

## GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES COMPARATIVE ANALYSIS OF WILD ANIMAL HAIRS

Murali Manohar Yadav<sup>\*1</sup>, Ankit Srivastava<sup>2</sup>, Kriti Nigam<sup>2</sup> & Vijay K. Yadav<sup>2</sup>

<sup>\*1</sup>Teaching Assistant, <sup>2</sup>Assistant Professor

Dr. APJ Institute of Forensic Science and Criminology, Bundelkhand University, Jhansi, India

---

### ABSTRACT

The present study was conducted to find out the macroscopic and microscopic characteristics of hair of nine endangered wild animals with the objective of species identification. Hairs remain unchanged chemically and histologically till several years. In present study the shredded hair sample of Bear (*Melursus ursinus*), Hyena (*Crocuta crocuta*), Lioness (*Panthera leo*), Lion (*Panthera leo*), Zebra (*Equus quagga*), Panther (*Panthera pardus*), Blackbuck (*Antelope cervicapra*), Sambar deer (*Rusa unicolor*) and Fishing cat (*Prionailurus viverrinus*) were collected from Lucknow zoological garden. Physical and cuticular characters were observed by trinocular compound microscope under 40x – 100x magnification. The specific variations were observed in this study among hair color, texture, scale margin, scale distance, and scale pattern. The combination of these parameters plays an important role in species identification.

**Keywords:** *Wildlife forensic, Microscope Hair characteristics, Wildlife animals*

---

### I. INTRODUCTION

Wildlife is highly valued as a resource by society but increasingly wildlife and society are coming into dispute [1]. Historically, human destroy the population of wild animals by hunting them for food and their products and also drastically reduced their habitat, but the transformation of society yields commercial exploitation decimated some of the species to the verge of extinction[2]. In India wildlife is protected under the Wildlife Protection Act 1972. All the listed animals under the schedules 1, 2, 3 and 4 of the wildlife Protection act 1972 are protected where poaching is punishable offence under this act[2].

The wild animals are being poached illegally for their parts, skin and internal organs. The cases involved wild animals normally have pug marks, skin, teeth, fur, bones and hair as evidence. Among these, hair is the most stable biological evidence and its histological structure retains their uniqueness for several years. The collection and analysis of hair are safer [3,4,5,6].

There are many non-invasive methods for species identification like track mark analysis, tagging, pug marks but these techniques are time-consuming and costly or are of temporary in nature[11,12,13]. Species identification from hair is modern and excellent technique which is simple and fast. The microscopic examination of hair for species identification is reliable and the court accepted [4, 6, 7]. The determination of the structure of hair is of great interest as it affords a method of identification of the particular animal from which it has originated [8]. Every species has its own pattern which is unique to that species. Cuticular and medullary characters of hair have been widely used for individualization [6].

The current study includes shredded hair and describes the cuticular configuration of nine endangered wild animals viz. Bear (*Melursus ursinus*), Hyena (*Crocuta crocuta*), Lioness (*Panthera leo*), Lion (*Panthera leo*), Zebra (*Equus quagga*), Panther (*Panthera pardus*), Blackbuck (*Antelope cervicapra*), Sambar deer (*Rusa unicolor*) and Fishing cat (*Prionailurus viverrinus*). These animals are an ungulate species native to the Indian subcontinent.

The purpose of this study is to determine microscopic characteristics of hair of these animals and establish the micro variations among them which will help in species identification and individualization.

## II. MATERIALS AND METHODOLOGY

The samples of shredded hair of wild animals were collected from the cage of animals of Lucknow Zoological Garden and packed separately in ziplock packets. Total nine wild animals were chosen for present study namely Bear (*Melursus ursinus*), Hyena (*Crocuta crocuta*), Lioness (*Panthera leo*), Lion (*Panthera leo*), Zebra (*Equus quagga*), Panther (*Panthera pardus*), Blackbuck (*Antilope cervicapra*), Sambar deer (*Rusa unicolor*) and Fishing cat (*Prionailurus viverrinus*). The trinocular compound microscope was used for observation at 100x.

