A C T A T H E R I O L O G I C A

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Morphological Characters of Mountain Populations of *Clethrionomys glareolus* (Schreber, 1780) and *Apodemus agrarius* (Pallas, 1773)

[With 2 Figs. & 5 Tables]

Morphological analysis was made of mountain populations of *Clethrionomys glareolus* (Schreber, 1780) and *Apodemus agrarius* (Pallas, 1771). Distinct morphological differences were shown to exist between high mountain and lowland populations of the bank vole. These differences are not, however, sufficient to justify considering the mountain populations of the Sudetes and Carpathians as a separate subspecies. The nominative subspecies thus occurs over the whole of Poland. Mountain populations of field mice do not differ from the lowland forms, which indicates that they are plastic only to a slight degree. It is suggested that the immigration of these mice in the mountainous parts of Europe is a new phenomenon which has lasted too short a time for to form qualitatively new characters. The nominative subspecies of the field mouse occurs in Poland.

I. INTRODUCTION

Mountain populations of small mammals differ in respect of dimensions and proportions of the body and skull from lowland populations. In some species these differences are so significant that many new subspecies have been described. The bank vole exhibits marked morphological differentiation within its geographical range. As a result a considerable number of subspecies have been described, some of them on the basis of scanty material and characters of little significance, and later the separateness of many of them has been questioned. The taxonomic problems of this species are, however, still a matter for discussion (Zimmermann, 1950; Corbet, 1964; Rossolimo, 1964; Claude, 1967, 1968; Serafiński, 1968). In the light of the estimate of, for instance, mountain populations there have been cases of fundamental contradictions in interpretation. The populations of the Carpathian and Sudetes Mountains have not been elaborated from this aspect. Only Zejda (1955) analysed

the Tatra population of bank voles, and on account of the lack of comparative data he put forward the cautious suggestion that it is close to *C. g. nageri* (Schinz, 1845).

The lowland populations have been given more detailed treatment in Poland — that from Białowieża (Wasilewski, 1952) and Wrocław (Haitlinger, 1965), and recently Serafiński (1968) undertook an assessment of intraspecies differentiation in the bank vole from the ecological aspect.

No mention has yet been made of mountain populations of field mice in Europe. It is difficult to establish whether this was due to an inadequate number of studies, or to a change in the situation in recent times as the result of successful migrations of this species to increasingly higher parts of mountains. It is a fact that field mice live in large numbers under foothill conditions in some regions, and even penetrate into the high mountain areas (Haitlinger, 1969). Isolated places of occurrence of this species under conditions difficult of access to them have been found previously (Haitlinger & Humiński, 1963). Morphological studies on *Apodemus agrarius* (Pallas, 1771) are particularly interesting since very little attention has so far been paid to them, and they have twice been analysed in detail in Central Europe (Haitlinger, 1962; Hamar, *et al.*, 1966).

During the last few years a series of bank voles and field mice have been obtained from mountain regions (Karkonosze, Góry Izerskie, Sudety Środkowe, Beskid Żywiecki). It will therefore be useful to trace the variations in the morphological characters of bank voles and mice from mountain populations and compare them with the characters of lowland populations from Wrocław, Pszczyna and the Koszalin.

II. MATERIAL AND METHODS

Bank voles and field mice were caught during the period from 1961—1968 in different places and at different altitudes above sea level, chiefly in the Karkonosze and Izerskie Mountains (Table 1). Smaller numbers of individuals were obtained from 1961—1963 from Ślęża (16°41′ E, 50°51′ N) and Góry Sowie (Jugów — 16°32′ E, 50°39′ N), and in the autumn of 1968 and spring of 1969 from Beskid Żywiecki (Milówka — 19°07′ E, 49°34′ N; Soblówka — 19°08′ E, 49°26′ N). Material from the Koszalin coast (Dąbki — 16°19′ E, 54°23′ N; Wicie — 16°29′ E, 54°30′ N) was obtained in July and August 1966 and 1967. I also had a small series of bank voles from Gryfów Śląski (15°25′ E, 51°02′ N) and field mice from Pszczyna (18°57′ E, 49°49′ N). Not only adult but also young animals were used for the comparisons.

