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Metazoan Parasites of Catfishes in the Big Thicket National Preserve and Surrounding Areas, Texas, U.S.A.

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ABSTRACT: A survey of 2 species of ictalurid catfishes, channel catfish (*Ictalurus punctatus*) and yellow bullhead (*Ameiurus natalis*), was conducted in southeastern Texas, United States. Sixty-nine channel catfish and 26 yellow bullhead were collected from 6 sites within the Big Thicket National Preserve and 6 sites in surrounding bodies of water. Thirty-one species of parasites were found including 11 trematodes, 8 nematodes, 5 copepods, 3 cestodes, and 1 each of an acanthocephalan, leech, monogene, and myxozoan. Channel catfish harbored 23 species of parasites, yellow bullhead harbored 17, and 9 species occurred in both host species. Adult endohelminths dominated the fauna (18 species). Trematodes (*Alloglossidium corti*, *Alloglossidium kenti*, *Polylekithum catahoulensis*), a cestode (*Megathylacoides giganteum*), a nematode (*Dichelyne robusta*), and an ectoparasitic copepod (*Ergasilus cerastes*) constituted over 75% of the total parasite abundance. Although this constitutes the highest species diversity reported among similar surveys of catfishes in North America, much of the high species density is due to the presence of generalists, e.g., species of *Spinitectus* and *Crepidostomum*, more-commonly known to parasitize fishes of other groups.

KEY WORDS: parasite, survey, *Ictalurus punctatus*, *Ameiurus natalis*, Trematoda, Cestoda, Nematoda, Acanthocephala, Copepoda, Big Thicket National Preserve, Texas.

Surveys of parasites from fishes in Texas, United States, are rare and have focused either on individual localities, a subset of the fish fauna, or both (Sparks, 1951; Lawrence and Murphy, 1967; Meade and Bedinger, 1972; Gruninger et al., 1977; Underwood and Dronen, 1984). There is no published account of the parasites of ictalurids (North American freshwater catfishes) in Texas, although they have been included in most of these surveys and have been the subject of sporadic taxonomic work (e.g., Chandler, 1935). Gruninger et al. (1977) conducted the most intensive survey of catfish ($n = 89$, all channel catfish), but the survey was limited to 2 small locales in a single lake. During a biodiversity inventory of the parasites of fishes from waters of the Big Thicket National Preserve, a collection of 2 species of catfishes was examined for nonprotistan parasites from multiple localities in southeastern Texas. The results of this survey are reported herein.

MATERIALS AND METHODS

Channel catfish (*Ictalurus punctatus*) and yellow bullhead (*Ameiurus natalis*) were collected from July 2009 to October 2013 by seine, gill net, and hook-and-line from 12 localities (Fig. 1). Six locales were located in streams, lakes, and rivers of the Trinity River system and the remaining 6 in streams and bayous of the western part of the Neches River system. Six locales were within the boundaries of the Big Thicket National Preserve.

Fish were transported alive to a local laboratory and dissected the day of collection. The external surfaces (skin, scales, fins) were examined under a dissecting microscope, several slices were made into the flesh and teased open, the eyes, gills, and all internal organs removed, and the body cavity and head examined with a dissecting microscope. All internal organs were teased apart, scraped, or both. Protozoa were not included in the survey. Collected parasites were killed and fixed according to group-specific protocols. Permanent mounts (stained in carmalum; mounted in damar balsam) were made for all specimens except the crustaceans, nematodes, and myxozoans. Identifications to the lowest level possible were made via comparisons to keys (e.g., Roberts, 1970; Caira, 1989; Hoffman, 1999), and all species-level determinations were confirmed by comparison to original species descriptions and redescriptions. Some taxa remain identified to higher-level categories due to insufficient or inadequate material.

Voucher specimens of most taxa were deposited in the Harold W. Manter Laboratory (HWML) of Parasitology, Nebraska State Museum, Lincoln, Nebraska, U.S.A. Use of ecological terms follows Bush et al. (1997).

