

CONTRIBUTIONS TO THE KNOWLEDGE OF *GULO* *SPELAEUS* GOLDFUSS FROM ROMANIA

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Remains of *Gulo spelaeus* have been recovered from the Secoel Scorotei Cave No. 4 (Retezat Mountains, Hunedoara dept.). The new fossil site of the Southern Carpathians may be situated within the Middle Würm (Würm II–III in the French chronology). Allometrical and morphological study of the skull and dentition indicated on the one hand that *Gulo spelaeus* of Europe is derived from an eastern immigrant and, on the other, that the Rissian wolverine group originated from *G. schlosseri*-like ancestors.

Key words: *Gulo spelaeus* (Carnivora, Mammalia), Middle Würm, Southern Carpathians, Romania, morphology, systematics.

INTRODUCTION

Dug in the Late Jurassic-Early Cretaceous limestones of the Retezat Mountains (eastern portion of the Southern Carpathians), the Secoel Scorotei Cave No. 4 is located at 1150 m abs. alt. and 150 m rel. alt.

The paleontological investigations in the lower level of the cave started in 1987. Using the underwater sieving technique, we have obtained a small mammal association which has been already studied (C. Rădulescu et al., 1991). Remains of big mammals have been also collected. As a whole, the mammalian association includes the following species :

Talpa europaea

Sorex araneus

Sorex minutus

Sicista betulina

Apodemus sylvaticus

Apodemus flavicollis

Clethrionomys glareolus

Arvicola terrestris

Pitymys sp.

Microtus arvalis

Chionomys nivalis

Canis lupus

Vulpes vulpes

Mustela nivalis

Putorius putorius

Martes martes

Ursus spelaeus

Gulo spelaeus

Panthera spelaea

Rupicapra rupicapra

Capra ibex carpatorum

PALEONTOLOGICAL MATERIAL AND THE METHOD OF STUDY

The remains of wolverine from the Secoel Scorotei Cave consist of a skull with connected lower jaws, a fragmentary right lower jaw containing M_{1-2} , isolated upper and lower teeth and a lot of bones of the fore and hind limbs. All the specimens are very well preserved. These fossils have been compared with the living forms of *Gulo gulo gulo* from Fennoscandia (Kurtén and Rausch, 1959), *Gulo gulo albus* from

the extreme North—East of Siberia and Kamchatka (Stroganov, 1962) and *Gulo luscus* from Alaska and arctic area of Canada (Kurtén & Rausch, 1959).

Gulo schlosseri, known from Betfia 2, Romania (Kormos, 1914), Mosbach, Germany (Tobien, 1957) and Grotte de l'Escale à Saint-Estève-Janson, France (Bonifay, 1971), *Gulo spelaeus* from different European last glacial sites ranging from the Republic of Moldova to Spain,

