Journal of Threatened Taxa | www.threatenedtaxa.org | 26 March 2014 | 6(3): 5574–5579

ISSN
Online 0974–7907
Print 0974–7893

OPEN ACCESS

Coprological prevalence of gastrointestinal parasites in carnivores and small mammals at Dhaka zoo, Bangladesh

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Abstract: A study on the coprological prevalence of gastrointestinal parasites using 94 faecal samples from different carnivores (n=32) and small mammals (n=15) was undertaken from January to May 2012 at Dhaka Zoo. The overall prevalence of parasitic infection was 78.72%, with a prevalence of 51.06% for helminths and 27.66% for protozoa. The identified parasites included—*Toxascaris leonina* (9.57%), *Balantidium coli* (25.53%) *Spirometra* sp. (10.64%), *Toxocara cati* (12.76%), Hook worm (4.26%), unidentified strongyles (3.19%), *Trichuris* sp. (7.45%), *Coccidia* sp. (2.12%), *Capillaria* sp. (1.06%), *Trichostrongylus* sp. (1.06%), and *Physaloptera* sp. (1.06%). Mixed infection was observed in Indian Lion (*Toxascaris leonina* and *Spirometra* sp.), Royal Bengal Tiger (*Balantidium coli* and *Toxocara cati*), Spotted Hyena (*Balantidium coli* and hook worm), Leopard (*Balantidium coli* and *Spirometra* sp.), Rhesus Macaque (*Trichuris* sp. and *Coccidia* sp.), Pig-tailed Macaque (*Balantidium coli* and *Trichuris* sp.), Hamadryas Baboon (*Balantidium coli* and *Trichuris* sp.), Golden Mangabey (*Trichuris* sp., *Balantidium coli* and unidentified strongyles), Large Indian Civet (*Balantidium coli* and unidentified strongyles), Torior Dog (*Balantidium coli* and *Physaloptera*), Rabbit (*Balantidium coli* and Hook worm), Hanuman Langur (*Balantidium coli* and *Capillaria* sp.). Due to the high prevalence of gastrointestinal parasites, the present study suggests to apply control measures against these parasites in order to safeguard the health of housed wild animals, especially in case of threatened species.

Keywords: Carnivores, coprology, gastrointestinal parasites, prevalence, small mammals.

Zoological gardens exhibit wild animals for aesthetic, educational and conservation purposes (Varadharajan & Pythal 1999). The main aim of zoological gardens is to preserve rare and endangered species. Parasitic diseases constitute one of the major problems and causes of mortality in these animals (Rao & Acharjyo 1984). In nature, wild animals range accross large areas and have consequently a low genetic resistance against parasitic infections because of low exposure. When herds of these wild animals are kept in a relatively small space in zoological gardens, the problem of various parasitic infections can aggravate and pose a serious threat to endangered species, occasionally causing sudden and unexpected local declines in abundance (Muoria et al. 2005). The occurrence of parasites in animals housed in zoos varies according to the husbandry practices, disease prophylaxis and treatment administered. Inadequate information on diseases and parasites of zoo animals is a major limiting factor in adopting prophylactic measures in zoological gardens. Investigations regarding endoparasitic fauna are important for the study of the prevalence, geographical distribution, systematics and biology of parasites (Zasityte & Grikienciene 2002).

DOI: http://dx.doi.org/10.11609/JoTT.o3569.5574-9 | **ZooBank:** urn:lsid:zoobank.org:pub:E6451C8F-244E-46C3-ABEA-DFD7455A4362

Editor: Ulrike Streicher, Wildlife Veterinarian / Wildlife Management Consultant, Danang, Vietnam. **Date of publication:** 26 March 2014 (online & print)

Manuscript details: Ms # o3569 | Received 27 March 2013 | Final received 16 March 2014 | Finally accepted 17 March 2014

Citation: Raja, M.M.R.U., A.R. Dey, N. Begum, U.K. Kundu & F.A. Ashad (2014). Coprological prevalence of gastrointestinal parasites in carnivores and small mammals at Dhaka zoo, Bangladesh. *Journal of Threatened Taxa* 6(3): 5574–5579; http://dx.doi.org/10.11609/JoTT.o3569.5574-9

Funding: Department of Parasitology provided fund for this research.

Competing Interest: The authors declare no competing interests.

Acknowledgements: We thank the respected teachers in the Department of Parasitology and also the authority of the Dhaka Zoo.

