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Variation in Colour Patterns of the Belly in Neomys anomalus

ZMIENNOŚĆ UBARWIENIA BRZUCHA U *NEOMYS ANOMALUS*

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A considerable number of representatives of *Neomys anomalus* Cabrera, 1907, with coloured marks on the belly (50%) occurred in 1983 in the Białowieża Primeval Forest. One animal had a light-coloured mark in the shape of the letter *v*, this having been observed up to the present only in *Neomys fodiens* (Pennant, 1771). The colour of the belly was observed to change during the individual's life, *i.e.* winter coat and second summer coat were lighter in colour than the first summer coat.

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1. INTRODUCTION

The colour of the ventral side of the body in *Neomys anomalus* Cabrera, 1907 from the Białowieża Primeval Forest has been described recently (Michalak, 1983). The most important conclusion put forward in the previous paper was that dark-coloured marks occur in this species against the lighter background of the belly itself (patch on the throat, stripe along the belly). Previously the occurrence of coloured marks was connected solely with the colour pattern of *Neomys fodiens* (Pennant, 1771), hence the finding by Bauer (1960) and Spitzenberger (1980) of two specimens of *Neomys anomalus* with dark marks on the throat was treated as exceptional cases of the coloration in this species.

Attention has been drawn in the present paper to the considerable frequency of occurrence in *N. anomalus* of coloured marks on the belly and to the relation between frequency of individuals with such marks and age and sex.

2. MATERIAL AND METHODS

The animals were trapped from May to August 1983 inclusive (n=56). The colour of the summer coat was defined *in vivo* immediately after catching the

animal, recording the colour and size of dark spots on the belly. The size of stripes was estimated by holding the animal by the scruff of its neck and laying a ruler along the stripe. The size of patches was drawn approximately on the plan of the animal's body. It was impossible to define the size of coloured marks more accurately since as the animal moves the skin is either more or less stretched. Grey or dark grey marks clearly visible against the background of the belly were considered "conspicuous" regardless of their size. Light grey marks less distinct were defined "faint". The term "very faint" was used to describe a very indistinct mark which might even have been overlooked during a superficial examination.

The sex of the animal was also noted and age defined in two categories: young born during the year of trapping, and old adults. Changes in colour of the belly after the autumn and spring moults were observed in three animals with distinct marks.

3. RESULTS AND DISCUSSION

The approximate length of a stripe with clearly visible, unblurred edges was from 8 to 22 mm, and width from 2—3 mm. It was only in one individual with a long, distinct stripe (about 17 mm) that there was delicate greying of the coat in the region of the upper part of the stripe, which together with the stripe formed a mark in the shape of the letter *v*. The occurrence of a coloured mark of this kind, although very faintly defined, is important in that it forms an analogy with the colour pattern hitherto described only in *N. fodiens* (Kahmann & Rössner, 1956; Bauer, 1960; Laar & Daan, 1976; Fedyk & Borowski, 1980).

Patches in *N. anomalus* were very small, usually in the form of a round spot from 2—3 mm in diameter. Data on intensity of the colour marks are given in Table 1. Among animals with coloured marks were those with only a stripe and those which had both stripe and patch (Table 1). In all 50% of specimens of *N. anomalus* caught in 1983 had a coloured mark, but only 15% during the period from 1979—1981 (*cf.* Michalak, 1983).

Coloured marks occurred more frequently in females than in males (Table 2). These differences were however found to be apparent only, since the connection between occurrence of coloured marks and sex was not found to be statistically significant in either of the two series examined (1983 and 1979—1981), when segregated into young and old adult animals (chi-square test, $p>0.1$).

In the present material (from 1983) frequency of occurrence of coloured marks was found to be significantly greater in young animals than in the group of old adults (chi-square test, $p<0.001$) (Table 2). Differences were also found in frequency of coloured forms in the two age groups in combined material from 1979—1981, but in this case

Table 1

Types of colour patterns of the belly in *N. anomalus* from a population in the Białowieża Primaeval Forest in 1983, indicating intensity of colour marks; C — conspicuous, F — faint, VF — very faint.

