Baseline Survey of Squirrel in Churia and Mahabharat Range of Northern Morang, Nepal

Submitted by

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Submitted to

Research Management Cell

Sukuna Multiple Campus, Tribhuvan University

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June, 2024

Declaration

This report describes work under taken as completion of a mini research grant provided by research management cell (RMC), Sukuna Multiple Campus, Tribhuvan University, Nepal. This report is the outcome of my original work, which has not been submitted earlier in other projects and organizations. All views and opinions expressed therein remain the sole responsibility of me.

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Date: 10 June, 2024

To
The RMC Head,
Sukuna Multiple Campus,
Sundarharaincha, Morang

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Baseline survey of squirrel in Churia and Mahabharat range of northern Morang

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Recommendation

This is recommended that the research report **"Baseline survey of squirrel in Churia and Mahabharat range of northern Morang, Nepal"** has been carried out by Mr. Dibya Raj Dahal a teaching assistant at Sukuna Multiple Campus, under our supervision.

To the best of our knowledge, this is his original work, which has been rigorously tested for plagiarism by iThenticate software and has passed with similarity index of just 2% affirming its originality and adherence to academic integrity.

Mr. Dibya's research support is through and well-executed, providing significant insights into the baseline data of squirrel in Churia and Mahabharat range of Morang. The methodology, analysis, presentation and finding are good quality, making this report valuable contribution for baseline data of squirrel.

RMC- Sukuna has funded for the completion of this research. So, we pleased to recommend this report to Research Management Cell, Sukuna Multiple Campus for Final Approval.

1. Ganesh Prasad Dahal
   Research Facilitator
   16 June 2024
   Asst. Campus Chief & Head RMC Sukuna Multiple Campus
2. Nara Prasad Bhandari
   Research Facilitator
   16 June, 2024
   Member RMC Sukuna Multiple Campus

Sukuna Multiple Campus ★ Sundarharaincha ★ Research Management Cell, Sundarharaincha

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Letter of Approval

SUKUNA MULTIPLE CAMPUS
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This mini-research report submitted by Mr. Dibya Raj Dahal, faculty of this campus, entitled **"Baseline survey of squirrel in Churia and Mahabharat range of northern Morang, Nepal"** is funded and approved by Research Management Cell (RMC-Sukuna) of this Campus.

Approval Committee

1. Ganesh Prasad Dahal
   Head RMC-Sukuna
   and research facilitator
   2024 June 25
2. Nara Prasad Bhandari
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4. Dipak Prasad Nepaune, PhD
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Date: 25 June, 2024

Sukuna Multiple Campus
Research Management Cell, Sundarharaincha

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Date: 25 June 2024

Thanking Letter

Mr. Dibya Raj Dahal

Teaching Assistant

Faculty of Science and Technology

Sukuna Multiple Campus

Sundarharaincha, Morang

Dear Mr. Dahal

I would like to express my heartfelt thanks to Mr. Dibya Raj Dahal, a faculty of Science and Technology of this campus for his invaluable contribution to the research report entitled **"Baseline survey of squirrel in Churia and Mahabharat range of northern Morang, Nepal".** Mr. Dahal's dedication and hard work have been instrumental in the successful completion of this study, and we are truly appreciative of his effort.

The mini-research has been financially supported by Research Management Cell of Sukuna Multiple Campus, and we are confident that the finding of this report will significantly contribute to our academic community. As such, the research support will be considered as valuable academic property of this campus.

Once again, thank you for your hard and commitment to this study. Lastly, we are proud to have him as a part of our campus community. We look forward to continuing our collaboration on future projects.

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Abstract

Squirrels belong to the order rodentia which is the most specious order of Mammalia. 11 species of squirrels were recorded from a wide range of elevations between 70 – 4000 m above sea level in the physiographic range from Terai to Trans-Himalayas. Squirrels are commonly known wild species of mammals. They coexist with human beings because most of them are situated near human settlement. People have a negative attitude toward squirrels. They believe squirrels are the common pest of maize, vegetables and local fruits. The baseline survey of squirrels in Chure and Mahabharat range of Kerabari rural municipality was conducted in October and November, 2023 through spot survey, camera trapping and night survey. *Ratufa bicolor*, *Calloscirus pagerythrus* and *Tempus macellandii* were recorded during this study. The Black giant squirrel (*R. bicolor*) is nationally endangered and globally near threatened species of squirrel and was first recorded in Morang. Local people have a negative attitude to squirrels and they are facing many local threats in between habitat degradation, habitat fragmentation, forest firing, trapping and hunting are major local threats. Long term monitoring, local policy for conservation and public awareness are essential for the win-win coexistence of squirrel northern mountain range of Morang.

