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ZBIGNIEW SZYNDLAR

Early Pleistocene reptile fauna from Kozi Grzbiet in the Holy Cross Mts

ABSTRACT: The Cromerian reptile fauna from Kozi Grzbiet locality in the Holy Cross Mts, Central Poland, contains two forms new for the Polish herpetofauna, viz. *Palaeomalpolon borealis*, gen. et sp. n. (Colubridae), and *Vipera* aff. *ammodytes* (Viperidae), associated with the following reptiles: *Lacerta agilis, Lacerta* cf. *viridis, Anguis fragilis, Elaphe longissima, Coronella austriaca, Natrix natrix,* and *Vipera berus*. The Pleistocene through Recent changes in the reptile fauna of Poland are discussed subsequently.

INTRODUCTION

The investigated reptile material comes from the Early Pleistocene (Cromerian) locality of the Kozi Grzbiet Hill near Chęciny in the Holy Cross Mts, Central Poland. The locality was discovered by Professor K. Kowalski in 1970 and entirely exhausted during a few successive years (*see* Głazek & *al.* 1976, 1977).

The sequence of karst deposits has been subdivided into five lithological units (Głazek & *al.* 1976). The reptile bony remains, as well as amphibian ones, were confined to the Unit 2, the latter being composed of three layers numbered *2a, 2b,* and *2c* (Text-fig. 1). Furthermore, some herpetological material was derived from a dump in a quarry nearby (*see* Tables 1—7).

The herpetological bony material from Kozi Grzbiet undoubtedly is the richest one in the Polish Cenozoic, outnumbering all the other collections. It approximates 112,000 reptile bones, with some 111,000 specimens representing snake vertebrae. The herpetofauna was described in general terms by Młynarski (1977) who listed 9 amphibian species and 6 reptile species. That list of reptiles is now supplemented with 3 species, one of these being new. The amphibians will be described in a separate paper (Sanchiz & Szyndlar, *in prep.*).

METHODS OF INVESTIGATION

All the investigated bony remains were identified with use of comparative materials. Furthermore, the data presented by Szunyoghy (1932) and Markert (1975) also were taken into account. The vertebrae of snakes were measured according to Auffenberg's (1963) methods, and the raw data (*cf.* Text-figs 2—3) were treated by basic statistical methods.

The nomenclature used in description of the recognized taxa follows that applied by Szunyoghy (1932), Hoffstetter (1939), Auffenberg (1963), and Rabeder (1977).

SYSTEMATIC PART

Order **SQUAMATA** Oppel, 1811
Suborder **SAURIA** Mc Cartney, 1802
Family **Lacertidae** Bonaparte, 1838
Genus *LACERTA* Linnaeus, 1758
Lacerta agilis Linnaeus, 1758
(Text-figs 4—5)

PREMAXILLARY: Robust, with very expanded processus nasalis, twice longer than wide; corpus of the bone thick; processes maxillares poorly separated; teeth with characteristic crenate tops.

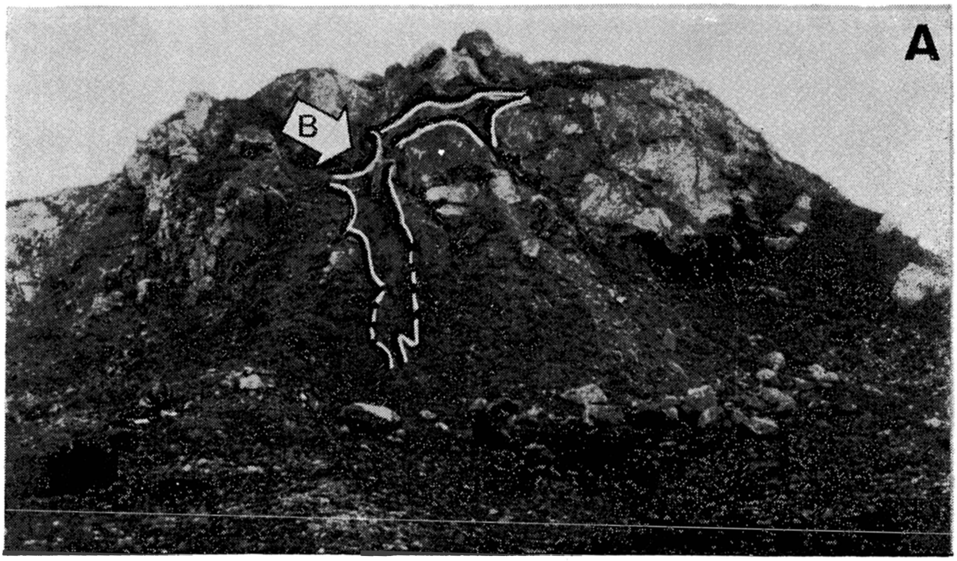
MAXILLARY: Processus frontalis sloping gently backwards and vehemently forwards, near the anterior end of the maxillare; processus praemaxillaris wide, projecting inwards under the anterior margin of the processus frontalis; teeth with characteristic crenate tops.

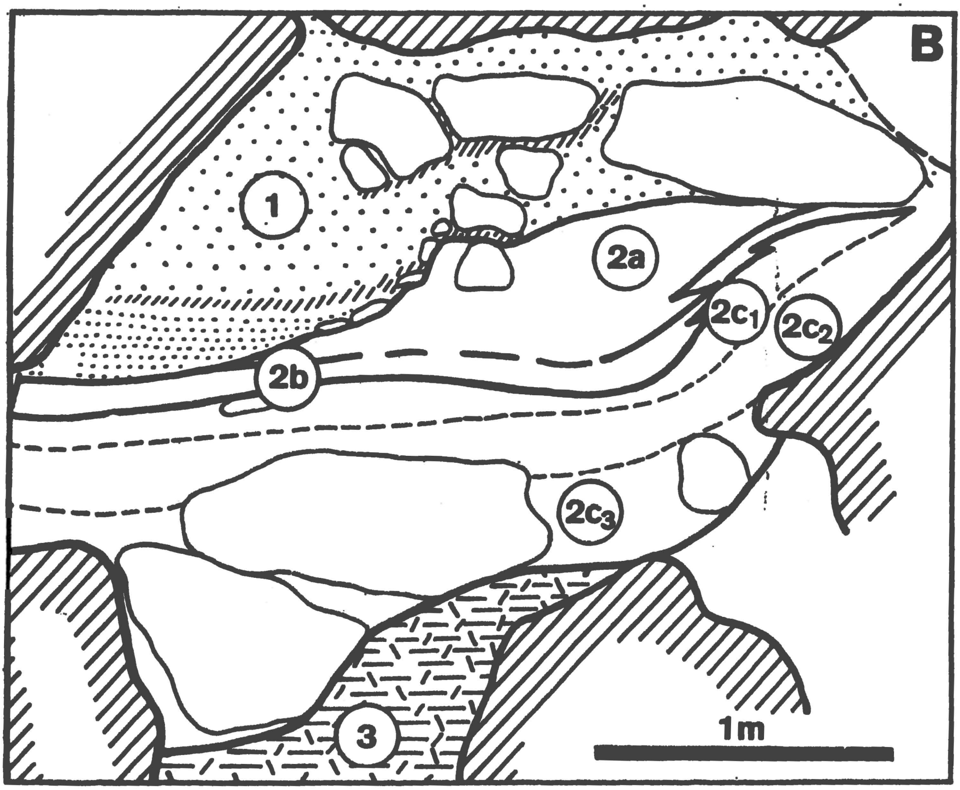
Table 1

Collected material of *Lacerta agilis* Linnaeus

Element	Layers				Dump
	2a	2b	2c	2/abc/	
premaxillary		1	1		1
maxillary R	2	1			
—— " —— L	2	1	1		
quadrate R	1				
dentary R	7	3	1	1	4
—— " —— L	4	2	2	2	5
sacral vertebra		1			

QUADRATE: Upper part very strongly outspread; crista tympani enormously developed, together with the central part of the bone making an impression of being "half-rolled"; trochlea quadrati relatively small, distinctly separated from the bone.





