Journal of Wildlife and Ecology (2023). 7(1):25-34

Research Paper **Open Access**

Changing Landscapes, Changing Lives: Terrestrial Mammalian Responses to Anthropogenic Influence near Margalla Hills National Park, Islamabad, Pakistan

Ayesha Iftikhar[1*], Muhammad Altaf[2], Muhammad Samar Hussain Khan[3]

1. Department of Zoology, Women University of Azad Jammu and Kashmir, Bagh, Pakistan
2. Institute of Forest Sciences, The Islamia University of Bahawalpur, Pakistan
3. Ministry of Climate Change and Environmental Coordination, Islamabad, Pakistan

***Corresponding author e-mail:** ayeshaifthakar@yahoo.com

Citation: Iftikhar, A., M. Altaf, and M. S. H. Khan. 2023. Changing Landscapes, Changing Lives: Terrestrial Mammalian Responses to Anthropogenic Influence near Margalla Hills National Park, Islamabad, Pakistan. Journal of Wildlife and Ecology 7(1):25-24.

SUMMARY

Anthropogenic impact may change distribution of mammals in an area. In the present study, quantitative evaluation has been made for the mammalian species response to anthropogenic activitiesin the vicinity of Margalla Hills National Park Islamabad. Many species generally decreased from forest to urban ecosystem like; Indian bush rat (*Golunda ellioti*), Mediterranean pygmy shrew (*Suncus etruscus*), cape hare (*Lepus capensis*), yellow throated marten (*Martes flavigula*), long-eared desert hedgehog (*Hemiechinus collaris*), Himalayan wood mouse (*Apodemus rusiges*), red fox (*Vulpes vulpes griffithi*), leopard cat (*Prionailurus bengalensis*), jungle cat (*Felis chaus*), Indian wild boar (*Sus scrofa*), Indian barking deer (*Muntiacus muntjak*), Himalayan grey goral (*Naemorhedus goral*), common palm civet (*Paradoxurus hermaphroditus*) and common leopard (*Panthra pardus*). Some species documented from natural habitats alongwith agriculture landscapes i.e. Indian field mouse (*Mus booduga*). Three species onlyobserved from human residential areas like house shrew (*Suncus murinus*), house rat (*Rattus rattus*) and house mouse (*Mus musculus*). Some species noted from multiple ecosystems viz. northern palm squirrel (*Funambulus pennantii*), Indian crested porcupine (*Hystrix indica*), Indian grey mongoose (*Herpestes edwardsii*), small Indian mongoose (*Herpestes javanicus*) and Rhesus macaque (*Macaca mulatta*). Urbanization was basically the most significant aspect in the distributions of mammalian species, and it is necessary to think the spatial scale of management according to the level of urbanization.

Keywords: Diversity, Distribution, Deer, Leopard, Indian grey mongoose

Received in January, 2023	**Accepted** in March, 2023

INTRODUCTION

The breathtaking beauty of our natural areas is diminishing, thanks to human activity (Laurance et al., 2014). The steady fading of our beautiful forest vistas can be attributed to the intensification of farming, the extension of pastures, and the rapid growth of our people. In the South Asian tapestry, Pakistan appears as one of the most urbanized nations, with vibrant cities (IGC, 2021). But, as the delicate beauty of our natural landscapes gives way to the flow of civilization, this urban expansion comes at a cost. Our natural beauty is deteriorating as a result of growing

urbanization and the desire for more crops (Altaf, 2016; FAO, 2021). In light of the strong threats occurring from exponential growth of human and arrangement for resources, knowing how worldwide mammalian response to degradation of forest is necessary to calculate how environment function and structure will modify (Sala et al., 2000; Whitworth et al., 2019), and for the improvement of suitable conservation actions (Stroud and Feeley, 2017). Mammals play an important role in conservation by providing a vital source of protein, engaging in herbivory, and assisting in seed dispersal. They frequently seize the spotlight as flagship species, guiding conservation concepts that protect numerous lesser-known organisms (Brodie et al., 2009).

Ecosystem changes influence different mammalian species in different ways, resulting in varied reactions to changes in landscapes and ecosystems (Keinath et al., 2017). Longer-lived mammals with larger ecosystems are often more vulnerable than species with shorter life cycles and smaller habitats (Morris et al., 2008). Larger mammals demand more energy and resources for their life cycles in human-altered habitats than smaller animals (Cardillo et al., 2005). As a result, bigger mammalian species are sometimes considered umbrella species in conservation plans, as safeguarding these species indirectly protects other mammalian occupants within the ecosystem (Rocha et al., 2018). Mammalian species have received less attention in the past, with researchers focusing mostly on plants and birds (Semper Pascual et al., 2018).

