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Thanks to Dr. Andrew Hope of the Kansas State University Department of Biology for trapping the rodents and preserving our specimens for study, as well as everyone in the SIUC parasitology lab.

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It is always worth it to check it again: examining nematodes of rodents from the Konza Prairie

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A thesis submitted to the University Honors Program in partial fulfillment of the requirements
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Southern Illinois University

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Abstract

The Konza Prairie Long-Term Ecological Research (LTER) is centered on the 3,487-hectare tallgrass Konza Prairie in eastern Kansas. The area supports 11 common species of rodents, some of which are reservoirs of zoonotic microparasites, including etiological agents for babesiosis and Lyme disease. Furthermore, each of the rodent species harbors an array of helminths. No baseline inventories of helminths or microparasites have yet been performed through the tallgrass prairie ecoregion. We captured rodents using Sherman traps, processed them via standard museum methods, and examined them for nematodes. Necropsies were completed on the same day of capture and nematodes collected were fixed and preserved with ethanol. Cleared specimens allowed the characterization of nematodes infecting seven species of mice. These include *Mastophorus cf. muris* found in the stomach of *Reithrodontomys megalotis*, *Microtus ochrogaster*, *Peromyscus leucopus*, and *Sigmodon hispidus*; *Pterygodermatites parkeri* from the small intestine of *Peromyscus leucopus*; *Syphacia cf. obvelata* collected in the large intestine of *Microtus ochrogaster*; *Trichuris spp.* found in the large intestine of *Neotoma floridana* and *Microtus ochrogaster*, and finally *Vexillata armandae* from the small intestine of *Chaetodipus hispidus*. *Mastophorus cf. muris* and *Syphacia cf. obvelata* appear to be common parasites of voles and mice across North America, however our analyses suggest that these organisms are fairly divergent from specimens assigned to these taxa elsewhere across the Holarctic. These parasite biodiversity surveys provide a fundamental first step to understanding evolution, distribution, and pathogen dynamics across spatial and temporal scales.

Introduction

The Konza Prairie is a Long Term Ecological Research Observatory (LTER) in Kansas, and as such may serve as a model for other regions of the Great Plains, including agricultural lands. There is currently no recent data regarding the species of nematodes present in the area. Developing an inventory of symbionts associated with the rodents residing in the prairie is an important first step in establishing a baseline for evaluating changes in community structure. The rodents found in the Konza Prairie are widely distributed across the central United States, and many of these act as potential reservoirs for various zoonotic diseases. The Konza is a predicted “hot spot” for many of these rodents². When these animals are subjected to stressors, including endoparasites such as nematodes, their diminished immune function may contribute to the spread of these diseases throughout the regions in which they inhabit. Common zoonotic diseases with rodent reservoirs include leptospirosis, tularemia, salmonellosis, and herpesvirus.

Objectives

- Develop an inventory of rodent endoparasites present in the Konza Prairie.
- Update current data regarding characteristics and distribution of these endoparasites.

Methods

Rodents were captured using Sherman traps, and were then processed via standard museum methods and examined for nematodes. Necropsies were completed on the same day of capture and nematodes collected were fixed and preserved with 70% EtOH and kept under refrigeration. Specimens were cleared using lactophenol in order to examine their characteristics. Various characteristics were then measured using microscopic imaging software

and compared to the diagnostic traits of similar species. Measuring traits such as the spicules of males and the eggs of females is important as these traits can be used to distinguish between species that otherwise may look identical in other life stages. *Syphacia cf. obvelata* specimens were cut into cross sections at the midbody to increase our chances of obtaining a large amount of quality DNA. The DNA was then extracted from the cross-sections, then we used primers to amplify COx1 and ITS using Qiagen DNeasy blood and tissue kit.

Results








	Sigmodontinae  <i>Sigmodon hispidus</i>	Neotominae  <i>Reithrodontomys megalotis</i>	 <i>Neotoma floridana</i>	 <i>Peromyscus leucopus</i>	Arvicolinae  <i>Microtus ochrogaster</i>	Geomyidae  <i>Geomys bursarius</i>	Heteromyidae  <i>Chaetodipus hispidus</i>
<i>Trichuris sp.</i>			x		x		
<i>Mastophorus muris</i>	x	x		x		x	
<i>Pterygodermatites parkeri</i>		x					
<i>Vexillata armandae</i>							x
<i>Syphacia cf. obvelata</i>					x		

Figure 1. Nematodes present in rodents of the Konza Prairie.

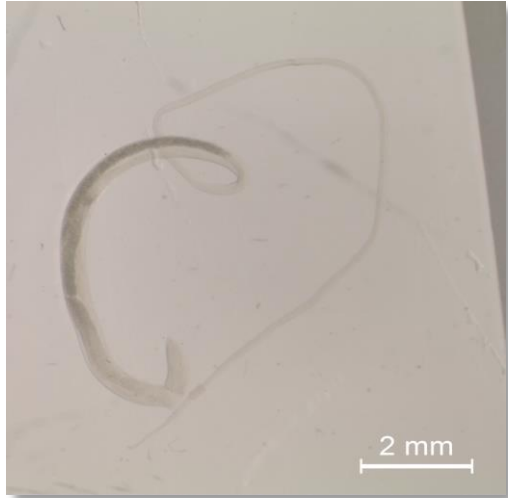


Figure 2. *Trichuris* sp.

