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A Preliminary Survey of Gastrointestinal Parasites of Animals in Federal University of Agriculture Abeokuta Zoological Park, Ogun State, Nigeria

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Abstract
Parasitic infections including gastrointestinal helminths are major cause of wildlife health complications and death. A cross-sectional study was conducted in the newly established Federal University of Agriculture, Abeokuta Zoological garden to examine occurrence of gastrointestinal parasitic infection among the captive animals in the park. Faecal samples were collected weekly from cages of 18 animals between April and July, 2014. The faecal samples were processed using Sodium acetate-Acetic acid-Formalin ether concentration method and examined for intestinal parasites ova or cysts under the microscope. Types of intestinal parasites found were recorded and the weekly egg count recorded and analysed to compute intensity of infection. Descriptive statistics was used to analyse important variables. Seven species of gastrointestinal parasites that include hookworm, *Trichuris spp*, *Ascaris spp, Enterobius spp*, *Trichostrongylus spp*, *Entamoeba spp,* and *Strongyloides spp* were identified from microscopic examination. Of the examined animals, 55.6% were infected with at least a parasite with hookworm the most prevalent with 22.2% of the animals infected. The Non-human primates were the most infected among the animals surveyed in which *Cercopithecus mona* (Mona monkey) carried the highest infection. Routine screening and deworming of captive animals should be incorporated into animal health management practices in this zoological garden.
Keywords: zoological garden, gastrointestinal parasites, non-human primates

Introduction:
Zoological garden is an ex-situ form of conservation where animals are kept in cages or enclosures for exhibition. Zoological gardens exhibit wild animals for aesthetic, educational or research and conservation purposes [1]. This act of keeping wildlife close to humans in captivity has gained approval and patronage of the populace over years.

Study of captive animal diseases is of continued veterinary importance and gastrointestinal helminths have been implicated in the cause of important diseases of animals and humans [2]. Gastrointestinal helminth and other parasitic infections are the major cause of wildlife health complications and death [3].

Despite the enormous evidence on the prevalence and epidemiology of gastrointestinal parasites among humans [4-7], little attention have been placed on the gastrointestinal parasites of wild animals, most especially the captive ones. However, recent evidences have revealed that gastrointestinal parasites of wild animals in captivity are similar to that of humans [3, 8-11]. The prevalence of these parasitic infections among captive animals and animals in the wild have also been reported to be similar to that of human [12-16].

The Federal University of Agriculture Abeokuta Zoological garden is newly established and with various evidences of gastrointestinal parasitic infection among different species of animals reported outside Nigeria [12, 14, 17-22] and establishment of infection with intestinal parasites among avian species in Nigeria [3], there is the need for a preliminary study to investigate occurrence and present a profile of gastrointestinal parasite of captive animals in the zoological garden. This will provide valuable information to the zoological garden management that will enhance the development of disease control and surveillance programs aimed at improving the health of the zoo animals.

Materials and Methods:
Study area: The study was carried out at Federal University of Agriculture, Abeokuta zoological garden located between (7.22191^0N, 3.44437^0E), Odeda Local Government, Ogun state, South-West, Nigeria (Figure 1). This zoological garden was established in 2008 but commenced full operation in 2010 and it is the only Zoological garden in Ogun state. The study was carried out between April and July 2014
Ethical considerations: The study was approved by the Ethics committee of the Federal University of Agriculture, Abeokuta, Ogun State. Animals were handled according to standard practices.
Study Animals: The study involved 3 classes (mammals, aves and reptiles) and 18 different species of animals available in the zoological garden. The animals include: Senegal parrot, Ostrich, Grey parrot, Gazelle, Jackal,

Monitor lizard, White geese, Tortoise, Parakeet, Crowned crane, Baboon, Patas monkey, Vervet monkey, Mona monkey, Mallard duck, Spotted hyena Porcupine and Speckled pigeon.

Sample collection: Freshly voided early morning faecal samples of the animals were collected with the assistance of the zoo keepers before routine cleaning of cages in the zoo. Sample bottles were labeled with the name of the animal in cages were it was taken. Samples collected were then immediately preserved with Sodium-acetate acetic acid formalin solution (SAF) before taken to the laboratory for analysis. All samples collected were analysed within 48 hours of collection.

Sample examination: Faecal samples were processed using Sodium acetate-Acetic acid-Formalin ether concentration method as described by Endriss *et al.* (2005) and examined for the presence of parasites ova or cyst under the microscope [9].

Data analysis: Laboratory data was analysed using Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive statistics that include frequency and means were used for the analysis.

