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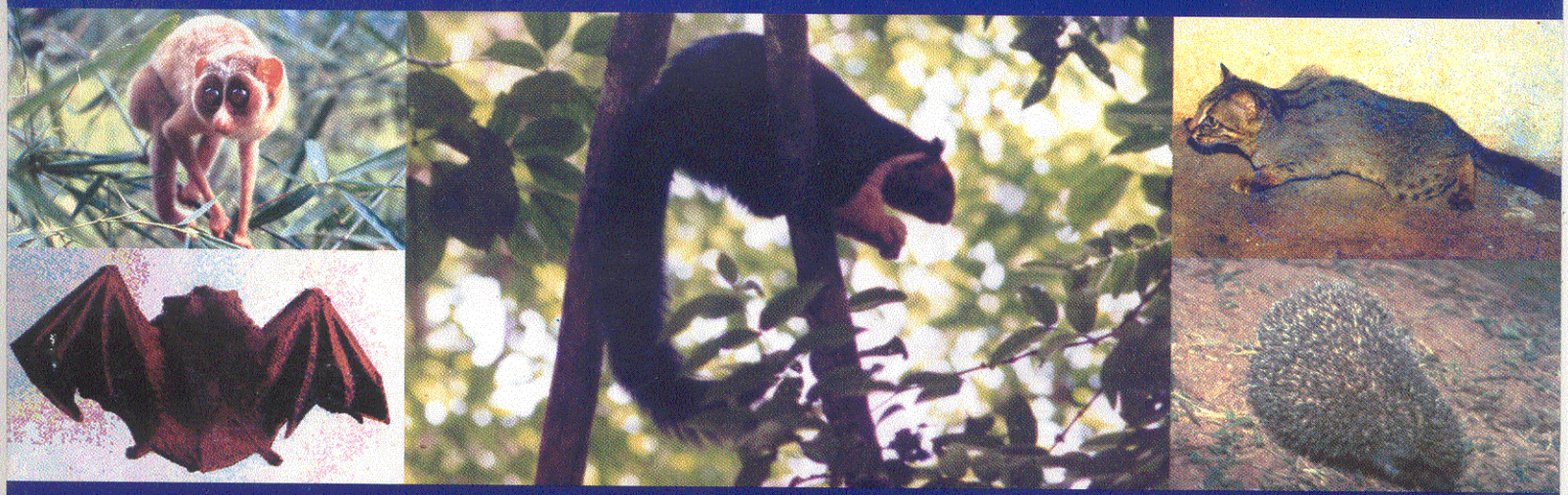

SURVEY OF SMALL MAMMALS IN KERALA WITH SPECIAL REFERENCE TO ENDANGERED SPECIES

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CONTENTS

Abstract

A survey of the small mammals (weighing less than 5 kg) was conducted in Kerala during 1993-1995. The area surveyed included coastal and midland areas in addition to the forested areas. Information from the secondary sources was also included. Sherman and pit-fall traps were used in most of the areas in addition to camera traps in selected areas.

Fifty seven species of small mammals were encountered during the present survey. Among these, Chiroptera and Rodentia outnumber the other groups. The niches or habitats selected by these groups also vary from human habitation to forested areas. Salim Ali's bat and Malabar civet are the critically endangered species and Grizzled giant squirrel is included in the endangered category. Brown palm civet, small Travancore flying squirrel, Travancore rat and Nilgiri marten are vulnerable based on IUCN criteria. Rest are either common or are without any immediate threat. One variant form of Grey mangoose was collected from Mannavanshola.

A comparison with the earlier records regarding the distribution and status of the mammalian species has been made and discussed. Reasons for the decline and the immediate threat to the small mammals are discussed.

ABSTRACT OF PROJECT PROPOSAL

Code	: KFRI/153/93
Title	: Survey of Small mammals in Kerala with special reference to endangered species
Objectives	: To prepare an inventory of small mammals in Kerala along with information on distribution
Date of Commencement	: January, 1993
Scheduled date of completion	: December, 1995
Funding Agency	: Kerala Forest Department (Wildlife)
Project Team	
Principal Investigator	: P. S. Easa
Associates	: James Zacharias (Kerala Forest Department) P. Padmanabhan

ACKNOWLEDGEMENTS

The authors are grateful to the Kerala Forest Department (Wildlife) for the financial assistance for the programme. Chief Conservators of Forests, especially Shri. P..K. Surendranathan Asari, Principal Chief Conservator of Forests encouraged and supported the programme. Dr. S. Chand Basha and Dr. K. S. S. Nair, the former Directors and Dr. J.K. Sharma, the Director of the Institute were very keen on the progress of the Research Programme. The staff of Kerala Forest Department throughout Kerala were very cordial and co-operative during the field work. Shri S. A. Sabu Jahas, Shri C.P. Shaji, Shri Saju. K. Abraham and Shri Joseph Thomas, the Research Fellows of the Division have contributed considerably to the project by doing the field work. The authors have benefited from the discussions with Dr. Ajith Kumar of SACON and the editorial comments from the colleagues in the Institute.

INTRODUCTION

The class Mammalia comprises highly adapted group of animals and some among these represent excellent examples of adaptive radiation and divergent evolution. The evolutionary history of mammals dates back to Synapsid reptiles of Cenozoic era. During these times, most of them were equipped with adaptive modifications and some of them became extinct either locally or from the earth.

Mammals have played an excellent role in our culture, traditions, myths and agriculture. As agriculture developed, some species were domesticated and with the wild varieties, we produced the hybrids. As far as wildlife is concerned, many of them were hunted for meat, horn, skin and tusk. Though wildlife was exploited, it was obviously in a sustainable manner in the ancient time.

Even with traditional conservation practices, a large number of animals and plants became endangered and a a few remain unknown to us. Most of our forested areas had to cope up with developmental activities. This indirectly led to the shrinkage of the wildlife habitats. This, by and large, affected the wildlife in general and the mammalian fauna in partiular.

Altogether 32 mammalian orders are recognized, of which 14 are extinct. Indian mammalian fauna is an assemblage of 372 species. The mammalian fauna in Indian region is primarily Indo-Chinese and Palaeoartic and Ethiopean origin (Kurup, 1986). Kurup (1986) has also discussed the distributional peculiarities of the mammalian fauna of the country.

AN OVERVIEW OF THE SMALL MAMMAL FAUNA OF THE WORLD

The orders rodentia and insectivora comprise a number of species. Out of the total 4629 species of mammals, there are 2021 species of rodents and 428 species of insectivores (Wilson and Reeder, 1993). They together constitute nearly 50% of the mammalian spectrum. Chiroptera, the bats, form the second largest group (20%). The geographical distribution of these three taxa are so expansive that they occur in almost all the six zoogeogrpahical realms. Insectivora occurs in all geographical realms except the Australian where its niche is occupied by the marsupials and very few occupy the Neotropical realm (Corbet and Hill, 1991)

It is often mistaken that only the larger mammals are susceptible to endangerment and face extinction. About 330 species of rodents are considered as threatened

by IUCN (Jordan, 1999). Sixteen species out of these belong to one genus *Gerbillus*. Many endemic species or subspecies are vulnerable or endangered either due to natural disaster or habitat loss (Jordan, 1999).

