# CHAPTER ONE

## 1.1 INTRODUCTION

Monkeys make up the majority of the primate orders and wonderfully diverse and intesting group. Three species of *Macaca* have been reported from Nepal: Rhesus macaques (*Macaca mulatta*), Assamese monkey (*Macaca assamensis*) and langur monkey (*Presbytis entellus*) (Chalise 2004). The Rhesus monkeys (*Macaca mulatta*) are the most common of all species in the world.

They are distributed in south and east – Asia i.e. Afghanistan, Bangladesh, Burma, China, India, Hong Kong, Sri Lanka, Thailand, Nepal etc. In Nepal they are usually found in the jungles of religious places like Pashupatinath temple, Swoyambhunath temples Dakshinkali, Ram temple and Nil Barahi and also natural forest of as Gokarna and Charkoshi Jhadi (Terai). They are even found in some localities of Kathmandu valley such as Tripureshower, Thapathali Sankhu, and Fulchowki dada, (Chalise 1998, Yadav 2004).

*Macaca mulatta* is one of the best known of the subfamily cercopithecinae, family ceropithecidae of primate. Order of Mammalian, (Chalise 1998) *Macaca mulatta* are commonly called as Rato Bandar in Neplai, Rhesus monkey in English, lala Banddra in Hindi, Macaque name for old world monkeys so genus *Macaca*.

Primates is the order of mammals which includes the monkeys, apes, human and other similar forms typically having dexterous hands and feet, binocular vision and as well as developed brain. About 200 species of primates are recognized. They are grouped into more than 50 genera and almost 100 extinct genera. (Tatersall, 1993).

The monkeys in the different area of Kathmandu valleys are living with the human communities but the habitat of monkey is being destroyed by the human encroachment. When an ecosystem is changed, all species will be affected. As human influences species, many influence species, many of which are endangered are exposed to increasingly diverse and complex stressors. Human encroachment may increase rates and severity of parasitism in wild non human primates via the direct

route of cross host transmission between phylogenetically related species (Ruminant to gorillas: *Nematodius* sp; human to sheep, *Entamoeba histolytica*). Dense human populations are excellent reservoirs for intestinal parasites. Parasites are significant sources of mortality in wild animal populations. Thus, it is of basic and applied impotence to assess accurately the patterns of parasitism in wild hosts and to identify host in transit factors that determine parasite diversity.

Primates are the highest order of mammals including lemurs, monkeys, an thropid, apes and man. These animals have many of the same structural characters as man. Three animals have many of the same structural characters as man. Some of them resemble him more in one feature, some in another. The major distinctive character in primates is the structure of their hands and feet, which are designed to serve the express purpose of grasping organs.

Rhesus monkeys are medium size animals with robust limbs of equal length. The head and body of Rhesus measure 45cm. and tail 21cm. It weight about 8 kg. It has a short tail, uniformly well brown hair, with much bright colour, more reddish-hind parts. The face is base is light pink, flesh colred or reddish. The ears are pointed and protruding. It possesses special pad, on their limbs. Fore lions and hind limbs are of equal size. They are mostly arboreal in habitat (Napier and Napier, 1985). The head and body length in male and female reach upto 48.5, 63.5, 47.0-531 respectively. The weight of male and female ranges from 5.6-10.9 kg. and 3.0-10.7 kg respectively. The tail length in male ranges from 20.3-30.5 cm and femal ranges from 19.0-26.5 cm. (Roon al and Mohnot, 1977). The size and weight of the male rhesus macaque is relatively large than female.

Parasites are living organisms which receive nourishment and shelter from other organism where they live. Intestinal parasites are indoparasite that attach in the Intestinal wall desire nutrition from the food in the Lumen and the intestinal wall in the process of which they harm the host. Most of the parasites follow a specific route in different part of the body before they are established in the intestine by which they cause variety of disorders. The intestinal parasites are generally are protozoan and heiminths.

Like other animals, Rhesus monkey also harhour many kinds of parasites of which helminth parasite are one of them. They are worm like parasites that attack alimentary tract of monkeys. They are multicultural and bilaterally symmetrical, elongated flat or round bodies helminths are broady classified into flat worms or platyhelminths. (Platy- flat) which include fluences and tapeworms and round worms or Nematodes (Nemato= Thread), which include nematodes. Helminths infection is particularly by intestinal parasites. It is one of the major causes of gross health problem.

Regarding to helminths parasites, the harm caused by them not only to man but also to other animals. It is great, but it never causes epidemics like protozoon due to lack of multiplication power within the host, yet they play major role in the civilization and prosperity of a nation and they remain always endemic in an area. The adult or larval stage or both may be pathogenic. They cause anemia, diarrohoea, eosinophilia, headache, local or generalized pains, dysentry, fever and paralysis (Kotpal, 2001).

Since helminth parasites are the causative agent of a terrible and list of deliberating, deforming and killing disease of primates, the studies in these regards are very important from epidemiological point of view. Some helminth infection, particularly due to intestinal parasites, is one of the major causes of gross health problem.

Macaques are social animals. They live partly on the ground and partly in the trees, the proportions varying with the species and the habitat. The Rhesus macaque (*Macaca mulatta*) is the most common monkey in south Asia. Since ancient times, it has played an important role in ecology of the area, culture and tradition of the human being. Many wild and captive monkeys are frequently influenced by parasite in their stomach and intestine. This gastrointestinal parasite affects the health of the host. The prevalence of infection may be related with the habitat.

The Rhesus macaque (*Macaca mulatta*) often called the Rhesus monkey, is one of the best known species of old world monkeys. Rhesus macaque may be found in grassland, woodland and mountainous regions upto 2500 metres elevation. The rhesus monkeys typical diet includes roots, fruits, seeds, barks, insets and small

animals. They live in active, noisy troops that can include up to 200 animals. They have the widest geographical distribution of any species of non human primate occurring naturally in Afghanistan, Pakistan, India, Nepal, Bhutan, Myanmar, Thailand, Vietham and China.

Rhesus monkeys are the most adaptable of all non human primates with the broadest ranges of habitat and the most cosmopolitan food habits. These monkeys are generally herbivorous, eating a wide variety of natural and cultivated plants. But they also forage occasionally for insets.

Due to the close relationship between human, monkeys and apes, there are many diseases that are easily transmitted both human and non human primates (Wolfe *et al*., 1998). The more closely related the non human primate to humans, the greater number of pathogens that may be exchanged. In some cases, an organism that is relatively no virulent in its host may be extremely virulent in a different species. Parasites and disease are among the most pressing challenges of presents day conservation programs for primates and other biodiversities (Wallis and Lee. 1999; Woodford *et al.,* 2001).

Parasitism is one of the major problems that affect the productivity and perfermatance of animals (Mohamed, 1994). Parasitic disease either lowers the working efficiency or even may result in death of animal or sometimes is potential danger for public health like hydatidosis. The gastrointestinal helminth parasites adversely affect the nutritional states of animals (Irfan, 1984), where as the ectoparasites harm the camel due to their parasitic nature and serve as a vector for transmission of a wide variety of pathogens (Pegram and Huggins, 1991). Parasites and infection diseases of wildlife are major threat to conservation of endangered species (Lyles and Dobson, 1993). Thus, there is a great need for studies documenting the prevalence of parasites among endangered species in the wild animals (Daszak *et al*., 2008).

Gastrointestinal parasites can impact host suruival and reproduction directly through pathologic effects and indirectly by reducing host condition (Boyce, 1990, Dobson and Hudson, 1992, Hudson *et al*., 1992, Coop and Holmes, 1996). Several gastrointestinal parasites can lead to blood loss, tissue damage, spontaneous

aberration, longenital malformations and death (Gillespie, 2006); gastrointestinal nematodes infection may result in elinica disease or confound experimental protocols that civilize non human primates. A study of gastrointestinal parasites is important for the management of primate colonies and the safety of colony personnel because many of these parasites are potentially zoonotic. Various studies have demonstrated that non human primates are naturally infected with parasites that are infectitious and pathogenic to man (Miller *et al*., 1990; Hamlen and Lawrence, 1994).

**1.2 Significance of the Study**

Rhesus monkeys are easily available in Swoyambhu area of Kathamndu Nepal. They are particularly susceptible to parasitic infection because they live in social groups that facilitate their transmission. Parasite can directly affect host survival by increasing predation risks or decreasing competitive abilities. In addition, if parasite loads affects health and physical appearance, they can influence patterns of female male a choice or the ability of individuals to complete directly for access to sexual patterns. The research will help in determining the prevalence of helminthes parasites in Rhesus monkey in Swoyambhu nath sites. This is very important for both effective and efficient management and conservation of them. On the other hand, they are used as experimental animals by microbiological institute. So, this species must be studied from different perspective.

The Rhesus macaques are the most familier of all the monkeys in the world. The close interaction of these macaques with the people forms perhaps the most intense relationship between human and non human primates anywhere in the world. The rhesus macaque can be easily tamed and taught various trieks, especially when young but is never fully domesticated.

It has been widely used in space research for the first time instance giving its name to Rh factor in blood in the second being among the first living creatures to be rocketed into space.

The Rhesus macaques has played a vital role in biomedical research for many years, the most important contribution being the identification of the Rhesus factor, a

blood characteristic which occasionally appears in both which occasionally appears in both the rhesus macaque and man.

Until a few years ago, the Rhesus macaque was used extensively in the production of the Salk and sabin polio-vaccines and in smaller numbers for research in field such as virology, neurology, cardiology and endocrinology. The behaviour and ecology of monkey's have always have been a source of great attraction for zoologists.

Primates are among the most interely social of all animals. This sociality forms an integral part of each individual's attempts to survive and reproduce successfully in the word; (Dunbar, 1988). The Rhesus macaque (*Macaca mulatta*) is the most common monkey in south Asia. Since ancient times, it has played an important role in ecology of the area, culture and tradition of the human being.

Rhesus monkeys are used for an extraordinary of biomedical and bank of research. Due to their close gentic, physiologic and metabolic similarities to humans, these species serve as an essential research tool in neuro science, behavioral biology, reproductive physiology, neuroendocrindoty, endocrinology, cardiovascular studies, pharmacology and many other areas. It has given its name to the Rhesus factor one of the elements of a person's blood group.

Rhesus monkeys have had a significant impact on human societies, particularly in the areas of science, culture and ecology. Monkey is a part of an ecosystem. So, we can't ignore its importance. It belongs to wiildlife population. We all are aware that wildlife population can serve as host reservoir or vectors for some disease that affect humans.

Various researches have been done all over the world including Nepal, in the field of human intestinal parasites. Because of this we are well educated about the consequences caused by them. But very little is known about the intestinal parasite in animal like monkeys, which have socio-religious value in our country.

This study will help to find out the prevalence rate of trematodes, nematodes and cestodes. Moreover, the present study may help to the future investigator to

advance their knowledge. Less attention ahs been paid toward the study on parasitic zoonotic disease in relation to monkey.

It is widely worshiped by Hindus as devotees of Lord Ram. Rhesus monkeys are always used as experimental animal by microbiological institutes. So these species are targeted for the study purpose. Being higher primates, many organ systems are similar to man. Only minor study has been done so far in Rhesus monkey.

A study of gastrointestinal parasites is important for the management of primate colonies and the safety of colony personnel because many of these parasites are potentially zoonotic. Various studies have demonstrated that non-human primates are naturally infected with parasites that are infectitious and pathogenic to man (Miller *et al*., 1990, Hamlen and Lawrence, 1994).

Non human primates are often valuable in study of either human diseases processes or vaccine and drug development. It is therefore important that animals used in such studies should not harbour parasites. The results obtained using parasitized animals may not revel the true picture; additionally these animals play an important role in natural ecosystem.

This study also helps in listing the prevalence of intestinal helminthes parasites in monkey. It will also help in determining the disease caused by them and their control too.

### 1.3 Limitations of Study:

This academic study has been carried out for the partial fulfillment of the requirements for the master's degree in Zoology at Tribhuvan University, Kathamndu, Nepal.

The research has limitation regarding finance and time constrains. The time for this study was also limited and carried out within two seasons only. Due to the lack of well-equipped laboratory, the identification of parasites was done upto general level only.

# CHAPTER TWO

# OBJECTIVES

## 2.1 General objectives

The general objective of this work is to study the intestinal helminthes parasites of Rhesus monkey (*Macaca mulatta*) from Swoyambhu area of Kathmandu Valley.

## 2.2 Specific Objectives

- Identification of eggs/ova.
- To determine the general prevalence rate of intestinal helminthes parasites.
- To determine the classwise prevalence rate of intestinal helminthes parasites.
- To determine the prevalence of trematodes, cestodes and nematodes.
- To determine the prevalence rate of specific helminthes.
- To compare the reasonable prevalence rate of intestinal helminthes parasite of monkey in Swayambhu area of Kathamndu Valley.
- To recommend for further planning regarding to the control and management of helminthes parasites in monkeys.

## 2.3 Hypothesis

$H_0$ = There is no significant difference in the prevalence of helminth parasites in winter and summer.

$H_1$= There is significant difference in the prevalence of helminth parasites in winter and summer.

# CHAPTER THREE

## LITERATURE REVIEW

Parasites can exert and important impact on host population regulation in terms of reducing fecundity and survival of the host individual (Scott and Dobson 1989; Hudson *et al*., 2002). They can even lead to rapid declines of host population or host species extinctions (Daszak 2000, Harvell *et al.*, 2002). Parasites are assigned central role in sexual section and the evolution of male secondary sexual characters that advertise their high parasite. Resistance because females should benefit from choosing parasites resistant males by the means of there sex traits or honest Signals (Hamilton and Zuk 1989; Malles 1990; Zuk , 1996).

Many different factors are assumed to shape parasite diversity in hosts by modulating the disease risk at any stage of the potential infection. Parasites encounter transmission parasite recruitment, colonization, parasite reproduction or establishment. Disease risk in difficult to measure in wild host population thus indirect surrogates are needed. Parasite species richness (PSR) describes the number of parasite species encountered per host (Morandand Harvey 2000; Nunn *et al*., 2003).

Parasite intensity is the number of parasite individuals of a particular species per host (Margolis *et al*., 1982; Bush *et al*., 1997). In summary, three metrics allow to estimate indirectly the disease risk in host population.

Helminth comprise a very diverse group of metazoan . Parasites of the phyla platyhelmintha (with the digeneous trematoda), monogenean cercomeromorpha and acanthocephalan (Schneider and Tenter 2006). Trematode infections are considered to be very same and a typical in New world primates (Dunn, 1968 and King, 1976). Around 11 species from five families are known to infect. New world monkeys (Toft and Eberhard, 1998).

Cestodes are highly diverse and commonly infect new world monkey species (King, 1976). The characteristic cestodes are of families Anoplocephalidae and Davaineidae (Dunn, 1968). At least 13 cestode species are identified to infect New world monkey (Toft and Eberhard 1998).

Intestinal nematode diversity in New world monkeys is extremely high to data approximately 68 species from 6 general have been identified (Toft and Eberhard 1998). Acanthocephalan infactions are very character ristic for New world primates (Kuntz and Myers 1972; Toft and Eberhard 1998).

### 3.1 Literature review in context to the world

Yamashita (1972) conducted a research on the helminthes parasites of primates represent 225 species (nematodes 164, acanthocephales 5, trematodes 23 and cestodes 33). The infected primates include 140 species having nematodes 14 species having acanthocephales, 21 species having tremtodes and 28 species having cestodes. In Japan, 23 species of helminth parasites (including 16 species o of nematodes,5 species of trematodes and 2 species of cestodes) have been found in native and imported primates,18 of these species having so far been Japan monkey centre.

Hayama and Migi (1963) carried out 228 species of helminth parasite including 166of nematodes, 5 of acanthocephales, 24 of trematodes and 33 of cestodes have been found among 103 species of primates in the world.

Horii *et al*., (1981), studied the incidence of eggs in individual faeces and the EPG of gastrointestinal nematodes far individually discriminated Japanese monkey of the Koshima troop were investigated monthly from October 1974 to June1997. Eggs of 4 nematode species (*Oesophagostomum aculeatum*, *Trichuris trichura*, *Streptopharagus pigmentatus* and *Strongyloides fuleiborni*) were frequently found and a few cestode segments of Berticella sp were occasionally found strogyloides fulleborni had a high incidence (100%) in young monkeys, suggesting that its incidence might vary with the monkey's age.

Dewit *et al.,* (1991) studied the helminth parasite in a natural population of primates at Polonnaruwa, Srilanka. Five fatally wounded or recently deceased toque macaques (*Macaca sinica*) and three langurs (*Presbytis senex* and *P*. *entellus*) were antopsied. The following nematodes were found; *Oesophaostomum aculeatum* (chabertidae), *Streptopharagus pigmenteata* (spirocercidae), *Physaloptera sp*.(spiruridae), *Enterobius vermicularis* (oxyuridae) and *Trichuris trichura* (Trichuridae) and one cestode, *Hymenolepsis* was also recovered from *P. entellus*.

