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# Prevalence and management of endo parasitic zoonoses in the Kumasi Zoo, Ghana

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## Abstract

Contact between human beings and animals on displays at zoos are unavoidable, allowing transmission of parasitic (diseases) zoonosis of all kinds from wild animals to man and domesticated animals and vice-versa. This study investigates prevalence and management of endo-parasitic zoonoses in Kumasi zoo. Freshly voided faecal samples from animals at the zoo were collected with sterilized forceps and kept in sterilized plastic bags. Floatation method for worm egg count was used to count worm eggs. Nine endo-parasitic zoonoses were recorded during the study period with Tapeworm (*Dipylidium caninum*) recording the highest (37%) number of observation followed by Strongyl (*Strongyloides fuelleboni*) (25%) and Ascaris (*Ascaris lumbricoides*) (15%). Strongyl was however, the commonest zoonoses. Prevalence of endo-parasites was highest in primates (25%), followed by carnivores (21%), ungulates (14%) and at similar levels (13%) for reptiles, birds and rodents. Preventive measures against worm infections include providing protective clothing for cage cleaners and animal feeders, whiles occasionally administering prophylactic treatments to animals to reduce infections. Given the relatively high levels of parasite infections in some zoo exhibits, transmission to humans (zoo staff and visitors) may be greatly reduced by regularly screening and de-worming zoo animals alongside setting up structures (including regular education) that focus on minimizing the risks of contracting zoonoses when visiting the zoo.

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## Introduction

The Kumasi Zoological Gardens (Kumasi Zoo) was officially opened in 1957 and managed under different regimes under the then Kumasi Municipal Council and then the Forestry Department until 1974 when management was transferred to the Wildlife Division of the Forestry Commission (Nimo, 2006). Animals (zoo exhibits) in the Kumasi Zoo are wild caught with some donated to the zoo by private individuals who originally kept these animals as pets and can no longer manage them, some confiscated from illegal dealers in the wildlife trade and some donated from various protected areas as orphaned juveniles. Unfortunately, over the years, the number and variety of animals in the Kumasi Zoo have continued to decline due to a number of reasons including several escapes, animal theft, injury, old age and the greater majority dying through diseases related causes (Nimo, 2006). Post-mortem results from the Veterinary Laboratory in Accra also indicated that the proportion of animals that died in the Accra Zoo between 1970 and 1998 ranged between 22.2% and 27.4% and the main causes of mortality were pneumonia (11.9%), septicaemia (8.5%), enteritis (7.7%), trauma (7.7%), unspecified bacterial infection (6.8%) and helminthiasis (5.1%), after documenting more than twenty-two diseases (Suu-Ire, 1998). Pneumonia was the major cause of death in herbivores and birds, septicaemia in birds while in carnivores bacterial infection played a major role. Unhygienic conditions, feeding contaminated food to animals by visitors and the cold concrete flooring of zoo cages accounted for the prevalence of these diseases (Suu-Ire, 1998). According to Suu-Ire (1998), some of the most significant threats facing wildlife and zoo collections are health related, which include diseases that occur as a result of parasite infestation.

Kumasi Zoo like most other zoos in the world was established with the objectives of increasing recreational centres, promoting education, conservation and research on wildlife. Based on these objectives, contact (either direct or indirect) between animals and humans are unavoidable, sometimes allowing transmission of parasitic zoonosis (diseases) of all kinds from wild animals to man and domesticated animals and vice-versa. Staff and visitors in the Kumasi Zoo are especially at risk to getting infected with parasitic zoonosis since they are most exposed to or directly get into contact with the animals. Monitoring the prevalence and management of ecto- and endo- parasitic zoonosis in Kumasi Zoo will enhance the health status of the zoo exhibits, zoo workers and the general public including researchers. This study therefore aims to identify the common endo-parasitic zoonoses in the Kumasi zoo and determine how these parasites are managed to reduced human-animal transmissions.

