



## Assessment of Mammalian Diversity and Ethnopharmacological Uses in Muzaffarabad, Azad Jammu and Kashmir, Pakistan

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### SUMMARY

There are 6,036 mammalian species worldwide, while 195 species of mammals are documented in Pakistan, and 41 mammalian species are noted from Azad Jammu and Kashmir, Pakistan. The main objectives of the study are to know the diversity of mammals and the traditional medicinal uses of mammalian species in the study area. The linear count method was applied to assess mammalian diversity. To evaluate mammal diversity, both direct and indirect methods were used. Ethnomammalogical data were collected through questionnaires. The questionnaires consisted of personal profiles, species information, and ethnopharmacological uses of the species. A survey of mammalian diversity in Muzaffarabad found 12 species from 5 orders, 9 families, and 12 genera. The Dominance Index ( $D= 0.1385$ ) indicates a relatively low concentration of individuals within a few species, suggesting a balanced community structure. This is further supported by the high Simpson Index ( $S = 0.8615$ ), which indicates high diversity and a low likelihood that two randomly selected individuals belong to the same species. The Shannon-Wiener Diversity Index ( $H'= 2.222$ ) shows moderate to high species diversity, while the Evenness Index ( $E = 0.769$ ) indicates that individuals are fairly evenly distributed among the observed taxa. The Richness Index ( $R = 2.626$ ) indicates a satisfactory level of species richness in comparison to the sample size. According to respondents, the meat and fat of the Indian crested porcupine are used topically to treat asthma, joint pain, skin issues, and wound healing. The skin, meat, and fat of the Rhesus macaque are used topically and taken orally to treat impotence, asthma, and joint pain.

**Keywords:** Ethnomammalogy, Mammalogy, Diversity, Ecology

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### INTRODUCTION

There are 6036 mammalian species in the world (IUCN, 2026). Pakistan has unique landscape. Some parts of Pakistan are located in three zoogeographical areas: the Oriental, Ethiopian, and Palearctic, resulting in a diverse range of animals and plants. According to Roberts (Roberts, 2005a; Roberts, 2005b), Pakistan's mammalian fauna includes 195 species. According to Roberts (1997), 41 mammalian species are present in Azad Jammu and Kashmir, Pakistan.

Ethno-mammalogy is the study of the traditional usage of mammalian species for human purposes. It is impossible to ignore the significance of animal species in human population life. Such species have environmental, social, spiritual, cost-effective, therapeutic, and nutritional significance; nonetheless, the global interchange of many of these species is a major cause of extinction. The market for these items provides useful information about the value of regional and foreign animal and plant species (Souto et al., 2012; Altaf, 2016; Altaf et al., 2017).

According to the World Health Organization, traditional folk remedies are used by 75 to 80 percent of the global population. People all across the world rely on natural items obtained for therapeutic purposes from natural sources, highlighting the value of animals and medicinal plants as integral parts of tradition. Substantial data demonstrate that anthropogenic factors have a negative impact on local species (Altaf et al., 2018). Globally, the cycle of urban expansion and global population increase, both of which are rising at unprecedented rates, endangers the viability of entire ecosystems. The ongoing growth of the human population and the subsequent extension of anthropogenic activities are thought to be the principal causes of an accelerated rise in global extinction rates (Alves et al., 2012; de Melo et al., 2014; Haidar and Bashir, 2021).

Animals have been an important part of human medicine since ancient times (Bashir et al., 2023). Medicinal animals are widely utilized in both rural and urban settings, and herbal animals are sold worldwide by herb vendors in public marketplaces. Many species of animals traded for medical purposes are officially classified as endangered or threatened, owing to high harvesting stress. The environmental, cultural, social, and public ramifications of the use of fauna, including a thorough inventory of the animal species utilized for therapeutic purposes and the socio-cultural context linked with their use, must be investigated immediately (Khan et al., 2024).

