

Late Pleistocene vertebrate fauna from Obłazowa 2 (Carpathians, Poland): palaeoecological reconstruction

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Abstract. A rich Mid-Vistulian (Late Pleistocene) fauna of vertebrates (dated 33430 ± 1230 years BP) was discovered in the Central Carpathians. It consists of fish remains, one amphibian, one reptile, 38 taxa of birds and 33 mammal species. The faunal composition indicates a park-steppe and/or forest-steppe biome abundant in humid environments. Both hydrophilous and typically steppe species were found; they evidence a much more diverse community as compared with the extant faunal composition in the Carpathians. This palaeofauna yielded five species of birds (*Branta leucopsis*, *Otis tetrax*, *Limosa limosa*, *Lanius excubitor*, *Turdus iliacus*) and one of mammals (*Sorex* cf. *kennardi*) new to Poland.

Key words: *Vertebrata*, Late Pleistocene, Vistulian, palaeoecology, Carpathians, Poland

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I. INTRODUCTION

The Quaternary history of the vertebrate fauna in the Central Carpathians is rather poorly known. The paucity of fossil vertebrate sites results partly from the Quaternary geological history of this region and partly from the lack of suitable excavations. The Central Carpathians consist of Tatra Mountains, Podhale Basin and Pieniny Klippen Belt (STARKEL 1991). Data on fossil and subfossil mammals from the Pieniny Klippen Belt and Podhale were very scarce up to the 1980s (KOWALSKI 1959; KULCZYCKI and HALICKI 1950), when two multidisciplinary studies were carried out. A small cave in the Sobczański Gully situated in the Pieniny Mountains has yielded relatively numerous remains of

Holocene vertebrates (ALEXANDROWICZ et al. 1985). A very abundant Late Quaternary fauna was collected during excavations in Obłazowa Cave in 1985-1992. Studies of these materials are under way and only preliminary information concerning the fauna has been published so far (NADACHOWSKI, WOLSAN 1987; VALDE-NOWAK et al. 1987; MADEYSKA 1991).

The discovery of a new fissure filling named Obłazowa 2, with numerous remains of vertebrates, considerably enriches our knowledge of the Pleistocene history of the fauna in the Central Carpathians.

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II. LOCALITY

The site is located in the Obłazowa Rock near the village of Nowa Białka in the Podhale Basin (Fig. 1). The bone-bearing sediments were discovered by M. WOLSAN in 1988 in the southern part of the Obłazowa Rock in an artificial cave, approximately 10 m above the Białka River level.

The cave is located in the southern part of the Obłazowa Rock; it is about 7 m long and 3 m wide with a big opening facing east (Fig. 2: 2). Probably in the 1920s and 1930s the eastern part of the Obłazowa Rock was being exploited as a quarry and at that time two big artificial caves were made (Fig. 1: 3, two blackened surfaces). The artificial shelter which yielded the bone-bearing sediment was probably established in a natural fissure developed at the contact zone between the crinoid limestone and the red nodular limestone. Only a small part of this fissure filled with the sediment was preserved in the deepest part of the cave (Fig. 2: 6). The fissure was ca. 240 cm long and 45 cm wide. The fossil-bearing sediment was also discovered at the bottom of the cave (Fig. 2: 3) as a result of inflow of sediment from the fissure.

The sediment consists of a large amount of sharp-edged limestone rubble and loamy clay intense brownish-red in colour. In the cross-section the rubble was distributed irregularly. Most of the limestone grains 20-40 mm in size were deposited in the higher part of the cross-section. The lower part contained some rubble with generally smaller grains. The fossil bones and teeth were regularly distributed in the sediment. All pieces showed intense dark-brown (even black) colour.

During excavations nine samples were taken from different parts of the sediment. Laboratory studies of the samples showed no quantitative or qualitative differences between them; thus all remains of the fauna were pooled for analyses.

