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

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Ryszard HAITLINGER

Morphological Variability of the Wrocław Population of *Apodemus sylvaticus* (Linnaeus, 1758)

[With 4 Figs. & 7 Tables]

Morphological analysis of 301 long tailed field mice captured in ruderal terrains of Wrocław in the years 1959—1965 was carried out. Four groups of dimensions showing different rate of growth were distinguished. The greatest increment during the whole life outside the nest (45%—192%) has been stated in the lengths of body and tail, and in body and skull weights. The increment of an intermediate intensity (18.5%—32%) was observed in: the Cb., total, basal lengths and in the length of nasal and frontal bones, in the zygomatic breadth, the palate depth, diastema and ear. The lack of increment or a minimal one (3.5%—12%) has been stated in: the length of hind foot, the occipital breadth the interorbital constriction, and the depth of brain case. A drop in the absolute value of dimensions (3.3%—4.1%), below the values attained by individuals of the age-group I or II, has been observed in the lenght of sagittal suture, the length of the maxillary tooth row, and the breadth of interparietal bone. The ratio: skull weight/body weight is different in each of the three species of the genus *Apodemus* (*A. sylvaticus*, *A. agrarius*, *A. tauricus*). Sexual dimorphism has been observed in most of the investigated dimensions. Long tailed field mice occuring in Poland belong to the nominal subspecies *Apodemus sylvaticus sylvaticus* (Linnaeus, 1758).

I. INTRODUCTION

Although *Apodemus sylvaticus* is one of more common species of small rodents occuring in Poland, a large series of those animals is hardly obtained in the course of the whole year, since they do not appear in great numbers in their habitats. For this reason long tailed field mice is not an object calling a wide interest in Poland, and all data concerning this species, found in the literature of this country bear a rather contributive character. In other countries the situation is quite different.

Species belonging to the subgenus *Sylvaemus* Ognev & Vorobiev, 1923, are the twin ones, and according to some opinions, able to hybridization. Having many morphological features closely resembling, their identification is much difficult, and therefore the common interest has been chiefly concentrated on the taxonomical problems (Felten, 1952; Larina, 1958; Bothschafter, 1963; Witte, 1964; Amtmann, 1965; Hamar *et al.*, 1966; Steiner, 1968; and others). A little attention has been paid to morphological changes in the structure of the skull and body taking place in the course of individual life and in various seasons of the year (Felten, 1952; Hamar *et al.*, 1966; Saint Girons, 1966).

The purpose of the present study is to fill up the lacking data. Since the material being at my disposal is not numerous, the paper has a rather preliminary character, and should be completed, especially in observations on morphological development of generations born in different seasons of the year.

II. MATERIAL AND METHODS

Long tailed field mice being taken solely from the Wrocław area have been captured in ruderal terrains in the years 1959—1965. The whole material (301 individuals) has been divided into 5 age-groups. Tooth wear was taken as criterion of the age (Table 1). The age-group II was been subsequently divided into 2 subgroups, according to the Cb.-length.

Table 1.

Complete list of *Apodemus sylvaticus* captured.

Age group	Months												Total
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
I			1			8	1	1	2				13
IIa					2	2	2	3	1	15		2	27
IIb	3		1	4	4	11	2	8	5	18	21	2	79
III	24	12	8	2		4	1	3	11	17	22	24	128
IV	2	3	7	2	8	4	1	1	3		3	4	38
V			1	3	3	3	1	4			1		16
Total	29	15	18	11	17	32	8	20	22	50	47	32	301

Group I — individuals in which M^3 is not fully developed — 3—5 weeks old.

Group II — individuals with complete dentition. No signs of the abrasion of tooth cusps — 1—2 month old.

II a — individuals in which Cb.-length does not exceed 20 mm,

II b — individuals in which Cb.-length exceeds 20 mm.

Group III — individuals in which tooth are distinctly worn — 2—5 months old.

Group IV — individuals in which tooth wear is much advanced especially well seen in M^3 — 4—9 months old.

Group V — individuals in which the surface of cusps is completely worn. More than 8 month old.

The above scheme corresponds to the classification made for stripped field mice (Haitlinger, 1962) but is not satisfactory in case when the range of age of individuals belonging to higher age-groups is to be strictly determined. Analysis of the distribution of the material could not yield satisfactory results because of too small number of individuals captured in separate months. Therefore the ranges of absolute age give only a rough information. A similar classification has been made for *A. sylvaticus* by Felten (1952) and Saint-Girons (1966). The above authors distinguished, however, a smaller number of groups.

Skull measurements were taken under a microscope with the accuracy to 0.01 mm, the skulls (without maxillae) were weighed with the accuracy to 0.5 mg. Significance of differences was tested by Student test for comparing two independent groups.

