

Site specific Conservation Action plan for bats in the Kathmandu valley, Nepal

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Photographs:

Front Cover: A colony of Intermediate Horseshoe Bat (*Rhinolophus affinis*) at an old abandoned house in Sankhu, the house was demolished in the 2015 Earthquake

All photographs by:

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1. Introduction

1.1. Bats in Kathmandu valley

1.1.1 Species richness

Altogether, 32¹ species of bats (which is about 60% of the total number of bat species occurring in Nepal) has been reported from the Kathmandu valley in between 19th century to hitherto (Annex II). In the timeline history species number record has increased recently. Before 1970 total number of species from known and unknown localities of Kathmandu valley recorded was 13. In between 1971 and 1999, the total number of species recorded was 18. The number of species (17) recorded during 2000-2010 was nearly same as earlier. However, from 2011 to 2017 the species number increased to 25 (Figure 1). Amongst six families of bats occurring in the Kathmandu valley, Vespertilionidae holds nearly 50% of total number of species, whereas, Rhinolophidae constitute more than 25%, Hipposideridae and Pteropodidae each comprise of 10% of total number of species. Megadermatidae and Miniopteridae include the least number of species which is 3% each of total number of species (Figure 2). In total 13 genera of bats are distributed in Kathmandu valley, among which genus *Rhinolophus* constitute more than 25% of the total number of bats species. Similarly, *Myotis*, *Hipposideros*, *Pipistrellus* and *Murina* comprise 20%, 10%, 10%, 10% of the total number of bats species, respectively. While other five genera, each include only 3% of the total number of bat species (Figure 3). Csorba's Mouse-eared Myotis (*Myotis csorbai*) is one of the two endemic mammals of Nepal and the only endemic bat of Nepal. Mandelli's Mouse-eared Myotis (*Myotis sicarius*) is an endemic bat species to the Himalayas. Two species of bats new to Nepal *Myotis frater* and *Nyctalus aviator* were added to the checklist of bats of the country during the Kathmandu Valley bats monitoring with the support from the Rufford Small Grants in 2017. Similarly, the monitoring reported two more species *Rhinolophus lepidus* and *Barbastella leucomelas*, new to the Kathmandu valley.

¹ Excluding *Hypsugo* sp. and *Myotis* sp.

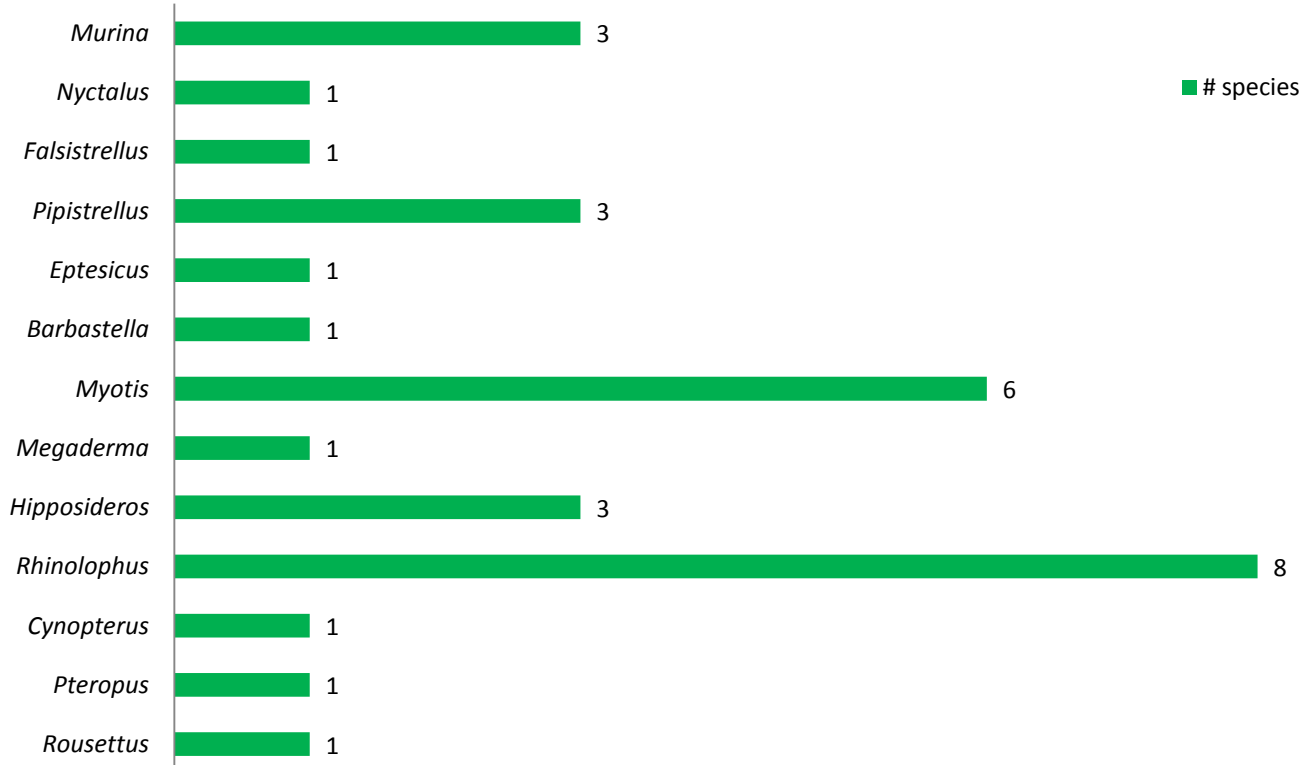


Figure 1: bat species composition according to genus in the valley

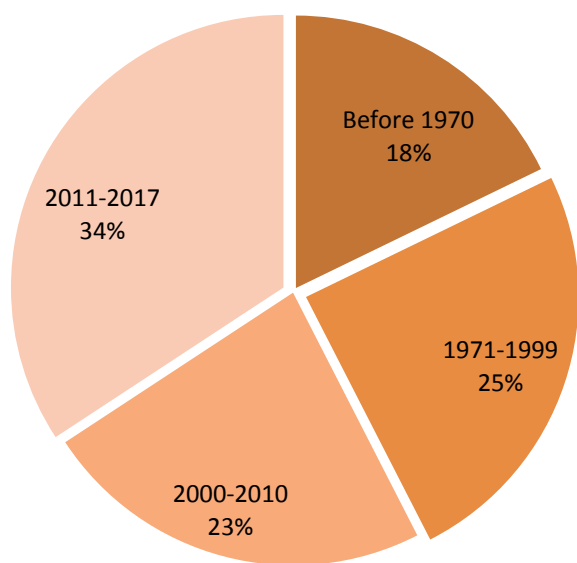


Figure 2: bat species composition according to family in the valley

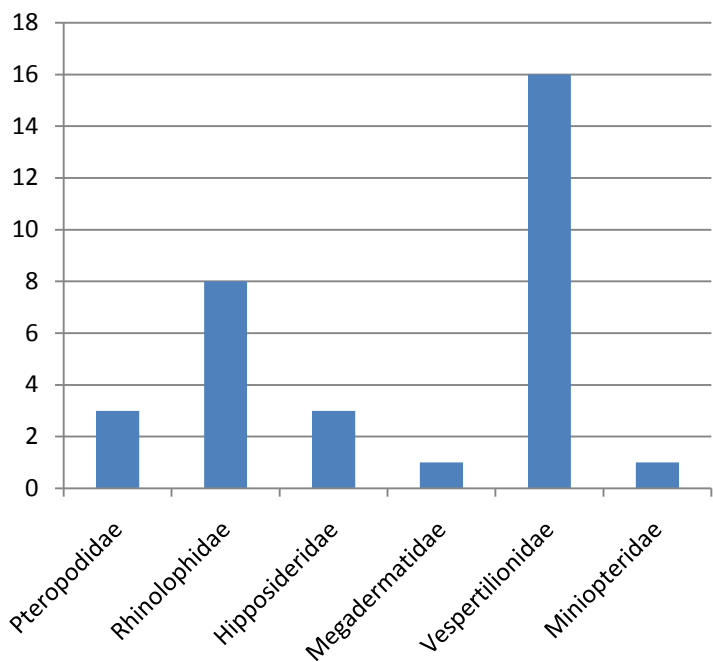


Figure 3: bat species composition according to time line history in the valley

1.1.2 Habitat

Bats assemblage is occurring in varied areas in the Kathmandu valley from urban, sub-urban to rural areas. Some species occur in all three areas while a few species are found in urban and sub-urban areas. In total, most of the species (26) are distributed in rural areas, while least number of species is confined to urban areas (11). However, roosting habitat of 16 species are found only in rural area, while three species are limited to sub-urban areas. Unfortunately, roosting colonies of only a single species (*Pteropus giganteus*) is restricted to urban areas (Figure 4).

Cave serve as the permanent roosts for most of the species (15), primary and secondary forests supports permanent and temporary roosts for 12 species. Tunnel, woodland and houses/buildings act as permanent and temporary roosts for five species each. Tree fringes support the least number of species (4). Interestingly, temple is preferred as temporary roosts by three species (*Rhinolophus affinis*, *R. sinicus* and *Barbastella leucomelas*) (Figure 5).

Forest provides a better foraging ground for 28 species. Bat species prefer Garden/Park (17 species), stream and river (15 species), agricultural field (10 species), woodland and urban open land (9 species each) for foraging (Figure 6).

Breeding ground of most of the species is not well explored and understood in Kathmandu valley. However, caves are breeding ground for most of the species and different parts of trees (foliage, bark, holes etc.) provides the breeding habitats for a few species.

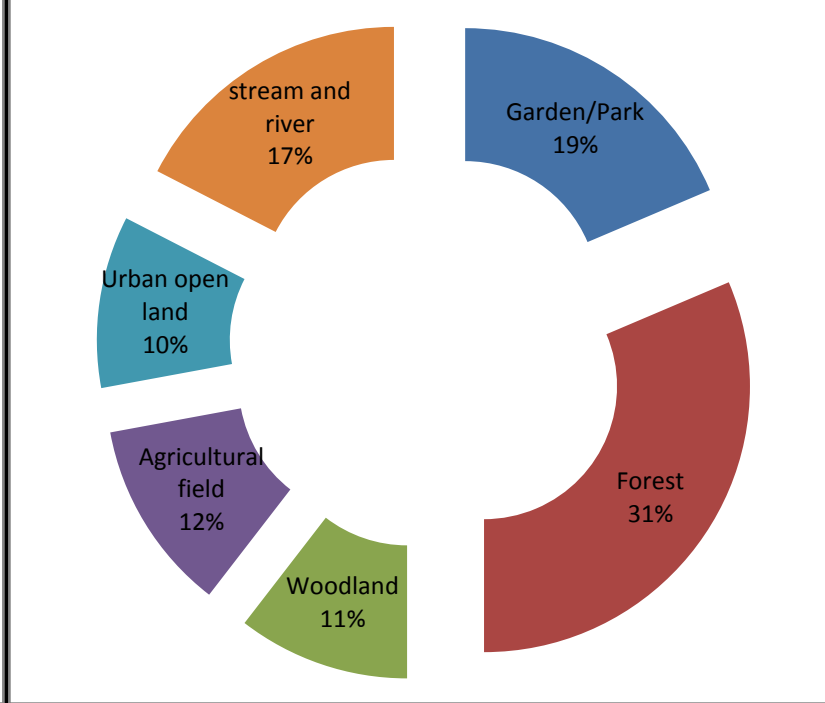
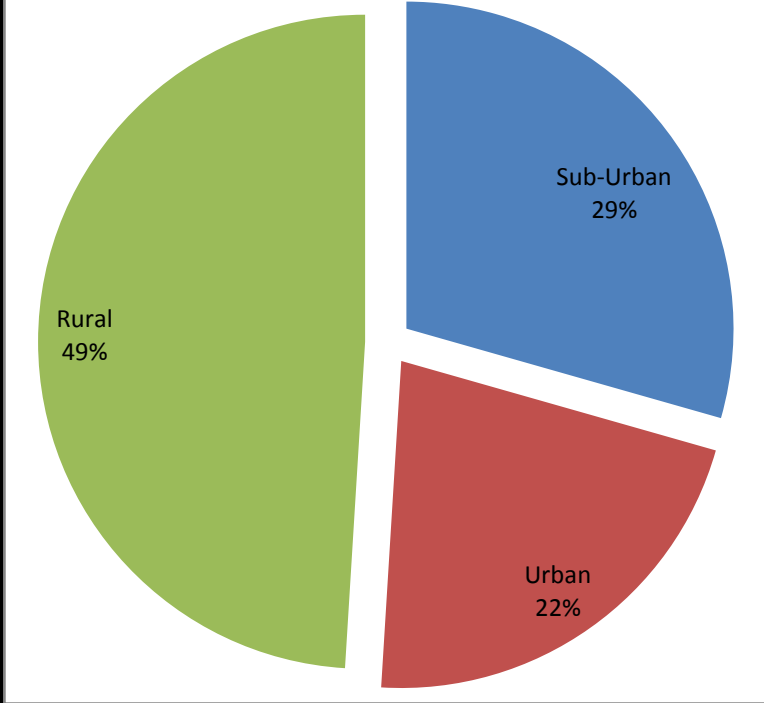


Figure 4: Type of area with bat habitat

Figure 5: Classified bat habitats (foraging) composition

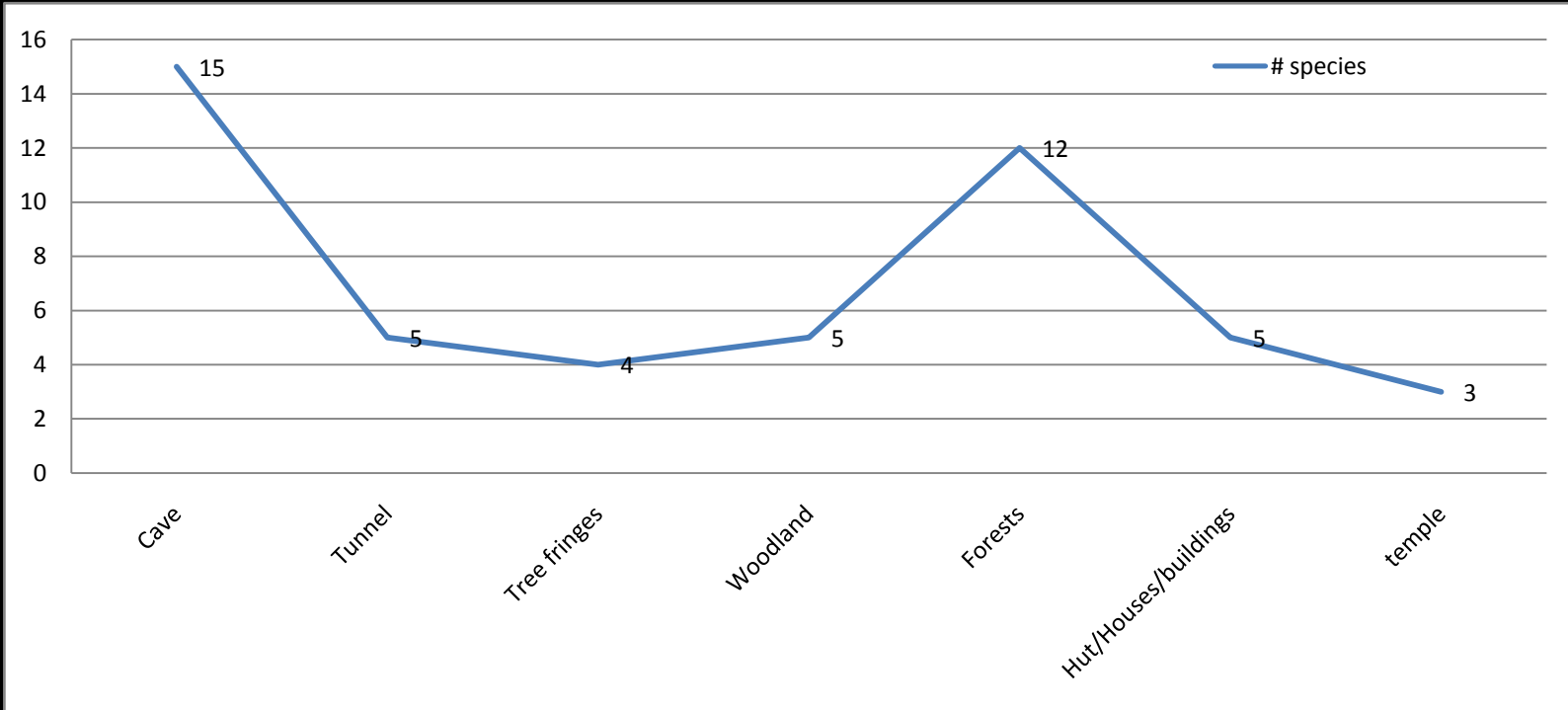


Figure 6: Classified bat habitats (roosting)



1.1.3 Conservation status

Although, 27 species of bats occurring in Kathmandu valley are assessed globally Least Concern (LC), *Myotis sicarius* is assessed globally Vulnerable (VU) and *Nyctalus aviator* is assessed globally Near Threatened (NT) and another two species *Myotis csorbai* and *Myotis frater* are assessed globally Data Deficient (DD) (IUCN Red List 2018) (Figure 7).

Nationally, among the 32 species of bats found in Kathmandu Valley, a single species *Myotis csorbai* is assessed Critically Endangered (CR), again a single species *Myotis sicarius* is assessed VU, two species *Murina aurata* and *Rhinolophus lepidus* are assessed as Near Threatened (NT), five species are DD (Jnawali et al. 2011) (Figure 7).

Two species *Myotis frater* and *Nyctalus lasiopterus* has not been assessed yet. In the local context of the Kathmandu valley 16 species are rare while 15 species are commonly found.

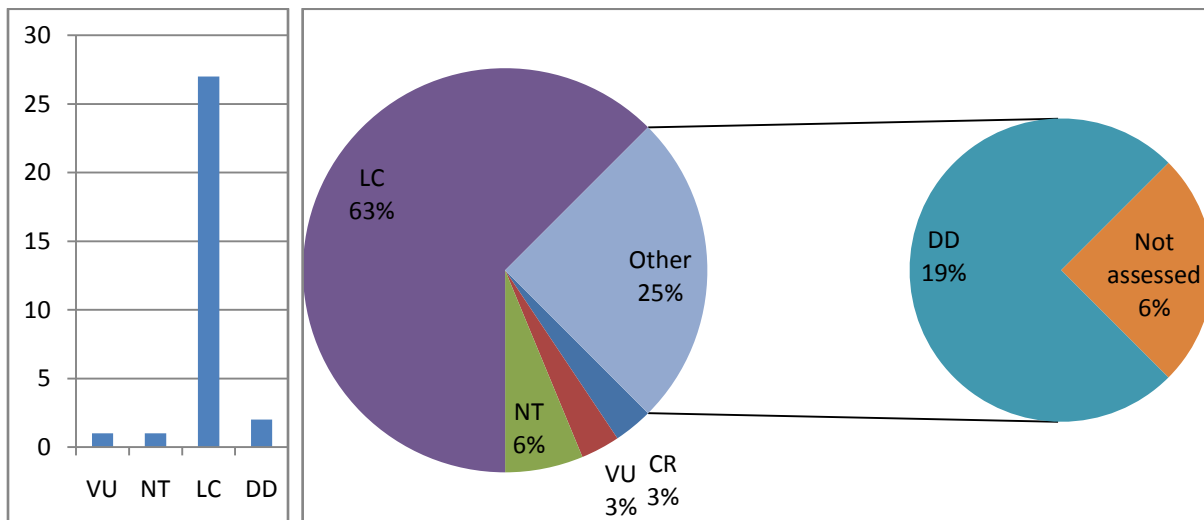


Figure 7: Global status (left) and National status (right) of bats occurring in Kathmandu valley

1.1.4 Overall threats

Although monitoring of bats has been continued within Kathmandu valley, it has not been yet undertaken regularly. Many species occurring in the valley do not have specific and sufficient data. Few major threats pertaining in the valley are as follows;

Lack of awareness

Local communities in the valley has negative attitude towards bats. Despite of its great importance in pollination, seed dispersal, pest and disease control, most of people treat bats as ghosts, witches, disease transmitters and dangerous animals. They blame bats to be responsible of cutting soft horns and ears of herds (cow, buffalo and goat) and also believe that bats urine blinds the people and even bats attack people occasionally. However, these believe and negative perception of the local community is completely irrational. This is because local people are not aware of their important role of ecosystem services.

Habitat disturbance

Cave dwelling bats are sensitive to microclimatic condition of hibernacula like temperature and humidity. Bats in hibernacula and at torpor stage are in real danger to the death if there is even slight fluctuation of these variables. Pregnant bats are more vulnerable to the microclimatic variation. Farmers and herders as well as hunters make camp fire inside the cave. Villager burns fire for retaliatory killing of rodent pest such as porcupine throughout the country including the rural areas of the Kathmandu Valley. Most of the caves in the Kathmandu valley are associated with cultural heritage in where visitors light lamps to worship the god. Unmanaged cave tourism (for domestic and international tourists) is unsafe for bats. The level of effect of cave visiting on roosting bats has yet to be known. All of these human induced disturbances alter the microclimatic condition (Carbondioxide level, temperature and humidity) inside the cave which is not acceptable to roosting bat due to their physiological constraints.

In the other hand, installation of gates with narrow gaps at Chobhar and Nagarjun has affected the occurrence and distribution of the bats species inside the cave, restricting larger bat species while supporting small species (*Hipposideros cineraceus*; *Rhinolophus pusillus*) to intermediate

species (*Rhinolophus* spp.). However, it has positive impact upon the occurrence of the species, since the caves at Chobhar has become permanent roost for *H. cineraceus*.

Tree dwelling bats are also equally suffering from human disturbance. Pelting stone to roosting bats, shaking the bat roosting trees and pruning as well as logging the bats roosting trees are some threats to them. Specifically, Flying Fox colonies within the heavy built areas in Kathmandu city and urban settlements in Bhaktapur city are threatened by human induced activities. The effect of noise and air pollution to bats has yet to be known.

Hunting and Trapping

People influenced by the traditional medicinal belief and practice of Nepal perceive that bat flesh can cure disease such as asthma, arthritis, tuberculosis, alimentary and renal diseases etc. Traditional medicinal use of bats is a rarely studied aspect of ethno-zoology in Nepal. Newar community in the Kathmandu valley used to kill bats to prepare bat oil that was used as medicine or as eardrops to expel an ear bug, as a topical baldness cure, and as an anti paralytic (Douglas, 2008). Bat flesh to feed cattle was also found as a common practice in rural areas from Kathmandu to cure the babesiosis in cattle. Feeding raw bat flesh to domestic cattle is one of the serious problems which can easily vector to transmit zoonotic disease.

Bat killing for fun by children and herders by throwing stone by hand and catapult, catching by hands, striking by long branches and sticks are unpleased act which needs to be controlled.



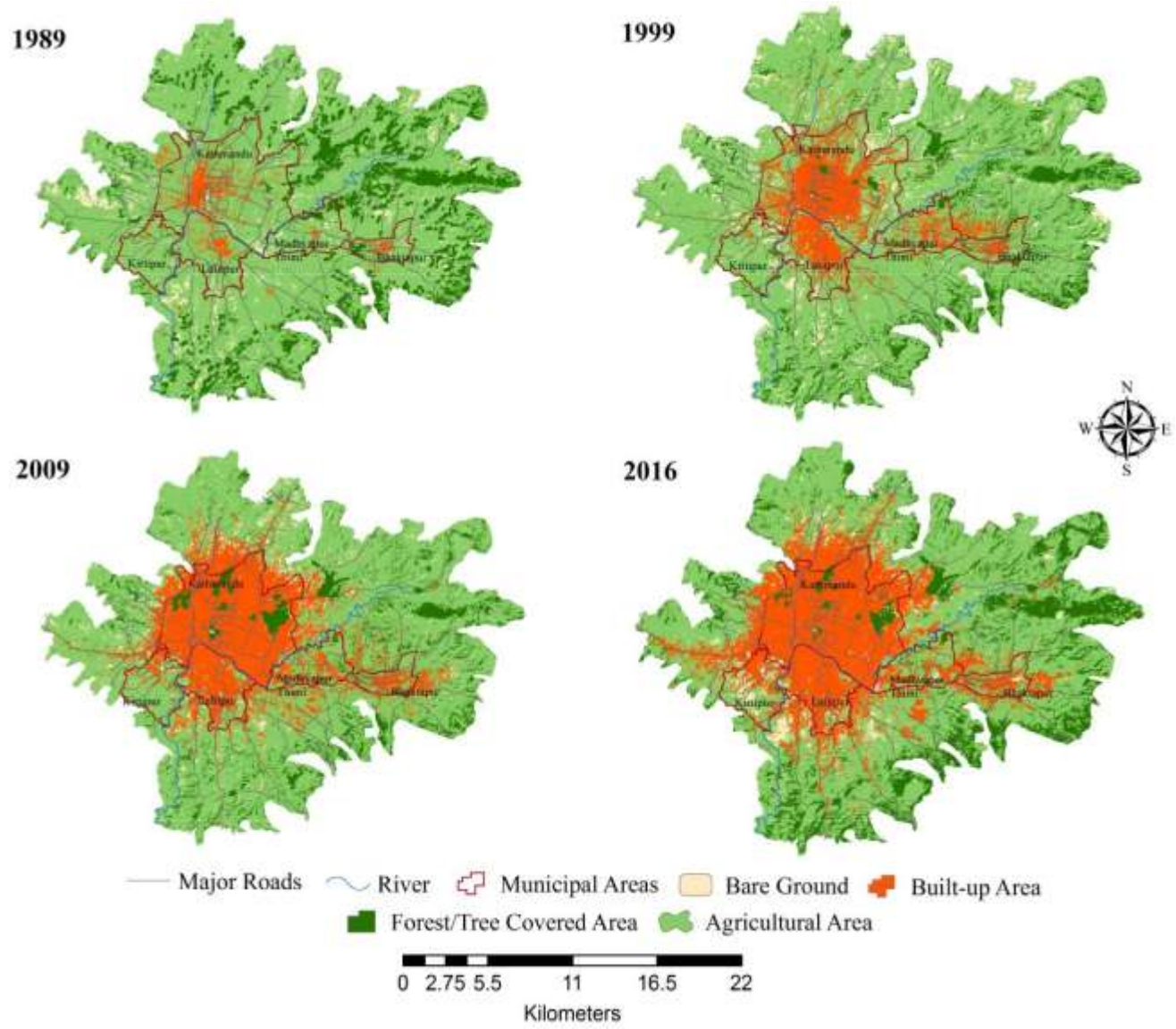


Figure 8: Remote sensing maps depicting Land Use Land Cover Change from 1989-2016

Source: Ishtiaque et al. 2017²

² Ishtiaque, A., Shrestha, M., Chhetri, N. 2017. Rapid Urban Growth in the Kathmandu Valley, Nepal: Monitoring Land Use Land Cover Dynamics of a Himalayan City with Landsat Imageries, *Environments*, 4: 72. doi:10.3390/environments4040072

Land Use Land Cover (LULC) change and its possible impact on bats assemblage in Kathmandu Valley

The rapid transformation and exponential expansion of the land use (intense cereal cropping to vegetable farming) land cover (forest to agricultural land, agricultural land to settlements and heavy built areas and even some parts back to mono-cultured forests) due to haphazard urbanization, reconstruction, infrastructure development, industrialization and occupation change caused by economic increment has encroached the major roosting and foraging habitats of bats. Not only direct effects are prominent but indirect human induced problems due to urbanization has also been observed, such as due to unmanaged sewage wastes, crow population has boomed and large and tall tree fringes within the urban areas are occupied by these crows which has led to competition for Flying Fox and other fruit bats for the roosting sites. On the other hand, with the expansion of heavy built areas and unmanaged urbanization, the occurrence and distribution of the species has shifted to distant outer parts (rural areas) in the valley. In the other hand, species diversity of cave dwelling bats has not been significantly affected but, decrease in population may have been resulted which needs to be studied further. Heavy use of pesticides in vegetable farming (land use change from intense cereal cropping such as maize, rice, millet) has affected the bats assemblage in the area. In overall, foraging habitats for all species is destructed due to land encroachment and its consequences such as air, noise and water pollution.



