Review of fossil Rodentia from Poland

Article in Senckenbergiana Biologica · September 1990

1 author:

Adam Nadachowski
Institute of Systematics and Evolution of Animals, Polish Academy of Sciences

SENCKENBERGIANA
BIOLOGICA

Wissenschaftliche Mitteilungen
der Senckenbergischen Naturforschenden Gesellschaft

Schriftleitung Dr. DIETER KOCK, Dr. HEINZ SCHRÖDER
und Dr. RICHARD ZUR STRASSEN

Senckenbergiana biol.	70 (1989)	(4/6)	229–250	Frankfurt am Main, 15. 10. 1990

Review of fossil Rodentia from Poland
(Mammalia).

By

ADAM NADACHOWSKI,
Kraków.

With 4 tables.

Abstract: A survey is given of 53 fossil rodent assemblages from Poland. The distribution of almost 190 taxa of rodents in particular localities is presented. Faunal succession and biostratigraphy of rodent communities from the Miocene to Holocene is discussed.

1. Introduction.

This paper presents a short review of fossil rodents from Poland, elaborated on the basis of a revision of published materials, supplemented by the author's own identifications.

Rodents constitute the most numerous group of the fossil vertebrates of Poland. Almost 190 taxa (60% determinable to the species level) have been recognized in the country. Most of them (75%) belong to fossil taxa. On the basis of the material from the Polish localities, 20 new fossil species belonging to 7 families have been described. Tab. 1–4 contain complete lists of the rodent taxa from the Miocene, Pliocene, Early Pleistocene and Late Quaternary, respectively.

The author is greatly indebted to A. BEDNARCZYK, Dr. A. PRADEL, Dr. A. SULIMSKI and Dr. M. WOLSAN for their personal communications. Special thanks are due to Prof. K. Kowalski and Dr. A. Sulimski, who were kind enough to read some parts of the manuscript and to help the author with their valuable remarks.

2. Historical outline.

The oldest infomation concerning fossil rodents from Poland appeared at the end of the 19th century and comprised Late Pleistocene materials from caves in the vicinity of Ojców, Cracow region (Zawisza 1874, 1878; Römer 1883). Further information from Silesia and from Mamutowa Cave near Ojców have been yielded by the studies of Zotz (1939) and Niezabitowski-Lubicz (1932). Kowalski (1959) summarized all data on fossil rodents up to 1958. In the fifties and early sixties, several new Pliocene and Pleistocene faunas have been described e.g. Podlesice (Kowalski 1956), Kadzielnia 1 (Kowalski 1958a), Węże 1 and 2 (Kowalski 1960b: Sulimski 1962a, b, 1964), Rębielice Królewskie 1A (Kowalski 1960a), and Kamyk (Kowalski 1960c). Some new Miocene materials found in Opole 2 (Kowalski 1967) have markedly complemented the list of taxa described from Opole 1 (Wegner 1913). At present, most of the mentioned faunas need a modern redescription.

Presently, revisions of particular systematic groups are undertaken. The following families of rodents have been brought up to date: Gliridae (Kowalski 1963), Cricetidae (Fahlbusch 1969, Pradel 1988), Sciuridae (Black & Kowalski 1974), Eomyidae (Fahlbusch 1978), and Zapodidae (Kowalski 1979). A monograph of Late Quaternary rodents of Poland has also been published (Nadachowski 1982). The studies of new Pliocene and Pleistocene faunas with detailed geological context (e.g. Kozi Grzbiet, Mała Cave, Ewy Cave, Żabia Cave) conducted over the last two decades provide an opportunity to correlate the fossil rodent materials from Poland with the well-documented ones from localities in other parts of Europe (Głazek et al. 1976a, 1977a, b; Sulimski et al. 1979, Głazek & Szynkiewicz 1980, Bosák et al. 1982).

3. Localities.

Reviewed principal Polish localities of the fossil rodent taxa consist of 53 faunal assemblages. Localities are listed in alphabetical order of two-literal abbreviations. The third and the forth member of the abbreviation (literal or numeral) denotes another site on the same place or another faunal assemblage (layer, fauna) in the same locality.

The short description of a locality contains the following information: geographical coordinates, age of the locality including absolute dates and respective literature, an the list of references concerning the rodent fauna (R). Detailed data referring to the age of particular layers of the Late Quaternary localities and their correlation can be found in the literature cited.

Boundaries between particular chrono- and biostratigraphic units are assumed after Fejfar (1976), Mein (1976), Horáček (1981), Fejfar & Heinrich (1983, 1987), Steininger & Rögl (1983) and Horáček & Sánchez Marco (1984).

BE2 — Bełchatów 2, 51°15′N–19°20′E, Miocene: Orleanian/Astaracian, MN 4–5–6? (Głazek & Szynkiewicz 1987).

BM — Bramka Rock-shelter, 50°12'N–19°49'E, Late Quaternary: Middle and Upper Pleniglacial, Holocene (MADEYSKA 1981). R: NADACHOWSKI (1982), PRADEL (1988).

CA — Ciemna Cave, 50°13'N–19°50'E, Late Quaternary: Early Glacial, Holocene. R: KOWALSKI (1979), NADACHOWSKI (1982).

CI — Ciasna Cave, 50°12'N–19°49'E, Late Quaternary: Upper Pleniglacial? — Late Glacial, Holocene. R: NADACHOWSKI (1982).

DK — Dziadowa Skała Rock-shelter, 50°32'N–19°32'E, Late Quaternary: Eemian?, Upper Pleniglacial. R: KOWALSKI (1958b, 1963), MADEYSKA (1981), NADACHOWSKI (1982).

DR1 — Draby 1, 51°05'N–18°48'E, Pliocene: Ruscinian, MN 15. R: GŁAZEK et al. (1976b, 1977c), GŁAZEK & SZYNKIEWICZ (1980).

DS — Dużej Sowy Cave, 50°09'N–19°47'E, Late Holocene. R: BOCHEŃSKI et al. (1983), NADACHOWSKI (1982).

EW — Ewy Cave, 51°05'N–18°48'E, Pliocene: Ruscinian, MN 15. R: GŁAZEK & SZYNKIEWICZ (1980).

GI — Giebułtów, 50°08'N–19°52'E, Middle Holocene. R: MŁYNARSKI (1961), NADACHOWSKI (1982).

JO — Józefów, 50°29'N–23°05'E, Middle Holocene. R: KOWALSKI et al. (1963), NADACHOWSKI (1982).

JZ — Żabia Cave, 50°35'N–19°31' E, Pleistocene: Early Biharian, Osztramos 8 — Villány 5 / Betfia boundary. R: BOSÁK et al. (1982), NADACHOWSKI (1990).

KA — Kamyk, 50°54'N–19°01'E, Pleistocene: Early Biharian, Osztramos 8 — Villány 5 phase (NADACHOWSKI 1990). R: BLACK & KOWALSKI (1974), FAHLBUSCH (1969), KOWALSKI (1960c, 1963, 1977, 1979), NADACHOWSKI (1990), PRADEL (1988). Remarks: Although fossils occur in three different layers (MOSSOCZY 1959), the fauna of rodents is uniform.

KD1 — Kadzielnia 1, 50°52'N–20°38'E, Pliocene / Pleistocene: Late Villányian / Early Biharian, Kisláng — Villány 3 — Osztramos 8 — Villány 5 — Betfia phases (NADACHOWSKI 1990). R: BARTOLOMEI et al. (1975), BLACK & KOWALSKI (1974), FAHLBUSCH (1969), KOWALSKI (1958a, 1963, 1977), NADACHOWSKI (1990), PRADEL (1988).

KG — Kozi Grzbiet, 50°51'N–20°21'E, Pleistocene: Late Biharian, Templomhegyian phase, Kozi Grzbiet Interglacial (= Nida / San, = Mindelian I / Mindelian II; age determination of fossil bones by the fluorine — chlorine — apatite and collagen method = 0·63–0·56 My B.P. (GLAZEK et al. 1976a, 1977a, b; LINDNER 1984, NADACHOWSKI 1990). R: BARTOLOMEI et al. (1975), BLACK & KOWALSKI (1974), KOWALSKI (1977, 1979), NADACHOWSKI (1985, 1990), PRADEL (1988).

KI — Kielniki, 50°45'N–19°18'E, KI1 — Kielniki 1, Pleistocene: Late Biharian, Nagyharsányhegy phase (NADACHOWSKI 1990); KI3A — Kielniki 3A, Pleistocene: Early Biharian, Osztramos 8 — Villány 5 phase (NADACHOWSKI 1990). R: KOWALSKI (1977), NADACHOWSKI (1990), PRADEL (1988); KI3B — Kielniki 3B, Pliocene: Late Villányian, MN 17.

KZ — Koziarnia Cave, 50°13'N–19°48'E, Late Quaternary: Eemian — Brørup — Lower and Middle Pleniglacial (MADEYSKA 1981); age determination of fossil bones by the fluorine — chlorine — apatite and collagen method = 102000–33000 y B.P. (16 dates, WYSOCZAŃSKI-MINKOWICZ 1969). R: CHMIELEWSKI et al. (1967), NADACHOWSKI (1982), PRADEL (1988).

MA4 + 5 — Mała Cave (layer 4 + 5), 51°05'N–18°48'E, Pliocene: Ruscinian, MN 14–15 (GŁAZEK & SZYNKIEWICZ 1980, 1987). R: SULIMSKI et al. (1979).

MM — Mamutowa Cave, 50°10'N–19°48'E, Late Quaternary: Pleniglacial, Holocene (MADEYSKA 1981). R: BLACK & KOWALSKI (1974), KOWALSKI (1979), NADACHOWSKI (1976, 1982), PRADEL (1988).

MO - Mokra, 50°56'N–18°55'E, MO1 — Mokra, layer 1, Pliocene: Ruscinian, MN 15; MO2 — Mokra, layer 2, Pliocene: ? Villányian, MN 16?

MS — Nad Mosurem Starym Duża Cave, 50°13'N–19°50'E, Upper Pleniglacial?, Holocene. R: NADACHOWSKI et al. (1989).

