

IDENTIFICATION OF DORSAL GUARD HAIRS OF NINE SPECIES OF THE FAMILY BOVIDAE (ARTIODACTYLA: MAMMALIA)

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INTRODUCTION

Tricho-taxonomic study of hair is very much significant in the study of mammalian taxonomy along with food habit, ecology, behaviour and even in the control of illegal trade of wildlife and its derivatives. Importance of hair analysis have been focused by a number of workers (Adorjan & Kolenosky 1969, Mathiak 1938, Williams 1938, Mayer 1952, Hausman 1920, Moore *et al.*, 1974, Koppikar & Sabnis 1976, 1977, Terrink 1991, Wallis 1993, De & Chakraborty 1995, 1998, 2002, 2006, Chakraborty & De 2001, 2002, 2005, Chakraborty *et al.*, 1996, 1999, Toth 2002). But meager information is available on the hair structure of the species of the family Bovidae (Order: Artiodactyla).

Out of nineteen Bovid species in India, only nine species are dealt in the present paper. Among the nine species five have been included in Schedule I and rest in the Schedule II or III in the Indian Wildlife (Protection) Act, 1972 amended in 2006 and five in CITES also (Table II). There is a standard identifying key (Pocock, 1941) by which a scientist can identify the species, if full specimen or the total skin is available. But this identifying key is not sufficient to identify the skin or products in part. It is expected that present study will help in identification of mammalia species from hair samples and also help in enforcement of wildlife Acts to check illegal trades.

MATERIALS AND METHODS

10-15 tufts of dorsal guard hairs were collected from the mid-dorsal region of three dry specimens of each species present in the Zoological Survey of India, Kolkata. The materials were processed for study following the method of Chakraborty *et al.*

(1996). Physical characteristics viz., diameter, total length were measured by the dial calipers and millimeter scale respectively and profile, banding pattern, colour were studied under WILD binocular. Nomenclature of colour is followed after Ridgway (1886). Other characteristics such as surface structure, medullary configuration, scale pattern and cross-sectional details were studied after Chakraborty *et al.*, (1996) and Brunner & Coman (1974). Structural nomenclature in respect of surface structure and medullary configuration is followed by Moore *et al.* (1974), Bruner and Coman (1974) and Teerink (1991).

OBSERVATIONS

Detailed results are shown in the table no. I and table no. II

1. *Budrocas taxicolor* Hodgson, 1850, Takin

Status : CITES: App. II

A. Physical Characters

- (i) Profile : Curly
- (ii) Colour : Tip-Claret Brown, Base-Orchraceous Rufous
- (iii) No. of bands: 2
- (iv) Length (mm): 44-99 (52.18±3.55)
- (v) Diameter (μ): 80-120 (105±5.80)

B. Surface Structure (Plate I, Fig. 3)

- (i) Scale margin distance: Close
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair : 225-415 (320±20.15)
- (iv) Scale pattern: Irregular

- (v) Side to side scale length (SS): 22-42 (28±3.2)
- (vi) Proximo-distal scale length (PD): 10-15 (12.2±1.25)

C. Medulla (Plate I, Fig. 2)

- (i) Medullary configuration: Wide Medulla lattice
- (ii) Medullary Index: 0.478-0.629 (0.48±0.002)

D. Transverse Section: Circular (Plate I, Fig. 1)

2. *Boselophus tragocamelus* (Pallas, 1766) ., Blue Bull

Status: IWPA: Sch. III

A. Physical Characters

- (i) Profile : Straight
- (ii) Colour : Black
- (iii) No. of bands : none
- (iv) Length (mm) : 55-94 (74.83±9.59)
- (v) Diameter (μ) : 100-150 (120±9.45)

B. Surface Structure (Plate I, Fig. 6)

- (i) Scale margin distance : Distant
- (ii) Scale margin : Smooth
- (iii) Scale count per mm length of hair : 200-260 (225±15.64)
- (iv) Scale pattern : Regular wave
- (v) Side to side scale length(SS) : 30-36 (32±1.5)
- (vi) Proximo-distal scale length(PD) : 6-13 (9.2±2.51)

C. Medulla (Plate I, Fig. 5)

- (i) Medullary configuration : Multiserial ladder
- (ii) Medullary Index: 0.812-0.888 (0.84±0.025)

D. Transverse Section: Circular (Plate I, Fig. 4)

3. *Antelope cervicapra* (Linnaeus, 1758) ., Black Buck
Status: IWPA: Sch. I, Pt. I; CITES: App. III

A. Physical Characters

- (i) Profile : Straight
- (ii) Colour : Hair Brown
- (iii) No. of bands: none
- (iv) Length (mm) : 14-19 (16.76±1.27)

- (v) Diameter (μ) : 40-60 (55±3.75)

B. Surface Structure : (Plate II, Fig. 2)

- (i) Scale margin distance : Distant
- (ii) Scale margin : Smooth
- (iii) Scale count per mm length of hair : 152-220 (195±14.02)
- (iv) Scale pattern : Regular wave
- (v) Side to side scale length(SS) : 28-62 (35±4.25)
- (vi) Proximo-distal scale length(PD) : 13-26 (15.45±1.73)

C. Medulla : (Plate II, Fig. 3)

- (i) Medullary configuration : Reversed Cloisonne
- (ii) Medullary Index: 0.916-0.925 (0.92±0.003)

D. Transverse Section : Concave (Plate II, Fig.1)

4. *Hemitragus jemlahicus* (Smith, 1826) .,
Himalayan Tahr

Status: IWPA : Sch. I, Pt. I

A. Physical Characters

- (i) Profile : Straight
- (ii) Colour: Tip-Clove Brown, Base-Hair Brown
- (iii) No. of bands: 2
- (iv) Length (mm): 65-86 (76.33±5.14)
- (v) Diameter (μ): 60-100 (75±10.75)

B. Surface Structure (Plate II, Fig. 6)

- (i) Scale margin distance: Close
- (ii) Scale margin: Crenate
- (iii) Scale count per mm length of hair: 280-420 (375±18.70)
- (iv) Scale pattern: Irregular wave
- (v) Side to side scale length(SS): 24-42 (32±3.95)
- (vi) Proximo-distal scale length(PD): 11-17 (12.25±1.10)

C. Medulla (Plate II, Fig. 5)

- (i) Medullary configuration: Narrow medulla lattice
- (ii) Medullary Index: 0.602-0.619 (0.61±0.005)

