

1. INTRODUCTION

1.1 General Background

Macaques (genus *Macaca*; Primate: Cercopithecidae) are an ecologically extremely adaptive primates which are distributed more widely than any other non-human primate genus. After a split off from the baboons, mandrills, drills and mangabeys, they moved out of Africa and today only the Barbary macaque (*Macaca sylvanus*) is still found in Africa. All other extant *Macaca* species occur in Asia, ranging from Pakistan, India, Nepal and Tibet in the west to the Northeastern tip of Japan and just South of the Wallace line in the Southeast (Thierry et al. 2004). Macaques are found in tropical rain forests across Asia but may live at high altitudes in the Himalayas and other temperate regions with long snowy winters (Schukle et al. 2011, Chalise 2013).

1.1.1 Primates

Primate is an order of mammals, which includes the monkeys, apes, humans and other similar forms typically having dexterous hands and feet, binocular vision and well developed brain. They are commonly called monkeys, excluding only the tree shrews; the lemur like form, the apes and humans and therefore embody tremendous evolutionary and adaptive arrangement of animals (Tattersall 1993). Of all the primates, monkeys, next to human have adapted best to widely diverse environmental conditions which are found in tropical forest, dry savannas, mountains, village, and temples and even in large cities (Van Hoff 1990).

Monkeys are included under the sub order Simiiae of order Primates. Further, monkeys according to the geographical distribution are categorized into two types: new world monkeys and old world monkeys. The new world monkeys lack cheek pouches and nostrils open two sides rather than down. Area between the nostrils is wide and flat. Most have long prehensile tail and non-have callous pads on the buttocks, eg. Spider monkeys, Capuchins etc. The old world monkeys have protruded muzzle and well developed cheek pouches, nostrils set close together facing forward and downward. The tail is never prehensile and some species are tail less. Both the hands and feet are adapted for

grasping. Callous pads on the buttocks are often bright and in case of females swollen during estrus period (Walker 1968).

Human and monkeys share the same root of evolution. The living inquiring minds the structure of the hand, the social system and mother infant relationship and manipulative skills of the monkeys certainly make us ponder about what W.S. Gilbert had said about man: “man however well behaved at best is only a monkey shaved”. In anatomy and behavior monkeys are our closest relatives. They may hold the key to our origins and the roots of what we considered the human characteristics of friendship, love, aggression and tool use (Linden 1992: Cited in Subba 1998).

Larger primates are widely hunted, many of the smaller ones are prized for commerce and the pet trade, and all suffer from habitat loss. Even where their forest remain, substance and commercial hunting in west and central Africa and south east Asia are resulting in vast areas of silent and empty forest. The 2000 IUCN Red List of Threatened species classifies primate's species and 224 species and sub species as threatened (Rylands 2001).

In Nepal, two species of macaques have been reported; Assamese macaque (*Macaca assamensis* McClelland 1840) and the Rhesus macaque (*Macaca mulatta* Zimmermann, 1780) among which the former one is less explored non-human primate of Nepal (Chalise 2000). *Macaca assamensis* is categorized as ‘Vulnerable’ and is one of the protected mammals by the Wildlife Protection Act 1973 of Nepal (Chalise 2013a). Distribution of *Macaca assamensis* is restricted to the Himalayan foothill regions of Nepal. It occurs from central Nepal east through the Himalaya to Southern most China and North and Central South-east Asia (Fooden 1982). It has never had intensive field study anywhere in South-east Asia, or, barely, in South Asia (Mitra 2002, 2003), so remains little known for such as a widespread monkey (Fooden 1982, Eudey 1991, Rowe 1996). It has conventionally been seen as a high land species (Lekagul and McNeely 1977), called it “an upland macaque, generally found in forested area above 500 m to as high as 3500 m”. A recent survey in Bhutan found Assamese macaques down to 600 m (Kawamoto et al. 2006). Choudhury (2008) referred to occurrences as low as 100 m, but detail information neither dealt nor discussed the finding.

This taxon is categorized as threatened due to its limited distribution of less than 22,000 km², an expected area of occurrence of about 914 sq. km. with ongoing decline in area,

lessening population and narrowing quality of habitat. As stated of its restriction of occurrence, rising threats to the individual and its habitat, and decreasing number in fragmented patches, the Nepal Assamese population is categorized as Endangered. As well as the National Parks and Wild life Conservation Act of 1973 lists the Assamese Macaque as a protected species of Nepal and appendix II of CITES (Chalise et al. 2005).

Because of their distribution pattern, Assamese macaque population would have been more influenced by forest habitat deterioration compared with rhesus macaque populations. The fragmented distribution of the Assamese macaque seems inadequate for maintaining a viable population in Nepal. There have been few studies to estimate the minimal viable population size necessary for the conservation of not only Assamese macaques, but also *Macaca* in general (Wada 2005). Species viability can be measured by evaluating population dynamics and environmental effects (Fa and Lind 1996).

Of equal concern is the fact that these animals are considered pest as a frequent crop raiding behaviour in Nepal and, as such conflict between local people and the macaque are on the rise, with an additional threat to the survival of present macaque population. In Nepal, crop damage is very common along the immediate periphery of National parks and protected area systems. Nevertheless, crop damage is not limited around or conservation area but also along the different habitat outside it (Chalise 2000a, 2001).

In Nepal, only three species of monkeys (Rhesus, Assamese monkeys and Hanuman langur) are recorded to date. The Rhesus monkeys (*Macaca mulatta*) are found freely ranging in wild as well as in urban religious places. The Assamese monkey (*Macaca assamensis*) reported from mid hills and high mountain forest of Nepal. The other species langur monkeys (*Semnopithecus entellus*) are found freely ranging in wild forest and marginal area of Nepal (Chalise 2013, Chalise and Johnson 2005).

1.1.2 The Primate Status and Phylogeny

There are 185 species list of primates available in the world with 28 species in Madagascar and about 50 each in Africa, S. America and Asia. Among the 52 Asian species, 44 species are recorded in south Asian countries (Sanjay et al. 2003). Primates are grouped again into- Strepsirrhines, the New World monkeys or Ceboidea, Platyrrhines- Old World monkeys and Man or Hominoids. All apes are offshoot of Old World

monkeys. Among the great apes orangutans, gorilla, chimpanzees resembles with other close relatives Human being in many capacities- social structure, taste, mental and emotional development and physiology. The little known pygmy chimpanzee, that resembles more than 98% with human, shows much more similarities in locomotion, communication and sexual behaviors (Jolly 1985). However, only three species (Hanuman Langur, Rhesus and Assamese Monkeys) are recorded so far in Nepal with their subspecies though densities as a whole are unavailable (Chalise et al. 2005a).

1.1.3 Assamese Monkeys

Assamese Monkeys of Nepal (so far named) is distinguished into a separate population as 'Nepal Population' from the existing two sub species (*M. a. assamensis* and *M. a. pelops*), based on the information on their colouration, head body tail length and its ratio, size variation and weight etc (Chalise 2013a). The other two existing species are from Assam, West Bengal and Garhwal, India and may be in Nepal too. Given its restricted extent of occurrence, threats on its population & habitat and small numbers in fragmented patches the status of this macaques is categorized as Nepal population and Endangered. It also rated the status of Endangered in distribution due to localization in Nepal only. The local vernacular names of this monkey are Pahare Bandar, Pupa, Timnyau, and KalaGanda (Chalise et al. 2005a, Chalise 2011).

Assamese monkeys are shy, timid and less aggressive to human beings in comparison to rhesus monkey. They are arboreal, terrestrial and omnivorous animals with multi-male and multi-female social troops (Chalise 2011). The Assamese monkey can be confused with the rhesus by general outlook and size but there is clear difference between them morphologically too. The orange red hue on the loins and rump is absent in this species while it also differs by general body coloration. It has darker fur in exposed area while whitish blonde-haired to ashy white in abdominal and inner parts. It has purple (eggplant color) snout particularly around the nose while crimsoned red to pinkish red around the eyes and chick (Chalise 1999; 1999a). Local saying finely reflects the fur color difference within a group as this species called 'Missal' means mixed group. The palm, sole and nails are dirty brown in color. The Ischial callosities in male are conspicuous from a distance and distinct in darker individuals. In higher elevation, the animals are with darker fur on back and whitish in abdominal parts resembling to Tibetan monkey.

General Assamese monkey consists of nearly 2 ft in head and body length while tail is one-third of it. It is heavier and larger than rhesus weighing more than 12 kg weight (Chalise 2003, 2011; Chalise et al. 2005a).

1.2 Distribution

Assamese monkeys inhabit in the mountains and hills along the Himalayas. It is recorded from Nepal, India (Mussoorie, Assam), upper Burma, south China and north Thailand ranging 610m to 1830m asl. Himalayan form has longer tail than Indian one. In Nepal, Chalise (2013) recorded it from 380 m in Mulghat Tamor to 2350m asl in Langtang. Mostly found in Mid-hills (warm temperate monsoon; cool temperate monsoon, 1000-3000m asl.) however they are recorded from lower elevation of 300m asl. Gorkha, Abukhaireni to Rimiche Langtang nearly 2500m asl. Assamese census was conducted in different occasion revealed that 1099 individual in 51 troops are recorded from East Makalu to West Api area of Nepal (Chalise 2013).

They are found in the Basin of Arun River around Apsuwa confluence, Bhumlingtar, Heluwabeshi; Tamor River, Bagmati, Trishuli, Sunkoshi, Gandaki and Karnali River basin at higher elevation but warmer valleys. Thus, Nepal population can be located in subtropical hill Sal forests areas to mixed deciduous forest, temperate broadleaved forest with rocky outcrops and along the riverside steep sloppy forests of above altitude. The species confirmed from Kimni Acham, Dadeldhura, Ramdi Palpa, Langtang NP and Helambu area, Makalu-Barun NP and Bhumlingtar, Hariharpur and Nagarjun forests of Kathmandu. The population so far recorded in Nepal from different sites shows altogether 282 mature individuals while total population with different age and sex comprises up to 525 (Chalise 2004, 2004a and 2005).

1.3 Statement of the Problem

Monkeys and human beings are in the sense that a particular species of monkey is popularly considered the remote ancestor of present day human. As well as human and monkey share the same roof of evolution. Man-monkey association is as old as man's own existence. Because of forest fragmentation and increasing land use by human beings, the Assamese macaques are facing pressures to utilize and adjust the new habitats

including orchard farms, private land, degraded forest area and abandoned land fringe area, which carry the conflict between human and monkey.

Human population growth and activities like deforestation, agriculture and urbanization lead to an ever increasing encroachment on wildlife habitats. The interface of wildlife habitat and human use dominated landscape has become ground for a wide range of human-wildlife conflict (Sinha et al. 2004).

The population is different from the Assamese monkeys decreased up to now from South-East Asia in respect to the head-body length, tail length, T/HB ratio and weight. The Body fur and facial colouration also differs in males and females than so far described population of this species (Chalise 2003, Chalise 2005).

In case of human-monkey conflicts, Annapurna Conservation Area including Taghring and Ghermu (Marsyandi River) area is no far an exception to this fate resulting in to man-monkey conflict which is likely to be intensified in future. As well there has been no detailed long term study in population structure, ecology behavior, distribution pattern throughout the Nepal as well as habitat utilization. It is essential to explore the present status, habits and habitat for the conservation of such species along the periphery of a famous Conservation area such as Annapurna Conservation Area- Project (ACAP).

1.4 Objectives of the Study

The major objective of the research was to assess the population status and distribution of Assamese macaque in Taghring and Ghermu VDC (Marsyandi River) in Annapurna Conservation Area of Western Nepal.

The specific objectives were as follows:

- To determine the population status of Assamese macaque in Taghring and Ghermu VDCs.
- To explore the spatial distribution of the Assamese macaque in the study area.
- To document the general behaviour of Assamese macaque in the study area.

