

Chapter I

INTRODUCTION

1.1 Background

A good deal of work has been done on the socio-biology and behaviour of Hanuman Langur (*Semnopithecus entellus* Dufresne, 1797) in various geographical regions within its wide distribution and some differences have been observed in different regions (Warren, 1967). The study reports on *Semnopithecus entellus* was published since 1836 and was followed by Blyth (1843), Hutton (1867), Hughes (1884) and Heape (1894) on different behavioral aspects. Blanford (1891) summarized the then existing knowledge on this species. Ayer (1948) studied the external and internal anatomy of Langur. Locomotor patterns and postures have been studied in considerable detail by Ripley (1967). Oboussier (1972) made a further study of skull variability from the point of view of sub-specific variation. Observations covering various other aspects like ecology, social behavior, eco-ethological investigations and about natural diets were carried out in wild by different scientists in different periods (Srivastava, 1989). Chalise (1995) made an extensive comparative study on the feeding ecology and behaviour of male and female Langur (*Semnopithecus entellus*) from Chitwan, Nepal.

Primate is an order of mammals, which includes the monkeys, apes, humans and other similar forms typically having dextrous hands and feet, binocular vision and a well developed brain. They are commonly called monkeys excluding only the tree shrews; the lemurs like forms, the apes and humans and therefore embody a tremendous evolutionary and adaptive arrangement of animals (Tattersall, 1993).

Primates today are found throughout the tropical zones of South America, Africa and Asia. Within those continental areas where they do occur, primates occupy all types of habitat from climax rain forest and moorland, on high mountain ranges to open savannah and desert habitat (Dunbar, 1988). In broader sense primates, now a days are confined 40⁰ N to 40⁰ S of equator in the moderate habitat (Chalise, 1999).

Monkeys are included under the sub-order simiae of order primates. Further, monkeys according to the geographical distribution are categorized into more types, New World Monkeys and Old World Monkeys. The New World monkeys lack cheek pouches and nostril open to side rather than down. Area between the nostrils is wide and flat. Most have long prehensile tail and none-have callous pads on the buttocks. e.g. Spider monkeys, capuchins etc. The Old World monkeys have produced muzzle and well developed cheek pouches, nostrils set close together facing forward and downward. The tail is never prehensile and some species are tailless. Both the hands and feet are adapted for grasping. Callous pads on the buttocks are often bright and in case of females are swollen during estrous period (Walker, 1968).

In Nepal, only three species of monkey viz. Hanuman Langur (*Semnopithecus entellus*), Rhesus (*Macaca mulatta*) and Assamese monkey (*Macaca assamensis*) are recorded (Chalise *et al.* 2005). The Hanuman Langur (*Semnopithecus entellus*) is the most intensively investigated of Asian colubines. It belongs within the order primates to the Cercopithecidae and is the largest among the sub-family colobinae. Taxonomy of Hanuman Langur is as follows.

Class: Mammalia

Order: Primates

Family: Cercopithecidae

Sub-family: Colobinae

Genus: *Semnopithecus*

Species: *entellus*

Hanuman Langur lives in a wide range of ecologically diverse habitats in India (Prater, 1993). In Jaipur, this species occurs in a variety of habitats like forest and urban areas like temple, tourist's spots and residential area (Mathur and Ram Manohar, 1987). Langur monkeys are also found in mountainous areas up to the Himalayan belt (Melamchi, Nepal) as well as in semi-desert areas (Rajasthan, India), Sub-tropical monsoon dry forests (Nepal Tarai) and tropical rain forests of Sri-Lanka (Chalise, 1995). These habitats include a wide range of vegetation zone, semi-desert,

dry open scrubs, open cultivated regions, open park woods, dry deciduous forests, moist deciduous evergreen dense forests and mountain forests up to the zones of rather homogeneous oak- coniferous forests. These habitats are located from sea level up to the height of about 4000 m. (Roonwal and Mohnot, 1977, Vogel, 1977).

Hanuman Langur is well adapted to arboreal as well as terrestrial habitats. Although in the forest they spend most of the time in trees and in open habitats they can be found up to 80% of their day time on the ground (Chalise, 1995).

Langur monkeys are vegetarian even though occasional feeding on insect has been observed (Sugiyama, 1964, Yoshiba, 1968, Srivastava, 1989, Chalise, 1995). More than 200 plant species were recorded as food plants in arid area (Srivastava, 1989) while 76 species in subtropical area of Nepal (Chalise, 1997). The plants eaten by them include trees, shrubs, herbs and grasses. They have eaten soil materials (Srivastava, 1989) and licked mosses stone in Nepal, they also have eaten termite, soil and insect larvae too (Chalise, 1995).

The ecological and behavioral research of Hanuman Langur have been conducted in India at Orcha and Kaukari in early 1960s (Jay, 1962, 1963, 1965) mostly on activity pattern. Similarly at Brahmpuri of India Lindburg (1971) and Polrier (1968) had studied on home range of Langur. Yoshiba (1974) did a detail study of activity pattern of *Presbytis entellus* at Dharwar, similarly Starin (1973) in Gir forest, Hardy (1974) in Mount Abu, Oppenheimer (1973a) in Singur and Sugiyama (1976, 1977) in Shimla.

In Nepal ecology and behavioral research of monkeys started around 1970s on rhesus of urban areas mostly of religious spots in Kathmandu Valley. Bishop and Curtin conducted the ecological and social behavioral research on Langur on highland species around Melamchi and Solukhumbu area. Langur monkeys of subtropical areas were studied since 1990 (Chalise, 1995).

In subtropical Sal (*Shorea robusta*) forest of Ramnagar Chitwan, this species was extensively studied by a German team and Chalise (1995) studied specifically on sex

differences in feeding ecology and behavior of Langur. Later, Chalise (2006) conducted Population census of primate species in different phytoecological zones of Nepal.

The Hanuman Langur is a large and diverse group of Asian leaf eating monkeys. Their average head and body length is 51.0-108.0cm and tail is 72.4-109.2 cm long. The weight of male is 9.0 -20.9 kg and females are of 7.5 -18.0 kg (Roonwal and Mohnot, 1977). All are slender in build with long arm and legs. The round head is frequently capped or crested and the face is mostly black with bushy eyebrows and a short nose. The hands are long with opposable thumb. The color of fur changes with the age growth. Infants have red skin and blackish fur. Within the first six months of life, skin and fur color change to black and gray respectively. Infant and Juveniles are mostly light gray in coat color while adults are dark gray. The color of adults may vary slightly with the age (Chalise, 1995).

1.2 Global distribution of Langurs

The Hanuman Langurs are the most widespread nonhuman primates and occur throughout the various habitats of the Indian subcontinent and SriLanka in the south and from Kathiwar in the east to the Shan state of China in the west. Langur lives in a variety of habitats ranging from plains to 3,600 m altitude in the Himalayas and from relatively dry tropical forests to open forests, scrub jungles and arid rocky areas with xerophytic vegetation (Roonwal and Mohnot, 1997). In the Himalayas, it appears to migrate seasonally, going up the mountains in the summer and coming down to lower altitudes in the winter, but may live in winter among snow-covered pines and firs (Prater, 1993).

1.3 Distribution of Langur in Nepal

In Nepal, the Langur monkeys are distributed in different topographical locations from Tarai plain to the valleys of high mountains (Chalise, 1995, 1997 and 1998). Langur is found at an altitude up to 3600 m in the Himalayas. It is distributed in Annapurna Conservation Area, Sagarmatha National Park, Shey-Phoksundo National Park, Makalu-Barun National Park, Langtang National Park, Khaptad National Park,

Rara National Park, Shivapuri National Park, Bardia National Park, Chitwan National Park, Shukla Phanta Wildlife Reserve, Parsa Wildlife Reserve and Koshi-tappu Wildlife Reserve. It is also reported from districts of Gorkha, Chitwan, Kailali, Kanchanpur, Taplejung, Ramechhap, Doti, Bajhang, Bajura, Ilam, Panchthar and Sankhuwasabha (Majupuria and Majupuria, 1998).

The study of this species has not been conducted in Devghat area which is one of the important religious places of Hindu-Kush region. Yearly thousands of people visit this area to celebrate their sacred religious days. Due to the regular visit of huge mass of people in this area, monkeys are harassed and scared by the people and disturbed their natural activities. Not only due to these reasons, but also the probability of the disease transmission through the junk foods provided by the people, the research work on this Langur species is necessary in the proposed study site.

1.4 OBJECTIVES OF STUDY

The main objective of the study is to understand the distribution and ecology of Hanuman Langur in Devghat area of Chitwan district. The specific objectives are:

- i. To explore the population and distribution of Hanuman Langur in Devghat area of Chitwan.
- ii. To investigate the floral composition of the Devghat area and their uses by Hanuman Langur.
- iii. To investigate the behavioral ecology and diurnal activities of Hanuman Langur in Devghat.

1.5 Justification of the Study

Human and monkey share the same root of evolution. It has been using in biomedical researches and can also be potential supporter for the human in many dangerous works like tree climbing. In natural condition it helps to maintain balanced ecosystem, seed dispersal and re-vegetation. In Nepal, still there are many unexplored places and ecological zones, which are important for Primatological study. One of those places is Devghat. This is unique in the sense that a lot of temples are situated nearby the study

area. This place is of religious importance and interaction between People and monkey is close, which might have created adverse effect on behavioral ecology and threats to their habitat. So the knowledge of distribution, their habitat, and behavioral ecology is essential for their proper management and long-term survival.

1.6 Scope and Limitations of the Study

The extent of intra-specific variability reported in the literature for the behavior of Langur and very little study were done in behavior about the *Semnopithecus entellus* of Nepal. So the present study was to achieve a generalized quantitative description of behavior of Langur troop living in an undisturbed habitat and compare these data with the research of other study sites on the same species.

The outcomes from the study will be valuable information for the person, researcher, organization and other line agencies working in the field of wildlife especially focusing in monkey species. The research work will help the Devghat Region Development Committee to manage them properly.

Sophisticated equipments, finance, security etc. were some of the lacks felt during the research work. Similarly, within the short period of time, it was difficult to habituate the Langur group, which made inconvenient for collecting the large behavioral data.

STUDY AREA

2.1 Background

Nepal, a Himalayan country, covered two biogeographically realms the Indo-Malayan and the Palearctic at the cross roads of floristic sub-region, including the Sino-Japanese grano Turanian, Central Asiatic and Indo-Malayan sub-regions. It is a country having both physiographic and climatic contrasts with a relatively small area of 1,47,181 sq. km. extending along east-west 800 km. and 145-241 km. along the north-south slopes of the Himalaya separating the arid Tibetan plateau to the north from the fertile Gangetic plain to the south. Nepal is a landlocked country bordered in the north by Tibet, the autonomous region of China in the east by Sikkim and West Bengal of India and in the south and west by Bihar, Uttar Pradesh and Uttaranchal of India. The country rise from the Indo-Gangetic plain, about 60m in the south to world's highest peak, Sagarmatha (Mt. Everest) 8848m in the north with increasing altitude vegetation changes from tropical through sub-tropical and temperate to alpine (Majupuria and Majupuria, 2006).

In Devghat, Kali Gandaki and Trishuli River merge to form the Narayani. Devghat occupies total area of 54.34 square kilometers. Devghat is one of the holiest places of Hindu religion. There is a general belief that all the people related to the Hindu religious should come to Devghat for the eternal peace and religion spirituality.

2.2 Geographical Location

Devghat lies in the central part of Nepal. Its geographical location is $84^{\circ} 22' 30''$ to $84^{\circ} 30' 00''$ E longitude and $27^{\circ} 42' 30''$ to $27^{\circ} 47' 30''$ North latitude. Its height varies from 200 m to 600m above the sea level. Topography of this place falls in the hills and inner tarai region of Nepal. It is the meeting point of Tanahun, Chitwan and Nawalparasi district. It is 6 km north to the Narayagarh of Chitwan district and 150 km south of capital city kathmandu of Nepal. Bharatpur Airport of Chitwan is the nearest airport, which is only about 8 km far from Devghat. Hourly Buses Shuttle between Narayangarh and Devghat taking half an hour (Figure 1).

