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# Additional Information on the Natural History and Ecology of Select Fauna (Decapoda; Actinopterygii; Mammalia) from Oklahoma

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**Abstract:** In our third contribution on the subject, we include noteworthy observations on the natural history and ecology of three species of crayfishes, eight native fishes, and two mammals in Oklahoma. Here, additional records of three uncommon species of crayfishes, early spawning dates for five fishes, an unusual occurrence of the egg filaments of *Labidesthes sicculus* entangled among the gill filaments and rakers of *Menidia audens*, and notable information on ecto- and endoparasites from two species each of fishes and mammals are documented. Our purpose is to help complement and fill gaps in our limited biological knowledge of this biota that should help in future studies conducted in the state.

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and two mammals of the state.

## Introduction

The state of Oklahoma is presently inhabited by 31 species of crayfishes (Morehouse and Tobler 2013; Taylor and Robison 2016), over 180 species of fishes (Miller and Robison 2004), and 106 species of mammals (Caire et al. 1989). Updated information on the natural history and ecology of this biota is essential in understanding their biology. Here, in our third contribution on the subject (McAllister and Robison 2016, 2017), we provide biological information on three species of crayfishes, eight native fishes,

## Methods

Crayfishes were collected by hand and preserved in 70% isopropyl alcohol. Fishes were taken with  $3.1 \times 1.8$  m or  $6.1 \times 1.8$  m seines (3.2 mm mesh), gill nets, bowhunting, and/or with a back-pack electrofisher (DC current). They were killed by immersion in a concentrated tricaine methanesulfonate solution following accepted methods (Use of Fishes in Research Committee 2014), preserved in 10% formalin, and stored in 45% isopropanol. Fishes were also measured for total length (TL)

and specimens were examined for reproductive characters; some containing ripe ova had their egg sacs weighed to the nearest g. Leeches from fish were slowly relaxed by adding increasing concentrations of ethanol to its container water before being preserved in 95% (v/v) DNA grade ethanol. The Brook Silverside (*Labidesthes sicculus*) egg was identified using Wallus and Simon (2006). A single bat was found dead on the road, and two woodrats were collected with Sherman live traps baited with oatmeal. Woodrats were killed with an intraperitoneal injection of sodium pentobarbital following accepted guidelines (Sikes et al. 2016). A midventral incision was made on each mammal and the entire gastrointestinal tract was removed and placed in Petri dishes containing 0.9% saline and contents examined under a stereomicroscope at 20-30 $\times$ . Nematodes were fixed in hot tap water and preserved in 70% (v/v) ethanol. They were later cleared by placing them in a mixture of 5% or 10% glycerin in 70% ethanol in an uncovered dish, and allowing the ethanol (and water) to evaporate. Cleared nematodes were studied as temporary mounts in glycerol. Localities are reported as GPS (latitude and longitude) coordinates. Crayfish and some fish voucher specimens were deposited in the Southern Arkansas University (SAU) Collection, Magnolia, Arkansas. Leeches were deposited in the Invertebrate Zoology Collections of the Peabody Museum of Natural History at Yale University (YPM), New Haven, Connecticut. Other fish and mammal vouchers were deposited in the Henderson State University (HSU) collection, Arkadelphia, Arkansas.

## Results and Discussion

The results of our findings are detailed below in an annotated format and phylogenetic order.

### Crustacea: Decapoda: Cambaridae (Cambarid Crayfishes)

***Cambarellus puer* Hobbs, 1945 – Swamp Dwarf Crayfish.** *Cambarellus puer* typically inhabits permanent, well vegetated, shallow, mud-bottomed swamps, sloughs, and lowland streams (Taylor et al. 2004). In Oklahoma, it is known from only a single location in McCurtain

County along the Little River (Morehouse and Tobler 2013). On 27 November 1992, two female *C. puer* were collected by aquatic dip net in a roadside ditch on US 259, 10.1 km (6.3 mi) S of Broken Bow, McCurtain County (33° 46' 47.8086"N, 94° 46' 30.7704"W). We document this additional collection site for an uncommon Oklahoma crayfish which represents only the second documented geographic locale for *C. puer* in the state.

