

Detailed monitoring survey of bats and their conservation through radio awareness programme and outreach programme to school children in Kathmandu Valley



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Cover Photo:

A pair of Intermediate Horseshoe bat (*Rhinolophus affinis*) one at the front with orange and at the back is grayish brown in the tunnel of Pharping hydroelectricity Power house.

Note: An ectoparasite inundated at the lower wing

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Abstract

Nepal ranks second in chiropteran diversity within South Asia after India accounting 4.6 percent of the world and 45 percent of the South Asia. However, research and conservation on bat fauna is expectedly insufficient comparing to its neighboring countries. Kathmandu Valley has been a centre for bat study since 19th century. 25 species of bats have been documented hitherto from Kathmandu Valley. A recent preliminary survey in 2008 re-recorded only three species which raised detailed monitoring requirement. Negative perception on the species and lack of awareness is the primary factor for the unwilling conservation. This project is designed in this background. Twenty sites within the Kathmandu Valley was the project study area. Mist nettings, scoop nettings, roost survey were the research methodologies; Radio-awareness programme and lectures to schoolchildren were conservation actions. Four species was added from this first phase of the project to the preliminary survey result, now totaling the species number to 7. Specific sites and bat habitats were discovered and documented in the study area. Availability of the species, population estimates, and habits were noted. Lectures were delivered to schoolchildren of eight schools at six sites within the study area. The community awareness radio-program is undergoing from 22nd January 2010. The remaining tasks will be completed by second phase of the project.

1. Introduction

1.1. Background

Nepal is diverse country in landscape geography ranging from plains to mountains, endeavored by numerous identified and unidentified caves which can be an easy accessible habitat for bats, 21 percent of forest land with patches of agricultural lands along with numerous water holes and channels in the mid hills. Hence, the country can possibly be a potential area for distribution of bats. Approximately 1100 species of chiropterans are accounted globally (Simmons, 2005). South Asian region hoards 123 species of bats with about 139 valid subspecies designated within (Walker and Molur, 2003) (i.e. 11.02% of the total bat species, seventeen species of bats are endemic to South Asia). However, In Nepal, 51 species of bats, that is 45% of total species in south Asia and 4.6% of the total species in the world, have been estimated so far (Huston et al., 2001), recently 53 species have been compiled (Baral and Shah, 2008), Among them 39 spp. remains in different categories of threats (IUCN, 2006); 2 Critical, 1 Endangered, 5 Vulnerable, 20 Near Threatened, 17 Least Concerned, 5 Data Deficient (Walker and Molur, 2003). One species, *Myotis csorbai* is endemic (Topal, 1997; Csorba et al., 1999) and status of some species is questionable (Walker and Molur, 2003). Some 38 spp. is known to live and breed in Nepal (Verheugt et al., 1995). An estimation of additional 17 species likely to existed in latest bat species list of the country have been added (Acharya and Ruedas, 2007). 90 possible species have been recently estimated (Myers et al., 2000).

Several Foreign scientists have contributed to study about distribution and taxonomy of bats, majorly: Hodgson, 1835; Blyth, 1844; Scully, 1887; Hinton and Fry, 1923; Fry, 1925; Sanborn, 1950; Wiegel, 1969; Sinha, 1973; Mitchell, 1975; Abe, 1982; Corbet and Hill, 1992; Koopman, 1993; Kock, 1996; Bates and Harrison, 1997, and others. Nepalese started to investigate since 2000. Even though foreign scientists have paid a remarkable attention to exploration of bat fauna to Nepal, still a systematic scientific research have been lacking.

1.2. Literature Review

Since, 19th century bat studies have been centered to Kathmandu Valley. Numerous bat habitats and roosting sites have been reported from Kathmandu valley. Up to date, 25 species of bats; 2 Mega and remaining microchiroptera

(Bates and Harrison, 1997) specimens of six species were collected (Csorba et al., 1999), 24 species of microchiropterans in Kathmandu valley have been compiled (Baral and Shah, 2008). But, Thapa et al., 2009 re-recorded only three species from eight sites. Voucher specimen of *Megaderma lyra* from Kathmandu is deposited at

Hungarian Natural History Museum (HNHM) (Bates and Harrison, 1997; Csorba et al., 1999). Bates and Harrison, 1997 reported *Rhinolophus ferrumequinum* from Kathmandu valley, an adult female specimen from Chobhar at an altitude of 1400m was collected on 16 April 1996 (Csorba et al., 1999). A voucher specimen of *R. affinis* collected from 1400m at Balaju Forest Reserve, Kathmandu is at HNHM (Bates and Harrison, 1997; Csorba et al., 1999); another specimen from 862m is at Field Museum of Natural History, Chicago, USA (FMNH) (Bates and Harrison, 1997). Fry, 1925 reported it from Shivapuri. Specimens from Thankot and Parchung are at The Natural History Museum, London (BMNH) (Bates and Harrison, 1997). In Kathmandu valley, *R. pusillus* was reported at about 1300m. Sinha, 1973 reported it from Soondarijal. Voucher Specimen is also available at Harrison Zoological Museum (HZM), specimens from Nagarjuna forest is at BMNH (Bates and Harrison, 1997). An adult male was collected from Chobhar at an altitude of 1400m on 20 March 1996 (Csorba et al., 1999). *R. subbadius* have probably originated from the Kathmandu Valley (Scully, 1887). Bates and Harrison, 1997 reported from unconfirmed locality of Kathmandu valley. Scully, 1887 located *R. luctus* in the deep forests of the more precipitous mountains of the Kathmandu valley. Fry, 1925 reported from Banssbahari, Bates and Harrison, 1997 from Chalnakhel. Hinton and Fry, 1923 reported *R. pearsonii* from approx. 3384m at Parchung and a specimen from Sundarijal is at FMNH (Bates and Harrison, 1997). It has been reported from Godawari (Shrestha, 2000).