MAP OF STUDY AREA

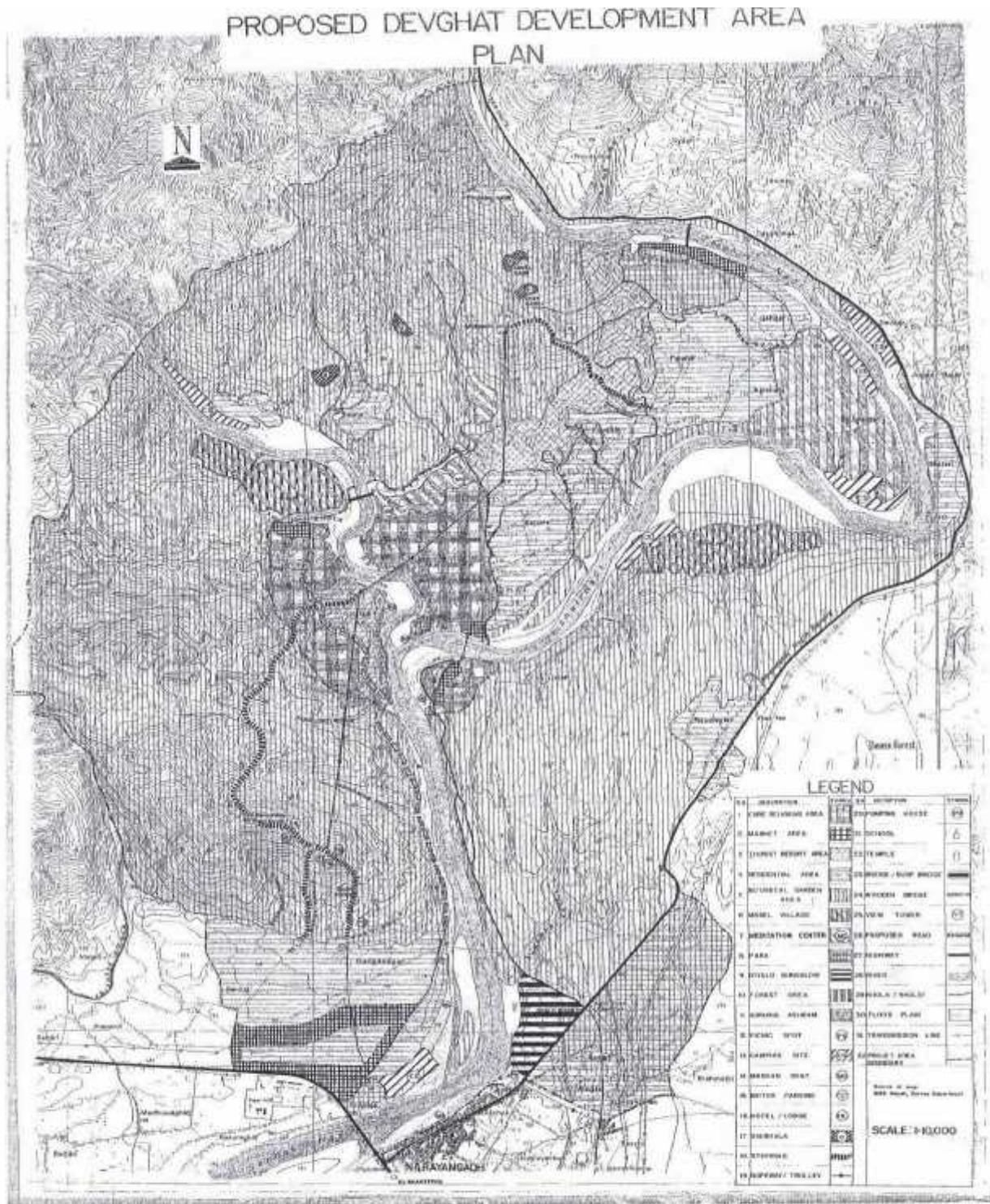


Figure 1. Map of Study Area, Devghat Development Area (Source: Devghat Development Area)

Devghat, also known as Shree Harihar Kshetra or Aadi Prayag is identified with very high glory of its own. According to Baraha Puran, Skanda Puran, Himwatkhand, Devghat, the holy place of pligrimage is also known as the converting point of such places of pligrimage as Siddhashram, Sham bhutapovan, Devghatta, Gajendra Tirtha, Trikutachal Kshetra, Siddhartha and Devnandi. The Study area lies in Bharatpur Municipality of Chitwan and Devghat V.D.C - 1, of Tanahun district.

2.3 Topography

Geologically Devghat area is located in the northern fringe of the Chitwan (inner Tarai) on the southern-western part of Kabilas hill of Mahabharat range. The eastern part of this area is connected with the protected forests for rhino *Rhinoceros unicornis* tranversed by Mugling-Narayangarh highway in mid and western part Narayani River flows connecting with Nawalparasi forest of Kalika temple.

2.4 Climate

Devghat is under the sub-tropical Climatic Zone on Nepal, 200-600 m.asl. The summer months are hottest with max 35⁰c with average maximum temperature of 32⁰C and the winter months are warm during the day while heart chilling cold in early morning and at night. The pleasant months are October and march when the temperature is around 30⁰c at noon but nice in morning and evening with around 25⁰c (figure 2) temperature reached maximum 35⁰c and minimum 18⁰c during the study period.

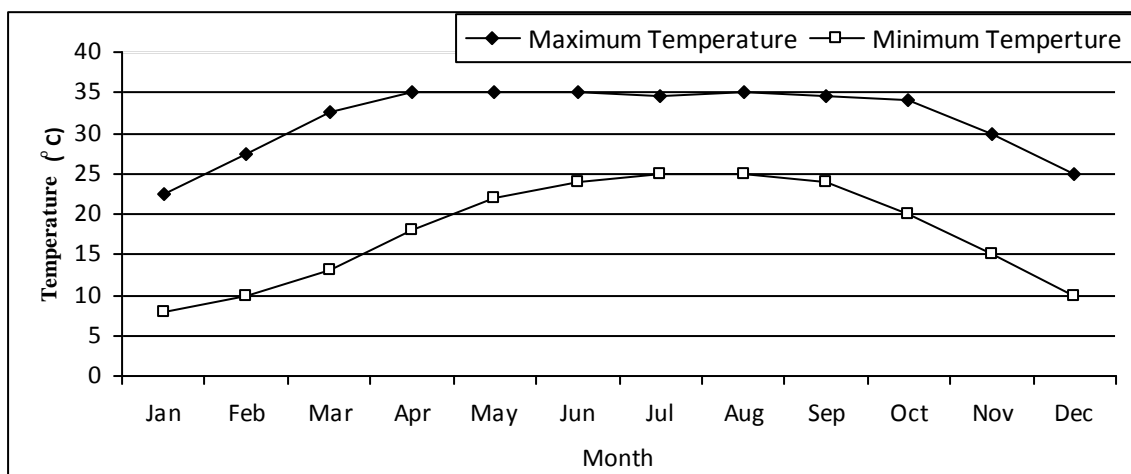


Figure 2: Mean monthly maximum and minimum temperature recorded at Rampur Station, Chitwan, 2002-2006 (Source: Department of Meteorology, 2007).

The precipitation of Devghat data shows that the main rainy days were in the months of July and August. The highest rainfall was recorded (800 mm) in the month of July during the study period. However the rainy season start from May /June and ends in September (Figure 3). As a whole, rain in Nepal is due to the monsoon wind arising from the Bay of Bengal. The winter monsoon from the Arabian ocean enters from the west part of Nepal and relatively low amounts of scattered showers occur in this area. However the wind situation of monsoon always changes, so the weather data can be different.

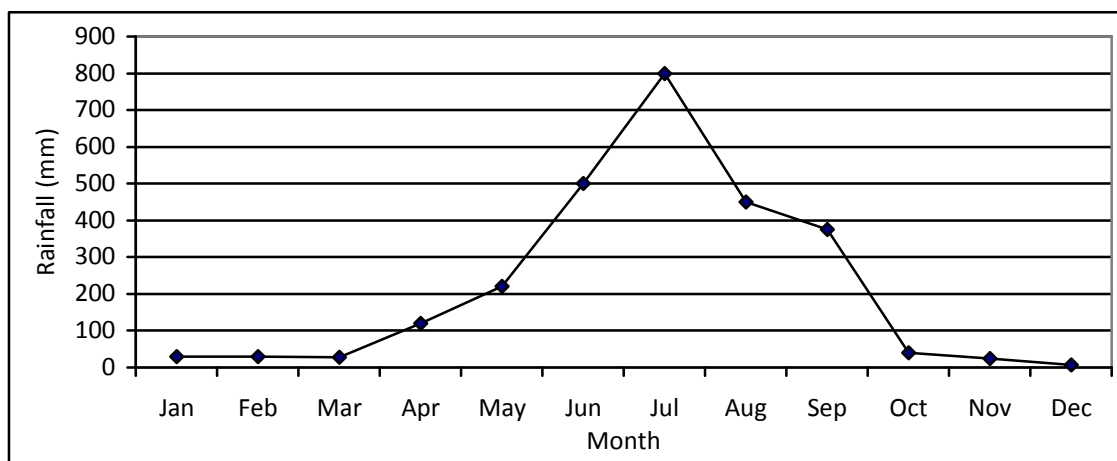


Figure 3: Mean monthly rainfall recorded at Rampur Station, Chitwan, 2002-2006 (Source: Department of Meteorology, 2007).

Mean monthly relative humidity varies from 51.8% at March to 99% in winter months like December and January (Figure 4). Normally, the rainy season is hot and humid. The winter nights due to the presence of dew are also humid but during the day it is drier. The summer months of March is dry and hot with humidity of air was 50%.

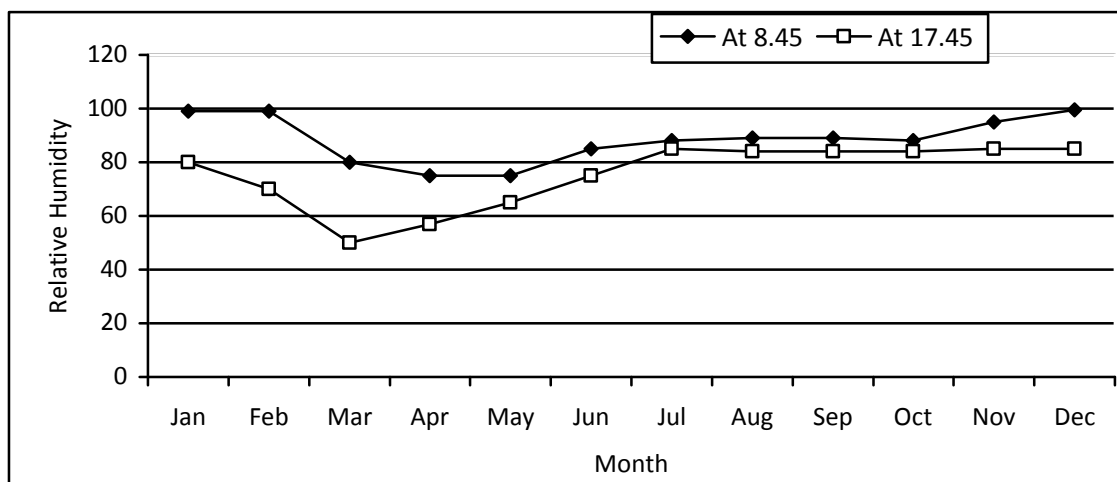


Figure 4: Mean monthly relative humidity recorded at Rampur Station, Chitwan, 2002-2006 (Source: Department of Meteorology, 2007).

2.5 Flora and fauna of Devghat

Devghat lies in the northern part of Chitwan valley and shows a little differentiation in the vegetation and landscape than rest of valley, due to different landscape with red denuded soil. Major plants of the study area are Sal (*Shorea robusta*), Jamuna (*Syzygium cumini*), Pipal (*Ficus religiosa*), Bel (*Aegle marmelos*), Sissoo (*Dalbergia sisoo*) Simal (*Bombax ceiba*), in trees, Main-kanda (*Xeromphis spinosa*), Khirra (*Holarrhema pubescens*), Dhurseli (*Colebrookea oppositifolia*), Rudhilo (*Pogostemon benghalensis*) in shrubs; Khole jhar (*Lacanthus peduncularis*), Bhiringi jhar (*Altrnanthera sessilis*), Mitha jhar (*Scopariae dulcis*), Banmara (*Eupatorium odorahim*), Halhale (*Elephantopus scaber*) in herbs and Kukurdaino (*Smilax lanceifolia*), Kane lahara (*Scindapsus officinalis*), Tarul (*Dioscorea bulbifera*), Debre (*Spatholobus parviflorus*), Birale (*Pueraria phaseoloids*) in climbers. The area is of sub-tropical climate with species such as *Rubus ellipticus*, *Woodferdia fructicosa*, *Melastoma normale* and *Schima wallichii*.

The fauna of Devghat can be divided into two major types: wild animals and domestic animals. The forest of this area shows the impact not only by human beings but also due to the presence of domestic animals. The herbivore animals are direct competitors of the Langurs for food and carnivorous are the predators of them.

a) Wild animals: The forest of Devghat harbours a variety of wild animals. The data of encounter of the mammalian fauna while studying the Langurs shows that *Axis axis* are found frequently associated with Langurs. The most abundant species among them is *Axis axis*. This deer species seems to be attracted towards the Langur's place where they eat the foliage thrown by monkeys. The other common species of the forest are barking deer (*Muntiacus muntjack*), sambhar deer (*Cervus unicolor*), wild boar (*Sus scrofa*), hare (*Lepus* sp.), squirrel (*Callosciurus* sp.), forest rat (*Bandicota* sp.) yellow throated marten (*Martes* sp.) and few are some of the herbivore competitors. The carnivorous include the common mongoose (*Herpestes edwardi*), porcupine (*Hystrix indica*), common jungle cat (*Felis chaus*), jackal (*Canis*

aureus), fox (*Vulpes bengalensis*), leopard (*Panthera pardus*) and wild dog (*Cuon alpinus*). Predators of Langurs can be counted as leopards, wild cat and for death; the domestic dogs are the problems.

b) Domestic animals: There are huge number of cattle and goats in Devghat area.

These animals are fully dependent on the forest area for green fodder around the village. The local farmers are of low economic status, so they only feed the forest products to these animals.

c) Birds: The common birds of Devghat forest are white breasted king fisher (*Halcyon smyrnensis*), white bellied drongo (*Dicrurus caerulescens*), black drongo (*Dicrurus adsimilis*), pond heron (*Ardeola grayii*) rose ringed parakeet (*Psittacula krameri*), common maina (*Acridotheres tristis*), jungle maina (*Acridotheres fuscus*), house crow (*Cervus domesticus*), koel cuckoo (*Eudynamys scolopacea*), Red Jungle fowl (*Gallus gallus*), etc. Some migratory birds also appear in the forest from time to time.

d) Reptiles: Some common lizards are found in the forest as the crested lizard, common lizard and golden monitor lizard (endangered), salamander and snakes as Karet, Dhaman, green viper, banded viper etc.

e) Others: There are some amphibians in the forest. The most commons are tree frog (*Racophores*), toad and common frog. Arthropods such as centipedes, millipedes and spider are abundant in the forest. The ticks and forest lice are also common after rainy season. Blood sucking leeches are abundant in the rainy season.

