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A Copro-parasitological Surveillance on Diverse Captive Wild Avian Species

V. Manjunatha[1], M. Rout[2], V. Sreevatsava[3], L.M. Kshamaa[4], Umashankar[5], B.P. Shankar[3], S.M. Byregowda[3]

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ABSTRACT

Background: Infections with gastrointestinal parasites are widespread and a major health issue for captive birds. Despite the significance being well known, not much studies have been conducted on its prevalence especially in captive avians in a zoo setup. The present study aims at determining the prevalence of parasites in captive birds of different orders maintained at Bannerghatta Biological Park, Bengaluru, Karnataka.

Methods: In this investigation, a survey through fecal sample examination was conducted to assess the parasitic infection in captive birds belonging to 6 different biological orders *e.g.* Casuariiformes, Anseriformes, Galliformes, Pelecaniformes, Psittaciformes {Emu (*Dromaius novaehollandiae*), Duck (*Anas platyrhynchos*), Peafowl (*Pavo cristatus*), red jungle fowl (*Gallus gallus*), grey pelican, (*Pelecanus philippensis*), purple heron (*Ardea purpurea*), silver pheasant (*Lophura nycthemera*), macaw (*Ara ararauna*), parakeet (*Psittacula eupatsia*)} and Ciconiiformes maintained at Bannerghatta Biological Park, Bengaluru, Karnataka. A total of 106 fecal samples from apparently healthy birds including 7 samples from emu, 3 ducks, 12 peafowls, 8 red jungle fowls, 24 grey pelicans, 1 purple heron, 13 silver pheasants, 8 macaws, 26 parakeets and 4 Indian open-billed storks were collected during 2015-2016 and were screened for parasitic eggs/oocysts.

Result: The screening result could detect ova of 2 (28.57%) *Eimeria* oocyst in emu, 3 (100%) *Eimeria* oocyst in duck, 7 (58.33%) *Capillaria* sp., 3 (25%) *Eimeria* oocyst, 2 (16.66%) *Ascardia galli*, 2 (16.66%) *Raillietina echinobothrida*, 1 (8.33%) *Tetrameres* sp. in peafowls, 3 (37.5%) *Ascardia galli,* 1 (12.5%) *Eimeria* oocyst in red jungle fowls, 5 (20.83%) *Ascardia galli* in grey pelican, 1 (100%) trematode ova in purple heron, 3 (23.07%) *Raillietina* sp., 2 (15.38%) *Eimeria* ocyst in silver pheasant, 2 (25%) *Ascaris* sp. in macaw, 12 (46.15%) *Ascaris* sp., 3 (11.53%) *Eimeria* oocyst in parakeet and 4 (100%) *Tetrameres* sp. in Indian open-billed storks.

Key words: Cestode, Duck, Eimeria oocyst, Emu, Grey pelican, Indian open billed stork, Macaw, Nematode, Parakeet, Peafowl, Purple heron, Red jungle fowl, Silver pheasant, Trematode.

INTRODUCTION

Biological parks or zoological gardens are *ex-situ* forms of conservation, where a wide diversity of animals and birds *e.g.* duck, peafowl, red jungle fowl, grey pelican, purple heron, silver pheasant, macaw, parakeets along with ratites {ostrich (*Struthio camelus*), emu (*Dromaius novaehollandiae*) and rhea (*Rhea americana*)} are displayed in enclosures for aesthetic, educational and conservation purposes. Endoparasites in birds are common in tropical areas due to poor husbandry practices favoured by climatic conditions (Imura *et al*.., 2012). The effects of parasitism on birds may be multifaceted starting from malnutrition, stunted growth and low egg production even increasing susceptibility to other infections and mortality in captivity. If a comfortable, stress-free environment gets compromised it may help introduction of pathogens and parasites causing different clinical manifestations in birds.

