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Morphological Examination of the Hair of Different Wild Animals: A Prospective Study

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Abstract

The present study was conducted to identify morphological and numerical features of hair samples of wild animals using light and scanning electron microscope to make a key for their identification. Hair samples were collected from different body regions of different species of animals, and animal hair structures were analyzed. Animals of the same species are more likely to have similar scale patterns. The guard hair diameter, color, shaft, cuticle pattern, the medulla, the scale patterns, and the root were examined using a light microscope. In the present study, different animal samples are collected from Mathikettan Shola National Park and Zoological Park in Thiruvananthapuram, Kerala. The samples were collected by using brushes and forceps, and each sample was packed separately in zip-lock bags to prevent mixing and preserve the integrity of the sample. Photographs of every sample were taken for visual reference, and they were taken to the laboratory for further examination. The analysis of the surface cuticular pattern, cross section, and medullary index provides information regarding the wild species of the animals.

Keywords: Animal Hair; Photography; Microscope; Medullary Index; Color.

INTRODUCTION

Hair samples are the most compelling evidence at crime scenes involving wildlife. These are important for species identification in wildlife forensic studies.[1] The chemical and histological composition of hair has remained constant over the years.[2] Hair color, texture, scale margin, scale spacing, and scale pattern showed significant differences.[3] The combination of these features is important when identifying species. Animal hair is called fur, while human hair is called hair [4]

Macroscopic and microscopic anatomical features of animals are often used to identify hairs and to study how animals adapt to their environment. Each species has its own unique pattern.[5] Many scientists have made practical applications of hair identification in biology and forensics.[6] Hair testing can also be useful in determining whether the individual was poisoned or under the influence of drugs.[7] Hair identification provides excellent and up-to-date information quickly.

Wild animals have different types of hair, including feathers, bristles, spines, quills, and fur[8] Each breed is developed for the animal's lifestyle and environment and serves a specific function[9]

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Many animals undergo a moulting process in which they shed old, damaged hair and grow new hair.[10] It is possible to maintain the functionality and quality of the coat.[11] This extraordinary adaptability allows these organisms to live in their environment and perform their ecological duties.

Wild animals have unique adaptations for their hair.[12] In colder climates, some animals develop thicker and longer fur during the winter to provide additional insulation. This is a phenomenon known as winter fur.[13] They use its form and colour patterns for displays and camouflage; they use it for its insulating properties, for self-defence, and even as a sensory organ.[14] It is important to remember that the specific characteristics of wild animal hair can vary greatly between species and evolutionary histories.[15] Each species has its own adaptations and traits that make its hair suitable for its environment and lifestyle.

Wild animal hair can be used to study animal populations, track migration routes, and monitor wildlife welfare.[16] Genetic analysis of hair samples provides insight into the genetic diversity, relatedness, and over all health of animal populations, which can aid conservation efforts and wildlife management planning.[17]

Hair identification plays an important role in wildlife research and is of great importance in several fields such as wildlife conservation, ecological research, and forensic investigation. It is also important for species identification and non-invasive sampling.[18] It helps researchers understand and protect wildlife, study ecosystems, solve crime, and make informed decisions for the well-being of animals and people. Information gained from hair samples helps scientists understand species diversity, population dynamics, ecological interactions, health conditions, and the impact of human activity on wildlife populations. This knowledge is essential for developing effective conservation strategies and ensuring the long-term survival of wildlife and their habitats.[19]

The current study involves shredded hair and describes the cuticular configuration of the wild animals like Deer, Sambar deer, Chital, Black buck, African buffalo, Bison, Lion, Leopard, Wild Cat, Fox, Indian Hare.

Cortelini *et al.* collected and examined the samples from 12 different species of mammals. Hair from scalp was collected. Twelve individuals from each species were taken to give required samples. For microscopic examination each hair was kept on slide and covered with a cover slip and examined under 10x.[20]

METHODOLOGY

The samples of shredded hair of wild animals were collected from Mathikettan Shola National Park (Idukki district, Kerala) and Zoological Park Thiruvananthapuram, Kerala, with the permission of Munnar Wild Life Warden. It was packed separately in zip-lock packets, photographs of each sample were taken, and it was sent to the laboratory for further analysis. A total of 12 animals were chosen for the study, namely deer, sambar deer, chital, black buck, African buffalo, Bison, Lion, Leopard, Wild Cat, Fox, and Indian Hare.

MICROSCOPIC EXAMINATION

A few strands of hair were placed parallel on the slide, and two drops of glycerin were dropped onto the hair to hold the hair in place. A coverslip was placed over the hair and scanned along the length of the hair under a compound microscope at 100x and 400x magnification to observe the morphological features of the cuticle and medulla, as well as the pigment distribution in the cortex. Focus was on the core of the hair and its size, shape, and transparency were examined. Width of the medulla was measured and the details, such as the presence or absence of constrictions were noted.

Determination of wild animal species was based on hair medullary index which requires comparison of hair sample with reference sample to know the similarities and dissimilarities of different species. Animal hair typically has a continuous, textured medulla that makes up more than one-third of the hair shaft's overall diameter.

