



## RESEARCH PAPER

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## Population studies of Malabar Giant Squirrel (*Ratufa indica indica*) in Umblebyle Range Forest, Shimoga, Karnataka

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### Abstract

*Ratufa indica indica* commonly known as Malabar Giant Squirrel is an arboreal, upper canopy dwelling sub-species endemic to India restricted to Western Ghats. The present study attempts to estimate the population density of *Ratufa indica indica* in Umblebyle Range Forest, although similar studies are conducted in the past elsewhere, no previous study was conducted in the study area. Umblebyle Range Forest is located in the foot hills of Western Ghats adjoining Bhadra Tiger Reserve and is subjected to pressure from the villages surrounding it. The survey used line transect methodology to collect the data laid out using ARC GIS software, walking over 20 line transects covering a total area of 8753.89 Ha with an effort of 47.7kms. The study revealed the density of Malabar Giant Squirrel to be  $2.32 \pm 0.24$  individuals / km<sup>2</sup>. The current study will provide baseline data for the comparison in future studies. The present study addresses urgent need for improving the habitat making it suitable to conserve the animal in its habitat.

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## Introduction

Squirrels from the Family Sciuridae includes 5 sub-families, 58 genera and 285 species. Giant squirrels are cat sized arboreal squirrel species from sub-family Ratufinae, genus *Ratufa* including 4 species *Ratufa macroura*, *R. indica*, *R. affinis* and *R. bicolor* confined to Asiatic patch (Srinivasulu, 2004), distributed in riverine to evergreen forests with tall trees (Ramachandra, 1989; Kumara 2006).

*R. affinis* is distributed in Indonesia, Malaysia and small islands nearby and *R. bicolor* is distributed in forests of Indomalayan zootope from Maritime and mainland South asian countries to East India,

*R. macroura* is distributed in south India and Sri Lanka (Prater, 1971), restricted to some hill ranges of southern India and *R. indica* has a wider distribution in peninsular India (Daniel, 1952; Abdulali, 2011; Corbet, 1992), but occurs in fragmented populations (Molur, 2005) in dry deciduous and moist to evergreen forests of Western Ghats (Ramachandran 1988; Rout, 2005), dry forest of Eastern Ghats (Kumara, 2006) and forests of central Indian hills (Agarwal, 1979; Datta, 1996) occurring at an elevation of 180-2300m (Parter, 1980), the animal has range restriction also faced local restriction in several areas with suitable habitat limiting to area it is occurring which is mainly due to hunting and habitat loss (Molur, 2016) *R. macroura* has 3 sub species and is endemic to South Asia (Veeramani, 2018) and *R. indica* has 4 sub species namely *Ratufa indica indica* *R. i. centralis* *R. i. maxima* and *R. i. dealbata*. *Ratufa indica indica* is endemic to India distributed in northern and central Western Ghats from Mumbai to Karnataka.

The animal has been classified under Least Concern (LC) [population decreasing] category of IUCN and is listed in Appendix II of CITES and Schedule II of Indian Wildlife (Protection) Act 1972 (Sharma, 2014)

It is a large diurnal, strictly arboreal, solitary, top canopy dwelling species rarely visiting ground, found in pairs during breeding season (Ramachandran, 1988; Nowak, 1999; Hayssen, 2008). They are omnivores feeding on flowers, fruits, bark, nuts, insects and bird eggs (Payne, 1979; Ramachandran,

1992; Nowak, 1999) constructing more than one globular nest with leaves and twigs during the breeding season in higher canopy of profusely branched tall trees (Borges, 1989; Thorington, 1989; Ramachandran, 1992). Habitat fragmentation is a major reason of isolation of many species into small population and decrease of abundance of arboreal mammals (Umapathy, 2000). Increasing human population demands exploitation of natural resources causing conversion of natural vegetation into croplands resulting in shrinking habitat of wildlife affecting their distribution, also lets people close to remaining wild habits allowing hunting further affecting their population (Kumar, 2006), which is severely fragmented due to urbanization and development activities around forest patch (Das, 2021) increasing the need for management plans and conservation strategies requiring documentation of present status and distribution. The present study was designed to record the population density and distribution of *R. i. indica* in Umblebyle Range Forest which is a fragmented forest adjoining Bhadra Tiger Reserve. The animal being a great indicator of forest health, this study not only helps us understand demography of the animal but also helps us analyse forest health.

