POLSKA AKADEMIA NAUK —— ZAKŁAD BADANIA SSAKÓW

ACTA THERIOLOGICA

VOL. II, 7. BIAŁOWIEŻA 8. XI. 1958

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Geographical variation of the squirrel *Sciurus vulgaris* L. in Poland

Zmienność geograficzna wiewiórki *Sciurus vulgaris* L. w Polsce

I. INTRODUCTION

The aim of this work is to investigate the variation of the species *Sciurus vulgaris* L. in Poland, and to establish which subspecies occur here.

The squirrel is a species widely distributed over the forest areas of almost the whole of Europe and north-east Asia. It is not, there-

fore, surprising that a species with so vast an area of occurrence has created a series of geographical races which often differ markedly from each other.

Systematicians distinguish about fifty subspecies of *Sciurus vulgaris* L. (Miller, 1912; Ogniev, 1940, Shorten - Vizoso, 1954). Literature on the squirrel is in general plentiful, but not as regards works dealing with Poland, which are either short faunistic reports, not based on large amounts of material, or else works which do not contribute much that is new to our knowledge of this animal.

Udziela (1924), solely on the basis of the colour of the coat, distinguished 6 subspecies in Poland: *S. vulgaris vulgaris* L., *S. vulgaris varius* Gmel., *S. vulgaris fuscoater* Altum, *S. vulgaris vilnensis* Udziela, *S. v. carpathicus* Pietruski, *S. vulgaris italicus* Bonaparte. This last subspecies is peculiar to the Appenines only, and Udziela's finding it in the Carpathian foothills is, to say the least of it, very strange.

Kuntze and Szynal, basing their opinion on an inspection of several squirrels from Eastern Poland, considered (1933) that *S. vulgaris fuscoater* and *S. vulgaris varius* occur in Poland. These authors agree with Lührig's view (1928), that in the light of genetics, the differences in colour, hitherto the chief feature of the races described, may be a phenotypical phenomenon, dependent on the temperature of the environment, while the black squirrels are an expression of „mendling melanism", in spite of the fact that this phenomenon is often explained as the result of the kind of food eaten (fruits of the spruce). The authors of the work cited above are of the opinion that it is unnecessary to distinguish *S. vulgaris vilnensis*, since it comes under the descriptions of *S. vulgaris varius*.

Sokołowski (1947) states that the squirrel occurs in the Świętokrzyskie Mountains in various colour phases, the phase represented in the greatest numbers being, in his opinion, *S. vulgaris fuscoater*. In addition to this phase, according to this author, the *S. vulgaris varius* and *S. vulgaris carpathicus* also occur. Sokołowski at the same time queries the distinguishing of the latter as a separate species. He also describes how all types of colour occur amongst the young of one litter. For example, in one nest containing 5 animals there were the following: 1 of the „*varius*" type, 2 „*carpathicus*" and 2 „*fuscoater*". In a second nest containing

4 young squirrels, 1 was a *„varius"* type, 1 *„carpathicus"* and 2 *„fuscoater"*. Sokołowski considers that these are phases of one species only (geographical races). These races interbreed freely.

A reminder should be given here that Shorten - Vizoso (1945) found similar relations in the *Sciurus carolinensis* in England, and assumed that melanism is a recessive feature. In her later work (1954) she withdrew her former views, and in conversation with me stated that the conclusions drawn in her previous work lack support, as she was not in possession of full data as to the parents of the litter in question.