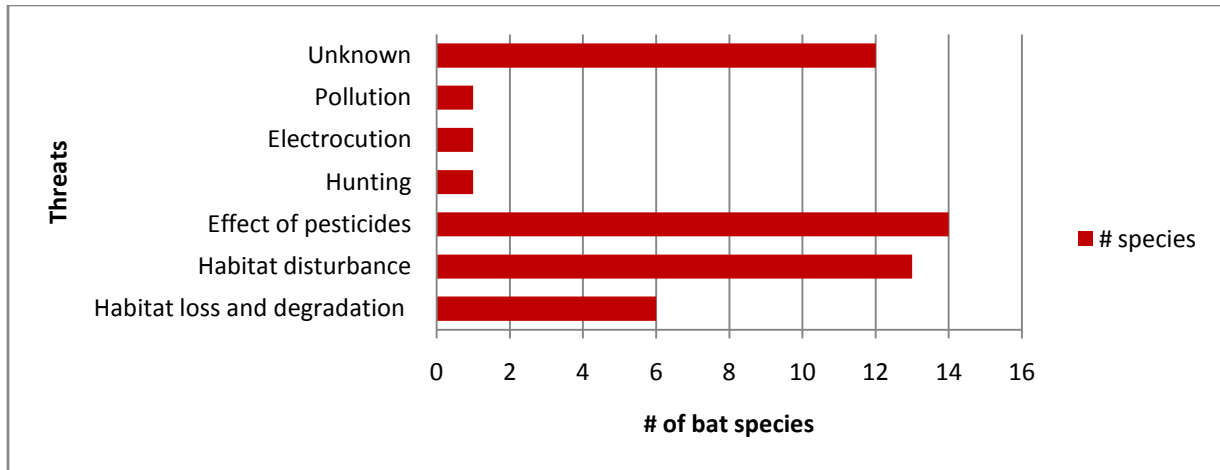


Figure 9: Possible threats to species

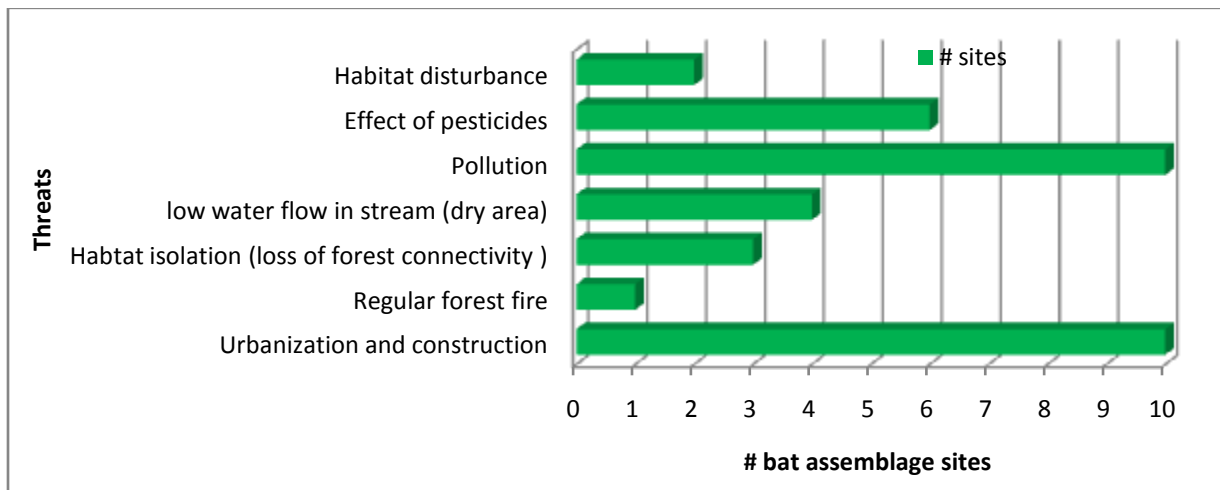


Figure 10: Threats at bat assemblage sites



Rani pokhari (a historical big pond) at the heart of the Kathmandu city was known to be visited by bats including Indian Flying fox for drinking and other insectivorous bats for foraging on insects over the pond. But, recently for the renovation, this pond has been dried recently; this may have affected the bats assemblage in the area.

There are positive aspects for the bats in between the urbanization, since, gardens, parks, and woodland (Bagmati UN Park; Manjushree Park etc.) are formed in the urban and sub-urban areas of the Kathmandu Valley, this may have supported a few species of bats for roosting and/ or foraging. In addition, cleaning campaign of Bagmati River in recent years may have impacted on the assemblage of bats positively by creating drinking and foraging grounds for them. Himal Cement Factory at Chobhar and Godawari Marble Factory at Godawari have been closed. May be, blasting at the mines used to disturb bats, which has stopped now. This also may have positive impact on assemblage of bats in the area.

Heavy use of pesticides

Agricultural landscape (terraces and fields) can act as a good foraging habitat (for eg. Mulsanghu), but heavy use of chemical pesticides especially for vegetables farming in the sub-urban and rural areas of Kathmandu Valley has poisoned insects in the farmlands. Bats

are harmed preying upon these poisoned insects. Consequently, the foraging grounds of bats are damaged.



Electrocution

Sporadic casualties of Indian Flying Fox (*Pteropus giganteus*) have been found due to electrocution in the open electric (utility) wire in different areas generally in urban and sub-urban areas of Kathmandu Valley. Few such cases have been observed within the premises of University Campus, Tribhuvan University. This is not a new case in Kathmandu area, occasionally these species were found tangled in utility wire as witnessed by Chesemore (1970).





Natural disaster

Bats and its colonies roosting in the old abandoned houses and buildings were affected by the 2015 earthquake as those old abandoned houses and buildings were demolished. Similarly cave roosting bats and colonies were affected by the tilting and movement of rocks inside and at the entrance of the caves (For eg. Ogharnath cave at Godawari). Regular and sporadic forest fire, mass forest destructions for fuel-wood and timbers, and landslides are other factors directly causing the loss of their roosting and foraging habitats. Falling down of tree that is inhabited by bats due to winds result the collapse of the roost and even makes the bats wounded.



1.1.5 Legal protection

Bat species are not included in protected list of wildlife by National Park and Wildlife Conservation Act 2029 (1973). However, nine species of bats: *Ia io*, *Myotis csorbai*, *M. sicarius*, *Scotomanes ornatus*, *Hipposideros pomona*, *Sphaerias blanfordi*, *Miniopterus pusillus*, *Murina aurata*, *Philetor brachypterus*³ were recommended for legal protection and include them in the protected list of wildlife (Himalayan Nature 2010).



³ The species occurring throughout South Asia is re-identified as *Hypsugo jofreii* (Thomas, 1915) (Saikia et al. 2017)

1.1.6 Conservation activities conducted in the Kathmandu valley

Bat conservation practices have been initiated recently in Kathmandu valley from the early 2000. In the beginning, bat conservation was led by individual. Then, it was continued by a student or group of university students. Sally R Walker and Zoo Outreach Organization triggered the Nepali individual to carry on bat conservation in the valley. Nepal Action Trust for Utility Resources and Education (NATURE) started the first conservation step for bat fauna in Kathmandu Valley. This was the first ever bat conservation activities in Nepal (Shrestha 2005; 2006). Since then there was a halt in conservation activities within Kathmandu Valley until 2009. Small Mammals Conservation and Research Foundation have been leading bat conservation activities in the valley and throughout Nepal since 2009. It targeted the initial conservation awareness and actions in Kathmandu Valley (Thapa et. al 2010a, b, c; Thapa 2011).

The Rufford Small Grants, Bat Conservation International, National Trust for Nature Conservation has supported bat conservation initiation in the Kathmandu valley.

So far, following bat specific conservation approaches has been undertaken;

Awareness Creation

Conservation awareness materials publication and dissemination

Brochures on bat conservation (SMCRF 2009), Bat conservation poster (Thapa 2011) and greeting card with photos of bats (SMCRF 2010) was published and disseminated to different parts of the valley.



School Awareness programme

Nepal Action Trust for Utility Resources and Education, NATURE started the conservation of bat fauna of Nepal through bat club formation programs in schools of Kathmandu (Shrestha, 2005 and 2006). SMCRF in joint venture with NATURE established Arniko School Bat Club, Satdobato, and Lalitpur. Several school awareness programme has been conducted in more than 20 schools in the valley (Thapa et al. 2012). Bat documentary shows “The Secret World of Bats” was shown in different schools in Kathmandu Valley, Central Department of Zoology and Central Department of Environment Science at Tribhuvan University, Kirtipur.

Radio-awareness program

National radio awareness program was conducted from Radio Kantipur, a leading FM of Nepal (Thapa et. al 2010c).

Boards display

A flex board had been displayed at the entrance of Nagarjuna Cave, Shivapuri-Nagarjuna National Park, and Kathmandu (Acharya et al. 2010).

Trainings

Trainings have been carried out to university students from time to time. Training in Field Techniques for Research and Conservation of Volant and Non-Volant Small Mammals organized by ZOO & WILD, India in collaboration with CBSG South Asia, RSG South Asia, CCINSA and RILSCINSA, Sponsored by BCI USA, Chester Zoo UK, Knowsley Safari Park UK (Daniel 2007) and Bat Conservation Educator Skills Training, Organized by ZOO/CCINSA, Sponsored by BCI, USA, in 2008. SMCRF has organized several one day to three days bats handlings, identification, field techniques, bat acoustics trainings to university students and enthusiasts at Central Department of Zoology and Central Department of Environment Science, Tribhuvan University since 2009 (Thapa et al. 2017).

Bat boxes (houses) installation

Bat box (house) had been installed at the Central Zoo for the awareness to the visitor as well as to develop artificial roosts for bats in urban area. This approach was up scaled by installation of additional twelve bat houses were installed in Kathmandu valley at Taudaha, Nagdaha, Sipadol, Gatthaghar, New Baneshwor, Kirtipur, Koteshwor, Kalanki, Tikabhairab, Kapan, Lazimpat, Sunakothi, (Thapa 2011). Although these bats boxes were installed to create artificial roosts to the bats as well as to educate the local community on the conservation needs and their role of ecosystem services, these installed bat boxes were not found occupied by bats during monitoring. Most of the bat boxes have been damaged and some can be used after repairing, therefore, reconstruction of bat boxes adopting well design so that bats occupy them for roosting is required.

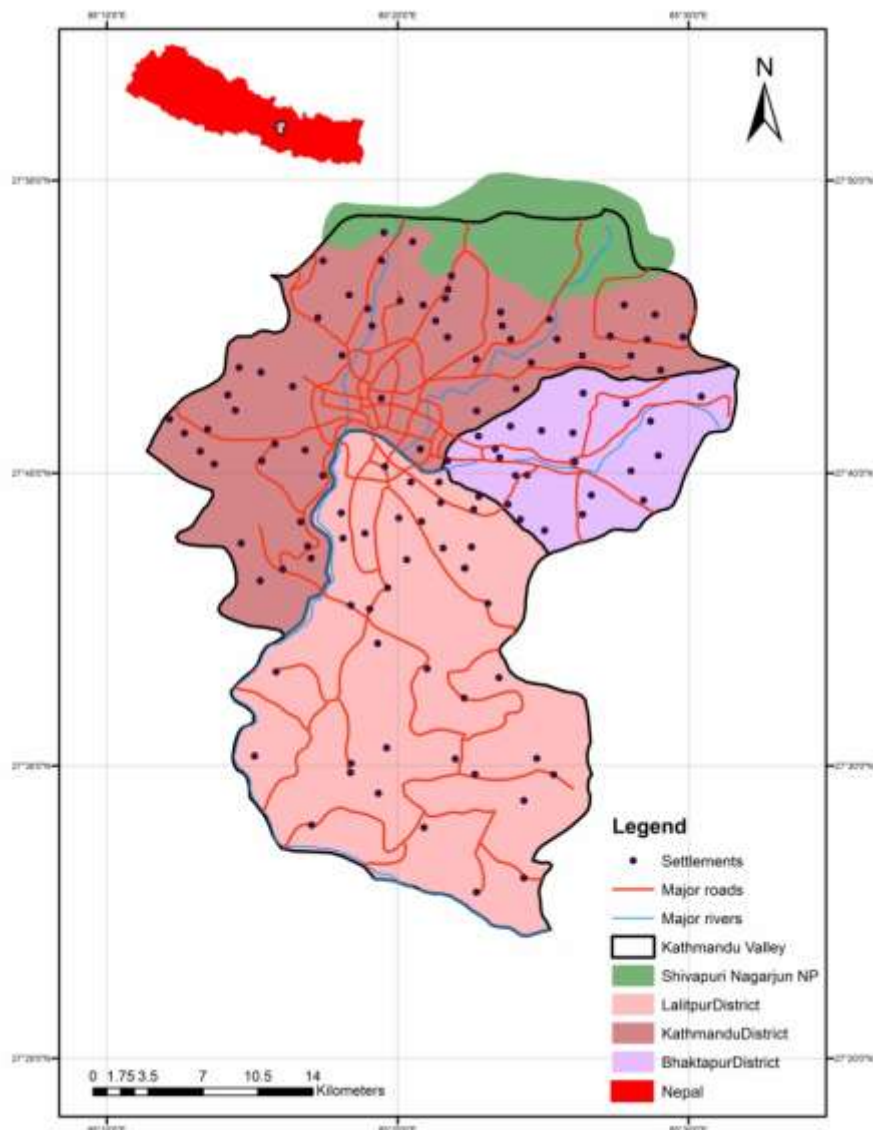


1.2 Project and studies related with bats in Kathmandu valley

1. "Habitat and Acoustic Survey and an action plan for bats conservation in the Kathmandu Valley" in 2017 supported by RSG (Thapa et al. 2017)
2. Population Status and Diurnal Behaviour of the Indian Flying Fox *Pteropus giganteus* (Brünnich, 1782) in Kathmandu Valley, Nepal in 2016 Manandhar et al. (2017)
3. Key to Identify Insects from Droppings of Some Insectivorous Bats of Nepal Pokhrel and Budha (2014)
4. Conservation of bats; an initiative through bat house installation in Kathmandu Valley, Central Nepal in 2011 supported by BCI (Thapa 2011)
5. Detailed monitoring survey of bats and their conservation through radio awareness programme and outreach programme to school children in Kathmandu valley in 2010 supported by RSG (Thapa et al. 2010; 2012)
6. A Report on Preliminary Study of Ectoparasites of Bats of Kathmandu Valley Dahal and Thapa (2010)
7. Monitoring of Ptero-camp at Lainchaur-Kathmandu (Timalsina and Ghimire 2010)
8. Population status, general behaviour and threats of Flying Fox (*Pteropus giganteus*) in Sallaghari, Bhaktapur, Nepal (Koju 2008)
9. Status and distribution of Indian Flying Fox in Kathmandu Valley, Nepal (Acharya 2008)
10. An Overview of the Bats in Sallaghari, Bhaktapur (Rachal 2006)

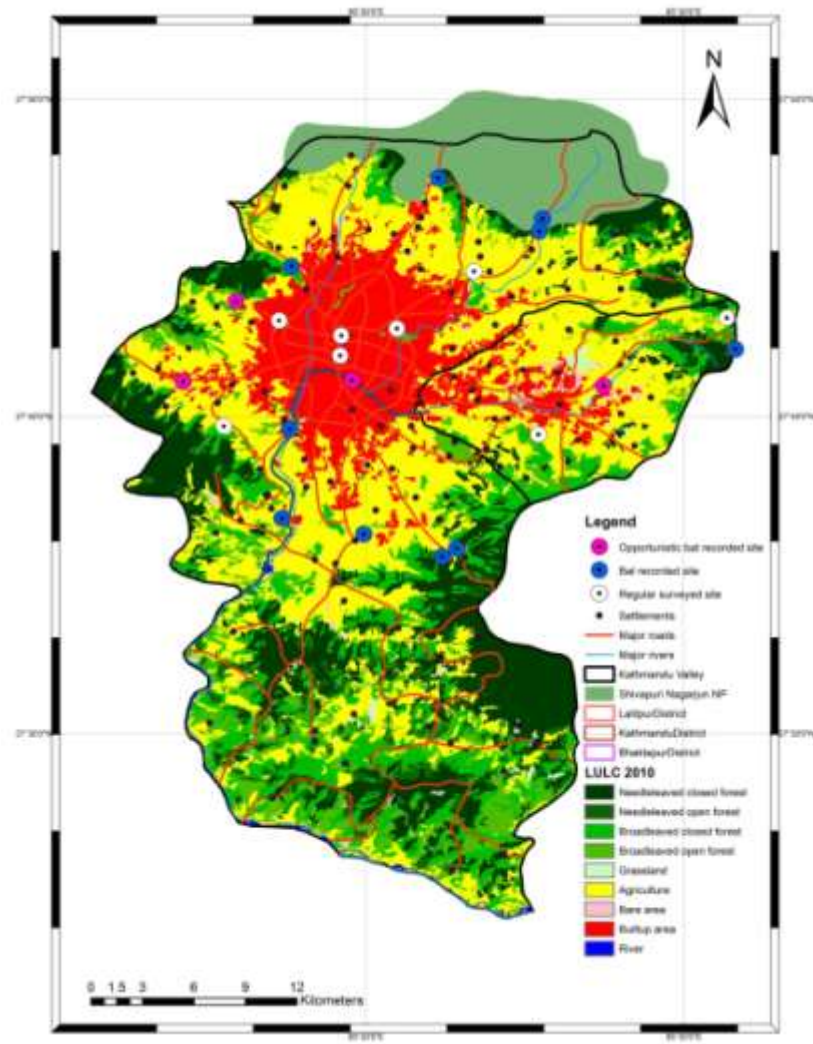
2. Kathmandu Valley and monitoring sites

Kathmandu Valley (27°35'00"N 85°15'00"E, 27°50'00"N 85°37'30"E) is comprised of three districts namely Kathmandu, Lalitpur and Bhaktapur Districts. It is an oval shaped, flat bottomed basin valley with hills: Phulchowki, Chandragiri, Shivapuri and Nagarjuna at southern, south western, northern and north western corners, respectively. The study area occupies 395 square kilometers and is situated at an elevation of 1372 m to 2732 m. Climate in Kathmandu Valley is characteristic temperate, influenced by the tropical monsoon. The average air temperature during summer season varies from 28–30 °C (82–86 °F) to 10.1 °C (50.2 °F) during the winter. The annual rainfall in Kathmandu city is about 1407 mm. The average humidity is 75%. Bagmati and Bishnumati are major rivers of this area with centripetal drainage system. The surrounding hilly area is covered with forest of *Alnus nipalensis*, *Pinus roxburghii*, *Prunus spp.*, *Quercus sps.* And bamboo as major vegetation while the fauna like Leopard (*Panthera pardus*), Wild boar (*Sus scrofa*), Common langur (*Semnopithecus entellus*), Rhesus monkey (*Macaca mulata*) etc, numerous volant fauna (bats and birds) are present. It's a religious and tourist attraction centre of Nepal. The Kathmandu Valley is a cultural and political hub of Nepal (https://en.wikipedia.org/wiki/Kathmandu_Valley). It was inscribed as a World Heritage Site by UNESCO in 1979. The project area comprises approximately 100km² and is entirely within the Valley; it contains the Shivapuri Nagarjun National Park (https://en.wikipedia.org/wiki/Shivapuri_Nagarjun_National_Park), 15 community forests, urban and sub-urban areas and agricultural landscape.



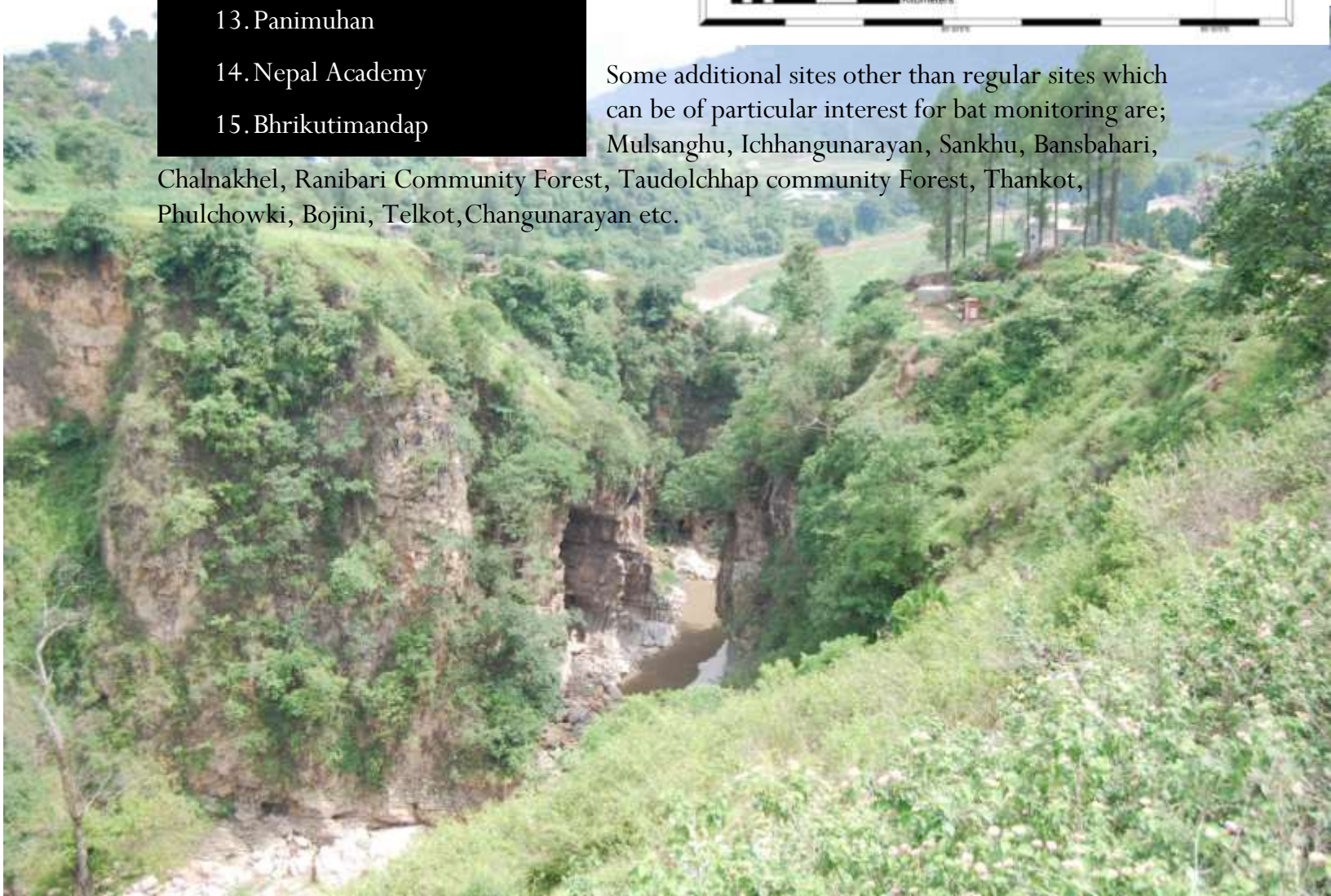
Fifteen regular monitoring sites including key habitats are as follows;

1. Chobhar
2. Godawari
3. Bajrabarahi
4. Sundarijal
5. Gokarna
6. Gujeshwari
7. Swayambhu
8. Nagarjun
9. Pharping
10. Machhegaun
11. Nagarkot
12. Suryabinayak
13. Panimuhan
14. Nepal Academy
15. Bhrikutimandap



Some additional sites other than regular sites which can be of particular interest for bat monitoring are;

Mulsanghu, Ichhangunarayan, Sankhu, Bansbahari, Chalnakhel, Ranibari Community Forest, Taudolchhap community Forest, Thankot, Phulchowki, Bojini, Telkot, Changunarayan etc.



4. Kathmandu Valley Bat Conservation Action Plan

4.1 Vision

Thriving populations of all bat (chiropteran) species in natural as well as artificial habitats in the Kathmandu valley.

4.2 Goals

4.2.1 Overall Goal

Preventing decline in the population (in numbers) and range of distribution of all bat species in the Kathmandu valley

4.2.2 Specific Goals

- A. Conserving bat species diversity and the population
- B. Protecting bat habitats (roosting and foraging)
- C. Reducing impact of land use land cover change on bats assemblage, population and its habitats
- D. Halting persecution of bats, increasing local people's willingness and participation for the conservation of bats and their habitats.

4.3 Targets

- A. Monitoring of bats population in key habitats
- B. Safeguard roosting and foraging habitats
- C. Protection by law
- D. Enhance or promote participatory approach for the conservation of bats and their habitats

4.4 Actions

Target A. Monitoring of bats population in key habitats

- Action 1. Annual Kathmandu valley bat monitoring for their population in key habitats
- Action 2. Develop and publish guidelines for bats monitoring inside and outside the protected areas (not to disturb or hamper bats during hibernation and torpor)
- Action 3. Build capacity of researchers, forest rangers, protected area managers and citizen scientists for bat monitoring

Target B. Safeguard roosting and foraging habitats

- Action 1. Identify and map the key potential and vulnerable roosting and foraging sites deploying cutting edge techniques including radio-telemetry
- Action 2. Develop those key potential sites that are vulnerable as bat conservation sites
- Action 3. Develop cave management guidelines and plans considering bat conservation priorities
- Action 4. conduct studies on diet of bat species
- Action 5. Initiate construction of 3 bat gardens and parks attracting insects and bats in the urban and heavy built areas
- Action 6. Reduce the use of pesticides in agricultural land by promoting organic farming
- Action 7. Initiate the control of the water pollution, air pollution and noise pollution that are beyond the tolerating thresholds to bats
- Action 8. Construct new bat boxes (houses) in the urban and heavy built areas
- Action 9. Initiate promotion and reforestation of broad leaved forest replacing needle leaved forest and develop corridors for the isolated habitats
- Action 10. Initiate protection of natural and construct artificial water reservoirs

Target C. Protection by law

- Action 1. Categorize the species which are tolerant and non-tolerant species to the land use land cover change impact
- Action 2. Analyze and identify the impact of construction to bats assemblage and its habitat during IEE and EIA
- Action 3. Analyze and identify gaps in national legislations
- Action 4. Initiate relevant amendments to the national legislations

Target D. Enhance or promote participatory approach for the conservation of bats and their habitats

Action 1. Identify the targeted groups/population/level associated and affected with bats and its habitat such as forest rangers, protected area managers, teachers and schoolchildren, tourists, government officials, land owners, users, environment consultants, construction workers, agriculture and horticulture farmers, gardeners etc.

Action 2. create and/or enhance awareness by conducting educational/outreach campaigns, capacity building for the target groups

Action 3. Enhance media advocacy

Action 4. Promote bat friendly eco-tourism

Action 5. Understand and inform all stakeholders including local community on the role of bats for ecosystem services (pollination, seed dispersal and agricultural pest control etc.) for the behavioural change and increase the level of tolerance and motivate the willingness amongst the targeted group for the co-existence of the species and local level long term conservation of bats.

