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Research Note

Metacercaria of *Alloglossidium corti* (Digenea: Macroderoididae) from 3 Species of Crayfish (Decapoda: Cambaridae) in Arkansas and Oklahoma, U.S.A.

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ABSTRACT: In total, 80 crayfishes, including 25 *Orconectes acares*, 8 *Orconectes palmeri longimanus*, 13 *Orconectes meeki meeki*, 2 *Orconectes neglectus neglectus*, 21 *Orconectes ozarkae*, 4 *Orconectes williamsi*, 4 *Procambarus liberorum*, and 3 *Procambarus tenuis*, were collected from several counties in Arkansas and LeFlore County, Oklahoma (*P. tenuis* only), and specimens were examined for antennal gland parasites. Three (3.8%) were found to harbor metacercariae of *Alloglossidium corti* (Lamont, 1921) Van Cleave and Mueller, 1932, including 1 (4%) *O. acares*, 1 (12.5%) *O. p. longimanus*, and 1 (67%) *P. tenuis*. We report 3 new host records for *A. corti* and the first report of any helminth in these crustacean hosts.

KEY WORDS: *Alloglossidium corti*, metacercaria, Trematoda, Digenea, Macroderoididae, crayfish, Arkansas, Oklahoma.

Within the family Macroderoididae, the most speciose genus of precocious trematodes is that of *Alloglossidium* Simer, 1929. This genus is unusual because unlike most digeneans, it includes 2 members that utilize ictalurid catfishes as definitive hosts, 3 others that use freshwater crustaceans, and 5 additional taxa that use leeches as definitive hosts (Carney and Brooks, 1991; Font, 1994). One species, *Alloglossidium corti* (Lamont, 1921) Van Cleave and Mueller, 1932, has been reported previously to use various fishes (primarily ictalurids) as definitive hosts (Font and Corkum, 1977; Hoffman, 1999) and freshwater crayfishes as intermediate hosts. The life cycle of *A. corti* has been studied by McCoy (1928), McMullen (1935), and Crawford (1937), who reported that the planorbid snail *Helisoma trivolvis* (Say) releases xiphidiocercariae that develop into daughter sporocysts, which in turn penetrate and encyst as metacercariae in crayfishes and dragonfly

and mayfly naiads. In crayfish hosts, most metacercariae occur in the antennal glands. Herein, we report 3 new intermediate hosts for *A. corti*, including 2 species of crayfish endemic to Arkansas and Oklahoma. In addition, we provide, for the first time, measurements for excysted *A. corti* metacercariae in crayfish.

Between November 2009 and June 2010, 80 crayfishes, including 25 red-spotted stream crayfish, *Orconectes acares* Fitzpatrick, 1965, 8 western painted crayfish, *Orconectes palmeri longimanus* (Faxon, 1898), 13 Meek's crayfish, *Orconectes meeki meeki* (Faxon, 1898), 2 ringed crayfish, *Orconectes neglectus neglectus* (Faxon, 1885), 21 Ozark crayfish, *Orconectes ozarkae* Williams, 1952, 4 William's crayfish, *Orconectes williamsi* Fitzpatrick, 1966, 4 Osage burrowing crayfish, *Procambarus liberorum* Fitzpatrick, 1978, and 3 Ouachita Mountain crayfish, *Procambarus tenuis* Hobbs, 1950, were collected by aquatic dip net from stream and spring localities in Garland, Hot Spring, Johnson, Madison, Marion, Perry, Polk, and Yell counties, Arkansas, and LeFlore County, Oklahoma (*P. tenuis* only). Ecologically, all crayfishes collected in the study generally inhabited small, clear upland streams with rocky or gravelly bottoms, except *P. liberorum*, which typically is a primary burrower (Crandall et al., 2009), but which occasionally may enter the pool regions of streams.

Specimens were placed in zip-lock bags on ice and returned within 48 hr to the laboratory for processing. Crayfish were relaxed in a dilute chloretone® (chlorobutanol) solution, and their antennal glands were removed, placed in 0.6% saline, and examined for trematodes. Worms were fixed in hot 70% ethanol, stained in Semichon's acetocarmine, dehydrated, cleared, and mounted in Canada balsam. Various measurements of morphological structures

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were taken of metacercaria using a calibrated ocular micrometer, and measurements are reported here in micrometers (μm) as means followed by ranges in parentheses. Voucher specimens of parasites were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland, U.S.A. Voucher specimens of hosts were deposited in the invertebrate collection of Southern Arkansas University (SAU), Magnolia, Arkansas, U.S.A.

