RESEARCH COMMUNICATION

Faecal helminth egg and oocyst counts of a small population of African lions (*Panthera leo*) in the southwestern Kalahari, Namibia

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ABSTRACT

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An endoparasite survey of a small pride of African lions (*Panthera leo*) was conducted at Intu Afrika Kalahari Game Reserve, southwestern Namibia, during winter and summer of 2003 and 2004, respectively. Overall, 23 fresh lion scats were collected opportunistically during fieldwork trials. A flotation technique was employed for the diagnosis of parasites. Three nematodes, *Ancylostoma braziliense*, *Gnathostoma spinigerum* and *Uncinaria stenocephala* and two coccidians, *Toxoplasma gondii* and *Isospora felis* were recorded. By using the McMaster method for quantification, a maximum number of 14 866 oocysts per gram of faeces was obtained for *I. felis* during winter 2003. Endoparasite taxa carried by the different individuals in the pride were found to be related to their levels of association. Rates of infection were relatively low as a result of the habitat, semi-captive conditions and earlier sporadic deworming.

Keywords: Coccidians, endoparasites, Kalahari Desert, nematodes, *Panthera leo*

INTRODUCTION

Little data are available on the endoparasites carried by free-ranging African lions (*Panthera leo*) in the Kalahari Desert. What is available stems from East Africa (Müller-Graf 1995; Müller-Graf, Woolhouse & Packer 1999; Bjork, Averbeck & Stromberg 2000) or are anecdotal records from dead lions (Le Roux 1958; Rodgers 1974) or institutions where they were held captive. Parasites are known to influence fitness and, more recently, have also been shown to influence behaviour (Zimmer 2000). The endoparasitic taxa carried by each individual in the pride are influenced not only by how pride members associate, but also by the general health of the individual, the size of the parasite suprapopulation as well as ecological factors. Here we report on the endoparasites of a small pride of lions in the southwestern Kalahari, Namibia, as determined by opportunistic collection of faeces during field observations.

MATERIALS AND METHODS

Research subjects

A small pride of lions on the western fringe of the Kalahari Desert in southeastern Namibia was studied. The pride was held in a 500 ha enclosure on a private reserve, Intu Afrika Kalahari Game Reserve (24°33' S, 18°31' E), situated approximately 60 km

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north-east of Mariental. The pride consists of two adult males, an adult female and two cubs. The younger male and female are siblings and are closely bonded. The pride was being rehabilitated and was provided with a live animal once a week. Fieldwork trials on aspects of their behaviour were performed during winter (May to July 2003) and again during summer (February and March 2004). The cubs were born during November 2003 and were included in the summer trials.

Faecal collection and preservation

Intestinal parasite surveys were conducted by opportunistic collection of scats during field observations. A total of 23 fresh samples were collected from the adult lions during both summer and winter. During the summer, six samples of scat from the cubs were also obtained, four from the male and two from the female. Nematode eggs, cestode eggs and proglottids, and oocysts in the faeces were preserved in 10 % formalin in 750 mℓ glass bottles within 12 h after collection.

A standard operating procedure (SOP CVI/07/02/014 Faecal Examination: Diagnostic and Quantitative) obtained from ClinVet International (Pty) Limited was employed. Eggs of *Taenia* spp. could be identified by using a flotation technique and expelled proglottids were located by washing over a sieve with 0.5 mm apertures. The resulting residues were suspended in a small amount of water and examined under a stereoscopic microscope for the presence of proglottids.

A quantitative parasite egg and coccidian oocyst count was done according to the modified McMaster method described by Reinecke (1983).