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Table 1: Matrix of targets and prioritized actions

Targets	Actions	Responsible Organization	Completion by
Monitoring of bats population in key habitats	Action 1. Annual Kathmandu valley bat monitoring for their population in key habitats	SMCRF, Universities, DoF, DNPWC	2022
	Action 2. Develop and publish guidelines for bats monitoring inside and outside the protected areas (not to disturb or hamper bats during hibernation and torpor)	SMCRF, DoF, DNPWC	2019
	Action 3. Build capacity of researchers, forest rangers, protected area managers and citizen scientists for bat monitoring	SMCRF, Universities, DoF, DNPWC	2022
Safeguard roosting and foraging habitats	Action 1. Identify and map the key potential and vulnerable roosting and foraging sites deploying cutting edge techniques including radio-telemetry	SMCRF, Universities, DoF, DNPWC, RSG	2020
	Action 2. Declare those key potential sites that are vulnerable, as bat conservation sites	SMCRF, DoF, DNPWC	2020
	Action 3. Develop cave management guidelines and plans considering bat conservation priorities	SMCRF, DoF, DNPWC, Cave Management Committees	2019
	Action 4. conduct studies on diet of bat species	SMCRF, Universities, DoF, DNPWC	2022
	Action 5. Initiate the construction of 3 bat gardens and parks attracting insects and bats in the urban and heavy built areas	Municipalities, DoF, SMCRF	2023
	Action 6. Initiate reduction of the use of pesticides in agricultural land by promoting organic farming	Municipalities, MoALMC, DoF, SMCRF	2023
	Action 7. Initiate control of the water pollution, air pollution and noise pollution that are beyond the tolerating thresholds to bats	Municipalities, MoALMC, DoF, SMCRF	2023
	Action 8. Construct new bat boxes (houses) in the urban and heavy built areas	SMCRF, DoF	2019
	Action 9. Initiate promotion and reforestation of broad leaved forest replacing needle leaved forest and develop corridors for the isolated habitats	SMCRF, DoF	2023
	Action 10. Initiate protection of natural and construct artificial water reservoirs	SMCRF, DoF	2023
Protection by law	Action 1. Categorize the species which are tolerant and non-tolerant species to the land use land cover change impact	SMCRF, Universities, DoF, DNPWC	2019

	Action 2. Analyze and identify the impact of construction to bats assemblage and its habitat during IEE and EIA	SMCRF, Universities, DoF, DNPWC	2020
	Action 3. Analyze and identify gaps in national legislations	SMCRF, Universities, DoF, DNPWC	2020
	Action 4. Initiate relevant amendments to the national legislations	SMCRF, Universities, DoF, DNPWC	2023
Enhance or promote participatory approach for the conservation of bats and their habitats	Action 1. Identify the targeted groups/population/level associated and affected with bats and its habitat such as forest rangers, protected area managers, teachers and schoolchildren, tourists, government officials, land owners, users, environment consultants, construction workers, agriculture and horticulture farmers, gardeners etc.	SMCRF, Universities, DoF, DNPWC	2019
	Action 2. create and/or enhance awareness by conducting educational/outreach campaigns, capacity building for the target groups	SMCRF, Universities, DoF, DNPWC	2020
	Action 3. Enhance Media advocacy	SMCRF, Universities, DoF, DNPWC	2020
	Action 4. Prepare bat documentary on demonstrating important role of bats in providing ecosystem services in Kathmandu Valley and in Nepal	SMCRF, Universities	2019
	Action 5. Promote bat friendly eco-tourism	SMCRF, Universities, DoF, DNPWC, NTB	2020
	Action 6. Understand and inform all stakeholders including local community on the role of bats for ecosystem services (pollination, seed dispersal and agricultural pest control etc.) for the behavioural change and increase the level of tolerance and motivate the willingness amongst the targeted group for the co-existence of the species and local level long term conservation of bats.	SMCRF, Universities, DoF, DNPWC	2020

DoF: Department of Forests, Kathmandu, Nepal, DNPWC: Department of National Parks and Wildlife Conservation, Kathmandu, Nepal MoALMC: Ministry of Agriculture, Land Management and Cooperatives, Nepal, NTB: Nepal Tourism Board, RSG: Rufford Small Grants, UK, SMCRF: Small Mammals Conservation and Research Foundation, Kathmandu, Nepal

Table 2: Matrix of site specific threats and suggested actions

S.N.	Site	Pertaining threats	Actions	Remarks
1	Bajrabarahi	Pollution in stream flowing at the edge of the religious forest	Identify and control source of water pollution, initiate cleaning campaign	
		The habitat is isolated (loss of forest connectivity)	Develop corridors by reforesting broad leaved mixed forest	
		Heavy use of pesticides in the agricultural lands surrounding the area (vegetable farming)	Reduce the heavy use of pesticides and promote organic farming	
		land mining undergoing adjacent to the religious forest	permission for land mining should be provided after careful EIA/IEE prioritizing impacts on wildlife	
2	Machhegaun	Increase in urbanization	Control haphazard urbanization, initiate improved land management for local development, permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife	Explore the causes for less activity of bats in the area
		low water flow in the stream and polluted stream	Initiate improved watershed management; Identify and control source of water pollution, initiate cleaning campaign	
		Heavy use of pesticides in the agricultural lands (vegetable farming)	Reduce the heavy use of pesticides and promote organic farming	
		Regular forest fire	Reduce and control forest fire	
		Plantation of coniferous forests	Reforestation of broadleaved mixed forest	
3	Pharping	Heavy use of pesticides in the agricultural lands (vegetable farming)	Reduce the heavy use of pesticides and promote organic farming	
		Forest destructed and conversion into agricultural lands, forest fringe remained	Reforestation of broadleaved mixed forest	

		Polluted water flowing in the Bagmati River	Identify and control source of water pollution, initiate cleaning campaign	
4	Chobhar	Polluted water flowing in the Bagmati River through the gorge	Identify and control source of water pollution, initiate cleaning campaign	Explore effect of pollution (air, water and noise) on bats population
				The cave entrance of caves at Manjushree Park have iron gate with narrow gaps which has impacted on passage of other large species of bats, however, it has supported the roosting of smaller bats and therefore, holds the permanent roost of <i>Hipposideros cineraceus</i> and <i>Megaderma lyra</i> visit outside of these caves to prey upon small bats. Therefore, it is suggested to widen the gaps of the iron gate at the cave entrance
			Plantation of vegetation favourable for roosts, foraging for fruit bats as well as attracting insects for insectivorous bats	There are some trees that are attracting fruit bats (<i>Pteropus giganteus</i> and <i>Rousettus leschenaultii</i>)
5	Godawari	Rocks in the Ogharnath Cave has been distorted due to 2015 earthquake		Disturbances due to blasting for the mining by Himal cement factory has been halted since the factory has been closed and the old abandoned factory set up and premises may act as promising habitat for bats, it is suggested to explore the impact of mining on bats population
		Water pollution in a pond due to washing of clothes by using soap		Disturbances due to blasting for Marble stone mining has been halted as the Godawari Marble factory has been closed, it is suggested to explore the impact of mining on bats population
6	Sundarijal	Heavy use of pesticides in the agricultural lands (vegetable farming)	Reduce the heavy use of pesticides and promote organic farming	Forest cover has increased and water flow in the streams has increased, it is also suggested to understand impact of forest cover and water flow in streams and watershed on bats assemblage
				Intact forest of Shivapuri Nagarjun National Park (SNNP) may have supported the bats assemblage it is suggested to study occurrence and distribution of bats in

		Urbanization increasing in the buffer zone of SNNP	Control haphazard urbanization, initiate improved land management for local development, permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife	different forest types
7	Panimuhan	Urbanization increasing in the buffer zone of SNNP	Control haphazard urbanization, initiate improved land management for local development, permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife	Intact forest of Shivapuri Nagarjun National Park (SNNP) may have supported the bats assemblage it is suggested to study occurrence and distribution of bats in different forest types
8	Nagarjun	Domestic and international visitors and tourists enter inside this peace cave as there is a Buddha statue inside, light candle and pray which may disturb bats especially during the hibernation and torpor.	Cave management plan or guidelines focusing on bats conservation should be prepared and implemented	At the entrance of the Dhiki Pako Cave (Now a days called Nagarjun Peace Cave) has an iron channel gate with narrow gaps and therefore bats of smaller to intermediate size has been supported while movement of larger bat species (<i>Megaderma lyra</i>) is restricted, it is suggested to widen the gaps of the iron gate at the cave entrance
				<i>Miniopterus fuliginosus</i> was captured in 2000, but then after 2000 the species has not been recaptured, it is suggested to continue site specific extensive monitoring
				The site is predominately occupied by <i>Rhinolophus</i> spp., it is suggested to study habitat selection of bats species at specific sites
		At the edge of this cave and SNNP, urbanization is exponentially expanding and construction is going on due to which foraging area has been damaged	Control haphazard urbanization, initiate improved land management for local development, permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife; construct bat gardens and parks in urban areas; install bat boxes	A busy road passes 50m ahead from the cave entrance which may have resulted casualties of bats crossing over the road, it is suggested to study on impact of roads on bats casualties

9	Swoyambhu	The religious forest is isolated in urban fringe	Develop corridors by reforesting broad leaved mixed forest;	Rhesus monkey population is booming, therefore, it is suggested to understand impact of booming monkey population on bats assemblage
		Needleleaved forest (<i>Pinus roxburghii</i>) is dominating vegetation and the soil is dry	Initiate improved watershed management	
		Stream polluted	identify and control source of water pollution, initiate cleaning campaign	
		surrounding the area, urbanization is exponentially expanding and construction is going on due to which foraging area has been damaged	Control haphazard urbanization, initiate improved land management for local development, permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife; construct bat gardens and parks in urban areas	
10	Gujeshwari	Mixed forest which is isolated in between the urban fringe	Develop corridors by reforesting broad leaved mixed forest;	Tribhuvan International Airport is adjacent to this site so noise pollution is greater, it is suggested to study on impact of noise pollution on bats assemblage
		Bagmati River flowing through the edge of this forest is polluted	Identify and control source of water pollution, initiate cleaning campaign	Rhesus monkey population is booming, therefore, it is suggested to understand impact of booming monkey population on bats assemblage
		surrounding the area, urbanization is exponentially expanding and construction is going on due to which foraging area has been damaged	Control haphazard urbanization, initiate improved land management for local development, permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife; construct bat gardens and parks in urban areas; install bat boxes	
11	Suryabinayak	Water flow in springs is low	Initiate improved watershed management	Bat assemblage and bat activity is low, it is suggested to explore the causes for less activity of bats in the area

		urbanization is expanding and construction is going on due to which foraging area has been damaged	Control haphazard urbanization, initiate improved land management for local development, permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife; construct bat gardens and parks in urban areas; instal bat boxes	Several brick factories are under operation in this area, it is suggested to study the impact of air pollution on bats assemblage
		Heavy use of pesticides in the agricultural lands (vegetable farming)	Reduce the heavy use of pesticides and promote organic farming	
12	Nagarkot	Construction especially for Tourism is undergoing	permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife	
		Water flow in springs is low	Initiate improved watershed management	
13	Bhrikutimandap	Heavy built area due to which foraging area has been damaged	Bat gardens and parks should be constructed; Bat boxes should be installed	
		Water, air and noise pollution	Study impact of water, air and noise pollution on bats assemblage	
		Tukuche river is polluted	Identify and control source of water pollution, initiate cleaning campaign	
14	Academy Hall	Heavy built area due to which foraging area has been damaged	Bat gardens and parks should be constructed; Bats boxes should be installed	Rani pokhari (A big pond at the heart of the Kathmandu city has dried up, this pond was the drinking and foraging site for the bats including Indian Flying Fox), it is suggested to study the impact of renovation of ponds in bats assemblage
		Pruning the trees during winter and autumn	Careful examination of bats inhabitation in the trees should be conducted before pruning the trees, if the bats are inhabiting, such trees should not be pruned	
15	Gokarna	Streams channeling to Bagmati River is heavily polluted	Identify and control source of water pollution, initiate cleaning campaign	Monoculture needle leaved trees dominating the forests does not serve as a good habitat for bats it is suggested to

	urbanization is expanding and construction is going on due to which foraging area has been damaged	Control haphazard urbanization, initiate improved land management for local development, permission for construction should be provided after careful EIA/IEE prioritizing impacts on wildlife; construct bat gardens and parks in urban areas; instal bat boxes	reforest broadleaved mixed forest
	Heavy use of pesticides in the agricultural lands (vegetable farming)	Reduce the heavy use of pesticides and promote organic farming	

Table 3: Matrix of species specific threats and actions

S.N.	Species	Threats	Actions
1	<i>Rousettus leschenaultii</i>	i. Foraging habitat destruction due to land use change	Plantation of preferred foraging plants; construction of bat gardens and parks
		i. Cave disturbance	Preparation of a cave management guidelines and plan, and implementation
2	<i>Pteropus giganteus</i>	i. Lack of roosts (tall trees) and foraging areas due to land use change	Plantation of roosting preferred trees and foraging plants; construction of bat gardens and parks
		ii. Unmanaged pruning of roosting trees	Careful examination of bats inhabitation in the trees should be conducted before pruning the trees, if the bats are inhabiting, such trees should not be pruned
		iii. Heavy use of pesticides in fruits plantation	Reduce the heavy use of pesticides and promote organic farming
		iv. Hunting for medicinal belief	increase awareness on role of ecosystem services by bats
		v. Electrocution	Insulation of electric (utility) wire or keeping appropriate gaps between these electric wires
		vi. Noise, air and water pollution	Study effect of pollutions (air, water and noise) on bats population
3	<i>Cynopterus sphinx</i>	i. Foraging and roosting habitat destruction due to land use change	Plantation of roosting preferred trees and foraging plants; construction of bat gardens and parks
		ii. Retaliatory killings as the species is perceived as crop pests	Raise the conservation awareness of bats and especially highlight their important role in terms of ecosystem services
4	<i>Megaderma lyra</i>	i. Roost disturbance	Preparation of a cave management guidelines and plan, and implementation

5	<i>Rhinolophus affinis</i>	i.Roost collapse due to natural disaster (earthquake)	??
		ii.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
6	<i>Rhinolophus ferrumequinum</i>	i.Roost disturbance	Preparation of a cave management guidelines and plan, and implementation
		ii. Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
7	<i>Rhinolophus pearsonii</i>	i. Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
8	<i>Rhinolophus macrotis</i>	i.Roost disturbance	Preparation of a cave management guidelines and plan, and implementation
		ii.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
9	<i>Rhinolophus luctus</i>	i.Roost disturbance	Preparation of a cave management guidelines and plan, and implementation
		ii.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
10	<i>Rhinolophus pusillus</i>	i.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
		ii.Roost disturbance	Preparation of a cave management guidelines and plan, and implementation
11	<i>Rhinolophus lepidus</i>	Unknown	Identify the direct and indirect threats to the survival of the species
12	<i>Rhinolophus sinicus</i>	i.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
13	<i>Hipposideros armiger</i>	i. Roost disturbance	Preparation of a cave management guidelines and plan, and implementation
		ii.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
14	<i>Hipposideros cineraceus</i>	i.Roost disturbance	Preparation of a cave management guidelines and plan, and implementation
15	<i>Hipposideros fulvus</i>	Unknown	Identify the direct and indirect threats to the survival of the species
16	<i>Myotis csorbai</i>	i.Roost disturbance	Preparation of a cave management guidelines and plan, and implementation
		ii.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
17	<i>Myotis formosus</i>	Unknown	Identify the direct and indirect threats to the survival of the species
18	<i>Myotis muricola</i>	Unknown	Identify the direct and indirect threats to the survival of the species
19	<i>Myotis nipalensis</i>	i.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
20	<i>Myotis sicarius</i>	i.Habitat loss, degradation and isolation	Develop corridors by reforesting broad leaved mixed forest
		ii.Heavy use of pesticides	Reduce the heavy use of pesticides and promote organic farming
21	<i>Myotis frater</i>	Unknown	Identify the direct and indirect threats to the survival of the species
22	<i>Barbastella leucomelas</i>	Unknown	Identify the direct and indirect threats to the survival of the species
23	<i>Eptesicus serotinus</i>	Unknown	Identify the direct and indirect threats to the survival of the species

24	<i>Pipistrellus coromandra</i>	i. Roost collapsed due to natural disaster (earthquake)	installation of bat boxes; construct bat gardens and parks
		ii. Heavy use of pesticides in agricultural fields	Reduce the heavy use of pesticides and promote organic farming
25	<i>Pipistrellus javanicus</i>	Unknown	Identify the direct and indirect threats to the survival of the species
26	<i>Pipistrellus tenuis</i>	i. Roost collapse due to natural disaster (earthquake)	installation of bat boxes; construct bat gardens and parks
27	<i>Falsistrellus affinis</i>	Unknown	Identify the direct and indirect threats to the survival of the species
28	<i>Nyctalus lasiopterus</i>	Unknown	Identify the direct and indirect threats to the survival of the species
29	<i>Murina huttoni</i>	Unknown	Identify the direct and indirect threats to the survival of the species
30	<i>Murina leucogaster</i>	i. Habitat loss and degradation	Plantation of roosting preferred trees and foraging plants; construction of bat gardens and parks; reforestation of broad leaved forests
31	<i>Murina aurata</i>	Unknown	Identify the direct and indirect threats to the survival of the species
32	<i>Miniopterus fuliginosus</i>	Unknown	Identify the direct and indirect threats to the survival of the species

Table 4: Tentative budget for executing the proposed actions

Targets	Actions	Tentative Budget in US \$	Tentative Budget in NPR	Funding Request to
Monitoring of bats population in key habitats	Action 1. Annual Kathmandu valley bat monitoring for their population in key habitats	5000	500,000	RSG, BCI, NTNC, WWF, DNPWC, DoF
	Action 2. Develop and publish guidelines for bats monitoring inside and outside the protected areas (not to disturb or hamper bats during hibernation and torpor)	10000	1,000,000	BCI, RSG, MBZ, WWF, DNPWC, DoF
	Action 3. Build capacity of researchers, forest rangers, protected area managers and citizen scientists for bat monitoring	5000	500,000	BCI, RSG, MBZ, WWF, DNPWC, DoF
Safeguard roosting and foraging habitats	Action 1. Identify and map the key potential and vulnerable roosting and foraging sites deploying cutting edge techniques including radio-telemetry	20000	2,000,000	BCI, RSG, MBZ, WWF, DNPWC, DoF

	Action 2. Declare those key potential sites that are vulnerable, as bat conservation sites	1,000	100,000	WWF, DNPWC, DoF
	Action 3. Develop cave management guidelines and plans considering bat conservation priorities	10000	1,000,000	BCI, RSG, MBZ, WWF, DNPWC, DoF
	Action 4. conduct studies on diet of bat species	10000	1,000,000	BCI, RSG, MBZ, WWF, DNPWC, DoF
	Action 5. Initiate construction of 3 bat gardens and parks attracting insects and bats in the urban and heavy built areas	50,000	5,000,000	Municipalities, DoF, UNDP, UNEP, GEF, giz, DFID, SNV, Swiss Development Agency
	Action 6. Initiate reduction of the use of pesticides in agricultural land by promoting organic farming	50,000	5,000,000	Municipalities, MoALMC, DoF, GEF, giz, DFID, SNV, Swiss Development Agency, UNDP, UNEP,
	Action 7. Initiate control of the water pollution, air pollution and noise pollution that are beyond the tolerating thresholds to bats	100,000	10,000,000	Municipalities, MoALMC, DoF, GEF, giz, DFID, SNV, Swiss Development Agency, UNDP, UNEP,
	Action 8. Initiate construction of new bat boxes (houses) in the urban and heavy built areas	5000	500,000	RSG, BCI, NTNC
	Action 9. Initiate the promotion and reforestation broad leaved forest replacing needle leaved forest and develop corridors for the isolated habitats	50,000	5,000,000	Municipalities, MoALMC, DoF, GEF, giz, DFID, SNV, Swiss Development Agency, UNDP, UNEP,
	Action 10. Initiate protection of natural and construct artificial water reservoirs	50,000	5,000,000	Municipalities, MoALMC, DoF, GEF, giz, DFID, SNV, Swiss Development Agency, UNDP, UNEP,
Protection by law	Action 1. Categorize the species which are tolerant and non-tolerant to the land use land cover change impact	1000	100,000	SMCRF
	Action 2. Analyze and identify the impact of construction to bats assemblage and its habitat during IEE and EIA	5000	500,000	

	Action 3. Analyze and identify gaps in national legislations	5000	500,000	DoF, NTNC, ZSL, WWF, DNPWC
	Action 4. Initiate relevant amendments to the national legislations	5000	500,000	DoF, NTNC, ZSL, WWF, DNPWC
Enhance or promote participatory approach for the conservation of bats and their habitats	Action 1. Identify the targeted groups/population/level associated and affected with bats and its habitat such as forest rangers, protected area managers, teachers and schoolchildren, tourists, government officials, land owners, users, environment consultants, construction workers, agriculture and horticulture farmers, gardeners etc.	1000	100,000	SMCRF
	Action 2.create and/or enhance awareness by conducting educational/outreach campaigns, capacity building for the target groups, peer to peer knowledge transfer	20000	2000,000	RSG, MBZ, BCI, DoF, NTNC, ZSL, WWF, DNPWC
	Action 3. Enhance Media advocacy	5000	500,000	RSG, MBZ, BCI, DoF, NTNC, ZSL, WWF, DNPWC
	Action 4. Prepare bat documentary on demonstrating important role of bats in providing ecosystem services in Kathmandu Valley and in Nepal	20000	2000,000	RSG, BCI, MBZ
	Action 5. Promote bat friendly eco-tourism	50,000	5,000,000	NTB, Municipalities, MoALMC, DoF, GEF, giz, DFID, SNV, Swiss Development Agency, UNDP, UNEP, RSG, MBZ, BCI, ZSL, WWF,
	Action 6. Understand and inform all stakeholders including local community on the role of bats for ecosystem services (pollination, seed dispersal and agricultural pest control etc.) for the behavioural change and increase the level of tolerance and motivate the willingness amongst the targeted group for the co-existence of the species and local level long term conservation of bats.	50,000	5,000,000	Municipalities, MoALMC, DoF, GEF, giz, DFID, SNV, Swiss Development Agency, UNDP, UNEP, RSG, MBZ, BCI, ZSL, WWF,

BCI: Bat Conservation International, USA; DoF: Department of Forests, Kathmandu, Nepal, DFID: Department for International Development, DNPWC: Department of National Parks and Wildlife Conservation, Kathmandu, Nepal, giz: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, GEF: Global Environment Facility, MBZ: The Mohammed Bin Zayed Species Conservation Fund, UAE; MoALMC: Ministry of Agriculture, Land Management and Cooperatives, Nepal, NTB: Nepal Tourism Board, NTNC: National Trust for Nature Conservation, Lalitpur, Nepal; RSG: Rufford Small Grants, UK, SMCRF: Small Mammals Conservation and Research Foundation, Kathmandu, Nepal, SNV:

Netherlands Development Organisation, UNDP: United Nations Development Programme, UNEP: United Nations Environment Programme, WWF: World Wide Fund, ZSL: Zoological Society of London,

Table 5: Implementing activities for targets and actions

Targets	Actions	Implementing activities
Monitoring of bats population in key habitats	Action 1. Annual Kathmandu valley bat monitoring for their population in key habitats	Activity 1. Organize Kathmandu valley Bat Monitoring Programme annually deploying trait-based studies at different habitat types
	Action 2. Develop and publish guidelines for bats monitoring inside and outside the protected areas	Activity 1. Draft a guidelines for bats monitoring inside and outside the protected areas
	Action 3. Build capacity of researchers, forest rangers, protected area managers and citizen scientists for bat monitoring	Activity 1. Organize trainings and workshops on bat handling and monitoring techniques including non-invasive sampling
Safeguard roosting and foraging habitats	Action 1. Identify and map the key potential and vulnerable roosting and foraging sites	Activity 1. Undertake a study on habitat use and preference by bats for roosting and foraging (deploying radio-tracking and camera trapping methods)
	Action 2. Declare those key potential sites that are vulnerable, as bat conservation sites	Activity 1. Establish bat conservation sites in public participatory approach in close coordination with Government agencies and local administration
	Action 3. Develop cave management guidelines and plans considering bat conservation priorities	Activity 1. Draft a guidelines and plans for cave management considering bat conservation priorities.
	Action 4. conduct studies on diet of bat species	Activity 1. Undertake a study on bat droppings, ejecta analysis
	Action 5. Initiate construction of 3 bat gardens and parks attracting insects and bats in the urban and heavy built areas	Activity 1. Initiate coordination with Metropolitan Cities and Municipalities for the new construction of bat gardens/parks in urban and built areas or transforming the existing parks and gardens suitable for bats
	Action 6. Reduce the use of pesticides in agricultural land by promoting organic farming	Activity 1. Workshop for agro-vets suppliers on role of bats in pest control
		Activity 2. Peer to peer knowledge transfer through veterinarian and agricultural suppliers
Action 7. Control the water pollution, air pollution and noise pollution that are beyond the tolerating thresholds to bats	Activity 1. Identify the source of water pollution, air pollution and noise pollution	

		Activity 2. Raise the level of awareness through mass campaign and household campaign to control the source of pollution
	Action 8. Construct new bat boxes (houses) in the urban and heavy built areas	Activity 1. Install new bat boxes (houses) in the urban and heavy built areas
	Action 9. Promote and reforest broad leaved forest replacing needle leaved forest and develop corridors for the isolated habitats	Activity 1. Capacitate local community to develop and manage community nursery
		Activity 2. Establish and manage community nursery
		Activity 3. Organize a well managed long-term plantation events promoting broad-leaved trees.
	Action 10. Protect natural and construct artificial water reservoirs	Activity 1. Maintenance of existing natural water reservoirs
		Activity 2. Construct new artificial water reservoirs
Protection by law	Action 1. Categorize the species which are tolerant and non-tolerant to the land use land cover change impact	Activity 1. Organize a phase 2 survey promoting noninvasive techniques such as genetic samaple analysis
	Action 2. Analyze and identify the impact of construction to bats assemblage and its habitat during IEE and EIA	Activity 2. capacitate IEE and EIA concerned authorities and experts on impact assessment of construction on bats
	Action 3. Analyze and identify gaps in national legislations	Activity 3. initiate dialogue and consultation with DNPWC for upgrading and amendments in NPWC Act
	Action 4. Initiate relevant amendments to the national legislations	
Enhance or promote participatory approach for the conservation of bats and their habitats	Action 1. Identify the targeted groups/population/level associated and affected with bats and its habitat such as forest rangers, protected area managers, teachers and schoolchildren, tourists, government officials, land owners, users, environment consultants, construction workers, agriculture and veterinary suppliers, agriculture and horticulture farmers, gardeners etc.	Activity 1. Organize PRA to identify the targeted groups and activities to raise the awareness level.

