

## Short note

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# The first report of albinism in a Sundaland endemic rodent

<https://doi.org/10.1515/mammalia-2020-0047>

Received April 25, 2020; accepted August 19, 2020; published online September 8, 2020

**Abstract:** Albinism, a congenital disorder that results in a lack of melanin deposition, is common in domesticated animals but rare in nature. Among the ~2500 species of rodents worldwide, only 67 have published reports of albinism. Here we report the capture of an albino murid (Muridae: Rodentia) from Mt. Singgalang in West Sumatra, Indonesia. The specimen is an adolescent but sexually mature male *Maxomys hylomyoides*, a montane Sumatran endemic. To our knowledge, this specimen represents the first reported albino rodent from Indonesia and Sundaland, and only the second from Southeast Asia.

**Keywords:** albino; Indonesia; *Maxomys hylomyoides*; Muridae; West Sumatra.

On occasion mammals have abnormal pelage color conditions, ranging from extremely dark to fully white. Pelage color abnormalities often reflect congenital disorders,

sometimes brought on by low genetic diversity (Brito and Valdivieso-Bermeo 2016; Hafner and Hafner 1987), that affect the melanogenesis pathway (Slominski et al. 2004). Mammals produce two pigmentation molecules, eumelanin and pheomelanin, through melanogenesis (Slominski et al. 2004). Eumelanin provides dark color while pheomelanin provides a reddish or buffy hue, and the deposition of these pigments in the integument determines color and pattern.

Disruptions in the production, transport, or deposition of either pheomelanin or eumelanin leads to unusual coloration (Lamoreux et al. 2010). One such disruption is melanism, which results from an increase in eumelanin, pheomelanin, or both. One well known example is the melanistic (black-colored) Eastern Grey Squirrels (*Sciurus carolinensis*) found regionally in the northern United States and southern Canada. These black squirrels have a melanism disorder that is fixed in the population (Creed and Sharp 1958; Schorger 1949).

Other melanogenesis disorders result in reduced pigmentation. One example is leucism, where melanins are properly produced, but their deposition is inhibited in the entire body or just in certain regions (Lamoreux et al. 2010; Romero and Tirira 2017). Leucism may lead to white or grey spots scattered among the wild-type pelage, sometimes called “piebald”, or white or grey pelage covering the entire body, referred to as “partial albinism” or incorrectly as “albinism.” Leucism is relatively common and is known from domestic species such as dogs and horses, and wild mammals including many rodent species (Brito and Valdivieso-Bermeo 2016; Hafner and Hafner 1987, Lamoreux et al. 2010; Naharuddin et al. 2015; van der Geer 2019). Importantly, leucistic species maintain their wild-type eye color, and often retain their natural skin color (Lamoreux et al. 2010). Lastly, albinism is the complete lack of melanin deposition in the entire body due to a lack of functional tyrosinase, an enzyme that transports melanin (Slominski et al. 2004). Albinism is shown by a bright white pelage, pale pink skin, and red eyes. Though the word “albino” is commonly used for other conditions, true albinism is extremely rare in nature (Romero et al. 2018; van Grouw 2006; Walter 1922).

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Albinism in domestic rodents is common. Two of the most familiar rodent species, *Mus musculus* and *Rattus norvegicus*, have been inbred for laboratory science for generations (Beermann et al. 2004). Inbreeding may cause a lack of functional tyrosinase, and therefore albinism is often associated with low genetic diversity (Beermann et al. 2004; Slominski et al. 2004). Wild albino rodents are much less common. A thorough review of albinism in rodents by Romero et al. (2018) discovered that < 2% of rodent species worldwide (64 species in 13 families) have reported cases of albinism. Since 2018, only three additional species of rodents have records of albinism: two wild rodents from South America (Dalapicolla et al. 2020; Stumpp et al. 2019), and one human commensal, *Rattus exulans*, from Nha Trang, Vietnam, collected in 1968 (van der Geer 2019). Reports of albinism in rodents are geographically biased, with 45 of the 64 species with reported albino individuals occurring in North America and Europe. Of particular note is the paucity of reported albino rodents in Asia (nine species) and Africa (one species) (Dalapicolla et al. 2020; Romero et al. 2018; Stumpp et al. 2019; van der Geer 2019), a pattern likely due to lower overall sampling.

