The Endoparasitic Helminths of Fishes from Lake Carl Blackwell, Oklahoma[1]

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INTRODUCTION

The purpose of this paper is to report and enumerate the endoparasitic helminths of fishes from Lake Carl Blackwell, a turbid reservoir located in northcentral Oklahoma. Similar studies in the southern Great Plains have been conducted in central and southern Oklahoma (Sneed, 1950; Bynum, 1951; Self, 1954; McIntosh and Self, 1955; Self and Timmons, 1955; Self and Campbell, 1956; Roberts, 1957; McDaniel, 1963; Mackiewicz, 1964; McDaniel and Bailey, 1966), in Texas (Harwood, 1935; Sparks, 1951; VanCleave and Timmons, 1952; Hopkins, 1966; Allison and McGraw, 1967; Casto and McDaniel, 1967; Hopkins, 1967; Lawrence and Murphy, 1967; McGraw and Allison, 1967; Meade and Bedinger, 1967; Nowlin, Price, and Schlueter, 1967), in Arkansas (Houghton, 1963; Holmes, 1964; Holmes and Mullan, 1965; Becker, Heard, and Holmes, 1966), in Kansas (Caruthers, 1935; Wilson, 1957; Harms, 1960), and in eastern Colorado (Cook, 1952). The present study was the first extensive survey of endoparasitic helminths of fishes from northern Oklahoma, although Krull (1933) and Steelman (1938) did limited studies in Payne County, and Seamster (1938) and others have reported on certain ectoparasites of fishes in this area.

Coincident with this survey were studies dealing with certain ecological aspects of the host-parasite relationship and papers covering these subjects are currently in preparation. Research funds, equipment and personnel were provided by the Oklahoma Cooperative Fishery Unit. Thanks are extended to: Dr. R. C. Summerfelt, Leader of the Fishery Unit, for directing this study; Dr. G. L. Hoffman of the Eastern Fish Diseases Laboratory, Kearneysville, W. Va., for help in identification of certain nematodes; Dr. J. S. Mackiewicz of the State University of New York, Albany, for help in identifying the caryophyllaeids; and Dr. S. H. Hopkins of Texas A & M University, College Station, for help in identification of certain proteocephalid tapeworms.

METHODS AND STUDY AREA

Lake Carl Blackwell is a 30-year-old, 3,300-acre watershed reservoir located in Payne County, near Stillwater, Oklahoma. This survey began in June, 1967, and continued through May, 1968. Fishes were collected by gill nets, modified fyke nets, electrofishing, and by use of rotenone

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from six collection sites within the lake, each presumed to represent a different habitat type.

The 11 hosts examined and their numbers included: 149 channel catfish (*Ictalurus punctatus*); 36 flathead catfish (*Pylodictis olivaris*); 37 bluegill (*Lepomis macrochirus*); 31 largemouth bass (*Micropterus salmoides*); 26 longear sunfish (*L. megalotis*); 176 white crappie (*Pomoxis annularis*); 12 carp (*Cyprinus carpio*); 30 drum (*Aplodinotus grunniens*); 35 gizzard shad (*Dorosoma cepedianum*); 38 river carpsucker (*Carpiodes carpio*); and 39 white bass (*Roccus chrysops*).

The necropsy techniques included removal and microscopic examination of the alimentary tract and associated organs, air bladder, kidneys, and urinary bladder, and the heart and associated blood vessels. Artificial pepsin-digest methods, similar to those suggested by Hoffman (1955) were sometimes employed to facilitate the removal and enumeration of encysted, larval helminths. After digestion, the residue was strained through a standard 60-mesh sieve (pore size 240 μ). Detergents, or an abbreviated pepsin digestion (10 min), were found useful for separating small helminths from the thick, mucoid chyme of certain hosts' intestines.

The helminths were fixed in hot (65 — 75 C) 10% formalin-saline. Staining of flatworms was by Semichon's aceto-carmine or Delafield's hematoxylin, which followed the recommendaton of E. D. Besch (Louisiana State University, 1967, personal communication). Roundworms were examined in temporary, lactophenol-cleared[2] mounts, or in permanent glycerol-gelatin preparations (Humason, 1962). Enface views of nematodes were obtained by decapitation or by the technique of Lee (1964).