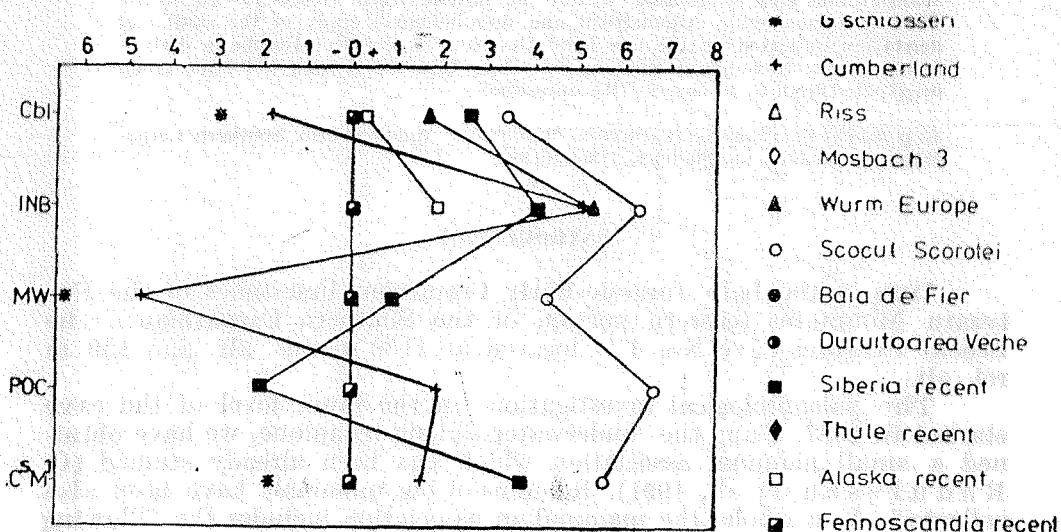


Fig. 1. — Ratio diagram, showing relative proportions of skull dimensions in: recent *G. gulo*, Fennoscandia (standard of comparison), recent *G. luscus*, Alaska, recent *G. gulo albus* Siberia, Middle Würm *G. spelaeus*, Romania (Scocul Scorotei Cave, Baia de Fier Cave, Duruitoarea Veche Cave), Würm *G. spelaeus*, Europe, Illinoian *G. gidleyi*, North America, *G. schlosseri*, (Grotte de l'Escale à Saint Estève-Janson).

as well as *Gulo gidleyi* from Cumberland, Maryland, USA (Gidley & Gazin, 1938) have also been used for comparative purposes.

At first, a directly graphic comparison of the skull and dental features with various living and fossil forms of *Gulo* was undertaken and the method of „ratio-diagram” was used (Simpson, Roe & Lewontin, 1960 : 356—358) (fig. 1—3). Afterwards, the features which appeared to be essential in the separation of different forms of *Gulo* were tested on the basis of bivariate analysis of dimensions by the comparison of the means in the analysis of variance. Logarithms of two correlated values were used and the regression lines were established.

In the ratio diagram, the standard is represented each time by various corresponding dimensions of extant *Gulo* population of Fennoscandia.

For the description of wolverine skull and dentition, the terminology and measurements are after Kurtén and Rausch (1959), Kurtén (1970, 1973) and Anderson (1975).

CBL — Condylbasal length

INB — Interorbital breadth

MW — Mastoid width

POC — length of postorbital constriction
 w C⁸ — C⁸ — width across the upper canines
 l C⁸—M¹ — length of upper tooth series, canine to M¹, inclusive
 l — length
 w — width
 ll — length of inner lobe
 lct — length of constriction

All measurements given are in millimeters (mm). Specimens labelled SS4, used in this study, are in the collection of the "Emil Racoviță" Speleological Institute, Bucharest.

DESCRIPTION OF THE MATERIAL AND THE STATISTICAL ANALYSIS

The wolverine skull from Seocul Scorotei is distinguished from extant *Gulo* of Fennoscandia by its greater interorbital breadth; in this respect, the fossil form, like other European specimens of the last glaciation, is close to *G. luscus* and *G. gulo albus* (fig. 1). On the other hand, the Illinoian form of North America is still wider. For a wider skull pleads even the strong transverse development of the muzzle (table 1).

In the scatter diagram of interorbital breadth — condylobasal length, our specimen is situated on the trend axis of the population from Alaska (fig. 4). Testing of the trend axis for this character shows that there are significant differences between the various populations, as follows :

