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COMMUNICATION

A STUDY ON DIVERSITY OF MAMMALIAN SPECIES USING CAMERA TRAPS AND ASSOCIATED VEGETATION IN MIZORAM UNIVERSITY CAMPUS, AIZAWL, MIZORAM

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A study on diversity of mammalian species using camera traps and associated vegetation in Mizoram University Campus, Aizawl, Mizoram

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Abstract: Fragmented forests often have conservation value, serving as a refuge or corridors for small mammalian species. In the study, the diversity of mammals was studied within Mizoram University (MZU) campus. Forty-eight plant species from 25 families were recorded on different sites. Thirty quadrates were nested at the locations of occurrence of mammalian species for vegetation type analysis. Schima wallichi was the most dominant plant species with the highest IVI values of (31.7%), followed by Aporosa octandra (22.93%) and Castanopsis tribuloide (21.17%). Camera trap method was used to collect information about the mammalian diversity in the campus. The mammalian species recorded in this study makes 15% of mammalian fauna of the state of Mizoram. Twelve mammal species and six bird species were recorded by the camera traps. With proper awareness among residents of the campus and a planned approach for developmental activities, the findings of our study can make an important extension for the coexistence of mammalian species and long term survivability within MZU campus.

Keywords: Camera traps, coexistence, mammalian diversity, Mizoram University, Urban biodiversity.
INTRODUCTION

The northeastern region of India shares two biodiversity hotspots and has rich mammalian and avian diversity (Choudhury 2006). The state of Mizoram is part of the Indo-Myanmar Biodiversity Hotspot region and harbours 126 species of mammals including 37 threatened species (Lalthanzara 2017). The rapid expansion of shifting cultivation and urbanization in the region has, however, led to a contemporary changes in landscape, forest fragmentation, and ecosystem modification (Teegalalapalli et al. 2009; Yadav 2013). Such anthropogenic activities have created a mosaic of remnant forest patches of varying size, demarcated by a network of roads, concerts, and settlements areas (Mazumdar et al. 2011). Recent researches on biodiversity conservation put urban areas having rich biodiversity into the limelight for the long-term persistence of native species (Ordenana et al. 2010; Lopucki & Kitowski 2017; Hill et al. 2018). Urbanization is often considered to have several negative impacts on the native flora and fauna; nevertheless, it also serves as valuable habitat and corridor for dispersal of certain animal species (Opdam et al. 2003; Fernandez & Simonetti 2013). Urban and semi-urban green forest patches serves as surrogate and refuge habitat to be utilized for dispersal and migration for birds and many small to medium size mammals (Gallo et al. 2017). The role of degraded forest landscapes and patches within the campus of academic institutions as a potential habitat for small mammals and birds has also been acknowledged in some studies (Vallejo et al. 2008; Mazumdar et al. 2011; Voon et al. 2014; Nerlekar et al. 2016).

The camera trap is a useful technique widely used for collecting information on elusive species (Kelly et al. 2008; Linkie & Ridout 2011). Information on species diversity and distribution is considered to be the primary need for conservation activities (Geldmann et al. 2013; Brncic et al. 2015). While information on biodiversity in megacities and large urban areas are easily available, the same is scarce in small cities and educational campuses (Lopucki et al. 2013; Lopucki & Kitowski 2017). Mizoram University (MZU) campus at Aizawl, Mizoram encompasses a large area with lush green landscape having several patches of natural forest vegetation. Although research on herpetofauna (Vanalhlimpuia 2012), butterfly (Barua 2017), spiders (Lalthafamkima 2017), and birds (Sailo et al. 2019) are available from MZU campus, no study has been undertaken on the distribution of mammalian species. Therefore, a study was planned to determine the mammalian diversity using mainly camera traps and direct observations within the campus.

MATERIALS AND METHODS

Study area

Mizoram University (MZU) is located at the western end of the Aizawl town, the state capital of Mizoram at a distance of about 15km. The campus of MZU is spread in an area of 978.1988 acres and lies between 23.7394°N & 92.6651°E. The elevation ranges between 300–880 m. University campus encompasses the administrative block, academic blocks, hostels, and other facilities which are sparsely embedded within regenerating tropical wet evergreen and semi-evergreen forests (Image 1). The campus also harbors a protected forested water catchment reserve in the north and a small biodiversity park. In the vicinity of the campus, there are settlement areas, where residents undertake agriculture practice (jhum cultivation), which is the primary source of income and livelihood. Several small natural and seasonal streams also flow through the campus. Vegetation profile is dominated by trees comprised of 384 species of vascular plants from 290 genera and 107 families (Lalchhuanawma 2008; Rai 2016; Sailo et al. 2019). A map of the university is presented in Figure 1.

