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Structure of *Lepus nigricollis* hair from various body regions with Scanning Electron Microscopy

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Abstract

Scanning Electron Microscopic (SEM) studies were made on the morphology of hair samples of the head, neck, dorsal body, ventral body, fore-limb, hind-limb and tail regions of the Indian hare, *Lepus nigricollis*. The hairs of various body regions tend to differ in colour and size. The type and pattern of arrangement of cuticular scales of these hairs also vary considerably from region to region. Scanning electron microscopic studies on the morphology of hairs of various body regions of any mammalian species form a useful tool in the identification of prey species by the analyses of faecal matter of predators, and for evidences for the presence of various species of animals in any forest habitat.

Introduction

‘Trichology’, the scientific study of hairs has specific relevance in the dietary investigation of carnivores and field survey of mammals (DAY 1966; DREYER 1966; RYDER 1973; PERRIN and CAMPBELL 1979; KEOGH 1983; BUYS and KEOGH 1984). Data obtained from recent wildlife surveys in various forests of Kerala make it possible to determine that there is a need for the identification of various mammalian hairs, especially those of the prey species, which facilitate the conclusive identification of the presence of various mammal hairs in the faeces of predators (VIJAYAN et al. 1979; BALAKRISHNAN 1984; BALAKRISHNAN and EASA 1986). The faecal matter of most of the wild predators have considerable quanta of hair and occasionally have undigested bones. The hairs of larger prey such as the sambar deer, *Cervus unicolor* and the spotted deer, *Axis axis*; can be comparatively easily identified in the droppings of larger carnivores such as the tiger, *Panthera tigris* and the wild dog, *Cuon alpinus*. However, a thorough identification of hairs commonly seen in the droppings of smaller predators such as the jungle cat, *Felis chaus*; the Asiatic jackal, *Canis aureus* and the Indian fox, *Vulpes bengalensis*, are difficult. Hence, an attempt has been made to identify hairs of a number of mammalian species from various forests of Kerala with the aid of Scanning Electron Microscopy. The present report incorporates the data on the fine structure of hairs of various body regions of the Indian hare, *Lepus nigricollis*.

Material and methods

Lepus nigricollis (Cuvier) of both sexes (four males and four females) were trapped from forest habitats in Wynad and Trivandrum, Kerala and hair samples were plucked carefully from their head, neck, dorsal body, ventral body, fore-limb, hind-limb and tail regions using a fine forceps. These samples were kept in hexane or in 70 % alcohol for 1–72 h for cleaning and were dehydrated in ascending grades of alcohol. Hair samples were cross sectioned at about the middle portion using a fine stainless steel knife. A few hairs were also sectioned longitudinally.

The samples were then mounted on studs, dried using a vacuum dryer and gold coated in a Type JEE 4B Vacuum Evaporator at high vacuum. These samples were scanned under a JOEL JEM 100C/JOEL JSM 35 Scanning Electron Microscope at an accelerating voltage of 10 kV and studied at magnifications ranging from X300 to X10,000. For comparison, exposures from middle portions of the samples were used.

Results

Observations on the morphology of hair collected from different regions did not reveal any marked sexual dimorphism and hence the data from male and female hares were combined. The table shows the data on size and pattern of colouration of hair samples of various body regions. In general, these hairs have a length of 10–25 mm depending on the body site of its

Table. Showing the size and colour pattern of hairs of various body regions of the Indian hare, Lepus nigricollis

Body region	Hair size, mm*		Proximal	Colour pattern of hair		
	Minimum	Maximum		Middle	Distal	Distal tip
Head	10	12	White-brown	Black	Cream	Black
Neck	18	22	Cream	Grey	Cream	Black
Dorsal body	18	25	White	Black	Cream	Black
Ventral body	12	18	White	White	White	White
Fore-limb	10	12	White	White	Cream	Cream
Hind-limb	15	20	White	Grey	Cream	Black
Tail	16	20	White	Black	Cream	Black

