THERYA NOTES 2023, Vol. 4 : 249-252 DOI: 10.12933/therya_notes-23-137 ISSN 2954-3614

First record of melanism in the northern palm squirrel *Funambulus pennantii* in Delhi, India

Primer registro de melanismo en la ardilla de palma del norte *Funambulus pennantii* en Delhi, India

Kanchan Puri[1], and Ritesh Joshi[1]*

[1]Eco-Sensitive Zone Division, Ministry of Environment, Forest and Climate Change. Jor Bagh Road. New Delhi – 110003, India.
E-mail: genetics_1407@yahoo.co.in (KP); ritesh_joshi2325@yahoo.com (RJ).
*Corresponding author

Melanism is a rare phenomenon in animals and is caused by an excessive development of dark pigments (melanin) that produces a darkening of the skin and hair of animals. In this note, we report and illustrate an observation of melanism in a northern palm squirrel, *Funambulus pennantii*, in an urban park, Siri Fort Park, in the National Capital Territory of Delhi, northern India. A northern palm squirrel with melanism was observed during field studies. The individual was partially black, with a blackish head, neck, ears, and forelimbs, while the rear part of the body and tail were of normal color. Because no cases of melanism in the northern palm squirrel have been reported in the region, this report constitutes the first record of the presence of the northern palm squirrel with melanism in the Territory of the Delhi Union. The above will open new dimensions in the natural history of the species. More studies are needed to help understand this rare phenomenon in the species, and the ecological and physiological implications, such as survival, of the species' populations.

Key words: Five-striped palm squirrel; north India; Siri Fort Park; urban green space.

El melanismo es un fenómeno poco común en los animales y es causado por un desarrollo excesivo de pigmentos oscuros (melanina) que produce un oscurecimiento de la piel y el pelo de los animales. En esta nota, informamos e ilustramos una observación de melanismo en una ardilla de palma del norte, *Funambulus pennantii*, en un parque urbano, Siri Fort Park, en el Territorio de la Capital Nacional de Delhi, al norte de la India. Durante los estudios de campo se observó una ardilla de las palmeras del norte con melanismo. El individuo era parcialmente negro, con cabeza, cuello, orejas y extremidades anteriores negruzcas, mientras que, la parte trasera del cuerpo y la cola tenían un color normal. Debido a que no se han reportado casos de melanismo en la ardilla de la palma del norte en la región, esta nota constituye el primer registro de la presencia de la ardilla de la palma de cinco rayas con melanismo en el Territorio de la Unión de Delhi. Lo anterior abrirá nuevas dimensiones en la historia natural de la especie. Se necesitan más estudios que ayuden a comprender este fenómeno raro en la especie, y las implicaciones ecológicas y fisiológicas, como la supervivencia, de las poblaciones de las especies.

Palabras clave: Ardilla de palma de cinco rayas; espacio verde urbano; norte de la India; Parque Fuerte Siri.

Melanism is a rare phenomenon in animals, which is caused by an over-development of melanin in the skin and hair and can turn animals completely or partially black. Melanism is opposite of albinism, which effect the abnormal deposition of melanin (not necessarily an increase of pigment) in the skin and/or hair follicles (Mahabal *et al.* 2019). Melanism is one of the most common types of phenotypic variation in many taxa including insects (True 2003), amphibians (van Dijk 1997), reptiles (lizards and snakes; Recknagel *et al.* 2018; Fănaru *et al.* 2022), birds (van Grouw 2017), and mammals such as felids (Graipel *et al.* 2019) and rodents (Majerus and Mundy 2003).

A total of 113 species of mammals have been reported worldwide with melanism, of which orders Rodentia and Carnivora group the largest number of species with melanism, being reported most frequently in countries on the American continent, followed by Asia, Africa, Europe, and Oceania (Medina and Medina 2019). The phenomenon of melanism occurs in several species of squirrels across the world but it is most frequently observed in eastern fox squirrels (*Sciurus niger*) and eastern gray squirrels (*S. carolinensis*; McRobie *et al.* 2019). It was recently shown that squirrels of the genus *Funambulus* from the south of the Indian subcontinent, and which live in humid and denser habitats, have darker fur, while individuals from the northern regions and which are found in dry and open habitats, are lighter in color (Nivetha *et al.* 2023).