Hipposideros armiger has been reported from Kathmandu Valley (Bates and Harrison), an adult female specimen was collected from Balaju Forest Reserve at an altitude of 1410m on 5 July, 1995; 3 adult males and 5 adult females were collected from Chobhar at an altitude of 1400m was collected on 16 April, 1996 (Csorba et al., 1999). A specimen of *Hipposideros cineraceus* is at BMNH (Bates and Harrison, 1997). Scully, 1887 and Bates and Harrison, 1997 reported *H. fulvus* from Kathmandu valley.

Fry, 1925 reported *Myotis sicarius* from Banssbahari. Scully, 1887 reported *M. formosus* from Kathmandu Valley. Bates and Harrison, 1997 reported *M. mystacinus* from Kathmandu. However, it was considered not common in the Kathmandu valley (Scully, 1887). *M. muricola* was found at 1230m at Kathmandu valley (Hinton and Fry, 1923). According to Scully, 1887 (In Hinton and Fry, 1923), *M. siligorensis* is one of the commonest bats in Kathmandu Valley. None of the specimens collected from June to November had descended testes or enlarged mammae; an immature female was obtained on June 30 and a very young male on 3 July (Scully, 1887). *Pipistrellus javanicus* was reported from Nagarkot; Shivapuri; Kathmandu (BMNH). *Pipistrellus affinis* was collected at an altitude of 2000m from Nagarkot (BMNH). *Nyctalus noctula* was collected from

1231m in the Kathmandu valley (Hinton and Fry, 1923), and about 2000m at Godawari (HZM). Scully, 1887 and Csorba et al., 1999 reported *Miniopterus schreibersii*.

1.3. Objectives

The aim of the study is to

- Re-record the bat species diversity, population and their habitats in Kathmandu valley
- Adopt a radio awareness programme and lectures to schoolchildren for the conservation of bats and nature for the substantial and long-lasting time.

1.4. Rationale

The rapid transformation of the land use pattern of the valley due to haphazard urbanization and industrialization and economic increment has encroached the major roosting habitats of bats, may have influence on the species loss. Regular monitoring of the species and their roosting habitats did not approach since 1997. Re-recording of only three species *Rhinolophus pusillus*, *Hipposideros armiger* and *H. cineraceus* during the preliminary survey (Thapa et al., 2009) fantasize the prediction. Unconfirmed diversity, status and distribution of bats are still the unanswered questions in the Chiropterology of Nepal. This study is expected to update the facts of the species and population prevailing and their roosting and hibernating habitats in the Kathmandu valley.

Each species has its own role in the environment. The people of Nepal have a negative attitude towards bats and little knowledge of their ecological importance regarding healthy forest maintenance and pest control in agriculture and therefore has nullified attempts for their conservation. It has become necessary to aware the local people and initiate them into monitoring for the conservation of bats as well as nature for their good health and well being.

2. Methodology

2.1. Study Area

Kathmandu Valley (from 27°35'00"N 85°15'00"E to 27°50'00"N 85°37'30"E) comprised of Kathmandu district, with the capital of Nepal; Lalitpur and Bhaktapur district is chosen as study area for the study. It is an oval shaped, flat bottomed basin valley with hills: Phulchowki; Chandragiri; Shivapuri and Nagarjuna, at Southern; Western; northern and western corner. The study area occupies 395 square kilometers and is situated at an altitude of 1372 m to 2732 m. Climate in Kathmandu Valley is characteristic temperate, influenced by the tropical monsoon. The average air temperature is 19° C but the mean annual temperature at summer season is 28° C while that in winter is 13° C. The annual rainfall in Kathmandu is about 140 mm (DHM, 2006).

Bagmati and Bishnumati are major rivers of this area with centripetal drainage system. Due to presence of riverine and lacustrine deposit, fertile land is abundant. The surrounding hilly area is covered with forest of *Alnus nipalensis*, *Pinus roxburghii*, *Prunus* sps. *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. Twenty project sites: such as Godawari; Phulchowki; Lakuribhanjyang, Bajrabarahi, Chapagaun, Nagdaha were aside the busy city in Lalitpur district; Pharping; Chalnakhel; Taudaha; Chobhar, Machhegaun; Nagarjuna Cave; Jhor; Muhanpokhari; Sundarijal; Gokarna were aside the busy city while Swoyambhu and Slesmantak forest at Pashupati-Gujeshwori area were in vicinity of the busy city at Kathmandu district; Nagarkot and Bajrayogini were aside the busy city while Suryabinayak in the vicinity of busy city within the Bhaktapur district.

Sites:

Godawari-Phulchowki Area

The site lies within one-kilometer periphery of 27°35'42.08"N 85°22'40.81"E, at an altitude 5000ft a.s.l. The area is moist, drained with water streams, north facing slope, dense vegetation of Chestnut *Castanopsis indica* (Katus), Box Myrtle *Myrica esculenta* (Kafal), Plum *Prunus cersoides* (Paiyun), Alder *Alnus nipalensis* (Utis), *Schima walichii* (Chilaune), Oak *Quercus* sp., Rhododendron spp. (Gurans), Walnut *Juglans regia* (Okhar), *Michelia champaca* (Chaanp) etc. Common Leopard *Panthera pardus* (Chituwa), Indian Crested Porcupine *Hystrix indica* (Dumsi), Squirrels, Bats are mammals sited frequently in the jungle. This area is

famous for resident birds and butterflies.

