

Old Biharian reptiles of Żabia Cave (Poland)

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Abstract. At the Żabia Cave locality (Old Biharian), altogether 8 taxa have been recognized, belonging to reptiles commonly widespread in the Central European area: *Natrix natrix*, *Natrix* cf. *tessellata*, *Natrix* sp., *Elaphe longissima*, *Coronella austriaca*, cf. *Coronella* sp., *Vipera berus* and *Lacerta* sp.. The snake vertebrae are of high intraspecific morphological variability, which is particularly true of the shapes of hemal keels of the *Colubrinae* (or hypapophyses of the *Natricinae*) and the shapes of the anterior border of the zygosphenal lips. The knowledge of this intraspecific variability could be helpful in determining the fossil material. The finding of *Natrix* cf. *tessellata* at the Żabia Cave locality is the northernmost European fossil discovery of this species. Correlation of the reptile assemblage with rodents has shown that the reptiles (and especially snakes) reflect negligible changes of the climate more distinctly than do small mammals.

Key words: *Reptilia*, *Serpentes*, *Sauria*, determination, osteology, Lower Pleistocene, palaeoecology, Poland.

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I. INTRODUCTION

The Żabia Cave locality is situated near the village of Podlesice in the Kraków-Wieluń upland in central Poland. This is a vertical pit filled with a sequence of sediments containing a rich Lower Pleistocene vertebrate fauna.

The cave (406.3 m above sea level) has been discovered in the northern slope of Somlów hill (427 m above sea level), NW of the village of Podlesice (Fig. 1). Żabia Cave was formed in massive Oxfordian limestones and its part explored reached the depth of 18.5 m in 1979. The cave has 3 shafts connected by two level passages, each of them being a cavity with lateral side-branches. The entrance shaft and the entrance tunnel to the upper cavity are completely filled by limestone debris, while the deeper parts of the cave are partially filled with speleothems and clastic sediments. In the II-nd and III-rd shafts a fossil vertebrate fauna was discovered. The stratigraphical age was determined on the basis of mammal remains (BOSÁK et al. 1982).

The material of reptiles was preliminarily investigated by SZYNDLAR (1984). All the material studied is deposited at the Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences in Kraków.

As regards the dimensions of vertebrae, only the length (CL) and width (NAW) of the vertebral centres were measured (in mm).

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II. SYSTEMATIC PART

Order *Squamata* OPPEL, 1811

Suborder *Serpentes* LINNAEUS, 1758

Superfamily *Colubroidea* OPPEL, 1811

Family *Colubridae* OPPEL, 1811

Subfamily *Natricinae* BONAPARTE, 1838

Genus *Natrix* LAURENTI, 1768

Natrix natrix (LINNAEUS, 1758)

1984 *Natrix* sp.: SZYNDLAR, p. 11.

M a t e r i a l. – one parietal (JZ 17 – 1761), 2 basisphenoids (JZ 17 – 1824, 1825), 4 prootics (JZ 17 – 1826-1829), 22 cervical vertebrae (JZ H – 113-117, JZ 17 – 112-114, JZ 17 – 1108-1113, JZ 81/1 – 45-50, JZ 81/1 – 700,701), 294 trunk vertebrae (JZ H – 1198-1317, JZ 17 – 1632-1643, JZ 17 – 1805-1810, JZ 17 – 1890-1935, JZ 81/1 – 461-489, JZ 81/1 – 710-759, JZ 1982

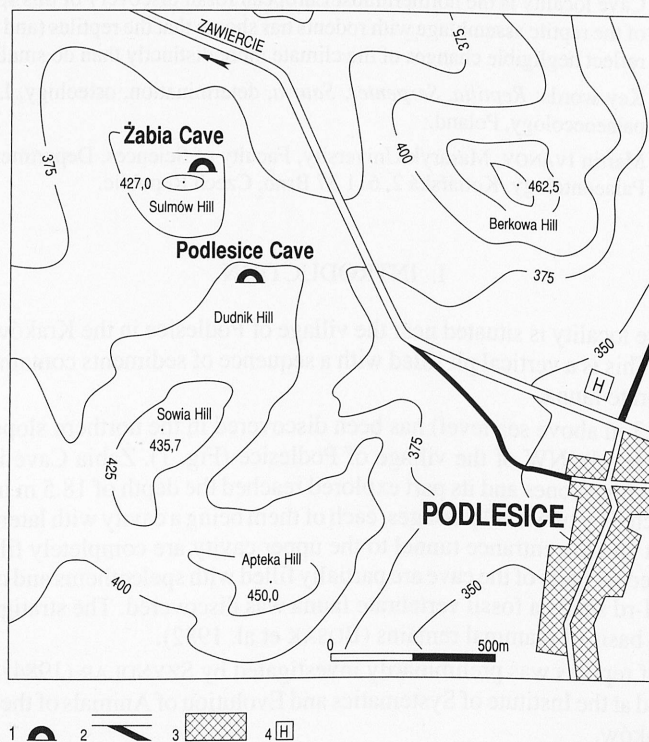


Fig. 1. Topographic sketch of the Podlesice area: 1 – caves containing vertebrate-bearing deposits; 2 – roads and cart roads; 3 – buildings; 4 – tourist hotel (after BOSÁK et al. 1982).

– 325-355), 96 caudal vertebrae (JZ H – 1574-1613, JZ 17 – 1028-1043, JZ 17 – 1737-1757, JZ ?17 – 22-24, JZ 81/1 – 673-681, JZ 81/1 – 800-804, JZ 1982 – 399,400).

Description. – Parietal (Fig. 2A): A single distal part of the bone has been found, with characteristic parietal crests not converging before its distal margin. A clearly visible groove extends over the medial part of the bone and two parietal foramina are located in the dorsal surface of the bone.

Basisphenoid (Fig. 2B): Two fragments of the distal part of the bone lacking their parasphenoid processes are rarely preserved. A typical sign is the triangular shape of the bone with low pterygoid crests. Both the anterior and the posterior orifices of the Vidian canals are clearly visible.

Prootic (Fig. 2C): The supraoccipital crest of the bone is strongly developed. All the bones display a small nerve foramen below the V2 orifice (ancient feature).

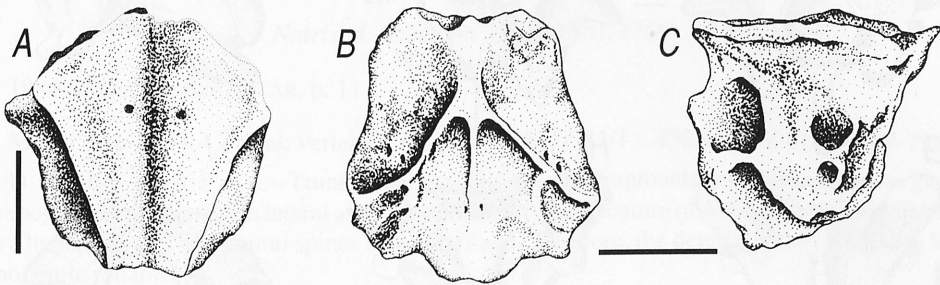


Fig. 2. *Natrix natrix* (LINNAEUS, 1758). A – parietal (JZ 17-1761); B – basisphenoid (JZ 17-1824); C – right prootic (JZ 17-1829). A – dorsal view; B – ventral view; C – lateral view. Each scale equals 2 mm.

Cervical and mid-trunk vertebrae (Fig. 3A-J): Most of the vertebrae are fragmentary, usually with hypapophyses and neural spines broken off. The shapes of the hypapophyses and the parapophyseal processes are typical of *Natrix*, especially of *Natrix natrix*.

Caudal vertebrae (Fig. 3K-O): All the vertebrae are fragmentary. The abundant posterior caudal vertebrae have strongly built pleurapophyses with broad bases and pointed anterior ends. The gracile and antero-ventrally directed pleurapophyses of the anterior caudal vertebrae have rarely been preserved. Most of the gracile haemapophyses are broken off. The low neural spines with anterior overhangings are characteristic of *Natrix natrix*.

Measurements of trunk vertebrae (N = 34). – CL: OR = 3.77 - 5.7; NAW: OR = 2.53 - 3.38; CL/NAW: OR = 1.46 - 1.86, mean 1.66 ± 0.10 .