Miller in his well-known work (1912) gives only one subspecies for Poland, *S. vulgaris fuscoater* Altum, the range of occurrence of which includes areas in Germany, part of Poland (areas in the former Prussian and Austrian territories seized from Poland under the partition), Czechoslovakia, Austria, Hungary and Roumania. The ranges of other subspecies distinguished by various authors in Poland are as follows: *S. vulgaris vulgaris* occurs only in Sweden (excluding the northern areas), and *S. vulgaris varius* occurs in northern Sweden, Finland and parts of northern Russia. Ogniev (1940) defined the range of this subspecies in the Soviet Union, and stated that the southern boundary of its range is Onezhsky Kray — districts to the north-east of Leningrad. He also gives, for the areas of Central Europe, in addition to the *S. vulgaris fuscoater,* a whole series of subspecies such as *S. vulgaris ukrainicus* Migul., *S. vulgaris fedjushini* Ogn., and *S. vulgaris ognevi* Migul. The differences between the various subspecies given by Ogniev are on the whole slight, and are usually connected with some particular area. I shall return to the question of these subspecies in the later part of this work.

Rozanov (1953) gives subspecies of the squirrel according to Ogniev's list, adding *S. vulgaris vilnensis* Udziela and *S. vulgaris carpathicus* Pietr. All the data given by Soviet writers concern, in essentials, the eastern areas of our country only.

In her latest monograph on the squirrel, Shorten - Vizoso (1954), like Miller, gives only the *S. vulgaris fuscoater* for Poland.

The position of the black squirrel distinguished and described by Pietruski (1853) as a separate species has not so far been established. Various zoologists considered this phase as a subspecies. I have endeavoured as far as possible to deal with this problem in greater detail in the present work.

I would like to take this opportunity of thanking my director, Professor Dr August D e h n e l for his valued help in preparing this work.

II. MATERIAL AND METHODS

a) T e c h n i q u e

I collected the material for this work from various parts of Poland (Table No. 1). The remainder of the material (skulls) were lent by the Department of Comparative Anatomy of the Jagiellonian University in Cracow, the Institute of Zoology of the Polish Academy of Sciences in Warsaw (chiefly material from the collection made by A. D e h n e l from Mokuszyn), the department of the Institute of Zoology in Cracow, and the Zoological Museum in Wrocław. The material which I myself collected is included in the collection of the Mammals Research Institute of the Polish Academy of Sciences in Białowieża.

Table No. 1.

Index of material.

Area	Total number	In „young" class
Białowieża	24	2
Świętokrzyskie Mountains	6	3
Carpathians	16	—
Kraków	2	1
Kórnik near Poznań	5	—
Mokuszyn (BSSR)	7	—
Polanica (Sudety Mts.)	5	—
Puławy	4	1
Warszawa	25	2
Wrocław	3	—
Total	**97**	**9**

I have endeavoured in my work to base my conclusions mainly on craniometric measurements, since the skull is relatively far less subject, in comparison with other parts of the body, to the influence of the environment, (with the exception of skulls of *Soricidae* — works by D e h n e l (1949), P u c e k (1955) and others). In addition, the measurements of skulls of mammals are of great significance to the establishment of the systematics of a given animal,

since the classification of mammals is to a large extent based on these measurements.

The material used for this work had been prepared dry. I used 80 skulls of adult individuals for these craniometric measurements. For purposes of comparison I used data on measurements of skulls given in the works of Miller, Ogniev, and Shorten - Vizoso. I measured the skulls with a technical sliding-rule with a nonius. Measurement of the nasal and frontal bones were made with technical compasses.

b) Measurements

I measured each dead squirrel with a ruler and also weighed it. I then made the following measurements: length of body, tail, ear, hind foot. Body measurements were made only of the material I myself had collected, since material from other sources was incomplete in this respect (no labels with measurements attached). In choosing suitable measurements for the skulls I was guided to a great extent by the work of Wasilewski (1952).

Below are given the measurements which I used as a basis for my work.

