
Parasites of the Silver Chub, *Macrhybopsis storeriana* (Cypriniformes: Leuciscidae) from the Red River, Choctaw County, Oklahoma

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Abstract: Three adult silver chubs, *Macrhybopsis storeriana* were collected by seine in August 2023 from the Red River, Choctaw County, Oklahoma, and examined for parasites. Found were a monogenean, *Dactylogyrus texomensis*, an encysted strigeid (neascus) trematode, a proteocephalidean metacestode, and the Asian fish tapeworm, *Schyzocotyle acheilognathi*. All are reported as new hosts for these parasites, and *S. acheilognathi* is documented from an Oklahoma fish for the third time.

Introduction

The silver chub, *Macrhybopsis storeriana* (Kirtland, 1845) ranges from southern Manitoba, Canada, and the Lake Erie drainage and Lake Ontario, Canada, south through the Ohio River drainage and Mississippi River Basin from Wyoming south through Louisiana, Mississippi, and Alabama; an isolated population occurs in Brazos River drainage, Texas (Gilbert 1978; Page and Burr 2011). In Oklahoma, *M. storeriana* occurs in about the eastern three-quarters of the state primarily in the Arkansas and Red River drainages and their tributaries

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(Miller and Robison 2004). It prefers larger, sandy-bottomed silty rivers and streams with deep water and moderate to swift current but also occurs in gravel-bottomed pools and backwaters of small and large rivers (Miller and Robison 2004; Page and Burr 2011). This species feeds mostly at or near the bottom on various insects, crustaceans, and molluscs (Becker 1983).

Information is available on the natural history and ecology of the silver chub (Kinney 1954; Gilbert 1978), including information on its parasites (under the old name, *Hybopsis storeriana*). Three monogeneans have been reported from *M. storeriana*, including

Dactylogyrus alabamensis Rogers and Mizelle, 1966 from Alabama and Georgia, *Dactylogyrus magnus* Rogers, 1967 from Alabama, and *Dactylogyrus texomensis* Seamster, 1960 from Oklahoma (Seamster 1960; Rogers and Mizelle 1966; Rogers 1967). Other parasites of the silver chub include: two trematodes, a 'neascus' sp. and *Plagioporus cooperi* (Hunter and Bangham, 1932) Price, 1934 from Lake Erie, Ohio, a cestode, *Ligula intestinalis* (L., 1758), and an acanthocephalan, *Leptorhynchoides thecatus* (Linton, 1891) Kostylew, 1924 (Bangham and Hunter 1939; Hoffman 1999). Here we report new records for some parasites of *M. storeriana* from the Red River of Oklahoma, including the third report of the Asian fish tapeworm (AFT), *Schyzocotyle acheilognathi* (Yamaguti, 1934) Brabec, Waeschenbach, Scholz, Littlewood, and Kuchta, 2015, from an Oklahoma fish.

Methods

Host collection

On 13 August 2023, three adult *M. storeriana* (mean \pm SD total length [TL] = 64.0 \pm 7.9, range 57–75 mm TL) were collected by seine by CTM and NHM from the Red River (Fig. 1) just north of Arthur City, Texas, off US 271 in Choctaw County, Oklahoma (33°52'36.77"N, -95°30'07.05"W). Additional attempts to collect more specimens from the same site were made by us on 17 September 2023 and 8 October 2023 but, unfortunately, none were collected.

Host processing

Specimens were placed in an aerated container of habitat water, taken to the lab for processing, and killed by cervical dislocation. Their gills,

