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Aquila kurochkini sp. n., a New Late Pliocene Eagle (Aves, Accipitriformes) from Varshets (NW Bulgaria)[1]

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Abstract—A new species of eagle (Accipitriformes: *Aquila*) is described based on eight skeletal elements from the middle Villafranchian (SCT 11 /sooner SCT 12/ of MNQ 17 zone, ca. 2.23–2.40 mya) of Northwestern Bulgaria.

Keywords: Accipitriformes, True Eagles, Tertiary birds, Raptors, Neogene avifauna, Bulgaria

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INTRODUCTION

The Neogene fossil record of the Accipitridae in Bulgaria includes 14 taxa (Boev, 2011), three of which (*Buteo spassovi* Boev, 1998, *Gyps bochenskii* Boev, 2010, and *Circaetus rhodopensis* Boev, 2012) were described from specimens collected in this country. The present paper presents a new eagle from the richest Bulgarian Neogene locality, the late Pliocene locality near Varshets.

The Varshets locality of fossil fauna and flora was uncovered in 1988 at ca. 6 km NNE of the town of Varshets (Montana District; NW Bulgaria). Some data about the site and the preliminary taxonomic identification have been published by Boev (1995, 1996, 2002, 2007). Data on the associated faunas and information about their dating is provided by Boev (1996, 2000, 2002).

The material described herein includes bones and bone fragments of 8 elements of the fore and hind limbs and the axial skeleton, and is referred to two adult specimens of an unknown species of eagle. They were compared with the skeletons of 31 recent species of Accipitridae (84 specimens) from four scientific collections (see Appendix); Vertebrate Animals Department of the National Museum of Natural History, Bulgarian Academy of Sciences (VAD-NMNHS) in Sofia; University Claude Bernard Lyon 1, Department of Earth Sciences (UCBL) in Lyon; Natural History Museum (NHM) in Tring, England; and the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences (ISEAK) in Krakow. Osteological terminology follows Baumel and Witmer (1993).

The measurements (Fig. 1) have been taken with a caliper gauge of 0.05 mm accuracy, but read only to the 1st digit after decimal point. "Smaller", "much smaller", "larger" or "much larger" in the "Comparison" section mean that the fossil specimens differ considerably in size from specimens of the compared species, and thus are excluded from further consideration. Two measurements of distal tibiotarsus of a specimen of *Aquila fasciata*, collection of Forschungsinstitut Senckenberg, Frankfurt am Main (SMF 5330), have been taken from photographs (Table 1).

SYSTEMATIC PALEONTOLOGY

Order Accipitriformes

Family Accipitridae Vieillot, 1816

Subfamily Aquilinae Swainson, 1837

Genus *Aquila* Brisson, 1760

***Aquila kurochkini* Boev, sp. nov.**

Plate 2, figs. 1, 4, 7, and 9; Plate 3, figs. 1, 3, 4, and 6

Etymology. The name *"kurochkini"* is given in honor of the eminent Russian paleontologist, Professor, D. Sci. Evgeniy Nikolaevich Kurochkin (1940–2011), who contributed much to our knowledge of the early avian evolution and the fossil birds of Eurasia.

Holotype. VAD-NMNHS, no. 138, distal fragment of right tibiotarsus; type locality Varshets [a ponor (steep-sided sink hole) in a rocky hill] in the vicinity (6 km North-Northeast) of the town of Varshets near the town of Vratsa (Montana District; Northwestern Bulgaria), 43.13 N, 23.17 E; Late Pliocene (middle Villafranchian; MNQ 17, ca. 2.23-2.40 mya) (Spassov, 1997); collected by the author between 1990 and 2000.

Paratypes. VAD-NMNHS, no. 137, sternum, pars coracoidalis; no. 242, sternum, tabula sterni dex-

[1] The article is published in the original.