The origin of the bone-bearing sediment in the fissure is probably homogeneous. Most of the vertebrate remains (birds and small mammals) were accumulated by raptors in the

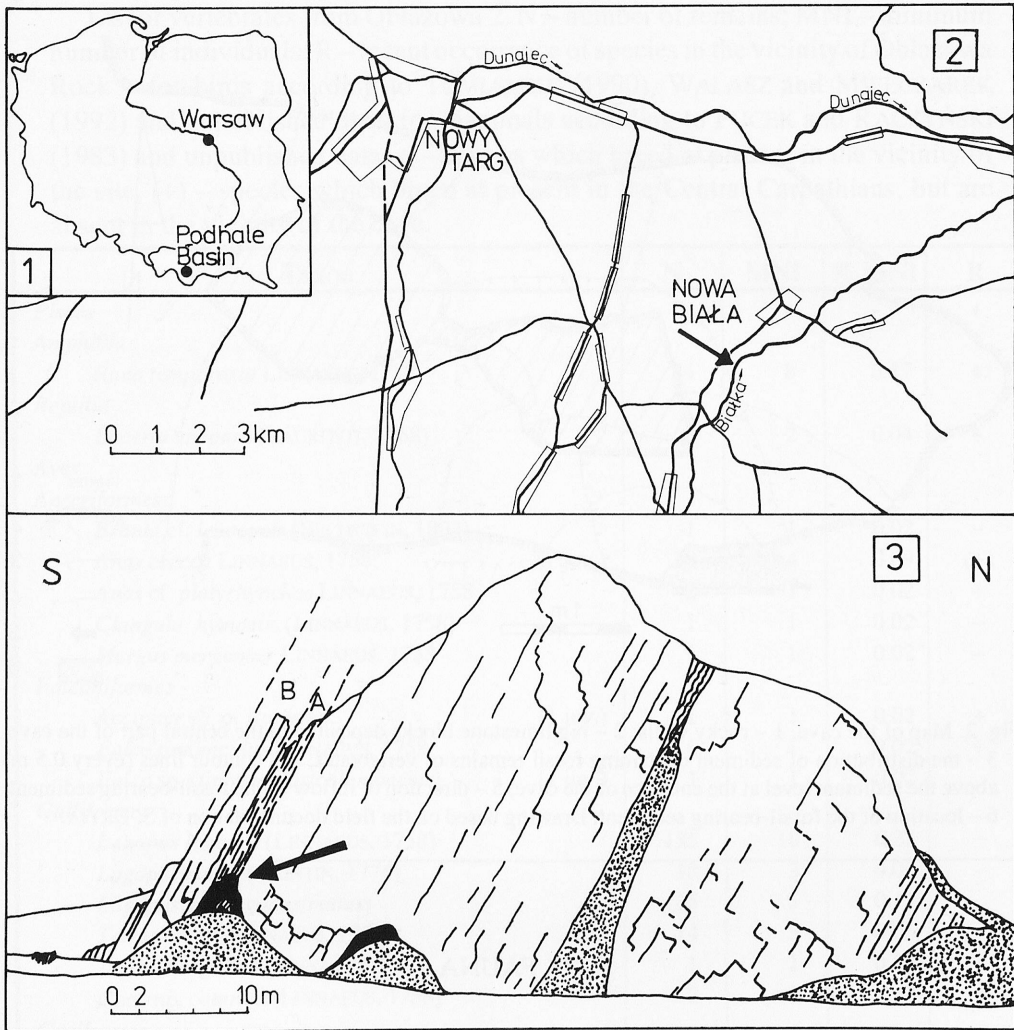


Fig. 1. 1 – location of the Podhale Basin in the Polish Carpathians; 2 – map of north-eastern part of the Podhale Basin, the Obłazowa Rock is indicated by the arrow; 3 – geological structure of the Obłazowa Rock (after BIRKENMAJER 1958), A/B the contact zone between the crinoid limestone (A) and the red nodular limestone (B). The entrance to the artificial cave, where the Obłazowa 2 site is located, is indicated by the arrow.

form of owl pellets. This hypothesis is also confirmed by the absence of molluscs, as well as the scarcity of bat remains (only two teeth were found) and of larger mammals.

