

## **Trematode Parasites (Digenea) of the Slender Madtom *Noturus exilis* and Black River Madtom *Noturus maydeni* (Siluriformes: Ictaluridae) from Arkansas, U.S.A**

Author(s): Chris T. McAllister, William F. Font, Matthew B. Connior, Henry W. Robison, Thomas J. Fayton, Nicholas G. Stokes, and Charles D. Criscione

Source: Comparative Parasitology, 82(1):137-143.

Published By: The Helminthological Society of Washington

DOI: <http://dx.doi.org/10.1654/4714.1>

URL: <http://www.bioone.org/doi/full/10.1654/4714.1>

---

BioOne ([www.bioone.org](http://www.bioone.org)) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/page/terms\\_of\\_use](http://www.bioone.org/page/terms_of_use).

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

## Trematode Parasites (Digenea) of the Slender Madtom *Noturus exilis* and Black River Madtom *Noturus maydeni* (Siluriformes: Ictaluridae) from Arkansas, U.S.A.

CHRIS T. McALLISTER,<sup>1,7</sup> WILLIAM F. FONT,<sup>2</sup> MATTHEW B. CONNIOR,<sup>3</sup> HENRY W. ROBISON,<sup>4</sup> THOMAS J. FAYTON,<sup>5</sup> NICHOLAS G. STOKES,<sup>6</sup> AND CHARLES D. CRISCIONE<sup>6</sup>

<sup>1</sup> Division of Science and Mathematics, Eastern Oklahoma State College, Idabel, Oklahoma 74745, U.S.A. (e-mail: cmcallister@se.edu),

<sup>2</sup> Department of Biological Sciences, Southeastern Louisiana University, Hammond, Louisiana 70402, U.S.A. (e-mail: wffont@selu.edu),

<sup>3</sup> Health and Natural Sciences, South Arkansas Community College, 300 S West Avenue, El Dorado, Arkansas 71730, U.S.A. (e-mail: mconnior@southark.edu),

<sup>4</sup> Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71754, U.S.A. (e-mail: hwrobison@yahoo.com),

<sup>5</sup> Gulf Coast Research Laboratory, University of Southern Mississippi, 703 E Beach Drive, Ocean Springs, Mississippi 39564, U.S.A. (e-mail: Thomas.Fayton@eagles.usm.edu), and

<sup>6</sup> Department of Biology, Texas A&M University, College Station, Texas 77843, U.S.A. (e-mail: ccriscione@tamu.edu)

**ABSTRACT:** Between June 2012 and July 2013, 43 slender madtoms (*Noturus exilis*) and 21 Black River madtoms (*Noturus maydeni*) were collected from 4 counties of northern Arkansas and examined for helminths. Eleven (26%) slender madtoms were infected with digenean trematodes, including 3 (7%) with metacercaria of *Posthodiplostomum minimum*, 3 (7%) with *Alloglossidium* sp., and 7 (16%) with *Plagioporus* sp.; a single (5%) Black River madtom was infected with *Caecicola* sp. We document new host records for each of these 4 helminths. Notable among these new host records are new distributional records for *Caecicola* sp. To our knowledge this represents the first report of any helminth from *N. exilis* and *N. maydeni*.

**KEY WORDS:** Arkansas, Ictaluridae, Trematoda, Digenea, *Noturus exilis*, *Noturus maydeni*, *Alloglossidium* sp., *Caecicola* sp., *Plagioporus* sp., *Posthodiplostomum minimum*.

The slender madtom, *Noturus exilis* Nelson, is a long, slender brownish ictalurid of clear creeks and small rivers of the upper Mississippi River basin ranging from southern Wisconsin and Minnesota to the Ouachita uplift of Arkansas, Kansas, and Oklahoma; a disjunct population occurs in the Cumberland, Green, and Tennessee river drainages (Page and Burr, 2011). In Arkansas, *N. exilis* occurs widely throughout the White and Arkansas river systems, as well as the Red River drainage in the Mountain Fork River (Robison and Buchanan, 1988). The Slender madtom inhabits small to moderately sized, permanent, clear spring-fed streams with rock and gravel bottoms where it feeds on aquatic insect larvae, crustaceans, nematodes, and gastropods (Robison and Buchanan, 1988). The Black River madtom, *Noturus maydeni* Egge, which is genetically and karyotypically distinct from the Ozark madtom (*Noturus albater*), is found in the upper Black and St. Francis river systems in Arkansas and Missouri where it is locally common (Egge and Simons,

2006; Page and Burr, 2011). The Black River madtom inhabits riffles and rocky pools of clear, cool, high-gradient creeks and small to medium-sized rivers (Burr and Mayden, 1984; Pflieger, 1997) where it feeds on similar food items as *N. exilis*.