Action 2.create and/or enhance awareness by conducting educational/outreach campaigns, capacity building for the target groups	Activity 1. Organize awareness campaigns; education to school children; mass meeting with the local communities; peer to peer knowledge transfer;
Action 3. Enhance Media advocacy	Activity 1. Broadcast programs on bats conservation to reach wide audience
Action 4. Prepare bat documentary on demonstrating important role of bats in providing ecosystem services in Kathmandu Valley and in Nepal	Activity 1. Produce a documentary to meet the target and objectives for Action 4
Action 5. Promote bat friendly eco-tourism	Activity 1. Integrate bat sightings, owl watching and cave tourism
Action 6. Understand and inform all stakeholders including local community on the role of bats for ecosystem services (pollination, seed dispersal and agricultural pest control etc.) for the behavioural change and increase the level of tolerance and motivate the willingness amongst the targeted group for the co-existence of the species and local level long term conservation of bats.	Activity 1. Produce a documentary highlighting role of bats in ecosystem services.
	Activity 2. Organize a workshop

Annex I

Table 6: SWOT Analysis for bat monitoring sites in Kathmandu valley

Site	Strengths	Weaknesses	Opportunities	Threats
Sagbarahi	Historical & Cultural Importance: Being named after the temple built in 1595 A.D, the estate holds a significant value for its religious purposes for Hindu devotees and gives an opportunity to learn about the past.	Recreational Activities: The site has a picnic park just around the premises of the temple. This park is especially busy during national holidays where people come to enjoy their leisure time. However, this creates chaos in the tranquil environment, disturbing the animals and birds of the area.	Learning Opportunities: Diversity in the area allows young scientists and biodiversity experts to learn and research more about the different types of plants and animal species, giving an opportunity to develop information regarding these living species.	Construction and Development: Hill cutting in the site was already done in order to put a settlement area. This would mean less more years of construction and development around the estate, causing disturbance in the natural habitat of various species in the area ultimately leading to population growth.
	Rich Biological Diversity: The site flourishes with a variety of flora and fauna species, giving an opportunity to increase subjects to discuss about different species and environments	Improper Waste Management: The site didn't have proper waste management that were collected from the temple and picnic park, resulting to a contaminated site premises	Recreational Activities: Educational and recreational activities such as bird watching and brief hiking can be promoted in the area in order to highlight the importance of this area along with awareness of bats and their conservation.	Nature Disturbance: Sagbarahi site was no stranger to the impacts caused by humans from population, construction, improper waste disposal and noise pollution. These if not controlled could lead to a massive nature destruction in the future.
Nepal Academy	Historical & Cultural Importance: The Academy, known for its research and promotion of cultural and intellectual endeavor of language, literature and social sciences of the country is itself an important	Pollution: Situated in the central area of the country, the area suffers with major pollution problems that is highly unlikely to be controlled with just few methods. This brings conflicts in the habitat of various species, especially when trying to create a management plan for target species	Learning Opportunities: The academy hosts various types of endeavor of social sciences by coordinating national and international activities. Hence, it made the use of the institution easy, various scientific research can be demonstrated to the local public that could mostly involve about bat conservation in the valley	Habitat Destruction: Since major construction is an on-going process experienced in this site, habitat disturbance and destruction is inevitable in the area. What could be harmful is the impacts that further accelerates with time and action towards creating other concrete endeavors.
	Access: Situated in the center of Kathmandu Valley, access to this site is simpler in comparison to other sites, making information flow easier and simpler.	Population: Highly dense population in the capital city of the country brings major dispute whilst trying to balance between protected areas for biodiversity and the increasing population of the retirees living around the site.	Information Center: Since access to this area is quite feasible and with various environmental issues visible in the site, information center to promote conservation and impacts of the ongoing pollution across the valley could create awareness opportunities to people of different age range and backgrounds.	Habitat Destruction: Heavy concrete buildings along with a busy metropolitan city, it is evident that further development constructions will take place in this area, leading to further habitat disturbance, adding threat to whatever is prevailing at the moment.
Shivshulmandap	Access: Another central concrete site among the rest, Shivshulmandap is an easy place to be located and can be reached through any public vehicles without much hassle.	Population: The site is a busy area full of students, employers and vehicles along the streets. With a bus stop around the area that departs public transports across the city, dense population is inevitable and could create high conflict while creating a conservation area.	Information Center: Along with religious information to the visitors, giving insights to the different plants and animals surrounding the area could arise awareness among national and international individuals who visit to view this place.	Recreational Activities: The fun park located in the area could be a question in matter as though not creating a jarring impact in the local environment, the materials and chemicals used for the use of various entertainment tools like the Ferris Wheel could become hazardous for the environment and conflict in the idea of conservation.
		Pollution: With population comes pollution created by man-made concrete buildings and extremely incompetent vehicles that emit dangerous smoke around the area. Highly harmful for the human body, it is unlikely that any other animal species would be living in a good state at this kind of environment		Habitat Destruction: By allowing majority of the area to be constructed into human settlement areas, the site of Shivshulmandap has experienced loss of various important natural resources. If not controlled, the area soon enough will be losing the least remaining bits of its natural resources.
Guhyeswari	Rich Biological Diversity: Shashmatak Forest, the sacred grove of this area that consists of various types of flora and fauna. Inside the grove, a protected area has been separated specifically for Sarking deers that are found in this place.	Construction and Development: Since its location is situated in the middle of a growing metropolitan city, construction is an on-going process. This however has highly vandalized the flow of river Bagmati, causing immense water pollution and habitat destruction.	Learning Opportunities: Diversity in the area allows young scientists and biodiversity experts to learn and research more about the different types of plants and animal species, giving an opportunity to develop information regarding these living species.	Habitat Destruction: To provide necessary comfort to the pilgrims visiting the temple, the prime focus has been promoting the religious aspects of the site. Although this is a necessary act, this might overshadow various other important plants and animal species found around the area and cause destruction of their habitat.
	Historical & Cultural Importance: Renowned to have the most important Hindu religion temple Pashupatinath within the area, the cultural site of Guhyeswari holds of great value, providing insights on the importance of the whole site itself.	Historical & Cultural Importance: As culture and religion holds the prime institution to this area, scientific changes could cause a rift among the devotees. This though the strength to conserving the sacred grove, could turn out to be disadvantageous towards low changes to create a conservation area among highly religious devotees.		
	Suitable Habitats: Primitive houses and ancient temples made of clay, wood and bricks are highly preserved in this area for religious purposes. These have been known to be an asset for bat roosting and can provide a strong argument towards it for bat conservation			
	Access: Reaching this historical area is quite simple as many different public transports drive around the site, although areas around the temple strictly prohibits vehicles unless stopped.			
Swayambhunath	Historical & Cultural Importance: Affiliated to the Buddhist religion and said to have been evolved more than 2000 years ago, the site is popular for its designation as UNESCO World Heritage Site to foreigners and native visitors. The presence of the Buddhist stupas has risen the fame and significance of the entire area.	Improper Waste Management: Though cleanliness of the stupas and surrounding temples is notified to have been done proactively, the area further away from this religious monuments have been neglected and very few things have been done to prevent the improper waste disposal.	Learning Opportunities: Providing the sacred forest grove for scientific research and other educational activities could further motivate the surrounding residents to conserve their environment focusing not only religious but other biodiversity and natural aspects of the area.	Habitat Destruction: Rise in the human settlement around the area ultimately brings rise in the construction of concrete buildings. To do so, various natural habitat will be demolished in the process and cause irreparable damage to the natural atmosphere.
	Rich Biological Diversity: Sacred forest of the stupas and a high number of rhinus macaque and various other birds gives a pleasant site to the area of Swayambhunath.	Construction and Development: Swayambhunath, in comparison to Guhyeswari is located a bit further away from central Kathmandu valley. Yet the popularity of this site has caused increase in employment and other economic opportunities and have brought rise in human settlement around the area, rising the construction activities throughout the estate.		
Chovar	Historical & Cultural Importance: The legendary Manjushree who out of a hill with his sword to let the water drain from Kathmandu valley created this historical place. Chovar that has been an essential area in forming an exit route of water from the valley towards the plains beyond the hills.	Improper Waste Management: It is not only just water that drains from this massive gorge. Sighting of wastes and non-degradable garbage is found in the banks of Bagmati River that itself flows with highly toxic water, unsuitable for the environment and the animals.	Recreational Activities: To indulge students and local people, recreational activities such as bird watching and hiking could be an educational way to flourish the information regarding the biodiversity and conservation acts conducted in the Chovar gorge.	Nature Disturbance: Located just outside the chaotic Kathmandu valley, Chovar provides the tranquility and greenery the city people miss and very often spend their weekends in this area. With a park recently inaugurated to promote this leisurely activity, the site has experienced increase in local and international tourism. Though this is a smart way to promote the area's importance, lack of management and improper wastage disposal of people visiting creates further natural chaos than promotion.
	Rich Biological Diversity: A geographically challenging area, the hills of Chovar are pretty much untouched and complements the area with the different types of flora and fauna found in the area.	Access: Although reaching the site has been made easier with smooth road and few public transports, the geography of Chovar itself is difficult to research every aspect of the area.	Information Center: An information center, that provides all the needed information regarding various plants, animals, birds, caves and their ancient history can provide necessary information to people visiting the site for the first time. That way, promotion of the location with its landmarks can be done in an influential method.	
Macchegau	Historical & Cultural Importance: A site of another cultural importance, Macchegau experiences pilgrims all across the country. Its rich religious background is the major promotional aspect that if merged efficiently, could become a smart way to promote scientific research and environmental conservation in this site.	Isolation: Although served as its strength, isolation of the area would also mean lack of research due to lack of any promotional activity. This results in very low knowledge and background regarding the site itself. It is not until an extensive study and research that one can come out with answers to the questions related to this place.	Learning Opportunities: Area cover in the southern side of the site is mostly forest and with the different birds, animals and plants found within these forests, Macchegau provides a delightful place to conduct scientific and cultural research.	Construction and Development: Although promoting the isolated site could be of ancient scientific and economically, the increment of employment and economy could increase human settlement in this area, causing construction of concrete houses. This could deplete the natural resources and habitats of the flora and fauna in the future.
	Isolation: A sub-urban area just outside the valley, this estate is peaceful and free from pollution. This encourages scientists to come forward and study the various kinds of plants and bird species found in the area.	Construction and Development: Despite the complex geography, construction and development hasn't been stopped and there are few areas that are going through some manufacture for the increasing tourism.	Information Center: Provided with an information center somewhere in the village of this site, visitors could have the opportunity to educate themselves regarding various different aspects of the site: historical, cultural and scientific.	
		Employment: Creating an information center along with local experts for scientific research, Macchegau would be providing employment opportunity for the local people and empowering their economical growth.		

Site	Strengths	Weaknesses	Opportunities	Threats
Nagarjun	Area of Conservation: Since the site is already designated as an area of conservation due to the habitat and species found, this holds a sense of security whilst promoting various conservation actions in the site.	Nature Disturbance: Nagarjun and its forest is famous for hiking and bird watching activities. The site gets visitors who are enthusiastic on such pursuit and although they are advised to be attentive about the environment they enter, few cases of improper waste disposal and insensitivity has caused disturbance of the natural habitat.	Learning Opportunities: The rich biodiversity of Nagarjun area provides any enthusiastic researcher to learn more regarding the environment and the various types of plants and animal species found in the site.	
	Rich Biological Diversity: Famous for its natural abundance and being a part of Shivapuri Nagarjun National Park, the various types of plants, animals and bird species creates an opportunity to promote conservation among the locals, nature enthusiasts and researchers.	Access: The geographical difficulty of this site makes access to this site difficult. Since the local transports only travels at the foot of the hills, it is only through tedious hiking or a private transportation that could allow accessing this conservation area.	Recreational Activities: Although there are few bird-watchers and nature enthusiasts who indulge in such nature involved activities, promoting recreational activities such as bird watching and hiking in the area would bring rise in the educational value of conservation activities required and conducted in the site.	
Nagarkot	Rich Biological Diversity: Various types of plants, animals and bird species found in this area allows in promoting conservation and awareness of environmental issues among the local people, nature enthusiasts and scientific researchers. It is also renowned to be the best place to view the Himalayan range during specific months.	Nature Disturbance: Due to its popularity as a good place to view the Himalayan region, there has been an increase in developing hotels and restaurants in the area. This advances into constructional activities and results in disturbing the natural habitat of the flora and fauna found in the site.	Learning Opportunities: Biodiversity of Nagarkot that includes a number of birds, plants and animals provides researchers and educators a vast range of subjects to learn regarding conservation, environment and the various issues that requires to be tackled.	Pesticide Poisoning: Since the agricultural land and the forest area overlaps with each other, there is high possibility of the pesticides used in the farmlands to denote the quality of the soil of the forest area. Though no specific reports have been registered in terms to this issue, extensive use of pesticides in the growing agricultural area could lead to problems in the future.
	Area of Conservation: Due to its rich biological diversity, forest areas of Nagarkot is designated as a conserved area, motivating local communities to form their own groups in contributing in conservation.	Access: Unfortunately, the area, isolated from the busy city area is quite difficult to access and only a handful of local transports would be traveling towards Nagarkot. It is only private vehicles that can be reliable whilst visiting this place.	Recreational Activities: Promoting bird watching, hiking and trekking activities in the Nagarkot area would promote the natural grandeur held by the place not only to people used to such activities, but also to the newly informed individuals regarding environment and its immediate need for conservation.	Construction and Development: Increase in creating suitable hotels and restaurants for the visitors that aren't managed and planned properly would only lead to disturbing the natural habitat of the site and could leave unrepairable damages in the environment.
Panimuhan	Area of Conservation: Since the site is already designated as an area of conservation due to the habitat and species found, this holds a sense of security whilst promoting various conservation actions in the site.	Nature Disturbance: Despite being located in a conserved land, few of the site's area has been used for human settlement that has only increased in the recent date. The increment has led to land plotting and hill cutting around the forest area for human settlement, creating disturbance in the nature.	Information Center: An information center, that provides all the detailed information regarding various plants, animals and birds along with their role in the ecology can provide necessary information to people visiting this site for the first time. That way, promotion of the location with its landmarks can be done in an influential method.	Construction and Development: Hill cutting in the site was already done in order to plot a settlement area. This would mean few more years of construction and development around the estate, causing disturbance in the natural habitat of various species in the area ultimately leading to population growth.
	Rich Biological Diversity: Known as the headquarters to manage Shivapuri Nagarjun National Park, the various types of plants, animals and bird species creates an opportunity to promote conservation among the locals, nature enthusiasts and researchers.	Improper Waste Management: The site didn't have proper waste management that were seen around the hotel areas. The waste coming out of these institutions are not managed properly and could lead to hazardous impacts in the soil and environment of the area.	Recreational Activities: Educational and recreational activities such as bird watching and brief hiking can be promoted in the area in order to heighten the importance of this area along with awareness of bats and their conservation.	
Pharping	Historical & Cultural Importance: Affiliated to the Buddhist religion and believed as a sacred village due to the various monasteries and ancient historical beliefs, the visitors are well aware of the importance of this area to both Buddhist and Hindu religion that has been residing peacefully for a long time. The presence of this Buddhist stupas has risen the fame and significance of the entire area.	Nature Disturbance: Due to its massive conservation area, increase in human settlement has been experienced and leading to developing open areas into human residential houses. This advances into constructional activities and results in disturbing the natural habitat of the flora and fauna found in the site.	Employment: As Buddhism flourishes across the world, Pharping experiences increase in tourism and visitors come from various different countries to see the monasteries and caves of the ancient Buddhist preacher. Providing local people with necessary training on dealing with new people in the area and ways to promote the importance of this estate brings opportunity for employment to the local people living there.	Pesticide Poisoning: Since the water body flows through agricultural land, overlapping their areas, there is high possibility of the pesticides used in the farmlands to denote the quality of the water of that area. Though no specific reports have been registered in terms to this issue, extensive use of pesticides in the growing agricultural area could lead to problems in the future.
	Rich Biological Diversity: The site flourishes with a variety of flora and fauna species, giving an opportunity to increase subjects to discuss about different species and environment.	Access: Unfortunately, the area, isolated from the busy city area is quite difficult to access and only a handful of local transports would be traveling from the main route. It is only private vehicles that can be reliable whilst visiting this place.	Information Center: An information center, that provides all the detailed information regarding various plants, animals, birds, caves and their ancient history can provide necessary information to people visiting this site for the first time. That way, promotion of the location with its landmarks can be done in an influential method.	
Sunderjal	Area of Conservation: Since the site is already designated as an area of conservation due to the habitat and species found, this holds a sense of security whilst promoting various conservation actions in the site.	Access: The geographical difficulty of this site makes access to this site difficult. Since the local transports only travels at the foot of the hills, it is only through tedious hiking or a private transportation that could allow accessing this conservation area.	Recreational Activities: Educational and recreational activities such as bird watching and brief hiking can be promoted in the area in order to heighten the importance of this area along with awareness of bats and their conservation.	
	Rich Biological Diversity: With the majority of its land residing as a part of Shivapuri Nagarjun National Park, the various types of plants, animals and bird species creates an opportunity to promote conservation among the locals, nature enthusiasts and researchers.		Learning Opportunities: The rich biodiversity of Sunderjal area provides any enthusiastic researcher to learn more regarding the environment and the various types of plants and animal species found in the site.	
Gokarna	Area of Conservation: Part of the Gokarna site has been designated as an area of conservation due to the habitat and species found, this holds a sense of security whilst promoting various conservation actions in the site.	Pollution: The forest area overlaps with the human settlement area that suffers with major pollution problems that is highly unlikely to be controlled with just few methods. This brings conflicts in the habitat of various species, especially when trying to create a management plan for target species.	Recreational Activities: Educational and recreational activities such as bird watching can be promoted in the area in order to heighten the importance of this area along with awareness of bats and their conservation.	Construction and Development: Unmanaged development that has been going on will likely increase due to the famous golf course. Such constructions that aren't planned properly would only lead to disturbing the natural habitat of the site and could leave unrepairable damages in the environment.
	Rich Biological Diversity: The forest area of this site consists of various types of flora and fauna creating an opportunity to flourish the conservation act further away from such conserved area.	Nature Disturbance: The human settlement area faces various kinds of construction acts to increase the metropolitan area. The increment has led to land plotting and hill cutting around the forest area for human settlement, creating disturbance in the nature.	Employment: When conservation acts are promoted in the area, experts in relation to environmental issues will be required and thus causes an increment in employment.	Habitat Destruction: Heavy concrete buildings along with a busy metropolitan city, it is evident that further development constructions will take place in this area, leading to further habitat disturbance, adding threat to whatever is prevailing at the moment.
Suryabiniyok	Historical & Cultural Importance: Another culturally important site, Suryabiniyok experiences pilgrims all across the country. Its rich religious background is the major promotional aspect that if merged efficiently, could become a smart way to promote scientific research and environmental conservation in this site.	Population: As the site is slowly developing from rural to sub-urban area, the population has been increasing. Whilst it is not as bad as few metropolitan cities of the valley, the exponential growth of this site from rural to sub-urban was rapid and trying to balance between protected areas for biodiversity and the increasing population of the citizens living around the site could create problems in the future.	Area of Conservation: A formal plan to create a Zoo in this site has already been approved. This decision can not only create an area of conservation, but also various other accompanying factors such as information center, employment and few recreational activities in the area.	Pesticide Poisoning: Since the agricultural land and the forest area overlaps with each other, there is high possibility of the pesticides used in the farmlands to denote the quality of the soil of the forest area. Though no specific reports have been registered in terms to this issue, extensive use of pesticides in the growing agricultural area could lead to problems in the future.
	Rich Biological Diversity: Sacred forest of this temple with its own history that consists of a large number of birds and animals makes the forest area of this site an opportunity to flourish various conservation acts.		Information Center: An information center, that provides all the detailed information regarding various plants, animals and birds along with their role in the ecology in the forest area of this site can provide necessary information to people visiting this site for the first time. That way, promotion of the location with its landmarks can be done in an influential method.	
Godevari	Rich Biological Diversity: Famous for its natural abundance and the National Botanical Garden situated in the estate, the various types of plants, animals and bird species creates an opportunity to promote conservation among the locals, nature enthusiasts and researchers.	Access: Although reaching the site has been made easier with smooth road and few public transports, there is restriction for public transports to go to various different places in the area. This void can only be covered with a private transport or hiking.	Recreational Activities: Promoting bird watching, hiking and trekking activities in the Godevari area would promote the natural grandeur held by the place not only to people used to such activities, but also to the newly informed individuals regarding environment and its immediate need for conservation.	Construction and Development: Although promoting the isolated site could be of advantage scientifically and economically, the increment of employment and economy could increase human settlement in this area, causing construction of concrete houses. This could deplete the natural resources and habitats of the flora and fauna in the future.
	Area of Conservation: Since the site is already designated as an area of conservation due to the habitat and species found, this holds a sense of security whilst promoting various conservation actions in the site.	Isolation: As the site is situated further away from sub-urban terrains, there are few security issues that individual researchers and visitors might go through from threatening bands to wild animals from the forest area. It is thus only advised to be visited in a big group of people.	Information Center: Provided with an information center somewhere in the village of this site, visitors could have the opportunity to educate themselves regarding various different aspects of the site, historical, cultural and scientific.	

Annex II Species Profile

Family: Pteropodidae

1. *Rousettus leschenaultii*

Common name: Leschenault's Rousette

Nepali Name: Jibro Padkaune Falahari

Chamero (Acharya et al. 2010)

Identifying Characteristics:

This species is much smaller in size than *Pteropus giganteus*. Muzzle is relatively short and slender than that of *Pteropus giganteus* while elongated than that of *Cynopterus sphinx*. Hind foot and thumbs are shorter. The second phalanx of the third metacarpal is also comparatively shorter. Pelage is soft, fine and silky with darker tone. It is fulvous brown on the head, back, flanks and throat; the belly is more grayish in the median area. The nostrils are less divergent and margins of pinnae are less marked than that in *Cynopterus sphinx*. Tail is short.

Habitat: This species can be found in variety of habitats ranging from tropical moist forest to urban environments. It roosts generally in caves, old and ruined buildings, forts and disused tunnels, in colonies ranging from a few to several thousand.

Threats:

