

OCCASIONAL PAPER NO. 180

**RECORDS OF THE
ZOOLOGICAL SURVEY OF INDIA**

**Taxonomic Studies on Indian Muridae
and Hystricidae**

(MAMMALIA : RODENTIA)

V. C. AGRAWAL

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V. C. AGRAWAL
Emeritus Scientist

Edited by the Director, zoological Survey of India



सत्यमेव जयते

**Zoological Survey of India
Calcutta
2000**

CITATION

Agrawal, V. C. 2000. *Taxonomic Studies on Indian Muridae and Hystricidae (Mammalia Rodentia)*. *Rec. zool. Surv. India*, Occasional Paper No. **180**. i-viii, 1-186 pp.
(Published : Director, Zoological Survey of India, Calcutta)

Published : May, 2000

ISBN 81-85874-31-X

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PRICE

Indian Rs. 300.00

Foreign \$ 20 ; £ 15

Published at the Publication Division by the Director, Zoological Survey of India, 234/4, AJC Bose Road, 2nd MSO Building, (13th Floor), Nizam Palace, Calcutta-700 020 after laser typesetting by Calcutta Repro Graphics, Calcutta 700 006 and printed at Hooghly Printing Co. Ltd. (Govt. of India Enterprises), Calcutta 700 071.

Records of the Zoological Survey of India

Occasional Paper

180

2000

Pages 1—177

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I. INTRODUCTION

General

The earliest consolidated account on Indian rodents are available from the works of Blyth (1863), Jerdon (1867), Sterndale (1884) and Blanford (1888, 1891). It was further enhanced through the collections made between 1911 and 1928 by the Mammal Survey of India, Burma and Ceylon, organised by the Bombay Natural History Society, Bombay. The collections brought from these surveys were studied by various workers and published from time to time in the Journal of the Bombay Natural History Society, Journal of the Asiatic Society of Bengal, Annals and Magazine of Natural History, etc. Later, some of these reports were summarised by Wroughton (1818-1820) in the form of a key for identification, and distribution. The Fauna of India : Rodentia by J. R. Ellerman was published in 1961, based on the Mammal Survey Collection as well as some additional material present in the British Museum of Natural History. Though this work became available in 1961, it was completed by him in 1945 and based on this work, a key for the identification of Indian rodents was published in 1947 (Ellerman, 1947 *a, b*).

Out of 29 families of rodents found in the world, four families namely Sciuridae, Muridae, Dipodidae and Hystricidae occur in India. Family Muridae, which is by far the largest family, is represented in India by 28 genera and 68 species, family Sciuridae by 12 genera and 29 species, family Dipodidae by one genus and one species, and family Hystricidae by 2 genera and 3 species. The family Dipodidae is mainly a Palaearctic one and spilled over to India in Jammu and Kashmir only. In the present study, families Muridae and Hystricidae have been covered with.

Since the completion of Fauna of India—volume on rodents in 1945 and its subsequent publication in 1961, a lot of work has been done on the taxonomy and distribution of Indian murids. Some important contributions on this family after 1945 are by Roonwal (1948-1987), Biswas and Khajuria (1955, 1957), Prakash (1956-1975), Ghose (1964), Agrawal (1967-1986), Biswas and Tiwari (1969), Musser (1970-1981), Chakraborty (1975-1983), Mishra and Dhanda (1975), Marshall (1976, 1977), Saha (1977, 1980, 1985), Agrawal and Chakraborty (1976-1982), Roberts (1977), Lekagul and McNeely (1977), Agrawal and Bhattacharya (1977, 1979, 1987), Musser *et al.* (1979), Mandal and Ghosh (1981), Musser and Newcomb (1983), Nowak and Paradiso (1983), Musser and Heaney (1985), Chakraborty and Chakraborty (1982, 1991), Prakash and Ghosh (1992), Corbet and Hill (1986, 1992), Prakash *et al.* (1995) etc. The recent work on Indian hystricids is limited to Corbet and Jones (1965) and van Weers (1977, 1979, 1983).

Of late, new classification of this order has been proposed by Anderson and Jones (1984), Corbet and Hill (1986) and Wilson and Reeder (1993). However, the classification adapted by Corbet and Hill (1992) has been followed, here. The arrangement of taxonomic categories has been made according to Ellerman (1961).

Scope of Work

Since the publication of Fauna of India : Rodentia by Ellerman (1961), a number of changes have occurred in the classification of rodents at the family, subfamily and generic level, besides the addition of a number of genera and species to the list of Indian fauna. Not only this, in the past, a good number of subspecies have been recognised under many species on the basis of minor variations in colour and average measurements of body and skull-parts from different geographical regions of the country, which needed reassessment. Moreover, the procurement of additional material from different parts of the country by the Zoological Survey of India and other Project leaders during the last fifty years has necessitated the updating of the distributional pattern of many of the species. However, the present State of Andhra Pradesh, except the Palkonda Hills, was neither surveyed by the Mammal Survey nor by ZSI, hence there is a visible gap in the distributional pattern of all the species of mammals particularly rodents. In recent times, some work on rodents have been done in and around Hyderabad and Araku valley.

Hence, the present work is an attempt to update the informations available on the taxonomy and distribution of murid and hystricid rodents from the Indian union after the publication of Ellerman's Fauna of India : Rodentia. The recorded distribution is based on published literature, collections present in the Zoological Survey of India as well as those identified by its scientists for other institutions. The subspecies have been revised, wherever possible, by statistical analysis of various morphological characters. Where sufficient material was not available, the body and skull measurements given by Ellerman (1961) were utilised. A 'character' has been considered as significant where two samples differed from the mean by more than one standard deviation. Only those colour characters have been taken into account which can easily be differentiated and defined. Under each species, a paragraph has been added on 'ecology and biology' which are based on personal observations as well as on published records. A chapter has been devoted to 'taxonomic criteria' especially for the beginners.

Abbreviations used in the text

AMNH = American Museum of Natural History, New York

apf = length of anterior palatal foramina

apf.w. = combined width of both anterior palatal foramina

b	=	length of bulla
Beng	=	Bengali
BM	=	British Museum of Natural History, London
BNHS	=	Bombay Natural History Society, Bombay
cb	=	condylobasal length
CMNH	=	Carnegie Museum of Natural History, Pittsburgh
CNHM	=	Chicago Natural History Museum
cw	=	cranial width
d	=	length of diastema
E	=	length of ear
Eng.	=	English
Gl	=	Greatest length of skull
HB	=	length of head and body
Hf	=	length of hind foot
Hin.	=	Hindi
ht	=	height of skull
iw	=	least interorbital width
m	=	length of maxillary toothrows
M ¹	=	first upper molar
M ²	=	second upper molar
M ³	=	third upper molar
M ₁	=	first lower molar
M ₂	=	second lower molar
M ₃	=	third lower molar
mw	=	maximum width of molars
n	=	length of nasal
NMNH	=	National Museum of Natural History, Washington, D.C.
nw	=	combined width of both nasals
onl	=	occipitonasal length
occ	=	height of occiput
orb	=	length of orbit
p	=	length of palate

pmxw	=	width of premaxilla
pow	=	postorbital width
t1-t10	=	cusps of molars from first to tenth
Tl	=	length of tail
zw	=	zygomatic width

II. TAXONOMIC CRITERIA

Rodents are characterised by a pair of upper and lower incisors, which have the power of persistent growth and are adapted for gnawing. There is always a space or diastema between incisors and the cheekteeth. Correlated with the modification towards gnawing, the jaw muscles have become extremely powerful and they modify the skulls in various ways and serve as good characters for the classification of the order into families. The cheekteeth as a rule, are adapted for dealing with vegetable food.

The dental formula is $\frac{1, 0, 0-2, 3.}{1, 0, 0-1, 3.}$. The zygomatic arch is complete but the orbit is never ringed by bone. The tympanic bulla is inflated.

Hair on the body may be soft, spiny or in the form of quills. The tail is either naked or furry. The digits of the limbs normally bear claws. The thumbs are vestigial or absent. The sole of the hindfoot bears pads and the toes vary from three to five.

Characters used in the identification

For the purpose of identification of rodents, the morphological characters, such as the colour and texture of the fur, the number and position of mammae, number of plantar pads, form and structure of teeth, measurements of different parts of the body and skull, etc., are normally taken into account. In recent years, characters like the number and shape of chromosomes, plasma-protein of blood, ectoparasites, etc., are also taken into consideration.

Colour and texture of fur

The coloration in murid-rodents is a character on which considerable stress is laid as a means of differentiation, especially at subspecific level. But this is not such an easy matter as might appear at the first sight, as nothing is more difficult than to describe accurately the tints and shades of colour in rats. To meet this difficulty, a scheme of standard colours has been drawn up by Ridgway (1912). This colour chart is taken as a standard for describing and comparing the colour of the body, so also of its parts.

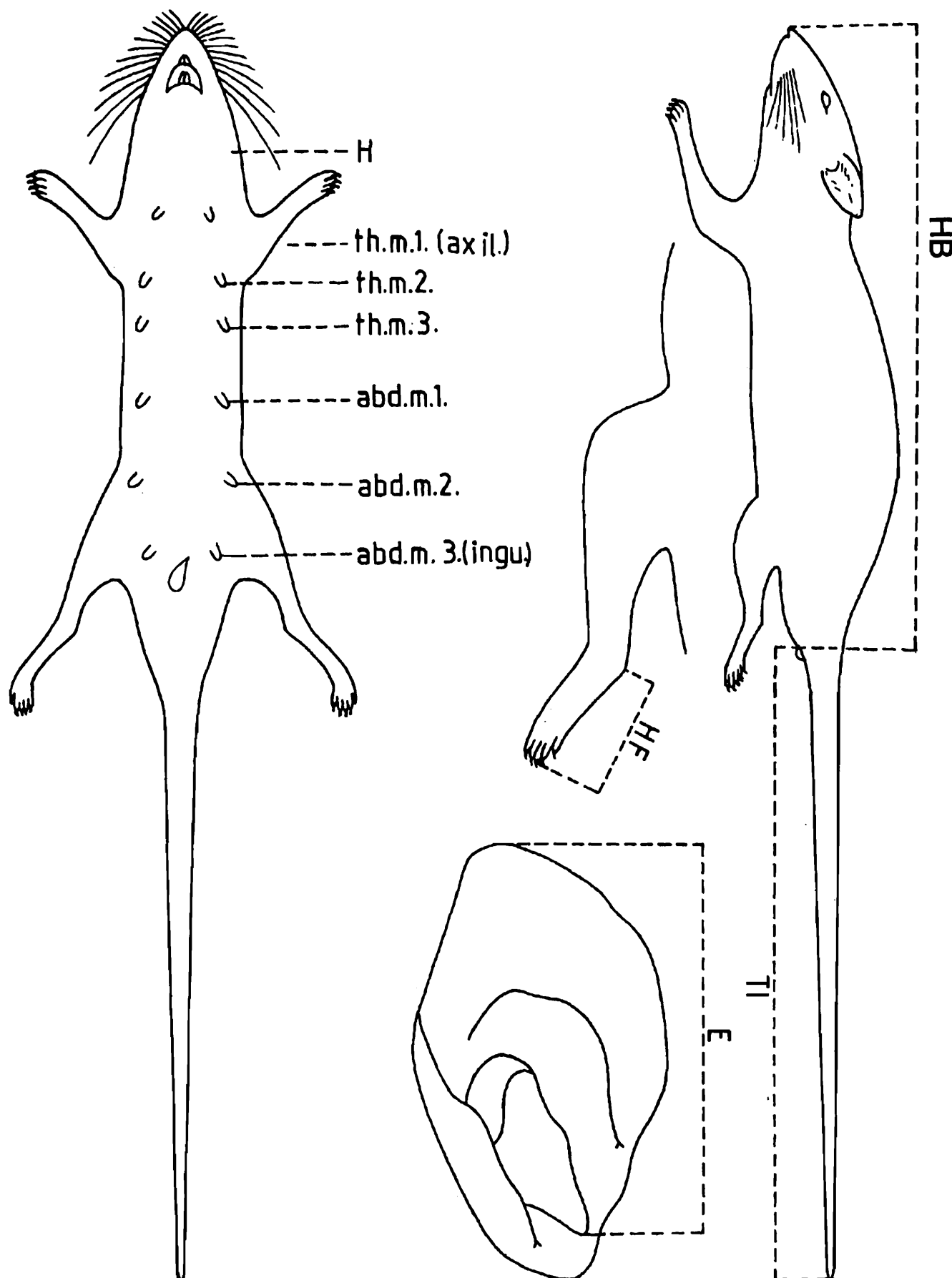


Fig. 1. *Rattus rattus*, showing external measurements of body and position of mammae. abd. m. 1-3, abdominal mammae 1-3; E, length of ear; HB, head and body length; Hf, length of hindfoot; th.m. 1-3, thoracic mammae 1-3; Tl, length of tail.

By the texture of fur, it is meant whether the fur is woolly or harsh, and its individual hair is soft, harsh, spiny or in the form of a quill.

Mammae

The number and position of mammae, in females, are other characters, which though not very reliable, sometimes, help in the identification of murid-rodents.

The mammae are broadly classified as thoracic (axillary, anterior thoracic and posterior thoracic) and abdominal (anterior abdominal, posterior abdominal and inguinal), depending on the position they occupy on the undersurface of the body (Fig. 1).

Tail

The tail, in murid-rodents, is normally covered with scales and short hairs. In some species, however, it is well-haired on the dorsal surface forming a tuft at its tip. It may be longer, equal to or shorter than the length of head and body. It may be of one colour all round or bicoloured. The latter may be dark above and paler below or all round dark on the proximal half and all round white at the distal half (Fig. 2).

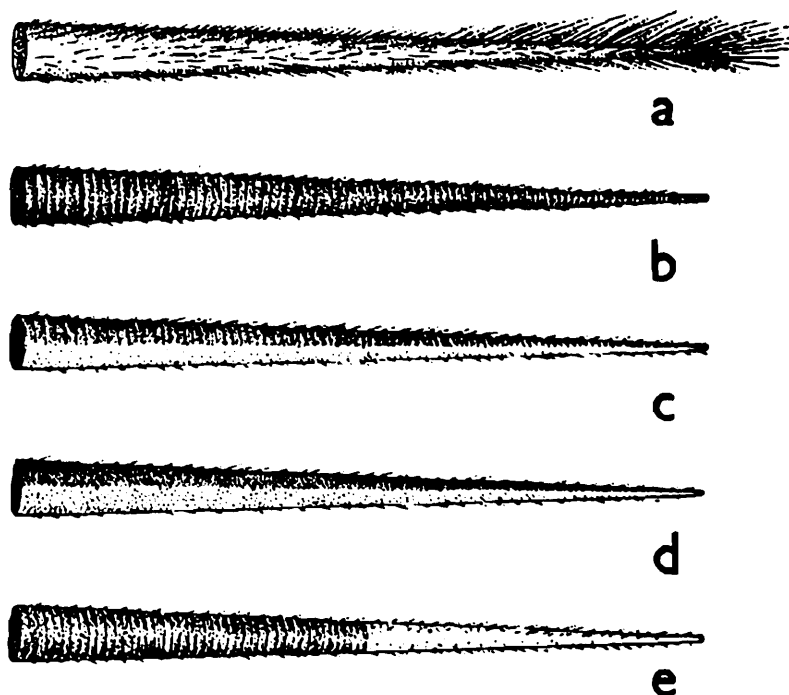


Fig. 2. Lateral view (semidigrammatic) of tails of (a) *Tatera indica*, (b) *Rattus rattus*, (c) *Niviventer fulvescens*, (d) *Diomys crumpi* and (e) *Cremnomys blanfordi*.

Digits and plantar pads

The forefoot or hand, in rodents, is normally provided with four functional fingers and the hindfoot with five toes; the hallux (first toe) and the fifth toe in the latter are shorter than the central three. The fingers and toes are generally all clawed but in some species, the first digit or both first and fifth digits are clawless (Figs. 3a, b).

The number of pads in the sole of hindfoot, in murids, vary from four to six and sometimes, helps in identification (Fig. 3c).

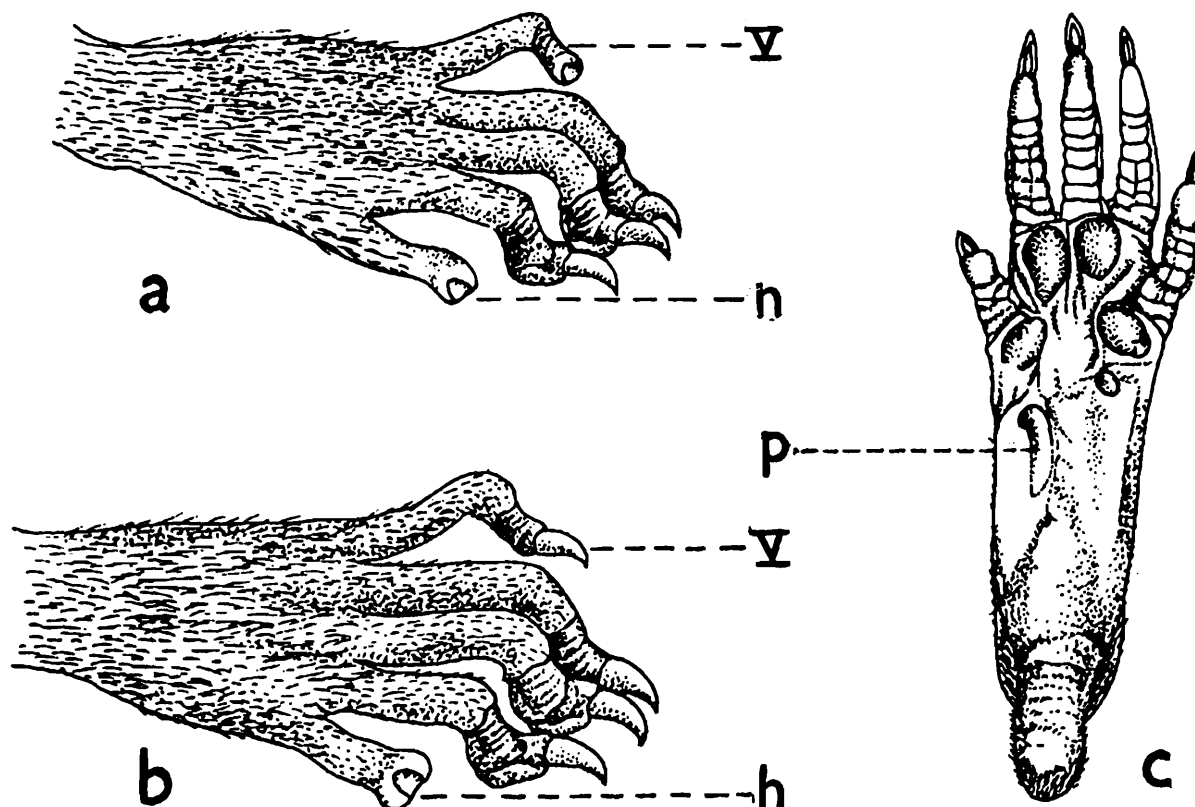


Fig. 3. Left hindfoot of (a) *Vandeleuria oleracea* and (b) *Chiropodomys gliroides*, and sole of hindfoot of (c) *Berylmys bowersii*. h, hallux; V, 5th toe; p, plantar pad.

Measurements

Selected measurements which are most useful for the identification of rodents are discussed here. All measurements are vertical distances between two points of reference. These are not taken along the curvature of the body or skull-parts. The measurements are expressed here in metric system, and usually in millimetres.

In many cases, indices are often more expressive as measures of difference between two allied forms than the absolute measurements. These may be expressed either as a percentage of one measure against another or as a fraction expressed in the decimal system. This method also reduces the chances of error in subadult specimens. Normally, for external body measurements, indices are best expressed in relation to the combined length of head and body (HB), and for skull-measurements in relation to the occipitonasal length or the greatest length of skull.

External measurements :

Body-measurements are taken on a freshly killed animal before *rigor mortis* has set in, and the body-parts fully relaxed and pressed against a flat surface (no stretching is

allowed). The following four measurements are taken. Their abbreviations are given in parentheses (Fig. 1).

(1) Length of head and body (HB)—from the tip of nose to the anterior end of anus.

(2) Length of tail (Tl)—from the ventral root of the tail above the anus to the tip of the tail vertebrae excluding the pencil of hairs, if any.

(3) Length of hind foot (Hf)—from the outer surface of the heel to the tip of the longest toe, excluding the claw or nail.

(4) Length of ear (E)—from the intertragal notch to the farthest edge of the pinna.

Skull-measurements :

Rodent-skulls being small, are best measured under a large magnifying lens. Vernier callipers with a dial graduation reading upto 0.1 mm is normally used. Some of the skull-measurements which are most useful in identification, are given below. Their abbreviations are given in parentheses (Fig. 4).

(1) Occipitonasal length (on)—from the most forward point of the nasal to the hindmost point on the occipital surface or to the centre of the top of the occiput when this projects backward behind the lambdoidal region.

(2) Condylbasal length (cb)—from the most forward point of premaxilla to the hindmost point of the occipital condyle.

(3) Greatest zygomatic width (zw)—greatest width across the outer surface of the two zygomatic arches measured at right angles to the long axis of the skull.

(4) Interorbital width or frontal width (iw)—least width of the frontal bones between the two orbits.

(5) Cranial width (cw)—greatest width of the cranium just above the squamosals.

(6) Length of tympanic bulla (b)—maximum length of the bulla in the antero-posterior axis excluding the spinous process at the anterior end and mastoid portion at the posterior.

(7) Nasal length (n)—maximum length of nasals in the antero-posterior axis.

(8) Length of anterior palatal foramen (apf)—maximum length of the anterior palatal foramen along the antero-posterior axis.

(9) Length of maxillary toothrow (m)—total length of all the maxillary teeth on the crown.

(10) Length of diastema (d)—from a point on the ventro-lateral side of the premaxilla where it meets the incisors to the most forward point on the base of the first maxillary tooth.

(11) Length of palate (pl)—from the front of the incisors to the back of the palate, excluding the palatal spine, if any.

(12) Width of maxillary toothrow (mw)—maximum width of upper molars.

(13) Nasal width (nw)—maximum combined width of both the nasal bones.

(14) Width of anterior palatal foramen (apf. w.)—maximum combined width of both the anterior palatal foramen.

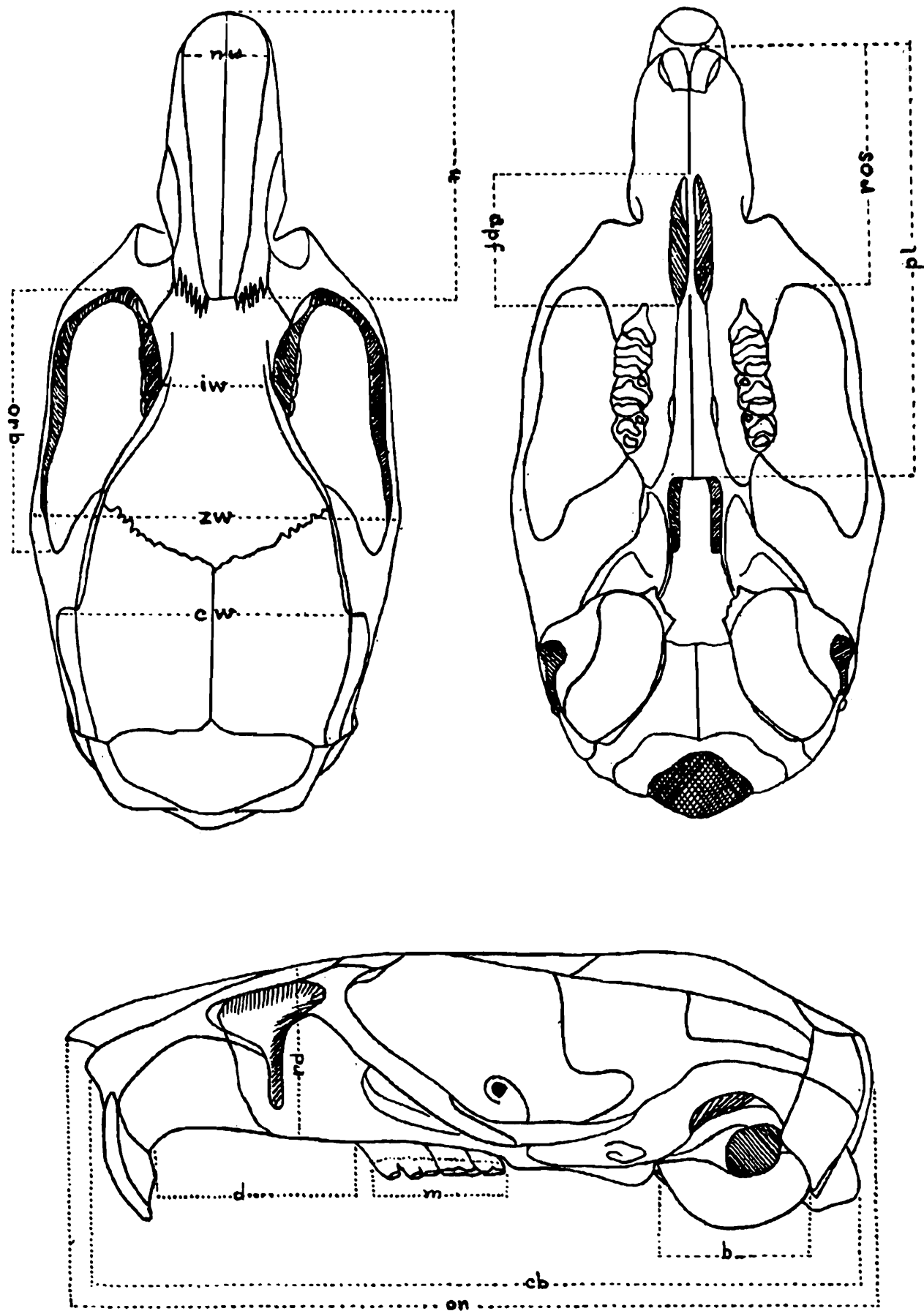


Fig. 4. Skull of *Rattus rattus*, showing different measurements used for identification of taxonomic categories.

(15) Width of nasal process of premaxilla (pmxw)—width of nasal process of premaxilla at a point on its lower margin midway between fronto-maxillary suture and masseteric ridge of maxilla.

(16) Height of skull (ht)—height of skull from palate to posterior end of nasals.

Dentition

The form and surface pattern of teeth also play an important role in the identification of rodents.

Incisors : The front surface of incisor tooth is either smooth or vertically grooved (Fig. 5).

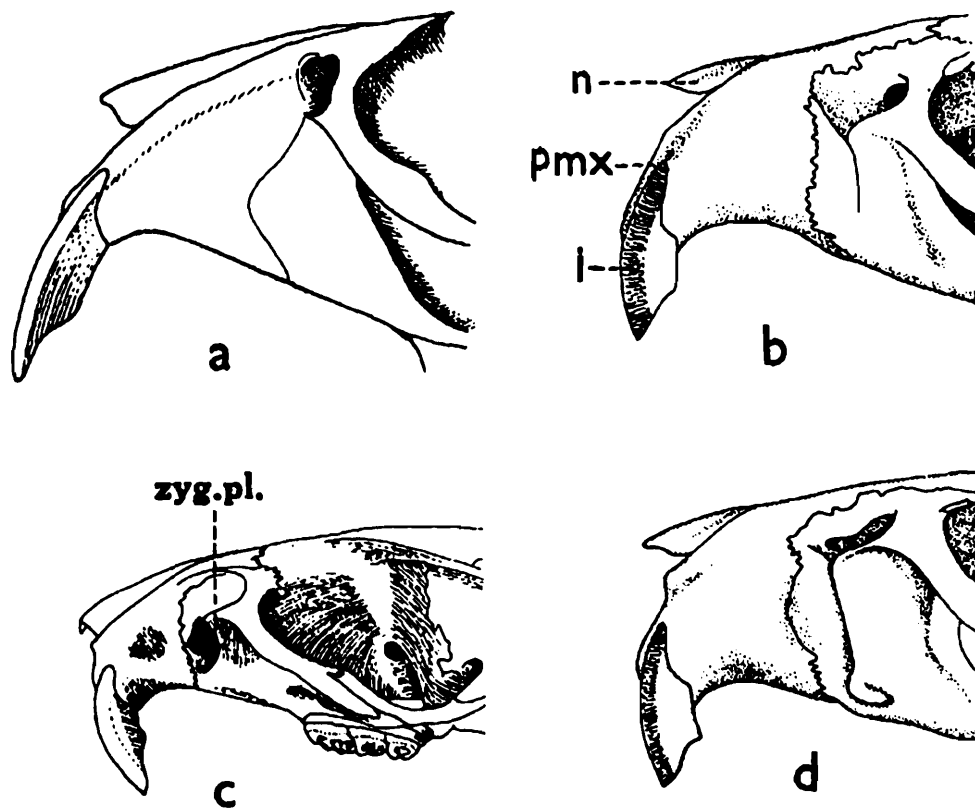


Fig. 5. Lateral view of skulls of (a) *Cannomys badius*, (b) *Bandicota bengalensis*, (c) *Hadromys humei* and (d) *Bandicota savilei* showing proodont (a, b), opisthodont (c) and orthodont (d) incisors. i, upper incisor; n, nasal; pmx, premaxilla.

The attachment of incisors to premaxilla in relation to the antero-posterior axis of skull is of three types.

- (i) Proodont : The incisors are projected forwards.
- (ii) Orthodont : The incisors are more or less vertical to antero-posterior axis.
- (iii) Opisthodont : The incisors are bent backwards.

Molars : The surface pattern of molars is characteristic for each subfamily of Muridae. It is characterised as under according to the condition present in the juvenile stage (Fig. 6).

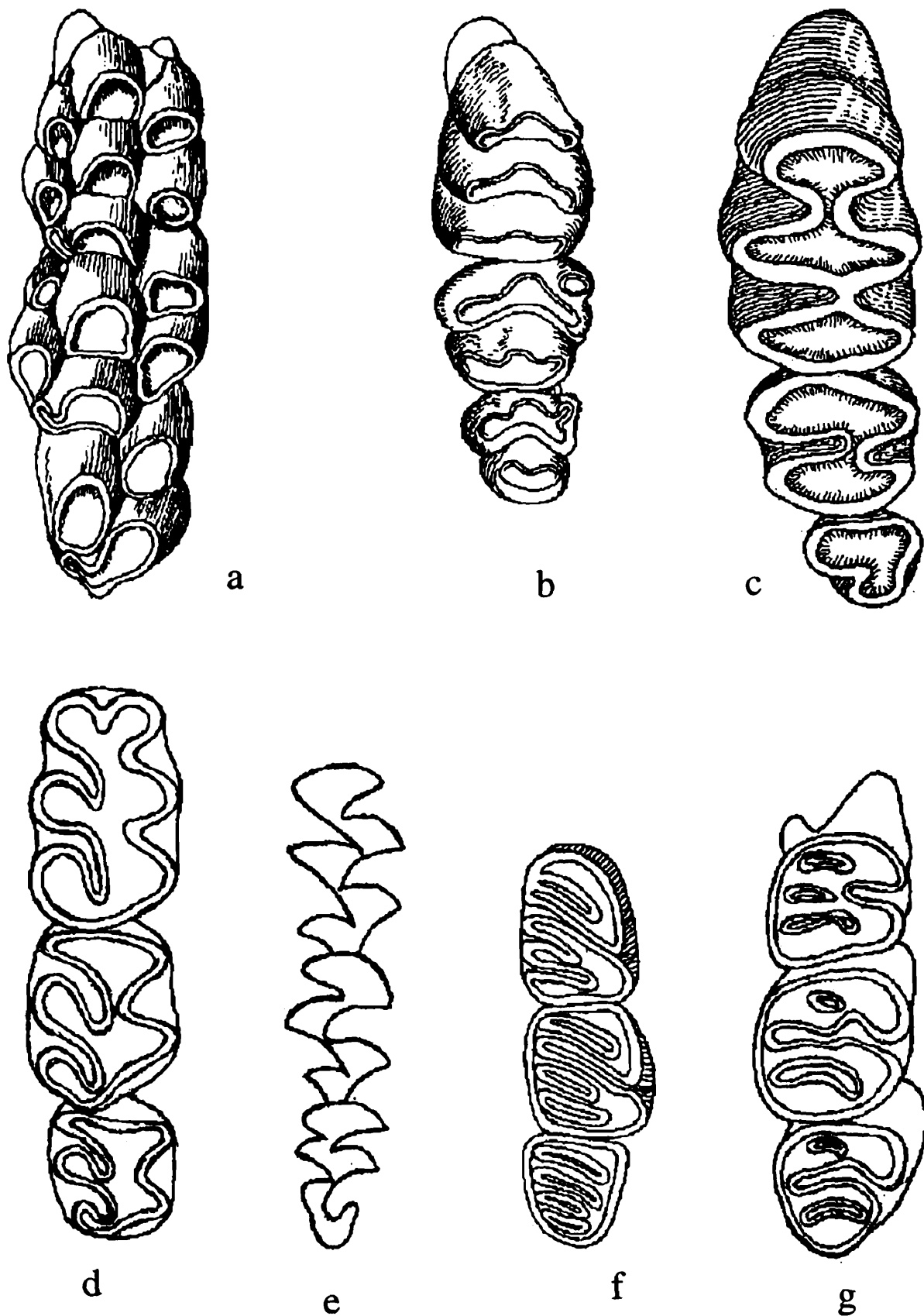


Fig. 6. Surface pattern of right upper molars of (a) *Golunda ellioti* (subfamily Murinae), (b) *Bandicota bengalensis* (subfamily Murinae), (c) *Tatera indica* (subfamily Gerbillinae), (d) *Cricetulus migratorius* (subfamily Cricetinae), (e) *Pitymys leucurus* (subfamily Arvicolinae), (f) *Platacanthomys lasiurus* (subfamily Platacanthomyinae) and (g) *Rhizomys pruinosus* (subfamily Rhizomyinae).

(i) Cuspidate : The surface pattern is composed of cusps, arranged in two or three longitudinal rows and are known as biserially cuspidate (as in subfamilies Cricetinae and Gerbillinae) or triserially cuspidate (as in subfamily Murinae) respectively.

(ii) Prismatic : The cusps take the shape of prisms as in the subfamily Arvicolinae.

(iii) Laminate : All cusps in a row fuse to form a lamina or plate as in the genus *Nesokia* of subfamily Murinae.

(iv) Flat crowned : The crown surface is flat, having a number of islands as in subfamilies Platacanthomyinae and Rhizomyinae and family Hystricidae.

Structure of molars (Fig. 7) : A typical murine molar consists of 9 cusps arranged in three rows, with three cusps to each row. The numbering of the cusps begin from the inner or lingual side of the first row and extends across to the outer or labial side (t1, t2 and t3), then continues from the lingual to labial side of the second row (t4, t5 and t6), and from lingual to labial side of the third row (t7, t8 and t9). In some genera,

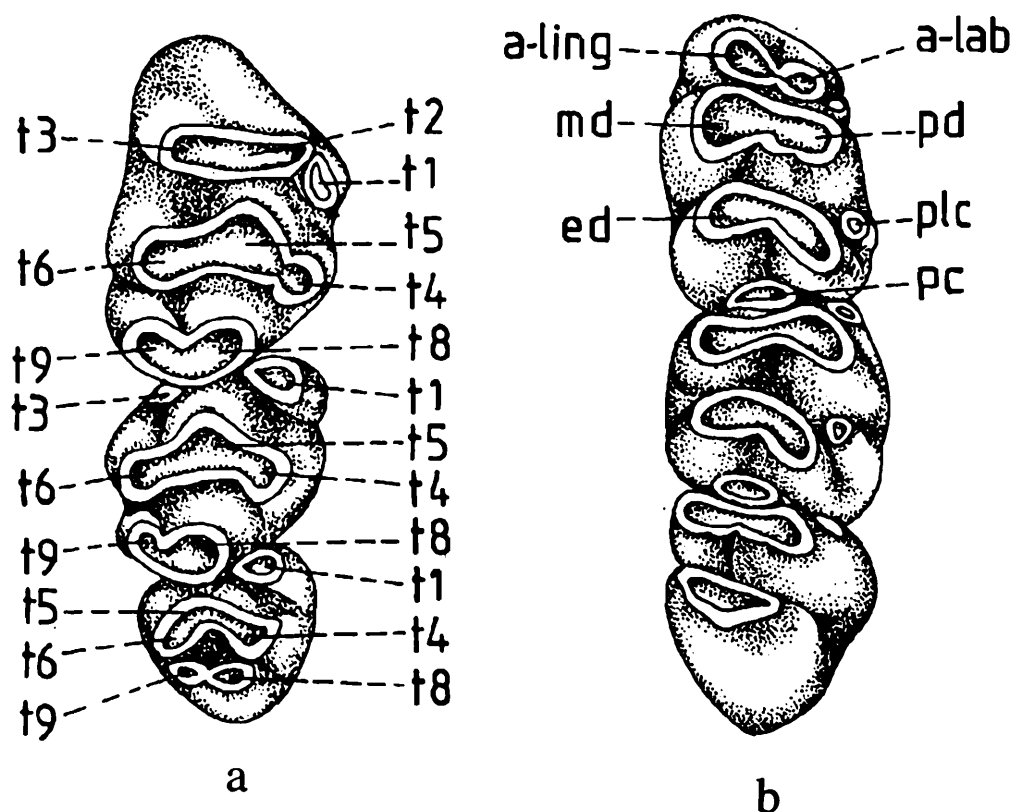


Fig. 7. Right upper and lower molars, illustrating dental terminology (Adapted from Musser & Brothers, 1994, p. 43).

t1-t9, cusps of upper molars ; a-lab, antero-labial cusp; a-ling, anterolingual cusp; md, metaconid; ed, entoconid; pc, posterior cingulum; pd, protoconid; plc, postero labial cusplet.

it is followed by a single posterior cusp or cingulum (t10). In the majority of murines, the postero-internal cusp (t7) is absent in upper molars. There is a further reduction of cusps t2 or t3 or both in second and third upper molars. (*vide* Musser & Brothers, 1994). In a few species of the genus *Mus*, an extra cusp is present on the anterior root of first upper molars, referred to here as anterior accessory cusp.

In lower molars, first molar has three transverse rows of cusps, two in each row; sometimes a small antero-medial cusp is present at the front of the tooth, and always a posterior cingulum. Two rows of two cusps and a cingulum are present in the second molar, and two rows of two cusps in the third molar. Additional cusplets often occur along the labial margin.

SYSTEMATIC ACCOUNT

Family MURIDAE

Family Muridae is characterised by enlarged (not over enlarged) infraorbital foramen, having a wider upper portion for muscle transmission and a narrower lower portion for nerve transmission, anterior root of zygomatic arch flattened in form of a zygomatic plate for muscle attachment, dental formula 1, 0, 0, 3/1, 0, 0, 3, and molar tooth may be cuspidate, laminate, prismatic or flat crowned, and the cusps arranged either in three (triserially cuspidate) or two (biserially cuspidate) longitudinal rows.

American authors, earlier, preferred to divide this group of rodents into two families. Family Muridae (subfamily Murinae as here dealt with) consisting of three longitudinal rows of cusps in the upper molars, and family Cricetidae (including subfamilies Cricetinae, Gerbillinae and Microtinae) having two rows of cusps in the upper molars. Later, it was found that in Cricetinae, the central row of cusps (present in subfamily Murinae) have become reduced. These are still traceable in some primitive American genera and a genus from Madagascar. Hence, Ellerman and Morrison-Scott (1951) divided the family Muridae into 5 subfamilies, Murinae, Cricetinae, Gerbillinae, Microtinae and Myospalacinae; the last one is found only in China.

According to recent classification adopted by Wilson and Reeder (1993) and Anderson and Jones (1984), family Muridae consists of 15 subfamilies in the world, of which six, namely, Cricetinae, Gerbillinae, Arvicolinae (Microtinae), Platacanthomyinae, Rhizomyinae and Murinae occur in India. This family here deals with 28 genera and 66 species.

Key to subfamilies of family Muridae

- 1 Cheek-teeth flat crowned, having transverse ridges or islands 2
- Cheek-teeth biserially or triserially cuspidate 3

2. Arboreal; dorsum spiny; hallux clawless; upper incisors opisthodont
 PLATACANTHOMYINAE
 Fossorial; dorsum not spiny; hallux clawed; upper incisors proodont
 RHIZOMYINAE
3. Cusps in cheek-teeth arranged in three longitudinal rows MURINAE
 Cusps in cheek-teeth arranged in two longitudinal rows 4
4. Cheek-teeth prismatic in surface pattern, forming a pattern of alternating triangles
 and loops ARVICOLINAE
 Cheek-teeth having cusps on their crown surface 5
5. Upper incisors grooved on front surface; bulla inflated, more than one-fifth of
 occipitonasal length GERBILLINAE
 Upper incisors not grooved on front surface; bulla not inflated, less than one-fifth
 of occipitonasal length CRICETINAE

Subfamily PLATACANTHOMYINAE

The Asian species of spiny dormouse are grouped under the subfamily Platacanthomyinae. It includes two very distinct genera, namely, *Platacanthomys* from southern India and *Typhlomys* from southern China. They are very different externally but have similar molar teeth, with diagonal laminae.

Genus *Platacanthomys* Blyth

1859. *Platacanthomys* Blyth, *J. Asiat. Soc. Bengal.*, 28 : 288.

Type species : *Platacanthomys lasiurus* Blyth.

Distribution : Southwestern India.

This is a specialised and aberrant arboreal dormouse, with a small bulla, less perfectly ossified palate and the cheekteeth 3/3 in number and flat-crowned. Mandibles lack a perforation in the angular process.

This genus is monotypic and endemic to India.

Platacanthomys lasiurus Blyth

(Plate 1, fig. A)

1859. *Platacanthomys lasiurus* Blyth, *J. Asiat. Soc. Bengal.*, 28 : 289 (Alipi, Malabar, Kerala, India).

Common name : Malabar Spiny Dormouse (Eng.).

Measurements : External : 18 ex : HB 118-138 (129±7); TI 76-104 (92.5±8); Hf 20-26 (24.5±1.6); E 21-24 (23±1). Cranial : 20 ex : *onl* 31.2-34.4 (33.2±1); *p* 13.5-16.6 (15.5±0.75); *b* 3.7-4.5 (4.1±.2); *m* 5.3-5.8 (5.6±.1); *iw* 6.1-7.4 (6.95±.3).

Diagnostic characters : A medium-sized dormouse, having the tail shorter (about 70%) than head and body, and ears large, subequal to or a little shorter than the length of hindfoot; whiskers large and prominent. Body covered with short spines; tail clad with coarse hairs throughout, becoming thick and bushy at its tip. Body reddish brown above, and whitish on the undersurface; tail of same colour as of the back; hindfoot brown, toe white; hallux and thumb clawless. Mammary 2 pairs.

Skull medium-sized; occipitonasal length exceeds condylobasal length; frontal bones very wide, more than one-fifth of *onl*, heavily ridged on outer side; palate short, poorly ossified and less than half of *onl*; anterior palatal foramina very small, less than one-tenth of *onl* and even shorter than posterior palatal foramina; bulla small, flattened and reduced, about 12% of *onl*. Mandibles lack a perforation in the angular process, which is found in *Dryomys*.

Upper incisors plain, ungrooved, orange and opisthodont. Molars 3/3 in number; M¹ and M² each having one inner fold which cuts the tooth obliquely into two halves; anterior portion further divided by one and posterior portion by two re-entrant folds; M³ like M² but smaller. With wear, some of the folds become isolated on crown surface. Lower molars each with four long re-entrant folds, the front one isolated on crown surface; folds dividing the tooth into five slanting transverse ridges.

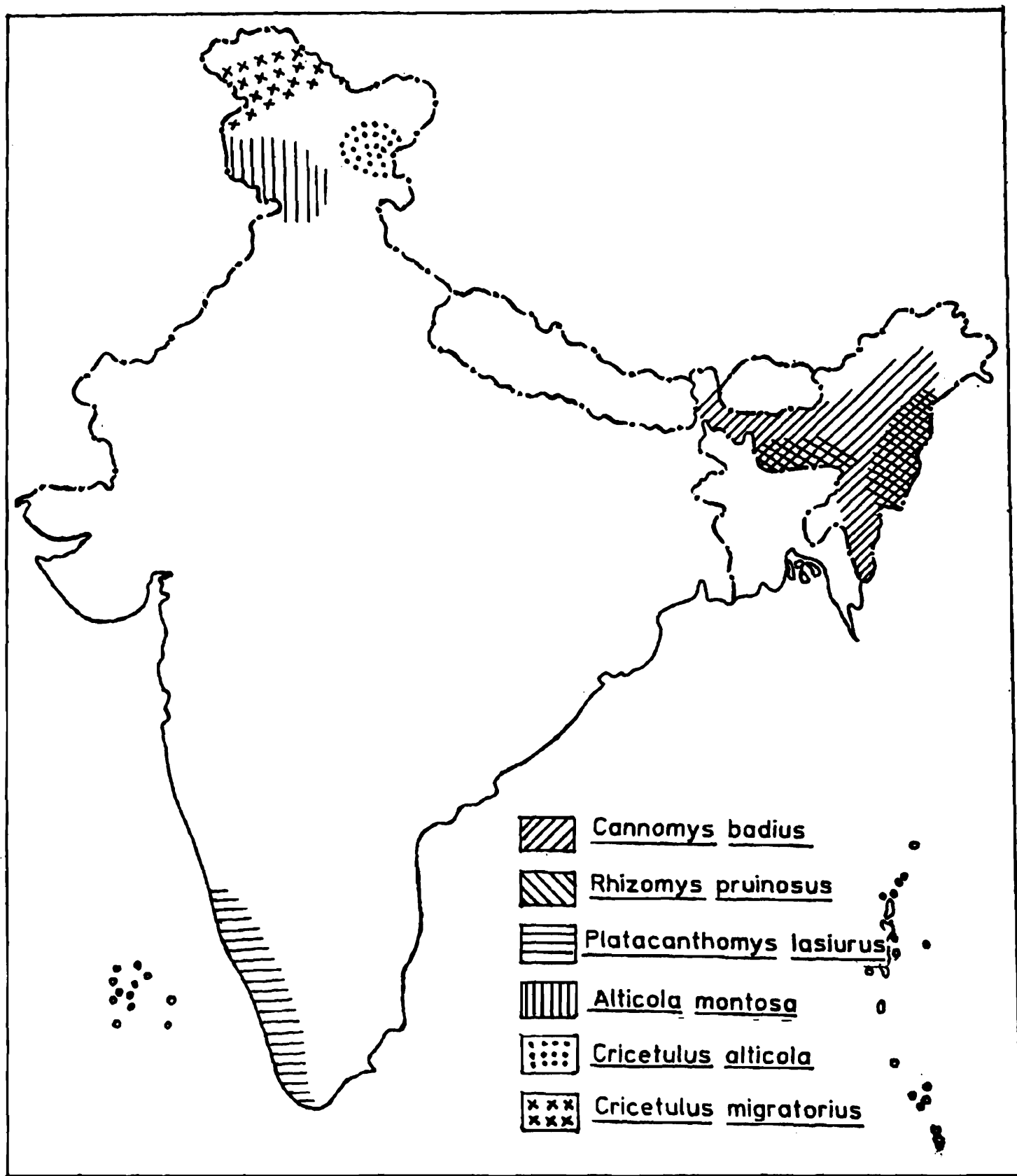
Distribution (Map 1) : SW. Peninsular India, north up to 14°N latitude. Reported from Kerala (Trivandrum) and Karnataka (Shimoga, Mysore-Kanara border and S. Coorg). Recently reported from Peppara WLS, Trivandrum district, Kerala (Jayson & Christopher, 1995). The species is endemic to India.

Ecology and biology : Occurs in moist evergreen forest. Arboreal. Lives in holes in large trees or in clefts among rocks. It is a pest of pepper (*Piper nigrum*), cashewnut (*Anacardium occidentale*), cardamom and jack-fruit; also likes fermented palm juice (Rajagopalan 1968). Nothing is recorded about its breeding habit. Its flesh and spines are used as a cure for respiratory diseases by the tribals.

Subfamily RHIZOMYINAE

Subfamily Rhizomyinae consists of bamboo-rats. These are heavily built rats, provided with strong claws in the limbs for digging, highly fossorial and prefer hilly terrain.

This subfamily is represented by three genera, namely, *Rhizomys*, *Cannomys*, and *Tachyoryctes*. The former two occur in India and the third in Africa. The Indian species forage above ground by digging for roots and rhizomes, especially of bamboo, and are less completely subterranean than the African one.



Map 1. Showing the distribution of six species of rodents in India.

Key to genera of subfamily Rhizomyinae

Small in size, head and body length less than 250 mm; diastema more than 40% of occipitonasal length; M¹ larger than M² and not worn below the level of the latter CANNOMYS

Large in size, head and body length more than 250 mm; diastema less than 40% of occipitonasal length; M¹ smaller or equal to M² and worn below its level RHIZOMYS

Genus *Cannomys* Thomas

1915. *Cannomys* Thomas, *Ann. Mag. nat. Hist.*, [8], 16 : 57.

Type species : *Rhizomys badius* Hodgson.

Distribution : Nepal, NE. India, Myanmar and Thailand.

The genus *Cannomys* is characterised by its relatively smaller size (head and body length less than 250 mm), smooth sole pads, proodont upper incisors, and first upper molar larger than second and not worn below its level.

The genus is monotypic.

Cannomys badius (Hodgson)

(Plate 1, fig. F)

1841. *Rhizomys badius* Hodgson, *Calcutta J. nat. Hist.*, 2 : 60 (Nepal).

Common name : Bay Bamboo Rat (Eng.)

Measurements : (Range, mean, standard deviation and sample size).

	<i>C.b. badius</i>	<i>C.b. castaneus</i>	<i>C.b. pater</i>
HB	166 – 231 202 ± 19 (62)	172 – 219 187 ± 15 (9)	185 – 235 215 ± 11 (10)
TI	47 – 96 61 ± 8.5 (62)	59 – 77 67 ± 7 (9)	64 – 94 77 ± 8.5 (10)
Hf	27 – 36 30 ± 2.3 (62)	26 – 31 28 ± 1.4 (9)	30 – 34 33 ± 1.4 (10)
E	8 – 14 10 ± 1.5 (62)	7 – 12 9 ± 1.4 (9)	10 – 14 11 ± 1.2 (10)

	<i>C.b. badius</i>	<i>C.b. castaneus</i>	<i>C.b. pater</i>
<i>onl</i>	41.0 – 47.1 44.2 ± 2.0 (11)	37.5 – 42.4 39.8 ± 1.7 (7)	41.6 – 47.6 44.9 ± 1.6 (9)
<i>m</i>	9.7 – 10.9 10.3 ± .35 (11)	8.8 – 9.5 9.1 ± .2 (7)	10.2 – 11.4 10.7 ± .4 (9)
<i>iw</i>	9.1 – 10.1 9.5 ± .3 (11)	7.5 – 8.5 8.15 ± .35 (7)	8.0 – 9.3 8.7 ± .4 (9)
<i>d</i>	16.0 – 20.7 18.2 ± 1.2 (11)	14.6 – 17.3 15.7 ± 1.0 (7)	17.2 – 21.5 19.4 ± 1.2 (9)
<i>occ</i>	9.3 – 11.0 10.1 ± .55 (11)	7.8 – 10.2 9.2 ± 1.0 (7)	10.5 – 13.2 11.5 ± 1.0 (9)

Diagnostic characters : A heavily built rat, having a short tail (less than 40% of head and body), scarcely covered with hairs; ears small, remain hidden in the fur; hindfoot powerfully clawed; soles of hindfoot smooth. Body chestnut bay or ashy brown with a rusty tinge above and ashy on the undersurface; tail unicoloured. The specimens of *C. b. plumbescens* (= *C. b. castaneus*) from Seén, Goktek and Pyalingaung, present in ZSI, are all purple black above and dark grey below. Mammae 4 pairs.

In skull, condylobasal length exceeds occipitonasal length; occiput high, with powerful lambdoid crest; interparietal absent in adults; diastema long, more than 40% of occipitonasal length; anterior palatal foramina small, situated medially between upper incisors and molars; root of lower incisors forming a prominent knob on outer surface of mandible, about as high as the condylar process.

Upper incisors red or yellow, ungrooved and proodont. Cheekteeth 3/3 in number, flat crowned; M¹ and M² 4-rooted; M¹ larger than M² and not worn below the level of the latter; M¹ with three outer and one inner reentrant folds, M² with two outer and one inner folds and M³ with two isolated islands. With wear, folds become isolated on the crown surface. In lower molars, first tooth with traces of two outer and three inner folds, second having one outer and two inner folds and the third with an anterior inner and posterior outer folds, latter cutting the inner margin.

Distribution (Map 1) : India : West Bengal (Darjiling and Hasimara), Assam (Goalpara, S. Kamrup, Golaghat), Meghalaya (Garo, Khasi and Jaintia Hills) Manipur

(Bishenpur, Tamenglong), Nagaland and Mizoram (Dampa sanctuary). Also found in Nepal, Myanmar and Thailand.

Ecology and biology : Nocturnal and highly fossorial. Occurs in montane forests. Lives in burrows dug by itself. Feeds on plant material like young shoots and roots, especially of bamboo and cereals. Nothing is known about its breeding habit. Its flesh is eaten by tribals.

Intraspecific variation : The nominate subspecies occurs within the Indian limits.

(1) *Cannomys badius badius* (Hodgson)

1841. *Rhizomys badius* Hodgson, *Calcutta J. nat. Hist.*, 2 : 60 (Nepal).

1843. *Rhizomys castaneus* Blyth, *J. Asiat. Soc. Bengal*, [1], 12 : 1007 (Arakan, Myanmar).

1915. *Cannomys badius plumbescens* Thomas, *Ann. Mag. nat. Hist.* [8] 16 : 315 (Gokteik, N. Shan state, Myanmar).

1915. *Cannomys pater* Thomas, *Ann. Mag. nat. Hist.*, [8], 16 : 315 (Mt. Popa, Myanmar).

Distribution : As mentioned under the species.

Remarks : Ellerman (1961) maintained three subspecies of *Cannomys badius*, namely, *badius castaneus* and *pater*, differing from each other in the length of body and skull, length of toothrows and diastema and interorbital width. On an analysis of these characters, it has been observed that there is no marked difference in any of these measurements among the three subspecies, except that the maxillary toothrow is marginally smaller in *castaneus* but very near to that in *badius*. Further, the body colour in seven specimens of *plumbescens* from Seén, Gokteik and Pyaunggung in Myanmar, is much darker than in the typical race. However, according to Ellerman (1961), this is not a constant character, and normal-coloured individuals occur with the blackish specimens. Hence, this dark series merely represent a colour phase rather than a valid subspecies.

Therefore, *castaneus*, *plumbescens* and *pater* are treated here as synonyms of the nominate subspecies.

Genus *Rhizomys* Gray

1831. *Rhizomys* Gray, *Proc. zool. Soc. Lond.*, 1831: 95.

1832. *Nyctocleptes* Temminck, *Bijdr. nat. Wetensch. Amsterdam*, 7, 5 (Type species *Mus sumatrensis* Raffles).

Type species : *Rhizomys sinensis* Gray.

Distribution : China, NE. India, Myanmar, Thailand, Vietnam. Malaysia and Indonesia.

The genus *Rhizomys* is characterised by its large size (head and body length more than 250 mm), granular soles of hindfoot, less extremely proodont incisors than in *Cannomys*, and M^1 equal to or smaller than M^2 and often worn below its level.

The genus is represented in India by a single species.

***Rhizomys pruinosus* Blyth**

1851. *Rhizomys pruinosus* Blyth, *J. Asiat. Soc. Bengal*, 20 : 519 (Cherrapunji, Khasi Hills, Meghalaya, India).

Common name : Hoary Bamboo-Rat (Eng.)

Measurements :

External : 8 ex : HB 256-350 (299 ± 26); TL 98-120 (108 ± 7) ; Hf 45-52 (48.5 ± 2.8); E 18-25 (20 ± 1.8).

Cranial : 6 ex : *onl* 60.3-64.0 (61.9 ± 1.3); *d* 19.1-22.7 (20.5 ± 1.5); *m* 12.8-14.4 (13.3 ± 1.5); *iw* 9.9-11.8 (10.6 ± 1.55); *occ* 13.7-16.7 (15.3 ± 1).

Diagnostic characters : A heavily built, thick-furred, hoary-coloured (dark brown grizzled with white) rat, with head and body length exceeding 250 mm and the tail more than one-third of it; eyes and ears fairly small; hind-foot powerfully clawed; sole-pads of hindfoot granulated; under surface of body dark but with a silvery effect, and the fur shorter than on the back; hindfoot dark. Mammae 4 pairs.

Skull large (occipitonasal length 61.9 ± 1.3 mm); diastema short, measuring less than one-third of *onl*, and height of occiput rarely reaching a quarter of occipitonasal length. Lower jaw with a conspicuous knob on the outer side formed by the root of lower incisors but not reaching as high as the condylar process.

Upper incisors yellow and less proodont than in *Cannomys*. M^1 equal to or smaller than M^2 and generally worn below its level. M^1 and M^2 4-rooted; M^3 smaller than M^2 but not much. Lower molars as in *Cannomys badius*.

Distribution (Map 1) : India : Meghalaya (Cherrapunji), Nagaland (Mokokchung), and Manipur (Bishenpur and Tamenglong). Also reported from Myanmar, Thailand, Malaysia, Vietnam and S. China.

Ecology and biology : The Hoary bamboo rat is an inhabitant of bamboo thickets at elevations ranging from 1200 to 3700 m. Nocturnal and fossorial. Feeds on roots and shoots of bamboo, grass, seeds and fruits. The breeding is reported in June-July and November-December; litter-size 3-5 (Walker, 1968).

