"DEVELOPMENT OF PREVENTIVE PACKAGE FOR CONTROL OF ENDOPARASITISM IN FREE RANGING WILDLIFE"

THESIS

Submitted to the

Maharashtra Animal and Fishery Sciences

University, Nagpur

In partial fulfillment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE

IN

VETERINARY MEDICINE

BY

NAVNATH KESHAV NIGHOT

DEPARTMENT OF VETERINARY CLINICAL MEDICINE, PREVENTIVE MEDICINE AND VETERINARY JURISPRUDENCE

NAGPUR VETERINARY COLLEGE, NAGPUR

MAHARASHTRA ANIMAL AND FISHERY SCIENCES UNIVERSITY, NAGPUR-440 006.

(INDIA)

University Enrolment No. V/02/717 **Year : 2003**

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE/ PHOTOGRAPH

LIST OF ABBREVIATION

@	at the rate
BCE	Body Condition Evaluation
BCI	Body Condition Index
B. wt.	Body weight
Cal.	Calculated
cu mm	Cubic millimeter
dl	deciliter
DLC	Differential Leucocyte Count
EPG	Egg Per Gram
gm	Gram
Hb	Haemoglobin
l	liter
mg	milligram
ml	milliliter
PCV	Packed cell Volume
ppm	Part per million
%	Percentage
S.E.	Standard error
TEC	total erythrocyte Count
TLC	total leucocyte count

INTRODUCTION

The perception of health of wild animals has changed over a period of time. The opinion has fluctuated in the past between the two extreme views namely; Wildlife diseases are natural phenomenon that needs no active management. However, now it is agreed that balanced view of carefully monitoring wild life health and interviewing at the appropriate time is an urgent need of today.

Internal parasite populations are a common part of the normal biology of most animals. The endoparasite plays an important role in the health status of wild animals and environmental health. They have a potential to affect the fitness and reproductive success of host individual. The effects of parasites on domestic animals are well documented. It is largely assumed that some holds true for free ranging wild animals, but the ecology of parasite in the wild is likely to be much different. Parasitic diseases can take a toll on both individual animals and populations in general. An understanding of both biology of the organisms involved and the methods of transmission help to determine the significance of these type of infections in free ranging animals. Domestic animal parasites and/or disease often have devastating effects when transmitted to free ranging wild animals. However, there are some instances, when natural parasites of wild animals can cause considerable pathogenesis in some domestic species and other introduced wild species. Transmission of parasites from domestic

animals to wild species is often a natural phenomenon with the outcome being of little consequence to the infected animals. When condition change and animal numbers increase beyond acceptable levels and when suitable habitat is either reduced or destroyed, parasitic diseases can often have a dramatic impact on populations. As a result, monitoring and ascertaining parasitic disease surveillance become extremely important in maintaining adequate numbers of healthy wild fauna.

The role of parasites needs particular attention in the present day environment of habitat encroachment, disturbance and fragmentation. There is a competition between domestic livestock for resources. Because of ever increasing contact between wildlife and domestic animals, not only thus new diseases are evolved but also the epidemiology has become complex. Host-parasite relationship needs to be studied before formulating preventive measures.

Due to human interference, natural habitats of wild animals are changing. Human pressure on a protected area appears in a variety of forms viz. air and water pollution, construction of dams and roads and livestock grazing. Some type of pressure affects entire areas like grazing and other are concentrated as a specific spot like use of water holes by domestic animals.

Condition of an animal responds to the changes in its habitat quality, which is governed by mainly interrelated component factors. The detoriation of condition not only due to chronic diseases and biological

processes but could also be due to nutritional stress making animals susceptible to diseases. Such nutritional deficiencies can have a noticeable effect on the body condition of wild animals but has received meagre attention. Since domestic animals living around protected areas often transmit diseases to wild animals. Many diseases are dependent on the density of the host population for its spread, higher the density the spread assumes higher.

Disease management in free ranging wild animals attempted not by treating individual sick animal but by manipulating those environmental factors that plays a role in the transmission of the disease.

Very little attention has been paid to the study of extremely varied nature of many parasitic species in regard to the host parasite relationship, their pathogenic role and determination of the hosts ranges of their definitive host, besides assessing the role of some of these animals acting as reservoirs of infection for domestic livestock and also human beings.

The present modern changes creating pressure on the environment and should therefore be of concern. Certain parasitic diseases, which are either shared among man/domestic and wild animals or may be transmitted, among when a definitive hosts ingests an intermediate host. Peripheral resident livestock during grazing contaminate the wildlife area i.e. shrubs and herbscontaminated through with faeces and urine, as a result the wildlife i. e. herbivores (Deer, Black buck, Sambar, Bison, Elephant, Monkey, Nilgai etc.) get infection by sharing these grassland. These parasitic

infections do not cause clinical disease until the infection is of higher magnitude, however it affects the health status of wild as well as domestic animals. Some time mortality also recorded due to this infection. Thus the interactions between livestock and wildlife are often and complex phenomenon. Ecto and endoparasites are one of the recognized disease problems in free living wildlife. This challenge demands a firm and dynamic approach in the development and formulation of policies for the livestock and wildlife sector for controlling endoparasitic infection in free ranging wildlife.

Hence, it has been contemplated in the present study,

1. To estimate the prevalence and distribution of helminthes across a wide range of host species of wild animals and domestic animals in protected areas of Pench National Park, Maharashtra.
2. To estimate the effect of the disease on an individual and on the population before and after therapeutic measures.
3. To study the effect of therapeutic measures against endoparasites (helminth) of peripheral resident livestock population.
4. To study soil-plant-animals relationship.

It is hoped that the envisaged study may help to develop methods for prevention and control or otherwise to reduce the parasitic infection/disease and its effects on wildlife population.

REVIEW OF LITERATURE

Prevalence of helminths in livestock (Cattle)

Herd and Hull (1981) documented egg of *Paramphistomum microbothroides* in the bull as well as bison and beef cattle.

Chaudhri *et al.* (1993) reported *Paramphistome cervi*, *Calicophoron calicophorum* in wide spread along with *Schistosomes* and *Fasciolides* in cattle. Cestodes infections *Moniezia* spp., *Thysaniezia giardi, Avitellina* spp. and *Taenia hydatigena* were more common in sheep and goat than in cattle.

Deka *et al.* (1995) recovered major trematodes in cattle viz. *Paramphistomum cervi*, *Homalogaster paloniae*, *Gastrothylax crumenifer*, *Cotylophoron* spp., *Fischoderium elongatus*, *Eurytrema pancreaticum*, *Fasciola gigantica*, *Schistosoma nasalis*, *Schistosoma spindale* and *Schistosoma indicum*. *Moniezia expansa*, metacestodes *Cysticercus bovis* and hydatid cysts were common among cestodes and *Toxocara vitulorum*, *Setaria digitata*, *Trichostrongylus colubrifarmis*, *Haemonchus contortus*, *Mecistocirrus digitatus*, *Onchocerca armillata were* the nematodes. Incidence of helminth infection showed trematodes (75.0%), cestode (28.1%), nematodes (53.4%) and overall incidence was 52.1 per cent. *Paramphostome* and *Trichostrongylus colubriformis* were major gastrointestinal nematode in cattle.

Agneessens *et al.* (1997) studied epidemiology of gastrointestinal nematode during grazing season. *Cooperia oncophora* in calves and *Ostertagia ostertagi*, *Oesophagostomum*, *Cooperia oncophora* and *Trichostrongylus axei* in cows was the predominant species. The cows were the major source of pasture contamination whereas winter born calves were having a higher intake resulting in a higher infection level.

Hirani *et al.* (1999) carried out faecal samples examination of 927 cattle and buffalo. Out of which 361 samples (38.86%) were positive for parasitic infections. The highest infection was of *Amphistomes* 203 (21.85%) followed by *Coccidia* 73 (7.86%), *Strongyles* 70 (7.33%), *Fasciola* 24 (2.58%), *Trichuris* 9 (0.97%) and *Moniezia* 1 (0.11%). The infection of trematode and nematode was 24.43 and 8.50 per cent, respectively. The infection of *Amphostome*, *Coccidia* and *Strongyle* were predominantly higher in summer season.

Yadav and Sadana (1999) reported outbreak of gastrointestinal nematodosis in dairy cattle aged 10 to 30 months in Hissar. Majority of the recovered worms were *Haemonchus placei*. *Oesophagostomum radiatum*, *Bunostomum phlebotomum* and *Trichuris globulosa* were also found in the five cattle necropsied.

Mondal *et al.* (2000) examined gastrointestinal helminth in livestock, grazing in grassland of Bangladesh and reported nematodes *Haemonchus contortus*, *Trichostrongylus axei*, *Mecistocirrus digitatus*,

Oesophagostomum spp., *Trichuris* spp. and *Bunostomum* spp. and Cestode as *Moniezia spp*. where cow calves and goat were reared together. They concluded that grasslands were one of the main sources of gastrointestinal parasitic diseases to livestock in Bangladesh.

Jithendran and Bhat (2001) studied epidemiology and control of parasitism of helminthic infection in cattle observed *Fasciola* spp. 63%, *Amphistomes* spp., 15.1%, *Dicrocoelium* spp. 2.1%, *Moniezia* spp. 0.9%, *Strongyle* spp. 1.7%, *Toxocara* spp. 2.1%, *Dictyocalus* spp. 0.7%, *Trichuris* spp. 1.6% and *Capillaria* spp. 0.9%. Ingestion and percutaneous penetration are two major routes of entry of parasites influenced by behaviour of the prospective human host and animal. This may be active as ingestion of soil containing infective stages of *Toxocara canis*, *Ascaris* spp., *Trichuris* spp. or *Ancylostoma* spp. or permissive as exposing the skin to water containing larva of *Schistosoma* spp. or soil containing larvae of *Necator* spp. or *Strongyloides* spp. Animal cestode infection resulted from ingestion of eggs directly from the faeces of definitive hosts or indirectly by contact with definitive hosts or from contaminated food, water and soil and infection in tourists living in the tents or native dwelling in rural settings and vast number of wild animals in thick belt of forest at high mountains resulting in contamination of environments and infection contracted either through contaminated food or untreated water which is common feature in the hilly regions.

Pal *et al.* (2001) studied prevalence of gastrointestinal parasites in cattle and buffalo from Chattisgarh region. Out 659 faecal samples of both cattle a buffalo, 261 of cattle in which 52 (19.9%) were reported positive for helminth infection and highest prevalence showed by *Strongyles* 28 (10.7%) followed by *Amphistomes* 21 (8.0%), *Trichuris* spp. 2 (0.7%) and *Fasciola* spp. 1 (0.3%). In cow calf 142 samples were showing 28.1% prevalence, which consist of highest in *Trichuris* spp. 18 (12.6%), *Eimeria* spp. 8 (5.6%), *Strongyles* 7 (4.9%), *Amphistomes* 5 (4.9%) and *Moniezia* spp. 2 (1.4%). They also reported overall prevalence about 23.3 per cent for various gastro-intestinal parasitic infections.

Rajkhowa and Hazarika (2001) noted 60.78% prevalence of intestinal nematodes in female calves of Greater Guwahati of Assam. *Toxocara vitulorum*, *Moniezia* spp. and *Strongylid* showed 35.48%, 3.22% and 11.29% prevalence respectively. Mixed types of infections were also recorded.

Kumar *et al.* (2002) reported incidence of helminth infection in Tarai and Western plains of Uttar Pradesh of cattle and buffalo. Overall incidence was about 42.62%. *Toxocara vitulorum* was prevalent in calves upto 6 months of age, *Strongyloides* upto 1 year, Monieziosis from 1-5 years, while Strongylosis, Amphostomosis and Fasciolosis occurred in the animals above 1 year of age.

Sahoo *et al.* (2002) studied prevalence of gastrointestinal helminthic infection among grazing and stall fed cattle in a rain fed district of Orissa. They examined 1175 faecal samples of cattle and reported 587 (49.96%) positive for single or mixed helminthic infection. Prevalence of parasitic infections in grazing cattle were 55.48% which included *Amphistome* (40.33%), *Strongyle* (2.61%), *Fasciola* (2.11%), *Ascaris* (1.40%), *Strongyloides* (1.11%), *Trichuris* (0.9%) and *Moniezia* spp. (0.6%). Mixed infection with one or more helminthic ova was detected in 5.29% cattle. Prevalence of helminth was more in grazing cattle than stall fed due to contamination of the grazing area with parasitic ova and larvae. The trend of higher helminthic infection in rainy season as observed due to increased concentration and/or contamination of the grazing area by the infective stage larvae of the parasites and thereby increasing the chance of contact between host and larvae.

Prevalence of helminths in wild herbivores

Patnaik and Acharjyo (1970) reported *Cotylophoron cotylophorum*, *Paramphistomum cervi* and *Gastrothylax cruminifer* infection in Sambar, Nilgai, Black buck and Barking deer.

Chauhan *et al.* (1972) recorded the incidence of *Trichuris* spp. infection in monkey in Zoological Park, Delhi and Lucknow Zoo. *Trichurid* and *Amphistome* infection was also observed in spotted deer in Lucknow Zoo.

Prestwood *et al.* (1975) documented helminth infections among free ranging intermingling population of white–tail deer (*Odocoileus virginianus*), cattle (*Bos taurus*) and swine (*Sus scrofa*) on an island of the Georgia coast. Of 39 species of helminths collected, 19 were found in deer, 17 in cattle and 13 in swine. Of 28 species of helminths recovered from ruminants, eight viz., *Capillaria bovis, Cooperia punctata, Dictyocalus viviparous, Gongylonema pulchrum, G. verrucosum, Haemonchus controtus, Moniezia benedeni* and *Trichostrongylus axie* occurred in both deer and cattle. Common liver flukes (*Fasciola hepatica*) infected cattle and swine but not deer. Only helminth *G. pulchurum* infected deer, cattle and swine. The finding suggested that helminths harboured by the host species are distinct with little exchange occurring.

Prestwood *et al.* (1976) studied parasitism among white-tailed deer and domestic sheep on common range. *Sarcocystis* spp., *Cysticercus tenuicollis, Oesophagostomum venulosum, Cooperia punctata* and *Gangylonema pulchrum* occurred in both deer and sheep. An index of similarity of 17.2 suggests that the parasite faunas of these hosts are distinct and that it is unlikely that white-tailed deer are reservoirs of common parasites of domestic sheep.

Hiregaudar (1976) documented *Oesophagostomum venulosum, Ashworthius martinagliai* and *Stephanofiliaria* spp. of two Nilgai (*Boselaphus tragocamelus*), *Stilesia globipunctata, Oesophagostomum*

radiatum in one Chital (*Axis axis*) at post-mortem. *Cervus unicolor* and *Gazella gazella* for *Trichuris* spp. and *Trichuris* spp. and *Trichostrongylid* ova, respectively.

Karasev and Litvinov (1977) reported *Fasciola hepatica* in wild boars and *Bison bonasus*, but the intensity of infection was low due to few intermediaries in the bison's habitat.

Gaur *et al.* (1979) studied prevalence of helminth infection in wild and zoo animals. Out of 122 samples of wild deer (*Axis axis* and *Cervus duvaucelli*) of National Jim Corbett Park, 79 (64.75%) were positive of helminthic infection include *Fasciola gigantica* 13 (16.46%), *Amphistomes* 10 (12.66%), *Strongyloides papillosus* 12 (15.19%), *Oesophagostomum* spp. 4 (5.06%), *Strongyle* 16 (20.25%) and *Haemonchus contortus* 24 (30.38%). In Zoological Park, Kanpur out of 11 samples of deer *Strongyle* (5) and *Bunostomum* spp. (1) were positive. In black buck and langur showed *Strongyles*, *Haemonchus contortus* and *Ancylostoma* spp., respectively.

Khan *et al.* (1981) recovered Toxocara spp. infection in one Olive baboon monkey at Nehru Zoological Park, Hyderabad.

McGhee *et al.* (1981) inoculated *Haemonchus contortus* of white tailed deer and cattle origin to the fawn, yearling of white tailed deer, lambs, calves and fawn of white tailed deer respectively. Deer harbouring *H. contortus* burdens >70 worms/kg body weight had decreased packed cell

volumes, haemoglobin and total serum protein value. There was neither a significant difference in infectivity of deer-derived *H. contortus* for these hosts, nor for deer of deer-derived or cattle-derived parasites.

Dakshinkar *et al.* (1983) reported *Trichuris* spp. in deer (*Axis axis*) and concluded that animal must have acquired the infection through infected fodder.

Bordoloi *et al.* (1991) calculated incidence of intestinal helminthic infection of captive deer, 33.33 per cent of deer infected by intestinal helminth infection. The highest infection (50%) was due to *Trichostrongylus* followed by *Bunostomum* (25%) and *Dicrocoellum* (25%).

Chakraborty (1992) reported *Trichuris* spp. infection in wild captive herbivores. Ten (4.67%) animals of six species were found to have the infection. Mouse deer (*Tragulus meninna*) 1, Black buck (*Antilope cervicapra*) 3, Serow (*Capricornis sumatraensis*) 2, Mithun (*Bos frontalis*) 1 and Giraffe (*Giraffa cameloporedelis*) 3 were affected. The parasites were identified as *Trichuris corvicapra* in Black buck and Serow, *Trichuris ovis* in Mithun and *Trichuris giraffae* in Giraffe.

Verma *et al.* (1993) recorded *Paramphistomes* from rumen and bile duct of a male sambar and concluded that ruminal and hepatic *Paramphistomes* occur in domestic and wild ruminants, which indicates that the sambar and other cervids under natural condition may serve as a reservoir host.

Chakraborty and Islam (1996) studied gastrointestinal parasitic infection in some living herbivores in the Kaziranga National Park. A total of 171 samples collected, 40.35% positive for one or mixed infections. Specieswise infection rate was found to be 22.85%, 21.85%, 49.31% and 58.06% in hog deer, swamp deer, water buffalo and elephant, respectively. Parasitic ova of *Paramphistomum, Fasciola, Strongyle, Trichuris, Oesophagostomum, Strongyloides, Ascaris* and Cestodes along with oocyst of *coccidia* in swamp deer and buffalo. The infection was higher in water buffalo than in cervids as the reservoir status of these wild animals for *Fasciola* infection appeared to be quite significant, as it is an important parasite of domestic ruminant

Modi *et al.* (1997) reported 46.67% of the herbivores zoo animals of Bihar was positive for parasitic infection. Maximum percentage of infection was observed during monsoon (46.59%) and minimum in summer season (41.39%). Capped langoor and golden langoor as well as common langoor showed the infection rate 100% and above 50%, respectively in most part of the year. The herbivores animals i.e. Nilgai, Black buck and Sambar maintained on range pastures, showed 25%, 26.31% and 28.36%, respectively compared to spotted deer (*Axis axis*) of 43.48%.