ND — Nad Jaskinią Niedostępną Rock-shelter, 50°12'N–19°50'E, Late Quaternary: Pleniglacial, Holocene (MADEYSKA 1981). R: NADACHOWSKI (1982), PRADEL (1988).

NI — Nietoperzowa Cave, 50°11'N–19°46'E. Pleistocene: Warta (Saalian) — Eemian — Vistulian (Weichselian), layer 6–^{14}C = 38160 ± 1250 y B.P. (MADEYSKA (1981); age determination of fossil bones by the fluorine — chlorine — apatite and collagen method = 103000–23000 y B.P. (14 dates, WYSOCZAŃSKI-MINKOWICZ 1969). R: BLACK & KOWALSKI (1974), KOWALSKI (1961), NADACHOWSKI (1982), PRADEL (1988).

OB — Obłazowa Cave, 49°25'N–20°09'E, Late Pleistocene: Pleniglacial (VALDE-NOWAK et al. 1987, NADACHOWSKI & WOLSAN 1987).

OP — Opole, 50°40'N–17°55'E, OP1 — Opole 1, Miocene: Astaracian, MN 6 (GŁAZEK & SZYNKIEWICZ 1987). R: WEGNER (1913); OP2 — Opole 2, Miocene: Astaracian MN 7? (GŁAZEK & SZYNKIEWICZ 1987). R: KOWALSKI (1967).

PN — Pańska Góra, 50°45'N–19°15'E, Pliocene: Ruscinian, MN 14.

PO — Podlesice, 50°34'N–19°31'E, Pliocene: Ruscinian, MN 14. R: AGADJANIAN & KOWALSKI (1978), BLACK & KOWALSKI (1974), FAHLBUSCH (1969, 1978), KOWALSKI (1956, 1958a, 1963, 1974, 1979), PRADEL (1988).

PR1 — Przeworno 1, 50°41'N–17°10'E, Miocene: Orleanian / Astaracian?. MN 5–6? (KUBIAK 1982, GŁAZEK & SZYNKIEWICZ 1987). R: KUBIAK & WOLSAN (1986).

PS — Puchacza Skała Rock-shelter, 50°13'N–19°47'E, Late Quaternary: Lower Pleniglacial — Late Glacial, Holocene. R: KOWALSKI et al. (1965), NADACHOWSKI (1982).

RA — Raj Cave, 50°50'N–20°30'E, Late Quaternary: Brørup — Lower Pleniglacial, Holocene (MADEYSKA 1981). R: BLACK & KOWALSKI (1974), KOWALSKI (1972), NADACHOWSKI (1982), PRADEL (1988).

RK — Rębielice Królewskie, 50°59'N–18°51'E, RK1A — Rębielice Królewskie 1A, Pliocene: Early Villányian, MN 16 (GŁAZEK & SZYNKIEWICZ 1987; MOSSOCZY 1959, 1961; NADACHOWSKI 1990). R: BLACK & KOWALSKI (1974), FAHLBUSCH (1969, 1978), KOWALSKI (1960a, d, 1963, 1977, 1979), PRADEL (1988). RK1B — Rębielice Królewskie 1B, Pleistocene: Late Biharian, Nagyharsányhegy phase (NADACHOWSKI 1990). R: KOWALSKI (1977), NADACHOWSKI (1990), PRADEL (1988); RK2 — Rębielice Królewskie 2, Pliocene: Early Villányian, MN 16. R: BLACK & KOWALSKI (1974), FAHLBUSCH (1969), KOWALSKI (1977), PRADEL (1988).

RN1 — Raciszyn 1, 51°06'N–18°51'E, Pliocene: Ruscinian, MN 15.

SW — Sąspowska Zachodnia Cave, 50°02'N–18°47'E. Late Quaternary: Late Glacial, Holocene (MADEYSKA 1981). R: KOWALSKI (1979), NADACHOWSKI (1982), PRADEL (1981, 1988).

TW — Tunel Wielki Cave, 50°13'N–19°47'E, Late Quaternary: Vistulian (Weichselian), Holocene (Madeyska 1981). R: Nadachowski (1982). TWB — Tunel Wielki Cave, fauna B, Late Biharian. R: Bartolomei et al. (1975).

UJ — Ujazd, 49°48'N–21°25'E, Late Pleistocene: ? Upper Pleniglacial. R: Kadyi & Kowalski (1975), Nadachowski (1982).

WE — Węże, 51°05'N–18°47'E, WE1 — Węże 1, Pliocene: Ruscinian, MN 15. R: Black & Kowalski (1974), Fahlbusch (1969), Kowalski (1960b, d, 1963, 1979), Pradel (1988), Schaub & Kowalski (1958), Sulimski (1960, 1962a, 1964). Remarks: The fauna of rodents is uniform; it is of the Late Ruscinian age and does not confirm the opinion of Głazek et al. (1976c) suggesting the occurrence in WE1 of 2–3 faunal assemblages of different age. WE2 — Węże 2, Pliocene: Ruscinian / Villányian, MN 15/16. R: Sulimski (1962b).

WS - Wąwóz Sobczański, 49°24'N–20°24'E, Holocene: R: Alexandrowicz et al. (1985).

ZA1 — Zalesiaki 1, 51°06'N–18°56'E, ZA1A — Zalesiaki 1 — fauna A, Pleistocene: Biharian, Betfia — Nagyharsányhegy phases (Nadachowski 1990). R: Black & Kowalski (1974), Kowalski (1977, 1979), Nadachowski (1990), Pradel (1988); ZA1B — Zalesiaki 1 — fauna B, Pliocene - Pleistocene: Ruscinian — Villányian — Biharian (Nadachowski 1990). R: Black & Kowalski (1974), Fahlbusch (1978), Kowalski (1977, 1979), Pradel (1988). Remarks: Materials from ZA1 (together 15 samples) have been divided into two groups. Group A (samples No. 1, 2, 3, 5, 7, 8, 9, 10 and 13) comprise only Biharian rodents, while group B (samples No. 3, 4, 6, 11, 12, 14, and 15) contains, besides dominating Biharian elements, also mixed Villányian and Ruscinian taxa.

ZD — Zamkowa Dolna Cave, 50°44'N–19°16'E, ZDA — Zamkowa Dolna Cave, fauna A, Pliocene: Villányian, MN 16?–MN 17. R: Kowalski (1977), Pradel (1988); ZDB — Zamkowa Dolna Cave — fauna B, Pliocene: Ruscinian, MN 15. R: Black & Kowalski (1974), Fahlbusch (1969), Kowalski (1979), Pradel (1988); ZDC — Zamkowa Dolna Cave, fauna C, Pleistocene: Late Biharian, Nagyharsányhegy phase. R: Kowalski (1977, 1979), Nadachowski (1990); ZD6 — Zamkowa Dolna Cave — layer 6, Vistulian (Weichselian): Pleniglacial (Nadachowski 1990). R: Black & Kowalski (1974), Kowalski (1979), Nadachowski (1982). Remarks: During excavations of the Late Pleistocene sediments in ZD, a deep hollow was discovered in the rocky bottom filled with a loam sediment (= unit C). It contained a very rich mixed fauna of vertebrates (especially rodents) of the Ruscinian (fauna B), the Villányian (fauna A) and the Biharian (fauna C) age (cf. Nadachowski 1990).

ZL — Zalas, 50°06'N–19°36'E, Vistulian (Weichselian): Late Glacial, layer 4–^{14}C = 11500 ± 400 y B.P. R: Bocheński et al. (1985), Pradel (1988).

ZS — Żytnia Skała Rock-shelter, 50°11'N–19°48'E, Late Quaternary: Pleniglacial — Late Glacial — Holocene (Madeyska 1981). R: Black & Kowalski (1974), Kowalski (1979), Kowalski et al. (1967), Nadachowski (1982), Pradel (1988).

ZY — Zdrody, 52°57'N–22°47'E, Late Quaternary: Eemian? R: Bałuk et al. (1979).

Tab. 1. Fossil rodents from the Miocene of Poland.

Taxa	Localities			
	PR 1	BE 2	OP 1	OP 2
S c i u r i d a e				
Palaeosciurus cf. *fissurae* (DEHM 1950)	–	–	–	•[1]
Spermophilinus bredai (MEYER 1848)	–	–	–	•[2]
Miopetaurista gaillardi (MEIN 1970)	–	–	–	•[3]
Miopetaurista gibberosa (HOFMANN 1893)	–	–	•[4]	•[5]
E o m y i d a e				
Keramidomys carpathicus (SCHAUB & ZAPFE 1953)	–	–	–	•[6]
C a s t o r i d a e				
Chalicomys jaegeri KAUP 1846	•	–	•[7]	•[8]
Steneofiber eseri (MEYER 1838)	–	–	–	•
Steneofiber minutus (MEYER 1838)	–	–	–	•
C r i c e t i d a e				
Eumyarion bifidus (FAHLBUSCH 1964)	–	–	–	•[9]
Eumyarion cf. *weinfurteri* (SCHAUB & ZAPFE 1953)	–	•	–	–
cf. *Megacricetodon bavaricus* FAHLBUSCH 1964	–	–	–	•[10]
Democricetodon gaillardi (SCHAUB 1925)	–	–	•[11]	•
Democricetodon gracilis (FAHLBUSCH 1964)	–	•	–	–
Anomalomys gaudryi GAILLARD 1900	–	–	–	•
G l i r i d a e				
Glis cf. *vallesiensis* AGUSTI 1981	–	–	–	•[12]

[1]= *Sciurus* cf. *fissurae*: KOWALSKI (1967); [2]= *"Sciurus" bredai*: KOWALSKI (1967); [3]= *Sciurus* cf. *goeriachensis*: KOWALSKI (1967), = *Cryptopterus gaillardi*: MEIN (1970); [4]= *Sciuropterus gibberosus*: WEGNER (1913); [5]= *Sciuropterus gibberosus*: KOWALSKI (1967), = *Miopetaurista albanensis*: BLACK & KOWALSKI (1974); [6]= *Pseudotheridomys carpathicus*

4. History of rodent fauna of Poland.

The most likely chrono- and biostratigraphical relationship of the principal Polish rodent localities and the known range of the particular rodent taxa is shown in Tab. 1–4. On the basis of such generalized tables, a reconstruction of the history of the rodent fauna of Poland from the Middle Miocene to the Holocene is attempted.

