

# The mammalian fauna from the Central Himalaya, Nepal

Hem Bahadur Katuwal<sup>1,2,\*</sup>, Bhaiya Khanal<sup>3</sup>, Khadga Basnet<sup>1</sup>, Bhim Rai<sup>4</sup>, Shiva Devkota<sup>5,6</sup>,  
Sanjeev Kumar Rai<sup>5</sup>, Michael Nobis<sup>6</sup> and Christoph Scheidegger<sup>6</sup>

<sup>1</sup>Central Department of Zoology, Tribhuvan University, Kathmandu, Nepal

<sup>2</sup>Small Mammals Conservation and Research Foundation, Kathmandu, Nepal

<sup>3</sup>Natural History Museum, Tribhuvan University, Kathmandu, Nepal

<sup>4</sup>Wilder Places Treks, Kathmandu, Nepal

<sup>5</sup>Central Department of Botany, Tribhuvan University, Kathmandu, Nepal

<sup>6</sup>Swiss Federal Research Institute WSL, Zurcherstrasse 111, CH-8903 Birmensdorf, Switzerland

(Accepted June 1, 2013)

## ABSTRACT

Nepal harbors unique mammalian fauna, but it is poorly studied at higher elevation. Mammalian fauna were recorded in Manaslu Conservation Area, Dudhkunda and Dudhkoshi valley of Solukhumbu district and Kanchenjunga Conservation Area of Nepal during March 2011 to April 2013 along the trail and the study plots from 700m to 4400m a.s.l. Semi-structured interviews were made with local people to understand their behavior and habitats. Altogether, 29 mammalian fauna were recorded. Five species were recorded new for the areas. Overall, Carnivore species (nine) were encountered more, followed by species of the order Cetartiodactyla (seven). The highest number of mammalian fauna (18) was identified from Manaslu Conservation Area whereas the least (11) from Dudhkunda and Dudhkoshi valley. Human wildlife conflict was frequent with Himalayan Goral (*Naemorhedus goral*), Barking Deer (*Muntiacus vaginalis*), Himalayan Tahr (*Hemitragus jemlahicus*), Rhesus Macaque (*Macaca mulatta*), Nepal Grey Langur (*Semnopithecus schistaceus*) and Himalayan Black Bear (*Ursus thibetanus*) for crop depredation in these areas. Although mammalian research started a long time ago, scenario of comprehensive research is not satisfactory in the Central Himalaya, Nepal.

**Key words:** mammalian fauna, human wildlife conflict, comprehensive research, Central Himalaya, Nepal

## INTRODUCTION

Nepal harbors 208 mammalian species constituting 4.2% of world's mammalian species (Baral and Shah, 2008; Jnawali *et al.*, 2011). Nepal shares mammalian fauna of both Oriental and Palaearctic region (Hunter and Yonzon, 1993) which makes its mammalian fauna more unique. The study on mammalian fauna started in the early 1820's in Nepal. However, more comprehensive studies were accomplished by Hodgson and Grey from 1830-1850 (Abe, 1971) and they were updated by Chesmore (1970), Abe (1971), Mitchell (1975), Mitchell and Punzo (1976). Simultaneously, other researchers mostly studied Cetartiodactyla (Seidensticker, 1976; Wegge, 1979; Mishra, 1982; Green, 1986; Kushwaha, 1986; Shrestha, 1989; Dhungel and O'Gara, 1991, Smith, 1993; Moe and Wegge, 1994; Gurung, 1995; Lasiwa, 1999; Aryal, 2005, 2009) followed by Carnivora (Jackson, 1979; Jackson and Ahlborn, 1990; Yonzon, 1989; Yonzon and Hunter, 1991; Ale *et al.*, 2007; Chetri, 2005, 2007, 2008; Ghimirey and Pal, 2009, Karki *et al.*, 2009; Sharma and Belant, 2009; Ghimirey, 2010); Lagomorpha (Kawamichi, 1968, 1971; Oliver, 1985; Bell, 1986, 1987; Khanal and Shrestha, 2000; Khanal, 2007; Yadav *et al.*, 2008; Thapa *et al.*, 2011), Perissodactyla (Chetri and Pokhrel, 2005; Khandel and Jhala, 2008; Jnawali *et al.*, 2009), Chiroptera (Mitchell, 1980; Csorba *et al.*, 1999; Molur *et al.*, 2002; Thapa, 2008, 2010; Thapa and Thapa, 2009;

Acharya *et al.*, 2010) and Primates (Chalise, 2003, 2008; Wada, 2005; Sayers and Norconk, 2008). Besides these, few studies on Pholidota (Gurung, 1996; Kaspal, 2008; Suwal, 2011), Rodentia (Mitchell, 1979; Ingles *et al.*, 1980; Mekada *et al.*, 2001; Molur *et al.*, 2005), Proboscidea (Pradhan and Wegge, 2007; Pradhan *et al.*, 2007) can also be found in Nepal.

Most of the studies mentioned above were concentrated in protected areas, but many species still exist in the areas where the habitat is vulnerable. Jnawali *et al.*, (2011) concluded that most of the mammalian species were threatened and their distribution poorly known. Twenty seven species of mammals are protected by the Department of National Parks and Wildlife Conservation Act 1973 in Nepal. Due to habitat loss, poaching, reduction in prey and diseases, around 4% of mammalian species were considered Critically Endangered, 12% Endangered, 7% Vulnerable, 3% Near Threatened, 35% Least Concern and remaining species being Data Deficient (38%) as per IUCN Red List category (Jnawali *et al.*, 2011). Bhuju *et al.*, (2007) reported 13 species of mammals from Kanchenjunga Conservation Area (KCA), 21 in Manaslu Conservation Area (MCA) and 33 species in Sagarmatha National Park (SNP). However, KMTNC (1998) had reported 33 species of mammals from MCA. These mammalian lists were compiled on the basis of data from discussions with local people. Since then there was a big gap in monitoring in the Central Himalaya. Thus, this research was conducted

\*Corresponding Author's E-mail: hello2hemu@gmail.com

with the objectives of recording the mammalian fauna from both protected and outside protected areas of the Central Himalaya, Nepal.