Measurements of skull

1. Condylobasal length — distance from front edge of intermaxillary bone (between the incisors) to the point of the occipital condyle furthest to the rear.
2. Length of base — distance from front edge of intermaxillary bone to the posterior slit of the occipital (lower edge of foramen magnum).
3. Length of nasal bone.
4. Diastema — distance from posterior edge of socket of incisor to the first upper molar.
5. Length of frontal bone.
6. Breadth of occipital (maximum) measured at the crista of occipital.
7. Breadth of skull at the processus zygomaticus of temporal.
8. Breadth of zygomatic — distance measured at sutures of arches.
9. Interorbital constriction.
10. Height of skull per bullae so measured that the lower arm of the sliding-rule rests on the most protuberant point of bullae, and the upper arm on the front part of the interparietal bone, vertically to the horizontal axis of skull.
11. Height of palate. One blade of the slide-rule rests on the posterior edge of the front foramen of palate, the second on the dividing line between the frontal and nasal bones.
12. Height of braincase measured from the dividing line between base of occiput and sphenoideum to the front edge of the interparietal bone.

In order to be able to compare the results obtained with suitable data in literature (Miller), I had of necessity to limit myself in this discussion to the following measurements: condylobasal length, length of diastema, breadth zyg-zyg, breadth of interorbitalia and length of nasalia, as a basis. The remaining measurements, given above, serve to give a more detailed picture of the course of variation in the material as a whole.

In addition to absolute measurements, I made use of the following factors:

$$\frac{\text{zyg-zyg.}}{\text{Cb}}; \quad \frac{\text{height per bullae}}{\text{Cb}}; \quad \frac{\text{diastema}}{\text{Cb}}; \quad \frac{\text{interorbitalia}}{\text{Cb}};$$

Application of the above factors has many advantages, such as independence of differences in size and age, and they also define the shape of the skull clearly.

On account of the somewhat scanty material available, I divided it into two classes only according to age, and based this division on the condylobasal length. All individuals over Cb. 45 mm I included in the „adult" class, and all below this size to the „young" class. This division is proved to be acceptable by the fact that when establishing age by the extent of wear of the teeth — Kirys (1937), Naumov (1934), Ognievv (1940), Petrides (1951), Shorten-Vizoso (1954) I obtained for individuals in the „young" class ages up to 9 months, which agrees with data on the period of approach to sexual maturity (Ognievv, 1940). Dissection and the remaining measurements of the body also bear out that we are dealing with sexually immature individuals.

III. CRANIOMETRIC MEASUREMENTS

I distinguished only 3 larger series, from Białowieża, the Carpathians and the Warsaw district, in which the number of individuals forming them made it possible to check whether the differences between them are statistically true, or whether they may be treated as three samples taken from one general mass.

I have set out all the results in Table No. 2, giving their absolute minimum and maximum values, and arithmetical averages.

As will be seen from the table, all the measurements are very similar, and all are contained within the limits of variability for the subspecies *S. vulgaris fuscoater* given by Miller. Similarly there are no great differences between the measurements of the

black squirrel from the Carpathians. The extreme values of measurements of each feature examined do not exceed the limits of variation of skulls from other areas. Certain deviations of absolute values of measurements in comparison with data given by Miller, may readily be explained by the small amount of material available, and not by the existence of real differences.

Table No. 2.
Craniometric measurements.

