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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 wallichii* 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.

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Competing interests: The authors declare no competing interests.

Author details: J.H. ZOTHANPUII is a MSc student of Department of Zoology, Mizoram University and the work is a part of her dissertation work. She is currently preparing for future possible research opportunities. SUSHANT GOUDA is a PhD scholar and is currently engaged in a NMHS based project under the Department of Zoology, Mizoram University. He is active in the field of wildlife biology and conservation education. His major research area is ecology and distribution of Himalayan bear. ABINASH PARIDA is a senior research fellow in the NMHS project in department of zoology. He is a vigorous field biologist and working on faunal diversity and conservation. His major research area is primate diversity, ecology, and conservation. G.S. SOLANKI is Professor in Zoology and Principal Investigator of Nation Mission on Himalayan Studies (NMHS) project in the Department of Zoology. This project is funded by G.B. Pant National Institute Himalayan Environment and Sustainable Development, Almora, Uttarakhand. Major research area is ecology and conservation of wilderness species with main emphasis on primates.

Author contribution: JHZ and AP have carried out the research work and collected the data. SG helped in preparation of this the manuscript. GSS was Principal Investigator and guiding teacher, and provided work plan and all logistic support required.

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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 (Teegalapalli 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 had 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 (Vanlalhlimpua 2012), butterfly (Baruah 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 (Lalchuanawma 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 Lalchuanawma (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,