1.5 Rationale of the Study

Non-human primates are not studied thoroughly in Nepal. Few research works had been done on population status and behaviors of primate (Chalise and Ghimire 1998 and Chalise 2006). In case of Assamese monkeys of different ecological zones of Nepal such as Lakuwa of Sankhuwasabha, Mulghat, Tapkedanda of Makawanpur, Helambu of Langtang, Gattekhola, Ramechhap, Phulchowki, Dhading, Phisling, Ramdi, Kaligandaki have already done the research work (Chalise 2008). In the case of *Macaca assamensis*, no research has been conducted in Lamjung District so far. This study explores the status of Assamese macaque in the northern belt of Lamjung in respect to population, distribution and general behaviour of the species. This study also determines the interaction of the animal with local people in the area. This study provides the reason for the human-macaque conflict and will help its management more effectively.

1.6 Limitation of the Study

- ❖ Due to the local people monkeys were offended in some places which made it difficult to see and follow the group regularly.
- ❖ Heavy tourist flow and freely moving domestic cattle in the conservation area disturbed the research work.
- ❖ The study was concentrated only for partial fulfillment of academic degree for masters in Zoology (Ecology). But were regular in each season in the fields.

2. LITERATURE REVIEW

Chalise (2003) studied Assamese macaques (*Macaca assamensis*) in Nepal. He estimated some differences from the Assamese macaques of Makalu-Barun Area from those so far described from Southeast Asia and recommended that in order to solve the taxonomic status, the molecular genetic studies is essential.

Cooper and Bernstein (2002) studied social grooming in Assamese macaque (*Macaca assamensis*) living on the Tukeshwari temple ground in Assam, India. Their study has shown in accordance with social grooming, females as long term inhabitants of this matrifocal group, groomed each other and juveniles more groomed one another or juvenile. In addition, males groomed female more often and for longer duration than female groomed males, but both males and females groomed juveniles more often than juveniles groomed them, juveniles groomed their elders for longer duration. Grooming was concluded that, function to establish and maintain affiliative social bonds rather than as a specific mechanism to obtain mating.

Cooper et al. (2005) studied the reconciliation and relationship quality of Assamese macaques group living near the Turkeshwari temple near Golpara, Assam, India. Their study stated that animals reconcile are likely to have strong social bonds. In which females reconciled more often with females with which they had stronger grooming and aiding relationship, which was significant for support to the aggressor and the victim, where as these couldn't be found in males. Their study provides evidence that females reconcile most often with valuable and compatible social partners.

Kawamoto et al. (2006) studied the distribution of Assamese macaques in the Inner Himalayan region of Bhutan and their mtDNA diversity. He recorded no group of Rhesus macaques (*Macaca mulatta*) in his survey, in contrast with the survey results in the Nepalese Himalayas. He concluded that the macaques of the Inner Himalayan regions in Bhutan are Assamese macaques and that they appear to be of a lineage distinct from Assamese macaque in the Indo-Chinese region (subspecies *Macaca assamensis assamensis*). He also concluded that on the basis of degree of mtDNA the Assamese macaque in Bhutan are of a more ancient ancestry than *Macaca assamensis assamensis*.

He suggested that the earlier speciation of Assamese macaques on the basis of greater mtDNA diversity than that of Rhesus macaques.

Khatriwada et al. (2007) stated that, the Assamese macaques are patchily distributed in the fragmented forests where they have been continuously facing the problem of habitat encroachment by the local people.

Regmi (2008) studied the status of Assamese macaque in Langtang National Park. He reported that a total of 213 Assamese macaques were encountered in 9 groups of 113 km² in which the group density was found to be 0.0790 groups/ km² with a population density of 1.8691 individuals/km² and a mean group size of 23.66 individuals within the total area surveyed of 113 km² at Langtang National Park. In addition, composition of Age-sex of macaque comprised 31% adult females, 16% adult males, 18% young, 16% juveniles and 19% were infants in the study area.

Chalise (2010) studied on Assamese monkey in Sebrubeshi of Langtang National Park, Nepal. The botanical quadrates data in their habitat revealed that the composition of forest was with 18 species trees and 12 species shrubs and herbs. According to this study, the monkeys spent time in forest (35%), rocky slope (30%), Barilam (27%), riverbed (4%) and lowland (4%) during their activities. Whereas the average troop composition was 14% adult male, 18% adult female, 24% sub-adult male, 20% young adult female, 10% juvenile and 14% infants.

Sarkar et al. (2012) studied activity profile of free ranging forest group of Assamese macaque, Jokai Reserved Forest (RF) Assam, India. They stated that the study group spent more than one third (40%) of their total annual time for foraging purpose, followed by 25% on locomotion, 13% on resting, 10% on grooming, 9% on monitoring, 1% on playing and 2% on sexual and other activities. The activity profiles of the forest group have revealed that foraging is the crucial factor responsible for the variation in the activity profiles. In forest, as the food was randomly distributed, the group arranged their total time cost-effectively and spent more time on foraging, locomotion and resting and less time in grooming, monitoring and play activities. They suggest that from their finding, nature of distribution of food resources is the guiding force for allocating time to various activities in different habitats.

Timmins and Duckworth (2013) studied Distribution and Habitat of Assamese macaque in Lao PDR, including its use of low altitude Karsts. They reported that the distribution and ecology of Assamese macaque remains little studied in south-east Asia. He stated that most records are from hill evergreen forest above 500m, consistent with standard literature, but the species occurs down to plains level (200m) on Karsts.

Bhattacharai (2002) studied the General Behavior and Habitat Use of Assamese macaque in Syabrubensi Area of Langtang National Park. He found that *Macaca assamensis* used broad-leaved conifer mixed forest and grassland with scattered trees of Urticaceae family abundantly. He recorded the time spent on sitting as highest as 33.3% followed by 29.6% on feeding, 28.2% on walking, 6.4% on grooming and 1.1% on mating. Chalise (2004) studied on Assamese macaque, major behaviour were recorded such as foraging (43.3%), moving (31.7%), sitting (18.5%), grooming (3.4%) and stone licking (1.7%).

Chalise (2004a) estimated a stable population of Rhesus monkeys species around 350 individuals in two religious places Pashupati and Swoyambhu area. Researcher suggested that clean water supply and restoration of natural habitat are urgently needed to manage these populations, which research work was done on the title of a case of population stability of semi-provisioned, free ranging temple Rhesus monkeys of Kathmandu valley, Nepal.

Nepal (2006) studied the habitat utilization of Rhesus monkey and its Conflicts with people in Shivapuri National Park, Nepal. He found that the Rhesus monkeys were found to be distributed ranging from 1390 to 2300m in Sundarijal, Panimuhan and Rolche area of Shivapuri National Park with total population of 125 individuals during the study period. Habitat type utilization was found maximum toward tree shrubs area (44.82%) which was followed by rocky area (23.02%), smooth ground (14.60%), stream side (9.68%) and crop land (7.88%).

3. MATERIALS AND METHODS

3.1 Materials

Following equipments were used during the field study.

- a) Binoculars b) Measuring tape c) Digital Camera d) Data sheet
- e) Topographic map of the study area f) GPS

3.2 Methods

3.2.1 Study Area

Annapurna Conservation Area Project (ACAP), launched in 1986, is the largest undertaking of KMTNC and the first and largest conservation area of Nepal. ACA is located in the mountain region of the west central Nepal which covers an area of 7,692 sq. Km or 5.18% of total area of Nepal, 27% of the total protected area of Nepal and is home to over 120,000 local people of different ethnic, cultural and linguistic groups, ACA is rich in biodiversity and is a treasure house for 1226 species of plants, 38 species of orchids, 9 species of rhododendron, 10 species, 101 species of mammals, 474 species of birds, 39 species of reptiles, and 22 species of amphibians. It harbors rare and endangered wildlife species such as Snow Leopard, Musk Deer, Tibetan Argali, Lophophorus Pheasant and Tragopan Pheasant. ACA is well known internationally and in Nepal for its beautiful mountains and a unique ecology. The area is bounded to the north by the dry alpine deserts of Dolpo and Tibet, to the west by the Dhaulagiri Himal, to the east by the Marshyandi valley and to the south by valleys and foothills surrounding Pokhara. Some of World's highest snow peaks over 8,000m and the World's deepest valley of the Kali Gandaki river are in ACA. These extreme diversities have made it Nepal's most popular trekking destination with over 70,000 trekking tourists in the year 2000, which is over 62 percent of the total trekking visiting Nepal (KMTNC 2005). ACA encompasses 57 Village Development Committee (VDC; the smallest political management unit of Nepal Government) of Five hilly and mountain districts of Nepal, namely Lamjung, Kaski, Myagdi, Manang, and Mustang. It spans over all parts of Mustang (all 16 VDCs), most of Manang (all 13 VDCs except 4 wards of Dharapani VDC), and Parts of Lamjung (8 VDCs), Kaski (17 VDCs) and Myagdi (3 VDCs) (Bista 2009).

3.2.2 Research Site

The Study area was carried out in Lamjung District of Gandaki Zone in the western Development region of Nepal. These two Taghring and Ghermu VDCs are also consisting of 61 VDCs of Lamjung District. Dharapani and Namarjung VDCs of Manang district; and Khudi, Bahundanda and Ghermu VDCs of Lamjung are the neighboring VDCs of Taghring VDC. Myardi spring is located in this VDC which has separated the boundary of Manang and Lamjung district. A feasibility study work has been done to construct the 30MW Myardi Khola hydropower by the association of local people at this Myardi Khola. Similarly, Upper Marsyangdi Hydropower-600 MW has reached in the last stage its overall feasibility study which is done before to operate the project and whose powerhouse will be located at Syange of this VDC. Besishahar-Chame Motor road has crossed at the lower region along of this VDC (TVDC 2066).

3.2.3 Geographical Location

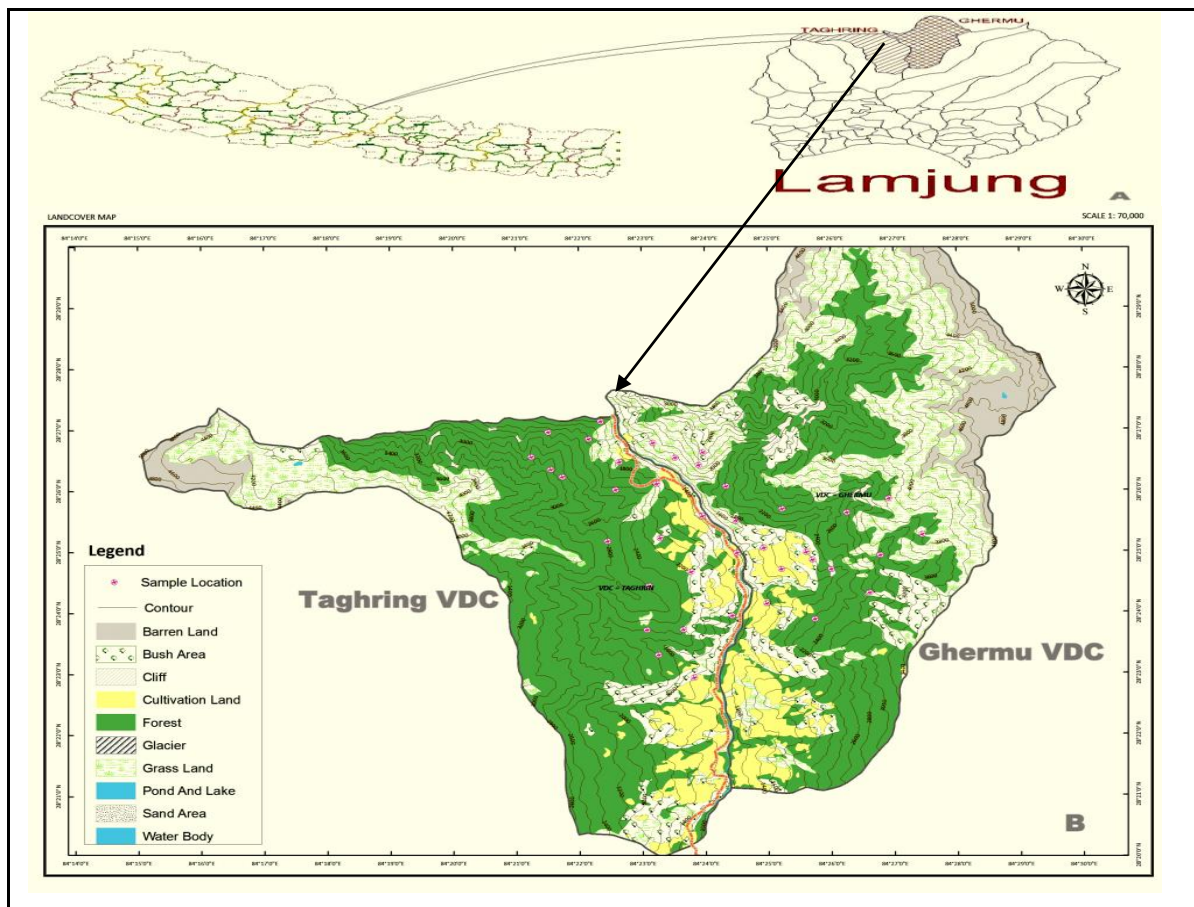


Figure 1: A) Location of Study Area and B) Distribution map of Assamese Macaque.