Area	Białowieża	Karpaty	Mokuszyn	Warszawa	Poland	S. vulgaris fuscoater /Miller, 1912/
Number of individuals	19	16	7	21	80	21
Condylobasal length	46,5–49,9 /48,45/	45,2–49,5 /48,02/	47,4–49,8 /48,36/	45,5–50,8 /48,76/	45,1–51,0 /48,36/	46,6–50,0 /48,11/
Zygomatic breadth	30,5–33,2 /31,83/	29,7–33,4 /31,15/	31,2–33,4 /32,34/	30,8–33,6 /32,15/	29,7–34,8 /31,75/	30,0–34,2 /31,60/
Interorbital constriction	16,4–18,6 /17,57/	16,0–19,9 /17,36/	15,6–17,4 /16,92/	17,2–19,2 /17,92/	15,6–19,9 /17,64/	16,4–19,0 /17,33/
Nasal	15,4–17,2 /16,35/	14,8–18,2 /16,22/	17,2–18,7 /16,52/	15,1–17,5 /16,30/	14,0–19,1 /16,25/	14,6–17,0 /15,70/
Diastema	11,8–13,9 /13,02/	12,0–14,0 /13,28/	12,2–13,4 /12,82/	12,0–14,5 /13,27/	11,3–14,5 /13,11/	12,2–13,2 /12,75/
Basal length	42,8–47,5 /45,27/	41,7–46,5 /44,65/	44,1–46,5 /45,04/	42,2–47,5 /45,43/	41,7–47,5 /45,08/	-
Frontal length	20,2–25,2 /23,16/	20,8–24,5 /22,72/	21,7–24,0 /22,60/	21,5–24,5 /23,38/	19,6–25,2 /22,99/	-
Palatine height	12,3–14,6 /13,39/	12,6–14,7 /13,28/	12,7–13,6 /13,20/	12,8–15,0 /13,80/	12,3–15,0 /13,43/	-
Occipital breadth	21,9–24,4 /22,94/	21,7–23,6 /22,56/	22,2–23,2 /22,70/	20,9–24,2 /22,58/	20,9–24,4 /22,61/	-
Height of sk. per bullae	16,4–18,5 /17,91/	17,2–18,6 /17,80/	17,5–18,4 /17,97/	17,2–18,8 /18,07/	16,4–18,8 /17,96/	-
Brain case height	16,9–18,6 /17,69/	16,7–19,1 /17,38/	16,0–17,6 /17,64/	16,8–19,2 /17,72/	16,0–19,2 /17,65/	-

Attention should here be drawn to the interesting similarity of material from Mokuszyn to the skulls of specimens from other parts of Poland and to comparative data from Miller's measurements for the *S. vulgaris fuscoater*, since the squirrels from this

area should, according to O g n i e v (1940) belong to the subspecies *S. vulgaris fedjushini*. I shall return to this subject in the section dealing with results. As will be seen from all the measurements included in Table No. 2, absolute measurements of skulls of squirrels from different areas do not reveal any important differences in excess of individual variation.

Table No. 3.
Correlation between zygomatic breadth and Cb.

Zyg-Zyg \ Cb.	45,0 - 45,9	46,0 - 46,9	47,0 - 47,9	48,0 - 48,9	49,0 - 49,9
29,0 - 29,9	1		1		
30,0 - 30,9		1	2 1	2 1	
31,0 - 31,9			2 1	4 5	1 3
32,0 - 32,9				6	1
33,0 - 33,9				1	1

Table No. 4.
Correlation between interorbital constriction and Cb.

Interorb. \ Cb.	45,0 - 45,9	46,0 - 46,9	47,0 - 47,9	48,0 - 48,9	49,0 - 49,9
16,0 - 16,9	1	1	1	1 2	
17,0 - 17,9			4 1	6 4	2 1
18,0 - 18,9				3	3
19,0 - 19,9				1	

Table No. 5.
Correlation between occipital breadth and Cb.

Occ.breadth \ Cb.	45,0 - 45,9	46,0 - 46,9	47,0 - 47,9	48,0 - 48,9	49,0 - 49,9
21,0 - 21,9			2 1		
22,0 - 22,9	1	1	2 1	6 8	1
23,0 - 23,9			1	2 3	2 3
24,0 - 24,9				1	

I drew up correlation tables for all measurements, and in these tables compared material consisting of squirrels from Białowieża and the Carpathians, as I wanted to check by this means the existence, if any, of a difference which could be grasped by craniometric measurement, between specimens from these two widely-separated areas (Tables No. 3—10).

Table No. 6.
Correlation between heigth of skull per bullae and Cb.

Height per bullae \ Cb.	45,0 – 45,9	46,0 – 46,9	47,0 – 47,9	48,0 – 48,9	49,0 – 49,9
16,0 – 16,9					1
17,0 – 17,9	1	1	4 2	4 5	2
18,0 – 18,9			1	4 7	3

Table No. 7.
Correlation between diastema and Cb.