RESULTS

The nematodes were the most abundant endoparasites found in this survey, both in kinds and numbers. Thirteen species of Nematoda were recovered; at least one taxon occurred in each host species examined (Table I). *Camallanus oxycephalus* was found in the intestine and rectum of channel and flathead catfishes, longear sunfish, bluegill, white crappie, largemouth bass, freshwater drum, and white bass. *Camallanus ancylodirus* was found in carp only. *Rhabdochona decaturensis* occurred in the intestine of all host species except gizzard shad. *Rhabdochona cascadilla* was found only in white crappie.

Spinitectus carolini was found in the intestine, and rarely in the parenchyma of the liver or in the mesenteries, of channel catfish, bluegill, longear sunfish, and freshwater drum. *Spinitectus gracilis* occurred in white crappie only. *Spinitectus* sp. was found in flathead catfish. *Contracaecum spiculigerum* (immature) were observed encysted in the mesenteries or under the serosa of the alimentary tract of channel and flathead catfishes, largemouth bass, and white crappie. *Contracaecum* sp., probably also *C. spiculigerum*, was found in bluegill, freshwater drum, white bass, and river carpsucker.

Spiroxys sp. (immature) was encysted in the viscera, primarily in the mesenteries, of channel catfish, largemouth bass, white crappie, and river carpsucker. *Dacnitoides robusta* was obtained from the intestine of channel catfish only. *Philometra nodulosa* was encysted under the integument of the oral cavity of largemouth bass only. An unidentified larval ascarid was found in the intestine and encysted within the viscera of white crappie, river carpsucker, gizzard shad, and white bass. An unidentified larval spirurid was encysted in the liver of channel catfish; a second unidentified species of Spiruroidea, different from the above, was found in the intestine of white crappie.

[2]Distilled water 20 ml, glycerine 40 ml, lactic acid 20 ml, phenol crystals 20 g.

TABLE I. PREVALENCE AND INTENSITY OF ENDOPARASITIC HELMINTHS IN FISHES FROM LAKE CARL BLACKWELL, STILLWATER, OKLAHOMA.

Taxa	Prevalence (%)			Mean Intensity		
	Male	Fem.	Total	Male	Fem.	Total
CHANNEL CATFISH (67 males; 82 females)						
Digenea:						
Phyllodistomum lacustri	26.9	28.0	27.5	1.1	1.3	1.2
Crepidostomum ictaluri	9.0	2.4	5.4	3.0	3.0	3.0
Alloglossdium corti	0	1.2	0.7	0	11.0	11.0
Eucestoda:						
Corallobothrium fimbriatum and C. giganteum	71.6	77.0	75.6	10.2	13.4	11.9
Proteocephalus sp.	19.4	32.9	26.8	3.5	4.0	3.8
Nematoda:						
Contracaecum spiculigerum*	28.4	20.7	24.2	1.8	3.4	2.5
Camallanus oxycephalus	17.9	17.1	17.4	1.8	2.8	2.3
Rhabdochona decaturensis	47.8	56.2	52.4	4.8	4.6	4.7
Spinitectus carolini	14.9	18.3	16.8	1.9	1.9	1.9
Dacnitoides robusta	3.0	6.1	4.7	1.5	3.2	2.7
Spiroxys sp*	1.5	0	0.7	2.0	0	2.0
Spiruroidea*	1.5	0	0.7	3.0	0	3.0
Acanthocephala:						
Leptorhynchoides thecatus	1.5	0	0.7	1.0	0	1.0
FLATHEAD CATFISH (13 males; 23 females)						
Digenea:						
Phyllodistomum lacustri	0	4.3	2.8	0	1.0	1.0
Eucestoda:						
Proteocephalus sp.	92.3	69.5	77.8	6.0	5.3	5.6
Corallobothrium fimbriatum and C. giganteum	84.6	91.3	88.9	15.6	16.1	16.0
Nematoda:						
Contracaecum spiculigerum*	77.0	73.9	75.0	4.2	8.6	7.0
Camallanus oxycephalus	23.1	4.3	11.1	1.3	1.0	1.2
Spinitectus sp.	7.7	0	2.8	1.0	0	1.0
Rhabdochona decaturensis	7.7	0	2.8	23.0	0	23.0
WHITE CRAPPIE (76 males; 100 females)						
Digenea:						
Posthodiplostomum minimum*	85.5	72.0	77.8	14.6	17.0	15.8
Eucestoda:						
Proteocephalidea including Proteocephalus amblopliti*	10.5	3.0	6.3	1.0	1.0	1.0

* Immature or larval form.