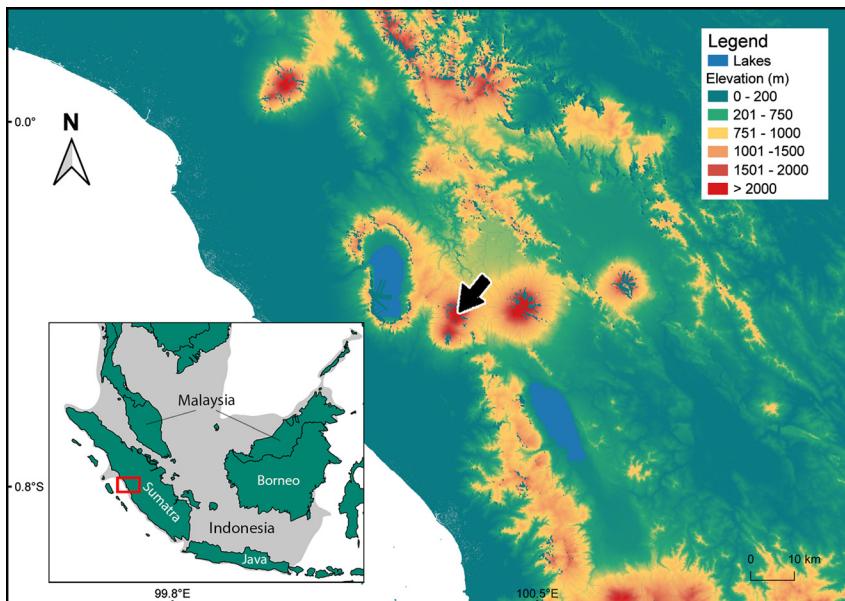
Muridae, the Old World rats and mice, is the most diverse family of mammals (~900 species; Burgin et al. 2018). Nevertheless, there are reports of albinism in only 11 murid species (Romero et al. 2018; van der Geer 2019), three of which are the lab rat *Rattus norvegicus*, the house mouse *Mus musculus*, and the widespread human commensal black rat, *Rattus rattus*. In addition to these three commensal species, Romero et al. (2018) reported an albino *Lemniscomys* from the UK, citing Barret-Hamilton and Hinton (1921). However, *Lemniscomys* is found exclusively in Africa (Wilson et al. 2019), and we were unable to locate any mention of an albino *Lemniscomys* in the UK in Barrett-Hamilton and Hinton's 1921 volume, or any of the volumes of "A History of British Mammals: Land Mammals" (Barrett-Hamilton and Hinton 1911–1921). Therefore, only 10 of approximately 900 murid species have published reports of wild albinism. Of these 10 species, three are from Europe (*Apodemus agrarius*, *A. flaviculus*, *A. sylvaticus*), two are from India (*Bandicota bengalensis*, *Madromys blanfordi*), one is from Africa (*Otomys tropicalis*), and four are human commensals (*Rattus exulans*, *R. norvegicus*, *R. rattus*, *Mus musculus*) (Romero et al. 2018). Despite the great diversity of murid rodents in East and Southeast Asia there is only one report of wild albinism (a *Rattus exulans* from in or near a large urban area in Vietnam; van der Geer 2019).