## MATERIALS AND METHODS

### Study area

The study sites included protected areas, community forests and government managed forests of Central Himalaya, Nepal. The surveys were carried out from March 2011–April 2013. Nubri and Tsum river valleys of Manaslu Conservation Area (MCA) of Gorkha district (N28°28'35.0178", E84°41'23.1"), Olanchungola and Ghunsa river valleys of Kanchenjunga Conservation Area (KCA) of Taplejung district (N27°37'32.6958", E87°46'34.7982") and Dudhkunda and Dudhkoshi river valleys with Sagarmatha National Park and its buffer zones (SNPBZ) and parts of community forests and government managed forests of Solukhumbu district (N27°47'27.5028", E86°39'39.9882") were chosen for the study of the mammalian fauna (Figure 1). The climate varies from subtropical to alpine zones in these sites. Precipitation occurs in the form of rain in lower elevations and in the form of snow at higher elevations. The vegetation pattern varies along the elevational zones. The vegetation of the subtropical zone (up to 1000 m) is characterized by *Shorea robusta*, *Dalbergia sissoo*, *Acacia catechu* and *Bombax ceiba*. The Mahabharat Range (1000–2000 m) harbors the mixed forests of *Schima wallichii*, *Castanopsis indica*, *Pinus roxburghii* and *Alnus nepalensis*, the sub-alpine zone (3000–4100 m) is characterized by *Abies spectabilis*, *Pinus wallichiana*, *Betula utilis* and *Rhododendron* spp., above 4100m there is an alpine zone comprising the scrubs of *Juniperus* spp., *Rhododendron* spp., *Caragana* spp., and alpine meadows (Acharya *et al.*, 2011).

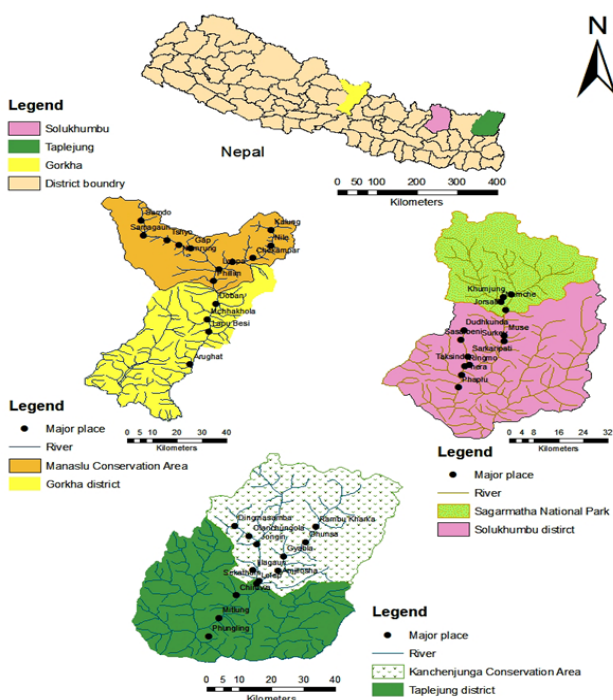


Figure 1. Map of study areas in Central Himalaya, Nepal

The Budigandaki and Siyar of Gorkha, Salleri and Dudhkoshi of Solukhumbu and Tamor and Ghunsa of Taplejung are the major rivers in the study area.

### Methods

The species were observed and recorded along the trails and study plots of the project (see Scheidegger *et al.*, 2010) during daytime between 700m a.s.l. to 4400m a.s.l. Semi-structured interviews (Chin and Pantel, 2009) were conducted with some local people to understand their peculiar behavior and typical habitats. Indirect evidences such as footprints and fecal matters were studied for some species. Field identification was done with the help of book "Wild Mammals of Nepal" (Baral and Shah, 2008) and unidentified species were identified by related field experts from Nepal and abroad from photographs.

## RESULTS/OBSERVATIONS

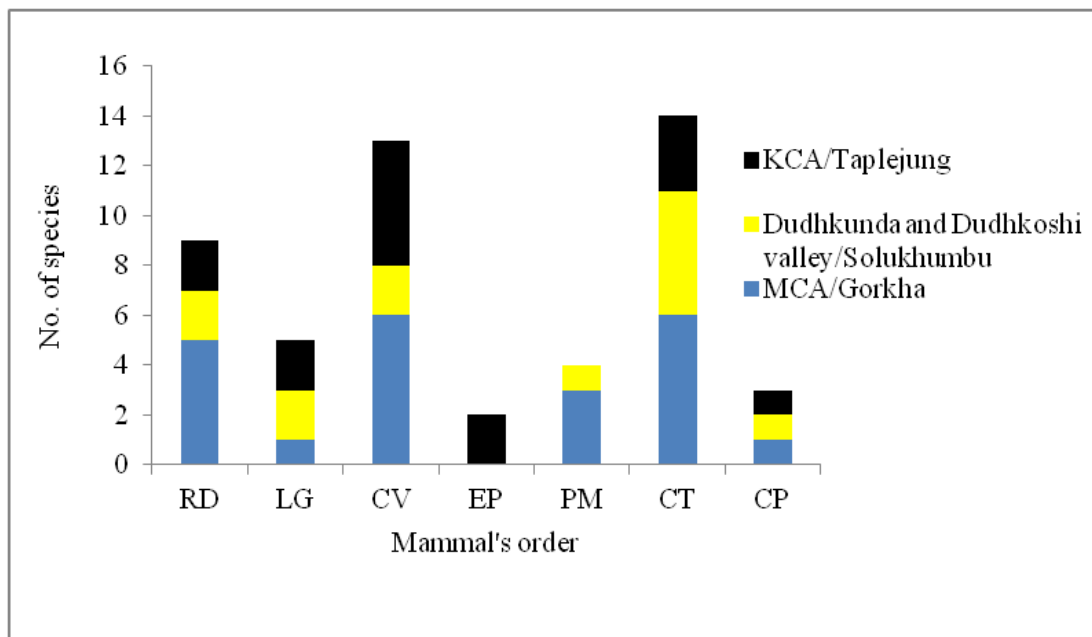
Altogether, 29 species of the mammalian fauna belonging to 14 families of seven orders were recorded during the survey in the study areas (Table 1).