RESULTS

Thirty-one species of parasites were found in channel catfish ($n = 69$) and yellow bullhead ($n = 26$) in the present investigation (Table 1). These include 11 trematodes (9 adults; 2 metacercariae), 3 cestodes (1 adult; 2 larvae), 1 monogenean, 8 nematodes (7 adult; 1 larva), 1 acanthocephalan, 5 copepods, 1 leech, and 1 myxozoan. The vast majority of species (26) were adults; only 5 of the parasite species were larval forms. Adult endohelminths dominated in terms of both the number of species (18) and abundance. Ten species were ectoparasites,

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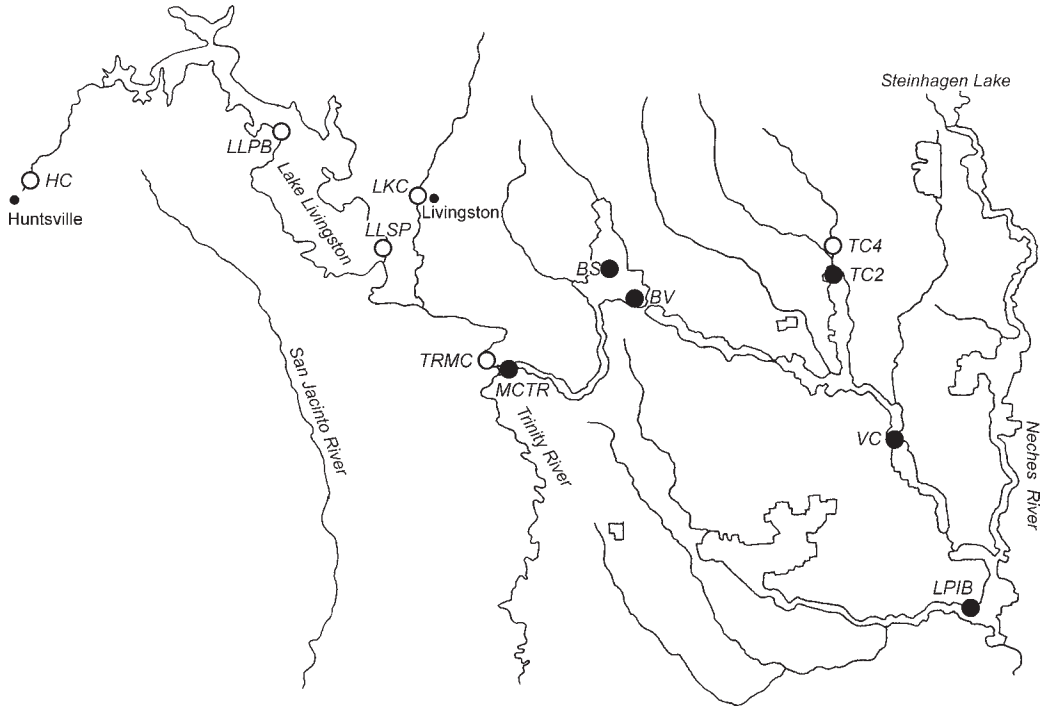

Figure 1. Map of collecting area. Closed circles indicate sites within the Big Thicket National Preserve (gray-shaded); open circles indicate sites outside of the Preserve. Site codes: BS, Big Sandy Creek at Sunflower Road; BV, Big Sandy Creek at Beaverslide Trail; HC, Harmon Creek at Sam Houston State Biological Station; LKC, Long King Creek at Livingston; LLPB, Lake Livingston at Point Blank; LLSP, Lake Livingston State Park; LPIB, Pine Island Bayou at Cook's Landing; MCTR, Menard Creek upstream of junction with Trinity River; TC2, Turkey Creek at FM 1943; TC4, Turkey Creek at FM 1013; TRMC, Trinity River upstream of junction with Menard Creek; VC, Village Creek at FM 418. See Table 1 for geographical coordinates and samples sizes.

and of these 7 have direct life cycles. Twenty-three species were found in channel catfish and 17 were found in yellow bullhead; 9 species were shared. The following species were found in channel catfish but not in bullhead: *Prosthenhystera obesa*, *Crepidostomum cornutum*, *Crepidostomum ictaluri*, the gill metacercariae, the larval cestode in the liver, the acanthocephalan, *Dichelyne diplocaecum*, *Spinitectus carolini*, *Spinitectus gracilis*, *Rhabdochona* sp., the unidentified nematode, *Henneguya* sp., *Ergasilus cerastes*, and *Ergasilsus arthrosis*. The following species were found in bullhead but not channel catfish: *Crepidostomum cooperi*, *Azygia* sp., the skin metacercariae, the larval cestode in the gallbladder, *Spinitectus macrospinosus*, *Ergasilus cyprinacea*, *Lernaea* sp., and the leech. Individual species accounts follow: Locality, prevalence, range of intensities, and mean abundance reported parenthetically after each host; dates given as months/years, including ranges of months within a year if collections spanned many months. Localities: BS, Big Sandy Creek at Sunflower Road; BV, Big Sandy Creek at Beaverslide Trail; HC, Harmon Creek at Sam Houston State Biological Station; LKC, Long King Creek at Livingston; LLPB, Lake Livingston at Point Blank; LLSP, Lake Livingston State Park; LPIB, Pine Island Bayou at Cook's Landing; MCTR, Menard Creek upstream of junction with Trinity River; TC2, Turkey Creek at FM 1943; TC4, Turkey Creek at FM 1013; TRMC, Trinity River upstream of junction with Menard Creek; VC, Village Creek at FM 418.

