STUDY ON GASTRO-INTESTINAL PARASITES IN SLOTH BEARS (*Melursus ursinus*) AT BEAR RESCUE CENTRE

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CERTIFICATE

This is to certify that the thesis entitled "**STUDY ON GASTRO-INTESTINAL PARASITES IN SLOTH BEARS (*Melursus ursinus*) AT BEAR RESCUE CENTRE**" submitted by **Mr. SUPRITH SURYA**, **I.D. No. MVHK 1550** in partial fulfilment of the requirements for the award of degree of **MASTER OF VETERINARY SCIENCE** in **WILDLIFE** of the Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, is a record of bonafide research work carried out by him during the period of his study in this University, under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

Bengaluru
November, 2017

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RESPECTFULLY DEDICATED

TO

THE INDIAN ARMED FORCES

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LIST OF ABBREVIATIONS

%	Per cent
@	At
BBRC	Bannerghatta Bear Rescue Centre
BW	Body Weight
CITES	Convention on International Trade in Endangered Species of Fauna and Flora
EPG	Egg per gram
g	Gram
IUCN	International Union for Conservation of Nature and Natural Resources
kg	Kilo gram
Ltd.	Limited
mg	Milli gram
ml	Milli litre
No.	Number
Pvt.	Private
rpm	Revolutions per minute
SE	Standard error
Sp. gr.	Specific gravity
sp.	Species
yr	Year

INTRODUCTION

I. INTRODUCTION

In India there are four bear species out of eight recognized bear species in the world namely brown bear [*Ursus arctos*], asiatic black bear [*Ursus thibetanus*], sun bear [*Helarctos malayanus*] and sloth bear [*Melursus ursinus*] (Kumar *et al*., 2014). Bears belong to the family Ursidae. Among the recognized bear species sloth bears are endemic to Indian sub-continent and are adapted to the habitat found in the Indian sub-continent.

Sloth bears were employed as dancing bears and the people who owned bears were solely dependent on these bears for their livelihood. Sloth bears are listed in "Appendix I" of "CITES" and are completely protected under "Schedule I" of the "Indian Wildlife Protection Act, 1972". Sloth bears are listed under threatened species (Dharaiya *et al*., 2016). According to IUCN 2016, it has been estimated that in India there are less than 20,000 bears and approximately 350 – 400 bears are estimated to be present in Karnataka.

Sloth bears are distributed in grassland, forest, rocky areas apart from hilly regions existing in India, Srilanka, Nepal, Bangladesh and Bhutan. In India, sloth bears are found in the Siwaliks, low hills bordering the outer range of the Himalayas from Punjab to Arunachal Pradesh, in abundance in Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, Tamilnadu and Kerala (Garshelis *et al*., 2008).

Bears are commonly infected with the helminth and protozoan parasites including *Echinococcus* sp., *Opisthorchis* sp., *Trichinella* sp., *Baylisascaris* sp., *Thelazia* sp., *Toxocara* sp., *Ancylostoma* sp., *Dirofilaria* sp., *Trichuris* sp., *Taenia* sp., *Giardia* sp.,

Cryptosporidium sp., *Toxoplasma* sp., *Leishmania* sp., *Trypanosona* sp., *Plasmodium* sp., *Sarcocystis* sp., *Eimeria* sp. Arthropods like fleas, ticks, and mosquitoes acts as major vectors in transmission and/or intermediate host for development of parasites responsible for causing parasitic diseases (Chhabra and Muraleedharan, 2016).

Parasitic diseases are common in countries with warm and tropical climates due to factors such as light, temperature and humidity that favor the development of parasites irrespective of the gender of animal.

The interface between human habitat and wildlife habitat is one of the major reasons for spread of infectious agents and parasites to uncommon hosts (wild animal) leading to the establishment of new host parasites and disease transmission chain.

Zoo animals living under captivity are susceptible to almost all types of parasitic diseases, particularly helminthic infections. Parasitic infections constitute one of the major managemental problems causing mortality and morbidity in captive wild animals. In free range animals there is a natural resistance against the parasitic infections or they live in a balanced system with their parasites commensals. Whereas, animals housed in the confined areas within the zoo enclosure makes them more prone to different parasitic infections despite proper attention to feeding, water and maintenance of hygiene in captivity. The change in environment and living conditions from free-living to captivity influences the animal's ecology and increases the sensitivity to the parasitic infections due to stress as these animals are exotic to that particular geographical location.

A number of factors threaten the existence of wild animals in India, including poaching, illegal trade, infectious diseases, particularly those of gastro-intestinal

parasites. Parasitic diseases contribute one of the major problems causing mortality in wild animals, particularly helminthic infection can frequently be a major problem in zoos due to the maintenance of animals in confined areas. Moreover, anthelmintic resistance limits the control of parasites in zoo animals hence there is a need for a well scheduled anthelmintic program that includes regular passive surveillance for parasitic infections and effective treatment program.

It is difficult to eliminate gastro-intestinal parasites completely from Zoo animals, especially in carnivores, due to constant source of infection within the enclosures through contaminated food and water, and less effective anthelmintic delivery system at the proper dose and/or anthelmintic resistance. The interaction between animals and their attendants also act as a major vehicle for disease transmission.

Parasites cause mortality and morbidity which leads to the loss of animal population leading to altered ecosystem hence there is a need for conservation of the sloth bears as they are listed under endangered species by the IUCN red data book. The present study on sloth bear is being undertaken in order to carry out a systematic work on gastro-intestinal parasites of sloth bears as there is paucity of information and the work is done with the following objectives.

Objectives of the study:

a) To study the prevalence of gastro-intestinal parasites in captive sloth bears.
b) To record the prevalence of gastro-intestinal parasites in sloth bears at different age group and sex (gender).
c) To know the effect of anthelmintics.

REVIEW OF LITERATURE

II. REVIEW OF LITERATURE

2.1 History of Bears

The phylogeny of the bears was thought to be evolved during the Oligocene period. The base genera for the existing bear sub-families were Cephalogale and Ursavas. In present period only three subfamilies are existing *viz.* Ailuropodinae, Tremarctinae, Ursinae (Mclellan and Reiner, 1994).

Bears are evolutionarily related to the terrestrial carnivores like canids, felids and mustelids. All the bears belong to the Order: Carnivora (Gittleman, 1999).

2.2 Classification of Sloth Bear

Binomial classification of sloth bears is as follows Kingdom: Animalia, Phylum: Chordata, Class: Mammalia, Order: Carnivora, Family: Ursidae, Sub family: Ursinae, Genus: Melusus, Species: *Melursus ursinus* (Santra, 2008).

2.3 Host parasite interaction

Puustinen and Mutikainen (2001) reported that in many host–parasite interactions the effects of parasitism hampers host growth, reproduction, and survival. Parasites manipulate host behavior; affect host vulnerability to predation, apart from the structure and dynamics of host communities by changing the competitive interactions among host species.

Torr *et al.,* (2004) indicated in their study that nematodes were lethal parasites widespread in nature and has a broad range of infective larvae found in the soil.

Nematodes are known to parasitize all major invertebrate groups in soils which acts as an intermediate host in the transmission of infection.

Parasites are found to be ubiquitously distributed across the vertebrate taxa and they are the major threat for conservation, management and welfare of the animals in free range and captivity (Pederson *et al.*, 2007).

Adeniyi *et al*., (2015) reported that in the wild, animals might have a natural resistance against parasitic infections or live mutually with their parasites due to their high immune status. Whereas change in the environment and living status from free ranging to captivity influences the animals' ecology and may increase the chances of susceptibility to parasitic infections as many of these animals are exotic to the geographical location of parks, zoos or gardens where they are housed.

2.4 Predisposing factors for parasitic infection

Rogers and Sommerville (1963) indicated that potential factors determining the transmission of parasites include; environmental conditions which affect the viability and behaviour of parasite propagules, feeding, movement, and defecation patterns of the host.

Corrêa and Passos (2001) in their study indicated that due to advancement in agriculture and cattle raising in the natural areas, movement of human in protected areas has increased the chances of contact with the wildlife habitat leading to spread of infectious agents and parasites to uncommon host and environment, there by establishment of new host parasites and disease transmission chain.

Goossens *et al.,* (2005) indicated that in the wild, animals might have a natural resistance against the parasitic infections or live in a balanced system with their parasites commensally. Animal housed in the confined areas within the zoo enclosure makes them more prone to different parasitic infections despite proper attention to feeding, water and maintenance of hygiene in captivity. Change in environment and living conditions from free-living to captivity influences the animal's ecology and increases the sensitivity to parasitic infections due to stress.

Chapman *et al*., (2006) reported that nutritional stress *viz.* limited food availability, deficiencies in dietary components- particularly protein and energy and debilitating diseases such as tuberculosis and other infectious diseases, influence susceptibility of hosts to parasites as they affect immuno-competence.

Thompson *et al.,* (2010) in their study indicated that the translocation and release of the animal to new habitat also increases the chance of either spreading or receiving of new pathogen into the population which poses a threat for conservation. These wild animals act as reservoir of parasitic infections.

Parasitic diseases are common in zoo carnivores in the countries of warm and tropical climates due to factors such as light, temperature and humidity that favor the development of parasites. Animal attendants could also act as vehicles for cross transmission (Adeniyi *et al*., 2015).

Chhabra and Muraleedharan (2016) in their study indicated that significant proportion of emerging human and domestic animal diseases of various infectious agents

including parasites are of wildlife origin which are mainly due to interaction with the wildlife population. Several factors like human encroachment into wildlife habitat and changing ecosystems, have highly contributed to this trend. Increased population of arthropods like fleas, ticks, and mosquitoes acts as intermediate host and major vectors in transmission of parasitic diseases.

Endoparasitic infections are one of the less common disease problems but with significant impact with respect to health of both free ranging and captive animals. Overcrowding of animals in enclosures is the major predisposing factor for the re-infection with parasites (Muraleedharan, 2016).

2.5 Effects of Parasitic Infection

The effect of parasitic infections on wildlife populations is an important factor influencing the distribution and abundance of species. Parasites can reduce body condition, reproductive success and survival of their hosts (Figueroa, 2015).