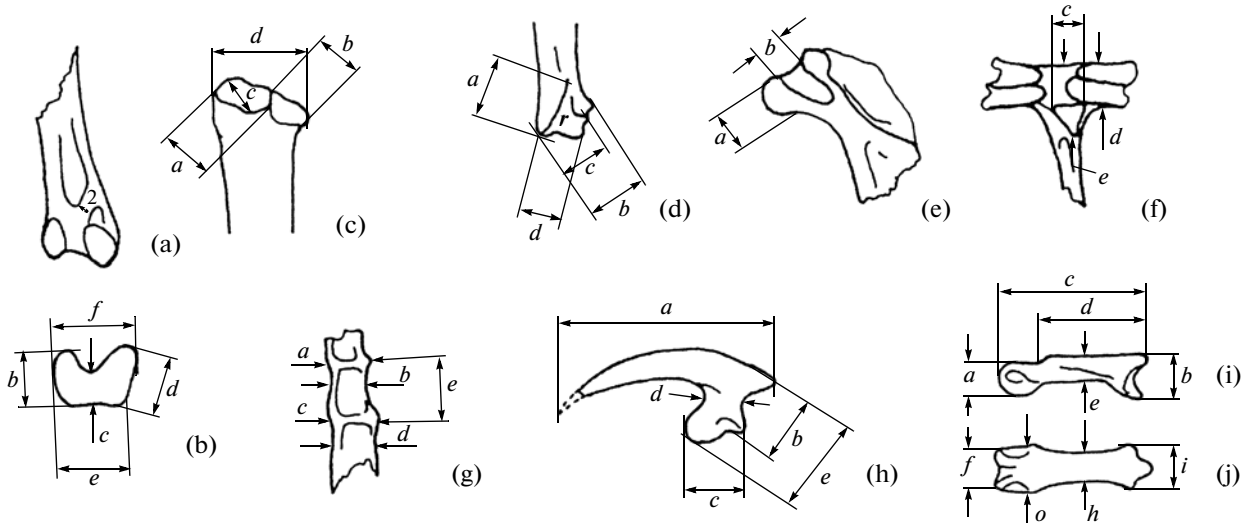

Fig. 1. Measurements of the skeletal elements of fossil and recent accipitrids (ref. to Tables 1–4): a, distal tibiotarsus, cranial view; b, distal tibiotarsus, ventral view; c, proximal ulna, medial view; d, distal ulna, cranio-lateral view; e, sternum, pars coracoidalis, lateral view; f, sternum, pars coracoidalis, cranial view; g, sternum, pars costalis, dorsal view; h, phalanx distalis digitus 2 pedis, lateral view; i, phalanx 4 digitus 4 pedis, lateral view; j, phalanx 4 digitus 4 pedis, dorsal view. Small letters refers to particular measurements (see text and Tables 1–3).

tra; no. 251, coracoid dextra; no. 253, ulna sinistra proximalis; no. 254, ulna sinistra distalis; no. 3002; phalanx distalis digitus 2 pedis sinistra; no. 15089. phalanx 4 digitus 4 pedis dextra. All specimens are from the type locality.

D e s c r i p t i o n. The holotype tibiotarsus represents a bone fragment, which is approximately one fourth of the presumed length of the whole bone and is almost completely preserved, but with the rear surfaces of both condyles lateralis and condyles medialis damaged (Plate 2, fig. 1).

M e a s u r e m e n t s. See Table 1.

C o m p a r i s o n s. Medium sized accipitrid, very similar both in morphology and size, to the recent Bonelli's Eagle *(Aquila fasciata)*, but differing by: (1) a shallower concavity above the condylus medialis; (2) a deeper concavity above the condylus lateralis; (3) a wider distal end of pons supratendineus in comparison to its proximal end, i.e. its shape is more recrangular than trapezium-like; (4) the condylus medialis twisted distally towards condylus lateralis, i.e. condylus medialis protrudes further distally than the condylus lateralis; and (5) a more proximally posi-

Table 1. Measurements (in mm) of distal tibiotarsus in some fossil and recent accipitriforms ("*a*"–"*f*" as indicated in Figs. 1a, 1b)

Species	*a*	*b*	*c*	*d*	*e*	*f*
Fossil – Varshets						
Aquila kurochkini sp. n. VAD-NMNHS 138	4.0	11.4	7.1	13.1	18.1	18.2
Recent						
Aquila fasciata SMF 5330	2.2	–	–	–	–	14.8
A. chrysaetos VAD-NMNHS 16/2010	3.7	12.4	7.0	13.4	18.4	18.6
A. clanga ISEAK A 2454/71	2.7	12.2	7.4	11.0	14.4	14.9
A. pomarina ISEAK A 4953/91	2.6	11.1	6.6	11.0	13.2	14.9
A. pomarina VAD-NMNHS 3/1989	3.1	10.7	6.9	10.6	14.5	15.5
A. pomarina VAD-NMNHS 4/1996	3.0	10.0	6.5	10.7	12.3	14.2
A. rapax ISEAK A 3931/82	2.9	13.3	9.6	13.9	18.5	19.0
C. gallicus ISEAK A 3348/77	2.6	11.0	6.7	10.3	13.2	15.0
C. gallicus UCBL 108/2	2.7	12.2	7.4	11.0	14.4	14.9
C. gallicus VAD-NMNHS 1/1984	3.2	10.9	7.1	10.9	13.7	15.7

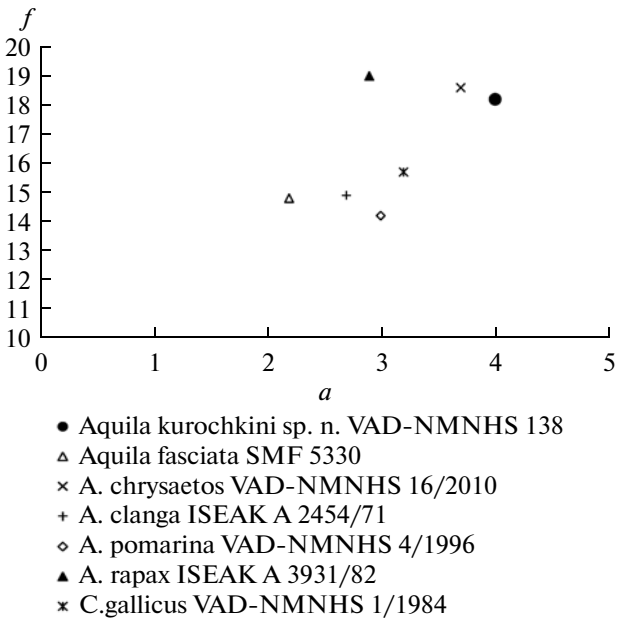

Fig. 2. Correlation between the minimal width of the pons supratendineus (*a*) and the maximal width of the distal epiphysis (*f*) of the tibiotarsus (in mm) in some fossil and recent accipitrids.

tioned tendineal fossa above the condylus medialis on the caudal surface (Plate 2). These characters of the tibiotarsus suggest a possible new genus, but better material is needed for this taxonomic decision.

