# Parasites and Selected Anomalies of Some *Fishes* of the North-Central* United States and Canada

*Iowa, Michigan, Minnesota,
North Dakota, South Dakota, Wisconsin,
Manitoba, Ontario, Saskatchewan

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**Minnesota Department of Natural Resources**
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# PARASITES AND SELECTED ANOMALIES OF SOME FISHES OF THE NORTH CENTRAL UNITED STATES AND CANADA

Iowa, Michigan, Minnesota, No. and So. Dakota, Wisconsin,
Canada - (Manitoba, Ontario, Saskatchewan)

Ellis J. Wyatt, Professor Emeritus of Biology
Hamline University, St. Paul, MN

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## INTRODUCTION
### 1981 Edition

A large body of information has been published in the generally accessible literature regarding diseases of fish. Other information obviously resides in files of individuals working for state, federal or other agencies who are engaged in fish pathology and management of the fishery resource. Two regional bulletins we are aware of that deal with parasitic diseases are Hugghins (1972) "Parasites of Fishes in South Dakota" and Allison, Hnath and Yoder (1977) "Manual of Common Parasites and Anomalies of Michigan Fishes."

Hoffman's Parasites of North American Freshwater Fishes, 1967, was a comprehensive work dealing with the literature up through 1965. Parasite hosts, sites of infections, geographical distribution, life cycles where they were known, synonymy, keys to the identification of the parasites, drawings, and a comprehensive bibliography were included in this book.

The format and information for the 1981 edition of this bulletin was based primarily upon the above work by Hoffman. Sport fishery abstracts from 1966 through 1979 were used to identify published papers and reports of fish parasites that fall within the geographic area covered. If sufficient information was found in the abstract, then the original paper was not read. A bibliography of all papers which were read and contained important information were included.

Shortly after the 1981 edition was begun, Margolis and Arthur (1979) published the book, Synopsis of the Parasites of Fishes of Canada. This is a very comprehensive checklist of the diseases of fish in the Canadian provinces. The parasites of fishes listed from the provinces of Manitoba, Ontario, and Saskatchewan were carefully checked against the parasite-host lists previously compiled. Those not appearing on the lists were added and are shown with an * symbol after the organism.

The bibliography of Margolis and Arthur was very useful because it dealt with accessible literature as well as in-house reports and bulletins that would be rather difficult to find or even be aware of.

### 1997 Revision

Revisions for the 1997 edition were made following a search of two major databases. The first of these was the NISC (National Information Services Corporation) CD ROM. This contains the Wildlife Review and Fisheries Review plus abstracts and citations compiled by the U.S. Fish and Wildlife Reference Service. This database was begun in 1971 and continues to the present. The second was ASFA (The Aquatic Sciences and Fisheries Abstracts/Cambridge Scientific Abstracts). Information for this is supplied by The Food and Agriculture Organization of the United Nations Organization (FAO), The Intergovernmental Oceanographic Commission of UNESCO (IOC), The United Nations Environment Programme (UNEP), and The United Nations Division for Ocean Affairs and the Law of the Sea (UNDOALOS). This database indexes information from 1988 to December 1995. In order to complete a literature search for 1996 and early 1997, on-line Biological Abstracts were used.

This bulletin was originally prepared to assist parasitologists, pathobiologists and field biologists to conveniently narrow down the known parasites of fishes covered from this region and to stimulate work on those not previously known. The decision to revise and upgrade the 1981 edition was based on the same goals. The oblique changes in our natural environment may very well be recorded through the changes manifested by parasites which inhabit fishes in our lakes and streams as well as the traditional measurements of pH, PCB'S, and other physio/chemical parameters being so carefully measured. Baseline studies so conspicuously lacking in the past are sorely needed today to measure these future changes. The complex life cycle of many of these parasitic forms depends upon several intermediate host organisms for their completion. This makes the paristofauna an excellent barometer for environmental change.

## TAXONOMY

The taxonomy used here has general significance as well as sufficient scientific accuracy to be useful to the specialist. Strict scientific accuracy may be sacrificed for a more general taxonomy which was thought to have a broader application. For example, a dissertation could be written as to the reasons why the Myxosporidans (Myxozoa) probably

are not Protozoa. However, they have been so long considered to be in this group that it would be of little value to change their name here for the person who is trying to figure out the nature and significance of a specific organism in this group. The same is true for certain other taxonomic categories of organisms. A brief review of the taxonomy used and useful details of the biology of the organisms included follows.

Protista

In recent years biologists have generally given up trying to categorize all unicellular and certain multicellular organisms that have no more than one kind of non-reproductive cell into the single category of the Protozoa. Instead the term Protista has been revived and used for fungi, algae, and heterotrophic organisms that fit the above definition. Protozoa has generally been reserved particularly for certain heterotrophic (organisms without chlorophyll) non-filamentous organisms.

Fungi - Generally reserved for heterotrophic multicellular or syncytial filamentous living things. The most ubiquitous fish disease organism in this group is represented by members of the genus *Saprolegnia*. This agent is generally conceded to require damaged or necrotic tissue for it to invade its host. Careless handling of hatchery fish or fish caught on hook and line may result in the breaking of the mucous skin barrier and lead to infection. Fish eggs are frequently attacked, especially if damaged or if non-fertile eggs are present. A white fuzzy material on egg or fish surfaces indicates this disease.

Protozoa

Mastigophora or Flagellata - Organisms that at some stage of the life cycle move by means of one or more flagella. Members of the genera *Costia* and *Hexamita* are found with almost all fish at some point in their life cycle. This group also includes blood dwelling organisms, some of which are transmitted by blood sucking leeches and crustacea (parasitic copepods). Trypanosones and Cryptobians are examples of these.

Sporozoa - No organelles for movement. Reproduction by spores.

Coccidia - Parasitic inside the epithelial cells of the gut. Some are also found in blood cells. Spores with sporozoites (the infective stage) pass the disease to other fish.

Microsporida - Feeding stages live and reproduce within cells. Spores are the infective units. Each spore has a single polar filament and is generally small (6-8 $\mu$m). The genera *Glugea* and *Plistophora* have caused mortalities of fish, especially in culture operations.

Myxosporida (Myxozoa)-Feeding stages live and reproduce outside of cells in tissues or in spaces of the body of the host. Spores have 1 to 4 polar capsules and are generally much larger than those of the Microsporida. Fish to fish transmission by spores has been shown for some coelozoic genera but not for histozoic forms. (Because they differentiate into more than one non-reproductive cell and for other technical reasons, these are thought to represent a divergent line of multicellular organisms with certain convergent evolution of structures. An analysis and comparison of their DNA with that of other living things suggests that they are more closely related to the Nematoda than any other living group!) *Myxobolus cerebralis* (formerly *Myxosoma cerebralis*) is a serious disease of salmonid fishes. It is international in distribution. It causes "**whirling disease**" and distortions of the spine (lordoscoliosis) of fish that are infected when young. Its spread should be vigorously avoided. The transmission of this disease involves another host. A tubifex worm that lives in the mud of ponds and streams eats the spores of *M. cerebralis*. Inside the gut of the worm another stage infective for fish is developed. When this stage is released from the worm in the mud and attaches to young salmonids, they will become infected.

Ciliophora or Ciliata - Organisms that move by means of cilia. Nuclei of two types, a large macronucleus and a smaller micronucleusis, are always present. The organism *Ichthyophthirius multfiliis* (ICH) probably infects all fish. It is one of the most costly fish pathogens especially of fish in hatcheries or under other culture. *Trichodina* and similar genera are probably found on all fish during some stage of their development and may cause disease and mortality of hatchery fish.

Suctoria - This is a group of ciliates that are found on the gills of fish. As mature forms they do not have cilia but rather suctorial tentacles. Larval forms have cilia. It is this fact that includes them in the Ciliata.

Platyhelminthes

Trematoda (Mongenea) - Monogenetic trematodes are flatworms that with few exceptions live on the exterior surface of fish (gills, fins, or body). They have only a single host, hence monogena. *Gyrodactylus* is a common genus.

Trematoda (Digenea) - Digenetic trematodes are flatworms (flukes) which have at least two hosts in their life cycle.

Those of fish have as a first intermediate host either snails or clams. Inside the hepatopancreas of this host, asexual reproduction takes place. It is important to note that a single infection of a snail or clam may lead to many thousands of infective units. The first product of this is a "sack" made up of many cells which is called a sporocyst. Variations of the cycle are numerous and are of the following themes: a) The sporocysts produce more internal "sacks" called daughter sporocysts. b) The original sporocyst or the daughter may produce more specialized "sacks" called redia. c) In some cases asexual daughter redia are produced from the original. The redia produce by asexual reproduction several units infective for fish or other organisms which are called cercaria. These usually have a tail appendage. The usual case is for the cercaria to bore through the tissues of the snail or clam to the water where it seeks out the next host, which may be a fish or some other organism; larval insects, crustacea, leeches or forage fish are some usual intermediate hosts. If it is a fish, it may become attached to the lumen of the alimentary tract and develop into an egg producing adult or migrate to the skin, fins, muscle or some internal organ and encyst as a metacercaria. Certain cercaria may attempt to enter the skin of humans causing a dermatitis called "swimmer's itch." The regular final host for these are geese and duck, so humans are inadvertently infected. Metacercaria in the skin or fins may cause "**blackspot**" disease which often concerns fisherman. If the encystment is in the fish muscle, a **yellow or white "grub"** may be seen in heavy infestations. These may be equally displeasing to anglers when filleting the fish. In rare cases, a phenomenon called progenesis occurs. Either in the snail/clam first host or in the second host, the larval form develops reproductive organs and becomes sexually mature. Another phenomena is where the infected snail is eaten and the cercaria need not enter the water to cause infection in the next host, usually the final or definitive host. Digenea have as final or definitive hosts, fish, amphibian, reptiles, birds, or mammals. These are either infected directly by cercaria, (two host cycle) or by the metacercaria which is obtained by eating the intermediate host carrying it. Adult trematodes live in the intestine or other spaces of the body of the host. They shed thousands of eggs which hatch in the water. The eggs have within them a ciliated larvae which is called a miracidium. This seeks out and bores into the appropriate snail or clam host to once again begin the cycle. Digenea life cycles are complicated with some being entirely unknown, others partly elucidated and others thoroughly understood. In some cases, larval stages have been assigned a generic and specific name which differs from that of the name of the adult form due to the difficulty of establishing the relationship.

Some major larval genera include *Diplostomulum*, *Tetracotyle*, *Neascus*, *Prohemistomulum* along with several others with fewer organisms placed in them.

Cestoidea or Cestoda - Flatworms with no gut and anterior end with a scolex made up of grooves, suckers or hooks. Most forms have a series of similar segments. Segments adjacent to the scolex are immature, becoming progressively more mature and gravid posteriorly.

The life cycle of tapeworms involves aquatic crustacea. The embryonated eggs are ingested by copepods, amphipods, or isopods. The eggs hatch and develop into a procercoid stage in the haemocoel (the space between the gut and body wall, often filled with blood) of the crustacean, which in turn is eaten by the definitive or final host or by another host, which may be another fish.. The stage in the second intermediate host is a plerocercoid. Many life cycles are unknown.

*Diphyllobothrium latum* is found as a plerocercoid larvae in the flesh of *Esox lucius, Perca flavescens, Stizostedion vitreum, S. canadense, Lota lota,* and possibly other fish. This is thought to be the only tapeworm that infects humans through fish intermediate hosts in the continental United States. Adequate cooking of fish will prevent such infections.

*Proteocephalus ambloplitis*, the bass tapeworm is known to be a serious pest in fish culture operations. The plerocercoid is sometimes so abundant and destructive that the ovaries of young black bass are obliterated and sterility may result.

*Ligula intestinalis*, is a plerocercoid found in the body cavity of certain fish. It is frequently quite large equaling or exceeding the length of the host fish. The final hosts are fish eating birds that eat infected fish.

Nematoda - Nematodes or round worms are multicellular organisms having a fixed cell number and a highly developed tough cuticle that must be shed in order for the animal to grow. Thus, they must go through several larval stages and molts before becoming adults. They have been placed in a phylum with organisms containing a complete gut, but they possess a pseudocoelom or false body cavity. Life cycles in this group may involve as a first host an arthropod. Frequently this is an aquatic insect larvae; sometimes mayfly nymphs and others occur in crustacea. Larval forms are also found in forage fish of various kinds. Many life cycles are not known. Larvae may be seen as white coils in muscle or visceral organs and if noticed disturb the aesthetic sensibilities of the angler. A nematode, *Anisakis* spp., encysts in marine fish. Humans have been infected with this organism from eating raw fish (sushi). In nature, seals and other marine mammals are probably the true final host with humans inadvertently becoming infected.

Acanthocephala - Spiny headed worms are placed in the same phylum as the nematoda along with five other kinds of organisms. Adults have a proboscis armed with hooks for attachment to the intestinal wall of the final host. Females lay eggs which pass into the water and are eaten by crustacea. The eggs hatch and become a larval stage called an acanthor which bores into the haemocoel of the crustacean where it grows and differentiates into the acanthella stage. Male worms have prominent testes, but females produce eggs from cells in a ligament in their bodies. In certain genera, larvae infect the fish host directly when the crustacean is eaten. In other cases where the larval worm is less than about 30 days old, the crustacean may be eaten by a fish causing the larvae to encyst in the mesenteries of the fish. The final host is infected with adult male and female worms after eating this fish.

Oligochaeta - These are segmented worms with a true body cavity. Earthworms and tubifex worms are placed here. The Hirudinea or leeches are sometimes external parasites of fish from which they obtain a blood meal. When feeding, they secrete an anticoagulant so the blood does not clot and interrupt their feeding. There are some leeches that do not ingest blood and are free living. Blood flagellates and other fish diseases are often transmitted by them. A few harbor the metacercaria of digenetic trematodes which consequently infect the fish when the leech is eaten.

Crustacea - The Arthropoda includes more individuals and kinds of living things than any animal phyla. Among these are the crustacea which include the copepods which are consumers of algae and protozoa in the fresh waters and oceans of the world. A few have adopted the parasitic way of life. They live on the fins, body surfaces, and gills of fish. Like nematodes (which are also very abundant), they have a strong exoskeleton made of chitin and as they grow, they must molt until the adult stage is reached. Some retain many of the features of their free living cousins and others become highly modified and almost non-recognizable as arthropods. Some form "anchors" and become partially embedded in the tissue of the fish host.

Coelenterata - This group is best known for its free living members such as corals, sea anenomes, and jellyfish. All of these except one type of jellyfish are found in the oceans of the world. *Hydra* spp. is a free living fresh water coelenterate. In the last few years, coelenterates have been uniquely found to occur in the body cavities among the eggs of sturgeon and very recently the paddlefish.

## SELECTED ANOMALIES OF MINNESOTA FISH

### Preface

The major objective of this manual is to provide assistance to various staff of the Minnesota Department of Natural Resources. Fisheries personnel may have the most interest in it. I hope that this section will be particularly helpful to these individuals. However, any person working in the field and meeting the public may be asked questions regarding fish that have caught or seen. This section specifically addresses the most common fish parasite questions likely to be asked.

In Minnesota, there has been a large increase in the number of anglers with a correspondingly greater harvest of fish species. It is also apparent that anglers are now showing more interest in the health aspects of their fish. Commercial fishers also appear to be more aware of abnormalities in the species that they catch. The private aquaculture community is also interested in fish health issues. Consequently, field personnel are frequently being asked to provide information concerning the diseases and parasites that occur in fishes of their region.

Certain diseases and anomalies have been singled out for this section. Those chosen are diseases or organisms that are most often observed with the naked eye. They may be seen on the surface of the body or tissues or become obvious when the fish is dressed. Additionally, certain diseases have significant potential to cause widespread mortality or significantly alter the viability of a fishery if they were to be introduced into new watersheds within the state or into the waters of other states or countries. The Pathology Section of Ecological Services must certify fish to be free of these diseases before they are relocated.

### Easily Seen Diseases or Conditions

#### Digenetic Trematode Metacercaria

**Blackspot** (*Neascus, Uvulifer, Crassiphiala*)- **Yellow Grub** (*Clinostomum*), **White Grub** (*Posthodiplostomum*), **Eye Fluke** (*Diplostomulum*).

When cercariae (see page 5 and 6) leave the snail host they bore into the fish. The parasite then migrates to the skin or other organs of the fish. Cells in the organs or skin react to the presence of a foreign agent and migrate to surround it, which effectively walls off the parasite. The colors referred to are due to the color of the cells of the parasite and/or due to pigment cells of the fish being involved in the walling off process. Blackspot or black grubs about 1-2 mm in length (a millimeter is about one twenty-fifth of an inch), are eaten along with their fish host by various fish eating birds. White grubs (1 mm long) are found in the livers, spleens, kidneys, and various other organs of fish. Herons and loons as well as other fish eating birds are the final hosts. Yellow grubs (2-4 mm) are found in the skin, muscles, and fins of many kinds of fish. The fish is eaten by great blue herons and the adult worm lives in the oral cavity of the bird. The Eye Fluke inhabits the lens and vitreous humor of the fish host. When eaten by fish eating birds (gulls are a common host), the metacercaria becomes an adult in the intestine of the bird.

#### Tapeworm Larval Stages

Adult tapeworms live in the gut of fish and many other kinds of hosts and shed their eggs into the water in the feces of the fish. When fish are being cleaned, sometime the gut is perforated and the milky white worm may be seen moving about (see page 6 and 7). Tissues of fish may contain the larval stages of tapeworms and if the fish is eaten by another fish or other host, they go to the gut of that fish and become adult worms. In certain cases, the crustacea eat the eggs of aquatic tapeworms. When the crustacean is eaten by a fish, it may directly become an adult. Others behave somewhat like a metacercaria of a digenetic trematode and become encysted in the tissues of that fish. If that fish is eaten, the larvae becomes an adult in that organism. These larval stages are clearly visible in the muscle and may be exposed when fish are filleted or when the visceral organs are removed. The mesenteries around the organs in the body cavity and on or in certain organs are likely sites of encystment. More details regarding these larval stages are given on page 1.

**Nematode Larvae**

Larval nematodes of the genera *Eustrongylides, Spiroxys, Hysterothylacium, Contracaecum, Capillaria, Rhabdochona, Dichelyne*, and *Philometra* sometimes are observed in the muscle and viscera of various fish. The musculature, liver, swim bladders, and mesenteries are organs and tissues where they are most numerous. Not all organisms of these genera may be so involved and this list obviously does not represent all genera. These worms can be recognized as small whitish coiled structures in the tissue. When fish fillets are held up to the light, these worms are sometimes seen. Other details regarding these organisms is given on pages 7 and 8.

**Oligochaeta=Leeches**

Leeches feed on the blood and tissue fluids of fish. Unless they are extremely numerous, they probably do little harm to the host. Blood flagellates and certain fish viruses are known to be transmitted by leeches. In a few cases, metacercaria are found encysted in them. Fish get the adult worm by eating the leech. Genera found on fish may include *Piscicola, Illinobdella, Myzobdella, Placobdella*, and *Actinobdella*.

**Crustacea=Parasitic Copepods=Fish Lice**

These organisms are related to organisms such as the common crayfish. They are obviously much smaller. Non-parasitic as well as those that are parasites have jointed appendages and a tough exoskeleton. To grow, they must shed this exoskeleton. The shape and form of the parasite on the fish becomes modified. In some cases, their shape is so modified that they would hardly be recognized as crustacea. These organisms attach to the fins, gills, and skin of fish and derive their nutrition from tissue fluids and cells. Genera frequently seen include are *Achtheres, Argulus, Ergasilus, Lernaea*, and *Salmincola*.

Some Bacterial and Fungal Diseases with External Symptoms

**Kidney disease**-*Renibacterium salmoninarum* is a disease of salmonid fishes. When an infected fish is being cleaned, one may see a white ropy mass in the kidneys which are the deep red brown tissue next to the backbone.

**Furunculosis**-*Aeromonassalmonicida* is a disease of many species of young fish. Warm water is conducive to the development of this disease. Sometimes raised swollen areas (similar to boils on humans) appear on the surface of the skin. In early stages, they are not hemorrhagic; later on these may seep bloody exudates.

**Fungal diseases**-*Saprolegnia parasitica* appears as a white fuzzy growth. The size of the area that is involved may be large or small and may appear on the body surfaces and gills. When fish are handled, the mucous secreted by epidermal cells as well a the epidermal cells themselves may become damaged. There is no evidence that this fungus can invade tissue that is not damaged (see page 3).

**Whirling disease**-*Myxobolus cerebralis* (Myxosoma) is only found in salmonid fishes. Young fish exhibit a spiral swimming symptom. This parasite invades the cartilage and other tissues of the head and brain and alters the equilibrium of the fish. This may also effect the development of the muscle system and cause a side to side and or up and down bending of the body muscle (lordosis/scoliosis). The young fish looks deformed. Most generally the areas about the caudal (tail) fin are involved, and a discoloration causing a blacktail is often seen (see page 4).

**Viral Diseases**

A variety of skin lesions of viral origin have been found in fishes from Minnesota and elsewhere and are described by Economon (1957, 1975, 1978). Some of the more conspicuous are tumorous growths, to which walleye seem to have a high susceptibility. Walleye can be affected by various skin tumors, including lymphocystis, dermal fibroma, and epidermal hyperplasia. A different virus is associated with each of these surface lesions. These lesions are benign and are confined to the external surfaces of the body. They are cyclical in nature, with the relative frequency appearing to fluctuate in successive years. They are also seasonal with the incidence most obvious during the coldwater months.

**Walleye Herpesvirus**-*Herpesvirus vitreum* is an agent isolated from epidermal lesions and postulated to be the a cause of walleye epidermal hyperplasia. Nonpapillomatous lesions have been observed in successive years in walleye from several lakes in northern Minnesota. The lesions appear as smooth, grayish-white spots and patches of slightly elevated, or thickened epidermis. Neither fungus nor slime bacteria are involved in these flat, non-necrotic surface lesions that vary in size up to several centimeters in diameter (a centimeter is about 0.4 inch). The plaques are harder than the normal skin surrounding the affected areas, and are resistant to abrasion. The lesions may occur on any part of the body, including the fins. Dorsal and caudal fin lesions seem to be most frequent, and are more noticeable due to the thickening and contrasting shades of color between the affected and unaffected portions of the fin. The presence of epidermal hyperplasia, because it is benign and localized in the skin of the walleye, does not affect the edibility of the fillets.

**Lymphocystis**- is a common, chronic, and benign infection caused by an iridovirus that results in greatly hypertrophied cells, typically in the skin and fins (Wolf 1988). The virus has been detected worldwide and effects some 97 species of fish. The disease was originally believed to be caused by a parasite and it was not until 1966 that a virus was found to be the causative agent. The lesions are macroscopic and occur mostly at the periphery of the vascular system.

This viral disease is characterized by irregular elevated, wart-like growths on various parts of the body and fins of fishes. The lesions may take the form of small bead like clusters of a yellowish-white color in early stages of infection, or may appear as light cream to grayish-pink lumps. The color of these legions vary according to their location and the proximity to blood supply.

A lesion consists of hypertrophic connective tissue cells that have become infected with the lymhocystis virus. The cellular swelling induced by the virus is spectacular, and infected cells increase enormously in size with no hyperplasia or proliferation of cells as in malignant tumors. The enlarged cells may reach a diameter of several millimeters before they finally rupture, or are sloughed off. Internally, lymphocystis cells can sometimes be found in muscle, peritoneum, and membranes. Lymphocystis may temporarily disfigure a fish, but the effects are reversible. Edibility of the fish is not affected.

**Mysterious Maladies**

**Dermal fibromas**- vary in appearance from small, round, variably pigmented papules (2-5 mm) to rather large nodular growths (1-2 cm) that often coalesce to form papillary clusters resembling the wart-like growths of lymphocystis. However, the pearly granulation tissue aspect of the latter is completely absent in fibromas. The nodules of dermal fibromas are more hemispherical and posses a smooth, firm textured surface. Larger lesions show a thinly-stretched or torn epidermal covering over a grayish-pink nodular mass, the crown of which is usually inflamed. Definitive diagnosis can only be obtained by a histological evaluation of the tissues by a trained histopathologist.

**Myofibrogranuloma (MFG)**- is a muscular dystrophy-like disease of walleye in which the skeletal muscle undergoes severe structural changes (Economon 1975). The condition is recognized by its swollen, coarsely-fibrous, granular, and fatty characteristics. The lesion has an opaque yellow brown color and fresh tissue looks very dry, similar to freezer burn in appearance. Included in this pattern of striated muscle deformation is a consolidation and fusion of contiguous muscle fibers to form prominent aggregates of rough, cordlike strands that eventually undergo a coagulation necrosis and calcification. The latter, more advanced stages of MFG are found in paravertebral muscle surrounding the spinal column. Less advanced lesions radiate from the spinal area into adjoining muscle segments. The swelling and general deterioration of the muscle is usually not apparent externally. These lesions may be seen when filleting a fish. Neither hyperplasia nor hemorrhage is evident in these nonsuppurative muscle fiber processes, and there is no visible evidence of lesion resorption or muscle regeneration. The lesions appear to be confined to striated muscle with no cardiac or smooth muscle being affected. MFG has been found exclusively in adult walleye ranging in age from 3 to 11 years.