Fennoscandia — Alaska, $t = 4.7938$ for 89 DF

Alaska — Last glacial fossil, $t = 4.3682$ for 69 DF

Fennoscandia — Last glacial fossil, $t = 7.2363$ for 26 DF

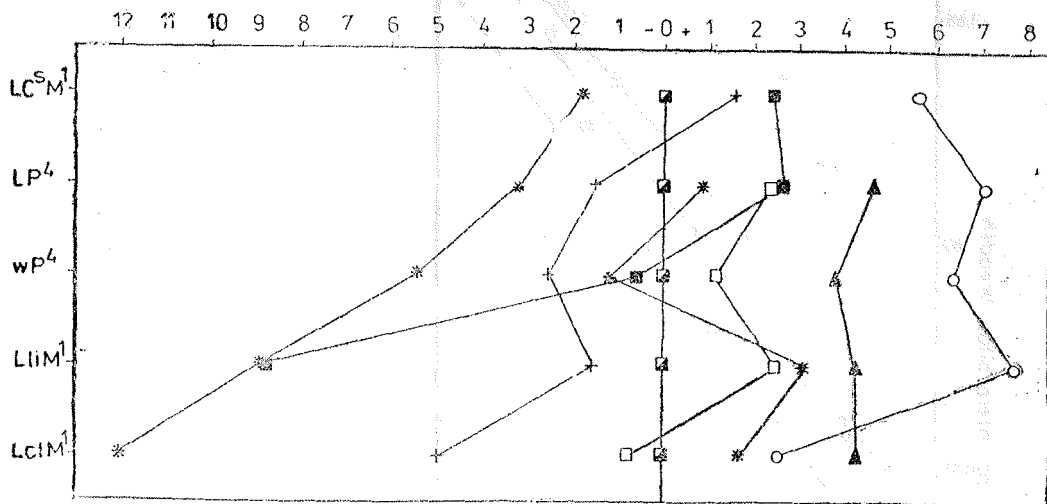


Fig. 2. — Ratio diagram, showing relative proportions of upper dentitions. Symbols as in fig. 1.

The upper dentition is strongly imbricated, the premolars overlapping lingually. The first and second premolars (P¹—P²) are small projecting unicusps, round (P¹) or ellipsoidal (P²) in shape. The third premolar

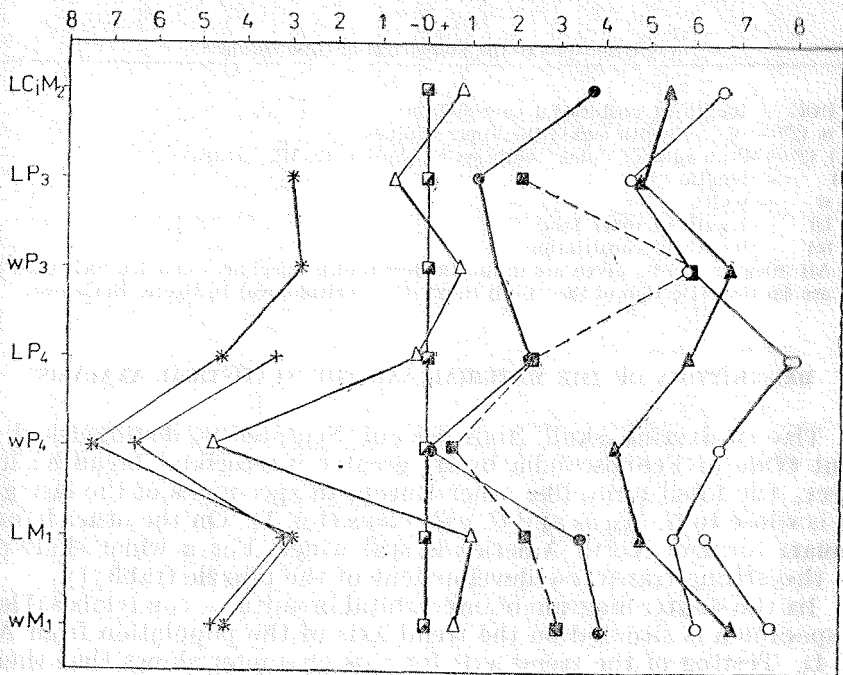


Fig. 3. — Ratio diagram, showing relative proportions of lower dentitions. Symbols as in fig. 1.

