Parasite Survey within a Population of Sanctuary Housed Chimpanzees in Northern Zambia

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Abstract

Chimfunshi, a sanctuary in Northern Zambia, is home to approximately one hundred and twenty five Chimpanzees, *Pan troglodytes*. Due to the remote nature of the sanctuary, there are limited resources and very basic accommodations for the staff and their families. Cleaning protocol within the sanctuary is minimal, and facilities lack basic supplies such as year-round running water. Although the medical care and basic supplies are scarce, the chimpanzees actually live fairly consistent to their wild counterparts by being housed in a variety of enclosures ranging in size from seventy to two hundred acres, respectively. Each enclosure varies slightly in design, which includes a great amount of ecological diversity in regards to water access and fruiting trees available. The family groups also range in number of chimpanzees, and encompass a wide variety of ages from newborns to fully mature chimpanzees. The purpose of this research is to survey the parasites present within the population and address the possible zoonotic implications.

Title

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Goals

The goals of this study are to evaluate the parasites present in this population of Chimpanzees, and to address the potential zoonotic implications.

Materials and Methods: Fecal samples were collected during July of 2011, preserved in 10% formalin, and shipped to Oklahoma State University. Samples were examined for parasites using sugar-centrifugation (Zajac and Conboy, 2012) during summer months of 2012. IDEXX *Giardia* SNAP tests (IDEXX Laboratories, Westbrook, ME) were used according to the directions on the package insert. The prevalence of parasite infections were compared using Chi-square test (Sokal and Rohlf 1997).

Results: Fecal samples from 50 chimpanzees (27 male, 21 female, and 2 of unknown sex) held in 5 separate enclosures were collected and processed. Eggs and cysts of 9 parasite species (2 helminthes and 7 protozoa) were observed (Table 1). The most common parasite was *Necator americanus* (66%) followed by *Cryptosporidium* spp. (54%), *Balantidium* coli (30%), *Enterobius anthropopithicus* (28%), *Entamoeba histolytica/dispar* (26%), *Entamoeba hartmanni* (20%), *Iodamoeba butschelii* (14%), *Entamoeba coli* (12%), and *Strongyloides fuelleborni* (8%). Comparison of the prevalence of parasite infections among chimpanzee sex and enclosures housing the animals showed that the prevalence of *N. americanus* in females (17 of 21 = 80%) was significantly higher (X^2 = 6.521, df = 2, P = 0.038) than that of males (16 of 27 = 60%). Prevalence of *N. americanus* infection in chimpanzees held in the first enclosure (16 of 16 – 100%) was higher (X^2 = 21.838, df = 4, P = 0.0002) than that in the other enclosures (72%, 37.5%, 16.7%, and 0%). The prevalence of *Enterbius anthropopithicus* in chimpanzees in enclosures 1 (8 of 16 = 50%) and 4 (3 of 6 = 50%) were higher(X^2 = 9.560, df = 4, P = 0.049) than those in the other three (11%, 12.5%, and 0% respectively). The prevalence of *Entamoeba coli* in chimpanzees in enclosure 1 (5 of 16 = 31.3%) was higher (X^2 = 9.557, df = 4, P = 0.049) than those in the other enclosures (0%, 0%, 16.7%, and 0%). None of the 22 samples tested by the *Giardia* SNAP test were infected with this parasite.

Summary: The results of our study are similar to a parasite survey done in a chimpanzee population in Tanzania from 2006-2008. In this population, the prevalence of parasites were as follows: *Necator americanus* 25.68% in 2006, and 71.43% in 2007, *Balantidium* coli 0% in 2006, and 10.39% in 2007, *Entamoeba histolytica/dispar* 70.89% in 2006, 72.73% in 2007, *Iodamoeba butschelii 65.82% in 2006, and 67.53% in 2007, Strongyloides fuelleborni 74.32% in 2006, 92.21% in 2007.* (T.R Gillespie ET al. 2010) In contrast, a study of wild chimpanzees in Senegal in 2005 produced the following results:

Necator americanus 0%, *Balantidium* coli 0%, *Entamoeba histolytica/dispar 0%, Entamoeba coli 10.16%, Iodamoeba butschelii 9.38%, Strongyloides fuelleborni 19.53%.* (Howells, Pruetz, and Gillespie 2011)

These two studies are closest in design to our project, although were both conducted on populations of wild chimpanzees. The population in Senegal, was conducted on "chimpanzees *that* were not fully habituated at the time of study" (Howells, Pruetz, and Gillespie 2011), in contrast to the chimpanzees at Gombe in Tanzania who are more conditioned to human interactions since the beginning of Jane Goodall's research in 1960. "Chimpanzees that inhabit pristine habitats with minimal anthropogenic impact exhibit greater prevalence and diversity of symbiotic ciliate species…Likewise the chimpanzees of Gombe National Park in northwestern Tanzania inhabit a small, restricted habitat surrounded by land that has been intensely modified by humans have only two symbiotic protozoa and are experiencing an increases in pathogenic parasites (Gillespie 2010)." (Howells, Pruetz, and Gillespie 2011) Taking this into consideration it is likely that the increased prevalence of nematodes and other pathogenic parasites in the Chimfunshi chimpanzee population could be due to their captivity, their large amount of human interaction, or a combination of both.

