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Craniometrical Measurements of Scandinavian Squirrels and Their Distribution

Pomiary kraniometryczne wiewiórek skandynawskich i ich rozmieszczenie

[with 2 tables]

I. INTRODUCTION

The systematisation of the squirrel subspecies *Sciurus vulgaris* Linnaeus, 1758 is very abundant (Ellermann, 1940; Ellermann & Morrison-Scott, 1951; Miller, 1912; Ognev, 1940; Shorten-Vizoso, 1954; Sidorowicz, 1958). In most of the cases, however, the subspecies taxonomy of squirrels is based on a small number of specimens. In subspecies differentiation the colouring was often taken as a basic feature for distinguishing the subspecies. This feature is very changeable in the case of the squirrel (Voipio, 1956; Sidorowicz, 1958). Voipio in a series of works on the colouring of squirrels from Finland describes their great individual variability. The squirrel is a typical polymorphic species. In nearly the entire area it occupies two colouring phases appear: the light one and the dark. This last phase from Poland was described by Zawidzka (1958). From this point of view the basing of subspecies systematisation on the colour of the pelage leads very often to erroneous inferences. I am of the opinion that only morphological analysis, based principally upon craniometrical measurements, can furnish decisive results (Sidorowicz, 1958).

Two squirrel subspecies from the Scandinavian Peninsula, *Sciurus vulgaris vulgaris* Linnaeus, 1758 and *Sciurus vulgaris varius* Kerr, 1792, have been described till now. Miller (1912) gives the following description of these forms:

„Dark brown phase essentially absent (Northern).
Winter pelage smoke-grey, the back strongly tinged with red (Scandinavian Peninsula, except extreme north)...

S. v. vulgaris...

Winter pelage pearl-grey, the back scarcely or not tinged with red (Extreme north of Scandinavian Peninsula, east into Russia)...

S. v. varius..."

As results from the above diagnose, these subspecies differ only in colouring.

Miller's views were generally accepted (Matthews, 1952; Shorten-Vizoso, 1954). It is usually considered that only the red phase appears in the north and the dark one in the south.

This opinion, however, is wrong (Voipio, 1956). The species is polymorphic on the whole terrain of Scandinavia (Collett, 1911—1912; Lönberg, 1923; Voipio, 1956; 1957). This last author stated that in Finland the dark phase is more often found in the northern than in the southern part of the country.

Data concerning craniometrical measurements of Scandinavian squirrels are very scarce in literature (Lilljeborg, 1874; Collett, 1911—1912; Lundberg, 1948). They are incomplete and of a more or less orientative character.

II. MATERIAL AND METHOD

I investigated in this work material from the Zoological Museums of the Bergen and Oslo Universities and the Royal Museum of Natural History in Stockholm. I disposed of 158 squirrel skulls and pelts from different parts of Norway and Sweden.

I measured the skulls by means of a sliding-rule with an exactitude up to 0.1 mm. The method of the measurements was described in my paper on the geographical variability of the squirrel in Poland (1958).

While working on the material, I compared a series of skulls of squirrels whose colouring was known to me. I did not succeed, however, in finding any interdependencies. I compared series descending from different parts of the Scandinavian Peninsula with the aim of determining whether a geographical variability exists and is expressed in the dimensions of the skull.

I chose the following regions:

1. Norway — the mountains of the southern part of Norway, the area to the south of Trondheim.

2. Southern Sweden — the terrain to the south of the 58th degree of latitude.
3. Central Sweden — the area to the south of the Västerbotten, province to the north of the 58th degree of latitude.
4. Northern Sweden — the province Västerbotten, Norrboten and the Norwegian province of Finmark, that is the whole of Norwegian and Swedish Lapland.

Such a division, although rather schematic, is very convenient. It allows the comparison of specimen groups from areas distant from each other. In the light of the data we possess up till now, concerning taxonomy of Scandinavian squirrels, the specimens descending from the three first areas ought to belong to the subspecies *S. v. vulgaris*, and the individuals from Lapland — to the race *S. v. varius*.

As I did not notice in Scandinavia any connection between the colouring and the dimensions of the skull, which is in accordance with observations concerning two colouring phases in the subspecies *S. v. fuscoater* (Altum, 1876) (Sidorowicz, 1958), I wanted to examine whether a geographical variation exists, what is the difference between the forms *vulgaris* and *varius* and whether these two forms differ from the race *fuscoater* from central Europe.

