

Color variation of small mammals's (Mammalia: Rodentia and Insectivora) coats from Bulgaria

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Abstract. During field surveys for small mammals in Bulgaria we found specimens of *Crociodura leucodon*, *Talpa europaea* and a *Mus* sp with color variation. We reviewed the national scientific collections and the available literature for cases of small mammals with color variations. Color variation in small mammals is very rare, so far we found nine cases only, five cases of *T. europaea* and one case each of *C. leucodon*, *C. suveolens*, *Sorex araneus* and *Mus* sp. The albino *C. leucodon* is one out of 143 white-toothed shrews (*Crociodura* sp.) or 0.69%. The form of the partially leucistic *Mus* sp. is one out of 633 mice (0.15%), caught between 2001 and 2007.

Key words: color variation, albinism, leucism, mole, shrew, mouse, Bulgaria.

Introduction

The fur coloration is an important factor that determines individual survival in mammals, mainly because of its camouflage function (Searle 1968). The terminology used throughout the literature to describe abnormal colorations is at times conflicting. Therefore, we chose to follow Grouw (1997) who clarifies the terminology. Generally, albinism is applied for all cases when pigmentation is missing in the coloration of an individual - either completely or partially. In the classic case, albinism is when pigment is missing in the coat, the eyes, or the skin. Leucism, also incorrectly termed partial albinism (Bowman & Curran 2000), describes a condition where the pigmentation is missing partially or completely in the coat, but the retina is normally colored. The second case is relatively rare within small mammals (Steen & Sonerud 2012).

The precise determination between the two variations sometimes is very difficult, not only in nature, but especially in museum specimens as a result of variations in the type of or method of preservation as well as changes due to aging of specimens.

Albinism is caused by a single genetic mutation that is thought to have no adaptive significance since albinos are rapidly removed from their populations by the predators. Melanism (black or very dark brown pelage), however, may be found

in 20% of the individuals in some populations (Caro 2005).

This study describes cases of rare color variations in insectivores and rodents found in Bulgaria.

Materials and Methods

The results are based on data collected in surveys between 2001–2012. The majority of the samplings are from the Thracian lowland, central Bulgaria. During an ecological survey in the upper part of the Thracian lowland, Kambourova-Ivanova et al. (2012) permanently set 70 wet pit-fall traps every year between 2008–2012. Pitfall traps consisted of plastic pots 12 cm across and 18 cm deep. Each trap was half-filled with a 40% solution of ethyl alcohol and water. Traps were not baited. Traps were emptied of specimens and more preservative added (if necessary) approximately every month from April to September. Specimens were preserved in a 50% solution of ethyl alcohol and water. During this period about 1000 individuals of small mammals from ten species were recorded. Part of the material is from studies of communities of small mammals in agricultural lands in northeastern Bulgaria (2001–2007). All individuals were identified based on Peshev et al. (2004).

We examined small mammal collections deposited in the largest scientific institutions in Bulgaria which are located in the Museum of Natural History - Varna, Museum of Natural History - Plovdiv, National Museum of Natural History (BAS) - Sofia, and the Institute of Biodiversity and Ecosystem Research (BAS). We reviewed the available literature for reported cases of color variation of small mammals in Bulgaria.

Results

During the field studies we identified different degrees of color variation of the coat in three species of small mammals – *Crocidura leucodon*, *Talpa europaea* and *Mus sp.*

One female specimen of albino bi-coloured white-toothed shrew (*C. leucodon*) was caught in a wet pitfall trap (Fig. 1A) on 6 July 2011 near Dobrovnitsa village (Pazardzhik district, Bulgaria) close to highway “Trakia” (N 42°13'30", E 24°23'22"). The albino specimen of *C. leucodon* was an adult female (Fig. 1A). It had heavily worn upper intermediate teeth which, under the discriminate scheme by Sokolov & Tembotov (1989), indicate that the relative age of this individual should be about one year old. The specimen had well-developed mamillas. This is the only albino form (0.69%) out of 143 white-toothed shrews (*Crocidura sp.*) caught during a survey in 2011 in the region of Plovdiv and Pazardzhik.

