.9	13.2	14.0	17.2	6.4	9.4	5.8
Rhyticeros undulatus BMNH S/1961.9.1	12.0	13.5	13.3	16.1	6.2	8.8	6.5
Rhyticeros subruficollis BMNH 1893.4.28.1	14.6	15.4	15.6	19.6	7.4	10.3	8.6
Rhyticeros plicatus BMNH 1859.9.6.204	16.0	18.0	19.2	22.4	8.2	10.3	7.9
Bycanistes fustilator BMNH 1865.5.9.13	6.9	7.6	8.0	9.6	3.6	5.4	3.6
Bycanistes bucinator BMNH S/1973.66.135	8.3	9.2	9.6	12.2	4.8	5.5	5.0
Ceratogymna atrata BMNH S/1980.2.2	9.8	11.0	12.1	14.8	5.6	8.5	5.2
Buceros rhinoceros BMNH 1893.4.28.2	13.9	14.5	ca. 17.0	19.4	7.7	-	6.9
Buceros bicornis BMNH S/1956.20.1	15.8	17.3	18.0	20.9	8.0	11.4	8.4
Buceros bicornis BMNH 1896.2.16.22	16.9	18.9	19.8	23.9	9.0	11.9	8.1
Buceros bicornis BMNH S/1988.46.1	13.5	15.4	16.5	18.6	7.0	9.0	6.9
Buceros bicornis ISEAC A 2343/70	16.4	17.6	18.9	22.6	9.2	10.7	8.7
Buceros hydrocorax BMNH 1878.6.20.93	10.8	11.6	11.8	15.5	5.5	7.4	5.4
Rhinoplax vigil BMNH S/1952.2.550	14.5	15.8	16.1	20.4	6.8	10.2	8.2

The very large size of both fragments of bones suggests a species of Bucorvinae or the largest species of Bucerotinae, that is, *Buceros* spp., *Rhyticeros* spp., *Aceros* spp., and *Rhinoplax* spp. Other Bucerotinae could be excluded because of the more oval than triangular shape of the facies articularis humeralis and the thinner medial part of the corpus scapulae.

Order: CORACIIFORMES Forbes, 1844
Family: BUCEROTIDAE (Vigors, 1825)
Subfamily: BUCORVINAE Verheyen, 1955
Euroceros gen. nov. Boev
Type species: *Euroceros bulgaricus* sp. nov.
Included species: Only the type species.
Etymology: After the name of the European continent ("Europa"), where the finds originate from, and the Greek for horn ("ceros").

Diagnosis: Bucerotidae of similar size to the recent ground-hornbills (*Bucorvus*), differing by the narrower (by approximately half) facies articularis clavicularis (measurement "c" in Fig. 4B) and thinner (by approximately one-third) corpus scapulae in its cranial part between facies articularis