The present work was focussed to collect information on the small mammals of Kerala and their distribution.

Being a comparative term, it is too difficult to define what is a small mammal (see the discussion by Walker, 1999). Delany (1974) used the term to include only the insectivore and rodent species weighing less than 120 grams. Bourliere (1975) considered any mammalian species up to 5 kg in weight as small mammal. Chew (1978) suggested that small mammals be defined as the size range within which the majority of species have diets at least partly dependant on seeds or insects and /or require a burrow for protection from extreme environmental temperatures and predators. We follow the definition of Bourliere (1975) in the present study.

REVIEW OF LITERATURE

Early explorations on mammals began after Linnaeus, which Chakraborty (1986) referred to as Pre Hodgson period. Belanger, Leschenault, Jacquemont, Duvaucel, Geoffroy and Blainville were the pioneer mammologists and many Indian species were named by them. Pallas and Erxlenben also contributed by describing new species during this period.

Another period of Indian mammology (as per Chakraborty, 1986) is the Hodgson-Jerdon period. Hodgson, during 1818-1858, made extensive collection from India and Nepal and described several new species. Blyth, the curator of Museum of Asiatic Society of Bengal published accounts on small mammals, rodents and bats.

The Blanford–Anderson period during 1865-1910 was granted by the Fauna volume (two parts) by Blanford (1888 and 1888-91).

The mammalian survey became active when the Bombay Natural History Society, the pioneering conservation agency, came into being. The Society made extensive surveys during 1911-1929 and about 25,000 specimens were collected with adequate field data. These surveys brought out an idea on the faunal picture of India (Hinton, 1918a, b c and d; Thomas and Wroughton, 1915; Thomas, 1919, 1922 and 1923; Wroughton, 1920 a and b). Based on these surveys, Pocock (1923 and 1939-1941) published Fauna of India covering the Primates and Carnivora. Finn (1929) revised Sterndale's (1884) popular work and published the Mammalia of India.

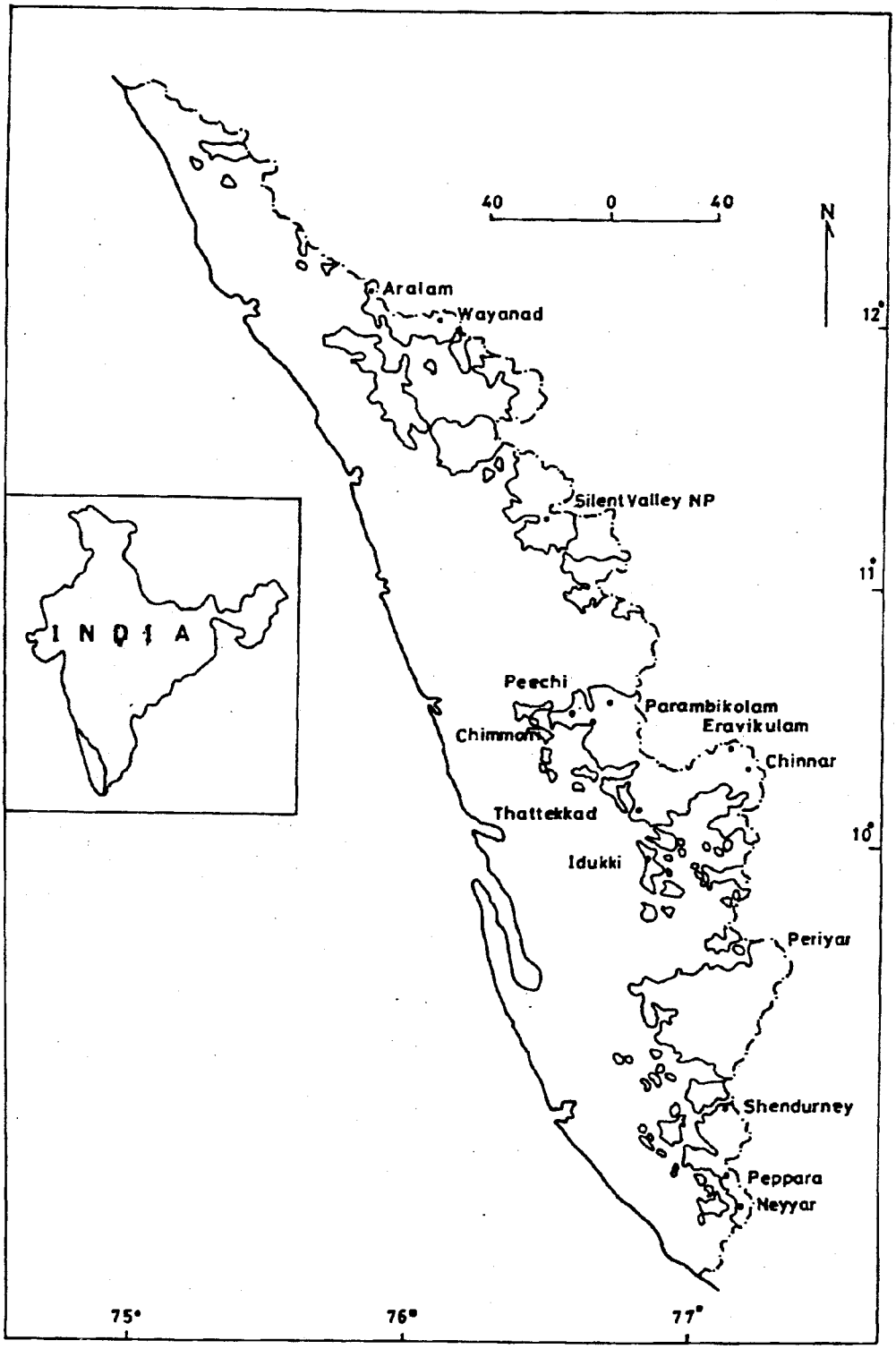

Figure 1. Study Area

The post independence period witnessed a series of publications based on surveys in various parts of India. The popular account on the mammals of India by Prater (1948) was outstanding. Among the surveys and checklists, 'The Checklist of Mammals' by Ellerman and Morrison-Scott (1951) is elaborate.

Regarding the small mammal studies in India, the contributions were by Ellerman (1940-1941, 1947a,b, c and d) and Ellerman and Morisson-Scott (1961) dealing especially with the Rodentia. Robinson (1917) described two new subspecies of squirrels from South India. Khajuria (1956) described a new species of primate. The bats of central India has been documented by Brosset (1962a, b and c). A series of accounts on small mammals were available during these periods (Roonwal, 1948; Moore and Tate, 1965; Ghosh, 1964; Kurup, 1965; Biswas and Tiwari, 1969; Mandal and Ghosh, 1981; Walker, 1983; Corbett and Hill, 1991). The revisionary studies were of Sinha (1973) on the *Rhinolophus* and of Chakraborty (1981) on *Sciuropterus*. The latest new description was of a genus of flying squirrel by Saha (1982). Bats of Western India was the recently documented group (Bates *et. al*, 1994 a, b and c) and apart from these, nothing is known about the small mammals especially the rodent and the like animals. The status of Indian mammals at a national level is available from 'Threatened Fauna of India' by Tikadar (1983).