The sex frequency ratio is about equal. According to reports from anglers, very few of the affected fish display any outward signs of paralysis or motor skill deficiency when captured. The captured fish is, however, sometimes submissive when hooked and removed from the water, so these traits make it nearly impossible to detect the disease from external examination or changed behavioral patterns. Detailed information on the incidence, distribution, and behavior of affected walleye is needed to determine what influence factors such as heredity, nutrition, and environment may have on the development of the disease.

MFG has been identified from widely-distributed locations in Minnesota, but there is an apparent difference in incidence of the myopathy between eutrophic and mesotropic waters, eutrophic waters have an incidence twice as high. A higher frequency of this disease has been observed in walleye from comparatively small, fertile lakes in which the species is maintained exclusively by stocking.

**Coldwater Peduncle Disease**- is a relatively new anomaly that has been recognized in the past three years in extensively cultured walleye. When walleye are being trapped from the rearing ponds, they often are held in trap nets for several hours prior to being to being loaded on hatchery trucks. This is a fall event that occurs when water temperatures are 7°C to mid-teens °C (in the upper 40s to mid-50°F). Some fish begin to exhibit a whitening of the caudal peduncle with necrosis and sloughing of the epithelium. To date no etiologic agent has been isolated. A probable bacterial pathogen is expected since the clinical signs resemble coldwater peduncle disease of salmonids.

## CERTIFIABLE DISEASES OF MINNESOTA FISH

The Fish Health Section of the American Fisheries Society certifies fish health inspectors. The certification process requires that certain college courses have been taken. A written examination is required. To renew certification, examinations must be periodically taken and passed. In addition, practical experience is required. The Fish Health Section publishes the "Bluebook" which outlines the procedures for sampling fish populations and the detection and identification of certain fin fish and shellfish pathogens. This assures a standard and uniform protocol has been used to certify fish are or are not free of pathogens.

Before fish or their eggs can be transferred between states or foreign countries and in some cases between watersheds within a state, they must be examined. When diseases that are treatable are found, the animals may be treated and examined after treatment and then if found to be disease free moved.

In some cases, it has been necessary to destroy fish infected with serious pathogens that might seriously threaten fish or fisheries. Before uniform inspections were established, several serious European fish diseases were inadvertently brought to the United States and some from this country have ended up in Europe. Likewise, diseases from the western part of the USA were brought to new areas in the east. Fish culture is now a worldwide enterprise. South America is rapidly developing aquaculture and certain important diseases have been accidentally introduced.

I am indebted to Lasee (1995) and Wolfe (1988) for some of the details reported here on certain certifiable diseases.

Viral diseases require sophisticated techniques for their diagnosis and identification. This requires that fish cell lines from tissues of several kinds of fish are available at a facility that can support tissue culture. Suspected tissue or ovarian fluid are placed in vials with cultured cells which grow as a thin layer on the glass of the flask. If a fish virus is present, the infected cells begin to die. Each virus has a unique pattern of causing cell death and this allows one to distinguish between them.

Bacteria from infected tissues are grown on petri dishes that have specific nutrients that will allow them to grow. Microscopic examination of stained slides determines the size and shape of bacteria. By growing bacteria on a wide variety of sugars and other nutrients, one can determine the kind of bacteria that is causing the disease.

Most protozoans (the Myxospora are included here for convenience), worms, and fungal diseases are diagnosed using the compound microscope. In some cases, they must be stained or treated with special dyes or

chemicals to facilitate their observation and identification.

**Infectious Hematopoietic Necrosis Virus (IHN)**

This is a disease of salmonid fishes. Atlantic salmon, rainbow trout, and chinook and sockeye salmon are susceptible. Young fish are most easily infected and decreasing susceptibility occurs with age. This disease occurs when water temperatures are below 10°C (50°F). Mortalities in hatchery fish may reach 90%. The virus can be transmitted from fish to fish contact and from free viral particles. It can also be transferred from parent to offspring on or in the eggs and sperm and the fluid that is around them. Blood sucking animals such as leeches and copepods also transmit the virus (page 8).

**Infectious Pancreatic Necrosis Virus (IPN)**

This is a disease of salmonids and a few other fishes. This disease exists now internationally. Very young fish (1-4 months old) suffer very high mortality. Older fish may become infected and harbor the virus without overt symptoms, but act as carriers and thus become a reservoir of infection.

**Viral Hemorrhagic Septicemia (VHS) Egvet Disease**

This is a disease of salmonid fishes and severely impacts rainbow trout fingerlings and yearlings. However, severe outbreaks have been diagnosed from salmon and brown trout. Hatchery fish are most likely to be infected by virus particles shed in fish urine and feces. The disease is most prevalent when water temperatures are at or below 10°C (50°F). Survivors act as a reservoir for future infections. The virus is international in distribution, but as the strains found in the United States seem to be unique, they probably evolved here.

**Channel Catfish Virus (CCV)**

This disease is found in channel catfish under culture. Fish that are less than 4 months old are the most susceptible and very severe mortalities up to 100% are not uncommon in infected ponds. Other ictalurid fishes are also likely to be susceptible. June to December are the most common months for epizootics. The disease can spread from fish to fish and also from adults to the offspring through eggs and sperm (the latter is called vertical transmission). This disease was found at the Waterville State Fish Hatchery in 1989. The fingerlings had typical clinical signs of this virus and 95% of them died. The remainder of the young fish and the broodstock were destroyed and the hatchery was disinfected.

**Epizootic Epitheliotrophic Virus (EEVD)**

This is a disease of lake trout and splake under culture and is relatively new. Details about its transmission include fish to fish transmission. It is not known whether vertical transmission can occur but is suspected. Mortalities are very high in infected fish. This disease is particularly difficult to deal with because cell lines and other less complicated methods for its diagnosis are not presently available. Electron microscopy, a very sophisticated and equipment costly procedure, is the only mechanism available to get a specific diagnosis.

**Bacterial Kidney Disease (BKD)**
**(*Renibacterium salmoninarum*)**

This is a disease of cultured and wild salmonids and is worldwide in its distribution. BKD is a difficult disease to diagnose using routine culture methods as well as general microscopy, so special techniques and assays have been developed. The DNR Ecological Services Laboratory has the special technology and expertise for this diagnosis. The bacterium is transmitted vertically and horizontally (from fish to fish). The exact mechanism of transmission is unknown.

**Enteric Redmouth (ERM) (*Yesernia ruckeri*)**

This is a disease primarily of salmonid fishes and particularly rainbow trout. Emerald dace, goldfish, carp and lake herring as well as crayfish are known to carry this organism. The disease is found throughout the United States and Canada. Crayfish are thought to be carriers only and do not exhibit clinical signs.

**Furunculosis** (*Aeromonas salmonicida*)

Furunculosis is a serious bacterial disease of cultured and wild fish that has been known since 1890. It infects salmonids, but also is found in cyprinids which include carp and goldfish and esocids which includes northern pike and muskellunge. Other warm water fishes are also susceptible to this disease. Furunculosis is worldwide in distribution. Diagnosis is fairly routine using standard bacteriological methods. Hatchery fish have been treated with antibiotics for many years to eradicate this disease and antibiotic resistant strains of this bacteria are fairly common. Resistance of bacterial isolates to specific antibiotics must be determined before treatments are recommended.

**Whirling Disease** (*Myxobolus cerebralis*) **(formerly** *Myxosoma*))

This parasite infects cultured and wild salmonid fishes. Lake trout and splake are not susceptible. There is no treatment for it, so containment is critical. This disease appears to have originated in Europe and was first reported there in 1903. It was diagnosed in the United States in 1955. The former Soviet Union, the British Isles, and other Eastern European countries have widespread cases of whirling disease. More recently outbreaks have been diagnosed in imported salmonids in South America. Diagnosis requires that cartilage from the head and gills be macerated in a blender. This slurry is screened for spores using specially prepared biochemical tags that attach specifically to *M. cerebralis* spores. The spores that have these tags attached to them fluoresce under the appropriate light from a special microscope (see page 4).

## PARASITE HOSTS

### Symbols and Notations in the Parasite Host Section

The symbol * (see also the introduction to the 1981 edition at bottom of page 1) indicates that the organism was found in Margolis and Arthur 1979. This work is primarily a checklist with an extensive bibliography and usually contains little information except the host and the site of infection. In some cases, the latter are not stated.

The term "Not available", regarding where in a host a parasite was found or details regarding its life history, may have several meanings. First, the references consulted by the author (see introduction to the 1981 edition) in which the organism was listed as being in a host may have said nothing about where it was found or may not have given any details regarding its life cycle. This may not have been known to the author because research notes were incomplete, the life cycle was not known to that author, or not yet studied. Second, a published paper not seen by the author of this manual or reviewed by other authors may have contained more specific information regarding the parasite. It is recommended that when more specific facts are desired, the reader should consult Hoffman (1967), Margolis and Arthur (1979), or an abstracting publication to obtain the collation of the original paper to determine if further information is available. It was not possible to do this additional research because of time constraints and the methodology decided upon at the beginning of this project.

Parasite names and additions to the bibliography in the 1997 addition are marked with a #. See the introduction to the 1997 edition for further details.

### Summary of Symbols

* Found in Margolis and Arthur 1979
# Found in the 1996-97 literature survey
No symbol, means the entry was from Hoffman (1967, 1980) literature survey

## ACIPENSERIDAE

*Acipenser fulvescens* - Lake sturgeon

| | |
|---|---|
| MONOGENEA | |
| *Diclybothrium armatum* | Not available |
| *Diclybothrium hamulatum* | Gills |
| *Paradiclybothrium* spp. * | Gills |
| DIGENEA | |
| *Allocreadium* spp. * | Intestine |
| *Azygia longa* # | Intestine |
| *Bunodera luciopercae* * | Intestine |
| *Crepidostomum auriculatum* # | Intestine |
| *Crepidostomum lintoni* | Intestine |
| *Homalometron armatum* * | Intestine |
| *Skrjabinopsolus manteri* * | Digestive tract |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; adult in heron |
| *Diplostomulum spathaceum* # | Eye |
| *Diplostomulum* spp. | Eye |
| CESTOIDEA | |
| Proteocephalidea # | Plerocercoid in gut |
| Tetraphyllidea # | Plerocercoid in gut |
| *Triaenophorus nodulosus* # | Liver |
| NEMATODA | |
| *Cucullanus chitellarius* | Intestine |
| *Cystidicoloides* spp. # | Intestine as larvae |
| *Rhadbochona cascadilla* | Larvae in mayflies; adult in intestine |

| | |
|---|---|
| *Raphidascaris* spp. # | Gut |
| *Spinitectus acipenseri* # | Gut |
| *Spinitectus gracilis* # | Digestive tract |
| *Spinitectus* spp. * | Digestive tract |
| *Truttaedacnitis clitellarius* * | Digestive tract |
| ACANTHOCEPHALA | |
| *Echinorhynchus leidyi* # | Larvae in amphipods; second intermediate host, Osmerus |
| *Echinorhynchus salmonis* | Intestine |
| *Leptorhynchoides thecatus* # | Intestine |
| *Metechinorhynchus salmonis* | Intestine # |
| *Neoechinorhynchus rutili* # | Intestine |
| *Neoechinorhynchus tennelus* # | Intestine |
| *Pomphorhynchus bulbocolli* # | Intestine |
| OLIGOCHAETA | |
| *Macrobdella decora* * | Not available |
| Glossiphionidae # | External body surface |
| Placobdella montifera # | External body surface |
| CRUSTACEA | |
| *Argulus stizostethi* | Not available |
| COELENTERATA | |
| *Polypodium hydriforme* | Eggs |

*Scaphirhynchus platorynchus* - Shovelnose sturgeon

| | |
|---|---|
| DIGENEA | |
| *Crepidostomum lintoni* | Cercaria in clam; metacercaria in insects and crustacea; adult in this fish |

| | |
|---|---|
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in this fish as yellow grub; adult in heron in mouth, esophagus |
| NEMATODA | |
| *Ascaris scaphirhynchi* | Intestine |

**POLYODONTIDAE**

*Polyodon spathula* - Paddlefish, spoonbill

| | |
|---|---|
| MONOGENEA | |
| *Cotylaspis cokeri* | Esophagus |
| *Diclybothrium hamulatum* | Gills |
| DIGENEA | |
| *Halipegus perplexus* | Adult in intestine |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in this fish as yellow grub; adult in heron in mouth, esophagus |
| CESTOIDEA | |
| *Marsipometra hastata* | Procercoid in Cyclops; adult in intestine and caeca |
| NEMATODA | |
| *Camallanus* spp. | Larvae as hyperparasites of *Marsipometra hastata* in intestine and pyloric caeca |
| *Thynnascaris dollfusi* | Adult in stomach |
| *Hysterothylacium dollfusi* # | Encysted in gut mucosa (stomach), intestine, pyloric caeca |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Not available |
| CRUSTACEA | |
| *Ergasilus elongatus* | Not available |

COELENTERATA

| | |
|---|---|
| *Polypodium hydriforme* | Eggs |

**LEPISOSTEIDAE**

*Lepisosteus platostomus* - Shortnose gar

PROTOZOA

MYXOSPORIDA

| | |
|---|---|
| Trophozoites | Gall bladder |

DIGENEA

| | |
|---|---|
| *Macroderoides spinifera* | First host snail, Helisoma; metacercaria in fish and tadpoles; adult in intestine of this fish |

DIGENEA METACERCARIA

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in this fish as yellow grub; adult in heron in mouth, esophagus |

CESTOIDEA

| | |
|---|---|
| *Proteocephalus perplexus* | Plerocercoids in Hyborhynchus, Roccus, Ictalurus |
| *Proteocephalus singularis* | Not available |

ACANTHOCEPHALA

| | |
|---|---|
| *Leptorhynchoides thecatum* | Larvae in amphipods; if larvae here less than 30 days, small fish may be second host |

CRUSTACEA

| | |
|---|---|
| *Argulus mississippiensis* # | Not available |
| *Ergasilus elegans* | Not available |
| *Lernaea variabilis* | Larvae on gills |

*Lepisosteus osseus* - Longnose gar

PROTOZOA

MYXOSPORIDA

| | |
|---|---|
| Trophozoites | Gall bladder |

DIGENEA

| | | |
|---|---|---|
| *Macroderoides parva* | | Cercaria in snail, Helisoma; metacercaria in fish and tadpoles; adult in this fish in intestine |
| *Macroderoides spiniferus* | * | Digestive tract |

DIGENEA METACERCARIA

| | | |
|---|---|---|
| *Clinostomum marginatum* | | Cercaria in snail, Helisoma; metacercaria in this fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum spathaceum* | # | Eye |

CESTOIDEA

| | | |
|---|---|---|
| *Bothriocephalus* spp. | * | Adult in pyloric caeca, intestine |
| *Proteocephalus ambloplitis* | * | Plerocercoids in fish, encysted in viscera, adult in intestine |
| *Proteocephalus perplexus* | | Procercoids in haemocoel of crustacea; plerocercoids in small fish |
| *Proteocephalus singularis* | * | Adult in intestine |

NEMATODA

| | | |
|---|---|---|
| *Cystidicola lepisostei* | * | Intestine |
| *Spiroxys* spp. | # | Mesentery |

ACANTHOCEPHALA

| | | |
|---|---|---|
| *Leptorhynchoides thecatum* | | Larvae in amphipods; if larvae here less than 30 days, small fish may be second host |

OLIGOCHAETA

| | | |
|---|---|---|
| *Placobdella montifera* | | Body surface |

CRUSTACEA

| | | |
|---|---|---|
| *Ergasilus elegans* | | Not available |

**AMIIDAE**

*Amia calva* - Bowfin

PROTOZOA

MYXOSPORIDA

| | | |
|---|---|---|
| *Henneguya amiae* | | Gills |

| | |
|---|---|
| Flagellata | |
| *Trypanosoma phaleri* # | Blood, develops in the leech *Desserobdella phalera* |
| DIGENEA | |
| *Azygia acuminata* | Cercaria in snail; metacercaria in host fish or carrier fish; adult in this fish in stomach |
| *Azygia angusticauda* | Cercaria in snail; metacercaria in host fish or carrier fish; adult in this fish in stomach |
| *Azygia longa* | Cercaria in snail; metacercaria in host fish or carrier fish; adult in this fish in stomach |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in insects crustacea |
| *Leuceruthrus micropteri* | Stomach |
| *Macroderoides parva* | First host snail, Helisoma; metacercaria in fish, tadpoles; adult in this fish in intestine |
| *Macroderoides typica* | Cercaria in snail, Helisoma; metacercaria in fish, tadpoles; adult in this fish in intestine |
| *Microphallus opacus* | Metacercaria in crayfish |
| DIGENEA METACERCARIA | |
| *Apophallus venustus* * | Metacercaria in musculature |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in this fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum spathaceum* # | Metacercaria in eye |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Echinochasmus donaldsoni* | Cercaria in snail; metacercaria in this fish in gills; adult in grebes |

| | |
|---|---|
| CESTOIDEA | |
| *Haplobothrium globuliforme* | Procercoid in Cyclops; plerocercoid encysted in liver of *Ictalurus nebulosus*, *Lebistes reticulatus*, *L. gibbosus*; adult in gut of this fish |
| *Proteocephalus ambloplitis* * | Plerocercoid in this fish encysted in viscera; adult in intestine in this fish |
| *Proteocephalus perplexus* | Plerocercoids in Hyborhynchus, Roccus, Ictalurus |
| *Triaenophorus nodulosus* # | Encysted in liver |
| NEMATODA | |
| *Haplonema immutatum* | Adult in stomach or intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach or intestine |
| *Spiroxys* spp. | First host Cyclops; larvae in mesenteries of fish and amphibia, dragonfly nymphs, snails |
| ACANTHOCEPHALA | |
| *Echinorhynchus dirus* | Larvae in amphipods; no second host |
| *Echinorhynchus salmonis* | Larvae in amphipods and Osmerus |
| *Leptorhynchoides thecatum* | Larvae in amphipods; if larvae less than 30 days, small fish may be second host |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea; some have second host |
| *Neoechinorhynchus rutili* # | Intestine |
| *Pomphorhynchus bulbocolli* | Larvae in amphipods and small fish |
| OLIGOCHAETA | |
| *Illinobdella* spp. | Not available |
| CRUSTACEA | |
| *Argulus americanus* | Not available |
| *Argulus maculosus* # | Not available |
| *Ergasilus* spp. # | Gills |

ARTHROPODA

| | |
|---|---|
| *Acarina* | Gills |

**HIODONTIDAE**

*Hiodon alosoides* - Goldeye

DIGENEA

| | |
|---|---|
| *Crepidostomum illinoiense* | Metacercaria in mayfly nymphs |
| *Crepidostomum* spp. * | Adult in intestine and gall bladder |

DIGENEA METACERCARIA

| | |
|---|---|
| *Paurorhynchus hiodontis* * | Metacercaria in body cavity |
| *Paurorhynchus tergisus* | Metacercaria in body cavity |

CESTOIDEA

| | |
|---|---|
| *Bothriocephalus cuspidatus* | Procercoid in copepod; plerocercoids at times in small fish |

CRUSTACEA

| | |
|---|---|
| *Ergasilus* spp. | Gills |

*Hiodon tergisus* - Mooneye

MONOGENEA

| | |
|---|---|
| *Mazocraeoides* spp. | Gills |

DIGENEA

| | |
|---|---|
| *Azygia longa* # | Intestine |
| *Crepidostomum hiodontos* | Cercaria in clam; metacercaria in aquatic insects (mayfly nymphs) and crustacea; small intestine, stomach, liver, swim bladder # |
| *Crepidostomum illinoiense* | Cercaria in clam; metacercaria in aquatic insects and crustacea |
| *Lissorchis crassicrurum* # | Intestine |
| *Plagioporus serratus* | Cercaria in snail; metacercaria in crustacea |

DIGENEA METACERCARIA

| | |
|---|---|
| *Paurorhynchus hiodontis* | Metacercaria in body cavity, heart, pericardium, muscle, stomach, intestine, liver, kidney, eye, swim bladder # |
| *Tetracotyle* spp. | Metacercaria encysted in this fish |

CESTOIDEA

| | |
|---|---|
| *Bothriocephalus cuspidatus* | Procercoids in copepod; plerocercoids at times in small fish |
| *Ligula intestinalis* # | Stomach |
| *Proteocephalus* spp. * | Intestine, pyloric caeca |

NEMATODA

| | |
|---|---|
| *Camallanus oxycephalus* | Larvae in copepods, other crustacea? adult in stomach and intestine of fish |
| *Cystidicola stigmatura* | Larvae in Gammarus, adult in swim bladder |
| *Cystidicoloides tenuissima* # | Stomach, gills, liver, kidney, swim bladder |
| *Raphidascaris acus* # | Intestine |
| *Rhabdochona cascadilla* | Larvae in mayflies, adult in intestine |
| *Rhabdochona canadensis* # | Intestine, stomach |

ACANTHOCEPHALA

| | |
|---|---|
| *Leptorhynchoides thecatum* | Larvae in amphipods, if larvae less than 30 days also in mesentaries of fish; adult in pyloric caeca |
| *Paurorhynchus hiodontis* # | Intestine, coelom |
| *Pomphorhynchus bulbocolli* | Larvae in amphipods and small fish |

CRUSTACEA

| | |
|---|---|
| *Ergasilus nerkae* # | Not available |

## ANGUILLIDAE

*Anguilla rostrata* - American eel

PROTOZOA

Ciliata

| | |
|---|---|
| *Ichthyophthirius multifiliis* # | Body surface, gills |
| *Trichodina* spp. # | Gills |

Coccidia

| | |
|---|---|
| *Eimeria anguillae* | Epithelium of anterior gut |

| | | |
|---|---|---|
| Flagellata | | |
| *Trpanosoma burresoni* | # | Blood |
| MYXOSPORIDA | | |
| *Myxidium illinoisense* | # | Gills, kidney |
| *Myxidium zealandicum* | * | Gills, kidney cysts |
| *Myxobolus* spp. | | Not available |
| DIGENEA | | |
| *Azygia acuminata* | | Cercaria in snail; metacercaria may be in small fish; adult in stomach, intestine |
| *Azygia longa* | | Cercaria in snail; metacercaria may be in small fish or host fish; adult in stomach, intestine |
| *Bunodera luciopercae* | * | Adult in intestine |
| *Centrovarium lobotes* | | Cercaria in snail; metacercaria in muscle of fish; adult in stomach and intestine |
| *Crepidostomum brevivitellatum* | | Cercaria in clam; metacercaria in aquatic insects, crustacea |
| *Crepidostomum cornutum* | | Cercaria in clam; metacercaria in aquatic insects and crustacea |
| *Deropristis inflata* | | Cercaria in Bittium; metacercaria in Nereis; adult in intestine |
| *Microphallus opacus* | | Metacercaria in crayfish; adult in stomach and intestine |
| DIGENEA METACERCARIA | | |
| *Diplostomulum flexicaudum* | | Cercaria in snail; metacercaria in lens of eye; adult in gulls |
| *Diplostomum spathaceum indistinctum* | | Metacercaria in eye |
| *Posthodiplostomum minimum* | | Metacercaria in fish; adult in (Neascus of) herons and other birds |
| CESTOIDEA | | |
| *Bothriocephalus claviceps* | | Procercoid in copepods; plerocercoid sometimes in small fish |
| *Diphyllobothrium* spp. | # | Stomach wall |

| | |
|---|---|
| *Proteocephalus macrocephalus* | Procercoid in crustacea; plerocercoid in small fish |
| *Proteocephalus* spp. | Plerocercoid in fish |
| NEMATODA | |
| *Contracaecum spiculigerum* | Larvae in fish; adult in piscivorous fish, birds and mammals |
| *Hapolnema hamulatum* # | Intestine |
| *Paraquimperia aditum* * | Adult in intestine |
| *Spinitectus* spp. # | Intestine |
| *Thynnascaris brachyura* * | Adult in intestine |
| ACANTHOCEPHALA | |
| *Echinorhynchus clavaeceps* | Larvae in amphipods; adult in intestine |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days may also be in mesenteries of fish |
| *Neoechinorhynchus cylindratum* | Larvae in small crustacea; some have second intermediate host |
| CRUSTACEA | |
| *Argulus laticauda* | Not available |
| *Ergasilus caeruleus* | Gills |
| *Lernaea cyprinacaea* | Head in musculature |

