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Atypical melanistic color in common hamsters *Cricetus cricetus* (Rodentia: Cricetidae) in Romania

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Abstract. The common hamster *Cricetus cricetus* is a widespread rodent in the Palearctic region, with a well-documented variation in its fur color, which can vary from white to dark, including true and atypical melanistic and other different color morphs within the typical tricolor pelage. We investigated the occurrence of melanistic forms in common hamsters in Romania. We reviewed the available literature and several natural history collections, data from citizen science, and made our own field observations to identify the presence of melanistic forms in the pelage of common hamsters. Three atypical melanistic common hamsters are reported.

Keywords: common hamster, *Cricetus cricetus*, color polymorphism, atypical melanism.

Introduction

The common hamster *Cricetus cricetus* (Linnaeus, 1758) is a semi-fossorial small mammal from the Cricetidae family, with a large range extending from some isolated populations in western Europe, central and eastern Europe, to the Yenisey River and the Altai Mountains in the east, through Siberia (Mitchell-Jones 1999, Kryštufek et al. 2020). It is characteristic to open landscapes, steppes, and cultivated land, but the Western European populations have decreased dramatically since the 1960s-1970s (Libois & Rosoux 1982), and recently the decline was observed across most of its range (La Haye et al. 2012, Rusin et al. 2013, Surov et al. 2016). As a result, it is now globally listed as critically endangered (Banaszek et al. 2020). In Romania, the common hamster inhabits lowland and hilly regions up to 600-700 m altitude with a range covering all parts of the country except the mountain areas and Dobrogea in the southeast. The current distribution is, however, rather laconic and less documented (Hegyeli et al. 2015). The distribution in Central and Western Romania shows five more or less connected populations in Ciuc and Braşov areas, Olt Valley, the Transylvanian Plateau, and the Pannonian Plain (Hegyeli et al. 2015). South of the Carpathians, there are at least two major populations, one in the Danube Plain and one in the Moldavian Plateau.

Despite their unfavorable conservation trends in Europe, all three European hamster species remain present in Romania (Aniței & Petrovan 2022), but the common hamster is easily recognizable by the larger adult size and a specific tricolor pattern coloration. The dorsal and lateral color is medium to pale brown, the ventral part is black, with white paws and nose, and cream-colored spots on the cheeks, neck, and right behind the forelimbs (Weinhold 2008). Also, a fourth light patch can occur in the thigh region of some individuals (Niethammer 1982, Kryštufek et al. 2016). Color polymorphism is one of the most common traits of this hamster species, with variation within the normal coloration including white, albino, flavistic, red, sand, iron-gray, bicolor, piebald, dark, atypical, and true melanistic (Kryštufek et al. 2020). A white spot on the chest is often mentioned as more frequent in the European distribution area (Kayser & Stubbe 2000, Kryštufek et al. 2016). Atypical melanistic hamsters are described as individuals with a coloration darker than normal, retaining rufous tints dorsally and on the rump and the head, sometimes intense black but with occasional remnants of the normal coloration, like the light spots (Kayser & Stubbe 2000, Kryštufek et al. 2016). Black morphs are considered relatively frequent in the Thuringia region in Germany, Ukraine, and Russia (Bashkiria and Volga-Kama region), and they were already known since the 18th and 19th centuries (Gershenson 1945, Zimmermann 1969, Kayser & Stubbe 2000, Kryštufek et al. 2020). Also, atypically dark or melanistic hamsters have been reported from the north-eastern foot-hills of the Harz Mountains, near Dresden and Rheinhessen (Kayser & Stubbe 2000), with a coloration ranging from marginally darker than normal to intense black. Intense black 'melanistic' individuals, except for white paws, ears, and snout, were documented from Bashkortosan, Ukraine, Nizhniy Novgorod, and Ciscaucasia in Russia, and atypical melanistic from Ukraine, Ciscaucasia, and Kazakhstan (Kryštufek et al. 2016). The black color and the white chest spot are inherited as simple autosomal dominant (Gershenson 1945, Kryštufek et al. 2020). The variability of coloration in different populations was explained as a legacy of evolutionary history or a short-term response to environmental conditions, melanistic hamsters being associated with high temperatures and high precipitation (Kryštufek et al. 2016).

