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Coprologic Survey of Parasites of Spotted Hyenas (*Crocuta crocuta*) in the Masai Mara National Reserve, Kenya

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ABSTRACT: Seventy fecal samples from spotted hyenas (*Crocuta crocuta*) in the Masai Mara National Reserve, Kenya were examined for parasite eggs and oocysts using sugar flotation. A total of nine parasite genera were identified, and all samples were positive for at least one parasite species. Most individuals were infected with *Ancylostoma* sp. and *Spirometra* sp., and these species had the highest median intensity of infection. Other parasites identified include *Isospora* sp., Taeniidae, Spirurida, *Toxocara* sp., *Mesocestoides* sp., *Dipylidium* sp., and *Trichuris* sp.

Key words: *Ancylostoma*, *Crocuta crocuta*, Kenya, parasites, *Spirometra*, spotted hyena.

Spotted hyenas (*Crocuta crocuta*) are the most abundant large carnivore in sub-Saharan Africa (Frank, 1986), yet little is known about their parasites. Hyenas feed on a wide array of prey (Cooper et al., 1999) and frequently interact with other predators and scavengers at kills (Kruuk, 1972). Thus, spotted hyenas may be infected with parasites similar to their sympatric competitors, and they may be reservoir hosts for some of these parasites. Most records of hyena parasites are accounts from a few dead individuals (Mettrick and Beverley-Burton, 1961; Graber and Blanc, 1979) or studies of particular parasite taxa (Nelson et al., 1965; MacPherson et al., 1983). Intestinal parasites reported in spotted hyenas include two nematode and five cestode species (Round, 1968; Bwangamoi, 1970; Jooste, 1990). Our goals were to identify intestinal parasites present in a large group of wild hyenas and to describe the prevalence and intensity of these parasites.

From June 1999 to July 2000, we collected 207 fresh fecal samples from 70 hyenas residing in a single social group in the Masai Mara National Reserve, Kenya (1°49′S, 35°20′E). Hyenas in the study population feed almost exclusively upon ungulates, although they have been observed eating invertebrates, birds, and other mammals (Cooper et al., 1999). Individual hyenas were recognized by their unique patterns of spots and other physical characteristics such as ear notches. All samples were collected from individuals observed defecating. We used liquid displacement to measure 0.5 ml of fecal matter into 7 ml of Sheather's sugar water solution (Zajac, 1994). The mixture was homogenized and centrifuged for 5 min at 7,200×G, then supernatant was transferred to a McMaster slide. All eggs and oocytes observed within the gridlines were identified and the number of eggs per gram was calculated and recorded. Because we examined eggs and oocytes rather than whole worms we were able to identify most parasites only to genus. In order to avoid pseudoreplication in analyses of prevalence and intensity of infection, only a single, randomly chosen sample from each individual was used.

Nine parasite taxa were identified in the 70 fecal samples (Table 1), including one spurious species (*Nematodirus* sp.). In 135 additional samples from the same individuals, two more species, *Trichuris* sp. and *Moniezia* sp. were identified. Like *Nematodirus* sp., *Moniezia* sp. was spurious (i.e., it was a parasite of the hyenas' prey). Neither spurious species was included in measures of parasite richness. All 70 individuals were positive for at least one species of parasite. On average, each individual was infected with 2.60±0.13 species (range 1–5). Intensity of infection, that is, the mean number of eggs per gram among infected individuals, was overdispersed

TABLE 1. Prevalence and intensity (eggs per gram of feces) of parasite eggs and oocytes in the feces of 70 wild spotted hyaenas.

