



## A study on occurrence of gastrointestinal parasites in Lions (*Panthera leo*)

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### Abstract

A study was carried out to know the occurrence of gastrointestinal parasites in lions at Bannerghatta Biological Park, Sri Chama Rajendra Zoological Garden (SCZG) and Tiger Lion Safari. Out of 20 faecal samples examined by direct and concentration methods, 15 samples revealed positive for helminthic infections viz., *Ancylostoma* spp. (66.6%), *Toxocara leonina* (60.0%), *Spirometra* spp. (20%) and protozoan infection of *Balantidium coli* (13.3%) cysts with an overall infection rate of 75.0 per cent. The mixed infections were recorded in 70.0 per cent of the samples. *Ancylostoma* spp. was found to be predominant in both males and females, followed by *T. leonina*, *Spirometra* spp. and *B. coli*. In cubs and adults age group, *T. leonina* and *Ancylostoma* spp. infections were found to be predominant whereas in subadults group, *Ancylostoma* infection was predominant.

**Keywords:** captive lions, gastrointestinal parasites, incidence

### 1. Introduction

Among wild carnivores, the lion (*Panthera leo*) is one of the epitome of king of forests and is also one of the big cats in the family *Felidae*. In captivity, though the health status of the animals depends on many factors, like feeding, animal management, environmental conditions. The parasitic infections are a major constraint and cause varied degrees of mortality and morbidity, weakness and unthriftiness in survivors with lowered body resistance and reproduction incapacities. There are various reports on gastrointestinal parasitic infections in wild carnivores documented from different zoological gardens either based on faecal or on post mortem examination viz., Gir forests in Gujarat; M.C. Zoological park, Chafbir in Patiala district Punjab; Bannerghatta Biological Park, Bangalore; Vakilabad Zoo in Mashhad, Iran and Tiger Lion Safari (TLS), Tyavarekoppa, Shivamogga [1, 2, 3, 4, 5].

Though, helminthic diseases are a major constraint to zoo animals, the occurrence of parasitic infections may vary depending on the type of husbandry practices viz., nutritional and physiological status, effective disease control programmes and type of treatment administered [6]. The availability of data on gastrointestinal infection in lions under captivity appears to be scanty and also there is paucity of systematic information in Karnataka state. Hence, the present literature aims at identification of common gastrointestinal parasitic infections in lions under captive conditions for better treatment and implementation of successful control programmes.

### 2. Material and Methods

The faecal samples from three different locations viz., Bannerghatta Biological Park (BBP), Bengaluru (12), Sri Chamarajendra Zoological Garden (SCZG), Mysuru (4) and

Tiger Lion Safari Tyaverakoppa (TLST), Shivamogga (4) were collected as per the procedure during the period from January to June, 2018 [7]. Representative fresh faecal samples from each animal kept in an individual enclosure and from cubs, pooled samples were collected in a clean dry, individually labelled plastic containers. The faecal samples were brought to the laboratory for macroscopic and microscopic examination of different parasitic stages. Microscopic examination was carried out by qualitative examination using direct and concentration methods [8] and quantitative by Mc Master's method to estimate eggs per gram (EPG) of faeces [9]. The parasitic eggs/larvae/cysts/oocysts were identified based on standard keys [8, 10, 11]. The micrometry of parasitic stages was carried out by using ocular and stage micrometer as per the standard procedure [11].

### 3. Statistical analysis

The statistical analysis of data was carried out by Fisher's exact and one-way ANOVA tests using graph pad prism software, version 5.01.

### 4. Results

#### 4.1 Macroscopic examination

On macroscopic examination, the faeces was found to be normal in consistency, dark greenish yellow in colour with foul smelling. However, in cubs the faeces was watery and were showing diarrhoea. None of the samples showed presence of mucus, blood, helminths or segments in the faeces.

#### 4.2 Microscopic examination

Out of 20 faecal samples examined by direct and concentration methods, 15 samples were found to be

positive for helminthic infections viz., *Ancylostoma* spp. (66.6%), *Toxocara leonina* (60.0%), *Spirometra* spp. (20%) and intestinal protozoan infection, *Balantidium coli* (13.3%) cysts with an overall infection rate of 75.0 per cent. Out of 12 samples examined from BBP, 10 (83.3%) were found positive for gastrointestinal parasites. Out of 10, 80.0 per cent of the samples were found positive for eggs of *Ancylostoma* spp., 60.0 per cent for *T. leonina*, 30.0 per cent for *Spirometra* sp. and 20.0 per cent for *B. coli* cysts. *Ancylostoma* spp. infection was found to be predominant followed by *T. leonina*, *Spirometra* sp. and *B. coli* cysts. In SCZG, out of four samples examined, two each were found positive for eggs of *Ancylostoma* spp. (50.0%) and *T. leonina* (50.0%). In a total of four samples examined from TLST, only one sample was found to be positive for *T. leonina* eggs (25.0%). The statistical differences between the infections in different locations was found to be non significant at  $P < 0.05$ .

