



BULGARIAN ACADEMY OF SCIENCES
NATIONAL MUSEUM OF NATURAL HISTORY

NEOGENE AVIFAUNA OF BULGARIA

IN THE CONTEXT OF THE EVOLUTION
OF THE EUROPEAN AVIFAUNA

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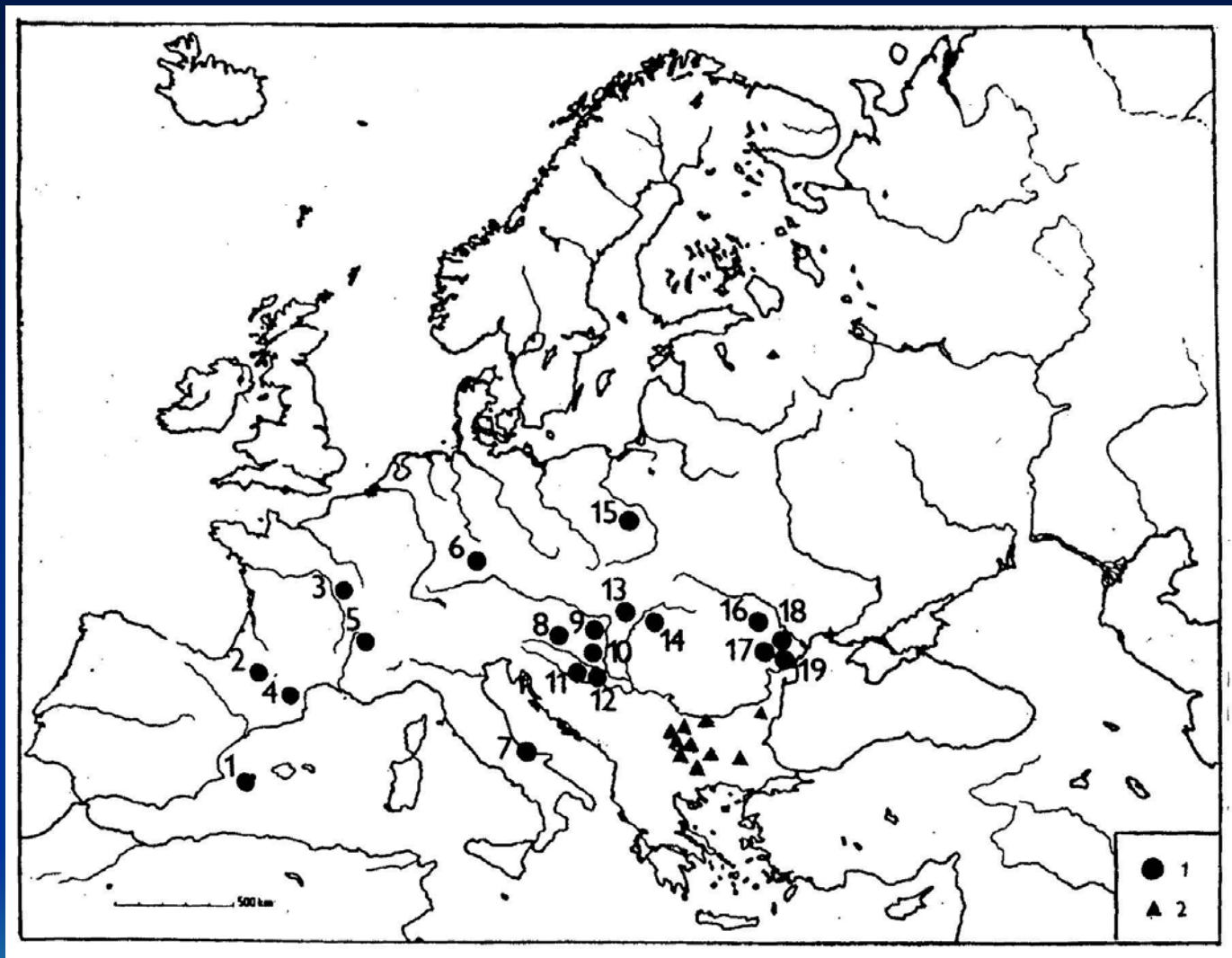
INTRODUCTION

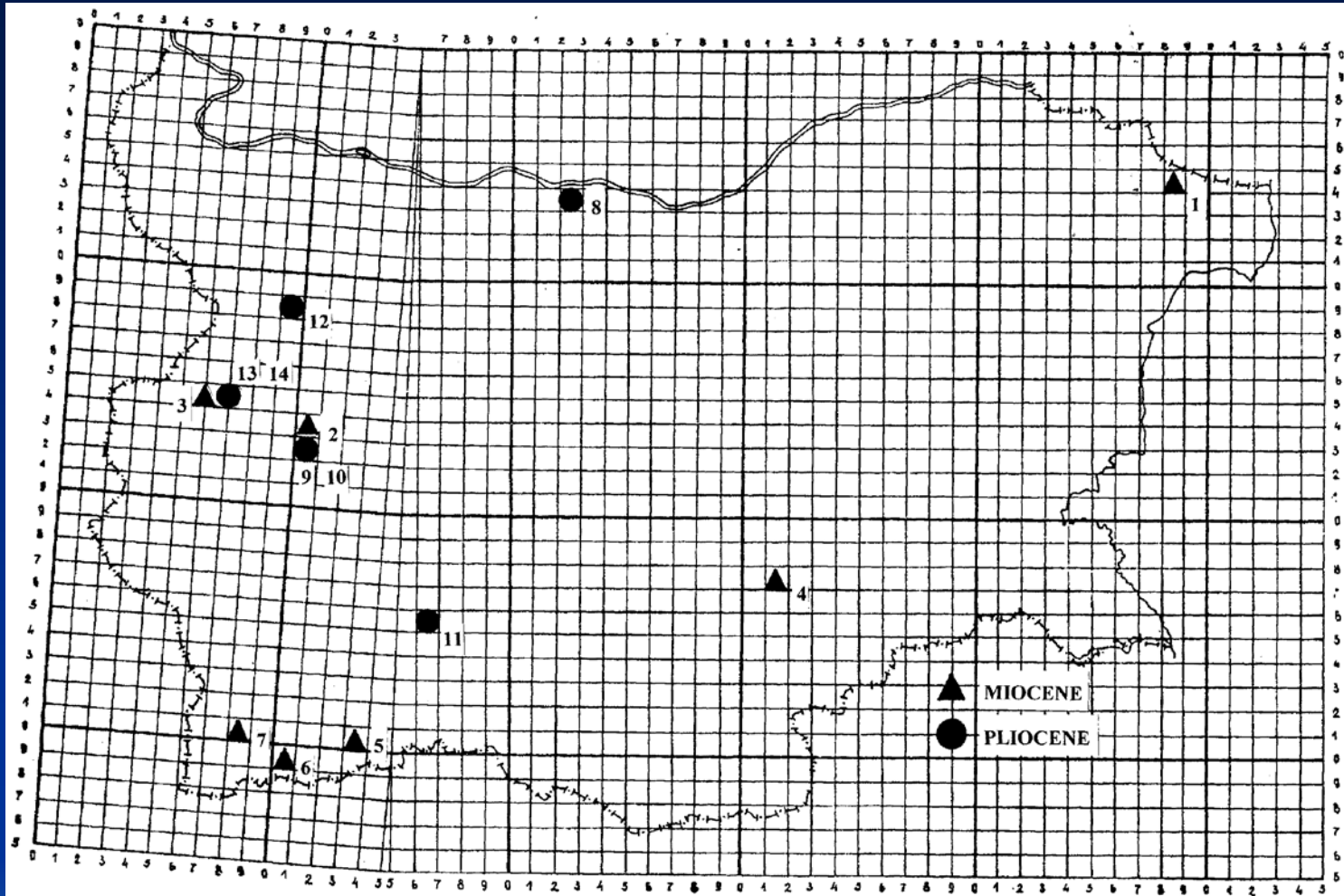
The Neogene lasted ca. 21 my (Table 1). Neogene record of Europe is relatively abundant (Fig. 1). The Neogene avifauna and all the fossil bird fauna of Bulgaria, remained unstudied almost until present time. Bulgarian Neogene avian sites represent destroyed former caves, coal mines, river banks, slope outcrops, sandy sediments of former water bodies, stone quarries, etc. By the 1984 only three sites were known, two of them (Hrabarsko and Troyanovo) provided two new species, both described in collaboration of foreign paleornithologists (Burchak-Abramovich & Nikolov, 1984), while the finds of the third one (Kardam) remained unexamined and unpublished. Since 1995 a series of papers describe several new avian taxa or new bird material from the Bulgarian Neogene deposits.



Table 1. Stratigraphic Reference Chart of Cenozoic, with approximate dates in millions of year before present

CAENO-ZOIC	QUARTER-NARY	HOLOCENE (RECENT)		0,01
		PLEISTOCENE		1,86
	TERTIARY	NEOGENE	PLIOCENE	5
			MIOCENE	23
		PALAEOGENE	OLIGOCENE	34
			EOCENE	56
			PALAEOCENE	66





Neogene avian localities of Bulgaria

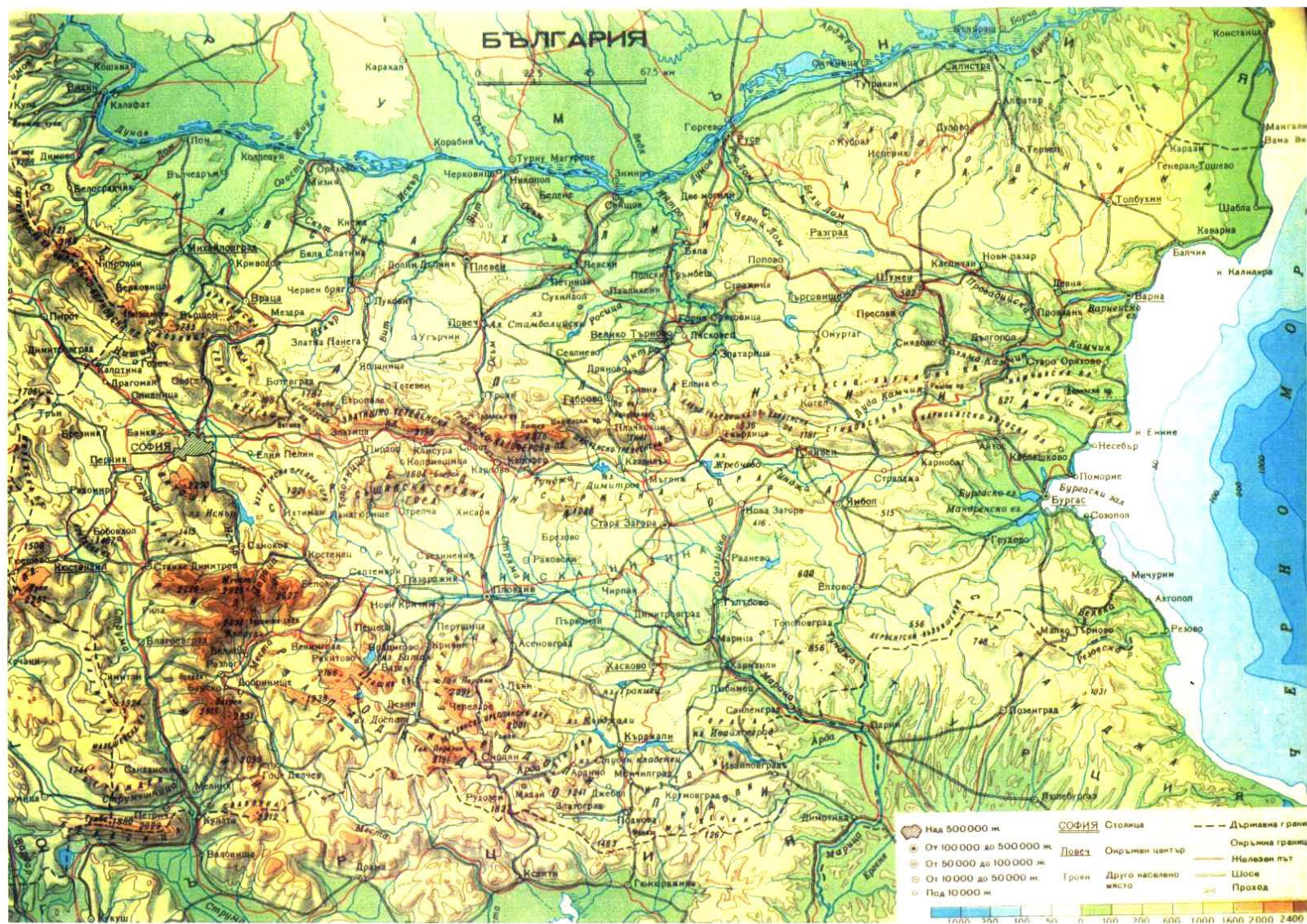


Table 1. Chronostratigraphical distribution of the Neogene avian fossils from Bulgaria

Periods	Subperiods	Sites	Number of finds	Percentage of all Neogene avian finds of Bulgaria	Number of taxa	Percentage of all Neogene avifauna of Bulgaria
	Late Pliocene	Balsha	3	0.16	1	0.83
		Slivnitsa	102	5.54	17	14.16
		Varshets	1638	89.02	78	65.00
Pliocene	Early Pliocene	Dorkovo	3	0.16	3	2.50
		Sofia - 2	1	0.05	1	0.83
		Sofia - 1	?	?	?	?
		Muselievo	14	0.76	5	4.16
		Hadzhidimovo	23	1.25	5	4.16
		Kalimantsi	1	0.05	1	0.83
		Gorna Sushitsa	1	0.05	1	0.83
		Troyanovo	21	1.14	2	1.66
		Hrabarsko	24	1.30	4	3.33
		Kremikovtsi	1	0.05	1	0.83
	Middle Miocene	Kardam	8	0.43	1	0.83
	Early Miocene	-	-	-	-	-
TOTAL			1840	100,00	120	100,00



Bird finds from the Neogene deposits are known at present from 14 sites (Fig. 2, 3), Pleistocene – 20, and Holocene – 67. Seven of the Neogene sites are of Miocene age including 1 Middle Miocene (Kardam) and 6 Late Miocene (Hrabarsko, Troyanovo, Kremikovtsi, Hadzhidimovo, Kalimantsi and Gorna Sushitsa). Seven other sites are of Pliocene age. Four sites contain fossils of the Early Pliocene (Ruscinian; Sofia - 1, Sofia - 2, Muselievo and Dorkovo) and 3 other of the Late Pliocene (Villanyian; Varshets, Slivnitsa and Balsha).

Here the full taxonomic list of the Neogene avifauna of all the 14 sites in Bulgaria is discussed.

The first avian Neogene fossil from Bulgaria was collected even in 1950-s. Since that time by the 2006, a total of 1840 bone fragments, bones and articulated skeletons (only 2 specimens) of at least 316 individuals have been collected (Table 2.).











Table 2. Taxonomic^[1] composition of the Neogene avian fossils from Bulgaria

Taxa	Collection numbers, NMNHS	Number of bone finds	MNI
MIDDLE MIOCENE			
1. Kardam			
Sturnidae gen.	1626-1633	8	1
Subtotal		8	1
LATE MIOCENE			
2. Kremikovtsi			
Anatini gen.	2948	1	1
Subtotal		1	1
3. Hrabarsko			
<i>Phalacrocorax serdicensis</i> Burchak-Abr. & Nikolov, 1982	1392-1406	15	1

^[1] Authors names are given only for taxa, which description is based on specimens, originated from Bulgaria.

Larinae gen.	1646	1	1
<i>Melanocorypha</i> sp. n.	475	1	1
Alaudidae gen. sp. n.	476	1	1
Aves indet.	477-482	6	1
Subtotal		24	5

4. Troyanovo

<i>Anser thraceiensis</i> Burchak-Abr. & Nikolov, 1982	1407-1420; 1622-1625	18	1
Anatinae gen.	1650-1652	3	1
Subtotal		21	2

5. Hadzhidimovo

<i>Struthio</i> cf. <i>Struthio</i> <i>karatheodoris</i>	16372	1	1
<i>Aquila</i> sp. ex gr. <i>clanga</i>	12531	1	1
<i>Buteo spassovi</i> Boev, 1998	10190	1	1
<i>Falco</i> sp. n. ex gr. <i>tinnunculus</i>	12539-12545; 12559- 12568	17	1

<i>Euroceros bulgaricus</i> Boev, 2007	12532-12533	2	1
Aves indet (Non- Passeriformes)	12534	1	1
Subtotal		23	6
6. Kalimantsi			
<i>Struthio</i> cf. <i>karatheodoris</i>	16371	1	1
Subtotal		1	1
7. Gorna Sushitsa			
Phasianidae gen. indet.	15143	1	1
Subtotal		1	1
EARLY PLIOCENE			
8. Muselievo			
<i>Lagopus</i> aff. <i>atavus</i>	422	1	1
<i>Pavo bravardi</i>	418-421	4	1
<i>Accipiter</i> sp. ex gr. <i>gentilis</i>	423	1	1
<i>Falco</i> sp. ex gr. <i>cherrug</i>	424	1	1

Passeres indet.	1614; 1619	2	2
Aves indet.	1612-1613; 1616-1618	5	3
Subtotal		14	9
9. Sofia-1			
(Aves indet.)		?	?
Subtotal		-	-
10. Sofia-2			
<i>Cygnus verae</i> Boev, 2000	1644	1	1
Subtotal		1	1
11. Dorkovo			
<i>Balcanas pliocaenica</i> Boev, 1998	484	1	1
<i>Tetrao rhodopensis</i> Boev, 1998	483	1	1
Perdicinae gen.	485	1	1
Subtotal		3	3

LATE PLIOCENE

12. Varshets

Anatinae gen.	11801	1	1
<i>Accipiter</i> sp.	113; 204	2	1
<i>Circaetus</i> cf. <i>gallicus</i>	162; 192	2	1
<i>Circaetus</i> sp.	273	1	1
<i>Aquila</i> sp. ex gr. <i>clanga</i>	138, 243	2	1
<i>Hieraaetus</i> cf. <i>fasciatus</i>	244; 251; 253; 254	4	1
<i>Hieraaetus</i> sp.	137-138; 251; 3002	4	1
cf. <i>Hieraaetus</i> sp.	150; 242; 244	3	1
Aquilinae gen.	14961	1	1
<i>Gyps</i> sp. n.	154; 159-160; 246; 248	5	1
<i>Buteo</i> sp.	261	1	1
Accipitridae gen.	3002	1	2
<i>Falco</i> ex gr. <i>tinnunculus</i>	131; 132; 136; 143-145; 189; 236; 304-306; 317-321	16	3
<i>Falco bakalovi</i> Boev, 1998	1642	1	1
<i>Falco</i> sp.	131	1	3

<i>Falco</i> sp.	131	1	3
Falconidae gen.	134	1	2
<i>Tetrao</i> aff. <i>partium</i>	157-158; 178; 185; 194; 196; 245; 278-282	12	2
<i>Lagopus balcanicus</i> Boev, 1995	1-13; 139; 249; 250; 322-326; 328; 329; 336-339; 377-386; 1634; 1640; 1641; 1643	41	5
<i>Tetrao/Lagopus</i>	164; 165; 257	3	1
cf. <i>Perdix</i> sp.	2690-2702	13	3

<i>Chauvireria balcanica</i> Boev, 1997	47; 48; 51-58; 77; 78; 80; 81; 84-86; 47-111; 396-410; 1647; 1648; 1653-2650; 3007; 11606; 11607; 11612-11616; 11770; 11784; 11792; 11794; 11795; 11798; 11799; 11811, 15085-15086, 15090, 15093, 15096-15097, 15100- 15102, 15104, 15107, 15109, 15110, 15114- 15115, 15119, 15124- 15125, 15127, 15133-15135, 15139- 15140, 15142	1138	52
Perdicinae gen.	12291	1	1
<i>Phasianus</i> sp.	256	1	1