Altogether two species of the genus *Natrix* are common at Central European Pleistocene localities: *Natrix natrix* and *Natrix tessellata*. The existing investigations (SZYNDLAR 1984; pers. comm.) make it possible to distinguish these two species from each other on the basis of:

1. the shapes of the hypapophyses (their distal ends are rounded in *N. natrix* while in *N. tessellata* they are sharp).
2. the shapes of the parapophyseal processes (in *N. natrix* these processes are strongly built in contrast to *N. tessellata*).

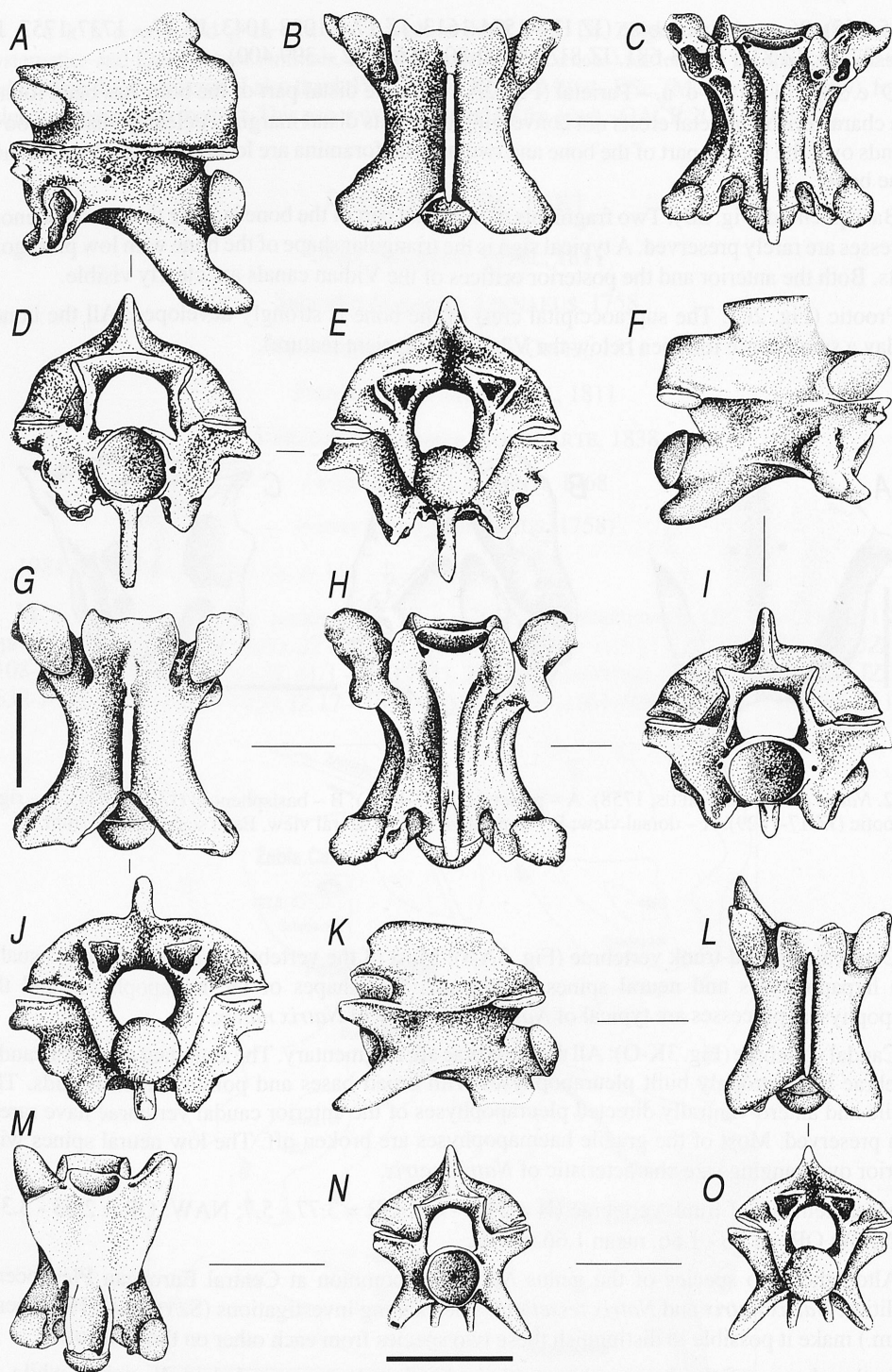


Fig. 3. *Natrix natrix* (LINNAEUS, 1758): A-E – cervical vertebra (JZ H-113); F-J – trunk vertebra (JZ H-1215); K-O – caudal vertebra (JZ H-1582). A, F, K – lateral views; B, G, L – dorsal views; C, H, M – ventral views; D, I, N – anterior views; E, J, O – posterior views. Each scale equals 2 mm.

However, a considerable number of vertebrae with pointed distal tips of the hypapophyses belonging undoubtedly to *Natrix natrix* have been found at the Mladeč Cave locality (Czech Republic) (IVANOV, in prep.). Their correct determination is also supported by the presence of cranial bones. Therefore, I do not believe that these two species could be distinguished from each other by the shapes of the hypapophyses solely. The shapes of the hypapophyses could rather be the manifestation of intraspecific morphological variability than a feature suitable for determination at the species level. Surprisingly no similar vertebrae of *N. natrix* have been found at other European localities. I cannot exclude the fact that the shapes of the hypapophyses change during the ontogeny, because rounded hypapophyses have mostly been observed in the largest vertebrae (quite clearly in adult specimens). Significant ontogenetic changes have been observed in the extinct *Natrix longivertebrata* (RAGE & SZYNDLAR 1986).

Subfamily *Natricinae* BONAPARTE, 1838

Genus *Natrix* LAURENTI, 1768

Natrix cf. *tessellata* (LAURENTI, 1768)

1984 *Natrix* sp.: SZYNDLAR, p. 11

M a t e r i a l. - 7 trunk vertebrae (JZ H - 1318, JZ 81/1 - 450,451, JZ 81/1 - 789-791).

D e s c r i p t i o n. - Trunk vertebrae (Fig. 4A-D): Fragmentary vertebrae possess gracile parapophyseal processes (in lateral aspect), which is a typical feature of *N. tessellata*. The vertebrae have hypapophyses and neural spines broken off and, therefore, the determination at species level is not quite reliable.

Measurements of trunk vertebrae (N = 7). - CL: OR = 2.56 - 3.95; NAW: OR = 1.83 - 2.58; CL/NAW: OR = 1.39 - 1.70, mean 1.55 ± 0.12

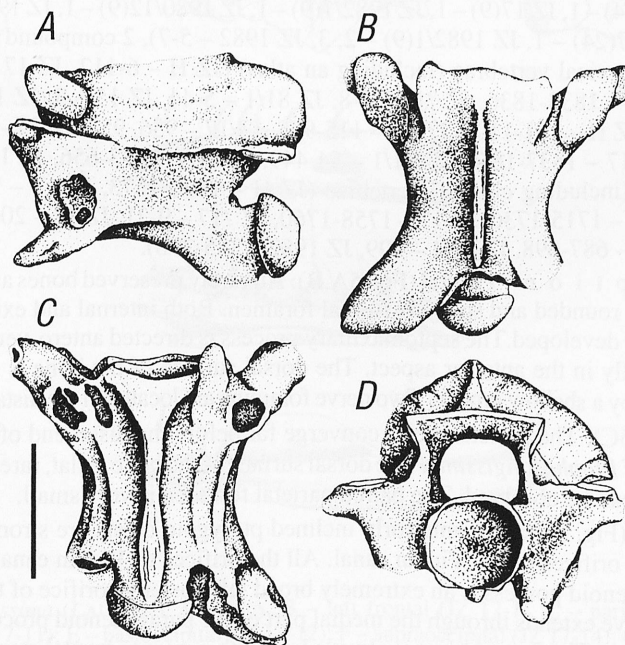


Fig. 4. *Natrix* cf. *tessellata* (LAURENTI, 1768): A-D - trunk vertebra (JZ H-1318). A - lateral view; B - dorsal view; C - ventral view; D - anterior view. Scale equals 2 mm.

Subfamily *Natricinae* BONAPARTE, 1838Genus *Natrix* LAURENTI, 1768*Natrix* sp.

1984 *Natrix* sp.: SZYNDLAR, p. 11

M a t e r i a l. – 505 trunk vertebrae (JZ H – 1319-1468, JZ 17 – 939-955, JZ 17 – 1644-1704, JZ 17 – 1811-1823, JZ 17 – 1854-1880, JZ 17 – 1936-2051, JZ 81/1 – 490-552, JZ 81/1 – 760-788, JZ 1982 – 356-384).