Although both madtoms are fairly well studied freshwater fishes (see citations in Rohde, 1980; Burr and Mayden, 1984; Pflieger, 1997), to our knowledge there is nothing known about their helminth parasites. Herein, we report 4 new hosts and a new distributional record for helminths of *N. exilis* from Arkansas.

Between July 2012 and July 2013, 43 slender madtoms (mean  $\pm$  1 SD total length [TL] = 83.0  $\pm$  14.9, range 52–137 mm) and 21 Black River madtoms (73.4  $\pm$  9.6, range 49–88 mm) were collected using a backpack electroshocker or by overturning rocks and capturing fish with a dip net. Collections were from 5 localities in 4 counties of the state, including Benton ( $n = 9$ ), Fulton ( $n = 21$ , *N. maydeni* only), Marion ( $n = 32$ ), and Searcy ( $n = 2$ ) counties. Specimens were placed in containers with cool aerated habitat water and examined postmortem within 24 hr. We followed accepted guidelines for the

<sup>7</sup> Corresponding author.

use of fish in research (AFS, 2004). Specimens were overdosed with a concentrated chlorethone solution, and a midventral incision was made to expose the gastrointestinal tract and internal viscera. Fish were examined for helminths, but their gills/gill filaments were not examined for monogeneans. Trematodes were fixed in hot tap water without coverslip pressure, transferred to 70–95% ethanol, stained with acetocarmine, and mounted in Canada balsam or Kleermount®. Voucher specimens of parasites were deposited in the U.S. National Parasite Collection (USNPC), Beltsville, Maryland, U.S.A. Host voucher specimens were deposited in the Henderson State University Museum (HSU), Arkadelphia, Arkansas, U.S.A., as HSU 3512, 3514, and 3516. Prevalence, mean intensity, and range of infection are provided and are in accordance with terminology given in Bush et al. (1997).

Of the 43 slender madtoms examined, 11 (26%) were infected with digenean trematodes, including 3 (7%) with metacercaria of *Posthodiplostomum minimum*, 3 (7%) with *Alloglossidium* sp., and 7 (16%) with *Plagioporus* sp.; a single (5%) Black River madtom was infected with *Caecicola* sp. Seven of 9 (78%) of the slender madtoms from the Illinois River drainage in Benton County were infected; 6 of 33 (18%) slender madtoms from the White River drainage in Marion and Searcy counties were infected.

**Trematoda: Digenea**  
**Strigeatida: Diplostomidae**  
***Posthodiplostomum minimum***  
**(MacCallum, 1921)**

*Hosts and localities:* 3 slender madtoms (74, 80, 85 mm TL) collected on 25 July 2013 from Kelly's Slab at Yellville, Marion County (36°15'9.9"N; 94°26'25.8"W).

*Prevalence:* 3/43 (7%) overall; 3/32 (9%) Marion County.

*Intensity:* 2.3 ± 1.2 (1–3) metacercaria.

*Site of infection:* Mesenteries.

*Other reported hosts:* White grub has been reported from many genera of North American fishes, including ictalurids such as black bullhead, *Ameiurus melas*; yellow bullhead, *Ameiurus natalis*; brown bullhead, *Ameiurus nebulosus*; blue catfish, *Ictalurus furcatus*; channel catfish, *Ictalurus punctatus*; and tadpole madtom, *Noturus gyrinus* (see Hoffman, 1999).

*Geographic range:* United States, Canada, and Mexico (see Hoffman, 1999).

*Additional Arkansas records:* Warmouth, *Lepomis gulosus*, bluegill, *Lepomis macrochirus*, white crappie, *Pomoxis annularis*, black crappie, *Pomoxis nigromaculatus*, largemouth bass, *Micropterus salmoides*, spotted bass, *Micropterus punctulatus* (Becker et al., 1966; Becker and Cloutman, 1975; Cloutman, 1975), and fathead minnow, *Pimephales promelas* (Mitchell et al., 1982).

*Specimens deposited:* USNPC 107266 (slide).

**Remarks**

Our specimens are presumed to be *P. minimum* because many metacercariae cannot be identified to species unless they are fed to a definitive host, and adult worms are obtained that can be identified to species on the basis of morphology. Additionally, some species of *Posthodiplostomum*, including *P. minimum*, have a high intraspecific morphological variability (see Ritossa et al., 2013). Indeed, natural infections of *Posthodiplostomum* have been found in a variety of vertebrates, mainly fish-eating birds of the Order Ciconiiformes and, to a lesser extent, Charadriiformes and Pelecaniformes (Dubois, 1970). This digenean has been experimentally (and to some extent naturally) transmitted in a wide range of birds and mammals, and even reptiles and amphibians have been shown to be suitable hosts. Physid snails (*Physa haley*) serve as first intermediate hosts (Bedinger and Meade, 1967).