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Research Cell, Sukuna Multiple Campus, Sundarharaincha, Morang

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Introduction

Squirrels are naturally distributed on all continents except Australia, Antarctica and Oceania and they are the most commonly known small mammals in the world (Mendes et al., 2019). A total of 285 species of squirrels are recorded in the world (Thorington et al., 2012). In contest of South Asia, 18 species of squirrels are recorded (Molur et al., 2005). 11 species of squirrels are distributed in a wide range of elevations between Terai to Trans Himalayas of Nepal. They are recorded from protected and outside the protected areas near human settlements (Thapa et al., 2016). Including11 species of squirrel, *R. bicolor* and *Petaurista nobilis* are globally near threatened species (Duckworth & Molur, 2016; Molur, 2016e); *Belomys pearsonii* is data deficient (Molur, 2016a); *Petaurista petaurista, Petaurista elegans, Petaurista magnificus, Hylopetes albogiger,* C. *pygerythus, Dremomys lokriah, T. macclellandii* and *Funambulus pennantii* are least concern species (Duckworth, 2016; Duckworth et al., 2016, 2017; Duckworth J. W., 2016; Molur, 2016c, 2016d, 2016b; Nameer & Molur, 2016).

Ten percentages of global species of squirrels are data deficient and the other 10 % are unknown in their existence. This is the worst status for future conservation of squirrels because the conservation practice and policy are difficult to generate due to the absence of baseline data. 20 % of species of squirrels are critically endangered and they are far away from good management and best practice of conservation (Steiner & Huettmann, 2023). Existing literature of squirrels shows the major distribution occurrence hotspot of *D. lokriah, P. magnificus, R. bicolor, C. prygerythus* and *C. erythreus* in Nepal (Baker & Harris, 2007; Steiner & Huettmann, 2023). Pallas squirrel *C. erythreus* has not been reported from Nepal till now.

Squirrels are among the few mammals that can be sustained in natural and urbanized areas. They are the common members of urban parks, zoos, green spaces and gardens (Steiner & Huettmann, 2023). Squirrels are important members of ecosystem services because they are meso-predators and eco-engineers of ecosystems (Callahan, 1993; Dalton, 2017). They are also prey of birds and mammals like owl, hawk, wolf, lynx, fox, cats etc. (Bizhanova et al., 2022; Schauffert et al., 2002).

The increase of the human population and its social transformation, demanding modern infrastructure and housing are drastically increasing. Eco-friendly natural human settlements are continuously converted into concrete asphalt and buildings (Wang et al., 2019). This is the major threat of urban squirrels. Due to rapid urbanization, squirrels and other small mammals are habituated to coexistence in human contact zone. This will create high risk for squirrels and humans too, because humans lose natural habitat and squirrels cause the vector and reservoirs of zoonotic diseases (Steiner & Huettmann, 2023). The aims of this study are distribution, species richness and threats of squirrels in northern Chure and Mahabharat ranges of Morang.

Rationale of study

All small mammals except red panda, pangolin and fishing cats are neglected groups in study in Nepal (Jnawali et al., 2011). Rodentia is more specious mammalian order. It plays a major role in species diversity of mammals and family sciuridae more neglected group in the study in Nepal (Acharya et al., 2010; Jnawali et al., 2011). The study of squirrels started in 1836 (Hodgson, 1842) but very less published information is available till now (Katuwal et al., 2013; Thapa et al., 2016; Thapamagar et al., 2020). *R. bicolor* is nationally endangered and globally near threatened species *Petaurista nobilis* is globally near threatened and nationally data deficient (Duckworth & Molour, 2016; Jnawali et al., 2011; Molur, 2016e). Globally near threatened species is data deficient in Nepal this literature justifies the study of squirrels is very poor in Nepal. The major parts of the study area contain pristine primary mixed forest, this is suitable habitat for *R. bicolor* and *P. nobilis*. This baseline survey is possible to recognize new occurrence records for them. Squirrels are facing massive threats like habitat fragmentation, habitat loss, forest fire, poisoning, hunting, monoculture plantation, construction and development (Thapa et al., 2016). This study aims to generate baseline information on species richness and evaluate the local threats on squirrels in Kerabari rural municipality, northern Morang. This is first survey in study area.

