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Molnar et al 1974

Reprinted from *J. Fish Biol.* (1974) **6**, 717–728

# Parasites of fishes from Laurel Creek, Ontario

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(*Received 9 January 1974*)

Two-hundred and nine fish of 13 species from Laurel Creek, Ontario, were examined for parasites between May and October 1973. Eighty-four species of parasites (22 of Protozoa, 24 of Monogenea, 17 of Digenea, 11 of Cestoda, 4 of Nematoda, 1 of Hirudinea, 1 of glochidia, and 4 of Crustacea) were collected and are listed and discussed.

## I. INTRODUCTION

Intensive parasitological investigations on fishes have been made in Ontario. Prominent among these are the studies by Bangham (1941), Bangham & Venard (1946), Dechtiar (1966), Freeman (1964), and Mizelle & Donahue (1944) from Algonquin Park, by Bangham (1955) and Mavor (1916) from Lake Huron, by Bangham & Hunter (1939) and Hunter & Bangham (1932, 1933) from Lake Erie, by Hanek & Fernando (1971*a,b*, 1972*a,b*, 1973) and Tedla & Fernando (1969*a,b,c,d*) from Lake Ontario, and by Dechtiar (1972) from the Lake of the Woods. Smaller habitats, particularly the streams, have been neglected. Laurel Creek, conveniently located within the immediate vicinity of the University of Waterloo, was therefore selected to fill a gap. The present study is an extension of the unpublished work of Kakonge (1970, 1972) on the ecology of fishes and other parasitoecological aspects of the stream.

## II. MATERIALS AND METHODS

Laurel Creek is a small, typical southern Ontario stream which flows into the Grand River, Lake Erie watershed. It is composed of pools alternating with shorter riffle sections and is 2·5–4·0 m wide and 50–120 cm deep at normal flow. The substrate of the pools is mud and plant debris while elsewhere the substrate is composed of fine sand or a mixture of sand and small gravel, except for the riffles which are composed of larger gravel and rubble. During the study period (May–October, 1973), the water temperature was warmer than 15° C, with a peak range of 24–28° C in July and August. The pH, dissolved oxygen concentration and conductivity ranged from 7·5–8·8, 40–190% saturation and 375–545 $\mu$mhos at 20° C respectively. Two-hundred and nine fish of 13 species (Table I) were subjected to a complete parasitological examination during the study period. They were caught with a small hand seine and by traps, and were brought to the laboratory alive and examined immediately. Conventional parasitological techniques were employed in the dissection of all fish and in preservation and preparation of the parasites. Hosts were identified using the keys and systematics of Hubbs & Lagler (1964), while systematic assignment of species follows the arrangement in Special Publication No. 6 of the American Fisheries Society (1970). Specimens of all the parasites found have been deposited in the collection of one of us (G.H.).

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TABLE I. Protozoan parasites collected from the Laurel Creek fishes