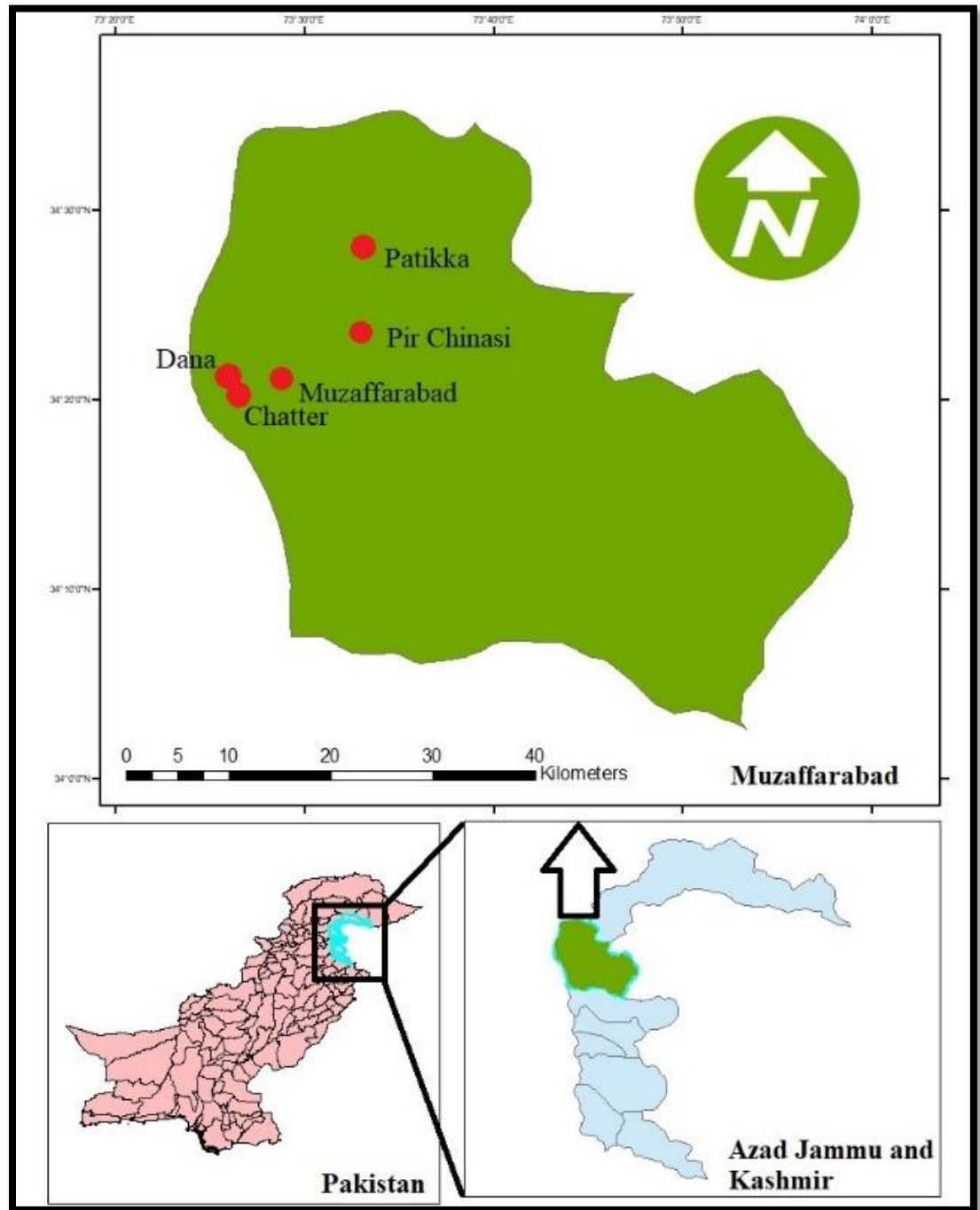
This study is the first comprehensive investigation of the mammalian diversity and ethnopharmacological uses of fauna in Muzaffarabad. Despite the region's rich biodiversity and the significant reliance of local communities on wildlife for traditional medicine, there is a lack of baseline data on species diversity and associated ethnopharmacological knowledge. Therefore, this research aims to evaluate the current state of mammalian diversity and to document, for the first time, the ethnopharmacological applications of local mammalian species. The main objectives include assessing species diversity, and recording traditional medicinal uses based on local knowledge, and highlighting conservation issues to promote the sustainable conservation of biodiversity and local practices.

## **MATERIALS AND METHODS**

### **DatSTUDY AREA**

Muzaffarabad is the capital city of Azad Jammu and Kashmir and is located at the convergence of the Neelum and Jhelum rivers. In July, the highest and lowest temperatures are around 35°C and 23°C, respectively, while in January, they are 16°C and 3°C. The average precipitation per annum in the district is 1,511 mm. The district has abundant forests, which cover 59 percent of the land and provide a significant

income source (Khan et al., 2019). The transect line was built at five locations: Muzaffarabad city, Dana, Chatter, Patikka, and Pir Chinnasi (Figure 1).



**Figure 1: Map of the study area.**

#### **ASSESSMENT OF MAMMALIAN DIVERSITY**

The linear count method was applied to check mammalian diversity (Altaf et al., 2012; Altaf et al., 2014). To assess mammal diversity, direct and indirect methods were used (Altaf et al., 2023). The direct method includes physical presence and

voice, while the indirect method includes body parts, footprints, hair mounting, fecal pellets, pugmarks, and questionnaires. Binoculars (32x50) and a microscope were used to detect the animals. The diversity and habitat of mammals in each region were also observed.

### STATISTICAL ANALYSIS

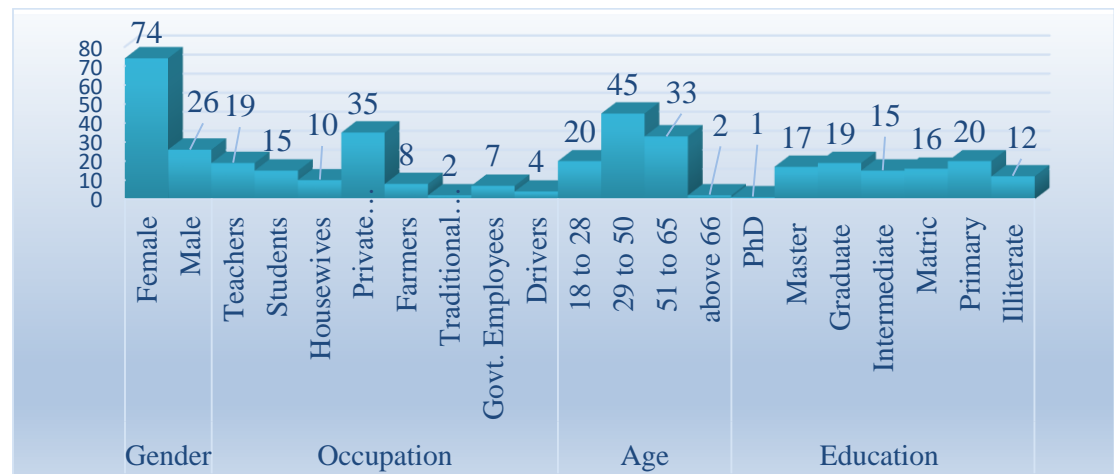
Statistical analysis was used to investigate the relationship between mammals and their habitats. Diversity indices were calculated using PAST (version 3), and OriginPro softwares .

