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Seasonality and diversity of mammalian fauna of Gautala reserve forest, Maharashtra, India

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Abstract

Mammalian communities play an important role in ecological integrity. Gautala reserve forest is an important part of the ecological system. In the current study, fifteen spots were selected to identify mammalian species and assess their survival in the Gautala sanctuary area. During the survey, 30 mammalian species from 17 mammalian families were detected. The transect method was used to sample direct and indirect evidence of mammalian species. The Cercopithecidae family contains numerous mammal species, whereas the Manidae family contains fewer mammal species reported in the current study. This paper discusses seasonal fluctuations in mammalian diversity and statistical analysis methods. Four species are vulnerable such as *Tetracerus quadricornis* (Blainville), *Rusa unicolor* (Kerr), *Panthera pardus* (Linnaeus), and *Melursus ursinus* (Shaw); one species is near to threatened (NT) as the *Hyaena hyaena* (Linnaeus); and two species are Endangered such as the *Cuon alpinus* (Pallas), *Manis crassicaudata* (E. Geoffroy) as per the IUCN red data. The current study compiled baseline data on the survivability of these mammalian species. Future planning for mammalian variety conservation will benefit from this information.

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Introduction

Terrestrial mammals are important components of tropical forest communities because they provide ecosystem services and serve as indicators of ecosystem health, making them a management and conservation priority (Kitamura *et al.*, 2010). Anthropogenic pressures are causing the extinction of half of the world's 5491 known species of mammals, and a fifth is certainly on the verge of extinction (Anon, 2016). As a result, to make informed conservation decisions, it is critical to document their diversity, patterns of species richness, and compositions in various forest conditions (Bernard *et al.*, 2013). However, it is extremely difficult to monitor these creatures in tropical forests due to their elusive and primarily nocturnal, prefer dense forests, occurring in low abundances, and enduring social connection (Datta *et al.*, 2008).

India comprises 450 different kinds of mammalian fauna, and for the past few decades, individuals have existed within (Singh and Banyal, 2012). International extinction of species is occurring at an incredible rate due to anthropogenic factors (Cardillo *et al.*, 2006; Isaac *et al.*, 2007; Morrison *et al.*, 2007; and Pimm, 2001). For the purpose of enhancing mammal conservation efforts, it is essential to consider the types of land utilization, land cover, human density, and socio-behavioral sensibility for species diversity and distribution (Cardillo *et al.*, 2004).

Mammals are especially vulnerable to extinction due to their huge body size, particular ecological demands, and used as characteristics (Brashares, 2003; Michalski and Peres, 2005). In addition to sustaining a flow of energy and efficiency as herbivores, predators, and granivores, mammals also shape natural ecosystems and surroundings over pollinating, seeds distribution, termites management, and ecological technology. These ecological systems are essential for human health (Lacher *et al.*, 2019; Shrestha *et al.*, 2022). Despite the fact that mammalian species are important to ecosystems, Almost 25% including entirely mammalian species are at risk of becoming extinct, with habitat loss, degradation, and biological resource extraction being the primary threats to their survival (Ceballos *et al.*, 2005; Schipper *et al.*, 2008). In the past century, several mammalian species have disappeared, and a large number are at risk of becoming extinct (Ceballos *et al.*, 2005).

The success of conservation efforts will depend on locating endangered species and environmental variables that contribute to their survival, particularly in areas where people predominate, like southern Asia. Research that includes both current and 25 Indian mammals' local susceptibility to extinction was assessed using previous distributions. In the previous 100 years, there have reportedly been significant effects on these mammalian species and their surroundings from widespread hunting, land-use changes (such as agricultural expansion and deforestation), and rapid economic growth (Madhusudan and Mishra, 2003).

