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# Habitat structure, Population studies of Malabar Giant Squirrel (*Ratufa indica indica*) in Umblebyle range forest, Shimoga, Karnataka, India.

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**ABSTRACT**

Malabar Giant Squirrel (*Ratufa indica indica*) of Family Sciuridae, subfamily Ratufinae is a endemic subspecies distributed in moist and dry deciduous forest of Western Ghats of Karnataka currently categorised under Least concerned category of IUCN Red List, Appendix II of CITES and protected under Wildlife Protection Act, 1972 with its population decreasing constantly. The animal being completely arboreal, upper canopy dwelling species, rarely visits grounds to overcome canopy breaks and completes its entire lifecycle on trees hence tree species diversity of the forest plays a crucial role in conservation of the animal in its habitat. The present study focuses on understanding habitat structure and population of the animal in Umblebyle Range Forest and population of the animal which was carried out using line transect methodology recording a total of 77 tree species were recorded in the study area belonging to 22 families. The density of the animal was recorded to be 2.32 ± 0.24 and 2.46 ± 0.51 individuals / $km^2$ in the year 2021 and 2022 respectively.

**KEY WORDS**

*Ratufa indica indica*, Oriental Giant Squirrels, Habitat structure, Population studies. Umblebyle Range Forest.

**INTRODUCTION**

Malabar Giant Squirrel from the Family Sciuridae, subfamily Ratufinae is one among the Oriental Giant squirrels, group of cat sized giant squirrels. The animal one of the 4 subspecies of the *Ratufa indica* endemic to Western Ghats of Karnataka distributed from Mumbai to Karnataka. The animal is a diurnal, solitary, altricial, arboreal, upper canopy dwelling rodent, currently categorised under Least concerned category of IUCN Red List, Appendix II of CITES and protected under Wildlife Protection Act, 1972 with population decreasing local trend found distributed in moist deciduous to dry deciduous forests of Western Ghats (Ramachandran 1988; Rout, 2005), occurring at an elevation of 180-2300m (Parter, 1980), the animal being extremely intolerant to habitat fragmentation, occurs in fragmented populations (Molur, 2005) caused due to Habitat fragmentation, increasing human population demands, anthropogenic pressure, exploitation of natural resources, conversion of

forests into plantations and croplands, shrinking habitat, poaching, hunting, urbanization and development activities around forest (Das, 2021). Understanding the demography of the animal helps us to analyse current status of the forest as the animal is a great indicator of forest health.

**STUDY AREA**

The Umblebyle range forest belonging to Shimoga and Chikmagaluru districts of Karnataka is located within the geographic coordinates of latitudes 14 ° 0′ 30″ to 13° 43′ 0″ N and longitudes 75° 30′ 0″ to 75° 47′ 30″ E in the south-western part of Bhadravathi forest division, Shimoga, Karnataka. The area enjoys tropical climate throughout the year with annual average rainfall of 769.4 mm, and minimum and maximum temperatures of 20˚C and 31˚C respectively. The area is drained by the seasonal tributaries of Tunga and Bhadra river most of which dry up on the onset of summers creating scarcity of water in the forest. The topography of the location showcases undulating hills and hillocks varying between 500 and 1520 m above (Mean Sea Level) MSL. The area is divided into 4 sections of which one is completely deprived of forest cover, so the study was only carried out in Umblebyle, Kydotlu, Lakkinkoppa sections with forest cover.