Five species of Rodentia, two species of Lagomorpha, and Eulipotyphla, seven species of Cetartiodactyla, three species of Primates and nine species of Carnivora were documented during the visits (Table 1, Figure 2). There might be at least two species of unidentified bats (Chiroptera), voles and mice (Muridae) respectively, which were observed but couldn't be identified as they were not captured. The dried seats of some carnivore species were frequently encountered but could not be identified. The highest number of species (18) was recorded from MCA whereas the least (11) from Dudhkunda and Dudhkoshi valley (Table 1). Himalayan Marmot (*Marmota himalayana*) was observed only in MCA whereas Orange-bellied Himalayan Squirrel (*Dremomys lokriah*) from all of the areas. A cut off tail of a Flying Squirrel was observed in the forest of Domje/Gho (MCA), which signified the presence of Red Giant Flying Squirrel (*Petaurista petaurista*) or Particolored Flying Squirrel (*Hylopetes alboniger*). The exact species could not be identified. Royle's Pika (*Ochotona roylei*) was observed in all areas but Large-eared Pika (*Ochotona macrotis*) only from Dudhkunda valley and KCA. Fawn-colored Mouse (*Mus cervicolor*) and Siberian Weasel (*Mustela sibirica*) were recorded for the first time from MCA. Siberian Weasel (*Mustela sibirica*) was in dark form with black color at the tip of its tail. Stone Marten (*Martes foina*) was found hanged at house to threaten other species at Shyo, MCA. Simultaneously, Altai Weasels (*Mustela altaica*) from SNPBZ and KCA were new records to the corresponding protected areas. Yellow-throated Marten (*Martes flavigula*) at KCA was observed at its highest elevation (3450m a.s.l). Golden Jackal (*Canis aureus*) and Dhole (*Cuon alpinus*) were sighted at MCA and KCA respectively. Thus Carnivore species were recorded more than other species (Table 1). Two shrews, Elegant Water Shrew (*Nectogale elegans*) and Arboreal Brown-toothed Shrew (*Episoriculus macrurus*) were recorded for the first time from KCA.

People living in the protected areas put pressure on the wild fauna of the area. Primates were not sighted at

**Table 1.** Total number of species recorded during two years of expedition in the Central Himalaya, Nepal (species classification based on Baral and Shah, 2008; Jnawali *et al.*, 2011)

Order	Family	Common Name	Latin Name	Location	Observed Habitat	Elevation (m)
Rodentia	Sciuridae	Himalayan Marmot	<i>Marmota himalayana</i> (Hodgson, 1841)	MCA	Alpine meadow with bushes of <i>Rosa</i> and <i>Berberis</i> spp.	3200-4400
		Orange-bellied Himalayan Squirrel	<i>Dremomys lokriah</i> (Hodgson, 1836)	MCA, SNP, KCA	Broad leaved forest	1800-2600
		Flying Squirrel	.....	Domje, Gho/MCA	Broad leaved forest	2600
	Muridae	Fawn-colored Mouse	<i>Mus cervicolor</i> Hodgson, 1845	Chhekampar/MCA	Settlements	3000
		Mice, Voles, Rats	-----	MCA, SNP, KCA	Settlements and forest	1500-3000
Lagomorpha	Ochotonidae	Royle's Pika	<i>Ochotona roylei</i> (Ogilby, 1839)	MCA, Dudhkunda valley, KCA	Meadow and rocky places	3200-4400
		Large-eared Pika	<i>Ochotona macrotis</i> (Günther, 1875)	Dudhkunda valley, KCA	Meadow and rocky places	3800
Carnivora	Felidae	Jungle Cat	<i>Felis chaus</i> Schreber, 1777	Simwa/Near KCA	Forest	1400
	Herspestidae	Small Asian Mon-goose	<i>Herpestes javanicus</i> (É. Geoffroy Saint-Hilaire, 1818)	Arughat/Gorkha	Settlements	700
	Canidae	Golden Jackal	<i>Canis aureus</i> Linnaeus, 1758	MCA	Cultivated land, forest and alpine meadow	3000-3800
		Dhole	<i>Cuon alpinus</i> (Pallas, 1811)	Illagaun/KCA	Forest	2600
	Ursidae	Himalayan Black Bear	<i>Ursus thibetanus</i> G.[Baron] Cuvier, 1823	MCA, SNP, KCA	Forest	2200-3200
	Mustelidae	Yellow-throated Marten	<i>Martes flavigula</i> (Boddaert, 1785)	MCA, KCA	Settlements	1300-3450
		Stone Marten	<i>Martes foina</i> (Erxleben, 1777)	Shyo/MCA	Settlements	3400
		Mountain/Altai Weasel	<i>Mustela altaica</i> Pallas, 1811	Lausiasa /SNPBZ, Dinga Samba/ KCA	Settlements and riverine forest	3400-3800
		Siberian Weasel	<i>Mustela sibirica</i> Pallas, 1773	MCA	Settlements	2600-3300
	Eulipotyphla	Soricidae	Elegant Water Shrew	<i>Nectogale elegans</i> Milne-Edwards, 1870	Illagaun/KCA	River
Arboreal Brown-toothed Shrew			<i>Episoriculus macrurus</i> (Blanford, 1888)	Rambukharka/KCA	Meadow with forest	3800
Primates	Cercopithecidae	Nepal Grey Langur	<i>Semnopithecus schistaceus</i> Hodgson, 1840	MCA, SNP	Settlements and forest	2000-3200
		Assam Macaque	<i>Macaca assamensis</i> M'Clelland, 1840	MCA	Rocky hills	1200-1600
		Rhesus Macaque	<i>Macaca mulatta</i> (Zimmermann, 1780)	MCA	Croplands	1200-2200
Cetartiodactyla	Moschidae	Alpine Musk Deer	<i>Moschus chrysogaster</i> (Hodgson, 1839)	Khumjung/SNPBZ	Forest	3000-3800
		Himalayan Musk Deer	<i>Moschus leucogaster</i> Hodgson, 1839	Namrung/MCA	Forest	3000
	Cervidae	Barking Deer	<i>Muntiacus vaginalis</i> (Boddaert, 1785)	MCA, SNP, KCA	Forest	1200-2500
	Bovidae	Himalayan Tahr	<i>Hemitragus jemlahicus</i> (C.H. Smith, 1826)	MCA, SNP	Forest	2800-3800
		Blue Sheep	<i>Pseudois nayaur</i> (Hodgson, 1833)	MCA, KCA	Alpine meadow with bushes of <i>Rosa</i> and <i>Berberis</i> spp.	3800-4400
		Himalayan Goral	<i>Naemorhedus goral</i> (Hardwicke, 1825)	MCA, SNPBZ, KCA	Cultivated land and forest	1200-3200
			Himalayan Serow	<i>Capricornis thar</i> Hodgson, 1831	Namrung/MCA, Phera and Chadung / Dudhkoshi valley	Forest and meadow
Chiroptera	Unidentified	Bats	-----	MCA, SNPBZ, KCA	Flying	2000-2600