* Data represent a minimum of 30 samples from each region

origin. The differential colour pattern also helps to identify hairs of one region from those of the other. The hairs of ventral body regions are particularly white and smooth, whereas those of other regions have bands of two to four colours such as white, black, cream and grey. The type and pattern of arrangements of cuticular scales of hairs of different body regions observed with the SEM revealed the following:

Head and neck: The cuticular scales of the hairs of head and neck of the hare are flattened, conical-shaped and are tightly packed. There are a number of ridges and grooves on the surface of neck hairs in the longitudinal plane as a result of the pattern of arrangement of the scales (Fig. 1). The pattern of arrangement of the scales could easily be used to distinguish head hair from body regions, but neck hair and fore-limb hair could not be distinguished by scale patterns.

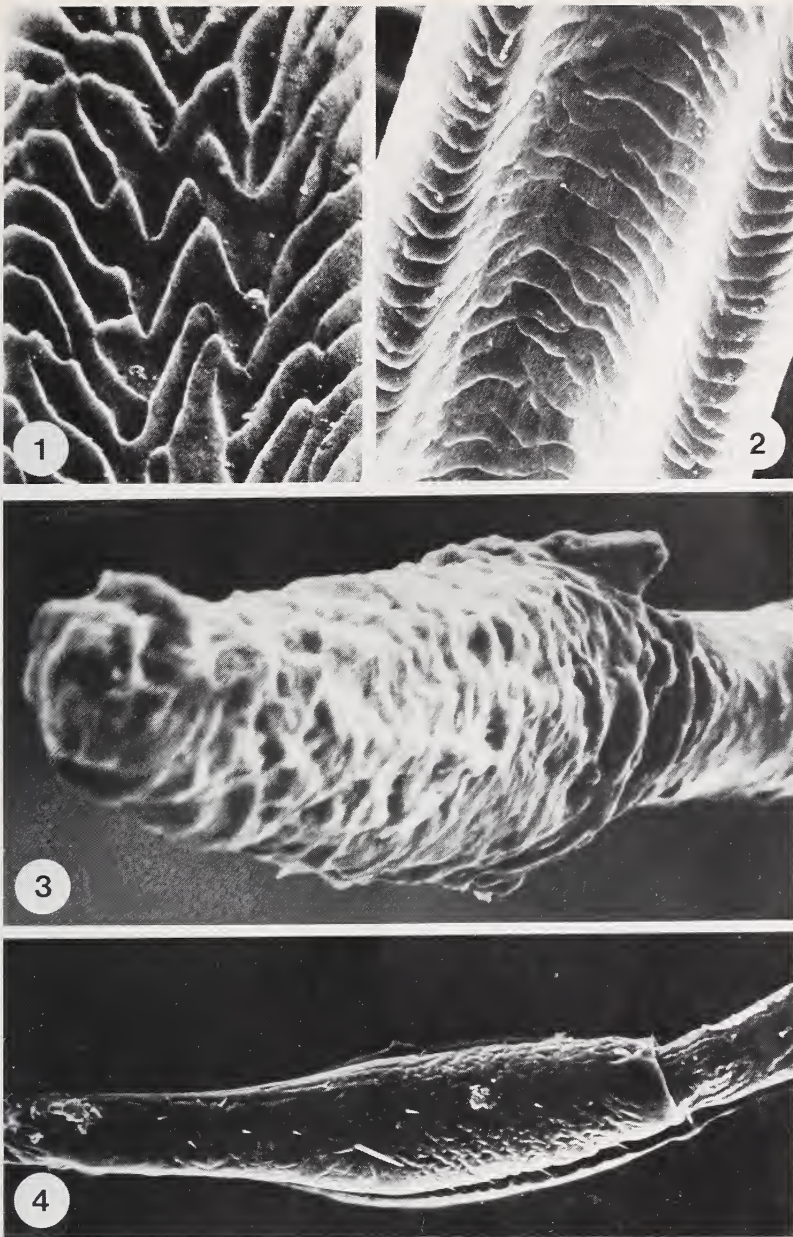
Dorsal body: The cuticular scales of dorsal body hair are flattened and are thickly packed (Fig. 2). Roots of these hairs are thick showing the typical patterns of roots of hare hairs (Fig. 3).