The second case of color variation was a specimen of *T. europaea* with cream colored coat (Fig. 1B), which was found (GB) near Vardim village (Veliko Tarnovo district, Bulgaria) (N 43°36'57", E 25°27'23") on 25 April 2008. Its age, sex and size are unknown – the specimen was not collected.

During a population dynamic study of small mammal communities in Dobrudzha on 18.06.2005 in a wheat field near Tsarev brod village (Shumen district) (N 43°19'26", E 26°59'54") we caught forms of *Mus sp.* which were partly leucistic (Fig. 1C). Its partial leucism included its white lower back and abdomen up to the chest. The specimen is one out of 633 individuals of *Mus sp.* (0.15%) caught between 2001 and 2007.

According to Peshev et al. (2004) in north Bulgaria two species of house mice are present, indistinguishable in the field – *M. spicilegus* and *M. musculus*; therefore, the specimen was not identified to the species level.

In total, nine individuals of five species with varying coloration anomalies were identified from field surveys, museum records, and literature review (Table 1).

Discussion

The forms of *T. europaea* with color variation are not as rare as we expected. In Bulgaria we found five specimens with coloration anomalies in

moles. Because these are all museum specimens and the natural eyes are missing, we cannot use the color of the retina to decide whether they exhibited albinism or leucism. Two records have white color of the fur, they are moles exhibited in National Museum of Natural History (BAS) and Museum of Natural History – Varna. Another two records were reported by Peshev et al. (2004) who described albino and straw-yellow moles from Vitosha Mt. and Rui Mt. (Table 1). Łopucki & Mróz (2010) in their review about the small mammal's coloration anomalies on the territory of Poland reported six mole individuals, all with cream color. There is a report for two albino moles from Czech Republic (Andera 2010).

Such high number of albino moles found in various parts of Europe supports the hypothesis that the relatively frequent appearance of albino individuals in the mole populations is a result of low predator pressure due to their subterranean way of life (Yokohata 2005, Łopucki & Mróz 2010). The effect of habitat isolation is less important because the mole occurs in various types of terrestrial biotopes and the barriers for this species are mainly big rivers and strongly urbanized areas (Łopucki & Mróz 2010).

In Bulgaria we found three cases with color variation of fur of shrews: *C. suaveolens*, *C. leucodon* and *Sorex araneus*. There are a several records for different color anomalies of shrews: a melanist, a full or a partial albino form of *Sorex araneus* (Gelling 2003, Chêtnicki et al. 2007, Łopucki & Mróz 2010), an albino form of *Suncus murinus* (Jogahara et al. 2008), a white-spotted albino form of *Neomys fodiens* (Janečková 2001). Bulgarian National Museum of Natural History (BAS) – Sofia exhibits one albino Lesser white-toothed shrew (*C. suaveolens*).

We found two reports about coloration anomalies (melanic form) of *C. leucodon* from Southern Slovakia (Balaž et al. 2007). The albinism cases of *C. leucodon* are rare, but there are two documented reports found (Nitsche 1885, Masseti 2012).

It is possible that shrews with coloration anomalies occur in the natural populations but they are under strong selection pressure. This might be caused by the lower viability of such animals, the pleiotropic effects of genes that determine coloration, or the reduced ability to hide from predators (Searle 1968). It is also notable that the populations in which the studied shrews originated are located on the boundaries of the contact zones between chromosome races (Chê-

