SMALL MAMMALS OF CENTRAL NEPAL*

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Introduction

A party of the Hokkaido University Scientific Research Trip to the Nepal Himalayas was sent to central Nepal by the Hokkaido University Himalayan Committee during the period from March to July, 1968.

It has been considered that some of the members of Japanese fauna are closely related phylogenetically with those of the Himalayan region. The main object of the research, therefore, was placed on biological survey which might contribute much to the solution of faunal problem of Japan.

Mammalogical information of Nepal has been accumulated since the early 1820's. The first comprehensive works were made by HODGSON and by GRAY during two decades from 1830 to 1850. They recorded more than 80 forms of mammals from this country. BLYTH (9) and HORSFIELD (19) also added several forms. Early in this century, at the time of mammalogical survey of the Indian region, which was carried out by the Bombay Natural History Society, HINTON (16, 17), HINTON & FRY (18), THOMAS & HINTON

(33), and THOMAS (32) studied the Nepalese mammals.

The works of POCOCK (23, 24), ELLERMAN & MORRISON-SCOTT (13), and ELLERMAN (11, 12) are also indispensable literature for the mammalogy of Nepal.

Later, BISWAS & KHAJURIA (7, 8) have studied the mammals of Khumbu district, eastern Nepal, and described several new forms of rodent and pika. KAWAMICHI (21) has made an observation of the Himalayan pika in the field and reported it. Recently, FRICK (14) has discussed the vertical distributions of Nepalese mammals.

By the works enumerated above, it seems that the mammal fauna of Nepal has been fairly well studied. However, as pointed out by HINTON & FRY (18), the informations of the small mammals such as Insectivora, Chiroptera, and Rodentia are incomplete as compared with those of larger ones. The author, therefore, has laid stress on the collection and the survey of small mammals in the present work.

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II. Localities surveyed

In central Nepal, the southern border is formed by a lowland plain, the Terai, which varies from 60 m to 300 m in altitude. The Terai is geographically composed of two parts, namely a cultivated open country and an area covered with subtropical jungles consisting mainly of sals and cotten trees. Along the northern margin of the Terai, there are low hills, the Siwaliks, which rise to a height of about 600 m. This range is also covered with subtropical jungles. To the north of the Siwaliks, the Mahabharat Range extends with the height of about 2000 m to 3000 m, the upper parts of which are covered with forests consisting mainly of oaks. Between the Mahabharat Range and the northern high mountains, the Himalayas proper, there are many valleys which are usually highly cultivated and often densely populated. The towns of Kathmandu and Pokhara are developed in such a valley.

The southern slopes of the Himalayas, ranging between 2000 m and 3800 m in altitude, are often covered with evergreen oaks and rhododendrons on the lower levels, and also with forests consisting of coniferous trees on the upper parts. From the upper margin of these forests upward, alpine meadows are usually formed, which disappear along with upward rising to snow line.

Though thick growths of grasses and thickets of scrubs are usually well inhabited by small mammals they are extremely poor in Nepal on the hills ranging from 1000 m to 2500 m, apparently owing to the heavy cultivation and the over-grazing or over-browsing by a number of sheeps, goats, buffalos and other herbivorous domestic animals. Forests situated on the upper zone of villages and even alpine meadows are usnally used as pastures for some of the graziers. Therefore, the forests have usually very poor undergrowths.

From such an ecological situation, habitats suitable for wild rodents and insectivores are extremely limited, especially at the end of the dry season. In the collecting work of small mammals, therefore, it was most important to find out appropriate habitats in which the traps were set. It was not easy task.

Climatically, Nepal belongs to the monsoon area and the precipitation is mostly confined to summer season, from June to September, while the other (dry) season, especially from October to April receives only a little amount of rainfall. The rainfall is usually much less in the northwestern districts than in the eastern parts of Nepal. Some places of the former districts has become almost a desert-like barren.

We performed two main trips in central Nepal. The first one was carried out in the course from Pokhara to Tukucha for about a month from April 25 to May 22, and the second from Adhabar in the jungle of the Terai to snowy Gosainkund, through the Kathmandu Valley, for about 40 days from May 27 to July 9 (Fig. 1).

The following is the list of the stations at which mammals were collected.

I. Localities between Pokhara and Tukucha.

Pokhara (800 m). Situated on the north-western border of a low sub-tropical valley which is formed along the Seti Khola (river). The alluvial grounds made by the river are in use for good cultivations, which are often walled with stone pile to protect crops from damaging by cattle (Plate I-4). *Ficus* spp., cotten trees and bamboos are planted around human dwellings in the village.

Swingket (1150 m). A flat bed of a branch stream flowing into the Seti

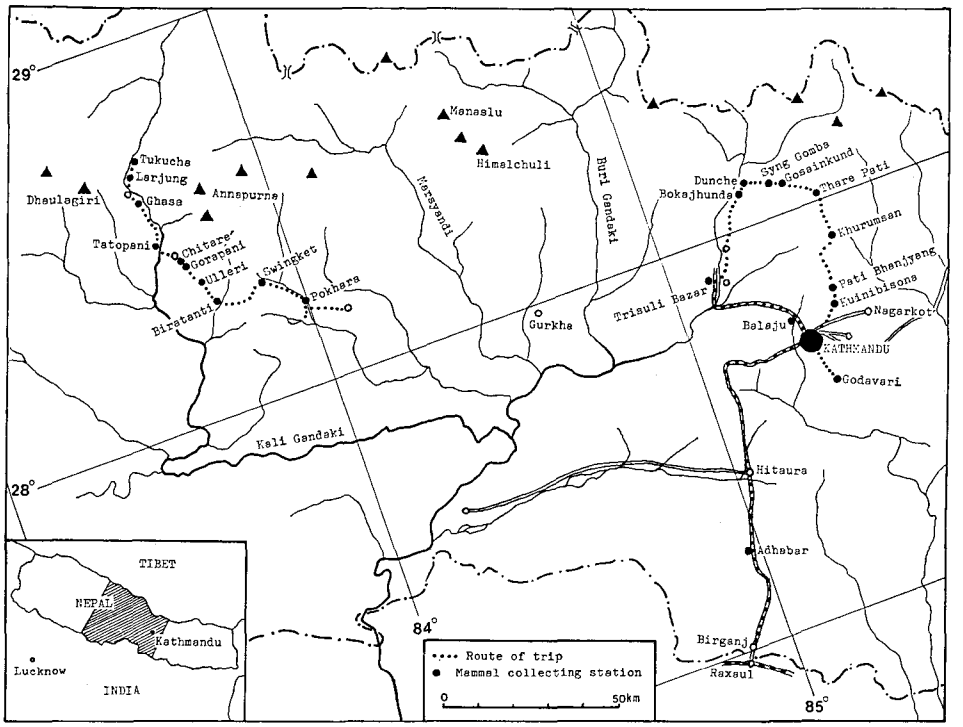

Fig. 1. Map of central Nepal.

Khola. The bed is almost cultivated for rice field and is surrounded by steep mountain slopes on the both sides. There is a wood consisting mainly of *Castanopsis indica* and *Schima Wallichiana* on the right side of the uppermost region of the flat bed.

Biratanti (1150 m). A small village, situated on the bottom of a narrow valley at which a tributary flowing from northwest is confluent with the Modi Khola. There are a few small patches of cultivations on the river sides. Steep slopes of both sides of the river are clothed with an alder and other broad-leaved trees.

Ulleri (2290 m). A village surrounded by wheat and potato cultivations, situated on the steep western slope of a branch of the Modi Khola. There is a narrow stony cultivation field on the upper part (2180 m) of the village. A large forest consisting of rhododendrons, oaks, and other broad-leaved trees is also formed from the upper border (2200 m) of the cultivation upward. The forest extending northward to Chitare through Gorapani is covered with mosses and lichens, but has poor undergrowths on the floor.

Gorapani (2730 m). A tiny village situated in a rhododendron forest on

the southern slope of the Gorapani pass (2850 m); the western, northern and eastern sides of the village are surrounded by mountains. There is a small stream originating from the forest.

Chitare (2400 m). Situated at a lower border of rhododendron and oak forests on the northern slope of the Gorapani pass. Pasture grounds and cultivations extend from the lower margin of the forest northward into the valley of the Kali Gandaki.

Tatopani (1240 m). A small village situated on narrow terraces along the Kali Gandaki river. Most of the terraces are cultivated and the river sides under the terraces are clothed with thickets of scrubs and ferns.

Ghasa (2080 m). A small village situated on a terrace along the right side of the Kali Gandaki river. There are patches of wheat cultivations and small pine stands on the terrace. Thickets of bamboo grow along stream-sides and also along the lower part of the mountain slope which is consisted in part of a pasture ground with scattered pine trees and an arid stony barren with dwarf shrubs (Plate I–3).

The eastern bank of the Kali Gandaki at Larjung (2530 m). The Kali Gandaki river suddenly extends the width of the bed from the upper part of Dhumpu northward. Larjung, a fairly large village, is situated on the right bank of the river, just at the eastern base of Mt. Daulagiri. The opposite (eastern) bank of the village is thickly covered with *Pinus Griffithii* intermixing *Tsuga dumosa*, *Juniperus Wallichiana*, *Cupressus torulosa* and *Taxus Wallichiana*. The forest is also used as a pasture for cattle (Plate I–2).

Tukucha (2600 m). Situated on the upper basin of the river. The village is formed on a flat which is slightly higher than the river bed. There are small patches of wheat cultivations around the village and also along branch streams. Roses and other spiny scrubs grow along the edges of the cultivations and the branch streams. Mountain slopes are arid stony barren with scattered dwarf junipers and other thorny shrubs such as *Caragana brevispina*, *Sophora*, *Berberis*, etc. This area is just on the upper border of the forest zone, probably owing to the poor rainfall (Plate I–1).

II. Localities between Adhabar in the Terai and Gosainkund.

Adhabar (300 m). Situated in the jungle of the Terai which is composed of sal, cotton tree and many other deciduous trees (Plate II–4). In rainy season, the jungle has relatively rich undergrowths at the edges, consisting of grasses and shrubs, and many puddles are formed on depressions in the jungle. Most of the puddles and rivers, however, dry up in dry season. The trunk road running from Birganj to Kathmandu crosses the jungle here.

Kathmandu City and the suburbs (1300 m). The greatest old city in Nepal, situated on the central part of the Kathmandu Valley and surrounded by a well cultivated open field. There are many rivers and irrigation ditches in the valley, and spiny shrubs grow well on the bank.

Godavari (1450 m). The foot of Mt. Godavari (2758 m) situated on the south-eastern end of the Kathmandu Valley. The cultivation of the valley reaches the foot of the mountain, but the evergreen forest of this mountain is well protected. There are many small streams in this area.

Trisuli Bazar (620 m). A village situated on a terrace along the Trisuli river. There are no forests but small stands of mango trees and cultivations.

Bokajhunda (2000 m). A small village situated on the steep eastern slope of the Trisuli river which forms a V-shaped deep valley along the upper basins further than about 15 kilometers north of Trisuli Bazar. This slope is mostly cultivated. On the northern part of the village there is a wood which consists of alders, rhododendrons, and other broad-leaved trees. Roses and nittles grow along the outskirts.

About 3 km E. of Dunche (2000 m). The river side of the Trisuli Khola, originated from Gosainkund mountains. Most of the river sides are clothed with alders and other broad-leaved trees, but a part of the river bank is cultivated for wheat field. The floor of the forest is covered with mosses.

Syng Gomba (3200 m). Situated in a coniferous forest consisting of fir and hemlock on the western slope of Gosainkund mountains. There is a lamasery at an edge of the forest of which a part is covered with dwarf bamboos, scrubs, and grasses grown after the mountain fire (Plath II–2).

Gosainkund (4300 m). Situated in an ablation valley of an old glacier, and there are several lakes at different levels in the valley. There is a stone hut on the lake side of one lake. The slope around the lake is covered with boulders and scanty alpine plants such as primulas, sedges, and mosses (Plate II–1).

Thare Pati (3530 m). A fairly large summer settlement situated on the south-eastern ridge of Gosainkund. There is a grassland for the summer pasture surrounded by stony slope which is covered with mosses, dwarf rhododendrons, and junipers.

Khurumsan (2500 m). A small village situated on the top of further southern part of the ridge on which Thare Pati is located. The eastern side of the ridge is cultivated, while on the western slope there are pastures and forests consisting of *Quercus* spp., *Viburnum* sp., *Cornus* sp., *Lyonia* sp., and so on. Tree trunks and branches and also the floor of the forest are well covered with mosses.

Pati Bhanjyang (1820 m). A village situated also on the top of southern ridge extended from Gosainkund. Most parts of the ridge are cultivated. There scatter small patches of broad-leaved forest in the village.

Kuinibisona (1890 m). An evergreen forest situated on the eastern part of Sheopuri mountains (Plate II–3). The forest trees and the floor are clothed with mosses and lichens. A large number of streamlets which are the tributaries of the Namote Khola (river) originate here and flow downward through the forest.

III. Material and method

a. Collecting work and specimens.

Field collecting work in the various parts of central Nepal as listed above covered approximately 3 months. One to 7 days were spent at each collecting site except for Kathmandu City at which we stayed for about two weeks in total.

The majority of specimens of small mammals was obtained by using about 20 to 50 rat traps per night which were baited with the seed of squash and peanut-butter and set in a conventional fashon. Occasionally, weasel traps were used to take larger mammals, such as bandicoot rats and pikas. Mist nets and insect nets were also employed to catch bats. The specimens collected were 231 in number.

All the specimens taken were measured and skinned in the field. The skins were dried as flat specimens. Genital organs were examined at the time of skinning in the field. Bodies of the specimens were preserved in 10 per cent formalin liquid for later study of stomach contents and endoparasites.

b. Measurements.

All external measurement was done according to ABE (2). The length of the foot indicates the length excluding the claw. Most measurements of the skull in Insectivora and Chiroptera were made also after ABE (2) and in Lagomorpha and Rodentia after ELLERMAN (11).

Palatal length in Insectivora and Chiroptera was measured from the anteriormost point of the posterior border of palate to the anteriormost margin of premaxillary bones (Insectivora and Megachiroptera) or to the posteriormost margin of concave front of palate (Microchiroptera).

The length of tooth row measured in Lagomorpha and Rodentia indicates the longest distance between the both alveolar margins of the tooth row.

All the measurements are given in grams or millimeters. Those given in this paper are of full adults unless otherwise indicated.

Capitalized color terms are those of RIDGWAY (25).

c. Age determination.

In order to compare morphological traits of animals for taxonomic work, the variability due to age and sex should be considered first. Therefore, all the specimens collected were examined to estimate the age.

The period of the collecting work ranged from the beginning to the height of breeding season in many mammals. The specimens collected, therefore, are usually composed of two groups of individuals, the full adults and the young. They are sharply different to each other in the degree of tooth wearing, in morphological characters of the skull and in size. The following are the method of age determination employed:

Insectivores. Young (Symbolized as y.): No wear on teeth or slight wear on the tips of unicuspids and of the cones of M1 and M2. In *Suncus murinus* the basioccipital suture is not yet closed or not yet disappears. Full adult (Symbolized as a.): The proto-, para-, and meta-cones of M1 and M2 are heavily worn. Occasionally the paracones of M2 and M3 are worn almost flat or hollowed out. In *Suncus murinus* the basioccipital suture is fused and usually disappears.

The tooth wearing in Chiroptera is lighter than that of Insectivora.

Murid rodents. Young: No wear on teeth or slight wear on the occlusal surfaces of cusps of teeth (M3 is not yet erupted in juveniles). Occlusal surfaces of cusps in M3 are still apart from each other, or that of middle cusp is joined with that of posterior one on the outer side of the surface. The anterointernal cusp usually with circular occlusal surface is always apart from others. Full adult: Molar teeth are worn over entire face; the occlusal surface of cusps joined with each other or the dental patterns disappear. Occlusal surface of the anterointernal cusp of M3 is semicircular or elliptical in shape, or completely joined with others of the tooth in seniles.

The relative age of microtine rodents, squirrels or pikas was easily estimated by the shape of the skull, the size, and the color of pelage.

All full adults of which age was determined by the abovementioned methods are considered to be animals born in the breeding seasons of the previous year (s), but the young are thought to be the individuals born in the breeding season of the year trapped.

IV. Geographical and vertical distributions of small mammals in central Nepal

The present specimens collected consist of 31 species of small mammals, namely 7 insectivores, 8 bats, 13 rodents, and 3 pikas.

TABLE 1. Vertical distributions of the small mammals obtained in Central Nepal

Zone	Alpine		Rhododendron or coniferous forest							
Locality / Species	Gosainkund, 4300 m	Thare Pati, 3530 m	Syng Gomba, 3200 m	W. of Syng Gomba, 2800 m	Gorapani, 2730 m	W. of Syng Gomba, 2650 m	Tukucha, 2600 m	Larjung, 2530 m	Khurumsan, 2500 m	Chitare, 2400 m	Upper Ulleri, 2290 m
Soriculus caudatus	+	+	+	+	+					+	+
Soriculus leucops					+						
Soriculus baileyi			+								
Soriculus nigrescens			+	+	+		+		+	+	+
Suncus etruscus											
Suncus murinus									+	+	
Chimarrogale platycephala											
Cynopterus sphinx											
Rhinolophus affinis											
Rhinolophus rouxi											
Rhinolophus pearsoni											
Myotis mystacinus											
Myotis siligorensis											
Pipistrellus babu											
Miniopterus schreibersii											
Mus cervicolor			+						+		
Rattus eha			+		+						
Rattus fluvescens									+	+	+
Rattus rattoides			+				+				
Rattus nitidus											
Rattus rattus brunneus											
Rattus r. brunneusculus											
Bandicota indica											
Bandicota bengalensis											
Apodemus flavicollis					+		+	+		+	+
Pitymys sikimensis	+	+	+		+						
Funambulus pennanti											
Callosciurus pygerythrus											
Dremomys lokriah				+		+			+		
Ochotona macrotis	+										
Ochotona roylei	+	+									
Ochotona sp.											