Results:

Of the total 18 species of captive animals surveyed in this study, 8(44.4%) were mammals, 8(44.4%) aves and 2(11.1%) were reptiles. Table 1 shows the classification of the surveyed animals.

A total of 10(55.6%) of the different types of animals present in the zoo were positive for gastrointestinal parasitic infections. Seven different parasites were observed among the examined animals (Figure 2). Hookworm is the most prevalent helminth infection observed infecting 4 (22.2%) of the surveyed animal species. *Trichuris spp.* was observed in 3(16.7%) of the captive animals studied. Table 2 shows the prevalence of gastrointestinal infection observed in the studied animals.

Highest prevalence of gastrointestinal helminth infection was observed among the mammals of which the non-human primates (NHP) are the major culprit habouring hookworms, *Trichuris spp* and *Strongyloides spp.* (Table 3).

Highest mean intensity of hookworm infection as found in repeated samples collected over 9 weeks was found in the Mona monkey with an average intensity of 253epg (Table 4). This was followed by baboon (113 epg) and the least intensity of hookworm infection was found in the vervet monkey with an average less than 50epg. Patas monkey was the most infected with *T. trichiura* followed by Mona monkey (table 4). A very low intensity of *Trichostongylus* spp was found in the hyena.

Moderate intensity of *Ascaris spp* infection was found in the ostrich. The African grey parrot was the most infected with *Entamoeba* spp followed by the rose ringed parakeet.

Discussion:

Helminthiasis, most especially infection with soil transmitted helminthes (STH), which ova accumulate in the environment, particularly in open soil enclosures, which cannot be easily disinfected constitute a major and big problem to wild animals in captivity[24] (Elena, 2011). This could explain the relatively high prevalence of 55.6% of infection observed in the present study, most of which are STH infections. The survival of these helminthes in the soil is also enhanced by favourable climatic factors. Other parasites require an intermediate host and are less likely to accumulate in a captive environment, because their intermediate host might not occur in the enclosure [25]. Protozoan infection observed in this study was only among the avian species which contrast the study of [26] that reported a higher protozoan infection among the NHP than other species of captive animals examined.

The source of acquisition and methods of introduction of animals into newly established zoological gardens is of key importance to the health of the captive animals afterwards [11].

Out of the 18 species of captive animals examined in this study, 10 species were infected with at least one type of intestinal helminths. Intestinal helminths are responsible for most diseases of veterinary importance, because they do not need intermediate host [27].

However, since the site and period of infection cannot be ascertained, as majority of the animals were sourced from other zoological gardens, markets and hunters, infection could have been introduced into the zoological garden from point of purchase or source. Infection observed in these animals however put the handlers and zoo keeper as great risk of contacting zoonotic diseases as the animals can serve as reservoir host for some of these parasites [28].

Also, of all the animal species examined, the NHP were the most infected and this agrees with the findings elsewhere [8]. The likelihood of zookeepers and visitors as a potential risk source of constant reinfection of some of the discovered intestinal helminthes cannot be ignored [8][28]. Since NHP are closer to humans and create the most fascinating environment in a zoological garden, zookeepers and visitors indirectly and unconsciously introduce contaminated foods to these animals in return for their wonderful display when food substances are dropped on the floor or thrown at the animal. These animals can pick such food from the grounds and could have been the reason why infection was higher in this group of animal, compared to others. Furthermore, the foods given to the NHP were always served on the ground which could also be a source of re-

infection even after treatment.

Parasitic infections in other studied animal species, for instance the Tortoise with *Enterobius spp* and Ostrich with *Ascaris spp* also conforms to the findings of [28] and [10]. Though *Ascaris spp* were the most predominant nematode of birds, findings of [3] reported the presence of other parasites like *Capillaria spp* and *Strongyloides spp* in the Ostrich. The discordance in these findings compared to that of [3] might be due to the differences in the methodology employed in the examination of stool samples and the treatment history of the captive animals, although the methodology employed in this study does not allow identification of parasites to species level.

Generally, the poor environmental hygiene observed in the zoological garden might contribute to the development and transmission of intestinal helminth infections. Also the personal hygiene attitudes and practices of zookeepers responsible for feeding captive animals have been implicated in continued transmission of intestinal helminth infections [8]. Contaminated cooking utensils and infected zookeepers responsible for feeding the animals might contaminate animal feeds. The introduction of foods to animals with contaminated hands and dirty finger nails can also be implicated in the transmission of intestinal helminths.

The presence of gastro intestinal helminth in captive animals can also be explained by husbandry, housing, feeding, and inconsistency in treatment programme or the existence of a favourable climatic condition [29]. Though the treatment programme of captive animals in the studied zoological garden was consistent, re-infection might occur through contaminated environment, feeding habits and hygiene attitude and practices of the zookeepers and visitors.