Chapter III

LITERATURE REVIEW OF RECENT STUDIES

3.1 Population status and Distribution of monkey in Nepal

Conservation Assessment and Management Plan (CAMP) workshop 2002 has classified available primates for Nepal (Sanjay *et al.* 2003). CAMP has classified Nepal's Langur into 3 Sub-species: *Semnopithecus entellus hector* (Lesser Hill Langur) as Critically Endangered, *Semnopithecus entellus ajax* (Himalayan Grey Langur) as Endangered and *Semnopithecus entellus schistaceous* (Central Himalayan Langur) as Near Threatened and Assamese monkey of Nepal designated as 'Nepal population' with endangered status based on morphological characteristics. The assessment to the Rhesus Monkey *Macaca mulatta* was categorized as Least Concern as its abundance population and larger area distribution.

The latest primate census data has been recorded for these three groups of monkeys in different ecological zones of Nepal from Tarai plain to the lap of Himalayas (Chalise, 2006). The population of Assamese monkey 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). Rhesus is found in different climatologically diverse topographical zones of Nepal. They are common in Tarai plain to midhill and up to the valleys of Himalayas. However, detail information on their ecology, behavior and distribution throughout Nepal is greatly felt for all available species: Rhesus and Langur are common and the Assamese is strictly protected under the National Park and Wildlife Act 1973 and has considered in endangered status (Chalise, 1997, and 1998). Population density of Rhesus macaque animal has been found more in temple, religious places and cities and towns. The total population of Rhesus recorded is 1696 individuals, with 1065 inside the Katmandu Valley and 631 out of valley. The total counts of Hanuman Langur population around different localities are 719 until 2004; more than 200 mature individuals were recorded (Chalise, 2004).

In Nepal, Hanuman Langur *Semnopithecus entellus ajax* is reported from east Langtang, Melamchi area *Semnopithecus entellus hector* from central to west Nepal in outer Tarai, and *Semnopithecus entellus schistaceous* is reported from south to north in central Nepal (Chalise, 2004).

3.2 Threats to *Semnopithecus entellus*

The Hanuman Langur is under constant threat of natural habitat destruction due to increasing human population. When forests are not totally cleared, they are still often impacted through illegal timber extraction, livestock grazing and lopping. As a result, primate population is being reduced or eliminated in many parts of the world (Wolfheim, 1983).

A secondary threat arises when the highly adaptable, commensal Langur moves into human habitats to acquire its daily needs often taking up permanent residence alongside humans. To counter their threats, forest conservation is an obvious priority. In addition, the attitudes of people toward monkeys need to be routinely assessed as Pirta (1986) did with Indian villagers toward crop raiding and King *et al.* (1984) did with suburban residents of material toward crop- raiding Vervet monkeys.

Therefore, main threat of primate conservation can be summarized for Nepal are habitat loss for agriculture expansion, logging and shifting cultivation followed by the revenge feeling of farmers due to their crop damage (Chalise, 2003).

Wild monkey-local people conflict was found to be a serious social and environmental problem. Rhesus problem is found in all areas of Vijayapur mainly in Narayanpur, ward no. 14, near Panchkanya forest and ward no. 1 and 2 to Hattisar Campus of Dharan Municipality. Langur problem is less, may be due to presence of natural food in the forest areas. Among the different problems due to monkey, crop raiding problem was found to be more in Narayanpur because the crop grown areas are nearest from natural forest and are linked with corridor of bamboo grooves. Grabbing and taking food, clothes tearing and cable network damage was found mostly in lower part of Vijapur (Hattisar) town. Several Hanuman temples are located there, where people (especially madwari) feed monkey by their religious faith. Due to artificial provisioning, the foraging behavior of monkey was found turned to provisioning only. They are lazy and stay mostly in residential and temple areas to acquire good nutrition, which decreases the period of reproductive age, and population went increasing. So, monkey conflict is high in these areas due to their population (Khatri, 2006).

3.3 Economic loss

Hanuman Langur raids the agriculture field and cause both direct and indirect loss. A study made by Chhaangani *et al.* (2004) at Kumbhalgarh Wildlife Sanctuary (KWS), India found that Hanuman Langur damage most agricultural crops to a considerable extent. Extent of crop damage depends on the number of troop members and crop protection strategies employed by farmers. In the home range of a troop, all the orchard farms are raided and damaged. It is found that Langur spoil more crops than they actually eat, Juveniles and infants in particular bring about damage during play on the ground as well as on the fruit trees. The damage is up to 27 % of total yield and rarely up to 50%. The estimate of damage was assessed on the basis of the information gathered from farmers and through visual observations from 12 farms. The calculated crop damage from two bisexual troops B- 1 and B-2 (including one focal troop (B-2) and two all male bands AMB-1 and AMB -2 (comes to about US \$ 900 per annum from a total of 102 animals living in the periphery of crop fields and orchards. If it is included the costs of crop protection per household it ranges between US \$ 150-200 per farm per year, which comes to US \$ 1800-2400 for 12 farms.

Besides this direct loss, they also cause indirect loss by feeding upon the flowering and fruiting trees, which reduces the fruit production considerably, which farmer cannot workout. Juveniles and infants break branches blooming with flowers and fruits during play. Among the lost 22892 kg of crops raided by monkey species Tamku Village Development Committee of Makalu-Barun Area: there were 14820 kg of cereals and 8072 kg of tubers and fruits found lost due to primate species. A loss of 286 kg per house included 185 kg (65%) cereals and 101 kg (35%) of fruits and tubers. The tubers like potatoes, sweet potatoes, rhizomes and fruits- banana, guava etc., were either eaten or damaged in search of palatable parts (Chalise 2003).

3.4 Monkeys and Biomedical research use:

The monkeys are physiologically similar to humans; Rhesus monkeys have been used as research model animals and exported from India to USA and other countries to an extent that has greatly reduced their population. India then bars their exportation. However inside the country, monkeys have been used extensively in research on human blood chemistry, biomedical research. Rh factor in blood derives its name

from rhesus monkey, psychological studies carried out on the animals have aided in the understanding of infant-mother relationships in humans.

Because of structural similarities to those of man, anatomical dissections of several species of monkeys were made since many years ago and more recently these animals have been the basis of studies in physiology and behaviour. They are used as best model for biomedical research, anthropology and psychobiological aspects of human beings and because of medium sized body and fast producers; they are widely used in laboratory for research. Monkeys and their tissues were essential to the studies and experiments, which led to the development of the Salk and Sabin Polio vaccines. Primate research made the osteoporosis, breast cancer, cervical cancer, ovarian cancer, endometriosis, polycystic ovary syndrome etc. curable, which are the health complications in females. The causes and treatments of miscarriage and birth defects were also first investigated in monkeys (Khanal, 2007). Non-human Primates are required for ensuring safety as many vaccines must be assessed for specificity and safety in a "near human" immune system before they are clinically used to human. Because of the high degree of genetic similarity of Asian Rhesus monkey (*Macaca mulatta*) with the human beings, they are now extensively used in 'Bio-medical Researches'. Monkeys are taken as delicacy in Indochina, Indonesia and Raute people of western Nepal and tribal people of east-northern and central India use them as food.

Rhesus and humans share similar diseases such as small pox, measles, tonsillitis, herpes 'B' etc caused by viruses, tuberculosis, bronchitis, tetanus, cold and cough by bacteria. The medicine against AIDS has been experimented on Rhesus monkeys, which are most successful events in the medical sciences that increase the life span of the human by the use of medicines. The other dangerous diseases such as hepatitis B, Swelling of liver (Cirrhosis), cancer has been experimented on them and the successful result has overcome to save human life (Chalise, 2004 b).

Chapter IV

MATERIALS AND METHODOLOGY

4.1 METHODOLOGY

4.1.1 Reconnaissance Survey

A preliminary survey of the study area was done on July 2006 to find out the distribution, ecological behavior and threats to Langur in Devghat area before starting of regular field work. The survey process included field observation, interaction and pretesting of questionnaire with local people.

4.1.2 Field Survey

Fieldwork was carried out in the second and third visit in the month of June to September 2007. During the field survey related information were collected by using various methods.

4.1.3 Research Design

Sampling method and sample size: -Stratified random sampling method was used to select respondents for the questionnaire survey. From the nearby study area, 25 respondents were selected randomly. Hence number of respondents from study area was 25 and as a whole the sample size was 100.

4.1.4 Data collection methods and procedures

Both the primary and secondary data were collected for the study.

4.1.4.1 Primary Data collection

A pre-tested semi-structured questionnaire was used to interview the respondents of household survey. Stratified random sampling method was used to select respondents for the questionnaire survey. The study site was first divided into four strata: Block A, Block B, Block C, and Block D. From each block 25 respondents were selected randomly. Hence number of respondents from each block was 25 and as a whole the

sample size was 100. Questionnaire containing information like the monkey visit, general behavior, threats to the Hanuman Langur and their distribution pattern etc. was used to collect the information from respondents. Most questions were fixed alternative for easy scoring and analysis.

4.1.4.2 Secondary Data collection

Secondary data collection related to the study was reviewing of different books, annual reports, news articles, research reports, dissertations, journals, websites, visiting different concern offices, and libraries.

4.1.5 Population Distribution of Langur

The head count of monkey population was done with the help of binoculars. First of all, the regular observation was done both early morning and evening time to locate their distribution in different sites. A regular watching was conducted without disturbing natural setting. The counting was done thoroughly in observes troop using continuous and focal sampling method as described by Chalise (1998) and formulated by Martin and Bateson (1993). All the activities and composition were recorded.

To determine the distribution pattern of Langur in Devghat area, the statistical formula as described by Odum (1996) was used to calculate the ratio of variance to

the mean value $\left(\frac{s^2}{x}\right)$.

If $\left(\frac{s^2}{x}\right) = 1$, it refers random distribution of Hanuman Langur in Devghat

If $\left(\frac{s^2}{x}\right) < 1$, it refers to regular distribution of Hanuman Langur in Devghat

If $\left(\frac{s^2}{x}\right) > 1$, it refers to the clumped distribution of Hanuman Langur in

Devghat

Where, the variance $(S^2) = \frac{1}{n} \sum (x - \bar{x})^2$

\bar{x} = mean value

The significance in the difference of sex groups in adult and sub-adult Langur was tested by Chi-square test.

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

Where, O = Observed value and E = Expected value

4.1.5.1 Troop composition

Troop composition was separated by direct counting the individuals in each group and age/sex ratio were distinguished by their body color, body proportion, height and body size (Roonwal and Mohnot, 1977).

During the study period (June to September 2007) there were 43 individuals in the focal troop.

The composition of the troop was differentiated age wise into adult males, adult females, sub-adult males, sub-adult females, juveniles, and infants according to their body size, coloration and behaviors.

4.1.5.2 Ad-libitum sampling

This is a sampling technique; in which additional information on rare events and on general occurrence (behavior) in the troop is noted down systematically (Chalise, 1995). This method was adopted to take information about the events of conflict and other behavior. Direct ocular observation method was employed for cataloguing the behaviour and monitoring the activities. The ocular observation was aided with 12 x 50 mm binoculars. Following behavior were observed including other social activities of Hanuman Langur in Devghat area.

- i) **Inactive:** -The state when monkey rests with the body supported upon the buttocks with hindquarters lowered onto a supporting surface.
- ii) **Moving:** -The behavioral phenomenon, in which monkey produces motion displacing from one place to another.
- iii) **Grooming:** -The behavioral phenomenon in which monkeys search their own fur or the fur of others for lice, bugs or dirt which include rubbing, licking and scratching.
- iv) **Foraging:** -The behavioral activity in which monkey searches for food or wanders in search for food including eating any substance, geophagy (licking stone and eating soil), drinking water slight movement with.
- v) **Playing:** -The behavioral activity in which monkey jumps from one branch of tree to another or within the same tree or in the ground for recreation and friendly manner.

Aggressive Interactions by monkey were categorized into following types:

- i) **Threat:-** One or more of the events with direct eye contact with the recipient such as head bob, facial grimace, charge threat etc.
- ii) **Biting and Nail scratch:** - Monkey inserting its nail or teeth into skin or any part of body.
- iii) **Food snatching:** - Grabbing the food carried by human or stored in the house.
Aggressive interaction by human beings:-
- iv) **Stone throw/catapult:** Throwing towards monkey with or without carrying stone. Stick or any weapons may be used.
- v) **Charge threat:** - On monkey head bob stimulation, small steps towards monkey and giving the motion of throwing object towards monkey.
- vi) **Shout:-** Yelled high sound in the direction of monkey.

Encroachment of habitat: - Cut trees or clear the natural vegetation or collection of firewood, fodder or natural foods including cattle grazing in noticeable amount.

4.1.6 Quadrata method

To study the vegetation pattern of natural forest of Devghat, the study site is divided into three transect of more or less equal differences. And to study the true of each transect, a quadrata of 10 m x 10 m was plotted . The presence of vegetation were determined in terms of dominance, diversity and relative density.