According to conservative estimates, 20% of the large mammalian species in India are in danger of disappearing, as well as other species have vanished from >90% of their distinctive variation (Madhusudan and Mishra, 2003). There exists a pressing demand in the persevering inhabitants for fundamental knowledge about current mammal distribution, as well as environmental and social causes. In the 1970s, the installation became a country-wide flora and fauna reserve system. Anthropogenic influences on mammalian species and their natural environments were more severe over the past century as a result of the rapid economic and demographic expansion of human populations (Forest Survey of India, 2000; Das, 2006). The wildlife population has declined in both abundance and distribution as a result of habitat loss, hunting, and agricultural land use practices, as well as land degradation caused by overgrazing (Gebresenbet *et al.*, 2018; Girma *et al.*, 2020 and Lemma *et al.*, 2020). To reverse the situation, research-based action is required (Berhanu *et al.*, 2021). A wide variety including bird, mammalian, and invertebrate species

all survive in the sanctuary (Sarkar *et al.*, 2014; Mirza *et al.*, 2021). The sanctuary's vegetation, fauna, and floral composition are crucial to the overall wildlife. It is necessary to raise people's awareness of its value and significance and to involve them in their preservation and conservation. The current study collected baseline data on the viability of numerous observed mammalian species found in the Gautala reserve forest region. This information will be useful in future planning for the conservation of mammalian diversity.

Materials and methods

The Gautala reserve forest was visited at regular intervals during the study to collect data on mammals during the rainy, winter, and summer seasons. From 2017 to 2018, a study was carried out to document the mammalian fauna in the Gautala reserve forest. The transect method was used to sample direct evidence of mammals (Burnham *et al.*, 1980). In the direct method, sighting and capturing them with a high-resolution DSLR camera Canon EOS 200D and lenses 18-55 mm and 55-250 mm were used for the study. Field Binocular with a magnification of 8 × 30 was used to observe the Mammals. The statistical analysis was performed using the 'R' programme.

Survey and monitoring of mammals

All significant mammalian habitats were thoroughly investigated using the transect method for both direct and indirect evidence. The transect method was used, with various transects of 200 lengths laid at random. As a result, their presence was evaluated using both direct and indirect methods. The mammals were observed by walking silently along transect on either side of transect and were recorded by direct sightings. The animals could sometimes be located by hearing the sounds of their feeding, locomotion, and calls or barks. Secondary data were gathered from scats, dung, pellets, kills, as well as pugmarks. Indirect methods involved quantifying indirect evidence such as hoof marks, pug marks, and mammalian fecal matter (Burnham *et al.*, 1980). However, high-quality images have also been captured to further the species identified. As a result, all identified mammalian species were classified using IUCN data as either endemic or non-endemic. In the reserve forest region, a total of fifteen sampling spots were selected through systematic sampling. A GPS receiver (Garmin GPS map 76CSx, Garmin) was used to ensure proper pacing.

Identification

The field guide books were used for the fieldwork i.e. The Book of Environment and Ecology, Fowler's Zoo and Wild Animal Medicine, and standard keys are used for species identification of observed mammals (Booth, 2015). The specialists' Laboratories (Department of Environmental Science at the Dr. B.A.M.University, Aurangabad).

Statistical analysis

In the current study, to identify observed mammalian species with comparable diversity, as assessed by the variety of species during the summer, winter, and rainy seasons were used descriptive analysis method. For the analyses, the statistical analysis of data software 'R Studio' was used.

Descriptive analysis

It is one of the most widely used methods for performing effective data analysis. Statistical analysis, there was used descriptive analysis for summarizing the gathered information from mammalian diversity data collection during the current study.

The frequency distribution

It was used to summarize the category distribution by counting the number of observed mammalian species and the percentage of each group. Also, it was used to describe the mammalian diversity's distribution range.

Measures of central tendency

The mean, mode, and median were used to determine the center of an observed mammalian species data set. The average data value was determined using central tendency.

Measures of dispersion

Dispersion measures were used to quantify seasonal variation in mammalian diversity. The most common

methods for describing the spread of mammalian diversity are variance and standard deviation.

Equations

The arithmetic mean is one of several different types of averages. Consider the arithmetic mean formula:

$$\mu=\sum xN\mu=\sum x \quad (1)$$

Where,

μ is the population mean,

x is the sample means,

$\sum x$ $\sum x$, and then divide by the number of species, N.