Bajrabarahi Forest, Chapagaun

The site lies within one kilometer periphery of 27°35'23.30"N 85°20'6.61"E, at an altitude 4872ft a.s.l. This area is special to bat habitats. Primary forest with older plantations guarded religiously is the specialty of the site. The forest centers the god Bishnu temple. 29 plants make up the vegetation in which *Castanopsis indica*, *Choerospondias axillaris* (Lapsi), *Ficus sp.*, *Myrica esculenta*, *Prunus cersoides*, *P. paschia* (Mayal), Oak *Quercus glauca* (Sano falant), *Schima wallichii* etc. dominates. Rose-ringed Parakeet, Oriole, Owl, Spotted Owlet, Woodpecker, Red-billed magpie, dove, drongo etc. makes up the avi fauna. Jackal and Jungle cats are the wild animals seen. A small stream covered by the dense vegetation borders at the west from the agricultural fields, also the southern east side of the forest ends to the agricultural fields.

Pharping

The site lies at 427°36'46.97"N 85°17'22.53"E, at an altitude 4159ft a.s.l. Agricultural lands surround the Pharping Hydro power plant.

Muhan Pokhari

The site lies at 27°47'2.09"N 85°22'52.68"E, at an altitude 6535 ft. a.s.l. This area is Moist with few small ponds, south facing slope with dense forest of *Alnus nipalensis*, *Schima wallichii*, *Siris Albizia sp.* (Siris), *Cryptomeria japonicum* (Dhupi Salla) etc. *Sus Scrofa*, *Panthera pardus*, *Hystrix indica*, Squirrels and bats are the mammals seen in this site.

Nagarjuna Forest (Shivapuri and Nagarjun National Park)

This is a culturally important site along the Kathmandu-Trishuli Highway. The area is a northward facing slope dominated by *Schima wallichii*, *Alnus nepalensis*, *Prunus spp.* and Chir Pine *Pinus roxburghii* (Raani Salla). There is a small cave called the Nagarjuna cave located at N 27° 44' 43.7", E 85° 17' 39.4" and altitude 1373m. Just after a congested entrance a large space is the microhabitat where about 200 *Rhinolophus pusillus* in few (5) colonies were observed on September 4, 2008 (Thapa et al., 2009).

Sundarijal Area

This is hydro-reservoir and tourist area at the eastern border of Shivapuri National park. This hilly area with south and east facing slopes are dominated by

Pinus wallichiana, *Prunus* sps, *Alnus nipalensis*, *Schima wallichii* and Bamboo as major vegetation. *Hipposideros armiger* inhabits in small colonies inside the tunnels. A tunnel harboring about 30 individuals located at N 27° 46' 18.5", E 85° 25' 35.4" and altitude 1579m, was observed. A few individuals were seen flying at 6 PM on September 13, 2008 at Ward no. 5, Mulkharka VDC. However, locals report this area consist large population and diversity of bats (Thapa et al., 2009).

Chobhar Gorge

This is another culturally important site dominated by *Pinus roxburghii* forest and famous caves of Nepal are located. The topography shows that hills of the gorge are mainly composed of limestone and dolomite. There are four caves Manjushree cave, Bagh cave, Naya cave, and Barahi cave in this area. This area lies within 500 meters of N 27° 39' 35.3", E 85° 17' 39.2", and elevation 1404m.

We could capture a *Hipposideros cineraceus* from the Eastern entrance of the cave on September 16, 2008. Numerous individuals were seen wandering during and noticed their flight at 6 PM (Thapa et al., 2009).

Other project sites were:

Nagarkot

This area is joint of Bhaktapur and Kavrepalanchowk districts. The sites are east and west facing slopes and lies at the periphery of one kilometer at 27°43'15.37"N 85°31'15.95"E, at an altitude of 6000 ft. Blue Pine *Pinus wallichiana* (Gobre Salla) and *Alnus nipalensis*, *Eucalyptus* sp.(Masala), *Cryptomeria japonica* dominates the vegetation. Few caves were found, some of them were facing disturbances. There are some caves in this area.

Jhor

The area lies at 27°47'19.76"N 85°17'26.31"E, at an altitude 5003ft. a.s.l. It borders Shivapuri and Nagarjuna National Park in the south. Vegetation consists of mixed forest of Pine, *Albizia* sp. vegetable farming is the new agricultural practice here. A temple of God Shiva is inside a cave.

Hattiban

This rocky area with Pine at the upper edges, lies at 27°37'24.00"N 85°16'56.18"E, at an altitude of 5042ft. a.s.l. The site consists of slate and stones mines. Pigeons were found nesting here. *Pinus wallichiana* at the drier parts and *Pinus roxburghii*

on relatively wet parts. At the lower edge, *Schima-Castanopsis* forest dominate the vegetation mixed with *Myrica esculenta* (Kafal), *Rhododendron arboreum*, *Myrsine capitellata* (Seti Kaath). Animals in the jungle are: *Macaca mulatta*, *Hystrix indica*, *Muntiacus muntjack*, Civet, jackal, *Panthera pardus*, Flying squirrel etc.

Swoyambhu

This upland in the Kathmandu valley lies at 27°43'1.19"N 85°17'15.90"E, at an altitude 4352 ft a.s.l. Mixed forest with *Schima wallichii*, *Prunus spp.* and Pine dominates the vegetation. This site is sacred holy land for Buddhist and home place for a large folks of monkeys.

Slesmantak forest

This area is sacred holy land for Hindu bordered in west and east by famous god Pashupatinath temple and goddess Gujeshwori temple respectively. This site lies in periphery of one kilometer at 27°42'32.79"N 85°20'59.61"E at an altitude of 4369ft. a.s.l. This site is also another home place for a large flock of monkeys. Chestnut *Castanopsis tribuloides* (Musure Katus), *Schima wallichii*, *Syzgium spp.*, Monkey Puzzle *Araucaria bidwillii*, Wild pear *Pyrus pashia* (Mayel), Oak *Quercus glauca* Saano falant, Woolly Oak *Q. lanata* (Saano baanjh), *Ziziphus incurva* (Haade Bayer) are dominating tree species, *Viburnum cotinifolium* and *V. erubescens* are dominating shrub species.