On 30 November 2018, during a small mammal survey of Mt. Singgalang in West Sumatra, Indonesia (Figure 1), one of us (AM) collected a male albino murid rodent

(Louisiana State University Museum of Natural Science 40343) in a Victor trap at 2150 m above sea level. The trapping locality was in lower montane forest with very minimal human disturbance, and was 6 km from Nagari Balingka, the closest human settlement. The albino rat had red eyes and no sign of melanin deposition in the skin or pelage (Figure 2). Standard external measurements of this specimen were Total Length = 265 mm, Tail Length = 135 mm, Hind Foot Length = 32 mm, Ear Length = 21 mm, and Mass = 52.2 g. Additional morphological characters include an elongate rostrum and a pelage comprising thick, yet flexible dorsal spines mixed with soft underfur. This albino specimen was determined to be a post pubescent adolescent male due to both sexual maturity (testes in the scrotal position, 16 × 9 mm), limited molar wear, and unfused epiphyses on long bones (McCutcheon and Marinelli 2009). Based on overall presentation, we determined the albino specimen to be *Maxomys hylomyoides*, a Sumatran endemic species, listed as data deficient (IUCN 2020) that is common in mid-to-upper montane forest of Mt. Singgalang (Appendix 1).

Given the rarity of this finding, and the potential for misidentification, we compared this specimen to other male murid rodents trapped during our expedition and curated at the Louisiana State University Museum of Natural Science (Table 1, Appendix 2). Captured murid species include: *M. hylomyoides*, *Mus crociduroides*, *Niviventer fraternus*, *Leopoldamys sabanus*, *Rattus cf. exulans*, *Rattus korinchi*, and *Sundamys muelleri*. We found that LSUMZ 40343 fits the measurements of other adult *M. hylomyoides* specimens and falls outside the range of all other taxa in at least one external measurement (Table 1). The skull of LSUMZ 40343 has pointed nasals protruding beyond the upper incisors, tear-drop shaped incisive foramina with posterior limits well anterior to the first molars, and a bony palette that ends anterior to the posterior margin of the third molar, all of which are reliable characters used to identify the genus *Maxomys* (Musser et al. 1979). Other common *Maxomys* species in Sumatra include *Maxomys surifer*, *Maxomys rajah*, and *Maxomys inflatus*. Both *M. surifer* and *M. rajah* are substantially larger than *M. hylomyoides* and are common at lower elevations <1500 m (Musser et al. 1979). We only trapped above 1800 m on this expedition and did not encounter either of these species. *M. inflatus*, another Sumatran endemic, has distinctly inflated nasolacrimal capsules (Musser et al. 1979), which LSUMZ 40343 and other *M. hylomyoides* lack.

LSUMZ 40343 represents, to our knowledge, the first record of an albino rodent from Indonesia, or other parts of the Malay Archipelago. There are reports of other albino



**Figure 1:** Location of field work conducted on Mt. Singgalang in late 2018. Field locality denoted by an arrow. Inset map shows the position of West Sumatra relative to the Sundaland region (gray shaded area).



**Figure 2:** (Upper) Albino *Maxomys hylomyoides* LSUMZ 40343. Note the red eyes and complete lack of melanin in the feet, ears, and tail. (Below) *Maxomys hylomyoides* LSUMZ 40302 with wild-type coloration. Both specimens are from Mt. Singgalang. Photos by Ryski Darma Busta.

mammals in Indonesia, including a well-publicized albino Bornean Orangutan (*Pongo pygmaeus*; Katz 2020), an albino Hairy-nosed Otter (*Lutra sumatrana*) from Bukit Barisan Selatan National Park, Sumatra (O'Brien and Kinnaird 1996), and an albino Sunda Slow Loris (*Nycticebus coucang*) also from Bukit Barisan Selatan National Park (International Animal Rescue 2018). Albinism may be less surprising in these larger, less abundant mammals, as all have undergone population declines due to habitat loss (IUCN 2020). We did not capture any other individuals with color abnormalities among 85 *M. hylomyoides*. Several folkloric stories from the people living near Gunung Singgalang place an emphasis on encountering all white birds or all white rats while hiking on the mountain. These stories, along with more abundant records from other regions, suggest that albinism in Southeast Asian murids is more common than indicated by the sparse scientific record.