## Materials and methods

*Study area*

The Kumasi zoo covers an area of about 11ha. It is located in Kejetia, a suburb of the central business area of the Kumasi Metropolitan Assembly in the Ashanti Region of Ghana (Fig. 1). The Kumasi Zoo is situated on the source of the Subin River, which flows through and bisects the Zoo grounds. It is also situated on the confluence of three major drainage channels originating from the Komfo Anokye Teaching Hospital, the Race Course area and the Mbrom/Ashanti New Town areas.

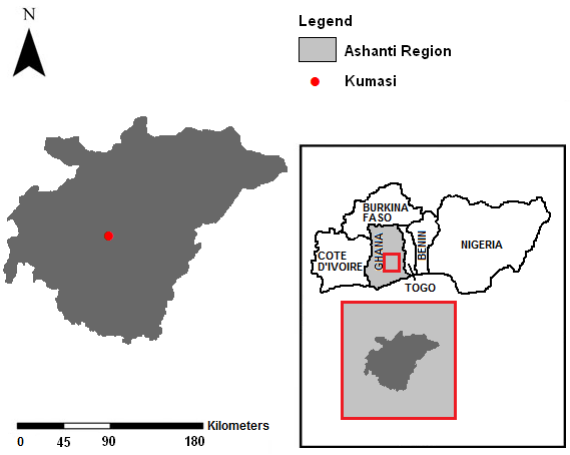


**Fig. 1.** Map of Ashanti Region, showing the location of Kumasi. The inset map shows the location of Ashanti Region in Ghana.

The Kumasi Zoo is home to a population of about 130 wild animals (zoo exhibits), belonging to 35 different species including the highly threatened

chimpanzee, leopard and Spotted Hyenas. Exhibits are displayed in cages for the viewing public. The Kumasi Zoo is currently being used to temporarily house inmates of the Accra Zoo due to ongoing relocation exercise to transfer the Accra Zoo to the Achimota Forest in the Accra Metroplis.

*Sampling methods*

Faecal sampling:

Freshly voided faecal samples from zoo animals of the same species were collected from each cage every morning (0600 GMT) and evening (1800 GMT) using sterilised large forceps (12 inch) and kept in sterilised plastic bags. These were temporarily stored in a cool box and immediately sent to the Wildlife Division laboratory in Kumasi for analysis and enumeration of faecal coli forms.

The floatation method for worm egg count (Cringoli, 2006)was used to count worm eggs. This method was used for quantitative analysis of faecal samples taken for each month. Fifteen grammes (15g) of faeces per species per cage was ground in a mortar with 45ml of saturated salt solution (NaCl), the suspension was then strained through wire gauze (mesh 40squares to1") mixed with a Pasteur pipette and immediately used to fill one chamber McMaster slide. The mixing was repeated and the second chamber filled. Using the lower power lens and focusing on the etched lines on the slide. The numbers of eggs in both chambers are counted, multiplying by 100 to give a total number of eggs/g of faeces (Allchurch, 2000). Faecal sampling spanned a period of five months from October 2010 to February 2011. The last month of sampling (i.e. February 2011) was purposely planned to coincide with a de-worming exercise for the zoo animals to serve as a basis for comparison with the other months when no prophylactic treatment was administered.

*Questionnaire survey*

A structured questionnaire was administered to each staff of the Kumasi Zoo to compile data on the management of endo-parasitic zoonoses in the Kumasi Zoo. Data was also compiled based on personal observations at the Zoo. The survey was done in the month of January 2011.

*Analysis of data*

Differences in frequency of occurrence of diseases across types of zoonoses and study months were explored using the Friedman nonparametric test. Percent similarity in the endo-parasitic community composition among study months was calculated using the Sorenson similarity index (Magurran, 1988). To distinguish between the endo-parasitic compositions present in the different months, a cluster analysis was conducted and a dendrogram produced to facilitate the visualization of patterns of similarity across study months. All statistical analyses were conducted in InfoStats v 1.4., (Infostat, 2004). Descriptive analyses were used to display the results in graphs and tables for easy understanding.

