

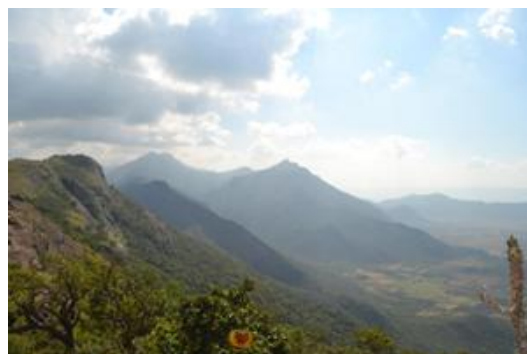
Assessing the status and distribution of large mammals in Highwavy and its environs, Southern Western Ghats



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G. Srinivas & S. Babu

Wildlife Information Liaison Development
Society, Coimbatore, India.



INTRODUCTION

The conversion of natural forests of Highway environs has been under practice since last two centuries for extracting firewood, timber and also for establishing commercially important crops such as tea, coffee, cardamom etc. In the beginning of 19th century, Wroughton (1917) identified 25 mammals and later Hutton (1949) reported 56 mammals including certain range restricted and threatened species. In 1979, Thonglongya described a new species of bat (Salim Ali Fruit bat *Latidens salimali*) from the hill range. Kumara *et al.*, (2011) mentioned that the environs hold one of the largest and viable populations of Endangered Lion-tailed macaques with higher group size. Further, Bhupathy et al., (2012) compiled various taxa from this landscape that also include mammals (62 species) and they concluded that this diversity could be due to various vegetation types and greater elevational gradient. The above review states that the Highway environs are home to diverse mammal species with patchy distribution pattern across undisturbed mosaics. Considering the paucity of information about the large mammals and significance of the Highway environs in establishing important wildlife corridor with the adjacent protected areas, the present study is initiated.

PROJECT INITIATION

Permission from Tamil Nadu forest department to carry out the research work in Theni, Srivilliputtur and Palni hills were obtained from Principal Chief Conservator of Forest and from the District Forest Officers of respective forest areas. Preliminary interaction with the DFOs and Forest Rangers of Theni and Srivilliputtur were made regarding the goal and expected output of the project. Field station was established at Chinnamanur, since it is being next to the study site.

GIS AND REMOTE SENSING WORKS DONE

The base map of Theni Forest Division and Megamalai Wildlife Sanctuary were digitized using notification of Tamil Nadu Forest Department and the same was compared with the base map of the state forest department. Despite the intensive study area, adjacent Protected Areas such as Periyar Tiger Reserve, Srivilliputtur Grizzled Squirrel Wildlife Sanctuary (SGGWLS), Mathikettan and Pambadum Shola National Parks and reserved forests (Palni hills, Munnar Division and Kottayam Division) were also digitized to identify possible critical links between the forest patches (Fig.01). Primary vegetation types in the intensive study area were digitized based on the vegetation map prepared by French institute of Pondicherry (Fig. 02). In this way 11 major vegetation types and plantations were classified and digitized. Other than these, attempts are underway to classify the vegetation types from remote sensing data (LANDSAT) by applying RS tools (ERDAS). Other than these, few remote sensing variables such as Normalized Difference Vegetation Index and Leaf Area Index were also prepared. Dams or major check dams and riparian system (Vaigai and Periyar) in and around the Highway environs were also digitized using Google Earth images and SOI topographic sheets respectively.

PARTNERSHIP WITH LOCAL STAKEHOLDERS

Establishment of partnership with the Tamil Nadu Forest Department (Inclusive of DFO's of Srivilliputtur and Theni Forest Division), local NGO's (Wildlife Association of Rajapalayam, VANAM in Theni and Ecologist in Periyar Foundation, Thekkady) and other local stake holders (farmers next to forest boundary) were made. In association with the WAR of Rajapalayam, a two-day workshop was conducted to the Sub-Inspector trainees regarding the biodiversity, which was held at Tirunelveli. One day training on "necessity and techniques for conducting census on large mammals in highway landscape" was given to the members of VANAM and other potential volunteers. This is required to them since the programme of conducting first large mammal census in the highway landscape is on pipeline. In addition, we also helped the forest department in conducting the wildlife census in SGSWLS last month (March 2012).