D e s c r i p t i o n. – Trunk vertebrae: The vertebrae are heavily damaged, with broken off hypapophyses and parapophyseal processes. For this reason, a more precise determination is not possible.

Measurements of trunk vertebrae (N = 35). – CL: OR = 3.52 - 5.44; NAW: OR = 2.42 - 3.58; CL/NAW: OR = 1.38 - 1.78, mean 1.60 ± 0.09 .

Family *Colubridae* OPPEL, 1811Subfamily *Colubrinae* OPPEL, 1811Genus *Elaphe* FITZINGER, 1883*Elaphe longissima* (LAURENTI, 1768)

1982 *Elaphe* sp.: BOSÁK et al., p. 221, Tab. 1;

1984 *Elaphe* aff. *longissima* (LAURENTI, 1768): SZYNDLAR, pp. 97-102.

M a t e r i a l. – 3 frontals (JZ 17 – 1, 2, JZ 17 – 1052), 6 parietals (JZ 17 – 4-8, JZ 17 – 1053), 8 basisphenoids (JZ 17 – 9-11, JZ 17 – 1762-1763, JZ 1982 – 1-3), 3 basioccipitals (JZ 17 – 12, 13, JZ 17 – 1063), 1 supraoccipital (JZ 17 – 14), 7 prootics (JZ 17 – 15-20, JZ 17 – 1064), 8 exoccipitals (JZ 17 – 21-25, JZ 17 – 1064, JZ 17 – 1830, 1831), 8 maxillaries (JZ H – 1, 2, JZ 17 – 1764, JZ 17(24) – 1, JZ 17(9) – 1, JZ 1982/1(9) – 1, JZ 1980/12(9) – 1, JZ 1982 – 4), 8 dentaries (JZ H – 4, 5, JZ 17(24) – 1, JZ 1982/1(9) – 2, 3, JZ 1982 – 5-7), 2 compound bones (JZ 17 – 27, JZ 15 – 2), 304 cervical vertebrae (including an atlas) (JZ H – 6-112, JZ 17 – 29-111, JZ 17 – 1066-1107, JZ 17 – 1833-1836, JZ ?17 – 1-8, JZ 81/1 – 5-44, JZ 15 – 3, JZ 1982 – 8-26), 3218 trunk vertebrae (JZ H – 121-1197, JZ 17 – 115-938, JZ 17 – 956, 957, JZ 17 – 1115-1631, JZ 17 – 1765-1804, JZ 17 – 1837-1853, JZ 81/1 – 54-449, JZ 81/1 – 613-656, JZ 15 – 26-30, JZ 12 – 3-5), 246 caudal (including cloacal) vertebrae (JZ H – 1490-1573, JZ 17 – 958-1027, JZ 17 – 1044-1051, JZ 17 – 1715-1736, JZ 17 – 1758-1760, JZ ?17 – 9-21, JZ 17 – 2061-2063, JZ 81/1 – 657-672, JZ 81/1 – 687-698, JZ 81/1 – 799, JZ 1982 – 385-398).

D e s c r i p t i o n. – Frontal (Fig. 5A,B): All rarely preserved bones are fragmentary. The frontal aperture is rounded and so is the frontal foramen. Both internal and external premaxillary processes are well developed. The septomaxillary process is directed antero-ventrally in the lateral aspect, and laterally in the anterior aspect. The dorsal surface of the bone is convex, the orbital margin is marked by a shallow groove. Two nerve foramina are located in the distal part of the groove.

Parietal (Fig. 5C): The parietal crests converge far before the distal end of the bone, which is a typical feature of *Elaphe longissima*. The dorsal surface of the bone is flat, rarely a shallow groove located medially can be observed. The paired parietal foramen is very small.

Basisphenoid (Fig. 5D): The anteriorly inclined pterygoid crests are strongly developed and cover the anterior orifices of the Vidian canal. All the orifices of Vidian canals are conspicuous; the single basisphenoid possesses an extremely broad left posterior orifice of the Vidian canal. A distinct deep groove extends through the medial part of the parasphenoid process which is visible in the ventral aspect. The frontal crest is always low with a minute frontal step.

Basioccipital (Fig. 5E): The bone shows a well developed basioccipital crest as well as medial crest. The basioccipital crest is low with prominent lateral lobes, the medial tubercle is indistinct.

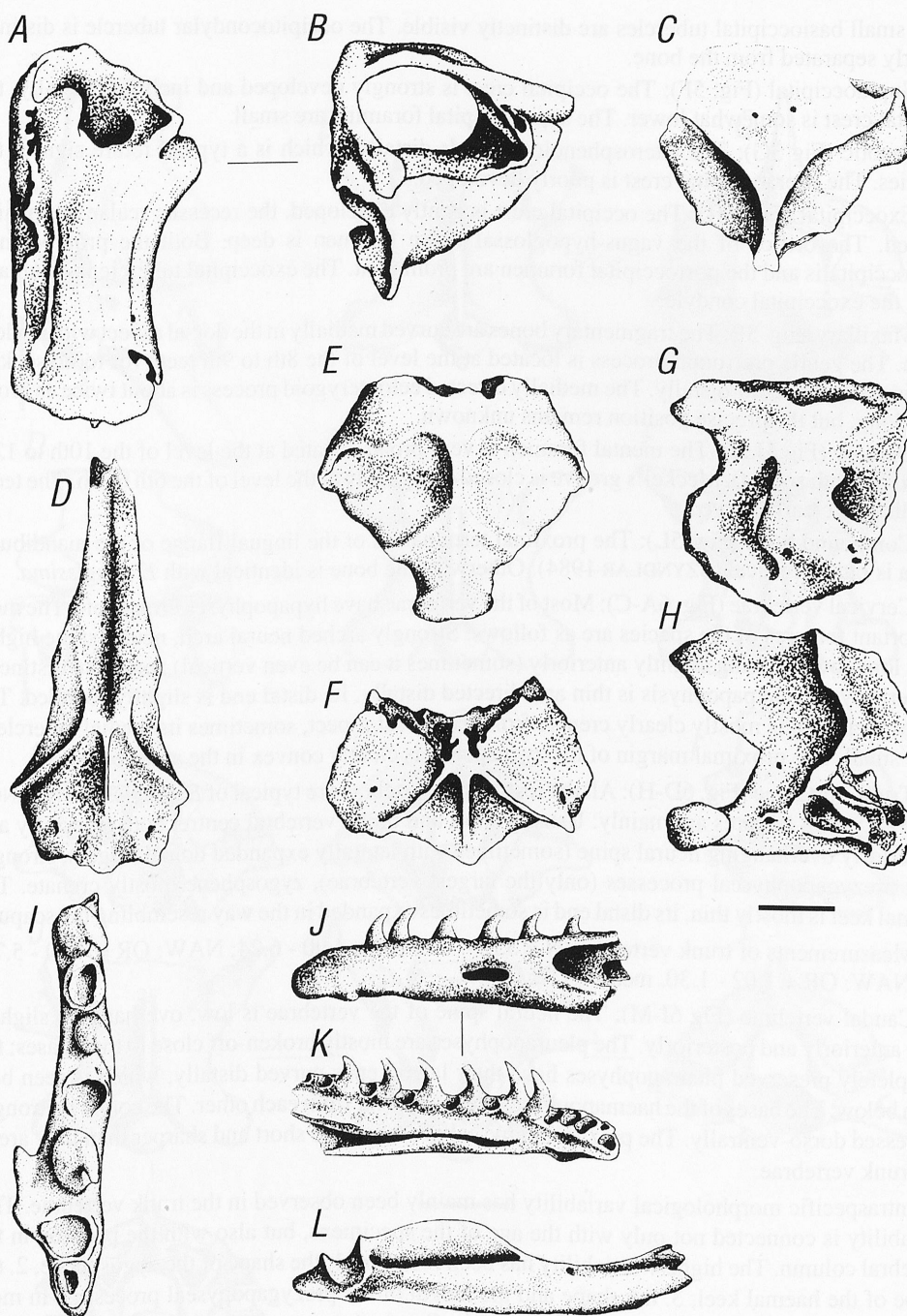


Fig. 5. *Elaphe longissima* (LAURENTI, 1768): A, B – left frontal (JZ 17-1); C – parietal (JZ 17-5); D – basisphenoid (JZ 17-11); E – basioccipital (JZ 17-12); F – supraoccipital (JZ 17-14); G – right prootic (JZ 17-16); H – right exoccipital (JZ 17-24); I – left maxillary (JZ 1980/12(9)-1); J, K – left dentary (JZ H-5); L – right compound bone (JZ 15-2). A, D, E, I – ventral views; B – anterior views; C, F – dorsal views; G, H – lateral views; J, L – labial views; K – lingual view. Scale equals 2 mm.