To reveal this, the mean equation can also be written as follows:

$$\mu=\sum fi(xi)N\mu=\sum fi(xi)N \quad (2)$$

Where,

f_i denotes the frequency of population members with the value x_i.

Results

Three seasons' of data from a comprehensive one-year study (June 2017 to May 2018) were compiled, and seasonal differences related to rainy, winter, and summer seasons were examined (Table 1, Figs 1-3).

Table 1. Checklist of mammalian species identified in the Gautala reserve forest

Sl	Common name	Scientific name	Family	IUCN
1.	Blue Bull	*Boselaphus tragocamelus* (Pallas)	Bovidae	LC-Stable
2.	Four-horned antelope	*Quadricornis Tetracerus* (Blainville)	Bovidae	VU-Decreasing
3.	Dhole/Indian Wild Dog	*Cuon alpinus* (Pallas)	Canidae	EN-Decreasing
4.	Jackal	*Canis aureus* (Linnaeus)	Canidae	LC- Increasing
5.	Indian fox	*Vulpes bengalensis*	Canidae	LC- Decreasing
6.	Indian Wolf	*Canis lupus pallipes*	Canidae	LC- Stable
7.	Bonnet Macaque	*Macaca Radiata* (Geoffroy)	Cercopithecidae	LC- Stable
8.	Grey Langur	*Semnopithecus entellus* (Dufresne)	Cercopithecidae	LC- Decreasing
9.	Spotted deer	*Axis axis* (Erxleben)	Cervidae	LC- Unknown
10.	Indian muntjac/barking deer	*Muntiacus muntjak* (Zimmermann)	Cervidae	LC- Decreasing
11.	Indian Chevrotain/Mouse Deer	*Moschiola indica* (Gray)	Cervidae	LC- Unknown
12.	Sambar	*Rusa unicolor* (Kerr)	Cervidae	VU-Decreasing
13.	Leopard	*Panthera pardus* (Linnaeus)	Felidae	VU-Decreasing
14.	Leopard cat	*Prionailurus bengalensis* (Kerr)	Felidae	LC- Stable
15.	Jungle Cat	*Felis chaus* (Giildenstaedt)	Felidae	LC- Decreasing
16.	Common Grey Mongoose	*Herpestes edwardsii* (Geoffroy)	Herpestidae	LC- Stable
17.	Striped Hyena	*Hyaena hyaena* (Linnaeus)	Hyaenidae	NT-Decreasing
18.	Indian crested porcupine	*Indica Hystrix* (Kerr)	Hystricidae	LC- Stable
19.	Indian Hare	*Lepus nigricollis*	Leporidae	LC- Unknown
20.	Thick-tailed pangolin	*Manis crassicaudata* (E. Geoffroy)	Manidae	EN-Decreasing
21.	Indian Gerbil	*Tatera indica*	Muridae	LC- Unknown
22.	Indian flying fox	*Pteropus medius* (Temminck)	Pteropodidae	LC- Decreasing
23.	Greater Short-Nosed Fruit Bat	*Sphinx of Cynopterus* (Vahl)	Pteropodidae	LC- Increasing
24.	Indian Palm Squirrel	*Funambulus palmarum* (Linnaeus)	Sciuridae	LC- Increasing
25.	Giant Squirrel of India	*Indica ratufa* (Erxleben)	Sciuridae	LC- Decreasing
26.	Wild Boar	*Sus scrofa* (Linnaeus)	Suidae	LC- Unknown
27.	Indian Tree shrew	*Anathana ellioti* (Waterhouse)	Tupaiidae	LC- Decreasing
28.	Sloth Bear	*Melursus ursinus* (Shaw)	Ursidae	VU- Decreasing
29.	Small Indian Civet	*Viverricula Indica* (Desmarest)	Viverridae	LC- Stable
30.	Palm Small Civet	*Paradoxurus Hermaphroditus* (Pallas)	Viverridae	LC- Decreasing