TREMATODA

Alloglossidium corti (Lamont, 1921) Van Cleave and Mueller, 1934

Hosts and localities: I. punctatus (BS, BV, MCTR, TC2, TRMC); *A. natalis* (BS, BV, TC4).

Prevalence, range, and mean abundance: 10 *I. punctatus* (0.14; 0–7; 0.36); 8 *A. natalis* (0.31; 0–33; 3.54).

Table 1. Geographical coordinates, sample sizes (*n*) of *Ictalurus punctatus* and *Ameiurus natalis*, and number of parasites species recovered from collection localities in survey.

Locality*	Latitude; Longitude	Fish species (*n*)	No. parasite species
BS	30°37′22.1′′N; 94°41′53.2′′W	*I. punctatus* (5)	6
		A. natalis (8)	13
BV	30°34′38.5′′N; 94°38′43.3′′W	*I. punctatus* (16)	11
		A. natalis (8)	4
HC	30°44′44.7′′N; 95°28′46.2′′W	*A. natalis* (5)	3
LKC	30°42′59.2′′N; 94°57′32.7′′W	*I. punctatus* (8)	5
LLPB	30°47′55.7′′N; 95°9′36.4′′W	*I. punctatus* (3)	3
LLSP	30°39′33.1′′N; 95°0.4′0.1′′W	*I. punctatus* (9)	6
LPIB	30°11′18′′N; 94°10′40.4′′W	*I. punctatus* (1)	0
MCTR	30°29′17.1′′N; 94°50′29′′W	*I. punctatus* (10)	10
TC2	30°37′11.3′′N; 94°21′23.7′′W	*I. punctatus* (8)	7
TC4	30°40′32.5′′N; 94°21′0′′W	*A. natalis* (5)	6
TRMC	30°29′16.7′′N; 94°50′29.2′′W	*I. punctatus* (8)	4
VC	30°23′54.3′′N; 94°15′50.9′′W	*I. punctatus* (1)	2
Totals		*I. punctatus* (69)	23
		A. natalis (26)	17
		Combined (95)	31

* Locality: BS, Big Sandy Creek at Sunflower Road; BV, Big Sandy Creek at Beaverslide Trail; HC, Harmon Creek at Sam Houston State Biological Station; LKC, Long King Creek at Livingston; LLPB, Lake Livingston at Point Blank; LLSP, Lake Livingston State Park; LPIB, Pine Island Bayou at Cook's Landing; MCTR, Menard Creek upstream of junction with Trinity River; TC2, Turkey Creek at FM 1943; TC4, Turkey Creek at FM 1013; TRMC, Trinity River upstream of junction with Menard Creek; VC, Village Creek at FM 418.

Dates of collection: 7/2009; 5–10/2010; 6,10/2013.

Site of infection: Intestine.

Specimens deposited: HWML 49928, 49930.

Remarks

Alloglossidium has been the subject of fairly intense scrutiny, primarily because many of these species occur as adults in leeches and crustaceans, leading to speculation and analyses intended to elucidate the evolutionary history of this group (Font, 1980; Carney and Brooks, 1991; Smythe and Font, 2001). Tkach and Mills (2011) resurrected *Alloglossidium kenti* Simer, 1929 from synonymy with *A. corti*, and in our study specimens of *A. corti* were easily distinguished from those of *A. kenti*. *Alloglossidium corti* was present in both host species in the present investigation but was more prevalent and abundant in yellow bullhead. Gruninger et al. (1977) reported *A. corti* from channel catfish from Eagle Mountain Lake, near Fort Worth, Texas.

Alloglossidium *kenti* Simer, 1929

Hosts and localities: I. punctatus (BS, BV, MCTR, TC2); *A. natalis* (BV, TC4).

Prevalence, range, and mean abundance: 21 *I. punctatus* (0.30; 0–23; 1.71); 3 *A. natalis* (0.12; 0–11; 0.54).

Dates of collection: 7/2009; 5–10/2010; 6,10/2013.

Site of infection: Intestine.

Specimens deposited: HWML 49565, 49566, 49567.