The small basioccipital tubercles are distinctly visible. The occipitocondylar tubercle is distinct, clearly separated from the bone.

Supraoccipital (Fig. 5F): The occipital crest is strongly developed and inclining distally, the sagittal crest is somewhat lower. The supraoccipital foramina are small.

Prootic (Fig 3G): The laterosphenoid expands distally, which is a typical feature sign of the species. The supraoccipital crest is poorly developed.

Exoccipital (Fig. 5H): The occipital crest is gently developed, the recessus scalae tympani is arched. The orifice of the vagus-hypoglossal nerve foramen is deep. Both the protuberantia postoccipitalis and the postoccipital foramen are prominent. The exoccipital tubercle is small and so is the exoccipital condyle.

Maxillary (Fig. 5I): The fragmentary bones are curved medially in the dorsal aspect with isodont teeth. The gentle prefrontal process is located at the level of the 8th to 9th teeth (or tooth socket) and is directed medio-distally. The medially directed ectopterygoid process is about twice as broad as is long, but the precise position remains unknown.

Dentary (Fig 5J,K): The mental foramen is very broad, located at the level of the 10th to 12th teeth (or tooth socket). Meckel's groove is closed completely at the level of the 6th tooth. The teeth are distally clearly curved.

Compound bone (Fig. 5L): The proximal termination of the lingual flange of the mandibular fossa is rather vertical (SZYNDLAR 1984). Otherwise the bone is identical with *E. longissima*.

Cervical vertebrae (Fig. 6A-C): Most of the vertebrae have hypapophyses broken off. The most important features of the species are as follows: Strongly arched neural arch, neural spine higher than long, overhanging slightly anteriorly (sometimes it can be even vertical) and more distinctly posteriorly. The hypapophysis is thin and directed distally. Its distal end is slightly rounded. The zygosphenal lip is mostly clearly crenate from the dorsal aspect, sometimes its medial tubercle is very small. The proximal margin of the zygosphenon is clearly convex in the anterior aspect.

Trunk vertebrae (Fig. 6D-H): All the features of vertebrae are typical of *E. longissima* (IVANOV 1996). Typical features are mainly: Usually short and broad vertebral centre, both anteriorly and posteriorly overhanging neural spine (sometimes with laterally expanded dorsal ridges), strongly built prezygapophyseal processes (only the largest vertebrae), zygosphenon mostly crenate. The haemal keel is mostly thin, its distal end is sometimes expanded in the way resembling the scapula.

Measurements of trunk vertebrae (N = 35). – CL: OR = 4.90 - 6.24; NAW: OR = 4.10 - 5.74; CL/NAW: OR = 1.02 - 1.30, mean 1.11 ± 0.06 .

Caudal vertebrae (Fig 6I-M): The neural spine of the vertebrae is low, overhanging slightly both anteriorly and posteriorly. The pleurapophyses are mostly broken-off close to their bases; the completely preserved pleurapophyses have their lateral ends curved distally, which is seen best from below. The bases of the haemapophyses are located far from each other. The cotyle is strongly depressed dorso-ventrally. The prezygapophyseal processes are short and sharper than they are in the trunk vertebrae.

Intraspecific morphological variability has mainly been observed in the trunk vertebrae. This variability is connected not only with the age of the specimens, but also with the position in the vertebral column. The highest variability has been found in: 1. the shape of the zygosphenon, 2. the shape of the haemal keel, 3. the shape and the length of the prezygapophyseal processes. In most cases (almost all vertebrae obtained from Žabia Cave), the zygosphenon is crenate but a lot of vertebrae – especially the largest ones – have a straight or even weakly concave anterior margin of the zygosphenon (Mladeč Caves). The shape of the haemal keel is connected mainly with its position in the axis. While the anterior trunk vertebrae have thin haemal keels, the posterior trunk vertebrae have broad and sometimes flattened haemal keels (very distinct subcentral grooves and subcentral ridges can also be seen). The character of the prezygapophyseal processes depends on the age of the specimens (young specimens possess gentle prezygapophyseal processes).

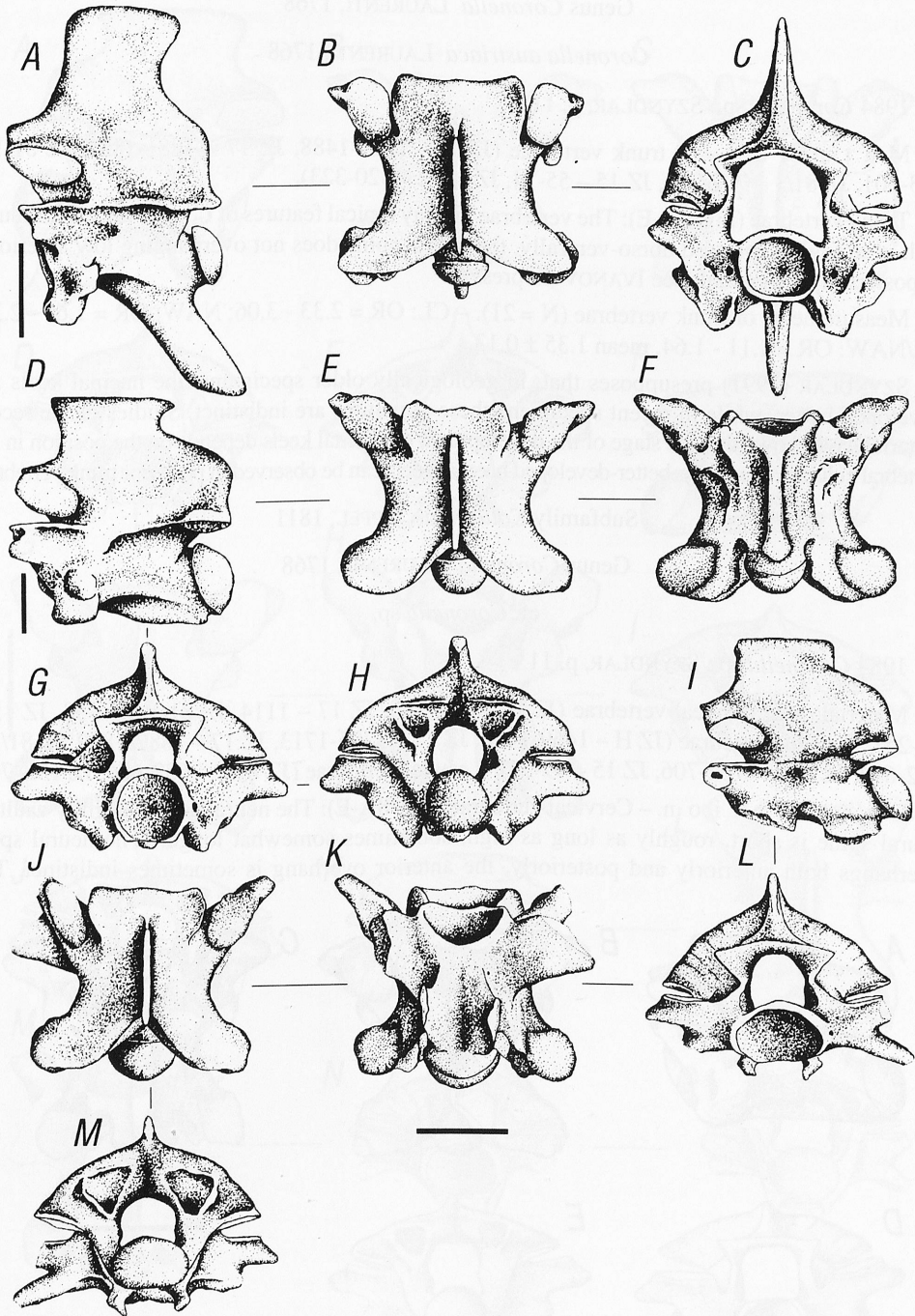


Fig. 6. *Elaphe longissima* (LAURENTI, 1768): A-C – cervical vertebra (JZ 1982-10); D-H – trunk vertebra (JZ 17-192); I-M – caudal vertebra (JZ 17-1044). A, D, I – lateral views; B, E, J – dorsal views; C, G, L – anterior views; F, K – ventral views; H, M – posterior views. Scale equals 2 mm.