III. THE INCREASE IN THE DIMENSIONS OF THE SKULL AND BODY

The growth rate of the separate dimensions of the body and skull in *A. sylvaticus* has a course similar to that observed in other related species. Within the first phase of the life outside the nest the growth rate is in general more intense, running with various intensity in the course

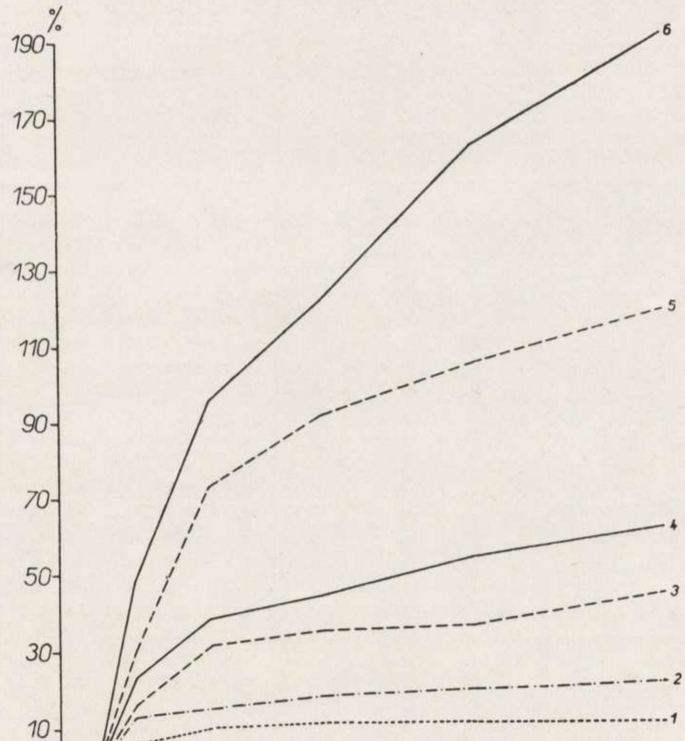

Fig. 1. The increment in the lengths of: hind foot (1), ear (2), tail (3), body (4), and weights of: skull (5) and body (6).

of the further development. Four groups of dimensions may be distinguished, according to growth rate (Fig. 1—3). A very intense increase (from 45% to 192%) in the whole life outside the nest has been stated in: weights of the body and skull and lengths of the body and tail. An intermediate increase (from 18.5% to 32%) during the whole or almost whole life outside the nest has been stated in total and basal lengths and those of nasal and frontal bones, the zygomatic breadth, the palatal depth, diastema and the length of ear. A minimal or a complete lack of increase (from 3.5% to 12%) have been stated in: the hind foot length, occipital breadth, the interorbital constriction and the depth of brain case (measured between *bullae tympanici*). A drop in absolute value of the dimensions (from 3.3% to 4.1%) below the values attained by individuals of the age groups I or II, has been observed in: the length of sagittal suture and of maxillary tooth row and in the breadth of interparietale.

Table 2.

Growth of body and skull

Age group	I					IIa					IIb	
	Min.	Avg.	Max.	n	S.D.	Min.	Avg.	Max.	n	S.D.	Min.	Avg.
Head & Body	50.5	60.6	74.5	12	6.20	67.8	74.8	83.8	26	4.95	74.1	84.1
Tail	47.0	57.3	72.2	12	6.95	57.8	66.7	76,5	23	4.82	63.5	75.5
Hind foot	16.4	18.7	21.2	12	1.48	18.3	19.9	21.0	26	0.68	19.0	20.7
Ear	11.9	13.4	15.2	11	1.16	13.7	15.2	16.8	10	0.90	14.0	15.5
Body wt.	5.0	7.5	10.5	12	1.70	8.0	11.1	17.5	27	2.21	10.3	14.7
Cb. length	17.2	18.0	18.7	8	0.51	18.3	19.1	20.0	29	0.60	20.0	21.0
Length of skull	19.0	19.6	20.2	8	0.46	19.7	20.7	21.7	29	0.55	21.1	21.8
Basal length	15.1	16.0	16.5	8	0.48	16.1	17.0	18.0	29	0.60	17.6	18.9
Length of nasalia	5.9	6.6	6.9	8	0.32	66.8	7.2	7.9	25	0.27	7.4	8.1
Length of frontale	6.8	7.3	8.2	8	0.39	6.9	7.6	8.3	28	0.38	7.3	8.2
Length of sut. sagitt.	3.3	4.1	4.4	8	0.33	3.8	4.4	5.0	28	0.31	3.6	4.4
Breadth of interparietale	2.4	2.7	3.0	8	0.23	2.1	2.6	3.1	28	0.19	2.0	2.7
Zygomatic breadth	9.4	9.6	9.8	6	0.14	9.2	10.3	11.5	18	0.59	10.0	11.0
Occipital breadth	9.4	9.8	10.2	7	0.28	8.9	10.0	10.9	27	0.36	9.8	10.4
Interorbital constriction	3.8	4.0	4.0	7	0.06	3.8	4.0	4.3	28	0.14	3.8	4.0
Palatal depth	3.7	3.9	4.0	7	0.12	3.7	4.0	4.5	27	0.22	4.0	4.3
Depth of brain case	6.2	6.7	7.2	8	0.31	6.5	6.9	7.3	24	0.22	6.4	7.2
Diastema	5.0	5.3	5.7	8	0.25	5.3	5.5	6.0	29	0.21	5.6	6.1
Maxillary tooth-row	3.1	3.5	3.6	8	0.16	3.2	3.7	3.9	28	0.13	3.4	3.8
Skull weight	95	111	120	12	7.94	95	144	195	24	24.27	135	192

The body weight is tripled in the course of the life outside the nest (Table 2). Light weight of the individuals of age-group I indicates that field mice leave their nest very early. The body weight increase intensly but in individuals of the age-groups IV and V the growth is inhibited. This is due to the fact that the age-group III consists chiefly of mice captured in autumn and winter, thus belonging to autumn generation, showing a lower growth rate in body weight. The maximal increment is very high (192%) and only slightly differs from that stated for *Apodemus agrarius* (Pallas, 1771), (Haitlinger, 1962) and amounting to 215.3%.