4.1. Miocene.

The fossil rodent material from the Miocene is not enough to demonstrate a local or temporal differentiation (Tab. 1). The faunal compositions of PR1, BE2, OP1 and OP2 comprise the periods around the boundary of the Orleanian and the Astaracian (MN 4?–MN 7). Most of the rodents described so far belong to the taxa known from many other localities, especially from Western Europe. Noteworthy is the absence of faunas from MN 8–13 in the territory of Poland; this probably connected with the palaeogeographical history of the area studied (GŁAZEK & SZYNKIEWICZ 1987).

4.2. Pliocene.

Numerous materials of rodents available (Tab. 2) made it possible to summarize the Pliocene faunal succession as follows:

1) Early Ruscinian — MN 14 (= Montpellierian sensu FEJFAR & HEINRICH 1987): Characterized by the predominance of sciurids, probably connected with woodland areas (*Blackia polonica, Pliopetaurista* cf. *dehneli, Pliopetes hungaricus,* cf. *Sciurotamias* MILLER 1901, *Sciurus* cf. *warthae, Tamias* cf. *orlovi*). Eomyids (*Estramomys* JÁNOSSY 1969, *Keramidomys mohleri* and *Leptodontomys* cf. *catalaunicus*), accessorial elements, are considered to be Miocene relic forms. Among cricetids, the most common are *Kowalskia magna* and *K. polonica* being index species for the period under discussion. Other hamster-like forms (*Microtodon kowalskii, Baranomys loczyi, Trilophomys* DEPÉRET 1892, „*Trilophomys*“ *canterranensis*) appear regularly as accidental or accessorial elements. The appearance of *Epimeriones progressus* and *E. austriacus* indicates warm and dry climatic conditions. *Prosomys insuliferus,* another index species relatively frequently represented, is the only species of voles present. Murids are rather scarce, while glirids are diversified (*Glirulus pusillus, Glis minor, Muscardinus* cf. *dacicus, M. pliocaenicus*). The faunal assemblage is supplemented by *Sminthozapus intermedius.*

KOWALSKI (1967); [7]= *Steneofiber subpyrenaicus* : WEGNER (1913); [8]= *Steneofiber jaegeri*: KOWALSKI (1967); [9]= *Cotimus bifidus*: KOWALSKI (1967); [10]= cf. *Democricetodon* (*Megacricetodon*) *gregarius bavaricus*: KOWALSKI (1967); [11]= *Cricetodon minus*: WEGNER (1913); [12]= *Glis* sp.: KOWALSKI (1967)

Tab. 2. Fossil rodents from the Pliocene of Poland.

Taxa / Localities	PO	PN	ZA 1B	MA 4+5	ZD B	WE 1	EW	MO 1	DR 1	RN 1	WE 2	RK 1A	RK 2	MO 2	ZD A	KI 3B
S c i u r i d a e																
Blackia polonica BLACK & KOWALSKI 1971	●	-	-	-	-	●	-	-	-	-	-	●	●	-	-	-
Miopetaurista cf. *thaleri* (MEIN 1970)	-	-	-	-	-	-	-	-	-	-	-	●[1]	-	-	-	-
Pliopetaurista sp.	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pliopetaurista dehneli (SULIMSKI 1964)	cf	-	-	-	-	-	-	-	-	-	●[2]	●	●	-	-	-
Pliopetaulista cf. *pliocaenica* (DEPERET 1897)	-	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
Pliopetaurista schaubi (SULIMSKI 1964)	-	-	-	-	-	●[3]	-	-	-	-	-	-	-	-	-	-
Pliopetes sp.	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-
cf. *Pliopetes* sp.	-	-	-	-	-	-	-	●[4]	-	-	-	-	-	-	-	-
Pliopetes hungaricus KRETZOI 1959	●	-	-	-	-	cf	-	-	-	cf[4]	-	-	-	-	-	-
cf. *Sciurotamias* sp.	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sciurus sp.	-	-	-	-	-	-	●	-	-	-	-	-	-	-	-	-
Sciurus warthae SULIMSKI 1964	cf	-	-	-	cf	●	-	-	-	-	-	●	●	-	-	-
Spermophilinus sp.	-	-	-	-	-	-	-	-	-	●[4]	-	-	-	-	-	-
Spermophilus polonicus (GROMOV 1965)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-
? *Tamias* sp.	-	●[4]	-	-	-	-	-	-	-	●[4]	-	-	-	-	-	-
Tamias orlovi (SULIMSKI 1964) •	cf	-	-	-	-	●[5]	-	-	-	-	-	●	●	-	-	-
E o m y i d a e																
Estramomys sp.	●	●[4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Estramomys cf. *simplex* JANOSSY 1969	-	-	●	-	●	-	-	-	-	-	-	●	-	-	-	-
Keramidomys mohleri ENGESSER 1972	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leptodontomys sp.	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-
Leptodontomys cf. *catalaunicus* (HARTENBERGER 1967)	●	●[4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C a s t o r i d a e																
Steneofiber wenzensis SULIMSKI 1964	-	-	-	-	-	●[6]	-	-	-	-	-	-	-	-	-	-
Trogontherium sp.	-	-	-	-	-	-	-	-	-	-	●	-	-	-	-	-
C r i c e t i d a e																
Allocricetus bursae SCHAUB 1930	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	●
Allocricetus ehiki SCHAUB 1930	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	●
Cricetidae gen et sp. indet.	-	-	-	-	-	-	●	-	-	-	-	-	-	-	-	-
Cricetus sp.	-	-	-	-	-	-	-	-	-	-	●	-	-	-	-	-
Cricetus sp. 1	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricetus sp. 2	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricetus sp. 3	-	-	-	-	-	-	-	-	-	-	-	●	●	-	-	-
Cricetus runtonensis NEWTON 1909	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-
Democricetodon sp.	-	-	-	-	-	●	-	-	-	-	-	-	-	-	-	-
Kowalskia sp.	-	●[4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kowalskia magna FAHLBUSCH 1969	●	-	●	-	●	-	-	-	-	-	-	-	-	-	-	-
Kowalskia polonica FAHLBUSCH 1969	●	-	-	-	●	-	-	-	-	-	-	●	-	-	-	-
Anomalomys sp.	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epimeriones austriacus DAXNER-HÖCK 1972 •	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-
Epimeriones progressus KOWALSKI 1974	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2.(continued - 2)

Taxa	Localities	PO	PN	ZA 1B	MA 4+5	ZD B	WE 1	EW	MO 1	DR 1	RN 1	WE 2	RK 1A	RK 2	MO 2	ZD A	KI 3B
Branomys sp.		-	-	•	•	•	-	•	-	-	-	-	•	•	-	-	-
Baranomys loczyi KORMOS 1933		-	•[4]	-	-	-	-	-	•[4]	-	•[4]	-	-	-	-	-	-
Baranomys longidens (KOWALSKI 1960)		-	-	-	-	-	•[7]	-	-	-	-	•[8]	-	-	-	-	-
Microtodon kowalskii (KRETZOI 1962)		•[9]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T r i l o p h o m y i d a e																	
Trilophomys sp.		-	•[4]	•	-	-	-	-	-	-	•[4]	-	•	-	-	-	-
"Trilophomys" canterranensis MICHAUX 1976		•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trilophomys pyrenaicus (DEPERET 1890)		-	-	-	-	-	•[10]	•	•[4]	-	-	•[4]	-	-	-	-	-
S p a l a c i d a e																	
? *Pliospalax* sp.		-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-
Prospalax sp.		-	•[4]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prospalax priscus (NEHRING 1897)		-	-	-	-	-	•	-	•[4]	•	•[4]	•	•	-	-	-	-
A r v i c o l i d a e																	
Germanomys weileri HELLER 1936		-	-	-	-	-	•[11]	-	•[4]	-	-	-	-	-	-	-	-
Stachomys trilobodon KOWALSKI 1960		-	-	-	-	•	•[12]	-	-	-	-	-	•	•	-	-	-
? *Ungaromys* sp.		-	-	-	-	-	•	-	-	-	-	•	-	•	-	-	-
Ungaromys nanus KORMOS 1932		-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Borsodia sp.		-	-	-	-	-	-	-	-	-	-	-	•	•	-	-	-
Borsodia arankoides (ALEXANDROVA 1976)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-
Borsodia cf. *hungarica* (KORMOS 1938)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-
Clethrionomys sp.		-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Clethrionomys cf. *kretzoii* (KOWALSKI 1958)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	-
Dolomys sp.		-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-
Dolomys cf. *milleri* NEHRING 1898		-	-	-	-	-	•[13]	-	-	-	-	-	-	-	-	-	-
Microtinae gen. et sp. indet.		-	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-
Mimomys sp.		-	-	-	-	-	-	•	-	-	•[4]	-	-	-	-	-	-
Mimomys cf. *altenburgensis* RABEDER 1981		-	-	-	-	-	-	-	-	-	-	-	•	•	-	-	-
Mimomys gracilis (KRETZOI 1959)		-	-	cf	-	•	•	-	•[4]	-	•[4]	•	-	-	-	-	-
Mimomys hassiacus HELLER 1936		-	-	-	-	-	•	-	-	-	•[4]	-	-	-	-	-	-
Mimomys pitymyoides JÁNOSSY & VAN D. MEULEN 1975		-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Mimomys ex gr. *pitymyoides*		-	-	•	-	-	-	-	-	-	-	-	•[14]	-	•	-	-
Mimomys cf. *pliocaenicus* (FORSYTH MAJOR 1889)		-	-	-	-	-	-	-	-	-	-	•	-	-	-	•	-
Mimomys polonicus KOWALSKI 1960		-	-	-	-	-	-	-	-	-	-	-	•[15]	•	-	-	-
Mimomys cf. *reidi* HINTON 1910		-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	•
Mimomys cf. *stehlini* KORMOS 1931		-	-	-	-	•	•	-	•[4]	•	-	•	-	-	-	-	-
Mimomys tornensis JÁNOSSY & VAN D. MEULEN 1975		-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Pliomys episcopalis MEHELY 1914		-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Propliomys sp.		-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-
Propliomys hungaricus (KORMOS 1934)		-	-	-	-	-	•	-	-	-	-	-	•	-	-	-	-
Prosomys insuliferus (KOWALSKI 1958)		•[16]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Villanyia sp.		-	-	•	-	-	-	-	-	-	-	-	•[17]	•[17]	•	•	-