**Results**

*Endo-parasitic zoonoses in Kumasi zoo*

Nine endo-parasitic zoonoses were recorded during the study period (Table 1). Tapeworm was the highest recorded zoonoses and contributed to the highest (37%) number of observations in faecal samples, followed by Strongyl (25%) and Ascaris (15%). Strongyl was however, the most common zoonoses and was detected in all the study months including February 2011 when animals were de-wormed. The remaining endo-parasitic zoonoses were not very common and each recorded percentages below 10% with Cocci and Capillaria recording less than 2% each. Tapeworm and Strongyl formed more than 50% of all parasites recorded whilst Capillaria, Hookworm, Cocci and Trichurus altogether amounted to only 10% of recordings.

Primates and carnivores were the most commonly infected species group in all the zoo animals (Figure 2), with chimpanzees representing the most infected species. Chimpanzees were recorded to have endo-parasites for four out of the five months of study, including the de-worming month of February 2011, whilst patas monkeys recorded endo-parasites for

three months. The baboon and Lowe's (Mona) monkey were relatively resistant to endo-parasites and recorded infections for only two months and one month respectively.

Ungulates, carnivores, reptiles, birds and rodents followed primates in order of decreasing vulnerability to endo-parasistic infections. Whilst all primates, ungulates and carnivores studied were associated with endo-parasites, less than 40% of the rodents found in the Kumasi Zoo showed symptoms of endo-parasites in their faeces. The infections of reptiles and birds were however in the range of 60% to 80% respectively.

**Table 1.** Endo-parasitic zoonoses (worms) detected in faecal samples.

| Common name | Scientific name | Months of study | | | | | Total | % |
|---|---|---|---|---|---|---|---|---|
| | | Oct 2010 | Nov 2010 | Dec 2010 | Jan 2011 | Feb 2011 | | |
| Tapeworm | *Dipylidium caninum* | 10 | 9 | 7 | 1 | 0 | 27 | 37 |
| Strongyl | *Strongyloides fuelleboni* | 3 | 7 | 4 | 2 | 2 | 18 | 25 |
| Roundworm | *Toxocara spp* | 0 | 2 | 0 | 2 | 0 | 4 | 6 |
| Ascaris | *Ascarislum bricoides* | 1 | 0 | 6 | 4 | 0 | 11 | 15 |
| Eimeria | *Eimeria spp* | 1 | 3 | 1 | 0 | 0 | 5 | 7 |
| Capillaria | *Capillaria hepatica* | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| Hookworm | *Ancylosta maunanaria* | 0 | 0 | 0 | 3 | 0 | 3 | 4 |
| Cocci | *Toxoplasma spp* | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| Trichurus | *Trichurus spp* | 0 | 0 | 0 | 3 | 0 | 3 | 4 |

*Measures of managing endo-parasitic zoonoses in Kumasi zoo*

More than 50% of respondents (staff) in the Kumasi Zoo were of the view that there was regular screening (at least 3 months intervals) and treatment of animals by a qualified veterinarian and that they worked with adequate protective clothing (boots and gloves) and cleaning materials (scrubbing brushes and waste disposal containers) (Fig. 3).

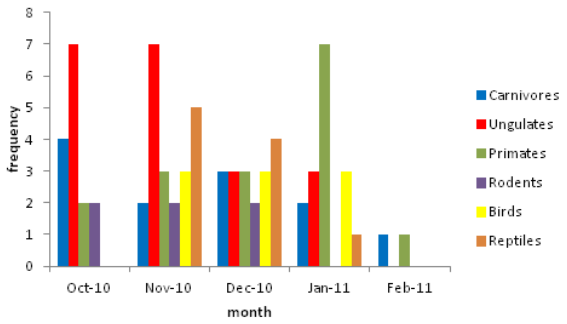


**Fig. 2.** Animal species groups and monthly frequency of parasitic infections at the Kumasi zoo.

On the other hand, most respondents (more than 50%) admitted that staff of the zoo were not regularly screened or tested for possible endo-parasitic infections. Other methods of reducing infections including administering of prophylactics to both animals and staff were also not regularly done even though in their view, animals were often tested. While there was a general consensus on the adequacy of scrubbing brushes, most respondents (cage cleaners) were undertaking their job without adequate detergents and disinfectants.