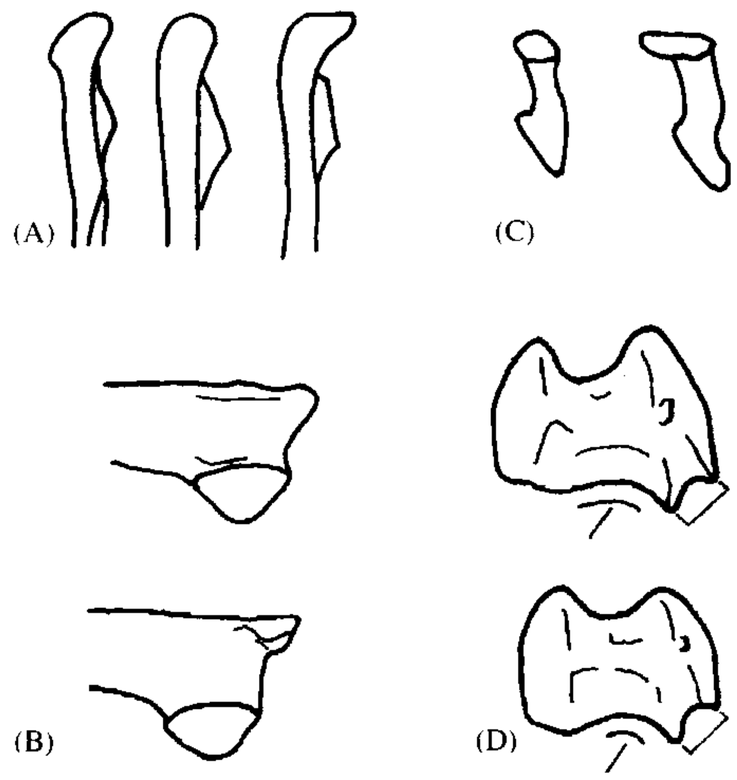


Fig. 5. Comparison of scapula dex, prox. and femur sin. dist. in Bucerotidae: (**A**). Scapula (dorsal view), left to right: *Buceros bicornis*, *Euroceros bulgaricus* gen. nov., sp. nov., *Bucorvus abyssinicus*; (**B**). Scapula (lateral view), *Euroceros bulgaricus* gen. nov., sp. nov. (above), *Bucorvus abyssinicus* (bellow); (**C**). Scapula (cranial view), left to right: *Euroceros bulgaricus* gen. nov., sp. nov., *Bucorvus abyssinicus*; (**D**). Femur: *Bucorvus abyssinicus* (above), *Euroceros bulgaricus* gen. nov., sp. nov. (below).

clavicularis and facies articularis humeralis (measurement "d" in Fig. 4B).

Preservation of the holotype: Scapula dextra proximalis NMNHS 12533 (Fig. 2). The preserved fragment is broken, but approximately the proximal two-fifths of the presumed length of the whole bone are almost completely preserved. The bone is partly included in matrix (white sandstone). The morphological comparison of the osteological features is given in Table 1.

Locality: Vicinity of the town of Hadzhidimovo near the town of Gotse Delchev (Blagoevgrad District; southwestern of Bulgaria), Girizite locality (also known as Hadzhidimovo-1, or Hadzhidimovo-Girizite), 41.30°N, 23.52°E; UTM grid: GM 30. 500 m a.s.l.

Horizon and chronostratigraphy: Grey-yellowish-colored sands and clay sands of oblique and complex inner stratification at a depth of 1.00–1.50 m. Late Miocene (Turolian–Meotian, lower part of the zone MN 11–12; dated ca. 7 million years ago).

Euroceros bulgaricus sp. nov. Boev

Holotype: NMNHS 12533, scapula dextra proximalis (Fig. 2a–c), collections of the Fossil and Recent Birds Department of the National Museum of Natural History–Sofia, Bulgarian Academy of Sciences. Collected by Mr. Dimitar Kovachev during the 1980s.

Paratypes: NMNHS 12532, femur sinistra distalis. Collected together with the holotype by Mr. Dimitar Kovachev during the 1980s.

Comparison: See Table 1.

Etymology: The name "*bulgaricus*" is given after the name of Bulgaria, the country where the finds were collected.

Measurements of the holotype: Table 2 and Fig. 4A–C.

Measurements of the paratype: Table 3 and Fig. 4D. Total length of the fragment: 31.3.

Diagnosis: As for the genus.

Locality, horizon, and chronology: As for the genus.

