
New Host and Distributional Records for Helminth Parasites (Trematoda, Cestoda, Nematoda) from Amphibians (Caudata, Anura) and Reptiles (Testudines: Ophidia) of Oklahoma

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Abstract: Between April 2012 and September 2016, 28 amphibians and seven reptiles from Delaware, Latimer, and McCurtain counties, Oklahoma, were examined for helminth parasites, including 10 Oklahoma salamanders, *Eurycea tynnerensis*, two Fowler's toads, *Anaxyrus fowleri*, five crawfish frogs, *Lithobates areolatus*, two spring peepers, *Pseudacris crucifer*, nine Cajun chorus frogs, *Pseudacris fouquettei*, two eastern cooters, *Pseudemys concinna*, and one each black racer, *Coluber constrictor priapus*, western mud snake, *Farancia abacura reinwardti*, plain-bellied watersnake, *Nerodia erythrogaster*, broad-banded watersnake, *Nerodia fasciata confluens*, and western ratsnake, *Pantherophis obsoletus*. A total of 11 helminths, including six trematodes (*Dasymetra conferta*, *Glypthelmins* sp., *Haematoloechus complexus*, *Renifer ellipticus*, *Renifer* sp. metacercaria, *Telorchis corti*), two cestodes (*Oochoristica eumecis*, *Ophiotaenia* sp.), and three nematodes (*Cosmocercoides variabilis*, *Omeia papillocauda*, *Oswaldocruzia pipiens*) were harbored by these hosts. Although we document six new host and two new distributional records, the total parasite fauna of Oklahoma's herpetofauna is probably underestimated, particularly from potential hosts in the western and panhandle regions of the state. ©2016 Oklahoma Academy of Science

Introduction

The state of Oklahoma with its diverse habitats support at least 58 species and subspecies of amphibians and 99 species and subspecies of reptiles (Sievert and Sievert 2011). In the last decade, a great deal of information has been published from our collaborative community effort in a series of papers on the helminth parasites of Oklahoma's herpetofauna (McAllister and Bursey 2007, 2012; McAllister et al. 2010, 2011, 2014 a, 2014b, 2014c, 2015a,

2015b). Here, we augment some of that void by reporting new host and distributional records for select amphibians and reptiles from three counties of the state.

Methods

Between April 2012 and September 2016, the following herpetofauna (amphibians, $n = 28$; reptiles, $n = 7$) were collected and examined for helminth parasites—Caudata: 10 Oklahoma salamanders, *Eurycea tynnerensis*; Anura: two Fowler's toads, *Anaxyrus fowleri*, five crawfish frogs, *Lithobates areolatus*, two spring peepers,

Pseudacris crucifer, nine Cajun chorus frogs, *Pseudacris fouquettei*; Testudines: two eastern cooters, *Pseudemys concinna*; Ophidia: one each black racer, *Coluber constrictor priapus*, western mud snake, *Farancia abacura reinwardti*, plain-bellied watersnake, *Nerodia erythrogaster*, broad-banded watersnake, *Nerodia fasciata confluens*, and western ratsnake, *Pantherophis obsoletus*. They were collected by hand, aquatic dipnet or snake tong from Delaware, Latimer, and McCurtain counties, measured for snout-vent length (SVL) or carapace length (CL), and examined for helminths. Specimens were placed in collection bags, placed on ice, and taken to the laboratory for necropsy within 24 hr. They were killed by prolonged immersion with a concentrated chlorethone® (chlorobutanol) solution (amphibians) or by intraperitoneal injection of sodium pentobarbital (reptiles). A bone saw was used to detach the plastron from turtles to expose the viscera which was removed, placed in a Petri dish, and its contents scanned using a stereomicroscope. The gastrointestinal tract was split lengthwise and examined as well as other organs, including the lungs, liver, and gonads. For other herpetofauna, a mid-ventral incision was made to expose the viscera and the entire gastrointestinal tract and other organs were examined for helminths in a similar manner. Trematodes and cestodes were fixed in hot tap water without coverslip pressure, stained with acetocarmine, dehydrated in a graded ethanol series, cleared in methyl salicylate or xylene and mounted in Canada balsam. Nematodes were fixed in hot tap water and studied as temporary mounts on a microscopic slide in a drop of glycerol. Parasites were either retained for future DNA studies or deposited in the Harold W. Manter Laboratory of Parasitology (HWML), University of Nebraska-Lincoln. Host voucher specimens are deposited in the Arkansas State University Herpetological Collection (ASUMZ), State University, Arkansas, or the Henderson State University Herpetological Collection (HSU), Arkadelphia, Arkansas.