**Plagiorchiida: Macroderoididae**  
***Alloglossidium* sp. Simer, 1929**  
**(Fig. 1)**

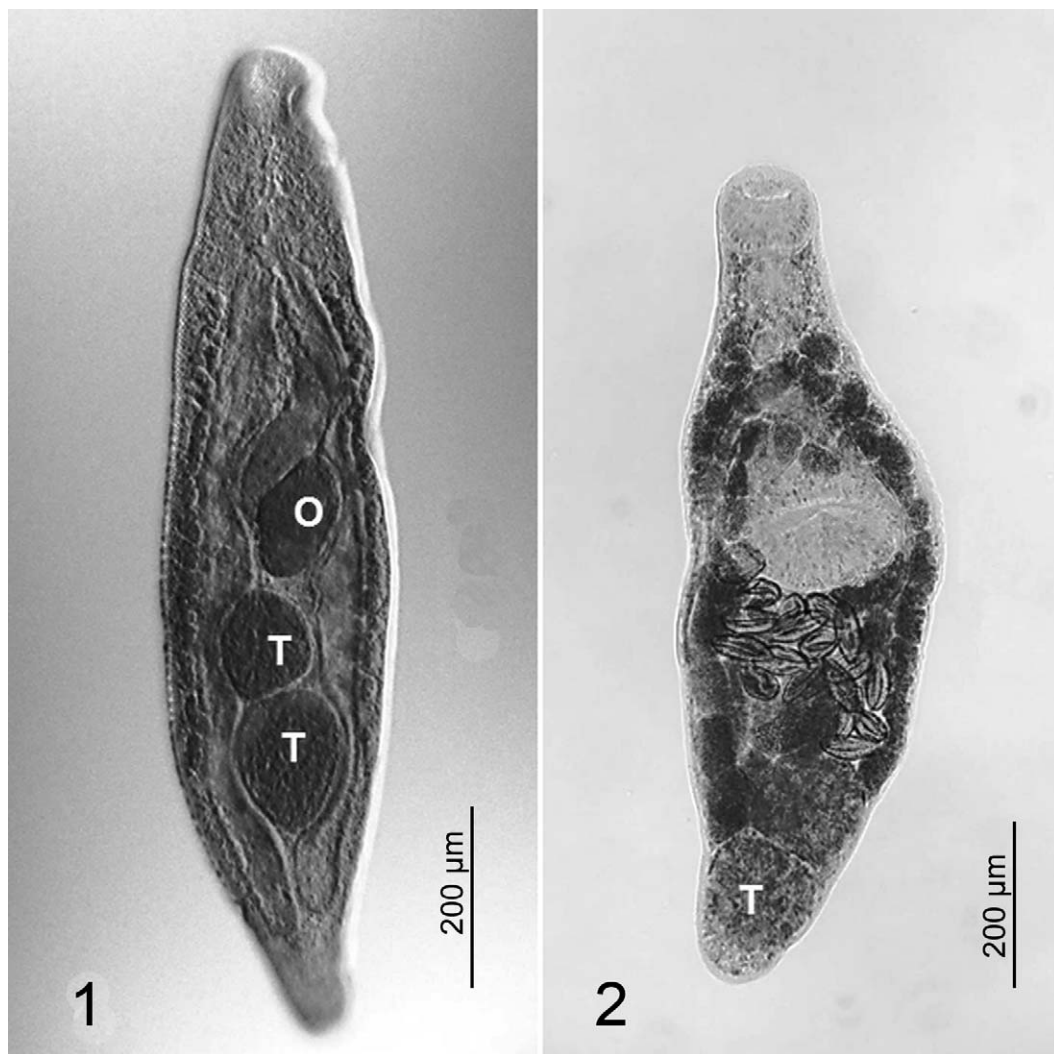
*Hosts and localities:* 2 slender madtoms (74, 85 mm TL) collected on 25 July 2013 from Kelly's Slab at Yellville, Marion County (36°15'9.9"N; 94°26'25.8"W); 1 slender madtom (137 mm TL) collected on 15 August 2012 from Water Creek at Mull, Searcy County (36°03'0.9"N; 92°35'42.4"W).

*Prevalence:* 3/43 (7%) overall; 2/32 (6%) Marion County; 1/2 (50%) Searcy County.

*Intensity:* 2.0 ± 1.7 (1–4) worms.

*Site of infection:* Small intestine.