Subfamily CRICETINAE

The subfamily Cricetinae is characterised by two longitudinal rows of cusps in the upper molars; the central row, present in the subfamily Murinae, is suppressed here. However, the same is traceable in some primitive American genera.

This subfamily is mainly Holarctic, represented there by more than 40 genera. There are five Palaearctic genera of which one namely, *Cricetulus* Milne Edwards has reached the Indian territory in Jammu and Kashmir and is known by two species.

Genus *Cricetulus* Milne Edwards

1867. *Cricetulus* Milne Edwards, *Ann. Sci. Nat.*, 7 : 376.

Type species : *Cricetulus griseus* Milne Edwards.

Distribution : Jammu & Kashmir, Pakistan, Afghanistan, Iran, Asia Minor, Syria, Israel, China and Russian Turkestan.

The genus *Cricetulus* is characterised by the presence of cheek-pouches, a short tail devoid of a terminal tuft, and short hindfoot; first upper molar having six cusps; third upper molar not ring-shaped.

Key to species of genus Cricetulus

Undersurface of body white, tympanic bulla large and inflated, more than 17% of occipitonasal length *C. migratorius*

Undersurface of body light grey; tympanic bulla small and flattened, less than 15% of occipitonasal length *C. alticola*

Cricetulus migratorius (Pallas)

(Plate 1, fig. E)

1773. *Mus migratorius* Pallas, *Reise*, 2 : 703: (From the region of Ural River, W. Siberia).

Common name : Little Grey Hamster (Eng.).

Measurements : As given under the subspecies.

Diagnostic characters : A thick-furred hamster, having a well-haired tail, less than one-third of head and body length, ears as long as or longer than hindfoot, and soles partly hairy. Body grey to sandy brown above and white below; tail mostly white; no mid-dorsal stripe on back. Cheek pouches present. Mammae 4 pairs.

Skull not heavily ridged; interparietal well-developed; palate less than half, bulla inflated and more than 17%, and anterior palatal foramina about 18% of occipitonasal length.

Upper incisors narrow, yellow and plain. Molars 3 pairs in each jaw; M^1 with three laminae, each bearing a pair of cusps; between each pair of cusps is a deep pit so that there are 3 deep pits in the centre of the tooth; M^2 with two laminae, 4 cusps and 2 central pits; M^3 relatively smaller, resembling M^2 but with one central pit. First lower molar with six cusps arranged asymmetrically in two longitudinal rows, separated by three inner and two outer re-entrant folds; second and third lower molars with four cusps only.

Distribution : A Palaearctic species, occurs in India in Jammu & Kashmir (Gilgit, Baltistan and Karakoram range); also Pakistan, Afghanistan, Iran, Iraq, Syria, Asia Minor, Chinese and Soviet Turkestan, S. Russia, and Israel.

Ecology and biology : This hamster is associated with the arid montane steppe but extending to cultivated valleys in Baluchistan. Nocturnal; shelters in burrows dug by itself. Largely graminivorous, also feeds on buds, young shoots, wild berries, insects, etc. (Roberts, 1977). In Jammu & Kashmir, it litters during the spring and the summer; litter size 4-8.

Intraspecific variation : One subspecies occurs within the Indian limits.

(1) *Cricetulus migratorius fulvus* (Blanford)

1875. *Cricetus (Cricetulus) fulvus* Blanford, *J. Asiat. Soc. Bengal.*, 44, 2 : 108.

Measurements : External : 6 ex. (Average) : HB 96, Tl 30, Hf 16, E 16. Cranial : 3 ex : *onl* 26.7-31.4 (29.7); *p* 12.8-15.3 (14.4); *apf* 5.0-5.7 (5.5); *b* 5.0-5.7 (5.4); *m* 4.3-4.6 (4.45).

Distribution (Map 1) : India : Jammu & Kashmir (Gilgit, Baltistan, northern side of Karakoram Mountains); also Chinese Turkestan.

Remarks : Ellerman (1961) differentiated *C. m. fulvus* from the nominate subspecies on the basis of longer maxillary toothrows. But the difference appears to be not enough as to warrant subspecific separation.

Cricetulus alticola Thomas

1917. *Cricetulus alticola* Thomas, *Ann. Mag. nat. Hist.*, [8], 19 : 455 (Shushul, Ladakh c 4117 m, Jammu & Kashmir, India).

Common name : Ladakh Hamster (Eng.).

Measurements : (vide Ellerman, 1961).

External : 6 ex: HB 82-100 (91 ± 6.5); Tl 29-33 (31 ± 2.2); Hf 15-17 (16 ± 0.6); E 13-15 (14.5 ± 0.5).

Cranial : 2 ex : *onl* 24.8, 26.4; *p* –, 12.4; *apf* 5.0, 5.2; *b* 3.4, 3.8; *m* 3.7, 3.9; *iw* 4.1, 4.3.

Diagnostic characters : Essentially like *Cricetulus migratorius* in size, etc., but differs from it in the ears being shorter than the length of hindfoot, bulla flattened and smaller, about 14% of *onl* and the undersurface of body light grey instead of white in the latter.

Distribution (Map 1) : India : Jammu & Kashmir (Ladakh); also reported from Tibet in China.

Ecology and biology : Similar to those of *Cricetulus migratorius*. Occurs above 3000 m altitude.

Subfamily GERBILLINAE

The Ethiopian subfamily Gerbillinae consists of gerbils which are found in arid and subarid tracts. In India, one species has extended its distribution to non-arid areas too. The gerbils are fossorial in habit, and characterised by a long tail, ending in a tuft of hair, long hindfoot, enlarged tympanic bulla, grooved upper incisors and biserially cuspidate molars.

Out of 14 genera under this subfamily, three are found within the Indian limits.

Key to genera of subfamily Gerbillinae

- 1 Upper molars prismatic in surface pattern, and laminae joined in mid-line
.....
MERIONES
- Upper molars biserially cuspidate; laminae not always joined 2
2. Size large, head and body length exceeds 130 mm and tail less than one and a half times of that; tail dark above and below and paler on sides TATERA
- Size small, head and body length less than 100 mm and tail generally more than one and a half times of that; tail dark above and paler on the undersurface
..... GERBILLUS

Genus *Gerbillus* Desmarest

1804. *Gerbillus* Desmarest, *Nouv. Dict. Hist. nat. Paris*, 1 : 24, page 22.

1881. *Dipodillus* Lataste, *Le Naturaliste*, Paris, 1 : 506 (Type species *Gerbillus simoni* Lataste).

Type species : *Gerbillus aegyptius* Desmarest.

Distribution : India, west up to Egypt.

The genus *Gerbillus* is characterised by small size (head and body length less than 100 mm), having a very long tail and long hindfoot; soles may be hairy or naked. Molars biserially cuspidate; inner folds larger than outer.

Out of 49 species of this genus, two are reported from India (Corbet and Hill, 1986).

Key to species of genus Gerbillus

Soles of hindfoot naked.....*G. nanus*

Soles of hindfoot partly hairy *G. gleadowi*

Gerbillus nanus Blanford

1875. *Gerbillus nanus* Blanford, *Ann. Mag. nat. Hist.*, 15 : 312 (Gedrosia, Baluchistan, Pakistan).

1920. *Dipodillus indus* Thomas, *J. Bombay nat. Hist. Soc.*, 26 : 935 (Gambat, Khairpur, Sind, Pakistan).

Common name : Baluchistan Gerbil (Eng.).

External :

India : 2 ex. HB 73, 74; TL 103, 109; Hf 19, 19; E 12, 12.

Pakistan : 14 ex, HB 61-90 (75±7); TL 103-134 (118±8); TL as % of HB 131-200 (157±18); Hf 19-24 (22±2); Hf as % HB 22-34 (30±4); E 11-14 (13±1).

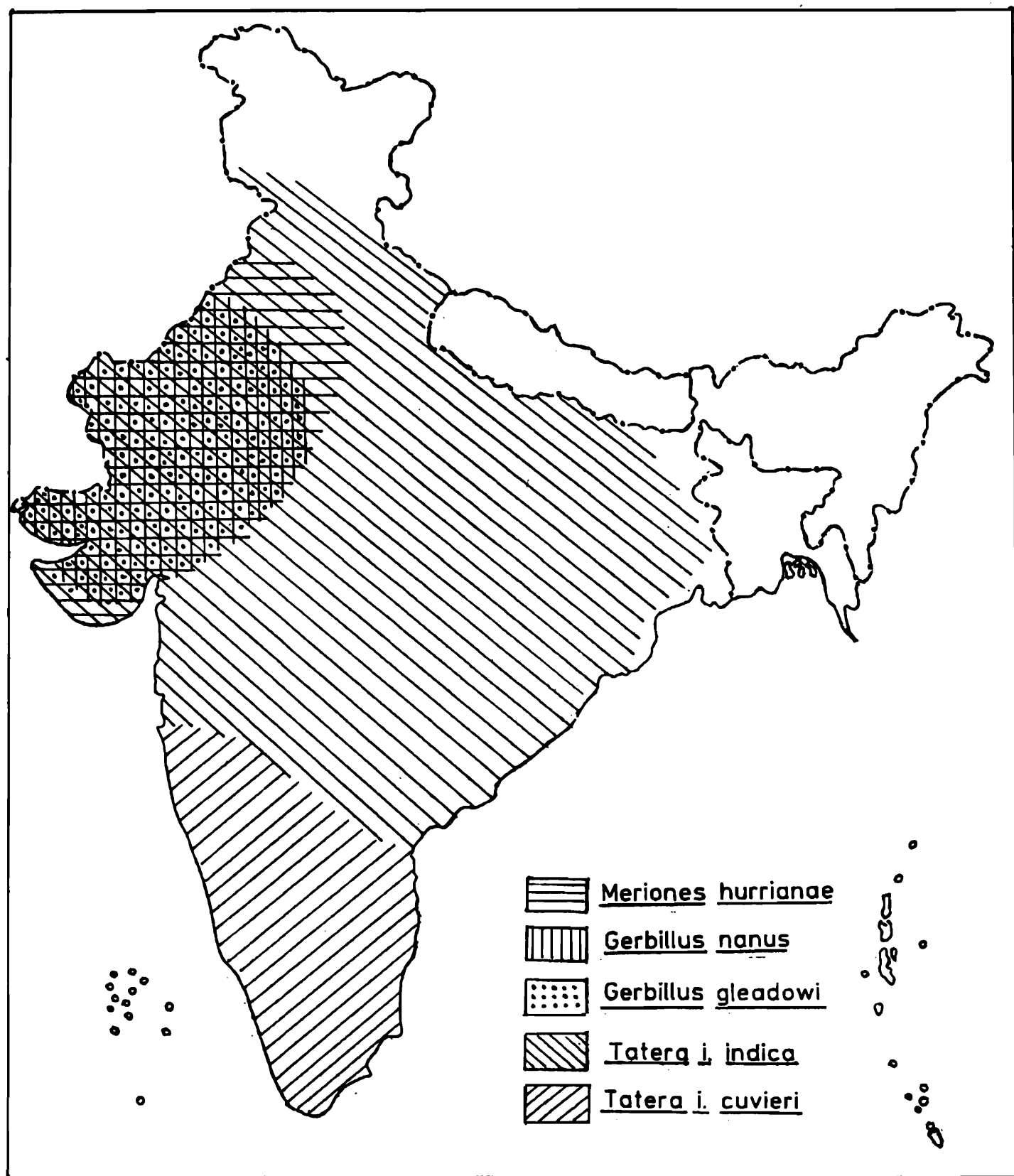
Cranial :

India 2 ex : *onl* 25.3, 25.6; *p* 12.5, 12.6; *apf* 4.1, 4.2; *b* 7.0, 7.1; *m* 3.2, 3.4; *iw* 5.2, 5.3; *n* 8.8, 9.4.

Pakistan : 13 ex : *onl* 24.4-27.8 (26.0±1); *p* 11.7-13.6 (12.9±.6); *apf* 4.1-4.8 (4.35±.3); *m* 2.8-3.5 (3.2±.2); *iw* 4.2-5.3 (4.7±.3); *b* 7.0-8.7 (7.8±.5); *n* 8.8-10.6 (9.5±.5).

Diagnostic characters : A small-sized gerbil (head and body length less than 100 mm), having a very long tail, measuring more than 140% of head and body, and tufted at tip; hindfoot long (22-34 % of HB); soles naked. Body sandy brown above and white below; tail bicoloured, dark above and white below; hindfoot whitish. Mammary 4 pairs.

Skull small and narrow; inter-orbital width 4.7±.3 mm and parietal width always less than 13 mm; nasals short, less than 40%, and bulla large, about 30% of occipitonasal length.



Map 2. Showing the distribution of five species and subspecies of rodents in India.

Upper incisors opisthodont, yellow and grooved on front surface. Molars 3/3 in number; biserially cuspidate; cusps separated by large inner and short outer folds. M^3 small, M^2 with one fold on each side, and M^1 with two folds on each side. In lower molars, M_1 having three laminae, M_2 two and M_3 very small.

Chromosome number $2N = 52$; acrocentrics 42 (Corbet and Hill, 1992).

Distribution (Map 2) : India : Rajasthan (Jaisalmer, Barmer, Jodhpur, Bikaner, Churu and Nagaur) and Gujarat (Palanpur, Muli). Also occurs in Pakistan, Iran, S. Arabia, Israel, Egypt and Algeria.

Ecology and biology : Prefers to live in stony areas, clay flats, patches of tropical thorny scrub and edges of cultivated fields. Nocturnal and fossorial. Feeds mainly on roots, shoots and seeds in the winter and insects during the summer. In Rajasthan, breeds from April to June; litter-size 2 or 3 (Prakash, 1971; Prakash and Jain, 1971).

Remarks : Ellerman (1961) treated *Gerbillus indus* as a subspecies of *Gerbillus dasyurus* but Petter (1961) and Harrison (1972) synonymised it with *Gerbillus nanus*.

Intraspecific variation : The nominate subspecies occurs in India.

(1) *Gerbillus nanus nanus* Blanford

1875. *Gerbillus nanus* Blanford, *Ann. Mag. nat. Hist.* 16 : 312.

Measurements : As mentioned under the species.

Distribution : India, west to E. Arabia.

Gerbillus gleadowi Murray

1886. *Gerbillus gleadowi* Murray, *Ann. Mag. nat. Hist.*, [5], 17 : 246 (Beruto, Rohri dist., Sind, Pakistan).

Common name : Little Hairy-footed Gerbil (Eng.).

Measurements : (Based on specimens from India).

External : 9 ex : HB 67-90 (82 ± 6); TI 110-145 (135 ± 11); TI as % of HB 152-177 (164 ± 7); Hf 26-30 (28 ± 1); Hf as % of HB 30-40 (34 ± 2.5); E 10-13 (12 ± 1).

Cranial : 6 ex : *onl* 25.7-29.8 (28.3 ± 1.4); *p* 12.9-14.8 (14.2 ± 0.7); *b* 7.8-8.7 (8.4 ± 0.3); *apf* 3.8-4.5 (4.0 ± 0.35); *m* 3.3-3.9 (3.6 ± 0.2); *iw* 5.0-6.0 (5.5 ± 0.35); *n* 9.4-11.0 (10.2 ± 0.6).

Diagnostic characters : A small gerbil, of the size of *Gerbillus nanus*, but differs from it in the hindfoot being exceptionally long (more than one-third of HB) and soles of hindfoot partly hairy and without sole-pads. Body sandy brown above and white

below; tail bicoloured, sandy above, white on the undersurface and hairy at tip; hindfoot white. Mammae 4 pairs.

Skull slightly longer and broader than of *Gerbillus nanus* (onl 28.2 ± 1.4 m 26.0 ± 1 mm); frontals well-ridged and wide, interorbital width always exceeds 5 mm and parietal width exceeds 13 mm.

Dentition as in *Gerbillus nanus*.

Chromosome number $2N = 50$; acrocentrics 28 (Corbet and Hill, 1992).

Distribution (Map 2) : India : Rajasthan (Jaisalmer, Bikaner, Barmer, Jodhpur, Jalore, Jhunjhunu, Churu and Sikar) and Gujarat (Palanpur). Also reported from Pakistan.

Ecology and biology : Lives in sandy areas and uncultivated patches (Prakash and Purohit, 1967). Nocturnal and fossorial. Feeds on seeds, vegetables and insects. Litters are born during the summer and in postmonsoon months; litter-size 2-6 (Prakash, 1971).

Genus *Tatera* Lataste

1882. *Tatera* Lataste, *Le Naturaliste*, Paris, 2 : 126.

1917. *Taterona* Wroughton, *J. Bombay nat. Hist. Soc.*, 25 : 40 (Type species *Gerbillus afra* Gray).

Type species : *Dipus indicus* Hardwicke.

Distribution : India, Pakistan, west to Africa.

Large gerbils (head and body length more than 130 mm), having the tail longer than head and body but not reaching one and a half times of it. Zygomatic plate, in skull, strongly thrown forwards; bulla tend to be small, and molars biserially cuspidate.

There is one valid species of this genus in Asia including India.

Tatera indica (Hardwicke)

1807. *Dipus indicus* Hardwicke, *Trans Linn. Soc. Lond.*, 8 : 279 (Between Varanasi and Hardwar, Uttar Pradesh, India).

Common names : Indian Antelope Rat (Eng.); Jhenku Indur (Beng.); Harna Musa (Hin.).

Measurements : As mentioned under the subspecies.

Diagnostic characters : A large, soft-furred gerbil (head and body length 130-230 mm), having the tail longer than head and body, at least in the Indian specimens (100-140% of HB), well-haired and tufted; hindfoot long (20-30% of HB); soles naked to

the heel. Body sandy brown to reddish brown above, white below; tail dark above and below and pale on the sides; hindfoot white. Mammary 4 pairs.

Skull large, more than 40 mm in occipitonasal length; nasals unusually long, more than 40% of *onl*; bulla large (though smallest in the subfamily gerbillinae), about one-fourth of *onl* and its relative length decreases from Baluchistan (mean 27.2% of *onl*) eastward to West Bengal and southward to Tamil Nadu and Kerala (mean 24% of *onl*), almost forming a cline; anterior palatal foramina long, roughly 18% of *onl* (Agrawal, 1971).

Upper incisors opisthodont, yellow and grooved on the front surface. Molars 3/3 in number; biserially cuspidate; M^1 trilaminar with two folds on each side, M^2 and M^3 bilaminar with one fold on each side; M^3 very small; outer folds larger than inner ones. In lower molars, M_3 ring-shaped, M_2 having two and M_1 three transverse laminae.

Chromosome number $2N = 68$ and $FN = 82-86$ (Aswathanarayana & Manjunatha, 1981).

Distribution (Map 2) : Found throughout India, the eastern limit being West Bengal. Also occurs in Nepal, Pakistan, Afghanistan, Iran, Iraq, Syria and Sri Lanka.

Ecology and biology : Amongst the Indian gerbils, this species appears to be the most adapted ecologically. It lives in burrows in ruderal, sandy, gravelly and rocky habitats. In ruderal, it occupies hedges, crop-fields and orchards (Prakash *et al.*, 1971). Nocturnal and fossorial. Feeds on rhizomes, seeds of grass, grain, leaves, flowers, etc., also on insects and garden snails. It is a serious pest of crops. Breeds throughout the year in Rajasthan, and from August to March in southern India; litter size 1-9 (mean 4.8) (Jain, 1970; Prakash, 1971). The annual productivity per adult female comes to about 18 young-ones.

Intraspecific variation : Ellerman (1961) recognised three subspecies of *Tatera indica* namely, *indica*, *hardwickei* and *cuvieri* from India and one, *ceylonica* from Sri Lanka. He differentiated them on the length of tail, hindfoot, bulla and anterior palatal foramina, and interorbital width. Agrawal and Chakraborty (1981) maintained only two subspecies, *indica* from northern India (southern limit being Bombay in Maharashtra and Madhya Pradesh), and *cuvieri* from southern India and Sri Lanka, based on the length of hindfoot.

Key to subspecies of Tatera indica

Length of hindfoot less than 41 mm.; supra maxillary root of zygomatic arch not robust, width 3.0 ± 4 mm. (Fig. 8a) *T. i. indica*

Length of hindfoot more than 41 mm; supra maxillary root of zygomatic arch broad and robust, width 3.7 ± 35 mm. (Fig 8b) *T. i. cuvieri*

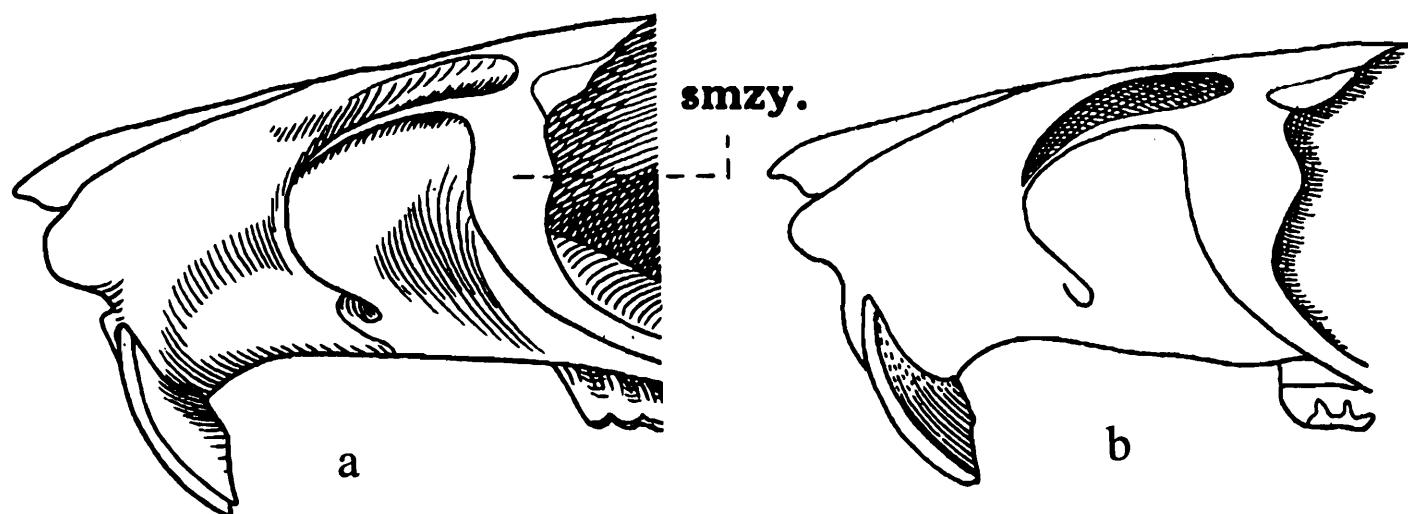


Fig. 8. Lateral view of skulls of (a) *Tatera indica indica* and (b) *Tatera indica cuvieri* showing the supramaxillary root of zygomatic arch (smzy).

(i) Tatera indica indica Hardwicke

1807. *Dipus indicus* Hardwicke, *Trans. Linn. Soc. Lond.*, 8 : 279 (Uttar Pradesh, India).

1906. *Tatera persica* Wroughton, *Ann. Mag. nat. Hist.*, [7], 17 : 477 (Seistan, Iran).

1917. *Tatera sherrini* Wroughton, *J. Bombay nat. Hist. Soc.*, 25 : 43 (Jacobabad, Sind, Pakistan).

1917. *Tatera dunni* Wroughton, *J. Bombay nat. Hist., Soc.*, 25 : 43 (Ambala, Haryana, India).

Measurements : (vide Agrawal & Chakraborty, 1981).

External : 219 ex : HB 130-195 (156 ± 13); TI as % of HB 98-133 (116 ± 8.3); Hf 31-42 (37 ± 2); Hf as % of HB 20-29 (24 ± 2).

Cranial : 136 ex : *onl* 38.5-49.7 (42.6 ± 2.2); *iw* 6.1-8.1 (7.0 ± 0.4); *b* as % of *onl* 23.4-29.9 (26.4 ± 1.3); *apf* as % of *onl* 16.5-20.4 (18.5 ± 0.9).

Distribution (Map 2) : India : Jammu & Kashmir (Jammu); Himachal Pradesh (Kangra, Solan and Sirmaur), Punjab (Ludhiana), Haryana (Ambala, Hissar), Rajasthan

(Mt. Abu, Sirohi, Udaipur, Bikaner, Jodhpur, Nagaur, Pali, Jhunjhunu). Gujarat (Junagadh, Rajkot, Kachch, Palanpur). Madhya Pradesh (Hoshangabad, Nimar, Indore, Jabalpur, Mandla, Chanda, Sagar, Gwalior), Maharashtra (Pune, Bhusawal, Ahmadnagar, Dhulia, Jalgaon), Orissa (Puri), Uttar Pradesh (Kumaon to Varanasi), Bihar (Daltongunj, Darbhanga) and West Bengal (Medinipur, Bankura, Hugli, Nadia and Murshidabad). Also reported from Pakistan to Iran.

(ii) *Tatera indica cuvieri* (Waterhouse)

1838. *Gerbillus cuvieri* Waterhouse. *Proc. zool. Soc. Lond.*, 1838 : 56 (Arcot, Tamil Nadu, India).

1843. *Gerbillus hardwickei* Gray. *List. Mamm.*, : 132 (Dharwar, Karnataka, India).

1906. *Tatera ceylonica* Wroughton. *Ann. Mag. nat. Hist.*, [7], 17 : 477 (Sri Lanka).

Measurements : (Range, mean, standard deviation and sample size.)

	<i>cuvieri</i>	<i>hardwickei</i>	<i>ceylonica</i>
HB	135 – 210 159 ± 17 (50)	145 – 203 173 ± 13 (60)	142 – 197 170 ± 13 (49)
Tl as % of HB	106–159 135 ± 16 (50)	101 – 129 117 ± 7 (60)	111 – 140 122 ± 7 (49)
Hf	40 – 46 43 ± 1.5 (50)	40 – 47 43 ± 2 (60)	42 – 50 45 ± 2 (49)
Hf as % of HB	23 – 32 27 ± 2.8 (50)	21 – 31 25 ± 2.8 (60)	23 – 31 26.3 ± 1.7 (49)
<i>onl</i>	39.4 – 47.2 43.1 ± 1.9 (29)	39.8 – 47.7 44.8 ± 2.0 (45)	42.0 – 48.2 45.7 ± 1.6 (34)
<i>iw</i>	6.6 – 8.1 7.2 ± .35 (29)	6.6 – 7.9 7.2 ± .3 (45)	7.2 – 8.6 7.8 ± .45 (34)
<i>b</i> as % of <i>onl</i>	23.1 – 27.8 24.8 ± 1.0 (29)	21.0 – 27.4 23.7 ± 1.1 (45)	22.0 – 26.7 23.8 ± 1 (34)
<i>apf</i> as % of <i>onl</i>	17.1 – 18.4 17.8 ± .5 (29)	17.8 – 20.9 19.1 ± .9 (45)	16.5 – 19.1 17.5 ± .7 (34)

Distribution (Map 2) : India : Maharashtra (Satara, Kolaba, Ratnagiri), Goa, Karnataka (Dharwar, N. Kanara, Bellary, Shimoga, Mysore, Coorg), Tamil Nadu (Arcot, Salem, Madurai, Coimbatore, Rameshwaram), Andhra Pradesh (Cuddapah, Kurnool, Palkonda Hills) and Kerala (Trivandrum). Also Sri Lanka.

Genus *Meriones* Illiger

1811. *Meriones* Illiger, *Prodr. Syst. Mamm.*, 82.

1919. *Cheliones* Thomas, *Ann. Mag. nat. Hist.*, [8], 3 : 265 (Type species *Gerbillus hurrianae* Jerdon).

1937. *Parameriones* Heptner, *Bull. Soc. nat. Moscow. biol.*, 46 : 190 (Type species *Gerbillus persicus* Blanford).

Type species : *Meriones tamariscinus* Pallas.

Distribution : N. Africa to Central Asia.

The genus *Meriones* consists of medium-sized gerbils in which molars are simple, prismatic in surface pattern and laminae joined in mid-line.

Out of 16 species of this genus, only one has been reported from the Indian territory.

Meriones hurrianae (Jerdon)

(Plate 1, fig. B)

1867. *Gerbillus hurrianae* Jerdon, *Mamm. India*, : 186 (Hissar, Haryana, India).

1919. *Cheliones hurrianae collinus* Thomas, *J. Bombay nat. Hist. Soc.*, 26 : 726 (Kohat, NWFP, Pakistan).

Common name : Indian Desert Gerbil (Eng.).

Measurements :

External : 47 ♂ : HB 110-137 (123±7); TI 106-129 (117±9); TI as % of HB 76-109 (96±8); Hf 26-32 (28±1.5); E 9-12 (10±1). 23 ♀ : HB 110-136 (120±6.5); TI 101-136 (114±8.5); TI as % of HB 81-108 (96±8); Hf 25-30 (27±1.5); E 8-11 (10±1).

Cranial : 29♂ : *onl* 31.4-36.5 (34.3±1.2); *iw* 5.8-8.0 (6.7±.55); *b* 9.3-10.5 (10.1±.3); *b* as % of *onl* 27.6-31.1 (29.3); *m* 4.6-5.3 (4.9±.2); *apf* 4.2-6.0 (5.1±.45). 17 ♀ : *onl* 31.9-35.1 (33.4±1.0); *iw* 5.7-6.8 (6.3±.3); *b* 9.1-10.3 (9.8±.35); *b* as % of *onl* 27.1-31.0 (29.3); *m* 4.8-5.0 (4.9±.1); *apf* 4.4-5.6 (5.0±.3).

Diagnostic characters : A medium-sized gerbil (head and body length 100-137 mm), having the tail subequal to head and body, well haired and tufted at tip; soles partly hairy; ears small, less than one-tenth of head and body. Mammae 4 pairs.

Fur short and harsh; body sandy grey to brownish grey above, pale yellow to dirty white below; tail having a black streak above, paler below; hindfoot light brown to whitish.

Skull medium-sized; nasals relatively short, less than 38% of *onl*; bulla smallest for the genus, 27-31% of *onl* but larger than in *Tatera indica*.

Upper incisors yellow, opisthodont and grooved on front surface; molars 3/3, prismatic, laminae joined in mid-line. M^1 trilaminar, separated by two outer and two inner folds; M^2 eight-shaped, laminae separated by one outer and one inner folds; M^3 small and ring-shaped. Lower molars more or less similar to upper ones.

Distribution (Map 2) : India : Haryana (Hissar dist.), Rajasthan (Barmer, Bikaner, Jaisalmer, Jodhpur, Jhunjhunu, Nagaur, Churu, Pali, Jalore, Sirohi and Ganganagar) and Gujarat (Palanpur, Surendranagar, Kachch). Also reported from Pakistan and SE. Afghanistan.

Ecology and biology : Lives in a variety of habitats, sandy, gravelly and ruderal. Diurnal and fossorial; makes extensive burrow system. Feeds mainly on seeds of grass, rhizomes, stems and insects. It is not a serious agricultural pest in India but causes desertification by destabilising the soil. Breeds throughout the year, with peaks in February and July. Litter-size 1-9 (Prakash, 1981).

Subfamily ARVICOLINAE

The subfamily Arvicolinae (earlier known as Microtinae) consists of voles and lemmings; the latter, however, are not found within the Indian limits. Voles are fossorial in habit and denizen of high elevation in the Himalaya. They are characterised by soft, velvety fur, a short tail, measuring less than one-half of head and body length and rootless, prismatic, cheek-teeth. The third upper and first lower molars are complex in structure and variable in surface pattern. In India, this subfamily is represented by four genera and ten species.

Key to genera of subfamily Arvicolinae

- 1 Posterior end of palate terminating as a simple transverse shelf 2
 Posterior median process of palate continuous with the inner border of postero-lateral pits to form a sloping septum PITYMYS
2. Palate short, less than 55% of occipitonasal length 3
 Palate long, about 60% of occipitonasal length HYPERACRIUS

3. Underparts darker; cheekteeth with narrow folds and crowded appearance EOTHENOMYS
 Underparts lighter; cheekteeth with wide folds and long drawn out appearance ALTICOLA

Genus *Eothenomys* Miller

1896. *Eothenomys* Miller, *N. Am. Fauna*, 12 : 45.

1896 *Antelionomys* Miller, *N. Am. Fauna*, 12 : 47 (Type species *Microtus chinensis* Thomas).

Type species : *Arvicola melanogaster* Milne Edwards.

Distribution : Japan, China, Myanmar and NE. India.

The genus *Eothenomys* is characterised by the supra orbital ridges remaining separate in adult skulls, palate terminating posteriorly as a simple transverse shelf and cheek-teeth rootless, and with narrow folds and crowded appearance.

This genus is mainly a Chinese one, represented by 11 species of which 9 occur in S. China including one spilled over to India.

Eothenomys melanogaster (Milne Edwards)

1872. *Arvicola melanogaster* Milne Edwards, in David, *Nouv. Arch. Mus. Hist. Nat. Paris*, 7 (Bull.) : 93 (Moupin, Szechuan, China).

Common name : Pere David's Vole (Eng.).

Measurements : As mentioned under the subspecies.

Diagnostic characters : A dark, thick-furred vole, having a moderately haired tail, measuring 30-50% of head and body length. Body clove-brown with golden hair-tips above, and a little lighter below. In this character, it differs from the genus *Alticola* where the undersurface is light grey or white. Tail and hindfoot dark. Mammae 2 pairs.

Skull weak; braincase flat; supraorbital ridges remaining separate; palate short, less than 55% of occipitonasal length, terminating, posteriorly in a simple transverse shelf; anterior palatal foramina long, sometimes exceeding one-fifth of *onl*; zygomatic arch well spread out from skull.

Upper incisors broad, yellow and plain. Molars 3/3 in number, rootless and with narrow folds and crowded appearance (Fig. 9 a, a'); M¹ with four inner and three outer

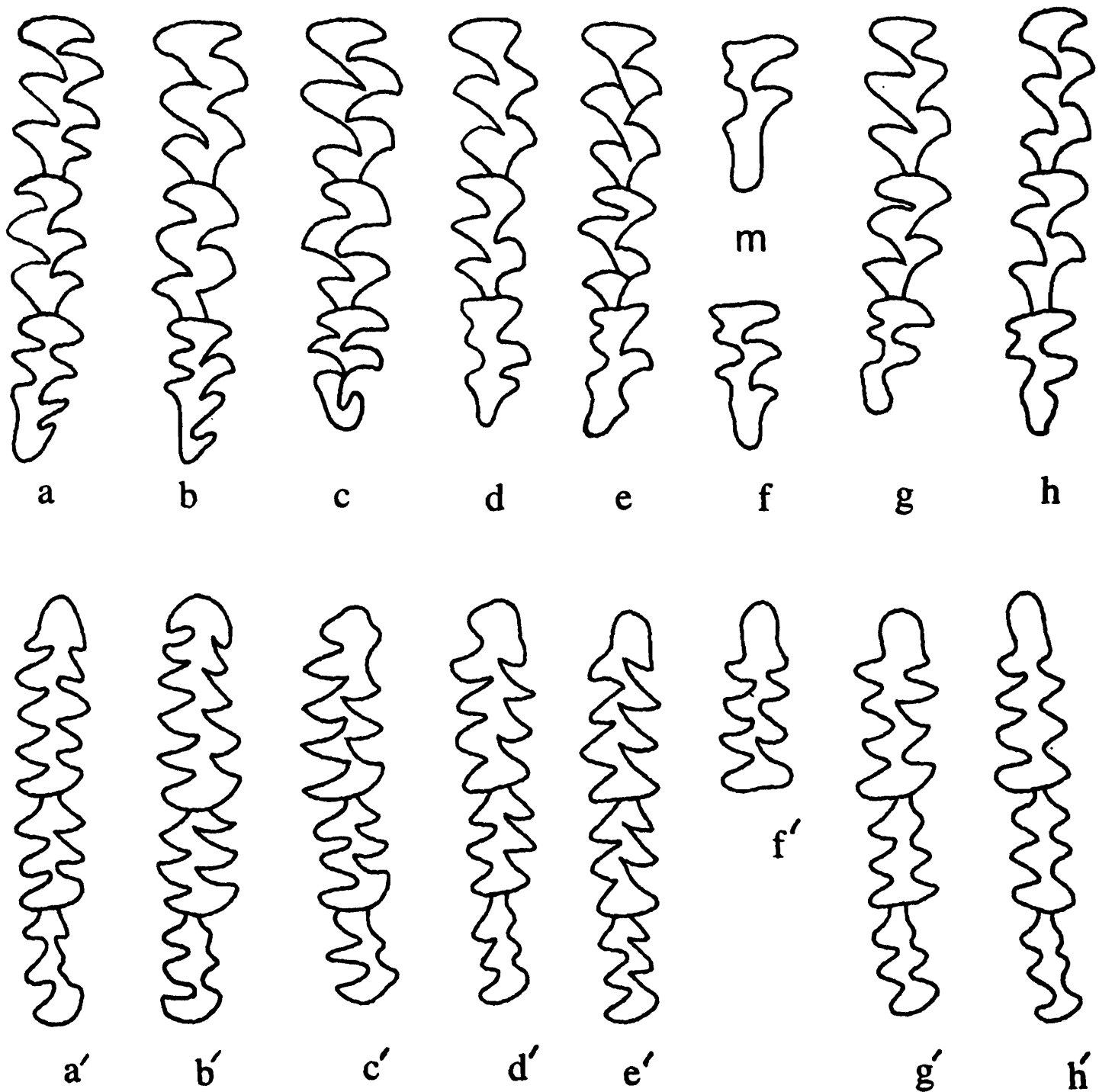


Fig. 9. Molar crown pattern in subfamily Arvicolinae. a-m, right upper molars; a'-h', right lower molars. a, a'—*Eothenomys melanogaster*, b, b'—*Pitymys sikimensis*, c, c'—*Pitymys leucurus*, d, d'—*Alticola roylei*, e, e'—*Alticola stoliczkanus*, m—*Alticola stracheyi* (third upper molar), f, f'—*Alticola blanfordi* (m³ and m₁), g, g'—*Hyperacrius wynnei*, h, h'—*Hyperacrius fertilis*.

salient angles, and M^2 and M^3 with three salient angles on each side; crown pattern in M^3 variable, especially the last loop.

Distribution : India : Arunachal Pradesh. Also occurs in Myanmar, S. China and Taiwan.

Ecology and biology : Frequents both wooded jungles and grassy meadows. Diurnal and fossorial. Nothing is recorded about its breeding habit except that 1-3 embryos have been found in the uterus from February to October.

Intraspecific variation : One subspecies of *Eothenomys melanogaster* is reported from India.

***Eothenomys melanogaster libonotus* Hinton**

1923. *Eothenomys melanogaster libonotus* Hinton, *Ann. Mag. nat. Hist.*, [9], 11 : 151 (Dreyer c 1567 m, Mishmi Hills, Arunachal Pradesh, India).

Measurements : (vide Ellerman, 1961).

External : 1♂, 2♀ : HB 105-118 (111); TL 35-40 (37); Hf 16-17 (16.7); E 11-13 (12).

Cranial : 1♂, 1♀ : *onl* 24.6, 25.2; *p* 13.2, 13.3; *apf* 4.9, 5.0; *m* 6.2, 6.4; *iw* 4.4, 4.5; *zw* 15.

Distribution (Map 3) : India : Arunachal Pradesh (Mishmi Hills). Also occurs in N. Myanmar (Anthony, 1941).

The Indian subspecies is distinguished by its relatively smaller tail, measuring about one-third of head and body length.

Genus *Alticola* Blanford

1881. *Alticola* Blanford, *J. Asiat. Soc. Bengal*, 50 : 96.

Type species : *Arvicola stoliczkanus* Blanford.

Distribution : Mongolia, China, SE. Russian Turkestan, Afghanistan, Pakistan and India.

A thick-furred vole, not specially modified for underground life; tail relatively longer and ears conspicuous as compared to those in other genera.

Occipitonasal length of skull may or may not be longer than condylobasal length; supraorbital ridges remain separate in adults; palate short, less than 55% of occipitonasal

length, ending posteriorly in a simple transverse shelf (Fig. 10a). Molars with wide folds and long drawn out appearance.

Five species of genus *Alticola* occur in India.

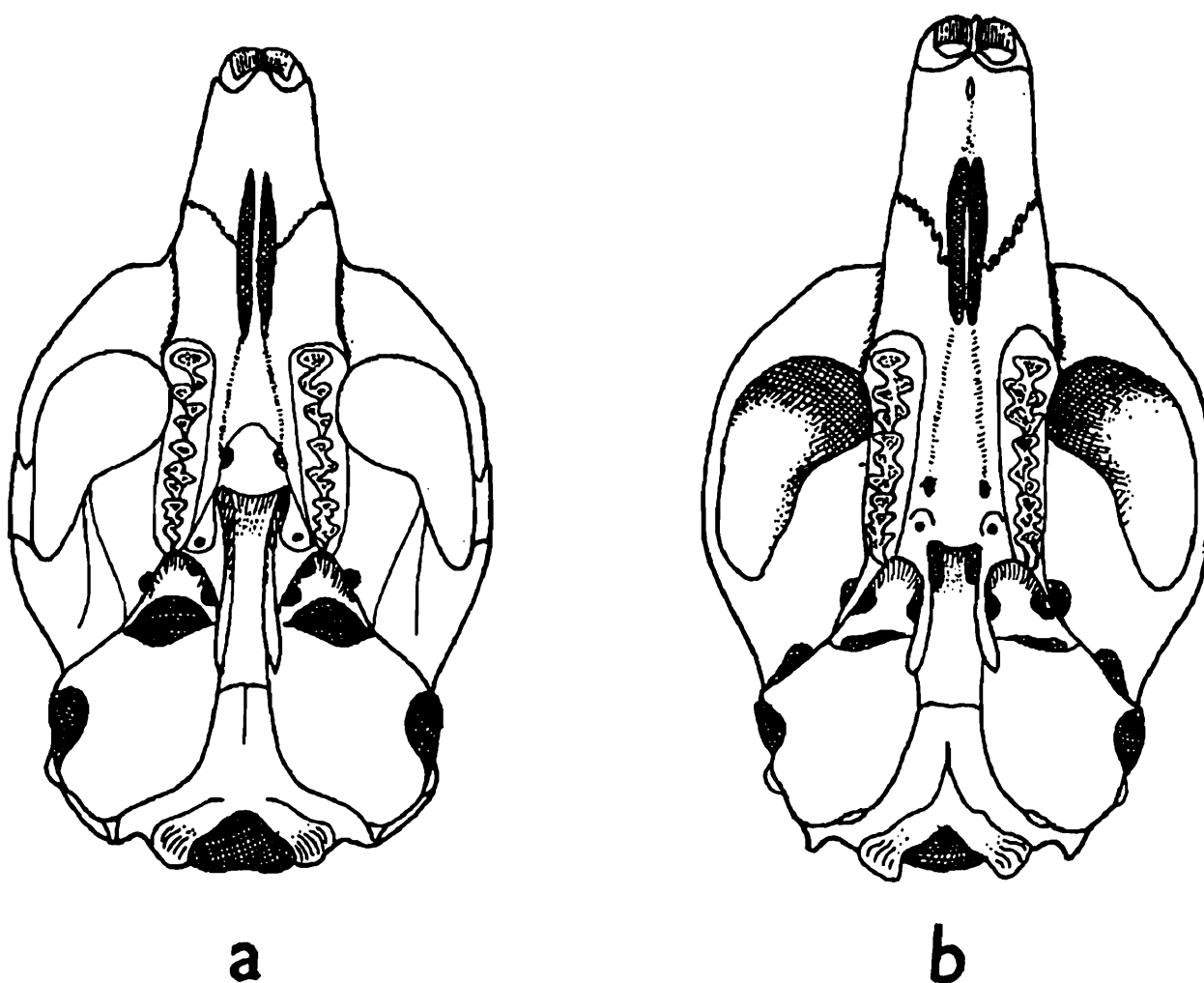


Fig. 10. Ventral view of skulls of (a) *Alticola roylei* and (b) *Pitymys sikimensis* showing the structure of posterior end of palate.

Key to species of genus Alticola

- 1 Tail longer, more than 30% of head and body length; M³ with three inner salient angles 2
- Tail shorter, less than 30% of head and body length; M³ with two inner salient angles 4
2. Tail medium-sized, less than 40% of head and body *A. roylei*
- Tail longer, on average more than 40% of head and body 3

3. M^3 with third outer fold distinct; maxillary toothrows less than 6 mm in length; zygomatic width less than 14.5 mm. *A. blanfordi*
- M^3 with third outer fold absent; maxillary toothrows generally more than 6 mm in length; zygomatic width more than 14.5 mm *A. montosa*
4. M^3 reduced, posterior loop short, less than half the length of crown *A. stoliczkanus*
- M^3 less reduced, posterior loop long and about half the length of crown *A. stracheyi*

***Alticola roylei* (Gray)**

1842. *Arvicola roylei* Gray, *Ann. Mag. nat. Hist.*, [1], 10 : 265 (Kumaon, Uttar Pradesh, India).

1976. *Alticola roylei cautus* Hinton, *Monogr. Voles and Lemmings*, 1 : 313 (Rahla, Lahul, Himachal Pradesh, India).

Common name : Royle's Vole (Eng.).

Measurements : External :

roylei : 18 ex : HB 97-113 (106 ± 4.5); Tl 32-39 (35 ± 2); Hf 18-20 ($18.5 \pm .5$); E 11-13 (12 ± 1).

cautus : 15 ex : HB 98-116 (110 ± 5.5); Tl 36-44 (40 ± 2.7); Hf 18-19 ($18.5 \pm .5$); E 14-15 ($14 \pm .3$).

Cranial :

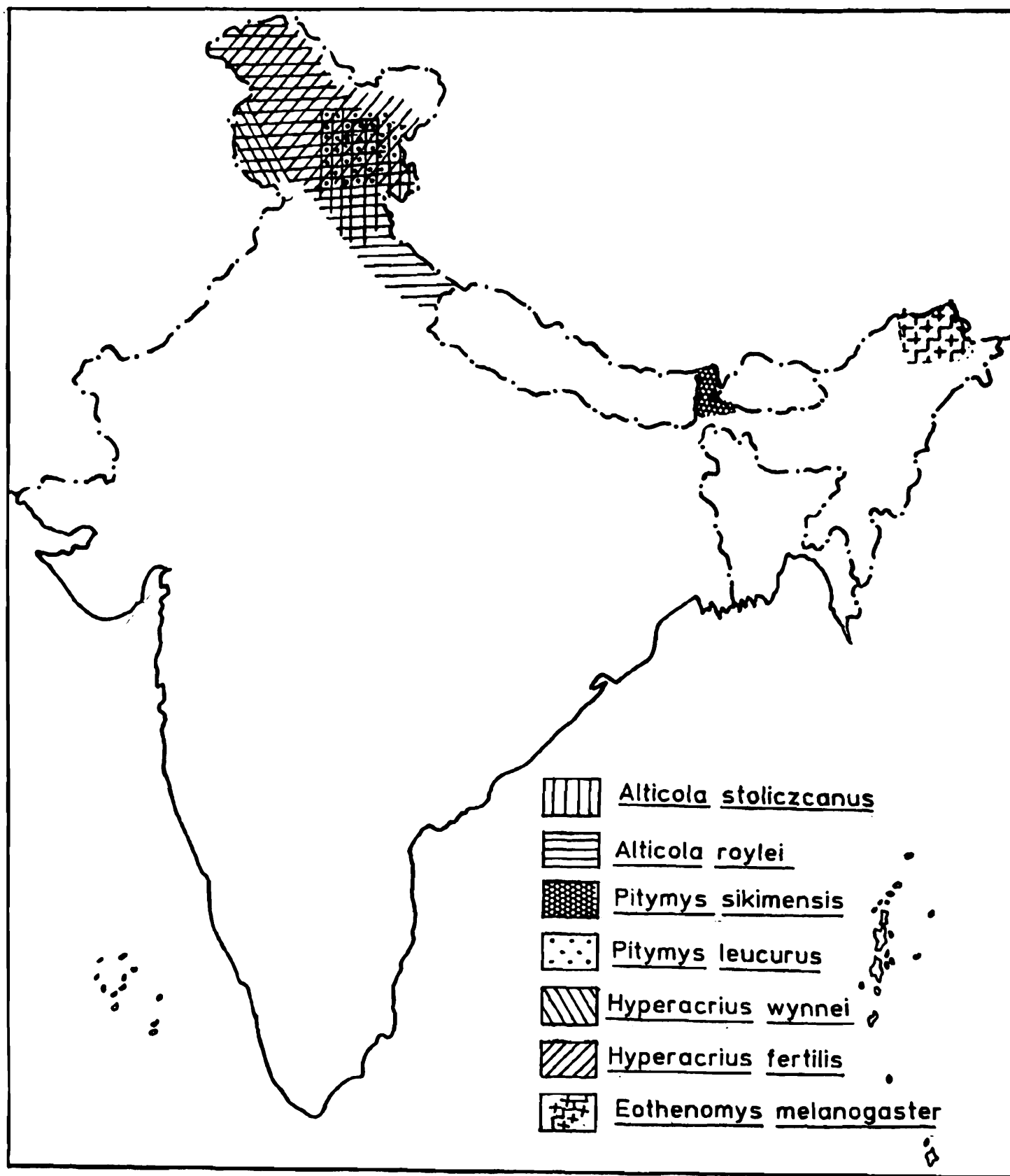
roylei : 11 ex : *onl* 24.0-26.5 ($25.6 \pm .8$); *p* 12.6-14.3 ($13.3 \pm .45$); *apf* 4.7-6.0 ($5.1 \pm .4$); *b* 5.2-6.4 ($5.8 \pm .35$); *m* 5.9-6.7 ($6.2 \pm .25$); *iw* 3.9-4.4 ($4.2 \pm .15$).

cautus : 6 ex : *onl* 25.6-27.1 ($26.3 \pm .5$); *p* 13.5-14.6 ($14.0 \pm .4$); *apf* 5.2-5.7 ($5.5 \pm .2$); *b* 6.1-6.5 ($6.3 \pm .15$); *m* 5.8-6.6 ($6.3 \pm .25$); *iw* 3.7-4.3 ($4.0 \pm .15$).

Diagnostic characters : A thick-furred vole, having a moderately short and imperfectly clothed tail (measuring less than 40% of HB); palms and soles naked between pads but haired posteriorly; claws not hidden by hair of digits. Body dark brown above, greyish and generally with a rusty tinge below; tail bicoloured, dark above and pale below; hindfoot greyish. Mammary 4 pairs.

Skull strongly built; occipitonasal length longer than condylobasal length; bulla small (less than one-fourth of *onl*) and maxillary tooth-rows long (more than 6 mm in length).

Upper incisors plain and pale yellow. Cheek-teeth 3/3 in number, folds wide open. M^3 and M_1 vary in structure in different species. M^3 consists of an anterior loop, three



Map 3. Showing the distribution of seven species of rodents in India.

small triangles often not fully closed, followed by a long straight posterior loop; third triangle confluent with posterior loop. Thus there are three salient angles on each side, third inner angle always well-developed; third outer fold reduced (Fig. 9d). M_1 consists of a posterior loop, five alternating triangles of which first four closed, and fifth merged with posterior loop and having three outer and four inner folds (Fig. 9d').

Distribution (Map 3) : India : Western Himalaya from Kulu valley in Himachal Pradesh to Kumaon in Uttar Pradesh between alt. 2600 and 3900 m. The species is endemic to India in the present form.

Ecology and biology : Royle's vole usually occurs from the upper limit of coniferous forest to the edge of snow line above 2600 m altitude. Diurnal. Lives in burrows. Feeds on grass, leaves of alpine herbs, roots, bulbs, etc. Breeds in June-July; litter-size 4-5.

Intraspecific variation : Hinton (1926) differentiated *A. roylei cautus* from *A. roylei roylei* by its longer ears (14-15 vs 11-13 mm), and hoary belly (vs rusty). Former difference appears to be due to individual way of taking measurement of the ear, and the latter overlapping. Some of the specimens of *A. r. roylei* do not have rusty tinge in the belly. Hence, *A. r. cautus* is treated here as a synonym of *A. r. roylei*.

Two more subspecies of *A. roylei* namely *A. r. albicauda* and *A. r. glacialis* are known from Baltistan, Jammu and Kashmir. Since the specimens of these taxa have not been examined, it is not possible to comment on their status.

Alticola blanfordi (Scully)

1880. *Arvicola blanfordi* Scully, *Ann. Mag. nat. Hist.*, [5], 6 : 399 (Gilgit c 2700-3000 m, Jammu & Kashmir, India).

1926. *Alticola blanfordi lahulius* Hinton, *Monogr. Voles and Lemmings*, 1 : 309 (Khyelang c 3166 m, Lahul, Himachal Pradesh, India).

Common name : Scully's Vole (Eng.).

Measurements : (vide Hinton, 1926; Ellerman, 1961).

	<i>A. b. blanfordi</i>	<i>A. b. lahulius</i>
HB	99, 115 (2)	91-117 (103±7) (22)
TI	48, 52 (2)	31-54 (43±4) (22)
Hf	19, 19 (2)	17-19 (18±1) (22)

	<i>A. b. blanfordi</i>	<i>A. b. lahulius</i>
E	—	14-17 (15±1) (22)
<i>onl</i>	27.2, 27.6 (2)	25.3-27.0 (26.0) (3)
<i>m</i>	5.8, 5.8 (2)	5.5-5.9 (5.7) (3)
<i>apf</i>	5.4, 6.1 (2)	4.9-5.3 (5.1) (3)
<i>p</i>	13.3 (1)	12.6-14.1 (13.2) (3)
<i>b</i>	6.8, 7.0 (2)	6.6-6.8 (6.7) (3)
<i>iw</i>	3.7, 4.1 (2)	3.7-3.7 (3.7) (2)
<i>zw</i>	14.1, 14.2 (2)	13.8-14.5 (14.3) (3)

Diagnostic characters : A medium-sized, soft-furred vole, having a moderately long tail (35-50% of HB), with a pencil of hair at its tip; soles clad with soft white hairs behind the pads; claws not hidden by hair. Body light greyish brown with a slight rufous tinge above, greyish white below; no sharp line of demarcation along the flanks; tail bicoloured, brown above, dirty white below; hind foot white. Mammae 4 pairs.

Skull long and narrow; zygomatic width 13.8-14.5 mm (Hinton, 1926); bulla long, one-fourth of *onl*; maxillary toothrows short, less than 6 mm in length.

Upper incisors yellow and plain. Molars 3/3 in number; M³ having three salient angles on each side, fourth outer salient angle may be small or vestigial; third triangle substantially closed behind (Fig. 9f); third outer fold discernible.

Distribution : Western Himalaya : Jammu & Kashmir (Gilgit, Nultan valley, Gulmarg) and Himachal Pradesh (Kangra, Kullu, Pattan valley c 3000-4200 m, Kyelang).

Ecology and biology : As in *Alticola roylei*.

Intraspecific variation : Hinton (1926) distinguished *A. blanfordi lahulius* from *A. blanfordi blanfordi* by its darker body colour, shorter nasals and less inflated auditory bulla. According to Ellerman (1961), bullae in *blanfordi* are not larger than those of *lahulius* in the limited number of specimens measured by him. The same thing is true about the length of nasals. Hence, he regarded *A. b. lahulius* as a synonym of *A. blanfordi*.

Remarks : Wilson and Reeder (1993) treated *A. blanfordi* as a subspecies of *A. argentatus*. But here Hinton (1926) has been followed.

Alticola montosa (True)

1894. *Arvicola montosa* True, *Proc. U. S. nat. Mus.*, 17 : 11 (Central Jammu & Kashmir, alt. 3300 m, India).

1905. *Microtus imitator* Bonhote, *Ann. Mag. nat. Hist.*, [7], 15 : 197 (Tullian c 3300 m, Jammu & Kashmir, India).

Common name : True's Vole (Eng.)

Measurements : (vide Ellerman, 1961 for Indian specimens).

External : 10 ex : HB 102-106 (109 ± 8); Tl 42-58 (47 ± 4.5); Hf 18-21 (20 ± 8); E 13-16 (14.5 ± 1).

Cranial : 9 ex : *onl* 25.1-28.3 (26.5 ± 1.1); *p* 13-15 (14 ± 6); *apf* 4.8-5.8 (5.4 ± 3); *b* 6.4-7.1 (6.65 ± 2.5); *m* 5.9-6.4 (6.1 ± 3); *iw* 3.5-4.1 (3.8 ± 2.5); *zw* 14.9, 15.3, 16.0 (Hinton, 1926).

Diagnostic characters : A soft-furred vole, having a moderately long tail (more than 40% of HB), with a short pencil of hair at its tip. Body greyish brown above, silvery grey below but without any buffy suffusion; a sharp line of demarcation present along the flanks between upper and undersurfaces; tail bicoloured, dusky above, whitish below; hindfoot greyish. Mammae 4 pairs.

Skull large, broad and heavy, zygomatic width 14.9-16.0 mm (Hinton, 1926); bulla large, about one-fourth of *onl*; maxillary toothrows long, generally more than 6 mm in length.

Upper incisors yellow and plain; M^3 having three salient angles on each side as in *Alticola roylei* but the third triangle substantially closed behind as in *A. blanfordi*; third outer fold absent.

Distribution (Map 1) : Western Himalaya : India : Jammu & Kashmir (Astor, Gulmarg, Sonemarg, Pahelgam and Kishtwar). Also reported from NWFP, Pakistan and Afghanistan (Ellerman, 1961).

Ecology and biology : As in *Alticola roylei*.

Alticola stoliczkanus (Blanford)

1875. *Arvicola stoliczkanus* Blanford, *J. Asiat. Soc. Bengal.* 44(2) : 107 (Kuenlun Mt., N. Ladakh, Jammu & Kashmir, India).

1899. *Alticola stoliczkanus aerophilus* Miller, *Proc. Acad. nat. Sci. Philadelphia* : 296 (Ladakh side of Karakoram Pass c 5100 m, Jammu & Kashmir, India).