Taudaha

This area is a small lake surrounded by agricultural fields with thin plantations. It lies 27°38'55.35"N 85°16'56.03"E at an altitude 4250ft. a.s.l. This lake has eight corners a Cutch tree *Acacia catechu* (Khair) in the north edge and a nearest station for bird watching from Kathmandu where one can see migrating birds; common coot *Fulica atra*, Cormorants *Phalacrocorax spp.*, Darter *Anhinga melanogaster*, Mallard *Anas platyrhynchos*, Eurasia Wigeon *Anas Penelope*, Gadwall *Anas strepera*, Common Pochard *Aythya ferina*, Red-crested Pochard *Netta rufina*, Bar-Headed Goose *Anser indicus*, Northern Shoveler, Northern Pintail are the winter visitors. Common moorhen is the summer visitor. Woodpeckers, Kingfishers, Barbets, Eagle, Black Kite, Cuckoo, herons, egrets etc. are the residential birds.

Chalnakhel

This area lies within one kilometer periphery of 27°38'17.91"N 85°16'28.36"E at an altitude 4670ft. a.s.l. *Schima-Castanopsis* forest dominate the vegetation mixed with *Myrica esculenta*, *Rhododendron arboretum*, *Myrsine capitellata*. Animals in

the jungle are: *Macaca mulatta*, *Hystrix indica*, *Muntiacus muntjack*, Civet, jackal, *Panthera pardus*, and Flying squirrel etc.

Machhegaun

This area lies within one kilometer periphery of 27°39'26.27"N 85°15'15.37"E at an altitude 5118ft. a.s.l. This site is north facing and at the foot of Chandragiri. *Myrica esculenta*, *Castanopsis indica*, Pine dominates the vegetation.

Bajrayogini

This area lies 27°44'32.30"N 85°28'40.79"E at an altitude 4836ft. a.s.l. The Bajrayogini temple is the tourist centre here. A dense jungle of *Schima-Castanopsis* and *Pinus wallichiana* patches are the dominating vegetation.

Nagdaha

This very small lake is the resting place for migrating birds in winter which lies at 27°37'28.01"N 85°20'0.25"E at an altitude 4521ft. a.s.l. common coot *Fulica atra*, Cormorants *Phalacrocorax spp.*, Darter *Anhinga melanogaster*, Mallard *Anas platyrhynchos*, Red-crested Pochard *Netta rufina*, Bar-Headed Goose *Anser indicus*, Northern Shoveler, Northern Pintail are the winter visitors. Common moorhen is the summer visitor. Woodpeckers, Kingfishers, Barbets, Eagle, Black Kite, Parakeets, Cuckoo, herons, egrets etc. are the residential birds.

Lakuribhanjyang

This area lies on kilometer within 27°36'45.18"N 85°24'39.93"E and at an altitude of 6675 ft. a.s.l. It is east-west sloping face, where vegetation is dominated by Pine, *Alnus nipalensis*, *Schima wallichii*.

Gokarna

It's the tourist place with golf resort and holy place for Hindu with temple of god Gokarneshwor Mahadev. The site lies within one kilometer periphery of 27°44'19.24"N 85°23'17.25"E at an altitude 4444ft. a.s.l. *Pinus roxburghii*, *Alnus nipalensis* is dominating vegetation of the area.

Suryabinayak

This is a religious spot for Hindu where lies god Ganesh temple in the vicinity of Suryabinayak Community forest. The vegetation is dominated by Schima-

Castanopsis forest intermingled with pine. The area lies within one kilometer of 27°39'25.60"N 85°25'25.27"E and at an altitude of 4541ft. a.s.l.

2.2. Mist netting

Mist netting was done randomly in each study site. Three mist nets were deployed near crevices/caves/ bushes/lakes, evening to 9 PM (11 PM at Chobhar and Nagarjuna).

2.3. Roosts survey

Tree barks, hollows, old houses, temples, caves etc. were searched at the daytime. The population in the colony was estimated and photographed. Bats were captured by scoop net/s and mist net/s.

2.4. Morphometrics and identification

The following external measurements was taken with the help of millimeter graded steel scale to the nearest 1 mm. T- Tail length (from the anus to last vertebra); FA - Forearm Length, E - Ear length from the lower border of the external auditory meatus (Posterior to tragus to the tip of pinna), TIB - Tibia length, HF- hind foot length (including claws). HB-Head body, 5mt-Fifth metacarpal, 4mt-Fourth metacarpal, 3mt-Third metacarpal,

1ph5mt-First Phalange Fifth metacarpal, 1ph4mt- First Phalange Fourth metacarpal, 1ph3mt- First Phalange Third metacarpal, 2ph5mt- Second Phalange. Fifth metacarpal, 2ph4mt- Second Phalange Fourth metacarpal, 2ph3mt- Second Phalange Third metacarpal, WSP-Wingspan, Thumb. All the measurements were noted in the form.

The body weight was measured with the help of simple spring balance graded with gram.

Additionally, the reproductive stage of them was noted by observing their genitalia and digital photographs were taken.

After capturing the bats spot identification was made with the help of the standard taxonomic keys obtained from the IUCN/SSC experts and other reference books. On the -basis of these measurements, we made taxonomic confirmation on the field. The key success was to give us confirmation then we released without giving any more stress to these bats.

2.5. Community awareness radio programme

Importance of bats in public benefits and sustainable environment, their

conservation threats and locals contribution towards their conservation through monitoring or else is being broadcasted in Nepali on Radio Kantipur (www.radiokantipur.com).

2.6. Programme of lectures to schoolchildren

Lecture classes to aware schoolchildren about bats and their importance was delivered in one or two schools from each study sites.