The age of the field mice was estimated on the basis of the 5-degree scale of tooth wear used in the study by Haitlinger (1962); the age of bank voles in accordance with the system accepted in the study by Haitlinger (1965). Measurements of skulls were carried out under a measuring microscope with accuracy to 0.01 mm.

III. MORPHOLOGICAL ANALYSIS

1. *Clethrionomys glareolus* (Schreber, 1780)

The greater part of the measurements were made on bank voles from the high mountain areas (Table 1).

Bank voles in age groups II, III and IV belong to the summer and autumn generation, groups VI and VII are old adults. Voles born in the earlier part of the year were eliminated in view of the different course taken by morphological development in successive generations, although on account of the shortening of the reproduction period under conditions prevailing in high mountain areas this question becomes less important in this case.

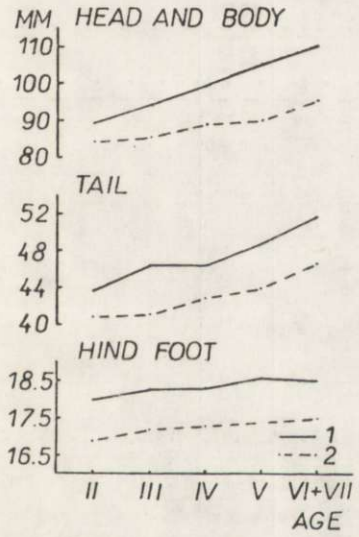

Fig. 1. Differences in some body measurements (average values) in bank voles from Wrocław and the Karkonosze mountains (higher parts) in successive age groups.
1 — High Karkonosze mountains, 2 — Wrocław.

The difference in growth rate in successive age groups between the Karkonosze and Wrocław populations is very distinct (Table 1). The Karkonosze voles in age group II attain the body size and tail length, and also body weight, typical of Wrocław individuals in age group IV. The average measurements of individuals in age groups V and VI—VII of voles from the higher and lower parts of mountains not only considerably exceed the average measurements given for lowland individuals (Wasilewski, 1952; Haitlinger, 1965), but also those of mountain bank voles considered as belonging to the *nageri* group (Claude, 1967). These differences would be even greater if group VII was completely separated.

The relative tail length varies in successive age groups but it was not possible to establish any dependence of this character on local conditions.

Table 1.

Average body and skull measurements in *C. glareolus* from Karkonosze Mts.
For age group V averages±S. D. and for group VI-VII also observed ranges are given.

Area	Karkonosze (900—1350 m a. s. l.)						Karkonosze (400—900 m a. s. l.)					
Age	II	III	IV	V	VI-VII		II	III	IV	V	VI-VII	
Head & body	89.4	94.7	99.7	105.3±4.00	102.4-122.3	110.2±4.82	88.4	92.7	98.9	102.6±4.94	100.4-118.3	107.2±4.41
Tail	43.9	46.8	46.4	48.9±3.67	45.6-59.8	51.6±3.10	42.2	43.7	49.3	49.0±3.64	43.0-58.8	48.7±3.92
Hind foot	18	18.3	18.3	18.6±0.55	17.2-19.4	18.5±0.58	17.8	18	18.1	18.3±0.96	17.0-18.9	18.2±0.48
Body wt.	16.7	19.8	21.9	26.4±4.21	20.5-38.5	29.5±4.31	15.0	17.1	20.7	23.9±3.60	22.5-36.0	26.7±3.10
Cb.-length	22.3	23.36	23.74	24.24±0.37	23.80-25.62	24.68±0.58	21.53		24.03		23.58-24.74	24.17±0.32
Lenght of skull	23.04	23.90	24.29	24.57±0.46	24.16-25.60	24.93±0.49	22.27		24.55		24.12-24.94	24.56±0.30
Basal length	20.56	21.54	22.07	22.56±0.48	22.13-24.13	23.06±0.64	19.88		22.35		22.03-22.97	22.42±0.33
Length of nasalia	5.82	6.32	6.35	6.67±0.28	6.33-7.26	6.81±0.26	5.81		6.35		6.18-7.06	6.73±0 26
Diastema	6.25	6.63	6.77	7.02±0.28	6.70-7.69	7.23±0.26	6.07		6.95		6.80-7.43	7.09±0 20
Lenght of frontale	8.84	9.06	9.22	9.39±0.17	8.73-10.18	9.42±0.46	8.48		9.48		8.70-9.56	9.25±0 24
Maxillary tooth-row	5.32	5.37	5.61	5.64±0.17	5.00-5.85	5.56±0.26	5.22		5.48		5.0-5.88	6.46±0.26
Occipital breadth	11.06	11.44	11.52	11.62±0.30	11.60-12.16	11.85±0.17	10.76		11.61		11.20-11.93	11 55±0.26
Interorbital constriction	3.88	3.93	3.91	3.88±0.30	3.81-4.11	3.97±0.10	3.86		3.94		3.78-4.09	3.94±0.10
n* 1	46	28	6	19	32		25	12	7	14	27	
n* 2	19	14	6	9	15		15		7		8	