The body and tail are increasing in length during the whole life, but differences in the growth rate are observed in separate periods. Consequently, the ratio of those dimensions is altered. *E. g.* the tail in individuals belonging to the age-group I constitutes 94.6% of the body length, in group II it constitutes 88.7% and in group V only 83.4%. Besides the first stage of development skull weight is increasing relatively slowly, the maximum increment being 119.8%. A comparison of the weight of the skull in 3 species of the genus *Apodemus* shows that the ratio: skull weight/body weight, differs with the species (Table 3), this being chiefly caused by the differences in the length of their skulls.

depending on the age of mice.

			III					IV					V				
Max.	n	S.D.	Min.	Avg.	Max.	n	S.D.	Min.	Avg.	Max.	n	S.D.	Min.	Avg.	Max.	n	S.D.
98.0	80	4.79	75.8	87.6	99.8	115	5.09	82.0	93.7	106.1	36	5.19	89.7	98.1	106.9	16	4.66
85.0	74	4.33	63.0	77.7	93.9	107	5.12	69.0	78.4	89.2	36	5.53	74.6	81.8	90.6	16	4.24
22.8	80	0.71	19.0	20.9	24.0	115	0.78	19.2	20.9	22.1	36	0.68	19.3	20.7	21.9	16	0.60
17.1	46	0.70	14.2	15.9	17.7		0.65	14.1	16.1	17.4	24	0.73	15.0	16.3	17.5	14	0.60
21.0	80	2.29	11.5	16.7	25.0	114	2.80	13.9	20.1	27.8	36	3.65	15.0	21.9	28.5	15	3.08
22.6	72	0.54	20.3	21.6	23.2	114	0.61	21.0	22.0	24.1	32	0.52	21.4	22.3	23.5	10	0.65
23.6	72	0.73	21.6	22.8	24.5	115	0.57	22.3	23.2	25.1	33	0.46	22.7	23.5	24.3	9	0.48
22.0	72	0.71	18.2	19.4	21.4	113	0.60	19.1	20.0	22.1	33	0.51	19.5	20.3	21.4	8	0.64
9.0	70	0.23	7.6	8.4	9.9	113	0.38	8.0	8.7	9.8	33	0.38	7.9	8.7	9.6	10	0.49
8.7	69	0.29	7.4	8.3	9.1	114	0.33	7.8	8.3	9.2	33	0.31	7.9	8.7	9.8	8	0.64
5.3	69	0.33	3.5	4.4	5.2	113	0.22	3.5	4.3	5.0	32	0.33	4.0	4.3	4.5	8	0.18
3.8	70	0.27	2.3	2.6	3.2	113	0.22	2.1	2.6	3.2	32	0.24	2.2	2.6	3.2	8	0.23
11.8	54	0.46	10.7	11.7	12.7	81	0.36	11.4	12.0	12.8	24	0.44	11.8	12.3	13.1	7	0.36
11.2	72	0.24	9.9	10.6	11.3	114	0.25	10.2	10.6	11.3	33	0.23	10.4	10.9	11.3	10	0.26
4.3	69	0.12	3.6	4.0	4.3	115	0.12	3.7	4.0	4.4	33	0.15	3.8	4.1	4.3	10	0.12
4.9	69	0.19	4.0	4.4	4.8	112	0.20	4.1	4.4	4.8	32	0.16	4.4	4.6	5.0	8	0.17
7.9	70	0.25	6.7	7.2	7.8	111	0.23	6.8	7.4	7.8	32	0.27	7.1	7.4	7.7	9	0.19
6.7	72	0.25	5.8	6.4	7.2	112	0.28	5.8	6.6	7.3	32	0.29	6.4	6.9	7.7	10	0.36
4.1	72	0.15	3.3	3.8	4.1	115	0.16	3.4	3.8	4.0	31	0.16	3.5	3.7	4.0	10	0.16
240	74	21.75	170	213	275	112	18.71	200	228	270	31	20.25	205	244	285	10	24.49

Within the next group of dimensions, the lengths: Cb., total and basal do not differ in the rate of increment from that previously described for other small mammals (W a s i l e w s k i, 1952, 1960; H a i t l i n g e r, 1962; 1965 and others). The total length shows a most uniform increase within the whole life. The Cb.-length and basal length show an intense increment in the age-group IIb. The smallest increment of all those dimensions has been observed in the oldest individuals. Within this groups of dimensions the greatest increments have been stated in nasal bone (34%). Its growth, however, is terminated earlier than the growth of other elements of the skull (in individuals of the age-group IV). The

