

# Mammalian diversity, distribution and potential key conservation areas in the Western Ghats

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**An updated list confirms the presence of 134 species of wild mammals in the Western Ghats, India. The superimposed distribution range of all, and threatened species of mammals depicts the potential mammalian key diversity areas for the Western Ghats, which can be prioritized for long-term conservation. These mammalian key diversity areas are confined to the central and the southern Western Ghats. The most crucial key diversity areas for both threatened and all mammalian species occur in Pushpagiri–Talakaveri, the Nilgiri Biosphere, the Anamalai Hills, the Periyar landscape and the Agasthyamalai Hills.**

**Keywords:** Conservation, distribution range, mammals, threatened species.

PLANNING conservation and management of animal/plant species and the landscapes they inhabit requires prioritization so that the stated conservation goals are achieved efficiently. Within this perspective, Myers *et al.*<sup>1</sup> prioritized different regions of the Earth for biodiversity that they considered as ‘biodiversity hotspots’. Initially, they came up with 25 hotspots, which were later expanded to 36 hotspots by Conservation International, which included four regions of India, i.e. ‘the Himalaya’, forests of the North East and Andaman group of islands under ‘the Indo-Burma’, the Western Ghats under ‘the Western Ghats and Sri Lanka’, and the Nicobar Islands under ‘the Sundaland’.

The terrestrial area of the Earth was also prioritized for the conservation of mammals by Ceballos and Ehrlich<sup>2</sup> considering three parameters, viz. species richness, the number of restricted-range species and the number of threatened species. Though the overall richness and diversity of restricted-range species in the Western Ghats of India are less compared to many other global biodiversity hotspots, the high richness of threatened and endemic species elevates the importance of the Western Ghats as a globally important mammalian hotspot<sup>2</sup>.

Although the prioritization of the terrestrial areas of the Earth was achieved by maintaining the biodiversity of mam-

mals, prioritization of the same within each hotspot is equally important to manage the hotspots efficiently. Among the global hotspots, the forests of the Western Ghats are highly threatened due to the high density of the human population<sup>3</sup> and anthropogenic activities. The prioritization of areas for conserving and developing the protected area network was attempted in the Western Ghats by considering threatened and endemic plants, vertebrate species, forest contiguity and vegetation types<sup>4</sup>. The study identified several pockets as irreplaceable and projected further expansion of protected areas to cover these for better protection<sup>4</sup>. The Gadgil Commission<sup>5</sup> advocated that the entire area of the Western Ghats should be declared as an ecologically sensitive area (ESA), whereas the Kasturirangan Committee<sup>6</sup> reduced it to 37% to balance the economic, developmental and conservation priorities. Presently, there are 2 Biosphere Reserves, 10 National Parks (NPs), 37 Wildlife Sanctuaries (WLS) and Reserved Forests. Although the checklist of mammals was prepared earlier by Nameer *et al.*<sup>7</sup> based on the available knowledge and distribution provided in the IUCN Red List, identification of the important areas for mammalian conservation was not attempted for the Western Ghats. Since the forests of the entire Western Ghats fall under different states (Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra and Gujarat) and many administrative divisions, managing forests and providing protection becomes a serious concern. To prioritize the conservation efforts, here we compile the updated information on the distribution of mammals in the Western Ghats and identify the important areas using the richness of all and threatened mammalian species.

## Analysis

The Western Ghats, a series of hill ranges with a length of about 1600 km from north to south and an east to west width of 30–80 km, runs parallel to the western coast of southwest India<sup>8</sup>. The hill system has been classified as comprising ecological zones, viz. wet evergreen forests, dry evergreen climax forests and deciduous climax forests<sup>9</sup>. High variation in altitude and rainfall has resulted in a wide variety of forest types. In brief, Western Ghats has tropical

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evergreen forests on the western slopes and the ridges and deciduous and scrub forests in the rainshadow areas of the eastern slopes of the hill system that supports a wide array of species.

We updated the list of mammals for the Western Ghats, considering recent knowledge of their distribution and taxonomy. We have provided the status of the species according to the IUCN Red List and the Indian Wildlife Protection Act 1972. We downloaded the shapefile of the distribution maps (geographic range) from the International Union for Conservation of Nature and Natural Resources (IUCN Red List) for all the species in the Western Ghats. We further updated the range map with recent findings from the published literature and created the shapefiles for each species known to occur in the Western Ghats.

We downloaded the shapefile of the Western Ghats boundary from India Biodiversity Portal – The Western Ghats (<http://thewesternghats.indiabiodiversity.org>). We overlaid the 10 km<sup>2</sup> grid cells on the Western Ghats boundary and considered each grid cell as a minimum unit of sampling. The geographical range map of all the species, and a separately assorted range map of threatened species (all species considered as ‘Endangered’, ‘Critically Endangered’, ‘Vulnerable’ and ‘Near Threatened’ by IUCN), were superimposed on these grid cells, and they were scored as the total number of species range covering a particular cell, which we considered as species richness and threatened species richness. The grid cell score was then used to identify areas of the Western Ghats that were likely to have the highest concentration of species and threatened species. For total species, the cells having more than 70% of total species were considered priority areas. For threatened species, the cells with 8–17 species (25–50% of species) were considered moderately important, and with ≥18 species (>50% of species) as high priority areas. These were accordingly plotted on the map based on the score from the richness data of each grid cell. The creation of all shapefiles on updating with the recent findings, gridding, scoring of the grid cells, and mapping the important areas for total species and for threatened species richness were done in QGIS.

### Comments on the species occurrence and the number of species in the Western Ghats

Using the data from a status assessment made for each species during a workshop in the 1997 Conservation Assessment and Management Plan (CAMP), Nameer *et al.*<sup>7</sup> projected 135 species of mammals to occur in the Western Ghats. Nameer<sup>10</sup> developed a database for mammals in the Western Ghats in 2020, where 121 species were reported. We updated this mammal list with the current nominal distribution range depicted on the IUCN Red List, and recent findings which clarify the status of some mammalian species (Table 1).