The present study was to investigate how habitat loss impacts mammalian species in the defined region, taking into consideration both changes through time and space. The hypothesis was concentrated on determining how terrestrial mammal species respond to ecosystems impacted by human activities in the region of Islamabad's Margalla Hills National Park. The knowledge gathered from such data could help us better comprehend the influence of human actions on the diversity of terrestrial animal species.

MATERIALS AND METHODS

Data were collected from March 2017 to March 208 in the vicinity of Margalla Hills National Park.

STUDY AREA

The Margalla Hills National Park (MHNP) is located in the beautiful Himalayan range's foothills. It includes the mountainous terrain directly north of Islamabad, as well as the surrounding regions of Rawal Lake and Shakar Parian Hills. The Margalla Hills are located at “73°7'3.32"E”, “33°41'59.61"N”, while Rawal Lake is located at “73°1'34.07"E”, “33°45'2.87"N” (as depicted in Figure 1).

METHODOLOGY

Data were collected through indirect count method including carcasses, fecal pellet, pug marks, hair mounting techniques as well as questions were raised from local respondents that (i.e. are you aware about species, diversity, and habitat preferences of mammals?). And also gathered data through direct count method (Altaf, 2016; Haider and Altaf, 2018). Mammalian species were observed through binoculars (i.e.

32x50). Books titled "Small Mammals of Pakistan and Large and medium sized Mammals of Pakistan" (Roberts, 2005a, b) referred to identifymammalian species.

STATISTICAL ANALYSIS

For the statistical analysis "PAST version 3.20 version" was used (Hammert et al., 2001) to know the "Simpson diversity index", "Shannon diversity index", "Evenness index", "Richness index", "Dominance index" and "Principle Component Analysis". Terrestrial mammalian species response against anthropogenic impacted habitats was calculated in "chord diagrams" using "circlize package" in "R software 3.6.1" (Gu et al., 2014).

Figure 1: Map of the study area.

RESULTS AND DISCUSSION

During the present study, total 26 mammalian species were documented from all the habitat types along Margalla Hills National Park, Islamabad (Table 1). The highest 24 mammalian species from forest, 11 species from rural area, 4 species from urban areas and 5 species from agriculture habitat wererecorded (Figure 2).

During this research it was reported that top diversity (i.e. H′=2.478 and S=0.8615) and richness (i.e. R=3.826) are noted from natural landscape, and the highest evenness (E=0.8203) are noted from anthropogenically affected ecosystems. The data demonstrated that modified lands have the lowest diversity. Few species are present with high populations therefore; evenness is the highest in urban ecosystems as shown in Table 2. During the study it was documented that high diversity of species

is present in study area and with IUCN Redlist status of mammalian species are listed as Least Concern (n=19), Endangered (i.e. n=1) and Vulnerable (n=1) as shown in Figure 3.