4.1.7 Data Analysis process and statistics

Data obtained while observing the Langur feeding ecology and behavior were edited, coded and tabulated. The editing was done thoroughly for analysis and interpretation. Both descriptive statistics (percentages, frequencies) and inferential statistics (probability value) were used to analyze the data. The software Epi info 2002 and Epi cal were used to analyze the data statistically. Charts, table, graphs, were used to present the data in most simplified and understandable form.

4.2 Materials

Following equipments were used during the field study:

- a. Binoculars
- b. Measuring tape
- c. Digital camera
- d. Data sheet

Chapter V RESULTS

5.1 Populations and Distribution of Hanuman Langur

A total of 43 individuals of Hanuman Langur (*Semnopithecus entellus*) were observed in Devghat area. The maximum numbers of monkeys were reported from behind the army camp whereas minimum numbers of monkeys were reported in water measurement center.

Table 1. Troops of Hanuman Langur in different study blocks of Devghat

Block	No. of Troops of Langur	Troop Size	Location
A	1	13	Behind Army Camp
B	1	9	Water Measurement Center
C	1	11	Bageshwori College
D	1	10	Opposite of Bageshwori College
Total	4	43	

5.1.1 Distribution of Hanuman Langur in different Blocks

Hanuman Langurs were recorded from all the four study blocks of Devghat. The area was divided into four different study blocks of Devghat area; one troop with 13 individuals in study Block A, one troop with 9 individuals in study Block B, one troop with individuals 11 in study Block C and one troop with 10 individuals in study Block D. A total of 13 individuals of Langur were observed in Block A, in between the Narayani River and the Army camp where there is plenty of food and water and less human interference too. Out of 13 Langurs, 5 were adult females and 2 adult males with 1 sub-adult male, 2 sub-adult females, 1 juvenile and 2 infants (Figure 5).

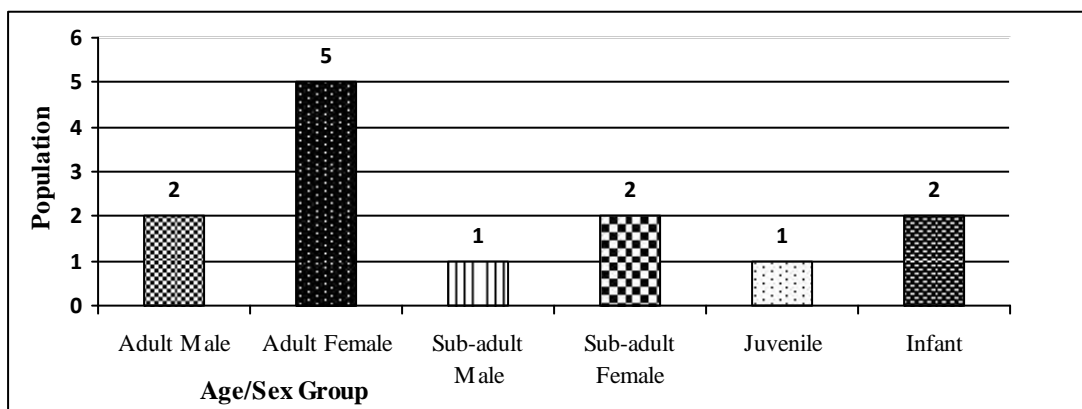


Figure 5: Distribution of Hanuman Langur in and around the Army Camp of Devghat, Chitwan in 2007.

A total of 9 individuals of Langur were observed in Block B, near Water measurement center, where plenty of palatable plant species like Jamuno (*Syzygium cumini*), Peepal (*Ficus religiosa*) etc are found, it is adjacent to the Narayani River and is also less disturbed. Out of 9 individuals observed, 4 were adult males and 2 adult females with 1 sub-adult male, 1 sub-adult female and 1 infant (Figure 6).

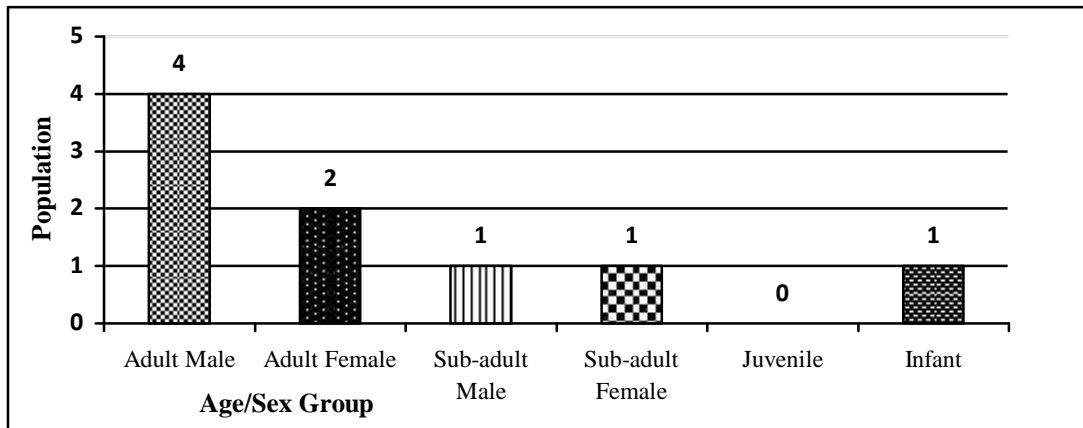


Figure 6: Distribution of Hanuman Langur in and around the Water Measurement Center of Devghat, Chitwan in 2007.

11 individuals of Langur observed in Block C, near Bageshwori College where they can get domestic wastes from college hostel and palatable plants like Peepal (*Ficus religiosa*), Bel (*Aegle marmelos*) etc. but there is no better provision of water. Among 11 individuals observed, 4 were adult females, 2 adult males and 4 infants (Figure 7).

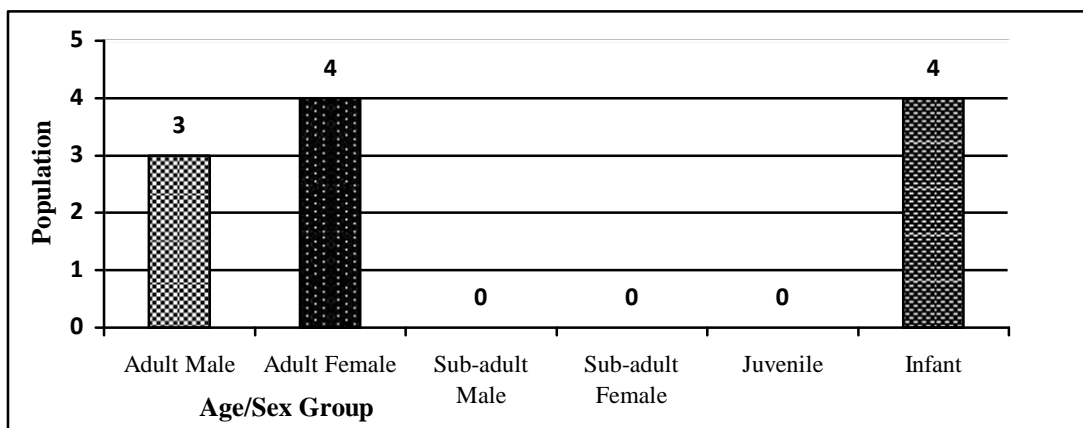


Figure 7: Distribution of Hanuman Langur in and around the Bageshwori College of Devghat, Chitwan in 2007.

A total of 10 individuals of Langur were observed in Block D, in the area opposite of Bageshwori College which is at the bank of Narayani River where monkeys can get palatable plant species like Sal (*Shorea robusta*), Kyamuno (*Cleistocalyx opperculatus*) etc. are present. Out of 10 Langurs, 3 were adult males and 3 adult females with 1 sub-adult male and 3 infants (Figure 8).

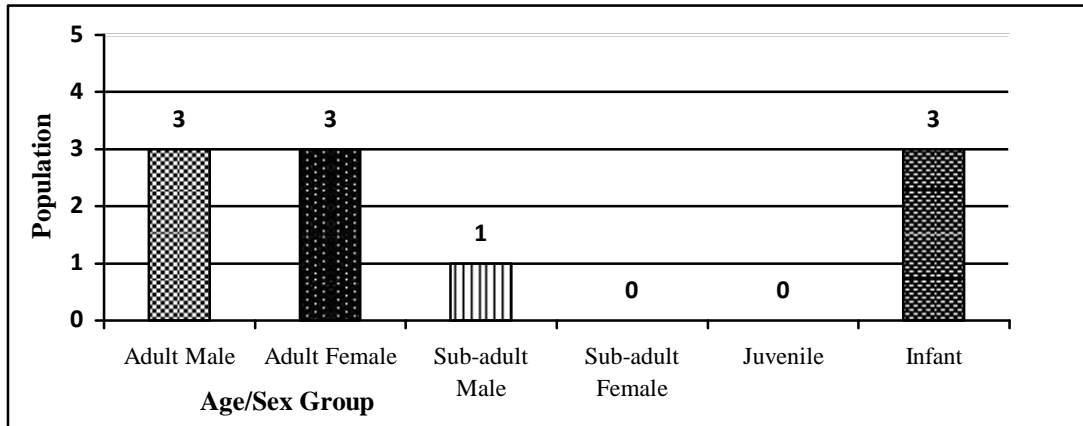


Figure 8: Distribution of Hanuman Langur in the area opposite of Bageshwori College of Devghat, Chitwan in 2007.

The variance to mean ratio was used to determine the distribution pattern of Hanuman Langur among four different study blocks. The calculated value of variance to mean ratio was found to be 0.2035. Since the value of $\left(\frac{s^2}{x}\right) < 1$, the result has shown regular type of distribution of Hanuman Langur in Devghat.

5.1.2 Age and Sex Composition

5.1.2.1 Adult males and females: Adult males are large pale dirty or darker on the shoulder and rump grayish brown on the tail. The body is slender in build, the round head is capped and the scrotal sacs are fully developed and hanged. The adult females are slightly smaller than adult males. Nipples were seen hanging from the chest. The fur colors are slightly lighter and rough. The adult males found to do the vocalization commonly known as ‘whoops sound’.

5.1.2.2 Juveniles: The Juvenile coat color changes with age in the order from black brown to light gray and slaty gray. The members of Juvenile are playing most of the time. The body size is medium i.e. smaller than adult

and the head, tail also smaller. The reproductive organ in males is not hanging but remains underneath of skin and females with no developed breast and buttock parts (Chalise, 1995).

5.1.2.3 Infant: They were small in size, head fur seen light gray skin and fur color change to black and gray according to their age. The most noticeable thing in infant behavior is to stay near the mother and cling with her frequently for breast-feeding.

Table 2: Total age-sex composition of the Hanuman Langur in the Study Area

Age and Sex	Total population
Adult male	12
Adult female	14
Sub-adult male	3
Sub-adult female	3
Juvenile	1
Infant	10
Total	43

Out of 43 individuals of Langur recorded from Devghat area adults were maximum (58.13%) followed by the infants (25.58%), sub-adults (13.95%) and juvenile (2.17%) (Table 2).

In the sex identified adult and sub-adult age groups of Langur in Devghat area total male population was 15 and total female population was 17. The male to female sex ratio was computed to be 1:1.13 i. e. 88.23 males among 100 females. There were more females than males, which did not depart significantly from 1:1 sex ratio ($\chi^2 = 0.124$, d. f. = 1, $p < 0.05$).

5.2 Floral Composition and Food Plants of Langur

The Hanuman Langur is widely spread throughout forest area of Devghat. Most of the area are dominated by Sal (*Shorea robusta*) forests as well as mixed type of forests. In the entry point of study area, there is Nepalese Army Camp; however study area is undisturbed habitat for Langur monkey. There are cemented houses and tall trees

around the home range of Langur monkeys in which they halt at night. The habitat consists of diverse, scrubby, dry deciduous forest and some grassland. In the main habitat of Langur the vegetation sampling was done establishing the plots measuring 10 x 10 m² area and vegetation composition was recorded.

5.2.1 Floral Composition

From four different study blocks of Devghat area by quadrat method of 10 m x 10 m chosen from random sampling a total of 87 species of trees, shrubs, herbs and climbers were identified and recorded during the study period (Table 3).

Table 3: Floral Composition of the study area in Devghat, Chitwan, 2007.