### ETHNOPHARMACOLOGICAL USES

The field survey was conducted from March 2019 to December 2020. Ethnomammalogical data were collected through questionnaires. The questionnaires consisted of personal profiles, species information, and ethnoparmacological uses of species. Data on ethno-medical uses and cultural values were analyzed using various indices such as Frequency of Citation (FC) and Relative Frequency of Citation (RFC).

### RESULTS AND DISCUSSION

Data were collected from males and females respondents (n=100); they were mostly educated (88%), while few were uneducated (12%). They belong to different occupations, i.e., Teachers (n=19), Students (n=15), Housewives (n=10), Private Employees (n=35), Farmers (n=8), Traditional Healers (n=2), Government Employees (n=7), and Drivers (n=4). Respondents ranged in age from 18 to 70 years old (Figure 2).



**Figure 2: Respondents of the study area.**

A mammalian diversity survey conducted in Muzaffarabad documented 12 species (i.e., *Sus scrofa*, *Vulpes vulpes*, *Canis aureus*, *Viverricula indica*, *Panthera pardus*, *Martes flavigula*, *Paguma larvata*, *Paradoxurus hermaphrodites*, *Semnopithecus entellus*, *Macaca mulatta*, *Hystrix indica* and *Eoglaucmys fimbriatus*), belonging to 5 orders (i.e., Rodentia, Primates, Cercopithecidae, Carnivora and Artiodactyla) (Figure 3), 9 families (i.e. Suidae, Canidae, Felidae,

Mustelidae, Viverridae, Semnopithecidae, Cercopithecidae, Hystricidae and Sciuridae) (Figure 4), and 12 genera (i.e. *Sus*, *Vulpes*, *Canis*, *Viverricula*, *Panthera*, *Martes*, *Paguma*, *Paradoxurus*, *Semnopithecus*, *Macaca*, *Hystrix* and *Eoglaucmys*) (Figure 5 and Table 1).

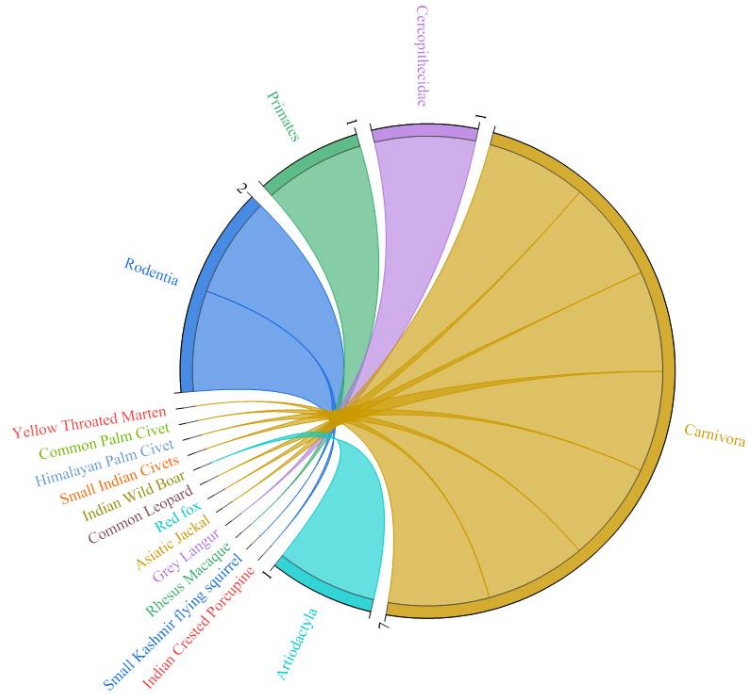


Figure 3: Order of mammalian species in the study area.