| Parasites | Locations | Hosts: *Notropis cornutus* (Mitchill) | *Notropis heterolepis* Eigenmann & Eigenmann | *Pimephales promelas* Rafinesque | *Pimephales notatus* (Rafinesque) | *Hybognathus hankinsoni* Hubbs | *Nocomis biguttatus* (Kirtland) | *Semotilus atromaculatus* (Mitchill) | *Catostomus commersoni* (Lacépède) | *Ictalurus nebulosus* (Lesueur) | *Micropterus salmoides* (Lacépède) | *Ambloplites rupestris* (Rafinesque) | *Etheostoma exile* (Girard) | *Perca flavescens* (Mitchill) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. examined: 20 | 15 | 10 | 15 | 15 | 15 | 15 | 10 | 22 | 20 | 10 | 22 | 20 |
| *Bodomonas concava* Davis, 1947 | Gills | | | | | | | | | 2 / xx | | | | |
| *Spironucleus* sp. | Intestine | | 5 / x | | 3 / xx | | | | | | 3 / x | | | 4 / xxx |
| *Eimeria degiustii* Molnar & Fernando, 1974 | Spleen | 11 / xxx | | 4 / xxx | | | | | | | | | | |
| *Eimeria freemani* Molnar & Fernando, 1974 | Kidney | 2 / x | | | | | | | | | | | | |
| *Eimeria hybognathi* Molnar & Fernando, 1974 | Intestine | | | | | 1 / xxx | | | | | | | | |
| *Eimeria ictaluri* Molnar & Fernando, 1974 | Intestine | | | | | | | | | 2 / xx | | | | |
| *Eimeria iroquoina* Molnar & Fernando, 1974 | Intestine | 6 / x | 1 / x | 3 / x | 5 / xx | | 1 / xx | | | | | | | |
| *Eimeria laureleus* Molnar & Fernando, 1974 | Intestine | | | | | | | | | | | | | 14 / xxx |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Eimeria* spp. | Intestine | | | | | | | | 6/xxx | | 2/xx | | 6/xx | | |
| *Sphaerospora* sp. | Kidney, urinary ducts | 1/xxx | | | | | | | | | | | | | |
| *Chloromyxum catostomi* Kudo, 1920 | Gallbladder | 4/xx | 1/xx | | | | | 1/xx | | | | | | | |
| *Myxidium* sp. | Gallbladder | 3/xxx | 1/xx | | | | | | 1/xxx | | | | | | |
| *Myxobolus hyborhynchi* Fatham *et al.*, 1939 | Kidney | | | 3/xx | 2/xx | | | | | | | | | | |
| *Myxobolus transversalis* Fatham *et al.*, 1939 | Kidney | 1/xx | 5/x | | | 3/x | | | | | | | | | |
| *Myxobolus* sp. | Gills | 6/xx | | 2/xx | | 2/x | 2/x | 3/xx | | | | 2/x | 1/x | | |
| *Myxobolus* spp. | Gallbladder, intestine | | | | 3/x | 2/x | 3/x | 1/x | | | | | | | |
| *Henneguya exilis* Kudo, 1929 | Gills | | | | | | | | | 2/xx | | | | | |
| *Glugea* sp. | Intestine, gallbladder | 1/xxx | | 1/x | | | | | | | | | | | |
| *Ichthyophthirius multifiliis* Fouquet, 1876 | Fins | | | | | | | | | 3/x | | | | | |
| *Apiosoma* spp. | Gills, fins | 1/xx | | | 1/x | | | | | 3/xx | 1/xx | 2/xx | 2/xx | | |
| *Trichodina* spp. | Gills, fins | 7/x | 6/x | 3/x | | 5/x | 2/x | 5/x | 1/x | 11/x | 10/x | | | 17/xxx | |
| *Trichodina* sp. | Urinary ducts | 1/xxx | | | | 2/x | | | | | | | | 15/xxx | |

Numerator = number of fish infested, denominator = infestation: x, slight; xx, moderate; xxx, high.

