

WILDLIFE HELMINTH RISK IN RADOM NATIONAL PARK; SOUTH DARFUR STATE, SUDAN

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ABSTRACT

Received at: 11/2/2014

Accepted: 9/4/2014

This paper describes the results of a survey of the gastro-intestinal helminth parasites in the faecal matters of fourteen wildlife species investigated in five sites in Radom National Park (R.N.P.), South Darfur State, Sudan. These sites were Radom area, Alhufra, Titrbi, Kafindibei and Kafiakingi. Out of 579 faecal matters examined, 177 were found containing eggs of helminth parasites with an overall prevalence of 30.6%. The Aardvark (*Orycteropus afer*) had the highest overall infection rate of helminth eggs (60%) (9/15), while the Patas monkey (*Erythrocebus patas*) showed the lowest prevalence (2.7%) (1/37). The helminth parasites recorded throughout this study included *Ascaris* spp., *Trichuris* spp., *Haemonchus* spp., *Oesophagostomum* spp., *Toxocara* spp., *Trichostrongylus* spp., *Strongyloides* spp., *Moniezia* spp. and Coccidia oocysts. Kafiakingi area showed the highest prevalence (35.9%) (65/181), followed by Kafindibei area (35.1%) (34/97) while Alhufra area showed the lowest prevalence (17.6%) (13/74). The results of this survey were compared and discussed with previous findings of similar studies conducted in Sudan and elsewhere.

Key words: Helminth parasites, Wildlife, Radom National Park, South Darfur State, Sudan.

INTRODUCTION

The available information on parasitic infection among wildlife species, particularly in Sudan, is scanty. There are few scattered papers published in scientific journals among which is the pilot work of Eisa *et al.* (1979) which contained a check-list of helminth parasites recorded in domestic and wild animals in Sudan during the period 1902 – 1975. According to these authors, *Cysticercus tenuicollis* was reported in the reedbuck, monkey and kob; *Cysticercus pisiformis* in the rabbit; *Trichuris* spp. was reported in the monkey and gazelle; *Toxocara canis* was reported in cheetah and wild cat; *Setaria labiotopapillosus* in the reedbuck; *Trichostrongylus* spp. in the giraffe; *Ascaris lumbricoides* in the wild pig; *Strongyloid* spp. in the gazelle; *Ascaris pythonis* in the python and *Toxascaris leonina* in the lion. All the investigated faecal matters for the above mentioned findings were collected from wildlife species kept in captivity at Khartoum Zoo. Saad and Eisa (1980) surveyed the parasites of seven hussar monkeys in which they reported the presence of three helminthes, namely; *Streptophagus pigmentatus*, *Oesophagostomum biforcum* and *Trichuris trichura*. The same authors

noticed that, although some wild mammals were infected by endoparasites, however, they did not show clinical evidence of disease and health deviation despite the presence of these parasites. In another work, laboratory examination of 184 faecal samples belonging to 44 species of wild animals kept at Khartoum Zoo (Sudan) revealed the presence of *Trichostrongylus* eggs in faeces of dorcas gazelles, cheetah, roan antelope, giraffe, red-fronted gazelles, *Nubis* baboons, vervet monkeys and cape buffaloes (Saad *et al.*, 1983). Free-ranging wild animals in Sudan were investigated for the prevalence of helminth parasites only once in Dinder National Park (D.N.P.) (Sayied and Agab, 2009).

The present study is intended to investigate the prevalence of helminth parasite in wildlife in Radom National Park.

MATERIALS and METHODS

Study Areas: The Radom National Park is located to the south-west of Lake Kundi on the border with the Central African Republic, in the south-western corner of Southern Darfur Region, Sudan. The park consists of an area of broken hilly country lying between two

main rivers, the Adda and the Umbelasha. Radom was declared a Biosphere Reserve in 1979 by the International Union for Conservation of Nature (IUCN) (1987). The vegetation is principally savannah woodland dominated by *Terminalia brownii*, *Combretum spp.*, *Anogeissus leiocarpus* and *Isoberlinia doka* trees.