3. Results

3.1. Present Status

Altogether seven species of bats were re-recorded from the monitoring study. Six species were captured from five sites (Godawari-Phulchowki; Bajrabarahi; Pharping; Chobhar, Nagarjuna). Six individuals of *Rhinolophus affinis*: three from site 1; two from site 15 and a single from site 17, A single individual of *R. ferrumequinum* and *R. macrotis* each from site 17, A single individual of *Myotis nipalensis* and *Pipistrellus sp.* from sites 1 and 11 respectively, two individuals of *Hipposideros cineraceus* from site 16 were captured. Bat/s flight/s was observed at three sites (Jhor, Muhan Pokhari, Hattiban) but bats could not be captured. A colony of *H. armiger* was observed in the cave at Godawari on November 2, 2009.

Bat flights were observed frequently and the population was estimated well at sites 1, 9, 11 and 16. Few flights were reported from sites 8 and 17. In the site 1 the time of flight started from 5: 45 PM and 5:30 PM and continued to 6: 59 PM and 7: 20 PM on 1st and 3rd November, 2009 respectively. On 2nd Nov. the single flight at 6:00PM was noted. Frequency calls were detected 35 kHz, 50 kHz, 60 kHz; 45 kHz, 40 kHz, 45 kHz, 55 kHz, 60 kHz; 45 kHz, 55 kHz, 60 kHz; on 1st, 2nd, and 3rd Nov., respectively.

In the site 9 the flight occurred from 5:39 PM to 6:49 PM, 5:45 PM to 6:45 PM and 5:53 PM to 6:40 PM on 11th, 12th and 13th December 2009. The frequency calls were detected; 45 kHz, 55 kHz and 60 kHz. In the site 11 the flight was observed from 5:32 PM to 8: 30 PM, 5:30 PM to 8:14 PM and 5: 43 to 8:00 PM, on 17th, 18th, and 19th December 2009, respectively. The frequency calls were detected; 40 kHz, 45 kHz, 55 kHz and 60 kHz. In the site 16; the flight was noted. In site 16 bats were found flying at the entrance of all caves (Bagh cave, Naya cave, Manjushree cave, Barahi cave). Among the four, maximum flight was observed at Bagh cave, seconded by Naya cave. On 30th December 2009, 5:29 PM was the bat flight noted first inside the Bagh cave, the bats flied outside on 5:45 PM, finally ceased after 6:15 whereas 5:45 PM was the time of maximum flight at Naya cave entrance. Next day 5:30 PM was the time of flight inside the Bagh cave. 5:42 PM and 5:50 PM timed for the nettings of two bat one after another. The frequency caught ranged 40-60 kHz.

In the site 8; the short bat flight emerged at 5:44 PM and ended at 5:50 PM on 7th December 2009. Three bats were observed flying and the frequency calls varied 45 kHz, 55 kHz and 60 kHz. It was reported that bats were found numerous in summer during monsoon in the cave.

In the site 17; the bat flight evolved at 5:37 PM, frequent activity was noted at 5:43 PM, first bat was netted at 5:58 PM, second bat netted at 7:59, third netted at 9:40 PM. The frequency determined were 25 kHz, 60 kHz and 90 kHz respectively. Continuous sound of Cicada was not listened as before.

In site 12; Chamere Gupha, called by the local is a good roosting habitat for bats. However, there were no bats. It was reported that bats were found numerous in summer during monsoon in the cave and they can be found in the tree holes of *Alnus nipalensis*.

In site 15; The tunnel (water outlet) is the good roosting habitat for bats.

In site 3; there are five small artificial caves carved in large rocks where bats rests during the foraging. Their fresh guano was observed.

In site 10; there is a small cave in the vicinity of the jungle south from the site. However, there were no bats.

In site 13; There is a small cave near by the temple, but this is not the habitat of bats.

In site 19; according to priests and guards' bats used to rest under the roots inside the temple, but we couldn't observe that.

Habitat disturbance (fire camp) inside the cave was found to be the major threat pertaining to the bats.

3.2. Species Profile

Family: Hipposideridae

Hipposideros armiger (Hodgson, 1835)

Common Name: Great Himalayan Leaf-Nosed Bat (IUCN 2009)

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

Conservation status:	In world;	LC (IUCN 2009)
	South Asia;	LC (Molur et. al 2002)
	Nepal;	LC (Molur et. al 2002)

Population: a colony of six individuals was observed hibernating in the cave at Godawari.

H. cineraceus (Blyth, 1853)

Common Name: Least leaf-nosed Bat (IUCN 2009)

Nepali Name: Fusro Golopatre Chamero (Baral and Shah 2008)

Conservation status:	In world;	LC (IUCN 2009)
	South Asia;	NT (Molur et. al 2002)
	Nepal;	NT (Molur et. al 2002)

Status: Two adult male individuals were mist netted at the entrance of the Bagh cave at Chobhar. All of them were non-reproducing.

Population: 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.

External characters: Average Forearm length measured is 37.5mm (2) ranging 37mm-38mm. Dorsal pelage is dull brown with whitish hair bases and ventral pelage is ginger brown at the lateral sides and shoulders while a large white patch is covering the chest and belly.

Remark; The ear of Hc1 is markedly grooved with longitudinal ridges while that of Hc2 is not impressive.

Habitat and Habit: Cave roosting (but their roosting site/s inside the cave was not found). The flight emergence was noted 5:45 in the evening. Two males were mist netted during 5:42 PM and 5:50 Pm one after another at the entrance of Bagh Cave, Chobhar on 31st December 2009. The bat detector Magenta Mkllb detected the frequency of 50 KHz. Maximum flight was observed at the entrance of Bagh Cave.