***Faxonius lancifer* (Hagen, 1870) – Shrimp Crayfish.** Until recently, this crayfish was placed in the genus *Orconectes*. The taxonomy of freshwater crayfishes was recently updated based on the last 20 years of phylogenetic studies that have called into question family, subfamily, genus, and subgenus affiliations for various taxa (Crandall and DeGrave 2017). This crayfish is most often found in permanent waters of oxbows, bayous, and lowland streams over substrates of mud or mixed mud and sand (Page 1985). Morehouse and Tobler (2013) reported this state crayfish was known from only two localities in McCurtain County. Herein, we report two additional collection sites of this uncommon crayfish in the state. On 27 November 1997, two female specimens of *F. lancifer* were taken by aquatic dip net from a roadside ditch along St. Hwy. 87, about 12.9 km (8 mi) SE of Tom, McCurtain County (33° 42' 29.7684"N, 94° 37' 53.6412"W). Three years later, on 30 November 2000, one additional male (form II) was collected from an unnamed swamp on US 259, 11.2 km (7.0 mi) S of Broken Bow, McCurtain County (33° 56' 42.093"N, 94° 45' 29.3214"W).

***Procambarus curdi* Reimer, 1975 – Red River Burrowing Crayfish.** In his original description of *P. curdi*, Reimer (1975) listed a number of collecting localities in southern Oklahoma, including three near Idabel, McCurtain County. Morehouse and Tobler (2013) later reported both males (form I and II) and females have been collected throughout the year in Oklahoma from burrows in the Red River drainage of the state. More recently, McAllister and Robison (2017) reported the first occurrence of an ovigerous female taken in Oklahoma.

We herein report the second collection of an ovigerous female in the state. On 25 March 2001 a single ovigerous female with 107 ova (1.0–1.5 mm in diameter) was dug from a burrow in a roadside ditch along U.S. Hwy. 70 (259), approximately 10.9 km (6.8 mi) NE of Idabel, McCurtain County (33° 57' 3.5742"N, 94° 45' 25.8798"W).

**Actinopterygii: Lepisosteiformes:  
Lepisosteidae (Gars)**

***Lepisosteus oculatus* Winchell, 1864 – Spotted Gar.** A 670 mm TL female *L. oculatus* was collected by bowhunting on 28 October 2018 from a private pond north of Idabel in McCurtain County (33° 55' 56.93"N, 94° 43' 43.22"W) and found to contain ripe eggs with a wet weight of 301 g. In Oklahoma, Spotted Gar are reported to spawn from about mid-April to early June (Tyler and Granger 1984). We document the earliest known date of potential spawning for *L. oculatus* in the state.

**Amiiformes: Amiidae**

***Amia calva* Linnaeus, 1766 – Bowfin.** A 470 mm TL female *A. calva* was collected by bowhunting on the same date and site above and contained ripe ova with a wet weight of 43.7 g. Bowfin are reported to spawn in spring (early April into June) in Oklahoma (Miller and Robison 2004). We report the earliest known date of impending spawning for *A. calva* in the state.