S.N	Local Name	Botanical Name	Family	Type
1.	Amala	<i>Phyllanthus emblica</i>	Euphorbiaceae	T
2.	Archal Sano	<i>Antidesma acidum</i>	Euphorbiaceae	T
3.	Bankainyo	<i>Wendlandia coriacea</i>	Rubiaceae	T
4.	Bansuntala	<i>Garcinia cowa</i>	Guttiferae	T
5.	Barro	<i>Terminalia bellirica</i>	Combrataceae	T
6.	Bel	<i>Aegle marmelos</i>	Ruteceae	T
7.	Bel	<i>Aegle marmelos</i>	Sapotaceae	T
8.	Bhellar	<i>Triwia nudiflora</i>	Euphorciaceae	T
9.	Chhatiwan	<i>Alstonia scholaries</i>	Apocynaceae	T
10.	Chilaune	<i>Schima wallichii</i>	Theaceae	T
11.	Hade Gayo	<i>Bridelia pubescens</i>	Euphorbiaceae	T
12.	Hattipailo	<i>Pterospermum cerifolium</i>	Sterculiaceae	T
13.	Jamun	<i>Syzygium cumini</i>	Myrtaceae	T
14.	Jhakrisalla	<i>Actinodaphne angustifolia</i>	Lauraceae	T
15.	Kadam	<i>Anthocephalus chinensis</i>	Rubiaceae	T
16.	Kalo Dumri	<i>Ficus nervosa</i>	Moraceae	T
17.	Karam	<i>Adina cardifolia</i>	Rubiaceae	T
18.	Khair	<i>Acacia catechu</i>	Mimosaceae	T
19.	Khanayo	<i>Ficus sarmentosa</i>	Moraceae	T
20.	Kumbhi	<i>Careya arborea</i>	Lecythidaceae	T
21.	Kutmiro	<i>Litsea glutinosa</i>	Lauraceae	T

22.	Lahare pakhuri	<i>Ficus hederacea</i>	Meraceae	T
23.	Nilo tanki	<i>Uraria lagopodiodes</i>	Leguminosae	T
24.	Phanir	<i>Syzygium jambos</i>	Myrtaceae	T
25.	Pidari	<i>Stereospermum chelonoides</i>	Bignoniaceae	T
26.	Pipal	<i>Ficus religiosa</i>	Moraceae	T
27.	Rukh dhaturu	<i>Ehleria laevis</i>	Cordiaceae	T
28.	Saj	<i>Terminalia alata</i>	Combrateceae	T
29.	Sal	<i>Shorea robusta</i>	Dipterocarpaceae	T
30.	Samipipal	<i>Ficus benjamina</i>	Moraceae	T
31.	Sandan	<i>Desmodium oojeinense</i>	Fabaceae	T
32.	Satisal	<i>Delbergia latifolia</i>	Fabaceae	T
33.	Seto Dumri	<i>Ficus racemosa</i>	Moraceae	T
34.	Silam	<i>Perilla frutescens</i>	Labiatae	T
35.	Simal	<i>Bombax ceiba</i>	Bombaceae	T
36.	Sindure	<i>Mallotus philippensis</i>	Euphorbiaceae	T
37.	Sirish	<i>Albizia chinensis</i>	Mimosaceae	T
38.	Sisso	<i>Dalbergia sissoo</i>	Fabaceae	T
39.	Abijato	<i>Drymaria diandra</i>	Caryophyllaceae	S
40.	Ainselu	<i>Rubus ellipticus</i>	Rosaceae	S
41.	Angeri	<i>Melastoma malabaricum</i>	Melastomataceae	S
42.	Dhurseli	<i>Colebrookea oppositifolia</i>	Labiatae	S
43.	Gol tapre	<i>Tylophora rotundifolia</i>	Asclepiadaceae	S
44.	Guyalo	<i>Callicarpa arborea</i>	Verbenaceae	S
45.	Khirra	<i>Holarrhena pubescens</i>	Apocynaceae	S
46.	Main kanda	<i>Xeromphis spinosa</i>	Rubiaceae	S
47.	Rudilo	<i>Pogostemon benghalensis</i>	Labiatae	S
48.	Ban Karela	<i>Momordica dioica</i>	Cucurbitaceae	C
49.	Birale	<i>Pueraria phaseo loides</i>	Leguminosae	C
50.	Debre	<i>Spatholobus parviflorus</i>	Fabaceae	C
51.	Dudhe lahara	<i>Hedyotis lineata</i>	Rubiaceae	C
52.	Ghiraula	<i>Trichosanthes tricus</i>	Cucurbitaceae	C
53.	Kane Lahara	<i>Scindapsus officinalis</i>	Araceae	C
54.	Kukurdaino	<i>Smilax lanceifolia</i>	Liliaceae	C

55.	Lahare Gayo	<i>Bridelia stipularis</i>	Euphorbiaceae	C
56.	Lahare sirish	<i>Dalbergia volubilis</i>	Fabaceae	C
57.	Lahre Chameli	<i>Hiptage benghalensis</i>	Malphiaceae	C
58.	Tarul	<i>Dioscorea bulbifera</i>	Dioscoreaceae	C
59.	Banmara	<i>Eupatorium odorahim</i>	Compositae	H
60.	Besar	<i>Chlorophytum arundina</i>	Liliaceae	H
61.	Bhiringi jhar	<i>Alternanthera sessilis</i>	Amaranthaceae	H
62.	Bokre phul	<i>Gnaphalium affine</i>	Compositae	H
63.	Chariamilo	<i>Oxalis corniculata</i>	Oxalidaceae	H
64.	Gai tihare	<i>Blumea balsamifera</i>	Compositae	H
65.	Gande	<i>Ageratum conyzoides</i>	Compositae	H
66.	Gande	<i>Houttuynia cordata</i>	Saurauraceae	H
67.	Ginger	<i>Zingiber chrycanthum</i>	Zingiberaceae	H
68.	Halhale	<i>Elephantopus scaber</i>	Compositae	H
69.	Harro	<i>Terminalia chebula</i>	Combrataceae	H
70.	Kade Jhar	<i>Tridax procumbens</i>	Compositae	H
71.	Khareto	<i>Phyllanthus urinaria</i>	Euphorbiaceae	H
72.	Khole Jhar	<i>Lacanthus peduncularis</i>	Urticaceae	H
73.	Kurilo	<i>Asparagus racemosus</i>	Liliaceae	H
74.	Kyamuna	<i>Cleistocalyx opperculatus</i>	Myrtaceae	H
75.	Lajjawati	<i>Biophyllum sensitivum</i>	Oxalidaceae	H
76.	Lajjawati	<i>Mimosa pudica</i>	Mimosaceae	H
77.	Mahuri jhar	<i>Claussenia pentaphylla</i>	Rutaceae	H
78.	Mitha jhar	<i>Scoparia dulcis</i>	Scrophulariaceae	H
79.	Mothe	<i>Cyperus compresus</i>	Cyperaceae	H
80.	Mothe sag	<i>Cyperus rotundus</i>	Cyperaceae	H
81.	Padke	<i>Albizzia lucidior</i>	mimosaceae	H
82.	Pire/gande	<i>Persicaria barbota</i>	Polygonaceae	H
83.	samundra phool	<i>Argyreia bella</i>	Convolvulaceae	H
84.	Jibre sag	<i>Ophioglossum reticulatum</i>	Ophioglossaceae	P
85.	Niuro	<i>Ampeopteris prolifera</i>	Aspidaceae	P
86.	Cylinder orchid	<i>Papilionanthe teres</i>	Orchidaceae	O
87.	Flat orchid	<i>Cymbidium alofolium</i>	Orchidaceae	O

5.2.2 Plants Used by Langur for Food

The investigated Langur lived in the sub-tropical forest that is dominated by Sal trees *Shorea robusta*. Out of 87 species of plants recorded from the study area during the study period, 13 species (14.94%) were found to be used by the Langur on feeding (Table 4). Among the plants utilized, leaves and seeds of most of them were found to be useful for Langur on feeding. Among 13 useful plant species recorded, body parts of Money plant, fruits of Jamuno (*Syzygium cumini*), Bel (*Aegle marmelos*) Kyamuna (*Cleistocalyx opperculatus*) etc. and leaves of Sal (*Shorea robusta*) were mainly used by Langur in Devghat.

Table 4. The plant species utilized for food by the Langur at Devghat Area in 2007.

S. N.	Local Name	Botanical Name	Plant parts used as food
1	Bel	<i>Aegle marmelos</i>	Fruits
2	Bheller	<i>Triwia nudiflora</i>	Leaves
3	Chilaune	<i>Schima wallichii</i>	Seeds, leaves
4	Jamuno	<i>Syzygium cumini</i>	Seeds
5	Karam	<i>Adina cardifolia</i>	Leaves
6	Khanayo	<i>Ficus sarmentosa</i>	Leaves, fruits
7	Kumbi	<i>Careya Arborea</i>	Seeds
8	Kyamuna	<i>Cleistocalyx opperculatus</i>	Seeds, leaves
9	Money plant	<i>Pothos Caudifolius</i>	Leaf base, buds
10	Pipal	<i>Ficus religiosa</i>	Leaves
11	Sal tree	<i>Shorea robusta</i>	Seeds, leaves
12	Silam	<i>Perilla frutescens</i>	leaves
13	Sisso	<i>Dalbergia sisso</i>	Leaves

5.3 General Behavior

5.3.1 Feeding

The investigated Langur troop utilized only 13 plant species for food during the study period. Majority of plants comes from shrubs and trees species and also climber and herb. The proportion of daytime was spent in different activities; while most of time was spent for feeding on different items were estimated by scan sampling of the troop.

The feeding time percentage of the Langur was dependent to the seasons. During the winter season they spent more time for feeding, at the time of afternoon. But during the summer months April and May they were spent comparatively lesser time for feeding. They feed mostly for longer period during morning. The total observation time was 150 hrs taken, as 100% among them total mean feeding time hours was spent 39.95% for continuous sampling and 5.82% for focal Langur troop.

5.3.2 Grooming

The monkeys search their own fur or the fur of another, which include rubbing, licking and scratching. The act of grooming involved looking through the fur for lice or other bugs or picking off dirt or in some case skin. In my observation period, the monkeys were grooming at the time of morning and pre-afternoon when they were on rest. In winter, there were three peaks of grooming i.e. morning, afternoon and evening. During summer, maximum grooming occurred in morning and afternoon. And during rainy season grooming was as its peak in the afternoon. There is auto-grooming in which a monkey searches its own body. The female mothers were the most active groomers then the males. The females were more often initiators than receiver or self- groomers. In contrast, male were mostly receivers and self-groomers. Infants were mostly receivers and rarely ever initiators.

Adult females groomed juveniles and were groomed by juveniles in almost equal frequency. Females groomed males as often as they groomed juveniles but were groomed in return her infant but rarely was groomed in return by infant. For adult males and females, members of own age/sex class were the most frequent recipients of grooming attentions Adult males groomed other males were the least active in grooming pairs recorded.

The total observation time was 150 hrs taken, as 100% among them total mean grooming time hours was spent 8.88% for continuous sampling and 0.71% for focal Langur troop.

5.3.3 Resting

Resting is the state when the position of Langur monkeys are either sitting or lying with or without eye close and not active in other activities. Generally the Langur monkey rest at the time of mid afternoon. They rest everywhere but mostly on tree. In winter (Nov. to Jan) they rest the morning and late afternoon, while in summer they rest in mid afternoon. Female were observed resting in contact or huddling with adult females more often than with males and adult males were never observe engaging in these behaviors with other adult males. Most huddling occurred in early morning in tree. More huddling seemed to occur in winter and summer. In the present study 74.99% of time were spent for resting by the focal Langur troop and but in the different months they were spent various percentage during different observation hours and 39.97% for continuous Langur troop.

5.3.4 Playing

Like all mammals, the old ones didn't play so much and the young ones play a lot. Infants and juveniles also engaged for playing. Sometime they play alone hanging in a tree branch and also following or attacking at insects. Sometimes more than two infants do running and wrestling each other.

Juveniles and infants also play together, chasing one another through thick bushes. Adult were rarely seen playing with each other or with juveniles during present study period. Some times adult females were playing each other while adult males were never observed playing each other.

During the month of December, the Langur monkeys were seen playing in rice hay. During the time June-July, the monkeys destroyed rice fields uprooting the saplings. In the present study, the Langur monkeys were spent only 1.67% in focal Langur sampling and 2.22% in continuous sampling.

5.3.5 Agonistic Behavior

Agonistic behavior is defined as the aggressive behavior that the other member of individual or different factors to disturbed their activities and attacked to this replacement of phenomenon.

Aggressive encounters usually short in duration and only accounted for 0.24% of total observation time. The information couldn't be recorded separately however the total % of threat, Chase, attacks and fight all collectively include in agonistic behavior. The visual threat gesture includes open mouth threat, slap ground and stare threat (a gesture in which the head is lowered and thrust forward with the mouth shut). These gestures were employed when the aggressor was in close proximity to the aggressor. The tactile threat gesture, while involved hand threats in which one individual made contact with another by grabbing, pulling the tail or by pushing the other individual away. The adults' male and females, mother infant and juvenile's aggressive behavior as chase, attack and some time fighting each other were recorded. Males were involved in aggression the most and more often as initiators. They initiator females chased males sometimes.

5.3.6 Vocalization

A number of disturbances external and internal to the troop were observed to elicit vocalization. Particularly the sight of large carnivorous birds, domestic animals, hunters and the observer's activities were found to evoke vocal responses by the troop members. They produced sound 'Hwa' and trampling the tree branch when they feel danger. Mostly the males produced such sound for the internal communication at morning and at intervals of feeding. The sudden events occurred in the area cause to produced "Khwak" sound by the adult males and females. The juveniles and infants produced sound "krack" and "chrick" respectively.

Generally the adult monkeys produced non - agonistic sound at the time of feeding and resting. The sound was "aau" the females have the same type of signal with low pitch. The calling behavior included is agonistic sounds and non-agonistic sounds.

5.4 Daily Activities

5.4.1 Daily Activities obtained from Focal Animal Sampling

5.4.1.1 Percentage of major behaviors in adult male Langur in Devghat

The Langur monkey at Devghat was found to invest more time on inactive (62.93%) followed by sleeping (24.81%), feeding (5.49%), locomotion (4.24%), grooming (1.54%), agonistic (0.97%) and urination (0.06%) on the summer and rainy season in sub-tropical forest area. (Figure 9).