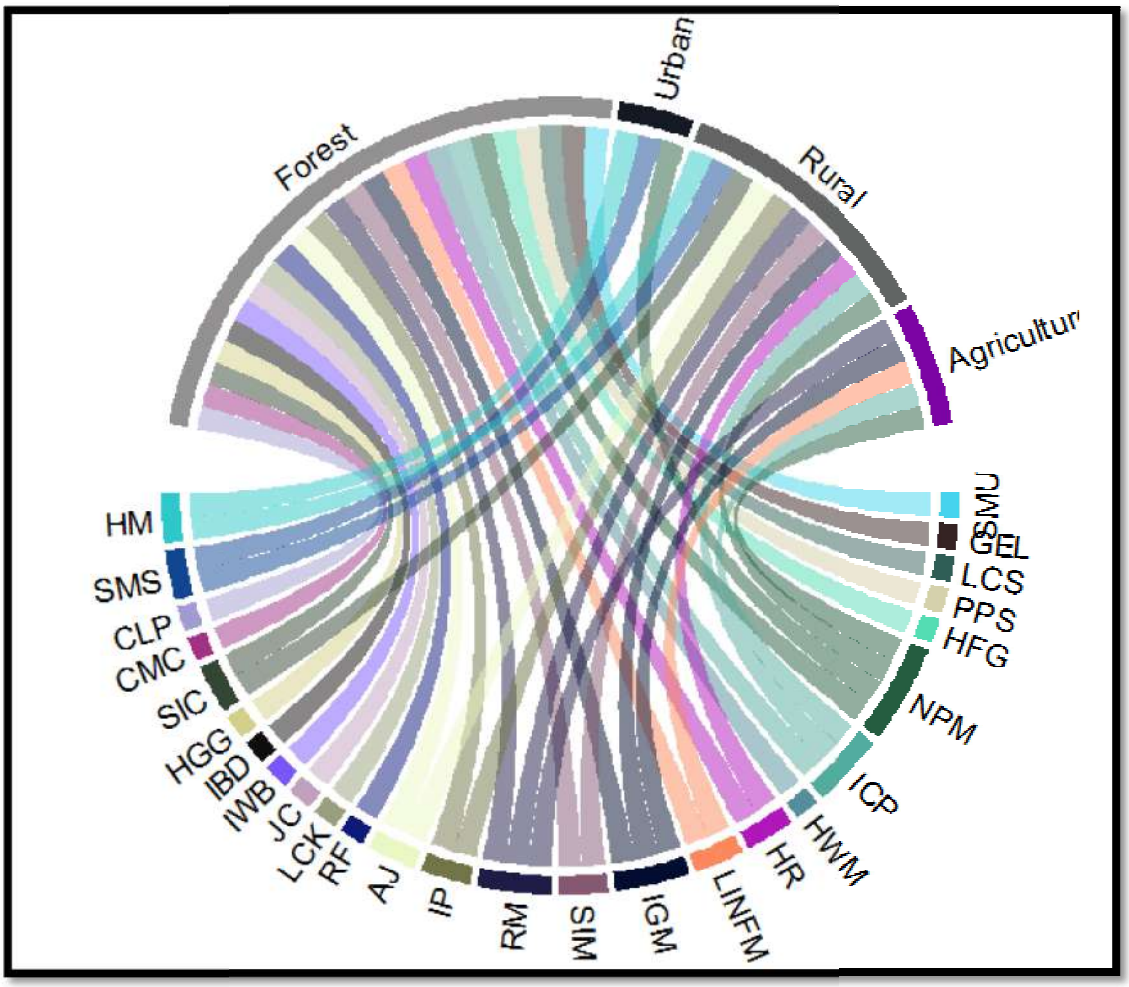

Figure 2: Terrestrial mammalian species response against anthropogenic impacted habitats in the study area (codes are present in Table 1).

Most of the documented e species prefer to live in natural habitats like Indian bush rat (*Golunda ellioti*), Mediterranean pygmy shrew (*Suncus etruscus*), cape hare (*Lepus capensis*), yellow throated marten (*Martes flavigula*), long-eared desert hedgehog (*Hemiechinus collaris*), Himalayan wood mouse (*Apodemus rusiges*), red fox (*Vulpes vulpes griffithi*), leopard cat (*Prionailurus bengalensis*), jungle cat (*Felis chaus*), Indian wild boar (*Sus scrofa*), Indian barking deer (*Muntiacus muntjak*), Himalayan grey goral (*Naemorhedus goral*), common palm civet (*Paradoxurus hermaphroditus*) and common leopard (*Panthra pardus*). Some species were documented from natural habitats alongwith agriculture landscapes i.e. Indian field mouse (*Mus booduga*), while some species were onlyobserved from human residential areas like house shrew (*Suncus murinus*), house rat (*Rattus rattus*) and house mouse (*Mus musculus*). Some species were collected from multiple ecosystems viz. northern palm squirrel (*Funambulus pennantii*), Indian crested porcupine

(*Hystrix indica*), Indian grey mongoose (*Herpestes edwardsii*), small Indian mongoose (*Herpestes javanicus*) and Rhesus macaque (*Macaca mulatta*).

Intensive urbanization reduces mammalian diversity and changes mammalian assemblages due to various factors including; habitat loss (Dickman, 1987; McKinney, 2008; Altaf et al., 2018), foodstuff subventions like garbage and crops (Fujita and Koike, 2009; Altaf, 2016), and human being avoidance attitude (Rytwinski and Fahrig, 2012). But richness does not always decline from urban to rural and may show different results (McDonnell and Hahs, 2008) e.g. richness enhances at rural in some species of mammals. Richness of some species of mammals in urban ecosystem is higher than other ecosystems (Magura et al., 2004).