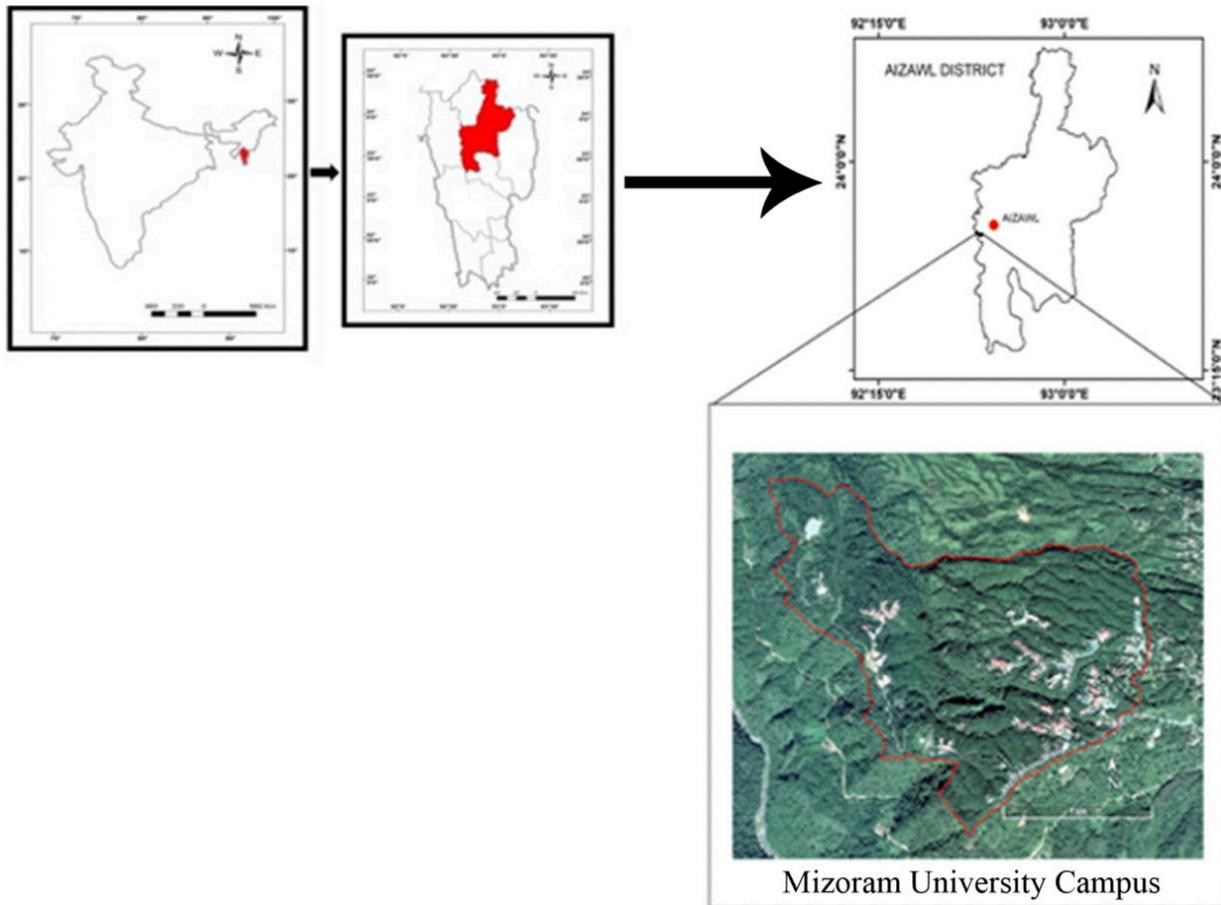


Figure 1. Location of Aizawl City and Mizoram University campus.

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.

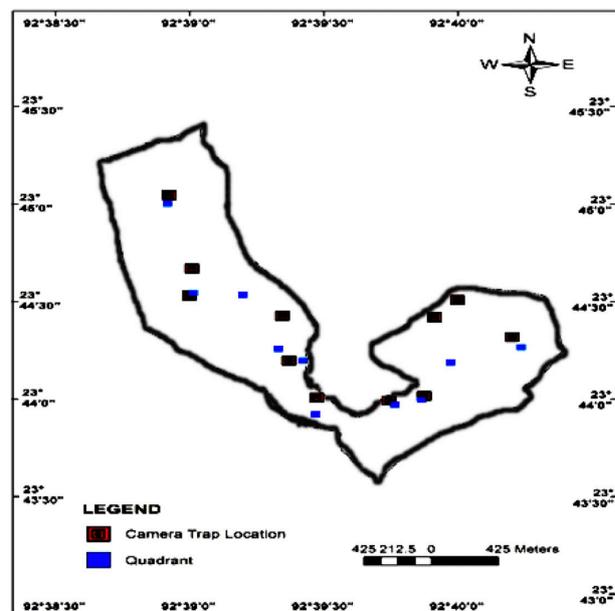


Figure 2. Location of camera traps and quadrates for vegetation sampling.



Image 1. a & b—view of MZU campus | c—installation of camera traps | d—habitat with water source, footprints, and tracks of different animal species. © Abinash Parida.

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 *Syzygium 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 Fagaceae 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

Table 1. Vegetation composition and analysis.