RESULTS

The eggs of three nematodes, *Ancylostoma braziliense, Gnathostoma spinigerum* and *Uncinaria stenocephala*, and the oocysts of two coccidians, *Toxoplasma gondii* and *Isospora felis*, were recovered and identified following Soulsby (1982) and the experience of the laboratory staff of ClinVet International. All these species, excluding *Uncinaria*, are listed by Boomker, Penzhorn & Horak (1997) as typical helminth and coccidian parasites of African lions. Table 1 indicates the seasonal occurrence of the parasite species recovered. Intact and fragmented nematodes were also found in the scat during the summer trial. They were present in each flotation performed. A total of six samples, three from each season, were negative for any eggs, oocycts or worms when quantitative counts were done with the McMaster method. All of these were collected from the adult lions. As shown in Table 2, the intensity of eggs and oocysts of the endoparasites decreased during the subsequent summer trial except for the hookworm, *A. braziliense*, which increased.

Results differed during the flotation and the McMaster slide investigations. Two species of parasite, *A. braziliense* and *T. gondii*, were present in both the male lions. Flotation results for the older male indicated *A. braziliense* and the McMaster slide results showed only the presence of *T. gondii*. The younger male's flotation results indicated only *T. gondii*, while the McMaster slide demonstrated the presence of *A. braziliense*. The female had the highest egg counts in both the flotation and the McMaster slide counts. Flotation showed that the female harboured the oocysts of *I. felis*, but they were not present in the McMaster slide. Results for the female cub's flotation included *A. braziliense* and *I. felis*, whereas the former and *T. gondii* were present in the McMaster slide. In the case of the male cub, flotation indicated the presence of *A. braziliense*, *T. gondii* and *G. spinigerum,* while the McMaster slide showed only *T. gondii*. The female cub had a higher egg and oocyst count than the male cub. *Uncinaria stenocephala* was not present during the summer trials.

DISCUSSION

Egg and oocyst counts during both the winter and summer trials indicate low rates of infection. Research in the Serengeti and Ngorongoro Crater (Müller-Graf 1995) indicated that median values per gram faeces may reach up to 5 700 for coelozoic helminths with no apparent ill-effects to the host. With the exception of *A. braziliense*, all egg counts decreased from the winter to the summer trials (Table 2). The scope of the increase of the former is reduced by the increase in sample size since two cubs were included in the summer trials. The results, however, may be attributable to the high egg production of *A. braziliense* which permits a higher fecundity (Hinz 1988). Schmidt & Roberts (1985) state that some 25 000–30 000 eggs may be produced per day by a female in the gastrointestinal tract. In respect of the histozoic coccidians and specifically *I. felis*, oocyst counts subside after initial infection which explains the substantial decrease in oocyst count from winter to summer. Cysts persist in the tissue, egg production all but ceases and immunity responses after the first infection is generally permanent (Schmidt & Roberts

TABLE 1 Endoparasite suprapopulation in African lions during two contrasting periods of study at Intu Afrika Kalahari Game Reserve

	A. braziliense	*G. spinigerum*	*U. stenocephala*	*T. gondii*	*I. felis*
Winter 2003					
Older male	✓	✗	✗	✓	✓
Female	✓	✓	✗	✓	✓
Younger male	✓	✗	✓	✗	✓
Summer 2003					
Older male	✓	✗	✗	✓	✗
Female	✓	✓	✗	✓	✓
Younger male	✓	✗	✗	✓	✗
Male cub	✓	✓	✗	✓	✗
Female cub	✓	✗	✗	✓	✓

TABLE 2 Egg and oocyst counts of endoparasites in the pride of African lions at Intu Afrika Kalahari Game Reserve

	Sample size	**Infected samples**	**Infected hosts**	**Mean intensity**	**Maximum intensity**
Winter 2003					
A. braziliense	11	4	3	133	200
G. spinigerum	11	1	1	666	666
T. gondii	11	4	2	233	400
I. felis	11	7	3	3 320	14 866
Summer 2004					
A. braziliense	17	4	3	173	600
G. spinigerum	17	1	1	66	66
T. gondii	17	7	4	173	200
I. felis	17	1	1	66	66

1985). The high oocyst count for *I. felis* during the winter trials indicates a new infection for the female. Further to the former, the pride was dewormed one year prior to the inception of the fieldwork and the animals are fed, albeit live animals reducing exposure to some of the nematodes. The specific habitat experienced drought conditions for two years before the research and this would have assisted in reduction of viable parasite eggs in the environment.