SAMPLING TECHNIQUES

In order to fine tune and get experience with the habitat covariates and methodologies, a reconnaissance survey was carried out in the SGGSWLS, where four sq. km grids were overlaid with the base map. Alternative grids were selected for sampling the large mammals and habitat covariates and by this way 50% of the total area was sampled. Because most portion of the Varshanad hill range (part of the intensive study area) are shared with this sanctuary and holds one of the populations of endangered grizzled giant squirrel. Further, this landscape also connects the non-protected area (*i.e.* Varshanad hills and its valley) of highway environ so to elucidate the possible potential areas in the link, we initiated the sampling in the SGSWLS. Out of 120, four sq. km grids, alternative grids *i.e.* 50% of the total grids were chosen for large mammal sampling. Within each grid, uniform sized five to eight replicates were laid in each grid. In places where we could not do eight replicates, a minimum of five replicates were sampled in the grids. Habitat covariates that influence the distribution and habitat use of large mammals were evaluated at every 100 m of a replicate. Habitat covariates include tree structural characteristics, understory characteristics, weed and anthropogenic pressure.

ENVIRONMENTAL FACTORS

Generalized linear model was fitted to the presence/absence of giant squirrel with binomial error and a logit link. Two arboreal giant squirrels (grizzled giant and Indian giant squirrel) were alone attempted to identify the landscape variables that influence the distribution and spatial variation in habitat utilization. Seven landscape variables consisting of three surrogate variables of primary productivity (Mean NDVI, CV of NDVI and Seasons maximum NDVI) and four topographic variables (Mean altitude, CV of altitude, mean slope and CV of slope). NDVI is a normalized ratio between near-infrared and red surface reflectance and its cumulative value is considered as a proxy for net primary productivity at regional and global scale. NDVI satellite images were provided 10-day maximum value composites at 1-km spatial resolution. Values of Mean_NDVI, CV_NDVI and Seasons maximum NDVI were extracted for each grid using ARC GIS tools. Mean NDVI corresponds to tree density and canopy cover and CV NDVI is a measure of the 'degree of deciduousness'. Altitude values for each 4 sq km grids were obtained from the satellite images derived from SRTM with a spatial resolution of 30m. Slope values were extracted from the digital elevation model of SRTM images.

RESULTS

SRIVILLIPUTTUR GRIZZLED SQUIRREL WILDLIFE SANCTUARY

A total of 114 km were sampled across 45 grids and it ranges from 2 to 4 km (Fig. 03). Twenty-five species of mammals were recorded including four primates and two giant squirrels. Number of species recorded in grids ranged from 4 to 14 species per grid. Encounter of indirect signs such as tracks and dropping are comparatively higher in the grids than direct sighting. Chital, sambar, gaur, porcupine and wild boar were recorded in most of the grids that we sampled. Only in nine grids each we recorded grizzled giant (Fig. 04) and Indian giant squirrel (Fig. 05) during the search trails, although the area holds one of the viable populations of grizzled giant squirrel. With respect to the population of threatened grizzled giant squirrel, most of them are believed to be in the Alagarkovil valley. But, during the study we also found a good population in the areas outside the protected areas especially in coconut, tamarind and mango plantations. Further exploration is required in plantations next to the protected area.

GLM RESULTS FOR GRIZZLED GIANT SQUIRREL

Parsimonious model of grizzled giant squirrel (GGS) presence contained CV of NDVI and season's maximum monthly NDVI. The probability of GGS presence in a 4 sq. km grid increased with season's maximum NDVI (Table 01) and decreased with increasing CV of NDVI (i.e. it prefers vegetation types with a least change in NDVI (for example Riparian forest)). Topographical variables did not have any support for explaining the presence of squirrel. Projected distribution showed two major clustered populations of GGS namely Alagarkovil valley and northern and southern slopes of Saptur range in the Srivilliputtur Grizzled Squirrel Wildlife Sanctuary and part of suitable sites are also projected in north-western slopes of Varusanad hill range of Theni Forest Division (Fig.06). We recorded the presence of GGS in the down hills of Varusanad hill range and further exploration in mid elevations of this hill range is required. Grid walk in these landscapes are progressing.