**Figure 2.** Total number of species of different orders of mammals sighted in each study area (RD-Rodentia, LG-Lagomorpha, CV-Carnivora, EP- Eulipotyphla, PM-Primates, CT- Cetartiodactyla and CP-Chiroptera).

KCA. Otherwise, most species of Primates and Cetartiodactyla were more frequently observed in all of the areas. However, Assam Macaque (*Macaca assamensis*) and Himalayan Musk Deer (*Moschus leucogaster*) were observed in MCA whereas Alpine Musk Deer (*Moschus chrysogaster*) only in Khumjung. Himalayan Goral (*Naemorhedus goral*), Barking Deer (*Muntiacus vaginalis*), Himalayan Tahr (*Hemitragus jemlahicus*), Rhesus Macaque (*Macaca mulatta*), Nepal Grey Langur (*Semnopithecus schistaceus*) and Himalayan Black Bear (*Ursus thibetanus*) were in conflict with the people due to crop depredation. As a consequence, survival of these animals was at risk in the studied areas due to retaliatory killings.

## DISCUSSION

The wildlife of higher elevations has been poorly explored. This is the first kind of comprehensive study on mammalian fauna of this region. Higher number of species was recorded from MCA, Gorkha district. This may be due to the landscape structure, easy accessibility and influence of Buddhism on non-killing of any kind of animals, even poultry and cattle in Tsum valley, MCA compared to other areas. Himalayan Marmots (*Marmota himalayana*) were social to human and prefer the food provided by herders. They were observed in alpine meadows at Shyo, Samagaun, Samdo, near Dhar-amshala and Kalung, with abundant burrows along the Larkepass of MCA. Aryal *et al.*, (2010) reported that Himalayan Marmots were excavated by Brown Bear (*Ursus arctos*) in MCA. Fawn-colored Mouse (*Mus cervicolor*) was caught at Chhekampar, Tsum valley. It was observed previously in Annapurna Conservation Area (Bhujju *et al.*, 2007), which is near MCA. Other Muridae were also observed but could not be identified. They were commonly observed within houses and near settlements. Orange-bellied Himalayan Squirrel (*Dremomys lokriah*) was commonly observed in oak-

rhododendron, bamboo, fir, alpine forests and nearby settlements of all study sites. Royle's Pika (*Ochotona roylei*) was observed in rocks near landslide, *Juniperus* spp., *Rhododendron* spp. and alpine scrub whereas Large-eared Pika (*Ochotona macrotis*) in dried alpine and spruce forest, as reported by Jnawali *et al.*, (2011) and Thapa *et al.*, (2011). One cut off tail of Flying Squirrel found in the area suggested the presence of Red Giant Flying Squirrel (*Petaurista petaurista*) or Particolored Flying Squirrel (*Hylopetes alboniger*) as reported by (KMTNC, 1998) and (Bhujju *et al.*, 2007) respectively. The squirrel might be hunted by some animals. Local people argued that Red Giant Flying Squirrel (*Petaurista petaurista*) was frequent in Gho, Lokpa and even at Jagat of MCA.

