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**Taxonomic Value of Mandible Measurements
in *Soricidae* (Insectivora)**

[With 4 Tables & 5 Figs.]

Studies were made of variations in dimensions of the rostral part of the skull in 9 species of *Soricidae* of the genera *Sorex*, *Neomys* and *Crocidura*, originating from Central and West Europe (n = 3124). The postglenoid breadth is a useful taxonomic character for distinguishing three lowland shrews of the genus *Sorex* and is of supplementary significance in identification of skulls of the genera *Neomys* and *Crocidura*. Mandible length and height of *ramus mandibulae* are good diagnostic characters. The two mandible measurements set out on a diagram of their correlations make it possible almost completely to identify the majority of the species. *Sorex alpinus* is almost completely distinguishable from *S. araneus* on the basis of the mandibular index (mandible length : height of *ramus mandibulae*). These methods can be applied practically in identification of fossil material or material originating from owl pellets under the conditions of Central Europe.

I. INTRODUCTION

In view of the increasing popularity of using owl pellets, for studying the composition of the food of these birds, and in zoogeography, the need has arisen for the elaboration of methods facilitating identification of different species (including *Soricidae*). As the material may be damaged to some extent it is essential to base findings on the best preserved elements.

In practice use has been made up to the present of both descriptive characters (Raczyński, 1961; Richter, 1964) and also of suitably chosen measurements of the rostral part of the skull (Buchalczyk & Raczyński, 1961; Richter, 1963; Bühler, 1964; Hamar & Simionescu, 1967; Schmidt, 1967 and 1969; and Rempé & Bühler, 1969).

It consequently appeared desirable to assess the practical usefulness of two measurements of the mandible applied simultaneously in the form of a correlation table (cf. Ruprecht, 1969) for distinguishing different

species of the genera *Sorex*, *Neomys* and *Crocidura*, in pairs differing little in respect of dimensions.

In addition a check was made of the usefulness of earlier data given by Buchalczyk & Raczynski (1961) on suitably numerous comparative material from different regions of Poland and Europe.

II. MATERIALS AND METHODS

Approximately 3124 specimens of *Soricidae*, belonging to 9 species, and originating from Poland, Czechoslovakia, Austria, Germany and Belgium, were used for these studies. The usefulness of mandible measurements was analyzed in the following pairs of species; *S. alpinus* — *S. araneus*, *S. caecutiens* — *S. minutus*, *S. caecutiens* — *S. araneus*, *N. fodiens* — *N. anomalus*, *C. leucodon* — *C. russula*, and also *C. leucodon* — *C. suaveolens*. Material from collections in the Mammals Research Institute of the Polish Academy of Sciences at Białowieża, Národní Muzeum in Prague, Zoological Museum of the Humboldt University, Berlin, Department of Zoology of the Agricultural College, Wrocław, and also the measurements of *N. fodiens* and *N. anomalus* from Fulda in Germany and Neusiedler See in Austria, which Dr. H. Pieper made available, were used for the above purpose.

Measurements were made of the rostral part of the skull with accuracy to 0.1 mm, as follows: (1) postglenoid breadth, (2) height of *ramus mandibulae* — the two first measurements after Buchalczyk & Raczynski (1961) and (3) mandible length measured from the pericentral margin of alveolus I_1 to the end of *proc. articularis mandibulae* (after Bühler, 1964).

In the case of a pair of species of similar dimensions (*S. alpinus* — *S. araneus*, calculation was made of the mandibular index — mandible length : height of *ramus mandibulae*).

Significance of differences between average values was checked as necessary by the *t*-Student test for comparison of averages of independent groups.

III. RESULTS

3. 1. *S. alpinus* — *S. araneus*

These species cannot be distinguished on the basis of absolute values of three measurements of the skull, as the ranges of their variations overlap to a great extent (Table 1).

It is, however, possible almost completely to separate the two species by means of the mandibular index (mandible length : height of *ramus mandibulae*) — (Fig. 1, Table 2).

This fact is due to the different proportions in the structure of the mandible in these shrews. *S. alpinus* is distinguished by an elongated mandible (avg. = 9.98 mm), with relatively low muscular process (*proc. coronoideus* — avg. = 4.00 mm) in relation to the more shortened (avg. = 9.62 mm) mandible, possessing a higher muscular process (avg. = 4.53 mm), in *S. araneus*.

Table 1
Comparison of skull dimensions for 9 species of *Soricidae* and values of correlation coefficient (r) for relation — mandible length : height of *ramus mandibulae*.