**Acknowledgments:** We thank Pak Sati and the citizens of Nagari Balingka, Kecamatan IV Koto, Kabupaten Agam, Sumatera Barat, for field assistance. Taufiq Afdhal, Inda Dwi Solina, Nuarti Sari Ramadhani, Andri Saputra, Tengku Lidra, and students at Andalas University provided critical support. Kementerian Riset dan Teknologi, Balai Konservasi dan Sumber Daya Alam (BKSDA), and the local governments of Agam District and Sumatera Barat Province provided research permits. The curatorial staff at Museum Zoologicum Bogoriense provided invaluable assistance. Lembaga Ilmu Pegetuan Indonesia (LIPI) provided

**Table 1:** Field-recorded measurements from adult specimens of the seven murid rodent species collected on Mt. Singgalang in 2018, along with the albino specimen.

Measurement	Albino	<i>Maxomys hylomyoides</i> (N = 44)	<i>Niviventer fraternus</i> (N = 32)	<i>Mus crociduroides</i> (N = 12)	<i>Rattus cf. exulans</i> (N = 8)	<i>Sundamys muelleri</i> (N = 6)	<i>Leopoldamys sabanus</i> (N = 3)	<i>Rattus korinchi</i> (N = 1)
Total length (mm)	265	273 ± 14.2 237 – 303	342 ± 22.2 206 – 384	218 ± 6.1 210 – 229	241 ± 14.5 214 – 260	691 ± 15.1 663 – 705	619 ± 11.5 607 – 630	416
Tail length (mm)	135	138 ± 7.2 119 – 154	207 ± 11.3 187 – 228	114 ± 3.6 108 – 121	124 ± 7.1 111 – 135	399 ± 13.8 377 – 416	377 ± 3.8 373 – 380	234
Hind foot (mm)	32	31 ± 1.5 28 – 33	32 ± 1.1 30 – 35	25 ± 2.4 23 – 31	25 ± 0.5 25 – 26	61 ± 1.2 59 – 62	51 ± 1.0 50 – 52	36
Mass (g)	52.2	67 ± 9.9 52 – 87	65 ± 10.5 46 – 85	27 ± 2.3 23 – 30	32 ± 1.1 30 – 35	581 ± 64.3 497 – 660	417 ± 10.3 407 – 427	115

Each measurement cell includes the mean ± standard deviation, with minimum and maximum values below. The albino individual falls within the range of *Maxomys hylomyoides* for all measurements.

export permits. Two anonymous reviews gave suggestions that greatly improved this manuscript.

**Author contribution:** All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

**Research funding:** JAN was supported by a U.S. National Science Foundation (NSF) Graduate Research Fellowship. This work was supported by NSF DEB-1754393, NSF DEB-1441634, the Coypu Foundation, and the Alfred L. Gardner and Mark S. Hafner Mammalogy Fund.

**Conflict of interest statement:** The authors declare no conflicts of interest regarding this article.

## Appendix 1:

Total number of murine rodents collected on Mt. Singgalang in November 2018.

*Leopoldamys sabanus* = 4, *Maxomys hylomyoides* = 85, *Mus crociduroides* = 25, *Niviventer fraternus* = 42, *Rattus cf. exulans* = 13, *Rattus korinchi* = 1, *Sundamys muelleri* = 7.

## Appendix 2:

LSUMZ specimens used for comparative measurements.

*Leopoldamys sabanus*: 40265, 40267 – 68; *Maxomys hylomyoides*: 40269 – 71, 40273, 40276, 40278, 40282 – 84, 40287, 40289, 40291 – 93, 40295 – 98, 40301 – 03, 40306 – 07, 40311, 40316, 40319, 40323, 40325, 40328 – 29, 40330 – 31, 40333 – 34, 40337, 40339, 40342 – 48, 40350 – 51; *Mus crociduroides*: 40355, 40357, 40359, 40361 – 63, 40371, 40374 – 78; *Niviventer fraternus*: 40380 – 81, 40383 – 89, 40391 – 96, 40399 – 03, 40405, 40408 – 12, 40414 – 18, 40421; *Rattus cf. exulans*: 40422 – 25, 40428, 40430, 40432 – 33; *Rattus korinchi*: 40442; *Sundamys muelleri*: 40435 – 38, 40440 – 41.

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