Shrivastav *et al.* (1997) examined herd of swamp deer in Kanha National Park (Madhya Pradesh), revealed the presence of several

Amphistomes from the rumen. The *Amphistomes* collected were identified as *Gastrothylax cruminifer* and *Gastrothylax glandiformis*. Both of these species of *Amphistomes* are parasites of sheep, goat, cattle and buffalo. Occurrence of these infections in wild host suggested that swamp deer could play a role of potential host for *Amphistomes*.

Singh and Banerjee (1997) stated certain parasitic diseases which are either shared among man / domestic and wild animals or may be transmitted among them when a definitive host ingests an intermediate host. The examples include Zebra and Wild Ass which are susceptible to almost all the parasitic diseases which affect horse like Surra, Ascarisis, Strongylosis, *Strongyloides westeri*, *Trichostrongylus* axei, *Dictyocalus amifieldi* and *Gastrodiscus* spp. Similarly Deer, Yak, Wild buffalo and Bison suffer from the parasitic diseases which affect other domestic ruminants mainly Coccidiosis, Babesiosis, Dicrocoeliasis, Paramphostomiasis, Monieziasis, Echinococasis and Taeniasis.

Bhat and Manickam (1998) recorded third stage larvae of *Strongyloides* spp., *Trichostrongylus* spp., and *Cooperia* spp. in spotted deer. Infection in the herbivores touched peak during winter and southwest monsoon because after rain due to luxurious growth of pasture and the atmosphere conducive for increased pasture contamination and development of infective larvae.

Varadharajan and Pythal (1999 a) carried out faecal sample examination of 32 Bonnet Macaques (*Macaca radiata*) in Mettala village,

Tamil Nadu, 30 monkeys were infected with one or more parasite species (16 with more than one). *Strongylids* and *Strongyloides* spp. were found in 13 monkeys, *Ascarids* in 11, *Coccidia* in 9. No trematode or cestode infections were found. None of the monkey showed any obvious clinical illness.

Varadharajan and Pythal (1999 b) investigated parasite of wild animals at the Zoological Garden at Kerala, 76% animal harbouring infection in which 74% helminthes and 20% protozoa. *Strongyles, Ascarididae, Toxocara*, *Coccidia* and Ciliates were found in herbivores and omnivores were positive for *Strongyloides, Fasciola, Spiruridae*, *Toxocara, Hymenolepsis, Entamoeba, Balantidium* and *Coccidia*. The affected animals appeared to be in good condition. 20999

Chakraborty and Goswami (2001) carried out necropsy study of 85 captive non-human primates of Assam State Zoo. The parasites identified were *Trichuris trichurina* (9.41%), *Filarial* parasite (7.05%), *Enterobius vermicularis* (4.70%), *Oesophagostomum aculeatum* (4.70%) and unidentified cestode parasite (1.70%). The occurrence of *Fasciola gigantica* in the bile duct of common langoor was recorded. Coprological examination revealed the presence of *Enterobius* spp. (41.66%), *Trichuris* spp. (33.33), *Ancylostoma* spp. (13.88%), *Ascaris* spp. (8.33%) and *Strongyloides* spp. (2.77%).

Parsani *et al.* (2001) documented prevalence of parasite in some wild mammals at Rajkot, 60.71% of animals positive for helminthic infection, out of which 68.75% nematode, 18.75% cestode and 18.75% suffered for intestinal protozoan infection. In herbivores animals prevalence reported 75% includes 83.33% *Trichostrongylus* and *Strongyloid*, *Coccidia* and *Balantidium coli*. Two samples of blue bull and spotted deer showed mixed infection of *Trichostrongylus* and *Balantidium coli* and *Trichostrongylus* and *Coccidia* infection, respectively. Black buck showed 50% of *Trichostrongylus* infection.

Pramod Kumar (2001) reported over all percentage of parasitic infection about 18.23% in wild as well as domestic animals. Amongst wild herbivores, highest prevalence was observed in bison (33.33) and in the resident livestock population, bullocks had the highest prevalence of 21.05%.

Agunolye *et al.* (2002) conducted survey of gastrointestinal nematode in soil samples of Ibadan, Nigeria and concluded soil may play an important role in the epidemiology of parasitic infection in animals and man.

Banerjee *et al.* (2002) screened faecal samples of wild animals in Uttaranchal for presence of various parasite eggs/oocyst. Deer (62.5%), Nilgai (80.9%), Elephant (90.9%) and Wild boar (90.6%) were found positive for parasitic eggs/oocyst. *Fasciola, Amphistomes*, *Strongyle* and *coccidian*

infections were common in deer, nilgai and elephants, whereas *Metastrongylus* spp., *Macracanthorynchus hirudinaceus*, *Trichuris* spp., *Capilloria* spp., *Strongyles* and *Physocephalus* spp. were common parasites in wild boars. Faecal samples of 60% musk deer examined showed the infection of *Protostrongylus, Muellerius, Strongyles* and *Coccidian* parasites.

Bhowmik (2002) studied the cause of decline of Hog deer (*Axis porcinus*) in protected areas of Himalayan West Bengal. During the survey, quite number of livestock animals, mainly cattle from the villages of protected areas were found grazing in the grassland. Livestock grazing more pronounced during summer months when competition for fodder between the wild herbivores and domestic cattle and buffalo occurs. Livestock grazing not only limits the availability of food for Hog deer and other wild herbivores, but also possibly exposes the Hog deer population to the risk of livestock borne disease. Certain parasitic diseases are likely to be transmitted from livestock animals that graze in the grassland habitats of the protected areas utilizing the common grazing fields of Hog deer and other wild herbivores.

Mandal *et al.* (2002) examined faecal sample of free ranging Chital from different area like grazing area distributed and undistributed by cattle and areas around water holes and from dead and kills in Mudumalai Wildlife Sanctuary and concluded the parasitic prevalence found increased

significantly in grazing area distributed by cattle in first wet season as compared to season which include the maximum percentage of helminthic infection are of *Strongyle* spp. (41.67%), *Strongyloides* spp. (11.46%), *Ascaris* spp.(5.29%), *Trichuris* spp. (8.33%), *Moniezia* spp. (2.08%), *Amphistome* (15.63%) and *Fasciola* spp. (13.54%).

Patel *et al.* (2003) studied helmintic infection of wild herbivores of captivity and Season Gir Forest. Faecal sample of deers, sambar, black buck, chinkara, nilgai and chowsinga positive for ova of helminths and/or oocyst of coccidia *Eimeria* spp. were recorded in 43.35% of captive animals and 84.05 % in free living animals. Prevalent species were *Trichostrongyles, Trichuris, Strongyloides, Fasciola* and *Amphistomes*. Species of parasite affecting free living and captive wild ruminants remained similar, but the prevalence and intensity of helminth was higher in free living than the captive animals.

Micrometry and Morphometry

Georgi and Theodorides (1980) presented the micrometry values of various parasites in animals.

Soulsby (1982) mentioned specifically as regards helminthes micrometry and morphometry of helminths ova of domesticated and wild animals.

Nama (1990) described on the micrometry and morphometry of various cestode parasites of Indian mammals.

Pramod Kumar *et al.* (2002) stated micrometry and morphometry of parasitic ova of free ranging wildlife. They described ova of *Trichuris trichuria* isolated from monkey, first stage larvae of *Dictyocalus viviparus* from bison, spotted deer, sambar, nilgai, *Strongyloides* spp. from wild boar, and *Strongyle* ova from spotted deer.

Treatment (Therapeutic Measures)

Booth and McDonald (1988) stated complete eradication of Moniezia tapeworms can be expected if regular therapeutic dose of fenbendazole @ 7.5 mg/kg of cattle, higher dose of 15 mg/kg. Fenbendazole is not much effective against *Fasciola hepatica* to that of albendazole but apparently has better activity against *Moniezia* and *Dicrocoelium* of sheep at increased single dose of 10 mg/kg and 100 mg/kg respectively. Adult and migrating immature stages of rumen flukes (*Paramphistomum* of cattle are partially susceptible - approximately 75%) to treatment with fenbendazole. Fenbendazole can be used in horses, dogs, swine and cattle. Fenbendazole is effective for lungworm infection caused by *Dictyocalus*. All the major gastrointestinal parasites of ruminants (*Haemonchus, Ostertagia, Chabertia, Oesophagostomum, Strongyloides*) are eliminated by the substituted benzimidazoles. The adult form of gastrointestinal parasites is most effectively expelled by benzimidazoles, including immature ones.

Sathyanarayana (1992) discussed that helminth parasites affect the behaviour, assimilation of nutrients and other aspect of the host thereby lead

to the ill health of wild animals. These effects may result in reducing the population of host well below the carrying capacity of the range. The problem becomes more complicated as these nematode parasites are combined. The infection could be controlled by reducing the probability of ingesting eggs and infected food, water and faeces. Similarly by prevention of contact between the diseased animals and other ungulates of the area, the infection can be prevented.

Shahardar *et al.* (1995) reported single dose of Fenbendazole @ 7.5 mg/kg body weight was highly effective against the common gastrointestinal nematodes of Kashmiri Hangul.

Shreedevi and Hafeez (2001) recorded 100 % efficacy in elimination of *Trichuris* in cattle on 14th day by using suspension of 25% fenbendazole @ 7.5-mg/kg body weight.

Faecal Egg Count

Shahardar *et al.* (1995) reported *Strongyles* and S*trongyloides* spp. in Kashmiri deer (Hangul). EPG varied between 100-150 of *Strongyle* and 100-1100 of *Strongyloides*.

Agneessens *et al.* (1997) studied epidemiology of gastrointestinal nematode during grazing season and observed high egg counts in the calves (Mean up to 778 EPG).

Yadav and Sadana (1999) recovered majority of *Haemonchus placei* in dairy cattle whose number varied from 1800 to 9150 (5670 ± 2996.6) in

five animals. *Oesophagostomum radiatum* (74.4 ± 70.2), *Bunostomum phlebotomum* (16.00 ± 19.9) and *Trichuris globulosa* (1.0 ± 1) were also found. The pre-treatment faecal eggs counts of live animals in the two groups were 1475 ± 497 and 1527 ± 457 respectively followed by reduction (99%) in faecal count on day 10 after treatment.

Shreedevi and Hafeez (2001) reported *Trichuris* infection in cattle and EPG ranges between 967-1033 in two different groups of cattle.

Haemato-biochemical of cattle

Thakur and Mishra (1973) carried out hematological studies in calves with helminthic infection and observed decrease in the percentage of Hb, PCV and total erythrocyte count, also monocyte and eosinophil with slight decrease in the neutrophil count in the affected calves.

Bhongade *et al.* (1993) recorded helminthic and liver fluke infection prevalent in large scale in dairy cow which include 66% of single type of worm (*Strongyles* 36.36% and liver fluke 36.36%) and 34% with more than one species of helminthes (Liver fluke and *Haemonchus* spp. 55.88%, *Ascaris* and *Haemonchus* 5.88%) clinicopathological study revealed sub optimal levels of haemoglobin, blood glucose, total serum protein and serum calcium during same infection, however the values were restored after therapy.

Waghmare *et al. (1993)* reported low haemoglobin concentration (8.62±0.34) in helminth infected calves. The lower values of Hb in infected calves improved significantly after effective treatment. The mean PCV per

(30.25±3.47) and post treatment (31.12±2.07) did not differ significantly. Differential leucocyte count revealed significant changes in neutrophil and eosinophil.

Raman *et al.* (1999) studied haemo-biochemial changes in experimental bovine haemonchosis. Mean haemogram values in the experimentally infected calves showed a positive correlation with blood loss due to the blood sucking activity of the parasite. Significant decrease was recorded in haemoglobin (16 %) and packed cell volume (34 %) in the infected calves from day 7 to 19 post infection. Marked lymphopaenia (42 %), neutrophilia (56 %) and eosinophilia (6 %) were also noted from 2-5 weeks of infection.

Bandyopathyay and Dasgupta (2000) documented reduced blood glucose levels in parasitised treated and untreated group of *Trichostrongyle* infection in calves. Maximum glucose level was observed in control group. Most of calves from parasitised treated group showed hypoproteinaemia followed by normalcy in blood glucose, serum albumin and total protein values after treatment.

Jithendran and Bhat (2001) reported prevalence of *Fasciola* spp., *Amphistome* spp., *Strongyles* spp., *Toxocara* spp., *Dicrocoelium* spp., *Strongyloides* spp., *Trichuris* spp., *Moniezia* spp., *Capillaria* spp. infection in cattle of nomadic situation. Peripheral blood eosinophilia (15-50%) one of the most important markers of parasitic infections. However, lack of eosinophils either in the blood or body fluids does not preclude the

diagnosis of parasitic infections.

Bharti *et al.* (2002) discussed haematological parameter viz., Hb, PCV and TEC found decrease significantly. However the parameters significantly increased on 10th day post treatment. The MCV, MCH and MCHC values were non-significant in both the infected young and adult animals after treatment.

Jani *et al.* (2003) examined haematological finding of elephant harbouring parasites (*Fasciola* spp. 15.00%), revealed mild anemia and eosinophilia whereas biochemical studies showed non-significant hypoproteinemia when compared with elephants not harbouring parasites.

Upadhyay *et al.* (2003) studied haematobiochemical alterations in experimental bovine fascioliasis. Significant decrease in haemoglobin, TEC and PCV occurred from 4th, 7th and 8th week respectively. Total protein value remained unchanged throughout the study period but continuous decreasing trend in serum albumin, however observed 2nd week onwards.

Body Condition Evaluation

Riney (1960) described a simple method of body condition evaluation for different species of African ungulates largely based on the protuberance of bony processes of hindquarters. In ungulates the key area of assessment include flank area, ribs, points of pelvic girdle, lateral view of vertebral column and the lumbar self.

Lardy (2000) developed comman body condition evaluation system to estimate the average body condition of cows in a herd of beef cattle. This system provides producers a relative score based on an evaluation of fat deposits in relation to skeletal features.

Soil, Fodder, Serum and water analysis

Pramod Kumar (2001) carried out soil analysis from three different locations of Pench revealed high contents of phosphorus and deficient in calcium. Forage was recorded also deficient in calcium.

Das *et al.* (2003) carried out micronutrient profile of feeds, fodders and animals in hill zone of West Bengal. Napier grass, the most commonly cultivated green fodder, showed moderate content of Ca (0.50%) and low level of P (0.20%). Feeds /tree leaves for animal feeding were moderate source of Ca (0.26-0.89%) but poor source of P (0.14-0.17%). Plasma Ca (mg/100 ml) in cattle 8.75 were within normal limits and plasma P level in buffaloes (3.93 mg/100 ml) was below the critical levels. High content of macro Ca in feed reflected in the blood of all the categories of animals, Most of the feed ingredients were deficient in P and the same trends also reflected in blood of cattle and buffaloes.

Sharma *et al.* (2003) documented prevalence of mineral deficiency in soil, plants and cattle of Uttar Pradesh. Over all deficiency of Ca, P in soil was 24.89% and 27.35% whereas fodder represents deficiency of Ca (19.19%) and P (23.89%). In cattle deficiency was 32.42% and

30.45% of Ca and P, respectively. These preclude that serum mineral deficiencies correspond with mineral status of soil and fodder.

Singh and Swarup (2003) described sources of fluoride toxicity in which stated that mineral supplement containing rock phosphate as a phosphorus sources contain 2-5% fluoride and also stated toxic effects of fluorosis and type of fluorosis. Top dressing of pasture with phosphatic limestone is a common cause of fluorosis.

Upadhyay *et al.* (2003) screened cattle and buffaloes in Central East India for monitoring the prevalence of bovine fluorosis. The overall prevalence of bovine fluorosis was 3.96%, which was almost equally distributed between cattle and buffaloes.

MATERIALS AND METHODS

The present study was undertaken on the resident domestic livestock (cattle) population within protected areas as well as various species of wild herbivores animals of Pench National Park, Maharashtra (Fig.1).

1. Sampling procedure of faecal samples:

Fresh faecal samples were collected from free living wild herbivores animals viz., Chital (*Axis axis*), Sambar (*Cervus unicolor*), Nilgai (*Boselaphus tragocamelus*), Bison (*Bison bison*), Langoor (*Prebytis entellus*), Barking deer *(Muntiacus muntjak)* and Bear *(Ursus americanus*) during the day after fresh defecations.

Faecal samples from Resident livestock population (Fig. 2) within protected area were collected directly from rectum.

The faecal sample of wild animals and livestock were preserved by adding 10% formaline.

2. Identification of endoparasites:

Faecal samples collected were processed by Sedimentation technique (Fig. 3) as per Soulsby, 1982. Microscopically the eggs and larvae were identified based on their morphometry and micrometry to ascertain the species of the helminths (Soulsby, 1982; Fowler, 1986 and Pramod Kumar *et al.*, 2002). The lengths of ova/eggs/larvae were measured with

microscope equipped with an object micrometer and an eyepiece micrometer.

3. Coprological examination:

The egg per gram (EPG) was assessed as per Stoll's dilution method (Soulsby, 1982) for assessing intensity of infection.

4. Therapeutic measures:

After confirmation of helminthic infection in the population of all resident livestock (cattle) in protected area of Pench National Park, Maharashtra, it was subsequently dewormed by Fenbendazole* @ 7.5 mg/kg body weight given orally. (Soulsby, 1982; Booth and McDonald, 1988)

5. Collection of blood samples:

Blood samples from 20 cattle from different pocket of resident livestock were collected from Jugular vein before and after therapeutic measure.

For haematological assay heparinised blood samples were collected in sterile bottle. Sodium fluoride was used as preservative for blood glucose estimation. Whole blood was collected in sterile vial for serum chemistry. After separation of serum, serum samples were stored in serum vials at

---

* Fentas bolus – 1.5 gm – Intas Pharmaceuticals Ltd., Ahmedabad (India).