In Romania, common hamsters are well-known animals for various reasons, ranging from being considered a crop pest to its former use in the fur trade. Over time probably, millions of individuals have been killed for the fur trade, and probably similar numbers have been poisoned by different methods of pest control in agriculture (Hamar & Sutova 1970, Nechay et al. 1977), but despite the enormous number of killed animals, there are no references or publication about the color variations of the pelage of common hamsters in Romania, nor on the presence of atypical colors or the frequency of light patches.

Black hamsters, without a clear indication of location or a clear description, are sometimes mentioned in the literature in Romania but with no details about their number or

frequency of occurrence (Popescu & Murariu 2001). One of the earliest descriptions of the color pelage of common hamsters from Romania goes back to 1912, from Miller's work, who describes the common hamsters from the type locality of *Cricetus cricetus nehringi* (Miller 1912). The description appears similar to the individuals belonging to nominate form but mentions that in one examined adult specimen, the light thigh spot is barely indicated by a few scattered whitish hairs (Miller 1912).

This study aimed to identify the presence of any melanistic forms in the pelage of common hamsters in Romania by reviewing the available material in collections and other sources.

Materials and methods

We analyzed the available common hamster specimens in natural history collections, the authors' field observations, and verified data from citizen science sources, where we checked for the presence of melanistic individuals. Several museum collections from Romania were included, summing 100 specimens prepared as rounded skins, pelts, or stuffed specimens as follows: Grigore Antipa National Museum of Natural History (GANMH) (n=38); The Museum of Natural History from Sibiu (n=5); Natural History Museum of Alexandru Ioan Cuza University in Iaşi (n=12); Faculty of Biology in Bucharest University (n=9); National Institute for Research and Development in Forestry "Marin Drăcea" Braşov (n=15); Research - Development Institute for Plant Protection Bucharest (n=12); Dorohoi Museum of Natural Sciences (n=8) and Galaţi Natural Sciences Museum Complex (n=1). We reviewed all the available records from the literature wherever color variation was mentioned. Records from citizen science sources ("Mammals of Romania" - Facebook page; "Fauna României – Conservare prin educaţie" – Facebook page and "D.O.R. (Dead on Road)" – Facebook page) comprised of 26 individuals and were considered only well-documented cases that included photos of live or dead animals (road kills or predation by domestic animals). Moreover, 91 other common hamsters have been observed in the field by the authors by direct observations and checked for color aberrations. Thus, a total number of 217 individuals of the common hamster from Romania were visually observed to identify the presence of specimens with melanistic patterns. Three specimens with standard tricolor pattern coloration were illustrated to help visualize the normal color pattern.

Results

Generally, the tricolor pattern of the analyzed common hamster specimens matched the described standard coloration from the literature (Niethammer 1982, Kryštufek 2017). The dorsal fur ranges from yellowish brown to brownish buff, occasionally with a russet of yellowish tinge, particularly on flanks and rump (Figure 1, 2), but dorsal fur can be darker in some specimens (Figure 2.C). The snout and the area around the eyes and ears are rusty, and the ears are rusty with white edges, as described in the literature. The ventral side and front legs are pure black, while the paws are white. The white cuff is more evident in some animals (Figure 1.B). The nose, cheeks, lips, and chin are white, with a streak stretching from the chin toward the chest. The light patches on the cheek (Figure 1.B.I.), neck (Figure 1.B.II.), axillary (Figure 1.B.III.), and thigh (Figure 1.B.IV.) are whitish and lie near the shoulders and on the flanks between the black and brown areas (Kryštufek et al. 2020). The light patches on the cheek, neck, and axillary were present in all the examined specimens, while the thigh light patch is present in most of the examined specimens but is lacking in others (Figure 3.C). A white spot on the chest can occur in some specimens (Figure 3.B.2).