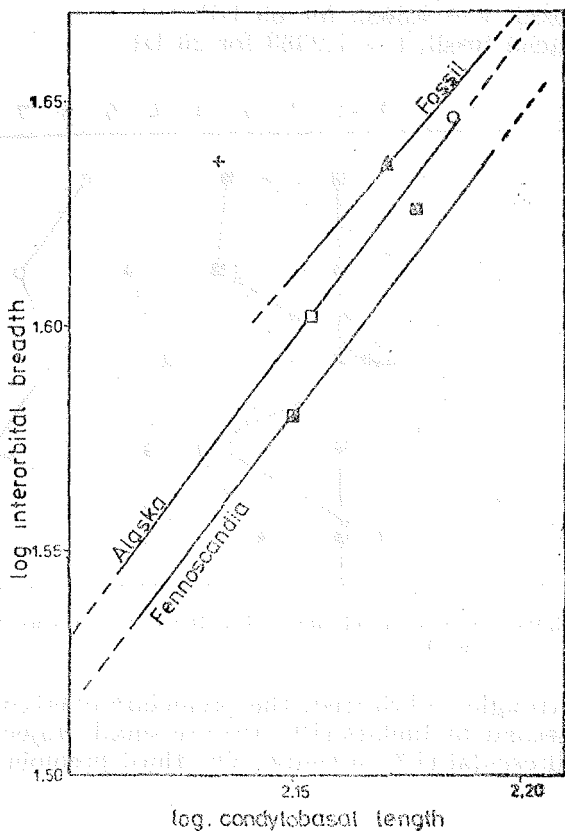


Fig. 4. — Allometric relationships between the interorbital breadth and the condylobasal length of *Gulo* skulls; lines are reduced major axes. Symbols as in fig. 1.

(P³) is longer, with slightly projecting protocone and distal part inserted between the protocone and paracone of the upper carnassial (P⁴).

The carnassial is massive with a well-developed internal talon strongly expanded lingually and the paracone much higher than the metacone. The enamel of the carnassial is finely wrinkled, as stated by Goldfuss at the beginning of the XIXth century when he described the species *G. spelaeus*.

As to the ratio of length to width, the fourth premolar is placed between the regression lines of the living forms from Alaska and the line of Würmian fossils (fig. 5), but its dimensions are considerably larger than the means of the latter. The upper carnassial is narrower in proportion to length in comparison with extant forms of Fennoscandia, a situation common for all the fossil specimens starting from the Middle Rissian.

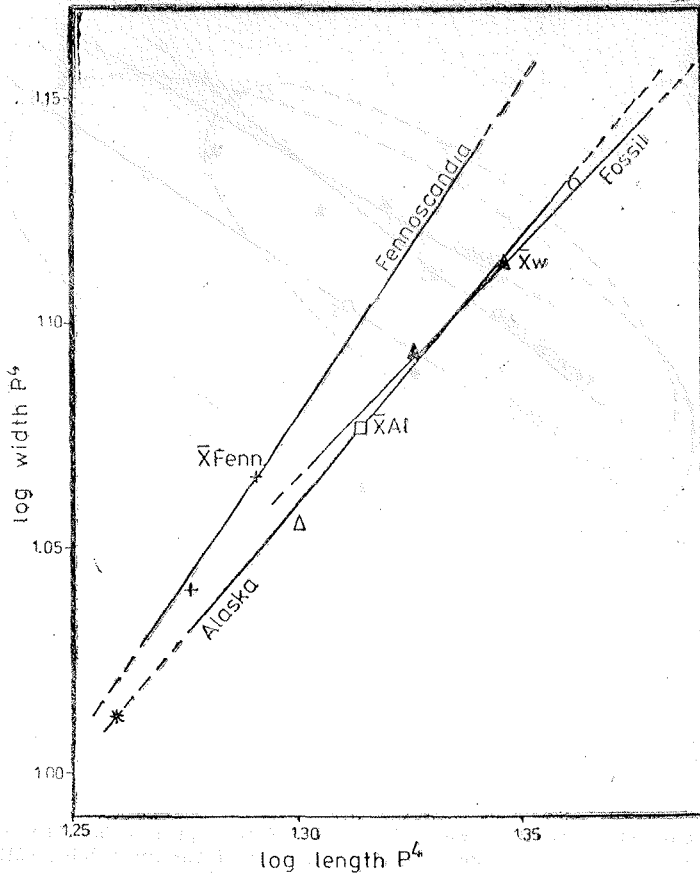


Fig. 5. — Allometric relationships width/length in upper carnassials of *Gulo*; lines are reduced major axes. Symbols as in fig. 1.

This pair of variables has a faint but significant difference for the forms from Alaska and Fennoscandia ($t = 3.4365$ for 50 DF), but it is not significant when the fossil forms are compared with those from Alaska.