	Name of species	Mizo name	Family	Relative density (%)	Relative Frequency (%)	Relative Dominance (%)	Important Value Index(IVI)
1	<i>Acer laevigatum</i>	Thingkhim	Aceraceae	0.54	0.36	0.38	1.28
2	<i>Albizia chinensis</i>	Vang	Mimosaceae	2.20	1.84	1.93	5.97
3	<i>Albizia richardiana</i>	Theichhawl	Mimosaceae	2.20	1.65	3.23	7.08
4	<i>Albizia procera</i>	Kangtek	Mimosaceae	1.37	1.10	2.48	4.95
5	<i>Anogeissus acuminata</i>	Zairum	Combretaceae	0.29	0.73	0.69	1.71
6	<i>Aporosa octandra</i>	Chhawntual	Euphorbiaceae	10.09	4.61	8.23	22.93
7	<i>Artocarpus lakoocha</i>	Theitat	Moraceae	0.83	1.10	1.01	2.94
8	<i>Balakata baccata</i>	Thingvawkpui	Euphorbiaceae	1.37	3.68	1.84	6.89
9	<i>Bischofia javanica</i>	Khuangthli	Euphorbiaceae	0.12	0.01	0.15	0.28
10	<i>Bombax insigne</i>	Pang	Bimbaceae	1.78	1.47	3.29	6.54
11	<i>Callicarpa arborea</i>	Hnahkiah	Verbenaceae	4.4	3.13	1.95	9.48
12	<i>Castanopsis indica</i>	Sehawr	Fagaceae	3.74	1.84	1.40	6.98
13	<i>Castanopsis lanceifolia</i>	Vawmbuh	Fagaceae	0.41	1.29	0.87	2.57
14	<i>Castanopsis tribuloides</i>	Thingsia	Fagaceae	8.43	3.13	9.61	21.1
15	<i>Cedrellatoona</i>	Tei	Meliaceae	0.29	0.36	0.30	0.95
16	<i>Cinnamomum cassia</i>	Thakthing	Lauraceae	0.12	0.01	0.13	0.26
17	<i>Cinnamomum tamala</i>	Tespata	Lauraceae	2.36	1.47	1.81	5.64
18	<i>Colona floribunda</i>	Hnahthap	Tiliaceae	0.12	0.36	0.17	0.65
19	<i>Cordiawallichii</i>	Muk	Boraginaceae	0.83	2.02	2.05	4.9
20	<i>Derris robusta</i>	Thingkha	Fanaceae	1.12	1.29	0.92	3.33
21	<i>Derris thrysiiflora</i>	Hulhu	Papilionaceae	0.12	0.01	0.19	0.32
22	<i>Drymicarpus racemosus</i>	Vawmbal	Anacardiaceae	3.44	1.65	5.24	10.3
23	<i>Duabanga grandiflora</i>	Zuang	Sonneratiaceae	0.12	0.01	0.28	0.41
24	<i>Embilica officinales</i>	Sunhlu	Euphorbiaceae	0.54	0.55	0.51	1.6
25	<i>Erythrina variegata</i>	Fartuah	Papilionaceae	0.41	0.73	1.99	3.13
26	<i>Ficus hirta</i>	Sazutheipui	Moraceae	0.54	0.62	0.67	2.13
27	<i>Glochidion heyneanum</i>	Thingpawncchia	Euphorbiaceae	2.78	2.02	2.15	6.95
28	<i>Gmlina arborea</i>	Thlanvawng	Verbenaceae	0.71	0.55	1.22	2.48
29	<i>Haldina cordifolia</i>	Lungkhup	Rubiaceae	2.20	1.10	1.62	4.92
30	<i>Hibiscus macrophyllus</i>	Vaiza	Malvaceae	0.12	0.01	0.07	0.20
31	<i>Ilex godajam</i>	Thinguihahni	Aquifoliaceae	0.41	0.73	0.82	1.96
32	<i>Lithocarpus elegans</i>	Thingpuithing	Fagaceae	0.70	0.36	0.72	1.78
33	<i>Litseamono petala</i>	Nauthak	Lauraceae	2.07	1.84	1.60	5.51
34	<i>Macaranga indica</i>	Hnahkhar	Euphorbiaceae	4.86	2.94	3.74	11.54
35	<i>Macropanax undulatum</i>	Phuanberh	Araliaceae	0.41	0.92	0.85	2.18
36	<i>Messua ferrea</i>	Hershse	Guttiferae	0.70	0.36	0.31	1.37
37	<i>Pandanus fascicularis</i>	Ramlakhuih	Pandanaceae	0.41	1.47	0.33	2.21
38	<i>Protium serratum</i>	Bil	Burseraceae	1.37	0.92	1.45	3.74
39	<i>Saurauia punduana</i>	Tiar	Actinidiaceae	2.78	1.29	1.96	6.03
40	<i>Schima khasiana</i>	Khiangzo	Theaceae	0.64	0.92	0.67	2.23
41	<i>Schima wallichii</i>	Khiang	Theaceae	13.29	4.05	14.36	31.70
42	<i>Sterculia villosa</i>	Khaupui	Sterculaceae	1.12	0.92	1.33	3.37
43	<i>Stereospermum tetragonum</i>	Zinghal	Bignoniaceae	0.41	1.17	0.75	2.63

	Name of species	Mizo name	Family	Relative density (%)	Relative Frequency (%)	Relative Dominance (%)	Important Value Index(IVI)
44	<i>Syzigiumcumini</i>	Lenhmui	Myrtaceae	0.71	1.47	1.43	3.61
45	<i>Syzigium praecox</i>	Hmuifang	Myrtaceae	6.35	2.76	8.75	17.86
46	<i>Toona ciliate</i>	Teipui	Meliaceae	0.41	0.55	0.94	1.90
47	<i>Trema orientalis</i>	Belphuar	Cannabaceae	0.41	0.92	9.03	10.36
48	<i>Wendlandia budieioides</i>	Batling	Rubiaceae	3.19	2.21	1.73	7.13