Taghring VDC is located between 84° 15'E to 84° 25'E longitude and 28° 20'N to 28° 28'N latitude and elevation ranges between 1322m to 4961m. Dharapani and Namarjung of Manang district and Khudi, Ghermu and Bahundanda of the Lamjung district are the neighbour VDCs. Ghermu and Bahundanda are adjoining VDCs even though which are separated by Marsyangdi River. This VDC lies in northwestern part of Lamjung district. Taghring VDC has an area of 83.14 square kilometer (TVDC 2066) whereas Ghermu VDC is located between 84° 22' E to 84° 30' E longitude and 28° 20' N to 28° 31' N latitude and elevation ranges 1154 m to 5166 m and this VDC has an area of 100 square kilometer (GVDC 2066).

3.2.4 Water Resources

Study area occupied many small streams, spring falls, lakes and rivers. Myardi Khola, Chamchey Chhara, Rendu Khola, Tapre Khola, Sirung Khola and Syange Khola are main streams of Taghring VDC and; Radhi Khola, Ghatta Khola, Panchi thara, Kaitro Khola and Lili Khola are located at the Ghermu VDC. Between these two study area, Marsyangdi River has crossed as a gorge, which is contributing the back bone of water resources to the biodiversity and so, it has enhanced the beauty of this site. This Marsyangdi gorge is a wild place of pure geological and hydrological entertainment.

3.2.5 Demographic Features

About 2318 individuals live in study area, while with 521 households i.e. 1113 male and 1205 female inhabitants inside the protected area (Taghring VDC) and with 402 households, 1776 people i.e. 822 male and 954 female live outside the protected area (Ghermu VDC). Ethnic groups are predominantly Gurung and majority of people are engaged in agriculture (CBS, 2011).

In the regional physiographic framework of Nepal, the study area expands through the Middle Mountains and High Mountain Physiographic Zones. The hills of Middle Mountain and High Mountain slowly rise to north and give away to snow-capped ranges of High Himalaya. Topographically, these VDCs are highly diverse varying in altitude from less than 1300 m to over 6000 m. Marsyangdi Basin experiences subtropical to temperate climates with severe winter cold varying with altitude.

3.2.6 Climate

This study area lies in the sub-tropical belt of Nepal. This study area has a unique geographical feature having both North and South facing topography. The climate of study area and its vicinity is mainly wet and moist. Upper region of the study area remains covered with snow in the winter season and till the late afternoon, the days are almost foggy while summer days are almost bright sunshine and clear visibility.

3.2.6.1 Temperature

The warmest and coldest months of the study area were May (32°C) and January (6.2°C) respectively. The average maximum temperature was recorded 27.42°C and minimum temperature was recorded 14.42°C (Fig. 2).

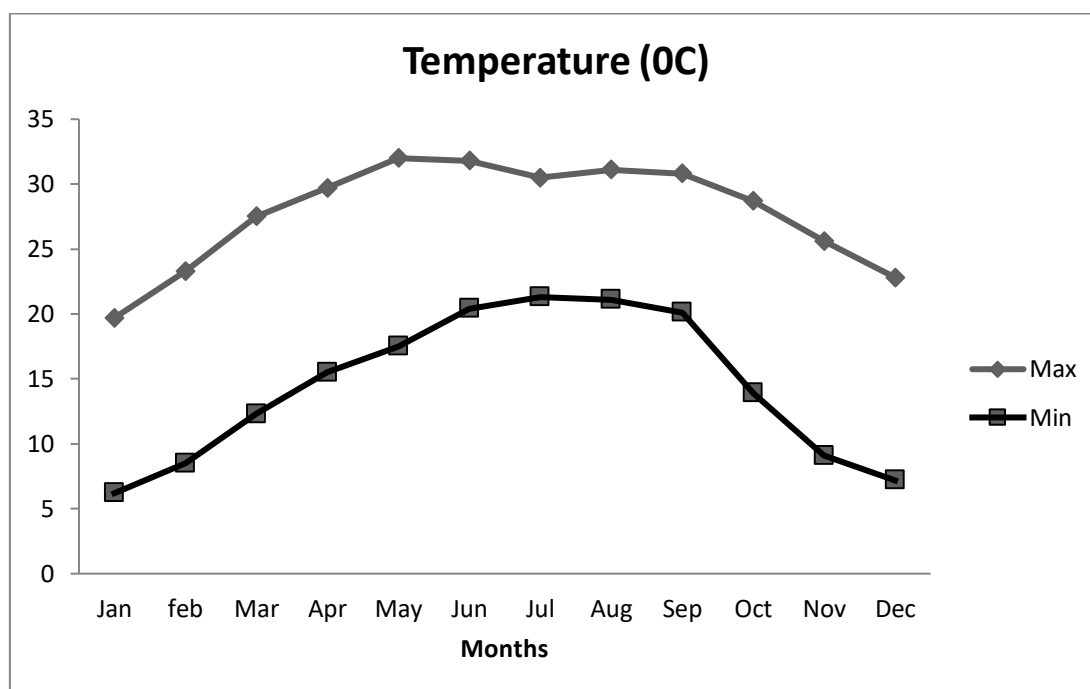


Figure 2: Temperature (Max. and Min.) recorded in 2012 at Khudi Bazar. (Source NG/DHM).

3.2.6.2 Relative Humidity

Relative humidity was recorded minimum (55.9%) in the month of March and maximum (88.9%) in July in the year of 2012. The average relative humidity was recorded 72.69%.

In the October and November, there were quite difference in relative humidity in two different measuring time (Fig. 3).

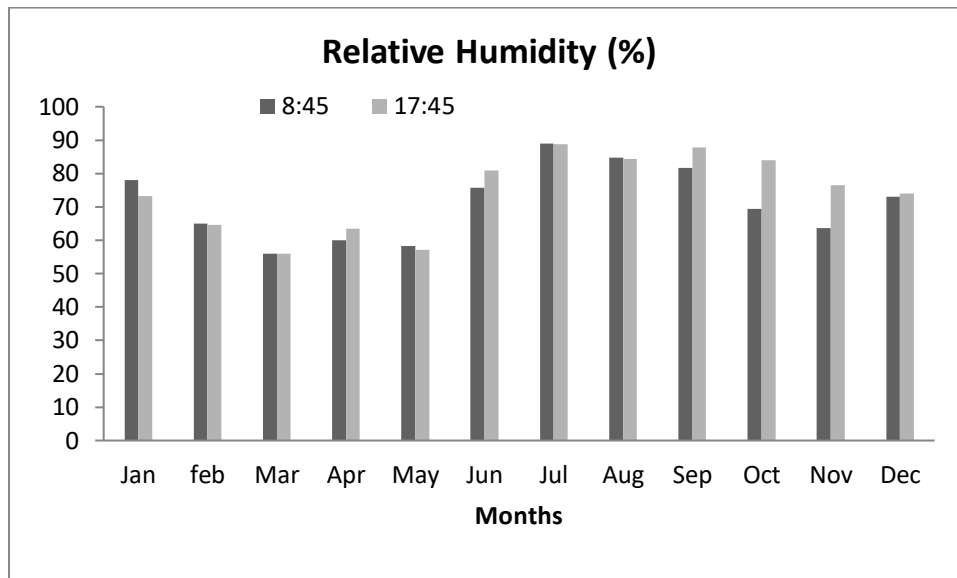


Figure 3: Relative Humidity (%) at 8:45 and 17:45 recorded in 2012 at Khudi Bazar. (Source: NG/DHM).

3.2.6.3 Precipitation

The precipitation of Khudi data shows that the main rainy days were in the months of July and August. The highest precipitation was recorded (908.8 mm) in the month of August during the study period, while there were not recorded of precipitation in the months of November and December (Fig. 4).

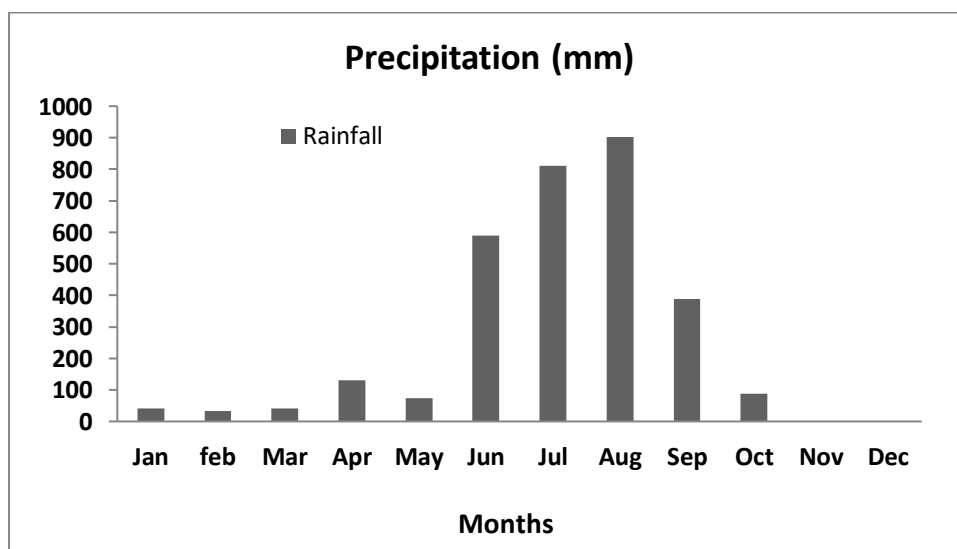


Figure 4: Monthly precipitation recorded in 2012 at Khudi Bazar. (Source: NG/DHM).