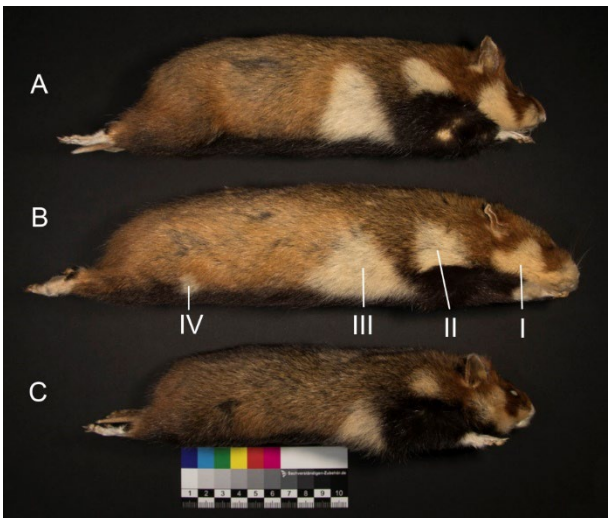

Figure 1. Lateral view depicting light patches diversity (I – cheek, II – neck, III – axillary, IV- thigh) in typical tricolor pelage of Common hamsters from Romania: A – adult male from Moftinu Mic, Satu Mare county (12.VII.2017), GANMH collection number MAM-12341; B – adult male from Oradea, Bihor county (22.XII.1965), GANMH c.n. MAM-9679; C – adult male from Ţârna Mare, Suceava county (12.VII.2017), GANMH c.n. MAM-13023.

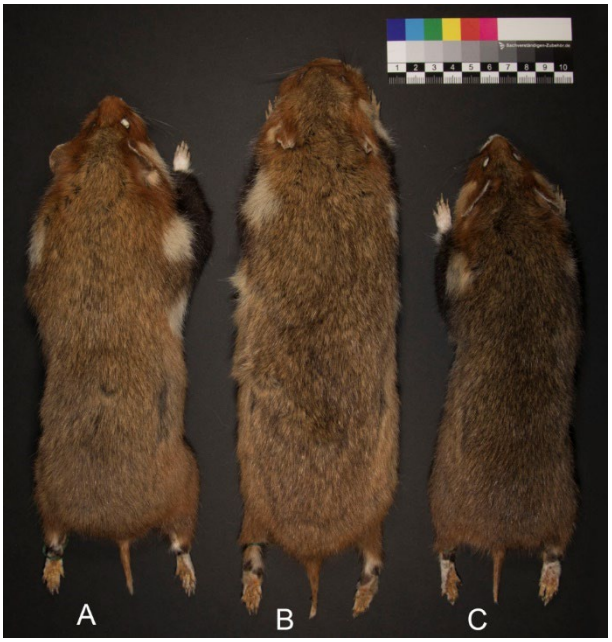

Figure 2. Dorsal view depicting typical tricolor pelage of Common hamsters from Romania: A – adult male from Moftinu Mic, Satu Mare county (12.VII.2017), GANMH collection number MAM-12341; B – adult male from Oradea, Bihor county (22.XII.1965), GANMH c.n. MAM-9679; C – adult male from Ţârna Mare, Suceava county (12.VII.2017), GANMH c.n. MAM-13023.

Figure 3. Ventral view depicting light patches diversity (1 – chin streak, 2 – cuff, 3 – chest spot, 4- thigh spot) in typical tricolor pelage of Common hamsters from Romania: A – adult male from Moftinu Mic, Satu Mare county (12.VII.2017), GANMH collection number MAM-12341; B – adult male from Oradea, Bihor county (22.XII.1965), GANMH c.n. MAM-9679; C – adult male from Ţârna Mare, Suceava county (12.VII.2017), GANMH c.n. MAM-13023.