* Number of measurements of the body (1) and skull (2).

The relative tail length is slightly smaller in mountain individuals (age groups V and VI—VII) (Fig. 1). When these relations were compared in the same range of body length (regardless of age) they proved to be identical in voles from both populations. With body length of over 100 mm increase in tail length takes place more slowly. In individuals from Wrocław with body length greater than 100 mm the relative tail length did not differ from that found for the Karkonosze population (49.2 to 48.5 mm). The principle difference consists in the Wrocław voles of more than 100 mm body length forming a minimum percentage of the animals obtained over a period of many years and are very old animals (age group VII), whereas the Karkonosze voles in these same ranges of body length are far younger.

The maximum differences are observed in the length of the hind foot. Even in age group II the average measurement for the hind foot is 0.5 mm longer than that of the oldest Wrocław individuals. This difference never falls below 1 mm in these same age groups. Fig. 2 shows that practically 60% of individuals from the Karkonosze population of age groups V—VI—VII comes outside the range of variation of this character in the Wrocław population. The length of the hind foot in high mountain voles exceeds on an average by 0.2—0.3 mm those from lower parts of the Karkonosze mountains (Table 1). This is also well illustrated by material obtained during the same period (September) from the Świeradów district (800 m above sea level) and Gryfów Śląski (350 m a.s.l.) about 8 km distant from each other in a straight line. Despite the fact that voles from Świeradów currently possessed smaller body measurements (86.4 to 89.6 mm), the length of the hind foot is 0.5 mm longer (18.1 to 17.6). Voles from Beskid Żywiecki were caught at an altitude of 500—700 m a.s.l. in October and November only, which narrowed their age differentiation. The morphological characters of these voles (length of foot) corresponds completely to the measurements of voles from the lower parts of the Karkonosze mountains (data from Table 2 refer to older voles from the higher zone of the mountains — 1200 m a.s.l.). Not all the voles from mountain areas exhibit measurements decidedly exceeding the analogical measurements in lowland voles. For instance individuals from Ślęża and Jugów (600—800 m a.s.l.) exhibit slower growth and lesser body, tail and foot length in comparison with the Karkonosze material. The first two measurements are closer to the Karkonosze individuals, but the length of foot to lowland voles (Table 2).

Despite the different climatic conditions the average values for foot length and also the distribution of these values in Wrocław and Ślęża populations differ to a minimum degree only. Voles in the lower parts of the Karkonosze were caught at altitudes from 400—700 m a.s.l., that

is, lower than Ślęża and under far more favourable climatic conditions. Despite this they are larger than voles from the Ślęża massif. Thus under similar conditions these characters are differently formed. The Ślęża massif is directly connected on practically all sides with the lowland areas surrounding it. In a straight line this distance is about 500 m. This relatively small distance from the summit zone makes migrations of

Table 2.

Average body and skull measurements of *C. glareolus* (VI—VII age groups) from mountain and lowland populations.

Arithmetical means ± standard deviations are listed.