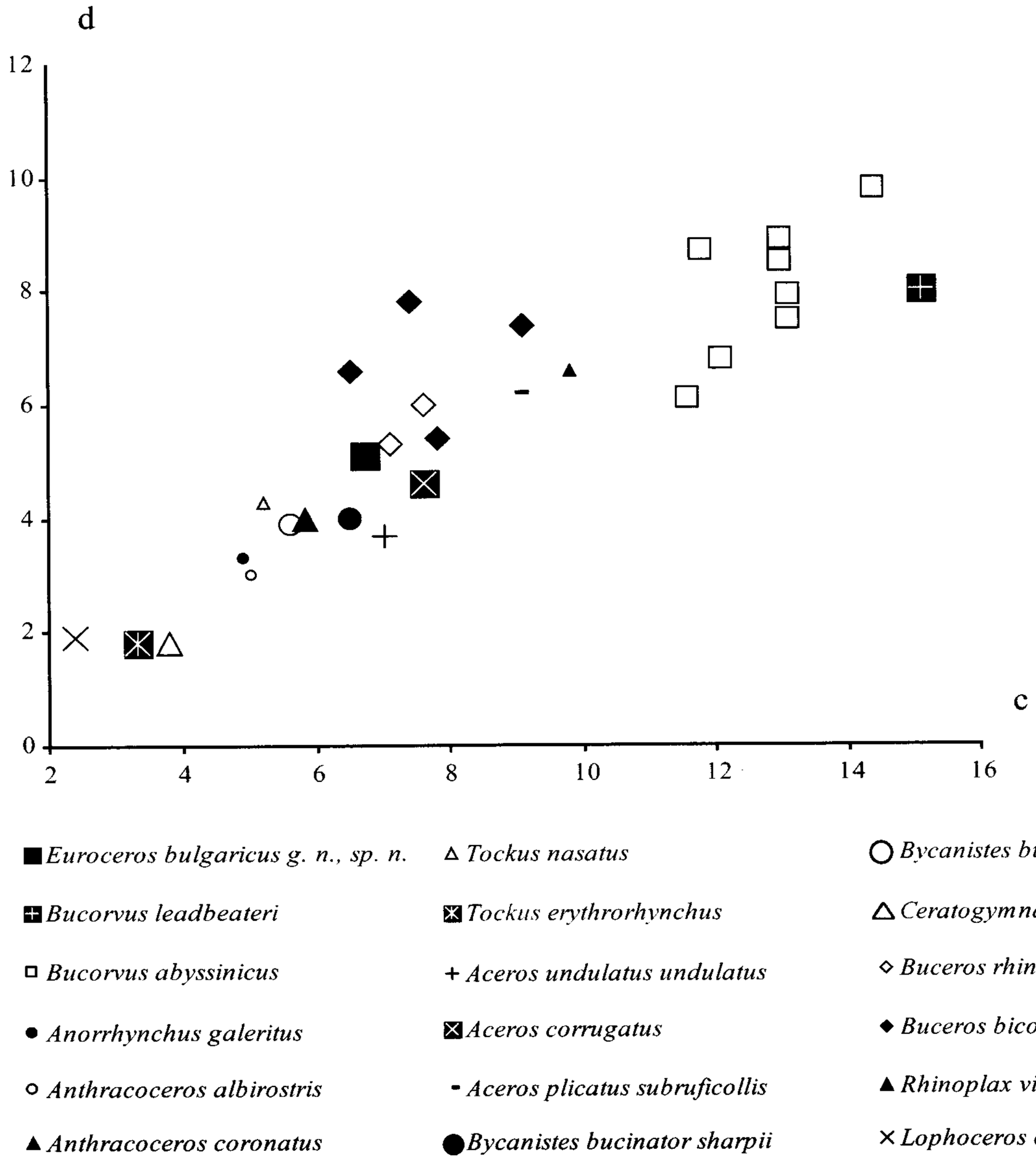