Owing to the importance of identification and control of parasites, there seems to be an obvious need for periodical parasitological surveys/studies on captive avian species. To have a better understanding on the prevalence of endoparasites as well as to establish the base-line incidence of gastrointestinal parasite profile of the said species at Bannerghatta Biological Park (BBP), Bengaluru, Karnataka, this study was attempted. Undoubtedly a regular surveillance for gastrointestinal parasites would assist in maintaining

[1]Wild Animal Disease Diagnostic Laboratory, Institute of Animal Health and Veterinary Biologicals, Bannerghatta Biological Park, Bannerghatta - 560 083, Bengaluru, India.
[2]ICAR-Directorate of Foot and Mouth Disease, IVRI Campus, Mukteswar - 263 138, Nainital, Uttarakhand, India.
[3] Institute of Animal Health and Veterinary Biologicals, Hebbal - 560 024, Bengaluru, India.
[4]Bannerghatta National Park, Karnataka Forest Department, Bannerghatta - 560 083, Bengaluru, India.
[5]Bannerghatta Biological Park, Bannerghatta - 560 083, Bengaluru, India.

Corresponding Author: V. Manjunatha, Wild Animal Disease Diagnostic Laboratory, Institute of Animal Health and Veterinary Biologicals, Bannerghatta Biological Park, Bannerghatta - 560 083, Bengaluru, India. Email: manjuvet330@gmail.com

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good health of zoo birds and will help in the development of better management process.

MATERIALS AND METHODS

Study area

The study was conducted during 2015-2016 at BBP. The bird collections are composed of several species housed separately in cages or aviaries depending on their size. Some birds are housed in uncemented enclosures, while some in cemented enclosures. Most of the species are free ranging during the day and housed at night. The 65,127.5 acre (260.51 km^2) national park is located about 22 km south of Bengaluru in the hills of the Anekal range with an elevation of 1245-1634m. The park's rainfall is 700mm per year. Bannerghatta is at a height of about 920 m above sea level with a latitudinal position of 12°48′033″ N 77°34′ 32″ E.

Study birds

A total of 106 fecal specimens from avian species within 6 orders were examined. The orders and scientific names of sampled birds are listed in Table 1. Closely related species of Anseriformes, Ciconiiformes and Pelecaniformes were housed together in open pond areas, according to their zoological order. Peafowls were free-roaming, while all the remaining birds were housed separately in aviaries according to the species. At the time of sampling, the large majority of birds did not show any clinical signs.

Sample collection

The birds sampled in this study belonged to 6 different orders: Casuariiformes (n = 7), Anseriformes (n = 3), Galliformes (n = 33), Pelecaniformes (n = 25), Psittaciformes (n = 34), Ciconiiformes (n = 4). A total of 106 fecal samples from apparently healthy birds belonging to the 6 above biological orders *e.g.* Casuariiformes {Emu (*Dromaius novaehollandiae*) (n = 7)}, Anseriformes {Duck (*Anas platyrhynchos*) (n = 3)}, Galliformes {Peafowl (*Pavo cristatus*) (n = 12), Red jungle fowl (*Gallus gallus*) (n = 8), Silver pheasant (*Lophura nycthemera*) (n = 13)}, Pelecaniformes {Grey pelican (*Pelecanus philippensis*) (n = 24), Purple heron (*Ardea purpurea*), (n = 1)}, Psittaciformes {Macaw (*Ara ararauna*) (n = 8), Parakeet (*Psittacula eupatria*) (n = 26)}, Ciconiiformes {Indian open-billed stork (*Anastomus oscitans*) (n = 4)}, with different ages of either sex were collected over a period between 2015 and 2016 (Table 1). Freshly voided fecal samples from birds under captive environment reared in the confined areas in different cages/

Table 1: Prevalence and diversity of gastrointestinal parasitic eggs/oocysts detected in captive avians at BBP.

