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Endoparasite in wild birds of Kota: A comprehensive study on helminths

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Abstract
India is home to a rich variety of plant and animal life, featuring three major biodiversity hotspots: The Western Ghats, Himalaya, and Indo-Burma. Within 104 national parks and 566 wildlife sanctuaries, covering nearly 160,000 square kilometers, various vulnerable species like the Royal Bengal Tiger, one-horned rhino, and elephant find sanctuary. Between June 2021 and September 2021, the study involved the collection of fecal samples from the forests near Kota City in Rajasthan. These selected sites represent the longstanding or permanent habitats of birds, hosting significant bird populations throughout the various seasons each year. These locations are referred as Location R, S, T, U, V, and W. In the current study, 200 faecal samples were collected from wild birds from three different forest sites. This technique was applied to positive samples using either the Direct method (Soulsby, 1982) or the Centrifugal sedimentation technique (Soulsby, 1982), as well as the Floatation technique (Soulsby, 1982), and McMaster's egg counting technique (Soulsby, 1982). The Prevalence of *Ascaridia* sp., *Capillaria* sp., *Heterakis* sp., *Raillietina* sp., and *Hymenolepis* Sp. was found 5%, 5.5%, 2.5%, 1%, and 1% respectively, The Study reveal highest occurrence of *Capillaria* sp. and least occurrence of *Raillietina* sp. and *Hymenolepis* sp. A total of 10 birds were submitted to a postmortem examination. 2 (20%) of the birds tested positive for *Capillaria sp* and *Heterekis sp.* gastrointestinal parasites. The lowest egg count of 100 EPG was found in a faeces sample of a Lapwing and Indian peafowl from Location R and W, while the maximum value of 800 EPG was found in a Laughing Dove.

Keywords: Helminths, wild birds, endoparasite

Introduction
Birds are an important part of almost every ecosystem, and it's no wonder they're frequently found in homes and zoos around the world. Birds can be infected by a variety of internal parasites, including nematodes, flukes, tapeworms, acanthocephalans and protozoa Altman (1997) [1]; Olsen *et al*. (2000) [13]. Parasites can cause serious problems and even death in newly caught birds that have been kept in cages for long periods of time due to the increased risk and stress caused by injury, disease or adapting to a new environment Krone (2002) [12]. The study and identification of helminths is based on the study of fecal parasitology which identifies eggs and other parasites extracted from the feces of birds (Snak *et al*., 2014) [17].
Parasite eggs vary in size, shell thickness, shape, and other morphological characteristics that can help identify them and their birds (Carneiro *et al.*, 2011; Cubas *et al*., 2014) [6, 8]. The impact of helminth infections on the care and protection of captive birds and the survival of wildlife and their ecosystems highlights the importance of understanding parasitic diseases of wild birds (Cubas *et al*., 2014) [8]. Rajasthan, in particular, houses a rich avifauna, boasting around 450 different bird species. Some of Indian`s most endangered species, such as the Lesser Florican, Great Indian Bustard, Stoliczka's Bushchat, Lesser Adjutant Stork, and Vultures, face significant threats. Additionally, Rajasthan is home to a variety of common bird species like parrots, doves, mynas, sparrows, crows, koels, partridges, pigeons, babblers, tailor birds, peacocks, green bee-eaters, red-vented bulbuls, sunbirds, kites, hoopoes, drongos, and more. Birds housed in zoological parks experience continuous stress and are susceptible to parasitic illnesses. Infections, especially helminthic infections, can pose a severe threat, sometimes leading to fatalities among birds. Zoonoses pose a threat to human health, and wild animals play a crucial role in transmitting parasitic zoonotic diseases. The epidemiology of these diseases, where wild animals act as reservoirs, is influenced by various human activities

and ecological factors (Thompson *et al*., 2009; Carmena and Cardona, 2014) [18, 3]. Factors such as human population growth, migration, deforestation, and the loss of wildlife habitats contribute to the spread of zoonotic illnesses. Zoonotic protozoa linked to wildlife encompass *Giardia* sp., *Cryptosporidium* sp., *Toxoplasma* sp., *Leishmania* sp., *Trypanosoma* sp., *Plasmodium* sp., *Sarcocystis* sp., *Echinococcus* sp., *Opisthorchis* sp., *Trichinella* sp., and *Toxocara* (Chhabra and Muraleedharan, 2016) [4]. This study aims to identify helminth eggs in fecal samples of wild birds Kota Region to demonstrate their presence and the importance of conservation of the species.