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

	Family	Common name	Scientific name	IUCN status	RAI
1	Felidae	Clouded Leopard	<i>Neofelis nebulosa</i>	Vulnerable	3.33
2	Felidae	Marbled Cat	<i>Pardofelis marmorata</i>	Near threatened	3.33
3	Felidae	Leopard Cat	<i>Prionailurus bengalensis</i>	Least concern	10.00
4	Suidae	Wild Pig	<i>Sus scrofa</i>	Least concern	3.33
5	Viverridae	Large Indian Civet	<i>Viverra zibetha</i>	Least Concern	13.33
6	Viverridae	Small Indian Civet	<i>Viverricula indica</i>	Least concern	10.00
7	Viverridae	Common Palm Civet	<i>Paradoxurus hermaphroditus</i>	Least concern	13.33
8	Herpestidae	Crab-eating Mongoose	<i>Herpestes urva</i>	Least concern	16.67
9	Canidae	Golden Jackal	<i>Canis aureus</i>	Least concern	3.33
10	Viverridae	Himalayan Palm Civet	<i>Paguma larvata</i>	Least concern	6.67
11	Mustelidae	Ferret Badger	<i>Melogale sp.</i>	Least concern	3.33
12	Tupaiidae	Tree Shrew	<i>Cladobats belangari</i>	Least concern	3.33

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 IVI and other quantitative values obtained for different plant species in the study coincide with the findings of Lalramenga (2006) and Lalchuanawma (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 Lalchuanawma (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 (Lalthanzara 2017). Presence of felids (three species) in the campus also forms 37.5%, as eight fields were previously reported by Lalthanzara (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 3. Mammalian species observed directly during study and their status.

	Family	Common name	Scientific name	IUCN status
1	Mustelidae	Yellow-throated Martin	<i>Martes flavigula</i>	Least Concern
2	Cervidae	Barking Deer	<i>Muntiacus muntjak</i>	Least Concern
3	Sciuridae	Pallas's Squirrel	<i>Callosciurus erythraeus</i>	Least Concern
4	Sciuridae	Himalayan Hoary-bellied Squirrel	<i>Callosciurus pygerythrus</i>	Least Concern
5	Tupaiaidae	Northern Tree Shrew	<i>Tupaia belangeri</i>	Least Concern
6	Muridae	Black Rat	<i>Rattus rattus</i>	Least Concern
7	Soricidae	House Shrew	<i>Suncus murinus</i>	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	<i>Lophura leucomelanos</i>	Least Concern	13.33
2	Muscicapidae	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	Least Concern	3.33
3	Muscicapidae	Forktail	<i>Enicurus leschenaulti</i>	Least Concern	3.33
4	Strigidae	Asian-barred Owlet	<i>Glaucidium cuculoides</i>	Least Concern	6.67
5	Campephagidae	Large Cuckoo Shrike	<i>Coracina macei</i>	Least Concern	3.33
6	Caprimulgidae	Long-tailed Nightjar	<i>Caprimulgus climacurus</i>	Least Concern	3.33