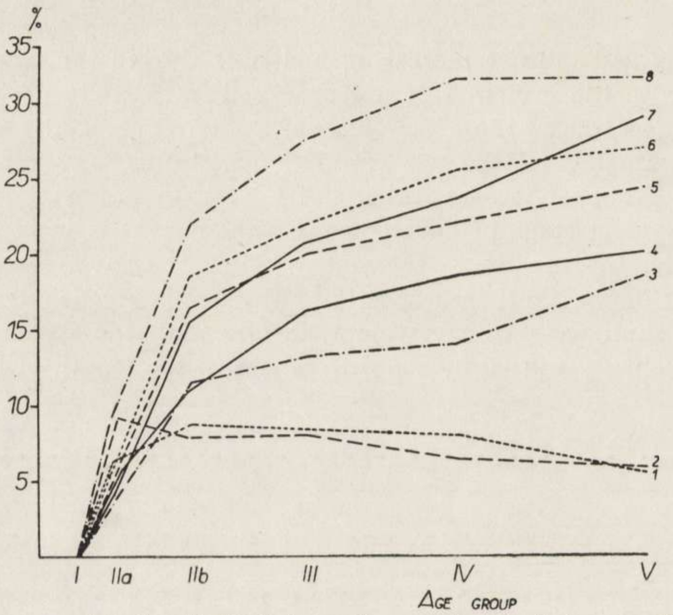

Fig. 2. The increment in longitudinal dimensions of the skull: 1 — length of maxillary tooth row; 2 — length of sagittal suture; 3 — length of frontal bone; 4 — total length; 5 — Cb.-length; 6 — basal length; 7 — diastema; 8 — length of nasal bone.

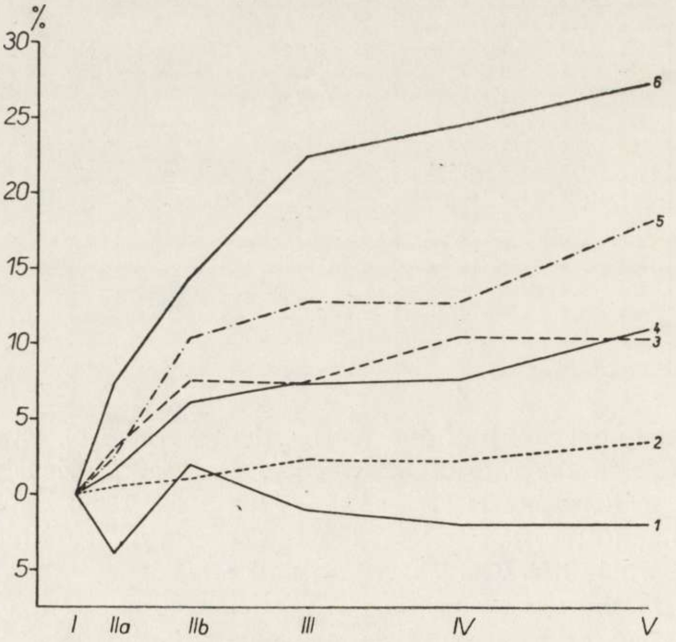

Fig. 3. The increment in the dimensions characterizing the width and height of the skull.
1 — interparietal breadth, 2 — interorbital constriction, 3 — brain-case depth, 4 — occipital breadth, 5 — palate depth, 6 — zygomatic breadth.

most intense growth of the nasal and frontal bones and of the diastema has been stated in individuals belonging to the age-group IIb. When the nasal bone does not grow any more in the further stages of the animal life, then the diastema and the frontal bone show the increments also in the last phase of the life. Zygomatic breadth is growing with the same rate in individuals of the age-groups II and III but in older individuals this rate is reduced by a half.

The palatal depth is characterized by irregular growth rate: low in the mid-phase and suddenly increased in the last phase of the life.

Within the third group of dimensions, besides the interorbital constriction, whose growth rate is in general very low, the growth rate of the remaining dimensions, *i. e.*: the hind foot length, the occipital breadth and the depth of brain-case, does not exceed 11% during the whole life. The hind foot having achieved the length characteristic of the individuals belonging to the age-group III does not increase any more,

Table 3.
Dependence of average skull weights on body weight in three species of *Apodemus*.

Body wt., g	13—15	15—17	17—19	19—21	21—23	23—25
A. agrarius	185	200	199	215	233	225
A. sylvaticus	197	209	220	224	239	244
A. tauricus	202	237	246	265	288	317

whereas the depth of brain-case, shows two periods of inhibition in growth. The lack of increment in the oldest animals proves that the depth of brain case attains its maximal size in individuals of the age-group IV. This is an essential statement, since according to Adamczewska (1959) the neurocranium in *A. tauricus* stops increasing in height not later than in first days of the life outside the nest.

In the last group of dimensions the lengths of sagittal suture and of maxillary tooth row and the breadth of interparietale show the maximum increment in individuals of the age-group IIa or IIb. In the remaining stages of life one observes that the absolute dimensions are decreasing to various extent, this being distinctly seen in the oldests individuals, especially in the changed length of the tooth row. This phenomenon is rather common in small mammals (Haitlinger & Ruprecht, 1967). The breadth of interparietale and the interorbital constriction are the dimensions which are almost never changing in the course of the life of those animals.