- i. Cave disturbance
- ii. Heavy use of pesticides in fruits plantation



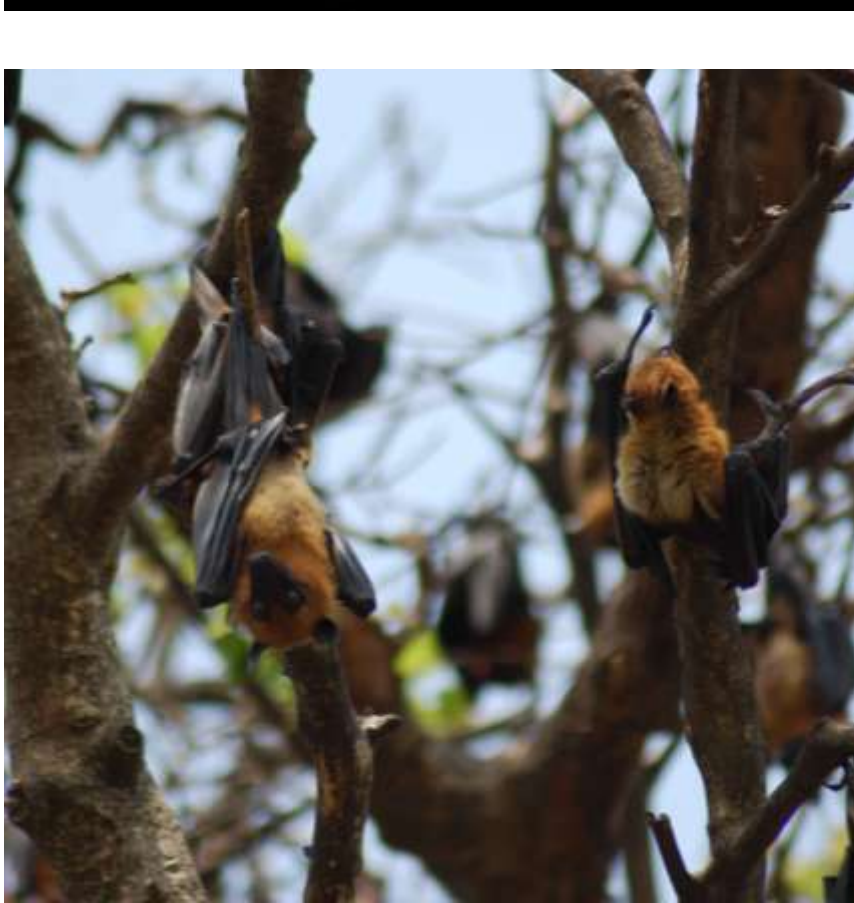
2. *Pteropus giganteus*

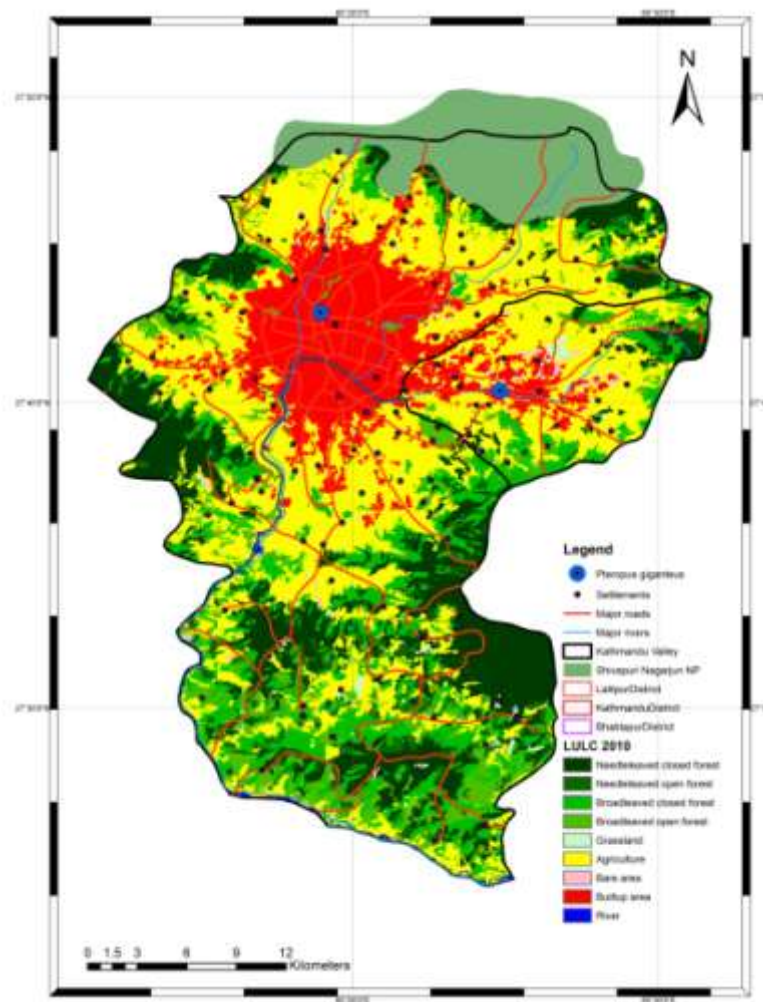
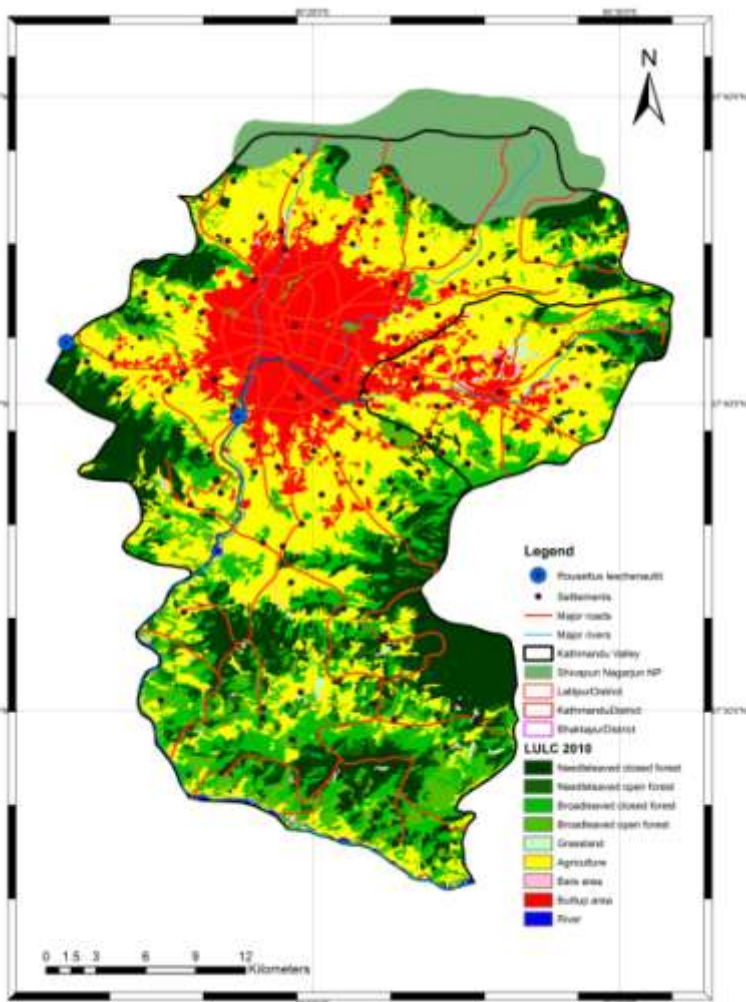
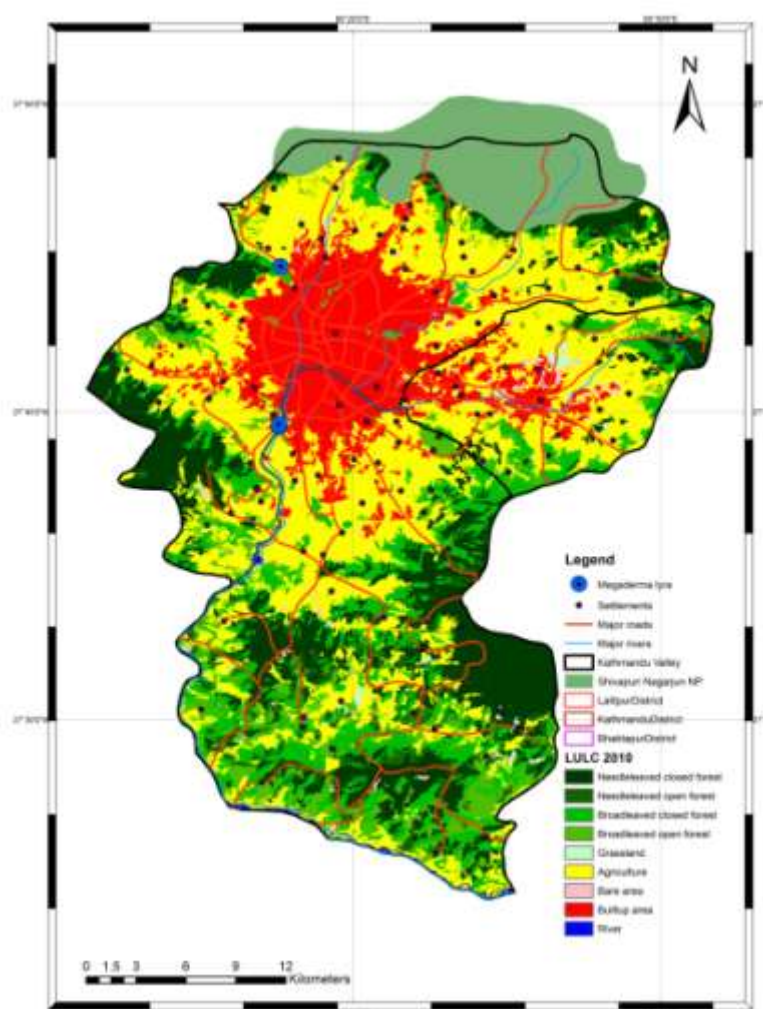
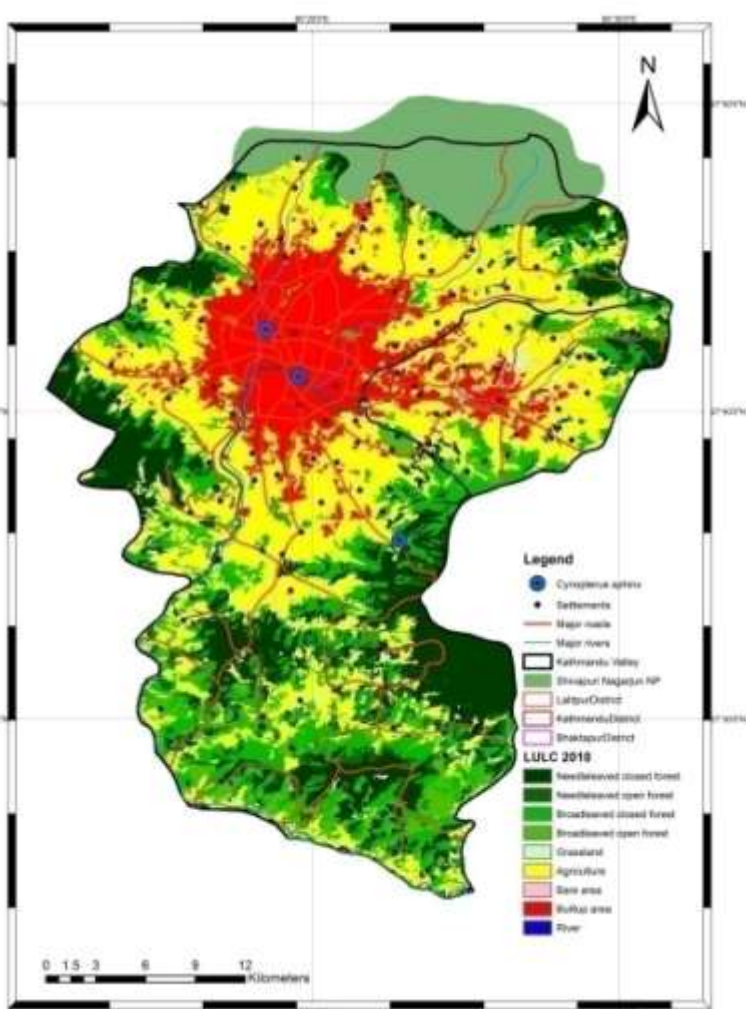
Common name: Indian Flying Fox

Nepali Name: Badura (Baral and Shah

2008)

Identifying Characteristics: The snout is long and hairy throughout appearing as the fox. There are two well-developed nostrils. Pinnae are black, virtually hairless, tall and pointed; they reach behind the eyes when folded forwards. Wings are massive arising from the sides of the dorsum. The first digit has a large claw and second digit with comparatively smaller claw. Feet are large with robust claw. Pelage is moderate in size and coarse over the head, on shoulders and ventral aspect. Its rich chestnut brown colored on crown of the head. Its orange brown to deep chest brown colored on the nape of the neck and mantle. Belly is scarcely paler. It's relatively darker around eyes and mouth. On the posterior shoulders and mid-dorsal region, pelage is short, sparse and black with some paler hair tips. The hairs on the belly are characteristically most variable in color ranging from pale orange to red or chestnut brown which is apparently independent of sex, age or season. The inter-femoral membrane is less developed concealing the tail in total.





Habitat: These are found generally in large colonies of hundred/s to thousand/s individuals and sometimes solitary to few individuals nearby the main roost. They roosts on large trees of *Bombax ceiba* (Simal), *Dalbergia sisso* (Sisso), Teak, Eucalyptus, others in rural to urban areas, close to agricultural fields, orchards, ponds and road sides. It was found roosting on the tree species; Simal (*Bombax ceiba*), Indian Rosewood, (*Dalbergiasisso*) Sisso, Kadam (*Anthocephaluschinensis*), Teak (*Tectona sp.*), *Eucalyptus sp.*, Siris (*Albizia sp.*), Banpeepal (*Sapium insigne*), Peepal (*Ficus religiosa*), Mango (*Mangifera indica*), Jack fruit (*Artocarpusheterophyllus*) RukhKathar. Generally it's found in large colonies but sometimes seen solitary or in small population (two to four individuals in Coconut trees at Biratnagar) (Thapa 2008; 2009).

Threats:

- i. Lack of roosts (tall trees) and foraging areas due to land use change
- ii. Unmanaged pruning of roosting trees
- iii. Heavy use of pesticides in fruits plantation
- iv. Hunting for medicinal belief
- v. Electrocution
- vi. Noise, air and water pollution

3. *Cynopterus sphinx*

Common name: Greater Short-nosed Fruit Bat

Nepali Name: Nepte Chamero (Baral and Shah 2008)

Identifying Characters: It is a medium sized fruit bat with an average FA of 70.2 mm (64-79 mm) while *C. brachyotis* has smaller FA of 60.3 mm (57.3- 63.3 mm). There is a considerable confusion between the two species, but recent molecular studies confirm that *C. sphinx* is genetically distinct from *C. brachyotis* (Bumrungsri, 2005). The wings arise from the flanks. Membranes are dark brown and distinctly paler stripes at digits (digits are darker in *C. brachyotis*). Pinnae are well marked with pale borders at anterior and posterior regions (pinnae are smaller in length and borders less distinct in *C. brachyotis*). Muzzle is short (relatively shorter in *C. brachyotis*), broad and nostrils divergently projected. In male, the forehead and nape of the neck are darker russet brown; chin, anterior parts of the shoulders, sides of the chest, belly and thighs are characteristically orange tinted and posterior to back is grey brown. In females the collar is usually more tawny brown; the rump is grey brown and the belly pale grey, with slightly lighter hair-tips (In *C. brachyotis*, body color generally brown to yellowish brown. Adult male possesses dark brown fur color while female yellowish while immature possesses grey color).



Habitat: These species are generally found in small colonies of 3-16 individuals and sometimes solitary. They roost underside the leaves of banana, *Schima wallichii* (Chilaune), palm, etc. It was found roosting underside the midrib of a banana leaf at banana plantation nearby Marsyangdi River. It has been seen resting among crown of beetle nut trees (Supari). These bats often called tent making bats since they modify the tree foliage for day roost. Though there is no information on roost preferences, dense canopied tree branches and broad leaves of trees are mainly used for tent roost. They forage at the vicinity of their roosting site within 5 km. In Nepal, *Cynopterus sphinx* is found from lowland terrain to upper hills especially in banana, palm and coconut orchards.

Threats:

- i. Foraging and roosting habitat destruction,
- ii. Land use change,
- iii. Heavy use of pesticides in fruits plantation
- iv. Retaliatory killings as the species is perceived as crop pests

Family: Megadermatidae

4. *Megaderma lyra*

Common name: Greater False Vampire

Nepali Name: Nakkali Boksi Chamero (Baral and Shah 2008)

Identifying Characteristics: Pinnae are characteristic and oval-shaped, large with fringe of white hairs on inner margins, which are joined at half to one-third of their length. Tragus is bifid; its posterior process is taller relatively. Forehead and upper cheeks of the face is hairy. Snout is naked and flesh colored. Nose-leaf is erect, straight and about 10 mm in height; which has a longitudinal ridge and a simple rounded horizontal base. Pelage is fine, soft and moderately long. Dorsal pelage is mouse grey with slightly brown shades. Ventral pelage paler with hair tips of throat and belly white while hair bases grey to dark grey. However, juveniles are comparatively darker. Membranes and pinnae are greyish to dark grayish and semi-translucent. Wings are attached to the base of the outer toe.

Habitat: It inhabits the dry as well as humid areas with agriculture fields and wetlands. It roosts solitarily and in small to large colonies ranging up to several hundred individuals. It has been found roosting in caves, old buildings, thatched huts, etc. It was observed hanging from the ceiling and feeding on another bat.

Threats:

- i. Roost disturbance
- ii. Heavy use of pesticides in farms





Family: Rhinolophidae

5. *Rhinolophus affinis*

Common name: Intermediate Horseshoe Bat

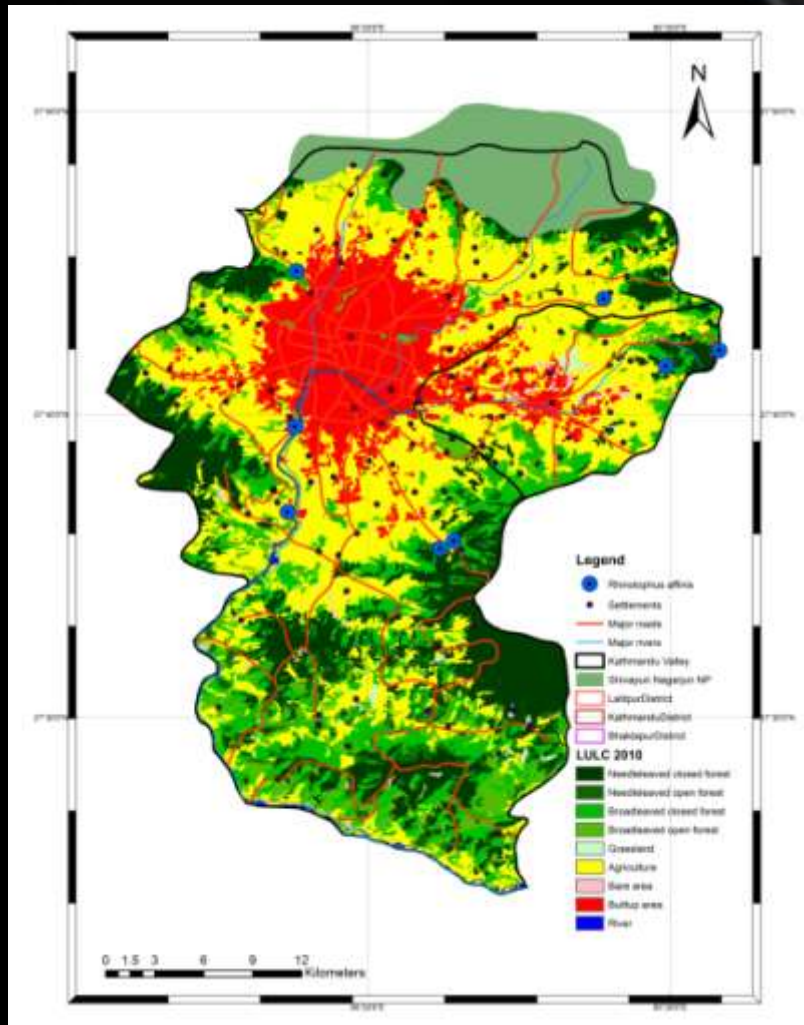
Nepali Name: Majhauila Ghodnale Chamero (Baral and Shah 2008)

Identifying Characteristics: This species has significantly short pinnae which arise to the highest level of head. Nose-leaf is similar with that in *R. ferrumequinum* with horseshoe relatively broader. In the wing, the third metacarpal averages 3.5% (0.4%-6.6%) shorter than the fourth and 6.2% (3.6%-7.7%) shorter than the fifth. The first phalanx of the third metacarpal is shorter in comparison to that of *R. ferrumequinum*; which is considerably less than half the length of respective metacarpal. However, the second phalanx is long about three quarters the length of the respective metacarpal that is 73.1% (66.3%-80.4%). Pelage is variable in color ranging from buffy brown to distinctive orange (in some individuals). Pelage in females appears average darker. Connecting process is rounded and originates from below the tip of sella. The sella is slightly concave. The anterior nose-leaf is broad, but does not cover the muzzle.

Habitat: It is one of the common species roosting in caves and old houses and buildings within the montane forest. It roosts in small to large colonies and co-occur with other species such as *Rhinolophus* sp. (*R. macrotis*, *R. pusillus*, *R. ferrumequinum*) and other species (*Myotis nipalensis* and *Hipposideros armiger*). They were also found roosting (hibernating) in pair inside the tunnel, 200m from the entrance, at Pharping Power house (Thapa et al. 2010).

Threats:

- i. Roost collapse due to natural disaster (earthquake)
- ii. Heavy use of pesticides





6. *Rhinolophus ferrumequinum*

Common name: Greater Horseshoe Bat

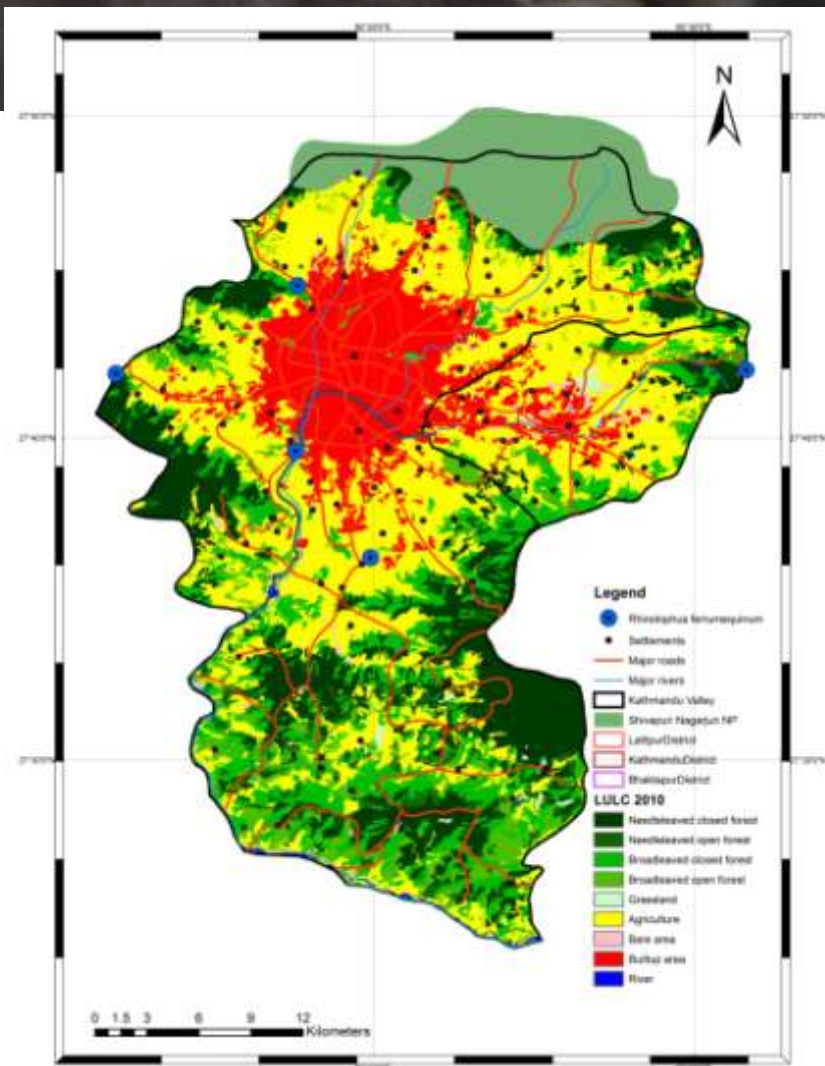
Nepali Name: Thulo Ghodnale Chamero (Baral and Shah 2008)

Identifying Characteristics: This species has nose-leaf similar with that in *R. affinis* with horseshoe relatively narrower. The sella is narrower than that of *R. affinis*; in frontal view, its anterior border is narrow above while widespread below. The superior connecting process is bluntly rounded off in side view, which differs to that of *R. affinis* by higher connecting process. The horseshoe is relatively narrow; not covering whole muzzle. The lancet is narrowly pointed with concave sides. In the wing, the third metacarpal is characteristically shorter than that of *R. affinis*; which averages 10.4% (8.1%-14%) shorter than the fourth and 13.1% (9.0%-16.0%) shorter than the fifth. The first phalanx of the third metacarpal is contrastingly greater than that in *R. affinis*; which exceeds half the length of respective metacarpal. Dorsal pelage is long, soft and dense varying from uniform light grayish to drab brown with paler hair bases. Ventral pelage is pale grayish brown. Immature specimens are greyer than adults.

Habitat: In south Asia this species is found in montane forests among the mountains and valleys of the Himalaya. It is gregarious and roosts in caves, old and ruined houses and buildings. It roosts solitary, in small to large colonies and co-occur with other species such as *Rhinolophus* sp. (*R. macrotis*, *R. pusillus*, *R. affinis*, *R. sinicus*) and other species (*Myotis nipalensis* and *Hipposideros armiger*).

Threats:

- i. Roost disturbance
- ii. Heavy use of pesticides





7. *Rhinolophus lepidus* Blyth, 1844

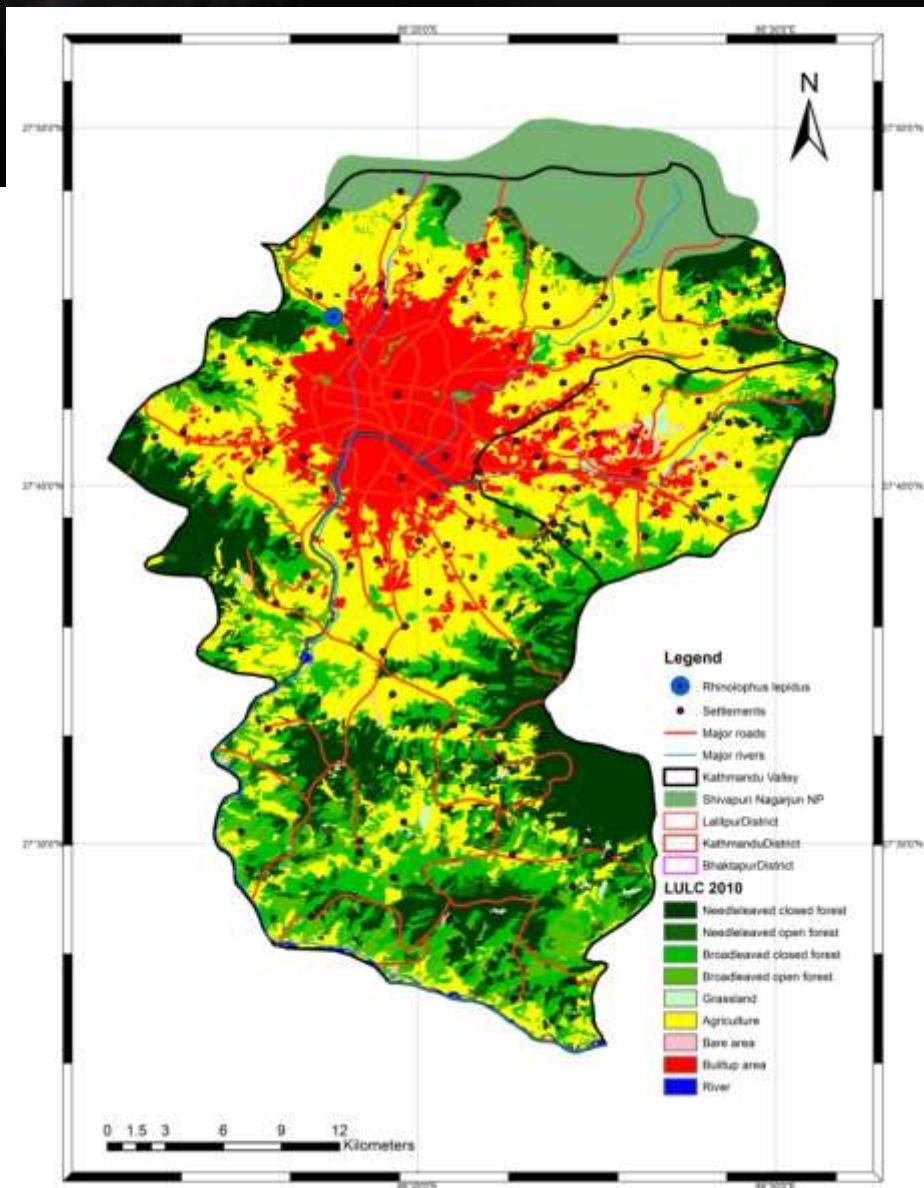
Common name: Blyth's Horseshoe Bat

Nepali Name: Blyth ko ghodnale chamero

Identifying characters: This species usually exceeds *R. pusillus* in size. It has **noseleaf** similar with that in *R. pusillus*; however, the **tip of the triangular shaped connecting process** is generally more broadly rounded off when seen laterally. The **lancet** is well developed which has broadly rounded off to pointed tip. Dorsal pelage is typically grey-brown. Ventral pelage is slightly paler. Longer FA and TIB measurements can distinguish *R. lepidus* from *R. pusillus*. They have three **mental grooves** at lower lip.

Ecology: This species is found in dry and moist forests and fringe areas (C. Srinivasulu pers. comm.). It roosts in caves, unused tunnels, old and ruined houses and buildings and old temples (Molur et al. 2002). Its flight is slow and low and feeds up on lepidopterans, coleopterans, dipterans, hymenopterans (Bates and Harrison 1997).

Threats: Unknown



8. *Rhinolophus luctus*

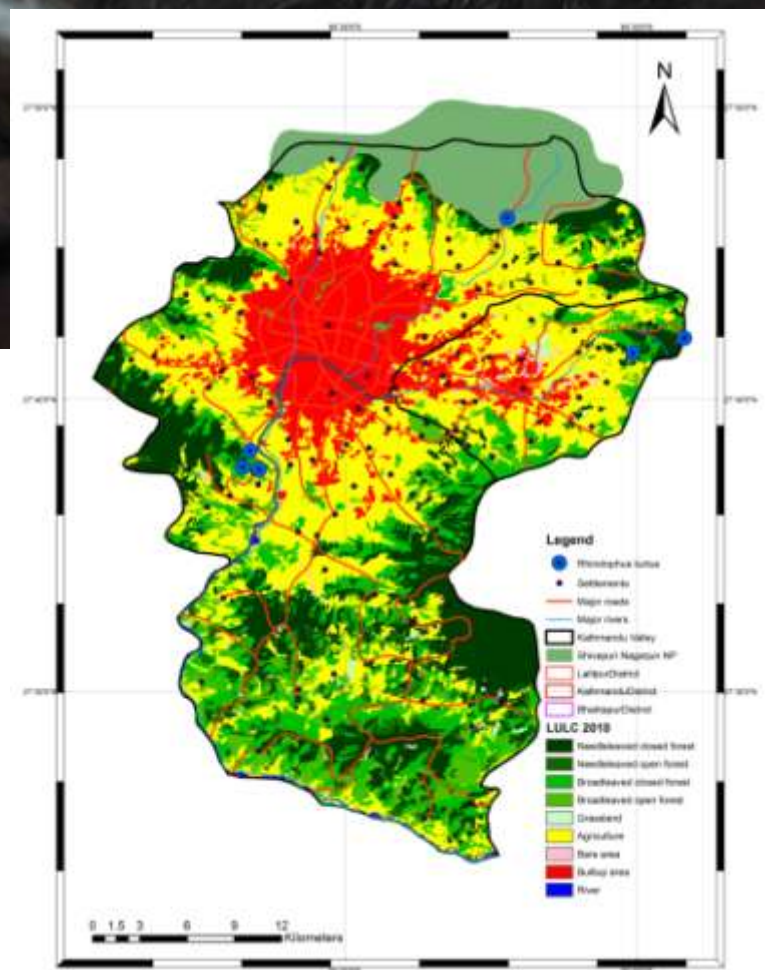
Common name: Great Woolly Horseshoe Bat **Nepali Name:** Makhamali Ghodnale Chamero (Baral and Shah 2008)

Identifying Characteristics: This species is a large Rhinolophid bat. The nose-leaf is characteristically large; with well-developed basal lappets on either side of the sella, the horseshoe is very broad which has a distinct median emargination which clearly divides it into two halves. The depth of the nostril pits is emphasized by the upturned edges of the inter-narial cup. When seen laterally, the anterior edge of the sella is convex with the superior connecting process broadly rounded off below. The base of the sella has a flange on each side forming the well pronounced basal lappets obscuring the upper edge of the inter-narial cup. The inferior surface of the sella is broad. The lancet is very high and well developed; it's sub-acutely rounded with rounded off tips. The pelage is characteristically long, dark and woolly with dark hair bases and slightly paler hair tips throughout. In the wing, third metacarpal is characteristically short, in average 86% (83.8%-87.9%) of the length of the fourth metacarpal. However, combined length of phalanges of the third metacarpal is greatly longer, 134.0% (125.1%-142.5%) than the respective metacarpal.

Habitat: This species is forest dweller. It roosts solitarily or in pairs in small or large caves, rocky outcrops, overhanging edges and large hollows in trees (Molur et al. 2002). It rests at the highest part of the cave and was found co-occurring with other *Rhinolophus* sp. (*R. pusillus* and *R. affinis*).

