First Record of *Aethycteron nigrofasciatus* (Harrises, 1962) (Monogenea: Dactylogyridae) from the Dusky Darter, *Percina sciera* (Swain) (Perciformes: Percidae), in Oklahoma

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Abstract: Virtually nothing is known regarding parasites of the Dusky Darter, *Percina sciera*. The only parasite reported to date from this host is a piscicolid leech. Here, we report *Aethycteron nigrofasciatus* on the gills of this host from the Little River Drainage of the Red River System of southeastern Oklahoma. Morphometric characters of *A. nigrofasciatus* from *P. sciera* from the state conform closely to those previously reported from its only other known host, the Blackbanded Darter, *Percina nigrofasciata* in Mississippi. Both possess a unique curved male copulatory organ with a spine on the distal half of the shaft and a flared distal end. *Aethycteron nigrofasciatus* on *P. sciera* represents a new host record and the first geographic distributional record of this monogenean from west of the Mississippi River.

Introduction

One of the most plentiful and ever-present groups of non-game fishes occurring in Oklahoma are the darters (Perciformes: Percidae: Etheostomatini), numbering about 32 species (Miller and Robison 2004). These active and multicolored fishes inhabit nearly all of the state's streams and rivers as well as many other watersheds. They are important ecologically in playing a role in the trophic structure of stream ecosystems (Cummins 1980). Yet, we know very little about the parasites of many darters in the state.

One species, the Dusky Darter, *Percina sciera* (Swain), is widely distributed in the Mississippi River basin from Ohio and West Virginia to eastern Illinois and south to Louisiana, and Gulf drainages from the Alabamba River in Alabama west to the Colorado River in Texas (Page and Burr 2011). In Oklahoma, *P. sciera* is found in the Red River and Poteau river systems and west to Rainy Mountain Creek, Kiowa County (Miller and Robison 2004). It primarily inhabits fast gravel riffles and runs of small to medium rivers, often associated with boulders, emergent vegetation, or fallen trees and brush. This darter is an invertivore that feeds mainly on small aquatic insects and crustaceans in riffles (Page and Smith 1970; Kuehne and Barbour 1983; Miller and Robison 2004; Robison and Buchanan 2020).

Although information is available on the natural history of *P. sciera* (Page and Smith 1970), very little is known about its parasites. Aside from a leech, *Myzobdella reducta* (Meyer,

1940), reported from *P. sciera* from Minnesota (Erickson 1978), nothing else is known of the parasitofauna of *P. sciera* (Hoffman 1999). This paper reports the presence of a monogenean on the gills of *P. sciera* in southeastern Oklahoma.

Methods

During stream surveys conducted between June 2014 and October 2017, three individual *P. sciera* (77, 77, and 90 mm total length [TL]) were collected from Yashau Creek, McCurtain County. The fish were collected by seine or backpack electrofisher and placed in containers with aerated creek water. We followed accepted guidelines for the use of fish in research per the American Fisheries Society (AFS 2014); specimens were overdosed by immersion in a concentrated chloretone (chlorobutanol) solution and preserved in 10% (v/v) neutral-buffered formalin. Gills were removed from the fish and examined for parasites under a stereomicroscope at 20–30×. Parasites (n = 2) were picked from the gills of a single host with minute needles. One was placed in glycerin as a temporary mount, and the other was mounted as a permanent slide in Grey and Wess medium stained with Gomori's trichrome (Kritsky et al. 1978). Observations were made with an Accuscope® 3000LED series phase contrast microscope (Accu-Scope Inc., Commack, New York). Measurements were made from digital images taken with a camera mounted on the microscope of sclerites, in micrometers (µm), as presented by Beverley-Burton and Suriano (1980) and Suriano and Beverley-Burton (1982). Prevalence and intensity were calculated according to Bush et al. (1997).

A voucher parasite specimen was deposited in the Harold W. Manter Laboratory of Parasitology (HWML), University of Nebraska, Lincoln, Nebraska. Voucher specimens of hosts were re-deposited in the Eastern Oklahoma State College Vertebrate Collection, Idabel, Oklahoma.

Results

A single *P. sciera* was found to harbor a monogenean that is listed below in annotated style as follows:

Monogenea Carus, 1863

Dactylogyridae Bychowsky, 1933

***Aethycteron* Suriano and Beverley-Burton, 1982**

Type-host and type locality: Mueller (1938) described *A. malleus* as *Cleidodiscus malleus* from Logperch, *Percina caprodes* (Rafinesque), and Blackside Darter, *Percina maculata* (Girard), from Chautauqua Lake, Chautauqua County, New York. Although Mueller (1938) did not explicitly establish a type host, he listed *P. caprodes* first (page priority) and provided line drawings only from that host. Thus, we recognize *P. caprodes* as the type host of *A. malleus* in spite of Suriano and Beverley-Burton (1982) providing a comprehensive redescription based on specimens from *P. maculata* from Ontario, Canada. This monogenean is also known from specimens from Manitoba, Canada (see Lubinsky and Loch 1979).

***Aethycteron nigrofasciatus* (Harrises, 1962)**

Type-host and type locality: Percina nigrofasciata Agassiz; Mississippi: Marion County, Foxworth Creek, 4 mi (6.4 km) N of Foxworth (Harrises 1962).

Other reported host and locality: P. nigrofasciata; Mississippi: Perry County, Thompson's Creek, 5 mi (8.0 km) S of Richton (Harrises and Vickery 1970).