IV. MORPHOLOGICAL DEVELOPMENT OF THE GENERATION BORN IN AUTUMN

The development of small mammals runs differently in different sesonal generations (Schwarz *et. al.*, 1964; Haitlinger, 1965). It may be said therefore, that a table which presents this problem solely in age-groups not dividing them into separate generations, represents the development of generations born in late summer or autumn (Table 2). This aspect may be of interest in comparative investigations of closely related species, where the chief purpose is to find the differences occuring in the process of the development of those animals. The comparison of individuals captured in the some month may play an important role in investigation of intraspecific variability. Because of a relatively poor material the development of individuals belonging to autumn generation is further disscused (Table 4). Fully grown individuals born in October, November and December (age-group III) were taken into consideration and the individuals of the age-groups IV and V have been eliminated, as being born either in early spring or in late autumn, their growth was inhibited. The animals of the age-group III (of autumn generation) in January, February and March grow older and were classified a new among consecutive age-groups which were subsequently taken into consideration.

Table 4.
Morphological development of autumn generation of *A. sylvaticus*.

Measurement	Months					
	X	XI	XII	I	II	III
Head & body	87 2	86.4	84.9	85.7	87.4	93.6
Tail	78.8	78.1	76.4	75.2	78.0	81.3
Body wt.	16.3	16.6	15.2	15.9	16.4	19.5
Cb.-length	21.35	21.51	21.44	21.47	21.61	22.40
Length of skull	22.55	22 63	22 66	22.73	22.82	23.53
Basal length	19.23	19.34	19.34	19.41	19.54	20.28
Length of nasalia	8.32	8.42	8.26	8.36	8.49	8.73
Diastema	6.33	6.39	6.37	6.43	6.47	6.67
Length of *sut. sagitt.*	4.49	4.56	4.35	4.41	4.16	4.21
Depth of brain case (between *bullae tympanici*)	7.1	7.1	7.1	7.3	7.1	7.3

A permanent drop in the body length in animals of similar age observed from October till December inclusive, results from a growth rate, lower in mice born in late autumn than in mice born earlier. In the breeding season young individuals (age-groups II and III) are, as a rule, prevailing in the captures. The number of older individuals is then constantly decreasing because of various reasons. Hence, in captures made in November and December specimens of late generations constitute the majority. Consequently the average body length is decreasing. Starting from January one observes a constant increase in dimensions, which is especially distinct in March. An analogical situation is observed in the increased body length and weight. Similar process has been already described for other species (Haitlinger, 1962; 1965). The increments in separate dimensions of the skull are more uniform than those in the body dimensions. Distinctly smaller dimensions in December than in October have been observed in the length of nasal bone and sagittal suture. It should be, however, emphasized that seasonal depression of skull has not been observed in field mouse. Although it is true that in February the depth of braincase is reduced but this observation must be verified because of a small number of individuals coming from this month. Changes in the length of sagittal suture are more interesting since this dimension is distinctly reduced in February and March. Unfortunately, because of small differences in the age of the individuals it is difficult to state whether this fact should be considered as seasonal variability or as a process associated with the age of animals.

V. SEXUAL DIMORPHISM

Sexual dimorphism is observed in the representatives of the genus *Apodemus*, but is distinctly manifested only in some body dimensions. In *A. sylvaticus* this problem was investigated by Felten (1952), Amtmann E. & Amtmann R. (1965), Hamar *et al.* (1966) and Saint-Girons (1966). Sexual dimorphism in Wrocław population has been studied in individuals of group III and of a joint group IV—V. All dimorphic differences observed in the oldest individuals are also distinctly expressed in the younger ones (Table 5). The males are heavier than females and their body is longer, and the above dimensions show the greatest differences. The maximum difference in the body length is observed in age-group IV—V, it amounts to 5 mm being the greatest known so far. It appears that most frequently it amounted to 1—2 mm (Felten, 1952; Hamar *et al.*, 1966), the value ranging within 4 mm has been only found by Saint Girons (1966) for *A. s. dichrurus* Rafinesque, 1814. Results obtained by the same authoress from the environments of Paris prove that it is not a rule, since within this population she did not find any difference in the body length between the males and females. The above mentioned authors agree, however, that the females have relatively longer tails, and with exception of German population (Felten, 1952) also absolutely longer tails. From the Table 5 it follows that in males of the age-groups III and IV—V the length of the tail is identical. This means that in males the growth of the tail

Table 5.
Sexual dimorphism in *A. sylvaticus*. F — females, M — males.

