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Gastrointestinal parasites infection in wild drill monkeys population at Afi Mountain Wildlife Sanctuary (AMWS), Cross River State, Nigeria

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Abstract

Gastrointestinal parasites in wild primates are of serious concern to Non-Human Primates as it can impact on the health and well-being of the animal's population because of potential disease implications. This study was conducted at Afi Mountain Wildlife Sanctuary (AMWS) to assess the gastrointestinal parasite species diversity and intensity as well as parasites load in wild drill monkeys population in two locations at AMWS. The study was conducted from January-December, 2020 using the floatation method. Parasite identification was limited to only morphological identification of the parasites using low power microscope (Olympus Biological microscope CHA & CHB). The broad objective of the study was to identify, catalogue and quantify gastrointestinal parasites in wild drill monkeys populations at Afi Mountain Wildlife Sanctuary. Results revealed that parasitic infection was high in the two drill monkeys groups (60%). Six different parasite taxa were identified in the wild drill monkeys population and the infection intensity was the same in the two drill monkeys group. The parasite load was higher in the adult and sub-adult population (36%) in the two locations. The identified gastrointestinal parasites were similar to some already reported by previous authors in Nigeria. It was therefore recommended that further study especially molecular studies is required to elucidate the impact of these parasites on the health of the affected animals and the host-parasite interaction.

Keywords: Gastrointestinal parasites, wild drill monkey's population, Afi Mountain Wildlife Sanctuary. Nigeria.

Introduction

Wild animals, both in captivity or in the wild, are important in the epidemiology of many described diseases, some of which are newly discovered and have been the focus of recent publications. Gastrointestinal parasites represent a major health problem and the symptoms resulting from these infections include: apathy, colic, diarrhea, malaise and weight loss[1]. Non-Human Primates (NHP) are one of the most common groups of animals known to harbor different gastro-intestinal parasite species which affect their survival and reproductive activity by causing gastro enteritis, hemorrhage, extra-intestinal infection, spontaneous abortion and death[2,3].

The close phylogenetic relationship between humans and these NHP and their association in the wild have caused frequent pathogen exchange with humans[4]. This phenomenon has also resulted into emerging zoonoses which currently threatens global health and has resulted in a decline in NHP population in the wild and in captivity[5]. NHP are particularly vulnerable to parasitic infestations because many species live in cohesive groups characterized by frequent social interactions that facilitate parasite transmission between individuals[6].

Gastrointestinal parasites infections have been reported in a range of NHP hosts which include gorilla (*Gorilla gorilla*), chimpanzee (*Pan troglodytes*), Green monkey (*Chlorocebus sabaeus*), Red patas (*Erythrocebus patas*), Drill monkeys (*Mandrillus leaucophaeus*), Red-capped mangabey (*Cercocebus torquatus*), Mona monkey (*Cercopithecus mona*) and Olive baboon (*Papio anubis*) in Nigeria[7-11].

Parasitological studies are fundamental to understand the life cycle of parasites and the potential transmissions to others animals and humans[12]. To assess and manage the effect of gastrointestinal parasites on any animal population dynamics, it is essential to evaluate their prevalence[1]. That is why this study was designed to determine the level of gastro-intestinal infestation in wild drill monkeys population in AMWS, Cross River State Nigeria.

Wild primates are known to be important transmitters of many described human diseases; however, there is paucity of information in catalogued gastrointestinal parasites of wild drill monkeys at AMWS.

The main objective of this study was to assess the gastro-intestinal parasites of wild drill monkeys at AMWS. While the specific objectives were: To catalogue for the first time, a database of gastrointestinal parasites known to infect wild drill monkeys at AMWS. Assess the prevalence, intensity and diversity of gastrointestinal parasites of wild drill monkeys at AMWS.

Methodology

Description of the Study Area: The study area is in Boki Local Government Area of Cross River State, Nigeria. It lies between Latitude 6°25' and 6°30' North and Longitude 8°45' and 9°15' East. The study area is approximately100km^2 in size and made up of massive rocky outcrops. It was carved out of Afi River Forest Reserve in the year 2000 following renewed international interest to protect endangered fauna species and their habitat such as the Cross River Gorilla, the Nigeria Cameroon chimpanzee and the Drill Monkeys. The study area serves as the sole water shade for the surrounding communities. The rainfall of 3500mm and above with mean temperatures of 27°C and Relative humidity of about 65% during the afternoons throughout the year have been reported for the study area (Figure-1).

