Vol. 2 No. 3 (2025)
ONLINE ISSN :3007-309X
PRINT ISSN :3007-3081

Journal of Medical & Health Sciences Review

EXPLORING THE WILD MAMMALIAN DIVERSITY IN DISTRICT PESHAWAR, PAKISTAN

Muhammad Uzair[1], Sajid Siyal[2], Majid Khan[3], Attia Bushra[4], Asma kanwal Thebo[5], Khalid Usman[6] , Khalid Hussain Buriro[7]

[1]M.Phil Zoology, Department of Chemical & Life Sciences, Qurtuba University of Science & Information Technology, Peshawar
[2,4]Department of Wildlife Management, Shaheed Benazir Bhutto University of Veterinary & Animal Sciences, Sakrand, Sindh, Pakistan
[3]Department of Zoology, Abdul Wali Khan University, Mardan, KPK, Pakistan
[5]Department of Zoology, Government Zubaida Girls College, Hyderabad, Sindh
[6]Assistant Professor, Department of Chemical & Life Sciences, Qurtuba University of Science & Information Technology, Peshawar
[7]Department of Zoology, Government Girls Degree College Dulatpur, Sindh

ARTICLE INFO:

Keywords:
Diversity, Fauna, Wild, Mammals, Preservation, Identification, Animals

Corresponding Author:
Muhammad Uzair,
M.Phil Zoology, Department of Chemical & Life Sciences, Qurtuba University of Science & Information Technology, Peshawar
Pakregi44@gmail.com

Article History:

Published on 04 August 2025

ABSTRACT

The homes of regular animals are often destroyed by humans for unusual reasons, which can be really bad for the variety of life that follows the rules of nature. The number of endangered species in many areas is still unknown because there aren't enough animal populations. In certain places, it's really important to keep records of the animals in the area to help protect them better. We collected data by counting animals along straight lines and paths. In our study, we found a total of fifteen species from twelve different families, spread across five different groups of animals. In the reported species belong to five order which are Artiodactyla with one family Suidae, Carnivora with three families canidae,felidae and herpestidae, Rodentia with three familes i.e sciuridae,Muridae Hystricidae , Eulipotyphla ,are represented by soricidae,liporidae Canidae families while chiropterais represented by vespertilionidae family,Similarly the species observed in the reported areas are Golden jacka *Canus aureus* l,red fox *Vulpes vulpes* grey mangoose *Herpestes edwardsii*, porcupine *Hystrix indica* ,plam squirrel *Funambulus pennantii*,house mouse *Mus musculus*,black house rat *Ratus rattus*, Asian house rat *Rattus taezumi* house shrew *Suncus murinus,*wild Rabbit *Lepus nigricollis*, indian flying fox or fruit bat Pteropus medius . The wild boar, known as Sus scrofa, has become the most dominant and commonly found animal in the area. Four different groups of animals are protected under the Khyber Pakhtunkhwa flora and fauna law from 2015. The animals are under pressure due to human activities and face various threats. In order to resolve conservation problems and ensure long-term sustainability of regional animal populations, one must ensure multidisciplinary integration of research projects. It is these issues that need to be dealt with profitably with the participation of the ecologists, zoologists, conservationists and the policy makers.

1. INTRODUCTION

Pakistan is spread over a range of 882,000 km^2, lying between 35° and 37 ° north, 61 ° and 75 ° east. It expands a few 1,700 km north from the Middle eastern Ocean seacoast and the mouth of the Indus Stream to its headstream within the Hindu Kush and Karakorum ranges of the Himalayan mountains. Pakistan contains a bank of almost 1,046 km with 22,820 km^2 of regional waters and a Select Financial Zone of almost 196,600 km^2. The nation contains three of the world's eight bio-geographic domains Indo-Malayan, Palearctic, and Afro-Tropical) with their unmistakable biotas, and ranges four of Earth's ten biomes forsake, calm zone, tropical regular timber and mountain (Iqbal & Athar, 2018).

