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Pliocene and Quaternary *Insectivora* (*Mammalia*) of Poland

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Abstract. The paper presents the present-day state of knowledge on the Pliocene and Quaternary insectivore fauna of Poland. The names of fossil taxa found in Poland, taxa first described from the Polish territory, names of the Polish localities in which insectivores have been found, with lists of forms in each of them and, lastly, the history of the Polish insectivore fauna from the Early Pliocene to the Holocene are given. A short paleoecological interpretation of the shrew (*Soricidae*) associations of the Pliocene and Lower Pleistocene in Poland is also presented.

Key-words: fossil mammals, *Insectivora*, Pliocene, Quaternary, Poland.

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I. INTRODUCTION

The paper is a survey of the fossil insectivores (*Insectivora*, *Mammalia*) known from the Pliocene and Quaternary of Poland. It is based on the material from 31 localities and 51 faunas /for example: locality KIELNIKI (KI) ($50^{o}45'N/19^{o}18'E$) contains 3 faunas of different ages: KIELNIKI 3B (KI3B) from the Late Pliocene, KIELNIKI 3A (KI3A) from the Early Pleistocene (Early Biharian) and KIELNIKI 1 (KI1) from the Early Pleistocene (Late Biharian)/. Most of the localities are situated in karstic sediments of the Kraków-Wieluń Upland in southern Poland.

The material consists of specimens belonging to 98 forms of 3 families, 7 subfamilies, 29 genera and about 75 species. On the basis of the Polish materials 5 genera and 27 species have been described as new to science (see section IV).

The studies were carried out by the author during the years 1971-1993. At that time 11 papers were published on *Erinaceinae*, *Uropsilinae*, *Desmaninae* and *Soricidae* (RZEBIK-KOWALSKA 1971, 1975, 1976, 1981, 1989, 1990a and b, 1991 and HARRISON and RZEBIK-KOWALSKA 1991, 1992, 1994). The papers by BAŁUK at al. (1979), BEDNARCZYK (1993), BOCHEŃSKI et al. (1983), BOSAK et al. (1982), CHMIELEWSKI et al. (1967), DAGNAN-GINTER et al. (1992), KOWALSKI (1956, 1958a and b, 1959, 1960a b, 1961, 1964, 1972, 1989), KOWALSKI at al. (1963, 1965, 1967), MŁYNARSKI (1961), NADACHOWSKI et al. (1989a and b, 1991, 1993), SKOCZEŃ (1976, 1980, 1993), SKURATOWICZ (1954), STACH (1964), SULIMSKI (1959, 1962a and b), SULIMSKI et al. (1979) and ZOTZ (1939) concerning the insectivores from Polish localities have also been used in this survey.

Several forms new to particular localities have been mentioned here for the first time.

The names of the authors who wrote about particular species, synonymy, geographical coordinates of localities, their age, full names and abbreviations of those names as well as the fauna accompanying the insectivores are given in section III.

All the fossil materials mentioned in this paper are housed in the collections of the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences in Cracow, the Institute of Palaeobiology, Polish Academy of Sciences and the Museum of the Earth, Polish Academy of Sciences, both in Warsaw, the Zoological Institute (Dept. of Palaeontology) of Wrocław University in Wrocław and the Harrison Zoological Museum in Sevenoaks (England).

The following abbreviations (listed in alphabetical order) have been used for localities:

CS1	– Cisowe Rock-Shelter 1
DU^{3}	– Duża Cave layer 3
DU^{5}	– Duża Cave layer 5
DS	– Dużej Sowy Cave
DZS	– Dziadowa Skała
GI	– Giebułtów
JO	– Józefów
KD1	– Kadzielnia 1
KA	– Kamyk
KI1	– Kielniki 1
KI3A	– Kielniki 3A
KI3B	– Kielniki 3B
KG	– Kozi Grzbiet
KZ^{1}	– Koziarnia Cave layer 1
KZ^{3-19}	– Koziarnia Cave layers 3-19
MA^{4+5}	– Mała Cave layers 4+5
MM^{2g}	– Mamutowa Cave layer 2g
MM^{2loess}	– Mamutowa Cave layer 2 loess
MS	– Nad Mosurem Starym Duża Cave
NI^{11-1}	– Nietoperzowa Cave layers 11-1
NI^{13-12}	– Nietoperzowa Cave layers 13-12
NI^{15-14}	– Nietoperzowa Cave layers 15-14
OB2	– Obłazowa 2
PN	– Pańska Góra

PO	– Podlesice
JP	– Południowa Cave
PE3A	– Przymiłowice 3A
PE1B	– Przymiłowice 1B
PE2B	– Przymiłowice 2B
PE3B	– Przymiłowice 3B
PE2D	– Przymiłowice 2D
PSI	– Puchacza Skała Cave I
PSIII	– Puchacza Skała Cave III
RA$^{1-10}$	– Raj Cave layers 1-10
RA^{11}	– Raj Cave layer 11
RK1A	– Rębielice Królewskie 1A
RK2	– Rębielice Królewskie 2
RK4	– Rębielice Królewskie 4
TC	– Tczew
WE1	– Węże 1
WE2	– Węże 2
JW	– Wschodnia Cave
ZA1A	– Zalesiaki 1A
ZA1B	– Zalesiaki 1B
ZDA	– Zamkowa Dolna Cave A
ZDB	– Zamkowa Dolna Cave B
ZDC	– Zamkowa Dolna Cave C
ZY	– Zdrody
JZ	– Żabia Cave
ZS1	– Żytnia Skała Cave 1
ZS2	– Żytnia Skała Cave 2

II. LIST OF POLISH FOSSIL TAXA

So far the following taxa have been found in Poland (for the full names of localities – see section I and III):

Family *E r i n a c e i d a e*

Subfamily *Erinaceinae*

Genus *Erinaceus* LINNAEUS, 1758

Erinaceus samsonowiczi SULIMSKI, 1959 from WE1

Erinaceus concolor MARTIN, 1838 from DU^{5}, DS, DU^{3}

Erinaceus sp. from RK1A, RK2, KD1, JZ, KA, CS1, PE2D, DZS

Family *T a l p i d a e*

Subfamily *Talpinae*

Tribe *Condylurini*

Genus *Condylura* ILLIGER, 1811

Condylura kowalskii SKOCZEŃ, 1976 from WE1, WE2, RK1A
Condylura izabellae SKOCZEŃ, 1976 from RK1A

Tribe *Urotrichini*

Genus *Neurotrichus* GÜNTER, 1880

"?*Neurotrichus polonicus*" SKOCZEŃ, 1980 from RK1A, ZDA, KD1
Neurotrichus polonicus SKOCZEŃ, 1980 from KI3B
Neurotrichus minor SKOCZEŃ, 1993 from WE2

Tribe *Scaptonychini*

Genus *Geotrypus* POMEL, 1848

"?*Geotrypus copernici*" SKOCZEŃ, 1980 from ZDA, KD1, KA

Genus *Scaptonyx* MILNE-EDWARDS, 1872

"*Scaptonyx* (?) *dolichochir*" (GAILLARD, 1899) from PO, WE1, RK1A, KD1

Tribe *Scalopini*

Genus *Scapanulus* THOMAS, 1912

Scapanulus agrarius SKOCZEŃ, 1980 from PO, WE1

Genus *Parascalops* TRUE, 1894

Parascalops fossilis SKOCZEŃ, 1993 from PO, WE1

Tribe *Talpini*

Genus *Talpa* LINNAEUS, 1758

Talpa minor FREUDENBERG, 1914 from PO, WE1, WE2, RK1A, KD1
Talpa cf. *minor* FREUDENBERG, 1914 from JZ
Talpa fossilis PETÉNYI, 1864 from WE1, KD1
Talpa cf. *fossilis* PETÉNYI, 1864 from WE2
Talpa europaea LINNAEUS, 1758 from NI^{15-14}, ZY, NI^{13-12}, TC, JW, ZS1, OB2, PSIII, KZ^{3-19}, NI^{11-1}, DS, DU^{3}, ZS2 , RA^{11}, MS, KZ^{1}, PE2D, DZS

Talpa sp. from KA

Subfamily *Uropsilinae*

Genus *Desmanella* ENGESSER, 1972

Desmanella aff. *dubia* RÜMKE, 1976 from PO

Subfamily *Desmaninae*

Genus *Desmana* GUELDENSTAEDT, 1777

Desmana nehringi KORMOS, 1913 from PO, WE1, RK1A,
Desmana sp. from KA

Genus *Galemys* KAUP, 1829

Galemys sulimskii RÜMKE, 1985 from WE1
Galemys kormosi (SCHREUDER, 1940) from RK1A, RK2

Galemys cf. *kormosi* (SCHREUDER, 1940) from WE2

Genus *Ruemkelia* RZEBIK-KOWALSKA and PAWŁOWSKI, 1994

Ruemkelia aff. dekkersi (RÜMKE, 1985) from PO

Talpidae gen. et sp. indet. from PE3A, PE1B, PE2B,

Family *S o r i c i d a e*

Subfamily *Allosoricinae*

Genus *Paenelimnoecus* BAUDELOT, 1972

Paenelimnoecus pannonicus (KORMOS, 1934) from PO, MA^{4+5}, ZA1B, WE1, RK1A, RK2

Paenelimnoecus sp. from RK1A

Subfamily *Soricinae*

Tribe *Amblycoptini*

Genus *Paranourosorex* RZEBIK-KOWALSKA, 1975

Paranourosorex gigas RZEBIK-KOWALSKA, 1975 from PO

Genus *Amblycoptus* KORMOS, 1926

Amblycoptus topali JÁNOSSY, 1972 from MA^{4+5}

Amblycoptus cf. *topali* JÁNOSSY, 1972 from ZDB

Amblycoptus sp. from RK2

Tribe *Blarinini*

Genus *Blarinoides* SULIMSKI, 1959

Blarinoides mariae SULIMSKI, 1959 from PO, ZDB, WE1, WE2, RK1A, RK2, ZDA, KD1, KA

Blarinoides sp. from PN

Genus *Mafia* REUMER, 1984

Mafia dehneli (KOWALSKI, 1956) from PO, PN

Mafia cf. *dehneli* (KOWALSKI, 1956) from MA^{4+5}

Mafia cf. *csarnotensis* REUMER, 1984 from PO, WE1, RK1A, RK2

Genus *Sulimskia* REUMER, 1984

Sulimskia kretzoii (SULIMSKI 1962) from PO, WE1, RK1A, RK2, KD1, (?)RK4

Tribe *Beremendiini*

Genus *Beremendia* KORMOS, 1934

Beremendia fissidens (PETÉNYI, 1864) from ZDB, ZA1B, WE1, WE2, RK1A, RK2, ZDA(?), KI3B, KD1, JZ, KA, KI3A, ZA1A, ZDC(?), KG

Beremendia minor RZEBIK-KOWALSKA, 1976 from RK1A

Beremendia cf. *minor* RZEBIK-KOWALSKA, 1976 from RK2

Beremendia sp. from PE3A, PE1B, PE2B, PE3B

Tribe *Soriculini*

Genus *Episoriculus* ELLERMAN and MORRISON-SCOTT, 1951

Episoriculus gibberodon (PETÉNYI, 1864) from PO, ZDB(?), ZA1B, WE1, RK1A, RK2, ZDA(?), KI3B,

Episoriculus cf. *castellarini* PASA, 1947 from JZ
Episoriculus sp. from PN

Genus *Neomysorex* RZEBIK-KOWALSKA, 1981

Neomysorex alpinoides (KOWALSKI, 1956) from PO,
cf. *Neomysorex alpinoides* (KOWALSKI, 1956) from ZA1B

Genus *Macroneomys* FEJFAR, 1966

Macroneomys brachygnathus FEJFAR, 1966 from KG

Genus *Neomys* KAUP, 1829

Neomys newtoni HINTON, 1911 from ZA1A, KG
Neomys fodiens (PENNANT, 1771) from RA^{1-10}, NI^{11-1}, DS, DU^{3}, MS
Neomys cf. *fodiens* (PENNANT, 1771) from PSI

Tribe *Soricini*

Genus *Blarinella* THOMAS, 1911

Blarinella dubia (BACHMAYER and WILSON, 1970) from PO, ZA1B
?*Blarinella dubia* (BACHMAYER and WILSON, 1970) from MA^{4+5}
Blarinella europaea REUMER, 1984 from PO, ZA1B, WE1, RK1A

Genus *Deinsdorfia* HELLER, 1963

Deinsdorfia reumeri RZEBIK-KOWALSKA, 1990 from PO
Deinsdorfia insperata RZEBIK-KOWALSKA, 1990 from PO
Deinsdorfia hibbardi (SULIMSKI, 1962) from WE1, RK1A, RK2, KI3B, KD1
Deinsdorfia cf. *kordosi* REUMER, 1984 from WE1, RK1A

Genus *Petenyia* KORMOS, 1934

Petenyia robusta RZEBIK-KOWALSKA, 1989 from PO, ZDB
Petenyia hungarica KORMOS, 1934 from WE1, WE2, RK1A, RK2, ZDA, KI3B, KD1, KA, KI3A, KI1
Petenyia cf. *hungarica* KORMOS, 1934 from JZ
Petenyia sp. from PN

Genus *Zelceina* SULIMSKI, 1962

Zelceina podlesicensis RZEBIK-KOWALSKA, 1990 from PO
Zelceina soriculoides (SULIMSKI, 1959) from WE1, RK1A, RK2
Zelceina cf. *soriculoides* (SULIMSKI, 1959) from WE2

Genus *Sorex* LINNAEUS, 1758

Sorex minutus LINNAEUS, 1766 from PO, MA^{4+5}, ZA1B, WE1, RK1A, RK2, KI3B, KD1, KI3A, ZA1A, ZDC, KG, NI^{15-14}, ZS1, MM^{2g}, RA^{1-10}, DU^{5}, JO, DS, DU^{3}, ZS2, RA^{11}
Sorex cf. *minutus* LINNAEUS, 1766 from WE2, JZ
Sorex bor REUMER, 1984 from PO, WE1, RK1A, RK2, KI3B, KD1, KA, KI3A
Sorex casimiri RZEBIK-KOWALSKA, 1991 from ZDB, ZA1B, RK1A
Sorex polonicus RZEBIK-KOWALSKA, 1991 from RK1A
Sorex pseudoalpinus RZEBIK-KOWALSKA, 1991 from WE1
Sorex praealpinus HELLER, 1930 from KI3B, ZDC, KG
Sorex runtonensis HINTON, 1911 from KI1, ZA1A, KG,

Sorex aff. *runtonensis* HINTON, 1911 from JZ
Sorex subaraneus HELLER, 1958 from KD1, KG, RK4
Sorex araneus LINNAEUS, 1758 from NI^{15-14}, NI^{13-12}, ZS1, MM^{2g}, PSIII, KZ^{3-19}, MM^{2loess}, RA^{1-10}, NI^{11-1}, DU^{5}, JO, DS, DU^{3}, PSI, ZS2, RA^{11}, MS, KZ^{1}
Sorex cf. *araneus* from OB2
Sorex minutissimus ZIMMERMANN, 1780 from KG, MM^{2g}, MM^{2loess}, NI^{11-1}
"*Sorex* cf. *kennardi*" HINTON, 1911 from OB2.
Sorex caecutiens LAXMANN, 1788 from ZY
Sorex sp. 1 from PO
Sorex sp. 2 from PO, RK1A
Sorex sp. 3 from PO
Sores sp. from MA^{4+5}, PN, WE2, JP

Subgenus *Drepanosorex* KRETZOI, 1941
Sorex (*Drepanosorex*) *praearaneus* KORMOS, 1934 from ZDA, KI3B, KD1, KA, KI3A, KI1
Sorex (*Drepanosorex*) *savini* HINTON, 1911 from ZA1A, ZDC, KG
Sorex (Drepanosorex) sp. 1 from KG
Sorex (*Drepanosorex*) sp. from JZ

Subfamily *Crocidurinae*

Genus *Crocidura* WAGLER, 1832
Crocidura leucodon (HERMANN, 1780) from JO, DS, DU^{3}, MS
Crocidura sp. from (?)ZS1, GI, ZS2

Soricidae gen. et sp. indet. 1 from PO
Soricidae gen. et sp. indet. 2 from PO
Soricidae gen. et sp. indet. 3 from PO
Soricidae.gen. et sp. indet. 4 from PO
Soricidae gen. et sp. indet. 5 from WE1
Soricidae gen. et sp. indet. 6 from RK1A, RK2
Soricidae gen. et sp. indet. 7 from RK1A
Soricidae gen. et sp. indet. 8 from RK2

III. LOCALITIES AND FAUNAS

(arranged in order of geological age, from oldest to youngest)

PODLESICE (PO) – 50°34'N/19°31'E; Early Pliocene, Early Ruscinian, MN14; *Amphibia, Reptilia, Mammalia*: *Insectivora, Chiroptera, Rodentia, Carnivora.*

INSECTIVORA

1. "*Scaptonyx* (?) *dolichochir*" : SKOCZEŃ 1980 /SKOCZEŃ who found several moles new to the Polish fauna and named several new taxa of talpids from Poland, in many cases placed question marks before or after their generic name. According to his personal

communication, the question marks do not mean that their generic affiliation is doubtful but rather that he was not sure if he had to do with the species proposed by him or a new species, because the material was incomplete; its inclusion in this genus is questioned by STORCH and QIU 1983/.