Table 01. Competing GLMs for variables influencing the presence of GGS in Srivilliputtur Grizzled Squirrel Wildlife Sanctuary

Species	Model	AIC	Δ_i	W_i
Grizzled giant squirrel	CV_NDVI + Max_NDVI	37.62	0.00	0.63
Grizzled giant squirrel	CV_NDVI + Max_NDVI + Mean_Alt	39.59	1.97	0.23
Grizzled giant squirrel	Mean_NDVI + CV_NDVI + Max_NDVI + Mean_Alt + CV_Alt + Mean_Slope	40.78	3.16	0.13

Akaike Information Criterion (AIC), the difference between AIC of the current model and the most parsimonious model (G_i) and the AIC weights (W_i) are given.

GLM RESULTS FOR INDIAN GIANT SQUIRREL

Similar to GGS, occurrence of Indian giant squirrel (MGS) in 4 sq km grid was not influenced by any of the topographical variables. The most-parsimonious model of IGS contained all NDVI based variables. The probability of occurrence of IGS increased with mean NDVI and decreased with increasing seasons' maximum NDVI (Table 02). Varied response of sympatric squirrels to the seasons' maximum NDVI value is one among the landscape variables that determines co-existence of these species in a same landscape. Projected suitable grids are found in the southern wet parts of the sanctuary (Fig. 07), where it connects wet zones of Periyar Tiger Reserve and the species have low probability in the dry zones of eastern off-shoot (Saptur range).

Table 02. Competing GLMs for variables influencing the presence of IGS in Srivilliputtur Grizzled Squirrel Wildlife Sanctuary

Species	Model	AIC	Δ_i	W_i
Indian giant squirrel	Mean_NDVI + CV_NDVI + Max_NDVI	40.11	0.00	0.53
Indian giant squirrel	CV_NDVI + Max_NDVI	40.55	0.43	0.43
Indian giant squirrel	Mean_NDVI + CV_NDVI + Max_NDVI + Mean_Alt + CV_Alt + Mean_Slope	45.10	4.99	0.04

Akaike Information Criterion (AIC), the difference between AIC of the current model and the most parsimonious model (G_i) and the AIC weights (W_i) are given.

THREATS AND CONSERVATION ISSUES

Other than cattle grazing (Fig. 08), pilgrimage and tree lopping, hunting dogs were used in the foot hills to hunt the wild animal in particular giant squirrels (See photo of such dog carrying a domestic hen - Fig. 09) and Indian chevrotain. The squirrels were captured while coming down to ground for crossing discontinuous tree canopy (Fig. 10).

THENI SCENARIO

A total of 132.1 kms were sampled across 65 grids and it ranges from 2 to 3 kms. Thirty-three species of mammals were recorded including five primates (nilgiri langur, tufted grey langur, bonnet macaque, lion-tailed macaque and grey slender Loris), two giant squirrels and a flying squirrel (Table 03). All three major carnivores namely tiger, leopard and dhole were recorded during the survey. Among the lesser carnivore, we could observe Jungle cat and vulnerable Rusty spotted cat during the night surveys in the low elevations, which is coming under the recently declared Wildlife Sanctuary. Although the upper reaches of Vellimalai region holds good population of endangered lion-tailed macaque, during our survey we could locate only single troop. Since it is found in low density, grid walk method may not give enough encounters of the species. In this context, we are planning for sweep survey/total count by employing volunteers to cover the entire stretches of high elevations, in particular estate regions. Commendable troops of vulnerable nilgiri langur were also recorded from the estate regions.