Helminth parasites pose substantial threats to the welfare, management and conservation of both natural and captive populations, there by leading to the extinction of species (Lynsdale *et al*., 2015).

Parasitic diseases constitute one of the major problems causing mortality in wild animals, the effects ranging from sub-clinical symptoms to death. Parasites can affect host survival and reproduction directly through blood loss, tissue damage, reduced immunity, spontaneous abortion, congenital malformations and death (Allwin *et al*., 2016).

2.6 Parasitism in Captive Bears

Varadharajan and Kandaswamy (2000) in their review study indicated that zoo animals living under captivity are susceptible to almost all types of parasitic diseases, particularly helminthic infections, which can frequently be a major problem causing mortality and morbidity in zoo animals. There is however a need for systematic work on parasites of wild animals as the information currently available is limited.

Mahali *et al.,* (2010) in their study screened 12 fecal samples of sloth bears housed in Nandankanan zoo, Orissa, out of which two samples were positive for single infection of *Hymenolepis* sp. with the prevalence rate of 16.66 %. It is difficult to eliminate GI parasites completely from Zoo animals, especially in carnivores, due to constant source of infection within the enclosures through contaminated food and water, and less effective anthelmintic delivery system.

Veeraselvam *et al*., (2013) in his work reported the incidence of nematode infection in captive sloth bears mainly due to the prevailing climatic conditions and lower immunity levels of the host due to malnutrition. It is difficult to eliminate the nematode eggs once the eggs contaminate the zoo environment after shedding.

Occurrence of parasites in animals housed in zoo might vary according to the type of husbandry practices, disease prophylaxis and treatment administered. Parasitic diseases often represent a major concern in zoo animals for the high environmental contamination due to the maintenance of animals in confined areas, ineffective disinfection and disposal of the excreta (Rahman *et al*., 2014).

2.7 Occurrence of Gastro-intestinal Parasites in Bears

Rogers and Rogers (1974) in their reports on parasites of bears has indicated *Baylisascaris* sp., *Toxocara* sp., *Ancylostoma* sp., *Dicrocoelium* sp., *Echinostoma* sp., *Nanophyetus* sp., *Taenia* sp., *Echinococcus* sp., and *Diphyllobothrium* sp. are the commonly encountered helminth parasites in bears.

Le Count (1981) during his study collected and screened 51 tongue samples of the black bear from Arizona which revealed the prevalence for 3.9 % Trichinella infection. Trichinae were reported in all 3 species of North American bears *viz*. polar bear, grizzly bear and black bear. Bears act as prime animals which are at high risk of contracting *Trichinella* sp. due to their opportunistic feeding (scavenging) behavior.

Duncan (1999) conducted necropsy of a black bear cub which was found dead in Virginia (USA), collected and fixed the tissue samples in 10% buffered neutral formalin. He reported the developmental stages of *Cryptosporidium parvum* in tissue sections from the small intestine and large nematodes were also noticed which were identified as *Baylisascaris transfuga*. Similarly, Wang and Liew (1990) have documented oocysts by fecal smears in two captive Malayan sun bear located in zoological parks of Taiwan.

Bauer (2013) in his study on *Baylisascaris* sp. reported that the Baylisascaris eggs passed in feces of infected animals, embryonate in the environment. The second stage larvae in intermediate hosts migrate extensively through tissues, where they grow and moult to the third-stage, causing extensive damage to the tissue. All *Baylisascaris* sp. are considered a potential cause of visceral, ocular and/or neural larva migrans in mammals including humans and in birds.

Holsback *et al.,* (2013) screened fecal samples from wild animals irrespective of their class (aves and mammals) at rehabilitation centres in the states of São Paulo and Mato Grosso do Sul. The prevalence rate of parasitic eggs was about 100 % (15 samples) and 52.17 % (23 samples) respectively in São Paulo and Mato Grosso do Sul rehabilitation centres respectively.

Veeraselvam *et al*., (2013) conducted a study on endo-parasitic infection in sloth bear and reported the prevalence of 79.6% including all three parks namely, Arignar Anna Zoological Park, Bannerghatta Biological Park and Nehru Zoological Park. Screening of 255 fecal samples yielded 203 positive samples and the parasites reported were the nematodes (*Strongylus vulgaris*, *Baylisascaris transfuga* and *Ancylostoma caninum*), cestodes (*Taenia saginata* and *Diphyllobothrium latum*) and oocysts of Coccidian species.

Thawait *et al.,* (2014) reported that the prevalence of gastro-intestinal parasites in captive wild animals of Nandan Van Zoo, Raipur was about 46.2 % after screening about 210 fecal samples. The prevalence rate was higher in primates (60 %), followed by herbivores (45.6 %) and carnivores (45.2 %). In sloth bears the prevalence was about 66.66 % out of 6 samples, all of which were infected solely by *Toxocara* sp. Among helminth infections prevalence of nematodal infections were higher than cestodal infection. Majority of the captive wild animals were reported to have mixed infections of *Toxocara* sp. and *Diphyllobothrium* sp.

Aghazadeh *et al*., (2015) in his study, screened fecal samples of 94 European brown bear (*Ursus arctos*), collected from Croatia and reported the prevalence rate of 33

% for gastro-intestinal parasites. The prevalence of single nematode infection was 11.7 % for *Baylisascaris* sp., 10.6 % for the *Ancylostoma* sp., 1.1 % for *Syngamus* sp. and single gastro-intestinal protozoan infection was 8.5 % for *Cryptosporidium* sp., 4.2 % for *Giardia* sp. and 1.1 % for *Eimeria* sp.

Figueroa (2015) in his study screened 28 fecal samples of Andean bear (*Tremarctos ornatus*) collected from the Laquipampa Wildlife Refuge and Yanachag Chemille´n National Park, Peru which revealed 57.1 % of prevalence and were positive for *Blastocystis* sp., *Cryptosporidium* sp., *Giardia* sp., *Strongyloides* sp., *Ascarididae* sp., and *Ancylostoma* sp.

Muraleedharan (2016) reported concurrent infections of ascarid and coccidia in sloth bears (*Melursus ursinus*) at Mysore Zoo and coccidial oocysts in sloth bears (*Melursus ursinus*) at BBP, Bengaluru in a report on endoparasites of wild carnivores.

Orosova *et al*., (2016) conducted a study on gastro-intestinal parasites of brown bear. Fifteen fecal samples and two gastro-intestinal tracts were collected from various sites in the protected landscape area CHKO-Polana of which 13 samples were found to be positive with the prevalence of 76.47 %. The samples were positive for *Baylisascaris transfuga* (46.15 %), *Ancylostoma* sp. (30.77 %), *Sarcocystis* sp. (15.38 %), *Cryptosporidium* sp. (15.38 %) and *Eimeria* sp. (7.69 %).

2.8 Zoonotic parasites reported in Bears

Chhabra and Muraleedharan (2016) reported that bears are susceptible to infection with zoonotically important parasites like *Giardia* sp., *Cryptosporidium* sp., *Toxoplasma*

sp., *Leishmania* sp., *Trypanosona* sp., *Plasmodium* sp., *Sarcocystis* sp., *Echinococcus* sp., *Opisthorchis* sp., *Trichinella* sp., *Baylisascaris* sp., *Thelazia* sp., *Toxocara* sp., *Ancylostoma* sp., *Dirofilaria* sp. Arthropods like fleas, ticks, and mosquitoes acted as major vectors in transmission of parasitic diseases.

Majority of the parasitic infections in carnivores are of zoonotic importance and should be handled in a most hygienic way to prevent zoonosis (Muraleedharan, 2016).

2.9 Seasonal influence on gastro-intestinal parasites in Bears

Mahali *et al.,* (2010) studied the prevalence of gastro-intestinal parasites with seasonal variations, and reported that the prevalence was 50 % out of four samples in post rainy/winter season (November to February). The samples were negative during rainy and summer season. There is paucity of information regarding parasitic prevalence with respect to seasonal variations in bears.

2.10 Age and sex - wise prevalence of gastro-intestinal parasites in Bear

Bears act as prime animals which are at high risk of contracting parasitic infections due to their opportunistic feeding (scavenging) behavior. They can contract infection irrespective of their sex (Le Count, 1981).

Heuschele *et al.,* (1986) demonstrated cryptosporidial oocysts in 21 exotic ruminants out of 40 animals which were showing signs of diarrhea and opined that neonatal diarrhea was one of the major causes for mortality and morbidity in case of neonates. Cryptosporidium infection was one of the major causes for gastroenteritis and diarrhea in many species of animals including domestic animals and exotic animals.

There is paucity of data regarding age-wise prevalence of gastro-intestinal parasites in sloth bears.

Healthy wild animals may harbor large number of protozoal and helminth parasites without showing clinical signs of disease. Helminth infection in carnivore wild animals causes high morbidity and mortality (Santra, 2008).

2.11 Therapeutic drugs against gastro-intestinal parasites of Bears

Bears are commonly encountered with nematode infections especially *Toxocara* sp. and they were treated with piperazine @ 100 mg per kg BW orally in single dose (Santra, 2008).

Mahali *et al.,* (2010) indicated that improper dose and/or anthelmintic resistance are major causes for ineffective anthelmintic therapy. It is necessary to examine the fecal samples periodically and take timely control measures before they can produce clinical disease.

Adeniyi *et al*., (2015) indicated that there is a need for a well scheduled anthelmintic program that includes regular passive surveillance for parasitic infections and effective treatment program.

MATERIALS AND METHODS

III. MATERIALS AND METHODS

3.1 Materials

3.1.1 Study animals

In the present study sloth bears maintained at Wildlife SOS, Bannerghatta Bear Rescue Centre (BBRC), Bannerghatta served as the source of animals.

3.1.1.1 Study period

Study period considered was from July to September, 2017. The study was initiated to know the occurrence of gastro-intestinal parasites with respect to age and sex of the animal, to know the effect of anthelmintic.