Family: Rhinolophidae

Rhinolophus affinis (Horsfield, 1823)

Common Name: Intermediate Horseshoe Bat (IUCN 2009)

Nepali Name: Majhauula Ghodnaale Chamero (Baral and Shah 2008)

Conservation status:	In world;	LC (IUCN 2009)
	South Asia;	LC (Molur et. al 2002)
	Nepal;	LC (Molur et. al 2002)

Status: Three adult male individuals were scoop netted (Ra1 and Ra2 inside the cave, 100m from the entrance, at Godawari while Ra4 inside the tunnel, 200m from the entrance, at Pharping Powerhouse). Two adult females were netted (Ra5 scoop netted inside the tunnel, 200m from the entrance, at Pharping Powerhouse while Ra6 mist netted at the entrance of the Nagarjuna Cave). One young male was scoop netted inside the cave, 100m from the entrance, at Godawari. All of them were non-reproducing.

Population: Six individuals were netted. Found roosting in a pair inside the tunnel, at Pharping Powerhouse. Population could not be estimated.

External characters: Average Forearm length measured is 53.83 (6) ranging from 50mm-56mm. Dorsal pelage is buffy brown with whitish hair bases while tips rufous brown to light grey (Shining in the light) in Ra1, Ra2 and Ra3 while the ventral pelage has short hairs pale brown to grayish brown.

Remark; The pelage of Ra5 is brilliant orange.

Habitat and Habit: Cave roosting (but their roosting site/s inside the cave was not found). Also found roosting inside the tunnel, 200m from the entrance, at Pharping Powerhouse. The flight emergence was noted 9:40 PM (mist netted) in the late night at the Nagarjuna cave. The bat detector Magenta Mkllb detected the frequency of 90 KHz. Inundated with numerous parasites. Frequent chirping sound and restless during handling.

R. ferrumequinum (Schreber, 1774)

Common Name: Greater Horseshoe Bat (IUCN 2009)

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

Conservation status: In world; LC (IUCN 2009)
South Asia; VU (Molur et. al 2002)
Nepal;

Status: an adult but non-reproducing male was mist netted from the entrance, at Nagarjuna cave.

Population: single individual was mist netted. Population could not be estimated.

External characters: Forearm was measured 62mm. Pelage is long, soft and dense but not markedly wooly. Dorsal pelage was found drab brown with pale hair bases while the ventral pelage has short hairs of buffy brown color.

Remark; The third metacarpal is shorter than the fourth metacarpal and shorter than fifth metacarpal.

Habitat and Habit: Cave roosting (but their roosting site/s inside the cave was not found). The flight emergence was noted 7:58 PM (mist netted) in the night at the Nagarjuna cave. Inundated with numerous parasites.

R. macrotis (Blyth, 1844)

Common Name: Big-eared Horseshoe Bat (IUCN 2009)

Nepali Name: Laamkaane Ghodnaale Chamero (Baral and Shah 2008)

Conservation status: In world; LC (IUCN 2009)
 South Asia; NT (Molur et. al 2002)
 Nepal; NT (Molur et. al 2002)

Status: a young and non-reproducing male was mist netted from the entrance, at Nagarjuna cave.

Population: single individual was mist netted. Population could not be estimated.

External characters: Forearm was measured 45mm. Pelage is soft and dense, somewhat wooly. Dorsal pelage was found buffy brown while the ventral pelage has short hairs of pale brown color.

Remark; Ears relatively larger in comparison to the small body.

Habitat and Habit: Cave roosting (but their roosting site/s inside the cave was not found). The flight emergence was noted 5:58 PM (mist netted) in the evening at the Nagarjuna cave. It was found inundated with few parasites.

Family: Vespertilionidae

Myotis nipalensis (Dobson, 1871)

Common Name: Nepal Myotis (IUCN 2009)

Nepali Name: Nepali Musa-Kaane Chamero

Conservation status: In world; LC (IUCN 2009)
 South Asia;
 Nepal;

Status: an adult male and non-reproducing male was scoop netted inside the cave at Godawari, 150m from the entrance.

Population: single individual was scoop netted. Population could not be estimated. Good number of populations was supposed flying.

External characters: Forearm was measured 36mm. Pelage is soft, short and dense. Dorsal pelage was found ashy brown (dark brown or black) on the head, while the ventral pelage is cream colored.

Remark; Upper lips in the muzzle has hairy fringe.

Habitat and Habit: Cave roosting (but their roosting site/s inside the cave was not found). Supposed flying over water pool and open fields at the edge of foot-hill primary forest during the early evening.

Pipistrellus sp.

Status: an adult male and reproducing male was mist netted in the forest cover stream at Bajrabarahi.

Population: single individual was mist netted. Population could not be estimated. Good number of populations was supposed flying.

External characters: Forearm was measured 34mm. Pelage is soft, short and dense. Dorsal pelage was found dark brown (black at shoulder), hair bases are dark and tips ash colored, while in the ventral pelage belly is ash colored. Yellow brown colored at the neck and lateral sides.

Habitat and Habit: tree roosting (but their roosting site/s inside the cave was not found). Supposed flying over stream and open fields at the edge of primary forest cover during the early evening to 8:30 PM.

3.3. Community awareness radio programme

A contract for the program "Mammalian World" was signed with Radio Kantipur (www.radiokantipur.com) for 30 minutes broadcasting each Friday 7:30-8:00 AM from 22nd January, 2010. The programme is undergoing. Advertisement pamphlet of this program supported by RSG was done in schools, colleges, VDC offices, and promo of the program is being broadcasted from the Radio Kantipur.

3.4. School Lecture Programme

Lectures of 45 minutes were delivered to schoolchildren of classes 6, 7 and 8 at eight schools in six project sites (except classes 4 and 5 at one school at site 4). Among the eight schools; five were government school from sites 2, 3, 4,5 and 6 while three were private school from sites 1 and 3. In Site 3 programme was

launched in each (government and private) schools.

Brochures on “awareness for bat conservation” published by SMCRF was distributed among the schoolchildren. Two 5' * 2' flex of the brochure was also displayed in the lecture class. At last, a photograph of participating schoolchildren was taken with the banner.