TABLE II. Monogenea collected from the Laurel Creek fishes

| Parasites | Locations | Hosts: *Notropis cornutus* (Mitchill) | *Notropis heterolepis* Eigenmann & Eigenmann | *Pimephales promelas* Rafinesque | *Pimephales notatus* (Rafinesque) | *Hybognathus hankinsoni* Hubbs | *Nocomis biguttatus* (Kirtland) | *Semotilus atromaculatus* (Mitchill) | *Catostomus commersoni* (Lacépède) | *Ictalurus nebulosus* (Lesueur) | *Micropterus salmoides* (Lacépède) | *Ambloplites rupestris* (Rafinesque) | *Etheostoma exile* (Girard) | *Perca flavescens* (Mitchill) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. examined: 20 | 15 | 10 | 15 | 15 | 15 | 15 | 10 | 22 | 20 | 10 | 22 | 20 |
| *Dactylogyrus attenuatus* Mizelle & Klucka, 1953 | Gills | | | | | | | 7<br>1–15 (6) | | | | | | |
| *Dactylogyrus bychowskyi* Mizelle, 1937 | Gills | | | 5<br>1–20 (7) | | | | | | | | | | |
| *Dactylogyrus banghami* Mizelle & Donahue, 1944 | Gills | 7<br>1–5 (3) | | | | | | | | | | | | |
| *Dactylogyrus bulbus* Mueller, 1938 | Gills | 14<br>1–30(14) | | | | | | | | | | | | |
| *Dactylogyrus cornutus* Mueller, 1938 | Gills | 12<br>1–24(11) | | | | | | | | | | | | |
| *Dactylogyrus dubius* Mizelle & Klucka, 1953 | Gills | 9<br>1–14(8) | | | | | | | | | | | | |
| *Dactylogyrus* spp. | Gills | | 10<br>1–15(6) | | | 6<br>1–25(10) | 2<br>2–7 | 3<br>1–7(3) | 1<br>10 | | | | | |
| *Actinocleidus fusiformis* (Mueller, 1934) | Gills | | | | | | | | | | 1<br>3 | | | |
| *Cleidodiscus alatus* Mueller, 1938 | Gills | | | | | | | | | | | 4<br>1–3(2) | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cleidodiscus pricei* Mueller, 1936 | Gills | | | | | | | 17<br>1–50(21) | | | | |
| *Cleidodiscus stentor* Mueller, 1937 | Gills | | | | | | | | | 2<br>1–2 | | |
| *Urocleidus adspectus* Mueller, 1936 | Gills | | | | | | | | | | | 13<br>1–24(7) |
| *Urocleidus chautauquensis* (Mueller, 1938) | Gills | | | | | | | | | 3<br>1–3(2) | | |
| *Urocleidus dispar* (Mueller, 1936) | Gills | | | | | | | | 1<br>2 | | | |
| *Urocleidus furcatus* (Mueller, 1937) | Gills | | | | | | | | 3<br>1–2 | | | |
| *Urocleidus principalis* (Mizelle, 1936) | Gills | | | | | | | | 2<br>2–2 | | | |
| *Urocleidus* sp. | Gills | | | | | | | | | | 1<br>3 | |
| *Octomacrum lanceatum* Mueller, 1936 | Gills | 3<br>4–20(11) | | | | 1<br>5 | | | | | | |
| *Gyrodactylus etheostomae* Wellborn & Rogers, 1967 | Fins | | | | | | | | | | 2<br>1–5 | |
| *Gyrodactylus hoffmani* Wellborn & Rogers, 1967 | Fins | | 3<br>1–5(3) | | | | | | | | | |
| *Gyrodactylus macrochiri* Hoffman & Putz, 1964 | Fins | | | | | | | | 5<br>1–4(2) | | | |
| *Gyrodactylus nebulosus* Kritsky & Mizelle, 1968 | Fins | | | | | | 1<br>2 | | | | | |
| *Gyrodactylus stunkardi* Kritsky & Mizelle, 1968 | Fins | | | | | 2<br>1–4 | | | | | | |
| *Gyrodactylus* spp. | Fins, gills | 9<br>1–14(4) | | 9<br>1–30(10) | 9<br>1–7(3) | | | | | | | |

Numerator = number of fish infested, denominator = range followed by average of infestation in parenthesis.

TABLE III. Other parasites (Digenea, Cestoda, Nematoda, Hirudinea, Crustacea, glochidia) collected from the Laurel Creek fishes