Rhesus macaques *Macaca mulatta* occur at the northern tip of the Western Ghats, though many groups are known to

be introduced in different parts of the northern Western Ghats<sup>11</sup>. Updates on Hanuman langurs *Semnopithecus* sp. show the occurrence of two species, i.e. black-footed gray langur *Semnopithecus hypoleucos* and gray-tufted Langur *Semnopithecus priam* in the Western Ghats<sup>12–14</sup>. We added rhesus macaque and two species of langurs instead of one species of Hanuman langur to the list of primates.

Among carnivores, the occurrence of Malabar civets *Viverra civettina* and fishing cats *Prionailurus viverrinus* in the Western Ghats is debatable. The Malabar civet was considered to occur in the western slopes of the Western Ghats<sup>15,16</sup>; however, Nandini and Mudappa<sup>17</sup> suspect the existence of the species itself. The fishing cat was considered to occur along the west coast. However, the lack of evidence for the occurrence of a species in several surveys raises doubts about the occurrence of the fishing cat anywhere in the Western Ghats<sup>18,19</sup>. Thus, both species have been removed from the list.

Among rodents, the occurrence of Layard’s striped squirrels *Funambulus layardi* in the Western Ghats was based on one juvenile, and the species was described without much clarity and detail. Further explorations have not recorded this species in the region. Thus, Molur *et al.*<sup>20</sup> consider this a misinterpretation, and the species may not be found in India; it however occurs in Sri Lanka. The Ranjinis’ Rat *Rattus ranjinae* has been removed from the genus *Rattus*<sup>21</sup>, and its status is debatable and uncertain. It is thus removed from the list.

The occurrence of two species of chiropterans in the Western Ghats is unclear. There are no reliable sight records for small mouse-tailed bats *Rhinopoma muscatellum* and Schreibers long-fingered bats *Miniopterus schreibersii* in the entire Western Ghats. *Hipposideros schistaceus* is a synonym of *Hipposideros lankadiva*<sup>22</sup>. Few bat species have been recently recorded from the Western Ghats, i.e. *Barbastella darjelingensis* and *Miniopterus fuliginosus*, which are confined to the Anamalai Hills in the southern Western Ghats, and their distribution in other areas is not clear<sup>23,24</sup>.

This reveals the occurrence of 7, 23, 31 and 50 species of primates, carnivores, rodents and chiropterans respectively, and 23 other species for the entire Western Ghats (Figure 1 a). Thus, the updated list comprises the occurrence of 134 species of mammals in the Western Ghats, including 13 species under ‘Endangered’, 13 species under ‘Vulnerable’, 5 species under ‘Data Deficient’ and 7 species under ‘Near Threatened’ status (Table 1 and Figure 1 b). Although 65 species are not assessed and listed in the Indian Wildlife Protection Act, 23 species are protected under Schedule-I, while 20, 6 and 20 species are protected under Schedules II, III and IV respectively (Figure 1 c).

### Distribution of mammals in the Western Ghats

Among primates, slender lorises *Loris lydekkerianus* and bonnet macaques *M. radiata* are widely distributed<sup>25,26</sup>, while lion-tailed macaques. *M. silenus* are confined to a narrow

**Table 1.** List of mammals, their IUCN Red List status and distribution in the Western Ghats (WG), India

Order	Family	Scientific name	Common name	IUCN Red List status	IWPA status	Distribution	
Artiodactyla	Bovidae	<i>Antelope cervicapra</i>	Blackbuck	LC	I	Fragmented population, eastern slopes or plains along the WG	
	Bovidae	<i>Bos gaurus</i>	Gaur	VU	I	Entire WG	
	Bovidae	<i>Boselaphus tragocamelus</i>	Nilgai	LC	III	Eastern plains of the WG in Maharashtra and further north	
	Bovidae	<i>Gazella benettii</i>	Indian gazelle	LC	I	Eastern plains of the WG in Maharashtra and further north	
	Bovidae	<i>Nilgiritragus hylocrius</i>	Nilgiri tahr	EN	I	Fragmented population in the southern and central WG	
	Bovidae	<i>Tetracerus quadricornis</i>	Four-horned antelope	VU	I	Central WG	
	Cervidae	<i>Axis axis</i>	Spotted deer, Chital	LC	III	Entire WG	
	Cervidae	<i>Rusa unicolor</i>	Sambar	VU	III	Entire WG	
	Cervidae	<i>Muntiacus muntjak</i>	Indian muntjac, barking deer	LC	III	Entire WG	
	Suidae	<i>Sus scrofa</i>	Wild boar	LC	III	Entire WG	
	Tragulidae	<i>Moschiola indica</i>	Indian chevrotain, mouse deer	LC	I	Entire WG	
	Carnivora	Canidae	<i>Canis aureus</i>	Golden jackal	LC	II	Entire WG
		Canidae	<i>Canis lupus</i>	Grey wolf	LC	I	Eastern plains of the WG in Maharashtra and further north
		Canidae	<i>Cuon alpinus</i>	Indian wild dog or dhole	EN	II	Entire WG
		Canidae	<i>Vulpes bengalensis</i>	Bengal (Indian) fox	LC	II	Eastern plains of the entire WG
		Felidae	<i>Felis chaus</i>	Jungle cat	LC	II	Entire WG
		Felidae	<i>Panthera pardus</i>	Leopard	VU	I	Entire WG
		Felidae	<i>Panthera tigris</i>	Tiger	EN	I	Fragmented population along the WG
		Felidae	<i>Prionailurus bengalensis</i>	Leopard cat	LC	I	Entire WG
		Felidae	<i>Prionailurus rubiginosus</i>	Rusty-spotted cat	NT	I	Entire WG
		Herpestidae	<i>Herpestes edwardsii</i>	Grey (common) mongoose	LC	II	Entire WG
		Herpestidae	<i>Herpestes smithii</i>	Ruddy mongoose	LC	II	Entire WG
		Herpestidae	<i>Herpestes vitticollis</i>	Stripe-necked mongoose	LC	II	Southern WG from North Kanara
Herpestidae		<i>Herpestes fuscus</i>	Indian brown mongoose	LC	II	Southern WG and Sri Lanka	
Hyaenidae		<i>Hyaena hyaena</i>	Striped hyena	NT	III	Drier forests – north of Palghat gap	
Mustelidae		<i>Aonyx cinereus</i>	Oriental (Asian) small-clawed (clawless) otter	VU	I	Hills of the southern WG	
Mustelidae		<i>Lutra lutra</i>	Common (Eurasian) otter	NT	II	Hills of the southern WG	
Mustelidae		<i>Lutrogale perspicillata</i>	Smooth-coated otter	VU	II	Entire WG	
Mustelidae		<i>Martes gwatkinsii</i>	Nilgiri marten	VU	II	Fragmented distribution in the southern WG and also be 29 in the central WG	
Mustelidae		<i>Mellivora capensis</i>	Ratel, honey badger	LC	I	Known from Bandipur Tiger Reserve, and Sathyamangalam forests	
Chiroptera		Ursidae	<i>Melursus ursinus</i>	Sloth bear	VU	I	Entire WG
		Viverridae	<i>Paradoxurus hermaphroditus</i>	Common palm civet, toddy cat	LC	II	Entire WG
		Viverridae	<i>Paradoxurus jerdoni</i>	Brown palm civet	LC	II	Wet forests of the entire WG
		Viverridae	<i>Viverricula indica</i>	Small Indian civet	LC	II	Entire WG
	Emballonuridae	<i>Saccolaimus saccolaimus</i>	Bare-rumped sheath-tail-bat, pouch-bearing bat	LC	II	Patchy distribution, entire WG	
	Emballonuridae	<i>Taphozous longimanus</i>	Long-winged tomb bat	LC	I	Entire WG	
	Emballonuridae	<i>Taphozous melanopogon</i>	Bearded sheath-tailed bat	LC	I	Entire WG	
	Emballonuridae	<i>Taphozous nudiventris</i>	Naked-rumped tomb bat	LC	I	Few locations in the central and northern WG	
	Emballonuridae	<i>Taphozous theobaldi</i>	Theobald's bat	LC	I	Few locations in the entire WG	