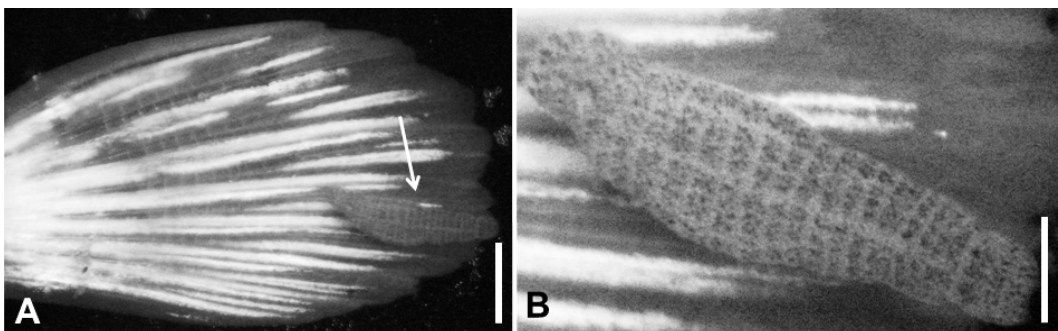
**Hiodontiformes: Hiodontidae**

***Hiodon alosoides* (Rafinesque, 1819) –**

**Goldeye.** A 143 mm TL *H. alosoides* was collected on 14 February 2018 with a gill net from near the Willis Bridge on Lake Texoma, Marshall County (33° 52' 32.4516"N, 96° 50' 2.3136"W) at a water temperature of 6.7°C (44°F). Examination of this female revealed it to be full of gravid (ripe) ova with a combined egg mass wet weight of 39.02 g. Spawning in *H. alosoides* occurs in early spring (April) in Oklahoma (Miller and Robison 2004). In other parts of its range, spawning has been reported in early spring in Illinois and in May to early July in Canada with a production of 6,000 to 25,000 eggs. We therefore document the earliest possible spawning of *H. alosoides* in Oklahoma.

**Cypriniformes: Cyprinidae (Carp and Minnows)**

***Campostoma pullum* (Agassiz, 1854) – Central Stoneroller.** A single leech, *Cystobranchus klemmi* (Williams and Burreson) was found on the pectoral fin of an 81 mm TL *C. pullum* (Figs. 1A–B) collected on 13 March 2017 from the Illinois River, Cherokee County (35° 57' 30.042"N, 94° 52' 10.0266"W). This represents a new host record for *C. klemmi*. *Cystobranchus klemmi* is primarily found on various stonerollers (Williams and Burreson 2005, Richardson et al. 2013) and the host list also includes other cyprinids such as Southern Redbelly Dace (*Chrosomus erythrogaster*), Bigeye Shiner (*Notropis boops*) and Creek Chub (*Semotilus atromaculatus*) (Richardson et al. 2013; Thigpen et al. 2015). This leech has now been reported from locales in Arkansas, Illinois, Missouri, and Oklahoma (Williams and



**Figures 1A-B.** Leech from *Campostoma pullum*. **A.** View of *Cystobranchus klemmi* (arrow) on pectoral fin; scale bar = 5.0 mm. **B.** Higher magnification of *C. klemmi* on pectoral fin. Scale bar = 2.0 mm.

Burreson 2005; Richardson et al. 2013; Thigpen et al. 2015; McAllister et al. 2018).

***Notropis nubilus* (Forbes, 1878) – Ozark Minnow.** Little is known concerning the actual time of spawning in Oklahoma of the Ozark Minnow. Miller and Robison (2004) did not specify dates and only stated that spawning occurs in the spring. Six nuptial males of *N. nubilus* collected on 7 April 2001 from the Illinois River at St. Hwy 51, S of Eldon, Cherokee County (35° 55' 16.5504"N, 94° 50' 14.8848"W) were in their orange breeding coloration and running milt. This is the first actual date of spawning condition in males reported for this species in Oklahoma.

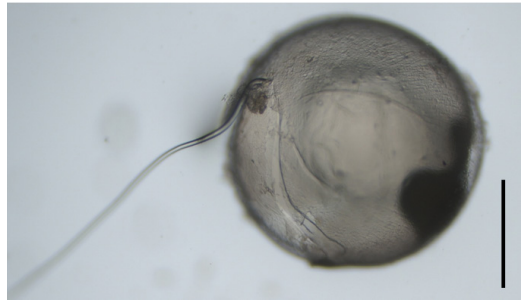
***Erimystax x-punctatus* (Hubbs and Crowe, 1956) – Gravel Chub.** Miller and Robison (2004) reported spawning in this species occurs from March to early May; however, little is known concerning the reproductive period of this chub in Oklahoma. On 13 March 1996, three male *E. x-punctatus* in reproductive condition (running milt) were collected from the Illinois River at St. Hwy 51, S of Eldon, Cherokee County (35° 55' 16.5504"N, 94° 50' 14.8848"W). This is the earliest date in March reported for this species in spawning condition documented from Oklahoma.