Collection and laboratory examination of faecal samples:

A total of 579 faecal samples were collected from the five sites in the Radom National Park, namely; Radom area, Alhufra, Titrbi, Kafindibei and Kafiakingi. The samples were collected from 14 wildlife species. The collected faecal samples were put in labeled nylon bags and mixed with 10% formaldehyde solution and then transported to the laboratory in Nyala for examination. In the laboratory, two qualitative

techniques, namely the floatation and sedimentation techniques were used in for separation, concentration and demonstration of parasite eggs and oocysts in the collected faecal samples. Both techniques were done following the method described by FAO (2006).

Results of the laboratory examination were analyzed using Chi-square analysis.

RESULTS

Frequencies and distributions of the tested samples by species and area are presented in Table 1. The Dikdik (*Madaqua guentheri*) represented the highest sampled animal (101/579) (17.4%) while the bushbuck (11/579) (1.9%) represented the lowest sampled species (Table1).

Table 1: Frequency and distribution of tested faecal samples of wildlife species and area of faecal collection for internal parasites in Radom National Park, South Darfur State, Sudan.

Factor and its level	Tested samples (No.)	Tested samples (%)
Number of faecal samples	579	100
Species:		
Warthog	75	13
Baboons	83	14.3
Patas monkey	37	6.4
Vervet monkey	35	6
Leopard	12	2.1
Reedbuck	17	2.9
Cheetah	27	4.7
Aardvark	15	2.6
Dikdik	101	17.4
Rabbit	69	11.9
Fox	41	7.1
Spotted hyaena	34	5.9
Bushbuck	11	1.9
Waterbuck	22	3.8
Area:		
Radom area	158	27.3
Alhufra	74	12.8
Titrbi	69	11.9
Kafindibei	97	16.8
Kafiakingi	181	31.3
Total	579	100

The overall prevalence of helminth parasites in the different species investigated in this study was found to be 30.6% (177/579) (Table 2).

According to the species of wildlife, the aardvark (*Orycteropus afer*) had the highest prevalence of internal parasites infection (9/15) (60%), whereas the spotted hyaena (*Crocota crocota*) showed the lowest prevalence (1/34) (2.9%) as presented in Table 2.

According to the area of sample collection, Kafiakingi showed the highest prevalence of internal parasites (35.9%) (65/181), followed by Kafindibei area (35.1%) (34/97), while Alhufra area showed the lowest prevalence (17.6%) (13/74) (Table 2).

Table 2: Prevalence of internal parasites by species and area in Radom National Park, South Darfur State, Sudan.

Factor and its levels	Number of tested samples	Number of positive samples	Prevalence (%)	95% CI	
				Lower	Upper
Wildlife species	579	177	30.6	26.85	34.35
Species:					
Warthog	75	33	44	32.77	55.23
Baboons	83	21	25.3	15.95	34.65
Patas monkey	37	7	18.9	6.28	31.52
Vervet monkey	35	11	31.4	16.02	46.78
Leopard	12	2	16.7	-4.4	37.8
Reedbuck	17	6	35.3	12.58	58.02
Cheetah	27	3	11.1	-0.75	22.95
Aardvark	15	9	60	35.21	84.79
Dikdik	101	35	34.7	25.42	43.98
Rabbit	69	30	43.5	31.8	55.2
Fox	41	6	14.6	3.79	25.41
Spotted hyaena	34	1	2.9	-2.74	8.54
Bushbuck	11	5	45.5	16.07	74.93
Waterbuck	22	8	36.4	16.29	56.51
Area:					
Radom area	158	49	31	23.79	38.21
Alhufra	74	13	17.6	8.92	26.28
Titrbi	69	16	23.2	13.24	33.16
Kafindibei	97	34	35.1	25.6	44.6
Kafakingi	181	65	35.9	28.91	42.89
Total/Overall	579	177	30.6	26.85	34.35

Out of all the internal parasites identified in the present study, *Moniezia spp.* recorded the highest prevalence rate (13.3%), followed by *Coccidia spp.* (12.1%) and finally *Trichuris spp.* (5.2%).