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Table 1. (Contd)

Order	Family	Scientific name	Common name	IUCN Red List status	IWPA status	Distribution
	Hipposideridae	<i>Hipposideros ater</i>	Dusky leaf-nosed bat	LC		Southern and parts of the central WG
	Hipposideridae	<i>Hipposideros fulvus</i>	Fulvous leaf-nosed bat	LC		Entire WG
	Hipposideridae	<i>Hipposideros galeritus</i>	Cantor's (Fawn) leaf-nosed bat	LC		Part of the central-northern WG
	Hipposideridae	<i>Hipposideros lankadiva</i>	Indian leaf-nosed bat, Kelaart's leaf-nosed bat	LC		Known from the central and northern WG
	Hipposideridae	<i>Hipposideros pomona</i>	Andersen's leaf-nosed (round leaf) bat	EN		Northern part of the southern WG
	Hipposideridae	<i>Hipposideros speoris</i>	Schneider's leaf-nosed bat	LC		Entire WG
	Megadermatidae	<i>Megaderma lyra</i>	Greater false-vampire bat	LC		Entire WG
	Megadermatidae	<i>Megaderma spasma</i>	Lesser false-vampire bat	LC		Entire WG
	Miniopteridae	<i>Miniopterus pusillus</i>	Small long-fingered bat	LC		Known from two locations in the southern and central WG
	Miniopteridae	<i>Miniopterus fuliginosus</i>	Eastern bent-wing bat	-		Recorded in Anamalai Hills, southern WG
	Molossidae	<i>Chaerephon plicata</i>	Wrinkle-lipped free-tailed bat	LC		Recorded in Goa and Karnataka, central WG
	Molossidae	<i>Otomops wroughtoni</i>	Wroughton's free-tailed bat	DD	I	Barapade cave Karnataka, central WG
	Molossidae	<i>Tadarida aegyptiaca</i>	Egyptian free-tailed bat	LC		Entire WG
	Pteropodidae	<i>Cynopterus brachyotis</i>	Lesser dog-faced fruit bat	LC	IV	Southern and central WG
	Pteropodidae	<i>Cynopterus sphinx</i>	Short-nosed fruit bat	LC	IV	Entire WG
	Pteropodidae	<i>Eonycteris spelaea</i>	Dawn (cave fruit) bat	LC	IV	Known from two locations in the southern and central WG
	Pteropodidae	<i>Latidens salimalii</i>	Salim Ali's fruit bat	EN	I	Known from a few locations in the southern WG
	Pteropodidae	<i>Pteropus medius</i>	Indian flying fox	LC	IV	Entire WG
	Pteropodidae	<i>Rousettus leschenaulti</i>	Fulvous (rousette) fruit bat	LC	IV	Entire WG
	Rhinolophidae	<i>Rhinolophus beddomei</i>	Beddome's horseshoe bat, lesser woolly horseshoe bat	LC		Entire WG
	Rhinolophidae	<i>Rhinolophus indorouxii</i>	Horseshoe bat	DD		Recorded in Anamalai Hills, southern WG
	Rhinolophidae	<i>Rhinolophus lepidus</i>	Blyth's (Little Indian) horseshoe bat	LC		Entire WG
	Rhinolophidae	<i>Rhinolophus luctus</i>	Woolly (Great Eastern) horseshoe bat	LC		Few locations in the southern WG
	Rhinolophidae	<i>Rhinolophus pusillus</i>	Least horseshoe bat	LC		Known from two locations in the southern and central WG
	Rhinolophidae	<i>Rhinolophus rouxii</i>	Rufous horseshoe bat	LC		Entire WG
	Rhinopomatidae	<i>Rhinopoma hardwickii</i>	Lesser mouse-tailed (lesser rat-tailed) bat	LC		Entire WG
	Rhinopomatidae	<i>Rhinopoma microphyllum</i>	Greater mouse-tailed bat	LC		Northern WG
	Vespertilionidae	<i>Barbastella darjelingensis</i>	Darjeeling barbastelle	-		Recorded in Anamalai Hills, southern WG
	Vespertilionidae	<i>Harpiocephalus harpia</i>	Lesser hairy-winged bat	LC		Southern part of the southern WG
	Vespertilionidae	<i>Hesperoternus tickelli</i>	Tickell's bat	LC		Northern part of the WG
	Vespertilionidae	<i>Hypsignathus affinis</i>	Chocolate bat	LC		Known from one location in the southern WG
	Vespertilionidae	<i>Kerivoula hardwickii</i>	Hardwicke's forest bat, common woolly bat	LC		Patchy distribution in the entire WG
	Vespertilionidae	<i>Kerivoula picta</i>	Painted woolly bat	NT		Entire WG
	Vespertilionidae	<i>Murina cyclotis</i>	Round-eared tube-nosed bat	LC		Known from one location in the southern part of the southern WG
	Vespertilionidae	<i>Myotis montivagus</i>	Burmese whiskered bat	DD		Known from two locations in the southern and central WG
	Vespertilionidae	<i>Myotis horsfieldii</i>	Horsfield's mouse-eared bat	LC		Entire WG
	Vespertilionidae	<i>Myotis peytoni</i>	Peyton's whiskered myotis	DD		East-central and southern parts of India