Gastrointestinal parasitic infection is a burden in this zoological garden. Continuous regular deworming of the animals, quarantine services for newly acquired animals and improved hygiene practices should be incorporated into the zoological garden animal health management practices. Also, policy barring visitors from feeding the animals into the zoo should be enforced so as to prevent visitors from infecting the animals and thus improve the health of the captive animals.

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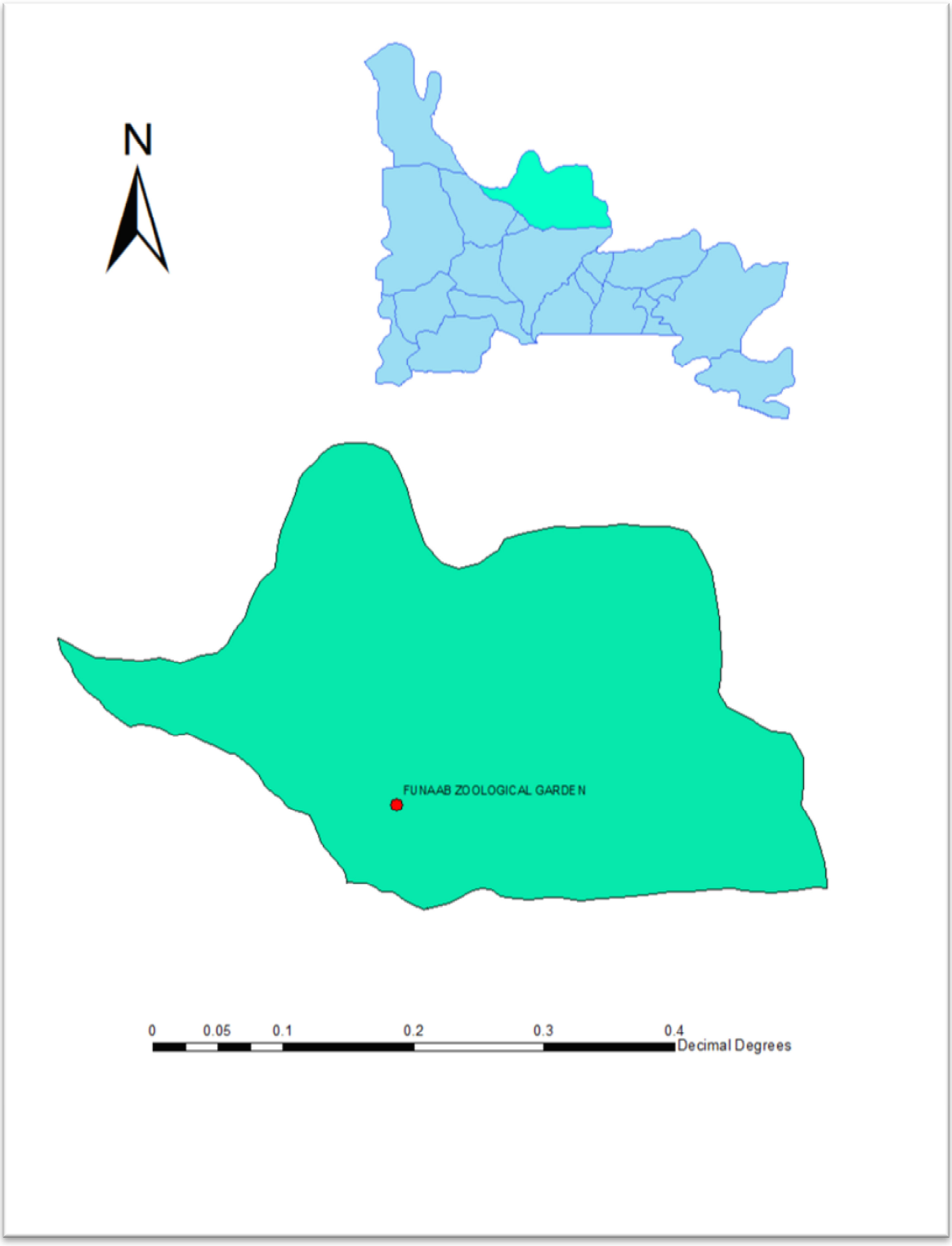