The mammalian studies in Kerala could be traced to the experts of British period and thereafter. But a source of comprehensive account on the mammals of Kerala is yet to be published and this is true in the case of small mammals. The studies were mostly on the larger mammals like elephant, tiger, gaur and tahr (Rice, 1984a, Vairavel, 1998, Balsubramanian, 1998). Nair and Easa (1997) briefly summarised and reviewed the mammalian studies done so far in Kerala. Nameer (1997) compiled a list of mammals in the Indian region. Major studies on mammals of Kerala are summarised in Table 1.

Table 1. Summary of mammalian studies in Kerala

Author/s	Year	Animal/s	Topic	Location/Area
Agrawal and Ghosal	1969	Rat	New species	Kerala
Ali	1985	LTM	Distribution	W. Ghats
Ashruf *et al.*,	1989	Viverrids	Survey	Kerala
Balakrishnan	1990	larger mammals	Habitats	Silent Valley
Balakrishnan & Easa	1986	Large mammals	Habitat	Parambikulam
Boston	1947	Tiger	Behaviour	Nelliampathy
Chandran	1980	Nilgiri tahr	Captive observation	Kerala

Chandran	1990	Elephant	Population dynamics	Periyar
Daniel	1967	N. Langur/ LTM	Status	South India
Daniel & Kannan	1967	N. Langur/ LTM	Status	South India
Das	1986	Bats	Taxonomy	Silent Valley
Easa	1989a	Elephant	Ethology & Ecology	Parambikulam
Easa	1989b	Elephant	Ranging	Parambikulam
Easa	1995	Prey-predator	Ecology	Eravikulam
Easa	1997	Larger mammals	Idukki	Idukki
Easa	1998	Gaur	Ecology	Parambikulam
Easa & Balakrishnan	1990	Larger mammals	Population	Parambikulam
Easa & Balakrishnan	1995	Elephant	Population	Parambikulam
Easa *et al.*	1997	LTM	Status & Distribution	S. W. Ghats
George & Joy	1981	Bandicoot rat	Eco-biology	Kerala
Green & Minkowski	1977	LTM	Habitat ecology	S. India
Horwich	1972	N. langur	Home range	S. India
Hutton	1949	mammals	survey	High wavy
Jayson & Christopher	1995	Spiny dormouse	Record	Peppara
Jayson & Ramachandran	1996	Larger mammals	Habitat utilization	Chinnar
Jayson & Easa	1996	Larger mammals	Status & distribution	Chimmoney
Karr	1973	LTM	Ecology	S. India
Kinloach	1923	Larger mammals	Survey	Nelliampathy
Krishnan	1971a&b		Survey	Peninsular India
Krishnan	1972	Larger mammals	Survey	Peninsular India
Kumar	1987	LTM	Population dynamics	S. India
Kumar & Kurup	1993	LTM	Demography	S. W.Ghats
Kurup	1975	Nilgiri langur	Survey	Nilgiris
Kurup	1978	LTM	Survey	W.Ghats
Kurup	1987	Malabar civet	Rediscovery	Malabar
Nameer	1997	Mammals	Checklist	India
Oates	1979	Nilgiri langur	Distribution	S. India
Oates *et.al.*,	1980	Nilgiri langur	Food & feeding	Kerala
Poirier	1968a	Nilgiri langur	Mortality	Travancore & Cochin
Poirier	1968b	Nilgiri langur	Home range	S. India
Poirier	1970	Nilgiri langur	Behaviour	S. India
Ramachandran	1990	Grizzled squireel	Habitat	Chinnar
Ramachandran	1996	Primates	Status	Shendurney
Ramachandran	1998	Primates	Status	Silent Valley
Rice	1984a	Nilgiri tahr	Ecology	Eravikulam
Rice	1984b	Large mammals	Prey predator	Eravikulam
Rice	1988a	Nilgiri tahr	Reproductive Biology	Eravikulam
Rice	1988b	Nilgiri tahr	Population dynamics	Eravikulam
Robinson	1917	Squirrel	New description	S. India
Schaller	1970	Nilgiri tahr	Field observations	Eravikulam

Simonds	1965	Bonnet macaque	Ecology	S. India
Subramoniam	1957	Loris	Field observations	Kerala
Sugiyama	1968	LTM	Ecology	Kerala
Vinod	1994	Elephant	Food and feeding	Idukki

But for the new description of the field rat by Agrawal and Ghosal (1969) and the survey of bats in Silent Valley by Das (1986), most of the works pertaining to the small mammals were on the captive ones (Xavier, 1993a and b; Xavier and Balakrishnan, 1993). Apart from these, nothing is known on the present status and distribution of small mammals of Kerala, which is a primary requisite for efficient management and further conservation prioritization. In this context, it is worth to mention about the workshop conducted by the Zoo Outreach Organization which brought some insights into the status of mammalian species in India (Anonymous, 1997).

STUDY AREA

The survey was conducted in various parts of the state, giving special emphasis on the forested areas and the coastal belts, during 1993 - 1996. All the Protected Areas in the State were sampled during the survey. In addition, parts of Achenkoil, Ranni, Kottayam,Vazhachal, Chalakudy, Thrissur, Nemmara, Munnar, Mannarkad, South Wayanad, North Wayanad, Nilambur (South and North) and Kannur Forest Divisions were also sampled.

METHODS

The rodents and other fossorial mammals were trapped by the conventional rat traps and the Sherman traps. In addition to these, pit fall traps were tried in some areas. The camera traps were set in various places for nocturnals and mist nets in some places for bats. The traps were randomly placed in the evenings and checked the next day morning. However, considering the diurnal habit of certain rodents, traps were set also in the morning and checked in the evening.

Reports on sighting of mammals from various parts of the state were frequent during these days. Some of the species were located in some areas based on these reports though a few of them were of wrong identification by the public. Most of the reports were from the coastal zone.

The indirect evidences such as scats/droppings and scales/hairs were collected and identified for species level confirmation in doubtful cases. Permanent hair materials preserved were used as reference materials for comparison (see Easa, 1995).

The systematic placement of the specimens was done based on the authentic records (Blanford, 1888 and 1888-1891; Pocock, 1939-1941; Prater, 1948; Ellerman (1940-41; Ellerman and Morrison-Scott, 1951; Brosset, 1962a, b and c; Tikadar, 1983; Corbett and Hill, 1991; Roonwal, 1986). The relevant literature referred are indicated in the appropriate places.

RESULTS

The present survey in different parts of Kerala could record a total of 39 species of small mammals. However, the 57 species so far reported from the state are dealt with in this report for completeness.