The fragment of a fox mandible analyzed in the Radiocarbon Accelerator Unit of Oxford University by Dr. R. A. HOUSLEY was dated at 33430 ± 1230 years BP (OxA-3696).

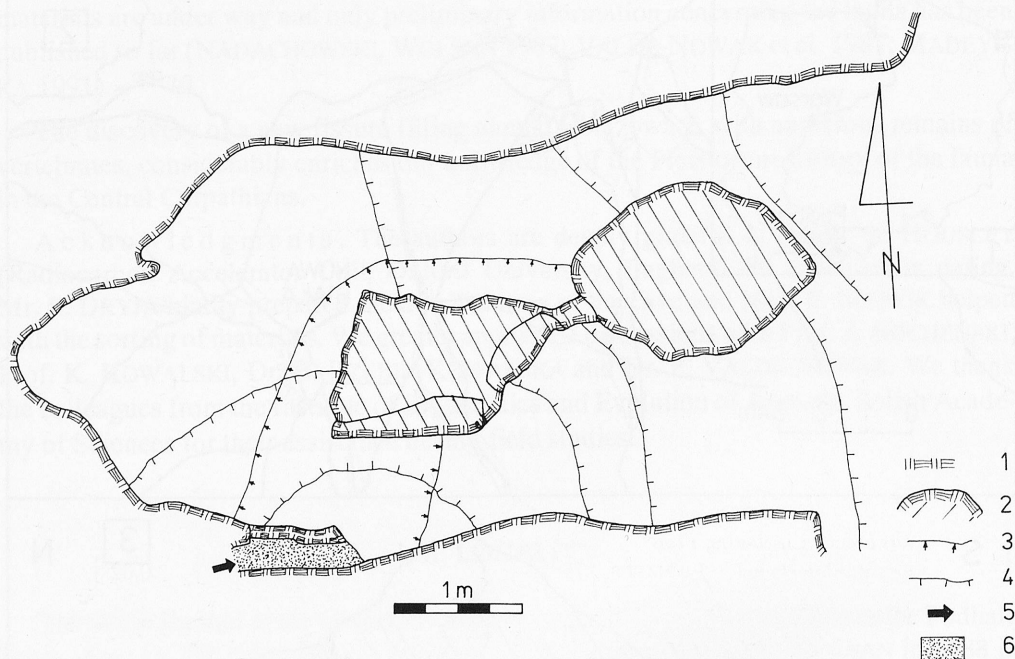


Fig. 2. Map of the cave. 1 – rocky walls; 2 – big limestone blocks deposited in the central part of the cave; 3 – the distribution of sediment containing fossil remains of vertebrates; 4 – contour lines (every 0.5 m) above the sediment level at the entrance of the cave; 5 – direction of inflow of the fossil-bearing sediment; 6 – location of the fossil-bearing sediment. Drawing based on the field documentation of S. DRYJA.

III. FAUNA

The organic inclusion removed from the sediment contained mainly teeth and fragments of bird and small mammal skeletons. Bigger bones were found only occasionally.

Sediments of the fissure have yielded at least 34 species of birds and 23 species of mammals. Table I lists the vertebrate taxa, their frequency in the site and the occurrence in the Central Carpathians at present.

The fossil bird fauna of Oblazowa 2 is very diverse from the palaeoecological point of view and can be divided into several groups. Among some species the bones of juvenile specimens were found (Table I). They surely indicate that these birds had bred in the Central Carpathians during the mid-Vistulian.