Table 2. (continued - 3)

Taxa / Localities	PO	PN	ZA 1B	MA 4+5	ZD B	WE 1	EW	MO 1	DR 1	RN 1	WE 2	RK 1A	RK 2	MO 2	ZD A	KI 3B
Villanyia exilis KRETZOI 1956	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Lemmus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•	•
Synaptomys europaeus KOWALSKI 1977	-	-	-	-	-	-	-	-	-	-	-	•[18]	•	-	-	-
M u r i d a e																
Apodemus sp.	•[19]	•[4]	-	-	-	-	-	-	-	•[4]	-	-	-	-	-	-
Apodemus dominans KRETZOI 1959	-	-	-	-	-	-	-	•[4]	-	•[4]	cf	•[20]	-	-	•	-
Micromys cf. *praeminutus* KRETZOI 1959	-	-	-	-	-	•	-	-	-	-	•	•	-	-	-	-
Muridae gen. et sp. indet.	-	-	-	-	-	•	•	-	-	-	-	-	-	-	-	-
Parapodemus coronensis SCHAUB 1938	•	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parapodemus lugdunensis SCHAUB 1938	-	-	-	•	-	-	-	-	-	-	-	-	-	-	-	-
Parapodemus schaubi PAPP 1947	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-
Rhagapodemus sp.	•[19]	-	-	-	•[19]	-	-	-	-	-	-	-	-	-	-	-
Rhagapodemus frequens KRETZOI 1959	-	-	-	-	-	•	-	•[4]	-	-	cf	•	-	-	-	-
G l i r i d a e																
? *Dryomys* sp.	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-
Gliridae gen. et sp. indet.	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-
Glirulus sp.	-	-	•	-	•	-	-	-	-	-	-	-	-	-	-	-
Glirulus pusillus (HELLER 1936)	•	•[21]	-	-	-	-	-	cf[21]	-	-	-	-	-	-	-	-
Glis sp.	-	-	-	-	-	-	-	•[21]	-	-	-	-	-	-	•	-
Glis minor KOWALSKI 1956	•	cf[21]	-	•	-	•	cf	-	-	•[4]	cf	•[22]	-	-	-	-
Muscardinus sp.	-	-	-	-	-	•	-	•[21]	-	-	-	-	-	-	-	-
Muscardinus cf. *dacicus* KORMOS 1930	•	•[21]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscardinus pliocaenicus KOWALSKI 1963	•	•[21]	-	•	-	•	cf	cf[21]	-	•[4]	•[23]	•	-	-	-	-
S e l e v i n i i d a e																
Plioselevinia gromovi SULIMSKI 1962	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	-
Z a p o d i d a e																
Sminthozapus intermedius (BACHMAYER & WILSON 1970)	•[24]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sminthozapus janossyi SULIMSKI 1962	-	-	-	-	-	•	•	-	-	•[4]	•[25]	•	-	-	-	-
Zapodidae incertae sedis	-	-	•[26]	-	-	-	-	-	-	-	-	-	-	-	-	-
H y s t r i c i d a e																
Hystrix primigenia (WAGNER 1848)	-	-	-	-	-	•	-	-	-	-	cf[27]	-	-	-	-	-

[1]= *Cryptopterus* cf. *thaleri*: BLACK & KOWALSKI (1974); [2]= *Sciurus* sp. nov.: SULIMSKI (1962b), = *Pliosciuropterus dehneli*: SULIMSKI (1964); [3]= *Pliosciuropterus schaubi*: SULIMSKI (1964), [4] A. SULIMSKI (personal communication); [5]= *Eutamias orlovi*: SULIMSKI (1964); [6]= *Borofiber weznensis*: RADULESCO & SAMSON (1972); [7]= *Microtodon longidens*: KOWALSKI (1960b, 1964): [8]= *Microdontomys longidens* and *Microdontomys lidiae*: SULIMSKI (1962b); [9]= *Baranomys loczyi*: KOWALSKI (1956,= *Microtodon loczyi*: KOWALSKI (1964), = *Baranomys kowalskii*: AGADJANIAN & KOWALSKI (1978); [10]= *Trilophomys* cf. *depereti*: BRANDY (1979); [11]= *Ungaromys weileri*: KOWALSKI (1960b); [12]= *Ungaromys weileri* (partim, text.fig. 2B): KOWALSKI (1960b), = *Germanomys trilobodon* and *Germanomys* sp.: SULIMSKI (1964); [13]= *Dolomys* cf. *nehringi*: SULIMSKI (1964); [14]= *Mimomys reidi*: KOWALSKI (1960a);

2) Late Ruscinian – MN 15: A distinct increase of species diversity of arvicolids and murids, and a simultaneous decrease of the amount of taxa belonging to eomyids and cricetids. Among arvicolids, *Stachomys trilobodon, Germanomys weileri, Mimomys gracilis, M. hassiacus* and *M. stehlini* are dominant elements. Sciurids are less frequent, although their species diversity is similar to previous faunal assemblages. Eomyids and typical cricetids disappear, or are extremely rare (*Democricetodon* FAHLBUSCH 1964), while *Baranomys* KORMOS 1933 (represented by two species) and *Trilophomys* are still common. The presence of beavers (*Steneofiber wenzensis* and *Trogontherium* sp. would indicate moist environments; on the other hand, *Prospalax priscus,* a typical steppe element regularely appears. Murids are diversified and relatively frequent (*Apodemus dominans, Micromys* cf. *praeminutus, Rhagapodemus frequens*). Glirids belong to the same taxa as those found in older faunal communities and become more common. Noteworthy is the presence of two interesting taxa: *Plioselevinia gromovi* and *Sminthozapus janossy.* The latter one, although accessorial, regularly appears in most of the localities, being a good index species of the biozone. Late Ruscinian fauna is also distinguished by the occurrence of *Hystrix primigenia.*

3) Early Villányian – MN 16 (= Villafranchian sensu FEJFAR & HEINRICH 1987): A continuous increase in the faunal diversity of arvicolids represented by serveral new taxa occurring with high frequency (e.g. *Borsodia* JÁNOSSY & VAN DER MEULEN 1975, *Dolomys* NEHRING 1898, *Mimomys polonicus* (index species). *M.* cf. *altenburgensis, M.* ex gr. *pitymyoides, Propliomys hungaricus, Villanyia* KRETZOI 1956). Among the taxa known from older localities, *Stachomys trilobodon* should be mentioned. RK1A and RK2 has yielded representatives of lemmings *(Synatomys europaeus),* indicating probably the oldest very cold break of the climate in Middle Europe. The same taxa of sciurids are still present (e.g. *Blackia polonica, Pliopetaurista dehneli, Sciurus warthae, Tamias orlovi*), supplemented by *Miopetaurista* cf. *thaleri.* For the majority of the mentioned species, zone MN 16 is their last appearance date in Poland. Eomyids are represented by the accidental, relic form – *Estramomys* cf. *simplex,* which definitely disappears in younger assemblages. Typical cricetids are scarce, represented by *Cricetus* LESKE 1779 and reappearing, relic, *Kowalskia polonica. Baranomys, Trilophomys* and *Prospalax priscus* are still present. Murids and glirids are diversified and represent typical Pliocene taxa known from older localities.

4) Late Villányian – MN 17: A distinct change in faunal composition and a decrease of species diversity. The most characteristic feature is the disappearance of sciurids mainly connected with forest habitats. *Spermophilus polonicus,*

---

[15]= *Mimomys* cf. *stehlini*: KOWALSKI (1960a); [16]= *Mimomys* cf. *pusillus*: KOWALSKI (1956), = *Promimomys insuliferus*: KOWALSKI (1958a), = *Polonomys insuliferus*: AGADJANIAN & YACENKO (1984); [17]= *Mimomys (Villanyia) exilis*: KOWALSKI (1960a), = *Villanyia veterior*: KRETZOI (1969); [18]= *Lemmus lemmus* (partim): CHALINE (1973), = *Lemmus*: KOWALSKI (1975); [19]= J. MICHAUX (personal communication); [20]= *Apodemus* sp.: KOWALSKI (1960a); [21]= A. BEDNARCZYK (personal communication); [22]= cf. *Glis* sp.: KOWALSKI (1960a); [23]= *Muscardinus avellanarioides*: SULIMSKI (1962a); [24]= *Protozapus intermedius*: AGADJANIAN & KOWALSKI (1978); [25]= *Pliosminthus janossy*: SULIMSKI (1962a); [26]= *?Sminthozaus* sp.: KOWALSKI (1979); [27]= *Hystrix* sp.: SULIMSKI (1962a, personal communication)

an inhabitant of open landscapes, appears for the first time. Among cricetids, the predominance of two new species of genus *Allocricetus* SCHAUB 1930 (*A. bursae*, and *A. ehiki*) is noted, accompanied by *Cricetus runtonensis*. The aberrant, hypsodont forms, such as *Baranomys* and *Trilophomys* are absent. Arvicolids comprise a new species composition. For the first time there appear the following taxa: *Ungaromys nanus* (its occurrence in the Early Villányian requires confirmation), *Borsodia arankoides*, *B.* cf. *hungarica*, *Clethrionomys* cf. *kretzoii*, *Mimomys pitymyoides*, (other taxa of this group are noted from Early Villányian). *M.* cf. *pliocaenicus*, *M. tornensis*, *M.* cf. *reidi* (material provisionally included in this taxon from the RK1A assemblage requires revision), *Pliomys episcopalis*, *Villanyia exilis* and *Lemmus* sp. From among numerous murid genera characteristic for MN 15–16 zones, only *Apodemus dominans* has survived. Glirids are very scarce while zapodids disappear.