INSECTIVORA

Shrews, hedge hogs and moles comprise the insectivores in the country. It is a primitive group and considering the difficulty of systematic placements, eminent zoologists commented that insectivores are the waste baskets among the mammalian orders. Except the tree shrew, all are nocturnal and with a pronounced long pointed snout projecting far beyond the lower jaw.

1. *Suncus murinus* (Linnaeus, 1758) **Grey musk shrew**

The species is distributed in all habitats including forests and human habitations. It is fossorial.

2. *Suncus dayii* (Dobson, 1888) **Day's shrew**

Day's shrew is a montane species endemic to the Western Ghats. This vulnerable species is reported from Eravikulam (Pradhan, Pers. comm.).

3. *Hemiechinus nudiventris* (Horsefield, 1851) **Pale-hedge hog**

Hedge hog is a small rodent like animal covered with spines except on its face and under parts. It is nocturnal and solitary. Pig-like snout gives the hedge hog its name. The body is stout and clumsy with short tail. The stumpy legs are with claws. The dorsum and sides have spines. The hedge hog is well protected with the spiny mantle and rolls into a ball when threatened. It is fossorial in habit.

The species is endemic to the Western Ghats. It was recorded from the rocky hills at Ottappalam where it is reported to be common. The status in the area could not be ascertained.

CHIROPTERA

Bats (Chiroptera), the only flying mammal, are not well understood though their role in insectivory and seed dispersal has been documented to a certain extent. Myths and superstitions still hang on in the minds of the people leading them to hate the bats. But for a few attempts by the scientists of Zoological Survey of India, there was no concerted effort even to make an inventory of bats in the state.

4. *Latidens salimali* (Thonglongya, 1972) Salim Ali's Fruit Bat

Latidens salimali is uniformly brown in colour. Adult male is strongly built with a grotesque muscular head and aggressive expression. Ears are uniformly darker without distinct margins. The animal is characterized by having one pair of incisors in both upper and lower jaws.

This Western Ghat endemic is arboreal and inhabits evergreen forests. A colony of this was observed in the interior of Periyar Tiger Reserve. The species is considered to be critically endangered considering the restricted distribution and continuing disturbance of habitats, especially in the High Wavys adjacent to Periyar.

5. *Rousettus leschenaulti leschenaulti* (Desmarest, 1820) Indian fulvous fruit bat

It is a comparatively large sized bat, with a large head and elongated dog like muzzle. Eyes are large and wings broad. The body fur is short and ventrum is slightly paler brown. Body is lighting brown in colour and occasionally yellowish. Older males are with dull grey flanks. This has a well-developed thumb. Completely hairless individuals are reported during the spring and summer months. A small vestigial tail is present. Females have two pectorally located mammae. New born young are pink but the back is pigmented brown and naked ventrally.

It is gregarious in habit and colonises in caves and man made constructions. Das (1986) recorded the species from Silent Valley. This was observed in Ernakulam and Thiruvananthapuram.

6. *Cynopterus sphinx* (Vahl, 1797) Shortnosed fruit bat

It is the smallest of the fruit bats and externally similar to *Rousettus leschnaulti*. It can generally be recognized by its smaller size and more rapid wing beats in flight. Nostrils are situated at the tip of slightly bifurcated fleshy projections. The upper tip is also deeply grooved down the center. Another distinctive feature is the

presence of a narrow whitish border along the margin of the ears. Tail is vestigial. The body fur is short and greyish – brown dorsally. The belly fur is paler grey with yellowish tinges. Males are often with a bright reddish or rusty brown colour. The naked skin on the wings as well as the ears and around the tip of the muzzle is dark brown.

It is widely distributed and seen in all types of habitats. The bat is arboreal, roosting in small groups or as solitary. The species was recorded from Thattekkad, Thiruvananthapuram and Thrissur.

7. *Cynopterus brachyotis ceylonensis* Gray, 1870 Lesser Shortnosed Fruit bat

The bat leads a soliatry mode of life or live in small colonies. They are seen in urban as well as forested areas. The record from Silent Valley by Das (1986) and was the first report from Kerala.

8. *Pteropus giganteus* (Brunnich, 1782) Indian flying fox

This large bat roosts in large colonies on trees. The eyes are large with dark brown iris. The ears are naked. There is a narrow flap of skin inside each hind leg. It is with rufous brown fur around the head and neck and is the commonest among the bats in Kerala and occupying all types of habitats.

9. *Taphozous melanopogan* Temminck, 1841 Bearded sheathtailed bat

This is a medium sized bat. Males are sandy yellowish – grey with a black beard of long and thick hairs. Females are brown with reddish tint. Young ones are dull dark grey in colour. The beard in males grow at the age of five to six months. During rut, a thick secretion produced by small glands under the chin drenches the beard.

It is reported to occupy caves, tunnels and buildings. This was observed in Ernakulam.

10. *Megaderma lyra* Geoffroy, 1810 Great Indian false vampire

This is a large bat with a rather ugly appearance due to its big head with prominent muzzle, huge naked ears and peculiar nose leaf. The body fur is greyer or slaty grey, paler or yellowish grey below. The wings are rather broad due to the last or fifth digit being relatively long. Tail is absent. The eye is quite long and conspicuous and the elongated nose-leaf extends up to between the eyes. There is no incisor on the upper jaw. Females have two pectoral mammae.

Living in colonies, the bats are recorded from caves, wells and abandoned buildings. The species was recorded from Thiruvananthapuram, Thrissur and Kuruva in Wayanad.

11. *Rhinolophus lepidus lepidus* Blyth, 1844 **Blyth's Horseshoe-bat**

This is a relatively small species of *Rhinolophus*. The pelage is typically grey-brown on the dorsal side with slightly paler ventral. The medium emargination is narrow, lacking any posterior triangular grove. It is found in colonies or as solitary and is reported from forested areas. Das (1986) recorded the species from Silent Valley National Park.

12. *Rhinolophus rouxi rouxi* Temminck, 1835 **Rufous horse shoe bat**

This is a medium-sized *Rhinolophus*. Ears are small and the pelage soft and silky. The colour of pelage ranges from orange to rosset brown to buffy brown to grey. There is an apparent seasonal bias in colour such that the orange and rufous tints predominate from October to April.

This cave dwelling species lives in colonies and was first reported by Jerdon (1874). Recently it was recorded from Silent Valley (Das, 1986)

13. *Rhinolophus luctus* Temminck, 1835 **Wooly horse shoe bat**

Wooly horse shoe bat is the largest among the genus. The body is long, woolly and slightly curly. Body is jet black in colour, hairs with ashy tips, occasionally reddish brown. Ears are large with tapering blunt tips. Nose is horseshoe shaped and large, projecting over the lip and deeply incised in the middle. The species roosts alone or in pairs in caves or old buildings and was recorded from Thrissur.

14. *Myotis peshwa* (Thomas, 1915) **Peshwa's Bat**

This rarest Indian bat was recorded from Silent Valley by Das (1986).