Generally, two-thirds of the nation is hilly. Varieties in height conceive various changes in species inside brief separations. Pakistan envelops a wide run of earthbound biological systems inside 12 major vegetative zones. These vegetative zones incorporate the perpetual snowfields and cold comeuppance of the north to the parched tropical zones of Sindh and Balochistan; the dry calm coniferous timbers of inward Himalayas to the tropical transitory timbers of the Himalayan foot slopes; the campo timbers of Sulaiman extend to the annoyance timbers of Indus fields; the wetlands and riverine communities of the Indus and its feeders to the mangrove timbers of the Indus delta and Middle eastern Ocean seacoast (Daran, Al Ajlani, Zia-ud-Din, & Elhajraoui, 2023)

Pakistan has lots of different animals, like the ones found in two big regions: the area west of the Indus River (like Europe and Asia) and the area east of the Indus River (like Southeast Asia). The biogeography of Pakistan shows the presence of an aggregate of eighteen globes orders with ten of those order presently being known ones. This variability is mainly brought about by the geographical location of the nation that serves as a bridge between the Palearctic and Oriental zoogeographical regions with only a minor part of its fauna belonging to the Ethiopian realm. The drawback of a discontinued polar ice cover in the late Pleistocene and formation of a complex of lakes and lagoons produced conditions favoring invasion of taxa not only to the east, but also to the west. In this timeframe location of distribution patterns is hence very closely determined by corridor based dispersion as well as availability/non-availability of material channel of migration which continue to be important enough in the current geography of Pakistan (Aslam et al., 2022).

There are 195 different animal species in Pakistan, belonging to 10 groups. Out of these, 44 are at risk of becoming endangered or are already in danger. Some species have even disappeared from certain areas, and we don't have enough information about many of them. Khyber Pakhtunkhwa Province, previously known as the North West Frontier Province, is home to various wildlife, including recognizable animals like the Himalayan wild cat *Lynx lynx isabellinus*, leopards *Panthera pardus*, snow leopards *Panthera uncia*, Kashmir markhor *Capra falconeri cashmiriensis*, Himalayan ibex Capra ibex sibirica, and urial *Ovis vignei*. However, there's been a worrying decrease in their numbers in Pakistan. This study aims to fill gaps in our knowledge about mammals in Peshawar District, helping us understand how to better care for and conserve these animals. Wildlife is crucial for the environment, as animals play important roles in ecosystems. Mammals, in particular, help with things like energy flow, maintaining biodiversity, and controlling pests (Lacher Jr et al., 2019).

Mammals are a diverse group of terrestrial animals characterized by a muscular diaphragm separating the thoracic and abdominal cavities, an endoskeleton, and skin covered in hair with sweat and sebaceous glands. They play crucial ecological and economic roles worldwide. However, human activities such as agriculture, manufacturing, and urbanization threaten their biodiversity. Therefore, there's a pressing need for comprehensive studies to explore and document mammalian diversity in District Peshawar, Pakistan. Such research will inform evidence-

based strategies for conservation, habitat restoration, and sustainable development. By identifying key habitats and assessing the well-being of mammalian species, including endangered ones, policymakers and conservationists can implement effective conservation measures. Additionally, public awareness programs will foster community engagement in wildlife protection efforts. This understanding of mammalian diversity will guide land use planning and management decisions in District Peshawar, Pakistan, helping to mitigate human-wildlife conflicts and ensure a sustainable future (Wilson, Wilson, & Mittermeier, 2011).

The paper assesses the number of mammalian species found in District Peshawar regarding their diversity, distribution, and relative abundance using field surveys and collecting data. Our system of survey covers a wide range of the heterogeneous habitats in our district by the use of many different techniques such as direct observation, spot lighting and camera trapping. The resulting data is then taken through statistical analyses and modelling to define trends in species richness, species composition, and habitat preference. We discussed our results with respect to the more general conservation and ecological frameworks and underlines recommendations on how to manage issues and what further research should be considered. In general, the analysis reveals the extensive influence of the activities of urban and agricultural development on the wild fauna of mammals in Peshawar and the subsequent shift in vegetation structure. Although habitat change caused by people can result in vegetative gains to particular species through the small scale, these are outweighed by the chronic macro changes and habitat functional changes. The pressures are enhanced by climate variables especially temperature increase thus limiting species richness and abundance. Taken together, all the results indicate that the existing conservation efforts, with a focus on the protection of habitats, can be supplemented by the active mitigation of climate extremes and by the wider ecological recovery efforts.