2. *Scapanulus agrarius* : SKOCZEŃ 1980 /inclusion in this genus is questioned by STORCH and QIU 1983/.
3. *Parascalops fossilis* : SKOCZEŃ 1993.
4. *Desmanella* aff. *dubia* : HARRISON and RZEBIK-KOWALSKA 1994
5. *Talpa minor* : KOWALSKI 1956, 1959, 1964.
6. *Desmana nehringi*: KOWALSKI 1956, 1959, 1964, RZEBIK-KOWALSKA 1971.
7. *Ruemkelia* aff. *dekkersi*: RZEBIK-KOWALSKA and PAWŁOWSKI 1994 / = *Dibolia* aff. *dekkersi* RÜMKE, 1985 in HARRISON and RZEBIK-KOWALSKA 1992/.
8. *Paenelimnoecus pannonicus*: RZEBIK-KOWALSKA 1990b / = *Suncus* cf. *pannonicus* (KORMOS, 1934) in KOWALSKI 1956, 1959 and *Petenyiella gracilis* (PETÉNYI, 1864) in KOWALSKI 1964/.
9. *Paranourosorex gigas*: RZEBIK-KOWALSKA 1975, HARRISON and RZEBIK-KOWALSKA 1991.
10. *Episoriculus gibberodon*: / = *Episoriculus borsodensis* JÁNOSSY 1973 in RZEBIK-KOWALSKA 1981 and *Soriculus cubinyi* KORMOS 1934 in KOWALSKI 1956, 1959, 1964/.
11. *Neomysorex alpinoides*: RZEBIK-KOWALSKA 1981 / = *Sorex alpinoides* KOWALSKI, 1956 in KOWALSKI 1956, 1959, 1964; according to some authors, it belongs to the genus *Episoriculus* or to the *Episoriculus* "group"/.
12. *Mafia dehneli*: RZEBIK-KOWALSKA 1990b / = *Sorex dehneli* KOWALSKI, 1956 in KOWALSKI 1956, 1959, 1964/.
13. *Mafia cf. csarnotensis*: RZEBIK-KOWALSKA 1990b.
14. *Sulimskia kretzoii*: RZEBIK-KOWALSKA 1990b / = *Sorex kretzoii* SULIMSKI, 1962 in SULIMSKI 1962a/.
15. *Blarinoides mariae*: RZEBIK-KOWALSKA 1976.
16. *Zelceina podlesicensis*: RZEBIK-KOWALSKA 1990a.
17. *Blarinella dubia*: RZEBIK-KOWALSKA 1989 / = *Petenyia hungarica* KORMOS, 1934 (partim) in KOWALSKI 1956, 1959, 1964/.
18. *Blarinella europaea*: RZEBIK-KOWALSKA 1989.
19. *Petenyia robusta*: RZEBIK-KOWALSKA 1989.
20. *Deinsdorfia reumeri*: RZEBIK-KOWALSKA 1990a.
21. *Deinsdorfia insperata*: RZEBIK-KOWALSKA 1990a.
22. *Sorex minutus*: KOWALSKI 1964, RZEBIK-KOWALSKA 1991 / = *Sorex* sp. (partim) in KOWALSKI 1956/.
23. *Sorex bor*: RZEBIK-KOWALSKA 1991.
24. *Sorex* sp. 1: RZEBIK-KOWALSKA 1991.
25. *Sorex* sp. 2: RZEBIK-KOWALSKA 1991.

26. *Sorex* sp.3: RZEBIK-KOWALSKA 1991 / = *Sorex* cf. *praearaneus* in KOWALSKI 1956 (partim), another specimen belonged to a bat/.
27. *Soricidae* gen. et sp. indet. 1: RZEBIK-KOWALSKA 1991.
28. *Soricidae* gen. et sp. indet. 2: RZEBIK-KOWALSKA 1991.
29. *Soricidae* gen. et sp. indet. 3: RZEBIK-KOWALSKA 1991.
30. *Soricidae* gen. et sp. indet. 4: RZEBIK-KOWALSKA 1991.

MAŁA CAVE layers 4+5 (MA^{4+5}) – $51^{o}05'N/18^{o}48'E$; Early Pliocene, Early Ruscinian, MN14; *Reptilia, Mammalia*: *Insectivora, Chiroptera, Rodentia.*

INSECTIVORA

1. *Paenelimnoecus pannonicus*: according to the author of the present paper / = *Petenyiella gracilis* (PETÉNYI, 1864) in SULIMSKI et al. 1979/.
2. *Amblycoptus topali*: SULIMSKI et al. 1979.
3. *Mafia* cf. *dehneli*: according to the author of the present paper / = "*Sorex*" cf. *dehneli* KOWALSKI, 1956 in SULIMSKI et al. 1979/.
4. ?*Blarinella dubia*: according to the author of the present paper / = *Petenyia hungarica* KORMOS, 1934 in SULIMSKI et al. 1979/.
5. *Sorex minutus*: according to REUMER 1984 / = *Petenyiella* aff. *repenningi* BACHMAYER and WILSON, 1970 in SULIMSKI et al. 1979/.
6. *Sorex* sp.: SULIMSKI et al. 1979.

PAŃSKA GÓRA (PN) – $50^{o}45'N/19^{o}15'E$; Early Pliocene, Early Ruscinian, MN14; *Gastropoda, Amphibia, Reptilia, Mammalia*: *Insectivora, Chiroptera, Rodentia.*

INSECTIVORA

1. *Episoriculus* sp.: BEDNARCZYK 1993.
2. *Mafia dehneli*: BEDNARCZYK 1993.
3. *Blarinoides* sp.: BEDNARCZYK 1993.
4. *Petenyia* sp.: BEDNARCZYK 1993.
5. *Sorex* sp.: BEDNARCZYK 1993.

ZAMKOWA DOLNA CAVE B (ZDB) – $50^{o}44'N/19^{o}16'E$; Early Pliocene, Early Ruscinian?, MN14?; *Mammalia: Insectivora, Chiroptera, Rodentia.*

INSECTIVORA

1. *Amblycoptus* cf. *topali*: RZEBIK-KOWALSKA 1975.
2. *Petenyia robusta*: RZEBIK-KOWALSKA 1989.

3. *Sorex casimiri*: RZEBIK-KOWALSKA 1991.
4. *Episoriculus gibberodon*: first report /it may belong here, to ZDA, or to both faunas, because the species survived to the Late Pliocene and all the fossils from Zamkowa Dolna Cave (faunas A, B, C) were mixed/.
5. *Blarinoides mariae*: RZEBIK-KOWALSKA 1976 /it may belong here, to ZDA, or to both faunas, because the species survived to the Early Biharian and all the fossils from Zamkowa Dolna Cave (faunas A, B, C) were mixed/.
6. *Beremendia fissidens*: RZEBIK-KOWALSKA 1976 /it may belong here, to ZDA, to ZDC, or to any two or possibly all the three of the faunas because the species survived to the Late Biharian and all the fossils from Zamkowa Dolna Cave (faunas A, B, C) were mixed/.

ZALESIAKI 1B samples 3, 6, 11, 12, 14, 15 (ZA1B) – 51°06'N/18°56'E; Early Pliocene, Ruscinian, MN14/15?; *Amphibia, Reptilia, Mammalia*: *Insectivora, Chiroptera, Rodentia.*

INSECTIVORA

1. *Paenelimnoecus pannonicus*: RZEBIK-KOWALSKA 1990b.
2. *Beremendia fissidens*: RZEBIK-KOWALSKA 1976.
3. *Episoriculus gibberodon*: first report.
4. cf.*Neomysorex alpinoides*: first report /see PO, no. 11/.
5. *Blarinella dubia*: RZEBIK-KOWALSKA 1989.
6. *Blarinella europaea*: RZEBIK-KOWALSKA 1989.
7. *Sorex minutus*: RZEBIK-KOWALSKA 1991.
8. *Sorex casimiri*: RZEBIK-KOWALSKA 1991.

WĘŻE 1 (WE1) – 51°05'N/18°47'E; Early Pliocene, Late Ruscinian, MN15; *Amphibia, Reptilia, Aves, Mammalia: Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora, Perissodactyla, Artiodactyla.*

INSECTIVORA

1. *Erinaceus samsonowiczi*: SULIMSKI 1959, 1962a, KOWALSKI 1964, RZEBIK-KOWALSKA 1971 / = *Erinaceus* sp. in SULIMSKI 1959/.
2. *Condylura kowalskii*: SKOCZEŃ 1976.
3. "*Scaptonyx* (?) *dolichochir*": SKOCZEŃ 1980 /on question mark see (PO) no. 1., p. 83; inclusion in this genus is questioned by STORCH and QIU 1983/.
4. *Scapanulus agrarius*: SKOCZEŃ 1980 /inclusion in this genus is questioned by STORCH and QIU 1983/.
5. *Parascalops fossilis*: SKOCZEŃ 1993.

6. *Talpa minor*: SULIMSKI 1959, 1962a, KOWALSKI 1964.
7. *Talpa fossilis*: SULIMSKI 1959, 1962a, KOWALSKI 1964 / = *Talpa* sp. in SULIMSKI 1959/.
8. *Desmana nehringi*: SULIMSKI 1959, KOWALSKI 1964, RZEBIK-KOWALSKA 1971 / = *Desmana kowalskae* RÜMKE, 1985 in RÜMKE 1985; according to the author of the present paper, it does not differ from *D. nehringi* coming from an older locality at Podlesice and a younger one of Rębielice Królewskie 1A/.
9. *Galemys sulimskii*: RÜMKE 1985 / = *Galemys* (?) sp. in SULIMSKI 1959 = *Desmana pontica* SCHREUDER, 1940 in SULIMSKI 1962a = *Desmana* cf. *kormosi* SCHREUDER, 1940 in SULIMSKI 1962a = probably also *Desmana kormosi* SCHREUDER, 1940 (from Węże 1) in RZEBIK-KOWALSKA 1971/.
10. *Paenelimnoecus pannonicus*: RZEBIK-KOWALSKA 1990b / = *Suncus pannonicus* (KORMOS, 1934) in SULIMSKI 1959, = *Petenyiella gracilis* (PETÉNYI, 1864) in SULIMSKI 1962a, KOWALSKI 1964 = *Suncus zelceus* SULIMSKI, 1959 in SULIMSKI 1959 = *Petenyiella zelcea* (SULIMSKI, 1959) in SULIMSKI 1962a, KOWALSKI 1964/.
11. *Beremendia fissidens*: SULIMSKI 1959, 1962a, KOWALSKI 1964 and RZEBIK-KOWALSKA 1976.
12. *Episoriculus gibberodon*: RZEBIK-KOWALSKA 1981.
13. *Mafia* cf. *csarnotensis*: RZEBIK-KOWALSKA 1990b.
14. *Sulimskia kretzoii*: REUMER 1984, RZEBIK-KOWALSKA 1990b / = *Sorex kretzoii* SULIMSKI, 1959 in SULIMSKI 1959, 1962a/.
15. *Blarinoides mariae*: SULIMSKI 1959, 1962a, KOWALSKI 1964 and RZEBIK-KOWALSKA 1976.
16. *Zelceina soriculoides*: SULIMSKI 1962a, RZEBIK-KOWALSKA 1990a / = *Neomys soriculoides* SULIMSKI, 1959 in SULIMSKI 1959, KOWALSKI 1964/.
17. *Blarinella europaea*: RZEBIK-KOWALSKA 1989.
18. *Petenyia hungarica*: SULIMSKI 1959, 1962a, KOWALSKI 1964, RZEBIK-KOWALSKA 1989.
19. *Deinsdorfia hibbardi*: RZEBIK-KOWALSKA 1990a / = *Sorex hibbardi* SULIMSKI, 1962 in SULIMSKI 1962a and KOWALSKI 1964/.
20. *Deinsdorfia* cf. *kordosi*: RZEBIK-KOWALSKA 1990a.
21. *Sorex minutus*: SULIMSKI 1959, 1962a, KOWALSKI 1964, RZEBIK-KOWALSKA 1991 /= *Sorex* cf. *minutus* in SULIMSKI 1959/.
22. *Sorex bor*: RZEBIK-KOWALSKA 1991 /may be = *Sorex runtonensis* HINTON,1911 in SULIMSKI 1959, 1962a and KOWALSKI 1964/.
23. *Sorex pseudoalpinus*: RZEBIK-KOWALSKA 1991 / = *Sorex* cf. *praealpinus* HELLER, 1930 in SULIMSKI 1962a/.
24. *Soricidae* gen. et sp. indet. 5: RZEBIK-KOWALSKA 1991.

R e m a r k

I have not found *Sorex subminutus, Sorex araneus, Sorex subaraneus, Sorex runtonensis* and *Sorex praearaneus* nor *Crocidura* cf. *kornfeldi* and *Crocidura* sp., all mentioned by SULIMSKI (1959, 1962 a) in the material from Węże 1 (see also RZEBIK-KOWALSKA 1991, pp. 327, 331, 341). According to REUMER (1984) the morphology of the mandibular condyles of the last two forms denies their belonging to the *Crocidurinae*.

WĘŻE 2 (WE2) – 51°05'N/18°47'E; Pliocene, Ruscinian/Villanyian, MN15/16; *Amphibia, Reptilia, Mammalia: Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora, Artiodactyla.*

INSECTIVORA

1. *Neurotrichus minor*: SKOCZEŃ 1993.
2. *Condylura kowalskii*: SKOCZEŃ 1993.
3. *Talpa minor*: SULIMSKI 1962b.
4. *Talpa* cf. *fossilis*: SULIMSKI 1962b.
5. *Galemys* cf. *kormosi*: RÜMKE 1985 / = *Desmana* cf. *kormosi* SCHREUDER, 1940 in SULIMSKI 1962b/.
6. *Beremendia fissidens*: SULIMSKI 1962b.
7. *Blarinoides mariae*: SULIMSKI 1962b.
8. *Zelceina* cf. *soriculoides*: according to the author of the present paper / = *Neomyina* cf. *soriculoides* in SULIMSKI 1962b/.
9. *Petenyia hungarica*: SULIMSKI 1962b.
10. *Sorex* cf. *minutus*: SULIMSKI 1962b.
11. *Sorex* cf. *runtonensis*: SULIMSKI 1962b /according to the author of the present paper this species is absent in the Pliocene of Poland/.
12. *Sorex* sp.: SULIMSKI 1962b.
13. *Crocidura* sp.: SULIMSKI 1962b /according to the author of the present paper this genus is absent in the Pliocene of Poland /.

RĘEBIELICE KRÓLEWSKIE 1A (RK1A) – 50°59'N/18°51'E; Late Pliocene, Early Villanyian, MN16; *Amphibia, Reptilia, Aves, Mammalia: Insectivora, Lagomorpha, Rodentia, Carnivora, Artiodactyla.*

INSECTIVORA

1. *Erinaceus* sp.: RZEBIK-KOWALSKA 1971.
2. *Condylura kowalskii*: SKOCZEŃ 1976.
3. *Condylura izabellae*: SKOCZEŃ 1976.

4. "?*Neurotrichus polonicus*": SKOCZEŃ 1980 /on question mark see (PO) no. 1., p. 83/.
5. "*Scaptonyx* (?) *dolichochir*": SKOCZEŃ 1980 /on question mark see (PO) no. 1., p. 83; inclusion in this genus is questioned by STORCH and QIU 1983/.
6. *Talpa minor*: KOWALSKI 1960a, 1964.
7. *Desmana nehringi*: KOWALSKI 1964, RZEBIK-KOWALSKA 1971, RÜMKE 1985.
8. *Galemys kormosi*: RÜMKE 1985 / = *Desmana kormosi* SCHREUDER, 1940 in KOWALSKI 1960a, 1964, RZEBIK-KOWALSKA 1971/.
9. *Paenelimnoecus pannonicus*: RZEBIK-KOWALSKA 1990b.
10. *Paenelimnoecus* sp.: RZEBIK-KOWALSKA 1991.
11. *Beremendia fissidens*: KOWALSKI 1960a, 1964, RZEBIK-KOWALSKA 1976.
12. *Beremendia minor*: RZEBIK-KOWALSKA 1976.
13. *Episoriculus gibberodon*: first report / = probably cf. *Neomys* sp. in KOWALSKI 1960a, but the specimen has been lost/.
14. *Mafia* cf. *csarnotensis*: RZEBIK-KOWALSKA 1990b.
15. *Sulimskia kretzoii*: RZEBIK-KOWALSKA 1990b.
16. *Blarinoides mariae*: KOWALSKI 1960a, 1964, RZEBIK-KOWALSKA 1976.
17. *Zelceina soriculoides*: RZEBIK-KOWALSKA 1990a / = *Neomys soriculoides* SULIMSKI, 1959 in KOWALSKI 1964/.
18. *Blarinella europaea*: RZEBIK-KOWALSKA 1989.
19. *Petenyia hungarica*: KOWALSKI 1964, RZEBIK-KOWALSKA 1989.
20. *Deinsdorfia hibbardi*: RZEBIK-KOWALSKA 1990a.
21. *Deinsdorfia* cf. *kordosi*: RZEBIK-KOWALSKA 1990a.
22. *Sorex minutus*: KOWALSKI 1960a, 1964, RZEBIK-KOWALSKA 1991 / = *Sorex* cf. *minutus* LINNAEUS, 1766 in KOWALSKI 1960a/.
23. *Sorex bor*: RZEBIK-KOWALSKA 1991 / = *Sorex runtonensis* HINTON, 1911 (partim) in KOWALSKI 1960a, 1964/.
24. *Sorex casimiri*: RZEBIK-KOWALSKA 1991 / = *Sorex runtonensis* HINTON, 1911 (partim) in KOWALSKI 1960a /.
25. *Sorex polonicus*: RZEBIK-KOWALSKA 1991.
26. *Sorex* sp. 2: RZEBIK-KOWALSKA 1991.
27. *Soricidae* gen. et sp. indet. 6: RZEBIK-KOWALSKA 1991.
28. *Soricidae* gen. et sp. indet. 7: RZEBIK-KOWALSKA 1991.

Remark

The remains described by KOWALSKI (1960a) as *Sorex runtonensis* have been revised and determined partly as *Sorex bor* and partly as *Sorex casimiri* (RZEBIK-KOWALSKA 1991).