Species	Postglenoid breadth				Height of <i>ramus mandibulae</i>				Length of mandible			
	n	min — —max	$\bar{X} \pm$ SD	C.v.	n	min — —max	$\bar{X} \pm$ SD	C.v.	min — —max	$\bar{X} \pm$ SD	C.v.	r
<i>S. araneus</i>	1200	5.0—5.9	5.41 \pm 0.35	6.47	1200	4.0—5.0	4.53 \pm 0.26	5.85	8.8—10.4	9.62 \pm 0.43	4.53	0.55
<i>S. caecutiens</i>	85	4.5—4.9	4.65 \pm 0.28	6.08	80	3.5—3.9	3.66 \pm 0.26	7.24	8.0—8.6	8.37 \pm 0.36	4.30	0.33
<i>S. minutus</i>	300	3.9—4.4	4.15 \pm 0.10	2.41	286	2.7—3.1	2.91 \pm 0.20	6.87	6.9—7.8	7.44 \pm 0.25	3.36	0.27
<i>S. alpinus</i>	146	4.9—5.7	5.33 \pm 0.35	6.56	190	3.7—4.3	4.00 \pm 0.28	7.00	9.4—10.5	9.98 \pm 0.30	3.00	0.59
<i>N. fodiens</i>	195	5.9—6.7	6.33 \pm 0.28	4.47	216	4.5—5.3	4.92 \pm 0.25	4.98	10.6—12.3	11.45 \pm 0.50	4.36	0.45
<i>N. anomalus</i>	143	5.3—6.0	5.72 \pm 0.20	3.49	142	3.6—4.4	3.94 \pm 0.14	3.59	9.6—10.7	10.19 \pm 0.47	4.60	0.42
<i>C. leucodon</i>	442	5.7—6.8	6.36 \pm 0.30	4.71	391	4.2—5.1	4.60 \pm 0.26	5.75	9.4—10.8	10.08 \pm 0.17	1.72	0.73
<i>C. suaveolens</i>	60	5.3—6.0	5.69 \pm 0.20	3.51	61	3.4—4.3	3.94 \pm 0.24	6.22	7.9—9.4	8.90 \pm 0.24	2.75	0.77
<i>C. russula</i>	32	6.1—6.7	6.37 \pm 0.30	4.71	35	4.3—5.4	4.98 \pm 0.30	6.02	9.6—11.2	10.57 \pm 0.36	3.40	0.36

The values of this index were in fact found slightly to overlap in class 2.36, which corresponds to 0.08% of the specimens of *S. araneus* and 1.05% of *S. alpinus* (Fig. 1). The variability of this character is slight in the case of *S. alpinus* ($C. v. = 5.64\%$), and slightly higher in *S. araneus* ($C. v. = 9.48\%$) which is undoubtedly due to the fact that the material came from different parts of Poland.

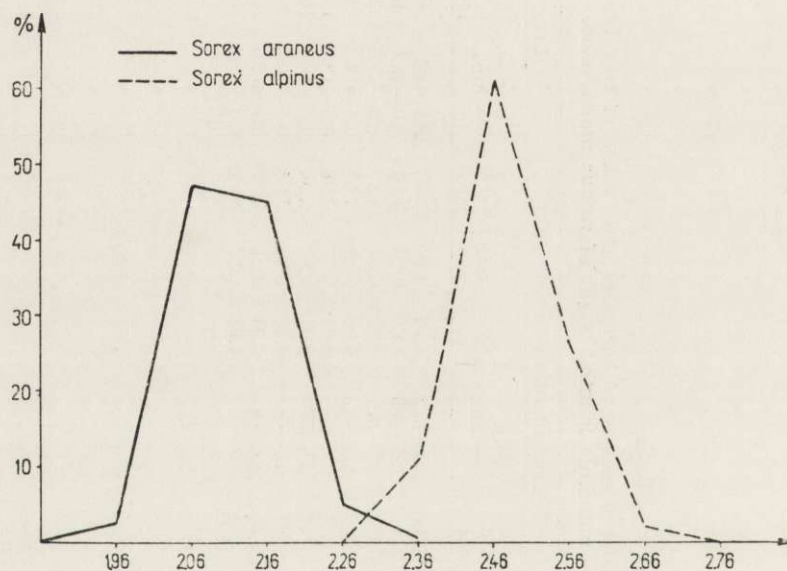


Fig. 1. Distribution in percentages of values of the mandibular index in *Sorex*.

Table 2
Ranges of variation in mandibular index for *S. araneus* and *S. alpinus*.

Species	n	min — max	$\bar{x} \pm SD$	C. v.
<i>Sorex araneus</i>	1200	1.95—2.36	2.11 ± 0.20	9.48
<i>Sorex alpinus</i>	190	2.36—2.70	2.48 ± 0.14	5.64

An equally satisfactory result was obtained when distinguishing between *S. alpinus* and *S. araneus*, and also for the remaining species of *Soricidae*, by correlating two measurements of the mandible — length and height of *ramus mandibulae*, after transferring them to the correlation table (Fig. 2). Under these circumstances a common class of mandible measurements was found for the two species — 9.9/4.2 mm, covering

0.08% of the specimens of *S. araneus* and 0.52% of *S. alpinus*. The variations in mandible measurements are not great in the two species, being slightly greater in the case of height of *ramus mandibulae* and postglenoid breadth (Table 1).