Note: LC stands for "Least Concern," NT for "Near Threatened," VU for "Vulnerable," and EN for "Endangered."[30]

The findings of this study showed a significant seasonal fluctuation in the diversity characteristics of mammals. A total of 30 observed mammalian species were found in their natural habitat in the current study. The remaining species, on the other hand, were unable to be recognized because higher vertebrates are scared of their surroundings and evacuate at the first comprehensive or track. The Gautala reserved forest is covered by a hilly, scrubby, bushy, deciduous forest. Mammals generally migrate from one location to another based on climate, specifically temperature differences and water availability because of the

abundance of water bodies and dense forest vegetation (Mirza and Patil, 2021 and 2023).

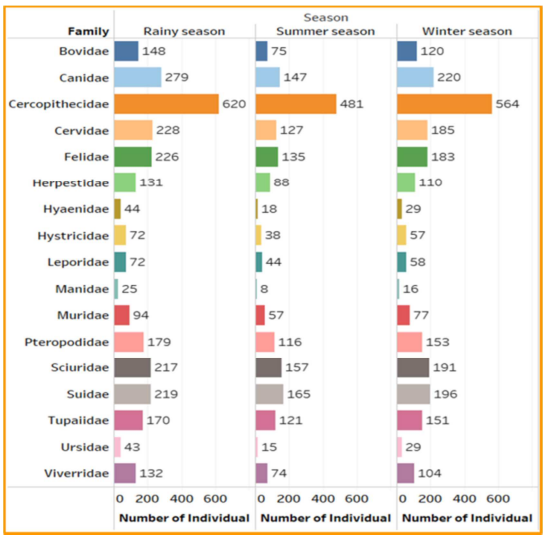

Fig. 1. Total number of mammalian species at different spots

Fig. 2. Comparison of total number of mammals' with different families

There are numerous families of observed mammals in the Gautala reserve forest, including the Bovidae (2), Canidae (4), Cercopithecidae (2), Cervidae (4), Felidae (3), Herpestidae (1), Hyaenidae (1), Hystricidae (1), Leporidae (1), Manidae (1), Muridae (1), Pteropodidae (2), and Sciuridae (2). The Gautala forest area contains 30 mammalian species and 17 mammal families. Four species are Vulnerable such as *Tetracerus quadricornis* (Blainville), *Rusa unicolor* (Kerr), *Panthera pardus* (Linnaeus), and *Melursus ursinus* (Shaw), One species is near to threatened (NT-Decreasing) as the *Hyaena hyaena* (Linnaeus), and two species are Endangered (EN-decreasing) such as the *Cuon alpinus* (Pallas), *Manis crassicaudata* (E. Geoffroy) as per the IUCN red data.

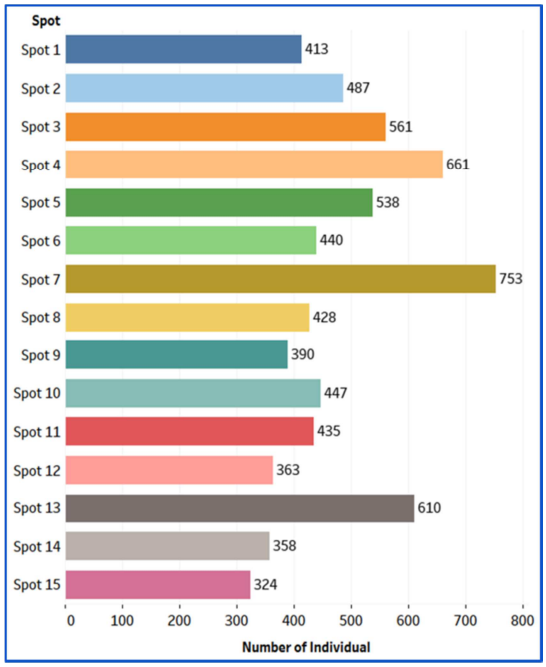

Fig. 3. Total number of mammals' at selected 15 spots

The surviving 7 species are LC- Stable, 5 are LC-Unknown, 3 are LC- Increasing, and 8 are LC-Decreasing.