Phasianidae gen.	35-37; 41; 188; 274-276; 288; 2706-2708; 11603; 11775; 11776	15	3
<i>Gallinula balcanica</i> Boev, 1999	112	1	1
<i>Porzana</i> sp. n..	301	1	1
<i>Otis</i> aff. <i>khosatzkii</i>	140-142; 149; 156	5	2
Otitidae gen.	148; 151	2	1
<i>Actitis balcanica</i> Boev, 1998	45	1	1
Charadriiformes fam.	3005	1	1
<i>Apus baranensis</i> Janossy, 1977	15-23	9	4
<i>Columba</i> sp. – 1	11601; 11604	2	1
<i>Columba</i> sp. – 2	127-130	4	1
<i>Streptopelia</i> sp.	299-300; 1161	3	1
<i>Athene</i> sp.	11 277	1	1
<i>Anthus</i> sp.	175-177	3	2
<i>Motacilla</i> sp.	284	1	1
<i>Melanocorypha</i> sp. n.	295; 296	2	1

<i>Alauda</i> sp.	297; 298	2	1
cf. <i>Alauda</i> sp.	174	1	1
<i>Lullula</i> sp.	173	1	1
<i>Galerida</i> sp. n. - 1	153	1	1
<i>Galerida</i> sp. - 2	155	1	1
<i>Eremophila</i> sp.	12 353	1	1
<i>Eremophila</i> sp. n.	179	1	1
Alaudidae gen.	270	1	1
<i>Parus</i> sp. ex gr. <i>major</i>	27; 34; 170	3	1
<i>Parus</i> sp.	43; 126; 167; 168; 277	5	1
Paridae gen.	202	1	1
<i>Regulus bulgaricus</i> Boev, 1999	24	1	1
cf. Sylviidae gen.	12266	1	1
cf. <i>Muscicapa</i> sp.	166	1	1
<i>Fringilla</i> cf. <i>coelebs</i>	169, 172, 180, 187, 191, 193, 241, 272	8	2
<i>Fringilla</i> sp.	171, 199-200; 302	4	2
<i>Loxia natevi</i> Boev. 1999	307-311	5	1

<i>Coccothraustes simeonovi</i> Boev, 1998	114; 116; 117; 119-121	6	2
<i>Carduelis</i> cf. <i>carduelis</i>	258-259, 388, 394-395	5	2
<i>Carduelis</i> sp.	260, 387, 289-393	7	2
Fringillidae gen.	208, 411-417	8	4
<i>Emberiza</i> sp.	28; 125; 186; 205	4	1
Emberizidae gen.	38-39; 705	3	1
<i>Turdus</i> sp. ex gr. <i>merula</i>	29; 31	2	2
<i>Turdus</i> sp.	190; 197	2	1
<i>Turdus</i> sp. ex gr. <i>philomelos</i>	314; 316; 11605	3	1
<i>Turdus</i> cf. <i>iliacus</i>	42	1	1
<i>Erithacus</i> sp.	203	1	1
Turdidae gen.	289	1	1
<i>Pyrrhocorax</i> cf. <i>pyrrhocorax</i>	30	1	1
<i>Pyrrhocorax</i> cf. <i>graculus</i>	12244	1	1
<i>Pyrrhocorax</i> sp.	209-221; 222-228	20	3
<i>Nucifraga</i> sp.	183	1	1
<i>Pica</i> sp. n.	146; 147; 229-235; 340-344	14	2

<i>Corvus</i> cf. <i>monedula</i>	240; 290; 292; 293; 347-376;	34	5
<i>Corvus</i> sp.	255; 286; 312-313	4	1
Corvidae gen.	195; 286; 287	3	3
<i>Sturnus</i> sp.	163; 268; 269	3	1
<i>Emberiza</i> sp.	28; 125; 186; 205	4	1
Emberizidae gen.	38-39	2	1
Oscines fam.	25; 26; 206-208; 271; 459	7	17

Aves indet.	40; 46; 345; 346; 3003; 3004; 3006; 11617; 11691-11769; 11774; 11777-11783; 11785- 11790; 11793; 11797; 11800; 11803-11810; 11812-11818; 12294; 12296-12297; 15079; 15087-15089, 15091- 15092, 15094-15095, 15098-15099, 15103, 15105-15106, 15108, 15111-15113, 15116- 1518, 15120-15123, 15126, 15128-15132, 15136-15138, 15141	156	71
Subtotal		1638	263

13. Slivnitsa

Botaurinae gen.	431	1	1
<i>Geronticus balcanicus</i> Boev, 1998	14; 453	2	1
<i>Anas</i> cf. <i>clypeata</i>	433	1	1
Aquilinae gen.	452	1	1
<i>Falco</i> sp. ex. gr. <i>tinnunculus</i>	438	1	2
<i>Chauvireria</i> sp. n.	3100; 3060; 3061; 3076; 3063-3083; 3085- 3098; 3107-3110; 3099; 3101-3105; 3111-3115	54	4
<i>Lullula</i> sp.	451	1	1
aff. <i>Lullula</i> sp.	430	1	1
<i>Turdus</i> cf. <i>philomelos</i>	443	1	1
Turdidae gen.	442	1	1
<i>Coccothraustes balcanicus</i> Boev, 1998	440	1	1
<i>Corvus</i> sp. ex gr. <i>monedula</i>	441; 447-450	5	1

<i>Corvus</i> aff. <i>praecorax</i>	432	1	1
<i>Corvus</i> sp.	425; 435; 437; 441; 444	5	1
<i>Pyrrhocorax</i> sp.	439; 445	2	1
Corvidae gen.	429	1	1
<i>Emberiza</i> sp.	446	1	1
Oscines fam.	11671; 11681-11683	4	2
Aves indet.	11668; 11669; 11672- 11680; 11684-11690	18	4
Subtotal		102	27
14. Balsha			
<i>Lagopus</i> sp. (cf. <i>lagopus</i>)	12315	1	1
cf. <i>Lagopus</i> sp.	12313; 12314	2	1
Subtotal		3	2
TOTAL		1840	316

The Paleontological material was identified during the last 20 years through the comparative osteological collections of the following institutions:

- National Museum of Natural History, Bulgarian Academy of Sciences – Sofia (NMNHS);
 - Center of the Earth Sciences, Claude Bernard University - Lyon (UCBL);
 - Natural History Museum, former British Museum (Natural History) - Tring (BMNH);
- Institute of Systematics and Evolution of Animals, Polish Academy of Sciences - Krakow (ISEAK);
- Paleontological Institute, Russian Academy of Sciences - Moscow (PIRASM).
 - National Museum of Natural History – Washington (NMNHW).



EVOLUTIONARY, PALEORNITHOGEOGRAPHICAL AND PALEOECOLOGICAL IMPLICATIONS

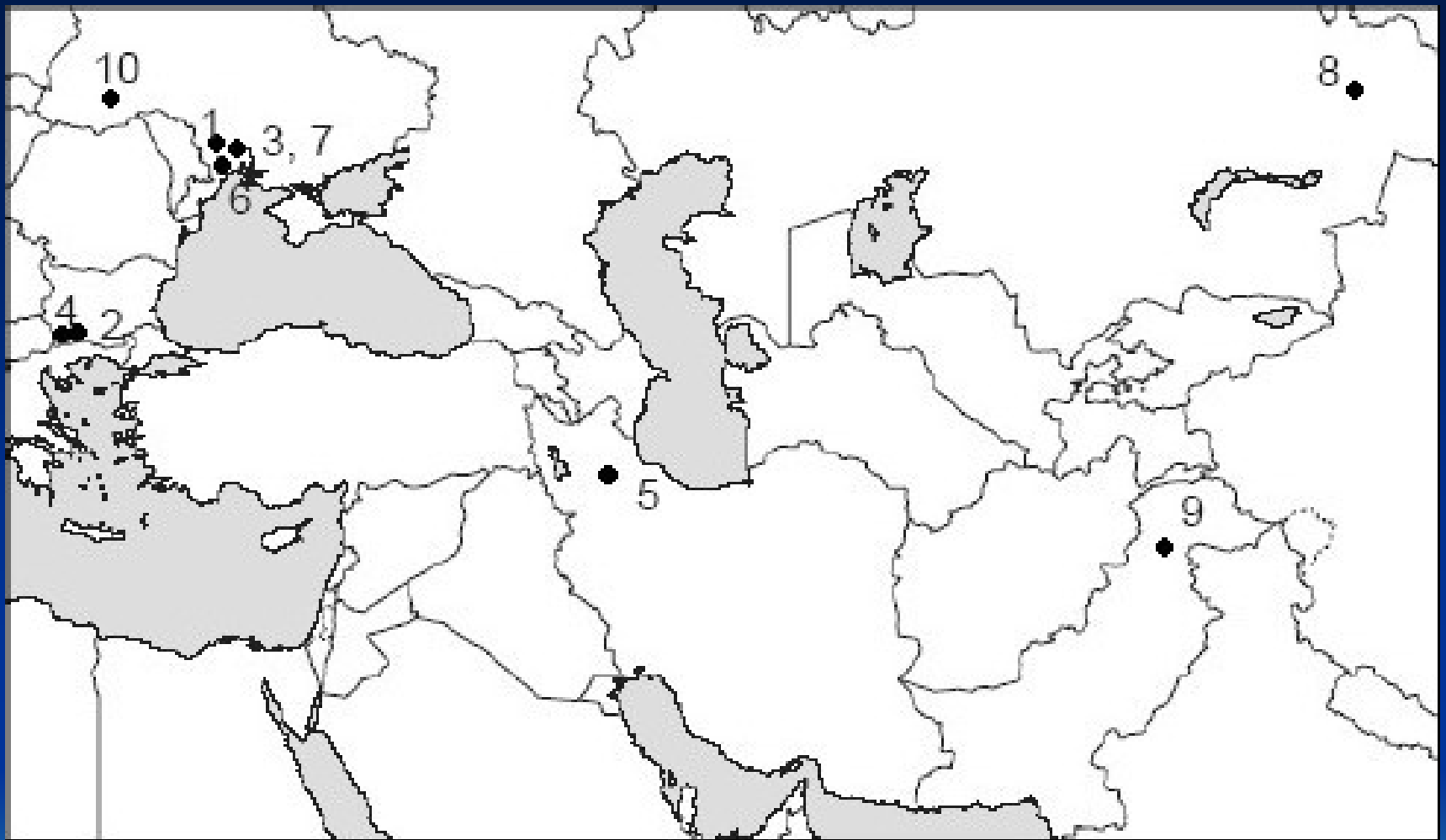
The complete taxonomic list of the Neogene birds from Bulgaria is given in Table 2. Here we will comment the significance only of some of the established taxa for avian phylogeny, zoogeography and paleoecology.

Struthioniformes **Struthionidae**

Struthio cf. *Struthio karatheodoris* Forsythe Major, 1888

After Mlíkovský (1996), all Tertiary records of *Struthio* in Europe “... are confined to its south-eastern parts It is possible, that *Struthio* has never reached Western Europe.”. On the other hand, *S. camelus* survived in the Ukraine and Moldova up to the beginning of the Pleistocene.

The late Miocene European ostrich finds are actually restricted to the N Peri-Pontic region, Greece and Bulgaria (Fig. 4). In spite of the fact that the Balkans and the N Pontic region have several faunal similarities in the late Miocene, the Bulgarian Turolian ostrich finds (Fig. 5, 6) are much closer to these from Pikermi and Samos Island. They represent an additional argument for the existence of faunal and environmental similarities in a large territory (from the Balkans to Iran and Afghanistan) during that time, the s. c. SE-European – SW-Asian “superprovince”, or the “Greek-Iranian province”.



Struthio cf. *Struthio karatheodoris*



It is suggested, in the beginning of the late Miocene the Balkan area was separated by the sea from the Asia Minor area. On the other hand, the taxonomic similarity of the ostriches from Samos, Pikermi, Hadzhidimovo and Kalimantsi, and their distinctions from the contemporaneous finds of the N Peri-Pontic area (Novo-Elizabetovka and Grebenniki) supports a supposition for the existence of a land connection between the Balkan and the Asia Minor areas during the transition from the early to the middle Turolian. At that time, this land bridge might have been played an important role for the exchange of the terrestrial fauna within the Greek-Iranian (Balkan-Iranian) zoogeographic province.

The site of Kalimantsi is a new (the 13-th) avian Tertiary locality of Bulgaria, unknown so far. Having a series of localities of the s. c. “Hipparion” fauna, where ostriches were one of the “obligatory” elements, according to data of foreign authors for the localities abroad, the former presence of the genus *Struthio* in the Bulgarian Neogene was expected. The taxonomical and stratigraphic analysis show that (1) two Turolian ostrich species have retained for the N Pontic region, *S. novorossicus* (accepted as a valid species unlike of *S. chersonensis* restricted to the type – an eggshell remain) and *S. brachydactylus*, and (2) one species for the W and S Pontic region and SW Asia – *S. karatheodoris*.



This conclusion also confirms the existence of a Balkan-Iranian zoogeographic province in the Turolian and the appearance and existence of a southern route of faunal exchange through the Balkans and Asia Minor in the Turolian no later than the early/middle Turolian.

The presence of the ostriches in the megafauna of the ~ middle Turolian localities of Kalimantsi and Hadzhidimovo supports also the conception of the existence of open spaces as a typical element of the mosaic landscape of the open woodlands/park type forest landscape in the western Pontic part of the of the Pikermian biome of the Balkan-Iranian late Miocene zoogeographic province.

Ciconiiformes

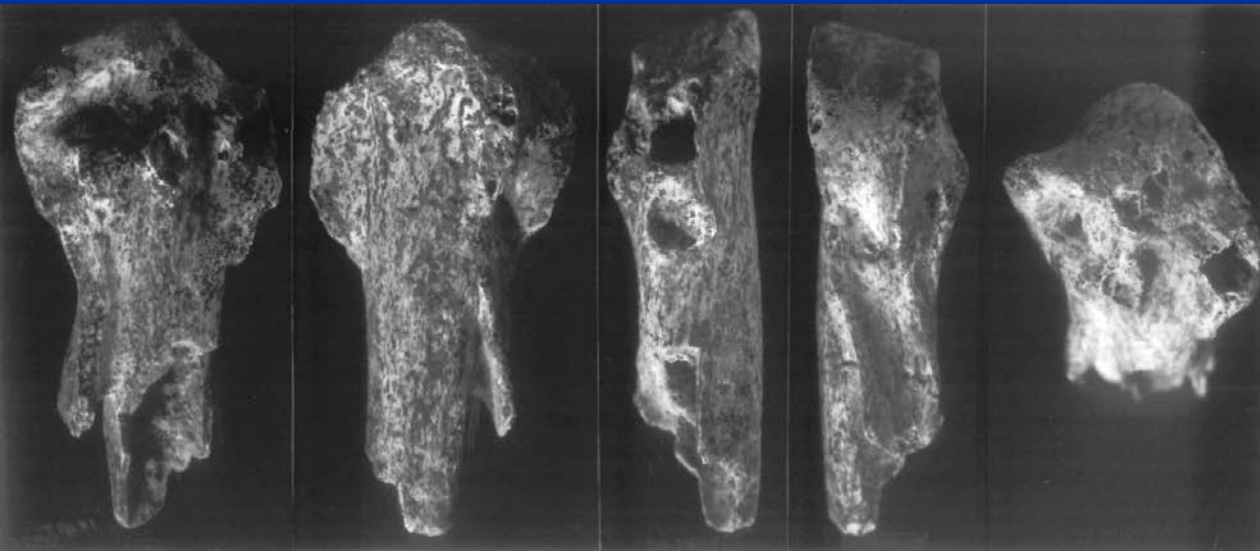
Ardeidae

Botaurinae

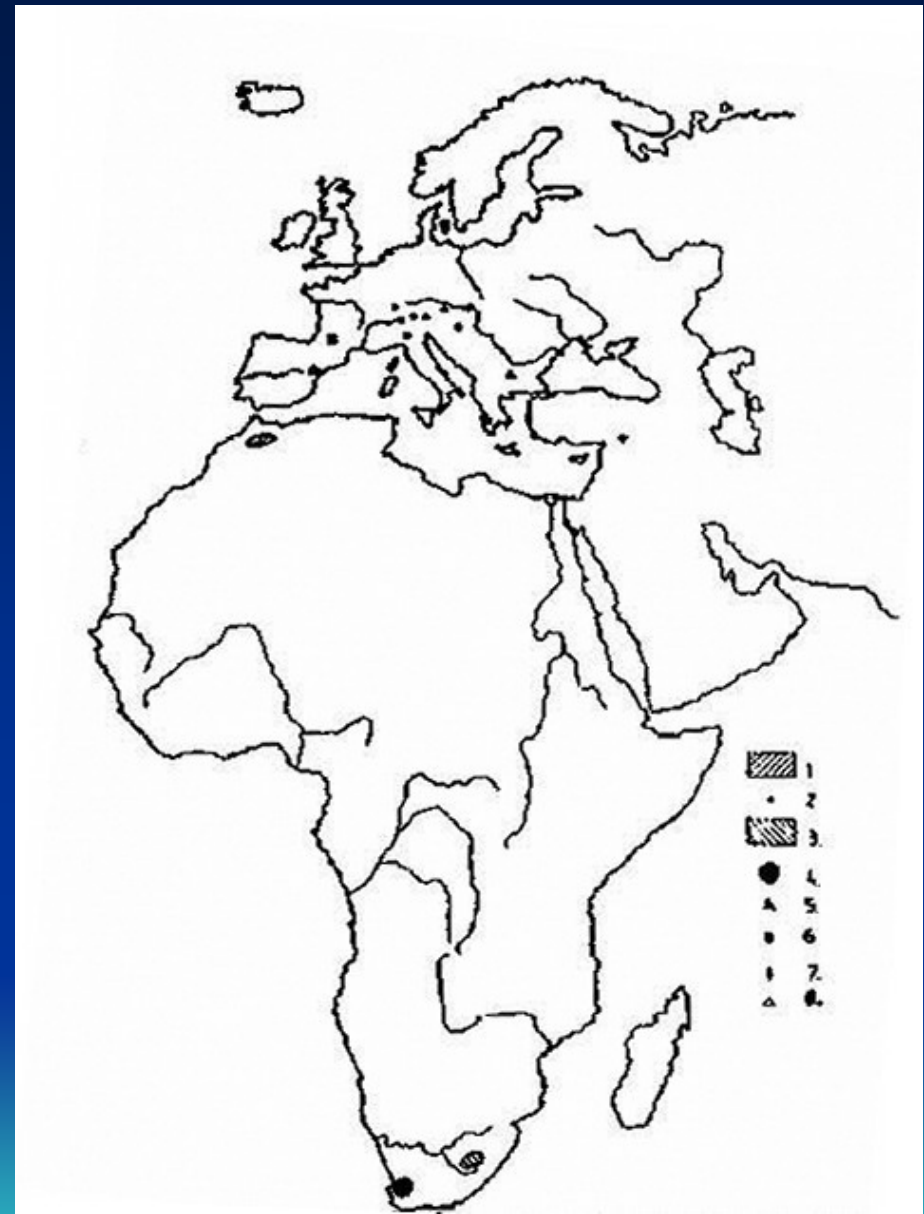
The find belongs to a bittern (Botaurinae) and represents a distal end (part of diaphysis) of the right carpometacarpus. Morphological features suggest a form similar to *Botaurus*, but because of its bad preservation it could not be determined further. It is the only Bulgarian fossil record of Neogene bitterns. Bochenski (1997) and Mlikovsky (2002) list no fossil taxa from Europe of Botaurinae.



