Journal of Zoo and Wildlife Medicine 31(1): 56–61, 2000

PARASITES AND PARASITE STAGES OF FREE-RANGING WILD LIONS (*PANTHERA LEO*) OF NORTHERN TANZANIA

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Abstract: Fecal samples from 33 lions (*Panthera leo*) in Serengeti National Park and Ngorongoro Crater Conservation Area in northern Tanzania contained 19 different parasites, 12 of which, including *Aelurostrongylus* sp., a species of Acanthocephala, a species of Anoplocephalidae, *Capillaria* sp., *Demodex* sp., *Eimeria* sp., *Habronema* sp., *Isospora felis, Isospora rivolta,* one species of *Isospora* that was previously undescribed from lions, one species of Trematoda that was previously undescribed from lions, and *Trichuris* sp., were new reports for lions. Seven other species had been previously reported from lions.

Key words: Lion, *Panthera leo,* survey, parasites, Serengeti, Africa.

INTRODUCTION

Numerous reports of African lion (*Panthera leo*) endoparasites originate from zoological parks and managed game reserves without indication of the lions' origins, their diets or prey, or their movements. Reports are sparse on parasites of free-ranging wild lions of eastern Africa. *Taenia regis, Taenia gonyamai,* and *Taenia simbae* were found in lion collections from the Serengeti,[5] and *Spirometra* sp. was frequent in these lions.[23]

Accounts of parasitism in free-ranging lions from other areas of Africa, particularly southern Africa, are more numerous. *Ancylostoma paraduodenale* has been found in lions in Northern Rhodesia,[4] as have *Lagochilascaris major* in the Congo,[27] *Echinococcus felidis* in Northern Transvaal,[12] and *Echinococcus granulosus felidis* in Transvaal.[28] *Trichinella spiralis, Dirofilaria sudanensis, Linguatula serrata, Linguatula nuttalli, Cylicospirura* sp.,[28] and *Schistosoma mattheei*[20] were reported from Kruger National Park. An individual lion from Northern Rhodesia was infected with *Pharyngostomum cordatum, Galoncus perniciosis, Gnathostoma spinigerum, Mesocestoides* sp., *Dipylidium* sp., *Ollulanus tricuspis, Toxascaris leonina, Physaloptera praeputialis, Dirofilaria acutiuscula, A. paraduodenale,* and *Ancylostoma tubaeforme.*[9] *Taenia hydatigena* was reported from a lion in Nigeria that had originated from the Leipzig Zoological Gardens, Germany, where it had been fed raw goat meat.[11]

Many reports of lion endoparasites are from zoos in India, but information on lion habitat, origin, or diet is incomplete. Sarcocysts were found in two zoo lions,[3] and *Taenia jaipurensis* was found in the intestine of a lion that died in the Jaipur Zoo.[25] *Spirometra erinacea,*[14] *Ascaris felis, Galonchus perniciosus,*[15] *T. leonina,*[6] and *Parascaris felis*[1] were all reported. Both wild Gir forest lions and Indian zoo lions had *Spirometra* sp., *Toxascaris* sp., and *Ancylostoma* sp.[7,13,18]

Toxocara cati, T. leonina, and *Spirometra* sp. were described in Australian circus lions,[21] and zoo lions in central California were serologically positive for *Toxoplasma gondii.*[22] *Giardia* sp. was reported from a captive lion.[8] Two undescribed species of *Isospora* were reported from captive lion cubs in England.[19] A spurious coccidian parasite, *Eimeria felina,* was observed in a lion from the Leningrad Zoo.[18]

MATERIALS AND METHODS

One freshly defecated fecal sample was collected from each of 33 individual wild adult lions from June to September 1985 and May to November 1986 in Serengeti National Park (central coordinates 34°50′E, 02°30′S) and the Ngorongoro Crater Conservation Area (35°35′E, 03°10′S) in northern Tanzania. Additionally, in Serengeti National Park in 1985, a fecal sample and whole gastrointestinal parasites were taken during necropsy from a 12-yr-old lioness within 12 hr after death, with the parasites preserved in 10% formalin. Each lion's individual identifier, age, gender, and location at the time of sample collection were recorded. When parasite identification was complete, the information was added to each lion's record.

Samples from 1985 were examined by direct smear and $ZnSO_4$ (Fisher Scientific, Pittsburgh, Pennsylvania 15238-2959, USA) solution centrifugal flotation[26] on the day of collection. A portion of the feces was saved in 10% formalin for later parasite identification. Samples from 1986 were fixed in 10% formalin, then examined within 6 wk by $ZnSO_4$ centrifugal flotation.