| Parasites | Locations | Hosts: *Notropis cornutus* (Mitchill) | *Notropis heterolepis* Eigenmann & Eigenmann | *Pimephales promelas* Rafinesque | *Pimephales notatus* (Rafinesque) | *Hybognathus hankinsoni* Hubbs | *Nocomis biguttatus* (Kirtland) | *Semotilus atromaculatus* (Mitchill) | *Catostomus commersoni* (Lacépède) | *Ictalurus nebulosus* (Lesueur) | *Micropterus salmoides* (Lacépède) | *Ambloplites rupestris* (Rafinesque) | *Etheostoma exile* (Girard) | *Perca flavescens* (Mitchill) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. examined: 20 | 15 | 10 | 15 | 15 | 15 | 15 | 10 | 22 | 20 | 10 | 22 | 20 |
| *Plagiporus sinitsini* Mueller, 1934 | Gallbladder | 2 / 1–9 | | 2 / 1–1 | | | | | 1 / – / x | | | | | 3 |
| *Triganodistomum attenuatum* Mueller & Van Cleave, 1932 | Intestine | | | | | | | | 4 / 1–4(2) | | | | | |
| *Phyllodistomum lysteri* Miller, 1940 | Urinary ducts | | | | | | | | 3 / 3–6(5) | | | | | |
| *Azygia angusticauda* (Stafford, 1904) | Stomach | | | | | | | | | | 3 / 1–1 | | 17 / 1–8(2) | 4 / 1–1 |
| *Glossidium geminum* (Mueller, 1930) | Intestine | | | | | | | | | 9 / 3–40(18) | | | | |
| *Allocreadium lobatum* Wallin, 1909 | Intestine | 5 / 1–6(2) | | | | | | | | | | | | |
| **Rhipidocotyle* sp. | Fins | | | | | 2 / 4–5 | | | | 3 / 1–7(3) | | | | |
| **Diplostomum spathaceum* (Rud., 1819) | Lenses | 11 / 1–15(5) | 14 / 1–5(3) | 6 / 1–6(4) | 3 / 1–3(2) | 5 / 3–5(4) | 5 / 1–4(3) | 3 / 1–18(7) | 5 / 1–20(11) | 22 / 1–35(11) | | 4 / 1–3(2) | 1 / 1 | 3 / 1–6(9) |
| **Diplostomum scheuringi* Hughes, 1929 | Vitreous chamber | | | | | | | | | | 1 / 1 | 3 / 1–7(3) | | 20 / 1–34(9) |
| **Tetracotyle* spp. | Brain, eyes, abdominal cavity | | | | 2 / 1–1 | 1 / 7 | | | 1 / 7 | 5 / 1–3(2) | 2 / 1–1 | | 19 / 1–4(2) | |
| **Ornithodiplostomum ptychocheilus* (Faust, 1917) | Brain, visceras | 20 / 50–250 (130) | 13 / 4–50(29) | 10* / 30–100 (60) | 15 / 30–100 (55) | 13 / 13–50 (31) | 4 / 1–20(10) | 15 / 18–100 (55) | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Posthodiplostomum minimum centrarchi* (MacCallum, 1921) Hoffman, 1958 | Liver | | | | | | | | | 8<br>1–20(10) | 9<br>1–30(17) | | 1<br>1 |
| **Posthodiplostomum minimum minimum* (MacCallum, 1921) Hoffman, 1958 | Mesenteries | 20<br>20–50<br>(38) | 9<br>10–30 | 15<br>3–40(15) | 12<br>10–30<br>(15) | 4<br>1–8(3) | 15<br>8–100<br>(40) | | | | | | |
| **Uvulifer ambloplitis* (Hughes, 1927) | Fins, skin, gills | 10<br>1–50(17) | 5<br>1–20(7) | 12<br>1–50(17) | 9<br>1–10(4) | 14<br>1–400<br>(50) | 9<br>1–100<br>(32) | 5<br>3–25(10) | | | 3<br>1–3(2) | 14<br>1–20(5) | 14<br>1–80(16) |
| **Neascus pyriformis* Chandler, 1951 | Fins, skin | 3<br>4–20(11) | | | | | 3<br>2–9(6) | | | | | | 6<br>6–50(20) |
| **Clinostomum marginatum* (Rud., 1819) | Skin, musculature | | | | | | | | 7<br>1–5(2) | | 4<br>1–3(2) | | 3<br>1–1 |
| **Ribeiroira ondatrae* (Price, 1931) | Skin | | | | | | | | | | 2<br>1–2 | | |
| *Biacetabulum biloculoides* Mackiewicz & McCrae, 1965 | Intestine | | | | | | | 1<br>3 | | | | | |
| *Glaridacris laruei* (Lamont, 1921) | Intestine | | | | | | | 3<br>2–20(8) | | | | | |
| *Hunterella nodulosa* Mackiewicz & McCrae, 1962 | Intestine | | | | | | | 3<br>6–14(9) | | | | | |
| *Monobothrium hunteri* Mackiewicz, 1963 | Intestine | | | | | | | 1<br>2 | | | | | |
| *Caryophyllidea* sp. | Intestine | | | | | | 1<br>16 | | | | | | |
| **Ligula intestinalis* (L., 1758) | Abdominal cavity | | | | | | | 1<br>1 | | | | | |
| *Schistocephalus solidus* (Müller, 1776) | Abdominal cavity | | | | | | | | | | | | 1<br>1 |
| *Corallobothrium fimbriatum* Essex, 1927 | Intestine | | | | | | | | 7<br>1–30(7) | | | | |
| *Corallobothrium* sp. | Intestinal serosa | | | | | | | | 3<br>6–8(7) | 6<br>1–15(5) | 5<br>1–40(14) | 20<br>1–8(3) | 13<br>5–30(14) |
| **Cysticercus dilepis unilateralis* (Rud., 1819) | Gallbladder | | | | | | | | | 3<br>1–1 | | | |
| **Cysticercus dilepis* sp. | Gallbladder | | | | | | | | | 2<br>1–1 | | | |
| *Philometra cylindracea* Ward & Magath, 1916 | Abdominal cavity, swimmbladder | | | | | | | | | | | | 4<br>1–3(2) |