## Study area

The study was carried out in Umblebyle Range Forest (Fig. 1) located within the geographic coordinates of 14° 30' 0" to 13° 43' 0" N and 75° 30' 0" to 75° 47' 30" E situated in the south western part of Bhadravathi forest division, Shimoga Karnataka in the foot hills of Western Ghats.

The forest patch adjoins Bhadra Wildlife Sanctuary which is a biodiversity hotspot, the forest type is primarily of dry deciduous and scrub type with patches of moist deciduous patches in kakanahosudi and chornedehalli state forests of Umblebyle Range.

The terrain of the forest is highly undulating with hills and hillocks with altitude widely varying from 500 and 1520 m above (Mean Sea Level) MSL. Tunga and Bhadra rivers are main seasonal rivers draining SSE (South-South-East) part, the area enjoys Tropical

climate with annual average rainfall of 1200-2600 mm with minimum and maximum temperature of 20°C and 31°C respectively.

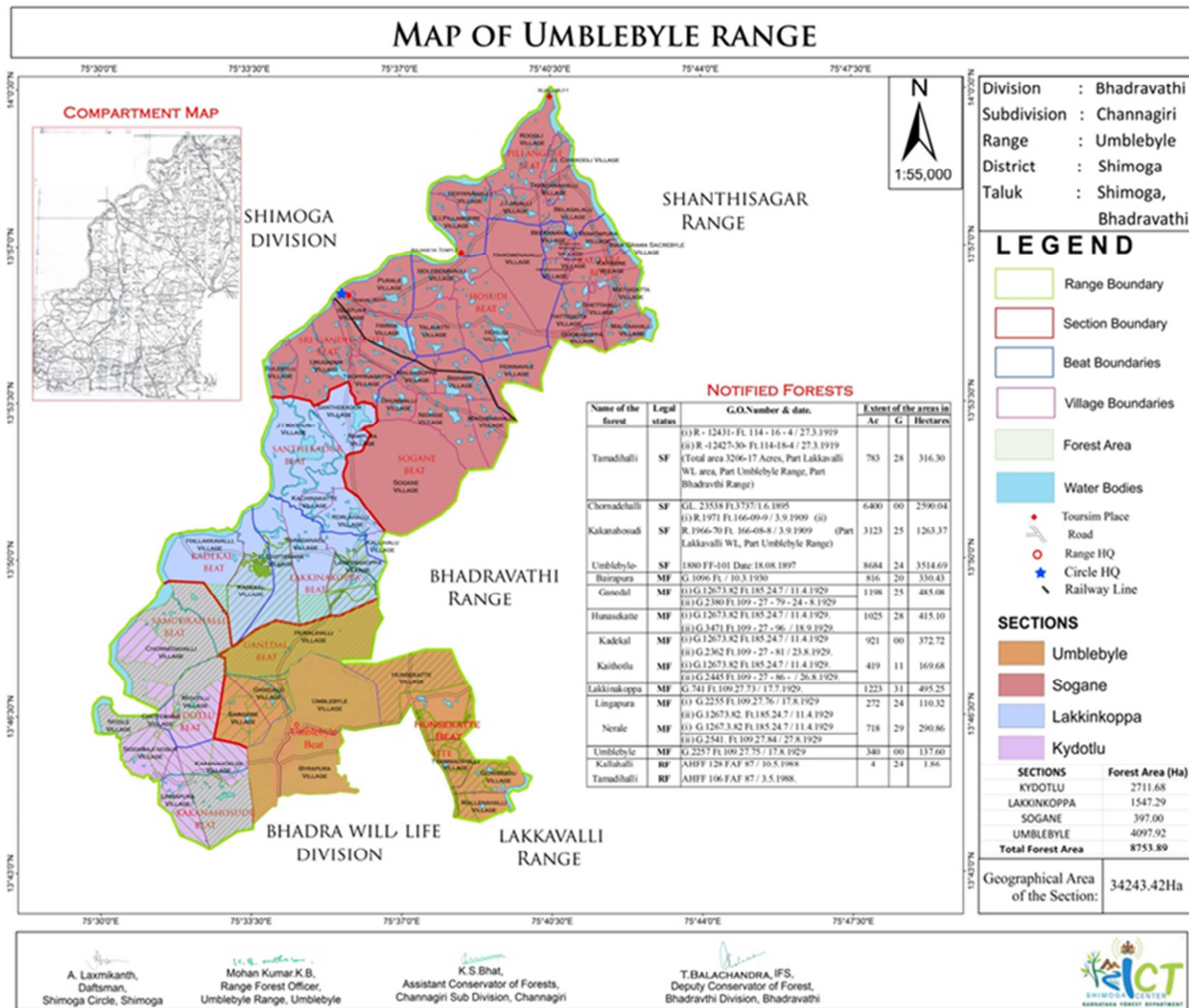


Fig. 1. Map of Umbleyle Range.