III. CRANIOMETRICAL MEASUREMENTS

Table 1 presents a list of all cranial measurements (mean numbers and limits of variability) of 158 Scandinavian skulls.

A series of inferences result from this table. When considering separate results, both mean figures and limits of variability in different groups, we distinctly perceive that they do not differ from those of southern Norway and Sweden. This is the more surprising as these individuals ought to belong to two different subspecies — *S. v. vulgaris* and *S. v. varius*.

An error caused by a small amount of material cannot arise here, the series being rather big. To state whether any essential statistical differences exist between them, the mean numbers were verified by means of Student's test. It was proved that the differences were statistically insignificant.

Separate skulls from different areas do not differ. It was found that in the entire Scandinavian Peninsula only the phenomenon of individual variability exists in squirrels. Small differences in mean numbers and the limits of variation are only caused by

individual variability. We have here a phenomenon resembling that of the Norwegian leming, *Lemmus lemmus lemmus* (Linnaeus, 1758) — (Sidorowicz, 1960).

The results obtained render questionable the appropriateness of dividing the subspecies systematisation of the squirrels from this part of Europe. This is especially interesting from the point of view of Voipio's works concerning the colouring of Finland squirrels and shall be discussed in the latter part of this paper

Table 1.

Craniometrical measurements of Scandinavian squirrels.

Measurement	Southern Sweden	Norway	Middle Sweden	Northern Sweden
Condylobasal lenght	44.2 - 48.8 /46.84/	44.8 - 48.1 /46.08/	44.5 - 48.7 /46.77/	44.7 - 48.8 /46.38/
Basal lenght	40.4 - 45.4 /43.55/	40.6 - 45.0 /42.92/	41.0 - 45.4 /43.59/	41.6 - 45.6 /43.29/
Diastema	11.1 - 13.4 /12.40/	11.2 - 13.6 /12.25/	11.2 - 13.7 /12.49/	11.6 - 13.4 /12.16/
Occipital breadth	20.7 - 24.1 /22.46/	21.1 - 23.7 /22.34/	21.6 - 24.0 /22.55/	21.7 - 23.2 /22.33/
Zygomatic breadth	29.4 - 32.8 /30.97/	29.0 - 32.0 /30.76/	30.1 - 33.0 /31.56/	29.2 - 32.1 /30.89/
Interorbital constriction	15.1 - 18.2 /16.97/	15.2 - 18.2 /16.63/	15.4 - 17.7 /16.63/	15.3 - 18.0 /16.60/
Height of skull p. bullae	20.4 - 24.1 /22.58/	20.7 - 24.9 /22.99/	20.8 - 23.3 /22.29/	20.8 - 24.8 /22.18/
Palatine height	11.4 - 13.8 /12.78/	11.6 - 13.6 /12.64/	11.9 - 13.8 12.80/	11.5 - 13.2 /12.62/
Depth of brain-case	16.2 - 20.2 /17.37/	16.3 - 19.2 /17.15/	16.5 - 18.1 /17.19/	16.2 - 18.8 /17.18/
No. of animals	46	56	22	34

It appears that we can treat in common all the Scandinavian squirrels. The four specimen groups are, from the statistical point of view, only four samples taken from a single general community. The Scandinavian squirrels are very uniform as to their morphology.

IV. DISCUSSION OF RESULTS

In his works Voipio (1956, 1957, 1958) stated that Miller (1912) distinguished geographical races of Scandinavian squirrels on a partly erroneous basis. Voipio considers, however, that two separate subspecies exist in the Finland area. He describes in his works the transitional forms between these races. Collett (1911—12) also stated that he observed transitional forms between *vulgaris* and *varius* in the central parts of Norway. The same phenomenon existed in Central Sweden. It must be noted, however, that all these considerations were based up till now upon colouring. Voipio (1956) writes: „This, however, does exclude the fact that the separation of the North European squirrels into the subspecies *vulgaris* and *varius* is somewhat doubtful as regards the hereditary nature of this character".

But, when analysing material morphologically, it appears that it is completely homogenetic. From this point of view both Scandinavian subspecies form one single race.

Let us now consider in detail the habitat of squirrels in Scandinavia. It is mostly composed of coniferous mountain forests or of the taiga. Evidently, there also are mixed and hardwood forests in southern Scandinavia, and scanty pine and birch forests near the river Pasvik (Finmarken), in the transitory zone between the taiga and the tundra, where I observed squirrels with different colours of pelage.