For *Trichuris* infection per wildlife species, the baboons (*Papio cynocephalus*) had the highest prevalence (25.3%) (21/83), with 95% CI±9.35, while Patas monkeys (*Erythrocebus patas*) showed the lowest prevalence (10.8%) (4/37), with 95% CI±10 (Table 3). For *Trichuris* infection per site, Radom area showed the highest prevalence (7.6%) (12/158), with 95% CI±4.13, while Titrbi showed the lowest prevalence (2.9%) (2/69), with 95% CI±3.96. The proportions of positive results of *Trichuris* infection differed between species and area. In the univariate analysis using chi-square, species was significantly (p-value = 0.000) associated with floatation and sedimentation methods of identification for *Trichuris* infection. However, area was not significantly associated (p-value=0.547) with floatation and sedimentation methods of identification regarding *Trichuris* infection.

Table 3: Univariate associations of factors with *Trichuris* infection positivity in Radom National Park, South Darfur State, Sudan.

Risk Factors With levels	No. of tested Samples	No. of positive Samples	%Positive (Prevalence)	95% CI	d.f.	X ²	P. value
Types:							
Wildlife	579	30	5.2	±1.81	1	31.900	0.000
Species:							
Warthog	75	0	0	0			
Baboons	83	21	25.3	±9.35			
Patas monkey	37	4	10.8	±10			
Velvet monkey	35	5	14.3	±11.6			
Leopard	12	0	0	0			
Reedbuck	17	0	0	0			
Cheetah	27	0	0	0			
Aardvank	15	0	0	0			
Dikdik	101	0	0	0			
Rabbit	69	0	0	0			
Fox	41	0	0	0			
Spotted hyaena	34	0	0	0			
Bushbuck	11	0	0	0			
Waterbuck	22	0	0	0			
Area:							
Radom area	352	12	3.4	±1.89			
Alhufra	129	4	3.1	±2.99			
Titrbi	184	2	1.1	±1.51			
Kafindibei	225	6	2.7	±2.12			
Kafiakingi	289	6	2.1	±1.65	4	3.068	0.547

For the prevalence of *Moniezia* by wildlife species, the warthog (*Phacochoerus aethiopicus*) showed the highest prevalence (44%) (33/75), with 95% CI±11.23, while the vervet monkeys (*Cercopithecus aethiops*) showed the lowest prevalence (5.7%) (2/35) (Table 4), with 95% CI±7.68. Area-wise, the prevalence of *Moniezia* was highest in Kafiakingi (16.6%) (30/181), with 95% CI±5.42, while Alhufra showed the lowest prevalence (5.4%) (4/74), with 95% CI±5.15. In the univariate analysis using chi square, species was significantly associated (p-value = 0.000) with floatation and sedimentation methods while the area of sample collection was not significantly associated (p-value=0.391) with floatation and sedimentation methods of identification regarding *Moniezia* infection.

Table 4: Univariate associations of factors with *Moniezia* infection positivity in Radom National Park, South Darfur State, Sudan.

Risk Factors With levels	No. of tested Samples	No. of positive Samples	% Positive (Prevalence)	95% CI	d.f	X²	P. value
<u>Types:</u>							
Wildlife	579	77	13.3	±2.77	1	16.241	0.000
<u>Species:</u>							
Warthog	75	33	44	±11.23	17	180.932	0.000
Baboons	83	0	0	0			
Patas monkey	37	3	8.1	±8.79			
Velvet monkey	35	2	5.7	±7.68			
Leopard	12	2	16.7	±21.1			
Reedbuck	17	0	0	0			
Cheetah	27	3	11.1	±11.85			
Aardvank	15	5	33.3	±23.85			
Dikdik	101	7	6.9	±4.94			
Rabbit	69	17	24.6	±10.16			
Fox	41	3	7.3	±7.96			
Spotted hyaena	34	0	0	0			
Bushbuck	11	0	0	0			
Waterbuck	22	2	9.1	±12.02			
<u>Area:</u>							
Radom area	352	35	9.9	±3.12	4	4.116	0.391
Alhufra	129	7	5.4	±3.9			
Titrbi	184	16	8.7	±4.07			
Kafindibei	225	24	10.7	±4.04			
Kafiakingi	289	33	11.4	±3.66			

For Coccidia infection among the wildlife in R.N.P., the bushbuck (*Tragelaphus scriptus*) had the highest prevalence (45.5%) (5/11), with 95% CI±29.43 whereas the spotted hyaena (*Crocota crocota*) showed the lowest prevalence (2.9%) (1/34), with 95% CI±5.64 (Table 5). Area-wise, Kafiakingi showed the highest prevalence of coccidian oocysts (16%) (29/181), with 95% CI±5.34, and Alhufra showed the lowest prevalence (6.8%) (5/74), with 95% CI±5.74. The univariate analysis using chi square, species was significantly associated (p-value = 0.000) with floatation and sedimentation methods of identification for Coccidia infection. However, area was not significantly associated (p-value=0.342) with floatation and sedimentation methods of identification for Coccidia infection.