Prominent tree species include *Terminalia paniculata*, *Terminalia tomentosa*, *Tectona grandis*, *Dalbergia latifolia*, *Grewia tillifolia*, *Xylia xylocarpa*, *Kydia calycina*, *Careya arborea*, *Anogeissus latifolia*, *Schleichera trijunga*, *Wrightia tinctoria*, *Pterocarpus marsupium*, *Lagerostroemia lanceolata* *Dillenia pentagyna* and *Terminalia bellirica*. The faunal diversity comprises of Indian Elephant (*Elephas maximus indicus*), Indian bison (*Bos gaurus*), Wild boar (*Sus scrofa*), Indian Jungle cat (*Felis chaus*), Sambar (*Rusa unicolor*), Tiger (*Panthera tigris*), Indian Leopard (*Panthera pardus fusca*), Dhole (*Cuon alpines*) Jungle cat (*Felis chaus*), Palm civet (*Paradoxurus hermaphroditus*) Spotted deer (*Axis axis*), Barking deer (*Muntiacus muntjak*), Bonnet macaque (*Macaca radiata*), Hanuman langur

(*Semnopithecus entellus*), Indian pangolin (*Manis crassicaudata*), Indian crested porcupine (*Hystrix indica*), Small Indian civet (*Viverricula indica*) Flying Squirrel (*Glaucomys sabrinus*) and Malabar Giant Squirrel (*Ratufa indica indica*).

**Materials and methods**

The study was carried out using Line Transect methodology (Buckland, 1993) in the Umbleyle Range Forest walking in the line transects which were laid using ARC GIS Software ensuring to cover the entire area and keep the transects spatially equidistant. A total of 20 line transects each ranging between 2-3kms were laid covering a total area of 8753.89 Ha. The Field sampling was carried out during the month of February to April 2021 as the

visibility of the animal is best during this period, in the morning from 06:00-10:00 am as the animal is active during this period (Pradhan, 2017), each transect was walked once and repeated walks were conducted if necessary. At every sighting of squirrel group size, observer to animal distance (ocular measurement), angle of detection (digital compass), tree species on which the squirrel was sighted, activity involved, information, tree height were recorded. An Olympus binocular was used to observe and identify the tree species. Population density was estimated using Distance 7.5 statistical software. (Buckland, 2004; Thomas, 2005)

**Results**

Population density was analysed by distance sampling technique using Distance version 7.5. (Buckland *et al.*, 2004). A total of 181 sightings of Malabar Giant Squirrels were recorded on the line transects during the study with the effort of 47.81km. The output of the line transect survey intended the overall density to be  $2.32 \pm 0.24$  (SE) individuals per km<sup>2</sup> (95% confidence interval of 1.86-2.89 squirrels per km<sup>2</sup>) with the percentage coefficient variation of 10.67%.

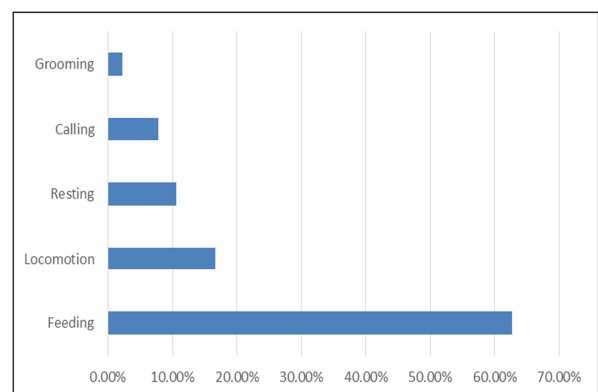
The total population in the study area was obtained by multiplying density with the total area (87.53km<sup>2</sup>) obtaining 203 individuals. The data was analysed by fitting different detection functions to the data collected to estimate the density, half-normal key with simple polynomial adjustment was selected to be the best fit model based on minimum AIC value of 851.32 and chi-square P value of 0.13709 for the giant squirrel data with the component percentages of variation (D) such as encounter rate of 84.4% and detection probability variation of 15.6.