Statistical relationship

In the current study, statistical patterns were used in descriptive analysis to describe the identified mammal species found in the Gautala reserve forest. The total number of mammals from various families was examined season-wise.

Discussion

Thirty mammalian species from seventeen different mammalian groups were identified throughout the survey. Only a few mammalian species were able to be observed directly, allowing their presence to be recorded. The majority of the fauna was discovered through direct evidence, such as pugmarks, fecal matter disposal patterns, fecal matter contents, non-decomposing parts of the body of dead animals, and the kinds of impressions on exposed land and tree

barks in the territory of the particular species. Because the literature on indirect evidence for identifying distinct taxa is limited, efforts were made to record each fauna up to the generic level. These taxa's vernacular and common names, on the other hand, are recorded in the local language. Pugmarks, dried feces, bones, and bundles of hair pulled in the animal battle were discovered during our investigation of the Gautala reserved forest. Recorded families-wise analysis of data showed that families Cercopithecidae, Cervidae, Hynaeidae, Sciuridae, etc. from Kalatop-khajjiar Wildlife sanctuary (Singh and Banyal, 2012). This research work is similar to the current study. Eighteen mammal species from 6 orders, 12 families, and 18 genera, and two species i.e. *Tetracerus quadricornis,* and *Rusa unicolor* are vulnerable were reported (Bhat and Bhat, 2022). These outcomes of the examination are similar to the present work. The feeding habits of the study area's mammals range widely. Carnivorous animals such as the hyena, fox, and leopard prey on other small animals or bird eggs. Animals such as the Sloth Bear are omnivores, with their diet consisting of more than 90% plant material (Hwang and Garshelis, 2007). Sloth bears infested local crops. They destroy crops and feed in plantations, where they harm trees by removing their bark and consuming their cambium (Gong and Harris, 2006). In some areas, the diet includes a significant amount of meat (Hwang *et al.*, 2002). In addition to consuming fruits, leaves, flowers, and buds, some herbivorous mammals like Grey Langurs, Bonnet Macaques, Barking Deer, etc. also feed on insects, tree trunks, and gums (Jerdan, 1985).

Leopard, a carnivorous animal that feeds on monkeys and ungulates in the wild, has emerged from the forest and now lives near human settlements. During the current study, Spot 7 exhibited the greatest diversity of mammals, while Spot 15 showed the least diversity of mammals. The mammalian species diversity index may fluctuate due to habitat type, availability of food, water, etc. The diversity and richness of observed mammalian species vary from spot to spot by habitat type. In a statistical examination, for all types of observed mammals, the rainy season has more species than the other seasons, while the winter season has fewer species than the other seasons.

Conclusion

Gautala Wildlife Sanctuary is also home to a variety of other wild creatures, Due to its natural beauty and rarity. The Sanctuary contains a variety of habitats, including aquatic, grassland, scrubland, and woodland. A wide range of wild animals was observed as a result of the sanctuary's diverse habitats. In the present study, 30 observed mammalian species representing 17 mammalian families were identified. The Cercopithecidae family contains numerous mammal species, while the Manidae family contains fewer mammal species recorded during the current study. The most commonly observed mammals are the Bonnet Macaque (Cercopithecidae), Grey Langur (Cercopithecidae), Wild Boar (Suidae), Indian Wild Dog / Dhole (Canidae), Jackal (Canidae), Indian Fox (Canidae), and Indian Wolf (Canidae). The Cercopithecidae family was plentiful in the research region due to the abundance of natural resources and the number of fruiting plants. The Manidae family of Indian pangolins (*M. crassicaudata*) is listed as endangered as per the IUCN. These different families of observed mammalian species were also exhibiting variation in species richness from spot to spot. This variation in mammalian species richness may be due to habitat type, food, water, shelter availability, and so on. This baseline data will be effective in treating older taxonomic work more effective and for the enumeration of endemic taxa in the Gautala region.

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