Table 5: Univariate associations of factors with *Coccidia* infection positivity in Radom National Park, South Darfur State, Sudan.

Risk Factors	No. of tested	No. of positive	%Positive	d.f	X²	P. value	
With levels	Samples	Samples	(Prevalence)	95% CI			
Types:							
Wildlife	579	70	12.1	±2.66	1	2.346	
Species:					17	162.325	0.000
Warthog	75	0	0	0			
Baboons	83	0	0	0			
Patas monkey	37	0	0	0			
Velvet monkey	35	4	11.4	±10.53			
Leopard	12	0	0	0			
Reedbuck	17	6	35.3	±22.72			
Cheetah	27	0	0	0			
Aardvank	15	4	26.7	±22.39			
Dikdik	101	28	27.7	±8.73			
Rabbit	69	13	18.8	±9.22			
Fox	41	3	7.3	±7.96			
Spotted hyaena	34	1	2.9	±5.64			
Bushbuck	11	5	45.5	±29.43			
Waterbuck	22	6	27.3	±18.62			
Area:					4	4.507	0.342
Radom area	352	38	10.8	±3.24			
Alhufra	129	9	7	±4.4			
Titrbi	184	16	8.7	±4.07			
Kafindibei	225	25	11.1	±4.1			
Kafiakingi	289	38	13.1	±3.89			

Regarding prevalence of *Ascaris* per animal species, the bushbuck (*Tragelaphus scriptus*) had the highest prevalence (18.2%) (2/11), with 95% CI ± 22.8, while the dikdik (*Madaqua guentheri*) showed the lowest prevalence (1%) (1/101), with 95% CI±1.94 (Table 6). All wildlife infected by *Ascaris* eggs were ruminant animals. As for the prevalence of *Ascaris* per site of faecal sample collection, *Radom* area showed the highest prevalence (1.7%) (6/352), with 95% CI±1.35, whereas *Kafiakingi* showed the lowest prevalence (1%) (3/289), with 95% CI±1.15.

Table 6: Univariate associations of factors with *Ascaris* infection positivity in Radom National Park, South Darfur State, Sudan.

Risk Factors With levels	No. of tested Samples	No. of positive Samples	%Positive (Prevalence)	95% CI	d.f	X ²	P. value
Types:							
Wild	579	3	0.5	±0.57	1	4.344	0.037
Species:					17	92.394	0.000
Warthog	75	0	0	0			
Baboons	83	0	0	0			
Patas monkey	37	0	0	0			
Velvet monkey	35	0	0	0			
Leopard	12	0	0	0			
Reedbuck	17	0	0	0			
Cheetah	27	0	0	0			
Aardvank	15	0	0	0			
Dikdik	101	1	1	±1.94			
Rabbit	69	0	0	0			
Fox	41	0	0	0			
Spotted hyaena	34	0	0	0			
Bushbuck	11	2	18.2	±22.8			
Waterbuck	22	0	0	0			
Area:					4	2.886	0.577
Radom area	352	6	1.7	±1.35			
Alhufra	129	0	0	0			
Titrbi	184	3	1.6	±1.81			
Kafindibei	225	2	0.9	±1.23			
Kafiakingi	289	3	1	±1.15			

The prevalence of *Toxocara* infection in wildlife was found to be 7.4% (43/579), with 95% CI±2.13. Regarding the prevalence of *Toxocara* by animal species, the leopards (*Panthera pardus*) had a prevalence of 50% (6/12), with 95% CI±28.29, and the warthog (*Phacochoerus aethiopicus*) showed a lower prevalence (4%) (3/75), with 95% CI ±4.43 (Table 7).