We had many informal meeting with district forest officers and other stakeholders regarding importance of estate areas (forest areas given to the estate managers for lease for planting tea, coffee, cardamom) and their role in conservation, further management related aspects, and wildlife conflict with farmers.

Fig 01. Location map of Theni Forest Division and its adjacent protected and unprotected areas

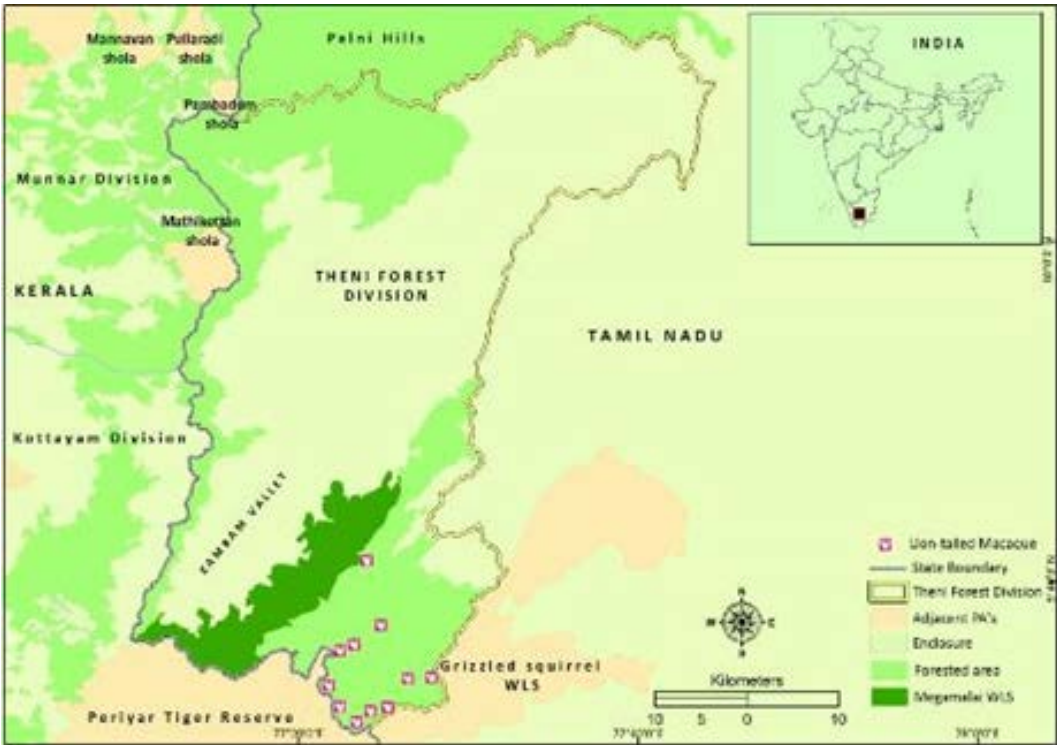


Fig 02. Vegetation map of Theni Forest Division and its adjacent landscapes

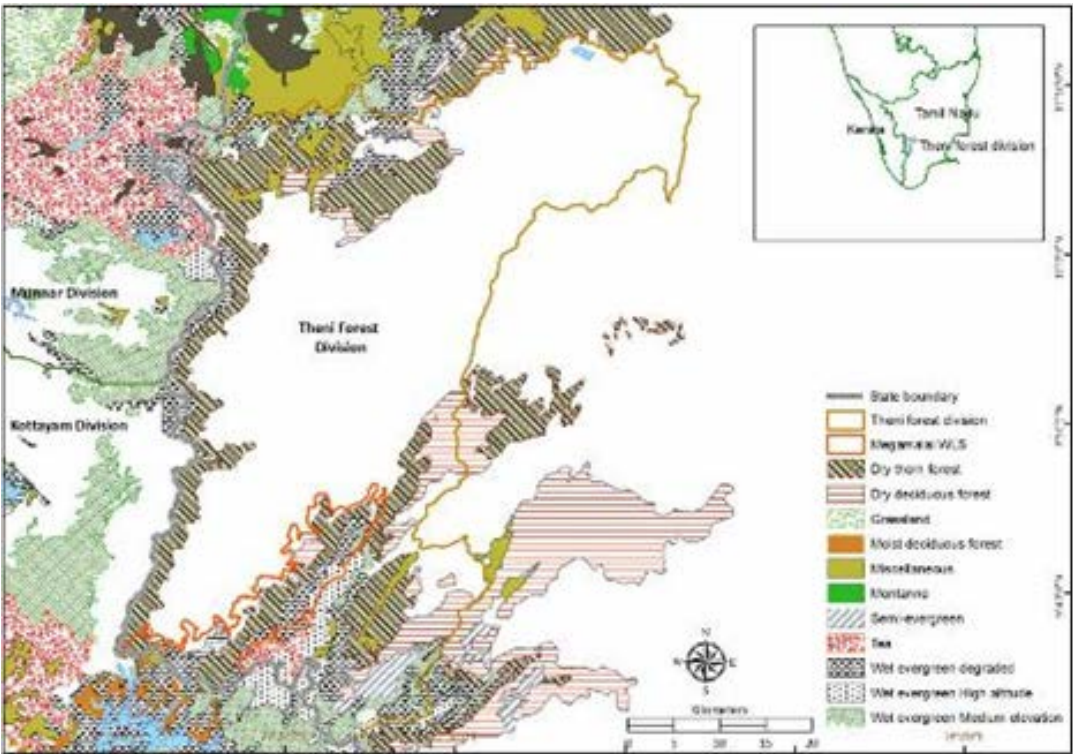


Fig. 03. Map showing the sampling grids and sampling completed grids in SGGSWLS.