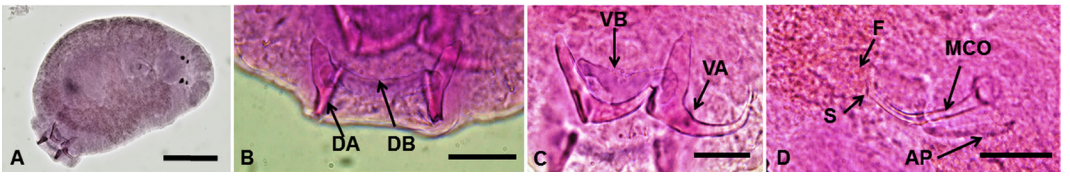
Host and locality (*present study*)*: Percina sciera*; Oklahoma: McCurtain County, Yashau Creek just S of Broken Bow off US 70, Little River Drainage (34°01'8.0004"N, 94°45'24.6996"W).

Deposited material: HWML 216914; 1 slide voucher.

Prevalence and intensity: 1 of 3 (33%), 2 worms.

Site of infection: Gills.

Comparative Description (Figs. 1A–D)



Figures 1A–D. ***Aethycteron nigrofasciatus*** **(HWML 216914). A. Whole mount (ventral). Scale bar = 50 µm. B. Haptor showing dorsal anchor (DA) and dorsal bar (DB). Scale bar = 20 µm. C. Haptor showing ventral anchor (VA) and ventral bar (VB). Scale bar = 20 µm. D. Male copulatory organ (MCO) and accessory piece (AP); MCO has small spine (S) in distal portion and flared distal end (F). Scale bar = 20 µm.**

With characters of the genus *Aethycteron* as diagnosed by Suriano and Beverley-Burton (1982) and Beverley-Burton (1984). Body (n = 2, based on formalin-fixed contracted specimens) 264–283 long × greatest width 188–210. No peduncle observed due to contracted body. Haptor 40–51 long × 101–107 wide. Cephalic lobes poorly developed, cephalic glands on lateral margins of pharyngeal region. Two pairs of pigmented light receptors, anterior pair smaller and closer apart than posterior pair. Pharynx ovate, 47–48 long × 36–38 wide. Gut smooth and confluent posteriorly. Two pairs of anchors; composed of solid base with short deep root, elongate superficial root, solid elongate, blade-like shaft curving to a sharp point; similar in shape, dorsal pair slightly smaller than ventral pair. Dorsal anchor 33–36 long (measurement "a" of Suriano and Beverley-Burton (1982) - distance from tip of superficial root to curve of blade); greatest width of base 20–22. Ventral anchor 35–36 long (measurement "a" of Suriano and Beverley-Burton (1982)); greatest width of base 27–30. Dorsal bar broadly curved with knobs on each end; 37–39 long. Ventral bar broadly yoke-shaped with wide medial posterior prong and large knobs on each end**;** 31–33 long. Fourteen hooks (7 pairs), similar in size and shape. Each hook composed of solid base (not observed in many of the hooks), solid slender shaft, sickle-shaped termination provided with opposable piece. Hook length 11–13. Copulatory complex composed of male copulatory organ (MCO) and sclerotized accessory piece. Male copulatory organ with lightly sclerotized base bearing slender, curved tubular shaft with a short spine on distal half of shaft and greatly flared distally, total length 62–70. Accessory piece solid, slender, sclerotized ribbon, 25–32 long. Testis post ovarian. Vagina not observed. Vitellaria distributed from pharynx to haptor.

Remarks: The morphological characteristics and measurements of the sclerites of *A. nigrofasciatus* parasitizing *P. sciera* from Oklahoma conform with the descriptions from *P. nigrofasciata* in Mississippi by Harrises (1962) and Harrises and Vickery (1970). The small hooked spine located in the distal half and the large flared distal end of a curved MCO of *A. nigrofasciatus* (Fig. 1D) are unique among species of *Aethycteron*. This is the first record of *A. nigrofasciatus* from *P. sciera* and from Oklahoma.

Discussion

The two known hosts of *A. nigrofasciatus* (*P. nigrofasciata* and *P. sciera*) are fairly closely related members of a clade traditionally recognized as the subgenus *Hadropterus* Agassiz (Near 2002; Near et al. 2011). Nine of the 13 (69%) described species of *Aethycteron* have been reported from only a single host, three (23%) from two hosts, and one (8%) from three hosts (Suriano and Beverley-Burton 1982; Beverley-Burton 1984; Hoffman 1999; McAllister et al. 2016, 2017; Cloutman and McAllister 2017; Million and Stallsmith 2019), indicating a fairly high degree of host specificity. This seemingly high host specificity, coupled with the apparent trend of a species or closely related species of *Aethycteron* parasitizing closely related hosts, may indicate considerable coevolution or host switching limited mainly to closely related hosts (Cloutman and McAllister 2017). However,

research concerning *Aethycteron* is in its infancy, and any phylogenetic inferences should be viewed with caution at this time.

As only 13 species of darters, representing 5% of the approximately 250 (including only 4 [10%] of 40 *Percina*) presently described (Near et al. 2011), have been reported as hosts for species of *Aethycteron*, much more descriptive work is necessary before diversity, host specificity, and definitive host-parasite phylogenies can be determined.

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