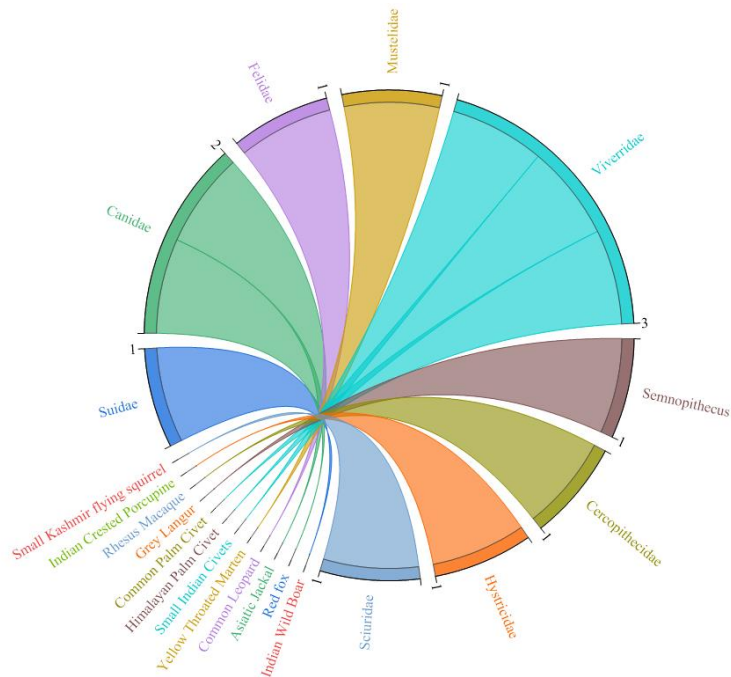
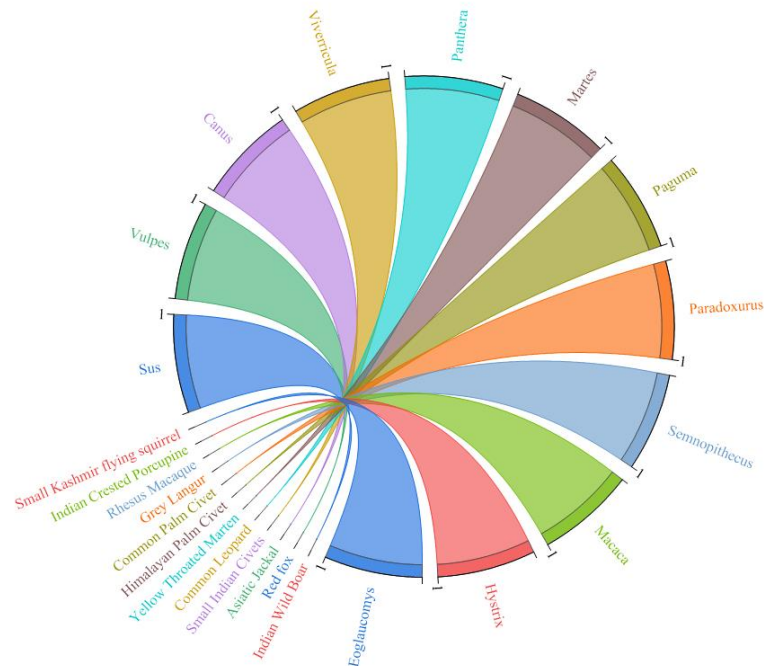


Figure 4: Families of mammalian species in the study area.



**Figure 5: Genera of mammalian species in the study area.**

Altaf et al. (2014) found 15 species of animals from 10 families and 6 orders in the Chenab River in Punjab, Pakistan. From the Chenab River, Roberts (1997) found 23 species of mammals, belong to 11 families and 6 orders. In their study of the riparian wetland of the Ravi River, 12 distinct mammalian species belongs to seven families and four orders were identified by Sial (2024).

The Dominance Index ( $D= 0.1385$ ) indicates a relatively low concentration of individuals within a few species, suggesting a balanced community structure. This is further supported by the high Simpson Index ( $S= 0.8615$ ), which indicates high diversity and a low likelihood that two randomly selected individuals belong to the same species. The Shannon-Wiener Diversity Index ( $H'= 2.222$ ) shows moderate to high diversity of species, while the Evenness Index ( $E= 0.769$ ) indicates that individuals are fairly evenly distributed among the observed taxa. The Richness Index ( $R= 2.626$ ) indicates a satisfactory level of species richness in comparison to the sample size (Table 2). Results are verified by different researches (Altaf et al., 2014; de Melo et al., 2014; de Andrade Melo et al., 2015; Kuipers et al., 2021; Kumara et al., 2023). The Shannon-Wiener diversity index for mammal species at Head Marala, Head Khanki, and Head Qadirabad was 0.86, 0.97, and 0.98, respectively, according to Altaf et al. (2014). At Head Qadirabad, Head Khanki, and Head Marala, the species evenness was 0.38, 0.39, and 0.2, respectively. Furthermore, the species richness scores for Head Qadirabad, Head Khanki, and Head Marala were 6.6, 6.2, and 7.1, respectively. Sulmanki, Islam, and Panjnad had Shannon-Wiener indices of 2.20, 2.13, and 2.45, respectively, according to Sial (2024). All three locations had the same species richness index, which was 1.61. Furthermore, the species evenness scores were 1.00 for Panjnad, 0.92 for Islam, and 0.95 for Sulmanki.

**Table 1: Mammalian diversity in Muzaffarabad, Azad Jammu and Kashmir, Pakistan.**

Name	Order Family	Status	Relative Abundance
Indian Wild Boar <i>Sus scrofa</i> Linnaeus, 1758	Artiodactyla Suidae	Least Concern	0.1515
Red fox <i>Vulpes vulpes</i> Linnaeus, 1759	Carnivora Canidae	Least Concern	0.1515
Asiatic Jackal <i>Canus aureus</i> Linnaeus, 1758	Carnivora Canidae	Least Concern	0.1818
Small Indian Civets <i>Viverricula indica</i> Desmarest, 1817	Carnivora Viverridae	Least Concern	0.0303
Common Leopard <i>Panthera pardus</i> Linnaeus, 1758	Carnivora Felidae	Vulnerable	0.0606
Yellow Throated Marten <i>Martes flavigula</i> Boddaert, 1785	Carnivora Mustelidae	Least Concern	0.0454
Himalayan Palm Civet <i>Paguma larvata</i> Hamilton-Smith, 1827	Carnivora Viverridae	Least Concern	0.0303
Common Palm Civet <i>Paradoxurus hermaphroditus</i> Pallas, 1777	Carnivora Viverridae	Least Concern	0.0303
Grey Langur <i>Semnopithecus entellus</i> Dufresne, 1797	Cercopithecidae Semnopithecus	Least Concern	0.0757
Rhesus Macaque <i>Macaca mulatta</i> Zimmermann, 1780	Primates Cercopithecidae	Least Concern	0.0303
Indian Crested Porcupine <i>Hystrix indica</i> Kerr, 1792	Rodentia Hystriidae	Least Concern	0.0757
Small Kashmir flying squirrel <i>Eoglaucomys fimbriatus</i> (Gray, 1837)	Rodentia Sciuridae	Least Concern	0.272