Each hair sample was cleaned before examination with the soap solution followed by distilled water 2-3 times for the removal of dust and debris present in it. Further the sample was washed with ether:alcohol (50:50) for around 2-3 minutes so as to remove fatty materials and blot dried. Each dried hair strand was treated with hydrogen peroxide for two hours in order to bleach the hair, which in return helped in making the line of differentiation between cortex and medulla lucid. The cuticular impressions of the hair surface were putted on a thin film of clear nail polish, having its application on a microscopic glass slide. A thin film of nail polish was poured on a microscopic glass slide with the help of glass rod and hair samples were placed gently on it with their ends free from the glass slide surface. As soon as the slides got dried in around 25 min, the hairs were plucked off with forceps followed by mounting of the hair strand. The hair samples were chopped into small pieces (2 cm). Each dried hair strand was cleaned with xylene accompanied with mounting on a microscopic slide by placing hair strand on the slide with a drop of xylene. A cover slip was placed on the hair sample allowing the medium to spread under cover slip-encasing hair. Each slide has been labeled appropriately and was allowed to dry approximately for 48 hours. The physical characteristics, the diameter of the shaft and cuticular characteristics were observed and studied.

## III. RESULTS AND DISCUSSION

### Macroscopic Hair Description

#### *Physical Observation*

Hairs of Sloth Bear (*Melursus ursinus*) are found to be very rough in feel and kinky. They are black in color.

The hair texture of Hyena (*Crocuta crocuta*), Lioness (*Panthera leo*), Zebra (*Equus quagga*), Panther (*Panthera pardus*), Lion (*Panthera leo*), Blackbuck (*Antilope cervicapra*), Sambar deer (*Rusa unicolor*) and Fishing cat (*Prionailurus viverrinus*) are smooth. Among them, Zebra (*Equus quagga*), Blackbuck (*Antilope cervicapra*) and Sambar deer (*Rusa unicolor*) have shiny hair. The color of the hairs of these animals is different mentioned in table no. 2.

### Microscopic Hair Description

Microscopic analysis of hair samples revealed fine details of scale and medulla.

#### *Cuticular Characteristics*

Sloth Bear hairs in the present study show imbricate, irregular wave scale pattern with crenate scale margin. The inter scale distance is found closer (fig 1). The cuticle scales of Hyena are irregular wavy and mosaic type. The scale margin and distance are crenate and near (fig 2). Lioness and Lion hair cuticle scales are not significantly different from each other. They show an irregular mosaic pattern while very little difference is seen in their scale margin. Lioness shows smooth margin whereas Lion shows rippled margin. The inter scale distances are found close in both animals (fig 3 and 6). In the present study, Zebra hairs show regular, mosaic scale pattern with smooth margin and close scale distance (fig 4). In Panther, regular wavy and imbricate scale pattern is found. The scale margin is smooth and the scale distance is near (fig 5). Minor difference is found between the scales of Blackbuck and Sambar deer. Both have the irregular wave, imbricate scale patterns and scales are wide and flattened. But the scale margin of Blackbuck is crenate type while the scale margin of Sambar deer is found as rippled type. Both have same near scale distance (fig 7 and fig 8). The cuticle scales of Fishing Cat hair shows regular mosaic scale pattern with the smooth margin and distant scale distance (fig 9).

*Table-1: Structural Details (Macroscopic and Microscopic) of The Hair Specimen*

Sr.	Species	Physical Observation		Cuticular Characteristics		
		Texture	Color	Scale Margin	Scale Distance	Scale Pattern
1.	Sloth Bear	Rough	Black	Crenate	Close	Imbricate, Irregular Wave
2.	Hyena	Smooth	White And Light Brown	Crenate	Near	Mosaic, Irregular Wave
3.	Lioness	Smooth	Base-White, Shaft-Yellow, Tip-Black	Smooth	Near	Mosaic, Irregular Wave
4.	Zebra	Smooth	Black , White	Smooth	Close	Mosaic, Irregular Waved
5.	Panther	Smooth	Black, Brown	Smooth	Near	Imbricate, Regular Wave
6.	Lion	Smooth	White, Yellow, Black	Rippled	Near	Mosaic, Irregular Wave
7.	Blackbuck	Smooth	White And Grayish	Crenate	Near	Imbricate, Irregular Wave, Wide, Flattened
8.	Sambar Deer	Smooth	Brown To Dark Brown	Rippled	Near	Imbricate, Irregular Wave
9.	Fishing Cat	Smooth	Brown	Smooth	Intermediate	Regular Mosaic