Figure 1: Map of Ogun State showing study location

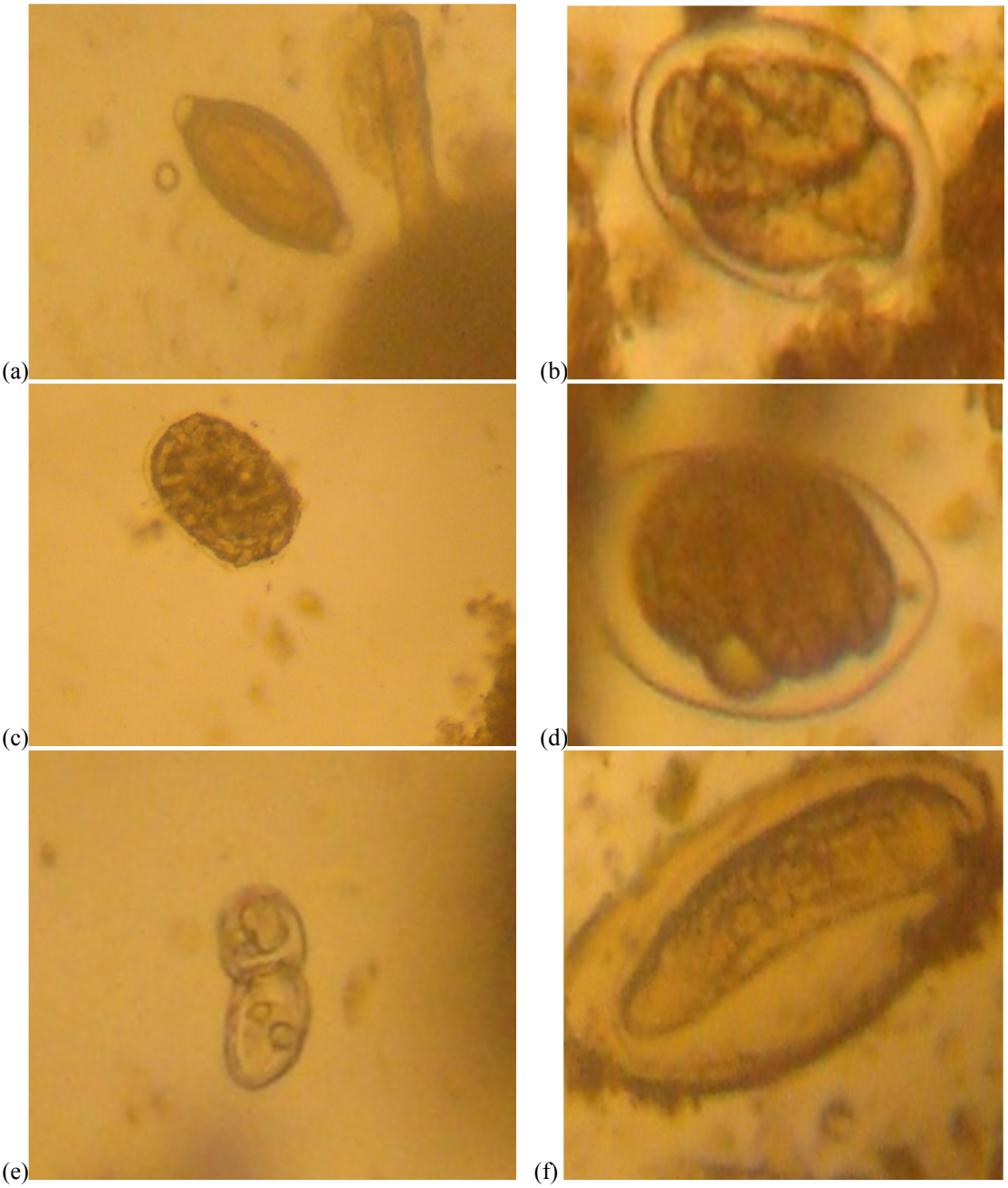

Figure 2 : Ova of parasites observed in faecal samples of examined zoological garden animals. (a) *Trichuris trichiura* (b) Hookworm (c) *Ascaris* spp (d) *Trichostrongylus* spp (e) *Entamoeba* spp (f) *Enterobius* spp