*Other reported hosts:* Of the 16 recognized species of *Alloglossidium*, 5 species of have been reported from fishes (mainly ictalurids), including *Ameiurus*



**Figures 1, 2.** *Alloglossidium* sp. and *Plagioporus* sp. from *Noturus exilis*. **1.** *Alloglossidium* sp. showing ovary (O) and testes (T). **2.** *Plagioporus* sp. showing testis (T).

spp., *Ictalurus* spp., and *Noturus* spp. (see Smythe and Font, 2001; Tkach and Mills, 2011; Kasl et al. 2014).

**Geographic range:** Five species have been reported from fishes in various states, including Arkansas, California, Florida, Georgia, Kansas, Kentucky, Idaho, Indiana, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New York, Ohio, Oklahoma, North Dakota, Texas, Virginia, and Wisconsin, as well as from Ontario, Canada (Carney and Brooks, 1991; Hoffman, 1999; Tkach and Mills, 2011; Kasl et al., 2014).

**Additional Arkansas records:** *Alloglossidium corti* (Lamont, 1921) Van Cleave and Mueller, 1932 has

been reported in *A. natalis*, *I. punctatus* (Becker and Houghton, 1969), and Ouachita madtom, *Noturus lachneri* (Fiorillo et al., 1999), with metacercaria in the antennal gland of some crayfishes from the state (McAllister et al., 2011). As yet, there are no additional species of *Alloglossidium* reported from Arkansas.

**Specimens deposited:** USNPC 107258 (slide).

#### Remarks

The recent publications of Tkach and Mills (2011) and Kasl et al. (2014) note that the subtle morphological variations within and among species in this genus

make species delimitation difficult. Thus, we feel it is premature to label these specimens with a species name based on morphology alone. Ongoing work in our labs is using molecular markers to elucidate the biogeography of species in the genus *Alloglossidium*. A more comprehensive biogeographic, morphologic, and genetic analysis that includes these specimens is in preparation and will be submitted in the near future. This is the first time the genus has been reported from *N. exilis*.

**Opecoelidae**  
***Plagioporus* sp. Stafford, 1904**  
**(Fig. 2)**

*Hosts and localities:* 7 slender madtoms (72, 86, 87, 95, 96, 102 [2] mm TL); 3 collected on 16–17 June 2013 from Flint Creek off Fairmont Road at Springtown, Benton County (36°15'9.9"N; 94°26'25.8"W) and 4 collected on 16–17 June 2013 from Flint Creek south of Gentry off US 59, Benton County (36°14'33.8"N; 94°29'14.5"W).

*Prevalence:* 7/43 (16%) overall; 7/9 (78%) Benton County.

*Intensity:* 3.0 ± 1.8 (1–6) worms.

*Site of infection:* Small intestine.

*Other reported hosts:* See McAllister et al. (2014).

*Geographic range of genus in North America:* See McAllister et al. (2014).

*Additional Arkansas records:* Banded sculpin, *Cottus carolinae* (McAllister et al., 2014).

*Specimens deposited:* USNPC 107257 (slide).

**Remarks**

Our specimens of *Plagioporus* sp. cannot be distinguished from those recently reported by McAllister et al. (2014) from *C. carolinae* within the same Benton County localities. It shares morphological affinities with plagioporidae species distributed east of the Rocky Mountains and is most morphologically similar to *Plagioporus sinitsini* Mueller, 1934, which was described from the gall bladder of white sucker, *Catostomus commersonii* from Oneida Lake, New York (Mueller, 1934), and subsequently redescribed from the gall bladder of cyprinid and catostomid hosts from the Huron River, Michigan (Dobrovolny, 1939). The type material of *P. sinitsini* was fixed under coverslip pressure (Mueller, 1934) preventing meaningful morphometric comparisons with our

specimens of *Plagioporus* sp., which were not flattened before fixation. *Plagioporus* sp. is similar to Dobrovolny's (1939) specimens of *P. sinitsini* with respect to oral and ventral sucker shape and ratios, body length, and egg size (length and width), along with the possession of a spindle-shaped body, short excretory vesicle, and testis, the latter of which cluster together near the posterior end of the body. *Plagioporus* sp. can be differentiated from *P. sinitsini* by its more narrow body and larger testis, and by having a more anterior posterior extent of the vitellarium at the anterior margin of the posterior testis (as opposed to the posterior end of the body in *P. sinitsini*). Additionally, *Plagioporus serratus* Miller, 1940, is not considered here; its specific status is problematic, in that the only characters that distinguish it from *P. sinitsini*, with which it occurs sympatrically in the St. Lawrence River (Quebec), are a smaller body size and parasitism of mooneye, *Hiodon tergisus* (Miller, 1940). *Plagioporus* sp. is the first species of its genus to be reported from a madtom in the eastern Nearctic and the second to be reported from an ictalurid (*A. melas*) in North America (Harms, 1959). It is most likely a new species; DNA analyses are ongoing, and it will be described in a forthcoming publication.