The first molar (M^1) has a relatively diminished metacone similar to that of Fennoscandian specimens. On the other hand, the strong median constriction of the crown is characteristic of the extant forms from the North of Canada, Alaska, Eastern Siberia as well as Rissian material of Europe.

This feature appears to distinguish the specimen from *Sciurus Scrotae* as compared with living Fennoscandian forms and European fossils Würmian in age (fig. 6).

The scatter diagram shows that the Rissian form coming from Tornewton Cave and the Würmian specimens of Europe (including the Late Würm material from Lezetxiki, Spain) are placed on the trend axis of the living Fennoscandian forms, whereas the unique specimen of *G. gid-*

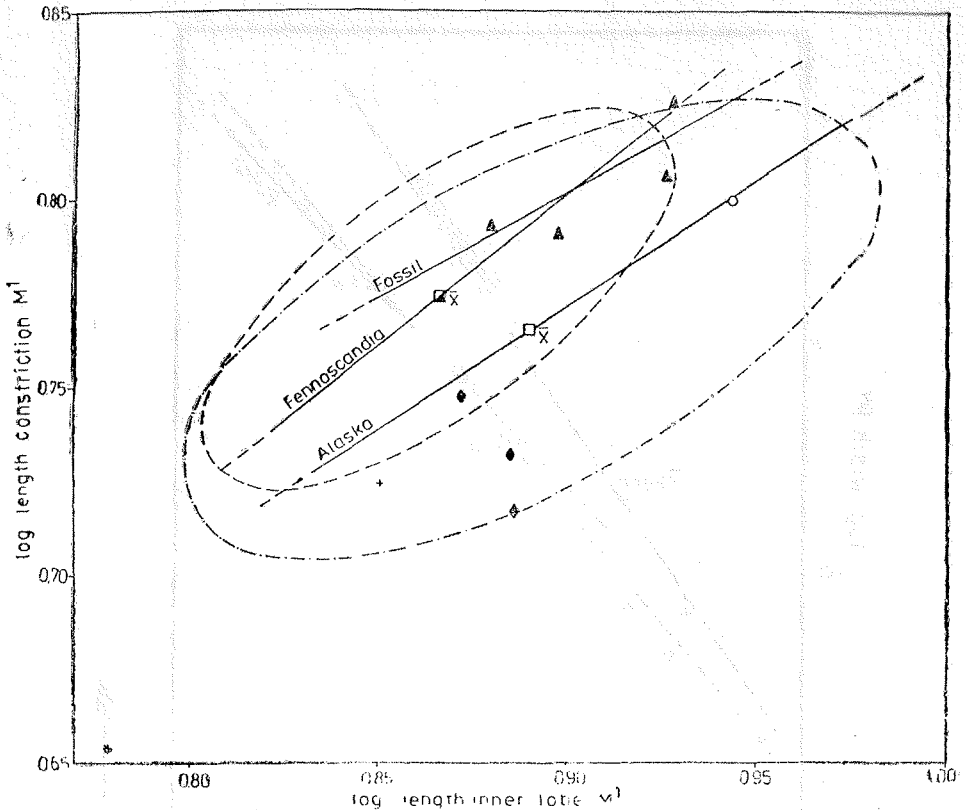


Fig. 6. — Allometric relationships between the length of the upper molar (M^1) (measured anteroposteriorly across the middle constriction) and length of the inner lobe. Ellipses are for 95% (dashed line for *G. gulo gulo* — Fennoscandia — and stippling line for *G. luscus* — Alaska); lines are reduced major axes. Symbols as in fig. 1.

leyi from Cumberland Cave, having a small size, is placed on the trend axis of the forms of Alaska, near the specimens from Canada (Thule), (fig. 6).

The axis of the samples from Fennoscandia and Alaska are almost parallel between them, but significantly distinct ($t = 4.0348$ for 52 DF).