Common name : Stoliczka's Vole (Eng.).

Measurements :

External Syntype : HB 101, TI 25, Hf 18.

Cranial : *onl* 25.8; *cb* 26.0; *apf* 5.0; *b* 6.3; *m* 6.0.

Diagnostic characters : A soft-furred vole, having a very short tail, measuring less than 30% of head and body, covered with stiff white hairs extending beyond the tail-tip; hindfoot small, armed with long, compressed claws, concealed by long white hairs; palms and soles posteriorly hairy, with a few hairs between digital pads; ears rather large but concealed in fur. Body bright ferruginous brown above, white below; tail white; hindfoot pale white.

Skull rather large, condylobasal length exceeding occipitonasal length.

Upper incisors yellow and plain. Molars $3/3$; M^3 reduced, with an anterior loop, one inner and one outer triangles, and a short straight posterior loop; two inner angles and one or atmost two inner folds present; posterior loop short and broad, less than half the length of crown (Fig. 9e).

Distribution (Map 3) : India : Jammu & Kashmir (N. Ladakh). Also reported from Nepal and China.

Ecology and biology : As in *Alticola roylei*.

Alticola stracheyi (Thomas)

1880. *Arvicola stracheyi* Thomas, *Ann. Mag. nat. Hist.*, [5], 6 : 332 (Ladakh, Jammu & Kashmir, India).

1899. *Microtus cricetulus* Miller, *Proc. Acad. nat. Sci. Philadelphia* : 294 (Tso-Kyun c 4800 m, Ladakh, Jammu & Kashmir, India).

1955. *Alticola bhatnagari* Biswas & Khajuria, *Proc. zool. Soc. Calcutta*, 8 : 29 (Mingbo c 4500 m, Langmoche valley, Khumbu, Nepal).

Common name : Thomas' short-tailed Vole (Eng.).

Measurements : (vide Ellerman, 1961; Biswas & Khajuria, 1955).

	<i>A. stracheyi</i>	<i>A. bhatnagari</i>
HB	88-120 101±10 (13)	82, 95
TI	18-30 23.2±3.2 (13)	24, 29

	<i>A. stracheyi</i>	<i>A. bhatnagari</i>
Hf	17-20 19±1 (13)	17.5, 18
E	14-16 15±1 (13)	11.5, 13
onl	24.6-27.3 26.3±1.1 (4)	24.9-26.2 25.6 (3)
p	13.2-14.7 14.1±.55 (4)	13.3, 14.2 (2)
apf	5.3-5.7 5.5±1.7 (4)	5.0-5.2 5.15 (3)
b	6.1-6.7 6.4±.27 (4)	5.8-6.4 6.1 (3)
m	5.5-6.1 5.9±.25 (4)	6.0-6.3 6.1 (3)

Diagnostic characters : Essentially like *Alticola stoliczkanus* but differs from it in the dorsum being pale yellowish brown, inconspicuously lined by longer blackish hairs; cheeks tend to be white. M³ less reduced, its posterior loop long and narrow, measuring half the length of crown; only two inner angles and one or sometimes two inner folds (Fig. 9m) present.

Distribution : India : Jammu & Kashmir (Ladakh, Rupshu, Khardong, Mipal valley, Chipchak river) and Himachal Pradesh (Lahul : Kyelong). Also reported from Nepal (Mt. Everest, Khumbu) and China.

Ecology and biology : Commonly seen in the month of April in Khumbu valley, Nepal (Biswas & Khajuria, 1957). Nothing is recorded about its breeding, except that two young-ones were collected from a nest under a large rock (Ellerman, 1961).

Remarks : No difference could be observed between *Alticola stracheyi* and *Alticola bhatnagari* either in body-colour and measurements or in the structure of M^3 . Hence, *A. bhatnagari* is treated here as a synonym of *A. stracheyi*.

Genus *Hyperacrius* Miller

1896. *Hyperacrius* Miller, N. Am. Fauna, 12 : 54.

Type species : *Arvicola fertilis* True.

Distribution : India (Jammu & Kashmir) and Pakistan.

The genus *Hyperacrius* is more specialised in external form than *Alticola*, and to a certain degree modified for fossorial life. Condylbasal length exceeds occipitonasal length; supraorbital ridges fuse to form a weak median interorbital crest; palate long, averaging more than 60% of occipitonasal length. Upper incisors proodont. Cheekteeth rootless, and tall-crowned; M^3 having its posterior loop shorter, broader and more reduced than in the genus *Alticola*.

Two species of genus *Hyperacrius* occur within the Indian limits.

Key to species of genus *Hyperacrius*

Larger size; occipitonasal length more than 25 mm and maxillary toothrows more than 6.2 mm; tail longer, more than 30% of head & body length *H. wynnei*

Smaller size; occipitonasal length less than 25 mm and maxillary toothrows less than 6.2 mm; tail shorter, less than 30% of head & body length *H. fertilis*

Hyperacrius wynnei (Blanford)

1881. *Arvicola wynnei* Blanford, *J. Asiat. Soc. Bengal*, 49 (1880) : 244-245 (Muree c 2100 m, Pakistan).

Common names : Muree Vole (Eng.); Kanis (Hin.).

Measurements : (vide Ellerman, 1961)

External

India (J&K) : 5 ex : HB 84-92 (86.6 ± 2.9); TL 32-35 (33.2 ± 1.2); Hf 16-17 ($16.4 \pm .5$); E 8-8.

Pakistan : 27 ex : HB 100-122 (109 ± 6); TL 23-45 (38 ± 4.5); Hf 17-19.5 ($18.0 \pm .6$); E 8-10 ($9.0 \pm .7$).

Cranial 5 ex : *onl* 25.4-28.8 (26.7 ± 1.2); *p* 15.2-17.3 ($16.1 \pm .8$); *apf* 4.3-5.4 ($4.9 \pm .4$); *b* 5.6-6.8 ($6.2 \pm .5$); *m* 6.2-7.2 ($6.7 \pm .35$); *iw* 4.1-4.5 ($4.2 \pm .15$).

Diagnostic characters : A dark brown vole, having a well-haired tail, generally more than one-third of head and body length; hands and feet with long slender claws; soles hairy behind pads; ears very small, less than one-tenth of head and body length. Fur soft, dense and velvety. Two colour phases—dorsum yellowish brown or blackish brown and venter greyish or brownish; tail obscurely bicoloured; hindfoot dark grey. Mammae 3 pairs.

Skull relatively large, occipitonasal length exceeds 25 mm; condylobasal length exceeds occipitonasal; supraorbital ridges fuse to form a weak crest over frontals; palate long, more than 60% of *onl*, terminating posteriorly as a simple transverse shelf; anterior palatal foramina narrow but not very short. Root of lower incisors forming a knob on the outer surface of mandible below condylar process.

Upper incisors wide, yellow and plain. Cheekteeth 3/3, rootless and tall-crowned; folds wide open and of long drawn out appearance. M^3 reduced, having two main folds on each side; postero-external fold widest; posterior loop very short (Fig. 9g). M_1 with a posterior loop, an inner closed triangle, two confluent triangles in front of that, followed by two more confluent triangles opening into anterior loop (Fig. 9g').

Distribution (Map 3) : India : Jammu and Kashmir (Sardalla). Also reported from Pakistan (Murree and Gharial in Punjab and Doonglagali in NWFP).

Ecology and biology : Occurs in moist temperate forest and grassy slopes between 1850 and 3050 *m* altitude. Diurnal and fossorial. Feeds on roots, rhizomes and tubers in the summer and on dead grass and other available vegetation in the winter. The information on its breeding habit is scanty. Probably, it breeds in the summer and the litter-size is 2 or 3 (Roberts, 1977).

Intraspecific variation : Specimens from Jammu & Kashmir are smaller in head & body length than those from Pakistan and there is a clear-cut difference.

***Hyperacrius fertilis* (True)**

1894. *Arvicola fertilis* True, *Proc. U. S. nat. Mus.*, 17 : 10 (Pir Panjal Mt. c 2550 *m*, Jammu & Kashmir, India).

1899. *Microtus* (*Hyperacrius*) *brachelix* Miller, *Proc. Acad. nat. Sci. Philadelphia*, : 290. (Nagmarg c 2700 *m*, Jammu & Kashmir, India).

Common name : True's Vole (Eng.).

Measurements : (*vide* Ellerman, 1961).

	<i>fertilis</i>	<i>brachelix</i>
HB	91-111 103±7 (16)	87-98 94±4 (8)
Tl	19-38 26±4 (16)	19-26.5 24±2.1 (8)
Hf	14-17 15.5±.9 (16)	14-19 16±1.8 (8)
E	8-14 11±1.4 (16)	7-10 9±1 (8)
<i>onl</i>	22.1-24.0 23.0±.7 (7)	22.2-23.7 22.9±.6 (8)
<i>p</i>	13.3-14.5 13.9±.35 (7)	12.7-14.5 13.7±.6 (8)
<i>apf</i>	4.1-5.2 4.55±.35 (7)	3.7-4.6 4.2±.25 (8)
<i>b</i>	4.7-5.7 5.2±.3 (7)	5.0-5.6 5.2±.25 (8)
<i>m</i>	5.6-6.2 5.8±1.5 (7)	5.5-6.0 5.7±.15 (8)
<i>iw</i>	3.6-3.9 3.7±.1 (7)	3.6-4.0 3.8±.15 (8)

Diagnostic characters : A soft-furred vole, having the tail relatively shorter than that of *Hyperacrius wynnei* (less than 30% of HB); ears small, about 10% of HB, slightly smaller in *brachelix* than in *fertilis*. Body dark brown above, dull ochraceous below; tail bicoloured, dark above, paler below; hindfoot sepia in colour. Mammae 3 pairs.

Skull smaller than that of *H. wynnei*, occipitonasal length less than 24 mm and maxillary tooth-rows less than 6.2 mm in length. Interorbital crest extends the whole length of frontals rather than at a point in *H. wynnei*.

Dentition essentially as in *H. wynni*, but there seems to be individual variation in the first lower molar as to how many of the triangles are closed. It varies from all to none (Fig. 9h, h').

Distribution (Map 3) : India : Jammu & Kashmir (Pir Panjal range, Gilgit, Pahalgam, Kishtwar, Gugga nullah, Leddar valley, Jogila Pass in Ladakh). Also reported from Pakistan (NWFP : Hazara, Kagan valley).

Ecology and biology : Inhabits the subalpine scrub zone and alpine meadows above the tree line between 2450 and 3600 m altitude. Diurnal and fossorial. Feeds principally on succulent roots and rhizomes. Two or three young-ones are born in a litter during spring and the summer.

Intraspecific variation ; No subspecies.

Genus *Pitymys* McMurtrie

1831. *Pitymys* McMurtrie, *Cuvier's Anim. Kingdom, Am. ed.*, 1 : 434.

1949. *Neodon* Hodgson, *Ann. Mag. nat. Hist.*, [2], 3 : 203 (Type species *Neodon sikimensis* Hodgson).

1863. *Phaiomys* Blyth, *J. Asiat. Soc. Bengal*, 32 : 89 (Type species *Phaiomys leucurus* Blyth).

Type species : *Psammomys pinetorum* Le conte.

Distribution : N. America, Continental Europe south of Baltic, Russia, Asia Minor, Himalaya and China.

The genus *Pitymys* is characterised by the posterior median process of palate continuous with the inner border of postero-lateral pits forming a sloping septum (Fig. 10b), and the first lower molar possessing three closed triangles instead of four or five in *Microtus*. The Chinese and Mongolian species, erroneously referred to *Phaiomys* by Allen, were relegated to *Lesiopodomys* (Lataste, 1887) by Hinton (1926) on account of the fact that their first lower molar has five closed triangles, and hence would, be regarded as a subgenus of *Microtus*.

Two species of genus *Pitymys* occur within the Indian limits.

Key to species of genus Pitymys

Tail shorter, less than one-third of head and body length; bulla large, more than 7 mm in length; M₁ having four inner and three outer folds..... *P. leucurus*

Tail longer, more than one-third of head and body length; bulla small, less than 7 mm in length; M₁ having five inner and four outer folds *P. sikimensis*

Pitymys leucurus (Blyth)

(Plate 1, fig. D)

1863. *Phaiomys leucurus* Blyth, *J. Asiat. Soc. Bengal*, 32 : 89 (Tsomoriri, Ladakh, Jammu & Kashmir, India).
1875. *Arvicola blythi* Blanford, *J. Asiat. Soc. Bengal*, 44 : 107.
1911. *Microtus (Phaiomys) waltoni petulans* Wroughton, *J. Bombay nat. Hist. Soc.*, 20 : 931 (Teza, Upper Sutlej valley).
1922. *Phaiomys everesti* Thomas & Hinton, *Ann. Mag. nat. Hist.*, [9], 9 : 182 (East Mt. Everest c 5100 m, Nepal).

Common name : Blyth's Vole (Eng.).

Measurements : (vide Ellerman, 1961).

External : 12 ex. HB 98-128 (113 ± 8.5); TI 26-35 (31.5 ± 2.5); TI as % HB 24-30 (28 ± 2.2); Hf 16-19 (18 ± 1); E 10-13 (11.5 ± 1); E as % of HB 10-12 (10.4 ± 0.65).

Cranial : 9 ex : *onl* 24.2-27.0 (25.65 ± 1.2); *p* 15.0-16.6 (15.8 ± 0.7); *apf* 4.2-5.3 (4.8 ± 0.4); *b* 6.5-8.2 (7.5 ± 0.5); *b* as % of *onl* 26.8-30.8 (29.0 ± 1); *m* 6.1-6.8 (6.4 ± 0.2); *iw* 3.6-3.9 (3.7 ± 0.1).

Diagnostic characters : A thick-furred vole, having a short hairy tail (less than 30% of HB), and small ears (less than one-eighth of HB); hind-foot studded with well-developed claws; soles partly hairy. Body yellowish brown above and greyish white below; coloration slightly darker in *petulans* and *everesti*; hind-foot white.

Condylbasal length of skull exceeds occipitonasal length; supraorbital ridges fuse to form a median crest over frontals; posterior median process of palate continuous with inner border of postero-lateral pits to form a sloping septum; palate long, more than 60% of occipitonasal length; bulla large and inflated, more than one-fourth of *onl.*, anterior palatal foramina narrow.

Upper incisors broad, yellow, plain and proodont. Molars 3/3, tall crowned and rootless. M^3 reduced, having an anterior loop, followed by two closed triangles and a small posterior loop; two folds on each side (Fig. 9c). M_1 having a posterior loop, three alternating closed triangles, followed by two confluent triangles merged into anterior loop; usually four inner and three outer folds present (Fig. 9c').

Distribution (Map 3) : India : Jammu & Kashmir (Ladakh c 4500 m alt.) and Himachal Pradesh (Kangra). Also reported from Nepal and SW China.

Ecology and biology : Found in mountainous region, above an altitude of 4500 m. Diurnal and fossorial; makes deep burrows on the bank of lakes or rivers. Nothing

much is known about its breeding habit except that the uterus of one specimen contained seven embryos (Ellerman, 1961).

Pitymys sikimensis (Hodgson)

1849. *Neodon sikimensis* Hodgson, *Ann. Mag. nat. Hist.*, [2], 3 : 203 (Sikkim, India).

1863. *Arvicola thricolis* Gray, *Cat. Hodgson's Coll. Brit. Mus.*, ed. 2, 10, nomen nud. (Darjeeling, West Bengal).

Common name : Sikkim Vole (Eng.).

Measurements :

External : 12 ex : HB 97-119 (105 ± 8); TI 38-52 (45 ± 4.5); TI as % of HB 39-45 (42); Hf 18-22 (20 ± 1.1); E 12-16 (14 ± 1.5); E as % of HB 12-15 (13).

Cranial : 16 ex : *onl* 25.4-27.5 (26.5 ± 7); *p* 14.9-16.4 (15.8 ± 6); *apf* 4.0-5.6 (4.8 ± 3.5); *iw* 3.7-4.5 (4.0 ± 2.7); *b* 5.6-6.8 (6.1 ± 3); *m* 6.0-7.0 (6.6 ± 2.7); *b* as % of *onl* 21.0-24.0 (22.7).

Diagnostic characters : A dark brown vole, of the size of *Pitymys leucurus*, having a well-haired tail, more than 40% of head and body length; ears slightly larger than in *P. leucurus*, about 13% of HB. Body slaty to reddish brown above, greyish white below; hind-foot grey. Mammae 3 pairs.

Condylbasal length of skull exceeds occipitonasal length. Supraorbital ridges fuse to form a median crest over frontals; palate long, on average, 60% of occipitonasal length; its posterior portion as in *P. leucurus*; bulla small, less than one-fourth of *onl*. Darjiling specimens are having smaller anterior palatal foramina than Sikkim ones (14.6-17.1 vs 18.1-20.0% of *onl*).

Upper incisors wide, yellow and slightly proodont. Molars 3/3, rootless and tall-crowned. M^3 having an anterior loop, three alternating closed triangles and a posterior loop; three outer and three inner folds present (Fig. 9b). M_1 complex, having a posterior loop, three alternating closed triangles, two pairs of confluent triangles and an anterior loop; five inner and four outer folds (Fig. 9b).

Distribution (Map 3) : India : Sikkim (Lachen, Yumthang, Thangu, Kapup) and northern West Bengal (Darjiling dist.). Also reported from Nepal (Biswas & Khajuria, 1957; Abe, 1971), and E. Bhutan (Me La vide Ellerman, 1961).

Ecology and biology : Inhabits meadows, rhododendron and coniferous forests, between 2100 and 3700 m altitude. Diurnal and fossorial. Feeds mainly on vegetable matter. Breeds in hollow of decayed trees or amongst the roots, making a nest of soft moss and grass; litter-size 2-4 (Khajuria, 1959; Abe, 1971).

Remarks : Honacki *et al.* (1982) treated *Pitymys irene* as a subspecies of *Pitymys sikimensis*. But Ellerman (1961) considered it as a full species with which the present author agrees. M^3 and M_1 are reduced in *irene* than in *sikimensis*. M_1 having only four inner and three outer folds as is found in *P. leucurus*. Being extralimital, *P. irene* has not been dealt with here.

Subfamily MURINAE

The subfamily Murinae is characterised by the upper molars being laminate, the laminae pressed close together, and the cusps, when present, are arranged in three longitudinal rows. The cheek-teeth are rooted and 3/3 in number. The infraorbital foramen is normally modified into a wider upper portion for muscle transmission and a narrow lower portion for nerve transmission. The zygomatic plate is broadened and tilted upwards. The tympanic bulla vary greatly in size from 9 to 25% and palate from 40 to 60% of occipitonasal length. The anterior palatal foramina may be as small as in *Nesokia* or as long as in *Millardia*, *Mus* and *Bandicota*, extending posteriorly between maxillary tooth-rows. With the exception of *Hapalomys*, there are only two functional rows of cusps in the lower molars. Externally, the form may be adapted to arboreal, ground-dwelling or fossorial life.

Within the Indian limits, the subfamily Murinae is represented by 17 genera and 47 species.

Key to genera of subfamily Murinae

- 1 Hallux clawless 2
 - Hallux clawed 3
2. Fifth finger and fifth toe lack a claw (Fig. 3a); interorbital width of skull less than 4 mm. VANDELEURIA
 - Fifth finger and fifth toe provided with a claw (Fig. 3b); interorbital width of skull more than 4 mm CHIROPDOMYS
3. Anterior border of zygomatic plate concave (Fig. 5c).....HADROMYS
 - Anterior border of zygomatic plate not concave 4
4. Upper incisors grooved on front surface; molars heavily cuspidate
 - GOLUNDA
 - Upper incisors not grooved; molars not heavily cuspidate 5

5. Upper incisors proodont; condylobasal length of skull exceeds occipitonasal length 6
 Upper incisors opisthodont or orthodont; occipitonasal length of skull exceeds condylobasal length 8
6. Small species, HB less than 130 mm and occipitonasal length less than 34 mm; molars 8-cusped (cusp t7 absent) DIOMYS
 Large species, HB more than 130 mm and occipitonasal length more than 34 mm; molars 9-cusped (cusp t7 present) 7
7. Anterior palatal foramina very small, less than 6.5 mm in length, not extending between maxillary toothrows NESOKIA
 Anterior palatal foramina long, more than 6.5 mm in length, extending between maxillary toothrows BANDICOTA
8. Cusp t7 present in upper molars 9
 Cusp t7 absent in upper molars 10
9. Pigmy form, occipitonasal length of skull less than 20 mm; tail prehensile ...
 MICROMYS
 Large form, occipitonasal length of skull more than 20 mm; tail not prehensile
 APODEMUS
10. First upper molar more than one-half the length of tooth-row; its antero-internal (t1) cusp distorted inwards to reach the level of second lamina; third upper molar extremely reduced MUS
 First upper molar less than half the length of tooth-row; its antero-internal (t1) cusp not distorted inwards except in *Millardia gleadowi*; third upper molar not extremely reduced 11
11. Maxillary toothrow long, more than one-fifth of occipitonasal length of skull
 DACNOMYS
 Maxillary toothrow short, less than one-fifth of occipitonasal length of skull.
 12
12. Anterior palatal foramina long, more than one-fifth of occipitonasal length, and extending between maxillary toothrows 13
 Anterior palatal foramina short, less than one-fifth of occipitonasal length, and not extending between maxillary toothrows 14

13. Palate long, exceeding half the length of occipitonasal; tail subequal or shorter than head and body length..... MILLARDIA
 Palate short, less than half the length of occipitonasal; tail longer than head and body length CREMNOMYS
14. Bulla very small, about one-tenth of occipitonasal length of skull (Fig. 11c).
LEOPOLDAMYS
 Bulla proportionately large, more than one-tenth of occipitonasal length of skull (Fig. 11 a, b) 15
15. Palate short, less than one half of occipitonasal length..... NIVIVENTER
 Palate long, more than one-half of occipitonasal length..... 16
16. Diastema short, less than 28% of occipitonasal length; palate extending posteriorly behind third upper molars RATTUS
 Diastema long, more than 28% of occipitonasal length; palate not extending posteriorly behind third upper molars BERYLMYS

Genus *Apodemus* Kaup

1829. *Apodemus* Kaup, *Skizz. Europ. Thierwelt*, 1 : 154.

1924. *Sylvaemus* Ognev, *Fauna vert. Gouv. Voronesh*, : 143 (Type species *Mus sylvaticus* Linnaeus).

1924. *Nemomys* Thomas, *J. Bombay nat. Hist. Soc.*, 29 : 889 (Type species *Mus sylvaticus* Linnaeus).

1928. *Alsomys* Dukelski, *zool. Anz.*, 77 : 42 (Type species *M. sylvaticus major* Radde).

Type species : *Mus agrarius* Pallas.

Distribution : A Palaearctic genus, extending south to the Himalaya.

A generalised mouse in which the postero-internal cusp (t7) is retained in the first and second upper molars, and M³ having three inner lobes. It differs from *Micromys* in being larger in size.

Remarks : Ellerman (1961) assigned specimens of *Apodemus* from India, Nepal and Pakistan to two species, namely, *A. flavicollis* and *A. sylvaticus*, differentiating them on the overlapping size of skull. In recent works, however, the population of *Apodemus* from Afghanistan (Niethammer, 1969), Pakistan (Roberts, 1977), Iran (Lay, 1967), the western Himalaya and the drier alpine zone of Nepal above 3000 m altitude (Martens and Niethammer 1972) have been assigned to *Apodemus sylvaticus*. The lower strata of central Nepal is occupied by yet another species *Apodemus gorkha* (Martens and Niethammer 1972). The population of *Apodemus* from eastern Himalaya which was

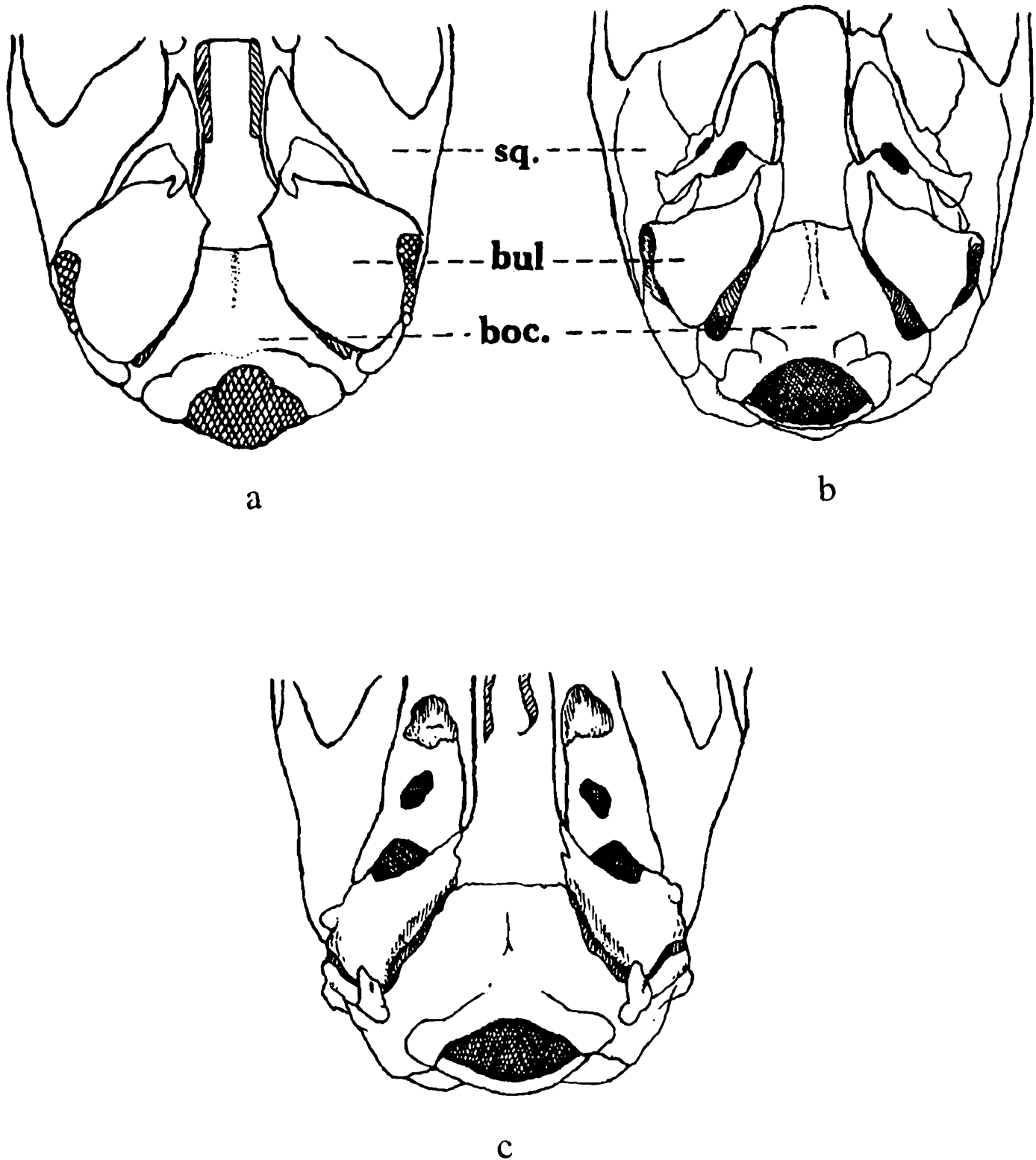


Fig. 11. Ventral view of skulls of (a) *Rattus rattus*, (b) *Berylmys bowersii* and (c) *Leopoldamys edwardsi*, showing the size of bulla in three genera.
sq, squamosal; boc, basioccipital; bul, bulla.

earlier considered as a subspecies of *A. sylvaticus* by Ellerman (1961) and of *A. draco* by Honacki *et al.* (1982), is now treated as a full species, *Apodemus orestes* Thomas.

Thus, three species of the genus *Apodemus* occur in the Himalaya, namely, *A. sylvaticus*, *A. gurkha* and *A. orestes*.

Key to species of genus Apodemus

- 1 Tail shorter, on average less than 110% of head and body length; mammae 3 pairs *A. sylvaticus*
 Tail longer, on average more than 110% of head and body length; mammae 4 pairs 2
2. Palate long, more than one-half of occipitonasal length of skull *A. gurkha*
 Palate short, less than one-half of occipitonasal length of skull *A. orestes*

Apodemus sylvaticus (Linnaeus)

1758. *Mus sylvaticus* Linnaeus, *Syst. nat.*, 10th ed., 1 : 62 (Uppsala, Sweden).

1894. *Mus arianus griseus* True, *Proc. U. S. nat. Mus.*, 17 : 8 (Central Kashmir, India).

1913. *Apodemus flavicollis rusiges* Miller, *Proc. biol. Soc. Wash.*, 26 : 81 (Central Kashmir, India).

Common name : Wood Mouse (Eng.).

Measurements : (Based on ZSI and BM specimens)

(Range, mean, standard deviation and sample size.)

	<i>A. s. rusiges</i> (C. Kashmir)	<i>A. s. wardi</i> (Ladakh)	<i>A. s. pentax</i> (Pakistan)
HB	83-107 97±7 (64)	92-111 100±6 (19)	88-105 96±6 (11)
Tl	91-120 106±8 (59)	90-124 101.5±8.5 (16)	82-96 90±5 (11)
Tl as % of HB	92-123% 108±8 (59)	95-117% 102±6.5 (16)	84-105 94±6 (11)
Hf	21-24 23±1 (64)	19-24 21.5±1.5 (19)	19-23 21.5±1.5 (11)

	<i>A. s. rusiges</i> (C. Kashmir)	<i>A. s. wardi</i> (Ladakh)	<i>A. s. pentax</i> (Pakistan)
E	15-19 17±1 (64)	15-19 17.5±1 (19)	13-16 15±1 (11)
<i>onl</i>	24.9-28.6 27.1±1.0 (19)	25.8-28.0 27.1±.8 (8)	25.4-27.8 26.3±.8 (5)
<i>p</i>	12.5-14.4 13.5±.6 (19)	13.1-14.5 13.6±.7 (8)	12.3-13.7 12.85±.5 (5)
<i>apf</i>	4.8-5.9 5.4±.3 (19)	4.8-5.9 5.3±.3 (8)	4.5-5.6 4.9±.4 (5)
<i>m</i>	3.5-4.3 3.9±.2 (19)	3.6-4.1 3.8±.15 (8)	3.5-4.0 3.7±.15 (5)

Diagnostic characters : A soft furred mouse, having the tail, on average, less than 110% of head and body length. Body yellowish to dark brown above, greyish white below; no clear mid-dorsal stripe present; tail bicoloured, dark above, paler below; hind-foot whitish. Mammae 3 pairs (1+2).

Occipitonasal length of skull exceeds condylobasal length; supraorbital ridges poorly developed; palate approximating to one-half, and anterior palatal foramina about one-fifth of occipitonasal length.

Upper incisors narrow, yellow and plain. Molars 3/3 in number and cuspidate; first upper molar with three laminae, each bearing three cusps, second molar with 8 cusps (t2 absent), and third molar with three inner lobe. A small t10 often traceable behind M¹. Lower molars biserially cuspidate, with three lamina on M₁ and two each on M₂ and M₃; a posterior cingulum present behind third lamina of first, and second lamina of second molar.

Distribution : A Palaearctic species, occurring in the Himalaya from Central Nepal, west to Pakistan and Afghanistan.

Ecology and biology : Found in varied habitats viz. arid, rocky, subalpine, scrub and meadow. In Pakistan, occurs between 1850 and 3600 m attitude. In Nepal, confined to the drier northern alpine zone above 3000 m altitude (Martens and Niethammer, 1972). Nocturnal and fossorial. Food consists of plant material, occasionally insects (Roberts, 1977). Breeds during the spring and the summer; litter-size 3-9.

Intraspecific variation : The length of tail (both absolute and in relation to HB) and the length of palate are, on average, shorter in *pentax* than in *rusiges* or *wardi*, but both the measurements overlap at one standard deviation. Further, the colour difference between *wardi* and *rusiges* are overlapping (Ellerman, 1961). Hence, the subspecies *A. f. rusiges* and *A. s. pentax* are treated here as synonyms of *A. s. wardi* (Wroughton).

(1) *Apodemus sylvaticus wardi* (Wroughton)

1908. *Micromys sylvaticus wardi* Wroughton, *J. Bombay nat. Hist. Soc.*, 18 : 282 (Ladakh, Jammu & Kashmir, India).
 1908. *Micromys sylvaticus pentax* Wroughton, *J. Bombay nat. Hist. Soc.*, 18 : 283 (Thandiani, Punjab, Pakistan).
 1913. *Apodemus flavicollis rusiges* Miller, *Proc. biol. Soc. Wash.*, 26 : 81 (Central Kashmir, India).

Measurements : Given under the species.

Distribution (Map 4) : India Jammu & Kashmir (Astor, Ladakh, Sardalla, Gulmarg, Gugga nullah), Himachal Pradesh (Kullu, Lahul and Spiti) and Uttar Pradesh (Kumaon Pindar valley). Also Nepal and Pakistan.

Apodemus gurkha Thomas

1924. *Apodemus gurkha* Thomas, *J. Bombay nat. Hist. Soc.*, 29 : 888 (Laprak c 3505 m, Gurkha, Nepal).

Common name : Himalayan Wood Mouse (Eng.).

Measurements : (vide Ellerman, 1961, Abe, 1971).

External 8 ex HB 85-102 (92 ± 5.3); TI 98-119 (110 ± 7); TI as % of HB 109-126 (119 ± 6); Hf 21-24 (22.5 ± 1); E 16-17 (16.5 ± 5).

(vide Abe 1971) : 16 ex : HB 101-110 (105); TI 106-125 (116); Hf 22-26 (24.3); E 16-19 (17.5).

Cranial : 3 ex onl 27.7-29.2 (28.5 ± 6); p 14.3-14.7 (14.5 ± 2); m 4.1-4.2 (4.17 ± 0.03); apf 5.7-5.9 (5.8 ± 1); p as % of onl 50.3-51.6 (51.0 ± 55).

Diagnostic characters : A soft-furred mouse, having the tail longer than head and body length, reaching up to 120% of HB in specimens from the type locality (Ellerman, 1961). Body mouse grey above, silvery grey on the undersurface; tail bicoloured; hind-foot white. Mammae 4 pairs (2+2).

Supraorbital ridges in skull, relatively well-developed; palate long, more than one-half, and anterior palatal foramina more than one-fifth of occipitonasal length. Antero-external cusp (t3) of second upper molar poorly developed.

Distribution (Map 4) : Nepal (Gurkha c 3500 m; Maharigaon c 3164 m; Gorapani c 2700 m; Takucha c 2600 m; Larjung c 2530 m; Chitare c 2400 m; upper Ulleri c 2290 m) (Abe, 1971).

Ecology and biology : Occurs in rhododendron and coniferous forests, between 2400 and 3500 m altitude (Martens & Niethammer, 1972). Nocturnal and fossorial. Gut contained more of insects than vegetable matter (Abe, 1971).

Apodamus orestes Thomas

1911. *Apodemus speciosus orestes* Thomas, *Abstr. Proc. zool. Soc. Lond.*, : 49; *Proc. zool. Soc. Lond.*, 1912 : 136 (Mt. Omi-san, W. Szechuan, China).

Common name : Chinese Wood Mouse (Eng.).

Measurements : (vide Ellerman, 1961).

External : 6 ex : HB 94-98 (96 ± 1.9); TI 98-132 (115 ± 11); TI as % of HB 103-134 (120 ± 10); Hf 20-22 (21.5 ± 5); E 15-19 (17 ± 1.4).

Cranial : 9 ex : *onl* 24.7-27.5 (26.3 ± 9); *p* 11.9-13.4 (12.8 ± 5); *p* as % of *onl* 48.0-49.6 (48.6 ± 5); *m* 3.8-4.0 (3.9 ± 5); *apf* 4.8-5.8 (5.35 ± 25).

Diagnostic characters : A small mouse, having a long tail, more than 110% of head and body length. Body blackish brown above, silvery grey on the undersurface; tail bicoloured, nearly black above and paler below; yellow chest spots generally absent. Mammae 4 pairs (Corbet and Hill 1992).

Supraorbital ridges, in skull, poorly developed; palate short, less than one-half, and anterior palatal foramina more than one-fifth of occipitonasal length.

Distribution (Map 4) : India Arunachal Pradesh (Mishmi Hills). Also recorded from N. Myanmar and S. China.

Ecology and biology : Occurs in mixed forests by the side of streams, at attitude between 2743 and 3400 m.

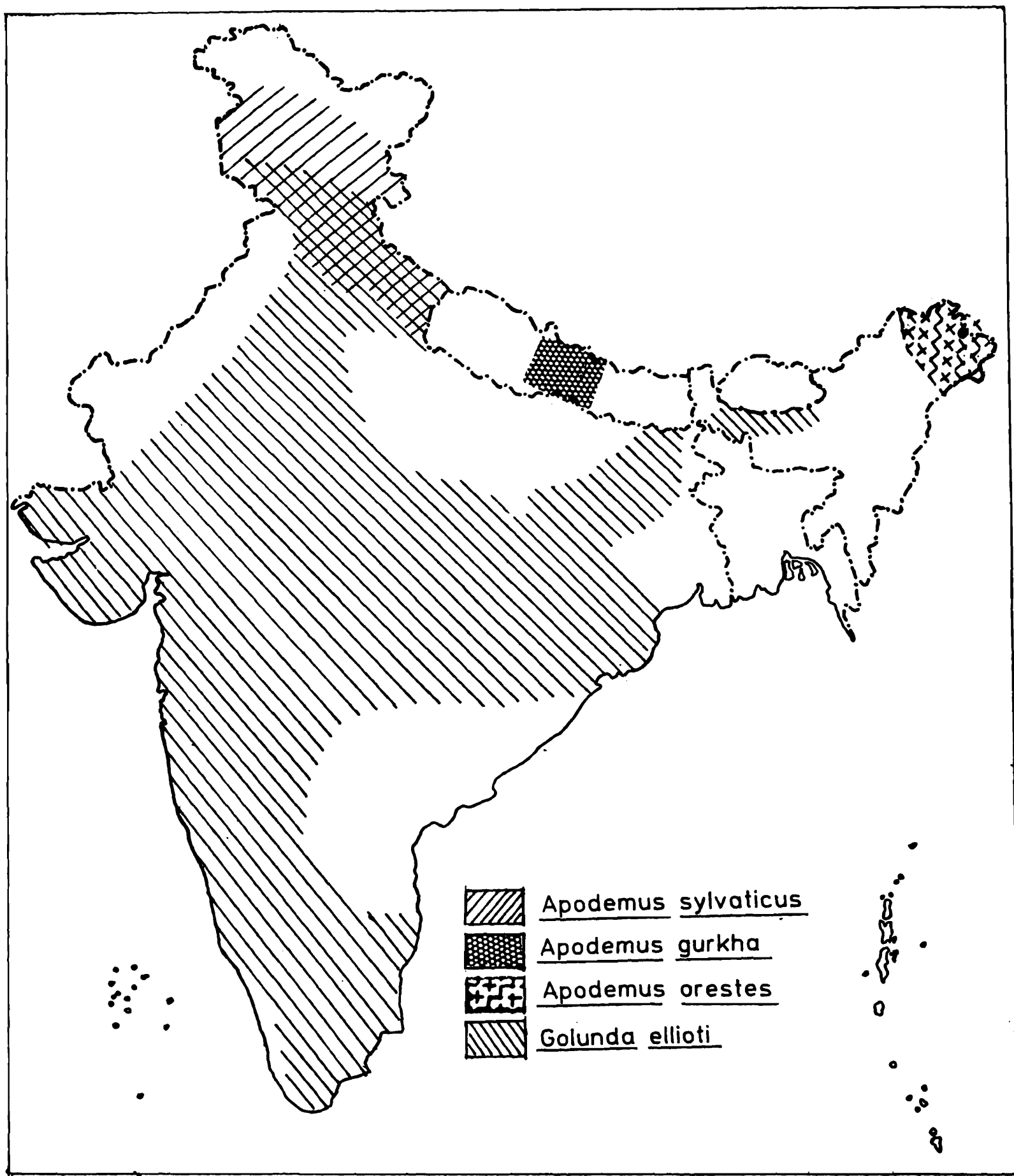
Genus *Micromys* Dehne

1841. *Micromys* Dehne, *ein neues Säugethier der Fauna von Dresden*, p. 1.

Type species : *Micromys agilis* Dehne = *Micromys soricinus* Hermann = *M. minutus soricinus*.

Distribution : A Palaearctic genus, extending south to NE India and east to China and Japan.

The genus *Micromys* is characterised by the presence of postero-internal cusp (t7) in first and second upper molars as in *Apodemus*, but differs from it by its smaller size,



Map 4. Showing the distribution of four species of rodents in India.

prehensile tail, and shorter rostrum and diastema. The hallux is clawed which distinguishes it from the genus *Vandeleuria*.

The genus is monotypic.

***Micromys minutus* (Pallas)**

1771. *Mus minutus* Pallas, *Reise Prov. Russ. Reichs.*, 1 : 454 (Simbrisk = Ulyanousk, U.S.S.R.).

Common name : Harvest Mouse (Eng.).

Measurements : (vide Ellerman 1961).

External : HB 60; Tl 90; Hf 15, E 10.

Diagnostic characters : A soft-furred, pigmy mouse, having a bicoloured prehensile tail, much longer than head and body length in the Indian subspecies; hallux and fifth toe clawed. Body greyish brown above, silvery grey below; tail bicoloured, dark above, pale below. Mammae 4 pairs.

Skull very small, occipitonasal length less than 20 mm; rostrum short; diastema about one-fifth and palate usually less than one-half of occipitonasal length.

Upper incisors narrow, yellow and plain. First upper molar has three laminae, each bearing three cusps (9 cusps in all), second upper molar generally with 7 cusps (t2 and t3 absent), sometimes traces of t3 present, and third upper molar small. Lower molars having two functional rows of cusps, three laminae on first and two each on second and third.

Chromosome number $2N = 68$ (Kral, 1971).

Distribution (Map 5) : A Palaearctic species, occurring in NE India in Meghalaya and Nagaland. Also reported from N. Myanmar to N. Vietnam and China.

Ecology and biology : Diurnal. Lives in tall trees or bamboo thickets. Feeds on seeds, fruit, buds and insects. It delivers its young in grass-nests, in trees; litter size 5-9.

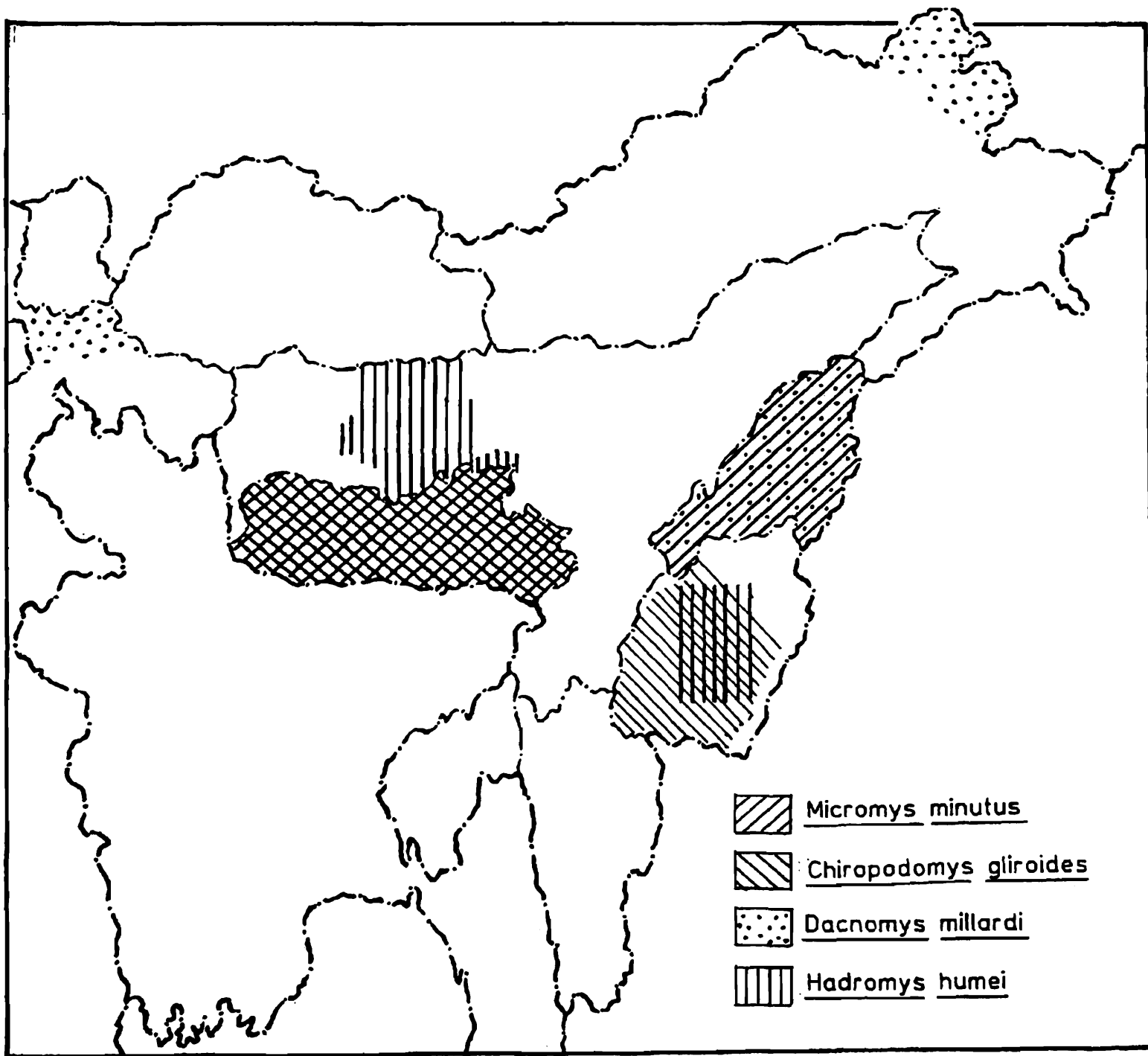
Intraspecific variation : One subspecies of *Micromys minutus* occurs in India.

(1) *Micromys minutus erythrotis* (Blyth)

1855. *Mus erythrotis* Blyth, *J. Asiat. Soc. Bengal*, 24 : 721 (Cherrapunji, Khasi Hills, Meghalaya, India).

1874. *Mus pygmaeus* Milne Edwards, *Rech. Mamm.*, : 291 (Maupin, Szechuan, China).

Measurements : As mentioned under the species.



Map 5. Showing the distribution of four species of rodents in India.

Distribution : India : Meghalaya (Cherrapunji) and Nagaland. Also reported from N. Myanmar, China and N. Vietnam.

Genus *Chiropodomys* Peters

1868. *Chiropodomys* Peters, *Monatsb. Preuss. Akad. Wiss. Berlin*, : 448.

Type species : *Chiropodomys penicillatus* Peters.

Distribution : Southeast Asia; from NE. India to S. China, Vietnam and Borneo.

The genus *Chiropodomys* contains specialised arboreal mice, in which the postero-internal cusp (t7) is retained in first and second upper molars and the hallux is clawless. It differs from its allied genus *Vandeleuria* in having proportionately wider frontals and the fifth toe clawed.

Out of five species of this genus found in SE Asia (Musser, 1979), one, namely, *Chiropodomys gliroides* occurs in India.

Chiropodomys gliroides (Blyth)

(Plate 2, fig. A)

1856. *Mus gliroides* Blyth, *J. Asiat. Soc. Bengal*, 24 : 721 (Cherrapunji, Khasi Hills, Meghalaya).

Common name : Penicillate-tailed Tree Mouse (Eng.).

Measurements : (Based on ZSI and BM specimens from Meghalaya and Myanmar).

External : 20 ex : HB 86-103 (92 ± 4); TI 116-148 (126 ± 9); TI as % of HB 126-151 (138 ± 8); Hf 17-20 (19.7 ± 8); E 15-19 (16.6 ± 7).

Cranial : 16 ex : *onl* 24.1-26.2 (25.0 ± 6); *p* 11.7-12.9 (12.3 ± 3); *apf* 3.1-4.2 (3.8 ± 3); *b* 3.2-4.1 (3.8 ± 3); *m* 3.5-4.1 (3.8 ± 2); *iw* 4.4-5.2 (4.6 ± 4).

Diagnostic characters : An arboreal mouse, with head and body length usually less than 100 mm; tail hairy, tufted terminally and much longer than head and body length; hallux clawless, and broadened at tip; fifth toe clawed; ears round, thin, scantily haired and brown in colour. Pelage thick, soft and dense. Facial vibrissae long. Body pale chestnut or reddish brown above, white below; cheeks buffy; tail unicoloured, greyish to dark brown; hind-foot whitish. Mammary 2 pairs.

Occipitonasal length 25 ± 6 mm; supraorbital ridges prominent over frontals; heavily widened braincase; rostrum short; nasals anteriorly end behind front edges of premaxilla; palate short, less than half of occipitonasal length and end slightly behind third upper molars; diastema relatively short and anterior palatal foramina long so that length of foramina ranges from 55 to 73% of diastema-length (Musser, 1979), much longer than in other species.

Upper incisors narrow, orthodont and orange in colour. Molars 3/3. First upper molar with three laminae, each bearing three cusps and a small postero-external one (t10) behind these; second upper molar like first but lacks the central cusp (t2) of the first lamina; third upper molar like second but much smaller. Lower molars having the usual two rows of cusps, with clear indications of the vestigial outer row.

Chromosome number $2N = 42$, all telocentric in specimens from Thailand; and $2N = 42$, $FN = 48$ in specimens from Malaya (Corbet and Hill, 1992).

Distribution (Map 5) : NE. India, Myanmar, Thailand, Laos, Vietnam, S. China, Malaysia and Indonesia.

Ecology and biology : Occurs in primary and secondary forests especially where bamboo clumps are common. Specimens have been obtained from tropical deciduous, semi-evergreen and evergreen rain forests on lowlands, coastal plains and hills up to an attitude of 1600 m (Musser, 1979). Nocturnal and arboreal. Feeds mainly on vegetable matter. Nests in hollows of bamboo; 1-3 (mean 2.2) embryos were found in uterii of this species in Malaysia (Harrison, 1955) and a litter of five young-ones was delivered in captivity (Medway, 1967).

Intraspecific variation : Out of five subspecies of *Chiropodomys gliroides*, the nominate subspecies occurs in India (Musser, 1979).

(1) *Chiropodomys gliroides gliroides* (Blyth)

1856. *Mus gliroides* Blyth, *J. Asiat. Soc. Bengal*, 24 : 721 (Cherrapunji, Khasi Hills, Meghalaya, India).

1859. *Mus peguensis* Blyth, *J. Asiat. Soc. Bengal*, 28 : 295 (Schwegyin, S. Myanmar).

Measurements : As given under the species.

Distribution : India : Meghalaya (E. Khasi Hills) and Manipur (Musser, 1979). Also reported from Myanmar, Thailand, Laos, Vietnam and S. China.

Characterised by longer anterior palatal foramina, shorter diastema, shorter palatal bridge and shorter distance between palatal foramina and first upper molar than in Malaysian subspecies (Musser, 1979).

Genus *Vandeleuria* Gray

1842. *Vandeleuria* Gray, *Ann. Mag. nat. Hist.*, [1] 10 : 265.

Type species : *Mus oleraceus* Bennett.

Distribution : India, Nepal, Sri Lanka, Myanmar, Thailand, Laos and Vietnam.

The genus *Vandeleuria* is characterised by the hallux and 5th toe clawless, frontals relatively narrow and the postero-internal cusp (t7) retained in first and second upper molars. This genus differs from *Chiropodomys* and *Micromys* in the fifth finger and fifth toe being clawless.

The genus *Vandeleuria* is represented in India by a single species *Vandeleuria oleracea*. The subspecies *V. oleracea nolthenü* (*sensu* Ellerman, 1961) from Sri Lanka, is now treated as a full species (Corbet & Hill 1992) and differs from *V. oleracea* by the grey colour of its venter

***Vandeleuria oleracea* (Bennett)**
(Plate 2, fig. B)

1832. *Mus oleraceus* Bennett, *Proc. zool. Soc. Lond.*, 1832 : 121 (Deccan, India).

Common name : Indian Long-tailed Tree Mouse (Eng.).

Measurements : (Based on ZSI, BNHS and BM specimens).
(Range, mean, standard deviation and sample-size.)

	<i>oleracea</i>	<i>spadicea</i>	<i>nilagirica</i>	<i>dumeticola</i>	<i>modesta</i>	<i>rubida</i>
HB	60-95 73±8 (58)	79-85 82.5±2.1 (4)	64-105 82±11 (19)	53-85 66±6 (88)	63-67 69.5±4 (12)	78
Tl as % of HB	117-178 149±14	125-138 131±5 (4)	115-175 145±17 (19)	130-204 165±15 (88)	142-175 156±9 (12)	159
Hf	14-20 17.5±2	18-19 18.2±.4 (4)	15-20.5 18.0±1.7 (19)	15-20 17±1.1 (88)	17-19 18±.7 (12)	18.5
E	12-18 15+1	15-16 15.5±.5 (4)	13-19 16.0±1.4 (19)	11-16 14.0±1.5 (88)	14-15 14.5±.5 (12)	15
<i>onl</i>	19.2-23.5 20.9±1.1 (27)	22.6-23.4 23.0±.35 (3)	22.4-23.9 23.1±.5 (12)	19.2-22.6 20.9±.8 (59)	20.3-23.1 21.6±.8 (8)	23.4
<i>m</i>	2.9-3.5 3.3±.14 (27)	3.4-3.5 3.45±.15 (3)	3.3-3.7 3.5±.1 (12)	3.0-3.5 3.2±.1 (59)	3.2-3.5 3.35±.1 (8)	3.4

Diagnostic characters : A small arboreal mouse, head and body length less than 100 mm, with tail much longer, about one and a half times of head and body, and not well-haired; hallux and fifth toe clawless and provided with short nails; fifth toe appears to be opposable (Fig. 3b). Dorsum dull to rusty brown, sandy in specimens from arid region; tail unicoloured and dark; venter white in Indian specimens; hind-foot pale. Mammary 4 pairs.

Skull narrow; frontals constricted, least interorbital width less than 4 mm; palate short, less than half of *onl*; anterior palatal foramina quite long, 16-18% of *onl*.

Upper incisors narrow, yellow and plain. Molars 3/3 in number. M^1 4-rooted. Postero-internal cusp (*t7*) is retained in upper molars so that M^1 is 9-cusped, M^2 8-cusped and M^3 reduced but originally trilaminar. Lower molars biserially cuspidate; subsidiary outer row of cusps not distinct.

Chromosome number $2N = 28$ in specimens from Mysore, Karnataka, India (Satya Prakash *et al.* 1976); $2N = 29$ in specimens from Himachal Pradesh (Pathak, 1971) and Varanasi, Uttar Pradesh (Sharma and Rajiv Raman, 1972).

Distribution : Throughout India in suitable habitats. Also reported from Nepal, Sri Lanka, and Myanmar to Vietnam.

Ecology and biology : Nocturnal and arboreal. Feeds on shoots, buds and fruit, also insects. Builds its globular nest in the hollows of trees preferably of cane, palm and bamboo thickets (Chauhan and Saxena 1982); also nests in thatched roof or in Baya's nest (Sharma, 1988). Litter-size 3-6.

Intraspecific variation : Ellerman (1961) maintained six subspecies of *Vandeleuria oleracea*, namely, *oleracea*, *dumeticola*, *modesta*, *rubida*, *spadicea* and *nilagirica* from India on the basis of body-colour and lengths of tail and occipitonasal. Agrawal and Chakraborty (1980) synonymised *modesta* with *dumeticola*. After the availability of additional material of this species from different parts of India (Punjab, Rajasthan, Gujarat, Uttar Pradesh, Andhra Pradesh, Orissa, West Bengal and Manipur), it is observed that lengths of occipitonasal and maxillary tooth-rows overlap in different populations. However, the specimens from southern India and Gujarat are of lighter colour (dull brown) than of northern India (rusty or reddish brown).

Hence, two subspecies, namely, *V. oleracea oleracea* from S. India and Gujarat, and *V. oleracea dumeticola* from N. India, are recognised on the basis of colour of dorsum. These two subspecies also differ in the chromosome number.

There is a tendency in specimens of *dumeticola* to be on average smaller in head and body length and longer in the relative length of tail than of the nominate subspecies, but the differences overlap at one standard deviation from the mean.

Key to subspecies of Vandeleuria oleracea

Dorsum of various shades of dull brown *V. o. oleracea*

Dorsum bright russet *V. o. dumeticola*

(i) *Vandeleuria oleracea oleracea* (Bennett)

1832. *Mus oleraceus* Bennett, *Proc. zool. Soc. Lond.*, 1832 : 121 (Dukhun, India).

1867. *Mus nilagiricus* Jerdon, *Mamm. India*, : 203. (Ootacamund, Tamil Nadu, India).

1914. *Vandeleuria wroughtoni* Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 658 (Surat, Gujarat, India).

1914. *Vandeleuria oleracea spadicea* Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 659 (Palanpur, Gujarat, India).

Distribution (Map 6) : India : Rajasthan (Mt. Abu c 1500 m), Gujarat (Surat, Junagadh, Dangs, Palanpur), Madhya Pradesh (Nimar, Balaghat, Sehore, Malwa, Seoni, Berar), Andhra Pradesh (Medak, Cuddapah, Balapalli Range, Shevroy Hills), Maharashtra (Pune, Nasik, Kolaba), Karnataka (Dharwar, Mysore), and Tamil Nadu (Salem, Coonoor, Ootacamund). Also found in Sri Lanka.