RESULTS AND DISCUSSIONS

After analyzing hair samples of different species it showed that the hair index refers to the presence or absence of the medulla, the column of cells that runs down the middle of the hair shaft. The medullary index is the ratio of the pith diameter to the diameter of the entire hair shaft. The medullary index can vary greatly between animal species. Some species had hairs with large, continuous piths, while others have fragmented or non-existent piths. By comparing the medullary index of a hair sample with the medullary index range of different species, it is possible to determine the species to which the hair belongs. If the medulla index falls within a range characteristic of a particular species,

this indicates that the hair sample is likely of that species. The medullary Index helped to distinguish between different animal species based on medulla size, shape, and structure. The pith can vary greatly between species and even between individuals of the same species. The medulla can have a variety of structures; for example, it can be continuous, segmented, or in specific patterns within the hair bundle. The size and shape of the marks may also vary. These features can be compared to known reference specimens to determine the likely species. The medullary index of individuals of the same species showed slight changes when body region changes, but showed marked changes at the species level. Forensic analysis of hair centers on color and structure, determined through microscopic magnification. The hair shaft has three forensically relevant layers: the cuticle, cortex and medulla. The Wild animals had a larger hair diameter than domestic ones. No relevant differences were observed between the wild investigated species; depending on the species, the scalp shape and the outline of their margins showed some peculiarities. The medullary and cuticular indices of individuals from the same species showed very small variations by changing the body regions.

In this study, most of the animals hair structure was rough, and the medullary index showed only a slight variation among the species. Cuticle had over lapping external scales, which helped in species identification.

Fig. 1 Hair sample of Deer, Leopard, Rhinoceros, Lion

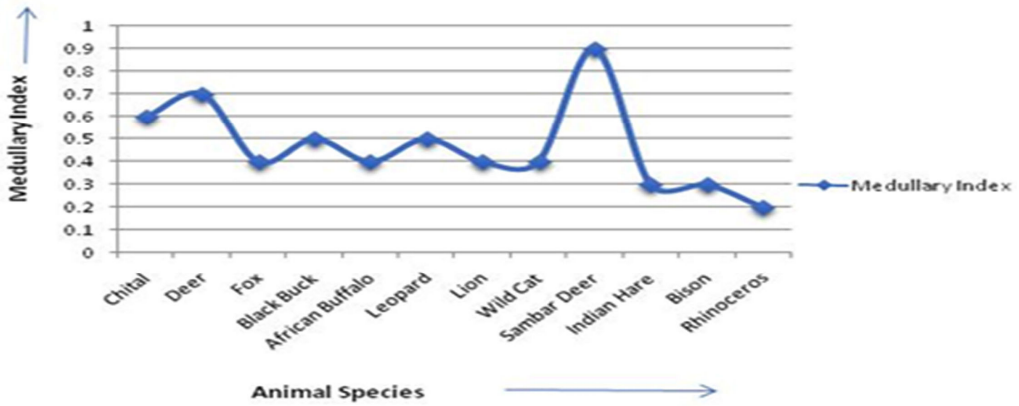
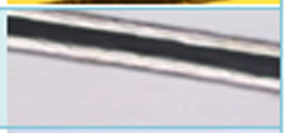
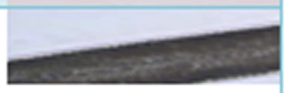
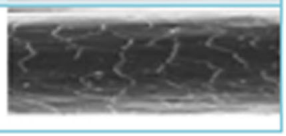


Fig. 2: Value of medullary index of different animal species

Fig. 2 represented the value and variation of the medullary index. Sambar deer had the highest medullary index value and rhinoceros had the lowest one

Table 1: Structuraldetails (microscopic and macroscopic) of the specimen

Si. No	Animal Name	Species	Scientific name	Colour of hair	Texture of hair	Medullary index	Microscopic image Of the sample
1	Chital	Axis	Axis Axis	Brown	Rough	0.6	
2	Deer	O.Virginiana	Odocoileus virginiana	Brown or Grey	Rough	0.7	
3	Sambar deer	R.unicolar	Russa unicolar	Greyish and brown	Rough	0.9	
4	Black buck	Cervicapra	Antilope Cervicapra	Black or brown	Smooth	0.5	
5	African Buffalo	Caffer	Syncerus Caffer	Black	Rough	0.4	
6	Leopard	Pardus	Panthera Pardus	Yellowish brown	Smooth	0.5	
7	Lion	Leo	Panthera Leo	Golden yellow or brown	Rough	0.4	
8	Wild Cat	Silvestris	Felis Silvestris	Brown or black	Smooth	0.4	
9	Fox	Vulpes	Vulpes Vulpes	Brown, White or grey	Smooth	0.4	
10	Indian Hare	L.nigricollis	Lepus Nigricollis	White, Brown	Smooth	0.3	
11	Bison	B.bison	Bison bison	Black or brown	Rough	0.4	
12	Rhinoceros	Unicornis	Rhinoceros Unicornis	Brownish black	Rough	0.2	

CONCLUSION

The present study was conducted to examine the morphological and numerical features of hair samples of several wild animal species using light microscopy and to find the key to their identification. Samples of hair were obtained from different body regions of Deer (Cervidae), Sambar deer (unicolor), Axis deer, Black buck (Antilope cervicapra), African buffalo (Syncerus caffer), Leopard (Panthera pardus), Lion (Panthera Leo), Wild cat (Felis Silvestris), fox

(vulpes), Indian Hare (Lepus Nigricollis), bison, and Rhinoceros. The medullary index of individuals of the same species showed slight changes when body regions changed but showed marked changes at the species level. This study shows that there is a wide range of variation among all species with respect to the medullary index. In the present study, the medullary index value of the lion was distributed in multicellular rows having a fine grained transparent structure, whether or not wild cats were observed to have a different structure. The hair structure of Lion, Black buck, Sambar deer, Wild cat, Fox, and Indian hare is smooth, while that of bison, rhinoceros chital, and lion is rough.

From the analysis, the medullary index of each species is different. The study gives a clear picture that Sambar Deer have the highest medullary Index value and Rhinoceros have the lowest.

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