REBIELICE KRÓLEWSKIE 2 (RK2) – 50°59'N/18°51'E; Late Pliocene, Early Villanyian, MN16; *Amphibia, Reptilia, Aves, Mammalia: Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora.*

INSECTIVORA

1. *Erinaceus* sp.: RZEBIK-KOWALSKA 1971.
2. *Galemys kormosi*: RÜMKE 1985 / = *Desmana kormosi* SCHREUDER, 1940 in RZEBIK-KOWALSKA 1971/.
3. *Paenelimnoecus pannonicus*: first report.
4. *Amblycoptus* sp.: first report.
5. *Beremendia fissidens*: RZEBIK-KOWALSKA 1976.
6. *Beremendia* cf. *minor*: first report.
7. *Episoriculus gibberodon*: first report.
8. *Mafia* cf. *csarnotensis*: RZEBIK-KOWALSKA 1990b.
9. *Sulimskia kretzoii*: RZEBIK-KOWALSKA 1990b.
10. *Blarinoides mariae*: RZEBIK-KOWALSKA 1976.
11. *Zelceina soriculoides*: RZEBIK-KOWALSKA 1990a.
12. *Petenyia hungarica*: RZEBIK-KOWALSKA 1989.
13. *Deinsdorfia hibbardi*: RZEBIK-KOWALSKA 1990a.
14. *Sorex minutus*: RZEBIK-KOWALSKA 1991.
15. *Sorex bor* : RZEBIK-KOWALSKA 1991.
16. *Soricidae* gen. et sp. indet. 6: RZEBIK-KOWALSKA 1991.
17. *Soricidae* gen. et sp. indet. 8: RZEBIK-KOWALSKA 1991.

ZAMKOWA DOLNA CAVE A (ZDA) – 50°44'N/19°16'E; Late Pliocene, Late Villanyian, MN17; *Mammalia: Insectivora, Lagomorpha, Rodentia, Carnivora.*

INSECTIVORA

1. "?*Neurotrichus polonicus*": SKOCZEŃ 1980 /on question mark see (PO) no. 1., p. 83/.
2. "?*Geotrypus copernici*": SKOCZEŃ 1980 / on question mark see (PO) no. 1., p. 83; inclusion in this genus is questioned by STORCH and QIU 1983/.
3. *Beremendia fissidens*: RZEBIK-KOWALSKA 1976 /see (ZDB) no. 6., p. 86/.
4. *Blarinoides mariae*: RZEBIK-KOWALSKA 1976 /see (ZDB) no. 5., p. 86/.
5. *Petenyia hungarica*: RZEBIK-KOWALSKA 1989 /it may belong here, or to ZDC, or to both faunas, because it survived to the Late Biharian and all the fossil remains (faunas A, B, C) in Zamkowa Dolna Cave were mixed/.
6. *Episoriculus gibberodon*: first report /see (ZDB) no. 4., p. 86/.
7. *Sorex (Drepanosorex) praearaneus*: RZEBIK-KOWALSKA 1991.

PRZYMIŁOWICE 3A (PE3A) – 50°45'N/19°19'E; Late Pliocene, Late Villanyian, MN17; *Gastropoda, Amphibia, Reptilia, Mammalia: Insectivora, Chiroptera, Lagomorpha, Rodentia.*

INSECTIVORA

1. *Talpidae* gen. et sp. indet.: NADACHOWSKI et al. 1991.
2. *Beremendia* sp.: NADACHOWSKI et al. 1991.

KIELNIKI 3B (KI3B) – 50°45'N/19°18'E; Late Pliocene, Late Villanyian, MN17; *Aves, Mammalia: Insectivora, Rodentia Lagomorpha* (+ other *Mammalia*)

INSECTIVORA

1. *Neurotrichus polonicus*: SKOCZEŃ 1993.
2. *Beremendia fissidens*: first report / material described in RZEBIK-KOWALSKA 1976 derived from KI3A/.
3. *Episoriculus gibberodon*: first report.
4. *Petenyia hungarica*: RZEBIK-KOWALSKA 1989.
5. *Deinsdorfia hibbardi*: RZEBIK-KOWALSKA 1990a.
6. *Sorex minutus*: RZEBIK-KOWALSKA 1991.
7. *Sorex bor*: RZEBIK-KOWALSKA 1991.
8. *Sorex praealpinus*: RZEBIK-KOWALSKA 1991.
9. *Sorex (Drepanosorex) praearaneus*: RZEBIK-KOWALSKA 1991.

POŁUDNIOWA CAVE (near Wojcieszów) (JP) – 50°56'N/15°54'E; Pliocen?; *Mammalia: Insectivora, Chiroptera* (+ other *Mammalia*).

INSECTIVORA

1. *Sorex* sp.: ZOTZ 1939, KOWALSKI 1959.

KADZIELNIA 1 (KD1) – 50°52'N/20°38'E; Late Pliocene, Late Villanyian, MN17 or Pliocene/Pleistocene boundary, Villanyian/Biharian, MN17/Q1; *Amphibia, Reptilia, Aves, Mammalia: Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora.*

INSECTIVORA

1. *Erinaceus* sp.: RZEBIK-KOWALSKA 1971.
2. "?*Neurotrichus polonicus*": SKOCZEŃ 1980 /on question mark see (PO) no. 1., p. 83/.
3. "?*Geotrypus copernici*": SKOCZEŃ 1980 / on question mark see (PO) no. 1., p. 83; inclusion in this genus is questioned by STORCH and QIU 1983/.

4. "*Scaptonyx* (?) *dolichochir*": SKOCZEŃ 1980 / on question mark see (PO) no. 1., p. 83; inclusion in this genus is questioned by STORCH and QIU 1983/.
5. *Talpa minor*: KOWALSKI 1958a, 1959, 1964.
6. *Talpa fossilis*: KOWALSKI 1958a, 1959, 1964.
7. *Beremendia fissidens*: KOWALSKI 1958a, 1959, 1964, RZEBIK-KOWALSKA 1976.
8. *Sulimskia kretzoii*: RZEBIK-KOWALSKA 1990b.
9. *Blarinoides mariae*: RZEBIK-KOWALSKA 1976.
10. *Petenyia hungarica*: KOWALSKI 1958a, 1959, 1964, RZEBIK-KOWALSKA 1989.
11. *Deinsdorfia hibbardi*: RZEBIK-KOWALSKA 1990a.
12. *Sorex minutus*: KOWALSKI 1964, RZEBIK-KOWALSKA 1991 / = *Sorex* sp. in KOWALSKI 1958a/.
13. *Sorex bor*: RZEBIK-KOWALSKA 1991 / = *Sorex runtonensis* HINTON, 1911 in KOWALSKI 1958a, 1959, 1964/.
14. *Sorex subaraneus*: RZEBIK-KOWALSKA 1991.
15. *Sorex* (*Drepanosorex*) *praearaneus*: RZEBIK-KOWALSKA 1991.

ŻABIA CAVE (JZ), – 50°35'N/19°31'E; Early Pleistocene, Early Biharian Q_1; *Pisces, Amphibia, Reptilia, Aves, Mammalia: Insectivora, Chiroptera, Rodentia, Lagomorpha, Carnivora, Artiodactyla.*

INSECTIVORA

1. *Erinaceus* sp.: BOSAK et al. 1982.
2. *Talpa* cf. *minor*: BOSAK et al. 1982.
3. *Crocidura* cf. *kornfeldi*: BOSAK et al. 1982 /mentioned in the list of fauna, without any comment; according to the author of the present paper this genus is absent in the Early Pleistocene of Poland/.
4. *Beremendia fissidens*: BOSAK et al. 1982.
5. *Episoriculus* cf. *castellarini*: BOSAK et al. 1982 /as so far nobody has revised the scanty material of *E. castellarini* described by PASA in 1947 from Italy, it cannot be decided whether it is yet another synonym of *E. gibberodon* or not/.
6. *Petenyia* cf. *hungarica*: BOSAK et al. 1982.
7. *Sorex* cf. *minutus*: BOSAK et al. 1982.
9. *Sorex* aff. *runtonensis*: BOSAK et al. 1982.
10. *Sorex* ex. gr. *pachyodon*/*margaritodon*: BOSAK et al. 1982 /according to the author of the present paper probably *Sorex* (*Drepanosorex*) sp./.

KAMYK (KA) – 50°54'N/19°01'E; Early Pleistocene, Early Biharian, Q_1; *Amphibia, Reptilia, Mammalia*: *Chiroptera, Lagomorpha, Rodentia, Carnivora.*

INSECTIVORA

1. *Erinaceus* sp.: RZEBIK-KOWALSKA 1971.
2. "?*Geotrypus copernici*": SKOCZEŃ 1980 / on question mark see (PO) no. 1., p. 83; inclusion in this genus is questioned by STORCH and QIU 1983 /.
3. *Talpa* sp.: KOWALSKI 1960b.
4. *Desmana* sp.: RZEBIK-KOWALSKA 1971.
5. *Beremendia fissidens*: KOWALSKI 1960b, 1964, RZEBIK-KOWALSKA 1976.
6. *Blarinoides mariae*: RZEBIK-KOWALSKA 1976.
7. *Petenyia hungarica*: KOWALSKI 1960b, 1964, RZEBIK-KOWALSKA 1989.
8. *Sorex bor*: RZEBIK-KOWALSKA 1991 / = *Sorex* sp. in KOWALSKI 1960b/.
9. *Sorex* (*Drepanosorex*) *praearaneus*: RZEBIK-KOWALSKA 1991.

<u>KIELNIKI 3A</u> (KI3A) – 50°45'N/19°18'E; Early Pleistocene, Early Biharian, Q_1; *Gastropoda, Amphibia, Reptilia, Mammalia: Insectivora, Lagomorpha, Rodentia, Carnivora* (+ other *Mammalia*).

INSECTIVORA

1. *Beremendia fissidens*: RZEBIK-KOWALSKA 1976.
2. *Petenyia hungarica*: RZEBIK-KOWALSKA 1989.
3. *Sorex minutus*: RZEBIK-KOWALSKA 1991.
4. *Sorex bor*: RZEBIK-KOWALSKA 1991.
5. *Sorex* (*Drepanosorex*) *praearaneus*: RZEBIK-KOWALSKA 1991.

<u>PRZYMIŁOWICE</u> 1B (PE1B) – 50°45'N/19;19'E; Early Pleistocene, Early Biharian, Q_1; *Amphibia, Reptilia, Mammalia*: *Insectivora, Chiroptera, Rodentia*.

INSECTIVORA

1. *Talpidae* gen. et sp. indet.: NADACHOWSKI et al. 1991.
2. *Beremendia* sp.: NADACHOWSKI et al. 1991.

<u>PRZYMIŁOWICE</u> 2B (PE2B) – 50°45'N/19°19'E; Early Pleistocene, Early Biharian, Q_1; *Reptilia, Mammalia*: *Insectivora, Chiroptera, Rodentia*.

INSECTIVORA

1. *Talpidae* gen. et sp. indet.: NADACHOWSKI et al. 1991.
2. *Beremendia* sp.: NADACHOWSKI et al. 1991.

<u>PRZYMIŁOWICE</u> 3B (PE3B) – 50°45'N/19°19'E; Early Pleistocene, Early Biharian, Q_1; *Gastropoda, Amphibia, Mammalia*: *Insectivora, Chiroptera, Rodentia*.

INSECTIVORA

1. *Beremendia* sp.: NADACHOWSKI et al. 1991.

KIELNIKI 1 (KI1) – 50°45'N/19°18'E; Early Pleistocene, Late Biharian, Q_2; *Mammalia*: *Insectivora, Chiroptera, Rodentia*.

INSECTIVORA

1. *Petenyia hungarica*: RZEBIK-KOWALSKA 1989.
2. *Sorex runtonensis*: RZEBIK-KOWALSKA 1991.
3. *Sorex* (*Drepanosorex*) *praearaneus*: RZEBIK-KOWALSKA 1991.

ZALESIAKI 1A samples 1, 2, 5, 7, 8, 9, 10 (ZA1A) – 51°06'N/18°56'E; Early Pleistocene, Late Biharian, Q_2; *Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Lagomorpha, Rodentia, Carnivora*.

INSECTIVORA

1. *Beremendia fissidens*: RZEBIK-KOWALSKA 1976.
2. *Neomys newtoni*: RZEBIK-KOWALSKA 1991.
3. *Sorex minutus*: RZEBIK-KOWALSKA 1991.
4. *Sorex runtonensis*: RZEBIK-KOWALSKA 1991.
5. *Sorex* (*Drepanosorex*) *savini*: RZEBIK-KOWALSKA 1991.

ZAMKOWA DOLNA CAVE C (ZDC) – 50°44'N/19°16'E; Early Pleistocene, Late Biharian, Q_2; *Amphibia, Reptilia, Mammalia*: *Chiroptera, Insectivora, Rodentia*.

INSECTIVORA

1. *Beremendia fissidens*: RZEBIK-KOWALSKA 1976 / see (ZDB) no. 6., p. 86/.
2. *Sorex minutus*: RZEBIK-KOWALSKA 1991 /it may belong here, or to ZDB or ZDA, to any two faunas of the three, or to all the three, but it has been mentioned here because the specimens are bigger than those from the Pliocene/.
3. *Sorex praealpinus*: RZEBIK-KOWALSKA 1991.
4. *Sorex* (*Drepanosorex*) *savini*: RZEBIK-KOWALSKA 1991.

KOZI GRZBIET (KG) – 50°51'N/20°21'E; Early/Middle Pleistocene, Late Biharian, Q_2; *Gastropoda, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia, Lagomorpha, Carnivora, Artiodactyla*.

INSECTIVORA

1. *Beremendia fissidens*: RZEBIK-KOWALSKA 1976.

2. *Neomys newtoni*: RZEBIK-KOWALSKA 1991.
3. *Macroneomys brachygnatus*: RZEBIK-KOWALSKA 1991.
4. *Sorex minutus*: RZEBIK-KOWALSKA 1991.
5. *Sorex praealpinus*: RZEBIK-KOWALSKA 1991.
6. *Sorex runtonensis*: RZEBIK-KOWALSKA 1991.
7. *Sorex subaraneus*: RZEBIK-KOWALSKA 1991.
8. *Sorex minutissimus*: RZEBIK-KOWALSKA 1991.
9. *Sorex (Drepanosorex) savini*: RZEBIK-KOWALSKA 1991.
10. *Sorex (Drepanosorex)* sp. 1: RZEBIK-KOWALSKA 1991.

<u>RĘBIELICE KRÓLEWSKIE 4</u> (RK4) – 50°59'N/18°51'E; Middle Pleistocene; *Mollusca, Reptilia, Mammalia*: *Insectivora, Chiroptera, Rodentia, Carnivora.*

INSECTIVORA

1. *Sulimskia kretzoii*: first record.
2. *Sorex subaraneus*: RZEBIK-KOWALSKA 1991.

R e m a r k

According to STWORZEWICZ and NADACHOWSKI (pers. comm.), the fauna of molluscs and rodents is of Middle Pleistocene age. The presence of *S. kretzoii* must be accidental (the latest record of this form comes from Kadzielnia, the locality referred to the Pliocene/Pleistocene boundary).

<u>NIETOPERZOWA CAVE</u> layers 15-14 (NI^{15-14}) – 50°11'N/19°46'E; late Middle Pleistocene (Riss), Q3; *Pisces, Mammalia: Insectivora, Chiroptera, Rodentia, Carnivora, Ungulata.*

INSECTIVORA

1. *Talpa europaea*: KOWALSKI 1961, STACH 1964.
2. *Sorex minutus*: STACH 1964.
3. *Sorex araneus*: KOWALSKI 1961, STACH 1964.

<u>ZDRODY</u> (ZY) – 52°57'N/22°47'E; Late Pleistocene (Eemian?), Q3; *Gastropoda, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia.*

INSECTIVORA

1. *Talpa europaea*: BAŁUK et al. 1979.
2. *Sorex caecutiens*: BAŁUK et al. 1979.

Remark

There are different opinions on the age of this locality. The authors of the original description (BAŁUK et al. 1979) ascribe it to "the Middle Polish Glaciation (Riss)", NADACHOWSKI et al. (1989a) to the Late Pleistocene (Eemian?).

NIETOPERZOWA CAVE layers 13-12 (NI^{13-12}) – 50°11'N/19°46'E; Late Pleistocene (Eemian) Q_4; *Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia, Carnivora, Ungulata.*

INSECTIVORA

1. *Talpa europaea*: KOWALSKI 1961, STACH 1964.
2. *Sorex araneus*: KOWALSKI 1961, STACH 1964.

TCZEW (TC) – 54°05'N/18°47'E; Late Pleistocene?, (Eemian?), Q_4? *Mammalia* indet.

INSECTIVORA

1. *Talpa europaea*: SKURATOWICZ 1954, KOWALSKI 1959.

WSCHODNIA CAVE (near Wojcieszów) (JW) – 50°56'N/15°54'E; Late Pleistocene, Eemian, Q_4; *Mammalia*: *Insectivora, Chiroptera* + other *Mammalia.*

INSECTIVORA

1. *Talpa europaea*: ZOTZ 1939, KOWALSKI 1959.

ŻYTNIA SKAŁA CAVE 1 (ZS1) – 50°11'N/19°48'E; Late Pleistocene, Early Vistulian; *Mollusca, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia, Carnivora, Ungulata.*

INSECTIVORA

1. *Talpa europaea*: KOWALSKI et al. 1967.
2. *Crocidura* sp.: KOWALSKI et al. 1967 /probably accidental, see p. 106/.
3. *Sorex minutus*: KOWALSKI et al. 1967.
4. *Sorex araneus*: KOWALSKI et al. 1967.

MAMUTOWA CAVE layer 2g (MM^{2g}) – 50°10'N//19°48'E; Late Pleistocene (Early Vistulian); *Amphibia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia, Lagomorha, Carnivora, Perissodactyla, Artiodactyla.*

INSECTIVORA

1. *Sorex minutus*: STACH 1964.
2. *Sorex minutissimus*: STACH 1964, RZEBIK-KOWALSKA 1991.
3. *Sorex araneus*: STACH 1964.

OBŁAZOWA 2 (OB2) – 49°25'N/20°09'E; Late Pleistocene, Middle Vistulian; *Pisces, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora, Perissodactyla, Artiodactyla.*

INSECTIVORA

1. *Talpa europaea*: NADACHOWSKI et al. 1993.
2. *Sorex* cf. *araneus*: NADACHOWSKI et al. 1993.
3. "*Sorex* cf. *kennardi*": NADACHOWSKI et al. 1993 /see p. 111/.

