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Helminth parasites of the raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), and striped skunk (*Mephitis mephitis*) from Keith County, Nebraska

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Nine raccoons (*Procyon lotor*), 6 Virginia opossums (*Didelphis virginiana*), and 1 striped skunk (*Mephitis mephitis*) collected from Keith County, Nebraska were examined for helminth parasites. Raccoons were infected with the nematodes *Arthrocephalus lotoris*, *Baylisascaris procyonis*, and *Capillaria plica*, the trematode *Fibricola cratera*, and the tapeworm *Atriotaeonia procyonis*. Opossums were infected with 1 nematode, 1 trematode, and 1 cestode species: *Physaloptera turgida*, *Plagiorchis elegans*, and *Oochoristica* sp., respectively. The single striped skunk was infected with the nematode *Physaloptera maxillaris* and the cestodes *Mesocestoides* sp. and *Oochoristica* sp.

Key words: *Procyon lotor*, *Didelphis virginiana*, *Mephitis mephitis*, *Arthrocephalus lotoris*, *Baylisascaris procyonis*, *Capillaria plica*, *Mesocestoides*, *Oochoristica*, *Physaloptera maxillaris*, *Physaloptera turgida*, *Plagiorchis elegans*, *Plagiorhynchus cylindraceus*, helminth parasites, Nebraska

Introduction

Although the helminth fauna of the raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*) and striped skunk (*Mephitis mephitis*) is fairly well known, great gaps exist in our knowledge concerning the distribution of helminths of these hosts throughout North America. This study reports on the helminth fauna of these furbearers from western Nebraska, specifically Keith County. This region is particularly interesting relative to the geographic distribution of the helminths of furbearers because little information exists concerning the helminth parasites of these hosts from the western Great Plains. Lying just east of the Rocky Mountains, the western Great Plains offers a unique epizootiological setting and approaches the western-most boundary of the opossum and raccoon in the eastern United States (Lowery, 1974; Sealander, 1979). The striped skunk is more ubiquitously distributed (Lowery, 1974). Durden and Richardson (2013) reported on the ectoparasites of these raccoons, opossums, and skunks.

Materials and Methods

Between 3 July 2005 and 13 August 2008, 6 Virginia opossums, 9 raccoons, and 1 striped skunk were live-trapped and killed with a .22 caliber rifle. The single striped skunk and 6 Virginia opossums were collected from the grounds of Cedar Point Biological Station, University of Nebraska-Lincoln, Keith County Nebraska. Eight raccoons were collected on and adjacent to the grounds of Cedar Point Biological Station between 41°12.629N northward to 41.12.676°N and 101°38.434W westward to 101°39.626W along the

south side of Lake Keystone and North Platte River, just East of Kingsley Dam and Lake McConaughy. One raccoon was collected from Clearcreek Wildlife Management Area, Keith County, Nebraska, on the North Platte River, west of Lake McConaughy (approximately 41°18.17N 120°04.35W). Necropsies were conducted as described by Richardson and Campo (2005) and all nematodes, cestodes, and trematodes collected were processed as described Richardson and Campo (2005). Acanthocephalans were processed as described by Richardson (2006). Voucher specimens were deposited in the Peabody Museum of Natural History, Yale University, New Haven Connecticut.

Results and Discussion

Raccoon (*Procyon lotor*)

The helminth fauna of *P. lotor* in western Nebraska was extremely depauperate. Three nematode, 1 trematode, and 1 cestode species were collected. Of the 9 raccoons examined, 6 were infected with 1 to 11 (mean 3.2) worms representing 1 to 2 species). Parasite accession numbers, location in host, prevalence, and mean intensities (\pm SE) are given in Table 1. Although the helminth fauna of *P. lotor* has been reported from throughout much of North America, little is known about the helminth fauna of this host in Nebraska.

Nematodes were the most commonly represented group of helminths from Nebraska raccoons being represented by 3 species, *Arthrocephalus lotoris*, *Baylisascaris procyonis*, and *Capillaria plica*. A single individual of *Arthrocephalus lotoris*, the common hookworm of the raccoon, was collected from the small intestine of a single

Table 1. Prevalence and intensity of helminth parasites in 9 raccoons (*Procyon lotor*), 6 opossums (*Didelphis virginiana*), and 1 striped skunk (*Mephitis mephitis*) from Keith County Nebraska.