**Table 2: Diversity indices of mammalian species in the study area.**

Diversity Indices	Values
Taxa (S)	12
Individuals	66
Dominance index (D)	0.1385
Simpson index (S)	0.8615
Shannon index (H')	2.222
Evenness index (E)	0.769
Richness index (R)	2.626

During the study, it was noted that, out of the total, all species are used for traditional medicine. The following parts are used orally and topically (Figure 6): meat (n=3), fat (n=12), and skin (n=1) to cure the following diseases (Figure 7): skin ailments, wound healing, tuberculosis, cough, back pain, asthma, impotence, and joint pain (Figure 8). The researchers (Borah and Prasad, 2017; Kendie et al., 2018; Abdul-Latiff et al., 2021; Hariohay et al., 2023; Acharya et al., 2025; Muvengwi and

Maroyi, 2025) have all documented the use of mammalian body parts in the manufacture of regional remedies.

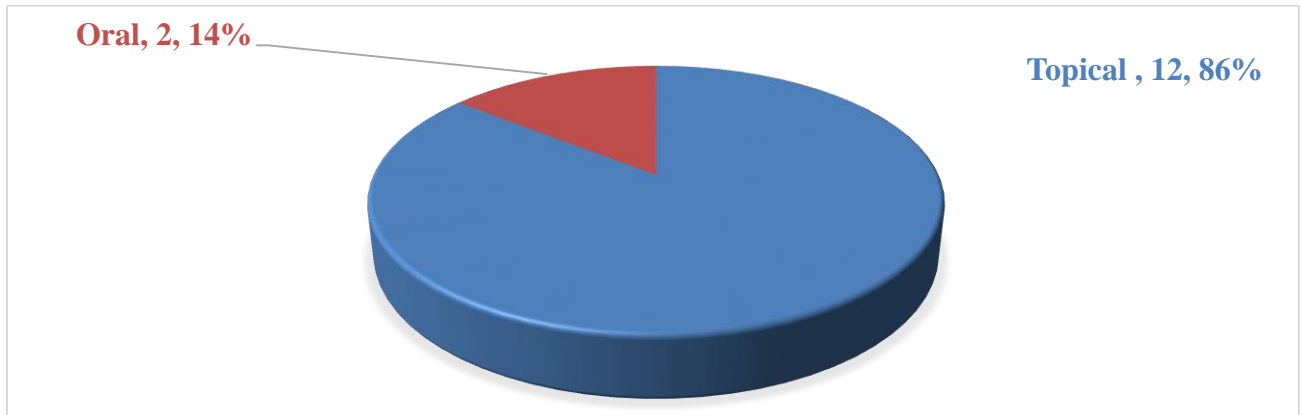


Figure 6: Mode of use in ethnopharmacological studies in the study area.

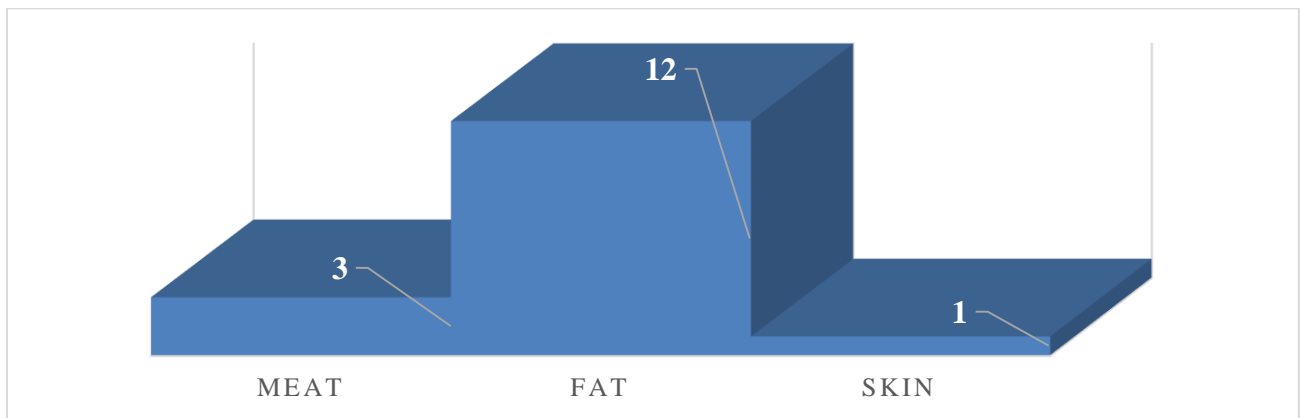


Figure 7: Parts of use in ethnopharmacological studies in the study area.