-7 ^{0}C by adding 1 ppm Merthiolate for estimation of serum total protein, calcium and phosphorus.

Thin blood smears were drawn on grease free slide by puncturing tip of ear for assessing possibilities of blood parasite infection.

6. Haematological study:

The haemoglobin (Hb) was assessed by Cyanmethaemoglobin method using Drabkins reagent. The pack cell volume (PCV) was done by microhaematocrit method and total leucocyte count (TLC) and total erythrocyte counts (TEC) was carried out using Neubaur Chamber method and expressed 10^3/cumm. and 10^5/cumm. The differential leucocyte cell counts (DLC) were arrived at by the methods of Feldman *et al.* (2000). The blood smears were stained with Leishman's stain and examined to rule out possibilities haemoprotozoan infection.

7. Haematobiochemical profile:

Blood glucose, serum calcium and phosphorus was estimated by commercial available kits (Span Diagnostic Laboratory Kits). Total serum protein was estimated by Biuret methods.

8. Collection of grass, soil and water samples:

Different grasses of common grazing land of wild herbivores and resident livestock population were collected in plastic bag from Pench

National Park, Maharashtra. About 500 gm sample was collected, after collection of samples they were brought to the laboratory. The samples were kept in oven for drying and subsequent finely ground samples were stored in small plastic bags for further mineral analysis.

Representative surface soil samples were collected from five different places (Fig.10). The oven dried samples were finely ground, stored in bags and used for further mineral analysis.

Representative sample of water from water whole of Pench National Park, Maharashtra were collected in a sterile bottle and kept it for further mineral analysis (Fig.16).

9. Digestion of soil and grass samples:

One gram oven dried and finely ground sample of soil and grass was weighed accurately. The sample was transferred to 100 ml conical flask to which 5 ml of concentrated nitric acid was added and kept for overnight. Next day 5 to 8 ml of di-acid mixture (nitric acid and perchloric acid 10:4) was added to it and kept for digestion on hot plate, initially at low temperature for half hour and then temperature was increased. The digestion was continued till clear liquid was obtained. The digested mixture was then transferred to 100 ml volumetric flask and volume was made with glass triple distilled water (AOAC, 1975).

10. Digestion of serum sample:

2 ml serum sample was taken in a test tube to which 2 ml 20% TCA solution (Trichloroacetic acid) was added. The test tube was heated 90 ^{0}C for 15 minute in water bath. After removing from the water bath it was centrifuged. The supernatant was used as a master sample. The master sample was diluted to forty fold glass triple distilled water (AOAC, 1975).

11. Soil, Grass and water analysis :

All the soil and grass samples were analysed for fluorine, calcium and phosphorus (F, Cu, P) and water samples for fluorine (F) using Atomic Absorption Spectrophotometer-4141 (ECIL, Hyderabad.).

12. Body condition evaluation (BCE):

A criteria suggested by Riney (1960) for evaluating body condition of some ungulates was adopted for monitoring the appearence of free-living mammals. Body condition evaluation involved judging the physical condition of the animals, based on the visual examination of the degree of protuberance of bony processes on the body surface. These proturbance are seen on the hip (as processes of pelvic bone), chest (as visibility or ribs), abdomen (as depression of flank area), back (as depression on either side vertebral column i.e. lumbar shelf).

BCE is generally expressed in the form of indices, referred here as body condition index (BCI). The method is made more qualitative by giving scores for different body parts and value is obtained. The recommended scores for the corresponding condition quality of different body parts are given in table. The index is employed to compare the mean body condition of two population of a same species, amongst different individual of any particular age and sex category of a population and between populations.

Evaluation of different body parts

BODY PART	POINT = 0	POINT = 1	POINT = 2	SCORE
Flank area	Depression is barely visible Flank area outline is indistinct.	Slightly concave outline visible	Depression concave and tucked up.	
Ribs	Thoracic surface is smooth and ribs are difficult to see.	Ribs are visible but not all can be counted with ease.	Ribs prominent with distinct intercostals depressions.	
Pelvic girdle	Bony projections of pelvic girdle are barely visible.	Outline slightly visible.	Bony projections of pelvic girdle are clearly visible.	
Vertebral column	When seen laterally, it runs smooth without any breaks. Lumbar processes visible.	Lateral processes of lumbar vertebrae are visible but not prominent.	Lateral processes of lumbar vertebrae prominent. Dorsal processes of vertebrae seen.	
Lumbar shelf	No depression in shelf. Appear almost round from behind.	Slight depression on either side.	Depression deep and concave.	

Interpretation { 0-4 Good
5-7 fair
8-10 Poor

13. Analysis for data:

Statistical analysis of the data was carried out by using standard statistical procedures and interpretations were based on findings as prescribed by Snedecor and Cochran (1967).

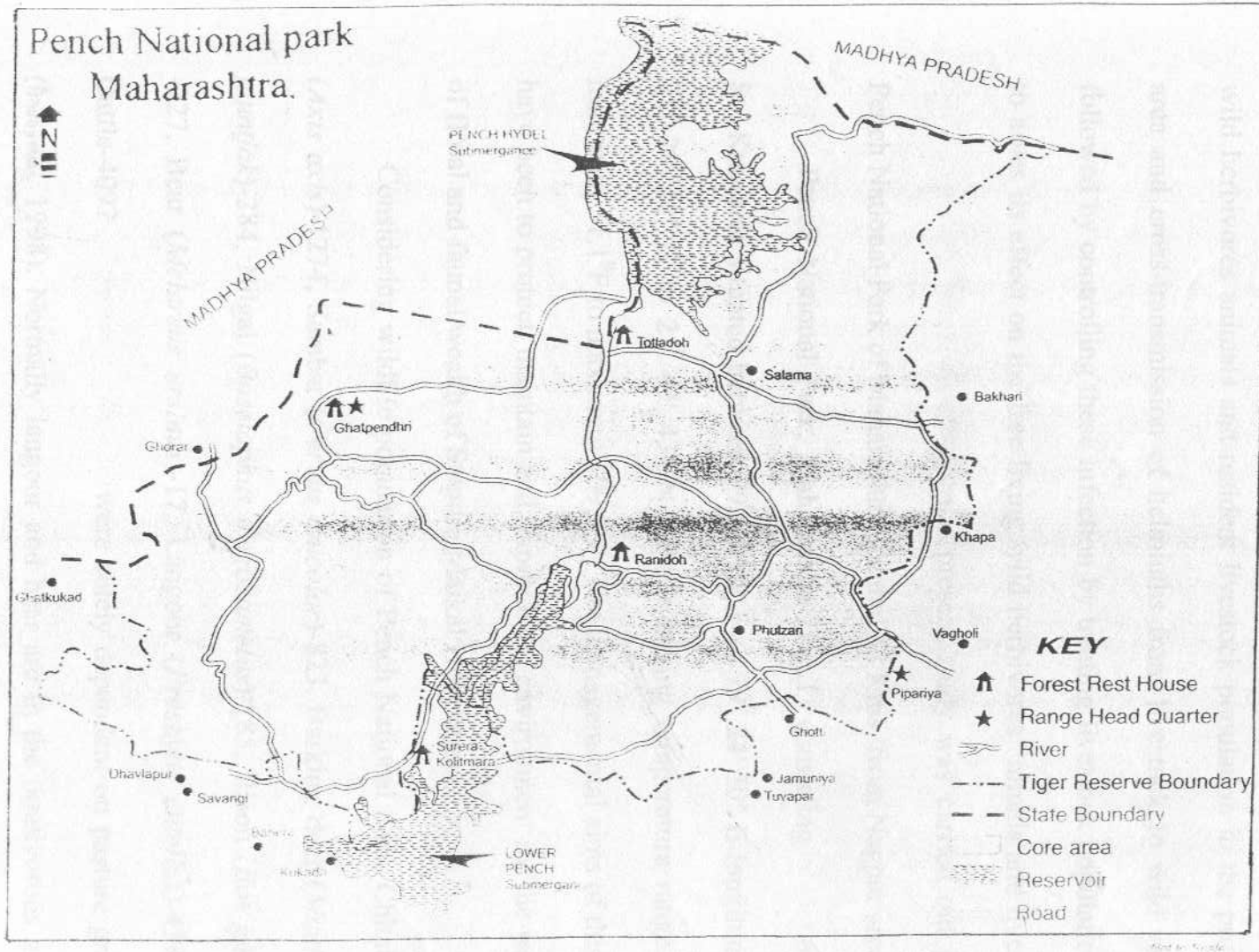

Fig. 1: Place of Work : Pench National park, Maharashtra.

RESULT AND DISCUSSION

To study the prevalence of helminthic infection in wild free range wild herbivores animals and resident livestock population in the protected area and cross-transmission of helminths from livestock to wild animals followed by controlling these infection by treating livestock population and to asses its effect on the free living wild herbivores animals and livestock, the present study was carried out in the Pench National Park of Maharashtra located 52 Kms. from Nagpur area.

Pench National Park, Maharashtra (Fig.1) consisting 664.30 Sq. Km. area situated between 79^0 4' 10" E to 79^0 24' 50" E longitude and 21^0 29' 15" N to 21^0 43' 43" N latitude having temperature range from minimum 51.1^0F to maximum 109.5^0F. The managemental aims of this park have been to protect, maintain and improve the environment for the welfare of floral and faunal wealth of Satpura Maikal Hill range.

Considering wildlife population of Pench National Park, Chital deer (*Axis axis*)-1274, Sambar (*Cervus unicolor*)-823, Barking deer (*Muntiacus muntjak*)-284, Nilgai (*Boselaphus tragocamelus*)-185, Bison (*Bos gaurus*) -227, Bear (*Melursus ursinus*)-17, Langoor (*Presbytis entellus*)-438 and Cattle-4097 were solely dependent on pasture grazing (Anonymous, 1998). Normally langoor and bear are in the omnivorous group, but due to their habitat by virtue of eating fruit, leaves and dead material,

which were fallen on the ground. Similarly sneezing ground and grasses thereby perpetuate contact with the pasture, hence included in the herbivores group in the present study.

During the course of present study, the prevalence and distribution of helminths among wild herbivores and resident livestock population that utilized common grassland for grazing purpose within protected area of Pench National Park, Maharashtra was carried out. Treatment using broad spectrum antihelminthic, Fenbendazole* @ 7.5 mg/kg body weight orally was given to livestock population (Soulsby, 1982; Booth and McDonald, 1988; Shreedevi and Hafeez, 2001). The effect of helminth on livestock and its impact on wild herbivores animals was studied and evaluated as under.

Table 1: Prevalence of parasitic infestation in free ranging wild herbivores and resident livestock population.

Sr. No.	Type of Animals	Total samples	Positive samples	
			No.	%
Pre treatment prevalence				
1.	Wild herbivores	148	29	19.59
2.	Resident livestock population (Cattle)	120	41	34.17
	Total	**268**	**70**	**26.12**
Post treatment prevalence				
1.	Wild herbivores	148	7	4.73
2.	Resident livestock population (Cattle)	120	2	1.67
	Total	**268**	**9**	**3.36**

* Fentas bolus – 1.5 gm – Intas Pharmaceuticals Ltd., Ahmedabad (India).

Fig- 2 : Resident livestock population grazing into forest.

Fig- 3 : Processing of faecal sample by sedimentation technique.

Of the 536 samples collected, in two phases considering half of these in pretreatment and half at post treatment. In phase I (pre treatment phase) 268 samples examined out of which 70 samples found positive for different parasitic infestations, the overall percentage of infection being 26.12%. In these examinations, 120 samples of livestock population and 148 samples of wild herbivores animals were screened out of which 41 (34.17%) and 29 (19.59%) were positive for different helminth infection, respectively (Table 1).

Deka *et al.* (1995) recorded a helminthic incidence in domestic animals (cattle) in Lakhimpur (Assam) and the percentage of infection found was 52.1%. Hirani *et al.* (1999) examined faecal samples of cattle and buffaloes of Kheda district of Gujrat, revealed 38.86% samples positive for parasitic infections. 60.78% prevalence of intestinal nematodes in female calves of Greater Guwahati of Assam was noted by Rajkhowa and Hazarika (2001). Sahoo *et al.* (2002) showed 49.96% prevalence of gastrointestinal helminthic infection among grazing and stall fed cattle in rain-fed district of Orissa. However, Pal *et al.* (2001) reported 19.9% prevalence of gastrointestinal parasites in cattle of Chattisgarh region. The variation in the present study could be attributed to a number of factors leading to climatic condition thereby favours contamination to pasture, in addition to above untreated water, moisture content of the faeces and the immune response of the host may also

contributes to suppress the fecundity of the parasites.

On considering wild herbivores animals in the present study the overall prevalence of helminthic infection showed 19.59%. Gaur *et al.* (1979) reported 64.75% prevalence in wild deer at National Jim Corbett Park, 60.71% prevalence documented in wild mammals by Parsoni *et al.* (2001) and 40.35% of prevalence recorded by Chakraborty and Islam (1996). Varadharajan and Pythal (1999 b) investigated 76% animals harbouring parasitic infection at Zoological Garden at Kerala. Maximum percent of infection was observed during monsoon (46.59%) and minimum in summer season (41.93%) in zoo animals of Bihar (Modi *et al.*, 1997). However Chakraborty (1992) indicated 4.67% prevalence in six species of wild captive herbivores animals. The scenario of variation as regards to prevalence observed indicates the fact that the managemental practices followed regularly in captivity includes deworming, hygienic management favours to curb the infection of worm in wild herbivores. In view of the fact intense burden of worm observed in captivity was definitely lesser than the free ranging animals. In addition to above parasitic ova, snails and other intermediate host are likely to be drained towards the water holes thus facilitating the surrounding areas to become more endemic for parasitic infestation. Environmental conditions are conducive for hatching for these parasitic ova and the greens, which are available at the periphery of water holes throughout the year and habit of the animals to congregate at such

place in more numbers, naturally acquires helminthic infestation. The shallow plane grazing area are normally utilized for grazing by the animals but in rainy seasons this areas available as a temporary water sources (Fig.18 and Fig.19) due to stagnation of water, and these area succumbed to contamination and act as source of infection during grazing and drinking water by animals. The finding of the present study shows prevalence of helminth infection in free range wild herbivores about 19.59% are in agreement to Pramod Kumar (2001), who reported 19.28% prevalence in Pench National Park. This could be probably due to similar habit predomination at the location.

Table 2 : Animalwise prevalence of parasitic infestation in free ranging wild herbivores and resident livestock population.

Sr. No.	Species of animals	Prevalence of parasitic infestation					
		Pre treatment			Post treatment		
		Total sample	Positive	%	Total sample	Positive	%
Wild herbivores							
1.	Chital deer	21	6	28.57	21	2	9.52
2.	Sambar	22	4	18.19	22	1	4.55
3.	Nilgai	20	2	10.00	20	1	5.00
4.	Bison	24	7	29.17	24	2	8.33
5.	Barking deer	20	4	20.00	20	1	5.00
6.	Bear	20	2	10.00	20	---	---
7.	Monkey	21	4	19.05	21	---	---
	Total	148	29	19.59	148	7	4.73
Resident livestock population							
1.	Resident livestock population (cattle)	120	41	34.17	120	2	1.67
	Grand Total	**268**	**70**	**26.12**	**268**	**9**	**3.36**

In all, seven species of wild herbivores from protected areas of Pench National Park were screened to ascertain the prevalence of helminthic infection and the result are presented in Table 2.

The 7, species of wild herbivores are included which normally found (habitat) in this particular area while the Bear and Monkey are normally included in omnivores group however by virtue of their simulating habitat corresponding to wild herbivores animals they are being included to herbivores group in the present study. It is evident from Table 2, that Bison registered highest prevalence of 29.17% followed by Chital deer 28.57% and Barking deer 20.00%, respectively. The estimated prevalence of gastrointestinal helminth in Sambar 18.19%, Nilgai 10.00%, Bear 10.00% and Monkey is about 19.05%.