Subfamily *Colubrinae* OPPEL, 1811

Genus *Coronella* LAURENTI, 1768

Coronella austriaca LAURENTI, 1768

1984 *Coronella* sp.: SZYNDLAR, p. 11.

M a t e r i a l. – 98 trunk vertebrae (JZ H – 1473-1488, JZ 17 – 1881-1886, JZ 81/1 – 553-601, JZ 81/1 – 707-709, JZ 15 – 55-74, JZ 1982 – 320-323).

Trunk vertebrae (Fig. 7A-E): The vertebrae display typical features of *C. austriaca*: The neural arch is strongly depressed dorso-ventrally, the neural spine does not overhanging low anteriorly or posteriorly. For details see IVANOV (in press).

Measurements of trunk vertebrae (N = 21). – CL: OR = 2.33 - 3.06; NAW: OR = 1.69 - 2.34; CL/NAW: OR = 1.11 - 1.64, mean 1.35 ± 0.13 .

SZYNDLAR (1991) presupposes that, in geologically older specimens, the haemal keels are developed better, while in recent specimens these structures are indistinct. Studies of the recent material have shown that the stage of the development of haemal keels depends on the position in the vertebral column. Generally, better-developed haemal keels can be observed in posterior trunk vertebrae.

Subfamily *Colubrinae* OPPEL, 1811

Genus *Coronella* LAURENTI, 1768

cf. *Coronella* sp.

1984 *Coronella* sp.: SZYNDLAR, p. 11

M a t e r i a l. – 22 cervical vertebrae (JZ H – 119, 120, JZ 17 – 1114, JZ 81/1 – 51-53, JZ 15 – 10-25), 38 trunk vertebrae (JZ H – 1469-1472, JZ 17 – 1705-1713, JZ 17 – 1887-1889, JZ 81/1 – 602-612, JZ 81/1 – 702-706, JZ 15 – 49-54), 6 caudal vertebrae (JZ 81/1 – 682-686, JZ 15 – 75).

D e s c r i p t i o n. – Cervical vertebrae (Fig. 8A-E): The neural arch is slightly vaulted, neural spine is short, roughly as long as high, sometimes somewhat longer. The neural spine overhangs both anteriorly and posteriorly, the anterior overhang is sometimes indistinct. The

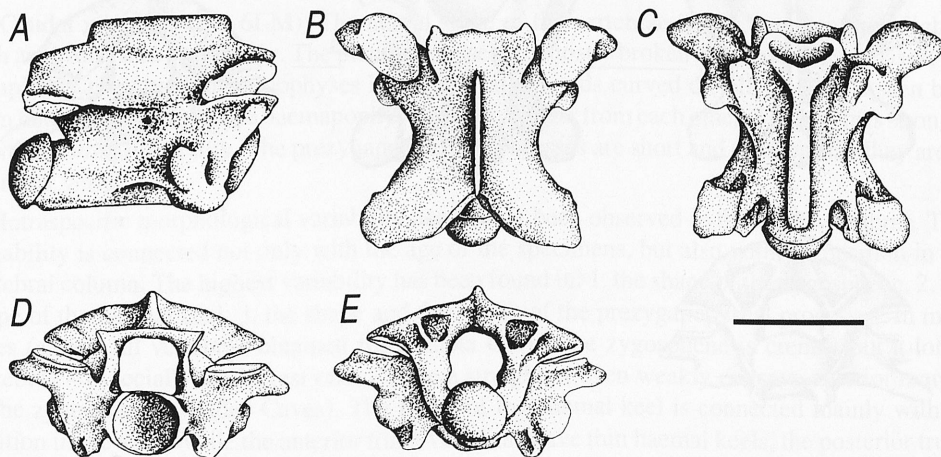


Fig. 7. *Coronella austriaca* LAURENTI, 1768: A-E – trunk vertebra (JZ 15-61). A – lateral view; B – dorsal view; C – ventral view; D – anterior view; E – posterior view. Each scale equals 2 mm.

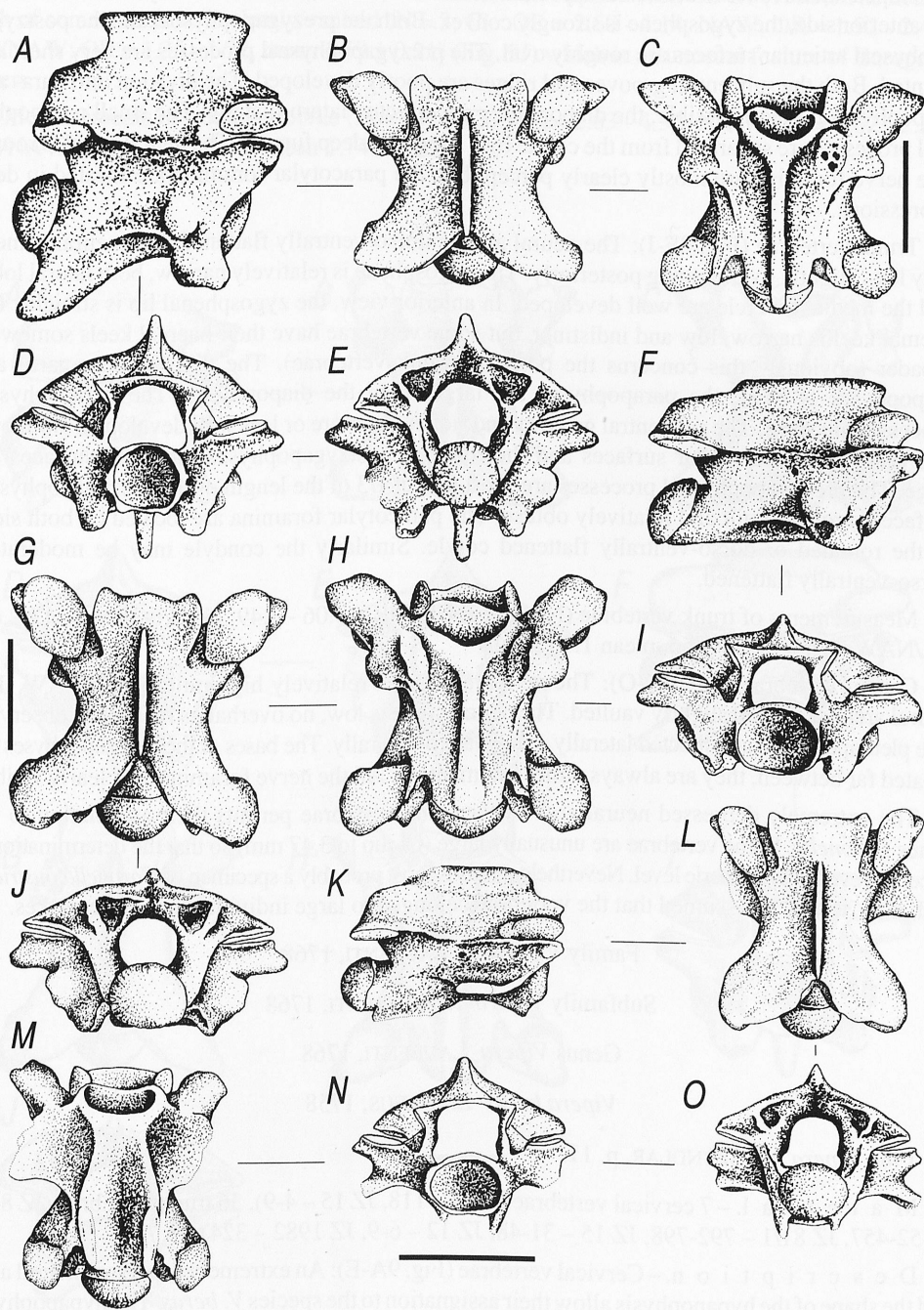


Fig. 8. cf. *Coronella* sp.: A-E – cervical vertebra (JZ 15-10); F-J – trunk vertebra (JZ H-1469); K-O – caudal vertebra (JZ 15-75). A, F, K – lateral views; B, G, L – dorsal views; C, H, M – ventral views; D, I, N – anterior views; E, J, O – posterior views. Each scale equals 2 mm.

hypapophysis is straight, its sharp distal tip is directed posteriorly. The zygosphenes have clearly developed lateral lobes in the dorsal aspect, the medial tubercle is sometimes very small. Seen from the anterior side, the zygosphenes are strongly convex. Both the prezygapophyseal and the postzygapophyseal articular surfaces are roughly oval. The prezygapophyseal processes are very short and pointed. Both the subcentral grooves and ridges are poorly developed. The division into para- and diapophyses is clearly visible, the diapophyses are directed latero-distally. The small parapophyseal processes are separated from the cotyle by a short and deep furrow. The neural canal is round. The nerve foramina are mostly clearly perceptible, the paracotylar foramina are located in deep depressions.