Parasite	Prevalence (%)	Median intensity (e.p.g.)[a]	Maximum intensity (e.p.g.)	Variance/mean ratio of abundance
Ancylostoma sp.	90.0	1,000	17,600	0.44
Spirometra sp.	74.3	3,000	67,200	1.07
Isospora sp.	25.7	200	4,000	1.91
Dipylidium sp.	21.4	300	1,200	2.00
Spirurida	15.7	200	300	1.90
Taeniidae	12.9	200	3,400	2.36
Mesocestoides sp.	11.4	200	500	2.11
Toxocara sp.	5.7	200	1,600	2.44
Nematodirus sp.	4.3	200	300	2.30
Unknown	2.9	150	200	—
Trichuris sp.[b]	0	0	0	—
Moniezia sp.[b]	0	0	0	—

[a] e.p.g.=eggs per gram of feces.
[b] *Trichuris* sp. and *Moniezia* sp. were observed in additional samples from the same individuals.

(variance>mean) for most parasite taxa, so median levels of infection are displayed in Table 1.

Hookworms (*Ancylostoma* sp.) were the most common parasite, with 90% of individuals infected. Graber and Blanc (1979) reported infections of *Ancylostoma duodenale* in hyenas from Ethiopia and the eggs found here (60×40 μm) were consistent with their description. The spirurid eggs were approximately 36×12 μm and were likely *Spirocerca lupi. Spirocerca lupi* is frequently found in Kenyan dogs, but it was not observed in three hyenas dissected by Brodey et al. (1977). We also found eggs of *Toxocara* sp. Although *Toxocara canis* has been identified in hyenas (Baylis, 1937), the dimensions of these eggs (62×60 μm) more closely resembled those of *Toxocara cati.*

Spirometra sp. eggs were common (74% of individuals infected) and had the highest median intensity of infection. These eggs (65×38 μm) were probably *Spirometra pretoriensis,* which Nelson et al. (1965) and Graber and Blanc (1979) found in hyenas. Plerocercoids (spargana) of *Spirometra* are relatively common in the hock joints and flesh of several ungulate species that hyenas feed upon (Sachs and Sachs, 1968), and *Spirometra* sp. was the most prevalent parasite in a survey of lion feces in Tanzania (Müller-Graf, 1995). Several other types of cestode eggs were also identified. We found numerous taeniid eggs (35 μm), which could be *Taenia crocutae, T. hyaenae, T. olngojinei,* or *Echinococcus granulosus,* all of which have been reported in hyenas (Baer, 1924; Mettrick and Beverley-Burton, 1961; Nelson et al., 1965; Dinnik and Sachs, 1969). In addition, we found 20×25 μm eggs of *Mesocestoides* sp., which have not previously been recorded in hyenas but are known to infect other African carnivores, including lions (*Panthera leo*), servals (*Felis serval*), and caracals (*Felis caracal*) (Round, 1968). In some samples, we found eggs (35×25 μm) of *Dipylidium* sp., a common parasite of Kenyan dogs and jackals (*Canis mesomelas*) (Nelson et al., 1965), which was previously reported in hyenas (Round, 1968).

A single protozoan, *Isospora* sp. was observed. The size of the oocysts (35×26 μm) was intermediate between that of *Isospora felis* and *I. leonina,* two species recorded in African lions but not in hyenas (Patnaik and Acharjyo, 1970; Bjork et al., 2000). The paucity of protozoan species recovered in this study may have been a result of the concentration method used.

Protozoans tend to become distorted and desiccated in saturated sugar and salt solutions (Zajac, 1994). Finally, 2.9% of samples contained unidentified parasites.

Spotted hyenas are generalists, and it is not surprising that many of the parasite genera that infect hyenas also infect other African carnivores. Most of the parasites that we found in hyena feces have a heteroxenous life cycle, which requires transmission through an intermediate host. Identification of these parasites to species level will provide greater insight into the overlap in parasite communities of sympatric carnivores.

Although fecal flotation procedures may effectively detect only a subset of parasite eggs present in a sample (Zajac, 1994), the techniques used in this study are relatively simple and can be replicated in remote field sites with little equipment. By collecting similar samples from different locations and over longer time periods, we may gain insight into the ecologic and behavioral factors that influence susceptibility of individuals and populations to parasitic infections.

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