Amongst, the wild herbivores, highest prevalence was observed in Bison (29.17%), which can be attributed to host body size and home range because a large host has higher intake of water and large home range, thus presumely acquiring large number of infective stage. In addition to above the habit of voracious feeding also contributes the chances of infection. The estimated prevalence in Chital deer was (28.57%), similar finding was observed by Bordoloi *et al.* (1991) that 33.33% of deer were infected by intestinal helminth infection. Since the transmission enhances with population density in view of the fact of higher prevalence ought to expect in these wild ruminants. Least estimated value in Bear (10.00%) could be due to meagre population

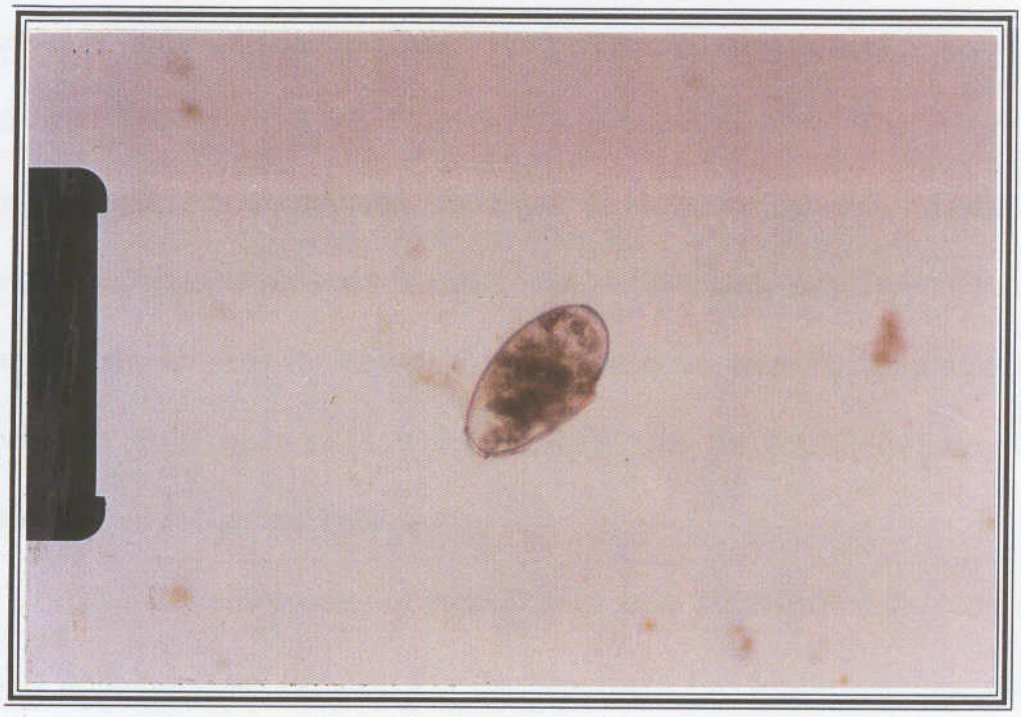

Fig- 4 : Ova of Paramphistome spp. of cattle. (100 X)

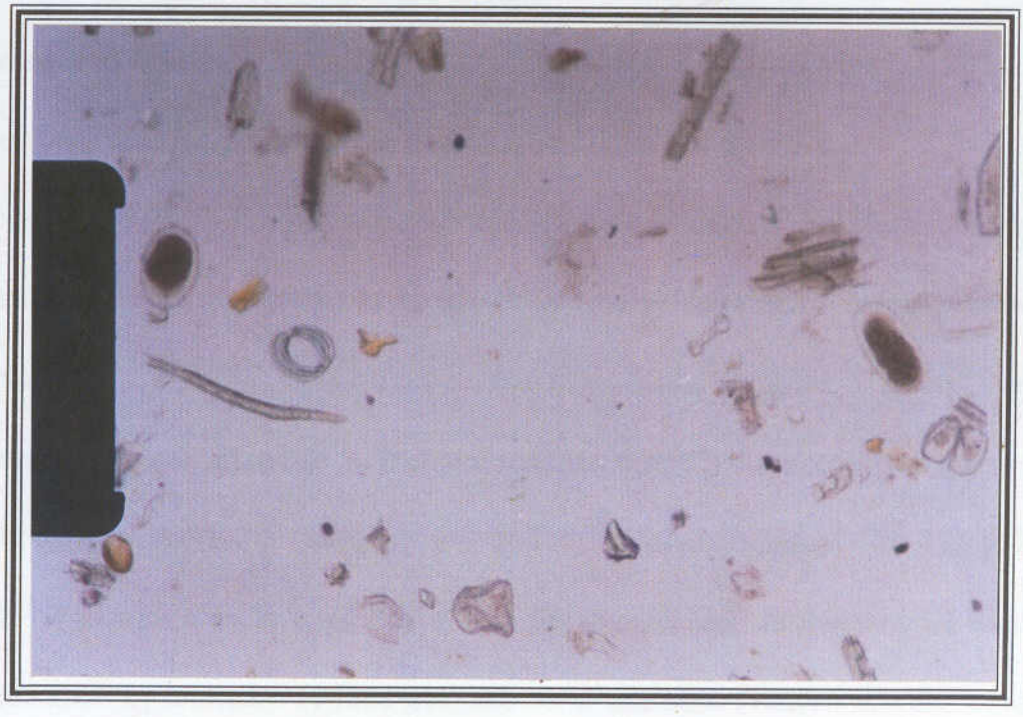

Fig- 5 : Ova of Strongyle spp. in cattle. (100 X)

density as well as lowest contact to the source of infection by virtue non-cohesion to the grazing land. The percentages were calculated on the basis of number of animals screened and found positive. The domestic animals within protected areas were also screened for parasitic infestation and the infestation recorded in cattle was 34.17%. Only cattle are included in domestic animals in view of the fact that these were the only animals available in the study areas, which regularly goes for grazing in protected areas of Pench National Park.

The different species of parasitic ova were identified on the basis of their morphological features and measurements for confirmed diagnosis. The details are presented in Table 3. The micrometry findings recorded in the present investigations are compared with standard book values in respect of domestic Vs wild animals for the same parasitic species, so as to confirm whether inter species transmission does occur or not.

The parasitic ova were photographed and classified into taxonomic units based on qualitative as well as quantitative features. *Paramphistomes* ova (Fig. 4 and Fig. 9) were recovered from faecal samples of Chital deer, Sambar, Nilgai, Bison as well as the resident cattle within protected areas of Pench National Park, however revealed the measurements of 110-115 μ by 75-79 μ which is in confirmation to the faecal egg dimensions of cattle indicated by Soulsby (1982) and for wild animals Pramod Kumar *et al.* (2002). *Cotylophron cotylophorum*, *Paramphistome cervi* and *Gastrothylax*

Table 3 : Micrometry of different parasitic ova of wild herbivores and resident domestic animals.

Sr. No.	Animals	Parasite	Ova	Micrometry	
				Length (µ)	Breadth (µ)
1.	i) Chital deer	*Paramphistome*	Ova	110	78
	ii) Chital deer	*Paramphistome*	Ova	112	77
	iii) Sambar	*Paramphistome*	Ova	115	75
	iv) Nilgai	*Paramphistome*	Ova	114	76
	v) Bison	*Paramphistome*	Ova	110	79
	vi) Bison	*Paramphistome*	Ova	112	78
	vii) Cattle	*Paramphistome*	Ova	112	78
	viii) Cattle	*Paramphistome*	Ova	110	75
2.	i) Chital deer	*Strongyle*	Ova	88	44
	ii) Chital deer	*Strongyle*	Ova	84	47
	iii) Sambar	*Strongyle*	Ova	80	44
	iv) Sambar	*Strongyle*	Ova	82	45
	v) Nilgai	*Strongyle*	Ova	83	47
	vi) Nilgai	*Strongyle*	Ova	84	47
	vii) Bison	*Strongyle*	Ova	83	47
	viii) Bison	*Strongyle*	Ova	84	47
	ix) Barking deer	*Strongyle*	Ova	83	45
	x) Barking deer	*Strongyle*	Ova	82	45
	xi) Bear	*Strongyle*	Ova	83	46
	xii) Monkey	*Strongyle*	Ova	84	46
	xiii) Cattle	*Strongyle*	Ova	79	45
	xiv) Cattle	*Strongyle*	Ova	80	46
3.	i) Chital deer	*Trichuris*	Ova	59	24
	ii) Chital deer	*Trichuris*	Ova	58	24
	iii) Monkey	*Trichuris*	Ova	58	24
	iv) Monkey	*Trichuris*	Ova	57	24
	v) Cattle	*Trichuris*	Ova	75	38
	vi) Cattle	*Trichuris*	Ova	76	37
4.	i) Chital deer	*Oesophagostomum*	Ova	75	38
	ii) Bison	*Oesophagostomum*	Ova	73	38
	iii) Barking deer	*Oesophagostomum*	Ova	74	37
	iv) Cattle	*Oesophagostomum*	Ova	75	39
5.	i) Bison	*Moniezia*	Ova	60 µ diameter	
	ii) Nilgai	*Moniezia*	Ova	62 µ diameter	
	iii) Cattle	*Moniezia*	Ova	62 µ diameter	
	iv) Cattle	*Moniezia*	Ova	64 µ diameter	
6.	i) Sambar	*Strongyloides papillosus*	Ova	55	27
	ii) Barking deer	*Strongyloides papillosus*	Ova	52	20
7.	i) Monkey	*Toxocara*	Ova	76	65
8.	i) Cattle	*Fasciola hepatica*	Ova	145	78
	ii) Cattle	*Fasciola hepatica*	Ova	148	79
9.	i) Cattle	*Dictyocalus* spp.	Ova	82	36
	ii) Cattle	*Dictyocalus* spp.	Ova	84	35

cruminifer have been commonly reported in Sambar, Nilgai, Black buck and Barking deer by Patnaik and Acharjyo (1970) and in bison by Herd and Hull (1981). Verma *et al.* (1993) recovered *Paramphistomes* from rumen and bile duct of male sambar and concluded that ruminal and hepatic *Paramphistomes* occur in domestic and wild ruminants, however indicates that the sambar and other cervids under natural condition may serve as a reservoir host, Chakraborty and Islam (1996) reported parasitic ova of *Paramphistome* in swamp deer and buffalo. Shrivastav *et al.* (1997) collected *Amphistomes* from rumen of swamp deer identified as *Gastrothylax crumenifer* and *Gastrothylax glandiformis* and suggested that these species of *Amphistomes* are parasites of sheep, goat, cattle and buffalo, however occurrence of these infection in wild host suggested that swamp deer can be a potential host for *Amphistomes*. *Paramphistome cervi*, *Calicophoron calicophorum* reported in the cattle by Chaudhri *et al.* (1993), Deka *et al.* (1995), Hirani *et al.* (1999), Jithendran and Bhat (2001), Pal *et al.* (2001), Sahoo *et al.* (2002). The present investigations were undertaken during the month of April-May when the climate was predominantly dry in this area. Thus snail population during this season becomes abundant around the area of natural water sources, which are covered with greens may likely to concentrate metacercaria over these small area fascilating exposures of susceptible host to the infective stages of the parasites. Based on the micrometry findings, it can be augmented that inter-species cross

transmission of *Paramphistome* can take place between resident domestic cattle and wild ruminants corresponding to Chital deer, Sambar, Nilgai and Bison.

Strongyles infection was observed in the present study in Chital deer, Sambar, Nilgai, Bison, Barking deer, Bear and Monkey as well as the resident cattle within protected areas of Pench National Park. Ova of *Strongyle* spp. (Fig.5) measured about 82-88 µ by 44-47µ (Table 3). Similar findings were reported by Soulsby (1982) and Pramod Kumar *et al.* (2002). Gaur *et al.* (1979) studied *Strongyle* infection in deer and black buck at Zoological Park, Kanpur, in swamp deer and buffalo by Chakraborty and Islam, 1996 . Banerjee *et al.* (2002) reported *Strongyle* infection found common in deer, nilgai, and elephants. Faecal sample examination of Bonnet Macaques revealed *Strongyle* infection as reported by Varadharajan and Pythal (1999 a). Hirani *et al.* (1999) reported *Strongyle* infection in cattle and buffalo, in nomadic cattle (Jithendran and Bhat, 2001), cattle and buffalo from Chattisgarh region (Pal *et al.*, 2001).

It could be revealed that the infective stage larvae of *Strongyle* does not actively enter the host but it crawls up blades of grass and other herbages and subsequently swallowed with herbage and water. Thus during mild light the contaminated grazing area and major water holes (Fig. 17) act as the source of infection to wild ruminant and domestic cattle.

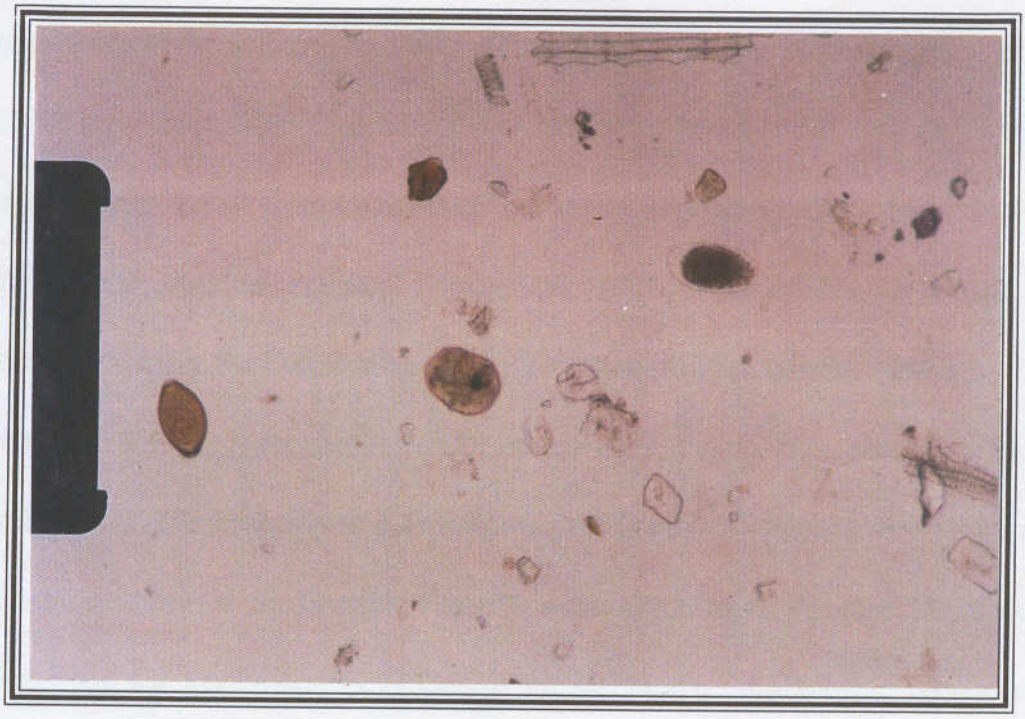

Fig- 6 : Ova of Trichuris spp. and Strongyle spp. mixed infection in Chital deer. (100 X)

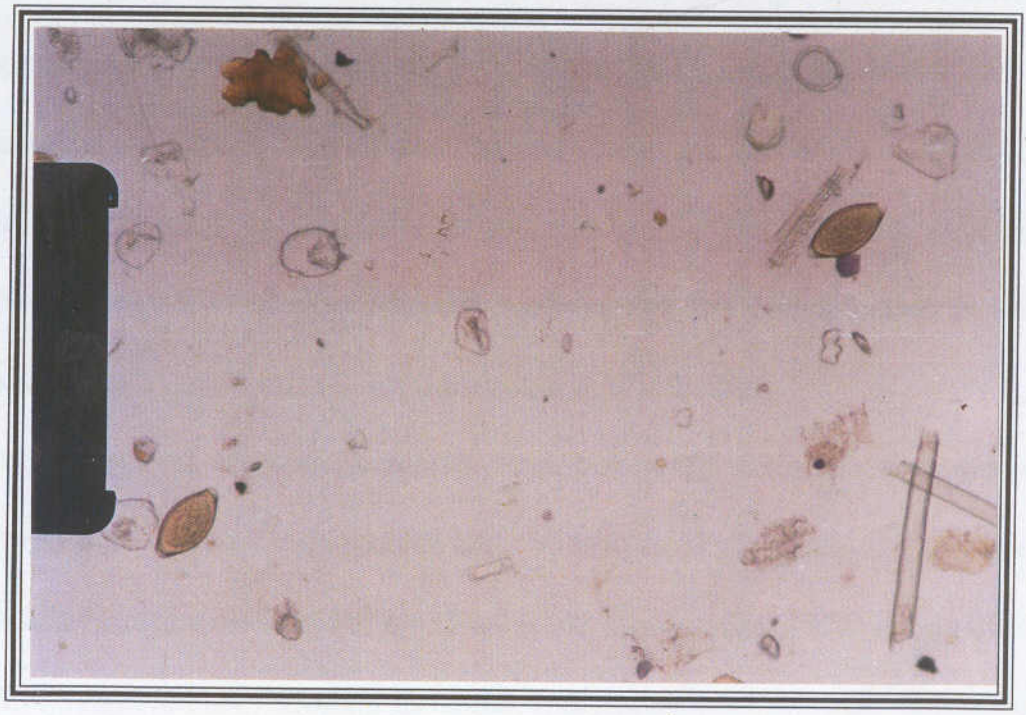

Fig- 7 : Ova of Trichuris spp. in monkey. (100 X)

Ova of *Trichuris trichuria* was isolated from monkey (Fig. 7). The eggs were brown, barrel-shaped, with a plug at either pole and measured 57-58 µ by 24 µ. Similar findings were reported by Fowler (1986). *Trichuris ovis* egg also recovered from chital deer and cattle measuring about 59 µ x 24 µ and 76 µ x 38 µ respectively. Hiregoudar (1976) reported *Trichuris* spp. in sambar, in deer by Dakshinkar *et al.* (1983) and Chakraborty (1992), who observed *Trichuris* spp. infection in mouse deer, black buck, serow, mithun and giraffe. Chakraborty and Goswami (2001) recorded *Trichuris* spp. in non-human primates of Assam State Zoo and monkey in Zoological park of Delhi and Lucknow Zoo (Chauhan *et al.* 1972). The similar observation recovered from cattle on faecal examination by Hirani *et al.* (1999), Sahoo *et al.* (2002) and Shreedevi and Hafeez (2001). The two species of *Trichuris* appeared to be morphologically similar but biologically distinct since the previous one infects monkey and the later one to the deer and cattle, but can be differentiated on the basis of measurements of eggs. The infection occurred through ingestion of egg, however assumes that the contaminated pasture might have land play an important role for transmission of infection.

Eggs of *Oesophagostomum radiatum* were detected in faeces of Chital deer, Bison, Barking deer and resident domestic cattle, the observed measurements were 73-75 µ by 37-39 µ. As Hiregoudar (1976) documented *Oesophagostomum radiatum* in Chital deer during post mortem, Gaur *et al.* (1979) observed *Oesophagostomum* species are the common prevalent

Ova of *Trichuris trichuria* was isolated from monkey (Fig. 7). The eggs were brown, barrel-shaped, with a plug at either pole and measured 57-58 µ by 24 µ. Similar findings were reported by Fowler (1986). *Trichuris ovis* egg also recovered from chital deer and cattle measuring about 59 µ x 24 µ and 76 µ x 38 µ respectively. Hiregoudar (1976) reported *Trichuris* spp. in sambar, in deer by Dakshinkar *et al.* (1983) and Chakraborty (1992), who observed *Trichuris* spp. infection in mouse deer, black buck, serow, mithun and giraffe. Chakraborty and Goswami (2001) recorded *Trichuris* spp. in non-human primates of Assam State Zoo and monkey in Zoological park of Delhi and Lucknow Zoo (Chauhan *et al.* 1972). The similar observation recovered from cattle on faecal examination by Hirani *et al.* (1999), Sahoo *et al.* (2002) and Shreedevi and Hafeez (2001). The two species of *Trichuris* appeared to be morphologically similar but biologically distinct since the previous one infects monkey and the later one to the deer and cattle, but can be differentiated on the basis of measurements of eggs. The infection occurred through ingestion of egg, however assumes that the contaminated pasture might have land play an important role for transmission of infection.