2. Review of Literature

(Akhtar, Saeed, & Khan, 2014) A study on biodiversity and its relevance to human life was conducted in the month of January 2013 to the month of December 2014 in Dumraon, Buxar district, Bihar, India. At this period, 18 wild mammal species of 12 families and 7 orders were recorded. The systematic ranking among mammals depicts that Rodentia has the largest number of species and family compared with others like Primates, Chiropteran, and Lagomorphs which are found with significantly low numbers of species and families.

(Naveed et al., 2022) studied that how human activities affect sea animals. They collected information from lots of studies done between 1991 and 2016, focusing on 121 different species around the world. They made maps to show where these animals are in danger, like which countries and seas have the most threats. By putting these maps together, they could see how bad the dangers are for different species. They found that many sea creatures are at risk, especially because of things people do near the coast. This can make it harder to protect these animals from harm.

(Akhtar et al., 2014) To complete this systematic survey of District Buner, Khyber Pakhtunkhwa, was conducted in the month of January to October 2014. Some of the mammalian species reported in the study were; gray Goral (*Pseudois nayaur*), Porcupine (*Hystrix indica*), Fox (*Vulpes vulpes*), Monkey (*Macaca mulatta*), Wild boar (*Sus scrofa*), Jackal (*Canis aureus*), Hare (*Lepus nigricollis*) and Bat (*Pteropodidae*). The gray Goral (*Naemorhedus goral*) is a species, which is endangered after a systematic study of mammalian diversity in District Buner, Pakistan indicated. Deforestation, increased human population and uncontrolled hunting were found to be the main factors leading to the decline. Further conservation measures are therefore highly needed to ensure survival of both the gray Goral and other mammalian taxa which are endemic in the district in the long run.

(Khan, Khan, & Chaudhry, 2015) studied the mammal population in Tharparkar from April 1-10 in 2013. They looked at how animals are doing in the Thar Desert and found 35 different species

living there. Most of the animals they found were rodents, with only 15 species being carnivores. The most common rodents were *Gerbillus gleodowi* and *Meriones hurrianae*, followed by Tatera indica and different types of mice. Many of the carnivores they found are rare or endangered. For example, the Indian wild ass is endangered in the Rann of Kutch. Striped hyenas, chinkara, and nilgai also need more protection.

3. Materials and Methods

3.1. Study Area

District Peshawar, located in the Khyber Pakhtunkhwa province of Pakistan, holds significant importance due to its historical, cultural, and geographic features. This paper aims to provide a comprehensive overview of District Peshawar as a study area, highlighting its geographical characteristics, cultural heritage, economic significance, and contemporary issues. Drawing upon various scholarly sources and official reports, this discussion aims to present a holistic understanding of the district for academic and research purposes. District Peshawar, located in the Khyber Pakhtunkhwa province of Pakistan, comprises several tehsils, each contributing to the diverse landscape and socio-economic fabric of the region.

3.2.Line Transects Method

During the study, we kept an eye on the mammals in the area by watching them closely. Every week, we visited at least one spot to see which mammals were around and gather information about them. We used a method called the line transects method. This means we picked a line that was 1 square kilometer long in different parts of the area we were studying. Then, we walked along this line, either on foot or in a vehicle, and looked out for mammals. We did this early in the morning and late in the evening, when animals are usually more active. By doing this, we were able to get a good idea of the mammals living in the area and how they behaved (Iqbal & Athar, 2018).

3.3. Linear Count Survey Method

In our study, we used a method called the linear count survey to estimate the population of mammals in the area we were observing. We employed both direct and indirect techniques to identify the diversity of mammals. Direct methods involved physically counting the animals we saw or listening for their calls or voices. Indirect methods included looking for signs like nests, fecal pellets, marks on trees, and footprints. We also surveyed local communities to gather information and used field guides like "Mammals of Pakistan" by T.J. Roberts to accurately identify species. To pinpoint exact locations, we used a GPS device (Garmin eTrax10), and binoculars helped us observe the mammals from a distance. For capturing images of the species, we utilized a Nikon D3500 DSLR camera with 24 megapixels. By combining these methods, we were able to comprehensively study the mammalian fauna of the area and gather valuable data for our research. (Rahman, Zahid, Ullah, & Al-Faryan, 2023).