D. Transverse Section : Hexagonal
(Plate II, Fig. 4)

5. *Naemorhedus goral* (Hardwicke, 1825) ., Goral

Status: CITES: App. I

A. Physical Characters

- (i) Profile: Straight
- (ii) Colour: Tip-Clove Brown, 2nd band-Broccoli Brown, 3rd band-Prout's Brown, 4th band-Mars Brown
- (iii) No. of bands: 4
- (iv) Length (mm): 48-58 (52±3.51)
- (v) Diameter (μ): 40-90 (65±5.95)

B. Surface Structure (Plate III, Fig. 4)

- (i) Scale margin distance: Distant
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair: 210-275 (245±16.05)
- (iv) Scale pattern: Regular wave
- (v) Side to side scale length(SS): 32-40 (35±2.75)
- (vi) Proximo-distal scale length(PD): 9-14 (10.25±1.21)

C. Medulla (Plate III, Fig. 2)

- (i) Medullary configuration: Globular
- (ii) Medullary Index: 0.611-0.615 (0.612±0.001)

D. Transverse Section : Circular
(Plate III, Fig. 1)

6. *Ovis ammon* (Linnaeus, 1758) ., Argali

Status: IWPA: Sch I, pt. I; CITES: App. I

A. Physical Characters

- (i) Profile: Curly
- (ii) Colour: Sepia
- (iii) No. of bands: none
- (iv) Length (mm): 47-56 (49.91±2.56)
- (v) Diameter (μ): 40-100 (75±15.50)

B. Surface Structure (Plate III, Fig. 6)

- (i) Scale margin distance: Near

- (ii) Scale margin: Rippled

- (iii) Scale count per mm length of hair: 288-425 (360±10.24)

- (iv) Scale pattern: Irregular wave

- (v) Side to side scale length(SS): 36-48 (38±1.05)

- (vi) Proximo-distal scale length(PD): 11-15 (12.30±1.22)

C. Medulla (Plate III, Fig. 5)

- (i) Medullary configuration: Narrow medulla lattice

- (ii) Medullary Index: 0.645-0.656 (0.65±0.002)

D. Transverse Section : Spindle type
(Plate III, Fig.3)

7. *Gazella bennetti* (Sykes, 1831) ., Chinkara

Status: IWPA: Sch II, pt. II

A. Physical Characters

- (i) Profile: Straight

- (ii) Colour: Gray

- (iii) No. of bands: none

- (iv) Length (mm): 18-27 (21.09±2.60)

- (v) Diameter (μ): 30-50 (45±3.45)

B. Surface Structure (Plate IV, Fig. 3)

- (i) Scale margin distance: Near

- (ii) Scale margin: Smooth

- (iii) Scale count per mm length of hair: 175-210 (190±10)

- (iv) Scale pattern: Regular wave

- (v) Side to side scale length(SS): 28-32 (30±1.5)

- (vi) Proximo-distal scale length(PD): 12-18 (14.50±2.25)

C. Medulla (Plate IV, Fig. 2)

- (i) Medullary configuration: Narrow medulla lattice

- (ii) Medullary Index: 0.925-0.944 (0.93±0.003)

D. Transverse Section: Oval (Plate IV, Fig. 1)

8. *Pseudois nayaur* (Hodgson, 1833) ., Blue sheep

Status: IWPA: Sch I, pt. I

A. Physical Characters

- (i) Profile: Straight
- (ii) Colour: Cream Buff
- (iii) No. of bands: none
- (iv) Length (mm): 41-60 (50.36±6.05)
- (v) Diameter (μ): 40-110 (85±7.65)

B. Surface Structure (Plate IV, Fig. 5)

- (i) Scale margin distance: Distant
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair: 310-335 (290±25)
- (iv) Scale pattern: Regular wave
- (v) Side to side scale length(SS): 32-40 (35±2.75)
- (vi) Proximo-distal scale length(PD): 9-14 (10.25±1.21)

C. Medulla (Plate IV, Fig. 4)

- (i) Medullary configuration: Filled
- (ii) Medullary Index: 0.932-0.951 (0.94±0.005)

D. Transverse Section : Circular (Plate IV, Fig.6)**9. Naemorhedus sumatraensis** (Bechstein, 1799),
Serow

Status: IWPA: Sch I, pt. I; CITES: App. I

A. Physical Characters

- (i) Profile: Straight
- (ii) Colour: Black
- (iii) No. of bands: none
- (iv) Length (mm): 31-45 (38.8±4.62)
- (v) Diameter (μ): 100-150 (125±1.5)

B. Surface Structure (Plate V, Fig. 3)

- (i) Scale margin distance: Distant
- (ii) Scale margin: Smooth
- (iii) Scale count per mm length of hair: 360-450 (400±15.25)
- (iv) Scale pattern: Regular wave
- (v) Side to side scale length(SS): 30-41 (33±2.60)
- (vi) Proximo-distal scale length(PD): 17-22 (19±1.95)

C. Medulla (Plate V, Fig. 2)

- (i) Medullary configuration: Simple
- (ii) Medullary Index: 0.595-0.658 (0.62±0.105)

D. Transverse Section: Circular (Plate V, Fig.1)**DISCUSSION**

Coat colour of the species belonging to the family Bovidae possess different shades of brown colour. The colour of dorsal guard hairs of *C. sumatraensis* and *B. taxicolor* is more blackish than the other species studied. *N. goral* is having different shades of brown, arranged in bands, starting from tip it is Clove Brown, Broccoli Brown, Prout's Brown and Mars Brown. In case of *H. jemlahicus* it is Clove Brown at tip and Hair Brown at the base. Coat colour of *O. amon* and *P. nayaur* is Sepia and Cream Buff respectively. Hairs of *G. bennetti* is generally black to Grey but almost White at proximal end and gradually turns to black at distal region with various shades of Brown in *B. tragocamelus*. According to Koppikar & Sabnis (1976) coat colour of *A. cervicapra* is Black at terminal and Grey at proximal end, but in the present study it was observed that female *A. cervicapra* is having Brown coat colour with shades of White & Black. As such, coat colour of mammalian species varies according to sex, age, habitat and season. It is observed that dorsal guard hairs of *B. taxicolor*, *H. jemlahicus* and *N. goral* are banded and others are devoid of any band. Only two species i.e. *B. taxicolor* and *O. ammon* have curly dorsal hairs and profile of the rest species is straight (Table I).