Vegetation analysis

A preliminary survey of campus area was carried out to select the sampling site for vegetation study. Transects were set up in areas where signs and evidence of animals’ presence were observed. For vegetation sampling 10m x 10m quadrates were plotted at every 200m interval along transects for tree diversity analysis. Thirty quadrates were plotted in different sites and only trees having DBH more than 10cm were considered for the analysis (Daniels et al. 1996). Vegetation analysis was done for the relative frequency of occurrence of the species; relative density, relative abundance and important value index (IVI) were determined following methods of Lalchhuanawma (2008) and Ahmed (2012).

Camera trapping

The camera traps are often used for understanding the secretive behavior or nocturnal activity, and estimating animal population comprehensively even at relatively low densities of animals (Ordenana et al. 2010; Gouda et al. 2020). Camera deployment points were chosen based on the presence of visible animal trails, footprints,
scats, activity areas such as dens or close to streams (Sasidhran et al. 2016). Nine camera traps (Cuddeback) were randomly deployed at 15 sampling points within the study sites for 45 days as presented in Figure 2. The cameras were installed on a tree trunk at a suitable height of 30–50 cm above the ground at optimum angles based on slope conditions for viewing the animal trails without the camera view being blocked by any objects (Image 1). Camera traps were programmed to take sequential photographs with five seconds delay registering date and time for each exposure. On average the camera traps were operational for five days and were checked every two days for photos and battery replacement. GPS (Garmin map 78S) was also used to record coordinates, elevation, and slope of camera trap locations. The relative abundance index (RAI) value was calculated using the method suggested by Jenks et al. (2011). Whenever possible we also recorded directly observed species especially arboreal ones around the camera trap locations.
RESULTS

Forty-eight plant species which belongs to 25 families were recorded along the transect lines during the vegetation study. Vegetation samples were analyzed for the parameters mentioned in Table 1. The analysis showed that *Schima wallichii* is the most dominant plant species having the highest IVI values (31.7%), followed by *Aporosa octandra* (22.93%), *Castanopsis tribuloide* (21.17%), and *Syzgium praecox* (17.86%). Plant species such as *Hibiscus macrophyllus*, *Bischofia javanica*, *Cinnamomum cassia*, and *Acer laevigatum* were some of the least available species (Table 1). The family Euphorbiaceae contributed for the highest IVI, followed by Theaceae and Fagacae while the family Pandanaceae had the lowest IVI values among the recorded plant families (Figure 3).

The mammalian diversity on MZU campus is 19 mammalian species; 12 were captured through camera traps (Table 2) (Image 2) and seven were recorded by direct observations (Table 3). Six bird species were also photo-captured during this study (Table 4) (Image 3). Among the mammalian species, civets are predominant with 30.17% followed by felids (25%). The presence of Marbled Cat *Pardofelis marmorata* (Near Threatened), Clouded Leopard *Neofelis nebulosa* (Vulnerable), and Golden Jackal *Canis aureus* (Least Concern) were important and majestic mammalian species. Such valuable observations from the fragmented habitat of an urban landscape are significant for species conservation. Other recorded species are categorised as Least Concern. The relative abundance index (RAI) value was highest (16.67) for Crab-eating Mongoose *Herpestes urva* followed by Common Palm Civet *Paradoxurus hermaphroditus* (13.3), and Leopard Cat *Prionailurus bengalensis* (10) (Table 2). Sites with minimal human disturbance and water bodies within the campus had higher RAI values. Among directly observed mammalian species squirrels and shrews were the major ones (Table 3). Seven avian species namely Khalij Pheasant (male and female), Blue Whistling Thrush, Forktail, Asian Barred Owlet, Long-tailed Nightjar, and Large Cuckoo

![Image 1](image-url)
Table 1. Vegetation composition and analysis.