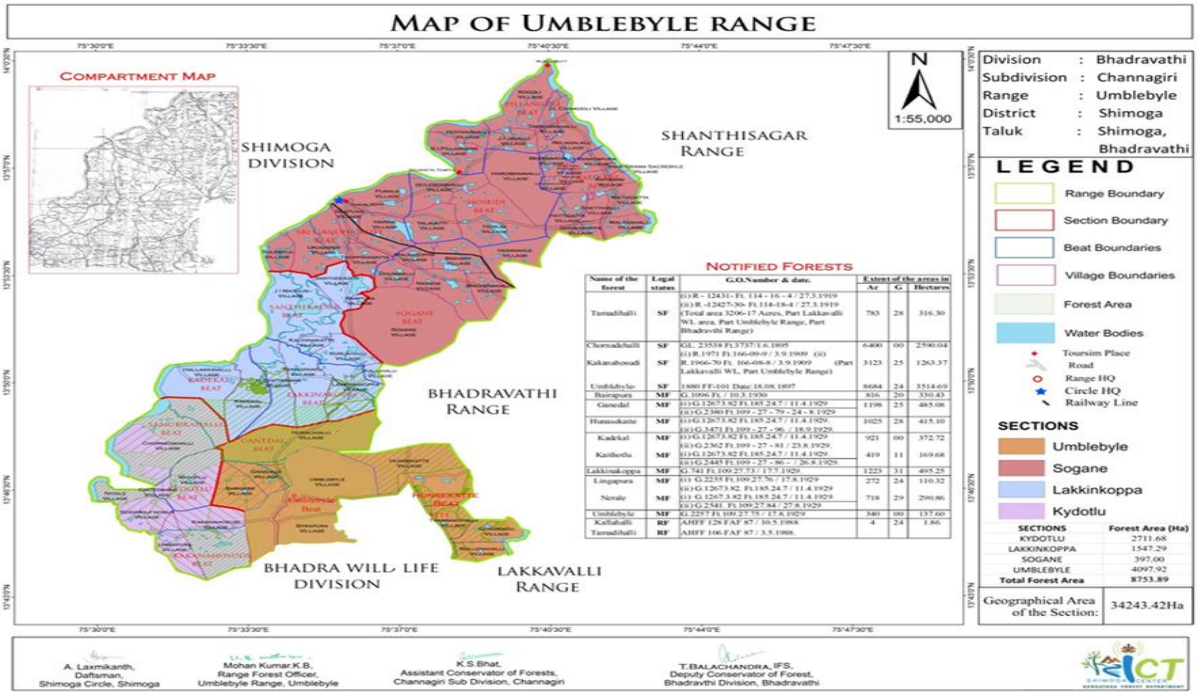


Fig. 1: Map of Umblebyle Range Forest

**METHODOLOGY**

The study area was surveyed during the preliminary survey to understand the basic ecology of the forest and based on the availability of the forest, fragmentation, nesting, animal activity, sightings, line transects were laid using Arc GIS software, ensuring they covered the entire study area and were spatially equidistant.(Buckland 1993). Further quadrants of 20x20m were then laid at every 250m interval of line transect to habitat; these quadrants were then surveyed to collect information on individual tree species, GPS location of trees, height of the trees etc. For the population studies data was collected walking on the same line transect methodology in the months of February to April of 2021 and 2022 by walking line transects in the morning from 06:00 am – 10:00 am as the activity of the animal was found to be highest during this time period (A. K. Pradhan 2017). On sighting of an animal, tree species on which the animal was sighted, animal bearing activity, GPS location of

the animal, distance of the animal from the transect, angle of detection were recorded (K. N. Basanta 2015) and the data collected were noted down on data sheets and the Scientific names were ascertained from the books Forest plants of the Nilgiris and Endemic woody plants of the Western Ghats. The data was further analysed using SPSS statistical software, Graphpad Prism and Distance 7.5 software.

**Results and Discussion**

A total of 4892 trees belonging to 77 tree species and 31 families (Table 1, Figure 2.) and 77 tree species were recorded in the study area (Table 1). Among the 31 families recorded Fabaceae was the most abundant family including 19 tree species contributing 25%, followed by Moraceae with 6 tree species contributing 8%, Combretaceae with 5 tree species, contributing 6%, and 3 tree species each including 3 tree species contributing 15% altogether.

| | | | |
|---|---|---|---|
| Anacardiaceae | 1 | Fabaceae | 19 |
| Annonaceae | 1 | Lamiaceae | 3 |
| Apocynacae | 2 | Lecythidaceae | 2 |
| Arecaceae | 1 | Loganiaceae | 1 |
| Bignoniaceae | 4 | Lythraceae | 2 |
| Boraginaceae | 1 | Malvaceae | 4 |
| Burseraceae | 1 | Moraceae | 6 |
| Calophyllaceae | 1 | Mythraceae | 2 |
| Cannabaceae | 1 | Phyllanthaceae | 1 |
| Celastraceae | 1 | Proteaceae | 1 |
| Cochlospermaceae | 1 | Rhamnaceae | 1 |
| Combretaceae | 5 | Rubiaceae | 4 |
| Cornaceae | 1 | Rutaceae | 3 |
| Dilleniaceae | 1 | Sapindaceae | 2 |
| Ebenaceae | 2 | Sapotaceae | 1 |
| Euphorbiaceae | 1 | | |

Table 1. Diversity of Family in Umblebyle Range Forest.

