



Tricho-taxonomic study of Dorsal Guard Hairs of Indian Species of Rodents Belonging to Subfamily- Sciurinae (Sciuridae: Rodentia: Mammalia)

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ABSTRACT: Tricho-taxonomic studies of dorsal guard hairs of different mammals have often been carried out by various workers around the world including India. But few works are available on animals belonging to Order—Rodentia. Although a few species of rodents and some small groups in particular have been studied by scientists both outside and within India, but proper and systematic study to develop an identification key for identification of parts of skin of wildlife animals seized from illegal trade is still wanting. The key is prepared on the basis of combination of characters such as transverse section, medullary configuration, medullary index, scale margin distance, scale pattern, scale count, Side to Side cuticular scale length, Proximo-distal scale length, etc.

Keywords: Dorsal guard hair, Tricho-taxonomy, Identification key, Illegal trade.

INTRODUCTION

Taxonomic studies on hairs – the most important morphological characteristic of mammals has often been used in food habitat studies, forensic sciences, taxonomy, archeological studies, etc. (Kennedy, 1982; Valente, 1983; Hess *et al.*, 1985; Oli, 1993; Wallis, 1993; Dagnall *et al.*, 1995; Meyer *et al.*, 1995; Dove *et al.*, 2001, Amman *et al.*, 2002). Previous studies on Rodents can be traced back to the 18th century by Pennant (1769) and later in 20th century by Williams (1938). Dorsal guard hair studies on Rodents have been made by Homan and Genoways (1978) on Heteromyid rodents where they found hair structure to be useful for identification only at the generic level. Stangl and Grimes (1987) found features of pelage useful in examining generic relationships among Sciurids. Bahuguna (2007, 2008, 2010) made some works on primary guard hairs of *Petaurista petaurista*, *Funambulus pennantii*, three species of *Callosciurus* and three species of *Ratufa*. Studies on hairs of squirrels were also done by Krapp (1998) and Menon (2003). Cavia *et al.* (2008) studied hair structure of small rodents from Central Argentina and provided a dichotomic key to identify hair at the species level.

However although all previous workers attempted to study only one or two or a few species belonging to a family or a subfamily, but this is the first time that an attempt has been made to study dorsal guard hair of all the Indian species belonging to a particular subfamily.

The main objective of this study is to develop an identification key to identify the species from scanty available sample such as skin parts, body parts, or handmade items and which in turn helps different enforcement agencies engaged for implementation of Wildlife (Protection) Act, 1972.

17 species of Subfamily – Sciurinae are found in India, among which 15 species were available in the National Zoological Collections present in the Zoological Survey of India, Kolkata. Once considered as pests, habitat destruction and dwindling population of many species have resulted in their inclusion in Schedule I and II in the Indian Wildlife (Protection) Act, 1972 as well as in CITES.

MATERIAL AND METHODS

10-15 tufts of dorsal guard hairs from the mid-dorsal region were collected randomly from 5-6 specimens of each species present in the Zoological Survey of India. The samples were washed in acetone and kept in Carbon Tetra Chloride overnight following the method of Chakraborty *et al.* (1996). Macroscopical study i.e. diameter, total length were measured by dial caliper and nomenclature of colour is after Ridgway (1886). Microscopical study such as surface structure, scale pattern, scale margin, scale margin distance, scale count, side to side cuticular scale length (SS), and proximo-distal cuticular scale length (PD) of hair were studied after Chakraborty *et al.* (1996) and Brunner and Coman, (1974).

Structural nomenclature in respect of surface structure, scale pattern, medullary configuration etc. are followed after Moore *et al.* (1974) and Teerink (1991). Hair cross sections (TS) are also made for formulation.

RESULTS AND DISCUSSION

Details of the findings of the study of dorsal guard hairs are summarized in Table I and II.

Most of the species belonging to Subfamily-Sciurinae possesses different shades of grey, black or brown colour. Study of colour variation and band pattern indicates that combination of band pattern and corresponding colour variation can be used to distinguish the male and female of same species along with interspecies identification of adult animals.

Among the three species of *Callosciurus*, dorsal guard hair of *C. caniceps* has 7 bands with Prouts Brown and Raw Umber alternately in female, and Broccoli Brown and Clove Brown in males alternately; both males and females of *C. erythraeus* has 3 bands with Tip-Black, Mid-Broccoli Brown and Base- Clove Brown respectively; males of *C. pygerythrus* have 5 bands with Broccoli Brown and Black alternately, while females have 7 bands with Broccoli Brown and Clove Brown alternately.

The three species of *Dremomys* show colour variation. Both male and female species of *D. lokriah* have 3 bands with Tip-Black, Mid-Drab grey and Base-Clove Brown respectively; *D. pernyi* is devoid of any band with Mouse Grey colour; and both male and females of *D. rufigenis* have 3 bands with Tip-Clove Brown, Mid-Cinnamon and Base-Prout's Brown respectively.

Among the four species of *Funambulus*, both male and female species of *F. tristriatus* has 5 bands with Clove brown and Sepia alternately; males of *F. palmarum* has 5 bands with Bistre and Clove Brown alternately, while females have 3 bands with same colour variation; males of *F. pennantii* has 3 bands with Clove Brown and Broccoli Brown alternately, while females also have 3 bands with Prout's Brown and Drab colour alternately; although both males and females of *F. sublineatus* has 3 bands, males are Clove Brown and Hair Brown in color, while females are Sepia and Clove Brown in colour. However Koppiker and Sabnis (1976) found hairs of *Funambulus* to be black or with alternate white and brown bands.