Data collection Technique: One fecal sample of about five (5) grams was collected from each drill age group per month for twelve months, January-December, 2020 using improvised sample stick, hand gloves and sample bottles. The fecal samples collected from each drill age group were stored separately in sample bottles and normal saline solution was added to it to avoid decay and then taken to the parasitological unit of the College of Veterinary Medicine, Joseph Sarwaun Tarka University Makurdi for laboratory processes of samples for parasites identification and quantification within 24 hours. A total of seventy-two (72) samples were collected, thirty-six (36) each from the two sites at AMWS.

Endo-Parasite identification Techniques: To identify gastro-intestinal parasites from mammals, feces are collected directly from the animal. All samples collected are analyzed using three different methodologies, centrifuge-flotation, qualitative flotation and simple fecal sedimentation techniques using concentrated sucrose solution, as described by Hoffmann[13]. The slides of each sample are analyzed under an optical microscope at 10X with confirmation at 40X[1]. Although, several techniques can be used in sampling intestinal parasites, in this study the Stool dilution flotation technique was used. The reason being that we were interested not just in the identification but also in the number of eggs per fecal sample[11].

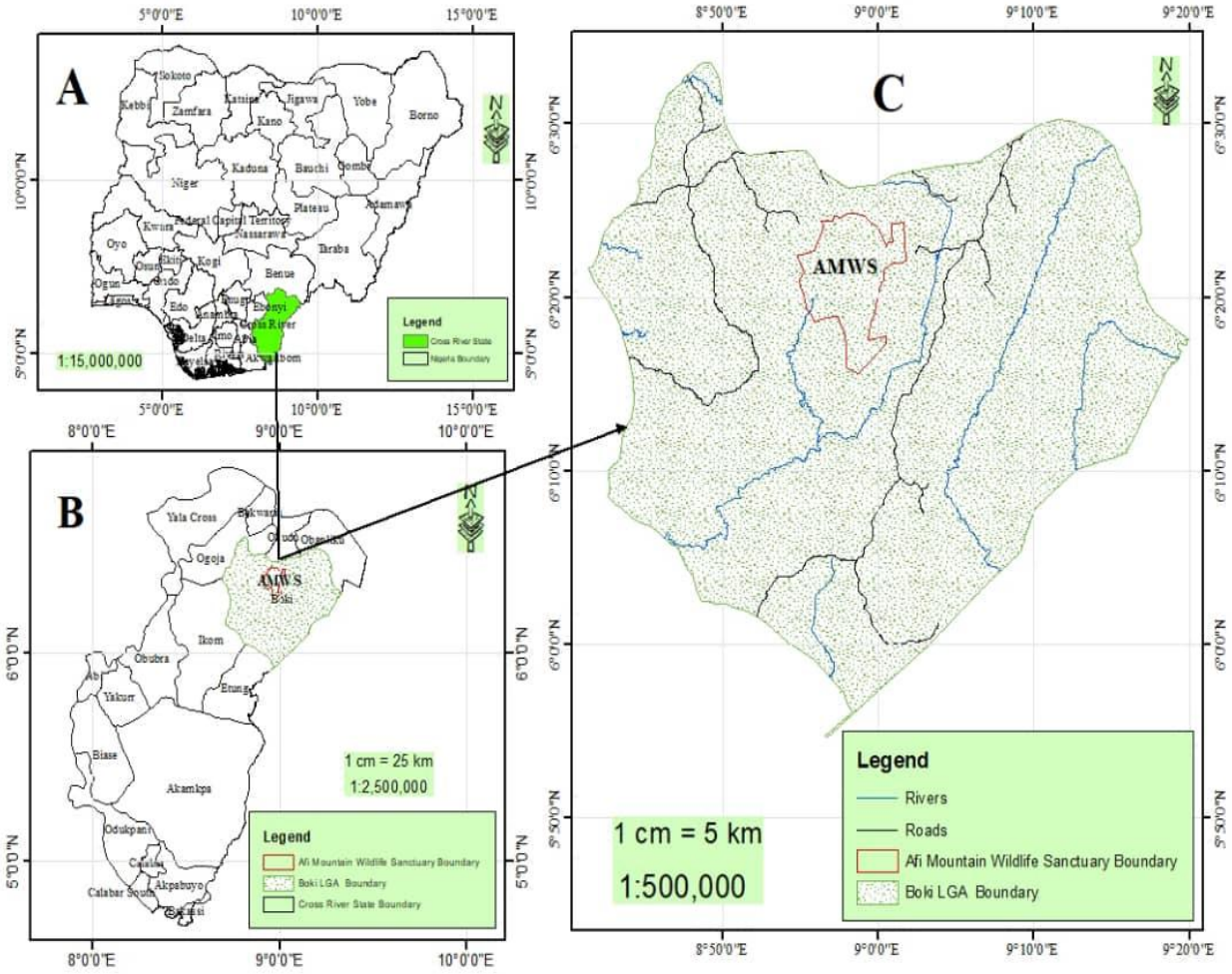

Figure-1: Map of Nigeria, showing the location of Afi Mountain Wildlife sanctuary in Cross River state.

Stoll's dilution technique: About 3 grams of feces from thoroughly crushed and mixed whole fecal pellets was taken in a stopper graduated flask to which 10 gram of Sodium hydroxide (NaOH) solution was added up to 45 ml mark. After adding10-12 glass beads, the flask is tightly closed and shaken gently to mix the contents. After shaking, 0.15ml of the well mixed suspension was drawn with a pipette and placed on a glass slide, covered with a cover slip and the total number of eggs in the entire preparation is counted under low power objective microscope. The number of eggs per gram of feces was determined by using the formula: EPG = Number of eggs x 100 (where 100 is the dilution factor).