Materials and Methods

Between June 2021 and September 2021, the study involved the collection of fecal samples from the forests near Kota City in Rajasthan. The research was conducted in the Kota district of the Rajasthan State, focusing on six distinct sites situated around Kota city. These selected sites represent the longstanding or permanent habitats of birds, hosting significant bird populations throughout the various seasons each year. These locations are referred as Location R, S, T, U, V, and W. Location R is the old habitat of Indian Peafowl it is surrounding of Instrumentation limited (IL) township, from this site of peafowl and Red vented bulbul. Location S is forest near the Karni Mata temple and Abheda Mahal from this site samples of Black kite. Location T is the most famous for Vultures sitting. Location U is the Chatra vilas Garden, Kshaar bag and gopal Niwas Baag from these location samples of Rose ringed parakeet were collected. Location V is the area around Kota barrage this site is feeding home for the laughing dove, Rock Dove, house sparrow and Indian crow. The last location is Location W surrounding of university of kota, site for Red-wattled lapwing species. In the current study, 200 faecal samples were collected from wild birds from three different forest sites, For the coprological examination, samples were collected directly in polybags and preserved in a collection vial containing 10% formalin. Postmortem samples were collected following the guidelines outlined in the Wildlife Protection Act, utilizing specific equipment. The microscopic analysis of fecal samples for the identification of parasitic eggs/ova involved employing the McMaster's egg counting technique. This technique was applied to positive samples using either the Direct method (Soulsby, 1982) [19] or the Centrifugal sedimentation technique (Soulsby, 1982) [19], as well as the Floatation technique (Soulsby, 1982) [19], and McMaster's egg counting technique (Soulsby, 1982) [19].

Results and Discussion

Different types of gastrointestinal parasites prevalent in different locations

Table 1: Different types of gastrointestinal parasites prevalent in different locations

Parasite Eggs	Location R (N=40)	Location S (N=20)	Location T (N=20)	Location U (N=20)	Location V (N=80)	Location W (N=20)	Total (N=200)
Ascaridia Sp.	2 (5%)	-	1 (5%)	2 (10%)	4 (5%)	1 (5%)	10 (5%)
Capillaria Sp.	4 (10%)	1 (5%)	-	-	4 (5%)	2 (10%)	11 (5.5%)
Heterekis Sp.	-	1 (5%)	-	1 (5%)	1 (1.25%)	2 (10%)	5 (2.5%)
Raillietina Sp	-	-	-	-	2 (2.5%)	-	2 (1%)
Hymenolepis Sp.	-	-	-	-	2 (2.5%)	-	2 (1%)