Parasites were identified at the University of

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Table 1. Parasites identified from 33 lions, structure used in identification, number of structures measured, size range and mean size of structures, and number and percentage of infected lions.

Parasite[a]	Structure	Mean length in μm (range)	Mean width in μm (range)	Lions infected (%)
Protozoa				
Eimeria sp.*	oocyst	50.0	25.0	1 (3)
Giardia sp.	trophozoite	—	—	2 (6)
*Isospora felis**	oocyst	43.0 (45.0–39.0)	30.0 (35.0–25.0)	16 (48)
*Isospora rivolta**	oocyst	25.0 (30.0–20.0)	21.0 (25.0–15.0)	2 (6)
Isospora sp.*	oocyst	15.0	15.0	1 (3)
Sarcocystis sp.	sporocyst	12.9 (13.8–12.5)	8.1 (8.8–7.5)	15 (45)
Toxoplasma-like sp.	oocyst	12.0 (12.5–11.25)	11.7 (12.5–11.3)	4 (12)
Trematoda				
Trematoda-like ''A''*	egg	63.6 (75.0–55.0)	35.6 (40.0–30.0)	11 (33)
Trematoda-like ''B''*	egg	40.0	25.0	1 (3)
Cestoda				
Anoplocephalidae*	egg	55.0	47.0	1 (3)
Taenia sp.**	segments	—	—	—
Taeniidae	egg	35.7 (37.5–35.0)	31.0 (35.0–30.0)	5 (15)
Nematoda				
Aelurostrongylus sp.*	larvae	281.9 (302.8–250.0)	14.4 (15.0–12.5)	7 (21)
Ancylostoma sp.	egg	61.0 (70.0–50.0)	40.6 (45.0–35.0)	9 (27)
*Ancylostoma paraduodenale**	adult worms	—	—	—
Capillaria sp.*	egg	75.0	35.0	1 (3)
Habronema sp.*	egg	49.0 (50.0–47.9)	10.0	2 (6)
Toxocara cati	egg	75.0	70.0 (75.0–60.0)	3 (9)
Trichuris-like sp.	egg	32.5	15.0	1 (3)
Acanthocephala				
Acanthocephala*	egg	80.0	50.0	1 (3)
Arthropoda				
Demodex sp.*	adult	—	—	1 (3)

[a] * = Parasites not previously documented from the lion; ** = parasites recovered from necropsied lion; not included in prevalence data.

Minnesota Veterinary Parasitology Laboratory, St. Paul, Minnesota 55108, USA.[8,10,16–18,26] Parasite stages were measured microscopically with a calibrated ocular micrometer (Olympus Optical Co. Ltd., Tokyo, Japan).

Data were analyzed with SAS version 6.12 software for the personal computer.[24] Differences in the mean number of parasite species between lion sexes and habitats were tested for significance by using Student's *t*-test. The relationship between lion age (as the predictive variable) and number of parasite species in the stool sample (as the response variable) was analyzed by simple linear regression.

RESULTS

Nineteen different parasites were identified. Prevalence, mean size, and size range of each type of parasite are presented in Table 1. The number of parasites recovered per lion ranged from zero to nine, and the mean was three. The mean number of parasite species did not differ with sex or habitat, and lion age was not a significant predictor for parasite number ($P > 0.05$).

Six apicomplexan protozoans and one mastigophoran were recovered from 26 lions and included sporocysts of *Sarcocystis* sp., oocysts of *Isospora*, and oocysts morphologically resembling *Toxoplasma* sp. One *Eimeria* sp. oocyst was identified from a single sample but was a spurious parasite. *Giardia* sp. trophozoites, but no cysts, were observed in the feces of two lions.

Helminth eggs, including trematode-like (trematode and/or pseudophyllidean cestode), cyclophyllidean, nematode, and acanthocephalan forms, were found in 23 samples. The trematode-type eggs included *Spirometra* sp. and a smaller, symmetrical

egg with a discrete operculum that could not be identified further. Taeniid eggs were observed in five samples, and anoplocephalid eggs were observed in one. *Taenia* sp. adults, too autolyzed to be identified to species, were recovered from the small intestine of the necropsied lion. The most common nematodes observed were first-stage larval forms morphologically resembling those of *Aelurostrongylus abstrusus* and morulate eggs identical to those of *Ancylostoma* spp. Adult hookworms identified as *A. paraduodenale* were observed in the small intestine of the necropsied lion. A single *Trichuris* sp. egg and another of *Capillaria* sp. were identified, as were eggs of *T. cati, Habronema* sp., and an acanthocephalan. Adult *Demodex* sp. mites were observed in the feces of one lion.