(ii) *Vandeleuria oleracea dumeticola* (Hodgson)

1845. *Mus dumeticola* Hodgson, *Ann. Mag. nat. Hist.*, [1] 15 : 268 (Nepal).

1845. *Mus povensis* Hodgson, *Ann. Mag. nat. Hist.*, [1] 15 : 269 (Nepal).

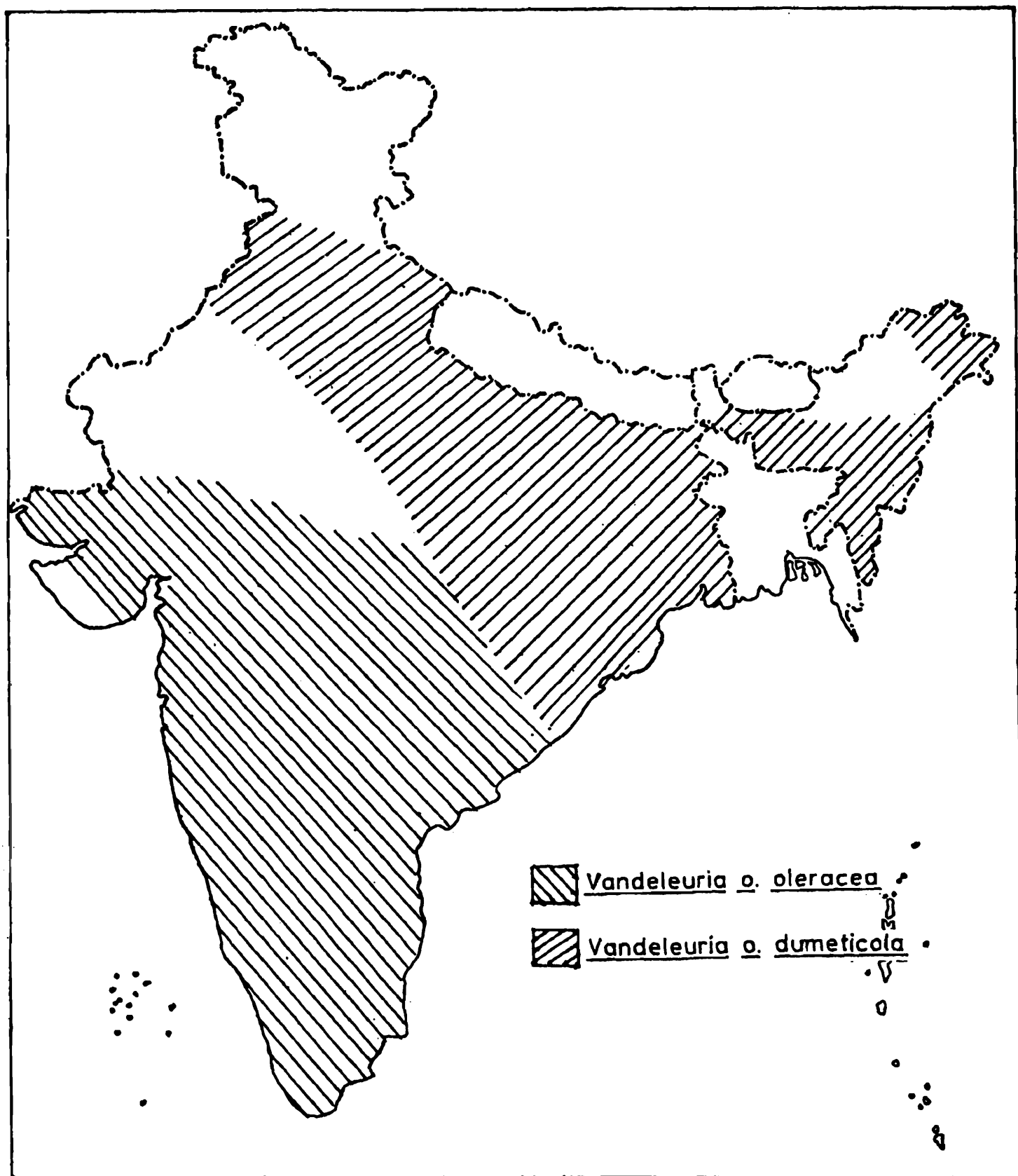
1859. *Mus badius* Blyth, *J. Asiat. Soc. Bengal*, 28 : 295 (Tenasserim, Myanmar).

1914. *Vandeleuria oleracea rubida* Thomas, *J. Bombay nat. Hist. Soc.*, 23 : 202 (Bageswar c 960 m, Kumaon, Uttar Pradesh).

1914. *Vandeleuria oleracea modesta* Thomas, *J. Bombay nat. Hist. Soc.*, 23 : 202 (Ramnagar c 330 m, Kumaon, Uttar Pradesh).

1915. *Vandeleuria oleracea marica* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 54 (Koira, Chaibassa Bihar).

Distribution (Map 6) : Punjab (Jalandhar), Haryana (Hissar, Dher), Rajasthan (Alwar), Uttar Pradesh (Kumaon), Himachal Pradesh (Kalka, Sirmaur), Bihar (Hazaribagh, Chaibassa), West Bengal (Purulia, Hansimara, Bharnabhavi), Orissa (Harishankar, Puri), Assam (Kamrup), Meghalaya (Jaintia Hills), Nagaland (Naga Hills), Mizoram (Aizawl, Lunglei), Manipur (Bishenpur, Tamenglong, Boori Bazar) and Arunachal Pradesh (Mishmi Hills). Also reported from Nepal, Bangladesh, Myanmar, and east to Vietnam.



Map 6. Showing the distribution of two subspecies of rodents in India.

***Rattus* complex**

Ellerman (1961) divided the genus *Rattus* from the Indian region into eight subgenera namely, *Rattus* Fischer, *Millardia* Thomas, *Cremnomys* Wroughton, *Leopoldamys* Ellerman, *Berylmys* Ellerman, *Maxomys* Sody, *Lenothrix* Miller and *Stenomys* Thomas. These, like most of the Asiatic subgenera recognised by Ellerman, were based on some skull-dimensions like the relative size of palate, diastema, bulla and anterior palatal foramina. Later, based on the detailed structure of skull, dentition, karyotype, ectoparasites, etc., five of the above subgenera, namely, *Rattus*, *Millardia*, *Cremnomys*, *Leopoldamys* and *Berylmys*, were raised to generic level. The species of the remaining three subgenera, *Lenothrix*, *Maxomys* and *Stenomys* were either reallocated under the existing genera or accommodated under the newly proposed ones (Missone, 1969; Agrawal, 1970; Marshall, 1976; Musser, 1981; Musser, Marshall & Boedi, 1979; Musser and Newcomb, 1983). The same are summarised below.

(a) The *niviventer* group of species which were earlier placed under the subgenus *Maxomys* Sody (*sensu* Ellerman, 1961) have now been accommodated under a new genus *Niviventer* Marshall, 1976.

(b) The *rajah* group of species from Tenasserim and SE. Asia, and *ohiensis* group of species from Sri Lanka, which were placed under the subgenus *Lenothrix* (*sensu* Ellerman, 1961), have now been put under the genus *Maxomys* Sody, and a new genus *Srilankamys* Musser respectively. The genus *Lenothrix* Miller is now limited to a single species *L. canus* Miller from Sumatra.

(c) The *bowersii* group of species from NE. India and SE. Asia, and the *muelleri* group of species from Sunda Shelf (a record of which from Andaman. Is. has been found to be erroneous) which were earlier placed under the subgenus *Stenomys* (*sensu* Ellerman, 1961) have now been accommodated under the genus *Berylmys*, and a new genus *Sundamys* Musser & Newcomb, respectively. The species *Rattus rogersi* from S. Andaman Island has been synonymised with *Rattus stoicus* from Henry Lawrence Island of Andaman group of islands.

(d) The species *Rattus blanfordi* (*sensu* Ellerman, 1961) has now been shifted from the subgenus *Rattus* to the genus *Cremnomys* Wroughton, based on karyological similarity.

Genus *Rattus* Fischer

1803. *Rattus* Fischer, *National Mus. nat. Paris*, 2 : 128.

1881. *Epimys* Trouessart, *Bull. Soc. Etudes Sci. Angers*, 10 : 117 (Type species *Mus rattus* Linnaeus).

1910. *Stenomys* Thomas, *Ann. Mag. nat. Hist.*, 6 : 507 (Type species *Mus verecundus* Thomas).

1941. *Pullomys* Sody, *Treubia*, 18 : 260 (Type species *Mus pulliventer* Miller, now in *Rattus rattus*).

Type species : Mus decumanus Pallas.

In the number of species, *Rattus* is the largest mammalian genus. The species of this genus occur in the wild in much of the Old World, while two namely, *Rattus rattus* and *Rattus norvegicus*, are cosmopolitan in distribution.

This genus includes species of varied sizes from 100 to 250 mm in the head and body length. It is characterised by the palate more than one-half of occipitonasal length, extending posteriorly much behind maxillary tooth-rows; bulla more than 15%, maxillary tooth-rows 15-19%, diastema less than 28%, and anterior palatal foramina less than one-fifth of occipitonasal length. Number of Mammae 5 or 6 pairs.

Chromosome number $2N = 42$, rarely 38.

The genus *Rattus* from India, as here understood, consists of 10 species, seven from the mainland (*rattus*, *nitidus*, *sikkimensis*, *turkestanicus*, *vicerex*, *norvegicus* and *ranjiniae*) and three (*stoicus*, *palmarum* and *burrus*) from the Andaman and Nicobar group of islands. The inclusion of *Rattus ranjiniae*, originally described as a member of the subgenus *Rattus* (*sensu* Ellerman, 1961), in the genus *Rattus* as restricted now is provisional, till the exact affinity is determined. *Rattus sikkimensis* which was earlier considered to be a subspecies and later a synonym of *Rattus rattus brunneusculus*, has now been given full specific rank by Musser and Heaney (1985). There is no record of *Rattus exulans* from India, contrary to that mentioned by Corbet and Hill (1992).

Some of the species from the Andaman and Nicobar group of Islands whose status was not clear (Ellerman, 1961, pp. 707-710), have now been suitably placed. Two species, *Rattus rogersi* and *Rattus tactiturnus* have been synonymised with *Rattus stoicus* (Musser & Heaney, 1985), *Rattus pulliventer* and *Mus flebilis* are being treated as subspecies of *Rattus rattus* (Corbet & Hill, 1992), and *Rattus burrus* and *Rattus burruscens* have been synonymised with *Rattus burrus*.

Key to mainland species of genus Rattus

- 1 Tail bicoloured, dark above, paler below 2
 - Tail unicoloured, wholly dark 3
2. Tail longer than head and body *R. turkestanicus*
 - Tail shorter than head and body *R. vicerex*
3. Nasals long, exceeding 38% of occipitonasal length of skull *R. nitidus*
 - Nasals short, less than 38% of occipitonasal length of skull 4

4. Skull small, head and body length less than 200 mm; tail generally longer than head and body (except in *R. r. brevicauda*)..... 5
Size large, head and body length more than 200 mm; tail, in adults, shorter than head and body 6
5. Maxillary toothrows longer than bulla length; postaxial pairs of thoracic mammae widely spaced (1 cm. apart)..... *R. sikkimensis*
Maxillary toothrows shorter than bulla length; postaxial pairs of thoracic mammae closely opposed (less than 1 cm apart) *R. rattus*
6. Maxillary toothrows less than 7.5 mm. in length; palate extending posteriorly behind third upper molars *R. norvegicus*
Maxillary toothrows more than 7.5 mm in length; palate not extending posteriorly behind third upper molars *R. ranjiniae*

Key to Island species of genus Rattus

- 1 Size large, occipitonasal length more than 47 mm; fur coarse and spiny 2
Size small, occipitonasal length less than 47 mm; fur soft *R. burrus*
2. Venter grey; tail faintly bicoloured *R. stoicus*
Venter white; tail unicoloured *R. palmarum*

Rattus rattus (Linnaeus)

(Plate 1, fig. c)

1758. *Mus rattus* Linnaeus, *Syst. nat.*, 10th ed., 1 : 61 (Uppsala, Sweden).
1817. *Mus alexandrianus* Desmarest, *Nouv. Dict. Hist. nat.*, 29 : 47 (Alexandria, Egypt).
1837. *Mus rufescens* Gray, *Ann. Mag. nat. Hist.*, 1 : 585 (Dharwar, Karnataka, India).
1839. *Mus flavescens* Elliot, *Madras J. Litt. Sci.* 10 : 214 (Dharwar, Karnataka, India).
1845. *Mus brunneus* Hodgson, *Ann. Mag. nat. Hist.*, 15 : 266 (Nepal).
1845. *Mus brunneusculus* Hodgson, *Ann. Mag. nat. Hist.*, 15 : 267 (Nepal).
1851. *Mus arboreus* Horsfield, *Cat. E. India. Mus.*, : 141 (Bengal).
1860. *Mus andamanensis* Blyth, *J. Asiat. Soc. Bengal.*, 29 : 103 (Andaman Is., India).
1902. *Mus flebilis* Miller, *Proc. U.S. nat. Mus.*, 24 : 762 (Henry Lawrence Island, India).
1902. *Mus pulliventer* Miller, *Proc. U.S. nat. Mus.*, 24 : 765 (Great Nicobar Island, India).
1903. *Mus atridorsum* Miller, *Proc. biol. Soc. Wash.*, 16 : 50 (Barren Island, Andamans, India).

Common names : Common House Rat (Eng.), Indur (Beng.), Chuha (Hin.).

Measurements : (Only range of measurements given).

External : HB 116-203; TL 159-256; Hf 26-36; E 21-28.

Cranial : *onl* 36.9-46.5; *m* 5.5-7.5; *n* 13.1-16.9, *b* 6.4-8.0; *p* 18.9-25.3.

Diagnostic characters : A medium-sized rat, having a completely unicoloured tail, generally longer than head and body length. Fur short and harsh, with many soft flattened spines in forms from the plains, and soft without spines at least in winter in forms from the montane habitats. Dorsum in various shades of brown; venter of two colours (i) greyish, tipped with buff (indoor forms) and (ii) white or creamish, with a medial streak of grey or irregular grey patches (outdoor forms). Mammae generally 5 pairs, if 6th pair present, then postaxial pairs close together (less than 10 mm apart).

Occipitonasal length of skull ranges from 36.9 to 46.5 mm; palate always more than one-half of occipitonasal length; extending posteriorly behind third upper molars; nasals relatively short, less than 38% of occipitonasal length and not extending behind ascending process of premaxilla; maxillary toothrow ranges from 5.5 to 7.5 mm and forms one of the main characters in the classification of species into subspecies *viz.* short-toothed forms (less than 6.6 mm in length) and long-toothed forms (more than 6.6 mm in length).

Upper incisors narrow, plain and yellow or orange. Molars 3/3 in number; M^1 5-rooted; upper M^1 having 8 cusps (t_7 absent), M^2 6-cusped (t_2 , t_3 , t_7 absent) and M^3 like M^2 but smaller. Among lower molars, M_1 having three laminae, and M_2 and M_3 two each; all except the last lamina of M_3 bicuspidate; last lamina single cusped. Posterior cingulum present behind first and second molars.

Chromosome number $2N = 38$ or 42 ; $FN = 62$ (Raman & Sharma 1977).

Distribution : A cosmopolitan species, occurring practically throughout India, both in the wild and commensal state.

Ecology and biology : Nocturnal; lives in varied habitats in houses, thatched huts, cultivated fields, secondary forests etc., both in the hilly areas and the plains. Primarily an arboreal species, reflected in its depredations on tree crops like coconut and oil palm. A serious pest of crops and stored grain; also eats insects. Breeds throughout the year; litter-size 1-9, even more (Mohan Rao, 1978; Jain, 1979). The annual productivity per female ranges from 12.2 to 56.2 (mean 31.3) young- ones (Southwick, 1966)

Intraspecific variation : It is not possible, at present, to correctly classify all the subspecies of *Rattus rattus*, due to lack of sufficient fresh specimens for study, of all the described subspecies from India and adjoining countries.

***Rattus turkestanicus* (Satunin)**

1845. *Mus rattoides* Hodgson, *Ann. Mag. nat. Hist.*, 15 : 267 (Nepal) Name preoccupied by *Mus rattoides* Pictet and Pictet, 1844.

1903. *Mus turkestanicus* Satunin, *Ann. Mag., St. Petersburg*, 7 : 588 (Ferghana, Uzbekistan, USSR).

Common name : Turkestan Rat (Eng.).

Measurements : As mentioned under the subspecies.

Diagnostic characters : A medium-sized rat, having the tail always longer than head and body length. Fur usually soft, sometimes stiffer (spinous). Fourteen out of 42 specimens from Murree and Salt Range (Pakistan), Jammu & Kashmir and Himachal Pradesh, collected between April and October, are spinous, probably a seasonal variation.

Body colour of two distinct types. Dorsum brown to sandy brown and venter white up to base in specimens from Pakistan, Jammu & Kashmir and Himachal Pradesh; whereas dorsum rufous to dark brown and fur of venter white on tip and grey on base in 90% specimens from Nepal and Sikkim. However, both kinds of specimens are found in Chamba (Himachal Pradesh) and Kumaon (Uttar Pradesh). Tail usually bicoloured, dark above and white below, tending to be indistinctly bicoloured or even unicoloured in a few specimens from Nepal (including Type of *R. rattoides* vide Ellerman, 1961) and Sikkim.

Mammae in specimens from Pakistan, Jammu and Kashmir and Himachal Pradesh are always 6 pairs (3+3), but in three females from Nepal and Sikkim these are 5 pairs (2+3) (ZSI collection; Khajuria, 1953; Ellerman, 1961). In rest of the female specimens, these are not discernible.

Skull more or less similar to that of *Rattus rattus* except that nasals are wider and not so constricted in the middle as in that species; nasal-width as compared to its length ranges from 25 to 36% (mean 31%) as against 24-28% (mean 27%) in *R. rattus* and *R. nitidus*. Anterior palatal foramina long, usually reaching posteriorly to maxillary tooththrows. Supraorbital ridges prominent.

Upper incisors opisthodont, yellow and plain. Molars 3/3 in number; M¹ 8 cusped (t₇ absent), M² 6 cusped (t₂, t₃, t₇ absent), and M³ like M² but smaller. Lower molars biserially cuspidate, with well-developed posterior cingulum behind first and second molars.

Chromosome number 2N = 42; FN = 62.

Distribution : India : Jammu & Kashmir, Himachal Pradesh, Uttar Pradesh, Sikkim and West Bengal. Also reported from China, Pakistan, Nepal, Afghanistan, E. Iran and SE. Russian Turkestan.

Ecology and habitat : Inhabits coniferous forest, barren rocky mountain sides, cultivated fields and in and around houses near human habitation, at altitudes ranging from 1200 to 4250 m. Feeds mainly on vegetable matter like walnuts, plum, fruit, etc.; also takes insects. Females build nests concealed in crevices or burrows; litter-size 4-8.

Discussion : Hodgson (1845) described *Mus rattoides* and *Mus pyctoris* from Nepal, based on dusky brown dorsum and dusky hoary venter. However, there was no mention of the colour of tail. In *rattoides*, the tail was longer than head and body, and in *pyctoris* it was much shorter, two-thirds of head and body.

Later, three white bellied-forms, having bicoloured tail (dark above and white below) were described from Russian Turkestan (*Mus turkestanicus* Satunin), Baltistan (*Epimys rattus shigarus* Miller) and Shimla, Himachal Pradesh (*Mus vicerex* Bonhote). In the former two, the tail was longer than head and body, and in the last one slightly shorter (about 90% of HB).

Ellerman (1961) synonymised *Mus vicerex* with *Mus turkestanicus* and treated the latter as a subspecies of *Mus rattoides* = *Rattus rattoides*, thus extending the range of the subspecies from Russian Turkestan to Himachal Pradesh, while that of the nominate subspecies to Uttar Pradesh (Kumaon), Nepal and Sikkim.

In 1971, Schlitter and Thonglongya found that the name *Mus rattoides* Hodgson, 1845 is preoccupied by *Mus rattoides* Pictet and Pictet, 1844 from Brazil and hence, the former was replaced by the next available name *Mus turkestanicus* = *Rattus turkestanicus* known from Russian Turkestan. They, further kept grey-bellied form from Uttar Pradesh, Nepal and Sikkim under *Mus vicerex*, without considering the facts that *M. vicerex* is a white-bellied form and its tail clearly bicoloured and shorter than head and body (Bonhote, 1903).

An examination of a series of specimens from Pakistan, India and Nepal present in ZSI revealed that (i) a white-bellied form, with light brown dorsum and distinctly bicoloured tail exists in Pakistan, Jammu and Kashmir and Himachal Pradesh, and (ii) a grey-bellied form, with dusky brown dorsum and bicoloured or indistinctly bicoloured tail occurs in Nepal and Sikkim. However, the ranges of the two forms overlap in Chamba (Himachal Pradesh) and Kumaon (Uttar Pradesh), so that both kinds of specimens are found there. Among the white bellied forms, majority are having the tail longer than head and body and six pairs of mammae, and are known as *R. turkestanicus turkestanicus*. The other white-bellied form from Shimla, Himachal Pradesh, are having the tail shorter than head and body. These were earlier accommodated under the species

Mus vicerex by Bonhote (1903), but later synonymised with *R. t. turkestanicus* by Ellerman (1961). Recently, based on the availability of a few more specimens of this short-tailed form from Islamabad district of Jammu & Kashmir, Chakraborty (1983) resuscitated the species *Mus vicerex*. The additional difference between the two may be the presence of four pairs of mammae instead of six pairs in *R. t. turkestanicus*.

Now, the problem is to give a name to the grey-bellied population from Nepal and Sikkim. Musser (in Wilson and Reader, 1993) suggested that the population from Nepal should be called *Mus pyctoris Hodgson*. But this view can not be accepted as the tail in that specimen is very short, about 2/3 rd of head and body. Hence, the next available name from Nepal, *Rattus rattus khumbuensis* Biswas & Khajuria, 1955 (a wrongly identified specimen of *R. rattoides*) should replace *Rattus rattoides rattoides*, and this population be called as *Rattus turkestanicus khumbuensis* Biswas and Khajuria.

Intraspecific variation : Two subspecies of *Rattus turkestanicus* occur in India.

Key to subspecies of R. turkestanicus

Dorsum yellowish brown; fur on venter white up to base *R. t. turkestanicus*

Dorsum dusky brown; fur on venter grey on base and white at tip
..... *R. t. khumbuensis*

(i) *Rattus turkestanicus turkestanicus* (Satunin)

(Plate 3; figs A, A')

1903. *Mus turkestanicus* Satunin, *Ann. Mag. St. Petersburg*, 7 : 588 (Fergana, Uzbekistan).

1913. *Epimys rattus shigarus* Miller, *Proc. biol. Soc. Washington*, 26 : 198 (Shigar, Baltistan, Jammu & Kashmir).

Measurements :

External : 23♂ : HB 142-217 (160±17); TI 167-230 (189±17); Hf 29-35 (32±2); E 19-26 (23.5±1.5).

16♀ : HB 139-190 (161±11.5); TI 176-202 (194±11.5); Hf 30-35 (32±1.4); E 22-26 (24±1).

Cranial : 5♂ : *onl* 41.0-43.0 (42.1±0.85); *p* 20.9-22.1 (21.6±.55); *apf* 7.1-8.0 (7.6±.25); *n* 13.8-15.6 (15±.6); *b* 7.1-7.8 (7.4±.33); *m* 6.6-7.3 (6.9±.25); *nw* 4.2-5.5 (4.8±.25); *nw* as % of *n* 25.1-36.4 (31.5±3.1).

5♀ : *onl* 39.7-44.7 (42.0±1.7); *p* 20.1-22.9 (21.8±.6); *apf* 6.7-7.8 (7.3±.5); *n* 14.1-16.5 (15.7±1); *b* 6.8-7.1 (7.0±.1); *m* 6.5-7.0 (6.8±.18); *nw* 4.4-5.0 (4.8±.25); *nw* as % of *n* 26.6-33.3 (30.0±2.5).

Distribution (Map 7) : India : Jammu & Kashmir (Sardulla c 2651 m alt; Daksum c 2438 m; Shikargarh c 2000 m) and Himachal Pradesh (Chamba c 1036-2286 m; Lahul c 3048-3230 m; Kullu c 2743 m).

(ii) *Rattus turkestanicus khumbuensis* Biswas & Khajuria

(Plate 3; figs B, B')

1955. *Rattus rattus khumuensis* Biswas & Khajuria, *Proc. Zool. Soc. Calcutta*, 8 : 27 (Phorcha c 4300 m, Khumbu, Nepal).

Measurements :

External : 5♂ : HB 139-172 (153±12); TI 169-210 (190±15); Hf 29-37 (33.4±2.5); E 22-26 (24±1.4).

9♀ : HB 142-173 (154±11.5); TI 157-208 (179±15); Hf 30-36 (33±2); E 19-26 (23.3±2.4).

Cranial : 2♂ : *onl* 37.2, 41.8; *p* 19.8, 22.5; *apf* 6.25, 7.6; *b* 6.3, 6.9; *m* 6.9, 6.9; *n* 13.5, 16.7, *nw* 4.5-5.2 (4.85); *nw* as % of *n* 31.7-33.3 (32.5%)

7♀ : *onl* 39.4-42.8 (40.6±1); *p* 21.0-22.7 (21.8±.55); *apf* 6.6-7.5 (7.1±.25); *n* 14.5-16.2 (15.5±.6); *b* 6.0-7.1 (6.5±.33); *m* 6.7-7.3 (7.0±.2); *nw* 4.6-5.1 (4.85±.18); *nw* as % of *n* 29.1-32.4 (31.0%±1.1).

Distribution (Map 7) : India : Uttar Pradesh (Kumaon c 2310-2743 m), West Bengal (Ghoom c 2246 m) and Sikkim (Chunthang c 1630 m; Lachen c 2750 m). Also Nepal (Nagerest c 2438 m; Helembu c 2245 m; Langtang c 3310 m; Namche Bazar c 3657 m; Tukucha c 2600 m; Phorcha c 4267 m; Syngomba c 3200 m; Ghasa c 2080 m and Tatopani c 1240 m) (*vide* Abe, 1971).

Rattus vicerex (Bonhote)

1903. *Mus vicerex* Bonhote, *Ann. Mag. nat. Hist.*, 11 : 473 (Shimla, Himachal Pradesh, India).

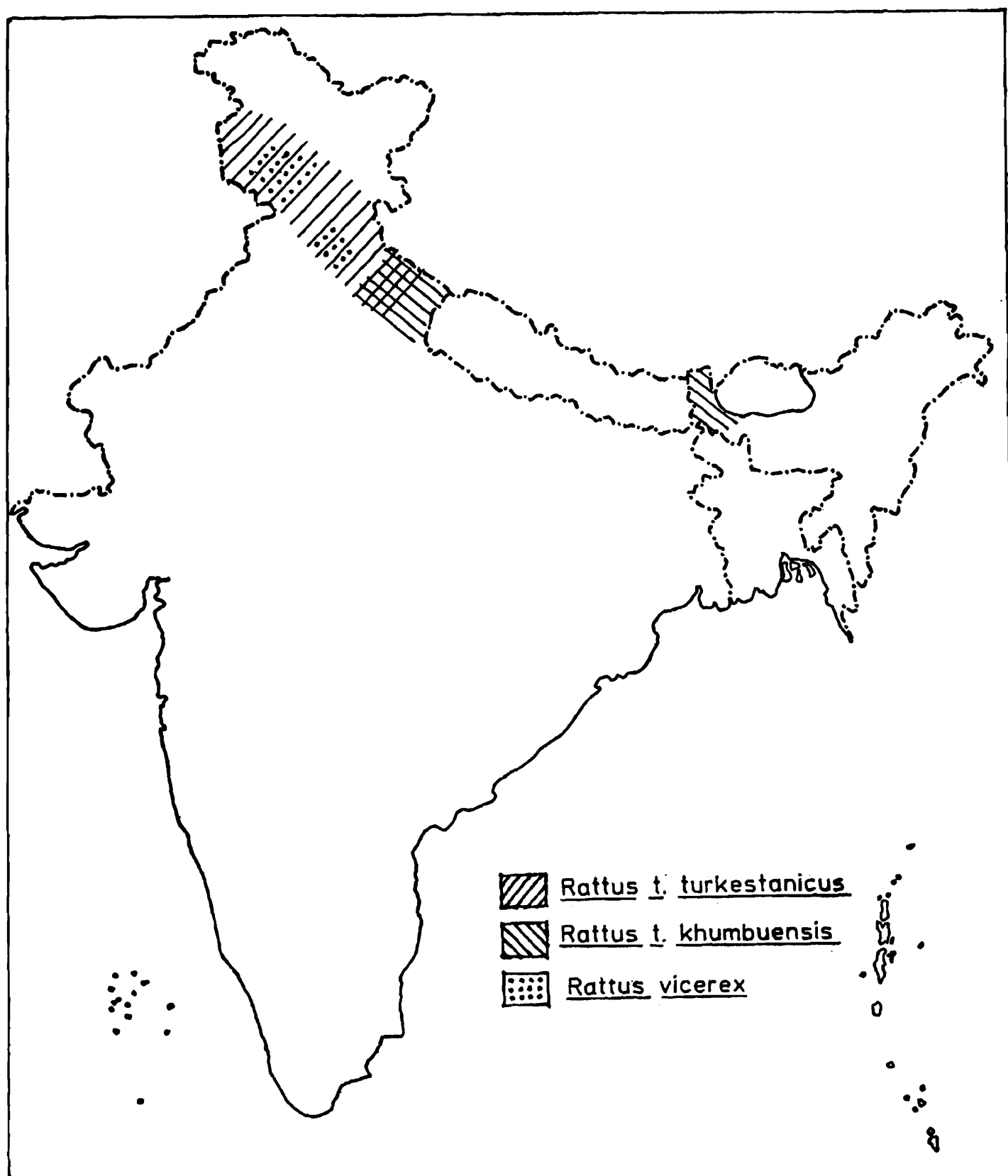
Common name : Short-tailed Turkestan Rat (Eng.).

Measurements :

External : 4♂ : HB 158-206 (177); TI 154-172 (161); HF 31-35(33); E 20-23 (21).

2♀ : HB 150-190 (170); TI 132-181 (156); HF 30-33 (31.5); E 16-23 (19.5).

Cranial : 5♂ : *onl* 36.5-44.9 (40.8); *p* 18.6-24.0 (21.4); *apf* 7.0-7.8 (7.4); *n* 12.6-16.7 (14.6); *m* 6.1-6.6 (6.4); *b* 6.3-7.4 (6.9).



Map 7. Showing the distribution of three species and subspecies of rodents in India.

4♀ : *onl* 34.3-37.4 (35.2); *p* 18.0-19.2 (18.6); *apf* 5.8-6.7 (6.2); *n* 11.8-13.5 (12.2); *m* 6.2-6.5 (6.3); *b* 6.3-6.6 (6.4).

Diagnostic characters : Pelage generally soft; harsh in a few specimens. Dorsum brown to greyish brown and venter perfectly white; tail distinctly bicoloured, dark above and white below.

Similar to *Rattus turkestanicus turkestanicus* from Jammu & Kashmir in all respects except the length of tail which is shorter than head and body.

Distribution (Map 7) : India : Jammu & Kashmir (Islamabad dist.) and Himachal Pradesh (Shimla dist.) (Bonhote, 1903; Chakraborty 1983).

Ecology and biology : Nocturnal and generally a house-dwelling form. Occurs sympatrically in Jammu & Kashmir with *Rattus turkestanicus* which is found mainly in the field and is active in the morning and afternoon. It lives in association with *Bandicota bengalensis* and *Mus musculus*. It is one of the important pest of stored grain and fruit (apple and walnut) in Jammu & Kashmir (Chakraborty, 1983).

Remarks : Ellerman (1961) treated *Mus vicerex* Bonhote as a synonym of *Rattus rattoides turkestanicus* (Satunin). Chakraborty (1983) resuscitated this taxa as *Rattus vicerex* on the character of the tail which is shorter than head and body length. His study material from Jammu & Kashmir consisted of 5 females, all except one are either juveniles or subadults. In one adult female specimen, the mammae are 4 pairs (2+2). In case this number is constant, it constitutes an additional character for differentiating this species from *Rattus turkestanicus* where mammae are either 6 pairs (Jammu & Kashmir) or 5 pairs (Sikkim).

Rattus nitidus (Hodgson)

1845. *Mus nitidus* Hodgson, *Ann. Mag. nat.Hist.*, 15 : 267 (Nepal).

1845. *Mus horeites* Hodgson, *Ann. Mag. nat. Hist.* 15 : 268 (Nepal).

1849. *Mus aequicaudalis* Hodgson, *Ann. Mag. nat. Hist.*, 3 : 203 (Nepal).

1919. *Rattus nitidus obsoletus* Hinton, *J. Bombay nat. Hist. Soc.*, 26 : 415 (Kindat, Chin Hills, Myanmar).

1952. *Mus guhai* Nath, *J. Zool. Soc. India*, 4 : 85 (Nongpoh, Khasi Hills, Meghalaya). Based upon a litter of *R. nitidus* (Marshall, 1977).

Common name : Himalayan Rat (Eng.).

Measurements : (Range, mean, standard deviation and sample size).

	<i>nitidus</i>		<i>obsoletus</i>
	♂	♀	♂ ♀
HB	149-182 167±12 (28)	141-188 162±11 (32)	150-187 164±14 (9)
Tl	133-210 177±17 (28)	146-190 172±11 (32)	120-186 152±12 (9)
Tl as % of HB	87-129 106±9 (28)	87-131 107±8.3 (32)	80-107 92±9.8 (9)
Hf	33-38 35±2 (28)	30-38 34±2 (32)	33-37 34±1.5 (9)
E	19-24 22±1.2 (28)	18-25 22±2 (32)	19-25 22.5±2 (9)
<i>onl</i>	39.4-46.7 42.5±1.7 (9)	40.2-44.7 42.3±1.4 (13)	41.6
<i>p</i>	21.4-25.4 23.0±1.2 (9)	21.7-24.6 22.9±1.0 (13)	22.4
<i>n</i>	15.0-17.2 16.2±0.6 (9)	15.7-18.0 16.5±.7 (13)	16.2
<i>nw</i>	4.2-4.7 4.5±.2 (9)	4.0-5.0 4.4±.3 (13)	4.3
<i>nw as % of n</i>	26.3-29.1 27.7±.8 (9)	23.9-29.1 26.5±1.6 (13)	26.3
<i>apf</i>	6.4-8.7 7.6±.6 (9)	6.9-8.4 7.6±.5 (13)	7.5
<i>b</i>	6.2-8.0 6.8±.5 (9)	6.1-6.8 6.4±.2 (13)	6.5
<i>m</i>	6.4-7.7 6.9±.4 (9)	6.5-7.3 7.0±.3 (13)	6.8

Diagnostic characters : A dusky-brown, soft-furred rat, wherein long hair piles almost wanting; undersurface of body silvery to dark grey, with or without a rusty tinge; tail wholly dark, longer or shorter than head and body length; hind-foot whitish. Mammary 6 pairs.

Skull most often exceeds 40 mm in occipitonasal length; supraorbital ridges well-developed; nasals long, exceeding 38% of *onl* and generally extending posteriorly behind premaxilla; nasals narrower than in *Rattus turkestanicus*, nasal width 24-29% of nasal length; bulla moderately well-inflated but smaller (14-16% of *onl*) than in *Rattus rattus*; palate long, more than half of *onl*, extending behind third upper molars; anterior palatal foramina long, extending posteriorly up to maxillary toothrows.

Upper incisors opisthodont, yellow and plain. Molars 3/3 in number; M¹ 8 cusped (t7 absent), M² 6-cusped (t2, t3, t7 absent), M³ like M² but smaller. Lower molars as in *Rattus rattus*.

Chromosome number 2N = 42; FN = 62.

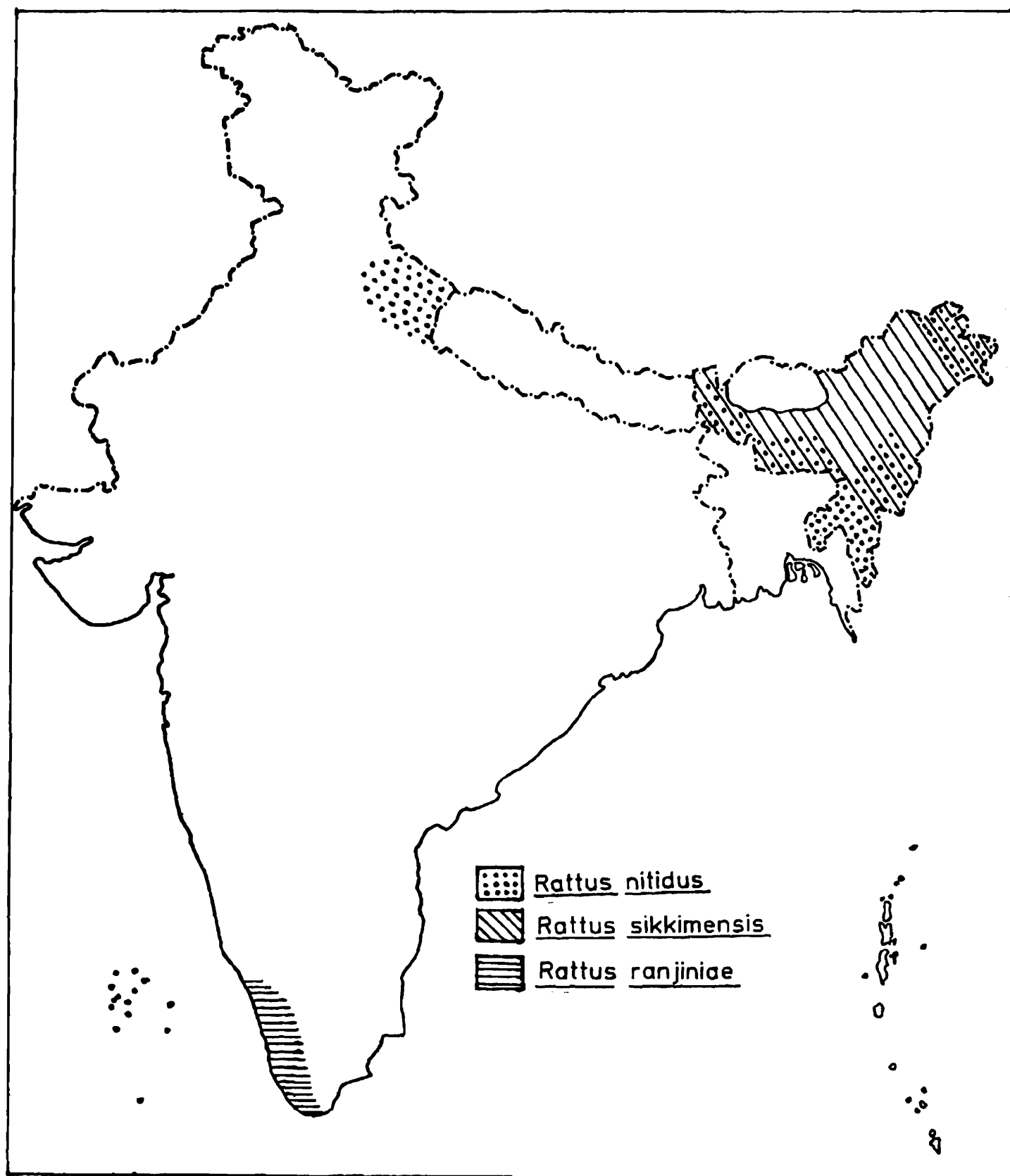
Distribution (Map 8) : Widely distributed in the Central and Eastern Himalaya and NE. India. Also found in Nepal, Bhutan, N. Myanmar, S. China, Thailand and Vietnam.

India : Uttar Pradesh (Kumaon), Sikkim (Gangtok), West Bengal (Darjiling), Arunachal Pradesh (Namdapha, Mishmi Hills); Meghalaya (Khasi, Garo and Jaintia Hills), Tripura (Ganganagar), Mizoram (Aizawl, Lunglei, Bhungtilang) and Manipur (Imphal, Tamenglong & Senapati dists.).

Ecology and biology : Occurs in montane forests and near rural dwellings at elevations ranging from 686 to 2740 m. Arboreal. Feeds mainly on vegetable matter, occasionally insects. A specimen collected during July, in Nepal, was having four placental scars (Abe, 1971). In captivity, a female delivered a litter of six young ones.

Intraspecific variation : Hinton (1919) differentiated *R. nitidus obsoletus* from *R. nitidus nitidus* on the colour of the undersurface of body, being grey with a rusty tinge in the former and silvery in the latter. Ellerman (1961) mentioned that this colour-difference seems to be not constant and provisionally differentiated the two subspecies on the length of tail, shorter in *obsoletus* (99% of HB) and longer in *nitidus* (107% of HB).

An appraisal of the specimens of *Rattus nitidus* present in ZSI reveals that there is no clear-cut difference between *nitidus* and *obsoletus* either in the colour of the undersurface of body or in the length of tail. Out of 80 examples of *nitidus*, 29 have grey ventrum instead of silvery, and 18 have tail shorter than head and body. Out of 9 specimens of *obsoletus* from Mizoram, Manipur and Myanmar, all have dark grey



Map 8. Showing the distribution of three species of rodents in India.

ventrum, and 7 have tail shorter than head and body. The over all tail length ranges from 87-131% (mean 107 ± 9) of HB in *nitidus* and from 80 to 107% (mean 92 ± 9.8) of HB in *obsoletus*. Thus, the length of tail, both in absolute and in relation to head and body, overlap at one standard deviation from the mean.

Hence, the subspecies *R. nitidus obsoletus* is being treated here as a synonym of *R. nitidus nitidus*.

Rattus sikkimensis Hinton

1919. *Rattus rattus sikkimensis* Hinton, *J. Bombay nat. Hist. Soc.*, 26 : 394 (Pashok, Darjeeling, West Bengal, India).

Common name : Sikkim Rat (Eng.).

Measurements : (vide Ellerman, 1961).

External : 22 ex. : HB 140-190 (162 ± 12.5); TI 156-237 (196 ± 23); Hf 29-36 (32 ± 1.6); E 21-25 (23 ± 1.1).

Cranial : 20 ex. : *onl* 37.5-45.4 (41.8 ± 2.0); *p* 20.3-24.8 (22.7 ± 1.1); *apf* 6.8-8.5 ($7.85 \pm .5$); *b* 6.5-7.2 ($6.8 \pm .25$); *m* 6.7-7.6 ($7.1 \pm .26$); *d* 9.0-12.0 ($10.6 \pm .8$); *n* 13.5-16.9 (15.35 ± 1.0).

Diagnostic characters : Corbet and Hill (1992) differentiated *Rattus sikkimensis* (= *R. remotus*) from *Rattus rattus* as follows :

Similar to *Rattus rattus* but having longer black hair in the mid-dorsal line of body, venter always pure white, mammae 6 pairs, 3 pairs of thoracic teats equally spaced, postaxial pairs at least 1 cm apart (as against 0.5 cm apart in *Rattus rattus*), rostrum wide and sides of braincase not vertical. In addition, maxillary toothrows are longer than tympanic bulla length in *R. sikkimensis*.

Distribution (Map 8) India : Sikkim (Singhik), West Bengal (Darjiling dist.), Meghalaya, Nagaland, Arunachal Pradesh and Manipur. Also reported from Nepal, Myanmar, Thailand, China, Laos and Vietnam (Musser and Heaney, 1985).

Remarks : Hinton (1919) described the subspecies *R. rattus sikkimensis*, which was later synonymised with *R. rattus brunneusculus* by Ellerman (1961). Musser and Heaney (1985) have considered *R. rattus sikkimensis* as a separate species distinct from *Rattus rattus*. Corbet and Hill (1992), however, synonymised *Rattus sikkimensis* with *Rattus remotus* from Peninsular Thailand purely on rules of priority. It is observed that the differences between *Rattus sikkimensis* and *Rattus rattus* do not stand in collections present in ZSI especially when compared with *R. r. brunneusculus* or *R. r. gangutrianus*.

***Rattus norvegicus* (Berkenhout)**

1769. *Mus norvegicus* Berkenhout, *Outlines Nat. Hist. Gr. Britain and Ireland*, 1 : 5 (Great Britain).

1779. *Mus decumanus* Pallas, *Nov. spec. Quad. Glir. Ord.*, 91 (Europe).

Common names : Norway Rat (Eng.), Desma Indur (Beng.).

Measurements :

External : 8♂ : HB 208-250 (233), TI 183-210 (196), Hf 38-47 (41), E 16-23 (19).

8♀ : HB 205-250 (228), TI 185-213 (200); Hf 37-42 (39); E 18-24 (21).

Cranial : 28 ex : *onl* 44.7-54.9 (49.8), *cb* 43.1-54.2 (48.5), *n* 17.0-21.4 (19.3), *p* 24.8-31.1 (27.9), *m* 6.2-7.3 (7.0), *mw* 2.0-2.3 (2.2), *apf* 8.0-10.1 (8.7), *apfw* 3.0-4.6 (3.8), *b* 8.1-8.6 (7.7), *d* 12.9-16.4 (14.7), *iw* 6.1-8.1 (7.0), *zw* 21.4-26.8 (24.4).

Diagnostic characters : A bandicoot-like large rat, having an obscurely bicoloured tail, shorter than head and body (80-95%) and relatively smaller ears (16-23 mm). Fur coarse and spiny. Dorsum dark brown and venter grey. Skull large, occipitonasal length 45-55 mm; supraorbital ridges powerful, extending backwards fairly straight up to occiput; palate long, more than one-half of occipitonasal length, extending posteriorly far behind third upper molars (Plate 4, fig. a); maxillary toothrows less than 15% of *onl*, and its width ranges from 2.0-2.3 mm; anterior palatal foramina, on average, 17% of *onl* and broad (3.0-4.6 mm), ending far ahead of first upper molars; braincase narrow, cranial width less than 28% of *onl*. Mammary 5 or 6 pairs.

Chromosome number $2N = 42$, $FN = 62$.

Distribution : A Palaearctic species, now distributed throughout the greater parts of the world including India, owing to accidental transportation by human agency. In India, it is mainly confined to ports and big cities like Mumbai and Calcutta.

Ecology and biology : Nocturnal. Lives in godowns and nearby areas. Predominantly a burrower, excavates tunnels under the foundation of buildings, drains, etc. Feeds mainly on stored grains. A prolific breeder; breeds throughout the year; gestation lasts for 22-25 days; litter-size 4-12, sometimes even more. Annual productivity per female ranges from 12.5 to 53.4 young-ones (Southwick, 1966). Earlier, it was a predominant species in godowns in Calcutta but now it is being gradually replaced by *Bandicota bengalensis*.

***Rattus ranjiniae* Agrawal & Ghosal**

1969. *Rattus ranjiniae* Agrawal & Ghosal, *Proc. zool. Soc. Calcutta*, 22 : 41-45 (Trivandrum, Kerala, India).

Common name : Ranjini's Field Rat (Eng.).

Measurements : Holotype : HB 162, TI 187, Hf 44, E 18. *onl* 43.0, *n* 14.9, *p* 23.7, *m* 8.3, *apf* 7.9, *apfw* 2.0.

Additional material examined :

External : 1♂ (Ad.) HB 261, Tl 232, Hf 47, E 20. 1♀ (Ad.) HB 210, Tl 210, Hf 45, E 21

Cranial : 1♂ : *onl* 53.4; *p* 29.5; *b* 8.2; *n* 19.5; *m* 9.1; *mw* 2.9; *apf* 10.4; *apfw* 2.5; *iw* 6.9; *zw* 26.9; *cw* 18.4; *dst* 15.6;

1♀ : *onl* 48.5; *p* 26.6; *b* 8.2, *n* 17.5; *m* 8.6; *mw* 2.7; *apf* 9.1; *apfw* 3.0; *iw* 6.8; *zw* 25.2; *cw* 18.7; *dst* 14.4.

Diagnostic characters : A large-sized field rat, with tail equal to or shorter than head and body length in fully adult specimens, and hindfoot long, studded with prominent claws. Dorsal fur long, with admixture of soft spines specially along mid-dorsal line. Dorsal colour bistre, darker on hind quarters, ventral dirty white; line of demarcation between dorsal and ventral sides not sharp; whiskers brown on base, whitish on tip; upper surface of manus and pes light fawn; tail unicoloured, thin and tapering, somewhat quadrangular in spirit-preserved specimens.

Skull large; nasals less than 38% of *onl*; maxillary toothrows long (8.2-9.2 mm) and palate more than half of *onl* and in line with or slightly extending posteriorly beyond third upper molars (Plate 4, fig. b); posterior palatal margin without spinous process; anterior palatal foramina long, extending posteriorly up to first upper molars, narrow (2.0-3.0, mean 2.2 mm), and their sides more or less parallel; braincase broad, cranial width 35-39% of *onl*.

Comparison : The species is close to *Rattus norvegicus* but differs from it in the length (8.2-9.1 vs 6.7-7.8 mm) and width (2.7-2.9 vs 2.0-2.3 mm) of maxillary toothrows, palate not extending posteriorly beyond third upper molars, combined width of anterior palatal foramina narrower (2.0-3.0 vs 3.0-4.6) and the cranium much broader, cranial width 35-39% vs 23-27% of *onl*.

Remarks : This species was described by Agrawal & Ghosal (1969) based on 1♂ & 3♀ specimens from Trivandrum, Kerala, India, in which all the three molars were fully erupted but unworn, hence, were taken as (young) adults. But subsequent collection of fully adult specimens from the rice fields of Trichur and Alleppy districts of Kerala revealed that the specimens upon which the species was described were sub-adults. Apart from size, the notable difference between the subadult and adult specimens is that the tail is longer than head and body in the former but smaller in the latter.

Distribution (Map 8) : Little is known about the complete distribution of the species. So far reported from Trichur, Alleppy and Trivandrum districts of Kerala, India. The species is endemic to India.

Ecology and biology : Collected from the rice fields. Nothing else is known.

***Rattus stoicus* (Miller)**

1902. *Mus stoicus* Miller, *Proc. U.S. natn. Mus.*, 24 : 759 (Henry Lawrence Is. Andamans, India).

1902. *Mus tactiturnus* Miller, *Proc. U.S. natn. Mus.*, 24 : 762 (South Andaman Is., India).

1907. *Mus rogersi* Thomas, *Ann. Mag. nat. Hist.*, 20 : 206 (South Andaman Is., India).

Common name : Miller's Long-footed Rat (Eng.).

Measurements :

Holotype : *External* : *stoicus* : HB 249; Tl 193; Hf 45. *rogersi* : HB 195; Tl 188; Hf 41

Cranial : *stoicus* : *onl* 51.9; *n* 20.5; *p* 29.3; *m* 7.8, *d* 16.0; *apf* 9.5; *b* 7.5; *crw* 18.7. *rogersi* : *onl* 48.0; *p* 26.0; *d* 13.2; *apf* 9.0; *b* 6.9; *m* 7.7.

Additional material :

External : 10 ex : HB 220-260 (241); Tl 192-212 (198); Hf 45-48 (46), (*vide* Miller, 1902).

Cranial : 14 ex : *onl* 46.4-55.1 (50.0 ± 2.3); *m* 7.6-8.6 (8.3 ± 0.3), (*vide* Musser & Heaney, 1985).

Diagnostic characters : A large, heavily built rat, having the tail much shorter than head and body, and hindfoot long, studded with prominent claws. Fur coarse and spinous. Dorsum greyish brown (a coarse grizzle of dark brown and ochraceous buff); venter grey; tail faintly bicoloured (Musser & Heaney, 1985); hindfoot greyish brown; soles naked, with six plantar pads. Mammary 4 pairs (Miller, 1902).

Skull long and slender, with long nasals (39% of *onl*), long diastema (30% of *onl*), smaller bulla (14% of *onl*), long and narrow anterior palatal foramina, not reaching posteriorly up to first upper molars, long maxillary toothrows, more than 7.6 mm in length, and palate extending posteriorly behind third upper molars.

Distribution : Known from Henry Lawrence Island and South Andaman Island, hence, endemic to India.

Ecology : Trapped in dense jungle. Nothing else is known.

Remarks : According to Miller (1902), this species resembles with *Rattus palmarum*.

***Rattus palmarum* (Zeblebor)**

1869. *Mus palmarum* Zeblebor, *Reise der Oesterr. Fregatte Novara, Zool. Th. I. Wirbelth.*, 1, *Saugeth.*, 26 (Nicobar Island, India).

Common name : Zeblebor's Nicobar Rat (Eng.).

Measurements :

Holotype : HB 275; Tl 215; Hf 48; *onl* 54; *zw* 25 (*vide* Miller, 1902)

Additional material : *onl* 49-54; *m* 8.9-9.0 (*vide* Musser & Heaney, 1985).

Diagnostic characters : A large rat, having the tail much shorter (78%) than head and body, and long hindfoot as in *Rattus stoicus*. Fur coarse and spinous. Dorsum dark brown; venter white; tail wholly dark. Mammae 5 pairs (Musser & Heaney, 1985).

Skull large, with appreciably long maxillary toothrows; palate extending posteriorly beyond third upper molars.

Distribution : Nicobar Islands, hence, endemic to India.

Ecology and biology : Common in Nicobar islands, where it occurs in the crown of palms, leaping from tree to tree (Miller, 1902).

Remarks : According to Miller (1902), this species is allied to *Rattus stoicus*. However a recent study by Musser & Heaney (1985) showed its probable closeness to *Rattus tiomanicus*.

***Rattus burrus* (Miller)**

1902. *Mus burrus* Miller, *Proc. U. S. nat. Mus.*, 24: 768 (Trinkat Is., Nicobars, India).

1902. *Mus burrulus* Miller, *Proc. U.S. nat Mus.*, 24 : 770 (Car Nicobar Is., Nicobars, India).

1902. *Mus burrescens* Miller, *Proc. U.S. nat. Mus.*, 24 : 771 (Great Nicobar Is., India).

Common name : Miller's Nicobar Rat (Eng.).

Measurements : Based on holotype specimens.

	<i>burrus</i>	<i>burrulus</i>	<i>burrescens</i>
HB	215	174	206
Tl	215	183	202
Hf	41	36	38
<i>onl</i>	46.8	41.1	44.0
<i>cb</i>	46.4	39.8	43.2
<i>p</i>	25.3	22.7	24.7
<i>zw</i>	22.3	19.5	21.0

	<i>burrus</i>	<i>burrulus</i>	<i>burrens</i>
<i>n</i>	18.1	14.7	16.1
<i>apf</i>	8.5	7.4	7.7
<i>b</i>	7.8	6.6	7.1
<i>m</i>	7.6	6.8	7.4
<i>cw</i>	17.0	16.0	16.5

Additional material : (vide Miller, 1902) : 10 ex : HB 195-225; TI 193-215; Hf 42-43

(vide Musser & Heaney, 1985) : 10 ex : *onl* 41.3-46.7 (43.1); *m* 7.4-7.9 (7.7).

Diagnostic characters : A large rat, having the tail subequal to head and body length, and hindfoot long. Fur spineless and soft. Dorsum a fine grizzle of dark brown or russet; venter light buff or creamy; hindfoot brown; tail uniformly dark brown. Mammary 5 pairs (2+3).

Skull long (41-47 mm) and slender (zygomatic width less than half of *onl*); palate long, extending posteriorly beyond third upper molars; nasals less than 38% of *onl*; bulla and maxillary toothrows more than 15% of *onl*, anterior palatal foramina not reaching posteriorly up to first upper molars; braincase broad (36-39% of *onl*) and less elevated.

Incisors opisthodont and orange. Molars 3/3 in number, like those of *Rattus rattus* in structure.

Distribution : India : Nicobar group of islands : Trinkat, Car Nicobar and Great Nicobar. The species is endemic to India.

Ecology and biology : Not known.

Remarks : Close to *Rattus rattus*, but differs from it in the length of hind-foot (36-43 mm). A recent study by Musser and Heaney (1985) showed its probable closeness to *Rattus tiomanicus*.

Genus *Berylmys* Thomas

1947. *Berylmys* Ellerman, *Proc. zool. Soc. Lond.*, 117 : 261, 267.

Type species : *Epimys manipulus* Thomas.

Distribution : NE. India, eastwards to China and Vietnam and southeastwards to Malaysia and NW. Sumatra.

Genus *Berylmys* is characterised by dense, crisp, iron grey pelage, palate long but not extending posteriorly beyond third upper molars, diastema more than 28% of occipitonasal length, bulla, in Indian species, about 15% of occipitonasal length and lower incisor root forming a prominent knob on outer side of lower jaw.

Upper incisors proodont. or orthodont. M^1 having 5 roots.

Chromosome number $2N = 40$.

This genus is represented by four species, *B. manipulus*, *B. bowersü*, *B. mackenziei* and *B. berdmorei*. Of these, the last one does not occur in India.

Key to species of genus *Berylmys*

- 1 Size small, occipitonasal length of skull less than 41 mm; diastema long, more than 33% of *onl*; upper surface of hind-foot including toes white ***B. manipulus***
 Skull large, occipitonasal length of skull more than 41 mm; diastema short, less than 33% of *onl*; upper surface of hindfoot brown, only toes white 2
2. Occipitonasal length of skull more than 52 mm; maxillary toothrows more than 9.6 mm in length; mammae 4 pairs ***B. bowersü***
 Occipitonasal length of skull less than 52 mm; maxillary toothrows less than 9.6 mm in length; mammae 5 pairs ***B. mackenziei***

Berylmys bowersü (Anderson)

1879. *Mus bowersü* Anderson, *Zool. Res. Yunnan*, : 304 (Hotha, Yunnan, China).

1921. *Rattus wellsi* Thomas, *J. Bombay nat. Hist. Soc.*, 28 : 26 (Mawphlang, Khasi Hills, Meghalaya, India).

Common name : Bower's Rat (Eng.).