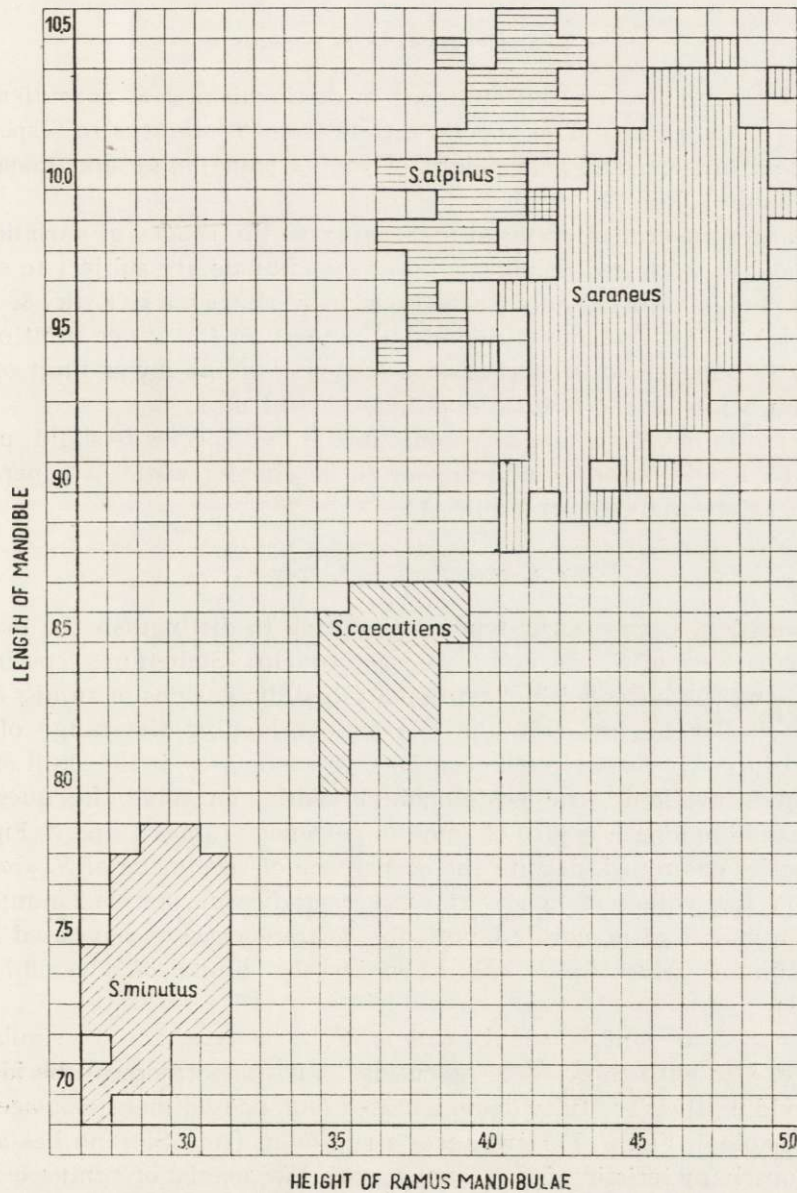


Fig. 2. Relation between mandible length and height of *ramus mandibulae* in representatives of the genus *Sorex*.

In *S. araneus* the maximum values of postglenoid breadth are 0.2 mm greater, and minimum values of height of *ramus mandibulae* 0.3 mm less than the earlier data given by Buchalczyk & Raczynski (1961). Thus the minimum values of *ramus mandibulae* approached the range of variations of this character characteristic of *S. caecutiens*.

3. 2. *S. caecutiens* — *S. minutus*

No great difficulty was encountered in distinguishing *S. caecutiens* on the basis of the results. This species differs from *S. minutus* in respect of postglenoid breadth and also height of *ramus mandibulae* and mandible length (Table 1, Fig. 2).

In a larger amount of material of *S. minutus* the ranges of variation of postglenoid breadth and height of *ramus mandibulae* are subject to slight changes comparable to the data gathered by Buchalczyk & Raczynski (1961). The author found an increase in the lower limit of 0.1 mm of the postglenoid breadth, and a lowering of the lower limit of the minimum height of the *ramus mandibulae* by 0.1 mm.

Variation in mandible measurements in the two species is slight, particularly its length which would appear to be characteristic in general of the dimension analyzed (cf. Table 1).

