
Helminth Parasites (Trematoda, Cestoda, Nematoda) of Select Mammals (Didelphimorpha, Chiroptera, Carnivora) from McCurtain County, Oklahoma

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Abstract: Between February 2019 and September 2019, five individual mammals were collected in McCurtain County, Oklahoma, and examined for helminth parasites as follows: Virginia opossum (*Didelphis virginiana*), two eastern red bats (*Lasiurus borealis*), bobcat (*Lynx rufus*), and gray fox (*Urocyon cinereoargenteus*). Eight taxa of parasites were recovered, including three trematodes, *Paralecithodendrium* sp., *Rhopalias coronatus* and *Fibricola cratera*, two cestodes, *Vampirolepis* sp., and *Taenia rileyi*, and three nematodes, *Physaloptera rara*, *Turgida turgida*, and *Cruzia americana*. We document seven new geographic records; all of these helminths (except *T. turgida*) are reported from Oklahoma for the first time.

Introduction

Oklahoma supports about 101 native species of mammals (Caire et al. 1989) in nine physiognomic regions that range from Piñon-Juniper Mesas in the Panhandle to the Oak-Hickory-Pine Ouachita Highlands and bottomland forest with loblolly pine (*Pinus taeda*) in the southeast corner of the state. The latter region of Oklahoma includes McCurtain County, the third largest in the state, with total area of 4,930 km² (1,902 mi²). It contains a varied topography that extends, in the north, from the rocky foothills of the Ouachita Mountains to the fertile Coastal Plain region along the Red River, which forms the southern boundary with Arkansas and Texas.

A recent survey of the mammals of Red Slough Wildlife Management Area in

southeastern McCurtain County (Roehrs et al. 2012) has shown that a wide variety of species occur there and throughout much of the county, but little to nothing is known about their parasites. Here, we document some distributional records for several helminth parasites of select mammals from the county.

Methods

Between February 2019 and September 2019, five individual mammals were collected opportunistically in various parts of McCurtain County as follows: Virginia opossum (*Didelphis virginiana*), two eastern red bats (*Lasiurus borealis*), bobcat (*Lynx rufus*), and gray fox (*Urocyon cinereoargenteus*). All specimens, except *D. virginiana*, were found recently dead on the road (DOR) without necrosis, salvaged, and processed within one hour; the opossum was euthanized with an intraperitoneal injection

of sodium pentobarbital (Nembutal®) following accepted guidelines (Sikes et al. 2011). A mid-ventral incision was made from the throat to anus of each specimen to expose the viscera and the entire gastrointestinal tract and other organs were placed in Petri dishes containing 0.9% saline, and examined for helminths under a stereomicroscope at 20–30×. Trematodes were fixed without coverslip pressure in near boiling water and transferred to 95% (v/v) molecular grade ethanol. Cestodes were detached from the host's intestine, gently rinsed in 0.9% saline, and fixed in hot 4% formaldehyde solution (formalin) with subsequent transfer to 95% molecular grade ethanol. Both were stained with acetocarmine, dehydrated in a graded ethanol series, cleared in methyl salicylate, and mounted in Canada balsam. Nematodes were fixed in near boiling water and preserved in 70% (v/v) ethanol. They were later cleared and identified in temporary mounts of lactophenol and then returned to the preservative.

Voucher specimens of parasites (except those retained for molecular analysis) were deposited in the Harold W. Manter Laboratory of Parasitology (HWML), University of Nebraska, Lincoln, Nebraska. Photovouchers of the hosts were deposited in the Henderson State University Museum (HSU), Arkadelphia, Arkansas.

Results and Discussion

Eight taxa of parasites were found, including three trematodes, two cestodes, and three nematodes; no acanthocephalans were observed. An annotated list of the specific parasites recovered and their host data follows.

Trematoda: Digenea: Echinostomatidae

***Rhopalium coronatus* (Rudolphi, 1819) Stiles and Hassall, 1898** – Several *R. coronatus* (HWML 216096) were found in the intestine of *D. virginiana* collected on the EOSC-Idabel campus (33°55'13.926" N, 94°46'40.8792" W) on 13 March 2019. Chandler (1932) reported this trematode from *D. virginiana* in Texas, and it has also been reported from various other didelphid hosts from México, Panama,

Argentina, Bolivia, Paraguay, and Venezuela (Monet-Mendoza 2005; Haverkost and Gardner 2008; Acosta-Virgen et al. 2015). Interestingly, recent molecular evidence from López-Caballero et al. (2019) suggests that specimens originally reported as *R. coronatus* found in the intestine of common opossum (*D. marsupialis*) from Yucatán, México, may actually represent a new species. In addition, a similar species, *R. macracanthus* Chandler, 1932 has been reported from *D. virginiana* from Oklahoma (Self and McKnight 1950) as well as several other states (Alden 1995). The life cycle is unknown, but based on the known life cycles of related taxa and phylogenetic data by Tkach et al. (2016) definitive hosts likely acquire the parasite by the ingestion of metacercariae encysted in amphibians or fish. We document *R. coronatus* from Oklahoma for the first time.