Among fresh faecal samples of 210, *M. sinica*, worm eggs of *Oesophagostomum* and *Strongyloides* were most abundant followed by *Trichostrongylus*. *Trichuris* and *Streptopharagus* eggs were found occasionally.

Anwar and Khan (1998) conducted on parasitism of camels in the Department of Veterinary Parasitology, university of Agriculture, Faisalabad, Pakistan. The prevalence was higher (69.2%) in males than in females (30.8%). The prevalence of gastrointestinal helminthes was 69.1% (415/600) and that of protozoa was 12.5% (75/600) of these 32.5% (135/315) had mixed infection of helminthes. The worm burden per animal ranged from 20-330, 4-40 and 30-250 for trematodes, cestodes and nematodes respectively.

Joseph *et al.*, (1999) informed on the parasitic load of two endangered primates Lion- tailed macaque and Nilgirilangur, inhabiting silent valley National part were collected during the period 1994-1995. Parasitic load with in these primate species in captility were also ascertained and compared with that of wild. The major intestional parasites identified from the wild samples were *Trichuris sp*. and *Oesophagostomum* sp.

Gotoh (2002) studied a carpological survey of gastrointestinal parasites in wild Japanese macaques (*Macaca fuscata*) from 14 natural habitats was done ova of five nematodes species (*Trichuris trichura, Strongyloides fulleborns, Streptopharagus pigmentatus, Oesophagostomum acculeatum* and *Gongylonema sp.* and worms of the cestode species, *Berticella. studeri*, were detected.The infection rate of *Strongyloides fulleborni, Streptopharagus pigmentatus* and *Trichuris trichura* were higher in the juvenile monkeys.

Varadharajan and Kandasamy (2000) reported a survey of gastrointestinal parasites of wild animals in captivity in the V.O.C. Park and Minizoo, and coimbatere by examing 60 faecal samples. The examination revealed high percentage (58%) captive animals were positive specifically for helminth parasitic infections and some (6%) were positive for protozoan infections. *Strongyle, Trichuris, Strongyloides* as well as coccidian were present in case of herbivores and *Taxocara, Ancylostoma* as well as *Artyfechinostomum* in case of carnivores.

Plesker *et al.,* (2001) dignosed 19 pig tailed macaques (*Macaca nemestrina*) at the Paul Ehrlich Institute, Germany and found three hydatidcysts in the liver which was confirmed as *Echinococcus granulosus* human and monkey in the same geographical region of northern Ghana.

Lilly *et al.,* (2002) reported the intestinal parasites in Gorillas, Chimpanzees and Humans at Mondika research site, Dzanga-Ndoki National Park, Central Africa Republic.

Gillespie *et al.,* (1998-2002), collected 293 faecal samples from free ranging individuals of the 4 guenon species of western Uganda, i.e. red tail Guenons(*Cereopithecus ascanius*), blue monkeys ( *Certcopithecus mitis*), hoesti monkeys (*Cercopithecusthoesti*) and vernet monkey (*Cercopithecus aethiops*), to quantify the prevalence of gastrointestinal parasites. Helminth eggs, larva and protozoan cysts were isolated by sodium nitrate flotation and fecal sedimentation. Helminth parasites were identified and infection prevalence was determined for 4 guenon species, 6 nematodes (*Strongyloides fulleborni*, *Oesophagostomum sp,* Unidentified *Strongyle*, *Trichuris* sp. *Stereptopharagus* sp. and *Enterobios* sp., 1 cestodes (*Bertiella* sp.), 1 trematode (*Dicrocoeliidae*) and 5 protozoans (*Entamoeba coli*), *Entamoeba histolytica*, *Iodameoba butschlii*, *Giardia lamblia* and *Chilomatix mesnili* were detected. Although prevalence never differed between male and female guenons only adult females were infected with *Oesophagostomum* sp. and *S. fulleborni*.

Gillespie *et al.,* (1997-2003) collected 2,103 faecal samples from free ranging individuals of the 3 colobus monkey of Uganda to identify and determine the prevalence of gastrointestinal parasites. Seven nematodes (*Strongyloides fuleborni, Strongyloides stercoralis and Oesophagostomum* sp.), 1 cestodes (*Berticella* sp.), 1 trematode (*Dicrocoeliidae*) and 3 protozoans (*Entamoeba coli, Entamoeba histolytica, Giardia lamblia*) were detected. Prevalence of *S. fulleborni* was higher in adult male compared to adult female red colombus.

Michaud *et al*., (2003) found that helminth parasites shared by non- human primates and man in Peru were *Analylostoma brazilliensis*, *Ascaris lumbricoides, Necator americanus, Hymenolepsis diminuta* and *Trichuris* sp.

Mutani *et al.,* (2003) examined fifty-three faecal samples for gastrointestinal helminthes using the zinc. Sulphate floalation method revealed an overall infection rate of 88.7%. The parasite observed included *Strongyloides* (62.4%), *Physaloplera* (58.5%), *Trichuris* (52.8%), Hookworm (34.0%), *Oesophagostomum* (30.2%), *Richostrongylus* (3.8%) and Ascaris (57%).

Ponnudurai *et al.,* (2003) examined 108 fecal samples of monkey in Tamil Nadu out of which 56 (51%) samples were positive for parasitic infection. Among the parasitic infections, *Entamoeba* sp. accounted for 14% *Oesophagostomum* sp. 28% and *Strongyles sp.*14% .The incidence of 3 parasites was seen as mixed infection in 17%.

Gillespie *et al.*,(2004) collected 293 faecal samples from free ranging individuals of the 4 guenen species of western Uganda i.e. red tail guenons (*Cercopithecus ancanius*), blue monkeys (*Cercopithecus mitis*), 1 hoesti monkeys (*Cercopithecus hoesti*) and vervet monkey ( *Cercopithecus acthiops*), from January 1998 to December 2002, to quantify the prevalence of gastrointestinal parasites. Six nematodes ( *Strongyoids fulleborni, Oesophagostomum* sp., unidentified *strongyle, Trichuris* sp., *Strreptopharaus* sp. and *Enterobius* sp. 1cestode (*Bertiella* sp.),1 trematode ( *Dicrocoeliidae*). Only adult females were infected with *Oesophagostomum* sp. and *S. fulleborni*.

Phillips *et al.,* (2004) collected faecal samples from 86 individuals of non human primates from Tambopata Research Center, Tambopata National Reserve, Peru and analyzed a concentration test the result of which indicate the presence of various Protozoans, *Anylostoma* sp. Ascaris sp. *Strongylrides stacolaris*, *Trichuris trichura, prosthenorchis elegans* and *Schistosoma mansoni*.

Bakuza and Nkwengulila (2005) collected faecal samples from 60 chimpanzees at Gombe National Park, Tanzania during January to September and examined them for parasites. Three nematodes *Oesophagostomum* sp., *Strongyloides fulleborni* and *Abbeviate caucassica* occured at higher prevalence (41.2-45.5%) but relatively lower than previous findings of (51-91%). They also diagonised unidentified *Strongyles* at a moderate prevalence (33%) lower than a previous record of 41% *Probstrmayria gombenris* occured at relatively low prevalence(16.4%) vs part observation (23-59%)

while the prevalence of *Trichuris* sp. (7.3%) was closely similar to previous records of 5-9 % . They also observed unidentified ciliate at 9% within the same range as in previous studies. (5-28%). The prevalence of *Troglodytella abrassarti* was 78% closely similar of previous findings of 75%. There was no significant variation in parasite prevalence between chimpanzees of the kasekela community and there of the mitumba community, although the former tended to have higher prevalence of helminthes than latter.

Gillespie *et al.,* (2005) studied the 2103 faecal samples from free ranging individuals of the 3 colobus monkey species of Uganda the endangered red colobus (*Piliocolobus tephrosceles*) the eastern black and white colobus (*Colobus guereza*) and the Angolan black and white colobus (C. angolensis) from August 1997 to July 2003 to identified and determine the prevalence of gastrointestinal parasites. Seven nematodes (*Strongyloides fulieborni, S. stercoralis, Oesphagostomum sp*., an unidentified *Strongyle, Trichuris* sp., *Ascaris* sp. and *Colobenterobios* sp.), 1 cestode (*Bertiella sp.*),1 trematode (*Discrocoellidae*) were detected prevalence of *S. fulleborni* was higher in adult male compared to adult female red colobus.

Gillespie *et al.,* (2005) studied the effect of logging on gastrointestinal parasite infections and infection risk in African primates.

Goosens *et al.,* (2005) studied a 12 month survey of gastrointestinal helminthes of *Antelopes gazelles* and giraffids kept at two zoos in Belgium. Nematode eggs were removed from 586 of 1606 (36.5%) individual fecal samples using flotation techniques. Nematode species recovered were *Comelostrongylus mentulatus* from the *abomasa, Trichostrongylus retortae formis, Nematodius fillicollis, Capillaria* sp. and *Trichuris* sp. from the intestine.

Hobbs *et al*., (2005) found abdominal cystecercosis in Rhesus macaque in Oregon National Primates Research Center, USA.

Muehlebein, (2005) studied the parasitic fauna of 37 adult, addescent and Juvenile male chimpanzees from the Ngogo group, Kibale National Park, Uganda, were assessed from 2 faecal samples collected over a 3 month period . Twelve taxa of intestinal species (five helminths and seven protozoans) were recovered from the

sample. The four most prevalent species were *Troglodytella abrassarti* (97.3%), *Oesophagostomum* sp. (811%), *Strongyloides* sp. (83.8%) and *Entamoeba chattoni* (70.3%). No species was found in all samples from any one animal and *Troglodytella abrassarti* the most common in testinal organism was found in all of the serial samples of only 69.4% of the chimpanzees.

Vanleishout *et al.,* (2005) examined 349 faecal samples of different primate from Ghana and found high prevalence of *Oesophagostomum biforcum* (75.99%).

Chapman *et al.,* (2006) examined how changes associated with the creation of edges in Kibale Natioanl Park, Uganda, Colobines: the endangered red colobus ( *Pilliocolobus cephrosceles*) and the black and with colobus (*Colobus guereza*). An analysis of 822 faecal samples from edge and forest interior groups revealed no different in the richness of parasite communities (i.e. the number of parasite species proportion of individuals with multiple infection was greater in edge than forest interior groups. The prevalence of specific parasites also varied between edge and forest interior groups *Oesophagostomum* sp. a potentially deleterious parasite was7-4 times more prevalent in red colobus on the edge than in those in the forest interior and entamoeba coli was 4 times moreprevalent in red colour on the edgethan in animals from the forest interior.

Gruijter *et al.,* (2006) compared adult *Oesophagostomum bifurcum* from human and non human primates from Ghana and found significant differences in morphological characters between *Oesophogostomum bifurcom* warm from humans, the mona, potas or green monkey. These findings suggest that *Oesophagostomum bifurcom* from distinct population variants.

Mbora *et al.,* (2006) conducted faecal egg counts of gastrointestinal parasites of 2 critically endangered primates endemic to the forest of Tana River, Kenya. Mangabeys would have a higher prevalence of primates 10 nematodes and 3 protozoans in mangabeys and 7 nematodes and 2 protozoans in colobus.

Adejinmi and Ayinmode (2008) investigated the 11 zookeepers at the university of Ibodon Zoological Garden, Ibadan Migeria for helminth Ova and Protozoan cysts and also conducted a sentinel study on the zoo animals. The facial samples of 7

(63.6%) zookeepers were positive for either helminth ova or protozoan cysts. Helminths encountered were those of *Anylostoma duodenale, Ascaris lumbricoides* and *Trichuris trichura.*

Bezjian, *et al.,* (2008) from may to June 2004 we collected 41fecale samples from free ranging olive baboons (*Papi anubis*) within the forested, Kibale National Park, Uganda. Samples were examined to determine the prevalence of gastrointestional helminthe in this forest dweling population of olive baboons. The prevalence nematodes identified from fecal flotation was *Oesophagostomum* sp. (85%), *Trichostrongylus* sp. (22%), *Trichuris* sp. (46%), *Strongyloides* sp. (49%), *Tervidens sp.* (5%), *Abbreviate* sp. 20% and *Molineus* sp. (2% ). Flotation techniques also recovered unidentified eggs, probably of hook worm origin (22%). No parasite eggs were recovered by sedimentation of eight samples. Coproculture technique using 13 of the 4 samples recovered larva from *Oesophagostomum* sp., *Strongyloides* sp. and *Trichostrongylus* sp. The high prevalence of nematodes recovered in this study seems to support previous theories of high nematode infections in forest habits.

Rothman *et al.,* (2008) studied to understand patterns of intestinal parasitism in health, undisturbed, endangered mountain gorillas (*Gorilla beringi*), we regularly collected faecal samples from a group of 14 wild gorillas residing in Bwindi Impenetrable National Park (BIND),Uganda, for about 1 year and identified the diagnostic stages of the following parasites strongylids (Strongylida), *Anoplocephala gorillae, Probstmayria* sp., *Strongyloides fuleborni* and a trematode.

Bakuza and Nkwengulila (2009) collected faecal samples from January to September 2005 from 60 chimparizees at Gombe National Park, Tanzania and examined them for parasites we identified 8 types of parasites, all of which had l preciously been decomented in the chimpanzees of Gombe. Three nematodes *Oesophagostomum* sp. *Strongylide fulleborni* and *Abbreviata caucassiea* occurred at higher prevalence (41.2- 45.5%) but relatively lower than previous (16.4%) vs part observation (23-59%) while the prevalence of *Trichuris* sp. (7.3%) was closely similar to previous records of (5-9%). The prevalence of *Troglodytella abrassarti* was (78%) closely similar to previous findings of (75%).

### 3.2 Literature Review in Context of Nepal

Limbu *et al*., (2006) reported strongylus and paramphistome groups in Rhesus monkey (Macaca multta) for the first time in Nilbarahi in the community forest.

Malla (2007) studied on the prevalence of intestinal Helminthes parasite of macaca multta from. Pashupati (Kathmandu district) and Nilbarahi area (Bhaktapur) district of Nepal. Out of total 202 samples from Pashupati and Nilbarahi area, 124 (61.38%) samples were found to be positive and 78 (38.6%) samples were found to be negative eggs of 18 helminth sp. (16 nematodes, 1 trematodes and 1 acanthacephala). The highest prevalence rate was found in pashupati (i.e. 64.70%) and least prevalence rate was found in Nilbarahi (i.e. 58%).

Dhubhadel (2007) conducted a study on the prevalence of intestinal helminth parasites in Rhesus monkey (*Macaca mulata*) of Swyambhu and Nilbarahi area of Kathamndu valley. A total of 206 stool samples were collected from two places (Swayambhu and Nilbarahi) and found over all helminth prevalence rate 62% parasitzation rate was found higher in Swayambhu 67% than of Nilbarahi, out of total positive samples the presence of Nematodes (85.82%), Trematodes (93.14%), Cestodes (7.08%) and Acanthocephala (3.93%).

# CHAPTER FOUR

# MATERIALS AND METHODS

## 4.1 Study site

### 4.1a. Swoyambhu

Nepal is a small land locked country neighbouring India and China. It covers 1,47,181 square kilometer area. It lies between 80°4’88°12’ east longitude and 26°22’ and 30°27’ North latitude. The length of Nepal is 885 km. east west and its breadth varies between 145 to 241 km. north south. Kathmandu valley which is the heart and capital of Nepal, is located 27°42’ North and 88°36’ east at an altitude of 4500 feet. It includes main cities Kathmandu, Bhaktapur and Lalitpur.

Swoyambhu lies in Kathamandu district of Bagmati zone. It is an ancient religious palce lying at the distance of 5 km. west of Kathmandu city. Physically it is situated between 85°18’30” and 27°42’30” to 27°43’30” east longitude and north latitude respectively. The temple complex sits over top of hill rising 1500m above the relieve. The temple is about 2000 years old. Swoyambhu area occupies 37 heactors of land and most of the area in under the influence of human encroachment. The forest in this area is subtropical type. It is 3 km west of Kathmandu city and situated a hillock about 177m above the sea level of Kathamndu valley. It was listed in the UNESCO world Heritage movement in 1979 AD.

### 4.1 b Study Design

### 4.1 c Laboratory based diagnosis

### 4.1 d Study Period

It is done from December 2009 to February 2010 and May to July 2010**.**

## 4.2 Sample Size

A total number of 300 samples were taken from Swoyambhu of Kathmandu valley in two seasons, winter of 2009 and summer of 2010. 150 samples were collected in each season.