3.1.1.2 Managemental practices

Sloth bears at wildlife SOS, BBRC are kept under semi captive condition. The sloth bears are housed in five different enclosures with individual cages for each animal with concrete flooring. The diet included ragi flour, jowar flour, soya powder, milk, boiled egg, fruits like watermelon/muskmelon and mashed vegetables like sweet potato/carrot. They are provided with enrichment within socialization area, allowed for safari after feeding, ponds were constructed in the safari to offer *ad lib.* drinking water. Veterinary care is available for 24 hours. They have been vaccinated against tetanus, canine distemper, infectious canine hepatitis, parvo viral gastro-enteritis, canine parainfluenza and leptospirosis annually. Deworming is done at every three months' interval based on the laboratory examination of individual sloth bear fecal samples.

3.1.2 Laboratory materials

The laboratory materials used in the present study are listed below under various sub-headings.

3.1.2.1 Equipments

a) Compound microscope (Olympus make, India)
b) Electronic weighing balance
c) Centrifuge and centrifugation tube
d) Refrigerator
e) McMaster's slide
f) Mortar and pestle
g) Tea strainers
h) Glass slides (Blue star, Polar Industrial Corporation, Mumbai)
i) Microscopic cover glass (Blue star, Polar Industrial Corporation, Mumbai)

3.1.2.2 Glass wares and plastic ware

The glassware used in the present study included neutral glass of Corning and Borosil India Ltd., make. Plastic ware included plastic container, centrifuge tubes, plastic petri plates procured from M/s. Tarson Products Pvt. Ltd., Kolkata.

3.1.2.3 Chemicals

a) The following floatation fluids were used
    1) Sodium chloride, NaCl (Sp. gr. 1.18)
    2) Sucrose, $C_{12}H_{22}O_{11}$(Sp. gr. 1.25-1.33)

3) Zinc sulphate, $ZnSO_4$ (Sp. gr. 1.18)

4) Magnesium sulphate, $MgSO_4$ (Sp. gr. 1.22)

b) Ziehl-Neelsen stain

3.1.2.4 Disposables

a) Disposable latex Gloves

b) Zip-lock packaging material

c) Plastic air tight containers

3.2 Methods

3.2.1 Collection of fecal sample

Approximately 15-20 grams of fresh fecal sample was collected from each individual animal in enclosure with utmost care to avoid parts of fecal material in contact with the floor. Samples were collected in a plastic container and was transported to laboratory for further examination. Samples were collected from five enclosures namely Panchavati block, Chithrakuta block, Kishkinda block, Dr. G.K.V block and Jambhava block.

3.2.2 Macroscopic examination of the fecal sample

Macroscopic examination of the fecal sample was made to note the characteristic features like consistency, color, and presence of mucus, blood, helminth parasites, segments.

3.2.3 Microscopic examination of the fecal sample

Fecal samples were screened by adapting different qualitative methods like direct method, centrifugal sedimentation technique and floatation technique for identification of parasitic eggs. Modified Zeihl-Neelsen staining procedure was adapted for identification of protozoan oocyst. Egg quantification was done with McMaster's egg counting technique to know the parasitic egg count.

3.2.4 Microscopic examination of the fecal sample using qualitative technique

3.2.4.1 Direct method (Soulsby, 1982)

1) A small quantity of feces was placed on a clean glass slide. It was mixed with a few drops of water with the help of glass rod.
2) Coverslip was placed on the slide and examined under microscope for the presence of parasitic egg/oocysts (objective 10x and 40x).

3.2.4.2 Centrifugal sedimentation technique (Bowman, 2009)

3.2.4.2.1 Principle

Based on the knowledge that specific gravity of parasitic eggs is considerably greater than that of water and fecal debris, if the feces are suspended in water, eggs will sediment faster than most fecal particles.

3.2.4.2.2 Methodology

1) 1-2 g of fecal sample was placed in a mortar.
2) 10-15 ml of water was added, mixed thoroughly using pestle.

3) The fecal suspension was filtered through a tea strainer into another beaker.
4) The fecal suspension was transferred to centrifuge tube and centrifuged at 3000 rpm for 3 minute.
5) Supernatant was discarded.
6) Sediment was mixed well and a small quantity of sediment was taken on a clean glass slide and mixed with drop of water.
7) Cover slip was placed on the slide and examined under low and high power objectives of microscope.

3.2.4.3 Floatation technique (Soulsby, 1982)

3.2.4.3.1 Principle

The principle is to use an emulsifying fluid of a greater specific gravity than that of the parasitic egg and/or oocyst, which results in flotation of eggs in the solution. Thereby mere examination of the solution in the top most layers will clearly indicate the presence of egg/oocyst. The fecal material and fiber settle at the bottom.

3.2.4.3.2 Methodology

1) 1-2 g of fresh fecal sample was placed in a mortar.
2) 10-15 ml of water was added, mixed thoroughly using pestle.
3) The fecal suspension was filtered through a tea strainer into another beaker.
4) The fecal suspension was transferred to centrifuge tube and centrifuged at 3000 rpm for 3 minute.
5) Supernatant was discarded.

6) Saturated sodium chloride solution, Zinc sulphate solution, magnesium sulphate solution and sucrose solution were used separately as flotation fluid and transferred into the separate test tubes containing fecal sediment.

7) Feces and flotation fluid were mixed (stirred) thoroughly.

8) The test tube was gently topped off with the suspension leaving a convex meniscus at the top of the tube.

9) A cover slip was carefully placed on top of the test tube and the test tube was allowed to stand for 20 minutes.

10) Cover slip was carefully lifted off from the tube, together with the drop of fluid adhering to it.

11) Cover slip was placed on a clean microscope slide labeled with the sample number.

12) Slides were examined using the 10x and 40x objective lens of a compound microscope for identification of parasite eggs, larvae and oocysts based on morphology.

3.2.5 Microscopic examination of the fecal sample using quantitative technique

3.2.5.1 Mc Master's egg counting technique (Soulsby, 1982)

1) Three grams of feces was placed in a mortar.

2) 42 ml of water was added and mixed thoroughly using pestle.

3) The fecal suspension was transferred to a centrifuge tube and centrifuged at 3000 rpm for 3 minutes.

4) Supernatant was discarded.
5) Saturated solutions of sodium chloride, zinc sulphate, magnesium sulphate and sucrose were used as floatation fluids and transferred into the separate test tubes containing fecal sediment and allowed to stand for 15 minutes
6) Both sides of the McMaster counting chamber were charged by the supernatant of the fecal suspension and allowed to settle.
7) The chambers were examined under low power objective of the microscope and all the eggs and oocyst within the engraved area of both chambers were counted.
8) The number of eggs per gram (EPG) of feces was calculated by adding the egg counts of the two chambers together and multiplied by multiplication factor of 50.

Comparison between the egg counts obtained using various floatation fluids were done.

3.2.6 Microscopic examination of the fecal sample using Modified Ziehl-Neelsen staining technique (Casemore, 1991)

3.2.6.1 Direct smear technique

1) A drop of fecal material was taken over a grease free slide and the smear was made.
2) It was allowed to air dry.
3) The smear was fixed with methanol for three minutes.
4) Stained with strong carbol fuchsin for 15-20 minutes.
5) Rinsed thoroughly with the tap water.

6) Decolorized in acid alcohol (1 % HCl in methanol) for 15-20 seconds.
7) Rinsed with the tap water and counterstained using methylene blue.
8) Rinsed with the tap water and allowed for air drying.
9) Examined under 100x objective lens.

3.2.6.2 Concentrated smear technique

3.2.6.2.1 Sedimentation technique

1) 1-2 g of fecal sample was placed in a mortar.
2) 10-15 ml of water was added, mixed thoroughly using pestle.
3) The fecal suspension was filtered through a tea strainer into another beaker.
4) The fecal suspension was transferred to centrifuge tube and centrifuged at 3000 rpm for 3 minute.
5) Supernatant was discarded.
6) A drop of sediment was taken on a clean grease free slide and a smear was drawn using another slide.
7) It was allowed to air dry.
8) The smear was fixed with methanol for three minutes.
9) Stained with strong carbol fuchsin for 15-20 minutes.
10) Rinsed thoroughly with the tap water.
11) Decolorized in acid alcohol (1 % HCl in methanol) for 15-20 seconds.
12) Rinsed with the tap water and counterstained using methylene blue.
13) Rinsed with the tap water and allowed for air drying.
14) Examined under 100x objective lens.

3.2.6.2.2 Floatation technique

1) 1-2 g of fecal sample was placed in a mortar.
2) 10-15 ml of water was added, mixed thoroughly using pestle.
3) The fecal suspension was filtered through a tea strainer into another beaker.
4) The fecal suspension was transferred to centrifuge tube and centrifuged at 3000 rpm for 3 minute.
5) Supernatant was discarded.
6) 10 ml of saturated sucrose solution and saturated sodium chloride solution were transferred into the separate test tubes containing fecal sediment and mixed thoroughly and allowed to settle.
7) A drop of the supernatant was transferred using a dropper and a smear was made.
8) It was allowed to air dry.
9) The smear was fixed with methanol for three minutes.
10) Stained with strong carbol fuchsin for 15-20 minutes.
11) Rinsed thoroughly with the tap water.
12) Decolorized in acid alcohol (1 % HCl in methanol) for 15-20 seconds.
13) Rinsed with the tap water and counterstained using methylene blue.
14) Rinsed with the tap water and allowed for air drying.
15) Examined under 100x objective lens.

3.2.7 Anthelmintic efficacy

Anthelmintic treatment with specific anthelmintic drug of choice with proper dosage was suggested based on the results obtained. Fecal samples were screened for presence of egg/larva on 7^{th}, 14^{th} and 21^{st} day respectively after deworming to know the efficacy.

RESULTS

IV. RESULTS

The present study was undertaken to study the occurrence of gastro-intestinal parasites in sloth bears maintained at Wildlife SOS, Bannerghatta Bear Rescue Centre (BBRC), Bengaluru, Karnataka state during the period July 2017 to September 2017. A total of 60 fecal samples were collected from the sloth bears housed at five different enclosures.