The tibiotarsus differs clearly from the other large Westen Palearctic accipitrids (Fig. 2) with *Aquila chrysaetos* and *Aquila rapax* being the closest species. The type specimen differs from the compared species as follows: *Aquila audax*—much larger; *A. chrysaetos*—cosiderably by the less developed tuberositas retinaculi musculus fibularis, the smaller size, and the relatively smaller measurement (c); *A. heliaca*:—similar, but differs by the relatively smaller condylus lateralis, the deeper sulcus extensorius, the lower relief of tuberositas retinaculi musculus fibularis, and the narrower epiphysis [measurements (b), (c) and (d)]; *A. clanga*—clear protuberance in the lateralis base of the pons supratendineus, the much larger size, the more concave sulcus cartilaginis tibialis in caudal view, wider pons supratendineus, larger general size, the stronger robustness of the bone, and the sharper distinguishing of condylus medialis from the distal epiphysis in medial view; *A. nipalensis*—less protuberant epicondylus medialis, wider peri-epiphysal part of the diaphysis, and more robust in general; *A. rapax*—bigger protuberant and clearly shaped epicondylus medialis, the sharper separating contour in medial view between the condylus medialis and the diaphysis, the better developed middle constriction (measurement c); *A. pomarina*—narrower condylus lateralis, condylus medialis protrudes further distally than the condylus lateralis, besides the larger dimensions (Table 1), but only differs by the more round condylus medialis in lateral view, instead elongated, bigger and wider and less limited in proximal direction epicondylus lateralis; *A. vereauxii*—wider pons supratendineus; *A. pennata*—larger dimensions, wider pons supratendineus, the axial, instead medial (towards the medial side of diaphysis) orientation of sulcus extensorius, and the lower inception of pons supratendineus in its proximal end; *A. fasciata*—very similar, but differing by the shallower concavity above the condylus medialis, and the wider distal end of pons supratendineus in comparison to its proximal end (In *A. fasciata* the distal end of pons supratendineus is obviously narrower than its proximal end). The Late Pliocene *A. bivia* Emslie and Czaplewski 1999 of Florida was 10–15% larger than *A. chrysaetos*. The Middle Miocene *Aquila bullockensis* Gaff and Boles, 2010 is known only by a distal humeral fragment from Australia. It is related to *A. audax* and is considered to be its ancestor. In size it is among that of the largest eagles of *Aquila* and *Haliaetus* (Gaff and Boles, 2010). I have excluded *Aquila bullockensis* from comparison because of its large size and the considerable geographical and chronostratigraphical distances.

R e m a r k s. The holotype tibiotarus is assigned to the Accipitridae based on its general morphology and its specific morphology of the distal epiphysis, pons supratendineus and sulcus extensorius tendineus. These features are all similarly shaped in medium-sized to large accipitrids. On the other hand, specimen no. 138 differs from other genera as follows: (a) It differs from the Pandionidae *(Pandion haliaetus)* by its

E x p l a n a t i o n o f P l a t e 2

Aquila kurochkini sp. n., Late Pliocene of Varshets, Bulgaria, compared with Recent species of eagles.

Figs. 1, 4, 7, and 9. *Aquila kurochkini* sp. nov.: (1) holotype VAD-NMNHS, no. 138, right distal tibiotarsus in cranial (1a), caudal (1b) and distal (1c) views; (4) paratype VAD-NMNHS, no. 254, left distal ulna in lateral (4a), ventral (4b) and distal (4c) views; (7) paratype VAD-NMNHS, no. 253, proximal left ulna in medial (7a), ventral (7b) and proximal (7c) views; (9) paratype VAD-NMNHS, no. 251, right coracoid in caudal (9a), ventral (9b) and dorsal (9c) views.

Figs. 2, 5, and 11. *Aquila fasciata* (Viellot, 1822), Recent, specimen SMF, no. 5330: (2) right distal tibiotarsus in cranial (2a), caudal (2b) and distal (2c) views; (5) lest distal ulna in lateral (5a), ventral (5b) and distal (5c) views; (11) right coracoid in ventral (11a) and dorsal (11b) views.

Figs. 3, 6, 8, and 10. *Aquila pomarina* Brehm, 1831, Recent, specimen VAD-NMNHS, no. 4/1996: (3) right distal tibiotarsus in cranial (3a), caudal (3b) and distal (3c) views; (6) lest distal ulna in lateral (6a), ventral (6b) and distal (6c) views; (8) proximal left ulna in medial (8a), ventral (8b) and proximal (8c) views; (10) right coracoid in ventral (10a) and dorsal (10b) views.

Scale bar—1 cm.

Plate 2


1a
2a
3a
1b
2b
3b
1c
3c
4a
5a
6a
4b
5b
6b
4c
6c
7a
8a
8b
7b
7c
8c
9a
10a
9b
11a
10b
9c
11b
10c

larger size, the shallower sulcus extensorius under pons supratendineus and the lacking of a distal tibiofibular simphysis. (b) General morphology fits to larger accipitrids. In the distal end at the inception of fibula, the cross-section of tibiotarsal diaphisys in the Circaetini is more or less elliptical rather than round as it is in the Aquilini. (c) It differs from *Circaetus gallicus* by the more protuberant pons supratendineus from the lateral side, the more medial location of sulcus extensorius towards the diaphysal axis, the narrower condylus lateralis in ventral view, the more protuberant pons supratendineus, the deeper sulcus extensorius, the highly protruding epicondylus medialis, and dimensionally. (d) The late Miocene *Circaetus rhodopensis* could not be compared because of the lack of homologous skeletal elements, (e) It differs from *Haliaeetus leucocephalus* by the longitudinal, instead transversal, orientation of the dorsal edge of condylus medialis, and the wider pons supratendineus. (f) It differs from *Spilornis cheela* by its larger size (The same difference is shown in all other compared skeletal elements, so that this species need not be further mentioned here), (g) It differs from *Polemaetus bellicosus* by the lack of a protuberance on the base of proximal end of pons supratendineus. (h) And finally it differs from *Terathopius ecaudatus* by the more protuberant part above the condylus lateralis in cranial view, and the larger size.