Measurement		Age group III				Age group IV—V			
		n	Avg.	S.D.	Difference*)	n	Avg.	S.D.	Difference*)
Head & Body	F	49	86.2	5.44	+	20	92.0	4.80	+
	M	58	89.8	4.77		30	97.3	5.11	
Tail	F	47	75.6	5.64	+	18	80.8	6.22	+
	M	53	78.7	4.61		25	78.8	4.45	
Hind foot	F	49	20.5	0.78	+	22	20.6	0.73	+
	M	58	21.1	0.77		29	21 0	0.61	
Ear	F	28	15.6	0.68	—	17	16.1	0.61	—
	M	44	15.9	0.64		21	16.1	0.74	
Body wt.	F	49	15.6	3.22	+	21	19.2	3.73	+
	M	58	17.5	2.40		30	21.7	3.31	
Cb. length	F	55	21.29	0.56	+	22	21.92	0.60	+
	M	60	21.81	0.64		22	22.32	0.50	
Length of skull	F	55	22.52	0.54	+	22	23.10	0.52	+
	M	60	22.99	0.61		21	23.47	0.41	
Basal length	F	53	19.19	0 56	+	22	19.91	0.61	—
	M	60	19.69	0.64		20	20.24	0.46	
Length of nasalia	F	54	8.32	0.39	+	22	8.60	0.39	—
	M	59	8.50	0.36		22	8.75	0.55	
Length of frontale	F	55	8.18	0.35	+	22	8.33	0.36	—
	M	59	8.36	0.31		21	8.49	0.43	
Diastema	F	55	6.32	0.26	+	22	6.57	0.28	—
	M	60	6.50	0.30		22	6.70	0.43	
Length of *sut. sagitt.*	F	55	4.36			21	4.22		
	M	58	4.42			20	4.42		
Breadth of interparietale	F	55	2.61			21	2.65		
	M	58	2.67			20	2.57		
Maxillary tooth row	F	55	3.78			22	3.70		
	M	60	3.78			22	3.79		
Breadth of *sut. zyg.*	F	38	11.69	0.36	—	17	11.94	0.46	
	M	43	11.83	0.35		15	12.15	0.41	
Occipital breadth	F	55	10.45			22	10.63		
	M	59	10.63			22	10.69		
Interorbital constriction	F	55	4.03			22	4.04		
	M	60	4.07			19	4.08		
Palatal depth	F	54	4.3			22	4.4		
	M	58	4.5			19	4.5		
Skull weight	F	53	208			22	228	22.90	
	M	61	216			19	235	20.07	

*) + statistically significant, — non significant.

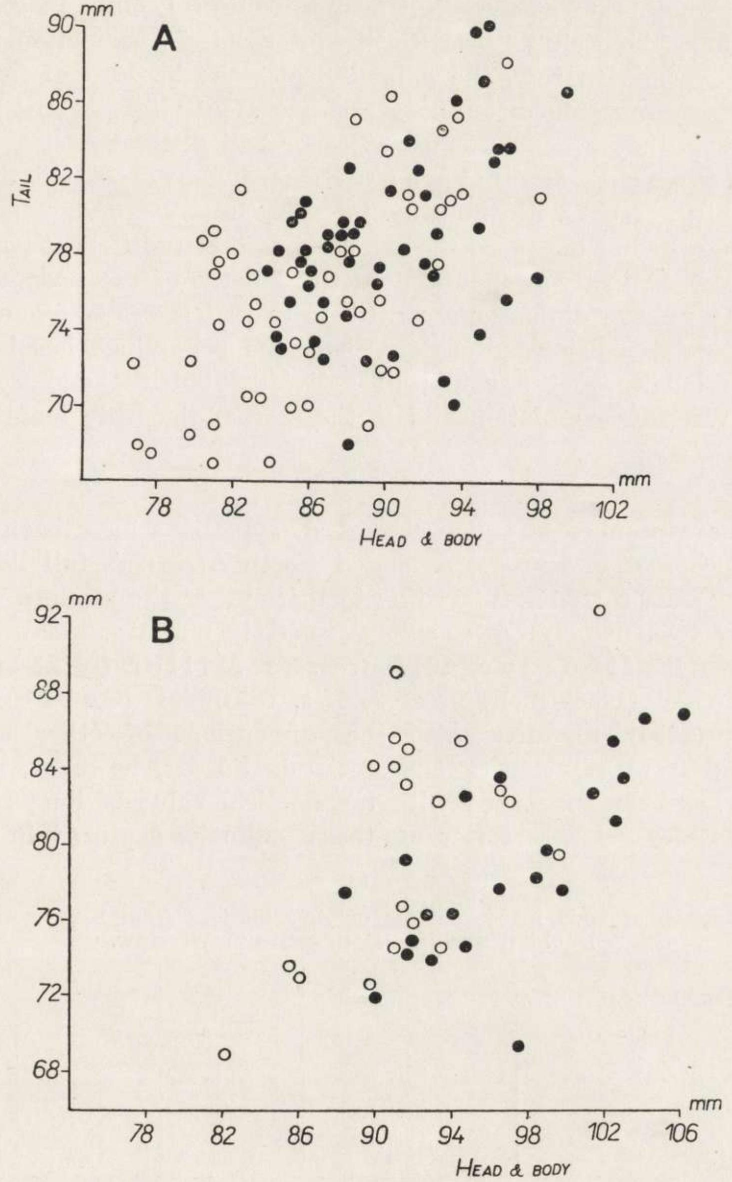

Fig. 4. The ratio of the tail length to the body length in females and males of the long tailed field mice (A) age-group III, (B) age-group IV—V.
○ — females ● — males

is termineted relatively earlier than in females. The changes in the ratio of the two dimensions occur in the late period of life (Fig. 4 A & B). It appears that in mice of the age-group III sexual dimorphism is not manifested, being distinctly observed in the group IV—V.

The growth rate of the skull is more uniform. Only in some of the dimensions (the occipital breadth, the interorbital constriction, the length of maxillary tooth row, the palatal depth, the breadth of interparietal bone) the dimorphic differences are not manifested, in the remaining dimensions they are manifested more or less distinctly.