15. *Pipistrellus coromandra* Gray, 1838 **Indian pipistrelle**

Body of Indian pipistrelle is dark brown with slightly paler below. Muzzle is blunt and without fur up to the eyes in the adult. Crown of head and forehead between eyes are densely furred. Ears are sub triangular and rounded at the tips.

The species live in colonies in crevices of buildings and tree barks. The specimen obtained from Wayanad agrees to the features of the species.

16. *Harpiocephalus harpia lasyurus* (Hodgson, 1847) **Hairy winged bat**

These bats are proportionally small. The skin is brownish–grey and the wing membranes and ears have yellow spots. The lower incisors are replaced by the eyeteeth, which in turn gave way to a second set of strongly developed spaced teeth. The molars are particularly high and slightly flattened with well-developed protuberances. Das (1986) recorded the species from Silent Valley National Park.

17. *Kerivoula picta* Pallas, 1767 **Painted bat**

Painted bat is a very small and beautiful brilliantly coloured bat. Body colour is bright orange or ferruginous. The orange colour extends to the wings along the fingers and flanks. Wing membrane is black with orange spots. Ears are funnel - shaped, tragus is very long and transparent.

This is reported to be very common in arecanut plantations and plantain farms near human habitations and was observed in Mannuthy, Peechi and Althara in Thrissur. Enquiries indicate its presence in Wayanad, Kottayam, Nilambur and Kozhikode areas.

PRIMATES

Though all the primate species recorded from the Peninsular India are reported from the state, only the Slender loris could be considered under small mammal.

18. *Loris tardigradus malabaricus* Wronghton, 1917 **Slender loris**

Slender loris is a small lanky animal of the size of a kitten having an elongated snout, large rounded ears, closed eyes encircled with brown hairs and slender limbs, but devoid of an external tail. It is dark grey to reddish brown with an embellishment of silvery hairs on the back and white or buff on the under surface. They are mainly insectivorous. The limbs are longer and slender and with large ears and more pointed snout. The eyes are more close-set and circled with black or dark brown. The fur is soft and woolly. Muzzle is white. Loris is seen either as solitary or in pairs and is nocturnal.

The species was recorded from Muthanga and Kuruva islands in Wayanad, Silent Valley, Peppara, Shendurney and Periyar Tiger Reserve. It was reported from Vazhani in Thrissur and in Nilambur. The animal is highly threatened due to indiscriminate killing because of the superstitious belief that their eyes are potent medicine for certain eye diseases.

PHOLIDOTA

Phoildota is represented by only one species in the state.

19. *Manis crassicaudata* (Gray, 1827) **Indian Pangolin**

The upper part of the head, back and sides of body, tail and sides of the limbs are covered with large overlapping scales. This protective cover is the characteristic distinguishing feature of pangolin. In defense, the animal curls into an armoured ball. The scales of pangolin are the modified hairs enormously enlarged and flattened. Feet are furnished with long, somewhat curved and blunted claws used for digging. Eyes are small and ears rudimentary. This is the only toothless mammal represented in the state.

This has been reported from all over the state. They were not abundant in any place as evident from the low sighting of the animal as well as indirect evidences. It was observed in Wayanad, Parambikulam, Peechi, Silent Valley, Aralam, Vazhachal, Periyar Tiger Reserve, Neyyar, and Peppara. Interestingly, the public from Chavakkad coastal belt caught one animal.

RODENTS

Rodents, mice and shrews are not very popular since most of them are considered as pests. The rodents contribute to the mammalian diversity of the earth by their enormous number and probably by the number of individual species. Information on the members of this group is rather scant.

20. *Hystrix indica* (Kerr, 1792) **Indian porcupine**

The body of porcupine is covered with spines, which are the modified hairs. Its neck and shoulders are crowned with a crest of bristles. Each quill is ornamental with deep brown or black and white rings. Tail is short, usually less than one fifth of head and body length. Hands and feet are broad with claws. The thumb is vestigial, the other four fingers are robust.

It is widely distributed all over the forested areas in Kerala. Abundance estimation from indirect evidences indicates higher population in Silent Valley, Thenmala, Wayanad, Idukki, Peechi, Neyyar, Peppara, Vazhachal and Munnar.

21. *Funambulus palmarum palmarum* (Linnaeus, 1766) Three-striped palm squirrel

It is distinctive in having three stripes on its back. Its head and body measures 12 to 15 cms with a slightly longer tail. A number of local races of these squirrels are

recognised. It is distributed throughout Kerala occupying all habitat types.

22. *Funambulus tristriatus* (Waterhouse, 1837) Jungle striped squirrel

This is the largest species of the genus. There are clear light stripes on the back, three in number, and the under parts are light or whitish. The tail is most often shorter than the head and body. Hands and feet are without any special peculiarity. Fourth finger is usually dominant in the hand.

The species is endemic to the Western Ghats (Swengel, 1993). It is reported from Bonnacord, Ponmudi, Kuttiyadi and Wayanad.

23. *Funambulus sublineatus* (Waterhouse, 1838) Dusky striped squirrel

It is distributed in the Western Ghats from Coorg southwards. It is also reported from Kerala. The assessment by the experts concludes that there is not enough data on the species to ascertain its status.

24. *Petinomys fuscocapillus fuscocapillus* (Jerdon, 1847) Small Travancore flying squirrel

It is a medium-sized flying squirrel with thick fur and broad, long feather shaped tail. There are four fingers on the hand and the fourth finger longest, the third next in length and second shortest. Foot is with five toes. Hairs are long and black and are present beside the ears. Back is reddish brown, sides are darker than the middle. Cheeks are apparently higher than shoulders. Hairs of the flying membrane are black. Feet are pale yellowish brown. Tail is with a central line of blackish hair. Under surface is white.

It is reported to be rare with vulnerable status. It was observed in Thattekkad.

25. *Petaurista phillipensis* (Elliot, 1842) Large brown flying squirrel

This is reported from dry deciduous to evergreen forests. It was recorded from Shendurney.

26. *Ratufa macroura* (Pennant, 1769) Grizzled giant squirrel

Grizzled giant squirrel is one of the most endangered species found along the riverine habitats in Chinnar and Pambar in Kerala. The dorsal is grizzled grey with an underlying brownish suffusion. The shoulders are usually black or blackish, white patch on the neck and the top of neck is black or blackish. Tail is black broadly washed with grey. Cheeks are usually pale. Under parts are whitish or buffy.

27. *Ratufa indica* (Schreber, 1784) **Malabar giant squirrel**

This is one of the most widely distributed species occupying all types of habitats. The latest population estimates (Easa and Jayaraman, 1998) indicate a good population throughout the forested areas in Kerala.

28. *Platacanthomys lasiurus* (Blyth, 1859) **Malabar spiny door mouse**

This species is easily distinguished by its combination of spiny fur, clawless hallux and bushy tail. Its ear is large and prominent, although it is usually less than one fifth of head and length. The whiskers appear very large and prominent. The back is fully covered by short flat spines, which tend to extend on to the head. The tail is haired throughout. Colour of back and tail is reddish brown. Under parts are rather greyish.