Both male and female species of *Ratufa bicolor* and *Ratufa indica* are devoid of any bands, and are Mummy Brown and Prout's Brown respectively; while the female of *Ratufa macroura* has 3 bands with Tip-Broccoli Brown, Mid - Prout's Brown, Base-Fawn colour, and the male species is Vandyke Brown with no bands.

Both males and females *Marmota himalayana* have 3 bands, with Tip-Clove brown, Mid-Pinkish Buff and Base-Mummy brown. *Tamiops macclellandi* shows 3 bands each, with Bistre and Clove brown in males, while Smoke grey and Black in females. The profile of hairs of all the species are 'Straight'. Average length of hair varies in different genus and also among species belonging to same genus. From Table I it can be said that among the 3 species of *Callosciurus*, it is maximum (21.9 ± 2.1) mm in *C. erythraeus* and minimum (18 ± 0.9) mm in *C. pygerythrus*; among 3 species in *Dremomys*, it is lowest (12.7 ± 1.8) mm in *D. pernyi* and highest (17.6 ± 2.1) mm in *D. rufigenis*. Among the 4 species of *Funambulus*, the average length is highest (13.8 ± 1.5) mm in *F. sublineatus* and lowest (10.8 ± 1.5) mm in *F. palmarum*. However 2 species of *Ratufa*, as *R. bicolor* and *R. macroura* has almost same length of hair, i.e. (30.4 ± 3.7) mm and (30.4 ± 2.9) mm respectively, while *R. indica* is a little longer (37.1 ± 3.1) mm; in *Marmota himalayana* it is (26.5 ± 1.3) mm, and in *Tamiops macclellandi* length is (11.7 ± 2.8) mm respectively. Koppiker and Sabnis (1976) reported that the length of hair of *F. palmarum* varies from 1.4 to 2 cm, while that of *R. indica* as 3.2 cm (Koppiker and Sabnis, 1977), which is close to that found in the present study.

Diameter of guard hairs also varies from species to species, i.e. highest (11 ± 5.7) μ in *C. pygerythrus*, and lowest (8.8 ± 4.9) μ in *C. erythraeus* among the 3 species of *Callosciurus*; maximum (10 ± 4.7) μ in *D. pernyi*, and minimum (7.7 ± 5.4) μ in *D. lokriah* among the 3 species of *Dremomys*; highest (10 ± 6.7) μ in *F. pennantii*, and lowest (8 ± 6.3) μ in *F. palmarum* among 4 species of *Funambulus*; maximum (20 ± 6.7) μ in *R. indica*, and minimum (11 ± 7.4) μ in *R. bicolor* among 3 species of *Ratufa*. Diameter of dorsal guard hairs of *Marmota himalayana* is taken as (14 ± 6.9) μ , whereas that of *Tamiops macclellandi* is (10 ± 6.6) μ . Koppiker and Sabnis (1976, 1977) reported the diameter of hair of *F. palmarum* is 27 μ , while that

of *R. indica* is 60 μ , and this findings are however quite different from the present study.

“Scale count” per millimeter of hair length is quite consistent among the different species of Sub-family—Sciurinae. Among the Genus- *Callosciurus*, *C. caniceps* has minimum (1627.1 \pm 33.9) scale count and *C. pygerythrus* has maximum (2022.6 \pm 58.6); *D. rufigenis* has minimum (1825.4 \pm 290.9) and *D. pernyi* has maximum (3326.2 \pm 23.1); *F. pennantii* has maximum (2619.2 \pm 25.7) and *F. sublineatus* has minimum (1566.2 \pm 83.4) scale count among the 4 species. *M. himalayana* has scale count of (1254.9 \pm 40.4), while that of *T. maccllelandi* is (2812.7 \pm 54.9). “Scale pattern” of *M. himalayana* is ‘irregular wave’, while that of all the other 14 species is ‘regular wave’. “Scale margin distance” of *F. pennantii* is ‘near’, and that of all others is ‘distant’.