Data Analysis: Data analysis was carried out using Statistical Package for Social Sciences (SPSS). The linear regression model built using the SPSS software was used to determine and compare parasite richness and prevalence and t-test was used to compare parasite richness and variation between the different drill age group and the months of occurrence.

Results and discussion

Catalogue of Identified gastrointestinal Parasites of wild drill monkeys at AMWS: The result of Identified gastrointestinal parasites of wild drill monkeys at AMWS is presented in Table-1 and Figure-2 and 3. Five (5) different species of gastrointestinal parasites in different developmental stages were identified. These were: *Ancylostoma duodenal, (Hookworm) Ascaris lumbrecoides, (Large roundworm) Entamoeba coli, (Protozoan) Strongyloides stercoralis; (Threadworm) Trichostrangylus spp. and Tricuris tricuria (Whipworm).*

Table-1: Catalogue of Identified gastrointestinal Parasites of wild drill monkeys at AMWS.

Parasite	Developmental Stage	Description
Ancylostoma duodenal, (hookworm)	Egg	Yellowish coloration, shell with a thin inner lining and a thick outer lining; full nucleus and oval in shape.
	Larvae	It is long in shape and pointed at both ends; colorless in coloration.
Ascaris lumbrecoides, (large roundworm)	Egg	Zigzaz in shape, reddish in coloration with embryo covering the shape outside with double layer. Body wall is very thick made up of one nucleus Blackish coat, C-curve shape with an embryo from mouth to tail.
	Larvae	It has thick rear round shape, has 8 nucleus in chromatin dot inside and bigger than that of entamoeba historical
Entamoeba coli, (protozoan)	Cyst	Oval in shape
Strongyloides stercoralis, (threadworm)	Egg	Blackish thin outer layer, oval in shape and contain 4-8 nuclie.
	Egg	Blackish in color, oval in shape and contain several nuclie.
Trichostrongylus spp. (roundworm)	Egg	Colorless coloration, pointed at both ends with two layer coats

Figure-2: Two spp. of gastrointestinal parasites found in drill monkeys at Afi Mountain Wildlife Sanctuary in different developmental stages.