This Western Ghat endemic is distributed in deciduous and evergreen forests and teak plantation. It is arboreal in habit and occupy the hollow of trees. The species was observed at Achenkovil and Periyar Tiger Reserve. It was reported from Peppara by Jayson and Christopher (1995).

29. *Bandicota bengalensis* (Gray & Hardwicke, 1833) **Indian Mole rat**

It is characterised by rounded head and ears, and short and broad muzzle. It is easily distinguished from others by its smaller size. The general body colour is greyish brown speckled with buff undersides. Hands are with four fingers, all clawed and foot with five toes. It was observed throughout Kerala occupying all habitat types.

30. *Bandicota indica* (Bechsten, 1800) **Bandicoot rat**

This fossorial bandicoot inhabit forest fringes, cultivated fields, swampy areas and drainage systems in urban areas. It is distributed throughout India including Kerala (Chakraborty, Pers. Comm.)

31. *Rattus rattus* (Linnaeus, 1758) **Black rat**

It is a medium sized species with the tail normally dark in colour and longer than the head and body. It is widely distributed in all habitat types.

32. *Cremnomys blanfordi* (Thomas, 1881) **White tailed wood rat**

The long well haired tail that tends to be slightly tufted terminally distinguishes the species. Fur is soft. Colour of the back varies from light brown to grey. Feet

are most often white. Belly and under parts are white. Hand is with four clawed fingers and foot with five clawed toes. The fifth hind toe is rather long. It is observed in crevices of trees and rocks in scrub, plantations, moist deciduous and evergreen forests. It was recorded from Parambikulam, Achenkovil and Chinnar.

33. *Rattus ranjiniae* Agrawal and Ghosal, 1969 **Travancore rat**

It is a medium sized field rat. Dorsal fur is long with admixture of soft spines, especially along the mid-dorsal line. Dorsal colour is bistre but darker on the hind quarter. Ventral fur is dense and woolly and dirty white in colour. Whiskers are brown on the base but with white tip. Upper surface of the manus and pes is light brown. Tail is dark and unicoloured.

It is known only from Thiruvananthapuram and no record after its first description. The species is considered as vulnerable.

34. *Rattus norvegicus* (Barkewhout, 1769) **Brown rat**

It is the common rat with short tail. Colour above is brown and below light greyish. Feet are rather light. Hallux is with claw. Brain case is narrow.

35. *Golunda ellioti* Gray, 1837 **Indian bush rat**

The Indian bush rat is distributed almost throughout India among the bushes and scrub jungles.

36. *Mus musculus* (Linnaeus, 1758) **House mouse**

House mouse is an exotic which later became naturalised. It is distributed throughout India in all habitats.

37. *Mus booduga* (Gray, 1837) **Little Indian field mouse**

Distributed throughout India in forest fringes and crop fields, it was reported from Eravikulam (Pradhan, Pers. Comm.).

38. *Mus saxicola* (Elliot, 1837) **Elliot's brown spiny mouse**

It is distributed in grasslands, scrub lands and dry cultivated areas and is reported from Kerala.

39. *Mus famulus* (Bonhote, 1898) **Bemjpte's mouse**

It is distributed in high altitude shola grassland system. The species was reported

from Kannur and Eravikulam (Pradhan, Pers. Comm.). This Indian endemic is considered to be endangered.

40. *Tatera indica* (Hardwicke, 1807) **Indian gerbil**

Gerbil is common in cultivated and uncultivated grounds. Foosorial in habit, it is reported from Thiruvananthapuram.

OTTERS

Otters belong to the Mustelid group with weasels and badgers which are adapted to semi aquatic habitat. There is lot of uncertainty on the taxonomy of otters. Three species of otters are believed to be present in India and the subspecies in South India are the Eurasian otter, *Lutra lutra nair* Cuvier 1823, Oriental small clawed otter, *Aonyx cinera nirnai* Pocock 1940 and the Smooth coated otter, *Lutra perspicillata perspicillata* Geoffroy, 1826. The specific identity of otters in Kerala is yet to be confirmed.

Otters are widely distributed in the state with frequent sightings in the resrvoirs in Periyar, Kakki, Shendurney, Neyyar, Peppara, Peechi, Idukki, Malampuzha and Parambikulam. These are also sighted in the river systems such as Chalakudy, Periyar, Pamba, Cheenkanni puzha and Karuvannur. Otters, which were once very common, are now rarely seen in the backwaters and wet lands in Kochi, Thrissur, Kollam and Alappuzha. One of the major threats to the species in the state is the poachers from other states trapping the animals by camping in different parts and also by the nomadic Narikurubas.

41. *Lutra lutra* (Linnaeus, 1758) **Common otter, Eurasian Otter**

Tail is thick and muscular. Feet are paddle like and the hind limb is larger than the forelimb. Body is streamlined and almost cylindrical. Head is broad and flattened. Ears are small and nostrils valvular to prevent the entry of water. The hind teeth are furnished with sharp cusps and are adapted for piercing and crushing hard scales and retaining a close grip on slippery prey. The body is covered with hairs and the hairs of muzzle terminate above the naked nose in an angular of zig-zag line.

42. *Lutra perspicillata* (I. Geoffroy, 1826) **Smooth Indian otter**

Head and body measure 63.5 – 73.6 cms, tail 40.6 – 45.72 cms and weighs about 7.11 kg. Tail is thick and muscular and feet are paddle like. Hind limb is always

larger than the forelimb. Body is stream lined and cylindrical. Head is broad and flattened. Ears are small and nostrils valvular. The hind teeth are with many cusps adapted for piercing and crunching the prey. Coat is smooth and sleek. It is blackish to rufous chocolate-brown, sometimes tawny brown or sandy. Dorsal fur is not grizzled. The hairs of the muzzle terminate in a straight line above the nape part of the nose.

43. *Martes gwatkinsi* (Horsefield, 1851) **Nilgiri marten**

It is with a proportionately longer tail measuring three-fourths the length of head and body. The colour varies among individuals and with season. The dorsal fur is variegated with deep brown from head to rump, the forequarters being almost reddish.

Though considered as terrestrial, Madhusudan (1995) reported the species in Eravikulam National Park on a tree. It was observed in Silent Valley and Periyar Tiger Reserve. The species is considered as vulnerable.

SMALL CARNIVORES

Small carnivores are the most elusive and shy animals. Most of them are nocturnal. They are also not well studied even for the basic information of distribution.

CIVETS

It belongs to the family Viveridae and is a diverse group with the civets, palm civets, lingsan and bear cats. The commonest Small Indian Civet and Palm Civet are reported from the state. The hope of locating Malabar Civet, once considered to be extinct, is alive with its record from Elayur near Manjeri (Kurup, 1987) and survey by Ahsruf *et.al.*, (1989).