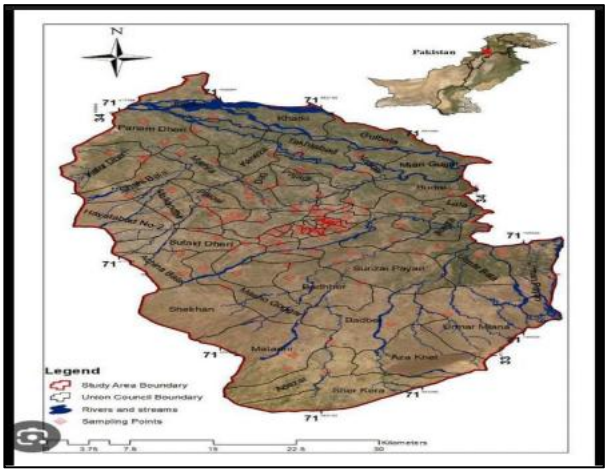


Figure. 1: ***Map of district Peshawar***
Source: https://earth.google.com/web/search

Figure. 2: ***Transect coordinate of animal location point at Peshawar***

Figure. 3: ***Survey Gadgets Apparatus***

Figure. 4: ***LED Torch and measuring tape***

3.4.Statistical analysis

The data was analyse using SPSS software and excel sheet.

4. Results

In our recent study, we conducted a thorough examination of various mammal species, encompassing a diverse range of families and orders. Our investigation focused on 15 distinct species, representing a broad spectrum of mammalian life. These species were classified into five different orders: Artiodactyla, Carnivora, Rodentia, Eulipotyphla, and Chiroptera. Within the Artiodactyla order, we identified a species belonging to the Suidae family. The Carnivora order yielded observations from three families: Canidae, Felidae, and Herpestidae, comprising animals like jackals, foxes, leopards, and mongooses. Rodentia, another significant order, featured representatives from three families: Sciuridae, Muridae, and Hystricidae,

including squirrels, mice, rats, and porcupines. Eulipotyphla and Chiroptera were also represented, with species from families like Sorcidae, Erinaceidae, and Vespertilionidae. Throughout our study, we employed various observation methods, with most sightings made directly, while distinctive features like the quills of porcupines aided in identification. Notably, our research uncovered intriguing findings, such as the presence of wild rabbits in the remote Urmarr Miana region and notable increases in populations of house mice and squirrels in the Peshawar district.

Figure.5: ***Red fox***

https://images.app.goo.gl/a9KHEJVJxeU3nxvW7

Figure. 6*: Grey mongoose*

https://images.app.goo.gl/9RMbVQM6Vu7e5o4J9

Figure. 7: House mouse

https://images.app.goo.gl/EhK1H7GhCugorczB7

Figure. 8: Black house rat

https://images.app.goo.gl/Gb58NLtFt6V1MyP3A

Figure. 9: House shrew

Figure. 10: Squirrel

Figure. 11: *Indian flying fox*

Table: 1. ***mammalian species with their common name, IUCN status, Regional status and sight direct or indirect***

Common name	Zoological name	Observation	Regional status	IUCN status
Wild boar	*Sus scrofa*	Direct seen	LC	LC
Golden jackal	*Canus aureus*	Direct seen	NT	LC
Red fox	*Vulpes vulpes*	Direct seen	NT	LC
Grey Mongoose	*Herpestes edwardsii*	Direct seen	LC	LC
Porcupine	*Hystrix indica*	Direct seen	LC	LC
Five stripped palm squirrels	*Funambulus pennantii*	Direct seen	LC	LC
House mouse	*Mus musculus*	Direct seen	LC	LC
Black house rat	*Ratus rattus*	Direct seen	LC	LC
Asian house rat	*Rattus taezumi*	Direct seen	LC	LC
House shrew	*Suncus murinus*	Direct seen	LC	LC
Wild rabbit	*Lepus nigricollis*	Direct seen	LC	LC
Indian flying fox	*Pteropus medius*	Direct seen	LC	LC