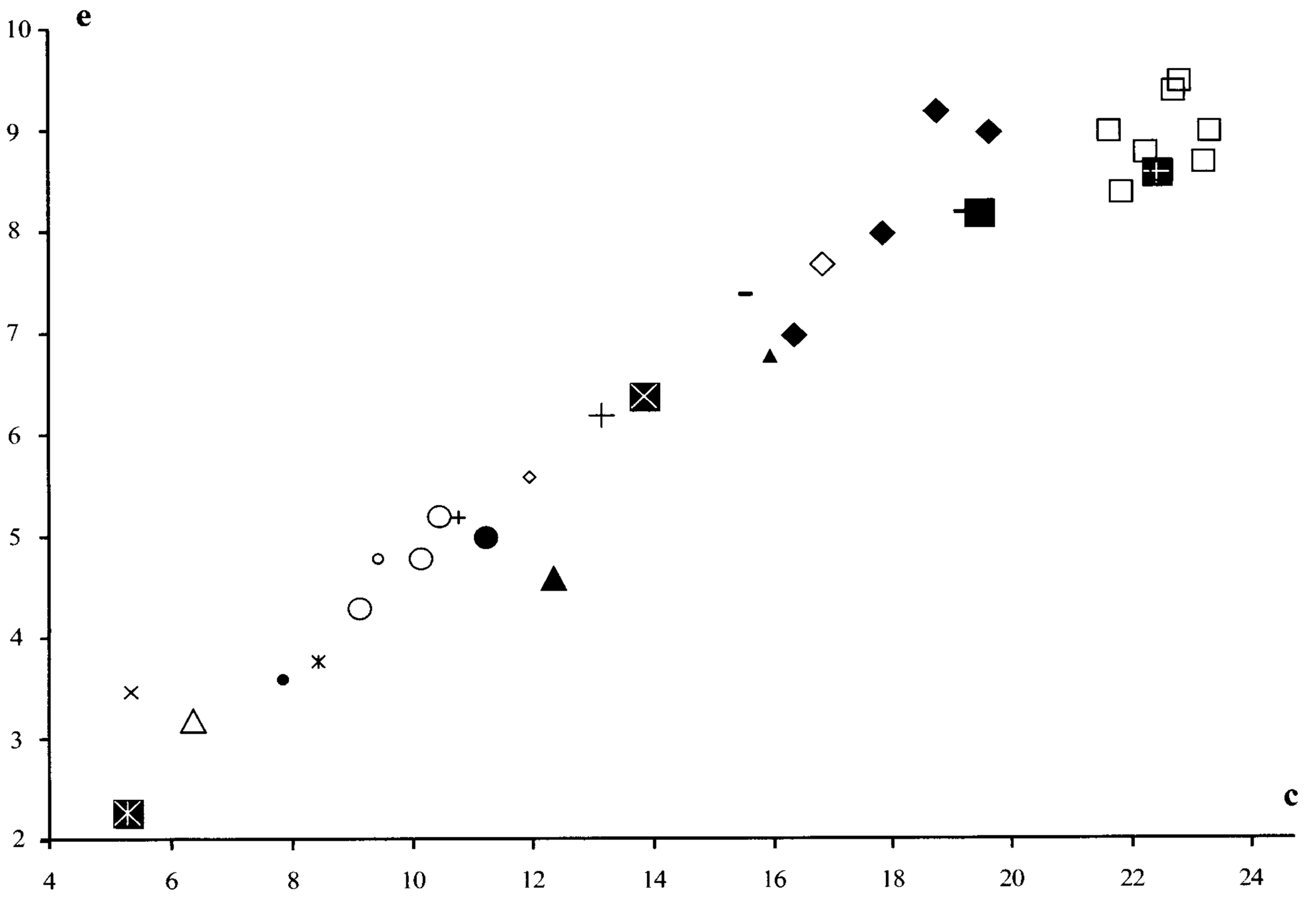