Over the years, research on gastro-intestinal parasites has been carried out on Common Mole, Cane Rat, Gorilla, birds in captivity (e.g., Chaunha et al. 1973), reptiles, ungulates and many zoo animals across the globe (e.g., Kumar et al. 2005; Singh et al. 2006).

A regular program of gastrointestinal parasite surveillance and control measures like effective treatment and proper prophylaxis based on correct diagnosis would certainly improve the health situation in zoo animals.

Considering these facts, the present study was undertaken to identify the gastrointestinal parasites and determine their prevalence based on morphometry and count of developmental stages in faecal samples from carnivores and small mammals of Dhaka Zoo.

Materials and Methods

This study was conducted at Dhaka Zoo from January to May 2012. The zoo houses many native and non native animals and wildlife.

Selection of animals: The study included the carnivores, non human primates and several small mammal species. Ninety-four samples were collected of which 70 were from carnivores including Indian Lion (24), Tiger (20), Hyena (4), Asiatic Black Bear (4), Dingo Dog (2), Ratel (2), Fox (2), Fishing Cat (2), Leopard (4), Binturong (2), Large Indian Civet (2), Torior Dog (2), 18 from non human primates including Rhesus Macaque (2), Pig-tailed Macaque (2), Hanuman Langur (2), Hamadryas Baboon (2), Vervet Monkey (2), Olive Baboon (4), Hoolock Gibbon (2), Golden Mangabey (2), and Guinea Pig (2), Rabbit (2) and Indian-crested Porcupine (2).

Collection and preservation of samples: Individual faecal samples were collected with the help of each animal's caretakers in the early morning. After collection the faecal sample was placed in a polythene bag containing 10% formalin. Then the opening edge of the bag was tightly tied with ribbon to avoid contamination and each sample was marked according to species.

Coprological examination: Samples were examined at the laboratory of the Department of Parasitology, Bangladesh Agricultural University, Mymensingh. The sample was processed for microscopic examination. The ova, cysts, oocysts and larvae of different parasites were tentatively identified according to the morphology and then quantitative estimation was done by applying the Stoll's ova dilution technique and McMaster technique to determine eggs per gram (EPG), cysts per gram (CPG) and oocysts per gram (OPG) of faeces as described by Soulsby (1982).

Morphological measurements of ova and cysts: The egg or cyst or oocysts were finally identified based on measurements (length and width) by using a micrometer as described by Cable (1965).

Results

Overall prevalence of gastrointestinal parasites: The overall prevalence of parasitic infection was 78.72% (74/94), of which 51.06 % (48) were helminthic and 27.66% (26) were protozoan infections (Fig. 1). The identified parasites included protozoa (*Balantidium coli*, *Coccidia* sp.), helminths (*Toxascaris leonina*, *Spirometra* sp., *Toxocara cati*, Hook Worm, *Trichuris* sp., *Capillaria* sp., unidentified strongyles, *Trichostrongylus* sp. and *Physaloptera* sp.). The results indicated that helminthic infections were more common than protozoan infections in carnivores and small mammals.

The prevalence and intensity of different gastrointestinal parasites: Prevalence of identified parasites was—9.57% for *Toxascaris leonina*, 25.53% for *Balantidium coli*, 10.64% for *Spirometra* sp., 12.76% for *Toxocara cati*, 4.26% for Hook worm, 3.19% for unidentified strongyles, 7,45% for *Trichuris* sp., 2.12% for *Coccidia* sp., 1.06% for *Capillaria* sp., 1.06% for *Trichostrongylus* sp. and 1.06% for *Physaloptera* sp. (Table 2). The mean of OPG, CPG, and EPG was calculated for all the animal species and the ranges are shown in Table 1. The highest EPG was found in Leopard for *Spirometra* sp. as 6200. The intensity in EPG of other parasites was 1500 for *Toxascaris leonina*, 800 for *Coccidia* sp., 500 for *Trichostrongylus* sp., 400 for *Capillaria* sp. and 400 for *Trichuris* sp.

Prevalence of mixed infection: Mixed infection was observed in 12 species including Indian Lion (*Toxascaris leonina* and *Spirometra* sp.), Royal Bengal Tiger (*Balantidium coli* and *Toxocara cati*), Spotted Hyena (*Balantidium coli* and Hook Worm), Leopard (*Balantidium*

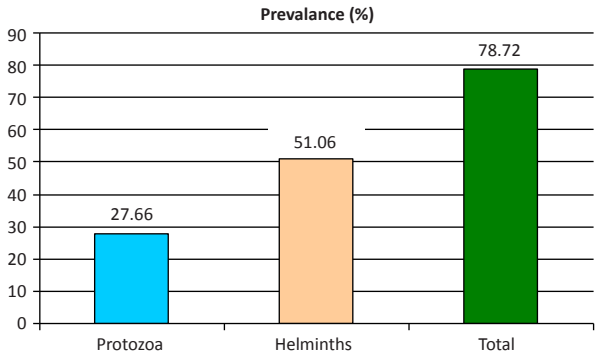

Figure 1. Overall prevalence of parasitic infection in carnivore and small mammals at Dhaka Zoo.