Broad-leaved evergreen forest (Cultivated hill range)	Ulleri, 2180 m	⋮		⋮										⋮		⋮	⋮										⋮			+
	Ghasa, 2080 m	+		⋮										+		+	+										⋮			
	3 km E. of Dunche, 2000 m	+	+	⋮										⋮		+	⋮										+			
	Bokajhunda, 2000 m	+		⋮										⋮		+	⋮										+			
	Kuinibisona, 1890 m	+		+	+									+		+	⋮	+												
	Pati Bhanjyang, 1820 m			⋮										+		⋮	⋮													
	Godavari, 1450 m			+			+	+	+		+			+		⋮	⋮			+										
	Kathmandu, 1300 m			+		+					⋮			+		⋮	⋮		+	⋮	+									
	Tatopani, 1240 m			+							⋮			+		⋮	+		+	⋮										
	Biratanti, 1150 m			+							⋮	+		+		+			+	+										
	Swingket, 1150 m			+						+	⋮	⋮		⋮					+	⋮										
Subtropical forest	Pokhara, 800 m			+							+	+	+	+					+	+										
	Trisuli Bazar, 620 m			⋮										⋮						⋮						+				
	Adhabar, 300 m			+										+						+		+			+					

As mentioned above, the survey was done in two limited regions consisting of 22 localities. So many areas even in central Nepal are still not represented by the specimens. Naturally, there are some other small mammals which were already recorded from this country by other authors. *Talpa micrura*, several kinds of bats, and certain kinds of rodents were not collected in this work.

The following accounts are thus a provisional report so far obtained from the information available at present.

Table 1 shows vertical distributions of small mammals obtained.

Shrews belonging to genus *Soriculus* are inhabitants of the forest zone at high levels. Among the shrews, *S. nigrescens* predominates most in distribution and population density, ranging from about 1800 m to upper forest zone. *S. caudatus* is also a common shrew with a similar range to that of the former species but the range extends as a whole further upward, the upper limit reaching the alpine zone. Though *S. baileyi* has been once reported by THOMAS (31) from Mishmi Hills (7500 ft), the present one is a new record to Nepal.

Suncus etruscus pygmaeoides and *Chimarrogale platycephala himalayica* have so far been recorded from the Himalayan regions excepting central Nepal. These are seemed to be shrews of the evergreen forest zone at about 2000 m in altitude.

Suncus murinus shows a wide range of which the upper border may coincide with that of permanent human settlements. However, it is very common in the warm areas below about 2000 m.

Altitudinally, *Mus cervicolor* has the widest distribution ranging from the subtropical jungle of the Terai to the high level of 3200 m at Syng Gomba. Most of the habitats, however, are confined to cultivated grounds and permanent human settlements.

Rattus rattoides has been recorded from Afghanistan, Russian Turkistan, Kashmir, Punjub, Nepal, and China (13) and seems to be a rat inhabiting relatively dry and cool habitats. In the present work, the rat was collected in the localities between Tatopani and Tukucha which have relatively little precipitation and low temperature. A juvenile rat obtained at Syng Gomba was tentatively identified as *R. rattoides* according to the character of nasals.

On the other hand, a similar species, *R. rattus* was common in localities south to those of the former species, actually being segregated in distribution. However, both species were obtained at Tatopani. In the eastern region, *R. rattus* was common in localities lower than Kathmandu Valley.

HINTON (17) recorded the habitats of *R. rattoides* as Kathmandu,

Nagarkot, Ferping, Hathiban, Thankot, Changoo, Sipari, and Ramchi, and listed up all the localities except for Changoo as those of *R. rattus* subspp. Although this account is somewhat different from the above-mentioned, some of these localities may be situated at the lower border of the range of the former species and also at the upper part of the range of the latter species.

Rattus eha occurs in the highest forest zone and apparently segregates the range from that of the lower resident, *R. fluvescens* which is very common in the forests and shrubs ranging from 2000 m to 2500 m in altitude.

Apodemus flavicollis gurkha and *Dremomys lokriah* are also forest dwellers, ranging from 2000 m to 3000 m in altitude just between those of *R. eha* and *R. fluvescens*.

Bandicota indica, *B. bengalensis*, *Funambulus pennanti*, and *Callosciurus pygerythrus* are dwellers of subtropical lower areas.

Pitymys sikimensis has been known so far from Sikkim and Khumbu district of Nepal (8) but the present record shows that the range extends much further westward. If the survey were made in western districts, the range would be further extended. This vole is confined in altitudinal distribution to the range from upper forest zone to the alpine habitat situated further upward of alpine meadows.

Ochotona macrotis wollastoni and *O. roylei roylei* have been considered to segregate the vertical distributions to upper and lower zone, respectively (33, 21). In Gosainkund area, both species were taken in the same habitat at high elevation (4300 m) but only the latter species was observed in lower zones than this elevation. *Ochotona* sp. obtained at Ulleri (2180 m) is seemed to have the lowest record for the Himalayan pikas.

Although the author observed a number of bats in various localities ranging to relatively lower altitudes, those taken in the present work are very few in number for the observed ones. Therefore, it is difficult to discuss the relationships of the ecological distributions among the species.

As pointed out by FRICK (14), the Himalayan fauna principally consists of three elements, i. e. oriental, Himalayan, and palaearctic ones. This is readily observable in the case of small mammals of central Nepal. Many of the small mammals ranging to the lower altitudes (lower than about 1800 m) belong to the oriental element, some of which, however, climb up to the altitudes of about 3000 m. The Himalayan element of small mammals is commonly found at the altitudes from about 2000 m to 3500 m in central Nepal. Small mammals belonging to the palaearctic region and ranging to relatively high altitudes in Nepal are fewer in number than the other two groups.

TABLE 2. Comparison of the small mammal faunas excluding Chiroptera in the ranges from the temperate to the arctic zones of Central Nepal and Japan (Central Honshu and Hokkaido)

Type	Central Nepal	Central Honshu	Hokkaido	Main habitat, habit, and food
Shrew	*Soriculus* ····· *caudatus* *leucops* *baileyi*	*Sorex* ····· *caecutiens* *hosonoi*	*Sorex* *caecutiens* *minutus* *minutissimus*	Forests and shrublands of upper zone; terrestrial; invertebrates in litter layer.
Shrew-mole	*Soriculus* ····· *nigrescens*	*Dymecodon* ····· *pilirostris* *Urotrichus talpoides*	*Sorex* *unguiculatus*	Shrublands along the outskirts of forests; semifossorial; invertebrates in litter and humus layers.
Shrew	*Suncus* ····· *murinus* *etruscus*	*Crocidura* ····· *dsinezumi*	*Crocidura* *dsinezumi*	Shrublands of lower zone; terrestrial; invertebrates in litter layer.
Mole	*Talpa* ····· *micrura*	*Talpa* ····· *mizura*	———	Forests; fossorial; earthworms and other invertebrates in soil.
Mole	——— ·····	*Mogera* ····· *wogura*	———	Grass fields of lower zone; fossorial; earthworms and other invertebrates.
Water-shrew	*Chimarrogale* ····· *platycephala*	*Chimarrogale* ····· *platycephala*	———	Stream-sides; aquatic; aquatic insects.
Vole	*Pitymys* ····· *sikimensis*	*Clethrionomys* ····· *andersoni* *Eothenomys smithii* *Microtus montebelli*	*Clethrionomys* *rutilus* *rufocanus*	Shrublands and grasslands; terrestrial or semifossorial; herbs.

Jumping mouse	*Rattus eha* *Apodemus flavicollis*	*Apodemus argenteus*	*Apodemus argenteus*	Forests of upper and middle zones; terrestrial-scansorial; seeds and insects.
Jumping mouse	*Rattus fluvescens*	*Apodemus speciosus*	*Apodemus speciosus*	Forests of lower zone, especially the outskirts; terrestrial; seeds and insects.
Rat	*Rattus rattoides*	*Rattus norvegicus*	*Rattus norvegicus*	Cultivated grounds and human settlements; terrestrial; omnivorous.
Rat	*Rattus rattus nitidus*	*Rattus rattus*	*Rattus rattus*	Cultivated grounds and human settlements; terrestrial-scansorial; omnivorous.
Mouse	*Mus cervicolor*	*Mus musculus*	*Mus musculus*	Cultivated grounds and human settlements: terrestrial; omnivorous.
Flying squirrel	*Hylopetes alboniger* *Petaurista magnificus*	*Pteromys momonga* *Petaurista leucogenis*	*Pteromys volans*	Forests; arboreal and griding; seeds, fruits, and buds,
Squirrel	*Dremomys lokriah*	*Sciurus lis*	*Sciurus vulgaris*	Forests; arboreal; seeds, fruits, and buds.
Ground-squirrel	(*Rattus fluvescens*)	(*Apodemus speciosus*)	*Tamias sibiricus*	Shrublands; terrestrial-scansorial; seeds, fruits, and insects.
Pika	Ochotona *macrotis roylei*	———	*Ochotona hyperborea*	Slide rock areas of alpine zone; terrestrial; herbs, mosses, and lichens.

V. The composition of small mammal fauna occurring in the range from the temperate to the arctic zones of central Nepal, with special reference to that of Japan.

There are much common features, especially concerning the habitat of small mammals, between the topographies and the vegetations of the areas ranging from the temperate to the arctic zones of central Nepal and those of Japan.

In the two countries, the temperate zone is covered with various broad-leaved forest of which the floor is formed by litter or moss layer. Coniferous forests often associated with a few broad-leaved trees occupy upward of the broad-leaved forests. Moreover, the upper boundary of the forest region is usually fringed with a belt of broad-leaved or coniferous shrubs which are displaced with alpine meadows in the alpine zone.

The coniferous forests and the upper parts of the broad-leaved forests often associate with bamboos in central Nepal while with sasa-bamboos in Japan, especially in the areas in which the canopy of the forest is broken down.

The most characteristic difference in the vegetations of the two countries is represented in the composition of the broad-leaved forests situated between the warm temperate and the subarctic zones. In Nepal it is consisted of evergreen trees, especially such as rhododendrons at the higher levels, while it is composed mainly with deciduous trees in Japan. As shown in the following accounts, however, the difference in the vegetations appears not to be important for the habitat of small mammals.

In Japan, the fauna of Honshu is somewhat different from that of Hokkaido due to the different geological situation in the ice age. Then, it must be worthy to compare the faunas of Japan with that of central Nepal (Table 2).

Shrew-typed mammals inhabiting the forests and shrubs of high altitudes or cool areas and feeding on small invertebrates in litter layer are seen in all the three regions, namely three species in Nepal, two in Honshu, and three in Hokkaido. Of these, however, only one species is ususlly dominant in respective region. Crocidurine shrews of the lower cultivated fields and shrubs in Japan correspond well in the ecological and morphological accounts to *Suncus* spp. in Nepal.

In Honshu, there occur two kinds of shrew-moles (Scalopinae, Talpidae) which have intermediate habits and external forms between shrews and true moles. They adapt to more subterranean life than shrews do, and feed much on earthworms and other invertebrates in deeper humus layer. Nepal and

Hokkoido, however, lack these kinds of shrew-moles in the fauna, while the habitats and niches are occupied by one of the soricid shrews, *Soriculus nigrescens* and *Sorex unguiculatus*, respectively. They feed on more earthworms than do the other shrews as shown by the analysis of stomach contents (3). Along with the ecological adaptation, the two shrews show evident morphological adaptation to the fossorial life, having stumpy body with short ears, enlarged hands and claws, and short tail.

Talpa (*Euroscaptor*) *micrura*, a kind of the true moles, has been recorded from the hill range of Nepal. The Japanese forestdwelling mole corresponding to this is *Talpa* (*Euroscaptor*) *mizura* in Honshu. Since these moles are primitive in form and sparse in number, they appear to occupy no important niche in the forest fauna in these regions.

Grassy fields and shrublands in Honshu furnish the fauna with the mole of advanced type (*Mogera wogura*). This kind of the mole, however, might have not been developed at all in Nepal. For yielding such a mole in evolution, wet, deep and productive soils just as those of Japanese Islands would be required. The Himalayan hill range provides no such habitats. This may be a principal reason for the absence of the advanced mole in this range.

Lacking of animals belonging to Talpidae in Hokkaido may have been resulted from the geological history of this island rather than from the climatical or soil condition of the habitat.

Streams in the montane forest of Nepal and also those of Honshu are occupied by a crocidurine water shrew, *Chimarrogale platycephala*, while there is none of that shrew in Hokkaido*.

All the three regions retain herbivorous voles. In central Nepal, only one vole, *Pitymys sikimensis*, has been recorded, while three in Honshu and two in Hokkaido. Those of the latter two regions usually segregate the ecological distributions to one another, and it is hardly observed that the two or three species are abundant in a single habitat at the same time. In central Honshu, *Clethrionomys andersoni* and *Eothenomys smithii* occur in the upper forest zone, but the former usually predominates over the latter (22). Lower grassy fields of Honshu are the main habitat of *Microtus montebelli*.

Clethrionomys rutilus of Hokkaido is a dominant vole in the upper coniferous forests and in the alpine shrubs where the other vole, *C, rufocanus* is rather scarce. The original habitat of *C. rufocanus* in the Continent is said to be certain forested lands, but in Hokkaido it is most common in

* In Sakhalin, a soricid water shrew, *Neomys fodiens*, inhabits the habitat.

lower shrublands and grassy fields (1, 34). The dominance of this vole in the grassy fields of Hokkaido may be caused by the absence of advanced herbivorous voles such as *Microtus*.

Semi-arboreal jumping mice in the upper forest zone of central Nepal involve *Rattus eha* and *Apodemus flavicollis*. They feed mainly on seeds and insects. A dominant forest-dweller, *Apodemus argenteus* is the Japanese representative corresponding to the Himalayan mice.

Rattus fluvescens in central Nepal and *Apodemus speciosus* in Japan are very much similar to each other concerning their external forms, habitats, and food habits, though they are different phylogenetically. The former is one of the dominant terrestrial jumping mice in the lower broad-leaved forests.

Rats and mice inhabiting cultivated grounds and human settlements have also correspondents respective to the region. In Honshu and Hokkaido, *R. norvegicus* predominates over *R. rattus*, and the latter scarcely spread the range over the fields far from human settlements. On the other hand, *R. rattus* of central Nepal is common only in the lower warm hill ranges, and it is replaced by *R. rattoides* in the higher, cooler ranges.

All the three regions retain flying-squirrels and arboreal squirrels, respectively. They are different in phylogeny but have similar extenal forms and habits.

In central Nepal and Honshu, there is no chipmunk-like mammal such as *Tamias sibiricus* inhabiting shrublands and forests in Hokkaido, feeding on seeds and insects. The habitat and niche for such animal in the former two regions appear to be inclusively occupied by *R. fluvescens* and *A. speciosus*, respectively. On the other hand, the ecological subordinance and hence the scarcity in number of *A. speciosus* in Hokkaido must be resulted at least from the ecological relationship between the mouse and the chipmunk.

Slide rock areas of high altitude in central Nepal and Hokkaido are usually occupied by the pika. The animal adapts to the life in the habitat and hence is the most dominant herbivorous animal there. The absence of the animal in Honshu may be due to the geological history of the island.

From these accounts and Table 2, it is evident that the ecological relationship among the members in a fauna is very much similar to each other, though the specific composition is very much different between the faunas. This may be resulted from that the three regions have common environmental conditions, especially concerning the habitat of small mammals.

VI. Order Insectivora

Family Soricidae

Soriculus caudatus (HORSFIELD)

Sorex caudatus HORSFIELD, Cat. Mamm. Mus. E. India. Co. p. 135, 1851 (Darjeeling, India).

Specimens examined. a. ♀1, Gorapani, May 2; a. ♂1, Chitare, May 11; a. ♀1, forest above Ulleri (2290 m), May 12; y. ♂2, ♀1, Syng Gomba, June 2–3; a. ♂1, Gosainkund, June 3; y. ♂2, Thare Pati, June 6. Total a. ♂2, ♀2; y. ♂4, ♀1.

Measurements. The following measurements contain those of young, because there are no great differences between the young and the adults collected concerning the measurements.

Body weight ♂4.5–7.5 (5.9), ♀5.5–7.0 (6.4); head & body ♂61.0–69.5 (64.9), ♀62.0–66.0 (63.7); tail ♂48.0–53.5 (51.3), ♀51.0–56.0 (53.0); fore foot ♂6.5–7.5 (7.1), ♀6.3–7.5 (7.0); hind foot ♂12.5–13.0 (12.8), ♀11.8–12.7 (12.3); ear ♂7.3–8.0 (7.7), ♀7.2–8.0 (7.6); greatest length of skull ♂17.7–18.1 (17.6) ($n=5$), ♀17.1–17.8 (17.5); palatal length ♂7.3–7.6 (7.4) ($n=5$), ♀7.3–7.6 (7.5); width of braincase ♂8.9–9.2 (9.1), ♀8.7–9.4 (9.0); width across molars ♂4.8–5.0 (4.9) ($n=5$), ♀4.6–4.8 (4.7); upper tooth row ♂7.6–7.9 (7.7) ($n=5$), ♀7.4–7.8 (7.6); upper unicuspid row ♂2.3–2.5 (2.4), ♀2.3–2.4 (2.4); rostral width ♂1.8–2.1 (2.0), ♀1.9-2.0 (1.9); interorbital width ♂3.9-4.3 (4.0) ($n=5$), ♀3.9–4.0 (4.0); length of tympanic ring ♂2.7–3.1 (2.9) ($n=5$), ♀2.9–2.9 (2.9); mandible ♂9.1-9.8 (9.4), ♀9.2–9.3 (9,3); lower tooth row ♂6.9-7.1 (7.0) ($n=5$), ♀6.8–7.1 (7.0).