Remarks

See *A. corti* above. This species was present in both host species but more prevalent and adundant in channel catfish than in yellow bullhead. Tkach and Mills (2011) re-established *A. kenti* as a recognizable taxon. Meade and Bedinger (1972) recorded *A. kenti* from *I. punctatus*, as well as *Alloglossidium geminus* from *A. natalis*, in nearby Madison and Walker counties, Texas.

Azygia sp.

Hosts and localities: A. natalis (BS).

Prevalence, range, and mean abundance: 1 *A. natalis* (0.04; 0–5; 0.19).

Dates of collection: 6/2013.

Site of infection: Stomach.

Specimens deposited: HWML 49925.

Remarks

Four species of *Azygia* have been reported from ictalurids (Hoffman, 1999): *Azygia acuminata*, *Azygia angusticauda*, *Azygia longa*, and *Azygia sebago*. All of the specimens collected herein were immature, precluding identification of the worms to species. Barger (2014) described a new species of *Azygia* from pirate perch (*Aphredoderus sayanus*) from the Big Thicket National Preserve and reviewed the taxonomic history of the genus.

Crepidostomum cooperi Hopkins, 1931

Hosts and localities: A. natalis (BS).

Prevalence, range, and mean abundance: 1 *A. natalis* (0.04; 0–1; 0.04).

Dates of collection: 5/2010.

Site of infection: Intestine.

Specimens deposited: None.

Remarks

Members of both *C. cooperi* and *C. cornutum* have been reported from numerous fishes in many genera and families. Both species were rare in the present investigation and probably represent only occasional infections of ictalurids. Centrarchids (sunfishes) collected syntopically with many of the catfishes reported herein were more-heavily infected with both species and probably are the primary definitive hosts in these locales (Caira, 1989).

Crepidostomum cornutum (Osborn, 1903) Stafford, 1904

Hosts and localities: I. punctatus (BV, MCTR).

Prevalence, range, and mean abundance: 3 *I. punctatus* (0.04; 0–8; 0.17).

Dates of collection: 5/2010; 6/2013.

Site of infection: Intestine.

Specimens deposited: HWML 49560.

Remarks

See *C. cooperi*.

Crepidostomum ictaluri Surber, 1928

Hosts and localities: I. punctatus (BV, MCTR).

Prevalence, range, and mean abundance: 2 *I. punctatus* (0.03; 0–5; 0.09).

Dates of collection: 6/2013.

Site of infection: Intestine.

Specimens deposited: HWML 49927.

Remarks

The generic placement of this taxon is not settled (Curran et al., 2006) and it might belong to *Megalogonia*. Although often reported from ictalurids and centrarchids in other locales (Hoffman, 1999), *C. ictaluri* was very rarely found in fishes in this survey. Perhaps the trematode is more common and abundant in other areas of eastern Texas including more-southern and eastern parts of the Neches River system. Gruninger et al. (1977) reported this species from channel catfish from Eagle Mountain Lake, Texas.

Metacercaria—gills

Hosts and localities: I. punctatus (LLSP).

Prevalence, range, and mean abundance: 1 *I. punctatus* (0.01; 0–1; 0.01).

Dates of collection: 6/2010.

Site of infection: Gills.

Specimens deposited: None.

Remarks

Only 1 specimen was recovered, and it was not identified.

Metacercaria—skin

Hosts and localities: A. natalis (HC).

Prevalence, range, and mean abundance: 1 *A. natalis* (0.04; 0–18; 0.69).

Dates of collection: 9/2010.

Site of infection: Skin.

Specimens deposited: None.

Remarks

Several specimens were recovered, but none were identified.

Phyllodistomum sp.

Hosts and localities: I. punctatus (LLSP); *A. natalis* (BS).

Prevalence, range, and mean abundance: 1 *I. punctatus* (0.01; 0–1; 0.01); 2 *A. natalis* (0.08; 0–3; 0.19).

Dates of collection: 5,6/2010.

Site of infection: Urinary bladder.

Specimens deposited: HWML 49742.

Remarks

Meade and Bedinger (1972) reported both *Phyllodistomum caudatum* and *Phyllodistomum lacustri* from ictalurids from Madison and Walker counties, which are adjacent to the Big Thicket to the west.

Polylekithum catahoulensis Curran, Tkach, & Overstreet, 2006

Hosts and localities: I. punctatus (BS, BV, TC2, VC); *A. natalis* (BS, TC4).

Prevalence, range, and mean abundance: 10 *I. punctatus* (0.14; 0–11; 0.49); 2 *A. natalis* (0.08; 0–4; 0.19).

Dates of collection: 5–10/2010; 8,10/2013.

Site of infection: Intestine.