### 4.2.1 Precaution and preservation of sample

- ❖ Only fresh samples were collected
- ❖ Samples were collected by the random sampling.
- ❖ The samples were collected in air tight container to prevent dessication.
- ❖ In case of fresh samples3-4 drops of 10% formalin were used.
- ❖ All samples were labeled individually with date and obtained time and the samples were brought to laboratory in preservatives ($K_2Cr_2O_7$ and formalin).
- ❖ Samples were immediately stored in the refrigerator (4°c) until they were processed.

### 4.3 Stool Examination

The stool samples were collected and brought to laboratory in preservatives 5% Potassium Dichromate ($K_2Cr_2O_7$) and 10% Formalin and refrigerated. The stool samples can be examined by differential floatation technique, sedimentation technique and stool's counting method. Sedimentation technique is very appropriate. Both the floatation and sedimentation technique is used for this study.

### 4.4 Floatation Technique

In the floatation technique, the suspending fluid (Sodium Chloride or Zinc Sulphate) has higher specific gratvity than parasitic forms which therefore rise to the surface.

All the helminthic eggs float in such a solution except the following unfertilized eggs of *Ascaris lumbricoides*, eggs of *Taenia solium* and *Taenia saginata* and also the eggs of intestinal fluke.The *Strongyloides* larvae do not float in salt solution.

### 4.4.1 Method

- About 3 gm. of faecal sample was taken.

- The sample was kept on porcelain basin and grinded about 42ml. of water was then added and again grinded and filtered.

- Filtrate of the faecal solution was mixed and about 15ml. of it was kept on plastic tube.

- The tube was centrifuged at 1000 rpm till 5 minutes.

- The tube was taken out the upper part of the water was removed with the help of pipette.

- The tube was filled with sodium chloride solution and centrifuged at 1000rpm for five minutes.

- More NaCl solution or Zinc sulphate solution was added upto the tip of the tube.

- A cover slip was placed over the top of the tube. So that NaCl touches the cover slip for few minutes and then the cover slip was placed on a slide and examined at 10x.

- For this process eggs of Nematode, certode, and coccidia can be detected for detection of long worm half saturated salt solution is used.

### 4.5 Sedimentation Technique

The technique is used for the detection of trematode eggs. It provided good results as the egg of nematode is a bit heaver than the other eggs and deposited in the bottom. (Source: Veterinary lab techniques, 2003).

#### 4.5.1 Method

- 3 gm of stool sample was taken in a beaker,42 ml. of water was added and grinded highly with the help of motor and pistle.

- The sample was filtered with a tea strainer and filtered samples were poured in a plastic test tube.

- The tube was taken out and upper water was removed with the help of a pipetle.

- Zinc sulphate solution was filled in the tube and again centrifuged at 1000 rpm for 5 minutes

- A drop of deposited materials was taken out from the test tube with the pipettle and placed on the slide, add drop of methylene blue into it and examined under the microscope at 4x and 10x.

### 4.5.2 Study Period

Lab examination of samples was during the month of December 2009 to February 2010 and May, June, July 2010.

### 4.6 Identification of the eggs

The identification of the eggs was confirmed by comparing the structure, color and size of eggs with that of Soulsby (1982), Georgi (1969), eggs were also compared with that of the chart at Central Veterinary Laboratory Tripureshwor.

### 4.6.1 Material Required

#### 4.6.1.1 Apparatus Required

Weighing scale, Beaker, mortor and pistle, slide cover, slip dropper, pipette, gloves, plastic tubes, tea strainer, oellotape, tooth pick, centrifuge machine, refrigerator, microscope, towel cotton, hand gloves, tooth pick, camera needle and cover slip.

#### 4.6.1.2 Chemical Required

- ❖ Sodium choloride mixture

- ❖ Zinc sulphate mixture

- Iodine solution
- Saline water
- Methylene blue Potassim dichromate 5%
- Distilled water
- Formalin 10%
- AFA Solution

# CHAPTER FIVE

# RESULTS

The study was conducted on the faecal samples of Rhesus mankey of Swoyambhu areas from December 2009 to February 2010 for winter season and from May to July 2010 for summer season. Total 300 number of samples of Rhesus monkey (*Macaca mulatta*) were collected in both seasons, 150 in each season. The samples were examined at Central Veterinary Laboratory, Tripureshwor. The result of the study is presented udner following headings:

## 5.1 Determination of the prevlance rate of helminth ova at differnt level

- General prvalence rate
- Classwise prevalence rate
- Seasonwise prevalence rate
- Prevalence rate of single and multiple infections of helminths.
- Prevalence rate of specific helminths.
- Identification and description of the ova**.**

### 5.1.1 General prevalence rate

Among 300 samples collected from the field, 255 samples were found to be positive with one or more than one helminth parasites and 45 were found to be negetive. Hence Positive percentage was (85%) and negative percentage was 15%. Therefore general prevalence rate of helminthes parasite of monkey was found to be 85%.

Among those 255 positive samples altogether, 20 different genera of helminth parasites were observed during lab examination. Among 20 different genera of helminth parasite, 15 genera of nematodes, 3 genera of trematodes and 2 genera of cestodes were observed.

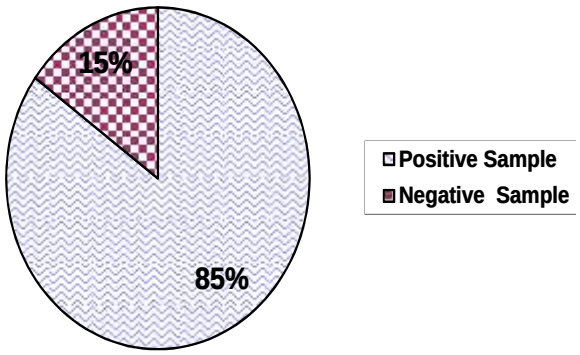



**Figure1: Diagrammatic representation of general prevalence of intestinal helminth parasites of Rhesus monkey (*Macaca mulatta*).**

### 5.1.2 Class wise prevalence rate of Helminths

Out of 255 positive samples, 20 different genera helminths were observed. Among them, 15(75%) genera were found to be positive for nematodes, 2(10%) genera were found to be positive for cestode and 3(15%) genera were found to be trematodes.

**Table 1: Class wise prevalence of intestinal helminths parasites of Rhesus monkey (*Macaca mulatta*)**

| S.N. | Class | S.N. | Genera of helminth |
|---|---|---|---|
| A | Nematodes | 1 | *Strongyloides* sp. |
| | | 2 | *Trichostrongylus* sp. |
| | | 3 | *Oesophagostomum* sp. |
| | | 4 | *Trichuris* sp. |
| | | 5 | *Capillaria* sp. |
| | | 6 | *Ostertagia* sp. |
| | | 7 | *Cooperia* sp. |

| | | | |
|---|---|---|---|
| | | 8 | *Dictyocaulus* sp. |
| | | 9 | *Oxyuris* sp. |
| | | 10 | *Ascaris* sp. |
| | | 11 | *Toxocara* sp. |
| | | 12 | *Chabertia* sp. |
| | | 13 | *Bunostomum* sp. |
| | | 14 | *Ancylostoma* sp. |
| | | 15 | *Haemonchus* sp. |
| B | Cestodes | 1 | *Taenia* sp. |
| | | 2 | *Dipylidium* sp. |
| C | Trematodes | 1 | *Dicrocoelium* sp. |
| | | 2 | *Schistosoma* sp. |
| | | 3 | *Fasciola* sp. |

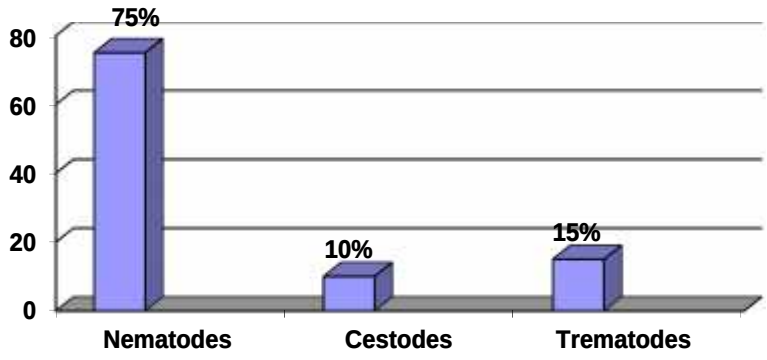



**Figure 2: Classwise prevalence of intestinal helminth parasites of Rhesus monkey (*Macaca mulatta*)**

The result of study indicates that maximum infection was found to be nematodes 75%, followed by trematodes 15% and then cestodes 10%.

### 5.2 Seasonwise prevalence rate of healminths

#### 5.2.1 Prevalence rate of helminthes in summer season

Out of 150 samples examined in summer season, 130 samples were found to be positive and rest 20 samples were found to be negative. Among 130 positive samples, 20 different genera of helminths were observed. Among them, 15(75%) genera were found to be nematodes, 2(10%) genera were found to be cestodes and 3(15%) genera were found to be trematodes.

**Table 2: Prevalence rate of Trematodes, Cestodes and Nematodes of Rhesus monkey (*Macaca mulatta*) in summer season.**

| **Class** | **S.N.** | **Parasites** | **Positive samples** | |
|---|---|---|---|---|
| | | | **No.** | **%** |
| Nematodes | 1 | *Strongyloides* sp. | 48 | 36.92 |
| | 2 | *Trichostrongylus* sp. | 15 | 11.53 |
| | 3 | *Oesophagostomum* sp. | 14 | 10.77 |
| | 4 | *Trichuris* sp. | 15 | 11.54 |
| | 5 | *Capillaria* sp. | 10 | 7.69 |
| | 6 | *Ostertagia* sp. | 10 | 7.69 |
| | 7 | *Cooperia* sp. | 11 | 8.46 |
| | 8 | *Dictyocaulus* sp. | 12 | 9.23 |
| | 9 | *Oxyuris* sp. | 8 | 6.15 |
| | 10 | *Ascaris* sp. | 13 | 10 |
| | 11 | *Toxocara* sp. | 18 | 13.85 |
| | 12 | *Chabertia* sp. | 10 | 7.69 |
| | 13 | *Bunostomum* sp. | 5 | 3.85 |
| | 14 | *Ancylostoma* sp. | 7 | 5.38 |
| | 15 | *Haemonchus* sp. | 6 | 4.62 |
| Cestodes | 1 | *Taenia* sp. | 12 | 9.23 |
| | 2 | *Dipylidium* sp. | 24 | 18.46 |
| Trematodes | 1 | *Dicrocoelium* sp. | 14 | 10.77 |
| | 2 | *Schistosoma* sp. | 22 | 16.92 |

| | | | | |
|---|---|---|---|---|
| | 3 | *Fasciola* sp. | 7 | 5.38 |

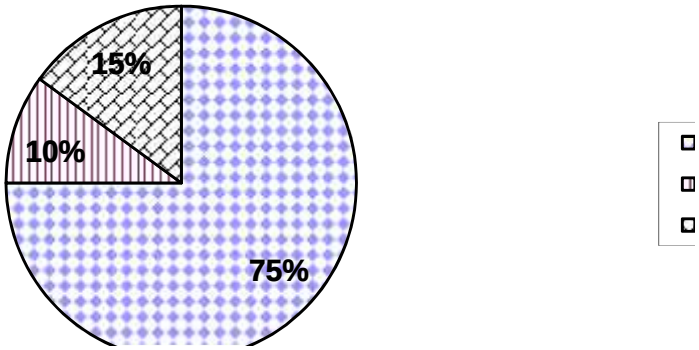



**Figure 3: Prevalence of Nemotdes, Cestodes and Tremotodes in summer season.**

In summer sevason, maximum number of parasites belongs to class nematodes which is 91.54% followed by trematodes and cestodes 30% and 29.23 % respectively. Among 20 genera, *Strongyloides* sp. was maximum number which is followed by *Dipylidium* sp.

### 5.2.2 Prevalence rate of helminthes in winter season

Out of 150 sampels collected in winter season, 125 samples were found to be positive and 25 smaples were found to be negative. Among 125 positive samples, 16 different genera of helminthes were observed. Among them, 11(68.75%) genera were nematodes, 3(18.75%) genera were trematodes and 2(12.5%) genera were cestodes.

**Table 3: Prevalence rate of Trematode, Cestodes and Nematodes of Rhesus monkey (*Macaca mulatta*) in winter season**

| Class | S.N. | Parasites | Positive samples | |
|---|---|---|---|---|
| | | | No. | % |
| Nematodes | 1 | *Strongyloides* sp. | 21 | 16.8 |
| | 2 | *Trichostrongylus* sp. | 14 | 11.2 |
| | 3 | *Dictyocaulus* sp. | 7 | 5.6 |

| | | | | |
|---|---|---|---|---|
| | 4 | *Haemonchus* sp. | 5 | 4 |
| | 5 | *Ostertagia* sp. | 5 | 4 |
| | 6 | *Trichuris* sp. | 10 | 8 |
| | 7 | *Capillaria* sp. | 6 | 4.8 |
| | 8 | *Toxocara* sp. | 15 | 12. |
| | 9 | *Chabertia* sp. | 12 | 9.6 |
| | 10 | *Ascaris* sp. | 6 | 4.8 |
| | 11 | *Oesophagostomum* sp. | 13 | 10.4 |
| Cestodes | 1 | *Dipylidium* sp. | 31 | 24.8 |
| | 2 | *Taenia* sp. | 13 | 10.4 |
| Trematodes | 1 | *Dicrocoelium* sp. | 11 | 8.8 |
| | 2 | *Schistosoma* sp. | 24 | 19.2 |
| | 3 | *Fasciola* sp. | 18 | 14.4 |

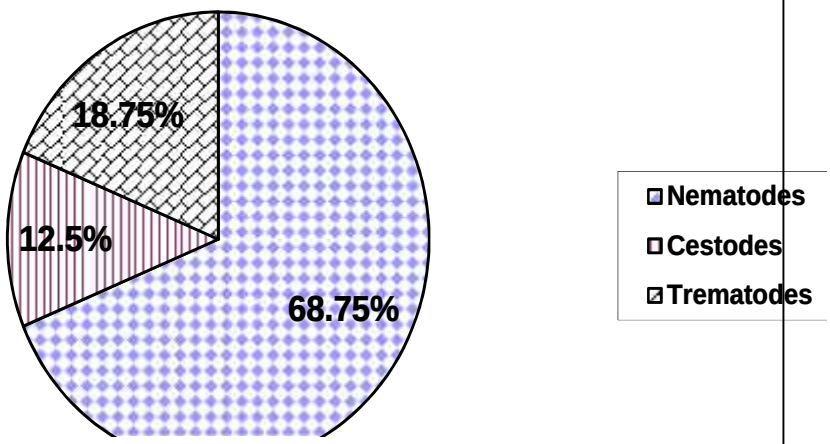



**Figure 4: Prevalence of Nematodes, Cestodes and Trematodes in winter season.**

The parasites were found in higher number in nematodes 68.75% followed by trematodes and cestodes 18.75% and 12.5% respectively. In comparision to summer season, the *Dipylidium* sp. was found to be in highest number (24.8%).

The difference in the prevalence of different genus of helminth parasites during both seasons (summer and winter) altogather were found statistically significant ($\chi^2$=16.73, P<0.05, d.f.=2).

### 5.3 Prevalence rate of single and multiple infections of helminthes

Out of 255 postive samples, single infection of helminth parasite was found in 101 (39.61%) samples and multiple infection was found in 154 (60.39) % samples. Single infection was found in *Strongyloides* sp., *Dipylidim* sp., *Trichuris* sp., *Oesophagostomum* sp., *Dictyocaulus* sp., *Dicrocoelium* sp., *Haemonchus controtus, Bunostomum* sp., *Fasciola* sp., *Taenia* sp., *Toxocara* sp., *Capillaria* sp., *Chabertia* sp., *Ascaris* sp., *Ostertagia* sp., *Trichostrongylus* sp., *Schistosoma* sp. where as *Dipylidium* sp., *Strongyloides* sp., *Trichostrongylus* sp., *Schistosoma* sp., *Toxocara* sp. were most common in double and multiple infection as compared to other species.