Threats:

- i. Roost disturbance
- ii. Heavy use of pesticides



9. *Rhinolophus macrotis*

Common name: Big-eared Horseshoe Bat

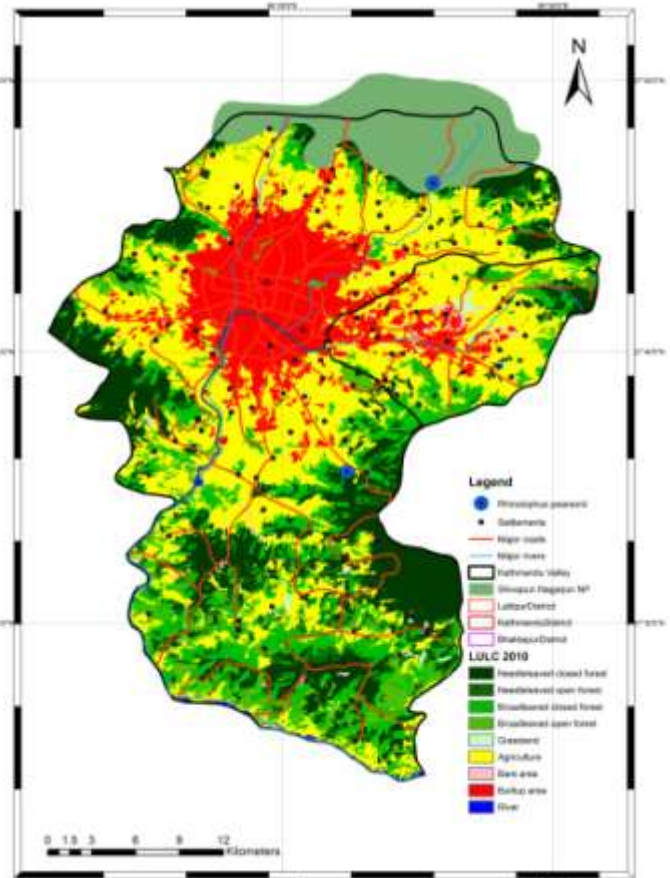
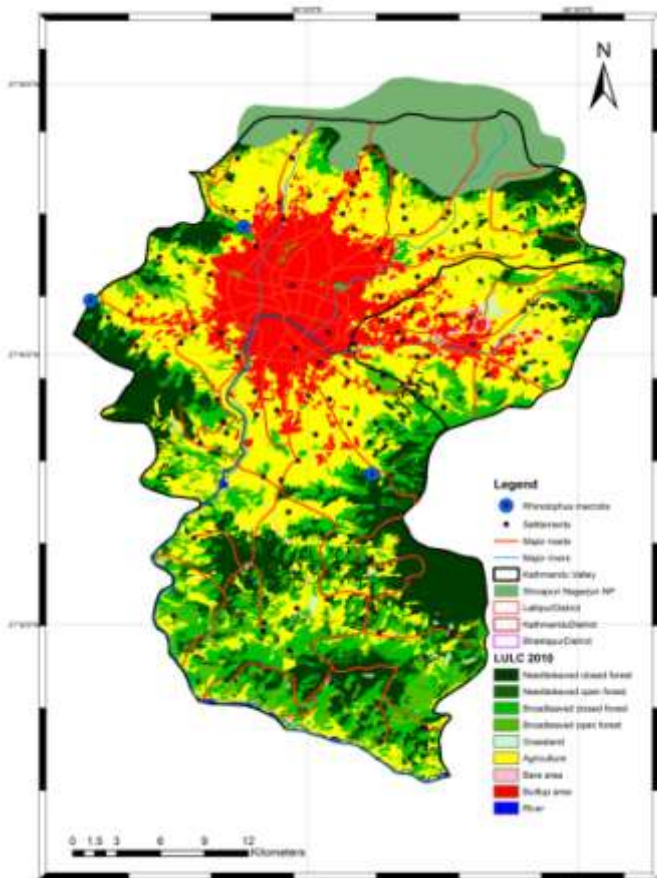
Nepali name: Lamkaane Ghodnale Chamero (Baral and Shah 2008)

Identifying Characteristics: The pinna is characteristically large. The nose-leaf is also markedly differing from other groups. When seen laterally, the superior connecting process is broadly rounded off while the anterior surface of the sella is short, slightly emarginated beneath the connecting process. The inferior surface of the sella is very broad at the base; its apex is rounded off and deflected downwards. The sella projects strongly forward. The lancet is relatively short with slightly convex sides and sub-acutely pointed tip. The pelage is soft and with wooly texture, the hairs are slightly exceeding than that in *R. lepidus*. The dorsal pelage is buffy brown while ventral pelage is slightly paler. The combined length of phalanges of the third metacarpal is about equal to the length of the respective metacarpal.

Habitat: This species roosts in small or large caves and abandoned mines (Molur et al. 2002). It was found co-occurring with other *Rhinolophus* sp. (*R. affinis*, *R. pusillus*, *R. ferrumequinum*) and other species (*Myotisnipalensis*, etc.) (Ghimire et al. 2010).

Threats:

- i. Roost disturbance
- ii. Heavy use of pesticides



10. *Rhinolophus pearsonii*

Common name: Pearson's Horseshoe Bat

Nepali name: Pearson ko Ghodnale Chamero (Baral and Shah 2008)

Identifying Characteristics: It is medium sized Rhinolophid bat. The nose-leaf is similar in structure with that of *R. luctus*; but smaller and without circular basal lappets on either side of sella. When seen laterally, the inferior extremity of the sella is not deflected downwards and forwards. The pelage is long soft and with wooly texture and mid-chest brown in color. Pinnae are smaller than that in *R. luctus*. Inter-femoral membrane is characteristically haired dorsally and at posterior border. Lower lip has a single deep groove.

Habitat: It is found in montane forests with bamboo intermixed and even in cultivated areas. This species roosts in small or large caves in hilly areas (Molur et al. 2002; Bates and Harrison 1997). It was found co-occurring with other *Rhinolophus* sp. (*R. affinis*, *R. pusillus*, *R. ferrumequinum*) and other species (*Hipposideros armiger*, etc.) (Csorba et al. 2010; Adhikari, 2010).

Threats:

- i. Heavy use of pesticides



11. *Rhinolophus pusillus*

Common name: Least Horseshoe Bat

Nepali name: Saano Ghodnale Chamero (Baral and Shah 2008)

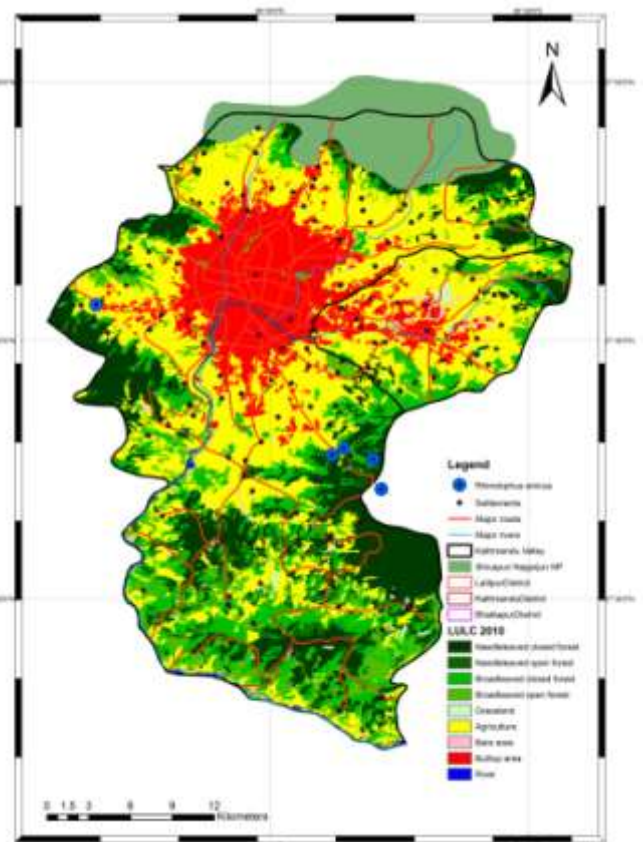
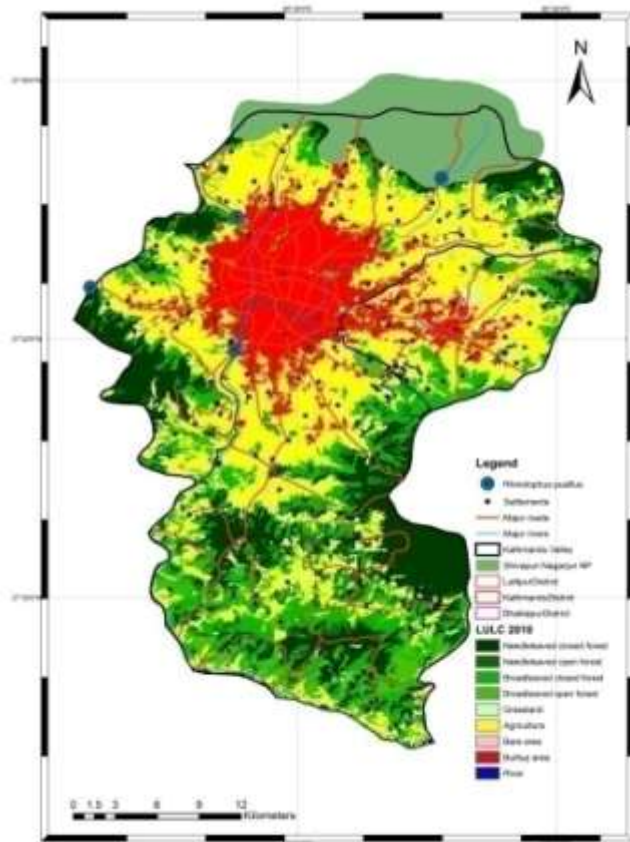
Identifying Characteristics: It is small sized Rhinolophid bat. The third metacarpal is about equal or exceeding the combined lengths of its respective phalanges (105%; 99%-113%). Tibiae are relatively shorter than that of *R. lepidus*. The nose-leaf is similar in structure with that of *R. lepidus*; but when seen laterally, the connecting process of the sella is triangular in shape and more acute in outline. However, in some specimens it appears horn like processes as in *R. subbadius* and *R. cognatus*. In frontal view the base of the sella is similar to that of *R. lepidus* with broadly rounded outline. Shape of lancet varies from short equilateral triangle to a more elongated structure. The pelage is very fine but short. Dorsal pelage is light buffy brown to dark teak brown in color with paler hair bases while ventral pelage is paler with whitish tinge.

Habitat: It is found in both primary and secondary tropical moist to montane forests. This species roosts in small or large caves in hilly areas (a colony up to 1500 individuals in China) and in houses (in small colonies) (Molur et al. 2002). It was found co-occurring with other *Rhinolophus* sp. (*R. affinis*, *R. luctus*, *R. ferrumequinum*, *R. macrotis*) and other species (*Hipposideros armiger*, *H. cineraceus*, *Myotis nipalensis* etc.) (Csorba et al. 1999; Ghimire et al. 2010; Thapa et al. 2010; Adhikari, 2010). It forages in a wide range of forest habitats including mature forest and disturbed areas. In Makalu region (1559m), it has been found visiting houses every night (Acharya 2010).

Threats:

- i. Heavy use of pesticides
- ii. Roost disturbance





12. *Rhinolophus sinicus*

Common name: Chinese Horseshoe Bat

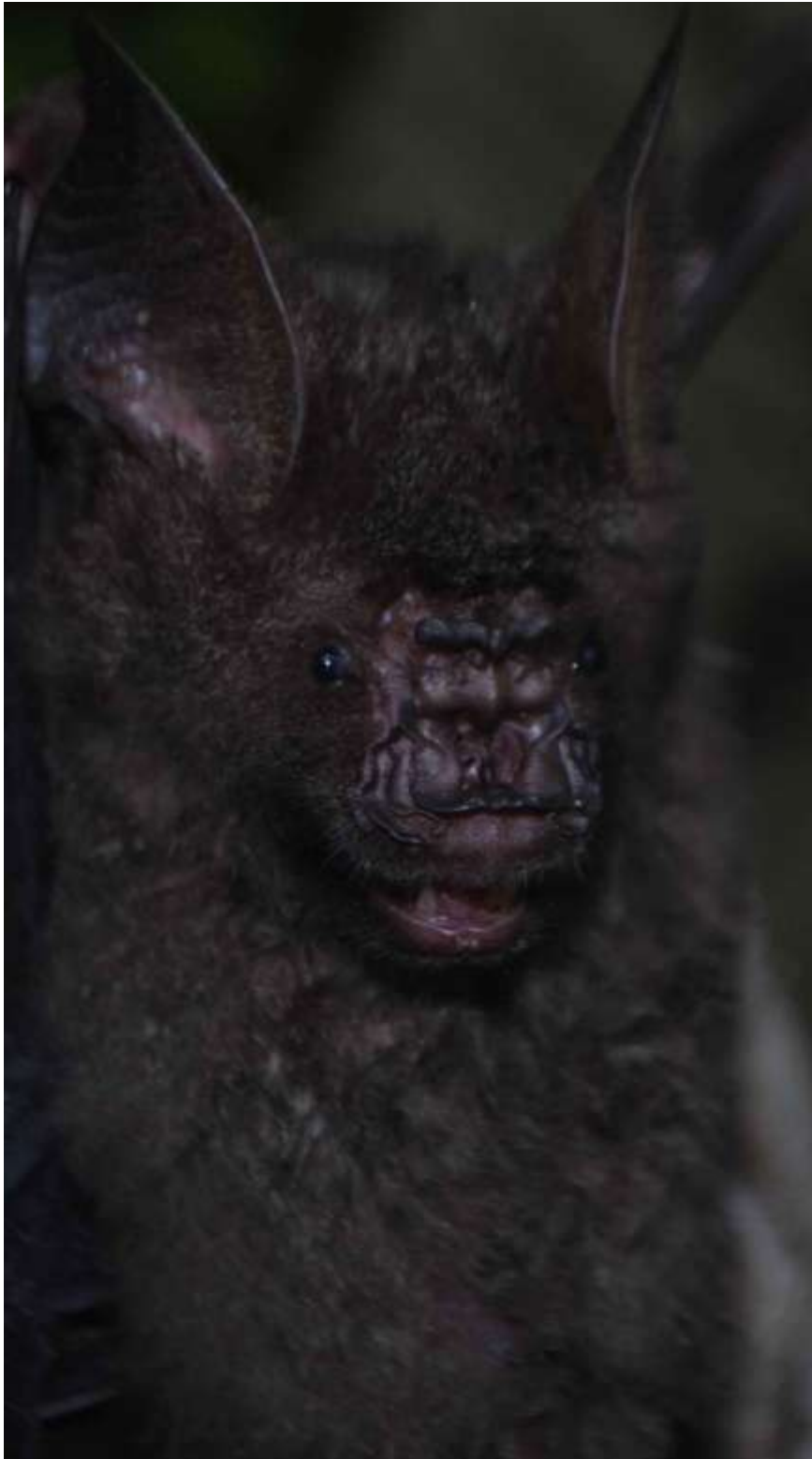
Nepali name: China Ghodnale Chamero (Acharya et al. 2010)

Identifying Characteristics: This species is smaller than *R. affinis*, however, their pinnae are slightly larger than that of *R. affinis* but smaller than that of *R. ferrumequinum*. The nose-leaf is broader but otherwise similar to that of *R. ferrumequinum*. Lancet is of variable height and shape; sometimes triangular with straight sides, sometimes with a well-developed tip and concave margins below. In the wing, the third metacarpal is not distinctly shortened as in *R. ferrumequinum*. The pelage is soft and silky, not wooly as in the *R. beddomei*. Pelage color varies from orange, russet brown, buffy brown to grey. Even seasonal variation occurs in pelage coloration; orange and rufous tints predominate during October to April and paler commonly during May to September.

Habitat: It is found in montane forests with heavy rainfall. It roosts singly or in colonies in caves, old disused tunnels. It was mist-netted at the edge of agricultural fields surrounded by small forest fragment. One specimen was additionally captured from small cavern in a cultivated landscape. It was found perching in niches under rocks solitarily. It was found co-occurring with *Rhinolophusaffinis* (Acharya, 2010).

Threats:

- i. Heavy use of pesticides



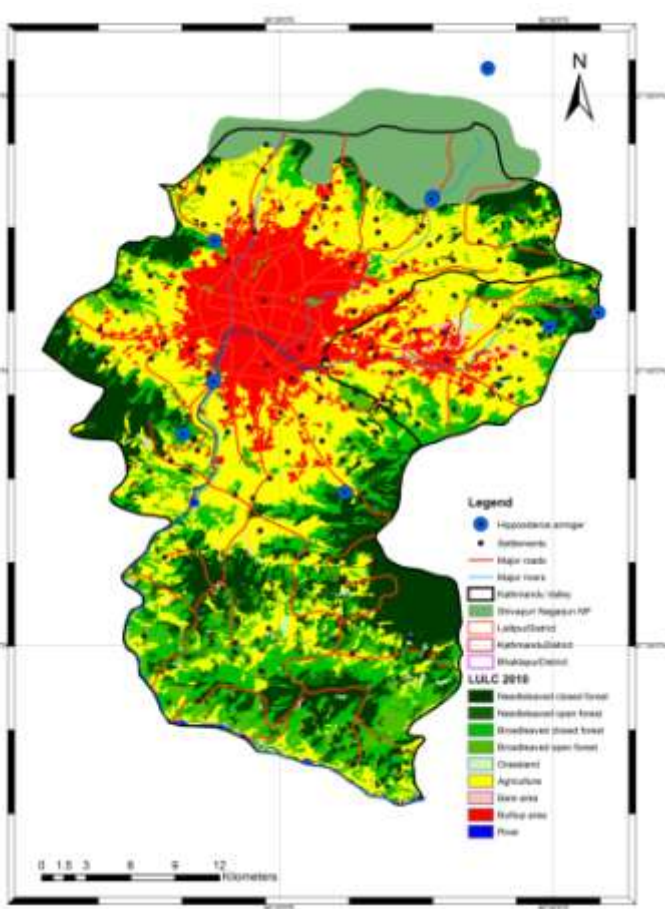
Family: Hipposideridae

13. *Hipposideros armiger*

Common name: Great Himalayan Leaf-nosed bat

Nepali name: Thulo Golopatre Chamero (Baral and Shah 2008); Thulo Patnaake Chamero

Identifying Characteristics: It's the largest hipposideros bat. Noseleaf has four supplementary leaflets, with the outerleaf distinctly smaller than the other three. The anterior leaf is without a median emargination, the narial lappets are scarcely developed, inter-narial septum is less inflated; intermediate leaf has a well-defined median process and has numerous vibrissae and the upper surface is "wave-shaped" with at least four convexities and three concavities; posterior leaf has three well defined septa and four cells and its upper surface has clearly defined median and lateral processes. Behind the posterior leaf, above each eye there is a fleshy elevation which is the characteristic of this species [in some specimens it is exceptionally developed (Csorba et al. 1999)]. Well-developed frontal depression is found in males while less developed in females. However, tufts of black hairs project out from this depression in both sexes. Posterior concavity of pinna is serrated [found less distinct in an individual from Sundarijal (Thapa et al. 2009)]. Pelage is soft, dense and long. It's dark-grey brown to blackish brown on the head and shoulders as well as darker brown to blackish brown on back and flanks with paler hair bases dorsally, ventral surface is paler and uniform grey-brown in coloration. In the wing, fifth metacarpal is significantly shorter than the third and fourth metacarpals. The third metacarpal exceeds combined lengths of its phalanges. Membranes are dark brown/black.



Habitat: Although it has been found roosting in lofts of houses, verandahs of old houses and old temples in South Asia but it's found commonly in cave in Nepal. They were found roosting on rock ceiling of the short tunnel at eastern side of Sundarijal water reservoir (Thapa et al. 2009). In the caves some colonies were found roosting in dry places while some were roosting in moist places. About 25 individuals were observed hanging on the moist surface and flying near the spring inside the Kailash Cave, some 300m inside (Thapa and Thapa 2009). A colony of six individuals was observed hibernating in the cave at Godawari (Thapa et al. 2010). They roost in colony of few individuals to hundred/s. Their flight emerges during sunset (at Mulkharka) to early evening (mistnetted at 18:56 at Siddha Cave, Bimalnagar). They were seen circling round the trees and hunted flying insects. These were found roosting inside the last spacious

area of the Kailash cave. Its colony can co-occur with colonies of other species such as *Rhinolophus sp.* (*R. affinis*, *R. macrotis*, *R. pusillus*, *R. ferrumequinum*) and other species (*Myotis nepalensis*, *M. csorbai* and *Miniopterus fuliginosus* etc).

Threats:

- i. Roost disturbance
- ii. Heavy use of pesticides

14. *Hipposideros cineraceus*

Common name: Least Leaf-nosed Bat

Nepali name: Fusro Golopatre Chamero (Baral and Shah 2008); Sano Patnaake Chamero

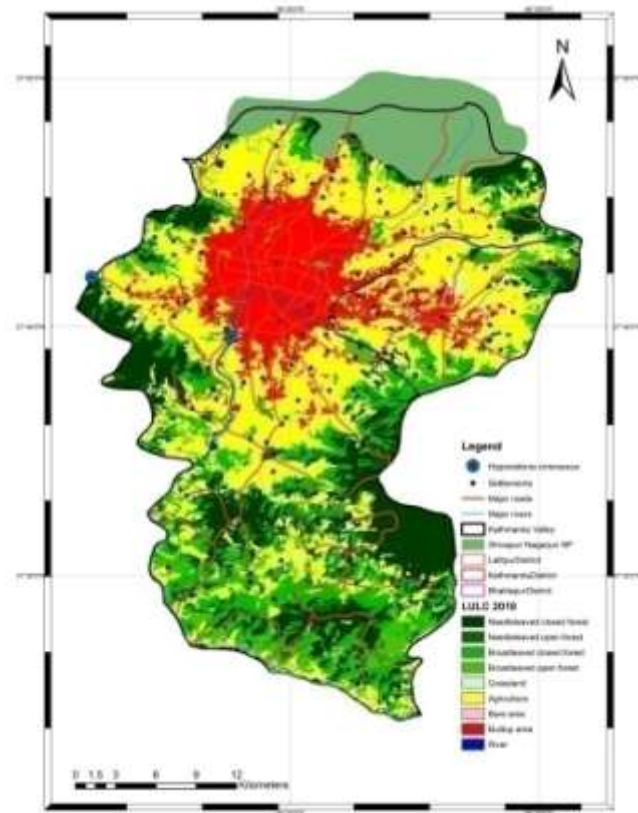
Identifying Characteristics: It's small hipposiderid bat. Noseleaf is generally about 4mm in width. The anterior leaf of noseleaf is without lateral leaflets or a median emargination; it's slightly concealed by short, fine hairs and consists of well-developed triangular shaped internarial septum. A small narial lappet surrounds each nostril on its outer margin. Intermediate leaf is slightly hairy with four long vibrissae. Posterior leaf scarcely exceeds the width of intermediate and anterior leaf and consists of less distinct septa and four cells and it has clearly defined frontal sac situated in the mid-line behind the posterior leaf. In the wing the third metacarpal is shortest and fourth is the longest. The combined lengths of phalanges of third metacarpal significantly exceed the metacarpal. Pelage is soft, dense but short. Its dull mid-brown with paler hair bases dorsally, ventral surface is paler in coloration with white patches on chest and belly. In some individuals hair tips at flanks are orange tinged. Membranes are dark brown.



Habitat: These species mainly roosts inside caves and rests on house ceilings (Acharya 2010). These are gregarious. More than a hundred individuals were estimated during their flight observation at entrances of four caves; Bagh cave, Naya cave, Manjushree cave and Barahi cave at Chobhar (Thapa et al. 2009; 2010). These can co-occur with other Hipposiderid species, *H. armiger* (Acharya 2010) and *Rhinolophus pusillus* (Thapa et al. 2010)

Threats:

- i. Roost disturbance



15. Hipposideros fulvus

Common name: Fulvous Leaf-nosed Bat

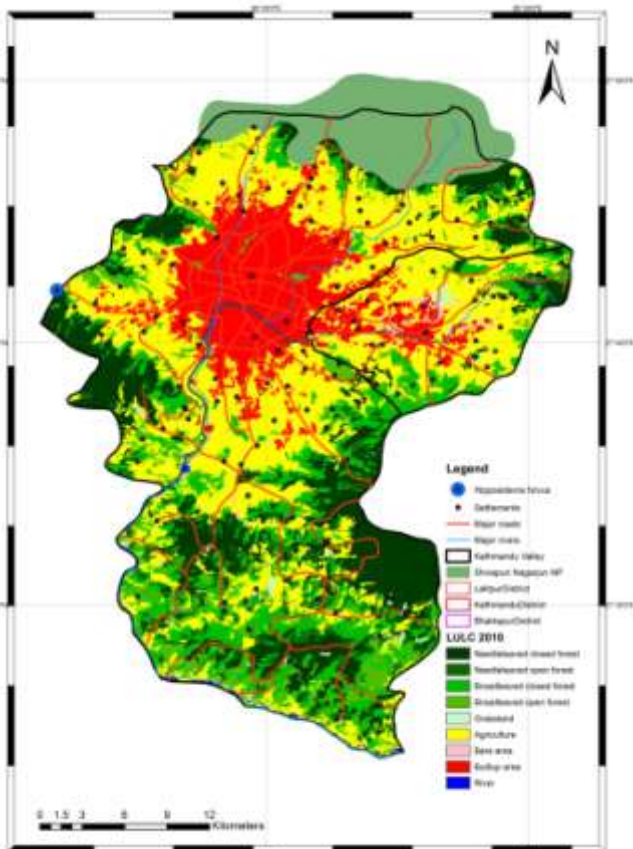
Nepali name: Kailo Golopatre Chamero (Baral and Shah 2008); Kailo patnaake Chamero, Thulo Kaane Paatnaake Chamero

Identifying Characteristics: It's medium sized hipposiderid bat. The pinnae are characteristically larger than other species which are broadly rounded off. The nose-leaf is generally about 5mm in width. In the wing the third metacarpal is significantly shorter than fourth and also shorter than fifth. The combined lengths of phalanges of third metacarpal significantly exceed the metacarpal. Pelage is varying in coloration from dull yellow, pale grey, dull brown and golden orange. An adult weighs between 8-9 grams.

Habitat: This species is found within arid regions to thick forests. They roost in colonies of a few to large number of individuals in caves.

Threats:

Unknown



16. *Myotis csorbai*

Common name: Csorba's Mouse-eared Bat

Nepali name: Csorbako Musakaane Chamero (Acharya et al. 2010)

Identifying Characteristics: The coloration of dorsal pelage is dark brownish while that of ventral pelage is dull gray. Cranio-dental diagnostic characteristics were found most helpful in distinguishing *M. csorbai*. The skull is small with bulbous braincase which is distinctly elevated above the flattenedrostrum. The sagittal and lamboid crests are scarcely evident. The zygomata are wide. The short coronoid process of each half mandible has vertical anterior border and horizontal posterior border. The condyle stands to the tip of lower canine. The first upper incisor (i^2) and second upper incisor (i^3) are distinct and bicuspidate. The upper canine is weak and equal about to height as well as about half of the crown area of third upper premolar (pm^4). The first upper premolar (pm^2) and second upper premolar (pm^3) are minute. pm^3 is half to the crown area of pm^2 . pm^3 is slightly displaced internally from the tooth row. The lower canine is characteristically smaller in comparison to upper one. It's about two third of the crown area of third lower premolar (pm^4). The molars are characteristically larger.

Habitat: It inhabits the area surrounded by subtropical secondary forests. It roosts in caves. This species was found to leave the cave early before total darkness during summer. It was captured above the river or river bank. These were found roosting inside crevices and small holes.