Diastema \ Cb.	45,0 – 45,9	46,0 – 46,9	47,0 – 47,9	48,0 – 48,9	49,0 – 49,9
11,0 – 11,9			1		
12,0 – 12,9		1	1 1	1 4	
13,0 – 13,9	1		4	6 8	2 4
14,0 – 14,9				1	

Table No. 8.
Correlation between diastema and nasal length.

Diastema \ Nasal	14,0 – 14,9	15,0 – 15,9	16,0 – 16,9	17,0 – 17,9	18,0 – 18,9
11,0 – 11,9		1			
12,0 – 12,9		1 3	3	1	
13,0 – 13,9	1	4	4 6	1 6	1
14,0 – 14,9			1		

Table No. 9.
Correlation between diastema and zygomatic breadth.

Diastema \ Zyg-Zyg	29,0 – 29,9	30,0 – 30,9	31,0 – 31,9	32,0 – 32,9	33,0 – 33,9
11,0 – 11,9			1		
12,0 – 12,9		1 2	1 1	3	
13,0 – 13,9	2	3 1	5 6	1 3	2 1
14,0 – 14,9			1		

Table No. 10.
Correlation between brain case heigt and zygomatic breadth.

Zyg.-Zyg. / Brain case height	21,0 - 21,9	22,0 - 22,9	23,0 - 23,9	24,0 - 24,9
16,0 - 16,9	1	4 1	1	
17,0 - 17,9	1	4 8	2 3	1
18,0 - 18,9		1 2	1 3	
19,0 - 19,9			1	

In the first space (on the left-hand side of the line), is the number of individuals in the given group from the Carpathians, and on the right-hand side, the number of specimens from Białowieża.

The similarity in the disposition of the material from both areas is clearly visible in the above table. We see that the greatest numbers of individuals in classes 48,0—48,9 mm and 47,0—47,9 mm is very similar in both these samples compared. This is evidence of the great similarity of the two groups of specimens. We obtain an analogical picture in the subsequent correlation tables. Just as the data from the absolute measurements were evidence of the similarity of these skulls, so the correlation tables also indicate this fact.

The fact of the analogy between the black squirrel from the Carpathians and the red squirrel from the lowlands (Białowieża) is shown irrefutably by all of the above correlation tables. They differ only as regards colour. Statistical comparison of the average lengths Cb. for the most numerous series from Białowieża, the Carpathians and the Warsaw district is given in Table No. 11.

Table No. 11.
Comparison of the average lengths Cb. for the most numerous series.

Area	M ± E/m/	P/t/ $\geqslant t_1$	No. of individuals
Białowieża	48,44 ± 0,593	Białowieża—Karpaty ≈0,1936	19
Karpaty	48,01 ± 0,486	Warszawa—Karpaty ≈0,0719	16
Warszawa	48,76 ± 0,997	Warszawa—Białowieża≈0,3859	21

As will be seen from the above table, there are no statistically true differences between these averages. We may, therefore, consider that these are 3 samples taken from one general mass. In addition, all the averages are within the limits of error from the average.

By using factors, we obtain a picture of the proportions of the shape of the skull, and absolute values then become of secondary importance.

Limits of individual variability and arithmetical averages of the four factors, for three areas (Białowieża, Carpathians and Warsaw), can be seen in Table No. 12. Similarly to the absolute cranio-

Table No. 12.
Variation of factors.

Factor \ Area	Białowieża	Karpaty	Warszawa
zyg - zyg / Cb.	63,7 - 67,7 /65,73/	62,2 - 68,7 /64,77/	62,3 - 67,7 /65,57/
interorbitalia / Cb.	34,1 - 38,2 /36,18/	33,6 - 41,4 /36,12/	35,2 - 38,5 /36,72/
height p. bullae / Cb.	32,8 - 38,7 /37,06/	34,8 - 38,9 /37,03/	35,7 - 39,1 /37,04/
diastema / Cb.	24,9 - 28,1 /26,82/	25,3 - 28,9 /27,70/	24,7 - 30,2 /27,17/

metric measurements, factors did not indicate the existence of real differences between particular areas of Poland.