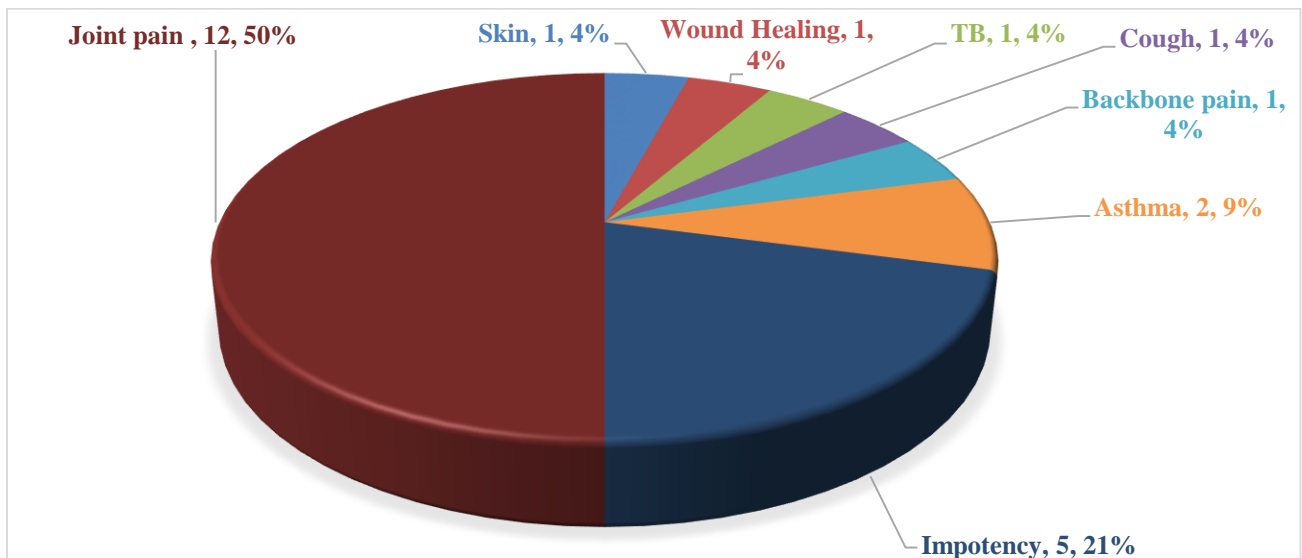


Figure 8: Diseases are treated with the help of parts from mammalian species in the study area.

It is impossible to dispute the significance of mammalian species for human communities' way of life (Borah and Prasad, 2017; Kendie et al., 2018; Abdul-Latiff et al., 2021). Many of these species have ecological, cultural, religious, medical, economic, and food importance, and their global trade is a major contributor to their extinction. The markets where these animals are traded offer important insights into the importance of both native and foreign plants and animals (Zarif et al., 2021; Al-Robai et al., 2022; Hsu and Harris, 2022; Naz et al., 2022; Umair et al., 2024; Jahangeer et al., 2026). Furthermore, ethno-mammalogy studies that use surveys to record the traditional use of mammalian species in local populations' livelihoods aid in the development of saving plans. Many animals have already been used medicinally in rural regions, but less is known about the traditional uses of animals for medicinal purposes in urban settings (Altaf et al., 2017; Altaf et al., 2021; Bashir et al., 2021; Faiz et al., 2022).

Meat and fat of the Indian crested porcupine are used topically to treat asthma, joint pain, skin issues, and wound healing, and the relative frequency of citation (RFC) was 0.23. The Rhesus macaque's skin, meat, and fat are used topically and taken orally to treat impotence, asthma, and joint discomfort; the relative frequency of citation (RFC) was 0.09. The meat of the Grey Langur is used topically and orally to treat T.B., cough, and joint pain, and the relative frequency of citation (RFC) was 0.04. The fat of the Asiatic Jackal, Red Fox, Common Leopard, Indian Wild Boar, Small Indian Civet, Himalayan Palm Civet, Common Palm Civet, Small Kashmir Flying Squirrel, and Yellow-Throated Marten is used topically for joint pain, back pain, and impotency, with the relative frequency of citation (RFC) being 0.05, 0.13, 0.16, 0.01, 0.03, 0.02, 0.08, 0.09, and 0.09, respectively (Table 3).

Mammalian species conservation strategies requires an understanding of the historical background of humanity's relationship with natural resources (Jahangeer et al., 2026). In this way, ethnomammalogy and ethnomedicine contribute significantly by providing essential knowledge, such as traditional conceptions of medicine (Rasheed and Faiz, 2024). Recognizing and controlling the dangers related to their use is essential to ensuring wild mammalian species' survival while satisfying the world's need for ecological assets. Due to their use in traditional medicinal systems and other purposes by indigenous people, a variety of mammalian species have become popular targets, leading to the extinction of mammalian species (Bashir et al., 2023). Different mammalian groups had varying degrees of threat, according to the conservation assessment of the documented taxa. A community-based conservation development program, including the government, non-governmental organizations, impacted individuals, and other interested parties, is desperately needed. Tanzania is a shining example of effective community-based conservation, where local inhabitants were supported while mammalian species were protected.

## **CONCLUSION**

It is concluded that a high diversity of mammalian species is present in the study area. This study provides the first comprehensive overview of the diversity of mammals and the ethnopharmacological use of animals in Muzaffarabad. The degree to which the local population depends on fauna to provide them with traditional medicine is demonstrated by the evidence of 12 mammal species that are relevant to

ethnopharmacology. Many people in the community are aware of the issue, and the use of animal parts—particularly meat and fat—to treat various ailments is proof of this. Therefore, it is necessary to implement conservation measures, preserve significant traditional knowledge for future generations, and encourage the sustainable use of wildlife.