#### 4.3 Mixed infections of gastrointestinal parasites

During this study, the mixed infections were recorded in 70.0 per cent of the samples. The mixed infections of *Ancylostoma* spp. and *T. leonina* were recorded in 50.0 per cent of the samples. The *Ancylostoma* and *Spirometra* spp.; *Ancylostoma* spp. and *B. coli* cysts infections were recorded in 20.0 per cent of the samples. *Ancylostoma* spp., *T. leonina* and *B. coli* cysts; *Ancylostoma* spp., *T. leonina* and *Spirometra* spp. were recorded in 10.0 per cent of the samples. In the present study, the mixed infections of *Ancylostoma* spp. and *T. leonina* were found to be predominant followed by the other infections.

#### 4.4 Gender wise occurrence of gastrointestinal parasites

Out of 13 males and 7 females examined by direct and concentration methods, 69.2 (9) and 85.7 (6) per cent of the lions were found positive for gastrointestinal parasitic infections, respectively. In both males and females, *Ancylostoma* spp. was found to be predominant followed by *T. leonina*, *Spirometra* spp. and *B. coli* cysts. During this study, an overall infection was found to be higher in females than compared to males. The statistical differences between the genders was found to be non-significant at  $P < 0.05$ .

#### 4.6 Age wise occurrence of gastrointestinal parasites

During this study, animals were divided into four groups viz., Cubs (< 2 years), subadults (2 to 3 years), adults (3 to 8 years) and old adults (> 8 years). Cubs less than two years of age showed positive for both *Ancylostoma* spp. and *T. leonina* eggs. In subadults group, two lions showed positive for *Ancylostoma* spp. and one for *Spirometra* spp. In adults group, out of 13 animals examined 8 were found to be infected with gastrointestinal parasitic infections viz., *T. leonina* (5), *Ancylostoma* spp. (5), *Spirometra* spp. (2) and *B. coli* (2) cysts. In old adults group, all the three were found to be positive with the mixed infections of *T. leonina* (2) and *Ancylostoma* spp. (1). In the present study, *T. leonina* and *Ancylostoma* spp. infections were found to be predominant in cubs. In cubs and subadults group, *Ancylostoma* infection was found to be predominant. However, in cubs, adults and subadults, *T. leonina* infection was found to be common.

#### 4.7 Quantitative estimation

The average mean EPG was found to be  $100 \pm 0$  for *Ancylostoma* spp.,  $11450 \pm 11250$  for *T. leonina* and  $100 \pm 0$  for *Spirometra* spp.

#### 5. Discussion

During this study, out of 20 faecal samples examined, 15 were found to be positive for helminthic infections viz., *Ancylostoma* spp. (66.6%), *T. leonina* (60.0%), *Spirometra* spp. (20%) and intestinal protozoan infection, *B. coli* (13.3%) with an overall infection rate of 75.0 per cent. The gastrointestinal parasitism was reported by different authors in India and abroad. *Toxocara*, *Ancylostoma* and *Artif echinostomum* were recorded in carnivores from V.O.C. Park and Mini Zoo, Coimbatore<sup>[12]</sup>. *T. leonina* eggs (39.1%) and *Ancylostoma* spp. (56.5%) were reported from Bannerghatta Biological Park, Bangalore<sup>[13]</sup>. *Ancylostoma* (50%) and *Toxocara* spp. (100%) were reported in lions (*Panthera leo*) from Rajkot municipal corporation Zoo (Rajasthan), respectively<sup>[14]</sup>. At Nandankanan Zoo (Odissa), out of 24 lions examined, 70.0 per cent of the samples were found positive for *T. leonina* and *Ancylostoma* spp.<sup>[7]</sup>. *Spirometra* (44.29%), *Paragonimus* (34.29%), *Taenia* (8.25%), strongyle (7.14%), *Toxocara* (4%), *Strongyloides* (3%) and *Trichuris* spp. (1) were recorded in tigers from Northern Kerala<sup>[15]</sup>.

The differences in the prevalence of gastrointestinal parasites in lions may be attributed to various managerial practices including type of housing conditions in animal enclosures<sup>[6]</sup>. In addition, other factors like overcrowding, animal food sources and different geographical conditions favouring the development of parasitic stages might have greater influences on occurrence of infection and housing more than one animal in an enclosure may lead to cross contamination. During this study, nematode infections were found to be common with predominant infection of *T. leonina* and *Ancylostoma* spp. which could be probably due to direct life cycles of nematodes without involvement of any intermediate host and are mainly transmitted by faecal contamination of feed, water and soil. Some helminths potentially accumulate in a captive environment especially in open soil enclosure which cannot be easily disinfected and also survivability of the helminth parasites is highly influenced by climatic factors<sup>[8]</sup>. In the present study, *Spirometra* spp. infection was found to be comparatively low because cestode infections, require an intermediate host for their transmission and are less likely to accumulate in the captive environment<sup>[16]</sup>. The infection was recorded in subadults and adults which could be probably due to hunting nature of this particular age group. During this study, though the animals were kept in an individual enclosure the prevalence of *T. leonina* and *Ancylostoma* spp. were found to be higher which could be probably due to regular movement of animals from enclosures to safari where animals can be frequently infected in free range.