Avian species sampled	Biological order	Number of fecal samples examined	Number and % positive	Eggs/oocysts of parasites identified
Emu (*Dromaius novaehollandiae*)	Casuariiformes	7	2 (28.57%)	Eimeria oocyst
Duck (*Anas platyrhynchos*)	Anseriformes	3	3 (100%)	Eimeria oocyst
Peafowl (*Pavo cristatus*)	Galliformes	12	7 (58.33%)	*Capillaria* sp.
			3 (25%)	Eimeria oocyst
			2 (16.66%)	*Ascardia galli*
			2 (16.66%)	*Raillietina echinobothrida*
			1 (8.33%)	Tetrameres sp.
Red jungle fowl (*Gallus gallus*)	Galliformes	8	3 (37.5%)	*Ascardia galli*
			1 (12.5%)	Eimeria oocyst
Silver pheasant (*Lophura nycthemera*)	Galliformes	13	3 (23.07%)	*Raillietina* sp.
			2 (15.38%)	Eimeria oocyst
Grey pelican (*Pelecanus philippensis*)	Pelecaniformes	24	5 (20.83%)	*Ascardia galli*
Purple heron (*Ardea purpurea*)	Pelecaniformes	1	1 (100%)	*Fasciola* sp.
Macaw (*Ara ararauna*)	Psittaciformes	8	2 (25%)	*Ascaris* sp.
Parakeet (*Psittacula eupatria*)	Pscittaciformes	26	12 (46.15%)	*Ascaris* sp.
			3 (11.53%)	Eimeria oocyst
Indian open-billed stork (*Anastomus oscitans*)	Ciconiiformes	4	4 (100%)	*Tetrameres* sp.

enclosures were collected in labeled containers with the help of the care-takers early in the morning. In cases of small and medium sized zoo birds, multiple fecal droppings were pooled from all birds of the same species to collect an adequate amount of feces (at least 2 grams) for parasitological examination, while for large birds like emu, individual droppings were collected. Samples collected in labeled, leak-proof and clean plastic vials, which were clearly marked with the time, date of collection and species or sub-species of the bird and transported to the Wild Animal Disease Diagnostic Laboratory immediately.

Parasitological examination

Immediately upon receipt, each sample was examined macroscopically for consistency, presence of blood, mucus and cestode proglottids and microscopically for eggs/ oocysts using standard methods by direct smear examination, standard sedimentation and floatation techniques (Soulsby, 1982). A part of each sample was also mixed with 2.5% Potassium dichromate ($K_2Cr_2O_7$) solution in petridish and kept at room temperature for sporulation of coccidian oocysts. Then, the parasitic eggs/ ova were identified using a light microscope at 10X, 40X and 100X magnifications and photomicrographed. Identification of parasitic ova and oocyst was done using the keys by Soulsby (1982) and Sloss *et al.* (1994).

RESULTS AND DISCUSSION

The present study could determine the prevalence of gastrointestinal parasites of birds of five different orders. A total of seven species of parasites including one protozoan (coccidian of *Eimeria* sp.), four nematodes (*Capillaria* sp., *Ascardia galli, Tetrameres* sp., *Ascaris* sp.), one cestode (*Raillietina echinobothrida*), one trematode egg were recorded. Coccidian of *Eimeria* sp. and nematodes *Ascardia galli* and *Ascaris* sp. were more prevalent. The diversity of gastrointestinal parasites was higher in order Galliformes comprising of Eimeria oocyst, *Ascardia galli*, *Capillaria* sp., *Raillietina* sp., *Raillietina echinobothrida*, *Tetrameres* sp. as compared to birds in other biological orders. The occurrence of parasites showed some variability like monoparasitoses with one parasite infection was observed in birds within order Casuariiformes and Anseriformes, while polyparasitoses with more diverse range of parasite infections (*Capillaria* sp., Eimeria oocyst, *Ascardia galli, Raillietina* sp., *Raillietina echinobothrida, Tetrameres* sp.) was observed in birds within the order Galliformes. Trematode ova and nematode *Ascardia galli* infection was seen in order Pelecaniformes, while *Ascaris* sp. and Eimeria oocyst were encountered in the order Pscittaciformes.