PUCHACZA SKAŁA CAVE III (PS III) – 50°13'N/19°47'E; Late Pleistocene, Late Vistulian; *Mollusca, Amphibia, Aves, Mammalia*: *Insectivora, Rodentia, Lagomorpha, Carnivora.*

INSECTIVORA

1. *Talpa europaea*: KOWALSKI et al. 1965.
2. *Sorex araneus*: KOWALSKI et al. 1965.

KOZIARNIA CAVE layers 3-19 (KZ^{3-19}) – 50°13'N/19°48'E; Late Pleistocene, Late Vistulian; *Mollusca, Pisces, Amphibia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia, Lagomorpha, Carnivora, Perissodactyla, Artiodactyla.*

INSECTIVORA

1. *Talpa europaea*: STACH 1964, CHMIELEWSKI et al. 1967.
2. *Sorex araneus*: STACH 1964, CHMIELEWSKI et al. 1967.

MAMUTOWA CAVE layer 2 loess (MM^{2loess}) – 50°10'N/19°48'E; Late Pleistocene, Late Vistulian; *Amphibia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia, Lagomorpha, Carnivora, Perissodactyla, Artiodactyla.*

INSECTIVORA

1. *Sorex minutissimus*: STACH 1964, RZEBIK-KOWALSKA 1991.
2. *Sorex araneus*: STACH 1964.

RAJ CAVE layers 1-10 (RA^{1-10}) – 50°50'N/20°30'E; Late Pleistocene, Vistulian; *Pisces, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia, Lagomorpha, Carnivora, Perissodactyla, Artiodactyla, Proboscidea.*

INSECTIVORA
1. *Sorex minutus*: KOWALSKI 1972.
2. *Sorex araneus*: KOWALSKI 1972.
3. *Neomys fodiens*: KOWALSKI 1972.

NIETOPERZOWA CAVE layers 11-1 (NI$^{11-1}$) – 50°11'N/19°46'E; Late Pleistocene, Vistulian; *Pisces, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Rodentia, Lagomorpha, Carnivora, Perissodactyla, Artiodactyla, Proboscidea.*

INSECTIVORA
1. *Talpa europaea*: KOWALSKI 1961, STACH 1964.
2. *Sorex minutissimus*: STACH 1964, RZEBIK-KOWALSKA 1991.
3. *Sorex araneus*: KOWALSKI 1961, STACH 1964.
4. *Neomys fodiens*: STACH 1964.

DUŻA CAVE (at Mączna Skała) layer 5 (DU^5) – 50°11'N/19°47'E; Late Pleistocene; *Gastropoda, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora.*

INSECTIVORA
1. *Erinaceus concolor*: DAGNAN-GINTER et al. 1992.
2. *Sorex araneus*: DAGNAN-GINTER et al. 1992.
3. *Sorex minutus*: DAGNAN-GINTER et al. 1992.

GIEBUŁTÓW (GI) – 50°08'N/19°52'E; Middle Holocene; *Mollusca, Amphibia, Reptilia, Mammalia*: *Insectivora, Rodentia.*

INSECTIVORA
1. *Crocidura* sp.: MŁYNARSKI 1961.

JÓZEFÓW (JO) – 50°29'N/23°05'E; Middle Holocene; *Mollusca, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptera, Rodentia, Carnivora.*

INSECTIVORA
1. *Crocidura leucodon*: KOWALSKI et al. 1963.
2. *Sorex minutus*: KOWALSKI et al. 1963.
3. *Sorex araneus*: KOWALSKI et al. 1963.

DUŻEJ SOWY CAVE (DS) – 50°09'N/19°47'E; Late Holocene; *Mollusca, Pisces, Amphibia, Reptilia, Aves, Mammalia*: *Insectivora, Chiroptea, Carnivora.*

INSECTIVORA
1. *Erinaceus concolor*: BOCHEŃSKI et al. 1983.

2. *Talpa europaea*: BOCHEŃSKI et al. 1983.
3. *Crocidura leucodon*: BOCHEŃSKI et al. 1983.
4. *Sorex minutus*: BOCHEŃSKI et al. 1983.
5. *Sorex araneus*: BOCHEŃSKI et al. 1983.
6. *Neomys fodiens*: BOCHEŃSKI et al. 1983.

DUŻA CAVE (at Mączna Skała) layer 3 (DU^3) – 50°11'N/19°47'E; Holocene; *Gastropoda, Mammalia*: *Insectivora, Chiroptera, Lagomorpha, Rodentia, Carnivora*.

INSECTIVORA

1. *Talpa europaea*: DAGNAN-GINTER et al. 1992.
2. *Erinaceus concolor*: DAGNAN-GINTER et al. 1992.
3. *Sorex araneus*: DAGNAN-GINTER et al. 1992.
4. *Sorex minutus*: DAGNAN-GINTER et al. 1992.
5. *Crocidura leucodon*: DAGNAN-GINTER et al. 1992.
6. *Neomys fodiens*: DAGNAN-GINTER et al. 1992.

PUCHACZA SKAŁA CAVE I (PSI), – 50°13'N/19°47'E; Holocen; *Mammalia*: *Insectivora, Chiroptera, Rodentia.*

INSECTIVORA

1. *Sorex araneus*: KOWALSKI et al. 1965.
2. *Neomys* cf. *fodiens*: KOWALSKI et al. 1965.

ŻYTNIA SKAŁA CAVE 2 (ZS2), – 50°11'N/19°48'E; Holocene; *Mollusca, Amphibia, Reptilia, Mammalia*: *Insectivora, Chiroptera, Rodentia*, domestic mammals.

INSECTIVORA

1. *Talpa europaea*: KOWALSKI et al. 1967.
2. *Crocidura* sp.: KOWALSKI et al. 1967.
3. *Sorex minutus*: KOWALSKI et al. 1967.
4. *Sorex araneus*: KOWALSKI et al. 1967.

CISOWE ROCK-SHELTER 1 (near Wojcieszów), (CS1), – 50°56'N/15°56'E; Holocene ?; *Mammalia*: *Chiroptera, Insectivora* + other *Mammalia*.

INSECTIVORA

1. *Erinaceus* sp.: ZOTZ 1939, KOWALSKI 1959.

RAJ CAVE layer 11 (RA^{11}), – 50°50'N/20°30'E; Holocene; *Mollusca, Amphibia, Reptilia, Aves, Mammalia: Insectivora, Chiroptera, Rodentia, Carnivora, Perissodactyla, Artiodactyla.*

INSECTIVORA

1. *Talpa europaea*: KOWALSKI 1972.
2. *Sorex minutus*: KOWALSKI 1972.
3. *Sorex araneus*: KOWALSKI 1972.

NAD MOSUREM STARYM DUŻA CAVE (MS) – 50°14'N/19°50'E; Holocene; *Mollusca, Pisces, Aves, Chiroptera, Mammalia: Insectivora, Rodentia, Carnivora, Perissodactyla, Artiodactyla.*

INSECTIVORA

1. *Talpa europaea*: NADACHOWSKI et al. 1989b.
2. *Crocidura leucodon*: NADACHOWSKI et al. 1989b.
3. *Sorex araneus*: NADACHOWSKI et al. 1989b.
4. *Neomys fodiens*: NADACHOWSKI et al. 1989b.

KOZIARNIA CAVE layer 1 (KZ^{1}) – (50°13'N/19°48'E; Holocene; *Mollusca, Amphibia, Aves, Mammalia: Insectivora, Rodentia, Carnivora, Artiodactyla.*

INSECTIVORA

1. *Talpa europaea*: CHMIELEWSKI et al. 1967.
2. *Sorex araneus*: CHMIELEWSKI et al. 1967.

PRZYMIŁOWICE 2D (PE2D) – 50°45'N/19°19'E; Holocene; *Amphibia, Reptilia, Aves, Mammalia: Insectivora, Chiroptera, Lagomorpha, Rodentia.*

INSECTIVORA

1. *Erinaceus* sp.: NADACHOWSKI et al. 1991.
2. *Talpa europaea*: NADACHOWSKI et al. 1991.

DZIADOWA SKAŁA CAVE (DZS) – 50°32'N/19°31'E; Holocen; *Aves, Mammalia: Insectivora, Lagomorpha, Rodentia, Carnivora, Artiodactyla, Perissodactyla.*

INSECTIVORA

1. *Erinaceus* sp.: KOWALSKI 1958b.
2. *Talpa europaea*: KOWALSKI 1958b.

IV. TAXA FIRST DESCRIBED FROM POLAND

The list contains the names of the taxa whose type localities are situated in Poland. For each family the names are listed in alphabetical order of generic taxa in which particular names were proposed. The names of the genera new to science are underlined. The names of authors, the dates of description, type localities, the actual names of species to which the taxa belong in the opinion of the author of the present paper or the latest revision (if different from original name) with paginal reference to the localities in which they were found are also given.

ERINACEIDAE

Erinaceus samsonowiczi SULIMSKI, 1959. T.l. (type locality) Węże 1, see also p. 79.

TALPIDAE

Condylura kowalskii SKOCZEŃ, 1976. T.l. Węże 1, see also p. 80.

Condylura izabellae SKOCZEŃ, 1976. T.l. Rębielice Królewskie 1A, see also p. 80.

Desmana kowalskae RÜMKE, 1985. T.l. Węże 1 / = *Desmana nehringi* KORMOS, 1913, see also p. 87.

Galemys sulimskii RÜMKE, 1985. T.l. Węże 1, see also p. 80.

"?*Geotrypus copernici*" SKOCZEŃ, 1980. T.l. Kadzielnia 1, see also p. 80.

Neurotrichus minor SKOCZEŃ, 1993. T.l. Węże 2, see also p. 80.

"?*Neurotrichus polonicus*" SKOCZEŃ, 1980. T.l. Rębielice Królewskie 1A, see also p. 80.

Parascalops fossilis SKOCZEŃ, 1993. T.l. Podlesice, see also p. 80.

Scapanulus agrarius SKOCZEŃ, 1980. T.l. Podlesice, see also p. 80.

SORICIDAE

Beremendia minor RZEBIK-KOWALSKA, 1976. T.l. Rębielice Królewskie 1A, see also p. 81.

<u>*Blarinoides*</u> SULIMSKI, 1959, see also p. 81.

Blarinoides mariae SULIMSKI, 1959. T.l. Węże 1, see also p. 81.

Deinsdorfia insperata RZEBIK-KOWALSKA, 1990. T.l. Podlesice, see also p. 82.

Deinsdorfia reumeri RZEBIK-KOWALSKA, 1990. T.l. Podlesice, see also p. 82.

Neomys soriculoides SULIMSKI, 1959. T.l. Węże 1 / = *Zelceina soriculoides* (SULIMSKI, 1959)/, see also pp. 82 and 87.

<u>*Neomysorex*</u> RZEBIK-KOWALSKA, 1981, see also p. 82.

<u>*Paranourosorex*</u> RZEBIK-KOWALSKA, 1975, see also p. 81.

Paranourosorex gigas RZEBIK-KOWALSKA, 1975. T.l. Podlesice, also see p. 81.

Petenyia robusta RZEBIK-KOWALSKA, 1989. T.l. Podlesice, see also p. 82.

Sorex alpinoides KOWALSKI, 1956. T.l. Podlesice /= *Neomysorex alpinoides* (KOWALSKI, 1956), see also pp. 82 and 84.

Sorex casimiri RZEBIK-KOWALSKA, 1991. T.l. Rębielice Królewskie 1A, see also p. 82.

Sorex dehneli KOWALSKI, 1956. T.l. Podlesice / = *Mafia dehneli* (KOWALSKI, 1956)/, see also p. 81.

Sorex hibbardi SULIMSKI, 1962. T.l. Węże 1 / = *Deinsdorfia hibbardi* (SULIMSKI, 1962)/, see also p. 82.

Sorex kretzoii SULIMSKI, 1959. T.l. Węże 1 / = *Sulimskia kretzoii* (SULIMSKI, 1959)/, see also p. 81.

Sorex polonicus RZEBIK-KOWALSKA, 1991. T.l. Rębielice Królewskie 1A, see also p. 82.

Sorex pseudoalpinus RZEBIK-KOWALSKA, 1991. T.l. Węże 1, see also p. 82.

Sorex subminutus SULIMSKI, 1962. T.l. Węże 1, see also p. 88.

Sulimskia REUMER, 1984, see also p. 81.

Suncus zelceus SULIMSKI, 1959. T.l. Węże 1 /= *Paenelimnoecus pannonicus* (KORMOS, 1934)/, see also p. 81.

Zelceina SULIMSKI, 1962, see also p. 82.

Zelceina podlesicensis RZEBIK-KOWALSKA, 1990. T.l. Podlesice, see also p. 82.

V. HISTORY OF THE PLIOCENE AND QUATERNARY INSECTIVORE FAUNA IN POLAND

The recent fauna of insectivore mammals (*Insectivora, Mammalia*) of Poland includes members of three families: *Erinaceidae, Talpidae* and *Soricidae*. All the three families are represented also in our fossil Pliocene and Quaternary faunas.

ERINACEIDAE

The recent hedgehogs divide into two subfamilies: spiny hedgehogs (*Erinaceinae* GILL, 1872), living today in a large area of the Old World, and spineless gymnures (*Hylomyinae* ANDERSON, 1879) from South-East Asia (FROST et al. 1991).

Only representatives of the spiny hedgehogs have been found in the Polish Pliocene and Quaternary localities. Their oldest remains come from the late Early Pliocene locality of Węże 1, from which small *Erinaceus samsonowiczi* SULIMSKI, 1959 was described. Besides, some remains of hedgehogs were found at Rębielice Królewskie 1A and 2, both dated to the early Late Pliocene, at Kadzielnia dated to the Pliocene/Pleistocene boundary and at Early Pleistocene Żabia Cave and Kamyk. The other finds are much younger, coming from the Late Pleistocene (Duża Cave, layer 5) and Holocene (Dużej Sowy Cave, Duża Cave l. 3, Cisowe Rock-Shelter, Przymiłowice 2D, Dziadowa Skała Cave). In all those localities the remains of hedgehogs were very fragmentary and not numerous, and therefore most of them have been determined as *Erinaceus* sp. This being so, it is difficult to say when the species living in Poland nowadays appeared for the first time. *Erinaceus concolor* MARTIN, 1938 was determined only from the Holocene sediments of Dużej Sowy Cave and Duża Cave. This form still lives in Poland and the western range of its distribution, coinciding with the Odra river, extends across this country. On the contrary for the other species (*Erinaceus europaeus* L., 1758) now living in Poland the Odra makes the eastern limit of its contemporary range in the Polish teritory. In some places the two species are sympatric. They have been included in two separate species on the grounds of their karyological differences (KRÁL 1967). Being similar in morphology and biology, they are considered by some authors (CORBET 1978) to be two subspecies only.

TALPIDAE

In comparison with hedgehogs the remains of moles are much more abundant in the Pliocene and Quaternary localities of Poland. The recent moles live in Europe, Asia and North America (NOWAK 1991). According to HUTCHISON (1974), the family consists of 5 subfamilies. Three of them (*Talpinae* FISCHER VON WALDHEIM, 1817, *Uropsilinae* DOBSON, 1883 and *Desmaninae* THOMAS, 1912) were found in the Polish fossil fauna, and *Talpinae* have their representatives in the present-day fauna of Poland.

Hitherto, 16 species of moles have been described from the Polish territory but only one of them, *Talpa europaea* L., 1758, has persisted to the present days. It lives in the whole country.

Talpinae

The two most interesting Pliocene species are: *Condylura kowalskii* SKOCZEŃ, 1976 described from Węże 1, 2 and Rębielice Królewskie 1A and *C. izabellae* SKOCZEŃ, 1976 found at Rębielice Królewskie 1A. Their morphology coincides with that of the star-nosed mole *C. cristata* ILLIGER, 1811, the only recent representative of that genus. This mole occurs in marshy areas, round the lakes of eastern Canada and United States. Its peculiar muzzle ringed with 22 fleshy tentacles resembles a star.

The origin of *Condylura* is not clear. In America, its oldest known remains come from the Pleistocene (HUTCHISON, 1968). That is why the star-nosed mole was considered to be endemic in the New World. On the contrary, the discovery of *Condylura* in Poland supported the hypothesis of the Old-World origin of that American mole (TRUE 1897). Its Palearctic origin is suggested also by the results of recent biochemical studies (YATES & GREENBAUM 1982). A new finding of a humerus, belonging probably to *Condylura* (HUTCHISON 1984), changes that supposition once more. This bone has been discovered in the western part of the United States (Oregon) in a locality, older than the European ones, of Late Miocene or Early Pliocene age. This suggests that *Condylura* is older than it was thought, its range in America was larger at that time, and so its origin was rather connected with the American continent. As the material is insufficient, the problem of the origin of *Condylura* is still open.

At Węże 1 and 2 and Rębielice Królewskie 1A the ecological conditions must have been similar to those prevailing today in the eastern part of North America. The Pliocene relatives of *Condylura* have disappeared from Europe, most probably outcompeted by *Desmaninae* moles. In general, the desmans, which occupied a similar ecological niche, were bigger and their dentition was stronger.

The remains of *Parascalops fossilis* found recently in Early Pliocene Podlesice also show some relationships between the European and American moles. As in the case of *Condylura*, the unique member of this genus *Parascalops breveri* BACHMANN, 1842 lives today in the north-eastern United States. It frequents light, well-drained soils in forests and open areas. So far, its fossil remains are unknown from that continent.

The other 4 fossil species coming from the Pliocene and Early Pleistocene localities of Poland /"*?Neurotrichus polonicus*" SKOCZEŃ, 1980, "*Scaptonyx* (?) *dolichochir*" (GAILLARD, 1899), "*?Geotrypus copernici*" SKOCZEŃ, 1980 and *Scapanulus agrarius* SKOCZEŃ, 1980/ also have supposed relationships with the recent moles of the western coasts of North America and south-eastern Asia. Their systematic (generic) position is however questioned by some authors, studying the morphology and evolution of *Talpidae* (STORCH and QIU 1983). SKOCZEŃ (pers. comm.) is convinced of the generic membership of his species, especially because in Late Ruscinian Węże 1 he found another species of *Neurotrichus*, *N. minor* SKOCZEŃ, 1993. According to him, the question marks placed in his papers before or after generic names do not mean that the generic affiliation of the created species is doubtful; they rather indicate that he was not sure if he had to do with a new species, because the material was incomplete.