In connection with the presence of squirrels in different types of forest, hunters distinguish the following types of colouring of pelts: the pine squirrel or redtail, the browntail and the spruce squirrel or darktail. Similar types are distinguished in the USSR. Zawidzka (1958) demonstrated the connection between the dark phase of the squirrels from the Carpathians and the types of trees in the forest. These squirrels, however, possessing pelage of different colours, do not differ in build or in the size of skulls.

The division of squirrels into species was heretofore established on the base of colouring. I wrote in my work (Sidorowicz, 1958) that the basing of subspecies systematisation of the squirrel upon the colour of the fur may lead to erroneous inferences caused by the existence of very considerable individual variability in this polymorphic species. Miller's division, especially, assuming that

there are no dark squirrels in the north, was entirely unfounded (Voipio, 1956). It is a fact that the population in the north is composed in 20% of the dark phase, which is relatively more common here than in the south of Finland. It is obvious that a series of intermediate forms exist in Scandinavia and in central Europe (Voipio, 1956). This author considers, in spite of the existing opinions, that both subspecies of Scandinavian squirrels exist in Finland. The area inhabited by the vulgaris species does not form one whole; this squirrel lives in the southern part of the Scandinavian Peninsula and in southern and central Finland.

Table 2.

Comparison of craniometrical measurements of the subspecies *Sciurus vulgaris vulgaris* (Scandinavia) and the *Sciurus vulgaris fuscoater* (Poland).

Measurements	Scandinavian Peninsula, Sciurus v. vulgaris			Poland, Sciurus v. fuscoater		
	min.	avg.	max.	min.	avg.	max.
Condylobasal length	44.2	46.48	48.8	45.1	48.36	51.0
Basal length	40.4	43.29	45.6	41.7	45.08	47.5
Diastema	11.1	12.30	13.7	11.3	13.11	14.5
Occipital breadth	20.7	22.33	24.1	20.9	22.61	24.4
Zygomatic breadth	29.0	30.96	33.0	29.7	31.75	34.8
Interorbital constriction	15.1	16.72	18.2	15.6	17.64	19.9
Palatine height	11.4	12.75	13.8	12.3	13.43	15.0
Brain case height	16.2	17.21	20.2	16.0	17.65	19.2
No. of animals		158			80	

Voipio, however, writes further in the same work: „We are once more compelled to conclude that the diagnoses of these subspecies so far as the colour of the fur is concerned, are to a certain extent doubtful if not erroneous in every single case".

The results obtained in the present work, stating the existence of a complete craniometrical homogeneousness of the entire material from different parts of the Scandinavian Peninsula, allow the conclusion that we have here one single geographical race. These results are confirmed by a statistical analysis. Colour factors cannot be decisive in the taxonomy of the Scandinavian subspecies of the squirrel. I consider therefore that we can state that in the area of the whole Scandinavian Peninsula only one squirrel subspecies exists, which we can name the north-european subspecies.

From the priority point of view, the name *Sciurus vulgaris vulgaris* Linnaeus, 1758 ought to remain, the denomination *Sciurus vulgaris varius* Kerr, 1792 being only a synonym of the form *vulgaris*.

The question of the terrains inhabited by this form is still being studied. In the light of results obtained by me, and as yet unpublished, concerning squirrels from USSR terrains, it appears that this form extends much further to the south than was previously supposed.

The interrelation of the forms *vulgaris* and *fuscoater* is interesting. There are no fundamental differences of colouring between them, with the exception that we hardly see entirely black individuals in the northern form. The basic difference lies in their size. As results from the comparison of craniometrical measurements of squirrels from northern and central Europe (the author's material from Poland) listed in Table 2, the northern form is decidedly bigger than the south-european one. The differences betwen mean numbers are considerable and statistically essential. The biggest northern specimens are of the size of average ones from Poland. This is not in accordance with their age, as all of them are adult individuals of about the same age. (Age was determined on the basis of abrasion of the molars).

It can be seen from the above data that these are two distinctly differentiated subspecies. The differences find their expression in the size of the skull and are simultaneously related to the geographical distribution of the subspecies.

As to the reasons causing such considerable differences in size, we can only proceed by supposition. It might be that some environmental factors, as well as genetical ones, play here a certain role. This can be caused by an inferior kind of food in Scandinavia, where there are less hardwood forests, or by more severe climatic conditions. In this case, however, the so-called „Bergmann's rule" finds no confirmation.