| Name of species            | Mizo name    | Family       | Relative density (%) | Relative Frequency (%) | Relative Dominance (%) | Important Value Index (IVI) |
|----------------------------|--------------|--------------|----------------------|------------------------|------------------------|-----------------------------|
| 1  Acer laevigatum         | Thingkhim    | Aceraceae    | 0.54                 | 0.36                   | 0.38                   | 1.28                        |
| 2  Albizia chinensis       | Vang         | Mimosaceae   | 2.20                 | 1.84                   | 1.93                   | 5.97                        |
| 3  Albizia richardiana     | Theichhawl   | Mimosaceae   | 2.20                 | 1.65                   | 3.23                   | 7.08                        |
| 4  Albizia procera         | Kangtek      | Mimosaceae   | 1.37                 | 1.10                   | 2.48                   | 4.95                        |
| 5  Anogeissus acuminate    | Zairum       | Combretaceae | 0.29                 | 0.73                   | 0.69                   | 1.71                        |
| 6  Aporosa octandra        | Chhawntual   | Euphorbiaceae| 10.09                | 4.61                   | 8.23                   | 22.93                       |
| 7  Artocarpus lacoocha     | Theitat      | Moraceae     | 0.83                 | 1.10                   | 1.01                   | 2.94                        |
| 8  Balakata baccata        | Thingvawkpui | Euphorbiaceae| 1.37                 | 3.68                   | 1.84                   | 6.89                        |
| 9  Bischofia javanica      | Khuanghli    | Euphorbiaceae| 0.12                 | 0.01                   | 0.15                   | 0.28                        |
| 10 Bombax insigne         | Pang         | Bimaceae     | 1.78                 | 1.47                   | 3.29                   | 6.54                        |
| 11 Callicarpa arboarea     | Hnakhkiah    | Verbenaceae  | 4.4                  | 3.13                   | 1.95                   | 9.48                        |
| 12 Castanopsis indicia    | Sehawr       | Fagaceae     | 3.74                 | 1.84                   | 1.40                   | 6.98                        |
| 13 Castanopsis lancefolia | Vawmbuh      | Fagaceae     | 0.41                 | 1.29                   | 0.87                   | 2.57                        |
| 14 Castanopsis tribuloides| Thingsia     | Fagaceae     | 8.43                 | 3.13                   | 9.61                   | 21.1                        |
| 15 Cedrelatoona            | Tei          | Meliaceae    | 0.29                 | 0.36                   | 0.30                   | 0.95                        |
| 16 Cinnamomum cassio       | Thalthing    | Lauraceae    | 0.12                 | 0.01                   | 0.13                   | 0.26                        |
| 17 Cinnamomum tamala       | Tespata      | Lauraceae    | 2.36                 | 1.47                   | 1.81                   | 5.64                        |
| 18 Colona floribunda      | Hnahthap     | Tiliaceae    | 0.12                 | 0.36                   | 0.17                   | 0.65                        |
| 19 Cordiawallichi          | Muk          | Boraginaceae | 0.83                 | 2.02                   | 2.05                   | 4.9                         |
| 20 Dennis robusta          | Thingkha     | Fanaceae     | 1.12                 | 1.29                   | 0.92                   | 3.33                        |
| 21 Dennis thrysiflora     | Hulhu        | Papilionaceae| 0.12                 | 0.01                   | 0.19                   | 0.32                        |
| 22 Drymarcus racemosus    | Vawmbal      | Anacardiaceae| 3.44                 | 1.65                   | 5.24                   | 10.3                        |
| 23 Duabanga grandiflora   | Zuang        | Sonnerataceae| 0.12                 | 0.01                   | 0.28                   | 0.41                        |
| 24 Emblica officinalis     | Sunhlu       | Euphorbiaceae| 0.54                 | 0.55                   | 0.51                   | 1.6                         |
| 25 Erythrina variegata     | Fartuah      | Papilionaceae| 0.41                 | 0.73                   | 1.99                   | 3.13                        |
| 26 Ficus hirta             | Sazuthiepui  | Moraceae     | 0.54                 | 0.62                   | 0.67                   | 2.13                        |
| 27 Glochidion keynaneum    | Thingpawncchia| Euphorbiaceae| 2.78                 | 2.02                   | 2.15                   | 6.95                        |
| 28 Gmelina arborea         | Thlanwawng   | Verbenaceae  | 0.71                 | 0.55                   | 1.22                   | 2.48                        |
| 29 Haldea cordifolia       | Lungkhup     | Rubiaceae    | 2.20                 | 1.10                   | 1.62                   | 4.92                        |
| 30 Hiliscus macrophyllus  | Vaiza        | Malvaceae    | 0.12                 | 0.01                   | 0.07                   | 0.20                        |
| 31 Ilex godajam            | Thinguihnhni | Aquifoliaceae| 0.41                 | 0.73                   | 0.82                   | 1.96                        |
| 32 Lithocarpus elegans     | Thingpuithing| Fagaceae     | 0.70                 | 0.36                   | 0.72                   | 1.78                        |
| 33 Litsea monon petala     | Nauthak      | Lauraceae    | 2.07                 | 1.84                   | 1.60                   | 5.51                        |
| 34 Macaranga indica       | Hnakhkhar    | Euphorbiaceae| 4.86                 | 2.94                   | 3.74                   | 11.54                       |
| 35 Macropanax undulatum    | Phuanberh    | Araliaceae   | 0.41                 | 0.92                   | 0.85                   | 2.18                        |
| 36 Messua ferrua           | Herhse       | Guttiferae   | 0.70                 | 0.36                   | 0.31                   | 1.37                        |
| 37 Pandanus fasicularis    | Ramlakhui    | Pandanaceae  | 0.41                 | 1.47                   | 0.33                   | 2.21                        |
| 38 Pterium serratum        | Bil          | Burseraceae  | 1.37                 | 0.92                   | 1.45                   | 3.74                        |
| 39 Saurauia punduana       | Tiar         | Actinidiaceae| 2.78                 | 1.29                   | 1.96                   | 6.03                        |
| 40 Schima khasiana         | Klango       | Theaceae     | 0.64                 | 0.92                   | 0.67                   | 2.23                        |
| 41 Schima wallichi         | Kl Iron      | Theaceae     | 13.29                | 4.05                   | 14.36                  | 31.70                       |
| 42 Sterculia villosa       | Khaupui      | Sterculaceae | 1.12                 | 0.92                   | 1.33                   | 3.37                        |
| 43 Stereospermum tetrangum | Zinghal      | Bignoniaceae | 0.41                 | 1.17                   | 0.75                   | 2.63                        |
Shrike were also captured by camera traps in different areas of the campus (Table 4, Image 3).