General view of the karst fissure exposed at the Kozi Grzbiet Hill near Chęciny in the Holy Cross Mts (A), and a sketch of the part of the fissure (arrowed in *A*) to show position of the bone-bearing layers distinguished in the text (B); adopted *from* Głazek *& al.* (1976, Text-figs 2 and 4, and Pl. 1, Fig. 1)

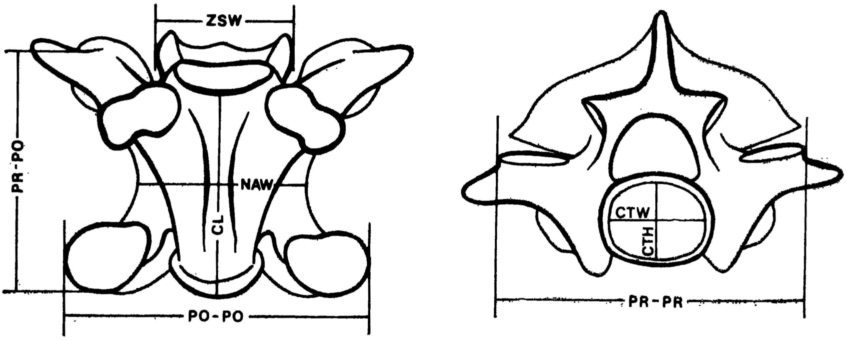


Fig. 2. Measurements used in description of snake vertebrae, ventral and anterior views

ZSW — zygosphene width; **NAW** — centrum width; **CL** — centrum length; **PO—PO** — width between the outer edges of postzygapophysial articular facets; **PR—PO** — length from the posterior edge of the postzygapophysial articular facet to the anterior edge of the prezygapophysial articular facet; **PR—PR** — width between the outer edges of prezygapophysial articular facets; **CTW** — cotyle width; **CTH** — cotyle height

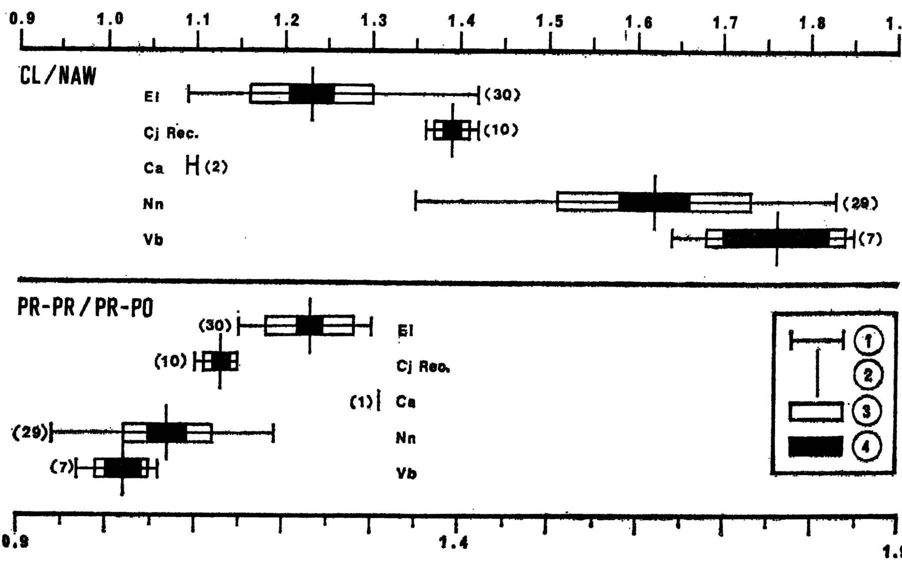


Fig. 3. *CL/NAW* and *PR—PR/PR—PO* ratios of snake vertebrae from Kozi Grzbiet
El — *Elaphe longissima*, **Cj Rec.** — recent *Coluber jugularis caspius* (*R/262/79*), **Ca** — *Coronella austriaca*, **Nn** — *Natrix natrix*, **Vb** — *Vipera berus*

1 observed ranges, *2* mean, *3* standard deviation, *4* 95 per cent confidence intervals for the mean; the number of specimens shown in parentheses

DENTARY: Dorsal margin rectilinear; sulcus Meckeli ranging from the anterior end of the bone, widening backwards; teeth with crenate tops, weakly projecting above the lateral margin.

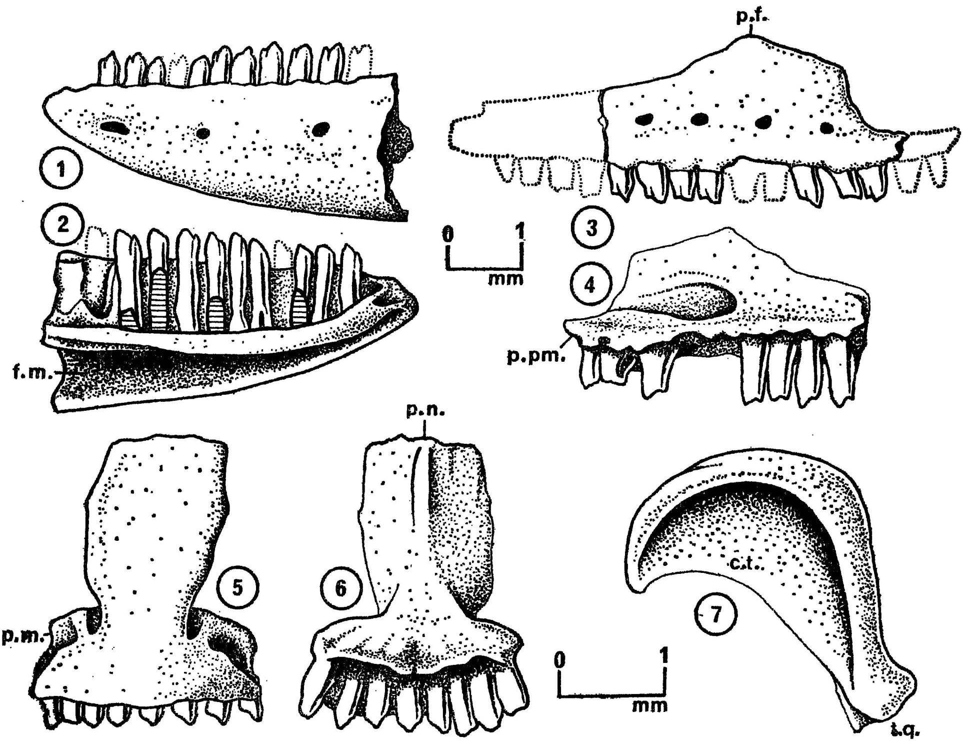


Fig 4. Some cranium bone remains of *Lacerta agilis* Linnaeus **1** — left dentary, lateral view; **2** — left dentary, internal view: *f.m.* — fossa Meckeli; **3** — right maxillary, lateral view: *p.f.* — processus frontalis; **4** — right maxillary, internal view: *p.pm.* — processus praemaxillaris; **5** — premaxillary, anterior view: *p.m.* — processus maxillaris; **6** — premaxillary, posterior view: *p.n.* — processus nasalis; **7** — left quadrate, lateral view: *c.t.* — crista tympani, *t.q.* — trochlea quadrati

SACRAL VERTEBRA: Centrum very long and flattened; dorsal side smooth; neutral arch wide and high, triangular in shape; neural spine dual, relatively low and thick; pre- and postzygapophysial articular facets elongate oval in shape; cotyle and condylus undersized; ribs, fused with the centrum strongly outspread and widening, interconnected at their ends.

Lacerta cf. *viridis* (Laurenti, 1768)
(Text-fig. 6)

Material: Two fragments of right maxillary (layer *2a*).

Remarks. — Well-preserved teeth, smooth, acuminate in shape, with no furrow at the top, resemble those characteristic of *Lacerta viridis* both in their shape and in size. There are noticeable replacement-teeth growing out of the inner margin of the investigated maxillary.

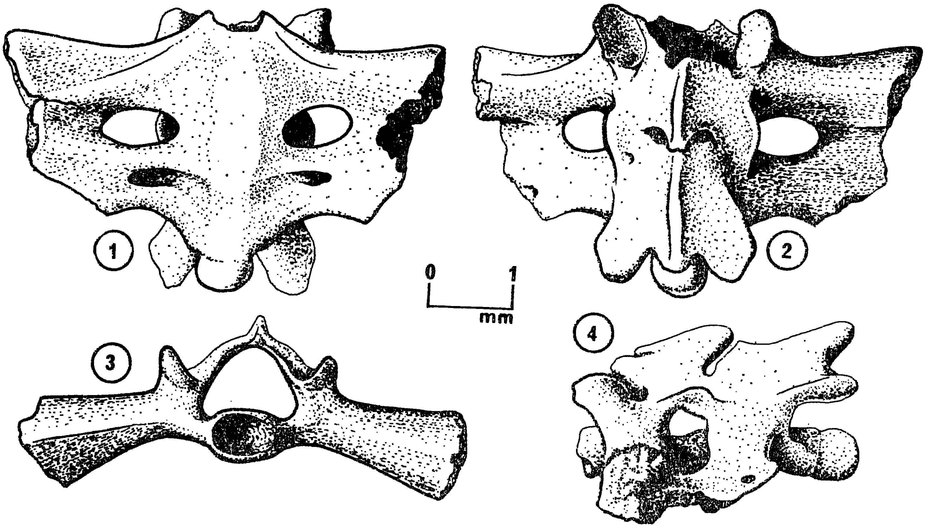


Fig. 5. Sacral vertebra of *Lacerta agilis* Linnaeus
1 ventral view, 2 dorsal view, 3 anterior view, 4 lateral view

Family **Anguidae** Gray, 1825
Genus *ANGUIS* Linnaeus, 1758
Anguis fragilis Linnaeus, 1758
(Text-figs 7—8)

Material: 55 precaudal vertebrae (Unit *2*) and 2 osteoderms (layer *2a*).

VERTEBRAE: Corpus elongate, smooth and strongly flattened, widening forwards; cotyle and condylus considerably flattened; neutral arch moderate in size, triangular in cross section; neutral spine low, triangular in lateral view; pre- and postzygapophysial articular facets large-sized, round-shaped, strongly curved upwards.

OSTEODERMS: Lenticular in outline; one third of the surface smooth, and the remainder covered with characteristic radial sculpture.