The finds of *Geronticus balcanicus* Boev, 1998 (Fig. 7) from Bulgaria represent the only Tertiary record of *Geronticus* on the Balkans and the Eastern Europe. They prove the existence of Bald Ibises in the Eastern Mediterranean contemporaneously with these of the Western Mediterranean, at least during the very end of the Pliocene. According to Tyrberg (1998) the stratigraphic range of *Geronticus eremita* encompasses “Late Pliocene/Early Pleistocene (MN 18) - present”. The fossil records of that species (Late Pliocene/Early Pleistocene in Eastern Spain and Middle Pleistocene in Sicily, Italy) are dated 1,6-2,7 MA (MN 17/18) and 0,5 MA respectively). The numerous historical records of *G. eremita* up to 17th century possibly indicate the native South-European or even Middle East (Fore-Asian) origin of this species (Fig. 8).



The relationships among different species of the genus *Geronticus* are insufficiently known. The genus numbers 4 taxa – 2 extant and 2 fossil. Having in mind the former distribution of *G. eremita* in S and C Europe until 17-th century (including the Balkan Peninsula) we suggest that the Middle Villafranchian Balkan Bald Ibis (*Geronticus balcanicus*) was possibly a more primitive sister-taxon to the recent *eremita* and that it was extinct in the Pleistocene. Paleoornithology has not firm data to consider the genus *Geronticus* to be of an African origin. Its presence in Europe is well documented since the Middle Miocene, through the final of the Upper Pliocene, Early Holocene and until recent times. Recently some new records also has been uncovered in Europe – France and Spain.



Anseriformes

Anatidae

Cygnini

Cygnus



Cygnus verae Boev, 2000 (Fig. 9) is an early Pliocene swan, differing from the recent *Cygnus* species by its well developed incisura capitis, which width in the narrowest place constitutes no less than one third of the width of caput humeri, whereas in all other Palearctic species it is less than one third. Its find together with finds of *Silurus serdicensis*, indicates the presence of a large water basin in the present day Sofia Kettle. *C. verae* is the 3rd anatid, described from the Balkan region.

Anatini

Anas

The occurrence of dabbling ducks (*Anatini* gen., *Anatinae* gen. and *Anas* cf. *clypeata*) indicates the presence of large water bodies with open surface of steady or slow-moving water at the sites of Troyanovo, Varshets and Slivnitsa respectively.

The find of *Anas* cf. *clypeata* is the oldest record of that species so far. It indicates its Pre-Glacial presence on the Balkans, defining it as a Tertiary relict in the modern SE-European (and Western Palearctic) avifauna.

The evolutionary trends of the *Marmaronetta angustirostris* lineage are traced by the Pliocene and it possibly belongs to a distinct subfamily. Our material does not support firmly its existence in the Miocene, but at least confirms, that a different lineage of small anatids, except that of genus *Anas*, was already evolved.



Balcanas

The morphological comparison characterises *Balcanas pliocaenica* Boev, 1998 as a small to medium sized duck, combining the features of *Anas* and *Aix* (Fig. 10). Such mosaic structure of skeletal elements is known for many Tertiary, mainly Neogene, taxa. For example, the Early Miocene ducks from France have been regarded as difficult to place even in a modern tribe (Olson, 1985). As the g. *Anas* is known since the Upper Oligocene of Europe (former Czechoslovakia) and Asia (Kazakhstan), we only may consider the Dorkovo specimen as parallel coexisting with *Anas* taxon in S (SE) Europe at least during the Late Miocene - Early Pliocene.

The presence of an anadid (*Balcanas pliocaenica* from Dorkovo), also suggests the existence of aquatic habitats in the vicinity of the site. Such suggestion was proved by the analysis of the bone finds accumulation, as well as the presence of fossil beavers (Castoridae gen.).



Accipitridae

Gyps

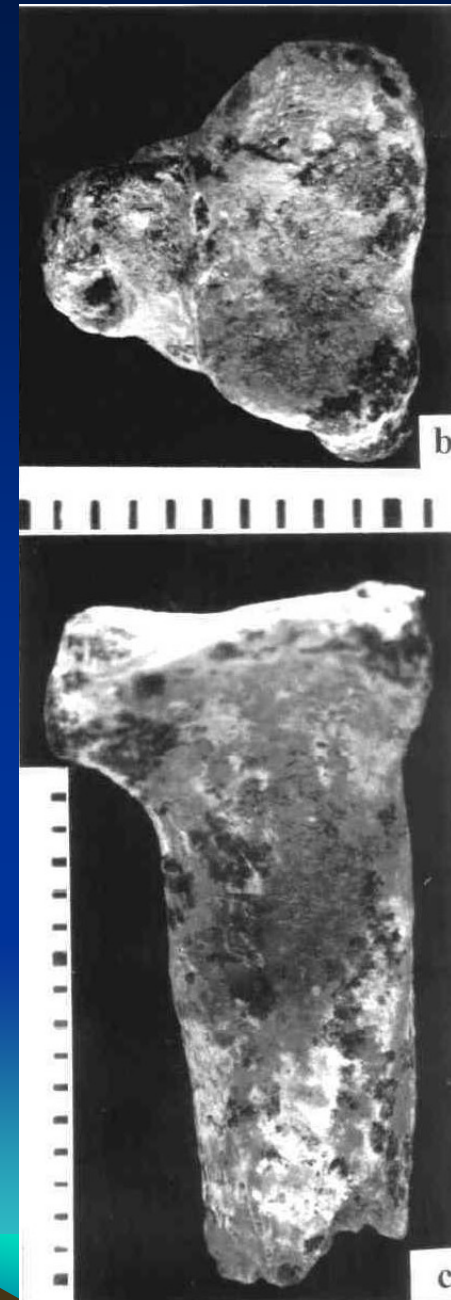
Griffons (*Gyps*) are the most varied genus among the recent vultures. They number 8 recent species and their present distribution suggests a South-Asian (foothill of Hymalayas) origin of the genus.

The relationships among the griffons are not sufficiently clear. Both osteology and dimensions show that the fossil griffon from Varshets was closer to recent *G. fulvus* than to dubious *G. melitensis*, which could be accepted as an aberrant island form adapted to endemic terrestrial island megafaunas. The presence of the large vultures as griffons (*Gyps* sp. n.) among the other forested-savanna components as *Otis khosatzkii*, *Circaetus* sp., *Hieraaetus* cf. *fasciatus*, *Aquila* sp. ex. gr. *clanga*, *Melanocorypha* sp., *Alauda* sp. among birds) of the Villanyian fauna of Varshets recembles to the analogous associations from other Pliocene sites of the Old World. It is the first site of that kind on the Balkans and completes the information on the Late Pliocene environment of this anteroom of Europe.

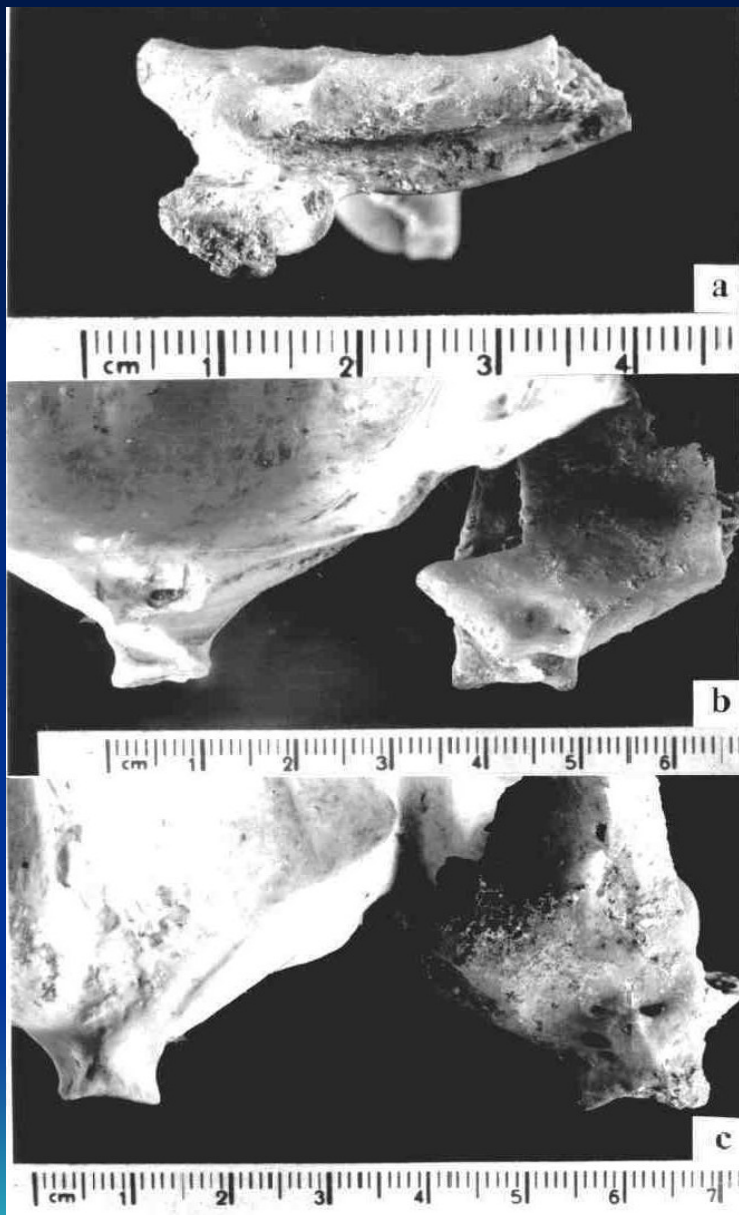
^[1] Here we divide the s. c. “Diurnal raptors” into two separate orders, Accipitriformes and Falconiformes, following some recent evidences of their ancient separate evolution. Even more the “nocturnal raptors” (Strigiformes) are recently approached to Falconiformes than to any other of the modern orders.



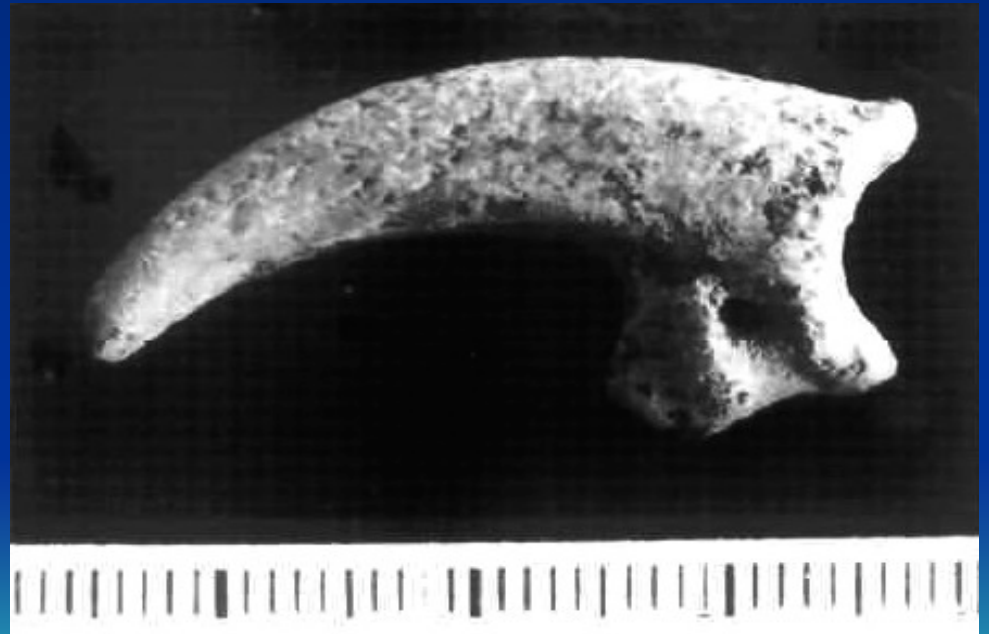
The finds of *Gyps* sp. n. (Fig. 11-16) are the oldest fossil record of the genus *Gyps* from Europe. They mark its presence at least from the Late Pliocene (Villanyian). On the other hand, Varshets is the first Pliocene (and Tertiary at all) site of *Gyps* in the Palearctic region. In spite of the southern origin of the genus, it is clear that by the beginning of the Quaternary *Gyps* was spread at least in the SE-European territories (Balkans).



Gyps sp. n.



Gyps sp. n.





The only Tertiary records of *Accipiter* in Europe originate from Bulgaria (Muselievo and Varshets; Mlikovsky, 1996).

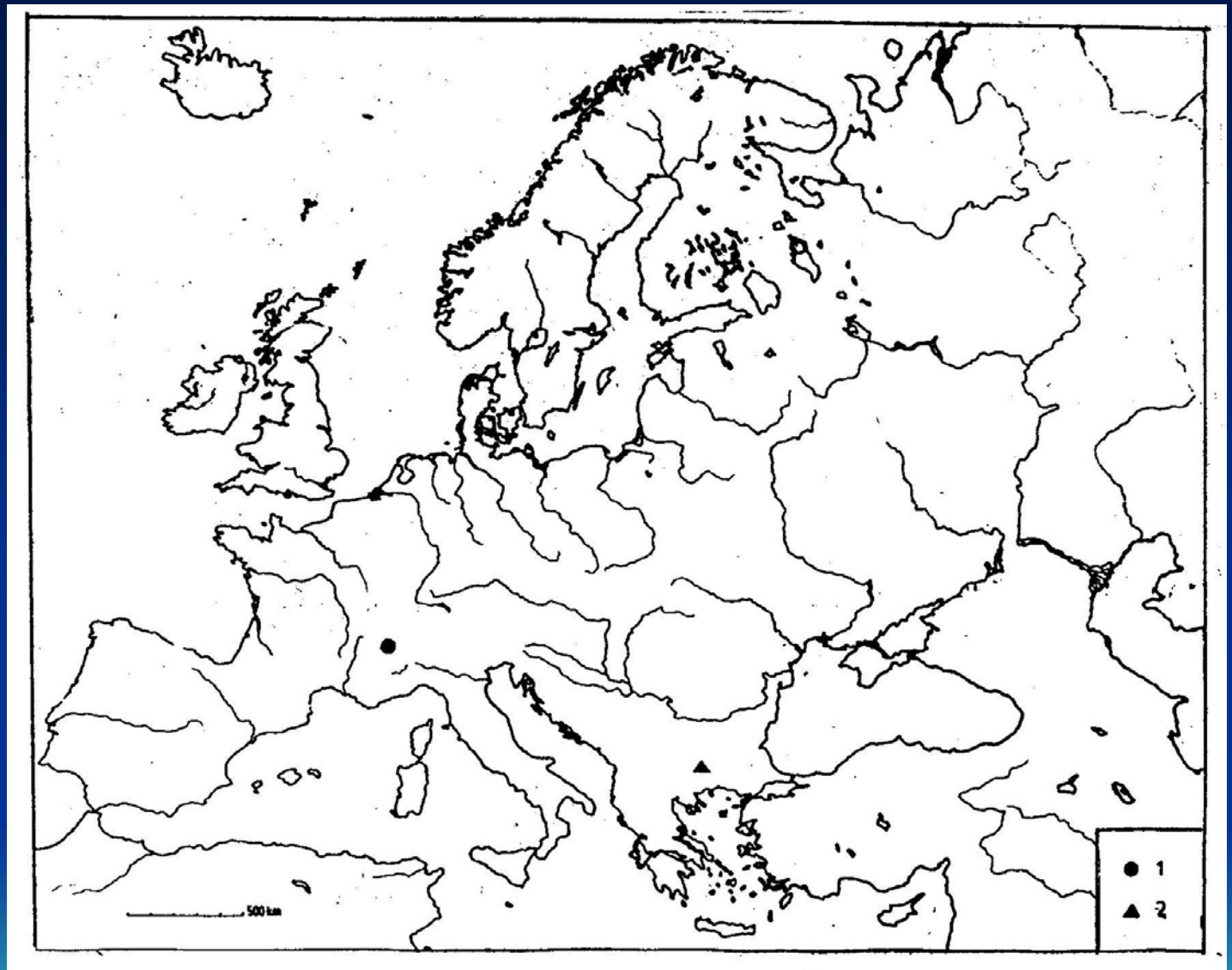
All the fossil taxa described in *Accipiter* originate from the Quaternary. The Muselievo specimen (Fig. 17) represents a fossil hawk of the *gentilis* group, differing from *A. gentilis* by: (1) the symmetrical profile of the sulcus m. scapulotricipitis; (2) round, but not angular profile of the condylus ventralis and (3) the almost twice more distally positioned foramen nutricium on the fossa m. brachialis.

Thus, the find of *Accipiter* sp. ex gr. *gentilis* represents the oldest record of the genus *Accipiter* and provides the second fossil taxon of that genus. This taxon possibly lies on the same evolutionary lineage as the recent *A. gentilis* and may be considered an ancestor of the recent Holarctic Goshawk.

Buteo



Judging by the higher number of recent species, spread both in S and N America, and bigger number of fossil taxa, described there, we may conclude that the *Buteo* originated in Western Hemisphere, possibly in S America, where most of the species still occur. So far the fossil record of *Buteo* in the Old World is very rare. The find of *Buteo spassovi* Boev, 1999 (Fig. 18) from Hadzidimovo represents the 2nd record of *Buteo* in Europe (and all the Western Palearctic). At the same time, it constitutes the 2nd European fossil species of the genus *Buteo*. Both Miocene sites (La Grive-Saint-Alban and Hadzidimovo) now mark the S European distribution of *Buteo* in the Miocene of Europe (Fig. 19).

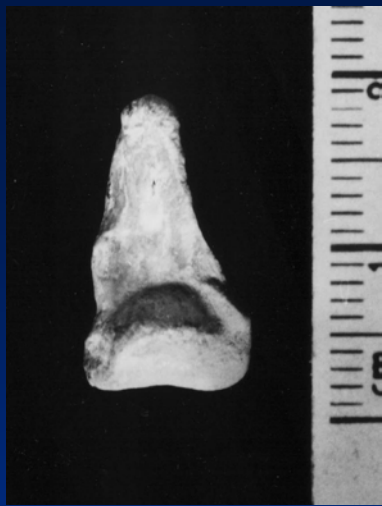


Circaetus

Similar is the situation with the records of some other accipitrid genera. The site of Varshets yielded the first fossil record of *Circaetus* in Europe, as well as in all the World (Fig. 20).

Hieraeetus

The same site yielded the oldest fossil record of the Bonelli's Eagle (*Hieraeetus fasciatus*), where 11 finds of an adult specimen were collected (Fig. 21-24).



Aquila

In the Hadzhydimovo site we identified one of the oldest European finds (except 2 from the Ukraine and Spain) of *Aquila* (Fig. 25). Material has been determined as *Aquila* sp. ex gr. *clanga* and represents the only record of the spotted eagles *Aquila clanga/pomarina* so far. Another eagle of *Aquila* sp. ex gr. *clanga* existed in the late Pliocene of Varshets.