Lecithodendriidae

***Paralecithodendrium* sp.** – Here, we follow Lotz and Font (1983) using the name *Paralecithodendrium*, which has priority over the name *Prosthodendrium* at the rank of genus. Three specimens of a *Paralecithodendrium* sp. were found in the anterior third of the intestine of *L. borealis* collected on 26 June 2019 from Idabel (33°55'0.4152"N, 94°51'01.8648"W). Eastern red bats have been reported to harbor *P. transversum* (Byrd and Macy, 1942) Lotz and Font, 1983 from Tennessee, Iowa, and Indiana, respectively (Byrd and Macy 1942; Kunz 1968; Pistole 1988). Representatives of this trematode genus was also reported from northern long-eared bat (*Myotis septentrionalis*) from adjacent Arkansas (McAllister et al. 2004). In addition, *L. borealis* from Minnesota and Iowa have been reported to harbor *Paralecithodendrium nokomis* (Macy, 1937) Lotz and Font, 1983 (Macy 1937; Blankespoor and Ulmer 1970) and red bats from Iowa are hosts of *Paralecithodendrium swansoni* (Macy, 1936) Lotz and Font, 1983 (Blankespoor and Ulmer 1970). *Paralecithodendrium naviculum* (Macy, 1936) Lotz and Font, 1983 was reported from Arkansas in American perimyotis (*Perimyotis subflavus*) (McAllister et al. 2011). In the life cycle, snails and anopheline mosquitoes serve as intermediate hosts, and the adult worm is found

in the intestinal tract of bats, which have most likely ingested intermediate hosts (Abdel-Azim 1936). Molecular analysis will be required to provide a specific identity for our specimens.

Diplostomatidae

Fibricola cratera (Barker and Noll, 1915)

Dubois, 1932 – Several of these trematodes (HWML 216095) were found in the small intestine of the same *D. virginiana* reported above. The life cycle involves aquatic snails (*Physa* spp.) as first intermediate hosts and anurans as second intermediate hosts (Hoffman 1955). This digenean has been previously reported from *D. virginiana* from Florida, Louisiana, Michigan, Tennessee and Wisconsin (Alden 1995). It is reported here for the first time from Oklahoma as well as the initial documentation from a geographic locality west of the Mississippi River.

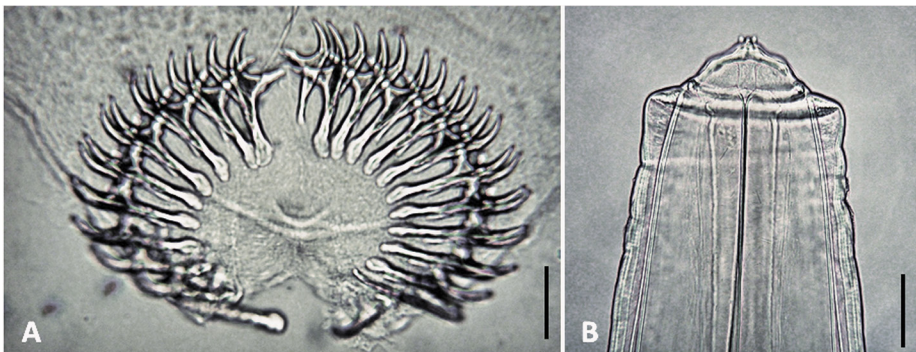
Cestoda: Cyclophyllidea: Hymenolepidae

Vampirolepis sp. – Two tapeworms were taken from the small intestine of a pregnant *L. borealis* female collected on 10 June 2019 from off St. Hwy. 152 at Cerrogordo (35°17' 27.276"N, 98°43'0.7284" W) and a single individual was collected from another eastern red bat from Idabel (33°55'0.4152"N, 94°51'01.8648"W) on 26 June 2019. Tapeworms of the genus *Vampirolepis* Spassky, 1954 are commonly reported from bats in North America (Nickel and Hansen 1967; Rausch 1975; Vaucher 1992); however, this is the first report

from eastern red bats and to our knowledge, the first time this genus has been reported from any bat from Oklahoma. Blankespoor and Ulmer (1970) and Pistole (1988) reported the tapeworm, *Cycloskrjabinia taborensis* (Loewen, 1934) from *L. borealis* from Iowa and Indiana, respectively. In addition, McAllister et al. (2005, 2006, 2017) reported a *Vampirolepis* sp. from Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), *Vampirolepis decipiens* (Diesing, 1850) from Brazilian free-tailed bats (*Tadarida brasiliensis*), and *Vampirolepis* sp. from eastern small-footed bats (*Myotis leibii*) from neighboring Arkansas, respectively. Specimens are being retained for molecular analyses.