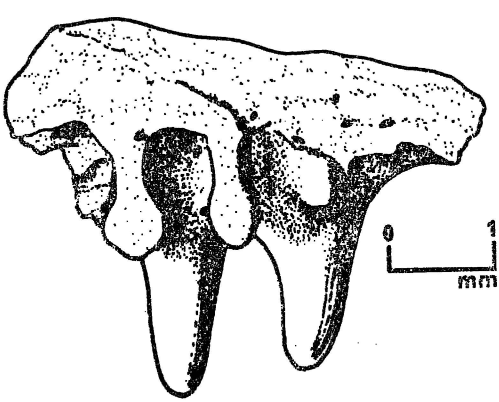


Fig. 6
Right maxillary fragment of *Lacerta* cf. *viridis* (Laurenti); internal view

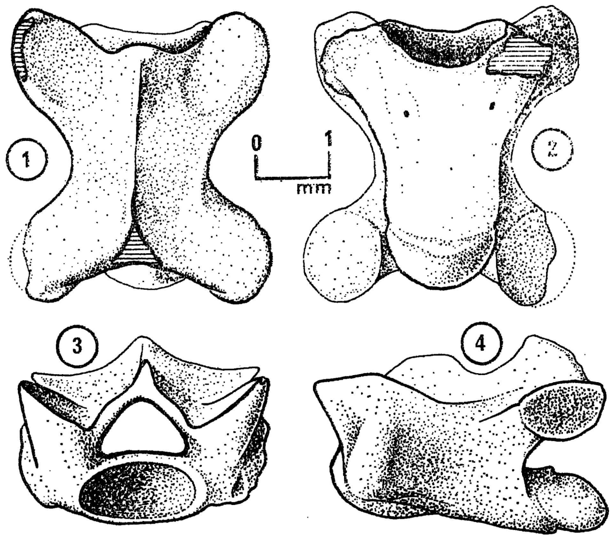


Fig. 7. Precaudal vertebra of *Anguis fragilis* Linnaeus
1 dorsal view, 2 ventral view, 3 anterior view, 4 lateral view

Suborder **SERPENTES** Linnaeus, 1758
Family **Colubridae** Gray, 1825
Subfamily **Colubrinae** Gray, 1825
Genus *ELAPHE* Fitzinger, 1833
Elaphe longissima (Laurenti, 1768)
(Text-figs 9—10)

PREMAXILLARY: Anterior margin regularly arched in shape; processes laterales rapidly narrowing towards their ends; processus nasalis relatively short and wide; processes vomerales poorly developed.

MAXILLARY: Dorsal surface fairly smooth, with slightly convex anterior part; teeth longer than the maxillary height, strongly hooked backwards; processus praefrontalis slender, obliquely projecting backwards; processus ectopterygoideus normal to the maxillary, twice longer than wide.

PALATINE: Splender-shaped, with relatively large teeth; processus praevomeralis well developed, narrow, slightly inclined forwards; processus maxillaris very strongly hooked backwards, almost parallel to the bone.

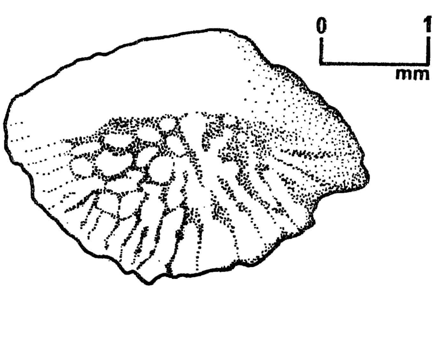


Fig. 8
Osteoderm of *Anguis fragilis* Linnaeus; external view

PTERYGOID: Inner margin regularly arched in shape; lateral margin close to rectilinear, with a small sinus behind processus ectopterygoideus, the latter being hardly discernible; crista pterygoidea poorly developed; teeth undersized, confined to the anterior half of the inner margin of the bone.

Table 2
Collected material of *Elaphe longissima* (Laurenti)

Element	Layers				Dump
	2a	2b	2c	2/abc/	
premaxillary			1		1
maxillary R			1	3	3
—— " —— L				1	1
palatine R	2				
—— " —— L	2				
pterygoid R	5				
—— " —— L	3				
parietal	10		1	1	2
basisphenoid	17			1	3
basioccipital	3				
quadrate R	3				
dentary R	55			3	5
—— " —— L	46		1	1	4
articular R	2		1		1
—— " —— L					1
precaudal vertebrae	±780	100	±120	±120	±250

PARIETAL: Cristae parietales almost parallel to one another in the anterior half of the bone, but converging at the posterior margin; anterior margin straight; dorsal side flat, without any furrows.

BASISPHENOID: Triangular in shape, irregular owing to strongly developed processes suborbitales; processes basipterygoides well developed, with lateral margins inbetween strongly curved inwards; processus parasphenoideus short, one third of the bone in length, and restrainedly wide; cristae pterygoideae strongly developed and inclined forwards; crista basisphenoidea absent.

BASIOCCIPITAL: Much wider than long in outline; crista basioccipitalis ranging close to the anterior margin of the bone, restrainedly developed (although with distinct processes), which is also the case with crista mediana; processes basioccipitales moderately developed; condylus basioccipitalis well separated from the bone.

QUADRATE: Upper end weakly outspread, a little wider than thick corpus quadrati; squama suprastapedialis well developed.

DENTARY: Teeth large-sized, strongly hooked backwards, decreasing in size and curved inwards in the posterior part of the bone; foramen mentale large and elongate.

ARTICULAR: Processus cornoideus high; cavitas sigmoidea fairly wide; processes articulares moderately protruded upwards; processus retroarticularis slender and long; crista supraangularis absent; ventral side of the bone, below the posterior part of the processus coronoideus, considerably concave.

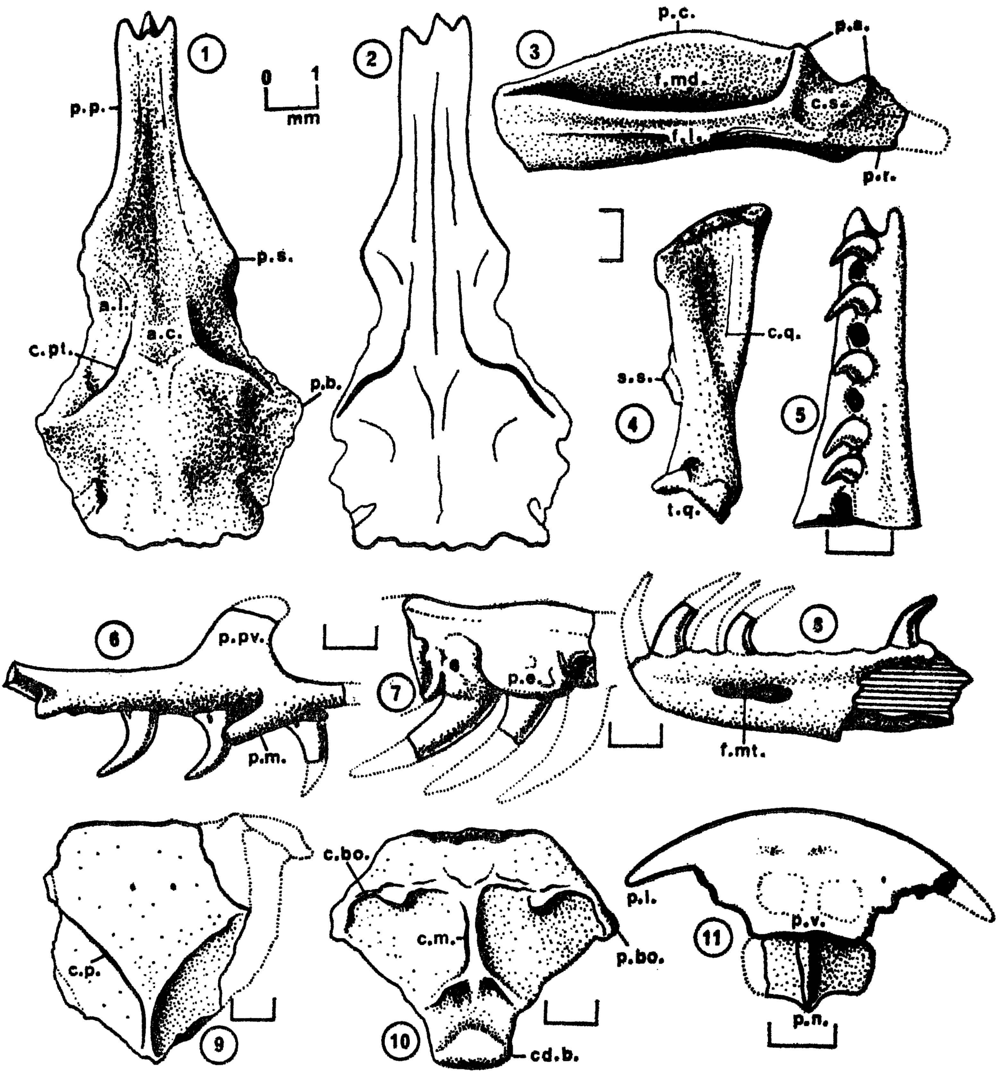


Fig. 9. Some cranium bone remains of *Elaphe longissima* (Laurenti)