The most numerous group consists of birds which require various water-and-marsh habitats. Wet meadows, peat-bogs and swamps are characteristic breeding habitats of snipes (*Gallinago gallinago*, *G. media*); *Limosa limosa*, the only owl species found in the fossil assemblage (*Asio flammeus*) as well as *Porzana porzana* occur in open marsh and

Table I

List of vertebrates from Obłazowa 2. N – number of remains; MNI – minimum number of individuals; R – recent occurrence of species in the vicinity of Obłazowa Rock – for birds according to TOMIAŁOJC (1990), WALASZ and MIELCZAREK (1992) and unpublished data, for mammals according to PUCEK and RACZYŃSKI (1983) and unpublished data. + – species which breed at present in the vicinity of the site, (+) – species which breed at present in the Central Carpathians, but are absent in the vicinity of the cave.

Taxon	N	MNI	% MNI	R
<i>Pisces</i>	+	+	–	+
<i>Amphibia</i>				
<i>Rana temporaria</i> LINNAEUS, 1758	84	8	0.17	+
<i>Reptilia</i>				
<i>Lacerta vivipara</i> (LAURENTI, 1768)	5	2	0.04	+
<i>Aves</i>				
<i>Anseriformes</i>				
<i>Branta</i> cf. <i>leucopsis</i> (BECHSTEIN, 1803)	1	1	0.02	–
<i>Anas crecca</i> LINNAEUS, 1758 (1 juv.)	30	4	0.09	(+)
<i>Anas</i> cf. <i>platyrhynchos</i> LINNAEUS, 1758	2	1	0.02	+
<i>Clangula hymealis</i> (LINNAEUS, 1758)	1	1	0.02	–
<i>Mergus merganser</i> LINNAEUS, 1758	1	1	0.02	–
<i>Falconiformes</i>				
<i>Accipiter</i> sp. or <i>Buteo</i> sp. (1 juv.)	1	1	0.02	+
<i>Falco tinnunculus</i> LINNAEUS, 1758	6	1	0.02	+
<i>Falco</i> sp. (<i>tinnunculus/columbarius</i>) (1 juv.)	1	1	0.02	
<i>Galliformes</i>				
<i>Lagopus lagopus</i> (LINNAEUS, 1758)	135	10	0.22	–
<i>Lagopus mutus</i> (MONTIN, 1776)	18	3	0.06	–
<i>Lagopus</i> sp. (<i>lagopus/mutus</i>)	35	5	0.11	
<i>Tetrao tetrix</i> (LINNAEUS, 1758)	14	3	0.06	(+)
<i>Tetrao urogallus</i> (LINNAEUS, 1758)	1	1	0.02	(+)
<i>Coturnix coturnix</i> (LINNAEUS, 1758)	2	1	0.02	+
<i>Gruiformes</i>				
<i>Grus grus</i> (LINNAEUS, 1758)	1	1	0.02	–
<i>Otis tarda</i> LINNAEUS, 1758	2	1	0.02	–
<i>Otis tetrax</i> (LINNAEUS, 1758)	1	1	0.02	–
<i>Crex crex</i> (LINNAEUS, 1758)	6	1	0.02	(+)
<i>Porzana porzana</i> (LINNAEUS, 1766)	4	1	0.02	–
<i>Fulica atra</i> LINNAEUS, 1758	1	1	0.02	–
<i>Gallinula chloropus</i> (LINNAEUS, 1758)	1	1	0.02	(+)
<i>Charadriiformes</i>				
<i>Gallinago gallinago</i> (LINNAEUS, 1758)	3	1	0.02	–
<i>Gallinago media</i> (LATHAM, 1787)	5	1	0.02	–
<i>Gallinago</i> sp. (<i>gallinago/media</i>) (2 juv.)	3	2	0.04	–
<i>Limosa limosa</i> (LINNAEUS, 1758)	6	1	0.02	–
<i>Pluvialis</i> cf. <i>apricaria</i> (LINNAEUS, 1758)	1	1	0.02	–
<i>Pluvialis</i> cf. <i>squatarola</i> (LINNAEUS, 1758) (1 juv.)	2	1	0.02	–