I refer to *Aquila kurochkini* sp. nov. two fragments of ulnae, a partial coracoid, sternal fragments and two phalanges because of similar relative size and morphological similarity to extant *Aquila*. The comparisons of all these skeletal elements exclude taxonomic identity with *Aquila chrysaetos, A. hliaca, A. verreauxii, A. bivia, Polemaetus bellicosus, Haliaeetus leucocephalus*, and *Stephanoetus* spp. because of their much larger size. On the other hand, *Spilornis cheela, Aquila pomarina* and *Circaetus gallicus* are smaller or considerably smaller in most measurements so that a taxonomic identity must be excluded.

Other comparisons, except lesser dimmensions, are as follows: The proximal portion of left ulna, specimen VAD-NMNHS, no. 253 (Plate 2, fig. 7). The find represents about 1/6th of the total presumed length of the bone. The olecranon is missing and the edges of condylus dorsalis and condylus ventralis are shell (damaged). Additional measurements (Table 2): (e) width of proximal diaphysis before condyles dorsalis; and (f) length of depressio musculus brachialis. The specimen differs from the Pandionidae *(Pandion haliaetus)* by larger dimensions, and the more round, instead triangle, section of condylus ventralis. In general morphology, it agrees with large accipitrids. The specimen differs from: *Haliaeetus leucocephalus* by the less shaped papillae remigales caudales and less developed tuberculum bicipitale; *Terathopius ecaudatus* by the less developed papillae remigales caudales, the more round profile of the section of margo caudalis, and the bigger size; late Miocene *Circaetus rhodopensis* could not be compared because of the lack of homologous skeletal elements; *Aquila audax* by the much larger size; *Aquila pomarina* by similar, but dimensionally larger, and by the stronger protruded papillae remigales caudales; *Aquila nipalensis* by the narrower pre-epiphysal part of proximal third of diaphysis, and by the almost round, instead triangle, section of diaphysis in the region of depressio musculus brachialis; *Aquila verreauxii* by the narrower diaphysis in the proximal third; *Aquila pennata* by the much larger size; and *Aquila fasciata* is similar.

The distal portion of left ulna, specimen VAD-NMNHS, no. 254 (Plate 2, fig. 4) represents about 1/8th of the total presumed length of the bone. A small section of the edge of condylus dorsalis in the distal end is broken and missing. The specimen differs from the Pandionidae *(Pandion haliaetus)* by the bigger dimensions (Table 3), and the oval, but not round, profile of condylus dorsalis. It differs from the Circaetinae *(Circaetus gallicus)* by the narrower condylus ventralis (measurement "h"). General morphology agrees with large accipitrids. The specimen differs from: *Neophron percnopterus* by the more elongated profile of the condylus dorsalis; *Polemaetus bellicosus* by the better developed tuberculum retinacula; *Haliaeetus leucocephalus* by the less shaped, tuberculum retinaculi; *Terathopus ecaudatus* by the less rounded profile of condylus dorsalis and larger size; *Aquila audax* by the much larger size; *A. pomarina* is similar, but dimensionally larger, differing by the more elongated (measurement "*e*"), but not rounded profile, of the condylus dorsalis, less marked sulcus radialis; *A. clanga* by the more protuberant tuberculum carpale, the more open arc of the lateral profile of condylus dorsalis, the smaller condylus dorsalis, less round, but more elongated, condylus dorsalis and the better developed and more caudal positioned tuberculum retinaculi in lateral view; *A. chrysaetos* is larger, but the general shape of its condylus dorsalis is similar to that of no 254; *A. heliacal* by the more open arc of condylus dorsalis in lateral view, and the more graduate transition of the arc into diaphysis in lateralis view; *A. nipalensis* by the narrower pre-epiphysal part of proximal third of diaphysis; *A. verreauxii* by the more developed tuberculum carpale; *A. pennata* by the much bigger size, but the shape of condylus dorsalis recembles that of the speciemen no. 254; *A. fasciata* is similar, but has a sharper tuberculum carpale in ventral view (a distinguishing feature) and slightly more open arc of condylus dorsalis in lateral view.

The right coracoid, specimen VAD-NMNHS, no. 251 (Plate 2, fig. 9) is fragmented through the incisura nervi supracoracoidei, although its position is well marked. Measurements (Table 4): (a) length between the incisura nervi supracoracoidei and facies articularis sternalis; (b) maximal width of facies articularis sternalis; (c) thickness in the tip of the impressio musculus sternocoracoidei; and (d) thickness in the middle of diaphysis. The specimen differs from: *Ichthyophaga humilis* by the more robust shaft and the

Table 2. Measurements (in mm) of proximal ulna in fossil and recent accipitiforms ("*a*"–"*f*" as indicated in Fig. 1c)

