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Preliminary results from a survey on the prevalence of parasitic helminths and protozoa in raccoons, opossums, and skunks, with special reference to *Baylisascaris* spp.

Michelle Belviy*, T.A. Yazwinski§, C.A. Tucker†,
and Jennifer Robins

ABSTRACT

Raccoons, skunks, and opossums (N=57, 60, and 60, respectively) were necropsied for parasite detection and identification from September, 2001 until April, 2002. Qualitative coprological exams and adult *Baylisascaris* collections have been completed. Fecal stages and/or types found were *Baylisascaris* and *Strongyloides*-type (skunks and raccoons); *Capillaria* and *Trichostrongyle*-type (raccoons and opossums); *Acanthacephalan* and ascarid type (opossums only); free larvae (skunks only); and coccidial (protozoan) oocysts (all three host species). Adult *Baylisascaris* were recovered from 33.3% of the raccoons and 58.3% of the skunks. Data collection relative to this survey, which is still ongoing, includes the determination of *Sarcocystis* prevalence in excised skunk and raccoon muscle as well as prevalence and magnitude of the numerous enteric helminths recovered from the three host animals.

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INTRODUCTION

Many pathogenic organisms are reservoired in wild (sylvatic) animals, which cause disease in domesticated animals as well as in humans (latter diseases referred to as zoonoses). *Sarcocystis neurona* is a protozoan parasite of the opossum's intestinal tract, but if the parasite is ingested by a horse, central nervous system infection and dysfunction follow, culminating in a disease called equine protozoal myeloencephalitis (EPM) (NAHMS, 2001). All life cycles of *S. neurona* have not been totally defined, especially in regard to the paratenic hosts that both reservoir and distribute this protozoan parasite (Dubey et al., 2001). Exposure of horses to the pathogen is common, with sero-positive rates of 50% or higher (Blythe et al., 1997). Fortunately, only a small percentage of exposed horses develop EPM, with early detection and treatment proving very successful (Fenger, 1996).

Results from the current survey will be valuable in assessing the extent of pathogen availability in our area, a factor directly related to the health threat that exists for horses.

The other parasites targeted in the current survey are *Baylisascaris procyonis* and *B. columnaris* of the raccoon and striped skunk, respectively. These nematodes are entirely enteric in the above hosts, but assume aberrant migrations (visceral, ocular, and neural larval migrans) in paratenic hosts including humans (Kazacos, 1986). These migrations are poorly diagnosed, and therapy is usually not obviated until central nervous system involvement is evident (Kazacos, 1982). Knowledge of the prevalence of these nematodes is therefore very important from the standpoint of human health concerns, especially in relation to those individuals who utilize the more natural parts of our "Natural State".

MEET THE STUDENT-AUTHOR



Michelle Belviy

I graduated in 1999 from Mount St. Mary Academy in Little Rock. I am a junior honors student majoring in animal science with an added pre-vet curriculum. I have received several scholarships and honors over the years including the Target All-Around Scholarship, Pre-Vet Club Scholarship, Arena Seat Scholarship, Meat Sciences Scholarship, University Housing Resident Assistant Scholarship, First Place-Gamma Sigma Delta Undergraduate Research competition, Dale Bumpers Undergraduate Research Grant, as well as several certificates for recognition of academic achievement.

During the summer of 2000, I interned with a veterinarian in Arizona and observed first-hand the procedures of veterinary medicine in the feed lot industry. I plan to graduate in May of 2003 with a B.S. degree in animal science and continue my education in veterinary school.

I am active in and have been an officer for several clubs on campus including Pre-Vet Club, Alpha Zeta, Sigma Alpha, and Student Health Advisory Committee. I am also a member of the National Society for Collegiate Scholars, Gamma Beta Phi, and Golden Key. Currently, I am a resident assistant for the medical sciences floor in Pomfret Hall.

I came upon this field of research because of my fascination with parasitology. Parasites are a major factor in animal

health, a field obviously very important to me. This study has helped me to expand my knowledge of animals and their parasites. The information I have gained by studying the symbiotic relationship between animals and helminths, identifying helminths, and learning time management to accomplish all of this, will be an excellent resource for me in veterinary school and beyond.