The mammal communities' change from anthropogenic impacted areas to natural gradients might vary in different areas around the globe e.g. red foxes (*Vulpes vulpes*) are very common in urban ecosystems in cool-temperate region in Japan (Uraguchi et al., 2009) and England (Harris and Smith, 1987), but red foxes are restricted to forest ecosystems in the warm-temperate region of Japan (Sonoda and Kuramoto, 2008). A numberof urban mammals' researches have been documented in Europe, Australia, America and Asia (Magle et al., 2012). *Funambulus pennantii* like better to reside in rural ecosystems (Altaf et al., 2012), *Hystrix indica*(Safeer et al., 2018), *Herpestes javanicus* (Altaf et al., 2018) and *Sus scrofa*(Chughtai et al., 2018) have a preference to extant in the agriculture environment. *Rattus rattus*, *Mus musculus* and *Suncus murinus*preferto live human residential areas (Altaf, 2016; Manzoor et al., 2018). Data regarding diversity and distribution of mammals isthe important step towards conservation of species (McKinney, 2002).

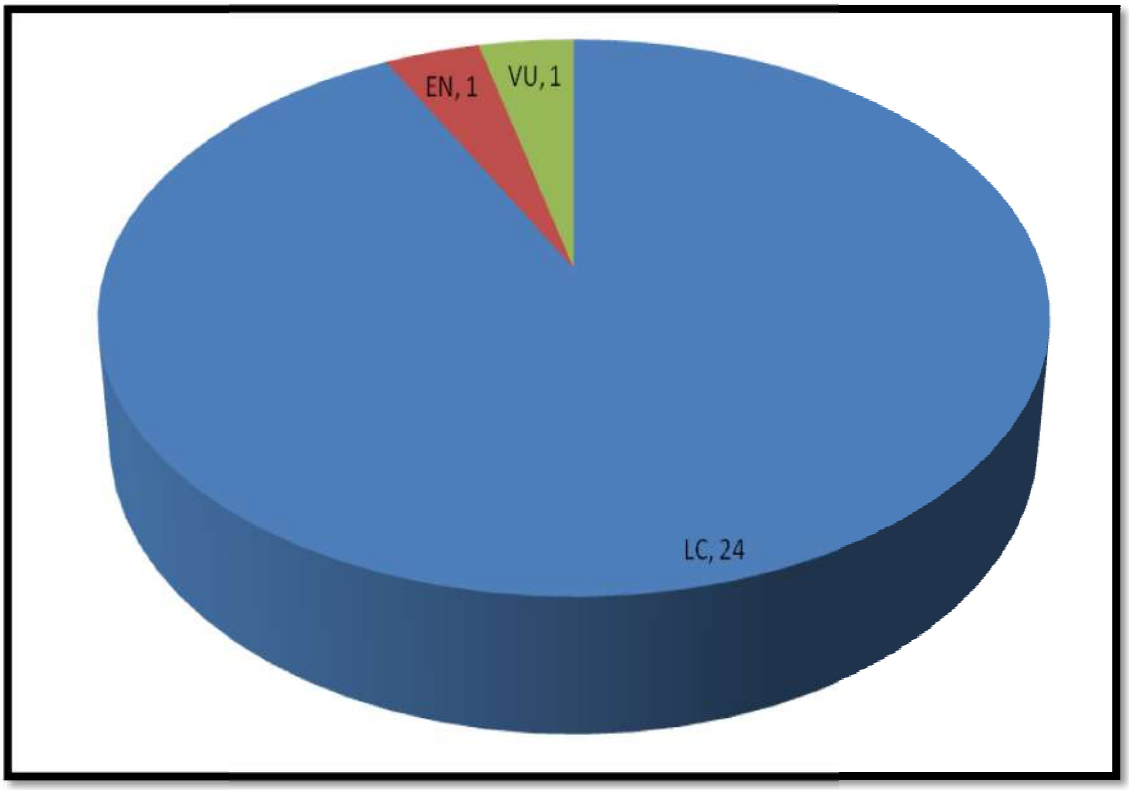

Figure 3: Status of terrestrial mammalian species in study areas.