1 — basisphenoid, ventral view: *a.c.* — area centralis, *a.l.* — area lateralis, *c.pt.* — crista pterygoidea, *p.b.* — processus basipterygoideus, *p.p.* — processus parasphenoideus, *p.s.* — processus suborbitalis; 2 — basisphenoid of recent *Elaphe longissima* (R/234/76); 3 — left articular, lateral view: *c.s.* — cavitas sigmoidea, *f.l.* — facies lateralis, *f.md.* — facies medialis, *p.a.* — processus articularis, *p.c.* — processus coronoideus, *p.r.* — processus retroarticularis; 4 — right quadrate, posterior view: *c.q.* — corpus quadrati, *s.s.* — squama suprastapedialis, *t.q.* — trochlea quadrati; 5 — anterior part of left pterygoid, ventral view; 6 — left palatine, internal view: *p.m.* — processus maxillaris, *p.pv.* — processus praevomerinus; 7 — fragment of left maxillary posterior part, interior view: *p.e.* — processus ectopterygoideus; 8 — left dentary, lateral view: *f.mt.* — foramen mentale; 9 — parietal, dorsal view: *c.p.* — crista parietalis; 10 — basioccipital, ventral view: *c.bo.* — crista basioccipitalis, *cd.b.* — condylus basioccipitalis, *c.m.* — crista mediana, *p.bo.* — processus basioccipitalis; 11 — premaxillary, ventral view: *p.l.* — processus lateralis, *p.n.* — processus nasalis, *p.v.* — processus vomeralis

PRECADUAL VERTEBRAE: Robust, with centrum moderate in length (*CL/NAW* = 1.23), slightly depressed, triangular in shape; hypapophysis underdeveloped; subcentral ridges moderately developed; parapophyses strong, without any distinct processes; cotyle subovate in outline (*CTW/CTH* = 1.11); neural arch high and wide; neutral spine relatively low; epizygapophysial spine absent;

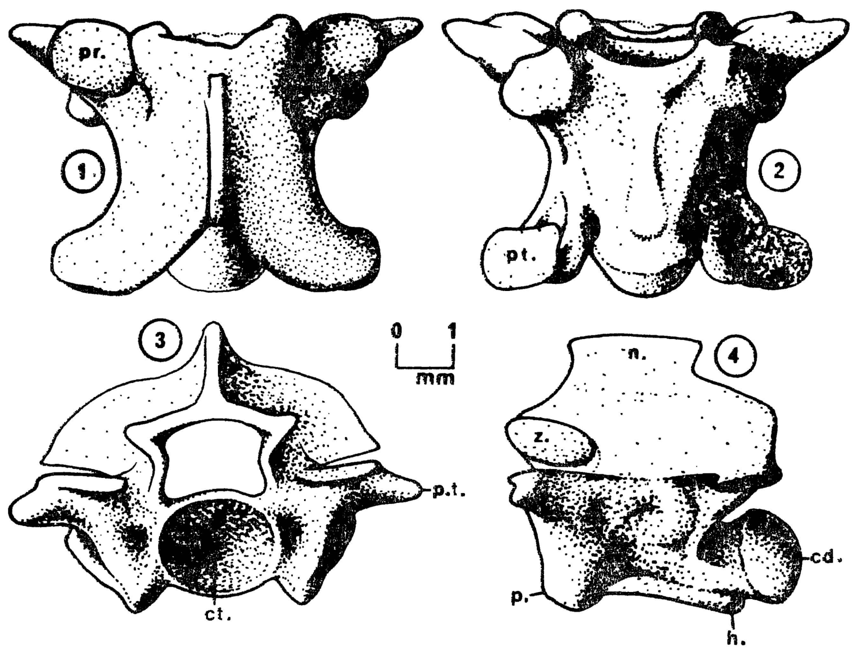


Fig. 10. Precaudal vertebra of *Elaphe longissima* (Laurenti)
1 — dorsal view: *pr.* — prezygapophysial articular facet; 2 — ventral view: *pt.* — postzygapophysial articular facet; 3 — anterior view: *ct.* — cotyle, *p.t.* — praezygapophysis; 4 — lateral view: *cd.* — condyle, *h* — hypapophysis, *n* — neurapophysis (neural spine), *p.* — parapophysis, *z.* — zygosphene

zygosphene dorso-ventrally thin, oval, outspread far away from one another (*CL/ZSW* = 1.35); prezygapophysial articular facets wide, oval to subcircular in outline; postzygapophysial articular facets much wider than long square in cross section.

Remarks. — There is little morphological difference between the vertebrae of *Elaphe* and *Coluber* and hence, some vertebral ratios recorded in *Elaphe longissima* from Kozi Grzbiet have been compared to those observed in the Recent form *Coluber jugularis caspius* (No. *R/262/79*). In fact, *Coluber* snakes commonly occur in the Polish Pliocene and Pleistocene (Młynarski 1962, 1977). All the ratios were evaluated with use of *t*-Student test. Except case, the differences are highly significant ($P<0.001$) in all the cases.

Genus *CORONELLA* Laurenti, 1768

Coronella austriaca Laurenti, 1768

(Text-fig. 11)

Material: 6 basioccipitals (layer *2a*) and 7 precaudal vertebrae (layers *2c* and *2a—c*).

BASIOCCIPITAL: Approximately as wide as long; crista basioccipitalis weakly developed; crista mediana thick and considerably outspread; condylus basioccipitalis restrainedly developed.

Table 3

Measurements (in *mm*) and ratios of the posterior precaudal vertebrae of *Elaphe longissima* (Laurenti); N = 30

	OR	$\bar{X}$	±SD	CV
PR-PO	4.28 - 6.20			
CL	3.70 - 4.89			
NAW	2.86 - 4.10			
ZSW	2.72 - 3.65			
PO-PO	5.21 - 7.06			
CTH	1.49 - 2.17			
CTW	1.63 - 2.35			
PR-PR	5.27 - 7.12			
CL/NAW	1.09 - 1.42	1.23	±.07	6.07
NAW/PO-PO	.52 - .64	.58	.03	4.45
CTW/CTH	1.02 - 1.25	1.11	.06	5.23
ZSW/NAW	.81 - .97	.92	.03	3.77
PR-PR/PR-PO	1.15 - 1.30	1.23	.04	3.26
ZSW/CL	.67 - .80	.74	.03	4.57
CL/ZSW	1.25 - 1,49	1.35	.07	4.89
PR-PR/NAW	1.72 - 1.98	1.83	.07	3.76

OR = observed ranges, $\bar{X}$ = mean, SD = standard deviation, CV = coefficient of variation

PRECADUAL VERTEBRAE: Robust, with centrum very short and wide (*CL/NAW* = 1.09—1.10), strongly depressed, smooth; hypapophysis practically absent; parapophyses poorly developed, without any processes; cotyle considerably flattened (*CTW/CTH* =1.30—1.34); neural arch high and wide; neural spine low; epizygapophysial spine absent; zygosphene articular facets dorso-ventrally very thin, oval,

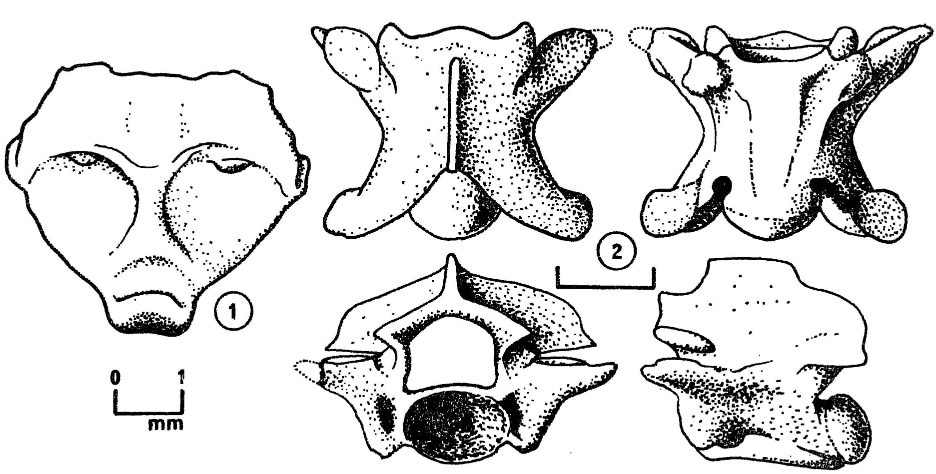


Fig. 11. Basioccipital (1) and a precaudal vertebra (2) of *Coronella austriaca* Laurenti

Table 4

Measurements (in *mm*) and ratios of the posterior precaudal vertebrae of *Coronella austriaca* Laurenti; N = 2

PR-PO	2.25 - 2.43	CL/NAW	1.09 - 1.10
CL	1.81 - 2.03	NAW/PO-PO	.58 - .61
NAW	1.65 - 1.83	CTW/CTH	1.30 - 1.34
ZSW	1.71 - 1.72	ZSW/NAW	.94 - 1.04
PO-PO	2.84 - 3.00	PR-PR/PR-PO	1.31
CTH	.82 - .86	ZSW/CL	.85 - .94
CTW	1.10 - 1.12	CL/ZSW	1.06 - 1.18
PR-PR	2.99	PR-PR/NAW	1.81

strongly slanting down, widely spaced (*CL/ZSW* = 1.06—1.18); zygapophyses small; prezygapophyses medium-sized; prezygapophysial articular facets oval and postzygapophysial ones triangular in outline.