3.2.7 Biodiversity

3.2.7.1 Flora

Though in broad classification the study area falls in *Schima-castanopsis* zone, this forest is not conspicuous in this area due to adverse topographic condition. The forest patches appear in the valley bottom and the sites of soil deposition. In general, the surrounding localities are fairly represented by *Schima-castanopsis* forest in lower sub-tropical belt and *Quercus lanuginosa*, *Rhododendron arboreum*, *Persea* sp., etc. in upper sub-tropical belts. However, analytical study of the study area shows the presence of some forest patches dominated by particular tree species as a site specific case. In short they can be categorised as 1) *Schima-Castanopsis* forest 2) *Bombax –Toona* association 3) *Alnus* patches with *Schima-Bombax* association, and 4) Mixed broadleaved forest. Other common tree species of this area include Kaphal (*Myrica esculenta*), *Englehardtia spicata*, *Zizyphus incurva*, *Erythrina stricta*, *Macaranga pustulata*, etc. Some species such as *Rhus wallichii*, *R. javanica*, *Ficus* spp., *Alangium salvifolium*, *Sapium insigne*, etc. are more common around the human settlements. Mixed type of forest is found in the study area. Tropical deciduous riverine forest, sub-tropical grassland, and sub-tropical evergreen forest are the forest types in the study area. The dominant tree species of the study area are Simal (*Bombax ceiba*), Sirish (*Albizia procera*), Uttis (*Alnus nepalensis*), Chilaune (*Schima wallichii*), etc. Similarly, the ground vegetation mainly comprises of Titepati (*Artenusia dubia*), Sisnu (*Girardinia palmata*), Khar (*Typha angustata*), Bhat (*Clerodendron infortunatum*), Plants are of bushy type. Trees includes simal (*Bombyx ceiba*), Katus (*Castanopsis indica*), Khair, Lapsi (*Choero ston dias*), Chilaune (*Schima wallichii*), Khirro, Ficus, Litsea, Euraya, Metsia, Kafal (*Myrica sculenta*), berries, Bamboos (*Arun dinaria*), Uttis (*Betula utilis*), Dhairo (*Woodfordia fruticosa*), Amala (*Phylleanthus emblica*), Harro (*Terminalia chebula*), and Barro (*Terminalia bellirica*) (Chalise 2011a).

3.2.7.2 Fauna

Forest of the study area harbors a variety of wild animals. Taghring and Ghermu VDCs are very rich in its faunal diversity as they contain rich species of different types of animals. Nineteen different species of mammals have been recorded in and around the study area. Animals in Study area includes mammals like Monkeys: Rhesus monkey

(*Macaca mullata*), Assamese monkey (*M. assamensis*), Grey Langur (*Semnopithecus entellus*), Common Leopard (*Panthera pardus*), Ghoral (*Naemorhedus goral*), Barking Deer (*Montiacus muntjak*), Main Land Serow (*Capricornis sumatraensis*), Himalayan Musk Deer (*Moschus chrysogaster*), Porcupine (*Hystrix indica*), Jackal (*Canis aureus*), Jungle Cat (*Felis chaus*), Yellow Throated Marten (*Martes flavigula*). Bengal Fox (*Vulpes bengalensis*), Black Bear (*Ursus spp.*) etc. Similarly, Birds include Jungle Crow (*Covus macrorhynchus*), Parrots (*Psittacula spp.*), Spiny Babbler (*Turdoides nipalensis*), House Sparrows (*Passer spp.*), Hawks, Eagles, Lammergeiers (*Gypaetus barbatus*), Owl (*Bubo spp.*) etc. Reptiles include Snakes, Common Lizards, Yellow Monitor Lizards, etc. Amphibians include Frogs, Toads, etc. (Chalise 2011a).

3.2.8 Tourism

Nepal has established an extensive network of protected areas to conserve biodiversity. Several problems relating to management of these protected areas have emerged, such as wildlife poaching and park-people conflicts (Bajracharya 2004). ACA is a very famous tourist destination around the world. It had greeted 79,900 tourists in the year of 2009 AD. In accordance to ACAP the amount of visitors visiting the region enhanced by 5.3% in 2009/10, while the enhancement in the last fiscal year was 16% and the year before was 30% (ACAP 2010).

Annapurna trekking circuit (Besishahar-Bahundanda-Chame) is popular tourist destination. Out of Annapurna trekking routes, most of the tourists enter through this circuit. Tourism industry has made major income source in Taghring and Ghermu VDCs. Largest Gurung village, Bhujung and Model village of South Asia, Ghale gaun are also the attracting sites for tourists which are located very near to Taghring and Ghermu VDCs. Similarly, Mustang (Kingdom), Jomsom, Marpha, Kagbeni, Muktinath, Tatopani (Myagdi) and Hot spring (Tatopani Kunda) are main destinations of ACA where most of tourists visit through this trekking circuit. More than 70 hotels and tea stalls are present along the trail from Bahundanda to Tal of Manang. In addition, white water rafting (Marsyangdi-Khudi) and Bee hunting have played important role to increase the tourism sector.

In 2001 AD, 15012 tourists entered and 2034 tourists existed from this trekking circuit while in 2006AD, only 8440 and 708 tourists entered and existed respectively from the same circuit (DDC 2006).

3.3 Data Collection

3.3.1 Block Design and Field Survey

A preliminary survey of the study area was done with academic supervisor on January 2012 to understand the geophysical and climatic conditions as well as the ecological behavior, threat and distribution to Assamese macaque in Taghring VDC of ACAP before starting of regular field-work. The survey process included mainly field, observation interaction and pretesting of questionnaire with local people. Information about location and species were gathered by interacting with experts and local people. Primary data were collected using direct observation and secondary data were obtained from published and unpublished literatures. Study area was visited on foot, animals were observed using 10×50 mm binoculars and behavioral data collection methods were practiced with experts. A total visually accessible area of 183.14 km² was selected with the help of topographic map (scale: 1: 50,000) without taking contours in to account for the survey and divided into three blocks namely Block A (Paune), Block B (Jagat) and Block C (Chipla). Blocks are designed on the basis of habitat preferred by Assamese monkeys. Which were differentiated from less human interference and high human interference i.e. Block A and B from protected area (Taghring VDC); and Block C was from non protected area (Ghermu VDC).

Field work was carried out four times in different seasons from April, 2012 to March, 2013. Related information was collected by using various study methods.

3.3.2 Questionnaire Survey

Sample size and sample method: Stratified random sampling method was used to select respondent for the questionnaire survey. Therefore, out of 480 households, 72 respondents were selected randomly as sample size from the closed study area.

3.3.3 Total Count and Age-Sex Composition

Population surveys throughout the study area (183.14Km²) were carried out from all the possible trails; the trails were walked slowly at 0.5 km/hr, covering a distance of 6 km per day. Observers paced along trails stopping every 500 meters to search the area for ½ hour by applying both visual and auditory cues simultaneously as described and practiced by Chalise (2003, 2013). A total count was carried out from all the available trails present. The topography of the region makes it difficult to undertake systematic surveys for continuous period. When Macaques were encountered, the following data were recorded: detection time, duration of observation, locality and its coordinates, activity and age-sex composition of the group. Age and Sex were categorized properly with the help of spotting scope. Counting was repeated 3 times in a observation session to minimize the bias in distinguishing age and sex of the groups. Assessing age will require study of the age classes used by previous researchers and some practice (Ross and Reeve 2003). So, this study followed Chalise (1997) to distinguish the age and sex of the macaques and practiced with the supervisor in the field. Group size and composition may be counted and, if groups are stable, then repeated estimations should lead to increasingly accurate counts. However these records may be inaccurate if some classes behave more conspicuously or avoid humans (e.g. mothers with infants) or because the group is widely dispersed and not all animals can be located (Ross and Reeve 2003). All areas were surveyed starting at 06:00 and finishing at 18:00.

3.3.4 Scan Sampling Method

By scan sampling, the behaviours of monkeys were recorded for one minute at intervals of 10 minutes (Altmann 1974; Martin and Bateson 1993; Chalise 1997) with the help of timer, and aided by binoculars. A total of 2640 scan samples were recorded covering all four distinct seasons' viz. Pre-monsoon, Monsoon, Post-monsoon and Winter. Observation started half an hour before sunrise and continued half an hour after sunset i. e. dawn to dusk. Other events and interesting behaviours of any members of the groups were also recorded whenever they were noticed.

Following behaviours were observed including other social activities of Assamese macaque in the study area.

- I) **Moving:** The behavioural phenomenon in which monkey produces motion displacing from one place to another.
- II) **Resting:** The state when Assamese rests with the body supporting upon the buttocks with hindquarters lowered on to a supporting surface.
- III) **Foraging:** The behavioural activity in which monkey searches for food or wonders in search for food including eating any substance, geophagy, licking stone, drinking water and slight movement in search of food.
- IV) **Grooming:** The behavioural phenomenon in which monkeys search their own fur or the fur of others for lice, bugs or dirt which include rubbing, licking and scratching.

3.4. Data Analysis

3.4.1 Population Status

Population density was calculated by total no. of individuals per total area surveyed. Group density was estimated by numbers of troop observed per total area surveyed. Similarly, sex ratio was taken as the number of males in 100 females .

3.4.2 Distribution

Assamese macaque distribution pattern in the study area was determined by calculating the ratio of variance and mean (S^2/\bar{X}) described by Odum (1996).

If, $S^2/\bar{X} = 1$ then it means there is a random distribution.

If, $S^2/\bar{X} < 1$ i.e. it has a regular distribution.

If, $S^2/\bar{X} > 1$ it indicates clump distribution.

Where, $S^2 = \text{Variance} = 1/n \sum (X - \bar{X})^2$,
 $X =$ Sample value,
 $\bar{X} =$ mean sample.

Chi- square contingency test was used to find significant difference in the distribution of Assamese macaque in different sample locations.

$$\text{Chi- square } (\chi^2) = \sum \frac{(X - a)^2}{a}$$

Where X = Observed or Sampled value;

a = Expected or mean value.

3.4.3 Vegetation Analysis

Vegetation of the habitat was analyzed by laying down twenty quadrates. Ten quadrates were used in each sites (Block A and B of protected area site and Block C of non-protected area site) of size 25m × 25m. Species diversity of trees was calculated from each site. The collected vegetation data were quantitatively analyzed for relative values of dominances. The sums of all the relative values are represented as important value index (IVI).

To understand characteristics and productivity of the habitat, different parameters like density, relative density, frequency, relative frequency, dominance, relative dominance and important value index (IVI) were determined (Zobel et al. 1987).

$$\text{Density of species A} = \frac{\text{Total no. of individuals of species A}}{\text{Total no. of plots surveyed} \times \text{Area of the plot}}$$

$$\text{Relative Density of species A} = \frac{\text{Density of species A}}{\text{Total density of all species}} \times 100$$

Frequency of a species is the percentage of quadrates in which the particular species occurs. It gives an index on the spatial distribution of a species and is a measure of relative abundance (Krebs 1978).

$$\text{Frequency of species A} = \frac{\text{No. of plots in which of species A occurs}}{\text{Total no. of plots surveyed}} \times 100$$

$$\text{Relative Frequency of species A} = \frac{\text{Frequency value of species A}}{\text{Total frequency value of all species}} \times 100$$

Basal area is one of the main characters determining dominance and nature of the community refers to the actual ground covered by the stems. It was calculated as following way.

$$\text{Dominance} = \frac{\text{Total basal area of the species}}{\text{Total Area sampled}}$$

Relative dominance is the proportion of a species to the sum of basal coverage of all the species in the area, which was calculated as:

$$\text{Relative Dominance of species A} = \frac{\text{Total Basal area of species A}}{\text{Total Basal area of all species}} \times 100$$

$$\text{Basal area (BA)} = \pi (\text{dbh})^2/4$$

The important value index (IVI) of each species was calculated by summing the percentage of relative dominance, relative density and relative frequency, each weighted equally for a species relative to a stand as a whole.

$$\text{IVI} = \text{RD} + \text{RF} + \text{RDOM}$$

Where,

RD= Relative density

RF= Relative frequency

RDOM= Relative dominance

3.4.4 Crop Raiding

The data collection of crop raiding was derived from the questionnaire survey (See Appendix IV). Data were quantitatively analyzed. It can be complementary to the population and species identification related to first objective and also intended to evaluate the total loss of different crops.

The given formulae are used to calculate the crop raid per unit area (Poudel 2007).

$$X = \frac{XE - XA}{XLC}$$

Where, X= Loss per unit land

XE= Expected yield before crop loss

XA= Actual value after crop depredation

XLC= Total cropping land of that field

$$\text{XL} = \text{XE} - \text{XA}$$

Where, XL= Total crop loss

Total economic = price of crop × total crop loss in the study area.