#### Atherinopiformes: Atherinopsidae

***Menidia audens* Hay, 1882 – Mississippi Silverside.** Forty-four *M. audens* (mean TL = 75.7, range 63–96 mm) were collected by seine on 19 April 2018 from near the University of Oklahoma Biological Station, Lake Texoma, Marshall County (35° 52' 45.9906"N, 96° 48' 7.6068"W). While examining specimens for monogenean gill parasites (none found), a single specimen was found to possess filaments of two eggs (Fig. 2) of what we believe to be from a Brook Silverside (*Labidesthes sicculus*) tangled in its gills and gill rakers. We suggest the *M. audens* ate the eggs and the filaments got tangled in its rakers. This silverside has been reported to feed primarily on plankton (Wallus and Simon 2006), so this event seems plausible.

#### Perciformes: Percidae

***Percina phoxocephala* (Nelson, 1876) –**



**Figure 2.** Egg of *Labidesthes sicculus* found on gill filament of *Menidia audens*; scale bar = 500  $\mu$ m.

**Slenderhead Darter.** Little is known about the parasites of *P. phoxocephala* (McAllister et al. 2016). Two of seven (29%) *P. phoxocephala* collected on 25 October 2013 from Cow Creek Crossing on the Little River, McCurtain County (34° 31' 5.9658"N, 94° 30' 19.8288"W) were infested with leeches, *Myzobdella reducta* Meyer on the caudal fins (Figs. 3A–B). This leech has also been reported from other fishes from this locality (Richardson et al. 2014). Meyer (1940) originally described *M. reducta* (as *Piscicolaria reducta*) from *P. phoxocephala* from Illinois. There is an additional report of this leech being reported from *P. phoxocephala* in Minnesota (Erickson 1978), but this is first time Slenderhead Darters from Oklahoma have been documented with *M. reducta*.

#### Mammalia: Chiroptera: Molossidae

***Tadarida brasiliensis* (I. Geoffroy, 1824) – Mexican free-tailed bat.** Three nematodes (two male, one female) of *Tadaridanema delicatus* (Schwartz, 1927) Falcon-Ordaz, Guzman-Cornejo, Garcia-Prieto, and Gardner, 2006 (HWML 110492) were found in the intestines of a single *T. brasiliensis* found dead on 1 November 2014 in Broken Bow, McCurtain County (34° 00' 23.66"N, 94° 45' 53.88"W). This nematode has been previously reported from *T. brasiliensis* from California, Florida, Louisiana, New Mexico, Texas, and México (Voge 1956; Jameson 1959; Cain 1966; Martin 1976; Falcón-Ordaz et al. 2006). We document *T. delicatus* in Oklahoma for the first time.

#### Rodentia: Cricetidae

***Neotoma floridana* (Ord, 1818) – Eastern**



Figures 3A-B. Leech from *Percina phoxocephala*. A. View of *Myzobdella reducta* (arrow) on caudal fin; scale bar = 10.0 mm. B. Closeup of same *M. reducta* (arrows) on caudal fin; scale bar = 10.0 mm.

**woodrat.** One of two *N. floridana* collected on 9 August 2018 from the Eastern Oklahoma State College Campus-Wilburton, Latimer County (34° 54' 54.3558"N, 95° 19' 51.9024"W) was found to harbor two murine whipworms, *Trichurus muris* (HWML 110493) in its cecum (Fig. 4). This species is a gastrointestinal parasite of mice which resides in the cecum and colon. In the life cycle, *Trichurus* eggs are unembryonated when passed in the host feces and take up to a month in a humid environment to become infective and require no intermediate host (Anderson 2000). The hosts obtain the infection by ingesting food items or drinking water contaminated with embryonated eggs. This whipworm has been reported from *N. floridana osagensis* from Oklahoma (Murphy 1952; Boren et al. 1993). Another species, *T. neotomae* Chandler has been reported from the southern plains woodrat, *N. micropus*,

from Texas (Charles et al. 2012) and dusky-footed woodrat, *N. fuscipes* from California (Chandler 1945; Boren et al. 1993). We report an additional infection in *N. floridana* and the first photomicrograph (Fig. 4) of *T. muris* from an eastern woodrat.

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Figure 4. *Trichurus muris* from *Neotoma floridana*. Scale bar = 1.0 mm intervals.

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