Nematoda:						
Camallanus oxycephalus	64.5	66.0	65.4	3.6	3.4	3.5
Spinitectus gracilis	3.9	6.0	5.1	1.0	1.3	1.2
Rhabdochona cascadilla and R. decaturensis	11.8	13.0	12.5	1.7	2.5	2.2
Spiroxys sp.*	2.6	0	1.3	2.5	0	2.5
Contracaecum sp.*	9.2	13.0	11.4	1.4	1.4	1.4
Ascaroidea*	2.6	1.0	1.7	2.5	1.0	2.0
Spiruroidea*	1.3	0	0.6	1.0	0	1.0
CARP (1 male; 11 females)						
Digenea:						
Clinostomum marginatum*	0	9.1	8.3	0	1.0	1.0
Cestoda:						
Khawia iowensis	0	18.2	16.7	0	2.5	2.5
Atractolytocestus huronensis	100.0	45.5	50.0	9.0	18.0	16.5
Proteocephalus sp.*	0	9.1	8.3	0	2.0	2.0
Nematoda:						
Rhabdochona decaturensis	100.0	72.7	75.0	19.0	28.9	27.8
Camallanus ancylodirus	0	9.1	8.3	0	3.0	3.0
DRUM (9 males; 21 females)						
Eucestoda:						
Proteocephalus sp.*	0	4.8	3.0	0	1.0	1.0
Nematoda:						
Rhabdochona decaturensis	66.7	80.9	76.7	25.2	16.4	18.7
Contracaecum sp.*	0	19.0	13.3	0	4.0	4.0
Spinitectus carolini	11.1	9.5	10.0	1.0	2.5	2.0
Camallanus oxycephalus	11.1	4.8	6.7	1.0	1.0	1.0
GIZZARD SHAD (14 males; 21 females)						
Nematoda:						
Ascaroidea*	7.1	9.5	8.6	4.0	3.5	3.7
RIVER CARPSUCKER (14 males: 24 females)						
Cestoda:						
Spartoides wardi	7.1	12.5	10.5	2.0	1.7	1.8
Biacetabulum sp. nov.	21.4	8.3	13.2	1.3	3.0	2.0
Proteocephalus sp.*	7.1	0	2.6	1.0	0	1.0
Nematoda:						
Contracaecum sp.*	7.1	0	2.6	2.0	0	2.0
Spiroxys sp.	14.3	20.8	18.4	1.5	2.0	1.9
Rhabdochona decaturensis	7.1	4.2	5.3	1.0	7.0	4.0
Ascaroidea*	7.1	0	2.6	1.0	0	1.0
WHITE BASS (16 males; 23 females)						
Eucestoda:						
Proteocephalus sp.*	0	8.7	5.1	0	1.0	1.0
Nematoda:						
Camallanus oxycephalus	56.3	47.8	51.3	3.9	4.9	4.5
Rhabdochona decaturensis	12.5	30.4	23.0	5.5	1.9	2.7
Contracaecum, sp.*	0	8.7	5.1	0	1.0	1.0
Clinostomum marginatum*	7.7	0	3.2	1.0	0	1.0

*Immature or larval form.

BLUEGILL (10 males; 27 females)						
Digenea:						
Posthodiplostomum minimum*	100.0	96.2	97.2	283.4	78.5	135.4
Uvulifer ambloplitis*	10.0	3.7	5.4	—	—	—
Eucestoda:						
Proteocephalidea including Proteocephalus ambloplitis	30.0	26.0	27.0	2.3	2.1	2.2
Nematoda:						
Contracaecum sp.*	20.0	0	5.4	2.0	0	2.0
Spinitectus carolini	50.0	40.8	43.3	1.8	1.8	1.8
Rhabdochona decaturensis	10.0	11.1	10.6	1.0	4.0	3.3
LARGEMOUTH BASS (13 males; 18 females)						
Digenea:						
Posthodiplostomum minimum*	76.9	55.5	64.5	23.7	19.2	21.5
Clinostomum marginatum*	7.7	0	3.2	1.0	0	1.0
Eucestoda:						
Proteocephalus ambloplitis*	46.2	50.0	48.4	3.7	8.1	6.3
Nematoda:						
Contracaecum spiculigerum*	100.0	89.9	93.5	8.3	6.4	7.2
Camallanus oxycephalus	30.8	22.2	25.8	6.8	7.8	7.3
Rhabdochona decaturensis	0	16.7	9.7	0	3.0	3.0
Spiroxys sp.*	15.4	0	6.5	1.0	0	1.0
Philometra nodulosa	7.7	0	3.2	1.0	0	1.0
LONGEAR SUNFISH (12 males; 14 females)						
Digenea:						
Posthodiplostomum minimum*	58.3	28.6	42.3	14.8	13.5	14.0
Eucestoda:						
Proteocephalidea including Proteocephalus ambloplitis*	50.0	28.6	38.7	1.5	1.3	1.4
Bothriocephalus sp.*	12.5	0	3.9	1.0	0	1.0
Nematoda:						
Camallanus oxycephalus	41.7	7.1	23.1	1.2	1.0	1.2
Rhabdochona decaturensis	0	28.6	15.8	0	1.8	1.8
Spinitectus carolini	0	21.4	11.5	0	1.7	1.7