What is essential in this study is that "*E.histolytica* ranks second in worldwide causes of human morbidity by parasitic infections, causing dysentery and colitis. " (Laughlin and Temesavari 2005). Additionally, "*Necator* sp…. Have the capacity to cause substantial pathology and death in primates. Heavy infections with these parasite have been associated with mucosal inflammation, ulceration, iron deficiency anemia, protein malnutrition, dysentery, weight loss and death in primates."(Roberts and Janovy 2009) Therefore, the implications of such an elevated parasite load at Chimfunshi is consequential. The parasites present, whether they originate in the chimpanzees or the human population, are zoonotic, and the human/chimpanzee interaction is high. The results of this study indicate that a parasite load exists, and that current care protocol in Chimfunshi could potentially contribute to zoonotic transmission to the keepers, and eventually to their families. Additionally the potential exists for human to chimpanzee transmission as well.

The prevalence of parasites, especially the two highest, N.americanus and Cryptosporidium necessitate a parasite prevention protocol in Chimfunshi. Although anthelmintic medical therapy would be ideal, the sustainability of such medical contributions is unlikely. The most effective way to decrease the parasite population therefore, is to implement a feeding and cleaning protocol, which decreases the current level of interaction with the chimpanzees and their feces. This poses many challenges due to the lack of clean, year round access to water, lack of medical equipment such as gloves and disinfecting chemicals, as well as the food preparation and a tactile based food distribution system.

In the future, we intend to extrapolate on this study by conducting similar research at other chimpanzee sanctuaries throughout Africa that have a variety of protocols, preferably with decreased transmission potential to Chimfunshi. Additionally, we would like to repeat the Giardia Snap tests on-site at Chimfunshi to avoid the potential false negatives that may have been due to the formalin storage of our samples. Finally, we would like to conduct sedimentations on our samples to perhaps reveal additional parasites that were undetected due to the methods we employed. It is with this research that we can hope to develop an improved protocol at Chimfunshi, which will improve the health and longevity of the chimpanzee as well as the keepers and their families.

Table 1. Demographic data and number of chimpanzees infected (%) with parasites

Enclosure	Sex	Age Group	N	*Necator americanus*	*Cryptosporidium* spp.	*Balantidium coli*	*Enterobius anthropopithecus*	*Entamoeba histolytica/dispar*	*Entamoeba hartmanni*	*Iodamoeba butschelii*	*Entamoeba coli*	*Strongyloides fuelleborni*
1	M	J	1	1 (2)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		A	4	4 (8)	2 (4)	2 (4)	3 (6)	1 (2)	0 (0)	1 (2)	0 (0)	0 (0)
		M	5	5 (10)	4 (8)	2 (4)	3 (6)	3 (6)	2 (4)	0 (0)	2 (4)	2 (4)
	F	J	0	—	—	—	—	—	—	—	—	—
		A	3	3 (6)	0 (0)	3 (6)	1 (2)	1 (2)	1 (2)	2 (4)	2 (4)	0 (0)
		M	3	3 (6)	3 (6)	1 (2)	1 (2)	2 (4)	2 (4)	1 (2)	1 (2)	1 (2)
2	M	J	4	4 (8)	2 (4)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		A	1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)
		M	2	1 (2)	2 (4)	1 (2)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	1 (2)
	F	J	2	1 (2)	1 (2)	0 (0)	0 (0)	1 (2)	1 (2)	0 (0)	0 (0)	0 (0)
		A	2	1 (2)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		M	7	6 (12)	4 (8)	2 (4)	1 (2)	0 (0)	2 (4)	2 (4)	0 (0)	0 (0)
3	M	J	1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		A	0	—	—	—	—	—	—	—	—	—
		M	4	0 (0)	3 (6)	1 (2)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	F	J	0	—	—	—	—	—	—	—	—	—
		A	1	1 (2)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		M	2	2 (4)	0 (0)	1 (2)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)
4	M	J	0	—	—	—	—	—	—	—	—	—
		A	2	0 (0)	2 (4)	1 (2)	1 (2)	0 (0)	1 (2)	0 (0)	1 (2)	0 (0)
		M	2	1 (2)	1 (2)	0 (0)	1 (2)	2 (4)	0 (0)	1 (2)	0 (0)	0 (0)
	F	J	0	—	—	—	—	—	—	—	—	—
		A	0	—	—	—	—	—	—	—	—	—
		M	0	—	—	—	—	—	—	—	—	—
	?	J	1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		A	0	—	—	—	—	—	—	—	—	—
		M	1	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sandy's Family	M	J	0	—	—	—	—	—	—	—	—	—
		A	1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
		M	0	—	—	—	—	—	—	—	—	—
	F	J	1	0 (0.0)	1 (2)	0 (0)	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)	0 (0)
		A	0	—	—	—	—	—	—	—	—	—
		M	0	—	—	—	—	—	—	—	—	—
Total (%)			**50**	**33 (66)**	**27 (54)**	**15 (30)**	**14 (28)**	**13 (26)**	**10 (20)**	**7 (14)**	**6 (12)**	**4 (8)**

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