4.3. Early Pleistocene.

Comparing the situation in the successive Early Pleistocene rodent assemblages (Tab. 3), the faunal changes can be reconstructed as follows:

1) Early Biharian — Q1 (Osztramos 8 — Villány 5 — Betfia phases): A slight increase in species diversity, although generally the particular communities show similar species compositions. The most important difference is the first appearance of the subgenus *Allophaiomys* KORMOS 1932 with rootless molars, represented by *Microtus (Allophaiomys) pliocaenicus deucalion* in the Plio-Pleistocene transitional period, *M. (A.) p. pliocaenicus* in younger faunas as well as *M. (A.) p. praehintoni* an *A. (A.) nutiensis* towards the end of Q1 (e.g. ZA1A, older samples cf. NADACHOWSKI 1990). It should be stressed that the *Mimomys* MAJOR 1902 species (*M. pitymyoides*, *M. pusillus* and *M. tornensis*) are still predominant; they are always accompanied by *Pliomys episcopalis*. Villányian relics occur relatively frequently during Osztramos 8 — Villány 5 phase (e.g. *Borsodia* cf. *hungarica*, *Villanyia exilis*, *Apodemus dominans*), and successively disappear near the end of Q1 (e.g. *Ungaromys nanus*). The Early Biharian rodent communities in Middle Europe north of the Carpathians show the absence of Lagurini, with the exception of the Osztramos 8 — Villány 5 / Betfia boundary (scarce remains of *Lagurodon praepannonicus* in JZ). The fist cold (glacial?) climatic phase with Dicrostonyxini (*Predicrostonyx* cf. *compitalis* in ZA1A, sample 13 acc. to NADACHOWSKI 1990) is probably recorded in the uppermost Betfia. The (cold?)-steppe environment is also indicated by *Spalax* GUELDENSTAEDT 1770 remains. Among murids, *Apodemus* cf. *flavicollis* makes its appearance. Sporadic reappearance of *Glirulus* THOMAS 1905 should be mentioned. The first records of *Sicista praeloriger* are also noted.

2) Late Biharian — Q2 (Nagyharsányhegy — Templomhegy phases): Starts with a further diversification of the *Microtus* group. Successively, there appear: *Microtus (Neodon) pitymyoides*, *M. (Stenocranius) hintoni*, *M. (Pitymys) arvalidens*, *M. (Stenocranius) gregaloides*, *M. (Microtus) nivaloides*, and *M.* ex gr. *hyperboreus*. The last mentioned species seems to be a characteristic taxon for the Nagyharsányhegy phase, at least for the northern area of Middle Europe. However, *Mimomys savini* is most important index species for the Late Biharian (its occurrence in earlier phases requires confirmation). The population of this species from

Taxa	KD 1	KA	KI 3A	JZ	ZA 1A	KI 1	ZD C	RK 1B	KG	TW B
Sciuridae										
Sciurus sp.	-	-	•	•	-	-	-	-	-	-
Spermophilus polonicus (GROMOV 1965)	•[1]	•[2]	-	-	•	-	•	-	-	-
Petauria sp.	-	-	-	-	-	-	-	-	•	-
Pliopetaurista meini BLACK & KOWALSKI 1974	-	-	-	-	•	-	-	-	-	-
? *Tamias* sp.	-	•	-	-	-	-	-	-	-	-
Castoridae										
Trogontherium cuvieri FRIESCH 1809	-	-	-	-	-	-	-	-	•[3]	-
Cricetidae										
Allocricetus sp.	-	-	-	•	-	-	-	-	-	-
Allocricetus bursae SCHAUB 1930	•	•	•	-	-	-	•	•	•	-
Allocricetus ehiki SCHAUB 1930	•	•	•	-	-	-	•	-	•	-
Cricetus sp.	-	-	-	•	-	-	-	-	-	-
Cricetus runtonensis NEWTON 1909	•	-	-	-	•	-	•	•	•	-
Spalacidae										
Spalax sp.	-	•	•	-	•	-	-	-	-	-
Arvicolidae										
Borsodia cf. *hungarica* (KORMOS 1938)	•	•[4]	-	-	-	-	-	-	-	-
Clethrionomys sp.	-	•	•	•	•	-	•	•	-	-
Clethrionomys glareolus (SCHREBER 1780)	-	-	-	-	-	-	-	-	•	-
Clethrionomys kretzoii (KOWALSKI 1958)	•	-	-	-	-	-	-	-	-	-
Dicrostonyx sp.	-	-	-	-	•	-	-	-	-	-
Dicrostonyx simplicior FEJFAR 1966	-	-	-	-	-	-	-	-	•	-
Lagurodon praepannonicus (TOPACHEVSKIJ 1965)	-	-	-	•[5]	-	-	-	-	-	-
Lemmus sp.	•	•	•	•	•	-	•	•	•	-
Microtus (*Allophaiomys*) *nutiensis* (CHALINE 1972)	-	-	-	-	•	-	-	-	-	-
Microtus (*Allophaiomys*) *pliocaenicus deucalion* (KRETZOI 1969)	•	-	-	-	-	-	-	-	-	-
Microtus (*Allophaiomys*) *pliocaenicus pliocaenicus* (KORMOS 1933)	•	•	•	•	•	-	-	-	-	-
Microtus (*Allophaiomys*) *pliocaenicus praehintoni* RABEDER 1981	-	-	-	-	•	-	-	-	-	-
Microtus (*Microtus*) *nivaloides* F. MAJOR 1902	-	-	-	-	•	-	•	•	-	-
Microtus (*Neodon*) *pitymyoides* (CHALINE 1972)	-	-	-	-	•	-	-	-	-	-
Microtus (*Pitymys*) *arvalidens* KRETZOI 1958	-	-	-	-	•	-	•	-	•	-
Microtus (*Stenocranius*) *gregaloides* (HINTON 1923)	-	-	-	-	•	-	•	•	•	-
Microtus (*Stenocranius*) *hintoni* (KRETZOI 1941)	-	-	-	-	•	-	-	-	-	-
Microtus ex gr. *agrestis*	-	-	-	-	-	-	-	-	•	-
Microtus ex gr. *hyperboreus*	-	-	-	-	•	-	•	-	-	-
Microtus ex gr. *oeconomus*	-	-	-	-	-	-	-	-	•	-
Microtus ex gr. *nivalis*	-	-	-	-	-	-	-	-	•	-
Mimomys pitymyoides JÁNOSSY & VAN DER MEULEN 1975	•[6]	•[7]	-	-	-	-	-	-	-	-
Mimomys pliocaenicus (F. MAJOR 1889)	•	-	-	-	-	-	-	-	-	-
Mimomys pliocaenicus ostramosensis JÁNOSSY & VAN DER MEULEN 1975	-	•	•	-	-	-	-	-	-	-

Table 3. (continued - 2)

Taxa / Localities	KD 1	KA	KI 3A	JZ	ZA 1A	KI 1	ZD C	RK 1B	KG	TW B
Mimomys pusillus (MEHELY 1914)	-	•[8]	-	•	•	•	•	-	-	-
Mimomys cf. *reidi* HINTON 1910	•	-	-	-	-	-	-	-	-	-
Mimomys savini HINTON 1910	-	-	-	?	cf	-	-	-	•	-
Mimomys tornensis JÁNOSSY & VAN DER MEULEN 1975	•[9]	•	•	-	-	-	-	-	-	-
Pliomys episcopalis MEHELY 1914	•	•[10]	•	•	•	-	•	•	•	-
Pliomys lenki (HELLER 1930)	•	-	-	-	-	•	-	-	•	•
Predicrostonyx cf. *compitalis* ZAZHIGIN 1976	-	-	-	-	•	-	-	-	-	-
Ungaromys nanus KORMOS 1932	•	•	•	•	-	-	-	-	-	-
Villanyia exilis KRETZOI 1956	•	•	-	-	-	-	-	-	-	-
M u r i d a e										
Apodemus sp.										
Apodemus dominans KRETZOI 1959	•	•	-	-	-	-	-	-	-	-
Apodemus cf. *flavicollis* (MELCHIOR 1834)	-	-	•	-	-	-	-	-	-	-
Micromys sp.	-	-	-	•	•	-	-	-	•	-
G l i r i d a e	-	•	-	-	-	-	-	-	-	-
Eliomys sp.										
Eliomys cf. *quercinus* (LINNAEUS 1758)	-	-	-	-	-	•[11]	-	-	-	-
Glirulus sp.	-	-	-	-	-	-	-	-	•	-
Glis sp.	-	-	•	•[11]	-	-	-	-	-	-
Glis sackdillingensis (HELLER 1930)	-	-	-	•[11]	•	-	•	-	-	-
Muscardinus sp.	•	•	•	•[11]	-	•[11]	-	-	•	-
Muscardinus cf. *avellanarius* (LINNAEUS 1758)	-	-	•	-	•	-	-	-	-	-
Z a p o d i d a e	•	-	-	•[11]	-	-	-	-	•	-
Sicista praeloriger KORMOS 1930	-	•	-	cf[12]	•	-	•	•	•	-

[1]= *Sciurus* sp.: KOWALSKI (1958a); [2]= *Citellus* cf. *nogaici*: KOWALSKI (1960a); [3]= *Castor fiber*: GLAZEK et al. (1976a, 1977a, b), M. WOLSAN (personal communication); [4]= *Mimomys hungaricus*: KOWALSKI (1975); [5]= *Lagurodon* cf. *arankae*: HOSÁK et al. (1982); [6]= *Mimomys reidi* and *Mimomys newtoni* (partim, Fig. 22B): KOWALSKI (1958a); [7]= *Mimomys* cf. *pusillus* (partim, Fig. 3C) and *Mimomys* sp. (partim): KOWALSKI (1960c); [8]= *Dolomys episcopalis* (partim, Fig. 1A, B) and *Mimomys* sp. (partim): KOWALSKI (1960c); [9]= *Mimomys newtoni* (partim): KOWALSKI (1958a); [10]= Microtinae Gen et sp. indet.: KOWALSKI (1960c); [11] A. BEDNARCZYK (personal communication); [12] A. SULIMSKI (personal communication)

KG shows transitional features between *Mimomys* and *Arvicola* LACÉPÈDE 1799. Another species of *Mimomys*, *M. pusillus*, probably occurred in the Nagyharsányhegy phase only. During the period under discussion, at least two cold climatic phases can be distinguished. The first one with *Dicrostonyx* sp. (ZA1A, sample 2, cf. NADACHOWSKI 1990) suggests the occurrence of a glacial period within the Nagyharsányhegy phase in the proximity of the Matuyama / Brunhes boundary, and the second one with *Dicrostonyx simplicior* (KG), faunistically correlated to Templomhegyian phase, indicates a probable occurrence of the Nida Glaciation (sensu LINDNER 1984 = Mindelian I). The mentioned Templomhegyian phase is also characterized by the reappearance of interesting sciurids (*Pliopetaurista meini, Petauria* DEHM 1962) and castorids *(Trogontherium cuvieri)*. In the period under discussion, the first remains of *Pliomys lenki, Microtus* ex gr. *oeconomus, M.* ex gr. *nivalis, M.* ex gr. *agrestis,* and *Eliomys* cf. *quercinus* are noted.