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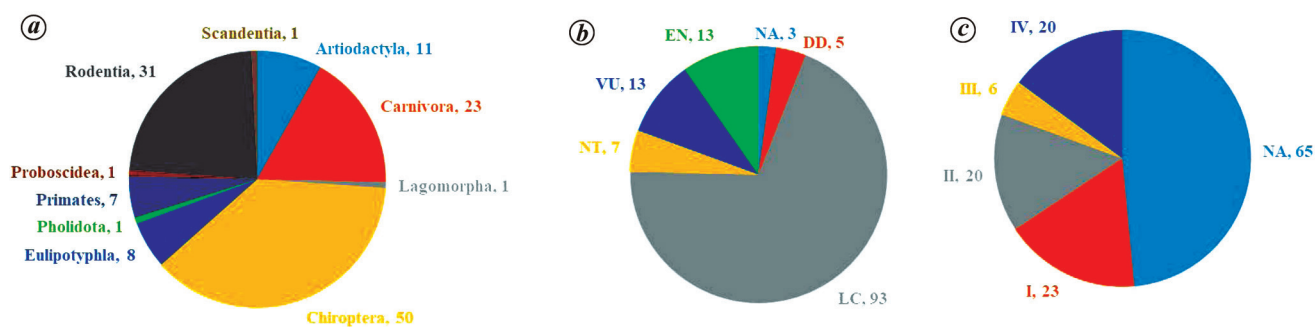
Table 1. (Contd)

Order	Family	Scientific name	Common name	IUCN Red List status	IWPA status	Distribution	
Eulipotyphla	Vespertilionidae	<i>Pipistrellus ceylonicus</i>	Kelaart's pipistrelle	LC	Entire WG		
	Vespertilionidae	<i>Pipistrellus javanicus</i>	Indian pipistrelle	LC	Entire WG		
	Vespertilionidae	<i>Pipistrellus javanicus</i>	Javan pipistrelle	LC	Entire WG		
	Vespertilionidae	<i>Pipistrellus tenuis</i>	Least pipistrelle	LC	Entire WG		
	Vespertilionidae	<i>Scotophilus heathii</i>	Greater Asiatic yellow house bat, common yellow bat	LC	Entire WG		
	Vespertilionidae	<i>Scotophilus kuhlii</i>	Lesser Asiatic yellow house bat	LC	Entire WG		
	Vespertilionidae	<i>Scotozous dormeri</i>	Dormer's bat	LC	Entire WG		
	Vespertilionidae	<i>Tylonycteris pachypus</i>	Lesser bamboo bat	LC	Part of the southern and central WG		
	Erinaceidae	<i>Paracichnus nudiventris</i>	Madras hedgehog	LC	IV	Eastern side of the WG, Kerala and Tamil Nadu	
	Soricidae	<i>Crocidura horsfieldii</i>	Horsfield's shrew	DD	Maybe entire WG		
	Soricidae	<i>Feroculus ferocalus</i>	Kelaart's long-clawed shrew	EN	Restricted distribution, recorded from Eravikulam National Park and Upper Bhavani in Nilgiri hills		
	Lagomorpha	Soricidae	<i>Suncus dayi</i>	Day's shrew	EN	Few isolated locations in the southern WG	
		Soricidae	<i>Suncus etruscus</i>	Pygmy white-toothed (Etruscan) shrew	LC	Entire WG	
		Soricidae	<i>Suncus niger</i>	Nilgiri mountain shrew	NA	Isolated patches in the central and southern WG	
		Soricidae	<i>Suncus murinus</i>	House (grey musk) shrew, musk rat	LC	Entire WG	
Soricidae		<i>Suncus stoliczkanus</i>	Anderson's (yellow-throated) shrew	LC	Northern WG		
Leporidae		<i>Lepus nigricollis</i>	Indian hare, black-naped hare	LC	Entire WG		
Manidae		<i>Manis crassicaudata</i>	Indian pangolin	EN	I	Entire WG	
Cercopithecidae		<i>Macaca mulatta</i>	Rhesus macaque	LC	II	Introduced, Some parts of the northern WG	
Cercopithecidae		<i>Macaca radiata</i>	Bonnet Macaque	VU	II	Entire WG	
Cercopithecidae		<i>Macaca silenus</i>	Lion-tailed macaque	EN	I	Kanyakumari to Aghanashini River in Karnataka WG from Kanyakumari to Kodagu	
Cercopithecidae		<i>Semnopithecus johnii</i>	Nilgiri langur	VU	I	North of Brahmagiri and Nagarhole	
Cercopithecidae		<i>Semnopithecus hypoleucos</i>	Black-footed gray langur	LC	II	South and east of Brahmagiri and Nagarhole	
Cercopithecidae		<i>Semnopithecus priam</i>	Tufted gray langur	NT	II	South of the central WG in Maharashtra	
Loridae		<i>Loris lydekkerianus</i>	Gray slender loris	NT	I	Southern and central WG	
Proboscidea		Elephantidae	<i>Elephas maximus</i>	Asian elephant	EN	I	Entire WG
Rodentia	Hystriidae	<i>Hystrix indica</i>	Indian crested porcupine	LC	IV	Entire WG	
Muridae	Muridae	<i>Bandicota bengalensis</i>	Indian mole-rat, lesser bandicoot rat	LC	IV	Entire WG	
	Muridae	<i>Bandicota indica</i>	Greater bandicoot rat	LC	IV	Entire WG	
	Muridae	<i>Cremnomys cutchicus</i>	Cutch rat	LC	Entire WG		
	Muridae	<i>Golunda ellioti</i>	Indian bush rat	LC	Entire WG		
	Muridae	<i>Madromys blanfordi</i>	White-tailed wood rat	LC	IV	Southern and Central WG	
	Muridae	<i>Millardia kondana</i>	Kondana rat	LC	EN	Known from a single location in the Northern WG (Singharh Plateau near Pune, Maharashtra)	
	Muridae	<i>Millardia melitana</i>	Soft-furred field rat (metad)	LC	IV	Entire WG	
	Muridae	<i>Mus booduga</i>	Little Indian field mouse	LC	IV	Entire WG	
	Muridae	<i>Mus cookii</i>	Cook's mouse	LC	Entire WG		
	Muridae	<i>Mus famulus</i>	Bonhote's mouse	EN	Known from two locations in the southern WG		
	Muridae	<i>Mus musculus</i>	House mouse	LC	IV	Origin uncertain, entire WG	
	Muridae	<i>Mus phillipsi</i>	Wroughton's small spiny mouse	LC	Entire WG		
	Muridae	<i>Mus platythrix</i>	Spiny field (Indian brown spiny) mouse	LC	IV	Entire WG	