Specimens deposited: HWML 49521–49527, 49929.

Remarks

Polylekithum catahoulensis was described by Curran et al. (2006) from blue and channel catfish in Louisiana. Barger (2012) redescribed the species and clarified how to distinguish it from *Polylekithum ictaluri*.

Prosthenhystera obesa (Diesing, 1850) Travassos, 1922

Hosts and localities: I. punctatus (BV, MCTR).

Prevalence, range, and mean abundance: 2 *I. punctatus* (0.03; 0–2; 0.04).

Dates of collection: 5/2010; 6/2013.

Site of infection: Gall bladder.

Specimens deposited: HWML 49529, 49926.

Remarks

Prosthenhystera obesa was recently redescribed (Kohn et al., 1997) based on numerous specimens collected over decades in South America. Only 2 channel catfish were infected with this trematode in the present investigation. Choudhury et al. (2007) summarized our limited knowledge of the biology of this fluke.

CESTODA

Larval cestode—gall bladder

Hosts and localities: A. natalis (BS).

Prevalence, range, and mean abundance: 1 *A. natalis* (0.04; 0–3; 0.12).

Dates of collection: 5/2010.

Site of infection: Gall bladder.

Specimens deposited None.

Remarks

These specimens were very small (<3 mm) and possessed a scolex with 4 very small suckers. The cestode possessed no proglottids.

Larval cestode—liver

Hosts and localities: I. punctatus (LLSP).

Prevalence, range, and mean abundance: 2 *I. punctatus* (0.03; 0–2; 0.04).

Dates of collection: 6/2010.

Site of infection: Liver.

Specimens deposited: None.

Remarks

Plerocercoids of a proteocephalid were recovered from only 1 site on Lake Livingston.

Megathylacoides giganteum (Essex, 1928) Frese, 1965

Hosts and localities: I. punctatus (BS, BV, LKC, MCTR, TC2); *A. natalis* (HC, TC4).

Prevalence, range, and mean abundance: 25 *I. punctatus* (0.36; 0–20; 1.43); 3 *A. natalis* (0.12; 0–3; 0.31).

Dates of collection: 7/2009; 5–10/2010; 6,10/2013.

Site of infection: Intestine.

Specimens deposited: HWML 49208.

Remarks

Megathylacoides giganteum was one of the most-prevalent parasites of channel catfish and was widely distributed both within the Big Thicket National Preserve proper and at sites outside the preserve.

MONOGENEA

Monogenea—gills

Hosts and localities: I. punctatus (LLPB, TRMC); *A. natalis* (BS, HC, TC4).

Prevalence, range, and mean abundance: 2 *I. punctatus* (0.03; 0–7; 0.12); 5 *A. natalis* (0.19; 0–13; 1.08).

Dates of collection: 8,9/2010; 10/2013.

Site of infection: Gills.

Specimens deposited: None.

Remarks

Monogeneans were noted during early collections of catfishes but were not identified to species.

NEMATODA

Dichelyne diplocaecum (Chandler, 1935)

Hosts and localities: I. punctatus (BV, MCTR).

Prevalence, range, and mean abundance: 6 *I. punctatus* (0.09; 0–4; 0.13).

Dates of collection: 6/2013.

Site of infection: Intestine.

Specimens deposited: HWML 69301.

Remarks

Although a congener was common in yellow bullhead (see *Dichelyne robusta*), *D. diplocaecum* was found only in channel catfish. The species was described from *Ictalurus furcatus* from Galveston Bay, Texas based on only 2 individuals (Chandler, 1935). As Perez-Ponce de Leon and Choudhury (2002) noted, the existing descriptions of *Dichelyne* species are not robust, and it is possible that the biodiversity of the genus is either much smaller or much larger than currently known.

Dichelyne robusta (Van Cleave and Mueller, 1932) Petter, 1974

Hosts and localities: I. punctatus (BS, BV, LKC, LLPB, LLSP, TRMC); *A. natalis* (BS, BV).

Prevalence, range, and mean abundance: 12 *I. punctatus* (0.17; 0–5; 0.35); 8 *A. natalis* (0.31; 0–5; 0.81).

Dates of collection: 7/2009; 5,6/2010; 6–8,10/2013.

Site of infection: Intestine.

Specimens deposited: HWML 63524.

Remarks

Dichelyne robusta was the most-prevalent nematode found in ictalurids in the present investigation. Nevertheless, intense infections were not observed.

Rhabdochona sp.

Hosts and localities: I. punctatus (MCTR).

Prevalence, range, and mean abundance: 1 *I. punctatus* (0.01; 0–2; 0.03).