Taxonomic notes. External measurements of the present specimens appear not to be significantly different from those of the Chinese allies, *S. c. sacratus* and *S. c. umbrinus* (30, 4), but the cranium is slightly smaller as a whole in the former.

The present specimen consists of two groups each of which has different coat color. The summer and winter coats of adults are near Mummy Brown or Clove Brown on back, Fuscous on belly in color. Tail is indistinctly bicolored, Fuscous above, Hair Brown below. The color of young is similar to, but slightly darker than, that of adults, Fuscous above and below. The tail is dark all around.

These characters of young well fit the description for *S. c. umbrinus* (4), although it is said that the type specimen of the latter is an adult one.

Subspecific relationships among them, therefore, should be reviewed by

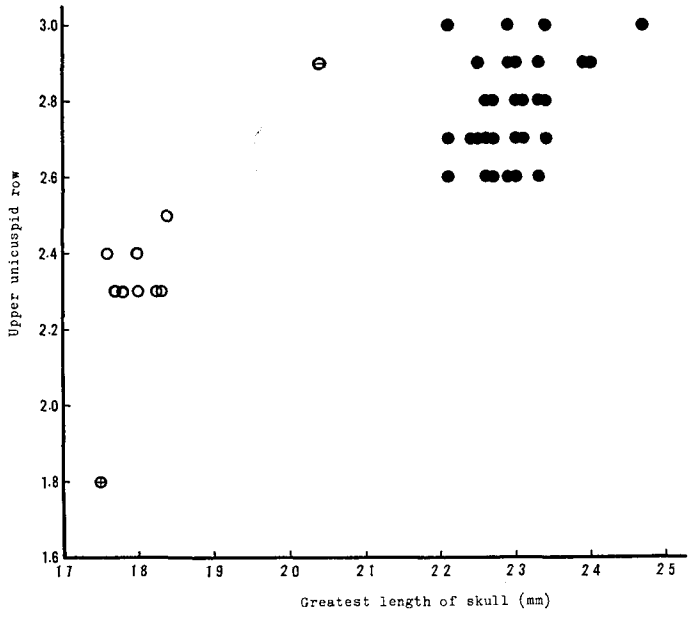

Fig. 2. Relationships between the upper unicuspid row and the greatest length of skull in 4 species of *Soriculus*.
● *S. nigrescens*, ⊖ *S. baileyi*,
○ *S. caudatus*, ⊕ *S. leucops*.

the examination with a large number of specimens from these ranges.

Ecological notes. This is a common shrew at the edges of rhododendron or coniferous forests and also on alpine meadows at high altitudes. This shrew appears to be fond of wet habitats such as river sides, bushes with rich litter layer or rocky grounds covered with grasses and mosses.

Present collection of this shrew consists of two sharply different age groups of individuals, namely full adults which were born at least in the breeding season of the previous year and young which were born in the early breeding season of the year trapped.

The adult female obtained at Ulleri on May 12 contained 5 embryos and another adult one collected at Gorapani had well grown uterine horn, 1.2 mm in thickness, and also well developed mammal glands.

Testes of adult males were 3.8 mm × 3 mm to 4 mm × 3 mm in size and remarkably larger than those of the young which range from 2.7 mm × 2 mm to 3 mm × 2.5 mm.

From these facts, the breeding of this shrew appears to begin from the end of dry season, probably from April.

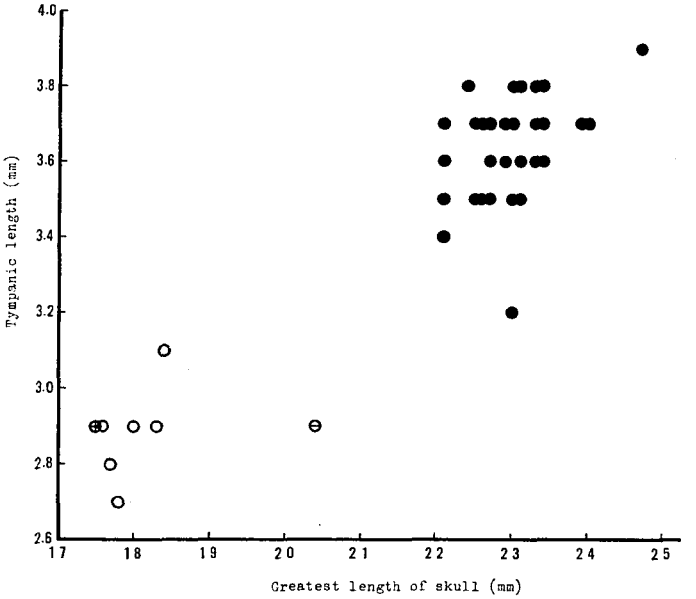

Fig. 3. Relationships between the tympanic length and the greatest length of skull in 4 species of *Soriculus*. Cf. Fig. 2.

Six stomachs examined contained the following food items in percentage by volume: Coleoptera (adults) 16.7, Lepidoptera (adults) 16.7, and undetermined insects 66.6.

Soriculus leucops (HORSFIELD)

Sorex leucops HORSFIELD, Ann. Mag. Nat. Hist. 16 : 111 (Nepal).

Specimens examined. a. ♂ 1, Gorapani, May 2.

Measurements. Body weight 5.5, head & body 66.0, tail 86.0, fore foot 8.7, hind foot 15.3, ear 8.0, greatest length of skull 17.0, palatal length 7.0, width of braincase 9.0, width across molars 4.8, upper tooth row 7.3, upper unicuspid row 1.8, rostral width 2.2, interorbital width 4.0, length of tympanic ring 2.9, mandible 9.0, lower tooth row 6.7.

Taxonomic notes. The color of the specimen with winter coat is much lighter than that of *S. caudatus*: between Fuscous and Chaetura Drab on back, Hair Brown washed by Cinnamon on belly.

Rostrum of the skull and upper unicuspid row are very short. The proportion (10.6%) of the latter to the greatest length of skull, therefore, is smaller than that (13.9%) of *S. caudatus* (Fig. 2). The tympanic ring is

relatively large in size, the proportion of its length to the greatest length of skull being 17.1% (Fig. 3).

Ecological notes. The long-tailed shrew was obtained at the river side in a rhododendron forest in which the former species was also trapped.

Soriculus baileyi THOMAS

Soriculus baileyi THOMAS, J. Bombay Nat. Hist. Soc. 22 : 683, 1941. (Tsu River, Mishmi Hills, 7500 ft., Assam).

Specimens examined. a. ♀1, Syng Gomba, June 3.

Measurements. Body weight 13.2, head & body 82.0, tail 76.0, fore foot 9.0, hind foot 16.0, ear 7.0, greatest length of skull 19.9, palatal length 8.6, width of braincase 10.1, width across molars 5.6, upper tooth row 8.8, upper unicuspid row 2.9, rostral width 2.4, interorbital width 4.7, length of tympanic ring 2.9, mandible 10.9, lower tooth row 8.0.

Taxonomic notes. According to THOMAS (31), the type specimen of this species has an imperfect skull of which only the tooth rows have been preserved. The present specimen with a perfect skull well fits the type in the external and tooth characters described by him. In addition to the specific characters enumerated by THOMAS, namely larger size, long unicuspid row (14.6% of the greatest length of skull in the present specimen), etc., the following is also the diagnostic character of this species: the very small tympanic ring, the proportion of its length to the greatest length of skull is 14.6% instead of 16.6% (♀) in *S. caudatus* and 16.5% (♀) in *S. nigrescens* (Fig. 2, 3).

This relatively large shrew has been regarded as a subspecies of *S. caudatus* by ELLERMAN & MORRISON-SCOTT (13). However, it appears to be a perfect species because of the morphological characters mentioned above and the following ecological situation in the habitat.

Ecological notes. The shrew was trapped together with *S. caudatus*, *S. nigrescens*, and *Pitymys sikimensis* in the wet habitat of Syng Gomba, which is covered with dwarf bamboos, scrubs, and grasses. This seemed to be a rare shrew in this country.

The individual obtained contained 6 embryos in her uterus and earthworms in the stomach.

Soriculus nigrescens (GRAY)

Corsira nigrescens GRAY, Ann. Mag. Nat. Hist. 10 : 261, (Darjeeling, India) (HINTON 1922).

Specimens examined. a. ♂2, ♀1, Gorapani, May 2; a. ♀2, Ghasa, May

4 and 9; a. ♂1, eastern bank of the Kali Gandaki River at Larjung, May 8: a. ♂6, ♀2, Chitare, May 11; a. ♂1, ♀2, forest above Ulleri, May 12; a. ♂1, ♀3, Bokajhunda, May 30; a. ♂3, ♀4, about 3 km E. of Dunche, May 31; a. ♂2, Syng Gomba, June 2; a. ♂2, ♀1, y. ♂4, ♀2, Khurumsan, June 8; a. ♂2, y. ♂2, ♀2, Kuinibisona, July 6–7. Total a. ♂20, ♀15; y. ♂6, ♀4.

Measurements. The following measurements of the skull contain inclusively those of young and adults as they show no significant difference in average to each other.

Body weight ♂17.5–25.5 (20.9), y. 13.5–21.0 (18.3), ♀17.5–23.0 (20.4), y. 13.0–20.3 (16.0); head & body ♂94.0–106.0 (99.0), y. 91.0–98.0 (94.8), ♀93.0–105.5 (98.0), y. 89.0–99.0 (92.8); tail ♂35.0–47.0 (41.6), y. 41.0–46.0 (43.5), ♀36.5–45.0 (41.4), y. 40.0–47.0 (42.5); fore foot ♂9.2–11.2 (10.0), y. 9.5–10.1 (9.8), ♀9.2–10.5 (9.7), y. 9.5–10.2 (9.8); hind foot ♂14.5–17.2 (15.3), y. 15.0–15.5 (15.2), ♀14.2–15.7 (14.9), y. 15.2–16.2 (15.6); ear ♂8.0–10.2 (9.1), y. 8.0–9.0 (8.6), ♀8.0–9.5 (8.8), y. 7.7–10.2 (8.7); greatest length of skull ♂21.7–24.4 (22.7) ($n=23$), ♀21.8–23.0 (22.4); palatal length ♂9.6–11.3 (10.2), ♀9.5–10.3 (9.9); width of braincase ♂11.6–13.0 (12.0) ($n=22$); ♀11.4–12.3 (11.9); width across molars ♂6.3–7.1 (6.7), ♀6.5–6.9 (6.7); upper tooth row ♂9.6–10.9 (10.1) ($n=25$), ♀9.4–10.4 (10.0); upper unicuspid row ♂2.6–3.0 (2.8), ♀2.6–3.0 (2.8); rostral width ♂2.6–3.1 (2.8) ($n=23$), ♀2.5–2.9 (2.7); interorbital width ♂5.1–5.9 (5.4) ($n=25$), ♀5.1–5.6 (5.4); length of tympanic ring ♂3.2–3.9 (3.6) ($n=21$), ♀3.4–3.8 (3.7); mandible ♂12.2–13.6 (12.7) ($n=22$), ♀12.0–13.0 (12.5); lower tooth row ♂8.6–9.8 (9.2) ($n=25$), ♀8.7–9.5 (9.0).

Taxonomic notes. HINTON (16) divided this species into 4 local subspecies. The measurements of the head and body length of the present specimens are larger than those of any subspecies. However, those of the tail, hind foot, ear, and cranium of the former are very similar to those of the subspecies, and most of the variations in these characters of the latter four subspecies fall in the ranges of the variations in the present sample.

TABLE 3. Proportions (%) of 3 dimensions to the length of head and body in *Soriculus nigrescens*

		Head & body length (mm)	Tail	Hind foot	Ear
Adult	♂	99.0	42.0	15.5	9.2
	♀	98.0	42.3	15.1	9.0
Young	♂	94.8	45.9	16.0	9.1
	♀	92.8	45.8	16.8	9.4

As shown in Table 3, the length of the head and body represents a remarkable age variation. Therefore, it is requisite to divide the sample into each proper age group before making the comparison of this character and discussing its related variables, as they have not been so far clearly considered.

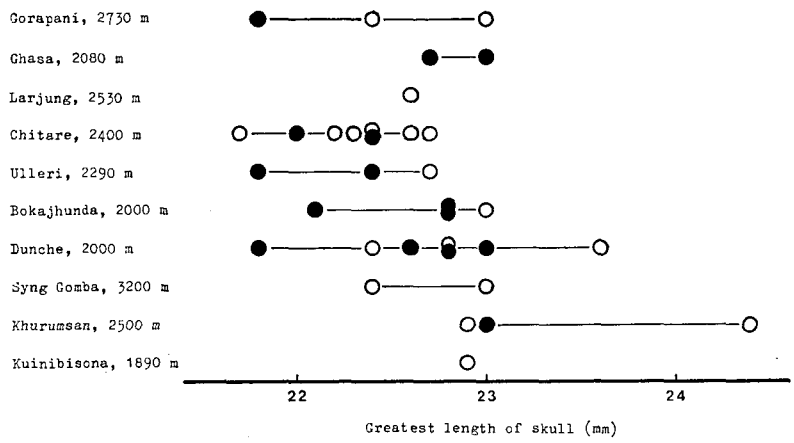

Fig. 4. Local variation of the greatest length of skull in *Soriculus nigrescens* (adult only).
○ male, ● female.

Fig. 4 expresses a geographical variation of the greatest length of the skull as one of the size characters. In this figure, the sample from Khurumsan appears to be slightly larger than others consisting of a relatively uniform assemblage of specimens. This difference, however, is not so remarkable as to be taken up as subspecific rank.

Diagnostic characters of the subspecies described by HINTON are, more or less, similar to the difference above cited. The taxonomic relationships among them, therefore, should be reviewed through the analytic study of specimens from intermediate localities.

From the above facts, the present sample from central Nepal is not identified with any subspecies but only with specific level.

Ecological notes. This is the most dominant shrew at the outskirts of evergreen broad-leaved forests and coniferous forests.

All the individuals collected during May were full adult shrews, but many young appeared in the trap line in June and July. Namely, ten of 15 individuals taken at Khurumsan on June 8 and at Kuinibisona on July 6–7 were young ones born in the early breeding season of the year trapped.

Eight of 14 adult females taken in May contained embryos, which vary in number from 5 to 9 per female, with a mean of 6.4, and also one had 6

placental scars in the uterus, suggesting the birth of the young. All the other adult females were in breeding condition which was expressed by swollen and vascular uteri, though there were no visible embryos. Three of 4 young females had also swollen and vascular uteri suggesting sexual maturity, but did not contain any visible embryos.

All the over-wintered adult males had well-developed testes with the size varying from 7 mm × 4.5 mm to 9 mm × 6 mm. Of the 6 young males born in the year trapped, three had almost matured testes, while those of the rest had smaller ones with the size ranging from 4 mm × 2.2 mm to 6.5 mm × 4.2 mm.

From these accounts, April, May and June are seemed to be the most active breeding season, and it is suggested that some of the newly born young rappidly attain the sexual maturity in the first summer.

Of the food items, insects and earthworms constitute the primary food of this shrew, and both items occupy about 90%, in volume of the diet. Berries were found in one stomach (Table 4).

TABLE 4. Stomach contents of 44 individuals of *Soriculus nigrescens*

	Percentage by bulk	Percentage by occurrence
Insecta	55.7	80.0
Coleoptera		
Larvae	3.1	5.0
Adults	10.5	20.0
Diptera		
Larvae	8.6	10.0
Adults	0.4	5.0
Hymenoptera (adults)	1.2	2.5
Undetermined insects		
Larvae	13.4	20.0
Adults	18.5	30.0
Chilopoda		
Geophilomorpha	1.9	10.0
Undetermined arthropoda	5.5	10.0
Oligochaeta		
Lumbricomorpha	32.9	50.0
Feathers of birds.	0.5	2.5
Undetermined animal matter	2.5	2.5
Plants		
Berries	1.0	2.5

Relatively rich earthworms in the stomach contents of this shrew along with the morphological characters such as large hand, short ear, and short tail suggest much subterranean activity, just as in the case of Japanese shrew-moles, *Urotrichus talpoides* and *Dymecodon pilirostris*.

Suncus etruscus pygmaeoides (ANDERSON)

Crocidura (Pachyura) pygmaeoides ANDERSON, J. Asiat. Soc. Bengal, 46: 279, 1877 (Himalayas).

Specimens examined. a. unsexed 1, about 3 km E. of Dunche, May 30.

Measurements. Body weight 1.6 (+); head & body 48; tail 25; greatest length of skull 13.7; palatal length 5.3; width of braincase 6.3; width across molars 3.9; upper tooth row 15.6; upper unicuspid row 1.7; rostral width 1.4; interorbital width 3.0; length of tympanic ring 2.6; mandible 7.0; lower tooth row 5.1.

Ecological notes. The pygmy shrew is seemed to be a rare mammal in this country. The author found a carcass of this shrew on a bank of the Trisuli Khola, 3 kilometers east of Dunche.

Suncus murinus murinus (LINNAEUS)

Sorex murinus LINNAEUS, Syst. Nat. 12th ed. 1: 74, 1766 (Java).

Specimens examined. a. ♀2, Godavari, April 18; a. ♂2, ♀1, y. ♂1, ♀1, Chatrapati and the bank of the Balaju River, Kathmandu, April 23, May 26, and July 3-4; a. ♂4, ♀1, y, ♂1, ♀1, Biratanti, April 29–30 and May 13–14; a. ♂1, y. ♀1, Tatopani, May 3; a. ♀1, Chitare, May 11; y. ♀2, Swingket, May 15; a ♂1, y. ♀1, Pokhara, May 22; a. ♀1, Khurumsan, June 9; a. ♀1, y. ♂2, Adhabar, June 26–27; y. ♂1, Kuinibisona, July 7. Total a. ♂8, ♀7; y. ♂5, ♀6.