Results and Discussion

A total of 11 helminths, including six trematodes, two cestodes, and three nematodes

were harbored by 16 hosts (10 amphibians, six reptiles). An annotated list of the helminths found and the host data follows.

Trematoda: Digenea: Plagiorchiida: Haematoloechidae

Haematoloechus complexus (Seely, 1906) Krull, 1933

One *H. complexus* (HWML 99910) was taken from the lung of one of five (20%) adult (90 mm SVL) *L. areolatus* collected on 13 March 2016 from 14.5 km E of Jay, Delaware County (36° 26' 44.65"N, 94° 37' 46.15"W). *Haematoloechus* is one of the most common genera of trematode found in the lungs of frogs. *Haematoloechus complexus* has been previously reported from Cope's gray treefrog, *Hyla chrysoscelis*, northern leopard frog, *Lithobates pipiens*, southern leopard frog, *L. sphenoccephalus utricularius*, wood frog, *L. sylvaticus*, green frog, *L. clamitans*, plains leopard frog, *L. blairi*, *P. crucifer*, and Woodhouse's toad, *Anaxyrus woodhousii* (Bolek and Janovy 2007). In experimental life cycle studies, amphipods, chironomids, and dragonfly larvae served as intermediate hosts of *H. complexus* (Bolek and Janovy 2007). It is a common eastern species and has already been reported from Oklahoma in *L. s. utricularius* (Vhora and Bolek 2015).

This ranid frog is one of the few in the genus rarely reported as a host of helminths. Harwood (1932) lists *L. areolatus* from Texas as a host of the trematode *Megalodiscus temperatus* and the nematode *Cosmocercoides variabilis* (as *C. dukae*). Parris and Redmer (2005) erroneously lists *L. areolatus* as a host of trematodes and nematodes based on previous studies of Kuntz (1941) and Walton (1949). *Haematoloechus complexus* becomes only the third helminth ever reported from *L. areolatus*.

Macroderoididae *Glyphelmins* sp.

One of nine (11%) adult (31 mm SVL) *P. fouquettei* collected on 22 February 2016 from Hochatown, McCurtain County (34° 09' 55.152"N, 94° 45' 35.8776"W) harbored three immature *Glyphelmins* sp. in its intestines. In addition, two *P. crucifer* (male 28 mm, female

33 mm SVL) collected on 13 March 2016 from 14.5 km E of Jay, Delaware County (36° 26' 44.65"N, 94° 37' 46.15"W) were found to harbor two and four immature (HWML 99895) *Glyphthelmins* sp. in their intestinal tract. Since no eggs were present in any trematode from either host it was not possible to assign a species designation. This is the first time this digenean has been reported from Oklahoma specimens of *P. crucifer* and the initial report of *Glyphthelmins* sp. from the Cajun chorus frog.

The northern spring peeper has rarely been surveyed in the state and they have only been reported to previously harbor larval *Physaloptera* sp. in Oklahoma (Morgan 1941). *Glyphthelmins pennsylvaniensis* Cheng, 1961 has been previously reported from this frog in Arkansas (McAllister et al. 2008), Michigan (Muzzall and Peebles 1991), Pennsylvania (Cheng 1961), West Virginia (Joy and Dowell 1994), and Wisconsin (Coggins and Sajdak 1982; Yoder and Coggins 1996). Another, *Glyphthelmins quieta* (Stafford, 1900) Stafford, 1905 has been reported from American bullfrog, *Lithobates catesbeianus* and *L. s. utricularius* from Oklahoma (Trowbridge and Hefley 1934; Brooks 1979) and *P. crucifer* from Ohio (Odlaug 1954).

McAllister et al. (2015a) examined 20 *P. fouquettei* from the same Oklahoma site reported herein and, although several helminths were found, they did not report a single *Glyphthelmins* sp. In addition, another survey of *P. fouquettei* in Arkansas and Texas did not report this digenean (McAllister et al. 2013). The prevalence is obviously low for this trematode in southern populations of *P. fouquettei*. Indeed, it would be difficult to predict if *Glyphthelmins* might be more common during other parts of the year because this frog is rarely taken outside of the breeding season (Feb.-Mar.) that our specimens herein were collected.