The average minimum hair length was observed as (16.76±1.27) in *A. cervicapra* and the maximum was observed in *H. jemlahicus* as (76.33±5.14) (Table I). In the present study, the range of hair length in *G. bennetti* was observed (18-27 mm with an average of (21.09±2.60). Koppikar & Sabnis (1976) observed 18 to 22 mm hair length in the same species. Hair length of *B. tragocamelus* observed in the present study as 55-94 mm (Table I) but Koppikar & Sabnis (1976) reported the same 23-27 mm. In fact the length of dorsal guard hairs in the Bovid species varies a lot not only in between the species but in the same species also. The lowest diameter observed in *G. bennetti* as (45±3.45) μ and highest as (125±1.5) μ (Table I). Koppikar & Sabnis (1976) reported the

diameter of hair of *G. bennetti* as 54 μ which differs very little from the present study. The average diameter of *B. tragocamelus* was observed in the present study as $(120 \pm 9.45) \mu$ and the same was reported by Koppikar & Sabnis (1976) as 140 μ which differs not much from the present study. Hair stem of Bovid species is very fragile and breaks easily and the same type of observation was noted by Koppikar & Sabnis (1976). Though observation of Koppikar & Sabnis (1976) in respect of average length and diameter of hairs of *A. cervicapra* and *G. bennetti* is in conformity with the present study yet. Hausman (1920) observed maximum hair diameter 105.40 μ in case of Thompson's Gazelle (*G. thompsoni nasalis*). Chakraborty *et al.* (1996) opined that difference in the length of hair within the same species may be attributed due to geographical and ecological factors. But according to Short (1978), diameter of hair is not specific, it varies from root to tip. Same type of observation has been made by Chakraborty & De (2005) in the study of hairs of species belonging to the family Viverridae. Hausman (1920) inferred that only a meagre amount of significance should be attached to hair magnitudes, except possibly in large averages, and between large groups, i.e. families or genera. So, from the present study, it may be pointed out that the average length & diameter of hairs may be considered as additional characters along with other characters at the time of identification. Moore *et al.* (1974) opined that the hairs of Artiodactyla species are generally larger than that of the species in other orders. The scale count per millimeter of hair length also differs greatly in the different species of the family Bovidae. It is interesting to note that the average scale count in *N. sumatraensis* is 400 ± 15.25 and that of *G. bennetti* is 190 ± 10 which is maximum and minimum respectively among the species studied (Table I). As this character is not so much variable, so it could not be considered as a distinct character for identification but the same could be taken as an additional character with age group of characters.

Scale pattern and scale margin are 'regular wave' and 'smooth' in *A. cervicapra*, *N. goral*, *G. bennetti* and *P. nayaur*. The same is 'regular mosaic' with 'smooth' margin in *B. tragocamelus* and *N. sumatraensis*. The dorsal guard hair of *H. jemlahicus*

and *O. ammon* are with 'irregular wave' scale pattern and 'crenate' and 'smooth' scale margin respectively (Table I). Koppikar & Sabnis (1976) also reported imbricate scale with smooth margin in the proximal and medial regions in case of hairs of *A. cervicapra*. The scale margin distance is 'distant' in *B. tragocamelus*, *A. cervicapra*, *N. goral*, *P. nayaur*, *N. sumatraensis*, whereas scale margin distance is 'close' in *B. taxicolor* & *H. jemlahicus* & 'near' in case of hairs of *O. ammon* & *G. bennetti*. So, these scalar characters may be used as identifying character with other characters.

'SS' does not varies much from species to species, which is lowest in *B. taxicolor* (28 ± 3.20) & highest in *O. ammon* & *P. nayaur* i.e. (38 ± 1.05) & (38 ± 3.20) respectively. The 'PD' observed is minimum in *B. tragocamelus* (9.2 ± 2.51), maximum in *N. sumatraensis* (19 ± 1.95) (Table-2). From the observation it may be opined that 'PD' is more or less similar in *B. taxicolor*, *H. jemlahicus*, *O. ammon* where as others vary to a small extent.

The present study shows "narrow medulla lattice" in *H. jemlahicus*, *O. ammon*, *G. bennetti*, whereas Koppikar and Sabnis (1975) reported 'continuous medulla' in *G. bennetti*. Wide medulla lattice' is observed in *B. taxicolor*. Whereas 'multiserial ladder', 'reversed cloisonne', 'glandular', 'filled', & 'Simple' medulla are noted in *B. tragocamelus*, *A. cervicapra*, *N. goral*, *P. nayaur* & *N. sumatraensis* respectively (Table-2). But Koppikar and Sabnis (1975) reported 'continuous medulla' in proximo-distal region of *B. tragocamelus* and 'fragmented' medulla in *A. cervicapra*.

Minimum medullary index (0.48 ± 0.002) is found in *B. taxicolor* and maximum (10.94 ± 0.005) in *P. nayaur*, which is almost similar in *A. cervicapra* (0.92 ± 0.003) and (0.938 ± 0.03) in *G. bennetti* (Table-2). Medullary index (0.64 ± 0.005), (0.65 ± 0.002) are found in *N. sumatraensis* and *O. ammon* respectively. *H. jemlahicus* and *N. goral* have almost same medullary index (0.61 ± 0.005) & (0.612 ± 0.001) respectively. Medullary index in *B. tragocamelus* is reported as (0.84 ± 0.025) only which is between the maximum and minimum (Table-2).

'Circular' transverse section is found in *B. taxicolor*, *B. tragocamelus*, *N. goral*, *P. nayaur* & *N. sumatraensis*. But 'Concave' section is noted in *A. cervicapra* and 'Hexagonal' in *H. jemlahicus*. Where

as *O. ammon* and *G. bennetti* possess 'Simple type' and 'Oval type' T.S. respectively (Table-2).

Based on the above characteristics of the dorsal guard hairs, a key to identify the different species of the Indian Bovid is presented below:

Key to the Indian species of the family Bovidae

1. Medullary index <0.50 2
 - Medullary index >0.50 3
2. Medullary index (0.48 ± 0.002), T.S. circular, medullary configuration 'wide medulla lattice', scale pattern 'irregular wave' with smooth scale margin, scale margin distance is 'close', Scale count/ mm (320 ± 20.15)..... **B. taxicolor**
3. T. S. circular..... 4
 - T. S. not circular..... 5
4. Medullary index (0.84 ± 0.025), medullary configuration 'multiserial ladder', scale pattern 'regular mosaic' with smooth margin, scale margin distance is 'distant', Scale count/ mm (225 ± 15.64).....**B. tragocamelus**
 - Medullary index (0.612 ± 0.001), medullary configuration 'globular', scale pattern 'regular wave' with smooth scale margin, scale margin distance is 'distant', Scale count/ mm (245 ± 16.05) **N. goral**
 - Medullary index (0.94 ± 0.005), medullary configuration 'filled,' scale pattern 'regular wave' with smooth margin and distance is 'distant', Scale count/ mm (290 ± 25) **P. nayaur**
 - Medullary index (0.62 ± 0.105), medullary configuration "simple", scale pattern 'regular mosaic' with smooth scale margin and scale margin distance is 'distant'; Scale count/ mm (400 ± 15.25) **N. sumatraensis**
5. Medullary configuration "narrow medulla lattice" 6

