First Report of *Cotylaspis cokeri* (Trematoda: Aspidogastrea: Aspidogastridae) and *Fornixtrema elizabethae* (Polyopithocotylea: Polystomatidae) from Eastern Musk Turtle, *Sternotherus odoratus* (Testudines: Kinosternidae), with an Additional Records for *Polystomoidella oblongum* (Polystomatidae) and *Hapalorhynchus* sp. (Digenea: Schistostomatoidea), from Southeastern Arkansas

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Abstract: During June 2014, two eastern musk turtles, *Sternotherus odoratus* (Latreille *in* Sonnini and Latreille) were collected in Cane Creek Lake, Lincoln County, Arkansas, and examined for parasites. Found were an aspidogastrid, *Cotylaspis cokeri* Barker and Parson, 1914, in the intestine, a polystome, *Fornixtrema elizabethae* (Platt, 2000) Du Preez and Verneau, 2020 in the conjunctival sac of the eye, and *Polystomoidella oblongum* (Wright, 1879) Price, 1939 in the urinary bladder. In addition, a *Hapalorhynchus* sp. occurred in visceral wash and mesenteric blood vessels of both turtles. The former two taxa represent new host and geographic records for these parasites, and *P. oblongum* and *Hapalorhynchus* sp. are reported for the first time in Arkansas.

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Introduction

The eastern musk turtle or stinkpot, *Sternotherus odoratus* (Latreille *in* Sonnini and Latreille) is a common kinosternid species that ranges from southeastern Ontario, Canada, New England, and Wisconsin, south to southern Florida and west to Texas (Powell et al. 2016). In Arkansas, *S. odoratus* occurs statewide in almost any type of still or sluggish watershed that has a soft substrate such as ditches, lakes, oxbows, ponds, sloughs, and streams (Trauth et al. 2004). It is an omnivorous bottom feeder. A good bit of information is available on its natural history and ecology (Iverson and Iverson 1980; Ernst 1986), including data on several parasites (Ernst and Ernst 1975, 1979; McAllister et al. 2013, 2016; and others). Here, we add two additional parasite species to its host list as well as providing new geographic distributional records for each taxon.

Methods

Host collection

On 28 June 2014, two adult *S. odoratus* (carapace lengths [CL] = 80, 100 mm) were collected with baited hoop nets from Cane Creek Lake at Cane Creek Lake State Park, Lincoln County, Arkansas (33°55′01″N, −91°45′55″W). They were placed individually in collection bags, returned to the lab, measured for carapace length (CL) (mm) and processed within 24 hr for parasites.

Processing

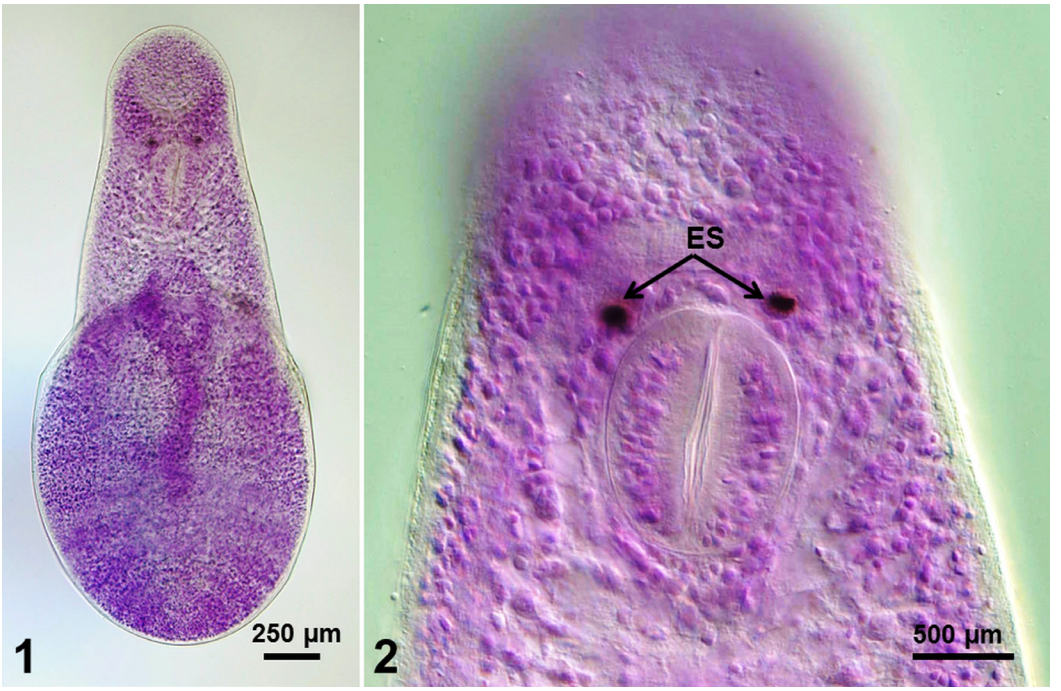
Turtles were killed with an intraperitoneal injection of a concentrated solution of tricaine methanesulfonate. Their mouth was examined as well as the conjunctival sacs of the eyes for polystomatid monogeneans. A bone saw was used to remove the plastron and a visceral wash from the blood vascular system of each was processed using a 7.0 g/L sodium citrate saline solution (to avoid blood clotting) following methods of Snyder and Clopton (2005). All internal organs from the throat to the vent was removed and placed in individual Petri dishes containing 0.9% (v/v) saline and examined. The entire intestinal tract was split lengthwise and cut into manageable sections (~50 mm) for examination of gastrointestinal parasites under a stereomicroscope. Four different parasites were found, heat-fixed in nearly boiling tap water without coverslip pressure, and placed in 95% DNA grade ethanol. They were later stained with acetocarmine, cleared in methyl salicylate, and mounted in Canada Balsam.