Ochetosomatidae

Renifer ellipticus Pratt, 1903

Twenty-one *R. ellipticus* (HWML 99907) were taken from the esophagus and oral cavity of an adult (740 mm SVL) *C. c. priapus*

collected on 20 April 2016 from off of US 259 in Hochatown, McCurtain County (34° 09' 55.152"N, 94° 45' 35.8776"W). *Ochetosoma ellipticus* was originally described by Pratt (1903) from specimens found in the mouth of an eastern hognose snake, *Heterodon platirhinos* (locality not given). It has been reported previously from blue racer, *Coluber constrictor foxi* from Illinois (Dyer and Ballard 1989) as well as other colubrid snakes in North America, including *Coniophanes* sp., indigo snake, *Drymarchion corais*, northern speckled racer, *Drymobius margaritiferus*, common kingsnake, *Lampropeltis getula*, northern cat-eyed snake, *Leptodeira septentrionalis*, *Micrurus* sp., *N. erythrogaster*, diamondback watersnake, *Nerodia rhombifer*, blackneck garter snake, *Thamnophis cyrtopsis*, and eastern ribbonsnake, *Thamnophis sauritis* from Arizona, New Mexico, South Dakota, and Tabasco, México (see Ernst and Ernst 2006). We document a new host record in the southern black racer as well as the first report of *R. ellipticus* from Oklahoma.

Renifer sp. metacercaria

Seven ochetosomatid metacercaria (*Renifer* sp.) were found in the intestinal tract of an adult (1,190 mm SVL) *F. a. reinwardti* collected on 8 April 2012 from Yashau Creek at Broken Bow, McCurtain County (34° 01' 08.2878"N, 94° 45' 17.4852"W). This is the first time *Renifer* sp. has been reported from this subspecies. *Renifer aniarum* has been reported previously from eastern mud snake, *Farancia abacura abacura* from an unknown locality by MacCallum (1921) (see McAllister and Bursey 2008).

Dasymetra conferta Nicoll, 1911

Five *D. conferta* (HWML 99891) were taken from the esophagus of an adult (660 mm SVL) *N. erythrogaster* collected on 23 August 2016 from Hochatown, McCurtain County (34° 10' 12.4926"N, 94° 45' 01.1442"W). Although this digenean has been previously reported from *N. erythrogaster* (Ernst and Ernst 2006), this is the first time it has been found in a plain-bellied watersnake from Oklahoma. McAllister and Bursey (2012) previously reported *D. conferta* from *N. rhombifer* from McCurtain County.

Telorchhiidae***Telorchis corti* Stunkard, 1915**

Two *T. corti* (HWML 99892) were found in the intestinal tract of an adult (290 mm CL) *P. concinna* collected from the vicinity of Bengal, Latimer County (34° 49' 58.3608"N, 95° 03' 42.861"W). This fluke has been reported from a number of turtles, including common snapping turtle, *Chelydra serpentina*, red-eared slider, *Trachemys scripta elegans*, and Mississippi mud turtle, *Kinosternon subrubrum hippocrepis* from Oklahoma (see McAllister et al. 2015b). We document a new host record for *T. corti*.

Cestoda: Cyclophyllidea: Linstowiidae***Oochoristica eumecis* Harwood, 1932**

A single adult (1091 mm SVL) *P. obsoletus* collected on 19 April 2016 from 14.5 km E of Jay, Delaware County (36° 26' 44.65"N, 94° 37' 46.15"W) was infected in its small intestine with two *O. eumecis* (HWML 99893). This is the first report of *O. eumecis* from a snake and from Oklahoma. Previous hosts include five-lined skink, *Plestiodon fasciatus* (type host) from Texas, western spiny-tailed iguana, *Ctenosaura pectinata* from México, and Madrean alligator lizard, *Elgaria kingii* from Arizona (Harwood 1932; Flores-Barroeta et al. 1958; Goldberg et al. 1999). However, Brooks et al. (1999) has suggested that all reports of *Oochoristica* in *C. pectinata* refer to *O. acapulocoensis* Brooks, Pérez-Ponce de León, and García-Prieto. We agree and document a new host and a new distribution record for *O. eumecis* as well as the third host of this tapeworm. We also provide comparative measurements of our specimens of *O. eumecis* with those in the original description by Harwood (1932) (Table 1). There is some variability in measurements; however, reproductive characters are very similar and we feel confident our specimens are *O. eumecis*.