Dates of collection: 6/2013.

Site of infection: Intestine.

Specimens deposited: None.

Remarks

Too few specimens were recovered for a positive species identification. A number of different species of *Rhabdochona* have been reported from fishes in Texas (Moravec and Huffman, 1988; Hoffman, 1999), including *Rhabodochona decaturensis* from channel catfish by Gruninger et al. (1977).

Spinitectus carolini Holl, 1928

Hosts and localities: I. punctatus (LKC, MCTR).

Prevalence, range, and mean abundance: 2 *I. punctatus* (0.03; 0–1; 0.03).

Dates of collection: 7/2009; 10/2013.

Site of infection: Intestine.

Specimens deposited: None.

Remarks

Underwood and Dronen (1984) found both *S. carolini* and *Spinitectus micracanthus* from *A. natalis* from the Upper San Marcos River, Texas. As with that study and Gruninger et al. (1977), these species were rare in ictalurids in the present investigation and more common in centrarchids (data not shown).

Spinitectus gracilis Ward and Magath, 1917

Hosts and localities: I. punctatus (BV).

Prevalence, range, and mean abundance: 1 *I. punctatus* (0.03; 0–5; 0.07).

Dates of collection: 6/2013.

Site of infection: Intestine.

Specimens deposited: HWML 69302.

Remarks

Although not abundant in catfishes in the present investigation, *S. gracilis* was more abundant in channel catfishes than was *S. carolini*. A similar pattern was observed by Gruninger et al. (1977), who found *S. gracilis* in *I. punctatus* but not in the centrarchids they surveyed.

Spinitectus macrospinosus Choudhury and Perryman, 2003

Hosts and localities: A. natalis (BS).

Prevalence, range, and mean abundance: 1 *A. natalis* (0.03; 0–1; 0.03).

Dates of collection: 6/2013.

Site of infection: Intestine.

Specimens deposited: None.

Remarks

Spinitectus macrospinosus was described by Choudhury and Perryman (2003) from *I. punctatus* in southern Manitoba, Canada. These authors also noted *S. macrospinosus* in ictalurids from Lake Texoma (on the border of Texas and Oklahoma) and Kentucky Lake (on the border of Kentucky and Tennessee). The present report extends its reported range to near the Gulf Coast. As with other species of *Spinitectus*, this one appears to be widely distributed in North America (Hoffman, 1999), but subsequent study may reveal more-subtle differences, distinguishing a greater number of species.

Spiroxys sp.

Hosts and localities: I. punctatus (LKC, LLSP, TC2, TRMC); *A. natalis* (BV, TC4).

Prevalence, range, and mean abundance: 8 *I. punctatus* (0.12; 0–1; 0.12); 2 *A. natalis* (0.08; 0–3; 0.19).

Dates of collection: 7/2009; 6–10/2010; 10/2013.

Site of infection: Body cavity.

Specimens deposited: None.

Remarks

All specimens of *Spiroxis* sp. were found imbedded in mesenteric tissue in the body cavity.

Unidentified Nematode

Hosts and localities: I. punctatus (BS).

Prevalence, range, and mean abundance: 1 *I. punctatus* (0.01; 0–1; 0.01).

Dates of collection: 6/2010.

Site of infection: Intestine.

Specimens deposited: None.

Remarks

Only 1 worm was recovered; it was immature and could not be identified.

ACANTHOCEPHALA

Unidentified Acanthocephalan

Hosts and localities: I. punctatus (TC2).

Prevalence, range, and mean abundance: 1 *I. punctatus* (0.01; 0–2; 0.03).

Dates of collection: 10/2010.

Site of infection: Intestine.

Specimens deposited: None.

Remarks

These worms were immature and in poor condition. A variety of acanthocephalans have been reported from catfishes, many of which are not primarily parasites of these fishes (Hoffman, 1999).

HIRUDINEA

Unidentified Leech

Hosts and localities: A. natalis (BS).

Prevalence, range, and mean abundance: 1 *A. natalis* (0.04; 0–1; 0.04).

Dates of collection: 5/2010.

Site of infection: Skin.

Specimens deposited: None.

Remarks

Only 1 leech was recovered; it was not identified.

CRUSTACEA

Achtheres sp.

Hosts and localities: I. punctatus (MCTR); A. natalis (BS).

Prevalence, range, and mean abundance: 1 *I. punctatus* (0.01; 0–1; 0.01); 1 *A. natalis* (0.04; 0–5; 0.19).

Dates of collection: 6/2013.

Site of infection: Gills.

Specimens deposited: HWML 68666.