Objectives of study

Following the objectives of the study:

1. To identify the species richness of squirrels in the study area.
2. To evaluate the local threats and initiate conservation through awareness.

Delimitations of study

1. The result, generalization and interpretation are on the basis of a short-term survey of squirrels.
2. Three transect represent the whole study area.
3. The survey was conducted just before winter. This is not the appropriate season for survey.
4. We stalled only three camera traps.

Literature review

Squirrels are typical types of mammals and belong to the order rodentia and the family sciuridae which includes 280 species in the world. They have a wide range of body weight, between 16 to 8000 grams and they are well known small mammals distributed all over the world except Australia, Antarctica and Oceania (Steiner & Huettmann, 2023).

In the history of Nepalese squirrel research was started in 1836 (Hodgson, 1842). Till recent studies, 11 species of squirrels have been reported from Nepal. *R. bicolor* and *P. nobilis* are globally near threatened (Molur & Molur, 2016; Molur, 2016e); *B. pearsonii* is globally data deficient (Molur, 2016a) and other eight are globally list concern species (Duckworth, 2016; Duckworth et al., 2016, 2017; Duckworth J. W., 2016; Molur, 2016c, 2016d, 2016b; Nameer & Molur, 2016). *Ratufa bicolor* is endangered, four species are data deficient and six species are least concern according to the national red list (Jnawali et al., 2011).

In contest of Nepal, squirrels are distributed in a wide range of elevations from Terai to Trans-Himalayas (70-4000 m asl.). They have been reported from protected area and outside the protected area. More diversity and population of squirrels have been distributed in urban vegetation. example, Sal dominated mixed forest in Terai, broadleaf mixed forest in Siwalik and Mahabharat range, Oak and Rhododendron Forest in Mid-hills and Himalayas and Tibetan steppe biotope of trans Himalayas (Jnawali et al., 2011; Thapa et al., 2016).

Squirrels are facing different threats like habitat loss, road kill, kill by dog, killing by local people for bush meat, poisoning, damaging the breeding nest are common in Nepal (Katuwal et al., 2013). Habitat degradation, keeping at home (illegal domestication), traps for pest control, hunting for bush meat and recreation are common, forest fire, monoculture of plantations and habitat fragmentation are serious problems in conservation of squirrels (Steiner & Huettmann, 2023; Thapa et al., 2016). Survey and monitoring of squirrel, public awareness for conservation, local conservation policy buildup and implementation are effective practices for conservation of squirrels in the global scenario (Steiner & Huettmann, 2023).

Materials and methods

Materials

Following materials were used in this study

1. Garmin Etrex 10 GPS tracker
2. EOS 1100 D Canon camera with 300 mm lens
3. Head light
4. Focus light
5. Range finder
6. Covert illuminator camera trap with dry cell