**Opisthorchiida: Cryptogonimidae**  
***Caecincola* sp.**  
**Marshall and Gilbert, 1905**  
**(Figs. 3–4)**

*Hosts and localities:* 1 Black River madtom (84 mm TL) collected on 27 July 2013 from the Spring River at Many Islands, Fulton County (36°23'14.3"N; 91°31'46.9"W).

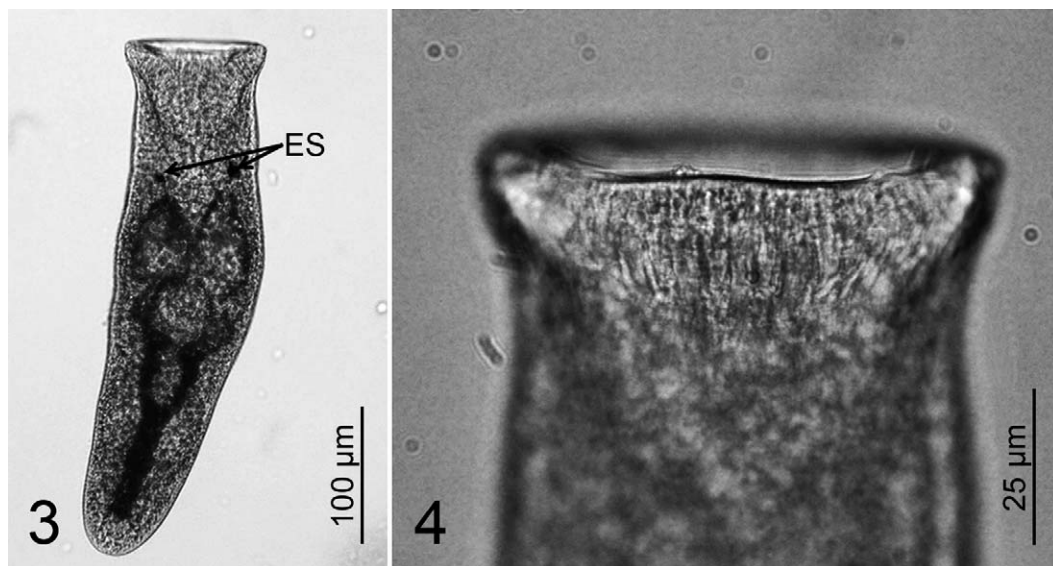
*Prevalence:* 1/21 (5%).

*Intensity:* 2 immature worms.

*Site of infection:* Small intestine.

*Other reported hosts of genus: Centrarchidae:* rock bass, *Ambloplites rupestris*; green sunfish, *Lepomis cyanellus*; *L. gulosus*; smallmouth bass, *Micropterus dolomieu*; *M. punctulatus*; *M. salmoides*; and *P. annularis*. **Ictaluridae:** Flathead catfish, *Pylodictis olivaris* (see Hoffman, 1999; Curran and Overstreet, 2009; Barger, 2010).

*Geographic range of genus: U.S.A.:* Arkansas (this report), Florida (Premvati, 1967), Georgia (Howard and Aliff, 1980), Illinois (Robinson and Jahn, 1980), Louisiana (Greer and Corkum, 1979, 1980), Michigan



**Figures 3, 4.** *Caecincola* sp. (unstained) from *Noturus maydeni*. **4.** View of entire specimen showing “eye spots” (ES). **5.** Higher magnification of cup-shaped oral sucker.

(Lundahl, 1941), Mississippi (Olsen et al., 2003, Curran and Overstreet, 2009), New York (Van Cleave and Mueller, 1934), Tennessee (Venard, 1940; Bangham and Venard, 1942; Curran and Overstreet, 2009), Texas (Allison and McGraw, 1967; Meade and Bedinger, 1972; Underwood and Dronen, 1984; Barger, 2010), Wisconsin (Marshall and Gilbert, 1905; Pearse, 1924a, b; Amin, 1982); **Canada:** Ontario (Dechtiar, 1972), Lake Huron (Bangham, 1955).

*Additional Arkansas records:* None.

*Specimens deposited:* USNPC 107265 (slide).

### Remarks

Five species of *Caecincola* have been described from North American fishes, including *Caecincola autumnae* Barger, 2010; *Caecincola latostoma* Greer and Corkum, 1979; *Caecincola longiscens* Curran and Overstreet, 2009; *Caecincola parvulus* Marshall and Gilbert, 1905; and *Caecincola wakullata* Premvati, 1967. Unfortunately, our 2 specimens were immature (Fig. 3) and could not be identified beyond genus. However, this is the first time *Caecincola* sp. has been reported from *N. maydeni*, as well as, in so far as we know, the first time from Arkansas. Additionally, *N. maydeni* is only the second ictalurid host reported for *Caecincola* sp., as most fishes previously reported as hosts are centrarchids (see other reported hosts above).