*Immature or larval form.

Second in importance in frequency of occurrence were the Cestoda. Four species of the monozoic order Caryophyllidea were found. *Atractolytocestus huronensis* and *Khawia iowensis* were collected from the foregut of carp, and *Spartoides wardi* and *Biacetabulum* sp.[3] were collected from the foregut of river carpsucker.

Proteocephalus ambloplitis were recovered as plerocercoids from the liver, ovaries and other organs of largemoth bass, white crappie, bluegill, and longear sunfish. Immature, adult-like stages were recovered from the

[3]The description for this species is being prepared by J. S. Mackiewicz of New York State University, Albany.

intestine of largemouth bass. *Proteocephalus* sp. (immature) was found in the intestine of channel and flathead catfishes, white bass, freshwater drum, carp, and river carpsucker. Numerous "spargana," frequently observed encysted in the viscera of the ictalurids and centrarchids, undoubtedly were larval proteocephalid tapeworms, but identification was impossible. *Bothriocephalus* sp. was observed in the intestine of bluegill.

Corallobothrium giganteum and *C. fimbriatum* were each collected from the intestine of both flathead and channel catfish, often occurring together in the same individual. Some doubt has been expressed by S. H. Hopkins (Texas A & M University(personal letter, 1968) concerning the separation of these two species but the classification is allowed to stand for now.

Digenetic flukes, *Posthodiplostomum minimum* excepted, were generally not abundant in fishes collected during this study. *Phyllodistomum lacustri* was found in the urinary bladder of channel catfish, and rarely in flathead catfish. *Crepidostomum ictaluri* and *Alloglossidium corti* were observed in the intestine and rectum, respectively, of channel catfish. *Clinostomum marginatum* metacercariae were loosely encysted beneath the integument of carp and largemouth bass. *Uvulifer ambloplitis* metacercariae were encysted beneath the skin of bluegill. *Posthodiplostomum minimum* metacercariae were encysted within the liver, spleen, kidneys, peri- and myocardium, intestinal serosa, and gonads of white crappie, largemouth bass, longear sunfish, and bluegill.

The Acanthocephala were the least significant group of helminths found in this study. A single species, *Leptorhynchoides thecatus*, was found in the foregut of channel catfish.

DISCUSSION

The relative abundance of parasitic worms undoubtedly is related to certain aspects of the environment, as well as to host-specific factors. The general paucity of Digenea in Lake Carl Blackwell fishes is apparently due to the scarcity of gastropod intermediate hosts. The reservoir is extremely turbid and largely void of rooted vegetation, conditions which may afford little protection for certain snails or substrate to support their growth.

The bottom sediment is moderately rich in organic detritus and supports a substantial population of benthic macroinvertebrates, specifically mayfly naiads (*Hexagenia*), which serve as intermediate hosts for certain nematodes found in abundance (e.g., *Rhabdochona*). Certain pelagic microcrustacea are also abundant and, as intermediate hosts, contribute to high numbers of nematodes (e.g., *Camallanus*) and proteocephalid tapeworms. The relative lack of Acanthocephala found does not comply with visible features of the reservoir, since a variety of potential intermediate and definitive hosts are found in the reservoir. Inter-specific antagonism between acanthocephalans and tapeworms has been previously reported (Scheuring, 1923, in Dogiel et al., 1961; Cross, 1933, 1934; Holmes, 1959) and might account for their scarcity in Lake Carl Blackwell fishes.

The following helminths are reported from the southcentral U.S. for the first time: *Rhabdochona decaturensis* and *Spiroxys* sp. Also, *R. decaturensis* in the white crappie, largemouth bass, bluegill, longear sunfish, flathead catfish, carp, river carpsucker, and white bass represent new host records. Other new host records probably include *Spinitectus carolini* in the freshwater drum and *Spinitectus* sp. in the flathead catfish.

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