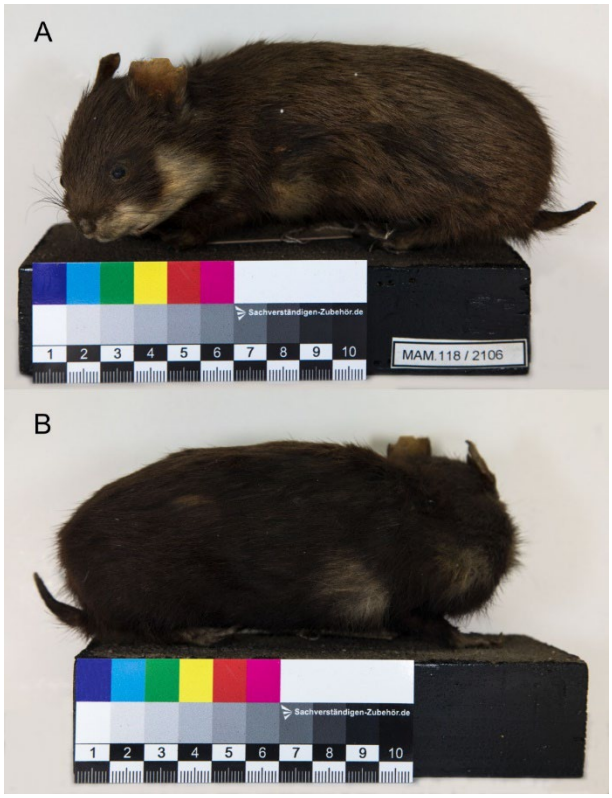

Figure 4. Lateral views of the oldest preserved specimen of common hamster with atypical melanistic color collected in Romania: (GANMH c.n. MAM-118 from Feteşti, Ialomiţa county (31.XII.1902)

Overall we found three specimens with atypical colors, which correspond to atypical melanistic according to the previously known forms described in the literature (Kayser & Stubbe 2000, Kryštufek et al. 2016).

Chronologically, the two first specimens date back to the beginning of the 20th century. Both animals were collected in Romania and were prepared by Robert Ritter von Dombrowski, a taxidermist at that time at the Grigore Antipa National Museum of Natural History in Bucharest.

The first specimen is presently kept in the G.A.N.M.H. mammal collection with inventory number MAM-631. It is a subadult unsexed individual, and it has no precise collecting data, and the only mention is that it was collected in Romania. The dorsal fur is presently dark brown, not black, due to time discoloration, and it is impossible to determine exactly if the original color was completely black. The snout, the ears, and the area around the eyes are also dark brown. The original color of the ears seems to have been black with white edges. A small post-auricular light patch is present. The ventral side and front legs are dark brown, the paws are white, and the cuffs are dark brown. The nose is darker than normal, while the cheeks, lips, and chin are white without any streak toward the chest. The light patches on the cheek, neck, and axillary are present on both flanks, while the thigh area is dark brown with no visible light patch. The specimen is in a poor preservation state and is not illustrated forward.

The second specimen was also prepared by Robert Ritter von Dombrowski, and it was collected on 31.XII.1902 from Feteşti - Ialomiţa county (44.3682° N, 27.8393° E), Romania. The specimen is presently kept in the G.A.N.M.H. mammal collection with the inventory number MAM-118 (Figure 4). The dorsal fur color is currently also dark brown, and it cannot be determined exactly if it is discolored due to time passage or if this was its original color. The snout, the ears, and the area around the eyes are also dark brown. The original color of the ears seems to have also been black, but the edges of the ears are too deteriorated to determine the original color. A small post-auricular light patch is present. The ventral side and front legs are dark brown, the paws are white, and the cuffs dark brown (Figure 4). The nose is dark brown, while the cheeks, lips, and chin are white without any streak toward the chest. The light patches on the cheek, neck, and axillary are present on both flanks, while the thigh area is dark brown with no visible light patch (Figure 4).

The exact intensity of the black color can no longer be determined precisely due to the precarious preservation conditions. The fur color is not symmetrically distributed as both specimens might suffer partial discolorations due to prolonged exposure to light in the museum exhibition. However, it is still obvious that both specimens are atypical melanistic, resulting from their labels and original registers.

The third specimen is a recently collected one, a subadult male, found as roadkill causality on 04.IX.2020 in Cujmir - Mehedinţi county (44.1985° N, 22.9257° E). The specimen is presently kept in the G.A.N.N.H. mammal collection with inventory number MAM-13492. The dorsal fur of the animal is completely black with slight yellowish-brown tips of the hairs barely visible in strong light, particularly on the flanks and rump (Figure 5). The snout and area around the eyes and ears are black, and the ears are also black with white edges. A

small post-auricular light patch is present. On the nose, there is one slight white stripe. The ventral side and front legs are pure black, while the paws are white, with short white cuffs (Figure 5). A short white chin streak is present. The nose, cheeks, lips, and chin are white. The light patches on the cheek, neck, and axillary are present on both flanks, while the thigh area is completely black with no visible light patch (Figure 5).