Of the approximately 200 nongame fish species reported from Arkansas (Robison and Buchanan, 1988), we are aware of only 4 species that have been surveyed for helminth parasites in general (Cloutman, 1976; Fiorillo et al., 1999; McAllister et al., 2014), whereas others are descriptions of monogenes from shiners (see Cloutman, 1994, 1995, 2011), a report of white grub in a minnow (Mitchell et al., 1982), and a study of black-spot disease in various fishes (McAllister et al., 2013). Therefore, as recently noted by Scholz and Choudhury (2014) and reiterated by McAllister et al. (2014), studies on freshwater fish parasites are mostly lacking, with an obvious paucity of reports on helminth parasites of fishes of Arkansas. As additional nongame fishes from the state are surveyed for helminth parasites, we expect additional new host and distributional records as well as new species will be reported, thus extending our knowledge of this important fauna.

### ACKNOWLEDGMENTS

We thank Patricia R. Pilitt (USNPC) and Dr. Renn Tumilson (HSU) for expert curatorial assistance and members of the Arkansas Game and Fish Commission (AG&F), specifically Kenneth Shirley, for assistance with electroshocking. C.D.C. and W.F.F. are supported by the National Science Foundation grant DEB 1145508. The AG&F and U.S. Depart-

ment of Agriculture Forest Service (Ozark region) provided Scientific Collecting Permits to C.T.M., M.B.C., and H.W.R.