Table 1. Prevalence and intensity of ova/cyst/oocysts of different parasites in different animals at Dhaka Zoo

Common Name	Name of the parasite	No. of positive case (No. of sample)	Prevalence (%)	Intensity of infection(EPG /CPG)/(OPG)
				Ranges
Indian Lion	*Toxascaris leonina*	9(24)	37.5	1200-1500
	Spirometra sp.	5(24)	20.83	800-1000
	Balantidium coli	3(24)	12.5	300-400
Royal Bengal Tiger	*Toxocara cati*	12(20)	60	1200-1400
	Balantidium coli	3(20)	15	300-400
Spotted Hyena	Hook worm	1(2)	50	600-800
	Balantidium coli	1(2)	50	300-400
Striped Hyena	*Balantidium coli*	1(2)	50	600-800
	Hook worm	2(2)	100	800
Asiatic Black Bear	*Balantidium coli*	1(4)	25	300-400
Dingo Dog	*Spirometra* sp.	1(2)	50	800-1000
Rattle	*Balantidium coli*	1(2)	50	600-800
Bengal Fox	*Balantidium coli*	2(2)	100	600-800
Fishing Cat	Nil	0(2)	0	-
Leopard	*Balantidium coli*	2(4)	50	600-800
	Spirometra sp.	4(4)	100	4800-6200
Indian-crested Porcupine	Nil	0(2)	0	-
Guinea Pig	Nil	0(2)	0	-
Rhesus Monkey	*Trichuris* sp.	2(2)	100	300-400
	Coccidia	1(2)	50	600-800
Pig-tailed Macaque	*Trichuris* sp.	1(2)	50	300-400
Hanuman Langur	*Balantidium coli*	1(2)	50	300-400
	Capillaria sp.	1(2)	50	300-400
Hamadryas Baboon	*Trichuris* sp.	2(2)	100	600-800
	Balantidium coli	1(2)	50	300-400
Rabbit	*Balantidium coli*	2(2)	100	300-400
	Hook worm	1(2)	50	400
	Coccidia	1(2)	50	600-800
Vervet Monkey	Nil	0(2)	0	-
Bingturong	Nil	0(2)	0	-
Olive Baboon	*Trichostrongylus* sp.	1(4)	50	500
	Balantidium coli	1(4)	50	600-800
Hoolock Gibbon	*Balantidium coli*	1(2)	50	800-1000
	Trichuris sp.	1(2)	50	400
Golden Mangabey	*Trichuris* sp.	1(2)	50	400
	Balantidium coli	1(2)	50	800-1000
	Unidentified strongyles	1(2)	50	300
Large Indian Civet	Stomach worm	2(2)	100	300
	Balantidium coli	1(2)	50	800-1000
Torior Dog	*Balantidium coli*	2(2)	100	600-800
	Physaloptera sp.	1(2)	50	300

coli and *Spirometra* sp.), Rhesus Macaque (*Trichuris* sp. and *Coccidia* sp.), Pig-tailed Macaque (*Balantidium coli* and *Trichuris* sp.), Hamadryas Baboon (*Balantidium coli* and *Trichuris* sp.), Golden Mangabey (*Balantidium coli*, unidentified strongyles and *Trichuris* sp.), Large Indian Civet (*Balantidium coli* and unidentified strongyles), Torior Dog (*Balantidium coli* and *Physaloptera* sp.), Rabbit (*Balantidium coli* and hook worm), Hanuman Langur(*Balantidium coli* and *Capillaria* sp.) (Table 3).

Sizes of eggs and cysts of different gastrointestinal parasites in different animals: The sizes (length by width) in µm of eggs, cysts and oocysts of different gastrointestinal parasites were measured (Table 4, Images 1–6).