- Medullary configuration not "narrow medulla lattice" 7
- 6. T.S.' hexagonal', Medullary index (0.61 ± 0.005), scale pattern 'irregular wave' with crenate scale margin, scale margin distance 'close.', Scale count/ mm (375 ± 18.70) **H. jemlahicus**
- T. S. 'spindle type', medullary index (0.65 ± 0.002), scale pattern' irregular wave 'with rippled scale margin, scale margin distance 'near', Scale count/ mm, (360 ± 10.24) **O. ammon**
- T.S. Oval, medullary index (0.93 ± 0.003), scale pattern 'regular wave' with 'smooth' scale margin, scale margin distance 'near', Scale count/ mm (190 ± 10) **G. bennetti**
- 7. Medullary configuration 'reversed cloisonné', T.S. concave, scale pattern 'regular wave' with smooth scale margin, scale margin distance 'distant', medullary index (0.92 ± 0.003), Scale count/ mm (195 ± 14.02) **A. cervicapra**

SUMMARY

The dorsal guard hairs of nine species of Indian Bovids viz., *B. taxicolor*, *B. tragocamelus*, *N. goral*, *P. nayaur*, *N. sumatraensis*, *H. jemlahicus*, *O. ammon*, *G. bennetti* and *A. cervicapra* have been studied. Among them only hairs of *B. taxicolor* possess medullary index <0.50 and medullary index of the rest of the species is >0.50 . Both medullary configuration and T.S. are of varied type among these 9 species. An identifying key is prepared on the basis of combination of characters such as transverse section, scale pattern, scale margin, scale margin distance, medullary configuration etc.