Species	*a*	*b*	*c*	*d*	*e*	*f*
Fossil – Varshets						
Aquila kurochkini sp. n. VAD-NMNHS 253	ca. 10.6	ca.7.5	ca. 9.8	ca. 17.2	ca. 15.0	33.9
Recent						
A. chrysaetos ISEAK A 1305/63	–	–	–	–	19.3	–
A. chrysaetos NHM 1930.3.24.260	13.0	8.5	12.6	20.5	19.5	39.3
A. chrysaetos NHM 1996.69.21	13.5	9.7	13.1	21.8	21.0	40.5
A. clanga NHM 1952.3.205	10.8	6.5	10.4	16.2	14.5	34.1
A. clanga NHM 1972.1.58	11.8	8.4	9.3	16.5	15.3	32.4
A. clanga NHM 1981.74.4	10.4	7.8	9.5	17.2	15.4	–
A. clanga UCBL 89/1	7.8	6.0	7.3	15.7	14.4	–
A. fasciata NHM 1847.10.21.50	–	–	–	–	15.3	–
A. fasciata NHM 1847.10.21.50	10.7	8.4	7.9	17.0	15.6	23.5
A. fasciata NHM 1898.12.13.1	10.9	8.7	9.8	16.4	15.8	29.4
A. fasciata NHM 1952.1.180	–	8.9	–	17.8	16.0	–
A. fasciata NHM 1996.69.22	10.7	7.4	9.1	16.1	16.1	26.0
A. heliaca NHM 1954.30.48	13.3	9.3	11.0	20.6	17.1	31.0
A. nipalensis NHM 1952.3.58	11.6	8.2	11.0	18.7	17.0	34.5
A. nipalensis NHM 1980.11.4	10.8	9.6	10.8	19.2	17.0	–
A. pennata ISEAK A3712/80	7.0	5.5	6.7	11.2	11.2	18.7
A. pomarina ISEAK A 2062/69	9.2	7.5	10.6	15.7	13.6	30.7
A. pomarina ISEAK A 4953/91	10.1	7.7	10.9	15.8	14.4	ca. 37.4
A. pomarina NHM 1995.23.1.	8.2	6.9	8.6	14.6	13.5	–
A. verreauxii NHM 1860.4.23.7	12.1	10.2	11.4	21.1	19.8	–
C. gallicus NHM 1863.7.30.11	–	8.0	9.1	17.1	14.5	–
H. leucocephalus NHM 1930.3.24.262	13.8	11.2	15.0	25	19.8	–
N. percnopterus ISEAK A 2864/73	9.3	8.9	10.3	16.2	12.8	30.6
P. bellicosus NHM 1957.9.1	14.0	13.8	11.9	21.0	19.3	39.3
P. haliaetus NHM 1955.22.5	–	–	–	–	12.6	–
S. coronatus NHM 1872.10.251	–	8.7	–	20.8	18.0	–
T. ecaudatus NHM 1871.9.28.4	–	–	–	–	13.6	–

more caudal, than lateral, positioned linea intermuscular is on the lateral surface of diaphysis; *Circaetus gallicus* by the narrower sternal half above the facies articularis sternalis, and the thicker diaphysis; late Miocene *Circaetus rhodopensis* could not be compared because of the lack of homologous skeletal elements; *Terathopius ecaudatus* by the thinner diaphysis, and the steeper processus lateralis; *Polemaetus bellicosus* by the more longitudinal, than transversal (diagonal), orientation of the linea intermuscularis, limiting impressio musculus sternocoracoidei; *Pandion haliaetus* by the wider diaphysis in the proximal (sternal) half, and the narrower facies articularis sternalis; *S. coronatus* by the shallower relief of impressio musculus sternocoracoidei; *Ichthyophaga ichthyaetus* by the more robust diaphysis and the longer widening of facies articularis sternalis; *Aquila clanga* by the longer wide part of facies articularis sternalis; *A. nipalensis* by the presence of a separating line between impressio musculus sternocoracoidei and f. dorsalis of the coracoid; *A. heliaca* by the clearly marked in scapular direction impressio musculus sternocoracoidei; *A. pomarina* by the more robust construction, thicker diaphysis in lateral view, and the wider facies articularis sternalis (measurement "*c*"); and *A. audax* by the much larger size. *A. fasciata* is similar, but it slightly differs by the even, instead of a slightly curved, caudal profile of the diaphysis in medial view, and the sharper, but not graduate curving of the line of facies articularis sternalis on the lateral side at its crossing by the longitudinal linea intermuscular is (both differences are

Table 3. Measurements (in mm) of distal ulna in fossil and recent accipitiforms ("*a*"–"*d*" as indicated in Fig. 1d)

Species	*a*	*b*	*c*	*d*
Fossil – Varshets				
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Recent				
A. chrysaetos ISEAK A 1305/63	19.3	17.6	14.0	13.1
A. chrysaetos NHM 1930.3.24.260	19.5	15.7	13.5	11.8
A. chrysaetos NHM 1996.69.21	21.0	17.0	14.3	13.2
A. clanga NHM 1952.3.205	14.5	12.8	9.7	9.8
A. clanga NHM 1972.1.58	15.3	10.8	10.1	10.2
A. clanga NHM 1981.74.4	15.4	14.1	11.3	11.1
A. clanga UCBL 89/1	14.4	13.6	11.0	11.2
A. fasciata NHM 1847.10.21.50	15.3	13.4	10.8	10.0
A. fasciata NHM 1847.10.21.50	15.6	13.4	10.8	10.1
A. fasciata NHM 1898.12.13.1	15.8	13.0	11.3	10.7
A. fasciata NHM 1952.1.180	16.0	–	–	ca. 11.3
A. fasciata NHM 1996.69.22	16.1	13.3	10.7	10.1
A. heliaca NHM 1954.30.48	17.1	16.5	14.0	13.8
A. nipalensis NHM 1952.3.58	17.0	15.0	12.4	11.7
A. nipalensis NHM 1980.11.4	17.0	14.6	10.2	10.6
A. pennata ISEAK A3712/80	11.2	9.4	7.5	6.8
A. pomarina ISEAK A 2062/69	13.6	13.3	10.7	10.0
A. pomarina ISEAK A 4953/91	14.4	13.5	11.0	10.4
A. pomarina NHM 1995.23.1.	13.5	12.4	7.1	9.1
A. verreauxii NHM 1860.4.23.7	19.8	17.0	13.9	11.8
C. gallicus NHM 1863.7.30.11	14.5	14.5	11.2	11.0
H. leucocephalus NHM 1930.3.24.262	19.8	–	–	13.7
N. percnopterus ISEAK A 2864/73	12.8	12.3	10.8	9.4
P. bellicosus NHM 1957.9.1	19.3	16.2	14.5	12.8
P. haliaetus NHM 1955.22.5	12.6	–	11.4	–
S. coronatus NHM 1872.10.251	18.0	–	–	10.8
T. ecaudatus NHM 1871.9.28.4	13.6	–	–	12.5

valid only for some of the compared recent specimens).

