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NOTE

THE IDENTIFICATION OF TAKIN *BUDORCAS TAXICOLOR* (MAMMALIA: BOVIDAE) THROUGH DORSAL GUARD HAIR

Manokaran Kamalakannan

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Takin *Budorcas taxicolor* Hodgson (1850) is a heavily built and clumsy-looking animal, native to northeastern India, Bhutan, China, and northern Myanmar (Salter 1997). *Budorcas taxicolor* is usually identified by its external morphology, i.e., long, shaggy coat that varies from golden yellow to deep dark brown, a dark stripe

running on the dorsal side from head to tail, and a dark brown face (Menon 2014). In the present study, however, it was found that *B. taxicolor* can also be identified with the help of its hair samples. Mammalian hairs have certain advantages from the viewpoint of taxonomy and systematics (Sarkar et al. 2011). There are many works worldwide on hair identification of different species of mammals (Mayer 1952; Brunner & Coman 1974; Moore et al. 1974; Teerink 1991). In India, studies on the hair of mammals were carried out on Artiodactyla (Koppikar & Sabins 1976), Rodentia (Sarkar 2012), Carnivora (Chakraborty & De 2010), and Primates (Sarkar et al. 2011). This study attempts to find out the hair characteristics of *B. taxicolor*, which was hitherto unknown.

A total of five tufts of dorsal guard hair was collected from the five preserved skins of *B. taxicolor* housed at the National Zoological Collections of the Zoological Survey of India, Kolkata, India, and was processed by following the method of Teerink (1991). Subsequently, the morphological characteristics of hair such as total length, diameter, and profile (n=20) were recorded using a dial calliper and hand lens. The cuticular scale

THE IDENTIFICATION OF TAKIN *BUDORCAS TAXICOLOR* (MAMMALIA: BOVIDAE) THROUGH DORSAL GUARD HAIR

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characteristics were studied according to the standard methodology (Brunner & Coman 1974; Teerink 1991) and the scale pattern, margin, margin distance, and count of the hair were studied by moulding the hair in clear varnish overnight and observing the impressions of its cuticular scales. The medullary characteristics such as composition, structure, and margins were recorded from the hair cleaned and mounted in a solution of xylene and DPX (50:50), after Chakraborty et al. (1996). The transverse section of hair too was performed as per Chakraborty et al. (1996). Different terminologies were followed according to Brunner & Coman (1974) and Teerink (1991). The photomicrographs were taken using a camera fitted with an optical light microscope (Olympus BX41) and scanning electron microscope (ZEISS Evo18 - special edition).

The hair of *B. taxicolor* can be easily identified by its morphologic and microscopic characteristics (Table 1). The dorsal guard hair of *B. taxicolor* studied is bicoloured, with alternated bands of earth yellow and coffee colours. The profile of the hair is undulated. The total length of hair varied greatly from 13.6mm to 51.6mm (30.4±12.8mm); similarly, the diameter of hair varied

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from 84.9 μ m to 258.8 μ m (215.6 \pm 25.2 μ m). The cuticular characteristics were recorded as follows: scale position - transversal, scale patterns - irregular wave, the structure of scale margins - rippled, and the distance between scale margins - near (Images 1a,b). All the measurement values of cuticular scales varied greatly and the average values were recorded as follows: cuticular scale count (per mm length of hair): 146.4 \pm 15.8 μ m, length of cuticular scale 98.8 \pm 12.1 μ m, and width of cuticular scale 11.1 \pm 1.1 μ m. The medullary characteristics were recorded as follows: the composition of medulla - unicellular irregular, the structure of medulla - uniserial ladder, and form of the medulla margins - scalloped (Image 1c); the average width of the medulla was recorded as 65.6 \pm 3.9 μ m. The shape of the transverse section was observed as circular (Image 1d).

A study by Kamalakannan (2015) on a total of 17 species of artiodactyls (11 bovines, four cervids, one suid, and one mouse deer) was found that the microscopic characteristics of hair of all the species were nearly the same, except in *B. taxicolor*. The dorsal guard hair of *B. taxicolor* possesses completely unique microscopic characteristics, especially that of the medulla (Image 1c) that differs from other species of mammals. According to the study, the unique structure of the medulla, uniserial ladder, was found only in *B. taxicolor* and was not reported earlier. The irregular wave of scale patterns, the rippled scale margins of the cuticle, and the circular shape of a transverse section of hair also determined the species identity of *B. taxicolor*, as these characteristics are infrequent in other species of mammals.