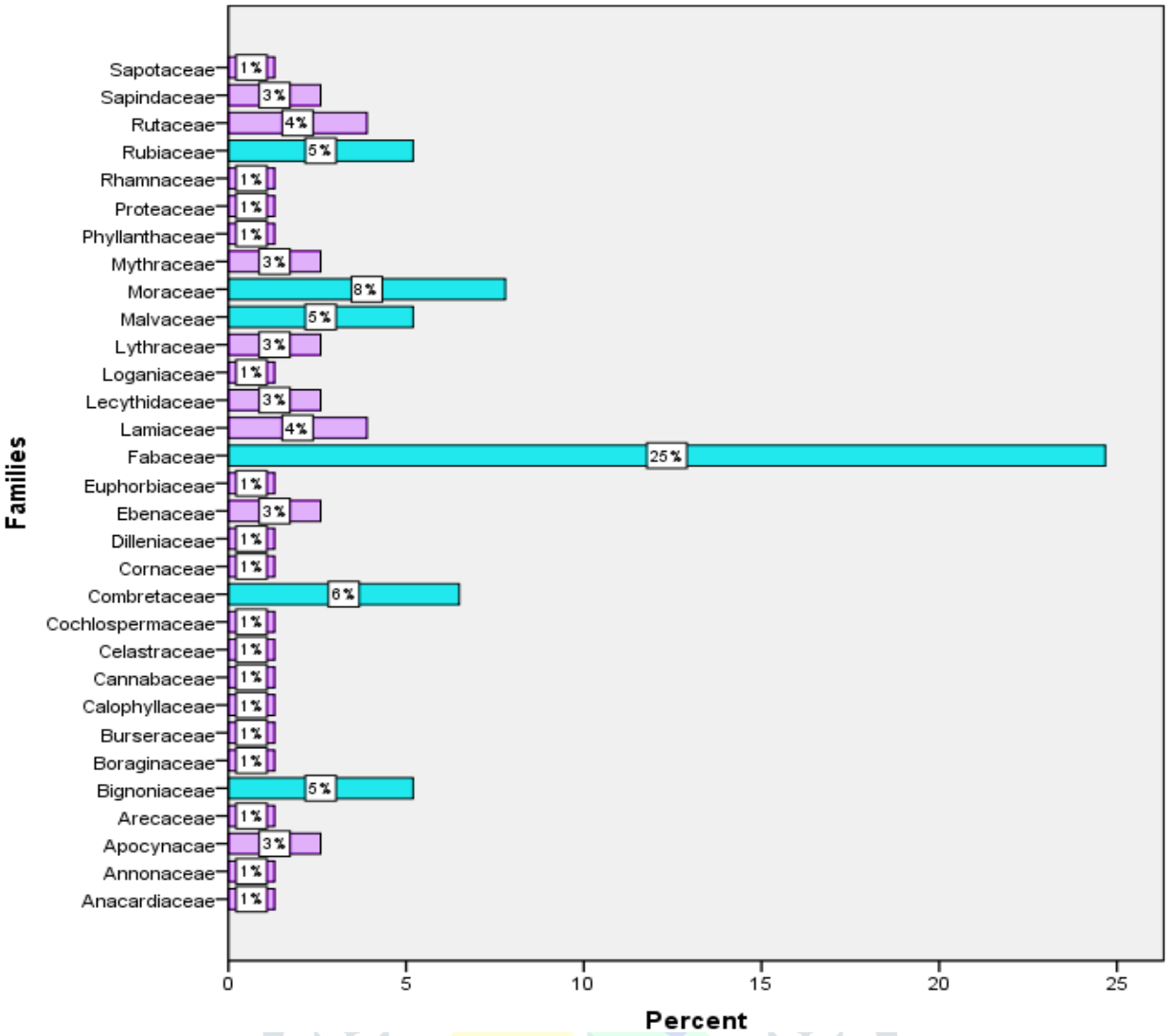


Figure 2. Percentage contribution of Families in Umblebyle Range Forest.

The tree species diversity of the forest was analysed by categorizing the tree species recorded during the habitat survey into 3 groups namely most abundant, average and least abundant using quadrille deviation in SPSS, of the 77 tree species recorded (Table 2.) only 19 species were most abundant contributing 84.09%, there were 43 tree species with average abundance while they only contributed 15.18% and a total of 15 tree species had lowest abundance making a overall of 0.97% contribution to the tree species diversity. Of the most abundant tree species (Figure 2.) there were 5 tree species which had highest contribution to the abundance namely *Terminalia tomentosa*, *Terminalia paniculata*, *Tectona grandis*, *Anogeissus latifolia* and *Xylia xylocarpa*.

| Most Sighted | | Average Sighted | | Least Sighted | |
|---|---|---|---|---|---|
| 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| *Terminalia paniculata* | *Terminalia paniculata* | *Anogeissus latifolia* | *Terminalia bellerica* | *Semecarpus anacardium* | *Saccopetalum tomentosum* |
| *Terminalia tomentosa* | *Terminalia tomentosa* | *Lagerstroemia lanceolata* | *Lagerstroemia lanceolata* | *Sterospermum xylocarpus* | *Diospyros monata* |
| *Pterocarpus marsupium* | *Schleichera trijunga* | *Kydia calycina* | *Tectona grandis* | *Cordia macleodii* | *Pongamia pinnata* |
| *Tectona grandis* | *Anogeissus latifolia* | *Albizia odoratissima* | *Hymenodicatyon excelsum* | *Garuga pinnata* | *Dalbergia paniculata* |
| *Schleichera trijunga* | *Pterocarpus marsupium* | *Xylia xylocarpa* | *Adina cordifolia* | *Diospyros monata* | *Ficus tsiela* |
| *Dillenia pentagyna* | *Dillenia pentagyna* | *Grewia tillifolia* | *Grewia tillifolia* | *Dalbergia paniculata* | *Syzigium cumini* |
| *Terminalia bellerica* | *Dalbergia latifolia* | *Adina cordifolia* | *Garuga pinnata* | *Cassia siamea* | *Eucalyptus globulus* |
| *Dalbergia latifolia* | *Xylia xylocarpa* | *Saccopetalum tomentosum* | *Ficus bengalensis* | *Careya arborea* | |
| | | *Bahunia malabarica* | *Semecarpus anacardium* | *Bombax ceiba* | |
| | | *Tamrindus indica* | *Albizia odoratissima* | *Ficus bengalensis* | |
| | | *Butea monosperma* | *Gmelina arborea* | *Mitragina perviflora* | |
| | | *Gmelina arborea* | *Strychnos nux-vomica* | *Bassia latifolia* | |
| | | *Hymenodicatyon excelsum* | *Kydia calycina* | | |
| | | | *Bombax ceiba* | | |
| | | | *Chloroxylon sweitenia* | | |