Threats:

- i. Roost disturbance
- ii. Heavy use of pesticides

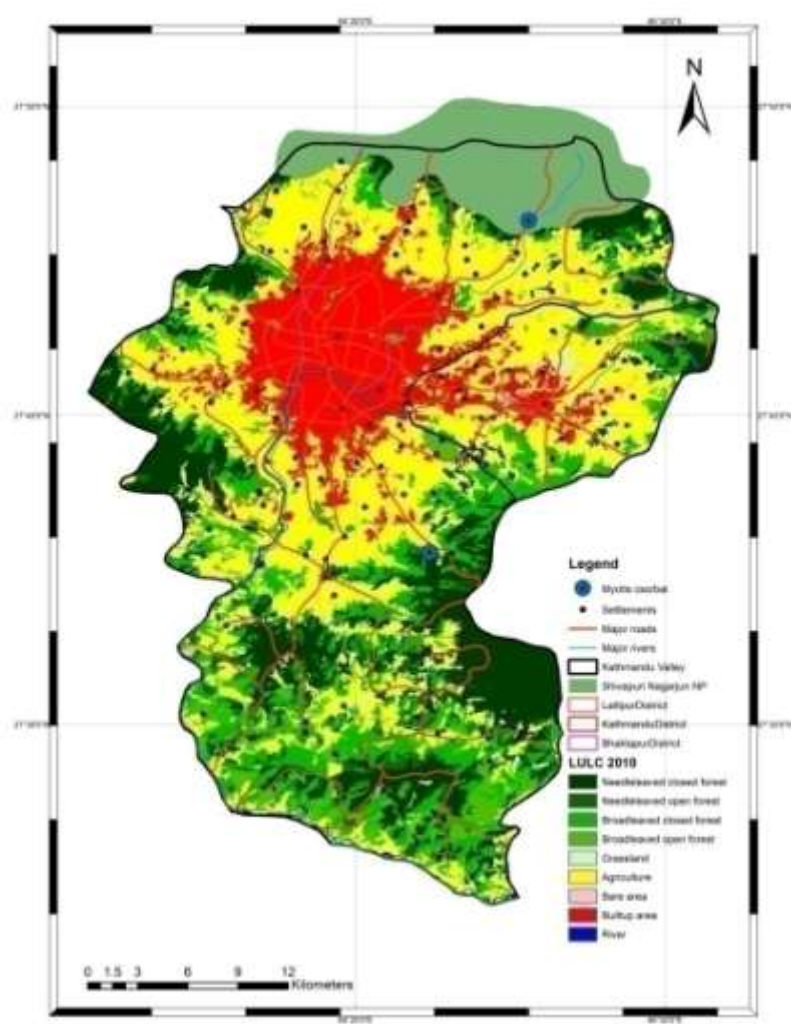
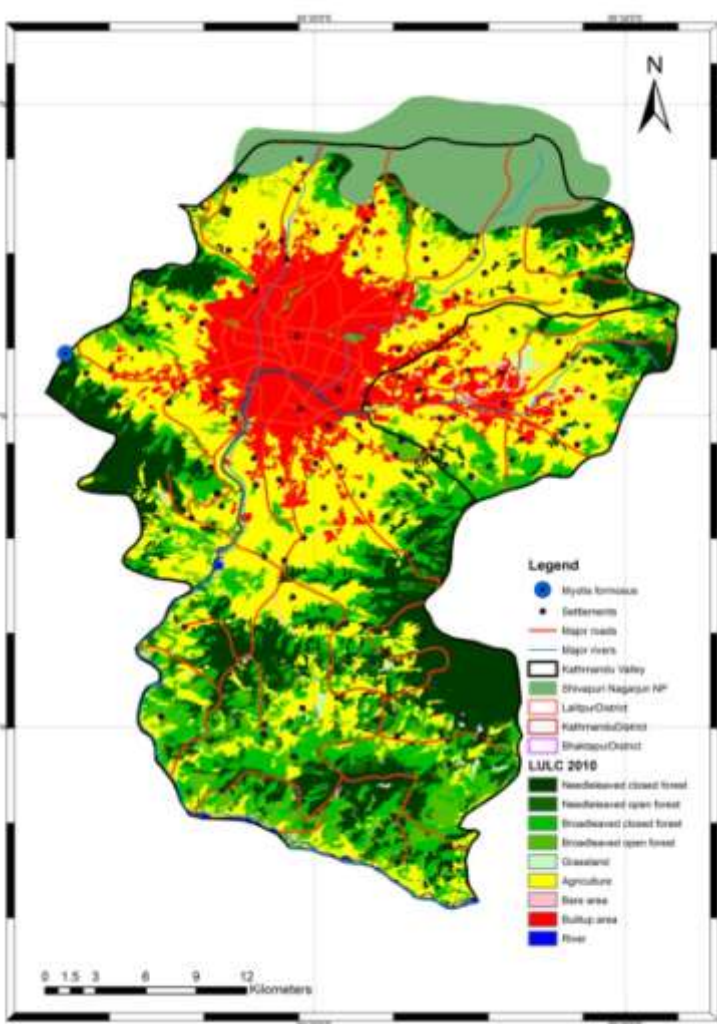


17. *Myotis formosus*

Common name: Hodgson's Bat

Nepali name: Hodgson ko Chamero (Baral and Shah 2008)

Identifying Characteristics: The pelage has characteristic coloration. Its mid-brown mid dorsally while orange brown on flanks. Pale Cinnamon brown on throat while deep orange posterior.



Head is hairy excluding around the eyes, nostrils and lips. Pinnae are short, ovate shaped naked and are orange colored with darker margins. The anterior margin is evenly rounded whereas shallow concavity on the posterior border. Tragus is long, narrow and obtusely pointed; anterior border is concave in its upper part. Wings are broad and characteristic in color pattern of orange and black. The orange color extends in narrow line along side of each metacarpal. Black triangular areas present between third, fourth and fifth metacarpals and inside the fifth metacarpal. Additionally, these black areas are dotted and marked with orange. The inter-femoral membrane is orange. The feet are averagely less than half the length of tibiae.

Habitat: It inhabits lowland and primary montane forests as well as secondary forests and other habitats from sea level to foothills of Himalayas. It roosts in caves, tree foliage, amongst bushes and in houses. During winter they hibernate in caves (Bates and Harrison, 1997; Smith and Xie, 2008). Specimen was mist-netted in a mature *Rhododendron* forest half an hour after sunset (Csorba *et al.* 1999).

Threats: Unknown



18. *Myotis muricola*

Common name: Nepalese Whiskered Myotis

Nepali name: Nepali Junge Muskane Chamero (Acharya et al. 2010)

Identifying Characteristics: It can be distinguished by darker ventral pelage color with essentially black hair bases and ochraceous brown tips. The tail may be shorter in *M. muricola* (32.9: 25.0-39.0 mm) than that in *M. nipalensis* (37.1: 32.0-42.0 mm). Dorsal pelage with dark brown/ black bases and tips flecked with russet brown. In general, the hairs are darker appearing on the back than those of *M. mystacinus* (Bates and Harrison 1997). Pinnae and feet are relatively small. Wings are attached to the distal end of the outer metatarsal of each foot. The upper lip has well developed fringe of hairs.

Habitat: It inhabits in primary and secondary montane and lowland forests, scrub, secondary growth and gardens. It roosts solitary or in small colonies of few individuals among tightly rolled leaves of broad leaved trees especially banana. It's fast flyer and often encountered in the forest understory and in gaps along streams (Rickart et al. 1993; Molur et al. 2002; Heaney et al. 2004; P. Bates and G. Csorba pers. comm. 2006; Sedlock pers. comm. 2006; Smith and Xie, 2008).

Threats: Unknown

19. *Myotis nipalensis*

Common name: Nepal Myotis

Nepali name: Nepali Muskane Chamero (Acharya et al. 2010)

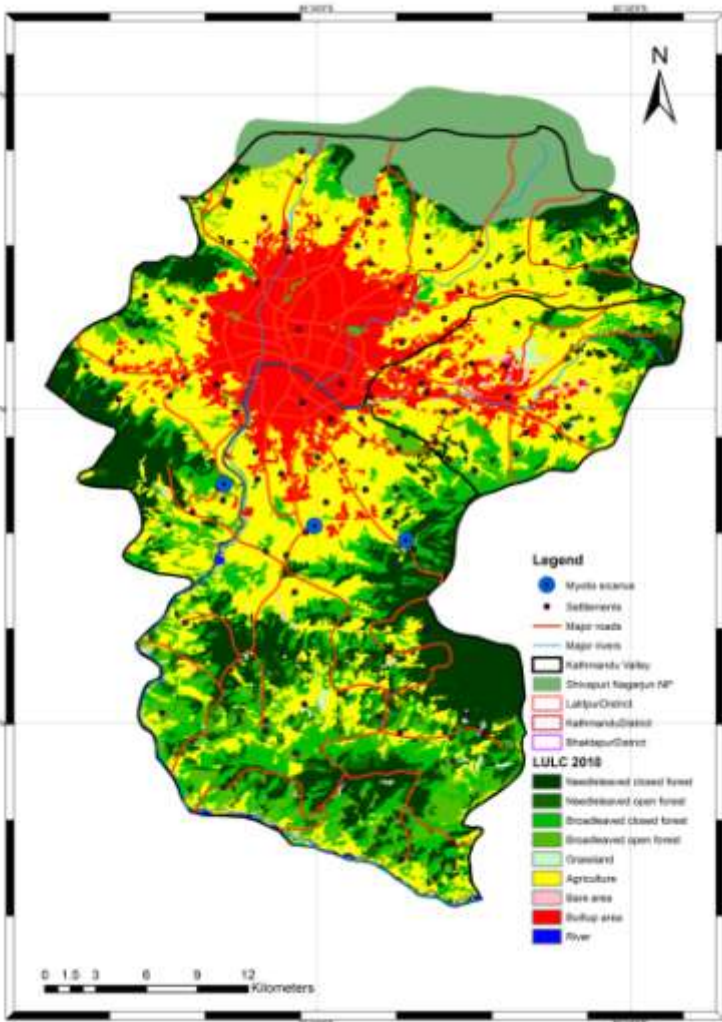
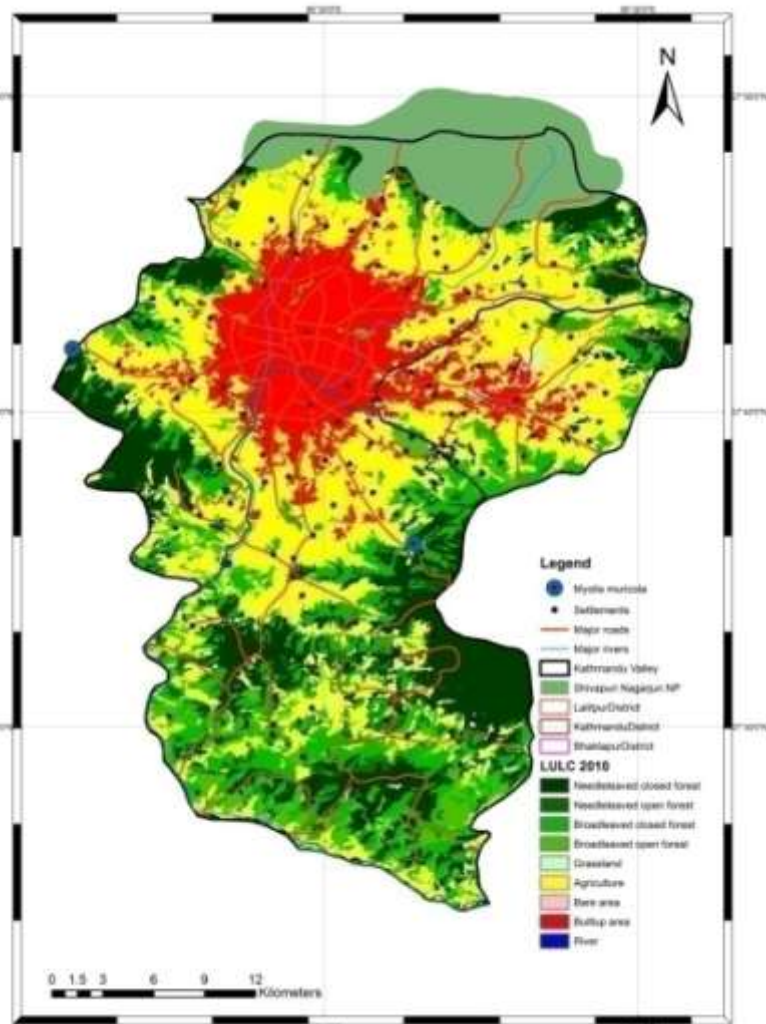
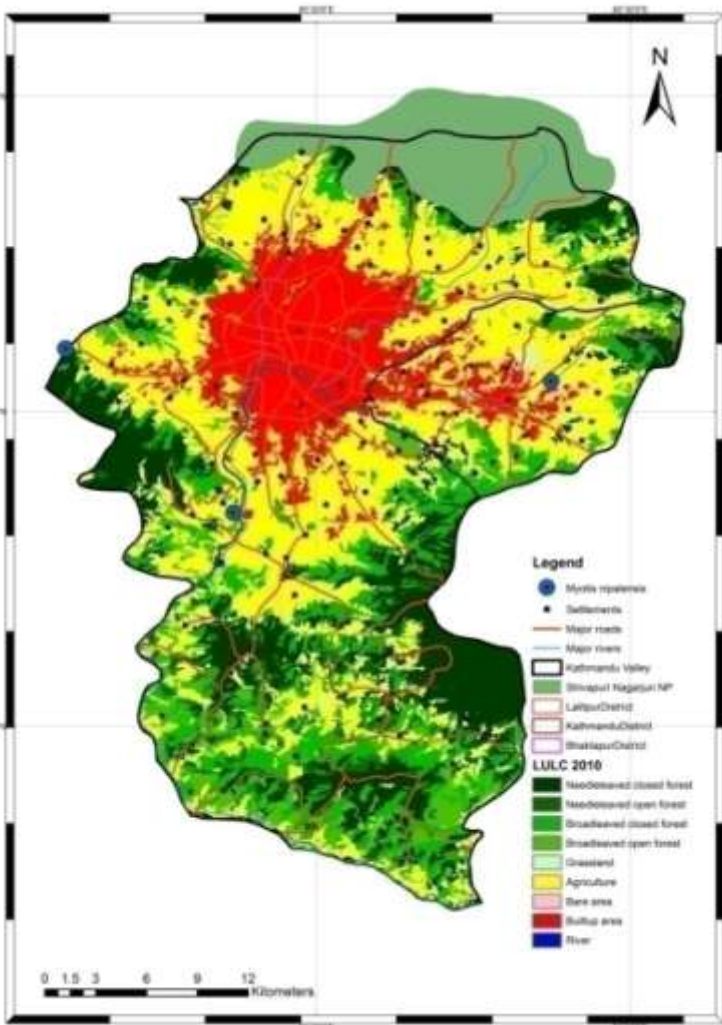
Identifying Characteristics: The naked part of the face and muzzle is reddish but not nearly black (as in *M. mystacinus*). The eyes are concealed under numerous fine hairs. The upper lip is fringed with hairs, that means snout is whiskered. Pinna is dark brown/ black and relatively short; the anterior margin is evenly convex while posterior margin has a shallow concavity beneath the rounded tip. Tragus is tall but narrow, about half the height of the pinna. Feet are small, less than half the length of tibiae. Dorsal pelage is russet brown, with dark hair roots. However, the hair root at ventral pelage is also darker but the hair tip is characteristically grey or creamy white. In the wing, the third metacarpal scarcely exceed the fourth and fifth. Wing membranes are naked and uniformly dark brown, and each wing is attached to the distal end of outer metatarsal of the foot. Inter-femoral membrane is also dark, which is slightly haired adjacent to the body and tibiae dorsally.

Habitat: It inhabits in wide variety of habitat; often found in arid or mountainous habitats, including forest, shrub land, grassland areas, desert, rural gardens and urban areas. It roosts in cracks, rocks, buildings, caves and old mines in colonies (Smith and Xie, 2008; Srinivasulu pers. comm. and Katerina Tsytsulina pers. comm.).

Threats:

- i. Heavy use of pesticides





20. *Myotis sicarius*

Common name: Mandelli's Mouse-eared Myotis
Nepali name: Mandelliko Muskane Chamero (Acharya et al. 2010)

Identifying Characteristics: The forehead and muzzle are covered in hairs, however, the ears, areas around eyes and nostrils are essentially naked and dark in color. Pinna is dark; the anterior margin is evenly rounded and convex while posterior margin has a well-marked shallow concavity beneath the bluntly rounded tip.



Tragus is tall but narrow, about half the height of the pinna. Feet are small but about equal to half the length of tibiae. Pelage is dense, short but very soft. Dorsal pelage is uniform deep chocolate brown to dark ferruginous brown. Ventral pelage is paler with the hair tip ginger colored and darker hair root, yellow shade at the belly. In the wing, the third metacarpal scarcely exceed the fourth and fifth. Wing membranes and interfemoral membranes are black in color, naked, semi translucent and uniformly dark brown/black. Each wing is attached to the base of first phalanx of outer metatarsal of the foot.

Habitat: It is found in montane forests on hill sides and in valleys (Molur et al. 2002). Three specimens were captured at 3m above the water over a river, in a partly deforested area. Two specimens were also captured over a stream at a foot to three feet above the water over a small stream in between the agricultural fields and dense canopied religious forest at Bajrabarahi (Thapa et al. 2010).

Threats:

- i. Habitat loss, degradation and isolation
- ii. Heavy use of pesticides

21. *Myotis frater*

Common name: Long-tailed Whiskered Bat

Nepali name: Lampuchhre Junge
Musakaane Chamero

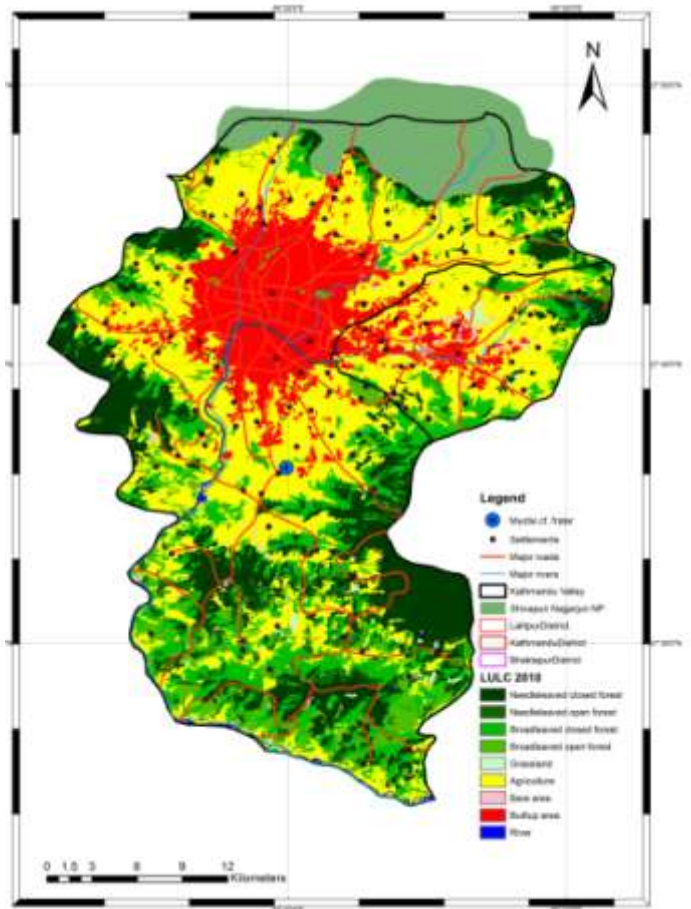
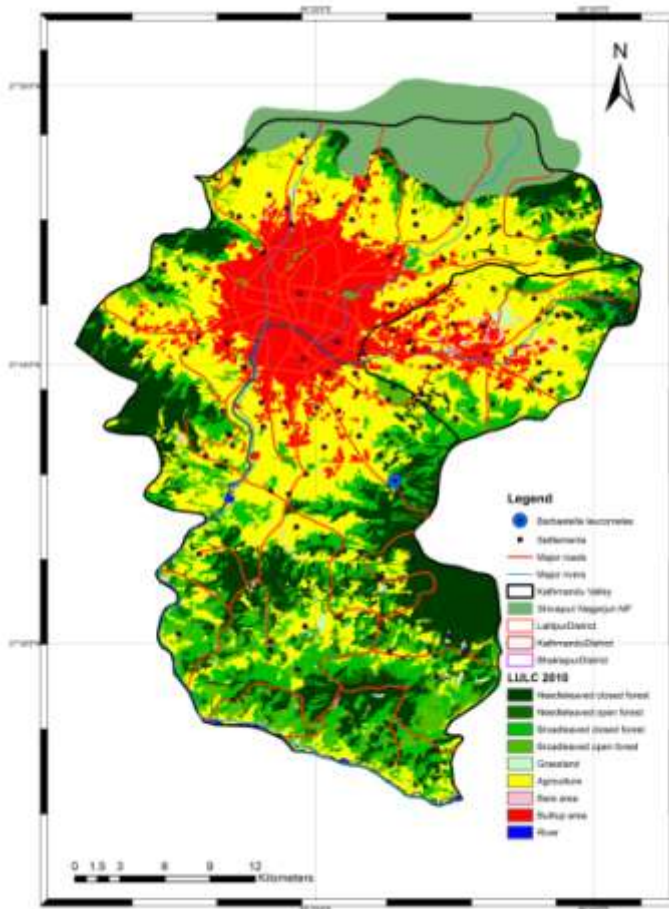
Identifying Characteristics: Fur is thick, brown, pale ventrally. Forearm length is 36-42 mm (Smith & Xie, 2008). The hind foot length is less than half the tibia length, and the wing membrane attaches at the heel. Calcar has a small keel.

Habitat: In Japan, it is found in tree hollows during the day, but also some breeding colonies over 100 individuals have been found in houses (Abe *et al.* 2005). One small colony was also found in a cave (Abe *et al.* 2005). In Russia, it was found in caves (during winter) and rock cracks. The type series collected in China were taken from holes in bamboo stems (Smith and Xie, in press).

Threats:

Unknown



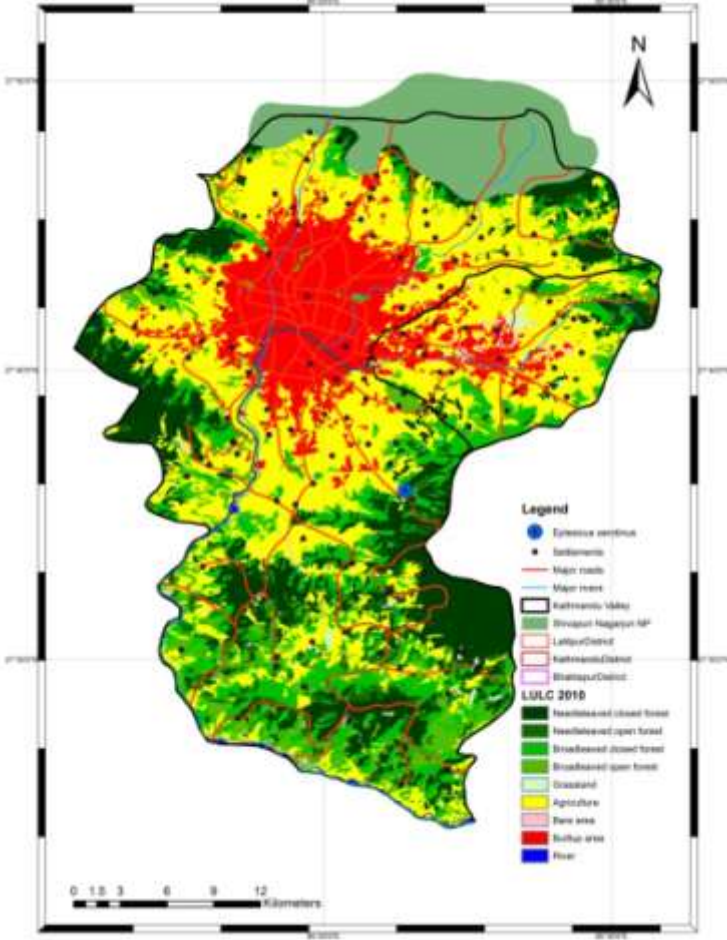


22. *Barbastella leucomelas*

Common Name: Eastern Barbastelle
Nepali name: Purbiya Himali Chamero
 (Baral and Shah 2008)

Identifying characters: It is small bat with short, flat and wide muzzle. Above the level of flat median area of the **muzzle** there are prominent glandular swellings covered by dense hairs. **Lip** fringed with hairs. **Nostrils** are crescent shaped and open upwards and outwards on a flat hairless median space which is bordered with two elevated crescentic ridges laterally. **Pinnae** darker brown with faint transverse ridges and hairy posterior margin, however, not extending to tips. They are not so enlarged but broad and faced forwards, nearly square in outline and anterior margin extends to join together at the bases on the forehead. **Tragus** is triangular and large (more than half of the height of the pinna). **Tibia** is long but foot relatively short. Wings and interfemoral membrane uniformly brown.





Wing is attached to the base of outer toe. Dorsal pelage is long, fine and soft while pelage at belly is short. Head and back essentially black, however, on the posterior back and flanks hairs are blackish brown, however, with slightly paler hairs surrounding vent in some specimens. Tail is long.

Habitat: It is found solitarily, in Himalayan moist temperate forest. It was captured from the montane primary broad-leaved forest (Csorba *et al.* 1999). It roosts in tunnels, cave crevices, abandoned and old building, mines, tree hollow and under the bark. They are late emerging for flight and insectivorous in food habit. According to Roberts 1977 females give birth earlier than other species and usually twins (Bates and Harrison 1997). According to Blanford (1888-91), it was common at an altitude of between 1538-2462 m a.s.l. (Bates and Harrison 1997). Roost singly or group (non – social colony) under bark and in tree hollow goes for hibernation during extreme cold of winter.

Threats: Unknown

23. *Eptesicus serotinus*

Common name: Serotine

Nepali Name: laampuchhre chamero (Baral and Shah 2008); Thulo laampuchhre chamero

Identifying characters: Large species of the genus. The muzzle is exceptionally broad with **glandular swellings**. **Upper lip** fringed with fine hairs. **Pinnae** are dark; moderate in length with about six transverse ridges. The **tragus** is less than half the height of the pinna; the tip of the tragus is bluntly pointed. Pelage is generally fine, dense and silky with hair bases or roots usually dark. Dorsal pelage is essentially dark brown with distinct gloss on the back. Pelage at throat and belly is paler, uniformly grey or buffy-grey.

Wings are broader in comparison to length. **Fifth metacarpal** is shorter than third and/ or fourth. Wing membranes join at the base of the outer toe. **Tail tip** extends 5 mm from the interfemoral membrane. The dorsal surface of interfemoral membrane is lightly haired adjacent to body and femora. Ventral surface of **wing membrane** are also lightly haired alongside forearm. The angular process of the mandible is smaller but slightly projecting beyond the condyle. Canines are about twice longer than the adjacent premolar (pm^4). Baculum is stunted with a scarce tip and bilobate base.

Habitat: This species inhabits in semi desert, temperate and subtropical dry forest, farmland and sub-urban areas. They forage in pastures, open woodland edges, tall hedgerows and forested regions. It feeds on large beetles, moths and flies (Bates and Harrison 1997).