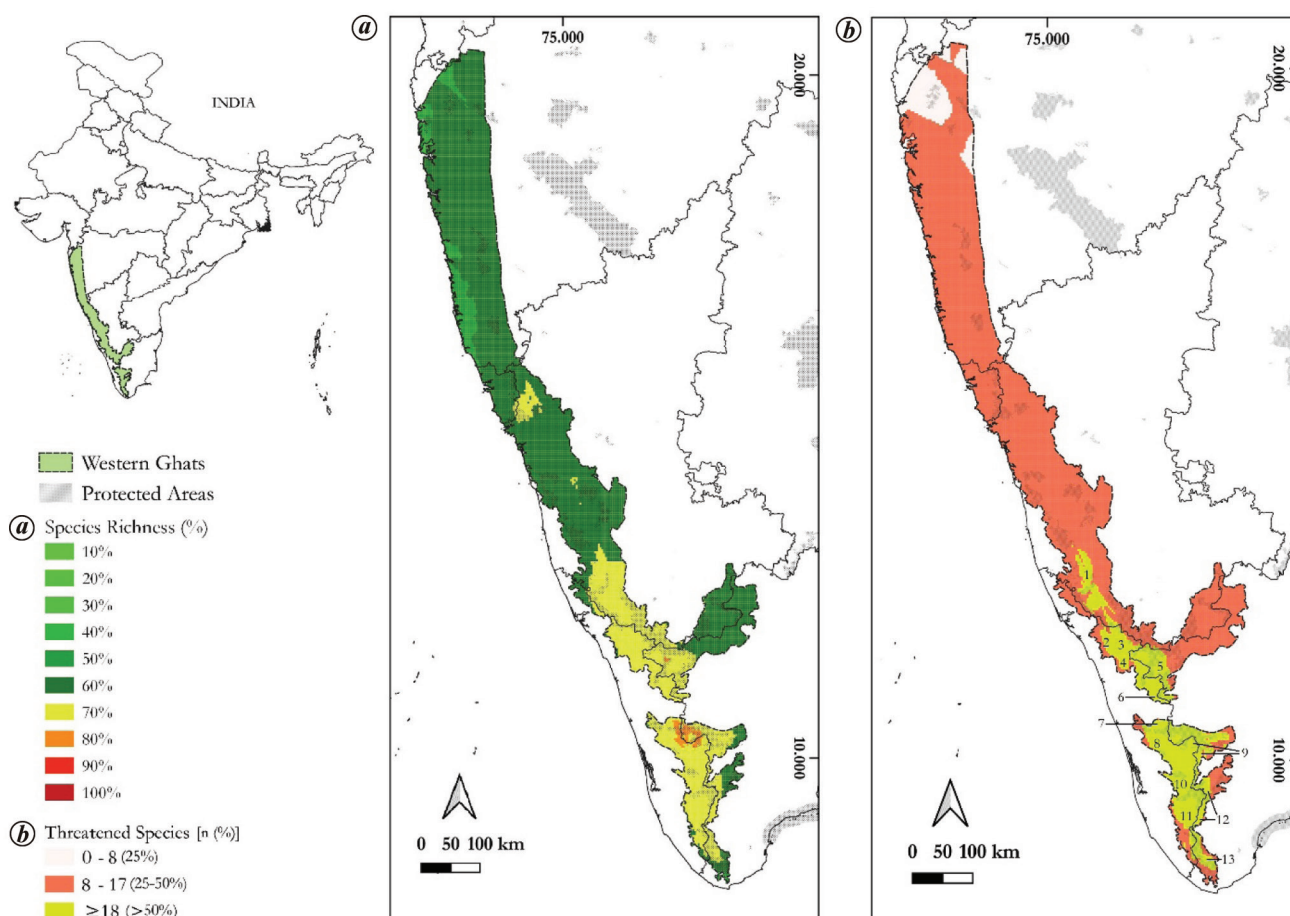
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Table 1. (Contd)