The mean of the diameter of hair shaft of these wild animals varies from 6.85 (Fishing cat) to 32.75 (Zebra) and standard deviation varies in between 0.39 (Blackbuck) to 5.55 (Zebra) given in table no. 2.

*Table-2: Diameter of the Shaft of the Hair of Different Wild Animals*

Animal	Measurement 1 (µm)	Measurement 2 (µm)	Measurement 3 (µm)	Mean	Standard Deviation
Bear	22.67	23.53	24.39	23.53	0.86
Black Buck	13.44	13.44	14.12	13.67	0.39
Fishing cat	7.12	7.12	6.32	6.85	0.46
Hyena	12.98	13.33	16.03	14.11	1.67
Lion	14.01	19.00	14.06	15.69	2.87
Lioness	16.8867	15.1169	14.752	15.58	1.14
Panther	10.29	10.22	11.91	10.81	0.96
Sambar deer	27.52	27.25	28.49	27.75	0.65
Zebra	26.71	33.89	37.64	32.75	5.55

Microphotographs of Slides

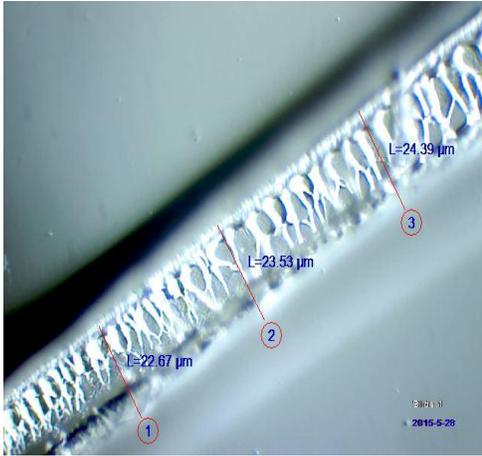


Fig.1 Sloth Bear



Fig.2 Hyena

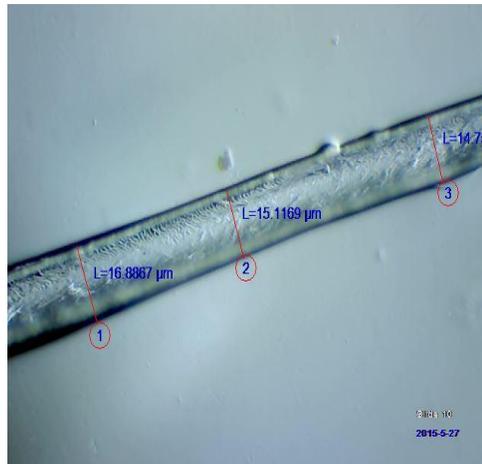


Fig.3 Lioness

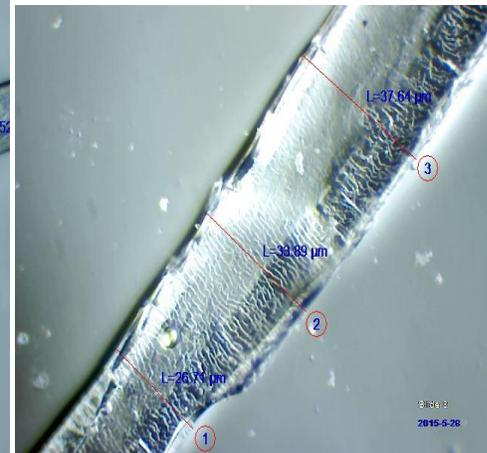


Fig.4 Zebra



Fig.5 Panther

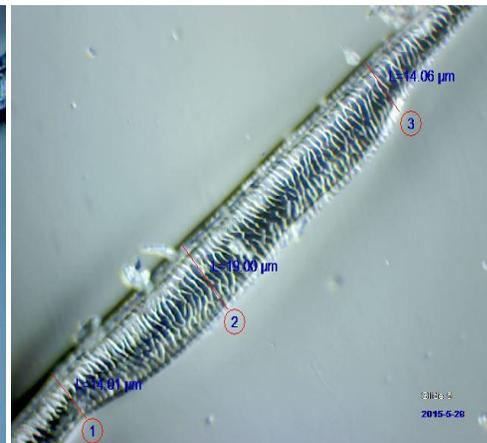


Fig.6 Lion

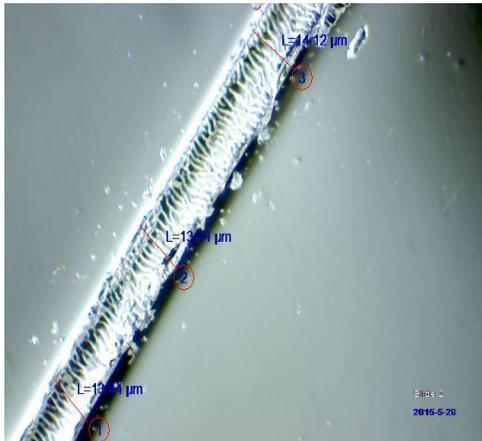


Fig.7 Black buck

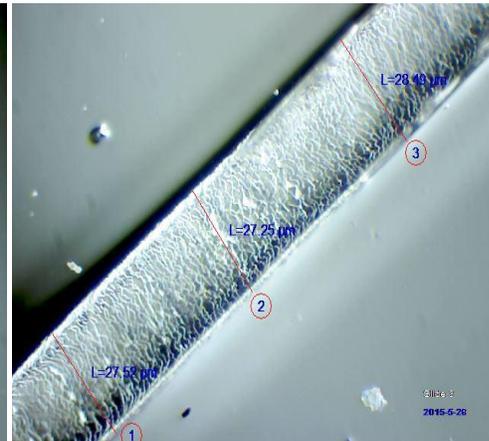


Fig.8 Sambar deer



Fig.9 Fishing cat

The present study reported the feasibility of identifying the most endangered wildlife species based on detailed microscopic examination of distinct morphological features of hair samples. In the present study, the cuticle of Sloth Bear showed irregular wave, imbricate scale pattern and crenate scale margin, Goyal *et al.* (2007) also described the same cuticular characteristics while Baddi *et al.* described the irregular mosaic pattern of such scale [2,7]. These variations could be due to the hair samples collected from the different region.

In this study, Panther hair cuticle scales showed regular wave and imbricate scale pattern and smooth scale margin. Gharu and Trivedi (2014) studied the same cuticular characteristics [5,6].

This study reported that irregular mosaic scale pattern with rippled scale margin and near scale pattern with rippled scale margin and near scale pattern found in Lion [9]. Gharu and Trivedi described the same margin but they reported regular wave scale pattern.

The present study described that the Zebra had regular wave scale pattern and smooth scale margin. Philip *et al.* (2012) described the same. But the difference found in scale margin which was rippled.

It is observed that the Black Buck showed irregular wave, imbricate scale pattern which was wide and flattened with crenate scale margin and near scale distance. Prasad *et al.* studied the same and same observation was reported in Atlas also[10].

The cuticle of Sambar Deer showed irregular wave scale pattern, rippled scale margin and near scale distance. This observation showed similarity with the study of Kush *et al.*, N. Dharaiya *et al.* Mumtaz Akhtar *et al.* (1988) reported in their study that Sambar Deer show crenate margin.

The hair morphology of Fishing Cat and Hyena was not studied by any researcher available on web network.