LC least concern, while NT Near threatened by (regional status is based on sheikh and Molur 2004)

Mr. Amjad Khan, who lives in Peshawar, hunts grey wild rabbits. He explained his

process, saying they first scout the hunting area two months in advance. Then, they prepare their dogs by feeding them a special diet of milk, butter, and special bread, and giving them regular exercise, especially in the early morning. On the day of the hunt, they stop feeding the dogs the night before. When they reach the hunting spot, they search for rabbits in the bushes with their dogs. If a rabbit runs, they let the dog chase it. Sometimes, rabbits hide in caves, but usually, the dogs catch them. Mr. Khan mentioned that rabbit hunting is tough because they're very fast, and sometimes they spend the whole day without catching any. The dogs usually catch the rabbits with their sharp teeth, but sometimes the rabbits injure themselves by hitting rocks or trees. He also mentioned that wild rabbit meat is delicious and some doctors recommend it for asthma patients.

Figure. 12: Wild cat

Figure. 13: Wild boar

In the area of Regi, wild cats have been spotted, while wild boars have been hunted in the Regi, Peshawar graveyard. Residents of the area told us that these wild boars are considered bad and forbidden in Islam. They explained that these animals cause damage to their crops, especially maize and sugarcane. The wild boars usually come out at night to search for food and move in groups with their young. When asked about conserving these animals, a farmer we interviewed didn't know much about conservation or why it's important. Unfortunately, we couldn't include a real picture of the wild boar because it was hunted, and it wouldn't be right to show it here. So, we've used a photo from Google instead.

Figure. 14: Cave of porcupine

Figure. 15: Spine of porcupine

The pictures are drawn of the parcopine cave system and its spines which is found on an Army managed land found opposite to Askari-6 Regi lalma peshawar.

Figure. 16: Wild Dog

Figure. 17: Wild rabbit

Figure. 18: Pellets of parcopine
https://images.app.goo.gl/mazaviir3VEw6vH77

Figure. 19: *Porcupine* *https://images.app.goo.gl/sgu9jhEbCAJWUKoS7*

Figure. 20: cave of jackal

Figure. 21: Golden jackal

https://images.app.goo.gl/MxcDx8k7pLxsypQQ9

During our survey a male golden jackal was accidentally killed on Warsak Road near Dag Lara. It's common to find these jackals all over Peshawar district. Residents in areas like Pir Bala are upset because these jackals often hunt their domestic hens and rabbits. Sometimes, when they're really hungry, they even come right up to people's homes looking for food, showing no fear.

Table. 2: Awareness among people about the conservation of mammalian biodiversity in District Peshawar

Status	Percentage
Very low	90%
Low	10%
Moderate	0%
High	0%
Very high	0%

A staggering 90% of respondents were found to be unaware of the importance and necessity of conserving mammalian species within their locality. This alarming statistic underscores concerning gap in environmental education and awareness programs within the region. Conversely, a mere 10% of the surveyed population demonstrated awareness about mammalian biodiversity conservation efforts. This minority awareness highlights the existence of a potential foundation upon which to build educational initiatives and conservation campaigns. The results suggest an urgent need for targeted interventions aimed at enhancing public understanding and engagement with mammalian biodiversity conservation efforts in District Peshawar.

Figure. 22: Awareness among people about the conservation of mammalian diversity in District Peshawar