Table I ctd

Taxon	N	MNI	%MNI	R
<i>Columbiformes</i>				
<i>Columba palumbus</i> LINNAEUS, 1758	1	1	0.02	+
<i>Strigiformes</i>				
<i>Asio flammeus</i> (PONTOPPIDAN, 1763)	4	1	0.02	–
<i>Passeriformes</i>				
<i>Alauda arvensis</i> LINNAEUS, 1758	1	1	0.02	+
<i>Hirundo rustica</i> LINNAEUS, 1758	1	1	0.02	+
<i>Anthus trivialis</i> (LINNAEUS, 1758)	1	1	0.02	+
<i>Lanius excubitor</i> LINNAEUS, 1758 (2 juv.)	3	2	0.04	(+)
<i>Turdus iliacus</i> LINNAEUS, 1766 (1 juv.)	18	5	0.11	+
<i>Turdus cf. philomelos</i> BREHM, 1831 (1 juv.)	1	1	0.02	+
<i>Turdus</i> sp.	1	1	0.02	
<i>Carduelis chloris</i> (LINNAEUS, 1758)	3	1	0.02	+
<i>Fringilla coelebs</i> (LINNAEUS, 1758)	2	1	0.02	+
<i>Mammalia</i>				
<i>Insectivora</i>				
<i>Talpa europaea</i> LINNAEUS, 1758	13	2	0.04	+
<i>Sorex cf. araneus</i> LINNAEUS, 1758	17	8	0.17	+
<i>Sorex cf. kennardi</i> HINTON, 1911	52	19	0.41	–
<i>Chiroptera</i>				
<i>Myotis</i> sp.	2	1	0.02	
<i>Lagomorpha</i>				
<i>Ochotona cf. pusilla</i> PALLAS, 1768	75	9	0.19	–
<i>Lepus timidus</i> LINNAEUS, 1758	64	2	0.04	–
<i>Rodentia</i>				
<i>Spermophilus citelloides</i> (KORMOS, 1916)	17	3	0.06	–
<i>Spermophilus superciliosus</i> (KAUP, 1839)	20	3	0.06	–
<i>Arvicola terrestris</i> (LINNAEUS, 1758)	142	77	1.67	(+)
<i>Clethrionomys glareolus</i> (SCHREBER, 1780)	15	10	0.22	+
<i>Dicrostonyx gulielmi</i> (SANFORD, 1870)	24	12	0.26	–
<i>Lemmus lemmus</i> (LINNAEUS, 1758)	111	61	1.32	–
<i>Microtus agrestis</i> (LINNAEUS, 1761)	518	267	5.77	(+)
<i>Microtus arvalis</i> (PALLAS, 1779)	965	498	10.75	+
<i>Microtus gregalis</i> (PALLAS, 1779)	5422	2765	59.67	–
<i>Microtus nivalis</i> (MARTINS, 1842)	16	12	0.26	(+)
<i>Microtus oeconomus</i> (PALLAS, 1776)	1579	802	17.32	–
<i>Sicista betulina</i> (PALLAS, 1778)	13	3	0.06	–
<i>Carnivora</i>				
<i>Mustela (Putorius)</i> sp.	3	1	0.02	–
<i>Mustela nivalis</i> LINNAEUS, 1766	15	4	0.09	+
<i>Vulpes vulpes</i> (LINNAEUS, 1758)	3	1	0.02	+
<i>Perissodactyla</i>				
<i>Equus</i> sp.	2	1	0.02	–
<i>Artiodactyla</i>				
<i>Rangifer tarandus</i> (LINNAEUS, 1758)	3	1	0.02	–
Total	9490	4636	100.00	

bog areas. The Common Crane nests in similar habitats but is often associated with scrub or various types of forests. This type of biotope can be inhabited also by some gallinaceous birds (e.g. *Lagopus lagopus*, *Tetrao tetrix*). At least partly overgrown bodies of water are typical of *Fulica atra*, *Gallinula chloropus* and ducks (*Anas platyrhynchos*, *A. crecca*).

Grasslands and steppes are the breeding habitats of bustards (*Otis tarda*, *O. tetrax*) as well as *Coturnix coturnix* and *Alauda arvensis*.