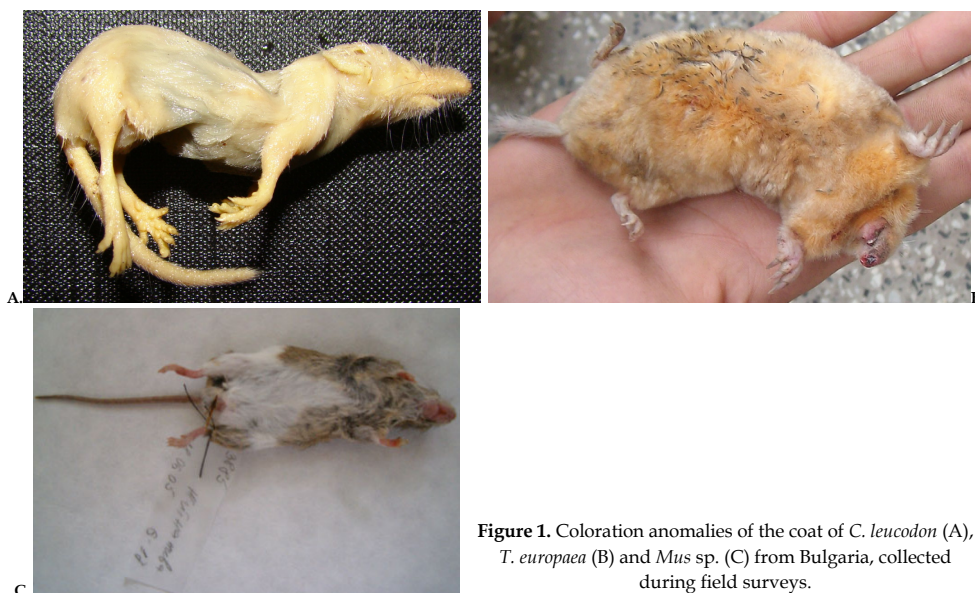


Figure 1. Coloration anomalies of the coat of *C. leucodon* (A), *T. europaea* (B) and *Mus* sp. (C) from Bulgaria, collected during field surveys.

Table 1. Cases of color variation of small mammals from Bulgaria.

Species	Coloration anomaly	No. of individuals	Locality	Coordinates	References
<i>Talpa europaea</i>	Albinism/leucism	1	Varna region	-	Museum of Natural History - Varna. No additional data.
		1	-	-	National Museum of Natural History (BAS). No additional data.
	straw-yellow	1	Vitosha Mt.	-	Peshev et al. (2004). No additional data.
		1	Rui Mt.	-	Peshev et al. (2004). No additional data.
	Cream	1	Vardim village (Veliko Tarnovo district)	N 43°36'57" E 25°27'23"	Collection data: G. Bardarov, 25.4.2008.
<i>Sorex araneus</i>	Albinism/leucism	1	Studenets hut, Rhodope Mts.	-	Museum of Natural History - Plovdiv. Collection data: D. Mitev, 12.7.1967. ♂, Ad.
<i>Crocidura suaveolens</i>	Albinism/leucism	1	Gorno Ezerovo village (Bourgas district)	-	National Museum of Natural History (BAS). Collection data: Al. Prostov, 15.10.1978. ♂, Ad.
<i>Crocidura leucodon</i>	Albinism	1	Dobrovnitsa village (Pazardzhik district)	N 42°13'30" E 24°23'22"	Collection data: Y. Koshev and N. Nedyalkov, 6.07.2011. ♀, Ad.
<i>Mus</i> sp.	Leucism (partial albino)	1	Tsarev brod village (Shumen district)	N 43°19'26" E 26°59'54"	Collection data: I. Raykov, 18.06.2005, Ad.

nicki et al. 2007).

The frequency of occurrence of atypically colored individuals in a population is largely affected by the environmental conditions. Thus, changes in the genetic structure of small mammal populations displayed as albinism or melanism can act as indicators for environmental changes (Łopucki & Mróz 2010).