The discrepancies between endoparasite presence in the flotation and McMaster slide can be explained in terms of the opportunistic nature of the scat collection and the random dispersion of endoparasite eggs and oocysts in faecal matter. When calculated in total, the female had the highest egg and oocyst counts using both the flotation and McMaster slide methods. Schmidt & Roberts (1985) call this phenomenon overdispersion and state that parasite infrapopulations are not randomly dispersed, but that a minority of the hosts will harbour a majority of the parasites.

A relative large number of intact and fragmented nematodes were found in the scat samples. In the case of both species of hookworms present, the eggs, after voiding, require warm and moist conditions to hatch into L1 or rhabditiform larvae (Schmidt & Roberts 1985). The majority of scats collected were in the form of diarrhoeic faeces. The lions were fed sporadically during the summer trials and engorged themselves when large ungulates were killed. The diarrhoeic faeces had to be left for a day or two to permit drying prior to being collected. During this time, some of the nematode eggs could have hatched. Alternatively, nematode eggs also hatch in warm, moist soil and as a result of the rains some of the hatched larvae in the scat may also have been present in the environment (Schmidt & Roberts 1985).

All of the helminth endoparasites found are transmitted either via the environment or by transplacental transmission. According to Noble & Noble (1988) congenital transmission of hookworms has been demonstrated in domestic dogs, but not in domestic cats. However, this has not been investigated in lions and remains to be proved or disproved. The infection of the female cub with *I. felis* was most likely due to contact with the female.

Curio (1988) reported that faecal egg counts matter correlate positively with dominance rank in the yellow baboon (*Papio cynocephalus*). The data collected on the Kalahari lion in this investigation does not support this. Although feeding habits of the older male should support greater exposure to parasites, especially *T. gondii* which has the herbivore as an intermediate host, behaviour may play a more prominent role in terms of the parasite burden. The older male spent most of his time alone and did not allogroom often and, as a result, his exposure to endoparasite eggs and oocysts from other members of the pride was reduced.

The younger male had the lowest egg and oocyst counts, which is contradictory to published data. The circumstances in which the lions were held were, however, unnatural and under more natural conditions the younger male would have left the pride for a nomadic lifestyle. All the behaviour of the younger male indicated that he was under considerable social pressure. Dominance from the older male was constant and turned violent as the younger male grew older and began to resist. When an animal is under stress, adrenal glands become hyperactive and corticosteroids are released (H. Bertschinger, personal communication 2004). This impacts negatively on the animal in question and reduces its resistance to parasites (Esch, Whitfield Gibbons & Bourque 1975).

Wilson (1976) makes mention of what Hans Seyle called the General Adaptation Syndrome in 1956, in which there is a sequence of three stages, namely the alarm stage when adrenal corticotropical hormones are released, a stage of resistance in which the adrenal glands enlarge due to a continuous increased demand for corticosteroids, and finally, a stage of exhaustion is reached when the body is not able to withstand the increased corticosteroid levels which increases the chances of infection. Aggressive interactions are named as the most potent of stressors. Exposure to infection in the younger male was also increased by the protracted periods spent with the female and later, the cubs.

The positive response determined in the younger male in terms of resistance to the parasites could be as a result of his response to the pressure. In all our observations of the animals' feeding, the younger male consumed the largest amounts of meat (on one occasion he fed for 4 h and 22 min) with an average consumption of 50 kg, and also drank water for 8.39 min, the longest time recorded. Although he was not weighed, he was obviously the most overweight of the lions and, as a result, he may have had the physiological resources to resist parasite infections.

The relatively low egg and oocyst counts and corresponding infection levels of the lion pride are as a result of a variety of factors. Firstly, the habitat was clean and parasites present in the environment would have been reduced by the two years of drought and the sporadic deworming prior to the inception of this study. Isolation of the lions from the greater reserve may also have been responsible for the fewer taxa present. Finally, the relative safety and lack of natural pressure on the animals would have permitted a well-functioning immune system allowing for a strong defense response to endoparasites.

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