For the prevalence of *Toxocara* infection by area of faecal sample collection, *Kafiakingi* showed a prevalence of 4.5% (13/289), with 95% CI±2.39, and *Alhufra* showed a lower prevalence (2.3%) (3/129), with 95% CI±2.59. The proportions of positive results for *Toxocara* infection differed between species and area. In the univariate analysis using chi-square, species was significantly associated with floatation and sedimentation methods of identification (p-value = 0.000). However, area was not significantly associated with floatation and sedimentation methods of identification for *Toxocara* infection (p-value=0.778).

Table 7: Univariate associations of factors with *Toxocara* infection positivity in Radom National Park, South Darfur State, Sudan.

Risk Factors With levels	No. of tested Samples	No. of positive Samples	%Positive (Prevalence)	95% CI	d.f	X ²	P. value
Types:							
Wildlife	579	43	7.4	±2.13	1	46.246	0.000
Species:					17	390.049	0.000
Warthog	75	3	4	±4.43			
Baboons	83	0	0	0			
Patas monkey	37	0	0	0			
Velvet monkey	35	0	0	0			
Leopard	12	6	50	±28.29			
Reedbuck	17	0	0	0			
Cheetah	27	8	29.6	±17.22			
Aardvank	15	0	0	0			
Dikdik	101	0	0	0			
Rabbit	69	0	0	0			
Fox	41	18	43.9	±15.19			
Spotted hyaena	34	8	23.5	±14.25			
Bushbuck	11	0	0	0			
Waterbuck	22	0	0	0			
Area:					4	1.772	0.778
Radom area	352	11	3.1	±1.81			
Alhufra	129	3	2.3	±2.59			
Titrbi	184	8	4.3	±2.93			
Kafindibei	225	8	3.6	±2.43			
Kafiakingi	289	13	4.5	±2.39			

Concerning the prevalence of *Haemonchus* by animal species, the reedbuck (*Redunca redunca*) had a prevalence of 17.6% (3/17), with 95% CI ±18.1 (Table 8). As far as the area of sampling is concerned, *Radom* area showed the highest prevalence of *Haemonchus* (2.6%) (9/352), with 95% CI ±1.66, while *Alhufra* showed the lowest prevalence (0.8%) (1/129), with 95% CI ±1.54. In the univariate analysis using chi-square, species (p-value = 0.000) was significantly associated with floatation and sedimentation methods of identification for *Haemonchus* infection. However, area (p-value=0.135) was not significantly associated with floatation and sedimentation methods of identification for this parasite.

Table 8: Univariate associations of factors with *Haemonchus* infection positivity in Radom National Park, South Darfur State, Sudan.

Risk Factors	No. of tested	No. of positive	% Positive	95% CI	d.f	X ²	P. value
With levels	Samples	Samples	(Prevalence)				
Types:							
Wildlife	579	5	0.9	±0.77	1	2.07	0.150
Species:					17	71.988	0.000
Warthog	75	0	0	0			
Baboons	83	0	0	0			
Patas monkey	37	0	0	0			
Velvet monkey	35	0	0	0			
Leopard	12	0	0	0			
Reedbuck	17	3	17.6	±18.1			
Cheetah	27	0	0	0			
Aardvank	15	0	0	0			
Dikdik	101	2	2	±2.73			
Rabbit	69	0	0	0			
Fox	41	0	0	0			
Spotted hyaena	34	0	0	0			
Bushbuck	11	0	0	0			
Waterbuck	22	0	0	0			
Area:					4	7.012	0.135
Radom area	352	9	2.6	±1.66			
Alhufra	129	1	0.8	±1.54			
Titrbi	184	0	0	0			
Kafindibei	225	2	0.9	±1.23			
Kafiakingi	289	4	1.4	±1.35			

The prevalence of *Oesophagostomum* helminth parasites in the wildlife in the study areas was found to be 0.9% (5/579), with 95% CI±0.77, with warthog (*Phacochoerus aethiopicus*) showing the highest prevalence (4%) (3/75) while *Patas* monkeys (*Erythrocebus patas*) showed the lowest prevalence (2.7%) (1/37), with 95% CI±5.22 (Table 9). Considering the prevalence of *Oesophagostomum* by area of faecal sample collection, *Radom* area showed the highest prevalence (6.5%) (23/352), with 95% CI±2.58, in contrast to *Titrbi* which showed the lowest prevalence (1.6%) (3/184), with 95% CI± 1.81. In the univariate analysis using chi-square, species (p-value = 0.000) was significantly associated with floatation and sedimentation methods of identification for *Oesophagostomum* infection. However, area (p-value=0.010) was not significantly associated with floatation and sedimentation methods of identification for this parasite.