Voucher Specimens

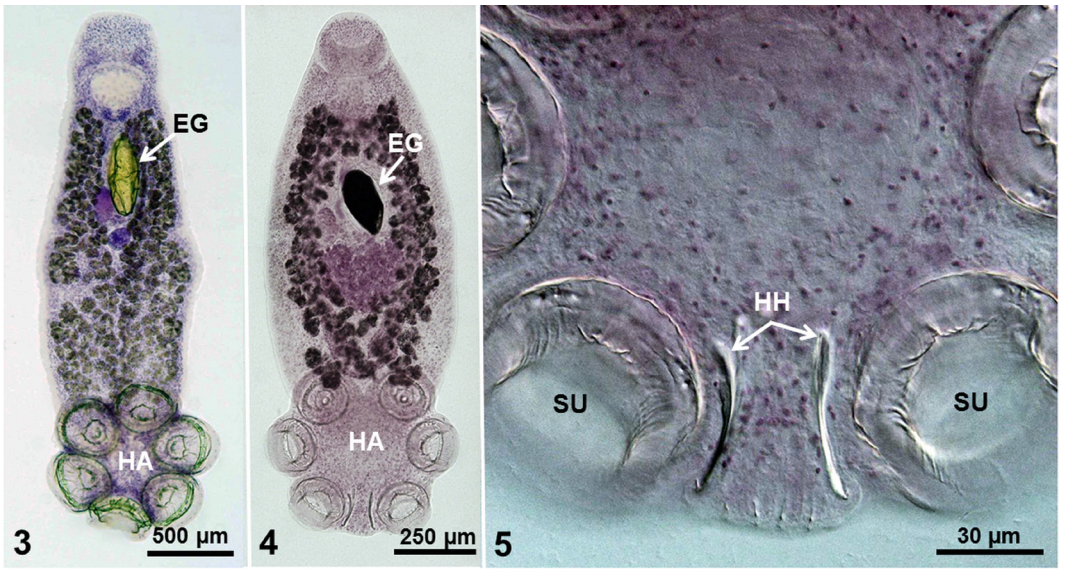
Parasite specimens were deposited in the Harold W. Manter Laboratory (HWML), University of Nebraska, Lincoln, Nebraska; some were retained for future molecular analyses. Host voucher specimens were deposited in the vertebrate collection of Northeast Texas Community College, Mt. Pleasant, TX. All turtle common and scientific names follow the Turtle Taxonomy Working Group (Rhodin et al. 2021).