However all species of Sub-family—Sciurinae have ‘smooth’ scale margin. However females of *C. erythraeus* and *R. indica* have ‘crenate’ scale margin. Koppiker and Sabnis (1976) found imbricate scales with plain edges in hair of *F. palmarum*, and coronal scales with serrate edges in *R. indica* (1977), which is quite different from the present study although scales of female species of *R. indica* support the view of Koppiker and Sabnis (1977). Except *F. pennantii* (which has ‘Near’ scale margin distance) all others have ‘Distant’ scale margin distance. Bahuguna (2010) however reported regular wave of scale pattern with rippled scale margin for all species of *Ratufa*. ‘SS’ varies considerably with (11.4 \pm 0.7) μ as minimum in *C. caniceps* and (23.9 \pm 0.5) μ as maximum in *C. erythraeus*. In *D. pernyi* it is minimum (2.9 \pm 0.2) and in *D. rufigenis* it is maximum (14 \pm 0.42) μ . Among the 4 species of *Funambulus*, SS is maximum in *F. pennantii* and *F. tristriatus*, i.e. (18.9 \pm 1.3) μ and (18.6 \pm 2.1) μ respectively, while minimum in *F. sublineatus* (8.8 \pm 0.8) μ . In *R. bicolor* it is maximum (17.5 \pm 2.1) and minimum in *R. macroura* (9.9 \pm 1.5) μ . ‘PD’ of all species are more or less similar, i.e. (5.7 \pm 0.3) μ , (5.8 \pm 0.6) μ , and (5.9 \pm 0.8) μ in *C. caniceps*, *C. erythraeus*, and *C. pygerythrus* respectively. In *D. lokriah* and *D. rufigenis* it is (5.4 \pm 0.2) μ and (5.1 \pm 0.8) μ respectively, while that of *D. pernyi* is (1.9 \pm 0.3) μ . ‘PD’ of *Funambulus* is almost consistent with (4.6 \pm 0.4) μ , (5 \pm 0.4) μ , (6.4 \pm 1.2) μ , and (6 \pm 0.5) μ in *F. palmarum*, *F. pennantii*, *F. sublineatus*, and *F. tristriatus* respectively. ‘PD’ in *Ratufa* varies

considerably, with (6.4 \pm 0.8) μ in *R. bicolor*, (5.2 \pm 1.2) μ in *R. indica*, and (3.9 \pm 0.8) μ in *R. macroura*. ‘SS’ and ‘PD’ in *M. himalayana* is (7.9 \pm 1.1) μ and (6.2 \pm 0.6) μ respectively, while that of *T. maccllelandi* is (10.2 \pm 0.3) μ and (4.8 \pm 0.8) μ respectively.

‘Medullary configuration’ does not vary considerably among the different species of Sub-family—Sciurinae. *C. caniceps* and *C. erythraeus* have ‘Wide medulla lattice’ and *C. pygerythrus* has ‘Narrow medulla lattice’; *D. lokriah* and *D. rufigenis* has Wide medulla lattice’, whereas *D. pernyi* has ‘Narrow medulla lattice’; *F. palmarum* and *F. sublineatus* has ‘Narrow medulla lattice’, but *F. pennantii* and *F. tristriatus* has ‘Wide medulla lattice’; *R. bicolor* and *R. macroura* has ‘wide aeriform lattice’ and *R. indica* has ‘simple’ medulla; and *M. himalayana* and *T. maccllelandi* both have ‘wide medulla lattice’. Koppiker and Sabnis (1976) reported fragmented type of medulla arranged in double rows for hairs of *F. palmarum*, while that of *R. indica* (1977) is discoidal type, which is not observed in the present study. However Bahuguna (2010) reported ‘wide aeriform lattice’ for *R. bicolor* and *R. macroura*, and ‘simple medulla’ for *R. indica*, which is at par with the present study.

“Medullary Index” varies considerably among the different species of a genus. Among the 3 species of genus *Callosciurus* it is lowest (0.87 \pm 0.01) in *C. caniceps*, and highest (0.95 \pm 0.06) in *C. pygerythrus*; highest (0.87 \pm 0.01) in *D. lokriah* and lowest (0.73 \pm 0.01) in *D. pernyi*; highest (0.90 \pm 0.01) in *F. tristriatus* and lowest (0.62 \pm 0.07) in *F. palmarum*; highest (0.93 \pm 0.02) in *R. indica* and lowest (0.78 \pm 0.05) in *R. bicolor*.

Transverse Section does not vary considerably among the different species of Sciurinae. Two species of *Ratufa*, i.e. *R. bicolor* and *R. indica* has ‘Oval’ shaped medulla and that of *F. palmarum* is ‘Round’; while all others i.e. *C. caniceps*, *C. erythraeus*, *C. pygerythrus*, *D. lokriah*, *D. pernyi*, *D. rufigenis*, *F. pennantii*, *F. sublineatus*, *F. tristriatus*, *T. maccllelandi*, *R. macroura*, and *M. himalayana* have ‘Oblong’ transverse section.

Based on the above characteristics of the dorsal guard hairs, a key to identify the different species of a genus belonging to Subfamily—Sciurinae is described below.

Key to identify the Indian species belonging to the Genus—*Callosciurus*

1. Medullary configuration 'Wide medulla lattice'2
Medullary configuration 'narrow medulla lattice'3
2. Scale count/mm length of hair (1808.2±53.4), Medullary index (0.90±0.06), transverse section 'oblong'*C. erythraeus*
Scale count/mm length of hair (1627.1±33.9), medullary index (0.87±0.01),.....*C. caniceps*
3. Scale count/mm length of hair (2022.6±58.6), medullary index (0.95±0.04).....*C. pygerythrus*.

Key to identify the Indian species belonging to the Genus —*Dremomys*

1. Medullary configuration 'wide medulla lattice'2
Medullary configuration 'narrow medulla lattice'3
2. Scale count/mm length of hair (11947.2±32.6), Medullary index (0.87±0.01), transverse section 'oblong'*D. lokriah*.
3. Scale count/mm length of hair (3326.2±23.1), medullary index (0.73±0.01),..... *D. pernyi*
Scale count/mm length of hair (1825.4±290.9), medullary index (0.80±0.07)..... *D. rufigenis*.