The following 44 crayfishes from Arkansas were negative for *A. corti*: 4 *O. williamsi* (Johnson County); 13 *O. m. meeki* (Johnson and Madison counties); 21 *O. ozarkae* (Marion County); 2 *O. n. neglectus* (Marion County); and 4 *P. liberorum* (Polk County). Six specimens of *A. corti* (metacercaria) were recovered from antennary glands as follows:

Trematoda

Digenea: Plagiorchiiformes:

Macroderoididae

Alloglossidium corti (Lamont, 1921) Van Cleave and Mueller, 1932

Synonyms: *Plagiorchis corti* Lamont, 1921; *Plagiorchis ameirurensis* McCoy, 1928; *Alloglossidium kenti* Simer, 1929 (Yamaguti [1971] and Vande Vusse [1980] considered the latter a valid species).

Hosts and localities: Red-spotted stream crayfish, *Orconectes acares* Fitzpatrick, 1965, collected on 16 March 2010 from 8.0 km W of Bismarck at Big Hill Creek, Hot Spring County, Arkansas (34.309998°N; 93.210926°W); western painted crayfish, *Orconectes palmeri longimanus* (Faxon, 1898), collected on 22 April 2010 from 8.0 km S of Hollis off State Highway 7 on Forest Service Road 780, Perry County, Arkansas (34.839168°N; 93.108101°W); Ouachita Mountain crayfish, *Procambarus tenuis* Hobbs, 1950, collected on 3 March 2010 from off State Highway 63 at Pidgeon Creek, LeFlore County, Oklahoma (34.647331°N; 94.532547°W).

Prevalence and intensity: 1/25 (4%) *O. acares* (1 worm); 1/8 (12.5%) *O. p. longimanus* (1 worm); 1/3 (33%) *P. tenuis* (4 worms).

Site of infection: Antennary glands (encysted).

Type host and locality: Tadpole madtom, *Noturus gyrinus* (Mitchill, 1817), Wisconsin (Lamont, 1921).

Measurements: Measurements of 6 excysted specimens of *A. corti* metacercariae were as follows: total length 1,008 (702–1,264); total width 283.5 (194–356); oral sucker length 107 (80–128); oral sucker

width 104.7 (82–120); prepharynx 86.7 (60–116); prepharynx length 52 (40–76); prepharynx width 63.7 (50–92); ventral sucker length 92.3 (68–114); ventral sucker width 92 (72–110); ovary length 82.3 (58–120); ovary width 86.3 (60–100); anterior testis length 112.3 (84–140); anterior testis width 170 (86–280); posterior testis length 124.7 (86–150); posterior testis width 178.3 (82–280). Crawford (1937) provided measurements of excysted metacercariae from experimentally infected dragonfly naiads. However, our measurements are the first recorded for *A. corti* metacercariae in naturally infected crayfish.

Additional Arkansas and Oklahoma records: None in crayfish.

Other reported hosts: Basses, *Ambloplites* spp. (Hoffman, 1999); freshwater eel, *Anguilla rostrata* (Hoffman, 1999); white catfish, *Ameiurus catus* (Hoffman, 1999); black bullhead, *Ameiurus melas* (Hoffman, 1999); yellow bullhead, *Ameiurus natalis* (Becker and Houghton, 1969; Williams and Dyer, 1992); brown bullhead, *Ameiurus nebulosus* (Williams and Dyer, 1992); flat bullhead, *Ameiurus platycephalus* (Hoffman, 1999); warmouth, *Chaenobryttus* (= *Lepomis*) *gulosus* (Williams and Dyer, 1992); channel catfish, *Ictalurus punctatus* (Allison, 1957; Becker and Houghton, 1969; Spall, 1969; Meade and Bedinger, 1972 [as *A. kenti*]); largemouth bass, *Micropterus salmoides* (Hoffman, 1999); stonecat, *Noturus flavus* (Hoffman, 1999); *Noturus gyrinus* (Muzzall and Prachell, 2007); margined madtom, *Noturus insignis* (Hoffman, 1999); Ouachita madtom, *Noturus lachneri* (Fiorillo et al., 1999); brindled madtom, *Noturus miurus* (Hoffman, 1999); and flathead catfish, *Pylodictis olivaris* (Pérez-Ponce de León and Choudhury, 2002).