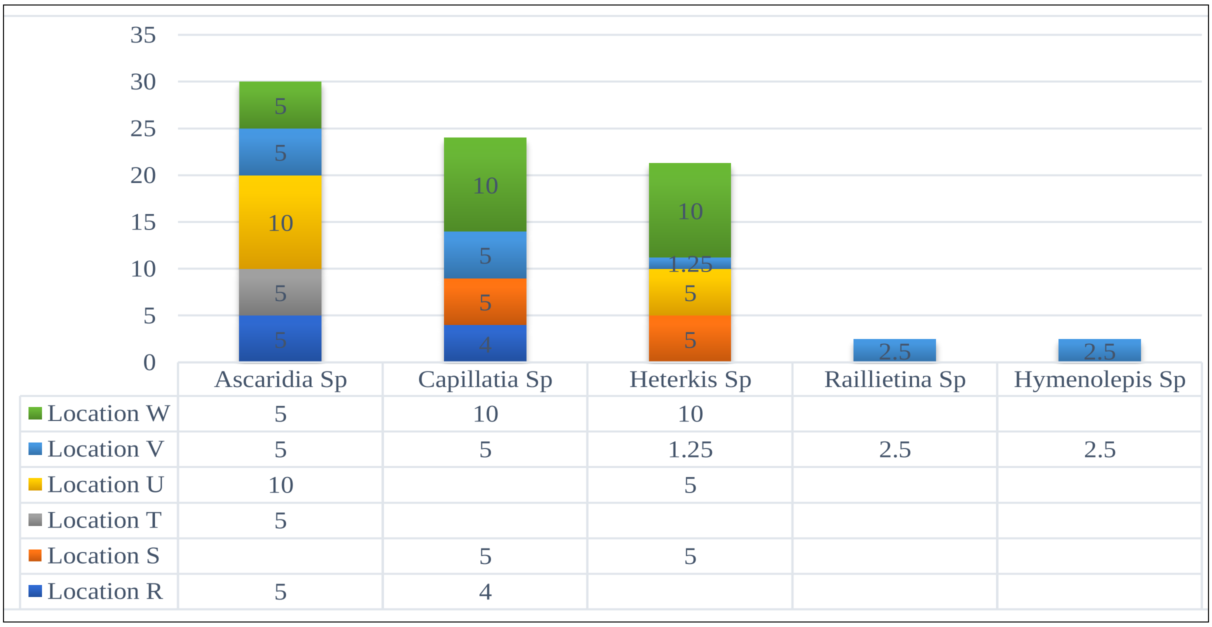

Fig 1: Different types of gastrointestinal parasites prevalent in different locations

Table: 1 and Fig. 1 show the various type of parasitic eggs found in wild birds at various study sites. The Prevalence of *Ascaridia* sp., *Capillaria* sp., *Heterakis* sp., *Raillietina* sp., and *Hymenolepis* Sp. was found 5%, 5.5%, 2.5%, 1%, and 1% respectively, The Study reveal highest occurrence of *Capillaria* sp. and least occurrence of *Raillietina* sp. and *Hymenolepis* sp. According to Mehmood *et al.* (2019) [5], *Raillietina* sp. (25 percent; 15/60), *Ascaridia* sp. (5 percent; 3/60), and the hairworm *Capillaria* sp. (6.67 percent; 4/60) were found in 22 (36.67 percent) of the 60 pigeons' gastrointestinal tracts (GIT). Coccidian parasites (58.3%; 35/60), cryptosporidian parasites (50%; 5/10), and *Trichomonas gallinae* (40%) (12/30). Prathipa (2015) [15] discovered in 12% of the samples, Cestode *Hymenolepis sp.*

eggs were detected, *Capillaria sp*. eggs were found in 19% of the samples, and mixed infection of these was identified in 17% of the samples. Carrera *et al*. (2018) [7]. A total of 348 fecal samples from 32 bird species were analyzed using the Min FLOTAC flotation method. Disease was detected in 31% (45/145) of captive bird samples and 65.5% (133/203) of free bird samples. Organisms of the captive population include parasites (Heterophora and other morphotypes), capillaries, apicoids, strongholds, parasites, and protozoans (Eimeria, Isospora, *Nucleospora*, and *Nea Miba* spp.). Parasites of white birds include roundworms (*Ascaris* spp., *Porrocaecum* spp. and other morphotypes), pinworms, apexes and strongworms (*Syngamus* spp.). And other morphotypes), tapeworms (*Choa notaenia* spp., Hymenolepis spp. and other morphotypes), Ilić *et al*. (2018) [10]. The presence of endoparasites was established in 51.96% (Belgrade), 46.16% (Palić) and 16.66% (Bor) of the tested birds. We diagnosed coccidian oocysts, eggs of *Capillaria* spp, *Heterakis* spp, *Trichostrongylus* spp, *Ascaridia* spp, Syngamus trachea and eggs of yet unidentified trematode Papini (2012) [14]. By microscopy, nematode eggs were detected in 26.7% (19.5-33.9%) of the birds, with 32.5% (22.4–42.6%) in zoo birds and 19% (9.3-28.7%) in pet birds. The occurrence of parasites showed some variability between the two avian groups, since *Ascaridia* and *Syngamus* were identified only in pet birds while *Porrocaecum* only in zoo birds. Unsporulated coccidia oocysts were found in 4.1% (0.9-7.3%) of the samples, showing prevalences of 6.3% (0.3-12.4%) and 2.4% (0-5.7%) in samples from pet and zoo birds, respectively. *Monoparasitoses* (i.e., strongylosis, ascaridiosis, or coccidiosis) were present in 19.2% (12.8–25.6%) of the animals, including 23.8% (13.3–34.3%) of pet birds and 15.7% (7.8–23.5%) of zoo birds.