Falconiformes

Falconidae

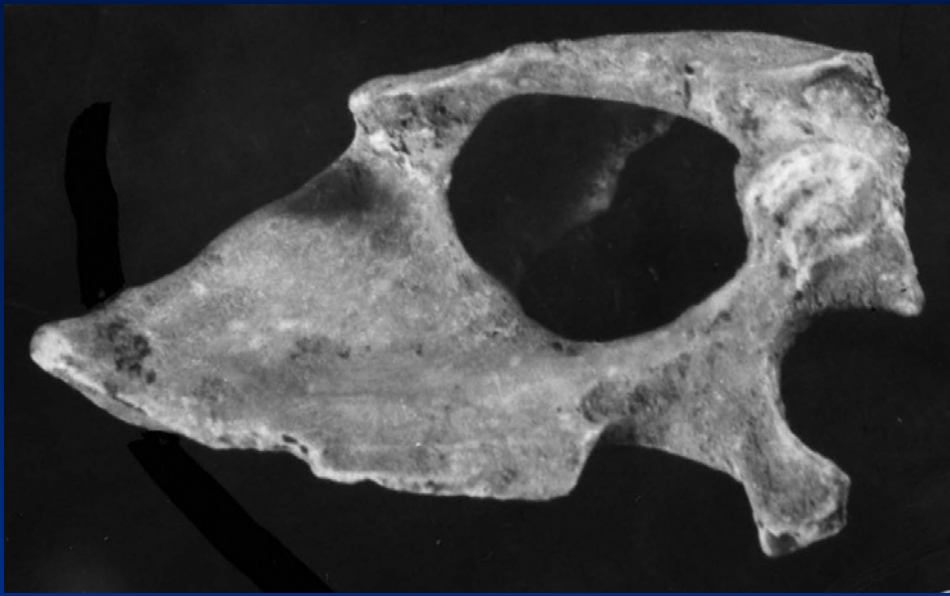
Falco

The g. *Falco* includes 37 species in the recent avifauna and their distribution suggests an Afro-South-Asian origin of the genus, nevertheless the present-day concentration of the family Falconidae in South America (Olson, 1985).

The fossil history of falcons in Europe and all over the world is very scant. The Old-World record includes 5 species, all from European localities, and all, except *Falco antiquus* Mourer-Chauvire (1975), came from the Neogene. *Falco medius*, described from the Late Miocene (Meotian; MN 11-13) of Umanskaya (1979) is the only known falcon of the Miocene both of Eurasia and Africa.

The four sites of fossil finds of *Falco* lie in the SE Europe (Hungary, Ukraine and Bulgaria) and provide the only fossil record of falcons on the continent during the whole Tertiary. Only 3 fossil species of the genus are described up till now in the Western Palearctic. They represent two different groups - the "*tinnunculus*" group (*F. medius* from the Miocene, and *F. umanskajae* from the Late Pliocene, both from the Ukraine) and the "*cherrug*" group (*F. antiquus* from the Middle Pleistocene of France).



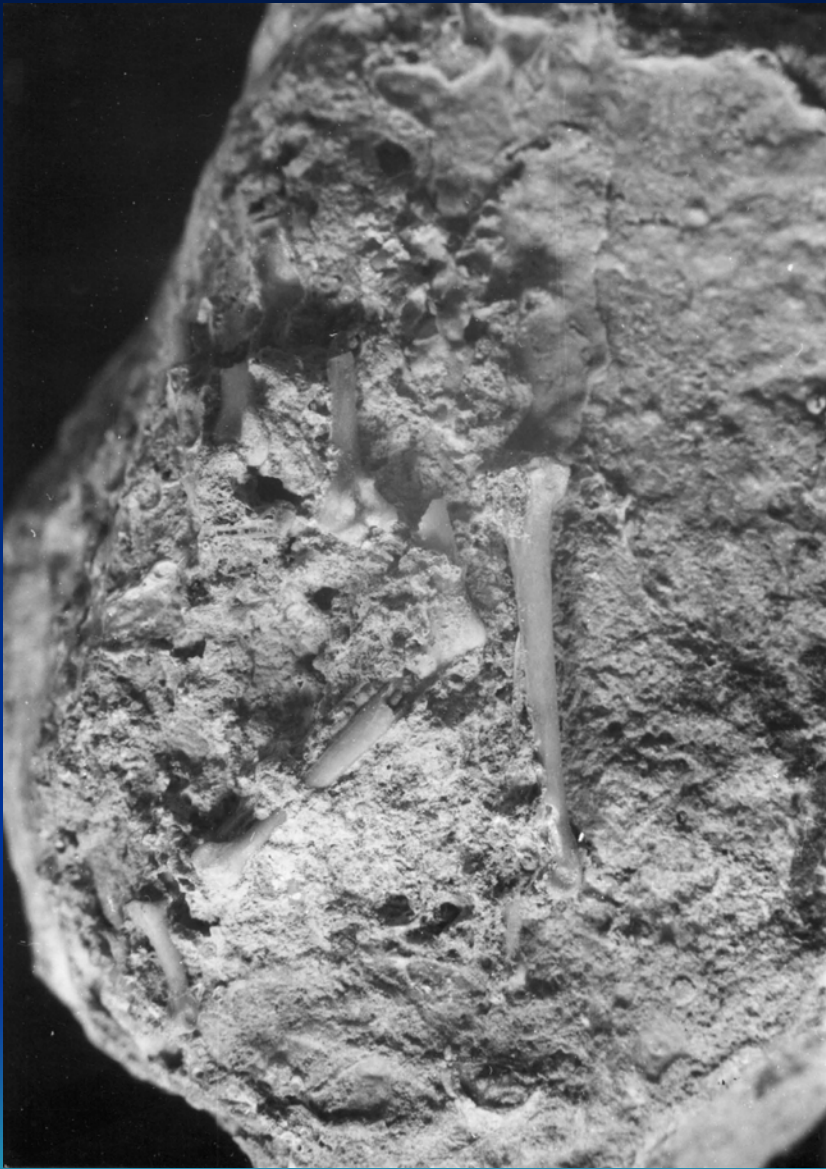


Two other sites (Beremend and Odessa catacombs) provide undetermined fossils of *Falco*. In spite of the southern origin of the genus, it is clear that by the beginning of Neogene, its representatives roamed widely the S-European territories.

The fossil species *Falco bakalovi* Boev, 1999 has been designated through a synsacral fragment (holotype, Fig. 26), collected in 1990. Since that time additional excavations for fossil material have been undertaken several years. Part of the collected rich material, still partly unexamined completely, belongs to a small falcon. We have listed a total of 16 new finds identified as *Falco* ex gr. *tinnunculus*. In addition some finds, collected in the last two years were also referred to this falcon.

The second taxon, the falcon from Hadzhidimovo is preserved by 17 bones of an adult specimen (Fig. 27-30). It is also a small falcon of the “*tinnunculus*” group, but it has relatively longer wings (humeri) and shorter legs (tiner, and possibly shorter, tarsometatarsi). Its examination started here, in the NHM in 2003, and should be completed.





Galliformes

Phasianidae

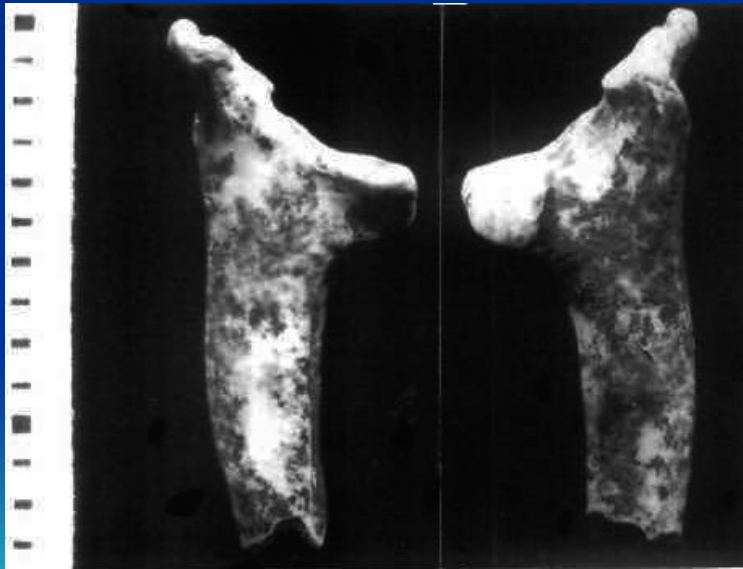
Chauvireria

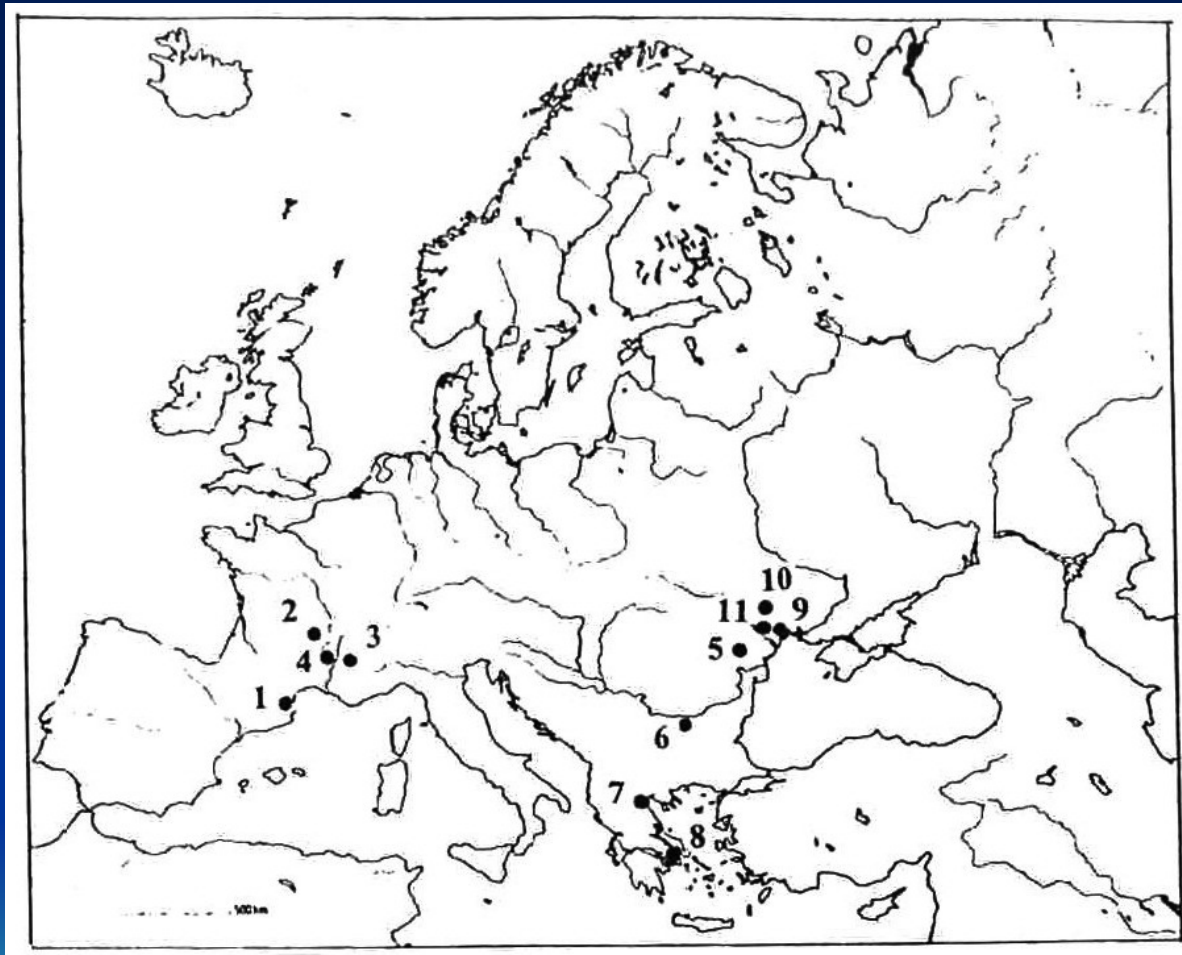
The extremely numerous remains (over 1160 bones and bone fragments from at least 52 individuals) of an unknown small phasianid of *Perdicinae* have been described as *Chauvireria balcanica* Boev, 1997 (Fig. 31-35). This Villanyian galliform is closely related to the genus *Palaeocryptonyx* Deperet, 1892. *Palaeocryptonyx donnezani* from the West Europe is taxonomically the closest Galliform. *Chauvireria balcanica* finds represent almost 62 percent of all the Neogene bird remnants, found in Bulgaria.



Diagnosis: A small phasianid of *Perdicinae* subfamily with almost parallel *os metacarpalis majus* and *os m. minus*, sharper and smaller *processus pisiformis*, more erected *processus extensorius*, narrower *spatium intermetacarpalis*, well developed *processus intermetacarpalis*, which reaches *os metacarpalis minus* and which cranial edge forms an almost right angle. Osteometrically *Chauvireria balcanica* was of the same size as recent *Ammoperdix griseogularis* and *A. heyi*.

It is surprisingly, but a second species of the same new genus, *Chauvireria*, existed in a slightly younger site, Slivnitsa, near Sofia. It is also numerous in its site and 54 remnants were collected of 4 individuals at least (Fig. 36-37). The description of that species is forthcoming





The Bulgarian finds of peafowl suggest that *Pavo bravardi* inhabited the South-European forests, both in the West and the East of the continent, but possibly not later than the Late Miocene - Early Pliocene (Fig. 38). The cervids' remains are numerous at species sites in the W Europe and they are indicators for woodland with scattered trees. A considerable abundance of finds of Cervidae is also established in the site of Muselievo.

After Mourer-Chauvire' (1990), the fluvatile, loessic, or lacustrine sites were among the preferred habitats of *P. bravardi* (Fig 39). This author concludes, the European peafowl disappeared soon after the first cold phases of Pretiglian. The open forest with undergrowth along streams, open woodlands, forest edge and riverine forest from the sea level up to 1000 m are also the favoured habitats of the two recent species of peafowl.



The stratigraphic range of *Pavo bravardi* is MN 15-17 (Early to Late Pliocene). *P. aesculapi* was in existence between MN 9 and MN 15 (Late Miocene to Early Pliocene). *Pavo aesculapi* was spread in Eastern and Central Europe, while *P. bravardi* roamed the whole Southern Europe, both Western and Eastern Europe. In the Western Europe the latter survived up to the very end of the Pliocene (Mourer-Chauviré, 1996). It is likely that in SE Europe this peafowl had survived in the relatively warmer habitats until more recent time by the beginning of the Pleistocene. Muselievo is the 10th European site of *Pavo*. Soon after its publishing we established the next, the 11th site in the N Greece, near Thessaloniki (Megalo Emvolon). Thus, 4 of the European sites are W-European (France), and 7 – E-European (Bulgaria, Greece, Moldavia and the Ukraine).


Phasianidae gen. indet.

The site of Gorna Sushitsa reveals the oldest Balkan galliform, coming from the Late Miocene, MN 11-12. It is still unexamined, but the preservation of the find (two thirds of a left ulna with proximal epiphysis) allows to be identified at least to generic level. The specimen coexisted with mammalian species of the s. c. Hipparion fauna.



The Neogene record of Tetraonidae is relatively scanty. As a country of southern geographical location Bulgaria has relatively abundant Neogene record of Tetraonidae. Four of the nine Tetraonid species in Bulgaria are fossil: *Lagopus atavus* Jánosy, 1974, *Lagopus balcanicus* Boev, 1995, *Tetrao partium* (Kretzoi, 1962) and *Tetrao rhodopensis* Boev, 1998.

Bocheński (1991) demonstrated that the origin of *Lagopus* in Europe dates to the Early Pliocene. Jánosy (1991), however, suggests that Tetraonidae have their origin in Europe in the Late Pliocene. Mourer-Chauviré (1993) also shows that the Tetraonidae appear as early as the Early Pliocene (MN 15) in Europe, a judgement based chiefly on data from Central Europe. *Tetrao rhodopensis* from S Bulgaria is a little bit older than *T. macropus*. The Bulgarian record of *L. atavus* is also among the oldest finds of the genus *Lagopus*. The locality of Rebielice Krolewskie 1, the type locality of *L. atavus*, is dated MN by 16, while the age of Weze 1, the type locality of *T. conjugens*, is MN 15 Both sites are in Southern Poland. The relative geographical proximity and the chronostratigraphical similarity (MN 15 - MN 16) proves that in the Ruscinian two regions of the continent, the Balkans and Central Europe, were inhabited contemporaneously by well-distinguished representatives of the basic genera of Tetraonidae. This suggests an older origin for Tetraonidae, i. e. not Ruscinian, but possibly the end of the Late Miocene (Turolian - Pontian).



It is interesting that the fossil record of the family does not agree with the recent mitochondrial DNA phylogeny of Lucchini et al. (2001). On the other hand their molecular data for the late Miocene (6-9 Ma) appearance of the first tetraonids surprisingly coincide with the analysis of the fossil record (MN 11-13) of this family. Lucchini et al. (2001) accept a North American (“western part of the Nearctic”, p. 157) origin of the family and all the constituent Tetraonidae genera, “with the possible exception of *Tetrao*”. They consider that the present distribution of the tetraonids should be regarded as a result of at least three dispersal events from North America to Eurasia, involving the ancestors of *Bonasa*, *Lagopus* and *Tetrao* in the Palearctic.

De Juana (1994) writes that it is speculative to decide where in North America or Eurasia the family first appeared. We do not accept such a position, because 9 species of the total 17 and 4 genera of the total 7 are represented in the recent Palearctic tetraonid fauna. The Bering Bridge served as a natural way for the interchange of the terrestrial faunas including large land birds such as tetraonids.



The Early Pliocene records suggest that the Palearctic (European, and even SE-Europe) is the area of the origin of the family, confirming a statement of Dr. Denes JÁNOSSY (in litt.). The relatively recent origin of Tetraonidae was also hypothesised by Potapov (1987) and De Juana (1994). The last author summarizes that *Tetrao* first appears in the Pliocene of Europe, and *Bonasa* and *Lagopus* appear in the Pleistocene of Europe. As mentioned above, our data disagree with these suggestions. Some results of the study of Lucchini et al. (2001) do not agree with such a statement. They determine the appearance of *Bonasa* as dating to 5-6 MA, while “the other genera diverged during the upper Pliocene, and most of the ... species ... originated during the lower Pleistocene.”.

It is not very likely that Tetraonidae appeared in Nearctic because no fossil evidence is known in North America besides the four (?)doubtful Miocene taxa, listed by Brodkorb (1964) and rejected by Olson (1985). No later records of the Tetraonidae from the Tertiary are known in North America and after this large hiatus the next oldest data for Tetraonidae comes from the Early to Middle Pleistocene (Wetmore 1940; Brodkorb 1964). The situation in the Western Palearctic is quite different. Here we have a well-documented fossil record of Tetraonidae (represented by 13 taxa, 9 of them fossil!) from the Ruscinian until the Early and Late Pleistocene and further up to recent times.

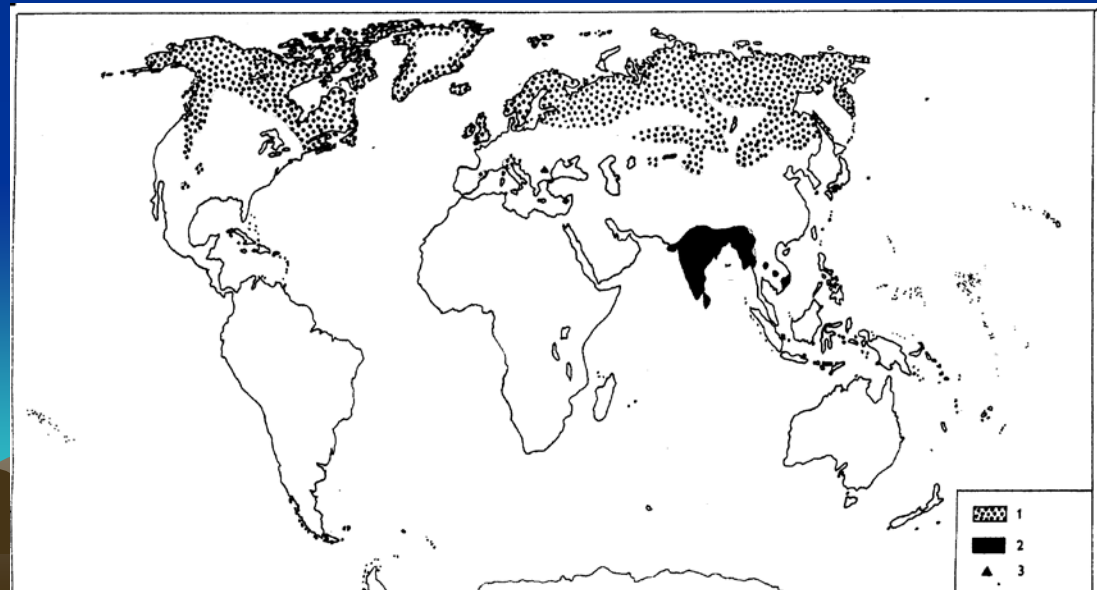


Another reason for rejecting a North American origin for Tetraonidae is that they are considered to have differentiated morphologically from Phasianidae (Potapov, 1987; De Juana 1994). Furthermore, phasianids are only found in the Old World, and no fossil record is known of the family from New World localities up to the present (Brodkorb 1964; Olson 1985). This completely causes one to reject the hypothesis that Nearctic was their area of origin.