4.4. Late Quaternary.

On the basis of abundant evidence (Tab. 4), one can describe the Late Quaternary faunal succession of rodents as follows:

1) Eemian: Predominance of *M.* cf. *arvalis* and *Clethrionomys* TILESIUS 1850 is observed, although the relatively small material does not allow more certain conclusions. *Arvicola, M. agrestis, Apodemus (Sylvaemus)* appear as accessorial elements, while *M. oeconomus, Cricetus, M. (Pitymys) subterraneus,* and *Sicista* GRAY 1827 are accidental. The immigration of *M. gregalis* in the KZ fauna indicates the probable first appearance of cooler conditions and steppe environments.

2) Vistulian 1 (= Weichselian 1): Colder break indicated by the immigration of the scarce lemmings (*Dicrostonyx* GLOGER 1841 and *Lemmus* LINK 1795 accompanied by *Cricetulus* MILNE-EDWARDS 1867) and the predominance of *M. gregalis* in the faunal assemblage. Most of the interglacial taxa (e.g. *Clethrionomys, M. oeconomus, Arvicola, M.* cf. *arvalis, M.* cf. *agrestis, Apodemus* KAUP 1829) survived. Worth noting is the first appearance of *Sciurus* LINNAEUS 1758 and *Castor* LINNAEUS 1758 (both in TW), probably towards the end of V1.

3) Vistulian 1/2 (i.e. Amerfoort, Brørup and ?Odderade interstadials): Distinguishable as a period of an increase of *Microtus arvalis* frequency; *M. gregalis* is relatively scarce. Both lemmings ar accidental elements, while *Lemmus* dominates over *Dicrostonyx*. There appear regularly: *Clethrionomys, Arvicola, M.* cf. *agrestis, M. oeconomus*. The steppe fauna is represented by *S. citelloides* and *Lagurus*. The presence of *M. (Pitymys) subterraneus* is uncertain and requires confirmation.

4) Vistulian 2 (Lower Pleniglacial): A gradual increase of frequency of steppe-tundra elements. In the beginning of the period, predomination of *M. arvalis* is still noted; successively, its percentage in the faunal community diminishes in favour of *M. gregalis*. An increase of the representation of *Lemmus* and *Dicrostonyx* is also observed. At first, *Lemmus* dominates over *Dicrostonyx*, while during the climatic minimum the mutual proportions are inversed. *M.* cf. *agrestis, M. oeconomus, Arvicola* and *Clethrionomys* are always present as accidental or accessorial elements. Species connected with steppe conditions *(S. superciliosus, S. citelloides, Lagurus, Cricetulus, Cricetus)* appear disorderly, and their frequency is very low.

5) Vistulian 2/3 (?Hengelo and Denekamp interstadials): Characterized by a gradual decrease of *Dicrostonyx, Lemmus* and *M. gregalis. M. oeconomus* and to a lesser degree *Arvicola* markedly increase their frequency. During warmer periods, a predominance of *M.* cf. *arvalis* is observed. Both *Spermophilus* CUVIER 1825 species and *Lagurus* have survived. Woodland taxa (e.g. *Clethrionomys* and *M.* cf. *agrestis*) are not represented abundantly, even in milder phases.

Tab. 4. Fossil rodents from the Late Quaternary of Poland.

Taxa / Localities	ZY	NI	KZ	TW	DK	CA	RA	ZS	PS	MM	ND	OB	BM	SW	ZD [6]	UJ	ZL	MS	CI	GI	JO	WS	DS
S c i u r i d a e																							
Marmota marmota (LINNAEUS 1758)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-	-	-	-	-
Sciurus vulgaris LINNAEUS 1758	-	-	-	●	-	-	●	-	-	-	●	-	●	●	-	-	-	●	●	-	-	-	●
Spemophilus sp.	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
Spermophilus citelloides (KORMOS 1916)[1]	-	●	-	-	-	-	●	-	-	-	-	-	-	-	●	-	-	-	-	-	-	-	-
Spermophilus superciliosus (KAUP 1839)[2]	-	●	-	-	-	-	●	●	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-
C a s t o r i d a e																							
Castor fiber LINNAEUS 1758	-	-	-	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-	-
C r i c e t i d a e																							
Cricetulus migratorius (PALLAS 1773)	-	●	-	-	-	●	●	-	-	●	-	-	-	-	-	-	●	-	-	-	-	-	-
Cricetus cricetus (LINNAEUS 1758)	-	●	●	-	-	●	-	●	-	●	●	-	●	●	-	-	●	●	-	-	-	-	●
A r v i c o l i d a e																							
Arvicola terrestris (LINNAEUS 1758)	-	●	●	●	●	●	●	●	●	●	●	●	●	●	-	-	●	●	●	-	●	●	●
Clethionomys glareolus (SCHREBER 1780)	cf	●	●	●	-	●	●	●	●	●	●	●	●	●	-	-	-	●	●	●	●	●	●
Dicrostonyx sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	●	-
Dicrostonyx gulielmi (SANFORD 1870)[3]	-	●	●	●	●	●	●	●	●	●	●	●	●	●	●	-	●	●	●	-	-	-	-
Lagurus lagurus (PALLAS 1773)	-	-	●	-	-	-	●	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-
Lemmus lemmus (LINNAEUS 1758)	-	●	●	●	●	●	●	●	●	●	●	●	●	-	●	-	-	-	-	-	-	-	-
Microtus (Chionomys) nivalis (MARTINS 1842)	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
Microtus (Microtus) agrestis (LINNAEUS 1761)[4]	●	cf	-	cf	-	cf	cf	cf	cf	cf	cf	-	cf	cf	-	-	-	●	cf	-	cf	●	-
Microtus (Microtus) arvalis (PALLAS 1779)[4]	-	cf	cf	cf	-	cf	cf	cf	cf	cf	cf	cf	cf	cf	cf	-	cf	●	-	-	-	●	●
Microtus (Microtus) oeconomus (PALLAS 1776)	-	●[5]	●	●	-	●	●	●[6]	●	●[7]	●	●	●	●	●	-	●	●	●	-	-	-	-

Table 4. (continued - 2)

Taxa / Localities	ZY	NI	KZ	TW	DK	CA	RA	ZS	PS	MM	ND	OB	BM	SW	ZD [6]	UJ	ZL	MS	CI	GI	JO	WS	DS
Microtus (Stenocranius) gregalis (PALLAS 1776)		•	•	•	•	•	•	•	•	•	•	•	•	-	•	-	•	•	-	-	-	-	-
Microtus (Pitymys) subterraneus (S.-LONGHAMPS 1836)	•	-	•	•	-	•	•	•	-	-	•	•	•	•	-	-	-	•	•	-	•	•	•
M u r i d a e																							
Apodemus agrarius (PALLAS 1771)	cf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Apodemus flavicollis/sylvaticus group	-	•[8]	•[9]	-	-	•[10]	•[10]	•[10]	•[9]	•[10]	•[9]	-	•[10]	•[9]	•[9]	-	-	•	•[9]	-	•[9]	•[11]	•
Apodemus microps KRATOCHVIL & ROSICKY 1952	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Micromys minutus (PALLAS 1771)	-	-	-	-	-	-	-	-	-	-	-	-	•	-	-	-	-	-	-	-	-	-	•
Mus musculus LINNAEUS 1758	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
Rattus norvegicus (BERKENHOUT 1769)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	•
G l i r i d a e																							
Eliomys quercinus (LINNAEUS 1766)	-	-	-	-	-	-	-	•	-	-	•	-	-	-	-	-	•	-	-	-	-	-	-
Glis glis (LINNAEUS 1776)	-	-	•	•	•	-	•	•	-	-	•	-	•	•	-	-	-	•	-	-	-	•	•
Muscardinus avellanarius (LINNAEUS 1758)	-	-	-	-	-	•	-	•	-	-	•	-	•	-	-	-	-	•	-	-	-	•	•
Z a p o d i d a e																							
Sicista betulina (PALLAS 1778)	•	-	-	-	-	•	-	•	-	•	-	-	-	•	•	-	-	•	-	-	-	-	-

[1]= *Citellus citelloides*: auct; [2]= *Citellus superciliosus*: auct; [3]= *Dicrostonyx torquatus*: auct; [4]= *Microtus arvalis - agrestis* group (partim): auct; [5]= *Microtus nivalis*: KOWALSKI (1961); [6]= *Microtus nivalis*: KOWALSKI et al. (1967); [7]= *Microtus nivalis*: NADACHOWSKI (1976); [8]= *Apodemus* cf. *sylvaticus*: NADACHOWSKI (1982); [9]= *Apodemus flavicollis*: NADACHOWSKI (1982); [10]= *Apodemus* cf. *sylvaticus* and *Apodemus flavicollis*: NADACHOWSKI (1982); [11]= *Apodemus* cf. *flavicollis*: ALEXANDROWICZ et al. (1985)

6) V i s t u l i a n 3 (Upper Pleniglacial): A repeated increase of *Dicrostonyx* and *Lemmus*, and a distinct predominance of *M. gregalis; M. oeconomus* is also relatively common. *S. superciliosus* and *Lagurus* have survived as accidental elements while *Cricetus* and *Cricetulus* reappear. Noteworthy is the presence of *Sicista* and probably of *Marmota* FRISCH 1775 (in the UJ assemblage). *M. nivalis* only occurs in the Carpathians (OB). At the end of the period under discussion, taxa connected with a mild climate and forest environments appear (e.g. *Glis* BRISSON 1762).