Gastrointestinal parasites recovered during postmortem examination

Table 2: Gastrointestinal parasites recovered during postmortem examination

Birds Sp	No. of Positive	Types of parasites
Spotted Dove (N = 2)	1	*Capillaria sp*
Rock Pig eon (N = 3)	0	-
Cattle Egret (N = 1)	0	-
Crow (N = 4)	1	*Heterekis sp.*

Post-mortem examinations were performed in Wild birds, A total of 10 birds were submitted to a postmortem examination. 2 (20%) of the birds tested positive for *Capillaria sp* and *Heterekis sp.* gastrointestinal parasites. Table: 2 shows the parasites in dead birds. No parasites were found in the gastrointestinal tracts of one cattle egret, three rock pigeons, three crows, and one spotted dove.

Faecal eggs per gram of various species of wild birds in different locations

Table 3: Faecal eggs per gram of various species of wild birds in different locations

Location	Species	EPG
Location R	Indian Peafowl	100
	Red Vented Bulbul	300
Location S	Kite	400
Location T	Vulture	300
Location U	Rose Ringed parakeet	400
Location V	Laughing Dove	800
	Rock pigeon	600
	Sparrow	200
	Crow	300
Location W	Lapwing	100

Table 3 shows the egg counts of positive faeces samples obtained in several species of wild birds, egg counts varied from 100 to 800EPG. The lowest egg count of 100 EPG was found in a faeces sample of a Lapwing and Indian peafowl from Location R and W, while the maximum value of 800 EPG was found in a Laughing Dove. Egg counts At Location R varied from 100 to 300 EPG, with Indian Peafowl having the lowest egg count of 100 EPG and Red vented bulbul having the highest egg count of 300 EPG. At Location S the egg counts 400 EPG in kites. At Location T egg counts 300 EPG in the vultures. At Location U in Rose ringed parakeet, the egg counts 400 EPG. At Location V egg counts ranged from 200 to 800 EPG with lowest egg count of 200 EPG in Sparrow and the higher egg count of 800 EPG in Laughing Dove and At Location W, egg counts 100 EPG in Lapwing. Daş *et al*. (2011) [9]. The precision of analyses remarkably heightened up to a breakpoint with an EPG count of ≤ 617. Scullion (2013) The regression line on a test-retest series of samples over a range of egg counts from 0 to 573 epg had a gradient of 0.96 (y=0.96x+6.28; r (2)=0.8408) for the new technique and 0.54 (y=0.54x+0.06; r(2)=0.4249) for the modified Wisconsin technique.

Conclusion
A total of five species of gastrointestinal parasites (eggs) were identified in wild birds, of them four species were nematode, namely *Ascaridia Sp.* (5%), *Capillaria* Sp. (5.5%) *Heterekis Sp.* (2.5%) and two species was cestode namely *Raillietina Sp.* (1%) and *Hymenolepis* Sp. (1%). The parasite load was determined by counting the eggs in the positive faecal samples. Wild birds, egg counts varied from 100 to 800 EPG. The faecal sample from Location W and R had a lower egg count of 100 EPG, but the Laughing Dove from Location V had a higher count of 800 EPG.

Future Scope
A comprehensive study on gastrointestinal parasites in wildlife not only contributes to our understanding of the current state of wildlife health but also holds promise for shaping future conservation strategies, advancing veterinary medicine, and safeguarding both animal and human populations.

Conflict of interest
The authors declare that there is no conflict of interest among them. This means that there are no financial, personal, or professional relationships or circumstances that could

potentially influence or bias their contributions to this work. The research and its findings are presented impartially and without any competing interests that might impact the objectivity of the study.

Author contribution

Akash Bairwa- collection of data, contributed data and analysis tools, perform analysis, wrote the paper.
Akhilesh Pandey-Conceived and designed the analysis, contributed data and analysis tools, perform analysis.

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