Most of the Carnivore species are solitary and nocturno-crepuscular (Hunter, 2011), so their presence could not be easily documented. During this study, most of the Carnivore species were observed within the protected areas except for Jungle Cat (*Felis chaus*) in Simwa, near KCA and Small Asian Mongoose (*Herpestes javanicus*) in Arughat, Gorkha. Golden Jackal (*Canis aureus*) was observed in Chhekampar, MCA, as also recorded previously by Bhujju *et al.*, (2007). People think that its population has been increasing rapidly during the last decade and constantly moving to Kalung, MCA (3800m) in search of more prey. Dhole (*Cuon alpinus*) was confirmed in MCA and SNPBZ (Bhujju *et al.*, 2007) and KCA (Khatiwada *et al.*, 2010). It often hunts yak and other domestic animals in these areas. Khatiwada *et al.*, (2010) reported 87% of livestock loss in KCA due to Dhole. Himalayan Black Bears (*Ursus thibetanus*) were widely distributed in mid hills of Nepal (Baral and Shah, 2008; Bista and Aryal, 2013). Conflicts with people due to crop depredation by Himalayan Bears were common in most of the areas of Nepal (Stubblefield and Shrestha, 2007; Bista and Aryal, 2013). A trap for Himalayan Bear was observed in Lokpa, MCA. Poaching of the animal was probably high in the area. The highest

elevation observation of Yellow-throated Marten (*Martes flavigula*) was from Ghunsa, KCA (3450m a.s.l.). They were mostly in pairs (Hunter, 2011) and frequently hunt the poultry. Siberian Weasel (*Mustela sibirica*) was in dark form, had black color at the tip of its tail, which is the typical character of the Himalayan species (Dr. Alexei V. Abramov, pers.comm. 2013). It was reported from Namrung, Chhekampar and Nilae of MCA. It used to visit the hotel rooms and sometimes eat chicken eggs. Stone Marten (*Martes foina*) was hanged at house near cultivated land at Shyo, MCA for protecting their poultry against other predators. Though Stone Marten was reported earlier by KMTNC (1998), but no proper records appeared afterwards (Bhujū *et al.*, 2007; Jnawali *et al.*, 2011). Mountain Weasel (*Mustela altaica*) sighted in Lausiasa in Sagarmatha and Dinga Samba (Olanchungola) in Kanchenjunga region was the first record of the species for these areas. In Lausiasa, it was observed within the settlements whereas in Dinga Samba/KCA, it was observed in the bank of Tamor river, far from the settlements.

Two shrews were found in KCA. Elegant Water Shrew (*Nectogale elegans*) was captured by the local fisherman in Tamor at Illagaun. The shrew gets entrapped occasionally in fish nets. Although they are often released, some of them may get killed. Arboreal Brown-toothed Shrew (*Episoriculus macrurus*) was observed in the alpine meadow in Rambukharka, Ghunsa, KCA. Detailed research should be conducted for a better understanding of this species' distribution and ecology. Similarly, Chiroptera species were not identified properly as they were not trapped. They were observed at Gaup, Lokpa, Chumling of MCA, Phera of Slukhumbu and Jongin of KCA. Thus, bats at higher elevations remain unexplored.

Four species of Primates are found in Nepal. Three species of Primates were observed in MCA but only Nepal Grey Langur (*Semnopithecus schistaceus*) was observed in Dudhkunda and Dudhkoshi valley of Solukhumbu district. Although Primates are common in KCA (Bhujū *et al.*, 2007) but they were not observed during this survey. Human-primates conflicts were common in these areas. There was an enormous crop loss annually in most of the areas due to Rhesus Macaque (*Macaca mulatta*) and Nepal Grey Langur (*Semnopithecus schistaceus*) but the people were not compensated by the authorities of these National Park and Conservation Areas. This scenario triggers the park people to hunt them illegally and clandestinely.

The large herbivores were adequately sighted previously in these areas (Bhujū *et al.*, 2007; Baral and Shah, 2008; Jnawali *et al.*, 2011). Common Goral (*Naemorhedus goral*), Barking Deer (*Muntiacus vaginalis*) and Himalayan Serow (*Capricornis thar*) share habitats at mid-hills (2000-3000 m), Himalayan Tahr (*Hemitragus jemlahicus*) and Musk Deer (*Moschus chrysogaster*) are common at around 2800-3800m, whereas Blue Sheep (*Pseudois nayaur*) independently graze mostly at higher altitude (3500-4500m) (Baral and Shah, 2008). Blue Sheep, Himalayan Tahr and Musk Deer were the important preys of the Snow Leopard (*Uncia uncia*) (Ale *et al.*, 2007; Chalise, 2011). Himalayan Serow (*Capricornis thar*) was observed near

Namrung at MCA and in most places from Surkey to Gonbo at Solukhumbu. It was recorded from MCA (KMTNC, 1998) but no proper documentation was available latter from the areas (Bhujū *et al.*, 2007; Jnawali *et al.*, 2011). Giri *et al.*, (2011) concluded that population of Himalayan Serow was getting isolated due to habitat degradation and lack of corridors. Local people disclosed that Himalayan Goral, Himalayan Tahr and Barking Deer were causing substantial crop loss in their areas.

## ACKNOWLEDGEMENTS

We acknowledge financial support from the Swiss National Science Foundation (grant JRP1Z70Z0\_131338/1 to C.S.), Prof. Dr. Krishna Kumar Shrestha, Central Department of Botany, Tribhuvan University, for project coordination, and Mr. Jyoti Prasad Gajurel, Central Department of Botany, Tribhuvan University, for helping in the fields. We are also thankful to the Department of National Parks and Wildlife Conservation, National Trust for Nature Conservation, Community Forest Users Groups of the areas for their consent and support in our endeavor. Sincere thanks go to Professor Karan Bahadur Shah, Natural History Museum, Mr. Yadav Ghimire, Friends of Nature, Dr. Alexei V. Abramov, Zoological Institute Russian Academy of Sciences, Russia for species identification and Mr. Sanjan Thapa, Small Mammals Conservation and Research Foundation for editing the manuscript. Special thanks are due to Tashi Sherpa, KCA, Jigdel Lama, Nenta Lama and Dorje Lama from MCA.