Host Parasite (YPM Accession #)	Site of infection*	Number infected (%)	Mean intensity ± SE (Range)
Raccoon (<i>Procyon lotor</i>)			
Nematoda			
<i>Arthrocephalus lotoris</i> (YPM68419)	SI	1 (11.1%)	1.0
<i>Baylisascaris procyonis</i> (YPM68420)	SI	2 (22.2%)	2.0 ± 1.0 (1-3)
<i>Capillaria plica</i> (YPM68421)	UB	1 (11.1%)	3.0
Trematoda			
<i>Fibricola cratera</i> (YPM68422 & YPM68423)	SI	1 (11.1%)	2.0
Cestoda			
<i>Atriotaenia procyonis</i> (YPM68424 & YPM68425)	SI	1 (11.1%)	4.5 ± 3.5 (1-8)
Virginia opossum (<i>Didelphis virginiana</i>)			
Nematoda			
<i>Physaloptera turgida</i> (YPM68426)	S, SI	6 (100.0%)	6.3 ± 2.7 (1-18)
Trematoda			
<i>Plagiorchis elegans</i> (YPM68427-YPM68429)	SI	2 (33.3%)	2.0
Cestoda			
<i>Oochoristica</i> sp. (YPM68430)	SI	1 (16.7%)	1.0
Acanthocephala			
<i>Plagiorhynchus cylindraeus</i> (YPM68431 & YPM68432)	SI	1 (16.7%)	2.0
Striped skunk (<i>Mephitis mephitis</i>)			
Nematoda			
<i>Physaloptera maxillaris</i> (YPM68433)	S, SI	1 (100.0%)	194.0
Cestoda			
<i>Mesocestoides</i> sp. (YPM68434)	SI	1 (100.0%)	23.0
<i>Oochoristica</i> sp. (YPM68435)	SI	1 (100.0%)	1.0

*S=stomach; SI=small intestine; UB=urinary bladder

raccoon. *Arthrocephalus lotoris* has been reported from throughout much of North America although this represents the first report of *A. lotoris* from Nebraska. *Baylisascaris procyonis*, the common ascarid of raccoons, was collected from the small intestine of 2 raccoons, 3 from 1 and 1 from the other. *Baylisascaris procyonis* poses a serious zoonotic threat to humans, as well as wild and domestic animals, as it is the etiologic agent of neural and ocular larva migrans sometimes leading to fatal eosinophilic meningoencephalitis (Kazacos, 2001; Duprey and Schantz, 2003). *Baylisascaris procyonis* was previously reported from 3 of 4 raccoons collected at the Henry Doorly Zoo in Omaha, Nebraska in the course of an epizootiological investigation of cerebral nematodiasis in macaws in the zoo resulting from infection with *B. procyonis* (Armstrong et al., 1989). The current report is the first of *B. procyonis* from western Nebraska. Three individuals of *C. plica* were collected from the urinary bladder of 1 raccoon. *Capillaria plica* is a cosmopolitan nematode of the urinary bladder of carnivorous mammals (Butterworth and Beverly-Burton, 1981; Richardson (1990). This represents the first report of *C. plica* from Nebraska.

Two individuals of the strigeid trematode, *Fibricola cratera* were collected from the small intestine of a single raccoon. *Fibricola cratera* has been reported from the raccoon throughout the eastern United States. Although *F. cratera* was originally described by Barker (1915) from Nebraska muskrats, this is the first report of this trematode from a Nebraska raccoon.

The tapeworm *Atriotaenia procyonis* was collected from the small intestine of 2 raccoons, 1 from 1 and 8 from the other. Although *A. procyonis* has been reported from the raccoon from throughout North America, this represents the first report of this cestode from Nebraska.

Virginia opossum (*Didelphis virginiana*)

One nematode, 1 trematode, 1 cestode, and 1 acanthocephalan species were collected. Of the 6 opossums examined, each was infected with 1 to 23 (mean 7.5 worms representing 1 to 4 species). Parasite accession numbers, location in host, prevalence, and mean intensities (±SE) are given in Table 1. Although the helminth fauna of *D. virginiana* has been reported from throughout much of North America (Alden 1995; Richardson

and Campo, 2005) this is the first report of helminths of the Virginia opossum from Nebraska.

The most commonly occurring helminth was the nematode *Physaloptera turgida*. Although a few individuals of *P. turgida* were collected from the small intestine, this species resides primarily in the stomach. This is a common nematode of *D. virginiana* throughout North America (Miller and Harkema, 1970; Alden, 1995; Ellis et al., 1999; Richardson and Campo, 2005).