3. 3. *S. caecutiens* — *S. araneus*

Some difficulty may occur when attempting to distinguish the mandibles themselves of *S. caecutiens* and *S. araneus*. Sometimes specimens occur among the latter with exceptionally low dimensions of *ramus mandibulae*, similar to, and frequently even overlapping the range of variations of this character in *S. caecutiens*. In such cases, if the skull of the specimen is available, the postglenoid breadth can solve the question, while mandible length is also of some importance (Tables 1 and 3, Fig. 2). In the series examined, despite the occurrence of specimens of *S. araneus* with very low values of height of *ramus mandibulae* (3.9—4.2 mm), the minimum values of mandible length for *S. araneus* were separated from the maximum values for *S. caecutiens* by the limits of class 8.7 mm (Table 1).

It is possible to confuse small skulls of *S. araneus* which are similar in respect of size with those of *S. caecutiens*, but the former can be identified providing they are fully documented (e.g. body dimensions, age and sex) — Table 3, Fig. 3. For instance: a specimen from Sierzno has a Cb. dimension characteristic of *S. araneus*, with low height of *ramus mandibulae*. A 50-day old individual of *S. araneus* kept in captivity (Mamm. Res. Inst., coll. no. 91121), on the other hand, has Cb. characteristic of

Table 3
Body and skull dimensions of extremely small representatives of the genera *Sorex* and *Neomys*, obtained from Poland.

Genus	Locality	Coll. no.	Sex & age	Head & body	Tail	Hind foot	Ear	Body wt.,g	Cb.	Post-glenoid breadth	Height of ramus mand.	Length of mandible
<i>Sorex</i>	Sierzno, district Bytów ¹	60198	♀ juv	55.0	36.5	12.0	5.5	5.4	18.1	5.1	4.1	9.2
	Cegielnia, district Kielce ¹	37607	♂ juv	62.0	35.5	12.5	6.5	5.0	16.9	5.2	4.1	8.8
	Lidzbark Warmiński ²	—	juv	—	—	—	—	—	—	—	4.0	8.7
	Zarnowiec, district Puck ²	—	juv	—	—	—	—	—	—	—	3.9	8.7
	Jazy, district Augustów ¹	58950	♀ juv	64.9	31.9	12.7	7.2	6.2	17.4	5.4	4.2	8.8
	Bolewice, district Nowy Tomyśl ¹	77879	♂ juv	63.0	39.0	12.1	7.1	7.1	18.3	5.0	4.2	9.5
	Białowieża, district Hajnówka ¹	91121	♀ juv	55.7	35.5	—	7.0	4.0	17.4	5.3	4.4	8.9
<i>Neomys</i>	Płazów, district Lubaczów ²	—	juv	—	—	—	—	—	—	—	4.6	10.6
	Opole Lubelskie ²	—	juv	—	—	—	—	—	—	—	4.6	10.7
	Aleksandrów Kujawski ²	—	juv	—	—	—	—	—	—	—	4.5	10.5

¹ from trapping, ² from the owl pellets.

S. caecutiens (17.4 mm), and remaining skull dimensions proper to *S. araneus*. A specimen from Bolewice is the largest among the remainder (Cb. = 18.3 mm) but at the same time is an exceptionally young animal with minimum postglenoid breadth and with tooth crowns not completely erupted. Specimens from Cegielnia and Jazy have Cb. measurements coming within the range characteristic of *S. caecutiens* (16.9 and 17.4 mm), but other skull dimensions proper to *S. araneus*. In all five cases these were young individuals of *S. araneus* with postglenoid breadth values

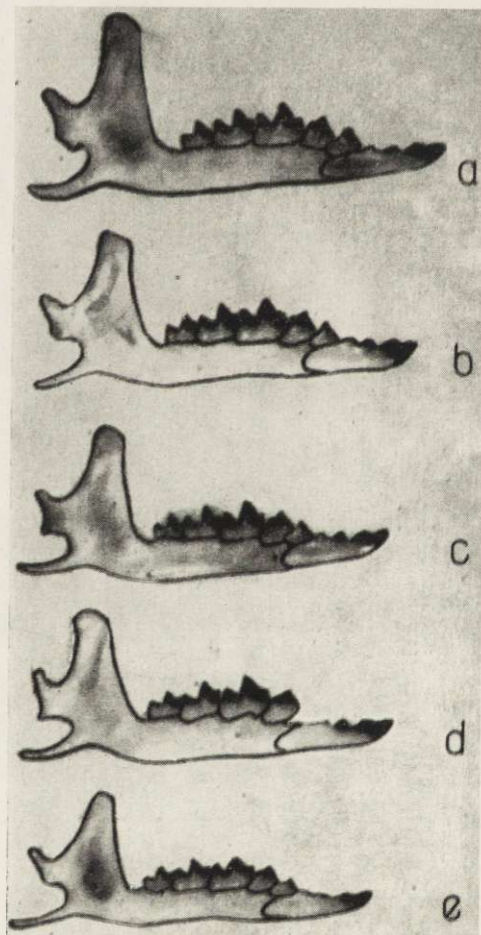


Fig. 3. Comparison of size of mandibles of the genus *Sorex*.

a — *S. araneus* from Białowieża, district Hajnówka, b — *S. araneus* from Bytów, district Sierżno, c — *S. araneus* from Cegielnia, district Kielce, d — *S. araneus* from Lidzbark Warmiński, e — *S. caecutiens* from Białowieża, district Hajnówka.

typical of this species. Specimens from Lidzbark Warmiński and Żarnowiec are the smallest mandibles in the collection from Polish territory and also belong to young animals, which allocates them to the species *S. araneus* with a high degree of probability, since it is difficult to accept that there are such young individuals of *S. caecutiens* distinguished by

relatively large, negligibly worn teeth and maximum mandible measurements.