Locality	Mountains				Lowland	
	Karkonosze 900—1350 m a.s.l.	Karkonosze 400—900 m a.s.l	Beskid Żywiecki	Ślęża Jugów	Dąbki	Wrocław
n	32	27	8	37	25	102
Head & body	110.2 ±4.82	107.2 ±4.41	105.1 ±5.89	104.7 ±3.75	102.8 ±3.80	96.2
Tail	51.6 ±3.10	48.7 ±3.42	49.0 ±4.80	48.4 ±2.98	46.4 ±3.16	46.7
Hind foot	18.5 ±0.58	18.2 ±0.48	18.4 ±0.64	17.7 ±0.60	17.06 ±0.40	17.5
Body wt.	29.5 ±4.31	26.7 ±6.22	25.5 ±6.22	26.3 ±3.22	25.3 ±3.83	18.4
n	15	8	8	14	8	102
Cb.-length	24.68 ±0.58	24.17 ±0.32	24.86 ±0.75	23.81 ±0.73	23.02 ±0.66	23.49
Length of skull	24.93 ±0 49	24.56 ±0.30	25.32 ±0.67	24.11 ±0.51	23.38 ±0.89	23.81
Besal length	23.06 ±0.64	22.42 ±0.33	23.83 ±0.58	22.18 ±0.76	21.48 ±0.41	21 87
Length of nasalia	6.81 ±0.26	6.73 ±0.29	7.11 ±0.48	6.65 ±0.29	6.51 ±0.32	6.34
Diastema	9.42 ±0.46	9.25 ±0.24	9.62 ±0.54	9.22 ±0.30	9.15 ±0.30	9.16
Length of frontale	7.23 ±0.26	7.09 ±0.2	7.36 ±0.35	6.69 ±0.33	6.80 ±0 20	6.60
Maxillary tooth-row	5 56 ±0.26	5.46 ±0.26	5.47 ±0.14	5.37 ±0 24	5.31 ±0.22	5.34
Occipital breadth	11 85 ±0.17	11.55 ±0.26	11.57 ±0.32	11.56 ±0.22	11.17 ±0.20	11.42
Interorbital constriction	3.97 ±0.10	3.94 ±0.10	3.94 ±0.20	3.87 ±0 14	3.86 ±0.10	3.88

individuals from the two populations possible in both directions. There is no situation making it possible for different characters to form, and also there is no contact with the true mountain populations. The population from the low parts of the Karkonosze is therefore, on account of the contacts between the lowland and mountain populations, a typical mixed population.

The external measurements of lowland voles do not always differ so markedly from those of voles from high mountain areas. For instance in 1965 (April—June) a series of individuals possessing large dimensions was obtained in Wrocław. Out of a total of 89 voles body length exceeded 100 mm in 48 of them (up to 116.3 mm). This approximately corresponds to the dimensions of voles from the lower parts of the Karkonosze, but the difference in length of the hind foot was maintained.

Dimensions of voles from the sea coast, apart from the slightly shorter tail, do not differ from those given for the Wrocław voles. Cb. length of the skull in voles from Beskid and Karkonosze is far greater than in lowland voles. Voles from Ślęża have intermediate Cb. length. Within these same ranges of body length it was only Cb. length in voles from the coast which is markedly smaller than in all the other populations.

The relation between the various skull dimensions and Cb. length in Wrocław and Karkonosze voles are almost identical (Table 1); on account of the far longer skull in the Karkonosze voles all the corresponding dimensions are greater. Differences occur in the length of the maxillary tooth row. Not only in age groups but in selected ranges of Cb. length the lowland voles and those from Ślęża have a shorter maxillar tooth row. Voles from the coast exhibit relatively (to Cb.) a longer nasalia and diastema, but occipital breadth is smaller (Table 2). It is, however, impossible to establish the appurtenance of the various individuals to a given population on the basis of any of these measurements.