#### **IV. CONCLUSION**

The present study was conducted on hairs of wild animals with the objective of identifying and differentiating them from each other on the basis of microscopic examination. In this study, it was described that on the basis of physical observation (color, texture), and cuticular characteristics (scale margin, scale distance, scale pattern) can establish the differences among the different species of wild animals. A considerable amount of variation was found based on hair parameter between species. Color and cuticular pattern showed a good variation between species. It is thus concluded that by combining given macroscopic and microscopic characteristics it is possible to characterize the hair of different wild animals. The observation of this study will be useful for the identification of species from wildlife offence case exhibits which will help in the conviction of poachers and help in the forensic investigation but for individualization, further research is suggested.

#### **V. ACKNOWLEDGMENT**

It is my privilege and most pleasant duty to acknowledge my deep sense of gratitude to Dr. Rupak Dey, Principal Chief Conservator of Forest, Government of U.P. who kindly permitted me to collect the shredded hair samples of various wild animals during the study. I also convey my thanks to all staff members of Lucknow Zoological Garden for providing me hairs of wild and endangered animals.

#### **REFERENCES**

1. Akhtar M, Beg MA and Mushtaq M. (1988) "Cuticular scale patterns of the guard hair of some game animals" *Pak. J. Agri. Sci.* 25(4)282.
2. Baddi SA, Prasad RV, Jamuna KV, Byregowada SM, Rao S and Ramkrishnav (2014) "Morphological studies on the hair of Sloth Bear (*Melursus ursinus*) under different microscopes" *Journal of wildlife research, Jan-March, 2014, Vol. 2, Issue 1, p.p. 01-03.*
3. Bruggers LR, Owens R, and Hoffman (2002) "Wildlife damage management research needs: perception of scientists, wildlife managers and stakeholders of the USDA / wildlife services program" *International biodeterioration and biodegradation*, 49 (2002) 213-223.
4. Dhariya N and Soni VC (2012) "Identification of hairs of some mammalian prey of large cats in Gir protected area, India" *Journal of threatened taxa* 4(9):2928-2932.
5. Gharu J and Trivedi S (2014) "Cuticle Scale Patterns, Medulla and Pigment in Hairs of Some Carnivores" *CBPS; Section B; Nov. 2014 – Jan. 2015, Vol. 5, No. 1; 538-544.*
6. Gharu J and Trivedi S (2015) "Hair cuticle scale patterns, medulla and pigment in Equidae" *JCBPS, section B, vol. 5, No. 2; 1441-1446.*
7. Goyal SP, Sahajpal V, Jayapal R, Yoganand K, and Thakar MK (2007) "Hair characteristics of four Indian bear species" *Science and justice* 48 (2008) 8 – 15. *Doi:10.1016/j.scijus.2007.05.001.*
8. Kshirsagar SV, Singh B, Fulari SP (2009) "Comparative Study of Human and Animal Hair in Relation with Diameter and Medullary Index" *Indian Journal of Forensic Medicine and Pathology. July-Sept 2009; Vol. 2 No.3.*
9. Kitpipit T and Thanakiatkrai P (2013) "Tiger hair morphology and its variations for wildlife forensic investigation" *Maejo Int. J. Sci. Technol.* 2013, 7(03), 433-443.

10. Prasad RV, Shambhulingappa YB, Jamuna KV, Narayanaswamy HD, Bhat MN and Ramkrishna (2014) "Histological characteristics of hair follicle pattern in Indian bison (*Bos gaurus*), Blackbuck (*Antelope cervicapra*) and Nilgai (*Boselaphus tragocamelus*)" *Veterinary World* 7(3): 189-193. doi: 10.14202/vetworld.2014.189-193.
11. Rajaram and Menon "A scanning electron microscope study of the hair keratins of some animals of the hair keratins of some animals of the Indian subcontinent-A preliminary report" *J. Bombay nationalist. Soc.* 83.
12. Sahajpal V, Goyal SP, Singh K and Thakur V. (2009) "Dealing wildlife offences in India: Role of the hair as physical evidence" *Int J Trichology*.2009 Jan-June;1(1):18-26., doi:10.4103/0974-7753.51928.
13. Shrivastava K, Joshi HR, Gaikwad SA and Tomar MPS (2012) "Comparative trichology of common wild herbivores of India" *Adv.appl. sci.res.*, 2012, 3(6):3455-3458.