4. Discussion

Five species and one family; Vespertilionidae, of bats were added to the monitoring study after the preliminary study conducted by Thapa et al., 2009. However, *Rhinolophus pusillus* was not found at the regular site: the Nagarjuna cave (Bates and Harrison, 1997; Malla, 2000, Thapa et al., 2009), Chobhar cave (Csorba et al., 1999), recently found roosting in 2008. It can be guessed that the species is summer migrant and roosts during summer and rainy season. Bats were present at some more sites during summer and rainy seasons only. Three more potential area of bats re-record was updated. The hibernating population was observed at some sites, some were missing even bat flights, at some sites bats flights were found frequent. *R. affinis*, *R. ferrumequinum*, and *R. macrotis* were first time recorded from Nagarjuna cave. The exact specific location in Kathmandu valley was missing before. *R. ferrumequinum* was first time found from Nagarjuna cave, the third site in Kathmandu valley. However, not found from the first site; Nagarkot (Bates and Harrison, 1997) and second site; Chobhar (Csorba et al., 1999). *R. affinis* was found at maximum sites, before the specific locations in Kathmandu Valley were not confirmed. Scoop netting of orange pelaged individual was experienced first time. *Hipposideros armiger* was absent from pre-recorded sundarijal tunnel (Sinha, 1973); Balaju Reserve Forest (Nagarjuna Forest) and Chobhar (Csorba et al., 1999), and first time re-recorded from Godawari after (Bates and Harrison, 1997). Population estimation of *H. cineraceus* was resulted from Chobhar cave. *Falsistrellus affinis* and *Pipistrellus javanicus* were not found as recorded before in Bates and Harrison, 1997. Among five *Myotis spp.* only *M. nipalensis* was re-recorded. *Megaderma lyra* could not be documented after Csorba et al., 1999. Three sites; Godawari, Bajrabarahi and Muhan Pokhari were found to be potential sites for bat assemblage to the pre-recorded three sites; Chobhar, Nagarjuna Forest, Sundarijal (Thapa et al., 2009). Re-recordings were failed from Nagarkot, Hattiban, and Sundarijal which were the prescribed sites (Bates and Harrison, 1997).

This first detailed monitoring also initiated the action-oriented conservation which aware the local s, students, schoolchildren about bats and their importance and expected to induce the conservation of bats in them. This project has become the first to start the radio-awareness program for bat conservation all

over Nepal, and this is the first kind of program in context of wildlife to broadcast through Radio Kantipur 96.1 and 101.8 MHz, leading FM station in the country.

5. Conclusion

Winter emigration of the bats and their colonies were observed. Bats were seen and netted majorly in the cave than outer space areas. Dense population of *Hipposideros cineraceus* was estimated. *Rhinolophus affinis* was frequently re-recorded from different sites. Three additional bats assemblage potential sites were recorded. Re-recording of remaining pre-recorded species as well as population estimation of other species still remained. Lectures to School children's in schools of remaining sites are left. Few episodes of radio-awareness program are going on.

6. Next Steps

Radio-awareness program, Lectures to schoolchildren and second phase survey in the project sites to be continued.

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ANNEXES

Photo Plates:



Left: Schedule survey in Tamang community at Godawari. Right: Mist netting at Godawari.



Left: Bat detector use at Godawari. Right: Temples nearby the water pool at Godawari.



Left: Statute of Lord Shiva inside a temple with patches of bat guano. Right: Camp fire inside the Chamere Gupha at Nagarkot.



Inside the Chamere Gupha at Nagarkot



Left: Mist netting at the entrance of Manjushree cave, Chobhar. Right: Inside the tunnel at Pharping Powerhouse.



Left: Inside the mine at Hattiban. Right: Pine forest above the mine at Hattiban.



Left: Stream at the Bajrabarahi forest edge. Right: Weighing a bat at Nagarjuna cave.



Left: Study area at Muhan Pokhari. Right: A pond at Bajrabarahi.



Left: Hiking in the Bajrabarahi forest. Right: Ground level mist netting at the Bajrabarahi forest edge.



Left: Schedule survey in Panidhara at Nagarjuna area. Right: Schedule survey in a Newar community at Nagarjuna area.



Left: A cave at Suryabinayak temple premises. Right: Climbing a tree for roost survey at Bajrabrahi.





Left: School Programme at Aatma Bikas Primary School, Muhan Pokhari. Right: Lecture to schoolchildren at Aatma Bikas Primary School, Muhan Pokhari.



School Programme at Baudeshwor Higher Secondary School, Jhor



Left: School Programme at Mohan Mala English School, Jhor. Right: Brochure distribution at Halchowk Secondary School, Swoyambhu.



Left: A student reading the brochure at Naldum Secondary School, Nagarkot. Right: Lecture to schoolchildren of Bajrayogini Higher Secondary School, Bajrayogini, Chapagaun.



Left: Demonstrating bat detector to schoolchildren of CPS Residential School, Godawari. Right: School Programme at Crescent Academy, Godawari.



Radio awareness programme advertisement at schools' noticeboards.



Left: *Hipposideros armiger* colony at Godawari. Right: *Myotis nipalensis*.



Left: *Rhinolophus affinis* at Godawari cave. Right: Bats flying behind mist net placed at the entrance of Bagh cave at Chobhar.



Left: *Hipposideros cineraceus* (with less distinct ear longitudinal ridges) at Chobhar. Right: *H. cineraceus* (with distinct ear longitudinal ridges) at Chobhar.



Left: *R. affinis* at Pharping (Male). Right: *R. affinis* at Pharping (Female).



Left: Bat mist netted at Bajrabarahi. Right: *Pipistrellus* sp.



Left: *R. affinis* at Nagarjuna. Right: *R. ferrumequinum*.