The Malabar Giant Squirrel is a solitary animal, found in pairs during the breeding season. The sightings ranged between 1-2 squirrels and a maximum of 2 individuals were recorded in a group with mean of  $1.16 \pm 0.37$  (SD) Malabar Giant Squirrels. About 83.11% of sightings were found to have single individuals and only 16.88% of sightings comprised squirrels in pairs in the Umbleyle Range Forest.

The population studies on Giant squirrels showed variations in different study areas which could be due to variations in biotic and abiotic factors in different study areas. The estimated density of Giant squirrel in the Umbleyle Range Forest is 2.32 squirrels/km<sup>2</sup> which is greater than density from Kalakand-Mundanthurai Tiger Reserve (1.7 squirrels/km<sup>2</sup>) while is similar to density from Mudumalai Wildlife Sanctuary (2.9 squirrels/km<sup>2</sup>) and Bandipur Tiger Reserve (2.36 squirrels/km<sup>2</sup>) but lower than that of Lakkavalli area (12.25 squirrels/km<sup>2</sup>), Bhimashankar Wildlife Sanctuary (12.4 squirrels/km<sup>2</sup>), Mudumalai Tiger Reserve (6.4 squirrels/km<sup>2</sup>), Srivilliputhur Wildlife Sanctuary (6.9 squirrels/km<sup>2</sup>), Satpura National park (5.59 squirrels/km<sup>2</sup>) and Similipal Tiger Reserve (25.6 squirrels/km<sup>2</sup>).

The activity in which the squirrel was involved in every sighting was recorded (Fig 2) which was broadly categorised into feeding, resting, locomotion, calling and grooming. Feeding was the highest activity observed accounting for 62.77% followed by locomotion (16.6%), Resting (10.55%), calling (7.77%) and grooming (2.22%).

The tree species on which the squirrel was sighted during the survey was recorded and the preference of the animal to different tree species was analysed (Fig 3), a total of 34 tree species were recorded while the animal preferred few species over others.



**Fig. 2.** Activity pattern of Malabar Giant Squirrel observed during the population studies.

*Terminalia paniculata* was the most preferred tree species contributing 19.88% that included 36 trees followed by *Terminalia tomentosa* including 26 trees contributing 14.36%, *Pterocarpus marsupium* including 16 trees contributing 8.83%, *Tectona grandis* including 12 trees contributing 6.6%, *Schleichera trijunga* including 11 trees contributing 6%, *Grewia tilifolia* including 10 trees

contributing 5.52%, *Terminalia bellerica* including 8 trees contributing 4.41%, *Dalbergia paniculata* including 7 trees contributing 3.86%, followed by 3 tree species each including 6 trees contributing 9.93%, 4 tree species including 3 trees each contributing 6.6%, 6 tree species including 2 trees each contributing 6.6%, 13 tree species each including 1 tree contributing 7.15%.