Table 9: Univariate associations of factors with *Oesophagostomum* infection positivity in Radom National Park, South Darfur State, Sudan.

Risk Factors With levels	No. of tested Samples	No. of positive Samples	% Positive (Prevalence)	95% CI	d.f	X ²	P. value
Types:							
Wildlife	579	5	0.9	±0.77	1	24.121	0.000
Species:					17	90.106	0.000
Warthog	75	3	4	±4.43			
Baboons	83	0	0	0			
Patas monkey	37	1	2.7	±5.22			
Velvet monkey	35	0	0	0			
Leopard	12	0	0	0			
Reedbuck	17	0	0	0			
Cheetah	27	0	0	0			
Aardvank	15	0	0	0			
Dikdik	101	1	1	±1.94			
Rabbit	69	0	0	0			
Fox	41	0	0	0			
Spotted hyaena	34	0	0	0			
Bushbuck	11	0	0	0			
Waterbuck	22	0	0	0			
Area:					4	13.241	0.010
Radom area	352	23	6.5	±2.58			
Alhufra	129	3	2.3	±2.59			
Titrbi	184	3	1.6	±1.81			
Kafindibei	225	6	2.7	±2.12			
Kafiakingi	289	7	2.4	±1.76			

For the prevalence of *Trichostrongylus* spp., the overall prevalence in wildlife in RNP was 10.2% (59/579) (Table 10). The Patas monkey (*Erythrocebus patas*) had the highest prevalence (37.8%) (14/37) in contrast to the warthog (*Phacochoerus aethiopicus*) which showed the lowest prevalence (2.7%) (2/75). Some animal species such as *Lepus capensis* (rabbits), *Canis adustus* (foxes), *Crocota crocota* (spotted hyaena) and *Tragelaphus scriptus* (bushbuck) showed no infection with any helminth or protozoal parasite at all. Moreover, the primates, *Cercopithecus aethiops* (vervet monkey) and *Erythrocebus patas* (Patas monkeys), recorded the highest prevalence of *Trichostrongylus* infection than all other animal species examined throughout this investigation. Animals in Radom area, Kafiakingi and Kafindibei showed the highest prevalence 14.5%, 14.5% and 14.2%, respectively, while those in Alhufra, on the other hand, showed the lowest prevalence (10.1%).

Table 10: Univariate associations of factors with *Trichostrongylus* infection positivity in Radom National Park, South Darfur State, Sudan.

Risk Factor	No. of tested Samples	No. of positive Samples	% Positive (Prevalence)	95% CI	d.f	X ²	P. value
Types:							
Wildlife	579	59	10.2	±2.47	1	10.109	0.001
Species:							
Warthog	75	2	2.7	±3.67			
Baboons	83	19	22.9	±9.04			
Patas monkey	37	14	37.8	±15.62			
Velvet monkey	35	13	37.1	±16			
Leopard	12	0	0	0			
Reedbuck	17	2	11.8	±15.34			
Cheetah	27	0	0	0			
Aardvank	15	0	0	0			
Dikdik	101	6	5.9	±4.6			
Rabbit	69	0	0	0			
Fox	41	0	0	0			
Spotted hyaena	34	0	0	0			
Bushbuck	11	0	0	0			
Waterbuck	22	3	13.6	±14.32			
Area:					4	3.052	0.549
Radom area	352	51	14.5	±3.68			
Alhufra	129	13	10.1	±5.2			
Titrbi	184	20	10.9	±4.5			
Kafindibei	225	32	14.2	±4.56			
Kafiakingi	289	42	14.5	±4.06			