## CLUPEIDAE

*Alosa pseudoharengus* - Alewife

| | |
|---|---|
| PROTOZOA | |
| *Trichodina* spp. # | Gills |
| DIGENEA METACERCARIA | |
| *Diplostomulum flexicaudum* | Cercaria in snails; metacercaria in this fish in lens of eye; adult in gulls |
| *Diplostomum spathaceum* * | Metacercaria in vitreous humor, lens |
| *Neascus* spp. | Cercaria in snails; metacercaria in this fish in lens of eye; adult in gulls |

| | |
|---|---|
| *Posthodiplostomum minimum* # | Mesenteries |
| *Tetracotyle intermedia* * | Metacercaria in heart, mesenteries |
| CESTOIDEA | |
| *Cyathocephalus truncatus* # | Pyloric caeca |
| *Diphyllobothrium* spp. # | Encysted around pyloric caeca |
| *Eubothrium salvelini* # | Anterior intestine, pyloric caeca |
| *Proteocephalus* spp. # | Anterior intestine |
| NEMATODE | |
| *Camallanus oxycephalus* # | Not available |
| *Capillaria* spp. # | Not available |
| *Contracaecum* spp. | Adult in piscivorous fish, birds and mammals, encysted in mesenteries this fish # |
| *Haplonema hamulatum* # | Intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Not available |
| *Acanthocephalus jacksoni* | Larvae in amphipods; no second host |
| *Acanthocephalus parksidei* | Larvae in amphipods; no second host |
| *Echinorhynchus salmonis* | Larvae in amphipods |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if larvae less than 30 days also in mesenteries of fish |
| *Metechinorhynchus salmonis* | Not available |
| CRUSTACEA | |
| *Argulus alosae* | Not available |
| *Ergasilus luciopercarum* # | Gills |
| ARTHROPODA | |
| *Hydrachna* spp. | Larvae on gills |

*Dorosoma cepedianum* - Gizzard shad

| | |
|---|---|
| PROTOZOA | |
| Microsporida | |

| | |
|---|---|
| *Plistophora cepedianae* | Cysts in visceral cavity |
| MYXOSPORIDA | |
| *Coccomyxa* spp. | Body cavity |
| MONOGENEA | |
| *Mazocraeoides olentangiensis* | Gills |
| *Pseudomazocraeoides ontariensis* | Gills |
| DIGENEA METACERCARIA | |
| *Clinostomum* spp. | Cercaria in snail, Helisoma; adult in heron in mouth, esophagus |
| *Diplostomulum spathaceum* # | Eye |
| *Diplostomulum* spp. | Cercaria in snails; adult in piscivorous birds, eye # |
| CESTOIDEA | |
| *Glaridacris confusus* | Not available |
| *Proteocephalus* spp. | Procercoid and plercercoid in haemocoel of crustacea |
| CRUSTACEA | |
| *Argulus appendiculosus* | Not available |
| *Argulus* spp. | Not available |

**CYPRINIDAE**

*Cyprinus carpio* - Carp

| | |
|---|---|
| MONOGENEA | |
| *Dactylogyrus anchoratus* | Gills |
| *Dactylogyrus extensus* | Gills |
| *Gyrodactylus fairporti* | Body and gills |
| *Gyrodactylus medius* # | Body surface, fins |
| *Pseudocolpenteron pavlovskii* | Body and fins # |
| DIGENEA | |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insect, crustacea |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in insect, crustacea |

| | |
|---|---|
| **DIGENEA METACERCARIA** | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum flexicaudum* | Not available |
| *Diplostomulum scheuringi* | Metacercaria in vitreous chamber of eye and brain of fish, newts |
| *Diplostomulum spathaceum indistinctum* * | Metacercaria in eye |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Neascus* spp. * | Metacercaria in mesenteries, gills, skin |
| **CESTOIDEA** | |
| *Archigetes iowensis* | Procercoid and plerocercoid in Tubificidae; plerocercoid may be in body cavity of fish; adult in intestine |
| *Atractolytocestus huronensis* | Not available |
| *Khawia iowensis* | Procercoid and plerocercoids in oligochaetes, adult anterior one half of the gut # |
| *Ligula intestinalis* | Procercoid in copepods; plerocercoid in fish; adult in fish eating birds |
| *Pomphorhynchus bulbocolli* # | Intestine |
| **NEMATODA** | |
| *Philometra* spp. | Under skin near eye |
| *Rhabdochona cascadilla* | Larvae in mayflies; adult in intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* * | Intestine |
| *Spiroxys* spp. | First intermediate host Cyclops; mesenteries of fish and amphibia, dragonfly nymphs and snails |
| **ACANTHOCEPHALA** | |
| *Acanthocephalus dirus* # | Intestine |
| *Acanthocephalus parksidei* | Larvae in amphipods |

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|---|---|
| *Leptorhynchoides thecatum* | Larvae in amphipod, if larvae less than 30 days may also be in small fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host, small fish |
| OLIGOCHAETA | |
| *Piscicola geometra* | Not available |
| *Placobdella montifera* | Not available |
| CRUSTACEA | |
| *Argulus appendiculosus* * | Fins |
| *Argulus biramosus* | Not available |
| *Argulus catostomi* | Not available |
| *Argulus japonicus* | Not available |
| *Argulus* spp. | Not available |
| *Ergasilus caeruleus* | Not available |
| *Lernaea cyprinacaea* * | Head in musculature with body protruding |
| <u>*Carassius auratus*</u> -Goldfish | |
| MONOGENEA | |
| *Dactylogyrus anchoratus* | Gills |
| *Dactylogyrus vastator* | Gills |
| *Gyrodactylus elegans muelleri* | Gills and body |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| CESTOIDEA | |
| *Triaenophorus nodulosus* | Procercoid in copepods; plerocercoid in forage fish |
| NEMATODA | |
| *Agamonema* spp. | Not available |
| *Philometra carassii* | Larvae in copepods; adult between caudal fin rays |
| *Philometra sanguinea* | Tail fin |

| | |
|---|---|
| ACANTHOCEPHALA | |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host, small fish |
| *Pomphorhynchus* spp. * | Digestive tract |
| CRUSTACEA | |
| *Argulus japonicus* | Not available |
| *Lernaea cyprinacaea* | Not available |

**CATOSTOMIDAE**

*Ictiobus bubalus* - Smallmouth buffalofish

| | |
|---|---|
| PROTOZOA | |
| Ciliata | |
| *Trichodinella* spp. | Gills |
| MYXOSPORIDA | |
| *Myxobolus bubalis* | Gall bladder |
| *Myxoblous transovalis* | Gills |
| *Myxobolus endovasa* # | Gills |
| *Myxobolus multiplicatum* # | Gills |
| *Myxobolus ovalis* # | Gills |
| DIGENEA | |
| *Nematobothrium texomensis* | Adult in tissue of ovary, 8-9' long |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| CESTOIDEA | |
| *Biacetabulum giganteum* | Procercoid and plerocercoid in Oligochaeta, Tubificidae |
| *Glaridacris confusa* | Procercoid and plerocercoid in Oligochaeta, Tubificidae |
| *Monobothrium ulmeri* | Procercoid and plerocercoid in Oligochaeta, Tubificidae |

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|---|---|
| NEMATODA | |
| *Philometra nodulosa* | Larvae in copepods; adult in fish tissue |
| ACANTHOCEPHALA | |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if larvae less than 30 days, also in small fish |
| *Pomphorhynchus bulbocolli* | Larave in amphipod; second intermediate host, small fish |
| *Ictiobus cyprinellus* - Bigmouth buffalo | |
| PROTOZOA | |
| Ciliata | |
| *Gyrodactylus dakotensis* # | External surface |
| MONOGENEA | |
| *Trichodina dakotensis* | Gills, fins |
| *Icelanochohaptor icelanochohaptor* | Gills |
| *Pellucidhaptor planacrus* | Nares, external surface # |
| DIGENEA | |
| *Lissorchis gullaris* | Intestine |
| CESTOIDEA | |
| *Biacetabulum giganteum* | Not available |
| *Hypocaryophyllaeus paratarius* | Procercoid and plerocercoid in Oligochaeta, Tubificidae; adult in intestine |
| *Monobothrium ingens* | Procercoid and plerocercoid in Oligochaeta, Tubificidae |
| *Monobothrium ulmeri* | Procercoid and plerocercoid in Oligochaeta, Tubificidae |
| *Protocephalus* spp. | Procercoid in copepods; plerocercoid in this fish |
| *Spartoides wardi* | Not available |
| NEMATODA | |
| *Camallanus ancylodirus* | Larvae in copepods, other crustacea; adult in stomach and intestine |

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|---|---|
| *Philometra nodulosa* | Larvae in copepods; adult in fish tissue |
| *Philometra* spp. | Larvae in copepods; adult in fish tissue |
| ACANTHOCEPHALA | |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second host, small fish |
| OLIGOCHAETA | |
| *Piscicola punctata* | Not available |
| CRUSTACEA | |
| *Argulus appendiculosus* | Not available |
| *Argulus biramosus* | Not available |

*Carpiodes cyprinus* - Quillback

| | |
|---|---|
| PROTOZOA | |
| Ciliata | |
| *Trichodina* spp. | Not available |
| *Trichodinella* spp. | Gills |
| MYXOSPORIDA | |
| *Myxobolus rotundum* # | Gills |
| *Myxobolus* spp. # | Skin, intestine |
| MONOGENEA | |
| *Acolpenteron catostomi* | Ureters |
| *Anonchohaptor anomalum* | Gills, fins |
| *Anonchohaptor* spp. | Not available |
| *Icelanonchohaptor fyviei* | Gills |
| *Neodiscocotyle carpioditis* | Gills |
| *Pellucidhaptor angularis* # | Fins, body surface |
| *Pellucidhaptor eriensis* # | Fins, body surface |
| *Pellucidhaptor eremitus* # | Fins, body surface |
| *Pellucidhaptor micracanthus* # | Fins, body surface |
| *Pellucidhaptor* spp. | Not available |

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|---|---|
| DIGENEA | |
| *Lissorchis attenuatum* | Adult in intestine |
| *Lissorchis gullaris* # | Intestine |
| *Rowardleus pennersis* | Intestine |
| *Sanguinicola* spp. | Cercaria in snail; no second intermediate host; adult in blood vessels |
| *Triganodistomum attenuatum* | Adult in intestine |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum* spp. # | Eye, vitreous humor |
| *Posthodiplostomum minimum minimum* | Metacercaria in fish; adult in herons |
| CESTOIDEA | |
| *Biacetabulum carpiodi* | Procercoid and plerocercoid in Oligochaeta |
| *Glaridacris confusa* | Procercoid and plerocercoid in Oligochaeta, adult in intestine |
| *Hypocaryophyllaeus paratarius* | Adult in intestine |
| *Ligula intestinalis* # | Not given |
| *Monobothrium ulmeri* | Procercoid and plerocercoid in Oligochaeta, Tubificidae |
| *Monobothrium hunteri* # | Intestine, liver |
| *Proteocephalus* spp. * | Intestine, pyloric caeca |
| *Spartoides wardi* | Not available |
| NEMATODA | |
| *Camallanus ancylodirus* | Larvae in copepods, other crustacea; adult in stomach and intestine of fish |
| *Camallanus oxycephalus* | Larvae in copepods; adult in intestine, shows red from anus |
| *Philometra nodulosa* | Larvae in copepods; adult in fish tissue |
| *Philometroides nodulosa* * | Cheek galleries |

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|---|---|
| *Rhabdochona cascadilla* | Larvae in mayflies; adult in intestine |
| ACANTHOCEPHALA | |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if larvae less than 30 days also in small fish |
| *Neoechinorhynchus carpiodi* | Larvae in small crustacea; some have second intermediate host |
| *Neoechinorhynchus crassus* | Larvae in small crustacea; some have second intermediate host |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second host, small fish |
| CRUSTACEA | |
| *Argulus appendiculosus* # | Skin |
| *Ergasilus caeruleus* | Gills |
| *Ergasilus lizae* # | Gills |
| *Moxostoma* spp. | |
| MYXOSPORIDA | |
| *Myxobolus conspicuus* | Subdermal cysts |
| *Myxobolus* spp. | Gut, gills |
| *Myxobolus* spp. # | Gills |
| Trophozoites | Gall bladder |
| MONOGENEA | |
| *Anonchohaptor anomalum* | Gills, fins |
| *Dactylogyrus* spp. * | Gills |
| *Dactylogyrus urus* | Gills |
| *Gyrodactylus* spp. * | Gills, fins, skin |
| *Gyrodactylus spathulatus* | Gills, fins |
| *Pellucidhaptor eriensis* # | Body surface, fins |
| *Pellucidhaptor moxostomi* # | Gills, fins |
| *Pellucidhaptor thelostea* # | Body surface, fins |
| *Pellucidhaptor* spp. | Not available |

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|---|---|
| *Pseudomurraytrema copulata* | Gills |
| *Pseudomurraytrema moxostomi* | Not available |
| *Pseudomurraytrema* spp. | Gills |
| DIGENEA | |
| *Biacetabulum infrequens* # | Intestine |
| *Lissorchis attenuatum* * | Adult in intestine |
| *Lissorchis crassicrurum* # | Intestine |
| *Lissorchis hypentelii* | Not available |
| *Phyllodistomum* spp. | Cercaria in clam; metacercaria in sporocysts in clam or arthropods; adult in ureters, urinary bladder |
| *Plagioporus serotinus* | Not available |
| *Sanguinicola* spp. | Cercaria in snail; adult in blood vessels |
| *Triganodistomum attenuatum* | Metacercaria in Oligochaeta and planaria; adult in intestine |
| DIGENEA METACERCARIA | |
| *Apophallus venustus* * | Metacercaria in musculature |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum flexicaudum* | Cercaria snail; metacercaria in eye; adult in gulls |
| *Diplostomulum spathaceum indistinctum* * | Metacercaria in eye |
| *Neascus* spp. | Skin |
| *Sellacotyle mustelae* | Cercaria snail; metacercaria in fish in flesh, mesenteries; adult in mammals in intestine |
| *Tetracotyle* spp. # | Pericardium |
| CESTOIDEA | |
| *Biacetabulum infrequens* | Procercoid and plerocercoid in Oligochaetes |
| *Glaridacris catostomi* | Not available |
| *Isoglaridacris folius* | Procercoid and plerocercoid in body cavity of Oligochaetes; plerocercoid may be in fish |

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|---|---|
| *Isoglaridacris longus* | Procercoid and plercercoid in body cavity of Oligochaetes; plerocercoid may be in fish |
| *Khawia iowensis* # | Intestine |
| *Monobothrium ulmeri* | Procercoid and plerocercoid in oligochaetes, tubifex |
| *Triaenophorus nodulosus* | Procercoid in copepods; plerocercoid in liver |
| NEMATODA | |
| *Contracaecum brachyurum* | Larvae in fish in liver, mesenteries; adult in fish eating birds, fish, and mammals |
| *Dorylaimidae* spp. # | Stomach, intestine |
| *Rhabdochona canadensis* # | Intestine |
| *Rhabdochona cascadilla* * | Intestine |
| *Rhabdochona milleri* | Some larvae in aquatic insects, adult in intestine |
| *Raphidascaris acus* # | Intestine, vitreous humor |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in intestine |
| *Thynnascaris brachyura* * | Intestine |
| ACANTHOCEPHALA | |
| *Leptorhynchoides thecatus* * | Larvae in amphipod, if larvae less than 30 days, also is small fish in intestine, encysted in mesenteries |
| *Neoechinorhynchus crassus* # | Intestine |
| *Neoechinorhynchus cristatus* # | Intestine |
| *Neoechinorhynchus distracuus* # | Intestine |
| *Neoechinorhynchus strigosum* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host, small fish; adult in intestine, encysted in mesenteries |
| OLIGOCHAETA | |
| *Myzobdella moorei* # | Skin |
| *Piscicola punctata* | Not available |

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|---|---|
| *Placobdella montifera* # | Skin, pericardium |
| CRUSTACEA | |
| *Ergasilus caeruleus* * | Gills |
| *Ergasilus versicolor* # | Gills |
| *Ergasilus* spp. | Gills |
| <u>*Hypentelium*</u> <u>*nigricans*</u> - Northern hog sucker | |
| PROTOZOA | |
| Coccidia | |
| *Eimeria catostomi* * | Intestine |
| *Eimeria fernandoae* | Anterior gut epithelium |
| MONOGENEA | |
| *Acolpenteron catostomi* | Ureters and urinary bladder |
| *Dactylogyrus apos* * | Gills |
| DIGENEA | |
| *Bucephalus elegans* | Cercaria in clam; metacercaria in fin and muscle of fish; adult in fish in intestine |
| *Lissorchis hypentelii* | Not available |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| CESTOIDEA | |
| *Glaridacris* spp. | Not available |
| *Isoglaridacris wisconsinensis* | Larvae in Tubifex oligochaetes; plerocercoid may be in fish |
| *Monobothrium ulmeri* | Procercoid and plerocercoid in Oligochaete, Tubifex |
| NEMATODA | |
| *Philometra* spp. | Larvae in copepod; adult in fish tissue |
| *Rhabdochona cascadilla* | Larvae in mayfly larvae; adult in intestine |

ACANTHOCEPHALA

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|---|---|
| *Leptorhynchoides thecatum* | Larvae in amphipod, if larvae less than 30 days also may be in small fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host, small fish |

CRUSTACEA

| | |
|---|---|
| *Argulus catostomi* | Not available |

*Catostomus commersoni* - White sucker

PROTOZOA

Flagellata

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|---|---|
| *Cryptobia catostomi* | Blood, transmitted by the leech *Actinobdella inequiannulata* # |
| *Trypanosoma catostomi* | Blood |

Ciliata

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|---|---|
| *Ichthyophthirius multifiliis* * | Skin, fins, gills |
| *Trichodina* spp. * | Gills, urinary bladder, ureters |

Coccidia

| | |
|---|---|
| *Eimeria catostomi* | Intestine, epithelium of anterior gut |
| *Eimeria fernandoae* | Intestine, epithelium of anterior gut |
| *Eimeria* spp. * | Intestine, kidney |

MYXOSPORIDA

| | |
|---|---|
| *Chloromyxum catostomi* | Gall bladder |
| *Myxidium macrocapsulare* | Gall bladder |
| *Myxidium* spp. * | Gall bladder, kidney |
| *Myxobolus catostomi* | Mouth subepithelium, muscle |
| *Myxobolus subcircularis* | In muscle of fin |
| *Myxobolus* spp. | Not available |
| *Myxobolus bibullatum* | Gills |
| *Myxobolus catostomi* | Muscle and connective tissue |
| *Myxobolus commersonii* | Skin |

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|---|---|
| *Myxobolus ellipticoides* | Sides of cleithrum |
| *Thelohanellus notatus* | Subdermal cysts |
| MONOGENEA | |
| *Acolpenteron catostomi* | Ureters and bladder |
| *Anonchohaptor anomalum* | Gills |
| *Dactylogyrus* spp. * | Gills |
| *Gyrodactylidae gen.* spp. * | Gills |
| *Gyrodactylus* spp. | Body, fins |
| *Gyrodactylus spathulatus* | Gills, fins |
| *Gyrodactylus stunkardi* | Gills, fins |
| *Octomacrum lanceatum* | Gills |
| *Pellucidhaptor catostomi* # | Fins, nasal cavity |
| *Pellucidhaptor nasalis* | Nasal cavity |
| *Pseudomurraytrema copulata* | Gills |
| DIGENEA | |
| *Allocreadium ictaluri* | Cercaria in clams, limpets; metacercaria in arthropods and clams |
| *Allocreadium lobatum* | Cercaria in clam and limpets; metacercaria in arthropods or clams and undergo progenesis |
| Bucephalus elegans | First host clam; metacercaria in fish, fin and muscle; adult in intestine of fish |
| *Bucephalus* spp. # | Gills |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insect, crustacea |
| *Lissorchis attenuatum* * | Adult in intestine |
| *Lissorchis crassicrurum* # | Intestine |
| *Lissorchis simeri* * | Adult in digestive tract |
| *Phyllodistomum etheostomae* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in urinary bladder |

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|---|---|
| *Phyllodistomum lysteri* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in urinary bladder |
| *Plagioporus sinitsini* | Cercaria in snail; metacercaria in sporocysts of same snail |
| *Sanguinicola* spp. | Cercaria in snail; adult in blood vessels |
| *Triganodistomum attenuatum* | Metacercaria in Oligochaetes, Planaria; adults in intestine |
| *Triganodistomum* spp. | Metacercaria in Oligochaetes, Planaria; adult in intestine |

DIGENEA METACERCARIA

| | |
|---|---|
| *Amphimerus pseudofelinus* | Cercaria in snail, Amnicola; metacercaria in flesh of this fish; adult in reptiles, birds, mammals |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria of fish as yellow grub and in gills, gill cavity, fins, musculature, mesenteries; adult in heron in mouth, esophagus |
| *Cotylurus communis* * | Metacercaria in mesenteries, liver |
| *Cryptocotyle concavum* | Cercaria in snail, Amnicola; metacercaria in flesh of fish; adult in intestine of birds and mammals |
| *Diplostomulum flexicaudum* | Cercaria in snail; metacercaria in eye of fish; adult in gulls |
| *Diplostomulum of Diplostomum spathaceum* | Cercaria in snail, Lymnaea; metacercaria in Catostomus; adult in gills |
| *Diplostomulum of Hysteromorpha* | Snail *Gyraulus hirsutus*; large metacercaria in muscle of *Ictalarus catostomus*; adult in heron, cormorrants, unfed chicks |
| *Diplostomulum spathaceum* * | Metacercaria in vitreous humor, lens of eye |
| *Diplostomulum spathaceum indistinctum* * | Eye |
| *Metorchis conjunctus* | Cercaria in snail; metacercaria in flesh of this fish; adult in mink, dog, man |
| *Neascus pyriformis* | Metacercaria in fins, skin |

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|---|---|
| *Neascus* spp. | Metacercaria integument, fins, flesh, eye socket, cranial cavity, mesentery and peritoneal surfaces of viscera |
| *Neascus of Posthodiplostomum minimum* | Metacercaria fish; adult in herons |
| *Tetracotyle communis* | Metacercaria in mesentery of fish; adult in gulls |
| *Tetracotyle intermedia* * | Metacercaria in heart, mesenteries |
| *Tetracotyle* spp. * | Metacercaria in heart, pericardium, mesenteries, kidney, musculature |
| *Tetracotyle of Cotylurus communis* | Metacercaria in pericardial cavity; adult in gull, Larus argentatus |
| *Uvulifer ambloplitis* * | Metacercaris in skin, musculature, fins, gills |
| CESTOIDEA | |
| *Biacetabulum biloculoides* | Procercoid and plerocercoid Oligochaetes |
| *Biacetabulum infrequens* | Not available |
| *Biacetabulum macrocephalum* | Procercoid and plerocercoid Oligochaetes |
| *Bothriocephalus biloculoides* | Procercoid in copepods; plerocercoids sometimes in small fish |
| *Bothriocephalus cuspidatus* | Procercoid in copepods; plerocercoids sometimes in small fish |
| *Diphyllobothrium latum* # | Not available |
| *Diphyllobothrium* spp. * | Plerocercoids in viscera, musculature, body cavity, blood vessels of heart of this fish |
| *Glaridacris catostomi* | Procercoid and plerocercoid in Oligochaetes |
| *Glaridacris confusus* | Not available |
| *Glaridacris intermedius* | Not available |
| *Glaridacris laruei* | Not available |
| *Glaridacris oligorchis* | Procercoid and plerocercoid Oligochaetes |

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|---|---|
| *Glaridacris* spp. | Intestine |
| *Hunterella nodulosa* | Procercoid and plerocercoid in Oligochaetes; adult in intestine |
| *Isoglaridacris bulbocirrus* # | Anterior intestine |
| *Ligula intestinalis* | Procercoids in copepods; plerocercoids in body cavity of this fish; adult in fish eating birds |
| *Monobothrium hunteri* | Procercoid and plerocercoid oligochaetes |
| *Monobothrium ingens* | Not available |
| *Monobothrium ulmeri* | Procercoid and plerocercoid in Oligochaete, Tubificidae |
| *Proteocephalus* spp. | Procercoid in haemocoel of crustacea; plerocercoid in small fish |
| *Triaenophorus nodulosus* | Procercoid in copepods; plerocercoid in liver; adult in piscivorous fish |
| *Triganodistomum attenuatum* | Procercoid in crustacea |
| NEMATODA | |
| *Camallanus oxycephalus* | Adult in intestine, shows red from vent |
| *Capillaria catenata* | Gut, liver, urinary bladder of vertebrates |
| *Capillaria catostomi* # | Posterior intestine |
| *Contracaecum* spp. | Liver, mesenteries |
| *Dacnitoides cotylophora* | Intestine |
| *Dorylaimus* spp. | Not available |
| *Eustrongylides* spp. * | Larvae in viscera, muscle, body cavity, ovary |
| *Hepaticola bakeri* | Intestine |
| *Nematoda gen.* spp. * | Viscera, muscle, mesenteries, intestine, stomach |
| *Philometroides huronensis* | Larvae in haemocoel of Cyclops; adult in fins, peritoneum around swim bladder |
| *Philometroides nodulosa* # | Under skin in fins |