Figures 1 and 2 present the parasite stages that have been reported from lion feces, and those found in this study are identified with an asterisk. All other renderings of parasite stages were based on images and descriptions from various sources.[6,9,12,17,18,20,26–28]

Discussion

This is the first documentation of enteric parasites in a wild population of African lions in the Serengeti region and complements an earlier survey of the hematozoans of this population.[2] Of the 19 parasites or parasite stages observed, published reports are available for six in African lions. Of the remaining 13, some may be spurious findings, with the most likely source being prey species. Lions of the Serengeti region feed on diverse prey including wildebeest, zebra, several members of the antelope family, and warthogs, depending on the season. Thus, a diversity of parasite eggs and cysts may traverse the lion gastrointestinal tract throughout the year. *Eimeria* spp. do not usually parasitize felids, so the oocyst found in this study is probably a spurious parasite.

The larval *Aelurostrongylus* sp. nematodes and the adult *Demodex* sp. mites were identical to those found in other felid species[16,26] and may represent a true parasitic infection. The *Capillaria* sp. egg differed morphologically from capillarids commonly encountered in other felids.[16,17,26] The single *Trichuris*-like egg was much smaller than those of domestic cats.

One of the trematode-like eggs was identified as *Spirometra* sp., which has been identified frequently from Serengeti lions.[23] The other trematode-like egg did not resemble other felid trematode or pseudophyllidean eggs and may have been spurious. Future studies should attempt to culture trematode-type eggs to a level of development that would allow a more precise identification.

Acanthocephalan eggs similar to the eggs of the swine parasite *Macracanthorhynchus hirudinaceus* and anoplocephalid eggs that resembled those found in a number of herbivores have not previously been reported from lions and may also have been spurious parasites.

Previously identified lion parasite taxa include *Sarcocystis* sp., *Toxoplasma*-like sp., *Giardia* sp., taeniid cestodes, strongylid nematodes, and *T. cati.* We observed the sporocyst stage of a *Sarcocystis* species, and this parasite has been previously reported only in the schizogonous stage in lion muscle. *Toxoplasma gondii,* identified by serum antibody titer in a captive lion,[22] has not been reported in lions in the oocyst stage.

Giardia sp. trophozoites were reported in two lions in this study. It is possible that a technique more suitable for the detection of *Giardia* spp. in preserved feces, such as a direct immunofluorescence assay (IFA), may reveal a higher prevalence of infection than did $ZnSO_4$ centrifugal flotation. Flotation is inadequate for detecting formalin-fixed *Giardia* sp. cysts. Testing by IFA may also be necessary to detect other parasites such as *Cryptosporidium* sp.

The eggs of *Taenia* spp. and *Echinococcus* spp. are indistinguishable from each other in a fecal flotation; however, the several adult *Taenia* sp. in the necropsied lion suggest that eggs may have been *Taenia* sp. Taeniid infections in lions may also be more prevalent than suggested in this study because gravid *Taenia* sp. segments are more common in scats than are individual eggs and are normally not observed on centrifugal flotations.

The strongylid eggs, morphologically similar to hookworm eggs, were probably from a species of *Ancylostoma.* The adult worms recovered from the necropsied lion suggest that some or all were *A. paraduodenale.* Adults and larvae of *O. tricuspis,* a trichostrongyle that parasitizes lions, are found in host vomitus and would not normally be encountered in feces. *Habronema* sp., a spirurid nematode parasite of equids, may have been spurious, resulting from lions preying on zebras. It is possible that species of spirurids noted in other studies (such as *P. praeputialis, G. spinigerum,* and *Cylicospirura* sp.) were not seen in this population of lions because of the limitations of the centrifugal flotation technique. Examination of direct smears or sediments of fecal material might reveal the presence of these parasites. *Toxocara cati* has been found previously in captive circus lions but has not been reported from wild, free-ranging lions.