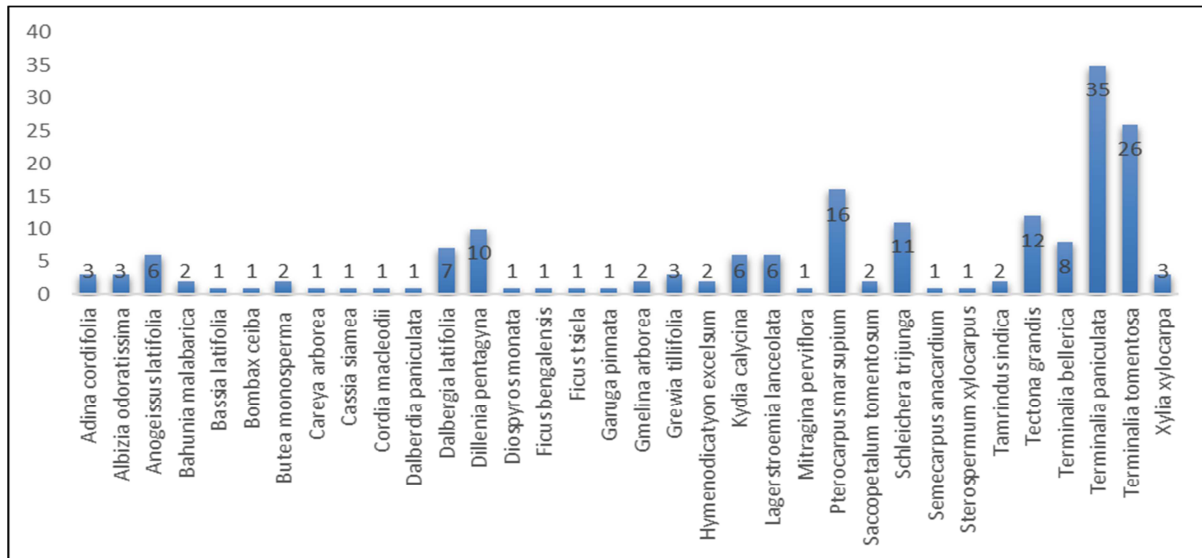


Fig. 3. Tree species on which Malabar Giant Squirrel was sighted.

**Discussion**

The density estimated in the study area provides a baseline for studies in future as this is the first effort undertaken in the Umblebyle Range Forest which can be used to compare changes occurring over time, although similar studies are conducted in Lakavalli region of Bhadra Tiger reserve, no studies on Malabar Giant Squirrel was conducted in Umblebyle Range Forest. Further the study area is discontinuous, patchy, subjected to anthropogenic pressure with villages surrounding it, over Lakavalli which has better habitat, protection methods and lesser anthropogenic pressure.

The activity pattern of Giant squirrel From Ramachandran (1988), Borges (1989) and Baskaran (2011) reports 40-60% time spent on feeding and 20-30% time spent on resting. The activity in which the animal was involved was recorded during the study

period where feeding was the highest activity involved accounting for 62.77%, resting accounted for 10.55% which is due to the time period during which the activity was recorded i.e., early in the morning when the animal is most active.

The study reveals the population density of Malabar Gaint Squirrel to be 2.32 ± 0.24 (SE) individuals per km<sup>2</sup> which is around the densities from Kalakand-Mundanthurai Tiger reserve, Mudumalai Wildlife Sanctuary and Bandipur Tiger Reserve but is significantly lesser than densities from Satpura National Park, Mudumalai Tiger Reserve, Srivilliputhur Wildlife Sanctuary, Lakkavalli area, Bhimashankar Wildlife Sanctuary and Simlipal Tiger Reserve. The Giant Squirrel being a completely arboreal, upper canopy dwelling species is extremely intolerant to habitat degradation, the animal prefers tall trees with greater GBH and canopy contiguity for

nesting, the reduction in the canopy cover, habitat loss, encroachment, Burning of trees for charcoal in the past, monoculture plantations, reduction in the diversity of tree species, firewood collection, quarrying, has significantly reduced the suitable habitat needed for the survival of the animal.

Although density of the animal is higher than that of Kalakand-Mundanthurai Tiger reserve and similar to Mudumalai Wildlife Sanctuary and Bandipur Tiger Reserve, the density is significantly lesser than that of Lakkavalli area which is situated in the north of Bhadra Tiger Reserve similar to Umblebyle Range Forest which is adjoining Bhadra Tiger Reserve. Population studies undertaken in the study area revealed the distribution of the animal to be patchy, fragmented and discontinuous. The significant reduction in density in the study area may be due to the increased anthropogenic interference encroachment and urbanisation causing habitat degradation creating patches of forests, canopy discontinuity limits the movement of Malabar Giant Squirrel restricting them to a certain area challenging the survival of the animal with the limited resources, also monoculture plantations used to meet the demands of timber doesn't provide a suitable habitat for the animal. Further construction of roads around, especially in the forest area divides the forest, breaks the canopy contiguity forcing the animal to descend to the ground that will cause accidents and road kills, Electric lines established in and around forest area can be deadly to arboreal animals, the squirrel in order to overcome canopy discontinuity may use the electric lines or may accidentally jump onto electric lines causing their death. Thus, appropriate management of anthropogenic pressure, increasing protection measures, maintaining canopy contiguity and providing the animal with suitable habitat plays a crucial role in conservation of the species in the habitat.

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This study has not received any external funding.

#### Conflicts of interests

The authors declare that there are no conflicts of interests.

#### Data and materials availability

All data associated with this study are present in the paper.

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