7) L a t e V i s t u l i a n (Late Glacial): A distinct increase of the faunal diversity indicated, first of all, by the appearance of forest inhabitants (e.g. *Glis, Sciurus, Muscardinus* KAUP 1829) during period of milder climate (e.g. ? Bølling, ? Allerød). *Clethrionomys* and a new element *M. (Pitymys) subterraneus* become dominant. In some faunal assemblages, also remains of *Arvicola* and *Apodemus* become abundant. On the other hand, during cooler periods (probably in Older and Younger Dryas), a recovery of steppe-tundra elements with a distinct domination of *M. gregalis* and *Dicrostonyx* is observed; *Lemmus* become less frequent and disappears completely in some assemblages, probably before Younger Dryas (cf. ZL faunal assemblage). This last supposition requires, however, confirmation. *Cricetulus* is present as the accidental element, while *Spermophilus* species and *Lagurus* have not survived. Generally, the period is characterized by distinct differences between rodent assemblages assignable to cooler or milder phases, those differences being manifested by the faunal composition and the relative proportions of the particular taxa.

8) H o l o c e n e: A continuous increase of the frequency of forest species, especially *Clethrionomys* and *M. agrestis.* Inhabitants of steppe-tundra environments (*Dicrostonyx* and *M. gregalis*) survived at least in the Cracow region, until the beginning of Late Holocene (? Sub-Boreal phase). The frequency of *M. arvalis* fluctuates depending on the expansion of cultivated fields, thus being connected with human activity. Synanthropic rodents (*A. agrarius, A. microps, Mus musculus* and *Rattus norvegicus*) only appear in historical times.

References.

AGADJANIAN, A. K. & KOWALSKI, K. (1978): *Prosomys insuliferus* (KOWALSKI 1958) (Rodentia, Mammalia) from the Pliocene of Poland and the European part of the USSR. — Acta Zool. Cracov., **23** (3): 29–53; Kraków.

AGADJANIAN, A. K. & YACENKO, V. N. (1984): Filogenticheskie sviazi polevok Severnoi Evrazyi. — Sb. Trud. Zool. Muz. MGU, **22**: 135–190; Moskva [in Russian].

ALEXANDROWICZ, S. W., NADACHOWSKI, A., RYDLEWSKI, J, VALDE-NOWAK, P. & WOŁOSZYN, B. W. (1985): Subfossil fauna from a cave in the Sobczański Gully (Pieniny Mts., Poland). — Folia Quatern., **56**: 57–78; Kraków.

BAŁUK, A., MŁYNARSKI, M. & SULIMSKI, A. (1979): Pleistocene fauna at Zdrody near Białystok (North-Eastern Poland). — Bull. Inst. Geol., **318**: 117–127; Warszawa.

BARTOLOMEI, G., CHALINE, J. FEJFAR, O., JÁNOSSY, D., JEANNET, M., KOENIGSWALD, V. W. & KOWALSKI, K. (1975): *Pliomys lenki* (HELLER 1930) (Rodentia, Mammalia) en Europe. — Acta Zool. Cracov., **20** (10): 393–468; Kraków.

Black, C. C. & Kowalski, K. (1974): The Pliocene and Pleistocene Sciuridae (Mammalia, Rodentia) from Poland. – Acta Zool. Cracov., **19** (19): 461–484; Kraków.

Bocheński, Z., Ginter, B., Kozłowski, J. K., Mook, W. G., Muszyński, M., Nadachowski, A., Stworzewicz, E. & Szyndlar, Z. (1985): Badania osadów schronisk podskalnych w Zalasie koło Krakowa. – Folia Quatern., **56**: 3–56; Kraków.

Bocheński, Z., Młynarski, M., Nadachowski, A., Stworzewicz, E. & Wołoszyn, B. W. (1983): Górnoholoceńska fauna z Jaskini Dużej Sowy (doniesienie wstępne). – Przegl. Zool., **27** (4): 437–456; Wrocław.

Bosák, B., Głazek, J., Horáček, I. & Szynkiewicz, A. (1982): New locality of Early Pleistocene vertebrates – Żabia Cave at Podlesice, Central Poland. – Acta Geol. Pol., **32** (3–4): 217–226; Warszawa.

Brandy, L. D. (1979): Contribution à l'étude du genre *Trilophomys* (Rodentia) du Pliocéne d'Europe. – Bull. Soc. Geol. France, **21** (2): 105–112; Paris.

Chaline, J. (1973): Biogéographie et fluctuations climatiques au Quaternaire d'après les faunes de rongeurs. – Acta Zool. Cracov., **8** (7): 141–166; Kraków.

Chmielewski, W., Kowalski, K., Madeyska-Niklewska, T. & Sych, L. (1967): Wyniki badań osadów jaskini Koziarni w Sąspowie, pow. Olkusz. – Folia Quatern., **26**: 1–67; Kraków.

Fahlbusch, V. (1969): Pliozäne und Pleistozäne Cricetinae (Rodentia, Mammalia) aus Polen. – Acta Zool. Cracov., **14** (5): 89–137; Kraków.

– – – (1978): Pliozäne und Pleistozäne Eomyidae (Rodentia, Mammalia) aus Polen. – Acta Zool. Cracov., **23** (2): 13–27; Kraków.

Fejfar, O. (1976): Plio-Pleistocene mammal sequences. – IGCP Project 73/1/24, Report 3: 251–266; Praha.

Fejfar, O. & Heinrich, W.-D. (1983): Arvicoliden-Sukzession und Biostratigraphie des Oberpliozäns und Quartärs in Europa. – Schrift. Geol. Wiss., **19/20**: 61–109; Berlin.

– – – (1987): Zur biostratigraphischen Gliederung des jüngeren Känozoikums in Europa an Hand von Muriden und Cricetiden (Rodentia, Mammalia). – Čas. Mineral. Geol., **32** (1): 1–16; Praha.

Głazek, J. , Kowalski, K., Lindner, L., Młynarski, M., Stworzewicz, E., Tuchołka, P. & Wysoczański-Minkowicz, T. (1977b): Cave deposits at Kozi Grzbiet (Holy Cross Mts. Central Poland) with vertebrate and snail faunas of the Mindelian I / Mindelian II interglacial and their stratigraphic correlations. – Proc. 7th Internat. Speleol. Congr.,: 211–214; Sheffield.

Głazek, J., Lindner, L. & Wysoczański-Minkowicz, T. (1976a): Interglacial Mindel I / Mindel II in fossil bearing karst at Kozi Grzbiet in the Holy Cross Mts. – Acta Geol. Pol., **26** (3): 377–393; Warszawa.

– – – (1977a): Geologiczna interpretacja stanowiska fauny staroplejstoceńskiej Kozi Grzbiet w Górach Świętokrzyskich. – Kras i Speleol., **185**: 13–28; Katowice.

Głazek, J., Sulimski, A., Szynkiewicz, A. & Wysoczński-Minkowicz, T. (1976b): Middle Pleistocene karst deposits with *Ursus spelaeus* at Draby near Działoszyn, Central Poland. – Acta Geol. Pol., **26** (3): 451–466; Warszawa.

– – – (1977c): Kopalny kras ze środkowoplejstoceńskimi szczątkami kręgowców w Drabach koło Działoszyna. – Kras i Speleol., **1** (10): 42–58; Katowice.

Głazek, J., Sulimski, A. & Wysoczański-Minkowicz, T. (1976c): On the stratigraphic position of Węże I locality (Middle Poland). – Proc. 6 Internat. Congr. Speleol.,: 435–442; Olomouc.

GŁAZEK, J. & SZYNKIEWICZ, A. (1980): Górnojurajskie wapienie i kras w rejonie Działoszyna. Kras,: 242–267. — In: BARCZYK, W. (Ed.): Przew. 52 Zjazdu P.T. Geol., Bełchatów, 11–14 IX 1980. — Wyd. Geol., 352 pp., Warszawa.

— — — (1987): Stratygrafia młodotrzeciorzędowych i staroczwartorzędowych osadów krasowych oraz ich znaczenie paleogeograficzne,: 113–130. — In: JAHN, A. & DYJOR, S. (Eds.): Problemy młodszego neogenu i eoplejstocenu w Polsce. — Ossolineum, 5–261; Wrocław.

HORÁČEK, I. (1981): Comments on the lithostratigraphic context of the Early Pleistocene mammal biozones of Central Europe. — IGCP Project 73/1/24, Report 6: 99–117; Prague.

HORÁČEK, I. & SÁNCHEZ MARCO, A. (1984): Comments on the Weichselian small mammal assemblages in Czechoslovakia and their stratigraphical interpretation. — N. Jb. Geol. Paläont. Min., **9**: 560–576; Stuttgart.

KADYI, S. & KOWALSKI, K. (1975): Pierwsze znalezisko kopalnego świstaka *Marmota marmota* (LINNAEUS, 1758) w Polsce. — Przegl. Zool., **19** (2): 241–244; Wrocław.

KOWALSKI, K. (1956): Insectivores bats and rodents from the Early Pleistocene bone breccia of Podlesice near Kroczyce (Poland), — Acta Paleont. Pol., **1**: 331–394; Warszawa.

— — — (1958a): An early Pleistocene fauna of small mammals from the Kadzielnia Hill in Kielce (Poland). — Acta Paleont. Pol., **3**: 1–47; Warszawa.

— — — (1958b): Plejstoceńskie Microtinae (Rodentia, Mammalia) z jaskini w Dziadowej Skale. — Acta Zool. Cracov., **2** (32): 805–823; Kraków.

— — — (1959): Katalog ssaków Plejstocenu Polski. — 267 p.; Warszawa — Wrocław.

— — — (1960a): Pliocene insectivores and rodents from Rębielice Królewskie (Poland). — Acta Zool. Cracov., **5** (5): 155–194; Kraków.

— — — 1960b): Cricetidae and Microtidae (Rodentia) from the Pliocene of Węże (Poland). — Acta Zool. Cracov., **5** (11): 447–504; Kraków.