Study design

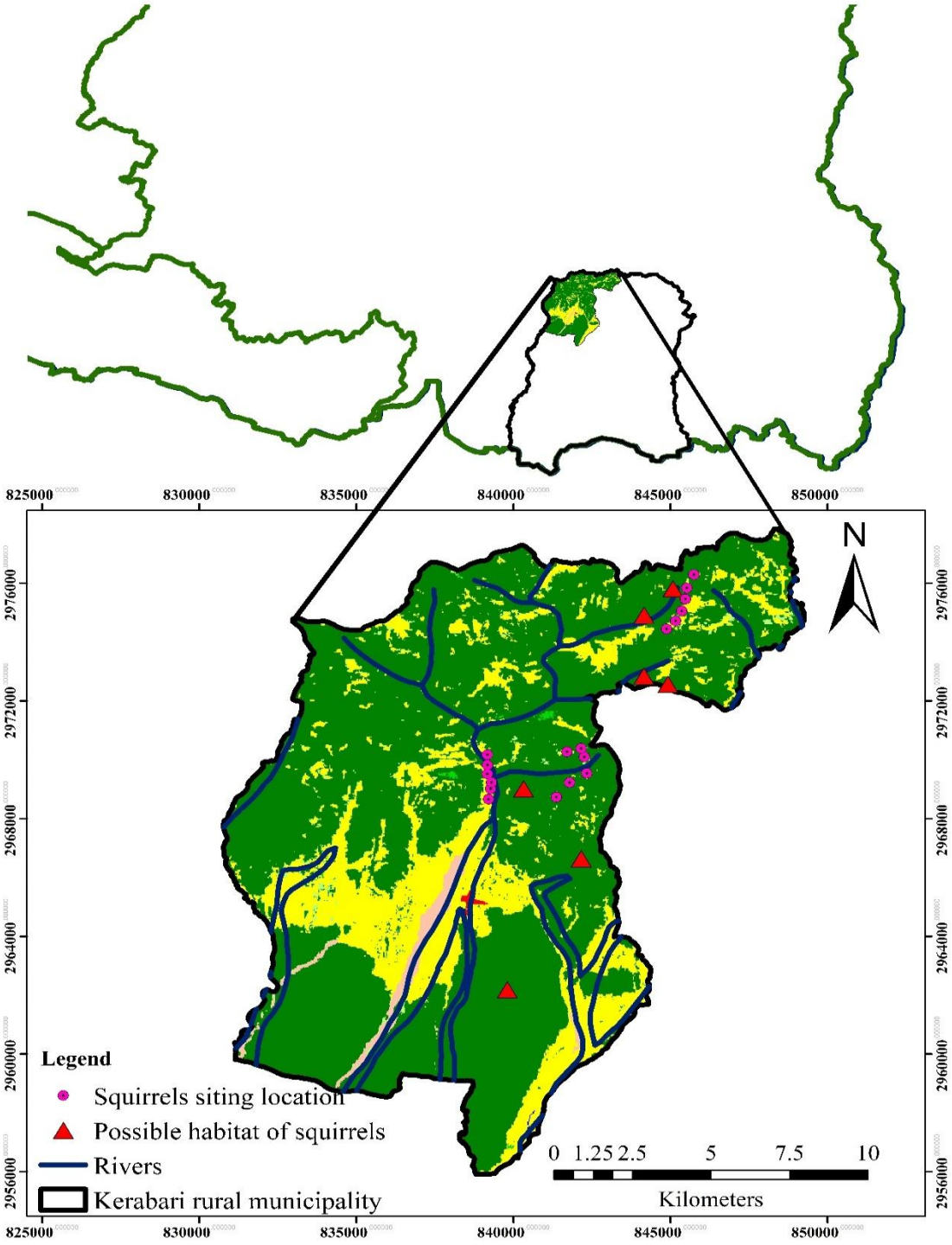
Three survey blocks the size of 2*2 km2 were laid in between the elevation range of Chure to Mahabharat. Live survey and drey count were conducted on the 2000 m length of three longitudinal transects of each survey block. Transects were laid in the reference of walking trail and rivers belt. The lowermost block was located in Chure range and it was a lower elevation range which covered 368 to 420 m above sea level (asl). other two blocks were located in the Mahabharat range mountains which covers 420 to 1802 m asl. The climatic and topographic features as well as vegetation of three study blocks were different from each other.

Study area

The study area was located in the mountain range of Kerabari rural municipality, which is located in northern Chure and Mahabharat range of Morang district (Fig. 1). The Chure range of the study area is dry and arid land with a subtropical climate. The major part is covered by Sal dominated primary forest and *Argemone* dominated grassland with loose red rocky soil. Some patches Chure are wet and covered by riverine mixed forest, farm land and patches of human settlement (Ojha & Niroula, 2021). Civets, jangle cat, porcupine, barking deer, rhesus macaques are common mammals in Chure area (Basnet et al., 2005). The study area of Mahabharat range contains many streams moving from cliff of stones.

Figure 1

Showing the land cover of Kerabari rural municipality pink spots representing squirrel sighting (live observation and camera trap) location in transect and read triangle represent the possible habitat of squirrel.



Temperate climate in Mahabharat range and covered by broad leaf mixed forest, patches of framed Nepalese broom grass, and large cardamom farm land and patches of human settlement. Some forest patches of Mahabharat range are oak and *Castanopsis* dominated plant. Fox, jackal, hares, civet, martin, porcupines are common species of mammals (Basnet et al., 2005).