In India, melanism has been reported in black palm squirrel (*Funambulus palmarum*) from Kerala State in southern India (Dileepkumar *et al.* 2021), Indian giant flying squirrel (*Petaurista philippensis*) from Tamil Nadu State in southern India (Ramakrishnan *et al.* 2016) and northern palm squirrel *Funambulus pennantii* from Gujarat (western India) and Haryana (northern India) States (Karan *et al.* 2020; Kumar *et al.* 2022). *Funambulus pennantii* is a rodent species that belongs to the family Sciuridae and is distin-

guished by 5 stripes, 3 of which run along the body and 2 more paler stripes on its sides, running between hind and forelegs; the fur is usually grey-brown, and the tail has interspersed long black and white hairs (Thorington *et al.* 2012; Datta and Nandini 2015). The species is the lightest *Funambulus* and has the highest pattern contrast as compared to other squirrels (Nivetha *et al.* 2023). The species is native to India, Nepal, Bangladesh, Pakistan, and Iran and widely distributed across the tropical and subtropical dry deciduous forests, montane ecosystems, scrublands, grasslands, and agricultural fields (Datta and Nandini 2015). The species is diurnal and arboreal; however, commonly use to forage on ground and is commonly found across the urban parks and well adapted to live in close proximity to the human habitations. Northern palm squirrel is listed as Least Concern in the IUCN Red List of Threatened Species (Nameer and Molur 2016).

In India, melanic palm squirrel individuals (all-black morphs) have been observed from the Vadodara (western India) and Rohtak (northern India) districts in Gujarat and Haryana States. So far, there are no records of melanism in northern palm squirrel *F. pennantii* in National Capital Territory of Delhi, India (Mahabal *et al.* 2019). In this work, we report a case of melanism in the northern palm squirrel in an urban park in the National Capital Territory of Delhi, northern India.

The present report of melanism in the palm squirrel occurred during a study that had the objective of documenting the avifauna of the Siri Fort Park. The park is located in south Delhi (28° 55′ 37.86″ N, 77° 22′ 77.50″ E; ~214 m) which has a territorial area of 161,874 m^2 (Figure 1). The vegetation surrounding the site where the sighting occurred includes plant species such as *Cassia fistula*, *Ficus religiosa*, *Ficus virens*, *Ficus benghalensis*, *Bombax ceiba*, *Bauhinia variegata*, *Polyalthia longifolia*, *Pithecellobium dulce*, *Alstonia scholaris*, *Mimus opselengi*, *Azadirachta indica*, *Dalbergia sissoo* and *Bambusa vulgaris* (Joshi and Puri 2021). During the sighting, the behavior of the squirrel was observed with the help of field binoculars (Nikon Action Series, 10×50 CF) and photographs of the specimen were taken with a Canon EOS-700D camera.

On December 18, 2022, at 10:40 hr, we observed 1 young individual of melanistic northern palm squirrel. The individual was partially black, with blackish head, neck, ears, and forelimbs; however, the individual's hind portion of the body along with the tail were normal colored (Figure 2a, b). The squirrel had very less hairs on its head, neck, cheeks, and forelimbs, where the wrinkles were visible. Besides, the lateral stripes on the head (1 from above the ear to eye and from below the ear past the eye to the rostrum) were not visible because of partially furred blackish skin. At the time of recording the squirrel with melanism, we observed that it was looking for food in the grass and that it fed on grass roots and grains. We observed the individual for about 2-3 min and later, startled by our presence, the individual ran away towards a black cutch tree (*Senegalia catechu*), where many squirrels were feeding on the grains under the tree. When the individual reached near its companion, 2-3 indi-