I would like to thank Dr. Yazwinski, Dr. Chris Tucker, and Jennifer Robins for all the guidance, time, and labor they have contributed to this project.

MATERIALS AND METHODS

Raccoons, opossums, and skunks were obtained starting in September of 2001 and collection continues at this time (May, 2002). The primary source of specimens was recent intact road-kill (< 1 day from time of demise). In addition, live-trapped animals humanely euthanized via gun-shot were also used. These latter animals were obtained under Arkansas Game and Fish Commission permit (License No. 197009 222001 112347). An adequate sample size of 60 animals per species was set as a target, which has been reached for skunks and opossums but not for raccoons (N=57).

All animals were necropsied according to standard protocol as provided below:

- (1) Haircoat and skin inspected for external parasites or lesions (i.e. mange).
- (2) Abdominal and thoracic cavities opened ventrally along the entire midline.
- (3) Intestinal tract from stomach to rectum removed (fecal sample obtained at this time for qualitative parasite egg detection via saturated MgSO₄ flotation followed by microscopic examination).
- (4) Intestinal tract opened lengthwise and all contents washed over a #120 mesh sieve.
- (5) Sieve residue placed in formalin until subsequent inspection, in total, at 10-40x for parasite collection, identification, and counting.

In addition to the above, sections of muscle were obtained from all skunks and the majority of the raccoons for shipment to Dr. Ellis Greiner (University of Florida School of Veterinary Medicine) for research as to the content and identity of encysted protozoan parasites (e.g. *S. neurona*).

Microscopy was conducted with a stereoscopic microscope for magnifications < 40 X and a compound microscope for magnifications > 40X. Small helminths (<2 CM) were cleared in lactophenol for 24 hrs. prior to inspection and/or photography. In regard to photography, egg and helminth images were received through a color video camera and digitized to a computer for recording.

RESULTS AND DISCUSSION

At the time of this writing, data collection is still in progress. Results from completed qualitative coprological examinations as well as the isolation, identification, and counting of adult *B. procyonis* and *B. columnaris* can be reported at this time.

The prevalence rates of the different types of fecal stages detected during the coprological exams are given

in Table 1. Pictures of the various stages are given in Fig. 1. Strongyloides-type eggs were the most frequently found in skunk samples—an egg characterized by the inclusion of a motile larva. Additionally, 68% of the skunk samples were positive for coccidial (protozoan) oocysts and 32% were positive for *B. columnaris* eggs. For raccoon samples, Trichostrongyle-type eggs were the most common, followed in frequency by coccidial oocysts and *B. procyonis* eggs. The most prevalent egg type found in opossum samples was acanthocephalan (“thorny-head”), a class of parasite only seen in the opossums obtained in the survey.

The opossum is the primary if not sole definitive host for *S. neurona*. In our survey, only 9.7% of the opossums were passing coccidial oocysts. In addition to a low frequency of oocyst shedding, the oocysts passed by the opossums in the survey did not appear (description and size) to be *S. neurona* (Cheadle et al., 2001). This apparent lack of *S. neurona* detection in the surveyed opossums might be due to laboratory technique and chemicals, factors extremely critical for the successful isolation of *S. neurona* stages (E. Greiner, personal communication). Therefore, documentation of *S. neurona* presence in Arkansas will hopefully be provided by the histological and molecular (DNA) work done at the University of Florida School of Veterinary Medicine from the raccoon and skunk muscle samples as obtained in this survey.

Characterization of the adult *Baylisascaris* burdens found in the surveyed raccoons and skunks is given in Table 2. Pictures of these nematodes are presented in Fig. 2. Adult forms of these parasites were found in 33.3% and 58.3% of the raccoons and skunks, respectively. Rates of patent infections (positive for fecal egg counts) were slightly lower due most likely to worm maturity. Overall rates of infection by these nematodes will undoubtedly be higher, once all smaller parasite forms are identified and counted.