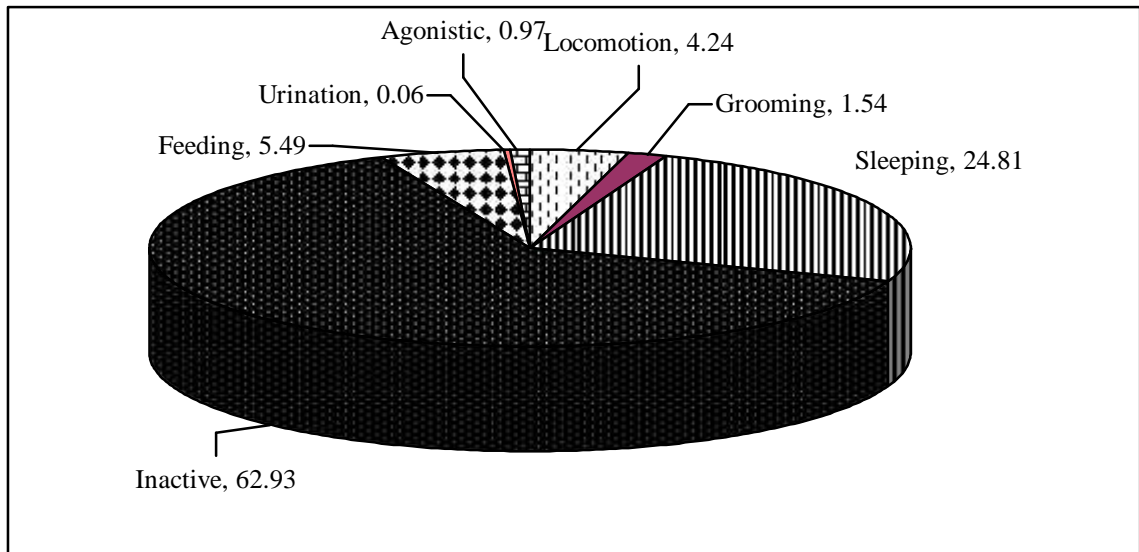


Figure 9: Percentage of major behavior in Adult male Langur of Devghat in 2007.

5.4.1.2 Percentage of major behaviors in adult female Langur in Devghat

The adult female Langur was found to invest more time on inactive (88%) followed by locomotion (10%), grooming (1%) and feeding (1%) (Figure 10).

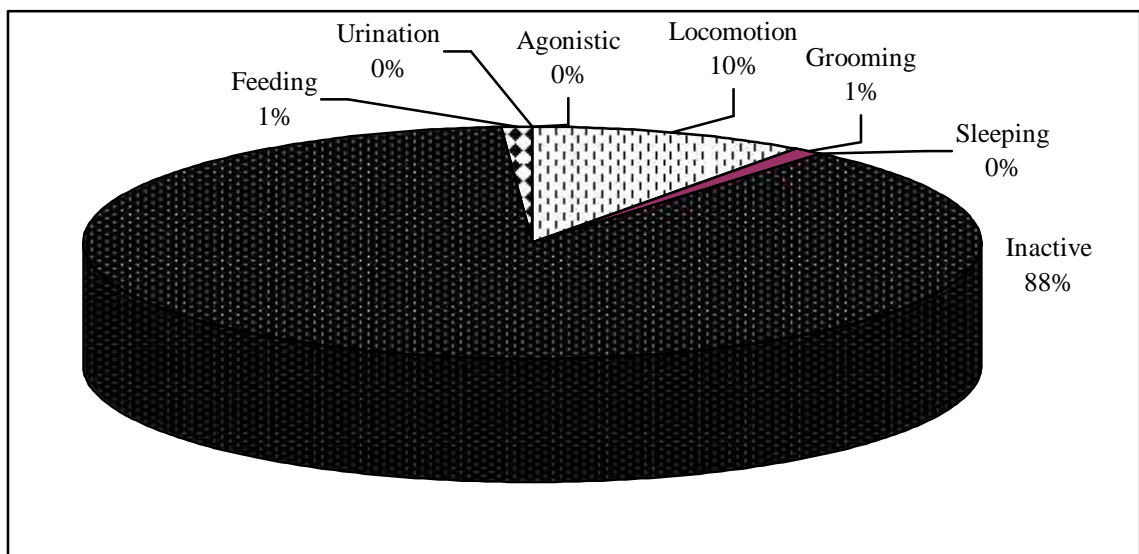


Figure 10. Percentage of major behavior in Adult female Langur of Devghat in 2007.

5.4.1.3 Percentage of major behaviors in Infant Langur

The monkey was found to invest more time on inactive (72%) followed by locomotion (17%), playing (8%), and feeding (3%) (Figure 11).

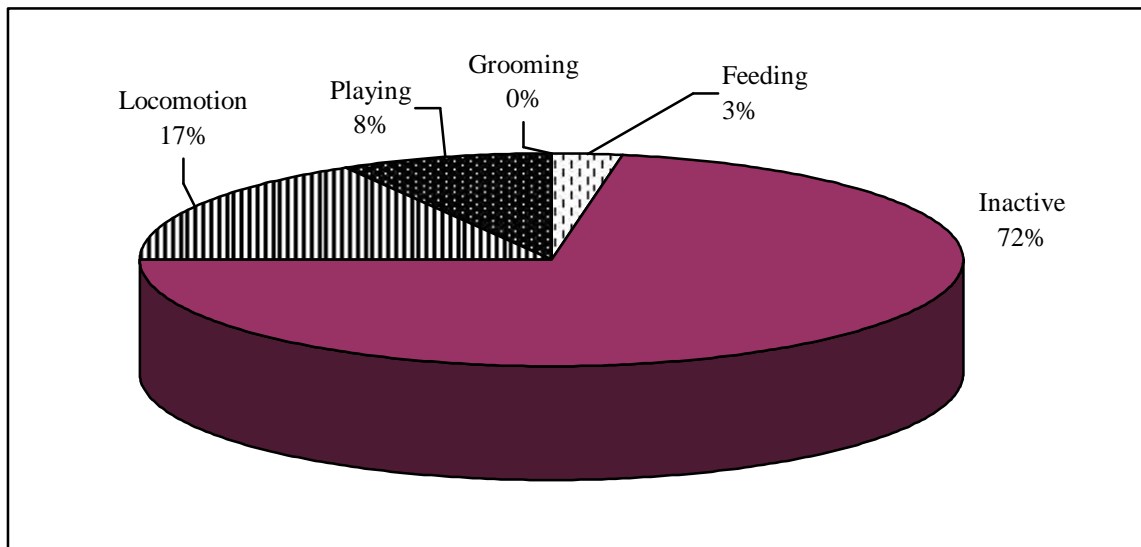


Figure 11. Percentage of major behavior in Infant Langur of Devghat in 2007.

5.4.1.4 Percentage of major behaviors in Juvenile Langur

The monkey was found to invest more time on inactive (77.01%), followed by locomotion (13.28%), playing (9.37%), groom (0.33%) and urination (0.01%) (Figure 12).

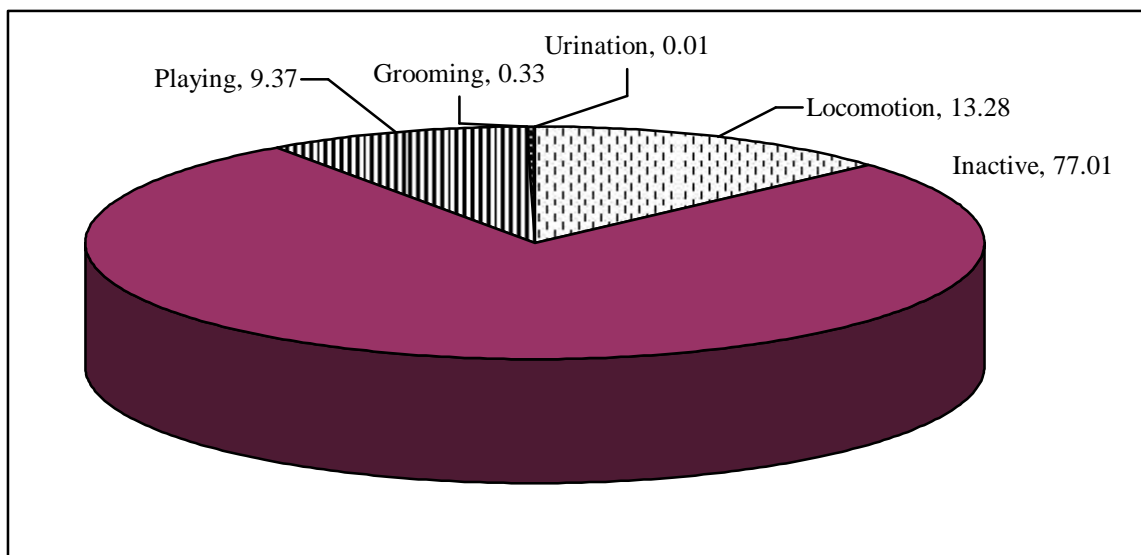


Figure 12. Percentage of major behavior in Juvenile Langur of Devghat in 2007.

5.4.2 Daily Activities as Seen from Continuous Sampling

5.4.2.1 Percentage of major behavior of adult male Langur

The adult male langur monkey was found to invest more time on inactive (38.88%) followed by foraging (36.10), locomotion (13.88%), and grooming (11.10%) by continuous sampling too (Figure 13).

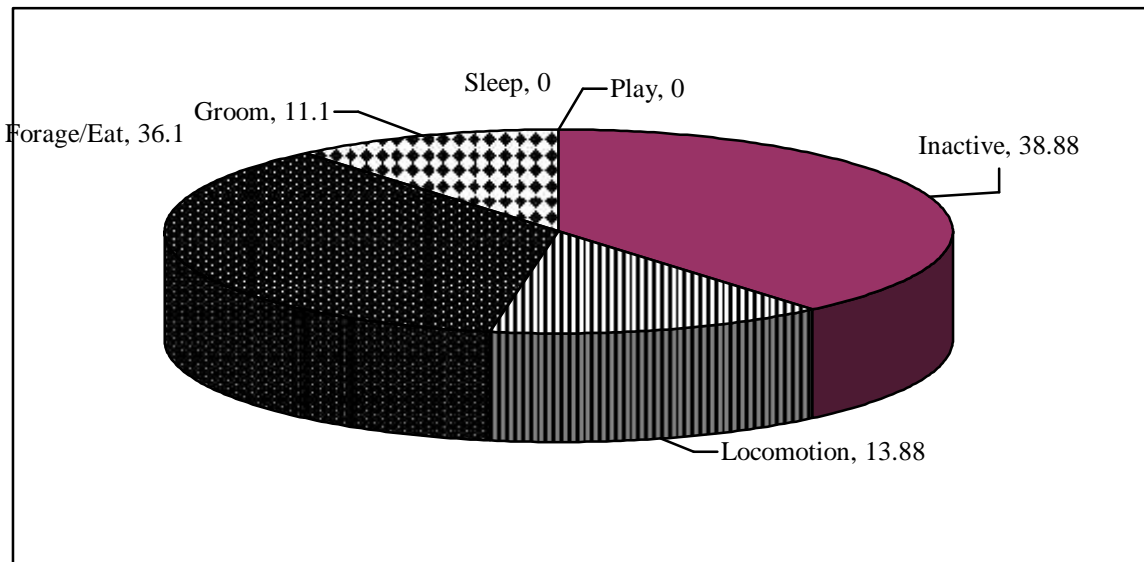


Figure 13: Percentage of major behavior in Adult male Langur of Devghat in 2007.

5.4.2.2 Percentage of major behavior of adult female Langur

The adult female langur monkey was found to invest more time on inactive (44.33%) followed by locomotion (33.33%), foraging (11.11%), groom (8.33%) and sleeping (2.77%) (Figure 14).

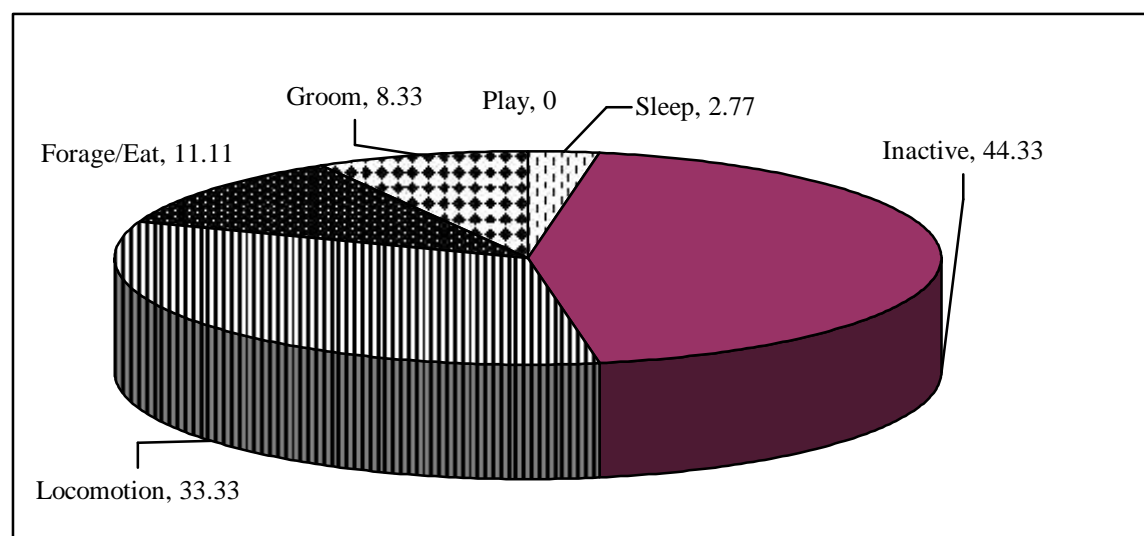


Figure 14: Percentage of major behavior in adult female Langur of Devghat in 2007.