Measurements : (vide Musser & Newcomb, 1983)

External : 16 ex : HB 236-285 (249.7 ± 12.6); TL 249-292 (269.3 ± 11.4); Hf 52-61 (57 ± 2.3); E 32-36 (33.8 ± 1).

Cranial : 16 ex : *onl* 52.1-58.5 (56.3 ± 1.9); *iw* 7.9-8.9 (8.3 ± 0.3); *d* 15.4-18.2 (16.0 ± 0.9); *p* 27.3-30.0 (29.6 ± 1.0); *apf* 10.2-11.8 (10.9 ± 0.5); *b* 7.2-8.2 (7.8 ± 0.3); *m* 9.4-10.6 (9.9 ± 0.3); *mw* 2.7-3.0 (2.8 ± 0.1).

Diagnostic characters : A large-sized rat, having the tail slightly longer than head and body length. Body dark brown to brownish grey above and white below; tail brown, its distal one-fifth portion white all round; hindfoot brown, toes white. Mammae 4 pairs.

Largest species of the genus, occipitonasal length more than 52 mm; maxillary tooth-rows long, more than 9.6 mm. in length; bulla small, less than 15% of *onl* and diastema short for this genus, 28-30% of *onl*.

Upper incisors orthodont, yellow and plain. Molars 3/3; M^1 5 rooted; M^1 having 8 cusps ($t7$ absent) and M^2 and M^3 6 cusps. Lower molars without peculiarity; M_1 trilaminate, M_2 and M_3 bilaminate; all biserially cuspidate; M_1 and M_2 each having a posterior cingulum.

Distribution (Map 9) : India : Arunachal Pradesh (Tirap dist.), Meghalaya (Khasi Hills), Nagaland (Mokokchung), Mizoram (Lushai Hills) and Manipur (Machi, Karong). Also reported from Myanmar, S. China, N. Thailand, N. Vietnam, Malay Peninsula and NW. Sumatra.

Ecology and biology : Nocturnal and fossorial. Commonly found in primary forests and in the highlands above 600 m attitude. Also occurs in disturbed primary and secondary forests and scrub. In Mizoram, it occurs in cultivated fields in complex burrow systems (Chauhan *et al.*, 1982). Feeds mainly on vegetable matter; also takes insects and land molluscs. Litter-size 4.

***Berylmys mackenziei* (Thomas)**

1916. *Epimys mackenziei* Thomas, *J. Bombay nat. Hist. Soc.* 24 : 410 (Haingyan ca 80 km w. of kindat, Chin Hills, Myanmar).

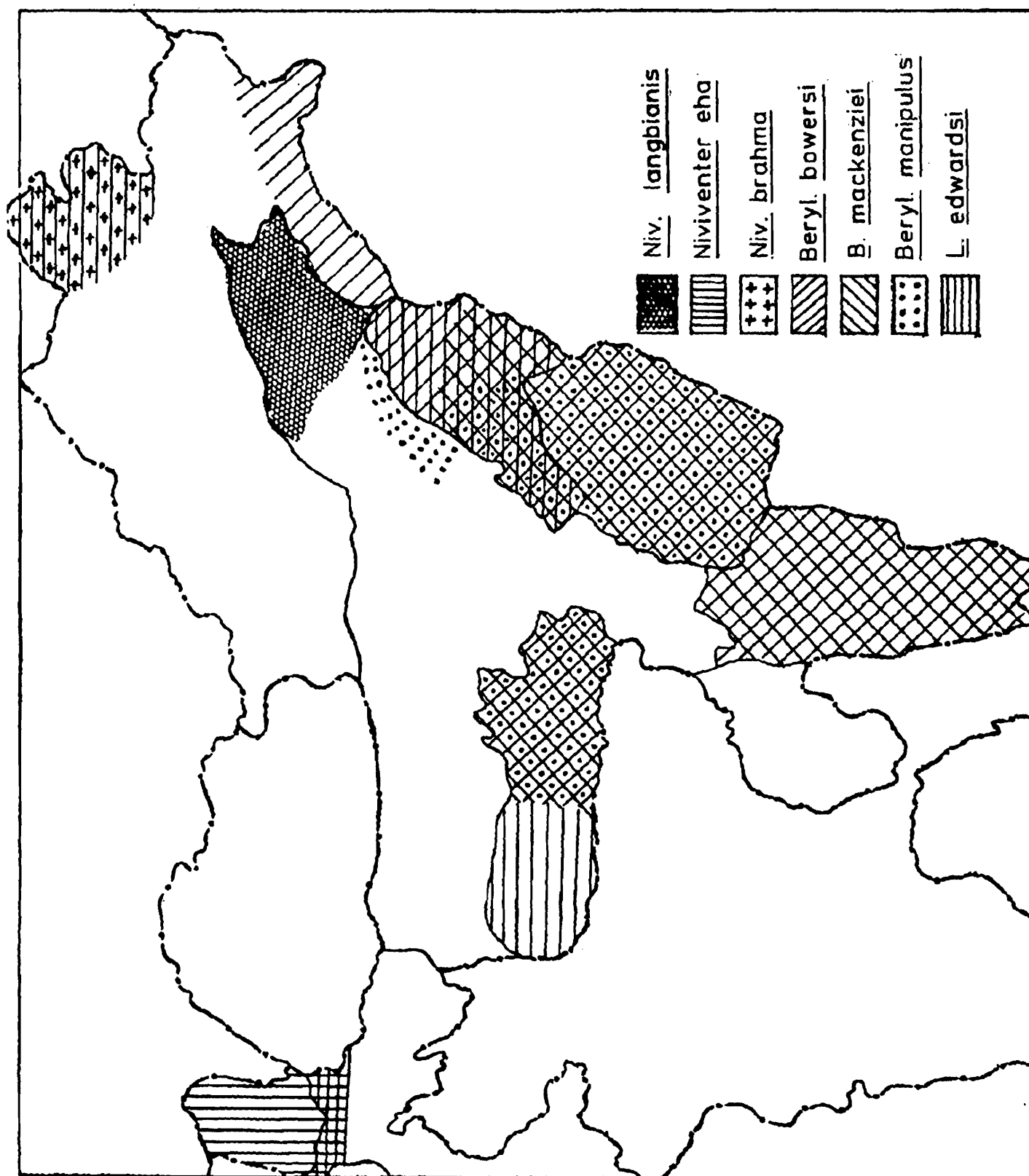
Common name : Mackenzie's Rat (Eng.).

Measurements : (Based on ZSI & BM collections from the Indian territory).

External : 22 ex. HB 160-220 (186 ± 18); TL 150-254 (211 ± 25); Hf 40-50 (45 ± 2.5), E 25-30 (28 ± 1.4).

Cranial : 22 ex. *onl* 40.5-51.7 (45.2 ± 2.6); *p* 21.3-26.6 (23.9 ± 1.3); *d* 10.9-15.4 (12.9 ± 1.0); *apf* 8.0-9.2 ($8.4 \pm .4$); *b* 6.0-6.8 ($6.4 \pm .2$); *m* 7.2-8.4 ($7.75 \pm .33$); *mw* 2.4-2.8 ($2.6 \pm .1$).

Diagnostic characters : Smaller than *Berylmys bowersü* in size. This is reflected in the lengths of head and body, hindfoot, occipitonasal and maxillary toothrows; bulla less than 15% of *onl*; diastema less than 31% of occipitonasal length as in *bowersü* but shorter than in *B. manipulus*. Body colour iron grey to dark grey above, white below; distal one-third to one-half of tail white, rest brown; hindfoot brown, toes white. Mammae 5 pairs.



Map 9. Showing the distribution of seven species of rodents in India.

Dentition as in *Berylmys bowersü*. Cusp t3 present in M² in about half of the specimens of *B. mackenziei* but absent in other species of *Berylmys* (Musser & Newcomb, 1983).

Distribution (Map 9) : India : Meghalaya (Shillong and Cherrapunji), Nagaland, Mizoram (Lushai Hills) and Manipur (Bishenpur; Tamenglong dist.). Also reported from Myanmar, China and S. Vietnam.

Ecology : Occurs in montane forests between 1000 and 2000 m attitude.

***Berylmys manipulus* (Thomas)**

1916. *Epimys manipulus* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 413 (Kabaw Valley, Kindat, Myanmar).

1948. *Rattus manipulus kekrimus* Roonwal, *Proc. natn. Inst. Sci. India*, 14 : 386 (Kekrima, Nagaland, India).

Common name : Manipur Rat (Eng.).

Measurements : (Based on ZSI and BM specimens from the Indian territory).

(Range, mean, standard deviation and sample size).

	<i>manipulus</i>		<i>kekrimus</i>
	♂	♀	♂ (Holotype)
HB	135-180 153±12 (12)	145-165 154±7.5 (4)	135
Tl	140-187 159±14 (10)	145-180 157±10 (4)	172
Tl as % of HB	94-107 104±5.5 (10)	98-109 102±4.2 (4)	127
Hf	30-37 33.5±2 (12)	32-33 32.7±.5 (4)	39
E	20-25 23.5±1.5 (12)	24-25 24.3±.5 (4)	—
<i>onl</i>	34.6-41.3 37.8±1.7 (11)	36.5-37.2 36.8±.3 (3)	40.2

	<i>manipulus</i>	<i>kekrimus</i>	
<i>p</i>	19.0-22.3 20.5±.9 (11)	19.9-20.7 20.3±.3 (3)	—
<i>d</i>	11.2-14.1 12.2±.9 (11)	11.6-12.5 12.0±.4 (3)	13.7
<i>apf</i>	6.2-8.0 7.2±.6 (11)	6.4-7.6 7.0±.5 (3)	7.4
<i>m</i>	5.5-6.1 5.75±.15 (11)	5.7-5.8 5.77±.5 (3)	6.0
<i>mw</i>	1.8-2.0 1.9±.1	1.8-2.0 1.9±.1	—
<i>b</i>	5.4-6.0 5.7±.2 (11)	5.6-5.7 5.67±.5	—

Diagnostic characters : Smallest of the Indian species of the genus *Berylmys*, having the tail equal to or longer than head and body length. Body having dense, crisp, iron-grey pelage above, and white below; distal one-third of tail white, rest brown; hindfoot including the toes white. Mammae 5 pairs.

Skull small, occipitonasal length less than 41 mm, having lengthened diastema (more than 33% of *onl*), smaller bulla (about 15% of *onl*) and smaller and narrower maxillary toothrows (length 5.5-6.1 mm and width 1.8-2.0 mm).

Upper incisors proodont. Molars as in *Berylmys bowersü* except that the antero-labial cusp present on M_2 (Musser and Newcomb, 1983).

The species *Berylmys berdmorei* with which *B. manipulus* was originally confused, differs from it by the length of tail, smaller than head and body and its distal half brown instead of white, and large inflated bulla (more than 7 mm or more than 18% of *onl*).

Distribution (Map 9) : India : Assam (Golaghat), Nagaland (Kekrima and Naga Hills), and Manipur (Bishenpur, Senapati dist. and Imphal). Also reported from Myanmar.

Ecology and biology : Nocturnal and fossorial. Common in oak scrub, evergreen jungle, riverine meadows, etc. between 80 and 1650 m. altitude. Feeds both on plant and animal (insects and earthworms) matter (Roonwal, 1950). In Myanmar, this species breeds in February-March; litter-size 8 or 9.

Intraspecific variation : Based on the study of four specimens from Kekrima, Nagaland, Roonwal (1948) described the subspecies *Rattus manipulus kekrimus* = *Berylmys manipulus kekrimus*. He differentiated it from the nominate subspecies from Manipur by the pelage being less grey and more brown, tail slightly longer (105% of HB vs 93%), tooththrow longer and anterior palatal foramina shorter.

	<i>apf</i>	<i>apf/onl</i>	<i>m</i>	<i>m/onl</i>
Manipur & Myanmar, 21 ex.	6.2-8.0 (7.05±.5)	17.4-21.0 (18.6±.9)	5.5-6.2 (5.8±.2)	13.8-17.0 (15.5±.9)
Nagaland, 4 ex.	6.7-7.4 (6.9±.3)	18.4-19.1 (18.7±.3)	5.6-6.4 (6.0±.3)	14.9-16.8 (16.1±.8)

When a large number of specimens of *B. m. manipulus* from Assam, Manipur and Myanmar were examined, it was observed that both the absolute and relative lengths of anterior palatal foramina and maxillary tooththrows overlap with those of *B. m. kekrimus* from Nagaland. Further, there is no marked difference in the colour of body or length of tail. Hence, *B. m. kekrimus* is treated here as a synonym of the nominate subspecies.

Genus *Leopoldamys* Ellerman

1947. *Leopoldamys* Ellerman, *Proc. zool. Soc. Lond.*, 177 : 261.

Type species : *Mus sabanus* Thomas.

Distribution : NE. India, east to Vietnam, S. China, Malaysia and Indonesia.

Genus *Leopoldamys* contains very large rats, having a very long tail; palate about half of occipitonasal length and not extending posteriorly behind third upper molars; bulla unusually small (less than 10% of *onl*) and maxillary tooththrows long (more than 8 mm in length). First upper molars having 4-roots (Musser, 1981).

Chromosome number $2N = 42$ or 44 ; $FN = 54$ or 56 .

The unusually small bulla, and palate not extending behind third upper molars bring this genus close to *Dacnomys*, but the maxillary tooththrows are much longer, exceeding one-fifth of occipitonasal length in the latter genus.

Out of four species of this genus, only *Leopoldamys edwardsi* occurs in India. The species *L. sabanus* reported from Meghalaya is a misidentification of *L. edwardsi*, as such *L. sabanus* does not occur in India (Musser, 1981).

***Leopoldamys edwardsi* (Thomas)**

1882. *Mus edwardsi* Thomas, *Proc. zool. Soc. Lond.*, : 587 (Mountains of W. Fujian, China).

1916. *Epimys listeri* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 406 (Pashok, Darjeeling, West Bengal, India).

1821. *Epimys listeri garonum* Thomas, *J. Bombay nat. Hist. Soc.*, 28 : 27 (Tura, Garo Hills, Meghalaya, India).

Common name : Edward's Rat (Eng.).

Measurements : (Based on ZSI & BM collections).

External : 6♂ : HB 210-258 (241±17); TI 264-315 (293±15); Hf 45-58 (47±1); E 28-32 (30±1).

2♀ : HB 232, 235; TI 289, 305; Hf 42, 46; E 30, 34.

Cranial : 6♂ : *onl* 54.1-57.6 (55.9±1.3); *p* 27.0-28.8 (27.75±.7); *apf* 7.8-9.6 (8.6±.6); *b* 5.5-6.0 (5.8±.2); *m* 8.7-10.1 (9.2±.4).

2♀ : *onl* 54.7, 57.6; *p* 27.2, 28.9; *apf* 8.8, 9.4; *b* 5.7, 5.8; *m* 9.1, 9.8.

Diagnostic characters : A large rat, having a long tail (106-140% of head and body) reaching up to 164% of HB in Malayan specimens; ears large, more than one-tenth of head and body length. Fur short and spiny. Body colour brown above, slightly darker in the middle; undersurface white; tail poorly to distinctly bicoloured, dark brown above, greyish to whitish below; hind foot pale brown, with white toes. Mammae 4 pairs.

Skull large, occipitonasal length, in Indian specimens, 54-58 mm; bulla very small (9-11% of *onl*); maxillary tooththrows long (8.7-10.1 mm); palate less than one-half of occipitonasal length, not extending posteriorly behind third upper molars; supraorbital ridges well-developed.

Upper incisors opisthodont, reddish and plain. Molars 3/3 in number; M¹ 4-rooted having 8 cusps (t7 absent), M² with 6 cusps (t2, t3, t7 absent), M³ reduced but clearly trilaminate. Lower molars biserially cuspidate, with marked posterior cingulum in M₁ and M₂.

Chromosome number 2N = 42; FN 56.

Distribution (Map 9) : India : West Bengal (Darjiling), Arunachal Pradesh (Mishmi Hills), Meghalaya (Garo Hills : Tura), and Nagaland (Mokokchung). Also reported from Myanmar, S. China, N. Thailand, Vietnam, Malaysia and Indonesia.

There is no record of this species from Sikkim, as erroneously shown by Musser (1981), as the type of '*listeri*' is from Pashok, Darjeeling dist., West Bengal and not Sikkim.

Ecology and biology : Occurs in montane forest above an attitude of 500 m. A pregnant female contained 2 embryos in the uterus (Ellerman, 1961).

Genus *Niviventer* Marshall

1976. *Niviventer* Marshall, In : *Mammals of Thailand*, pp. 397-487.

Type species : *Mus niviventer* Hodgson.

Distribution : From the Himalaya to China and Vietnam in the east, and to Malaysia and Greater Sunda Shelf in the southeast.

A medium-sized rat, having the tail longer than head and body, sometimes tufted at the tip. Pelage dense with short guard hairs and flattened spines. Dorsum dark grey to reddish brown, venter white or grey; tail unicoloured or bicoloured (dark above and pale below). Palate short, less than one-half of occipitonasal length, ending in a line with posterior margin of maxillary toothrows; bulla small, less than 15% of occipitonasal length; anterior palatal foramina long and narrow but shorter than in *Cremnomys* and *Millardia*, reaching posteriorly up to alveoli of first upper molars; squamosal root of zygomatic arch originate moderately high on the sides of braincase. Molars rather narrow, laminae chevron-shaped and cusp t9 very small; M¹ having 4 or 5 roots, and M₁ 4 roots. Mammae 3-4 pairs.

Chromosome number 2N = 46.

Discussion : The genus *Niviventer* is represented by about 15 species (Corbet and Hill, 1986). Earlier, these species were included in the subgenus *Maxomys* of genus *Rattus* (Ellerman, 1961) and later in the genus *Maxomys* (Missone, 1969). However, the type species of *Maxomys* namely, *Rattus bartelsi* Jentink was later found to be very different from other species included there. Hence, Marshall (1976) erected a new genus *Niviventer* to accommodate those species. The species *Mus confusianus* Milne Edwards from S. China, which was treated as a subspecies of *Rattus niviventer* by Ellerman & Morrison-Scott (1951) was subsequently given specific rank under the genus *Niviventer* by Marshall (1976). Later, Musser (1981), who reviewed this genus, synonymised *Rattus mentosus* Thomas with *Niviventer confusianus* without assigning any reason. He, further, treated *Rattus langbianis* Robinson and Kloss as a full species distinct from *Rattus cremoriventer* = *N. cremoriventer*.

Ellerman (1961) differentiated the species *niviventer* from *fulvescens* by the length of tail, less than 140% of head and body in the former and more than that in the latter. However, Abe (1977) found it to be 109% ± 4.58 in the former and 128% ± 7.49 in the latter species, in central Nepal. An analysis of measurements of specimens present in ZSI and British Museum show that though there is a tendency in the tail being longer in

fulvescens than in *niviventer* but there is no clearcut difference if the specimens of both the species from their entire range in the Himalaya and NE India are considered. It appeared to be the main cause of confusion in identifying many of the specimens of *fulvescens* from Chamba, Himachal Pradesh by Ellerman (1961), and *Rattus mentosus* from Manipur by Roonwal (1950). However, the species can easily be differentiated on the basis of colour of dorsum, greyish brown in *niviventer*, and fulvous to reddish brown in *fulvescens*.

Specimens of *N. niviventer* and *N. fulvescens* collected by the Mammal Survey of India team from Nepal and Sikkim are smaller than those from NE India. However, later collections made by Abe (1971) from Nepal, and by Ghose (1964) from Darjiling are more or less as large as from NE India.

Thus, five species of the genus *Niviventer*, namely, *N. niviventer*, *N. fulvescens*, *N. brahma*, *N. langbianis* and *N. eha* occur in India.

Key to species of genus *Niviventer*

- 1 Fur on ventral surface of body grey or grey on base and white at tip; mammae 3 pairs 2
- Fur on ventral surface of body white up to base; mammae 4 pairs 3
2. Smaller species, occipitonasal length of skull less than 33 mm and maxillary toothrows less than 6 mm *N. eha*
- Larger species, occipitonasal length of skull more than 33 mm and maxillary toothrows more than 6 mm. *N. brahma*
3. Tail wholly dark; first upper molars 4-rooted; rostrum shorter *N. langbianis*
- Tail normally bicoloured, dark above and pale below; first upper molars 5-rooted; rostrum longer 4
4. Dorsum dark grey to greyish brown *R. niviventer*
- Dorsum fulvous to reddish brown *R. fulvescens*

Niviventer niviventer (Hodgson)

(Plate 5; figs. B, B')

1836. *Mus (Rattus) niviventer* Hodgson, *J. Asiat. Soc. Bengal*, 5 : 234 (Kathmandu, Nepal).

1916. *Epimys lepcha* Wroughton, *J. Bombay nat. Hist. Soc.*, 24 : 429 (Chunthang, Sikkim, India).

Common name : Himalayan White-bellied Rat (Eng.).

Measurements : (Based on ZSI and BM specimens).

(Range, mean, standard deviation and sample size)

	<i>Nepal/Kumaon</i>	<i>Sikkim</i>	<i>Darjiling</i>	<i>NE India</i>
HB	115-139 127±9.6 (13)	114-140 126±8 (10)	128-153 141±8 (5)	132-166 151.5±10 (11)
Tl	149-182 156±12 (12)	142-170 159±9.5 (9)	165-206 192±11.5 (5)	167-205 186±18 (11)
Tl as % of HB	110-135 121±7.5 (12)	105-137 126±9.5 (9)	127-147 136±7 (5)	106-139 122.5±11 (11)
Hf	23-27 25.2±.7 (13)	27-30 28.6±1 (10)	27-30 28±1.2 (5)	26-32 29±1.7 (11)
E	18-21 19.5±1.2 (12)	20-22 21±1 (10)	21-22 21.6±.5 (5)	20-24 22±1.3 (11)
<i>onl</i>	32.2-37.0 33.6±1.8 (5)	32.4-36.8 34.1±1.3 (7)	35.5-38.4 36.7±1.1 (4)	33.6-39.9 36.7±1.8 (11)
<i>m</i>	4.7-6.1 5.3±.5 (5)	5.0-5.3 5.15±.1 (7)	5.3-5.7 5.45±.15 (4)	5.4-6.2 5.7±.24 (11)
<i>b</i>	4.3-5.0 4.6±.25 (5)	4.6-5.0 4.75±.12 (6)	5.1-5.4 5.2±.1 (4)	4.0-5.0 4.7±.3 (11)

Diagnostic characters : A small to medium-sized rat, having a moderately long tail (106-147%, mean 126% of head and body length), distinctly bicoloured, dark above and whitish below; sometimes distal one-fourth portion unpigmented all round. Pelage on dorsum spiny or soft. Coat colour dark grey above, white below, sharply demarcated on sides; Hindfoot brownish to whitish, with toes white; mid-ventral streak or dark patches present on thorax in specimens from Sikkim and high altitude areas of Darjiling (West Bengal). Mammary 4 pairs.

Skull ranges from small to medium in size, rather flat over cranium; supraorbital ridges heavier in specimens from NE India than in those from Nepal and Sikkim; palate short, less than half of occipitonasal length, ending posteriorly in line with maxillary tooththrows; anterior palatal foramina long and narrow, and end anterior to first upper molars; bulla small, 12-14% of *onl*.

Upper incisors orthodont or opisthodont, and orange in colour. Molars 3/3; M^1 5-rooted. M^1 8 cusped, M^2 6 cusped, M^3 like M^2 but smaller. Lower molars normal; M_1 having 3 laminae and a posterior cingulum, M_2 two laminae and a posterior cingulum, and M_3 bilaminar.

Chromosome number $2N = 46$; $FN = 54$.

Distribution (Map 10) : A montane rat, found in the Himalaya up to 3600 m alt. Also reported from Nepal (2100-3200 m alt., Abe, 1977), Bhutan (Susuna) and Myanmar.

India : Uttar Pradesh (Kumaon alt. c 1828-2743 m), West Bengal (Darjiling dist. c 2250-3600 m), Sikkim (Chunthang c 1630 m, Lachen c 2682 m, and Bakhim c 2743 m), Assam (Digboi, Sadiya), Nagaland (Mokokchung), Arunachal Pradesh (Mishmi Hills c 685-1567 m), Meghalaya (Jaintia Hills c 1219-1371 m), Manipur (Imphal and Chandel dists.).

Ecology and biology : Nocturnal and cursorial. Occurs in dense evergreen and riverine jungle in the vicinity of streams. Feeds mainly on vegetable matter, sometimes insects too. Nothing is recorded about its breeding habit.

Intraspecific variation : Two subspecies are recognised in India.

Key to subspecies of Niviventer niviventer

Grey throat patch or mid-ventral stripe present..... *N. n. lepcha*

Grey throat patch or mid-ventral stripe absent *N. n. niviventer*

(i) *Niviventer niviventer niviventer* (Hodgson)

1836. *Mus (Rattus) niviventer* Hodgson, *J. Asiat. Soc. Bengal.*, 5 : 234 (Kathmandu, Nepal).

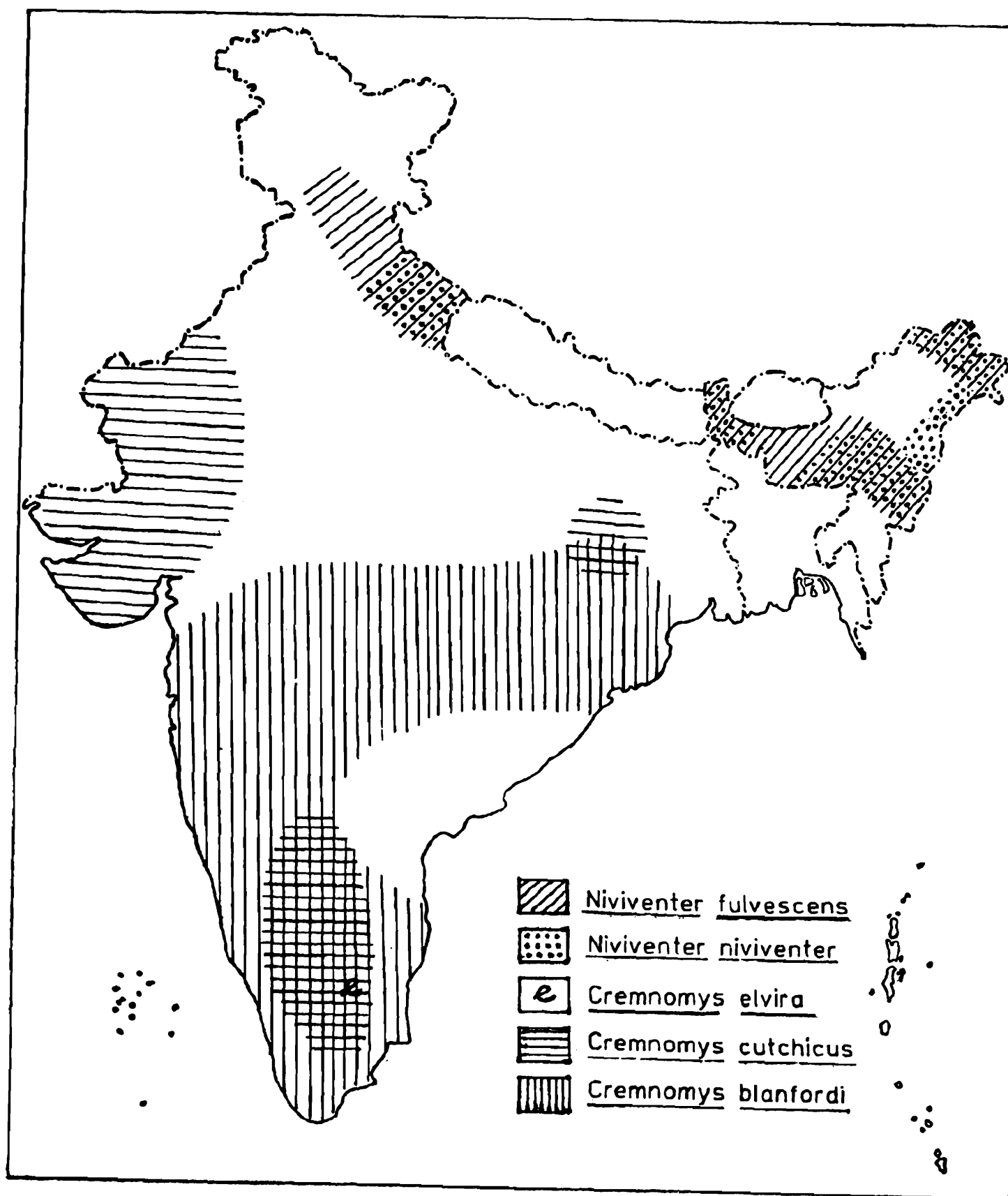
Distribution : Uttar Pradesh (Kumaon) to NE India except Sikkim and Darjiling. Also Nepal and Bhutan.

(ii) *Niviventer niviventer lepcha* (Wroughton)

1916. *Epinys lepcha* Wroughton, *J. Bombay nat. Hist. Soc.*, 24 : 429 (Chunthang, Sikkim, India).

1964. *Rattus niviventer monticola* Ghose, *Proc. zool. Soc. Calcutta*, 17(2) : 193-197 (Palmajua, Darjiling dist., West Bengal, India).

Distribution : Sikkim and high altitude areas of Darjiling dist., West Bengal.



Map 10. Showing the distribution of five species of rodents in India.

The grey patches on throat in specimens from Darjiling (Ghose, 1964) are exactly similar to those present in recently collected specimens from Sikkim. Hence, *R. n. monticola* Ghose is treated here as a synonym of *R. n. lepcha* (wroughton)

The throat patch or mid-ventral stripe is however, absent in a specimen from Ghoombhanjan, lower altitude of Darjiling district, West Bengal.

Niviventer fulvescens (Gray)

(Plate 5; figs. A, A')

1847. *Mus fulvescens* Gray, Cat. Hodgson Colln., : 18 (Nepal).

1849. *Mus caudator* Hodgson, Ann. Mag. nat. Hist. 3 : 203 (Nepal).

1863. *Leggada jerdoni* Blyth, J. Asiat. Soc. Beng., 32 : 350 (Sikkim, India).

1863. *Mus octomammis* Gray, Cat. Hodgson Colln., 2nd ed. : 10.

Common name : Himalayan Chestnut Rat (Eng.)

Measurements :

	Nepal ZSI/BM material	Nepal (Abe, 1971) ♂ ♀		Himachal Pradesh	Sikkim and Darjiling	NE. India
HB	118-135 124±6.4 (11)	129-158 144 (6)	126-148 141 (7)	114-160 129±13 (15)	112-145 130.5±9 (57)	115-164 145±11 (27)
Tl	169-212 186±12 (11)	167-210 183.5 (6)	159-209 178.4 (7)	137-200 168±18 (15)	133-222 193±17.5 (56)	183-223 198±15 (26)
Tl as % of HB	125-160 150±10 (11)1		— —	121-138 130±6 (15)	122-164 147±9 (56)	117-153 136±9 (26)
Hf	27-31 28.5±1.5 (11)	27-32.5 28.8 (6)	25-28 26.7 (7)	25-31 29±1.5 (15)	26-31 28.5+1.5 (57)	26-34 29.5±1.5 (27)
E	20-22 21±.7 (11)	19.5-23 20.9 (6)	19-22.5 20.6 (7)	19-21 20±1 (15)	18-21 20.3±1 (57)	20-25 22±2 (27)

	Nepal ZSI/BM material	Nepal (Abe, 1971)		Himachal Pradesh	Sikkim and Darjiling	NE. India
		♂	♀			
<i>onl</i>	33.1-36.2	33.9-37.4	33.7-36.7	32.0-39.1	32.3-39.4	35.0-39.7
	34.35±1.1 (4)	35.4 (6)	34.9 (7)	36.4±2 (11)	35.9±1.8 (37)	37.3±1.4 (25)
<i>m</i>	5.3-5.8	5.6-6.0	5.6-6.3	5.5-5.9	5.2-6.1	5.3-6.2
	5.5±1.8 (4)	5.9 (6)	5.9 (7)	5.7±1 (11)	5.6±.3 (36)	5.8±.2 (24)
<i>b</i>	4.4-4.9	4.6-4.9	4.7-4.8	4.4-4.9	4.5-5.1	4.5-5.1
	4.7±.18 (4)	4.8 (6)	4.8 (7)	4.7±.18 (8)	4.75±.18 (10)	4.8±.2 (22)

Diagnostic characters : Essentially like *Niviventer niviventer* in size and appearance, but differs in coat colour; dorsum fulvous to reddish brown (throughout the year) as against dark grey in *niviventer*; venter white; hindfoot flesh-coloured, with white toes; tail generally bicoloured (dark above and pale below), sometimes unicoloured in specimens from Sikkim & West Bengal. Pelage spiny or soft. Though there is a tendency in the tail being longer in *fulvescens* (121-164%, mean 141% of head and body) than in *niviventer* (113-147%, mean 126% of HB), there is no clearcut difference even at one standard deviation from the mean. Mammae 4 pairs.

Occipitonasal length of skull varying between 32 and 40 mm; supraorbital ridges distinct; palate short, less than one-half, and bulla small, less than 14% of occipitonasal length; maxillary toothrows shorter than in *N. brahma*, less than 6.2 mm in length.

Dentition as in *Niviventer niviventer*.

Chromosome number $2N = 46$; $FN = 54$.

Variation : Out of 36 specimens of this species from Sikkim and Darjiling, 18 specimens from Selimbong (Darjiling), Lachen (c 2682 m) and Chunthang (c 1631 m) collected during December, January and March are soft-furred. Of these, 10 are having unicoloured and the rest 8 faintly bicoloured tail. The specimens from Chamba (Himachal Pradesh) (alt. 1646-2286 m) collected in December are also soft-furred but the tail in all the specimens are clearly bicoloured. However, neither there is any difference in the head and body length nor in the relative length of tail in both sets of specimens from Darjiling dist. and Sikkim.

Locality	Pelage and season	Tail	HB	Tl as % of HB
Sikkim & Darjiling dist.	Soft (winter)	Unicoloured	112-145 125±12 (18)	122-164 145±12 (18)
	Spiny (summer)	Bicoloured	117-141 130±8 (18)	133-158 147±9 (18)

The difference in the nature of fur appears to be a seasonal variation but nothing can be said about the colour of tail. However, the same tendency of tail becoming unicoloured has also been noticed in specimens of *Rattus turkestanicus* from Nepal and Sikkim.

Distribution (Map 10) : A montane rat, found in India in the Himalaya, from Himachal Pradesh to northeast. Also reported from Nepal, Myanmar, China, Thailand, Laos and Vietnam.

India : Himachal Pradesh (Chamba c 1646-2286 m alt.), Uttar Pradesh (Kumaon c 2316 m), West Bengal (Darjiling dist. c 1066-2286 m alt), Sikkim (Chunthang c 1631 m, Rabangla c 2010 m, Lachen c 2682 m), Assam (Kamrup c 182 m), Meghalaya (Garo Hills c 397-427 m, Khasi Hills c 732 m, Jaintia Hills), Arunachal Pradesh (Mishmi Hills c 685-1567 m) and Manipur (Imphal c 1066 m).

Ecology and biology : Lives in evergreen, broad-leaved forests, shrubs, rocks, etc. near water. Nocturnal and fossorial. Feeds mainly on plant material, occasionally insects. In Nepal, breeds between April and June; litter-size 3-8 (Abe, 1971).

Intraspecific variation : No subspecies. Niethammer and Martens (1975) however, have regarded *fulvescens* as a synonym of *niviventer*. In the opinion of the present author, the whole confusion comes when one considers the length of tail for identification. The two species can be differentiated on the colour of dorsum.

The Mammal Survey collections from Jaintia Hills (Meghalaya) present both in ZSI and BM are *Niviventer niviventer* (and not *N. fulvescens* as originally identified). Similarly, the specimens from Manipur identified as *Rattus mentosus* by Roonwal (1950) and those from Chamba, Himachal Pradesh having a shorter tail (identified as *N. fulvescens* with a question mark by Ellerman, 1961) also belong to *N. fulvescens*. Out of 75 specimens of *N. fulvescens* examined by the present author all except 6 have fulvous or reddish brown colour. The six specimens from Pashok, Darjiling district, lack the rufous tinge.

***Niviventer brahma* (Thomas)**

1914. *Epimys brahma* Thomas, *J. Bombay nat. Hist. Soc.*, 23(2) : 232 (Anzong valley c 1815 m, Mishmi Hills, Arunachal Pradesh, India).

Common name : Thomas' Chestnut Rat (Eng.).

Measurements :

External : 5♂, 1♀ : HB 140-155 (146±5); TI 215-240 (226.5±9); TI as % of HB 143-158% (153±5); Hf 28-32 (31±1.8); E 24-25 (24.6±.5).

Cranial : 3♂, 1♀ : *onl* 35.7-38.0 (37.4±1.0); *p* 17.4-18.5 (18.0±.4); *d* 8.9-9.5 (9.2±.25); *apf* 6.7-7.3 (7.0±.25); *b* 4.9-5.2 (5.0±.1); *m* 6.3-6.8 (6.6±.2).

Diagnostic characters : Essentially like *Niviventer fulvescens* in size and appearance, but differs from it in having the pelage of body soft, dense and long (c 15 mm), dorsum orange brown and venter greyish (basal half of hairs grey and apical half white), tail longer (153±5% of HB), hairy, penicillate and poorly bicoloured (dark above and greyish below), and maxillary toothrows (6.3-6.8 vs 5.2-6.2) longer. Mammary 3 pairs (*vide* Ellerman 1961, p. 654).

Distribution (Map 9) : India : Arunachal Pradesh : Mishmi Hills (Anzong Valley c 1815 m). Also reported from Myanmar (Adung valley and Nyetmaw river, c 2623 m).

Ecology and biology : Occurs in cool, moist, dense temperate forests in the highlands (Musser, 1970).

Remarks : Ellerman (1961) treated *Epimys brahma* as a subspecies of *Rattus fulvescens*, but Musser (1970) resuscitated it as a full species under the genus *Niviventer*, and considered it more near to *N. eha* than to *N. fulvescens*.

***Niviventer eha* (Wroughton)**

1916. *Epimys eha* Wroughton, *J. Bombay nat. Hist. Soc.* 24 : 428 (Lachen c 2684 m, Sikkim, India).

Common name : Little Himalayan Rat (Eng.).

Measurements :

External : 12♂, 5♀ : HB 98-125 (110±10); TI 158-201 (175±11.5); TI as % of HB 145-167% (160±8); Hf 23-28 (26±2); E 19-22 (20±1).

Cranial : 4♂, 3♀ : *onl* 29.4-31.5 (30.1±.9); *p* 13.5-15.2 (14.05±.6); *apf* 5.1-6.0 (5.5±.35); *m* 4.6-5.0 (4.9±.15); *b* 4.1-4.8 (4.3±.25); *d* 6.6-8.5 (7.1±.6).

Diagnostic characters : A small-sized, soft-furred rat (much smaller than *N. fulvescens* or *N. brahma*), having a very long tail, more than 150% of head and body

length, moderately hairy and tends to be tufted at the end. Fur dense and spineless. Body reddish brown above, grey below, sharply contrasted with back; face with a dark ring around the eyes; tail bicoloured, dark above, whitish below. Mammary 3 pairs.

Supraorbital ridges, in skull, scarcely developed; palate less than half of occipitonasal length; anterior palatal foramina long, usually reaching the maxillary toothrows; bulla small, less than 15% of *onl*.

Upper incisors narrow, yellow and plain. Molars 3/3 in number; M^1 4 or 5 rooted; M^1 having 8 cusps, M^2 6-cusps and M^3 small and reduced. Lower molars biserially cuspidate; M_1 and M_2 having posterior cingulum.

Distribution (Map 9) : A montane rat, found in the Central Himalaya. Also reported from Nepal (Abe, 1971), N. Myanmar and W. China.

India : Sikkim (Lachen c 2682 m; Yumthang c 3475 m; Thangu c 3048 m), and West Bengal (Palmajua c 2250 m; Sandakphu c 3600 m).

Ecology and biology : Found in coniferous and rhododendron forests, bamboo shrubs, etc., between 2250 and 3700 m. altitude. Feeds mainly on insects, also vegetable matter. Breeds during the summer, in Nepal; 2-3 embryos were found in the uterus (Abe, 1971).

Intraspecific variation : Out of two subspecies, the nominate subspecies occurs in India. According to Ellerman (1961), it differs from the Chinese one, *N. e. ninus* by the brighter body colour and longer tail (more than 150% of HB).

(i) *Niviventer eha eha* (Wroughton)

1916. *Epimys eha* Wroughton, *J. Bombay nat. Hist. Soc.*, 24 : 428 (Lachen c 2684 m, Sikkim, India).

Distribution : As mentioned under the species.

Niviventer langbianis (Robinson & Kloss)

1922. *Rattus langbianis* Robinson & Kloss, *Ann. Mag. nat. Hist.*, (ser 9), 9 : 96 (Langbian Peak, S. Vietnam).

1932. *Rattus indosinicus* Osgood, *Field Mus. Publ. Zool.*, 18 : 307 (Chapa, Tonkin).

Common name : Dark-tailed Himalayan Rat (Eng.).

Measurements :

From India (*vide* Ellerman, 1961) : 1♀ : HB 140; TI 148; Hf 24; E 20. *onl* 35.7; *iw* 5.4; *apf* 6.3; *p* 16.7; *b* 4.9; *m* 5.8.

From Myanmar (*vide* Musser, 1973) : 3♂, 1♀ : HB 125-134 (129); TI 151-177 (162); Hf 28-31 (29); E 22-24 (23). *onl* 32.9-35.5 (34.4); *iw* 5.7-5.8 (5.7); *apf* 6.0-6.7 (6.4); *p* 15.9-17.0 (16.5); *b* 5.1-5.6 (5.4); *m* 6.1-6.5 (6.25).

Diagnostic characters : A medium-sized rat, having the tail longer than head and body but shorter than in *eha* or *fulvescens*, and dark and unicoloured all round. Pelage long (c 15 mm), generally soft, sometimes spinous. Body brownish grey above, bright orange brown on the flanks and white below; hindfoot short and broad; plantar pads well-developed. Mammae 4 pairs.

Supraorbital ridges, in skull, well-developed; bulla large and inflated, more than 4.9 mm in length; anterior palatal foramina posteriorly extending to maxillary toothrows

Upper incisors orange yellow and plain. First upper molars having 4 roots and second 3-roots. M^1 having 8-cusps, M^2 with 6, and M^3 with 6 but smaller. Lower molars as in *N. niviventer*.

Distribution (Map 9) : India : Assam (Margherita c 60 m). Also reported from Myanmar (Chin Hills, Mt. Victoria c 2200-2800 m and Tenasserim c 970 m), Thailand, Laos and Vietnam.

Ecology and biology : Lives in primary and secondary evergreen forests (Musser, 1973) up to 2800 m altitude.

Intraspecific variation : No subspecies. Musser (1973) treated *Rattus langbianis* from Thailand as a full species, differing from *cremoriventer* by its brownish grey pelage, large bulla (more than 4.9 mm) and first and second upper molars 4 and 3 rooted respectively, as against 5 and 4 rooted in *cremoriventer*. He further, treated *Rattus indosinicus* Osgood as a synonym of *Niviventer langbianis* Robinson & Kloss.

Genus *Cremnomys* Wroughton

1912. *Cremnomys* Wroughton, *J. Bombay nat. Hist. Soc.*, 21 : 338-342.

1941. *Madromys* Sody, *Treubia*, 18 (2) : 260. (Type species *Mus blanfordi* Thomas).

Type species : *Cremnomys cutchicus* Wroughton.

Distribution : Peninsular India and Sri Lanka.

Genus *Cremnomys* is characterised by soft-furred rats, having the tail longer than head and body, fifth toe of hindfoot long, six plantar pads and 3 pairs of mammae; palate less than half of occipitonasal length; anterior palatal foramina unusually long, extending posteriorly between maxillary toothrows; squamosal root of zygomatic arch arising high on the sides of cranium.

Chromosome number $2N = 36$.

This genus is represented in India by three species, *Cremnomys cutchicus*, *Cremnomys elvira* and *Cremnomys blanfordi*. All these species are found on rocky hills, with trees or scrub.

The species *blanfordi* which was earlier placed under the subgenus *Rattus* of genus *Rattus* by Ellerman (1961) was transferred to genus *Cremnomys* by Missone (1969).

Key to species of genus Cremnomys

1. Tail bicoloured, wholly dark proximally and white all round distally; bulla large more than 17% of occipitonasal length *C. blanfordi*
 Tail unicoloured or faintly bicoloured, dark above and pale below; bulla small, less than 15% of occipitonasal length 2
2. Larger in size, occipitonasal length more than 36 mm..... *C. elvira*
 Smaller in size, occipitonasal length less than 36 mm *C. cutchicus*

Cremnomys cutchicus Wroughton

1912. *Cremnomys cutchicus* Wroughton, *J. Bombay nat. Hist. Soc.*, 21 : 340 (Kutch, Gujarat, India).
 1916. *Cremnomys medius* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 224-243 (Junagadh, Gujarat, India).
 1916. *Cremnomys medius rajput* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 241 (Mt. Abu, Rajasthan, India).
 1916. *Cremnomys medius caenosa* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 241 (Gaya, Bihar, India).
 1916. *Cremnomys australis* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 242 (Vijayanagar, Bellary, Karnataka, India).
 1916. *Cremnomys australis siva* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 242 (Sivasamudrum, Mysore Karnataka, India).
 1974. *Cremnomys cutchicus leechi* Harrison, *Mammalia*, 38 : 681 (Windhyam, Mirzapur, Uttar Pradesh, India).

Common name : Cutch Rock Rat (Eng.).

Measurements :

	<i>cutchicus</i>	<i>medius</i>	<i>rajput</i>	<i>australis</i>	<i>siva</i>
HB	104-121 112±6.2 (23)	104-132 117±7.5 (44)	114-132 122±4.3 (52)	114-147 129±8 (46)	108-149 132±9(17)
Tl	132-156 144±7 (22)	120-165 145±11 (37)	128-166 151±9 (44)	126-174 150—12 (41)	117-167 147±17 (17)

	<i>cutchicus</i>	<i>medius</i>	<i>rajput</i>	<i>australis</i>	<i>siva</i>
Tl as % of HB	120-145 131±8 (21)	113-146 125±7 (37)	108-133 124±6 (44)	100-138 116±10 (41)	107-125 114±6 (17)
Hf	23-26 24.2±.9 (26)	25-27 26±.9 (45)	25-27 26.3±.8 (54)	25-28 26.5±.7 (45)	23-29 26.5±1.2 (21)
<i>onl</i>	31.4-33.7 32.6±.8 (7)	32.2-34.3 33.7±.7 (7)	33.0-35.0 34.0±.7 (11)	32.5-35.5 33.7±.8 (10)	32.6-34.0 33.6±.4 (7)
<i>m</i>	5.0-5.9 5.4±.3 (7)	5.2-5.7 5.4±.15(7)	5.3-6.1 5.7±.3 (11)	5.0-5.5 5.3±.2 (10)	5.0-5.6 5.3±.2 (7)

Diagnostic characters : A medium-sized, soft-furred rat, having the tail longer than head and body (100-146% of HB) and well haired; fifth toe of hindfoot longer than hallux; six plantar pads present. Body drab grey to brown above, and from white to white mixed with grey below; tail either wholly dark or faintly bicoloured (dark above, paler below). Mammae 3 pairs.

Occipitonasal length of skull 31-36 mm; palate short, less than half of *onl*, extending posteriorly up to back of third upper molars; bulla 14-15% of *onl*; anterior palatal foramina long, more than 22% of *onl* and extending posteriorly between maxillary toothrows.

Upper incisors opisthodont, yellow and plain. Molars 3/3; upper molars well cuspidate. M^1 having 8 cusps (t7 absent), M^2 with 7 cusps (t2, t7 absent, t3 very small) and M^3 small. Lower molars as usual biserially cuspidate; subsidiary outer cusplets traceable in young specimens. Posterior cingulum present at the back of M_1 and M_2 .

Chromosome number $2N = 36$; $FN = 36$ (Rishi and Puri, 1984).

Distribution (Map 10) : Peninsular India extending north up to Rajasthan and Bihar. Hence, the species is endemic to India.

India : Rajasthan (Barmer, Jodhpur, Jaisalmer, Jalore, Jhunjhunu, Pali and Sirohi dists.), Gujarat (Kutch, Junagadh, Palanpur), Bihar (Gaya and Hazaribagh), Andhra Pradesh (Hyderabad), Karnataka (Bellary, Kolar and Mysore dists), and Tamil Nadu (Salem dist.).

Ecology and biology : Prefers rocky habitat, with sparse vegetation, from 150 to 1500 m altitude. Feeds mainly on plant material; also takes insects. Breeds from February to September; litter-size 3-10 (mean 4.62) at Mt. Abu, Rajasthan (Prakash, 1995).

Intraspecific variation : Ellerman (1961) recognized 5 subspecies of *C. cutchicus* as follows :

<i>cutchicus</i>	: Kutch (Gujarat)
<i>medius</i>	: Junagadh (Gujarat)
<i>rajput</i>	: Mt. Abu (S. Rajasthan)
<i>australis</i>	: Bellary (Karnataka)
<i>siva</i>	: Mysore (Karnataka)

Ellerman (*loc cit*) differentiated *australis* and *siva* from the other three subspecies in being larger in the head and body length (more than 130 mm), *cutchicus* from *rajput* and *medius* in having a longer tail (more than 130% of HB), and *rajput* from *medius* in having a buffy patch on neck.

A study of specimens of this species present in the Zoological Survey of India and the Bombay Natural History Society revealed that though the specimens in the south tend to be larger in head and body length than in the north and northwest, the absolute lengths overlap even at 1 standard deviation (see Table), and that smaller specimens of the size of *Cremnomys cutchicus cutchicus* occur also in Salem district, Tamil Nadu (Ellerman 1961, p. 681). Further, Prakash (1995) gave measurements of about 100 specimens from Abu Hills (type locality of *rajput*) as ♂ 131.38 ± 1.31 , ♀ 124.00 ± 1.30 , which do not differ much from those of *australis* or *siva*. Furthermore, it was observed that there is no marked difference in the absolute length of tail among the 5 subspecies. The difference in the relative length of tail (largest in *cutchicus* and smallest in *siva* and *australis*) is due to variation in the head and body length.

As regards the difference between *rajput* and *medius*, Prakash (1995) commented that out of 223 examples collected, only 120 possessed a buffy patch on the neck, and both types (with or without a patch) were collected in a single trap line from almost all habitats of Abu Hills (Rajasthan). Hence, he synonymised *rajput* with *medius*. Further, venter is white in 6 out of 11 specimens from Mt. Abu present in ZSI. It is grey on base and white at tip in the rest five as is found in majority of specimens from other localities.

Therefore, different subspecies of *C. cutchicus* are being treated here as synonyms of the nominate subspecies.

***Cremnomys elvira* Ellerman**

1947. *Rattus (Cremnomys) elvira* Ellerman, *Ann. Mag. nat. Hist.*, 13 : 207 (Kurambapatti, Salem, Tamil Nadu, India).

Common name : Large Rock Rat (Eng.).

Measurements : (vide Ellerman, 1961).

External : 2♀ : HB 126, 149; TI 180, 196; Hf 30, 32; E 21, 22.

Cranial : 2♀ : *onl* 38.2, 41.2; *p* 18.9, 20.5; *apf* 7.9, 9.1; *d* 9.5, 10.8; *m* 5.9, 6.1; *b* 5.6, 5.9.

Diagnostic characters : A medium-sized, soft-furred rat, having the tail more than 130% of head and body length; fifth toe longer than hallux; plantar pads six in number. Mammæ 3 pairs. Body brownish grey above, greyish white below; tail poorly bicoloured, dark above, pale below; hindfoot white.

Skull like that of *Cremnomys cutchicus* in structure, etc., but considerably larger, occipitonasal length 38-41 mm vs 31-36 mm in the latter; palate about one-half and bulla about 14% of occipitonasal length; anterior palatal foramina long, extending posteriorly between maxillary toothrows.

Dentition as in *Cremnomys cutchicus*.

Distribution (Map 10) : Known only from the type locality namely, Kurambapatti, Salem dist., Tamil Nadu, India, hence endemic to this country.

Ecology and biology : Nothing is known.

***Cremnomys blanfordi* (Thomas)**

1881. *Mus blanfordi* Thomas, *Ann. Mag. nat. Hist.*, [5], 7 : 24 (Kadapa, Tamil Nadu, India).

Common name : Blanford's Rat (Eng.).

Measurements :

External : 10 ex : HB 151-182 (164±10); TI 185-208 (195±7); Hf 32-37 (34±1); E 25-27 (26±1).

Cranial : 10 ex *onl* 40.7-43.9 (41.8±1); *p* 19.8-21.6 (20.6±.4); *apf* 7.8-9.5 (8.6±.4); *d* 10.3-11.4 (10.7±.4); *m* 6.0-7.0 (6.5±.3); *b* 7.9-8.4 (8.1±.15).

Diagnostic characters : A medium-sized rat, having a bicoloured tail, wholly dark proximally and wholly white distally, well-haired and tends to be slightly tufted at tip; fifth hind toe rather long, not much shorter than central three; plantar pads 6 in number. Body grey to reddish brown above and white below; hindfoot white. Mammæ 3 pairs.

Skull having long nasals and pointed rostrum; palate short, less than half of *onl*; anterior palatal foramina long, about 20% of *onl*; bulla large, about 17% of *onl* and differs from other two species in being larger.

Upper incisors narrow, yellow and plain. Molars 3/3; M^1 5-rooted; M^1 having 8 cusps (t7 absent), M^2 7 cusps (t2 and t7 lacking), M^3 with 6 cusps (t2, t3, t7 lacking). Lower molars biserially cuspidate except the last lamina of M_3 , which is single cusped. Posterior cingulum present at the back of M_1 and M_2 .

Chromosome number $2N = 36$; $FN = 36$ (Sharma & Gadi, 1977); all chromosomes except submetacentric Y, are acrocentric.

Distribution (Map 10) : India and Sri Lanka.

India : Bihar (Hazaribagh), West Bengal (Puruliya), Madhya Pradesh (Berar, Jabalpur, Mandla and Hoshangabad), Orissa (Mayurbhanj and Keonjhar) Maharashtra (Satara, Khandala, Pench, Nagpur), Karnataka (Kanara, Mysore), Goa, Kerala (Trivandrum, Cochin) and Tamil Nadu (Palni and Shevaroy Hills and Salem).

Ecology and biology : Lives in all types of habitats viz dry deciduous forest, scrub jungle, among rocks and boulders, caves, etc.; also burrows in soft soil (Khajuria, 1981). Nocturnal. Feeds mainly on plant matter, occasionally insects too. Breeds from June to October; litter size 2 or 3.

Remarks : *Mus blanfordi* Thomas is an aberrant species. Ellerman (1961) placed it under the subgenus *Rattus* with which it resembles in the length of bulla, but commented that it stands rather well apart from the typical *Rattus* and is probably allied to *Cremnomys*. Missone (1969) included *blanfordi* in the genus *Cremnomys*, with which it resembles in tail being longer than head and body, short palate & long anterior palatal foramina. It also resembles the genus *Millardia* in long anterior palatal foramina, and cusp t9 being mesial in position, and large and distinct from t8. Hence, Missone (1969) remarked that *blanfordi* could be made as well a genus of its own. This view further finds support from the study of their lice fauna (Misra, 1981), according to which the lice *Hoplopleura blanfordi* and *Hoplopleura kondana* harbouring *Cremnomys blanfordi* and *Millardia kondana* respectively are more closely related to each other than to *Hoplopleura pacifica* parasitising *Cremnomys cutchicus* and *Rattus rattus*. This suggests that *blanfordi* may be given an independant status as a genus equivalent to *Millardia*, *Cremnomys* and *Rattus*, and for that the name *Madromys* Sody, 1941 is available.

Genus *Millardia* Thomas

1911. *Millardia* Thomas, J. Bombay nat. Hist. Soc., 20 : 998.

1911. *Grypomys* Thomas, J. Bombay nat. Hist. Soc., 20 : 999 (Type species *Mus gleadowi* Murray).

1917. *Guyia* Thomas, *J. Bombay nat. Hist. Soc.*, 25 : 201 (Type species *Millardia kathleenae* Thomas).

1941. *Millardomys* Sody, *Treubia*, 18 (2) : 261 (Type species *Millardia kathleenae* Thomas).

Type species : Golunda meltada Gray.

Genus *Millardia* is an assemblage of heterogeneous species. Based on the reduction in the number of plantar pads, Thomas (1911) erected the genus *Millardia* on an earlier described species *Golunda meltada* Gray. Ellerman (1941) synonymised *Grypomys* Thomas, 1911 and *Guyia* Thomas, 1917 with *Millardia* because all had shortened fifth toe on the hindfoot, plantar pads less than six in number and less cuspidate molars. Ellerman (1961) considered *Millardia* to be a subgenus of *Rattus* Fischer because of its resemblance with some South African species of *Rattus*. Missone (1969) in an attempt to rearrange members of the family Muridae on hypothetical evolutionary trend considered *Millardia* as a genus. He included it in *Pyromys* group due to its close resemblance with the genera *Pyromys* and *Kritimys*. Agrawal (1970), unaware of Missone's work independently proposed generic status to *Millardia*, with less than 6 plantar pads as the main character. After the discovery of yet another species, *M. kondana* Mishra and Dhanda from Pune, India, having 6 pads in the hindfoot, Mishra and Dhanda (1975) redefined the characters for the genus *Millardia*.

This genus is characterised by the tail being shorter than head and body, shortened fifth toe, scarcely reaching the fourth, a long palate, more than one-half of occipitonasal length, and long anterior palatal foramina, more than 22% of occipitonasal length, extending posteriorly between maxillary toothrows.