Key to identify the Indian species belonging to the Genus —*Funambulus*

1. Medullary index <0.80.....2
Medullary index >0.80.....3
2. Transverse section 'round', medullary configuration 'narrow medulla lattice', scale count/ mm length of hair (2125±24.9).....*F. palmarum*
Transverse section 'oblong', medullary configuration 'narrow medulla lattice', scale count/ mm length of hair (1566.2±83.4).....*F. sublineatus*
3. Medullary configuration 'wide medulla lattice', scale count per mm length of hair (2012.4±34.1).....*F. tristriatus*
Medullary configuration 'wide medulla lattice', scale count per mm length of hair (2619.2±25.7)... *F. pennantii*.

Key to identify the Indian species belonging to the Genus —*Ratufa*

1. Transverse section 'oblong'2
Transverse section 'oval'3
2. Medullary index (0.79±0.03), medullary configuration 'wide aeriform lattice', scale count/mm length of hair (2229.1±41.1).....*R. macroura*
3. Medullary index (0.78±0.05), medullary configuration 'wide aeriform lattice', scale count/mm length of hair (2783.7±261.6).....*R. bicolor*
Medullary index (0.93±0.02), medullary configuration 'simple', scale count/mm length of hair (1777.3±69).....*R. indica*.

Table 1: Comparative account of the characteristics of guard hairs of 15 Indian species of Subfamily-Sciurinae, Family- Sciuridae, Order—Rodentia, (Mean & SD given in parenthesis).

Sl. No.	Name of Species	Colour	No. of bands	Length (mm)	Diameter (μ)	Scale pattern	Scale margin distance	Scale margin	Scale count/ mm hair length
1	<i>Callosciurus caniceps</i> (Gray, 1842)	Prouts Brown and Clove Brown alternately	7	18-21 (19.7 \pm 0.9)	0-20 (9 \pm 7.4)	Regular wave	Distant	Smooth	1563.6-1665.3 (1627.1 \pm 33.9)
2	<i>Callosciurus erythraeus</i> (Pallas, 1779)	Tip-Black, Mid-Broccoli brown, Base-Clove brown	3	19-26 (21.9 \pm 2.1)	0-15 (8.8 \pm 4.9)	Regular wave	Distant	Smooth	1723.6-1876.9 (1808.2 \pm 53.4)
3	<i>Callosciurus pygerythrus</i> (L. Geoffroy Saint Hilarie, 1831)	Broccoli Brown and Black alternately	5	17-20 (18 \pm 0.9)	0-20 (11 \pm 5.7)	Regular wave	Distant	Smooth	1952.9-2090.7 (2022.6 \pm 58.6)
4	<i>Dremomys lokriah</i> (Hodgson, 1836)	Tip-Black, Mid-Drab Grey, Base-Clove	3	13-20 (16.7 \pm 2.3)	0-14 (7.7 \pm 5.4)	Regular wave	Distant	Smooth	1912.5-1988.3 (1947.2 \pm 32.6)
5	<i>Dremomys pernyi</i> (Milne-Edwards, 1867)	Mouse Grey	No band	10-15 (12.7 \pm 1.8)	0-20 (10 \pm 4.7)	Regular wave	Distant	Smooth	3298.5-3357.8 (3326.2 \pm 23.1)
6	<i>Dremomys rufigenis</i> (Blanford, 1878)	Tip-Clove Brown Mid-Cinnamon Base-Prout's Brown	3	15-21 (17.6 \pm 2.1)	0-20 (8 \pm 6.3)	Regular wave	Distant	Smooth	1511.1-2285.7 (1825.4 \pm 290.9)
7	<i>Funambulus palmarum</i> (Linnaeus, 1766)	Bistre and Clove brown alternately	5	9-14 (10.8 \pm 1.5)	0-20 (8 \pm 6.3)	Regular wave	Distant	Smooth	2097-2151 (2125 \pm 24.9)
8	<i>Funambulus pennantii</i> (Wroughton, 1905)	Clove brown and Broccoli brown alternately	3	8-15 (11 \pm 2.1)	0-20 (10 \pm 6.7)	Regular wave	Near	Smooth	2592.7-2655.6 (2619.2 \pm 25.7)
9	<i>Funambulus sublineatus</i> (Waterhouse, 1838)	Clove brown and hair brown alternately	3	11-16 (13.8 \pm 1.5)	0-20 (9 \pm 7.4)	Regular wave	Distant	Smooth	1466.7-1649.6 (1566.2 \pm 83.4)
10	<i>Funambulus tristriatus</i> (Waterhouse, 1837)	Clove brown and Sepia alternately	5	10-15 (12 \pm 1.6)	0-20 (9 \pm 5.7)	Regular wave	Distant	Smooth	1960-2046.5 (2012.4 \pm 34.1)
11	<i>Marmota himalayana</i> (Hodgson, 1841)	Tip-Clove brown, Mid-Pinkish Buff Base-Mummy brown	3	25-29 (26.5 \pm 1.3)	0-30 (14 \pm 6.9)	Irregular wave	Distant	Smooth	1196.4-1298.2 (1254.9 \pm 40.4)
12	<i>Ratufa bicolor</i> (Sparman, 1778)	Mummy Brown	No band	26-36 (30.4 \pm 3.7)	0-20 (11 \pm 7.4)	Regular wave	Distant	Smooth	2433.3-3166.7 (2783.7 \pm 261.6)
13	<i>Ratufa indica</i> (Erxleben, 1777)	Prout's Brown	No band	32-42 (37.1 \pm 3.1)	10-30 (20 \pm 6.7)	Regular wave	Distant	Smooth	1682.5-1864.7 (1777.3 \pm 69)
14	<i>Ratufa macroura</i> (Pennant, 1769)	Tip-Broccoli Brown Mid-Prout's Brown Base-Fawn colour	3	26-35 (30.4 \pm 2.9)	0-20 (13 \pm 6.7)	Regular wave	Distant	Smooth	2187.5-2285.7 (2229.1 \pm 41.1)
15	<i>Tamiops macclellandi</i> (Horsfield, 1840)	Bistre and Clove Brown alternately	3	9-17 (12.6 \pm 3.0)	0-20 (10 \pm 6.6)	Regular wave	Distant	Smooth	2741.6-2885.4 (2812.7 \pm 54.9)