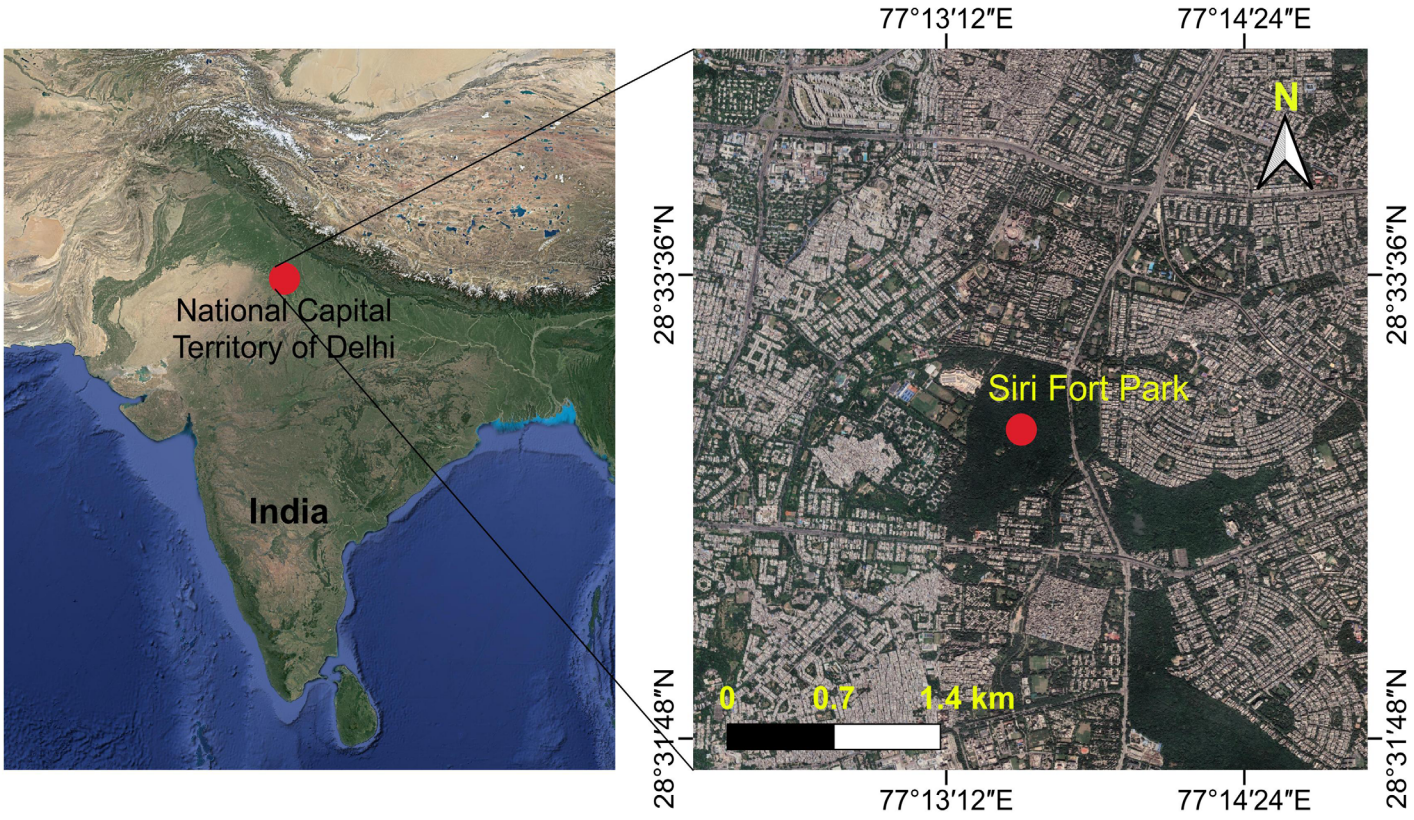

Figure 1. Geographic location of Siri Fort Park, National Capital Territory of Delhi, India, place of the record of melanism in *Funambulus pennantii*.

viduals started chasing away the individual speedily, and in the next moment the individual quickly climbed up in the tree and peeking towards other squirrels in ground. Thereafter, the individual returned to the grassy patch after taking 2 quick rounds of the tree trunk.

Considering the morphological features and coloration of the body, the squirrel was identified as *Funambulus pennantii*. As melanistic northern palm squirrel has not been reported from the National Capital Territory of Delhi so far, this report constitutes first ever record of melanistic northern palm squirrel.

In numerous wild species, melanin-based coloration associates to different behavioral, physiological, and morphological traits, yet the proximate basis of such associations remains largely unknown (San-Jose and Roulin 2020). Some of the studies have also pointed out that melanin-based color patterns are associated with higher aggression, bold behavior, and social dominance across taxa (McKinnon and Pierotti 2010; San-Jose and Roulin 2018). A similar study pointed out that melanin-based coloration is associated with suites of behavioral traits, which are under both genetic and environmental influence and coloration can thus evolve as a direct or indirect response to predation, but it can also be a signal of antipredator strategies to potential mates (van den Brink *et al.* 2012).

Some of the studies have demonstrated that melanism is associated with behavior in vertebrates, especially in terms of sexual activity, aggressiveness, boldness, exploration, and sociability (Cote *et al.* 2018; San-Jose and Roulin 2018). Melanic phenotypes of mosquito-fishes (*Gambusia holbrooki*) are found more aggressive towards females in captivity, chasing them and attempting more mattings than their silver siblings, however, females are observed avoiding melanic-male mating attempts more than silver-male mating attempts (Horth 2003). However, in a study carried out to determine the significant differences between black and gray morphs of *Sciurus carolinensis* in New York (Syracuse), no differences were observed between the color morphs in wariness, aggression, and sunning behavior (Gustafson and van Druff 1990).