Trunk vertebrae (Fig. 8F-J): The neural arch is dorso-ventrally flattened. The neural spine is very low, slightly overhanging posteriorly. The zygosphenes are relatively narrow, both lateral lobes and the medial tubercle are well developed. In anterior view, the zygosphenal lip is straight. The haemal keel is narrow, low and indistinct, but some vertebrae have their haemal keels somewhat broader (obviously this concerns the posterior trunk vertebrae). The division into para- and diapophyses is clear, the parapophyses are larger than the diapophyses. The parapophyseal processes are short. The subcentral grooves and ridges are more or less well developed. Both oval prezygapophyseal articular surfaces and the rounded postzygapophyseal articular surfaces are large. The prezygapophyseal processes are short (about 1/3 of the length of the prezygapophyseal surface), strongly built and relatively obtuse. The paracotylar foramina are located on both sides of the rounded or dorso-ventrally flattened cotyle. Similarly the condyle may be moderately dorso-ventrally flattened.

Measurements of trunk vertebrae (N = 11). – CL: OR = 3.06 - 3.49; NAW: OR = 2.11 - 2.62; CL/NAW: OR = 1.22 - 1.55, mean 1.40 ± 0.10

Caudal vertebrae (Fig. 8K-O): The vertebrae have a relatively high ratio of CL/NAW. The neural arch is low and slightly vaulted. The neural spine is low, no overhangs have been observed. The parapophyses are directed laterally, rarely latero-ventrally. The bases of the haemapophyses are located far between, they are always rather fragmentary. All the nerve foramina are clearly visible.

The extremely depressed neural arch of the trunk vertebrae permits their assignation to the genus *Coronella*. Some vertebrae are unusually large (CL up to 3.47 mm) so that the determination is uncertain even at the generic level. Nevertheless, this is most probably a specimen of *Coronella austriaca* and, if so, it may be assumed that the vertebrae belonged to large individuals of these snakes.

Family *Viperidae* LAURENTI, 1768

Subfamily *Viperinae* LAURENTI, 1768

Genus *Vipera* LAURENTI, 1768

Vipera berus LINNAEUS, 1758

1984 *Vipera* sp.: SZYNDLAR, p. 11.

M a t e r i a l. – 7 cervical vertebrae (JZH – 118, JZ 15 – 4-9), 36 trunk vertebrae (JZ 81/1 – 452-457, JZ 81/1 – 792-798, JZ 15 – 31-48, JZ 12 – 6-9, JZ 1982 – 324).

D e s c r i p t i o n. – Cervical vertebrae (Fig. 9A-E): An extremely depressed neural arch and the shape of the hypapophysis allow their assignation to the species *V. berus*. The hypapophysis is slender, shorter and directed more distally and so unlike that in the members of the "*V. ammodytes* group". The parapophyseal processes are relatively long and directed distinctly antero-ventrally. The zygosphenes are crenate in the anterior aspect, seen from above the zygosphenes are straight. Both prezygapophyseal and postzygapophyseal articular surfaces are oval. The nerve foramina are distinct.

Trunk vertebrae (Fig. 9F-J): The hypapophysis is lower and more markedly distally directed than it is in the cervical vertebrae. For a more detailed description see IVANOV (1995). The neural arch of some vertebrae is clearly vaulted (N = 3; CL: OR = 2.60 - 4.14; NAW: OR = 1.92 - 2.41; CL/NAW: OR = 1.35 - 1.72, mean 1.59 ± 0.21) (Fig. 9J) which is an unusual feature of European vipers.

Measurements of trunk vertebrae (N = 20). – CL: OR = 2.63 - 4.50; NAW: OR = 1.62 - 2.39; CL/NAW: OR = 1.48 - 2.14, mean 1.74 ± 0.23 .

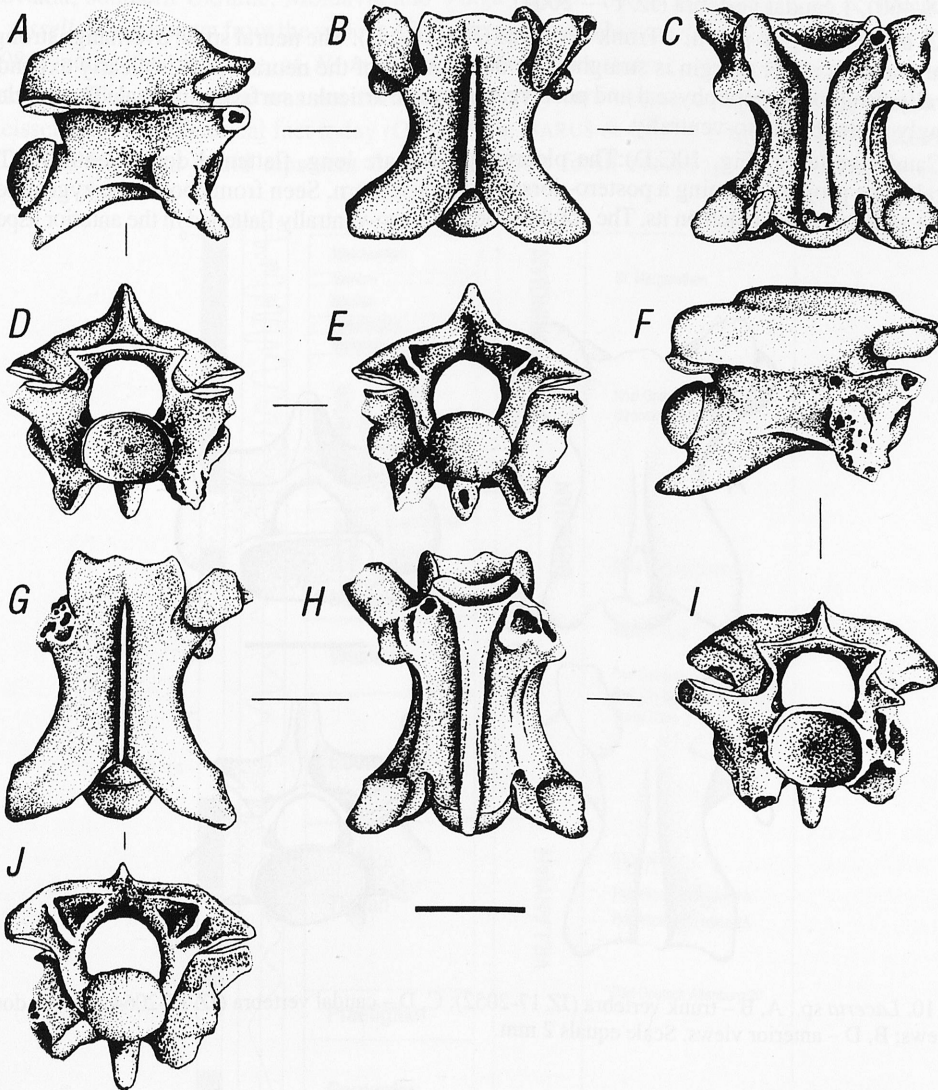


Fig. 9. *Vipera berus* LINNAEUS, 1758: A-E – cervical vertebra (JZ H-118); F-J – trunk vertebra (JZ H-15-31). A, F – lateral views; B, G – dorsal views; C, H – ventral views; D, I – anterior views; E, J – posterior views. Scale equals 2 mm.

Suborder *Sauria* MCCARTNEY, 1802

Superfamily *Lacertoidea* FITZINGER, 1826

Family *Lacertidae* BONAPARTE, 1831

Genus *Lacerta* LINNAEUS, 1758

Lacerta sp.

1982 *Lacertilia* g. sp.: BOSÁK et al., p. 221, Tab. 1.

M a t e r i a l.—14 trunk vertebrae (JZ H – 1489, JZ 17 – 1714, JZ 17 – 2052-2060, JZ 81/1 – 458-460), 1 caudal vertebra (JZ 17 – 2064).