To sum up the examples given it must be said that body measurements and Cb. length of the skull cannot form an absolutely certain basis for allocating such »atypical« specimens to the species *S. caecutiens*. A correct diagnosis can only be made if a whole complex of characters is taken into consideration.

3. 4. *N. fodiens* — *N. anomalus*

No great difficulty was encountered in distinguishing the two species of the genus *Neomys*, except in the case of three specimens (cf. Table 3). Mandible measurements were entered on the correlation table and then completely divided the two species, despite the fact that the values of their length dimensions partly overlapped each other (Fig. 4).

Postglenoid breadth exhibits a tendency in both species for the extreme values to overlap, nevertheless it can be of supplementary taxonomic value (Table 1).

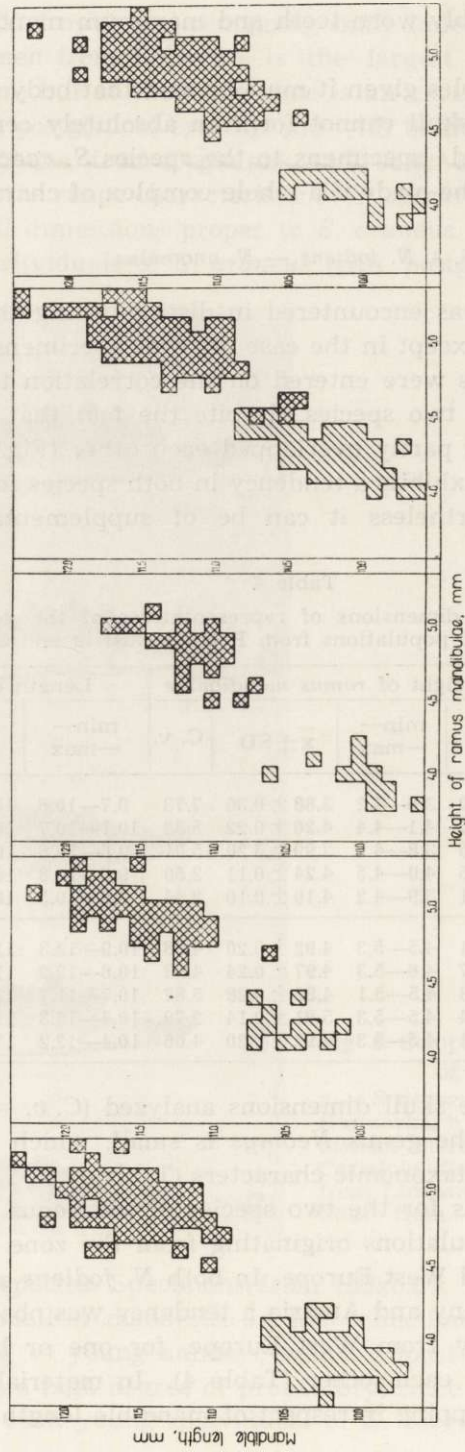
Table 4

Variations in mandible dimensions of representatives of the genus *Neomys* from five sympatric populations from Poland, Austria and Germany.

Species	Locum	Height of <i>ramus mandibulae</i>				Length of mandible		
		n	min— —max	$\bar{x} \pm SD$	C. v.	min— —max	$\bar{x} \pm SD$	C. v.
<i>N. anomalus</i>	Białowieża	109	3.6—4.2	3.88 ± 0.30	7.73	9.7—10.6	10.17 ± 0.49	4.82
	Bieszczady Mts	17	4.1—4.4	4.20 ± 0.22	5.32	10.1—10.7	10.48 ± 0.45	4.27
	Pomerania	16	3.8—4.2	3.99 ± 0.20	5.01	9.6—10.6	10.01 ± 0.32	3.16
	Neusiedler See	75	4.0—4.5	4.24 ± 0.11	2.59	9.6—10.8	10.21 ± 0.37	3.62
	Fulda	21	3.9—4.2	4.10 ± 0.10	2.44	9.6—10.5	10.04 ± 0.41	4.08
<i>N. fodiens</i>	Białowieża	101	4.5—5.3	4.92 ± 0.20	4.06	10.9—12.3	11.54 ± 0.43	3.77
	Bieszczady Mts	77	4.6—5.3	4.97 ± 0.24	4.93	10.6—12.2	11.49 ± 0.48	4.17
	Pomerania	38	4.5—5.1	4.82 ± 0.28	5.87	10.7—11.7	11.14 ± 0.30	2.69
	Neusiedler See	174	4.5—5.3	5.01 ± 0.14	2.79	10.4—12.3	11.42 ± 0.30	2.62
	Fulda	171	4.5—5.3	4.92 ± 0.20	4.06	10.4—12.2	11.24 ± 0.22	1.96

Variation in the three skull dimensions analyzed ($C. v. = 3.49—4.98\%$) in the two species of the genus *Neomys* is small, which justifies their being regarded as good taxonomic characters (Table 1).