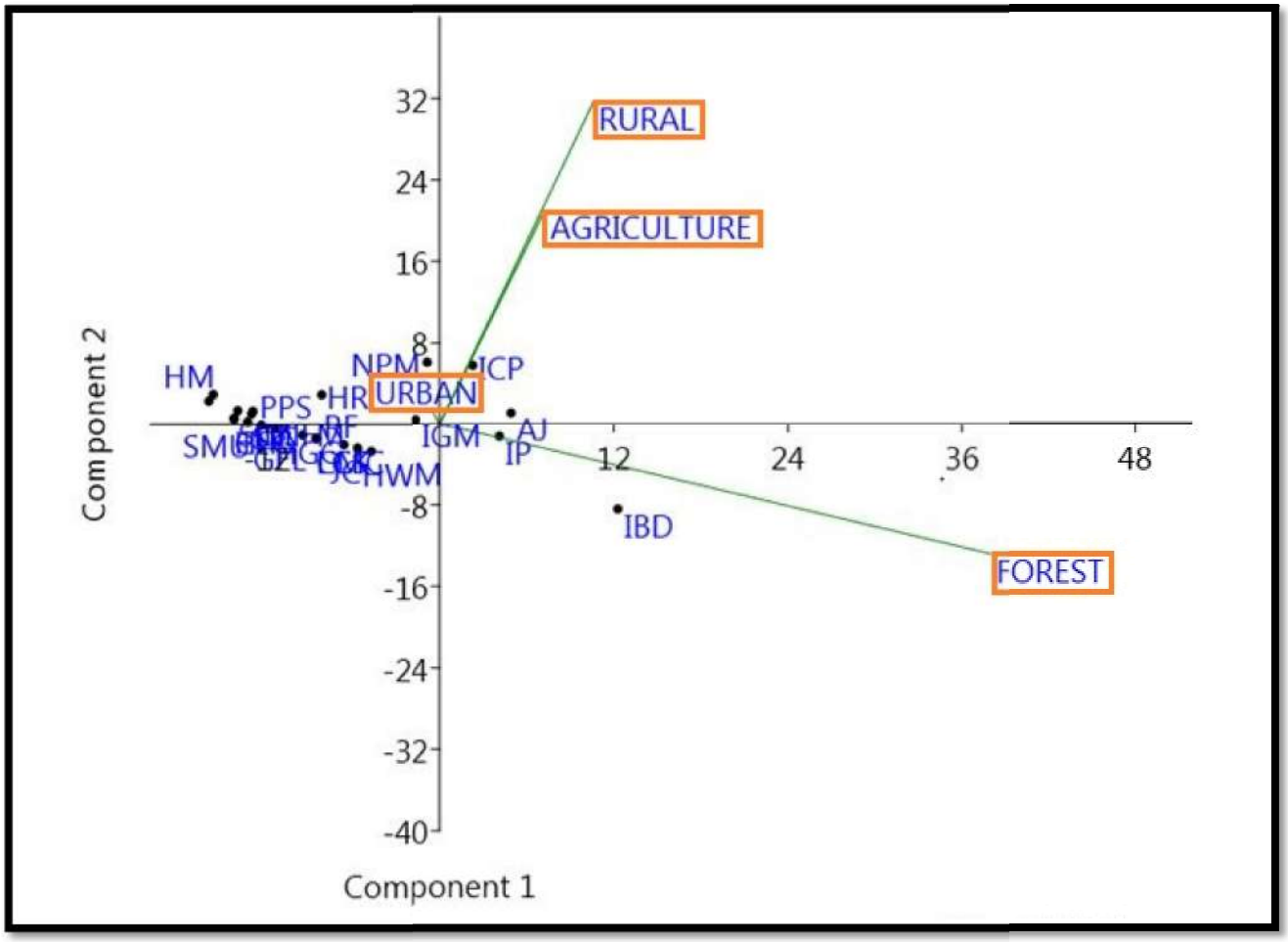

Figure 4: Principal components analysis representing distribution of mammals (codes are present in table 1).

The first two principal component analysis (PCA) dimensions accounted for 99.31% of the changes found in the sampled avian population (Component 1: 90.242%; Component 2: 9.0659%). Forest (r = 0.94), urban (r = -0.01239), rural (r = 0.26431), and agriculture (r = 0.1804) were all impactful on Component 1. The interaction of these parameters revealed that Component 1 encompasses the mammalian community's combined reaction to semi-urban and urban contexts, effectively indicating a gradient of development. Component 2 included both natural and altered habitats (forest: r = -0.31945; urban: r = 0.032508; rural: r = 0.78968; agriculture: r = 0.52278). Each principal component is independent of the others, and the avian community patterns highlighted by Component 2 differ from those explained by Component 1. The PCA emphasizes habitat distinctions and the significant role of human-induced changes on altering mammal communities (as shown in Figure 4). These findings are consistent with Altaf (2016) research, adding more evidence.

Human activities stand out as the key factor influencing animal behavior (Stoate et al., 2009). As a result, global conservation and management strategies for

these species should be properly documented (Branton and Richardson, 2011). However, it is worth mentioning that in human-influenced landscapes, the presence of corridors and tiny green spaces is critical for the conservation of mammalian species. These interconnecting corridors and patches of greenery are critical in protecting these species and their habitats by ensuring connectivity.