4. RESULTS

4.1 Population Status of Assamese Macaque.

A total of 53 individuals of Assamese Macaques (*Macaca assamensis*) were observed in the study area. The minimum of Assamese were reported from the Jagat and Paune of Taghring VDC where as maximum numbers of Assamese were reported in Chipla of Ghermu VDC.

Table1. Troop of Assamese Macaques in different blocks of study area.

Block	GPS Location	Altitude (m)	No. of Troop	Troop Size
A (Paune)	28 ⁰ 43'39"N, 84 ⁰ 37'47"E	1796	1	13
B (Jagat)	28 ⁰ 40'95"N, 84 ⁰ 41'83"E	1325	1	15
C (Chipla)	28 ⁰ 41'16"N, 84 ⁰ 41'25"E	1705	1	25

4.1.1 Group and Population Density

Total of 53 Assamese Macaques were seen which were existing in 3 groups in 183.14 km² area. The mean group size was found 17.66 (Range 13-25) individuals. The group density was found 0.016 groups/ Km² with a population density of 0.28 individuals/ Km².

4.1.2 Age-Sex Composition

Age-Sex composition of the Assamese troops recorded in the study area showed the highest percentage of adult female 15 (28%) followed by young-adult female 9 (17%), sub-adult male 8 (15%), juvenile 8 (15%), adult male 7 (13%) and infant 6 (12%) (Fig.5).

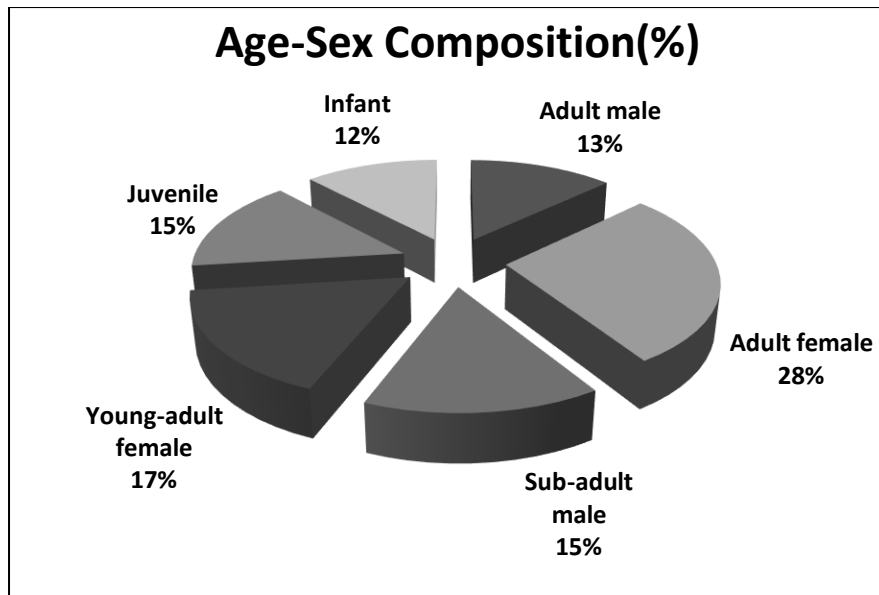


Figure 5: Age-Sex composition (%) of Assamese Monkeys in study area

4.1.3 Adult Sex Ratio

The adult sex ratio (male to female) observed during the entire study area was 0.46 (46 males per 100 females) i. e. 1:2.14.

The adult sex ratio was 0.40 (40 males per 100 females) i. e. 1: 2.50 in Block A, 0.50 (50 males per 100 females) i.e. 1:2 in Block B and Block C separately.

4.2 Distribution of Assamese Macaques in Different Blocks.

Assamese Macaques were recorded from all the three blocks of study area. The study area was divided into three different study blocks of Taghring and Ghermu VDCs.

Block A

One troop with 13 individuals were recorded in this Block, where 2 adult males and 5 adult females with 2 sub- adult male, 1 young- adult female, 2 Juveniles and 1 Infant were found in Paune of Taghring VDC having less human interference and plenty of food and water sources (Fig 6).

Block B

One troop with 15 individuals was recorded in this Block. Where 2 adult males, 4 adult females, with 2 sub-adult males, 3 young-adult females, 2 juveniles and 2 infants were found near the Jagat Bazar of Taghring VDC having more human interference due to which it is more disturbed area to the monkeys, even though monkeys feed on the waste food which is deposited by the people of Jagat Bazar and monkey's habitat is very close with human settlement near Marsyangdi River. As well as monkeys feed on fruits of *Careya arborea* and *Choerospondies axillaris* in different seasons (Fig. 6).

Block C

The Chipla Village of Ghermu VDC consists of less human disturbed habitat. 25 individuals of Assamese were observed in this block where, 3 adult males and 6 adult females with 4 sub-adult males, 5 young-adult female, 4 Juveniles and 3 Infants were found. They could get cultivated food grown by farmers as well as seasonal palatable fruits like *Choerospondies axillaris*, *Ficus semicordata* etc. are located a bit far from the human settlement and area is almost rocky hill with good sources of water (Fig. 6).

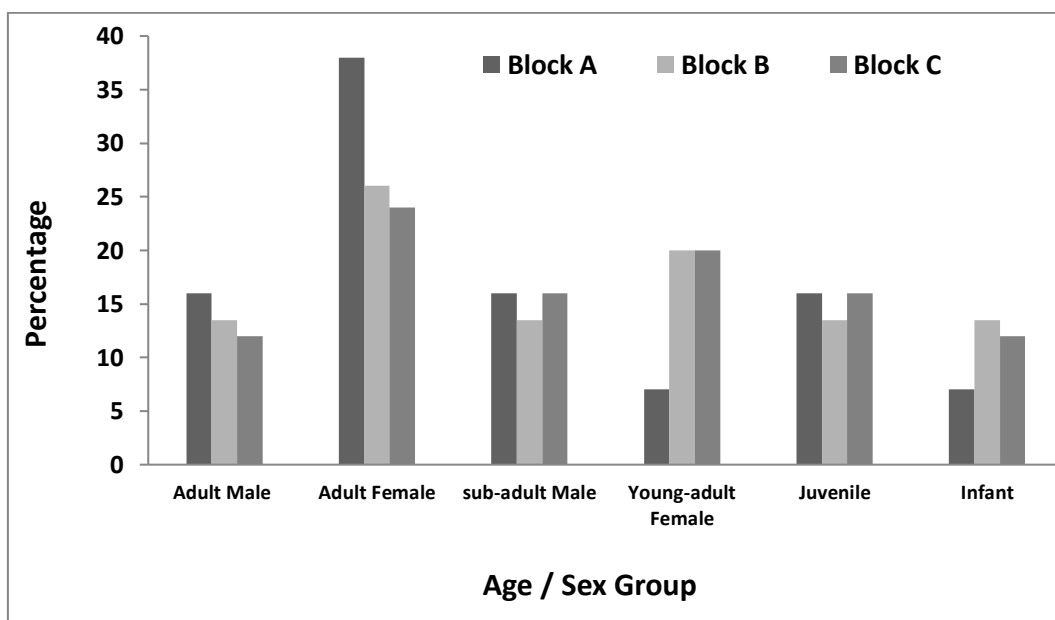


Figure 6: Distribution of Assamese Macaques in 3 different Blocks of study area.

The variance to mean ratio was used to determine the distribution pattern of Assamese Macaques among three different study Blocks. The calculated value of variance to mean ratio was found to be 1.55. Since, the value of $(S^2/\bar{X}) > 1$, the result has shown clumped distribution of Assamese Macaque in Taghring and Ghermu VDCs.

Chi square significance test showed that there was no significant difference in distribution of Assamese Macaques among three different blocks. ($\chi^2 = 4.6$, d. f. = 2, p = 0.05).

4.3 Vegetation Analysis

In protected area, Taghring VDC, thirty two species of trees (the DBH>25cm) were found where as twenty eight species of trees of similar form were found in non-protected area, Ghermu VDC.

The IVI of a species indicates its dominance and ecological success, its good power of regeneration and greater amplitude. This study concluded from the calculation, between the two studied sites i.e. protected and non protected area major tree species *Schima wallichii*, *Pinus wallichiana*, *Castanopsis indica*, *Alnus nepalensis*, *Persea odoratissima* etc. were found having different IVI in both areas.

In protected area *Schima wallichii* (IVI= 33.22) was found the most dominant followed by *Pinus wallichiana* (IVI=18.95) and *Castanopsis indica* (IVI=17.42) whereas, in non protected area *Alnus nepalensis* (IVI=52.011) was found the most dominant followed by *Schima wallichiana* (IVI=32.65) and *Castanopsis indica* (IVI=16.74).

It was seen that *Schima wallichii* was found most dominant in protected area and co-dominant in non protected area while *Alnus nepalensis* was found most dominant in non protected area and which was found in least proportion in protected area. The detail list of vegetation is given in Appendices II and III.

4.4 General Behaviour

The Assamese Macaque showed distinct variation in different behaviours such as Foraging, Locomotion, Resting and Grooming. The trend stands true not only in annual variation but also in season.

4.4.1 Annual Activity Budget

From the study, it was found that 45% of their total annual time spent on foraging purpose, followed by 24% on locomotion, 21% on resting and 10% on grooming (fig.7).

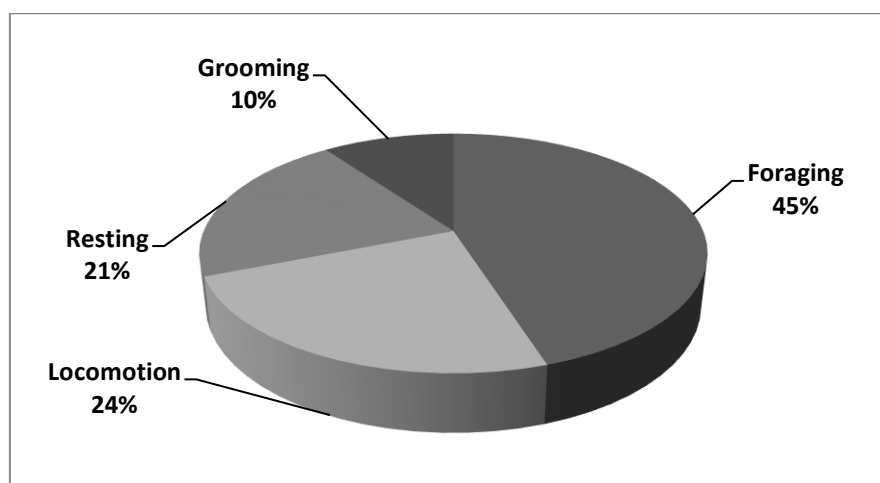


Fig. 7: Annual activity budget of Assamese in study area 2012/13.

4.4.2 Seasonal Activity Budget

4.4.2.1 Feeding

The feeding activity has been found as the major activity profile in the case of Assamese Macaque. They represent about 47% of their total time in feeding activity in winter, 45% in pre monsoon, 44% in monsoon and 43% in post monsoon. These differences of foraging activity have been found statistically significant in winter season, from pre monsoon, monsoon and post monsoon. The deviation from average foraging activity revealed that the studied group spent more time during winter and pre monsoon seasons while spent less time than the average time spent during monsoon and post monsoon. However, a highest negative deviation was recorded during post monsoon seasons.

(Fig.8). Foraging behaviour in three different blocks showed, 42% in block A, 46% in block B and 45% in block C. Block B showed the highest percentage in foraging activity.