DISCUSSION

This study can make an important extension in documentation and range of faunal species available within a university campus. The VI and other quantitative values obtained for different plant species in the study coincide with the findings of Lalramenga (2006) and Lalchhuanawma (2008) that were carried out within the campus. The rich floral diversity plays a key role in supporting both the avifauna and mammalian fauna in the campus. The presence of roadside plants like *Ficus benghalensis*, *F. religiosa*, *Trema orientalis*, *Lantana camara*, *Musa paradise*, and *Casia auriculata* in MZU campus can serve as good habitat and feeding grounds for birds and small mammals as reported by Lalchhuanawma (2008) and Rai (2016).

The undisturbed forest patches within MZU campus appears to support a diverse group of mammalian species. The record of 19 mammalian species in the campus is an evidence of its rich mammalian diversity, which contributes for 15% of the mammalian fauna of the state of Mizoram. Family viverridae is highly diverse in MZU campus; five species of family viverridae were also reported earlier in Mizoram (Lalthanza 2017). Presence of felids (three species) in the campus also forms 37.5%, as eight fields were previously reported by Lalthanza (2017) in Mizoram. Species such as Clouded Leopard, Marbled Cat, Golden Jackal, and Ferret Badger not only indicates the potential of the university campus to support the cohabitation and co-existence with mammals but also highlights the values of urban diversity.