D e s c r i p t i o n.—Trunk vertebrae (Fig. 10A,B): The neural spine overhangs strongly distally and its upper margin is straight. The dorsal ridge of the neural spine is clearly expanded laterally. Both prezygapophyseal and postzygapophyseal articular surfaces are oval. The cotyle is strongly flattened dorso-ventrally.

Caudal vertebra (Fig. 10C,D): The pleurapophyses are long, flattened dorso-ventrally. The neural spine projects forming a postero-dorsally directed thorn. Seen from above, the zygosphenes shows a half-rounded notch on its. The cotyle is clearly dorso-ventrally flattened in the anterior aspect.

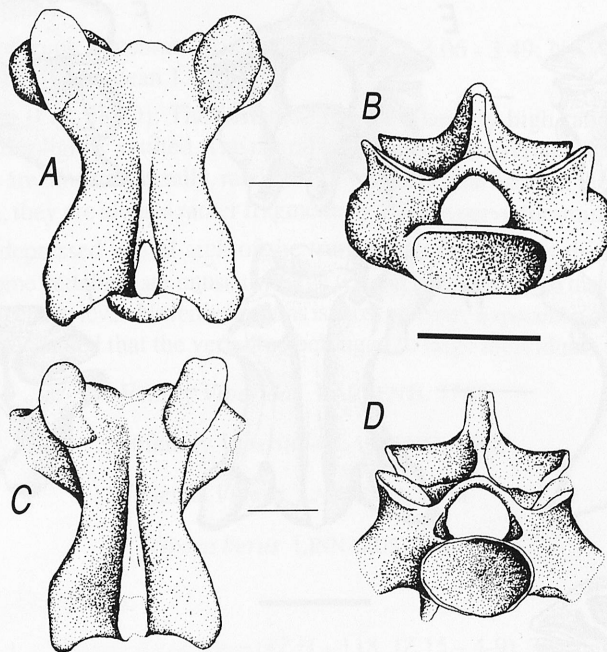


Fig. 10. *Lacerta* sp.: A, B – trunk vertebra (JZ 17-2052); C, D – caudal vertebra (JZ 17-2064). A, C – dorsal views; B, D – anterior views. Scale equals 2 mm.

III. PALAEOECOLOGY

The stratigraphical age of the Žabia Cave is Lower Biharian. A comparison with the stratigraphical positions of some other European localities from where the reptile fauna has been described,

is presented in Fig. 11. The position of the Malá Dohoda Quarry is not clear at the present time, as can be seen from recent investigations at the Stránská Skála Hill locality (MUSIL, pers. comm.).

The composition of the reptile community at Žabia Cave entirely corresponds to the other Lower Pleistocene localities of Central Europe. All the taxa described (Table I) are also known from other Polish Pleistocene localities, of course, with the exception of *Natrix* cf. *tessellata* whose northernmost fossil occurrences have been described from the Moravian area (IVANOV 1995; unpubl. data).

Recently, the northernmost Central European continuous species distribution of *N. tessellata* extends in the south of Switzerland, Austria (with exception of its western part), Czech Republic, Slovakia, southern Ukraine, Moldavia and Volga region. The isolated places of occurrence of *N. tessellata* are known from the valleys of the German rivers Meuse, Rhein, Lahn and Nase. JOGER (1982) noted the presence of *N. tessellata* in the upper course of the Weser river but the autochthonous occurrence was not confirmed. A very rare occurrence in the Elbe valley near Meissen is only a historical fact today (OBST 1976; BARUŠ & OLIVA et al. 1992). The discovery of *N. cf. tessellata* could represent the northernmost fossil record of *N. tessellata*. It is still

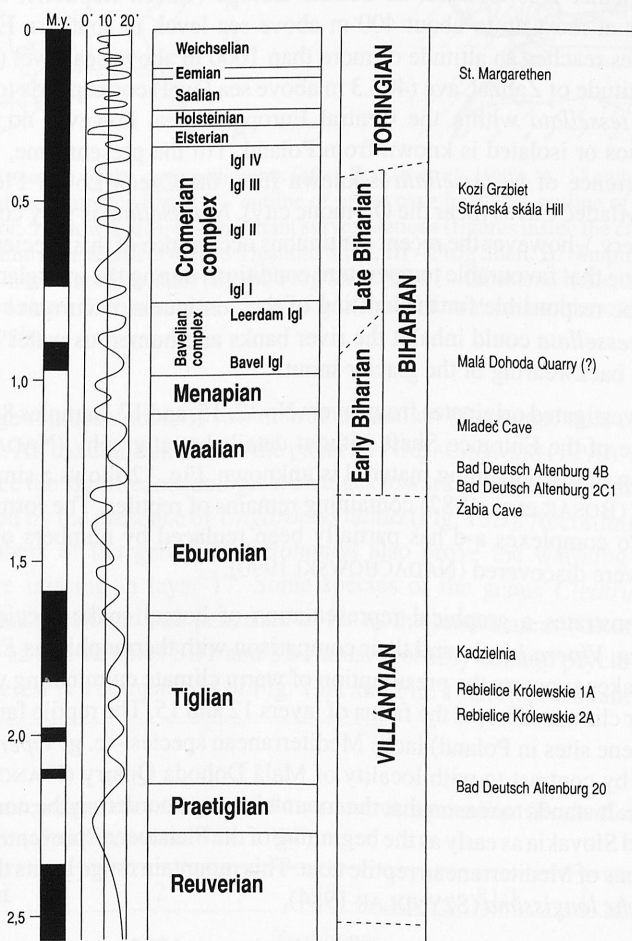


Fig. 11: Stratigraphic position of some Pliocene and Pleistocene localities with reptile fauna. Data concerning Quaternary stratigraphy modified after ROEBROEKS & VAN KOLFSCHOTEN (1994).

Table I

Composition of the reptilian assemblage at the locality Žabia Cave

Layer	12	15	17	81/1	82/1	Pit tip	(1982)	Total	Total %
Number of bones									
<i>Natrix natrix</i>	0	0	120		101	165	33	419	8.46
<i>Natrix cf. tessellata</i>	0	0	0		6	1	0	7	0.14
<i>Natrix</i> sp.	0	0	234		92	150	29	505	10.19
<i>Elaphe longissima</i>	5	7	1673		511	1272	333	3801	76.73
<i>Coronella austriaca</i>	0	20	6		52	16	4	98	1.98
cf. <i>Coronella</i> sp.	0	23	13		24	6	0	66	1.33
<i>Vipera berus</i>	4	24	0		13	1	1	43	0.87
<i>Lacerta</i> sp.	0	0	11		3	1	0	15	0.30
Total	9	74	2057		802	1612	400	4954	100

impossible to decide whether the occurrence in Žabia Cave represents a continuous distribution of *N. tessellata* or whether it is isolated. In Central Europe (Czech Republic, Slovak Republic) *N. tessellata* occurs at most up to about 400 m above sea-level, in southern Europe (Romania, Bulgaria) the species reaches an altitude of more than 1000 m above sea-level (BARUŠ & OLIVA et al. 1992). The altitude of Žabia Cave (406.3 m above sea level) corresponds to the hypsometric distribution of *N. tessellata* within the Central European area, however no recent record of occurrence continuous or isolated is known from Poland. Till the present time, the northernmost certain fossil occurrence of *N. tessellata* is known from the Czech Lower Pleistocene (Lower Biharian) locality Mladeč Caves (near the Olomouc city). *N. tessellata* is very common at that site (IVANOV, pers. observ.), however the recent continuous occurrence of this species is shifted farther to the south. I assume that favourable temperature conditions during the interglacials of the Lower Pleistocene could be responsible for the shifting of the continuous occurrence as far as Poland. Most probably *N. tessellata* could inhabit the river banks and numerous water reservoirs, which originated after the backwearing of the glacier snout.

The material investigated originates from layers No 12, 15, and 17. Samples 81/1 and 82/1 were taken from the base of the Entrance Shaft without detailed stratigraphy (NADACHOWSKI 1990). The precise position of the remaining material is unknown. Fig. 12 shows a simplified section of the cave sediments (BOSÁK et al. 1982) containing remains of reptiles. The former division of the cave sediments into complexes a-d has partially been replaced by numbers of layers in which vertebrate faunas were discovered (NADACHOWSKI 1990).