5.4.2.3 Percentage of major behavior in Sub-adult male Langur

The sub-adult male monkey was found to invest more time on foraging (50%) followed by inactive (33.33%), locomotion (13.88%), and grooming (16.66%) (Figure 15).

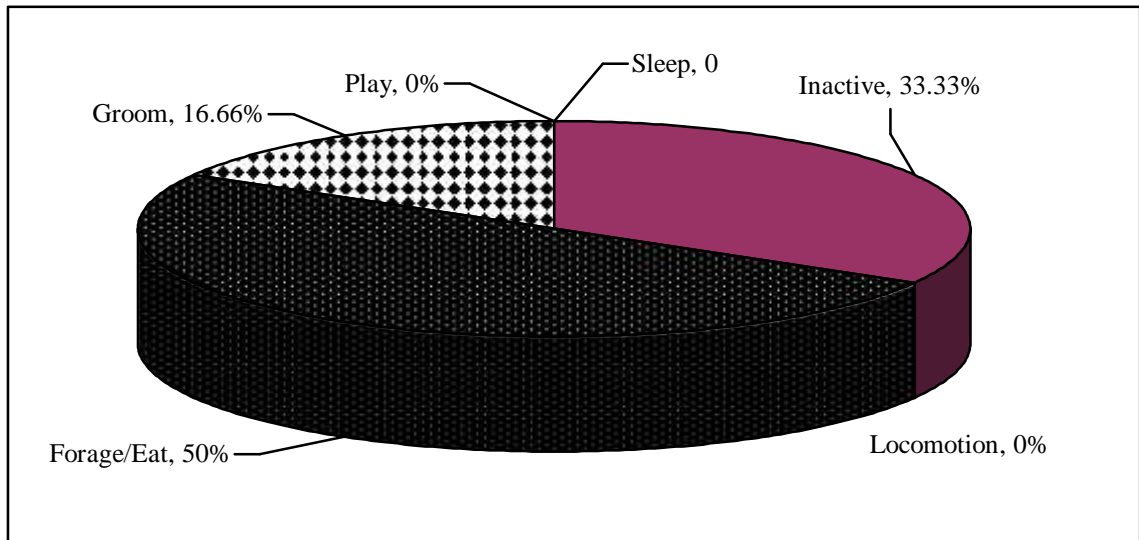


Figure 15: Percentage of major behavior in sub-adult female Langur of Devghat in 2007.

5.4.2.4 Percentage of major behavior of sub adult female Langur

The sub-adult female monkey was found to invest more time on inactive (41.66%) followed by foraging (33.33%) and locomotion (25%) (Figure. 16).

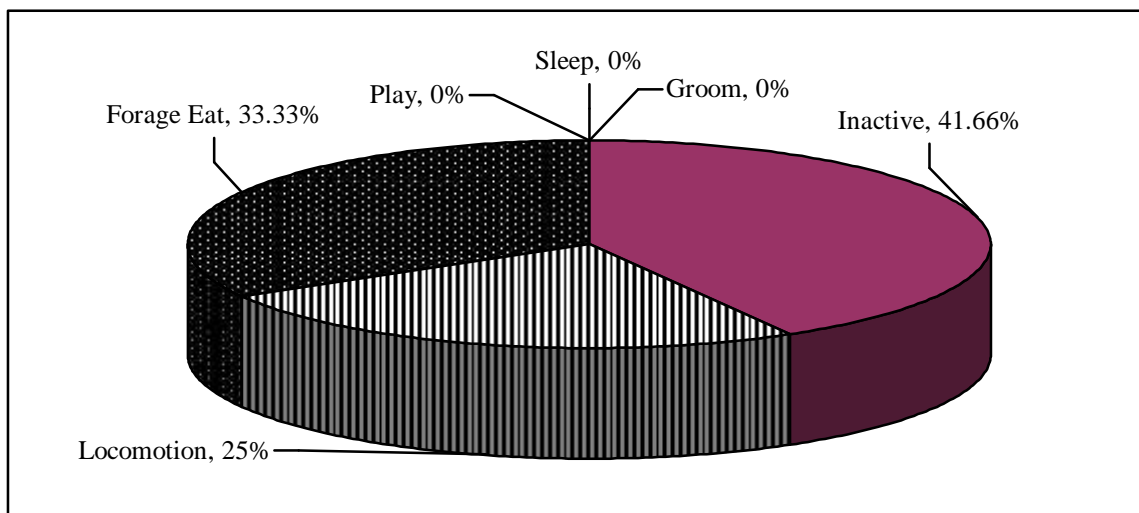


Figure 16: Percentage of major behavior in sub-adult female Langur of Devghat in 2007.

5.4.2.5 Percentage of major behavior of Juvenile Langur

The juvenile monkey was found to invest more time on inactive (41.66%) followed by foraging (16.66%), locomotion (16.66%) playing (11.11%), grooming (8.33%) and sleeping (5.55%) (Figure 16).

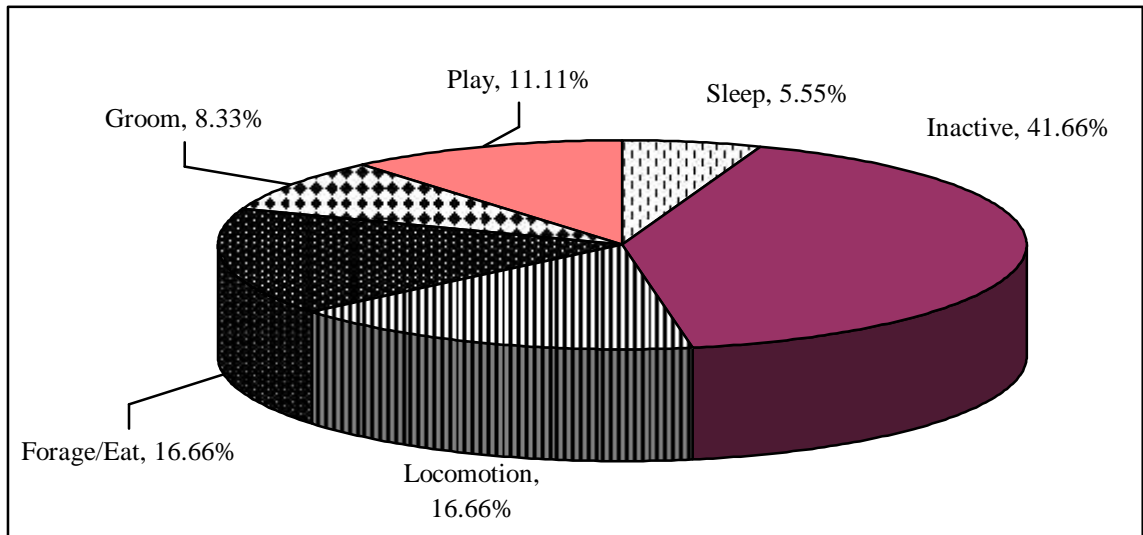


Figure 17. Percentage of major behavior in Juvenile Langur of Devghat in 2007.

Chapter VI DISCUSSION

Among the three different species of monkeys reported from Nepal, only two species of monkeys Rhesus monkey (*Macaca mulatta*) and common Hanuman Langur (*Semnopithecus entellus*) were found in the study area Devghat Chitwan. Devghat area may be suitable habitat for both of these monkeys. Assamese monkey *Macaca assamensis* was not found in the study area. The population of *Semnopithecus entellus* is declining due to deforestation, predators' pressure by domestic dogs and wild cats. Interspecific competition with domestic livestock (cattle, goats etc) for green fodders also seems to be the contributing factors for the decrease in the number of hanuman Langur population.

A total of 43 individuals in four different troops were recorded with highest number (13) in Block A of the research area which is near to the Nepalese Army Camp. The hanuman Langur was found distributed in the study site behind the army camp (13 individuals in a troop), near the water measurement center (9 individuals in a troop), in Bageshwori College (11 individuals in a troop), and the area opposite to the Bageshwori College (10 individuals in a troop) of Devghat Chitwan. The higher population of monkeys in the area close to the army camp and Bageshwori College may be due to their suitable habitat for resting, grooming, self protection, feeding etc. as these areas are full of trees, open ground and water sources. Similarly the habitat is near to human settlement, army camp and college where they can easily get food and received security from human beings against wild predators.

The sex ratio of Hanuman Langur population varies from place to place. Pandit (1999) reported 101 individuals of Hanuman Langur from 9.79 square kilometer of Baurokhola Area of Tanahun with the adult male to adult female sex ratio of 1:1.6 i.e. 62 males to 100 populations of females. The adult males were 21.21% and adult females were 34.34% of the total populations. Chalise (1999) recorded the sex composition of Langur troops as 15% adult males, 43% adult females, 4% sub-adults,

15% juveniles and 23% infants from Makalu-Barun area. The sex ratio of Langur is 1:5 at Kumoan hills (Vogel, 1971) and Gir forest (Rahaman, 1973). During this study at Devghat area of Chitwan district the total population of the Hanuman Langur from four different blocks of study area was 43, out of which 26 (60.46%) were adults, 6 (13.95%) were sub-adults, 1 (2.32%) was juvenile and 10 (23.25%) were infants. The male to female sex ratio in adult and sub-adult age group was computed to be 1:1.13 i.e. 88.23 males among 100 females. There were more females than males which did not depart significantly from 1:1 sex ratio ($\chi^2 = 0.124$, d. f. = 1, $p < 0.05$). Despite difference in climatic zones of different research areas mentioned above, the sex ratio composition of Langur troops seems to be relatively similar.

Langurs are commonly found in social aggregations known as troops. Pandit (1999) reported the troop size of 99 individuals of Langur from Baurokhola Area of Tanahun that was multi-male and multi-female troop which is a rare troop. Chalise (1997) found the population of Langur troop with 12 to 25 individuals in multi-male troop of mountain range while all male groups were 4 and 7 individuals at that area in Yachamkhha hill and Wayang forest of Makalu Barun Conservation Area. Oppenheimer (1973b) reported the mean size of two groups as 12 in west Bengal; each group included an adult male. Rahaman (1974) observed bi-sexual groups of 16-48 langurs with occasional all-male groups of 2 or 3 from Gujarat. Curtin (1975) identified two troops in Solu Khola area with 13 and 19 individuals in the troop. Bogges (1976) recorded the 11 to 15 individuals in a troop of Langur from Junbesi area. In peninsular India, Sugiyama and his coworkers found a significant difference in group size between relatively open and forested areas: the mean group size (both bisexual and all-male group) in the forested area was 14.4 individuals, and in the open area 17.1. The average group size for both areas was 15.1, with 8 females and 5.3 infants and juveniles (Roonwal and Mohnot, 1997). During this study at Devghat area the troops of 9 to 13 individuals were recorded which is almost similar to all the above researches except that of Pandit (1999).

The variance to mean ratio of Langur population from different study blocks is found to be less than one from the study of 4 different locations of Devghat, Chitwan; the result showed regular type of distribution of Langur. It may be due to more competition in smaller sampling area and more or less uniform habitat among four different study blocks of the Devghat. This finding supports the idea of Odum (1971) that random or regular distribution may occur where competition between individuals is severe in small area.

Primates are selective in feeding more than ruminants do (Khanal *et al.* 2005). Langur monkeys (*Semnopithecus entellus*) are vegetarian even though occasional feeding on insects had been observed (Sugiyama, 1964; Chalise, 1995, 1997, 2003). But such insectivorous nature was not noticed during this study. Chalise (1995) recorded 333 plant species nearby study area, Ramnagar out of which food parts were exploited from 75 plant species. Podzuweit (1994) recorded 51 plant species utilized by Langur for food in Ramnagar from July 1991 to June 1992. Pandit (1999) recorded 133 plant species from Baurokhola Area of Tanahun, out of which 60 species of plants were utilized by Langur as food, majority of which came from shrubs, tree, climber and herbs. Gupta and Chivers (2000) recorded that the use of 26 plant species out of 53 plant species recorded from the Khajuria in Tripura, Northeast India accounted more than 75% of the feeding matter. Among the 87 identified plant species in the study area, food parts were exploited from 13 plant species.

Langur monkey species poorly adapted to a folivorous diet due to its dental structure and relatively low stomach volume for the fermentation and digestion of folivorous materials. Therefore they depend mainly on highly digestible food as fruits (Chalise, 1995). The species and parts of plants chosen for food vary from area to area and season to season (Roonwal and Mohnot, 1977). Rahaman (1974) recorded 41 plant species on whose leaves and flowers the Hanuman Langur feeds in the Gir Forest. Krishnan (1972) reported over 30 species of food plants (leaves, leaf buds, shoots, flowers and fruits) in peninsular India. Ali (1983) recorded 68 plant species to be eaten by the langur out of which 24 food species accounted for more than 92 percent

of all feeding. Among 60 plant species reported (Pandit, 1999) utilized by Langurs as food from Bauro Khola Area of Tanahun, mostly used were leaf and stem of Gurjo Lahara (*Tinospora cordifolia*), fruits of Barro (*Terminalia belerica*) and leaf-base of Birale (*Pueraria phaseoloides*). Chalise (1995) recorded leaf constituted 50.11% of the food followed by 17.88% of fruits, 12.82% of flowers and 2.27% of leaf base. Newton (1983) found that Langur feeds on mature leaf that constituted 34.9% of the feeding time in Kanha Tiger Reserve, India. Amerasinghe *et al.* (1971) reported that the diet of langur consists of about 65% fruits and 35% leaves and flower buds. During this study at Devghat, among the plants utilized, leaves and seeds of most of them were found to be useful for Langur on feeding. Chalise (1995) recorded that the *Spatholubus parviflores* was mostly eaten (36.10%) by the langur in Ramnagar area followed by *Terminalia bellirica*, *Syzygium cumini*, *Dilenia pentagyna* etc. by langur monkey. Among 13 useful plant species recorded as food of Langur from Devghat during this study, body parts of Money plant, fruits of Jamuno (*Syzygium cuminii*), Bel (*Aegle marmelos*) Kyamuna (*Cleistocalyx opperculatus*) etc. and leaves of Sal (*Shorea robusta*) were mainly used.