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Plate I

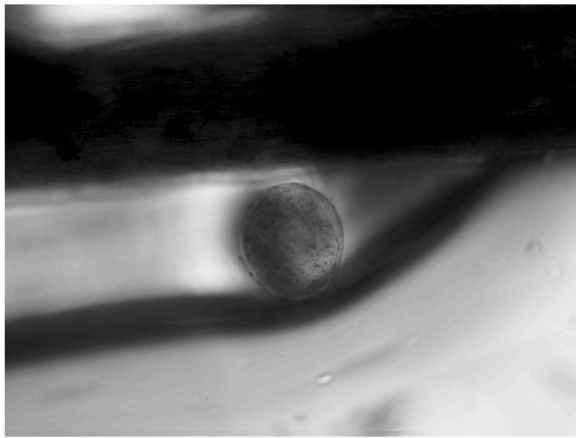


Fig. 1 : T.S. of dorsal guard hair of *B. taxicolor*

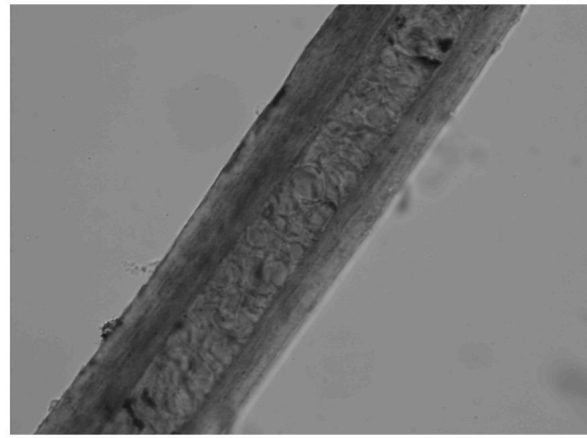


Fig. 2 : Medulla of dorsal guard hair of *B. taxicolor*

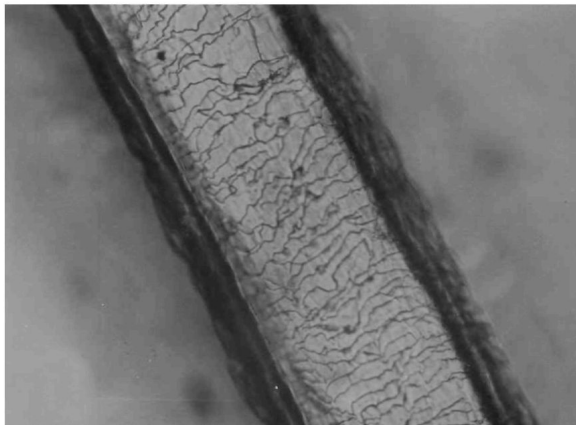


Fig. 3 : Cuticular scales of dorsal guard hair of *B. taxicolor*

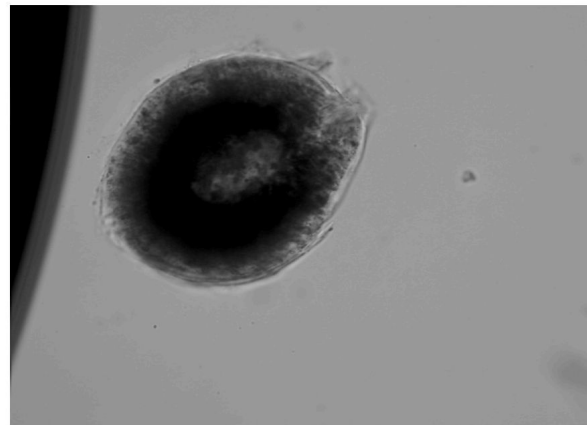


Fig. 4 : T.S of dorsal guard hair of *B. tragocamelus*

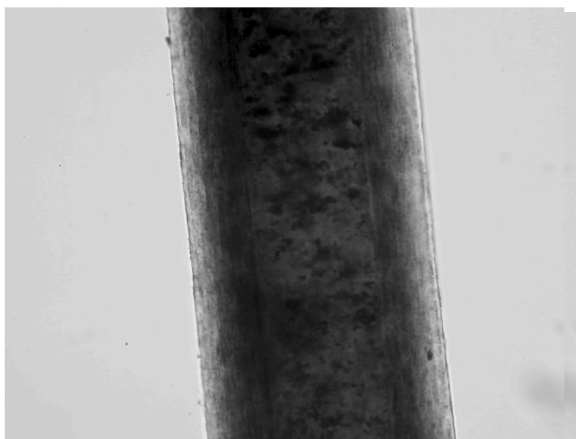


Fig. 5 : Medulla of dorsal guard hair of *B. tragocamelus*

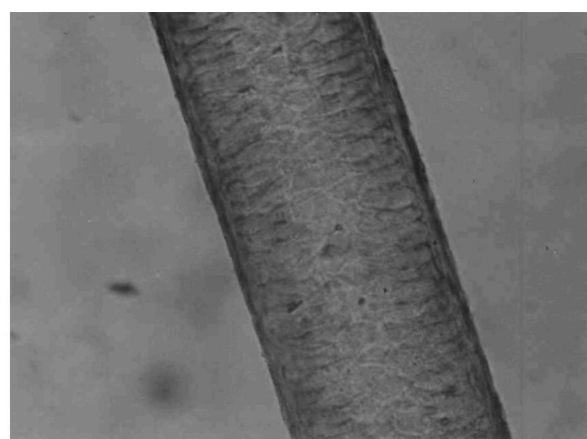


Fig. 6 : Cuticular scales of dorsal guard hair of *B. tragocamelus*

Plate II

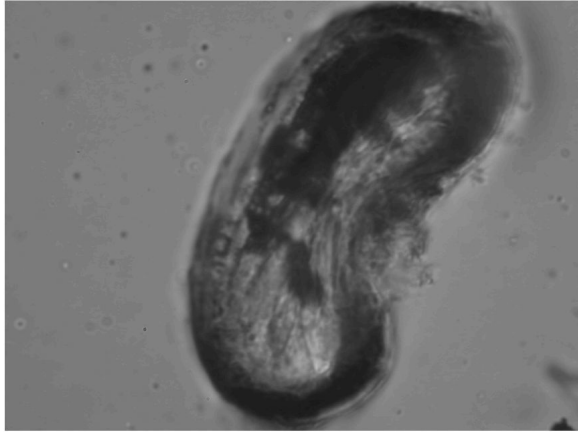


Fig. 1 : T.S. of dorsal guard hair of *A. cervicapra*

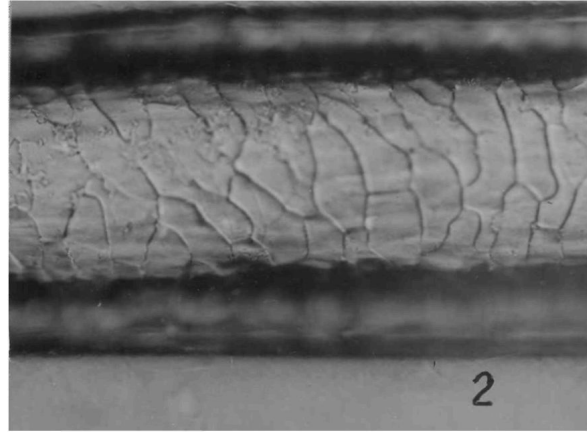


Fig. 2 : Cuticular scales of dorsal guard hair of *A. cervicapra*

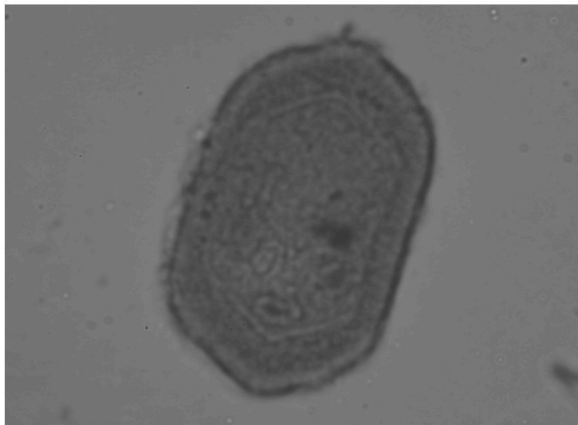


Fig. 3 : Medulla of dorsal guard hair of *A. cervicapra*

