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Frequency distribution, species richness and egg per gram of gastrointestinal parasites in free-ranging Papio Ursinus species in a semi-arid savanna ecosystem of Zimbabwe

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Abstract:
A cross-sectional study of the free-ranging baboon (*Papio ursinus*) troops was undertaken at the Epoch Mine campus, Insiza district, Zimbabwe with the objective of investigating the frequency distribution, species richness and eggs per gram (EPG) of gastrointestinal parasites among three baboon troops. Baboons are general feeders and have been observed to interact with both livestock and humans at Epochmine campus this can lead to cross exchange of parasites among these organisms. One hundred and twenty (120) fresh faecal samples were collected from February 2023 to September 2023. Floatation technique was utilised to process the faecal samples, thereafter samples were placed in Mcmaster slides and viewed under a microscope. Parasite ova were identified based on morphological features like size and shape. There was significant difference in the parasite frequencies among the troops (P=0.041). No significant difference (P = 0.311) was observed in parasite species richness. There was significant differences in egg per gram among the three troops (P=0.00193). The high frequency and EPG of gastrointestinal parasites among the three troops can be attributed to eating less of fortified food among peoples' resident bins and limited use of natural herbs. The high species richness among the baboons can be attributed to larger baboon home range thereby resulting in acquisition of many different gastrointestinal parasites along the way. The observed research outputs calls for active surveillance of gastrointestinal disease outbreaks among humans and livestock since the baboons carry potential zoonotic parasites.

Introduction

Parasites are a common threat in natural animal populations impacting the health of wild animals. The most prevalent of these parasites are the gastrointestinal (GIT) (Obanda *et al*. 2019). Parasites weaken the physical health of the host thereby affecting its ability to forage and consequently being fatal in some instances (Mason *et al*. 2022). Baboons are known to host parasites including those of zoonotic importance (Banda *et al*. 2024). Papio species easily adapt to different environments and interact often with humans

and livestock in the human-wildlife-livestock interfaces making baboons, humans and livestock prone to cross-species disease transmission (Ebbert *et al*. 2013). About 68-70% of the known primate parasites have been reported as multi-host species (Pedersen *et al*. 2005). Close interactions in wildlife-livestock interfaces due to sharing resources like grazing land and water sources can facilitate parasite spill over, spillback and species hybridization (Khanyari *et al*. 2022).

Zoonotic diseases of parasitic origins affect the health and behaviour of baboons and livestock which in turn impacts foraging patterns, vegetation patterns, range land biodiversity and poses a risk to livestock productivity and wildlife conservation (Talukdar *et al*. 2020). Understanding baboon-parasite dynamics and parasite epidemiology across multi-use rangelands is imperative to conservation strategies and mitigation of emerging parasitic diseases (VanderWaal *et al*. 2014). Parasite species richness is another metric often used in primate studies to understand parasite-host dynamics (Deere *et al*. 2021). In light of the foregoing, the study aimed to test the null hypothesis that frequency distribution and parasite species richness would be similar among the three troops present at the Gwanda State University, Epoch Mine campus where wild animals interact with livestock and humans. Especially more often the baboons interact with livestock, eating the animal feed, goat kids if unattended and drinking from livestock water points. This association will likely lead to cross exchange of parasites between baboons and livestock.

Materials and methods

Study site

The study was done at Gwanda State University, Epoch Mine campus, Filabusi, Insiza district. Insiza district is situated in Zimbabwe's natural agro-ecological region 4, which receives mean annual rainfall of 350mm and has mean temperature ranges from 9.93°C to 33.8°C (Chisadza *et al*. 2023). Other primates present in the study area were Vervet monkeys (*Chlorocebus pygerythrus*) (Banda *et al*. 2024).

Sample collection and analysis

Using a descriptive and analytical cross-section design (Larbi *et al*. 2020), the study was undertaken to investigate the frequency distribution, species richness and egg per gram (EPG) of gastrointestinal parasites among three free-ranging baboon troops. One hundred and twenty (120) fresh faecal samples were collected from February 2023 to September 2023. The troops were trailed and fresh faecal samples were randomly collected immediately after defecation or when the baboons had left the immediate vicinity (Banda *et al.* 2024). Collected faecal samples were immediately preserved in 10% formalin. Analysis of samples was done at the Bulawayo Provincial Veterinary Laboratory using the centrifugal floatation technique to process the faecal samples (Hansen and Perry 1990). Thereafter the McMaster technique was used to quantify the observed parasite ova using a compound light microscope (Optika brand, Italy) at x100 magnification (Zajac *et al*. 2021). Parasite ova were identified based on morphological features like size and shape (Taylor *et al*. 2015). Identification was done to suborder and genus level.

Data analysis

Frequency distribution was analysed graphically and a Chi-square test was used to determine if there was significant difference among the troops (Fowler et al. 2013). Margalef index (D_Mg) was used to measure parasite species richness (Aslam 2009). A Kruskall-Wallis test was conducted to test for significant differences among troops. Egg per gram was counted using the McMaster egg counting technique. A Kruskall-Wallis test was conducted to test for significant differences among troops. Analysis was done using the R Studio package version 4.3.2 (R Core Team, 2022).