Taeniidae

Taenia rileyi Loewen, 1929 – Various specimens (HWML 111234) of these tapeworms matched the description of *T. rileyi* (Rausch 1981) and were found in the intestinal tract of a pregnant female *L. rufus* collected on 16 April 2019 in Idabel (33°53'37.41"N, 94°51'09.8352" W). Measurements of specimens of *T. rileyi* are as follows: the rostellum (Fig. 1A) has 42 hooks (21 large, 21 small) that measured 235 and 188 µm, respectively. Surveys of bobcat parasites have been conducted from Canada to México, as well as in between in several US states, including specimens from Alabama, Arkansas, Georgia, Kansas, Illinois, Massachusetts, Nebraska, New Mexico, North Carolina, Oklahoma, South Carolina, Texas, Utah, Virginia, and West Virginia (Marchiondo et al.



Figures 1A–B. Some parasites of Oklahoma mammals. (A) Rostellar hooks of *Taenia rileyi* from *Lynx rufus*; scale bar = 100 µm. (B) Anterior end of *Physaloptera rara* from *Urocyon cinereoargenteus*; note: large cephalic collarette and two large, simple triangular lateral pseudolabia. Scale bar = 100 µm.

1986; Reichard et al. 2004; see also references in Hiestand et al. 2014). *Taenia rileyi* has been reported in bobcats from Georgia, Illinois, Minnesota, Nebraska, “New England”, North Carolina, South Carolina, Texas, Utah, Virginia, and West Virginia (Hiestand et al. 2014). Larval *T. rileyi* have been reported in rodents in Florida and Georgia and may serve as intermediate hosts of this tapeworm (Kinsella 1974, 1988, 1991). In Illinois, Hiestand et al. (2014) reported *T. rileyi* occurred in high prevalence (70%) and caused intense infections in bobcats; it is also considered to be a bobcat-specific helminth. We here document *T. rileyi* from Oklahoma for the first time.

Nematoda: Spirurida: Physalopteridae

***Physaloptera rara* Hall and Wigdor, 1918** – Three *P. rara* (HWML 111237, Fig. 1B) were found in the lower esophagus and stomach of an adult male *U. cinereoargenteus* collected on 25 September 2019 from Idabel (33°55'0.4152"N, 94°51'01.8648"W). There are about 100 species or more in the genus (Pereira et al. 2013). Ubelaker et al. (2015) noted that *P. rara* has been reported previously from gray foxes from Florida, Illinois, Minnesota, New Mexico, and Texas. The life cycle involve insects as intermediate hosts, including beetles, cockroaches, and crickets. This nematode shows little host specificity as it has also been reported from other North American carnivores (domestic dogs, coyotes, wolves, raccoons, domestic cats, and bobcats), including kit foxes (*Vulpes macrotis*) and swift foxes (*V. velox*) from New Mexico (Ubelaker et al. 2014a, b). Here, for the first time, we report *P. rara* from *U. cinereoargenteus* from Oklahoma.

***Turgida turgida* (Rudolphi, 1819)** – Specimens (HWML 111233) were found attached to the stomach wall of *D. virginiana*. This nematode is a relatively common parasite of *D. virginiana* and other didelphids in both North and South America. It has been reported in *D. virginiana* from México (Acosta-Virgen et al. 2005; Monet-Mendoza 2005) and at least 15 U.S. states (Alden 1995; Matey et al. 2001; Richardson and Campo 2005; Nichelason et al. 2008), including Oklahoma (Hill 1939).

Kathlaniidae

***Cruzia americana* Maplestone, 1930** – Several specimens of *C. americana* (HWML 111232) were found in the cecum of *D. virginiana*. This nematode feeds on the intestinal mucosa, taking nutrients and ingesting blood and has been reported to cause significant illness in opossums (Jones 2013). It has been reported in *D. virginiana* from California (Nichelason et al. 2008; Jones 2013), Connecticut (Richardson and Campo 2005), Georgia, Illinois, North Carolina, Ohio, Pennsylvania, Texas, and Virginia (Alden 1995), and México (Monet-Mendoza 2005). This is the initial report of *C. americana* from Oklahoma.

In conclusion, we document seven new geographic records for these mammalian parasites as well as the initial report of *F. cratera* being found in a host from a geographic locale west of the Mississippi River. Although this was a small, opportunistic survey, it shows that there are many mammalian parasites yet to be reported from the state. With additional examinations, we expect additional geographic as well as new host records will be documented, including the possibility of discovering new species.

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