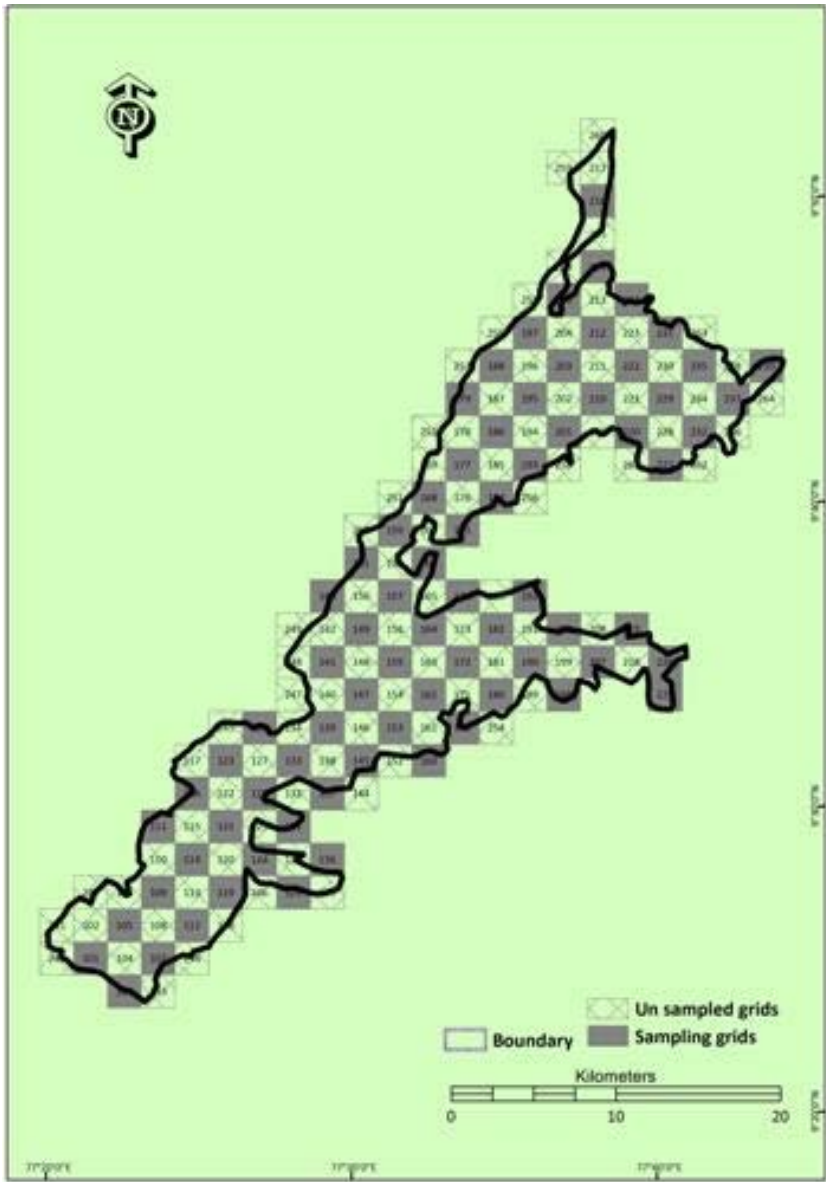


Fig 04. Grizzled giant squirrel in a coconut palm



Fig 05. Malabar giant squirrel



Fig.07. Predicted distribution of Malabar giant squirrel in SGSWLS

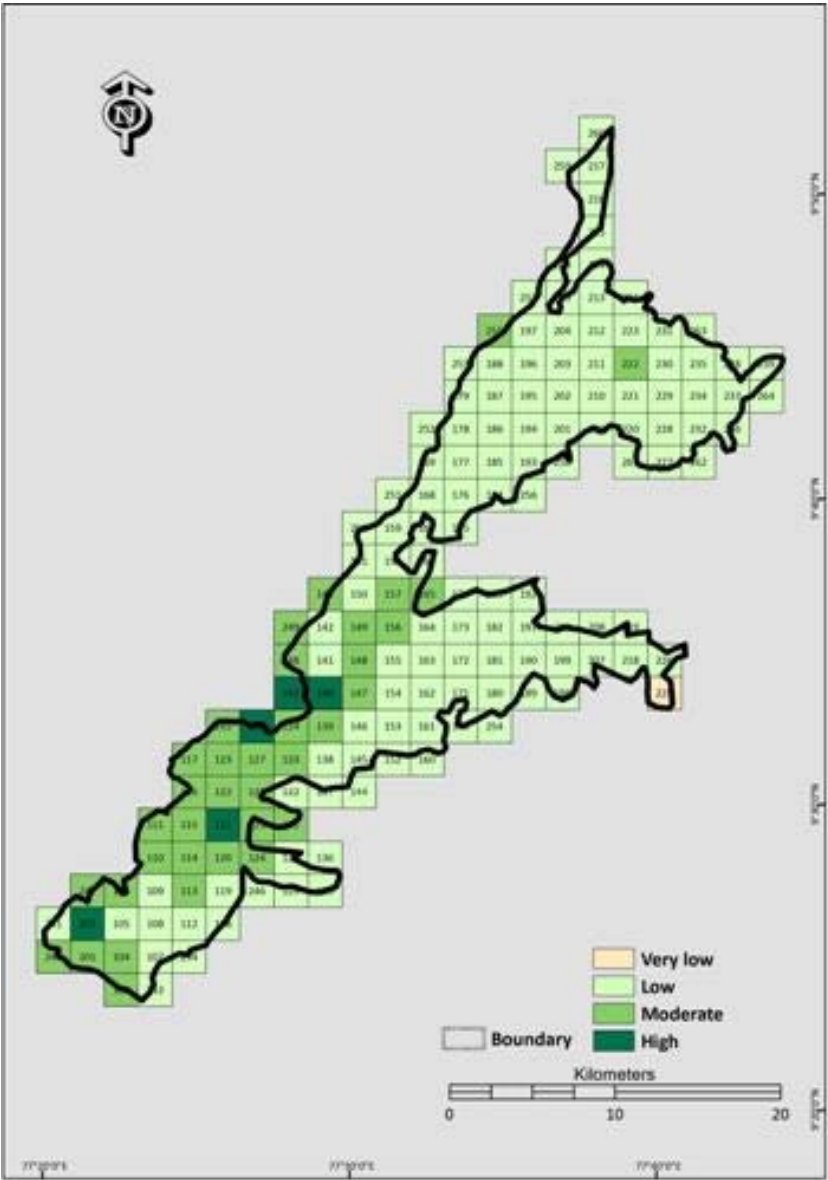


Fig 08. Cattle grazing in low elevations



Fig. 09. Dog carrying a domestic hen



Fig. 10. Grizzled giant squirrel on ground



PROPOSED ACTIVITIES

Large mammal sampling will be continued in the intensive study area and we are expecting to complete the work within this year. Camera traps are deployed by employing systematic sampling tools for understanding the presence/absence of nocturnal and elusive mammals in the grids. Nocturnal surveys were initiated in the places where there is enough road access. Since we have not completed the field work in the Theni Forest Division, we could not come out with the consolidated results however, preliminary results of Srivilliputtur alone presented.