The coracoidal portion of sternum, specimen VAD-NMNHS, no. 137 (Plate 3, fig. 1) measures (Fig. 1d): (*a*) 8.0, (*b*) 3.2, (*c*) ca. 6.4, (*d*) 6.8, and (*e*) 12.5. The specimen differs from the Pandionidae *(Pandion haliaetus)* by the bigger manubrium sterni, and the wider arc of the sterno-coracoidal part in dorsalis view. Its general morphology agrees with large accipitrids. The specimen differs from: *Ichthyophaga humilis* by the symmetrical manubrium in cranial view and the less concave edge above it; *Terathopius ecaudatus* by the lacking of an inner axial separationin the cranial end of the sternum, and by the presence of a foramen pneumaticum on the same place. *Haliaeetus leucocephalus* by the well-developed foramen pneumaticum; *Circaetus gallicus* is similar, but more robust. It differs by the higher manubrium sterni (measurement "*a*") and thicker base of crista sterni in the cranial end under the manubrium sterni, the sharper angle (ca. 80° instead 100°) between the labrum ventralis dextra and labrum ventralis sinistra; late Miocene *Circaetus rhodopensis* could not be compared because of the lack of homologous skeletal elements; *Ichthyophaga ichthyaetus* by the bigger manubrium, the more distal (caudal) position of the foramen pneumaticum, and the deeper sulcus carinae; *Aquila rapax* by the rounder profile and the hanging as a hook dawnwards manubrium, by the smaller size, and the narrower facies articularis coracoidales; *A. clanga* by the bigger manubrium (measurement "*a*"), the relatively wider facies articularis coracoidales (measure-

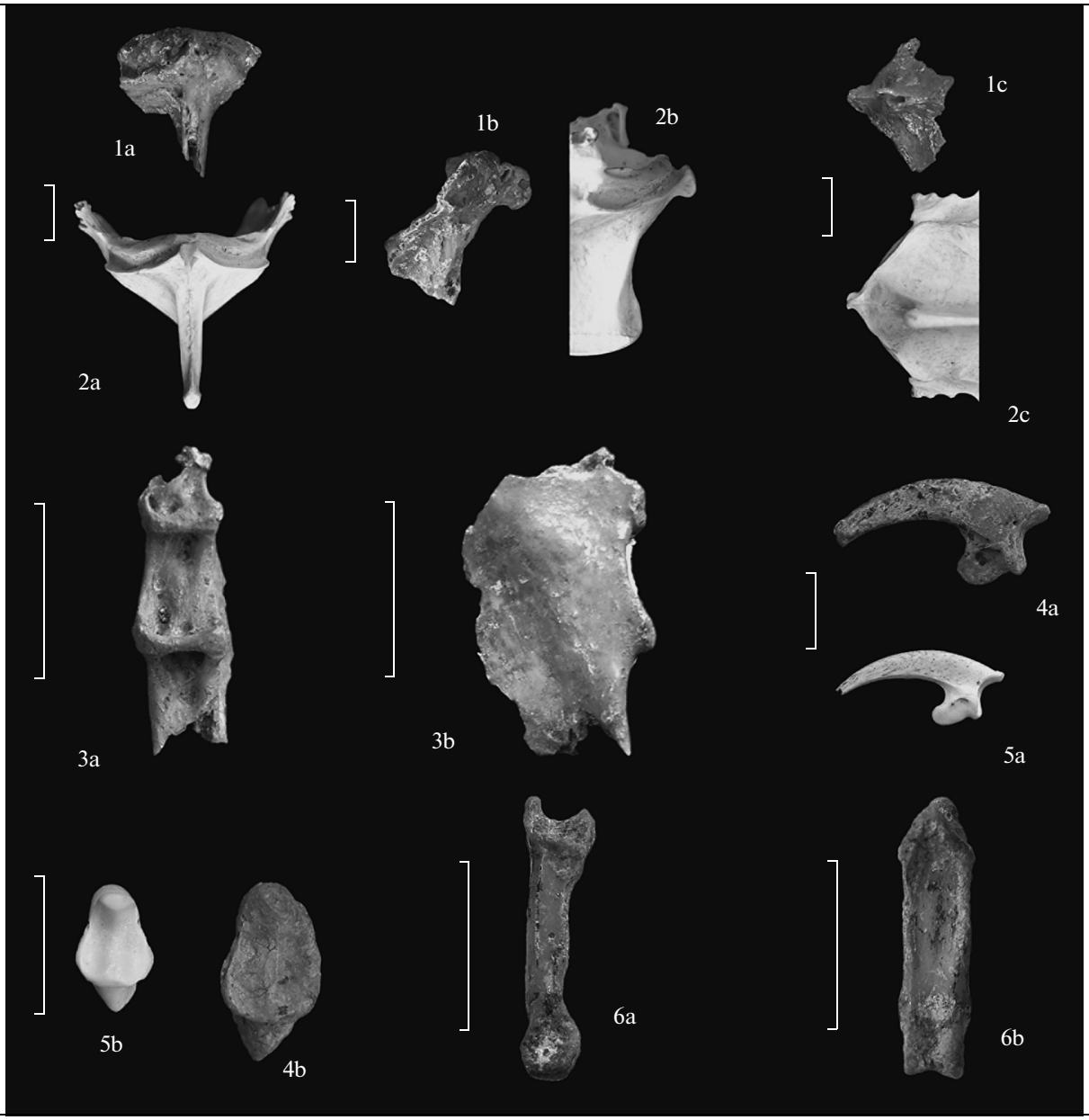
Table 4. Measurements (in mm) of coracoid in some fossil and recent accipitriforms ("*a*"–"*d*" as indicated in the text)