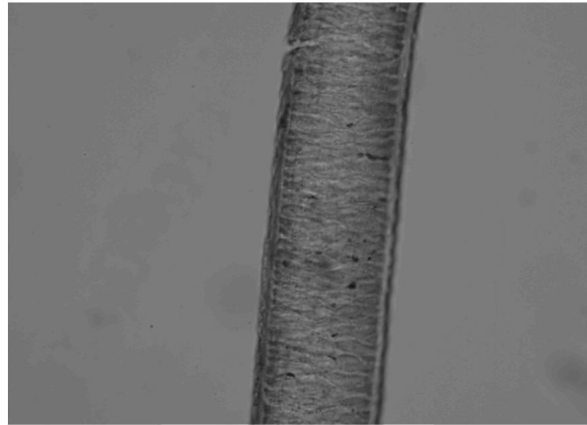


Fig. 4 : T.S. of dorsal guard hair of *H. jemlahicus*

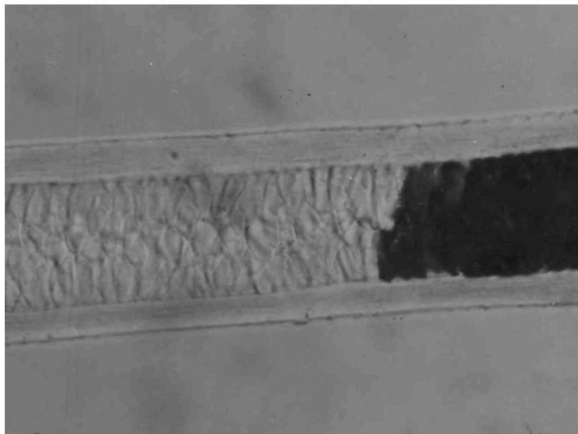


Fig. 5 : T.S. of medulla of dorsal guard hair of *H. jemlahicus*

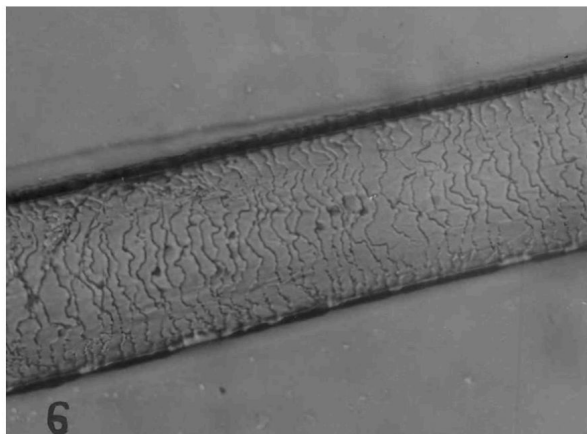


Fig. 6 : Cuticular scales of dorsal guard hair of *H. jemlahicus*

Plate III

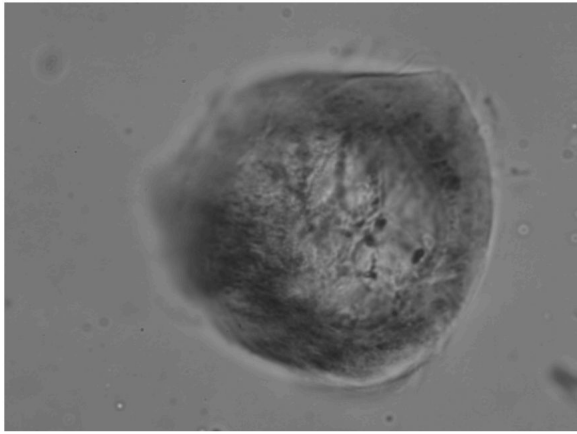


Fig. 1 : T.S. of dorsal guard hair of *N. goral*

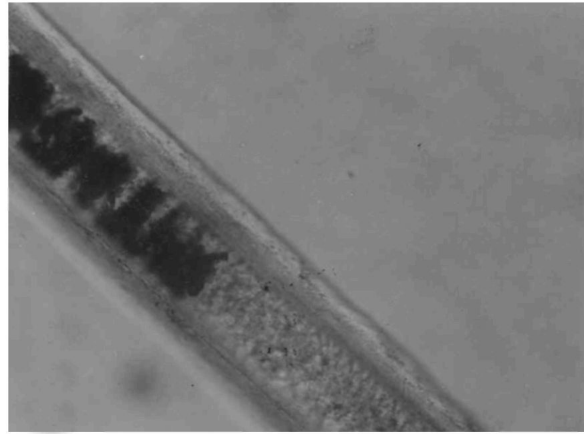


Fig. 2 : Medulla of dorsal guard hair of *N. goral*

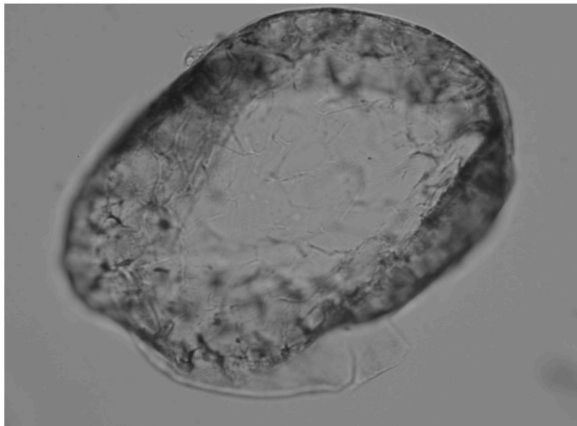


Fig. 3 : T.S. of dorsal guard hair of *O. ammon*

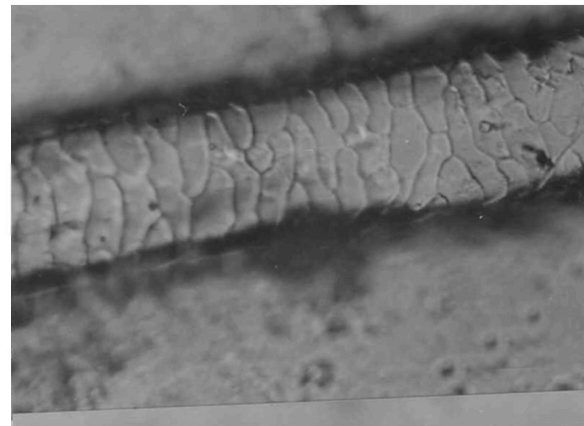


Fig. 4 : Cuticular scales of dorsal guard hair of *N. goral*

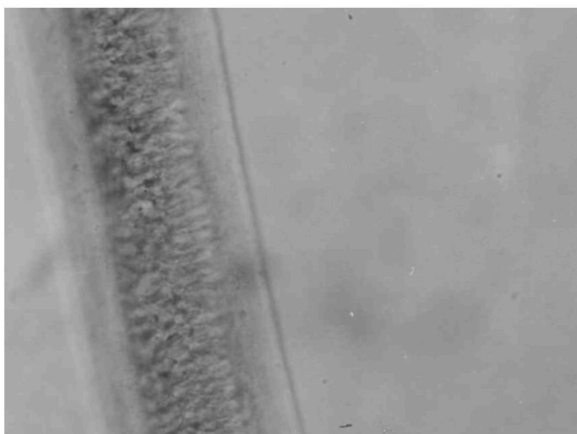


Fig. 5 : Medulla of dorsal guard hair of *O. ammon*

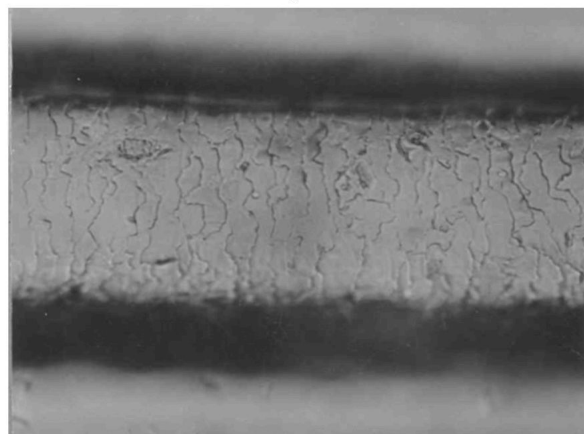


Fig. 6 : Cuticular scales of dorsal guard hair of *O. ammon*

Plate IV

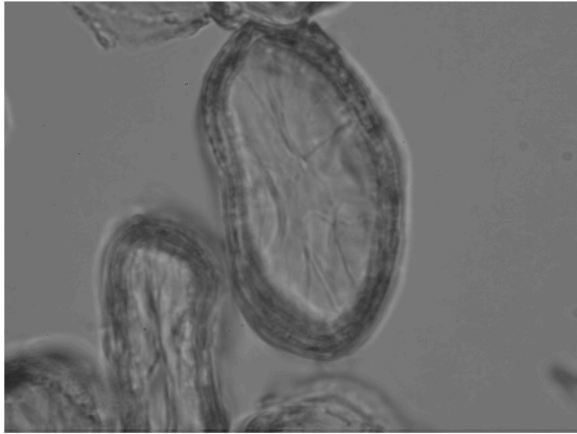


Fig. 1 : T.S. of dorsal guard hair of *G. bennetti*