TABLE III—*continued*

| Parasites | Locations | Hosts: *Notropis cornutus* (Mitchill) | *Notropis heterolepis* Eigenmann & Eigenmann | *Pimephales promelas* Rafinesque | *Pimephales notatus* (Rafinesque) | *Hybognathus hankinsoni* Hubbs | *Nocomis biguttatust* (Kirtland) | *Semotilus atromaculatus* (Mitchill) | *Catostomus commersoni* (Lacépède) | *Ictalurus nebulosus* (Lesueur) | *Micropterus salmoides* (Lacépède) | *Ambloplites rupestris* (Rafinesque) | *Etheostoma exile* (Girard) | *Perca flavescens* (Mitchill) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. examined: 20 | 15 | 10 | 15 | 15 | 15 | 15 | 10 | 22 | 20 | 10 | 22 | 20 |
| *Philometra* sp. | Abdominal cavity, swimmbladder | | | | | | | | 7 / 1–5(4) | | | | | |
| **Spiroxis contortus* (Rud., 1819) | Intestinal serosa | | | | | | | | | 1 / 7 | | | | 1 / 1 |
| **Eustrongylides* sp. | Abdominal cavity | | | | | | | | | | | | | 1 / 1 |
| *Actinobdella triangulata* Moore, 1924 | Gills | | | | | | | | 1 / 1 | | | | | |
| *Glochidium* spp. | Fins, gills | 9 / 1–10(3) | 2 / 1–5 | 3 / 3–7(5) | 1 / 2 | 7 / 3–8(5) | 6 / 1–20(7) | | | 1 / 2 | 2 / 5–7 | 4 / 2–8(3) | | |
| *Argulus catostomi* Dana & Herrick, 1837 | Fins | | | | | | | 1 / 1 | | | | | | |
| *Ergasilus caeruleus* Wilson, 1911 | Gills | | | | | | | 1 / 1 | | | | | | |
| *Ergasilus centrarchidarum* Wright, 1882 | Gills | | | | | | | | | | 5 / 1–20(10) | 2 / 2–2 | | |
| *Ergasilus cyprinaceus* Rogers, 1969 | Gills | | | 4 / 1–2 | 1 / 1 | | | | | | | | | |

Numerator = number of fish infested, denominator = range followed by average of infestation in parenthesis.
*, larval stage.