— — — (1960c): An Early Pleistocene fauna of small mammals from Kamyk (Poland). — Folia Quatern., **1**: 1–24; Kraków.

— — — (1960d): *Prospalax priscus* (NEHRING) (Spalacidae, Rodentia) from Poland. — Anthropos. supl. Mamm. Pleist., **1**: 109–114; Brno.

— — — (1961): Plejstoceńskie gryzonie Jaskini Nietoperzowej w Polsce. — Folia Quatern., **5**: 1–22; Kraków.

— — — (1963): The Pliocene and Pleistocene Gliridae (Mammalia, Rodentia) from Poland. — Acta Zool. Cracov., **8** (14): 533–567; Kraków.

— — — (1964): Paleoekologia ssaków pliocenu i wczesnego plejstocenu Polski. — Acta Theriologica., **8** (4): 73–88, Białowieża.

— — — (1967): Rodents from the Miocene of Opole. — Acta Zool. Cracov., **12** (1): 1–18; Kraków.

— — — (1972): Fossil fauna. Studies on Raj Cave near Kielce (Poland) and its deposits. — Folia Quatern., **41**: 45–59; Kraków.

— — — (1974): Remains of Gerbillinae (Rodentia, Mammalia) from the Pliocene of Poland. — Bull. Acad. Pol. Sci., Cl. II (Sci. Biol.) **22** (9): 591–595; Warszawa.

— — — (1975): Earliest appearance of lemmings in the Quaternary of Poland,: 99–104. — In: ALBERDI A. T. & AQUIRRE E. (Eds.): Acta I Col. Internat. Biostrat. Cont. Neog. Sup. Quatern. Inf., 250 pp.; Montpellier — Madrid.

— — — (1977): Fossil lemmings (Mammalia, Rodentia) from the Pliocene and Early Pleistocene of Poland. — Acta Zool. Cracov., **23** (9): 298–317; Kraków.

— — — (1979): Fossil Zapodidae (Rodentia, Mammalia) from the Pliocene and Quaternary of Poland. — Acta Zool. Cracov., **23** (9): 199–210; Kraków.

Kowalski, K., Kozłowski, J. K., Krysowska-Iwaszkiewicz, M., Pawlikowa, B. & Wiktor, A. (1967): Badania osadów schronisk podskalnych w Żytniej Skale (Bębło, pow. Kraków). — Folia Quatern., **25**: 1–27; Kraków.

Kowalski, K., Kozłowski, J. K., Krysowska, M. & Wiktor, A. (1965): Badania osadów schroniska w Puchaczej Skale w Prądniku Czajowskim, powiat Olkusz. — Folia Quatern., **20**: 1–42; Kraków.

Kowalski, K., Młynarski, M. Wiktor, A. & Wołoszyn, B. W. (1963): Postglacjalna fauna z Józefowa pow. Biłgoraj. — Folia Quatern., **14**: 2–26; Kraków.

Kretzoi, M. (1969): Sketch on the Late Cenozoic (Pliocene and Quaternary) terrestrial stratigraphy of Hungary. — Födl. Közl., **17** (3): 179–204; Budapest.

Kubiak, H. (1982): Die miozänen Wirbeltierfunde von Przeworno (Dolny Sląsk, VR Polen). — Z. geol. Wiss., **10** (7): 997–1007; Berlin.

Kubiak, H. & Wolsan, M. (1986): Castoridae (Rodentia, Mammalia) from the Miocene of Przeworno in Silesia (Poland),: 155–160. — In: Pilleri, G. (Ed.): Investigations of Beavers. Brain Anat. Inst., **5**: 1–160; Berne.

Lindner, L. (1984): An outline of Pleistocene chronostratigraphy in Poland. — Acta Geol. Pol., **34**: 27–49; Warszawa.

Madeyska, T. (1981): Środowisko człowieka w środkowym i górnym paleolicie na ziemiach polskich w świetle badań geologicznych. — Stud. Geol. Pol., **69**: 1–125; Warszawa.

Mein, P. (1970): Les Sciuroptéres (Mammalia, Rodentia) neogenes d'Europe occidentale. — Geobios, **3** (3): 7–77; Lyon.

— — — (1976): Biozonation du Neogene Méditerranéen à partir des mammifères. — In: Seneš, J. (Ed.): Proceedings of the VIth Congres R.C.N.M.S.; Bratislava.

Młynarski, M. (1961): Czwartorzędowa fauna węży (Colubridae) z Giebułtowa koło Krakowa. — Folia Quatern., **6**: 1–9; Kraków.

Mossoczy, (1959): Odkrycie miejsc występowania kości kręgowców kopalnych koło Kłobucka. — Przegl. Geol., **3**: 132–143; Warszawa.

— — — (1961): Rembielice Królewskie,: 35–37. — In: INQUA VIth Congress, Guide-Book of excursions from the Baltic to the Tatras, Part II, 2, Middle Poland; Warszawa.

Nadachowski, A. (1976): Fauna kopalna w osadach Jaskini Mamutowej w Wierzchowiu koło Krakowa. — Folia Quatern., **48**: 17–36. Kraków.

— — — (1982): Late Quaternary rodents of Poland with special reference to morphotype dentition analysis of voles. — 109 p., Warszawa — Kraków (PWN).

— — — (1985): Biharian voles (Arvicolidae, Rodentia, Mammalia) from Kozi Grzbiet (Central Poland). — Acta Zool. Cracov., **29** (2): 13–17; Kraków.

— — — (1990): Lower Pleistocene Rodents of Poland: Faunal Succession and Biostratigraphy. — Quartärpaläont., **8**: 215–223; Berlin.

Nadachowski, A., Madeyska, T., Rook, E., Rzebik-Kowalska, B., Stworzewicz, E., Szyndlar, Z., Tomek, T., Wolsan, M. & Wołoszyn, B. W. (1989): Holocene snail and vertebrate fauna from Nad Mosurem Starym Duża Cave (Grodzisko near Cracow): palaeoclimatic and palaeoenvironmental reconstructions. — Acta Zool. Cracov., **32** (10): 495–520; Kraków.

Nadachowski, A. & Wolsan, M. (1987): A new location of the Late Pleistocene fauna in the Polish Carpathians. — Curr. Res. Pleist., **4**: 112–114; Orono.

NIEZABITOWSKI-LUBICZ, E. (1932): *Lagopus lagopus* L. et. *Lagopus mutus* MONTON ainsi que la faune qui les accompagne dans le quaternaire de la Pologne. — Roczn. Pol. Tow. Geol., **8** (2): 179–192; Kraków.

PRADEL, A. (1981): *Cricetus cricetus* (LINNAEUS, 1758) (Rodentia, Mammalia) from the Pleistocene — Holocene deposits of Sąspowska Cave (Ojców, Southern Poland). — Acta Zool. Cracov., **25** (12): 293–306; Kraków.

— — — (1988): Fossil hamsters (Cricetinae, Rodentia) from the Pliocene and Quaternary of Poland. — Acta Zool. Cracov., **31** (6): 235–295; Kraków.

RADULESCO, C. & SAMSON, P. (1972): Nouvelles données sur les Castoridés (Rodentia, Mamm.) du Villafranchien inférieur de la Dépression de Braşov (Roumanie). — N. Jb. Geol. Paläont. Min., **2**: 95–107; Stuttgart.

RÖMER, F. (1883): Die Knochenhöhlen von Ojców in Polen. — Paleontographica, **29**: 1–41; Cassel.

SCHAUB, S. & KOWALSKI, K. (1958): *Trilophomys pyrenaicus* DEP. im Pliozän von Węże (Polen). — Eclogae Geol. Helv., **51** (2): 479–482; Berne.

STEININGER, F. & RÖGL, F. (1983): Stratigraphic correlation of the Tethys-Paratethys Neogene: Project 25. — Geol. Corr., Special Issue, IGCP/UNESCO, 65–66; Paris.

SULIMSKI, A. (1960): *Hystrix primigenia* (WAGNER) in the Pliocene fauna of Węże. — Acta Paleont. Pol., **5** (3): 319–338; Warszawa.

— — — (1962a): Two new rodents from Węże 1 (Poland). — Acta Paleont. Pol., **7** (3–4): 503–512; Warszawa.

— — — (1962b): O nowym znalezisku kopalnej fauny kręgowców w okolicy Działoszyna. — Przegl. Geol., **4** (5): 219–223; Warszawa.

— — — (1964): Pliocene Lagomorpha and Rodentia from Węże 1 (Poland). — Acta Paleont. Pol., **9** (2): 149–261; Warszawa.

SULIMSKI, A., SZYNKIEWICZ, A. & WOŁOSZYN, B. W. (1979): The Middle Pliocene micromammals from central Poland. — Acta Paleont. Pol., **24** (3): 377–403; Warszawa.

VALDE-NOWAK, P., NADACHOWSKI, A. & WOLSAN, M. (1987): Upper Palaeolithic boomerang made of a mammoth tusk in south Poland. — Nature, **329**: 436–438; London.

WEGNER, R. N. (1913): Tertiär und umgelagerte Kreide bei Oppeln (Oberschlesien). — Paleontographica, **60**: 175–274; Stuttgart.

WYSOCZAŃSKI-MINKOWICZ, T. (1969): Próba oznaczania wieku względnego kości kopalnych metodą fluoro-chloro-apatytową. — Studia Geol. Pol., **28**: 1–79; Warszawa.

ZAWISZA, J. (1874): Jaskinia Mamutowa w dolinie Wierzchowskiej (oraz jaskinia Wierzchowska i ogólny pogląd na jaskinie tej okolicy). — Wiad. Archeol., **2**: 1–23; Warszawa.

— — — (1878): La caverne de Mammouth en Pologne. — Mém. Soc. Anthrop. Paris, **2** (1): 439–447; Paris.

ZOTZ, L. (1939): Die Altsteinzeit in Niederschlesien. — 146 pp.; Leipzig (Kabitsch).

Author: Dr. ADAM NADACHOWSKI, Institute of Systematic and Experimental Zoology, Polish Academy of Sciences, Sławkowska 17, 31–016 Kraków., Poland.