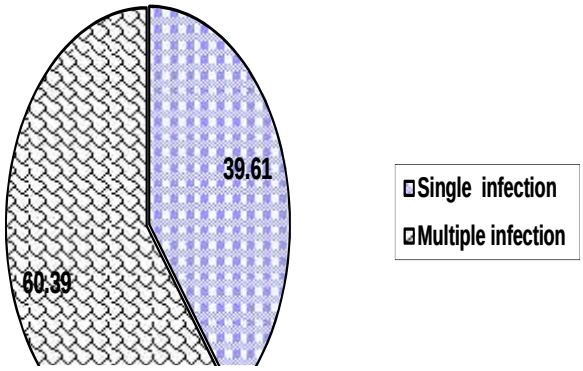



**Figure 5: Diagrammetic representation of prevalence rate of single and multiple infections of intestinal helminth parasites of Rhesus monkey (*Macaca mulatta*).**

### 5.4 Prevalence rate of specific helminthes

Out of 255 (85%) positive samples for helminthes parasitic infection, *Strongyloides* sp. (27.06%), *Trichostrongylus* sp. (11.37%), *Oesophagostomum* sp. (10.59%), *Trichuris* sp. (9.80%), *Capillaria* sp. (6.27%) *Cooperia* sp. (4.31%),

*Dictyocaulus* sp. (7.45%), *Oxyuris* sp. (3.14%), *Ascaris Lumbricoides* (7.45%), *Toxocara* sp. (12.94%), *Chabertia* sp. (8.63%), *Bunostomum* sp. (1.96%), *Ancylostoma* sp. (2.75%), *Haemonchus* sp. (4.31%), *Taenia* sp. (9.80%), *Dipylidium* sp. (21.57%), *Schistosoma* sp. (18.04%), *Fasciola* sp. (9.80%), and *Ostertagia* sp. (5.88%).

**Table 4: Prevalence rate of specific helminthes**

| Class | Parasites | Positive samples | |
|---|---|---|---|
| | | No. | % |
| Nematodes | *Strongyloides* sp. | 69 | 27.06 |
| | *Trichostrongylus* sp. | 29 | 11.37 |
| | *Oesophagostomum* sp. | 27 | 10.59 |
| | *Trichuris* sp. | 25 | 9.80 |
| | *Capillaria* sp. | 16 | 6.27 |
| | *Ostertagia* sp. | 15 | 5.88 |
| | *Cooperia* sp. | 11 | 4.31 |
| | *Dictyocaulus* sp. | 19 | 7.45 |
| | *Oxyuris* sp. | 8 | 3.14 |
| | *Ascaris* sp. | 19 | 7.45 |
| | *Toxocara* sp. | 33 | 12.94 |
| | *Chabertia* sp. | 22 | 8.63 |
| | *Bunostomum* sp. | 5 | 1.96 |
| | *Ancylostoma* sp. | 7 | 2.75 |
| | *Haemonchus* sp. | 11 | 4.31 |
| Cestodes | *Taenia* sp. | 25 | 9.80 |
| | *Dipylidium* sp. | 55 | 21.57 |
| Trematodes | *Dicrocoelium* sp. | 25 | 9.80 |
| | *Schistosoma* sp. | 46 | 18.04 |
| | *Fasciola* sp. | 25 | 9.80 |

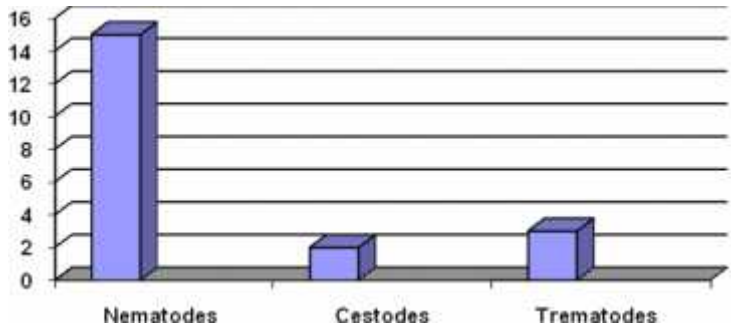



**Figure 6: Diagrammatic representation of prevalence of specific helminthes of gastrointestinal parasite of Rhesus monkey (*Macaca mulatta*).**

### 5.5 Identification and description of ova

Out of total 300 samples, 255 (85%) samples are found positive and 45 (15%) sample are negative. Altogether 20 genera of helminthes were observed including eggs, larva. The eggs of different genera of helminthes were identified according to their character and morphology. Among 255 positive samples, 75% genera were nematodes, 15% genera were trematodes and 10% genera were cestodes.

Nematodes 15 genera

Treamtodes 3 genera

Cestodes 2 genera

Identification of eggs of helminths was done on the basis of their morphology and characters. Identification of eggs of helminths in brief was done as follows:

#### 5.5.1 Cestodes

***Taenia* sp.**

*Taenia* is commonly known as tapeworm. *Taenia* infection is worldwide and endemic in the human population while eating raw or in adequately cooked meat. It is common in India, Japan, Philippines, America and Mexico.

**Classification**

Family - Taenidae

Genus - *Taenia* sp.

**Description of eggs**

Eggs are 31µm in diameter, spherical brown and are provided with a double layered shell. The outer shell is thin and transparent. The inner shell containing a thick embryophore is brown, radially striated.

**Discussion**

- In 1758, Linnaeus reported *Taenia solium* in the small intestine of man.
- In 1982, ADPCD reported *Taenia* sp. from dog, cat and human of Kathamndu.
- In 2002, Ghimire reported *Taenia* sp. 1.42% in human from Kathmandu.
- In 2003, Karki reported *Taenia* sp. 46.15% in Magar community of Barangdi VDC, Palpa.
- In 2005, Manandhar reported *Taenia* sp. 12.8% from stray dogs of Kathmandu.
- In 2007, Dhoubhadel reperted *Taenia* sp. 7.08% from Rhesus monkey of swoyambhu and Nilbarahi areas of Kathmandu.
- In 2008, Dhakal reported *Taenia* sp. in 0.14% from Anarmani VDC 2 of Jhapa district.
- In 2009, Bashir reported *Taenia* sp. 22.78% in Goats from Khasibazar, Kalanki, Kathmandu.

### *Dipylidium sp.*

*Dipylidium Caninum* is commonly known as dog tapeworm. It is commonly found in pets (dogs and cats) but rarely in children. Dog louse and dog-flea are secondary hosts in which cysticerciods develops.

**Classification**

Family - Dipylidiidae.

Genus- *Dipylidium* sp.

**Description of eggs**

Eggs are 25-50 µm in diameter, 4-20 µm globular eggs per capsule.

**Discussion**

- In 1842, Gross, J. reported *Dipylidium* sp. in goats and sheep of Canada.
- In 2006, Ravichandran reported prevalence of *Dipylidium* sp. in street days of Tamilnadu, Inida.
- In 2008, Dhakal reported *Dipylidium* sp. in cattle (8.15%) from Anarmani VDC 02, Jhapa.

**5.5.2 Trematodes**

### ***Dicrocoelium* sp.**

*Dicrocoelium* is a less frequent zoonotic infection of the human. *Dicrocoelium* infection of sheep, deer and other herbivorous and omnivorous animals had been recorded most commonly from Europe, Turkey, Northern Asia, Northern Africa, parts of South America and less frequently from South and North America.

Life cycle is completed in different classes of hosts, the adult fluke is lancet shaped and are transparent and measures 5mm to 15mm in length and 1.5mm to 2.5 mm in breadth. The eggs always hatch inside the snail to release the miracidia. The

later undergo through two generation of sporocyst to develop into cercariae. Redia stage is absent. The cercaria is spinous.

**Classification**

Family - Dicrocoelidae

Genus - *Dicrocoelium* sp.

**Description of Eggs**

Eggs are thick shelled, yellowish/dark brown, opercolated and measures 38µm - 45µm by 22 µm -30µm. The eggs are mature containing miracidium when fleshly laid.

**Discussion**

- In 1899, Loss reported *D. lancaetum* from the bile duct of the sheep, goat and cattle.
- In 1990, Sheikh reported *Dicrocoelium* sp. egg in human being.
- In 1991, Schuster reported *Dicrocoelium metacercariae* in ants of Germany.
- In 1996, Jithendran and Bhatta reported *D. dendricum* in sheep and goats in hilly areas of India.
- In 1997-2003, Thomas, R. G. reported *Dicrocoelium* sp. in Columbus monkey of Uganda.
- In 2007, Mukhia reported *Dicrocoelium lanceatum* in Buffalo from Nepal.
- In 2007, Malla reported *Dicrocoelium* sp. in Pashupati and Nilbarahi area of Kathmandu.
- In 2007, Dhoubhadel reported *Dicrocoelium* sp. (3.14%) in Rhesus monkey from Swoyambhu and Nilbarahi area of Kathamndu.
- In 2007, Karki reported *Dicrocoelium* sp. in elephants of Nepal.

- In 2008 Dhakal reported *Dicrocoelium* sp. (5.38%) in cattle from Anarmani VDC 02, Jhapa.

- In 2009, Bashir reported *Dicrocoelium* sp. 2.53% in goat (*Capra hircus*) of Khasibazar , Kalanki, Kathmandu.

### ***Schistosoma* sp.**

*Schistosoma* is commonly known as blood flukes. The old name of *Schistosoma* is Bilharzia. It causes the kidney damage. Blood flukes live in the blood of the small branches of urinary bladder tract, mesenteric and potal veins. It is digenetic, primary host is man and secondary host is *Balinus* and other snails. The eggs pass out from man with urine or faeces and hatch when they come in contact with water.

Different larval stages of blood flukes are miracidium, sporocyst, cercaria, redia and metacercaria. Metacercaria stages do not occur in blood fluke. Infection is caused either by penetration of cercaria through the skin or by contaminated water. It is pathogenic causes *Schistosomiasis or Bilharziasis.*

**Classification**

Family - Schistosomitidae

Genus - *Schistosoma* sp.

**Description of Eggs**

Eggs are 200µm by 70-90µm in size, spindle shaped, flattened at one side, greatly elongated with straight slender terminal spine.

**Discussion**

- In 1851, Bilhar reported the adult worm of *Schistosoma* in mesenteric viens of a man in Cairo.

- In 1876, Sonsino reported *S. bovis* from the portal and mesenteric viens of cattle and sheep.

- In 1904, Katsurade reported *S. japanicum* from the portal and mesenteric viens of man and animals.

- In 1954 Roa reported *Schistosoma* sp. in elephants in Bombay, India.

- In 1966, Montgomery reported *Schistosoma* sp. from the mesenteric veins of ruminants.

- In 1993, WHO reported *Schistosoma* sp. in cow, water buffalo, dogs and pigs in Phillipines.

- In 2004, Agatsoma reported *Schistosoma* sp. in elephant in S--ri-lanka.

- In 2007, Gurung reported that 28.1% *Schistosoma* sp. infection in buffaloes of Satungal brought for slaughter purpose.

- In 2007, Mukhia reported *Schistosoma* sp. in buffaloes of Kathmandu Valley.

- In 2007, Karki reported *Schistosoma* sp. in buffaloes of Nepal.

- In 2008, Dhakal reported *Schistosoma* sp. in cattle (5.38%) from Anarmani VDC of Jhapa district.

- In the present study, *Schistosoma* sp. is reported for the first time from Rhesus monkey in Nepal.

### ***Fasciola* sp.**

*Fasciolosis* is caused by the trematode *Fasciola hepatica* is a world wide parasitic disease common in ruminants, especially cattle, buffaloes, sheep, goats and swine. It may however affect humans. One ingested parasites migrate through the lives parachyama to reach the bileduets. It is the common parasite of sheep.

**Classification**

Family – Fascioliade

Genus – *Fasciola* sp.

**Description of eggs**

Eggs are found to be 130-150 µm by 63-104 µm in size, oval shaped , yellowish in colour with embryonic mass and shell, operculum are usually indistinct.

**Discussion**

- In 1758, Linnaeus reported *F. hepatica* from the bile ducts of the sheep and other ruminants.
- In 1965, Malakar reported *Fasciola hepatica* from (cow and goat) domestic animals.
- In (1967-1992) Parajuli reported 56.75% *Fasciola* in buffaloes from Surkhet district.
- In (1969-1992) Mainali reported *Fasciola* sp. from lulum cattle.
- In 1970, Singh reported *F. species* in sheep and goat from middle Terai.
- In 1975, Joshi and Tiwari, Reported *Fasciola* sp. in yaks of the Himilalyans.
- In 1978, Joshi reported *F. hepatica* in goat from Jamunapari of Nuwakot district.
- In 1980, Fredrick and Reece reported *Fasciola hepatica* in cow in Soloman Island.
- Lohani and Jackle (1981-1982) conducted a study to report Fasiola sp. in livestocks from Tansen, Palpa.
- In 1983, Dhakal, I.P. and Nepali, D.B. reported *Fasciola* infection in cattle and buffaloes.
- In 1987, Ghimire, reported *Fasciola* sp. in cattle buffaloes and goats from Surkhet district.
- In 1987, Karki reported *Fasciola* sp. in sheep

- In 1993, Mahato reported the prevalence of *Fasciola* is ranging between 50-90% in buffaloes of Nepal.

- In 1993, Mahato reported *Fasciola* prevalence of 57.9% in buffalo in the hills and 4.3% in the terai.

- In 1996, Acharya reported 30% of *Fasciola* sp. in buffalo and 21.6% in cow.

- In 1997, Shrestha and Joshi reported *Fasciola* sp. in cattle in the western hills of Nepal.

- In 1997, Joshi *et al.*, reported more than 50% *Fasciola* sp. in cattle and buffaloes in different parts of Nepal.

- In 1998-1999, Sharma reported 40.12% *Fascioliasis* in animals of Panchthar district.

- In 1999, Regmi *et al.*, reported *Fasciola* sp. in 67.66% and 62.10% in buffalo and cattle respectively from Thula dihi VDC of Sanjuha district.

- Mahata *et al.*, (1997-2000) reported on epidermiological basis of the control of *Fascioliaris* in Nepal.

- In 2002, Pandey, Mahato and Gupta reported *Fasciola* infection in lymnea sanils and buffaloes in Devbhumi Baluwa VDC of Kavre district.

- In 2002/2003, CVL reported *Fasciola* (61% in buffaloes in area of Kathamndeu Valley).

- In 2003, Rabcoin, Joshi and Chhetri reported *Fasciola* sp. in yaks from chandanbari, Langtang.

- In 2002-2003, Adhikari, Shrestha and Shrestha reported *Fasciola* sp. in cattle (36%) and buffaloes (61%) in Kathamndu valley.

- In 2006, Jaiswal reported *Fasciola* infection 56.02% in buffalo, 49.36 percent in cattle and 31.25% in goat.

- In 2007, Gurung reported 38.75% *Fasciola* sp. infection out of 61.90% Trematodes.

- In 2007, Karki, Reported *Fasciola* sp. in elephant of Nepal.

- In 2001-2007, Michigan DNR wildlife disease laboratory reported *Fasciola magna* in deer in perninsula.

- In 2008, Dhakal reported 6.13% *Fasiola* sp. in cattle *Bos sp.* from Anarmani VDC 02 Jhapa out of 33.33 % trematodes.

- In 2009, Bashir reported 12.65% *Fasciola* in *Capra hircus* (goat) from Khasibazar , Kalanki, Kathmandu.

### 5.5.3 Nematodes

***Strongyloides sp.***

*Strongyloides fulleborni* is a natural parasite of monkeys and apes. It has been reported in Africa and parts of Asia. The infection is transmitted from mothers to infants through milk by breast feeding. Adult females are hardly visible to the naked eyes and measures 2.5mm by 0.04mm. Life cycle is completed in the single host. *Stronglyoides* sp. shows two distint life cycles, one within the host body and the other living in the soil. Infection occurs mainly through penetration of the skin and occasionally through buccal mucosa by the infective fillariform larva.

**Classifications**

Family: Strongylidae

Genus: *Strongyloides*

**Description of eggs**

Eggs are 40 - 64 µm by 20 - 40 µm in size, ellipsoidal thin shelled, embryonated when laid.

**Discussion**

- In 1911, Ransom reported *Strongyloides* sp. from the small intestine of sheep, goat and cattles.

- In 1973, Singh et al., reported *Strongyloides* sp. in goat and sheep from Kathmandu.

- In 1977, Shakya reported *Strongyloides strecoralis* in human from Lalitpaur.

- In 1997, Joshi reported *Strongyloides papillosus* in goat and sheep from western hills of Nepal.

- In 1999, Acharya reported *Strongyloides papillosces* in sheep and goat of IAAS livestock from Chitwan.

- In 2002-2003, Adhiklri, Shrestha and Shrestha reported 10 percent *Strongyloides* sp. among buffaloes from areas of Kathamndu Valley.

- In 2003, Rabin *et al.,* reported *Strongyloides* sp. in harsen from Langtang.

- In 2003, Khakural and Khakural reported *Strongloides* in farm ruminant from Maidi VDC, Dhading.

- In 2007, Dhaubhadel reported *Strongyloides* in monkey from Swoyambhu and Nilbarahi area of Kathamndus valley.

- In 2007, Malla reported *Strongyloides* in monkey from Pashupati and Nilbarahi area of Kathamndu valley.

- In 2008, Dhakal reported *Strongyloides* in cattle from (7.77%) from Anarmani VDC -2, Jhapa.

- In 2009, Bashir reported *Strongyloides* 26.58% in goat from Khasibazar Kalanki, Kathamndu.