Table 1: Classification of surveyed animals at FUNAAB zoological garden

S/N	Common name	Scientific name	Family	Order	Class	Phylum
1	Senegal parrot	*Poicephalus senegalus*	Psittacidae	Psittaciformes	Aves	Chordata
2	Ostrich	*Struthio camelus*	Struthionidae	Struthioniformes	Aves	Chordata
3	Grey parrot	*Psittacus erithacus*	Psittacidae	Psittaciformes	Aves	Chordata
4	Gazelle	*Eudorcas thomsonii*	Bovidae	Artiodactyla	Mammalia	Chordata
5	Jackal	*Canis aureus*	Canidae	Carnivora	Mammalia	Chordata
6	Monitor lizard	*Veranus indicus*	Varanidae	Squamata	Reptilia	Chordata
7	White geese	*Chen caerulescens*	Anatidae	Anseriformes	Aves	Chordata
8	Tortoise	*Geochelone gigantea*	Testudinidae	Testudines	Reptilia	Chordata
9	Baboon	*Papio Anubis*	Cercopithecidae	Primate	Mammalia	Chordata
10	Mona monkey	*Cercopithecus mona*	Cercopithecidae	Primate	Mammalia	Chordata
11	Vervet monkey	*Chlorocebus aethiops*	Cercopithecidae	Primate	Mammalia	Chordata
12	Patas monkey	*Erythrocebus patas*	Cercopithecidae	Primate	Mammalia	Chordata
13	Mallard duck	*Anas platyrhynchos*	Anatidae	Anseriformes	Aves	Chordata
14	Spotted Hyaena	*Crocuta crocuta*	Hyaenidae	Carnivora	Mammalia	Chordata
15	Crested porcupine	*Hystrix cristata*	Hystricidae	Rodentia	Mammalia	Chordata
16	Speckled pigeon	*Columba guinea*	Columbidae	Columbiformes	Aves	Chordata
17	Rose ringed Parakeet	*Psittacula krameri*	Psittaculidae	Psittaciformes	Aves	Chordata
18	Crowned crane	*Balaerica pavonina*	Gruidae	Gruiformes	Aves	Chordate

Table 2: Table showing prevalence of gastrointestinal parasitic infection in surveyed animals of FUNAAB Zoological garden

Infection	Number of animal species examined	No of animals infected	Percentage of infection (%)
Hookworm	18	4	22.2
Trichuris spp.	18	3	16.7
Ascarsis spp.	18	1	5.6
Enterobius spp	18	1	5.6
Strongyloides spp.	18	1	5.6
Entamoeba spp	18	2	11.1
Trichostrongylus spp.	18	1	5.6

Table 3: Distribution of intestinal helminths among animal species surveyed in FUNAAB zoological garden

Animal/Parasite	Hookworm	*Trichuris spp*	*Ascaris spp*	*Enterobius spp*	*Strongyloides spp*	*Entamoeba spp*	*Trichostrongylus spp*	Total infection
MAMMALS								
Jackal	-	-	-	-	-	-	-	0
Baboon	+	-	-	-	-	-	-	1
Mona monkey	+	+	-	-	+	-	-	3
Vervet monkey	+	+	-	-	-	-	-	2
Patas monkey	-	+	-	-	-	-	-	1
Gazelle	+	-	-	-	-	-	-	1
Hyaena	-	-	-	-	-	-	+	1
Crested porcupine	-	-	-	-	-	-	-	0
AVES								
Roseringed parakeet	-	-	-	-	-	+	-	1
Ostrich	-	-	+	-	-	-	-	1
Crowned crane	-	-	-	-	-	-	-	0
Mallard duck	-	-	-	-	-	-	-	0
Speckled pigeon	-	-	-	-	-	-	-	0
Senegal parrot	-	-	-	-	-	-	-	0
White geese	-	-	-	-	-	-	-	0
African grey parrot	-	-	-	-	-	+	-	1
REPTILES								
Monitor lizard	-	-	-	-	-	-	-	0
Tortoise	-	-	-	+	-	-	-	1

(-): no ova or cyst found; (+): ova or cyst is present

Table 4: Intensity of helminth ova in the faecal samples of captive animals, FUNAAB Zoological garden

	Hookworm	*Trichuris spp*	*Ascaris spp*	*Enterobius spp*	*Strogyloides spp*	*Entamoeba spp*	*Trichostrogylus spp*
MAMMALS							
Baboon	+++	-	-	-	-	-	-
Mona monkey	+++++	++++	-	-	+	-	-
Vervet monkey	+	+	-	-	-	-	-
Patas monkey	-	++++	-	-	-	-	-
Gazelle	++	-	-	-	-	-	-
Hyena	-	-	-	-	-	-	+
AVES							
Rose ringed parakeet	-	-	-	-	-	+	-
Ostrich	-	-	++	-	-	-	-
African grey parrot	-	-	-	-	-	++	-
REPTILES							
Tortoise	-	-	-	++	-	-	-

(+):1-50 eggs per gram (epg); (++): 51-100 epg; (+++):100-150 epg; (++++):151-200 epg; (+++++):201-300epg
*Intensity is mean of observed intensity of infection for 9 weeks

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