Two opossums each contained 2 individuals of *Plagiorchis elegans*. In one opossum both individuals were immature, while in the other both were gravid. This is the first report of the genus *Plagiorchis* from *D. virginiana*, although its occurrence in the Virginia opossum is not surprising given the broad host spectrum and extremely wide geographic distribution exhibited by this species (Gorman, 1980; V. Tkach, personal communication). *Plagiorchis elegans* is considered a cosmopolitan trematode of both birds and mammals (Gorman, 1980). Examination of museum specimens HWML48131 reported from Connecticut opossums by Richardson and Campo (2005) as *Brachylaima didelphis* revealed these individuals to be *Plagiorchis elegans*. The finding of gravid females of this trematode from *D. virginiana* from Nebraska and Connecticut indicates that this worm is widely distributed across the eastern United States and that the opossum is a competent natural host for this parasite.

The tapeworm fauna of opossums from Keith County Nebraska proved to be extremely depauperate. A single tapeworm of the genus *Oochoristica* was found in one of the opossums. The specimen preserved poorly rendering further identification impossible. As pointed out by McAllister et al. (1985), the genus *Oochoristica* is a large unwieldy complex of species parasitizing more than 56 species of reptiles and mammals. Leigh (1940) reported 3 specimens of *Oochoristica* from 1 of 16 opossums examined from Illinois. Additionally several species of *Oochoristica* have been described from South American opossums, including *Didelphis marsupialis*. Tapeworms of the genus *Oochoristica* have also been reported from spotted and striped skunks in North America (Perry, 1939; Self and McKnight, 1950; Chandler, 1952). The tapeworm fauna of Oklahoma was shown to be similarly depauperate. Self and McKnight (1950) reported that only one of 15 opossums from the Wichita Mountains of Oklahoma contained a fragment of a single tapeworm, although 6 of 57 striped skunks examined were infected with tapeworms of the genus *Oochoristica*, presumably *Oochoristica mephitis*.

Two immature individuals of the acanthocephalan *Plagiorhynchus cylindraceus* were collected from the small intestine of one opossum. *Plagiorhynchus cylindraceus* normally utilizes passerine birds as definitive hosts, particularly American robins (*Turdus migratorius*)

and starlings (*Sternus vulgaris*) and the terrestrial isopod (*Armadillidium vulgare*) as intermediate host. Immature individuals of *P. cylindraceus* were previously reported from an opossum from Arkansas (Ellis et al., 1999). As in the case reported by Ellis et al. (1999), the current finding likely represents an "accidental" infection and is not surprising given the opportunistic feeding habits of *D. virginiana* (Ellis et al., 1999). *Plagiorhynchus cylindraceus* likely originated in Europe and has been introduced to Asia, North America, Africa, and Australia through transcontinental introductions of passerine birds, especially the European starling, American robin and the Australian magpie (*Gymnorhina tibicens*) (Skuballa et al., 2010). *Plagiorhynchus cylindraceus* is abundant in American robins in Keith County, Nebraska (pers. observation).

Eastern Striped Skunk (*Mephitis mephitis*)

The single striped skunk examined in this investigation was infected with 1 nematode and 2 cestode species. One-hundred-ninety-four individuals of the nematode *Physaloptera maxillaris* were collected; 190 from the stomach and 4 from the small intestine. Although this common physalopterid has been reported from throughout the United States this constitutes the first report of this parasite from Nebraska.

Twenty-three individuals of *Mesocestoides* sp. were collected from the small intestine. Tapeworms of the genus *Mesocestoides* have been reported from *M. mephitis* from throughout North America. Although this is the first report of *Mesocestoides* from Nebraska skunks, *Mesocestoides* spp. have been reported from a dog and a raccoon in Nebraska (Coatney, 1936). Representatives of the genus *Mesocestoides* are among the most commonly reported helminth parasites of carnivores in North America. Unfortunately, in view of the taxonomic confusion surrounding *Mesocestoides* spp. (Webster, 1949), and in view of the paucity of knowledge concerning the life history of *Mesocestoides* spp., it is premature to attempt specific designation of *Mesocestoides* of medium-sized mammals (Snyder and Fitzgerald, 1985; Richardson and Campo, 2005).

A single specimen of *Oochoristica* sp. was collected from the small intestine. In view of the taxonomic confusion surrounding the genus *Oochoristica* identification to species level was not attempted. Although *Oochoristica* spp. have previously been reported from skunks in North America (Skinker, 1935; Perry, 1939; Self and McKnight, 1950; Chandler, 1952), this constitutes the first report of *Oochoristica* sp. from a Nebraska skunk.

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