### LITERATURE CITED

- Allison, T. C., and J. L. McGraw.** 1967. The helminth parasites of Centrarchidae from the Navasota River system of Texas. *Texas Journal of Science* 19:326–238.
- [AFS] **American Fisheries Society.** 2004. Guidelines for the use of fishes in research [web application]. J. G. Nickum (Chair). Bethesda, Maryland: American Fisheries Society. [http://fisheries.org/docs/policy\\_useoffishes.pdf](http://fisheries.org/docs/policy_useoffishes.pdf). Accessed 2014 Jan 22.
- Amin, O. M.** 1982. Adult trematodes (Digenea) from lake fishes of southeastern Wisconsin with a key to the species of the genus *Crepidostomum* Braun, 1900 in North America. *Proceedings of the Helminthological Society of Washington* 49:196–206.
- Bangham, R. V.** 1955. Studies on fish parasites of Lake Huron and Manitoulin Island. *American Midland Naturalist* 53:184–194.
- Bangham, R. V., and C. E. Venard.** 1942. Studies on parasites of Reelfoot Lake fish. IV. Distribution studies and check-list of parasites. *Journal of the Tennessee Academy of Science* 17:22–38.
- Barger, M. A.** 2010. A new species of *Caecincola* (Trematoda: Cryptogonimidae) from spotted bass (*Micropterus punctulatus*) in the Big Thicket National Preserve, Texas, U.S.A. *Comparative Parasitology* 77: 6–8.
- Becker, D. A., and D. G. Cloutman.** 1975. Parasites of selected game fishes of Lake Fort Smith, Arkansas. *Proceedings of the Arkansas Academy of Science* 29: 12–18.
- Becker, D. A., R. G. Heard, and P. D. Holmes.** 1966. A pre-impoundment survey of the helminth and copepod parasites of *Micropterus* spp. of Beaver Reservoir in northwest Arkansas. *Transactions of the American Fisheries Society* 95:23–34.
- Becker, D. A., and W. C. Houghton.** 1969. A survey of the helminth parasites of selected game fishes of Lake Fort Smith, Arkansas. *Proceedings of the Arkansas Academy of Science* 28:110–117.
- Bedinger, C. A., and T. G. Meade.** 1967. Biology of a new cercaria for *Posthodiplostomum minimum* (Trematoda: Diplostomidae). *Journal of Parasitology* 53:985–988.
- Burr, B. M., and R. L. Mayden.** 1984. Reproductive biology of the checkered madtom (*Noturus flavater*) with observations on nesting in the Ozark (*N. albater*) and slender (*N. exilis*) madtoms (Siluriformes: Ictaluridae). *American Midland Naturalist* 112:408–414.
- Bush, A. O., K. D. Lafferty, J. M. Lotz, and A. W. Shostak.** 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. *Journal of Parasitology* 83:575–583.
- Carney, J. P., and D. R. Brooks.** 1991. Phylogenetic analysis of *Alloglossidium* Simer, 1929 (Digenea: Plagiorchiiformes: Macroderoididae) with discussion of the origin of truncated life cycle patterns in the genus. *Journal of Parasitology* 77:890–900.
- Cloutman, D. G.** 1975. Parasite community structure of largemouth bass, warmouth, and bluegill in Lake Fort Smith, Arkansas. *Transactions of the American Fisheries Society* 104:277–283.
- Cloutman, D. G.** 1976. Parasitism in relation to taxonomy of the sympatric sibling species of stonerollers, *Campostoma anomalum pullum* (Agassiz) and *C. oligolepis* Hubbs and Greene, in the White River, Arkansas. *Southwestern Naturalist* 21:67–70.
- Cloutman, D. G.** 1994. *Dactylogyrus boopsi* (Monogenea: Dactylogyridae) from the bigeye shiner, *Notropis boops* (Gilbert) (Pisces: Cyprinidae). *Journal of the Helminthological Society of Washington* 61:219–220.
- Cloutman, D. G.** 1995. *Dactylogyrus greenei* (Monogenea: Dactylogyridae) from the wedgespot shiner, *Notropis greenei* Hubbs and Ortenburger (Pisces: Cyprinidae). *Journal of the Helminthological Society of Washington* 62:10–12.
- Cloutman, D. G.** 2011. *Dactylogyrus robisoni* n. sp. (Monogenea: Dactylogyridae) from the bluehead shiner, *Pteronotopis hubbsi* (Bailey and Robison), 1978 (Pisces: Cyprinidae). *Comparative Parasitology* 78:1–3.
- Curran, S. S., and R. M. Overstreet.** 2009. *Caecincola longiscens* n. sp. (Digenea: Cryptogonimidae) from the white crappie, *Pomoxis annularis*, in Mississippi, U.S.A. *Comparative Parasitology* 76:19–23.
- Dechtiar, A. O.** 1972. Parasites of fish from Lake of the Woods, Ontario. *Journal of the Fisheries Research Board of Canada* 29:275–283.
- Dobrovolny, C. G.** 1939. Life history of *Plagioporus sinitini* Mueller and embryology of a new cotylocercous cercariae (Trematoda). *Transactions of the American Microscopical Society* 58:121–155.
- Dubois, G.** 1970. Synopsis des Strigeidae et des Diplostomatidae. *Memoires de la Societe Neuchateloise des Sciences Naturelles* X:259–728.
- Egge, J. D. J., and A. M. Simons.** 2006. The challenge of truly cryptic diversity: diagnosis and description of a new madtom catfish (Ictaluridae: *Noturus*). *Zoologica Scripta* 35:581–595.
- Fiorillo, R. A., R. B. Thomas, and C. M. Taylor.** 1999. Structure of the helminth assemblage of an endemic madtom catfish (*Noturus lachneri*). *Southwestern Naturalist* 44:522–526.
- Greer, G. J., and K. C. Corkum.** 1979. Life cycle studies on three digenetic trematodes, including descriptions of two new species (Digenea: Cryptogonimidae). *Proceedings of the Helminthological Society of Washington* 46:188–200.
- Greer, G. J., and K. C. Corkum.** 1980. Notes on the biology of three trematodes (Digenea: Cryptogonimidae). *Proceedings of the Helminthological Society of Washington* 47:47–51.
- Harms, C. E.** 1959. Checklist of parasites from catfishes of northeastern Kansas. *Transactions of the Kansas Academy of Science* 62:262.
- Hoffman, G. L.** 1999. Parasites of North American Freshwater Fishes, 2nd ed. Comstock Publishing Associates, Ithaca, New York. 539 pp.
- Howard, C. N., and J. V. Aliff.** 1980. Metazoan parasites of fishes from Piedmont and coastal plain Georgia. *Georgia Journal of Science* 8:173–179.
- Kasl, E. L., T. J. Fayton, W. F. Font, and C. D. Criscione.** 2014. *Alloglossidium floridense* n. sp. (Digenea:

- Macroderoididae) from a spring run in North Central Florida. *Journal of Parasitology* 100:121–126.
- Lundahl, W. S.** 1941. Life history of *Caecincola parvulus* Marshall and Gilbert (Cryptogonimidae, Trematoda) and the development of its excretory system. *Transactions of the American Microscopical Society* 60:461–484.
- Marshall, W. S., and N. C. Gilbert.** 1905. Three new trematodes found principally in the black bass. *Zoologischen Jahrbuchern* 22:476–488.
- McAllister, C. T., M. B. Connor, W. F. Font, and H. W. Robison.** 2014. Helminth parasites of the banded sculpin, *Cottus carolinae* (Scorpaeniformes: Cottidae), from northern Arkansas, U.S.A. *Comparative Parasitology* 81:203–209.
- McAllister, C. T., H. W. Robison, and W. F. Font.** 2011. Metacercaria of *Alloglossidium corti* (Digenea: Macroderoididae) from 3 species of crayfish (Decapoda: Cambaridae) in Arkansas and Oklahoma, U.S.A. *Comparative Parasitology* 78:382–386.
- McAllister, C. T., R. Tumilson, H. W. Robison, and S. E. Trauth.** 2013. An initial survey on black-spot disease (Digenea: Strigeoidea: Diplostomatidae) in select Arkansas fishes. *Journal of the Arkansas Academy of Science* 67:200–202.
- Meade, T. G., and C. A. Bedinger.** 1972. Helminth parasitism in some species of fresh water fishes of eastern Texas. *Southwestern Naturalist* 16:281–295.
- Miller, M. J.** 1940. Parasites of freshwater fish. 3. Further studies on the internal trematodes of fish in the central St. Lawrence watershed. *Canadian Journal of Research* 18:423–434.
- Mitchell, A. J., C. E. Smith, and G. L. Hoffman.** 1982. Pathogenicity and histopathology of an unusually intense infection of white grubs (*Posthodiplostomum minimum*) in the fathead minnow (*Pimephales promelas*). *Journal of Wildlife Diseases* 18:51–57.
- Mueller, J. F.** 1934. Two new trematodes from Oneida Lake fishes. *Transactions of the American Microscopical Society* 53:231–236
- Olsen, P. D., T. H. Cribb, V. V. Tkach, R. A. Bray, and D. T. J. Littlewood.** 2003. Phylogeny and classification of the Digenea (Platyhelminthes: Trematoda). *International Journal for Parasitology* 33:733–755.
- Page, L. M., and B. M. Burr.** 2011. Peterson field guide to freshwater fishes of North America north of Mexico, 2nd ed. Houghton Mifflin Harcourt, Boston. 663 pp.
- Pearse, A. S.** 1924a. Observations on parasitic worms from Wisconsin fishes. *Transactions of The Wisconsin Academy of Science, Arts, and Letters* 21:147–160.
- Pearse, A. S.** 1924b. The parasites of lake fishes. *Transactions of the Wisconsin Academy of Science, Arts, and Letters* 21:161–194.
- Pflieger, W. L.** 1997. *The Fishes of Missouri*, revised ed. Missouri Department of Conservation, Jefferson City, Missouri. 372 pp.
- Premvati, G.** 1967. *Multigonotylus micropteri* gen. et sp. n. and *Caecincola wakullata* sp. n. (Digenea: Cryptogonimidae) from freshwater bass, *Micropterus salmoides*. *Journal of Parasitology* 53:743–746.
- Ritossa, L., V. Flores, and G. Viozzi.** 2013. Life-cycle stages of a *Posthodiplostomum* species (Digenea: Diplostomidae) from Patagonia, Argentina. *Journal of Parasitology* 99:777–780.
- Robinson, G. L., and L. A. Jahn.** 1980. Some observations of fish parasites from pool 20, Mississippi River. *Transactions of the American Microscopical Society* 99:206–212.
- Robison, H. W., and T. M. Buchanan.** 1988. *Fishes of Arkansas*. University of Arkansas Press, Fayetteville, Arkansas. 536 pp.
- Rohde, F. C.** 1980. *Noturus exilis* Nelson, slender madtom. Page 452 in D. S. Lee, C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer Jr., eds. *Atlas of North American Freshwater Fishes*. North Carolina State Museum of Natural History, Raleigh, North Carolina.
- Scholz, T., and A. Choudhury.** 2014. Parasites of freshwater fishes in North America: why so neglected? *Journal of Parasitology* 100:26–45.
- Smythe, A. B., and W. F. Font.** 2001. Phylogenetic analysis of *Alloglossidium* (Digenea: Macroderoididae) and related genera: life-cycle evolution and taxonomic revision. *Journal of Parasitology* 87:386–391
- Tkach V. V., and A. M. Mills.** 2011. *Alloglossidium fonti* sp. nov. (Digenea, Macroderoididae) from black bullheads in Minnesota with molecular differentiation from congeners and resurrection of *Alloglossidium kenti*. *Acta Parasitologica* 56:154–162.
- Underwood, H., and N. O. Dronen Jr.** 1984. Endohelminths of fishes from the upper San Marcos River, Texas. *Southwestern Naturalist* 29:377–385.
- Van Cleave, H. J., and J. F. Mueller.** 1934. Parasites of Oneida Lake fishes. Part III. A biological and ecological survey of the worm parasites. *Roosevelt Wild Life Bulletin* 3:161–334.
- Venard, C. E.** 1940. Studies on parasites of Reelfoot Lake fish. I. Parasites of the large-mouth black bass, *Huro salmoides* (Lacépède). *Journal of the Tennessee Academy of Science* 15:43–63.