Langur spends more time in trees than in the ground in monsoon. Conversely, more time is spent on the ground in the winter, when the ground is dry and vegetables grown in the fields form an important source of food; also there are few leaves and little fruits available. Ali (1983) reported the variation of feeding from 15-25% of the total activities from Mundanthurai Sanctuary, Tamilnadu. During this study from Devghat, about 30% of the total day time was found to be invested by the langur in feeding.

Among the 7 types of behavior observed in Adult male by focal animal sampling method, inactive was found maximum (62.93%). Similarly among the four types of behaviors observed in adult female, inactive was found maximum. Among the 5 types of behavior observed in infant, inactive was found maximum (72.23%). Among the five types of behavior observed in juveniles, inactive was found maximum (77.01%).

By continuous sampling, 5 types of behavior were observed in adult male, adult female, sub adult male, sub adult female, juvenile and infant. Among them, sleep was found maximum (38.88%) in adult male. Inactive was found maximum (44.33%) in adult female. Inactive was found maximum in sub adult female (41.66%). Foraging was found maximum in sub adult male (50%). Inactive was found maximum (41.66%) in juvenile.

Southwick (1967) reported that they spent 60% of their time on feeding on the contrary Teas (1978) reported that they spent 25% of their time on feeding. Pandit (1999) found that the Langur monkeys of Thaprek VDC at Bauro Khola area mostly feed the leaf-base of Birale *Pueraria phaseoloides* and fruit of Barro *Terminalia belerica*. But during this study it was found that they feed the leaf base of money plant and seeds of Jamuna, while the data were not collected in percentage of feeding items.

Semnopithecus entellus starts feeding shortly after waking up at dawn and continues during the morning while wandering about. There is an intense bout of feeding in the afternoon and some feeding at the roosting sites in the evening. The most important feeding periods are early mornings (6.00 – 7.30 A.M.) and late evenings (4.30 – 6.00 P.M.) (Roonwal and Mohnot, 1997). Oppenheimer (1973a) reported the feeding mostly in the cool hours of the day and resting in the hot hours. Pandit (1999) found that 49.05% of time was spent on feeding which includes 0.78% on drinking. In Kanha Tiger reserve central India, Newton, (1984) investigated Langur ecology over a period of one year. He found 41.9% of time inactive, 25.7% feeding and 13.1% moving by the Langur in the day time. Similarly, Mathur (1988-1989) observed 3 activities and found feeding 38.0% in winter, 25.75% summer and 22.5% in rainy season within 1300-1400 hours of study period. She also found the data for winter, summer and rainy season on grooming and group movement 24.0%, 42.0%, 47.25% and 20.25%, 37.25% and 31.25% respectively. Podzuweit (1994) recorded 32.90 % of

feeding time for adult female langurs annually from Ramnagar area. Chalise (1995) reported the 32.27% of the time spent on feeding for an adult Langur in the observation period of one year and he found that feeding time percentage of an adult Langur was negatively correlated with the temperature of the month. The feeding activities were peaked in winter (46%) and were least in during the summer (16.55%) as they needed more energy in the cold months than the summer. During this study period from the data obtained by continuous sampling, the Langurs in Devghat were found to spend 24.3% of an average day time on feeding during rainy season. It is almost similar as explained by Chalise (1995).

The monkeys need more energy in the winter than the summer, so they spend much of their day time on feeding during the winter whereas they remain much inactive during the hot and humid rainy season (Chalise, 1995). Activity rhythm is diurnal and they spend as much as 80% of their time on the ground (Shrestha, 2003). In the present study also, Langur monkeys were found to spend more time on resting during the rainy season.

A considerable part of daily activity of adult langurs involves mutual grooming. Adult-adult, adult-subadult, adult-juvenile, and adult-infant grooming are frequent. Sub-adult females also participate in the mutual grooming of adults and occasionally groom sub-adults and juveniles. Grooming is absent among juveniles and infants but juvenile females at times attempt to groom, for a short time their mothers or other females sitting near the mother; this is a learning process (Roonwal and Mohnot, 1997). Pandit (1999) found that 10.25% of time spent for grooming and 21.25% in resting by Langur. During this study at Devghat area of Chitwan 1.14% of the day time was found to be spent by the adult and sub-adult langurs in grooming while this behaviour was almost absent in juveniles and infants.

Play forms a considerable part of langur monkey's daily activity, including chasing, hitting, fighting, wrestling, biting, leaping, somersaulting, hanging by the tail,

swaying from branches, repeated jumping on thin branches, tail twisting, mounting, biting the tail and carrying the twigs and other parts of plants in mouth. Play continues in males into the sub-adult stage and consists of running fast, chasing, jumping in an undulating manner, raising the whole body up suddenly and mild buffeting during mornings and evenings (Roonwal and Mohnot, 1997). Playing behavior is a social behavior. The partners generally involved are juveniles and infants; adult males and females are rarely involved. This behavior seems to be dependent on age. During the present study playing was found 9.37% in case of juveniles and 8.23% in case of infants whereas 11.11% of time was spent by juveniles, in continuous sampling.

Aggressive interaction is permanent, intensive, far-reaching and not dependent on a particular situation. Adult and sub-adult males clearly avoid each other; associating conditions are hardly seen between adult males (Roonwal and Mohnot, 1997). Males have social relationships almost exclusively with age-mates however females spend a considerable part of their time (several hours of a day) with adult females and infants and are as a rule less active and aggressive than a male does. Female juveniles usually avoid males. Male juveniles indulge a great deal in boisterous but silent play (Jay, 1963). Barsha (1999) found that males rather than females or juveniles performed initiation of aggression more in macaques. Females became more aggressive in defence of infants rather than in relation to other activities. Mukherji (1969) found most of the agnostic behavior during feeding time. During this study it was found that 0.97% of time was spent by adult male out of the total study hours.

According to the habitats home range size also varies: dry zone forest can support more groups, dense forest even more and open habitats are more extensive than other areas. Within uniform habitats home range size is mainly related to troop size, the larger the troops size the wider the home range. The low availability of food and competition with other animals tend to force them in larger home range (Roonwal and Mohnot, 1977; Vogel, 1977).

Chapter VII

CONCLUSION

Total population of Hanuman Langur monkey was recorded to be 43 in Devghat during the study period of June 2007 to September 2007. Maximum number was reported near Nepalese Army Camp and minimum number was recorded in water measurement center. Distribution of Langur in four blocks of Devghat area was found to be a regular type of distribution. The sex ratio of Langur monkey was found to be 1:1.33 i.e. 88.23 males among 100 females. There were more females than males which did not depart significantly from 1:1 sex ratio.

The ecological behaviors were observed in adult male, female, juveniles and infants. In adult male, 7 types of behaviors were observed in which time spent for inactive was found maximum (62.93%) and aggression was found minimum (0.97%). In adult female, 4 types of behaviors were observed in which time spent for inactive was maximum (88%) and feeding was minimum (1%). In infant, 5 types of behaviors were observed among them time spent for inactive was maximum (72%) and grooming was minimum (0.1%). In juveniles 5 behaviors were observed among them time spent for inactive was maximum (77.01%) and grooming was minimum (0.33%).

Six different behaviors were observed by continuous sampling in adult male, adult female, sub adult male, sub adult female, juveniles and infants. In adult males time spent for inactive was maximum (38.88%) and playing was minimum (0.2%). In adult female time spent for inactive was maximum (44.33%) and playing was minimum (0%). In sub adult male time spent for foraging was maximum (50%), playing was minimum (0%). In sub adult female time spent for inactive was maximum (50%), playing was minimum (0%). In juveniles, time spent for inactive was maximum (41.66%) and sleeping was minimum (5.55%).

Hanuman Langurs in Devghat are also not out of ecological threats. Deforestation, human encroachment to forest, pressure of pligrimage, competition with domestic livestock (cattle, goats) were felt as major threats.

RECOMMENDATIONS

Based on the findings of this research work, following recommendations can be made for the conservation and management of Hanuman Langur in Devghat area of Chitwan.

1. People living inside Devghat forest area should be shifted and immediately removed.
2. To increase natural foods of monkeys, forestation of fruiting and flowering plant should be carried out.
3. Further human settlement in and around the habitat of monkey should be discouraged.
4. Bharatpur Municipality and Devghat VDC should take responsibility for overall management of forest area.
5. Participatory conservation works should be done with local people.
6. Visitors and local people should be aware to decrease the causes of conflict and local people should be educated about the importance of Hanuman Langur.
7. Research on the ecology and behavior of monkey should be carried out through university research agency and wildlife expert.
8. The efforts to control village dog population from the local areas of Devghat should be continued and strengthened.
9. Awareness raising Programme among the local people in and around the 'Devghat Area' should be given higher priority for the minimization of human disturbances and promotion of their attitude towards conservation.
10. The responsibility of regulating livestock grazing and grass cutting inside Devghat Area should be given to the 'Local Conservation Committees' with the direct involvement of local people.
11. For the livelihood options for local people promotion of nearby community forest, implementation of modern agricultural techniques and promotion of alternative economic sources instead of livestock rearing should be given higher priority.
12. Detailed study on ecological, behavioral and genetic aspects of Hanuman Langur should be given higher priority.

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Survey Questionnaire for the Research

Date:

Respondents Details

Name of respondent: Age: Gender: Education:

1. Have you seen the monkeys in Devghat area?
2. If so, what types of monkeys have you seen?
 Hanuman Langur (Dhedu) Rhesus macaque (Rato Badar) Assamese macaque (Pahare Badar)
3. In which part is they seen mostly?
 Around the Army Camp Water measurement Centre Bageshwori College Opposite to Bageshwori College
4. Are they seen in all the months?
 Yes No
5. What is the estimate number of monkeys?
 Below 50 50-100 Above 100
6. Do they create any disturbances in the village?
7. If Yes, what type of disturbances/damages do they create?
 Grabbing/taking foods and clothes from house/temple
 Disturbing night sleep by running on the roof of the house/temple
 Teasing girls and babies
 Damaging the cable network and electric connection
 Damaging crops in the field
 Snatching and Biting
 Others, specify
please.....
8. Among the different problems listed above, which you think the most severe one?
Please
specify.....
9. Which age groups of monkeys are more destructive?
 Juveniles Infants Sub-adults Adults All age stage
10. Can you list the plant species, which are most, preferred by the monkey?
11. Does monkeys have attacked anyone in your locality?
 Yes No
If Yes, When, Where and to Whom? Please specify...
12. Where the monkey most prefer to stay more and why?
 Deep in the forest
 In the periphery area of the forest
 In the temples
 Near to arable Crops
 Near people residence
 Others specify please.....
13. Have you ever practiced artificial provisioning?
 Yes No
If Yes, What kind of food you offer to monkey and for what reasons? Specify
please...
14. Have you ever seen artificial provision to monkeys by others?
 Yes No
 If Yes, Who are they?

- Domestic Visitors
 - Tourists from foreign countries
 - Pilgrims
 - Researchers
 - Others specify please.....
15. What is the frequency of monkey entering your compound?
- Daily 2-3 days interval Weekly Fortnightly Monthly Seldom Others
16. Have you ever seen the people who utilized the food left/touch by monkeys?
.....
17. What are the measures that you apply to be safe from their destruction?
- Making them frighten by using catapult or stone
 - Scolding and charging
 - Fencing all around the houses
 - Providing food for them in particular area
 - Providing poison bait
 - Others specify please.....
18. Can you suggest which deterrent method is most effective for monkey?
19. Did you complain about monkey problem?
 Yes No
If yes, where?
If no, why?
21. Do you have killed the monkey till now?
 Yes No
If yes, for what reason,
specify.....
22. Do you think, monkey need to be protected?
 Yes No
23. Do you have knowledge about diseases transmission between monkey and human?
24. What will you do if you were bite/scratch by the monkey?
25. What are your perceptions?
- a. Collecting fodder from forest affects monkey's habitat Yes/No
 - b. Scratch/bite from monkey may transfer disease from monkey to human & vice versa Yes/No
 - c. Monkey dominates children/woman's easily & generally harasses them (Yes/No)
 - d. Artificial provisioning is changing the behaviors of monkey inviting more conflicts. (Yes/No)
 - e. Teasing, eye contact with monkey make them more aggressive towards human (yes/No).

PHOTO PLATES



Photo 1. Hanuman Statue in Devghat Religious Area



Photo 2. Two Langurs resting at a tree twig above the roof of Bageshwori College.



Photo 3. Way to Devghat, a place of religious importance

PHOTO PLATES



Photo 4. An adult male Langur resting on the Sal (*Shorea robusta*) tree.



Photo 5: Researcher, noting the behavioral data of Langur from Devghat



Photo 6: An adult female with juvenile and infant foraging on leaves of Sal

PHOTO PLATES



Photo 7: An adult Langur resting, as seen from the back.



Photo 8: An adult Langur resting, as seen from the front.



Photo 9: The Devghat Suspension Bridge is frequently used by Langurs.