Table 2. Abundance of tree species in Umblebyle Range Forest

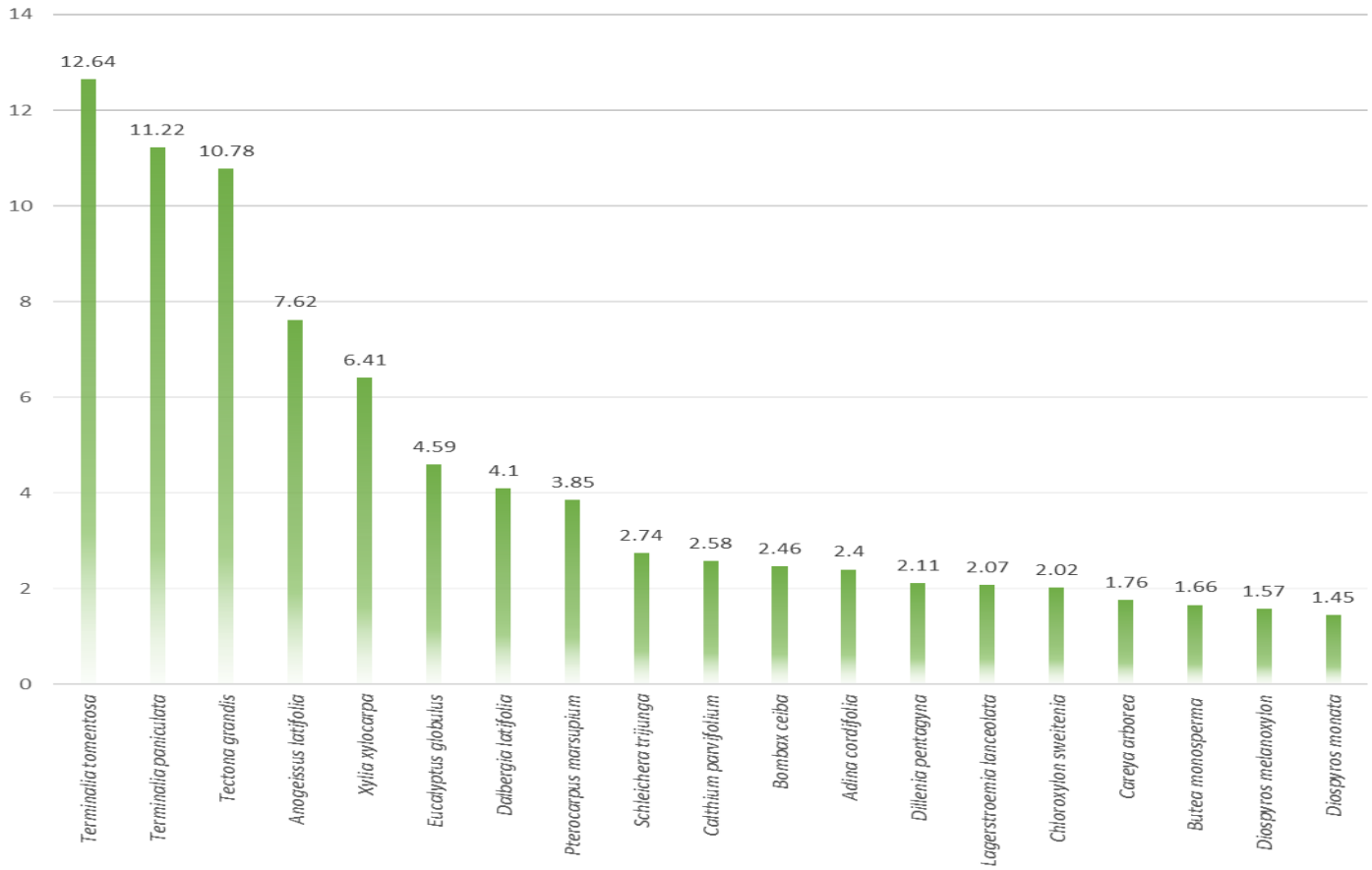


Figure 3. Most abundant trees species of Umblebyle Range Forest.