## REFERENCES

- Abe, H. 1971. Small mammals of Central Nepal. *Journal of the Faculty of Agriculture, Hokkaido University* 56: 367-423.
- Acharya, K.P., Vetaas, O.R. and Birks, H.J.B. 2011. Orchid species richness along Himalayan elevational gradients. *Journal of Biogeography* 38(9): 1821-1833.
- Acharya, P.R., Adhikari, H., Dahal, S., Thapa, A. and Thapa, S (compilers and editors). 2010. Bats of Nepal: A field guide. Small Mammals Conservation and Research Foundation (SMCRF), Kathmandu, Nepal.
- Ale, S.B., Yonzon, P. and Thapa, K. 2007. Recovery of snow leopard *Uncia uncia* in Sagarmatha (Mount Everest) National Park, Nepal. *Oryx* 41 (1): 89-92.
- Aryal, A. 2005. Status and Distribution of Musk deer in Manage District of Nepal. A Report submitted to ITNC, UK.
- Aryal, A. 2009. Habitat ecology of Himalayan Serow (*Capricornis sumatraensis* ssp. *thar*) in Annapurna Conservation Area of Nepal. *Tiger paper* 34(4): 12-20.
- Aryal, A., Sathyakumar, S. and Schwartz, C.C. 2010. Current status of brown bears in the Manasalu Conservation Area, Nepal. *Ursus* 21(1):109-114.
- Baral, H.S. and Shah, K.B. 2008. Wild Mammals of Nepal. Himalayan Nature, Kathmandu, Nepal.
- Bell, D.J. 1986. A study of the Hispid Hare *Caprolagus*

- hispidus* in Royal Suklphanta Wildlife Reserve, Western Nepal: A summary report. *Journal of Jersey Wildlife Preservation Trust* 23: 24-31.
- Bell, D.J. 1987. A Study of the Biology and Conservation Problems of the Hispid Hare, University of East Anglia, Norwich.
- Bhujju, U.R., Shakya, P.R., Basnet, T.B. and Shrestha, S. 2007. Nepal Biodiversity Resource Book-Protected Areas, Ramsar Sites and World Heritage Sites. 1<sup>st</sup> ed. ICIMOD, Kathmandu.
- Bista, R. and Aryal, A. 2013. Status of the Asiatic black bear *Ursus thibetanus* in the southeastern region of the Annapurna Conservation Area, Nepal. *Zoology and Ecology* 23(1): 83-87.
- Chalise, M.K. 2003. Assamese Monkeys (*Macaca assamensis*) in Nepal. *Primate Conservation* 19: 99-107.
- Chalise, M.K. 2008. Primate Census in Kathmandu and West Parts of Nepal. *Journal of Natural History Museum* 23: 60-64.
- Chalise, M. 2011. Snow Leopard (*Uncia uncia*), Prey Species and Outreach in Langtang National Park, Nepal. *Our Nature* 9: 138-145.
- Chesemore, D.L. 1970. Notes on the Mammals of Southern Nepal. *Journal of Mammology* 51(1): 162-170.
- Chetri, M. 2005. Status, Habitat use and conservation of Tibetan gazelle in Dhaulung Rangeland, Upper Mustang, Upper Mustang Biodiversity Conservation Project. National Trust of Nature Conservation. Nepal.
- Chetri, M. 2007. Gray wolf (*Canis lupus*) in Upper Mustang: Problems and Constraints in Conservation. *Greenery-a journal of environment and biodiversity* 97-103.
- Chetri, M. 2008. Brown Bear (*Ursus arctos*) from upper mustang. Prakriti. *Newsletter of the National Trust for Nature Conservation* 19-22.
- Chetri, M. and Pokhrel, A. 2005. Status and Distribution of Tibetan argali and Kiang in Damodar Kund area, Upper Mustang, Nepal. *Our Nature* 3: 56-62.
- Chin, S.Y. and Pantel, S. 2009. Pangolin Capture and Trade in Malaysia. In: Pantel, C. and Yun, C.S. (ed.). 2009. Proceedings of the Workshop On Trade And Conservation of Pangolins native to South And Southeast Asia, 30 June – 2 July 2008, Singapore Zoo 144-162.
- Csorba, G., Kruskop, S.V and Borissenko, A.V. 1999. Recent records of bats (Chiroptera) from Nepal, with remarks on their natural history. *Mammalia* 63(1): 61-78.
- Dhungel, S.K. and O'Gara, B.W. 1991. Ecology of the hog deer in Royal Chitwan National Park Nepal. *Wildlife Monographs* 119: 3-40.
- Ghimirey, Y. and Pal, P. 2009. First Camera Trap Image of Asiatic Golden Cat in Nepal. *CAT News* 47: 27-28.
- Ghimirey, Y. 2010. Assessing the status of small carnivores with a special focus on clouded leopard in Makalu-Barun national park. A report submitted to WWF Nepal Program. WWF Nepal, Kathmandu, Nepal.
- Giri, S., Aryal, A., Koirala, R.K., Adhikari, B. and Raubenheimer, D. 2011. Feeding Ecology and Distribution of Himalayan Serow (*Capricornis thar*) in Annapurna Conservation Area, Nepal. *World Journal of Zoology* 6 (1): 80-85.
- Green, M.J.B. 1986. The distribution, status and conservation of the Himalayan Musk Deer. *Biological Conservation* 35: 347-375.
- Gurung, J.B. 1995. Population, habitat selection and conservation of the Himalayan Tahr in Annapurna Sanctuary. M.Sc. Thesis. Agricultural University of Norway.
- Gurung, J.B. 1996. A pangolin survey in Royal Nagarjung Forest in Kathmandu, Nepal. *Tiger paper* 23(2): 29-32.
- Hunter, L. 2011. Carnivores of the world. Princeton University Press.
- Hunter, M.L. Jr and Yonzon, P. 1993. Altitudinal Distribution of Birds, Mammals, People, Forests and Parks in Nepal. *Conservation Biology* 7(2): 420-423.
- Ingles, J.M., Newton, P.N., Rands, M.R.W. and Bowden, C.G.R. 1980. The first record of rare murine rodent *Diomys* and further record of three shrew species from Nepal. *Bulletin of British Museum of Natural History (Zoology)* 39(3): 205-211.
- Jackson, R. 1979. Snow leopards in Nepal. *Oryx* 15: 191-195.
- Jackson, R. and Ahlborn, G. 1990. The role of protected areas in Nepal in maintaining viable population of snow leopards. *Intl. Ped. Book of Snow Leopard* 6: 51-69.
- Jnawali, S.R., Pradhan, N.M.B., Chapagain, N.R., Murphy, S. and Amin, R. 2009. The status and distribution of the greater one-horned rhino in Nepal, DNPWC, Kathmandu, Nepal.
- Jnawali, S.R., Baral, H.S., Lee, S., Subedi, N., Acharya, K.P., Upadhyay, G.P., Pandey, M., Shrestha, R., Joshi, D., Lamichhane, B.R., Griffiths, J., Khatiwada, A. and Amin, R (compilers). 2011. The Status of Nepal's Mammals: The National Red List Series. Department of National Parks and Wildlife Conservation, Kathmandu, Nepal.
- Karki, J.B., Jnawali, S.R., Shrestha, R., Pandey, M.B., Gurung, G. and Thapa (Karki), M. 2009. Tiger and Their Prey Base Abundance in Terai Arc Landscape Nepal. Government of Nepal, Ministry of Forests and Soil Conservation, Department of National Parks and Wildlife Conservation and Department of Forests.
- Kaspal, P. 2008. Status, Distribution, Habitat Utilization and Conservation of *Manis pentadactyla* Linnaeus, 1758 (*Chinese pangolin*) in the Community Forests of Suryabinayak Range Post, Bhaktapur District. M.Sc. Thesis. Environmental Science. Khowpa College, Bhaktapur.
- Kawamichi, T. 1968. Winter behavior of the Himalayan Pika, *Ochotona roylei*. *Journal of the Faculty of Science, Hokkaido University* 6(16): 582-594.
- Kawamichi, T. 1971. Daily activities and social pattern of two Himalayan Pikas, *Ochotona macrotis* and *O. roylei*, observed at Mt. Everest. *Journal of the Faculty of Science, Hokkaido University* 6 (17): 587-609.