Remarks

Gruninger et al. (1977) reported *Achtheres micropteri* from *I. punctatus* from Eagle Mountain Lake, Texas. The specimens collected herein were not identified to species.

Ergasilus arthrosis Roberts, 1969

Hosts and localities: I. punctatus (LKC, VC).

Prevalence, range, and mean abundance: 3 *I. punctatus* (0.04; 0–7; 0.14).

Dates of collection: 8,10/2013.

Site of infection: Gills.

Specimens deposited: HWML 68515.

Remarks

This species has been reported primarily from ictalurids but also from species of shad (*Alosa*) and sunfish (*Lepomis*) (Roberts, 1970). Gruninger et al. (1977) reported this species from *I. punctatus* from Eagle Mountain Lake, Texas.

Ergasilus cerastes Roberts, 1969

Hosts and localities: I. punctatus (LLPB, LLSP).

Prevalence, range, and mean abundance: 9 *I. punctatus* (0.13; 0–31; 1.38).

Dates of collection: 6/2010; 8,10/2013.

Site of infection: Gills.

Specimens deposited: HWML 68513.

Remarks

Roberts (1969) described this species from ictalurids from an unknown locality, but existing specimens at the time from Florida and Washington, D.C. were verified as *E. cerastes*. This copepod was found only in channel catfish in Lake Livingston, where it was prevalent.

Ergasilus cyprinaceus Rogers, 1969

Hosts and localities: A. natalis (BS).

Prevalence, range, and mean abundance: 1 *A. natalis* (0.04; 0–1; 0.04).

Dates of collection: 8/2010.

Site of infection: Gills.

Specimens deposited: HWML 68514.

Remarks

Only 1 specimen was recovered from a yellow bullhead from Big Sandy Creek. This species has been reported often in other species of fishes, including cyprinids (*Hybopsis, Pimephales*) and sticklebacks (*Culaea*) (Roberts, 1970).

Lernaea sp.

Hosts and localities: A. natalis (BS).

Prevalence, range, and mean abundance: 1 *A. natalis* (0.04; 0–1; 0.04).

Dates of collection: 5/2010.

Site of infection: Gills.

Specimens deposited: HWML 67083.

Remarks

Gruninger et al. (1977) reported *Lernaea cyprinacea* from *I. punctatus* from Eagle Mountain Lake, Texas. Only 1 specimen was collected in the present investigation.

MYXOZOA

Henneguya sp.

Hosts and localities: I. punctatus (BV, TC2).

Prevalence, range, and mean abundance: 4 *I. punctatus* (0.06; 0–3; 0.09).

Dates of collection: 5–10/2010.

Site of infection: Gills.

Specimens deposited: HWML 67124.

Remarks

Henneguya exilis is one of the most-commonly reported myxozoans of ictalurids in North America (Hoffman, 1999, and citations therein), and these specimens probably represent that species.

DISCUSSION

Parasite species diversity in channel catfish and yellow bullheads in eastern Texas is high compared to what has been reported previously. In the studies most similar to the present investigation, Bangham (1940) found 25 parasite species from 89 ictalurids representing 5 species in a survey of fishes in southern Florida. Harms (1959, 1960), in a checklist of parasites from catfish in Kansas, listed 25 parasite species from 135 ictalurids representing 3 species. Fischthal (1947a, b) found 25 parasite species from 146 fishes representing 4 species of ictalurids in northwest Wisconsin waters. Van Cleave and Mueller (1934) found 24 species of helminths from an unreported number of 5 species of ictalurids. Bangham and Hunter (1939) reported 22 parasite species from 54 fishes representing 2 ictalurids, and Baker and Crites (1976) reported 20 parasite species from 178 channel catfish, both from Lake Erie. All other surveys that included catfishes reported fewer than 20 species (Bangham, 1941, 1944; Bangham and Adams, 1954; Hugghins, 1959; Anthony, 1963; Perez-Ponce de Leon and Choudhury, 2002; Rosas-Valdez et al., 2007). Most other parasite surveys including catfishes involved insufficient sampling effort to allow meaningful comparisons of species diversity (e.g., Muzzall, 1982) or report on catfish parasites outside of their native range (Choudhury et al., 2004; Linder et al., 2012). Not surprisingly, in these latter studies, adult trematodes were absent.