Table 2: Comparative account of the characteristics of guard hairs of 15 Indian species of Subfamily - Sciurinae, Family- Sciuridae, Order—Rodentia, (Mean & SD are given in parenthesis); ‘SS’ = Side to side cuticular scale length; ‘PD’= Proximodistal cuticular scale length; ‘TS’= Transverse section.

Sl. No.	Name of Species	SS (μ)	PD (μ)	Medullary Configuration	Medullary Index	T. S.	Common name / Status
1	<i>Callosciurus caniceps</i>	10.6-12.2 (11.4 \pm 0.7)	5.4-6.1 (5.7 \pm 0.3)	Wide medulla lattice	0.86-0.88 (0.87 \pm 0.01)	Oblong	Golden Back Squirrel Not known
2	<i>Callosciurus erythraeus</i>	23.3-24.4 (23.9 \pm 0.5)	5.0-6.1 (5.8 \pm 0.6)	Wide medulla lattice	0.83-0.97 (0.9 \pm 0.06)	Oblong	Palla’s Squirrel CAMP: LRnt (Nat.), DD (Glob.)
3	<i>Callosciurus pygerythrus</i>	13.3-15.6 (14.2 \pm 0.8)	5.0-7.2 (5.9 \pm 0.8)	Narrow medulla lattice	0.90-0.99 (0.95 \pm 0.04)	Oblong	Hoary Bellied Himalayana Squirrel or Irrawady squirrel CAMP: LRnt (Nat.), DD (Glob.)
4	<i>Dremomys lokriah</i>	13.3-14.4 (13.7 \pm 0.4)	5.0-5.6 (5.4 \pm 0.2)	Wide medulla lattice	0.85-0.88 (0.87 \pm 0.01)	Oblong	Orange Bellied Squirrel CAMP: LRnt (Nat.), DD (Glob.)
5	<i>Dremomys pernyi</i>	2.7-3.3 (2.9 \pm 0.2)	1.6-2.2 (1.9 \pm 0.3)	Narrow medulla lattice	0.72-0.75 (0.73 \pm 0.01)	Oblong	Perny’s long nose Squirrel Not known
6	<i>Dremomys rufigenis</i>	13.5-14.5 (14 \pm 0.4)	3.9-6.1 (5.1 \pm 0.8)	Wide medulla lattice	0.69-0.89 (0.80 \pm 0.09)	Oblong	Red Cheeked Squirrel Not known
7	<i>Funambulus palmarum</i>	14.4-15.5 (14.9 \pm 0.4)	4.0-5.0 (4.6 \pm 0.4)	Narrow medulla lattice	0.55-0.72 (0.62 \pm 0.07)	Round	Indian Palm squirrel CAMP: LRnt (Nat.), DD (Glob.)
8	<i>Funambulus pennantii</i>	17.4-20.3 (18.9 \pm 1.3)	4.4-5.6 (5 \pm 0.4)	Wide medulla lattice	0.83-0.86 (0.85 \pm 0.01)	Oblong	Northern Palm Squirrel IWPA: Sch IV; CAMP: LRlc (Nat.), DD (Glob.)
9	<i>Funambulus sublineatus</i>	7.2-9.9 (8.8 \pm 0.8)	5.0-7.8 (6.4 \pm 1.2)	Narrow medulla lattice	0.55-0.68 (0.63 \pm 0.050)	Oblong	Dusky Striped squirrel CAMP: Nationally and Globally
10	<i>Funambulus tristriatus</i>	16.2-20.9 (18.6 \pm 2.1)	5.5-6.8 (6 \pm 0.5)	Wide medulla lattice	0.89-0.92 (0.90 \pm 0.01)	Oblong	Jungle Striped Squirrel CAMP: LRnt (Nationally)
11	<i>Marmota himalayana</i>	6.6-9.4 (7.9 \pm 1.1)	5.6-7.2 (6.2 \pm 0.6)	Wide medulla lattice	0.59-0.69 (0.63 \pm 0.03)	Oblong	Himalayan Marmot CITES: App III
12	<i>Ratufa bicolor</i>	14.5-19.8 (17.5 \pm 2.1)	5.5-8.3 (6.4 \pm 0.8)	Wide aeriform lattice	0.70-0.83 (0.78 \pm 0.05)	Oval	Large Malay Squirrel IWPA: Sch II, p II ; CITES: App III
13	<i>Ratufa indica</i>	10.6-18.8 (14.5 \pm 3.3)	3.3-6.7 (5.2 \pm 1.2)	Simple	0.90-0.95 (0.93 \pm 0.02)	Oval	Indian Giant Squirrel IWPA: Sch I, p II; CITES: App II
14	<i>Ratufa macroura</i>	7.8-12.2 (9.9 \pm 1.5)	2.8-4.9 (3.9 \pm 0.8)	Wide aeriform lattice	0.76-0.83 (0.79 \pm 0.03)	Oblong	Grizzled Indian Squirrel IWPA: Sch I, p I; CITES: App II
15	<i>Tamiops macclellandi</i>	9.9-10.6 (10.2 \pm 0.3)	3.8-6.1 (4.8 \pm 0.8)	Wide medulla lattice	0.76-0.88 (0.83 \pm 0.05)	Oblong	Himalayan Stripped Squirrel CAMP: LRnt (Nat.), DD (Glob.)