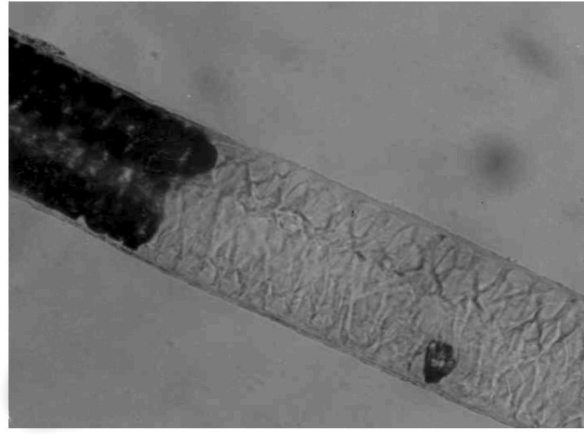


Fig. 2 : Medulla of dorsal guard hair of *G. bennetti*

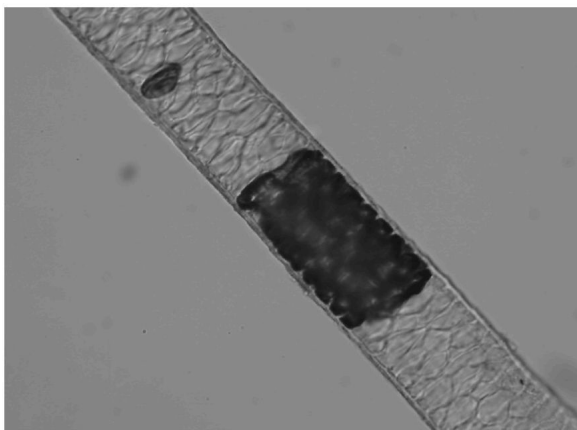


Fig. 3 : Cuticular scales of dorsal guard hair of *G. bennetti*

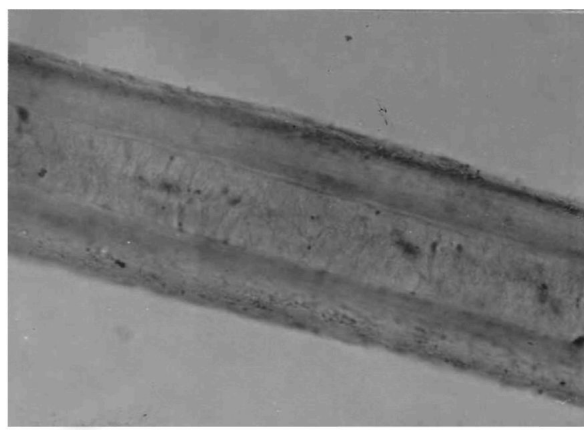


Fig. 4 : Medulla of dorsal guard hair of *P. nayaur*

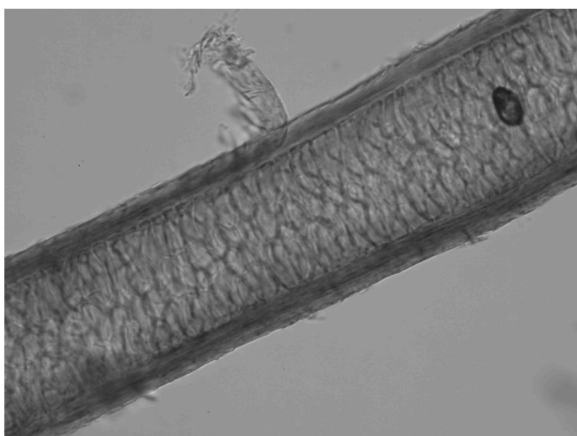


Fig. 5 : Cuticular scales of dorsal guard hair of *P. nayaur*

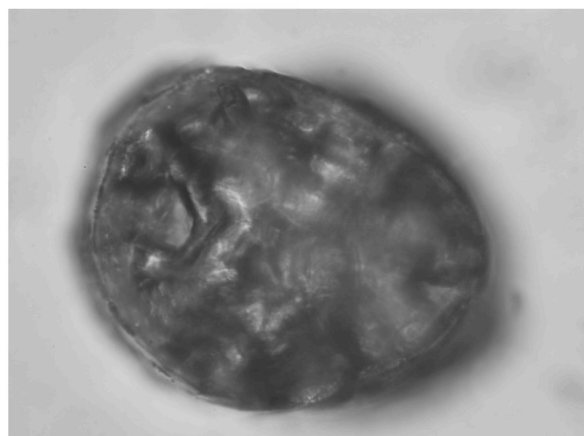


Fig. 6 : T.S. of dorsal guard hair of *P. nayaur*

Plate V

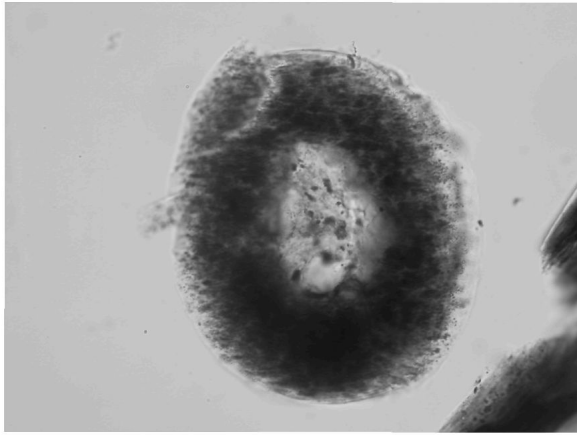


Fig. 1: T.S. of dorsal guard hair of *N. sumatraensis*

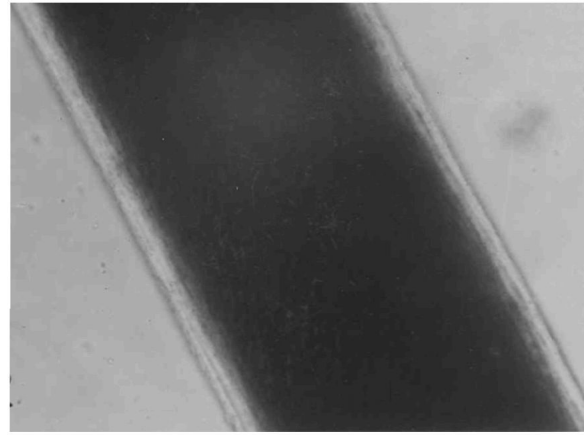


Fig. 2: Medulla of dorsal guard hair of *N. sumatraensis*

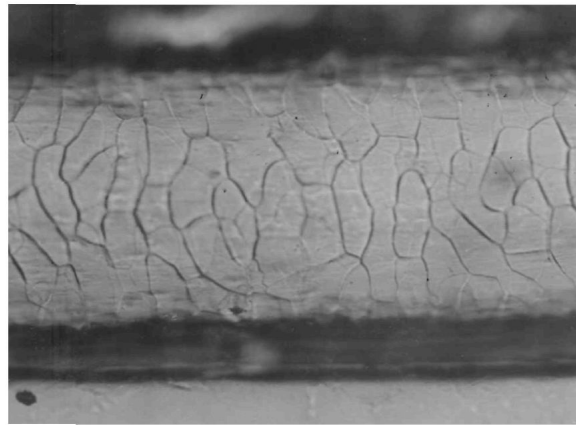


Fig. 3: Cuticular scales of dorsal guard hair of *N. sumatraensis*

Table I : Comparative account of the characteristics of the guard hairs of nine Indian species of the Family Bovidae(Mean and SD given in parenthesis).