Fossil – Varshets	*a*	*b*	*c*	*d*
Aquila kurochkini sp. n. VAD-NMNHS 251	ca. 25.3	ca. 8.0	7.0	6.8
Recent				
A. clanga NHM 1981.74.4	25.5	8.1	7.7	7.0
A. pomarina NHM 1898.5.7.5	20.8	8.4	6.0	6.0
A. pomarina NHM 1845.1.12.11	28.6	10.0	7.9	6.7
A. pomarina NHM 1995.23.1	20.5	7.7	5.9	6.0
A. nipalensis NHM 1980.11.4	24.4	7.6	8.6	7.5
A. nipalensis NHM 1952.3.58	25.3	11.4	8.4	8.3
A. chrysaetos NHM 1996.69.21	33.4	12.4	10.4	8.7
A. chrysaetos NHM 1919.12.10.1206	32.0	13.0	9.3	9.0
A. chrysaetos NHM 1896.9.30.2	ca. 41.7	13.7	ca. 10.0	10.5
A. heliaca NHM 1954.30.48	28.7	ca. 7.6	8.3	8.4
A. heliaca NHM 1845.1.12.8	30.3	9.6	8.8	9.2
A. verreauxii NHM 1860.4.23.7	25.3	11.9	8.9	9.6
C. gallicus NHM 1863.7.30.11	27.6	ca. 9.5	7.4	6.6
T. ecaudatus NHM 1871.9.28.4	25.4	6.8	8.3	7.8
H. leucocephalus NHM 1930.3.24.262	34.2	–	–	–
A. fasciata NHM 1898.12.13.1	24.7	9.5	7.5	8.4
A. fasciata NHM 1851.8.25.39	23.0	18.9	7.4	8.3
A. fasciata NHM 1847.10.21.50	23.0	8.0	7.8	7.5
A. fasciata NHM 1952.1.180	24.4	9.8	7.3	7.4
P. haliaetus NHM 1955.22.5	23.2	7.9	6.3	6.3
P. bellicosus NHM 1954.9.1	37.4	14.1	9.8	8.7
S. coronatus NHM 1872.10.251	21.5	11.0	10.1	7.4
I. humilis NHM 1924.1.24.3	30.7	7.0	7.9	5.2
I. ichthyaetus NHM 1845.1.12.20	ca. 25.5	8.8	7.4	6.6

ment "*d*"), the more caudally positioned foramen pneumaticum on the tabula sterni, and the crossing, instead parallel, labrum dorsale and labrum ventralis; *A. pomarina* by the more distally positioned foramen pneumaticum on the tabula sterni, sharper angle between both labrum externa sternae in ventral view; *A. heliaca* by the thinner peri-manubriumal part and by the sharper angle between the labrum ventralis dextra and labrum ventralis sinistra; *A. audax* by the much larger size; *A. verreauxii* by the well-developed foramen pneumaticum; *A. pennata* by the larger size, and the larger, round and hanging downwards manubrium sterni; *A. chrysaetos* by the thinner axial part; and *A. fasciata* by the similar, but the base of manubrium sterni is slightly thinner (6.6 : 6.8 mm).

The costal portion of sternum, specimen VAD-NMNHS 242 (Plate 3, fig. 2a, 2b) measures (Fig. 1e): (*a*) 4.9, (*b*) 4.0, (*c*) 5.7, (*d*) 4.0, and (*e*) 7.1 The fragment preserves a small part of tabula sterni along with incisura intercostalis IV, V, and VI. Total length is 17.6 mm. The specimen differs from the Sagittariidae (*Sagittarius serpentarius*) by the smaller size and the less abundance of pores on the area of facies articularis of incisura intercostalis, and the Pandionidae (*Pandion haliaetus*) by the lesser dimensions and the strongest concavity of tabula sterni in the region of the incisura intercostalis. Its general morphology agrees with large accipitrids. The specimen differs from: *Terathopius ecaudatus* by the narrower incisura intercostalis; *Circaetus gallicus* by smaller size; late Miocene *Circaetus rhodopensis* could not be compared because of the lack of homologous skeletal elements; *Aquila rapax* by the narrower incisura intercostalis; *A. audax* by the much larger size; *A. clanga* by the deeper relief of incisura intercostalis, the wider in dorsalis view processus costales (measurement "*c*"); *A. pomarina* by the bigger size; *A. nipalensis*: by the more distant position of processi costales; *A. veraeuxii*: by the thinner tabula sterni;

Plate 3



Explanation of Plate 3

Figs. 1, 3, 4, and 6. *Aquila kurochkini* sp. nov.: (1) paratype VAD-NMNHS, no. 137, coracoid portion of sternum in cranial (1a), right lateral (1b) and ventral (1c) views; (3) paratype VAD-NMNHS, no. 242, costal portion of right side of the sternum in dorsal (3a) and lateral (3b) views; (4) paratype VAD-NMNHS, no. 3002, distal phalanx of the 2nd toe of the left foot in lateral (4a) and caudal (4b) views; (6) paratype VAD-NMNHS, no. 15089, 4th phalanx of the 4th toe of the right foot in lateral (6a) and ventral (6b) views.