gallbladders, urinary bladders, fins, integument, other major organs, and musculature were placed in Petri dishes containing 0.9% saline and macroscopically examined for myxozoan plasmodia with a stereomicroscope at 20-30 \times magnification. The gills were also examined for monogeneans, which were mounted on slides in Grey and Wess medium stained with Gomori's trichrome (Kritsky et al. 1978), and observed and photographed with an AccuScope 3000LED series phase contrast microscope (Accu-Scope Inc., Commack, New York). Digital images of syntypes of *Dactylogyrus texomensis* Seamster, 1960 (USNPC 30026 = USNM 1339486), previously examined and photographed by DGC with an Olympus OLY-200 camera mounted on an Olympus BX41 phase contrast microscope (Olympus Optical Co., Ltd., Tokyo, Japan), were compared with material found. Terminology for sclerites is that of Cloutman et al. (2020). The gastrointestinal tract was likewise examined for helminth parasites and split lengthwise from the esophagus to anus. A metacystode cyst as well as an encysted trematode were found in the coelomic cavity, placed on a cover-slipped microscopic slide with saline, and photographed as photovouchers. A tapeworm was taken from the small intestine, rinsed in saline, and its terminal proglottid was removed and placed in 95% DNA grade ethanol for future molecular analysis. The remaining specimen was fixed in hot 4% formalin, stained in Semichon's acetocarmine, cleared in methyl salicylate, and mounted in Canada Balsam.

A voucher for the monogenean and tapeworm was deposited in the Harold W. Manter Laboratory of Parasitology (HWML), Lincoln,



Figure 1. Habitus of silver chub in Red River, Choctaw Co., Oklahoma.

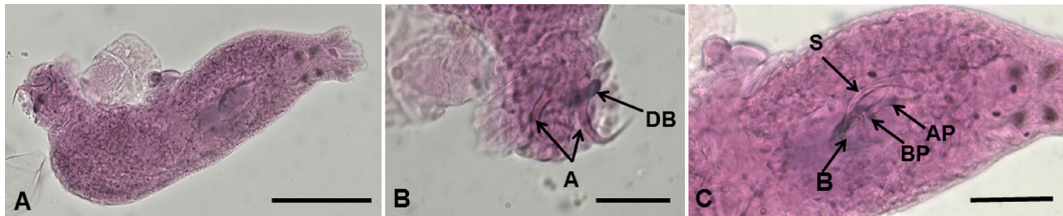


Figure 2. Digital images of voucher specimen of *Dactylogyrus texomensis* from the Red River, Choctaw Co., Oklahoma. (A) Whole mount. Scale bar = 50 μm . (B) Haptor. Abbreviations: A = dorsal anchors, DB = dorsal bar. Scale bar = 20 μm . (C) Male copulatory organ (MCO). Abbreviations: AP = accessory piece, B = base of MCO, BP = basal process of MCO (bent downward), S = shaft of MCO. Scale bar = 20 μm .

Nebraska. Photovouchers of the strigeid trematode and metacystode were also deposited in the HWML, and voucher hosts were deposited in the Eastern Oklahoma State College (EOSC) Vertebrate Collection, Idabel, Oklahoma.

Results and Discussion

All three individual silver chubs harbored parasites. Two silver chubs harbored one each of the monogenean, *Dactylogyrus texomensis* Seamster, 1960 (HWML 217058; Figs. 2–3); one (57 mm TL) possessed an unknown digenean strigeid (neascus) cyst in its coelomic cavity (HWML 217084; Fig. 4A); one (75 mm TL) had an unknown encysted metacystode in its coelomic cavity (HWML 217085; Fig. 4B); and

another (60 mm TL) had a mature (gravid) AFT in its small intestine (HWML 217847; Fig. 5).

This is the second report of *D. texomensis* (Figs. 2A–C), confirmed by comparison with syntype specimens (Figs. 3A–F), both recorded from the silver chub from the Red River drainage. All specimens were very similar, with notable differences in the angle of the basal process (Fig. 2C and Figs. 3C, E, F) due to effects of preservation, mounting, and angle of view. Seamster (1960) reported studying 10 specimens and depositing a holotype (but he did not specify a particular specimen) and unspecified number of paratypes for *D. texomensis* as USNM 30026. The two available slides examined by DGC (USNPC 30026 = present USNM 1339486)