Trichuris sp. was found in the large intestine of *Neotoma floridana* and *Peromyscus leucopus*. The order Trichocephalida is characterized by its narrower anterior end compared to its posterior end, and its stichosome⁵. The family Trichuridae, or “whip-worms” are characterized by their whip-like shape, the anterior end of which embeds itself into the mucosa of the lower intestine. The genus *Trichuris* is characterized by the shape of the eggs, which are lemon-shaped with plugs at both ends, with females being 3-7 cm in length. We were unable to identify which species it was due to lack of males, which have the characteristics required to make an accurate diagnosis. However, the species is likely *Trichuris muris*, a species found in rodents.



Figure 3. *Mastophorus muris*

M. muris was found in the stomach of *Sigmodon hispidus*, *Reithrodontomys megalotis*, *Peromyscus leucopus*, and *Geomys bursarius*. The order Spiruroida is characterized by the anterior region, which have at least one pair of lateral labia or pseudolabia. The family Spiruridae is characterized by larvae having an insect host, and adults having a vertebrate host⁵. We based this genus and species diagnosis on the number of denticles found in the anterior end⁶.



Figure 4. *Pterygodermatites parkeri*

P. parkeri was found in the small intestine of *Reithrodontomys megalotis*. The order Spiruroida is characterized by the anterior region, which have at least one pair of lateral labia or pseudolabia. The family Rictulariidae is characterized by a large buccal capsule containing teeth. The genus *Pterygodermatites* is characterized by the three large esophageal teeth of the infective larva that is preserved in the adult stage⁵. We based our species diagnosis on the number of buccal teeth found in the buccal cavity, as well as the number of cuticular spines³.



Figure 5. *Vexillata armandae*

V. armandae was also found in the small intestine of *Reithrodontomys megalotis*. The superfamily Trichostrongyloidea is characterized by the bursa of the males and their distinctive bursal rays, with the arrangement of these rays being diagnostic of the genus *Vexillata*⁵. We concluded our specimen was *Vexillata armandae* based on the number of bursal rays found our male specimens, as well as their asymmetrical distribution¹.

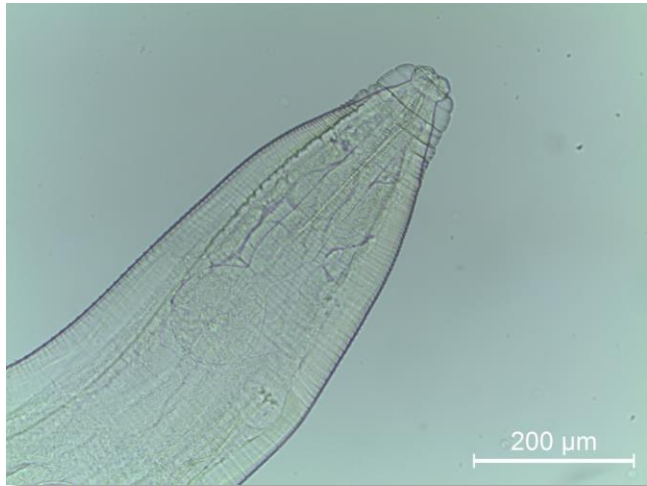


Figure 6. *Syphacia cf. obvelata*

S. cf. obvelata was found in the large intestine of *Microtus ochrogaster*. The order Oxyurida, or pinworms, are characterized by their small size with the anterior and posterior ends tapering to a point, as well as their short and oval-shaped eggs⁵. Only members of the genus *Syphacia* are found in rodents. We based our species diagnosis on the length of the bulb, corpus, and the length between the vulva and anterior end, all of which look very similar to *Syphacia obvelata*⁴. However, DNA analysis shows that this specimen is more closely related to *Syphacia montana*.

Discussion

Of all the nematodes found in the rodents across the Konza Prairie, *Mastophorus muris* seems to be relatively common, as it was found in 4 of the 7 rodent species documented. The other nematodes were much more host specific, with the exception of *Trichuris sp.*, which was found in 2 of the 7 rodent species. Based on the DNA sequence obtained from *Syphacia cf. obvelata*, it may be a new species. Its closest relative, *S. montana*, is found in Japan, and its presence in the Konza prairie suggests that it may have migrated to North America relatively

recently. Comparing the genetic sequence of the specimens found in the Konza to the genetic sequence of a specimen confirmed to be *S. montana* would provide us with a more definitive conclusion as to whether or not there is a new species of *Syphacia* present in the Konza Prairie.

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