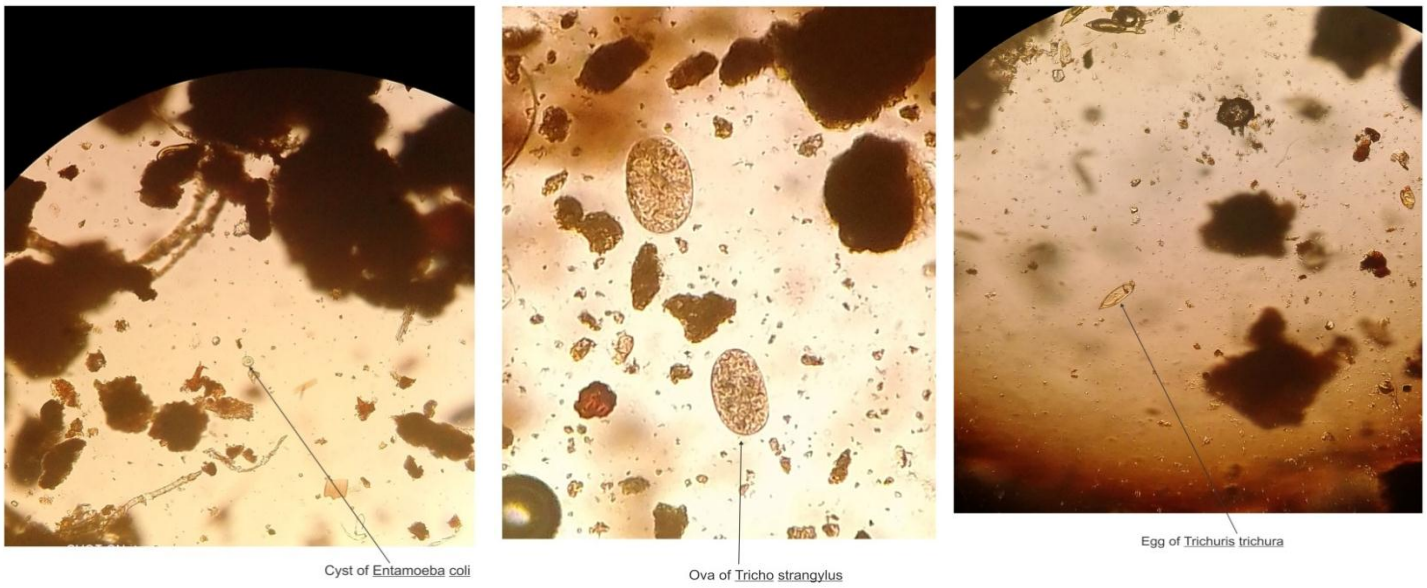

Figure-3: Three spp. of gastrointestinal parasites found in drill monkeys at Afi Mountain Wildlife Sanctuary in different developmental stages.

Diversity of gastrointestinal parasites of wild drill monkeys at AMWS: The result of the diversity of gastrointestinal parasites of wild drill monkeys at AMWS is presented in Table-2 and 3 and Figure-4.

Table-2: Diversity of parasites taxa across the month in the **Northern** site.

Parasite	Parasite Number (N)	n-1	n(n-1)
Ad	8	7	56
AI	4	3	12
Ec	2	1	2
Ss	2	1	2
Ts	0	-1(0)	0
Tt	6	5	30
Total	22		

Simpson index (D) is given by the formula:

$$D = \frac{\sum_i n(n_i - 1)}{N(N-1)}$$

Then the diversity index of the Northern site is given as $DI = 0.78$ (The closer the value is to one, the more diverse are the species).

Table-3: Diversity of parasites taxa across the month in the **Southern** site.

Parasite	Parasite Number(N)	n-1	n(n-1)
Ad	7	6	42
AI	5	4	20
Ec	0	-1(0)	0
Ss	6	5	30
Ts	0	-1(0)	0
Tt	4	3	12
Total	22		

Simpson index (D) is given by the formula:

$$D = \frac{\sum_i n(n_i - 1)}{N(N-1)}$$

Then the diversity index of the Southern site is given as D2= 0.77

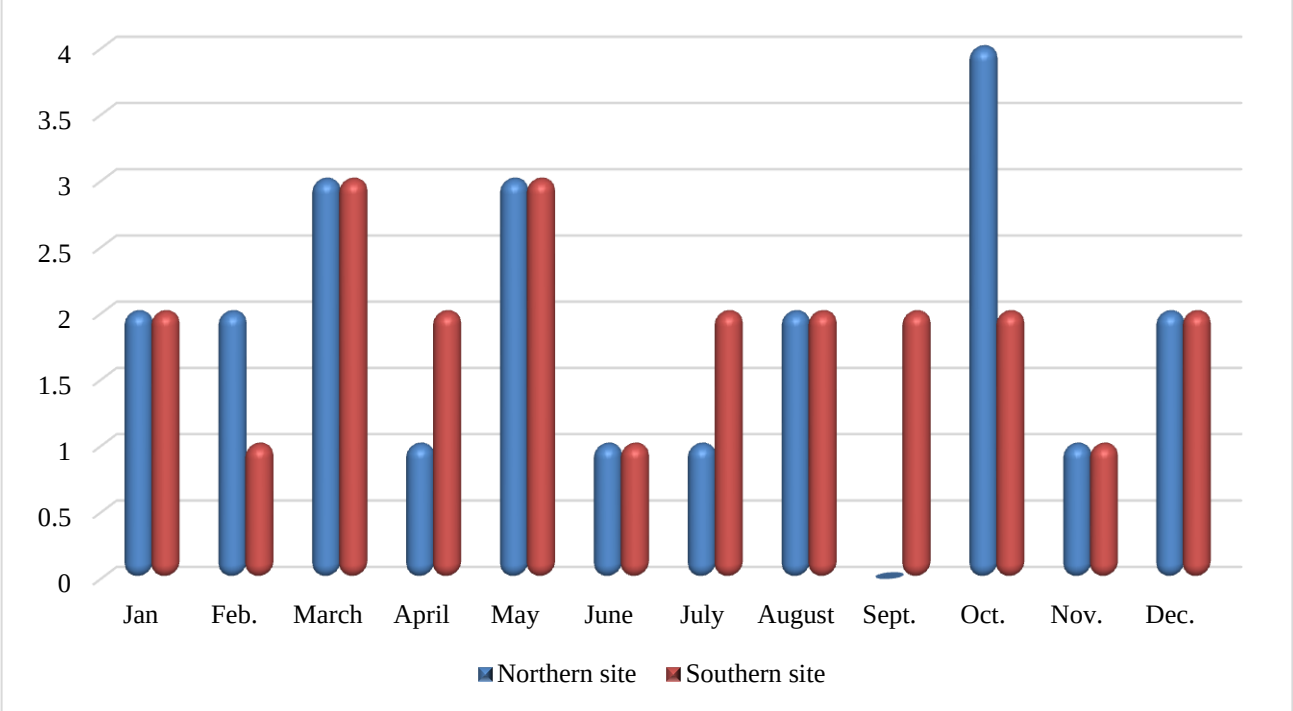

Figure-4: Diversity of gastrointestinal parasites taxa across the month in wild drill monkeys at AMWS.

Prevalence of gastrointestinal parasite of wild drill monkeys at AMWS across the month: The results of prevalence of gastrointestinal parasites of wild drill monkeys at AMWS across the month are presented in Table-4.

Table-4: Prevalence of gastrointestinal parasites across the month.

Month	North	South
Jan	0.4	0.4
February	0.4	0.2
March	0.6	0.6
April	0.2	0.4
May	0.6	0.6
June	0.2	0.2
July	0.2	0.4
August	0.4	0.4
Sept.	0.0	0.4
October	0.8	0.4
November	0.2	0.2
December	0.4	0.4

t-Test: Two-Sample Assuming Equal Variances for parasite prevalence for the two sites, shows that the prevalence of parasite doesn't significantly differ between the northern and southern sites. We fail to reject the null hypothesis that the variances of the two sites (north and south) are the same (=0), because our probability level (83%) is bigger than 5% at one and two tails. NS@ 0.05 P(T<=t) two-tail 0.826287.

Variation in gastrointestinal parasites infection load in wild drill monkey's age group at AMWS: The result of the variation in gastrointestinal parasites infection load in wild drill monkey's age group at AMWS is presented in Figure-5.

Discussion: On the catalogue of identified gastrointestinal parasites in wild drill monkeys population at AMWS as shown in Table-1, six gastrointestinal parasites species were identified. This number of parasites species taxa is less than that identified by Bukie *et al.*[11] in a captive population of primates at Makurdi Zoological Garden. It is also less than that identified by Mbaya and Udendeye[10] in semi captive primates at Afi Mountain Conservation Center, Calabar. Also, in this study; only one morphotype of the parasites taxa was identified, different from Kamani *et al.*[14] where four morphotypes of Trichuris spp. eggs (T1–T4) were identified in captive primates in zoos and parks in Northern Nigeria. The findings in this study are similar to those of Mul et al.[15], where free-ranging Orangutan populations were found to contain less infection of strongyloides sp. than the captive population. This finding is also at variant with the findings of Adrus *et al.*[16], where at least 44 species of gastrointestinal parasites comprising of protozoan's (7 species), nematodes (26 species), cestodes (5 species) and trematodes (5 species) and pentastomidal (1 species), were detected in wild, urban and captive primates in Malaysia.