Amtmann E. & Amtmann R. (1965) have stated that sexual dimorphism occurs with the same intensity in *A. sylvaticus* and *A. tauricus*, regardless of the place the sample was taken (different populations). It is most distinctly pronounced in the lengths of the body and of the skull. The above dimensions constitute in both cases 98.5% of the corresponding dimensions in males. The same percentage has been found for the length of the skulls in individuals of the age-group IV—V of the Wrocław population and in the case of the body length (95.6%).

VI. TAXONOMICAL REMARKS

So far a number of subspecies of *A. sylvaticus* have been described from the areas of Europe, Asia and North Africa. A full list is given by Ellerman (1949). According to this author the western subspecies are only two, namely: *A. s. sylvaticus* (Linnaeus, 1758) and *A. s. dichrurus* Rafinesque, 1814, whereas Miller (1912) and Zimmermann (1936) mention also *A. s. callipides* (Cabrera, 1907). Ursin (1956) mentions also the dimensions of other subspecies, described from Winterberg and Iceland. So far, however, nobody in Poland has been concerned with taxonomical value of long tailed field mice. Besides a larger series of those animals, captured in Wrocław,

Table 6.

Comparison of body measurements of *A. sylvaticus* from Karkonosze Mts., Dąbki (Koszalin Palatinate) and Wrocław.

Measurement	Karkonosze Mts. n = 30	Wrocław n = 30	Dąbki n = 19	Wrocław n = 19
Head & body	83.2	83.9	89.0	89.0
Tail	78.4	75.5	73.6	76.6
Hind foot	21.1	20.9	20.9	20.8
Ear	15.3	15.5	15.8	15.4
Body wt.	15.5	14.7	17.9	17.8

a small number of individuals captured in the North Poland (Dąbki, Koszalin district) and in Karkonosze Mts. were used as a comparative material. Since only young individuals (age-group III) were obtained from mentioned localities, comparable series was chosen from Wrocław population (*i. e.* captured in the same months, and of the corresponding body length). It follows that the differences occur only in the tail length, which in specimens coming from the North Poland is distinctly shorter, and in individuals coming from the mountains longer than in mice captured in Wrocław region (Table 6). Only the differences between the northern and southern (Karkonosze) populations appeared to be statistically significant.

Table 7.
Changes in tail/head and body ratio (in %) in *A. sylvaticus* from different geographical areas.

Author	Locality	Per cent
Haitlinger, this study	Wrocław	83.4
Ursin, 1956	Jylland Bornholm Sjaelland Lüneburg Iceland	85.3 85.9 89.3 89.5 89.5
Kratochvíl & Rosicky, 1952	Czechoslovakia	89.7
Hamar *et al.*, 1966	Rumania	90.1
Ursin, 1956	Lithuania	90.4
Kratochvíl & Zejda, 1960	Czechoslovakia	91.3
Argyropulo, 1946	Tartaria Armenia	91.8 91.9
Ursin, 1956	Yugoslavia Rhein/M.	96.3 96.6
Tatarinov, 1956	Ukraine	96.6
Ursin, 1956	Slovakia Switzerland Berno Belgium Liege	97.6 97.6 97.9
Saint Girons, 1966	Paris	98.6
Hamar *et al.*, 1966	Hungary	99.4
Ursin, 1956	Switzerland (Ticino)	101.5
Saint Girons, 1966	Bas Languedoc	105.1

The ratio between tail length and body length is different in different parts of Europe. It shows an increasing tendency from south east westward and southward, but the most distinct direction is observed from south to the north. It reaches its minimum in Lower Silesia (Table 7).

From the data quoted by Ursin (1956) it follows that this ratio increases also in mountain populations not only in Alpean but also in Carpathian ones (Slovakia). Data obtained from Karkonosze series, as well as the results obtained by Kratochvil & Rosicky (1952) and Kratochvil & Zejda (1960) indicate that this situation is not so clear. Since it has been generally assumed that the ratio: tail length/ body length has a taxonomical value it should be underlined that in Wrocław population the tail was either equal or slightly longer than the body only in 2.3% of individuals. These are young individuals of the age-group II and III, captured from October to January. Consequently, it cannot be excluded that in those individuals the tail grows in spring more slowly than the body, as such cases were not observed in long tailed field mice of the age group IV—V.

The data concerning the lengths of head and body and of hind foot, found in the literature (most frequently for a short series of animals without the date of capture) are probably more or less corresponding to the average dimensions of the individual of the age-group IV—V and to the mice of the age-group III captured during summer months. In view of the above it can be stated that the body length of long tailed field mice does not show any differences all over Europe, except for southern, Alpean and northwest regions (Iceland). The Alpean, south, and south-west individuals are, however, classified among separate subspecies, whereas Wrocław population differs from the others by small dimensions of the hind foot. A distinctly smaller lenght of foot has been observed in Armenia and Tataria (Argyropulo, 1946), slightly different in Rumania (Baragan) (Hamar *et al.*, 1966), Yugoslavia and Germany (Zimmermann, 1936).