- Khanal, B. 2007. New Report on the Symbiotic Relation of *Ochotona roylei* (Lagomorpha: Ochotonidae) and Scaly Breasted Wren Babbler (*Pnoepyge albiventer*) at Ganesh Himalaya Areas of Central Nepal. *Our Nature* 5: 37-40.
- Khanal, B. and Shrestha, K. 2000. Habitat preferences by Royle's pika (*Ochotona roylei*) in Gosaikunda, Rasuwa district of central Nepal. *Journal of Natural History Museum* 19: 27-33.
- Khandel, R.C. and Jhala, Y.V. 2008. Demographic Structure Activity Patterns, Habitat Use and Food habits of *Rhinoceros unicornis* in Chitwan National Park, Nepal. *Journal of Bombay Natural History Society* 105(1): 5-13.
- Khatiwada, A.P., Awasthi, K.D. and Gautam, N.P. 2010. The Pack Hunter (Dhole): Received Little Scientific Attention. *The Initiation* 8-13.
- KMTNC. 1998. Manaslu Conservation Area project proposal. King Mahendra Trust for Nature Conservation Report.
- Kushwaha, H.P. 1986. Comparison of census data for wild buffalo and domestic livestock (buffalo and cow) in KoshiTappu Wildlife Reserve. Institute of Forestry, Tribhuvan University, Nepal.
- Lasiwa, T.K. 1999. Population status Habitat mapping of Nilgai (*Boselaphus tragocamelus*) and vegetation analysis of South Western section of the Royal Bardia National Park, Nepal. M.Sc. Thesis. Central Department of Zoology, Tribhuvan University.
- Mekada, K., Koyasu, K., Harada, M., Narita, Y., Shrestha, K.C. and Oda, S-I. 2001. Faunal survey of small mammals in Central Nepal, with reference to the distribution of the genus *Soriculus* (Insectivora, Mammalia). *Biogeography* 3: 33-40.
- Mishra, H.R. 1982. The ecology and behaviour of Chital (*Axis axis*) in the Royal Chitwan National Park, Nepal. Ph.D. Thesis. University of Edinburgh, UK.
- Mitchell, R. and Punzo, F. 1976. New mammal records from Nepal. *Journal of the Bombay Natural History Society* 73 (1): 54-58.
- Mitchell, R.M. 1975. A checklist of Nepalese Mammals (excluding bats). *Saugetierkundliche Mitteilungen* 23: 152-157.
- Mitchell, R.M. 1979. The Sciurid Rodents (Rodentia: Sciuridae) of Nepal. *Journal of Asian Ecology* 1: 21-28.
- Mitchell, R.M. 1980. New records of bats (Chiroptera) from Nepal. *Mammalia* 44 (3): 339-342.
- Moe, S. and Wegge, P. 1994. Spacing behaviour and habitat use of axis deer (*Axis axis*) in lowland Nepal. *Canadian Journal of Zoology* 72(10): 1735-1744.
- Molur, S., Srinivasulu, C., Srinivasulu, B., Walker, S., Nameer, P.O. and Ravikumar, L. 2005. Status of non-volant small mammals: Conservation Assessment and Management Plan (C.A.M.P) workshop report. ZOO, CBSG-SA, WILD.
- Molur, S., Marimuthu, G., Srinivasulu, C., Mistry, S., Hutson, A.M., Bates, P.J.J., Walker, S., Padmapriya, K. and Binupriya, A.R. 2002. Status of South Asian Chiroptera: Conservation Assessment and Management Plan (C.A.M.P) workshop report.
- Oliver, W.L.R. 1985. The distribution and status of the Hispid Hare, *Caprolagus hispidus*, with some additional notes on the Pigmy Hog *Sus salvinius*. Jersey Wildlife Preservation Trust, Jersey.
- Pradhan, N.M.B., Wegge, P. and Moe, S.R. 2007. How does a re-colonizing population of Asian Elephants affects the forest habitat? *Journal of Zoology* 273 (2): 183-193.
- Pradhan, N.M.B. and Wegge, P. 2007. Dry season habitat selection by a recolonizing population of Asian elephants *Elephas maximus* in lowland Nepal. *Acta Theriologica* 52(2): 205-214.
- Sayers, K. and Norconk, M. 2008. Himalayan Langur *Semnopithecus entellus* at Langtang National Park, Nepal: diet, activity patterns, and resources. *International Journal of Primatology* 29(2): 509-530.
- Scheidegger, C., Nobis, M.P. and Shrestha, K.K. 2010. Biodiversity and livelihood in land-use gradients in an era of climate change- outline of a Nepal-Swiss research project. *Botanica Orientalis* 7: 7-17.
- Seidensticker, J. 1976. Ungulate populations in Chitawan valley, Nepal. *Biological Conservation* 10(3): 183-210.
- Sharma, H.P. and Belant, L.L. 2009. Distribution and observations of Red panda *Ailurus fulgens* in Dhorpatan Hunting Reserve, Nepal. *Small Carnivore Conservation* 40: 33-35.
- Shrestha, T.K. 1989. Biology, status and conservation of the Ganges River dolphin, *Platanista gangetica*, in Nepal. In: Perrin, W. F., Brownell, R. L. Jr., Zhou, K. and Liu, J. (eds), *Biology and Conservation of River Dolphins*. 70-76. IUCN Species Survival Commission Occasional Paper 3.
- Shrestha, T.K. 1997. Mammals of Nepal with reference to those of India, Bangladesh, Bhutan and Pakistan. Mandal Book Press and Bimala Shrestha. Kathmandu, Nepal.
- Smith, B. 1993. 1990 Status and Conservation of the Ganges River Dolphin (*Platanista gangetica*) in Karnali River, Nepal. *Biological Conservation* 66:159-170.
- Stubblefield, C.H. and Shrestha, M. 2007. Status of Asiatic black bears in protected areas of Nepal and the effects of political turmoil. *Ursus* 18(1): 101-108.
- Suwal, T.L. 2011. Status, Distribution, Behaviour and Conservation of Pangolins in private and Community Forest of Balthali in Kavre, Nepal. M.Sc. Central Department of Zoology, Tribhuvan University of Nepal.
- Thapa, A. and Thapa, S.B. 2009. Baseline Survey of bats roosting in Kailash Cave, Syangja district, Western Nepal. Small Mammals Conservation and Research Foundation, New Baneshwor, Kathmandu, Nepal.
- Thapa, A., Dahal, B.V., Koju, N.P. and Thapa, S. 2011. A Review on Pikas of Nepal. Small Mammals Conservation and Research Foundation, New Baneshwor, Kathmandu, Nepal.
- Thapa, S. 2008. Reporting Pteropus colonies and bat roosts from Eastern Nepal. *Bat net Newsletter* 9(1): 22-23.
- Thapa, S. 2010. Detailed monitoring survey of bats and their conservation through radio awareness