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|---|---|
| *Philometra kobuleji* * | Under serosa of air bladder, body cavity |
| *Philometra nodulosa* | Larvae in copepods; adult in fish tissue, under skin in fins # |
| *Philometra* spp. | Larvae in copepods; adult in fish tissue |
| *Raphidascaris acus* # | Intestine, vitreous humor |
| *Rhabdochona canadensis* # | Intestine |
| *Rhabdochona cascadilla* | Larvae in mayflies; adult in intestine |
| *Rabdochona ovifilamenta* # | Not available |
| *Rabdochona* spp. * | Intestine |
| *Skrjabino bakeri* * | Intestine |
| *Spiroxys* spp. | First host Cyclops; larvae in mesenteries of fish and amphibia, dragonfly nymphs and snails |

ACANTHOCEPHALA

| | |
|---|---|
| *Acanthocephalus dirus* | Larvae in Asellus and Gammarus; no second intermediate host |
| *Acanthocephalus jacksoni* * | Intestine |
| *Aacanthocephalus lateralis* | Larvae in Asellus and Gammarus |
| *Acanthocephalus parksidei* | Larvae in amphipods; no second intermediate host |
| *Echinorhynchus leidyi* | Larvae in amphipods |
| *Echinorhynchus salmonis* | Larvae in amphipods; second host, Osmerus |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if larvae less than 30 days also may be in small fish |
| *Metechinorhynchus leidyi* * | Intestine, stomach |
| *Metechinorhynchus salmonis* | Not available |
| *Neoechinorhynchus crassum* | Larvae in crustacea and fish; adult in intestine |
| *Neoechinorhynchus cristatus* | Larvae in small crustacea; some have second intermediate host; adult in fish |
| *Neoechinorhynchus. cylindratum* | Larvae in crustacea and fish |

| | |
|---|---|
| *Neoechinorhynchus distractus* # | Intestine |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Neoechinorhynchus* spp. * | Intestine |
| *Neoechinorhynchus strigosum* | Larvae in crustacea and fish |
| *Octospinifer macilentus* | Larvae in ostracod, crustacea |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host, small fish |
| *Pomphorhynchus* spp. * | Digestive tract |
| *Tanaorhamphus* spp. * | Intestine |
| OLIGOCHAETA | |
| *Actinobdella inequiannulata* * | Gill cavity, inner surface of operculum, transmits |
| *Trypanosoma catostomi* # | |
| *Actinobdella triannulata* | Gill cover (inner) |
| *Illinobdella* spp. | Not available |
| *Myzobdella moorei* # | Skin |
| *Piscicola punctata* | Not available |
| *Placobdella montifera* # | Skin |
| CRUSTACEA | |
| *Argulus appendiculosus* | Skin # |
| *Argulus catostomi* # | Body surface |
| *Argulus biramosus* | Not available |
| *Argulus catostomi* | Not available |
| *Argulus stizostethi* | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus confusus* | Not available |
| *Ergasilus nerkae* # | Not available |
| *Ergasilus* spp. | Not available |
| *Ergasilus versicolor* | Gills # |
| *Lernaea cyprinacaea* | Not available |

## ICTALURIDAE

*Ictalurus punctatus* - Channel catfish

PROTOZOA

Ciliata

Suctoria

| | |
|---|---|
| *Trichophyra ictaluri* | Gills |
| *Trichophyra piscium* | Gills |

"True ciliates"

| | |
|---|---|
| *Ichthyophthirus multifiliis* # | Fins, gills |
| *Tripartiella symmetricus* | Gills |

MYXOSPORIDA

| | |
|---|---|
| *Henneguya exilis* | Gills |
| *Myxidium macrocapsulare* | Gall bladder |

MONOGENEA

| | |
|---|---|
| *Cleidodiscus floridanus* | Gills |
| *Cleidodiscus pricei* | Gills |
| *Gyrodactyloidea gen.* spp. * | Gills, skin |
| *Ligictaluridus floridanus* # | Gills |

DIGENEA

| | |
|---|---|
| *Acetodextra ameiuri* | Metacercaria in liver of stonecat; adult in ovary and air bladder |
| *Acetodextra* spp. | Adult in ovary and air bladder |
| *Alloglossidium corti* * | Adult in intestine |
| *Alloglossidium kenti* | Metacercaria in dragonfly nymphs; adult in intestine |
| *Azygia angusticauda* * | Adult in intestine, stomach |
| *Crepidostomum ambloplitis* | Metacercaria in mayfly nymphs |
| *Crepidostomum cornutum* * | Intestine, pyloric caeca, gall bladder |
| *Macroderoides* spp. * | Digestive tract |
| *Megalogonia ictaluri* * | Intestine |
| *Microphallus opacus* * | Intestine |

| | |
|---|---|
| *Phyllodistomum lacustris* | Cercaria in clam; metacercaria in sporocyst in clam or arthropod |
| Polylekithum ictaluri # | Digestive tract |
| *Polylekithulm* spp. * | Ureters, urinary bladder |
| *Vietosoma parvum* * | Digestive tract |
| DIGENEA METACERCARIA | |
| *Diplostomulum* spp. * | Eye, brain, pharynx |
| CESTOIDEA | |
| *Bothriocephalus* spp. | Pyloric caeca, intestine |
| Corallobothrium fimbriatum | Procercoid in Cyclops; plerocercoid in *Notropis blennius*; adult in intestine |
| *Corallobothrium giganteum* # | Procercoid in Cyclops; plerocercoid in Notropis blennius; adult in intestine |
| *Haplobothrium globuliforme* | Procercoid in copepods; plerocercoid encysts in liver of fish |
| *Megathylacoides giganteum* * | Digestive tract |
| *Ophiotaenia fragilis* # | Not given |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepod; adult in intestine, shows red from vent |
| *Dacnitoides cotylophora* | Intestine |
| *Nematoda gen.* spp. * | Viscera, musculature, mesenteries. intestine and stomach |
| *Spinitectus carolini* | Larvae in mayfly larvae; stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; stomach and intestine |
| *Spiroxys* spp. | First host Cyclops; mesenteries of fish and amphibia, dragonfly nymphs, snails |
| ACANTHOCEPHALA | |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if larvae less than 30 days may also be in small fish |

| | |
|---|---|
| *Metechinorhynchus salmonis* # | Intestine |
| *Neoechinorhynchus rutili* | Larvae in small crustacea; some have second intermediate host |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host in small fish |
| *Pomphorhynchus* spp.* | Digestive tract |
| OLIGOCHAETA | |
| *Cystobranchus verrilli* | Not available |
| *Illinobdella moorei* | Not available |
| *Myzobdella moorei* * | Fins |
| *Piscicolaria* spp. | Not available |
| CRUSTACEA | |
| *Achtheres micropteri* | Not available |
| *Achtheres pimelodi* | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus megaceros* | Not available |
| Ergasilus *versicolor* | Not available |
| *Ictalurus nebulosus* - Brown bullhead | |
| PROTOZOA | |
| Flagellata | |
| *Bodomonas concava* * | Gills |
| Ciliata | |
| *Apiosoma* spp. | Fins, gills, skin |
| *Ichthyophthirius multifiliis* * | Skin, gills, fins |
| *Trichodina* spp. * | Gills, urinary bladder, ureters |
| *Trichophrya* spp. | Gills |
| MYXOSPORIDA | |
| *Henneguya exilis* | Gills |
| *Myxobolus* spp. | Gills |
| *Sphaerospora hankai* # | Renal tubules |
| Coccidia | |

| | |
|---|---|
| *Eimeria ictaluri* * | Intestine |
| MONOGENEA | |
| *Cleidodiscus floridanus* | Not available |
| *Cleidodiscus pricei* | Gills |
| *Gyrodactyloidea gen.* spp. * | Gills, skin |
| Gyrodactylus nebulosus | Fins |
| *Gyrodactylus rarus* | Not available |
| *Ligictaluridus monticelli* # | Nares |
| *Ligictaluridus pricei* # | Gills |
| DIGENEA | |
| *Acetodextra ameiuri* | Metacercaria in stonecat liver; adult in ovary and air bladder |
| *Alloglossidium corti* * | Adult in intestine |
| *Alloglossidium geminus* | Cercaria in snail; metacercaria in dragonfly nymphs; adult in intestine |
| *Allocreadium ictaluri* | Cercaria in clam, limpet; metacercaria in arthropods and clams |
| *Azygia angusticauda* | Cercaria in snail, snail eaten; metacercaria in small fish carriers; adult in intestine |
| *Crepidostomum ambloplitis* | Cercaria in clam; metacercaria in insects, crustacea |
| *Crepidostomum cornutum* * | Adult in intestine, pyloric caeca, gall bladder |
| *Crepidostomum ictaluri* | Cercaria in clam; metacercaria in aquatic mayflies and crustacea; adult in intestine |
| *Glossidium geminum* | Intestine |
| *Macroderoides spinifera* | Cercaria in snail, Helisoma; metacercaria in fish muscle; adult in intestine |
| *Megalogonia ictaluri* * | Adult in intestine |
| *Microphallus opacus* * | Adult in intestine |
| *Petasiger nitidus* | Cercaria in snail, Helisoma, snail eaten; metacercaria in fish; adult in intestine |

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|---|---|
| *Phyllodistomum americanum* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in urinary bladder |
| *Phyllodistomum* spp. | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in ureters |
| *Phyllodistomum staffordi* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in urinary bladder |
| *Polylekithum ictaluri* * | Adult in intestine |
| *Vietosoma parvum* * | Adult in digestive tract |
| DIGENEA METACERCARIA | |
| *Centrovarium lobotes* * | Metacercaria in musculature |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth and esophagus of heron |
| *Diplostomum spathaceum* | Cercaria in snail; metacercaria in eye of fish; adult in birds |
| *Diplostomum* spp. | Metacercaria in eye of fish; adult in birds |
| *Echinochasmus donaldsoni* | Cercaria in snail; metacercaria in nares and cloaca; adult in mink |
| *Posthodiplostomum minimum minimum* | Adult in birds |
| *Rhipidocotyle* spp. * | Metacercaria in fins |
| *Tetracotyle* spp. | Metacercaria in mesenteries and kidney; adult in birds |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepods; plerocercoid sometimes in small fish; adult in intestine |
| *Bothriocephalus cuspidatus* | Procercoid in copepods; plerocercoids sometimes in small fish; adults in intestine |
| *Bothriocephalus* spp. * | Pyloric caeca, intestine |
| *Cestoda gen.* spp. (*metacestode*) * | Encysted in musculature, mesenteries, viscera, free in intestine |
| *Corallobothrium fimbriatum* | Procercoid in Cyclops; plerocercoid, *Notropis blennius* |

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|---|---|
| *Corallobothrium parafimbriatum* | Procercoid in copepod; plerocercoid in copepod or fish; adult in intestine |
| *Corallobothrium parvum* | Procercoid in Cyclops; plerocercoid in *Glaridichthys talcatus* |
| *Corallobothrium* spp. * | Intestine |
| *Corallotaenia minutia* | Procercoid in copepod; plerocercoid in copepod or fish; adult in intestine |
| *Haplobothrium globuliforme* | Procercoid in Cyclops; plerocercoid encysted in liver of *Amia calva*; adult in intestine |
| *Proteocephalus ambloplitis* | Procercoid in haemocoel of crustacea; plerocercoid in mesenteries of small fish |
| *Proteocehhalus pearsi* * | Intestine |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepod; adult in intestine shows red from anus |
| *Capillaria* spp. * | Intestine, stomach |
| *Contracaecum* spp. | Adult in mesenteries and liver of fish |
| *Cucullanellus cotylophora* * | Intestine |
| *Dacnitoides cotylophora* | Intestine |
| *Dichelyne robustus* * | Intestine |
| *Dioctophyma renale* * | Larvae in viscera, mesenteries, muscle |
| *Eustrongylides tubifex* # | Mesenteries |
| *Metabronema prevosti* | Larvae in mayfly nymphs |
| *Rhabdochona cascadilla* * | Intestine |
| *Rhabdochona* spp. * | Intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult stomach and intestine |
| *Spiroxys contorta* | Larvae in Odonata nymphs, adult in turtles and fish |

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| *Spiroxys* spp. | First host Cyclops; mesenteries of fish and amphibia, dragonfly nymphs |
| ACANTHOCEPHALA | |
| *Acanthocephalus* spp. | Larvae in amphipods; no second host; adult in intestine |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days may also be in small fish |
| *Metechinorhynchus salmonis* * | Intestine |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host small fish, may be in this fish |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Not available |
| *Illinobdella* spp. | Not available |
| *Myzobdella moorei* * | Fins |
| *Piscicolaria* spp. | Not available |
| CRUSTACEA | |
| *Achtheres pimelodi* | Not available |
| *Argulus americanus* | Not available |
| *Argulus appendiculosus* | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus megaceros* | Nasal fossae |
| *Ergasilus* spp. * | Gills |
| *Ergasilus versicolor* | Not available |

*Ictalurus melas* - Black bullhead

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|---|---|
| PROTOZOA | |
| Ciliata | |
| *Ambiphyra ameiuri* | Gills |
| MYXOSPORIDA | |
| *Henneguya exilis* | Gills, gut, skin, gall bladder |
| *Henneguya gurleyi* | Base of spine |

| | |
|---|---|
| *Henneguya limatula* | Gall bladder |
| *Myxidium macrocapsulare* | Gall bladder |
| MONOGENEA | |
| *Cleidodiscus floridanus* | Gills |
| *Cleidodiscus pricei* * | Gills |
| *Gyrodactylus fairporti* | Fins |
| DIGENEA | |
| *Acetodextra ameiuri* | Metacercaria in liver of stonecat; adult in ovary and air bladder |
| *Allocreadium ictaluri* | Cercaria in clam, limpet; metacercaria in arthropods, clams; adult in intestine |
| *Alloglossidium corti* | Intestine |
| *Alloglossidium* spp. | Metacercaria dragonfly nymphs; adult in intestine |
| *Azygia angusticauda* | Intestine, stomach |
| *Azygia longa* | Cercaria in snail; metacercaria may be in carrier fish or host fish; adult in intestine, stomach |
| *Bucephaloides pusillus* | Cercaria in clam; metacercaria fish; adult in intestine |
| *Centrovarium lobotes* | Metacercaria fish flesh; adult in stomach and intestine |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Crepidostomum ictaluri* | Metacercaria in mayfly nymphs |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in insect nymphs |
| *Glossidium geminum* | Intestine |
| *Leuceruthrus micropteri* * | Stomach |
| *Megalogonia ictaluri* * | Intestine |
| *Microphallus opacus* | Metacercaria in crayfish |
| *Phyllodistomum americanun* | Cercaria in clam; metacercaria in sporocyst in clam, arthropods; adult in urinary bladder |
| *Phyllodistomum* spp. | Cercaria in clam; metacercaria in sporocysts in clam, arthropods |

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|---|---|
| *Phyllodistomum staffordi* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in urinary bladder |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth and esophagus of heron |
| *Diplostomulum flexicaudum* | Unencysted in lens; adult in birds |
| *Diplostomulum of Hysteromorpha* | Cercaria in snail; large metacercaria in muscle |
| *Macroderoides spinifera* | Cercaria in snail, Helisoma; metacercaria in muscle of fish; adult in intestine |
| *Ribeiroia ondatra* | Cercaria in snail, Helisoma; metacercaria in lateral line of fish; adult in muskrats, ospreys, hawks |
| *Sellacotyle mustelae* | Metacercaria in flesh and mesenteries; adult in intestine of mammals |
| CESTOIDEA | |
| *Corallobothrium fimbriatum* | Procercoid in Cyclops; plerocercoid in *Notropis blennius* |
| *Corallobothrium giganateum* | Procercoid in copepods; plerocercoid in small fish |
| *Corallobothrium* spp. | Procercoid in copepods; plerocercoid in small fish; adult in intestine |
| *Proteocephalus ambloplitis* * | Plerocercoids encysted in viscera |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepod; adult in intestine, shows red from anus |
| *Contracaecum spiculigerum* | Intestine and mesentery |
| *Cucullanellus cotylophora* * | Intestine |
| *Dacnitoides cotylophora* | Intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* | Larave in mayfly larvae; adult in stomach and intestine |

| | |
|---|---|
| *Spiroxys* spp. | First host Cyclops; mesenteries of fish and amphibia, dragonfly nymphs, snails |
| ACANTHOCEPHALA | |
| *Acanthocephalus parksidei* | Larvae in amphipod; midgut of this fish |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days may also be in small fish |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host is this fish |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Not available |
| *Illinobdella* spp. | Not available |
| *Piscicola punctata* * | Body surface, gills |
| *Piscicolaria* spp. | Not available |
| CRUSTACEA | |
| *Achtheres ambloplitis* | Gills |
| *Achtheres pimelodi* | Not available |
| *Argulus appendiculosus* | Not available |
| Argulus biramosus | Not available |
| *Argulus catostomi* * | Fins |
| *Argulus* spp. | Gills |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus elegans* | Not available |
| *Ergasilus megaceros* | Nasal fossae |
| *Ergasilus* spp. | Not available |
| *Ergasilus versicolor* | Not available |
| *Lernaea* spp. | Not available |
| *Lernaea variabilis* | Larvae on gills |
| *Ictalurus natalis* -Yellow bullhead | |
| MONOGENEA | |
| *Cleidodiscus floridanus* | Gills |

| | |
|---|---|
| DIGENEA | |
| *Acetodextra ameiuri* | Metacercaria in Noturus (stonecat); adult in ova next to swim bladder, ova passed during spawning |
| *Alloglossidium corti* | Cercaria in snail; metacercaria in dragonfly nymphs; adult in intestine |
| *Azygia angusticauda* | Cercaria in snail, snail eaten; metacercaria in small fish |
| *Centrovarium lobotes* | Cercaria in snail; metacercaria in fish muscle; adult in stomach and intestine |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in aquatic insects, crustacea; adult in birds |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Crepidostomum ictaluri* | Cercaria in clam; metacercaria in mayfly nymphs, Gammarus |
| *Glossidium geminum* | Not available |
| *Macroderoides spinifera* | Cercaria in snail; metacercaria in muscle of fish, tadpoles; adult in intestine |
| *Phyllodistomum staffordi* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth and esophagus of heron |
| *Diplostomulum* spp. | Cercaria in snail; larvae metacercaria in muscle; adult in herons and other birds |
| Neascus of *Posthodiplostomum minimum* | Metacercaria in fish; adult in herons and other birds |
| CESTOIDEA | |
| *Corallobothrium fimbriatum* | Procercoid in Cyclops; plerocercoid in Notropis |
| *Proteocephalus ambloplitis* | Procercoid in copepods; plerocercoid inviscera |

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|---|---|
| *Proteocephalus pearsi* | Procercoid in copepods; plerocercoid in yellow bullhead |
| *Proteocephalus* spp. | Procercoid in copepods; plerocercoid in many fish |
| NEMATODA | |
| *Camallanus* spp. | Larvae in copepods and other crustacea; adult in stomach and intestine |
| *Contracaecum spiculigerum* | Larvae in fish; adult in cormorants, mergansers, gulls, pelicans |
| *Contracaecum* spp. | Larvae in fish; adult in birds |
| *Spinitectus carolini* | Larvae in mayfly larvae |
| *Spinitectus gracilis* | Larvae in mayfly larvae |
| *Spinitectus* spp. | Larvae in mayfly larvae |
| *Spiroxys* spp. | Larvae in mesenteries of fish, amphibia, dragonfly nymphs, snails, (Cyclops experimentally) |
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Intestine |
| *Leptorhynchoides thecatum* | Larvae in amphipods, if less than 30 days also may be in mesenteries of fish |
| *Neoechinorhynchus rutili* | Larvae in crustacea; some have second intermediate host |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second host small fish |
| OLIGOCHAETA | |
| *Piscicolaria* spp. | Not available |
| CRUSTACEA | |
| *Achtheres pimelodi* | Not available |
| *Ergasilus versicolor* | Not available |
| *Ictalurus furcatus* - Blue catfish | |
| DIGENEA | |
| *Allocreadium ictaluri* | Cercaria in clam; metacercaria arthropods, clams; progenesis sometimes in clams |

| | | |
|---|---|---|
| DIGENEA METACERCARIA | | |
| *Diplostomulum scheuringi* | | Vitreous humor |
| *Neascus* spp. | | Muscle |
| CRUSTACEA | | |
| *Ergasilus versicolor* | | Not available |

**ESOCIDAE**

*Esox lucius* - Northern pike

| | | |
|---|---|---|
| FUNGI | | |
| *Branchiomyces demigrans* | | Gills |
| PROTOZOA | | |
| Ciliata | | |
| *Trichodina* spp. | | Not available |
| MYXOSPORIDA | | |
| *Henneguya schizura* | | Eye muscle, sclera, choroid |
| *Myxidium lieberkuehni* | | Urinary bladder |
| MONOGENA | | |
| *Gyrodactyloidea gen.* spp. | * | Gills, skin |
| *Tetraonchus monenteron* | | Gills |
| *Urocleidus mimus* | | Gills |
| DIGENEA | | |
| *Azygia angusticauda* | | Cercaria in snail; adult in stomach or intestine |
| *Azygia longa* | | Cercaria in snail, eaten; metacercaria in host fish or carrier fish; adult in host fish |
| *Azygia sebago* | | Cercaria in snail, eaten; metacercaria in host fish or carrier fish; adult in host fish |
| *Azygia* spp. | | Cercaria in snail, eaten; metacercaria in host fish or carrier fish; adult in host fish |
| *Bucephaloides pusillus* | | Cercaria in clam; metacercaria in fish; adult in intestine |
| *Centrovarium lobotes* | | Metacercaria in fish muscle; adult in stomach and intestine |

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|---|---|
| *Crepdiostomum cooperi* | Cercaria in clam; metacercaria in insect or crustacea |
| *Crepidiostomum farionis* # | Not given |
| *Macroderoides flavus* | Cercaria in snail; metacercaria in fish and tadpoles; adult in intestine |
| *Maritrema obstipum* | Adult in intestine, normally in birds, accidentally in fish |
| *Microphallus opacus* | Metacercaria in crayfish; adult in intestine and urinary bladder |
| *Phyllodistomum americanum* | Cercaria in clam; metacercaria in arthropod, sporocysts in clam; adult in urinary bladder |
| *Phyllodistomum folium* | Cercaria in clam; metacercaria in arthropod, sporocysts in clam; adult in urinary bladder |
| *Phyllodistomum* spp. # | Not available |
| *Rhipidocotyle papillosum* | Cercaria in clam; metacercaria in fish; adult in stomach and intestine |

DIGENEA METACERCARIA

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in Helisoma; metacercaria as yellow grub; adult in intestine, stomach of heron |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber and brain of fish and newts |
| *Diplostomulum spathaceum* # | Eye, vitreous humor |
| *Diplostomulum* spp. # | Eye, brain, pharynx |
| *Neascus* spp. | Metacercaria in integument, fins, flesh, eye socket, cranial cavity, mesentery and peritoneum |
| *Neascus of Crassiphiala bulboglossa* | Cercaria in snail, Helisoma; metacercaria black spot, skin cysts; final host, kingfisher |
| *Posthodiplostomum minimum* | Metacercaria in liver, mesenteries; adult in birds |
| *Tetracotyle* spp. | Metacercaria in mesenteries; adult in birds |