In SCZG and TLST, infection was found to be very low and opined that it could be probably due to an examination of faecal samples within one-month interval period after administration of ivermectin @ 10 mg / kg (4 tablets/animal). In TLST, no information was available on deworming status of animals however, all the four animals

were maintained in an individual enclosure, with one animal Keeper which might have resulted in less contamination between the enclosures. The overall infection was found to be higher in females than compared to males. Similarly, 66.7 per cent of *Toxocara* sp. in female and 33.3 per cent in male lions were recorded at Lahore Zoo and Lahore Safari park, Pakistan [17]. Such differences could be probably due to variations between the individuals in their exposure to infective stages and difference in their susceptibility [18]. It was also reported that both male and female lions remain equally susceptible to the endoparasitic infections [19]. However, higher infection of *Spirometra* in females was reported than compared to males and also opined that neither sex or nor reproductive status play a role, though male lion had high testosterone level, a higher white blood cell count and high chances of parasitic contact due to greater food intake [20].

In the present study, *T. leonina* and *Ancylostoma* spp. infections were found to be predominant in cubs and adults. However, in cubs and subadults group, *Ancylostoma* infection was found to be predominant. *Spirometra* infection was recorded in subadults and adults and *B. coli* only in adults. The present findings indicated that cubs and adults group remain susceptible to both *Ancylostoma* and *T. leonina* infections which might be probably due to age dependant factors like development of acquired immunity or lowered adult innate immunity and hunting habits. Similarly, more severe infection of toxocarosis in lion cubs than compared to adults was reported from M. C. Zoological Park, Chhatbir district [2]. However, higher infection of *Spirometra* was reported in unweaned cubs and opined that increased burden may be due to lack of acquired immunity or lower innate susceptibility [20]. In contrary to the present findings, low parasitic infections in cubs were reported at Lahore Zoo and Lahore Safari park, Pakistan and opined that low infection could be due to more care and attention given to cubs for better livability and growth which indirectly help prevent the invasion of infected stages of parasites [17]. However, high parasitic burden was reported in old age lions (10 to 20 years) which was in contrast to the present findings where low parasitic infection was recorded in old adult group between 10 to 14 years.

During the study, the average mean egg per gram of faeces (EPG) was found to be  $100 \pm 0$  for *Ancylostoma* spp.,  $11450 \pm 11250$  for *T. leonina* and  $100 \pm 0$  for *Spirometra* spp. During this study, the EPG counts of *T. leonina* was found to be higher ( $11450 \pm 11250$ ) which could be attributed to the fact that the ascarid eggs have potential to withstand the harsh environmental conditions and also it is difficult to remove *T. leonina* and *Toxocara* spp. infection from the zoo environment due to passage of large number of eggs everyday by the infected individuals [21]. However, EPG counts of *Ancylostoma* and *Spirometra* were found to be minimal which could be probably due to very low parasitic burden and the faeces of wild felids often contain too much of fat which may lead to formation of a plug after charging the Mc Master's slide strongyle interferes with the assessment of egg counts [22].

However, the differences in the egg counts observed could be probably due to consistency of the faeces at the time of collection because eggs are concentrated in a smaller output in dry faeces and there will be variation in egg counts in individual animals in a group/pride. Additionally, the egg production of female worms is greatly influenced by factors

such as immunity of the host, age of parasites etc., and a fairly diurnal fluctuation in faecal egg count has been shown to occur [22].

## 6. Conclusion

Though the gastrointestinal parasitic infections are commonly known to occur in captive wild carnivores, the control strategies would depend upon several factors like life cycle, availability of intermediate host, survivability of the non-infective stages of parasites in nature, availability of susceptible host, status of nutrition, season and environment. Therefore, it is desirable to have a better understanding of the design and dimension of animal enclosure, micro and macroclimate of the enclosure environment, species, population size, sex and age group of carnivores maintained for an implementation of effective control measures.

## 7. Ethical Statement

The Principal Chief Conservator of Forests (Wildlife), Karnataka has permitted to collect the faecal samples and to carry out the research work (No. PCCF/ (WL)/E2/ CR/57/ 2017-18 dated 2/2/2018).

## 8. Acknowledgements

The authors gratefully acknowledge the Centre of Advanced Faculty Training, Department of Veterinary Parasitology, Veterinary College, Bengaluru, ICAR, New Delhi for extending the laboratory facilities to carry out the research work and the assistance provided by all the zoo veterinarians during sample collection.

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