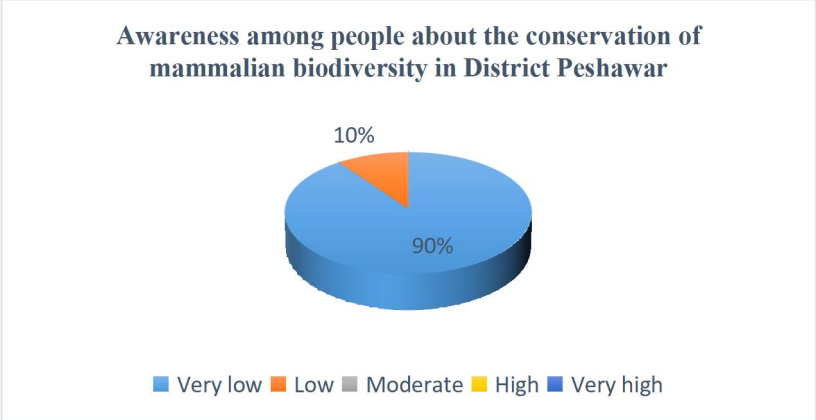
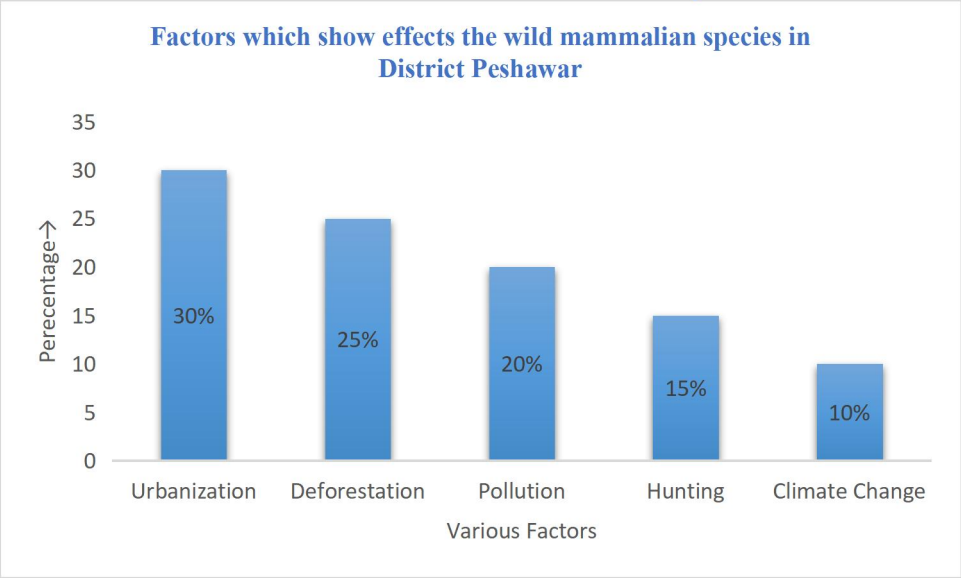


Table. 3: Habitat where wild mammals at high risk in District Peshawar

Sites	Status
Regi lalma model town	very high
Hayatabad	very high
DHA Peshawar	High
Urmar payan	Moderate
Mera surizai payan	Moderate
Chamkani	High
Naguman	Low
Chandan Ghari	Low

A tabular presentation has been made showing the risk levels induced by mammalian diversity of various geographical units; this is as indicated below. The risk levels namely very high, very high, high, moderate, moderate, high, low, low levels are related to localities Regi Lalma Model Town, Hayatabad DHA Peshawar, Urmarr Payan, Surizai Payan, Chamkani, Naguman and Chandan Ghari in that particular order.

Figure. 23: factors which show effects the wild mammalian species in district Peshawar