Order	Family	Scientific name	Common name	IUCN Red List status	IWPA status	Distribution
	Muridae	<i>Mus saxicola</i>	Elliott's brown spiny mouse	LC	Entire WG	
	Muridae	<i>Mus terricolor</i>	Pygmy (earth-coloured) field mouse	LC	Entire WG	
	Muridae	<i>Rattus norvegicus</i>	Brown (Norway) rat	LC	IV	Introduced, entire WG
	Muridae	<i>Rattus rattus</i>	House (roof, black) rat	LC	IV	Entire WG
	Muridae	<i>Rattus satarae</i>	Sahyadri forest rat	VU	IV	Southern and central WG
	Muridae	<i>Tatera indica</i>	Indian gerbil (antelope rat)	LC	IV	Entire WG
	Muridae	<i>Vandeleuria nilagirica</i>	Nilgiri long-tailed tree mouse	EN	IV	Known from two areas in the southern and central WG
	Muridae	<i>Vandeleuria oleracea</i>	Asiatic long-tailed climbing mouse	LC	IV	Entire WG
	Platacanthomyidae	<i>Platacanthomys lasiurus</i>	Malabar spiny-backed tree mouse	VU	IV	Wet forests of the southern and central WG
	Sciuridae	<i>Funambulus palmarum</i>	Three-striped palm squirrel	LC	IV	Entire WG
	Sciuridae	<i>Funambulus pennantii</i>	Five-striped palm squirrel	LC	IV	Introduced, Northern WG
	Sciuridae	<i>Funambulus sublineatus</i>	Dusky striped squirrel	VU	IV	Southern WG
	Sciuridae	<i>Funambulus tristriatus</i>	Western Ghats striped squirrel	LC	IV	Entire WG
	Sciuridae	<i>Petinomys fuscocapillus</i>	Travancore flying squirrel	LC	I	Western slopes – south of Goa
	Sciuridae	<i>Petaurista philippensis</i>	Indian giant flying squirrel	LC	II	Entire WG
	Sciuridae	<i>Ratufa indica</i>	Indian (Malabar) giant squirrel	LC	II	Entire WG
	Sciuridae	<i>Ratufa macroura</i>	Grizzled giant squirrel	NT	I	Patchy distribution, eastern slopes of the southern WG
Scandentia	Tupaiaidae	<i>Anathana ellioti</i>	South Indian (Madras) tree shrew	LC	IV	Entire WG



**Figure 1.** Number of mammal species under (a) different orders, (b) IUCN status and (c) Indian Wildlife Protection Act-1972 status.



**Figure 2.** Key diversity areas of (a) all and (b) threatened mammalian species richness in the Western Ghats, India.

strip of rainforests south of Aghanashini River in the central Western Ghats to the southern tip of the hill system<sup>27,28</sup>. The northern limit of the distribution range of Nilgiri langurs *S. johnii* marks Brahmagiri Hills in the central Western Ghats, whereas *S. hypoleucos* replaces the same niche at the north of these hills, and *S. priam* occupies the rainshadow areas, especially the eastern slopes of the Western Ghats<sup>12,14,28</sup>.

The elephant *Elephas maximus* is a large-bodied herbivore that occurs in the southern and central Western Ghats; nevertheless, few elephant herds occur or visit the southern

part of the northern Western Ghats<sup>29-31</sup>. Although elephants have disappeared from some parts of the northern Western Ghats<sup>32</sup>, they are widely distributed and occur in high density in parts of the southern and central Western Ghats. Other species like gaurs *Bos gaurus*, sambars *Rusa unicolor*, chitals *Axis axis*, Indian chevrotains *Moschiola indica*, muntjacs *Muntiacus muntjak* and wild boars *Sus scrofa* are widely distributed in the entire Western Ghats, while Nilgiri tahrs *Nilgiritragus hylocrius* are confined to high-altitude montane forests of the southern Western Ghats<sup>33</sup>. Conversely,

**Table 2.** Details of threatened mammal-rich areas in WG

Mammalian key diversity areas	Site	State	Forest status	Area (km <sup>2</sup> )	Elevation gradient (minimum–maximum) (m)	Vegetation
Pushpagiri–Talakaveri	Madikeri Division and Mangaluru Forest Division (Subramanya Sub-division)	Karnataka	Pushpagiri WLS, Talakaveri WLS, Reserved Forest	890	60–1700	<ul style="list-style-type: none"> <li>• Medium altitude forest type with <i>Mesua ferrea–Palaquium ellipticum</i></li> <li>• Low altitude rainforest type with <i>Persea macrantha–Diospyros</i> spp.–<i>Holigarna</i> spp.</li> <li>• Coffee and cardamom plantations</li> <li>• Wet evergreen forests</li> <li>• Grasslands</li> </ul>
Aralam–Kottiyoot–Malabar	Kottiyoor RF covers the area between Aralam WLS and Malabar WLS. The area also falls inside the Anamudi ER	Kerala	Part of Aralam WLS, Malabar WLS, Reserved Forest	320	600–1200	<ul style="list-style-type: none"> <li>• West coast tropical evergreen forest</li> <li>• West coast semi-evergreen forests</li> <li>• South Indian moist deciduous forest</li> <li>• Southern hilltop evergreen forest</li> <li>• Plantations</li> </ul>
Wayanad	Maximum area of the district	Kerala	Human-dominated landscape	650	700–2100	<ul style="list-style-type: none"> <li>• Evergreen rainforests</li> <li>• Dry mixed deciduous forest</li> <li>• Moist mixed deciduous forest</li> </ul>
Vavul Mala	Areas around the Vavul Mala Hill	Kerala	Reserved Forest	170	600–2339	<ul style="list-style-type: none"> <li>• Plantations of teak, eucalyptus and silver oak</li> <li>• Marshy lands, locally called ‘vayals’</li> <li>• West coast tropical evergreen forest</li> <li>• West coast semi-evergreen forests</li> <li>• South Indian moist deciduous forest</li> <li>• Southern hilltop evergreen forest</li> <li>• Plantations</li> </ul>
Nilgiri Biosphere Reserve	Silent Valley NP Wayanad WLS New Amarambalam WLS Karpuzha WLS Attappadi Reserved Forest Mudumalai TR Mukurthi NP Pine Forest Ooty Avalanche Hill Pandiyyar Forest O Valley	Kerala Kerala Kerala Kerala Tamil Nadu Tamil Nadu Tamil Nadu Tamil Nadu Tamil Nadu Tamil Nadu Tamil Nadu Kerala Kerala Kerala	National Park Wildlife Sanctuary Wildlife Sanctuary Wildlife Sanctuary Reserved Forest Tiger Reserve National Park Reserved Forest Reserved Forest Reserved Forest Reserved Forest Reserved Forest Reserved Forest Reserved Forest Reserved Forest Reserved Forest	5000–7000	80–2600	<ul style="list-style-type: none"> <li>• Evergreen rainforests</li> <li>• Montane forests</li> <li>• Dry mixed deciduous forest</li> <li>• Moist mixed deciduous forest</li> <li>• Grasslands</li> <li>• Thorn forests</li> <li>• Monoculture plantations, plantations of teak, eucalyptus and <i>Grewelia</i></li> </ul>
Palakkad	Gopanari RF Malampuzha Pudussery East Elivai Malai	Tamil Nadu Kerala Kerala	Reserved Forest Reserved Forest Reserved Forest Reserved Forest	300	100–2100	<ul style="list-style-type: none"> <li>• Southern wet tropical evergreen</li> <li>• Southern subtropical broadleaved hill forests</li> <li>• Grasslands</li> </ul>
Nelliampathy	Nelliampathy	Kerala	Reserved Forest	250	467–1572	<ul style="list-style-type: none"> <li>• Tropical wet evergreen forest</li> <li>• Southern subtropical broadleaved hill</li> <li>• Grasslands/tea</li> <li>• Monoculture plantations</li> <li>• Wet evergreen</li> <li>• Semi-evergreen forest types</li> <li>• Plantations of teak and tea</li> </ul>
Sholayar Reserved Forest	Koovappara Forest, Edamalayar Forest Range, Idamalayar	Kerala	Reserved Forest	550	500–2500	<ul style="list-style-type: none"> <li>• Plantations of teak and tea</li> </ul>