PALAEOMALPOLON gen. n.

Type species: Palaeomalpolon borealis sp. n.
Type locality: Kozi Grzbiet Hill, Holy Cross Mts, Central Poland.
Type horizon: Lower Pleistocene (Cromerian age).
Derivation of the name: After Gr. *palaeo* — ancient, and *Malpolon* — the Recent colubrid genus to which the relation is recognized.
Diagnosis: Medium-sized colubrid genus, different from all the other extinct and extant members of the subfamily Colubrinae in the presence of widely outspread processes basipterygoides in the basisphenoid bone, this feature makes a resemblance to the genus *Malpolon*, but all the other characteristics considerably differ the two genera.

Palaeomalpolon borealis sp. n.
(Text-fig. 12)

Holotype: Basisphenoid (No. *RF/290/80*), collected by Professor M. Młynarski in 1974.
Type locality and horizon: As for the genus.
Derivation of the name: Latin *borealis* — northern, to emphasize the more north-European occurrence relative to the Recent range of the genus *Molpolon*.
Diagnosis: As for the genus.

Dimensions of the holotype (in *mm*):

Total length	10.04
Length of processus parasphenoideus (as measured along sulcus trabeculus)	3.66
Width between processes suborbitales	3.21
Width between right processus bosipterygoideus and the symmetry line	2.67
Width of fossa hypophyseos	2.03

Description. — Basisphenoid is isosceles triangular in shape, with poorly developed processes suborbitales in the mid-length. Processes basipterygoides, situated close to the posterior margin of the bone, are unusually strongly developed and outstanding far asides (left processus of the holotype is broken). Processus parasphenoideus is restrainedly wide, indistinctly separated from the central part of the bone. Crista basisphenoidea is absent. Cristae pterygoideae are strongly inclined backwards, reaching inwards only less than one third of the basisphenoid in width each. Generally, ventral side of the bone is flattened and smooth. Processus parasphenoideus shows a plain ventral surface. Processes basipterygoides display very weakly lowered margins, with a shallow furrow in-between. Area centralis is somewhat convex. There is a narrow and fairly low crista at the dorsal side of processus parasphenoideus. Sulci trabeculae are very deep, and fossa hypophyseos is of considerable dimensions.

Remarks. — The basisphenoid seems to be of crucial taxonomic significance when compared to other cranial bones of snakes. Moreover, it considerably varies in structure among genera, as well as among congeneric species. The author is therefore of the opinion that even a single basisphenoid specimen permits erection of a new genus.

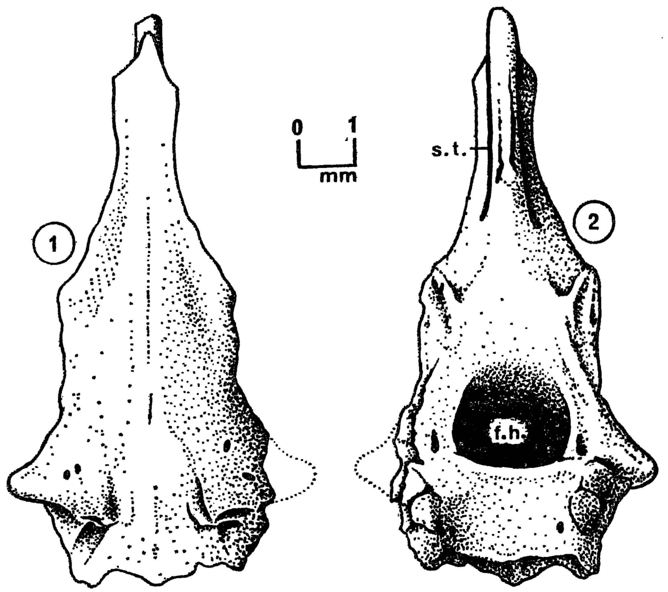


Fig. 12. Basisphenoid of *Palaeomalpolon borealis* gen. n., sp. n.
1 — ventral view; 2 — dorsal view: *f.h.* — fossa hypophyseos, *s.t.* — sulcus trabeculus

The above described basisphenoid considerably differs from those observed in other snake genera. Its enormously developed processes basipterygoides make, however, a resemblance to the genus *Malpolon.*

Judging from the basisphenoid, one may imagine the overall skull structure of *Palaeomalpolon borealis.* Its neurocranium was wide as indicated by widely outspread processes basipterygoides, the parietal region relatively long as indicated by the very long distance between processes suborbitales and processes basipterygoides; and the posterior part of the cranium (area postpterygoidea) was considerably shortened. The orbital region also must have been rather strongly shortened, as the processus parasphenoideus is very short. One may thus conclude that *P. borealis* exhibited a solid and considerably shortened skull.

The affinity in basisphenoid structure between *P. borealis* and the only European species of the genus *Malpolon,* viz. *M. monspessulanus* (Hermann), inheres only in their processes basipterygoides (*see* diagnosis). Nevertheless, the processes basipterygoides are considerably shorter and displaced forwards, into a proximity of the processes suborbitales, in the latter species. Furthermore, the processus parasphenoideus is more slender and much longer in *M. monspessulanus,* as it is also the case with the posterior part of the basisphenoid (area postpterygoidea). Consequently, the whole suborbitalis and occipitalis regions are widely different between the two species and by implication genera.

Subfamily **Natricinae** Guenther, 1838
Genus *NATRIX* Linnaeus, 1758
Natrix natrix (Linnaeus, 1758)
(Text-figs 13—14)

PREMAXILLARY: Anterior margin regularly arched in shape; processes laterales terminally narrowing; processus nasalis long and slender; processes vomerales well developed.

MAXILLARY: Dorsal surface smooth, with posterior part slightly raised as a rule; posterior teeth considerably bigger than the preceding ones (feature characteristic of frog-eating snakes); processus praefrontalis normal to the maxillary; processus ectopterygoides obliquely projecting forwards.

PALATINE: Slender in shape; processus praevomeralis moderately developed, spade-shaped; teeth undersized; processus maxillaris strongly hooked backwards.

PTERYGOID: Inner margin rectilinear except for its anterior third, the latter being considerably curved outwards; teeth disposed all over the inner margin in length; lateral margin slightly concave, with moderately developed processus ectopterygoideus; crista pterygoidea distinct.

Table 5
Collected material of *Natrix natrix* (Linnaeus)

Element	Layers				Dump
	2a	2b	2c	2/abc/	
premaxillary	5				
maxillary R	2		3	4	6
—— " —— L	3		2	4	4
palatine R	1				1
—— " —— L	2				
pterygoid R	2				
—— " —— L	4				
transversum R	1				
—— " —— L	2				
parietal	19			6	5
basisphenoid	111		2	8	18
basioccipital	20				2
quadrate R	3				1
—— " —— L	1				2
dentary R	±200		5	6	7
—— " —— L			6	9	8
articular R	23				1
—— " —— L	26			1	
precaudal vertebrae	±57000	±7500	±13000	±16000	±16000

TRANSVERSE (=ECTOPTERYGOID): Corpus transversi regularly cylindrical in shape, constricted in the mid-length; ramus externus wide, spade-shaped; ramus internus well developed, narrowing.

PARIETAL: Cristae parietales rectilinear, ranging from postfrontal region to posterior margin of the bone, never converging to one another; anterior margin

V-shaped; dorsal side with a symmetrically situated shallow furrow all over the length.

BASISPHENOID: Isosceles triangular in shape, with moderately developed processes suborbitales; processes basipterygoides restrainedly developed but distinct, displaced up to the posterior margin of the bone; processus parasphenoideus slender and long, almost half the bone in length; cristae pterygoideae and crista basisphenoidea well developed, the former ones being inclined backwards.

Table 6

Measurements (in *mm*) and ratios of the posterior precaudal vertebrae of *Natrix natrix* (Linnaeus); N = 29

	OR	X̄	±SD	CV
PR-PO	3.59 - 5.46			
CL	3.04 - 4.55			
NAW	1.99 - 2.71			
ZSW	1.84 - 2.62			
PO-PO	4.04 - 5.70			
CTH	1.02 - 1.71			
CTW	1.13 - 1.92			
PR-PR	4.08 - 5.90			
CL/NAW	1.35 - 1.83	1.62	±.11	6.56
NAW/PO-PO	.42 - .55	.50	.03	5.28
CTW/CTH	.96 - 1.22	1.09	.06	5.51
ZSW/NAW	.82 - 1.03	.95	.05	5.73
PR-PR/PR-PO	.94 - 1.19	1.07	.05	5.09
ZSW/CL	.46 - .68	.58	.05	8.79
CL/ZSW	1.47 - 2.00	1.72	.13	7.34
PR-PR/NAW	1.92 - 2.19	2.00	.09	4.28

OR = observed ranges, X̄ = mean, SD = standard deviation, CV = coefficient of variation

BASIOCCIPITAL: Approximately as long as wide; crista basioccipitalis reaching one third of the bone in length, poorly undulate but with bossy processes distinctly protruded outwards; crista mediana hardly discernible; processes basioccipitales almost unseparated from the bone; condylus basioccipitalis restrainedly separated.