Measurements. Body weight ♂ 47.0–90.0 (62.0), ♀ 32.0–63.0 (44.2), y. ♂ 32.5–78.0 (52.7), ♀ 22.0–34.0 (28.1); head & body ♂ 129.0–158.0 (143.1), ♀ 117.0–142.0 (132.6), y. ♂ 125.0–167.0 (144.2), ♀ 110.0–125.0 (116.8); tail ♂ 64.0–82.0 (72.9), ♀ 62.0–79.0 (67.4), y. ♂ 70.0–88.0 (76.0), ♀ 57.0–64.0 (61.0); fore foot ♂ 13.5–15.0 (14.3), ♀ 11.5–14.5 (13.5), y. ♂ 13.2–15.8 (14.6), ♀ 11.8–13.5 (12.7); hind foot ♂ 19.5–23.7 (21.0), ♀ 17.7–21.0 (19.7), y. ♂ 19.7–22.8 (21.5), ♀ 17.8–20.0 (18.9); ear ♂ 12.0–13.5 (12.7), ♀ 11.0–12.5 (11.9), y. ♂ 11.5–14.0 (12.5), ♀ 11.0–12.0 (11.4); greatest length of skull ♂ 30.2–35.0 (31.5), ♀ 27.7–32.6 (30.4), y. ♂ 28.9–34.8 (32.5), ♀ 27.2–28.8 (28.0); palatal length ♂ 13.7–16.3 (14.4), ♀ 13.0–15.2 (14.2), y. ♂ 13.3–16.4 (15.2), ♀ 12.6–14.0 (13.2); width of braincase ♂ 13.0–14.9 (13.7), ♀ 12.1–13.1, y. ♂ 13.0–15.0 (14.1), ♀ 11.7–12.3 (12.0); width across molars ♂ 9.2–10.7 (9.8), ♀ 8.4–10.0 (9.3), y.

♂9.3–10.7 (9.9), ♀8.4–9.4 (8.9); upper tooth row ♂13.8–16.4 (14.6), ♀13.0–14.8 (14.1), y. ♂13.8–16.2 (15.3), ♀12.6–14.0 (13.4); upper unicuspid row ♂4.6–5.3 (4.9), ♀4.4–4.9 (4.6), y. ♂4.6–5.2 (4.9), ♀4.2–4.5 (4.3); rostral width ♂3.7–4.8 (4.1), ♀3.4–3.8 (3.6), y. ♂3.9–4.6 (4.2), ♀3.1–3.7 (3.3); interorbital width ♂5.9–6.6 (6.2), ♀5.4–6.1 (5.9), y. ♂5.8–6.5 (6.2), ♀5.4–6.0 (5.6); mandible ♂15.8–20.2 (17.6), ♀15.4–18.6 (17.0), y. ♂16.4–19.6 (18.4), ♀15.1–17.0 (15.8); lower tooth row ♂12.5–14.9 (13.3), ♀11.9–13.5 (12.8), y. ♂12.5–14.8 (13.8), ♀11.4–12.8 (12.2).

Taxonomic notes. The color of the fur varies in the present sample from Olive Brown to Chaetura Drab on the dorsum and from Drab to Mouse Gray on the venter. The color of the young is darker as a whole, Chaetura Gray on the dorsum and Deep Mouse Gray on the venter.

The sizes of the body and the skull are variable locally. Fig. 5 represents the variation in the greatest length of the skull, being considered as one of the size characters. Although the sexual difference of the size is observable, shrews from flat productive fields such as Kathmandu Valley and Adhabar (Terai) are distinctly larger than those from hill ranges. The variation of this pattern is known also in the Japanese moles, *Mogera* spp. (2).

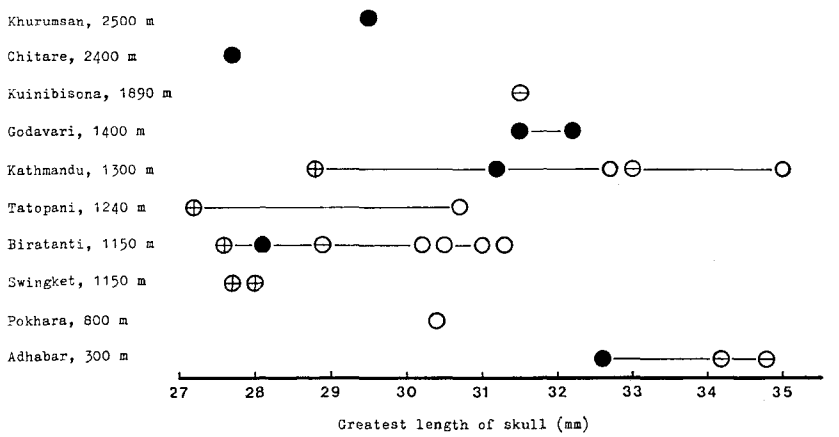

Fig. 5. Local variation of the greatest length of skull in *Suncus murinus*.
○ adult male, ⊖ young male,
● adult female, ⊕ young female.

Ecological notes. The house shrew is a common mammal around human settlements, along stream-sides, and at the edges of cultivated grounds. It penetrates sometimes into evergreen broadleaved forests.

The present specimens collected in spring and summer are roughly

grouped by the grade of tooth wearing into three age classes: 11 young, 2 young adults, and 13 old adults. The young are regarded as shrews born early in the breeding season of the year trapped, the young adults born in the previous fall or winter, and the old adults born in the earlier season(s) of the previous year(s).

Of the 7 adult females examined, five had embryos varying in number from 3 to 5 per female with an average of 4.0, and one had old placental scars in her uterus. Three of 6 young females had also embryos, 3, 4, and 5 in number, respectively.

Testes of adult males ranged in size from 6.5 mm × 5 mm to 7.7 mm × 5 mm, and most of them were at the process of degeneration. One of the young males examined had almost matured testes measuring 8.5 mm × 5.5 mm though the others had smaller, immature testes.

The most important food for this shrew is insects which occupy about

TABLE 5. Stomach contents of 26 individuals of *Suncus murinus*

	Percentage by bulk	Percentage by occurrence
Insecta		72.2
Coleoptera		
Larvae	3.9	5.6
Adults	5.8	16.7
Diptera (larvae)	10.0	16.7
Lepidoptera (larvae)	1.7	5.6
Orthoptera		
Blattaria	3.3	5.6
Undetermined insects		
Larvae	13.9	16.7
Adults	6.9	16.7
Chilopoda		
Epimorpha	0.6	5.6
Arachnida	17.2	22.2
Undetermined arthropoda	6.7	11.1
Oligochaeta		
Lumbricomorpha	19.7	33.3
Gastropoda		
Pulmonata	2.5	11.1
Amphibia		
Anura	2.2	5.6
Undetermined animal matter	5.6	5.6

a half of the whole foods. Earthworms and spiders constitute more than one third of the food in volume (Table 5).

Chimarrogale platycephala himalayica (GRAY)

Crossopus himalayicus GRAY, Ann. Mag. N. H. 10: 261. 1842 (Chamba, North-eastern Punjab).

Specimens examined. a. ♂1, ♀1, Kuinibisona, July 6–7.

Measurements. Body weight ♂47, ♀33.5; head & body ♂122.5, ♀121.0; tail ♂84.5, ♀83.0; fore foot ♂15.7, ♀14.0; hind foot ♂25.2, ♀22.5; ear ♂7.5, ♀7.0; greatest length of skull ♂27.2, ♀26.6; palatal length ♂12.5, ♀12.2; with of braincase ♂14.7, ♀13.9; width across molars ♂8.5, ♀8.3; upper tooth row ♂12.2, ♀12.3; upper unicuspid row ♂3.4, ♀3.6; rostral width ♂3.6, ♀3.4; interorbital width ♂6.7, ♀6.0; length of tympanic ring ♂3.1, ♀3.1; mandible ♂15.3, ♀15.0; lower tooth row ♂11.0, ♀11.1.

Taxonomic notes. The size of the body is apparently larger than those of *C. p. styani*, *C. p. leander*, and *C. p. varenni*. The typical subspecies of Japanese Islands varies in size with locality, i.e. specimens from Honshu are much larger than those from Kyushu (35). The Himalayan subspecies, therefore, intermediates in size between them.

The color (summer fur) of Himalayan water shrews examined is as follows: Chaetura Black above, near Hair Brown under. This is quite similar to that of the specimens from certain localities (e.g. Hiwa, Hiroshima Pref.) in Honshu, in which the color is variable.

The size and the shape of the skull of *himalayica* very much resemble those of specimens from Honshu. In Honshu, however, the shape of tympanic ring is somewhat variable locally, i.e. the frontal margin of the bone is nearly straight and angular on both ends of the straight portion in the specimens from Nagano and Tottori Prefectures, while it is round and not angular at all in those from Hiroshima Pref. as those of *himalayica* and specimens from Kyushu (Japan).

Adding to the smaller size, the specimen from Kyushu is evidently different in the shape of $P\underline{4}$ from those of Honshu and Nepal, i.e. the protocone of the tooth is very primitive in shape in the former. The antero-inner angle of the protocone which is made, viewed from above, with the anterior and inner margins of the cone is nearly rectangular (75 to 90 degrees) in the specimens from Nepal, and from 96 degrees to 125 degrees in those from Honshu, but it is much wider (140 to 150 degrees) in those from Kyushu. If only these characters are taken into account the difference between the specimens from Kyushu and those from Honshu and Nepal is

much larger than that between the latter two.

However, another character of P4 and M1 of the Himalayan specimens is evidently different from those of all the Japanese specimens examined. Namely, when viewed from above, the rear concaves of the teeth are much deeper in the former. For example, the distance between the line connecting the posterior tips of metastyle and of the posterior lobe of hypocone and the anterior margin of the concave portion in P4 is 0.66 mm in average, ranging from 0.62 mm to 0.70 mm in the former ($n=2$), but 0.52 mm in average, ranging from 0.43 mm to 0.58 mm in the latter ($n=17$).

Between the two groups of the specimens no other characters of the skull and the teeth are distinguishable. From these accounts, only the shape of P4 and M1 is recognizable as a significant diagnostic character in these two subspecies.

Ecological notes. The habitat of the Himalayan water shrews collected by the author was clear streamlets flowing through the evergreen forest of Kuinibisona. The water of the streamlets was appeared to be almost always clear even when the main stream was made muddy by the heavy rain of the monsoon. One of the shrews examined was caught in a shallow streamlet early in the morning and the other with a trap set along another streamlet. Both specimens are full adult shrews.

The male had relatively large testes measuring 9 mm × 5.5 mm while the female had well developed reddish mammal glands along with fairly developed uterus.

One of the two stomachs contained adult beetles (20%) and larvae of crane fly (80%), but the other had nothing.

Order Chiroptera

Family Pteropidae

Cynopterus sphinx (VAHL)

Vespertilio sphinx VAHL, Skr. Nat. Selsk Copenhagen, 4, 1 : 123. 1797. (Tranquebar, Madras, India).

Specimens examined. a. ♂ 4, ♀ 2, Chatrapati, Kathmandu, April 17–22 and June 12.

Measurements. Body weight ♂ 35.0–50.0 (43.5), ♀ 50.0–50.0 (50.0); head & body ♂ 94.5–106.0 (99.1), ♀ 103.0–104.0 (103.5); tail ♂ 7.5–9.5 (8.1), ♀ 6.0–6.0 (6.0); fore arm ♂ 63.0–70.0 (67.0), ♀ 66.0–69.5 (67.8); hind foot ♂ 14.0–16.6 (15.2), ♀ 15.5–16.2 (15.9); tibia ♂ 24.0-27.5 (26.1), ♀ 25.7–27.5 (26.6); ear ♂ 19.5–21.0 (20.1); ♀ 18.5–19.5 (19.0); greatest length of skull ♂ 30.6–32.5

(31.5), ♀30.5–31.6 (31.1); condylobasal ♂29.1–31.0 (30.0), ♀29.2–30.0 (29.6); palate ♂15.6–16.3 (15.9), ♀15.8–15.9 (15.9); zygomatic width ♂19.2–20.1 (19.8), ♀19.1–19.9 (19.3); mastoid width ♂12.7–13.7 (13.2), ♀12.7–12.9 (12.8); width across molars ♂8.8–9.8 (9.3), ♀9.2–9.2 (9.2); interorbital width ♂5.6–6.3 (6.0), ♀5.5–5.8 (5.7); length from orbit to nostril ♂7.1–8.1 (7.6), ♀7.3–7.8 (7.6); upper tooth row ♂11.1–11.6 (11.4), ♀10.8–11.6 (11.2); mandible ♂23.0–24.3 (23.5), ♀22.9–23.6 (23.3); lower tooth row ♂12.0–12.3 (12.3), ♀11.8–12.6 (12.1).

Ecological notes. All the specimens examined were collected in a garden with palms, plum trees, oranges, and bottle-brush trees in Kathmandu City.

Each female contained one embryo, and the testes of the male were relatively large, measuring about 6.3 mm × 5.4 mm.

Nothing were found in every stomach examined.

Family Rhinolophidae

Rhinolophus affinis himalayanus ANDERSEN

Rhinolophus affinis himalayanus ANDERSEN, Proc. Zool. Soc. London, 2: 103. 1905. (Mussorie, Kumaon, India).

Specimens examined. a. ♂2, Godavari, April 18–20.

Measurements. Body weight 14.8–16.0 (15.4); head & body 63.5–67.0 (65.3); tail 22.0–22.0 (22.0); fore arm 54.0–56.0 (55.0); third metacarpal 37.5–39.0 (38.3); III–1 15.0–16.0 (15.5); III–2 27.0–29.0 (28.0); fourth metacarpal 38.0–41.0 (39.5); fifth metacarpal 40.0–41.0 (40.5); hind foot 11.2–11.5 (11.4); tibia 24.5–25.0 (24.8), ear 19.0–21.0 (20.0); greatest length of skull 23.4–23.7 (23.6); palatal bridge 2.0–2.1 (2.1); zygomatic width 11.4–11.6 (11.5); mastoid width 10.4–10.8 (10.6); interorbital width 2.1–2.3 (2.2); supraorbital length 4.9–5.0 (5.0); width of nasal swellings 5.6–5.6 (5.6); C–M3 8.8–8.9 (8.9); width across molars 8.6–8.7 (8.7); mandible 15.4–15.6 (15.5); lower tooth row 10.1–10.4 (10.3).

Taxonomic notes. The color of the fur is paler Natal Brown on the back and Wood Brown on the belly.

The lateral margin of the sella is slightly concave. The lancet is cuneate.

The second phalanx of the third finger is long and more than one and a half the length of the first phalanx.

The palatal bridge is shorter than one fourth the length of the maxillar tooth row.

The third lower premolar is very small and external in position. The second and fourth premolars are almost in contact. The second upper premolar is in the tooth row; hence the canine and the fourth upper

premolar are evidently separated.

Rhinolophus rouxi rouxi TEMMINCK

Rhinolophus rouxi TEMMINCK, Mon. Mamm. 2 : 306. 1835. (Pondicherry and Calcutta, India).

Specimens examined. y. ♂1, ♀1, Godavari June 16.

Measurements (young). Body weight ♂9.5, ♀9.5 ; head & body ♂63.5, ♀59.0 ; tail ♂23.5, ♀22.0 ; fore arm ♂47.5, ♀47.5 ; hind foot ♂9.5, ♀10.5 ; tibia ♂19.8, ♀19.0 ; ear ♂19.5, ♀17.5 ; greatest length of skull ♂20.3, ♀19.6 ; palatal bridge ♂2.2, ♀2.0 ; zygomatic width ♂9.8, ♀9.8 ; mastoid width ♂9.2, ♀9.4 ; interorbital width ♂2.8, ♀2.9 ; supraorbital length ♂5.4, ♀5.6 ; width of nasal swellings ♂4.8, ♀4.9 ; width across molars ♂7.0, ♀7.2 ; C–M3 ♂7.5, ♀7.4 ; mandible ♂13.6, ♀12.9 ; lower tooth row ♂9.1, ♀8.7.

Taxonomic notes. The present specimens are very young individuals which migth be born in the breeding season of the year taken.

The color of the pelage is paler Fuscous on the back and Drad or Light Drab on the venter.

The sella is parallel-margined from base to summit at which it is broadly rounded off.

The upper canine and the fourth premolar are distinctly separated, and the second upper premolar is in the tooth row. The third lower premolar is quite external in position, and the cingula of the second and fourth lower premolars are in contact.

Rhinolophus pearsoni pearsoni HORSFIELD

Rhinolophus pearsoni HORSFIELD, Cat. Mamm. Mus. E. Ind. Co. 33. 1851. (Darjeeling, India).

Specimens examined. a. ♀1, Godavari, April 18.

Measurements. Body weight 18.1 ; head & body 70.0 ; tail 22.0 ; fore arm 55.0 ; third metacarpal 35.0 ; III–1 18.0 ; III–2 24.0 ; fourth metacarpal 40.0 ; fifth metacarpal 42.0 ; hind foot 12.0 ; tibia 28.5 ; ear 23.6 ; greatest length of skull 24.3 ; palatal bridge 2.9 ; zygomatic width 12.0 ; mastoid width 11.0 ; interorbital width 2.5 ; supraorbital length 5.5 ; width of nasal swellings 6.1 ; C–M3 9.2 ; width across molars 9.0 ; mandible 16.6 ; lower tooth row 11.0.

Taxonomic notes. The present specimen retains the following characters : The color of slightly curled pelage is darker Natal Brown on the back and similar to but a trifle lighter than the back on the belly. The membranes are deeply pigmented.

The sella has a broad and rounded summit and well-developed basal lappets. The posterior connecting-process is extremely low and rounded off. Only one mental groove is retained.

The third metacarpal is much shorter than the fifth. The first phalanx of the third finger is much lengthened.

The saggital crest is high in front and abruptly descending towards the postnasal depression, and then the latter part is deeply hollowed out. The interorbital constriction and the basioccipital are narrow.

The upper incisors are relatively large in size and placed close together. The second upper premolar is in tooth row. The upper canine and the fourth premolar are well separated. The third lower premolar is almost external in position, but the second and the fourth lower premolars are well separated.