The tree species were categorised into deciduous, evergreen and semievergreen, Umblebyle being a dry to moist deciduous forest had highest abundance of deciduous trees over evergreen and semievergreen trees, 62 among 77 tree species were found to be deciduous while only 10 and 5 tree species were found to be evergreen and semi-evergreen respectively. The trees were further categorised based on their height and GBH. The forest was dominated by trees of average GBH and tree height 40 and 42 of 77 tree species were found to have average height and GBH while only 19 tree species were tall with wide GBH and 18 and 16 tree species were short with average GBH (Table 3.)

Malabar Giant Squirrel was spotted on a total of 33 and 30 tree species belonging 17 and 16 Families in the year 2021 and 2022 respectively (Figure 4, 5). Among the Families recorded Fabaceae (27%, 2021 and 20%, 2022) was the most abundant family followed by Combretaceae (12%, 2021 and 13%, 2022), Malvaceae (9%, 2021 and 10%, 2022), Rubiaceae (9%, 2021 and 7%, 2022), Lamiaceae (6%, 2021 and 7%, 2022), Moraceae (3%, 2021 and 7% 2022) and Mythraceae (7%, 2022).

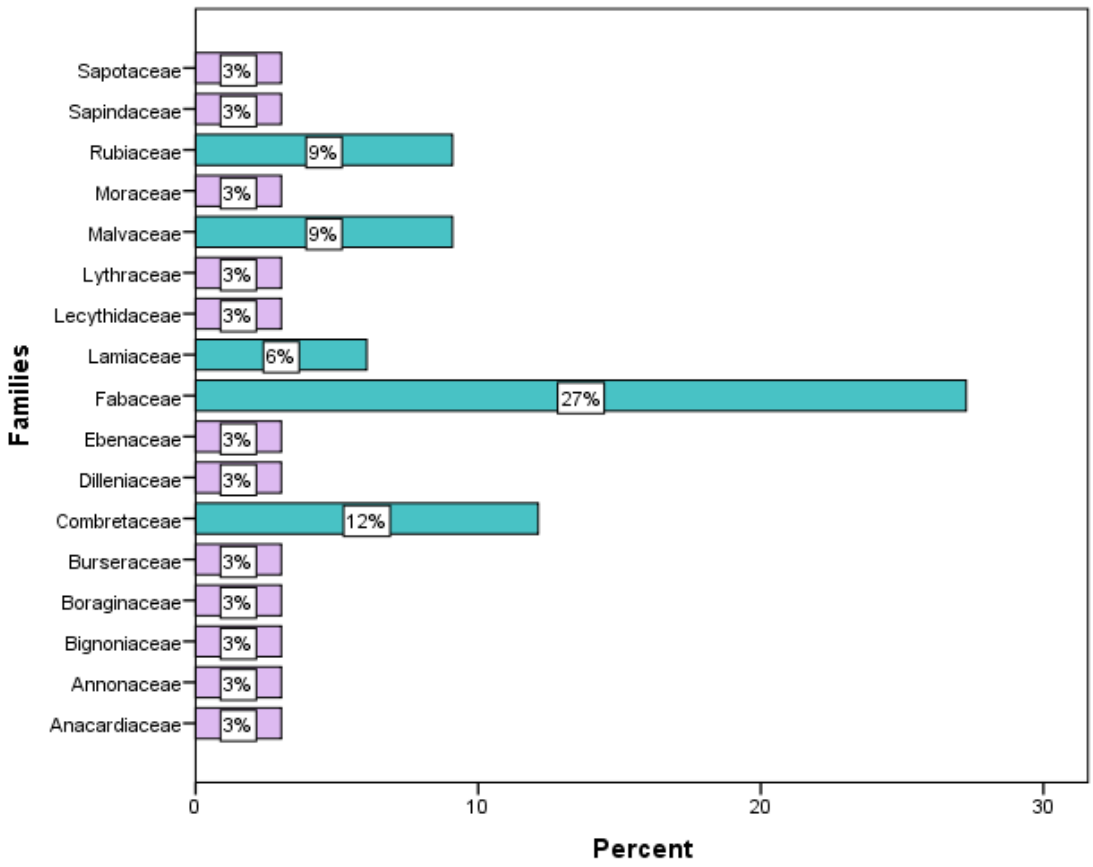


Figure 4. Family usage by Malabar Giant Squirrel in 202

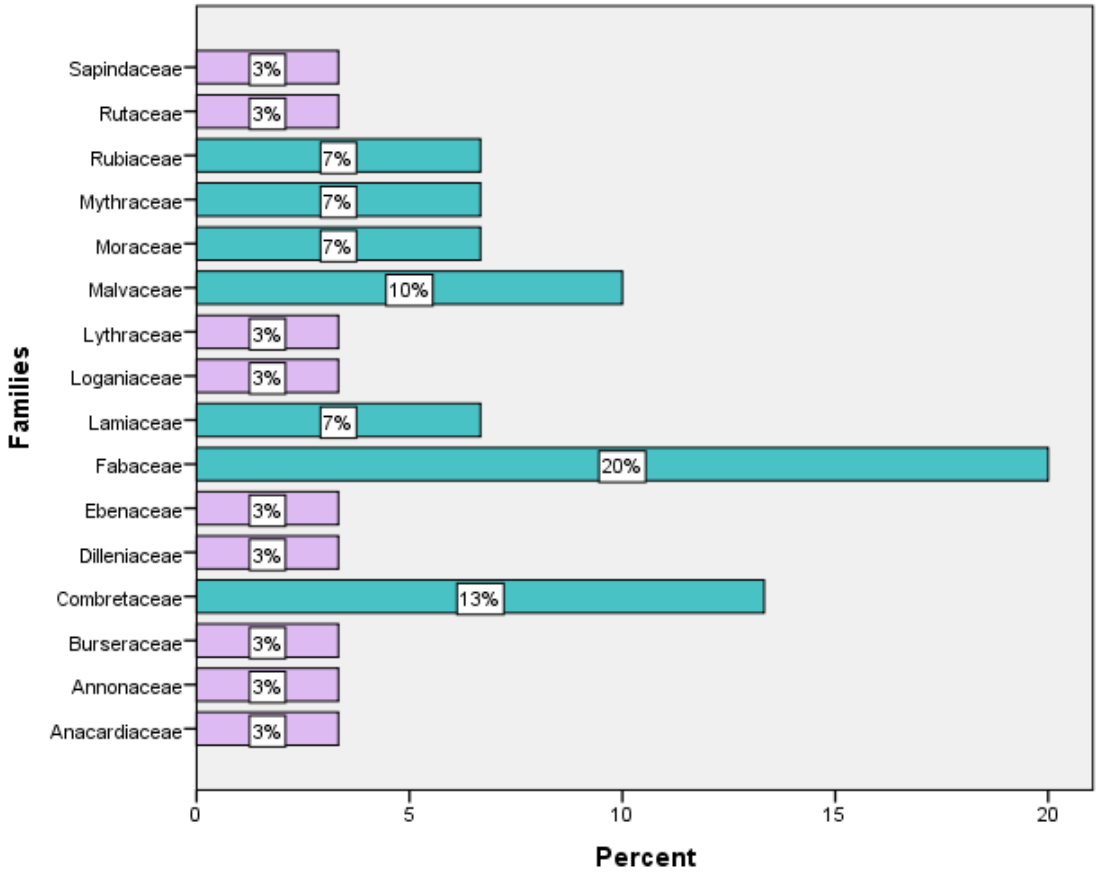


Figure 5. Family usage by Malabar Giant Squirrel in 2022

The tree species on which Malabar Giant Squirrel was sighted was recorded (Table 4.), and the animal was sighted most on 8 tree species which comprised 70.01% (2021) and 70.06% (2022) of overall sightings, average sightings included 13 and 15 tree species contributing 23.20% (2021) and 26.28% (2022) and least sightings included 12 and 7 tree species contributing 6.62% (2021) and 3.6% (2022) respectively. Among the most sighted tree species, *Terminalia paniculata*, *Terminalia tomentosa*, *Pterocarpus marsupium*, *Schleichera trijunga*, and *Terminalia ballerica* had highest sightings both in the year 2021 and 2022 (Figure 6.)