### ***Trichostrongyloids* sp.**

The infection of *Trichostrongylus* is prevalent through out the world. The infection in man has been recorded most frequently in Japan, Korea, Egypt and Central Africa. A wide variety of animals particularly the herbirorous animals are infected by the worm. The herbirorous animals are common reservoir host. Man requires infection from these animals as accidental host. The male measures 4 to 5

mm. in length and female measures 4 to 6.5 mm in length. In animals, the massive infection by *Trichostrongylus* results in the development of profound weakness of the limbs. This infection is often nick named as pseudohook worm diseases.

**Classification**

Family – Trichostrongyloidae

Genus – *Trichostrongylus* sp.

**Description of the Eggs**

Eggs are oval and bilaterally symmetrical. These are relatively larger (63-115 « m) then those of hook worm ova. The shell has outer chitinous layer and a thin inner layer. The embryonic mass is multisegmented and varies from 16 to 32.

**Discussion**

- In 1967-92, Mainali reported *Trichostrongylus* sp. from lulu cattle.
- In 1973, Singh reported *Trichostrongylus* sp in callte and buffalo from Kathamndu.
- In 1997, Joshi reported *Trichostrongylus orientalis* in goat and cattle from western hills of Nepal.
- In 1997, Joshi reported *Trichostrongylus axei* in goat and cattle from western hills of Nepal
- In 1997, Joshi reported *Trichostrongylus colubiformis* in goat and cattle from western hills of Nepal.
- In 1998, Joshi reported *Trichostrongylus* sp. in goats from Jamunapari of Nuwakot district.
- In 1999, Joshi reported *Trichostrongylus* sp. in goat and cattle from Kaski district.

- In 1999, Acharya Reported *Trichostrongylus* sp. in sheep and goat of IAAS livestock, farm of Central Lab, Tripureshwar.

- In 2003, Thakur reported *Trichostrongylus axei* in pig from eastern hills of Nepal.

- In 2003, Rabwin *et al.*,reported *Trichostrongylus* sp.in western hills of Nepal.

- In 2007, Dhoubhadel reported *Trichostrongylus* sp. in monkey from Swoyambhu and Nilbarhi area of Kathmandu valleys.

- In 2007, Malla reported *Trichostrongylus* sp. in monkey from Pashupati Nath and Nilbarahi area of Kathmandu valley.

- In 2008, Dhakal reported *Trichostrongylus* sp. 7.77 % in cattle from Anarmani VDC-2 Jhapa.

- In 2009, Bashir reported *Trichostrongylus* sp. 5.06% in goat from Khasibazar, Kalanki, Kathamndu.

### ***Dictylocaulus* sp.**

This parasite lives in the bronchi of cattles, ships, horses and donkeys. They are major cause of parasite bronchitis in these hosts. It is world wide in distribution but especially important in temperate climate. Adults are thread like worms, males are 3-8 cm in length and females are 5.0-11.0cm in length. Thier location is in the trachea and bronchi.

**Classification**

Family – Dictyocaulidae

Genus – *Dictyocaulus* sp.

**Description of the Eggs**

Eggs are 82- 88 µm by 33-30 µm in size, ellipsoidal, contain fully developed larva when laid on first stage larva.

**Discussion**

-In 1809, Rudolphi reproted *Dictyocaulus* sp. from the bronchi of sheep goat and wild ruminants.

- In 1982, ADPCD reported *Dictyocaulus* sp. in goat and sheep from Kathmandu.

- In 2007, Dhoubhadel reproted 7.87% *Dictyocaulus* sp. in rhesus monkey from Swoyambhu and Nibarahi area of Kathamndu.

- In 2007, Malla reported *Dictyocaulus* sp. in Rhesus monkey 7.25% out of 89.51% nematods from Pashupati Nath and Nilbarahi area of Kathamndu valley.

- In 2008, Dhakal reported 1.37% *Dictyocaulus* sp. out of 55.33% nematode in cattle from Ananmani VDC-02 Jhapa.

- In 2009, Bashir reported 35.44% *Dictyocaulus* sp. in goat from Khasibazsar, Kalanki, Kathamndu.

***Haemonclus Controtus***

It is the most common parasite of domestic sheep through out the world. It is the world wide in distribution. This parasite is commonly known as twisted stomach worm or the sheep wire worm. It is a blood sucking nematodes occurring in fourth stomach (abomasum) and occasionally in duodenum of sheep and other ruminants. Infection of man is accidental. The disease caused by *Heamonchus contorted* is *haemonchiasis.* The adult worms are distingushed by a single curved lancet in the depth of the small buccal cavity and by a pail of spine - like cervical papillae. The size of male is 10-20 µm by 0.4 µm is smaller than female 18-30µm by 0.5µm**.**

**Classification**

Family – Trichostrongylidae

Genus – *Haemonchus* sp.

**Description of the Eggs**

Eggs are 70 - 85 µm by 41- 48 µm in size, embryo 16-32 celled when laid.

**Discussion**

- In 1967 -92 Mainali reported *Haemonchus* sp. from lulu cattle.
- In 1973, Singh *et al.*, reported *Haemonchus* sp. in cattle, sheep and buffalo from Kathamndu.
- In 1978, Joshi reported *Haemonchus* sp. in gaots from Jamunapari of Nuwakot district.
- In 1997, Joshi reported *Haemonchus contortus* in sheep and goat from western hills of Nepal.
- In 1999, Acharya reported *Haemonchus contortus* in sheep and goat of IAAS livestock farm from Centrial Lab, Tripureshwor, Kathmandu.
- In 1999, Joshi reported *Haemonchus contortus* in sheep and goat from Kaski district, Pokhara.
- In 2007, Parajuli studied and reported the prevalence of *Haemonchus* sp. in the intestine of goats brought to Khasibazar for slaughter purpose.
- In 2007, reported *Haemonchus* sp. 2.41% out of 89.51% nematode from Rheuss monkey from Pashupati Nath and Nilbarahi area of Kathamndu.
- In 2008, Dhakal reported *Haemonchus* sp. (3.66%) out of 55.55% nematodes in cattle of Anarmani VDC 02, Jhapa district.
- In 2009 Bashir reported *Haemonchus* sp. (17.72%).

***Ostertagia* sp.**

*Ostertagia* sp. is especially important in temperate climate and sub tropical regions with winter rainfall. It is world wide in distribution. The adult worms are reddish brown in colour up to 1.0 cm long. Therefore they are commonly called as

brown stomach warm or brown hair worm. This geneus is the major cause of parasitic gastritis in ruminants in temperate areas of the world.

**Classification**

Family – Trichostrongylidae

Genus - *Ostertagia* sp.

**Description of the Eggs**

The egg measures 74-90 µm in length and 40-45 µm in size and is elliptical in shape.

**Discussion**

- In 1907, Ransom reported *Ostertagia* sp. from the abomasums and small intestine of sheep, cattle, and other ruminants.
- In 1982, ADPCD reported *Ostertagia* sp. in pig, cattle and buffalo from Kathamndu.
- In 1997, Joshi reported *Ostertagia* sp. leptospicularis in sheep from western.
- In 1999, Acharya reported *Ostertagia* sp. in sheep and goats of IAAS live stock Central lab Tripureshwor.
- In 1999, Joshi repoted *Ostertagia* sp. in sheep and goat from Kaski district, Pokhara.
- In 2007, Gurung reported *Ostertagia* sp. for the first time in Pashupati Nath and Nilbarahi area of Kathamndu.
- In 2008, Dhakal reported *Ostertagia* sp. in cattle 4.11 % out of 55.55% nematode in Anarmani VDC 02, Jhapa district.
- In 2009, Bashir reported *Ostertagia* sp. (12.64%) in goats from Khasibazar, Kalanki, Kathamndu.

## *Trichuris* sp.

*Trichuris* is commonly known as whip-worm. Definitive hosts are goats, sheep, and cattles. The adults are usually found in the caccum but are occasionally present in sufficient numbers to be clinically significant. It is world wide in distribution but more common in the warm-mist region of the world. The length of body ranges from 30 to 40 µm in male and 10 to 50 µm in female. The worm feed on epithelial cells and blood. Life cycle is direct with no intermediate host. Development of eggs take place in the moist soil and the infective juveniles are formed in 3 weeks. Man becomes infected by taking food and water contaminated with the embroyonated eggs which have in the intestine. The liberated juveniles grow into adults within a month. The life span of the adult worms is several years. In host, a heavy infection result in anemia, abdominal pain and bloody stool but light infection is asymptomatic.

**Classification**

Family – Trichuridae

Genus - *Trichuris* sp.

**Description of the Eggs**

The egg measure 70-80 µm by 30-42 µm in size, brown in colour, contain unsegmented embryo, barrel shaped with transparent plug at either pole.

**Discussion**

- In 1795, Abidgaad reported *T. Ovis* from the cacum of sheep, cattle and other ruminants.
- 1965, Sharma reported *Trichuris trichura* in human from Bhaktapur.
- In 1970, Singh repotted *Trichuris globulosa* in goat from Kathmandu.
- In 1977, Shakya reported *Trichuris trichura* in human from Surkhet.
- In 1981, IFP and PCP reported *Trichuris trichura* in cattle.

- In 1981 Bol *et al.*, reported *Trichuris trichura* in human from Panchkhal.
- In 1988, Gupta reported *Trichuris trichura* in human from Kirtipur.
- In 1997, Joshi reported *Trichuris* sp. in goat and sheep from western hills of Nepal.
- In 2004, Khanal reported *Trichuris* sp. in cat from Nawalparasi and Chitwan district.
- In 2007, Dhaubadel reported *Trichuris* sp. in Rhesus monkey from Swoyambhu and Nilbarahi areas of Kathamndu valley.
- In 2007, Gurung reported *Trichuris* sp. in Rhesus monkey from Pashupati Nath and Nilbarahi area of Kathmandu valley.
- In 2008, Dhakal reported *Trichuris* sp. in cattle (*Bos* sp.*)* from Anarmani VDC 02, Jhapa.
- In 2009, Bashir reported *Trichuris* sp. in goat (5.06%) from Khasibazar, Kalanki, Kathmandu.

### ***Capillaria* sp.**

*Capillariasis* is a newly recognized zoonotic helminthic infection of man caused by a few species of the genus *Capillaria*. These are more than 200 recognized species in the genus *Capillaria*. The eggs of *Capillaria* are more or less similar to that of *Trichuris sp.* but in comparison to *Trichuris* eggs, the shell is almost colourless , the eggs is barrel shaped, with the sides nearly parallel. The size of egg is smaller than that of *Trichuris trichura* i.e. 44-50µm by 24-33µm. The color is pale brown but not bile stained. They had fine striations in the egg shell. Life cycle is of direct type. Hosts are infected through the contaminated foods and water with eggs with infected larva.

**Classification**

Family - Capillariidae

Genus - *Capillaria* sp.

**Description of the Eggs**

The eggs are 30-33 µm in size, barrel shaped contain unsegmented embryo, colourless shell.

**Discussion**

- In 1800, Zeder reported *Capillaria* sp. from the small intestine of dog and cattle.
- In 1982, ADPCD reported *Capillaria aerophila* in cat from Nawalparasi and Chitwan district.
- In 1967-1992, Mainali reported *Capillaria* sp. from cattle.
- In 2004, Khanal reported *Capillaria aerophila* in cat from Nawalparasi and Chitwan district.
- In 2007, Parajuli reported *Capillaria* sp. in goat from Khasibazar of Kalanki, Kathmandu.
- In 2007, Malla reported *Capillaria* sp. in Rhesus monkey from Pashupati Nath and Nilbarahi area of Kathmandu.
- In 2007, Dhaubhadel reported *Capillaria* sp. (3.93%) in Rhesus monkey from Swoyambhu area of Kathmandu valley.
- In 2008, Bashir reported *Capillaria* sp. 6.32% in goat of Khasibazar, Kalanki, Kathamndu.
- In 2009, Dhakal reported *Capillaria* sp. (0.29%) in cattle (*Bos* sp.) from Anarmani VDC 02, Jhapa.

## *Toxocara* sp.

*Toxocara canis* infection of dogs is high through out the world. It is widely distributed throughout the world, in both temperate and tropical countries. The eggs is round, with the characteristic pitted shell and measures 75 by 85µm. Most of the infection in man are produced by the larva of the dog ascarid *Toxocara canis* and less frequently by ascarid of other animals. It completes life cycle into single host. The adult usually inhabits in the intestinal tract of dog. The adult worms are not found in man. The female are comparatively longer than the male and measures 6 to 10cm in length and 4 to 6mm in breadths.

### Classification

Family - Ascaridae

Genus - *Toxocara* sp.

### Description of the Eggs

The egg are 75 - 95 µm by 60 -75 µm in size sub globular and have finely pitted albuminous layer occasionally two celled.

### Discussion

- In 1982, Goere reported *T. Vitulorum* from the small intestine of cattle and buffaloes.
- In 1970, Singh reported *Toxocara leonine* from leopard.
- In 1982, ADPCD reported *Toxocara* sp. in dog and cat from Kathmandu.
- In 1987, Ghimire reported *Toxocara* sp. in cattle, buffaloes and goats from Surkhet district.
- In 2003, Khaniya and Shah reported *Toxocara canis* in dogs from Kathmandu.
- In 2004, Khanal reported *Toxocara canis* in cat from Nawalparasi and Chitwan district.

- In 2007, Gurung reported *Toxocara canis* in Rhesus monkey from Pashupati Nath and Nilbarahi area of Kathmandu valley.

- In 2007, Dhoubhadel reported *Toxocara* sp. in Rhesus monkey from Swoyambhu and Nilbarahi area of Kathmandu valley.

- In 2008, Dhakal reported *Toxocara* sp. in cattle in from Anarmani VDC 02, Jhapa.

### ***Chabertia* sp.**

It is commonly known as large mouthed bowel worm. It is world wide in distribution. *Chabertia* sp. is present usually in low number, in the majority of sheep and goats. The adult worms are stout and are white in colour. Males are 13.0-14.0mm in length and female are 17.0-20.0mm in length. The life cycle is direct. The worms are found attached to the mucosa of colon.

**Classification**

Family – Trichonematidae

Genus – *Chabertia* sp.

**Description of the Eggs**

The egg laid in morula stage and it measures 90-105 µm in length, 50-55 µm in breadth and Oval in shape.

**Discussion**

- In 1973, Singh reported *Chabertia ovina* in goat, cattle and sheep from Kathmandu.

- 1997, Joshi reported *Chabertia ovina* in goat and sheep from western hills of Nepal.

- In 1999, Acharaya reported *Chabertia ovina* in sheep and goat of IAAS livestock, from of central lab, Tripureshwor.

- In 2007, Mukhiya reported *Chabertia* sp. infection 0.38 percent among buffaloes brought to Satungal for slaughter purpose.

- In 2007, Dhoubhadel reported *Chabertia* sp. infection in Rhesus monkey from Swoyambhu and Nilbarahi area of Kathamndu.

- In 2007, Malla reported *Chabertia* sp. in Rhesus monkey from Pashupati and Nilbarahi area of Kathmandu valley of Nepal.

- In 2008, Dhakal reported *Chabertia* sp. in cattle from Anarmani VDC 2, Jhapa district.

- In 2009 Bashir reported *Chabertia* sp. in Goats (*Capra hircus*) of Khasibazar, Kalanki, Kathmandu.

### *Ascaris lumbricoides*

*Ascaris lumbricoides* is commonly known as round worm. Body is cylindrical, elongated and unsegmented. *Ascaris lumbricoides* has a world wide in distribution. Nearly one fourth of the world population is infected with these parasites. The parasite is found most commonly in countries with poor sanitary condition. It is the largest intestinal nematode parasitising the human. The life cyle is monogenetic i.e man. Person gets infection through the contaminated water, hands and raw vegetables. Adult male measures 15cm to 30cm in lengths and 3 mm to 4mm in diameter whereas females are relatively larger than the males. A female measure 20cm to 40cm in length and 2 mm to 6 mm in diameter.

**Classification**

Family - Ascarididae

Genus - *Ascaris* sp.

**Description of the Eggs**

Both fertilized and unfertilized eggs are present in the faeces.

**Fertilised eggs**

These eggs are oval to sub spherical in shape and measure 45 to 70 µm in length and 35 to 50 µm in breadth. They are bile stained and golden brown in colour.

**Unfertilized eggs**

These eggs are brown thin shelled, ellipsoidal and measures 78mm to 105 mm in length and 38 mm to 55 mm in breadth. These are heaviest of all the helminthic eggs hence do not float in saturated salt solution.