**Table 3: Ethnomedicinal uses of mammalian species in Muzaffarabad, Azad Jammu and Kashmir, Pakistan.**

Common name	Part use/Mode use	Treatment	FC	RFC
Indian Crested Porcupine	Meat and fat/Topical	Asthma, joint pain, skin issues and wound healing	32	0.23
Rhesus Macaque	Skin, meat, and fat/Oral and topical	Joint pain, asthma and impotency	12	0.09
Grey Langur	Meat/Topical and oral	TB, cough and joint pain	5	0.04
Asiatic Jackal	Fat/Topical	Joint pain, backbone pain	7	0.05
Red Fox	Fat/Topical	Joint pain, impotency	18	0.13
Common Leopard	Fat/Topical	Joint pain, impotency	22	0.16
Indian Wild Boar	Fat/Topical	Joint pain	1	0.01
Small Indian Civets	Fat/Topical	Joint pain, impotency	4	0.03
Himalayan Palm Civet	Fat/Topical	Joint pain, impotency	3	0.02
Common Palm Civet	Fat/Topical	Joint pain	11	0.08
Small Kashmir Flying Squirrel	Fat/Topical	Joint pain	12	0.09
Yellow Throated Marten	Fat/Topical	Joint pain	12	0.09

#### REFERENCES

- Abdul-Latif, M. A. B., M. A. Afqah, F. Zahari, N. Othman, H. Haris, M. F. Najmuddin, and B. M. Md-Zain. 2021. The ethnozoology, wildlife utilisation and hunting practices of the Semoq Beri Tribe in Pahang Resource Use and Sustainability of Orang Asli: Indigenous Communities in Peninsular Malaysia. Springer.
- Acharya, R., S. K. Das, A. Bhowal, and K. Sen. 2025. Healing from the wild: an ethnozoological exploration of animal-based medicine in Jhargram, West Bengal, India. *Journal of Ethnobiology and Ethnomedicine*. 21(32):1-59.
- Al-Robai, S. A., A. A. Ahmed, H. A. Mohamed, A. A. Ahmed, S. A. Zabin, and A. A. Alghamdi. 2022. Qualitative and quantitative ethnobotanical survey in Al Baha province, southwestern Saudi Arabia. *Diversity*. 14: 867.
- Altaf, M. 2016. Assessment of avian and mammalian diversity at selected sites along river Chenab, PhD thesis. University of Veterinary and Animal Sciences, Lahore, Pakistan.
- Altaf, M., A. Javid, A. M. Khan, S. Nazer, K. J. Iqbal, M. S. Haider, and S. Ashraf. 2023. Habitat Preferences of Wild Mammalian Species around River Chenab in Sialkot, Gujrat and Gujranwala Districts, Punjab, Pakistan. *Pakistan Journal of Zoology*. 55: 2887-2893.
- Altaf, M., A. Javid, M. Munir, S. Ashraf, M. Umair, K. Iqbal, A. Khan, and Z. Ali. 2014. Diversity of wild mammalian fauna of Chenab riverine forest, Punjab, Pakistan. *JAPS: Journal of Animal and Plant Sciences*. 24: 1342-1347.
- Altaf, M., A. Javid, M. Umair, K. J. Iqbal, Z. Rasheed, and A. M. Abbasi. 2017. Ethnomedicinal and cultural practices of mammals and birds in the vicinity of river Chenab, Punjab-Pakistan. *Journal of Ethnobiology and Ethnomedicine*. 13(41):1-14.
- 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: 9-12.
- Altaf, M., A. M. Khan, S. Zahoor, M. Umair, and M. S. Amjad. 2021. Ethno-Medicinal Uses of Wildlife in Azad Jammu and Kashmir, Pakistan. *Ethnobiology of Mountain Communities in Asia*. Springer.
- Altaf, M., M. Umair, A. R. Abbasi, N. Muhammad, and A. M. Abbasi. 2018. Ethnomedicinal applications of animal species by the local communities of Punjab, Pakistan. *Journal of Ethnobiology and Ethnomedicine*. 14(55):1-25.
- Alves, R. R. N., R. O. S. Neta, D. Trovão, J. Barbosa, A. T. Barros, and T. L. P. Dias. 2012. Traditional uses of medicinal animals in the semi-arid region of northeastern Brazil. *Journal of Ethnobiology and Ethnomedicine*. 8: 4269-4268.