QUADRATE: Upper end of the bone very strongly outspread; corpus quadrati slender; squama suprastapedialis poorly developed; trochlea quadrati very concave.

DENTARY: Teeth undersized, slightly curved backwards, constant in size; foramen mentale small-sized, often rounded in outline.

ARTICULAR: Posterior part of the bone relatively slender; processus coronoideus low; cavitas sigmoidea pretty narrow; processes articulares projected high up; processus retroarticularis short, narrowing backwards; crista supraangularis absent; ventral side of the bone, below the posterior part of processus coronoideus, slightly concave.

PRECADUAL VERTEBRAE: Centrum long and slender relatively to other representatives of the Colubrinae (*CL/NAW* = 1.62 in *Natrix natrix*, and 1.23 in *Elaphe longissima*), with a well developed hypapophysis; subcentral ridges distinct, extending from diapophyses up to a close proximity of condylus; parapophysial

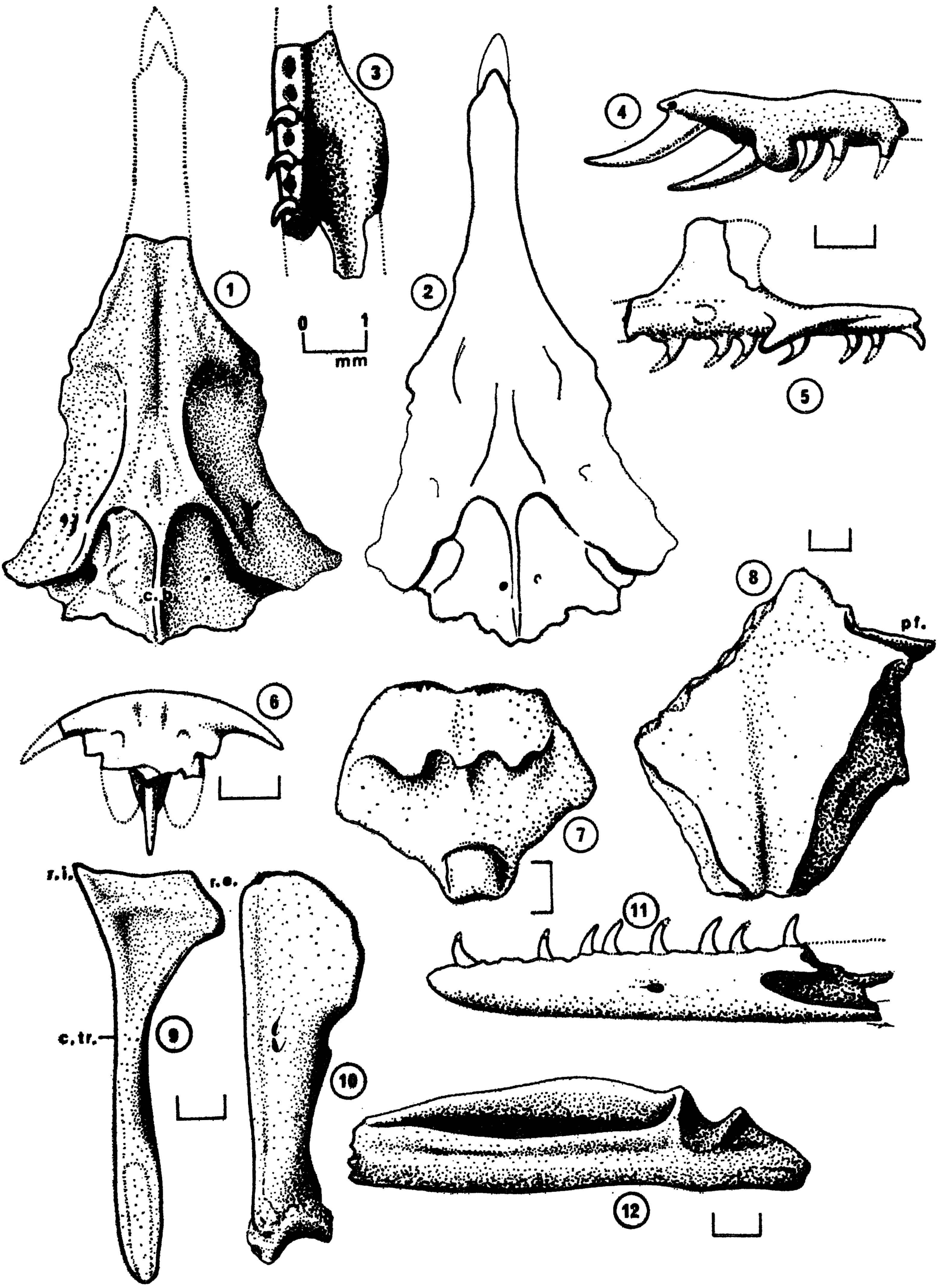


Fig. 13. Some cranium bone remains of *Natrix natrix* (Linnaeus)
1 — basisphenoid, ventral view: *c.b.* — crista basisphenoidea; **2** — basisphenoid of recent *Natrix natrix* (R/23/74); **3** — anterior part of left pterygoid, ventral view; **4** — posterior part of left maxillary, internal view; **5** — left palatine, internal view; **6** — premaxillary, ventral view; **7** — basioccipital, ventral view; **8** — parietal, dorsal view; **9** — left transverse, ventral view: *c.tr.* — *corpus transversi*, *r.e.* — ramus externus, *r.i.* — ramus internus; **10** — left quadrate, posterior view; **11** — left dentary, lateral view; **12** — left articular, lateral view

processes well developed, projected downwards and subsequently forwards; cotyle almost circular in outline ($CTW/CTH = 1.09$); neutral spine moderate in height, with an axe peculiar in shape; epizygapophysial spine small-sized but distinct; zygosphene dorso-ventrally thin, oval in shape, very narrow relative to the centrum length ($CL/ZSW = 1.72$); prezygapophysial articular facets oval as a rule,

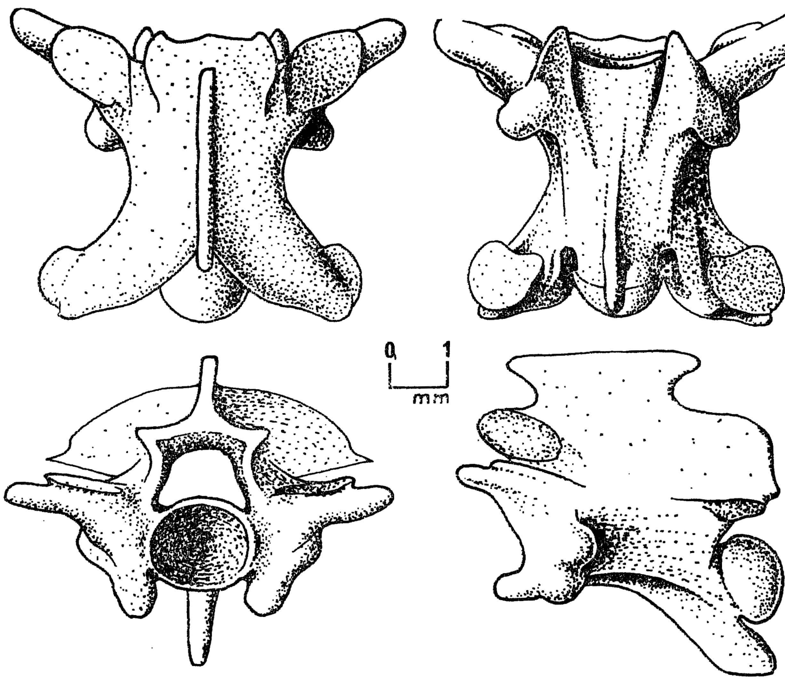


Fig. 14. Precaudal vertebra of *Natrix natrix* (Linnaeus)

and postzygapophysial ones subtriangular in shape; prezygapophyses very long, strongly projecting outside their articular facets.

Colubridae indet.

The investigated material contains also a number of colubrid remains which cannot be reliably identified because of their taxonomic insignificance, preservation state, etc. The material includes: 3 prefrontals (supposedly attributable to *Elaphe longissima*), 7 exoccipitals (probably attributable to *Natrix natrix*), 33 atlases (the majority probably attributable to *N. natrix*, the remainder to *E. longissima*), and a lot of caudal vertebrae (probably representative of both the species). There are also lots of colubrid vertebrae with pathological characteristics (*cf.* Młynarski 1977).

Family **Viperidae** Gray, 1825

Genus *VIPERA* (Linnaeus, 1758)

Vipera berus (Linnaeus, 1758)

(Text-figs 15—16)

Material: One left maxillary (layer 2a) and 9 precaudal vertebrae (8 of these from layer *2b*, the remaining one from layer *2a*).

MAXILLARY: A fang in an inside pocket; distance between the crest above the articular fossa (for transverse) and the top of the bone approximating one fifth of the bone in height (it is one third of the bone height in *V. ammodytes*).