Within Texas, only Gruninger et al. (1977) conducted an intensive survey of catfish parasites, finding 15 parasite species in 89 *I. punctatus* from Eagle Mountain Lake in north-central Texas (northwest of Fort Worth). Geographically, Meade and Bedinger (1972) conducted a similar study, but their work focused almost exclusively on centrarchids (sunfishes); host sample sizes were not provided, but only 5 trematodes were reported from *I. punctatus* and *A. natalis*. Underwood and Dronen (1984) dissected 5 ictalurids from the Upper San Marcos River, Texas, and Lawrence and Murphy (1967) reported 7 species of parasites from 21 *I. punctatus* collected from Benbrook Lake, located just a few miles south of Eagle Mountain Lake. In Louisiana, Arnold et al. (1966) conducted the largest-scale survey of fish parasites in the central Gulf of Mexico region, which included 59 ictalurids representing 5 species. Unfortunately, the data were summarized to a point that few details can be gleaned; however, 13 species were recovered from 36 channel catfish and 11 species were recovered from 16 *A. natalis*.

The distribution of parasite species among higher taxa is remarkably similar between this study and several others. For example, following are percentages of the total number of species for this study and that of Bangham (1940) in Florida, respectively: trematodes (35% vs. 32%), nematodes (26% vs. 24%), crustaceans (16% vs. 16%), cestodes (10% vs. 12%). This same similarity holds true when comparisons are made with other large-scale, intensive surveys of ictalurid parasites (Bangham and Hunter, 1939; Bangham, 1944; Fischthal, 1947a, b; Harms, 1959, 1960). Surveys from more-northerly locales often report a greater relative cestode diversity, e.g., up to 22% of the fauna in the survey of Bangham (1944) in northern Wisconsin waters. In almost all large surveys of catfishes in North America, adult trematodes and nematodes constituted the bulk (>50%) of parasite species found.

Although the parasite fauna of ictalurids in eastern Texas is species diverse, few of the constituent species could be considered prevalent and abundant. Species of *Alloglossidium* constituted 36% of all specimens recovered; adult trematodes as a group comprised 46.5% of the total abundance. Combined with *M. giganteum* (15.6%) and *E. cerastes* (13.8%), over 75% of the parasite individuals represented just over one third of the parasite species (11). The 6 most-abundant species (*A. kenti*, *A. corti*, *M. giganteum*, *E. cerastes*, *D. robusta*, and *P. catahoulensis*) constituted almost 78% of the parasites found; 7 parasite species were represented by just 1 individual in the present investigation.

Many of the rare species are more-commonly associated with hosts in other taxa. For instance, *S. carolini* and *S. gracilis* are primarily found infecting sunfishes, although they are occasionally reported from ictalurids (Hoffman, 1999, and citations therein). The same is true of *C. cooperi* and *C. cornutum*, both of which were rarely found in ictalurids in the present investigation (see also Caira, 1989; Hoffman, 1999). *Ergasilus cyprinaceus* has been reported from multiple hosts but primarily minnows (Roberts, 1970; Hoffman, 1999). In contrast, *S. macrospinosus* and *C. ictaluri* are primarily parasites of ictalurids (Caira, 1989; Hoffman, 1999; Choudhury and Perryman, 2003) but were rare in the

present study. Similarly, *E. arthrosis*, *Henneguya* sp., and *D. diplocaecum* are known parasites of ictalurids but were rare herein.

The parasite fauna of ictalurids in southeastern Texas is the most diverse reported in North America to date, and it is dominated numerically by a small group of adult endohelminths (3 trematodes, 1 cestode, and 1 nematode) and a crustacean. Most of the diversity is made up of species that were rare in the present investigation, including those generalist parasites more commonly parasitizing fishes from other groups. This pattern is remarkably similar to what Perez-Ponce de Leon and Choudhury (2002) reported for parasites of ictalurids in Mexico when they identified species of trematodes (*Alloglossidium*, *Crepidostomum*, *Phyllodistomum*, *Polylekithum*), cestodes (*Corallobothrium* and *Megathylacoides*), and nematodes (*Dichelyne*) as forming a biogeographical core set of species commonly distributed across Mexico and primarily parasitizing ictalurids. With the exception of *Corallobothrium*, the above-mentioned genera include those most-commonly represented in ictalurids in the present investigation. Rosas-Valdez and Perez-Ponce de Leon (2011) found similar distinctions among ictalurid specialists and generalists in Mexico more broadly.

The surveying of ictalurids, as well as all other local freshwater fishes, continues in southeastern Texas with the goal of providing a comprehensive accounting of the parasites of freshwater fishes in the Big Thicket National Preserve and areas historically part of the Big Thicket set of ecosystems. Further work in the far-southern regions (Pine Island Bayou, Little Pine Island Bayou) and the Neches River units will likely reveal additional parasites of ictalurids.

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