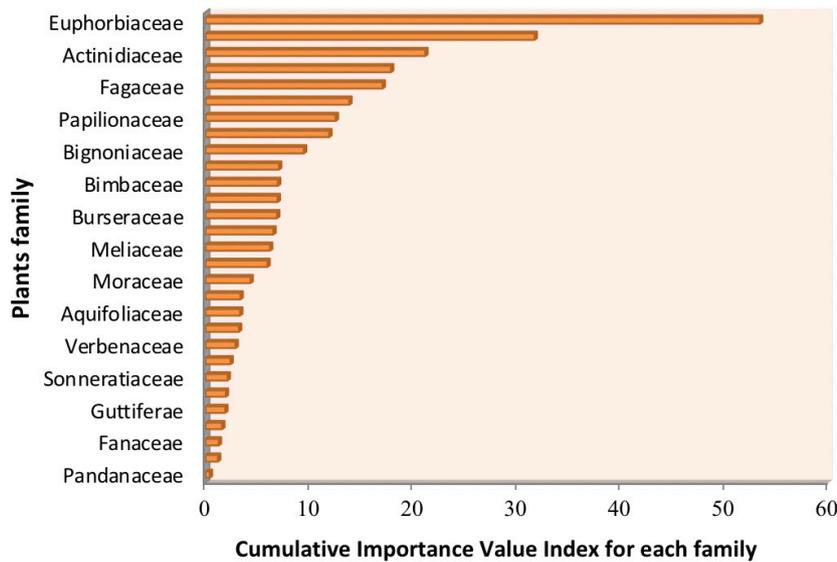


Figure 3. Plant families and their IVI values.

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.



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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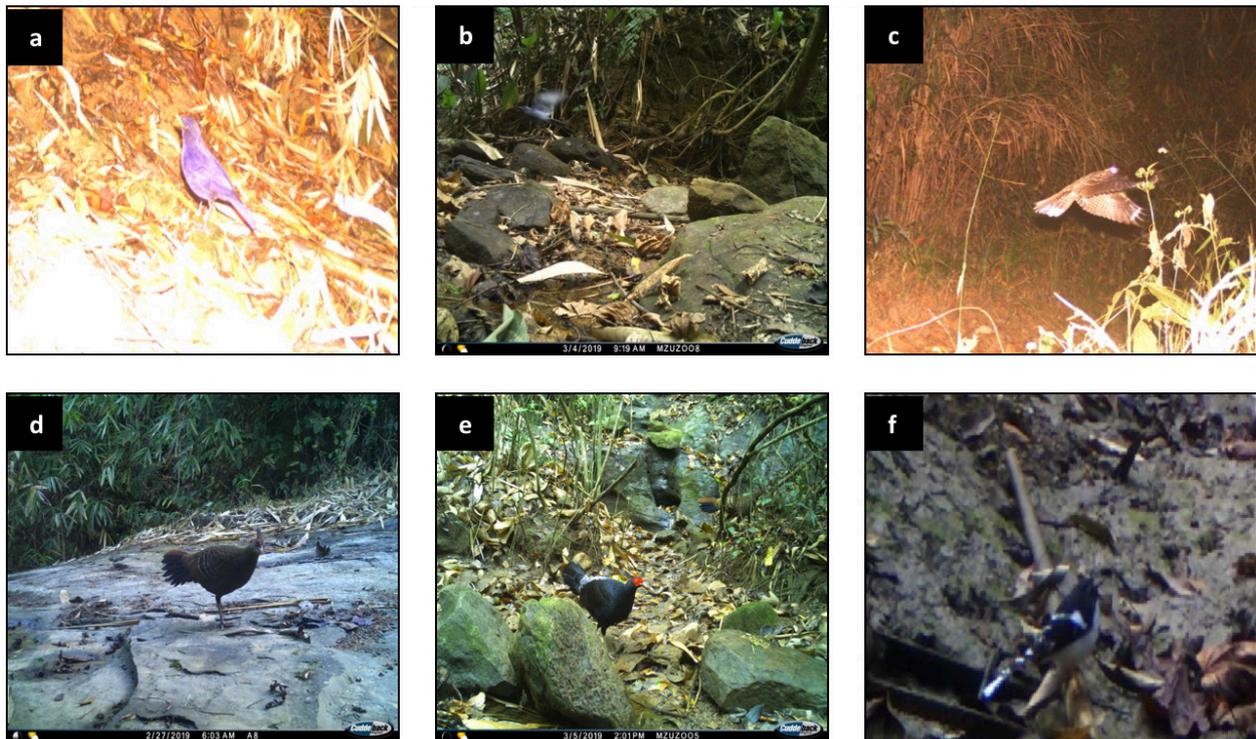


Image 3. Birds captured by camera trap: a—Blue Whistling Thrush | b—Large Cuckoo Shrike | c—Long-tailed Nightjar | d—Khalij Pheasant female | e—Khalij Pheasant male | f—Forktail.

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