Ventral body: The scales of ventral body hair are elongated in shape and are tightly packed. Elongated grooves on the cuticular surface are also seen as in the case of neck hairs. These hairs are deep-rooted. However, the root is thin (Fig. 4) when compared to the other hair roots. The medulla of these hairs is divided into two columns by the mid-medullary growth of cortical tissues (Fig. 5).

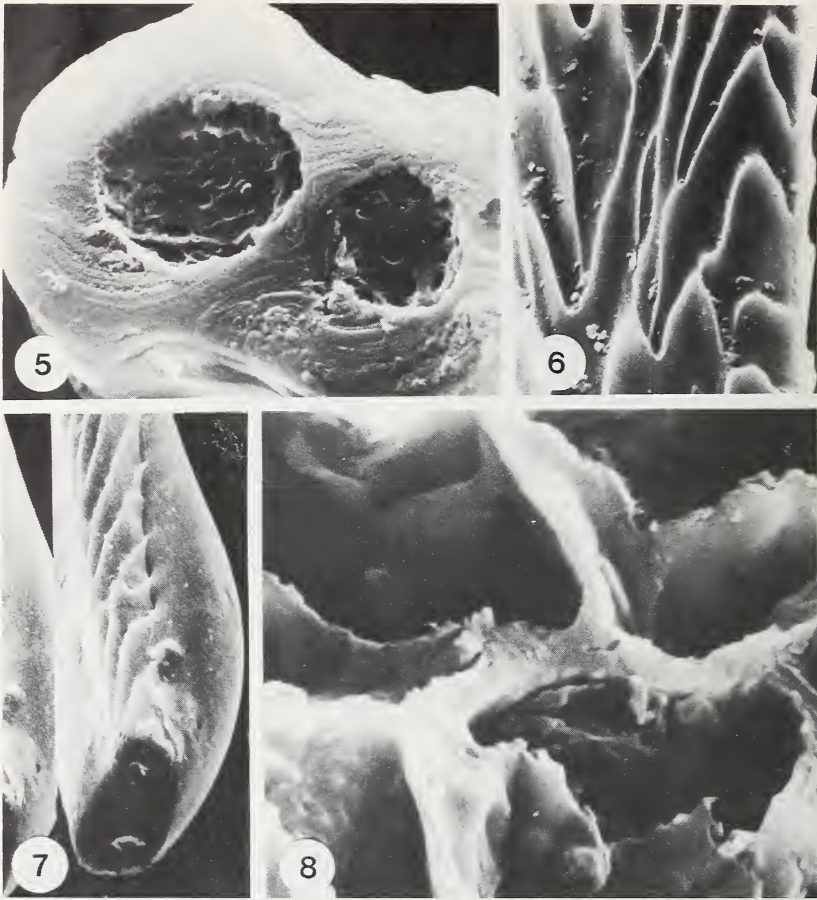
Fore-limb: The scales of the hair of fore-limbs are flattened and elongated, and the distal ends are conical-shaped (Fig. 6). These hairs are not deep-rooted. The proximal portions of them are more or less oval in shape. Cuticular scales are also seen on the surface of these roots (Fig. 7). Well developed medullary cells of these hairs are shown in Fig. 8.

Hind-limb: The scales of the hair of hind-limbs are flattened and thickly packed along the entire length (Fig. 9). The cortex is thin and the medulla is extended with larger cells (Fig. 10).

Tail: The cuticular scales of the hair of the tail are flattened and are similar to scales of hair of the dorsal body region. These scales are also tightly packed in a uniform pattern (Fig. 11).