In a study carried out on the impact of urbanization in promoting rare genotype/black morphs of Eastern grey squirrels (*Sciurus carolinensis*), it was pointed out that cities can serve as refuges for rare genotype by neutralizing selective pressures that favor a widespread morph in the rural landscape (Gibbs *et al.* 2019). Documenting such records, underpinning the natural history of the species, especially in context of changing climatic conditions, would thus be of paramount importance in management of native faunal species in the urban ecosystems. More studies are necessary to understand this rare phenomenon has been reported on few occasions; however, it is necessary to document these reports as it can help understand the ecological and physiological implications, such as survival in *F. pennantii* populations.

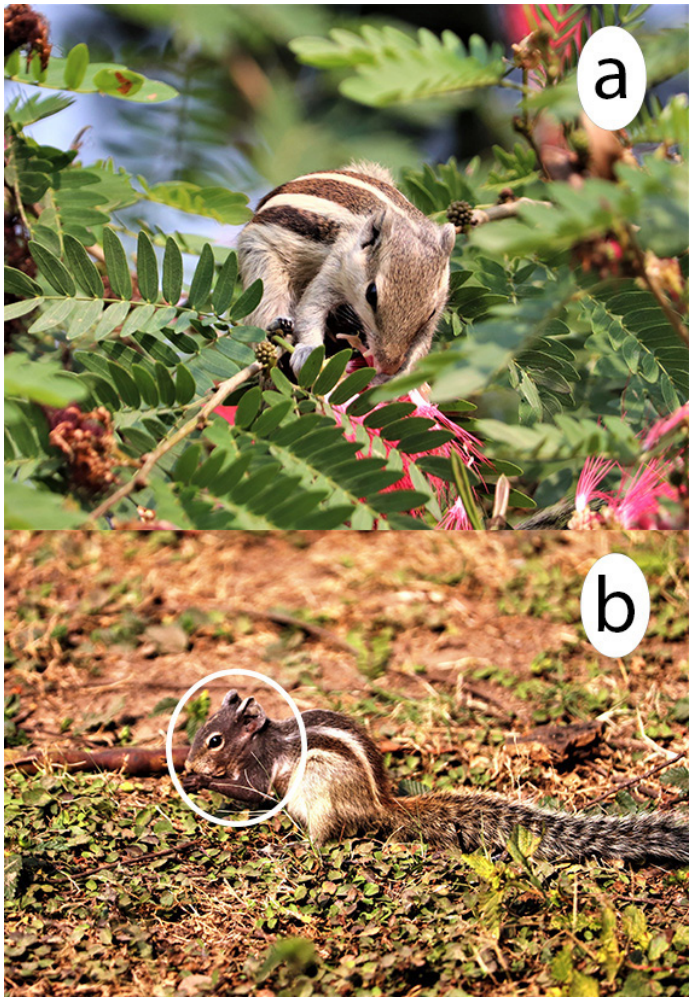

Figure 2. Fur color pattern in northern palm squirrel *Funambulus pennantii*. a) Normal pattern and b) fur with melanistic. The white circle indicates the areas of the ear, head, and neck portion with melanism. Images available at ritesh_joshi2325@yahoo.com.

Acknowledgements

We thank 2 anonymous reviewers for their comments that helped improve the first version of the note.

Literature cited

Cote, J., *et al*. 2018. Melanin-based coloration and host - parasite interactions under global change. Proceedings of the Royal Society B-Biological Sciences 285:9.

Datta, A., and R. Nandini. 2015. Sciurids. Pp. 513-573 *in* Mammals of South Asia, Volume 2 (Johnsingh, A. J. T., and N. Manjrekar, eds.). University Press. Hyderabad, India.

Dileepkumar, R., *et al*. 2021. Black palm squirrel (*Funambulus palmarum* Linn.) from India: association with a frame shift mutation in the MC1R gene. Current Science 121:306-312.

Fănaru, G., *et al*. 2022. Melanism in the grass snake *Natrix natrix* (Linnaeus, 1758) from the Danube Delta Biosphere Reserve, Romania. Herpetozoa 35:257-263.