Methods of hair identification need exact identification keys (Brunner & Coman 1974; Teerink

1991) as they have some similarities between the species. Hair identification keys of the family Bovidae are much required in the field of forensic science and predator diet analysis for species identification (Sahajibal et al. 2010; Dharaia & Soni 2012). *Budorcas taxicolor* is a Vulnerable species as per the IUCN Red List of Threatened Species (2018) and is listed under the Schedule-I of the Indian Wildlife (Protection) Act, 1972, and Appendix-II of CITES (Song et al. 2008). It is trafficked for its meat, which is consumed locally, its skin, and other derivatives (Menon & Kumar 1999). On the other hand, it is also the chief prey of large carnivores. Therefore, the identification keys along with the photomicrographs presented here can be used in animal forensic science as well as in predator diet analysis as an appropriate reference for species identification of *B. taxicolor*.

References

- Brunner, H. & B.J. Coman (1974). *The Identification of Mammalian Hair*. Inkata Press, Melbourne, Australia, 176pp.
- Chakraborty, R. & J.K. De (2010). *Atlas on Hairs of Indian Mammals, Part I: Carnivora*. Zoological Survey of India, Kolkata, 141pp.
- Chakraborty, R., J.K. De & S. Chakraborty (1996). Identification of dorsal guard hairs of Indian species of the genus *Panthera* Oken (Carnivora: Felidae). *Mammalia* 60(3): 473–480.
- Dharaia, N. & V.C. Soni (2012). Identification of hairs of some mammalian prey of large cats in Gir Protected Area, India. *Journal of Threatened Taxa* 4(9): 2928–2932.
- Kamalakannan, M. (2015). Tricho-taxonomic studies of Indian mammal species belonging to the orders Artiodactyla and Lagomorpha. PhD Thesis. University of Kalyani, West Bengal, India.
- Koppikar, B.R. & J.H. Sabins (1976). Identification of hairs of some Indian mammals. *Journal of the Bombay Natural History and Society* 73: 5–20.
- Mayer, W.V. (1952). The hair of California mammals with keys to the dorsal guard hairs of California mammals. *American Midland Naturalist* 38: 480–512.

Table 1. Morphologic and microscopic characteristics of dorsal guard hair of *Budorcas taxicolor*

Hair characteristics	Result	Hair characteristics	Result
Coat colour	Brownish-grey	Distance between cuticular scale margins	Near
Colour of hair	Bicoloured; base: earth yellow, tip: coffee	Cuticular scale count/mm length of hair	123–167 (146.4 \pm 15.8)
Number of colour bands	Two	Length of cuticular scale (μ m)	84.6–120 (98.8 \pm 12.1)
Profile	Undulated	Width of cuticular scale (μ m)	9.1–12.5 (11.1 \pm 1.1)
Length (mm)	13.6–51.6 (30.4 \pm 12.8)	Composition of medulla	Unicellular irregular
Diameter (μ m)	84.9–258.8 (215.6 \pm 25.2)	Structure of medulla	Uniserial ladder
Cuticular scale position	Transversal	Margins of medulla	Scalloped
Cuticular scale patterns	Irregular wave	Width of medulla (μ m)	56.3–70.3
Cuticular scale margins	Rippled	Transverse section	Circular