**Discussion**

- In 1965, Sharma reported *Ascaris lumbricoides* in human from Bhaktapur.
- In 1975, Salsa reported *Ascaris lumbricoides* in human from pokhara.
- In 1977, Shakya reported *Ascaris lumbricoides* in human from surkhet.
- In 1980, Khetan reported *Ascaris lumbricoides* in human from Narayani.
- In 1981, Bol reported *Ascaris lumbricoides* in human form Narayani.
- In 1982, IFP and PCP reported *Ascaris lumbricoides* in human from Panchkhal.
- In 1982, ADPCD reported *Ascaris ruis* in pigs from Kathamndu.
- In 1982, ADPCD reported *Ascaris sp*. buffaloes and chauri from Kathmandu.
- In 1988, Gupta reported *Ascaris lumbricoides* in human from Kirtipur.
- In 1997-1998, Sharma reported *Ascaris* sp. 43.69% in animals from Panchthal district.
- In 2002, Shrestha reported *A. lumbricoides* 35.7% from 10 years old children in Kthamndu and Bhacoidesktapur.
- In 2003, Karki reported *A. lumbricoides* 35.7% from 10 years old children in Kathmandu and Bhaktapur.

- In 2007, Malla reported *Ascaris lumbricoides* in *Macaca mulatta* r 10.48% out of 89.51% nematode from Pashupati and Nilbarahi area of Kathmandu.

- In 2007, Dhoubhadel reported *Ascaris lumbricoides* in Rhesus monkey (1.57%) from Swoyambhu and Nilbarahi area of Kathmandu Valley.

- In 2009, Bashir reported *Ascaris* sp. (7.59%) in goats (*Capra hircus*) of Khasibazar, Kalanki, Kathmandu.

### ***Oesophagostomum* sp.**

*Oesophagostomum* sp. is the natural intestinal parasite of apes and monkeys in Africa, Asia and South America. Human *Oesophagostomiasis* has been reported from east and West Africa and South America. Adult worms are found in the large intestine and are 1-2 µm long. Larvae are found in nodules in the large intestine and small intestine. About 5-7 days later the larvae return to the lumen, travel to the colon and develop into an adult worm. The adult is very small and is covered with a cuticula. The male measures 8-10 mm in length and 0.35 mm in breadth. Female are 8.5 to 10mm long and 0.35mm thick. The parasite causes dysentry in these animals. Certain species of *Oesophagostomum* also parasitise the intestine of swine and sheep and produce tumour like nodules in the intestine, hence are commonly known as nodular worms. The man acquires infection by ingestion of the third stage larva of *Oesophagostomum* sp. in man. The nematode causes *Oesophagostomiasis* in man. The condition in man is self limiting. It is characterized by production of a solitary tumour like exudative nodule in the wall of the intestine, especially in the intracaecal region.

**Classification**

Family - Trichonematidae

Genus - *Oesophagostomum* sp.

**Description of the Eggs**

The eggs are oval, thin shelled and non- bile stained and measures 60-63 µm by 30-40 µm. A clear space is always present between the segmented ovum and the eggs shell.

**Discussion**

- In 1982, ADPCD reported *Oesophagostomum* sp. in pig, cattle and buffalo from Kathmandu.
- In 1997, Joshi reported *Oesophagostomum venulosum* in goat from western hills of Nepal.
- In 1997, Joshi reported *Oesophagostomum asperum* in goat and sheep from western hills of Nepal.
- In 1999, Acharya reported *Oesophagostomum* sp. in sheep and goat of IAAS livestock farm from central lab Tripureshwor.
- In 2003, Thakur reported *Oesophagostomum* sp. in pigs from eastern hills of Nepal.
- In 2007, Dhoubhadel reported *Oesophagostomum* sp. in Rhesus monkey from swoyambhu and Nilbarahi area of the Kathmandu valley.
- In 2007, Malla reported *Oesophagostomum* sp. in *Macaca mulatta* from Pashupati (Kathmandu district) and Nilbarahi area (Bhaktapur district) of Nepal.
- In 2008, Dhakal reported *Oesophagostomum* sp. in cattle (*Bos sp.*) of Anarmani VDC 2, Jhapa.
- In 2009, Bashir reported *Oesophagostomum* sp. in goats (*Capra hircus*) of Khasibazar, Kalanki, Kathmandu.

## *Ancylostoma* sp.

*Ancylostoma duodenale* is commonly known as old world hook worm. The hook worm causes *Ancyclostomiasis* in humans. This parasite is world wide in distribution mostly in areas with warm and mist climate. The worms are cylindrical, grayish, white and slightly carved. The anterior end of the worm is bent slightly in the same direction of the body curve and gives its name hook warm. Males are 8µm in lengths and are smaller than females (12.5 µm in length). Life cycle is completed in single host. No intermediate host is needed.

### Classification

Family - Ancylostomatidae

Genus - *Ancylostoma* sp.

### Description of the Eggs

The eggs are oval (60 µm in length and 40 µm in bredth), thin shelled and non bile stained. The eggs usually contain seven to eight blastomeres. A clear space is always present hetwen the segmented worm and two egg shell.

### Discussion

- In 1965, Sharma reported *Ancylostoma duodenale* in human from Bhaktapur.
- In 1971, Sharma *et al.,* reported *Ancylostoma duodenale* in human from Kathamndu.
- In 1977, Shakya reported *Ancylostoma duodenale* in human from Surkhet.
- In 1980, Khetan reported *Ancylostoma duodenale* in human from Narayani.
- In 1980, IFP and PCP reportede *Ancylostoma duodenale* in human from Panchkhal.
- In 1981, Bol *et al*., reported *Ancylostoma duodenale* in human from Lalitpur.

- In 1982, ADPCD reported *Ancylostoma duodenale* in human from eastern hills of Nepal.

- In 1988, Gupta reported *Ancylostoma* sp. in dog and cat from Kathmandu.

- In 2004, Khanal reported *Ancylostoma* sp. in cat from Nawalparasi and chitwan district.

- In 2007, Malla reported *Ancylostoma sp.* in *Macaca mulatta* from Pashupati (Kathamndu) and Nilbarahi area (Bhaktpur) of Nepal.

- In 2008, Dhakal, reported *Ancylostoma* sp. in cattles (*Bos* sp.) from Anarmain VDC 02, Jhapa.

- In 2009, Bashir reported *Ancylostoma* sp. in goat (*Capra hircus*) of Khasibazar, Kalanki, Kathmandu.

### ***Bunostomum* sp.**

Adult *Bunostomum trigonocephalum* (hook worm) are found in the jejunum. The life cycle and clinical findings are essentially the same as for the cattle hookworm (*Bunostomum* sp.). As few as 100 worms may cauuse clinical signs

**Classification**

Family - Necatorinae

Genus - *Bunostomum* sp.

**Description of the Eggs**

Eggs are 79-106 µm by 47-50 µm in size, elliptical, have blunt ends and clearly pigmented embryonic cells.

**Discussion**

- In 1808, Rudolphi reported *Bunostomum* sp. in the small intestine of sheep and goats.

- In 1996, Dhakal, Jha and Basnet reported *Bunostomum* sp. from goats of Pathivara VDC, Sankuwashava.

- In 2006, Dhital reported *Bunostomum* sp. from goats of IAAS livestock form and Mangalpur VDC 02, Chitwan.

- In 2007, Parajuli reported the prevalence of *Bunostomum* sp. from the goats brought to Khasibazar, Kalanki, Kathmandu for slauglter purpose.

- In 2008, Dhakal reported the prevalence of *Bunostomum* sp. in cattle (*Bos sp.*) from Anarmani VDC 2, Jhapa.

- In 2009, Bashir reported the prevalence of *Bunostomum* sp. in goats (*Capra hircus*) of Khasibazar, Kalanki, Kathmandu.

### ***Oxyuris* sp.**

This parasite is world wide in distribution. Mature females are large white worms, which may 10.0cm in length where as the mature males are generally less than 1.0cm in length.

**Classification**

Family - Oxyuridae

Genus – *Oxyuris* sp.

**Description of the Eggs**

Eggs are asymmetyrical, the size measures from 80µm to 90µm in length and 40µm to 45µm in breadth, flattened in one side with operculum, which is often plugged with mucus at one pole and passes in the faces in an advanced morula stage.

**Discussion**

- In 1982, ADPCD reported *Oxyuris equi* in horse from Kathmandu.

- In 2003, Rabusin, Joshi and Chhetri reported *Oxyuris equi* in horse from Kyanjin Gompa, Langtang.

- In 2007, Malla reported *Oxyuris* sp. in Rhesus monkey from Pashupati Nath and Nilbarahi area of Kathamndu valley.

- In 2007, Dhoubhadel reported *Oxyuris* sp.in Rhesus moneky from Swoyambu and Nilbarahbi area of Kathamndu valley.

- In 2009, Bashir reported *Oxyuris* sp.in goats (*Capra hircus*) from Khasibazar, Kalanki, Kathmandu.

### ***Cooperia* sp.**

Adult area reddish when fresh, male measures 4-4.5 mm in length whereas female measures 5.8-6.2 mm in length. It is world wide in distribution. In temperate areas, members of the genes *Cooperia* usually play a secondary role in the pathogenesis of parasitic gastroenteritis of ruminants, although they may be the most numerous *Trichostongly* present.

**Classification**

Family - Trichostrongylidae

Genus - *Cooperia* sp.

**Description of the Eggs**

Eggs are 70-82µm by 35-41µm in size. Their sides are parallel and have less than 16 pale yellow blastomers when laid.

**Discussion**

- In 1982, ADPCD reported *Cooperia* sp. in goat, sheep and buffalo from Kathamndu.

- In 1997, Joshi reported *Cooperia curticei* in sheep from western hills of Nepal.

- In 1997, Joshi reported *Cooperia punctata* in sheep from western hills of Nepal.

- In 1999, Acharaya reported *Cooperia* sp. in sheep and goats of IAAS livestock farm of cental lab Tripureshwor.

- In 2007, Dhoubhadel reported *Cooperia* sp. in Rhesus monkey from Swoyambhu and Nilbarahi area of Kathmandu.

- In 2007, Malla reported *Cooperia* sp.in Rhesus monkey from Pashupati Nath and Swoyambhu area of Kathamndu valley.

- In 2008, Dhakal reported *Cooperia* sp.in Rhesus monkey from Swoyambhu area of Kathamndu valley.

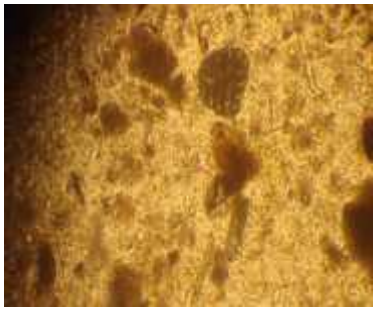
- In 2008, Dhakal reported *Cooperia* sp. in Cattle (*Bos.* sp.) from Anarmini VDC 02, Jhapa district.

PHOTOGRAPHS

Plate 1

**EGGS OF CESTODES OBSERVED**

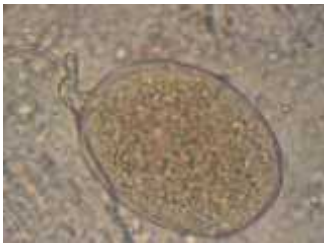
*Taenia* sp. (10Xx10X)



*Dipylidium* sp. (10Xx4X)

**EGGS OF TREMATODES OBSERVED**

*Dicrocoelium* sp. (10Xx4X)

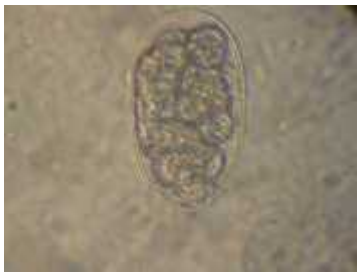


*Schistosoma* sp. (10Xx10X)

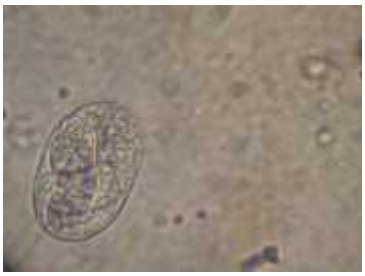
*Fasciola* sp. (10Xx4X)

**EGGS OF NEMATODES OBSERVED**

*Strongyloides* sp. (10Xx10X)

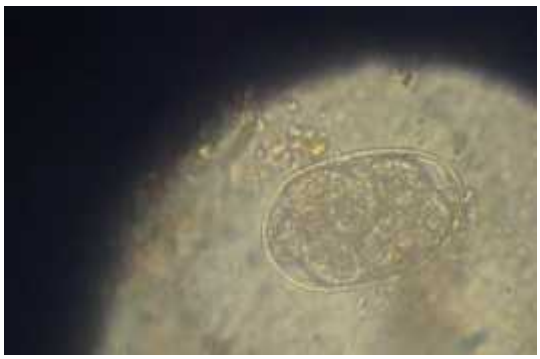


*Trichostrongylus* sp. (10Xx10X)

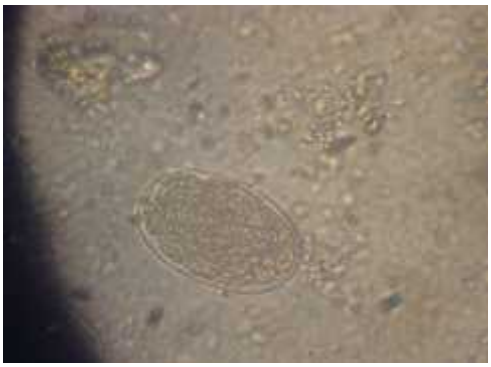


*Dictyocaulus* sp. (10Xx10X)

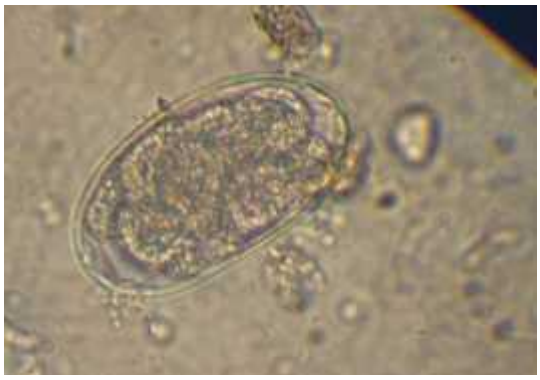
Plate 2



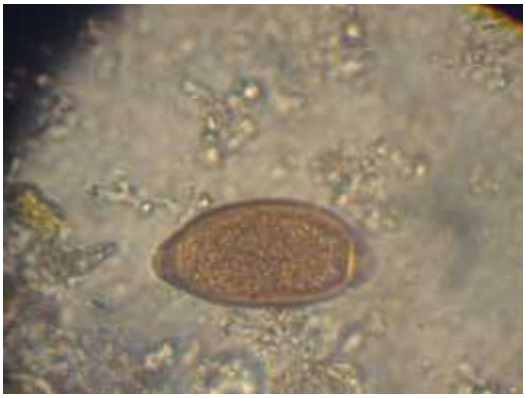
*Haemonchus* sp. (10Xx10X)



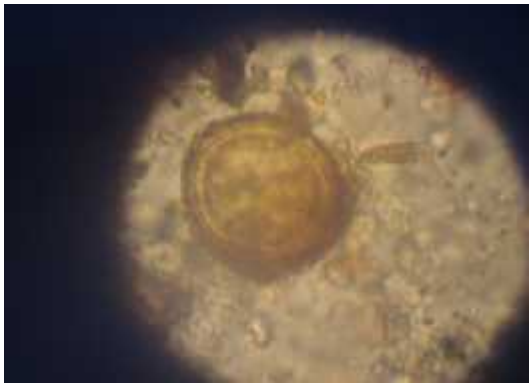
*Oesophagostomum* sp. (10Xx10X)



*Ancylostoma* sp. (10Xx10X)

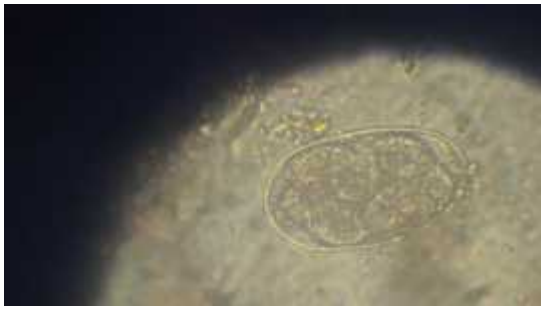


*Trichuris trichiura* (10Xx10X)



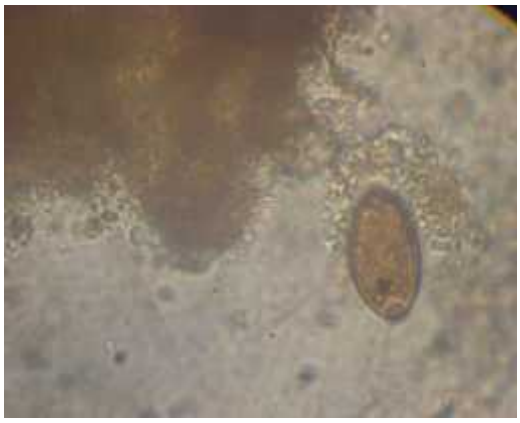
*Toxocara* sp. (10Xx10X)