Comparative materials for the two species of the genus *Neomys* were available from five populations originating from the zone of their sympatric range in East and West Europe. In both *N. fodiens* and *N. anomalus* from Poland, Germany and Austria a tendency was observed in some populations, particularly from West Europe, for one or both mandible dimensions to overlap each other (Table 4). In material from Poland a zone of mutual overlapping in respect of mandible length was observed



Białowieża 52°42'N, 23°50'E
 Bieszczady Mts. 49°14'N, 22°20'E
 Pomerania 54°47'N, 18°11'E
 Neusiedler See (Austria) 47°57'N, 16°52'E
 Fulda (West Germany) 50°36'N, 9°52'E

Fig. 4. Relation between mandible length and height of *ramus mandibulae* in five sympatric populations of *Neomys*.

in the population from Bieszczady Mountains (Cisna, district Lesko) out of the three examined (two remaining populations — Krokowa, district Puck — Pomerania and Białowieża, district Hajnówka — Białowieża Primeval Forest). In material from West Germany (Fulda) and Austria (Neusiedler See), on the other hand, values of two mandible dimensions were found mutually to overlap (Table 4).

Complete separation of the two species was, however, obtained on the correlation table, both for Polish and West European specimens, when ranges of variations in mandible dimensions were individually considered within each sympatric population separately (Fig. 4).

Three mandibles of *Neomys* were found, for which the species was not known, and which differed considerably in their lengths from typical dimensions for *N. fodiens*. On the correlation table they came in between the two species. Calculation of the index after B ü h l e r (1964), contained within limits 18.34—18.78, and detailed comparison with mandibles of both species justified the conclusion that they belong to *N. fodiens*.

3. 5. *C. russula* — *C. leucodon*

Skulls of two species of *Crocidura* cannot be distinguished on the basis of absolute values of the measurements used (Table 1). Even when the two measurements of the mandible were entered on the distinguishing diagram (Fig. 5) completely reliable results could not be obtained. The range common to both species falls in mandible length classes 9.6—10.8 mm and of height of *ramus mandibulae* 4.3—5.1 mm, containing 31.42% of the specimens of *C. russula* and 10.48% of *C. leucodon*.

3. 6. *C. leucodon* — *C. suaveolens*

Complete separation of these two species on the basis of absolute values of the measurements used, treated individually, is limited (Table 1), but postglenoid breadth may be of supplementary significance here (Table 1).

Complete separation of the two species could not be obtained even by using the correlation table (Fig. 5). The range in common, however, falls only on the following classes: mandible length 9.4 mm and height of *ramus mandibulae* 4.2—4.3 mm, covering 1.02% of the specimens of *C. leucodon* and 6.53% of *C. suaveolens*.

The fact merits emphasis that low values of mandible dimensions, as in the case of *S. araneus*, were observed only in very young representatives of *C. leucodon* (minimal wear of teeth) and that it seems likely that it is in fact their immaturity and consequently incomplete growth of the

skull which might have contributed to the degree of overlapping of their dimension values which was found in the range of *C. suaveolens*.