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|---|---|
| *Uvulifer ambloplitis* | Cercaria in snail, Helisoma; metacercaria in skin; adult in kingfisher |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepod; plerocercoid may be in small fish; adult in intestine |
| *Bothriocephalus cuspidatus* * | Pyloric caeca, intestine |
| *Diphyllobothrium latum* | Procercoid in copepod; plerocercoid fish; adult in bears, dogs, man |
| *Diphyllobothrium* spp. * | Plerocercoid in viscera, musculature, body cavity, blood vessels of heart |
| *Glaridacris catostomi* # | Not available |
| *Proteocephalus perplexus* | Plerocercoids in Hyborhynchus; Notatus, Roccus, Ictalurus |
| *Proteocephalus pinguis* | Procercoid in copepods; plerocercoid in fish |
| *Proteocephalus* spp. | Intestine |
| *Triaenophorus crassus* | Procercoid in copepods; plerocercoid in forage fish; adult in intestine |
| *Triaenophorus nodulosus* | Procercoid in copepods; plerocercoid in forage fish; adult in intestine |
| *Triaenophorus* spp. * | Adult in intestine |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepods; adult red from anus of fish |
| *Camallanus* spp. * | Spleen |
| *Contracaecum brachyurum* | Larvae in stomach, intestine; adult in fish eating fish, birds, mammals |
| *Haplonema* spp. | Larvae in Cottus |
| *Hysterothylacium brachyurum* # | Intestine |
| *Philometra transulucida* | Larvae in copepods; adult in fish tissue |
| *Raphidascaris acus* | Larvae small fish |

| | |
|---|---|
| *Raphidascaris canadense* | Larvae in small fish, minnows, perch; adult in teleosts |
| *Raphidascaris* spp. * | Liver and digestive tract |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach or intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach or intestine |
| *Spiroxys* spp. | First intermediate host, Cyclops; larvae in mesenteries of fish, amphibia, dragonfly nymphs and smail |
| *Thynnascaris brachyura* * | Intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus jacksoni* # | Intestine |
| *Leptorhynchoides thecatus* | Larvae in amphipods; less than 30 days larvae may also be in fish; adult in intestine |
| *Metechinorhynchus salmonis* | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Neoechinorhnchus tenellum* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod, small fish |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Not available |
| *Illinobdella* spp. | Fins |
| *Mollibdella grandis* * | Body surface |
| *Placobdella montifera* # | Skin |
| *Placobdella parasitica* | Not available |
| *Piscicola milneri* # | Not avaliable |
| CRUSTACEA | |
| *Argulus appendiculosus* # | Skin |
| *Argulus biramosus* | Not available |
| *Argulus canadensis* # | Not available |
| *Argulus maculosus* # | Not available |

| | |
|---|---|
| *Ergasilus caeruleus* # | Gills |
| *Ergasilus* spp. | Gills |
| *Lernaea cyprinacaea* | Flesh and fins |
| *Salmincola extenus* # | Not avalilable |

*Esox masquinongy* - Muskellunge

PROTOZOA

MYXOSPORIDA

| | |
|---|---|
| *Henneguya acuta* | Gills |

MONOGENEA

| | |
|---|---|
| *Gyrodactyloides gen.* spp. * | Gills, skin |
| *Gyrodacyylus* spp. # | Gills |
| *Tetraonchus loftusi* * | Gills |

DIGENEA

| | |
|---|---|
| *Azygia angusticauda* | Cercaria in snail, snail eaten by host fish, small fish may act as carriers; adult in intestine |
| *Azygia longa* * | Intestine, stomach |
| *Cestrahelmins laruei* | Intestine |
| *Cryptogonimus chyli* | Metacercaria in fish muscle; adult gastrointestinal |
| *Macroderoides spinifera* | Cercaria in snail, Helisoma; metacercaria in fish and tadpoles; adult in intestine |
| *Phyllodistomum staffordi* | Cercaria in clam; metacercaria sporocyst, arthropods; adult in urinary bladder |

DIGENEA METACERCARIA

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in Helisoma; metacercaria as yellow grub; adult in intestine, stomach of heron |
| *Diplostomulum flexicaudum* | Cercaria in snail; metacercaria in fish; adult in birds |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber and brain of fish and newts |
| *Diplostomulum spathaceum indistinctum* * | Eye |

| | |
|---|---|
| *Diplostomulum* spp. * | Eye, brain, pharynx |
| *Neascus of Crassiphiala bulboglossa* | Cercaria in snail, Helisoma; metacercaria as black spot, skin cysts; adult in kingfisher |
| CESTOIDEA | |
| *Cyathocephalus truncatus* # | Not available |
| *Proteocephalus pinguis* | Procercoid in copepods; plerocercoid in fish |
| *Triaenophorus crassus* | Plerocercoids in Coregonus, *Lota lota*, *Oncorhynchus nerka*, *Percopsis omiscomaycus*, *Petromyzon marinus*, *Prosopium* spp., *Salvelinus namaycush*, *Stenodus leucichthys*, *Thymallus signifer* (muscle); adult in *Esox* spp. |
| *Triaenophorus nodulosus* | Plerocercoids in viscera of *Catostomus* spp., *Coregonus* spp., *Cottus cognatus*, *Esox* spp., *Micropterus* spp., *Moxostoma* spp., *Notropis* spp., *Perca flavescens*, *Poxomis nigromaculatus*, *Salvelinus fontinalis*, *Thymallus signifer* |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepod; red nematode from anus |
| *Contracaecum brachyurum* | Larvae in stomach and intestine; adult in fish eating fish, birds, mammals |
| *Hysterothylacium brachyurum* # | Intestine |
| *Metabronema salvelini* | Larvae in mayfly nymphs |
| *Philometra* spp. | Larvae in copepods; adult in fish tissue |
| *Raphidascaris acus* # | Not available |
| *Raphidascaris canadense* | Larvae in the liver of minnows and perch; adult in teleosts |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach and intestine |

| | |
|---|---|
| *Spiroxys* spp. | First host Cyclops; larvae in mesenteries of fish and amphibia, dragonfly nymphs, snails |
| *Thynnascaris brachyura* * | Intestine |
| ACANTHOCEPHALA | |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days may be in small fish |
| *Metechinorhynchus salmonis* | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish, larvae in this fish; adult in this fish |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Neoechinorhynchus tenellus* | Larvae in small crustacea, some have second intermediate host; adult in intestine |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod, small fish |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Not available |
| *Illinobdella* spp. | Not available |
| *Placobdella parasitica* | Not available |
| CRUSTACEA | |
| *Argulus americanus* | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus luciopercarum* # | Not available |

**OSMERIDAE**

*Osmerus mordax* - Rainbow smelt

| | |
|---|---|
| PROTOZOA | |
| Coccidia | |
| *Eimeria osmeri* * | Intestine |
| Microsporida | |
| *Glugea hertwigi* | In many organs, intestine, gonads, etc. |

| | |
|---|---|
| DIGENEA | |
| *Azygia longa* | Cercaria in snail, eaten; metacercaria in host fish or carrier fish; adult in stomach or intestine |
| *Azygia sebago* | Adult in stomach or intestine |
| *Brachyphallus crenatus* | Not available |
| *Derogenes varicus* | Adult in esophagus, stomach |
| *Hemiurus appendiculatus* | Adult in stomach |
| DIGENEA METACERCARIA | |
| *Diplostomulum flexicaudum* | Cercaria in snail; metacercaria in lens of eye; adult in birds |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber of fish and newts |
| *Diplostomulum* spp. * | Not available |
| *Diplostomulum spathaceum* * | Metacercaria in eye, brain, pharynx |
| *Diplostomulum spathaceum indistinctum* * | Metacercaria in eye |
| *Tetracotyle intemedia* * | Metacercaria in heart, mesenteries |
| *Tetracotyle* spp. * | Metacercaria in heart, pericardium, mesenteries, kidney, musculature; adult in birds |
| CESTOIDEA | |
| *Cyathocephalus truncatus* | Procercoid in amphipod; plerocercoid in small fish |
| *Eubothrium* spp. * | Immature parasite in posterior intestine and rectum # |
| *Ligula intestinalis* | Procercoid in copepods; plerocercoid in body cavity of fish; adult in fish eating birds |
| *Proteocephalus* spp. | Procercoid in haemocoel of crustacea; plerocercoid in small fish; adult in intestine, pyloric caeca, immature parasite this fish # |

| | | |
|---|---|---|
| NEMATODA | | |
| *Capillaria* spp. | # | Immature parasite, pyloric caeca and anterior intestine |
| *Cystidicola farionis* | * | Swim bladder |
| *Cystidicola*. spp. | | Swim bladder, immature parasite in pyloric caeca and anterior intestine # |
| *Cystidicola stigmatura* | | Larvae in Gammarus; adult in swim bladder, air vessels, rarely esophagus |
| *Philometra* spp. | * | Body cavity, intestine |
| *Spinitectus gracilis* | | Larvae in mayfly larvae; adult in stomach or intestine |
| *Thominx catenata* | * | Intestine |
| ACANTHOCEPHALA | | |
| *Acanthocephalus jacksoni* | * | Intestine |
| *Acanthocephala parksidei* | | Larvae in amphipods; no second intermediate host |
| *Corynosoma hardweni* | | Adult in seal |
| *Echinorhynchus salmonis* | | Larve in amphipod, encapsulated in mesenteries, of digestive tract, liver and swimbladder # |
| *Leptorhynchoides thecatum* | | Larvae in amphipod; second intermediate host, small fish |
| *Metechinorhynchus salmonis* | | Intestine |
| *Neoechinorhynchus pungitius* | * | Intestine, stomach |
| *Neoechinorhynchus rutili* | * | Intestine |
| *Neoechinorhynchus tumidus* | | Larvae in small crustacea, some have second intermediate host |
| *Pomphorhynchus bulbocolli* | | Larvae in amphipod; second intermediate host, small fish |
| OLIGOCHAETA | | |
| *Piscicola geometra* | | Not available |
| *Pisciscola punctata* | | Not available |
| CRUSTACEA | | |
| *Argulus coregoni* | | Not available |

| | |
|---|---|
| *Ergasilus centrarchidarum* | Not available |

**SALMONIDAE**

*Salvelinus fontinalis* - Brook trout

PROTOZOA

Ciliata

Suctoria

| | |
|---|---|
| *Trichophyra piscium* | Gills |

"True Ciliates"

| | |
|---|---|
| *Balantidium* spp. | Intestine |
| *Ichthyophthirius multifiliis* # | Fins, gills, skin |
| *Trichodina* spp. * | Gills, urinary bladder, ureters |
| *Trichodinella* spp. | Gills |

Sporozoa

| | |
|---|---|
| *Sarcocystis salvelini* | Muscle |

Coccidia

| | |
|---|---|
| *Eimeria salvelini* | Anterior gut epithelium |
| *Eimeria truttae* | Anterior gut epithelium |

Haemosporidia

| | |
|---|---|
| *Dactylosoma salvelini* | In red blood cells |
| *Leucocytozoon salvelini* | In red blood cells |

MYXOSPORIDA

| | |
|---|---|
| *Myxobolus cerebralis* # | Cartilage of head and gills, intermediate host, tubifex worms |
| *Myxobolus ovoidalis* | In skin |
| *Unicauda fontinalis* | In skin |
| *Zschokkela salvelini* | Kidney capsule |

MONOGENEA

| | |
|---|---|
| *Discocotyle sagittata* * | Gills |
| *Discocotyle salmonis* | Gills |

| | |
|---|---|
| DIGENEA | |
| *Azygia angusticauda* | Stomach, intestine |
| *Azygia longa* | First host snail; metacercaria in fish host or carrier fish; adult in stomach, intestine |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insect, crustacea |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Crepidostomum farionis* | Cercaria in clam; metacercaria in mayfly, Gammarus |
| *Crepidostomum* spp.. | Cercaria in clam; metacercaria in insect, crustacea |
| *Phyllodistomum lachancei* | First host clam; metacercaria sporocyst in clam, arthropods; adult in urinary bladder |
| *Pleurogenes* spp. | Accidental (usually in frogs), metacercaria in crayfish |
| *Tetracotyle* spp. # | Heart, kidney |
| DIGENEA METACERCARIA | |
| *Aphophallus brevis* | Cercaria in snails, Amnicola; metacercaria in fish as black cyst; adult in gulls, loons, muskrats |
| *Aphophallus imperator* * | Metacercaria in skin, fins |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum scheuringi* | First host snail, Helisoma; metacercaria in vitreous chamber of eye in fish and newts |
| *Diplostomulum spathaceum* # | Eye |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Posthodiplostomum minimum* * | Metacercaria in mesenteries, liver, kidney |
| CESTOIDEA | |
| *Diphyllobothrium sebago* | Plerocercoids in fish |
| *Diphyllobothrium* spp. | Not available |

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|---|---|
| *Eubothrium salvelini* | Procercoids in copepods; no second intermediate host required |
| *Ligula intestinalis* | Procercoids in copepods; plerocercoids in body cavity of fish; adult in fish eating birds |
| *Ligula* spp. * | Plerocercoids in body cavity |
| *Proteocephalus ambloplitis* * | Adult in intestine |
| *Proteocephalus arcticus* | Procercoids in copepod; plerocercoids in small fish |
| *Proteocephalus parallacticus* | Procercoids in Cyclops; plerocercoids in Cyclops |
| *Proteocephalus pinguis* | Procercoids in copepod; plero cercoids in fish |
| *Proteocephalus* spp. * | Adult in intestine, pyloric caeca |
| *Triaenophorus crassus* | Procercoid copepod; plerocercoid forage fish; adult in intestine |
| NEMATODA | |
| *Cystidicola farionis* * | Adult in swim bladder |
| *Cystidicoloides ephemeridarum* # | Stomach |
| *Cucullanus* spp. # | Not available |
| *Hepaticola bakeri* | Intestine |
| *Hysterothylacium brachyurum* # | Intestine |
| *Metabronema canadense* | Larvae in mayfly nymphs |
| *Metabronema harwoodi* | Larvae in mayfly nymphs |
| *Metabronema salvelini* | Larvae in mayfly nymphs |
| *Oxyuridea* spp. | Not available |
| *Philometra* spp. | Larvae in copepods; adult in tissue |
| *Raphidascaris alius* | Larvae in small fish; adult in teleosts |
| *Raphidascaris canadense* | Larvae in small fish; adult in teleosts |
| *Rhabdochona cascadilla* | Larvae in mayflies; adult in intestine |
| *Rhabdochona laurentianus* | Larvae in small fish; adult in teleosts |

| | |
|---|---|
| *Skrjabino bakeri* * | Adult in intestine |
| *Thynnascaris brachyura* * | Adult in intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus jacksoni* # | Intestine |
| *Acanthocephalus lateralis* | Larvae in Asellus and Gammarus |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if larvae less than 30 days also in small fish |
| *Metechinorhynchus salmonis* # | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea, fish |
| *Neoechinorhynchus rutili* | Larvae in crustacea, fish |
| *Neoechinorhynchus saginatus* # | Intestine |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; small fish |
| OLIGOCHAETA | |
| *Piscicola punctata* | Not available |
| CRUSTACEA | |
| *Argulus coregoni* | Not available |
| *Argulus stizosthethi* | Not available |
| *Salmincola edwardsi* | Not available |

*Salvelinus namaycush* - Lake trout

| | |
|---|---|
| PROTOZOA | |
| Ciliata | |
| Suctoria | |
| *Trichophyra piscium* | Gills |
| "True Ciliates" | |
| *Chilodenella* spp. | Gills |
| *Ichthyophthirius multifilis* | Skin |
| *Trichodina* spp. | Gills |
| MONOGENA | |
| *Disocotyle sagittata* # | Gills |

| | |
|---|---|
| DIGENEA | |
| *Azygia angusticauda* | Adult in intestine, stomach |
| *Azygia longa* | Adult in intestine, stomach |
| *Crepidostomum farionis* | Adult in intestine, pyloric caeca, gall bladder |
| DIGENEA METACERCARIA | |
| *Apophallus brevis* | Cercaria in snail, Amnicola; metacercaria in fish as black cyst; adult in gulls, loons |
| *Apophallus* spp. * | Metacercaria in skin |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in brain, vitreous chamber of eye, fish and newts |
| *Diplostomulum spathaceum* # | Eye |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Tetracotyle intermedia* # | Heart |
| *Tetracotyle* spp. # | Heart, kidney |
| CESTOIDEA | |
| *Bothriocephalus cuspidatus* * | Pyloric caeca, intestine |
| *Bothriocephalus* spp. | Pyloric caeca, intestine |
| *Diphyllobothrium dendriticum* * | Plerocercoid in viscera |
| *Diphyllobothrium latum* * | Plerocercoid in musculature, body cavity |
| *Diphyllobothrium* spp. | Procercoid in copepod, other fish; plerocercoids, immature adult |
| *Eubothrium crassum* | Procercoid in copepod; no second intermediate host required; adult intestine of fish |
| *Eubothrium salvelini* | Procercoid in copepod, no second intermediate host required; adult intestine of fish |
| *Proteocephalus ambloplitis* * | Intestine |

| | |
|---|---|
| *Proteocephalus parallacticus* | Procercoid and plerocercoid in copepod |
| *Proteocephalus pusillus* * | Intestine, pyloric caeca |
| *Proteocephalus salvelini* | Procercoid and plerocercoid in Cyclops |
| *Proteocephalus* spp. * | Intestine, pyloric caeca |
| *Triaenophorus crassus* | Procercoid in copepod, plerocercoid in muscle, adult in fish |
| NEMATODA | |
| *Cystidicola cristivomeri* | Larvae in Gammarus, swim bladder, air vessels, esophagus |
| *Cystidicola farionis* * | Swim bladder |
| *Cystidicola stigmatura* | Swim bladder |
| *Hepaticola bakeri* | Not available |
| *Hysterothylacium brachyurum* # | Not avalilable |
| *Metabronema salvelini* | Larvae in mayfly nymphs |
| *Philonema agubernaculum* | Larvae in Cyclops, larger trout get by eating smelt |
| *Philonema oncorhynchi* * | First host copepod; larvae in body cavity, wall of swim bladder |
| *Philonema* spp. * | Larvae in body cavity, wall of swim bladder, stomach |
| ACANTHOCEPHALA | |
| *Acanthocephalus jacksoni* # | Intestine |
| *Acanthocephalus parksidei* | Larvae in amphipods, no second intermediate host required |
| *Echinorhynchus leidyi* | Larvae in amphipods |
| *Echinorhynchus salmonis* | Larvae in amphipods, *Osmerus mordax* |
| *Leptorhynchoides thecatum* | Larvae in amphipods; if larvae here less than 30 days, small fish may be second host |
| *Metechinorhynchus lateralis* # | Intestine |
| *Metechinorhynchus salmonis* | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish |

| | |
|---|---|
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Neoechinorhynchus tumidus* # | Intestine |
| *Pomphorhynchus bulbocolli* | Larvae in amphipods, small fish |
| OLIGOCHAETA | |
| *Piscicola milneri* * | Body surface, fins |
| CRUSTACEA | |
| *Argulus coregoni* | Not available |
| *Achtheres coregoni* | Not available |
| *Ergasilus nerkae* # | Not available |
| *Ergasilus* spp. # | Not avalilable |
| *Salmincola beani* | External surface of body |
| *Salmincola siscowet* * | Gills, body, fins |
| *Salmincola* spp. * | Body, gills, fins |

*Oncorhynchus mykiss* - Rainbow trout (formerly *Salmo gairdneri*)

| | |
|---|---|
| PROTOZOA | |
| Ciliata | |
| Suctoria | |
| *Trichophyra piscium* | Gills |
| "True Ciliates" | |
| *Carchesium* spp. | On eggs |
| MYXOSPORIDA | |
| *Henneguya salmonis* | Subcutaneous |
| *Myxobolus cerebralis* # | Cartilage of brain and gill arches, transmission via tubificid worms in the form of *Tractinomyxon* sp. |
| MONOGENEA | |
| *Discocotyle sagittata* | Gills |
| *Discocotyle salmonis* | Gills |
| DIGENEA | |
| *Azygia longa* | Snail eaten; metacercaria in host fish or carrier fish; adult in stomach, intestine |

| | |
|---|---|
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insect, crustacea |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Crepidostomum farionis* | Cercaria in clam; metacercaria in mayfly and Gammarus |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in insects, crustacea |
| *Phyllodistomum lachancei* | Metacercaria in sporocyst in clam or in arthropods; adult in urinary bladder |
| DIGENEA METACERCARIA | |
| *Apophallus brevis* | Cercaria in snail, Amnicola; metacercaria enclosed in black cyst in fish; adult in gulls, loons, muskrats |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| *Clinostomum* spp. * | Not available |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metaercaria in vitreous chamber of eye of fish and newts, adult in birds |
| *Diplostomulum spathaceum* # | Eye |
| *Diplostomulum* spp. * | Lens of eye; cataract |
| *Neascus* spp. | Skin |
| *Tetracotyle intermedia* # | Heart |
| *Tetracotyle* spp. # | Mesenteries |
| CESTOIDEA | |
| *Caryophyllaeidae* | Intestine and liver |
| *Diphyllobothrium* spp. | Not available |
| *Eubothrium crassum* | Procercoid in copepods; no second host required; adult in fish |
| *Eubothrium salvelina* | Procercoid in copepods; no second intermediate host required |
| *Eubothrium* spp. | Procercoid in copepods; no second intermediate host required |

| | |
|---|---|
| *Proteocephalus pinguis* | Procercoid in copepods; plerocercoid in fish |
| *Proteocephalus* spp. | Not available |
| *Triaenophorus crassus* # | Plerocercoids encysted in muscle, *Cyclops bicuspidatus* first host |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepod; adult in intestine, shows red from anus |
| *Capillaria salvelini* # | Intestine |
| *Cystidicola farionis* # | Swim bladder |
| *Cystidicola* spp. * | Not available |
| *Cystidicola stigmatura* | Not available |
| *Cystidicoloides tenuissima* * | Not available |
| *Hepaticola bakeri* | Intestine |
| *Metabronema salvelini* | Larvae in mayfly nymphs |
| *Rhabdochona cascadilla* | Larvae in mayflies; intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Intestine |
| *Acanthocephalus jacksoni* # | Intestine |
| *Acanthocephalus parksidei* | Larvae in crustacea, no second intermediate host |
| *Echinorhynchus leidyi* | Larvae in amphipods |
| *Echinorhynchus salmonis* | Larvae in amphipods, Osmerus |
| *Echinorhynchus* spp. | Not available |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days, small fish may be second host |
| *Metechinorhynchus lateralis* # | Intestine |
| *Metechinorhynchus salmonis* # | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in amphipod; if less than 30 days, small fish may be second host |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |

| | |
|---|---|
| *Neoechinorhynchus* spp. | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipods and small fish |
| OLIGOCHAETA | |
| *Illinobdella* spp. | Not available |
| *Piscicola geometra* | Not available |
| *Piscicola milneri* # | Not avalilable |
| *Piscicola punctata* | Not available |
| CRUSTACEA | |
| *Argulus coregoni* | External body surfaces |
| *Ergasilus luciopercarum* # | Gills |
| *Salmonicola californiensis* # | Gills |
| *Salmonicola edwardsi* | Not available |
| COELENTERATA | |
| *Hydra* spp. | Eggs and fry |
| *Salmo salar* - Atlantic salmon | |
| DIGENEA | |
| *Brachyphallus crenatus* | Not available |
| *Derogenes varicus* | Adult in esophagus and stomach |
| *Podocotyle simplex* | Adult in intestine |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber of eye of fish and newt |
| CESTOIDEA | |
| *Eubothrium crassum* | Procercoid in copepod, no second intermediate host required; adult in intestine of fish |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepod; adult in intestine, shows red from anus |

| | |
|---|---|
| *Cystidicola stigmatura* | Adult in swim bladder |
| *Hepaticola bakeri* | Intestine |
| ACANTHOCEPHALA | |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days, small fish may be second host |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipods and small fish |
| OLIGOCHAETA | |
| *Illinobdella* spp. | Not available |
| CRUSTACEA | |
| *Argulus coregoni* | Not available |
| *Argulus stizostethi* | Not available |
| *Salmo trutta* - Brown trout | |
| PROTOZOA | |
| Ciliata | |
| *Trichodina* spp. | Gills |
| MYXOSPORA | |
| *Myxobolus cerebralis* # | Cartilage of head and gills, intermediate host is tubificid oligochaete |
| MONOGENEA | |
| *Discocotyle sagittata* * | Not available |
| *Discocotyle salmonis* | Gills |
| *Gyrodactylus elegans salmonis* | Not available |
| DIGENEA | |
| *Azygia longa* | Cercaria in snail; metacercaria in carrier fish |
| *Bunodera luciopercae* | Cercaria in clam; metacercaria in crayfish and copepods |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in aquatic insects and crustacea |

| | |
|---|---|
| *Crepidostomum cornutum* # | Not available |
| *Crepidostomum farionis* | Cercaria in clam; metacercaria in mayfly nymphs or Gammarus |
| DIGENEA METACERCARIA | |
| *Apophallus brevis* | Metacercaria black cyst in this fish; adult in gulls, loons, muskrats |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in cyst in vitreous chamber, brain, eye |
| *Diplostomulum* spp. | Cercaria in snail, Helisoma; metacercaria in fish as black cyst in muscle; adult in pelican |
| *Neascus* spp. | Snail; metacercaria in fishes, blackspot cyst; adult in heron |
| CESTOIDEA | |
| *Caryophyllaeidae* | Intestine |
| *Diphyllobothrium* spp. | Procercoid in copepods; plerocercoid in fish; adult in mammals, birds |
| *Proteocephalus parallacticus* | Procercoid and plerocercoid in Cyclops |
| *Proteocephalus pinguis* | Procercoid in copepods; plerocercoid in fish |
| *Proteocephalus* spp. | Primarily plerocercoids |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in crustacea and copepods; adult in stomach and intestine; shows red from vent |
| *Contracaecum* spp. | Adult in piscivorous birds, fish and mammals |
| *Metabronema canadense* | Intestine |
| *Metabronema harwoodi* | Not available |
| *Metabronema salvelini* | Larvae in mayfly nymphs # |
| *Spinitectus gracilis* | Larvae in mayfly nymphs; adult in stomach and intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Intestine |

| | |
|---|---|
| *Acanthocephalus parksidei* | Larvae in amphipods; no second intermediate host required |
| *Echinorhynchus salmonis* | Larvae in amphipods; second host Osmerus mordax |
| *Neoechinorhynchus cristatus* # | Intestine |
| *Neoechinorhynchus rutili* | Larvae in crustacea; sometimes have second host |
| *Pomphorhynchus bulbocolli* # | Intestine |
| CRUSTACEA | |
| *Lernaea cruciata* | Not available |
| *Ergasilus luciopercarum* # | Not available |