4.4.2.2 Locomotion

The locomotion activity has been identified as the major activity next to foraging. The study group spent 26% of their total time in locomotion in post monsoon, 25% in winter, 24% in pre monsoon and 22% in monsoon season. Although, the difference in average time spent in locomotion in different season is little statistically significant. The deviation from average locomotion activity reported that the Assamese spent lowest time than average during monsoon seasons and more than average during post monsoon season (Fig. 8). Locomotion activity occurred, 24% in block A, 26% in block B and 23% in block C. Block B has represented the highest percentage in locomotion because of less availability of food resources.

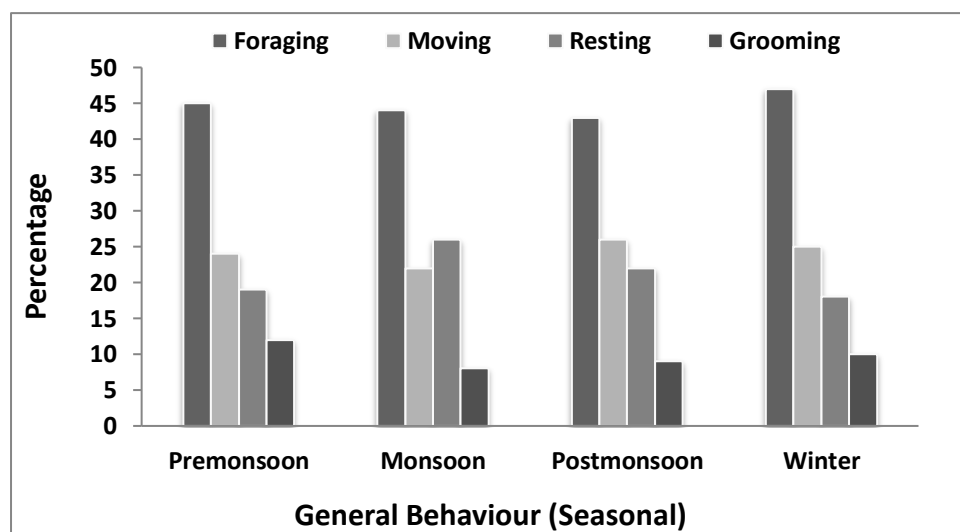


Figure 8: Time spent for different behaviours by Assamese Macaque.

According to this study, there is no any significant difference in the behavior patterns in Assamese Macaques across the different seasons of the year.

4.4.2.3. Resting

The time in resting activity depends upon locomotion and foraging activities. They spent about 26% of their total time in resting activity in monsoon, 22% in post-monsoon, 19%

in pre-monsoon and 18% in winter. The differences in time spent in resting are statistically significant in all respective three seasons with monsoon. The deviation from expectation indicated that the Assamese spent more time in monsoon while less than expectation (lowest) in winter season (fig. 8). In the different blocks, Assamese Macaques spent their time 23% in block A, 19% in block B and 22% in block C for the resting activity. Block A has occupied the highest percentage in resting due to the presence of good source of food.

4.4.2.4 Grooming

The time spent in grooming by Assamese Macaque was 12% in pre-monsoon, 10% in winter, 9% in post-monsoon and 8% in monsoon. Although the difference in average time spent in grooming in different seasons is not statistically significant. The deviation from expectation indicated that the Assamese spent more time in grooming activity in pre-monsoon while a less than expectation in monsoon and post-monsoon seasons (Fig. 8). Similar patterns of grooming activity have occurred in case of three different blocks, whereas 11% in block A, 9% in block B and 10% in block C.

4.5 Conflict due to Monkey

4.5.1 Crop Raiding

Crop raiding was found to be the major problem caused by monkeys. All three species (langurs, Assamese and Rhesus) were found to raid major crops during the study but the local people were unable to report the crop lost categorically by these monkeys. Due to this reason, the data of crop raiding pattern was combined for these three species. Major Crops raided by monkeys include maize, potato, millet, wheat, paddy, vegetables (pumpkin, bean, cauliflower, cabbage etc.), and fruits (pear, peach, cucumber, etc.) in which maize was the highest raided crop. From the total 72 respondents, total loss noted was 44% for maize followed by 27% potato, 13% millet, 7% wheat, 4% paddy, 3% fruits and 2% vegetables. Most of respondents had very limited crop land to grow their crops. Out of these respondents, 70% respondents were facing more trouble from the crop raiding problem and 8% respondents had already left some land fallow due to severe crop raiding problem (Fig. 9).

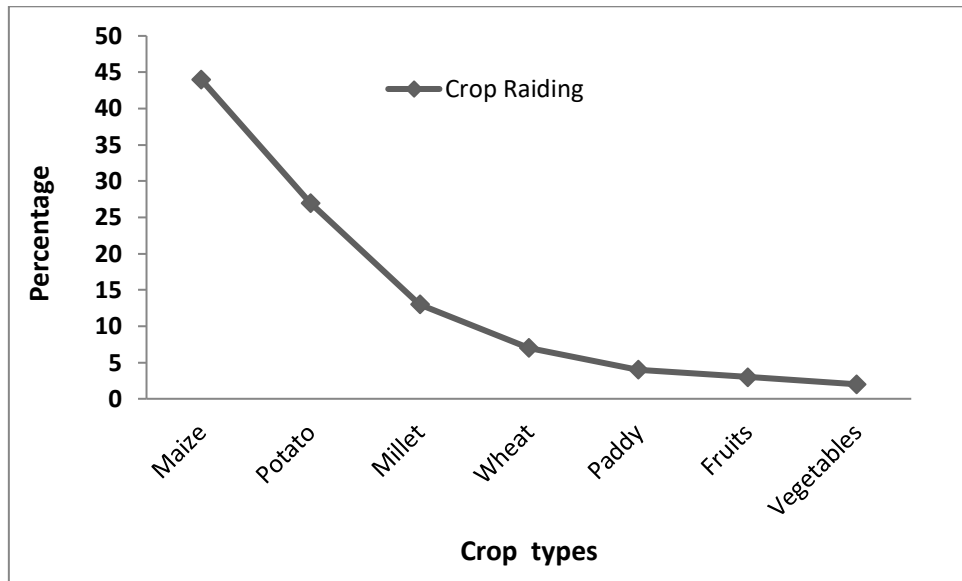


Figure 9: Crop damage (%) by Assamese Macaques.

As stated above from the total respondents, a total of 45.73 hectare of land was utilized for the cultivation of crops. In that land area, total yield of crop was expected to be 551.12 quintals but 449.56 quintals was observed yield during the study time. It is indicated that 99.47 quintals of crops was lost by the Macaques, on the basis of average monetary value was accumulated from Jagat Bazar (Appendix-V). Among the various raided crops, maize was found highly raided that worth the loss of Rs. 1, 05,500. Altogether, the loss of raided crops worth Rs. 1, 63,527.5 from questionnaire surveyed area. The result showed that 9.87 quintals of crops was raided in each hectare of land (Appendix-VI).

4.6 Crop Protection Measures

Farmer adopted various methods to protect their crop fields from wildlife including Assamese Macaque. Mostly, conflict was found to occur due to several measures practiced by human beings to protect their crops.

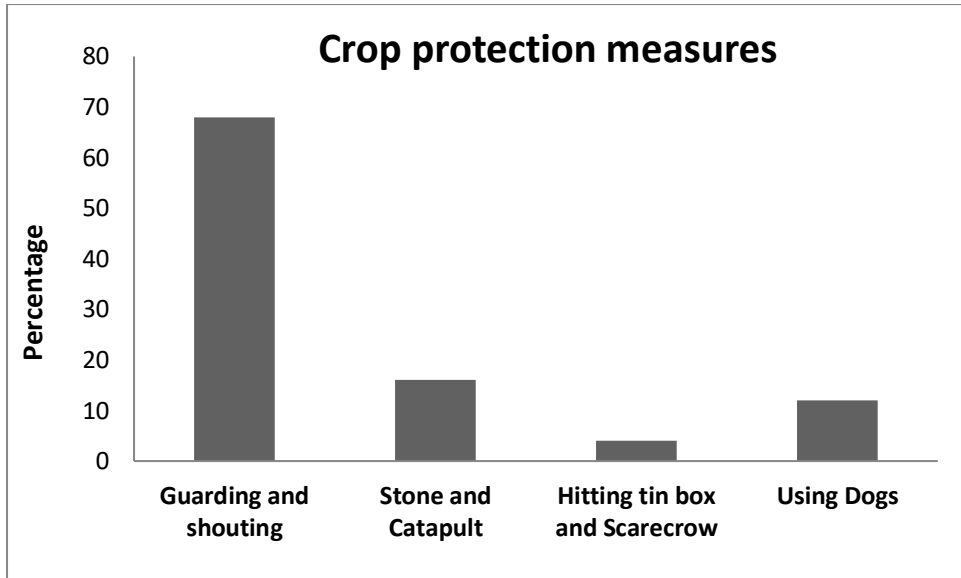


Figure 10: Different crop protection strategies used by farmers

Protocols included shouting and guarding, scarecrows, hitting tin box, stone and catapult and using dogs. Under these protocols, the most commonly used crop protection strategy was by guarding their crop field, which method was applied by 68% of the farmers. About 16% were used stone and catapult, 4% hitting tin box and scarecrows and some farmers (12%) used dogs to chase the monkey away from the field. Some farmers said that they used the gun to scare monkeys but not in a regular pattern (fig. 10).

5. DISCUSSION

5.1 Population Status and Distribution

Assamese Macaques in Taghring and Ghermu VDCs were found to be distributed in three different parts (Paune, Jagat and Chipla) from different elevation of different VDCs i. e. inside the protected area and outside the protected area. The lowest altitude has 1230m in Jagat area and highest was 1792m in Paune. From the rest parts of these VDCs, the Assamese Macaques could not report because of high human interference as well as inadequate habitat. A total of 53 individuals in 3 different troops were recorded with highest number in Block C (Chipla, Ghermu VDC) village. In Block B and C, Assamese troops were found in almost open area near the edge of Marsyangdi River, crop land and human settlement where as in Block A, single troop were observed into deep or dense forest. The crop lands and human settlement areas are either inside or boundary of the protected area (ACAP) Taghring VDC while crop lands and settlement areas are located completely outside from the protected area.

The studies of wild primate population normally involve a substantial investment of resources and time i.e. equipment money, and labour (Ross and Reeve 2003). The macaques' groups in this study area were comparatively more stable and less persecuted by human beings made the group size estimation and composition more accurate. But only investing these resources may not be adequate for the survey of primates in such mountainous topography that prevent the most of the systemic survey methods impractical.

Hanya et al. (2003) estimated the group density of Japanese Macaques as 1.43 and 0.737 group /km² in disturbed area and undisturbed area by the method of combining point census and group follow within a census area of 7km² in the Western area of Yakushima, an island in South Japan. Regmi (2008) reported the group density of Assamese macaques as 0.0790 groups/ km² in LNP where as in the present study the group density of Assamese macaques was found to be 0.016 group/km² by applying a method total population count within a census of 183 Sq Km. Hanya et al. (2003) in the same study area, population was calculated to be 22.9 and 11.8 individuals/km² in the disturbed and undisturbed area

respectively with the mean group size of 16 and Regmi (2008) estimated the population density of Assamese macaques was found to be 1.8691 individuals/km² with the mean group size of 23.66 whereas in the present study, the population density of Assamese macaques was found to be 0.82 individuals/km² with the mean group size of 17.66. The altitude of census area was 700-1300 m asl in the study area of Hanya et al. (2003), 900-2500 m as in the study of Chalise (1997) and Regmi (2008) 1200- 3300 m asl. Whereas the altitude of census area was 1230- 1792 m asl. in the present study.