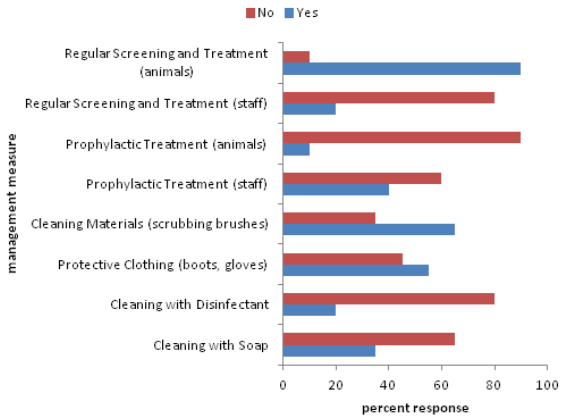


**Fig. 3.** Management measures taken to minimize parasitic infections at the Kumasi zoo.

*Monthly comparisons of endo-parasitic zoonoses and infected animals*

There wasno significant difference in the type of endo-parasitic zoonoses (Friedman Test: $x^2$=8.366, P>0.05) registered across the five study months (Figure 4). However, the number of infected animals

in a month was significantly different ($x^2$=11.962, P<0.05) over the study period.

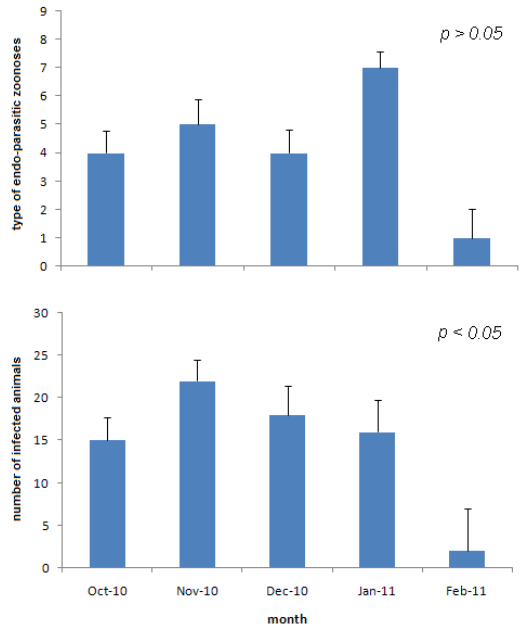


**Fig. 4.** Type of endo-parasite and infected animals in five months in Kumasi Zoo. Data shows standard errors. Statistical difference across months is based on Friedman Tests.

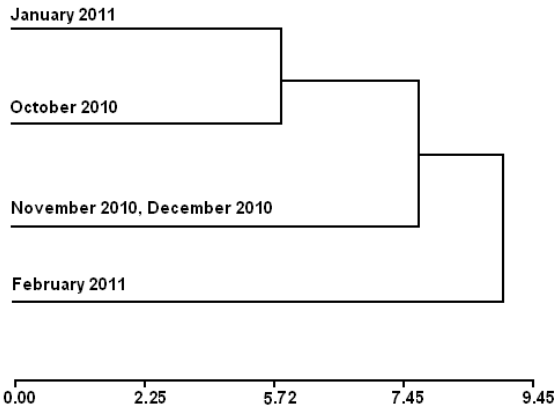


**Fig. 5.** Cluster analysis of prevalence of endo-parasitic zoonoses across study months in Kumasi Zoo.

The mean prevalence of endo-parasitic zoonoses per month was significantly lower (Wilcoxon Signed Rank Test: $Z$=-2.410, P<0.05) in February 2011(when de-worming was done) than the remaining months (no de-worming), while mean number of infected animals per month was also very low ($Z$=-2.232, P<0.05) in February 2011, distinguishable from the other months.

Of the 9 recorded zoonoses (Table 1), 3 were found only in the month of January 2011, 1 was found uniquely in November 2010, 4 were found consistently from October 2010 to January 20011, whilst 1 was found in all the fivestudy months. No species were found uniquely in February 2011.