PRECAUDAL VERTEBRAE: Centrum relatively long and slender ($CL/NAW = 1.76$), although fairly short in lateral view because of well developed neural spine and long hypapophysis; neural arch with anterior margin normal to the centrum; subcentral ridges distinct; parapophysial processes strongly developed, dagger-shaped, obliquely projecting downwards and slightly asides; cotyle some-

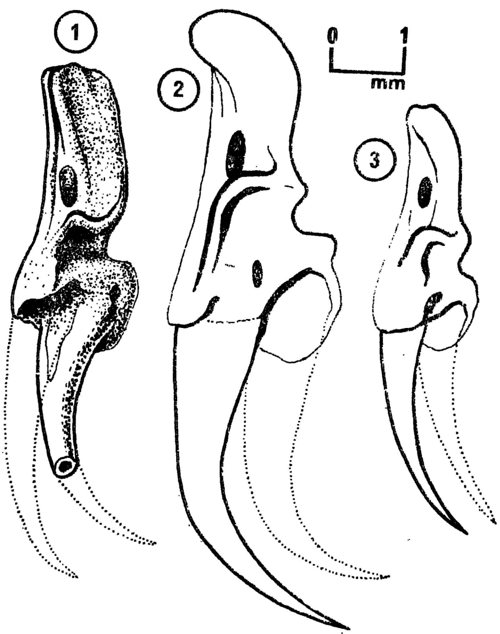


Fig. 15
Left maxillaries of the vipers discussed in the text
1 — left maxillary of *Vipera berus* (Linnaeus) from Kozi Grzbiet, laterally-posterior view; 2 — left maxillary of recent *Vipera ammodytes* (R/263/79); 3 — left maxillary of recent *Vipera berus* (R/22/74)

what oval in shape ($CTW/CTH = 1.16$); epizygapophysial spine absent; postzygapophyses at a very acute angle to the posterior margin fo neural arch; zygosphene dorso-ventrally very thin, oval in shape, relatively densely spaced ($CL/ZSW = 1.79$); prezygapophysial articular facets oval, and postzygapophysial ones square in outline; prezygapophyses very short, hardly projecting outside their articular facets.

Vipera aff. *ammodytes* (Linnaeus, 1758) (Text-fig. 17)

Material: Two basiphenoids (layer 2*a*).

BASISPHENOID: Processes suborbitales strongly developed, causing the bone behind processus parasphenoideus to be regularly rectangular in shape, twice longer than wide; processes basipterygoides almost indiscernible; processus parasphenoideus wide and relatively short (one third of the bone in length); crista basisphenoidea distinct, extending from the posterior margin to the center of the bone where it splits into two cristae running towards processes suborbitales; cristae pterygoideae absent.

Remarks. — The basisphenoid of extant *Vipera ammodytes* resembles the investigated specimens in its rectangular shape but it is longer. In turn, the processes suborbitales of *V. berus* usually are considerably less outspread and consequently, the basisphenoid is subrectangular in shape; rarely, these processes are more strongly developed but then, the distance inbetween is much less than that between the processes basipterygoides.

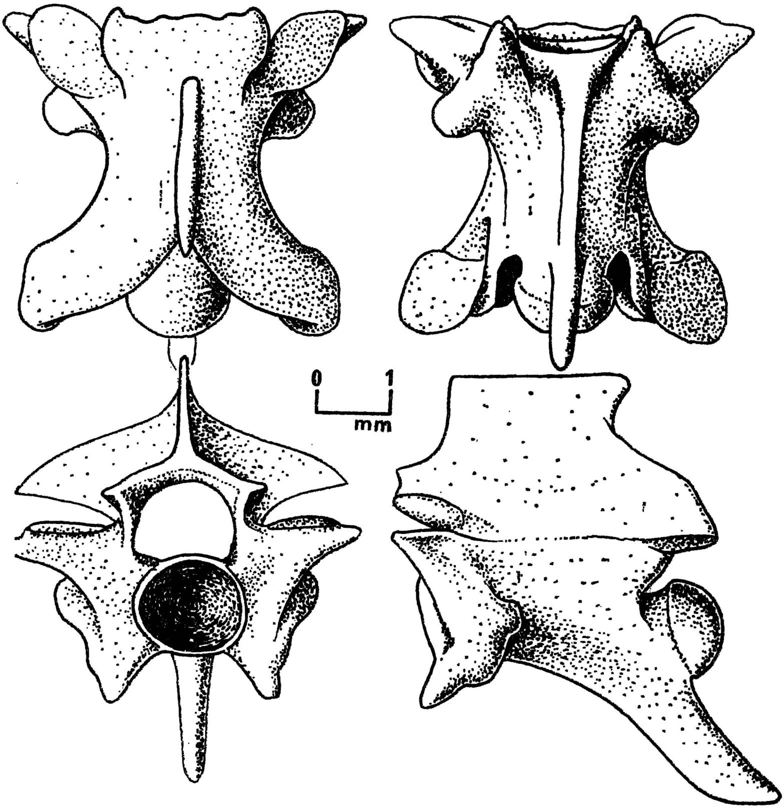


Fig. 16. Precaudal vertebra of *Vipera berus* (Linnaeus)

ENVIRONMENTAL AND ECOLOGICAL SIGNIFICANCE OF THE REPTILE FAUNA

The reptile bony material from Kozi Grzbiet is predominated by remains of the grass snake, *Natrix natrix*, accounting for 98% of the collection (111,000 bones which corresponds to about 500 snake specimens). Some 1.3% of the material are accounted for by remains of the Aesculapian snake, *Elaphe longissima*, while the contributions by the remaining 7 species are minor. The material of the grass snake approximates in number only that of *Triturus* cf. *cristatus*, the most abundant amphibian at the investigated locality (Młynarski 1977), and hence these two species are to be regarded as dominant in the Kozi Grzbiet herpetofauna.

At the Recent time, the both dominant species are generally confined to forests and/or deciduous shrubs. One might therefore be tempted to infer such a habitat for the Kozi Grzbiet landscape. This is, however, counterevidenced by the remaining reptiles. Even taken for granted that the majority of thermophilous forms are to be neglected because of

Table 7
Measurements (in *mm*) and ratios of the posterior precaudal vertebrae of *Vipera berus* (Linnaeus); N = 7

	OR	X̄	±SD	CV
PR-PO	4.41 - 5.32			
CL	3.91 - 4.32			
NAW	2.11 - 2.51			
ZSW	2.11 - 2.70			
PO-PO	4.50 - 5.39			
CTH	1.30 - 1.56			
CTW	1.31 - 1.88			
PR-PR	4.41 - 5.57			
CL/NAW	1.64 - 1.85	1.76	±.08	4.70
NAW/PO-PO	.46 - .50	.48	.02	3.52
CTW/CTH	1.01 - 1.26	1.16	.09	7.38
ZSW/NAW	.94 - 1.09	1.00	.09	8.81
PR-PR/PR-PO	.97 - 1.06	1.02	.03	2.96
ZSW/CL	.51 - .61	.56	.04	7.17
CL/ZSW	1.61 - 1.97	1.79	.13	7.37
PR-PR/NAW	1.99 - 2.28	2.12	.11	5.06

OR = observed ranges, X̄ = mean, SD = standard deviation, CV = coefficient of variation

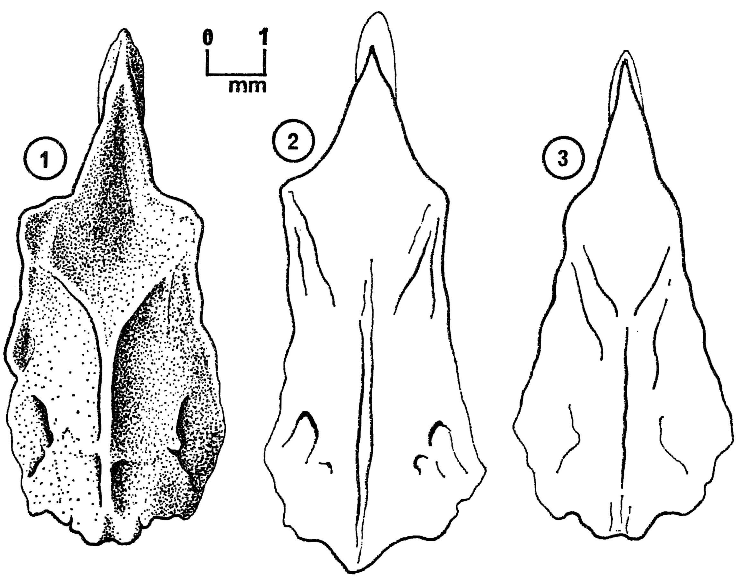


Fig. 17. Basisphenoids of the vipers discussed in the text
1 — basisphenoid of *Vipera* aff. *ammodytes* (Linnaeus) Kozi Grzbiet, from ventral view; **2** — basisphenoid of recent *Vipera ammodytes* (**R/263/79**); **3** — basisphenoid of recent *Vipera berus* (**R/22/74**)

their minor contributions to the fauna, *Elaphe longissima* has to be taken into account. This southern species, as well as *Lacerta* cf. *viridis* and *Vipera* aff. *ammodytes* (and presumably *Palaeomalpolon borealis* sp. n.), certailny are indicative of very hot and xerothermic conditions for isolated microhabitats at least if not for the whole area under consideration. Such an environment was required also by an extinct amphibian, *Pliobatrachus langhae,* discovered recently at Kozi Grzbiet (Młynarski 1977). The problem is made even more ambiguous when theriological data are taken into account because they are suggestive of a cold steppe habitat (Kowalski 1975).