Genus *Millardia* is represented by four species, *M. meltada*, *M. gleadowi*, *M. kondana* and *M. kathleenae*, of which the first three occur in India, and the last one in Myanmar.

Key to species of genus Millardia

1. Larger species, head and body more than 100 mm in length; ears shorter than hindfoot; mammae 4 pairs..... 2
 Smaller species, head and body length less than 100 mm; ears subequal to hindfoot; mammae 3 pairs..... *M. gleadowi*
2. Head and body length more than 150 mm; plantar pads six in number.....*M. kondana*
 Head and body length less than 150 mm; plantar pads less than six in number..... *M. meltada*

***Millardia meltada* (Gray)**

1837. *Golunda meltada* Gray, *Mag. nat. Hist.*, 1 : 586 (Dharwar, Karnataka, India).
1839. *Mus lanuginosus* Elliot, *Madras J. Litt. Sci.*, 10 : 212.
1907. *Mus listoni* Wroughton, *J. Bombay nat. Hist. Soc.*, 17 : 998 (Konkan, Karnataka, India).
1907. *Mus comberi* Wroughton, *J. Bombay nat. Hist. Soc.*, 17 : 999 (Nasik, Maharashtra, India).
1914. *Millardia meltada pallidior* Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 659 (Lunwa, Gujarat, India).
1917. *Millardia meltada dunni* Thomas, *J. Bombay nat. Hist. Soc.*, 25 : 202 (Handisera, Ambala, Haryana, India).
1981. *Millardia meltada singuri* Mandal & Ghosh, *Bull. zool. Surv. India*, 4 : 235-238 (Singur, Hugli dist., West Bengal, India).

Common name : Soft-furred Metad (Eng.).

Measurements : (Range, mean, standard deviation and sample size).

	<i>meltada</i>	<i>pallidior</i>	<i>singuri</i>
HB	115-154 131±11 (34)	110-146 128±11 (21)	107-152 123±15 (6)
Tl	92-131 115±11 (34)	99-136 120±11 (21)	104-126 115±11 (6)
Hf	21-29 25±2 (34)	22-28 25±1.5 (21)	22-26 24±1.5 (6)
E	18-24 21±1.5 (34)	18-24 20±1.5 (21)	18-21 20±1 (6)
onl	30.5-36.3 32.7±1.3 (32)	29.8-35.9 32.6±1.7 (19)	29.5-35.6 31.5±2.0 (6)
p	16.0-18.7 17.2±.8 (32)	16.3-18.6 17.1±.8 (19)	15.2-18.7 16.3±1.2 (6)

	<i>meltada</i>	<i>pallidior</i>	<i>singuri</i>
<i>d</i>	7.8-9.9 8.5±.6 (32)	7.5-9.3 8.6±.5 (19)	8.2-10.3 8.9±.8 (6)
<i>apf</i>	6.7-8.9 7.9±.5 (32)	6.7-8.7 7.8±.5 (19)	7.1-8.5 7.6±.5 (6)
<i>b</i>	5.3-6.4 5.8±.3 (32)	5.3-6.5 5.9±.3 (19)	5.7-6.3 5.95±.2 (6)
<i>m</i>	5.0-6.2 5.7±.3 (32)	5.2-6.1 5.6±.3 (19)	5.0-5.7 5.4±.2 (6)

Diagnostic characters : A medium-sized, soft-furred rat, having the tail shorter than head and body length, ears rounded and shorter than hindfoot, and plantar pads five in number. Body grey to dark brown above, and grey to greyish white below; venter much whiter in specimens from Gujarat; tail bicoloured, dark above, paler below; hindfoot whitish. Mammae 4 pairs.

Nasals long, tend to be narrower behind; supraorbital ridges well-developed; palate long, more than one-half of occipitonasal length; anterior palatal foramina long, more than 22% of *onl*, extending posteriorly between maxillary tooththrows; bulla large and inflated but less enlarged than in *M. gleadowi*.

Upper incisors narrow, yellow and plain. Molars 3/3; M^1 having 8-cusps, M^2 with 7-cusps (t_3 very small), and M^3 with 6-cusps and small; antero-internal cusps (t_1) in M^1 not distorted inwards. Lower molars biserially cuspidate except the last lamina of M_3 which is single cusped; M_1 trilaminate; M_2 and M_3 bilaminate; a well-marked posterior cingulum present at the back of M_1 and M_2 .

Chromosome number $2N = 50$; $FN = 57$ (Raman and Sharma, 1977).

Distribution : Throughout India except northeast; also reported from Pakistan, Nepal and Sri Lanka.

India (Map 11) : Jammu & Kashmir (Pathankot), Himachal Pradesh (Kangra, Dhamtal, Solan), Punjab (Ludhiana), Haryana (Ambala, Hissar), Rajasthan (Jhunjhunu, Churu, Jalore, Bisalpur, Sri Ganganagar and Abu Road), Uttar Pradesh (Varanasi, Gorakhpur, Kanpur), Gujarat (Rajkot, Junagadh, Kutch, Dhrangadhra, Palanpur), Maharashtra (Nasik, Pune, Ahmednagar), Madhya Pradesh (Mandla, Gwalior, Rewa, Sagar, Nimar, Chanda,

Asirgarh, Hoshangabad), Bihar (Hazaribagh, Darbhanga), West Bengal (Hugli), Andhra Pradesh (Hyderabad), Tamil Nadu (Madura, Salem, Coimbatore, Ootacamund), and Karnataka (Dharwar, Coorg, Bangalore).

Ecology and biology : Nocturnal and fossorial. Mostly occurs in irrigated crop fields and grasslands; also inhabits gravelly soil. Lives in burrows which become complex with maturity of crop (Chopra and Sood, 1980). Feeds on plant material, occasionally insects. It is a major pest of crops like jowar, maize, ground nut, cotton, til, moong, barley wheat, etc. In Rajasthan, it breeds throughout the year, with peak from March to September (Prakash, 1975); litter-size 4-10 in the field, and 1-8 in captivity (Bindra and Sagar, 1968). The annual productivity per female comes to about 52 young ones.

Intraspecific variation : Ellerman (1961) recognised two subspecies of *M. meltada* namely, *M. m. meltada* and *M. m. pallidior* from India. Latter subspecies differ from the former in having more pallid grey dorsum and whitish venter. Mandal and Ghosh (1981) described yet another subspecies from Hugli dist., West Bengal, which is darker (dorsum Mouse grey and venter greyish, with blackish-slate base) than the other two.

An examination of specimens of this species present in ZSI revealed that the colour of dorsum in a few specimens from Rewa and Gwalior (Madhya Pradesh), Darbhanga (Bihar) and Madura (Tamil Nadu) is as pale grey as in specimens of *pallidior* from Gujarat. Similarly, the colour of venter in half of the specimens of the nominate subspecies is as light as in those of *pallidior*. As regards the subspecies *singuri*, since the specimens have recently been collected these appear to be dark. After some foxing, the colour will be similar to those of *M. meltada* from other localities. Further, there is no marked difference in the external and cranial measurements among the three subspecies.

Hence, the subspecies *M. meltada pallidior* and *M. meltada singuri* are treated here as synonymous with the nominate subspecies.

Millardia gleadowi (Murray)

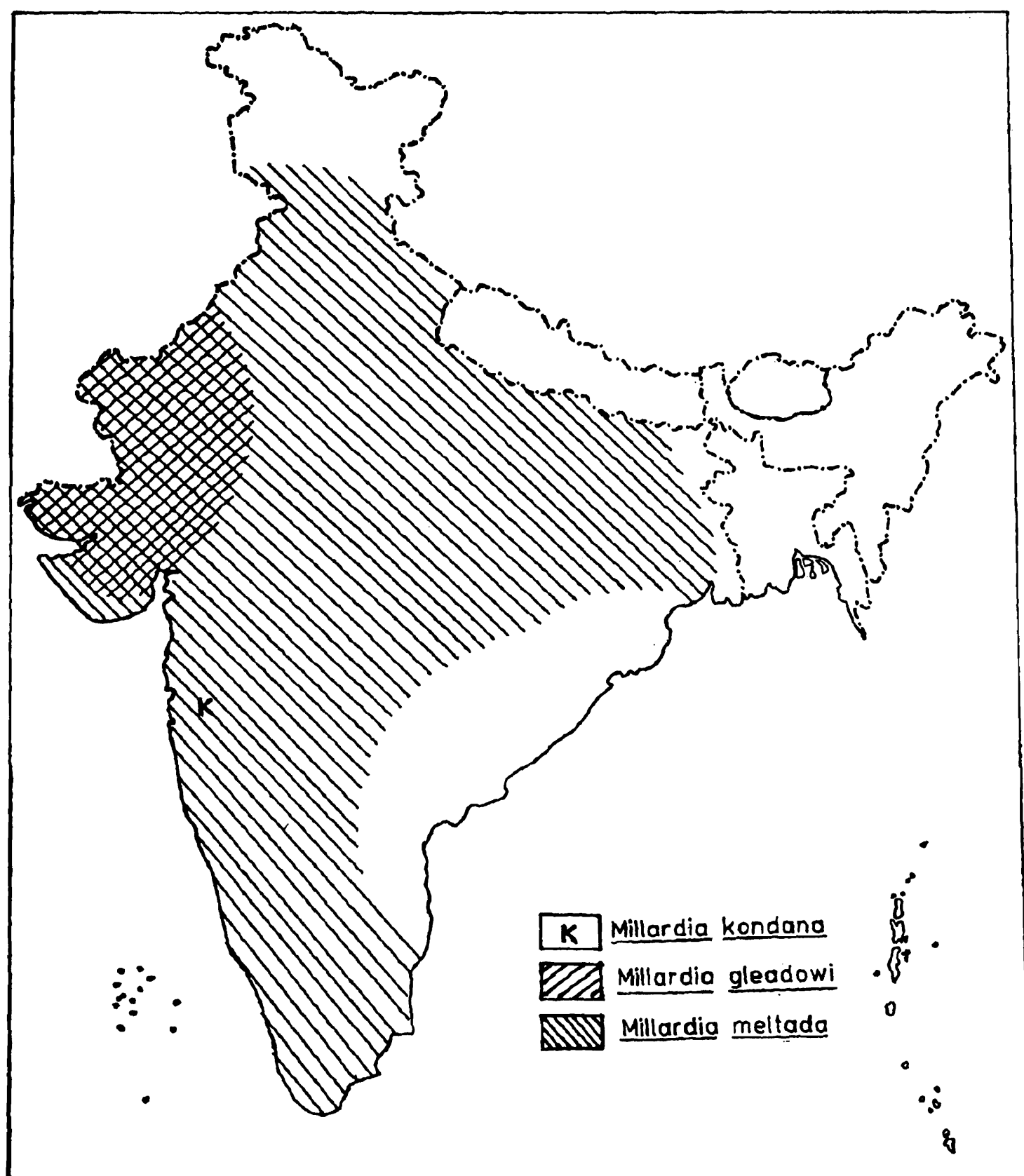
1885. *Mus gleadowi* Murray, *Proc. zool. Soc. Lond.*, : 809 (Karachi, Pakistan).

Common name : Sand-coloured Metad (Eng.).

Measurements : (Based on ZSI & BM specimens).

External : 24 ex. : HB 77-97 (85 ± 6); Tl 67-93 (79 ± 7), Hf 18-20 (19 ± 1); E 18-21 (19 ± 1).

Cranial : 27 ex. : *onl* 24.0-27.3 (25.6 ± 1.1); *p* 12.3-15.0 ($13.7 \pm .7$); *d* 5.5-7.2 ($6.4 \pm .4$); *apf* 5.2-6.5 ($5.9 \pm .4$); *b* 4.8-5.8 ($5.25 \pm .25$), *m* 4.1-4.6 ($4.4 \pm .15$).



Map 11. Showing the distribution of three species of rodents in India.

Diagnostic characters : A small-sized rat, having the tail equal to or shorter than head and body length; ears long, subequal to length of hindfoot; fifth toe scarcely longer than hallux; plantar pads four in number. Mammary 3 pairs. Body sandy-brown above, white below; a fulvous patch present on throat; tail usually bicoloured, dark above, white below, or wholly pale; hindfoot white.

Skull small, occipitonasal length 24-27 mm; palate more than one-half of occipitonasal length; bulla large and well inflated, usually more than 20% of *onl* ; anterior palatal foramina long, extending posteriorly between maxillary toothrows ; posterior palatal foramina prominent.

Upper incisors narrow, yellow and plain. M^1 8-cusped, M^2 7-cusped and M^3 6-cusped. Antero-internal cusp (t_1) of M^1 distorted inwards to reach the level of second lamina, as in *Mus*. Lower molars as in *M. meltda*.

Chromosome number $2N = 40$; $FN = 47$ (Raman and Sharma, 1977).

Distribution (Map 11) : NW. India and Pakistan.

India : Rajasthan (Bikaner, Bhopalgarh, Jodhpur and Pali) and Gujarat (Palanpur, Dhrangadhra and Rajkot).

Ecology and biology : Nocturnal. Lives in burrows. Prefers dry sandy and rocky areas away from the irrigated fields. Largely graminivorous in diet, but also feeds on tender shoots and buds. Breeds from August to October in Rajasthan; litter-size 2 or 3 (Prakash, 1975).

***Millardia kondana* Mishra & Dhanda**

1975. *Millardia kondana* Mishra and Dhanda, *J. Mammal.*, 56 : 76 (Sinhgarh, Pune, India).

Common name : Large Metad (Eng.).

Measurements : (*vide* Mishra and Dhanda, 1975).

External : 11♂ : HB 168-200 (185); TI 115-186 (158); Hf 30-34 (31.6); E 18-23 (20.0).

12♀ : HB 150-180 (164); TI 110-158 (139.4); Hf 27-32 (30.0); E 16-22 (19.0).

Cranial : 11♂ : *onl* 39.0-44.5 (41.5); *p* 21.3-24.5 (22.9); *apf* 9.1-10.0 (9.8); *b* 6.3-6.8 (6.5); *m* 7.0-7.8 (7.4); *d* 11.3-13.7 (12.3).

12♀ : *onl* 37.0-42.0 (39.2); *p* 21.0-23.5 (21.8); *apf* 8.5-10.0 (9.3); *b* 6.1-7.0 (6.5); *m* 7.0-8.0 (7.4); *d* 10.5-13.0 (11.6).

Diagnostic characters : This species is easily distinguishable from other three species of the genus by its large external and cranial measurements and in possessing six plantar pads.

A large-sized metad, having the tail shorter than head and body length ; ears shorter than hindfoot; plantar pads six in number. Mammae 4 pairs. Body dark brown above, greyish white below; tail poorly haired and faintly bicoloured, dark above and greyish below.

Skull large, occipitonasal length more than 39 mm; palate long, more than half of *onl*; anterior palatal foramina long, extending posteriorly between maxillary toothrows; bulla relatively smaller, less than 15% of *onl*, and diastema longer, more than 28% of *onl* than in *M. meltada*; maxillary toothrows long, more than 7 mm. in length.

Upper incisors opisthodont, yellow and plain. Molars 3/3; M^1 5-rooted; M^1 having 8 cusps, M^2 7 cusps (t_3 very small) and M^3 6 cusps (t_2 , t_3 , t_7 absent). Lower molars beserially cuspidate except the last lamina of M_3 which is single-cusped; posterior cingulum present at the back of M_1 and M_2 ; remnants of third outer row of cusps present.

Distribution (Map 11) : Known only from the type locality, Sinhgarh, Pune, Maharashtra, India., hence endemic to this country.

Ecology and biology : Nocturnal. Lives in burrows on top of a plateau (alt 1270 m), having bushes and a few trees. Breeds during October; litter-size 3-9 (Mishra and Dhanda, 1975).

Genus *Dacnomys* Thomas

1916. *Dacnomys* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 404.

Type species : *Dacnomys millardi* Thomas.

Distribution : Northeastern India, Nepal and N. Laos.

The genus *Dacnomys* is characterised by unusually large maxillary toothrows, exceeding one-fifth of occipitonasal length, and small bulla, less than 11% of occipitonasal length. Upper molars devoid of cusp t_7 . Short crest-like extensions present at the back of cusps t_1 , t_3 , t_4 and t_6 on first upper molar, and cusps t_1 , t_4 and t_6 on second.

This genus is monotypic.

Dacnomys millardi Thomas

1916. *Dacnomys millardi* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 405 (Gopaldhara, Darjiling dist., West Bengal, India).

1922. *Dacnomys wroughtoni* Thomas, *J. Bombay nat. Hist. Soc.*, 28 : 430 (Dreyi, Mishmi Hills, Arunachal Pradesh, India).

Common name : Millard's Rat (Eng.).

Measurements : Based on ZSI collection and *vide* Thomas (1916) and Ellerman (1961).

millardi : *External* : 2 ex. : HB 228, 270; TI 325, 330; Hf 50,53; E 26, 29.

Cranial : 2 ex : *onl* 52.7, 54.1; *p* 27.7, 27.7; *b* 5.9, 5.6; *m* 11.1, 11.5; *apf* 9.1, 10.3; *m* as % of *onl* 20.4-21.6 (21.0).

wroughtoni : *External* : 2 ex : HB 290, 290; TI 335, 330; Hf 56, 55; E 27, 25.

Cranial : 3 ex : *onl* 58.4-60.9 (59.9); *p* 30.8-32.4 (31.5); *b* 5.8-6.2 (6.0); *m* 11.5-12.4 (12.0); *apf* 10.7-11.7 (11.4); *m* as % of *onl* 19.7-20.3 (20.0).

Diagnostic characters : A large, heavily built rat, having the tail longer than head and body (114-142% of head and body). Dorsum dark grey to brown, flecked with buff, venter silvery grey to greyish white; tail brown and unicoloured; hindfoot brown, lighter terminally. Mammae 4 pairs.

Skull large, having a long palate, more than one-half of occipitonasal length, but not extending posteriorly beyond posterior margin of third upper molars; unusually long and broad maxillary toothrows (length 11.1-12.4 mm and width 3.3-3.8 mm), length more than one-fifth of occipitonasal length; bulla small (9-11% of occipitonasal length); anterior palatal foramina long (18-19% of occipitonasal length), but short of reaching the anterior margin of first upper molars; supraorbital ridges prominent; zygomatic plate narrow, barely projecting forward ahead of the anterior zygomatic root.

Upper incisors orange, orthodont and plain. Molars 3/3 and hypsodont. M¹ 8 cusped (cusp t7 absent), M² 6 cusped (cusp t2, t3 & t7 absent), and M³ large but smaller than second. Short crest-like extensions present at the back of cusps t1, t3, t4 & t6 in M¹ and cusps t1, t4 and t6 in M². Cusp t9 of M¹ and M² merged with cusp t8, in old skulls. A posterior cingulum present behind first and second lower molars.

Distribution : (Map 5) : NE. India, Nepal and N. Laos (Musser, 1981).

Ecology and biology : No information is available about the habitat of this species except that it was collected from highlands between 1050 and 1830 m altitude.

Intraspecific variation : Thomas (1922) differentiated the species *Dacnomys wroughtoni* from *Dacnomys millardi* on the basis of warmer coloration (Prout's brown vs smoky brown) and larger size of skull. Ellerman (1961) however, mentioned that *millardi* is based on younger skulls and *wroughtoni* on older ones. He, further, gave *wroughtoni* subspecific rank under *D. millardi* due to allopatric distribution. However, no definite opinion can be offered, at present, on the status of the subspecies, till a large series of specimens of both sexes and different age groups are studied.

Two subspecies occur in India.

Key to subspecies of Dacnomys millardi

Smaller size, occipitonasal length of skull less than 55 mm. *D. m. millardi*

Larger size, occipitonasal length of skull more than 60 mm. *D. m. wroughtoni*

(i) *Dacnomys millardi millardi* Thomas

1916. *Dacnomys millardi* Thomas, *J. Bombay nat. Hist. Soc.*, 24 : 405 (Gopaldhara, Darjiling, West Bengal, India).

Measurements : As mentioned under species.

Distribution : India : West Bengal (Darjiling) and Nagaland (Okotso). Also Nepal (Musser, 1981).

(ii) *Dacnomys millardi wroughtoni* Thomas

1922. *Dacnomys wroughtoni* Thomas, *J. Bombay nat. Hist. Soc.*, 28 : 430 (Dreyi, Mishmi Hills, Arunachal Pradesh, India).

Measurements : As mentioned under species.

Distribution : India : Arunachal Pradesh (Mishmi Hills).

Genus *Hadromys* Thomas

1911. *Hadromys* Thomas, *J. Bombay nat. Hist. Soc.*, 20 : 999.

Type species : *Mus humei* Thomas.

Distribution : NE. India.

The genus *Hadromys* is characterised by the anterior border of zygomatic plate being concave, upper incisors broad, and third upper molar not much smaller than second.

This genus is monotypic.

Hadromys humei (Thomas)

1886. *Mus humei* Thomas, *Proc. zool. Soc. Lond.*, 1886 : 63 (Moirang, Manipur, India).

Common name : Hume's Rat (Eng.).

Measurements : (Based on ZSI and BM specimens).

External : 28 ex. : HB 98-140 (112 ± 12); TL 120-138 (126 ± 6); Hf 23-28 (25 ± 1); E 15-22 (18.5 ± 1.5).

Cranial : 21 ex : *onl* 28.4-32.2 (30.4 ± 1.0); *p* 15.3-16.8 ($15.9 \pm .5$); *m* 5.2-5.7 ($5.55 \pm .15$); *apf* 5.1-7.2 ($5.75 \pm .4$); *iw* 4.1-5.7 ($4.6 \pm .4$); *b* 4.2-5.7 ($4.65 \pm .3$).

Diagnostic characters : A large-sized mouse, having the tail slightly longer than head and body length; hind foot with 5 toes; fifth toe and hallux clawed. Pelage soft or spiny. Body speckled brown above, pale fawn to greyish white below, and having a rusty tinge on rump; tail bicoloured, dark above and paler below; hindfoot fawn-coloured. Mammary 4 pairs.

Skull much larger than that of a mouse; occipitonasal length exceeds condylobasal length; palate long, more than one-half of *onl*; anterior palatal foramina narrow and long, about 18% of *onl* and not extending posteriorly between maxillary toothrows; bulla, on average, 15% of *onl*; anterior border of zygomatic plate concave.

Upper incisors broad, reddish and plain. Molars 3/3 in number and wide; M^1 about 2 mm in width. M^1 8 cusped (t7 absent); M^2 and M^3 6 cusped (t2, t3 and t7 absent); M^3 scarcely smaller than M^2 . Lower molars biserially cuspidate; M_1 having three laminae, and M_2 and M_3 two each; posterior cingulum of M_1 and M_2 much reduced.

Distribution (Map 5) : India : Manipur (Bishenpur c 916-1219 m altitude and Senapati dist.) and Assam (Kamrup, Angarkhata). Also reported from W. Yunnan (Corbet and Hill, 1992)

Ecology and biology : Commonly found in oak parkland, but also in oak scrub and evergreen forest (Roonwal, 1949). Food mainly consists of tender shoots and leaves. Breeds during September and October.

Genus *Mus* Linnaeus

1758. *Mus* Linnaeus, *Syst. Nat.*, 10th ed. 1 : 59.

1837. *Leggada* Gray, *Charlesworth's Mag. nat. Hist.*, 1 : 586. (Type species *Mus booduga* Gray).

1911. *Pyromys* Thomas, *J. Bombay nat. Hist. Soc.*, 20 : 996. (Type species *Pyromys priestlyi* Thomas).

1914. *Leggadilla* Thomas, *J. Bombay nat. Hist. Soc.*, 22 : 682. (Type species *Mus platythrix* Bennett).

1915. *Coelomys* Thomas, *J. Bombay nat. Hist. Soc.*, 23 : 414. (Type species *Coelomys mayori* Thomas).

Type species : *Mus musculus* Linnaeus.

Distribution : As a commensal genus, distributed throughout the world. Wild species occur throughout the greater parts of Europe, Asia and Africa.

The genus *Mus* includes species of varied sizes, generally small but sometimes even longer than the species of rats. The genus is characterised by the first upper molar being enlarged, usually reaching about half the length of maxillary toothrow, and its antero-

internal cusp (t1) distorted inwards to be in line with the second lamina, combined with extreme reduction of third upper molar; the anterior root of M^1 usually projected forward.

Remarks : Taxonomy of the genus *Mus* was in array for a long time and a thorough revision was long due. Based on morphology, karyology and ectoparasites, Marshall (1977) has given a new classification of this genus. Though he has become successful in removing earlier anomalies in *platythrix*-complex, but the taxonomy of *booduga-cervicolor* complex is still confusing.

Key to species of genus Mus

- 1 Anterior palatal foramina short, less than one-fifth of occipitonasal length and not extending posteriorly between maxillary toothrows *M. pahari*
Anterior palatal foramina long, more than one-fifth of occipitonasal length and extending posteriorly between maxillary toothrows 2
2. Tail unicoloured, and longer than head and body length; diastema, in skull, equal to or less than one-fourth of occipitonasal length *M. musculus*
Tail bicoloured, dark above and paler below, equal to or shorter than head and body length; diastema, in skull, generally more than one-fourth of occipitonasal length 3
3. Fur generally spiny; supraorbital ridges, in skull, well-developed 4
Fur soft; supraorbital ridges either absent or scarcely developed 6
4. Smaller form, occipitonasal length 20-23 mm; maxillary toothrows less than 4 mm in length *M. phillipsi*
Larger form, occipitonasal length 23-30 mm; maxillary toothrows more than 4 mm in length 5
5. An anterior accessory cusp present on first lamina of first upper molar; chromosome number $2N = 22$ or 26 *M. saxicola*
No anterior accessory cusp present on first lamina of first upper molar; chromosome number $2N = 30$ *M. platythrix*
6. Upper incisors proodont; fur soft *M. cervicolor*
Upper incisors orthodont or opisthodont; fur soft or bristly 7

7. Smaller species, occipitonasal length of skull less than 20 mm. *M. booduga*
 Larger species, occipitonasal length of skull more than 20 mm 8
8. Fur soft; dorsum chocolate brown; mammae 3 pairs *M. famulus*
 Fur bristly or harsh; dorsum light brown; mammae 5 pairs *M. cooki*

***Mus musculus* Linnaeus**
 (Plate 2, fig. C)

1758. *Mus musculus* Linnaeus, *Syst. nat.*, 10th ed., 1 : 62 (Uppsala, Sweden).

Common name : House Mouse (Eng.).

Measurements : Given under the subspecies.

Diagnostic characters : A small mouse (head and body 52-116 mm in length), having tail a little longer than head and body length. Dorsum sandy brown to dark brown, and venter white to ochraceous brown; tail faintly bicoloured (dark above and white below) and hindfoot white in *praetextus*, and tail wholly dark and hindfoot cinnamon with white toes in *castaneus*. Mammae 5 pairs.

Skull small, occipitonasal length 18.0-23.5 mm; supraorbital ridges poorly developed; palate usually exceeds half the occipitonasal length; muzzle short, diastema generally less than one-fourth of *onl*; anterior palatal foramina elongated, extending posteriorly between maxillary toothrows.

Upper incisors narrow, yellow and opisthodont.. Molars 3/3; M^1 larger than M^2 and M^3 together; M^1 8-cusped (t_7 absent), M^2 6-cusped (t_2 , t_3 , t_7 absent), and M^3 reduced; front root of M^1 extends in front of first lamina of that tooth. Lower molars having three laminae on M_1 , and two each on M_2 and M_3 ; latter very small; all biserially cuspidate; posterior cingulum present behind last lamina of M_1 and M_2 .

Chromosome number $2N = 40$, all telocentric.

Distribution : Palaearctic and Oriental in distribution. Owing to human introduction, found also in America, Australia and tropical Africa.

Ecology and biology : Nocturnal; occurs both indoors and outdoors, in houses, godowns, shops, garden and fields. Feeds mainly on vegetable matter, occasionally takes insects. Breeds throughout the year; litter-size 1-15 (average 5.3). In Rajasthan, the annual productivity per female comes to about 31 young (Mohan Rao and Balsubramanyam, 1992).

Intraspecific variation : Three subspecies are recognised within the Indian limits.

Key to subspecies of Mus musculus

- 1 Undersurface of body white or greyish white..... 2
 Undersurface of body dark grey or ochraceous brown *M. m. castaneus*
2. Dorsum sandy brown; venter white *M. m. praetextus*
 Dorsum tawny or cinnamon; venter greyish white *M. m. homourus*

(i) *Mus musculus praetextus* Brants

1827. *Mus praetextus* Brants, *Gesl. der. Muizen*, 125 (Syria).

1846. *Mus bactrianus* Blyth, *J. Asiat. Soc. Bengal*, 15 : 140 (Kandahar, Afghanistan).

Measurements : (vide Chakraborty, 1983).

External : 12 ex. : HB 57-90 (77); Tl 64-99 (78); Hf 17-19 (18); E 11-14 (12).

Cranial : 9 ex. : *onl* 20.0-23.5 (21.7); *p* 10.0-12.3 (11.1); *apf* 4.3-5.6 (5.0); *m* 3.3-4.2 (3.5); *d* 5.0-6.4 (5.5).

Distribution : India : Jammu & Kashmir, Haryana and Rajasthan. Also occurs from Pakistan to NW Africa.

Ecology : An outdoor subspecies.

(ii) *Mus musculus homourus* Hodgson

1845. *Mus homourus* Hodgson, *Ann. Mag. nat. Hist.*, [1], 15 : 268 (Nepal).

1849. *Mus darjilingensis* Hodgson, *Ann. Mag. nat. Hist.*, [2], 3 : 203 (Darjiling, West Bengal, India).

1955. *Mus musculus pygmaeus* Biswas & Khajuria, *Proc. zool. Soc. Calcutta*, 8 : 28 (Nepal). Name preoccupied. = *M. m. khumbuensis* Biswas & Khajuria, 1968, *Sci. & Cult.*, 34 : 218.

Measurements : (vide Agrawal *et al.* 1992).

External : 24 ex. : HB 63.0-94.0 (77); Tl 69.0-92.0 (83); Hf 12-19 (17); E 11-15 (13.3).

Cranial : 14 ex. : *onl* 20.3-23.6 (21.4); *p* 10.2-12.0 (11.2); *apf* 4.3-6.0 (4.7); *m* 2.8-3.8 (3.5); *d* 5.1-5.8 (5.45).

Distribution : Southern slope of the Himalaya from Jammu & Kashmir to West Bengal, thence south to Manipur and Nagaland. Also reported from Nepal, Myanmar, Thailand, Laos, Vietnam and S. China.

Ecology : An outdoor subspecies, found in cultivation.

(iii) *Mus musculus castaneus* Waterhouse

1843. *Mus castaneus* Waterhouse, *Ann. Mag. nat. Hist.*, [1], 12 : 134 (Philippines).

1845. *Mus urbanus* Hodgson, *Ann. Mag. nat. Hist.*, [1], 15 : 269 (Nepal).

1859. *Mus tyleri* Blyth, *J. Asiat. Soc. Bengal*, 28 : 296 (Dehradun, Uttar Pradesh).

Measurements : (vide Agrawal *et al.*, 1992).

External : 12 ex. : HB 55-80 (69.5); TI 68-88 (80); Hf 15-17 (16); E 11-13 (11.7).

Cranial : 5 ex. : *onl* 19.4-21.8 (20.3); *p* 8.4-10.6 (9.8); *apf* 3.9-4.7 (4.3); *m* 3.1-3.4 (3.2); *d* 4.8-5.3 (5.0).

Distribution : Throughout India. Also reported from Nepal, Sri Lanka, China (Yunnan) and SE Asia.

Ecology : An indoor subspecies.

Mus booduga (Gray)

(Plate 2, fig. E)

1837. *Leggada booduga* Gray, *Charlesworth's Mag. nat. Hist.*, 1 : 586 (South Mahratta, India).

1852. *Mus fulvidiventris* Blyth, *J. Asiat. Soc. Bengal*, 21 : 351 (Trincomali, Sri Lanka).

1852. *Mus albidiventris* Blyth, *J. Asiat. Soc. Bengal.*, 21 : 351 (Near Calcutta, India).

1866. *Mus beavanü* Peters, *Proc. zool. Soc., Lond.*, 559 (Manbhoum, India).

1931. *Leggada lepidoides* Fry, *J. Bombay nat. Hist. Soc.*, 34 : 921 (Mount Popa, Myanmar).

1851. *Mus terricolor* Blyth, *J. Asiat Soc. Bengal.*, 20 : 172 (Southern India).

1912. *Leggada dunni* Wroughton, *J. Bombay nat. Hist. Soc.*, 21 : 339 (Ambala, Haryana, India).

Common names : Common Indian Field Mouse (Eng.); Metho Nengtee Indur (Beng.), Chuhiya (Hin.).

Specimens examined :

White undersurface : Andhra Pradesh (Araku & Guntur dist.), Tamil Nadu (Salem, Madurai, Cape Comorin, Coimbatore), Karnataka (Gadag, Bellary), Gujarat (Rajkot, Palanpur, Vankaneer, Junagadh, Sasan, Mali), Madhya Pradesh (Sehore, Balaghat, Hoshangabad), Jammu & Kashmir (Udhampur), Nepal (Banke), and Pakistan (Bahawalpur).

Greyish white undersurface : Uttar Pradesh (Kumaon), Bihar (Chaibassa), Orissa (Koirā), Andhra Pradesh (Araku), West Bengal (Duars & Bankura).

Grey undersurface : Andhra Pradesh (Araku), Karnataka (Dharwar, Shimoga), Maharashtra (Ratnagiri), Nepal and Pakistan (Sialkot).

Measurements : (Range, mean, standard deviation and sample-size)

	<i>Venter white</i>	<i>Venter greyish white</i>	<i>Venter grey</i>
Anterior accessory cusp present (+)	+ 8 (29)	+ 5 (13)	+ 10 (21)
HB	52-85 63±8.6 (29)	55-87 63.5±9 (13)	50-81 61±8 (21)
TI	51-72 60±6 (29)	53-66 58±3 (13)	51-70 59±5 (21)
Hf	13-16 14±.8 (29)	13-16 14±.8 (13)	13-17 15±1 (21)
<i>onl</i>	17.7-21.5 19.1±1.1 (14)	17.7-21.5 19.2±1.3 (9)	17.5-21.0 18.5±1.1 (17)
<i>p</i>	9.2-11.1 10.1±.55 (14)	8.9-11.2 9.9±.8 (9)	8.9-10.8 9.6±.6 (16)
<i>d</i>	4.5-6.1 5.2±.45 (14)	4.4-6.0 5.2±.6 (9)	4.4-5.6 4.9±.4 (17)
<i>m</i>	3.05±3.35 3.2±.13 (14)	3.0-3.4 3.2±.2 (9)	2.9-3.4 3.27±.1 (17)
<i>apf</i>	4.1-4.6 4.2±.22 (14)	3.2-4.6 4.0±.4 (9)	3.6-4.8 4.0±.3 (17)
<i>iw</i>	3.1-3.5 3.3±.13 (13)	3.1-3.4 3.25±.1 (9)	3.1-3.4 3.25±.1 (17)

Diagnostic characters : A small, soft-furred mouse, having a bicoloured tail (dark above and paler below), equal to or shorter than head and body length. Dorsum varies from light (sandy or greyish) to dark reddish or rusty brown; venter perfectly white, greyish white or grey, depending upon individual hair being white up to base, grey on basal half and white at tip or completely grey. Both white and grey-bellied forms are reported to occur at Ambala (Haryana), Kumaon and Varanasi (Uttar Pradesh), Khajuraho and Hoshangabad (Madhya Pradesh), Pune (Maharashtra), Arakau valley (Andhra Pradesh) and Bellary and Dharwar (Karnataka). Mammae 5 pairs.

Skull small, occipitonasal length 17.5-21.5 mm; muzzle less shortened than in *Mus musculus*, diastema-length generally more than one-fourth of occipitonasal length; supraorbital ridges poorly developed; maxillary toothrows small, less than 3.5 mm in length; palate long, more than half of *onl*; anterior palatal foramina extending posteriorly between maxillary toothrows.

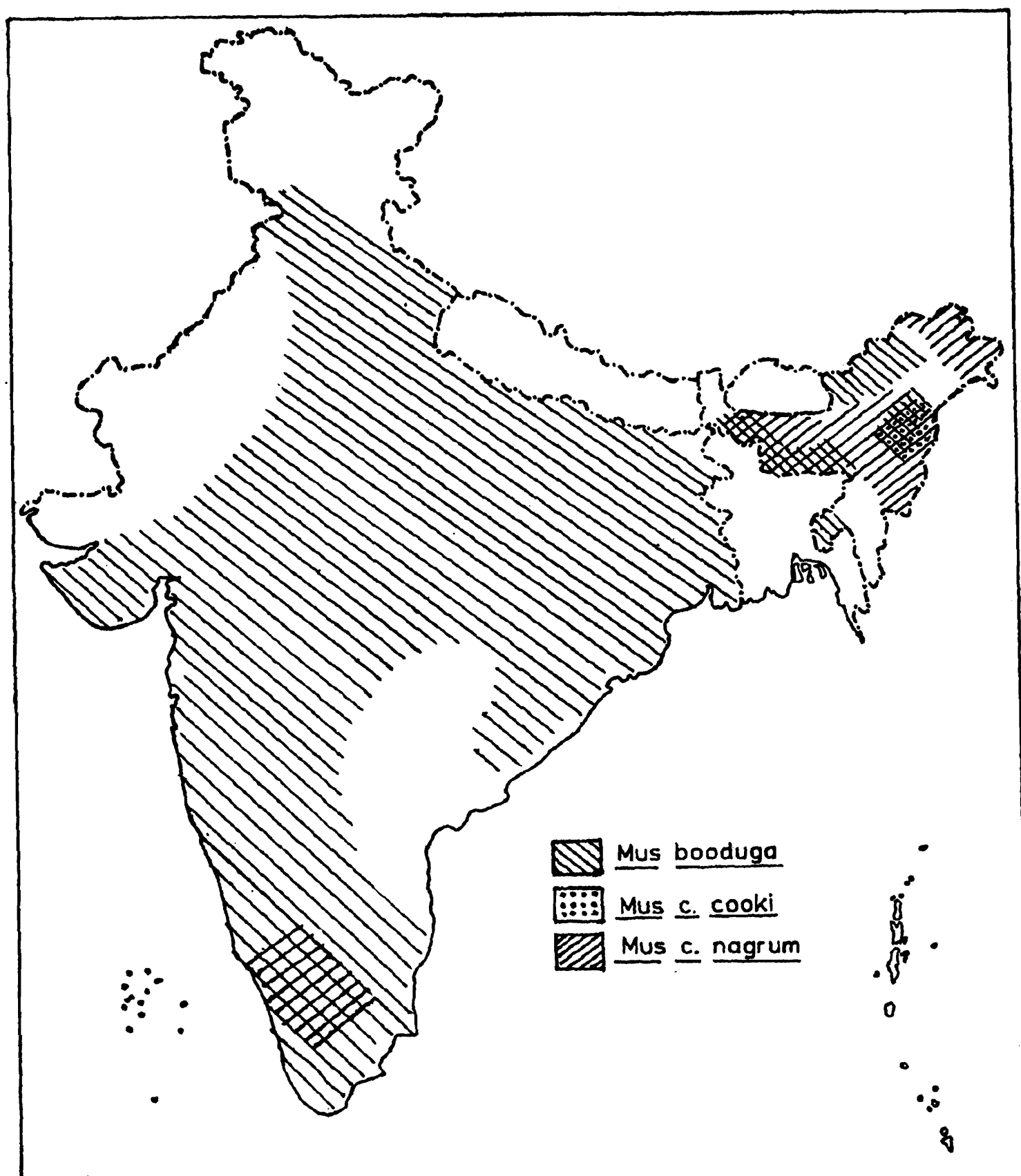
Upper incisors narrow, yellow and opisthodont, often with a subapical notch. Molars 3/3; M¹ 8-cusped, M² 6-cusped, and M³ very small; front root of M¹ extending forward and may bear an extra cusp referred to here as anterior accessory cusp. This cusp was found to be present or absent in all three types of white or grey-bellied forms. Lower molars as in *Mus musculus*.

Chromosome number $2N = 40$. The G-band pattern is similar in populations of *Mus booduga* and *Mus dunni* (= *Mus terricolor*) but differs in the distribution of constitutive heterochromatin (Sen and Sharma, 1983).

Distribution (Map 12) : Occurs throughout India (Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Rajasthan, Tripura, Tamil Nadu, Uttar Pradesh, and West Bengal. Also reported from Bangladesh (Posamentier, 1989), Nepal and Pakistan.

Ecology and biology : Nocturnal and fossorial. Inhabits burrows in irrigated fields or patches of thorn scrub on the edges of cultivation. Feeds on vegetable matter including seeds; also takes insects. It is a pest of crops. Breeds throughout the year; gestation lasts for about 21 days; litter size 2-13 (Mohan Rao, 1980). The annual productivity per female is about 21 in Andhra Pradesh. (Mohan Rao. and Balsubram anyam 1992).

Intraspecific variation : The karyological studies have been undertaken on specimens of Little Indian Field Mouse from Varanasi (Uttar Pradesh), Khajuraho (Madhya Pradesh), Pune (Maharashtra) and Madras (Tamil Nadu) in India, but none on specimens from the type localities viz South Mahratta and Ambala (Haryana). The number of chromosomes, however, was found to be $2N = 40$ in all the specimens studied. In some of these



Map 12. Showing the distribution of three species of rodents in India.

specimens, the sex chromosomes as well as the autosomes were all telocentric, while in others from the same localities, X-chromosome is a large metacentric and a varying number of autosomes submetacentric or subtelocentric. According to Marshall (1977), the specimens having all telocentric chromosomes were white-bellied and he called them as *Mus booduga*, and those having metacentric or submetacentric chromosomes were grey-bellied and he referred them as of *Mus dunni* (= *Mus terricolor*). Firstly, it is not clear whether the latter category of specimens have greyish white or dark grey undersurface. Secondly, the other morphological characters of *Mus dunni* mentioned by Marshall (1977) viz presence of anterior accessory cusp on M¹ and shorter anterior palatal foramina are also found in white-bellied specimens. Hence, it is not possible to demarcate the two species morphologically except the colour of undersurface. However, it may be mentioned that the two type specimens of *Mus terricolor* present in ZSI are very small, of which the body-colour has completely faded due to long preservation in ethyl alcohol, and it is not possible to compare their colour with either *Mus booduga* or *Mus dunni*. Further, Thomas (1912) mentioned about the ventral colour of body in *Mus dunni* as pure white in some specimens and hairs having short grey bases in others including the type. But there is no mention about the third variety, having fully grey venter. Therefore, till the confusions are removed, *Mus dunni* and *Mus terricolor* are treated here as synonyms of *Mus booduga*.

Mus cervicolor Hodgson

(Plate 2, fig. D)

1845. *Mus cervicolor* Hodgson, *Ann. Mag. nat. Hist.*, [1], 15 : 268 (Nepal).

Common name : Fawn-coloured Mouse (Eng.).

Measurements :

External : 21 ex. : HB 60-95 (78±9); TL 56-76 (66±5); Hf 14-18 (15.5±1); E 11-14 (12±1).

Cranial : 18 ex. *onl* 20.5-23.3 (21.6±.8); *p* 10.8-12.6 (11.5±.55); *m* 3.2-3.7 (3.4±.14); *apf* 4.2-5.4 (4.7±.4); *d* 5.4-6.9 (6.2±.45); *iw* 3.4-4.0 (3.6±.2); *n* 7.0-8.9 (8.0±.4).

Diagnostic characters : A soft-furred mouse, averaging larger than *Mus booduga* (head & body length 78±9 vs 63±9; occipitonasal length 21.6±.8 vs. 19.1±1.0). Fur soft. Body dark brown above and greyish white on the undersurface; tail bicoloured, dark above and pale below and shorter than head and body length; hindfoot whitish. Mammae 5 pairs.

Nasals long, overhanging the upper incisors; supraorbital ridges scarcely developed; diastema long, more than one-fourth of occipitonasal length; anterior palatal foramina

more than one-fifth but less than 23% of occipitonasal length and may or may not extend deep between maxillary toothrows.

Upper incisors narrow, yellow and proodont. Molars as in *Mus booduga*.

Chromosome number $2N = 40$, all telocentric (Marshall, 1977).

Distribution (Map 13) : India : Jammu & Kashmir (Chakraborty 1983), Uttar Pradesh, West Bengal, Meghalaya and Manipur. Also Nepal, Myanmar, Thailand, Laos, Vietnam and Indonesia.

Ecology and biology : Nocturnal and fossorial. Equally at home in riverine scrubs, cultivated fields and forests. Burrows are simple. Feeds on vegetable matter and insects. Breeds from September to November in West Bengal; litter-size 5-12.

Intraspecific variation : The nominate subspecies occurs in India.

Mus cervicolor cervicolor Hodgson

1845. *Mus cervicolor* Hodgson, *Ann. Mag. nat. Hist.*, [1], 15 : 268 (Nepal).

1845. *Mus strophiatatus* Hodgson, *Ann. Mag. nat. Hist.*, [1], 15 : 268 (Nepal).

1855. *Mus cunicularis* Blyth, *J. Asiat. Soc. Bengal*, 24 : 721 (Cherrapunji, Meghalaya, India).

1948. *Leggada nagrum imphalensis* Roonwal, *Proc. nation. Inst. Sci. India*, 14 : 386 (25 km. N. of Imphal, Manipur, India).

Distribution : India : Jammu & Kashmir (Islamabad dist.), Uttar pradesh (Garhwal), West Bengal (Hugli, Jalpaiguri, Medinipur, North & South 24-Parganas and West Dinajpur), Meghalaya (Khasi Hills), Manipur (Imphal) and Andaman and Nicobar islands (Mandal and Ghosh, 1984). Also reported from Nepal and N. Myanmar.

Measurements : As mentioned under species.

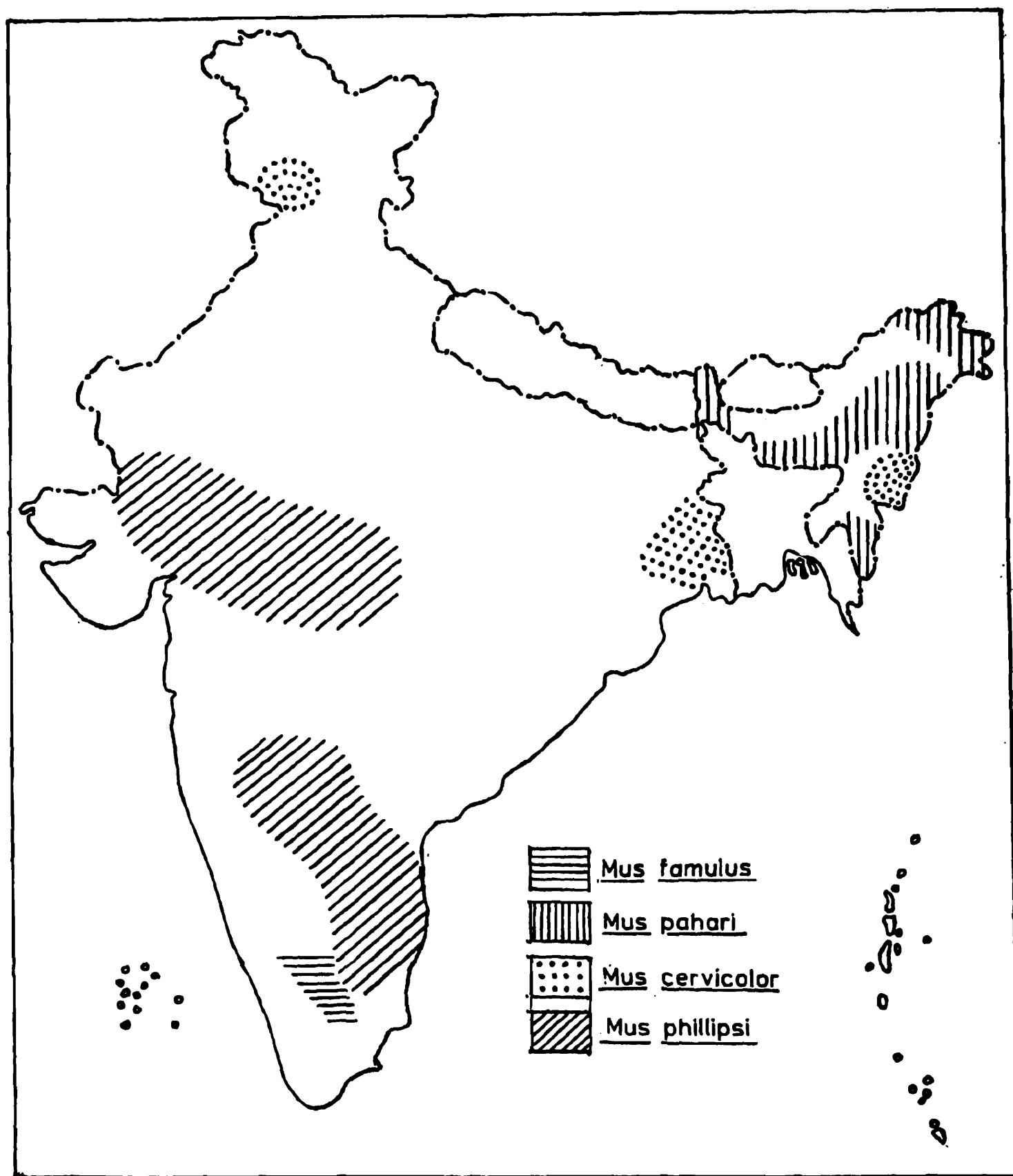
Remarks : The body and skull measurements of *M. c. cervicolor* given above overlap with those of *M. n. imphalensis* (Roonwal, 1948), so also the body colour. Hence, the latter is treated here as a synonym of the nominate subspecies.

Mus phillipsi Wroughton

1912. *Mus phillipsi* Wroughton, *J. Bombay nat. Hist. Soc.*, 21 : 772 (Asirgarh, Nimar, Madhya Pradesh, India).

1913. *Leggadda surkha* Wroughton & Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 17 (Vijayanagar, Bellary, Karnataka, India).

Common name : Wroughton's Small Spiny Mouse (Eng.).



Map 13. Showing the distribution of four species of rodents in India.

Measurements : (Based on specimens from ZSI, BM and CNHM).

External : 12 ex. : HB 62-80 (69 ± 5.2); TL 50-62 (56.5 ± 3.8); Hf 14-18 (15 ± 1.1); E 11-14 (12.5 ± 1.1).

Cranial : 12 ex. : *onl* 21.2-23.2 (22.2 ± 0.6); *m* 3.4-3.9 (3.7 ± 0.5); *m / onl* % 14.6-17.4 (16.6 ± 0.7); *apf* 4.5-5.3 (4.8 ± 0.3); *apf / onl* % 20.2-23.8 (21.9 ± 1.4); *p* 10.8-12.6 (11.6 ± 0.6); *p / onl* % 50.7-54.5 (52.1 ± 1.5); *d* 5.3-7.0 (6 ± 0.6); *d / onl* % 25-30.3 (26.8 ± 1.8).

Diagnostic characters : A small-sized mouse, having the tail smaller than head and body (about 80% of HB). Fur spiny. Body brown to buff above, and white below; tail bicoloured, dark above and paler below; hindfoot white. Mammary 5 pairs.

Skull small (occipitonasal length 22.2 ± 0.6 mm), with well-developed supraorbital ridges; maxillary toothrows less than 4 mm in length; anterior palatal foramina extending posteriorly between maxillary toothrows.

Upper incisors opisthodont, plain and yellow on front surface; a notch may be present or absent. Molars 3/3; first upper molar without an anterior accessory cusp; antero-internal cusp (t1) distorted inwards to be in line with second. M¹ with 8 cusps, M² with 6 cusps and M³ very small. Lower molars as in *Mus musculus*.

Distribution (Map 13) : India : Rajasthan (Jalore, Mt. Abu and Bisalpur), Gujarat (Palanpur), Madhya Pradesh (Berar, Nimar), Andhra Pradesh (Kurnool, Cuddapah, Palkonda Hills), Karnataka (Bellary), and Tamil Nadu (Salem dist). Also reported from Nepal (Abe, 1977).

Ecology and biology : Nocturnal and fossorial. Trapped in rocky habitat. In Rajasthan, pregnancy has been recorded in December; litter-size 2-6 (mean 4.4) (Prakash, 1971).

Remarks : Ellerman (1961) treated this form as a subspecies of *Mus cervicolor*, mainly influenced by its size, paying less importance to characters like the spiny fur, white venter and well-developed supraorbital ridges in the skull. However, Marshall (1977) rightly resuscitated it as a full species.

***Mus cookii* Ryley**

1914. *Mus cookii* Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 664 (Gokteik, Shan State, Myanmar).

Common name : Ryley's Spiny Mouse (Eng.).

Measurements : Given under the subspecies.

Diagnostic characters : Essentially like *Mus cervicolor* but differs from it, on an average, larger size (head and body length 70-100 mm), bristly fur and opisthodont or

orthodont upper incisors; tail generally smaller than head and body, sometimes longer in specimens from southern India. Body light brown above, grey on the undersurface; tail bicoloured, dark above, paler below; hindfoot darker in the nominate subspecies, whitish in others. Mammary 5 pairs.

Supraorbital ridges traceable but weak; diastema more than one-fourth of occipitonasal length; anterior palatal foramina long, more than one-fifth but less than 23% of occipitonasal length, and not extending deep between maxillary toothrows.

Dental characters as in *Mus cervicolor* except that the incisors are opisthodont or orthodont instead of proodont in the latter.

Distribution : India, Nepal, Myanmar, China, Thailand, Laos and Vietnam.

Ecology : Occurs in grassy areas in conifer and broad leaf-forests, mostly in mountainous regions; sometimes found in adjacent cultivated fields. Nothing is reported about its feeding or breeding habit.

Intraspecific variation : Ellerman (1961) accommodated *Leggada nagrum* and *Leggada palnica* under *Mus cervicolor* on the basis of their size and length of maxillary toothrows. Marshall (1977) shifted them under *Mus cookii*, a species found in Myanmar, Thailand and Vietnam, on the basis of orthodont incisors and bristly fur.

Ellerman (1961) differentiated *nagrum* from *palnica* in having dull body colour and tail shorter than head and body. This difference in tail-length was statistically analysed and was found to overlap even at one standard deviation. Moreover, the measurements of head and body, and tail, mentioned by Marshall (1977) are the same in both populations. Hence, *L. palnica* has been treated here as a synonym of *L. nagrum* = *Mus cookii nagrum*.

Thus, two subspecies of *Mus cookii* occur in India.

Key to subspecies of Mus cookii

Size large, occipitonasal length of skull more than 23 mm. *M. c. cookii*

Size small, occipitonasal length of skull less than 23 mm. *M. c. nagrum*

(i) *Mus cookii cookii* Ryley

1914. *Mus cookii* Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 664 (Shan State, Myanmar).

Measurements : (vide Ellerman, 1961).

External : 22 ex. : HB 70-99 (84±9); TL 60-96 (81±9); Hf 15-21 (18.5±1); E 12-17 (15±1).

Cranial : 10 ex. : *onl* 23.4-25.8 (24.2 ± 0.8); *p* 11.2-13.4 (12.3 ± 0.5); *d* 5.6-7.4 (6.25 ± 0.45); *m* 3.7-4.1 (3.95 ± 0.15); *apf* 4.8-6.0 (5.2 ± 0.3).

Distribution (Map 12) : India (Naga Hills). Also reported from Myanmar (Kabaw valley), China (Yunnan), Thailand, Laos and Vietnam.

(ii) *Mus cookii nagrum* (Thomas)

1921. *Leggada nagrum* Thomas, *J. Bombay nat. Hist. Soc.*, 27 : 597 (Golaghat, Assam, India).

1923. *Leggada palnica* Thomas, *J. Bombay nat. Hist. Soc.*, 29 : 87 (Shambagama c 1830 m, Palni Hills, Tamil Nadu).

Measurements : External :

nagrum : 32 ex : HB 64-86 (74.4 ± 5.5); TL 56-82 (68.4 ± 7); Hf 15-19 (16 ± 1.6); E 10-16 (13 ± 1.5).

palnica : 10 ex : HB 65-95 (76.4 ± 9); TL 71-90 (78.2 ± 6); Hf 16-18 (17 ± 0.5); E 13-14 (13.5 ± 0.5).

Cranial :

nagrum : 19 ex : *onl* 19.2-22.4 (21.4 ± 1.3); *p* 9.0-11.8 (10.6 ± 0.7); *d* 4.6-6.1 (5.34 ± 0.45); *m* 2.9-3.9 (3.5 ± 0.3); *apf* 4.1-5.4 (4.7 ± 0.3).

palnica : 7 ex : *onl* 21.0-22.9 (21.9 ± 0.8); *p* 10.5-11.5 (11.05 ± 0.4); *d* 5.4-5.9 (5.55 ± 0.2); *m* 3.5-3.6 (3.5 ± 0.05); *apf* 4.5-5.3 (4.8 ± 0.3).

Distribution (Map 12) : India : Arunachal Pradesh (Mishmi Hills), Assam (Golaghat, N. Kamrup), Meghalaya (Khasi & Jaintia Hills), Manipur (Chandel dist.), Nagaland, West Bengal (Darjiling), Maharashtra (Pune), Karnataka (Coorg, Mysore), Kerala (Cannonore) and Tamil Nadu (Palni Hills, Kodaikanal) (Ellerman, 1961; Marshall, 1977).

Mus famulus Bonhote

1898. *Mus famulus* Bonhote, *J. Bombay nat. Hist. Soc.*, 12 : 99 (Coonoor, Nilgiri Hills, India).

Common name : Bonhote's Mouse (Eng.).

Measurements : (Based on specimens from BM and AMNH).

External : 4 ex HB 79-91 (84 ± 4.5); TL 79-83 (81 ± 1.5); Hf 20-21 (20.75 ± 0.25), E 14-16 (15 ± 1).