Eggs of *Oesophagostomum radiatum* were detected in faeces of Chital deer, Bison, Barking deer and resident domestic cattle, the observed measurements were 73-75 µ by 37-39 µ. As Hiregoudar (1976) documented *Oesophagostomum radiatum* in Chital deer during post mortem, Gaur *et al.* (1979) observed *Oesophagostomum* species are the common prevalent

infection in wild deer, followed by swamp deer and buffalo (Chakraborty and Islam, 1996). Prestwood et al. (1976) recovered *Oesophagostomum venulosum* in white-tailed deer and domestic sheep of common range. Agneessens *et al.* (1997) reported *Oesophagostomum* was predominant species in cow, which would be a major source of pasture contamination, Yadav and Sadana (1999) recovered *Oesophagostomum radiatum* in necropsied cattle and Mondal *et al.* (2000) documented *Oesophagostomum* spp. in cows, where calves and goat were also reared. They could summarize that these grasslands were one of the main sources of gastrointestinal parasitic diseases to livestock in Bangladesh.

Strongyloides parasites may exist in a free living or a parasitic, parthenogenic phase. In the present study *Strongyloides* infection was detected in sambar and barking deer but not in domestic cattle and the parasitic ova measured 52-55 μ by 20-27 μ hence confirms with the findings of Soulsby (1982) and Georgi and Theodorides (1980). Gaur *et al.* (1979) also recovered *Strongyloides papillosus* in wild deer and in the hog deer, swamp deer, water buffalo and elephant by Chakraborty and Islam (1996) also in spotted deer (Bhat and Manickam, 1998). Varadharajan and Pythal (1999 a) in Bonnet Macaques. Mandal *et al.* (2002) reported in free ranging chital from different areas of grazing around water holes and dead/kills in Mudumalai, and stated that parasitic prevalence found increased significant variation in grazing area distributed by cattle in first

wet season as compared to dry season. While controversy finding noted by Rajkhowa and Hazarika (2001) stated *Strongyloid* in female calf and Sahoo *et al.* (2002) found in grazing and stall fed cattle in a rain fed districts of Orissa. The present study carried out in dry seasons, however denotes controversy in this regard.

Ova of *Moniezia* spp., the tape worm of cattle recovered from Bison, Nilgai and residential domestic cattle in the present study. Morphologically the egg are somewhat triangular in shape, measured about 62-64 μ in diameter confirms with the finding of Soulsby (1982) and Nama (1990). Mandal *et al.* (2002) reported *Moniezia* spp. in chital deer. Singh and Banerjee (1997) confirmed that Deer, Yak, Wild buffalo and Bison suffer from the parasitic diseases, which affect other domestic ruminants.

In the transmission of *Moniezia* oribatid mites play an important role since Cysticercoids of *Moniezia* developed in these mites, this support the fact that this infection to ruminants can be perpetuated by ingestion of infected mites with herbage.

In the present study, ova of *Toxocara* species reported in monkey, measuring about 76 μ by 65 μ, which are in agreement with Fowler (1986). Normally, these parasites found in Carnivores animal and cow calf (Kumar *et al.* 2002), however Khan *et al.* (1981) reported in Olive Baboon monkey.

Ova of *Fasciola hepatica* and *Dictyocalus* spp. reported in cattle in the present study, measured about 145-148 μ by 78-79 μ and 82-84 μ by

35-36 μ, respectively. These measurements are confirmatory to Soulsby (1982) and Georgi and Theodorides (1980). Infection of *Dictyocalus* spp. and *Fasciola* spp. was recorded by Jithendran and Bhat (2001) in cattle of nomadic areas at Himachal Pradesh, however Karasev and Litvinov (1977) documented *Fasciola hepatica* in wild boars and *Bison bonasus*. Chakraborty and Islam (1996) reported *Fasciola* infection in some wild herbivores in the Kaziranga National Park and the infection was more in water buffalo than in cervids as the reservoir status of wild animals for *Fasciola* infection appeared to be quite significant. Since, it is an important parasite of domestic ruminants, in view of the fact that infection probably might not have been noted in wild herbivores in the present study.

For estimating prevalence of haemoparasites in resident livestock population, blood smears collected from resident livestock population (cattle) of Pench National Park, however revealed that not a single case found positive for haemoprotozoan, but Pramod Kumar (2001) documented 17.24% resident livestock positive for haemoprotozoan infection at Pench National Park. But the present study did not reveal any observation as regards the haemoprotozoan predominance could be probably due to non-prevalence of ticks on the body surface of animals. In addition to above, the study undertaken by the earlier author was during rainy season could be the probable reason for persistence of infection which might have caused the relative occurrence of haemoprotozoan.

After confirmation of helminthic infection in resident livestock population and wild herbivores animal at Pench National Park, Fenbendazole @ 7.5 mg/kg body weight orally (Soulsby, 1982 Booth and McDonald, 1988) given to all cattle of Pench National Park. As Fenbendazole is the safest drug and can be given at any stage of pregnancy. It does not have any teratogenic or embryotoxic effect. Fenbendazole possess broad spectrum of activity in cattle, buffalo, sheep and goat. It has high degree of efficacy and eliminates adults and larval stages of nematodes, lungworm and cestodes (Shahardar *et al.*, 1995; Booth and McDonald, 1988; Shreedevi and Hafeez, 2001). In the present study, after treatment the prevalence of helminths in resident domestic cattle was reduced from 34.17 to 1.67 per cent within 60 days. Shreedevi and Hafeez (2001) recorded 100% efficacy in elimination of *Trichuris* in cattle on 14th day using 25% suspension of Fenbendazole. In the present study proposed deworming to the resident domestic cattle population has revealed the chemotherapeutic effect against helminth infection pertaining to wild herbivores, which appeared to bring improvement against prevalence of helminth infection (Table 2). In the present study cattle were the major source of infection through contaminating water and pasture land as it defecates in water and common pastureland where wild animals could also graze. According to Mondal *et al.* (2000) grass lands are one of the main sources of gastrointestinal parasitic diseases to livestock, soil may also play an

important role in the epidemiology of parasitic infection in animals (Agunolye *et al.* 2002), higher trend of helminthic infection in rainy season observed by Sahoo *et al.* (2002) due to increased concentration and/or contamination of the grazing area by the infective stage larvae of the parasite or ova thereby, elevating the chance of contact between host and larvae or egg. The infection occurs by different route described by Jithendran and Bhat (2001) to wild animals and domestic population in the thick belt of forest at high mountains. Cross-transmission of parasitic infection is also depend upon the population density of the animal and also the prevalent species of infection in the particular area. Similar observations have been observed in the present study. Singh and Banerjee (1997) concluded that wild buffalo and bison suffer from parasitic diseases, which affect other domestic ruminants mostly due to Paramphistomiasis and Monieziasis.

Overall prevalence observed in wild herbivores animal (19.59%) in the present study which reduced to 4.73%, the specieswise prevalence also got altered as presented in Table-2, due observation is expected after subjecting treatment to domestic animals, the probability of source of infection by contamination of pasture land and water source needs to be checked, so as to minimize the intensity of infection in wild herbivores by virtue of interspecies transmission. Finally it could be concluded that regular deworming to domestic animal in the protected area of Pench

National Park is suggested followed by rotational grazing which could help to minimizing the contamination of pasture.

The incidence of endoparasite in domestic animals has been studied by many workers (Dakshinkar *et al.*, 1983; Chaudri *et al.*, 1993; Deka *et al.*, 1995; Hirani *et al.*1999; Yadav and Sadana, 1999; Sahoo *et al.*, 2002), but the ecology of parasite in wild appeared to be much different. It has been endeavored in the present study to establish rational means of expressing parasite species diversities in different wild herbivores host species and resident livestock population. The observed prevalence is presented in Table 4 (Pre and post treatment).

It is evident from Table 4 that the prevalence of *Paramphistome* spp. (Fig. 9) was 13.80% in wild herbivores distributed across the Bison (6.90%), Chital deer (3.45%) and Sambar (3.45%) and overall estimated prevalence in domestic cattle at the protected area was 39.02%. Similar findingshave been noted by Gaur *et al.* (1979) who ascribed that prevalence of *Amphistomes* in wild deer (*Axis axis* and *Cervus duvaucelli*) was 12.66% and cattle 40.30% (Sahoo *et al.* 2002). The infestations in domestic animals and wild herbivores topographically appeared to be almost parallel thereby denoting the fact that the infection is being maintained in the environment through aegis of domestic livestock. The domestic animal appears to be a perceptual source of infection for the wildlife and is substantiated in the present study, but the subjecting animal to

Table 4: Specieswise prevalence of parasitic infestation in free living wild herbivores and domestic cattle.

Sr. No.	Species	Paramphistome		Fasciola hepatica		Strongyle		Trichuris		Dictiocalus		Oesophagostomum		Strongyloides		Moniezia		Hydatid Cyst/ Toxocara		Mixed infection	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Wild herbivores																					
1.	Chital deer	1 **1**	3.45 **14.29**	--	--	1 **1**	3.45 **14.29**	1	3.45	--	--	1	3.45	--	--	--	--	--	--	2	6.90
2.	Sambar	1	3.45	--	--	2 **1**	6.90 **14.29**	--	--	--	--	--	--	1	3.45	--	--	--	--	--	--
3.	Nilgai	--	--	--	--	-- **1**	-- **14.29**	--	--	--	--	--	--	--	--	1	3.45	--	--	1	3.45
4.	Bison	2 **1**	6.90 **14.29**	--	--	1 **1**	3.45 **14.29**	--	--	--	--	1	3.45	--	--	1	3.45	--	--	1	3.45
5.	Barking deer	--	--	--	--	2 **1**	6.90 **14.29**	--	--	--	--	1	3.45	--	--	--	--	--	--	1	3.45
6.	Bear	--	--	--	--	1	3.45	--	--	--	--	--	--	1	3.45	--	--		--	--	--
7.	Monkey	--	--	--	--	1	3.45	2	6.90	--	--	--	--			--	--	1	3.45	--	--
	Total	**4** **2**	**13.80** **28.57**	--	--	**8** **5**	**27.59** **71.43**	**3**	**10.35**	--	--	**3**	**10.35**	**2**	**6.90**	**2**	**6.90**	**2**	**6.90**	**5**	**17.24**
Domestic animals																					
1.	Cattle	16 **1**	39.02 **50.00**	1	2.44	10	24.39	4	9.76	2	4.88	1	2.44	0	0	3 **1**	7.32 **50.00**	0	0	4	9.76

* Figure in bold indicated total number of sample and % of prevalence after treatment.

* Treatment was subjected to domestic animal only.

anthelminthic treatment which are followed in the resident livestock, however the number of wild herbivores animal having *Paramphistome* spp. infection get reduced 2/4 and prevalence was 28.57%. It is clearly observed that only herbivores were infected with this parasitic infection and it is logical to say that interspecies transmission between domestic ruminants and wild ruminants or vice-versa may be occurring and could be precisely checked by treating the domestic ruminants. The highest prevalence observed in Bison (6.90%) was reduced as compared to the other host species of wildlife and can be attributed to body size. Since Bison has a large body size, higher intake of food and water is expected with resultant ingestion of more number of infective stages of the parasite.

Strongyle infestation was observed in Sambar 6.90% and Barking deer 6.90% followed by Chital deer 3.45%, Bison 3.45%, Bear 3.45%, Monkey 3.45% and resident domestic cattle within protected areas appeared 27.59%. Similar prevalence of parasite of wild deer at Jim Corbett National Park had been documented by Gaur *et al.* (1979) and Varadharajan and Pythal (1999 b), in Chital deer by Mandal *et al.* (2002) where grazing area distributed by cattle. It appears that these nematodes have been adapted well to the host and as such reservoir status of deer for helminthes is of considerable significance. After treatment to resident livestock the infection get reduced, as it remains in prepatent condition there by leads decline of infection in animals 5 out of 8 (Table 4).

anthelminthic treatment which are followed in the resident livestock, however the number of wild herbivores animal having *Paramphistome* spp. infection get reduced 2/4 and prevalence was 28.57%. It is clearly observed that only herbivores were infected with this parasitic infection and it is logical to say that interspecies transmission between domestic ruminants and wild ruminants or vice-versa may be occurring and could be precisely checked by treating the domestic ruminants. The highest prevalence observed in Bison (6.90%) was reduced as compared to the other host species of wildlife and can be attributed to body size. Since Bison has a large body size, higher intake of food and water is expected with resultant ingestion of more number of infective stages of the parasite.

Strongyle infestation was observed in Sambar 6.90% and Barking deer 6.90% followed by Chital deer 3.45%, Bison 3.45%, Bear 3.45%, Monkey 3.45% and resident domestic cattle within protected areas appeared 27.59%. Similar prevalence of parasite of wild deer at Jim Corbett National Park had been documented by Gaur *et al.* (1979) and Varadharajan and Pythal (1999 b), in Chital deer by Mandal *et al.* (2002) where grazing area distributed by cattle. It appears that these nematodes have been adapted well to the host and as such reservoir status of deer for helminthes is of considerable significance. After treatment to resident livestock the infection get reduced, as it remains in prepatent condition there by leads decline of infection in animals 5 out of 8 (Table 4).

There are numerous reports of nematodes parasite in wild (Chakraborty and Islam, 1996; Chakarborty and Goswami, 2001). Nematodes that cause disease problems in Monkey includes *Strongylids, Strongyloides* spp., *Ascarids*, *Coccidia, Ancylostoma* and *Trichuris* and in Chital deer *Strongyles*, *Strongyloides*, *Oesophagostomum* and *Trichuris* (Gaur *et al*., 1979; Dakshinkar *et al*., 1983). However, in the present study prevalence of *Trichuris* reported 20.35% in which Monkey shows 6.90 and Chital deer 3.45 per cent, the resident livestock shown 9.76 % prevalence to *Trichuris* infection. No case found to be positive in wild as well domestic ruminants after following deworming to resident domestic cattle. The development of infective stage is limited to soil, moisture and temperature and as such infective eggs may remain viable for several years thus maintaining infection in the environment. However, opinion about the pathogenicity of the parasite varies and it appears that the parasite is opportunistic for the host species, which corraborated with the present study.

Prevalence of *Oesophagostomum* spp. found 10.35% in wild herbivores and 2.44% in resident domestic animal (Table 4). In the prevalence of wild herbivores Chital deer, Bison and Barking deer showed 3.45% respectively, which are in agreement with the finding of Gaur *et al.* (1979) in wild deer at Jim Corbett National Park.

The observed prevalence of *Moniezia* in the present study was found to be 6.90% in wild herbivores includes 3.45% in Nilgai, 3.45% Bison and 7.32% in resident livestock in protected area. *Moniezia* spp. occurs in the small intestine of cattle, sheep, goat and several other ruminants in most parts of the world. Singh and Banerjee (1997) documented Deer, Yak, Wild buffalo and Bison suffer from the parasitic diseases which affects other domestic ruminants mainly Monieziasis.

Varadharajan and Pythal (1999 b) investigated *Strongyloides* in omnivorous animals at Zoological Garden at Kerala and in wild herbivores of captivity and Sasan forest of Gir by Patel *et al.* (2003). In present study, *Strongyloides* spp. prevalent in 6.90% in wild herbivores, which includes 3.45% in Sambar and 3.45% in Bear.

Fasciola hepatica and *Dictyocalus* spp. showed prevalence about 2.44% individually in resident livestock population, similar finding corraborated with (Pal *et al.*, 2001, Sahoo *et al.*, 2002), who reported *Fasciola* in domestic cattle, but none reported in wild herbivores indicating that the relationship with other wild herbivores could not be established.

The interesting finding of the present study was that the estimated prevalence of *Toxocara* in Monkey was 3.45%, since Varadharajan and Pythal (1999 a) reported in Bonnet Macaques of Tamil Nadu. The infection of Hydatid cyst showing prevalence to the tune of 3.45% however reported in Bison in the present study. It is stated that dog play an important role in

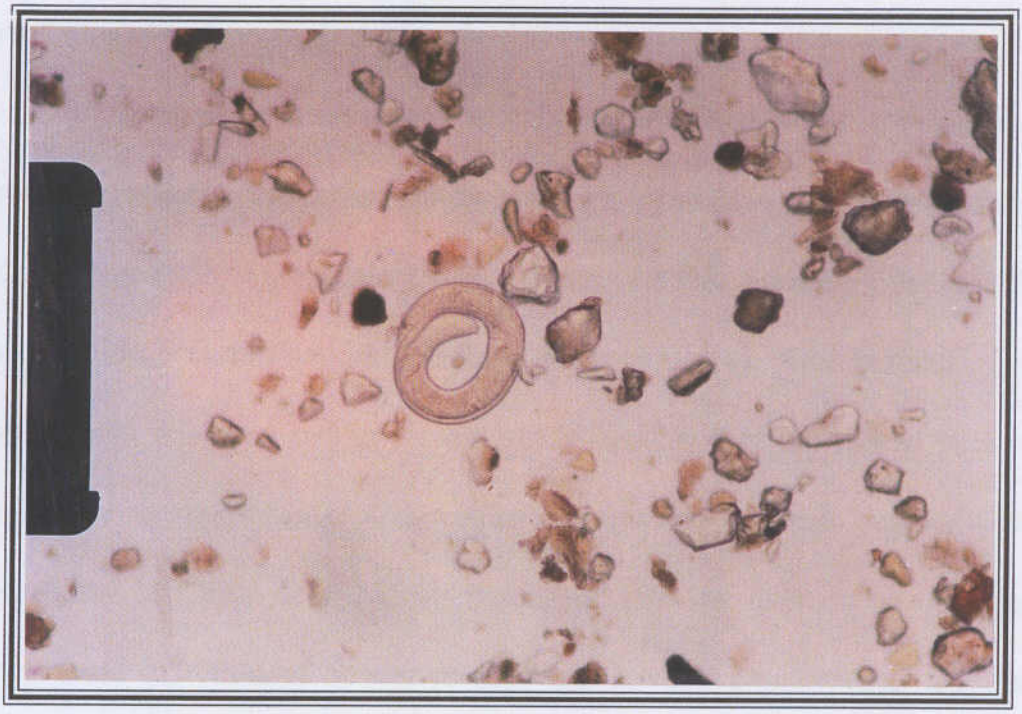

Fig- 8 : Larvae of unidentified spp. from faecal sample of Barking deer. (100 X)