## III. RESULTS AND DISCUSSION

Eighty-four species of parasites (22 of Protozoa, 24 of Monogenea, 17 of Digenea, 11 of Cestoda, 4 of Nematoda, 1 of Hirudinea, 1 of glochidia, and 4 of Crustacea) (Tables I, II, III) were obtained, and all the species of parasites reported in this study constitute new distribution records. Twelve new host records are as follows: *Bodomonas concava* and *Henneguya exilis* for *Ictalurus nebulosus*; *Eimeria iroquoina* for *Nocomis biguttatus, Notropis heterolepis, Pimephales notatus* and *P. promelas*; *Chloromyxum catostomi* for *Notropis cornutus* and *Semotilus atromaculatus*; *Myxobolus transversalis* for *Hybognathus hankinsoni* and *Notropis heterolepis*; *Cysticercus dilepis unilateralis* for *Micropterus salmoides*; and *Schistocephalus solidus* for *Perca*

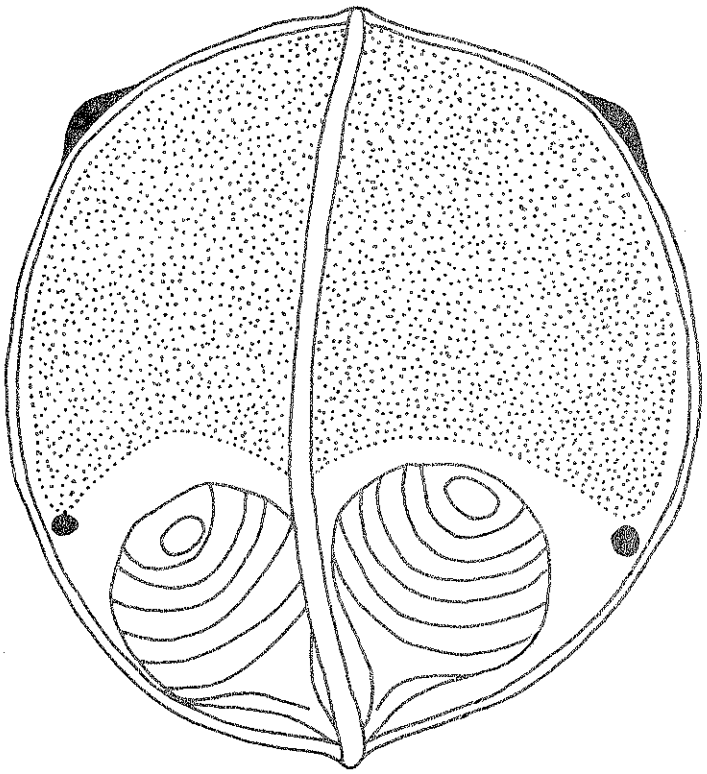

FIG. 1. *Sphaerospora* sp.

*flavescens*. Furthermore, *Cysticercus dilepis unilateralis* is reported for the first time from North America, and several species of the genera *Dactylogyrus* and *Gyrodactylus* (listed in Table II as *Dactylogyrus* spp. and *Gyrodactylus* spp.) are new for science and their detailed description is now in preparation (Hanek, Molnar, & Fernando, in press). When examining the intestine of various fish species we have often noticed flagellates with eight flagella resembling *Hexamita salmonis* (Moore, 1923), which is a common parasite of North American salmonids (Davis, 1953). Kulda & Lom (1964) have done much work on this group of parasites which they consider to belong to the genus *Spironucleus* Lavier, 1936. Fantham *et al.* (1939) described *Sphaerospora notropis* from the oral epithelium and muscles of *Notropis cornutus*. The spores of *Sphaerospora* sp. noticed during the present study (Fig. 1) were found in the ureter and