As can be seen from the above data, *Baylisascaris* is of high prevalence in our area. Numerous reports document the adverse effects of this parasite when it is accidentally ingested by humans and migrates to the eye (ocular larval migrans) or brain (neural larval migrans) (Kazacos, 1986; Kazacos, 1997; Kazacos and Boyce, 1989). In addition, non-human vertebrates serving as paratenic hosts also suffer from the nematode’s larval migration (Clark et al., 1969; Kazacos, 1981; Stringfield and Sedgwick, 1997). Therefore, without question, this parasite is ubiquitous and poses considerable threat to human as well as animal health and should be scrutinized along with the more notorious sylvatic, zoonotic parasites such as *Giardia*, *Toxoplasma*, *Echinococcus*, and *Trichinella*.

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Table 1. Prevalence of progeny shedding by type of fecal stage and host.

Characterization of fecal stage/type	Percentage of animals positive by host		
	Skunk	Raccoon	Opossum
<i>Baylisascaris</i>	32.0	25.6	0.0
<i>Strongyloides</i> - type	70.0	7.7	0.0
<i>Trichostrongyle</i> - type	0.0	84.6	41.9
<i>Capillaria</i>	0.0	28.2	32.3
<i>Acanthacephalan</i>	0.0	0.0	87.1
Ascarid - type	0.0	0.0	16.1
Free larvae	22.0	0.0	0.0
Protozoan oocyst	68.0	74.4	9.7

Table 2. Comparative characterization of adult *Baylisascaris* burdens as found in this study.

Item	Host (Nematode)	
	Raccoon (<i>B. procyonis</i>)	Skunk (<i>B. columnaris</i>)
Arithmetic mean for adult forms in positive animals	13.7	5.0
Range in number of adult forms in positive animals	1-40	1-19
% of animals infected with adult forms	33.3	58.3
% of animals with positive fecal egg counts (% patent)	25.6	32.0



Fig. 1a. Parasitic eggs from opossum, fecal flotation.

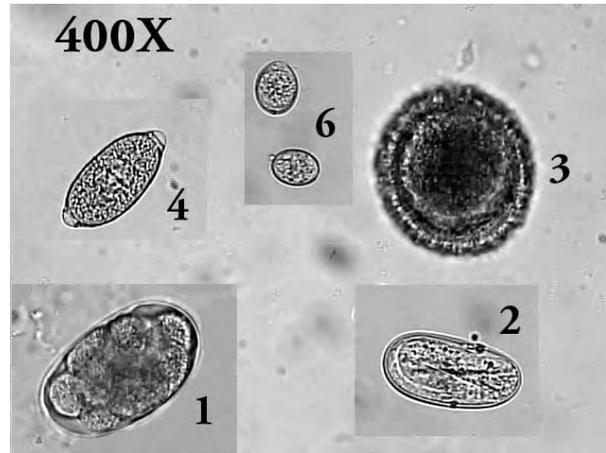


Fig. 1b. Parasitic eggs from raccoon, fecal flotation.

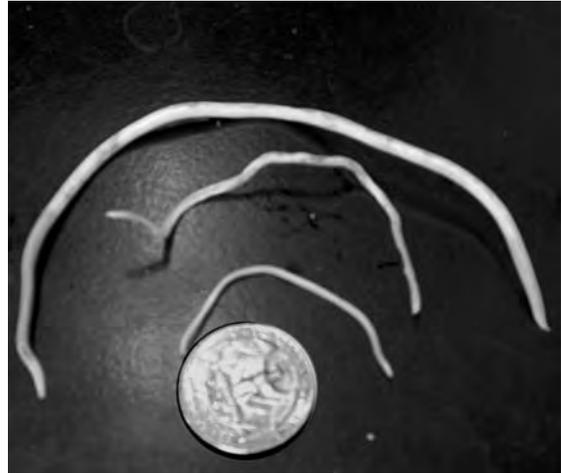


Fig. 1c. Parasitic eggs from skunk, fecal flotation.

- Egg/Oocyst Type
1. *Trichostrongylid*
 2. *Strongyloides*
 3. *Baylisascaris*
 4. *Capillaria*
 5. *Acanthocephalan*
 6. Protozoan oocyst



Baylisascaris procyonis



Baylisascaris columnaris

Fig. 2. Typical *Baylisascaris* specimens recovered and counted as adults