2. *Apodemus agrarius* (Pallas, 1771)

The possibility of making a taxonomic analysis of field mice in the present study is somewhat limited, since the material obtained does not cover the full age scale. It is clear from the dimensions given in Table 4 that this species exhibits only slight morphological differentiation over the whole of the area examined. It is only the individuals from the Koszalin coast which have a minimally longer body and hind foot than individuals from the west and south of Poland. The data contained in Table 4 are the average values for the whole year, and are known to vary in successive months. Comparison of the average dimensions from the same month (July) even up these differences to a minimum. Field mice from mountain areas exhibit a tendency to reduction in length of the body and hind foot. The sole distinct difference in Cb. length between age group II mice and the remainder is due to the different allometric growth of Cb. in the spring-early summer generation.

Greater differences, chiefly in length of diastema and maxillary tooth row, occur between mice from Wrocław and the coast. All the popula-

tions examined, however, apart from the Wrocław population, possess long tooth rows. These divergences are thus of a local character.

IV. DISCUSSION

The problem of the taxonomic differentiation of bank voles and field mice in Poland has not yet been solved. The reasons for this are on the one hand an insufficient amount of comparative material, and on the other a certain degree of confusion existent in this field. According to some authors (Ognev, 1950) Poland is included in the geographical range of two subspecies: *C. g. glareolus* (Schreber, 1780) and *C. g. istericus* (Miller, 1909). The north-east areas are supposed to form transitional territory between *C. g. glareolus* and *C. g. suecicus* (Miller, 1900). No Polish author has made any detailed statements of opinion on this subject. The two more thoroughly elaborated populations from the north-east and south-west of Poland have been considered as belonging to the nominative subspecies (Wasilewski, 1952; Haitlinger, 1965). The mountain individuals differ distinctly from the lowland voles in respect of certain morphological characters and growth rate. New subspecies have been described in Europe from every higher mountain range, but discussion has been roused and differing opinions expressed in relation to voles from the Carpathians, in particular from the Tatras. Stein (after Hanzak & Rosický, 1949) expresses the view that voles from the Tatras should be considered as *C. g. nageri*; Zejda (1955) suggests the possibility of allocating the Tatra forms to a separate subspecies; Schaefer (after Hanzak & Rosický, 1949) and Serafiński (1968) consider that they have to do with the typical ecological form. Hanzak & Rosický (1949) allocate voles from Czechoslovakian territory, including those from the most varied mountainous parts, to the nominative subspecies. In doing so they reject the opinions of their predecessors, who considered that voles from the lower parts of Czechoslovakia belong to *C. g. istericus*, and consider this subspecies as a synonym of the nominative subspecies.

Fundamental differences in external characters between mountain and lowland voles are manifested in the relative length of the tail and absolute length of the hind foot. It is clear from the data given in this study that a relatively long tail is not a character typical of all the mountain individuals. Voles from the Sudetes and Carpathians have a relative tail-length even smaller than that of lowland individuals (Fig. 2). The Tatra populations have short tails (Zejda, 1955). The variety of the voles' reactions to similar habitat conditions in different parts of Europe is thus marked (long tails of the Central Alps and Pirin; short tails of the

Carpathian Sudetes mice). As one of the typical characters of voles from the *nageri* group is the relatively long tail, exceeding 50% of body length, the Sudetes and Carpathian voles cannot be allocated to this group. There is no justification for accepting them as mixed forms, as Zimmermann (1951) does. The mountains referred to are covered from all sides by the range of one lowland subspecies (*C. g. glareolus*); there is absolutely no contact with the *nageri* group.

The difference separating mountain populations from lowland populations of *C. g. glareolus*, although marked, does not form grounds, on the

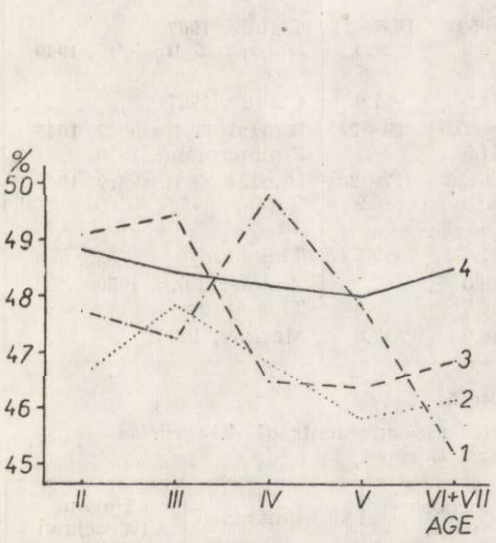

Fig. 2. Variations in relative tail length in voles from mountain and Wrocław populations, in successive age groups. 1 — Low Karkonosze mountains, 2 — Ślęża, 3 — High Karkonosze mountains, 4 — Wrocław.