CONCLUSION

The research providesuseful insights into the dynamic reactions of terrestrial mammalian species to anthropogenic influences in the region of Islamabad's Margalla Hills National Park. The study has socumented a clear pattern of distribution change among numerous species in connection to different environments using quantitative analysis, showing the effects of urbanization on their populations. Subsequently this study provides an important reference point for policy makers, conservationists, and urban planners as they work to establish sustainable habitats that meet both human requirements and the complex demands of the terrestrial mammalian species that share the same environment. Based on finding of the study, it is suggested to ensure the coexistence and preservation of biodiversity in the vicinity of Margalla Hills National Park and beyond with this comprehensive strategy.

ACKNOWLEDGEMENT

We are thankful to local community and Management of Margalla Hills National Park, Islamabad Pakistan.

Table 1: Anthropogenic impacts on the diversity of mammals in the Margalla Hills National Park Islamabad.

Sr.	Common name	Scientific name	Species authority	Code	F	U	R	A	Status 2020
1.	House shrew	*Suncus murinus*	Linnaeus, 1766	SMS	0.000	0.474	0.011	0.000	LC
2.	Mediterranean pygmy shrew	*Suncus etruscus*	Savi, 1822	SMU	0.007	0.000	0.000	0.000	LC
3.	Indian bush rat	*Golunda ellioti*	Gray, 1837	GEL	0.017	0.000	0.000	0.000	LC
4.	Cape hare	*Lepus capensis*	Linnaeus, 1758	LCS	0.020	0.000	0.000	0.000	LC
5.	Yellow throated marten	*Martes flavigula*	Boddaert, 1785	PPS	0.010	0.000	0.000	0.000	LC
6.	Long-eared desert hedgehog	*Hemiechinus collaris*	Gray, 1830	HFG	0.005	0.000	0.000	0.000	LC
7.	Northern palm squirrel	*Funambulus pennantii*	Wroughton, 1905	NPM	0.032	0.211	0.085	0.106	L.C
8.	Indian crested porcupine	*Hystrix indica*	Kerr, 1792	ICP	0.039	0.000	0.096	0.106	L.C
9.	Himalayan wood mouse	*Apodemus rusiges*	Miller, 1913	HWM	0.029	0.000	0.000	0.000	L.C
10.	House rat	*Rattus rattus*	Linnaeus, 1758	HR	0.017	0.000	0.053	0.000	L.C
11.	House mouse	*Mus musculus*	Linnaeus, 1758	HM	0.000	0.263	0.021	0.000	LC
12.	Little Indian field mouse	*Mus booduga*	Gray, 1837	LINFM	0.007	0.000	0.000	0.043	LC

13.	Indian grey mongoose	*Herpestes edwardsii*	É. Geoffroy Saint-Hilaire, 1818	IGM	0.034	0.053	0.043	0.021	LC
14.	Small Indian mongoose	*Herpestes javanicus*	É. Geoffroy Saint-Hilaire, 1818	SIM	0.005	0.000	0.011	0.000	LC
15.	Rhesus macaque	*Macaca mulatta*	Zimmermann, 1780	RM	0.245	0.000	0.532	0.723	LC
16.	Indian pangolin	*Manis crassicaudata*	É. Geoffroy, 1803	IP	0.049	0.000	0.053	0.000	EN
17.	Asiatic Jackal	*Canus aureus*	Linnaeus, 1758	AJ	0.049	0.000	0.085	0.000	LC
18.	Red fox	*Vulpes vulpes griffithi*	Linnaeus, 1758	RF	0.025	0.000	0.000	0.000	LC
19.	Leopard cat	*Prionailurus bengalensis*	Kerr, 1792	LCK	0.020	0.000	0.000	0.000	LC
20.	Jungle cat	*Felis chaus*	Schreber, 1777	JC	0.027	0.000	0.000	0.000	LC
21.	Indian Wild boar	*Sus scrofa*	Linnaeus, 1758	IWB	0.245	0.000	0.000	0.000	LC
22.	Indian barking deer	*Muntiacus muntjak*	Zimmermann, 1780	IBD	0.074	0.000	0.000	0.000	LC
23.	Himalayan grey goral	*Naemorhedus goral*	Hardwicke, 1825	HGG	0.012	0.000	0.000	0.000	LC
24.	Small Indian Civet	*Viverricula indica*	É. Geoffroy Saint-Hilaire, 1803	SIC	0.007	0.000	0.011	0.000	LC
25.	Common palm civet	*Paradoxurus hermaphroditus*	Pallas, 1777	CMC	0.020	0.000	0.000	0.000	LC
26.	Common leopard	*Panthra pardus*	Linnaeus, 1758	CLP	0.005	0.000	0.000	0.000	VU

Table 2: Diversity indices of the mammals of Margalla Hills National Park Islamabad.