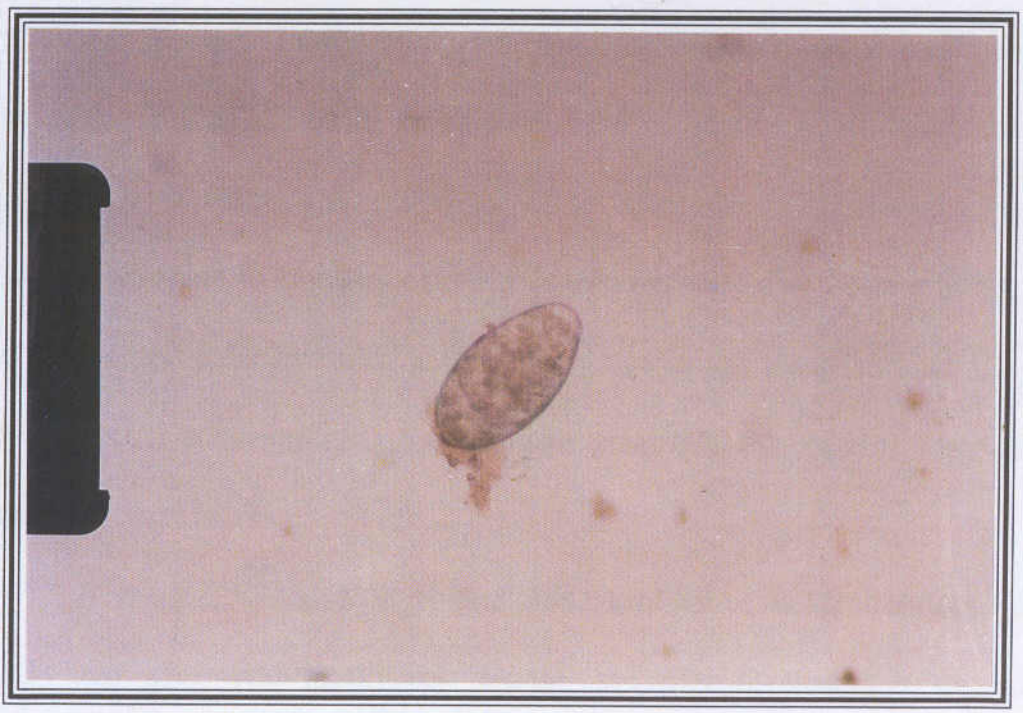

Fig- 9 : Ova of Paramphistome spp. in Sambar. (100 X)

the transmission of intermediate host of tapeworm viz. *Echinococcus granulosus.*

The parasitic disease of free ranging wild herbivores are numerous but the present investigation indicated mixed infestation (Fig. 6) recorded in Chital deer (6.90%), Nilgai (3.45%), Bison (3.45%), Barking deer (3.45%) and resident cattle within protected area (17.24%). The percentage of prevalence observed in the present study denotes that the mixed parasitic infection corresponding to resident cattle population concomitantly paralleled in Chital deer, Nilgai, Bison and Barking deer. In barking deer the mixed infection of *Strongyle* spp. and larvae of unidentified spp. are also noted (Fig. 8). It is likely that parasitic diseases of resident domestic livestock, Chital deer, Nilgai, Bison and Barking deer are transmissible in a vice-versa manner. In the study of cross-transmission and intermingling insular population of White tailed deer, feral cattle and feral swine, about 17 species of cattle transmitted to white–tailed deer (Prestwood *et al.*, 1975). According to Bhowmik (2002) certain parasitic diseases are likely to be transmitted from livestock animal that graze in the grass land habitat of the protected areas utilizing the comman grazing fields of Hog deer and other wild herbivores.

Average EPG value of pre and post treatment of residential domestic cattle and also wild herbivores animal, by offering treatment to only residential domestic cattle are presented in Table 5.

Table-5 : Specieswise Mean ± SE of EPG of helminth infection in wild herbivores and domestic cattle (Pre and Post treatment)

Sr.No.	Species of animals	Param-phistome		Strongyle		Trichuris		Oesopha-gostomum		Mixed infection		Other		Total Mean± SE	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Wild Herbivores															
1.	Chital deer	600 (1)	100 (1)	300 (1)	300 (1)	400 (1)	-	200 (1)	-	600 (2)	-	-	-	450± 71.87 (6)	200± 100.02 (2)
2.	Sambar	600 (1)	-	400 (2)	200 (1)	-	-	-	-	-	-	200 (1)	-	400± 91.29 (4)	200± 0 (1)
3.	Nilgai	-	-	-	300 (1)	-	-	-	-	500 (1)	-	100 (1)	-	300± 200.03	300±0 (1)
4.	Bison	600 (2)	100 (1)	400 (1)	200 (1)	-	-	200 (1)	-	900 (1)	-	200 (1)	-	483.33± 110.78 (5)	150± 50.01 (2)
5.	Barking deer	-	-	500 (2)	100 (1)	-	-	200 (1)	-	800 (1)	-	-	-	500± 122.48 (4)	100±0 (1)
6.	Bear	-	-	300 (1)	-	-	-	-	-	-	-	100 (1)	-	200± 100.02 (2)s	-
7.	Monkey	-	-	300 (1)	-	550 (2)	-	-	-	-	-	200 (1)	-	400± 91.29 (4)	-
	Mean ± SE	600 ±00 (4)	100 ±00 (2)	387.50 ±35.09 (8)	220 ± 37.35 (5)	500 ±57.80 (3)	-	200 ±00 (3)	-	680.00 ±73.36 (5)	-	160.00 ±24.45 (5)	-	421.43 ±39.64 (28)	185.72 ±34.02 (6)
Domestic Animals															
	Domestic Cattle Mean ± SE	737.5 ±41.71 (16)	200 (1)	770 ±21.36 (10)	-	900 ±40.83 (5)	-	200 (1)	-	925 ±110.87 (4)	-	133 ±21.08 (6)	100 (1)	678.05 ±44.04 (41)	150 .±50.01 (2)

*Figure in parenthesis indicate total number of animals.

Mean EPG of the residential domestic cattle at 0 day (Pre treatment) show 678.05 ± 44.04, it reduced to nil at 60th day (Post treatment). Only two animals showing *Paramphistome* spp. and *Moniezia* spp. respectively was reported positive, the animal again dewormed with Fenbendazole @ 7.5 mg/kg body weight orally. Booth and McDonald (1988) reported for better activity of Fenbendazole against *Moniezia* and *Dicrocoelium,* however accured that the required increased dose to facilitate the response against adult and migrating immature stages of rumen flukes (*Paramphistome* of cattle).

Agneessens *et al.* (1997) reported high egg counts of nematode in calves to the tune of 778 EPG during grazing seasons. Yadav and Sadana (1999) also documented faecal eggs counts in the two group of dairy cattle found to be 1475 ± 497 and 1527 ± 457 followed by reduction (99%) in faecal count on day 10 after treatment. According to Shreedevi and Hafeez (2001) noted EPG ranges 967-1033 in two different group of cattle suffering from *Trichuris* infection and 100 % recovery was observed in treated group with Fenbendazole at 14th day. In the present study, the treatment subjected against helminth infected cattle revealed 100% recovery however indicates that the source of infection of contamination of soil, water holes and comman grazing land of domestic animal and wild herbivores might have checked by virtue of subjecting these resident domestic animals to treatment thus revealed that transmission of infection

from resident domestic animals could have definitely declined. As Sahoo *et al.* (2002) reported prevalence of helminth was more in grazing cattle than stall-fed, due to contamination of grazing area with parasitic ova and larvae. Grasslands are considered to be main sources of infection of gastrointestinal parasitic disease in Bangladesh. (Mondal *et al.*, 2000).

Mean EPG of wild herbivores of similar grazing area of domestic cattle were estimated at pre and post treatment of residential domestic cattle (Table 5). Mean EPG of chital deer, sambar, nilgai, bison, barking deer, bear and monkey at pre treatment (Treatment is given only to cattle) was 450 ± 71.87, 400 ± 91.29, 300 ± 200.03, 483.33±110.78, 500±122.48, 200±100.02 and 400±91.29, respectively and the post treatment value indicated in chital deer (200±100.02), sambar (200), nilgai (300), bison (150±50.01) and barking deer (100). The infection in the wild animal does not get totally checked indicating the persistence of infection in the same. But considering the incidence of helminth in wild herbivores at pre treatment was 19.60%, which was declined to 4.72% (Table 2).

Thus, it can be argued that by virtue of checking the helminths infection in resident domestic cattle, the concomitant decline effect on the incidence of helminth infection in wild herbivores was seen in respect. Sathyanarayana (1992) stated that infection could be controlled by reducing the probability of ingesting egg and infected food, water and faeces, in addition to prevention of contact between the diseased animals and other

ungulates of the area. It is pertinent to note that the controlling helminthic infection of wild herbivores, it is necessary to fallow regular deworming with mass population of the surrounding resident domestic animal followed by rotational grazing can help to limit the perpetuation of infection in free ranging wild animals.

The out come of helminth infection in domestic animals and on its production are well documented which includes stunted growth, decline in weight gain and production due to anorexia, reduced feed intake, loss of blood and plasma protein into gastrointestinal tract. Gastrointestinal parasitism also caused alteration into protein metabolism, depressed levels of mineral and reduced in calcium and/or phosphorus absorption (Soulsby, 1982). During the present study alteration in haematobiochemical parameter were estimated in resident livestock population. Haematobiochemical parameter of resident livestock population were estimated on 0 day (Pre treatment) and on 60th day of treatment (post treatment). Significance of difference was estimated with the help of Paired 't' test. The average value and standard error for haemoglobin, packed cell volume, total erythrocyte count, total leucocyte count, differential count, blood glucose, serum total protein, calcium and phosphorus are projected in Table 6.

ungulates of the area. It is pertinent to note that the controlling helminthic infection of wild herbivores, it is necessary to fallow regular deworming with mass population of the surrounding resident domestic animal followed by rotational grazing can help to limit the perpetuation of infection in free ranging wild animals.

The out come of helminth infection in domestic animals and on its production are well documented which includes stunted growth, decline in weight gain and production due to anorexia, reduced feed intake, loss of blood and plasma protein into gastrointestinal tract. Gastrointestinal parasitism also caused alteration into protein metabolism, depressed levels of mineral and reduced in calcium and/or phosphorus absorption (Soulsby, 1982). During the present study alteration in haematobiochemical parameter were estimated in resident livestock population. Haematobiochemical parameter of resident livestock population were estimated on 0 day (Pre treatment) and on 60th day of treatment (post treatment). Significance of difference was estimated with the help of Paired 't' test. The average value and standard error for haemoglobin, packed cell volume, total erythrocyte count, total leucocyte count, differential count, blood glucose, serum total protein, calcium and phosphorus are projected in Table 6.

Table- 6 : Mean and Standard Error and Level of significance of haematobiochemical parameter in resident Domestic Population with Fenbendazole

Sr. No.	Parameter	Pre treatment	Post treatment	't' cal
1.	Haemoglobin (gm/dl)	9.19±0.14	10.44±0.21	7.33 **
2.	Packed cell volume (%)	28.45±0.82	31.30±0.37	5.55 **
3.	Total erythrocyte count ($\times 10^5$/cumm.)	9.65±0.21	7.26±0.26	6.22 **
4.	Total leucocyte count ($\times 10^3$/cumm.)	19.59 ±0.45	13.43±0.57	9.39 **
5.	Neutrophil (%)	15.8 5 ±0.40	26.45± 0.71	17.12 **
6.	Lymphocyte (%)	62.60 ±0.99	60.90±0.76	5.47 **
7.	Eosinophil (%)	14.75 ± 0.50	7.20±0.31	17.58 **
8.	Monocyte (%)	5.15±0.53	5.20 ± 0.50	7.02 **
9.	Total Protein (gm/dl)	3.03±0.35	6.98±0.28	11.90 **
10.	Blood Glucose (mg/dl)	38.95 ±1.42	49.85±0.53	0.71
11.	Serum calcium (mg/dl)	7.89±0.45	8.51±0.32	2.78 *
12.	Serum Phosphorus (mg/dl)	4.62±0.33	4.70± 0.20	3.08 **

* ($P < 0.05$) t tab (20) = 2.07
** ($P < 0.01$) t tab (20) = 2.82

Significant difference were observed between haemoglobin value on pre treatment and post treatment (Table-6). Low haemoglobin concentration (9.19 ± 0.44 gm/dl) found in infected cattle, might have been due to injuries to capillaries of intestinal mucosa causing pin point hemorrhages, continuous malnutrition and poor haemopoiosis. The Hb of infected cow improved significantly when the helminths got eliminated due to effective anthelminthic treatment (10.44 ± 0.21 gm/dl). Bhongade *et al.* (1993),

Raman *et al.* (1999), Bharati *et al.* (2002) and Upadhyay *et al.* (2003) also reported significantly deceased haemoglobin concentration, which was restored after treatment.

Packed cell volume were significantly increased (31.30±0.37%) after treatment as compared to pre treatment values (28.45±0.82 %). Similar finding were deplicted by Thakur and Mishra (1973), Waghmare *et al.* (1993), Raman *et al.* (1999) and Bharti *et al.* (2002).

There was significant difference observed in pre treatment and post treatment values of total erythrocyte count. Pre treatment TEC (7.26 ± 0.26 $\times 10^5$/cumm.) was improved after treatment (9.65±0.21 $\times 10^5$/cumm.). Bharti *et al.* (2002) documented significantly decreased TEC value, which was found to be increased on 10^{th} day post treatment.

Significant difference in total leucocyte count were reported in present study. TLC increased (19.59±0.43 $\times 10^3$/cumm.) during helminthic infection, which was decreased significantly (13.43±0.57 $\times 10^3$/cumm.) after deworming the animals. Increased TLC value of infected resident domestic cattle as recorded in the present study might be due to helminthic infections, which got declined after treatment due to defensive reaction of body to the action of invaders.

Significant difference were observed in Neutrophil, in respect to pre treatment value (15.65±0.40%), which got increased after treatment (26.45±0.71%). The finding are in agreement with Waghmare *et al.* (1991).

The pre treatment value of lymphocyte 62.60 ± 0.99 % have been significantly decreased to 60.90 ± 0.76 % after treatment, similarly there is marked increased in Monocyte per cent from pre treatment (5.15 ± 0.53 %) to post treatment value (5.20 ± 0.50 %). Thakur and Mishra (1973) reported slight increased in monocyte per cent in helminths infected calves. However, finding of present study did not find in accordance to Waghmare *et al.* (1991), who observed mean value of lymphocyte and monocyte count was not differed significantly. This may be due to chronic helminthic infection.

Eosinophil per cent showed significant difference, pre treatment value 14.75 ± 0.50 % decreased up to 7.20 ± 0.31 per cent, as Jithendran and Bhat (2001) stated that peripheral blood eosinophilia (5-15%) is one of the most important markers of parasitic infection. These findings support the finding of Waghmare *et al.* (1993). Progressive eosinophilia observed in the present study of helminthic infested resident domestic livestock might have been due to the released of histamine because of cellular damage by helminths.

In infected resident domestic cattle, significant difference were observed for total serum protein. Pre treatment cattle showed hypoproteinemia, (3.03 ± 0.35 gm/dl), however showed improvement on deworming, thus post treatment value showed 6.98 ± 0.28 gm/dl total serum protein. The status of total serum protein can easily be correlated

corresponding to the reduction of worm load as a result of therapy, which appeared inaccordance with Bhongade *et al.* (1993). Bandyopathyay and Dasgupta (2000) also reported significance difference ($P<0.05$) for total serum protein in parasitised treated and untreated crossbred cow calves. However, Updhyay *et al.* (2003) mentioned that serum total protein value remains unaltered in animal normal to that of serum albumin, where continuous decreasing trend have been noted.

Reduced blood glucose levels (38.92 ± 1.42 mg/dl) recorded in helminth infested cattle, which showed improvement after treatment (49.85 ± 0.53 mg/dl). But in the present study, it is pertinent to state that the blood glucose level which showed non-significant difference. Bandyopathyay and Dasgupta (2003) reported declined blood glucose level in parasitised treated and untreated calves, which found to be increased in parasitised treated bovine calves after 6 weeks. Bhongade *et al.* (1993) also revealed similar observation. The non-significant level of blood glucose in the present study might have been due to poor nutritional source of energy subjected to cattle by virtue of grazing solely on the forest land. The out come of such findings however preclude that the fodder naturally grown on such forest land may not revealed the nutritional status. Inspite of the fact that the history revealed the owner of resident livestock located nearby forest did not offer balanced nutritional diet to the animal.

Serum calcium value showed significant difference ($P<0.05$), where pre treatment value found to be 7.89 ± 0.45 mg/dl and subsequently shown improved after post treatment 8.51 ± 0.31 mg/dl in resident domestic cattle. The observation of the present study in respect of serum calcium are in close proximity of the observation reported by Bhongade *et al.* (1993).

Serum phosphorus levels also showed significant difference. Pre treatment value 4.62 ± 0.33 mg/dl which was slightly found elevated after treatment 4.70 ± 0.20 mg/dl.

In essence the value indicated above represent that presence of helminthic infection has a definite effect upon the blood picture of the affected resident domestic cattle of Pench National Park, Maharashtra. It can be precluded that the similar effect might be revealing in wild herbivores as reported by Jani *et al.* (2003) who studied haematological attributes of elephants of those who were harbouring parasite infection (*Fasciola spp.*-15%) with concomitant manifestation of mild anemia and eosinophilia. The biochemical studies carried out the same animals showed non-significant hypoproteinemia when compared with those elephants free from the same parasites. McGhee *et al.* (1981) support the present finding that deer harbouring *Haemonchus contortus* burden > 70 worms/kg body weight manifested decreased in the level of PCV, Hb and total serum protein value.

Endoparasite plays an important role in the health status of wild as well as domestic animals. They however play a potential role to affect the fitness and reproductive status of the host individual. The effect of parasitism on the over all health of resident domestic population was determined in the present study by evaluating general condition of the residential domestic cattle. The results are presented in Table 7.

Table-7 : Health Status of infected Resident Domestic Population.

Health Status				
Sr. No.	**Animal Reared**	**Good**	**Fair**	**Poor**
1.	Infected cow	-	10 (62.5)	2 (100)
	Non infected cow	13 (100)	6 (37.5)	-
	Total	13 (41.94)	16 (51.61)	2 (6.45)
2.	Infected Bullock	1 (25)	8 (66.67)	1 (100)
	Infected Bullock	3 (75)	4 (33.33)	-
	Total	4 (23.53)	12 (70.59)	1 (5.88)
Grand Total		**17 (35.42)**	**28 (58.33)**	**3 (6.25)**

* Figure in parenthesis indicates percentage.