The summary data for Europe shows (Mlíkovský 1996 a) that Tertiary records of Tetraonidae was confined to only four countries – France, Poland, Hungary and Bulgaria. Mlíkovský (1996 b) summarizes that “Tetraoninae [i. e. Tetraonidae – Z. B.] genera were recorded in Europe from the Ruscinian (*Tetrao*, incl. *Lyrurus*), and Villanyian (*Lagopus*) respectively”. As can be seen from the Bulgarian record, the appearance of *Lagopus* (*L. atavus*) could also be considered the most ancient, i. e. from the Ruscinian (MN 16 in Rebielice Krolewskie 1 and MN 15 B in Muselievo), instead of the Villanyian. *Tetrao* and *Lagopus* coexisted in Rebielice Krolewskie 1 (Bocheński 1996) and since that time have always coexisted in the Western Palearctic. Their coexistence in the Villayian is proved by the fossil records from the locality of Varshets.



Another fact deserves special attention: traditionally Tetraonidae have been considered cold-loving birds. “A major ecological feature of the Tetraonidae is their perfect adaptation to cold climates.” (De Juana 1994). This may be true, if we consider recent species. However, the earliest fossil tetraonids do not fit such a view and data from Bulgaria rejects it. *Lagopus balcanicus* and *Tetrao partium* from Varshets coexisted with the warm-loving *Apus baranensis* Jánossy, 1977 (Boev 2000 b), *Hieraaetus* cf. *fasciatus*, *Gyps* sp. n., *Circaetus* sp., n. *Tetrao rhodopensis* also shared the surroundings of Dorkovo with a small undetermined species of *Perdicinae*, while *Lagopus atavus* in Muselievo coexisted with *Pavo bravardi* (Boev 1998, 2001; Fig. 40). If not the whole family, at least the genus *Lagopus*, appeared in the forested savanna or savanna-forest. The habitats for the earliest representatives of *Tetrao* may have been similar. Examples of more or less forested savanna (mosaic habitats/ open forests) inhabitants from the long lists of the mammalian taxa from Dorkovo, Muselievo, as well as that from Varshets confirm such a statement.



Thus, the open light forests and the savanna-like forests were the habitats of the earliest known Tetraonidae in SE Europe. In Dorkovo, Muselievo and Varshets, the climate was milder, moister (in Dorkovo), drier (in Varshets) and warmer, than at present. This strongly contradicts to the statement of Lucchini et al. (2001) that

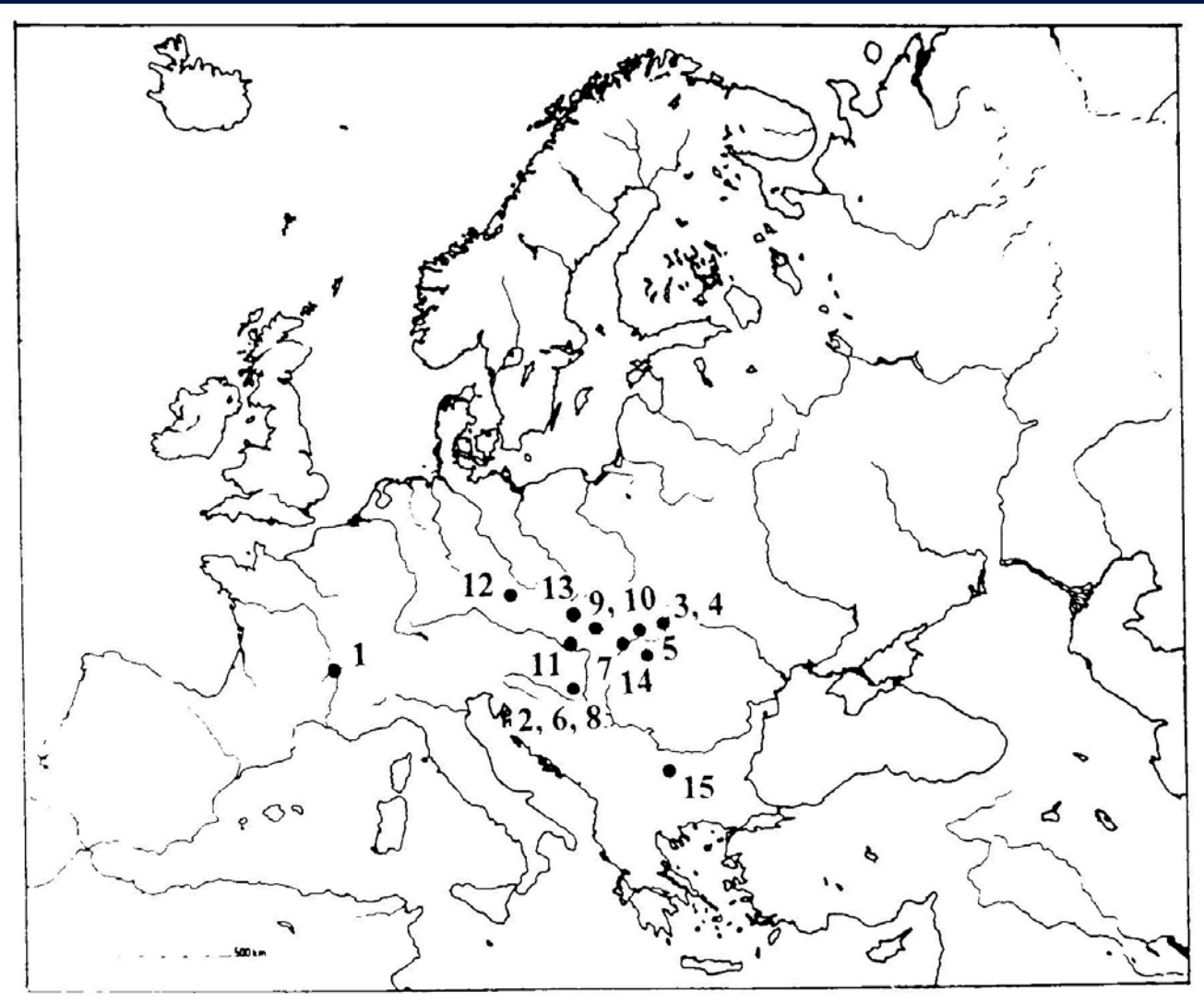
“Ancestral grouse might have evolved from North American phasianids when deciduous temperate forests replaced tropical forests during the Tertiary period.”. It also contradicts the assumptions that (1) *Tetrao* “... evolved later and expanded northward [along the Rocky Mountains in North America – Z.B.] during the Pliocene-Pleistocene climate cooling”, and that (2) *Lagopus* has a North American origin.

In short, Tetraonidae probably first appeared in the Western Palearctic (most likely SE Europe - SW Asia) during the Late Miocene (Pontian), because *Lagopus* and *Tetrao* are known from the Ruscinian as two distinctive and differentiated genera. *Tetrao* first appeared in the Balkans and Europe not later than the Early Pliocene, while the earliest record of *Lagopus* is MN 15. Forested savanna, savanna-steppe or parkland forest was the habitat of the first tetraonids. The earliest tetraonids were not cold-loving birds, they lived in habitats of a warmer climate than the family lives in today. Their adaptations to colder climates and habitats with snow are a more recent phenomenon, i. e. Late Pliocene – Early Pleistocene. This change was accomplished very quickly, although their relatively limited specific variety was preserved.

The Tertiary fossil record (MN 14-15, i. e. 5,4-3,4 Ma) of Tetraonidae, especially of *Lagopus* and *Tetrao*, from the Western Palearctic confirms the monophyletic origin of Tetraonidae.

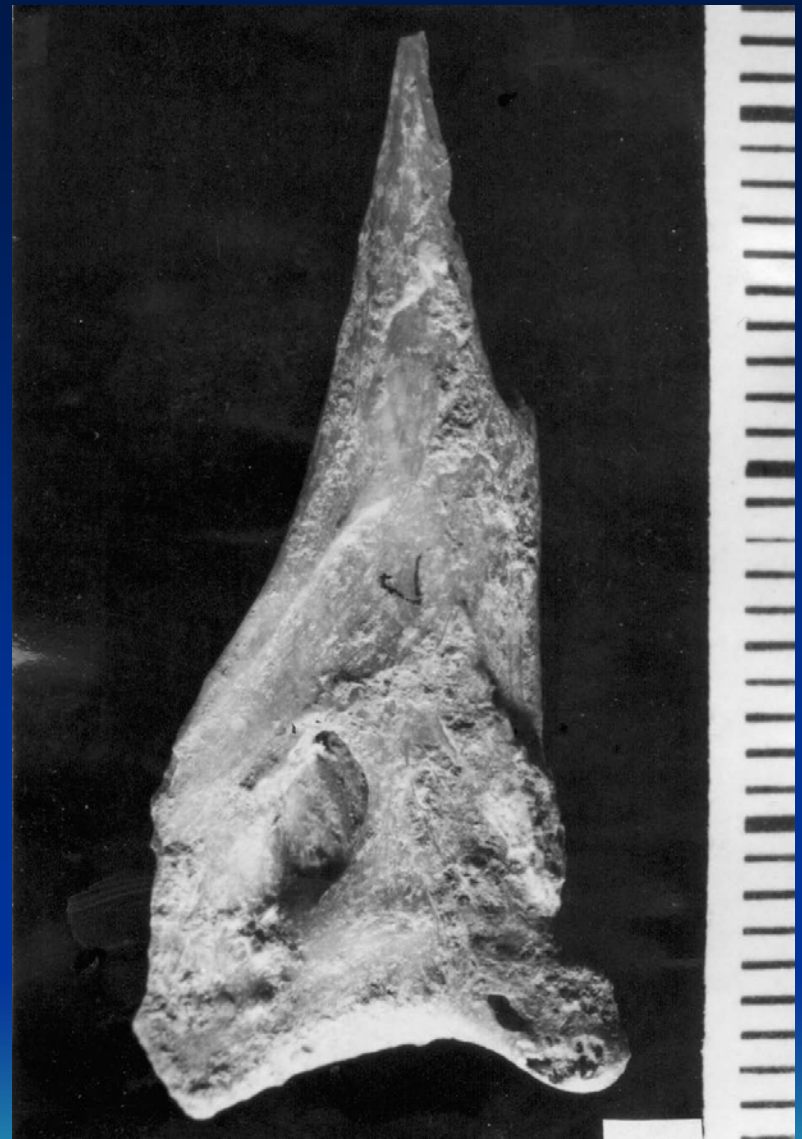
Tetrao

The geographical range of *Tetrao partium* (Kretzoi, 1962) following Janossy (1976) encompasses a large territory of Europe from France to Ukraine (Fig. 41), while stratigraphically the species was spread from the Middle Villafranchian to Mindel.



At the same time, Mlikovsky (1996) lists no Tertiary sites of that species in Europe. Most abundant summary data were cited by Tyrberg (1998). According to him, the stratigraphic range of *T. partium* is between 19 and 21 MNQ zones, while the geographic range encompasses France, Hungary, Romania, Austria, Germany and former Czechoslovakia.

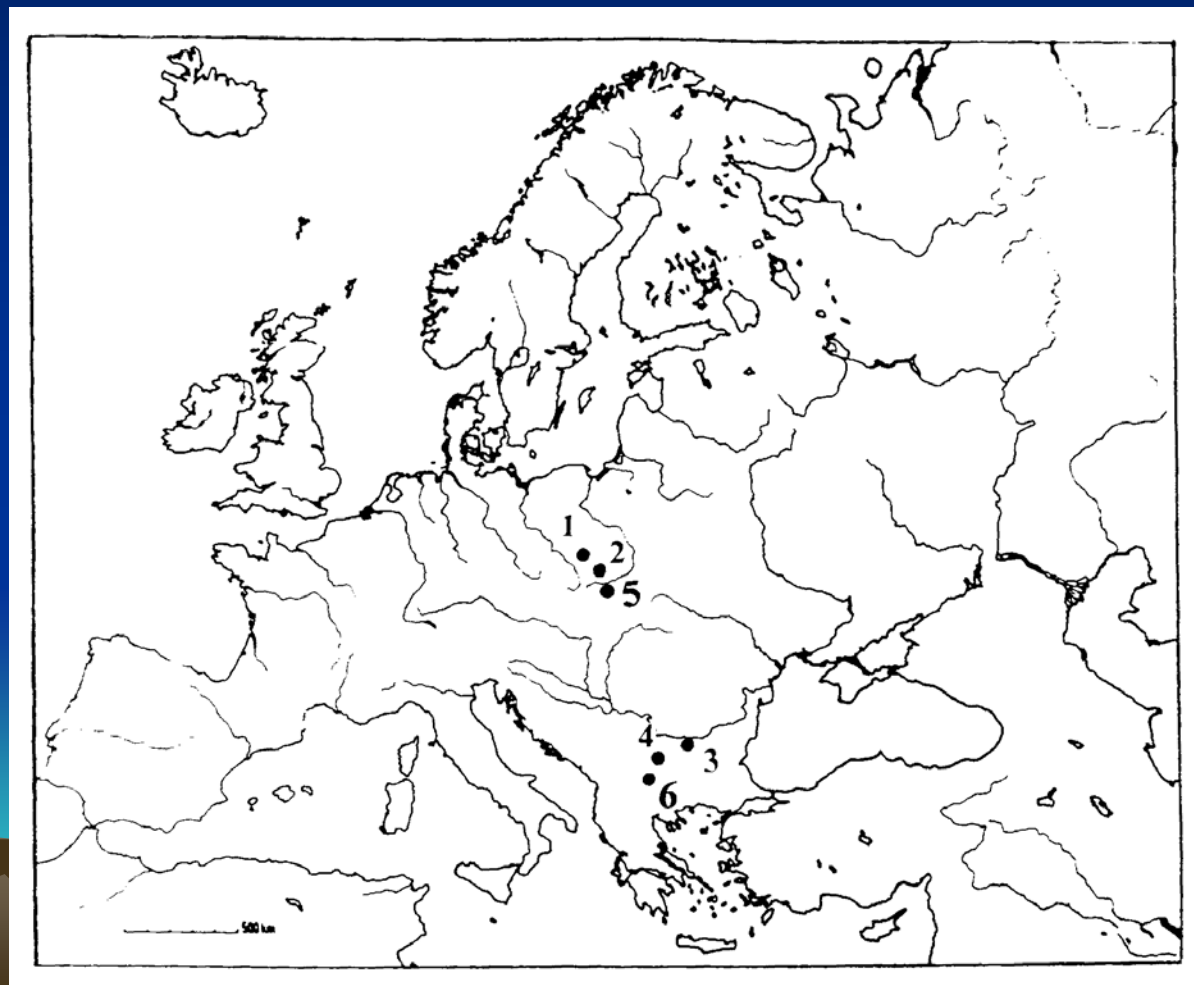
The finds of *T. partium* from Bulgaria (Fig. 42-43) came from Varshets. They show that at least in the Middle Villafranchian the species occurred not only in the West and Central Europe, but also also in the Eastern part of the continent. The record from Bulgaria is the earliest find of the species on the Balkans and marks the southern limit of its range.

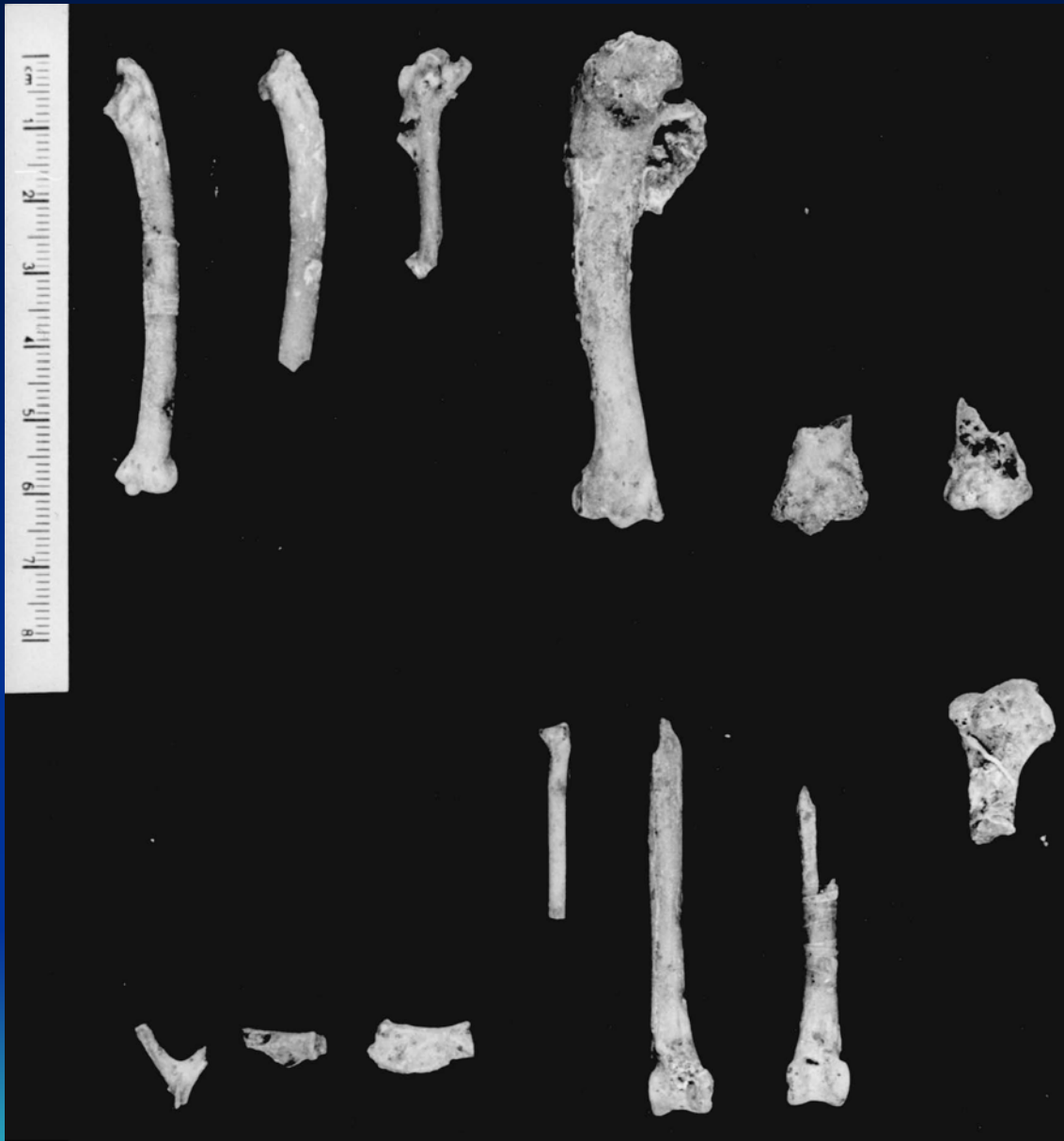


Summary data of Janossy (1991) indicate that all Tetraonid fossils were younger than the end of Ruscinian. The genus *Tetrao* (“*urogallus*” lineage) is an indicator for a forest landscape and it occurs mainly in the coniferous and mixed coniferous-deciduous forest zone in the mountains of Southern Palearctic. The presence of *Tetrao* among the fossils of Dorkovo confirms the suggestion that a forest landscape might occurred in the region of the site. The find of *Tetrao rhodopensis* Boev, 1998 from Bulgarian Ruscinian of Dorkovo also confirms the splitting of the *Lagopus* and *Tetrao* lineagers at least in the beginning of the Pliocene.