Diversity Indices	Forest	Urban	Rural	Agriculture
Species	24	3	11	5
Population	408	19	94	47
Simpson (S)	0.8615	0.6593	0.6852	0.4518
Shannon (H')	2.478	1.188	1.653	0.9272
Evenness (E)	0.4966	0.8203	0.4749	0.5055
Richness (R)	3.826	1.019	2.201	1.039

REFERENCES

Altaf, M. 2016. Assessment of Avian and Mammalian Diversity at Selected Sites along river Chenab University of Veterinary and Animal Sciences, Lahore-Pakistan.

Altaf, M., A. M. Khan, M. Umair, Irfan, and M. A. Munir. 2012. Status of wild birds and mammals in urban habitats of Gujranwala, Punjab, Pakistan. Punjab University Journal of Zoology 27 (1):9-12.

Altaf, M., S. Nazer, Musarat, I. Manzoor, B. Safeer, and S. Yasrub. 2018. Study of human activities impacts and interaction with small Indian mongoose in Dhirkot, district Bagh, Azad Jammu and Kashmir. Journal of Wildlife and Ecology 2(3):31-37.

Branton, M., and J. S. Richardson. 2011. Assessing the Value of the Umbrella-Species Concept for Conservation Planning with Meta-Analysis. Conservation biology 25(1):9-20.

Brodie, J. F., O. E. Helmy, W. Y. Brockelman, and J. L. Maron. 2009. Bushmeat poaching reduces the seed dispersal and population growth rate of a mammal-dispersed tree. . Ecological Applications 19(4):854–863.

Cardillo, M., G. M. Mace, K. E. Jones, J. Bielby, O. R. P. Binindaemonds, W. Sechrest, D. D. L. Orme, and A. Purvis. 2005. Multiple Causes of High Extinction Risk in Large Mammal Species. Science 309:1239-1241.

Chughtai, M. S., M. Altaf, I. Manzoor, B. Safeer, and S. Yasrub. 2018. Assessment of human and wild boar (*Sus scrofa*) conflict from district Bagh, Azad Jammu and Kashmir, Pakistan. Journal of Wildlife and Ecology 2(1):10-21.

Dickman, C. R. 1987. Habitat fragmentation and vertebrate species richness in an urban environment. Journal of Applied Ecology:337-351.

FAO. 2021. FAO in Pakistan; Pakistan at a Glance.

Fujita, M., and F. Koike. 2009. Landscape effects on ecosystems: birds as active vectors of nutrient transport to fragmented urban forests versus forest-dominated landscapes. Ecosystems 12(3):391-400.

Gu, Z., L. Gu, R. Eils, M. Schlesner, and B. Brors. 2014. circlize implements and enhances circular visualization in R. Bioinformatics 30(19):2811-2812.

Haider, R., and M. Altaf. 2018. Hair mounting techniques for conservation of mammals-A review. Journal of Wildlife and Ecology 2(1)(37-46)

Hammert, Q., D. A. T. Harper, and P. D. Ryan. 2001. Past paleontological statistical software package for education and data analysis. Palaeontol. stat.:4.

Harris, S., and G. Smith. 1987. Demography of two urban fox (Vulpes vulpes) populations. Journal of Applied Ecology:75-86.

IGC. 2021. The six biggest challenges facing Pakistan's urban future.

Keinath, D. A., D. F. Doak, K. E. Hodges, L. R. Prugh, W. Fagan, C. H. Sekercioglu, S. H. M. Buchart, and M. Kauffman. 2017. A global analysis of traits predicting species sensitivity to habitat fragmentation. Global Ecol. Biogeogr 26:115-127.

Laurance, W. F., J. Sayer, and K. G. Cassman. 2014. Agricultural expansion and its impacts on tropical nature. Trends in Ecology & Evolution 29(2):107-116.

Magle, S. B., V. M. Hunt, M. Vernon, and K. R. Crooks. 2012. Urban wildlife research: past, present, and future. Biological Conservation 155:23-32.

Magura, T., B. Tóthmérész, and T. Molnár. 2004. Changes in carabid beetle assemblages along an urbanisation gradient in the city of Debrecen, Hungary. Landscape Ecology 19(7):747-759.