***Ophiotaenia* sp.**

Two gravid proglottids of an *Ophiotaenia* sp. was found in the small intestine of an adult (223 mm SVL) *N. f. confluens* collected on 30 June 2013 from Yashau Creek at Broken Bow, McCurtain County (34° 00' 42.0336"N, 94° 44' 57.9186"W). Two cestodes, *Proteocephalus faranciae* and *Ophiotaenia perspicua* has been

reported previously from *N. fasciata* (Ernst and Ernst 2006).

Nematoda: Ascaridida: Cosmocercidae***Cosmocercoides variabilis* (Harwood, 1930)****Travassos, 1931**

A single *P. crucifer* (male 28 mm) collected on 13 March 2016 from 14.5 km E of Jay, Delaware County (36° 26' 44.65"N, 94° 37' 46.15"W) was infected with a single male *C. variabilis* (HWML 99894) in its rectum. Muzzall and Peebles (1991) reported *Cosmocercoides* sp. from this host in Michigan, and Yoder and Coggins (1996) reported *C. dukae* (more likely *C. variabilis*) from *P. crucifer* from Wisconsin. This common nematode has been reported from a plethora of herpetofauna from the Nearctic and Neotropical regions (see Bursey et al. 2012) and, in Oklahoma, from a salamander, four anurans, and a colubrid snake (see McAllister et al. 2015a, 2015b). This is the first time this parasite has been reported from Oklahoma specimens of *P. crucifer*.

Seuratoidea: Quimperidae***Omeia papillocauda* Rankin, 1937**

Three of 10 (30%) adult (36–42 mm SVL) *E. tynerensis* collected on 15 May 2015 from Flint Cave, Delaware County (36° 12' 27.83"N, 94° 42' 15.78"W) were infected in their intestines with seven (3 males, 4 females) *O. papillocauda* (HWML 99896) nematodes. *Omeia papillocauda* has previously been reported from *E. tynerensis* from nearby Arkansas (McAllister et al. 2014c). This is the first time *O. papillocauda* has been reported from Oklahoma *E. tynerensis*.

Strongylida: Molineidae***Oswaldocruzia pipiens* Walton, 1929**

One of two *A. fowleri* (91 mm SVL) collected on 12 September 2016 from Hochatown, McCurtain County (34° 09' 55.152"N, 94° 45' 35.8776"W) was infected with 11 (3 male, 8 female) *O. pipiens* (HWML 99874) in its small intestine. Previous hosts in Oklahoma include *A. a. americanus*, Rocky Mountain toad (*A. woodhousii woodhousii*), *L. s. utricularius*, and Hurter's spadefoot (*Scaphiopus hurterii*) (see McAllister et al. 2014a). This is another nematode that shows little host specificity as it

Table 1. Comparison of *Oochoristica eumecis* Harwood with current specimens.

Character	Harwood (1932) (<i>n</i> = 1)	Current specimens (<i>n</i> = 2)
Length	103 mm	100–110 mm
Scolex	500 μ m	497–510 μ m
Suckers	220 \times 260 μ m	204 \times 255 μ m
Neck	350 \times 2000 μ m	408 \times 1472–2176 μ m
Immature segments	not given	832–960 \times 320–960 μ m
Mature segments	800–900 long \times 1180–1200 μ m wide	1150–1340 long \times 768–960 μ m wide
Gravid segments	absent	absent
Genital pore	anterior fourth or fifth	end of first quarter
Cirrus sac	260–180 long \times 60–70 μ m wide	224–178 long \times 89–96 μ m wide
Testes number	40–55 (1 field)	45–52 (1 field)
Testes size	not given	26 μ m (in diameter)
Ovary	400 μ m wide	384 μ m wide
Vitellaria	not given	triangular 192 \times 192 μ m
Egg	no gravid proglottids	no gravid proglottids

has been reported from other anurans as well as various North American reptiles (McAllister et al. 2014b). We document a new host record for *O. pipiens*.

Several new host and distributional records are documented herein. Additional surveys are recommended, particularly on those amphibians and reptiles in the western and panhandle parts of the state where the ecoregions (and its herpetofauna) differ considerably from those in eastern Oklahoma. Furthermore, exposure of this fauna to its parasite's life cycles, which include vastly different intermediate hosts, will likely portend additional new host and geographic distribution records, including the possibility of discovering new species.

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