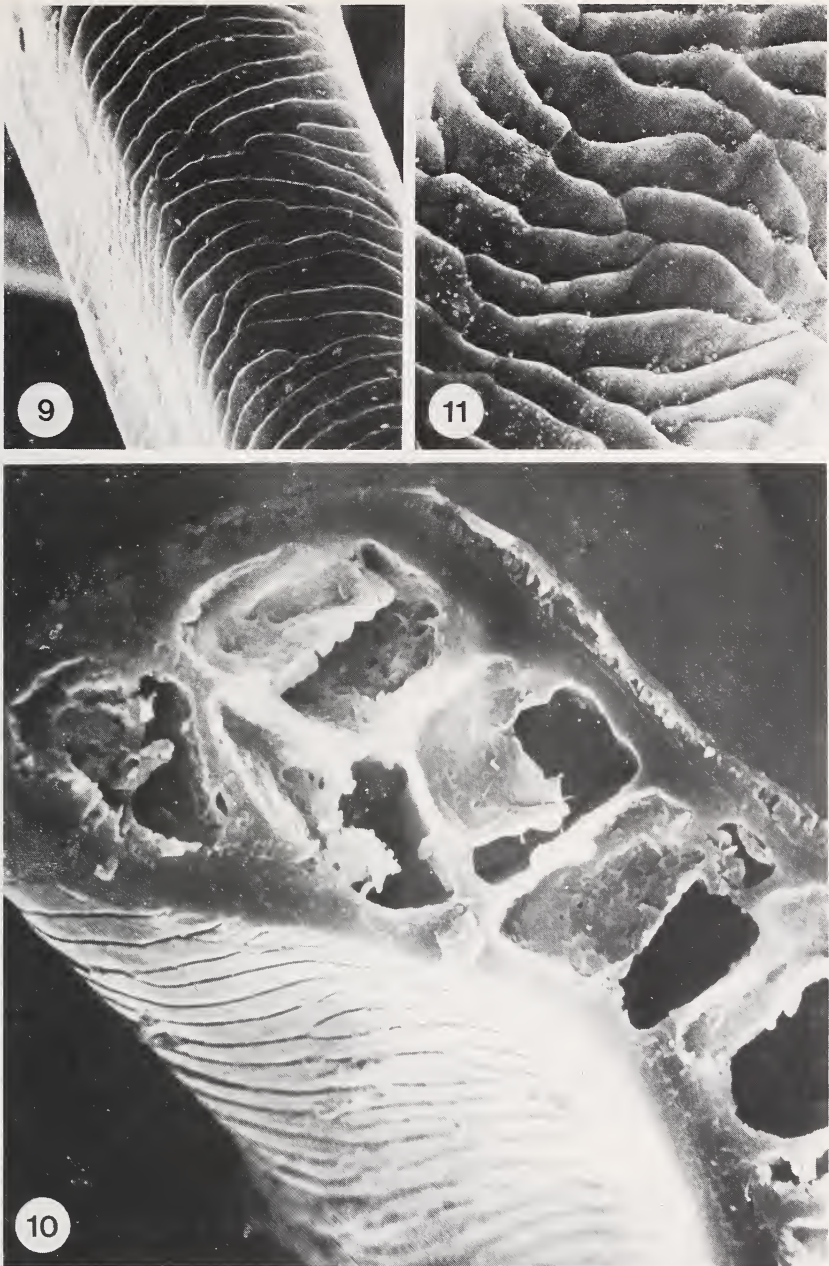
Figs. 1-4. 1: The flattened, elongated and conical shaped cuticular scales of the head and neck hair. ($\times 1,370$); 2: Dorsal body hair showing the tightly packed pattern of arrangement of cuticular scales. ($\times 1,370$); 3: The typical structure of root of hairs of head and dorsal body. ($\times 910$); 4: The morphology of a root of ventral body hair. (Note the difference in the size and shape of roots of dorsal body hairs). ($\times 1,830$)



Figs. 5-8. 5: The cross section of a ventral body hair showing the partition of medulla into two columns. ($\times 4,120$); 6: Fore-limb hairs have elongated cuticular scales with conical shaped apices. ($\times 1,280$); 7: The oval shaped roots of fore-limb hairs are shown. Note the development of cuticular scales on roots and the proximal openings of the medulla. ($\times 2,390$); 8: The medullary cells of the fore-limb hair showing the pattern of arrangement of chamber-like formation with the development of intercellular septa. ($\times 4,120$)