Fig. 6. Width of facies articularis clavicularis (c; *x*-axis) versus minimum cranial thickness of the corpus scapulae (d; *y*-axis) of the proximal scapula in Bucerotidae.

4. Discussion

The associated avifauna, known from the site of Hadzhidimovo up to the present, includes five taxa: Spassov's buzzard (*Buteo spassovi*), Eagles (*Aquila* sp. (ex gr. *pomarina*)), Falcons (*Falco* sp. ex gr. *tinnunculus*), unidentified avian remains (Aves ordo indet.) (Boev, 2002; Boev and Kovachev, 1998), *Struthio* cf. kazatheodoris (Boev et al., in preparation). The large mammals fauna indicates a forested savanna: Hyaenotheriums (*Hyaenotherium* gr. *wongii*, Hyaenictitheriini indet., cf. *Miohyaenotherium bessarabicum*), hyenas (*Adcrocuta eximia*), sabre-toothed felids (*Paramachairodus* cf. *orientalis, Machairodus giganteus*, *Metailurus* cf. *major*), proboscideans (*Mammut* gr. *borsoni*, Gomphotheriidae indet.), ancylopods (*Ancylotherium pentelicum*), Chalicotheriinae indet., rhinocerids (?*Ceratotherium neumayri*, *Dicerorhinus pikermiensis*), tapirs (*Tapirus* aff. *jeanpiveteaui*), equids (*Hipparion* gr. *mediterraneum*, *Hipparion* gr. *brachypus*, *Hipparion* gr. *platygenys*), girafids (*Helladotherium duvernoyi*), antelopes (*Palaeoryx* sp., *Gazella* (*Procapra*) sp., *Palaeorheas lindermayeri*), porcupines (*Hystrix primigenia*), primates (*Mesopithecus* gr. *delsoni*), etc. (Spassov, 2002).

This faunal complex suggests that *Euroceros bulgaricus* in its appearance, behavior and ecological adaptations may have resembled the recent ground-hornbills. This is only tentatively, because of the presence of the savanna-like open grass habitats,



■ *Euroceros bulgaricus g. n., sp. n.*
⊞ *Bucorvus leadbeateri*
□ *Bucorvus abyssinicus*
● *Anorrhynchus galeritus*
○ *Anthracoceros albirostris*
▲ *Anthracoceros coronatus*
+ *Anthracoceros malayanus*
△ *Tockus nasatus*
⊠ *Tockus erythrorhynchus*
✳ *Penelopides panini affinis*
+ *Aceros undulatus undulatus*
⊠ *Aceros corrugatus*
- *Aceros plicatus subruficollis*
● *Bycanistes bucinator sharpii*
◯ *Bycanistes bucinator*
◇ *Ceratogymna atrata*
◇ *Buceros rhinoceros*
◆ *Buceros bicornis*
▲ *Rhinoplax vigil*
◆ *Buceros hydrocorax semigaleatus*
× *Lophoceros erythrorhynchus*

Fig. 7. Width of condylus medialis (c; *x*-axis) and the width of trochlea fibularis (e; *y*-. axis) of distal femur in Bucerotidae.

where possibly the ostrich is the most diagnostic species among birds.

Both the morphological and proportional comparisons (Figs. 5–7) show a very good separation of the Bulgarian ground-hornbill from its closest relatives (*Bucorvus abyssinicus* and *B. leadbeateri*). Unfortunately, it cannot be compared with *B. brailloni*, due to the absence of analogous skeletal remains. The remaining taxa of larger or similar size (*Buceros* spp., *Aceros* spp., etc.), approaching to *Euroceros bulgaricus* gen. nov., sp. nov., are distributed in South and South-East Asia, and are quite distinct in their bone morphology (Table 1).

The fossils of Hadzhidimovo are the oldest known record of Bucerotidae so far (Brodkorb, 1971; Olson, 1985, 1993; Mlíkovský, 1996, 2002). Brunet (1971) dates the find of *Bucorvus brailloni* (a distal tarsometatarsus) from Morocco as from the middle Miocene. However, this find is mentioned by Kemp (2001) erroneously as "femur from the leg" (p. 437) and dated "middle Miocene ... about 15 million years ago." (opus citatum.).

The Beni-Mellal locality of *Bucorvus brailloni* lies at least 1500 km from the present range of the Bucerotidae in Africa (Brunet, 1971). The Hadzhidimovo locality of *Euroceros bulgaricus* gen. nov., sp. nov. is located ca. 3300 km from the nearest parts of the recent range of the hornbills in South-West Arabia and ca. 5100 km from the nearest parts in Pakistan. The new locality from Bulgaria suggests a formerly much wider Afro-Euroasiatic range of Bucerotidae in the Tertiary, or at least in the Miocene.