44. *Paradoxurus hermaphroditus* (Pallas, 1777) Common palm civet/toddy cat

This is one of the commonest viverrid, widely destributed throughout, both in the forests and the habitations including urban areas. There seems to be a seasonal change in the coat colour, the inferior coat being blackish as evident from the speciemen observed in Elayur near Manjeri in December. The change in coat colour leads to the identification of the animal as "Bhuthakkali veruku" considering it as different from the usual toddy cat. The animal is widely distributed in good numbers in all the areas sampled as evident from the indirect evidences and sightings.

45. *Viverricula indica* (Desmarest, 1804) **Small Indian Civet**

The small Indian civet is somewhat cat-like in general appearance having relatively long forelegs and conspicuous rounded ears. Muzzle is pointed. There is a conspicuous region of smooth black hair below the inner corner of each eye. The body colour is tawny grey or greyish brown, lined and streaked on the back and croup, spotted more or less in rows along the flanks.

There are usually some cross bars on the neck. All the four legs are black or very dark brown and often there are small patches of white fur around one or more of the paws. The tail is long and bushy but tends to a point with the hairs laterally compressed particularly in the proximal region. Dorsally, the tail is conspicuously marked with concentric black rings. There is a scent gland situated in the perineal region producing an alkaloid called civetone used in the preparation of Ayurvedic medicines. Claws are non-retractile.

The species is widely distributed all over Kerala including the urban areas such as Thiruvananthapuram, Ernakulam and Kozhikode where the animal was sighted more often while crossing the road at night . Interstingly, a good population of the animal is sighted along the coastal areas as indicated by the purposeful trapping incidences reported.

46. *Viverra civettina* (Blyth, 1862) **Malabar civet**

This is one of the critically endangered species considered to be extinct till the report of Kurup (1987) from Elayur. The crest in this species is long and fall, the contour hairs of the crest and flanks being 30 mm and 50 mm respectively. The ground colour is clear grey, the pattern is black, the spots being smaller and more spotted on the chest and shoulders. The tail has five white rings. White is more in muzzle and chin.

About a month was spent in Elayur and nearby areas setting various types of traps and making night visits. Enquiries with the local people confirm its presence in the area. There were several claims from different parts of the state on sighting of this animal. Most of these were proved to be either wrong or in some cases doubtful.

47. *Paradoxurus jerdoni jerdoni* Blanford, 1885 Brown/Jerdon's palm civet

Face of Brown palm civet is uniformly coloured or with faint traces of grey speckling, but without definite grey pattern; the body on the average is less

conspicuously speckled with grey-tipped or buff-tipped hairs. The body colour varies from glossy brown to dark brown with the back behind the shoulders, the flanks, and belly speckled with clear grey, and sane grey in front of the ears. The animal has a white tail tip and some yellow at the base of the tail. The animal has been observed in Periyar Tiger Reserve, Nelliampathy, Parambikulam and was reported from Silent Valley (Ramachandran, 1991) and Shenduruney (Ramachandran, 1996).

MONGOOSES

Mangoose, grouped into the family Herpestidae, has common mangoose, brown mangoose and stripe necked mangoose represented in the State.

48. *Herpestes fuscus fuscus* (Waterhouse, 1838) Brown Mangoose

It is a large, heavily built and blackish brown mangoose, more or less speckled with yellow or tawny. Paws are almost black. Tail is nearly equal in length to head and body. Though sightings are limited to Chinnar, Parambikulam and Periyar Tiger Reserve, there have been unconfirmed sightings in other areas also.

49. *Herpestes vitticollis* (Bennet, 1835) Stripenecked mongoose

This is the largest Asiatic mangoose. Distinctive character of this mangoose is the presence of black stripe reaching backwards from the ear to the shoulder. Coat colour is grizzled grey tipped with chestnut-red and red increasing in intensity on the hindquarters. The animal was sighted in all the sampled areas.

50. *Herpestes smithi* (Gray, 1837) Indian ruddy mongoose

Ruddy is larger than the common mangoose. Presence of black tip on its tail is its distinctive character. External pinna are much reduced and rounded, with vestigial bursa. Feet are with three digits and fossorial claws. This was observed in Chinnar, Wayanad, Silent Valley, Peppara, Periyar Tiger Reserve and Parambikulam.

51. *Herpestes endwardsi* Geoffroy Saint Hilliare, 1818 Common or Grey mongoose

This is one of the widely distributed mongooses in the state. Body colour is tawny yellowish grey. The alternate light and dark rings on its hairs gives a grizzled 'pepper and salt' tinge. The tail is long, tipped with white or yellowish-red. It is considerably large and is easily distinguished in the field by the longer contour hairs which form almost a cape along the flanks and over the hindquarters.

The head is characteristically conical with the fore crown sloping straight to the pointed nose. There seems to be changes in the coat colour. One of the animals trapped from Mannavanshola in Marayur was blackish in colour. It is distributed throughout Kerala.

LESSER CATS

Lesser cats reported from the state include leopard cat, rusty spotted cat, fishing cat and jungle cat.

52. *Felis chaus* (Guldenstadt, 1777) Jungle cat

Jungle cat is widely distributed and was observed from forested areas to coastal belt. It is comparatively larger than domestic cat. Legs are long and tail is short. The colour of eye is pale green. Colour of fur varies from grey to yellowish grey. The tail has black rings and end in black tip. The paws are pale yellowish, black or sooty brown underneath. The ears are reddish ending in a small pencil of black hairs. A dark band runs down from the inner lower corner of each eye down to the nose on either side. In sub adults, there were dark bars on inner aspects of the upper half or the forelimbs and on abdomen. The distinguishing features are the bands on the tail and legs. This was observed in almost all the areas including coastal areas of Chavakkad and even areas near cities such as Kochi.

53. *Prionailurus viverrinus* Bennet, 1833 Fishing cat

The body is covered with short earthy grey fur fused with brown. A series of elongate spots are arranged in longitudinal rows with varying size and sharpness. Six to eight dark lines run from the forehead over the crown to the neck, breaking up into shorter bars and spots on the shoulders. The cheeks are greyish white with two horizontal black or brown stripes. Two dark bars are present on the inside of the forearm. Lower parts of the body are spotted and tail is ringed with black. Fore feet have well developed web and toes. Claw sheaths are not large enough to completely envelop the retracted claws. Its tail and legs are short.
The fishing cat was believed to be distributed throughout the coastal belt and is known as "Kattanpuli". There are unconfirmed reports of its occurrence in Periyar.

54. *Prionailurus rubiginosus* (Geoffroy, 1834) Rusty spotted cat

This is one of the endangered lesser cats. This cat is about half or three quarters of the size of the domestic cat. It is lightly built and active creature with soft

smooth fawn grey coat, patterned with brown bars and spots arranged in more or less regular lines. The marking on its head and shoulders are dark brown and they change to rusty on the flanks and are reduced to smaller round spots on the hind quarters. The under parts are nearly white with black spots. Its tail is unmarked, which distinguishes it from leopard cat.

The first record of its occurrence in Kerala was from the animal located at Pushpagiri hospital at Thiruvalla. This animal was trapped from an abandoned house in Thiruvalla while raiding poultry. There was one more record of its sightings from Kundara. There are unconfirmed reports of its sightings in Kuttanad in Alappuzha district.