IV. COLOUR

The colour of squirrels is subject to great variation within wide limits. The colour depends on the season (summer or winter coat), and there are very considerable individual variations. This is especially noticeable in areas where both colour phases occur, and specimens with dark, almost black tails are relatively frequently encountered.

Lühr ig (1928) distinguished 6 variants of colour in squirrels of the subspecies *S. vulgaris fuscoater*.

From Table 13 below it will be seen that in this same area specimens occur which, if the colour of their fur were taken as sole criterion, could be divided into various subspecies. I have defined the „subspecies" on the basis of Lubicz - Niezabitowski's key, which he gives according to Udziela and Miller.

It may be stated that in principle the darker specimens are encountered in mountain forests, or forests in which the majority of

trees are spruce or fir (Zawidzka, 1958). At the same time it is possible to find dark-coated squirrels in the purely pine forest stands of the lowlands. This colour has no connection either with sex or age, and there are no statistically true craniometric differences between these squirrels. The phenomenon of occurrence of

Table No. 13.
Occurence of different colour forms of squirrel in the same area.

Area	"fuscoater" type	"vulgaris" type	"varius" type
Białowieża	8	1	7
Warszawa	8	4	6

subspecies of squirrel in two colour phases, light and dark, is fairly common, and occurs (Miller, 1912) in the *S. vulgaris fuscoater* Altum, *S. vulgaris italicus* Bonaparte, *S. vulgaris lilaeus* Miller, *S. vulgaris alpinus* Desmarest, *S. vulgaris numantius* Miller, *S. vulgaris infuscatus* Cabrera. Usually the occurrence of the black squirrel is connected with mountains (Lühr ig, 1928) or with a certain type of forest (Spärck, 1936). This can be seen from the map of occurrence of subspecies of squirrel in Europe. Both these phases occur in the same area, and as a rule live together, cross-breeding freely. There are 3 skins of such hybrids in the collection of the Mammals Research Institute of the Polish Academy of Sciences. These are skins of black squirrels, with a line of red fur at the edge of the black fur of the back and sides, and the white fur of the belly. Cases of finding litters of young squirrels composed of black and red specimens are frequently described in literature (Shorten - Vizoso, 1945; Sokołowski, 1947).

It should be presumed, therefore, that the black squirrel occurring in the Carpathians, the Sudetens and their foothill areas is merely a geographical phase, the occurrence of which is connected with a certain group of ecological factors.

V. RESULTS

It may therefore be stated that only one subspecies of squirrel occurs in Poland, *S. vulgaris fuscoater* Altum, in its two colour phases, light and dark. An attempt at basing the systematics of

subspecies of squirrel on so variable a feature as colour of coat is, to say the least of it, a risky procedure.

In connection with the above data, the question may be raised as to whether the present division of the subspecies systematics of this species in Central Europe serves any useful purpose. Shorten-Vizoso has already put forward the assumption that *S. vulgaris russus* Miller and *S. vulgaris fuscoater* are merely synonyms.