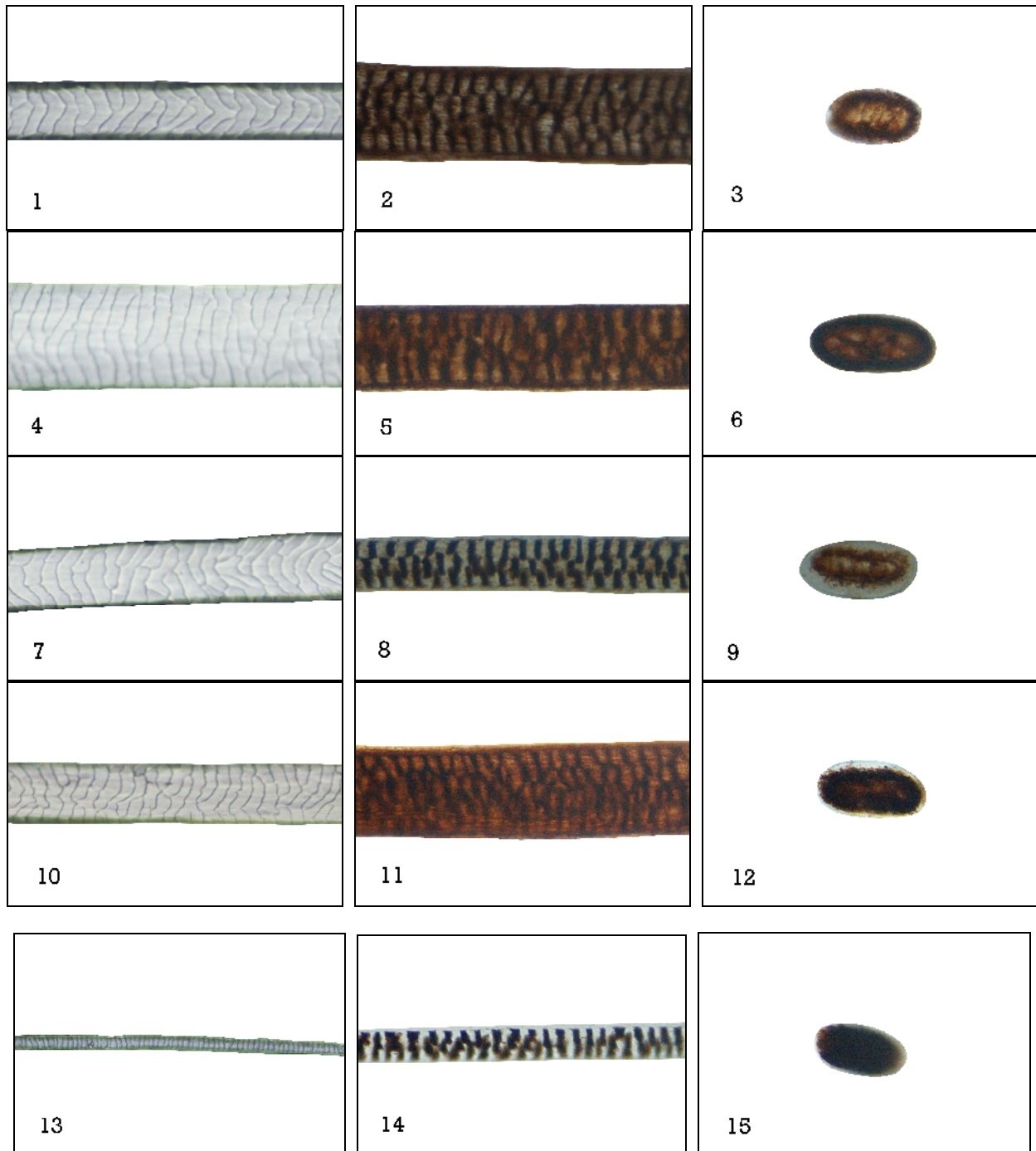


Plate 1. Cuticular scales of dorsal guard hair of *C. caniceps*, 2. Medulla of dorsal guard hair of *C. caniceps*, 3: T.S. of dorsal guard hair of *C. caniceps*, 4: Cuticular scales of dorsal guard hair of *C. erythraeus*, 5: Medulla of dorsal guard hair of *C. erythraeus*, 6: T.S. of dorsal guard hair of *C. erythraeus*, 7: Cuticular scales of dorsal guard hair of *C. pygerythrus*, 8: Medulla of dorsal guard hair of *C. pygerythrus*, 9: T.S. of dorsal guard hair of *C. pygerythrus*, 10: Cuticular scales of dorsal guard hair of *D. lokriah*, 11: Medulla of dorsal guard hair of *D. lokriah*, 12: T.S. of dorsal guard hair of *D. lokriah*, 13: Cuticular scales of dorsal guard hair of *D. pernyi*, 14: Medulla of dorsal guard hair of *D. pernyi*, 15: T.S. of dorsal guard hair of *D. pernyi*.