Appendix.01. List of mammals observed in SGGSWLS and Theni Forest Division and their conservation status

S.No	Family	Common Name	Scientific Name	IUCN Status
1	Cercopithecidae	Bonnet Macaque	<i>Macaca radiata</i>	LC
2		Lion-tailed Macaque	<i>Macaca silenus</i>	EN
3		Nilgiri Langur	<i>Trachypithecus johnii</i>	VU
4		Tufted Grey Langur	<i>Semnopithecus priam</i>	NT
5	Lorisidae	Grey Slender Loris	<i>Loris lydekkerianus</i>	LC
6	Cervidae	Sambar	<i>Rusa unicolor</i>	VU
7		Southern Red Muntjac	<i>Muntiacus muntjak</i>	LC
8		Spotted Deer	<i>Axis axis</i>	LC
9	Tragulidae	Indian Chevrotain	<i>Moschiola indica</i>	LC
10	Bovidae	Nilgiri Tahr	<i>Nilgiritragus hylocrius</i>	EN
11		Gaur	<i>Bos gaurus</i>	VU
12	Suidae	Wild Boar	<i>Sus scrofa</i>	LC
13	Elephantidae	Asian Elephant	<i>Elephas maximus</i>	EN
14	Ursidae	Sloth Bear	<i>Melursus ursinus</i>	VU
15	Canidae	Golden Jackal	<i>Canis aureus</i>	LC
16		Dhole	<i>Cuon alpinus</i>	EN
17	Felidae	Leopard	<i>Panthera pardus</i>	NT