Chalise (2000) reported seven troops of Assamese Macaques in Makalu-Barun Area in 1997 and estimated group size of 7- 50 and the ratio of adult males to the adult females were 1:2.03 and again, in 1998 from the same study area, he reported 1:1.9 adult sex-ratio from group size in range of 13-27 of 4 troops. Southwick et al. (1964) reported two troops of Assamese monkeys in Darjeeling and estimated group size of 10-25 and the ratio of adult males to the adult females were 1:1.7. Regmi (2008) recorded 9 Assamese Macaques troops in LNP and observed troop size ranges from 13-35 individuals and the ratio of adult males to the adult females were 1:1.92 whereas the present study recorded 3 Assamese Macaques troops and observed troop size varies from 13 to 25 individual in Taghring and Ghermu VDCs. The adult sex ratio of Assamese macaques troops observed in this study i.e. 1:2.14 is apparently similar to that of the above stated in the study of Chalise (2000) i.e. 1:2.03 in 1997, 1:1.9 in 1998 and Regmi (2008) i.e. Macaque live in multi male, Female kin bonded groups and the ratio of males to females ranges from 1:2.2 (*Macaca radiata*) to 1:9 (*Macaca nemestrana*) (Feeroz 1996). These findings support that the *Macaca assamensis* also live in multi –male and female-kin, bonded groups like as other macaques.

Ale (2010) estimated the population density of Highland langurs in LNP using line transect method covering the area of 32 km² was found to be 4.65 langurs/km², Wangchuk (1995) calculated the population density of Golden langurs using the same method covering the area of 58.5 km² was found to be 2.1 langurs/km² and in the present study, the population density of Assamese macaques was found to be 0.28 individuals/km². Environmental constraints and human interference might affect group composition and group size of the macaques (Machairas et al. 2003). Actually, this study area bears less human population as well as very less crop food and more flow of tourists due to which the Assamese macaques are distributed in very limited space of the study

area whereas small group size (13) observed in Block B (Jagat) having the altitude of 1320m. This altitude could not support to minimize the foraging costs because of presence of high human pressure and less resource of food. The group size may affect itself when such effect is probably found by the patchiness of resource distribution.

The variance to mean ratio of Assamese macaques from different study blocks was found to be more than one. The result showed clump distribution which is the most common type of distribution and also called as cluster or contagious and aggregated. It may be due to the response of seasonal weather, environmental changes and social behaviour as well as it may tend to concentrate around a geographical feature that provides nutrients or shelter and when the occurrence of small sized groups (including blanks) and large sized groups is more frequent and the occurrence of middle sized groups less frequent than expected in studied blocks. This finding supports the idea of Smith (1996) and Odum (1996).

5.2 General Behaviour

Behaviour is the response of both the physical as well as habitat condition of animals. It varies from habitat to habitat depending up on the resource distribution. In primate, food, mates, drink and roosting trees are the most important resources, which control activities (Sarkar 2000).

During present study period, three groups of Assamese macaques were recorded in pre-designed three blocks of Taghring and Ghermu VDCs. All these three groups were observed in different seasons for exploring the general behaviour of the Assamese macaques from the study area in 2012/13. Four major behaviours were recorded in four different seasons (pre-monsoon, monsoon, post-monsoon and winter) during the study period in which average behaviour of such four seasons were recorded as foraging 45%, moving 24%, resting 21% and grooming 10% as well as in the three different blocks foraging (42%, 46% and 45%), locomotion (24%, 26% and 23%), resting (23% 19% and 22%) and grooming (11%, 9% and 10%) were recorded in Blocks A, B and C respectively where as Chalise et al. (2005a) recorded foraging 43.4%, moving 31.7%, sitting 18.5%, grooming 3.4% and stone licking 1.7% in LNP and Bhattarai (2002) recorded eating 29.20%, sitting 33%, walking 28.20%, grooming 6.40%, mating 1.1%,

aggregation 0.71% and play 0.40% in the same LNP, similarly, Regmi (2008) recorded foraging 49%, moving 26%, resting 16% and grooming 9% in LNP.

The amount of time spent on locomotion is determined primarily by the distribution of food and food plant species in the habitat and by the nature of food items (Sarkar 2000). Therefore, the Assamese macaques had to allot 24% time (range 22-26) to locomotion. Similar results were recorded by Sarkar et al. (2012) in forest group of Assamese macaque in Jokai reserved forest (RF) of Assam as 25% time (range 23-26) for locomotion. Similarly, Chalise (2000) recorded four major behaviors during the study in both expeditions (1997/98) in Makalu-Barun National Park taking geophagy into separate account and found 3 to 4% difference in cases of feeding, (1997/98) invested 29/25%. The present study showed that the Assamese macaques spent 45% of their total annual time range (43-47) on feeding while Sarkar et al. (2012) showed that the forest group spent 40% of their total annual time (range 38-45) on feeding. Chalise (2000) found 47/44% which is 3 to 4% difference in case of feeding in his study (1997 to 1998) in Makalu Barun National Park. While the average amount of time spent for feeding was 44% of the total activity where the highest foraging percentage of monkeys were recorded up to 70.2% per day and least amount of time invested was 21.3% in 1998, Subba (1998) found 43% in foraging, where Aggimarangsee (1992) found only 16.8% for feeding which is very less amount of time spent by monkeys for feeding with this study. So, this study suggests that distribution pattern of the food resource guides in relocation of activity profile for higher time spends of feeding activity in Assamese macaques.

Higher time spent in locomotion, costs higher expenditure of energy. The Assamese macaques which spent more time on locomotion, had to spend more time in resting in order to make a balance of energy demand and supply. Hence the *Macaca assamensis* spent annually 21% (range 18-26) of their total time in resting where different time spent was recorded by Sarkar et al. (2012) in resting for 13% (range 7-20). Similarly, Chalise (2000) found 9/13% in two different years of 1997 and 1998 and Aggimarangsee (1992) found 31.2% time for resting.

As the food randomly distributed in the study area, individual of primate do not able to monopolize the resources. So, social tension due to aggregation is comparatively less in the forest group as compared to provision or temple group (Sarkar 2000). Grooming

behaviour in long term serves the function of reducing 'social tension' (Schino et al. 1988) and establishes a social bonding (Kurland 1977) among the individuals within the group, so the Assamese macaque spent only 10% (range 8-12) of their total time in grooming in the present study. Whereas Chalise et al. (2005a) recorded grooming 3-4%, Regmi (2008) recorded grooming 9%, Bhattarai (2002) recorded grooming 29/25%, Aggimaragsee (1992) recorded grooming 8% and similar result also obtained in Assamese macaques group spent 10% (range 6-14) of grooming by Sarkar et al. (2012) which is different in temple macaque like Chopra et al. (1992) showed 14% in grooming by rhesus macaque. Hence, lack of extra social tension in the Assamese macaque due to its less size reduce the time spent on grooming.

5.3 Threats to Monkeys (Crop-Raiding and its Consequences)

Crop raiding was found as a major cause of conflict though physical hurt and harassment, taking and grabbing of food materials were also reported as the problems caused by monkeys. Among the respondents crop raiding was reported by 78% but the extent of crop raiding was found to be different areas. Crop raiding was to be highest like in the village near to the forest of Jagat bazaar (75%) followed by the Chipla village. Village near to the forest of Paune reported least to the crop raiding 45%. Higher extent of crop raiding in former two is due to the settlement and crop field very near to the forest. Khatri (2006) found that 76% of the respondents of Vijayapur Area of Dharan reported the crop raiding as a major problem. Similar in the study of Patty Mc.Court (2005) 92% respondents of Hetauda were found to suffer from crop damage from monkeys.

Chalise (2000) collected the information of crop raiding by the interviews in Lakuwa village of MBCA and reported that Rhesus and Assamese macaques were the most crop raider and Langurs visited the least and the villagers blamed that among the two species, Assamese monkeys were the terrible than rhesus. This study couldn't similar with this present study where the villagers blamed that among the two species, rhesus monkeys were the terrible than Assamese, and he stated that monkeys raid heavily to the maize field 29% then followed potatoes 23% (tubers also), rice 13%, fruits 12% and millets 12%. The tubers and fruits came to 35% of the total loss and all the cereals combinedly made 65% loss in Lakuwa village but here this crop raiding ratio of fruit and cereals crop is similar to this present study. Regmi (2008) reported crop raiding in LNP by 62% for

maize, 23% for potato, 7% for millet, 6% for buckwheat and 2% for other, which result is similar to this study. Khatri (2006) also supports that maize is the prominently vulnerable crops for raiding by primates.

Local people could not yield sufficient food to fulfill their family needs as raided by monkeys and fallowing of land. As perceived by local people, lack of natural food in the forest was the major cause compelling monkey to raid the crop. All the respondents were of the opinion that monkeys came to their crop field to eat as there was no food in the forest. People thought the increasing of monkey population was the next major cause for the increasing of problem. Lacks of arms and no provision of killing the monkeys, increasing of forest, crop field of very near of forest etc were other major components responsible to increase the problem of monkey as responded by of the local people.

Different preventive measures were applied to deter monkey, though chasing of monkey by shouting and guarding was found to be most effective and widely used measure. Local peoples usually protect their crop and chased monkey by shouting and guarding. Small hut, locally called "chhapro" were made to guard the field. Use of dogs, use of catapult and stone to chase monkeys, hitting tin boxes as well as other method like planting alternative crops were also found. Khatri (2006) in Vijayapur found the use of catapult to frighten the monkeys to be the most effective which is similar with present study.

In the study area, all the villagers have been trapped both inside and outside the conservation area and process of proper compensation of damage was not found. So, instead of traditional agricultural system, herbal plants and animal husbandry is seemed to be more productive and economically sound for local (Chalise 2001). Chalise and Johnson (2002) suggested to plant crops, which gives economic return such as species, medicinal herbs, nettle, lokta and bamboo, which are not harmed by monkeys.

McCourt (2005) in Hetauda found stone throw catapult 40% followed by chasing 20%, threaten 18% and stick wave 2%. Thus, types of aggregation were found similar with more use of catapult, which is more effective to deter and harm monkey from distance.

6. CONCLUSION ANDRECOMMENDATIONS

Conclusion

Total population of Assamese macaques was recorded to be 53 from three troops in Taghring and Ghermu VDCs during the study period of April, 2012 to March, 2013. Maximum number was reported near the Chipla village of Ghermu VDC and minimum number was recorded in Jagat Bazar. Distribution of Assamese in three blocks of study area was found to be clumped type of distribution. The sex ratio of Assamese macaques was found to be 1:1.24 i.e. 46 males in 100 females. There were more females than males, which did not depart significantly from 1:1 sex ratio. Average group size was found 17.66 individuals in the study area. Assamese macaques were encountered nearer to Marsyangdi River and other streams of study area.

The study shows the general behaviour of Assamese macaques in 4 different seasons in which the feeding activity has been found the major activity profile i. e. maximum feeding activity was found in winter while minimum was found in post-monsoon seasons. Similarly, maximum locomotion was recorded in post-monsoon and minimum was in winter season. Monsoon holds the maximum resting and winter season hold the minimum. For grooming, maximum time was found in pre-monsoon and minimum was in monsoon season.

Crop raiding was found more in farms near the forest than far distance. Maize crops were highly preferred by the Assamese macaque as a major crop raiding which is followed by potato tubers. Shouting and guarding was the most effective crop protection strategies adopted by the farmers.

Recommendations

Based on the finding of this research work, following recommendations can be made for the management and conservation of Assamese macaques in Taghring and Ghermu VDCs of Lamjung.

1. To increase natural food of monkeys, forestation of fruiting and flowering plant should be carried out to minimize their raid in crop field.
2. Participatory conservation works should be done with local people.
3. Visitors and local people should be aware to decrease the causes of conflict and local people should be educated about the importance of wildlife for the welfare of themselves.
4. Need more researches on the ecology and behaviour of Assamese monkeys should be carried out through Universities, research agencies and wildlife experts.
5. Population estimation of Assamese Macaques should be carried out not only in Lamjung district but also in entire country.

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Appendix–I: Climatic parameters recorded at Khudi Bazar Station in the year 2012.