These characters given above are well coincided with those of the *luctus* section of the *philippinensis* group which was arranged by TATE & ARCHBOLD (29) and TATE (28). The size, however, is decidedly smaller than that of *R. luctus perniger* of Nepal and close to that of *R. trifoliatus* (*philippinensis* group) from which it is different in the shape of sella (broad instead of tapered) and in the closeness of the large incisors contrary to small, widely spaced upper incisors in *trifoliatus* (5, 28). The size and the other characters of the present specimen resemble those of *R. pearsoni* which is one of the members of *luctus* section by TATE. ANDERSEN (6) placed *R. pearsoni* into the *R. macrotis* group. Later, TATE (23) altered the arrangement, and refered the former to the *luctus* section and reduced to a subspecies of *R. luctus*. The present author, however, agrees with the modified arrangements of ELLERMAN & MORRISON-SCOTT (13) owing to the following accounts. The ecological situation concerning the bats in Nepal in which larger *R. luctus perniger* and smaller *R. pearsoni* occur, is likewise seen in northwest Fukien, China, affording also *R. luctus lanosus* and *R. pearsoni*.

Ecological notes. The specimen examined contained one embryo in the right horn of the uterus.

Family Vespertilionidae

Myotis mystacinus muricola (GRAY)

Vespertilio muricola GRAY, Cat. Hodgson Coll. British Mus. 4. 1846. (Nepal).

Specimens examined. a. ♂1, Swingket, May 15.

Measurements. Body weight 4.0; head & body 50.0; tail 32.0; fore arm 34.2; hind foot 8.0; tibia 15.5; ear 12.5; tragus 5.7; greatest length of skull 13.4; zygomatic width 8.3; interorbital width 3.45; mastoid width

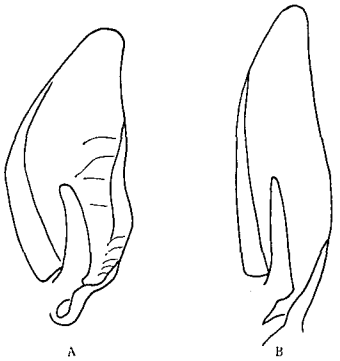

Fig. 6. Auricles of *Myotis mystacinus muricola* (A) and *Myotis siligorensis siligorensis* (B).

6.8 ; C–M3 5.0 ; M1–M3 3.15 ; width across molars 5.45 ; height of braincase 5.1 ; mandible 9.8 ; lower tooth row 6.4.

Taxonomic notes. The color of the present specimen is darker on the back but lighter on the venter than those of *siligorensis*, i. e. near Clove Brown on the back and Pale Drab-Gray or Pale Smoky Gray on the venter. The hairs of the back have pale golden metalic reflection.

The ear is relatively slender in form in fresh specimen. The tragus is a half as high as the ear conch, and curves inwards at the terminal tip (Fig. 6).

The third metacarpal is about 3 mm shorter than the fore-arm when the wing folded ; the subequal fourth and fifth are about 1.5 mm shorter than the third. The wing membrane inserts at the base of outer toe ; the keel on calcar moderately developed. Hairs on the lower surface of the interfemoral membrane are gathered and grouped in small aggregates of several ones along the course of each stria, leaving spaces between each group.

The skull is relatively narrow and low, with a rather abrupt frontal elevation and raised supraoccipital area, the latter on the same level as that of the former in the profile. The braincase is long and oval when viewed from above ; the rostrum is low.

The canine is distinctly longer than the long cusp of the fourth premolar, both in the upper and lower jaws. The small upper premolars are somewhat crowded between canine and large premolar in the present specimen. The second premolar is small and slightly moved inward, and only a part of the central cusp is visible from outside. The third upper premolar retains a well-developed antero-internal cusp. Lower teeth are as usual (26, 20).

From the characters shown above, the present specimen coincides in general accounts, with those of *M. mystacinus muricola*, but it is not clear whether the characters of the tragus and the second upper premolar of the present specimen are common to Nepalese race or it is an individual variation.

TATE (26) recognized two subspecies from Nepal, *muricola* with dark coat, and *nipalensis* with white ventral fur. However, the latter may be synonymous to the antedated former, because the present specimen retains whitish, but not pure white, ventral fur, which is intermediate between them.

Myotis siligorensis siligorensis (HORSFIELD)

Vespertilio siligorensis HORSFIELD, Ann. Mag. N. H. 16 : 102. 1855. (Siligori, Nepal).

Specimens examined. a. ♀1, Pokhara, April 25 ; a. ♀1, y. ♂1, ♀1, Godavari, June 15–16.

Measurements. Body weight ♂ y. 4.6, ♀4.0–5.8 (4.9), y. 4.7 ; head & body ♂ y. 46.5, ♀47.0–53.0 (50.0), y. 47.0 ; tail ♂ y. 32.0, ♀34.0–37.0 (35.5), y. 32.0 ; fore arm ♂ y. 35.0, ♀35.5–35.5 (35.5), y. 30.5 ; hind foot ♂ y. 9.5, ♀ 8.7–8.8 (8.8), y. 9.3 ; tibia ♂ y. 15.8, ♀16.0–16.0 (16.0), y. 15.2 ; ear ♂ y. 13.0, ♀13.7–15.3 (14.5), y. 12.5 ; tragus ♂ y. 6.4, ♀6.0–7.3 (6.7), y. 6.3 ; greatest length of skull ♂ y. 12.7, ♀13.5–13.5 (13.5), y. 12.5 ; zygomatic width ♂ y. 7.6, ♀8.05–8.3 (8.2), y. 7.6 ; interorbital width ♀3.2–3.35 (3.3), y. 3.0 ; mastoid width ♂ y. 6.7, ♀6.8–6.9 (6.9), y. 6.4 ; C–M$\underline{3}$ ♂ y. 4.7, ♀5.0–5.05 (5.03), y. 4.7 ; M$\underline{1}$–M$\underline{3}$ ♂ y. 2.9, ♀3.0–3.0 (3.0), y. 2.9 ; width across molars ♂ y. 4.75, ♀5.05–5.4 (5.2), y. 5.25 ; mandible ♂ y. 9.2, ♀9.8–9.9 (9.85), y. 9.2 ; lower tooth row ♂ y. 6.0, ♀6.4–6.4 (6.4), y. 6.0.

Taxonomic notes. This is a bat quite similar, in general accounts, to the former species. The back of the present specimens is Snuff Brow or Olive Brown in color in adults, but much darker, Fuscus or Chaetura Drab, in young. The hairs have no metalic reflection. The venter is Drab in color both in adults and young.

The ear is very slender in fresh specimens, and the anterior border is not so evidently convex as that of the former species. The inner surface of the ear conch lacks well-defined transverse striations. The tragus is narrow and straight (Fig. 6).

The third, fourth, and fifth metacarpals are gradually diminishing in length, and the longest third is about 2.5 mm to 3 mm shorter than the fore arm when the wing folded. The wing membrane inserts at the base of outer toe and the keel on calcar is primitive or moderately developed. Hairs on the lower surface of the interfemoral membrane are scattered,

without special pattern, singly over the membrane.

The skull also resembles that of the previous species. The braincase is long and oval. It is different, in several respects, from the latter, i. e. the rostral sinus is slightly broader, the frontals rise more abruptly, and the anterior portion of the muzzle is much higher. So the dorsal profile forms a stronger concavity at the interorbital region. The supraoccipital is higher.

The canine is very small, and subequal in hight to the third premolar on the upper jaw or smaller than that on the lower jaw. The small premolars of the upper jaw are crowded between canine and large premolar, and the second is situated more inwardly than in the former species. The second lower premolar, however, is completely in the tooth row. The third upper premolar retains a well-developed antero-internal cusp.

Pipistrellus babu THOMAS

Pipistrellus babu THOMAS, J. Bombay N. H. Soc. 24: 30. 1915. (Murree, 8000 ft., Punjab).

Specimens examined. a. ♀1, Pokhara, April 25; a. ♀1, Biratanti, May 13.

Measurements. Body weigh 6.2–7.2 (6.7); head & body 46.0–46.0 (46.0); tail 34.0–34.0 (34.0); fore arm 31.0–32.6 (31.8); hind foot 6.0–6.5 (6.3); tibia 12.6–13.3 (13.0); ear 8.8–9.2 (9.0); tragus 5.0–5.7 (5.4); greatest length of skull 11.75–11.8 (11.8); 12.15–12.2 (12.2) (with I); zygomatic width 7.5–7.95 (7.7); mastoid width 6.9–7.0 (7.0); interorbital width 3.1–3.2 (3.2); width across molars 5.1–5.2 (5.2); height of braincase 4.3–4.75 (4.5); palatal length 3.95–4.2 (4.1); C–M$\underline{3}$ 4.1–4.25 (4.2); M$\underline{1}$–M$\underline{3}$ 2.7–2.7 (2.7); mandible 8.4–8.5 (8.5); lower tooth row 5.2–5.45 (5.3).

Taxonomic notes. One of the two adult specimens examined is very old while the other is young (yearling?).

The fur is Bister on the back in color, Saccardo's Umber with pale golden tinge on the venter, but very slightly lighter as a whole in the old one. Rostrum, palate, and braincase are very wide and short respectively in the latter, while those of the young are much narrower and longer. The braincase is rather steep in profile in frontal region.

The first upper incisors of both specimens have only a trace of supplemental cusp, in the one, but entirely lack it in the other. The secondary cusp of the upper canine is present (young) or prominent (old adult). The small upper premolar which is displaced inward is subequal in crown area to that of the outer incisor and about a half the height of larger premolar.

The present specimens are slightly smaller than the Indian specimens in size (27) and the former approaches (especially in skull size) to smaller *P. mimus mimus* of which the color is near Bister and the fore arm is 27 mm–28 mm in length. TATE (27) placed the two species into a separate species group, respectively, i. e. *babu* into *kuhlii* group and *mimus* into *tenuis* group. However, the difference between the two groups is not always clear. From these accounts, the Nepalese bat of this kind is still open to question.

Ecological notes. The two females obtained contained 2 embryos, each having one in each horn of the uterus.

Miniopterus schreibersii fuliginosus (HODGSON)

Vespertilio fuliginosa HODGSON, J. Asiat. Soc. Bengal, 4 : 700. 1835. (Nepel).

Specimen examined. a. ♂1, Pokhara, May 18.

Measurements. Body weight 10.2 ; head & body 63.0 ; tail 43.0 ; fore arm 43.5 ; hind foot 9.0 ; tibia 17.8 ; ear 9.5 ; tragus 5.5 ; greatest length of skull 14.1, 14.3 (with I) ; zygomatic width 7.8 ; interorbital width 3.8 ; mastoid width 8.1 ; C–M3 5.3 ; M1–M3 3.0 ; width across molars 5.7 ; palate 5.0 ; height of braincase 6.3 ; mandible 10.4 ; lower tooth row 6.6.

Taxonomic notes. The present specimen (young adult) has the fur as usual for the subspecies, but the size is smaller and rather similar to *M. s. blepotis* from Java and the synonymous *fuscus* from the Liu-kiu Islands (10, 26). TATE (26) reduced and grouped *M. s. japoniae* and *M. s. parvipes* as a synonym, respectively, into the subspecies *M. s. fuliginosus*. The size of the former two, however, is distinctly larger than that of the present specimen and also that of typical *fuliginosus* (fore arm length 46 mm) given by himself. For example, the fore arm length of Japanese specimens ($n=$ 547) ranges from 45.2 mm to 50.5 mm, and is much longer than that of the specimen from Nepal. From these accounts, the Japanese and Chinese bats belong possibly to a separate subspecies and, if it is correct, to the antedated *M. s. japoniae*.

Order Lagomorpha

Family Ochotonidae

Ochotona macrotis macrotis (GÜNTHER)

Lagomys macrotis GÜNTHER, Ann. Mag. N.H. 16: 231. 1875. (Doba, Kuenlum mountains, Chinese Turkistan).

Specimen examined. a. ♀1, Gosainkund (4300 m), June 3.

Measurements. Body weight 160.0 ; head & body 187.0 ; hind foot 33.0 ; ear 26.5 ; occipitonasal 43.6 ; condylobasal 39.0 ; palate 16.9 ; diastema 9.4 ;

upper tooth row 8.6; bullae 10.7; nasal 15.6; frontal 5.0; mandible 30.7.

Taxonomic notes. The rostrum of the skull is narrow and long, and therefore, the proportion of the nasal length to the width at the former projections of jugals is 83 per cent. The frontoparietal suture is of wide V-shape. This is apparently different from that of *O. roylei*. The specimen examined has a pair of fenestrations on the frontals as usual in this species, though it is a full-grown adult (Fig. 7).

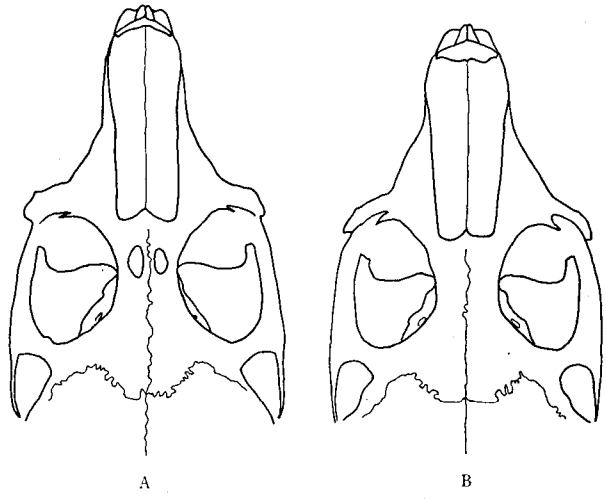

Fig. 7. Anterior parts of the skulls of *Ochotona macrotis* (A) and *O. roylei* (B).

Ecological notes. The specimen examined was collected in a slide rock area in Gosainkund together with specimens of *roylei*. They seem to coexist in this area. This may be the uppermost part of distribution of the latter species.

Ochotona roylei roylei (OGILBY)

Lagomys roylei OGILBY, Royle's Ill. Botany Himalaya, IXIX, pl. 4. 1839. (Choor Mountain, 60 miles north of Saharanpur, Punjab).

Specimens examined. a. ♀2, Gosainkund (4300 m), June 3–4; a. ♂2, ♀1, y. ♂3, Thare Pati, June 5–6; a. ♀1, Top (3300 m) of the south ridge of Thare Pati, June 7. Total a. ♂2, ♀4; y. ♂3.

Measurements. Body weight ♂148.0–153.0 (150.5), ♀144.0–199.0 (163.5); head & body ♂192.0–204.0 (198.0), ♀188.0–207.0 (195.3); hind foot ♂33.0–34.5 (33.8), ♀33.0–34.5 (33.8); ear ♂22.5–26.0 (24.3), ♀23.0–24.3 (23.8); occipitonasal ♂45.1 ($n=1$), ♀41.0–44.5 (42.8); condylobasal ♂41.5 ($n=1$), ♀38.0–

41.7 (39.8); palate ♂ 17.0–17.3 (17.2), ♀ 15.3–16.8 (16.3) ($n=3$); diastema ♂ 9.1–9.6 (9.4), ♀ 8.2–9.5 (9.0); upper tooth row ♂ 8.6–8.8 (8.7), ♀ 8.2–8.6 (8.4); bullae ♂ 10.8 ($n=1$), ♀ 9.0–10.0 (9.5); nasals ♂ 14.6–15.4 (15.0), ♀ 14.4–14.6 (14.5) ($n=3$); frontals ♂ 5.0–5.2 (5.1), ♀ 4.7–5.4 (5.0) ($n=3$); mandible ♂ 29.3–31.0 (30.2), ♀ 28.6–30.2 (29.4).

Taxonomic notes. Five of the 6 adult specimens examined have winter fur except for the facial parts in which new rufous summer fur is coming up. One from the southern ridge of Thare Pati, however, finished already the molting to the summer fur. Adult males have a wide chestnut color band on the throat.

Even in full-grown adults, the rostrum is relatively short, i.e. the proportion of the nasal length to the width at the former projections of jugals ranges from 73.4 per cent to 78.6 per cent, with an average of 75.9 per cent ($n=5$).

The fronto-parietal suture is ⌣-shaped and the posterior part is nearly straight. Juveniles have a pair of fenestrations on the frontals or thin semi-transparent parts at the positions of the bones, but they disappear in adults (Fig. 7).

Ecological notes. The main habitat of the Royle's pika is slide rock area in which there are many interspaces for the subterranean runway and also for the nest chamber. The habitat which is usually situated at the alpine zone is covered with lichens, mosses or grasses. It somtimes extends into the lower rhododendron forest zone. The lowest range of distribution observed in Gosainkund range is on the top (3300 m) of a ridge extended from Gosainkund. The summer huts, Kalkha, of the natives are also used as a part of the habitat at Gosainkund and Thare Pati.

One of the most characteristic habits of the pika is the calling behavior. The pika of the Gosainkund range, however, by no means makes the posture of the behavior and hence produce no characteristic high calls, as pointed out by KAWAMICHI (21). The present author observed many pikas, young and adults, males, and females, in this range. However, no one produced high calls although a low guttural sound was sometimes heard. The latter was able to hear only in a few meters from the pika.

Two adult females from Gosainkund had already given birth to the young and had placental scars in the uteri, the number being 3 and 2, respectively. Moreover, one of them contained a second litter consisting of 5 embryos. On the other hand, many juveniles were observed on the slide rock area and around the Kalkha at Thare Pati. Two adult females from this locality still contained 2 and 4 embryos, respectively. The adult males

examined also retained well-developed reproductive organs.

Green herbs (73.9%) and mosses (26.1%) constitute the whole stomach contents of 9 individuals examined.

Ochotona sp.

Specimen examined. y. ♂1, Ulleri (2180 m), May 12.