The last glacial specimens have also been tested and compared with living forms from Alaska and Fennoscandia; the differences between these samples are also important, as showed by the following values:

Fennoscandia — Last glacial fossil $t = 2.8529$ for 25 DF

Alaska — Last glacial fossil $t = 6.3638$ for 29 DF

Similarly to the upper cheek-teeth, the lower ones are strongly imbricated. The first premolar (P_1), judging from its alveolus, was small sized and situated on the posterointernal part of the canine; the second premolar (P_2) is more shifted lingually as compared with the third premolar (P_3).

The fourth premolar (P_4), having the distal portion strongly widened overlaps externally with the anterior end of the carnassial.

This distal widening is lacking in *G. schlosseri* whose (P_4) is distinguished by a variable but less important difference between the mesial and distal widths oscillating from 0.3 to 0.4 mm with a mean of 0.33 mm.

The two (P_4) from Scocul Scorotei display higher values for the same difference, 1.3 and 1.2 respectively. On the (P_4) from Baia de Fier the difference is only 0.9 mm.

Generally speaking, the fourth premolar is narrower in Elsterian (Mosbach 3) and Würmian forms as compared with extant *Gulo* from Fennoscandia and even from Alaska. The Würmian material from the Duruitoarea Veche Cave (the Republic of Moldova) and Baia de Fier as well as a specimen of *Gulo gulo albus* from Siberia are distinguished by a ratio length/width of the fourth premolar which appear to situate them between the samples from Alaska and those from the Würmian of Europe (fig. 7).

The Rissian fossil (Tornewton Cave and partly Cumberland Cave) are placed under the trend axis of living forms from Alaska, but they have generally small sizes, whereas the specimens from La Fage and Santenay (France) are considerably larger.

Judging from this character, the differences between *G. spelaeus* and *G. schlosseri* ($t = 1.7847$ for 13 DF) and *G. schlosseri* and *G. gidleyi* ($t = 0.3984$ for 10 DF) are rather faint. Differences, statistically significant, have been registred between the following species:

G. spelaeus — *G. gidleyi* $t = 7.1137$ for 11 DF

G. luscus — *G. gidleyi* $t = 8.4276$ for 19 DF

G. luscus — *G. schlosseri* $t = 11.0049$ for 21 DF

G. luscus — *G. spelaeus* $t = 11.4356$ for 22 DF

We had the possibility to examine four lower carnassials (M_1) coming two from Scocul Scorotei, one from Baia de Fier and one from Duruitoarea Veche. The two specimens from Scocul Scorotei have a developed and lingually expanded talonid on which a small endoconid is outlined; this formation, according to the available data, was never mentioned for the genus *Gulo*. The talonid represents 23.77% of the whole molar on the mandibula connected to the skull and 23.58% on the other specimen from Scocul Scorotei. At the base of the paraconid, on the lingual side, the crown displays a vertical groove which seems to continue even on the root; this character appears to be proper to *G. gulo*. This groove is absent in *G. schlosseri*.