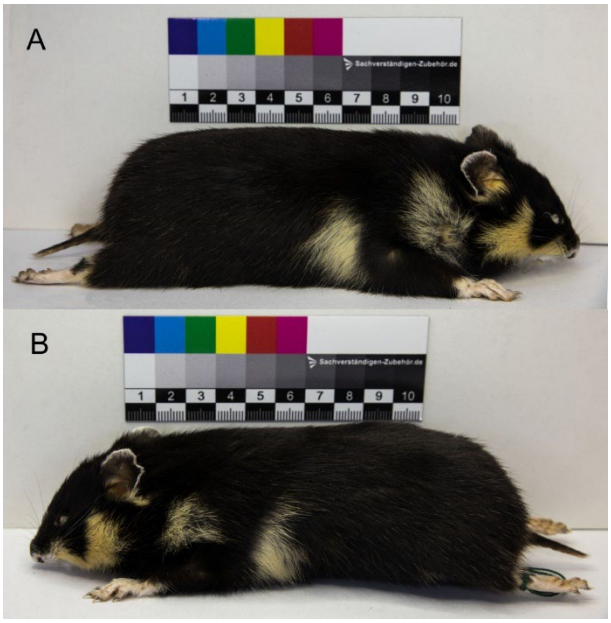

Figure 5. Lateral views of atypical melanistic common hamster (GANHM c.n. MAM-13492) from Cujmir, Mehedinți county (04.IX.2020).

Discussion

Among the examined material from Romania, besides the typical morphological elements such as the light patches on the cheek, neck, axillary, and thigh, some individuals presented a white spot on the chest or a chin streak as described in the literature (Schroder et al. 2014). The light spot on the thigh is present in some individuals and is lacking in others. The thigh spot is lacking in all three atypical melanistic hamsters we describe. The frequency of appearance of these morphological traits in different populations from Romania could not be investigated due to the scarcity of available material.

Although in the past, a very large number of common hamsters were reported as trapped for the fur trade in Romania, ranging from 200000 to 1.3 million individuals per year between 1955-1966 (Hamar 1967, Nania 1991, Hedrzak et al. 2021) very few specimens are presently kept in museum collections. Thus, due to poorly kept records and a lack of interest in collecting and preserving museum specimens in the past, there was no previous publication of melanistic forms in Romania. Regarding the natural science collections, unfortunately, Romania stands in line with the trend manifested by other countries from Eastern Europe (Kryštufek et al. 2015), where unstable funding for research in zoology correlated with the lack of interest in development and preservation of natural science collections lead to the loss of some priceless natural history collections.

Moreover, even though the common hamster was listed as a strictly protected species in Appendix II of the Bern Convention and Annex IV of the Habitats Directive, in Romania, trapping continued legally until 2009 when the Ministry of Environment granted a harvesting quota of 110000 hamsters (Ministerul Mediului 2009), and still we haven't found any information about the individuals collected.

It is stated that the proportion of color variants in common hamsters increases with population density and consequently may decrease with dwindling genetic diversity (Gershenson 1945, Kayser & Stubbe 2000, Kryštufek et al. 2020). We suspect that the intense pressure caused by massive trapping and pest control on the population, correlated with other important decline factors such as intensive agriculture practices of monoculture crops and loss of habitat (Murariu 1998, Hegyeli et al. 2015), may lead to a decrease of the number of individuals in the population and loss of genetic diversity and inbreeding (Charlesworth & Willis 2009). Inbreeding increases homozygosity, lowers fitness, and can increase color anomalies frequencies in a population (Crnokrak & Roff 1999). Habitat loss and fragmentation are known to greatly influence the genetic structure of the natural population, losing the connectivity between them and interrupting the gene flow (Banaszek et al. 2011). However, the extremely few mentions in Romania in the last hundred years, which are limited to the identification of three specimens of common hamsters with atypical melanistic fur, have been correlated with the absence of any research on the frequency of appearance of various other aberrant forms of the color of the fur of common hamsters, and there are no conclusions to be drawn regarding the changes in the frequency of occurrence of these color varieties at the population level.

In this paper, we analyzed a total amount of 217 common hamsters from Romania and found three specimens with an atypical melanistic pattern of the fur. This is the first report of the presence in Romania of this color variation on common hamsters, contributing to a better knowledge of the distribution of this color variation within the global Common hamster range.

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