4.1 Macroscopic examination of fecal samples

Sixty fecal samples of sloth bears were brought to the laboratory in which the consistency of fecal sample was semi-solid, the color of fecal sample ranged from reddish brown to yellowish green. There was no presence of mucus or occult blood in the fecal samples collected. It was also noticed that neither segments of tapeworm nor helminth parasites could be grossly observed.

4.2 Microscopic examination of fecal samples (Qualitative methods)

Out of sixty fecal samples of sloth bears screened 30 (50 %) were positive for single infection and mixed infection. Among them 15 (50 %) were positive for *Toxocara* sp., 8 (26.66 %) were positive for *Joyeuxiella* sp., 7 (23.33 %) were positive for mixed infection with *Toxocara* sp. and *Joyeuxiella* sp. (Table 1 and Figure 1). In the modified Ziehl-Neelsen staining method no parasitic stage could be demonstrated.

Fecal samples were screened for the presence of helminth parasites qualitatively by direct smear examination technique, sedimentation technique and floatation technique. In the direct smear examination technique out of 60 samples screened 25 (41.66 %) were

positive for parasitic ova. In the sedimentation and floatation technique 27 (45 %) samples and 30 (50 %) samples were positive respectively for parasitic ova. Single infection and mixed infection of *Joyeuxiella* sp. and *Toxocara* sp. was recorded.

Among 25 (41.66 %) positive samples in direct smear examination 13 (52 %) were positive for *Toxocara* sp., 7 (28 %) were positive for *Joyeuxiella* sp., 5 (20 %) were positive for mixed infection with *Toxocara* sp. and *Joyeuxiella* sp. In sedimentation technique out of 27 positive samples 13 (48.14 %) were positive for *Toxocara* sp., 7 (25.92 %) were positive for *Joyeuxiella* sp., 7 (25.92 %) were positive for mixed infection with *Toxocara* sp. and *Joyeuxiella* sp. In floatation technique out of 30 positive fecal samples 15 (50 %) were positive for *Toxocara* sp. (Plate 1 and Plate 2), 8 (26.66 %) were positive for *Joyeuxiella* sp. (Plate 3 and Plate 4), 7 (23.33 %) were positive for mixed infection with *Toxocara* sp. and *Joyeuxiella* sp. (Table 2 and Figure 2)

Occurrence of gastro-intestinal parasites in five different enclosures in floatation technique were as follows, among 12 sloth bears fecal samples collected from Panchavati block, 7 (58.33 %) were positive for gastro-intestinal parasites which included 3 (42.85 %) *Joyeuxiella* sp., 2 (28.57 %) *Toxocara* sp., and 2 (28.57 %) mixed infection for *Joyeuxiella* sp. and *Toxocara* sp. eggs. Out of 10 sloth bears fecal samples collected from Chithrakuta block, 5 (50 %) were positive for gastro-intestinal parasites which included 3 (60 %) *Joyeuxiella* sp. and 2 (40 %) mixed infection for *Joyeuxiella* sp. and *Toxocara* sp. eggs. A total of 10 sloth bears fecal samples collected from Kishkinda block, 6 (60 %) were positive for gastro-intestinal parasites which included 1 (16.66 %) *Joyeuxiella* sp. and 5 (83.33 %) *Toxocara* sp. eggs. Among 13 fecal samples of sloth bears collected

from Dr. G.K.V block, 7 (53.84 %) were positive for gastro-intestinal parasites which included 1 (14.28 %) *Joyeuxiella* sp. and 6 (85.71 %) *Toxocara* sp. eggs. Out of 15 sloth bears fecal samples collected from Jambhava block, 5 (33.33 %) were positive for gastro-intestinal parasites which included 2 (40 %) *Toxocara* sp. and 3 (60 %) mixed infection for *Joyeuxiella* sp. and *Toxocara* sp. eggs. (Table 3 and Figure 3)

4.3 Microscopic examination of fecal samples (Quantitative methods)

Among the total 60 fecal samples of sloth bears screened by floatation technique, twenty-two sloth bear fecal samples were positive for *Toxocara* sp. infection. These were subjected for egg counting by McMaster's egg counting technique. The egg counts were recorded using different floatation solutions *i.e.* saturated sodium chloride solution, saturated zinc sulphate solution, saturated magnesium sulphate solution and saturated sucrose solution which resulted in mean egg counts of 959.09±277.75, 1195±298.73, 925±244.63 and 915.90±259.37 respectively per gram of feces. Among the floatation fluids used saturated zinc sulphate solution was more effective compared to other solutions. (Table 4 and Figure 4)

4.4 Gender-wise occurrence of gastro-intestinal parasites in Sloth bears.

Out of 60 sloth bear fecal samples screened 23 were of male and 37 were of female sloth bears. Out of 23 male sloth bear fecal samples 15 (65.21 %) samples were positive for gastro-intestinal parasites, among 37 female sloth bear fecal samples 15 (40.54 %) were positive for gastro-intestinal parasites. (Table 5 and Figure 5)

4.5 Age-wise occurrence of gastro-intestinal parasites in sloth bears

Age-wise categorization was done based on report suggested by Lintzenich *et al.,* (2006). Bears from birth to 12 months of age were grouped as cubs, two years to four years were grouped as sub-adults and the bears of five years and above were grouped as adults. Out of 60 sloth bears two were cubs, nine were sub-adults and 49 were adults in which two (100 %) cubs, 5 (55.55) % sub-adults and 23 (46.93 %) adult sloth bears were positive for single and mixed infections of *Toxocara* sp. and *Joyeuxiella* sp. (Table 6 and Figure 6)

4.6 Treatment and anthelmintic efficacy

Fecal samples of sloth bears which showed helminth infection were 30 out of 60 samples screened. Single infection and mixed infection with *Toxocara* sp. and *Joyeuxiella* sp. were recorded in the fecal samples screened from the sloth bears. The sloth bears positive for the gastro-intestinal parasitic infection were suggested with the single dose of broad spectrum anthelmintic. The dosage indicated was praziquantel @ 5 mg/kg BW and ivermectin @ 0.2 mg/kg BW orally. No overnight fasting was indicated. Post deworming fecal samples were screened on 7^{th}, 14^{th} and 21^{st} day and were negative for parasitic ova.

Table 1: Occurrence of gastro-intestinal parasitic infection in Sloth bears (N=60)

Total number of samples screened	Occurrence (%)	Infection		
		Single infection		Mixed infection
		Toxocara sp.	*Joyeuxiella* sp.	*Toxocara* sp. and *Joyeuxiella* sp.
60	30 (50 %)	15 (50 %)	8 (26.66 %)	7 (23.33 %)

Figure 1: Occurrence of gastro-intestinal parasitic infection in Sloth bears (N=60)

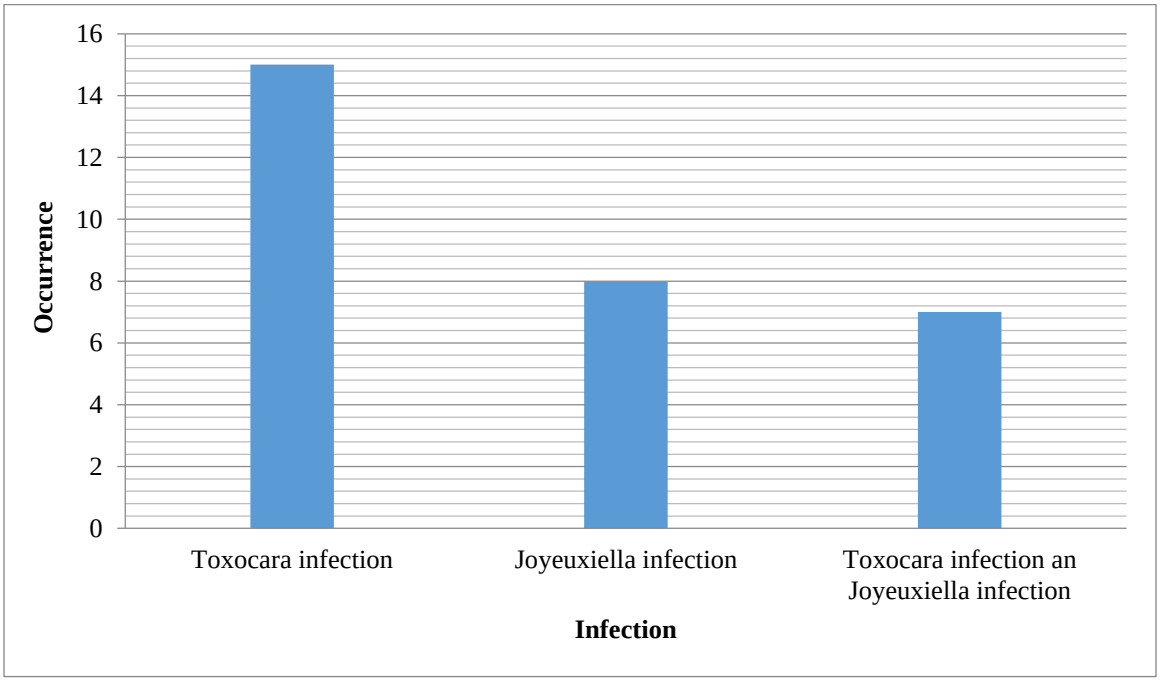


Table 2: Comparison of qualitative methods in occurrence of parasitic ova in Sloth bears (N=30)

Methods used	Number of positive samples	Type of infection		
		Single infection		Mixed infection
		Toxocara sp.	*Joyeuxiella* sp.	*Toxocara* sp. and *Joyeuxiella* sp.
Direct smear examination	25	13	7	5
Sedimentation technique	27	13	7	7
Floatation technique	30	15	8	7

Figure 2: Comparison of qualitative methods in occurrence of parasitic ova in Sloth bears (N=30)