The genus *Talpa* L., 1758 whose representatives are known only from the Old World, has also been found in Pliocene and Quaternary sediments of Poland.

T. minor FREUDENBERG, 1914 was listed from Early Pliocene Podlesice to Early Pleistocene Żabia Cave. According to RABEDER (1972), the species has survived to the present days and lives in the Apennine Peninsula, Balkans and Caucasus, where it is known as *T. caeca* SAVI, 1822.

T. fossilis PETÉNYI, 1864, common in the fossil localities of Europe, in Poland was found at late Early Pliocene Węże 1 and 2 and at Plio/Pleistocene Kadzielnia. RABEDER (1972) is of the opinion that the size and morphology of *T. fossilis* lie within the range of variation of the recent *T. europaea*.

T. europaea, the only mole living today in Poland, according to some authors (RABEDER 1972), derives from *T. fossilis*. Its fossil remains are known from Polish localities from the late Middle Pleistocene onwards.

Uropsilinae

In Poland the subfamily *Uropsilinae* (shrew moles) is represented only by fossil *Desmanella* aff. *dubia* RÜMKE, 1976 found at Early Pliocene Podlesice. The moles of the genus *Desmanella* are known mainly from the Miocene localities of Europe and Asia, but their presence in the Early Pliocene has already been noted by ENGESSER (1980). *D. dubia* had survived in Europe to that time as a relict form like e. g. *Paenelimnoecus* (*Soricidae*). Today the shrew moles have a limited range in the mountains of China and Burma, where one to three genera (depending on particular authors) have been recognized (NOWAK 1991).

Although the knowledge of the fossil *Talpinae* and *Uropsilinae* from Asia is scanty, the south eastern part of that continent is regarded as the centre of their dispersal. Many Miocene and Pliocene forms of Europe and North America have no local Oligocene ancestors, but are obvious immigrants. Such territories as Burma and China are taken into account, because there some species related to the Miocene forms of the European and American continents still occur.

Desmaninae

The third subfamily of moles, *Desmaninae*, is also represented exclusively by fossils in Poland. Three species have hitherto been found. The biggest one, *Desmana nehringi* KORMOS, 1913, known from several European countries such as Germany, Hungary or Slovakia, was noted in the Early Pliocene localities of Podlesice and Węże 1 and in the early Late Pliocene of Rębielice Królewskie 1A. Smaller *Galemys kormosi* (SCHREUDER, 1940), also very common in Europe during the Pliocene, was found at Węże 1 and Rębielice Królewskie 1A and 2. The smallest of them, *Ruemkelia* aff. *dekkersi* (RÜMKE, 1985), known from the Early Pliocene localities of Spain and Greece has unexpectedly been discovered in Poland, at Podlesice. The youngest Polish locality from which desmans (*Desmana* sp.) was described is Kamyk dated to the Early Pleistocene.

Remains of desmans found in large numbers in the Pliocene and Early Pleistocene European localities, from Spain to the Caspian Sea, became rare in the Middle Pleistocene. Only two species have persisted to the present days. The smaller of them *Galemys pyrenaicus* (GEOFFROY, 1811) lives in the Pyrenees and in the northern part of the Iberian Peninsula. The larger, *Desmana moschata* (L., 1758), which is the biggest form of the recent moles, inhabits the Volga, Don, Oka and Ural drainage areas. Both forms, especially *D. moschata*, are well adapted to aquatic life. The status of *G. sulimskii* RÜMKE,1985 is uncertain.

Soricidae

Today the most widespread and abounding in species family of the *Insectivora* are the *Soricidae*. Now its representatives inhabit Eurasia, Africa, North and Central America, and 3 species have entered the northern part of South America. Their remains were also most abundant of all the insectivores in the Pliocene and Quaternary fossil localities.

According to REUMER (1987, 1992, 1994), the family consists of 5 subfamilies. Three of them (*Allosoricinae* FEJFAR, 1966, *Crocidurinae* MILNE-EDWARDS, 1874 and *Soricinae* FISCHER VON WALDHEIM, 1817) occur in fossil and *Crocidurinae* and *Soricinae* also in the present-day faunas of Poland.

Allosoricinae

The oldest member of this extinct, exclusively European subfamily (genus *Paenelimnoecus*) was found in the Early Miocene in Germany (ZIEGLER 1989). Its remains are known also from other European countries, among them from Poland, where *P. pannonicus* (KORMOS, 1934) was collected in 6 localities dated to the Early and early Late Pliocene. The taxonomic position of the genus *Paenelimnoecus* and taxonomic status of the whole group (some authors consider it to be the tribe *Allosoricini* of the *Soricinae* subfamily) were discussed by REUMER (1984, 1992). These very small shrews have no counterparts in the recent fauna, so it is difficult to say something about their mode of life or the environment in which they lived.

Crocidurinae

In general, the recent white-toothed shrews are tropical forms of the Old World, with their main distribution in Africa. There, as well as in India and Ceylon, they are the unique representatives of shrews. The most diversified genus of the subfamily is *Crocidura* WAGLER, 1832 (in Africa more than 100 species). Although the oldest documented (late Early Pliocene) remains of *Crocidura* come from Asia Minor (Rhodos) (VAN DE WEERD et al. 1982) and Europe (Spain) (ROCA, unpublished article 1988) most authors agree that its ancestor arrived to Europe from the African continent.

During the warmer phases of the Plio/Pleistocene *Crocidura* expanded to the north of Europe and in the Last Interglacial it was traced as far as England (RZEBIK 1968, STUART 1976). The beginning of the Last Glaciation caused its retreat from the British Isles and the northern part of the European continent. Nowadays it is present in Europe, but it does not live in higher latitudes than 53^{o} (VAN DEN BRINK 1967).

So far, certain remains of *Crocidura* have been found in Poland only in the Holocene localities (e. g. Giebułtów, Józefów, Żytnia Skała Cave and others). At present two species inhabit Polish territory, *C. leucodon* (HARMANN, 1780) in the eastern part of the country (east of the Vistula river) and *C. suaveolens* (PALLAS, 1811) in its south-western part.

A comparison of the data concerning the Pliocene to Holocene *Crocidura* from the south-western European and Polish localities indicates that the white-tooth shrews colonised western Europe passing south of the Carpathians. North of these mountains they did not appear before the Holocene.

Soricinae

The *Soricinae* occur in Eurasia, North, Central and the northern part of South America. Although absent in Africa now, they appeared there for a short time (see genus *Episoriculus*) about the Pliocene/Pleistocene boundary. The oldest member of the subfamily (?*Hemisorex* sp.) was discovered in Germany at the locality dated to the Early Miocene (ZIEGLER 1989). According to REUMER (1984, 1992, 1994), the subfamily consists of 6 tribes. In the fossil fauna of Poland 5 of them (*Soricini* FISCHER VON WALDHEIM, 1817, *Blarinini* KRETZOI, 1965, *Beremendiini* REUMER, 1984, *Amblycoptini* KORMOS, 1926, *Soriculini* KRETZOI, 1965) are represented, in the recent one only two of them, *Soricini* and *Soriculini*.

Soricini

The *Soricini* have an Holarctic distribution and they appear to be the least specialized group within the *Soricinae*. They include several fossil, but only two present-day genera: *Sorex* L., 1758 and *Blarinella* THOMAS, 1911.

Blarinella is represented only by one living species *B. quadraticauda* (MILNE-EDWARDS, 1872). According to HUANG et al. (1991), fossil remains of this species are known from the Early Pleistocene of China. During the Late Miocene to early Late Pliocene two other species determined as *Blarinella* /*B. dubia* (BACHMAYER and WILSON, 1970) and *B. europaea* REUMER, 1984/ lived in the European continent. Two unnamed species of *Blarinella* were also reported from the Late Miocene (STORCH and QIU 1983) and Early Pleistocene (HUANG et al. 1991) of China.

In Poland the remains of *Blarinella* were found in the Early Pliocene to early Late Pliocene localities, among others at Podlesice, Zalesiaki 1B and Rębielice Królewskie 1A. At that time *Blarinella* had probably a Euroasiatic distribution and the present population in the mountains of south China is its relict. Further studies are needed to uncover the phylogeny of these fossil and extant species.

Besides *Blarinella* such *Soricini* as *Deinsdorfia* HELLER,1963, *Petenyia* KORMOS, 1934, *Zelceina* SULIMSKI, 1962 and *Sorex* L., 1758 have been found in the Polish fossil fauna.

The genus *Deinsdorfia* includes 4 species. *D. reumeri* RZEBIK-KOWALSKA, 1990 and *D. insperata* RZEBIK-KOWALSKA, 1990, both described from the Early Pliocene locality of Podlesice, are known only from Poland so far. *D. hibbardi* (SULIMSKI, 1962) and *D. kordosi* REUMER, 1984, were found also in other European countries. The first one inhabited Poland from the end of the Early Pliocene (Węże 1) to the Pliocene/Pleistocene boundary (Kadzielnia), the second was found at Węże 1 and Rębielice Królewskie 1A, this last dated to the beginning of the Late Pliocene. All species of *Deinsdorfia* are characterized by more or less inflated (exoedaenodont) teeth which, according to most authors, indicate a diet consisting of molluscs. The origin of those shrews is not known.

Petenyia hungarica KORMOS, 1934, one of the most ubiquitous species of the Pliocene and Early Pleistocene of Europe, was also very common in Poland and found in 9 localities (from the late Early Pliocene of Węże 1 to Late Biharian of Kielniki 1). For a long time it was the only known species of this genus, but lately another species, *P. robusta* RZEBIK-KOWALSKA, 1989, has been described from the oldest Polish Pliocene locality at Podlesice. The origin of *Petenyia* is also unknown. Some authors (REUMER 1984) think, that it was a descendant of *Blarinella dubia* or that both of them had a common ancestor. As they disappeared totally during the Pleistocene, their mode of life and ecological requirements are not known.

Zelceina is represented also by two species. Both of them as well as the genus were described from Poland. The older species, *Z. podlesicensis* RZEBIK-KOWALSKA, 1990, was found in the Early Pliocene of Podlesice, the other, *Z. soriculoides* (SULIMSKI, 1959), in the late Early Pliocene of Węże 1. It is listed also from other European localities, e. g. in Hungary and Slovakia (RZEBIK-KOWALSKA 1990). No ancestor of *Zelceina* is known. It is possible, however, that more advanced *Z. soriculoides* derived from *Z. podlesicensis*.

The main genus of the *Soricini* tribe is, however, the genus *Sorex*. It contains much more species (fossil and modern) than any other genus of the subfamily *Soricinae*. Its oldest remains come from the Early Pliocene localities of Europe and North America. Lately STORCH and QIU (1991) have mentioned *Sorex* sp. from the Late Miocene of China, but their material is very scanty and not quite diagnostic.

A revision of the *Sorex* materials from Poland (RZEBIK-KOWALSKA 1991) shows that at least 16 species of this genus inhabited the Polish territory during the Pliocene-Holocene period, but only two of them (*S. minutus* L., 1766 and *S. araneus* L., 1758) have survived to the present-day. The numbers of *Sorex* species in particular Polish localities are presented in Tables I, II and III).

S. minutus has lived in Poland (and in other countries of Europe) since the beginning of the Early Pliocene. It is the first of the living *Sorex* species that appeared in the Polish (and European) fauna and has persisted morphologically almost unchanged till our days. Today it occupies a large area, from the North Spain to Japan. In Poland it is very common, one of the most frequently caught shrews.

S. araneus, which today occupies almost whole Europe and continental Asia (north of the steppe-zone) as far as Japan, in Poland appeared for the first time in the sediments dating from the end of the Middle Pleistocene (Nietoperzowa Cave, layers 15-14). Its remains from the Late Pleistocene and Holocene are already very numerous. Studies of different populations made in a vast territory show the enormous variability of its karyotype. On the basis of its variability several dozen chromosomal races difficult to distinguish on the grounds of morphological features, have been described within *S. araneus*.

Table I

Sorex species and their numbers in the Pliocene localities of Poland

Locality	PO	MA 4+5	PN	ZD B	ZA 1B	WE 1	WE 2	RK 1A	RK 2	ZD A	KI 3B	JP	KD 1
Age (MN)	14	14	14	14	14/15	15	15/16	16	16	17	17	PLI?	17/Q1
Sores sp. 1	*	–	–	–	–	–	–	–	–	–	–	–	–
Sorex sp. 2	*	–	–	–	–	–	–	*	–	–	–	–	–
Sorex sp. 3	*	–	–	–	–	–	–	–	–	–	–	–	–
S. minutus	*	*?	–	–	*	*	*cf.	*	*	–	*	–	*
S. bor	*	–	–	–	–	*	–	*	*	–	*	–	*
S. casimiri	–	–	–	*	*	–	–	*	–	–	–	–	–
S. pseudoalpinus	–	–	–	–	–	*	–	–	–	–	–	–	–
S. praealpinus	–	–	–	–	–	–	–	–	–	–	*	–	–
S. polonicus	–	–	–	–	–	–	–	*	–	–	–	–	–
S. subaraneus	–	–	–	–	–	–	–	–	–	–	–	–	*
S. (D.) praearaneus	–	–	–	–	–	–	–	–	–	*	*	–	*
S. sp.	–	*	*	–	–	–	*	–	–	–	–	*	–
Total	5	2	1	1	2	3	2	5	2	1	4	1	4

Table II

Sorex species and their numbers in the Pleistocene localities of Poland

Locality	JZ	KA	KI 3A	KI 1	ZA 1A	ZD C	KG	NI 15-14	RK 4	ZY	NI 13-12	ZS 1	MM 2g	OB 2	PS III	KZ 3-19	MM 2loess	RA 1-10	NI 11-1	DU 5
Age	Q_1	Q_1	Q_1	Q_2	Q_2	Q_2	Q_2	Q_3	MPLE	LPLE	Q_4	LPLE EVI	LPLE EVI	LPLE MVI	LPLE LVI	LPLE LVI	LPLE LVI	LPLE VI	LPLE VI	LPLE
S. minutus	*cf.	–	*	–	*	*	*	*	–	–	–	*	*	–	–	–	–	*	–	*
S. bor	–	*	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S. runtonensis	*aff.	–	–	*	*	–	*	–	–	–	–	–	–	–	–	–	–	–	–	–
S. praealpinus	–	–	–	–	–	*	*	–	–	–	–	–	–	–	–	–	–	–	–	–
S. subaraneus	–	–	–	–	–	–	*	–	*	–	–	*	–	–	–	–	–	–	–	–
S. minutissimus	–	–	–	–	–	–	*	–	–	–	–	–	*	–	–	–	*	–	*	–
S. kennardi	–	–	–	–	–	–	–	–	–	–	–	–	–	*cf.	–	–	–	–	–	–
S. caecutiens	–	–	–	–	–	–	–	–	–	*	–	–	–	–	–	–	–	–	–	–
S. araneus	–	–	–	–	–	–	–	*	–	–	*	*	*	*cf.	*	*	*	*	*	*
S. (D.) praearaneus	–	*	*	*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S. (D.) savini	–	–	–	–	*	*	*	–	–	–	–	–	–	–	–	–	–	–	–	–
S. (D.) sp. 1	–	–	–	–	–	–	*	–	–	–	–	–	–	–	–	–	–	–	–	–
S. (D.) sp.	*?	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total	3	2	3	2	3	3	7	2	1	1	1	2	3	2	1	1	2	2	2	2

(for the full names of localities see section I; MPLE = Middle Pleistocene, LPLE = Late Pleistocene, VI = Vistulian, EVI = Early Vistulian, MVI = Middle Vistulian, LVI = Late Vistulian)

Table III

Sorex species and their numbers in Holocene localities in Poland

Locality	JO	DS	DU 3	PS 1	ZS 2	RA 11	MS	KZ 1
Age	MH	LH	H	H	H	H	H	H
S. minutus	*	*	*	_	*	*	_	_
S. araneus	*	*	*	*	*	*	*	*
Total	2	2	2	1	2	2	1	1

(for the full names of localities see section I; H = Holocene, MH = Middle Holocene, LH = Late Holocene)

It is supposed (JAMMOT 1977) that *S. araneus* evolved from *S. subaraneus* HELLER, 1958. The last one appeared in Europe probably about the Pliocene/Pleistocene boundary (in Poland at the locality of Kadzielnia). It is known in many European localities of the Early and Middle Pleistocene. Great morphological variability makes the identification of *S. subaraneus* difficult. JAMMOT (1977) thinks that it may have been ancestral form not only for all chromosomal races of *S. araneus,* but also for west European *S. coronatus* MILLET, 1828.

The third species of *Sorex* living today in Poland, *S. alpinus* SCHINZ, 1837 has persisted in European mountains (Pyrenees, Alps, Balkans, Harz, Carpathians, Sudetes) as a relict. Unknown as a fossil from the Polish area; it appeared in the European continent in the Middle Pleistocene. It probably derived from *S. praealpinus* HELLER, 1930, which is sporadically found in Pleistocene sediments of Europe. Its earliest remains known come from the end of the Pliocene, in Poland from Kielniki 3B. It was also found in Zamkowa Dolna Cave C and Kozi Grzbiet. It is always very rare.

The last of the *Sorex* species living in Poland is *S. caecutiens* LAXMANN, 1788. It can be found only in the northern part of the country (forest of Białowieża) where runs the western limit of its vast range, which extends as far as North Korea and Sakhalin Island. It was found once as a fossil, in the locality of Zdrody (north-eastern Poland) dated to the Late Pleistocene. Its first appearence is, however, noted from the Early Pleistocene localities of Moldavia and Ukraine (TATARINOV 1970). BOSAK et al. (1984) mentioned *S.* cf. *caecutiens* also from the Pleistocene (Q3) locality of Turold in Moravia. It may well be that it derived from *S. bor* REUMER, 1984, a smaller species, but similar in morphology. *S. bor* was described from an Early Pliocene locality in Hungary and also found in Poland in 8 localities representing the period from the Early Pliocene (Podlesice) to Early Pleistocene (Kielniki 3A).