Without thorough demonstrations of life cycles and cross-infectivity studies of a number of these parasites, no positive identification to species can

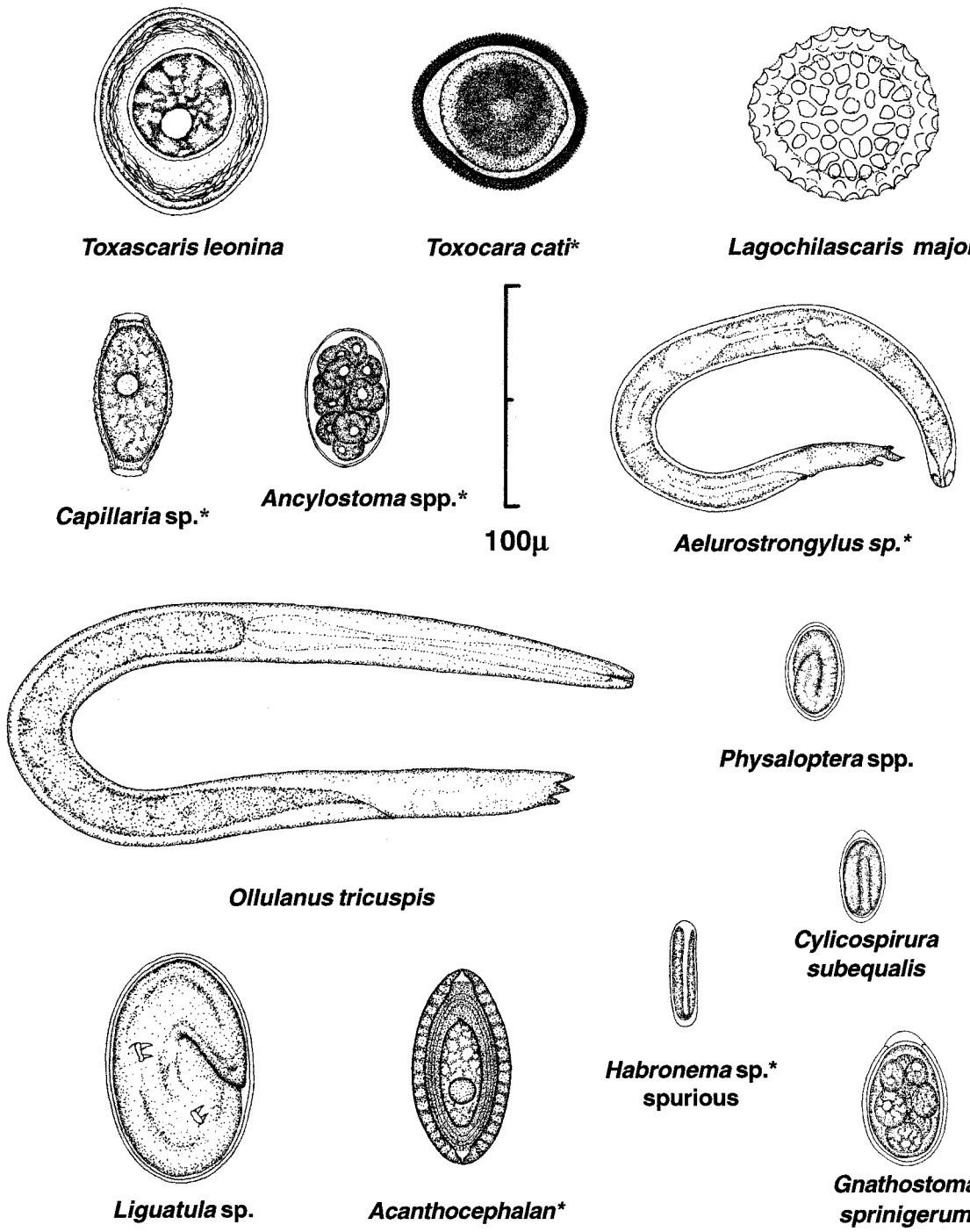

Figure 1. Nematode, acanthocephalan, and pentastomid stages observed in lion feces or vomitus (*Ollulanus tricuspis*). Spurious indicates that the structure is thought to have originated from a prey species and does not represent a true parasite of lions. Asterisk indicates products observed during this study. All other renderings of parasite stages were based on images and descriptions from sources referenced in the text. Scale bar = 100 µm.