The find from Muselievo (Fig. 44) is among the oldest records of *Lagopus*. Moreover, the site of Muselievo marks its southernmost distribution in the Tertiary. The site is unique with the coexistence of *Lagopus* and *Pavo* in the Early Pliocene of SE Europe. It reveals an association that so far has been unknown.





The numerous Pliocene remains of *L. balcanicus* Boev, 1995 (Fig. 45) confirm the forested savanna-forest or forest-steppe origin of genus *Lagopus*. Even in the Pleistocene *Logopus* species adapted to the Boreal/mountain treeless habitats.

Gruiformes

Rallidae

Olson (1985) summarizes, that rails occur regularly in the Neogene deposits of the Northern hemisphere. According to Bochenski (1997) 12 Neogene and 1 Quaternary rallids have been described from Europe. This author lists only one species of Rallidae, established in the Pliocene deposits from Europe. The fossil taxa (2 fossil species and 1 fossil subspecies) were spread throughout Eastern Europe and all of them came from sites that are located in the hilly landscapes near the running water basins.



Besides the morphological differences between both species, we consider the Pliocene *Porzana* sp. n. from Bulgaria (Fig. 46-47) a possible ancestor or a fossil sister species, close to *Porzana porzana*. *Porzana* sp. n. existed in MNQ 17 zone, while the oldest finds of the closest species, *P. porzana*, originate from the Middle Pleistocene, MNQ 22 zone. Considerable dimensional differences between the Varshets specimen of *Porzana* sp. n. and the smaller Western-Palearctic species of genus *Porzana* (e. *P. parva*, *P. pusilla*) allow to place it into the *P. porzana* lineage, distinguishing it from the *P. pusilla/parva* lineage.



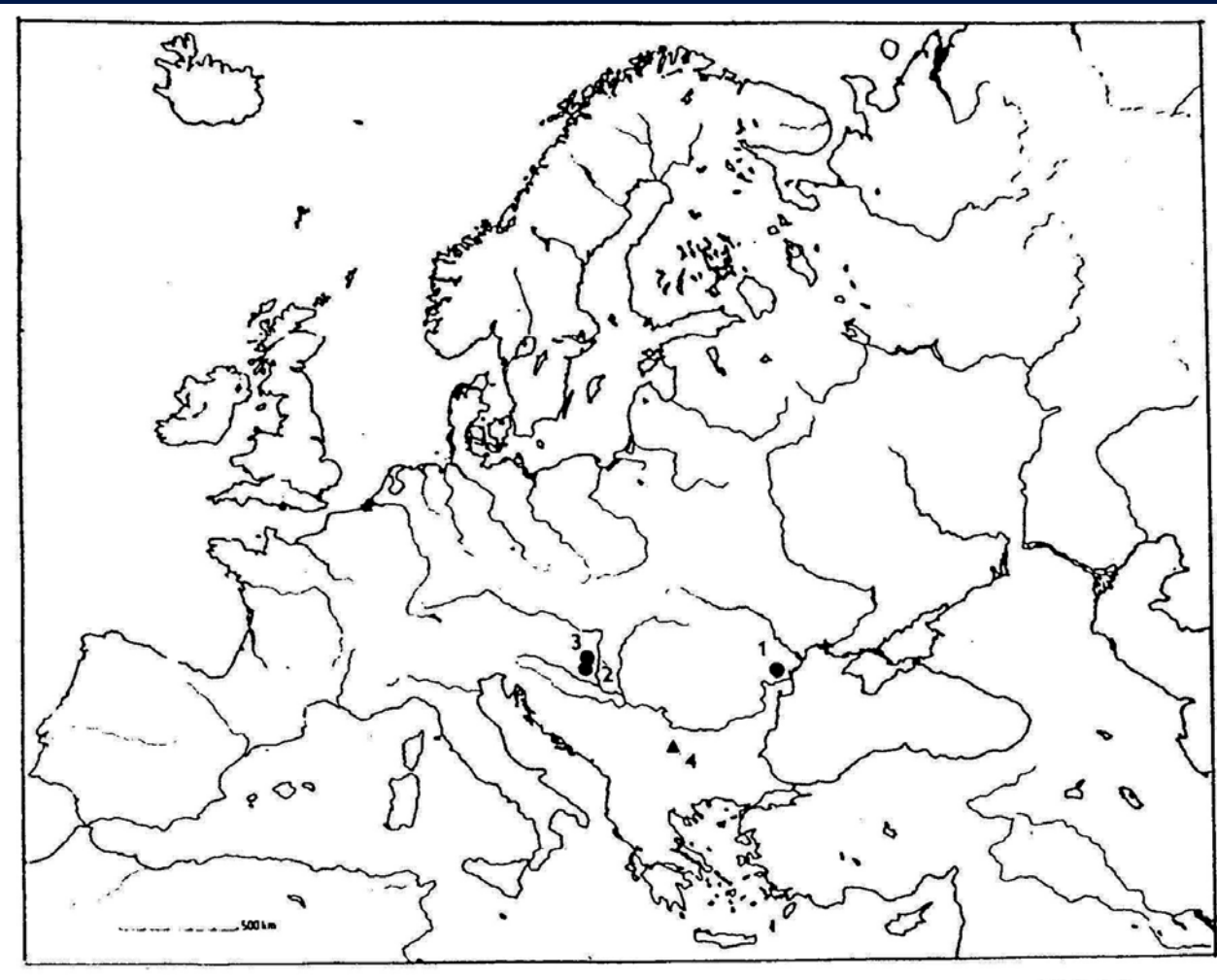


The second rallid, *Gallinula balcanica* Boev, 1999 from the Middle Villafranchian (Fig. 48), is considered to be a direct ancestor of the recent *chloropus*. Finds of *Gallinula* are reported from the Early Pliocene (MN 15) in Hungary. No other Tertiary finds (except these of Tanzania) are reported up to now (Mlikovsky, 1996). Only one fossil species of this genus, *Gallinula gigantea* Tchernow, 1980, is recognized from the Early Pleistocene from Israel (MNQ 19) and from the Middle Pleistocene (MNQ 21) from Czechia (Tyrberg, 1998). In his Synopsis of the Fossil Rallidae Olson (1977), lists no Old World taxa.

Otitidae

The fossils of bustards are not numerous in the Tertiary sites. All finds of *Otis khosatzkii* originate from plain (Etulya, Polgardi), or hilly (Beremend, Varshets) regions of Central and SE Europe.

These regions are specific for all recent Otitidae species. The presence of bustard remains indicates an openland habitat with grass vegetation and scant bushes or scattered trees.

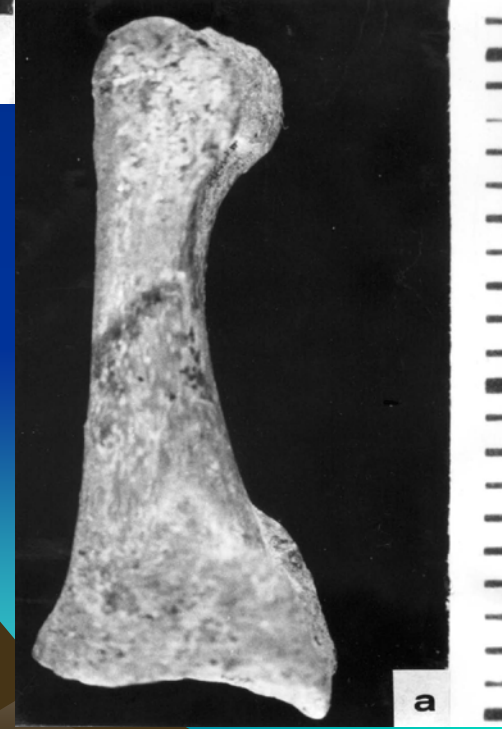


The medium sized Khosatzkiy's bustards had probably been wide spread in the Late Pliocene throughout S and E Europe before the first Pleistocene glaciation events of considerable importance took place. According to the available data so far, its range encompassed the perri-Carpathian region (Hungary, Moldova, Bulgaria) (Fig. 49). On our opinion, the Khosatzki's Bustard was a species of (South-) East-European distribution.

As Janossy (1991) has summarized, at the end of Tertiary there was an evolutionary explosion of bustards, mainly in the Eastern part of Europe. He considers the Late Miocene (Pontian, MN 13) remains of *Otis khosatzkii* as the first proof of the presence of *Otis* in the region. Besides the large chronostratigraphical hiatus, Janossy (1991) described a subspecies, *O. k. beremendensis*, from the Early Villafranchian.

The finds of Varshets (Fig. 50-53) correspond best to this form both dimensionally and chronologically, so we refer them to it. Recently Mlikovsky (2002) has synonymized all the records of *Otis khosatzkii* from Moldavia, Hungary and Bulgaria to the recent Houbara Bustard (*Chlamydotis undulata*), without seeing and examination of Bulgarian finds.





Charadriiformers

Scolopacidae

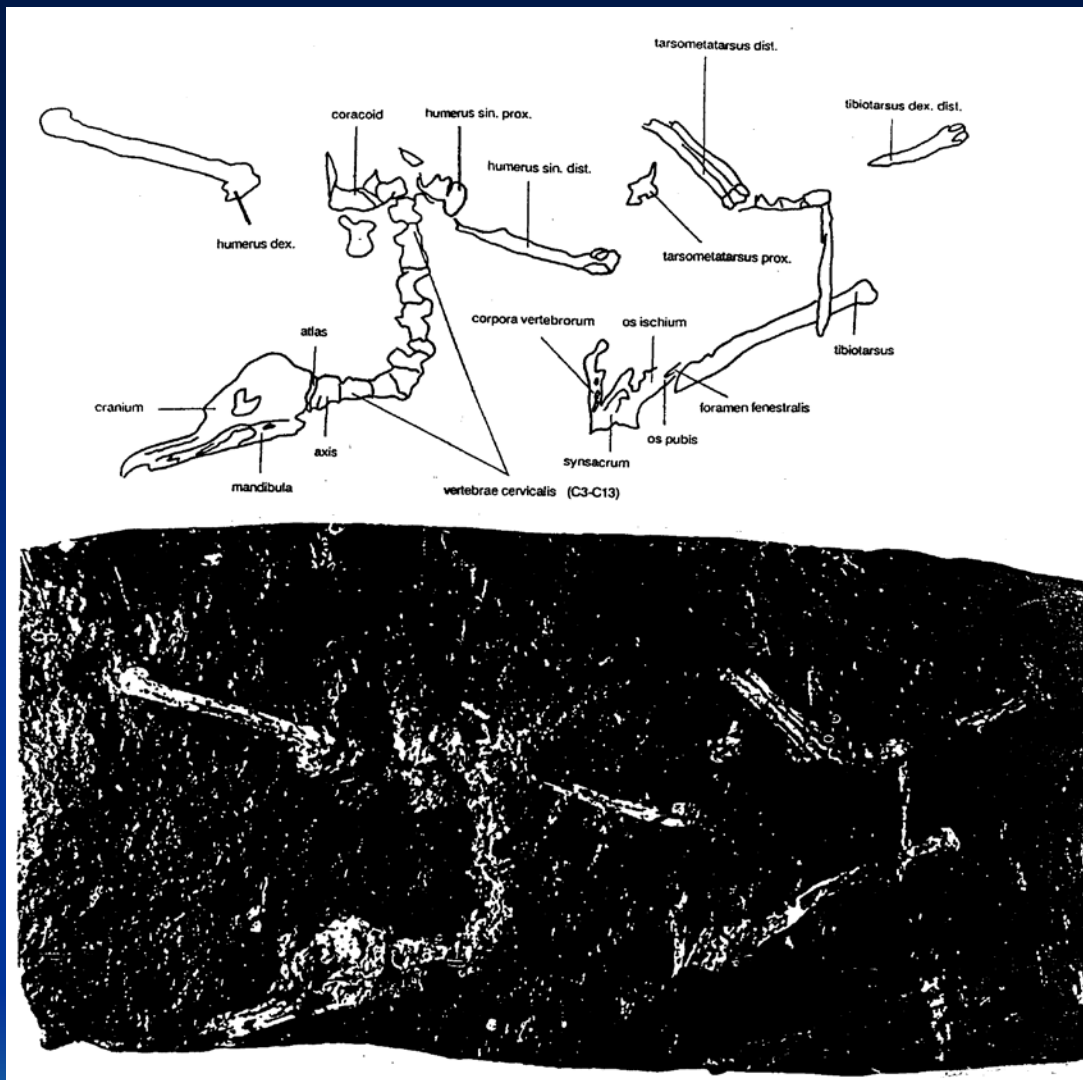


Until now, the earliest finds of *Actitis* originate from the Late Pleistocene and they chiefly come from the South-European sites (France, Spaine, Italy, Crimea). The Pliocene distal tarsometatarsus from Varshets (Fig. 54) is the earliest record of *Actitis* at all. As the larger part of the breeding range of the genus lies in the Palearctic region and the earliest finds originate from Europe, we may consider the Pliocene South-European fresh-water shore habitats as the initial grounds, where the *Actitis* evolved. It is quite possible that *A. balcanucus* sp. n. was the direct ancestor of recent *A. hypoleucos*.

Laridae

The fossil gulls are represented in the Neogene deposits chiefly by the genus *Larus* (Mlikovsky, 1996 a). According to this author its record in Europe is concentrated in the Vallesian deposits (MN 9-10). Turolian sites are not very numerous. Mlikovsky (1996 a) lists 44 sites of that age from Europe and a total of 46 established avian genera. His data show that there is no fossil record of Laridae family both in the Turolian and the Ruscinian deposits of Europe.

Seven species were described in the genus *Larus* from Europe. The Bulgarian find from Hrabarsko (Fig. 55) represents a skeleton, laying on its left side up. The find is included in a coal block.



Besides the incomplete determination (Larinae gen.), the find of the gull from Hrabarsko has important significance. It is the 2nd aquatic species both, among mammals and birds, established there. Thus, while terrestrial mammalian megafauna indicates dry forest-steppe landscapes, avian fauna not only confirms the presence of such habitats (proved by two larks - *Melanocorypha* sp. n. and Alaudidae cf. *Lullula*), but also indicates the presence of large water bodies (*Phalacrocorax*, Larinae gen.). The studied specimen has intermediary size between the recent *Larus minutus* and *Larus ridibundus*.

Columbiformes

Columbidae

The six late Pliocene finds, identified as *Columba* sp. – 1 and *Columba* sp. – 2 came from the site of Varshets. They could not be determined further, because they all belong to immature individuals, except a specimen (No 11 277), which morphologically differs from the recent Rock Pigeon (*Columba livia*). Three other finds from the same site belongs to *Streptopelia* sp. Mlikovsky (2002) lists no other Neogene records of that genus for Europe.



Strigiformes

Strigidae

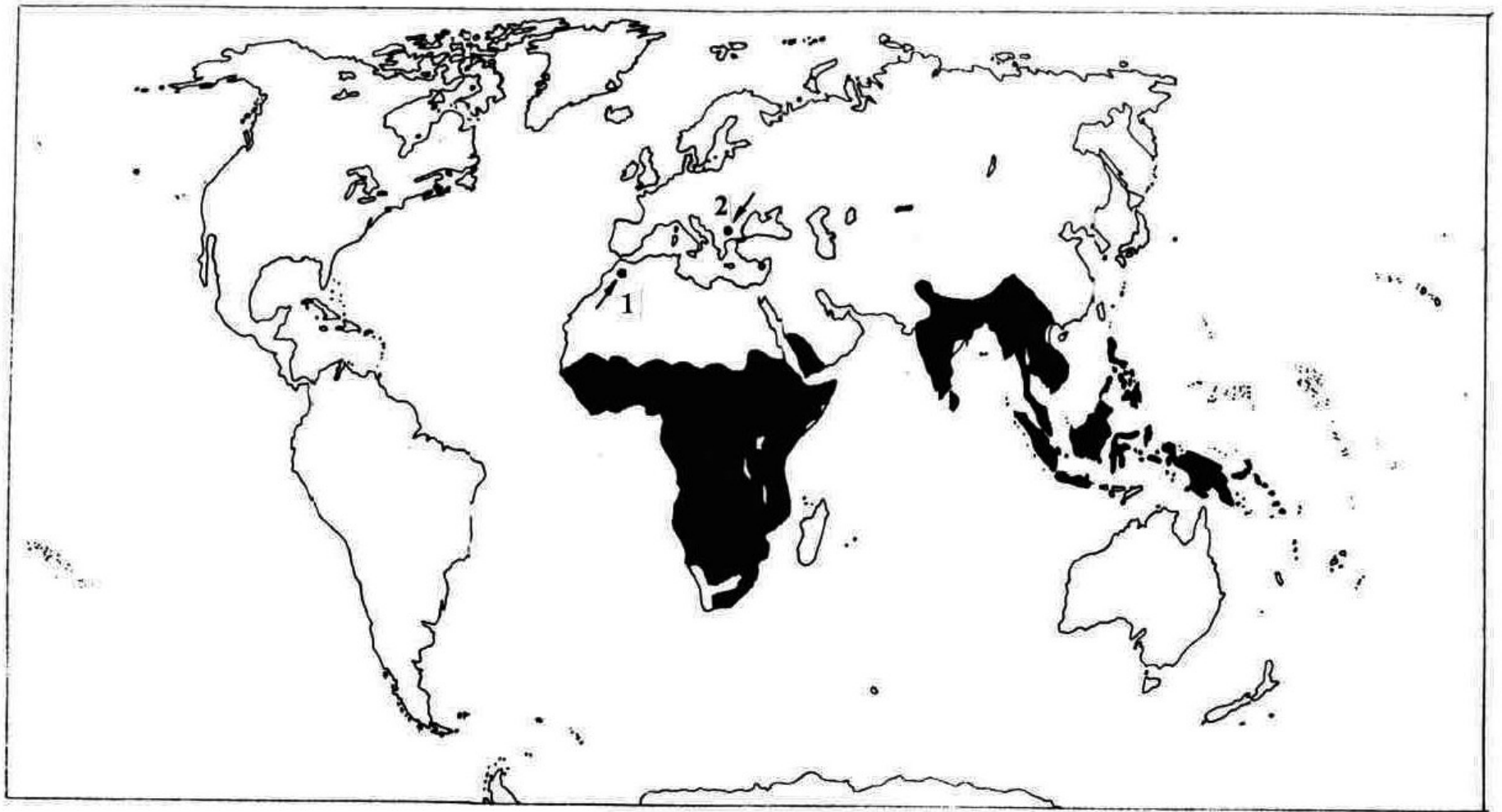
The Neogene record of Strigiformes from Bulgaria is extremely rare. Being woodland group of birds, owls are not numerous in general in the fossil record. Their only find (an incomplete sternum), identified as *Athene* sp. originates of the end of Late Pliocene from Slivnitsa. Besides its incomplete identification, after Mlikovsky (2002) it is the oldest so far European record of that genus in Europe.