In the present study fourty eight resident domestic cattle of protected area were observed for estimating the health status, out of which 17/48 (35.42%) animals were in good condition, 28/48 (58.33%) in fair and 3/48 (6.25%) in poor condition. Riney (1960) and Lardy (2000) described the method of body condition evaluation depending on visual observation and differences revealing in respect of bony prominence by offering score and presenting the body condition index (BCI) of different wild ungulates and beef cattle, respectively. On considering the over all general condition

Fig- 10 : Sampling of Grasses and Soil at Pench National Park.

Fig- 11 : Hariyali grass.

of cow the 13/31 (41.94%) found in good, 16/31 (51.61%) in fair and 2/31 (6.45%) in poor condition. Helminths infested cattle revealed 62.5% of fair condition followed by poor status in 100%. Over all body condition of bullock 4/17 (23.33%) are in good condition, 12/17 (70.49%) in fair, and 1/17 (5.88%) revealed in poor condition. The overall 25% bullock exposed to helminth infestation revealed in good condition followed by 66.66% in fair and 100% in poor condition. It can be deduced from Table-7 that body condition of helminth infested cattle however found declined as compared non-infected cattle (Fig. 2). Sathyanarayana (1992) opion that helminths parasite induces the effect on the behavior assimilation of nutrients and on other general aspect of the host, there by leads to the manifestation of ill-health in wild animals. Similar observation was noted by Yadav and Sadana (1999) with the finding that the helminth affected cattle shows the overall reflection towards decline of body condition in cattle.

The complex relationship with respect to trace elements in soil, plants and animals is well documented, however, the characteristics of plants and trace element interaction usually result in poor availability or trace elements imbalances. Keeping in view, the study on determination of soil-plant-animal relationship for the macro-element and the estimation of trace elements are considered. To explore fluorosis in water sources in view to augment the pollution due to fluorosis, the present study also involved the determination of fluorine in water sources at Pench National Park.

Since, human pressure on a protected area is now increasing in various modes i.e. air, water pollution, commercial exploitation,

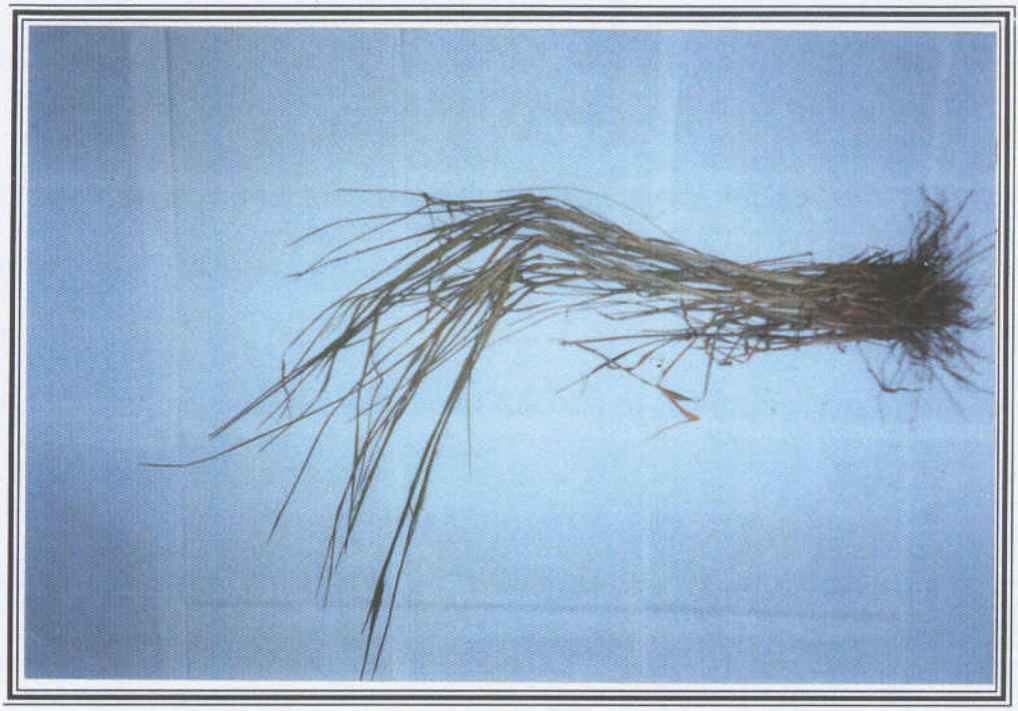

Fig- 12 : Kushri grass.

Fig- 13 : Pitondi grass.

construction of dams, roads, livestock grazing and also hydro electric power station.

Soil influences disease in many ways, inspite of the fact little attention is explored to review the geochemistry of soil. Therefore, the present study involves the study of geochemistry of the soil associated with the distribution and occurrence of number of nutritional deficiency diseases in domestic animals. Knowledge of the role of minerals against diseases of wildlife is still fragmentary.

Table 8 : Analysis of soil, grass, serum and water plant.

Parameter	Area of estimation	Calcium	Phosphorus	Fluorine
Soil (Value in ppm)	i) Pench – 1	73.60	9.8	18.02
	ii) Pench – 2	77.09	8.4	11.03
	iii)Pench – 3	76.83	8.53	11.88
	iv)Pench – 4	77.51	7.98	16.32
	v) Pench – 5	76.72	8.02	12.02
	Mean ± S.E.	**76.35 ± 0.7008**	**8.546 ± 0.3309**	**11.854 ± 2.959**
Grass (Value of Ca and are in % / kg n D.M. basis.)	i) Hariyali (Fig.11)	0.31	0.25	0.61 ppm
	ii) Kushri (Fig.12)	0.28	0.24	0.83 ppm
	iii) Pitondi (Fig.13)	0.24	0.21	0.78 ppm
	iv) Ken (Fig.14)	0.26	0.22	0.69 ppm
	v) Kharatya (Fig.14)	0.24	0.21	0.62 ppm
Serum (Cattle) (Value of Ca and are in mg/dl)	1	9.85	6.03	0.18 ppm
	2	9.81	6.15	0.23 ppm
	3	8.3	5.85	0.21 ppm
	4	10.4	6.08	0.16 ppm
	5	9.5	5.2	0.21 ppm
	Mean± S.E.	**9.572 ± 0.3495**	**5.862 ± 2.6216**	**0.198 ± 0.0124**
Water (Value in ppm)	1	---	---	0.7
	2	---	---	0.6
	3	---	---	0.8
	4	---	---	0.9
	5	---	---	0.9
	Mean± S.E.	---	---	**0.78 ± 0.0583**

Fig- 14 : Ken grass.

Fig- 15 : Kharatya grass.

It was evident from Table 8, the calcium level in the soil at Pench showing 76.35 ± 0.70 ppm which is higher than the normal i.e. 30-40 ppm. The value of normal ranges in grasses presented in Table 8. The serum calcium of cattle at Pench showed 9.572 ± 0.35 mg/dl, which appeared in the normal ranges. However, Sharma *et al.* (2003) documented overall 24.89% deficiency of Ca in soil, 23.09% in fodder and 32.42% in cattle and further precludes that serum mineral deficiencies in cattle usually corresponds with mineral status of soil and fodder. The finding of present study is in accordance to Pramod Kumar (2001) who reported in his study that all three places of Pench have shown deficient status of calcium in soil, which could be attributed and considering the different location of the sampling. Das *et al.* (2003) stated that high content of micro calcium in feed reflected in the blood of all the categories of animals.

The status of phosphorus in respect of soil, in the present study however indicated elevated level of phosphorus in soil (8.546 ± 0.33 ppm) as compared to normal (0.035 to 0.185 ppm). The grasses showing the highest level of phosphorus (Table 8), however level of serum phosphorus in cattle as in present study found to be 5.862 ± 2.622 mg/dl. On considering the relationship of soil-plant-animals in the present study, however indicated that the value of phosphorus revealed strong relationship. Besides this high content of phosphorus in soil, grass have definite reflection on the blood phosphorus level. Pramod Kumar (2001) reported in

It was evident from Table 8, the calcium level in the soil at Pench showing 76.35 ± 0.70 ppm which is higher than the normal i.e. 30-40 ppm. The value of normal ranges in grasses presented in Table 8. The serum calcium of cattle at Pench showed 9.572 ± 0.35 mg/dl, which appeared in the normal ranges. However, Sharma *et al.* (2003) documented overall 24.89% deficiency of Ca in soil, 23.09% in fodder and 32.42% in cattle and further precludes that serum mineral deficiencies in cattle usually corresponds with mineral status of soil and fodder. The finding of present study is in accordance to Pramod Kumar (2001) who reported in his study that all three places of Pench have shown deficient status of calcium in soil, which could be attributed and considering the different location of the sampling. Das *et al.* (2003) stated that high content of micro calcium in feed reflected in the blood of all the categories of animals.

The status of phosphorus in respect of soil, in the present study however indicated elevated level of phosphorus in soil (8.546 ± 0.33 ppm) as compared to normal (0.035 to 0.185 ppm). The grasses showing the highest level of phosphorus (Table 8), however level of serum phosphorus in cattle as in present study found to be 5.862 ± 2.622 mg/dl. On considering the relationship of soil-plant-animals in the present study, however indicated that the value of phosphorus revealed strong relationship. Besides this high content of phosphorus in soil, grass have definite reflection on the blood phosphorus level. Pramod Kumar (2001) reported in

Fig- 16 : Sampling of water.

Fig- 17 : Major water holes in Pench National Park.

his study that the soil phosphorus level revealed very high in the three different locations of soil.

The relation of Ca: P is appeared to be varied in the present study, which could be, attributed poor body condition and reproductive status of animal.

The soil in the area of present study involves the parent bedrock and the long-term climate, which affected both the plant and animal species present in that area. Considering geographic condition of Pench National Park, it was decided to estimate fluorine content of soil-water-grass-animal to ruled out possibility of fluorosis as Upadhyay *et al.* (2003) monitored prevalence of bovine flurosis in central east India. Fluorine of soil at Pench showed 11.85 ± 2.96 ppm which was found to be lowere than the tolerance level of fluorine i.e. > 100 ppm, however water samples from water holes commonly shared by both wild and domestic animal revealed 0.78 ± 0.58 ppm fluorine, which is against the tolerance level of 0.7-1.7 ppm. Grass showed fluorine level 0.61-0.83 ppm which is higher than normal level > 20-50 ppm. Singh and Swarup (2003) described sources of fluoride toxicity and stated that mineral supplement containing rock phosphate in form of phosphorus sources is 2-5% fluorine and further stated that top dressing of pasture with phosphatic lime stone is a common source of flurosis. Value of serum fluorine indicated 0.198 ± 0.0124 ppm out of which three samples of fluorine showed slight higher value i.e. > 20-30

Fig- 18

Fig- 19

Fig. 18 - 19: Temporary water holes of Pench National Park.

ppm. Thus, considering the plant and animal correlation with that of fluorine the strong relation have been observed as regards to plant and animal. However, Sharma *et al.* (2003) opinion that serum mineral deficiencies usually corresponds with mineral status of soil and fodders.

On considering the fact stated above, it could be emphasised that levels of trace minerals in soil have direct relationship to the plant and animals.

CONCLUSIONS

The results obtained in the present study revealed the following conclusion:

1] Various species of free living wild herbivores suffer with helminthic infection and the estimated overall prevalence was 19.59% and should be of concern.

2] Prevalence of helminthic infection in resident livestock population (cattle) within protected areas was found to be 34.17% however indicated that a strong link exist between domestic and wild herbivores in the scope of transmission of endoparasite in both the directions.

3] Incidence of helminthic infection in residential domestic cattle was reduced from 34.17 to nil after deworming. However, incidence in wild herbivores was reduced 19.59% to 4.73% by virtue of checking source of infection in faeces of domestic animals, which appears to be prominent source of soil and grassland contamination.

4] The possibility of occurrence of helminth infection associated with haematobiochemical alteration in resident livestock Vs free wild herbivores has been indicated on the basis of parameter studied which returned to normal after therapy with fenbendazole. Effective recovery in the EPG status was recorded in both the species. In

essence the findings are of valuable confirmation in the interest of development of preventive package against endoparasitism towards free living wild fauna following regular deworming to resident livestock of adjoining forest in addition to the practices of rotational grazing could be of use to curb the perpeuatation of helminth infection in wild animals.

5] Regular deworming to resident livestock population and rotational grazing may prove to control helminthic infection in wild herbivores animals.

6] The prevalence of helminthic infection can reflect the effect on body health of domestic animals and such effect on the body health of animals could be categorized in form of fair and poor status.

7] Water holes and soil in the forest may likely to contain evidence of fluorine and could be given due attention while planning of the project.

8] There appears a strong relationship between soil-plant-animal as regards phosphorus and moderately with fluorine.

9] The finding could be of valuable confirmation in the interest of field veterinarian entrusted with wild life medicine.

SUMMARY

The présent study was carried out on the free living wild herbivores and resident livestock population (cattle) of the protected areas of Pench National Park, Maharashtra for development of preventive package for control of endoparasitisum within free living wildlife.

For the present study 536 faecal samples was examined for resident livestock population and wild herbivores animals, 248 samples examined before therapeutic measure in respect of resident livestock population. Out of 248 samples collected, 70 samples were positive for different helminth infection, the overall percentage of infection found was 26.12%. Prevalence of helminth infection reported in present study in resident livestock (cattle) was 34.17% and in wild herbivores (19.59%). Amongst wild herbivores, highest prevalence was observed in Chital deer (9.52%) followed by Bison (8.33%).

No haemoparasites reported in resident livestock population in the present study.

The different helminthic species identified were *Paramphistome* spp, *Fasciola hepatica*, *Strongyle* spp, *Trichuris* spp., *Dictyocalus* spp., *Oesophagostomum* spp., *Strongyloides* spp., *Moniezia* spp. and *Toxocara* spp. Hydatid cyst reported in Bison and unidentified larvae found in Barking deer.

The treatment with Fenbendazole @ 7.5 mg/kg body weight was used for deworming all the resident domestic cattle at Pench National Park. The subjected therapeutic measures revealed Mean EPG 678.05 ± 44.04 (0 day), which subsequently found reduced 150 ± 50.01 (60 day). After repeatation of deworming, it becomes almost nil in resident domestic cattle. However in wild herbivores animals mean EPG decreased from 421.43 ± 39.64 (0 day) to 185.72 ± 34.02 (60 day). The over all incidence of helminthic infection in resident domestic cattle becomes nil, where as in wild herbivores it reduced from 19.59% to 4.73%.

In resident domestic cattle of Pench National Park, the haematobiochemical attribute, however indicated that haemoglobin, packed cell volume, total erythrocyte count, neutrophil (%), lymphocyte (%), serum total protein, serum calcium and phosphorus showed significant increasing trend after deworming, while blood glucose increased non-significantly. The total leucocyte count, eosinophil (%) and monocyte (%) decreased significantly after deworming.

Body condition of resident livestock population were evaluated and further revealed that 62.5% of cow and 66.66% of bullock, which were parasitised found in fair condition followed by 100% of cow and 75% of bullock, thus non-parasitised exhibited good condition indicating that the overall 35.42% animals revealed in good condition, 58.33% in fair condition and 6.25% in poor condition.

Analysis of representative water samples collected from Pench National Park, revealed the presence of 0.78 ± 0.058 ppm of fluorine followed by soil, grass and animal serum from different location revealed high phosphorus contents. Thus, calcium was found higher in soil as compared to grass and in animal serum sample, which were to wards normality.

LITERATURE CITED

Agneessens, J., P. Dorny, W. Hollanders, E. Claerebout and J. Veroruysse (1997) Epidemiological observations on gastrointestinal nematode infections in grazing cow calf pairs in Belgium. Vet. Parasitol., **69** (1-2) : 65-75.

Agunolye, C.A., J.O. Esan and R.O. Adejuyighe (2002) A survey of gastrointestinal nematodes in soil samples in Ibodan, Nigeri. Nigerian Vet. J., **23** (1) : 75-78.

AOAC (1975) Official methods of Analysis. 12th edn. Association of Official Analytical Chemists. Washington, D.C. pp.1094.

Bandyopathyay, B. and C.K. Dasgupta (2000) Studies on the levels of blood glucose and serum proteins in *Trichostrongyle* infection in calves. J. Vet. Parasitol., **14** (1) : 71-73.

Banerjee, P.S., R. Garg, H. Ram and C.L. Yadav (2002) Parasites of wild animals in Uttaranchal. Abstr. Published at 13th National Congress of Veterinary Parasitology on 14-16th Feb. at Kolkata.

Bharti, P., K.D. Prasad and S. Kumar (2002) Haematological observations in calves and cattle during pre-and-post anthelmintic treatment. Indian J. Anim. Helmnthol., **41** (1) : 55-57.

Bhat, M.N. and R. Manickam (1998) Coprocul ture and study of seasonal variation in parasitic burden in spotted deer (*Axix axis*) in different sanctuaries in Tamil Nadu. Indian Vet. J., **75** : 469-471.

Bhongade, H.G., D.B. Sarode, V.A. Sapre and A.M. Rode (1993) Effect of anthelmintic therapy on haemato-biochemical profiles of dairy cows under rural management. VET, **5** (1) : 36-40.

Bhownik, M.K. (2002) The causes of decline of Hog deer (*Axis-procinus*) in protected areas of Himalayan West Bengal. Zoo's Print J., **17** (8) : 858-860.

Booth, N. H. and L. E. McDonald (1988) Veterinary Pharmacology and Therapeutics, 6th edn. Panima Publishing Corporation, New Delhi, pp. 1227.

Bordoloi, G.C., G.C. Datta, I. Das, M. Pathak and A. Choudhary (1991) Note in incidence of intestinal helminthic infection of deer in captivity. Zoo's Print, **6** (11) : 17.

Anonymus **(1998)** Project Tiger-Status Report. Ministry of Environment and forest. Govt. of India. , New Delhi, 2001:130-135.

Chakraborty, A. (1992) *Trichuris* spp. infection in wild captive herbivores. J. Vet. Parasitol., **6** (2) : 37-40.

Chakraborty, A. and P.K. Goswami (2001) Parasites of nonhuman primates of Assam State Zoo. J. Vet. Parasitol., **15** (2) : 121-124.