S. minutissimus ZIMMERMANN, 1780, one of the smallest living mammals, was also listed in the Polish fossil fauna. Today it inhabits the northern part of the Scandinavian Peninsula and the zone of taiga as far as Sakhalin and Kamchatka. In the cool stages of the Middle Pleistocene this species reached northern France and Bulgaria, and in the Late

Pleistocene as far as the British Isles. In Poland it was found at Kozi Grzbiet, dated to the end of the Early Pleistocene and in the Late Pleistocene, in Mamutowa (layers 2g and 2 loess) and Nietoperzowa (layers 11-1) Caves. Later on, it withdrew to the north, where it can live under very severe conditions, tolerating as low temperatures as – 40°C.

Besides the species mentioned above, four other fossil *Sorex* species known from different European localities were discovered in Poland. These are: *S. runtonensis* HINTON, 1911, *S.* (*Drepanosorex*) *praearaneus* KORMOS, 1934, *S.* (*D.*) *savini* HINTON, 1911 and *S.* cf. *kennardi* HINTON, 1911.

S. runtonensis was a middle-sized shrew of delicate frame. It is known from the Early to Middle Pleistocene, but was particularly common in the Late Biharian. Its presence in older localities (KOWALSKI 1964, SULIMSKI 1959, 1962a and b) is hardly possible. The origin of this shrew is not known. Besides Poland (Żabia Cave, Kielniki 1, Zalesiaki 1A, Kozi Grzbiet), it is found in many European countries such as England, Germany, Austria, France, Italy, Hungary etc.

S. (*D.*) *praearaneus* is the oldest (MN17) and most primitive member of *Sorex* characterized by big size, general robustness and exoedaenodont dentition. This last feature suggests a diet consisting of molluscs. This form, or its descendant had survived in Europe probably until the Late Pleistocene. Outside Poland (Kielniki 3B, Kadzielnia, Kamyk and others) it is known from the Netherlands, Hungary, Italy and Ukraine.

The second form of this subgenus, *S.* (*D.*) *savini*, possibly descends from *S.* (*D.*) *praearaneus* or its ancestor. It must have separated from the common stock in the Early Pliocene and then two lineages evolved parallel, but they were exposed to selection under different conditions. One of them remained more or less slender /*S.* (*D.*) *praearaneus*/, the other became increasingly robust and its teeth exoedaenodont /*S.* (*D.*) *savini*/. *S.* (*D.*) *savini* is restricted to the Biharian. Outside Poland it is known from England, Germany, Czech Republic, France etc.

S. kennardi was described by HINTON in 1911 from the locality at Ponders End in England. As its description was very brief, the material very scanty and the locality undated the knowledge of this shrew was poor. Outside England *S. kennardi* was mentioned from several Late Biharian and Late Pleistocene localities in Germany, Austria and Poland (HELLER 1958, KOENIGSWALD 1973, RABEDER 1972, HARRISON in NADACHOWSKI et al. 1993 etc). Some authors, e. g. BARTOLOMEI (1964), did not see any diferences in size and morphology between *S. kennardi* and *S. runtonensis* and united them in the *Sorex runtonensis-kennardi* group. Others, e.g JAMMOT (1977), were of the opinion that the material and description were insufficient and the name *S. kennardi* nonvalid. In his latest revision of the English and Polish *Sorex kennardi* materials (in which the holotype was redescribed and compared with Obłazowa 2 specimens) HARRISON (in press) points out that *S. kennardi* and *S. runtonensis* are actually conspecific and that *S. runtonensis* is the valid name owing to its page priority.

So far, *Sorex casimiri* RZEBIK-KOWALSKA, 1991, *S. polonicus* RZEBIK-KOWALSKA, 1991, *S. pseudoalpinus* RZEBIK-KOWALSKA, 1991 and some unnamed forms of *Sorex* i.e. *S.* sp. 1, 2 and 3 and *S.* (cf. *Drepanosorex*) sp. 1 have been described and are known only from the Pliocene and Pleistocene localities of Poland (RZEBIK-KOWALSKA, 1991).

At the time of their appearence in Europe in the Early Pliocene the representatives of *Sorex* were already more diversified in the north-eastern than in the south-western part of this continent. In Hungary (REUMER 1984), Slovakia (FEJFAR 1966), France (CROCHET 1986), Netherlands (REUMER 1984) and Spain (CROCHET 1986) no more than 3 (0-3) *Sorex* species were found together in one locality and only in the Middle Pleistocene this number rose to 4 or 5, according to the data from Germany (KOENIGSWALD 1972, 1973).

On the other hand, 5 species were described from the Early Pliocene localities of Poland and at the end of the Early Pleistocene their number increased to 7.

That east-west cline in the number of *Sorex* species is also visible at present, because no representatives of *Sorex* are present in the southern part of the Iberian Peninsula, whereas in its northern part there live 3 species, in France and Poland 4, in Finland 5 (NIETHAMMER and KRAPP 1990) and in Siberia 13 (6-8 being sympatric, JUDIN 1989).

It is very probable, therefore, that eastern Europe was more open to migrations from Asia and its climate more favorable to the *Sorex* species.

Blarinini

Today, the *Blarinini* have their representatives exclusively in America. In that part of the world there live several species of *Blarina* GRAY, 1838, the shrews of middle size, characterized by very dark (almost black) pigment of teeth. They are typical opportunists, which are met within all environments. The members of the genus *Cryptotis* POMEL, 1848 inhabit mainly forests. Lately, three species of this genus have entered the northern part of South America.

Data about the oldest (Miocene) members of the tribe come from the American continent, but *Blarinoides mariae* SULIMSKI, 1959, similar though loosely related to the American genus *Blarina*, has been described from Poland (Węże 1). Later on, it was found in 8 other Polish localities and also in other European countries such as Hungary, Austria, Slovakia and Italy (REUMER 1984).

Besides *Blarinoides*, two species of *Mafia* REUMER, 1984 /*M. dehneli* (KOWALSKI, 1956) and *M. csarnotensis* REUMER, 1984/ and one species of *Sulimskia* REUMER, 1984 /*S. kretzoii* (SULIMSKI, 1962)/ belong to this tribe. They were found in several Polish, Hungarian, Slovakian and Greek localities representing the period from the Early Pliocene to the Plio/Pleistocene boundary. So far, little is known on their ecological requirements and relationships with the American shrews. According to REUMER's study (1984), *Mafia* has been found among the shrews belonging to open country assemblages.

Beremendiini

This tribe includes the members of only one fossil genus *Beremendia* KORMOS, 1934 with two species: *B. fissidens* (PETÉNYI, 1864) and *B. minor* RZEBIK-KOWALSKA, 1976. Being commonly found in Europe, *B. fissidens* was very numerous in Poland. It was found in 12 localities dated from the beginning of the Early Pliocene to the end of the Early Pleistocene. On the other hand, *B. minor* had a limited range. It was found only in Poland

and Hungary (MN14-16). *Beremendia* probably arrived from Asia because nobody has encountered its ancestors in Europe.

Amblycoptini

In comparison with *Soricini*, the *Amblycoptini* contain highly specialized shrews, with more or less heavy and reduced dentition. The only living member of the tribe *Anourosorex squamipes* MILNE-EDWARDS, 1872 inhabits forested mountains in south-eastern Asia. It is reported to live in burrows dug in the ground. The oldest, Late Miocene remains of *Anourosorex* were found in China (STORCH and QIU 1991), two other fossil species dated to the Early Pleistocene also derived from that territory (HUANG et al. 1991). According to STORCH and QIU (1991), the Late Miocene remains coming from Europe (Spain, Austria, Germany) (GIBERT 1974, BACHMAYER and WILSON 1970, STORCH 1978) and Inner Mongolia in China (MILLER 1927) should rather be included in the genus *Crusafontina* GIBERT, 1974.

In Poland, the *Amblycoptini* are represented by members of the extinct genus *Amblycoptus* KORMOS, 1926 related to *Anourosorex*. They were characterised by the reduction of the upper and lower third molars. Besides Poland (Zamkowa Dolna Cave B, Mała Cave, Rębielice Królewskie 2) they have been found in Hungary and Turkey, in localities not younger than the beginning of the Late Pliocene (REUMER 1984).

Paranourosorex gigas RZEBIK-KOWALSKA, 1975 described from Poland was similar to *Amblycoptus* and *Anourosorex*, but much bigger. Its big and "bulbous" teeth were adapted to a mollusc diet. It lived in the Early Pliocene (Podlesice). Its remains were also mentioned from the Ukraine by TOPACHEVSKY et al. 1988, from the locality Obukhovka 1, dated to the beginning of MN15.

Soriculini

The recent members of the *Soriculini* inhabit the Palearctic. Today the species belonging to *Soriculus* BLYTH, 1854 live in humid forests and scrubs of south-eastern Asia. Their fossil remains have been mentioned from China, from localities dated to the Early Pleistocene (HUANG et al. 1991). On the other hand, in Europe many fossils described as *Episoriculus* have been found. Two contemporary species of the genus *Episoriculus* (considered by some authors to be the subgenus of *Soriculus*) have approximately the same distribution as *Soriculus*, but they are smaller and their tails are longer.

In Europe, the oldest remains determined as *Episoriculus* have been found in south Spanish locality Salobrena, dated to the Late Miocene, in other words from before the Messinian (AGUILAR et al. 1984). This is the unique so far known presence of that genus in the Miocene of Europe. During the period from Pliocene to Early Pleistocene the forms generally considered as ancestors of the recent *Episoriculus* occupied a large area extending from Spain to Turkey (RZEBIK-KOWALSKA in press). The presence of *Episoriculus* was recorded also from about the Plio/Pleistocene boundary, in Morocco (JAEGER 1975, CROCHET 1986, RZEBIK-KOWALSKA 1988) and from the Late Pliocene of Kashmir in India (KOTLIA 1991).

The occurence of *Episoriculus* in North Africa permits us for the first time to establish with certainty that the *Soricinae* (shrews with pigmented teeth) were present in the African continent. As it is well known, now they do not occur in that area and their fossil remains have not hitherto been found there, either. *Episoriculus* probably got to Morocco from the east, along the southern coast of the Mediterranean Sea. How long it persisted in north-western Africa and what was its range is unknown.

Owing to the deterioration of the climate, first at the Ruscinian/Villanyian boundary and later during the Pleistocene, *Episoriculus* withdrew south of the European continent. Its presence in the Middle Pleistocene was found only in one locality of Romania (TERZEA and JURCSÁK 1969) and in the Late Pleistocene only in one locality in Kroatia (MALEZ and RABEDER 1984). At the end of the Pleistocene it disappeared totally from the continent but, according to some authors (REUMER 1984), its direct descendents (several species of *Nesiotites* BATE, 1945) were living on the Mediterranean Islands till the Holocene. This opinion is not shared by the author of the present paper. The dental morphology of *Nesiotites* seems to be much closer to *Neomys* than it is to *Episoriculus* (RZEBIK-KOWALSKA 1988).

According to the latest study of HUTTERER (in press) the extant Asian species of the genus *Episoriculus* are not congeneric with the European fossil taxa of *Episoriculus*. In this situation he proposed for the last ones the name *Asoriculus*, created by KRETZOI (1959) for a subgenus of the genus *Soriculus*. Further studies are needed to establish the relationship between the fossil *Asoriculus* and living *Episoriculus* species.

In Poland, *E. gibberodon* (PETÉNYI, 1864) was found in 7 localities dating from the beginning of the Early Pliocene (Podlesice) to the Early Pleistocene (Żabia Cave).

In Polish territory the tribe *Soriculini* is represented also by extinct *Neomysorex alpinoides* (KOWALSKI, 1956), which was related to *Episoriculus* and found in the Early Pliocene of Podlesice, and the members of two other genera: extinct *Macroneomys* FEJFAR, 1966 and still living *Neomys* KAUP, 1829.

M. brachygnatus FEJFAR, 1966 is characterised by its massive jaws and big "bulbous" teeth adapted for shell crushing. In Poland one fragment of its characteristic mandible was found at Kozi Grzbiet, the locality dated to the end of the Early Pleistocene. Outside Poland, its remains are known from Slovakia, Hungary and Germany. All those localities are referred to the period between the end of the Early and the end of the Middle Pleistocene. The remains of *Macroneomys* are nowhere common.

The water shrews of the genus *Neomys* have a more or less fringed tail and feet and they are adapted to aquatic life. They are most abundant in marshes and on the banks of streams, but can be found also in woodlands, far from any water bodies. Thy are known from the Early Pleistocene to Recent of Europe, today they live also in Asia.

The fossil remains of *Neomys* are rare. Extinct *Neomys newtoni* HINTON, 1911 described from the Middle Pleistocene of England, was found in Poland in slightly older localities, dated to the Early Pleistocene (Zalesiaki 1A, Kozi Grzbiet). Outside Poland it was mentioned from Germany, Italy and France.

Neomys fodiens (PENNANT, 1771), one of two species living now in Poland (all over the country, where the conditions are suitable) was found in 5 fossil localities. The oldest ones are dated to the last glaciation only (Raj Cave l. 1-10, Nietoperzowa Cave l. 11-1). The second species, *N. anomalus* CABRERA, 1907, lives today, forming insulated populations, mainly in north-western and south-eastern Poland, but smaller groups are also present at Białowieża and the Sudeten Mountains. So far, its fossils are unknown.

VI. PALEOECOLOGICAL INTERPRETATION OF SORICID ASSOCIATIONS

Only the *Soricidae* from the localities studied by the author are presented in the tables. The minimum number of individuals (MNI) has been estimated on the basis of the greatest number of the most numerously preserved element (mainly M_1). The tables show also the percentages of individuals of different species and genera in particular localities studied. To reconstruct the palaeoenvironment of the shrew fauna found in fossil localities the division of soricids into groups established by REUMER (1984) as paleoecological indicators and named "wet", "forest", "steppe" and "opportunist" groups, has been used. Some modifications of this grouping were, however, necessary.

According to REUMER, the "wet" group indicates "the presence of open water, with *Episoriculus* as an indicator, and perhaps also *Drepanosorex*".

Among the members of his "wet" group REUMER mentioned also the entire tribe *Soriculini* (p. 125) and in the case of *Episoriculus* he remarked that it was "a warmth-loving genus" (p. 127).

Among the recent *Soriculini*, however, only *Nectogale* MILNE-EDWARDS, 1870, *Chimarrogale* ANDERSON, 1877 and *Neomys* KAUP, 1829 are really aquatic. Neither these genera nor their direct fossil ancestors have been found in the Pliocene faunas of Europe. Therefore they cannot be used for paleoecological analysis of that period.

The Recent species of *Soriculus* and *Episoriculus*, another genera of *Soriculini*, inhabit damp forests of south-eastern Asia, and so only this type of environment may be suggested by the presence of their fossil relatives.

Neither do the species of the subgenus *Drepanosorex* and other shrews (*Macroneomys, Amblycoptus, Anourosorex, Paranourosorex, Dimylosorex* or *Deinsdorfia*) with more or less exoedaenodont teeth, regarded by REUMER (1984) as an adaptation to aquatic life necessarily indicate the presence of open waters. Most of them are extinct and the unique living species, mole-shrew *Anourosorex squamipes* MILNE-EDWARDS, 1872 inhabits mountain forests.

Exaedaenodont dentition was probably efficient not only in feeding on active snails but also on those hidden in shells. The crushing of shells was observed even in species not adapted to the mollusc diet. ROZMUS (1960) noted it in captive *Sorex araneus* LINNAEUS, 1758. It is all the more probable in shrew species with specialized dentition, which therefore were able to enter more arid environments where snails were numerous but inactive in dry seasons.

Sorex mirabilis OGNEV, 1937 regarded by some authors (e. g. JAMMOT 1977) as a living member of *Drepanosorex* subgenus has been captured near forest streams, but its morphology suggests neither water adaptations nor a diet composed of molluscs. According to OKHOTINA (1969), its main food consists of earthworms.

It seems therefore clear that at least as regards the Pliocene the "wet" group represented by *Episoriculus* and *Drepanosorex* cannot indicate the presence of open waters but rather the same forest environment as that of the "forest" group.

Basing himself on the diagrams showing the numbers of specimens (teeth and condyles) from succesive layers of the Hungarian Pliocene locality of Csarnota 2, REUMER (1984) found that *Episoriculus* was positively correlated with *Sorex*. This fact speaks also in support of the similarity of the ecological requirements of his "wet" and "forest" forms.

Also the supposition that the "wet" group indicates the presence of a warm climate needs some comments.

The presence of *Episoriculus*, according to REUMER (1984), an indicator of a rather warm climate, together with *Sorex*, preferring the cold climate today, in the same locality may indicate that the fossil members of *Sorex* lived formerly in warmer conditions and gradually, during the Late Pliocene and Pleistocene, became adapted to a more boreal climate in which they live today. On the other hand, KOTLIA (1991) found some remains of *Episoriculus* in the Late Pliocene locality of Karewas (Kashmir, India) together with the *Arvicolidae*, which, according to some authors (VAN DE WEERD and DAAMS 1978, REPENNING 1985), are considered to be indicators of a rather cool type of climate. The presence of a temperate climate in Kashmir at that time was confirmed also by a study of pollen (AGRAVAL et al. 1989).

All those facts do not allow us to regard *Episoriculus* either as an aquatic or as an exclusively thermophilous form, but they speak in favour of the inclusion of the "wet" group in the "forest" one. The first species of the genus *Neomys* did not appear in European fossil localities until the Early Pleistocene, when they were indicators of the existence of open water bodies (streams, lakes) in their paleoenvironment. The differentiation of the "wet" group of shrews is therefore justified only for the Quaternary.

On the other hand, in the Pliocene, the existence of an aquatic environment can be inferred from the presence of remains of other *Insectivora*, such as desmans or *Condylura*-type moles (all belonging to *Talpidae*).

Another modification must be made in the "steppe" group. According to REUMER (1984), it mainly contains the genus *Crocidura*. The absence of *Crocidura* in the Pliocene and probably also in the Pleistocene of Poland makes it impossible to use this genus as an indicator of steppe environment.