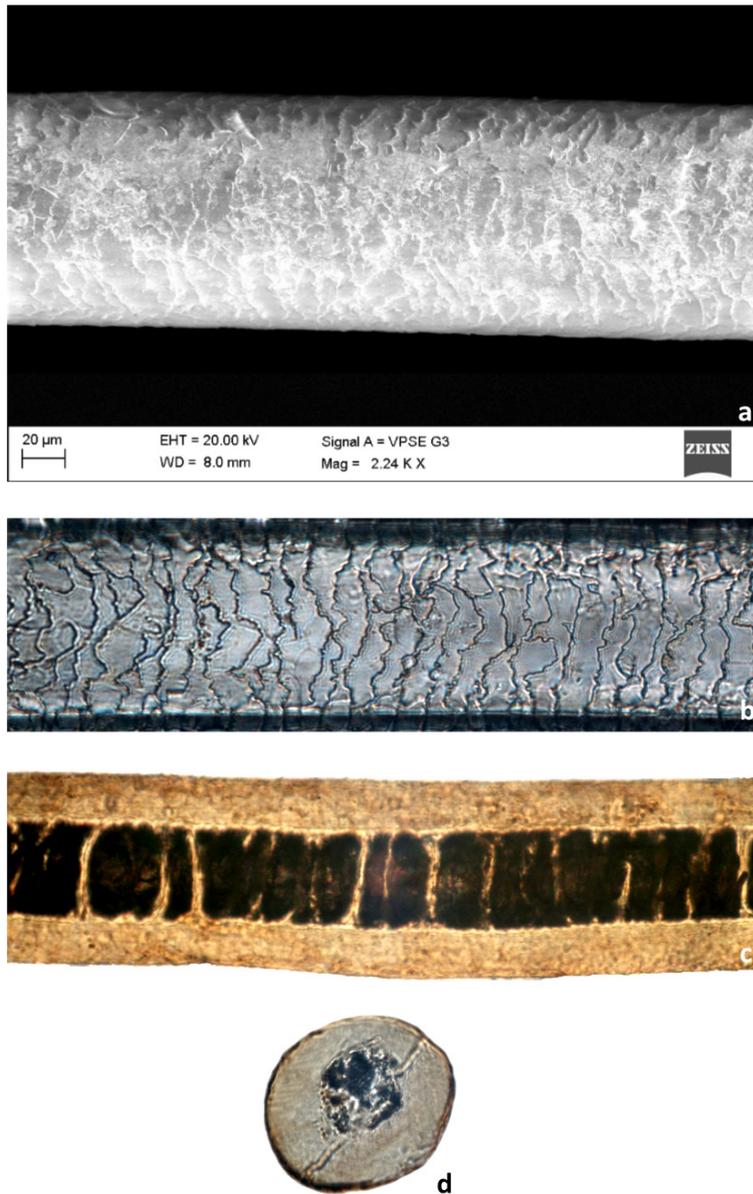


Image 1. Microscopic characteristics of dorsal guard hair of *Budorcas taxicolor*.
a - scanning electron micrograph of the cuticle,
b - cuticle (300 X),
c - medulla (300 X),
d - transverse section (300 X).
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- Menon, V. (2014).** *Indian Mammals: A Field Guide*. Hachette Book Publishing India Pvt. Ltd., Gurgaon, India, 528pp.
- Menon, V. & A. Kumar (1999).** *Wildlife Crime: An Enforcement Guide*. Wildlife Protection Society of India, New Delhi, 111pp.
- Moore, T.D., L.E. Spence & C.E. Dugnolle (1974).** *Identification of the Dorsal Guard Hairs of Some Mammals of Wyoming*. Game and Fish Department, Wyoming, 177pp.
- Sahajibal, V., S.P. Goyal, K. Singh & V. Thakur (2010).** Dealing wildlife offences in India: role of the hair as physical evidence. *International Journal of Trichology* 1(1): 18–26.
- Salter, R.E. (1997).** Myanmar, pp278–283. In: Shackleton, D.M. & The IUCN/SSC Caprinae Specialist Group (eds.). *Wild Sheep and Goats and their Relatives: Status Survey and Action Plan for Caprinae*. IUCN, Gland, Switzerland, and Cambridge, UK, 390pp.

- Sarkar, P.S. (2012).** Tricho-taxonomic study of hairs of Indian mammals: order-Primates and Rodentia. PhD. Thesis. University of Kalyani, Kalyani, West Bengal, India.
- Sarkar, P.S., J.K. De & C.K. Manna (2011).** Identification of dorsal guard hair of five species of the family Cercopithecidae (Primates: Mammalia). *Current Science* 100: 1725–1728.
- Song, Y.-L., A.T. Smith & J. MacKinnon (2008).** *Budorcas taxicolor*. The IUCN Red List of Threatened Species 2008: e.T3160A9643719. Downloaded on 06 December 2018. <https://doi.org/10.2305/IUCN.UK.2008.RLTS.T3160A9643719.en>
- Teerink, B.J. (1991).** *Hair of West-European Mammals: Atlas and Identification Key*. Cambridge University Press, Cambridge, 223pp.





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