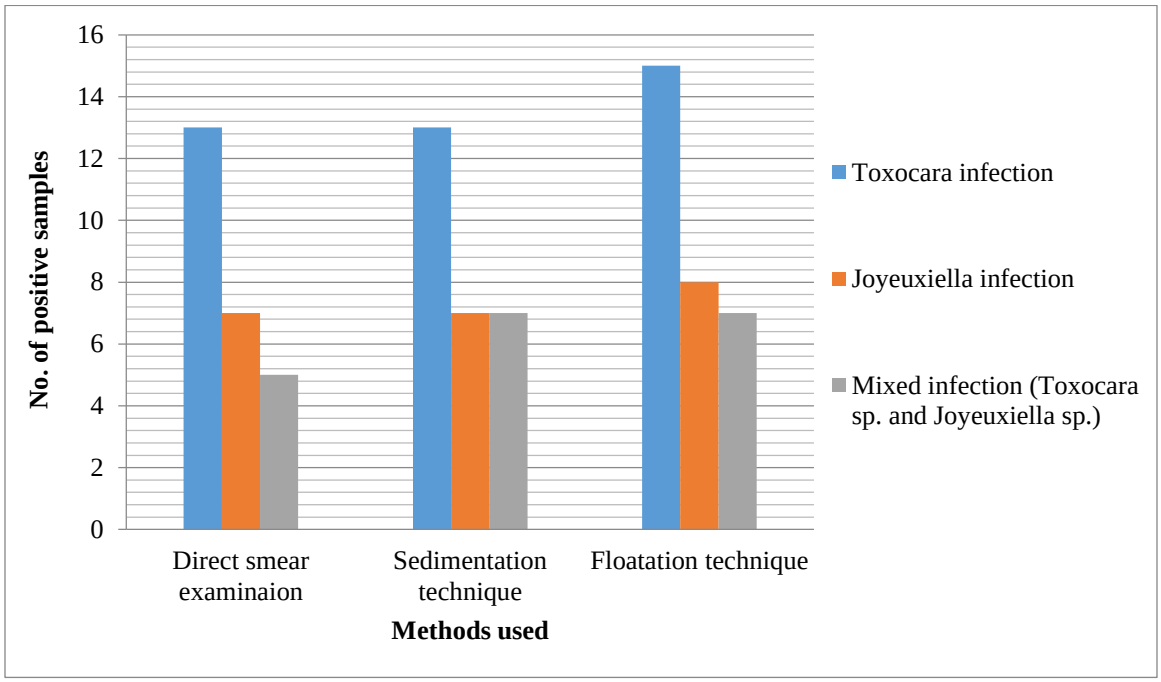


Table 3: Occurrence of parasitic infection in Sloth bears at different enclosures (N=60)

Name of enclosure	Total No. of fecal samples examined	No. of animal positive (%)
Panchavati Block	12	07 (58.33 %)
Chithrakuta Block	10	05 (50.00 %)
Kishkinda Block	10	06 (60.00 %)
Dr. G.K.V Block	13	07 (53.84 %)
Jambhava Block	15	05 (33.33 %)
Total	60	30 (50 %)

Figure 3: Occurrence of parasitic infection in Sloth bears at different enclosures (N=60)

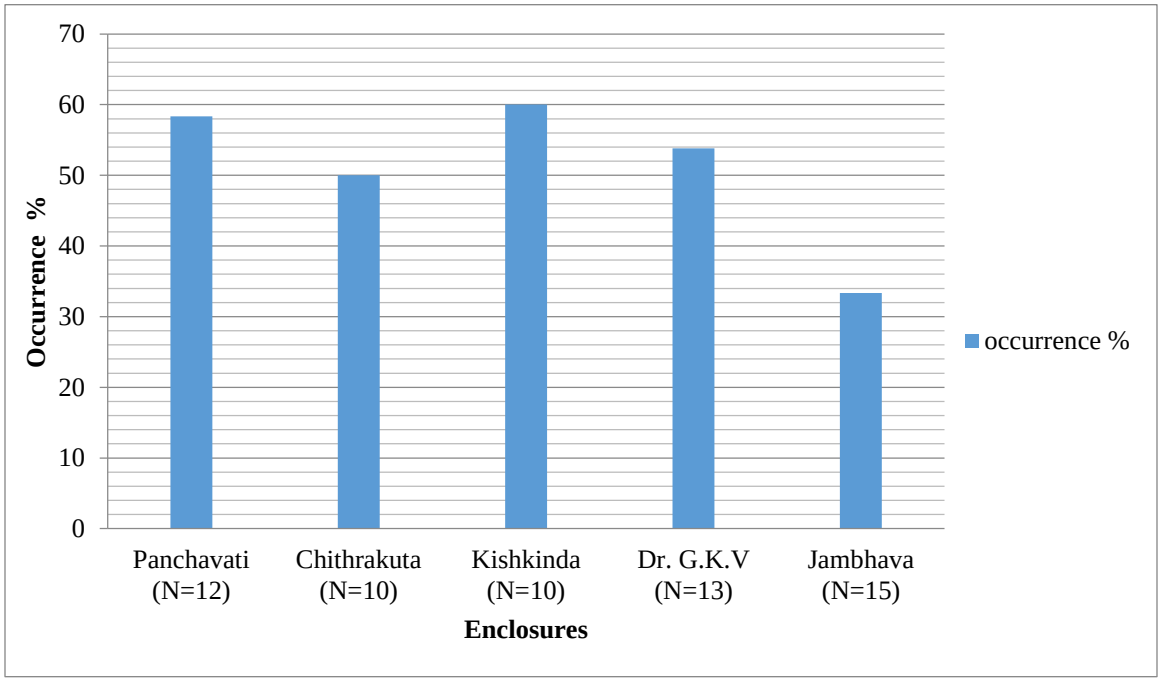


Table 4: Comparison of different floatation fluids used in quantification of nematode eggs (N=22)

Floatation fluids	Parasitic egg	EPG	Mean fecal egg count
Saturated sodium chloride solution	*Toxocara* sp.	50-4850	959.09±277.75
Saturated zinc sulphate solution	*Toxocara* sp.	150-5050	1195.45±298.73
Saturated magnesium sulphate solution	*Toxocara* sp.	50-4600	925.00±244.63
Saturated sucrose solution	*Toxocara* sp.	50-4700	915.90±259.37

Figure 4: Comparison of different floatation fluids used in quantification of nematode eggs (N=22)

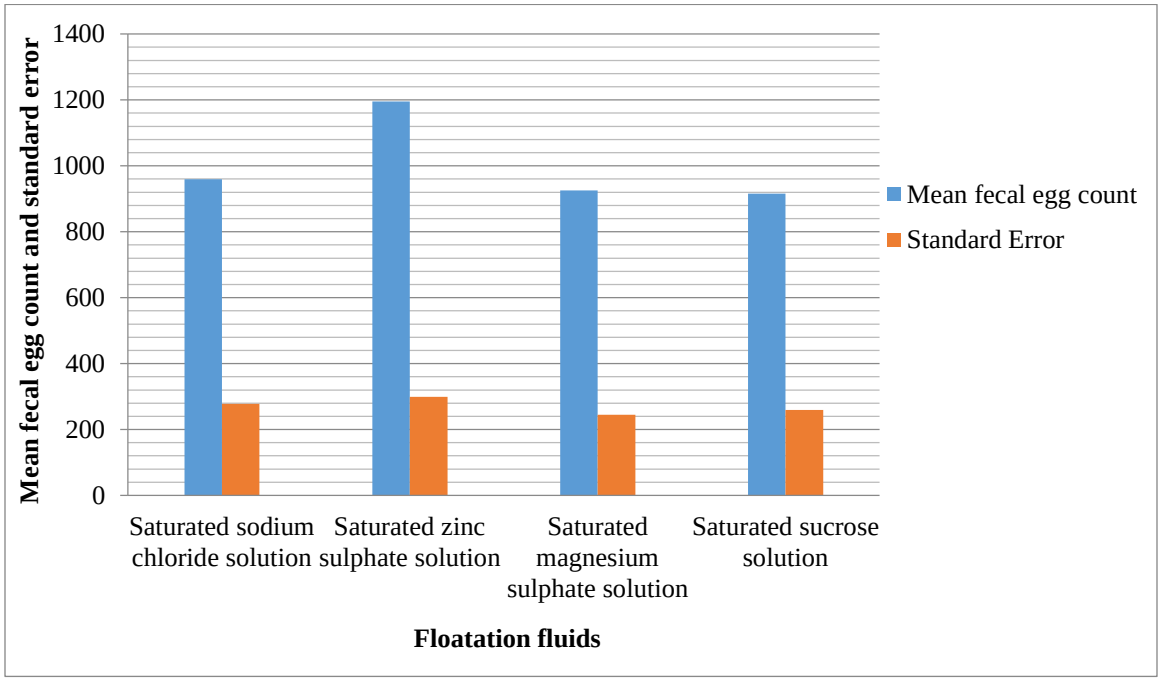


Table 5: Gender-wise occurrence of parasitic infection in Sloth bears (N=60)

Gender	No. of animal examined	No. of animal positive (%)
Male	23	15 (65.21 %)
Female	37	15 (40.54 %)
Total	60	30 (50 %)

Figure 5: Gender-wise occurrence of parasitic infection in Sloth bears (N=60)