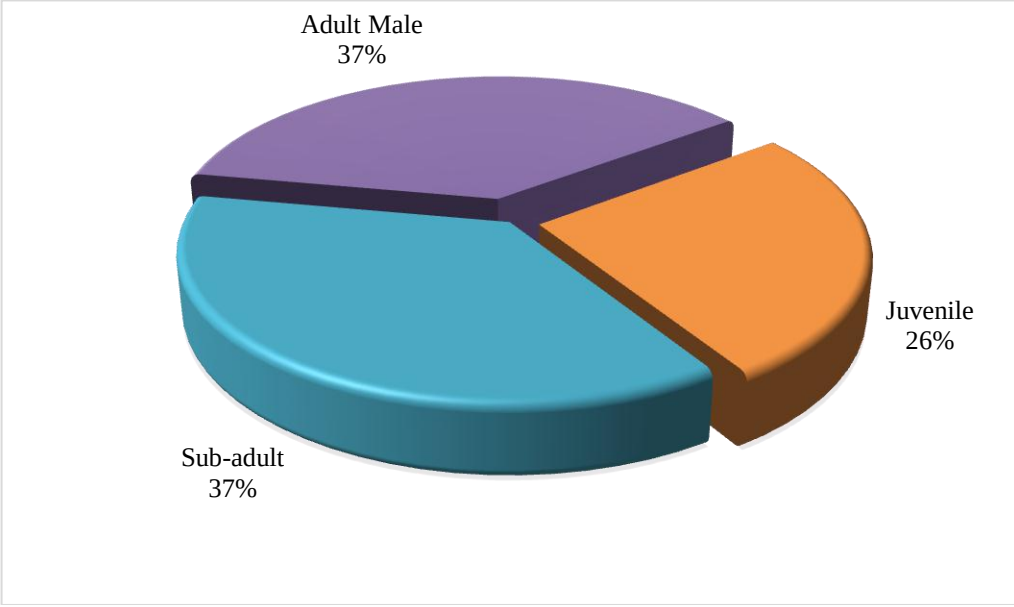

Figure-5: Variation in gastrointestinal parasites infection load in wild drill monkeys' age group at AMWS.

On the diversity of gastrointestinal parasites taxa in the two locations at AMWS as presented in Table-2 and 3 and Figure-10, the results shows no significant difference in the level of diversity. The Samson' diversity indices (0.78 for the northern site and 0.77 for the southern site) show that the level of significant in the two sites is the same. The reason for this could be because the two sites are not significantly different in environmental and ecological conditions. These findings are however, at variance with those of Kamani *et al*[14], that revealed a level of significant in the prevalence and diversity of GIP in four locations in northern Nigeria. And the findings of Olarewaju *et al*.[17] in savanna primates.

As presented in Figure-11, the gastrointestinal parasites infection load was highest in the adult and sub-adult age-group in the two locations (37% for the adult population and 37% for the sub-adults population). The juvenile population infection load however, was 26%. The reason for this variation could not be ascertain. Even though the animals share the same environment and most likely, feed from the same food sources, the difference in the low gastrointestinal load in the juvenile population cannot be ascertain.

Conclusion

In conclusion, seven (7) different gastrointestinal parasites in different developmental stages were reported. Six of these parasites were helminths and one was a protozoan. Six (6), of those parasitic helminths were found in the northern population, while five (5), of those parasitic helminths and a protozoan, were found in the southern population. The gastrointestinal parasites found in wild drill monkeys population at AMWS, were among those reported by several authors in Nigeria. Although the diversity of the parasites taxa was different in the two sites, Simpson diversity index showed no significant difference, there was also no significant difference in the parasites prevalence in the two sites. However, the parasitic load in the individuals was higher in adults and sub-adults than in juveniles, a situation that has been reported by several authors. It was therefore recommended that a more comprehensive study to elucidate the genetic diversity of gastrointestinal parasites species in circulation in wild drill monkey's population in AMWS is necessary. Therefore, molecular studies on gastrointestinal parasites of wild drill monkeys at AMWS are needed in order to elucidate the host-parasite interactions in the affected individuals.

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