Results

Six parasite taxa were observed (Figure 1). Troop 1 had the highest number of samples infected with one or more parasite taxa. *Strongylid* nematodes had the highest frequency across the three troops followed by *Schistosoma* spp.

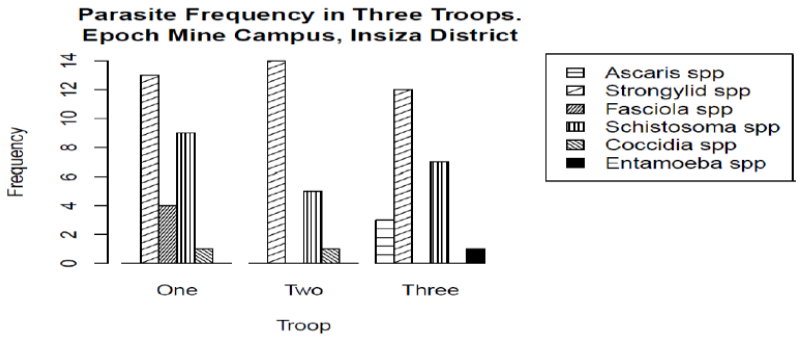

Figure 1 Frequency of parasites in three *Papio ursinus* troops at the Epoch Mine campus, Zimbabwe

A Kruskall-Wallis test indicated significant differences among the troops frequencies (*P*= 0.041). Furthermore, pairwise comparison using Dunn's test (post-hoc analysis) showed no significant differences (*P*= 0.541) between Troop 2 and Troop 3 troops frequencies. However, Troop 1 significantly differed from Troop 2 troops (*P*= 0.026) and Troop 3 (*P*= 0.012) frequencies.

Parasite Species Richness

The Margalef Index (D_Mg) indicated that Troop 3 had the highest parasite species richness (D_Mg =1.361) followed by Troop 1 (D_Mg =1.315), whilst troop 2 had the lowest (D_Mg =1.038) However, there was no significant difference in parasite species richness among the three troops (*P* = 0.311).

Egg per gram

Schistosoma spp. in troop 2 had the highest average EPG among all three troops across all species. The average EPG for Strongylid was the highest in troop 2 (303.85 EPG), while lowest in troop 3 (195.83 EPG). *Coccidia* spp and *Entamoeba* spp had the same and the least average epg. There was a significant difference in average epg among the three troops (Kruskal-Wallis, *P*= 0.00193). A pairwise comparison indicated that troop 1 significantly differed from both troop 2 and 3 (Dunn's test, *P*=0.037; *P*=0.002, respectively), however troop 2 and 3 are not significantly different (Dunn's test, *P*= 0.145).

Discussion

The study observed four helminths and two protozoa taxa. There was a significant difference among the troop frequencies. Strongylid nematodes are common parasites of baboons and they co-occurred in all troops with high frequency (Obanda 2015). Strongylid nematodes have been observed to cause severe diarrhoea; weight loss leading to death if left untreated; affect the respiratory and the gut system in livestock (Income *et al*. 2021). Schistosomiasis caused by *Schistosoma spp* is a neglected tropical disease infecting primates, livestock and humans (Jones *et al*. 2011). Schistosoma species have been found to hybridise, this suggests the probability of exponential growth in emerging zoonotic parasites which might be of public health and veterinary importance (Tober *et al*. 2021). Despite *Coccidia spp* and *Entamoeba spp* being

asymptomatic and recording low frequencies in the study, there is a need for further research on the pathogenicity of such species (N'da *et al*. 2022).

The parasite species richness in this study included six species, which is comparable within the range of most parasite species richness observed in most baboon populations of five to eight species (Obanda 2015). No significant differences were noted in parasite species richness among the troops which may be attributed to similar intermediate host ecology in the study area and parasite migration which may occur due to a new individual joining another troop after being chased away from their own troop (Ebbert *et al*. 2013). Five of the taxa have been well-documented in primate studies except for *Fasciola* spp. which was observed in troop 1 only (Banda *et al*. 2024). Further research on spill over and transmission of parasites from baboons to domestic, wildlife species and humans in the study area is imperative. Parasites of zoonotic potential observed in this study highlight the necessity for caution regarding monitoring emerging, re-emerging infections and conservation efforts (Hahn *et al*. 2003). The significant differences in average EPG among different troops may be due to variations in the troops foraging areas. Some troops may be eating more of fortified food from human dustbins, while others forage where livestock graze, thus exposing them to high risk of parasites from livestock (Ryan *et al*. 2012).

Conclusion

The presence of gastrointestinal parasites in baboons suggests future health and livestock productivity implications due to disease emergence and re-emergence. The study highlights the need for active surveillance system to be put in place so as to curb public health and veterinary diseases. Further on, a wider scope/area coverage study is needed as this is a study in a University campus which may differ from the real situation in the country. Strongylid nematodes were not identified to species level hence it is difficult to conclude whether the high frequency observed was a result of a single species or mixed infection of Strongylid nematodes (Ryan *et al*. 2012). This underscores the need for molecular analysis of parasites to the species level to ascertain the potential health implications.

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