55. *Prionaiturus bengalensis* Kerr, 1792 **Leopard cat**

Leopard cat is one of the forest dwelling lesser cats. Ground colour and pattern vary individually, from ochreous-buff to buffish white on the flanks, but typically darker on the head and back. Spots on the flanks are typically large and well spread. The stripes on back also vary, particularly the broad ones on the shoulders. The tail typically exceeds half the length of the head and body more than twice the length of the hind foot. Its ears are more rounded and shorter. The animal was observed in Silent Valley, Sulthan Bathery and Nilambur. There are some indications of its occurrence in Idukki, Vazhachal, Aralam and Achenkovil.

LAGOMORPHS

56. *Lepus nigricollis* Cuvier, 1823 **Black-naped hare**

This is a smaller hare, being of a paler sandy– buff colouration, lacking the rufescent tinges and particularly having no trace of a collar of black hairs in the region of the lesser neck which gives to the specific name *nigricollis*. The upper lip is split and the incisors are covered with white enamel. Presence of a dark brown or black patch on the back of its neck from the ears to the shoulder is a distinctive character. It is widely distributed in the forested areas.

TRAGULIDAE

57. *Moschiola meminna* (Erxleben, 1777) **Mouse deer**

Mouse deer is a smaller cute animal with a shoulder height up to 33 cm. They have four well developed toes on each foot. Antlers are not well developed as in other deer. Limbs are slender. It is olive-brown minutely speckled with yellow. The

flanks are marked with rows of buff or white spots, which elongate and pass into longitudinal bands. The lower parts are white. The throat has three white stripes.

It is one of the shy animals difficult to be sighted. However, they were observed in Periyar Tiger Reserve, Parambikulam, Sholayar, Wayand, Nilambur, Vazhachal, Peppara, Aralam, Shendurney and Idukki. Evidences indicate its presence throughout the forested areas.

DISCUSSION

Smaller mammals are susceptible to the alterations in the habitat and thus could be a good indicator of the habitat health. In India, studies on small mammals are mostly restricted to arid and semi-arid areas (Ghosh, 1975; Prakash, 1975; Goyal and Ghosh, 1993; Prakash *et. al.,* 1995). Population changes and reproductive biology of small mammals in the cultivated landscapes were the major topic of study in the southern part of the country (Balakrishnan and Alexander, 1977; Bhat and Mathew, 1984; Balakrishnan, 1987; Bhat *et. al.,* 1987; Bhat, 1992). The recent field studies were those of Chandrasekar-Rao and Sunquist (1996), Prabhakar (1998) and Shanker (1998). These and the studies elsewhere (Walker and Rabinowitz, 1992; Wu *et. al.,* 1996) have shown that only very few species could be obtained from capture studies. Shanker (1998) could trap only nine species after covering about 20,000 trap nights. One of the limitations of the present study was the low trap success in the forested areas. Though the objective was only inventorying, the distributional details have been affected because of the low rate of capture.

The survey has resulted in an inventory of 57 small mammal species of which, a few especially the bats, could not be observed. A critical review of the erstwhile records (eg. Pillai, 1940) reveals the presence of many mammalian species abundantly in the erstwhile Travancore region.

The insectivore *Hemiechinus nudiventris,* reported from the rocky areas of the Ottappalam (Palakkad district) is worth mentioning. Pillai (1940), in the Travencore State Manual has mentioned its occurrence in areas about Nagercoil. Though Nameer (1997) has included Kerala in the distribution of the species, there is no mention of the location. Prater (1948) mentioned the distribution as the plains of South India. The local villagers in Ottappalam consider it as abundant, though not frequently sighted.

Malabar civet was considered as extinct till Kurup (1987) located it from Elayur

(Malappuram district) of northern Kerala. Both the Small Indian and Malabar civets were reported to be tamed for their secretion (Pillai, 1940). Obviously, Malabar civet which is considered as 'extinct' should have been common at least in 1940s. Wozencraft indicated that the earlier distribution of Malabar civet was confined to the coastal belt of the state (Pers. Comm., 1986). According to him, there was one record of its occurrence in Wayanad. The survey in Elayur and the enquiries through press indicate the possibility of locating a live specimen, though there could be erroneous reports from various places. It would be interesting to trace the historical records for more information on the earlier distribution in the whole of its known range.

The Rusty spotted cat, which was recorded from Thiruvalla during the survey also indicates the presence of a few of the species which were found in the low country though "not common" (Pillai, 1940). The attempt to locate the Fishing cat in all its known ranges did not succeed. It is possible that the cat has become rare in all its former ranges.

The Fishing cat was present in Thrissur district as per the District Gazetteers (Menon, 1962). There were unconfirmed claims of sighting this animal in Viyyur and the coastal belt in Chavakkad.

The grizzled giant squirrel population in Chinnar deserves special mention due to the isolated poulations in the fragments. Animals with higher dispersal capabilities survive for longer periods of time in fragmented landscapes (Karr, 1982; Laurance, 1994). But the one like grizzled giant squirrel with habitat preference and sensitivity to changes in environment could fail in the long run.

Earlier records indicate the presence of Nilgiri marten (formerly known as White cheeked marten) in Peerumade and Cardamom Hills. The species has become rare in these areas as evident from the low sightings. Two species of otters were recorded earlier from the backwaters in Kerala - the common otter and the smooth Indian otter. However, the specimen obtained from Ochira alone could be examined which agrees with the characteristics of Common otter. Conversion of wet lands and poaching have reduced its numbers in all the former ranges.

Nair (1986) mentions the occurrence of *Millivora capensis* (honey badger) in Peerumade. However, this could not be located during the present survey.

The occurrence of a colour variant of common mangoose in Mannavan shola is

also interesting. Its coat colour was fully white with brown at the hair tip. Appreciable difference in the morphological characters and confined distribution enable the institution of a species or subspecies. But we are not in a position to exercise the power only due to lack of further sightings or additional specimens.

The present survey indicates that the coastal areas of Kerala are as rich as the uplands. The Jungle cat, small Indian civet, toddy cat, otter, pangolin, painted bat, large Indian flying squirrel and common mongoose obviously prove that these areas are also viable habitats for the small mammals.

Small mammals with smaller area requirements would have been the last one to be affected due to the changes in the landscape and habitat degradation. However, the fragmentation, alteration, degradation and loss of habitat seem to have adversely affected the small mammals to a great extent. The discontinuous distribution of at least a few, especially the lesser cats like rusty spotted cat also is a cause for concern. Smaller isolated populations have been shown to be vulnerable to extinction (Simberloff and Abele, 1982). Small populations have also been vulnerable due to demographic and environmental stochasticity and loss of genetic variability and pathogenic diseases (Gilpin and Soule, 1986; Quinn and Hastings, 1987; Saltz, 1996). It will be necessary to have a concerted effort concentrating more on the distribution and status of lesser cats in selected smaller areas in the state.

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