With reference to individual parasite, the screening result could detect ova of 2 (28.57%) *Eimeria* oocyst in emu (Fig 1), 3 (100%) *Eimeria* oocyst in duck, 7 (58.33%) *Capillaria* sp. (Fig 2), 3 (25%) *Eimeria* oocyst, 2 (16.66%) *Ascardia galli*, 2 (16.66%) *Raillietina echinobothrida*, 1 (8.33%) *Tetrameres* sp. in peafowls (Fig 3), 3 (37.5%) *Ascardia galli,* 1 (12.5%) *Eimeria* oocyst in red jungle fowls, 5 (20.83%) *Ascardia galli* in grey pelican (Fig 4), 1 (100%) trematode ova of *Fasciola* sp. in purple heron (Fig 5), 3 (23.07%) *Raillietina* sp., 2 (15.38%) *Eimeria* ocyst in silver pheasant, 2 (25%) *Ascaris* sp. in macaw, 12 (46.15%) *Ascaris* sp., 3 (11.53%) *Eimeria* oocyst in parakeet and 4 (100%) *Tetrameres* sp. in Indian open-billed storks (Fig 3). Notably, not much literature is available on report of *Tetrameres* sp. in Indian open-billed stork.

However, in this survey, none of the positive subjects presented frank clinical signs, probably as a result of low parasite burden. *Ascaridia galli* is an intestinal roundworm common in both domestic chickens and jungle fowl. In small number, asarids are usually not pathogenic causing only occasional unthriftiness. However, they can produce overt clinical disease if their number is sufficiently high to induce

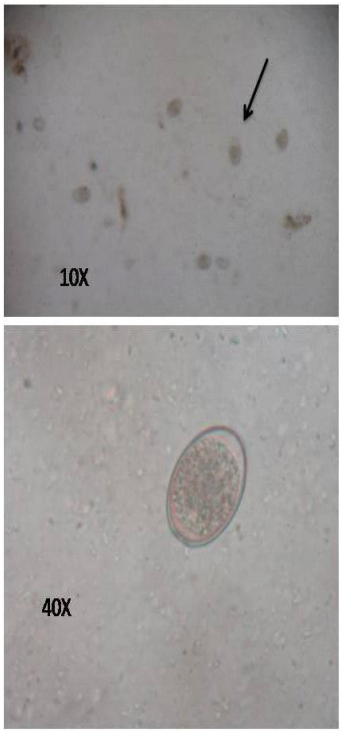

Fig 1: Eimeria oocyst fecal smear of Emu (10X and 40X).

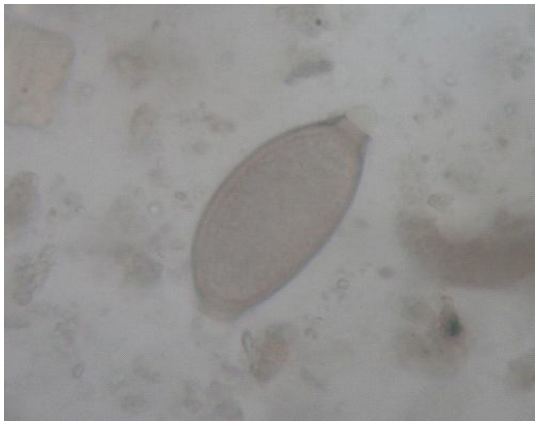

Fig 2: Capillaria eggs in fecal smear of peafowl (40X).

anaemia, severe inflammatory response and starvation. Intestinal coccidia in birds include species of the genera Eimeria, Isospora, Tyzzeria and Wenyonella. Previous studies have shown that Eimeria and Isospora infections can occur in Passeriformes, Psittaciformes, Struthioniformes and Anseriformes (Ibrahim *et al*., 2006; Yabsley, 2009). Unidentified coccidia have been reported in Casuariiformes (Yabsley, 2009). The genus Eimeria was the most likely cause of coccidian infection of captive avians in the present survey.