Figs. 2 and 5. *Aquila pomarina* Brehm, 1831, Recent, specimen VAD-NMNHS, no. 4/1996: (2) coracoid portion of sternum in cranial (2a), right lateral (2b) and ventral (2c) views; (5) distal phalanx of the 2nd toe of the left foot in lateral (5a) and caudal (5b) views.

Scale bar—1 cm.

A. pennata by the larger size; and *A. fasciata* is similar, but differs by the deeper concavity on the outer side of tabula sterni, thicker base of the inner side of tabula sterni in the 3rd and 4th pairs of ribs.

The distal phalanx of 2nd toe of the left foot, specimen VAD-NMNHS, no. 3002. (Plate 3, fig. 5) measures (Fig. 1f): (*a*) ca. 32.0, (*b*) 10.5, (*c*) 15.1, and (*d*) 7.7. The almost complete phalanx is preserved and

only its tip is lacking. It differs from: *Ichthyophaga ichthyaetus* by the more open arc (less curved) of the phalanx, besides the similar dimensions; *Haliaeetus leucocephalus* and *Stephanoetus* spp. by the sharper dorsalis part of facies articularis; *Circaetus gallicus* and *Terathopius ecaudatus* by the larger size; late Miocene *Circaetus rhodopensis* could not be compared because of the lack of this skeletal element; *Polemaetus bellicosus* by the better-shaped articular concavities; *Aquila audax* by the much larger size; *A. clanga* by the wider, but not pearlike shape of facies articularis, and the larger general size; *A. pomarina* by the much larger size; *A. nipalensis* by the more symmetrical cuttings of facies articularis; *A. heliaca* and *A. chrysaetos* by the sharper angle of the dorsalis edge of the facies articularis in ventralis view; and *A. fasciata* is similar, but differing by the more robust body of the phalanx and mainly, the thicker base.

The 4th phalanx of the 4th toe of the right foot, specimen VAD-NMNHS, no. 15089 (Plate 3, fig. 6) measures: (a) total length (16.8); (b) heigth of distal articular end (3.5); (c) width of proximal articular end (4.7). *Circaetus gallucus* is similar in size; but is less convex in lateral view; *Aquila fasciata* by the smaller size; *A. pomarina* slightly smaller and more robust, and *A. clanga* is similar.

DISCUSSION

The Neogene fossil record of birds from Bulgaria enriches the data of the European avian raptor fauna. Other Neogene localities provided record of three other late Miocene raptors—*Buteo spassovi, Circaetus rhodopensis* and *Falco bulgaricus* Boev, 2011, all originated from the Hadzhidimovo locality (Turolian, MN 11—beginning of MN 12 zone, dated ca. 7.5 mya, late Miocene). In addition, *Accipiter* sp. ex gr. *gentilis* and *Falco* sp. ex gr. *cherrug* are known from the early Pliocene (MN 15) locality of Muselievo (Boev, 2001). The find of *Accipiter* are the oldest European record of that genus while that of *Falco* is the oldest in Europe record of the large falcons (Mlíkovský, 2002).

Although these fossils are not preserved perfectly, they allow a definite taxonomic determination as a new species of *Aquila*. Only two pedal phalanges are preserved completely.

The examined avian material of this site described in this publication represent 0.43% of the total collected finds (total—1841) in the site (Boev, 2007). The list of raptor species in the Varchets locality so far included *Falco bakalovi* Boev, 1998 and *Gyps bochenskii*. The four established diurnal raptors, along with *Aquila kurochkini* sp. n., are an indication of rich paleo-ornithocoenosis of the locality. With more than 79 bird taxa Varshets stands among the richest Pliocene avian localities of Europe, as well as in the World.

APPENDIX 1

List of examined species of Accipitriformes. *Haliaetus leucocephalus* (Linnaeus, 1766); *Terathopius ecaudatus* (Daudin, 1800); *Milvus migrans* (Boddaert, 1783); *Aquila fasciata* (Vieillot, 1822); *Aquila pennata* (Gmelin, 1788); *Circaetus cinereus* (Vieillot, 1818); *Aegypius monachus* (Linnaeus, 1766); *Buteo buteo* (Linnaeus, 1758); *Spilornis cheela* Latham, 1790; *Stephanoaetus coronatus* (Linnaeus, 1766); *Aquila heliaca* Savigny, 1809; *Neophron percnopterus* (Linnaeus, 1758); *Pernis apivorus* Linnaeus, 1758); *Aquila chrysaetos* (Linnaeus, 1758); *Aquila clanga* Pallas, 1811; *Ichthyophaga ichthyaetus* (Horsfield, 1821); *Aquila hastata* (Lesson, 1834); *Ichthyophaga humilis* (Müller and Schlegel, 1841); *Aquila pomarina* Brehm, 1831; *Lophaetus occipitalis* (Daudin, 1800); *Polemaetus bellicosus* (Daudin, 1800); *Accipiter gentilis* (Linnaeus, 1758); *Spizaetus ornatus* (Daudin, 1800); *Pandion haliaeetus* (Linnaeus, 1758); *Sagittarius serpentarius* (J.F. Miller, 1779); *Circaetus gallicus* (Gmelin, 1788); *Aquila nipalensis* (Hodgson, 1833); *Aquila rapax* (Temminck, 1828); *Aquila verreauxii* Lesson, 1830; *Aquila audax* (Latham, 1802); *Circaetus cinerascens* von Müller, 1851.

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