<u>*Oncorhynchus*</u> spp. - Salmon

| | |
|---|---|
| PROTOZOA | |
| Ciliata | |
| *Epistylis* spp. # | Not avaliable |
| *Trichodina* sp. # | Not avaliable |
| Suctoria | |
| *Trichophyra piscium* | Gills |
| MYXOSPORIDA | |
| *Myxobolus cerebralis* # | Cartilage of brain, gill arches, Intermediate host tubificid oligochaete |
| MONOGENEA | |
| *Discocotyle sagittata* | Gills |
| *Gyrodactylus* spp. # | Gills |
| DIGENEA | |
| *Crepidostomum cooperi* # | Intestine |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in mayfly nymphs or Gammarus sp. |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in insects, crustacea |
| DIGENEA METACERCARIA | |

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fishes as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomum spathaceum* # | Eye |
| *Tetracotyle intermedia* * | Metacercaria in heart, mesenteries |
| CESTOIDEA | |
| *Cyathocephalus truncatus* # | Not available |
| *Diphyllobothrium* spp. | Not available |
| *Eubothrium salvelini* # | Intestine |
| *Proteocephalus arcticus* | Procercoid in copepods; pleroercoid in small fish |
| *Proteocephalus parallacticus* # | Intestine |
| *Proteocephalus wickliffi* # | Stomach, intestine |
| *Triaenopnorus crassus* # | Muscles |
| *Triaenopnorus nodulosus* # | Plerocercoids in liver, viscera |
| NEMATODA | |
| *Camallanus oxycephalus* # | Intestine |
| *Camallanus salvelini* # | Intestine |
| *Cystidicola farionis* * | Swim bladder |
| *Cystidicola stigmatura* | Swim bladder |
| *Cystidicoloides tenuissima* # | Gut |
| *Dorylamida* spp. # | Intestine |
| *Haplonema hamulatum* # | Larval stage |
| *Hepaticola bakeri* | Intestine |
| *Metabronema salvelini* | Larvae in mayfly nymphs |
| *Philonema oncorhynchi* # | Body cavity |
| *Raphidascaris acus* # | Liver, serosa, swim bladder |
| *Rhabdochona cascadilla* | Larvae in mayflies; intestine |
| *Rhabdochona canadensis* # | Not available |
| *Spinitectus gracilis* * | Intestine |
| *Thominx catenata* * | Intestine |

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|---|---|
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Intestine |
| *Acanthocephalus jacksoni* * | Intestine |
| *Acanthocephalus parksidei* | Larvae in amphipods; no second intermediate host |
| *Echinorhynchus lateralis* # | Intestine |
| *Echinorhynchus salmonis* | Larvae in amphipods; second host *Osmerus mordax* |
| *Echinorhynchus* spp. | Intestine |
| *Leptorhynchoides thecatus* * | Larvae found encysted in mesen teries; adult in intestine |
| *Metechinorhynchus lateralis* # | Intestine |
| *Metechinorhynchus salmonis* * | Intestine |
| *Neoechinorhynchus pungitius* * | Intestine, stomach |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Neoechinorhynchus tumidus* * | Intestine |
| *Pomphorhynchus bulbocolli* | Larvae in amphipods, small fish; in this fish in intestine, encysted in mesenteries |
| OLIGOCHAETA | |
| *Placobdella parasitica* | Not available |
| CRUSTACEA | |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus luciopercarum* # | Gills |
| *Ergasilus nerkae* # | Gills |
| *Salmincola edwardsi* | Not available |
| COELENTERATA | |
| *Hydra* spp. | Fry |
| ARTHROPODA | |
| *Hydrachna* spp. * | Larvae on gills |

*Coregonus artedii* - Cisco or Lake herring

| | |
|---|---|
| PROTOZOA | |

| | |
|---|---|
| MYXOSPORIDA | |
| *Henneguya* spp. | Gills |
| MONOGENEA | |
| *Discocotyle sagittata* | Gills |
| *Discocotyle salmonis* | Gills |
| *Tetraonchus variabilis* | Gills |
| DIGENEA | |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insects or crustacea |
| *Crepidostomum farionis* | Cercaria in clam; metacercaria in mayfly nymphs or Gammarus |
| *Salmincola extumescens* # | Blood vessels of gills |
| *Phyllodistomum* spp. | Cercaria in clam; metacercaria in clam sporocysts or in arthropods; adult in ureters |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in stomach, esophagus |
| *Diplostomulum flexicaudum* | Cercaria in snail; metacercaria in small fish; adult in birds |
| *Diplostomulum scheuringi* | Cercaria in snails, Helisoma; metacercaria in vitreous chamber of the eye of fish and newts |
| *Diplostomulum spathaceum* # | Eye |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Tetracotyle intermedia* | Metacercaria in heart, mesenteries |
| *Tetracotyle* spp. * | Metacercaria in heart, pericardium, mesenteries, kidney, musculature; adult in gulls |
| *Triaenophorus crassus* # | Muscle |
| CESTOIDEA | |
| *Bothrimonus sturionis* * | Adult in intestine |
| *Bothriocephalidae gen.* spp. | Plerocercoid in intestinal wall or encysted on stomach wall |

| | | |
|---|---|---|
| *Bothriocephalus cuspidatus* | * | Procercoid in copepod; plerocercoid in small fish sometimes; adult in intestine |
| *Cestoda gen.* spp. *(metacestode)* | * | Plerocercoid encysted in musculature, mesenteries, viscera, or free of intestine |
| *Cyathocephalus truncatus* | | Procercoid in amphipod; plerocercoid in small fish; adult in intestine |
| *Diphyllobothrium dendriticum* | # | Plerocercoid in viscera |
| *Diphyllobothrium ditremum* | * | Plerocercoid in viscera |
| *Diphyllobothrium laruei* | | Procercoid in copepod; plerocercoids in fish; adult in birds, mammals, cats, dogs |
| *Diphyllobothrium oblongatum* | | Procercoid in copepods; plerocercoids in fish; adult in gulls, and terns |
| *Diphyllobothrium* spp. | | Not available |
| *Eubothrium crassum* | | Procercoid in copepods; second intermediate host not required; adult in fish |
| *Eubothrium salvelini* | | Procercoid in copepods; adult in intestine |
| *Proteocephalus exiguus* | | Procercoid in copepods; plerocercoid in small fish |
| *Proteocephalus filicollis* | | Procercoid in copepods; plerocercoid in small fish |
| *Proteocephalus laruei* | | Procercoidin haemocoel of crustacea; plerocercoid in small fish; adult in intestine |
| *Proteocephalus pusillus* | * | Adult in intestine, pyloric caeca |
| *Proteocephalus* spp. | | Procercoid in haemocoel of crustacea; plerocercoid in small fish; adult in intestine |
| *Proteocephalus wickliffi* | | Procercoid in copepods; plerocercoid in small fish |
| *Triaenophorus crassus* | | Procercoid in copepods; plerocercoid in skeletal muscle |
| NEMATODA | | |
| *Cystidicola canadensis* | | Larvae in Gammarus; adult in swim bladder, air vessels |

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|---|---|
| *Cystidicola farionis* * | Adult in swim bladder |
| *Cystidicola* spp. * | Adult in swim bladder, body cavity |
| *Cystidicola stigmatura* | Larvae in Gammarus; adult in air bladder |
| *Contracaecum brachyurum* # | Not available |
| *Metabronema salvelini* # | Intestine |
| *Philometra* spp. | Larvae in copepods; adult in fish tissue |
| *Philonema oncorhynchi* * | Larvae in body cavity; wall of swim bladder |
| *Raphidascaris* spp. # | Not available |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in esophagus, stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in intestine |
| ACANTHOCEPHALA | |
| *Echinorhynchus leidyi* | Larvae in amphipods |
| *Echinorhynchus salmonis* | Larvae in amphipods, Osmerus |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days may go to small fish |
| *Metechinorhynchus lateralis* # | Intestine |
| *Metechinorhynchus salmonis* | Larvae in crustacea, intestine. |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea |
| *Neoechinorhynchus tumidus* # | Intestine |
| *Neoechinorhynchus* spp. * | Intestine |
| OLIGOCHAETA | |
| *Piscicola milneri* | Not available |
| CRUSTACEA | |
| *Achtheres ambloplitis* | Not available |
| *Achtheres coregoni* | Not available |
| *Achtheres* spp. | Not available |
| *Argulus appendiculosus* # | Skin |
| *Argulus canadensis* | Surface of body |

| | |
|---|---|
| *Argulus stizostethi* | Not available |
| *Argulus* spp. | External surface |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus nerkae* # | Not avaliable |
| *Ergasilus* spp. | Gills |
| *Salmincola edwardsi* | Not available |
| *Salmincola extensus* | Body, fins |
| *Salmincola extumescens* | Gills, gill cavity |
| *Salmincola intermis* | Not available |
| *Salmincola wisconsinensis* | Not available |

Coregonus clupeaformis - Lake whitefish

MONOGENEA

| | |
|---|---|
| *Discocotyle sagittata* | Gills |
| *Discocotyle salmonis* | Gills |

DIGENEA

| | |
|---|---|
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in aquatic insects and crustacea; adults in intestine, pyloric caeca, gall bladder |
| *Crepidostomum farionis* * | Adult in intestine, pyloric caeca, gall bladder |
| *Digenea gen.* spp. * | Adult in intestine, caeca, stomach, urinary and swim bladders |
| *Phyllodistomum coregoni* | Cercaria in clam; metacercaria encysts in sporocysts in clam or arthropods; adult in urinary bladder |

DIGENEA METACERCARIA

| | |
|---|---|
| *Diplostomulum scheuringi* | Cerceria in snail, Helisoma; metacercaria in vitreous chamber, brain, eye |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx, adult in bird |
| *Diplostomulum spathaceum* * | Metacercaria in vitreous humor, lens |
| *Diplostomulum spathaceum indistinctum* * | Eye |

| | |
|---|---|
| *Tetracotyle intermedia* | Metacercaria in heart, mesenteries; adult in birds |
| CESTOIDEA | |
| *Bothriocephalus* spp. * | Adult in pyloric caeca, intestine |
| *Cestoda gen.* spp. * | Plerocercoid encysted in musculature, mesenteries |
| *Cyathocephalus truncatus* | Procercoid in copepods; plerocercoid in forage fish; adult in intestine and pyloric caeca |
| *Diphyllobothrium dendriticum* # | Viscera, encapsulated |
| *Diphyllobothrium ditremum* # | Stomach wall |
| *Diphyllobothrium* spp. | Procercoid in copepods; plerocercoid in fish; adult in mammals, birds |
| *Diplocotyle olrikii* | Not available |
| *Eubothrium crassum* * | Adult in intestine, pyloric caeca |
| *Eubothrium. salvelini* * | Adult in intestine, pyloric caeca |
| *Proteocephalus exiguus* | Procercoid in crustacea; plerocercoid in small fish; adult in fish |
| *Proteocephalus laruei* | Procercoid in crustacea; plerocercoid in small fish; adult in fish |
| *Proteocephalus singularis* * | Adult in intestine |
| *Proteocephalus* spp. | Not available |
| *Schistocephalus* spp. * | Plerocercoid in body cavity |
| *Triaenophorus crassus* | Procercoid in copepods; plerocercoid in forage fish and this fish; adult in this fish |
| NEMATODA | |
| *Capillaria salvelini* # | Intestine |
| *Cystidicola farionis* * | Swim bladder |
| *Cystidicola* spp. * | Swim bladder, body cavity |
| *Cystidicola stigmatura* | Larvae in Gammarus, adult in swim bladder, air vessels, rarely esophagus |
| *Metrabronema salvelini* # | Intestine |

| | | |
|---|---|---|
| *Nematoda gen.* spp. | * | Viscera, musculature, mesenteries, intestine, stomach |
| *Philometra* spp. | * | Body cavity, intestine |
| *Philonema oncorhynchi* | * | Body cavity, wall of swim bladder |
| *Rhabdochona* spp. | * | Adult in intestine |
| *Spinitectus gracilis* | * | Adult in intestine |
| ACANTHOCEPHALA | | |
| *Acanthocephalus jacksoni* | * | Intestine |
| *Echinorhynchus salmonis* | | Larvae in amphipods; second host of this species is *Osmerus mordax* |
| *Leptorhynchoides thecatum* | | Larvae in amphipods; if less than 30 days larvae may encyst in mesenteries of fish; adult intestine |
| *Metachinorhynchus lateralis* | | Intestine |
| *Metachinorhynchus salmonis* | * | Intestine |
| *Metachinorhynchus* spp. | * | Intestine |
| *Neoechinorhynchus tumidum* | | Intestine |
| OLIGOCHAETA | | |
| *Piscicola milneri* | | Not available |
| *Piscicola punctata* | | Not available |
| CRUSTACEA | | |
| *Achtheres ambloplitis* | | Not available |
| *Achtheres coregoni* | | Not available |
| *Achtheres corpulentus* | | Not available |
| *Argulus canadensis* | | Not available |
| *Argulus stizostethi* | | Not available |
| *Argulus caeruleus* | | Not available |
| *Ergasilus* spp. | * | Gills |
| *Salmincola extensus* | * | Body, fins |
| *Salmincola extumescens* | * | Gills, fill cavity |

*Prosopium cylindraceum* - Round whitefish

| | | |
|---|---|---|
| MONOGENEA | | |
| *Discocotyle sagittata* | * | Gills |
| *Discocotyle salmonis* | | Gills |
| *Tetraonchus variabilis* | * | Gills |
| DIGENEA | | |
| *Crepidostomum cooperi* | | Cercaria in clam; metacercaria in insects, crustacea |
| *Crepidostomum farionis* | | Cercaria in clam; metacercaria in mayfly nymphs or Gammarus |
| *Phyllodistomum* spp. | # | Ureters |
| *Salmincola extumescens* | # | Blood vessels of the gills |
| DIGENEA METACERCARIA | | |
| *Clinostomum marginatum* | | Cercaria in snail, Helisoma; metacercaria in fish as a yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum extumescens* | # | Eye |
| *Diplostomulum scheuringi* | | Cercaria in snail, Helisoma; metacercaria in vitreous chamber of eye of fish and newts |
| *Diplostomulum spathaceum* | # | Eye |
| *Diplostomulum* spp. | * | Metacercaria in eye, brain, pharynx |
| *Tetracotyle intermedia* | | Metacercaria encyst in pericardium; adult reared in chick |
| CESTOIDEA | | |
| *Cyathocephauls truncatus* | # | Not avalilable |
| *Diphyllobothrium* spp. | # | Larval stage |
| *Eubothrium salvelini* | # | Intestine |
| *Pomphorhynchus bulbocolli* | # | Intestine |
| *Proteocephalus exiguus* | | Procercoid in copepod; plerocercoid in small fish |
| *Proteocephalus laruei* | * | Intestine |
| *Triaenophorus crassus* | # | Larvae in this fish |

| | |
|---|---|
| NEMATODA | |
| *Capillaria salvelini* # | Intestine |
| *Cystidicola farionis* * | Swim bladder |
| *Cystidicola stigmatura* | Swim bladder |
| *Hepaticola bakeri* | Intestine |
| *Philometra* spp. | Larvae in copepods; adult in fish tissue |
| *Raphidascaris* spp. # | Not available |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* * | Intestine |
| ACANTHOCEPHALA | |
| *Echinorhynchus salmonis* | Larvae in amphipod; second host is *Osmerus mordax* |
| *Metechinorhunchus lateralis* # | Intestine |
| *Metechinorhunchus salmonis* * | Intestine |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Neoechinorhynchus tumidum* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod and small fish |
| OLIGOCHAETA | |
| *Pisciola milneri* | Not available |
| CRUSTACEA | |
| *Achtheres coregoni* | Not available |
| *Argulus canadensis* # | Not avalilable |
| *Argulus caeruleus* * | Gills |
| *Ergasilus nerkae* # | Not available |
| *Ergasilus* spp. * | Gills |
| *Salmincola extensus* * | Body, fins |
| *Salmincola extumescens* # | Not available |
| *Salmincola* spp. * | Body, gills, fins |

*Thymallus arcticus* - Arctic grayling

PROTOZOA

Ciliata

| | |
|---|---|
| *Trichophrya* spp. # | Gills |

MONOGENEA

| | |
|---|---|
| *Tetraonchus rauschi* | Not available |

DIGENEA

| | |
|---|---|
| *Crepidostomum farionis* | Cercaria in clam; metacercaria in mayfly nymphs and Gammarus |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in insects, crustacea # |

DIGENEA METACERCARIA

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in heron in mouth, esophogus |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber of eye of fish and newts |
| *Diplostomulum* spp. # | Lens of the eye |
| *Ornithodisplostomum* spp. # | Brain |

CESTOIDEA

| | |
|---|---|
| *Protocephalus* spp. # | Anterior intestine |

NEMATODA

| | |
|---|---|
| *Spiroxys* spp. # | Intestine |

ACANTHOCEPHALA

| | |
|---|---|
| *Pomphorhynchus bulbocolli* # | Posterior intestine |

**PERCOPSIDAE**

*Percopsis omiscomaycus* - Trout perch

PROTOZOA

Ciliata

| | |
|---|---|
| *Gyrodactylus* spp. # | Fins |
| *Trichodina* spp. | Gills |

| | |
|---|---|
| MYXOSPORIDA | |
| *Myxobolus procerum* # | Gills |
| *Myxobolus* spp. * | Not available |
| MONOGENEA | |
| *Cleidodiscus baldwini* * | Gills |
| *Cleidodiscus* spp. | Gills |
| *Gryodactyloidea gen.* spp. * | Gills, skin |
| *Gryodactylus* spp. | Gills |
| *Urocleidus baldwini* # | Gills |
| DIGENEA | |
| *Bucephalus* spp. # | Cercaria in clam; metacercaria in fish; adult in intestine of this fish |
| *Crepidostomum isostomum* | Cercaria in clam; metacercaria in aquatic insects, crustacea; adult in intestine |
| DIGENEA METACERCARIA | |
| *Bucephalus* spp. | Intestine, ? immature |
| *Centrovarium lobotes* | Metacercaria in cyst in flesh |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |
| *Cotylurus communis* * | Metacercaria in mesenteries, liver |
| *Diplostomulum flexicaudum* | Cercaria in snail; metacercaria in eye; adult in gulls |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber of fish and newts |
| *Diplostomulum* spp. * | Metacercaria eye, brain, pharynx |
| *Diplostomulum spathaceum* * | Metacercaria in vitreous humor, lens |
| *Diplostomulum spathaceum indistinctum* * | Metacercaria in eye |
| *Neascus* spp. * | Metacercaria in mesenteries, gills, skin |
| *Posthodiplostomum minimum* * | Metacercaria in mesenteries, liver, kidney |

| | |
|---|---|
| *Tetracotyle communis* | Metacercaria in liver, mesenteries; adult in gulls |
| *Tetracotyle diminuta* | Metacercaria encysted pericardial cavity and adipose tissue behind eye; adult reared in unfed chicks |
| *Tetracotyle intermedia* * | Metacercaria in heart, mesenteries |
| *Tetracotyle* spp. * | Metacercaria in heart, pericardium, mesenteries, kidney, musculature |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepod; plerocercoid sometimes in small fish; adult in intestine |
| *Bothriocephalus cuspidatus* * | Adult in pyloric caeca, intestine |
| *Bothriocephalus formosus* | Procercoid in copepod; plerocercoid sometimes in small fish; adult in intestine |
| *Proteocephalus pearsei* * | Adult in intestine |
| *Triaenophorus nodulosus* * | Plerocercoid in liver, viscera |
| *Triaenophorus* spp. * | Plerocercoid in this fish; adult in this fish in intestine |
| *Triaenophorus stizostedionis* | Procercoid in copepods; plerocercoid in liver |
| NEMATODA | |
| *Camallanus oxycephalus* * | Adult in intestine, shows red at vent |
| *Contracaecum brachyurum* | Adult in stomach and intestine of fish eating fish, birds, mammals |
| *Dacnitoides cotylophora* | Adult in intestine |
| *Rhabdochona cascadilla* * | Intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Thynnascaris brachyura* * | Intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus jacksoni* # | Intestine |
| *Echinorhynchus salmonis* | Larvae in amphipod, second intermediate host, Osmerus mordax |

| | |
|---|---|
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days second intermediate host may be small fish |
| *Metechinorhynchus salmonis* * | Intestine |
| *Neoechinorhynchus* spp. * | Intestine |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; small fish; larvae also in this fish |
| OLIGOCHAETA | |
| *Illinobdella* spp. | Not available |
| CRUSTACEA | |
| *Argulus* spp. * | External surface |
| *Argulus versicolor* | Fins |
| *Ergasilus caeruleus* | Gills |

**APHREDODERIDAE**

*Aphredoderus sayanus* - Pirate perch

| | |
|---|---|
| DIGENEA | |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in insect, crustacea |
| *Phyllodistomum pearsii* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in urinary bladder |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |

**GADIDAE**

*Lota lota* - Burbot

| | |
|---|---|
| PROTOZOA | |
| Ciliata | |
| *Elliptis* spp. # | Not available |
| *Epistylis* spp. # | Not avalialble |
| *Trichodina* spp. | Urinary bladder |
| MYXOSPORIDA | |
| *Myxidium lieberkuhni* | Urinary bladder |

| | |
|---|---|
| *Myxobolus* spp. | Gills |
| DIGENEA | |
| *Azygia angusticauda* | Intestine and stomach |
| *Azygia longa* | Cercaria in snail, eaten; metacercaria in host and carrier fish; adult in intestine and stomach |
| *Azygia* spp. # | Not avalialble |
| *Crepidostomum farionis* | Cercaria in clam; metacercaria in mayfly nymphs or Gamarus |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in insect or crustacea |
| *Microphallidae gen.* spp. * | Not available |
| DIGENEA METACERCARIA | |
| *Clinostomum marginata* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber and brain of fish and newts |
| *Neascus* spp. * | Metacercaria in mesenteries, gills, skin |
| *Tetracotyle* spp. | Metacercaria in mesenteries, kidney; adult in birds # |
| CESTOIDEA | |
| *Bothriocephalus* spp. * | Adult in pyloric caeca, intestine |
| *Diphyllobothrium latum* | Procercoid in copepods; plerocercoid in fish; adult in bear, dogs, man |
| *Diphyllobothrium* spp. | Not available |
| *Eubothrium crassum* | Procercoid in copepods; no second host required; adult in intestine |
| *Eubothrium rugosum* | Procercoid in copepods; no second host required; adult in intestine |
| *Proteocephalus pearsi* * | Adult in intestine |
| *Proteocephalus* spp. * | Adult in intestine, pyloric caeca |

| | |
|---|---|
| *Triaenophorus crassus* * | Adult in intestine |
| *Triaenophorus nodulosus* | Procercoid in copepods; plerocercoid in liver |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepods, possibly other crustacea; adult in intestine |
| *Capillaria bakeri* | Intestine |
| *Contracaecum brachyurum* | Intestine |
| *Cystidicoloides tenuissima* # | Not available |
| *Cucullanellus cotylophora* * | Intestine |
| *Dichelyne cotylophora* | Intestine |
| *Haplonema hamulatum* | Stomach |
| *Hepaticola bakeri* | Intestine |
| *Rhabdochona cascadilla* | Some larvae develop in mayflies, adult in intestine |
| *Raphidascaris acus* # | Not available |
| *Skrjabinocapillaria bakeri* * | Intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in intestine |
| *Thynnascaris brachyura* * | Intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus parksidei* | Larvae in amphipods; no second intermediate host required |
| *Echinorhynchus leidyi* | Larvae in amphipods |
| *Echinorhynchus salmonis* | Larvae in amphipods; second intermediate host, Osmerus |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days, second host may be small fish |
| *Metechinorhynchus leidyi* * | Intestine and stomach |
| *Metechinorhynchus salmonis* # | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish |
| *Neoechinorhynchus pungitius* # | Not available |

| | |
|---|---|
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Neoechinorhynchus saginatus* # | Not available |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host small fish |