Method

Transect survey

Live and drey surveys of squirrels were conducted in the morning and evening in each line transect. Equal length of three line transect were laid in each survey block with the reference of walking trail, stream and river belts. Transect surveys took place in the morning and evening from 6:30 to 9:30 o'clock and 14:30 to 17:30 o'clock. One day in each transect was spent on habitat survey, live survey and drey count.

Camera trapping

Camera trapping was conducted on possible nesting and passing sites of each transect. Three cameras were instilled video mode at the height of 10 to 15 feet with support of a tree or rock cliff. Each camera trap was kept for seven days in each spot.

Night survey

The night survey on the focus of flying squirrels was conducted from early in the evening to 20:o'clock. Gliding and feeding activities were noted by seeing from possible survey stations, like picking of mountain or cliff rocks near the roosting places.

Threats mapping

Local threats of squirrels were mapped by visualization of threat indicators like habitat degradation, habitat fragmentation, forest firing, pressure of pesticides in agriculture, negative perceptions of local people.

Social survey

Informal questionnaires (Appendix I) focusing on local perception of squirrels were asked by local ethnic peoples of each survey station. The answers of respondents were noted. The information and feedbacks of local respondents were utilized for

finding the location of drey and passing stations. Information provided by local respondents was valuable for designing the transect and understanding the local perception of squirrels.

Results

Species diversity of squirrels

A total of 118 survey hours from 27 October to 10 November were spent in three transects located in three survey blocks. The transects were laid with the references of river and walking trail, they covered the elevation range of 368 m asl. to 2000 m asl. The spot survey was the most effective method of survey because camera traps and night survey were unable to record any species during this study. Three species of squirrels were recorded during this study (Table 1).

Table 1

Showing the distribution of species and numbers record of squirrels in three study blocks of study area

S. N.	Squirrels	Number of sightings in Kerabari block	Numbers of sighting in Bhogateni block	Numbers of sighting in Singhadevi-Jephale block
1	*Ratufa bicolor*	1	0	0
2	*Cllosciurus pygerythrus*	0	2	1
3	*Tamipos macclellandii*	0	0	1

The single individual of R. bicolor is a nationally endangered and globally near threatened species of squirrel which was recorded in the Sal dominated forest of Chure range in Kerabari block at 9:00 o'clock on 27, November 2023. Two individuals of *C. pygerythus* were recorded in broadleaf mix forest at 18:15 o'clock on 28 November 2023. They were foraging the nuts and moving in branches of *Schima wallichii*. One/one individual of *C. pygerythus* and *T. macclellandii* were recorded in Siinghadevi-Jephle survey block on 7 November 2023. Both species were recorded in the early morning in oak - dominated mixed forest. The old squirrel nest (Fig. 2) also recorded in *S. wallichii* covered by creepers of *Phanera vahlii* (Bhorlo in Nepali). During this survey, suitable possible habitats of squirrels were also mapped (Fig. 1). Some forest patches of the study area are primary and pristine forest. They are indicated by a red triangle in Fig. 1 they are a good habitat for squirrels and other

wild animals. Possible habitat mapping may be utilized for integrated survey and further monitoring of squirrel.

Local threats

Forest fire, massive collection of timber, habitat fragmentation, road construction were major threats in the study area (Fig 3). The pressure of timber collection is more and more at upper altitude. Rumbling sounds of chainsaw during the cutting of timber disturb the wild animals, including squirrels. This is an emerging threat of squirrels in remote areas of Nepal.

Figure 2

Showing the older nest of squirrel in Singhadevi-Jephale block, Singhadevi Cheple Pakha

Uncontrolled and massive degradation of habitat was seen in Singhadevi-Jephale block and high forest firing in Kerabari block. Most of all respondents have negative on squirrels because they think squirrels are a major agricultural pest because

they damage maize, apricot, pumpkins, chayote and other local fruits. Due to the negative perception, local people are poisoning and killing the squirrels. Some local people are hunting flying squirrels for bush meat. They commonly use local traps, arrows and rubber blow-pellets for hunting the squirrels. Some people are damaging the nests of squirrels and killing the young kittens as well. To save the squirrels and coexistence with human beings is essential in the study area. It is possible by awareness of the local people, including school children, by highlighting the social service and economic importance of squirrels.