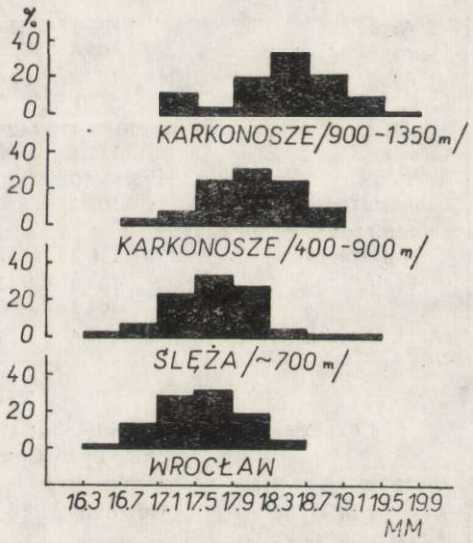

Fig. 3. Range of variations in length of hind foot (in %) in voles from mountain populations of the Sudetes mountains and lowland populations from Wrocław (V—VI—VII age group).

basis of the characters mentioned, for treating mountain populations in the form of an independent taxonomic unit. The results obtained by morphophysiological studies are similar (Kostelecka-Myrcha, Gębczyński & Myrcha, 1970). The differences between them are, however, greater than between Alpine and lowland subspecies from Central Europe. For instance, differences between the Sudetes and Carpathian (Beskid, Tatra) populations and the lowland population (Białowieża, Wrocław are greater than between *C. g. helveticus* (Miller, 1900) and *C. g.*

nageri (C l a u d e, 1967, 1968) (Table 3). Populations from West, Central, North and East Europe are generally characterized by lesser relative tail length than populations from South Europe. The presence in the high eastern Alps of the short-tailed form *C. g. ruttneri* (W e t t s t e i n, 1926) may suggest that the Alps should be considered as the borderland for two (in the wide sense) populations of voles — the south and east. The

Table 3.

Comparison of the body measurements of *C. glareolus* from different mountains of Europe.

Area and subspecies	Head & body	Tail	Hind foot	Author
Alps,	107—114	51—59	18.6—21	Claude, 1967
C. g. nageri	101.8	59.6	18.9	Hanzak & Rosický, 1949
Alps,				
C. g. helveticus	98.0	54.0	17.9	Claude, 1967
Alps,	101—119	42—60.5	19—21	Hanzak & Rosický, 1949
C. g. ruttneri	111.5	57.9		Zimmermann, 1950
Tatra	82—105	38—55	17—20	Hanzak & Rosický, 1949
C. g. glareolus	103.1	50.0	18.9	Zejda, 1955
Sudetes				
C. g. glareolus	110.2	51.6	18.5	This study
Pirin	103.3	52.0		Zimmermann, 1950
	104.7	54.7	18.8	This study
Stara Planina	102.4	46.9	17.6	Markov, 1968

Table 5.

Comparison of the body and skull measurements of *A. agrarius* from Central Europe.

Country	Germany	Czechoslo-vakia	Rumania	Poland (Wrocław)
Author	Miller, 1912	Kratochvil & Rosicky, 1952	Hamar *et al.*, 1966	Haitlinger, 1965
Head & body	97—115	99.9	96.5	100.9
Tail	71—84	73.2	72.6	72.2
Hind foot	18—21	18.8	19.5	18.8
Cb.-length			23.10	22.80
Length of nasalia			9.12	8.70
Diastema			6.45	6.61
Maxillary tooth-row			3.87	3.81

glareolus form occupying territory to the north, east and west of the Alps and in the south, possibly as far as Stara Planina (on the basis of measurements given by M a r k o v, 1968) created separate mountain forms in the Sudetes and Carpathians (not having contact with voles from the south) and intermediate forms on the fringe of the Alps.