Chakraborty, A. and S. Islam (1996) A survey of gastrointestinal parasitic infection in some free living herbivores in the Kaziranga National Park. Zoo's Print, **11** (3) : 3-5.

Chauhan, P. P. S. , B.B. Bhatia, G. S. Arora, R.D. Agrawal, S. S. Ahluwalia (1972) A preliminary survey of parasitic infections among mammals and birds at Lucknow and Delhi Zoos. Ind. J. Anim. Sci., **43** (2) : 163-168.

Choudhri, S.S., R.P. Gupta and A.K. Sangwan (1993) Helminthic diseases in ruminants of Haryana and their control : A review. Agri. Rev., Karnal, **14** (3-4) : 121-132.

Dakshinkar, N. P., T. K. Dixit and Dhakate, M .S. (1983) Occurrence of *Trichuris* spp. in deer (*Axis axis*) . Veterinarian, **7** (11) :9.

Das, A., P. Biswas and D. Rajendran (2003) Micronutrient profile of feeds, fodders and animals in hill zone of West Bengal. Anim. Nutr. Feed. Tech., **3** : 9-16.

Deka, D.K., S. Choudhury and A. Chakaraborty (1995) Parasites of domestic animals and birds in Lakhimpur (Assam). J. Vet. Parasitol., **9** (1) : 21-25.

Feldman, B.F., J.G. Zinkl, and N.C. Jain (2002) Schalm's Veterinary Hematology, 5th edn. , A Walters Kluwer Company, pp. 1344.

Fowler, M. E. (1986) Zoo and Wild animal Medicine- current therapy-3. 2nd edn. W.B. Saunders Company, pp. 617.

Gaur, S.N.S., M.S. Sethi, H.C. Tewari and O. Prakash (1979) A note on the prevalence of helminth parasites in wild and zoo animals in Uttar Pradesh. Indian J. Anim. Sci., **49** (2) : 159-161.

Georgi, J.R. and V.J. Theodorides (1980) Parasitology for veterinarians, 3rd edn., pp. 344.

Herd, R.P. and B.L. Hull (1981) *Paramphistomum microbothrioides* in American bison and domestic beef cattle. J. Ame. Vet. Med. Assoc., **179** (10) : 1019-1020.

Hirani, N.D., M.A. Katariya, A. Patel, J. J. Hasnani, L.G. Kathiria and P.V. Patel (1999) Prevalence of gastrointestinal parasite infections in cattle and buffalo of Kheda district of Gujrat. J. Vet. Parasitol., **13** (2) : 147-149.

Hiregoudar, L.S. (1976) Some parasites of wild ruminants in Gir Forest of India. Indian Vet. J., **53** (3) : 237.

Jani, R.G., R.H. Sabapara and P.R. Patel (2003) Prevalence and haemato-biochemical studies of gastrointestinal parasites in Indian elephants (*Elephas maximus*). Abstr. Souvenir – National Symposium and XXI ISVM Convention- 2003, Anand. Session, **4** (6) : 180.

Jithendran, K.P. and T.K. Bhat (2001) Epidemiology and control of parasitism in Nomadic situations in Himachal Pradesh. ENVIS Bull. : Himalayan Ecology and Development, **9** (1) : 1-10.

Karasev, N.F. and V.F. Litvinov (1977) Trematodes of wild ungulates in the Belorussion poozer'y. Materialy-Nouchnoi-Konferentsii-Vsesoyunogo-Obschestava-Gel. Mintologov-Trematody-I-trematodozy, **29** : 55-58.

Khan, M. G. A., A. M. Khan and D. Rao (1981) Balantidiosis in monkeys of Nehru Zoological Park, Hyderabad. Livestock Advisor, **6** (6) : 39-42.

Kumar, M., P.S. Banerjee and N. Singh (2002) Incidence of different helminth infections in Tarai and Western Plains of Uttar Pradesh. Indian Vet. Med. J., **26** (1) : 105-108.

Lardy, G. (2000) Body Condition Scoring I: Managing your cow herd through body condition scoring. Manuel Encinias. AS-1026.

Mandal, P., M. G. Jayathangaraj, L. John, B.R. Latha and M. Raman (2002) Prevalence of helminthic infection in free ranging Chital (*Axis axis*) at Mudumali Wildlife Sanctuary, Tamil Nadu. Abstr. Published at 13th National Congress of Veterinary Parasitology on 14-16th Feb. at Kolkata.

McGhee, M.B., V.F. Nettles, E.A. Roller III, A.K. Prestwood, W.R. Davidson (1981) Studies on cross-transmission and pathogenecity of *Haemonchus contortus* in white tailed deer, domestic cattle and sheep. J. Wildlife Dis., **17** : 353-364.

Modi, G.S., B.N. Prsad and B.K. Sinha (1997) Seasonal effect on prevalence of parasitic zoonotic diseases among zoo animals of Bihar. Zoo's Print, **12** (4) : 8-11.

Mondal, M.M.H., M.K. Islam, H. Jin, L. Johnhwa and B. Byeong Kirl (2000) Examination of gastrointestinal helminths in livestock in grassland of Bangladesh. Korean J. Parasitol., **38** (3) : 187-190.

Nama, H. S. (1990) Cestode Parasites of Indian Mammals.1st edn. Scientific Publishers, pp. 342.

Pal, S., S. Roy and A.K. Pathak (2001) Prevalence of gastrointestinal parasites in cattle and buffaloes from Chhattisgarh region. J. Vet. Parasitol., **15** (2) : 155-156.

Parsani, H.R., R.R. Momin, M.G. Maradia and V. Sing (2001) A survey of gastrointestinal parasites of captive animals at Rajkot Municipal Corporation Zoo, Rajkot, Gujrat. Zoo's Print J., **16** (10) : 604-606.

Patel, P.V., A.I. Patel, J.B. Solanki, R.H. Sabapara and R. Vyas (2003) Helminthic infection in wild herbivores. Abstr. Souvenir-National Symposium and XXI ISVM Convention- 2003, Anand. Session **4** (5) : 179.

Patnaik, M.M. and L.N. Acharjyo (1970) Notes on the helminth parasites of vertebrates in Baranga Zoo. Indian Vet. J., **47**: 722.

Pramod Kumar, G. (2001) Free living wildlife and livestock disease interaction with special reference to endoparasites. Unpublished M.V.Sc thesis Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

Pramod Kumar, G., N.P. Dakshinkar, S.W. Kolte, G.R. Bhojne and D.B. Sarode (2002) Micrometry of different parasitic ova of free ranging wild life. Indian Vet. Med. J., **26** (6) : 151-152.

Prestwood, A.K., F.E. Kellogg, S.R, Pursglove and F.A. Hayes (1975) Helminth parasitisms among interminingling insular population of White tailed deer, feral cattle and feral swine. J. Amer. Vet. Med. Assoc., **166** : 787-789.

Prestwood, A.K., S.R. Pursglove and F.A. Hayes (1976) Parasitism among white-tailed deer and domestic sheep on common range. J. Wildlife Dis., **12** (3) : 380-385.

Rajkhowa, S. and G.C. Hazarika (2001) Prevalence of intestinal nematodes in female calves of Grater Guwahati of Assam. Indian Vet. J., **78** (5) : 449-451.

Raman, M., S.A. Joseph and R. Anandan (1999) Some haemo-biochemical changes in Experimental Bovine Haemonchosis. J. Vet. Parasitol., **13** (1) : 39-41.

Riney, T. (1960) A field technique for assessing physical condition of some ungulates. J. Wildlife Mgmt., **24** : 92-94.

Sahoo, N., T.N. Mohanty and S. Samal (2002) Prevalence of gastrointestinal helminthic infections among grazing and stall fed cattle in a rain fed district of Orissa. J. Vet. Parasitol., **16** (1) : 61-62.

Sathyanarayana, M.C. (1992) Significance of parasitology of wildlife management. Zoo's Print, **7** (12) : 39.

Shahardar, R.S., A.S. Mir, M.M. Mir, B.A. Pandit and M.A. Ahmad (1995) Efficacy of fenbendazole against gastrointestinal nematodes of Kashmir deer (Hangul). Indian Vet. J., **72** (7) : 781-782.

Sharma, M.L., C. Joshi and S. Gupta (2003) Prevalence of mineral deficiency in soil, plants and cattle of certain districts of Uttar Pradesh. Indian J. Vet. Med., **23** (1) : 4-8.

Shrivastav, A.B., R.K. Chaudhary, H.O.P. Shrivastav and R. Gopal (1997) Amphistome infection in Swamp deer (*Cervus duvauceli branderi*). Zoo's Print, **12** (9) : 27.

Sing, J.L. and D. Swarup (2003) Bovine Fluorosis : An emerging crippling disease in India. Intas Polivet, **4** (1) : 54-61.

Singh, S. and D.P. Banerjee (1997) Role of wildlife in parasitic diseases of man and animals. Zoo's Print, **12** (4) : 14-16.

Snedecor, G.W. and W.G.Cochran (1967) Statistical methods. 6th edn. The Iowa State College Press, Ames, Iowa, pp.593.

Soulsby, E.J.L. (1982) Helminths, Arthopods and protozoa of domesticated animals, 7th edn. ELBS and Bailliere Tindall, London, pp. 809.

Sreedeevi, C. and M. Hafeez (2001) Efficacy of fenbendazole against *Trichuris* infection in cattle. Indian Vet. J., **78** (2) : 170-171.

Thakur, D. K. and S. K. Mishra (1973) Hematological studies in calves with natural helminthic infections around coastal belt of Orissa. Indian J. Ani. Health. **12** : 171-174.

Upadhyay, A.K., V. Jain and M. Kumar (2003) Haemato-biochemical alterations in experimental bovine fasciolosis. Abstr. Souvenir-National Symposium and XXI ISVM Convention- 2003, Anand. Session-**6** (34) : 250.

Upadhyay, S.R., S. Roy, P.K. Pande, M. Roy, C.N. Galdhara and A. Tiwari (2003) Studies on prevalence of bovine fluorosis in Central East India. Abstr. Souvenir – National Symposium and XXI ISVM Convention- 2003, Anand. Session-**7** (23) : 249.

Varadharajan, A. and C. Pythal (1999 a) Incidence of gastrointestinal parasitism in free living, ferral bonnet macaque (*Macaca radiata* L.). Zoo's Print J., **14** (6) : 41-42.

Varadharajan, A. and C. Pythal (1999 b) Parasites of Wildlife-I. A preliminary investigation on the parasites of wild animals at the Zoological Garden, Thriruvanthapuram, Kerala. Zoo's Print J., **1-14** (3-12) : 159-164.

Varma, T.K., B.M. Arora, H.C. Malviya and A. Prasad (1993) On the occurrence of *Paramphistomum epiclitum Fischoeder*, 1904 from rumen and *Gigantocotyle explanatum* (replin, 1847) Nasmark, 1937 from bile duct of Sambar (*Cervus unicolor*). Indian J. Anim. Sci., **63** (30) : 630.

Rajkhowa, S. and G.C. Hazarika (2001) Prevalence of intestinal nematodes in female calves of Grater Guwahati of Assam. Indian Vet. J., **78** (5) : 449-451.

Raman, M., S.A. Joseph and R. Anandan (1999) Some haemo-biochemical changes in Experimental Bovine Haemonchosis. J. Vet. Parasitol., **13** (1) : 39-41.

Riney, T. (1960) A field technique for assessing physical condition of some ungulates. J. Wildlife Mgmt., **24** : 92-94.

Sahoo, N., T.N. Mohanty and S. Samal (2002) Prevalence of gastrointestinal helminthic infections among grazing and stall fed cattle in a rain fed district of Orissa. J. Vet. Parasitol., **16** (1) : 61-62.

Sathyanarayana, M.C. (1992) Significance of parasitology of wildlife management. Zoo's Print, **7** (12) : 39.

Shahardar, R.S., A.S. Mir, M.M. Mir, B.A. Pandit and M.A. Ahmad (1995) Efficacy of fenbendazole against gastrointestinal nematodes of Kashmir deer (Hangul). Indian Vet. J., **72** (7) : 781-782.

Sharma, M.L., C. Joshi and S. Gupta (2003) Prevalence of mineral deficiency in soil, plants and cattle of certain districts of Uttar Pradesh. Indian J. Vet. Med., **23** (1) : 4-8.

Shrivastav, A.B., R.K. Chaudhary, H.O.P. Shrivastav and R. Gopal (1997) Amphistome infection in Swamp deer (*Cervus duvauceli branderi*). Zoo's Print, **12** (9) : 27.

Sing, J.L. and D. Swarup (2003) Bovine Fluorosis : An emerging crippling disease in India. Intas Polivet, **4** (1) : 54-61.

Singh, S. and D.P. Banerjee (1997) Role of wildlife in parasitic diseases of man and animals. Zoo's Print, **12** (4) : 14-16.

Snedecor, G.W. and W.G.Cochran (1967) Statistical methods. 6th edn. The Iowa State College Press, Ames, Iowa, pp.593.

Soulsby, E.J.L. (1982) Helminths, Arthopods and protozoa of domesticated animals, 7th edn. ELBS and Bailliere Tindall, London, pp. 809.

Sreedeevi, C. and M. Hafeez (2001) Efficacy of fenbendazole against *Trichuris* infection in cattle. Indian Vet. J., **78** (2) : 170-171.

Thakur, D. K. and S. K. Mishra (1973) Hematological studies in calves with natural helminthic infections around coastal belt of Orissa. Indian J. Ani. Health. **12** : 171-174.

Upadhyay, A.K., V. Jain and M. Kumar (2003) Haemato-biochemical alterations in experimental bovine fasciolosis. Abstr. Souvenir-National Symposium and XXI ISVM Convention- 2003, Anand. Session-**6** (34) : 250.

Upadhyay, S.R., S. Roy, P.K. Pande, M. Roy, C.N. Galdhara and A. Tiwari (2003) Studies on prevalence of bovine fluorosis in Central East India. Abstr. Souvenir – National Symposium and XXI ISVM Convention- 2003, Anand. Session-**7** (23) : 249.

Varadharajan, A. and C. Pythal (1999 a) Incidence of gastrointestinal parasitism in free living, ferral bonnet macaque (*Macaca radiata* L.). Zoo's Print J., **14** (6) : 41-42.

Varadharajan, A. and C. Pythal (1999 b) Parasites of Wildlife-I. A preliminary investigation on the parasites of wild animals at the Zoological Garden, Thriruvanthapuram, Kerala. Zoo's Print J., **1-14** (3-12) : 159-164.

Varma, T.K., B.M. Arora, H.C. Malviya and A. Prasad (1993) On the occurrence of *Paramphistomum epiclitum Fischoeder*, 1904 from rumen and *Gigantocotyle explanatum* (replin, 1847) Nasmark, 1937 from bile duct of Sambar (*Cervus unicolor*). Indian J. Anim. Sci., **63** (30) : 630.

Waghmare, S. P., A.M. Rode, V. A. Sapre and N.P. Dakshinkar (1993) Hematological studies in buffalo calves with natural gastrointestinal helminth infection. Livestock Advisor, **18** (12): 7-12.

Yadav, C.L. and J.R. Sadana (1999) An outbreak of gastrointestinal nematodiosis in dairy cattle in Hisar, Indian J. Vet. Parasitol., **13** (1) : 23-26.

THESIS ABSTRACT

a)	Title of the thesis	:	**DEVELOPMENT OF PREVENTIVE PACKAGE FOR CONTROL OF ENDOPARASITISM IN FREE RANGING WILDLIFE.**
b)	Full name of student	:	**Navnath Keshav Nighot**
c)	Name and address of Major Advisor	:	**Dr. D. B. Sarode,** Professor & Head, Department of Veterinary Medicine, Nagpur Veterinary College, Nagpur
d)	Degree to be awarded	:	Master of Veterinary Science
e)	Year of award of degree	:	2003
f)	Major subject	:	Veterinary Medicine
g)	Total number of pages in the thesis	:	73
h)	Number of words in the abstract	:	364
i)	Signature of Student	:	NK_Nighot
j)	Signature, Name and address of forwarding authority		**(Dr. V. R. Bhamburkar)** Associate Dean Nagpur Veterinary College, Nagpur

ABSTRACT

The present investigation was carried out in free living wild herbivores animals and resident livestock population of the protected areas of Pench National Park, Maharashtra for development of preventive package for controlling endoparasites in free ranging wildlife with special reference to helminthic infection.

Of the 536 faecal samples collected, 248 were examined before treatment out of which 70 samples were positive for different helminthic infection, the overall percentage of infection revealed 26.12%. No haemoprotozoan infection was reported in the present study.

Animal wise prevalence of helminthic infection in free ranging wild herbivores was 19.59% and in a resident domestic cattle 34.17%. Amongst wild herbivores the highest prevalence was observed in Chital deer (9.52%) followed by Bison (8.33%).

Intensity of infestation as regards parasitic species are concerned, it was found to be heavy for *Strongyle* (27.59%) in wild herbivores followed by *Paramphistomes* (39.02%) in resident domestic cattle population.

Efficacy of Fenbendazole @ 7.5 mg/kg body weight orally found effective up to 100%. Mean EPG count 678.05 ± 44.04 (0 day) was reduced 150 ± 50.01 (60 days) and become nil in two positive cases after re-deworming to this resident livestock population (cattle). While mean EPG of wild herbivores reduced 421.43 ± 39.64 to 185.72 ± 34.02. However, the incidence of helminthic infection in resident livestock population reduced from 34.17% to nil, while in wild herbivores it reduced from 19.59% to 4.73%.

Decreased haemoglobin, packed cell volume, total erythrocyte count, neutrophil per cent, lymphocyte per cent, serum total protein, serum calcium and phosphorus during course of helminthic infection which was

significantly restored after deworming of resident livestock population. While blood glucose increase non-significantly. The level of increased total leucocyte count, eosinophil and monocyte per cent decreased significantly.

Body condition of parasitised cow and bullock showed fair and poor health as compared to non-parasitised, which manifested good and fair health status.

Water analysis from Pench revealed 0.78 ± 0.058 ppm of fluorine, but soil, grass showed normal level, increased serum fluorine content was 0.18-0.23 ppm manifested in some cattle (mean ± S.E.=0.198 ± 0.124 ppm).

It can be deduced from the present study that strong relationship can be indicated in soil-plant-animals as regards to phosphorus and moderately with fluorine.