| Most Sighted | | Average Sighted | | Least Sighted | |
|---|---|---|---|---|---|
| 2021 | 2022 | 2021 | 2022 | 2021 | 2022 |
| *Terminalia paniculata* | *Terminalia paniculata* | *Anogeissus latifolia* | *Terminalia bellerica* | *Semecarpus anacardium* | *Saccopetalum tomentosum* |
| *Terminalia tomentosa* | *Terminalia tomentosa* | *Lagerstroemia lanceolata* | *Lagerstroemia lanceolata* | *Sterospermum xylocarpus* | *Diospyros monata* |
| *Pterocarpus marsupium* | *Schleichera trijunga* | *Kydia calycina* | *Tectona grandis* | *Cordia macleodii* | *Pongamia pinnata* |
| *Tectona grandis* | *Anogeissus latifolia* | *Albizia odoratissima* | *Hymenodicatyon excelsum* | *Garuga pinnata* | *Dalbergia paniculata* |
| *Schleichera trijunga* | *Pterocarpus marsupium* | *Xylia xylocarpa* | *Adina cordifolia* | *Diospyros monata* | *Ficus tsiela* |
| *Dillenia pentagyna* | *Dillenia pentagyna* | *Grewia tillifolia* | *Grewia tillifolia* | *Dalbergia paniculata* | *Syzigium cumini* |
| *Terminalia bellerica* | *Dalbergia latifolia* | *Adina cordifolia* | *Garuga pinnata* | *Cassia siamea* | *Eucalyptus globulus* |
| *Dalbergia latifolia* | *Xylia xylocarpa* | *Saccopetalum tomentosum* | *Ficus bengalensis* | *Careya arborea* | |
| | | *Bahunia malabarica* | *Semecarpus anacardium* | *Bombax ceiba* | |
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| | | *Butea monosperma* | *Gmelina arborea* | *Mitragina perviflora* | |
| | | *Gmelina arborea* | *Strychnos nux-vomica* | *Bassia latifolia* | |
| | | *Hymenodicatyon excelsum* | *Kydia calycina* | | |
| | | | *Bombax ceiba* | | |
| | | | *Chloroxylon sweitenia* | | |