The relative abundance index (RAI) indicates that ground dwelling birds such as Khalij Pheasant (male and females) were dominant (RAI = 13.33) and also are the prey species for carnivorous mammals. The mammalian species evident in MZU campus are very rare and may be difficult to record even in a protected forest. Dense shrub forests, tall fruiting trees, and low lying natural streams along the edges of the campus that provides ideal forest

### Table 2. Mammalian diversity based on photo captured and their status

| Family          | Common name         | Scientific name | IUCN status      | RAI  |
|-----------------|---------------------|-----------------|------------------|------|
| Felidae         | Clouded Leopard     | Neofelis nebulosa | Vulnerable      | 3.33 |
| Felidae         | Marbled Cat         | Pardofelis marmorata | Near threatened | 3.33 |
| Felidae         | Leopard Cat         | Prionailurus bengalensis | Least concern   | 10.00 |
| Suidae          | Wild Pig            | Sus scrofa      | Least concern    | 3.33 |
| Viverridae      | Large Indian Civet  | Viverra zibetha | Least Concern    | 13.33 |
| Viverridae      | Small Indian Civet  | Viverricula indica | Least concern   | 10.00 |
| Viverridae      | Common Palm Civet   | Paradoxurus hermaphroditus | Least concern  | 13.33 |
| Herpestidae     | Crab-eating Mongoose | Herpestes urva  | Least concern    | 16.67 |
| Canidae         | Golden Jackal       | Canis aureus    | Least concern    | 3.33 |
| Viverridae      | Himalayan Palm Civet | Paguma larvata | Least concern    | 6.67 |
| Mustelidae      | Ferret Badger       | Melogale sp.    | Least concern    | 3.33 |
| Tupaiidae       | Tree Shrew          | Cladobats belingari | Least concern  | 3.33 |
Table 3. Mammalian species observed directly during study and their status.

| Family       | Common name               | Scientific name            | IUCN status |
|--------------|---------------------------|----------------------------|-------------|
| 1 Mustelidae | Yellow-throated Martin    | Martes flavigula           | Least Concern|
| 2 Cervidae   | Barking Deer              | Muntiacus muntjak          | Least Concern|
| 3 Sciuridae  | Pallas’s Squirrel         | Collosciurus erythraeus    | Least Concern|
| 4 Sciuridae  | Himalayan Hoary-bellied Squirrel | Collosciurus pygerythrus | Least Concern|
| 5 Tupaiidae  | Northern Tree Shrew       | Tupaia belangeri           | Least Concern|
| 6 Muridae    | Black Rat                 | Rattus rattus              | Least Concern|
| 7 Soricidae  | House Shrew               | Suncus murinus             | Least Concern|

Table 4. Avian species photo-captured during the study and their status.

| Family       | Common name                | Scientific name             | IUCN         | RAI |
|--------------|----------------------------|----------------------------|--------------|-----|
| 1 Phasianidae| Khalij Pheasant            | Lophura leucomelanos        | Least Concern| 13.33 |
| 2 Muscicapidae| Blue Whistling Thrush     | Myophonus caeruleus         | Least Concern| 3.33 |
| 3 Muscicapidae| Forktail                  | Enicurus leschenaulti       | Least Concern| 3.33 |
| 4 Strigidae  | Asian-barred Owlet         | Glaucidium cuculoides       | Least Concern| 6.67 |
| 5 Campephagidae| Large Cuckoo Shrike      | Coracina macei              | Least Concern| 3.33 |
| 6 Caprimulgidae| Long-tailed Nightjar      | Caprimulgus climacurus      | Least Concern| 3.33 |

Cover and feeding opportunities are contributing to the abundance of these species within the campus. The low resident human population (little over 2000 individuals) with a good sense of conservation value and long forest corridors are also key factors for the distribution of such majestic species within the campus. Anthropogenic activities like hunting, jhumming or shifting cultivation in the vicinity of the campus, collection of NTFP’s and the ever-increasing chain of construction works can have negative impacts on biodiversity in general and particularly on mammals of MZU campus. Information on mammalian diversity recommends that a long-term and systematic study on biodiversity profile of the MZU campus is needed.
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Image 2. a—Clouded Leopard | b—Golden Jackal | c—Himalayan Palm Civet | d—Crab-eating Mongoose | e—Leopard Cat | f—Large Indian Civet | g—Small Indian Civet | h—Himalayan Hoary-bellied Squirrel | i—Common Palm Civet | j—Ferret Badger | k—Wild Boar | l—Marbled Cat.

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Image 3. Birds captured by camera trap: a—Blue Whistling Thrush | b—Large Cuckoo Shrike | c—Long-tailed Nightjar | d—Khalij Pheasant female | e—Khalij Pheasant male | f—Forktail.

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