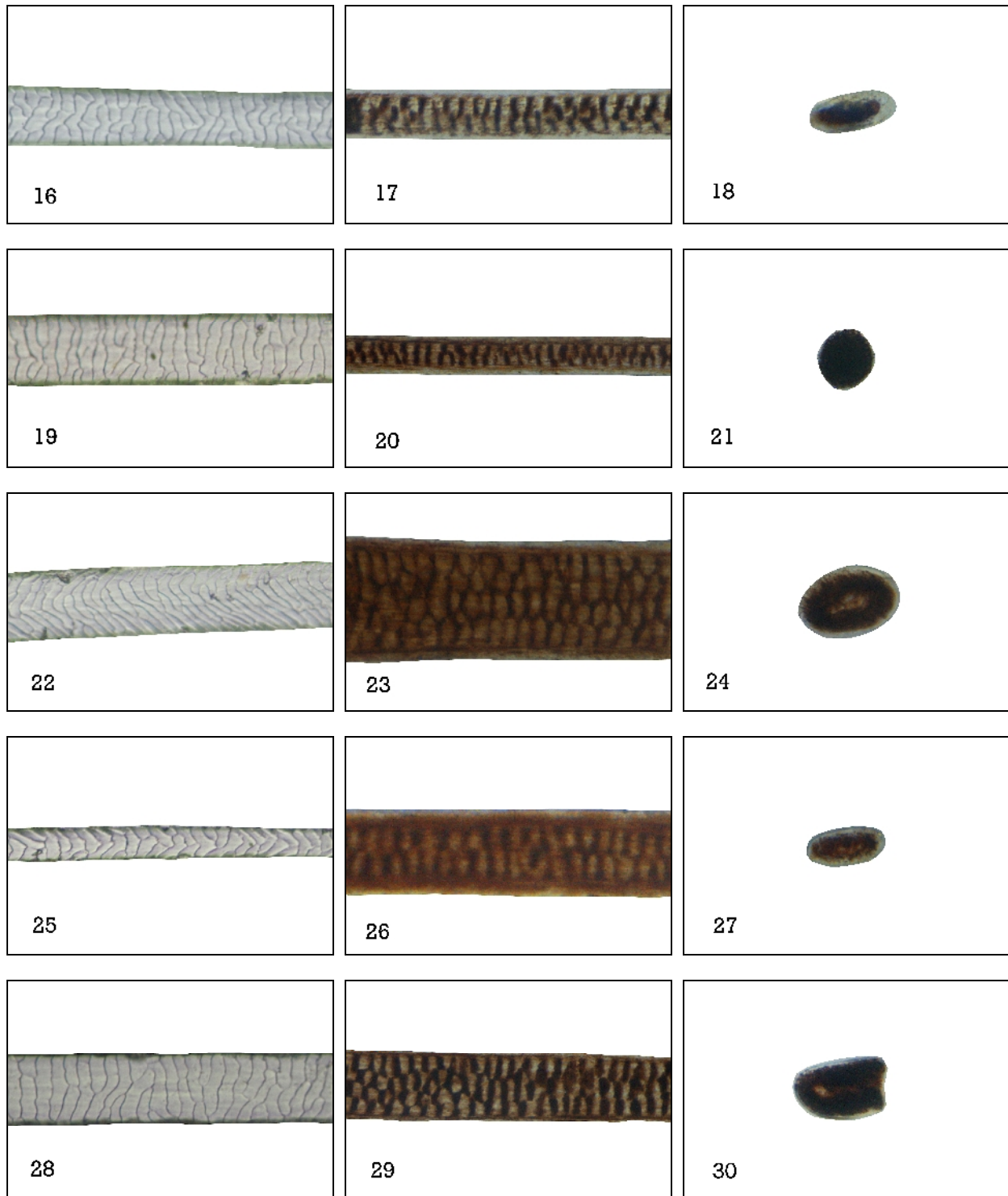


Plate II. 16. Cuticular scales of dorsal guard hair of *D. rufigenis*, 17: Medulla of dorsal guard hair of *D. rufigenis*, 18: T.S. of dorsal guard hair of *D. rufigenis*, 19: Cuticular scales of dorsal guard hair of *F. palmarum*, 20: Medulla of dorsal guard hair of *F. palmarum*, 21: T.S. of dorsal guard hair of *F. palmarum*, 22: Cuticular scales of dorsal guard hair of *F. pennantii*, 23: Medulla of dorsal guard hair of *F. pennantii*, 24: T.S. of dorsal guard hair of *F. pennantii*, 25: Cuticular scales of dorsal guard hair of *F. sublineatus*, 26: Medulla of dorsal guard hair of *F. sublineatus*, 27: T.S. of dorsal guard hair of *F. sublineatus*, 28: Cuticular scales of dorsal guard hair of *F. tristriatus*, 29: Medulla of dorsal guard hair of *F. tristriatus*, 30: T.S. of dorsal guard hair of *F. tristriatus*.