		No. animals with stripe			
		C	F	VF	Absent
No. animals with patch	C	2	0	0	0
	F	7	1	0	0
	VF	1	0	1	0
	Absent	6	4	6	28

Table 2

Connection between occurrence of coloured marks and age and sex of the water-shrews.

Age or sex	n	% of animals with marks	n	% of animals with marks
	1979—81		1983	
Young	41	19.5	39	69.2
Old adults	19	5.3	17	5.9
Females	21	28.6	26	65.4
Males	39	7.7	30	36.7

the divergence between the theoretical and observed number of coloured phenotypes proved not be significant (chi-square test, $p>0.1$), (Table 2).

Interpretation of the causes of the existence of these differences in frequency of occurrence of animals with coloured marks in the young and old adult groups is limited to loose assumptions only. It is possible that the survival of individuals with marks is for some reason lower than in unmarked animals, hence the latter predominate old adults. Another possibility is that the colour pattern of the belly in Mediterranean water shrews undergoes change during the individual's life. Support for this assumption is provided by observation of three animals which overwintered in captivity. The marks on the belly after the autumn and spring moults became smaller and less distinct (Table 3). It was only in one animal that definition of intensity of the stripe

after moults did not change, but it must be emphasized that this particular animal had the largest and most distinct stripe when compared with the other two shrews, and although the stripe became smaller after the moult, it continued to be distinct. The general colour of the belly in the animals observed was lighter in both the winter and second summer coat than in the first summer coat. It may thus be anticipated that at least the faint-coloured stripes or marks in young individuals disappear with the passage of time or become unnoticeable, since the whole of the coat becomes light in colour in old adults.

In order to verify the above two hypotheses it is essential to compare the colour of young animals in a given year and that of old adults in

Table 3

Changes in colour of the belly during the individual's life observed in three specimens of *Neomys anomalus*. S I — belly coloration in first summer (1983), W — belly coloration in winter (1983/1984), S II — belly coloration in second summer (1984).

Coll. number	250	257	266
	Belly coloration		
S I	light grey	light grey	light grey
W	white	white	white
S II	white	white	white
	Intensity of stripe		
S I	conspicous	conspicous	conspicous
W	faint	very faint	very faint
S II	conspicous	faint	very faint
	Intensity of patch		
S I	faint	faint	absent
W	very faint	absent	absent
S II	very faint	absent	absent

the subsequent year. Unfortunately the very low population numbers of *N. anomalus* in 1984 (it proved impossible to catch a single individual) made such comparisons out of the question.

Irrespective of the foregoing assumptions the fact must be emphasized that the appearance of a large number of young animals with marks in 1983 was undoubtedly connected with the laws, unknown to us, but favouring such changes, of the inheritance of colour in *N. anomalus*. This is also borne out by the fact that both in material from 1979—1981 and in the sample from 1983 the frequencies of animals with marks in the old adult group are very similar (respectively 5.3 and 5.9%), whereas the frequencies of young individuals with marks differ greatly (19.5 and 69.2%).

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On the Assessment of Trapping Success

SZACOWANIE EFEKTYWNOŚCI ODŁOWÓW

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Frequency of captures of small mammals are often expressed as trapping success. Three different methods for calculating trapping success are empirically validated. It is shown that different conclusions could be drawn about frequency of captures depending upon the method employed.

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Microhabitat use by small mammals has been traditionally studied through trapping, in such a way that differential rates of captures at given trap locations are interpreted as an index of microhabitat use (Price, 1977). The results are often expressed as animals per trap-night (sensu Grinnell, 1914). When using this index, it must be considered the decrease in trapping efficiency resulting from traps removed from the overall catching effort. This concept is known as gear saturation, and states that as the gear (*i.e.* traps) become full — less are available for future captures — its efficiency decreases. The reduction in trapping efficiency implies that catch-per-unit-effort or trapping success does not necessarily represent the relative abundance of the organisms being sampled (Kennedy, 1951).

Traps for small mammals are removed from the overall catching effort when they are sprung either by the species under study or other non-target species, as well as when they are accidentally sprung due to mechanical failure of the spring mechanism. Traps from which bait