Discussion

It has been emphasized that identification of ingested hair is a useful tool determining the feeding habits and food preferences of predators (BRUNNER and COMAN 1974; PERRIN and CAMPBELL 1979). Identification of hairs may also play a salient role in the field of forensic science (ADORGAN and KOLENOSKY 1969; KEOGH 1983). However, only a few mammals have been subjected to systematic studies on the structure of hair (NOBACK 1951; LYNE and McMAHON 1951; BENEDICT 1957; STAINS 1958; KHEMELEVASKAYA 1965; DAY 1966; ADORJAN and KOLENOSKY 1969; TREVOR-DEUTH 1970; RYDER 1973; BRUNNER and COMAN 1974; KOPPIKER and SABNIS 1976, 1977; PERRIN and CAMPBELL 1979; SOKOLOV 1979; KEOGH 1983; RAJARAM and MENON 1986). Despite the structural differences of cuticular scales of different species of mammals discernible during these studies



Figs. 9–11. 9: Showing the hind-limb hairs with tightly packed flattened scales. ($\times 1,540$); 10: A cross section of a hind-limb hair showing the pattern of arrangement of medullary cells. ($\times 2,340$); 11: The tail hair with tightly packed, flattened cuticular scales. ($\times 1,180$)

(HASHIMOTO and SHIBAZAKI 1975), major distinguishing features of hairs of different body parts of the same animal were not observed.

The present study made it possible to observe distinguishing features in the types, and in the pattern of arrangement of cuticular scales of hairs of various body regions of *L. nigricollis*. The type and pattern of arrangement of the cuticular scales of hair are found to be prominent factors in differentiating the hair of one region from those of the other. In addition to the patterns of arrangement of cuticular scales of the cortex, the medullary cells also help to differentiate the hair of various body regions. These features can be clearly observed by scanning diverse samples of hair of different body regions, and can depend on these for the identification of hair samples of various species (RAJARAM and MENON 1986) as well as hair of different regions of the same species.

Faecal analyses of predators indicate that the droppings have lots of hairs of prey animals. Undigested materials in the faeces of predators would provide information on food preferences of any animal species. Hence identification of hair samples in the droppings of predators would be helpful for studies on the feeding habits of predators. This necessitates a thorough investigation, on the structure of hair samples of various body region of all the prey animals in any forest. Scanning electron microscopic studies on the morphology of the hairs form a comparatively easy and fool-proof technique to identify the hairs of any species. Since the fine surface structure of hair of various body regions of the same animal differ considerably, it is necessary to study the hair samples of various body regions of any species for a knowledge on the structure of body hairs and for detailed analyses of faecal remains of hair samples. Although many of the smaller prey animals could not be seen directly during field surveys (BALAKRISHNAN 1984; BALAKRISHNAN and EASA 1986), the presence of hair in the faeces of predators provides indirect evidence for the presence of these species in the forest area. Further detailed studies on the fine structure of various mammalian hair would be helpful for identification of hair which may be seen on fences, twigs and on the habitat and exploratory grounds of animals. This, in turn would be helpful for species identification and for inferences of animal movements in any forest habitat.

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Zusammenfassung

Struktur der Haare von Lepus nigricollis aus verschiedenen Körperregionen im rasterelektronenmikroskopischen Bild

Rasterelektronenmikroskopische Untersuchungen wurden an Haaren aus verschiedenen Körperregionen vom indischen Hasen *Lepus nigricollis* durchgeführt. Die Haare dieser Art zeigten regionale Unterschiede in Färbung und Größe sowie in der Ausprägung der Cuticular-Muster. Vergleichbare Untersuchungen an anderen Säugetieren können einen hilfreichen Beitrag zur Artbestimmung an Haaren liefern. Sie sind insbesondere dann von Nutzen, wenn das Beutetierspektrum von Raubtieren über Kotanalysen erfasst werden soll.