Only a few coprological surveys were carried out in a wide range of avian species in zoo settings (Patel *et al.,* 2000; Parsani *et al.,* 2003; Gurler *et al.,* 2010; Papini *et al.,* 2012). Previous studies showed that 48.1-71.4% of zoo birds in India (Patel *et al.,* 2000; Parsani *et al.,* 2001) were infected with gastrointestinal parasites. Kathiravan *et al.* (2017) reported the prevalence of endoparasitic infection in free ranging peacocks of southern Tamil Nadu and showed that *Eimeria* sp. was the most common (43%) particularly *E. mayurai* and *E. pavonis*. The other detected worm species and their respective frequencies were *Hymenolepis* sp. (4.16%), *Ascardia* sp. (6.9%), *Strongyloides* sp. (4.16%) and strongyles (2.77%). Based on morphology, Hauck and Hafez (2012) described coccidian *Eimeria pavonina* in peafowl in Germany further sequencing parts of the 18s rRNA gene and the cytochrome oxidase subunit 1 (cox-1) gene. Fiaz Qamar *et al.* (2013) reported prevalence of coccidiosis by *Eimeria* sp. in peacock at Lahore, Pakistan. Titilincu *et al.* (2009) reported *Ascaridia* sp., *Heterakis* sp., *Syngamus trachea*, *Capillaria* sp. in peacocks. Sahoo *et al.* (2009) assessed the prevalence of gastrointestinal parasites (*Ascaridia, Capillaria,* Strongyle and *Strongyloides* species) of captive birds of Nandankanan zoo, Odisha.

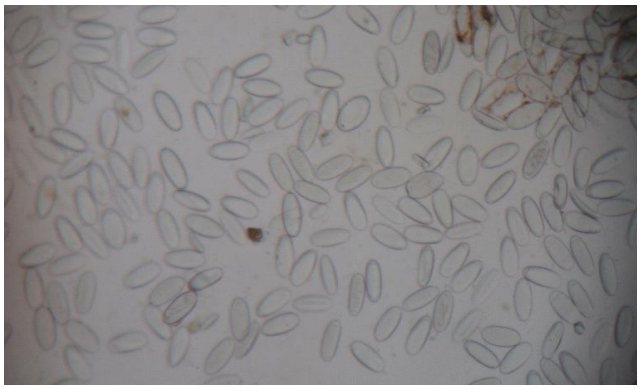

Fig 3: Tetrameres ova in peafowl and Indian open-billed stork (10X).

The most frequently encountered gastrointestinal parasite, *Capillaria* species are small roundworms of small intestine and infection is usually asymptomatic, but birds with heavy parasite load may show clinical signs of anorexia, diarrhoea, emaciation, reduced water intake, ruffled feathers and weakness (Yabsley, 2009). However, none of the infected birds with *Capillaria* sp. in this study showed clinical signs. Reports on helminths in herons are numerous (Sitko, 2012; Santoro *et al.,* 2016). Various authors have examined small numbers of pelicans and reported 17 species of helminths. Courtney and Forrester (1974) reported infection with 31 species of helminths including 14 trematodes, 4 cestodes, 11 nematodes and 2 acanthocephalans in 113 brown pelicans from Florida and Louisiana. Overstreet and Curran (2005) reported parasites of the American white pelican. Jaiswal *et al.* (2013) reported endoparasitic infections in Indian peacocks of Veterinary College Campus, Mathura and found eggs and oocysts of cestodes and coccidia belonging to *Eimeria* and *Isospora* species. Pradeep *et al.* (2017) reported incidence of endoparasites in captive pheasants in Arignar Anna Zoological Park, Chennai and revealed the presence of *Ascaridia*, *Capillaria* sp., *Strongyloides* sp., Strongyle, oocyst of *Eimeria* sp. An incidence of 88.33% helminthic parasitic infections was reported by Kashid *et al.* (2003) in peacocks in Maharashtra. Fecal screening for endoparasites among free-ranging peafowl at Tirunelveli and Kanyakumari in Tamil Nadu (Subramanian *et al.,* 2003) revealed the infection with a wide range of nematodes (*Heterakis, Ascaridia, Capillaria, Syngamus* and *Strongyloides* species), an acanthocephalan and an unidentified cestode egg.