Manzoor, I., M. Altaf, B. Safeer, and S. Yasrub. 2018. Study of diversity, distribution and cultural uses of house mouse (Mus musculus) in district Bagh, Azad Jammu and Kashmir-Pakistan. Journal of Wildlife and Ecology 2(1):22-29.

McDonnell, M. J., and A. K. Hahs. 2008. The use of gradient analysis studies in advancing our understanding of the ecology of urbanizing landscapes: current status and future directions. Landscape Ecology 23(10):1143-1155.

McKinney, M. L. 2002. Urbanization, Biodiversity, and Conservation The impacts of urbanization on native species are poorly studied, but educating a highly urbanized human population about these impacts can greatly improve species conservation in all ecosystems. BioScience 52(10):883-890.

McKinney, M. L. 2008. Effects of urbanization on species richness: a review of plants and animals. Urban ecosystems 11(2):161-176.

Morris, W. F., C. A. Pfister, S. Tuljapurkar, C. V. Haridas, C. L. Boggs, M. S. Boyce, E. M. Bruna, D. R. Church, T. Coulson, D. F. Doak, S. Forsyth, J. M. Gaillard, C. C. Horvitz, S. Kalisz, B. E. Kendall, T. M. Knight, C. T. Lee, and E. S. Menges. 2008. Longevity can buffer plant and animal populations against changing climatic variability. Ecology 89:19-25.

Roberts, T. J. 2005a. Field guide to the large and medium-sized mammals of Pakistan. Oxford University Press.

Roberts, T. J. 2005b. Field guide to the small mammals of Pakistan. Oxford University Press.

Rocha, E. C., D. Brito, P. M. e. Silva, J. Silva, P. V. d. S. Bernardo, and L. Juen. 2018. Effects of habitat fragmentation on the persistence of medium and large mammal species in the Brazilian Savanna of Goiás State. Biota Neotropica 18(3):1-9.

Rytwinski, T., and L. Fahrig. 2012. Do species life history traits explain population responses to roads? A meta-analysis. Biological Conservation 147(1):87-98.

Safeer, B., Z. Rasheed, M. Altaf, I. Manzoor, and S. Yasrub. 2018. Assessment of human-Indian crested porcupine (*Hystrix indica*) conflict in district Bagh, Azad Jammu and Kashmir. Journal of Wildlife and Ecology 2(2):1-12.

Sala, O. E., F. S. Chapin, J. J. Armesto, E. Berlow, J. Bloomfield, R. Dirzo, E. Huber-Sanwald, L. F. Huenneke, R. B. Jackson, and A. Kinzig. 2000. Global biodiversity scenarios for the year 2100. Science 287(5459):1770-1774.

Semper Pascual, A., L. Macchi, F. M. Sabatini, J. Decarre, M. Baumann, P. G. Blendinger, B. Gómez Valencia, M. E. Mastrangelo, and T. Kuemmerle. 2018. Mapping extinction debt highlights conservation opportunities for birds and mammals in the South American Chaco. Journal of Applied Ecology 55(3):1218-1229.

Sonoda, Y., and N. Kuramoto. 2008. Effect of forest fragmentation on species composition of non-flying mammals in the Tama hill and Kanto mountain region. Ecol. Civil Eng. 11 (1), 41-49, 2008. Ecology and civil engineering 11(1):41-49.

Stoate, C., A. Báldi, P. Beja, N. Boatman, I. Herzon, A. Van Doorn, G. De Snoo, L. Rakosy, and C. Ramwell. 2009. Ecological impacts of early 21st century agricultural change in Europe–a review. Journal of environmental management 91(1):22-46.

Stroud, J. T., and K. J. Feeley. 2017. Neglect of the tropics is widespread in ecology and evolution: A comment on Clarke et al Trends in Ecology and Evolution 32: 626-628.

Uraguchi, K., K. Yamamura, and T. Saitoh. 2009. Estimating number of families for an urban fox population by using two public data sets. Population ecology 51(2):271-277.

Whitworth, A., C. Beirne, R. Pillco Huarcaya, L. Whittaker, S. J. Serrano Rojas, M. W. Tobler, and R. MacLeod. 2019. Human disturbance impacts on rainforest mammals are most notable in the canopy, especially for larger-bodied species. Diversity and Distributions 25(7):1166-1178.

***Competing interests**:* Authors have declared that no competing interests exist.
***Funding**:* Authors have no source of funding for this work.
Authors' contributions: Iftikhar has designed this project, collected data and written this article; while Ataf and Khan have critically analyzed this article and approved as final.