R. macrotis.

Table 1. Details of School lecture Programme

Site No:	Site	Date of lecture	School Name	No. of School children participating
1	Godawari-Phulchowki	Nov. 2, 2009	Crescent Academy	108
		Nov. 3, 2009	CPS Residential School	47
2	Swoyambhu	Dec. 3, 2009	Shree Halchowk Secondary School	120
3	Jhor	Dec. 8, 2009	Mohan Mala English School	60
		Dec. 9, 2009	Shree Baundeshwor Higher Secondary School	150
4	Muhan Pokhari	Dec. 13, 2009	Shree Aatma Bikas Primary School	40
5	Bajrabarahi	Dec. 18, 2009	Shree Bajrabarahi Secondary School	105
6	Nagarkot	Dec. 23, 2009		115

Table 2. Bats captured in different sites and their characters

Site No:	Site Name	Date	Species netted	No. of individuals	Sex	Age	Repro-status
1	Godawari-Phulchowki	Nov. 1-3, 2009	<i>Myotis nipalensis</i>	1	M (all)	A	R
			<i>Rhinolophus affinis</i>	3		2A (Ra1, Ra2), 1Y (Ra3)	NR (all)
2	Naagdaha	Nov. 13-14	-	-	-	-	-
3	Bajrayogini	Nov. 16-17	-	-	-	-	-
4	Machhegaun	Nov. 20-21	-	-	-	-	-
5	Taudaha	Nov. 22-23	-	-	-	-	-
6	Swoyambhu	Dec. 2-4	-	-	-	-	-
7	Pashupati (Slesmantak Forest)	Dec. 5-6	-	-	-	-	-
8	Jhor	Dec. 7-9	-	-	-	-	-
9	Muhanpokhari	Dec. 11-13	-	-	-	-	-
10	Laakuribhanjyang	Dec. 15-16	-	-	-	-	-
11	Bajrabarahi (Bungmati)	Dec. 17-19	<i>Pipistrellus sp.</i>	1	M	A	R
12	Nagarkot	Dec. 22-24	-				
13	Suryabinayak (Sipadol)	Dec. 25-26	-				
14	Hattiban (Chalnakhel)	Dec. 27-28	-				
15	Pharping	Dec. 29-30 (day)	<i>Rhinolophus affinis</i>	2	1M (Ra4), 1F(Ra5)	A (all)	NR(all)
16	Chobhar	30 (night)-31 Dec.	<i>Hipposideros cineraceus</i>	2	M (all)	A (all)	NR(all)

17	Nagarjuna	Jan. 5-7, 2010	<i>Rhinolophus macrotis</i>	1 (all)	M	Y	NR (all)
			<i>Rhinolophus ferrumequinum</i>		M	A	
			<i>Rhinolophus affinis</i>		F	A	
18	Sundarijal	Jan. 18-19, 2010	-	-	-	-	-
19	Gokarna	Jan. 20-21, 2010	-	-	-	-	-

Note: M=Male; F=Female; A=adult; Y=Young; NR=Non-Reproducing.

Table 3. External measurements of captured bats

Measurements (mm) ⇒ Species ↓		HB	T	TIB	HF	FA	Thumb	WSP	E	Tragus (height)	NL (height)	NL (breadth)	Wt. (gm)
<i>Rhinolophus affinis</i>	Ra1	65	25	25	10	55	13		19		13	9	20
	Ra2	55		25	9	55	15		15		15	9	15
	Ra3	51	24	24	8	54	13		15		12	8	11
	Ra4	52	26	28	9	56		310	16		14	10	16
	Ra5	59	28	27	11	53		360	12				20
	Ra6	45	20	23	6	50	12	280	13		14	8	10
<i>R. ferrumequinum</i>		65	34	22	10	62	10	360	22		18	10	30
<i>R. macrotis</i>		45	20	20		45		240	20		15	9	10
<i>Hipposideros cineraceus</i>	Hc1	45	25	15	5	38		240	15			4	10
	Hc2	37	25	17	6	37	5	210	14			4	8
<i>Myotis nipalensis</i>		44	33	17	8	36	7		13	6			7
<i>Pipistrellus sp.</i>		48	28	15		34	6	240	8				6

Table 3 continued.

Measurements \Rightarrow (mm) Species \Downarrow		3mt	4mt	5mt	1ph3mt	2ph3mt	1ph4mt	2ph4mt	1ph5mt	2ph5mt
<i>Rhinolophus affinis</i>	Ra1	38	41	44	14	30	10	17	13	15
	Ra2	45	41	43	15	32	11	19	12	15
	Ra3	36	39	41	11	28	8	17	10	16
	Ra4	40	42	45	16	30	10	17	13	11
	Ra5	40	42	44	14	30	10	18	13	15
	Ra6	35	38	40	14	29	10	16	10	12
<i>R. ferrumequinum</i>		40	44	48	20	38	13	22	15	20
<i>R. macrotis</i>		30	34	34	14	18	8	11	10	12
<i>Hipposideros cineraceus</i>	Hc1	25	28	28	20	14	10	6	12	10
	Hc2	25	27	27	16	13	9	7	11	10
<i>Myotis nipalensis</i>		34	31	31	11	17	9	10	9	9
<i>Pipistrellus sp.</i>		28	30	25	13	19	11	8	5	

Note: HB=Head Body; T=Tail; TIB=Length of Tibia; FA=Forearm; 3mt=Third Metacarpal; 4mt=Fourth Metacarpal; 5mt=Fifth Metacarpal; 1ph3mt=First Phalange Third Metacarpal; 1ph4mt= First Phalange Fourth Metacarpal; 1ph5mt= First Phalange Fifth Metacarpal; 2ph3mt=Second Phalange Third Metacarpal; 2ph4mt= Second Phalange Fourth Metacarpal; 2ph5mt= Second Phalange Fifth Metacarpal; E=Ear (Pinna from base to tip); Wt. =Weight; NL=Nose leaf.