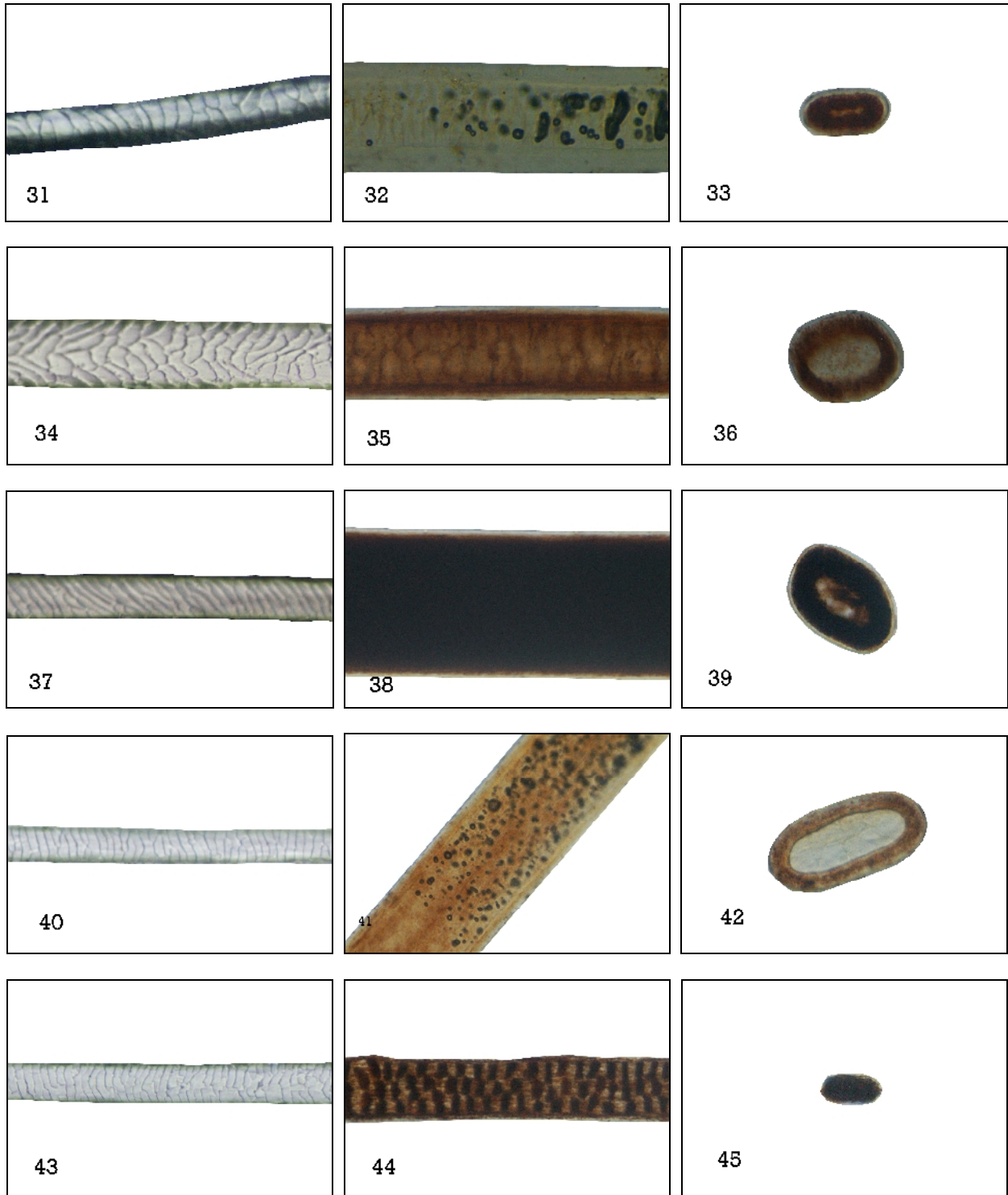


PLATE III. 31: Cuticular scales of dorsal guard hair of *M. himalayana*, 32: Medulla of dorsal guard hair of *M. himalayana*, 33: T.S. of dorsal guard hair of *M. himalayana*, 34: Cuticular scales of dorsal guard hair of *R. bicolor*, 35: Medulla of dorsal guard hair of *R. bicolor*, 36: T.S. of dorsal guard hair of *R. bicolor*, 37: Cuticular scales of dorsal guard hair of *R. indica*, 38: Medulla of dorsal guard hair of *R. indica*, 39: T.S. of dorsal guard hair of *R. indica*, 40: Cuticular scales of dorsal guard hair of *R. macroura*, 41: Medulla of dorsal guard hair of *R. macroura*, 42: T.S. of dorsal guard hair of *R. macroura*, 43: Cuticular scales of dorsal guard hair of *T. macclellandi*, 44: Medulla of dorsal guard hair of *T. macclellandi*, 45: T.S. of dorsal guard hair of *T. macclellandi*.

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