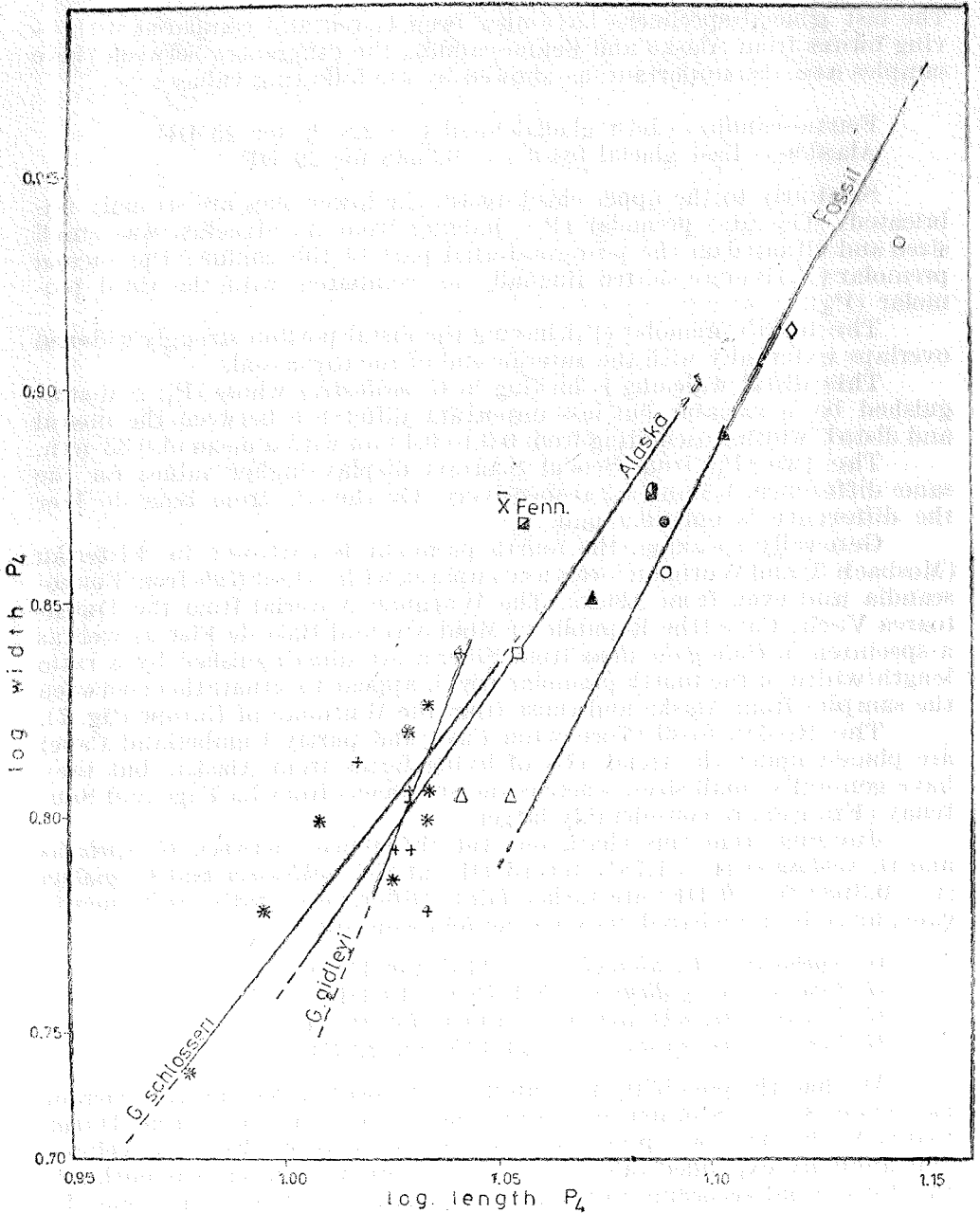


Fig. 7. — Relationships between length and width of P_4 in *Gulo*; lines are reduced major axes. Symbols as in fig. 1.

The carnassials belonging to the specimens from Baia de Fier and Duruitoarea Veche are distinguished by slightly developed talonids, occupying 21.74% and 21.79% respectively of the length of the crown; on