DISCUSSION

In the present study, 14 wildlife species in Radom National Park (R.N.P.), South Darfur State (Sudan) were investigated for gastrointestinal helminthes by examination of faecal samples. Of the several gastrointestinal tract (GIT) nematodes recorded, *Trichostrongylus* and *Strongyloides* spp. represented the highest and most prevalent helminth parasites among the wildlife investigated in the present study. The prevalence of *Trichostrongylus* spp. reported in the present study is in agreement with that reported in wildlife kept at Khartoum Zoo (Sudan) by Saad *et al.* (1983) in faeces of dorcas gazelles, Indian cheetah, roan antelope, giraffe, red-fronted gazelles, Nubis baboons, vervet monkeys and cape buffaloes. It was also reported in guenons (*Cercopithecus* spp.) of

western Uganda by Thomas *et al.* (2004). The present study reported that *Trichostrongylus* spp. was the most predominant parasite in Patas monkeys (*Erythrocebus patas*) in Radom area and Kafiakingi.

The present study confirmed the presence of *Ascaris* spp. as the most predominant parasite in bushbuck (*Tragelaphus scriptus*) in Radom area. *Ascaris* worms are known to have a wide range of hosts and were formerly reported in waterbuck in Lake Mburo National Park in Uganda (Ocaido *et al.*, 2004).

The prevalence of *Toxocara* parasites in the study area was higher (63.51%) in the rainy season as compared to the winter season (50%). The first report of *Toxocara cati* in wildlife was in the leopard (*Panthera pardus saxicolor*) in Iran and was

documented by Esfandiari *et al.* (2010). It was also reported in the tiger, lion, leopard and jungle cat in India (Mahali *et al.*, 2010). *Toxocara* worms were recovered in the faeces of *Nubis* baboons, Hussar monkeys, *Asmara* gazelle and lion by Saad *et al.* (1983) who reported the same parasite in a tiger and a lion in Khartoum Zoo, Sudan. Similar results were also recorded in the present study in which *Toxocara* eggs were reported in leopards (*Panthera pardus*) in *Kafiakingi* where these worms had the highest prevalence in leopards (50%) than in other animals in the study area. It worths mentioning that *Kafiakingi* was more populated with feline and canine animals compared to the other remaining four study sites.

The results of this study recorded that *Haemonchus spp.* was the most predominant parasite of reedbuck (*Redunca redunca*) in *Radom* area. The samples collected from reedbuck were few (only 17) which might be the reason that the reedbuck represented the highest percentage of infection. *Haemonchus spp.* was reported as the most predominant parasite in mountain Reedbuck (*Redunca fulvorufula*) in South Africa (Boomker *et al.*, 1989). It was also reported in the *Loskop* Dam Nature Reserve and the Mountain Zebra National Park (Boomker *et al.*, 1983) in South Africa. *Haemonchus contortus* is a cosmopolitan helminth parasite of sheep and goats (Chaudary *et al.*, 2007). It was also reported in blue wildebeest and *Kudu* in South Africa (Van Wyk and Boomker, 2011). The different species of genus *Haemonchus* had a wide range of domestic and wildlife animal hosts as it is a known and widely spread ruminant parasite (Soulsby, 1982).

Oesophagostomum spp. was reported as the most predominant parasite in cattle in the neighboring *Abyei* area, South-western Sudan (Idriss *et al.*, 2012). *Oesophagostomum* eggs were found in the faeces of warthog (*Phacochoerus aethiopicus*) in Dinder National Park (Sudan) by Dunn (1978). Also *Oesophagostomum dentatum* was reported as a helminth of swine. *Oesophagostomum macombiquei* was described from 9 females of warthog (*Phacochoerus aethiopicus*) by Boomker (1990) in northern Mozambique. Also *Oesophagostomum spp.* was reported in water buffaloes in Bangladesh (Islam *et al.*, 1992).

The presence of *Trichuris* worms in olive and chacma baboon is commonly reported in Africa by Kuntz and Myers (1966), Kuntz and Myers (1967), Eley *et al.* (1989), McGrew *et al.* (1989), Muller *et al.* (1996), Munene *et al.* (1998), Murray *et al.* (2000), Hahn *et al.* (2003), Ocaido *et al.* (2003), Hope *et al.* (2004) and Legesse and Erko (2004). The present study confirmed that *Trichuris spp.* was the most predominant parasite of baboons (*Papio cynocephalus*) in *Radom* area. *Trichuris spp.* is known to infect different species of animals including man.