resemble the species commonly found in the kidneys of European and Asian fishes. The short description is as follows: spores spherical with somewhat protrusive anterior pole and sutural ridge; valves smooth. Small lateral outgrow present on the slightly flattened posterior pole. Polar capsules slightly pyriform. Length of spores 9·0–10·4 $\mu$, width 9·0–9·6 $\mu$, length of capsules 3·0–3·3 $\mu$, diameter 2·5–2·7 $\mu$. The parasitofauna of the fishes of Laurel Creek was characterized by the high intensity of infestation with metacercaria, those of *Ornithodiplostomum ptychocheilus* and *Posthodiplostomum minimum* being the most frequent parasites. The high intensity of infestation can be explained by the rich fauna of birds in this region. Furthermore, the metacercaria of *Ornithodiplostomum ptychocheilus* were encountered in about equal numbers in the abdominal and cranial cavities; the only exception being *Notropis heterolepis* in which the metacercaria infested the cranial cavity only. Also, it was found that the metacercaria of *P. minimum* were localized on the serosas in the abdominal cavities of cyprinids, while this parasite was found infesting only the livers of the centrarchids and *Perca flavescens*. This finding supports the opinion of

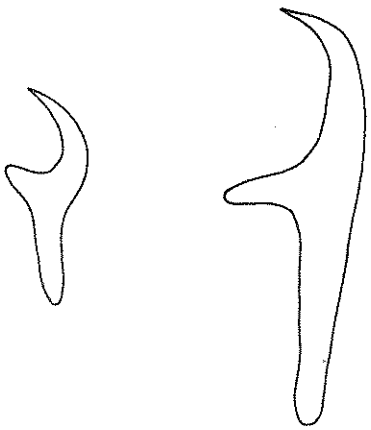


FIG. 2. *Cysticercus dilepidis* sp. (a) lower row hook, (b) upper row hook.

Hoffman (1958) that there are two subspecies of *P. minimum*: *P. m. minimum* infesting the cyprinids and *P. m. centrarchi*, infesting the centrarchids. Infestation with *Diplostomum spathaceum* was significant in *Ictalurus nebulosus*, and like Ali & Hanyu (1964) we have found this parasite infesting the small hernias of the lenses, which they called ' multiple lenses '. The infestation with *Neascus* of *Uvulifer ambloplites* was also fairly high. In some cases we have found these metacercaria together with *Neascus pyriformis*; the later species differs from *U. ambloplites* in having a pyriform inner cyst wall, and according to Chandler (1951) it may be identical with the metacercaria of *Uvulifer semicircumcisus*. Two morphologically different types of *Cysticercus* were collected from the gallbladder of *Micropterus salmoides*. One of them was identical with the larval form of *Dilepis unilateralis* and its short description is as follows: body oval, 500–520 $\mu$ long and 220–250 $\mu$ wide. Head with four simple suckers and single terminal trunk armed with two rows of hooks; 10 hooks in each row. Length of upper row hooks 23–24 $\mu$, lower row hooks 10–11 $\mu$. The short description of the other type, *Cysticercus dilepidis* sp. follows: body oval, 520–560 $\mu$

long and 220–250 $\mu$ wide. Head with four simple suckers and single terminal trunk armed with two rows of hooks; also 10 hooks in each row. Length of upper row hooks [Fig. 2(b)] 37–39 $\mu$, lower row hooks [Fig. 2(a)] 19–21 $\mu$. Despite the frequent occurrence of glochidia, we did not deal with this group in detail, because these parasites were intensively studied by Kakonge (1972) who investigated the ecology and pathology of *Anodonta plana*, *Anodontoides ferussacianus*, *Lasmigona compressa* and *Lampsilis* sp.

This research was supported by the National Research Council of Canada and by the Canadian National Sportsmen's Show. We wish to express our appreciation to Mr P. Buerschper, Ichthyological Section, Royal Ontario Museum, Toronto, for identification of the hosts, to Dr J. S. Mackiewicz, State University of New York at Albany for identification of caryophylleids, and to Prof. H. B. N. Hynes, University of Waterloo, for his constructive comments on the manuscript.

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Printed in Great Britain by Henry Ling Ltd., at the Dorset Press, Dorchester, Dorset