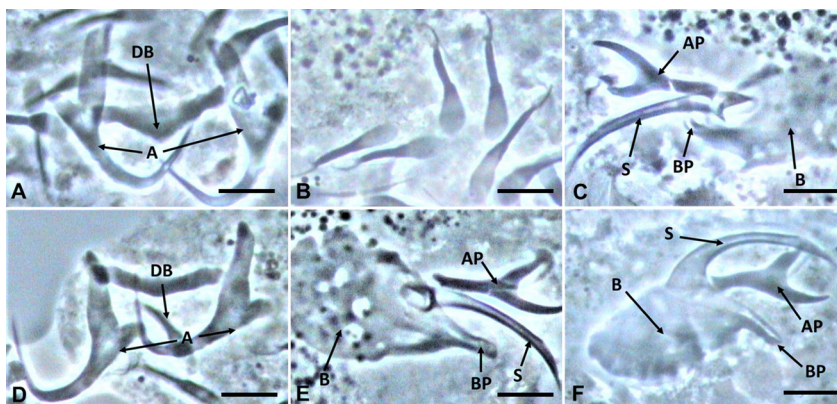


Figure 3. Lectotype and paralectotype of *Dactylogyrus texomensis* from Lake Texoma, Oklahoma. (A) Haptor of lectotype. Abbreviations: A = dorsal anchors, DB = dorsal bar. (B) Hooks of lectotype. (C) MCO of lectotype. Abbreviations: AP = accessory piece, B = base of MCO, BP = basal process of MCO (bent upward), S = shaft of MCO. (D) Haptor of a paralectotype. A = dorsal anchors, DB = dorsal bar. (E) MCO of a paralectotype. Abbreviations: AP = accessory piece, B = base of MCO, BP = basal process of MCO (straight), S = shaft of MCO. (F) MCO of a paralectotype. Abbreviations: AP = accessory piece, B = base of MCO, BP = basal process of MCO (bent downward), S = shaft of MCO. Scale bars = 10 μm .

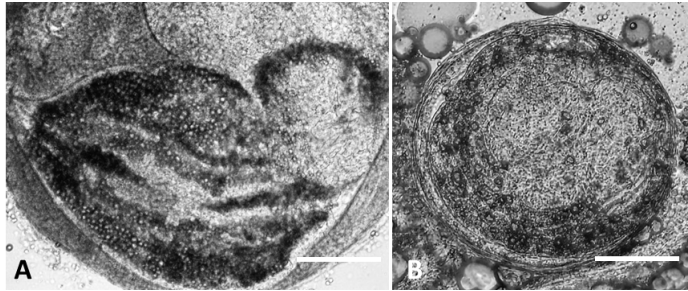


Figure 4. Immature helminths from silver chub. (A) Unknown encysted strigeid neascus (Trematoda: Digenea). (B) Unknown encysted metacestode (Cestoda). Scale bars = 25 µm.

are labelled as cotypes (a term to be avoided and should be referred to as syntypes according to Recommendation 73E of the International Code of Zoological Nomenclature [ICZN 1999]). One slide with Seamster's accession number 692-12 contains three specimens. The other slide with Seamster's accession number 692-13 contains one specimen and is labelled cotypes. This plural "cotypes" designation on a slide with one specimen indicates that both slides are part of a cotype (=syntype) series, rather than a holotype and paratype series. In addition, two different male copulatory organs (MCOs) and dorsal bars and one set of dorsal anchors and a hook were drawn in Seamster's (1960) description of *D. texomensis*, neither of which conform unequivocally to any particular of the four specimens on the two slides, but appear to represent the same species as the four specimens on the two slides. Thus, there is no clearly indicated holotype specimen in Seamster's (1960) description. In accordance with Recommendation 73F and Article 73.2 of the code (ICZN 1999), we propose designation of the specimen on slide 692-13 of USNM 1339486 (= USNPC 30026) as the lectotype of *D. texomensis*, and the three specimens on slide 692-12 as paralectotypes.

Two other monogeneans have been reported from *M. storeriana*, *D. alabamensis* from Alabama and Georgia, and *D. magnus* from Alabama. *Dactylogyrus texomensis* has not been found with these other two species east of the Mississippi River, and the other two have not been found west of the Mississippi River (Seamster 1960; Rogers and Mizelle 1966; Rogers 1967; present study).