Considering the Cb.-length, lengths of nasal bone, diastema and maxillary tooth row, it may stated that Wrocław population of long tailed field mice belong to short and narrow-headed specimens with relatively long diastema and short maxillary tooth row. It seems that populations having this type of feature are characteristic of Central and Mid-West Europe, being mostly resembling to Danish populations (Ursin, 1956). On the other hand, long-headed specimens with a long maxillary tooth row prevail in Mid-East (Hamar *et al.*, 1966) and South-East Europe and in Central Asia (Argyropulo, 1946). Similar direction in which the length of maxillary tooth row is changing (*i. e.* from west southward) is quoted by Ursin (1956).

Taxonomical investigation have been recently conducted in Bulgaria by Peshev & Georgiev (1961). They established the presence not only of *A. s. sylvaticus* but also *A. s. dichrurus*. Some more detailed investigations conducted in France by Saint Girons (1966) stated the presence of 4 subspecies of *A. sylvaticus*. *A. s. sylvaticus* and *A. s. dichrurus* occur most frequently. According to this authoress the Cb.-length, the interorbital constriction and the length of maxillary tooth row are the best diagnostic features. Populations coming from the environments of Paris and classified as the nominal subspecies do not differ more from *A. s. dichrurus* (except the ratio: tail length/body length) not very much than from Wrocław or Rumanien population also classified among *A. s. sylvaticus*.

In view of the so far obtained results it my be stated that long tailed field mice occuring in North, North-West, Central, and partially, in South--East and East Europe, and constituting within this area a whole mosaic of intermediate forms, belong to the subspecies *A. s. sylvaticus*. Therefore it seems possible to classify the representatives of these mice living in Poland, among the nominal subspecies. (Nevertheless, it cannot be excluded that the mountain populations (Carpathian and Sudeten) belongs to a separate subspecies. This problem requires further investigations).

Much attention has been recently given to the taxonomical problems within the subgenus *Sylvaemus*. Witte (1964) and Amtmann (1965) have found within some populations the presence of hybrids between *A. tauricus* and *A. sylvaticus*. This fact creates additional difficulty in systematics. It should be emphasized that within Wrocław populations so far I have not observed individuals with characters resembling to the both species. The above observations have been confirmed by Hamar *et al.* (1966) and Steiner (1968). When comparing the ranges of variability of taxonomically important dimensions (hind foot, tail, Cb.-length) obtained for long tailed field mice of the age-group IV—V with the data quoted by Kowalski (1964) for *A. tauricus* no overlaping were found. Comparison made between Wrocław and Rumanian populations shows that only Cb.-length does not overlap. *A. tauricus* in Poland has been investigated by Adamczewska (1959), but because of the lack of suitable segregation of individuals according to their age, the obtained results have no comparative value. It is also worth while to remark that Wrocław population compared, say, with Rumanien populations of *A. sylvaticus* and *A. microps* Kratochvil & Rosicky, 1952 (irrespectively of the typical differences of a fundamental taxonomical value such as the lengths of ear, foot and body) shows a number of characteristics which are much nearer to *A. microps* than to *A. sylvaticus* (*e. g.* the Cb.-length, zygomatic breadth). The data quoted by Humiński (1964) confirm the above observations. Thus in Wrocław conditions taxonomical problems may take place only when the two species are to be identified.

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College of Agriculture,
Department of Zoology,
Wrocław, Cybulskiego 20.

Ryszard HAITLINGER

ZMIENNOŚĆ MORFOLOGICZNA WROCŁAWSKIEJ POPULACJI *APODEMUS SYLVATICUS* (LINNAEUS, 1758)

Streszczenie

1. Przeprowadzono analizę morfologiczną 301 myszy zaroślowych odłowionych na terenach ruderalnych Wrocławia w latach 1959—1965 (Tabela 1).

2. Przyrost wymiarów poszczególnych części ciała i czaszki wykazuje u *A. sylvaticus* podobny przebieg jak u innych drobnych gryzoni. Wyróżniono 4 grupy wymiarów wykazujących różny charakter przyrostu (Ryc. 1, 2, 3. Tabela 2). Największy przyrost (od 45% do 192%) w ciągu życia pozagniazdowego wykazują: długość ogona, ciała, ciężar czaszki i ciężar ciała. Przyrost o średniej intensywności (18.5%

—32%) wykazują: długość Cb., ogólna, podstawowa, kości nosowej, czołowej, szerokość jarzmowa, wysokość podniebienna oraz diastema i długość ucha. Brak przyrostu lub minimalny przyrost (3.5%—4.1%) poniżej osiągniętych przez osobniki I lub II grupy wiekowej obserwuje się w długości szwu strzałkowego, górnego szeregu zębowego oraz szerokości kości międzyciemieniowej.

3. Stosunek ciężaru czaszki do ciężaru ciała kształtuje się odmiennie u każdego z trzech gatunków rodzaju *Apodemus* (*A. sylvaticus, A. agrarius, A. tauricus*). (Tabela 3).

4. Nie stwierdzono w rozwoju czaszki depresji zimowej (Tabela 4).

5. Zaobserwowano występowanie dymorfizmu płciowego w większości badanych wymiarów (Tabela 5, Ryc. 4, 5).

6. Na podstawie analizy kraniometrycznej i porównawczych danych z literatury przyjęto, iż myszy zaroślowe występujące na terenie Polski należą do podgatunku nominalnego *Apodemus sylvaticus sylvaticus* (Linnaeus, 1758) (Tabela 6, 7).