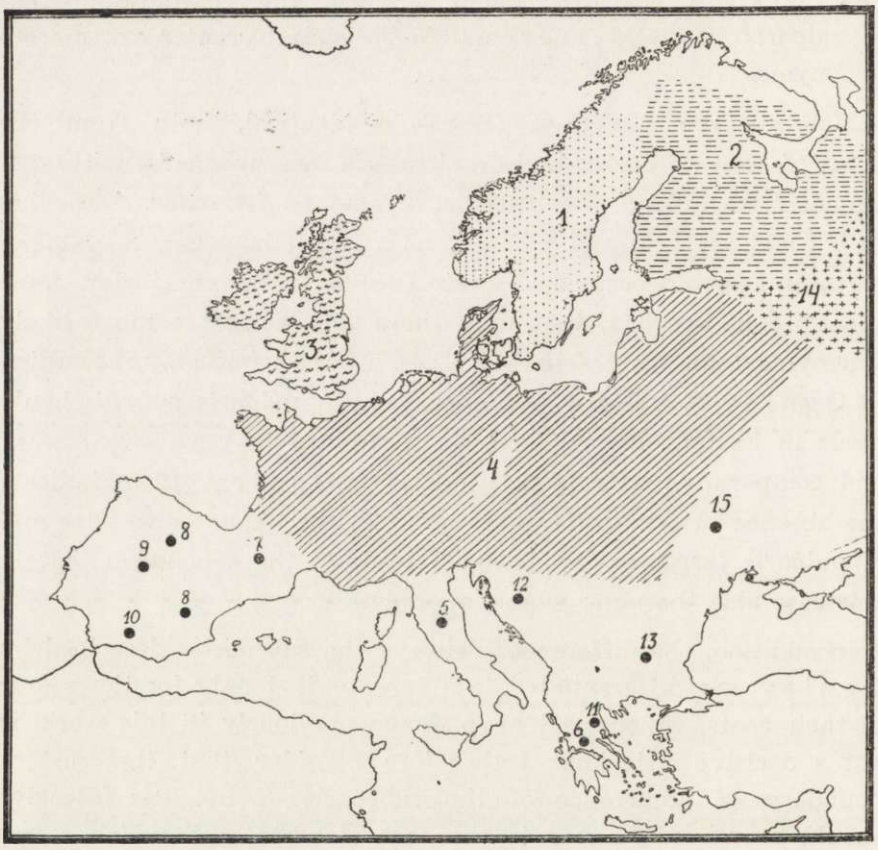
Material from Mokuszyn (BSSR) is identical, both from the point of view of colour and craniometric measurements, with specimens from Poland, identified as *S. vulgaris fuscoater*. According to Ogniev (1940) and Sierżanin (1953) however, *S. vulgaris fedjushini* should occur in Polesie (BSSR). The conclusion must therefore be reached, that both these subspecies are more likely synonyms than truly separate races. In the same way, according to Ogniev *S. vulgaris ukrainicus* and *S. vulgaris ognevi* should occur in Eastern Poland. Material examined in the present work and comparative data from literature (Ogniev, 1940) indicate the absence of true differences between the above subspecies and *S. vulgaris fuscoater*, which again leads to the conclusion that in this case also these are synonyms only.

In addition, the differences between the subspecies described by Ogniev are differentiated to a large extent only by the colour of their coats, which, as I have shown previously in this work, is not a decisive criterion. I therefore consider that the eastern boundary of occurrence of the subspecies *S. vulgaris fuscoater* should be moved further to the east, if we accept, which seems highly probable, that the above subspecies are identical. In such a case the range of occurrence of the subspecies *S. vulgaris fuscoater* to the east would be adjacent to the range of *S. vulgaris formosovi* or even *S. vulgaris varius*, which possibly in the Soviet Union reaches further to the west than stated by Ogniev. The eastern limit of range of *S. vulgaris fuscoater* requires, of course, accurate definition. If we accept that all the subspecies compared here form one *S. vulgaris fuscoater* which, within the entire area

of its occurrence, creates a series of local phases, the distribution of geographical races of the squirrel in Europe may be diagrammatically illustrated by the enclosed map.

Map No. 1.

Distribution of subspecies of *Sciurus vulgaris* L. in Europe (Ognievi, 1940; Shorten - Vizoso, 1954 and Sidorowicz schematically).



Explanation to Map 1.