Table 4. Tree species on which Malabar Giant Squirrel was sighted in Umblebyle Range Forest

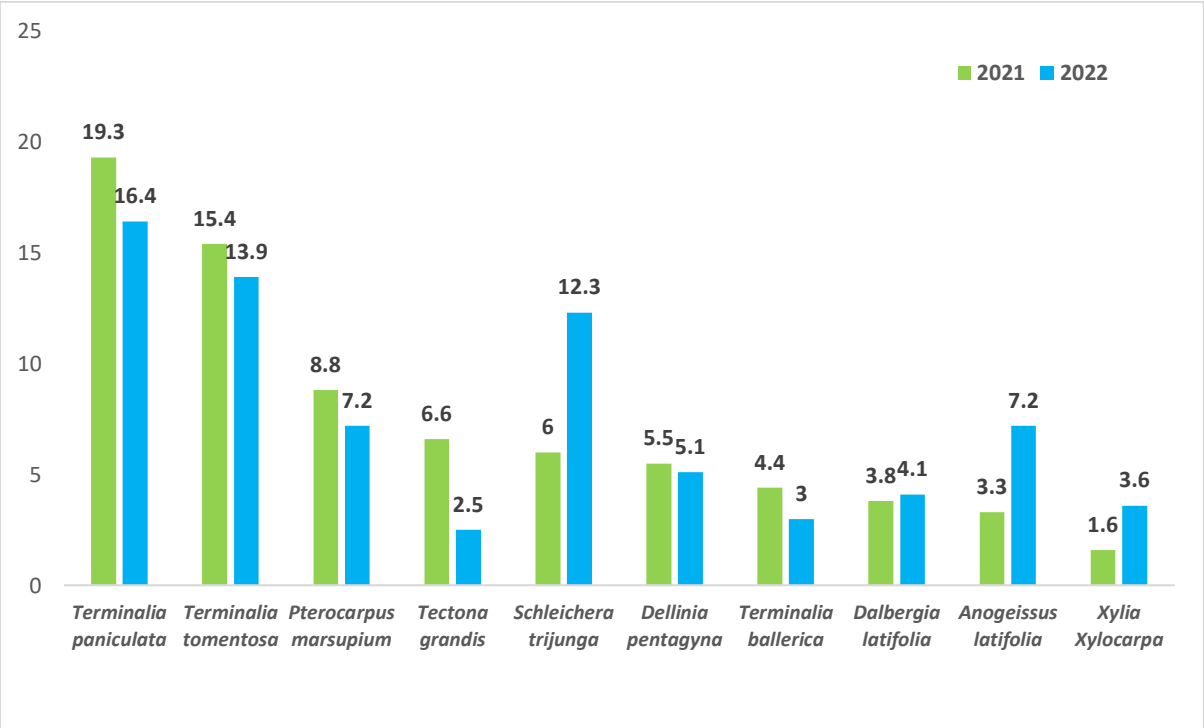


Figure 6. Tree species on which Malabar Giant Squirrel was most sighted.

The tree species on which the Malabar giant squirrel was sighted were categorised into deciduous, evergreen and semievergreen, the animal was found to have preference to deciduous trees over evergreen and semievergreen trees 27 and 25 among 33 and 30 tree species were found to be deciduous while only 2 tree species were found to be evergreen and 4 and 3 tree species were found to be semi-evergreen respectively.

The density of Malabar Giant Squirrel was estimated to be 2.32 ± 0.24 (SE) individuals per $km^2$ (95% confidence interval of 1.86-2.89 squirrels per $km^2$) with the percentage coefficient variation of 10.67% fitted using half normal key with simple polynomial adjustment and minimum AIC value of 851.32 and chi square p value of 0.137 in the year 2021 and 2.46 ± 0.51 (SE) individuals per km2 (95% confidence interval of 1.63-3.71 squirrels per km-2) with the percentage coefficient variation of 21.09% fitted using half normal key with cosine adjustment and minimum AIC value of 914.12 and chi square p value of 0.609 in the year 2022 respectively.