V. SUMMARY

Material composed of 158 skulls of squirrels from different parts of the Scandinavian Peninsula was analysed. A statistical analysis did not show the existence of essential differences in the mean numbers from measurements of skulls from sundry

areas. The entire material is very homogeneous and distinctly forms a single geographical race. Squirrels distributed in the entire Scandinavian Peninsula belong to the north-european subspecies — *Sciurus vulgaris vulgaris* Linnaeus, 1758. This subspecies is polymorphic as to colouring.

The author considers hat, on the basis of the above facts, it can be stated that the form described as *Sciurus vulgaris varius* Kerr, 1792 is only a synonym of the subspecies *S. v. vulgaris* and that there is no foundation for differentiating it as a separate subspecies.

When comparing the subspecies *S. v. vulgaris* from the Scandinavian Peninsula with the subspecies *Sciurus vulgaris fuscoater* (Altum, 1876) from Poland, the author ascertained that there exist between them considerable differences in size. They are therefore two distinctly separate geographical races.

Acnowledgement. I wish to express my sincere thanks to the Directors of the Zoological Museums in Bergen, Oslo and Stockholm for enabling me to study their collections — as well as my gratitude to Professor A. Dehnel for his valuable suggestions and indications.

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REFERENCES

1. Collett, R., 1907: Ecornen i Norge (*Sciurus vulgaris* L.). Norsk Jaeger og Fisker Foretnings Tidsskrift: Kristiania, *36:* 1—6.
2. Collett, R., 1911—1912: Norges Pattedyr. Kristiania.
3. Ellermann, J. R., 1940: The families and genera of living rodents. *1,* Brit. Mus. London.
4. Ellermann, J. R. & Morrison-Scott, T. C. S., 1951: Checklist of Palaearctic and Indian Mammals, 1758 to 1946. Brit. Mus. London.
5. Lilljeborg, W., 1874: Sveriges och Norges Ryggvadsdjur. Uppsala.
6. Lönnberg, E., 1923: Sveriges jaktbara djur. Stockholm.
7. Lundberg, G., 1948: Ekorren, in Svenska Djur. Stockholm.
8. Matthews, L. H., 1952: British Mammals. Collins, London.
9. Miller, G. S., 1912: Catalogue of the Mammals of Western Europe... Brit. Mus. London.
10. (Ognev, S. I.) Огнев, С. И., 1940: Звери СССР и прилежащих стран. А. Н. СССР, *4,* Москва—Ленинград.
11. Shorten-Vizoso, M., 1954: Squirrels. Collins, London.
12. Sidorowicz, J., 1958: Geographical variation of the squirrel, *Sciurus vulgaris* L. in Poland. Acta Theriol. *2,* 7: 141—157, Białowieża.

13. Sidorowicz, J., 1960: Problems of the morphology and zoogeography of representatives of the genus *Lemmus* Link, 1795 from the Palaearctic. Acta Theriol., *4*, 5: 53—80, Białowieża.
14. Voipio, P., 1956: Some remarks on the taxonomy of Finnish Squirrels. Arch. Soc. „Vanamo", *11*, 2: 97—107. Helsinki.
15. Voipio, P., 1957 Über die Polymorphie von *Sciurus vulgaris* L. in Finland. Ann. Zool. Soc. „Vanamo", *18*, 7: 1—24. Helsinki
16. Zawidzka, E., 1958: Geographical distribution of the dark phase of the squirrel *(Sciurus vulgaris fuscoater* Altum) in Poland. Acta Theriol., *2*, 8: 159—174, Białowieża.

STRESZCZENIE

Na podstawie analizy pomiarów kraniometrycznych 158 czaszek wiewiórek, pochodzących z Półwyspu Skandynawskiego, autor stwierdził, iż na terenie tym nie występuje zjawisko zmienności geograficznej, znajdujące swój wyraz w wielkości czaszki. Z tego względu autor sądzi, iż mamy tu do czynienia tylko z jednym podgatunkiem — wiewiórką północno-europejską — *Sciurus vulgaris vulgaris* Linnaeus, 1758. Formy opisywane dotychczas jako *Sciurus vulgaris varius* Kerr, 1792 są tylko synonimami formy *vulgaris*. Podgatunek ten jest polymorficznym pod względem ubarwienia.

Porównując podgatunek wiewiórki północno-europejskiej z okazami należącymi do podgatunku wiewiórki środkowo-europejskiej — *Sciurus vulgaris fuscoater* (Altum, 1876) pochodzącymi z terenu Polski, widzimy istnienie dużych różnic wielkościowych. Są to wyraźnie odgraniczone rasy geograficzne (Tabela 2).

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