Samples in floatation and sedimentation techniques

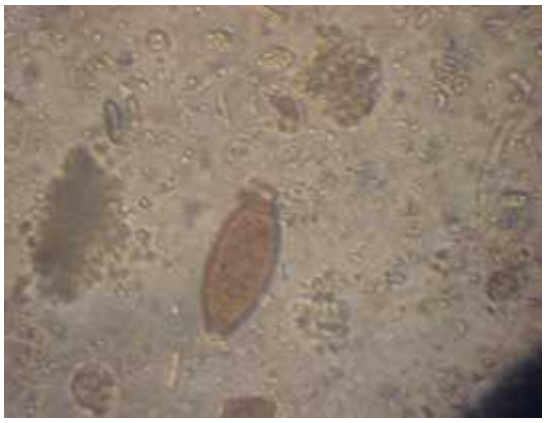


*Chabertia* sp. (10Xx10X)

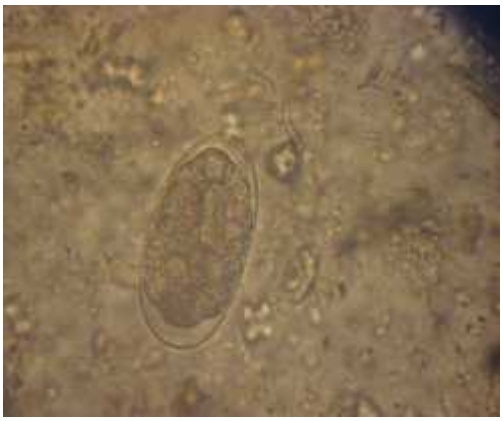
*Oxyuris* sp. (10Xx10X)



*Capillaria* sp. (10Xx10X)



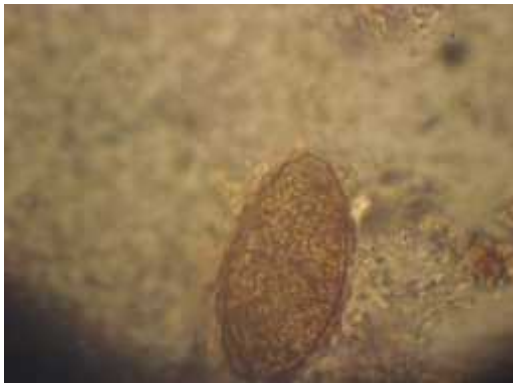
*Trichuris ovis* (10Xx10X)



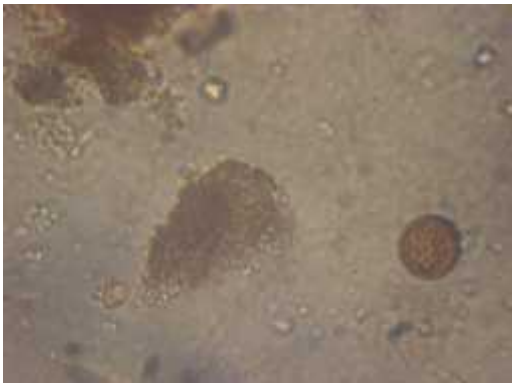
*Ostertagia* sp. (10Xx10X)

Samples ready to observe

*Cooperia* sp. (10Xx10X)



Unfertilized egg of *Ascaris* sp. (10Xx10X)



Fertilized egg of *Ascaris* sp. (10Xx4X)

Lab work at CVL., Tripureshwor, Kathmandu

Rhesus Monkeys *(Macaca mulatta* ) of Swoyambhu Area

Collection of stool samples at Swoyambhu Area

# CHAPTER SIX

## DISSCUSSION AND CONCLUSION

The aim of the study was to investigate the "seasonal prevalence of Intestinal Helminth parasite of Rhesus monkey from Swoyambhu of Kathmandu valleys". The samples were collected equally in both season (summer and winter). Altogether 300 samples were collected and obsreved from two seasons. The present investigation was carried out from December 2009 to February 2010 for winter season and May, June, July of 2010 for summer season. Out of 300 samples, 255 (85%) sample were found to be positive and rest 45 (15%) sample were found to be negative. During the study period the prevalence of nematodes for both season was found to be 212 (83.14%) followed by by trematode 84 (32.94%) and cestodes 77 (30.20%).

Parasites are the part of ecosystem without which natural balance can not be imagined. The topic is so vast that not all of the known human and animal intestinal helminth parasite infection has been surveyed properly from through out the world. In Nepal, there is no such studies have been done in wild life and in case of monkey. The *Macaques* in the Swoyambhu area live mostly in the out skirts of temple during day time so they are mostly fed by the visitors; this also helps to promote the parasite infection in them.

Intestinal parasites are cosmopolitan in distribution. All animals whether humans, domestic animals or wild animal, bears the different kinds of parasite. No one is free from the parasitic of infection. Out of 255 positive samples, 20 different genera of helminthes were observed. Among them, 15(75%) genera was found to be positive for nematodes, 2(10%) genera were cestodes and 3(15%) genera were found to be positive for Nematodes. Among nematodes, *Strongyloides* sp., *Trichostrongylus* sp., *Oesophasgostomum* sp., *Trichuris* sp., *Capillaria* sp., *Ostertagia* sp., *Cooperia* sp., *Dictyocaulus* sp., *Oxyuris* sp., *Ascaris* sp., *Toxocara* sp., *Chabertia* sp., *Bunostomum* sp., *Ancylostomum* sp., *Haemonchus* sp. were found which were 15 in numbers. Similarly, in trematodes, *Dicrocoelium* sp., *Fasciola* sp., *Schistosoma* sp. were found which was 3 in number. Cestodes comprise *Taenia* sp. and *Dipylidium* sp. They were 2 in number. In present study 2genera of cestodes, 3 genera of trematods and 15 genera of Nematodes, altogether 20 different genera was observed. In summer,

there were altogether 20 gerera (2 cestodes, 3 trematode and 15 nematodes) was observed. Likewise in winter 16 genera (2 cestodes, 3 trematodes and 11 nematodes) were observed.

The research work was done under different headings viz: general prevalence rate, classwise prevalene rate, seasonal prevalence rate, single and multiple infections of helminths and prevalence rate of specific helminths.

Among the positive samples, 101 (39.61%) samples were found with single infection and rest 154 (60.39%) with multiple infections. Single infection were of *Strongyloides* sp., *Dipylidium* sp., *Trichuris* sp., *Oesophagostomum* sp., *Dictyocaulus* sp., *Dicrocoelium* sp., *Haemonchus* sp. *Bunostomum* sp., *Fasciola* sp., *Taenia* sp., *Toxocara* sp., *Capillaria* sp., *Chabertia* sp., *Ascaris* sp., *Ostertagia* sp., *Trichostrongylus* sp., *Dictyocaulus* sp, *Schistosoma* sp. where as *Dipylidium sp, Strongyloides* sp., *Trichostrongylus* sp., *Schistosoma* sp., Toxocara sp. were most common in double and multiple infection when compared to other species.

In both the seasons, *Dicrocoelium, Fasciola, Schistosoma*, genera of trematodes and *Taenia and Dipylidium* genera of cestodes were observed. However, very little different was observed in their prevalence in both season. In case of Nematodes, 11 genera were observed in winter seasons. *Cooperia, Ancylostoma, Bunostomum, Oxyuris* were not observed during winter. Among trematodes, *Fasciola, Dicrocoelium* and *Schistosoma* were common during winter and summer season. Likewise, *Taenia* and *Dipylidium* was also found to be common during both the seasons. In winter season, the prevalence of *Dipylidium* and *Taenia* sp. was found to be highest no in comparision to summer season among cestodes. In trematodes, *Schistosoma* and *Fasciola* were found to be in highest number in comparision to summer season. In summer season, *Dicrocoelium* was found to be in highest percentage.

During the study, out of 150 samples taken in winter, 125 samples were found to be positive and 25 samples were found to be negative. Out of positive samples, 59 (47.2%) samples were found to have single infection and 66 (52.8%) were found to have multiple infections. Similarly, during summer season, out of 130 positive samples, 42 samples (32.31%) were found to have single infection and 88 samples

(67.7%) were found to have mixed infection. The study showed that the average rate of multiple infections (60.39%) during both seasons was greater than the average rate of single infection (39.61%) during both seasons. The abundance of multiple infections mainly during summer might be the availability of suitable temperature and moisture.

Prevalence rate of nematode was very high in most of the previous research. In this study, it is also found to be very high. The prevalence rate of nematode is highest because nematodes are transmitted through the contaminated food and water. Some of them can also be transmitted through skin.

Horii *et al.*, (1981) had found the highest incidence (100%) of *Strongyloides fulieborni* in young monkey of Koshima troop of Japan. Limbu *et al.*, (2006) had also reported *Strongyloides* and *Paramphistoma* groups in Rhesus monkey for the first time in Nilbarahi in the community forest.

Horii *et al.,* (1981) had discovered only 1 cestode species and 4 nematode species. Gillespie *et al.*, (1998-2003) had discovered only 1 cestode 1 trematode and 7 nematodes species. Yamashita (1962) had discovered 16 species of nematodes, 15 species of trematode and 2 species of cestodes. Nematode was most prevalent in their research. Joseph *et al.,* (1999) had also discovered only nematodes. Leishout *et al*., (2005) also found high prevalence of nematodes i.e 75.99%. In most of the research, the most prevalence rate was found for nematodes species. In present study, the nematodes species was found to be highest prevalance rate i.e. 75%.

In the present study, *Strongyloides* sp. was found to be the highest prevalence (i.e. 27.06%) among other helminth parasites. It is due to the natural specific host of this parasite. The *Stronglyoides* sp. are the soil transmitted helminth parasites. It can also be transmitted through contaminated food and water. So they can easily be transmitted through the skin. But some of other helminth species need contaminated food and water and some of them also need secondary or tertiory host for their completron of lifecycle. Because of this, *Strongyloides* sp. have accounted in great number.

Benjian *et al.,* (2008) had found the 44% *Strongyloides* sp. from free ranging olive baboons (*Papio anubis*) with the forested Kibale National Park, Ugonda. Similarly, Mutani *et al.,* (2003) also examined fifty three faecal samples for gastrointestinal helminths using the zinc sulphate floatation method. This method revealed an overall infection rate of 88.7%. In this research also *Strongyloides* sp. was found to be highest number (ie 62.4%) than that of other helminthes.

Muchlebein (2005) studied the parasitic fauna of 37 adult, addescent and Juvenile male chimpanzees from the Ngo go group, Kibale National Park, Uganda. The result of which indicates that the prevalence of *Strongyloides* sp. was found to be in 83.8%.

Philips *et al.,* (2004) collected faecal samples from 86 individuals of non human primates from Tambopata Research Center, Tambopata, Peru and analysed a concentration test. The result of which indicate the prevalence of various protozoans *Ancyclostoma* sp., *Ascaris* sp., *Strongyloides stercolaris, Trichuris trichura*, *Prosthenorchis elegans* and *Schistosoma mansoni*.

In present study, 2 different types of cestodes, *Taenia* and *Dipylidium* detected while Dewit *et al*., (1991) found one cestode, *Hymenotepic*. Also in 1962 Yamashita found 2 species of cestodes from Japan Monkey Centre. Gillespie *et al.,* (2003) found one cestode (*Bertiella* sp.) from red colobus monkey of Uganda. Similarly Malla (2007) also reported only one cestode (i.e. *Taenia* sp.) from Rherus monkey of Pashupati Nath and Nilabarahi area of Kathmandu. Dhoubhadel (2007) reported *Dipylidium* sp. for the first time from Rhesus monkey of Swoyambhu Nath, Kathmandu to be 7.08%. But in present study, it was found to be 9.80%.

In present study different types of Trematodes ie *Dicrocoelium sp.*, *Schistosoma* sp. and *Fasciola* sp. were found in Rhesus monkey of Swoyambhu but Malla (2007) found only one kind of Trematode (i.e. *Dicrocoelium*) in Pashupati Nath and Nilbarahi area of Kathmandu valley.

Phillips *et al.,* (2004) found 1 cestodes (*Schistosoma mansoni*) from non human primate from Tambopata Research Center, Tambopata National Reserve. Gillespie *et al*., (2005) found 1trematodes (*Dicrocoellidae*) from Colombus monkey

of Ghana. Dhoubhadel (2007) reported (93.14%) trematode from Rhesus monkey of Swoyambhu. Yasnashita (1962) found 5 species of trematodes fom Japan monkey centre.

In present study, 15 different kinds of nematodes were detected while Horii *et al.,* (1981) found 4 different kinds of nematodes where as Gillespie *et al.,* (2005) found severs kinds of nematodes; michand et al; (2003) formed 2 kinds of nematodes, phillips et al; (2004) found 4 kinds of nematodes.

Ponnudurai et al; (2003) showed 2 nematudes from sample of monkey in Tamil Nadu. Eberhard *et al*., (2001) found 1nematodes (i.e. *Oesophagostomum bifurcom*) found in human and monkey in the same geographical region of northern Ghana.

Malla (2007) found 16 nematodes; Dhoubhadel (2007) reported 14 nematodes. Benjian, *et al.,* (2008) found 7 different types of nematodes from free ranging olive baboons (*Papioanubis*) with in the forested kibale National Park, Uganda from May to June 2004.

Mbora *et al*., (2006) found 10 nematodes. Gotoh (2006) studied 5 different types of nematodes species, Dewit *et al.,* (2008) also found 8 number of nematode, Bakuze *et al.,* (2009) found 3 nematodes. In the present study, many kinds of nematodes were detected. Such different may be due to topography and climate. The distribution of parasites is also dependent upon the distribution of intermediate host; public awareness may also be the reason for different result which is mainly due to illiteracy and poverty. *Strongyloides* sp. is found to be the most prevalent which is quite natural because *Strongyloides* sp. was natural parasites of monkey and apes. Horii *et al.,* (1981) also found highest incidence of *Strongyloide* sp. i.e 100% in young monkey of Koshima troop. The prevalence rate of *Cooperia* sp., *Oxyuris* sp., *Broncostomum* sp. and *Ancyclostoma* sp. was found to be the least prevalence.

Varadharajan and Kandasamy (2000) found 58% of captive animals were positive especially for helminth parasitic infection from a survey of gastrointestinal parasites of wild animals in captivity in the V.D.C Park and mini 200, Coimbatore.

The seasonal prevalence rate of cestodes genera during summer and winter season found in Rhesus monkey was *Taenia* (9.23/10.4)% and *Dipylidium* sp. (18.46/24.8)% .Similarly the prevalence rate of *Trematodes* during summer and winter were *Dicrocoelium* sp. (10.77/8.8)%, *Schistosoma* sp. (16.92/19.2)% and *Fasciola* sp. (5.38/14.4)%. Similarly in nematodes, *Strongyloides* sp. (36.92/16.8)%, *Trichostrongyloides* sp. (11.54/11.2)%, *Oesophagastomum* sp. (10.77/10.4)%, *Trichuris* sp. (11.54/8)%, *Capillaria* sp. (7.69/4.8)%, *Ostertagia* sp. (7.69/4)%, *Cooperia* sp. (8.46/0)%, *Dictyocaulus* sp. (12/5.6)%, *Oxyuris* sp. (6.15/0)%, *Ascaris* sp (10/4.8)%, *Toxocara* sp. (13.85/12)%, *Chabertia* sp. (7.69/9.6)%, *Bunostomum* sp. (3.85/0)%, *Ancylostoma* sp. (5.38/0)%, *Haemonchus* sp. (4.62/4)%.

The present study, the number of parasites in two seasons (summer and winter) differs significantly. Statistically, ($\chi^2_{(cal)}$=16.73, $\chi^2_{(tab)}$=10.59, P<0.05, d.f.=2). The tabulated value is less than calculated value. So this result rejects the hypothesis of the study.

In overall *Strongyloides* sp. was the most encounter species followed by *Schistosoma* sp. and *Toxocora* sp. and least prevalence species were *Bunostomum* sp. and *Ancycostoma* sp. In the present study, *Schistosoma* sp. and *Fasciola* sp. of trematodes genera is reported for the first time in Rhesus monkey from Nepal. Similarly in cestodes, *Dipylidium* sp. is reported for the first-time in Rhesus monkey of Swoyambhunath area of Kathmandu. Similarly, *Bunostomum* sp. is also reported for the first time present in Trematodes, in Rhesus monkey of Nepal. Therefore during the above mentioned particular study period genera-namely *Schistosoma, Dipylidium, Fasciola* and *Bunostomum* were reported from Rhesus monkey of Nepal for the first time.