The accumulation of snake remains in the investigated karst fissure at Kozi Grzbiet is representative of a wintering den. As indicated by studies on Recent forms, snakes typically occur in great numbers at a single locality during hibernation. For instance, Aleksiuk (1978) estimated a wintering den of the North-American colubrid snake *Thamnophis sirtalis* (Linnaeus) to include 10,000—15,000 individuals; and Viitanen (1967) recorded some 800 individuals of *Vipera berus* at a single den in Finland. Viitanen (1967) and some older authors referenced by him (Service 1902, Wollebaek 1918, Volsøe 1944) ascertained also that adders often hibernate along with other reptiles and/or amphibians. Klauber (1972) reported as many as 21 diverse snake species hibernating together with a rattlesnake (*Crotalus*) species. On the other hand, the mortality rate of hibernating snakes is high; for example, it was estimated for 15% among hibernating adders by Viitanen (1967). One may therefore conclude that the reptile bony breccia from Kozi Grzbiet has not originated as a so-called "karst trap" or an accumulation of excrements or fecal pellets of predatory mammals or birds, and its interpretation as a wintering den seems to be very plausible.

QUATERNARY CHANGES IN THE REPTILE FAUNA OF POLAND

The reptile fauna of Kozi Grzbiet displays much characteristics in common with the Recent fauna of Poland. It contains species which were infrequent at the Pliocene time but do occur at present in Poland. In turn, species absent from the Recent fauna are represented at Kozi Grzbiet by only a few bone remains.

A phylogenetically primitive species, *Anguis fragilis,* replaced at the Early Pleistocene time a large-sized limbless lizard, *Ophisaurus pannonicus* Kormos. The lizard genus *Ophisaurus* occurs commonly in the Polish Miocene to Pliocene (Bachmayer & Młynarski 1977); it ranges also in the Lower Pleistocene but it began to decline at the beginning of the Pleistocene. The southern lizard genus *Podarcis* is absent from the Polish Pleistocene, replaced with *Lacerta agilis* and *L. viridis*, both the species persistent up to the Recent (the latter was last noted half a century ago; Bocheński & *al.* 1968). The grass snake, *Natrix natrix*, which is at present the commonest snake in Poland and occurred abundantly at Kozi Grzbiet, was recorded in the Polish Pliocene but only among rarities. The species *Coronella austriaca*, previously unknown from Poland in a fossil state, for the first time appears in the fauna of Kozi Grzbiet. This is the case also with its relative, *Elaphe longissima*, which replaced in the Polish Pleistocene its congeners and *Coluber* species. The appearance of *Vipera berus* at Kozi Grzbiet makes the first record of boreal elements in the Polish herpetofauna; this species ranges now even north of the Arctic circle. Its close relative, *V. ammodytes*, is a prominent thermophilous form, confined now to the southeastern Europe.

At the Pliocene time, thermophilous reptiles considerably outnumbered eurythermic ones in Poland; during the Cromerian, the former contributed less than a half to the total number of Polish reptiles; and at present, there is only a single thermophilous reptile species falling to the total number of eight (*see* Text-fig. 18). Apart from the extinct

Pliocene	Cromerian (KOZI GRZBIET)	RECENT
*Testudo szalaii Młynarski	Lacerta cf. viridis (Laurenti)	Elaphe longissima (Laurenti)
Testudo sp. (Large form)	Elaphe longissima (Laurenti)	
*Emys wermuthi Młynarski	*Palaeomalpolon borealis gen. n., sp. n.	
*Geoemyda mossoczyi Młynarski	Vipera aff. ammodytes (Linnaeus)	
*Geoemyda sp.		
*Ophisaurus pannonicus Kormos		
Lacerta cf. viridis (Laurenti)		
Podarcis cf. sicula (Rafinesque)		
Podarcis cf. muralis (Laurenti)		
*Coluber robertmertensi Młynarski		
Coluber cf. viridiflavus (Lacépède)		
Elaphe cf. situla (Linnaeus)		
Elaphe cf. quatuorlineata (Lacépède)		
Emys cf. orbicularis (Linnaeus)	Anguis fragilis Linnaeus	Emys orbicularis (Linnaeus)
Anguis cf. fragilis Linnaeus	Lacerta agilis Linnaeus	Anguis fragilis Linnaeus
Lacerta cf. agilis Linnaeus	Coronella austriaca Laurenti	Lacerta agilis Linnaeus
Natrix cf. natrix (Linnaeus)	Natrix natrix (Linnaeus)	Lacerta vivipara Jacquin
	Vipera berus (Linnaeus)	Coronella austriaca Laurenti
		Natrix natrix (Linnaeus)
		Vipera berus (Linnaeus)

Fig. 18. Pliocene through Recent distribution of the reptiles in Poland
Thermophilous forms are listed over, and eurythermic forms below the horizontal line; extinct species are indicated by an asterisk
The list of Pliocene species is compiled from the reports presented by Młynarski (1962, 1977; and unpublished data)

forms, those reptiles recognized herein for thermophilous are living in southern Europe, usually far off the southern boundary of Poland (*cf.* Arnold & Burton 1977). One may conclude that at the Early Pleistocene the southern elements of the Polish reptilian fauna have become extinct, and the modern eurythermic herpetofauna started to be formed.

During the Late Pleistocene (Riss), the Aesculapian snake, *Elaphe longissima*, ranged northwards up to northeastern Poland (Bałuk & *al.* 1981). Beginning with the Early Holocene, it occurred in southern Poland, near Cracow and Biłgoraj (Bocheński & *al.* 1968), and at present it is confined to the Bieszczady Mts and Zamość region in southeastern Poland where peculiarities of topographic and climatic situation permit considerably xerothermic conditions (Kaźmierczak 1965). This species was also recorded in the Polish Jura Chain half a century ago but it has disappeared from that area (Bocheński & *al.* 1968).

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Z. SZYNDLAR

WCZESNOPLEJSTOCEŃSKA FAUNA GADÓW ZE STANOWISKA KRASOWEGO NA KOZIM GRZBIECIE W GÓRACH ŚWIĘTOKRZYSKICH

(Streszczenie)

Praca niniejsza * przedstawia opis wczesnoplejstoceńskiej (kromerskiej) fauny gadów ze stanowiska Kozi Grzbiet w Górach Świętokrzyskich (*patrz* fig. 1; *oraz* Głazek & *al.* 1976, 1977), skąd znana jest od niedawna bogata fauna płazów i gadów (*patrz* Młynarski 1977).

Szczątki gadów z Koziego Grzbietu stanowią najbogatszy materiał tego typu w Polsce; zawiera on około 112 tys. kości, w tym 111 tys. kręgów węży (co odpowiada mniej więcej 500 osobnikom tych zwierząt). W zebranym materiale oznaczono 9 gatunków gadów (*patrz* fig. 2—17 oraz tab. 1—7). Wśród jaszczurek są to: jaszczurka zwinka — *Lacerta agilis* Linnaeus, jaszczurka zielona — *Lacerta* cf. *viridis* (Laurenti), oraz padalec — *Anguis fragilis* Linnaeus. Natomiast wśród węży są to: wąż Eskulapa — *Elaphe longissima* (Laurenti), gniewosz — *Coronella austriaca* Laurenti, *Palaeomalpolon borealis* gen. et sp. n., zaskroniec — *Natrix natrix* (Linnaeus), oraz żmija zygzakowata — *Vipera berus* (Linnaeus) i *Vipera* aff. *ammodytes* (Linnaeus).

Gatunkiem zdecydowanie dominującym w badanym zespole jest zaskroniec (98% materiału), a ponadto dość liczny jest również wąż Eskulapa (1.3%); kości pozostałych gatunków są bardzo nieliczne.

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* Praca wykonana w ramach planu międzyresortowego *MR. II-3*.

W badanym materiale rozpoznano jeden nowy rodzaj i gatunek węża, *Palaeomalpolon borealis* gen. et sp. n., należący do rodziny Colubridae. Forma ta była, jak się wydaje, bardzo zbliżona do współczesnego południowoeuropejskiego rodzaju *Malpolon*. Nowym elementem dla czwartorzędowej fauny Polski jest także południowoeuropejski gatunek żmii *Vipera* aff. *ammodytes*. Ponadto, Kozi Grzbiet jest jedynym w Polsce stanowiskiem, w którym znaleziono kopalne formy żmii zygzakowatej (*Vipera berus*) i gniewosza (*Coronella austriaca*).

Podczas tworzenia się stanowiska wczesnoplejstoceńskiej herpetofauny jaskinia na Kozim Grzbiecie spełniała przypuszczalnie funkcję zimowiska tej fauny (*por.* Viitanen 1967, Klauber 1972). Znajdowane tam szczątki gadów pochodzą zatem od osobników, które nie przeżyły hibernacji.

W pracy przeprowadzono także dyskusję dotyczącą zmian gatunkowych fauny gadów na obszarze Polski w okresie od pliocenu do czasów dzisiejszych. Z dostępnych obecnie danych wynika, iż we wczesnym plejstocenie nastąpił szybki zanik ciepłolubnych elementów ponto-bałkańskich (znacznie przeważających w pliocenie), co w konsekwencji doprowadziło do ukształtowania się współczesnej herpetofauny o charakterze eurytermalnym (*patrz* fig. 18).