18		Tiger	<i>Panthera tigris</i>	EN
19		Jungle Cat	<i>Felis chaus</i>	LC
20		Rusty Spotted Cat	<i>Prionailurus rubiginosus</i>	VU
21	Mustelidae	Otter	<i>Lutrogale</i> sp	
22	Viverridae	Small Indian Civet	<i>Viverricula indica</i>	LC
23		Common Palm civet	<i>Paradoxurus hermaphroditus</i>	LC
24	Herpestidae	Grey Mongoose	<i>Herpestes edwardsii</i>	LC
25	Leporidae	Indian Hare	<i>Lepus nigricollis</i>	LC
26	Hystriidae	Indian Crested Porcupine	<i>Hystrix indica</i>	LC

27	Sciuridae	Indian Giant Squirrel	<i>Ratufa indica maxima</i>	LC
28		Grizzled Giant Squirrel	<i>Ratufa macroura</i>	NT
29		Common Palm Squirrel	<i>Funambulus palmaram</i>	LC
30		Large Brown Flying Squirrel	<i>Petaurista philippensis</i>	LC
31	Pteropodidae	Indian Flying Fox	<i>Pteropus giganteus</i>	LC
32	Platacanthomyidae	Malabar Spiny Dormouse	<i>Platacanthomys lasiurus</i>	VU
33	Mustelidae	Nilgiri Marten	<i>Martes gwatkinsii</i>	VU

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