Sl. No	Name of the species	Profile	Colour	No.of band	Scale margin Distance	Length (mm)	Diameter (i)	Scale county/mm hair length	Scale Pattern	Scale Margin
1.	<i>Budrocas tuxicolor</i>	Curly	Tip: Claret Brown Base: Orchrac-aceous Rufous	2	Close	44-99 (52.18 ± 3.55)	80-120 (105 ± 5.80)	225-415 (320 ± 20.15)	Irregular wave	Smooth (Pt. I, Fig.3)
2.	<i>Boselophus tragocamelus</i>	Straight	Black	-	Distant	55-94 (74.83 ± 9.59)	100-150 (120 ± 9.45)	200-260 (225 ± 15.64)	Regular mosaic	Smooth (Pt. I, Fig.6)
3.	<i>Antelope cervicapra</i>	Straight	Hair Brown	-	Distant	14-19 (16.76 ± 1.27)	40-60 (55 ± 3.75)	152-220 (195 ± 14.02)	Regular wave	Smooth (Pt. II, Fig.2)
4.	<i>Hemitragus jemlahicus</i>	Straight	Tip: Clove Brown Base: Hair Brown	2	Close	65-86 (76.33 ± 5.14)	60-100 (75 ± 10.75)	280-420 (375 ± 18.70)	Irregular wave	Crenate (Pt. II, Fig.6)
5.	<i>Naemorhaetus goral</i>	Straight	Tip:Clove Brown 2 nd band: Broccoli Brown 3 rd band: Prout's Brown 4 th band:Mars Brown	4	Distant	48-58 (52 ± 3.51)	40-90 (65 ± 5.95)	210-275 (245 ± 16.05)	Regular wave	Smooth (Pt. III, Fig.4)
6.	<i>Ovis ammon</i>	Curly	Sepia	-	Near	47-56 (49.91 ± 2.56)	40-100 (75 ± 15.50)	288-425 (360 ± 10.24)	Irregular wave	Rippled (Pt. III, Fig.6)
7.	<i>Gazella bennetti</i>	Straight	Gray	-	Near	18-27 (21.09 ± 2.60)	30-50 (45 ± 3.45)	175-210 (190 ± 10)	Regular wave	Smooth (Pt. IV, Fig.6) Fig.3
8.	<i>Pseudis nayaur</i>	Straight	Cream Buff	-	Distant	41-60 (50.36 ± 6.05)	40-110 (85 ± 7.65)	310-335 (290 ± 25)	Regular wave	Smooth (Pt. IV, Fig.5)
9.	<i>Naemorhaetus sumatraensis</i>	Straight	Black	-	Distant	31-45 (38.8 ± 4.62)	100-150 (125 ± 1.5)	360-450 (400 ± 15.25)	Regular mosaic	Smooth (Pt. V, Fig.3)

Table 2: Comparative account of the characteristics of the guard hairs of nine Indian species of family Bovidae (Mean and SD given in parenthesis); 'SS' = Side to Side cuticular scale length; 'PD' = Proximo-distal cuticular scale length; T.S = Transverse Section.

Sl. No.	Name of the species	SS (\bar{x})	PD(\bar{x})	Medullary Configuration	Medullary Index	T.S	Common name/ Status
1.	<i>Budrocas taxicolor</i>	22-42 (28 \pm 3.20)	10-15 (12.2 \pm 1.25)	Wide Medulla Lattice (Pt. I, Fig.2)	0.478- 0.629 (0.48 \pm 0.002)	Circular (Pt. I, Fig.1)	Takin CITES: CITES : Appendix II
2.	<i>Boselophus tragocamelus</i>	30-36 (32 \pm 1.5)	6-13 (9.2 \pm 2.51)	Multiserial Ladder (Pt. I, Fig.5)	0.812- 0.888 (0.84 \pm 0.025)	Circular (Pt. I, Fig.4)	Blue Bull WL (P) Act,'72, Sch III
3.	<i>Antilope cervicapra</i>	28-62 (35 \pm 4.25)	13-26 (15.45 \pm 1.73)	Reversed Cloisonn'e (Pt. I I, Fig.3)	0.916- 0.925 (0.92 \pm 0.003)	Concave (Pt.II, Fig.1)	Black Buck WL (P) Act,'72, Sch I, Part I CITES: Appendix III
4.	<i>Hemitragus jemlahicus</i>	24-42 (32 \pm 3.95)	11-17 (12.25 \pm 1.10)	Narrow Medulla Lattice (Pt. II, Fig. 5)	0.602- 0.619 (0.61 \pm 0.005)	Hexagonal (Pt.II, Fig.4)	Himalayan Tahr WL (P) Act,'72, Sch I, Part I
5.	<i>Naemorhedus goral</i>	32-40 (35 \pm 2.75)	9-14 (10.25 \pm 1.21)	Globular (Pt.III, Fig.2)	0.611- 0.615 (0.612 \pm 0.001)	Circular (Pt.III, Fig.1)	Goral CITES: Appendix I
6.	<i>Ovis ammon</i>	36-48 (38 \pm 1.05)	11-15 (12.30 \pm 1.22)	Narrow Medulla Lattice (Pt.III, Fig.5)	0.645- 0.656 (0.65 \pm 0.002)	Spindle type (Pt.III, Fig.3)	Argali WL (P) Act,'72, Sch I, Part I CITES: Appendix I
7.	<i>Gazella bennetti</i>	28-32 (30 \pm 1.5)	12-18 (14.50 \pm 2.25)	Narrow Medulla Lattice (Pt.IV, Fig.2)	0.925- 0.9440 (0.93 \pm 0.003)	Oval (Pt.IV, Fig.1)	Chinkara WL (P) Act,'72, SchII, Part II
8.	<i>Pseudois nayaur</i>	35-46 (38 \pm 3.20)	15-22 (18 \pm 2.75)	Filled (Pt.IV, Fig.4)	0.932- 0.951 (0.94 \pm 0.005)	Circular (Pt.IV, Fig.6)	Blue Sheep WL (P) Act,'72, Sch I, Part I
9.	<i>Naemorhedus sumatraensis</i>	30-41 (33 \pm 2.60)	17-22 (19 \pm 1.95)	Simple (Pt. V, Fig.2)	0.595- 0.658 (0.62 \pm 0.105)	Circular (Pt. V, Fig.1)	Serow WL (P) Act,'72, Sch I, Part I CITES: Appendix I