Measurements. Body weight 92.0; head & body 175.0; hind foot 34.0; ear 22.5; occipitonasal 38.9; condylobasal 35.7; palate 14.8; diastema 7.3; upper tooth row 7.8; bullae 7.8; nasals 13.0; frontals 5.5; mandible 26.8.

Taxonomic and ecological notes. The specimen examined is a young male which seems to have been born early in the breeding season of the year taken. The color is quite similar to that of the young of *roylei*. A large full adult which was observed at the same habitat had a rufous coat similar to the summer coat of the latter species.

The form of the skull of the present specimen is also similar to that of the latter, but the fronto-parietal suture is V-shaped and rather resembles that of *macrotis*.

The present specimen produced characteristic high calls which induced the author to take it.

The morphological and ecological characters of this pika are distinctive from the previous two ones suggesting separate species, but the specimen taken is too young to determine the species to which it belongs.

Owing to the preference for cool habitats and to their susceptibility to pneumonia and aspergillosis in warm environments (15), pikas are usually impossible to live in warm habitats for long time. Therefore, the Himalayan deep valley of which the bottom is sometimes of subtropical climate may become a barrier against the distribution of some terrestrial alpine mammals like the pika. The species differentiation in the Himalayan pikas may have been occurred in such isolated local colonies.

Order Rodentia

Family Sciuridae

Funambulus pennanti WROUGHTON.

Funambulus pennanti WROUGHTON, J. Bombay N. H. Soc. 16, 3: 411. 1905. (Mandvi Taluka, Surat district, Bombay Presidency, India).

Specimens examined. a. ♂3, Adhabar, Terai, June 25–28.

Measurements. Body weight. 106.0–125.0 (113.3); head & body 150.0–162.0 (156.3); tail 141.0–154.0 (148.0); hind foot 38.3–39.5 (39.1); ear 15.0–

17.5 (15.8); occipitonasal 37.7–38.6 (38.1); condylobasal 35.6–36.3 (35.9); palate 18.9–19.0 (19.0); diastema 8.4–8.7 (8.6); palatal foramina 2.1–2.3 (2.2); upper tooth row 7.3–7.4 (7.4); nasals 11.1–11.5 (11.3); frontals 10.5–11.0 (10.7); orbit 11.7–11.8 (11.8); mandible 24.0–24.1 (24.0).

Ecological notes. This is a common squirrel found at the outskirts of the jungle in the Terai. A number of males were making reciprocal calling among them during the last week of June. This may be the beginning of the breeding season. Every male examined had well-developed testes.

Stomach contents of three individuals are consisted of the following items: Dipteran larvae (43.3%), coleopteran larvae (18.3%), berries (21.7%), and seeds (16.7%).

Dremomys lokriah (HODGSON)

Sciurus lokriah HODGSON, J. Asiat. Soc. Bengal, 5: 232. 1836. (Nepal).

Specimens examined. a. ♀1, Bokajhunda, May 29; a. ♂1, ♀1, oak forests (2650 m and 2800 m), west of Syng Gomba, June 1; a. ♀1, Khurumsan, June 9.

Measurements. Body weight ♂173.0, ♀157.0–163.0 (159.3); head & body ♂185.0, ♀179.0–184.0 (182.3); tail ♂133.0, ♀126.0–134.0 (128.7); hind foot ♂44.5, ♀42.0–43.5 (42.8); ear ♂18.0, ♀18.5–19.5 (18.8); occipitonasal ♂46.7, ♀46.8–47.2 (46.9); condylobasal ♂42.2, ♀42.6–42.9 (42.7); palate ♂22.1, ♀21.6–22.7 (22.0); diastema ♂10.6, ♀10.3–10.6 (10.5); palatal foramina ♂3.1, ♀2.7–3.2 (2.9); upper tooth row ♂8.5, ♀7.9–8.8 (8.4); nasals ♂15.9, ♀15.2–16.4 (15.8); frontals ♂14.5, ♀15.0–15.5 (15.3); orbit ♂15.2, ♀14.8–15.1 (14.9); mandible ♂28.9, ♀28.4–29.2 (28.9).

Ecological notes. This squirrel commonly inhabits the oak forests ranging from 2000 m to 3000 m in altitude. The author observed 10 individuals of this species in a oak forest situated on the lower part of the slope on which Syng Gomba is located. Six of them appeared to be in a group. The others consisted of two pairs.

Two of the 3 females examined had already given birth to the young and retained placental scars. One had 2 countable scars, but in the other one scars were sbscure. The uterus of the third one contained neither visible embryos nor placental scars.

Stomach contents of 4 individuals consist of insects (52.5%) and berries (47.5%).

Callosciurus pygerythrus lokroides (HODGSON)

Sciurus lokroides HODGSON, J. Asiat. Soc. Bengal, 5: 232. 1836. (Nepal).

Specimens examined. a. ♀1, Trisuli Bazar, May 28.

Measurements. Body weight 194.0; head & body 199.0; tail 180.0; hind foot 43.0; ear 18.0; occipitonasal 47.4; condylobasal 42.9; palate 22.4; diastema 10.8; palatal foramina 3.2; upper tooth row 9.0; nasals 14.2; frontals 16.1; orbit 15.4; mandible 29.7.

Ecological notes. The author observed 6 individuals of this species which were feeding in a stand of mango trees on the river bank of Trisuli Bazar.

In the stomach of one female contained ants (5%), lepidopteran larvae (35%) and fruits (60%). It had two placental scars in the uterus.

Family Muridae

Mus cervicolor HODGSON

Mus cervicolor HODGSON, Ann. Mag. N. H. 15 : 268. 1845. (Nepal).

Specimens examined. a. ♂1, ♀1, Godavari, April 18–20; a. ♂1, ♀1, the bank of the Balaju River, Kathmandu, April 24; a. ♀2, Syng Gomba, June 2–3; y. ♀2, Khurumsan, June 8–9; a. ♂1, y. ♂1, Pati Bhanjyang, June 10; y. ♂1, Sundarijar (1450 m), N. E. of Kathmandu, June 10; a. ♂1, Kuinibisona, July 6; a. ♂1, Adhabar, June 27; a. ♂5, ♀2, y. ♀1, Pokhara, April 26–27, May 22; a. ♂2, Biratanti, April 29, May 14; a. ♂1, Tatopani, May 3; a. ♀3, y. ♀2, Ghasa, May 9. Total a. ♂13, ♀9, y. ♂2, ♀5.

Measurements. Body weight ♂10.0–16.0 (12.9), ♀8.0–22.5 (15.7); head & body ♂74.0–86.0 (79.5), ♀72.0–97.0 (82.5); tail ♂68.5–84.0 (72.9), ♀64.5–80.0 (71.7); hind foot ♂14.5–17.7 (16.9), ♀15.8–17.0 (16.6); ear ♂12.5–13.6 (13.0) ($n=11$), ♀11.7–14.0 (12.7); occipitonasal ♂20.0–22.3 (21.4) ($n=11$), ♀20.0–22.8 (21.2); condylobasal ♂19.1–21.2 (20.6) ($n=11$), ♀18.7–21.7 (19.9); palate ♂10.2–11.4 (10.8), ♀10.1–11.5 (10.7); diastema ♂4.7–6.0 (5.4), ♀5.0–5.8 (5.3), palatal foramina ♂4.5–5.4 (4.8), ♀4.5–5.3 (4.8); upper tooth row ♂3.4–3.8 (3.6), ♀3.4–3.9 (3.6); nasals ♂7.0–8.6 (8.0), ♀7.1–8.6 (7.8); frontals ♂3.4–3.8 (3.6) ($n=12$), ♀3.5–3.7 (3.7); zygomatic width ♂10.3–11.2 (10.8) ($n=11$), ♀10.3–12.0 (11.0); mandible ♂11.4–12.7 (12.1) ($n=12$), ♀11.1–12.4 (11.7).

Taxonomic notes. ELLERMAN (12) regarded the typical subspecies of Nepal as a mouse in which the tail is longer than the head and body length. However, he examined only a few specimens. The present samples of 26 individuals indicate an average of 91.4 per cent in tail ratio, ranging from 80.7 per cent to 104.5 per cent. Only in two of them the tail exceeds the head and body length.

The proportion of the palatal foramina to the occipitonasal length varies from 21.3 per cent to 23.7 per cent, with an average of 22.7 per cent.

The size of this mouse usually increases with the ascending altitude of the habitat in central Nepal. However, this tendency is applicable only to the mice inhabiting cultivated grounds near human settlements. The mice (arrows have been added to the points on Fig. 8) taken in the forests of Kuinibisona and Syng Gomba which are situated far from cultivated grounds are smaller in size than would otherwise be expected for the altitude, probably due to that the forests are not primary habitat for this mouse. Except for the size difference, however, there are no significant differences in the external and cranial characters between those and other specimens from cultivated grounds.

As shown in Fig. 8, small sized spesimens from lower altitudes approach in size to a small species, *M. booduga*, of Indian Peninsula. Although the author has not yet examined any specimens of this species, it is quite pos-

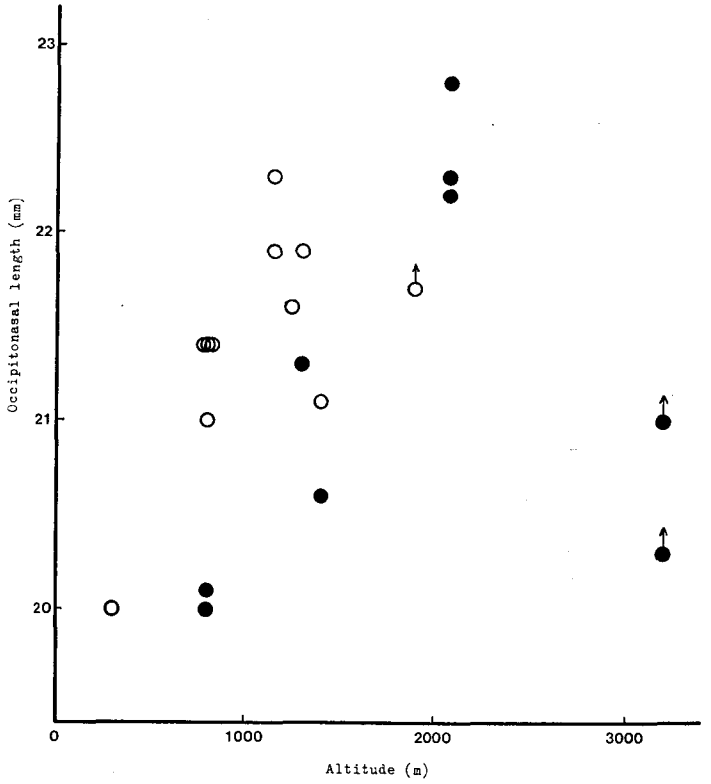

Fig. 8. Altitudinal variation of the occipitonasal length of *Mus cervicolor*. Individuals to which arrows have been added were taken in the forests which are far from cultivated grounds. ○ male, ● female

sible that *cervicolor* is a mere local form of the antedated former species judging from the descriptions of the other author and also from the above-mentioned phenomenon. Problems on the relationships between them, therefore, are open to question.

Ecological notes. Permanent human settlements, stone piles, and the growths of grasses and scrubs surrounding cultivated fields are the main habitat of the fawn-colored mouse, though it is sometimes found in forests far from cultivations.

One adult female contained 7 embryos, while 6 others had countable (4 to 8) or indistinct placental scars in the uteri. Two of 13 adult males had well-matured testes and seminal vesicles, the former measuring 9 mm × 5 mm and 8 mm × 4.5 mm, respectively. The others, however, were not in active condition concerning the reproductive organs showing small testes and small seminal vesicles along with the semi-transparent epididymides. Reproductive organs of young, males and females, were still in progress of development.

Stomach contents indicate that about one third of the food is animal matter, most of which are consisted of insects, and the other is plant matter (Table 6). Some of the latter might be from the agricultural crops of cultivations. Namely, many broken ears of wheat which were supposed to be cropped and bitten by this mouse were found on the outer side of a wheat-field at Ghasa where some mice were actually trapped.

TABLE 6. Stomach contents of 20 individuals of *Mus cervicoler*

	Percentage by bulk	Percentage by occurrence
Insecta		55.0
Coleoptera	5.0	5.0
Undetermined insects		
Larvae	19.7	45.0
Adults	5.0	5.0
Chilopoda		
Geophilomorpha	1.3	5.0
Plants		
Seeds	36.5	40.0
Berries	4.8	5.0
Starchy paste	27.7	30.0

Rattus eha eha (WROUGHTON)

Epimys eha WROUGHTON, J. Bombay N. H. Soc. 24: 428. 1916. (Lachen, Sikkim).

Specimens examined. a. ♂1, Gorapani, May 2; a. ♂3, ♀3, Syng Gomba, June 2–3.

Measurements. Body weight ♂47.0–49.0 (47.5), ♀36.0–44.0 (40.3); head & body ♂118.0–128.0 (123.0), ♀120.0–124.0 (121.3); tail ♂150.0–174.0 (162.8), ♀152.0–156.0 (154.0); hind foot ♂26.0–27.7 (26.7), ♀25.2–26.0 (25.7); ear ♂19.0–21.0 (20.3), ♀19.5–20.6 (20.0); occipitonasal ♂31.2–32.4 (31.6), ♀30.6–31.5 (30.9); condylobasal ♂29.9–30.7 (30.3) ($n=3$), ♀29.0–30.2 (29.5); palate ♂14.9–15.2 (15.1), ♀14.3–15.0 (14.7); diastema ♂7.8–8.1 (8.0), ♀7.2–8.0 (7.6); bullae ♂4.2–4.4 (4.4), ♀4.4–4.5 (4.4); upper tooth row ♂5.1–5.3 (5.2), ♀5.2–5.3 (5.3); frontals ♂4.8–5.1 (5.0), ♀4.8–4.8 (4.8); nasal length ♂10.8–11.7 (11.1), ♀11.0–11.1 (11.0); nasal width ♂3.4–3.8 (3.7), ♀3.6–3.6 (3.6); palatal foramina ♂5.4–6.2 (5.8), ♀5.7–6.0 (5.8); mandible ♂17.3–18.3 (17.7) ($n=3$), ♀17.2–18.0 (17.6); lower tooth row ♂4.8–5.2 (5.0) ($n=3$), ♀5.0–5.1 (5.0).

Taxonomic notes. The specimens examined well fit in general color the typical subspecies, but those taken at Syng Gomba have ivory yellow patches of various size on the mid-ventral portion.

The present specimens have slightly larger bodies and relatively shorter tails than those of the typical subspecies arranged by ELLERMAN (12). The tail ratios, which range from 117.2 per cent to 147.3 per cent, with an average of 130.5 per cent, are much smaller than in the latter. However, this may be resulted in part from that all the specimens examined consist of overwintered old ones which have grown to the largest size of the body and perhaps in part from somewhat differing method of measurements used by the collectors.

Ecological notes. *R. eha* is a rat inhabiting the upper forest zone which is covered with rhododendrons and coniferous trees. At Syng Gomba (3200 m), the rat was also collected in the bushes of dwarf bamboos and shrubs which grew on a slope after the burning of the original forest.

One adult female trapped at Syng Gomba contained 2 embryos, while the other two taken at the same place had 3 placental scars in the uterus, respectively. Males examined had well developed testes, the size varing from 10 mm × 6.5 mm to 11.5 mm × 8 mm.

A majority of the stomach contents was consisted of animal matter in which insects were dominant. Of the plant matter found in stomachs, the starchy paste and the fibrous matter might come from fruits or root stocks (Table 7).

TABLE 7. Stomach contents of 7 individuals of *Rattus eha*

	Percentage by bulk	Percentage by occurrence
Insecta		71.4
Coleoptera	1.4	14.3
Undetermined insects		
Larvae	53.6	57.1
Adults	2.1	14.3
Chilopoda		
Geophilomorpha	0.7	14.3
Undetermined arthropoda	14.3	14.3
Plants		
Seeds	2.9	14.3
Starchy paste	9.3	14.3
Fibrous matter	15.7	28.6

Rattus fluvescens fluvescens (GRAY)

Mus fluvescens GRAY, Cat. Hodgson Coll. 18. 1847. (Nepal).

Specimens examined. a. ♂1, Biratanti, April 29; a. ♂1, Ulleri, May 12; a. ♂1, ♀1, Chitare, May 11; a. ♂3, ♀3, Ghasa, May 4–9; a. ♀1, Bokajhunda, May 30; a. ♂1, ♀2, y. ♀2, about 3 km E. of Dunche, May 31–June 1; a. ♀1, y. ♂2, Khurumsan, June 8–9; y. ♀1, Kuinibisona, July 6. Total a. ♂7, ♀8, y. ♂2, ♀3.

Measurements. Body weight ♂63–92 (75.1), ♀60–76 (68.9); head & body ♂129–158 (143.9), ♀126–148 (141.3); tail ♂167–210 (183.5) ($n=6$), ♀159–209 (178.4) ($n=7$); hind foot ♂27–32.5 (28.8), ♀25–27.8 (26.7); ear ♂19.5–23 (20.9), ♀19–22.5 (20.6); occipitonasal ♂33.9–37.4 (35.4), ♀33.7–36.7 (34.9); condylobasal ♂32.0–35.2 (33.2), ♀31.1–33.7 (32.4); palate ♂16.0–17.3 (16.6), ♀15.8–17.0 (16.4); diastema ♂7.9–9.6 (8.6), ♀6.3–9.0 (8.0); bullae ♂4.6–4.9 (4.8), ♀4.7–4.8 (4.8); upper tooth row ♂5.6–6.0 (5.9), ♀5.6–6.3 (5.9); frontals ♂5.2–6.0 (5.5), ♀5.2–5.9 (5.5); nasals ♂13.4–14.4 (13.9), ♀12.6–14.3 (13.5); nasal width ♂3.6–4.4 (4.1), ♀3.6–4.1 (3.9); palatal foramina ♂5.4–6.4 (6.1), ♀5.8–6.7 (6.3) ($n=7$); mandible ♂18.3–20.4 (19.1), ♀17.9–19.5 (18.8); lower tooth row ♂5.3–5.9 (5.6), ♀5.2–5.8 (5.6).