References

- ADORJAN, A. S.; KOLENOSKY, G. B. (1969): A manual for the identification of hairs of selected Ontario mammals. Res. Report (Wildlife) No. 90. Ontario: Dept. Lands and Forests.
- BALAKRISHNAN, M. (1984): The large mammals and their endangered habitats in the Silent Valley forests of South India. *Biol. Conserv.* **29**, 277–286.
- BALAKRISHNAN, M.; EASA, P. S. (1986): Habitat preferences of the larger mammals in the Parambikulam Wildlife Sanctuary, Kerala, India. *Biol. Conserv.* **37**, 191–200.
- BUYS, D.; KEOGH, H. J. (1984): Notes on the microstructure of hair of the Orycteropodidae, Elephantidae, Equidae, Suidae and Giraffidae. *S. Afr. J. Wildl. Res.* **14**, 111–119.
- BENEDICT, F. A. (1957): Hair structure as a generic character in bats. *Univ. Calif. Pub. Zool.* **59**, 285–548.
- BRUNNER, H.; COMAN, B. (1974): The identification of mammalian hair. Melbourne: Inkata Press.
- DAY, N. G. (1966): Identification of hair and feather remains in the gut and faeces of stoats and weasels. *J. Zool., Lond.*, **48**, 201–217.
- DREYER, J. H. (1966): A study of hair morphology in the family Bovidae. *Onderstepoort J. Vet. Res.* **1966**, 379–472.
- HASHIMOTO, K.; SHIBAZAKI, S. (1975): Ultrastructural study on differentiation and function of hair. In: *Biology and disease of the hair*. Ed. by K. TODA, Y. ISHIBASHI, Y. HORI and F. MOTIKAWA. Tokyo: Univ. Park Press.
- KEOGH, H. J. (1983): A photographic reference system of the microstructure of the hair of southern African bovids. *S. Afr. J. Wildl. Res.* **13**, 89–132.
- KEHMELEVASKAYA, N. V. (1965): Structure of the rodent hair cuticle, its variability and significance for taxonomy. *Zool. Zhur.* **40**, 1064–1074.
- KOPPIKER, B. R.; SABNIS, J. H. (1986): Identification of hairs of some Indian mammals. *J. Bombay nat. Hist. Soc.* **73**, 5–20.
- KOPPIKER, B. R.; SABNIS, J. H. (1977): Further studies on the identification of hairs of some Indian mammals. *J. Bombay nat. Hist. Soc.* **74**, 50–59.
- LYNE, A. G.; McMAHON, T. S. (1951): Observations on the surface structure of the hairs of Tasmanian monotremes and marsupials. *Pap. Roy. Soc. Tasmania* **1950**, 71–84.
- NOBACK, C. R. (1951): Morphology and phylogeny of hair. *Ann. N.Y. Acad. Sci.* **53**, 476–492.
- PERRIN, M. R.; CAMPBELL, B. S. (1979): Key to the mammals of the Andries Vosloo Kudu Reserve (Eastern Cape), based on their hair morphology, for use in predator scat analysis. *S. Afr. J. Wildl. Res.* **10**, 3–14.
- RAJARAM, A.; MENON, R. K. (1986): A Scanning electron microscope study of the hair keratins of some animals of the Indian sub-continent – A preliminary report. *J. Bombay nat. Hist. Soc.* **83**, 427–429.
- RYDER, M. L. (1973): *Hair*. London and Southampton: Institute of Biology. Camelot Press Ltd.
- SOKOLOV, V. E. (1979): Adaptive features of mammalian hair. In: *The adaptive features of epithelium and its derivatives – An atlas of scanning electron microscopic photographs*. Moscow: Nauka publishing office.
- STAINS, H. J. (1958): Field key to guard hair of Middle Western furbearers. *J. Wildl. Mgmt.* **22**, 95–97.
- TREVOR-DEUTCH, B. (1970): Hair morphology and its use in the identification of taxonomic groups. M. Sc. Thesis, Canada, McGill University.
- VIJAYAN, V. S.; BALAKRISHNAN, M.; EASA, P. S. (1979): Periyar Tiger Reserve: a reconnaissance report. Peechi; Kerala Forest Res. Inst.
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