In a previous study conducted in Dinder National Park by Sayied and Agab (2009), *Moniezia spp.* was reported as the most predominant parasite in the park where it is noticed that the degree of this tapeworm (*Moniezia spp.*) infection in the warthog was higher (22%) than in the other wildlife species investigated in the Dinder National Park, namely, reedbucks (15.8%), waterbucks (13%) and buffaloes (6.9%). In Iran, *Moniezia expansa* was also reported in the goitered gazelle which were harbouring cestode and nematode worms (Eslami *et al.*, 1981). The results of the present study confirmed that *Moniezia spp.* was the most predominant parasite in warthog (*Phacochoerus aethiopicus*) in *Kafiakingi*. However, *Moniezia spp.* had the highest prevalence (44%) in warthog than in other animals investigated in the study area, possibly due to differences and uniqueness in feeding behavior of the warthog.

Coccidia spp. was reported as the most predominant parasite in bushbuck in South Western Uganda (Apio and Wronski, 2004). Sayied and El Mubarak (2007) recorded a high infection rate with this protozoan parasite in other wildlife species in DNP including baboons, buffaloes and waterbucks. In a more recent survey, coccidian oocysts were also detected in the faeces of all wild animals in Dinder National Park by Sayied and Agab (2009). Unlike the previous reports, the present study demonstrated that *Coccidia* oocysts had the highest prevalence in bushbuck (*Tragelaphus scriptus*) whereas the spotted hyaena (*Crocota crocota*) showed the lowest prevalence which may be due to the differences in the feeding behavior of the two types of animals.

The high prevalence of helminth parasites recorded among wildlife in this investigation necessitates the need to design and implement a control policy of helminths parasites in wild animals as well as adoption of a control policy in the domestic animals which were frequently found co-grazing with the wildlife in *Radom* National Park.

ACKNOWLEDGEMENTS

The technical assistance of Mr. S. A. Noja is greatly acknowledged. Due thanks are extended to Nyala Veterinary Research Laboratory Staff for their help and encouragement. Special acknowledgement and great appreciation for the General Administration of Wildlife Protection personnel, Nyala, Region, for help in wildlife faeces identification and for field guidance and orientation.

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مهددات الإحتشار الطفيلي الداخلي في الحيوانات البرية في حظيرة الردوم ، ولاية جنوب دارفور ، السودان

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تقدم هذه الورقة نتائج بحث ميداني عن الإحتشار الطفيلي الداخلي في عينات روث أربعة عشر نوعاً من الحيوانات البرية. تم جمع العينات من خمس مناطق بحظيرة الردوم المحمية القومية بولاية جنوب دارفور بغرب السودان وتشمل منطقة الردوم ، الحفرة ، تيتربي ، كفن دبي وكفية كنجي. تم رصد وجود علامات ودلائل الإحتشار الطفيلي في عينات الروث التي تم جمعها وفحصها أثناء المسح الميداني من جميع أنواع الحيوانات البرية. وجد أن من بين 579 عينة روث شملتها الدراسة وجود الإحتشار الطفيلي الداخلي في 177 عينة وبنسبة إصابة مئوية بلغت %30.6. وجد أن أبو الضلاف يملك أعلى نسبة إصابة بين الحيوانات التي شملها البحث الميداني بلغت %60 وأن الضبع المنقط (المرفعين) يملك أقل نسبة إصابة بين الحيوانات التي شملها البحث الميداني والتي بلغت %2.9. بلغت نسبة إصابة الحيوانات البرية بالإحتشار الداخلي %30.6. نسبة الإصابة في منطقة كفية كنجي وهي أعلى نسبة إصابة حيث بلغت %35.9، تليها منطقة كفن دبي بنسبة إصابة بلغت %35.1 بينما نسبة الإصابة في منطقة الحفرة وهي أقل نسبة إصابة حيث بلغت %17.6. تمت مقارنة ومناقشة نتائج هذا البحث مع نتائج بحوث سابقة مماثلة أجريت في السودان وكذلك مع بحوث مشابهة أجريت في مناطق أخرى من العالم.