Coraciiformes

Bucerotidae

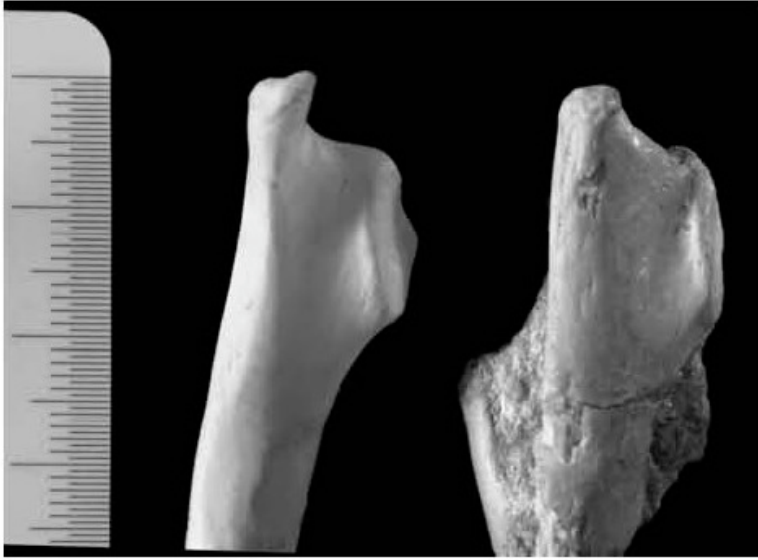
Hornbills are currently distributed through the Paleotropics (Fig. 56). The Ground-hornbills (Bucorvinae) include two recent and one fossil species (Brunet, 1971; Kemp, 2001).





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 tarsometatarsus from the late Miocene of Beni-Mellal in the Atlas Mountains (N Morocco), described as *Bucorvus braillyi* 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 the modern Palearctic region" was correct, bearing in mind the recent discovery in Bulgaria. This faunal complex suggests that *Euroceros bulgaricus* Boev, 2007 (Fig. 57) in its appearance, behaviour 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, where possibly the ostrich is the most diagnostic species among birds.

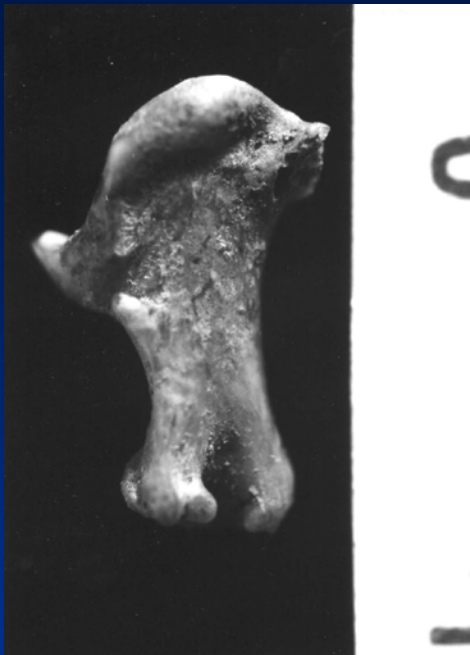






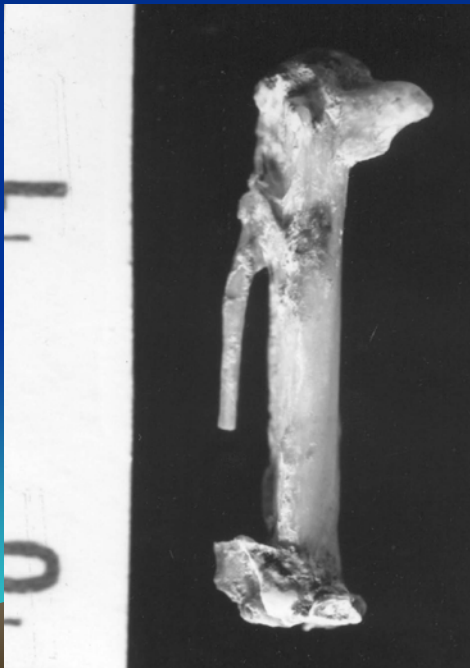
The proportional comparison of the osteometrical dimensions shows a very good separation of the Bulgarian Ground-hornbill from its closest relatives (*Bucorvus abyssinicus* and *B. leadbeateri*). It cannot be compared with *B. brailloni*, due to the absence of analogous skeletal remains. The remaining taxa of larger or similar size (*Buceros* spp., *Aceros* spp., etc.), approaching to *Euroceros bulgaricus*, are distributed in S and SE Asia, and are quite distinct in their bone morphology. The fossils of Hadzhidimovo are the oldest known record of Bucerotidae so far. The Beni-Mellal locality of *Bucorvus brailloni* lies at least 1500 km from the present range of the Bucerotidae in Africa. The Hadzhidimovo locality of *Euroceros bulgaricus* 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. This record for the first time proves the former distribution of Bucerotidae in Europe. 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.





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*) at least.

The scapula morphology and the relative contemporaneity show different evolutionary lineages of *Euroceros bulgaricus* and of *Bucorvus brailloni*. Anyway, the finds from Hadzhidimovo confirm the statement that Bucorvinae separated from Bucerotinae in the Miocene. After Kemp (2001) this separation is dated ca. 7 mya. On the other hand, possibly, the Ground Hornbills actually could be considered the ancestral group for the remaining Asian hornbills, as stated by Kemp (2001).

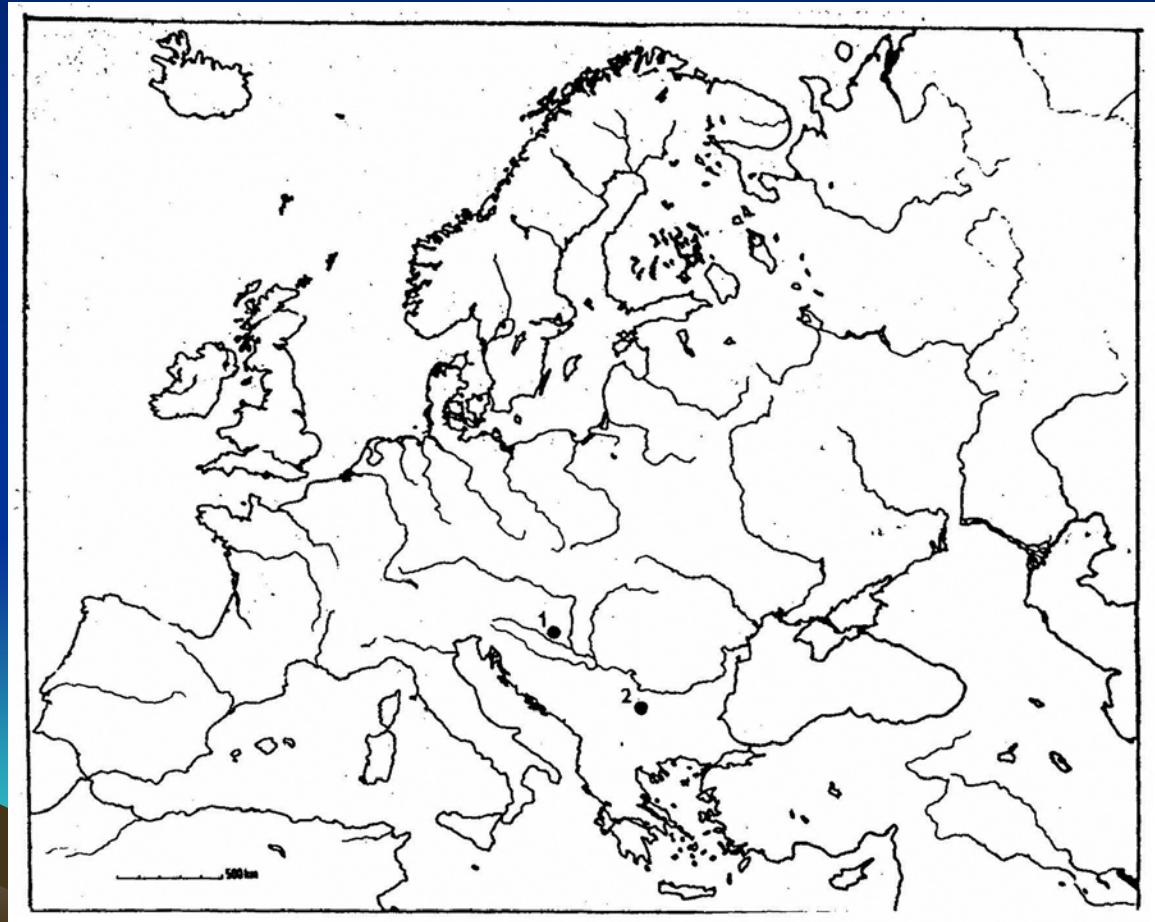


Apodiformes

Apodidae

The Pliocene swiftlet *Apus baranensis* Janossy, 1977 (Fig. 58-59), was spread at least in Central (S Hungary) and South-Eastern (W Bulgaria) Europe.

We may expect further finds of this species in other southern regions of the continent - particularly Apennines and Balkans. The two known sites (Beremend 5 in Hungary and Varshets in Bulgaria) lie within 480 km each of other (Fig. 60). The site of Varshets is the first confirmation of the species' existence up to now, after its description in 1977 from Beremend in Southern Hungary. Recently Mlikovsky (2002) because of the “general agreement in age and locality ...”, has synonymised all record of *A. baranensis* to *Apus wetmorei* Ballman, 1976, described from S Italy.



Passeriformes

Alaudidae



It is believed that Passeriformes accomplished their rapid flourishing in the Neogene. Alaudidae are usually placed among the first families of the suborder Oscines in the Old World avian systematics. It is accepted, that it has steppe origin. Dry and relatively warmer climate in some regions in combination of more humid and warmer climate in other regions, formed a mosaic-like habitat distribution was widely spread during the most of the Neogene in SE Europe.

The Bulgarian Neogene record of larks is relatively abundant and 16 fossils have been collected so far. The site of Hrabarsko yielded the earliest records of the family at all, except the find listed as “Alaudidae” from the middle Miocene of France. The late Miocene specimen of Hrabarsko belongs to a new, unknown species of *Melanocorypha* and represents a complete coracoid of excellent preservation (Fig. 61).

Another unknown species of *Melanocorypha* of lesser size has been uncovered in the late Pliocene of Varshets (Fig. 62). *Alauda* sp., *Galerida* sp. and *Eremophila* sp. are established in Varshets and represent the oldest European records of these genera. The excellent preservation of the specimen No 170 of *Eremophila* sp. n. from Varshets marks the earliest until now, appearance of the horned larks in Europe, ca. 2.25 my.



Motacillidae

Both basic genera (*Anthus* and *Motacilla*) in the recent fauna of the family in the Western Palearctics, are represented in the Bulgarian Neogene record, both in the site of Varshets. These finds, together with the finds of S Hungary (Beremend 5 and Polgardi 5), are the oldest ones so far.

Regulidae

Genus *Regulus* consists of 6 recent species. Two of them (*R. regulus* and *R. ignicapillus*) are spread in the Palearctic region, but the overall range of *Regulus* may be defined as Holarctic. No fossil taxa of that genus have been described so far and *Regulus bulgaricus* Boev, 1999 is the only yet known fossil kinglet (Fig. 63).



As known, *R. ignicapillus* inhabits chiefly lowland deciduous forests which relates better to our data for the presence of open light savannah-type forests in the vicinity of the site in the Middle Villafranchian. According to Blondel (1997), the Northern coniferous belt in the Holarctic appeared as a vegetation zone in the mountains of Eastern Siberia, is a definitely new event, unknown in the whole pre-Pleistocene history of the vegetation in the Northern Hemisphere. Thus, its avifauna is also younger and of a modern origin. This fact makes possible the acceptance of *R. bulgaricus* as a possible ancestor of *R. ignicapila*, or at least, as a stage of its evolutionary lineage. *R. regulus* is more “boreal”, inhabiting chiefly the coniferous massifs of the Temperate zone at present, a habitat that had not obviously been in existence around the site before the end of Pliocene. Hence, *R. regulus* can be defined as the younger species of the Palearctic kinglets. It can be ascertained that the fossil record of *R. regulus* started from the Late Pleistocene, and that the species differentiation must have occur not later than the Middle Pleistocene.

Sylviidae

Only a find (proximal half of a humerus), demonstrating some similarities to *Sylvia*, is referred to this family, but it could be hardly determined further.



Muscicapidae

The only record is a find of *Muscicapa* sp. from the Late Pliocene of Varshets. After Mlikovsky (2002) it is the second Cenozoic record of *Muscicapa* genus (besides a site of Mallorca) and the oldest one so far in Europe.

Turdidae

Bulgarian turdid fossil fauna came from the two Villafranchian sites, Varshets and Slivnitsa, and numbers a total of 8 taxa and 3 species at least. The records of these 3 species (*Turdus merula*, *T. iliacus* (Fig. 64) and *T. philomelos*) are the earliest known records at all.

In addition, a find of *Erithacus* sp. from Varshets is also the oldest record of that genus so far (Mlikovsky, 2002).





Paridae

The site of Varshets also yielded the earliest record of the Paridae. Part of the finds belong to *Parus* cf. *major* (Fig. 65), the oldest record of the Great Tit, while another smaller species (*Parus* sp.) coexisted with it.

Sturnidae

The fossil record of sturnids encompasses mainly the Pleistocene, and no Tertiary records are known (Mlikovsky (2002). In SE Europe, including the Balkans, there are no data of this family, now highly diversified in the Indo-Malayan Region. Sturnids are strictly arboreal, some live on flocks and build numerous nesting colonies. Only three species of starlings are spread in the Western Palearctic.

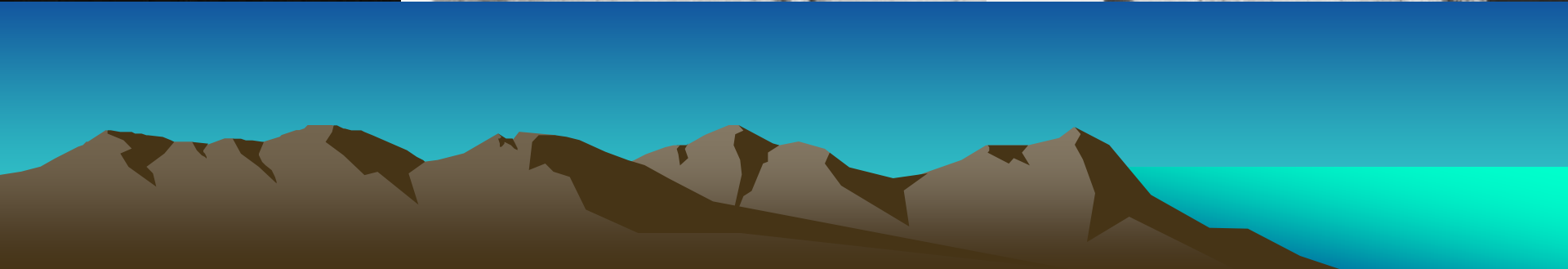
The late Pliocene *Sturnus* sp. from Varshets (Fig. 66) differs morphologically by its 3 finds from the modern *Sturnus vulgaris*, *St. roseus* and *St. pagodarum*, and most probably represent a new species.



Another species of Sturnidae is the oldest record of the family, originating from the middle Miocene (MN 5-8) of the site of Kardam. A partial skeleton of an adult specimen was discovered in the 1950s in the slab from drilling operations. Eight separate bones have been extracted from the matrix. In 1986 at the NHM in London jointly with Dr. Cyril Walker we referred this specimen to Sturnidae. In 1987 at the PIRAN in Moscow especially were examined the humeral parts of coracoids, and in 1990 at the NMNHW we compare again the finds with specimens of 45 passerine families, while at the UCBL we compared it with 11 other families, and obtained the same result, i. e. its belonging to sturnids. The specimen show higher similarity both to *Sturnus*, *Speo* and *Lamprotornis* from Sturnidae. *Sturnus* (incl. subgenera *Pastor* and *Temenuchus*). It lies within the measurements range of *Sturnus* spp., but it could not be firmly referred to any of the compared recent genera of Sturnidae. Thus, even its incomplete identification so far, the specimen of Kardam marks the presence of the Sturnidae family even in the middle Miocene of SE Europe.







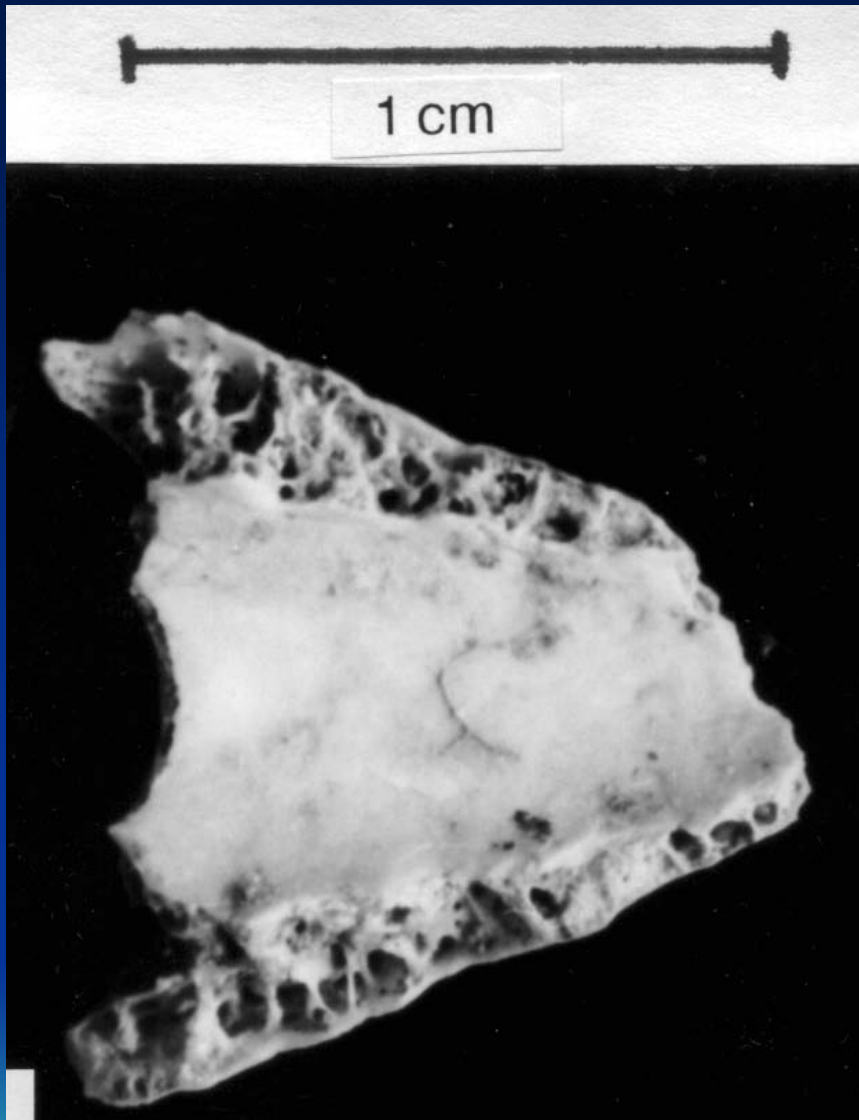


The richest corvid Neogene faunas in Europe is discovered so far in two late Pliocene sites of Bulgaria – Varshets and Slivnitsa, where 5 genera and 5 taxa were distinguished. The records of *Nucifraga* sp., *Pica* sp. (Fig. 67), *Pyrrhocorax pyrrhocorax*, and *Corvus* cf. *monedula* from Varshets are the earliest records of these genera/species. The record of *P. graculus* is the 2nd one after that of Csarnota in Hungary (Mlikovsky, 2002).