Cranial : 2 ex : *onl* 23.5, 23.9; *p* 12.0, 12.2; *d* 6.0, 6.4; *apf* 5.1, 5.0; *m* 3.7, 3.7; *iw* 4.1.

Diagnostic characters : A soft-furred field mouse, having the tail smaller than head and body. Body reddish to chocolate brown above, chestnut with grey bases below, sharply demarcated along the flanks; tail wholly dark; hindfoot dark brown. Mammae 3 pairs.

Skull larger than that of *M. cervicolor*, occipitonasal length more than 23 mm; diastema exceeds one-fourth of occipitonasal length. According to Corbet and Hill (1992), anterior palatal foramina in this species is less than 20% of *onl*, but in both the specimens mentioned above, it is more than 20% of *onl*.

Mus famulus differs from *Mus platythrix* in having softer fur, brown undersurface and number of mammae 3 vs 5 pairs.

Distribution (Map 13) : Reported from Kalapatti and Avalanchi (c 1540 m alt.) in Nilgiri Hills, Tamil Nadu. Hence, this species is endemic to India.

Ecology : Poorly known. Nocturnal and fossorial. Trapped in evergreen forest at an altitude of c 1540 m.

***Mus platythrix* Bennett**

1832. *Mus platythrix* Bennett, *Proc. zool. Soc. Lond.*, : 121 (Deccan, Southern India).

1913. *Leggada bahadur* Wroughton & Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 18 (Karwar, Kanara, Karnataka, India).

1913. *Leggada grahami* Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 434 (Wotekolli, Coorg, Karnataka, India).

1913. *Leggada hanningtoni* Ryley, *J. Bombay nat. Hist. Soc.*, 22 : 435 (Makut, Coorg, Karnataka, India).

Common name : Brown Spiny Mouse (Eng.).

Measurements : (Based on specimens from ZSI, BNHS, CMNH, AMNH & NMNH).

External : HB 77-123, 95±13 (36); TI 51-81, 71±7 (31); Hf 17-22, 19±1.8 (36).

Cranial : *onl* 23.5-27.6, 25.2±1.4 (39); *m* 4.0-4.7, 4.3±1.5 (39); *m/onl* % 15.3-18.8, 17.2±0.9 (39); *apf* 4.2-5.4, 5.05±0.35 (39); *apf/onl* % 17.5-22.4, 20.0±1.0 (39); *p* 11.9-14.5, 13.2±.75 (38); *p/onl* % 50.0-54.7, 52.2±1.1 (38); *d* 6.1-8.4, 7.0±.55 (38); *d/onl* % 25.2-30.4, 27.55±1.2 (38); *width of interpterygoid space* 0.7-1.2, 0.85±0.12 (28).

Ectoparasite : Louse, *Hoplopleura sinhgarh* on Pune-specimens (Mishra *et al.*, 1972).

Karyotype :

(i) Pune-specimens : $2N = 30$; Y-metacentric, X and all autosomes telocentric (Dhanda *et al.*, 1973).

(ii) Araku-specimens : $2N = 30$; X, Y and all autosomes telocentric.

Diagnostic characters : A medium-sized mouse (head and body length 95 ± 13 mm), having a short tail, less than 80% of HB. Fur spiny. Colour of body dusky to dark brown above, white to greyish white below; tail bicolour, dark above and paler below; hindfoot white, with or without a slaty spot on it. Mammary 5 (3+2) pairs.

Skull medium in size (*onl* 25.2 ± 1.4 mm), largest in population from Pune and Karnataka; supraorbital ridges prominent; anterior palatal foramina relatively short, less than 21% of *onl*, extending posteriorly up to anterior root of first upper molar; palate always more than one-half of occipitonasal length; interpterygoid space wider (width 0.85 ± 0.12 mm) than in *Mus saxicola*.

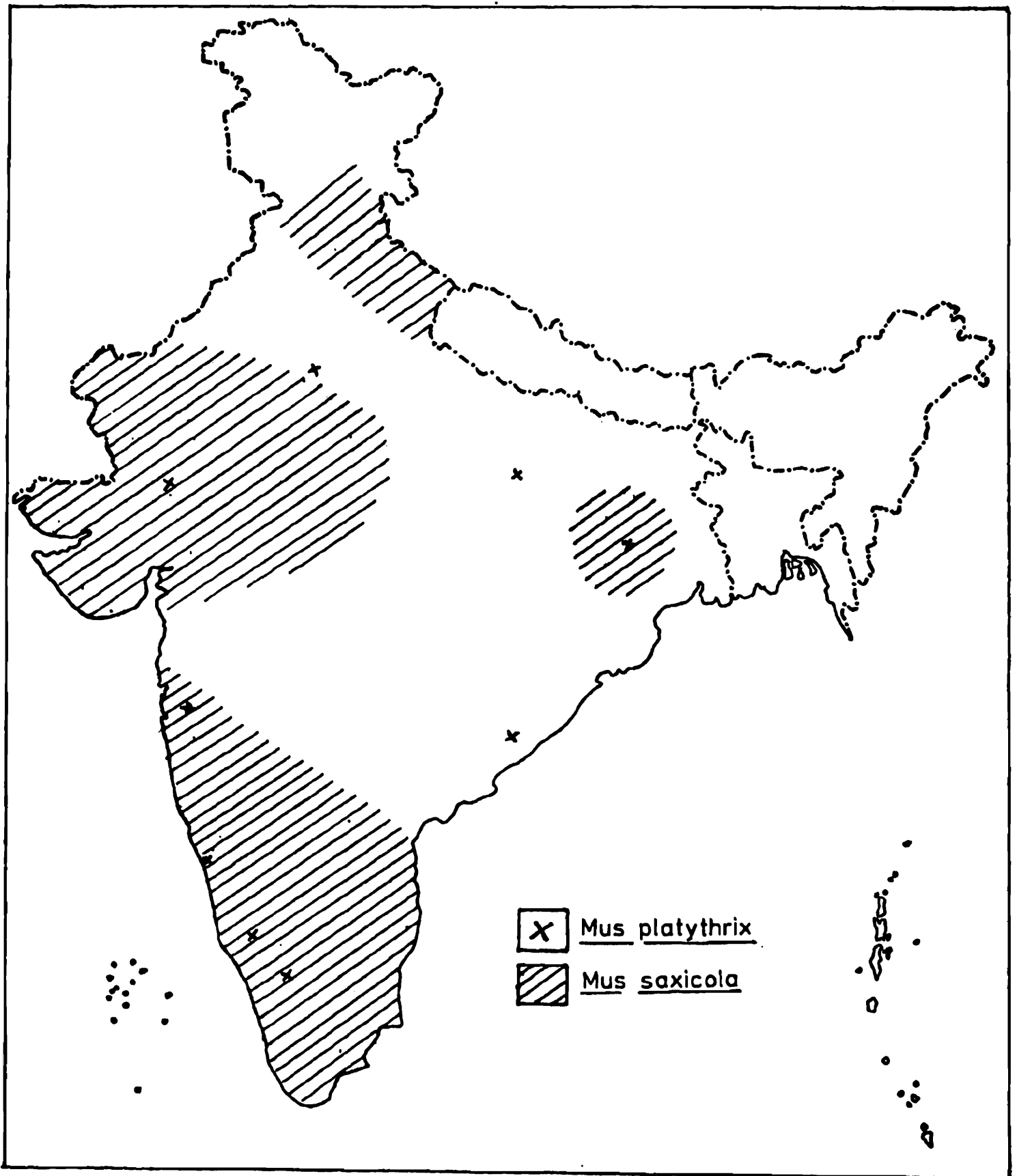
Upper incisors opisthodont or orthodont, with or without a notch. Molars 3/3 in number; M^1 having 8-cusps (t_7 absent), M^2 with 6 cusps and M^3 small. No anterior accessory cusp present on anterior root of M^1 . Lower molars as in *Mus musculus*.

Distribution (Map 14) : India : Maharashtra (Pune & Dhulia), Karnataka (Karwar, Coorg), Tamil Nadu (Nilgiris), Andhra Pradesh (Araku valley & Hyderabad), Madhya Pradesh (Jabalpur), Rajasthan (Mt. Abu) and West Bengal (Puruliya). Hence, this species is endemic to India.

Ecology and biology : Nocturnal and fossorial. Lives in sandy, rocky or gravelly habitat. It avoids irrigated cropland. Omnivorous in diet. Breeding is reported from May to February in Hyderabad (Jain, 1980); litter-size varies from 2 to 9. The annual productivity is about 18 young per female (Mohan Rao, 1981) in Andhra Pradesh.

Intraspecific variation : The specimens from different geographical areas are more or less alike in morphological characters. But the karyotypes differ in specimens from Pune (Maharashtra) and Araku valley (Andhra Pradesh). This difference is further reflected by the presence of slaty brown spot on the hindfoot in specimens from Pune and in a few specimens from Araku valley, while absent in others (both from Araku valley and Puruliya, West Bengal). However, it is not clear whether these differences are constant, and hence, more study is required to treat these populations as separate subspecies.

Marshall (1977) regarded the subspecies *M. p. shortridgei* from Myanmar as a full species, differing from *M. platythrix* in the colour of ventral surface of body being grey, larger size and in the chromosome number $2N = 46-49$.



Map 14. Showing the distribution of two species of rodents in India.

***Mus saxicola* Elliot**

1839. *Mus saxicola* Elliot, *Madras J. Litt. Sci.*, 10 : 215 (Madras, India).

Common name : Elliot's Spiny Mouse (Eng.).

Measurements : (Based on specimens from ZSI, BNHS, BM, CMNH and AMNH).
(Range, mean, standard deviation and sample size)

External : HB 71-112, 87 ± 10 (206); TI 53-96, 71 ± 7 (192); Hf 16-19, 17.6 ± 1 (206).

Cranial : *onl* 22.6-28.0, 24.9 ± 1.2 (107); *m* 4.0-4.85, 4.4 ± 0.2 (107); *m/onl* % 16.2-19.4, 17.7 ± 1.0 (107); *apf* 5.0-6.7, 5.7 ± 0.4 (107); *apf/onl* % 20.0-26.5, 23.1 ± 1.2 (107); *p* 12.2-15.1, 13.5 ± 0.65 (52); *d* 6.1-8.0, 7.0 ± 0.5 (47); *width of interpterygoid space* 0.3-0.7, 0.5 ± 0.1 (12).

Ectoparasite : Louse, *Hoplopleura ramgarh* has been reported to parasitise specimens of *Mus saxicola* from Pune (Maharashtra) and West Bengal (Mishra *et al.*, 1972; Adhikari and Ghosh, 1994).

Karyotype :

(i) Himachal Pradesh : $2N = 22$. X-submetacentric, an autosome metacentric, and rest telocentric (Pathak, 1970).

(ii) Pune, Maharashtra : $2N = 24$ or 26 ; X-submetacentric, an autosome may or may not be metacentric, rest telocentric (Dhanda *et al.*, 1973).

(iii) Mysore, Karnataka : $2N = 26$; X, Y and all autosomes telocentric (Satya Prakash *et al.*, 1972).

Diagnostic characters : A medium-sized mouse (head and body length 87 ± 10 mm), having a short tail, less than 90% of HB. Fur soft or spiny. Colour of body pale sandy to dark greyish brown above, white to dirty white below; tail bicolour, dark above and paler below; hindfoot white. Mammary $4+2 = 12$, sometimes $3+2 = 10$.

Skull medium-sized (*onl* 24.9 ± 1.2 mm); supraorbital ridges prominently developed; anterior palatal foramina long, more than 22% of *onl*, extending posteriorly up to second lamina of first upper molar; palate more than one-half of *onl*; interpterygoid space narrower than in *Mus platythrix* (0.5 ± 0.1); sometimes pterygoids arise very close from the palate.

Upper incisors opisthodont or orthodont and without a notch. Molars 3/3 in number and similar to *Mus platythrix* in structure except that an accessory cusp present on the anterior root of first upper molars.

Distribution (Map 14) : Found throughout India, the eastern limit being West Bengal. Also occurs in Pakistan and Nepal.

Ecology and Biology : Similar to those of *Mus platythrix*.

Intraspecific variation : It is difficult to differentiate the subspecies of *Mus saxicola* purely on body colour as there is considerable overlap. Hence, here, support has also been taken from karyotypic studies.

Three subspecies of *Mus saxicola* have tentatively been recognised here.

Key to subspecies of Mus saxicola

1. Anterior lamina of first upper molar not elongated 2
Anterior lamina of first upper molar elongated so as to appear longer than broad
..... *M. s. sadhu*
2. Fur soft; dorsum pale sandy brown to dark greyish brown; chromosome number
 $2N = 22$ *M. s. gorkha*
Fur spiny; dorsum pale brown to golden brown; chromosome number $2N = 24$ or
 26 *M. s. saxicola*

(i) *Mus saxicola saxicola* Elliot

1839. *Mus saxicola* Elliot, *Madras J. Litt. Sci.*, 10 : 215 (Madras, Tamil Nadu, India).

1908. *Mus ramnadensis* Benthams, *Rec. Indian Mus.*, 2 : 385 (Ramnad, Madura, Tamil Nadu, India).

Distribution : India : Maharashtra (Pune, Nasik, Khandala, Ratnagiri), Karnataka (Dharwar, Mysore), Tamil Nadu (Salem, Madura, Madras), Andhra Pradesh (Kurnool, Balapalli Range).

(ii) *Mus saxicola sadhu* (Wroughton)

1911. *Leggada platythrix sadhu* Wroughton, *J. Bombay nat. Hist. Soc.*, 20 : 1001 (Virawah, Sind, Pakistan).

1912. *Leggada cinderella* Wroughton, *J. Bombay nat. Hist. Soc.*, 21 : 770 (Bhuj, Kutch, Gujarat, India).

1911. *Pyromys priestleyi* Thomas, *J. Bombay nat. Hist. Soc.*, 20 : 996-999 (Based on a skin of this race accidentally associated with a skull of *Millardia*).

Distribution : India : Rajasthan (Barmer, Jodhpur, Pali, Sirohi, Mt. Abu), Gujarat (Kutch, Junagadh, Palanpur, Dhrangadhra, Vankaneer), and Madhya Pradesh (Gwalior, Malwa). Also reported from Pakistan.

(iii) *Mus saxicola gurkha* (Thomas)

1914. *Leggadilla gurkha* Thomas, *J. Bombay nat. Hist. Soc.*, 23 : 200 (Ramnagar, Kumaon, Uttar Pradesh, India).

Distribution : India : Himachal Pradesh (Kangra, Dhamtal), Uttar Pradesh (Kumaon), Bihar (Hazaribagh, Paresnath) and West Bengal (Puruliya, Bankura, Birbhum and Medinipur).

Mus pahari Thomas

1916. *Mus pahari* Thomas, *J. Bombay nat. Hist. Soc.*, 24 (3) : 415 (Batasia c 1830 m, Darjiling dist., West Bengal, India).

1921. *Leggada jacksoniae* Thomas, *J. Bombay nat. Hist. Soc.*, 27 : 596 (Laitkynsao, Khasi Hills, Meghalaya, India).

Common name : Sikkim Mouse (Eng.).

Measurements : (Based on ZSI & BM specimens)

(Range, mean, standard deviation and sample size).

	<i>pahari</i>	<i>jacksoniae</i>
HB	75-99 88±5.5 (19)	82-102 90±5 (26)
Tl	85-100 92±4 (19)	80-108 92±6 (26)
Hf	17-20 19.5±1 (19)	18-23 19.7±1 (26)
E	14-16 15.2±1 (19)	15-18.5 16±1 (26)
<i>onl</i>	23.8-25.9 25.2±.8 (5)	24.7-26.1 25.6±.4 (7)
<i>p</i>	11.1-12.5 12.0±.5 (5)	12.4-13.4 12.9±.4 (7)

	<i>pahari</i>	<i>jacksoniae</i>
<i>apf</i>	4.7-5.1	4.5-5.1
	4.8±.15 (5)	4.8±.2 (7)
<i>m</i>	3.5-4.0	3.5-4.3
	3.7±.2 (5)	3.9±.25 (7)
<i>iw</i>	4.5-4.9	4.3-4.7
	4.7±.15 (5)	4.45±.15 (7)
<i>d</i>	6.1-6.7	6.1-7.5
	6.4±.25 (5)	7.0±.5 (7)

Diagnostic characters : A medium-sized mouse, generally less than 100 mm in head and body length and tail slightly longer or subequal to that. Fur tends to be bristly. Body greyish to dark brown above, light grey on the undersurface; tail bicoloured, dark grey above and paler below; hindfoot greyish white. Mammae 4 or 5 pairs.

Skull moderately large, occipitonasal length 24-26 mm; supraorbital ridges absent; anterior palatal foramina short (less than one-fifth of occipitonasal length), barely reaching back to maxillary toothrows; palate less than half the length of occipitonasal and posteriorly in line with third upper molars.

Upper incisors narrow, yellow, plain and often with subapical notch. Molars 3/3 in number and of generalised pattern.

Chromosome number $2N = 48$; $FN = 48$ (Gropp *et al.*, 1973).

Remarks : Differs from its allied species *Mus mayori* from Sri Lanka in being smaller (*onl* less than 27 *vs* more than 27 mm); lengths of diastema and maxillary toothrows, however, overlap in both.

Distribution (Map 13) : India : Sikkim (Chunthang), West Bengal (Darjiling dist.), Arunachal Pradesh (Mishmi Hills), Assam (Sadiya, Golaghat), Nagaland (Mokokchung), Meghalaya (Khasi, Jaintia and Garo Hills) and Mizoram (Aizwal and Lunglei dists.). Also reported from N. Myanmar and Bhutan.

Ecology and biology : Nocturnal; occurs in evergreen forest in hilly areas. Makes globular nest of dry grass. There is a record of 6 young-ones in a litter.

Intraspecific variation : The nominate subspecies occurs in India.

Ellerman (1961) differentiated the two subspecies from the Indian territory, namely, *M.p. pahari* and *M. p. jacksoni* on the length of skull (*onl* more than 25 mm vs less than 25 mm). However, on a perusal of specimens of both subspecies present in ZSI, no difference could be noticed between the two either in body colour or in body and skull measurements. Hence, *M. p. jacksoni* is being treated here as a synonym of the nominate subspecies.

(i) *Mus pahari pahari* Thomas

1916. *Mus pahari* Thomas, *J. Bombay nat. Hist. Sec.*, 24(3) : 415 (Batasia c 1830 m, Darjiling dist., West Bengal, India).
1921. *Leggada jacksoniae* Thomas, *J. Bombay Nat. Hist. Soc.*, 27 : 596 (Laitkynsae, Khasi Hills, Meghalaya, India).

Distribution : As mentioned under the species.

Genus *Golunda* Gray

1837. *Golunda* Gray, *Charlesworth's Mag. nat. Hist.*, 1 : 586.

Type species : *Golunda ellioti* Gray.

Distribution : Pakistan, India, Nepal, Bhutan and Sri Lanka.

The genus *Golunda* is characterised by highly unusual dentition. Upper incisors broad, prominently grooved and red in colour. Cusps of upper molars abnormally enlarged (grape-shaped), particularly in middle and inner rows; third upper molar large, lacks the outer row of cusps, and with wear tends to become the largest tooth (Fig. 6 a). Maxillary toothrows long, generally one-fifth of occipitonasal length.

This genus is represented in India by a single species, *Golunda ellioti* Gray.

Golunda ellioti Gray

1837. *Golunda ellioti* Gray, *Charlesworth's Mag. nat. Hist.*, 1 : 586 (Dharwar, Karnataka, India).
1839. *Mus hirsutus* Elliot, *Madras J. Litt. Sci.*, 10 : 213 (South Mahratta Country, India).
1845. *Mus myothrix* Hodgson, *Ann. Mag. nat. Hist.*, 15 : 267 (Nepal).
1850. *Golunda coffaeus* Kelaart, *J. Ceylon Br. Asiat. Soc.*, 2 : 213 (Sri Lanka).
1876. *Pelomys watsoni* Blanford, *Proc. Asiat. Soc. Bengal*, 181 (Kirthar, Sind, Pakistan).

Common name : Indian Bush Rat (Eng.).

Measurements : (Based on ZSI, BNHS and BM specimens).

(Range, mean, standard deviation and sample size)

	<i>elliotti</i>	<i>paupera</i>	<i>myothrix</i>	<i>coenosa</i>	<i>watsoni</i>	<i>gujerati</i>	<i>nuwara</i>
HB	102-170 122±13 (88)	106-123 116±7 (3)	104-150 122±11 (62)	97-142 116±13 (16)	100-130 114±10 (10)	105-134 122±6 (55)	115-147 131±10 (7)
TI	86-131 104±11 (78)	95-98 96±1 (3)	86-129 107±10 (55)	84-112 99±8 (13)	92-122 110±10 (10)	94-126 110±8 (45)	89-119 98±9 (7)
TI as % of HB	69-100 86±8 (78)	77-90 83±5 (3)	70-103 88±6.5 (55)	72-94 85±6 (13)	87-112 97±7 (10)	77-102 89±6 (45)	70-82 75±4.3 (7)
Hf	22-28 24.2±1.2 (86)	21-22 21.7±.5 (3)	22-27.5 25±1.4 (61)	22-28 25±1.4 (15)	21-25 23.6±1.3 (10)	22-26 23.8±.9 (55)	25-28 26.3±.9 (7)
Hf as % of HB	16.2-22.6 20.1±1.6 (86)	17-20.7 18.8±1.5 (3)	17.2-23.8 20.6±1.6 (61)	18.3-25.8 22±2 (15)	19.2-23.5 20.8±1.2 (10)	17.5-21.9 19.5±1 (55)	17.7-22.6 20.1±1.8 (7)
Ear as % of HB	11.2-16.5 13.8±1.4 (84)	12.2-16.0 13.9±1.6 (3)	12.0-17.1 14.6±1.3 (61)	14-16.4 15.3±1.3 (15)	13-16.7 15.1±1.3 (10)	11.2-14.6 12.8±.8 (52)	10.9-14.1 12.8±1 (7)
<i>onl</i>	28.0-35.4 30.5±1.3 (49)	—	28.9-34.3 31.1±1.1 (22)	31.1-33.3 32.7±.7 (8)	31.8-35.2 32.9±1.2 (5)	28.5-33.5 31.0±1.1 (35)	30.0
<i>p</i>	14.4-16.5 15.33±.6 (31)	—	14.0-16.5 15.6±.7 (22)	15.4-17.3 16.15±.6 (5)	16.0-17.6 16.6±.55 (5)	14.5-16.5 15.6±.5 (27)	15.0
<i>apf</i>	4.4-6.5 5.33±.46 (31)	—	4.8-6.2 5.7±.6 (22)	4.8-6.2 5.4±.45 (5)	6.0-6.5 6.2±.2 (5)	4.7-6.1 5.27±.33 (27)	5.1
<i>m</i>	5.8-6.8 6.5±.25 (49)	—	6.0-6.9 6.4±.2 (22)	6.0-6.7 6.3±.2 (8)	6.3-6.7 6.5±.16 (5)	5.8-6.7 6.3±.2 (35)	7.2
<i>h</i>	4.6-5.6 5.2±.2 (31)	—	5.0-6.0 5.4±.3 (22)	5.1-5.4 5.25±.1 (4)	5.4-6.0 5.65±.2 (4)	4.6-5.8 5.4±.27 (25)	5.4

Diagnostic characters : A medium-sized rat, having the tail shorter than head and body; hindfoot varies from 21 to 28 mm and on average longest in specimens from Sri Lanka and shortest in those from Ambala (Haryana) but measurements overlap with specimens from other parts of India; outer digit of hindfoot and 5th finger shortened; ears moderate in length, shorter in specimens from Gujarat and Sri Lanka than in those from other parts of India. Mammae 4 pairs.

Pelage thick, but texture varies with age, altitude and season, hence, fur may be long and soft or short and spiny. Hairs, covering the tail, short and coarse. Body colour greyish brown to blackish above, and white to bluish grey on the undersurface; hands and feet dirty white to brown; tail distinctly bicoloured, dark brown above, paler below (Agrawal & Chakraborty, 1982).

Occipitonasal length of skull 29-35 mm; palate approximates to half the occipitonasal length and narrow; anterior palatal foramina long but less than one-fifth of *onl*; maxillary toothrows long, approximating to or more than one-fifth of occipitonasal length; bulla large, usually 16-17% of *onl*; zygomatic plate may individually be concave anteriorly as in *Diomys*.

Dentition as mentioned under the generic characters. M^1 having 8 cusps (t_7 absent), M^2 7 cusps (t_2 , t_7 absent) and M^3 possesses four functional cusps; when worn M^2 or M^3 appear to be longer than M^1 . Lower molars biserially cuspidate; M_1 having 3 laminae, and M_2 and M_3 2-laminae each; posterior cingulum in M_1 and M_2 small.

Distribution (Map 4) : Found practically throughout India in suitable habitats. Also reported from Pakistan, Nepal, Sri Lanka and SE Iran (Missone, 1990).

India : Jammu & Kashmir (Jammu dist.), Himachal Pradesh (Kangra, Chamba c 610-1890 m), Uttar Pradesh (Kumaon), Rajasthan (Jalore, Jodhpur, Bisalpur, Mt. Abu), Haryana (Ambala), Gujarat (Kutch, Rajkot, Surendranagar and Palanpur), Madhya Pradesh (Nimar, Berar, Sagar Hoshangabad, Balaghat, Chanda, Gwalior), Bihar (Hazaribagh), Orissa (Puri), West Bengal (Duars c 183 m), Assam (Kamrup), Maharashtra (Pune, Dhulia, Nasik, Satara, Ratnagiri), Karnataka (Dharwar, Konkan, Mysore, Coorg), Tamil Nadu (Salem, Madura), and Andhra Pradesh (Palkonda Hills, Hyderabad).

Ecology and biology : Diurnal. Lives in forests, bushes and orchards, near cultivation. Feeds on seeds, berries, young shoots and all kinds of succulent vegetable matter. Breeds practically throughout the year (Prakash 1971) in Rajasthan; nests are made up of fibres, dried leaves and grasses; litter-size 4-11 (mean 7.3) at Mt. Abu, Rajasthan (Prakash, 1995).

Intraspecific variation : Agrawal and Chakraborty (1982) recognised two subspecies of *Golunda ellioti* from the Indian territory, namely, *G. e. ellioti* and *G. e. gujerati* on the basis of colour of the undersurface of body, grey in the former and white in the latter. On reexamination of the specimens from Gujarat present in the Zoological Survey of India, it has been observed that 11 out of 16 specimens have ventral fur white up to base while 5 have basal half of hairs grey and tip white, giving the undersurface a greyish texture. On the contrary, 6 out of 124 specimens of *ellioti* (two from Salt Range, one from Sind, one from Kumaon and two from Madhya Pradesh)

have fur on the undersurface of body white up to base. Hence, this character also appears to be over-lapping. As such, the subspecies *G. e. gujerati* is being treated here as a synonym of *G. e. ellioti*.

Further, since the specimens of *G. nuwara* from Sri Lanka could not be examined, it is not possible to comment on the status of that taxa. Its dorsum, however, is blackish (Ellerman, 1961) and maxillary toothrows long, 6.8-7.4 mm (Corbet and Hill 1992, p. 351).

Thus, the nominate subspecies occurs in India.

(i) *Golunda ellioti ellioti* Gray

1837. *Golunda ellioti* Gray, Charlesworth's Mag. nat. Hist., 1 : 586 (Dharwar, Karnataka, India).

1923. *Golunda ellioti paupera* Thomas, J. Bombay nat. Hist. Soc., 29 (2) : 374 (Ambala, Haryana, India).

1923. *Golunda ellioti gujerati* Thomas, J. Bombay nat. Hist. Soc., 29 (2) : 374 (Palanpur, Gujarat, India).

1923. *Golunda ellioti bombax* Thomas, J. Bombay nat. Hist. Soc. 29 (2) : 375 (Bombay, India).

1923. *Golunda ellioti coraginis* Thomas, J. Bombay nat. Hist. Soc., 29(2) : 375 (Coorg, Karnataka, India).

1923. *Golunda ellioti coenosa* Thomas, J. Bombay nat. Hist. Soc., 29 (2) : 376 (Hasimara, Bhutan Duars, India).

Distribution : As mentioned under the species except Sri Lanka.

Genus *Nesokia* Gray

1842. *Nesokia* Gray, Ann. Mag. nat. Hist., [1], 10 : 264.

1860. *Spalacomys* Peters Abh. K. Acad. Wiss. Berlin : 139 (Type species *Spalacomys indicus* Peters).

Type species : *Arvicola indica* Gray.

Distribution : India, Bangladesh, Nepal, Pakistan, Afghanistan, Iran, Iraq, Arabia, Israel, Syria, Russian Turkestan and Egypt.

All bandicoot-rats were formerly referred to the genus *Nesokia* Gray. Later, Gray (1873) erected the genus *Bandicota* and differentiated it from *Nesokia* on the basis of long anterior palatal foramina. Thomas (1907) divided them into three genera namely, *Nesokia* Gray, *Bandicota* Gray and *Gunomys* Thomas. However, Ellerman (1961) synonymised *Gunomys* with *Bandicota*, and retained *Nesokia* for the highly specialised Palaearctic bandicoot rats.

Genus *Nesokia* is characterised by a short tail, less than three-quarters of head and body length, condylobasal length of skull exceeding occipitonasal length, and strongly shortened anterior palatal foramina, situated equidistant from upper incisors and molars

(Plate 6, fig. a). Molars simple, consisting of a series of transverse laminae.

Chromosome number $2N = 42$.

This genus is monotypic.

Nesokia indica (Gray)

(Plate 2, fig. 4)

1830. *Arvicola indica* Gray, *Illustr. Ind. Zool.*, 1, pl xi (India).

Common name : Short-tailed Bandicoot-Rat (Eng.).

Measurements : (Based on Indian specimens) :

External : 3♂, 2♀ : HB 145-177 (157); TL 84-105 (94); Hf 29-31 (30); E 18-20 (19).

Cranial : 4♂, 2♀ : *onl* 35.0-41.9 (38.6); *p* 21.5-26.8 (24.6); *apf* 4.8-5.4 (5.1); *b* 7.7-8.9 (8.4); *m* 7.0-8.0 (7.5); *n* 10.5-13.0 (11.8).

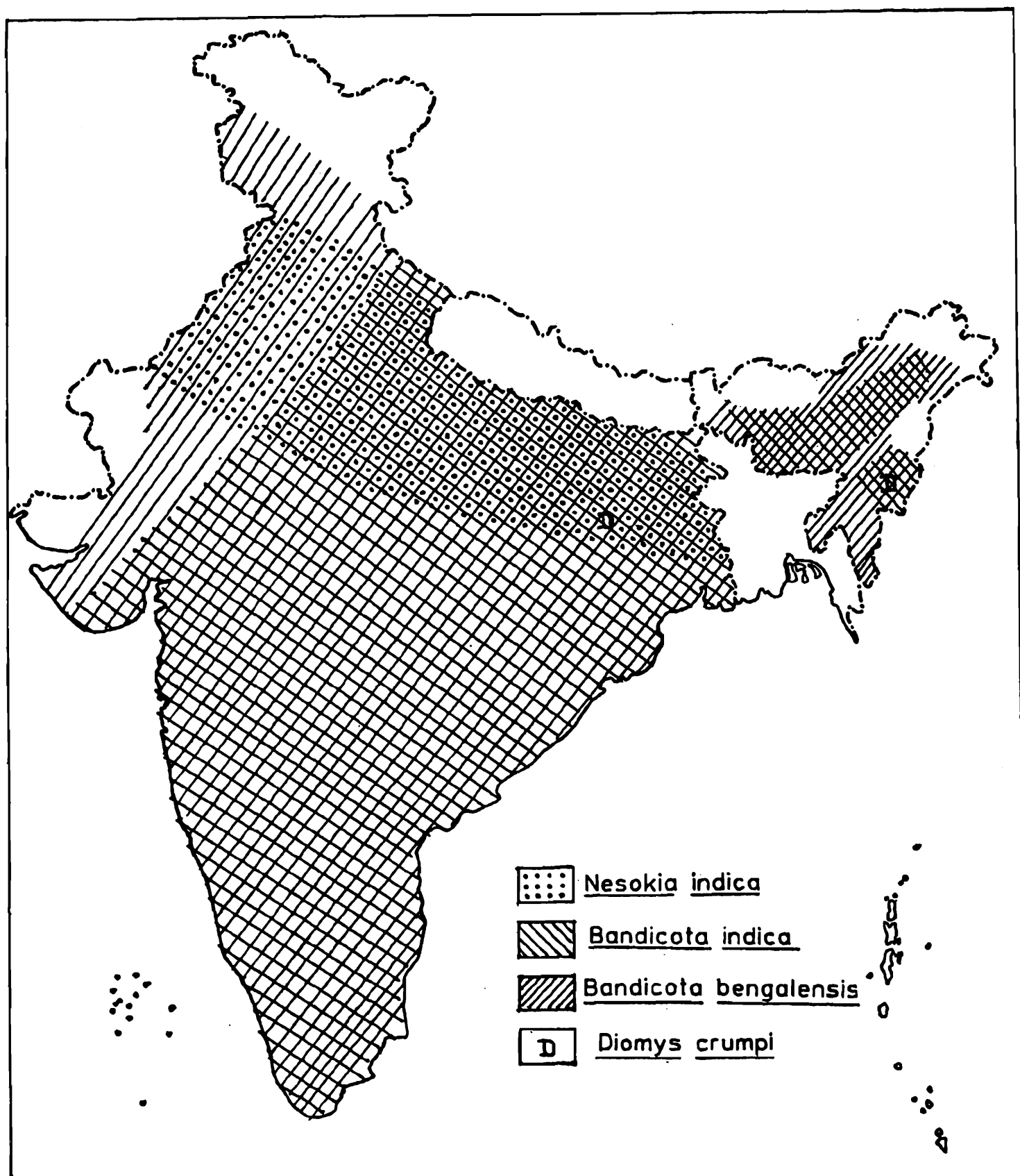
Diagnostic characters : A heavily built rat, having tail much shorter (60-75% of HB) than head and body length and poorly haired; ears more than one-tenth of head and body. Pelage short and harsh in summer-specimens and soft in winter-ones. Dorsum reddish to slaty brown in Indian-specimens, and pale sandy brown in those from Baluchistan; Venter grey; tail dark and unicoloured. Mammary 4 pairs.

Skull massive in build; condylobasal length exceeding occipitonasal length; supraorbital ridges well developed, continue backwards through parietals up to occiput; palate long, more than 60% of *onl*, but not extending posteriorly behind molars; anterior palatal foramina short, less than 6 mm in length, situated equidistant from upper incisors and molars; bulla enlarged, more than one-fifth of *onl*; nasals very short, less than 30% of *onl*. Lower incisor root projecting outwards on outer side of mandible.

Upper incisors proodont, wide and yellowish or whitish. Molars 3/3; M^1 5-rooted; all molars simple and laminate; M^1 with three laminae, M^2 and M^3 with two each; cusp t_7 present in upper molars; however, M^2 and M^3 always lack cusps t_1 , t_2 and t_3 . Lower molars like upper ones.

Chromosome number $2N = 42$; Y-chromosome polymorphism reported (Jhanwar and Rao, 1973).

Distribution (Map 15) : India : Punjab, Haryana, Delhi, Uttar Pradesh (Ramnagar and Fatehgarh), Rajasthan (Jaipur and Ganganagar), Bihar (Vaishali) and West Bengal (Nadia dist.). Also reported from Nepal, Bangladesh (Posamentier, 1989), Pakistan, Afghanistan, Iran, west to Egypt.



Map 15. Showing the distribution of four species of rodents in India.

Ecology and biology : Nocturnal and fossorial. Inhabits natural grassland, cultivated fields and fruit-orchards; prefers soft, moist soil and bunds for making burrows. Feeds on grass, young shoots, roots, grain, potato, tomato, brinjal, water melon, sugarcane etc. Breeds throughout the year, in captivity; litter-size 2-7 (Ramesh, 1992).

Intraspecific variation : The nominate subspecies occurs in India.

(i) *Nesokia indica indica* (Gray)

1830. *Arvicola indica* Gray, *Illustr. Ind. Zool.*, 1, pl. xi.

1837. *Mus hardwickei* Gray, *Charlesworth's Mag. nat. Hist.*, 1 : 585.

1851. *Nesokia griffithi* Horsfield, *Cat. Mamm. Mus. East. India Co.*, 145 (NWFP, Pakistan).

1860. *Spalacomys indicus* Peters, *Abh. K. Akad. Wiss. Berlin*, : 143 (Eastern India).

1908. *Nesokia beaba* Wroughton, *J. Bombay nat. Hist. Soc.*, 18 : 741 (Central Sind, Pakistan).

Distribution : India, Pakistan, Bangladesh and Nepal.

Genus *Bandicota* Gray

1873. *Bandicota* Gray, *Ann. Mag. nat. Hist.*, [4], 12 : 418.

1907. *Gunomys* Thomas, *Ann. Mag. nat. Hist.*, [7], 20 : 203 (Type species *Arvicola bengalensis* Gray).

Type species : *Bandicota gigantea* Hardwicke

Distribution : Indo-Malayan region.

A specialised fossorial rat, having the condylobasal length of skull equal to or more than occipitonasal length, lengthened palate (more than 55% of *onl*), extending posteriorly behind upper molars, long anterior palatal foramina, more than 7.0 mm in length, reaching up to or extending between first upper molars, proodont incisors and laminate molars; upper molars retain cusp t7 (postero-internal) which is absent in *Rattus* and *Mus*.

The genus *Bandicota* is represented in India by two species, namely, *Bandicota bengalensis* and *Bandicota indica*.

Key to species of genus Bandicota

Size small, occipitonasal length less than 48 mm; anterior palatal foramina narrower at posterior than anterior end; nasals short, less than one-third of occipitonasal length *B. bengalensis*

Size large, occipitonasal length more than 48 mm; anterior palatal foramina equally broad at both ends; nasals long, more than one-third of occipitonasal length *B. indica*

***Bandicota bengalensis* (Gray)**

(Plate 2, fig. G)

1835. *Arvicola bengalensis* Gray, *Illustr. Indian Zool.*, 2 : pl. 21 (Bengal).*Common name* : Indian Mole Rat (Eng.).*Measurements* : (Based on ZSI, BNHS and BM specimens. Measurements of *lordi* vide Pradhan 1979).

(Range, mean, standard deviation and sample-size).

	<i>bengalensis</i>	<i>kok</i>	<i>gracilis</i>	<i>wardi</i>	<i>lordi</i>
HB	132-237 179±21 (115)	130-225 165±24 (96)	158-202 180±15 (6)	140-198 175±17 (14)	221-261 241±20
Tl	99-202 148	100-217 149	121-170 140	108-162 141	— —
Tl as % of HB	68-98 82±8 (115)	62-103 85±8 (96)	72-84 79±4 (6)	67-93 81±6 (14)	— —
Hf	29-39 33.7±2 (115)	27-39 33.5±2 (96)	31-35 33±1.3 (6)	32-37 35±1.7 (14)	41-48 44.5±2
<i>onl</i>	33.3-45.5 39.1±2.6 (72)	33.8-45.4 39.2±2.2 (77)	35.8-42.0 39.2±2.5 (5)	36.6-41.2 38.8±1.6 (5)	43.5-47.9 45.7±2
<i>p</i>	22.1-27.9 24.3±1.5 (40)	21.6-27.2 23.9±1.2 (41)	21.5-25.1 23.1±1.4 (6)	22.2-24.8 23.5 (2)	— —
<i>m</i>	5.9-8.0 7.15±.4 (72)	6.3-8.5 7.25±.4 (74)	6.2-7.0 6.7±.3 (4)	7.3-8.0 7.7±.3 (5)	6.3-7.9 7.65±1.15
<i>apf</i>	7.3-9.6 8.2±.55 (39)	7.3-9.8 8.25±.55 (42)	7.2-8.8 7.8±.5 (5)	9.2-10.6 10.05±.4 (6)	— —
<i>n</i>	11.5-15.0 12.6±.9 (39)	10.8-14.7 12.55±.9 (40)	11.4-14.4 12.7±1.3 (5)	11.7-12.3 12.0 (2)	— —
<i>b</i>	7.7-9.8 8.9±.45 (39)	7.6-9.9 8.66±.5 (39)	7.8-8.8 8.2±.45 (6)	8.4-8.5 8.45 (2)	— —

Diagnostic characters : A robust rat, having the tail shorter than head and body; ears almost round in outline. Mammae 6-8 pairs. Pelage short and harsh, soft and thick in specimens from Jammu and Kashmir and Himachal Pradesh. Dorsum greyish brown to blackish, occasionally with a reddish hue; venter light to dark grey ; tail dark and unicoloured; hindfoot brown.

Skull large; condylobasal length exceeding occipitonasal length; supraorbital ridges well-developed; palate long, more than 60% of *onl*; anterior palatal foramina long, more than 7 mm in length, extending posteriorly up to first lamina of first upper molars, its posterior end narrower than anterior (Plate 6, fig. c); bulla large, more than one-fifth of *onl*; nasals short, less than one-third of *onl*.

Upper incisors broad, proodont, and orange to lemon yellow on front surface; molars 3/3 and M^1 5 rooted ; three laminae on M^1 , and two each on M^2 and M^3 ; upper molars retain cusp t7, though merged with t8 and t9 to form a lamina; traces of antero-internal cusp (t1) present on M^2 and M^3 . Lower molars like upper ones, M_1 trilaminar, and M_2 and M_3 bilaminar ; no posterior cingulum behind M_1 and M_2 .

Distribution (Map 15) India, Pakistan, Nepal, Bhutan, Bangladesh, Sri Lanka, and Myanmar. Also reported from Malaysia (Pinang Is.) and Indonesia (Sumatra), probably introduced (Corbet and Hill, 1992).

Ecology and biology : Nocturnal and fossorial. Inhabits burrows in cultivated fields as well as in and around food godowns. Makes extensive burrow system. It is one of the most serious pest of crops in India, and hoards large quantity of grain in its burrow. Breeds throughout the year; litter-size 1-19 (Spillet, 1968; Mohan Rao, 1978; Jain, 1979; Pradhan, 1980; Sri Hari *et al.*, 1984; Chakraborty, 1992). The annual productivity in godown population comes to about 70 young per female (Spillet, 1968).

Intraspecific variation : Agrawal and Chakraborty (1976) recognised two subspecies from India, namely, *B. bengalensis bengalensis* and *B. b. wardi*.

Pradhan (1979) undertook bio-chemical studies on specimens of *B. b. lordi* from Bombay (= Mumbai), Maharashtra. He not only found in them a different haemoglobin pattern but also reported them to be larger than those of *bengalensis* and *kok* in lengths of head and body, hindfoot and occipitonasal. None of the specimens of *lordi* present in the Zoological Survey of India, Calcutta, and three out of five present in the British Museum, London, are as large as reported by Pradhan (1979). Moreover, the hindfoot length appears to have been wrongly measured. Hence, *lordi* is still treated as a synonym of *B. bengalensis bengalensis*, as was done by Ellerman (1961).

Key to subspecies of B. bengalensis

- Pelage long, soft, glossy and greyish brown ***B. b. wardi***
 Pelage short, harsh, brown to dark brown and without any glossy texture
 ***B. b. bengalensis***

(i) ***Bandicota bengalensis bengalensis*** (Gray)

1835. *Arvicola bengalensis* Gray, *Illust. Ind. Zool.*, 2, pl 21 (Bengal).
 1837. *Mus kok* Gray, *Charlesworth's Mag. nat. Hist.*, 1 : 585 (Dharwar, Karnataka, India).
 1839. *Mus providens* Elliot, *Madras J.*, 10 : 209 (S. Mahratta, Karnataka, India).
 1854. *Mus daccaensis* Tytler, *Ann. Mag. nat. Hist.*, 14 : 173 (Deccan, India).
 1908. *Gunomys lordi* Wroughton, *J. Bombay nat. Hist. Soc.*, 18 : 746 (Kolaba dist., Maharashtra, India).
 1908. *Gunomys indicus* Wroughton, *J. Bombay nat. Hist. Soc.*, 18 : 746 (Sind, Pakistan).
 1902. *Nesokia gracilis* Nehring, *S. B. Ges. nat. Fr. Berlin*, : 116 (Sri Lanka).
 1936. *Gunomys kok insularis* Phillips, *Spolia Zeylan.*, 20 : 95 (N. Province, Sri Lanka).

Distribution : India : Jammu & Kashmir (Islamabad dist.) Punjab (Ludhiana), Haryana (Hissar, Kurukshetra), Uttar Pradesh (Gorakhpur, Kanpur, Kumaon, Fatehpur, Sitapur, Varanasi, Oadh), Bihar (Daltongunj, Giridih, Purneah, Chaibassa), Orissa (Baleswar, Ganjam, Mayurbhanj), West Bengal (all 16 districts), Assam (N. Kamrup, Golaghat), Meghalaya (Shillong), Tripura (Belonia), Mizoram (Aizawl, Lunglei), Manipur (Imphal), Madhya Pradesh (Gwalior, Asirgarh, Nimar, Jabalpur), Rajasthan (Bikaner, Mt. Abu), Gujarat (Amreli, Dangs, Rajkot, Surat, Junagadh, Vadodara, Bharuch), Maharashtra (Nasik, Dhulia, Ratnagiri, Bombay, Pune, Satara), Andhra Pradesh (Hyderabad, Nagarjunasagar, Bapatla, Guntur, Cuddapah), Karnataka (Bellary, Dharwar, Kanara, Mysore, Bangalore, Coorg), Tamil Nadu (Chennai, Ootacamund) and Kerala (Trichur and Trivandrum).

(ii) ***Bandicota bengalensis wardi*** (Wroughton)

1908. *Gunomys wardi* Wroughton, *J. Bombay nat. Hist. Soc.*, 18 : 745 (Pandritton c 1678 m, Jammu & Kashmir, India).

Distribution : India : Jammu & Kashmir (Ramban, Jhajjarkotli) and Himachal Pradesh (Chamba, Kangra, Mandi, Solan, Sirmaur and Shimla).

Bandicota indica (Bechstein)

(Plate 2, fig. F)

1800. *Mus indicus* Bechstein, *Veber Vierf. Thiere.*, 2 : 497 (Pondicherry, India).
 1993. *Bandicota maxima* Pradhan, Mandal, Bhagwat & Agrawal, *Rec. zool. Surv. India*, 93 : 175-200 (Pune, Maharashtra, India).

Common names : Large Bandicoot Rat (Eng.); Ghuis (Hin.); Baro Dhere Indur (Beng.).

Measurements : (vide Chakraborty and Chakraborty, 1992).

(Range, mean, standard deviation and sample-size)

	<i>indica</i>	<i>gigantea</i>	<i>malabarica</i>	<i>nemorivaga</i>
HB	245-305 278±17 (8)	209-366 300±24 (13)	205-345 280.5±21 (44)	210-335 269±24 (464)
TI	245-315 289±12 (8)	229-330 297±17 (13)	210-340 281±18 (43)	185-317 244±26 (464)
Hf	45-60 55±4.5 (8)	50-63 58±3 (12)	48-70 56±4.5 (44)	46-60 51.5±5 (463)
E	30-34 31.5±1.2 (8)	28-39 31±3.5 (12)	26-43 32±5 (44)	20-40 27.5±5.5 (463)
<i>onl</i>	52.7-60.5 56.3±3.2 (5)	48.5-68.7 61.1±5.1 (12)	54.8-66.3 59.0±2.5 (33)	48.3-64.1 57.0±1.2 (421)
<i>p</i>	31.7-35.6 33.4±1 (5)	25.4-38.9 35.16±3 (12)	30.5-39.6 35.0±2.3 (27)	28.3-36.7 32.6±2 (416)
<i>n</i>	20.3-24.4 22.5±.8 (5)	18.6-27.7 24.4±2 (12)	22.0-27.0 24.5±1.1 (32)	16.0-25.0 20.3±1.2 (421)
<i>n as % of onl</i>	37.6-41.7 39.6±1.5 (5)	38.3-42.4 39.8±1.7 (12)	38.9-43.4 41.0±1.2 (32)	27.4-41.0 35.8±2 (421)
<i>m</i>	9.2-10.9 9.37±.4 (5)	9.5-11.4 10.6±.6 (11)	9.4-11.6 10.2±.4 (27)	8.2-10.6 10.3±.7 (409)
<i>apf</i>	10.2-11.7 10.9±.3 (5)	9.1-12.1 11.25±1 (12)	10.0-12.7 11.5±.6 (28)	8.7-11.6 10.3±.7 (416)
<i>b</i>	8.8-10.1 9.5±.4 (5)	8.9-11.0 9.98±.6 (11)	8.6-10.7 9.88±.3 (26)	8.5-11.5 9.7±.6 (402)

Diagnostic characters : A very large, heavily built rat, head and body length, in Indian subspecies, exceeds 200 mm; tail subequal to head and body. Fur harsh, spiny in a few specimens; many long, stiff, black hairs present on mid-dorsum. Body blackish brown above, grey on undersurface; tail dark and unicolour, covered with thin minute spiny hairs; hands and feet dark ; base of nails white. Mammae 6 pairs.

Skull large, occipitonasal-length exceeds 48 mm; condylobasal length may or may not exceed occipitonasal length; palate more than one-half but generally less than 60% of *onl*; anterior palatal foramina as long as in *B. bengalensis* but equally broad at both ends (Plate 6, fig. b); nasals long, more than one-third of *onl*.

Upper incisors thick, orange yellow and plain. Molars 3/3, and laminate; M^1 5-rooted. M^1 trilaminate, M^2 and M^3 bilaminate; cusp t7 present in upper molars; cusp t1 (antero-internal cusp) traceable in M^2 and M^3 ; Lower molars as in *Bandicota bengalensis* except that the posterior cingulum present behind M_1 and M_2 .

Distribution (Map 15) : Found in greater parts of India. Also reported from Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar, Thailand, Vietnam, Laos and S. China. Introduced in Malaysia (Marshall, 1977) and Indonesia (Musser and Newcomb, 1983).

Ecology and biology : Nocturnal and fossorial. Found in both rural and urban areas, inhabiting fields as well as residential complexes. However, all their inhabiting places are associated with natural or artificial water bodies. It lives in self constructed elaborate burrow system. Feeds on grass, roots, grain, tubers, corn, molluscs, crabs, insects, etc. (Chakraborty and Chakraborty, 1982). Breeds round the year in West Bengal (Chakraborty, 1985), and from September to March in Hyderabad (Jain, 1979). Litter-size ranges from 1-8 (mean 4.8) in West Bengal, and 1-4 in Hyderabad. The annual productivity comes to about 20 young per female in West Bengal (Chakraborty R., 1992).

Intraspecific variation : Two subspecies of *Bandicota indica* are recognised (Ellerman 1961; Chakraborty and Chakraborty 1992).

Key to subspecies of Bandicota indica

Nasals longer, on average more than 22 mm in length or more than 38% of occipitonasal length ***B. i. indica***

Nasals smaller, on average less than 22 mm in length or less than 38% of occipitonasal length ***B. i. nemorivaga***

***Bandicota indica indica* (Bechstein)**

1800. *Mus indicus* Bechstein, *Ueber Vierf. Thiere*, 2 : 497 (Pondicherry, India).

1800. *Mus bandicota* Bechstein, *Ueber, Vierf. Thiere*, 2 : 498.

1801. *Mus malabarica* Shaw, *Genl. Zool.*, 2 : 54 (Malabar, India).

1801. *Mus perchal* shaw, *Genl. Zool.*, 2 : 55.

1804. *Mus giganteus* Hardwicke, *Trans. Linn. Soc. Lond.*, 7 : 306 (Hardwar, Uttar Pradesh, India).

Distribution : India : Uttar Pradesh (Kumaon), Delhi, Rajasthan (Sambhar, Ganganagar), Punjab (Ferozpur), Haryana, Gujarat (Palanpur, Sasangir), Madhya Pradesh (Balaghat, Chanda), Bihar (Hazaribagh), Orissa (Chilka), Andhra Pradesh (Cuddapah, Hyderabad), Maharashtra (Mumbai, Nasik, Pune, Satara), Tamil Nadu (Chennai, Nellore, Odagamandalam), Karnataka (Dharwar, Sagar, Kolar, Bangalore, Coorg), Goa (Margao) and Kerala (Trivandrum, Khasargod).

(ii) ***Bandicota indica nemorivaga*** (Hodgson)

1836. *Mus (Rattus) nemorivagus* Hodgson, *J. Asiat. Soc., Bengal*, 5 : 234 (Nepal).

1845. *Mus macropus* Hodgson, *Ann. Mag. nat. Hist.*, 15 : 268 (Nepal).

1878. *Mus (Nesokia) elliotanus* Anderson, *J. Asiat. Soc. Bengal*, 46 (4) : 231 (Calcutta).

Distribution : India : West Bengal (Calcutta, Burdwan, Hugli, Howrah, Medinipur, North and South 24 Parganas, Jalpaiguri), Meghalaya (Khasi Hills), Assam (Kamrup), and Manipur (Imphal). Also reported from Nepal, Bangladesh, Thailand and China (Yunnan).

Remarks : Pradhan *et al.* (1993) differentiated *Bandicota maxima* from *Bandicota indica* on the basis of occipitonasal length of skull exceeding condylobasal length and hair sculpture of dorsum being chevron type in *maxima*, as against $cbl > onl$ and hair sculpture wavy mosaic in *indica*. The difference in skull appears to be nothing but individual variation due to growth changes. The character *onl* exceeding *cbl* has been reported to be present in 350 out of 398 skulls of *Bandicota indica nemorivaga* (Chakraborty and Chakraborty, 1991), hence can not be treated as characteristic for *Bandicota maxima* only. As regards the difference in hair sculpture, more study is needed on specimens from different sex and age groups and from different geographical locations. Here, *Bandicota maxima* has tentatively been kept under *Bandicota indica*.

Genus ***Diomys*** Thomas

1917. *Diomys* Thomas, *J. Bombay nat. Hist. Soc.*, 25 : 203.

Type species : *Diomys crumpi* Thomas.

Distribution : India, Nepal and N. Myanmar.

The genus *Diomys* is characterised by small body size, condylobasal length of skull exceeding occipitonasal length, long palate, extending posteriorly behind maxillary

toothrows, long anterior palatal foramina (about 23% of occipitonasal length), extending between maxillary toothrows, large bulla (about 19% of *onl*), proodont incisors and upper molars lacking cusp t7.

This genus is monotypic.

Diomys crumpi Thomas

1917. *Diomys crumpi* Thomas, *J. Bombay nat. Hist. Soc.*, 25 : 204 (Paresnath, Hazaribagh dist., Bihar, India).

Common name : Crump's Mouse (Eng.).

Measurements : (Based on ZSI and BM specimens).

External : 30 ex : HB 102-135 (116 ± 11); TI 109-130 (121 ± 7); Hf 24-28 (26 ± 1.1); E 19-27 (22 ± 1.8).

Cranial : 21 ex *onl* 29.4-33.2 (31.4 ± 1.1); *p* 16.3-18.5 (17.6 ± 0.6); *m* 5.1-5.6 (5.36 ± 0.14); *apf* 7.0-7.9 (7.5 ± 0.3); *b* 5.6-6.4 (6.1 ± 0.2); *d* 8.6-10.2 (9.5 ± 0.45).

Diagnostic characters : A small-sized rat, having tail a little longer than head and body, ears relatively large (about 19% of HB), and hallux and fifth toe subequal, but much shorter than central three. Pelage thick and soft. According to Musser and Newcomb (1983), plantar pads are five in number, but in two ZSI-specimens, the sixth one is also present. Body brownish grey above, greyish white (dark basally and white terminally) below; tail sharply bicolour, deep brown above, greyish below; hindfoot white.

Skull characters as mentioned in the generic description.

Upper incisors proodont and pale, sometimes faintly grooved. Molars 3/3; M¹ having 8 cusps (t7 absent) and M² 6 cusps; M³ quite largish, with an antero-internal cusp (t1) and two laminae behind it. Lower molars biserially cuspidate; M₁ and M₂ having posterior cingulum.

Distribution (Map 15) : India : Bihar (Paresnath, Hazaribagh dist) and Manipur (Bishenpur c 914-1219 m alt.). Also reported from Nepal (Ingles *et al.*, 1980) and N. Myanmar (Musser and Newcomb, 1983).

Ecology : It occurs in hilly terrain; a specimen was taken from the tall elephant grass in Myanmar (Musser and Newcomb 1983).

Remarks : The description of the species is based on a broken skull mismatched with a specimen of *Millardia meltada*, from Paresnath Hills, Bihar. The species has not subsequently been collected from the type locality and it remains doubtful if the same was correctly recorded (Corbet & Hill, 1992).

Family HYSTRICIDAE

Family Hystricidae consists of porcupines. These are characterised by their fur being modified into true quills or spines, angular process of mandible strongly distorted outwards, infraorbital foramen large, without a distinct canal for nerve transmission, and cheekteeth 4/4 in number and flat-crowned.

This family occurs in Africa, southern Palearctic and most of the Indo-Malayan region. It is represented by three genera, *Trichys*, *Atherurus* and *Hystrix*, of which the last two occur in India.

Key to genera of family Hystricidae

True quills present on the back of body; tail short, less than one-fourth of head and body length and bears hollow quills at its tip; molars hypsodont and rootless

..... *Hystrix*

True quills replaced by spines on the back of body; tail long, more than one-third of head and body length and bears a cluster of alternately expanded and contracted papery hairs at its tip; molars less high crowned and rooted. *Atherurus*

Genus *Atherurus* F. Cuvier

1829. *Atherurus* Cuvier, *Dict. Sci. Nat.*, 59 : 483.

Type species : *Hystrix macrourus* Linnaeus (Type by monotypy).