OLIGOCHAETA

| | |
|---|---|
| *Cystobranchus verrilli* * | Opercular region |
| *Myzobdella lugubris* # | Not available |
| *Myzobdella moorei* | Fins |
| *Piscicola milneri* | Not available |
| *Pisicola punctata* | Fins |

CRUSTACEA

| | |
|---|---|
| *Achtheres ambloplitis* | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus celestis* * | Gills |
| *Ergasilus osburni* | Gills |
| *Salmincola lotae* # | Oral cavity |

**COTTIDAE**

*Myoxocephalus octodecemspinosus* - Longhorn sculpin

PROTOZOA

Flagellata

| | |
|---|---|
| *Trypanosoma* spp. | Blood |

Coccidia

| | |
|---|---|
| *Haemogregarina myoxocephali* | In blood cells |

Myxosporida

| | |
|---|---|
| *Myxidium myoxocephali* | Gall bladder |

DIGENEA METACERCARIA

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; Metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |

CESTOIDEA

| | |
|---|---|
| *Eubothrium crassum* | Procercoid in copepods; no second host required; adult in intestine of fish |

**PERCICHTHYIDAE**

*Morone chrysops* - White bass

PROTOZOA

Ciliata

| | |
|---|---|
| *Ichthyophthirius multifiliis* * | Skin, fins, gills |
| *Trichodina* spp. * | Gills, urinary bladder, ureters |
| *Trichophrya* spp. * | Gills |

MONOGENEA

| | |
|---|---|
| *Gyrodactyloidea gen.* spp. | Gills, skin |
| *Onchocleidus chrysops* # | Not available |
| *Urocleidus chrysops* | Not available |
| *Urocleidus mimus* | Not available |

DIGENEA

| | |
|---|---|
| *Allacanthochasmus artus* | Metacercaria in fish; adult in intestine |
| *Allacanthochasmus varius* * | Digestive tract |
| *Azygia acuminata* | Cercaria in snail, eaten; metacercaria in host or small fish; adult in stomach or intestine |
| *Bucephalus* spp. | Cercaria in clam; metacercaria in fish; adult in caeca |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insects and crustacea |
| *Leuceruthrus micropteri* | Adult in mouth and stomach |
| *Leuceruthrus* spp. * | Digestive tract |
| *Neochasmus umbellus* # | Intestine |

DIGENEA METACERCARIA

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in snail; Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |

| | |
|---|---|
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber, eye, brain of mice, newts and fish |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Neascus of Posthodiplostomum minimum* | Cercaria in snail, Physa; metacercaria encysted in kidney, liver, pericardium and spleen, 4 years in fish at 12 degrees C; adult in herons, loons, chicks |
| *Neascus of Posthodiplostomum minimum* * | Metacercaria in mesenteries, gills, skin |
| CESTOIDEA | |
| *Bothriocephalus cuspidatus* * | Adult in pyloric caeca, intestine |
| *Proteocephalus ambloplitis* * | Plerocercoid in this fish; adult in intestine |
| *Proteocephalus pearsei* | Procercoid in copepod; plerocercoid in small fish |
| *Triaenophorus nodulosus* * | Adult in intestine |
| NEMATODA | |
| *Camallanus oxycephalus* * | Intestine |
| *Cucullanellus cotylophora* * | Intestine |
| *Dacnitoides cotylophora* | Intestine |
| *Rhabdochona* spp. * | Intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach or intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach or intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus jacksoni* # | Intestine |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days second host may be small fish |
| *Metechinorhynchus salmonis* # | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish |
| CRUSTACEA | |
| *Argulus appendiculosus* | Not available |

| | |
|---|---|
| *Argulus stizostethi* | Not available |
| *Ergasilus centrarchidarum* | Not available |
| *Ergasilus versicolor* | Not available |

*Morone saxatilis* - Striped bass

ACANTHOCEPHALA

| | |
|---|---|
| *Leptorhynchoides thecatum* | Larvae in amphipoda, if less than 30 days may be found in mesenteries of fish |

**CENTRARCHIDAE**

*Micropterus salmoides* - Largemouth bass

PROTOZOA

Flagellata

| | |
|---|---|
| *Spironucleus* spp. * | Intestine |

Ciliata

Suctoria

| | |
|---|---|
| *Trichophyra piscium* | Gills |

"True ciliates"

| | |
|---|---|
| *Apiosoma* spp. * | Fins, gills, skin |
| *Chilodonella* spp. | Gills |
| *Ichthyophthirius multifiliis* * | Skin, fins, gills |
| *Scyphidia micropteri* # | Gills |
| *Trichodina* spp. * | Gills, urinary bladder, ureters |
| *Trichodinella myakkae* | Gills |

MYXOSPORIDA

| | |
|---|---|
| *Chloromyxum trijugum* | Gall bladder |
| *Myxobolus inornatus* | In flesh |

Coccidia

| | |
|---|---|
| *Eimeria micropteri* | Anterior gut epithelium |

MONOGENEA

| | |
|---|---|
| *Acolpenteron ureteroecetes* | Ureters and bladder |
| *Actinocleidus fusiformis* | Gills |

| | |
|---|---|
| *Actinocleidus mizellei* | Gills |
| *Clavunculus unguis* | Not available |
| *Cleidodiscus helicus* | Gills |
| *Gyrodactyloidea gen.* spp. * | Gills, skin |
| *Gyrodactylus macrochiri* | Gills and fins |
| *Haplocleidus furcatus* # | Not available |
| *Onchocleidus helicis* # | Gills |
| *Syncleithrium fusiformis* * | Gills |
| *Urocleidus dispar* * | Gills |
| *Urocleidus furcatus* | Gills |
| *Urocleidus helicis* * | Gills |
| *Urocleidus principalis* | Gills |
| *Urocleidus* spp. * | Gills |
| DIGENEA | |
| *Azygia angusticauda* * | Adult in intestine, stomach |
| *Azygia* spp. | Cercaria in snail, snail eaten; metacercaria in fish or small fish may act as carriers; adult in host fish |
| *Bunodera luciopercae* | Cercaria in clam; metacercaria in mayfly nymphs, crustacea, copepods, crayfish; adult in intestine and caeca |
| *Bunodera sacculata* | Cercaria in clam; metacercaria in mayfly nymphs, crustacea, copepods, crayfish; adult in intestine and caeca |
| *Caecincola parvulus* | Metacercaria in Lepomis; adult in caeca and intestine |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Crepidostomum ictaluri* | Cercaria in clam; metacercaria in aquatic insects, crustacea |
| *Cryptogonimus chyli* | Metacercaria fish flesh; adult gastrointestinal |
| *Leuceruthrus micropteri* | Adult in stomach |
| *Microphallus opacus* * | Adult in intestine |

| | |
|---|---|
| *Phyllodistomum pearsii* | Cercaria in clam; metacercaria in sporocyst, arthropod, insect larvae; adult in urinary bladder |
| *Proterometra macrostoma* # | Not available |
| *Rhipidocotyle papillosum* | Cercaria in clam; metacercaria in fish; adult in caeca of fish |
| *Sanguinicola huronis* | Cercaria in snail; adult in blood vessel |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber and brain of fish, newts, mouse |
| *Diplostomulum spathaceum* # | Eye |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Neascus* spp. * | Metacercaria in mesenteries, gills, skin |
| *Posthodiplostomum minimum* * | Metacercaria in mesenteries, liver, kidney |
| *Posthodiplostomum minimum centrarchi* * | Metacercaria in liver |
| *Tetracotyle* spp. * | Metacercaria in heart, pericardium, mesenteries, kidney, musculature |
| *Uvulifer ambloplitis* # | Not available |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepods; plerocercoid sometimes in small fish; adult in intestine |
| *Bothriocephalus* spp. # | This fish parenteric host for |
| *Corallobothrium* spp. * | Not available |
| *Dilepis* spp. *cysticercus* * | Not available |
| *Dilepis unilateralis cysticercus* * | Not available |
| *Eubothrium crassum* | Procercoids and plerocercoids in copepods; adult-in intestine of fish |

| | |
|---|---|
| *Ligula intestinalis* | Procercoid in copepods; plerocercoid in body cavity of fish; adult in fish eating birds |
| *Proteocephalus ambloplitis* | Procercoids in copepods; plerocercoid in ovary and spleen, adulat in the intestine |
| *Proteocephalus fluviatilis* | Procercoids in copepods; plerocercoid in small fish |
| *Proteocephalus pearsei* * | Not available |
| NEMATODA | |
| *Camallanus oxycephalus* * | Not available |
| *Camallanus* spp. | Larvae in copepods, other crustacea |
| *Capillaria catenata* | Gut, liver, urinary bladder of vertebrates |
| *Contracaecum brachyurum* | Adult in fish eating fish, birds, mammals in stomach and intestine |
| *Cucullanellus cotylophora* * | Not available |
| *Dacnitoides cotylophora* | Intestine |
| *Dioctophyma* spp. * | Not available |
| *Philometra cylindracea* | Larvae in copepods; adult in tissue |
| *Philometra nodulosa* | Larvae in copepods; adult in tissue |
| *Rhabdochona cascadilla* | Larvae in mayflies; adult in intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spiroxys* spp. | First host Cyclops; larvae in mesenteries of fish, amphibia, dragonfly nymphs |
| *Thynnascaris brachyura* * | Not avalilable |
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Intestine |
| *Acanthocephalus parksidei* | Larvae in amphipods |

| | |
|---|---|
| *Acanthocephalus salmonis* | Larvae in amphipod; second host, Osmerus |
| *Leptorhynchoides thecatum* | Larvae in amphipod and mesenteries of young fish; adult in intestines |
| *Metechinorhynchus salmonis* * | Not available |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea; larvae and adult in mesenteries |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod and small fish; both larvae and adult in mesenteries |

OLIGOCHAETA

| | |
|---|---|
| *Illinobdella moorei* | Not available |
| *Placobdella montifera* * | Not available |

CRUSTACEA

| | |
|---|---|
| *Achtheres micropteri* | Not available |
| *Achtheres pimelodi* # | Gills |
| *Argulus appendiculosus* | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus centrarchidarum* | Not available |
| *Ergasilus megaceros* # | Gills |
| *Ergasilus nigratus* | Not available |
| *Ergasilus* spp. | Not available |
| *Lernaea cyprinacaea* | Not available |

*Micropterus dolomieu* - Smallmouth bass

PROTOZOA

Ciliata

| | |
|---|---|
| *Chilodonella dentatus* | Gills |
| *Epistylis niagarae* # | Not available |
| *Ichthyophthirius multifiliis* * | Skin, fins, gills |
| *Scyphidia micropteri* # | Gills |

| | |
|---|---|
| Coccidia | |
| *Eimeria micropteri* | Epithelium of anterior gut |
| MYXOSPORIDA | |
| *Myxidium* spp. | Gall bladder |
| *Myxobolus kostiri* | Subcutaneous |
| *Myxobolus osburni* | Mesenteries and peritoneum |
| Trophozoites | Gall bladder |
| MONOGENEA | |
| *Acolpenteron ureteroecetes* | Ureters and bladder |
| *Actinocleidus fusiformis* | Gills |
| *Actinocleidus mizellei* | Gills |
| *Cleidodiscus banghami* | Gills |
| *Cleidodiscus glenorensis* | Gills |
| *Cleidodiscus* spp. * | Gills |
| *Dactylogyrus extensus* | Gills |
| *Gyrodactyloidea gen.* spp. * | Gills, skin |
| *Gyrodactylus macrochiri* | Fins |
| *Gyrodactylus micropteri* # | Not available |
| *Onchocleidus ferox* # | Gills |
| *Onchocleidus principalis* # | Gills |
| *Tetracleidus banghami* # | Gills |
| *Syncleithrium fusifomis* * | Gills |
| *Urocleidus dispar* | Gills |
| *Urocleidus ferox* | Gills |
| *Urocleidus furcatus* | Gills |
| *Urocleidus principalis* | Gills |
| DIGENEA | |
| *Asymphylodora amnicolae* | Cercaria in snail, Amnicola; metacercaria may undergo progenesis in snail; adult in intestine |
| *Azygia angusticauda* | Adult in intestine and stomach |

| | |
|---|---|
| *Azygia longa* | Cercaria in snail, eaten; metacercaria in host fish or carrier; adult in intestine and stomach |
| *Bucephaloides pusillus* | Cercaria in clam; metacercaria in fish; adult in intestine of fish |
| *Caecincola parvulus* | Metacercaria beneath skin; adult in intestine |
| *Centrovarium lobotes* | Metacercaria in fish muscle; adult in intestine or stomach of fish |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insects, crustacea |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Cryptogonimus chyli* | Metacercaria in fish muscle; adult in intestine or stomach of fish |
| *Leucerythrus micropteri* | Adult in stomach |
| *Lissorchis* spp. * | Not available |
| *Microphallidae gen.* spp. * | Not available |
| *Microphallus opacus* | Metacercaria in crayfish; adult in intestine |
| *Neochasmus umbelus* | Adult in intestine |
| *Proterometra macrostoma* # | Not available |
| *Rhipidocotyle papillosum* | Cercaria in clam; metacercaria in fish; adult in caeca |
| *Rhipidocotyle septpapillata* | Cercaria in clam; metacercaria in fish; adult in caeca |
| *Sanguinicola huronis* | Cercaria in snail; adult in blood vessels |
| DIGENEA METACERCARIA | |
| *Clinostomum complanatum* * | Metacercaria in gills, musculature |
| *Clinostomum. marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in stomach, esophagus of heron |
| *Clinostomum* spp. * | Metacercaria in musculature, viscera |

| | |
|---|---|
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber and brain of fish, newts |
| *Diplostomulum spathaceum* * | Metacercaria vitreous humor, lens |
| *Diplostomulum* spp. * | Metacercaria eye, brain, pharynx |
| *Neascus* spp. * | Metacercaria in mesenteries, gills, skin |
| *Posthodiplostomum minimum* * | Metacercaria in mesenteries, liver, kidney, spleen # |
| *Ribeiroia ondatrae* | Cercaria in snail, Helisoma; metacercaria in lateral line of fish; adult in osprey, hawks, muskrats |
| *Tetracotyle* spp. | Metacercaria in mesenteries; adult in birds |
| *Uvulifer ambloplitis* | Cercaria in snail, Helisoma; metacercaria in skin, fins; adult in kingfisher |

CESTOIDEA

| | |
|---|---|
| *Bothriocephalus claviceps* | Procercoid in copepods; plerocercoid sometimes in small fish; adult in pyloric caeca and intestine |
| *Bothriocephalus cuspidatus* | Procercoid in copepods; plerocercoid sometimes in small fish; adult in pyloric caeca and intestine |
| *Bothriocephalus* spp. * | Pyloric caeca, intestine |
| *Ligula intestinalis* | Procercoid in copepod; plerocercoid in body cavity; adult in fish eating birds |
| *Proteocephalus ambloplitis* | Procercoids in copepods; plerocercoid in ovary, body cavity; adult in intestine |
| *Proteocephalus fluviatilis* | Procercoids in copepods; plerocercoid in ovary of this fish or in small fish; adult in fish |
| *Proteocephalus microcephalus* | Procercoids in copepods; plerocercoid in ovary of this fish or in small fish; adult in fish |
| *Prteocephalus pearsei* * | Adult in intestine |

| | |
|---|---|
| *Proteocephalus stizostethi* | Procercoids in copepods; plerocercoid in ovary of this fish or in small fish; adult in fish |
| *Triaenophorus nodulosus* * | Plerocercoid in this fish; adult in intestine of this fish |
| *Triaenophorus spp.* * | Plerocercoid in this fish; adult in intestine of this fish |

NEMATODA

| | |
|---|---|
| *Agamonema* spp. | Larvae in fish, in liver, mesenteries |
| *Camallanus oxycephalus* | Larvae in copepods, other crustacea; adult in intestine shows red from vent |
| *Capillaria catenata* | Gut, liver urinary bladder of vertebrates |
| *Capillaria. spp.* * | Adult in intestine, stomach |
| *Contracaecum brachyurum* | Adult in fish eating birds, fish, mammals |
| *Contracaecum* spp. * | Adult in intestine, larvae in mesentery # |
| *Cucullanellus cotylophora* * | Adult in intestine |
| *Dacnitoides cotylophora* | Intestine |
| *Eustrongylides tubifex* # | Mesenteries |
| *Hysterothylacium brachyurum* # | Intestine |
| *Nematoda gen.* spp. * | Larvae or adult in viscera, musculature, mesenteries, intestine, stomach |
| *Philometra* spp. * | Larvae in copepod; adult in body cavity, intestine |
| *Rhabdochona cascadilla* | Larvae in mayfly; adult in intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* * | Intestine |
| *Spiroxys* spp. | First host Cyclops, second intermediate hosts, mesenteries of fish and amphibia, dragonfly nymphs, snails |
| *Thynnascaris brachyura* * | Intestine |

ACANTHOCEPHALA

| | |
|---|---|
| *Echinorhynchus leidyi* | Larvae in amphipod; second host, Osmerus |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days small fish may be second host |
| *Metechinorhynchus salmonis* * | Intestine |
| *Neoechinorhynchus cylindratum* | Larave in crustacea and fish |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod or this fish; second host, small fish |

OLIGOCHAETA

| | |
|---|---|
| *Illinobdella alba* * | Body surface |
| *Illinobdella elongata* * | Body surface |
| *Illoinobdella moorei* | Not available |
| *Illinobdella* spp. * | Fins |
| *Piscicola punctata* * | Body surface, gills |
| *Piscicolaria* spp. | Not available |
| *Placobdella montifera* | Not available |

CRUSTACEA

| | |
|---|---|
| *Achtheres ambloplitis* | Not available |
| *Achtheres micropteri* | Not available |
| *Achtheres pimelodi* # | Gills |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus centrarchidarum* | Not available |
| *Ergasilus luciopercarum* # | Gills |
| *Ergasilus* spp. | Not available |
| *Lernaeidae gen.* spp. * | Partially embedded in flesh |

*Lepomis cyanellus* - Green sunfish

MYXOSPORIDA

| | |
|---|---|
| *Chloromyxum trijugum* | Gall bladder |

| | |
|---|---|
| MONOGENEA | |
| *Cleidodiscus* spp. | Not available |
| *Haplocleidus furcatus* | Not available |
| DIGENEA | |
| *Asymphylodora amnicolae* | Cercaria in snail; metacercaria in snail, may undergo progenesis |
| *Bucephaloides pusillus* | Cercaria in clam; metacercaria in fish; adult in fish intestine |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in aquatic insects, crustacea; adult in fish |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish; adult in fish |
| DIGENEA METACERCARIA | |
| *Cryptogonimus chyli* | Metacercaria in fish flesh |
| *Diplostomulum scheuringi* | Cercaria in snail; metacercaria in vitreous chamber of eye, brain of fish |
| *Neascus of Uvulifer ambloplitis* | Cercaria in snail, Helisoma; metacercaria in fish as a black spot; adult in kingfisher |
| *Posthodiplostomum minimum centrachi* | Cercaria in snail, Physa; (Neascus of) metacercaria in kidney, liver, pericardium, spleen; adult in heron and other birds |
| *Psilostomum ondatrae* | Metacercaria in lateral line of fish |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepods; plerocercoid sometimes in small fish |
| *Bothriocephalus cuspidatus* | Procercoid in copepods; plerocercoid sometimes in small fish |
| *Bothriocephalus formosus* # | Intestine, pyloric caeca |
| *Bothriocephalus* spp. | Plerocercoid in this fish |
| *Proteocephalus ambloplitis* | Plerocercoid in this fish |

| | |
|---|---|
| *Proteocephalus pearsei* | Procercoid in copepods; plerocercoid in this fish |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepods, crustacea; adult in intestine, shows red from vent |
| *Contracaecum spiculigerum* | Larvae in fish; adult in comorants, gulls, mergansers, pelicans |
| *Contracaecum* spp. | Larvae in fish; adult in fish |
| *Dacnitoides cotylophora* | Not available |
| *Hysterthylacium brachyurum* # | Not available |
| *Spinitectus carolini* | Larvae in mayfly; adult in stomach and intestine of fish |
| *Spinitectus gracilis* | Larvae in mayfly; adult in stomach and intestine of fish |
| *Spiroxys* spp. | First host Cyclops; larvae in mesenteries of fish, dragonfly nymphs, snails |
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Intestine |
| *Acanthocephalus parksidei* | Larvae in amphipods; no second intermediate host |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days may encyst in mesenteries of fish |
| *Neoechinorhynchus cylindratum* | Larvae in small crustacea; some have second intermediate host |
| *Neoechinorhynchus spp.* | Larvae in small crustacea; some have no second intermediate host |
| OLIGOCHAETA | |
| *Piscicola punctata* | Not available |
| CRUSTACEA | |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus centrarchidarum* | Not available |
| *Lernaea cyprinacaea* | Not available |

*Lepomis gibbosus* - *Pumkinseed*

PROTOZOA

Ciliata

| | |
|---|---|
| *Trichodina tumefaciens* # | Fins, gills, nares, skin |
| *Trichodina* spp. | Not available |

Sporozoa

| | |
|---|---|
| *Eimeria esoci* # | Swim bladder |
| *Eimeria patersoni* # | Renal tubule cells, spleen, liver parenchyma |
| *Goussia laureleus* # | Caecum, gall bladder, gut |

MYXOSPORIDA

| | |
|---|---|
| *Chloromyxum gibbosum* | Gall bladder, kidney, muscle, spleen, swim bladder, ureters # |
| *Chloromyxum trijugum* # | Gall bladder |
| *Myxobilatus ohioensis* | Ureters, urinary bladder |
| *Myxobilatus cotti* # | Kidney, ureters |
| *Myxobolus dechtiari* | Gills |
| *Myxobolus cyprinicola* # | Brain, heart |
| *Myxoblous gibbosus (lii)* # | Connective tissue of gill arches |
| *Myxobolus lepomicus* # | Gall bladder, gill, gut, heart, muscle, swim bladder |
| *Myxobolus magnaspherus* | Parietal peritoneum of kidney |
| *Myxobolus osburni* | Mesenteries and peritoneum, gall bladder, pancreas |
| *Myxoblous paralintoni* # | Heart |
| *M.yxobolus poecilichthidis* # | Gills |
| *Myxobolus* spp. | Connective tissue |
| *Myxobolus uvuliferis* | In cyst wall of metacercaria of the trematode (*Uvulifer ambloplitis*) |
| *Sphaerospora diminuta* # | Renal tubules, ureters |

MONOGENEA

| | |
|---|---|
| *Actinocleidus fergusoni* | Gills |
| *Actinocleidus gibbosus* | Gills |
| *Actinocleidus incus* * | Gills |
| *Actinocleidus. oculatus* | Gills |
| *Actinocleidus recurvatus* | Gills |
| *Actinocleidus scapularis* * | Gills |
| *Actinocleidus sigmoideus* * | Gills |
| *Cleidodiscus robustus* | Gills |
| *Gyrodactylus avalonia* | Fins |
| *Gyrodactylus macrochiri* | Gills, fins |
| *Haplocleidus dispar* | Gills |
| *Haplocleidus furcatus* | Gills |
| *Lyrodiscus seminolensis* # | Fins, gills |
| *Onchocleidus ferox* # | Gills |
| *Pterocleidus acer* # | Gills |
| *Urocleidus acer* | Gills |
| *Urocleidus attennatus* | Gills |
| *Urocleidus dispar* * | Gills |
| *Urocleidus ferox* | Gills |
| *Urocleidus megalonchus* * | Gills |
| *Urocleidus procax* * | Gills |
| *Urocleidus similis* | Gills |