programme and outreach programme to school children in Kathmandu Valley. Rufford Small Grants Report.

Wada, K. 2005. The distribution pattern of rhesus and Assamese monkeys in Nepal. *Primates* 46(2): 115-119.

Wegge, P. 1979. Aspects of the population ecology of blue sheep in Nepal. *Journal of Asian Ecology* 1: 10-20.

Yadav, B.P., Sathyakumar, S., Koirala, R.K. and Pokharel, C. 2008. Status, distribution and habitat use of hispid hare (*Caprolagus hispidus*) in Royal Suklaphanta Wildlife Reserve, Nepal. *Tiger paper* 35(3): 8-14.

Yonzon, P.B. and Hunter M.L. Jr. 1991. Cheese, Tourists, and Red Pandas in the Nepal Himalayas. *Conservation Biology* 5(2): 196-202.

Yonzon, P.B. 1989. Ecology and Conservation of Red Panda in Nepal Himalaya. Ph.D. Thesis. University of Maine, Orono, USA.



**Plate 1.** (a) Alpine Musk Deer, (b) Altai Weasel, (c) Arboreal Brown-toothed Shrew, (d) Blue Sheep, (e) Himalayan Goral, (f) Elegant Water Shrew, (g) Fawan-colored Mouse, (h) Himalayan Marmot





**Plate 2.** (i) Himalayan Tahr, (j) Nepal Grey Langur, (k) Orange-bellied Himalayan Squirrel, (l) Rhesus Macaque, (m) Siberian Weasel, (n) Yellow-throated Marten, (o) Stone Marten, (p) Royle's Pika. Except Stone Marten (photo by Jyoti Prasad Gajurel), all photographs were taken by the first author.