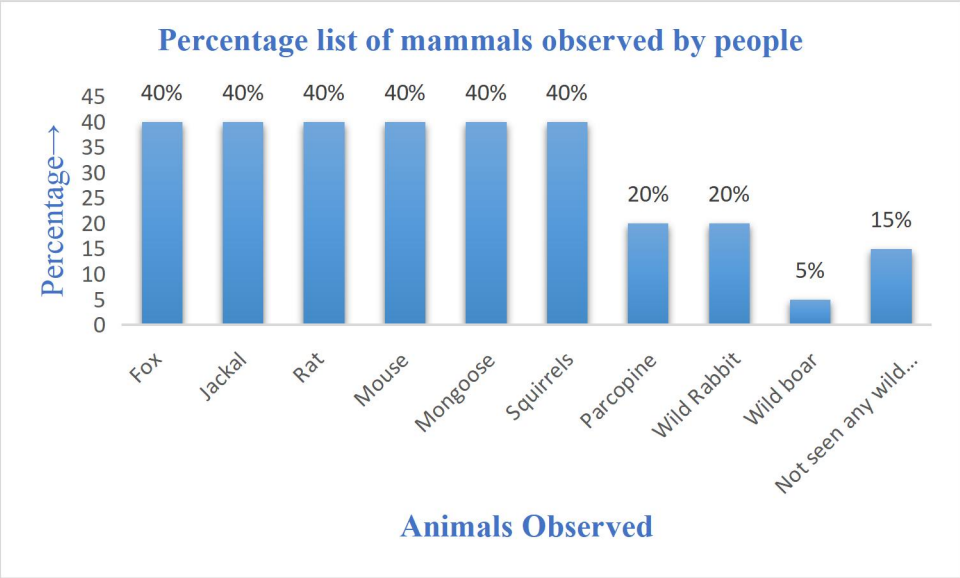


Group questionnaire report show that urbanization in district Peshawar has highest effect on the life wild mammalian diversity which is 60% followed by agriculture and industry which about 20%. The deforestation and hunting and poaching was 8% and 6% respectively, while pollution and all the factors was 2%and 4% respectively.

Table.4: Percentage list of mammals observed by people

Animals observed	Percentage
Fox	40%
Jackal	40%
Rat	40%
Mouse	40%
Mongoose	40%
Squirrels	40%
Parcopine	20%
Wild Rabbit	20%
Wild boar	5%
Not seen any wild mammals	15%

Figure. 24: Percentage list of mammals observed by people



A survey was conducted in Peshawar district using questionnaires. It found that 40% of people had seen animals like foxes, jackals, rats, mice, mongooses, and squirrels, while 20% had seen porcupines and wild rabbits. Only 5% of people, mainly farmers and watchmen, had seen wild boars. Surprisingly, 15% were unaware of any wild species and didn't provide any information. The areas rich in wild mammalian diversity in Peshawar district were identified as Urmarr Payan, Surizai Mera, Regi Lalma, and Hayatabad Phase 7. These areas had more

wildlife compared to remote parts of the district. The survey revealed a significant increase in the population of mice and wild squirrels over the past decades. However, the numbers of porcupines and wild boars have decreased. Additionally, there has been a rise in the population of stray dogs. Respondents blamed the decrease in wild species on population growth and lack of awareness about wildlife protection. They noted that people from neighboring districts like Mohmand, Charsadda, Mardan, DI Khan, and Bannu, coming to Peshawar for education and trade, also impact wildlife. There's little public awareness about wildlife conservation, and people often hunt wild species out of fear or for recreation. Unfortunately, there are no active wildlife organizations in Peshawar district working on awareness, welfare, or protection of wild species, nor does the local community play a significant role.

5. Discussion

The wild boar is protected by law in Khyber Pakhtunkhwa under the Wildlife and Biodiversity Act of 2015. Our study found that wild boars are the most common animals in all the areas we looked at, and they can live in many different types of habitats like plains, mountains, and forests. In Pakistan, they're usually found below 1000 meters above sea level. Due to religious reasons, people don't hunt wild boars for meat or trophies, which have caused their population to grow quickly. Wild boars are often spotted at night near human settlements. They're good at living near people and can cause big problems by damaging forests, crops, and spreading diseases to livestock, which can lead to significant economic losses (Killian, Wagner, Fagerstone, & Miller, 2008).

In the past, there have been occasional attempts to manage the number of wild boars, like allowing people to hunt them for rewards in Punjab. Some people also hunt them for sport in certain places. However, these efforts haven't been enough to keep up with how quickly the boar population grows. Among small animals, there were a lot of grey mongooses and wild rabbits. The mongooses were seen all over the place during the study. But the wild rabbits were found more often in places where there weren't many people around. When mongooses were present, we didn't see many small mammals. People have reported that mongooses can harm communities of small animals. Wild rabbits were mostly found in hilly areas, but we also saw some in the plains of Azakhel. Wild rabbits like to live in places with lots of shrubs, bushes, or forests to hide from predators. There are many wild rabbits in the Tarakai Game Reserve in Dak Ismail Khel, which has hilly areas with tall grass and thick forests (Khattak et al., 2022).