Discussion

In this study we found 78.72% of the faceal samples infected with parasites. This result is similar to the earlier report of Corden et al. (2008) and Opara et al. (2010) who revealed 72.5% respectively 76.6% positive cases. Higher prevalences were found by Mutani et al. (2003), who reported 88.7% postitive samples from Barbados. In contrary much lower prevalences were found by Stuart et al. (1990), who only found 48% of the animals were infected with parasites in Costa Rica. However, both these studies are conducted on primates, do not include carnivores and small mammals and are furthermore conducted on free ranging animals and not in a captive setting. But they illustrate that both higher and lower prevalences of parasite infections can be found even in free ranging animals.

The prevalence of helminthic infection (52.06%) was found higher than protozoan infection (27.66%). In this the present study differs from the report of Parasani et al. (2001) who revealed 68.8% animals positive for helminthic infections and 18.8% for protozoan infections in Rajkot Municipal Corporation Zoo. Both studies were conducted in a captive setting and included a variety of animal groups. The difference in findings demonstrates that even under a similar setup, parasite prevalences might still be very different due to different geographic conditions, management practices, animal food sources and other influences. In non human primates, the isolated parasities included *Trichuris* sp., *Balantidium coli* and unidentified strongyles, with *Balantidium coli* having the highest prevalence. *Trichuris* sp. has often been recorded in primates (Mutani et al. 2003; Kimberley et al. 2004; Corden et al. 2008; Lim et al. 2008; Singh et al. 2009) and *Balantidium coli* has been previously reported by Leveck et al. (2007).

In this study, Royal Bengal Tigers were found to be infected with *Toxocara cati*. The occurrence of *T. cati in this species* has already been reported by Fagiolini et al. (2010) and Gonzalez et al. (2007). Lion were infected with *Toxascaris leonina*, *Spirometra* sp. and *Balantidium*

Table 2. Prevalence of parasites in different animals at Dhaka zoo

Types of parasites	Name of the parasites	No. of positive case	Prevalence (%)
Protozoa	*Balantidium coli*	24	25.53
	Coccidia	02	2.12
Nematode	*Toxocara cati*	12	12.77
	Capillaria sp.	01	1.06
	Trichuris sp.	07	7.45
	Toxascaris leonina	09	9.57
	Hook worm	04	4.26
	Unidentified Strongyles	03	3.19
	Trichostrongylus sp.	01	1.06
	Physaloptera sp.	01	1.06
Cestode	*Spirometra* sp.	10	10.64

Table 3. Prevalence of mixed infection

Name of the parasites	No. of case	Prevalence (%)
Balantidium coli and *Toxocara cati*	05	5.31
Balantidium coli and Unidentified strongyles	01	1.06
Balantidium coli and hook worm	02	2.12
Balantidium coli and *Spirometra* sp.	02	2.12
Balantidium coli and *Trichuris* sp.	02	2.12
Balantidium coli and *Capillaria* sp.	01	1.06
Toxascaris leonina and *Spirometra* sp.	01	1.06
Balantidium coli and *Physaloptera* sp.	01	1.06
Trichuris sp. and Coccidia	01	1.06
Balantidium coli and unidentified strongyles and *Trichuris* sp.	01	1.06

Table 4. The size of ova/cysts/oocysts of different parasites

Name of the parasites	Size of ova/cyst/larvae/oocyst(µm)
Toxascaris leonina	72.5 x 43.5
Spirometra sp	58 x 29
Toxocara cati	72.5 x 72.5,
Unidentified strongyles	72.5 x 43.5
Trichostrongylus sp.,	72.5x43.5
Physaloptera sp.	45x30
Trichuris sp.	58 x 29
Coccidian oocysts	43.5 x 29
Balantidium coli	43.5 x 29

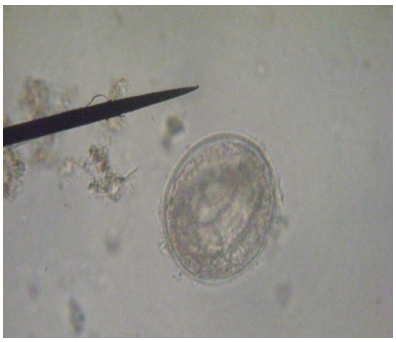

Image 1. Egg of *Toxascaris leonina* of Lion (720X)

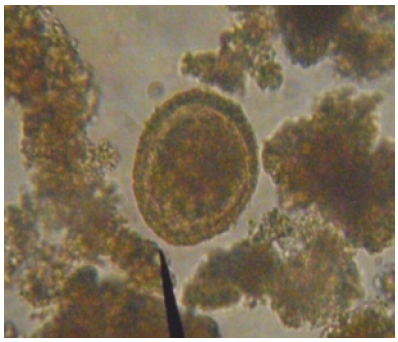

Image 2. Egg of *Toxocara cati* of Tiger (720X)