The animal bearing activity was recorded and categorized into feeding, locomotion, resting, calling and grooming Feeding was the highest activity recorded contributing 64.94% and 62.7%, followed by locomotion contributing 13.91% and 16.60%, resting contributing 9.79% and 10.55%, calling contributing 8.76% and 7.77% and grooming contributing 2.57% and 2.22% in the year 2021 and 2022 respectively.

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**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.

**REFERENCES**

1. **Abdulali, H. & J.C. Daniel (1952).** Race of the Indian giant squirrel (*Ratufa indica*). *Journal of the Bombay Natural History Society* 50: 469–474.
2. **Altmann, J. (1974).** Observational study of behaviour sampling method. *Behaviour* 49: 227–265. https://doi.org/10.1163/156853974X00534.
3. **Basanta, K. N. and K. P. Ajay (2015)**. Feeding and nesting ecology of Indian giant squirrel (*Ratufa indica*) (Erxleben 1777) in Kuldiha Wildlife Sanctuary, Balasore, Odhisha, India and its conservation. *International Journal of Bioassays* 4(03): 3741-3746.
4. **Borges, R. (1989).** Resource heterogeneity and the foraging ecology of the Malabar Giant Squirrel (Ratufa indica). PhD Thesis, University of Miami, Florida.
5. **Borges, R., R.S. Mali & H. Somanathan (1998).** The status, ecology and conservation of the Malabar Giant Squirrel Ratufa indica. Final report, Wildlife Institute of India.
6. **Buckland, S. T., Anderson, D. R., Burnham, K. P. and J. L. Laake (1993).** Distance Sampling: Estimating Abundance of Biological Populations. Chapman & Hall, London.
7. **Devcharan, J. N., Samba, K. and K. K. Ullas (2008).** Measuring Indian Giant squirrel (*Ratufa indica*) abundance in southern India using distance sampling. Special editing: Arboreal squirrel. *Current Science* 95(7): 885-888.
8. **Mishra, A. T., Kazmi, S. E. H and P. Satya (2011).** Nesting and Feeding Behaviour of Indian Giant Squirrel (*Ratufa indica*) in Dalma Wildlife Sanctuary, Jamshedpur (Jharkhand). *The Indian Forester* 137(10): 1155-1159.
9. **Nagarajan, B., Venkatesan, S., Mani, J., Sanjay, K. S. and Ajay A. D. (2011).** Some aspects of the ecology of the Indian Giant Squirrel Ratufa indica (Erxleben, 1777) in the tropical forests of Mudumalai Wildlife Sanctuary, southern India and their conservation implications. *Journal of Threatened Taxa* 3(7): 1899–1908.

**10. Prater, S. H. (1980).** *The Book of Indian Animals*. Bombay Natural History Society, Mumbai. 348 pp.

**11. Pradhan, A. K., Shrotriya, S., Rout, S. D. and P. K. Dash (2017).** Nesting and feeding habits of the Indian giant squirrel (*Ratufa indica*) in Karlapat wildlife sanctuary, India. *Animal Biodiversity and Conservation* 40(1): 63-69.

12. **Ramachandran, K. K. (1988).** Ecology and behaviour of Malabar giant squirrel, Ratufa indica maxima (Schreber) 1788. Report of the Project Wild 04/83. Division of Wildlife Biology, Kerala Forest Research Institute, Peechi, Kerala, 47pp.

13. **Ramachandran, K.K. (1992).** Certain aspects of ecology and behaviour of Malabar Giant Squirrel Ratufa indica (Schreber). PhD Thesis. Department of Zoology, University of Kerala, 191pp.

**14. Ravi, S. K. (2008).** Nesting sites of Indian giant squirrels in Sitanadi wildlife Sanctuary, India. *Current Science* 95(7): 882-884.

**15. Samson, A. (2020).** Nesting Behaviour of (*Ratufa indica* Erxleben 1777) in Mudumalai Tiger Reserve, Western Ghats, Southern India. *Journal of Threatened Taxa* 3(7): 1899–1908.

16. **Satya, P., Anil, K. M. and R. Mohammad (2011).** Studies on the nesting habits of Indian giant squirrel *Ratufa indica centralis* (Ryley 1913) in Dalma wildlife sanctuary, Jharkhand, India. *Columban Journal of Life Science* 12(1&2): 9-18.

17. **Navendu Page (2017).** Endemic woody plants of the Western Ghats. Trail Blazer Printers and Publishers, Bangalore, 207pp.

18. **Keystone Foundation (2015).** Forests plants of the Nilgiris Southern Nilgiri Biosphere Reserve A pictorial field guide. Keystone Foundation, Tamil Nadu, 365pp.