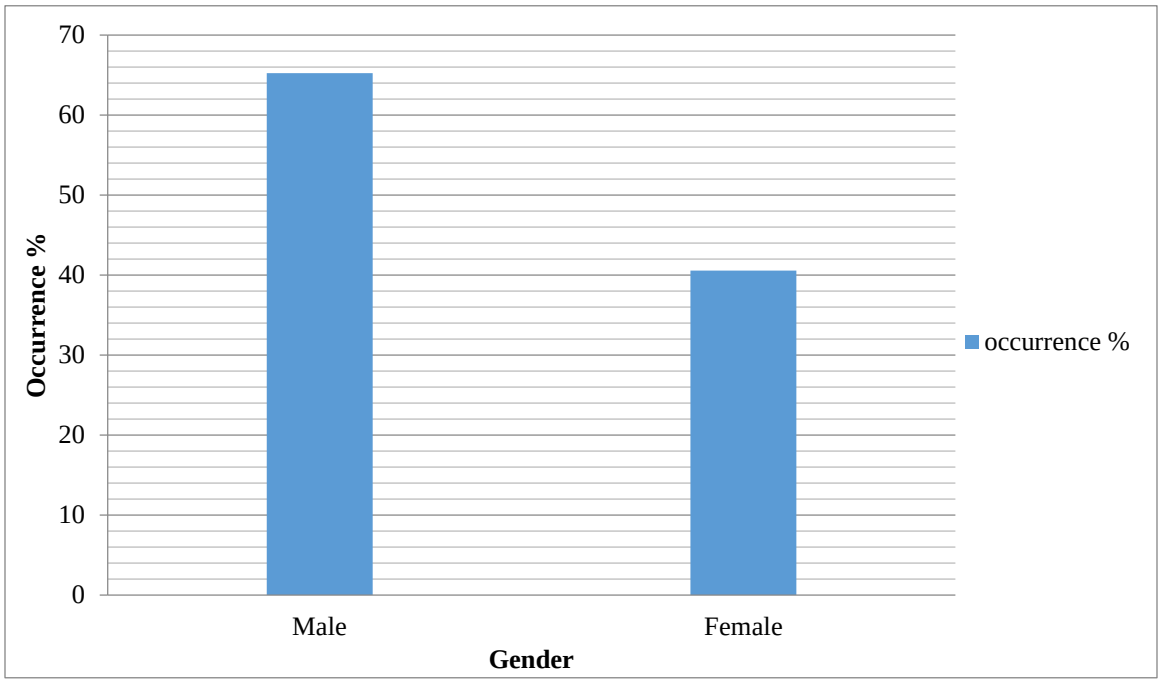
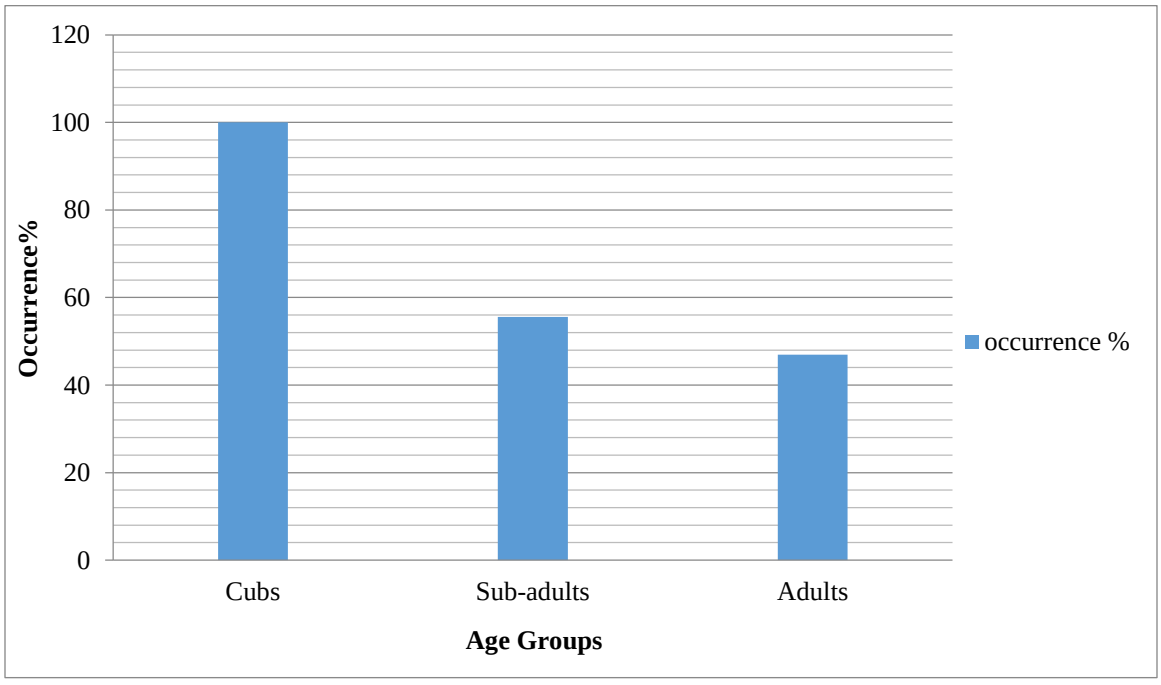


Table 6: Age-wise occurrence of parasitic infection in Sloth bears (N=60)

Age group	No. of animals	No. of animal positive (%)
Cub (birth to 12 months)	02	02 (100 %)
Sub-adults (2-4 years)	09	05 (55.55 %)
Adults (5 years and above)	49	23 (46.93 %)

Figure 6: Age-wise occurrence of parasitic infection in Sloth bears (N=60)



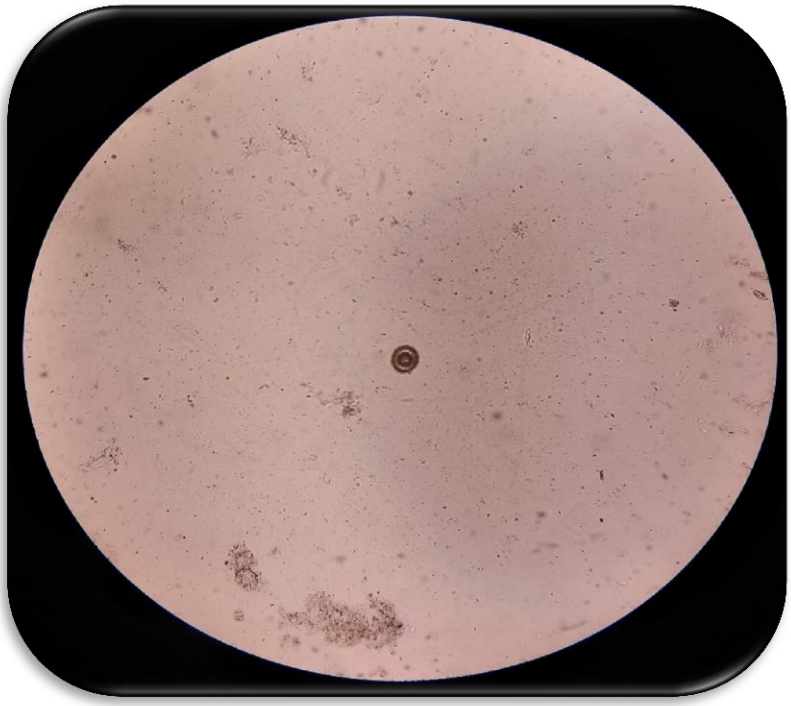


Plate 1: Egg of *Toxocara* sp. identified in fecal sample of sloth bear (10x)

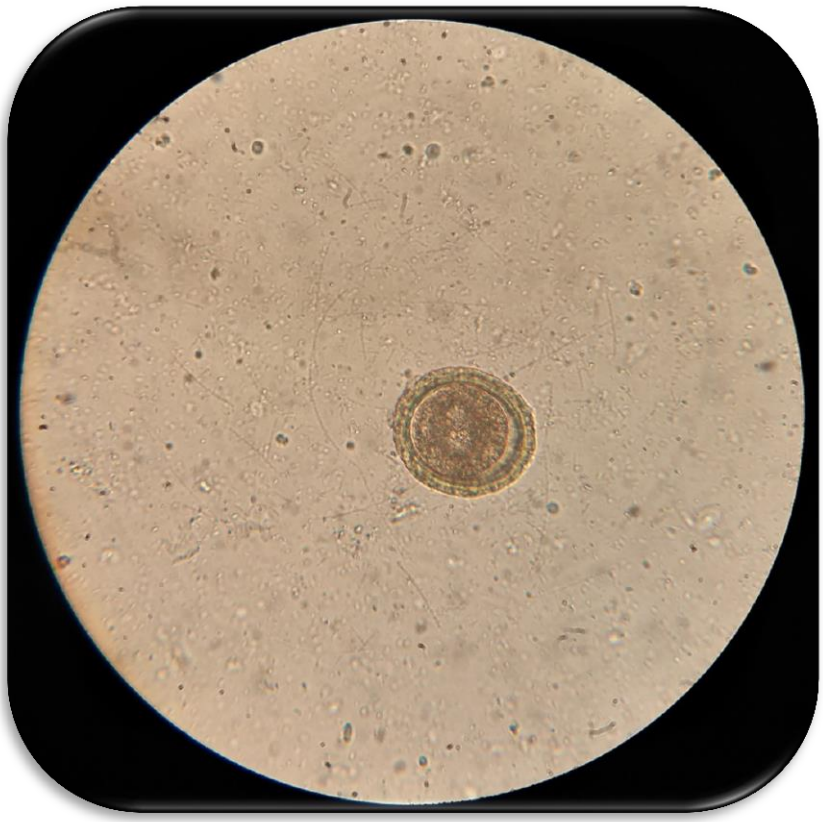


Plate 2: Egg of *Toxocara* sp. identified in fecal sample of sloth bear (40x)

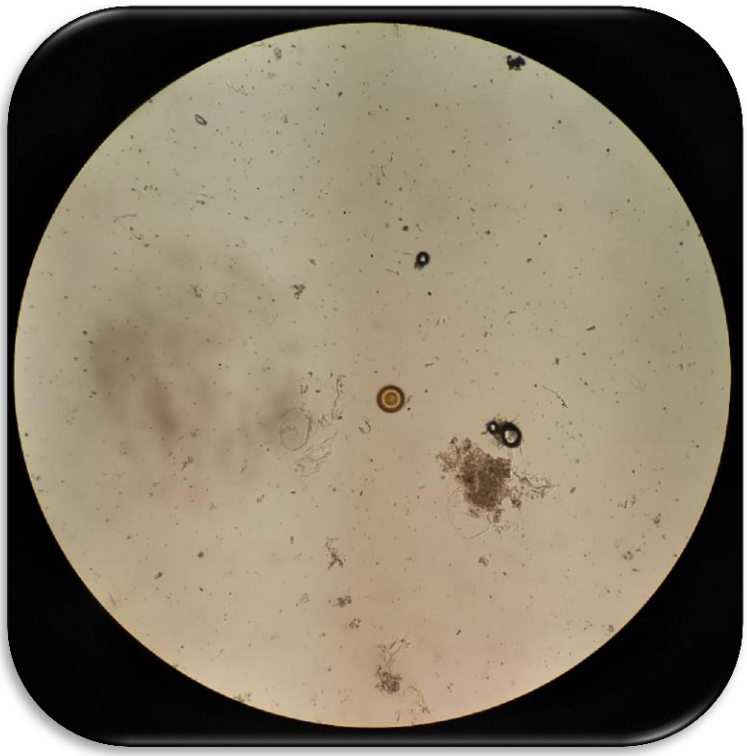


Plate 3: Egg of *Joyeuxiella* sp. identified in fecal sample of sloth bear (10x)