Table 4.

Average body and skull measurements of *A. agrarius* from different localities (III—V age group). Arithmetical means ± standard deviations are listed.

Locality	Karkonosze	Beskid	Gryfów Śl.	Wicie, Dąbki	Wrocław	Pszczyna	Wrocław	Pszczyna	Wrocław	Wicie, Dąbki
Age group	III	III	III	III	III	IV	V	V	V	V
n	46	24	13	11	231	11	125	8	60	13
Head & body	86.7±3.35	82.7±5.16	85.6±3.90	96.2±4.73	81.0	91.5±4.32	90.4	98.5±5.01	100.9	105.6±3.39
Tail	70.0±4.59	67.9±2.91	71.1±4.97	72.3±3.50	69.9	71.8±3.29	74.9	78.3±2.98	79.2	80.1±3.91
Hind foot	18.6±0.45	18.2±0.52	19.1±0.65	18.0±0.56	18.6	18.2±0.58	18.8	18.6±0.71	18.8	19.1±0.62
Body wt.	16.9±2.37	15.5±2.68	13.7±1.47	21.8±3.53	14.5	17.5±3.16	17.8	21.1±4.18	22.7	31.7±3.99
n	46	24	13	11	219	11	125	8	35	10
Cb.-length	21.16±0.49	20.99±0.62	21.14±0.37	21.49±0.48	20.99	21.99±0.49	21.82	22.75±0.45	22.80	23.11±0.68
Length of skull	22.49±0.50	22.27±0.61	22.47±0.36	22.91±0.37	22.14	23.01±0.43	22.82	23.54±0.62	23.81	24.08±0.32
Basal length	19.27±0.50	19.00±0.70	19.24±0.35	19.46±0.55	18.96	20.08±0.54	19.53	20.57±0.75	20.84	21.30±0.47
Length of nasalia	8.08±0.30	7.98±0.24	8.04±0.14	8.19±0.32	8.05	8.48±0.22	8.35	8.69±0.20	8.70	9.13±0.30
Length of frontale	6.22±0.20	6.11±0.22	6.26±0.17	6.47±0.22	5.96	6.54±0.12	6.25	6.71±0.20	6.61	7.06±0.32
Diastema	7.82±0.30	7.73±0.33	7.97±0.33	7.92±0.33	8.08	7.93±0.35	8.31	8.00±0.26	8.63	8.23±0.20
Maxillary tooth row	3.77±0.10	3.52±0.24	3.75±0.14	3.71±0.10	3.56	3.76±0.10	3.56	3.76±0.20	3.62	3.81±0.17
Occipital breadth	10.39±0.22	10.39±0.22	10.44±0.20	10.46±0.32	10.20	10.67±0.17	10.44	10.81±0.34	10 61	10.79±0.20
Interorbital	4.02±0.10	3.96±0.10	4.05±0.10	4.08±0.11	4.05	4.04±0.17	4.03	3.96±0.37	4.08	4.17±0.10

The above formulation of this problem throws doubt on the reality of many of the taxonomic units within Europe. Wasilewski (1952) considered that division into subspecies within *C. glareolus* cannot be established by means of differences in the skull. The external characters, and in particular Wettstein's coefficient, do not make it possible to define appurtenance to subspecies. Mayr (1965) rightly warns researchers against hasty description of new subspecies on the basis of biometric analysis, where differences are only small. The criterium proposed by Corbet (1964) that it should be possible to identify at least 90% of the individuals in a given population, should surely be considered the best and duly applied.

In the light of the present study and literature it must be accepted that only the nominative subspecies *Clethrionomys glareolus glareolus* (Schreber, 1780) occurs in Poland.