# CHAPTER SEVEN

## RECOMMENDATIONS

On the basis of the outcome of present study, the following measures are recommended:

1. Strategic antihelminthic treatment should be applied to eliminate the parasite from the host.
2. Monkey should be dewormed to reduce the transmission of zoonotically infectious diseases.
3. Monkeys should be regularly dewormed to improve their health.
4. Wild animals should be managed properly.
5. Monkey’s habitat should not be encroached.
6. More research work should be focused in this field. Further research work should be carried out on wild animals.
7. The Foods for monkeys should be monitored.
8. Local people of the study area are unaware of many zoonotic diseases which may be transmitted through monkeys. So people should be alerted through awareness programs.
9. The practical application of biological and epidermiological knowledge should be provided through mass media like radio, television etc.

## References


Acharya, B. (1999). Study on GI parasite of goats and sheep of IAAS livestock farm. *Bulletin of veterinary science and animal husbandary,* **27**:35-37.

Adejinmi, O.J. and Ayinmode, A.B. (2008). Preliminary Investigation of Zooanthroponosis in a Nigerian Zoological Garden, *Veterinary Research,* **2**(3-4):38-41.

Adhikari, B., Shrestha, B. and Shrestha, R.M. (2003). A study on the prevalence and diversity of *Fasciola sp.* in cattle and Buffaloes in area of Kathmandu valley. *Central Veterinary Laboratory Annual Technical Report,* **1**:59-66.

ADPCD (1982). A study of Helminth parasites from animals in Kathmandu valley. *Animal Disease and parasite central Annual Technical Report.*1979-1986, **1**:6.

Anwar and Khan (1998). Parasitic fauna of camel in Pakistan. *In Proceedings of the Third Annual Meeting for Animal Production Under Arid Conditions,* **2**:69-76. United Arab Emirates University.

Ash, L.R., and T.C. Orihel and L. Savioli. (1994). Bench Aids for the Diagnosis of Intestinal Parasites. *In: Programme on Intestinal Parasitic Infections, Division of Communicable Diseases World Health Organization, Geneva.*

Baird,W.(1853). Helminthes, Arthropods and Protozoa of Domesticated Animals by E.J.L. Soulsby (1982). Seventh Edition. The English Language Book Society and Bailliere Tinadall, London :143.

Bakuza, J.S. and Nkwengulila, G. (2009). Variation Over Time in Parasite Prevalence Among Free Ranging Chimpanzees at Gombe National Park, Tanzania. *Int. J. Primatol*. **30**:43-53.

Bezjian, M., Gillespie, T.R, Chapman, C.A. and Greiner, E.C. (2008). Coprologic Evidence of Gastrointestinal Helminths of Forest Baboons, Papio, Anubus, In Kibale Nationa Park, Uganda. *Journal of wild life Disease*, **44**(4):878-887.

Bol, J.P.M. and Roder, E.C. (1981). Soil Transmitted Nematodes in Lalitpur District in Nepal. *Jour. Inst. Med*. **3**(2):167-178.

Boyce, M.S. (1990). The Red Queen Visits Sage Graovse Leks. *Am. Zoul*, **30**:263-270.

Brumpt, E.J.A. (1927). Helminths, Arthropods and Protozoa of Domesticated Animals by E.J.L Soulsby 1982. Seventh Edition. The English language Book society and Baillieve Tinadall, London,:152.

Chailise, M.K. (1989). Non Human Primate Census in Different Part of Nepal. *Natural History Society of Nepal Bulletin* **8**, 4-15.

Chaudhari, S.S., Gupta S.K., Banerjee, D.P., Bhatnagar P.K. and Rupraki N.S. (2003). Mammal of Veterinary Helminthology, **1**:10-87.

Cheng, T.C. (1986). General Parasitology by K.O. Chattergee ($12^{th}$ edition) Report 2000, Chatterjee Medical Publishers, India, P.154.

Chapman C.A., Speirs, M.L., Gillespie, T,R., Holland, T. and Austad, K.M. (2006). Life on the Edge. Gastrointestinal Parasites from the Forest Edge and Interior Primate Groups. *American Journal of Primatology*, **68**:397-409.

Chitwood, M., (1970). Comparative Relationships of Some Parasites of Man and New World Sub Human Primates Lab. *Anim. Care*, **21**(2):389-394.

Collet, J.Y., Galdikan, B.M.F., Sugardjito, J., Jojosudharmo, S., (1986). A Coprological Study of Parasitism in Orangutans (*Pango pygmaeus*) in Indonesia. *J.Med Primatol*, **15**:121-129.

Daszak, P., (2000). Emerging Infectious Diseases of Wildlife Threats to Biodiversity and Human Health. *Science*, **287**:443-449.

Dewit,T., Dittus, W.P.I., Vercruysse, J., Harris, E.A., Gibson, D.I., (1991). Gastrointestinal Helminths in a Natural Population of *Macaca sinica* and *Preshytis sp*. at Polonnarowa, Srilanka. *Primates*, **32**(3):391-395.

Dhakal, I.P. and Kharel, M. (1988). Common Diseases of Livestock in Chitwan District of Nepal. *Journal of Institute of Agriculture and Animal Science*, **9**:69-74.

Dhakal, J.P. and Nepali, D.B. (1983). Incidence of Liverfluke Infection in Cattle and Buffaloes at Livestock Farm IAAS. *Journal IAAS*, **4**:24-26.

Dhakal, K.P. (2008). A Preliminary Coprological Study on Helminth Pararites in Cattle (*Bos sp.*) of Anarmani VDC 2, Jhapa. M.Sc. thesis submitted to CDZ, T.U. :21-51.

Dhital, V.P. (2006). Prevalence of Gastro Intestinal Parasites in Goats at the IAAS Livestock Farm of Mangalpur VDC 9, Chitwan. *The Blue Cross*, **8**:122.

Dunn, F.L.1988. The parasites of Saimiri in the Context of Platyrhine Parasitism in L.A. Resenblum and R.W. Cooper (eds): The Squrriel Monkey. Academic Press New York, :31-68.

Gillespie, J.R., Chapman, C.A. and Greiner, E.C., (2005). Effects of Logging on Gastrointestines Parasites Infectious and Infection Risk in Africa Primates. *Journal of Applied Ecology*, **42**,699-707.

Gillespie, T.R., Greiner, E.C. and Chapman, C.A. (2005). Gastro Intestinal Pararites of the Colobus Monkeys of Uganda. *J.Parasitol*, **91**(3):569-573.

Gillespie, T.R., Greiner, E.C and Chapman, C.A. (2004). Gastro Intestinal Parasites of the Guenons of Western Uganda. *J. Parasitol*, **90**(6):1356-1360.

Gillespie, T.R. (2006). Non Invasive Assessment of Gastro Intestinal Parasite Infection in free Ranging Primates. *Int. J. Primatol*. **27**, 1129-1143.

Goossens, E., Dorny, P., Boomker, J., Vercammen, F. and Vercruysse, J. (2005). A 12- Month Survey of the Gastro Intestinal Helminth of Antelopes

Gazelles and Giraffids Kept at Two Zoos in Belgium. *Veterinary Parasitology*, **127**:303-312.

Gotoh, S.C. (2008). Regional Differences in the Infestion of Wild Japanese Macaques by Gastro Intestinal Helminth Parasite. *Primates*, **41**(3):291-298.

Gupta, R. (1987). Some New Records of Helminth Parasite and Their Hosts from Nepal. *Jour.Mat.Hps.Mus.* **11**(1-4) :27-40.

Gupta, R.(1989). Some New Records of Helminth Parasites and Their Hosts From Nepal. *Journal of National History Museum,* **41**:27-40.

Gupta, R. (1997). Diversity of Parasitic Helminth Fauna in Nepal. A Report Submitted to Research Division, Rector's officer, T.U. Kritipur, Nepal.

Gurung, B. (2007). Prevalence of Eggs of Three Trematode Genera (*Fasciola sp*., *Dicrocoelium sp.*, and *Schistosoma sp.*) in Buffaloes from Satungal Slaughter House, Kathmandu. Thesis submitted to *CDZ, TU*.**1**:15-3).

Hamilton, W.D., and Zuk, M. (1989). Heritable True Fitness and Bright Birds: A Role of Parasite, *Science*, **218**:384-387.

Harris, R.J.C. (1962). The Problems of Laboratory Animal Disease. Head of the Division of Experimental Biology and Virology Imperical Cancer Research Foundation London. Academic Press London and New York, :143-211.

Harvel, C.D., Mitchell C.E., Ward, J.R., Altizer, S., Dobson, A.P. Ostield, R.S. and Samuel, M.D. (2002). Ecology Climate Warming and Disease Risks for Terrestrial and Marine biota. *Science,* **296**:2184-2162.

Hayama, S. and Nigi, H. (1963). Investigation on the Helminth Parasites in the Japan Monkey Centre During:1959-1961. *Primates*, **4**(1):97-112.

Hobbs, T.R., Clogin, L.M.A., Maginnis, G.M. and Lewis, A.D (2005). *Comparative Medicine (Memphis)* **53**(5):545-547.

Hudson, P.J., Dobson, A.P., Newborn, D. (1992). Do Parasites Make Prey Vulnerable to Predation, Red Grouse and Parasites. *J. Anim. E.Col*, **61**:681-692.

Joshi, B.R., Gibbons

Khanal, B.P. (2004). Studies on Some Intestinal Helminth Parasites of Felis Catus (Linnaeus, 1758) from Nawalparasi and Chitwan District, Nepal. *A* Thesis Submitted for the Master's Degree of Science in Zoology. T.U., Kathmandu, Nepal.

Khaniya and Sah (2003). Study on Gastro Intestinal Parasitic Problems in Dogs. *The Blue Cross*, **6**:55-56.

Khetan, R.P.(1980). Incidence of Parasitic Infestation in Narayani Zone. *Jour. Nep. Med. Assoc*, **18**(4):29-31.

King, N.W. (1976). Synopsis of the Pathology of New World Monkeys. *Am. Health Org*, **317**:169-198.

Lilly, A.A., Mehlman, P.T., Doran, D. (2002). Intestinal Parasites in Gorillas, Chimpanzees and Humans at Modika Research Site, Dzanga-Ndoki National Park, Central African Republic. *International Journal of Primatology*, **23**:555-573.

Limbu, A.K. and Pant, D.R.(2005). Intestinal Parastic Infections in Rhesus Monkey. *Journal of Institute of Science and Technology*,**14**:1.

Michaud, C., Tataleon, M., Ique, C., Montoya, E. and Geozalo, A. (2003). A Survey of Helminth Parasite in Feral New World Non-human Primate Population and its Comparison with Parasitological Data from Man in the Region. *Journal of Medical Primatology*, **32**:341.

Malla, V. (2007). Intestinal Helminth Parasites of *Macaca mulatta* from Pashupati (Kathmandu district) and Nillbarahi area (Bhaktapur district) of Nepal. These Submitted for the Master Degree of Science in Zoology. T.U., Kathmandu, Nepal (unpublished).

Miller, R.A., Brondson, M.A., Kuller, L., Morton, W.R. (1990). Clinical and Pararitology Aspects of Cryptosporidiasis in Non Human Primates. *Lab. Animal Science*; **40**:42-46.

Molin, R. (1861). Helminthes, Arthropods and Protozoa of Domesticated animals by E.J.L souls by 1982. Seventh edition. The English language Book Society and Bailliere Tinadall. London., 186-191,172.

Moller, A.P. (1990). Parasites and Sexual Selection Current Status of the Hamilton and Zuk hypothesis. *J.Eevolution Bilol*, **3**:319-328.

Morel, A.M. (1986). Speciation of Human Hookworm in the Eastern Hills of Koshi(Nepal). *Jour. Nep. Med. Assoc*, **24**(1):45-46.

Muehlenbein, M.P. 2005. Parasitological Analyses of the male chimpanzees at Ngogo, Kibale national Park, Uganda. *American Journal of primatology*; 65:167-179.

Mukhia, G.( 2007). Intestinal Helminth Parasites of Buffalo Brought to Satungal, (Kathmandu) for Slaughter Purpose. A thesis submitted for the Master Degree of Science in Zoology T.U., Kathmandu Nepal. (unpublished).

Mutani, A., Rhynd, K. and Brown G.(2003).A Preliminary Investigation on the Gastrointestinal Helminthes of the Barbados Green Monkey, *Cercopithecus aethiopssabaeus*. *Rev. Inst. Med. Trop S. Paulo*, **45**(4):193-195.

Nunn, C., Altizer, S.M., Jones, K.E. and Sechrest W. (2003). Comparative Tests of Parasite Species Richness in Primates. *An. Nat*. **162**:597-614.

Petrzelkova, K.J., Hasegawa, H., Moscovice, L.R., Kaur, T., Issa, M., and Huffman, M.A. (2006). *International Journal of Primatology*, **27**(3):767-777.

Plesker, R., Barer, C., Tackmann, K. and Dinkel, A. (2001). *Journal of Veterinary Medicine Series B.* **48**(5):367-372.

Ponnudurai, G., Anna, T. and Harikrishnan, T.J. (2003). Parasitic Infection Among Monkeys in Tamil Nandu. *Indian Journal of Animal Sciences* **73**(4) :397-398.

Rabwin, D.E., Joshi, D.D., and Chhetri, B. (2003). Prevalence of Intestinal Parasites in Yak and Other Animals of Langtang Valley. *Nepalese Vet. Journal,* **27**:81-88.

Roonwal, M.L. and Mohnot, S.M. (1997). Primates of South Asia, Ecology, Sociology and Behavior. Harvard University Press, Cambridge, London, England.

Rothman, J.M., Pell, A.N. and Bowman, D.D. (2008). Host Parasite Ecology of the Helminthes in Mountain Gorillas. *Journal of Parasitology* **94**(4):834-840.

Scott, M.E. and Dobson, A.P. (1989). The Role of Parasites in Regulating Host Abundance. *Paraitol. Today,* **5**:176-183.

Shrestha, B. (1999). Study of Agnostic Behavior of Rhesus Monkey in Pashupati Area of Nepal. M. Sc. Thesis Submitted to Central Department of Zoology, Tribhuvan University Kathmandu, Nepal.

Shrestha, T.K. (1997). Mammals of Nepal :277-278.

Shrikhande, G.B., Satpute, A.K., Zanzad, S.S and Maske, D.K. (2007). Helminth Parasites in Captive Wild Animals of Rajiv Gandhi Zoological Park Veterinary World, **1**(7):207.

Singh, S.S. (1970). Some Helminth Parasites and the Vertebrates from Kathmandu Valley with Refrence to Ecological Aspect. Thesis Submitted for Ph. D., Patna University, India.

Tattersall, I. (1993). The New Grolier multimedia and Encyclopedia.

Thakur, R.P. (2003). Control of Endoparasitic Disease of Pigs in the Eastern Hills of Nepal VETCON.**3**:83-90.

Veterinary Laboratory Techniques, (2003). Central Veterinary Laboratory Tripureshwar.

Varadharajan, A. and Kandasamy, A. (2000). A Survey of Gastrointestinal Parasites of Wild Animals in Captivity in the V.O.C. Park and Mini Zoo, Coimbatore. *Zoos' Print Journal* **15**:257-258.

Velasco J. and Claverian, F.G. (2009). Intestinal Parasite Identified in Caged Orangutans (*Pongo sp.*) at the Avilon Zoo. Montalban Zoological Park, Rizal Phillippiness .*J. Protozool Res,***19**:12-15.

Wada, K. (2005). The Distribution Pattern of Rhesus and Asamese Monkey in Nepal. *Primates,* **46**:115-119.

Wallis, J., and Lee, R.D. (1999). Primate Conservation. The Prevention of Disease Transmission. *International Journal of Primatology*, **20**:803-826.

Wang, T., Yang G.-Y., Yan, H-J., Wang, S., Bian, Y., Chen, A., Bi, F.-J. (2008). Comparison of Efficiency of Selamectin in Vermeetin and Mebendazole for the Control of Gastrointestinal Nematodes in Rhesus macaques, China. *Veternary Parasitology*, **153**:121-125.

Wolfe, N.D., Escalante, A.A., Karesh, W.B., Kilbourn, A., Spielman, A., and Lal, A.A. (1998). Wild Primate Population in Emerging Infectious Disease Research. The Missing Link? Emerging Infectious Diseases, **4**:149-158.

Woodford, M.H., Butynski, M.I., and Karesh, W.B. (2002). Habituating the Great Apes. The Disease Risks. *Oryx*, **36**:153-160.

Yadav, D.P. (2004). Study of Feeding Behavior of Rhesus Monkey in Thapathali Area Kathmandu, Nepal. A Thesis Submitted for the Master Degree of Science in Zoology T.U, Kathmandu, Nepal.

Yamashita, J. (1962). Ecological Relationships Between Primates and Their Helminth Parasites. *Primates,* **3**(1):89.

Zuk, M. (1996). Disease, Endocrine-immune Interactions, and Sexual Selection. *Ecology,* **77**:1037-1042.