Results

Three monogenean parasites were recovered, several aspidogastrid polystomes, *Cotylaspis cokeri* (Figs. 1–2) from the intestine matching the description of Barker and Parsons (1914), two *Fornixtrema* (=*Neopolystoma*) *elizabethae* (Fig. 3) from the conjunctival sacs conforming with the morphometric characters described originally described by Platt (2000) and redescribed by Du Preez and Verneau (2020), and a one and 57 individual *Polystomoidella* (=*Polystoma*) *oblongum* (Figs. 4–5) originally described by Wright (1879) from the urinary bladder of both turtles matching the description of Price (1939). In addition, both turtles harbored a *Hapalorhynchus* sp. from the visceral wash and mesenteric blood vessels.



Figures 1–2. Aspidogastrid, *Cotylaspis cokeri* from *Sternotherus odoratus*. (1) Entire worm. (2) Higher magnification showing eyespots (ES).



Figures 3–5. Polystomes from *Sternotherus odoratus*. (3) *Fornixtrema elizabethae* showing egg (EG) and six haptoral suckers (Type III of Du Preez and Theunissen [2021]) on haptor (HA). (4) *Polystomoidella oblongum*, entire worm showing egg (EG) and haptor (HA) with three pairs of haptoral suckers (Type III). (5) Higher magnification of haptor of *P. oblongum* showing large haptorial hooks (HH) and haptoral suckers (SU).

Discussion

Aspidogastrean polystomes are a small assemblage of flatworms with a cosmopolitan distribution. They are characterized by possessing a ventral holdfast organ with rows of alveoli or suckerlets, or just presenting a row of rugae or suckers (Rohde 2024). They infect molluscs as obligate hosts and various vertebrates (fishes, turtles) as facultative or obligate final hosts (Rohde 2024). Previous chelonian hosts of the families Trionychidae and Emydidae, respectively, of *C. cokeri* include: *Apalone ferox* (Schneider) and *Graptemys flavimaculata* Cagle, *Graptemys geographica* (Lesueur), and *Graptemys pseudogeographica pseudogeographica* (Gray) from Florida, Iowa (type locality), Mississippi, and Ohio (see summary in Alves et al. 2015). In addition, *C. cokeri* has been reported from paddlefish, *P. spathula* Bonaparte from Mississippi (Hoffman 1999). We document an additional family, Kinosternidae, as a host of this parasite.

De Preez and Verneau (2020) provided a revised classification of parasitic flatworms that infect the conjunctival sac of chelonians, introducing three new genera: *Apaloneotrema*, *Aussietrema*, and *Fornixtrema*, based on detailed morphological comparisons of these parasites across various turtle taxa. *Fornixtrema elizabethae* was originally described by Platt (2000) from the western painted turtle, *Chrysemys picta belli* (Gray) from Indiana, Michigan (type locality), and Wisconsin.

Polystomoidella oblongum was originally described by Wright (1879) from the urinary bladder of *S. odoratus* from Canada. It has also been reported from additional chelonian hosts from Iowa, Maryland, North Carolina, Texas, and Virginia, and México (Stunkard 1917; Price 1939; Mendoza-Garfias et al. 2017). We report this parasite from Arkansas for the first time, and from west of the Mississippi River for the second time.

Several *Haplorhynchus* sp. was found in the visceral wash of the blood vascular system. These blood digeneans are commonly found in turtles (Ernst and Ernst 1977), including *H. reelfooti* (Byrd, 1939) Platt and Snyder, 2007 from *S. odoratus* from Alabama, Indiana, Tennessee, and Virginia, (Byrd 1939; Platt and Snyder 2007; Roberts et al. 2017). To our knowledge, there are no previous reports of species of *Haplorhynchus* from an Arkansas chelonian host so we document a new distribution record and the second from west of the Mississippi River (see McAllister et al. 2015). Specimens are being retained for molecular analyses (V. V. Tkach, *pers comm*).

Although numerous parasites have been reported previously from *S. odoratus* over the past century or more, this is the first time either *C. cokeri* or *F. elizabethae* has been documented in this host. In addition, both of these parasites as well as *P. oblongum* and *Hapalorhrynchus* sp. are reported from Arkansas for the first time. This brief survey shows, even with a small sample size (n = 2), that it is possible to discover novel parasitological information in a well-examined turtle.

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