Name	Type locality
1. *S. vulgaris vulgaris* L.	Sweden (Uppsala)
2. *S. vulgaris varius* Gmelin	Northern Europe
3. *S. vulgaris leucorus* Kerr	Great Britain and Ireland
4. *S. vulgaris fuscoater* Altum	France, Germany, Holland
syn. *S. vulgaris russus* Miller	Poland, Austria, Hungary
syn. *S. vulgaris ognevi* Migulin	Czechoslovakia, Roumania
syn. *S. vulgaris fedjushini* Ognev	Western part of USRR
syn. *S. vulgaris ukrainicus* Migulin	

5. *S. vulgaris italicus* Bonaparte	Italy
syn. *S. vulgaris silanus* Hecht	
6. *S. vulgaris lilaeus* Miller	Greece (Parnassus Mts.)
7. *S. vulgaris alpinus* Desmarest	Pyrenees
8. *S. vulgaris numantius* Miller	Spain (Burgos)
syn. *S. vulgaris segurae* Miller	
9. *S. vulgaris infuscatus* Cabrera	Spain (Avilla)
10. *S. vulgaris baeticus* Cabrera	Spain (Seville)
11. *S. vulgaris ameliae* Cabrera	Greece (Mt. Olympus)
12. *S. vulgaris croaticus* Wettstein	Yugoslavia (Croatia)
13. *S. vulgaris balcanicus* Heinrich	Bulgaria (eastern Balkans)
syn. *S. vulgaris istrandjae* Heinrich	
syn. *S. vulgaris rhodopensis* Heinrich	
14. *S. vulgaris formosovi* Ognev	USSR (Nijni Novgorod)
15. *S. vulgaris kessleri* Migulin	USSR (West Ukraine)

VI. CONCLUSIONS

1. Craniometric and statistical analysis of the whole of the material revealed the absence of any statistically true differences between the series of skulls from different areas. On these grounds it should therefore be considered that they all belong to one subspecies.

2. Squirrels occurring in Poland belong to the subspecies *Sciurus vulgaris fuscoater* Altum. This subspecies occurs in Poland in its two colour phases, light and dark.

3. There are no grounds for distinguishing in Poland a subspecies of Carpathian squirrel, or others, which have hitherto been cited in theriological literature.

4. All attempts at basing the systematics of subspecies of squirrel on colour of coat, are, in view of the great individual and seasonal variations, inadvisable as they may lead to erroneous conclusions.

5. On the basis of the data given, it should be assumed that the forms described under the names of *S. vulgaris ukrainicus* Migulin, *S. vulgaris fedjushini* Ogn. and *S. vulgaris ognevi* Migulin, are synonyms of the subspecies *Sciurus vulgaris fuscoater* Altum. The author does not see any real grounds for distinguishing them as separate subspecies.

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STRESZCZENIE

Na podstawie analizy kraniometrycznej 80 czaszek wiewiórek pochodzących z różnych terenów Polski, autor stwierdził brak jakichkolwiek statystycznie istotnych, różnic między nimi. Krajowi przedstawiciele rodzaju *Sciurus* L. należą do jednego podgatunku — *Sciurus vulgaris fuscoater* Altum, który występuje w Polsce w obu swych fazach barwnych, jasnej i ciemnej. Wobec istniejącej dużej zmienności osobniczej i sezonowej w ubarwieniu wiewiórki, próby oparcia systematyki podgatunkowej na tak zmiennej cesze jak kolor futerka, są raczej nie wskazane, gdyż mogą prowadzić do mylnych wniosków. Z materiału opracowanego przez autora wynika, że formy opisane pod nazwą *S. vulgaris ukrainicus* Migulin, *S. vulgaris jedjushini* Ogn., i *S. vulgaris ognevi* Migulin, są synonimami podgatunku *S. vulgaris fuscoater* Altum. Autor nie widzi realnych podstaw do wyróżniania ich jako osobnych podgatunków.

Państwowe Wydawnictwo Naukowe * Warszawa 1958 r.
Nakł. 1600 egz. Ark. wyd. 1.057. Maszynopis otrzym. 9.VIII.58 r.
Podpis. do druku 30.X.58 r. Druk ukończono 8.XI. 1958 r.
Pap. druk. sat. kl. III. 80 g. Format B-1.
Białostockie Zakłady Graficzne. Zam. 2059. E-3. Cena 5 zł.