Field mice do not present such taxonomic problems. Two doubtful subspecies differing very little have so far been distinguished in Europe: *A. a. agrarius* (Pallas, 1771) and *A. a. karelicus* Ehrström, 1913. The lack of a sufficient number of studies of a morphological and taxonomic nature makes it difficult to establish significant differences between these forms, most often distinguished from each other on the basis of differences in colour (Argyropulo, 1940). Krachovil & Rosický (1952) in Czechoslovakia and Hamar *et al.* (1966) in Rumania establish the presence of the nominative form. Haitlinger (1962) in analysing the Wrocław population, did not express any definite opinion on this subject. On the basis of the present data it may be accepted that the whole of Poland is occupied by a uniform population which must be considered as belonging to *Apodemus agrarius agrarius* (Pallas, 1771) (Table 4, 5). The absence of morphological differentiation in field mice from foothill and mountain areas is interesting, as it is a well known fact that the reverse situation prevails in Asia (Sviridenko, 1943). It would seem that the causes should be sought for in the relatively recent and progressing occupation by field mice of this habitat in Central Europe.

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CECHY MORFOLOGICZNE GÓRSKICH POPULACJI NORNICY RUDEJ I MYSZY POLNEJ

Streszczenie

1. Górskie populacje nornic wyraźnie różnią się morfologicznie od populacji nizinnych, należących do podgatunku nominatywnego. Odmiennie też przedstawia się tempo ich rozwoju (Tabela 1; Ryc. 1).

2. Populacje górskie posiadają wszystkie wymiary odpowiednio większe. Są tu jednak zależności allometryczne i w odpowiednich klasach długości ciała u obu populacji zależności te kształtują się na ogół podobnie, z wyjątkiem długości tylnej stopy i długości górnego szeregu zębowego. Na podstawie pierwszej z tych cech można wyodrębnić 60% osobników VI—VII grup wiekowych od okazów nizinnych. Długość stopy już u osobników II grupy wiekowej (w przeciętnych) przekracza średnie dla najstarszych okazów populacji nizinnych (Tabela 2; Ryc. 1—3).

3. Górskie populacje z Karpat i Sudetów różnią się od alpejskiej grupy *nageri* względną długością ogona. Względna krótkoogonowość form sudecko-karpackich wskazuje na ich związek z nizinnymi populacjami środkowej Europy należącymi do *C. g. glareolus*. Przypuszcza się, że długoogonowe populacje alpejskie mają związek z nizinnymi długoogonowymi populacjami południowymi. Nie wykluczone, że w rozgraniczeniu ich należy szukać przyczyn historycznych (Tabela 3).

4. Populacje z pogórza i podnóża wyższych partii gór wykazują cechy pośrednie między populacjami wysokogórskimi i nizinnymi. Nie są one jednak wprost proporcjonalne do różnicy wzniesień npm. Przypuszcza się, że odgrywa tu rolę usytuowanie terenu; w niskich górach otoczonych bezpośrednio przez obszary nizinne cechy morfologiczne nornic nie różnią się od cech okazów nizinnych (Ślęża), co wynika z permanentnego mieszania się form nizinnych z przebywającymi w wyższych partiach i małej „głębokości" tej strefy. W strefach o większej „głębokości" i przy stałym kontakcie z formami wysokogórskimi cechy morfologiczne nornic z niżej położonych terenów są pośrednie (Tabela 2).

5. Nizinne i górskie populacje nornic z obszaru Polski należą do podgatunku nominatywnego *C. g. glareolus* (Schreber, 1780) (Tabela 2).

6. Cechy morfologiczne myszy polnych z kilku wybranych miejsc kraju nie wykazują różnic. Na tej podstawie oraz w konfrontacji z literaturą przyjmuje się, iż należą one do podgatunku nominatywnego *A. a. agrarius* (Pallas, 1771) (Tabela 4, 5).

7. Górskie populacje myszy polnych nie różnią się od form nizinnych co wskazuje na ich słabą plastyczność. Sugeruje się, że imigracja w tereny górskie jest na obszarze Europy zjawiskiem nowym i zbyt krótkotrwałym dla wytworzenia nowych jakościowo cech.