The Bulgarian record of Tertiary hornbills has considerable paleo-zoogeographical significance, proving the former distribution of Bucerotidae on the European continent. Furthermore, the finds suggest a more diversified fauna of the ground-hornbills in the past, possibly consisting of species that occupied specific ground niches of the large faunal complex termed the Hipparion fauna, which is still mainly used only for the mammalian coenoses.

The more diversified fauna of the ground-hornbills in the Miocene is suggested by the presence of two fossil taxa of two genera (*Bucorvus brailloni* and *Euroceros bulgaricus* gen. nov., sp. nov.) at least.

Osteological comparison of the morphology of the femur bone of the fossil specimen shows a high similarity to recent ground-hornbills (Fig. 3), proving their ancient existence in the Tertiary. More interesting is the morphology of the scapula, differing considerably in some structures (clavicular joint) and surprisingly similar in other structures (humeral articular joint). Perhaps this indicates a more primitive form having relatively poorer flying capacity than that which later evolved (modern ground-hornbills). The scapula morphology and the relative contemporaneity show different evolutionary lineages of *Euroceros bulgaricus* gen. nov., sp. nov. and of *Bucorvus brailloni*. Perhaps *Euroceros* gen. nov. was more terrestrial and less advanced for flight in comparison to *Bucorvus*. Anyway, the finds from Hadzhidimovo confirm the statement that Bucorvinae separated from Bucerotinae in the Miocene. This separation is dated ca. 7 million years ago (Kemp, 2001). On the other hand, possibly, the ground-hornbill could be considered the ancestral group for the remaining Asian hornbills, as stated by Kemp (2001).

Peafowls (*Pavo bravardi* Boev, 2001), ostriches (*Struthio* cf. kazatheodoris) and hornbills (*Euroceros bulgaricus* gen. nov., sp. nov.) are the only three avian groups of recent Afro-tropical/Afro-tropical–Indo-Malayan distribution established in the Neogene fossil record of Bulgaria so far. The finds of the last ones confirms the former range continuity throughout Europe, possibly, at least until the Late Miocene.

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Appendix A

A.1. Examined specimens belonging to recent species in the Bucerotidae

Northern ground-hornbill *Bucorvus abyssinicus* ISEAC A 3531/78, ISEAC A 1805/67, ISEAC A 1806/67, ISEAC A 3805/81, BMNH 1869.10.24.52, BMNH 1869.2.2.18, BMNH S/1952.2.553, BMNH S/1956.4.1, BMNH S/1956.4.2. Southern ground-hornbill *Bucorvus leadbeateri*: NMNHS 228–1/1986. Bushy-crested hornbill *Anorrhinus galeritus* BMNH S/1969.1.50. African Grey hornbill *Tockus nasutus*: BMNH S/1989.2.1. Red-billed hornbill *Tockus erythrorhynchus*: ISEAC A 3187/76, BMNH S/1997.33.1. Indian Pied hornbill *Anthracoceros coronatus* BMNH 1868.12.22.3. Oriental Pied hornbill *Anthracoceros albirostris*: BMNH 1866.7.3.17, BMNH 1867.10.5.10, BMNH 1891.7.20.20. Black hornbill *Anthracoceros malayanus*: BMNH 1848.10.31.4. Great hornbill *Buceros bicornis*: ISEAC A 2343/70, BMNH S/1956.20.1, BMNH 1896.2.16.22, BMNH S/1988.46.1. Rhinoceros hornbill *Buceros rhinoceros* BMNH 1869.10.19.10, BMNH 1893.4.28.2. Rufous hornbill *Buceros hydrocorax*: BMNH 1878.6.20.93, BMNH 1878.5.20.94. Helmeted hornbill *Rhinoplax vigil*: BMNH S/1952.2.550. Mindanao Tarictic hornbill *Penelopides affinis* BMNH 1878.5.20.91. Wrinkled hornbill *Aceros corrugatus* BMNH 1869.10.19.11. Papuan hornbill *Rhyticeros plicatus*: BMNH 1859.9.6.204, BMNH 1893.4.28.1. Wreathed hornbill *Rhyticeros undulatus*: BMNH 1961.9.1,