(Contd)



Table 2. (Contd)

Mammalian key diversity areas	Site	State	Forest status	Area (km <sup>2</sup> )	Elevation gradient (minimum–maximum) (m)	Vegetation
Anamalai Hills	Chinnar WLS	Kerala	Wildlife Sanctuary	3500–4000	300–2695	<ul style="list-style-type: none"> <li>• Evergreen rainforests</li> <li>• Montane forests</li> <li>• Dry mixed deciduous forest</li> <li>• Moist mixed deciduous forest</li> <li>• Grasslands</li> <li>• Thorn forests</li> <li>• Monoculture plantations</li> </ul>
	Anamudi Shola NP	Kerala	National Park			
	Pambadum Shola NP	Kerala	Wildlife Sanctuary			
	Parambikulam TR	Kerala	Tiger Reserve			
	Eravikulam NP	Kerala	National Park			
	Marayur Sandal Reserved Forest	Kerala	Reserved Forest			
	Anamalai TR	Tamil Nadu	Tiger Reserve			
	Bodi Hill North Forest	Tamil Nadu	Reserved Forest			
	Manjampatti–Kudiraiair–Kookal Forest	Tamil Nadu	Reserved Forest			
	Idukki WLS	Kerala	Wildlife Sanctuary			
Idukki	Cardamom Hills	Kerala	Reserved Forest	1500–1800	100–2650	<ul style="list-style-type: none"> <li>• Tropical evergreen forests</li> <li>• Grasslands</li> <li>• Semi-evergreen forests</li> <li>• Moist mixed deciduous forests</li> <li>• Eucalyptus plantations</li> <li>• Tropical evergreen forests</li> <li>• Tropical semi-evergreen forests</li> <li>• Moist deciduous forests</li> <li>• Grasslands</li> </ul>
	Mathikettan Shola NP	Kerala	National Park			
Periyar	Periyar TR	Kerala	Tiger Reserve	1900–2100	60–2100	<ul style="list-style-type: none"> <li>• Eucalyptus plantations</li> <li>• Tropical evergreen forests</li> <li>• Tropical semi-evergreen forests</li> <li>• Moist deciduous forests</li> <li>• Grasslands</li> </ul>
	Ranni Forest Division	Kerala	Reserved Forest			
	Konni RF	Kerala	Reserved Forest			
	Thenmala RF	Kerala	Reserved Forest			
Megamalai–Sivagiri	Megamalai Forest	Tamil Nadu	Wildlife Sanctuary, Reserved Forest	850	100–1700	<ul style="list-style-type: none"> <li>• Eucalyptus plantations</li> <li>• Tropical evergreen forests</li> <li>• Semi-evergreen forests</li> <li>• Dry deciduous forests</li> <li>• Moist mixed deciduous forests</li> <li>• Grasslands</li> </ul>
	Srivilliputhur Grizzled Squirrel WLS	Tamil Nadu	Wildlife Sanctuary			
	Settur RF	Tamil Nadu	Reserved Forest			
	Sivagiri RF	Tamil Nadu	Reserved Forest			
	Krishnapuram RF	Tamil Nadu	Reserved Forest			
	Vellakalthur RF	Tamil Nadu	Reserved Forest			
	Vairavankulam RF	Tamil Nadu	Reserved Forest			
	Singampatti Zamindar Forest	Tamil Nadu	Reserved Forest			
	Kanyakumari WLS	Tamil Nadu	Wildlife Sanctuary			
	Kalakad–Mundanthurai TR	Tamil Nadu	Tiger Reserve			
Agasthyamalai Biosphere Reserved	Singampatti Zamindar Forest	Tamil Nadu	Reserved Forest	450	40–1900	<ul style="list-style-type: none"> <li>• Tropical evergreen forests</li> <li>• Montane wet grasslands</li> <li>• Semi-evergreen forests</li> <li>• Teak forests</li> <li>• Moist mixed deciduous forests</li> <li>• Dry mixed deciduous forests</li> <li>• Dry savannah forests</li> <li>• Thorn scrub forests</li> <li>• Wet bamboo brakes</li> <li>• Inland wetlands and marshes</li> <li>• Riparian fringing forests</li> </ul>
	Kanyakumari WLS	Tamil Nadu	Wildlife Sanctuary			

all antelopes occur only in the eastern foothills of the Western Ghats.