The variation in the dimensions of the rostral part of the skull found

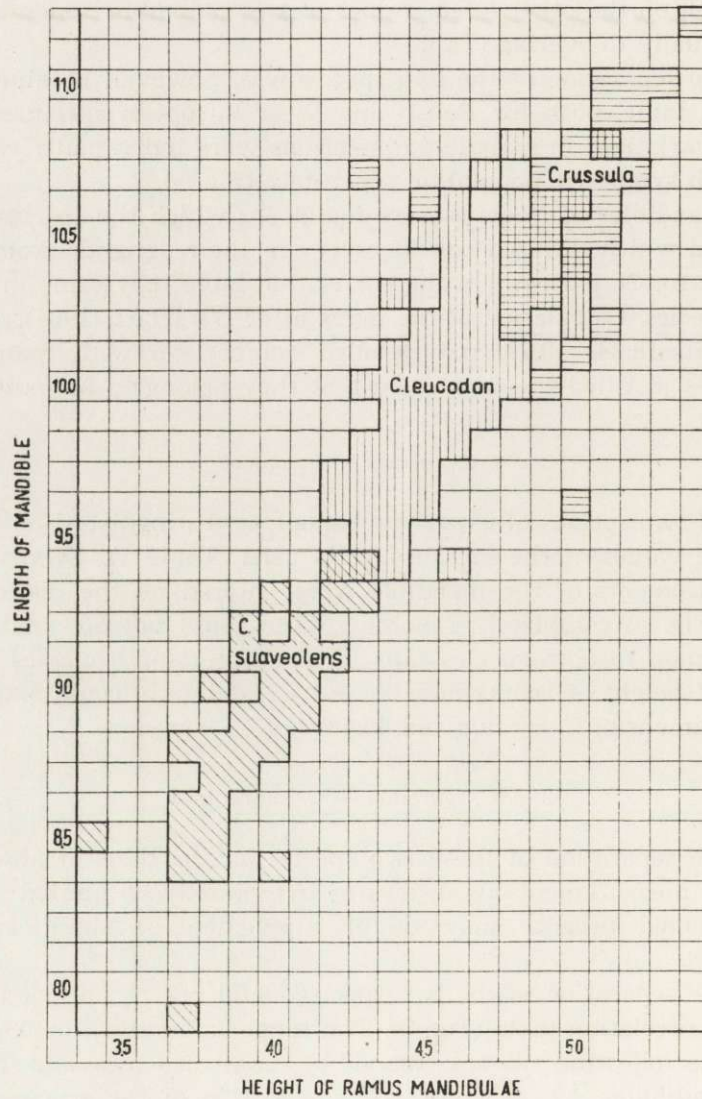


Fig. 5. Relation between mandible length and height of *ramus mandibulae* in representatives of the genus *Crocidura*.

in representatives of the genus *Crocidura* is also small in comparison with species belonging to the other genera examined (Table 1).

IV. DISCUSSION

In the case of the three lowland species of shrews of the genus *Sorex* and representatives of the genus *Neomys*, the measurements made of the rostral part of the skull possess full taxonomic value (Table 1, Fig. 2 and 4) and fully confirms the usefulness of the earlier data given by Buchalczyk & Raczynski (1961).

Analysis made to distinguish *S. alpinus*, on the basis of both the mandibular index and two mandible dimensions, gives a satisfactory result. This is of real practical importance, particularly as the double-peaked crown of tooth I_2 is not an adequate character for this purpose, since the crown becomes worn with age and these teeth might be missing in fossil material or material obtained from owl pellets. In addition, transitory irregular wear of the crown of I_2 , similar to the relations found in *S. alpinus*, may occur in some representatives of *S. araneus* (Dehnel, 1949).

The ranges of mandibular length mutually overlapped (1 specimen) in the sympatric populations of the two species of *Neomys* from Bieszczady Mountains and Fulda, while overlapping in both measurements of the mandible was observed in material from Neusiedler See (Fig. 4, Table 4). The latter case applied to the four specimens identified by Dr. H. Pieper as *N. fodiens*.

No mutual overlapping was observed in the height of *ramus mandibulae* in specimens obtained from three Polish populations, and from similar material from Hungary and Rumania (Schmidt, 1969; Hamar & Kovacs, 1964) and Fulda (West Germany). However, the West European species of this genus (Bühler, 1964; Meylan, 1967), frequently exhibit a considerable degree of mutual overlapping in values of the height of *ramus mandibulae*. It is thus only possible completely to distinguish between these species in western Europe by using a discrimination analysis (cf. Bühler, 1964; Rempe & Bühler, 1969). It was found, however, that this is not always essential, since relatively often it is possible to distinguish the two species of the genus *Neomys* solely on the basis of the height of *ramus mandibulae*. In addition, application of a correlation diagram to these populations in which mutual overlapping of different measurements of the mandible was found to occur permits complete distinction to be made between the two species (cf. Fig. 4).

Some authors have drawn attention to differences in dimensions between different populations of the two species of *Neomys*. For instance Pieper (1966) states that the height of *ramus mandibulae* in Europe in *N. anomalus* decreases from west to north-east and that *N. fodiens* exhibits the reverse trend. Meylan (1967) showed that *N. anomalus*

from Switzerland are larger than individuals of this species from Białowieża (cf. also Kratochvíl, 1954). These authors encountered difficulty on account of these differences in distinguishing between the two species in West Europe. It would, however, be difficult to describe a clearly directional trend in variations here, when it is remembered that differences in the height of *ramus mandibulae* in *N. anomalus* from Białowieża are significantly different from both the eastern population from the Bieszczady Mountains, and also from the West European (Neusiedler See, Fulda) by ($0.01 > P < 0.05$ and $0.01 > P < 0.05$) respectively. The situation is similar in the reciprocal differentiation of dimensions in *N. fodiens* between different populations. It would also seem that these differences are shown synchronously, in the same degree in both species of *Neomys*.