The record of *Corvus* aff. *praecorax* (Deperet, 1890) could be the first proof for the existence of that species, described from the early Pliocene of France, in the very end of the Pliocene on the Balkans. On the other hand, Mlikovsky (2002) has synonymized it to the recent *Corvus corone*, because of “the same size category”.

Such a corvid fauna is an example of the s.c. “mixed” faunas, as all the taxa established are specific to the openland habitats or rocky areas, except *Nucifraga*, which is a typical woodland form.

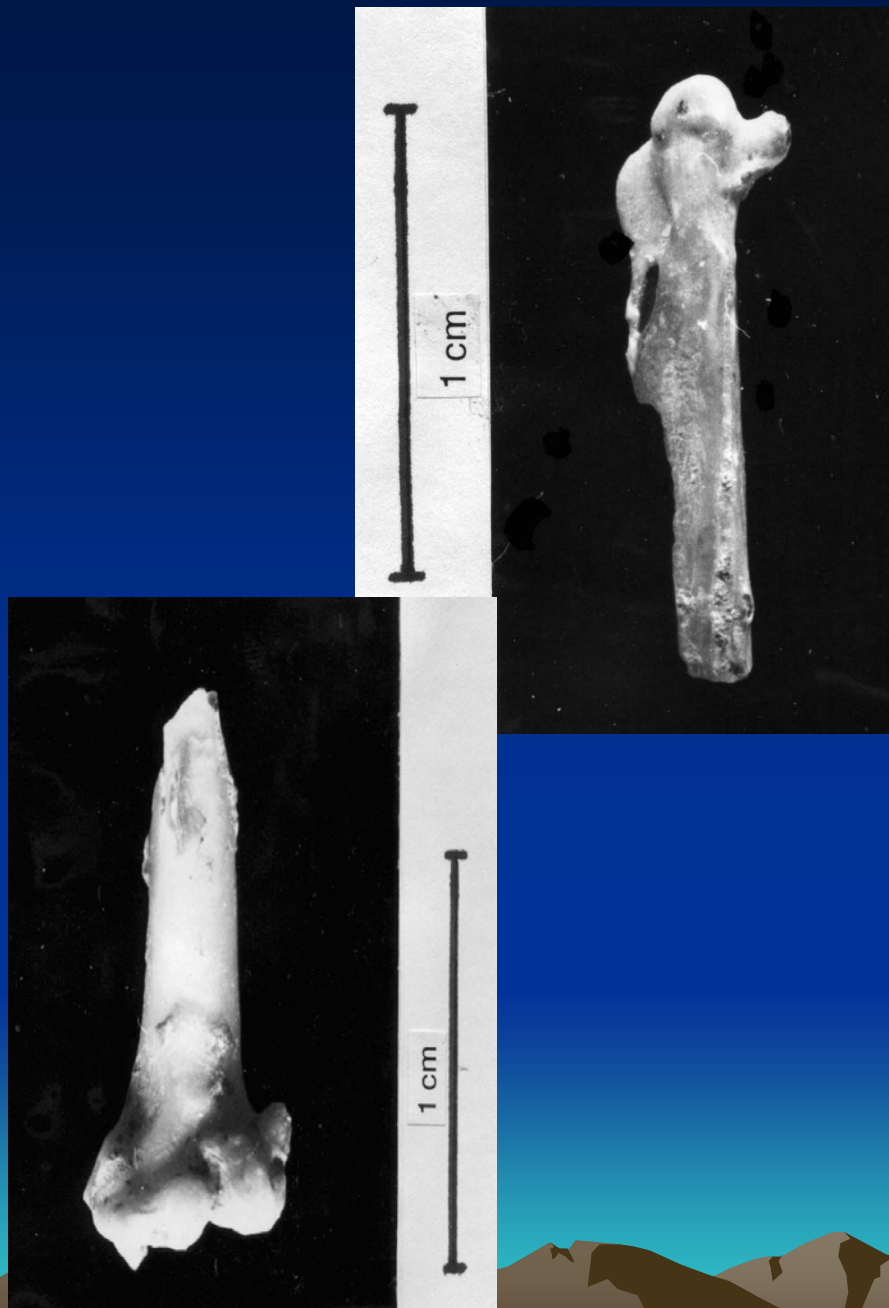
Fringillidae



Four genera (*Carduelis*, *Loxia*, *Fringilla* and *Coccothraustes*) were established in the Bulgarian late Pliocene deposits. All they also are the oldest record in the European Neogene.

Only a middle Miocene site of *Fringilla* sp. from Spain pre-dates the Bulgarian finds from Varshets. As seen below, the only known prehistoric species of extant genera of the World fringillid fauna came namely from the Bulgarian Neogene.

The late Pliocene finds from Varshets and Slivnitsa provide the earliest record of the *Coccothraustes* up till now. *Coccothraustes balcanicus* Boev, 1998 (Fig. 68), is considered as the Late Pliocene direct ancestor of recent Hawfinches (*C. coccothraustes*) in W Palaearctic.



A taxonomical identity of *C. balcanicus* and *C. simeonovi* Boev, 1998 (Fig. 69-70), cannot be excluded - both date from the end of SE European Middle Villafranchian. Because of the lack of analogous skeletal remains from both sites, and the chronological difference (about 0,5 my), we distinguished the finds from Slivnitsa and Varshets as two different species until additional homologous remains are collected. In any case, the late Pliocene finds from Varshets and Slivnitsa provide the earliest record of the genus *Coccothraustes*, until now. Both species mark the distribution of a forested landscape in the vicinities of the sites during the Villaniyan.

No fossil species of *Loxia* have been described up to now. The Middle Villafranchian crossbill *Loxia patevi* Boev, 1999, of the Balkan Mountains inhabited the light mixed open broadleaf forests of park type, which have grown on the lots alternating with the steppe grassland lots. At present *Loxia* is an indicator for a forest habitat. This record is the 2nd one in Europe, after a record from the early Miocene from France. Five species of tree hemixerophytes have been established by their fossilized seeds in the deposits of Varshets: *Celtis praebalcanica*, *Prunus fruticosa* f. *fossilis*, *Crataegus pentagyna* f. *fossilis*, *Pyracantha coccinea* f. *fossilis*, and *Swida sanguinea* f. *fossilis* (Palamarev, 2001). All of them are indicators of dry and warm climate and xeric or semiarid landscape, similar to present-day African savannah-steppe. The seeds of *Celtis* are numerous (over 500) and almost all of them, broken by the beaks of a seed-eating avian species. These data confirm the type of the palaeoenvironment restored through the palaeoavifaunistical analysis, indicating a subxerophyllous subarid climate.

The numerous finds (13 bones) of *Carduelis* cf. *carduelis* and *Carduelis* sp. from Varshets are the earliest known record of the European Goldfinch. Its pre-glacial occurrence determines it as a Tertiary relics in Europe. The same could be stated for the 8 finds of *Fringilla coelebs*.

Emberizidae

Eight finds of *Emberiza* sp. from the Middle Vilafranchian of Varshets and Slivnitsa mark the distribution of buntings in the pre-glacial time throughout the SE Europe. After Mlikovsky (2002) they are still the earliest fossil record of that numerous genus on the continent.

ECOLOGICAL FAUNAL COMPLEXES AND THE “MIXED” AVIFAUNAS

Eliminating temporal (chronostratigraphical) distribution, four major avifaunal complexes could be divided – aquatic, woodland, openland (and rocky/stone areas) and shrubland (incl. broken woodland).

Neogene record of the aquatic avian complex of Bulgaria (6 orders, 8 families):

Pelecaniformes: *Phalacrocorax serdicensis*;

Ciconiiformes: *Geronticus balcanicus* and Botaurinae gen.;

Anseriformes: *Anser thraceiensis*, *Balcanas pliocaenica*, *Cygnus verae*, *Anas* cf. *clypeata* and Anatinae gen.;

Gruiformes: *Gallinula balcanica*, *Porzana* sp. n.;

Charadriiformes: *Actitis balcanica* Boev, 1998, Larinae gen. indet. and Charadriiformes fam.

Passeriformes: *Motacilla* sp.



Neogene record of the woodland avian complex of Bulgaria (5 orders and 12 families):

Accipitriformes: *Accipiter* sp. ex gr. *gentilis*, *Accipiter* sp., *Aquila* sp. ex gr. *clanga*,
Buteo spassovi, *Buteo* sp.,

Galliformes: *Tetrao rhodopensis*, *Tetrao* aff. *partium*, *Pavo bravardi*,

Strigiformes: *Athene* sp.,

Columbiformes: *Streptopelia* sp.,

Passeriformes: *Lullula* sp. *Parus* sp. ex gr. *major*, *Parus* sp., *Regulus bulgaricus*,
Muscicapa sp., *Fringilla* cf. *coelebs*, *Coccothraustes simeonovi*, *Coccothraustes*
balcanicus, *Loxia patevi*, *Turdus* cf. *merula*, *Turdus* cf. *iliacus*, *Turdus* cf. *philomelos*,
Turdus sp., *Erithacus* sp., *Nucifraga* sp., *Pica* sp. n., *Corvus* aff. *praecorax*



Neogene record of the openland (incl. rocky/stone areas) avian complex of Bulgaria (7 orders and 9 families):

Struthioniformes: *Struthio* cf. *Struthio karatheodoris*

Accipitriformes: *Gyps* sp. n.,

Galliformes: *Chauvireria balcanica*, *Chauvireria* sp. n., cf. *Perdix* sp., *Lagopus balcanicus*, *Lagopus* aff. *atavus*, *Lagopus* sp.,

Gruiformes: *Otis* cf. *khosatzkii*, Otitidae gen.

Coraciiformes: *Euroceros bulgaricus*

Apodiformes: *Apus baranensis*,

Passeriformes: *Melanocorypha* sp. n., *Alauda* sp., *Eremophila* sp. n., *Pyrrhocorax* cf. *graculus*, *Pyrrhocorax* c *pyrrhocorax*, *Corvus* cf. *monedula*

Neogene record of the shrubland (incl. broken woodland) avian complex of Bulgaria (2 orders and 2 families):

Accipitriformes: *Circaetus* cf. *gallicus*, *Circaetus* sp., *Hieraaetus* cf. *fasciatus*,
Hieraaetus sp.,

Falconiformes: *Falco bakalovi*, *Falco* sp. ex gr. *tinnunculus*, *Falco* sp. ex gr. *cherrug*,
Falco sp.



Incompletely identified taxa of uncertain habitat preferences:

Galliformes: Phasianidae gen, Perdicinae gen.,


Columbiformes: *Columba* sp.

Passeriformes: Alaudidae gen., *Anthus* sp., *Corvus* sp., *Sturnus* sp., n.,

Fringillidae gen., Emberizidae gen,

Besides this, more or less, provisional dividing, the Bulgarian Neogene bird fauna shows varied composition, not only in taxonomic, but also in the ecological (habitat) aspect.

Pliocene “mixed” faunas have been already mentioned. This phenomenon is well known among the mammalian faunistic complexes of SE Europe, which were best represented at the end of Pliocene during the Villafranchian. The southernmost regions of the breeding range of *Lagopus* (*L. mutus*) lie in Central Asia (Pamir Alai Mts in Tadjikistan) of 1 200 km away from the northernmost parts of the range of *Pavo* (*Pavo cristatus*) in Aravali Mts in India. All over the world both genera are spread at much larger distance. Ornithogeography considers Peafowls of *Pavo* as tropical and subtropical inhabitants of the Asian jungle-like forests (del Hoyo et al., 1994). On the other hand, the Willow Grouse and Ptarmigans (*Lagopus*) have Holarctic present day distribution. They occur in the open country and the broadleaf shrub in the Arctic, Alpine and Boreal zones. After Harrison (1982), Cramp & Simmons (1979) and del Hoyo et al. (1994), they favour mosaic habitat types.

A dark brown silhouette of a mountain range with jagged peaks, spanning the width of the slide at the bottom.

Another example of “mixed” avifauna: *Struthio* and Bucorvini, coexisting with *Aquila* sp. ex. gr. *clanga* in the late Miocene of Hadzhidimovo. In the late Pliocene in the region of the site of Varshets lived both *Otis* and *Tetrao*, *Lullula* and *Melanocorypha*, *Parus* cf. *major* and *Eremophila*, *Regulus* and *Pyrrhocorax*, *Loxia* and *Galerida*, etc. In Slivnitsa coexisted *Coccothraustes* and *Pyrrhocorax*, *Lullula* and *Falco* sp. ex gr. *tinnunculus*.

Recently some new data on the "mixed" faunas have been obtained from the Transcacasias. They provide examples, that disagree with our traditional ideas on the bionomy of *Lagopus*, *Pavo* and *Gallus* in the Plio-Pleistocene.

AFRO-TROPICAL AND AFRO-INDO-MALAYAN ELEMENTS IN THE NEOGENE AVIFAUNA OF BULGARIA AND THEIR PALEOZOOGEOGRAPHICAL IMPLEMENTATIONS

The peafowl, ostriches and ground-hornbills are the only three avian taxa of recent Afro-tropical/Afro-tropical – Indo-Malayan distribution, established in the Bulgarian Neogene record. They are also excellent examples of taxa from sites, located between the present day disjunct parts of the groups' ranges: (1) The sites of *Pavo bravardi* lie between the ranges of *Afropavo congensis* (tropics of Africa) and the *Pavo muticus* and *Pavo cristatus* (S and SE Asia – Hindustan and Indochina); (2) The site of *Euroceros bulgaricus* lie between the present day ranges of Bucerotidae in Africa (south of Sahara) and that of S and SE Asia (Hindustan and Indochina);

(3) The sites of *Struthio cf karatheodoris* lie between the present day range of struthionids (*Struthio camelus* in Africa (south of Sahara) and its subrecent range in Arabian Peninsula and its former Holocene range in the Central Asia and China, where it possibly survived up to 10th century A.D.

The Bravard's peafowl, roamed the Balkan forests, possibly by the first cooling of climate in the very end of Pliocene. It is the last resident (non-migratory) avian species of the s. c. “tropical” complex of Europe. In some refugia it is likely that this peafowl survived in the relatively warmer habitats until more recent time by the beginning of the Pleistocene.

The finds of the ground-hornbills confirm the former range-continuity throughout Europe, possibly, at least until the end of the late Miocene. They suggest that within the Bucorvini in the Turolian - Meotian at least two lineages (these of *Bucorvus* and *Euroceros*) existed. On the other hand, they also confirm former presence of the savannah-like biomes in the Southern Bulgaria.

This is supported also by the finds of *Struthio* in the same site and a neighbouring locality of the same age. Their records (of *Struthio cf. Struthio karatheodoris*) in two sites (very close to the Greek border) seriously contribute to the hypothesis of the very fast elevation of the surrounding mountains. At present the landscape of this region is highly mountainous and the fossils of the ground-hornbills and ostriches confirms the very rapid and intensive elevation of the relief. Now both sites lie ca. 80 km away from the highest peak of the Balkan Peninsula, the Mount Musala (2925 m a. s. l.) in the Rila Mountain. In the late Miocene ca. 9 mya the regions in the vicinities of the localities were similar to the present day African plains with open clear grass savannah with scattered trees and shrubs.

THE VALUE OF THE BULGARIAN NEOGENE AVIFAUNA TO THE KNOWLEDGE OF THE WORLD NEOGENE AVIFAUNAS

Bulgaria's 400 species of the recent fauna represent ca. 3.68 percent of the total recent World's avifauna, numbering over 10 200 species. Only one recent avian species, *Streptopelia decaocto*, was described from Bulgaria, representing even 0.01 percent of modern birds. On the other hand, from ca. 1500 fossil bird species, 17 (1.13 percent; all of them Neogene) were described from Bulgaria. This determines the fossil (Neogene) fauna of the country much more important to the knowledge of the World bird fauna of this period.

The following parameters characterize the significance of the researches of the Bulgarian Neogene bird fauna:



Number of new species, described from Bulgaria – 17:

Pelecaniformes

Phalacrocorax serdicensis Burchak-Abramovich & Nikolov, 1982

Ciconiiformes

Geronticus balcanicus Boev, 1998

Anseiformes

Anser thraceiensis Burchak-Abramovich & Nikolov, 1982

Balcanas pliocaenica Boev, 1998

Cygnus verae Boev, 2000

Accipitriformes

Buteo spassovi Boev, 1998

Falconiformes

Falco bakalovi Boev, 1998

Coraciiformes

Euroceros bulgaricus Boev, 2007

Galliformes

Tetrao rhodopensis Boev, 1998

Lagopus balcanicus Boev, 1995

Chauvireria balcanica Boev, 1997



Gruiformes

Gallinula balcanica Boev, 1999

Charadiiformes

Actitis balcanica Boev, 1998

Passeriformes

Regulus bulgaricus Boev, 1999

Loxia patevi Boev, 1999

Coccothraustes simeonovi Boev, 1998

Coccothraustes balcanicus Boev, 1998

Number of new genera, described from Bulgaria – 3:

Balcanas Boev, 1998 (of Anatini – Anseiformes)

Chauvireria Boev, 1997 (of Perdicinae – Galliformes)

Euroceros Boev, 2007 (of Bucorvini – Coraciiformes)



Number of taxa of the Neogene avifauna of Bulgaria:

orders – 13
families – 24
genera – (incl. “cf.” and “aff.” categories) - 48
species (incl. “cf.” and “aff.” categories) – 30

Number of fossil taxa, described from other regions of the World, established in the Bulgarian Neogene record - 7:

Struthio cf. *Struthio karatheodoris*
Lagopus aff. *atavus*
Tetrao aff. *partium*
Pavo *bravardi*
Otis aff. *khosatzkii*
Apus *baranensis*
Corvus aff. *praecorax*



CONCLUSIONS

Bulgarian Neogene fauna consist in 120 taxa (26 families and 13 orders) at least.

The greate majority of the avian record (80.0 percent) comes from the Late Pliocene, where 96 taxa at least were established.

Early Pliocene record is much poorer and consists in 7.5 percent and 9 taxa. All the Miocene record is represented by 12.5 percent and 15 taxa.

The quantitative chronostratigraphical distribution of the families is as follows: Middle Miocene - 1, Late Miocene - 9, Early Pliocene - 6, and Late Pliocene - 22.

Twenty-four taxa are represented by the earliest European record in the Neogene deposits of Bulgaria and marks their appearance on the continent. Even more, in most cases, they are the only known so far fossil record in Europe, or all over the World.

Varshets is the richest Neogene site in Bulgaria and the richest one of the Late Pliocene (Villanyian) of Europe, containing fossils of at least 78 taxa. The exploration of the Bulgarian Neogene avian record is a promissing research for the understanding of the formation and development of the European avifauna in the Miocene and Pliocene.



ACKNOWLEDGMENTS

The author is very grateful to Drs.: Cécile Mourer-Chauviré (UCBL), Robert Prys-Jones, Cyril Walker, Joane Cooper and Don Smith (Bird Group, BMNH), Zygmunt Bochenski, Tereza Tomek and Zbigniew Bochenski (ISEAK), Evgeny Kurochkin and Alexander Karhu (PIRASM) for their valuable help during the work in their institutions.

The study was sponsored by the Foundation Scientifique de Lyon et du Sud-Est (France), the Short Study Visits Program of the Royal Society and the SYS-Resource program (U.K.), the National Science Fund of Bulgaria, and the BAS. Special gratitude to the anonymous referees for their competent and useful remarks on a manuscript on this topic (Boev, 2002).

Thank you very much for your interest to this subject.