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References

- Andera, M. (2010): Current distributional status of insectivores in the Czech Republic (Eulipotyphla). *Lynx* (Prague) 41: 15–63.
- Balaž, I., Bridišová, Z., Ambros, M. (2007): Nálezy melanických foriem bielozúbky bielobruchej (*Crocidura leucodon*) a hraboša poľného (*Microtus arvalis*) na Podunajskej rovine [Records of melanic forms of the bicoloured white-toothed shrew (*Crocidura leucodon*) and the common vole (*Microtus arvalis*) in Podunajská nížina (Danube Lowland, southern Slovakia)]. *Lynx* (Prague) 38: 99–102. [in Czech, with a summary in English]
- Bowman, J., Curran, R.M. (2000): Partial albinism in a Red-backed vole, *Clethrionomys gapperi*, from New Brunswick. *Northeastern Naturalist* 7: 181–182.
- Caro, T. (2005): The Adaptive significance of coloration in Mammals. *BioScience* 55(2): 125–136.
- Chétnicki, W., Fedyk, S., Bajkowska, U. (2007): Cases of coat colour anomalies in the Common Shrew, *Sorex araneus* L. *Folia Biologica* 55(1/2): 73–76.
- Gelling, M. (2003): Partial albinism in the common shrew *Sorex araneus*. *Mammal Review* 32(2): 189–190.
- Grouw, H.J. van. (1997): Not every white bird is an albino: sense and nonsense about colour aberrations in birds. *Dutch Birding* 28: 79–89.
- Janečková, K. (2001): Nález bielej škvrnitosti u dulovnice väčšej, *Neomys fodiens* (Pennant, 1771) v Malých Karpatoch. [White spotted water shrews *Neomys fodiens* (Pennant, 1771) in the Malé Karpaty Mts.]. *Folia Faunistica Slovaca* 6(16): 131–133. [In Slovak, with a summary in English]
- Jogahara, T., Ogura, G., Higa, G., Ishibashi, O., Oda, S. (2008): Survey and capture of albino-like house musk shrews (*Suncus murinus*) in Okinawa, Japan, and a preliminary report regarding inheritance of the albino like mutation. *Mammal Study* 33(3): 121–124.
- Kambourova-Ivanova, N., Koshev, Y., Popgeorgiev, G., Ragyov, D., Pavlova, M., Mollov, I., Nedialkov, N. (2012): Effect of traffic on mortality of amphibians, reptiles, birds and mammals on two types of roads between Pazardzhik and Plovdiv region (Bulgaria) – preliminary results. *Acta Zoologica Bulgarica* 64(1): 57–67.
- Lopucki, R., Mróz, I. (2010): Cases of colouration anomalies in small mammals of Poland, and reasons for their incidence. *Annales UMCS, Biologia* 65(1): 67–76.
- Masetti, M. (2012): Atlas of terrestrial mammals of the Ionian and Aegean islands. De Gruyter, Berlin.
- Nitsche, H. (1885): Albino einer Spitzmaus (*Crocidura leucodon*) im Glashause des forstbotan. Gartens in Tharandt gefangen. *Zoologische Garten* 26: 58.
- Peshev, Ts., Peshev, D., Popov, V. (2004): The Fauna of Bulgaria. Vol. 27: Mammalia. „Marin Drinov“ Publishing, Sofia. [In Bulgarian, with a summary in English]
- Popov, V., Sedefchev, A. (2003): Field guide to the Mammals in Bulgaria. Geosoft Publishing, Sofia. [In Bulgarian]
- Searle, A.G. (1968): Comparative genetics of coat colour in Mammals. Logos Press/Academic Press, London.
- Sokolov, V., Tembotov, A. (1989): Mlekopitajuscie Kavkaza: Nasekomojadnye [Mammals of Caucasus: Insectivores]. Nauka, Moskva. [in Russian]
- Steen, R., Sonerud, G.A. (2012): A bank vole (*Myodes glareolus*) with complete leucism captured by a Eurasian kestrel (*Falco tinnunculus*) in Norway. *Annales Zoologici Fennici* 49: 306–308.
- Yokohata, Y. (2005): A brief review of the biology on moles in Japan. *Mammal Study* 30(Suppl.): 25–30.