Basing himself on the above mentioned diagrams from Csarnota 2, REUMER (1984) found a negative correlation between the presence of the forest *Sorex*, on the one hand, and the presence of *Mafia*, on the other. That fact allowed him to suppose that *Mafia* prefers a more open environment. So, among the shrews, *Mafia* would be the only indicator of an open area in the Polish localities of that time.

The "opportunist" group contains, according to REUMER (1984), the genera of shrews (*Blarinoides, Beremendia, Petenyis*) that are ubiquitous in European localities. It seems clear that they tolerated different ecological conditions.

The remaining genera of shrews, not included in any of REUMER's groups, are those which were not as generally present in fossil localities as were the opportunists, but which were encountered in some of them, are now extinct and have no close relatives. Their ecological preferences are unknown. I designate them as "indeterminate". Here belong the genera *Zelceina*, *Sulimskia* and probably *Paenelimnoecus*.

Summarizing, the following ecological groups (EG) were used to reconstruct the paleoenvironment in Poland. Four of them were present in the Pliocene:

1. the "forest" group (marked "f") indicating the presence of a humid sylvan environment, with the genera *Episoriculus*, *Sorex*, *Blarinella* and perhaps *Amblycoptus*, *Paranourosorex* and *Deinsdorfia*.

2. the "steppe" group (marked "s") suggesting a rather dry and open area, represented by *Mafia*.

3. the "opportunist" group (marked "o") the members of which are present in almost all European Pliocene localities, representing forest and steppe environments, warmer and cooler climates (*Beremendia*, *Blarinoides* and *Petenyia*).

4. the "indeterminate" group (marked "i") of unknown ecological requirements and not as abundant and common as that of oportunists, with *Zelceina* and *Sulimskia*. As for *Paenelimnoecus*, see REUMER (1984, p. 127).

5. In the Pleistocene all these groups are also represented, but in addition, there may be members of the fifth, "wet" group (marked "w") as well. It indicates the presence of open water bodies and is represented by *Neomys* and perhaps also by *Macroneomys*.

Generally speaking, shrews do not appear to be very good indicators of the paleoenvironment. It should also be kept in mind that the differences in the number of members of ecological groups in particular localities may be connected with taphonomic factors, mainly with different predatory species responsible for the accumulation of shrew remains.

On the basis of the fauna of shrews of the Polish Pliocene and Early Pleistocene localities the folloving paleoecological picture can be obtained.

PLIOCENE

PODLESICE

The oldest Pliocene fauna in Poland is recorded from Podlesice (Table IV), the locality referred to the Early Ruscinian, MN14. It consists of numerous remains of small vertebrates, among which moles and, especially, shrews are extremely diversified.

The fauna of almost the same period has been found also in Mała Cave[4+5], Pańska Góra, Zamkowa Dolna Cave B and Zalesiaki 1B, although the remains of shrews are there much less abundant.

The *Soricidae* fauna of Podlesice is dominated by forms most probably inhabiting humid forests. *Episoriculus* and *Neomysorex* (*Soriculini*), *Sorex*, *Blarinella* (*Soricini*), perhaps *Paranourosorex* (*Amblycoptini*) and *Deinsdorfia* (*Soricini*), belonging to similar ecological groups, form more than 66 % of its composition. Two species of *Mafia* (*Blarinini*), probably preferring a more open country, constitute 14 % of the thanatocenosis

Podlesice Table IV

Species	EG	MNI	%MNI		%MNI
Episoriculus gibberodon	f	96	28.07	+	47.95
Neomysorex alpinoides *	f	68	19.88		
Blarinella dubia	f	23	6.73	+	7.90
Blarinella europaea	f	4	1.17		
Deinsdorfia reumeri	f	12	3.51	+	4.68
Deinsdorfia insperata	f	4	1.17		
Sorex minutus	f	9	2.63		
Sorex bor	f	3	0.88		
Sorex sp. 3	f	2	0.58	+	4.67
Sorex sp. 1	f	1	0.29		
Sorex sp. 2	f	1	0.29		
Paranourosorex gigas	f	4	1.17		1.17
$\sum$	f	**227**	**66.37**		**66.37**
Mafia dehneli	s	44	12.87	+	14.33
Mafia cf. *csarnotensis*	s	5	1.46		
$\sum$	s	**49**	**14.33**		**14.33**
Petenyia robusta	o	9	2.63		2.63
Blarinoides mariae	o	1	0.29		0.29
$\sum$	o	**10**	**2.92**		**2.92**
Zelceina podlesicensis	i	35	10.23		10.23
Paenelimnoecus pannonicus	i	10	2.92		2.92
Sulimskia kretzoii	i	2	0.58		0.58
Soricidae gen. et sp. indet.	i	9	2.63		2.63
$\sum$	i	**56**	**16.36**		**16.36**

* According to some authors, it belongs to the genus *Episoriculus* or to the *Episoriculus* "group".

of shrews, and the "oportunists" make 3 %. The ecological status of the remaining taxa (about 16.5 %) is unknown.

The arboreal rodents, like *Sciuridae*, numerous *Gliridae* and *Muridae* also suggest the existence of woody und bushy areas. The presence of an open environment is indicated by some rodents belonging to *Cricetidae*.

Forest with some open areas must have spread near the Podlesice cave. The existence of a nearby stream or river is suggested by two species of desmans. At that time the climate was possibly cooler and drier than in the Miocene, similar to the present East-Mediterranean one (KOWALSKI 1989).

ZALESIAKI 1B

A fairly similar composition of shrews is shown by the slightly younger (MN14/15) fauna from Zalesiaki 1B (Table V), because more than 70 % of its species belong to the "forest" group. The lack of such "steppe" or open country elements as *Mafia* and the bigger percentage of the "opportunists" may be accidental and connected with a small number (15) of individuals.

In Europe, a similar ecological picture is represented e.g. by the faunas from the nearly contemporary localities, Osztramos 9 and Osztramos 1 (Hungary), where the forest species of *Soricidae* form 80% and 60%, respectively.

Zalesiaki 1B

Table V

Species	EG	MNI	%MNI	%MNI
Blarinella dubia	f	2	13.33	+ 26.66
Blarinella europaea	f	2	13.33	
Sorex minutus	f	2	13.33	+ 26.66
Sorex casimiri	f	2	13.33	
cf. *Neomysorex alpinoides*	f	2	13.33	+ 20.00
Episoriculus gibberodon	f	1	6.67	
$\sum$	**f**	**11**	**73.32**	**73.32**
Beremendia fissidens	**o**	**3**	**20.00**	**20.00**
Paenelimnoecus pannonicus	**i**	**1**	**6.67**	**6.67**

WĘŻE 1

The interpretation of the ecological conditions on the basis of the *Soricidae* fauna from the Late Ruscinian (MN15) locality in Węże 1 (Table VI) is much more difficult. This fauna is strongly dominated by ecologically "indeterminate" shrews (about 42%), which are followed by opportunists (about 33.5%). The forest species make only 22.5% of the total *Soricidae*. *Mafia*, presumably indicating the open country, is present but not frequent (only about 2%).

However, studies of the very rich Węże 1 fauna, especially of its numerous and diversified rodents, indicate a more humid climate than in the Early Ruscinian, although a mosaic of biotopes such as grassland (presence of *Seleviniidae*, *Spalacidae*), woodland (presence of arboreal *Sciuridae*, *Gliridae*) and waters (presence of *Desmaninae*, *Condylurini*, *Castoridae*) is evident (KOWALSKI 1989).

Węże 1 Table VI

Species	EG	MNI	%MNI	%MNI
Sorex bor	f	38	8.72	
Sorex minutus	f	14	3.21 +	14.22
Sorex pseudoalpinus	f	10	2.29	
Deinsdorfia hibbardi	f	16	3.67 +	4.59
Deinsdorfia cf. *kordosi*	f	4	0.92	
Blarinella europaea	f	15	3.44	3.44
Episoriculus gibberodon	f	1	0.23	0.23
$\sum$	**f**	**98**	**22.48**	**22.48**
Mafia cf. *csarnotensis*	s	9	**2.06**	**2.06**
Beremendia fissidens	o	71	16.28	16.28
Blarinoides mariae	o	51	11.70	11.70
Petenyia hungarica	o	24	5.50	5.50
$\sum$	**o**	**146**	**33.48**	**33.48**
Zelceina soriculoides	i	128	29.36	29.36
Sulimskia kretzoii	i	39	8.94	8.94
Paenelimnoecus pannonicus	i	14	3.21	3.21
Soricidae gen. et sp. indet.	i	2	0.46	0.46
$\sum$	**i**	**183**	**41.97**	**41.97**

It is characteristic that the slightly younger fauna from Osztramos 7 (Hungary) is also strongly dominated by opportunists, although the climates of the two localities were probably different. It was warmer and more humid at Węże 1 and cooler and somewhat drier in Osztramos 7 (REUMER 1984).

RĘBIELICE KRÓLEWSKIE 1A

In the Early Villanyian (MN16) locality of Rębielice Królewskie 1A (Table VII) the forest shrews are numerous again. They strongly prevail in the material, making about 60% of the total of *Soricidae*. The opportunists are also frequent (36%), but *Mafia* is rare, it does not exceed 1.5%.

The existence of forest is confirmed by the presence of 5 species of deer, 5 species of arboreal *Sciuridae*, several murids and a few glirids. There are still two desmans, two star-nosed moles (*Condylura*), very differentiated amphibians, freshwater turtles, and beavers. A humid woodland with local meadows and open waters probably occupied the vicinity of the cave where fossil remains were accumulated.

Rębielice Królewskie 1A Table VII

Species	EG	MNI	%MNI	%MNI
Sorex bor	f	86	28.67	
Sorex minutus	f	30	10.00	
Sorex casimiri	f	13	4.33	+ 45.00
Sorex polonicus	f	4	1.33	
Sorex sp.2	f	2	0.67	
Deinsdorfia hibbardi	f	38	12.67	+ 13.67
Deinsdorfia cf. *kordosi*	f	3	1.00	
Blarinella europaea	f	2	0.67	0.67
Episoriculus gibberodon	f	1	0.33	0.33
∑	**f**	**179**	**59.67**	**59.67**
Mafia cf. *csarnotensis*	**s**	**4**	**1.33**	**1.33**
Beremendia fissidens	o	47	15.67	+ 18.00
Beremendia minor	o	7	2.33	
Blarinoides mariae	o	37	12.33	12.33
Petenyia hungarica	o	17	5.67	5.67
∑	**o**	**108**	**36.00**	**36.00**
Sulimskia kretzoii	i	3	1.00	1.00
Zelceina soriculoides	i	1	0.33	0.33
Paenelimnoecus pannonicus	i	1	0.33	+ 0.66
Paenelimnoecus sp.	i	1	0.33	
Soricidae gen. et sp. indet.	i	3	1.00	1.00
∑	**i**	**9**	**2.99**	**2.99**

RĘBIELICE KRÓLEWSKIE 2

The *Soricidae* fauna from Rębielice Królewskie 2 (Table VIII), being of the same age (MN16), is not as rich as that from Rębielice Królewskie 1A. The forest indicators, especially the members of *Sorex*, are here also less numerous, but on the other hand, the ecologically not significant "indeterminate" species are much better represented. *Mafia* constitutes a little more than 2% of the total.

KIELNIKI 3B

Also in Late Villanyian (MN17) Kielniki 3B (Table IX) the forest shrews prevail (61.5%). The remaining *Soricidae* are ecological opportunists (38.5%).

On the southern side of the Carpathians the contemporaneus fauna of Villany 3 (Hungary) is strongly dominated by *Crocidura kornfeldi* (59%), considered to be a "steppe" element, while the frequency of forest species is very low (about 7% only).

Rębielice Królewskie 2 — Table VIII

Species	EG	MNI	%MNI	%MNI
Sorex bor	f	4	9.52	+ 16.66
Sorex minutus	f	3	7.14	
Deinsdorfia hibbardi	f	6	14.29	14.29
Episoriculus gibberodon	f	1	2.38	2.38
Amblycoptus sp.	f	2	2.38	2.38
∑	**f**	**15**	**35.71**	**35.71**
Mafia cf. *csarnotensis*	s	1	**2.38**	**2.38**
Beremendia fissidens	o	6	14.29	+ 16.67
Beremendia minor	o	1	2.38	
Petenyia hungarica	o	4	9.52	9.52
Blarinoides mariae	o	4	9.52	9.52
∑	**o**	**15**	**35.71**	**35.71**
Sulimskia kretzoii	i	4	9.52	9.52
Paenelimnoecus pannonicus	i	2	4.76	4.76
Zelceina soriculoides	i	2	4.76	4.76
Soricidae gen. et sp. indet.	i	2	7.14	7.14
∑	**i**	**11**	**26.18**	**26.18**

Kielniki 3B — Table IX

Species	EG	MNI	%MNI	%MNI
Sorex minutus	f	6	23.08	+ 38.46
Sorex bor	f	2	7.69	
Sorex praealpinus	f	2	7.69	
Sorex (Drepanosorex) praearaneus	f	4	15.38	15.38
Episoriculus gibberodon	f	1	3.85	3.85
Deinsdorfia hibbardi	f	1	3.85	3.85
∑	**f**	**16**	**61.54**	**61.54**
Beremendia fissidens	o	7	26.92	26.92
Petenyia hungarica	o	3	11.54	11.54
∑	**o**	**10**	**38.46**	**38.46**

KADZIELNIA 1

The shrew fauna of Kadzielnia 1 (X), the locality dated to the Pliocene/Pleistocene boundary (MN17/Q_1), is strongly dominated by opportunists (about 72%). The forest species form only 26 %, and ecologically indefinite *Sulimskia* 2.6 %.

The entire fauna of Kadzielnia 1 suggests a significant change in the climate of the Polish area, which became more similar to the present climate. As the forest rodents (e.g., squirrels) disappeared and hamsters and ground squirrels emerged, the landscape prevailing in the vicinity of the locality must have been that of an open area. The presence of *Allophaiomys* and other *Arvicolidae* with permanently growing molars mark the beginnig of the Quaternary.

Kadzielnia 1 Table X

Species	EG	MNI	%MNI	%MNI
Sorex minutus	f	3	7.69	
Sorex subaraneus	f	3	7.69 +	17.94
Sores bor	f	1	2.56	
Sorex (Drepanosorex) praearaneus	f	2	5.13	5.13
Deinsdorfia hibbardi	f	1	2.56	2.56
$\sum$	**f**	**10**	**25.63**	**25.63**
Beremendia fissidens	o	20	51.28	51.28
Petenyia hungarica	o	7	17.95	17.95
Blarinoides mariae	o	1	2.56	2.56
$\sum$	**o**	**28**	**71.79**	**71.79**
Sulimskia kretzoii	i	1	**2.56**	**2.56**

EARLY PLEISTOCENE

KAMYK

In the Early Biharian (Q_1) fauna from Kamyk (Table XI) only 5 soricid species have been found. The opportunists are the most abundant group again (about 67%), the remaining 33% being formed by the forest group represented by two species of *Sorex*. Voles (*Arvicolidae*) dominate among the rodents. The entire fauna is similar to that inhabiting the mixed-forest zone of Central Europe. The climate probably resembled the present or was a little warmer.

Kamyk — Table XI

Species	EG	MNI	%MNI
Sorex bor	f	11	17.46
Sorex (Drepanosorex) praeauraneus	f	10	15.87
$\sum$	**f**	**21**	**33.33**
Petenya hungarica	o	22	34.92
Beremendia fissidens	o	17	26.98
Blarinoides mariae	o	3	4.76
$\sum$	**o**	**42**	**66.66**

KIELNIKI 3A

The same ecological groups of *Soricidae*, pointing to the ecological conditions similar to those at Kamyk, were found in the fauna from Kielniki 3A, slightly younger but still belonging to Q_1 (Table XII). The forest species were however a little more numerous than the oportunists at Kielniki 3A.

Kielniki 3A — Table XII

Species	EG	MNI	%MNI	%MNI
Sorex bor	f	2	22.22 +	33.33
Sorex minutus	f	1	11.11	
Sorex (Drepanosorex) praearaneus	f	2	22.22	22.22
$\sum$	**f**	5	**55.55**	**55.55**
Beremendia fissidens	o	3	33.33	33.33
Petenyia hungarica	o	1	11.11	11.11
$\sum$	**o**	4	**44.44**	**44.44**

KIELNIKI 1

5 individuals of *Soricidae* found in the probably Late Biharian (Q_2) locality of Kielniki 1 (Table XIII) are too few to permit a discussion of their paleoecological meaning.

Kielniki 1 — Table XIII

Species	EG	MNI	%MNI
Sorex runtonensis	f	1	20.00
Sorex (Drepanosorex) praearaneus	f	1	20.00
$\sum$	**f**	**2**	**40.00**
Petenyia hungarica	o	3	**60.00**

ZALESIAKI 1A

Slightly more numerous shrews than at Kielniki 1 have been preserved at the more or less contemporaneus locality of Zalesiaki 1A (Table XIV) (Q_2). Here the most numerous are the forest forms of the genus *Sorex* (about 74%), the oportunists being represented only by *Beremendia* (about 22%). The first appearance of a true representative of the "wet" group (indicating the presence of an open water body), e. g. a *Neomys* species is the most interesting finding.

At the same time the appearance of the collared lemming *Dicrostonyx* suggests a certain cooling of the climate.

Zalesiaki 1A — Table XIV

Species	EG	MNI	%MNI	%MNI
Sorex runtonensis	f	7	30.43 +	56.52
Sorex minutus	f	6	26.09	
Sorex (Drepanosorex) savini	f	4	17.39	17.39
$\sum$	f	17	73.91	73.91
Neomys newtoni	w	1	4.35	4.35
Beremendia fissidens	o	5	21.74	21.74

KOZI GRZBIET

The fauna of Kozi Grzbiet (Table XV) represents the end of the Early Pleistocene (Late Biharian, Q_2). The *Soricidae* became richer in species than in the Early Biharian, but most of them (more than 96% of individuals) belong to the "forest" group represented by the genus *Sorex*. *Beremendia*, the most ubiquitous form in the Pliocene, is still present, but only in minute numbers (less than 1%). This is its last appearence in Polish localities. *Neomys* and exoedaenodont *Macroneomys*, related to it, constitute together 3% of that thanatocenosis of shrews, indicating the presence of open water bodies.