Taxonomic notes. All the specimens (full adults) except one from Biratanti are between Ochraceous-Tawny and Cinnamon-Brown in color of back, but that of the latter is bright reddish brown (Cinnamon or near

Orange-Cinnamon) with a certain mixture of black spine on the middle portion. The underparts are Ivory Yellow or pure white. Young individuals have darker coat as a whole.

Although the present sample has brownish dorsal fur which is common in *R. fluvescens*, the tail ratio to the head and body length varies from 114.0 per cent to 143.1 per cent, with an average of 127.2 per cent, and rather well fits that of *R. niviventer* which has been given by ELLERMAN (12). Thus, the character of the present specimens is much different from that of *fluvescens* arranged by ELLERMAN (12). However, this might be resulted in part from the aged specimens used in the present work and also probably from differing method of measurements used by the collectors as seen in the previous species. Anyway, the taxonomic and ecological relationships between the two species should be reviewed by researching a large series of samples which might be collected with an appropriate method.

Ecological notes. This is a common rat in evergreen broadleaved forests, especially in the shrubs at the outskirt, but not found at all in the coniferous forest zone at higher altitude.

Except for two juveniles taken at 3 km east of Dunche on May 31, all the individuals collecetd during April and May were full adult ones.

Four adult females contained embryos ranging in number from 3 to 8 with an average of 4.5. All the other ones examined had already given

TABLE 8. Stomach contents of 20 individuals of *Rattus fluvescens*

	Percentage by bulk	Percentage by occurrence
Insecta		70.0
Coleoptera	0.0	5.0
Undetermined insects		
Larvae	32.3	50.0
Adults	0.6	15.0
Undetermined arthropoda	5.0	10.0
Plants		
Berries	20.0	25.0
Seeds	29.1	35.0
Green seedlings	2.5	5.0
Mushrooms	5.0	5.0
Starchy paste	5.0	5.0
Undetermined plant matter	0.5	5.0

birth to the young and retained placental scars (3 to 6 with an average of 4.5) in their uteri. Moreover, two females of the latter had two types of scars of different size in their uteri. The large countable ones apparently indicate a recent reproduction but the smaller ones suggest the absorption of embryos or earlier parturition. The reproductive organs of all the adult males examined were in active condition which is shown by the large sized testes measuring 14 mm × 7.5 mm to 18 mm × 9 mm, well developed seminal vesicles ranging in length from 16 mm to 21 mm, and also milk-colored epididymides full of sperms.

All the accounts enumerated above indicate that the months from April to June are the most active breeding season of this rat.

Plant matter constituted about two thirds of the stomach contents and it was showed that berries and seeds were most favored. Much of the berries were *Rubus ellipticus* which were at their season when the rats were trapped. The proportion of the animal matter in the stomach contents is smaller than that of the previous species (Table 8).

Rattus rattoides (HODGSON)

Mus rattoides HODGSON, Ann. Mag. N. H. 15 : 267. 1845. (Nepal).

Specimens examined. a. ♂ 1, Tatopani, May 3 ; a. ♂ 1, Ghasa, May 4 ; a. ♂ 2, ♀ 2, Tukucha, May 6–7 ; y. ♂ 1, Syng Gomba, June 2. Total a. ♂ 4, ♀ 2, y. ♂ 1.

Measurements. Body weight ♂ 122.0–158.0 (134.3), ♀ 97.0–106.0 (101.5) ; head & body ♂ 174.0–199.0 (182.5), ♀ 175.0–176.0 (175.5) ; tail ♂ 180.0–209.0 (195.3), ♀ 180.0–200.0 (190.0) ; hind foot ♂ 33.2–35.0 (34.1), ♀ 32.0–32.7 (32.4) ; ear ♂ 23.0–25.0 (24.0), ♀ 24.0–24.0 (24.0) ; occipitonasal ♂ 39.3–43.2 (41.0), ♀ 40.0–40.4 (40.2) ; condylobasal ♂ 37.4–41.9 (39.6), ♀ 38.4–38.5 (38.5) ; palate ♂ 20.8–22.8 (21.7), ♀ 20.8–21.2 (21.0), diastema ♂ 10.1–11.5 (10.9), ♀ 10.1–10.3 (10.2) ; bullae ♂ 6.8–7.4 (7.1), ♀ 6.7–6.9 (6.8) ; upper tooth row ♂ 7.3–7.8 (7.6), ♀ 7.0–7.5 (7.3) ; frontals ♂ 6.1–6.4 (6.2), ♀ 6.0–6.2 (6.1) ; nasals ♂ 13.7–16.5 (15.2), ♀ 15.0–15.3 (15.1) ; nasal width ♂ 4.6–5.5 (4.8), ♀ 5.1–5.1 (5.1) ; palatal foramina ♂ 7.6–8.5 (8.0), ♀ 7.2–7.9 (7.6) ; mandible ♂ 23.1–25.6 (24.1), ♀ 23.2–23.7 (23.5) ; lower tooth row ♂ 7.0–7.6 (7.4), ♀ 6.8–7.1 (7.0).

Taxonomic notes. The external and cranial characters and the color (especially, of the tail) of the present specimens well agree with those described by HINTON (17) and ELLERMAN (12).

The following may be also available for the diagnostic characters of this species : The posterior tips of nasals usually extend further postward than the middle of the sutures of maxillas and frontals (Fig. 9). In 5 of the 7

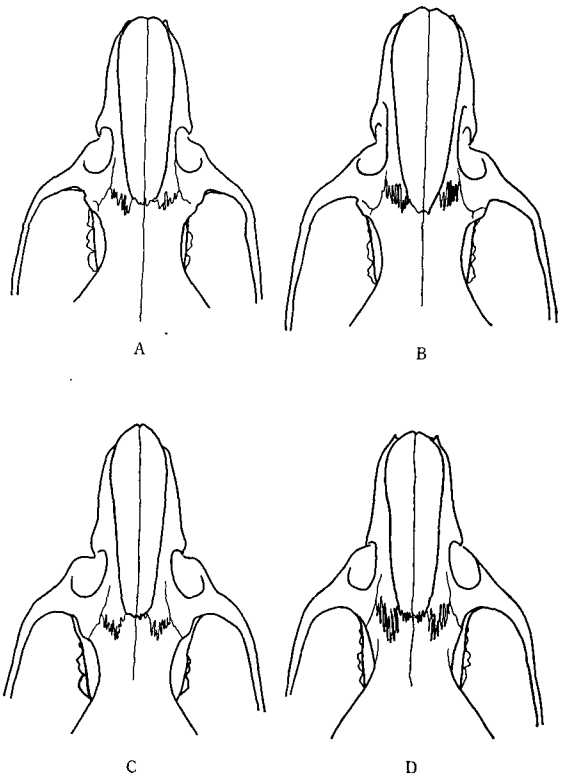

Fig. 9. Anterior parts of the skulls of *Rattus rattoides* (A and B) and *R. rattus* (C and D).

individuals examined they reach the posterior tips of the maxillas, but the rest have nasals of which the posterior tips are at the middle of the sutures. In full grown adults, the nasals are wide and not so constricted at middle as in *rattus*, and the proportion of the width to the length ranges from 29.5 per cent to 34.0 per cent with an average of 32.2 per cent (Fig. 10). The palatal foramina are long and 18.0 per cent to 19.7 per cent (19.3 per cent in average) of the occipitonasal length.

Ecological notes. The Turkistan rat occurs in drier or cooler localities in which *R. rattus* is usually absent, and appears to occupy the same ecological niche as that of the latter species ranging to warmer habitats. All the rats examined were taken at the edges of cultivated fields or near human settlements.

One of the two adult females collected contained only one embryo, while the other retained 5 placental scars. All the adult males examined had well

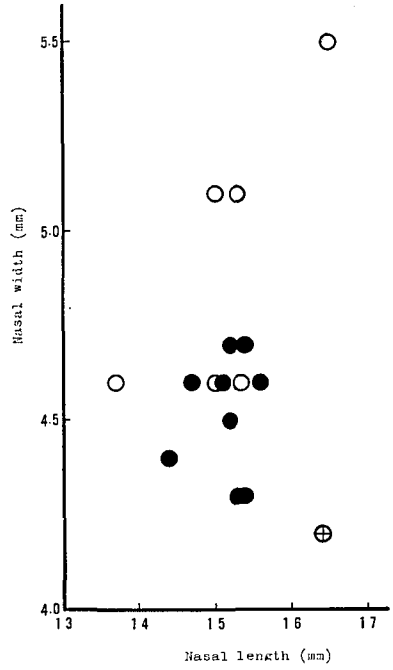

Fig. 10. Relationships between the width and the length of nasals in three species of *Rattus*.
○ R. *rattoides*, ● *R. rattus*, ⊕ *R. nitidus*.

TABLE 9. Stomach contents of 6 individuals of *Rattus rattoides*

	Percentage by bulk	Percentage by occurrence
Insecta		42.9
Coleoptera (adults)	1.7	16.7
Diptera (larvae)	4.2	16.7
Undetermined insects		
Larvae	12.5	16.7
Adults	8.3	16.7
Plants		
Fruits	16.7	16.7
Seeds	40.0	66.7
Starchy bulbs	16.7	16.7

developed reproductive organs in which the testes and the seminal vesicles are measured 21 mm × 15 mm and 28 mm at their largest, respectively.

Seeds, fruits, and starchy bulbs were most favored as the food. Insects constituted also an important part of it (Table 9).

Rattus nitidus (HODGSON)

Mus nitidus HODGSON, Ann. Mag. N. H. 15 : 267. 1845. (Nepal).

Specimens examined. a. ♀1, Kuinibisona, July 7.

Measurements. Body weight 108.0; head & body 173.0; tail 153.0; hind foot 33.0; ear 21.2; occipitonasal 40.7; condylobasal 38.4; palate 22.2; diastema 11.2; bullae 6.0; upper tooth row 6.6; frontals 5.9; nasals 16.4; nasal width 4.2; palatal foramina 7.9; mandible 23.9; lower tooth row 6.5.

Taxonomic notes. The width of nasals is only 25.6 per cent of the length and the posterior tip reaches the posterior part of the sutures of maxillas and frontals (Fig. 11).

Ecological notes. One Himalayan rat (♀) was trapped on the stream-side in the evergreen forest of Kuinibisona where water shrews were also collected. It had 4 placental scars in the uterus. Insect remains were in the stomach.

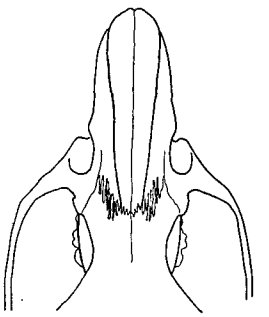

Fig. 11. Anterior part of the skull of *Rattus nitidus*.

Rattus rattus brunneus (HODGSON)

Mus brunneus HODGSON, Ann. Mag. N. H. 15 : 266. 1845. (Nepal).

Specimens examined. a. ♀1, Pokhara, April 27; a. ♂1, Swingket, May 15; a. ♂1, ♀2, Biratanti, April 30 and May 13; a. ♀1, Tatopani, May 3; y. ♀1, Chatrapati, Kathmandu, July 4. Total a. ♂2, ♀4, y. ♀1.

Measurements. Body weight ♂158.0–172.0 (165.0), ♀138.0–150.0 (144.5); head & body ♂192.0–200.0 (196.0), ♀164,0–189.0 (179.8); tail ♂195.0–198.0 (196.5), ♀182.0–213.0 (196.5); hind foot ♂35.5–37.0 (36.3), ♀33.0–33.8 (33.4); ear ♂22.0–25.0 (23.5), ♀22.0–25.0 (23.9); occipitonasal ♂41.8–42.8 (42.3), ♀41.4–42.2 (41.7); condylobasal ♂40.7–41.0 (40.9), ♀39.7–40.1 (40.0); palate ♂22.4–22.9 (22.7), ♀22.1–22.8 (22.4); diastema ♂11.0–11.2 (11.1), ♀10.7–11.1 (10.8); bullae ♂7.0–7.4 (7.2), ♀6.6–7.4 (7.0); upper tooth row ♂7.4–8.0 (7.7), ♀6.9–7.6 (7.2); frontals ♂6.2–6.5 (6.4), ♀5.7–6.3 (6.0); nasals ♂15.1–15.4 (15.3), ♀14.4–15.3 (15.0); nasal width ♂4.6–4.7 (4.7), ♀4.3–4.7 (4.5); palatal foramina ♂7.4–7.9 (7.7), ♀7.2–7.6 (7.4); mandible ♂24.5–24.8 (24.7), ♀24.2–

25.1 (24.6); lower tooth row ♂7.2–7.2 (7.2), ♀6.9–7.3 (7.1).

Rattus rattus brunneusculus (HODGSON)

Mus brunneusculus HODGSON, Ann. Mag. N. H. 15: 267. 1845 (Nepal).

Specimens examined. y. ♂1, Pokhara, May 22; a. ♀1, y. ♂3, ♀2, Biratanti, May 13; y. ♂1, Adhabar, June 26; a. ♂1, ♀1, Godavari, April 20. Total a. ♂1, ♀2, y. ♂5, ♀2.

Measurements. Body weight ♂125.0, ♀122.0–139.0 (130.5); head & body ♂181.0, ♀177.0–184.0 (180.5); tail ♂116.0(+), ♀166.0(+)–189.0; hind foot ♂32.0, ♀32.5–34.0 (33.3); ear ♂23.2, ♀24.0–25.0 (24.5); occipitonasal ♂42.7, ♀40.8–41.7 (41.3); condylobasal ♂40.7, ♀39.0–40.1 (39.6); palate ♂23.0, ♀22.1–22.4 (22.3); diastema ♂11.5, ♀10.2–10.9 (10.6); bullae ♂6.6, ♀6.6–7.4 (7.0); upper tooth row ♂7.2, ♀7.6–8.2 (7.9); frontals ♂6.2, ♀6.2–6.4 (6.3); nasals ♂15.6, ♀14.7–15.4 (15.1); nasal width ♂4.6, ♀4.3–4.6 (4.5); palatal foramina ♂7.7, ♀7.0–7.5 (7.3); mandible ♂24.9, ♀24.1–24.5 (24.3); lower tooth row ♂7.1, ♀7.3–7.7 (7.5).

Taxonomic notes (two subspecies combined). The Nepalese subspecies of *R. rattus* are apparently different in the character of the nasals from *R. rattoides*, i. e. the posterior tips of nasals of the former are situated at the anterior portions of the sutures of maxillas and frontals, and only in two of 27 specimens they reach the middle of the sutures as in the latter species. In this case, however, other characters such as of the nasals which are suddenly attenuated at middle and of the tail which is wholly dark are useful for discriminating this species from *rattoides*.

The nasal width is 29.5 per cent, in average, of the length, with the range from 27.9 per cent to 30.6 per cent, in full-grown adults. The palatal foramina is short and 17.8 per cent, in average, of the occipitonasal length, with the range from 17.2 per cent to 18.4 per cent.

Ecological notes. This is a common and dominant rat in towns and villages of lower warm regions of Nepal. This long-tailed rat is terrestrial-scansorial in habit. The author has observed some of the arboreal life at the garden in Kathmandu City (*brunneus*) and in the forest of Godavari (*brunneusculus*?). In the former case, a rat was sitting and resting, in broad day light, on a twig under the canopy of a broad-leaved tree which is about 3 meters high. The other one was found in a simple nest ball made with broadleaves on the base of a branch which is stretched out from the trunk at about 1.5 meters height from the ground. This is appeared to be the original habit which would have been inherited from the old wild stock.

Of 6 adult females, five had placental scars ranging from 5 to 11 with

an average of 6.8 in number, and the one had also 9 embryos. Three adult males retained active reproductive organs, and the testes were measured 24 mm × 15 mm at their muximum length.

Stomach contents of 17 individuals indicate the intake of much plant matter as their diet and are somewhat similar to those of *R. rattoides* (Table 10).

TABLE 10. Stomach contents of 17 individuals of *Rattus rattus*

	Percentage by bulk	Percentage by occurrence
Insecta		35.3
Coleoptera (adults)	4.1	5.9
Undetermined insects		
Larvae	5.9	17.6
Adults	4.1	11.8
Undetermined arthropoda	0.6	5.9
Undetermined animal matter	5.9	11.8
Plants		
Berries	28.2	29.4
Seeds	39.7	64.7
Seedlings	11.5	17.6

Bandicota bengalensis bengalensis GRAY & HARDWICKE

Arvicola bengalensis GRAY & HARDWICKE, Illustr. Ind. Zool. 2, pl. 21. 1833. (Bengal).

Specimens examined. a. ♂1, ♀1, Adhabar, Terai, June 26–27.

Measurements. Body weight ♂170.0, ♀110.0; head & body ♂187.0, ♀178.0; tail ♂143.0, ♀125.0; hind foot ♂32.0, ♀32.2; ear ♂20.5, ♀20.0; occipitonasal ♂37.0, ♀38.1; condylobasal ♂37.8, ♀39.5; palate ♂22.0, ♀23.0; diastema ♂11.0, ♀11.8; palatal foramina ♂7.9, ♀7.7; upper tooth row ♂7.7, ♀8.1; bullae ♂7.7, ♀8.1; nasals ♂11.6, ♀12.0; frontals ♂6.1, ♀6.4; mandible ♂24.4, ♀26.9.

Ecological notes. Small mounds and holes which were made by the Lesser bandicoot rat were often found on the grounds in the jungle of the Terai. The present specimens of this rat were obtained by means of the trap set at the openings of the burrows.

A female obtained had 10 placental scars, and a male retained relatively

large matured testes measuring 16 mm × 10 mm.

The latter contained orthopterans and lepidopteran larvae in the stomach, while the former had nothing in it.