Geographic range: U.S.A.: Alabama (Williams and Dyer, 1992); Arkansas (Becker and Houghton, 1969; Fiorillo et al., 1999; this report); California (Hoffman, 1999); Colorado (Hoffman, 1999); Florida (Bangham, 1939, 1969); Georgia (Booth and Aliff, 1978); Idaho (Hoffman, 1999); Illinois (Hoffman, 1999); Indiana (Hoffman, 1999); Iowa (Barnhart et al., 1976); Kansas (Harms, 1960); Kentucky (Hoffman, 1999); Louisiana (Font and Corkum, 1977); Michigan (Muzzall and Prachell, 2007); Minnesota (Crawford, 1937 [experimental infection]; Larson, 1966); Mississippi (Hoffman, 1999); Missouri (Hoffman, 1999); Nebraska (Hoffman, 1999); New York (Van Cleave and Mueller, 1934); North Dakota (Forstie and Holloway, 1984); Ohio (Bangham and Hunter, 1939; Bangham, 1941, 1972); Oklahoma (Spall,

1969); Texas (Meade and Bedinger, 1972); Virginia (Hoffman, 1999); and Wisconsin (Pearce, 1924; Bangham, 1944; Fischthal, 1947; Anthony, 1963). Canada: British Columbia (Bangham, 1941; Bangham and Adams, 1954); Ontario (Dechtiar, 1972). Mexico: Pérez-Ponce de León and Choudhury (2002).

Specimens deposited: USNPC 103361 (*P. tenuis*), 103362 (*O. acares*), 103363 (*O. p. longimanus*) (slides).

Remarks: Our excysted specimens agree morphologically with previous descriptions of *Alloglossidium corti* metacercariae from crayfish by McCoy (1928) (as *Plagiorchis ameiriurensis*), who conducted life-history studies on this species, including experimental infections of crayfish with cercariae from snails and subsequent infection of catfishes with metacercariae from crayfish. Our metacercariae also correspond to the description of specimens of *A. corti* metacercariae that McMullen (1935) obtained from naturally infected crayfish, dragonflies, and mayflies and fed to catfishes.

We regard *Alloglossidium kenti* Simer, 1929 from Mississippi as a junior synonym of *A. corti*. Van Cleave and Mueller (1934, pg 213) stated that “the species which Simer (1929) described as *A. kenti* is very clearly a renamed *P. corti*.” McMullen (1935) agreed with Van Cleave and Mueller’s synonymy, and the name *Alloglossidium corti* has been used for the species by all subsequent workers except for Yamaguti (1971), who provided no evidence to support his taxonomic position (McMullen, 1935; Crawford, 1937; Font, 1980; Carney and Brooks, 1991; Smythe and Font, 2001). Interestingly, Vande Vusse (1980) suggested that *A. kenti* be retained as distinct based on the more posterior extent of vitellaria in ictalurids versus the more anterior extent in *A. corti* from bullheads and madtoms. However, we believe that metacercariae of *A. corti* are readily distinguished morphologically from other members of the genus that utilize arthropod hosts (*Alloglossidium greeri*, *Alloglossidium progeneticum*, and *Alloglossidium renale*) in having testes greater in diameter than the ovary (Sullivan and Heard, 1969; Font and Corkum, 1975; Carney and Brooks, 1991; Font, 1994). More recently, Brooks (2003) did not include *A. kenti* in phylogenetic trees depicting relationships among all known members of the genus. Perhaps a molecular approach will be used in the future to help answer this lingering controversy.

Geographically, the 3 crayfish species harboring antennal gland parasites were collected from aquatic sites within the Ouachita Mountains of Arkansas and Oklahoma. *Orconectes acares* and *O. tenuis* are both Ouachita Mountain endemics (Robison and Allen, 1995; McAllister and Robison, 2010), while *O. p. longimanus* is a common inhabitant of the Ouachita Mountains, but its range extends southwestward into other physiographic regions (Jones and Bergey, 2007). The stream crayfishes that proved to be without antennal trematodes were all Ozark Mountain endemics, or their center of distribution was primarily in the Ozark Mountains, namely, *O. m. meeki*, *O. n. neglectus*, *O. ozarkae*, and *O. williamsi* (Wagner et al., 2010). A fifth species, *P. liberorum*, in addition to inhabiting the Ozarks, extends its range southward into the Arkansas River Valley and enters the northern flank of the Ouachita Mountains (Robison and McAllister, 2006). The significance of this geographic observation, if any, is not readily understood and will require additional collection and examination of crayfish.

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