Sorenson similarity indices showed that the overall similarity in the endo-parasitic community across the study months was highly variable, ranging from 0.23 to 0.79. November 2010 was most similar to December 2010 (similarity index of 0.79); November 2010 and February 2011 had a similarity index of only 0.23. October 2010 and January 2011 had a similarity index of 0.66. A cluster analysis showed a clear separation of the prevalence of endo-parasitic zoonoses in the month of February 2011 from the months of October, 2010, November, 2010, December 2010 and January 2011, and further separated November 2010 and December 2010 from October 2010 and January 2011(Fig. 5).

## Discussion

*Endo-parasitic zoonoses in Kumasi Zoo*

There is little scientific data to reliably show the trend in frequency of endo-parasitic zoonoses in humans and animals over the years in the Kumasi Zoo, however, there is much anecdotal evidence supporting an increasing trend with the recentinflux of the Kumasi Zoo with the inmates from the Accra Zoo. While current endo-parasitic infections in zoo animals may occur for most parts of the year, our study recorded least infections in February 2011, coinciding with a major de-worming exercise in the zoo.

Tapeworm and Strongyl were the most recorded endo-parasitic zoonoses during the study period. Primates and carnivores were found to be the most affected species in terms of parasitic infections and were detected to harbour parasites in all the study months including February 2011 when all zoo animals were de-wormed.

*Measures of managing endo-parasitic zoonoses in Kumasi zoo*

Faecal screening is the main mode of detection of endo-parasitic zoonoses in the Kumasi Zoo. This is supposed to be done regularly on a 3-month interval with a follow up prophylactic treatment. However, for the five months of study only one de-worming exercise was conducted, which resulted in a significant drop in worm infestation in the zoo animals sampled. This suggests that regular de-worming is essential in zoo collections. This corroborates the need to ensure enforcement of the proposed three months regular faecal screening and de-worming of animal collection in zoos (Allchurch, 2000).

Majority of staff in the Kumasi Zoo were not regularly screened or tested for possible endo-parasitic infections. Administering of prophylactics to both animals and staff were also not regularly done and limited to just a few doses of multivitamins and antibiotics. The main existing preventive measure against worm infections for zoo staff waswearing of protective clothing and the use of scrubbing brushes, which based on the study, was adequate for majority of respondents. Though this could decrease the chances of contracting infections either from man to animals and vice versa, there was a general consensus on the inadequacy of detergents and disinfectants. Most of the sanitary sections in the zoo had no soap dispensers and permanent boot disinfectants for workers (cage cleaners) and visitors were also lacking. Under such circumstances, workers are forced to send their work gear home in order to clean them, instead of doing it in on the zoo premises. Both scenarios may contribute to increase the chances of transmission of infections in and out of the zoo, thus leading to the spread of parasitic infections (Bender and Shulman, 2004; Crump *et al.,* 2002 and Bopp *et al.,* 2003)

*Monthly comparisons of endo-parasitic zoonoses and infected animals*

There were important differences in the prevalence of endo-parasitic zoonoses in zoo animals for the study months. Of the five months, October 2010 to January 2011undoubtedly registered the greatest infestation in zoo animals. In addition to forming the largest percentage of the study period and not subjected to any de-worming exercise, these four months had the highest endo-parasitic species composition and abundance in zoo animals and contained all nine parasitic species. For the period, these parasites also affected all animal species groups, including large mammals and primates that are either endangered or of high concern conservation concern (IUCN, 2008).

In contrast to the other study months, February 2011 coincided with the de-worming of zoo animals and registered little value for endo-parasitic infestation. February 2011 had the lowest endo-parasitic species composition and abundance in zoo animals and contained only one parasitic species, affecting only one primate species i.e. chimpanzees (compared to a sum total of nearly 30 species in the other months). The single parasitic species – *Strongyloides fuelleboni*–is clearly favoured by the conditions present within or adjacent chimpanzee environs and our results suggest an interesting relationship between both species that needs further investigation. Cluster analyses for months similarly showed a sharp division between the month of de-worming and the other months when no de-worming took place.

This pattern of decreasing prevalence of endo-parasites in the zoo animals sampled with respect to de-worming suggests the importance of regular screening and de-worming in zoo collections (Allchurch, 2000) alongside setting up structures (including regular education) that focus on minimizing the risks of contracting zoonoses when visiting the zoo.

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