The AFT is a very successful invasive parasite known from various freshwater fishes. To date, it has been reported from more than 300 fish species with the greatest number of records from North American cyprinid (or leuciscid) hosts (Kuchta et al. 2018). The tapeworm has been previously reported from fishes from Canada, México, and Puerto Rico as well at least 20 US states, including Arkansas, Arizona, California, Colorado, Florida, Kansas, Hawaii, Indiana, Kentucky, Louisiana, Michigan, Nebraska, New Hampshire, New Mexico, New York, Nevada, North Carolina, Texas, Utah, and Wisconsin, but no records were posted from Oklahoma (Kuchta et al. 2018, see their fig. 4). However, McAllister et al. (2015) reported *S. acheilognathi* from 1 of 16 (6%) Western mosquitofish, *Gambusia affinis* (Baird and Girard), and McAllister et al. (2016) found a larval AFT in 1 of 13 (8%) Western creek chubsucker, *Erimyzon claviformis* Mitchell, both collected from Yanubbee Creek, McCurtain County, Oklahoma. To our knowledge this is the first report of AFT from the silver chub or any species of *Macrhybopsis* (see host lists in Hoffman 1999; Cole and Choudhury 2015; Kuchta et al. 2018). The tapeworm is easily identified by its heart shaped scolex (when viewed laterally) with deep bothria (Fig. 5A), and also possesses characteristic acraspedote proglottids (Figs. 5B, C). The stained and cleared wholmount also shows the typical distribution of vitelline follicles and testes (Figs. 5B, C). It is evident from the gravid worm we collected here that the silver chub is a very suitable host, capable of sustaining the tapeworm population in the Red River. It is possible that AFT was introduced into the Red River drainage by invasive grass carp, *Ctenopharyngodon idella* (Valenciennes

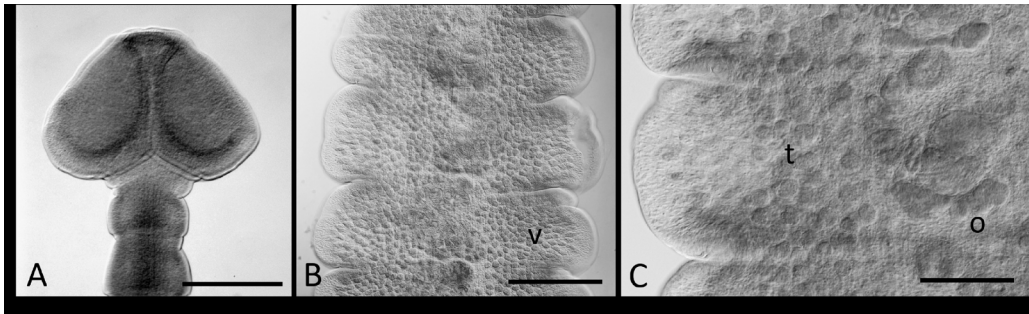


Figure 5. Asian fish tapeworm, *Schyzocotyle acheilognathi* from silver chub. (A) Scolex of tapeworm in lateral view. Scale bar = 400 μm . (B) An early gravid segment (proglottid) showing the typical superficial distribution of vitelline follicles (v). Scale bar = 500 μm . (C) An early mature but non-gravid segment (proglottid) showing the testes (t) and ovary (o). Scale bar = 200 μm

in Cuvier and Valenciennes) now established in that drainage (Hargrave and Gido 2004; Shelton and Snow 2017). The grass carp is considered to be a principal host of this tapeworm and is responsible for its original introduction into the U.S. in the 1970s (Hoffman 1999; Choudhury and Cole 2012). It would not be surprising to also find other leuciscid fish species in the Red River infected with this tapeworm. However, McAllister et al. (2015) reported that they did not find any AFT in 256 fishes from various Arkansas watersheds, including 10 species of leuciscids ($n = 72$). Therefore, prevalence can be quite low for the AFT.

In the life cycle of *S. acheilognathi*, proceroids are found in copepods, with smaller fishes occasionally acting as “carriers”, and the adult occurs in the intestine of teleost fishes, with a predilection for cyprinid and leuciscid fishes (see Hoffman 1999; Choudhury and Cole 2012; Kuchta et al. 2018). Although this tapeworm is a known pathogen having a potential negative impact on many fishes, particularly cyprinids (Scott and Grizzle 1979; Salgado-Maldonado and Pineda-Lopez 2003; Scholz et al. 2012), the effect on these Oklahoma fishes is unknown.

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