Gibbs, J. P., M. F. Buff, and B. J. Cosentino. 2019. The biological system-urban wildlife, adaptation, and evolution: Urbanization as a driver of contemporary evolution in Gray Squirrels (*Sciurus carolinensis*). Pp. 269-286 *in* Understanding urban ecology (Hall, M. H. P., and S. B. Balogh, eds.). Springer International Publishing. Cham, Switzerland.

Graipel, M. E., *et al*. 2019. Melanism evolution in the cat family is influenced by intraspecific communication under low visibility. PLoS One 14:e0226136.

Gustafson, E. J., and L. W. van Druff. 1990. Behavior of black and gray morphs of *Sciurus carolinensis* in an urban environment. American Midland Naturalist 123:186-192.

Horth, L. 2003. Melanic body colour and aggressive mating behavior are correlated traits in male mosquito fish (*Gambusia holbrooki*). Proceedings Royal Society London (Biological Sciences) 270:1033-1040.

Joshi, R., and K. Puri. 2021. Mating behavior of *Herpestes auropunctatus* (Hodgson, 1836) (Carnivora: Herpestidae) in National Capital Territory of Delhi. Biological Forum 13:30-32.

Karan, R., U. Kartik, and S. Azaz. 2020. Record of melanistic five-striped squirrel from Vadodara, Gujarat. Small Mammal Mail 430 in Zoo's Print 35:1-2.

Kumar, A., *et al*. 2022. The rare black northern palm squirrel from Haryana, India. Small Mammal Mail 441 in Zoo's Print 37:23-25.

Mahabal, A., *et al*. 2019. Colour aberration in Indian mammals: a review from 1886 to 2017. Journal of Threatened Taxa 11:13690-13719.

Majerus, M. E. N., and N. I. Mundy. 2003. Mammalian melanism: natural selection in black and white. Trends in Genetics 19:585-588.

McKinnon, J. S., and M. E. R. Pierotti. 2010. Colour polymorphism and correlated characters: genetic mechanisms and evolution. Molecular Ecology 19:5101-5125.

McRobie, H. R., N. D. Moncrief, and N. I. Mundy. 2019. Multiple origins of melanism in two species of North American tree squirrel (*Sciurus*). BMC Evolutionary Biology 19:140.

Medina, Y. K., and C. E. Medina. 2019. First record of melanism in *Phyllotis limatus* (Rodentia: Cricetidae), with an updated list of melanistic wild mammals in the world. Peruvian Journal of Biology 26:509-520.

Nameer, P. O., and S. Molur. 2016. *Funambulus pennantii*. *In* IUCN 2016. The IUCN Red List of Threatened Species. Version 2016: e.T8702A115088099. www.iucnredlist.org. Accessed on October 26, 2023.

Nivetha, M., *et al*. 2023. Multifunctional evolution of palm squirrel coat colour and pattern. bioRxiv:1-22.

Ramakrishnan, B., A. Samson, and S. Ramasubramanian. 2016. Observation of melanism in Indian giant flying squirrel *Petaurista philippensis* at Sathyamangalam Tiger Reserve, Tamil Nadu, southern India. Zoo's Print 31:8.

Recknagel, H., *et al*. 2018. Melanism in common lizards (Squamata: Lacertidae: *Zootoca vivipara*): new evidence for a rare but widespread ancestral polymorphism. Herpetology Notes 11:607-612.

San-Jose, L. M., and A. Roulin. 2018. Toward understanding the repeated occurrence of associations between melanin-based coloration and multiple phenotypes. American Naturalist 192:111-130

San-Jose, L. M., and A. Roulin. 2020. On the potential role of the neural crest cells in integrating pigmentation into behavioral and physiological syndromes. Frontiers in Ecology and Evolution (Evolutionary Developmental Biology) 8:278.

Thorington, R. W., *et al*. 2012. Squirrels of the world. Johns Hopkins University Press. Maryland, U.S.A.

True, J. R. 2003. Insect melanism: the molecules matter. Trends in Ecology & Evolution 18:640-647.

van den Brink V., *et al*. 2012. Melanic color-dependent antipredator behavior strategies in barn owl nestlings. Behavioral Ecology 23:473-480.

van Dijk, D. E. 1997. Melanism in *Strongylopus* (Amphibia: Ranidae). African Journal of Herpetology 46:54-57.

van Grouw, H. 2017. The dark side of birds: melanism-facts and fiction. Bulletin of the British Ornithologists' Club 137:12-36.

Associated editors: Itandehui Hernández Aguilar and Beatríz Bolívar Cimé.
Submitted: May 25, 2023; Reviewed: November 27, 2023.
Accepted: November 28, 2023; Published on line: November 30, 2023.