Of the 23 carnivore species, 16 are small, one is a meso-carnivore and the remaining six are large. The Indian gray wolf *Canis lupus* is confined to the eastern border of the northern Western Ghats<sup>34,35</sup>, whereas the Golden jackal *Canis aureus* shows patchy distribution, and is not recorded in the wet forests of the southern Western Ghats, though it is occasionally seen in the central and the northern Western Ghats. The striped hyena *Hyaena hyaena* is known only from the eastern foothills within drier forests of the Nilgiri Biosphere (Mudumalai Tiger Reserve, Bandipur Tiger Reserve (TR), and Sathyamangalam TR). Tigers *Panthera tigris*, leopards *Panthera pardus* and dholes *Cuon alpinus* have a wide range of distribution in the entire Western Ghats; however, a sizable population occurs in a few pockets, largely in the Nilgiri Biosphere<sup>36</sup>. The brown mongoose *Herpestes fuscus*, the Nilgiri marten *Martes gwatkinsii*<sup>37</sup> and the brown palm civet *Paradoxurus jerdoni*<sup>38,39</sup> are confined to wet forests of the southern and central Western Ghats. The common palm civet *Paradoxurus hermaphroditus*, the small Indian civet *Viverricula indica*, the stripe-necked mongoose *Herpestes vitticollis* and the gray mongoose *Herpestes edwardsii* are widely distributed in the Western Ghats, while the ruddy mongoose *Herpestes smithii* is confined to the drier forests on the eastern slopes<sup>18,38,40-43</sup>. The sight records of the jungle cats *Felis chaus*, leopard cats *Prionailurus bengalensis* and rusty spotted cats *Prionailurus rubiginosus* are available from large parts of the Western Ghats. The honey badger *Mellivora capensis* is known only from a few locations in the drier forests of Bandipur TR and Sathyamngalam forests of the southern Western Ghats.

The Madras hedgehog *Paraechinus nudiventris* is confined to the eastern plains of the southern Western Ghats<sup>44</sup>. Pygmy shrews *Suncus etruscus*, South Indian tree shrews *Anathana ellioti*, house shrews *Suncus murinus*, and Horsfield's shrews *Crocidura horsfieldii* are confined to a few isolated patches in the Western Ghats. Most of the rodent species are widely distributed, where the Travancore flying squirrel *Petinomys fuscocapillus* is confined to the wet forests from the southern tip of the Western Ghats to the south of Goa<sup>45</sup>, while the grizzled giant squirrel *Ratufa macroura* is confined to a few isolated riverine forests on the eastern slopes of the southern Western Ghats<sup>46</sup>. Kondana rats *Millardia kondana* is known from a single location in Sinagharh Plateau near Pune in the northern Western Ghats<sup>20</sup>, whereas the Malabar spiny-backed tree mice *Platacanthomys lasiurus* are known from the wet forests of the southern and central Western Ghats<sup>20,47-49</sup> and Bonhot's mice *Mus famulus* are known from a few locations in the southern Western Ghats<sup>20</sup>. The Etruscan shrew *Suncus etruscus* is known from Kodagu in the central Western Ghats<sup>49</sup>. The *Rattus norvegicus* was probably an introduced species<sup>50</sup>; however, it is reported from many parts of the Western Ghats and is listed in many checklists related to the region, e.g. Nameer<sup>50</sup>; thus the species is included in the current list. Although the *Funam-*

*bulus pennantii* is known from northern India, its distribution range in IUCN Red List encompasses the northern Western Ghats, which requires proper exploration. Molur and Singh<sup>49</sup> reported the *Suncus niger* from Kodagu district, which is a recognized species. It is not under the *S. montanus*, which is restricted to Sri Lanka.

Among 50 species of bats, 24 are widely distributed while other species are confined to one or few locations in the Western Ghats<sup>51</sup>. The highly threatened Sálím Ali fruit bat *Latidens salimalii* is recorded from a few locations in the southern Western Ghats. Wroughton's free-tailed bat *Otomops wroughtoni* is known from Barapade caves in the central Western Ghats in Karnataka.

### Mammalian key diversity areas in the Western Ghats

*All species:* Of the 12,798 grid cells, 26.31% had more than 70% of species of mammals, and these cells were considered as mammalian key diversity areas. The minimum number of mammalian species in any of the grid cells was 46. The mammalian key diversity areas were largely confined to the Nilgiris and the southern Western Ghats, while three mammalian key diversity areas were in the central Western Ghats: (a) area between Anshi NP, Netravali WLS and Kali River Basin Forests; (b) area between Sharavathi Valley WLS and Shettihalli WLS and (c) area between Bandipur TR, Nagarahole TR, Bramhagiri WLS, Talakaveri WLS and Pushpagiri WLS (Figure 2 a).

*Threatened species:* Except for 11 grids, all other cells had at least one threatened species. Of the total cells, 77.34% had 8–17 species, while only 17.10% of the cells had ≥18 species that we considered as mammalian key diversity areas for threatened species. These were confined to the Nilgiris and the southern Western Ghats, except for Pushpagiri WLS, Talakaveri WLS and the adjoining reserved forests in the central Western Ghats (Table 2 and Figure 2 b). Although a large part of the mammalian key diversity area has about 23 protected areas, about 55% of the area is under reserved forest and few under private plantations.

Relatively detailed data on the distribution range are available for large mammals than small mammals. The local extinction and colonization of a species have become a natural phenomenon due to various natural and anthropogenic reasons. Thus, periodic updating of such information at a smaller geographic range will help provide a higher resolution map and prioritize the smaller units of area for conservation and management of at least biodiversity-rich regions. This study provides updated information on mammals, their current distribution range, and their key diversity areas that would help in planning conservation and management initiatives in the Western Ghats.

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