A New Host and Geographic Record for *Paracapillaria sonsinoi* (Nematoda: Capillariidae) from Timber Rattlesnake, *Crotalus horridus* (Serpentes: Crotalidae) from Oklahoma

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Abstract: Compared to other members of the genus *Crotalus*, little is known about the helminth parasites of the timber rattlesnake, *Crotalus horridus*. Here, we report, for the first time, a species of capillariid nematode from *C. horridus* and from Oklahoma.

Introduction

The timber rattlesnake, *Crotalus horridus* L., 1758, is a heavily-bodied venomous snake that ranges from southcentral New Hampshire and the Lake Champlain region south to northern Florida and west to southeastern Minnesota and central Texas (Powell et al. 2016). In Oklahoma, *C. horridus* is found from the eastern tier of counties westward to the central part of the state (Sievert and Sievert 2011). This snake occurs in a wide variety of terrestrial habitat but typically occurs in mountainous regions but will also inhabit rocky woodland hardwood and pine hillsides, swampy wetlands, and river floodplains. Much is known about the natural history and ecology of this snake (Collins and Knight 1980). It is an ambush predator that feeds mostly on small mammals, birds, and snakes. The species is ranked S3 (vulnerable) by NatureServe (2020) in Oklahoma.

Surprisingly little is known about the helminth parasites of *C. horridus* (Ernst and Ernst 2006). A trematode and five species of nematodes have been previously reported from this host from the Catskill Mountains (New York), Louisiana, North Carolina, and Virginia (Fantham and Porter 1954; Solomon 1974; Bowman 1984; Ernst and Ernst 2006; Davis et al. 2016). More recently, McAllister et al. (2018) reported an unknown species of capillariid (egg) from *C. horridus* from Oklahoma. However, no adult helminths have been reported from *C. horridus* from Oklahoma. Here, we document a new host and geographic distributional record for a nematode from *C. horridus*.

Methods

Between June 2013 and July 2020, two adult and one juvenile *C. horridus* (snout vent length [SVL] = 750–1,030 mm) were collected in McCurtain County, Oklahoma, and examined for endoparasites. Snakes were euthanized with an intraperitoneal injection of sodium pentobarbital (Nembutal®). A midventral incision was made from the cloaca to oral cavity to expose the viscera and the gastrointestinal tract and associated organs (lungs, liver, gallbladder, gonads) were placed in individual Petri dishes containing 0.9% saline. Feces from the rectum was collected and placed in an individual vial containing 2.5% (w/v) potassium dichromate

($K_2Cr_2O_7$) and, after flotation in Sheather's sugar solution (sp. gr. 1.30), examined for coccidians by brightfield microscopy. Organ contents were examined at 20 to 30× under a stereomicroscope and parasites found were rinsed of mucus. 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.

Standard common and scientific names follow Crother et al. (2017). Voucher specimens of snakes were deposited in the EOSC collection, Idabel, Oklahoma. Voucher specimens of nematodes were deposited in the Harold W. Manter Laboratory of Parasitology (HWML), University of Nebraska, Lincoln, Nebraska.

Results

Eight very thin nematodes were found in the small intestine of a single *C. horridus*. No snakes were found to be passing coccidians. Information on the nematode species follows.

Nematoda: Trichuroidea: Capillariidae

Syn. *Trichosoma soninoi* Parona, 1897.

***Paracapillaria* (*Ophidiocapillaria*) *soninoi* (Parona, 1897) Moravec, 1986**

Type host: Green whip snake, *Hierophis viridiflavus* (Lacépède, 1789).

Location in type host: Intestine (Parona 1897).

Type locality: Pisa, Italy (Parona 1897).

Other hosts and localities: Viperine water snake, *Natrix maura* (L., 1758), southern France (Moravec 1986); diamondback watersnake, *Nerodia rhombifer* (Hallowell, 1852), Louisiana (Moravec 1986).

Location in other hosts: intestine and rectum; urinary bladder (Moravec 1986).

New host: Timber rattlesnake, *Crotalus horridus* L., 1758, collected on 2 July 2020, 750 mm SVL.

Specimens deposited: HWML 111651.

New locality: USA: Oklahoma: McCurtain County, Eastern Oklahoma State College campus, Idabel (33° 55' 17.1012" N, 94° 46' 43.5612" W).

Prevalence and intensity: 1/3 (33%); 8 female worms.

Site of infection: Intestine.

Remarks: Moravec (1986) reported that *Paracapillaria* included two subgenera, *Paracapillaria* and *Ophidiocapillaria*. Presently, three subgenera are now recognized: *Paracapillaria* Mendonça, 1963, *Ophidiocapillaria* Moravec, 1986, and *Crossicapillaria* Moravec, 2001 (Moravec 2001). Biserkov et al. (1994) disagreed with the revision by Moravec (1986) who suggested the synonymy of the species of *Paracapillaria* infecting snakes. The former concluded that the species *P. sonsinoi*, *P. mingazzinii* Rizzo, 1902, *P. colubra* Pence, 1970, *P. viperae* Biserkov, Georgiev and Genov, 1985, *P. ptyasi* Wang, 1982, *P. xochimilcensis* Caballero and Cercero, 1943, and *P. heterodontis* Harwood, 1932, be considered distinct species within the genus and we concur until molecular analysis can be conducted.

The average length of our specimens was 30 mm, eggs were near the vulva in a single row, but occasionally farther away in two rows, and eggs possessed a roughened surface. They fit the description of *P. sonsinoi* by Moravec (1986) very well.

Discussion

Other than the report of *P. sonsinoi* from the urinary bladder of *N. rhombifer* (Moravec, 1986), there are only two other species of *Paracapillaria* currently known from North American snakes. Harwood (1932) described

P. heterodontis from the rectum of eastern hog-nosed snake, *Heterodon platirhinos* Latreille, 1801 from Texas, and additional hosts include *N. rhombifer* and northern cottonmouth, *Agkistrodon piscivorus* (Lacépède, 1789) from Louisiana (Fontenot and Font 1996). Pence (1970) provided a description of *P. colubra* from the oviducts of southern black racer, *Coluber constrictor priapus* Dunn and Wood, 1939 from Louisiana. Several additional snake hosts have also been reported with *P. colubra*, including broad-banded watersnake, *Nerodia fasciata confluens* (Blanchard, 1923), plain-bellied watersnake, *Nerodia erythrogaster* (Forster, 1771), and northern watersnake, *Nerodia sipedon sipedon* (L., 1758) from North Carolina (Collins 1973). In addition, Davis et al. (2016) reported *P. colubra* from *A. piscivorus*, eastern copperhead, *Agkistrodon contortrix* (L., 1758), and *C. horridus* from North Carolina; however, they were not able to report the site of the infection from their salvaged hosts. We therefore document the first report of *P. sonsinoi* from a crotalid snake and of this nematode species from west of the Mississippi River in Oklahoma.

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