The genus *Atherurus* is characterised by its body covered with short, flattened spines instead of true quills, tail long, from one-third to one-half of head and body length, studded with broom-like, papery, coarse and alternately expanded and contracted hairs at its tip, and vertebral column having 14 dorsal and 19-23 caudal vertebrae (instead of 16 dorsal and 23-25 caudal vertebrae in the genus *Trichys*). Molars relatively less hypsodont than in *Hystrix* and rooted.

This genus occurs in Africa, NE India and SE Asia. Out of two recognised species of this genus, namely, *Atherurus africanus* and *Atherurus macrourus*, the latter occurs in India. The Asian species however, differs from the African one in the total absence of true quills on the body, and the skull relatively flatter (van Weers, 1977).

Atherurus macrourus Linnaeus

(Fig. 12)

1758. *Hystrix macroura* Linnaeus, *Syst. Nat.*, 10th ed., 1 : 57 (Malacca, Malaysia).

1858. *Atherurus asamensis* Thomas, *J. Bombay nat. Hist. Soc.*, 27 (3) : 598 (Cherrapunji, Meghalaya, India).

Common name : Brush-tailed Porcupine (Eng.)

Measurements : Holotype of *A. assamensis* (vide Thomas 1921, and van Weers 1977 in parantheses).

External : ♂ HB 420; TI 220; Hf 65; E 34.

Cranial : ♂ Gl 96 (93.1); cb 87; zw 44 (43.3); n 28.5 (25.5); nw 14.5 (14.0); pow 27.5 (25.4); p 39 (46.7); m 16.4 (16.4) ht 25 (23.6); cw 29.

Other specimens examined from Arunachal Pradesh, India, present in ZSI.

External : 4 ♂ 1 ♀ HB 425-445 (430 ± 8); TI 160-195 (172 ± 12); Hf 68-70 (69 ± 1); E 33-40 (35.5 ± 2.5).

Cranial : 5 ♂ 1 ♀ : onl 86.9-95.5 (91.2 ± 2.9); cb 80.2-88.7 (85.1 ± 2.7); zw 44.1-47.8 (46.3 ± 1.2); n 24.6-30.6 (27.2 ± 2.2); nw 12.5-15.3 ($14.1 \pm .9$); pow 24.3-27.0 (26.4 ± 1.2); p 40.5-44.1 (42.2 ± 1.4); m 14.8-17.2 ($16.1 \pm .9$); ht 25.5-28.1 (26.8 ± 1).

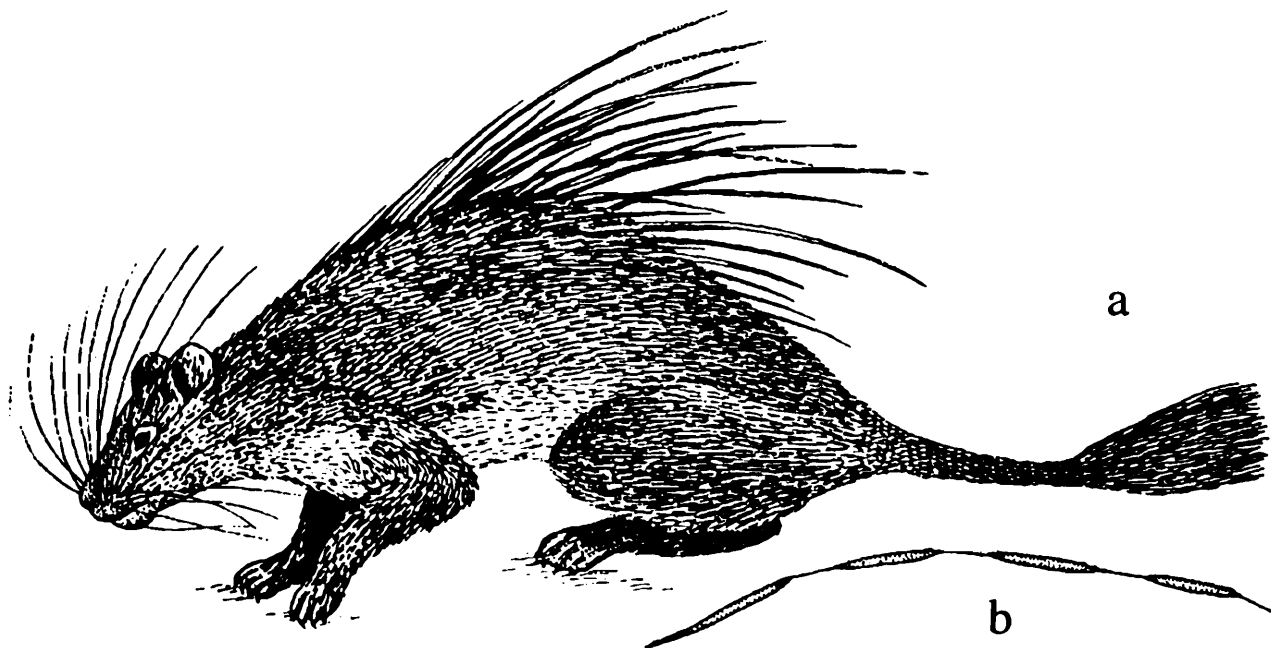


Fig. 12. Line drawing of (a) Brush-tailed porcupine, *Atherurus macrourus*, and (b) an enlarged tail-hair.

Diagnostic characters : Smaller in size as compared to the genus *Hystrix*, head and body length less than 500 mm, and the tail ranging from one-third to one-half of that; no crest on head; neck, shoulders, and undersurface of body covered with soft flattened spines; back covered with rigid spines, those of lumber region longer and mixed with

a few long white bristles; tail bears scales, with short spiny bristles in between, ending in a cluster of alternately expanded and contracted papery hairs 8-10 cm long; each having 3-6 expansions, 1-3 mm wide and 10-15 mm long; pollex vestigial and hallux clawed. Mammary 3 pairs.

Body dark brown above, with tips of spines whitish; white on the undersurface, less so in the type of *A. assamensis* (Thomas, 1921); tail brown all round, terminal caudal hairs whitish.

Skull large for a rodent but small for a member of this family, occipitonasal length less than 100 mm; nasals short, less than one-third of *onl*, projecting posteriorly slightly beyond premaxilla; frontals longer than nasals and not inflated; interparietal distinct; occiput prominent and well ridged; palate less than one-half of *onl*, extending posteriorly up to second upper molars; no post-plalatal spinous process; maxillary toothrows short, less than one-fifth of *onl*; anterior palatal foramina reduced and situated far in front of maxillary toothrows; infraorbital foramen large, without a distinct canal for nerve transmission; jugal long but not approaching lacrymals; mandible with angular portion weakly distorted outwards.

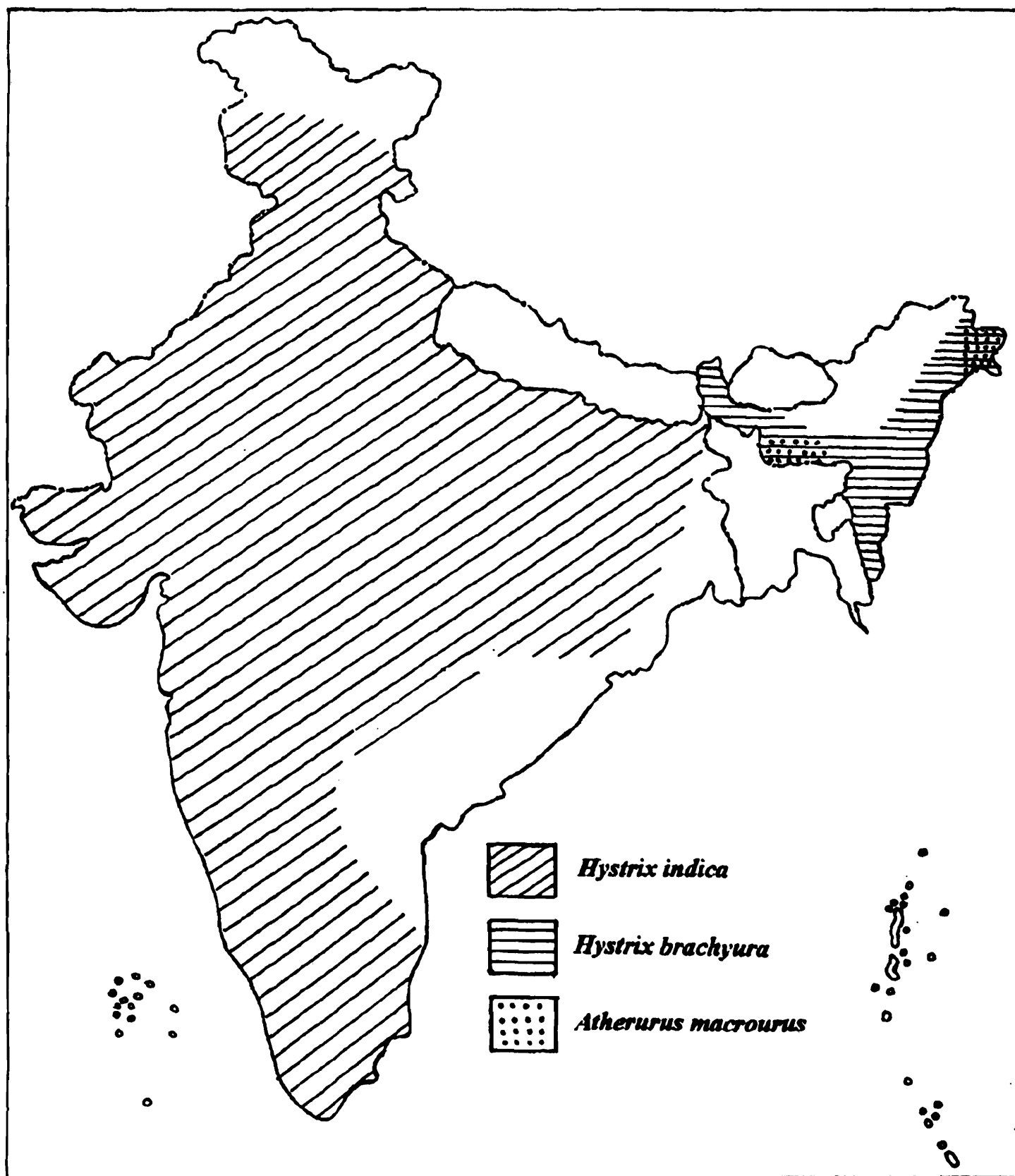
Upper incisors orange and ungrooved; cheekteeth 4/4 in number, not conspicuously differing in size, brachyodont and flat-crowned; each tooth with one main inner and three outer folds, soon isolating as islands on the crown surface. Lower molars reversing the pattern of uppers and the folds isolating as islands.

Chromosome number $2N = 54$ (Yong *et al.*, 1973).

Distribution : (Map 16) India Arunachal Pradesh (Sanglang district) and Meghalaya (Khasi Hills district). Also reported from S. China, N. Myanmar, N. Thailand, Laos, Vietnam, Malay Peninsula and adjacent islands (van Weers, 1977).

Ecology and biology : Nocturnal; takes shelter in burrows among rocks, in hilly areas. Small colonies of 6-8 animals live together. Food consists of vegetable matter, bark of trees, insects and the carrion, specially bones. Litter-size is reported to be one. This species was supposed to be rare in India, as it is poorly represented in the collections of the British Museum of Natural History and the Zoological Survey of India, Calcutta.. But it is not so rare as was thought. Six specimens of this species were collected within two nights from an uninhabited hill-top at Gandhigram, Sanglang district, Arunachal Pradesh.

Intraspecific variation : According to van Weers (1977), all the nine subspecies of *Atherurus macrourus* described so far are poorly characterised and a satisfactory division of species into subspecies is not possible. The minor differences in measurements of body and skull- parts are likely to overlap, if a large number of specimens are available



Map 16. Showing the distribution of three species of rodents in India.

for study. Further, the variation in the blackish brown colour of back and sides is mainly caused by different frequencies of visible white parts of spines and tactile bristles, which, in turn, may be influenced by shrinkage or stretching of a skin during rolling.

The main characters of *Atherurus assamensis* as given by Thomas (1921) when compared with specimens from Arunachal Pradesh and N. Myanmar, it was noticed that both have practically the same body colour as well as body- and skull- measurements. The drab brown colour of venter in *assamensis* appears to be an individual variation. Hence, *A. assamensis* is treated here as a synonym of the nominate species.

Genus *Hystrix* Linnaeus

1758. *Hystrix* Linnaeus, *Syst. nat.*, 10th ed., 1 : 56 (Type species *Hystrix cristata* Linnaeus)

1823. *Acanthion* Cuvier, *Mem. Mus. Hist. nat. Paris*, 9 : 425, 431 (Type species *Acanthion javanicum* Cuvier)

1907. *Thecurus* Lyon, *Proc. U. S. natn. Mus.* 32 : 582 (Type species *Thecures sumatrae* Lyon).

A short-tailed porcupine, having the head and body length, in adults, more than 600 mm, and the tail less than one-fourth of that. True quills present on back of body; a well-developed crest may or may not be present on crown. Nasals long and inflated, more than one-half of occipitonasal length. Cheekteeth 4/4 in number, hypsodont and flat-crowned.

Van Weers (1979) recognised three subgenera in the genus *Hystrix*, namely *Hystrix* Linnaeus, *Acanthion* F. Cuvier and *Thecurus* Lyon. The subgenus *Hystrix* is represented by *H. cristata* and *H. africae australis* from Africa and *H. indica* from Asia, the subgenus *Acanthion* by *H. brachyura* and *H. javanica* from SE Asia, and the subgenus *Thecurus* by *H. crassipinis*, *H. sumatrae* and *H. pumila* from Borneo, Sumatra and the Philippines.

Thus, two species of the genus *Hystrix*, *H. indica* and *H. brachyura* occur in India.

Key to species of genus *Hystrix*

A prominent crest present on crown and neck; quills bearing more than one brown band *H. indica*

A rudimentary crest may or may not be present on crown and neck; quills bearing only one brown ring, rest white *H. brachyura*

Hystrix brachyura Linnaeus

1758. *Hystrix brachyura* Linnaeus, *Syst. Nat.*, 10th ed., 1 : 57 (Malacca, Malaysia).

1847. *Acanthion hodgsoni* Gray, *Proc. zool. Soc. Lond.*, : 101 (Nepal).

1847. *Hystrix alophus* Hodgson, *J. Asiat. Soc. Bengal*, 16 : 771 (Himalaya).

1851. *Hystrix bengalensis* Blyth, *J. Asiat. Soc. Bengal*, 20 : 170 (Bengal)

1871. *Hystrix subcristata* Swinhoe, *Proc. zool. Soc. Lond.*, (1870) : 638 (China).

1822. *Acanthion millsii* Thomas, *J. Bombay nat. Hist. Soc.*, 28 (2) : 431 (Naga Hills, India)

Common names : Sajaru (Beng.); Himalayan crestless porcupine (Eng.).

Measurements : As given under subspecies.

Diagnostic characters : Similar to *Hystrix indica* in size etc., but can readily be distinguished by the crest of hairs on the crown being absent or poorly developed, quills on the back of body having one dark ring, being in the majority white terminally and basally, but in some white on base and dark at tip. Anterior end of body covered with flat flexible spines and posterior with quills; caudal rattling quills poorly developed; ventral surface covered with coarse, flat hairs.

Anterior half of body including the head dark brown, posterior part more white due to exposure of white tip of quills; a narrow band of white-tipped spines forms a collar; undersurface of same colour as back.

Skull very large, occipitonasal length (118-136 mm) exceeds condylobasal length; nasals very long, more than half of occipitonasal length, about $2\frac{1}{2}$ times longer than frontals, much broader at posterior than anterior end, and extending posteriorly beyond nasal process of premaxilla; latter narrow due to broadening of nasals, width less than 10 mm; a strong sagittal crest present over interparietal, meeting posteriorly the lambdoid crest; occiput high and ridged; palate long, more than half of *onl*; anterior palatal foramina very small, situated just behind upper incisors; infraorbital foramen very large, with no canal for nerve transmission; jugal long, broader at anterior end but not reaching lacrymals. Angular portion of mandible strongly distorted outwards.

Upper incisors thick, yellow and plain. Cheekteeth 4/4 in number, not greatly differing in size, hypsodont and flat-crowned; one inner and three outer folds present in each upper tooth but folds isolating as islands on crown surface. Lower cheekteeth reversing the pattern of upper series.

Chromosome number : $2N = 66$ (Yong *et al.*, 1973).

Distribution (Map 16) : Occurs in central and eastern Himalaya from Nepal to Arunachal Pradesh, thence south to Meghalaya, Nagaland, Mizoram and Manipur. Also

reported from Bangladesh, Thailand, S. China, Myanmar, Laos, Vietnam, Malay Peninsula, Sumatra and Borneo.

Ecology and biology : Nocturnal; confined to self-dug burrows during the day, mostly in rocky habitat. Food consists mainly of vegetable matter. Breeds during the spring; litter-size is reported to be two (Blanford, 1891).

Remarks : Lekagul and Mc Neely (1977) though maintained *hodgsoni* as a species distinct from *brachyura*, yet agree that the differences between the two may be of individual nature and vary with age. van Weers (1979), however, kept *Hystrix hodgsoni* under *Hystrix brachyura*.

Intraspecific variation : Two subspecies of *H. brachyura* occur in India.

Key to subspecies of Hystrix brachyura

Crest on crown absent; size small, occipitonasal length less than 120 mm.....
..... *H. b. hodgsoni*

Crest on crown very small but distinct; size large, occipitonasal length more than 125 mm *H. b. subcristata*

(i) *Hystrix brachyura hodgsoni* (Gray)

1847. *Acanthion hodgsoni* Gray, *Proc. zool. Soc. Lond.*, : 101 (Nepal).

1847. *Hystrix alophus* Hodgson, *J. Asiat. Soc. Bengal*, 16; 771.

1851. *Hystrix bengalensis* Blyth, *J. Asiat. Soc. Bengal*, 20 : 170 (Bengal).

Measurements : (vide Ellerman, 1961)

External : 1 ♂ : HB 600; TI 100; Hf 87; E 36.

Cranial : 5 ex. : *onl* 117.5-119.1 (118.8±.7); *n* 61.3-66.1 (64.0±2.0) *p* 56.7-62.3 (60.6± 2.3); *m* 22.5-26.7 (24.7±1.4); *d* 30.3-32.4 (30.9±.8).

Distribution : India : Sikkim and West Bengal (Darjiling district). Also? Bangladesh (Sunderbans), Bhutan and Nepal.

(ii) *Hystrix brachyura subcristata* Swinhoe

1870. *Hystrix subcristata* Swinhoe, *Proc. zool. Soc. Lond.*, : 638 (Fujian, China).

1916. *Acanthion klossi* Thomas, *Ann. Mag. nat. Hist.*, 17 : 139 (Tenasserim, Myanmar).

1922. *Acanthion millsii* Thomas, *J. Bombay nat. Hist. Soc.*, 28(2) : 431 (Naga Hills, India).

Measurements :

External : 1 ♀ : HB 765; TI 85; Hf 105; E 43.

1 ♀ (subad.) : HB 555; TI 120; Hf 85; E 37.

Cranial : 2 ex. (Ad.) : *onl* 128.2, 136.0; *cb* 122, 130.5; *n* 68.5, 79.5; *nw* (ant.) 29, 31.9; *nw* (post.) 35.5, 42.5; *p* 65.8, 68.5; *pow* 43.5, 46.4; *d* 34.1, 34.5; *ht* 48.6, 54; *pmxw* 7.0, 7.5; *m* 25.5, 29.4.

Millsi (vide Ellerman, 1961) : 4 ex. : *onl* 125.3-134.1 (128.7); *n* 66.1-73.7 (69.4); *p* 67.5-68.3 (67.7); *m* 24.5-28.7 (26.8); *d* 34.1-35.9 (35.2).

Distribution : India : Arunachal Pradesh (Sanglang district), Nagaland (Okotso and Sangrachu), Meghalaya (Mawphlang), Manipur (Imphal) and Mizoram (Aizawl). Also reported from Myanmar, China, Thailand, Laos and Vietnam.

***Hystrix indica* Kerr**

(Fig. 13)

1792. *Hystrix cristata* var *indica* Kerr, *Anim. kingd.*, : 213 (India).

1831. *Hystrix leucurus* Sykes, *Proc. zool. Soc. Lond.*, : 103 (Deccan, India).

1851. *Hystrix zeylonensis* Blyth, *J. Asiat. Soc. Bengal*, 20 : 171 (Sri Lanka).

1865. *Hystrix malabarica* Sclater, *Proc. zool. Soc. Lond.*, : 353 (Cochin, Kerala, India),

1812. *Hystrix cuneiceps* Wroughton, *J. Bombay nat. Hist Soc.*, 21 : 771 (Nokania, Kutch, Gujarat, India).

Common names : Indian crested porcupine (Eng.); Sajaru (Beng.); Sahi (Hin.)

Measurements :

External : 4 ♂ 3 ♀ : HB 650-765 (721±37); TI 100-150 (115±17); Hf 95-104 (98±3.5); E 40-47 (43±3).

Cranial :

ZSI : 1 ♂ : *onl* 161.0; *cb* 153.0; *n* 81.6; *nw* (ant.) 40.5; *nw* (post.) 43.0; *p* 83.0; *d* 49.0; *pow* 59.5; *pmxw* 24.6; *ht* 66.5.

Additional cranial measurements from India (vide Ellerman, 1961) : 11 ex. : *onl* 139.6-163.0 (150.9±6.8); *n* 70.2-82.3 (74.7±3.8); *d* 41.4-50.5 (45.0±2.9); *m* 30.2-35.2 (32.4±1.8).

Diagnostic characters : Massive in build, head and body length exceeds 600 mm, with a short tail, less than one-fifth of that; hands and feet broad, pollex vestigial but

hallux clawed and well developed; claws covered with bristles. A long, brown crest of bristles present on the head and neck, sometimes exceeding 30 cm in length; shoulder

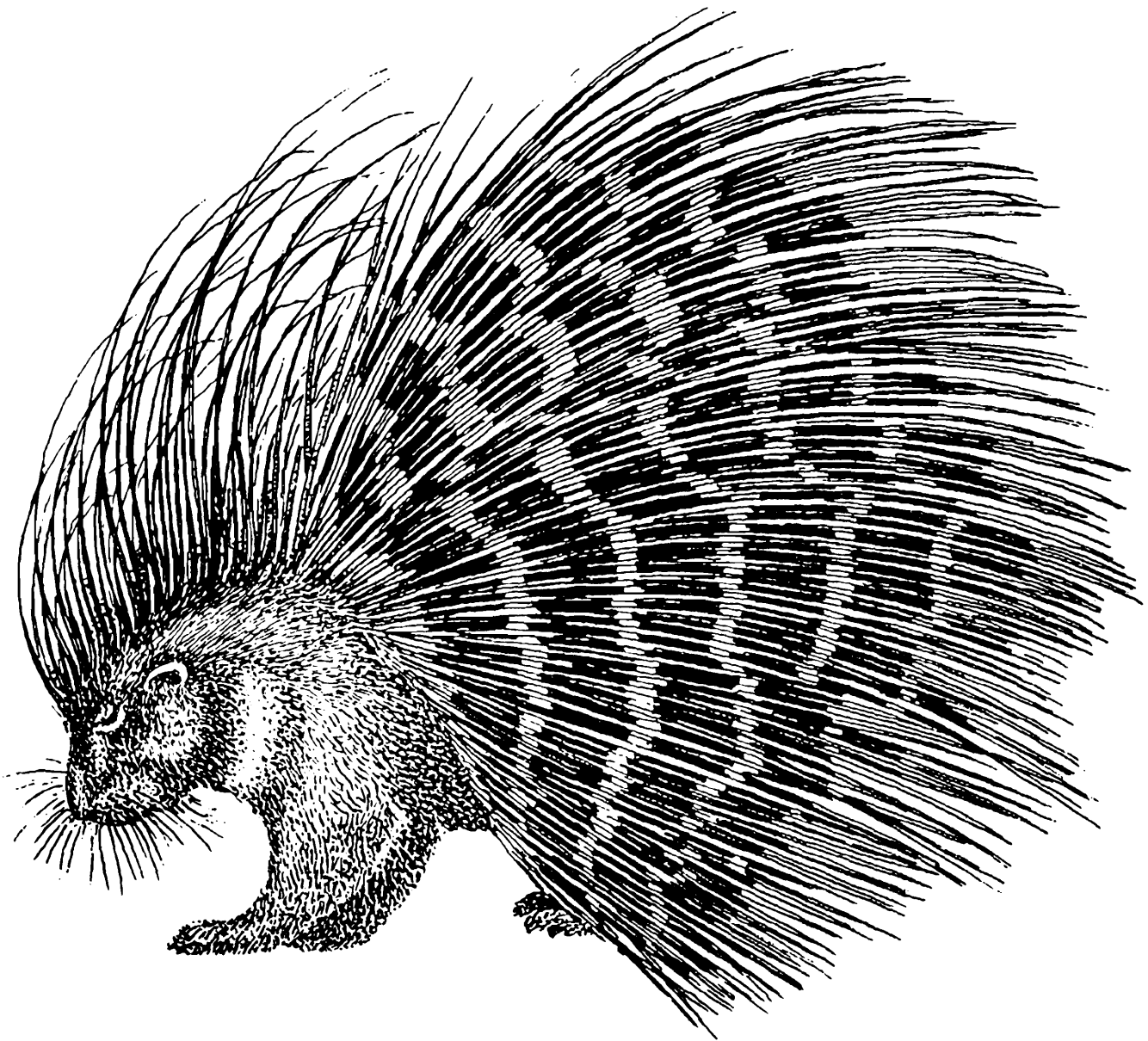


Fig. 13. Line drawing of Indian crested porcupine, *Hystrix indica*.

and belly covered with coarse bristles; back covered with long quills, bearing more than one alternating bands of brown and white; back, shoulder and undersurface blackish brown; tail-quills white. Mammae 3 pairs.

Skull large, occipitonasal length (139-163 mm) exceeds condylobasal length; nasal length though more than half the length of occipitonasal, yet shorter than in allied species *H. cristata* (less than 57% vs more than 57% of *onl*); also not much widened for a

porcupine of this genus (nasal width less than 60% of nasal length) and more or less parallel-sided. Since nasals are not much widened posteriorly, nasal process of premaxillae are much wider as compared to those of *brachyura*, more than 20 mm in width; nasals, longer than frontals which, in turn, are longer than parietals; interparietal fused in old skulls; occiput upstanding and heavily ridged; palate more than half the occipitonasal length, and of medium width; anterior palatal foramina very small, situated just behind upper incisors; no postpalatal spinous process; infraorbital foramen very large as in *H. brachyura*; jugal broader in front than behind but not reaching lacrymals; angular portion of mandible strongly distorted outwards; coronoid process well developed but lower than condylar process.

Upper incisors thick, yellow and plain; cheekteeth 4/4 in number, hypsodont and flat crowned; folds soon isolating as islands on crown surface, most often with 4 outer islands, and one inner fold. Lower cheekteeth reversing the pattern of the upper series.

Distribution : Found throughout India, Sri Lanka, Nepal, Pakistan, west to Israel and north to southern Russian Turkestan.

India (Map 16) : Jammu & Kashmir (Ashkote), Himachal Pradesh (Kangra), Uttar Pradesh (Kumaon, Saharanpur, Pilibhit, Bijnor, Agra), Rajasthan (Sambhar Lake), Madhya Pradesh (Agar Malwa, Sehore, Hoshangabad), Gujarat (Kutch, Junagadh), Maharashtra (Khandesh), Karnataka (Dharwar), Kerala (Travancore, Cochin), Tamil Nadu (Nilgiri and Palni Hills), and West Bengal (Bankura, Puruliya and S. 24 Parganas).

Ecology and biology : Nocturnal and fossorial. Lives both in moist deciduous forest and in tracts dominated by sand dunes, but prefers rocky habitat. Feeds mainly on vegetable matter; destructive to crops of sweet potato, sugarcane and maize, and to forestry by barking trees at ground level. It has a curious habit of gnawing bones, horns and antlers. Breeding has been recorded during March-April in Pakistan (Roberts, 1977); litter-size 1-3 (Prakash, 1971).

Intraspecific variation : No subspecies.

SUMMARY

The present work is an attempt to update the informations available on the taxonomy and distribution of murid and hystricid rodents from the Indian union after the publication of Ellerman's Fauna of India : Rodentia. It deals with the taxonomic account of 28 genera and 66 species of family Muridae and 2 genera and three species of family Hystricidae.

The intraspecific variations have been discussed in detail, and wherever possible, the status of subspecies settled by statistical analysis of various morphological characters.

Keys for the identification of subfamilies, genera, species and subspecies have been given.

The distribution of each species has been recorded, based on the collection present in the Zoological Survey of India, specimens identified by ZSI scientists for other institutions, as well as on published accounts.

Under each species, a paragraph has been given on its ecology and biology, based on personal observations and published records.

The following changes have occurred in the classification of murid and hystricid rodents after Ellerman's faunal work.

(i) Family Rhizomyidae has been given subfamily status under family Muridae. Subfamily Platacanthomyinae has been shifted from family Muscardinidae to Muridae. The subfamily Microtinae is now known as Arvicolinae.

(ii) Family Muridae now consists of six subfamilies, namely. Platacanthomyinae, Rhizomyinae, Cricetinae, Gerbillinae, Arvicolinae and Murinae.

(iii) Genus *Rattus* (*sensu* Ellerman, 1961) has been splitted into six genera, namely, *Rattus*, *Berylmys*, *Leopoldamys*, *Niviventer*, *Cremnomys* and *Millardia*.

(iv) The following species were added to the Indian fauna

Rattus ranjiniae (newly described)

Rattus vicerex (resurrected)

Millardia kondana (newly described)

Niviventer langbianis (invaded from Northeast)

Mus saxicola (resurrected)

(v) The following subspecies were raised to specific rank.

Apodemus flavicollis gurkha = *Apodemus gurkha*

Apodemus sylvaticus orestes = *Apodemus orestes*

Rattus bowersi mackenziei = *Berylmys mackenziei*

Rattus fulvescens brahma = *Niviventer brahma*

Mus cervicolor phillipsi = *Mus phillipsi*

Mus famulus cookii = *Mus cookii*

Alticola roylei blanfordi = *Alticola blanfordi*

Alticola roylei montosa = *Alticola montosa*

Alticola stoliczkanus stracheyi = *Alticola stracheyi*

(vi) The following species do not occur in India.

Apodemus flavicollis

Leopoldamys sabanus

Niviventer cremoriventer

Gerbillus dasyurus

(vii) The following species have been synonymised.

Rattus rogersi = *Rattus stoicus*

Rattus burrus = *Rattus burrus*

Rattus burruscens = *Rattus burrus*

Rattus pulliventer = *Rattus rattus*

Bandicota maxima = *Bandicota indica*

Mus guhai = *Rattus nitidus*

Hystrix hodgsoni = *Hystrix brachyura*

Atherurus assamensis = *Atherurus macroura*

Alticola bhatnagari = *Alticola stracheyi*

(viii) Nomenclatural change due to preoccupation.

Rattus rattoides = *Rattus turkestanicus*

Rattus r. rattoides = *Rattus turkestanicus khumbuensis*

Rattus r. turkestanicus = *Rattus t. turkestanicus*

(ix) The following subspecies have been synonymised.

<i>Vandeleuria o. nilagiricus</i>	}	= <i>V. o. oleracea</i>
<i>Vandeleuria o. spadicea</i>		

<i>Vandeleuria o. rubida</i>	}	= <i>V. o. dumeticola</i>
<i>Vandeleuria o. modesta</i>		

Rattus nitidus obsoletus = *Rattus nitidus nitidus*

Rattus cutchicus siva
Rattus cutchicus australis
Rattus cutchicus medius
Rattus cutchicus rajput

} = *Cremnomys cutchicus cutchicus*

Rattus cremoriventer indosinicus = *Niviventer langbianis*

Rattus niviventer monticola = *Niviventer n. lepcha*

Millardia meltada pallidior
Millardia meltada singuri

} = *Millardia meltada meltada*

Rattus sabanus garonum = *Leopoldamys edwardsi*

Golunda ellioti gujerati
Golunda ellioti paupera
Golunda ellioti myothrix
Golunda ellioti coenosa
Golunda ellioti watsoni

} = *Golunda ellioti ellioti*

Bandicota bengalensis kok
Bandicota bengalensis gracilis

} = *Bandicota bengalensis bengalensis*

Mus cervicolor nagrum
Mus cervicolor palnica

} = *Mus cookii nagrum*

Mus platythrix bahadur = *Mus platythrix*

Mus ramnadensis = *Mus saxicola saxicola*

Mus platythrix sadhu = *Mus saxicola sadhu*

Leggdilla gorkha = *Mus saxicola gorkha*

Leggada jacksoni = *Mus pahari*

Mus booduga lepidoides = *Mus booduga booduga*

Mus bactrianus = *Mus musculus praetextus*

Mus musculus tytleri
Mus musculus urbanus

} = *M. m. castaneus*

Tatera indica hardwickei }
Tatera indica ceylonica } = *T. indica cuvieri*

Pitymys leucurus everesti = *Pitymys l. leucurus*

Cannomys badius castaneus }
Cannomys badius pater } = *Cannomys badius badius*

ACKNOWLEDGEMENTS

I express my deep sense of gratitude to Dr. J. R. B. Alfred, Director, Zoological Survey of India for the award of an Emeritus Scientistship and for providing laboratory facilities. I am also indebted to Dr. A. K. Ghosh, Ex-Director, ZSI, for suggesting the problem, and to Dr. R. K. Varshney, Ex-Additional Director, ZSI., for going through the manuscript and offering useful comments. I also wish to express my sincere thanks to the following for assistance in various ways :—To Dr. S. Chakraborty, Scientist SE and to Shri Ajay Kumar Mandal, Scientist SD, of the Mammal & Osteology Section, and to Dr. R. A. Khan, Scientist SF. Thanks are also due to Shri Arun Ghosh, Artist, for making some illustrations.

The curators in charge of collections in the Carnegie Museum of Natural History, Pittsburgh, Chicago Natural History Museum, Chicago, American Museum of Natural History, New York, and National Museum of Natural History, Washington D. C. allowed me to study specimens of the genus *Mus* under their care, for which the author is grateful to them.

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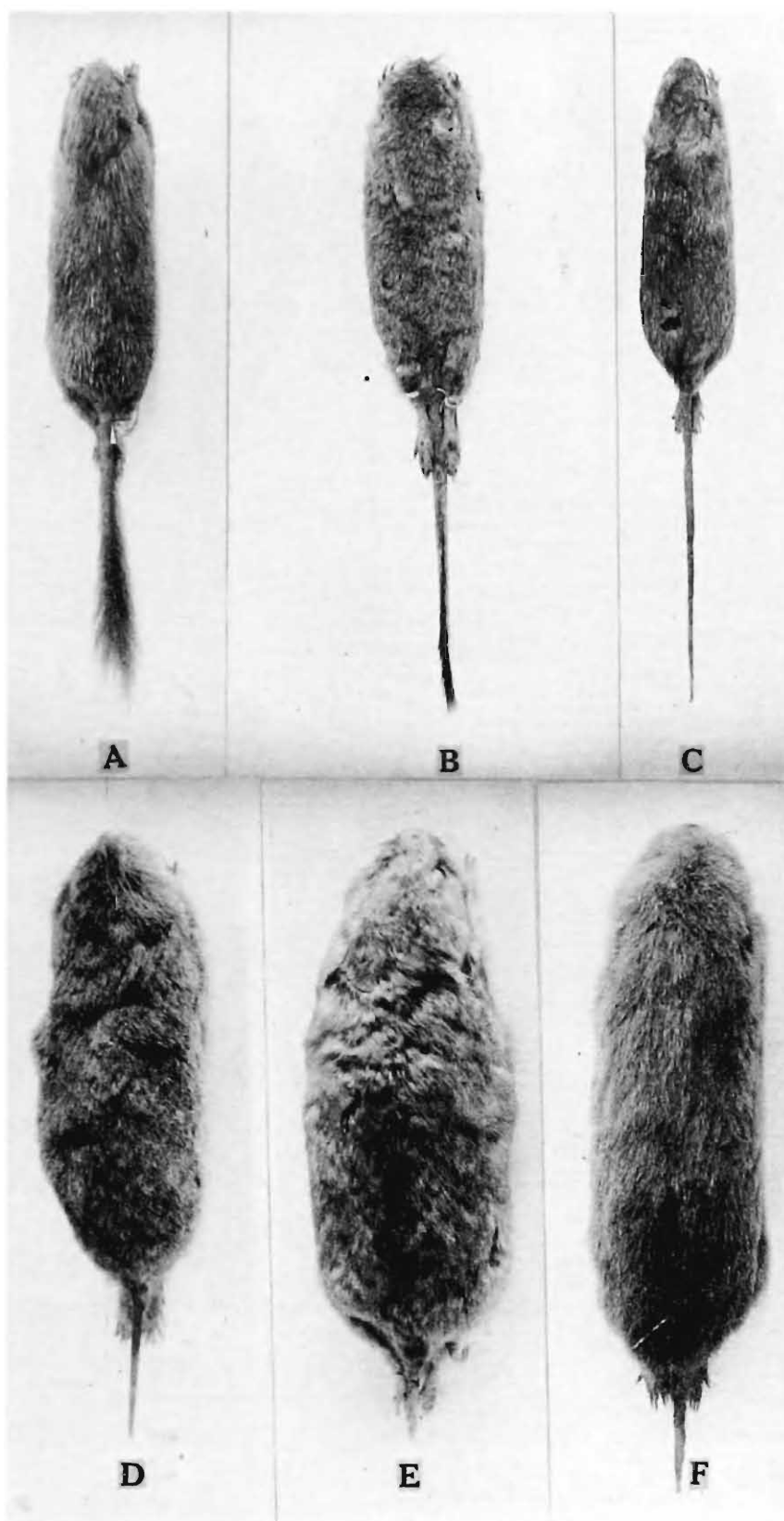
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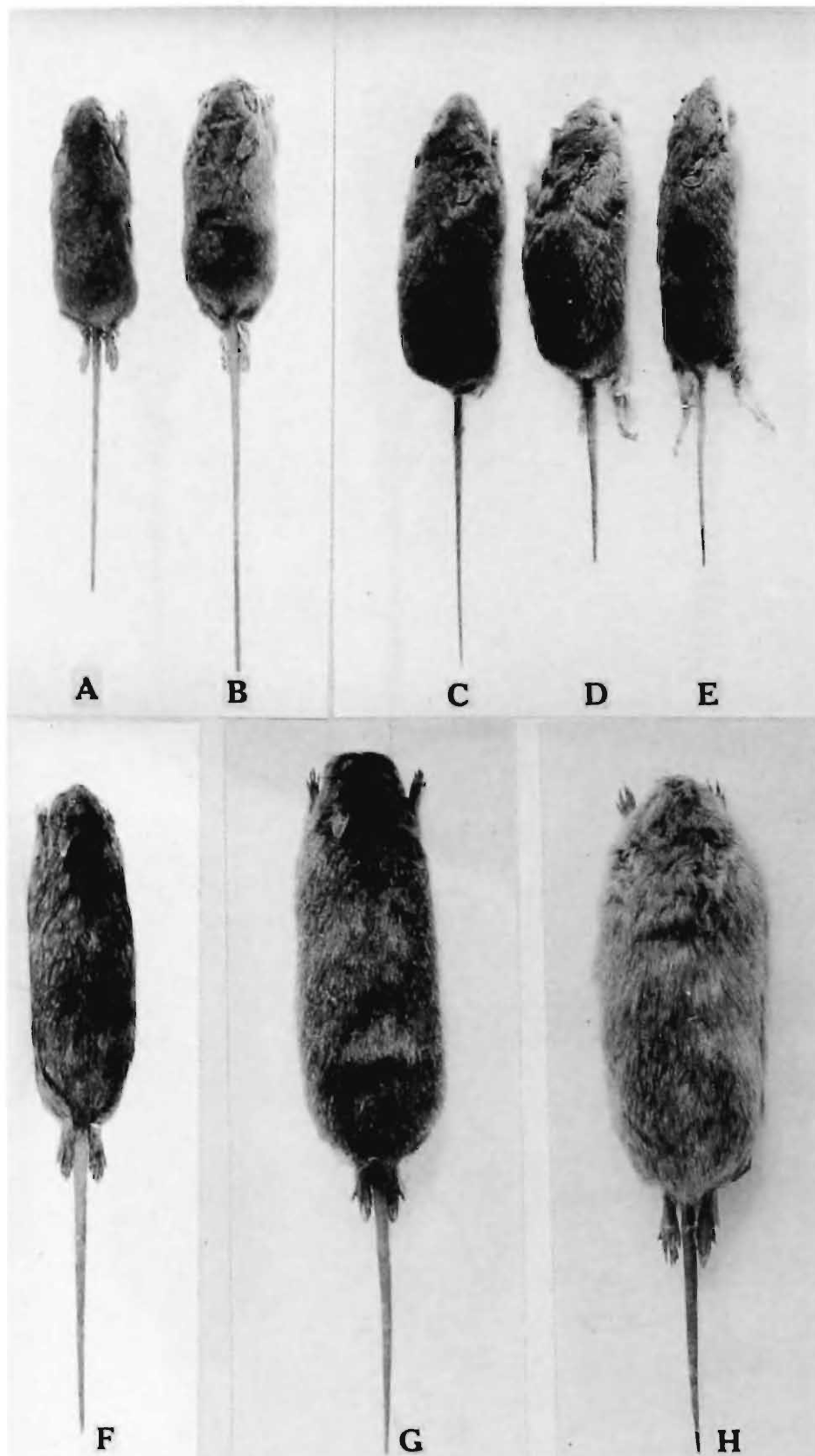
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PLATE 1



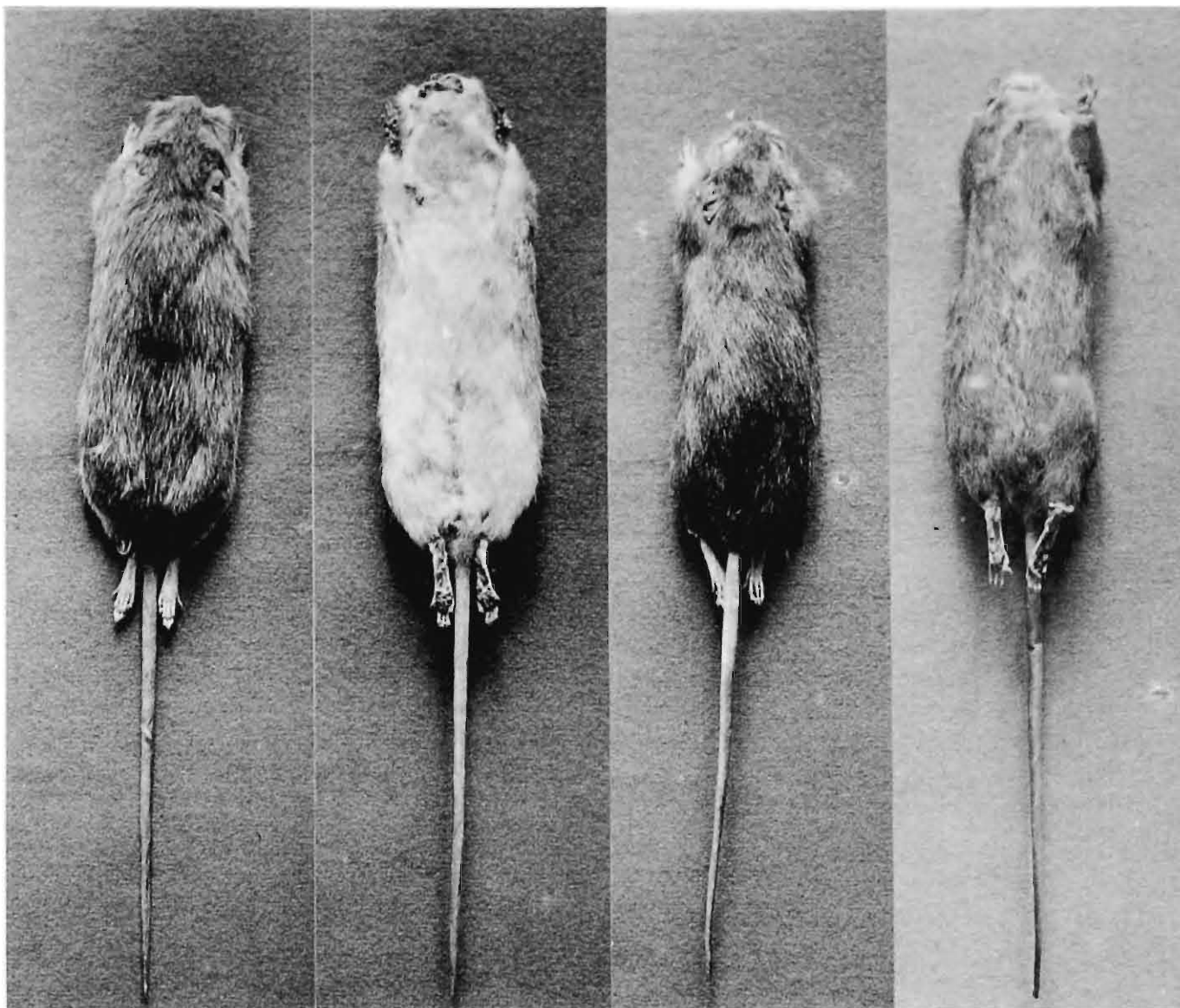
A—*Platacanthomys lasiurus* ; B—*Meriones hurrianae* ; C—*Rattus rattus* ; D—*Pitymys leucurus* ;
E—*Cricetulus migratorius* ; F—*Cannomys badius*.

PLATE 2



A—*Chiropodomys gliroides* ; B—*Vandeleuria oleracea* ; C—*Mus musculus* ; D—*Mus cervicolor* ;
E—*Mus booduga* ; F—*Bandicota indica* ; G—*Bandicota bengalensis* ; H—*Nesokia indica*.

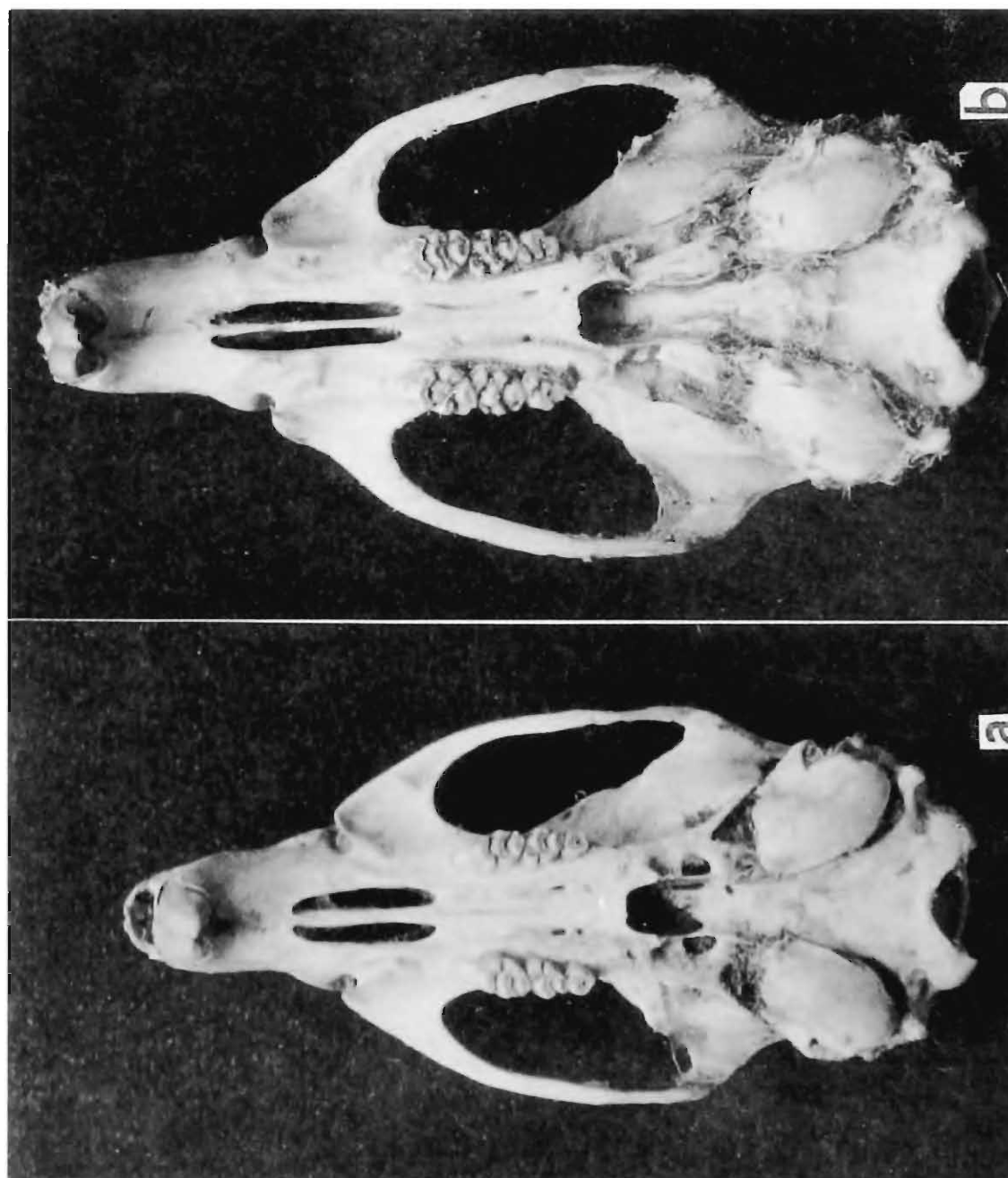
PLATE 3



A, A'—Dorsal and ventral views of *Rattus turkestanicus turkestanicus*.

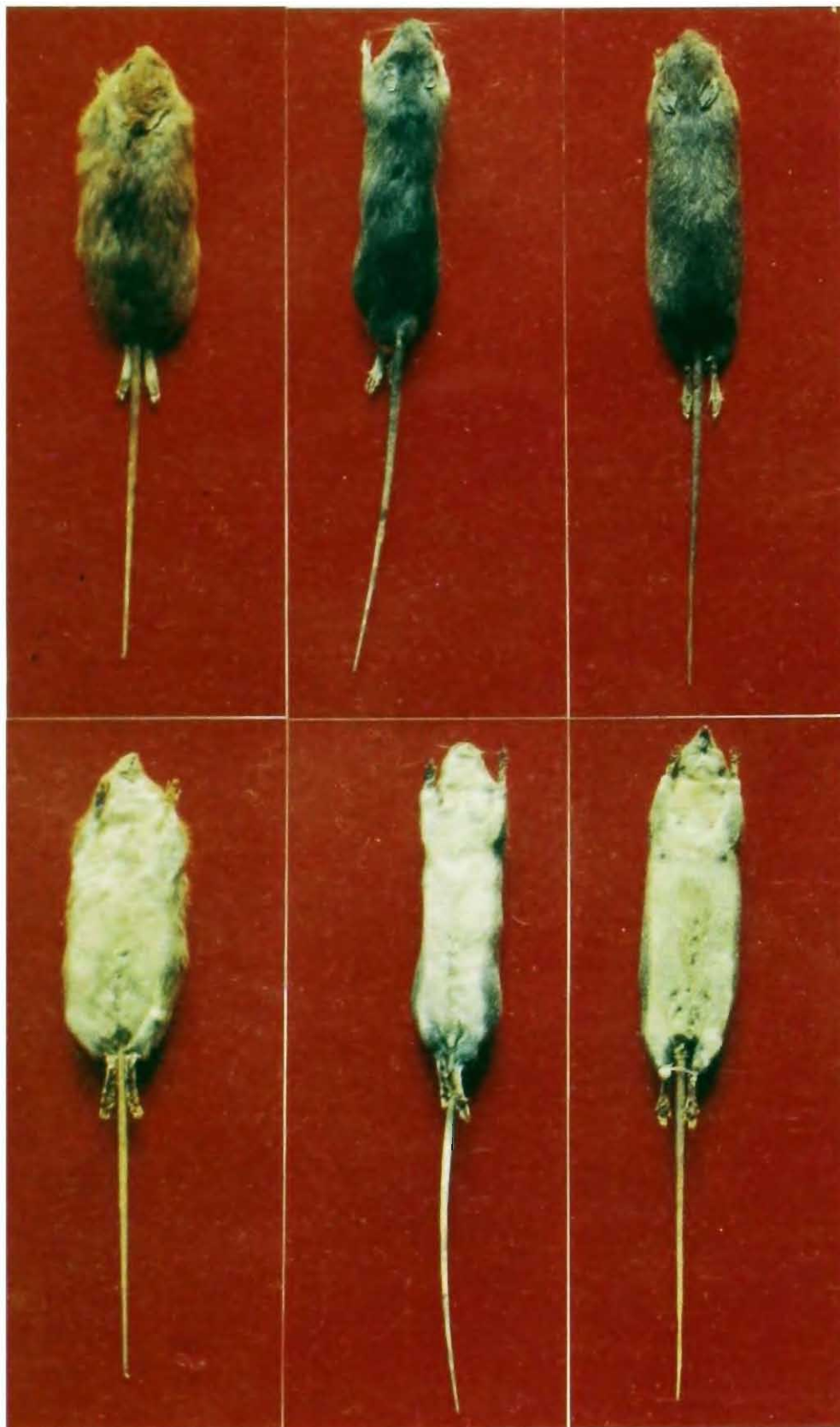
B, B'—Dorsal and ventral views of *Rattus turkestanicus khumbuensis*.

PLATE 4



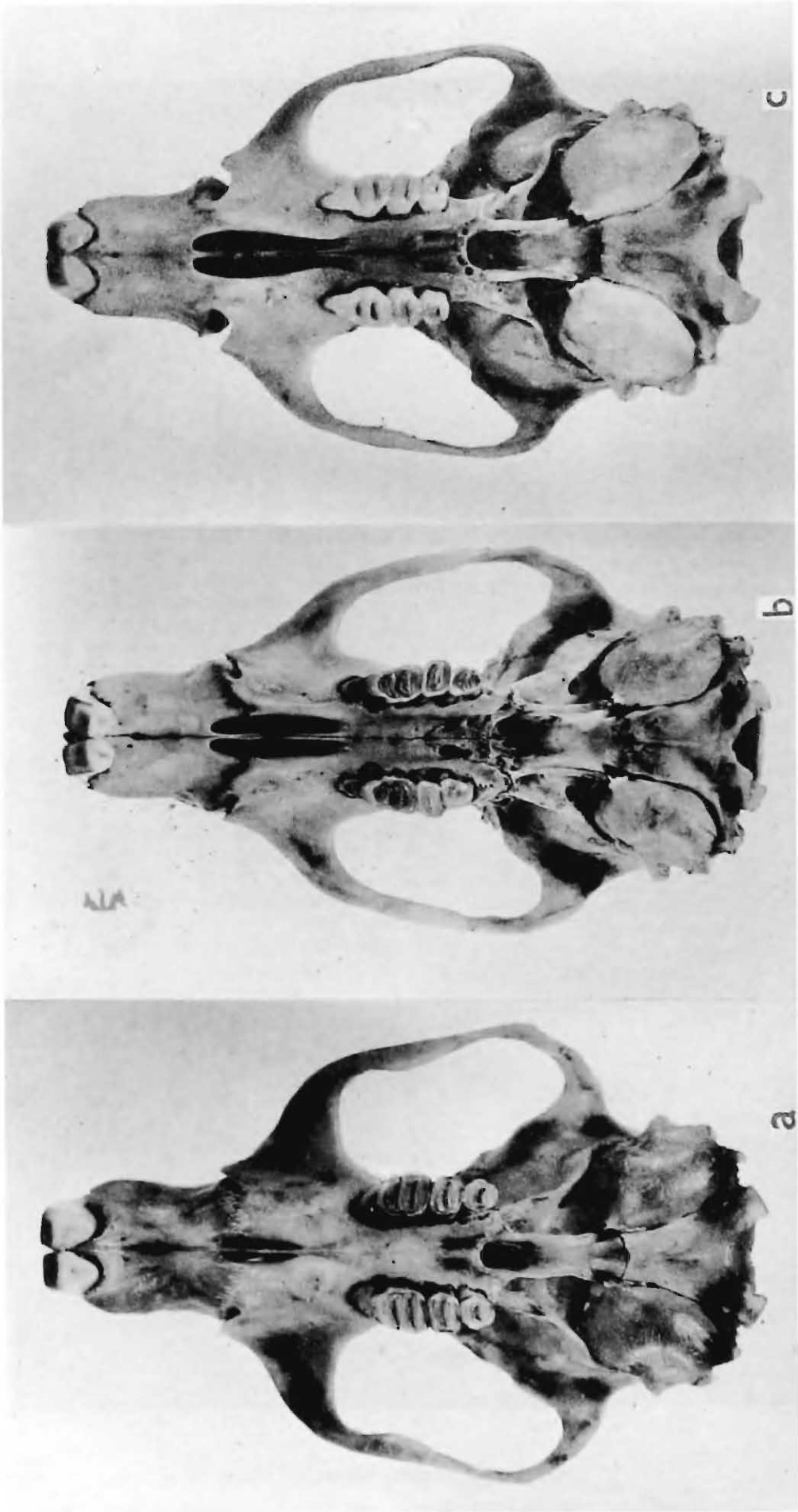
Ventral view of skulls of (a) *Rattus norvegicus* and (b) *Rattus ranjinae*.

PLATE 5



Dorsal and ventral views of skins of
A, A'—*Niviventer fulvescens* ; B, B'—*Niviventer niviventer* ; C, C'—*Niviventer mentosus*.

PLATE 6.



Ventral view of skulls of (a) *Nesokia indica* (b) *Bandicota indica* and (c) *Bandicota bengalensis*.