Bandicota indica nemorivaga (HODGSON)

Mus nemorivagus HODGSON, J. Asiat. Soc. Bengal, 5 : 234. 1836. (Nepal).

Specimens examined. a. ♂1, ♀1, the bank of the Balaju River and Chatrapati, Kathmandu, July 3–9.

Measurements. Body weight ♂745.0, ♀525.0; head & body ♂296.0, ♀289.0; tail ♂234.0, ♀226.0; hind foot ♂51.0, ♀49.0; ear ♂29.0, ♀29.0; occipitonasal ♂59.7, ♀59.7; condylobasal ♂60.7, ♀60.7; palate ♂36.1, ♀36.4; diastema ♂18.6, ♀18.6; palatal foramina ♂10.7, ♀10.8; upper tooth row ♂11.5, ♀12.1; bullae ♂9.5, ♀10.1; nasals ♂22.0, ♀20.4; frontals ♂9.1, ♀8.5; mandible ♂39.6, ♀39.4.

Ecological notes. There are sometimes large holes varying in diameter from 8 cm × 6 cm to 10 cm × 8 cm in the garden of the City, along river bank, and on the ridge separating cultivated grounds in the Kathmandu Valley. These are openings of the burrows of the large bandicoot rat. This rat, however, is not so common as *R. rattus* in central Nepal.

A female taken had 13 placental scars in her uterus and the testis of a male examined was in process of development, measuring 29 mm × 13 mm.

The former had some kinds of fruits in the stomach but nothing in that of the other individual.

Apodemus flavicollis gurkha THOMAS

Apodemus gurkha THOMAS, J. Bombay N. H. Soc. 29, 4: 888. 1924. (Laprak, Gorgha, Nepal).

Specimens examined. a. ♂1, upper Ulleri, May 12; a. ♀3, Gorapani, May 2; a. ♂1, Chitare, May 11; a. ♂1, ♀1, Larjung, May 8; a. ♂1, Tukucha, May 6. Total a. ♂4, ♀4.

Measurements. Body weight ♂31.5–33.5 (32.7), ♀24.5–28.0 (25.6); head & body ♂104.0–110.0 (107.0), ♀101.0–105.0 (102.8); tail ♂116.0–125.0 (119.8), ♀106.0–115.0 (111.3); hind foot ♂24.2–25.8 (25.0), ♀21.8–25.0 (23.7); ear ♂16.5–19.0 (17.9), ♀16.0–18.0 (17.0); occipitonasal ♂27.4–30.1 (28.7), ♀26.3–28.4 (27.5); condylobasal ♂26.4–28.6 (27.3), ♀24.6–26.7 (26.0); palate ♂14.3–15.4 (14.8), ♀13.6–14.7 (14.1); diastema ♂7.6–8.1 (7.9), ♀7.2–7.7 (7.5); bullae ♂4.3–4.9 (4.7), ♀4.5–4.8 (4.7); upper tooth row ♂4.7–4.7 (4.7), ♀4.5–4.8 (4.6); frontals ♂4.8–4.8 (4.8), ♀4.7–4.9 (4.7); nasals ♂10.1–12.1 (11.3), ♀9.1–11.4 (10.3); nasal width ♂3.2–3.6 (3.3), ♀3.0–3.1 (3.1); palatal foramina ♂5.8–6.0

(5.9), ♀5.5–5.9 (5.8); mandible ♂15.8–17.0 (16.4), ♀16.0–16.6 (16.3); lower tooth row ♂4.2–4.6 (4.4), ♀4.1–4.6 (4.3).

Ecological notes. This is a mouse inhabiting rhododendron and coniferous forests at relatively high level.

Most of the adult females examined retained immature reproductive organs but one had a swollen vascular uterus and a vaginal plug in the vagina, suggesting copulation. On the other hand, all the males trapped had well-developed reproductive organs, the testes measuring about 15 mm × 9 mm and the epididymides containing sperms.

Insects constitute, in volume, more than a half of the diet of this mouse. Plant matter is also favoured (Table 11).

TABLE 11. Stomach contents of 7 individuals of *Apodemus flavicollis gurkha*

	Percentage by bulk	Percentage by occurrence
Insects		71.4
Coleoptera (adults)	41.4	57.1
Diptera (larvae)	2.9	14.3
Undetermined insects	11.4	14.3
Undetermined animal matter	14.3	14.3
Plants		
Green fibrous matter	21.4	42.9
Starchy bulbs	8.6	14.3

Pitymys sikimensis (HODGSON)

Neodon sikimensis HODGSON, Ann. Mag. N. H. 3: 203. 1849. (Sikkim)

Specimens examined. a. ♂2, Gorapani, May 2; a. ♂3, ♀3, Syng Gomba, June 2–3; a. ♂3, ♀2, Gosainkund, June 4; a. ♀1, Thare Pati, June 7. Total a. ♂8, ♀6.

Measurements. Body weight ♂27.0–37.0 (32.2), ♀22.5–45.0 (32.4); head & body ♂109.0–117.0 (112.9), ♀99.5–115.0 (109.8); tail ♂32.0–42.0 (35.8), ♀29.5–38.0 (33.3); hind foot ♂17.5–18.5 (17.9), ♀17.2–18.5 (17.7); ear ♂11.0–14.0 (12.6), ♀11.5–13.7 (12.5) occipitonasal ♂25.6–26.4 (26.0), ♀23.7–26.3 (25.5); condylobasal ♂24.9–27.3 (26.3), ♀24.4–26.3 (25.4); palate ♂14.8–16.1 (15.3), ♀14.4–15.3 (14.9); diastema ♂7.6–8.2 (7.9), ♀7.3–7.9 (7.6); palatal foramina ♂4.6–5.0 (4.9), ♀4.2–5.0 (4.7); upper tooth row ♂6.5–7.3 (7.0), ♀6.4–7.1 (6.8); bullae ♂5.6–6.2 (5.8), ♀5.5–6.0 (5.7); nasals ♂7.5–8.0 (7.7),

♀6.5–7.9 (7.6); zygomatic width ♂14.7–16.4 (15.6), ♀14.6–16.2 (15.4); frontals ♂3.4–4.0 (3.8), ♀3.7–4.0 (3.9); mastoid width ♂11.6–12.5 (12.1), ♀11.4–12.2 (11.8); mandible ♂16.3–17.4 (17.0), ♀16.2–17.5 (16.9).

Taxonomic notes. The proportions of the ear and the tail to the head and body length in the present specimen are slightly smaller than those arranged by ELLERMAN (12). This might be resulted from that the present specimens consist of full-grown adults. The skulls and the teeth well fit those of the latter.

Ecological notes. The Sikkim vole is fairly common in the bushes growing at the outskirt of rhododendron and coniferous forests and also in the alpine meadow in central Nepal.

All the voles taken on the Gosainkund area during the first week of June were active in their reproduction. Namely, five of 6 females contained embryos ranging in number per female from 2 to 3, with an average of 2.6, and the rest (one) had also a well-grown uterus. Moreover, considering the presence of placental scars (2), one of the pregnant females might have already given birth to another litter. All the males had well matured reproductive organs.

The contents of 14 stomachs examined consist of plant matter. In it 95 per cent, by bulk, green herbs, 2.1 per cent brown plants (mosses?) and 2.9 per cent seeds are identified.

Summary

The small mammal survey was carried out at 22 localities of central Nepal during about 3 months from April to July, 1968.

Seven species of insectivores, 8 species of bats, 13 species of rodents and 3 species of pikas were collected in this work.

Taxonomic problems, ecological distributions, habitats, reproductions and food habits were studied in many of these species. Moreover, the composition of the small mammal fauna of this region was compared with that of Japan.

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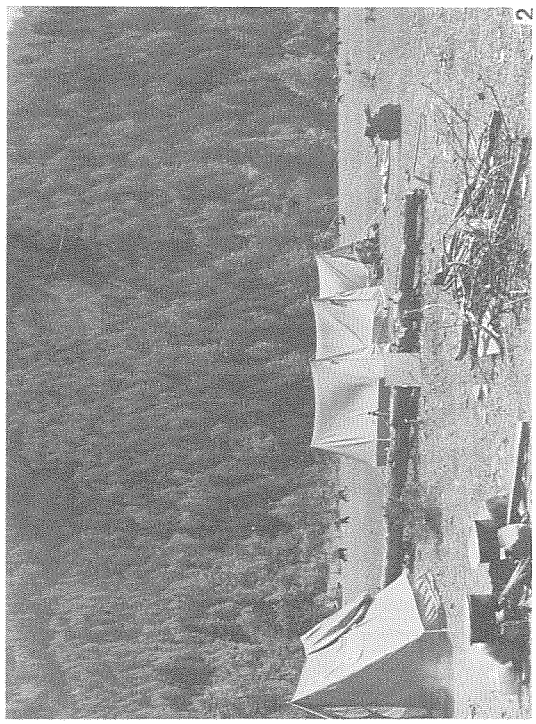
PLATE I.

1. A dried mountain slope and wheat fields on the river bed, Tukucha (2600 m). Bushes along the margin of the wheat fields are the main habitat of *R. rattoides* and *A. flavicollis* in this locality.

2. A coniferous forest on the eastern side of the Kali Gandaki river, at Larjung (2530 m). *S. nigrescens* and *A. flavicollis* were collected in this forest.

3. Wheat fields and the village of Ghasa (2080 m). *S. nigrescens, M. cervicolor, R. fluvescens* and *R. rattoides* were trapped in the bamboo brushes along the wheat fields and streamlets.

4. A stone pile made along the margin of the cultivation in Pokhara (800 m). This is a habitat of *S. murinus, M. cervicolor* and *R. rattus.*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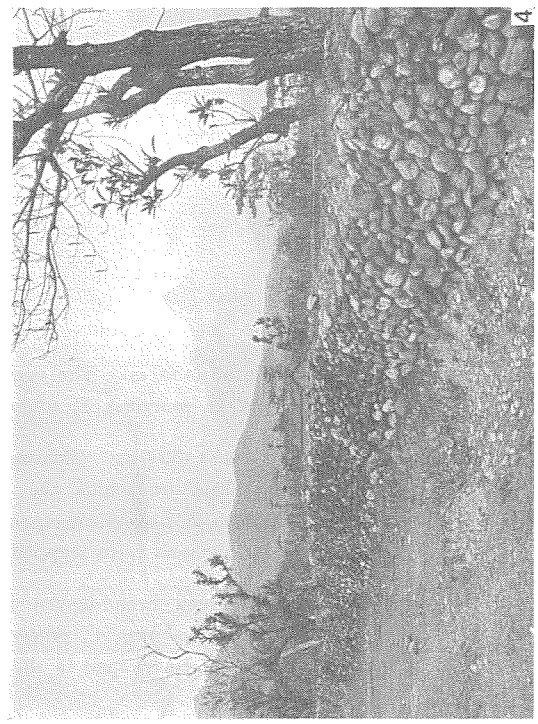
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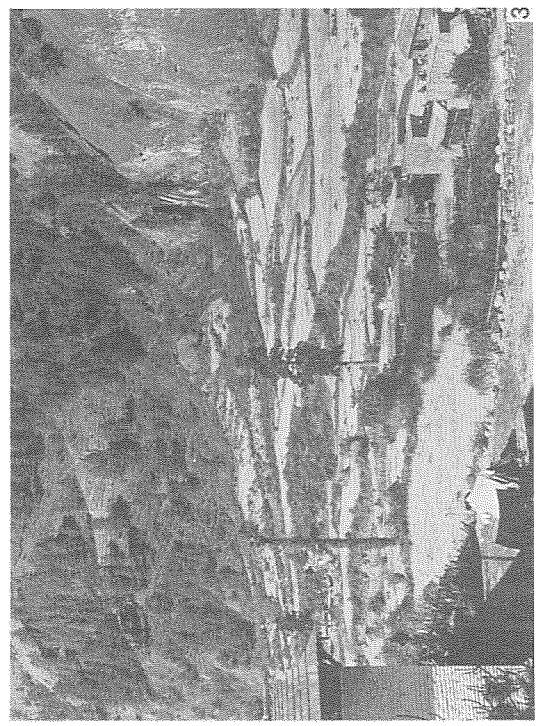
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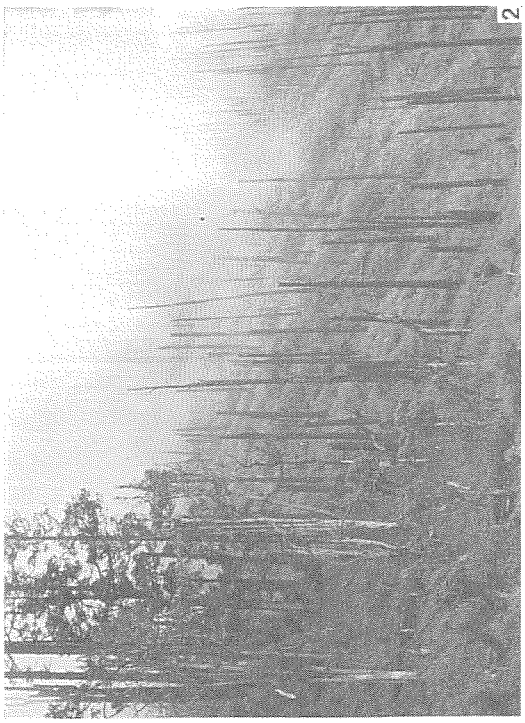
PLATE II.

1. Gosainkund (4300 m). The vegetation is very poor on this slope, but *O. roylei*, *O. macrotis*, *P. sikimensis* and *S. caudatus* were taken here.

2. Syng Gomba (3200 m). Shrubs, dwarf bamboos and grasses well grow on the slope on which the coniferous forest has been burnt off. *S. caudatus*, *S. baileyi*, *S. nigrescens*, *M. cervicolor*, *R. eha*, *R. rattoides* and *P. sikimensis* were trapped around here.

3. The evergreen broad-leaved forest of Kuinibisona (1980 m). *S. nigrescens*, *S. murinus*, *C. platycephala*, *M. cervicolor*, *R. fluvescens* and *R. nitidus* were trapped in the forest.

4. The deciduous broad-leaved forest of Adhabar (300 m) in the Terai. *S. murinus*, *M. cervicolor*, *R. rattus*, *B. bengalensis* and *F. pennanti* were common in this jungle.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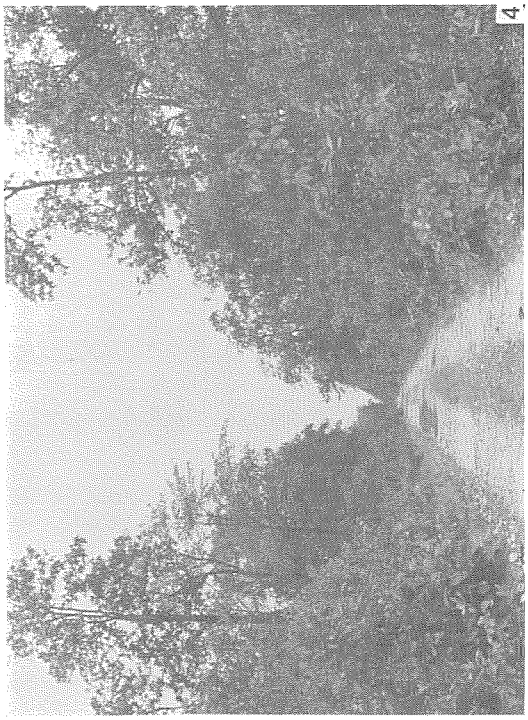
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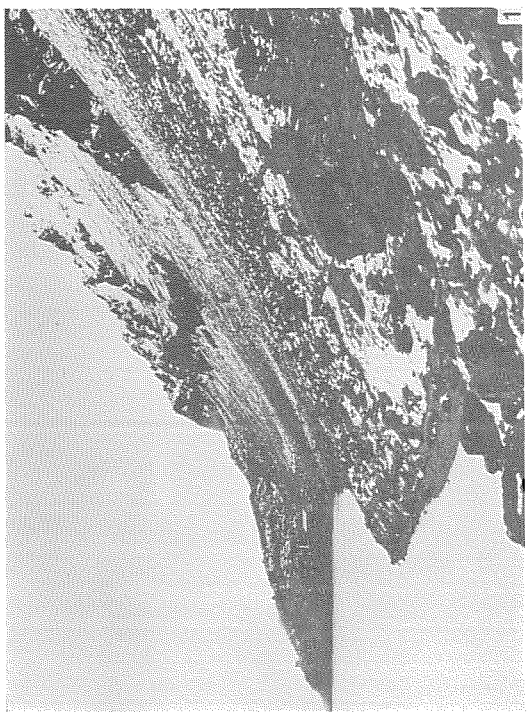
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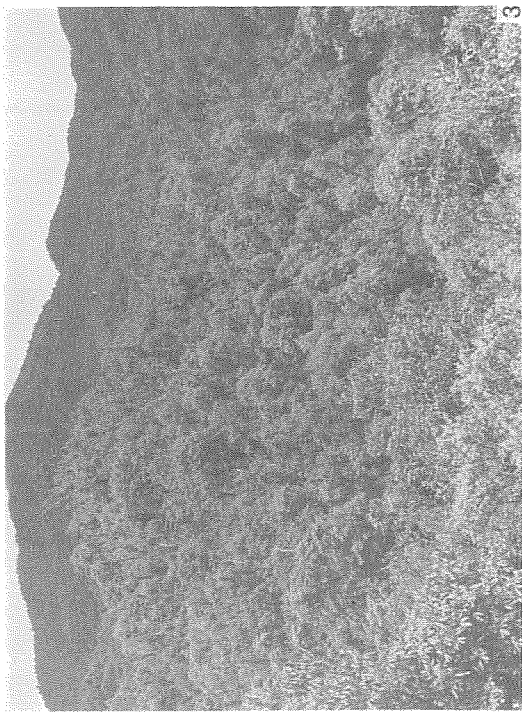
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