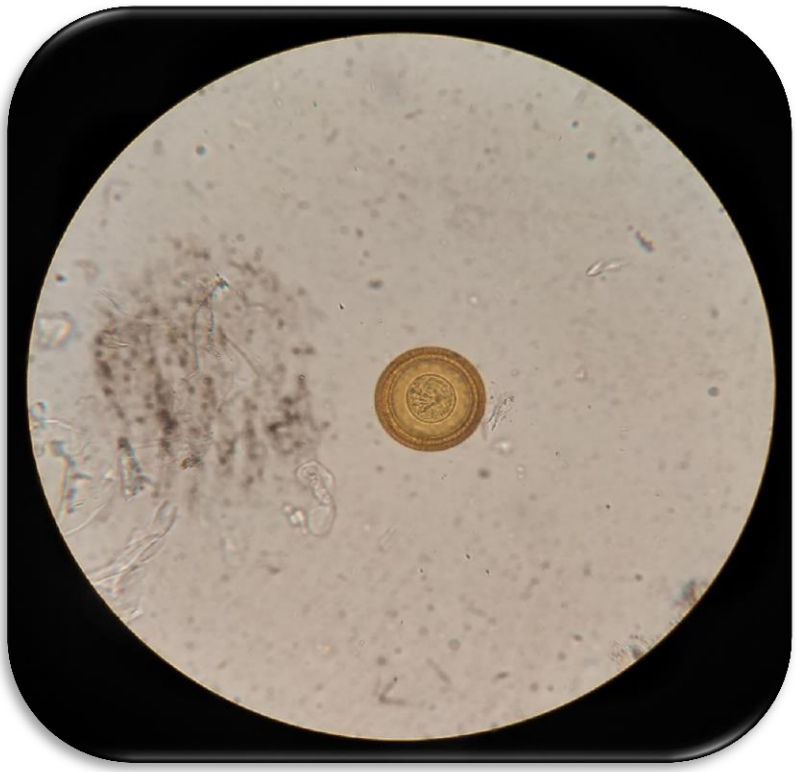


Plate 4: Egg of *Joyeuxiella* sp. identified in fecal sample of sloth bear (40x)

DISCUSSION

V. DISCUSSION

Sixty fecal samples screened from sloth bears maintained at Wildlife SOS, BBRC, Bengaluru, Karnataka under semi-captive condition for gastro-intestinal parasitic infection during the study period from July 2017 to September 2017 is discussed herewith.

5.1 Macroscopic examination of fecal samples

Sixty fecal samples of sloth bears were brought to the laboratory in which the consistency of fecal sample was semi-solid, the color of fecal sample ranged from reddish brown to yellowish green. The color of fecal sample is associated with the feeding in sloth bears based on availability of food ingredient, vegetables and seasonal fruits. As the sloth bears at BBRC were fed with watermelon during the study period, the reddish tinge of feces could be attributed to seasonal fruit, watermelon. Whereas, green color could be due to the accessibility of sloth bears to the green grass during socialization period. It would be opined that consistency and color of feces varies with respect to the diet provided. This is in agreement with Whitaker, (1996) who has indicated that the consistency of the feces would be semisolid and color of the feces would be brownish in sloth bears. There was no mucous or occult blood in fecal samples suggesting no presence of infection in the samples collected. Neither segments of tapeworm nor helminth parasites could be grossly observed, as the infection with *Joyeuxiella* sp. and *Toxocara* sp. are usually asymptomatic (Chabra and Singh, 1998). In Joyeuxiella infection eggs are usually released in the feces than the gravid proglottids (Papazoglou *et al.*, 2006).

5.2 Microscopic examination of fecal samples (Qualitative methods)

Out of sixty fecal samples screened, 30 (50 %) were positive for gastro-intestinal parasitic ova, among which 15 (50 %) were positive for *Toxocara* sp., 8 (26.66 %) were positive for *Joyeuxiella* sp., 7 (23.33 %) were positive for mixed infection of *Toxocara* sp. and *Joyeuxiella* sp. Veeraselvam *et al.,* (2013) and Thawait *et al.,* (2014) reported higher prevalence of 80.7 % in sloth bears at Bannerghatta Biological Park and 66.66 % in sloth bears at Nandan Van Zoo respectively for gastrointestinal parasites, whereas Mahali *et al.,* (2010) reported lower incidence of 16.66 % at Nandankanan Zoological Park as the number of fecal samples screened were less. The decreased incidence in the present study at Bannerghatta could be attributed to better managemental practices followed at BBRC since 2013. In the modified Ziehl-Neelsen staining procedure no protozoan oocysts could be demonstrated which could be related to the age group, season and availability of source of infection. This could be due to refractoriness to Cryptosporidiosis or no access to infection.

In the direct smear examination, out of 60 samples screened 25 (41.66 %) were positive for parasitic ova, whereas in sedimentation and floatation technique 27 (45 %) samples and 30 (50 %) samples were positive respectively for parasitic ova. In the present study floatation technique gave better results in identification of parasitic ova compared to sedimentation and direct smear examination. This could be attributed to the lower percentage of egg identification in direct smear, which could be due to debris and other extraneous materials present in the feces which hinders in identification of parasitic ova. This is in agreement with Dryden *et al.,* (2005) who have indicated that in direct smear they failed to identify the eggs of tapeworm and ascarids. In sedimentation

technique most of the heavier eggs are concentrated and lighter eggs may be discarded during the processing. In the floatation technique use of floatation solutions will allow the eggs to come to the top for examination. This specificity of the technique is beneficial in the floatation method. The above justification is in agreement with the studies made by Dryden *et al.,* (2005), Bowman, (2009), Veeraselvam *et al.,* (2013), Thawait *et al.,* (2014) who have adopted the technique and have opined the same.

Occurrence of gastro-intestinal parasites in five different enclosures namely Panchavati block, Chithrakuta block, Kishkinda block, Dr. G.K.V block and Jambhava block were 7 (58.33 %) out of 12 fecal samples, 5 (50 %) out of 10 fecal samples, 6 (60 %) out of 10 fecal samples, 7 (53.84 %) out of 13 fecal samples and 5 (33.33 %) out of 15 fecal samples respectively. The occurrence of gastro-intestinal parasitic infection in the five different enclosures had a varied percentage of infection which could be attributed to the different age group of animals in the enclosures, availability of source of infection, management practices adopted and animal attendants.

Nematodes are widespread in nature and infective larvae are found in soil (Torr *et al.,* 2004). Singh (2003) indicated that the ascarid eggs are viable in the environment for about 20 – 54 weeks after voiding them through the feces. The environmental conditions like sunlight, temperature, humidity affects the viability which in turn alters propagules (Rogers and Sommerville, 1963). The other factors which influence the occurrence of infection could be attributed to ecological alteration, nutritional status and overcrowding predispose to the parasitic infections (Goossens *et al.,* 2005, Chapman *et al.,* 2006, Muraleedharan, 2016). The managemental practice, disinfection and availability of eggs

in the socialization area also contribute for occurrence of infection. Animal attendants could act as vehicle for cross transmission of parasitic infections (Adeniyi *et al.,* 2015).

Thus it could be opined that recurrence of the parasitic infection occurs though regular deworming is adopted as the above factors contribute for parasitic infections.

5.3 Microscopic examination of fecal samples (Quantitative methods)

Among the chemical solutions used in the quantitative method saturated zinc sulphate solution had higher specificity compared to other floatation fluid which is in agreement with the reports of Dryden *et al.,* (2005), Bowman (2009) who have opined that zinc sulphate solution was superior compared to other solutions in their study. With the saturated zinc sulphate solution egg recovery was good which could be the reason for higher egg counts in the present study. However, there was no statistical significance among the floatation fluids used.

5.4 Gender-wise occurrence of gastro-intestinal parasites in Sloth bears.

Among 60 fecal samples screened 23 were male and 37 were female, out of which 15 (65.21 %) male and 15 (40.54 %) female was positive for gastro-intestinal parasites. In the present study male sloth bears had higher parasitic infection in comparison to female. Review of literature indicated that there is no variation with respect to the sex relation in occurrence of gastro-intestinal parasites. However, Le Count (1981) has reported that both the sexes of bear are equally susceptible for gastro-intestinal parasitic infections due to their opportunistic feeding (scavenging) behavior.

5.5 Age-wise occurrence of gastro-intestinal parasites in Sloth bears

Out of 60 screened samples the occurrence of gastro-intestinal parasites was observed in 2 cubs (100 %) out of two cubs, 5 sub-adults (55.55 %) out of nine sub-adult sloth bears and 23 adults (46.93 %) out of 49 adult sloth bears. In the present study as majority of animals were adults, the occurrence in relation to age had limited correlation. However, younger animals showed higher incidence of 100 % and 55.55 % in cubs and sub adults which was in agreement with the reports of Foster *et al.,* (2004) who have reported 90.90 % incidence in bear cubs. This could be attributed due to indiscriminate feeding of young animals apart from their feeding habits compared to that of adults which is predisposing factor in young animals, and they are also predisposed during their socialization period.