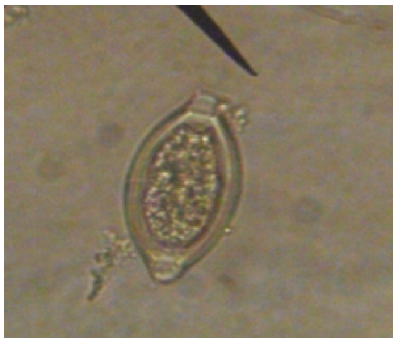

Image 3. Egg of *Trichuris* sp. of Rhesus Macaque (720X)

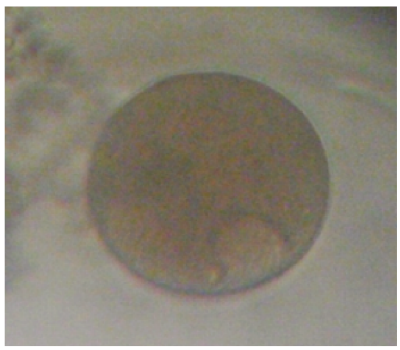

Image 4. Cyst of *Balantidium coli* of Hamadryads Baboon (720X)

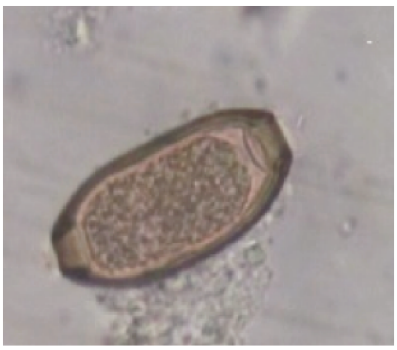

Image 5. Egg of *Capillaria* sp. of Common Langur(720X)

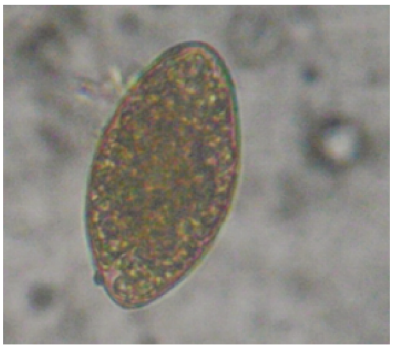

Image 6. Egg of *Spirometra* sp. of Indian Lion (720X)

coli. This supports the findings of Fagiolini et al. (2010), who revealed *Toxascaris leonina* in lion. *Spirometra* is on the other hand a new report for captive lions in Bangladesh as to date this parasite has only been reported in wild lions, where it was found to be the most common parasite (Barutzki et al. 1985, Ghoshal et al. 1988, Tang et al. 1988, Muller-Graf 1995). However comparatively lower prevalence was recorded as 7.1% by Lim et al. (2008). The occurrence of Spirometra in this study might be due to the feeding management and the availability of intermediate hosts in the environment. Two intermediate hosts are required to complete the life cycle of *Spirometra* sp.; crustaceans are the first intermediate host and snakes, birds and mammals are second intermediate host (Soulsby 1982). The presence of *Spirometra* sp. in the lion of Dhaka Zoo might be due to ingestion of contaminated beef with infective secondary stage of larvae.

In the present study, mixed infection was observed in 12 species. Mixed parasite infections in zoo animals was recorded by Kanungo et al. (2010) and Mutani et al. (2003) found that 58.5% of all monkeys examined had at least three parasite species and only 34.0% had one and two parasite species. This suggests that there is a fairly high rate of transmission of the parasites observed between individuals either because of the monkeys' gregarious nature or because of suitable environmental conditions (Mutani et al. 2003). It has to be kept in mind however, that Mutani's study was conducted in free ranging monkeys and hence could be expected to be even lower than in a captive setting.

The finding of mixed infection in this study therefore is not surprising and might be due to the presence of all animals of different ages in the same cages, feeding management, insufficient cleaning and improper disposal of faeces.

Conclusion

Gastrointestinal parasites were prevalent in animals of this zoo. Better management practices and adequate prophylactic measures are important strategies to control gastrointestinal parasites. Further, long term epidemiological studies of parasitic infections are essential to understand infection routes and to prevent the possible recurrence of infections in captive animals at the zoo. Such studies will provide a clear concept

regarding parasitic infection of the captive animals at Dhaka Zoo and will help to develop appropriate preventive and therapeutic measures against parasitic infection in zoo animals.

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