Figure 3

Figure showing the local threats of squirrels in study area (A. & C. Forest fire, B. Habitat degradation by massive timber collection, D. Habitat fragmentation by road construction)

Conclusion and recommendation

Conclusions

1. Three species of squirrels were confirmed during the baseline survey. Including them, R. bicolor is a nationally endangered and globally near threatened species.
2. Massive and uncontrolled degradation of primary forest reducing the proper habitat of squirrels. This was a major threat. Besides them, forest fire, poisoning, hunting, trapping was also noted during the survey.
3. Local people have a negative perception of squirrels because they think squirrels are a common pest of maize, local vegetables and fruits.
4. Some patches of forest in the study area are primary and pristine still now. These forest patches are mapped as possible habitats for squirrels (Fig 1).

Recommendations

1. The conclusions of this were drawn on the basis of a short-term baseline survey only. Long-term seasonal monitoring of squirrels including breeding and nesting season will provide the community composition and species diversity of them.
2. Nationally endangered and globally near threatened species were recorded from the study area. Local conservation policy and implementation is essential to prevent local extinction.
3. To minimize the local threats and negative attitudes in the community of the study area, awareness is necessary.
4. Collaborative monitoring between academic organizations and local governments will be applicable for conservation of squirrels and other wild life.

References

Acharya, P. R., Adhikari, H., Dahal, S., Thapa, A., & Thapa, S. (2010). *Bats of Nepal A field guide*. Small Mammals Conservation and Research Foundations (SMCRF).

Baker, P. J., & Harris, S. (2007). Urban mammals: What does the future hold? An analysis of the factors affecting patterns of use of residential gardens in Great Britain. *Mammal Review*, *37*(4), 297–315. https://doi.org/10.1111/j.1365-2907.2007.00102.x

Basnet, Y. R., Tamang, B., &Benu, G. (2005). *Bird diversity and their habitat and status at Rajarani community forest Bhogteny, Morang, Nepal*. Bird conservation

Nepal.

Bizhanova, N., Steiner, M., Rametov, N., Grachev, A., Grachev, Y., Bespalov, M., Zhaparkulov, T., Saparbayev, S., Sailaukhanuly, A., Bespalov, S., Bolatuly, A., Saparov, K., & Sah, S. A. M. (2022). The Elusive Turkestan Lynx at the Northwestern Edge of Geographic Range: Current Suitable Habitats and Distribution Forecast in the Climate Change. *Sustainability (Switzerland)*, *14*(15). https://doi.org/10.3390/su14159491

Callahan, J. R. (1993). Squirrels as predators. *The Great Basin Naturalist*, *53*(2), 137–144.

Dalton, J. (2017). *Arctic ground squirrels as ecosystem engineers of projected tundra shrub encroachment*. University of Illinois.

Duckworth J. W. (2016). *Callosciuruspygerythrus*, Hoary-bellied Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T3604A22253451.en

Duckworth, J. W. (2016). *Petauristapetaurista*, Red Giant Flying Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016

Duckworth, J. W., Lunde, D. P., &Molur, S. (2017). *Tamiopsmacclellandii*, Himalayan Striped Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2017

Duckworth, J. W., &Molur, S. (2016). *Ratufa bicolor*, Black Giant Squirrel. *The IUCN Red List of Threatened Species*. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T19377A22261810.en

Duckworth, J. W., Tizard, R. J., &Molur, S. (2016). *Hylopetesalboniger*, Particolored Flying Squirrel.The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016

Hodgson, B. (1842). *Classified catalogue of Nepal, (Corrected to end of 1841, frist printed in 1832)*. Bengal civil science.

Jnawali, S. R., Baral, H. S., Lee, S., Acharya, K. P., Pandey, M., Shrestha, R., Joshi, D., Lamichane, B. R., Griffiths, J., Khatiwada, A. P., Subedi, N., & Amin, R. (2011). *The*

Status of Nepal's Mammals: The National Red List Series. Department of National Parks and Wildlife Conservation Kathmandu, Nepal.