Nemejc and Lukesova (2012) reviewed the parasite fauna of ostriches, emus and rheas. *Eimeria* sp. (protozoan), *Houttuynia struthionis* (cestode) and wireworm (stomach worm) *Libyostrongylus douglassii* (nematode) belong to parasites causing the most serious economic losses in

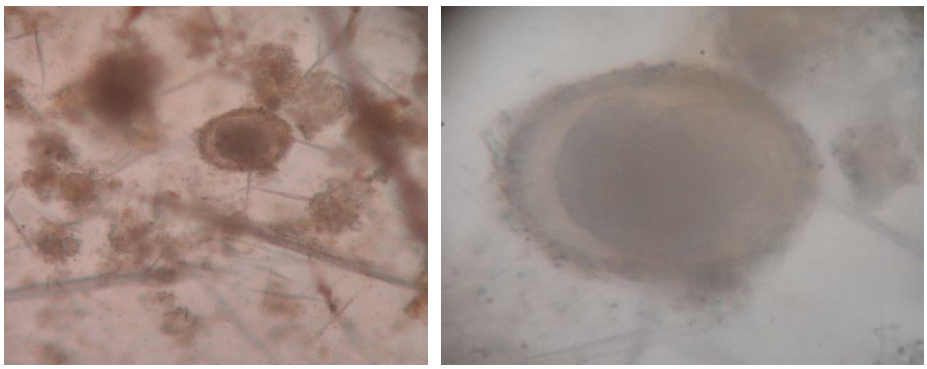

Fig 4: *Ascardia galli* fecal smear of Pelican (10X and 40X).

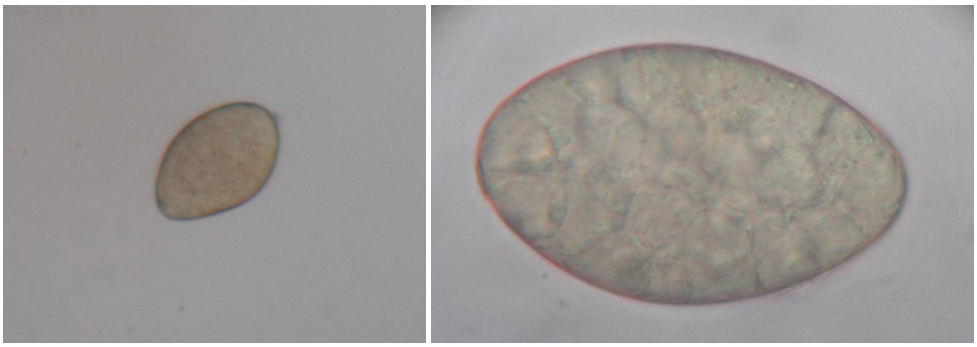

Fig 5: Fasciola eggs in fecal smear of purple heron (10X and 40X).

ratites in the world. Coccidiosis is common in emu chicks (Jurajda, 2002). In our study, we could observe trematode eggs of *Fasciola* sp. in purple heron. Patel *et al.* (2000) studied the prevalence of gastrointestinal parasites in captive birds of Gujarat zoos *e.g.* Kamala Nehru Zoo, Ahmedabad and Sayyajibaug Zoo, Vadodara. They reported eggs of *Ascaris* sp., *Capillaria* sp., oocysts of *Eimeria* sp. *Ascaridia galli* worms were also recovered during postmortem of hariyal pigeon, parrot, peacock and cockatiel. Oocysts of *Eimeria* sp. were found in most birds either as pure infection or as mixed infection with other hemlinths.

From an epidemiological standpoint, helminthic (*e.g.*, *Ascaridia* sp.) and protozoan (*e.g.*, coccidians) infections pose a serious threat to the health of exotic birds, especially when they present high parasitic loads and visible clinical signs. Thus, the monitoring, diagnosis and treatment of parasitic infections should be a routine component of the health care of zoo birds. Identification of parasites and establishment of their prevalence may be of paramount importance in zoo birds. Future studies over a considerable period of time are needed in order to determine the extent to which the infections might influence the performance of the birds.

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