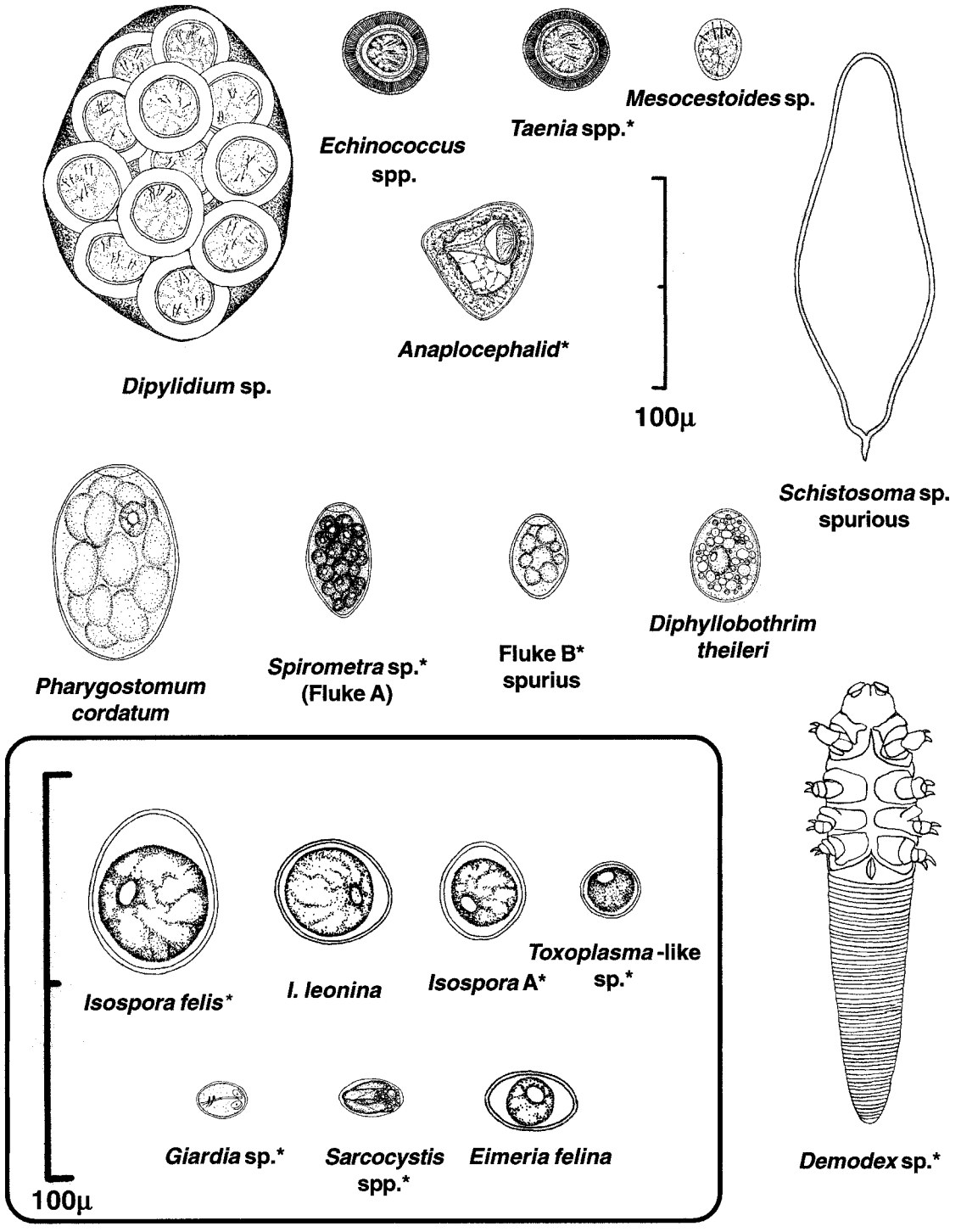

Figure 2. Cestode, trematode, protozoan, and arthropod stages observed in lion feces. Spurious indicates that the structure is thought to have originated from a prey species and does not represent a true parasite of lions. Asterisk indicates products observed during this study. All other renderings of parasite stages were based on images and descriptions from sources referenced in the text. Scale bar = 100 µm.

be made. To differentiate true parasitism from spurious findings, careful collection of parasites, complete cultures, and other techniques must be performed. In addition, single random samples from a group of lions may not be representative of the temporal or spatial variation in parasitic infection in a wild population. This study is therefore qualitative in nature. Further taxonomic and epidemiologic studies to determine parasite speciation, intermediate hosts and life cycles, and the importance of parasites and other diseases in predator–prey relationships are needed.

Acknowledgments: We thank Craig Packer and Anne Pusey, University of Minnesota, Tanzania National Parks, Serengeti Wildlife Research Institute, Ngorongoro Conservation Area Authority, and Tanzania National Research Council for enabling us to conduct this study and Lisa Gizzi for editorial assistance with the manuscript. This work was supported in part by National Science Foundation grant BSR-8507087 and a grant from the Minnesota Veterinary Medical Council.

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Received for publication 20 April 1998