Katuwal, H. B., Khanal, B., Basnet, K., Rai, B., Devkota, S., Rai, S. K., Nobis, M., &Scheidegger, C. (2013). The mammalian fauna from the Central Himalaya, Nepal. *Asian Journal of Conservation Biology*, *2*(1), 17.

Mendes, C. P., Koprowski, J. L., &Galetti, M. (2019). Neosquirrel: a data set of ecological knowledge on Neotropical squirrels. In *Mammal Review* (Vol. 49, Issue 3, pp. 210–225). Blackwell Publishing Ltd. https://doi.org/10.1111/mam.12152

Molur, S. (2016a). *Belomyspearsonii,* Hairy-footed Flying Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016-1.RLTS.T2756A22256636.en

Molur, S. (2016b). *Dremomyslokriah,* Orange-bellied Himalayan Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016-3.RLTS.T6821A22255622.en

Molur, S. (2016c). *Petaurista elegans,* Spotted Giant Flying Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T16719A22272724.en

Molur, S. (2016d). Petauristamagnificus, Hodgson's Giant Flying Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016-2.RLTS.T16721A22271868.en

Molur, S. (2016e). *Petaurista nobilis,* Bhutan Giant Flying Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016-3.RLTS.T16722A22271710.en

Molur, S., Srinivasulu, C., Srinivasulu, B., Walker, S., Nameer, P. O., & Ravikumar, L. (2005). *Status of South Asian non-volant small mammals: Conservation Assessment & Management Plan (C.A.M.P.) Workshop report*. 618.

Nameer, P. O., &Molur, S. (2016). *Funambuluspennantii,* Five-striped Palm Squirrel. The IUCN Red List of Threatened Species. https://doi.org/10.2305/IUCN.UK.2016

Ojha, R., &Niroula, B. (2021). Inventory of Ferns and Fern Allies of Raja-Rani Wetland and Adjoining Forest, Eastern Nepal. *Journal of Plant Resources*, *19*, 55–61.

Schauffert, C. A., Koprowski, J. L., Greer, V. L., Alanen, M. I., Hutton, K. A., & Young, P. J. (2002). Interactions between Predators and Mt. Graham Red Squirrels (Tamiasciurushudsonicusgrahamensis). *The Southwestern Naturalist*, *47*(3), 498–501. https://www.jstor.org/stable/3672515

Steiner, M., &Huettmann, F. (2023). *Sustainable Squirrel Conservation* (I). Springer Cham. https://doi.org/https://doi.org/10.1007/978-3-031-23547-4

Thapa, S., Katwal, H. B., Koirala, S., Dahal, B. V., Devkota, B., Rana, R., Dhakal, H., Karki, R., & Basnet, H. (2016). *Sciuridae (Order: Rodentia) in Nepal*. Small

Mammals Conservation and Research Foundation. https://www.researchgate.net/publication/312595722

Thapamagar, T., Youlatos, D., Bhusal, D. R., & Bhandari, S. (2020). Habitat and nest use by hoary-bellied squirrels (*Callosciuruspygerythrus*): preliminary observations in central Nepal. *Tropical Ecology*, *62*(1), 139–143. https://doi.org/10.1007/s42965-020-00116-3

Thorington, R. W., Koprowski, J. L., Steele, M. A., &Whatton, J. F. (2012). *Squirrels of the world*. The John Hopkins University Press.

Wang, Z., Ahmed, Z., Zhang, B., & Wang, B. (2019). The nexus between urbanization, road infrastructure, and transport energy demand: empirical evidence from Pakistan. *Environmental Science and Pollution Research*, *26*(34), 34884–34895. https://doi.org/10.1007/s11356-019-06542-8

Appendix I
Questionnaire form

Name: Gender: Age:

Address: Occupation: Ethnicity:

1. What is a squirrel?

……

2. Can you see squirrels?

……..

3. How many types of squirrels do you seen?

…….

4. Squirrels are available hare?

……

5. Where are they available?

……

6. Which season do they frequently seen?

……

7. Do you see flying squirrels?

……

8. Where did you show?

……

9. What is the different between squirrels and flying squirrels?

……

10. Squirrels are beneficial or harmful?

……

11. What are the harms?

……

12. What are the benefits?

……

13. Peoples killing squirrels?

……..

14. If peoples are killing. Why are they killing?

……

15. They necessary to save? Why?

……