Threats: Unknown





24. *Pipistrellus coromandra*

Common name: Coromandel Pipistrelle

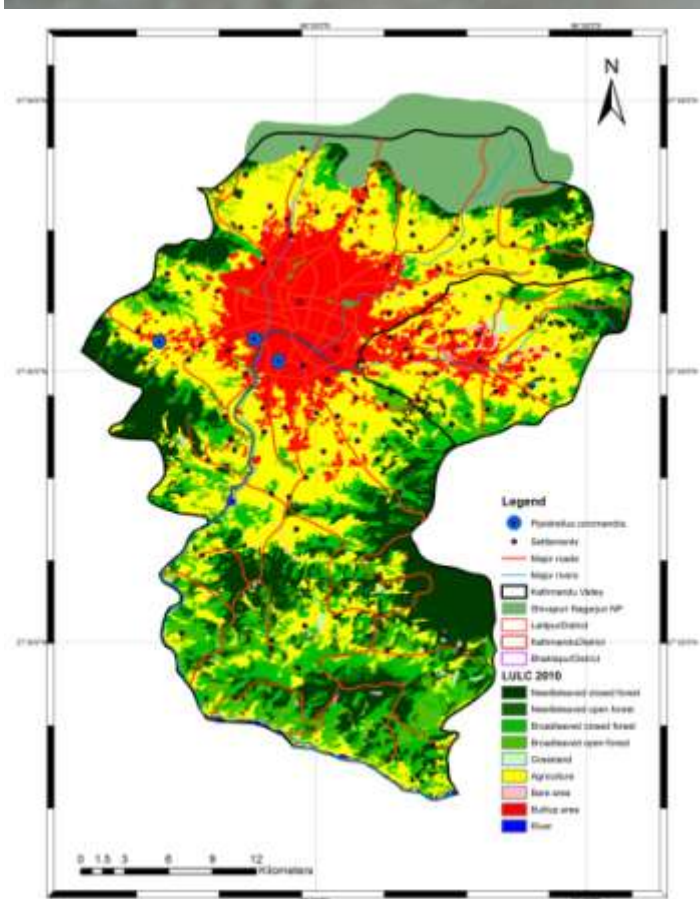
Nepali name: Buchche Chamero (Baral and Shah 2008); Coromandel ko Pipistrelle Chamero (Acharya et al. 2010)

Identifying Characteristics: Dorsal pelage is uniform brown ranging from chestnut to dark clove brown. Ventral pelage is distinctly paler with beige brown to cinnamon brown hair tips and dark hair roots. Pinnae and membranes are mid to dark brown and essentially naked, except inter-femoral membrane is slightly haired throughout adjacent to the body and tail. The first upper incisor (i^2) has anterior and secondary cusps. The secondary cusp may be occasionally small or absent, however, attains half the height of anterior cusp. The second upper incisor (i^3) is well developed with larger principal cusp and a smaller lateral accessory cusp. i^3 usually exceeds the height of secondary cusp of i^2 . The upper canine has a secondary cusp and a distinct Cingular cusp posterior. The first lower premolar is half to three quarters the crown area of the second lower premolar. The baculum has a straight or slightly sinuous shaft with a distinctly bifid tip and basal lobes deflected ventrally.

Habitat: This species is found in varied habitat types from forested regions, agricultural landscapes to urban areas. It roosts in trees, crevices and cracks in walls (Dahal and Thapa pers. obs. comment) and ceilings of houses, tiles of huts, old buildings, temples, under bark and in holes of large trees, signboards, tree hollows in small groups of few individuals. It has been captured from bamboo hollows of huts and sheds (Thapa, 2010).

Threats:

- i. Roost collapsed due to natural disaster (earthquake)
- ii. Use of pesticides in agricultural fields



25. *Pipistrellus javanicus*

Common name: Javan Pipistrelle

Nepali name: Java ko Chamero (Baral and Shah 2008); Java ko Pipistrelle Chamero

Identifying Characteristics: Dorsal pelage varies from a uniform chestnut brown to darker clove brown with a light frosting of paler brown hair tips. Ventral pelage has buffy brown hair tips and black hair roots. Pinnae and membranes are uniform dark brown and essentially naked.



The first upper incisor (i^2) has anterior and secondary cusps. The secondary cusp may be indistinct, however, attains three-quarter ($\frac{3}{4}$) height of anterior cusp. The second upper incisor equals the height of secondary cusp of i^2 . It has larger central and a smaller lateral accessory cusp. The upper canine has a distinct posterior secondary cusp which is also present in *P. tenuis*. The first lower premolar is half to three quarters the crown area of second lower premolar as in *P. coromandra* and two-thirds the height of second lower premolar as in *P. tenuis*. The baculum has a long but narrow shaft, strongly bifid tip and ventrally deflected well developed basal lobes.

Habitat: This species is found in varied habitat types from primary and secondary forested regions, agricultural landscapes to urban areas. It roosts in trees, crevices and cracks in walls and ceilings of houses, tiles of huts, old buildings, temples, under bark and in holes of large trees, signboards, tree hollows. Frequently observed hunting at canopy level in primary forest and in agricultural landscapes over corn fields (Csorba et al. 1999).

Threats: Unknown

26. *Pipistrellus tenuis*

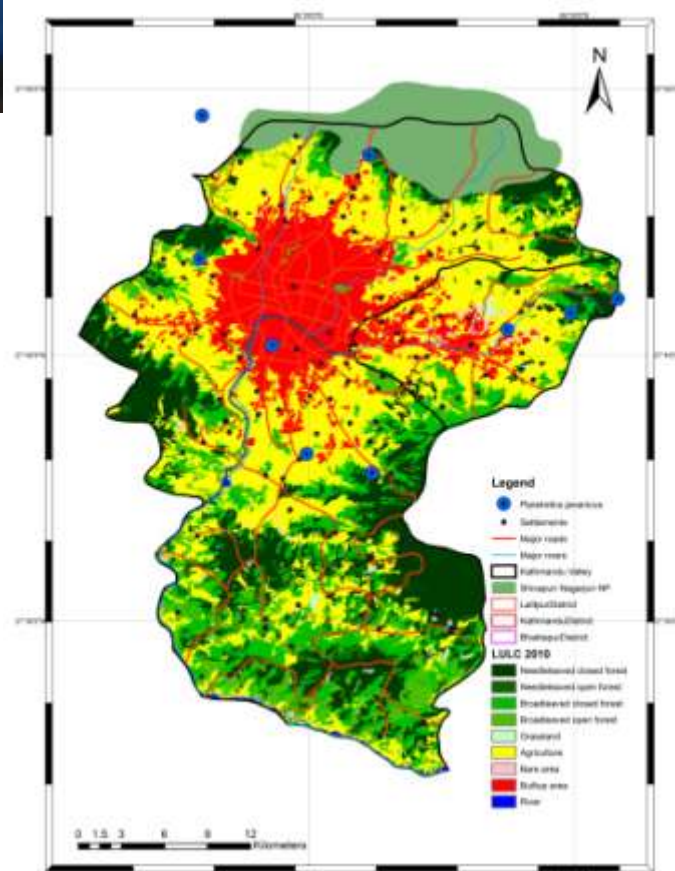
Common name: Least Pipistrelle

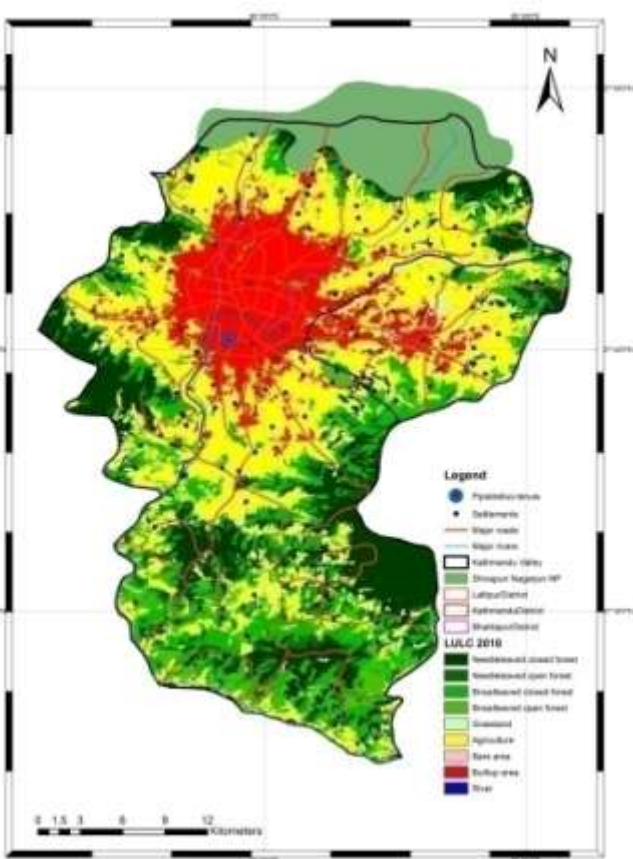
Nepali name: Sano Chamero (Baral and Shah, 2008); Sano Pipistrelle Chamero

Identifying Characteristics: Generally dorsal

pelage is uniform brown but varies in tone from midbrown to deep clove brown. Ventral pelage is same as in *P. javanicus* but with dark brown or black hair roots. Pinnae and membranes are dark throughout and essentially naked. The first upper incisor (i^2) has anterior and

secondary cusps. The secondary cusp attains half the height of principal cusp as in *P. coromandra*. The second upper incisor exceeds the height of secondary cusp of i^2 . The upper canine has a distinct posterior secondary cusp. The first lower premolar is





three quarters the crown area of second lower premolar and about two-thirds the height of second lower premolar. The baculum is shorter but similar with that of *P. javanicus* except with distinct notch on basal lobes.

Habitat: This species is found in varied habitat types from arid zones, wet and humid areas to forested areas in rural and urban landscapes (C. Srinivasulu pers. comm.). It roosts in hollows of trees, holes, crevices and cracks in walls and ceilings of old buildings, dead leaves of trees. They occur in small groups of few individuals. It has also been found roosting in bamboo hollow of huts and sheds (Thapa 2010).

Threats:

Roost collapse due to natural disaster (earthquake)

27. *Falsistrellus affinis*

Common name: Chocolate pipistrelle

Nepali name: Chaklety chamero (Baral and Shah 2008)

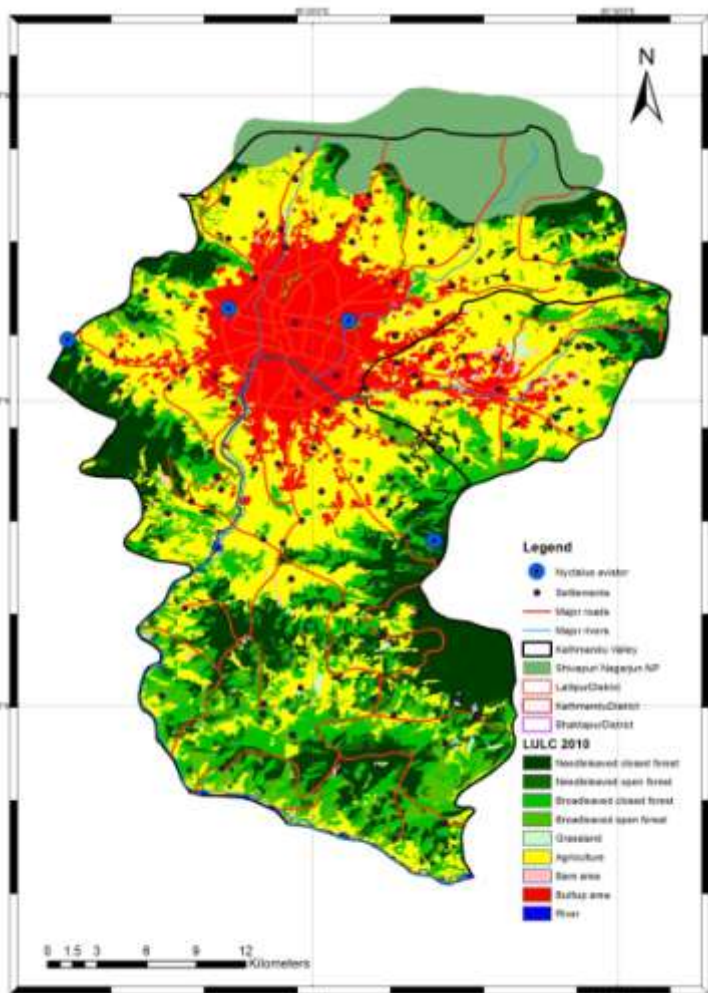
Identifying Characteristics: Its pelage is characteristically soft, dense and comparatively long. Dorsal pelage is essentially dark brown with extreme tips of some of the hairs that are pale grey giving a slightly grizzled effect. Ventral pelage is slightly paler. The membranes, ears and naked parts of the face are uniform blackish to brown.

Braincase appears relatively smaller to the rostrum. Coronoid process of each mandible exceeds the lower canine in height. Incisors are not separated from canines in the toothrows. Upper canines are unicuspid and broad at base. Baculum has thick and broad shaft, proximal wide and ventrally deeply fluted end and simple distal end.

Habitat: It roosts in small colonies of five or six individuals in roofs of buildings and cracks, hollows in trees, near human habitations (Molur et al. 2002).

Threats: Unknown





28. *Nyctalus aviator*

Common name: Japanese Large Noctule

Identifying Characteristics: large sized noctule larger than *Nyctalus noctula*; thumb is short, however, with strong claw; calcar is keeled; fur is dense and velvety; pelage is dark yellowish brown.

Habitat: This species inhabits mountainous and hilly areas, where it forages in deciduous mixed forests. They come out of tree cavities swiftly falling down and take flight at the sub-canopy level and they leave their roost early in the evening and forage actively for flying insects fairly high off the ground. Diurnal roosts are frequently in tree cavities.

Threats:
Unknown

29. *Murina leucogaster*

Common name: Rufous Tube-nosed Bat

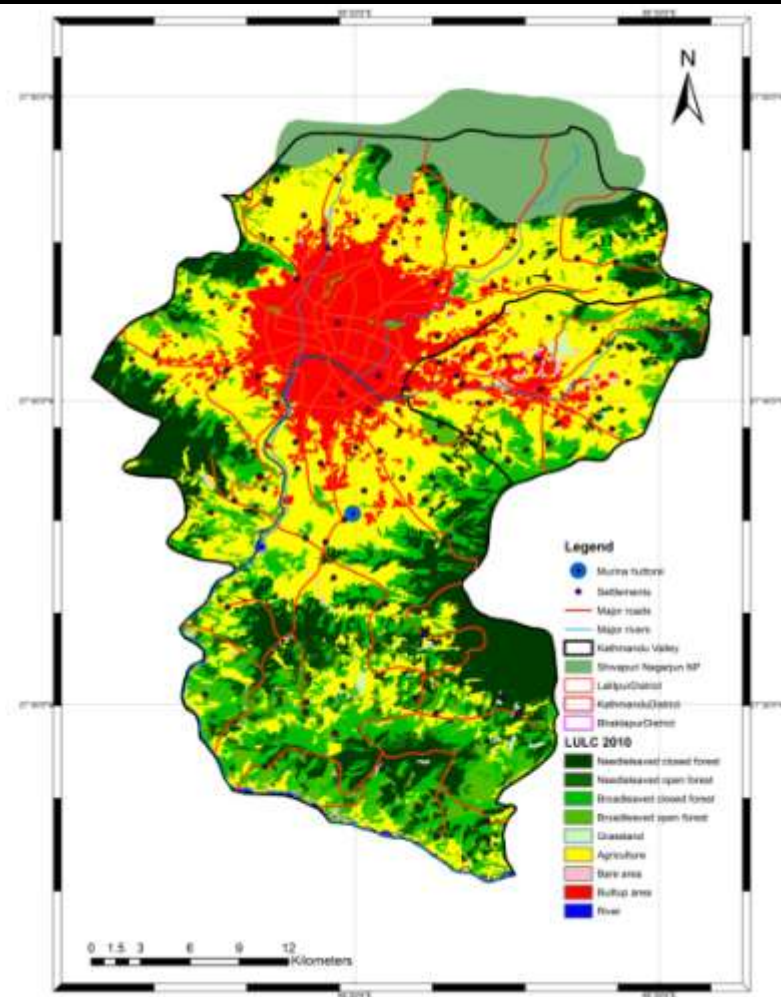
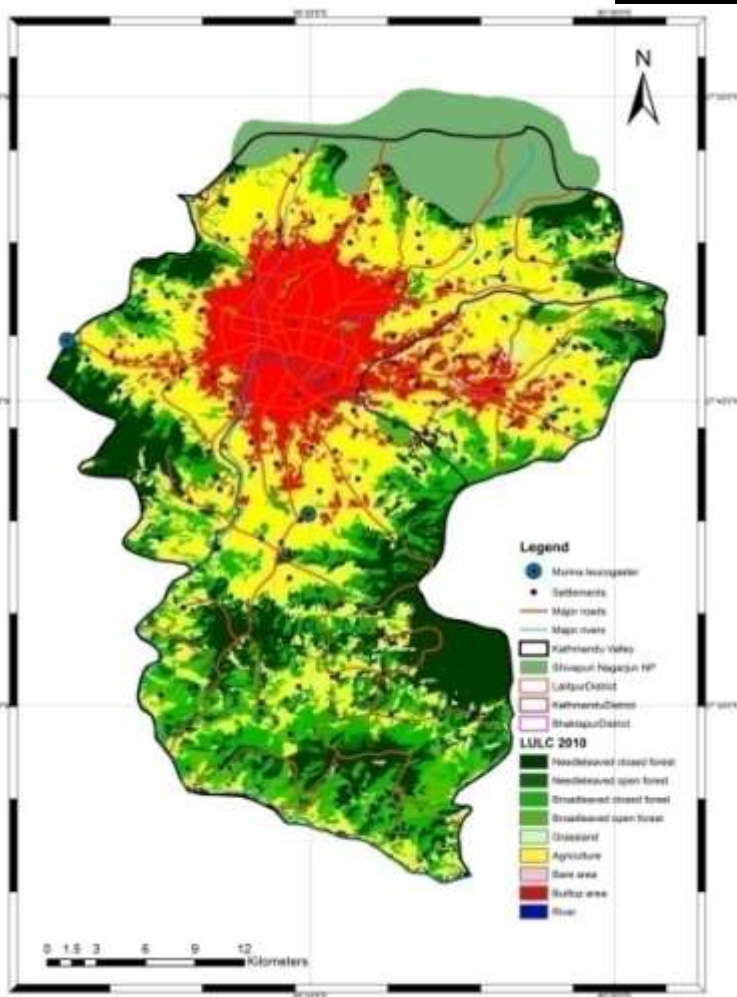
Nepali Name: Thulo Naalikaane Chamero (Baral and Shah 2008)

Identifying Characteristics: This is the large species of the genus. Muzzle and lower lips are naked, fleshy and dark. Nostrils are tubular and protuberant; orifices are circular and open obliquely. Upper lip fringed. Eyes are smaller and located near the anterior bases of the ear. Pinna is short but broad, anterior margin is smoothly convex with rounded tips and its interior is haired, while posterior margin is consequently nearly straight above and convex below. Tragus is long, narrow and tapering. Anterior margin is slightly convex, concave above and slightly convex below with a basal notch. Pelage is dense and velvety. The dorsal pelage is ferruginous red, intermixed with fawn with dark grey hair roots. Ventral pelage is paler in appearance with the hair roots paler. The inter-femoral membrane is moderately haired dorsally with fine reddish hairs and its naked ventrally. Wing is short but broad with larger thumb, which joins the base of outer toe of each foot. Feet have hairy toes characteristically.

Habitat: It inhabits in forest. In China this species is found roosting in caves, trees and houses. It forages in both forested and open areas (Smith and Xie, 2008). While foraging in open fields, it apparently skims closely over the surface of crops and grasses (Scully, 1887). It was mist netted over a stream in the edge of primary religious forest and agricultural terraces (Thapa et al. 2017).

Threats:

- i. Habitat loss and degradation



30. *Murina huttoni*

Common name: White-bellied Tube-nosed Bat

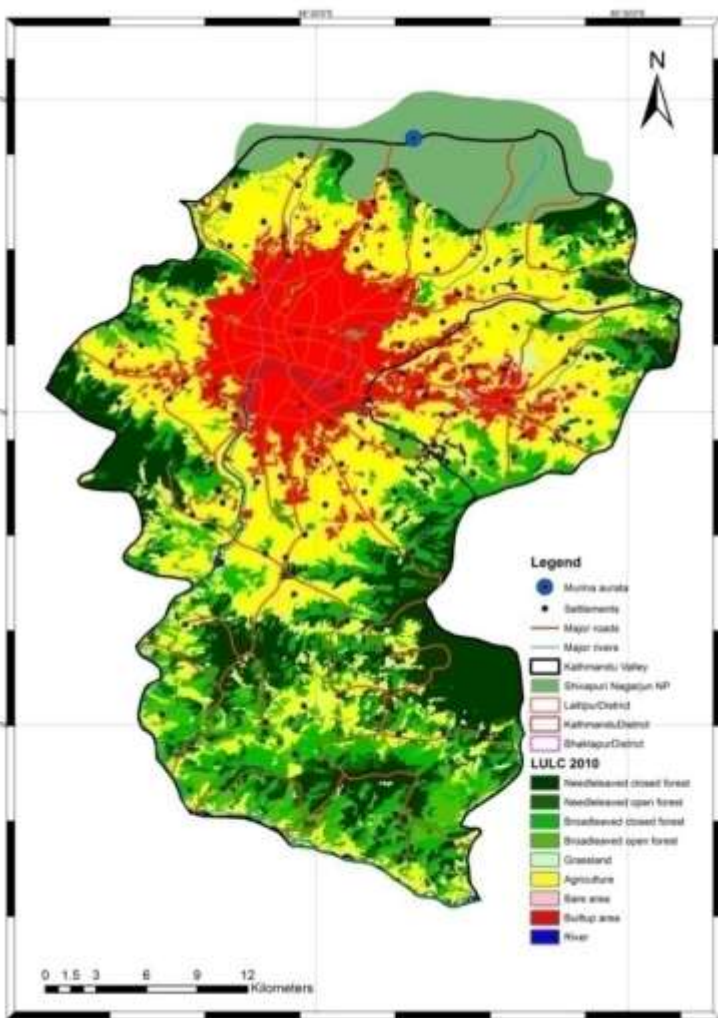
Nepali name: Hutton ko Naalinaake Chamero (Baral and Shah 2008)

Identifying Characteristics: Pelage is dense and velvety, characteristically browner and less reddish. The dorsal pelage has mid grey hair roots and pale grey to brown hair tips. Ventral pelage is paler in appearance although the hair roots are darker. It distinguishes with *M. cyclotis* by shorter forelimb and longer pinnae. The inter-femoral membrane is moderately haired dorsally with long and pale brown hairs and its naked ventrally. Feet are hairy. The posterior border of pinna is smoothly convex and without an emargination. Muzzle is typical of the genus.

Habitat: It inhabits in montane forests, tropical broadleaved forests and banana plantations. It roosts among banana leaves, and the base of banana plants and under tree bark (Molur et al. 2002). The specimens were captured at Makalu and Kanchenjunga region of Nepal. They were found roosting in leaf tent of banana tree (*Musa* species). One was found roosted in dry leaf tent whereas another was found roosting inside the modifying cylindrical structure of abanana leaf. However both captured specimens were solitary sub-adults and the exact roost of adults is still unknown. In Sedua, the banana patch is at the farm land irrigated with stream water i.e. marshy or damp type adjacent to stream (Acharya 2010).

Threats:

- i. Unknown



31. *Murina aurata* Milne-Edwards, 1872

Common name: Tibetan Tube-nosed Bat

Nepali name: Sano Nalinaake chamero (Baral and Shah 2008) Tibatti Nalinaake chamero)

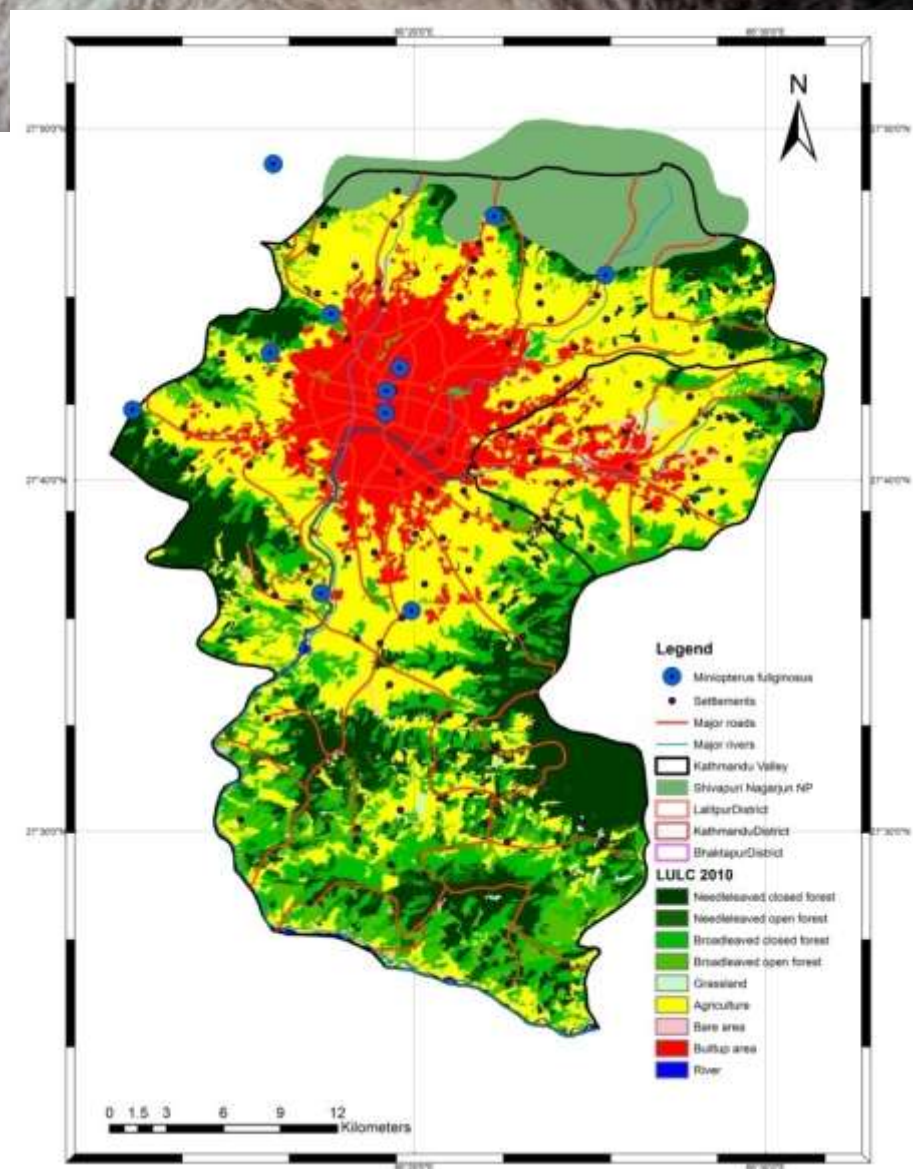
Identifying Characteristics: Nostrils are tubular and outwardly protuberating. **Pinna** is broad and rounded, without an emargination on the posterior border. **Tragus** is long but narrow and tapering white colored. **Pelage** is thick and very soft. Dorsal pelage is characteristically mixed; golden and brown in color with the bases of hairs dark brown, pale straw brown midway and hair tips golden. Ventral pelage has dark hair roots and grey hair tips. **Wings** are essentially naked with uniform mid-brown coloration. **Interfemoral membrane** is moderately haired dorsally, with



golden hairs while slightly covered by short grey hairs ventrally. **Feet** are also hairy.

Habitat: It is believed to be roosting in tree or foliage in China (Smith and Xie 2008). This species hunts close to ground and it is thought to be hibernating in trees in the forest during the winter. It has been recorded from Sedonchen, Sikkim at an altitude of 2000m a.s.l. The area is a small village surrounded by steep mountain slopes covered by thick mixed forest of pine, oak, maple, walnut and bamboo. Few fields of buck wheat were also found in the locality (Bates and Harrison 1997).

Threats: Unknown



32. *Miniopterus fuliginosus*

Common name: The Eastern Bent-wing Bat

Nepali name: Schreiber ko Laampakhete Chamero (Acharya et al. 2010)

Identifying Characteristics: Head and body length is 10–11 cm. Forearms are 4–5 cm. Wingspan is 30–31 cm. Color varies from reddish brown to dark blackish brown above, underparts are lighter. Wing membrane is blackish brown. Fur is dense and soft, long above and short below. Ears are small; cheeks are hairless below the eyes.

Habitat: It forages in a variety of open and semi-open natural and artificial habitats, including suburban areas. It has an altitudinal range of sea level up to 2,120 m a.s.l. in southern parts of its range. It is a colonial species that roosts almost exclusively in caves and mines (although it has occasionally been found in man-made tunnels), often in large mixed colonies with other cave-dwelling bat species. Large and warm caves are preferred. Solitary animals and small groups may sometimes occupy other types of shelter. In winter it hibernates in underground sites (usually large caves with a constant microclimate). It is a migrant species which changes its roosts frequently, long-distance movements occur occasionally (Chiozza, 2008).

Threats: Unknown