Months	Temperature (°C)		Humidity (%)		Rainfall (mm)
	Maximum	Minimum	8:45	17:45	
January	19.7	6.2	63.4	70.5	40.4
February	23.3	8.5	71.6	76.1	33.8
March	27.5	12.3	62.3	70.8	41.1
April	29.7	15.5	68.0	66.9	130
May	32	17.5	77.3	76.2	73.7
June	31.8	20.4	90.5	88.9	590
July	30.5	21.3	84.8	86.6	810.4
August	31.1	21.1	81.3	81.9	902.8
September	30.8	20.1	80.8	82.4	389
October	28.7	13.9	64.0	65.2	87.9
November	25.6	9.1	58.2	58.2	0
December	22.8	7.2	75.9	76.2	0

(Source: NG/ DHM)

Appendix-II: Values of different parameters for tree species in protected area (Taghring VDC).

S. N.	Common Name	Scientific Name	R. D.	R. F.	R. Dom.	IVI
1	Chilaune	<i>Schima wallichii</i>	13.208	2.0319	17.975	33.2145
2	Gobre Salla	<i>Pinus wallichiana</i>	8.4906	1.3062	9.1603	18.9571
3	Dhale Katus	<i>Castanopsis indica</i>	7.0755	1.0885	9.2613	17.4253
4	Kaulo	<i>Persea odoratissima</i>	5.6604	0.8708	5.7316	12.2628
5	Lali gurans	<i>Rhododendron arborium</i>	4.717	0.7257	5.2656	10.7083
6	Khirro	<i>Sapium insigne</i>	6.1321	0.9434	3.2337	10.3092
7	Kafal	<i>Myrica esculenta</i>	4.2453	0.6531	4.7078	9.6062
8	Simal	<i>Bombax ceiba</i>	2.3585	0.3628	6.5504	9.27178
9	Dhupi	<i>Juniperus indica</i>	4.2453	0.6531	2.18	7.07836
10	Bhimal	<i>Grewia optiva</i>	3.3019	0.508	2.5734	6.38326
11	Lapsi	<i>Choerospondies axillaris</i>	1.8868	0.2903	3.7713	5.94836
12	Khanayo	<i>Ficus semicordata</i>	2.8302	0.4354	2.5284	5.79405
13	Kadam	<i>Anthocephalus chinensis</i>	2.3585	0.3628	2.5081	5.2294
14	Amala	<i>Phyllanthus emblica</i>	3.3019	0.508	1.3673	5.17717
15	Dar	<i>Debregeasia salicifolia</i>	2.3585	0.3628	2.4315	5.15279
16	Hade Okhar	<i>Juglans regia</i>	2.8302	0.4354	1.7351	5.00067
17	Bhakamilo	<i>Rhus javanica</i>	3.3019	0.508	1.1024	4.91228
18	Uttis	<i>Alnus nepalensis</i>	2.3585	0.3628	1.9128	4.6341
19	Siris	<i>Albizia procera</i>	2.3585	0.3628	1.8812	4.60254
20	Harro	<i>Terminalai chebula</i>	1.4151	0.2177	2.6378	4.27062
21	Kyamuno	<i>Careya arborea</i>	1.8868	0.2903	1.6648	3.84182
22	Sindure	<i>Bixa orelana</i>	1.8868	0.2903	1.0733	3.25041
23	Amaro	<i>Spondias pinnata</i>	0.9434	0.1451	2.024	3.11257
24	Bilaune	<i>Maesa chisia</i>	1.4151	0.2177	1.1323	2.76508
25	Timur	<i>Zanthoxylum armatum</i>	1.8868	0.2903	0.5639	2.74101
26	Tiju	<i>Diospyros malabarica</i>	0.9434	0.1451	1.5192	2.60776
27	Gayo	<i>Bridelia retusa</i>	1.4151	0.2177	0.8647	2.49749
28	Kutmero	<i>Litsea monopelata</i>	1.4151	0.2177	0.734	2.36684
29	Archal	<i>Antidesma bunius</i>	1.4151	0.2177	0.5183	2.1511
30	Mauwa	<i>Engelhardia spicata</i>	0.9434	0.1451	0.8835	1.972
31	Belauti	<i>Psidium guajava</i>	0.9434	0.1451	0.1938	1.28231
32	Badahar	<i>Artocarpus lakoocha</i>	0.4717	0.0726	0.3132	0.8575

Appendix-III: Values of different parameters for tree species in non protected area (Ghermu VDC).

S. N.	Common Name	Scientific Name	R. D.	R. F.	R. Dom.	IVI
1	Uttis	<i>Alnus nepalensis</i>	21.026	11.475	19.511	52.012
2	Chilaune	<i>Schima wallichii</i>	8.2051	8.1967	16.255	32.657
3	Dhale Katus	<i>Castanopsis indica</i>	5.1282	4.918	6.6947	16.741
4	Gobre Salla	<i>Pinus wallichiana</i>	5.641	3.2787	6.6326	15.552
5	Tiju	<i>Diospyros malabarica</i>	4.1026	4.918	6.3626	15.383
6	Khirro	<i>Sapium insigne</i>	4.6154	4.918	3.9217	13.455
7	Bilaune	<i>Maesa chisia</i>	4.6154	6.5574	2.128	13.301
8	Champ	<i>Maglonia cambelli</i>	2.5641	3.2787	6.3712	12.214
9	Kafal	<i>Myrica esculenta</i>	3.5897	4.918	3.3269	11.835
10	Siris	<i>Albizia procera</i>	4.1026	3.2787	3.4101	10.791
11	Khanayo	<i>Ficus semicordata</i>	4.1026	3.2787	2.8706	10.252
12	Lali gurans	<i>Rhododendron arborium</i>	3.5897	4.918	1.0684	9.5761
13	Kaulo	<i>Persea odoratissima</i>	3.0769	3.2787	3.0075	9.3631
14	Bhakamilo	<i>Rhus javanica</i>	4.1026	3.2787	0.9209	8.3021
15	Dar	<i>Debregeasia salicifolia</i>	1.5385	3.2787	2.2125	7.0297
16	Sindure	<i>Bixa orelana</i>	2.0513	3.2787	1.4198	6.7497
17	Bhimal	<i>Grewia optiva</i>	1.5385	3.2787	1.0412	5.8584
18	Lapsi	<i>Choerospondies axillaris</i>	1.5385	3.2787	0.9921	5.8092
19	Simal	<i>Bombax ceiba</i>	1.5385	1.6393	2.5594	5.7372
20	Dhupi	<i>Juniperus indica</i>	2.5641	1.6393	1.3271	5.5306
21	Guyallo	<i>Callicarpa macrophylla</i>	2.0513	1.6393	1.6496	5.3403
22	Harro	<i>Terminalai chebula</i>	1.0256	1.6393	2.3915	5.0565
23	Mauwa	<i>Engelhardia spicata</i>	2.0513	1.6393	1.2333	4.9239
24	Amala	<i>Phyllanthus emblica</i>	2.0513	1.6393	0.8338	4.5244
25	Hade Okhar	<i>Juglans regia</i>	1.5385	1.6393	1.006	4.1839
26	Kyamuno	<i>Careya arborea</i>	1.0256	1.6393	0.3652	3.0302
27	Timur	<i>Zanthoxylum armatum</i>	0.5128	1.6393	0.3325	2.4846
28	Archal	<i>Antidesma buniis</i>	0.5128	1.6393	0.1549	2.3071

Appendix -IV: Pre-structured Questionnaire for crop raiding.

Q. N.:- Date:
 Name: Age..... Sex: M/F District:VDC
VillageWard No.....Occupation:

1. How many members are there in your family?
2. How much lamddo you own? Khet:Bari:Pakho:
3. Which crops do you grow in your field?

Name of Crops	Plantation	Harvesting	Name of Crops	Plantation	Harvesting
Maize			Potato		
Paddy			Vegetables		
Wheat			Fruits		
Millet			Others		
Mustard					

4. Do animals or birds damage your crops?
 Yes [] No []
 If yes Name: - Local Name:
5. Does the monkey raid crops?
 Yes [] No []; If yes which monkey species
 Name: Local Name:
6. Which crop does the monkey raid most?
 Crop:
 Maize Pathi /Kg. Paddy Pathi /Kg.
 Wheat Pathi /Kg. Millet Pathi /Kg.
 Mustard Pathi /Kg. Potato Pathi /Kg.
 Vegetables Pathi/Kg. Fruits..... Pathi/Kg.
 Others Pathi/Kg.
7. Which year: Every year last yearThis yearNever.....
8. Time of raid: Early morning/Noon/Afternoon/Evening/Night

9. Proximity of damage field to the jungle: 100m/200m/500m/1000m/2000m

10. What is the preferable stage to raid the crops?

Crop	Raiding Stage	Season	Crop	Raiding Stage	Season
Maize	Sprouting	.....	Potato	Sprouting	.....
	Young shoot	.....		Young shoot	.....
	Milky	.....		Young	.....
	Ripen	.....		Ripen	.....
Millet	Sprouting	.....	Vegetable	Sprouting	.....
	Young shoot	.....		Young shoot	.....
	Milky	.....		Grown up	.....
	Ripen	.....		Old	.....
Wheat	Sprouting	.....	Fruits	Sprouting	.....
	Young shoot	.....		Young shoot	.....
	Milky	.....		Juicy	.....
	Ripen	.....		Ripen	.....
Paddy	Sprouting	.....	Others		
	Young shoot	.....		
	Milky	.....		
	Ripen	.....		

11. What is the frequency of monkey interference in crops?

Name of Crops	Frequency/ Months	Name of Crops	Frequency/months
Maize	Mustard	.....
Paddy	Wheat	.....
Millet	Vegetables	.....
Fruits	Others	.....

12. Any land left fallow because of the crop raiding of monkey?

KhetBari..... Pakho

13. Any other kinds of nuisance activities/harassment besides crop raiding?

Yes [] No []

If yes, what kinds?

Biting [] Disease transmission [] Accidents [] Others.....

14. What are the preventive methods that you are using to control?

Guarded by man/ woman /young/ Children/ Dog/ Scarecrows/ Noising/ Fencing/
Poison/ Fire cracker/ Hunting/ Others

15. Have you asked to forest official for compensation or other solution?

Yes [] No [] Unknown []

16. What will be the suggestive solution?

17. What are the benefits from forest? Fuel wood/ fodder/ timber/ cattle grazing/
Employment/ others

18. What do you think about the conservation of forest in your area?

Beneficial [] Harmful [] Unknown []

19. What do you think about the wildlife of this forest?

i) Should be protected ii) translocated iii) killed

20. Are you happy with the present forest (ACAP) management system?

Yes [] No []

21. What do you expect from the ACAP authority?

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Appendix-V: Local market price of crops at Jagat Bazar.

S.N	Crops	Average Monetary value in NRs per Quintal in local market
1	Maize	2,500
2	Potato	3,000
3	Millet	2,625
4	Wheat	2,000
5	Paddy	5,000
6	Fruits	3,000
7	Vegetables	4,200

Appendix-VI: Rate of crop raiding by Assamese Macaque in the study area.

Cultivated crop	Total Land (ha)	Expected Yield (quintal)	Observed Yield (quintal)	Loss (Quintal)	Loss (NRs)	Loss Quintal/Ha
Maize	12.22	95.92	53.72	42.2	1,05,500	3.45
Potato	7.01	65.37	45.73	17.64	52,920	2.51
Millet	16.37	261.46	227.39	33.98	89,197.50	2.07
Wheat	3.41	28.59	26.59	2	4,000	0.58
Paddy	4.71	77.95	74.84	3.11	15,550	0.66
Fruits	0.76	11.52	11.18	0.34	1,020	0.44
Vegetables	1.25	10.31	10.11	0.2	840	0.16
Total	45.73	551.12	449.56	99.47	1,63,527.5	9.87