BMNH S/1972.1.96. Piping hornbill *Bycanistes fistulator*: BMNH 1865.5.9.13. Trumpeter hornbill *Bycanistes bucinator*: BMNH S/1973.66.135. Black-casqued hornbill *Ceratogymna atrata*: BMNH S/1980.2.2, BMNH S/1955.5.38.

References

Baumel, J.J., Witmer, L.M., 1993. Osteologia. In: Baumel, J., King, A.,Breazile, J., Evans, H., Vanden Berge, J. (Eds.), Handbook of Avian Anatomy: Nomina Anatomica Avium. Publication by the Nuttall Ornithological Club 23. Cambridge, Massachusetts, pp. 44–132.

Bochenski, Z., 1997. List of European fossil bird species. Acta Zoologica Cracoviensia 40, 293–333.

Boev, Z., 2001. Early Pliocene avifauna of Muselievo (C Northern Bulgaria). Acta Zoologica Cracoviensia 44, 37–52.

Boev, Z., 2002. In: Zhou, Z., Zhang, F. (Eds.), Neogene avifauna of Bulgaria, Proceedings of the 5th Symposium of the Society of Avian Palaeontology and Evolution, Beijing, 01-04.06.2000. Science Press, Beijing, pp. 29–40.

Boev, Z., Kovachev, D., 1998. *Buteo spassovi* sp. nov.: a Late Miocene Buzzard (Accipitridae, Aves) from SW Bulgaria. Geologica Balcanica 29, 125–129.

Brodkorb, P., 1971. Catalogue of fossil birds. Part 4. Bulletin of the Florida State Museum. Biological Sciences, Gainesville 15, 163–266.

Brunet, J., 1971. Oiseaux miocènes de Beni Mellal (Maroc) ; un complément à leur étude. Notes et Mémoires du Service géologique du Maroc 31, 109–111.

Chenevaḷ, J., 2000. L'Avifaune de Sansan. In: Ginsburg, L. (Ed.), La faune miocène de Sansan et son environnement. Mémoire du Muséum national d'Histoire naturelle, Paris, 183. pp. 321–388.

Kemp, A.C., 2001. Family Bucerotidae (Hornbills). In: del Hoyo, J., Elliot, A., Sargatal, J. (Eds.), Handbook of the Birds of the World. Vol. 6. Mousebirds to Hornbills. Lynx Edición, Barcelona, pp. 436–523.

Komarek, V., 1979. Anatomia Avium Domesticarum, Diel 1. Priroda, Bratislava.

Mlíkovský, J., 1996. Tertiary avian faunas of Europe. In: Mlíkovský, J. (Ed.), Tertiary avian localities of Europe, Acta universitatis Carolinae Geologica Univerzita Karlova 39 (1995), (Praha), pp. 777–818.

Mlíkovský, J., 2002. Cenozoic Birds of the World. Part 1: Europe. Ninox Press, Praha.

Olson, S.L., 1985. The fossil record of birds. In: King, J.R., Parker, D.C. (Eds.), Avian Biology, vol. 8. Academic Press, New York, pp. 79–252.

Olson, S.L., 1993. Index to Brodkorb's Catalogue of Fossil Birds. Society of Avian Paleontology and Evolution, Special Publication, 1, Lyon-Villeurbanne, 1–78.

Spassov, N., 2002. The Turolian megafauna of West Bulgaria and the character of the Late Miocene "Pikermian biome". Bollettino della Società Paleontologica Italiana 41, 69–81.