- Bashir, S. M., M. Altaf, T. Hussain, M. Umair, M. Majeed, W. M. Mangrio, A. M. Khan, A. B. Gulshan, M. H. Hamed, and S. Ashraf. 2023. Vernacular taxonomy, cultural and ethnopharmacological applications of avian and mammalian species in the vicinity of Ayubia National Park, Himalayan Region. *Biology*. 12: 609.
- Bashir, S. M., M. Altaf, M. Umair, S. Zahoor, M. S. Amjad, and A. M. Abbasi. 2021. Ethnomedicinal Uses of Animals in Vicinity of Ayubia National Park, Khyber Pakhtunkhwa-Pakistan. *Ethnobiology of Mountain Communities in Asia*. Springer.
- Borah, M. P., and S. B. Prasad. 2017. Ethnozoological study of animals based medicine used by traditional healers and indigenous inhabitants in the adjoining areas of Gibbon Wildlife Sanctuary, Assam, India. *Journal of Ethnobiology and Ethnomedicine*. 13: 1-13.
- de Andrade Melo, É. R., J. R. Gadelha, M. de Nazaré Domingos da Silva, A. P. da Silva, and A. R. M. Pontes. 2015. Diversity, abundance and the impact of hunting on large mammals in two contrasting forest sites in northern amazon. *Wildlife Biology*. 21: 234-245.
- de Melo, R. S., O. C. da Silva, A. Souto, R. R. N. Alves, and N. Schiel. 2014. The role of mammals in local communities living in conservation areas in the Northeast of Brazil: an ethnozoological approach. *Tropical Conservation Science*. 7: 423-439.
- Faiz, M., M. Altaf, M. Umair, K. S. Almarry, Y. B. Elbadawi, and A. M. Abbasi. 2022. Traditional uses of animals in the Himalayan region of Azad Jammu and Kashmir. *Frontiers in Pharmacology*. 13: 807831.
- Haidar, R., and S. M. Bashir. 2021. Chemical composition, traditional and modern uses of meat of animals-a review. *Journal of Wildlife and Ecology*. 5: 47-55.
- Hariohay, K. M., J. G. Chagama, A. K. Machumu, R. D. Lyamuya, J. Ntalwila, and J. R. Kideghesho. 2023. Ethnozoological uses of wild animals among the Iraqw in Northern Tanzania. *Tropical Zoology*. 36.
- Hsu, E., and S. Harris. 2022. *Plants, health and healing: On the interface of ethnobotany and medical anthropology*. Berghahn Books.
- IUCN. 2026. IUCN red list of threatened species; <https://www.iucnredlist.org/search?query=Mammals&searchType=species>.
- Jahangeer, M., M. Altaf, N. Irshad, M. Tariq, S. Chowhan, T. Hussain, A. H. Narejo, M. Ali, M. Muhamad, and S. Ashraf. 2026. Cultural and ethnopharmacological uses of wildlife in the himalayan region of Azad Jammu and Kashmir, Pakistan. *Journal of Ethnobiology and Ethnomedicine*. 22(13):1-35
- Kendie, F. A., S. A. Mekuriaw, and M. A. Dagne. 2018. Ethnozoological study of traditional medicinal appreciation of animals and their products among the indigenous people of Metema Woreda, North-Western Ethiopia. *Journal of Ethnobiology and Ethnomedicine*. 14(37):1-12.
- Khan, A. M., M. Altaf, T. Hussain, M. H. Hamed, U. Safdar, A. Ayub, Z.-n. Memon, A. Hafiz, S. Ashraf, and M. S. Amjad. 2024. Ethnopharmacological uses of fauna among the people of central Punjab, Pakistan. *Frontiers in Veterinary Science*. 11: 1351693.
- Khan, A. M., R. Qureshi, and Z. Saqib. 2019. Multivariate analyses of the vegetation of the western Himalayan forests of Muzaffarabad district, Azad Jammu and Kashmir, Pakistan. *Ecological Indicators*. 104: 723-736.
- Kuipers, K. J., J. P. Hilbers, J. Garcia-Ulloa, B. J. Graae, R. May, F. Verones, M. A. Huijbregts, and A. M. Schipper. 2021. Habitat fragmentation amplifies threats from habitat loss to mammal diversity across the world's terrestrial ecoregions. *One Earth*. 4: 1505-1513.
- Kumara, H. N., S. Mahato, M. Singh, S. Molur, and A. D. Velankar. 2023. Mammalian diversity, distribution and potential key conservation areas in the Western Ghats. *Current Science*. 124: 38.
- Muvengwi, J., and A. Maroyi. 2025. Traditional ecological knowledge and practices in Zimbabwe: medicinal ethnobotany and ethnozoology among communities in Chipinge district. *Journal of Ethnobiology and Ethnomedicine*. 21(55):1-22.
- Naz, A., M. S. Amjad, M. Umair, M. Altaf, and J. Ni. 2022. Medicinal plants used as therapeutic medicine in the Himalayan region of Azad Jammu and Kashmir. *South African Journal of Botany*. 150: 194-216.
- Rasheed, S., and M. Faiz. 2024. Ethnomammalogical uses among the people of Abbaspur, Azad Jammu and Kashmir. Pakistan. *Journal of Wildlife and Ecology*. 8: 186-195.
- Roberts, T. J. 1997. *The mammals of Pakistan*. Oxford University Press Karachi.
- Roberts, T. J. 2005a. *Field guide to the large and medium-sized mammals of Pakistan*. Oxford University Press Karachi.
- Roberts, T. J. 2005b. *Field guide to the small mammals of Pakistan*. Oxford University Press Karachi.
- Sial, M. A. 2024. Diversity, evenness, and richness of wild mammals along the Sutlej River, Punjab, Pakistan. *Frontiers in Ecology and Evolution*. 12: 1447694.
- Souto, W. M. S., R. R. D. Barboza, J. da Silva Mourão, and R. R. N. Alves. 2012. Traditional knowledge of sertanejos about Zootherapeutic practices used in ethnoveterinary medicine of NE Brazil. *Indian Journal of Traditional Knowledge*. 11: 259-265.

- Umair, M., M. Altaf, T. Ahsan, R. W. Bussmann, A. M. Abbasi, M. K. Gatasheh, and M. Elrobh. 2024. Study of medicinal plants used in ethnoveterinary medical system in riverine areas of Punjab, Pakistan. *Journal of Ethnobiology and Ethnomedicine*. 20: 48: 1-29.
- Zarif, M., K. Ahmed, M. Ahmed, M. Altaf, and S. Zarif. 2021. Ethnobotany of medicinal plants of Tehsil Kotli Sattian, District Rawalpindi. *International Journal of Biosciences*. 13(1): 387-400

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