The birds strictly connected with forest are not as numerous as the above-mentioned groups. First of all the grouse must be included in this group. Of them *Tetrao urogallus* is characteristic of large areas of coniferous and mixed forests – *T. tetrix* lives usually at forest edges. Also a few passerines identified in the fauna of Obłazowa 2, and the Pigeon *Columba palumbus* represent woodland or parkland birds.

The data of Table I indicate that many of the birds identified in the Late Pleistocene fauna of Obłazowa 2 do not breed now in its vicinity. At least 7 of them have not bred in the Polish territory in the last hundred years. *Branta laucopsis*, *Clangula hymealis*, *Lagopus lagopus*, *Lagopus mutus* and *Pluvialis squatarola* inhabit, according to HARRISON (1982), arctic, subarctic, boreal and in the case of *L. mutus* also alpine zones. On the other hand, *O. tetrax* represents temperate to warm temperate zones. Thus, the fossil bird fauna from Obłazowa 2 represents not only the mosaic of habitats in which open and marsh ones prevailed, but also the mosaic of climates: from arctic to warm temperate.

Five species of birds have been recorded for the first time in the fossil state from Poland (*Branta leucopsis*, *Otis tetrax*, *Limosa limosa*, *Lanius excubitor*, *Turdus iliacus*). Further nine species (*Clangula hymealis*, *Grus grus*, *Fulica atra*, *Gallinula chloropus*, *Otis tarda*, *Gallinago gallinago*, *Columba palumbus*, *Anthus trivialis*, *Fringilla coelebs*) were described from the Holocene sites in Poland, however they have not hitherto been found in the Late Pleistocene (BOCHEŃSKI 1993).

Generally, the fauna of birds is indicative of park-steppe or forest-steppe landscape with rather moist habitats.

The mammal fauna recognized in Obłazowa 2 is dominated by small mammals. Larger mammals are poorly represented, presumably owing to taphonomic factors. Among insectivores two species of shrews predominate (*Sorex* cf. *araneus* and *S.* cf. *kennardi*); the former now inhabits both grassland and woodland areas. The presence of the mole (*Talpa europaea*) is also significantly indicative of a relatively mild climate. Lagomorphs are represented by relatively common *Ochotona* cf. *pusilla* and *Lepus timidus*, both being typical dwellers of a Pleistocene open environment in Central Europe. Rodents, which dominate in the fossil assemblage, consist of members of different ecological groups. Three species of voles (*Microtus gregalis*, *M. oeconomus* and *M. arvalis*) which prevail in the community, are accompanied by rather scarce inhabitants of tundra (*Dicrostonyx gulielmi*, *Lemmus lemmus*) and typically steppe species (*Spermophilus citelloides*, *S. superciliosus*). The frequency of forest dwellers is rather low (*Clethrionomys glareolus*, *Sicista betulina*). Among carnivores *Mustela nivalis* and *Vulpes vulpes* are eurytopic species. The fossil assemblage is accompanied by horse (*Equus* sp.) and reindeer (*Rangifer tarandus*).

Among mammals, one species has been found in the Polish Pleistocene for the first time. The Kennard's shrew (*Sorex kennardi*) remains a rather little known taxon. It was described from the remarkably well-preserved holotype found by A. S. KENNARD in the section at Ponders End, Lea Valley, Middlesex, England. It consists of the anterior cranium and both mandibular rami of one individual. The site, part of the Third Terrace drift, was not dated.

Knowledge of this shrew has since remained scanty in Britain, although a posterior mandible has been discovered in the mid-Devensian sands and gravels of the River Stour at Conningbrook, Kent. The specimen agrees precisely in size and morphology with the holotype and is referred to *S. kennardi*. This Kentish site has been dated at 34000-38000 years BP and is thus nearly contemporaneous with Obłazowa 2.