It would appear that the facts found are primarily an expression of interpopulation differences. They undoubtedly depend to some extent on local conditions under which the given population of water shrews lives. It would be possible finally to interpret the significance of these differences, only if special studies were carried out.

The usefulness of the three dimensions of the rostral part of the skull in representatives of the genus *Crocidura* is relatively slight in relation to the pair of species — *C. leucodon* and *C. russula*, but far greater in the case of *C. leucodon* and *C. suaveolens*. In order to identify skulls of the genus *Crocidura* more exactly it would therefore be necessary as a basis to take the whole complex of measurements and descriptive characters given by Richter (1963 and 1964), and also the data given by Schmidt (1967), and Hamar & Simionescu (1967). Odontological characters have been shown to be completely unreliable in the light of data given by Buchalczyk (1958), Richter (1963) and Humiński & Wójcik-Migala (1967).

Analysis of comparative materials allowed the author to draw attention to representatives of *S. araneus* and *N. fodiens* distinguished by minimum dimensions of the skull. Cases of specimens with small body and skull measurements in *S. araneus* are not rare (cf. Kubik, 1951; Schubarth, 1958), but these authors define them by the term »dwarf« and base their assumption on fully documented representatives. In the present study attention was originally paid to them only on account of their minimum dimensions of the mandible.

It is difficult to assess the origin of the dwarf specimens of *S. araneus* and at present goes no further than hypothesis. Kubik (1951) assumes that these animals are shrews orphaned early on by their mothers, immediately after leaving the nest, and in consequence they bear lasting traces of starvation. The author's assumption is also likely, that owls

might have caught the shrews while still young and not fully grown, and that they were later found in the pellets. Such specimens may undoubtedly occur more often in owls' prey than in collections of *S. araneus* obtained by trapping. For instance a 13-day old specimen of *S. araneus* from captivity had a mandible length of 8.6 mm, and height of *ramus mandibulae* — 3.6 mm, and therefore it came within the ranges characteristic of *S. caecutiens*. This example, and also data from table 3, confirm the author's original assumption that minimum dimensions of the mandible in *S. araneus* may be primarily accounted for by the given individual having failed to complete postnatal development.

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TAKSONOMICZNA WARTOŚĆ POMIARÓW ŻUCHWY U *SORICIDAE*
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Streszczenie

Zbadano zmienność wymiarów rostralnej części czaszki u 9 gatunków *Soricidae* z rodzaju *Sorex*, *Neomys* oraz *Crocidura*, pochodzących z obszaru Europy środkowej i zachodniej (n = 3124). Materiał był analizowany w parach gatunków, wymiarowo mało zróżnicowanych. Zmienność trzech wymiarów części rostralnej czaszki u badanych gatunków jest niewielka. Długość żuchwy jest zmienna w najmniejszym stopniu w odróżnieniu od bardziej zmiennych — szerokości postglenoidalnej i wysokości gałęzi żuchwy (Tabela 1). *Sorex alpinus* jest prawie całkowicie odróżnialny od *Sorex araneus* na podstawie indeksu mandibularnego (długość żuchwy : wysokość gałęzi żuchwy) — (Ryc. 1, Tabela 2). Pewną trudność w oznaczeniu mogą nastręczać okazy ryjówek wymiarowo zbliżonych do *S. caecutiens*. W takich wypadkach, o ile możliwe, należy opierać się o kompleks cech pomiarowych ciała i czaszki (Ryc. 3, Tabela 3). Szerokość postglenoidalna jest dogodną cechą taksonomiczną dla wyróżniania trzech nizinnych ryjówek z rodzaju *Sorex* i ma ona znaczenie cechy uzupełniającej przy identyfikacji czaszek z rodzaju *Neomys* i *Crocidura* (Tabela 1 i 3). Obydwa wymiary żuchwy, zestawione na diagramie ich korelacji, umożliwiają prawie całkowite oznaczenie większości badanych gatunków (Ryc. 2, 4 i 5). W sto-

sunkowo najmniejszym stopniu, bo tylko w 68,6% są odróżnialne żuchwy *C. russula* i *C. leucodon*, w oparciu o dwa stosowane wymiary. Bardziej przydatną cechą opisową, pozwalającą na odróżnianie żuchw obu gatunków tych zębieńków, jest według Richtera (1964), zróżnicowanie morfologiczne *proc. angularis mandibulae*. U obu gatunków rzęsortków obserwowano mniejszą lub większą tendencję do wzajemnego zachodzenia wartości badanych pomiarów w pięciu populacjach. Zastosowanie diagramu korelacji obu wymiarów żuchwy w przypadku pięciu populacji sympatycznych obu gatunków *Neomys*, umożliwiło pełne ich rozdzielenie przy indywidualnym rozpatrywaniu każdej populacji (Ryc. 4). Metody te mogą znaleźć praktyczne zastosowanie przy identyfikacji materiałów kopalnych, względnie pochodzących ze zrzutek sów w warunkach Europy środkowej.