The whole fauna of Kozi Grzbiet suggests the presence of woodland and a climate similar to the recent one. Some species suggesting a cool climate e.g. lemmings, which have been found in this locality, may have come from the neighbouring mountains, or at that time they lived in niches differing from those they occupy now.

MIDDLE PLEISTOCENE TO HOLOCENE

The Middle Pleistocene localities are almost absent in Poland. That long period, characterized by a series of alternate colder and warmer phases and the maximum extent of the Scandinavian ice-sheet in the Polish territory, did not leave many well-dated fossil remains.

In Nietoperzowa Cave (layers 15-14) only two species of the modern shrews, both of the genus *Sorex* from the "forest" group, were found in an undetermined phase preceding the last glaciation (?Riss).

Kozi Grzbiet

Table XV

Species	EG	MNI	%MNI	%MNI
Sorex runtonensis	f	79	48.47	
Sorex subaraneus	f	38	23.31	
Sorex minutus	f	14	8.59+ +	89.57
Sorex praealpinus	f	8	4.91	
Sorex minutissimus	f	7	4.29	
Sorex (Drepanosorex) savini	f	10	6.13 +	6.74
Sorex (Drepanosorex) sp.1	f	1	0.61	
∑	**f**	**157**	**96.31**	**96.31**
Neomys newtoni	w	4	2.45	2.45
Macroneomys brachygnatus	w	1	0.61	0.61
∑	w	**5**	**3.06**	**3.06**
Beremendia fissidens	o	1	**0.61**	**0.61**

In the Late Pleistocene, besides the species living at present in Poland, the *Soricidae* are represented by *Sorex minutissimus* and "*S.* aff. *kennardi* ". The first one was found in two localities, at Mamutowa Cave (layers 2 "loess" and 2g) and Nietoperzowa Cave (layers 1-11). The nearest place in which this species lives today is Finland (see p. 110). "*S.* aff. *kennardi* " was found in Obłazowa 2. Now, it is totally extinct (see p. 111).

In the Holocene, shrew fauna was enriched with *Crocidura* species (Giebułtów, Józefów, Dużej Sowy Cave, Duża Cave etc.). Their appearence may be partly connected with the activity of man. Earlier data on their presence in Poland seem to be dubious.

In conclusion it should be mentioned that the Polish shrew fauna, very rich in the Early and early Late Pliocene became much poorer at the end of that period, probably owing to a climatic deterioration. The diversity of species increased once more at the end of the Early Pleistocene, but those were mainly members of *Sorex*, nowadays the most numerous and ubiquitous genus in the northern hemisphere.

VII. DISTRIBUTION IN TIME OF *INSECTIVORA* IN POLAND

Tables XVI, XVII and XVIII show that the great number of the extremely diverse insectivore taxa composing the faunas of the Early and the early Late Pliocene of Poland (30 at Early Ruscinian Podlesice, 24 at Late Ruscinian Węże 1, 28 at Early Villanyian Rębielice Królewskie 1A) diminished gradually, reaching their lowest value during the Late Pleistocene (4 at Nietoperzowa Cave 11-1) and Holocene (6 at Dużej Sowy Cave and Duża Cave 3).

The paleontological data indicate that the European moles and hedgehogs were numerous and diversified during the Miocene, but shrews belonging mainly to two subfamilies, *Heterosoricinae* and *Crocidosoricinae*, were much less abundant at that time, both in number of species and individuals. The first modern *Soricinae* appeared in Europe in the Late Miocene and starting from the Early Pliocene became dominant group at this territory. Their diversity at that time must have been caused partly by radiation inside the area and partly by an invasion of new forms from Asia, some forms (e. g. *Blarinella*) having their ancestors in older European localities, others (e. g. *Beremendia*) being not known from Europe in earlier periods (REUMER 1984, RZEBIK-KOWALSKA in press).

In Poland, the Pliocene and Quaternary remains of the *Erinaceidae* and *Talpidae* are not very rich and the identification of moles needs a revision. In this situation they are not very useful for biostratigraphical purposes.

The shrews, which make more than 90% of the *Insectivora* remains in the fossil Pliocene and Quaternary faunas of Poland are much better known but their comparatively slow rate of evolution limits their stratigraphic usefulness. Nevertheless, some of them are limited to a shorter or longer geological time and can therefore be used as indicators of particular periods. *Mafia dehneli*, *Amblycoptus topali*, *Paranourosorex gigas*, *Zelceina podlesicensis*, *Petenyia robusta*, *Deinsdorfia reumeri*, *D. insperata*, *Neomysorex alpinoides* and *Sorex pseudoalpinus* can be used as indicators of the Early Ruscinian (MN14).

The end of the Early Villanyian (MN16) coincides with the disappearence of all *Paenelimnoecus*, *Amblycoptus*, *Mafia*, *Blarinella*, and *Zelceina* species. They have never been found from later periods. Generally speaking, in the Late Villanyian the number of taxa decreases drastically and no more than 15 species can be found together in one locality. On the other hand, in the Late Villanyian (MN17) some new species appeared for the first time in Poland. These are *Sorex subaraneus* and a big *Sorex*, *S.* (*Drepanosorex*) *praearaneus*.

In the Early Biharian (Q_1) the number of shrews decreased again, not exceeding 9 species. Among the old Pliocene forms *Blarinoides*, *Beremendia*, *Petenyia* and *Episoriculus* were still present. Later on, they all became extinct, only *Beremendia fissidens* survived until the Early/Middle Pleistocene boundary. It was present, for the last time, at the Late Biharian (Q_2) locality Kozi Grzbiet. The number of shrew species is however almost the same (10) as in the Early Biharian, although most of them belong to the genus *Sorex*. In Poland, the Late Biharian is marked by the first appearence of *Sorex runtonensis*, *S. minutissimus*, *S.* (*D.*) *savini*, *Neomys newtoni* and *Macroneomys brachygnatus*.

On account of the maximum extent of the Scandinavian ice-sheet a long period of the Middle Pleistocene left almost no traces of the fauna in the Polish territory. Only in the unique late Middle Pleistocene locality Nietoperzowa Cave 15-14 three *Insectivora* species have been noted. These are *Talpa europaea*, *Sorex minutus* and *S. araneus*, all still extant in Poland.

Today, 11 species of *Insectivora* live in the Polish territory, the namely, *Erinaceus europaeus*, *E. concolor*, *Talpa europaea*, *Crocidura leucodon*, *C. suaveolens*, *Neomys fodiens*, *N. anomalus*, *Sorex minutus*, *S. araneus*, *S. alpinus* and *S. caecutiens*. The fossil evidence is available for 7 of them. The oldest data concern *Sorex minutus*, which has persisted since the beginning of the Early Pliocene. Others, such as *S. araneus* and *Talpa europaea* have been found for the first time in localities dated to the late Middle Pleistocene

Table XVI

Fossil insectivores from the Pliocene of Poland

Taxa	Localities and their age (MN)													
	PO 14	MA^{4+5} 14	PN 14	ZDB 14	ZA1B 14/15	WE1 15	WE2 15/16	RK1A 16	RK2 16	ZDA 17	PE3A 17	KI3B 17	JP PLI?	KD1 17/Q[1]
Erinaceus samsonowiczi	–	–	–	–	–	*	–	–	–	–	–	–	–	–
Erinaceus sp.	–	–	–	–	–	–	–	*	*	–	–	–	–	*
Condylura kowalskii		–	–	–	–	*	*	*	–	–	–	–	–	–
Condylura izabellae		–	–	–	–	–	–	*	–	–	–	–	–	–
"*?Neurotrichus polonicus*"	–	–	–	–	–	–	–	*	–	*	–	–	–	*
Neurotrichus polonicus	–	–	–	–	–	–	–	–	–	–	–	*	–	–
Neurotrichus minor	–	–	–	–	–	–	*	–	–	–	–	–	–	–
"*?Geotrypus copernici*"	–	–	–	–	–	–	–	–	–	*	–	–	–	*
"*Scaptonyx* (?) *dolichochir*"	*	–	–	–	–	*	–	*	–	–	–	–	–	*
Scapanulus agrarius	*	–	–	–	–	*	–	–	–	–	–	–	–	–
Parascalops fossilis	*	–	–	–	–	*	–	–	–	–	–	–	–	–
Talpa minor	*	–	–	–	–	*	*	*	–	–	–	–	–	*
Talpa fossilis	–	–	–	–	–	*	*cf.	–	–	–	–	–	–	*
Desmanella dubia	*aff.	–	–	–	–	–	–	–	–	–	–	–	–	–
Desmana nehringi	*	–	–	–	–	*	–	*	–	–	–	–	–	–
Galemys sulimskii	–	–	–	–	–	*	–	–	–	–	–	–	–	–
Galemys kormosi	–	–	–	–	–	–	*cf.	*	*	–	–	–	–	–
Ruemkelia dekkersi	*aff.	–	–	–	–	–	–	–	–	–	–	–	–	–
Paenelimnoecus pannonicus	*	*	–	–	*	*	–	*	*	–	–	–	–	–
Paenelimnoecus sp.	–	–	–	–	–	–	–	*	–	–	–	–	–	–
Paranourosorex gigas	*	–	–	–	–	–	–	–	–	–	–	–	–	–
Amblycoptus topali	–	*	–	*cf.	–	–	–	–	–	–	–	–	–	–
Amblycoptus sp.	–	–	–	–	–	–	–	–	*	–	–	–	–	–
Blarinoides mariae	*	–	–	*	–	*	*	*	*	*	–	–	–	*
Blarinoides sp.	–	–	*	–	–	–	–	–	–	–	–	–	–	–
Mafia dehneli	*	*cf.	*	–	–	–	–	–	–	–	–	–	–	–
Mafia csarnothensis	*cf.	–	–	–	–	*cf.	–	*cf.	*cf.	–	–	–	–	–

Table XVI cntd.

	PO	MA4+	PN	ZDB	ZA1B	WE1	WE2	RK1A	RK2	ZDA	PE3A	KI3B	JP	KD1
Sulimskia kretzoii	*	–	–	–	–	*	–	*	*	–	–	–	–	*
Beremendia fissidens	–	–	–	*	*	*	*	*	*	*	–	*	–	*
Beremendia minor	–	–	–	–	–	–	–	*	*cf.	–	–	–	–	–
Beremendia sp.	–	–	–	–	–	–	–	–	–	–	*	–	–	–
Episoriculus gibberodon	*	–	–	*	*	*	–	*	*	*	–	*	–	–
Episoriculus sp.	–	–	*	–	–	–	–	–	–	–	–	–	–	–
Neomysorex alpinoides	*	–	–	–	*cf.	–	–	–	–	–	–	–	–	–
Blarinella dubia	*	*?	–	–	*	–	–	–	–	–	–	–	–	–
Blarinella europaea	*	–	–	–	*	*	–	*	–	–	–	–	–	–
Deinsdorfia reumeri	*	–	–	–	–	–	–	–	–	–	–	–	–	–
Deinsdorfia insperata	*	–	–	–	–	–	–	–	–	–	–	–	–	–
Deinsdorfia hibbardi	–	–	–	–	–	*	–	*	*	–	–	*	–	*
Deinsdorfia kordosi	–	–	–	–	–	*cf.	–	*cf.	–	–	–	–	–	–
Petenyia robusta	*	–	–	*	–	–	–	–	–	–	–	–	–	–
Petenyia hungarica	–	–	–	–	–	*	*	*	*	*	–	*	–	*
Petenyia sp.	–	–	*	–	–	–	–	–	–	–	–	–	–	–
Zelceina podlesicensis	*	–	–	–	–	–	–	–	–	–	–	–	–	–
Zelceina soriculoides	–	–	–	–	–	*	*cf.	*	*	–	–	–	–	–
Sorex minutus	*	*	–	–	*	*	*cf.	*	*	–	–	*	–	*
Sorex bor	*	–	–	–	–	*	–	*	*	–	–	*	–	*
Sorex casimiri	–	–	–	*	*	–	–	*	–	–	–	–	–	–
Sorex polonicus	–	–	–	–	–	–	–	*	–	–	–	–	–	–
Sorex pseudoalpinus	–	–	–	–	–	*	–	–	–	–	–	–	–	–
Sorex praealpinus	–	–	–	–	–	–	–	–	–	–	–	*	–	–
Sorex subaraneus	–	–	–	–	–	–	–	–	–	–	–	–	–	*
Sorex sp. (2)	*	*	*	–	–	–	*	*	–	–	–	–	*	–
Sorex (Drepanosorex) praearaneus	–	–	–	–	–	–	–	–	–	*	–	*	–	*

1 – on question marks see p. 83.
2 – in some localities there are more than one *Sorex* sp. (see lists of taxa in Tables I-III)
– forms which have not been identified to genus or species are not listed in the table
– for the full names of localities see section I
– PLI = Pliocene

Fossil insectivores

Taxa	Localities										
	JZ Q_1	KA Q_1	KI3A Q_1	PE1B Q_1	PE2B Q_2	PE3B Q_2	KI1 Q_2	ZA1A Q_2	ZDC Q_2	KG Q_2	NI15-14 Q_3
Erinaceus concolor	–	–	–	–	–	–	–	–	–	–	–
Erinaceus sp.	*	*	–	–	–	–	–	–	–	–	–
?*Geotrypus copernici* (1)	–	*	–	–	–	–	–	–	–	–	–
Talpa minor	*cf.	–	–	–	–	–	–	–	–	–	–
Talpa europaea	–	–	–	–	–	–	–	–	–	–	*
Talpa sp.	–	*	–	–	–	–	–	–	–	–	–
Desmana sp.	–	*	–	–	–	–	–	–	–	–	–
Blarinoides mariae	–	*	–	–	–	–	–	–	–	–	–
Beremendia fissidens	*	*	*	–	–	–	–	*	*	*	–
Beremendia sp.	–	–	–	*	*	*	–	–	–	–	–
Episoriculus sp. (2)	*	–	–	–	–	–	–	–	–	–	–
Macroneomys brachygnatus	–	–	–	–	–	–	–	–	–	*	–
Neomys newtoni	–	–	–	–	–	–	–	*	–	*	–
Neomys fodiens	–	–	–	–	–	–	–	–	–	–	–
Petenyia hungarica	*cf.	*	*	–	–	–	*	–	–	–	–
Sorex minutus	*cf.	–	*	–	–	–	–	*	*	*	*
Sorex bor	–	*	*	–	–	–	–	–	–	–	–
Sorex praealpinus	–	–	–	–	–	–	–	–	*	*	–
Sorex runtonensis	*aff.	–	–	–	–	–	*	*	–	*	–
Sorex subaraneus	–	–	–	–	–	–	–	–	–	*	–
Sorex araneus	–	–	–	–	–	–	–	–	–	–	*
Sorex minutissimus	–	–	–	–	–	–	–	–	–	*	–
"*Sorex kennardi*" (3)	–	–	–	–	–	–	–	–	–	–	–
Sorex caecutiens	–	–	–	–	–	–	–	–	–	–	–
Sorex (*Drepanosorex*) *praearaneus*	–	*	*	–	–	–	*	–	–	–	–
Sorex (*Drepanosorex*) *savini*	–	–	–	–	–	–	–	*	*	*	–
Sorex (*Drepanosorex*) sp.	*?	–	–	–	–	–	–	–	–	*	–

1 – on question mark see p. 83.
2 – see p. 92.
3 – see p. 111.
4 – on question mark in JZ see p. 92.

Table XVII

from the Pleistocene of Poland

and age

RK4 MLPLE	ZY Q_3	NI13-12 Q_4	TC Q_4	JW Q_4	ZS1 LPLE EVI	MM2gl. PLE EVI	OB2 LPLE MVI	PSIII LPLE LVI	KZ3-19 LPLE LVI	MM2loess LPLE LVI	RA1-10 LPLE VI	NI11-1 LPLE	DU5 LPLE
–	–	–	–	–	–	–	–	–	–	–	–	–	*
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	*	*	*	*	*	–	*	*	*	–	–	*	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	*	*	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	*	*	–	–	–	–	*	–	*
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
*	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	*	–	–	*	*	* cf.	*	*	*	*	*	*
–	–	–	–	–	–	*	–	–	–	*	–	*	–
–	–	–	–	–	–	–	* cf.	–	–	–	–	–	–
–	*	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–

– forms which have not been identified to genus or species are not listed in the table

– for the full names of localities see section I

– MPLE = Middle Pleistocene, LPLE = Late Pleistocene, VI = Vistulian, EVI = Early Vistulian, MVI = Middle Vistulian, LVI = Late Vistulian

Table XVIII

Fossil insectivores from the Holocene of Poland

Taxa	Localities and age											
	GI MH	JO MH	DS LH	DU3 H	PSI H	ZS2 H	CS1 ?H	RA11 H	MS H	KZ1 H	PE2D H	DZS H
Erinaceus concolor	–	–	•	•	–	–	–	–	–	–	–	–
Erinaceus sp.	–	–	–	–	–	–	•	–	–	–	•	•
Talpa europaea	–	–	•	•	–	•	–	•	•	•	•	•
Neomys fodiens	–	–	•	•	•cf.	–	–	–	•	–	–	–
Sorex minutus	–	•	•	•	–	•	–	•	–	–	–	–
Sorex araneus	–	•	•	•	•	•	–	•	•	•	–	–
Crocidura leucodon	–	•	•	•	–	–	–	–	•	–	–	–
Crocidura sp.	•	–	–	–	–	•	–	–	–	–	–	–

– for the full names of localities see section I
– H = Holocene, MH = Middle Holocene, LH = Late Holocene

(penultimate glaciation, "Riss"). *Sorex caecutiens* and *Erinaceus concolor* had their first appearence, as far as is known, in the Late Pleistocene (Eemian) and *Neomys fodiens* later in the Late Pleistocene, in the Vistulian. The first certain data on *Crocidura leucodon* derive from the Middle Holocene. Nothing is known so far about the appearance of the remaining four species.

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