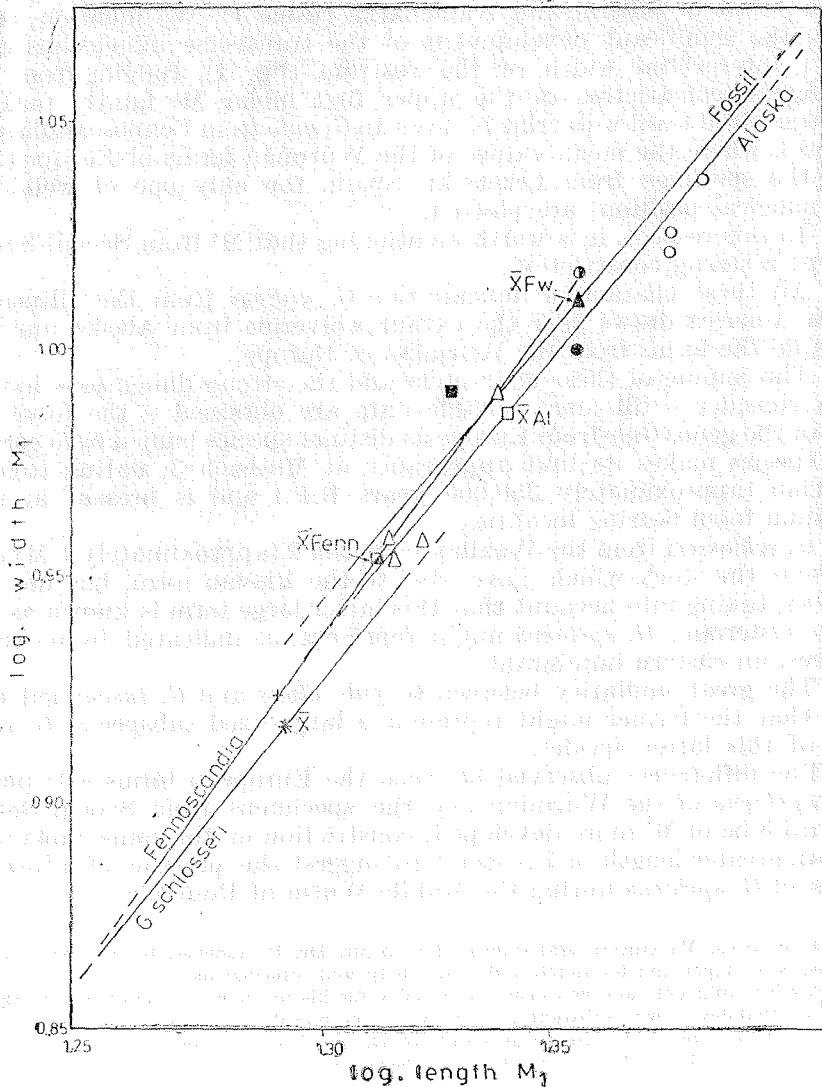


Fig. 8. — Allometric relationships length/width in lower carnassials (M_1) of *Gulo*; lines are reduced major axes. Symbols as in fig. 1.

these molars only the hypoconid is present. The groove placed at the base of the paraconid is very faint, almost absent. All the four carnassials we have examined are characterized, as their upper counterparts, by a finely wrinkled structure of the enamel.

DISCUSSION

Synthesizing the essential morphological feature of large-sized fossil *Gulo* of Europe, we point out a series of peculiarities which flatly draw it to *G. luscus* from the North of America and to *G. gulo albus* from the

North—East of Siberia and Kamchatka (table 1). We mention, in this sense, the significant development of the transverse dimensions of the skull: interorbital width of the rostrum (fig. 1). Judging from other characters (constriction of the upper first molar M^1 faintly outlined), the large-sized fossil wolverine is closer to *G. gulo* from Fennoscandia shown in fig. 6, where the mean values of the Würmian forms of Europe (including the specimen from Lezetxiki, Spain, the only one of well-known chronological position) are plotted.

In this respect, it is worth mentioning that M^1 from Scocul Scorotei present a strong constriction.

All these characters indicate that *G. gidleyi* from the Illinoian of North America draws near the extant wolverine from Alaska and Siberia as do the forms from the Würmian of Europe.

The joining of these characters and the strong dimensions have led us to consider — till more reliable data are obtained — the fossil large form of the genus *Gulo* from Europe as distinct species named *Gulo spelaeus*. This species makes its first appearance at Mosbach 3, dating from the Elsterian (approximately 350,000 years B.P.) and is present at many Würmian fossil bearing localities.

G. schlosseri from the Waalian of Betfia 2 (approximately 1. My) may represent the stock which gave rise to the Rissian form, but not to *G. spelaeus*, taking into account that this latter large form is known as early as the elsterian; *G. spelaeus* might represent, as indicated by its cranial features, an eastern immigrant.

The great similarity between *G. gulo albus* and *G. luscus* led us to think that the former might represent a large-sized subspecies *G. luscus albus* of this latter species.

The differences observed between the European forms attributable to *G. spelaeus* of the Würmian and the specimens from Scocul Scorotei (internal lobe of M^1 more developed, constriction of the same molar more marked, greater length of P_4) seems to suggest the presence of a new subspecies of *G. spelaeus* during the Middle Würm of Romania.

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