5.6 Treatment and anthelmintic efficacy

The sloth bears which were positive for gastro-intestinal parasitic infection were dewormed with broad spectrum anthelmintic which had combination of ivermectin and praziquantel at the dose rate of 0.2 mg/kg BW and 5 mg/kg BW respectively, as a single dose. The post deworming fecal samples screened on 7^{th}, 14^{th} and 21^{st} day indicated 100 % efficacy. Similar results were reported by Rehbein *et al*., (2003), Chhaiya *et al.*, (2012), Alsaqabi and Lofty, (2014) in their anthelmintic efficacy studies.

Conclusion

Saturated zinc sulphate solution used in the floatation technique showed higher recovery of the eggs compared to other floatation fluids used. Though regular deworming was adopted 50 % parasitic infection was recorded in the present study. Sunlight,

temperature, humidity, ecological nature, nutritional status, managemental practice, disinfection and animal attendants play role in occurrence of parasitic infection. Anthelmintic efficacy was 100 % after deworming with suitable anthelmintics. Thus it is advised to implement the following measures for better results to control the parasitic infections;

a. Screening of the fecal sample before initiation of deworming
b. Regular disinfection
c. Avoid moisture in the enclosure
d. Removal of the source of infection by turning over the soil
e. Maintaining the hygienic measure for the animal attendants

SUMMARY

VI. SUMMARY

The present study was undertaken to know the occurrence of gastro-intestinal parasites in sloth bears maintained at Wildlife SOS, Bannerghatta Bear Rescue Centre (BBRC), Bengaluru, Karnataka state. The occurrence of parasitic infection was studied in relation to age, sex and anthelmintic efficacy. The study period considered was from July 2017 to September 2017.

Sixty fecal samples from sloth bears maintained under semi-captivity were screened for gastro-intestinal parasites. Macroscopic examination of the fecal samples indicated semi-solid consistency of the feces with varied color range of feces with reddish brown to yellowish green in color. There was no presence of mucous or occult blood and neither segments of tapeworm nor helminth parasites could be seen in the feces.

Out of 60 fecal samples 30 (50 %) samples were positive for single infections and mixed infection of *Toxocara* sp. and *Joyeuxiella* sp. Among 30 positive samples 15 (50 %) were positive for *Toxocara* sp., 8 (26.66 %) were positive for *Joyeuxiella* sp., 7 (23.33 %) were positive for mixed infection of *Toxocara* sp. and *Joyeuxiella* sp.

Among the qualitative methods used 25 (41.66 %) samples were positive for parasitic ova in direct smear examination, whereas in sedimentation and floatation technique 27 (45 %) samples and 30 (50 %) samples were positive respectively for parasitic ova. Floatation technique was found to be ideal among the various qualitative techniques used in present study.

Among different floatation fluids used saturated zinc sulphate solution was superior as higher number of eggs could be concentrated.

The occurrence of parasitic infection was 58.33 %, 50 %, 60 %, 53.84 % and 33.33 % out of 12, 10, 10, 13, 15 fecal samples screened from Panchavati block, Chithrakuta block, Kishkinda block, Dr. G.K.V block and Jambhava blocks respectively.

Occurrence of parasitic infection in male sloth bears (65.21 %) was high when compared to female sloth bears (40.54 %).

The occurrence of parasitic infection was high in cubs (100 %), followed by sub-adults (55.55 %) and adults (46.93 %).

Deworming was done with praziquantel @ 5 mg/kg BW and ivermectin @ 0.2 mg/kg BW as single dose orally. The anthelmintic efficacy was 100 %.

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VII. BIBLIOGRAPHY

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ABSTRACT

VIII. ABSTRACT

A study was undertaken to assess the prevalence of gastro-intestinal parasites in semi-captive sloth bears maintained at Wildlife SOS, Bannerghatta Bear Rescue Centre (BBRC), Bannerghatta, Bengaluru. The study was conducted from July to September, 2017. The study was conducted in relation to age and sex of sloth bears, the effect of anthelmintic treatment was also incorporated. A total of 60 fecal samples of sloth bears were screened using qualitative and quantitative techniques. Out of 60 samples screened 30 were positive out of which 50 % were infected with *Toxocara* sp., 26.66 % with *Joyeuxiella* sp. and 23.33 % had mixed infection of *Toxocara* sp. and *Joyeuxiella* sp. Among various qualitative screening techniques floatation technique was more effective. Among the floatation fluids used saturated zinc sulphate solution showed higher concentration of eggs compared to other floatation fluids. However, there was no statistical significance. The occurrence of gastro-intestinal parasites in various enclosures namely Panchavati block, Chithrakuta block, Kishkinda block, Dr. G.K.V block and Jambhava block were 58.33 %, 50 %, 60 %, 53.84 % and 33.33 % respectively. The incidence was higher in male (65.21 %) compared with female (40.54 %). Among the age groups studied occurrence of gastro-intestinal parasites was high in cubs (100 %) followed by sub-adults (55.55 %) and adults (46.93 %). The sloth bears which were positive for gastro-intestinal parasitic infection were dewormed with broad spectrum anthelmintic which contained ivermectin and praziquantel at the dose rate of 0.2 mg/kg BW and 5 mg/kg BW respectively as single dose orally. Anthelmintic efficacy was 100 %.

Keywords: Semi-captive sloth bears, occurrence, gastro-intestinal parasite, *Toxocara* sp., *Joyeuxiella* sp.

APPENDICES

APPENDIX-I

DATA OF SLOTH BEARS SCREENED AT WILDLIFE SOS, BBRC, BANNERGHATTA, BENGALURU.

Sl. No.	Name of the Sloth Bear	Age (Yr)	Sex	Eggs present
1.	Cub (rescued 1)	6 months	Male	*Toxocara* sp.
2.	Cub (rescued 2)	6 months	Female	*Toxocara* sp.
3.	Sagar	02	Male	*Toxocara* sp.
4.	Cupid	02	Female	*Joyeuxiella* sp.
5.	Suvarna	02	Female	*Joyeuxiella* sp., *Toxocara* sp.
6.	Swapna	02	Female	-
7.	Shari	02	Female	-
8.	Shyama	02	Female	-
9.	Aarathy	04	Female	*Joyeuxiella* sp.
10.	Sarathy	04	Male	*Joyeuxiella* sp., *Toxocara* sp.
11.	Lucky	04	Female	-
12.	Meenakshi	05	Female	*Joyeuxiella* sp., *Toxocara* sp.
13.	Bali	05	Male	*Toxocara* sp.
14.	Kasthuri	06	Female	-
15.	Tulsi	07	Female	-
16.	Hamsi	07	Female	-
17.	Chandra	08	Female	-
18.	Indra	08	Female	*Joyeuxiella* sp.
19.	Binny	08	Female	-
20.	Kavi	10	Female	*Joyeuxiella* sp.
21.	Durga	10	Female	-
22.	Anandhi	11	Female	-
23.	Ashok	12	Male	*Joyeuxiella* sp., *Toxocara* sp.
24.	Rathna	12	Female	*Toxocara* sp.
25.	Charles	13	Male	*Joyeuxiella* sp.
26.	Tate	13	Male	-
27.	Gayathri	13	Female	*Joyeuxiella* sp.
28.	Swathi	14	Female	-

Sl. No.	Name of the Sloth Bear	Age (Yr)	Sex	Eggs present
29.	Gomathi	14	Female	-
30.	Kuki	14	Female	*Toxocara* sp.
31.	Arosi	14	Female	-
32.	Anusha	15	Female	-
33.	Adit	15	Male	-
34.	Avani	15	Female	-
35.	Usha	15	Female	-
36.	Deva	16	Male	-
37.	Gokul	16	Male	*Toxocara* sp.
38.	Bharathi	16	Female	*Toxocara* sp.
39.	Rathi	16	Female	*Toxocara* sp.
40.	Dhrub	17	Male	*Toxocara* sp.
41.	Bhalu	17	Male	*Joyeuxiella* sp., *Toxocara* sp.
42.	Chithra	17	Female	-
43.	Basanthi	17	Female	*Joyeuxiella* sp., *Toxocara* sp.
44.	Amritha	18	Female	-
45.	Savitha	18	Female	*Toxocara* sp.
46.	Hari	18	Male	-
47.	Gubbi	18	Female	-
48.	Ganesha	18	Male	*Toxocara* sp.
49.	Johnson	18	Male	-
50.	Percy	18	Male	*Joyeuxiella* sp.
51.	Shobha	19	Female	-
52.	Dhanush	19	Male	*Toxocara* sp.
53.	Dhoni	20	Male	*Joyeuxiella* sp.
54.	Lakshman	20	Male	*Joyeuxiella* sp., *Toxocara* sp.
55.	Ghajini	20	Male	*Toxocara* sp.
56.	Rukmani	20	Female	-
57.	Sundari	24	Female	*Toxocara* sp.
58.	Sanjay	25	Male	-
59.	SharathBabu	25	Male	-
60.	Bobby	25	Male	-

APPENDIX-II

EGG COUNTS OF *TOXOCARA* BY DIFFERENT FLOATATION FLUIDS

Sl. No.	Name of the Sloth Bear	Saturated Sodium Chloride solution	Saturated Zinc Sulphate solution	Saturated Magnesium Sulphate solution	Saturated Sucrose solution
1.	Ashok	300	550	400	400
2.	Baalu	500	850	450	450
3.	Bali	150	200	100	100
4.	Basanthi	100	250	150	150
5.	Bharathi	50	150	50	50
6.	Dhanush	150	250	100	100
7.	Dhruv	1750	1950	1800	1800
8.	Gajni	150	200	150	150
9.	Ganesh	600	850	650	650
10.	Gokul	4850	5050	4600	4600
11.	Kuki	250	350	200	200
12.	Laxman	350	450	300	300
13.	Meenakshi	500	900	650	650
14.	Rati	200	250	100	100
15.	Ratna	1550	1950	1600	1600
16.	Sagar	800	900	800	800
17.	Sarathy	100	150	200	200
18.	Savitha	1750	1850	1550	1550
19.	Sundari	50	150	100	100
20.	Suvarna	2150	2950	2450	2450
21.	Cub (rescued 1)	4100	4600	2750	2750
22.	Cub (rescued 2)	700	1500	1200	1200