HINTON's (1911) description of *Sorex kennardi* was unfortunately rather brief. A detailed re-description and comparison with the abundant material from Obłazowa 2 is a clear necessity.

Sorex kennardi is intermediate in size between *S. araneus* and *S. minutus*. HINTON (1911) noted that the mandible is distinguished by its form and size, without specifying any details except that the condyle agrees better with *S. minutus* than with *S. araneus*. Our own observation of the holotype as well as the Conningbrook jaw and Obłazowa 2 material reveal some distinctive morphological features in which they all agree. The tall, narrow coronoid process is disproportionately small in relation to the size of the teeth. The mandibular foramen is strikingly small. The measurements of the mandibles and teeth agree closely (Table II). Pending a full redescription of the holotype and comparison of the maxillary dentition with the Polish material, it appears reasonable to regard the dominant smaller shrew of Obłazowa 2 as *Sorex cf. kennardi*.

It is interesting to note that in the opinion of SCHAEFER (1975) in Novy Cave 1 (in the Tatra Mountains) two bigger shrews named *S. araneus* and *S. arcticus* occurred in the sediments dated ca. 30000 years BP which perhaps correspond to *S. araneus* and *S. cf. kennardi* from Obłazowa 2, respectively.

The fauna of mammals confirms the palaeoecological picture suggested by the avifauna. Most of the species do not occur at present in the Central Carpathians and are associated with open or park-steppe environments. The percentage distribution of rodents, especially the low frequency of lemmings, indicates interstadial conditions, characterized by a relatively mild and moist climate within the last glaciation.

Table II

Mandibular measurements of *Sorex kennardi* (mm)

Locality	M1-M3	Coronoid height
Ponders End (Holotype BM)	3.52	3.90
Conningbrook (HZM 3.13623)	3.58	4.03
Obłazowa 2	3.49-3.71	3.71-4.22
	n = 11	n = 9

IV. DISCUSSION

A comparison of the mid-Vistulian vertebrate assemblage from Obłazowa 2 with those of other Polish localities of similar age located in the Cracow Upland reveals both similarities and some distinct differences. Fossil assemblages of Mamutowa Cave (layers 3, II-VI) (BOCHEŃSKI 1974; NADACHOWSKI 1976, 1982) and Nietoperzowa Cave (layers 5-7) (BOCHEŃSKI 1974; KOWALSKI 1961; NADACHOWSKI 1982) are probably of Dene-kamp Interstadial age in the sense of the West-European climatostratigraphy (KOLSTRUP and WIJMSTRA 1977), or more widely, of Inter-Pleni-Vistulian age (sensu MADEYSKA 1982), and thus contemporaneous with the Obłazowa 2 site. They are characterized by a lower frequency of strictly tundra species (e.g. lemmings) and a slight increase of the species diversity in comparison with faunas dated to Vistulian 3 (= Younger-Pleni-Vistulian) (MADEYSKA 1982; NADACHOWSKI 1989). In the Carpathians the Denekamp Interstadial is distinguishable by the occurrence of steppe or grassland species among birds (e.g. *Otis tarda*, *Otis tetrax*) and mammals (*Spermophilus citelloides*, *S. superciliosus*), which do not occur in these mountainous areas at present. Another feature is the wide representation, especially in the bird fauna, of hydrophilous species. The index tundra species (*Lagopus mutus*, *Dicrostonyx gulielmi*, *Lemmus lemmus*) are less frequent than in the Cracow Upland. From among the typically mountainous taxa, only the snow vole (*Microtus nivalis*) was found.

The composition of the fossil assemblage from Obłazowa 2 suggests a higher species diversity in several groups of vertebrates in comparison with the present animal associations. The Inter-Pleni-Vistulian time or, more precisely, the Denekamp Interstadial, was a period of the much wider distribution of open and moist habitats in the Podhale Basin. The composition of the assemblage further testifies a relatively wide expansion of park-steppe and coniferous or mixed forests. This type of landscape offered also good circumstances for the existence of typically steppe species, which do not occur at present in the Carpathians.

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