In this study, we found two types of rats that live in the same area, the black house rat (*Rattus rattus*) and the Asian house rat (*Rattus tanezumi*). These rats are common pests that can cause damage to crops and store grains in their hiding places. They also spread diseases to humans and other animals (Khattak, Liu, Teng, & ur Rehman, 2021).

6. Conclusion

Future research will benefit from this study, which provides a foundation for the work of zoologists, conservationists, and wildlife experts. In the Pakistani district of Peshawar, Khyber Pakhtun Khawa, some species are under peril. It should have become apparent that these natural species are vulnerable and that the Peshawar district needs to take extra precautions to safeguard them, as well as enact regulations to that effect. Strict oversight is required about overpopulation, deforestation, and illegal hunting. In order for them to successfully propagate, we implore you to carefully consider how they may affect native species. We recommend doing similarly focused studies, such as conservation and welfare studies of wild mammalian species and human-flora and fauna struggle, in order to accurately document, examine, and maintain the record of the aforementioned fauna.

7. References

Akhtar, N., Saeed, K., & Khan, S. (2014). Current status of mammals in district buner Khyber Pakhtunkhwa, Pakistan. *International Journal of Molecular Evolution and Biodiversity, 4*(4).

Aslam, S., Siddiqui, S., Ullah, U., Manzoor, U., Lateef, T., Samreen, N., & Ghalib, S. (2022). Vertebrate wildlife of Pakistan: A review. *Canadian J Pure Appl Sci, 16*(2), 5483-5495.

Daran, D. E., Al Ajlani, R., Zia-ud-Din, M., & Elhajraoui, F. E. (2023). Management of biodiversity in Pakistan protected areas and its legal implications. *Journal of Wildlife and Biodiversity, 7*(supplementary issue), 1-13.

Iqbal, M. F., & Athar, H. (2018). Validation of satellite based precipitation over diverse topography of Pakistan. *Atmospheric Research, 201*, 247-260.

Khan, A. A., Khan, W. A., & Chaudhry, A. A. (2015). Mammalian Diversity in Thar Desert Habitat of Tharparkar District, Sindh, Pakistan. *Pakistan Journal of Zoology, 47*(5).

Khattak, R. H., Liu, Z., Teng, L., & ur Rehman, E. (2021). The Wild Mammalian Fauna of Nowshera District Khyber Pakhtunkhwa, Pakistan. *Pakistan Journal of Zoology*.

Khattak, R. H., Mehmood, T., Teng, L., Ahmad, S., Rehman, E. U., & Liu, Z. (2022). Assessing human–Asiatic black bear (Ursus thibetanus) conflicts in Kumrat Valley—western flanks of Hindu Kush Region, northern Pakistan. *Global Ecology and Conservation, 38*, e02230.

Killian, G., Wagner, D., Fagerstone, K., & Miller, L. (2008). *Long-term efficacy and reproductive behavior associated with GonaCon use in white-tailed deer (Odocoileus virginianus).* Paper presented at the Proceedings of the Vertebrate Pest Conference.

Lacher Jr, T. E., Davidson, A. D., Fleming, T. H., Gómez-Ruiz, E. P., McCracken, G. F., Owen-Smith, N., . . . Vander Wall, S. B. (2019). The functional roles of mammals in ecosystems. *Journal of Mammalogy, 100*(3), 942-964.

Naveed, M., Ijaz, M., Ahmed, A., Ghumman, N., Ishaq, M., Muzammil, I., & Javed, M. (2022). Molecular evidence, risk factors analysis, and hematological alterations associated with Theileria spp. spillover in captive wild mouflon sheep in Punjab, Pakistan. *Iranian Journal of Veterinary Research, 23*(4), 349.

Rahman, H. U., Zahid, M., Ullah, M., & Al-Faryan, M. A. S. (2023). Green supply chain management and firm sustainable performance: The awareness of China Pakistan Economic Corridor. *Journal of Cleaner Production, 414*, 137502.

Wilson, D. E., Wilson, D. E., & Mittermeier, R. A. (2011). *Handbook of the mammals of the world, volume 2: hoofed mammals*: Lynx Ediciones Barcelona.