Fig. 13A demonstrates a graphical representation of boreal snake species (*Natrix natrix*, *Coronella austriaca*, *Vipera berus*) and their comparison with thermophilous *Elaphe longissima*. The presence of snakes supports the presumption of warm climate culminating within layer 17. A substantially cooler climate affected the fauna of layers 12 and 15. The reptile fauna of Žabia Cave (and other Pleistocene sites in Poland) lacks Mediterranean species – e. g. *Vipera ammodytes* and *Coluber caspius* – by contrast to with locality of Malá Dohoda Quarry (IVANOV 1996) which is roughly similar age. It stands to reason that the mountain range bordering the northern areas of the Czech Republic and Slovakia as early as the beginning of the Pleistocene prevented the longitudinal northward migrations of Mediterranean reptile taxa. This mountain range limits the recent northern occurrence of *Elaphe longissima* (SZYNDLAR 1984).

The discoveries of amphibians (MŁYNARSKI & SZYNDLAR 1989) are not stratified and the taxa discovered (*Mioproteus wezei* (an extinct species), *Bufo bufo*, *Bufo* sp. and *Rana* sp.) are of no greater importance to the description of the paleoecological situation at the locality.

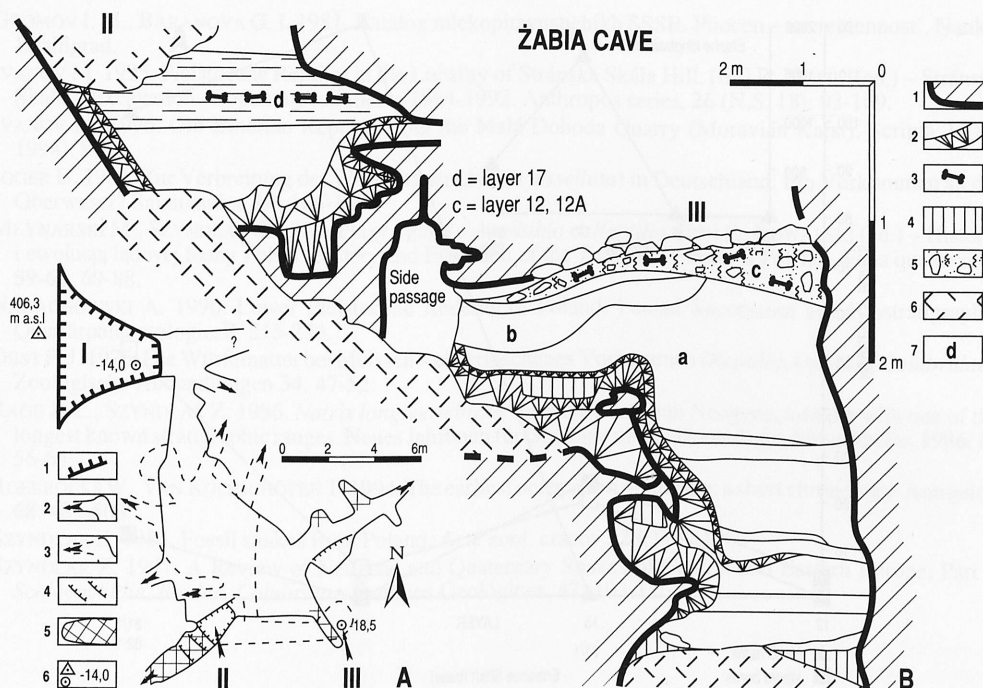


Fig. 12. Simplified section of the cave sediments (after BOSÁK et al. 1982). A: Sketch map of the cave: 1 – surface outline of the Entrance Shaft; 2 – outline of upper cave level; 3 – outline of lower cave level; 4 – sharp drop in floor; 5 – flowstones; 6 – important survey stations (figures inside the cave denote depth from the surface); I – Entrance Shaft; II – Cold Threshold Shaft, III – Frog Shaft. B: Simplified west-east section of cave deposits in the Threshold Shaft (II) and Frog Shaft (III): 1 – limestone walls; 2 – calcite flowstones; 3 – bones; 4 – red clays; 5 – brown cave loams with corroded limestone boulders; 6 – limestones scree; 7 – location of samples.

The percentage representation of two micromammalian (*Rodentia*) taxa of the Žabia Cave is shown in Table II. All the data come from the paper by NADACHOWSKI (1990). Based on the rodent fauna, we can trace the significant ecological changes towards a rise of humidity and temperature, which is confirmed by the presence of *Ungaromys nanus* (Fig. 13B). According to NADACHOWSKI (1990), the members of the genus *Clethrionomys* also prove the warming-up of the climate, however, they are missing in layer 17. Some species of the genus *Clethrionomys* inhabit the steppe-forest climatic belt and can penetrate as far as the tundra areas (GROMOV & BARANOVA 1981), thus layer 12 and samples 81/1 and 82/1 most probably contain psychrophilous species of this genus. Of interest is a comparison of Fig. 13A and Fig. 13B. Reptiles (and especially snakes)

Table II

The percentage representation of two micromammalian (*Rodentia*) taxa of the Žabia Cave (after NADACHOWSKI 1990)

Layer	12	17	81/1	82/1
% of bones				
<i>Clethrionomys</i> sp.	3.8	0	9.6	3.4
<i>Ungaromys nanus</i>	0	21.1	19.6	4.5

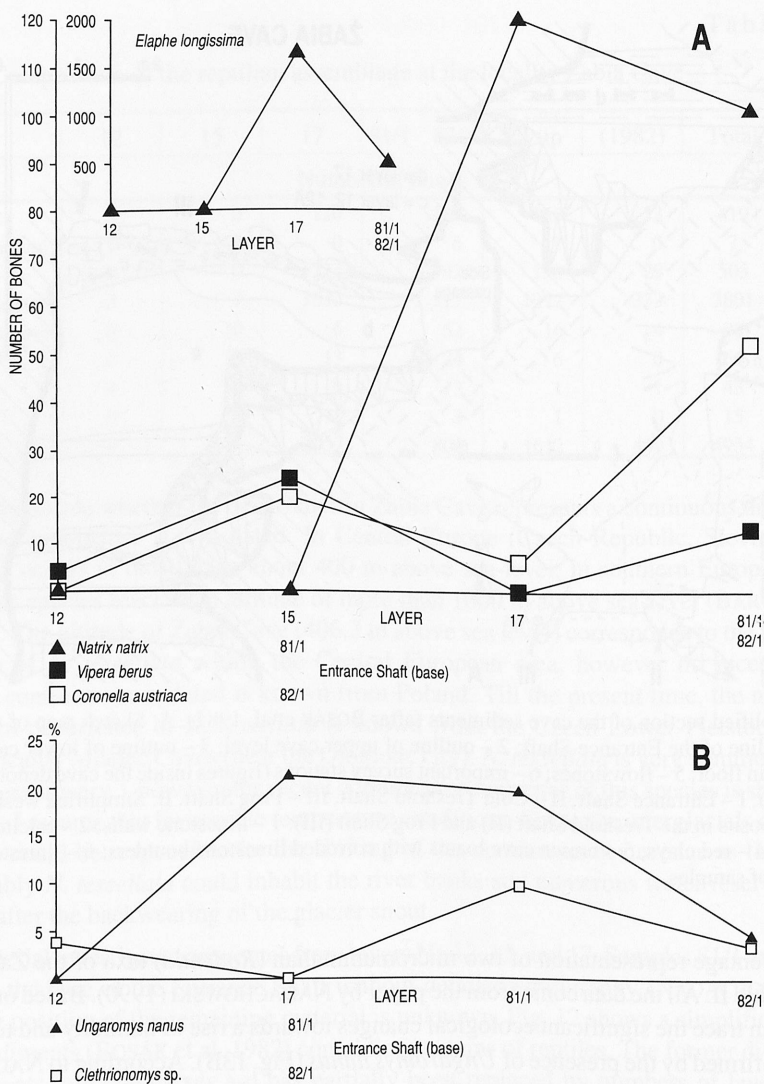


Fig. 13. A: Graphical representation of the boreal snake species (*Natrix natrix*, *Coronella austriaca*, *Vipera berus*) and their comparison with the thermophilous *Elaphe longissima*. B: Graphical representation of the micromammalian (*Rodentia*) species *Ungaromys nanus* and *Clethrionomys sp.* The data concerning rodents after NADACHOWSKI (1990).

reflect otherwise negligible changes in the climate probably more distinctly than do small mammals. This higher sensitivity is caused by poikilothermy and, thus, by their higher dependence on the temperature of the environment.

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