DIGENEA

| | |
|---|---|
| *Allocreadium spp.* * | Intestine |
| *Asymphylodora amnicolae* | Cercaria in snail, Amnicola; metacercaria in snail, progenesis in snail in some cases; adult in intestine |
| *Azygia angusticauda* | Cercaria in snail, snail eaten; metacercaria in host fish or small carrier fish; adult in intestine |

| | |
|---|---|
| *Azygia longa* | Cercaria in snail; metacercaria in host or carrier fish; adult in intestine or stomach |
| *Bunodera sacculata* * | Cercaria in clam; metacercaria in copepods, crustacea, crayfish; adult in intestine and caeca |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insect, crustacea |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Crepidostomum farionis* | Cercaria in clam; metacercaria in mayfly nymphs, Gammarus |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in aquatic insects, crustacea; adult in fish in pyloric caeca |
| *Cryptogonimus chyli* | Metacercaria in fish muscle; adult in gastrointestinal |
| *Homalometron armatum* # | Intestine |
| *Phyllodistomum pearsii* | Cercaria in clam; metacercaria in sporocyst in clam, arthropod; adult in urinary bladder |
| *Proterometra dickermani* # | Cercaria in snail; complete life cycle in snails, Goniobasis, eaten by fish |
| *Proterometra macrostoma* | Cercaria in snail, complete life cycle in snail; adult in esophagus of fish |
| *Rhipidocotyle septpapillata* | Cercaria in clam; metacercaria in fish; adult in stomach and intestine |

DIGENEA METACERCARIA

| | |
|---|---|
| *Apophallus brevis* | Cercaria in snail; metacercaria in capsule of bone, caudal fin, operculum; adult in gulls, loons, muskrats |
| *Apophallus venustus* * | Metacercaria in musculature |
| *Caecincola parvulus* | Metacercaria in this fish beneath skin; adult in stomach, intestine of this fish |

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber and brain of fish, newts |
| *Diplostomulum spathaceum huronense* * | Metacercaria in eye |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Diplostomulum of Diplostomum huronense* | Snail not known; metacercaria in lens and vitreous chamber; adult in gulls |
| *Echinochasmus donaldsoni* | Cercaria in snail; metacercaria in gills; adult in grebes |
| *Euparyphium melis* | Cercaria in snail; metacercaria in nares and cloaca of this fish; adult in mink. |
| *Heterophyidae gen.* spp. * | Metacercaria in skin, gills, musculature |
| *Neascus* spp. * | Metacercaria in mesenteries, gills, skin |
| *Neascus of Posthodiplostomum minimum* | Metacercaria in kidney, liver, spleen and pericardium; adult in heron and other birds |
| *Opisthorchis tonkae* | Cercaria in snail, Amnicola; metacercaria in fish; adult in bile duct, gall bladder |
| *Petasiger nitidus* | Cercaria in snail, Helisoma, eaten; metacercaria in fish; adult in intestine |
| *Posthodiplostomum cuticola* * | Metacercaria in mesenteries, kidney, liver |
| *Posthodiplostomum minimum centrarchi* | Cercaria in snail; metacercaria in liver, kidney; adult in loons,herons |
| *Ribeiroia ondatrae* | Cercaria in snail; metacercaria in lateral line of this fish; adult in muskrats, ospreys, hawks |
| *Tetracotyle* spp. | Metacercaria in air bladder, kidney, muscle in this fish |

| | |
|---|---|
| *Uvulifer ambloplitis* | Cercaria in snail; metacercaria in striated muscle, dorsal and caudal fins; adult in kingfisher |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepod; plerocercoid in small fish; adult in intestine |
| *Bothriocephalus. cuspidatus* | Procercoid in copepod; plerocercoid in small fish; adult in intestine |
| *Bothriocephalus spp.* * | Adult in pyloric caeca, intestine |
| *Dilepididae gen.* spp. * | Larvae encysted liver, mesenteries |
| *Diphyllobothrium* spp. * | Plerocercoid in viscera, musculature, body cavity, blood vessels of heart |
| *Hymenolepis* spp. * | Plerocercoid encysted body cavity, liver |
| *Proteocephalus ambloplitis* | Procercoid in copepods; plerocercoid in small fish; adult in liver and mesenteries |
| *Proteocephalus fluviatilis* * | Adult in intestine |
| *Proteocephalus pearsei* | Adult in intestine |
| *Proteocephalus stizostethi* | Procercoid in crustacea; plerocercoid in small fish |
| *Triaenophorus nodulosus* | Procercoid in copepods; plerocercoid in small fish; adult in liver |
| NEMATODA | |
| *Ascaris angulata* | Adult in intestine |
| *Camallanus oxycephalus* | Larvae in copepod; adult in intestine, shows red from vent |
| *Capillaria catenata* | Gut, liver, urinary bladder of vertebrates |
| *Contracaecum* spp. | Larvae in liver of fish; adult in fish eating birds, fish, mammals |
| *Cucullanelus cotylophora* # | Intestine |
| *Dacnitoides cotylophora* | Intestine |

| | |
|---|---|
| *Dichelyne* spp. | Parasites of teleosts; larvae in this fish |
| *Eustrongylides* spp. | Larvae in muscle cyst, ovary of fish, red; adult in proventriculus of fish eating birds |
| *Eustrongylides tubifex* # | Mesenteries |
| *Hysterothylacium brachyurum* # | Intestine, second stage larvae in intestinal wall |
| *Hysterothylacium analarum* # | Intestinal serosa, adult intestine |
| *Oxyuridea* spp. | Not available |
| *Philometra* spp. * | Body cavity, intestine |
| *Rhabdochona* spp. * | Adult in intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spiroxys* spp. | Larvae in mesenteries of fish, amphibia, dragonfly nymphs and snails |
| *Thynnascaris brachyura* * | Adult in intestine |
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Intestine |
| *Echinorhynchus salmonis* | Larvae in amphipod; second intermediate host, Osmerus |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days small fish may be second intermediate host |
| *Metechinorhynchus salmonis* * | Adult in intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocoli* | Larvae in amphipod, small fish second intermediate host |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Not available |
| *Illinobdella* spp. | Not available |
| *Myzobdella moorei* * | Fins |

| | |
|---|---|
| *Piscicola punctata* * | Body surface, gills |
| *Placobdella montifera* * | Body surface |
| *Placobdella parasitica* | Not available |

CRUSTACEA

| | |
|---|---|
| *Achtheres ambloplitis* | Gills # |
| *Argulus catostomi* # | Fins |
| *Ergasilus caeruleus* | Gills # |
| *Ergasilus centrarchidarum* | Gills # |
| *Ergasilus* spp. | Not available |
| *Lernaea cyprinacaea* | Not available |
| *Lernaea dolabrodes* | Not available |
| *Lernaea pomotidis* | Not available |
| *Lernaea variabilis* | Not available |

*Lepomis macrochirus* - Bluegill

PROTOZOA

Flagellata

| | |
|---|---|
| *Bodomonas concava* | Gills |

Ciliata

| | |
|---|---|
| *Gyrodactylus* spp. | Not available |
| *Scyphidia (Ambiphrya) ameiuri* | Gills |
| *Trichodina discoidea* | Gills |
| *Trichodina* spp. | Not available |

MYXOSPORIDA

| | |
|---|---|
| *Chloromyxum trijugum* | Gall bladder |
| *Myxidium macrocapsulare* | Gall bladder |
| *Myxobolus osburni* | Gall bladder |
| Trophozoites | Gall bladder |

MONOGENEA

| | |
|---|---|
| *Actinocleidus bakeri* | Gills |

| | |
|---|---|
| *Actinocleidus brevicirrus* # | Gills |
| *Actinocleidus fergusoni* | Gills |
| *Actinocleidus gibbosus* | Gills |
| *Actinocliedus oculatus* | Gills |
| *Actinocleidus unguis* | Gills |
| *Anchorodiscus triangularis* # | Gills |
| *Cleidodiscus robustus* | Gills |
| *Cleidodiscus* spp. | Not available |
| *Cleidodiscus venardi* | Gills |
| *Gyrodactyloidea gen.* spp. * | Gills, skin |
| *Gyrodactylus macrochiri* | Gills and fins |
| *Haplocleidus dispar* | Not available |
| *Haplocleidus furcatus* | Not available |
| *Lyrodiscus longibasus* | Fins and body |
| *Lyrodiscus seminolensis* | Fins, body |
| *Lyrodiscus* spp. | Not available |
| *Onchocleidus ferox* # | Gills |
| *Pterocleidus acer* # | Gills |
| *Urocleidus dispar* | Gills |
| *Urocleidus ferox* | Gills |
| DIGENEA | |
| *Asymphylodora amnicolae* | Cercaria in snail; metacercaria in snail, progenesis in snail |
| *Azygia acuminata* | Cercaria in snail, snail eaten; metacercaria in small host fish or carrier fish; adult in host fish |
| *Azygia angusticauda* | Cercaria in snail, snail eaten; metacercaria in small host fish or carrier fish; adult in host fish |
| *Azygia sebago* | Cercaria in snail, snail eaten; metacercaria in small host fish or carrier fish; adult in host fish |
| *Bunodera luciopercae* * | Adult in intestine |

| | |
|---|---|
| *Bunodera sacculata* # | Intestine |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in aquatic insects, crustacea; adult in fish |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish; adult in fish |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in crayfish; adult in fish |
| *Cryptogonimus chyli* | Metacercaria in flesh of fish; adult in fish |
| *Microphallus opacus* | Metacercaria in crayfish; adult in intestine and urinary bladder |
| *Proterometra autraini* | Cercaria from snail (*Elimia livescens*) |
| *Proterometra dickemani* | Cercaria in snail, Goniobasis; metacercaria in snail with progenesis in snail |
| *Proterometra macrostoma* | Cercaria in snail, Goniobasis; metacercaria in snail with progenesis in snail |
| *Rhipidocotyle papillosum* | Cercaria in clam; metacercaria in fish; adult in intestine and caeca of fish |

DIGENEA METACERCARIA

| | |
|---|---|
| *Amphimerus elongatus* # | Muscle, fin rays |
| *Bolbophorus confusus of Diplostomulum* | Cercaria in snail; metacercaria in fish; adult in pelican |
| *Clinostomum marginatum* | Cercaria in snail; metacercaria in fish as yellow grub; adult in heron in mouth, esophagus |
| *Diplostomulum scheuringi* | Metacercaria in vitreous humor, not encysted |
| *Diplostomulum spathaceum* | Cercaria in snail; metacercaria in fish in lens of eye; adult in gulls |
| *Echinochasmus donaldsoni* | Cercaria in snail; metacercaria in fish in gills; adult in grebe |
| *Euparyphium melis* | Cercaria in snail; metacercaria in nares and cloaca of fish; adult in mink |

| | |
|---|---|
| *Neascus ambloplitis of Uvulifer* | Cercaria in snail, Helisoma; Ambloplitis metacercaria in fish as black spot; adult in kingfisher |
| *Neascus of Posthodiplostomum minimum* | Cercaria in snail, Helisoma; centrarchid metacercaria in kidney, liver, pericardium, spleen of fish; adult in herons, loons |
| *Petasiger nitidus* | Cercaria in snail, snail eaten by fish; metacercaria in fish; adult experimentally in canaries |
| *Posthodiplostomum minimum* * | Metacercaria in mesenteries, liver, kidney |
| *Posthodiplostomum minimum centrarchi* | Encysted in mesenteries and viscera |
| *Psilostomum ondatrae* | Metacercaria in lateral line of fish |
| *Tetracotyle* spp. * | Metacercaria in heart, pericardium, mesenteries, kidney, musculature |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepods; plerocercoid sometimes in small fish |
| *Bothriocephalus cuspidatus* | Plerocercoid in this fish |
| *Bothriocephalus* spp. | Plerocercoid in this fish |
| *Proteocephalus ambloplitis* | Plerocercoid in this fish |
| *Proteocephalus pearsei* | Procercoid in copepod; plerocercoid in this fish |
| *Proteocephalus stizostethi* | Procercoid in copepod; plerocercoid in this fish |
| *Triaenophorus nodulosus* | Procercoid in copepod; plerocercoid in this fish |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae in copepod, crustacea; adult in intestine of fish, shows red from vent |
| *Camallanus spp.* | Larvae in copepod, crustacea |
| *Capillaria catenata* | Adult in intestine |
| *Contracaecum* spp. | Not available |

| | |
|---|---|
| *Contracaecum spiculigerum* | Larvae in fish; adult in cormorants, mergansers, gulls, pelicans |
| *Cucullanellus cotylophora* * | Adult in intestine |
| *Dichelyne* spp. | Larvae in fish |
| *Hysterothylacium brachyurum* # | Not available |
| *Hhsterothylacium* spp. # | Liver |
| *Nematoda gen.* spp. | Viscera, musculature, mesenteries, intestine, stomach |
| *Rhabdochona* spp. * | Adult in intestine |
| *Spinitectus carolini* | Larvae in mayfly; adult in stomach and intestine of fish |
| *Spinitectus gracilis* | Larvae in mayfly; adult in stomach and intestine |
| *Spiroxys* spp. | First host Cyclops; larvae in mesenteries of dragonfly nymphs, fish, snails |
| ACANTHOCEPHALA | |
| *Acanthocephalus dirus* # | Intestine |
| *Acanthocephalus parksidei* | Larvae in amphipods; no second intermediate host |
| *Leptorhynchoides thecatum* | Larvae in amphipod, if less than 30 days to mesenteries of fish a second intermediate host |
| *Metechinorhynchus salmonis* # | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in small crustacea; some have second host |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host, small fish |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Not available |
| *Illinobdella* spp. | Not available |
| *Piscicola punctata* * | Body surface, gills |
| *Placobdella parasitica* | Not available |

CRUSTACEA

| | |
|---|---|
| *Achtheres micropteri* | Not available |
| *Argulus americanus* | Not available |
| *Argulus* spp. | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus centrarchidarum* | Not available |
| *Ergasilus versicolor* | Not available |
| *Lernaea cyprinacaea* | Flesh and fins |
| *Lernaea. dolabrodes* | Not available |
| *Lernaea. pomotidis* | Not available |
| *Lernaea variabilis* | Not available |

*Ambloplites rupestris* - Rock bass

PROTOZOA

Ciliata

| | |
|---|---|
| *Apiosoma* spp. * | Fins, gills, skin |
| *Epistylis niagarae* # | Not available |
| *Trichodina* spp. # | Gills |

MYXOSPORIDA

| | |
|---|---|
| *Myxobolus* spp. | Intestinal wall |

MONOGENEA

| | |
|---|---|
| *Cleidodiscus alatus* | Not available |
| *Cleidodiscus chautauquaensis* | Gills |
| *Cleidodiscus glenorensis* | Gills |
| *Cleidodiscus* spp. | Not available |
| *Cleiodiscus stentor* | Gills |
| *Gyrodactylus georani* # | Fins |
| *Gyrodactylus* spp. | Gills |
| *Lyrodiscus minimus* | Fins |
| *Lyrodiscus rupestris* | Nasal cavities, fins, skin |

| | |
|---|---|
| *Onchocleidus chautauquaensis* # | Gills |
| *Tetraclidus glenorensis* # | Gills |
| *Tetraclidus stentor* # | Gills |
| *Urocleidus alatus* * | Gills, skin, fins |
| *Urocleidus chautauquaensis* | Not available |
| DIGENEA | |
| *Allogossidium corti* | Metacercaria in dragonfly nymphs; adult in intestine |
| *Azygia angusticauda* | Adult in stomach or intestine |
| *Azygia longa* | Cercaria in snail, eaten; metacercaria in host or carrier fish; adult in stomach or intestine of this fish |
| *Bucephalus elegans* | Cercaria in clam; metacercaria in fish; adult in caeca of fish |
| *Bunodera luciopercae* * | Adult in intestine |
| *Caecincola parvulus* | Cercaria in snail, Amnicola; metacercaria in Lepomis; adult in gastrocaecum, intestinal |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insects and crustacea |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Crepidostomum lintoni* | Not available |
| *Leuceruthrus micropteri* * | Adult in stomach |
| *Microphallus opacus* | Cercaria in crayfish |
| *Phyllodistomum* spp. | Cercaria in clam; metacercaria in sporocysts in clam or arthropods |
| *Phyllodistomum lohrenzi* # | Ureters |
| *Protenteron diaphanum* | Adult in intestine |
| *Proterometra macrostoma* | Life cycle in snail; adult in esophagus of fish |
| DIGENEA METACERCARIA | |
| *Centrovarium lobotes* | Cercaria in snail; metacercaria in fish muscle |

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in snail; Helisoma; metacercaria in fish as yellow grub in muscles; mouth, esophagus of herons # |
| *Cryptogonimus chyli* | Metacercaria in flesh of this fish |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber of fish, newts, mouse |
| *Diplostomulum spathaceum* * | Metacercaria in vitreous humor, lens |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx |
| *Euparyphium melis* | Cercaria in snail; metacercaria in nares and cloaca of this fish, adult in mink |
| *Neascus* spp. * | Metacercaria in mesenteries, gills, skin |
| *Petasiger nitidus* | Cercaria in snail, Helisoma, eaten by fish; metacercaria in this fish esophagus; adult experimentally in canaries |
| *Posthodiplostomum minimum* * | Metacercaria in mesenteries, liver, kidney |
| *Posthodiplostomum minimum centrarchi* | Metacercaria in kidney, liver pericardium of fish |
| *Rhipidocotyle papillosa* | Cercaria in clam; metacercaria in fish; adult in intestine and caecum |
| *Ribeiroia ondatrae* | Cercaria in snail, Helisoma; metacercaria in lateral line of this fish; adult in hawks, ospreys, muskrats |
| *Tetracotyle* spp. | Metacercaria in mesenteries of this fish |
| *Uvulifer ambloplitis* | Cercaria in snail; metacercaria in skin; adult in kingfisher |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepods; plerocercoid in small fish; adult in intestine |

| | |
|---|---|
| *Bothriocephalus cuspidatus* | Procercoid in copepods; plerocercoid in small fish; adult in intestine |
| *Corallobothrium* spp. * | Adult in intestine |
| *Ligula intestinalis* * | Plerocercoid in body cavity |
| *Proteocephalus ambloplitis* # | Plerocercoid in liver and mesenteries; adult in intestine |
| *Proteocephalus pearsei* * | Adult in intestine |
| *Proteocephalus perplexus* | Plerocercoids in Hyborhynchus, Roccus, Ictalurus. |

NEMATODA

| | |
|---|---|
| *Ascaris labiata* | Adult in intestine of fish |
| *Ascaris lucii* | Adult in intestine of fish |
| *Camallanus oxycephalus* | Larvae in copepods; adult in intestine, shows red from vent |
| *Capillaria catenata* | Adult in gut, liver or urinary bladder of vertebrates |
| *Contracaecum brachyurum* | Adult in stomach and intestine of fish eating fish, birds, mammals |
| *Contracaecum* spp. * | Intestine, stomach, viscera, mesenteries, musculature |
| *Cucullanellus cotylophora* * | Adult in intestine |
| *Dacnitoides cotylophora* | Not available |
| *Eustronglylides tubifex* # | Larvae in mesentery |
| *Hysterothlacium brachyurum* # | Intestine, larvae in mesentery, liver |
| *Raphidascaris acus* # | Liver |
| *Rhabdochona cascadilla* | Larvae in mayfly; adult in intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in intestine |
| *Spiroxys* spp. | First intermediate host Cyclops; Larvae in mesenteries of fish and amphibia, dragonfly nymphs, snails |

| | |
|---|---|
| *Thominx catenata* * | Adult in intestine |
| *Thynnascaris brachyura* * | Larvae in liver, mesenteries; adult in intestine of this fish |
| ACANTHOCEPHALA | |
| *Acanthocephalus lateralis* | Larvae in Asellus and Gammarus |
| *Echinorhynchus salmonis* | Larvae in amphipod; fish Osmerus as second intermediate host |
| *Leptorhynchoides thecatum* | Larvae in amphipods; if less than 30 days fish may be second intermediate host |
| *Metechinorhynchus salmonis* * | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea; some have fish as second host; larvae may be in this fish |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; small fish second intermediate host, may be this fish |
| *Pomphorhynchus rocci* | Larvae in amphipod; second host, small fish |
| OLIGOCHAETA | |
| *Illinobdella alba* # | Fins |
| *Illinobdella* spp. | Not available |
| *Myzobdella moorei* * | Fins |
| *Piscicola punctata* * | Body surface, gills |
| *Piscicolaria* spp. | Not available |
| CRUSTACEA | |
| *Achtheres ambloplitis* * | Gills |
| *Achtheres micropteri* * | Gills, mouth |
| *Actheres pimelodi* # | Gills |
| *Argulus biramosus* | Not available |
| *Ergasilus caeruleus* * | Gills |
| *Ergasilus centrarchidarum* * | Gills |

| | |
|---|---|
| *Ergasilus elegans* | Not available |
| *Ergasilus megaceros* # | Gills |
| *Ergasilus* spp. * | Gills |
| *Lernaea cruciata* | Skin |

<u>*Pomoxis*</u> spp. - Crappie

PROTOZOA

Ciliata

| | |
|---|---|
| *Trichodina* spp. | Gills |

MYXOSPORIDA

| | |
|---|---|
| *Chloromyxum trijugum* | Gall bladder |
| *Myxobolus discrepans* | Gills |
| *Myxobolus iowensis* | Gills |
| *Myxobolus intestinalis* | Intestinal wall |
| *Myxobolus okobojiensis* | Intestine |
| *Myxobolus osburni* | Gall bladder |
| *Myxobolus sparoidis* | Gall bladder and intestine |
| *Myxobolus* spp. | Not available |

MONOGENEA

| | |
|---|---|
| *Cleidodiscus adspectus* | Not available |
| *Cleidodiscus capax* | Gills |
| *Cleidodiscus longus* | Gills |
| *Cleidodiscus* spp. | Not available |
| *Cleidodiscus stentor* | Gills |
| *Cleidodiscus unifomis* | Gills |
| *Cleidodiscus vancleavei* | Gills |
| *Gyrodactyloidea gen.* spp. * | Gills, skin |
| *Lyrodiscus longibasus* | Fins, body |
| *Lyrodiscus* spp. | Not available |
| *Tetracleidus capax* # | Gills |

| | |
|---|---|
| *Tetracleidus longus* # | Gills |
| DIGENEA | |
| *Azygia angusticauda* | Adult in stomach and intestine |
| *Caecincola parvulus* | Cercaria in snail, Amnicola; metacercaria in Lepomis; adult gastrocaecal, intestinal |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insect and crustacea |
| *Crepidostomum cornutum* | Cercaria in clam; metacercaria in crayfish |
| *Cryptogonimus chyli* | Metacercaria in fish flesh; adult gastrointestinal |
| *Proterometra macrostoma* | Life cycle in snail; adult in esophagus |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of herons |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber, brain of fish and mice |
| *Diplostomulum* spp. * | Metacercaria in eye, brain, pharynx of fish |
| *Neascus* spp. | Metacercaria in skin of fish |
| *Neascus of Posthodiplostomum minimum centrarchi* | Cercaria in snail, Physa; metacercaria encyst in kidney, liver, pericardium, spleen, longevity 4 years in fish @ 12°C; adult in herons, loons, unfed chicks |
| *Posthodiplostomum minimum* | Metacercaria in mesenteries, liver, kidney of fish |
| *Tetracotyle* spp. | Metacercaria in mesenteries of fish |
| CESTOIDEA | |
| *Bothriocephalus* spp. | Procercoid in copepods; plerocercoid sometimes in small fish; adult in intestine |

| | |
|---|---|
| *Proteocephalus ambloplitis* | Procercoid in crustacea; plerocercoid encysted in liver of this fish |
| *Prteocephalus pearsei* | Procercoid in copepods and other crustacea; adult in intestine of fish |
| NEMATODA | |
| *Camallanus oxycephalus* * | Adult in intestine, shows red from vent |
| *Capillaria catenata* | Larvae in gut, liver, urinary bladder of vertebrates |
| *Contracaecum spiculigerum* | Coiled in viscera |
| *Dacnitoides cotylophora* | Adult in intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spiroxys* spp. | First host Cyclops; larvae in mesenteries of fish and amphibia, dragonfly nymphs, snails |
| ACANTHOCEPHALA | |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days small fish may be second intermediate host |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish second intermediate host |
| Pomphorhynchus bulbocolli | Larvae in amphipod; small fish second intermediate host |
| OLIGOCHAETA | |
| *Myzobdella alba* # | Fins |
| CRUSTACEA | |
| *Argulus appendiculosus* | Not available |
| *Argulus biramosus* | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus centrarchidarum* | Not available |

*Lepomis gulosus* - Warmouth

PROTOZOA

Ciliata

| | |
|---|---|
| *Trichodina* spp. | Gills, urinary bladder, ureters |

MYXOSPORIDA

| | |
|---|---|
| *Chloromyxum gibbosum* * | Gall bladder |
| *Myxobilatus ohioensis* * | Ureters, urinary bladder |
| *Myxobolus dechtiari* * | Cysts in gills |
| *Myxobolus magnaspherus* * | Cysts in parietal peritoneum of kidney |
| *Myxobolus osburni* * | Cysts, mesenteries and pancreas |
| *Myxobolus* spp. * | Gills, mesenteries, viscera, skin |
| *Myxobolus uvuliferis* * | Found in fibrous capsule of the trematode metacercaria of *Uvulifer ambloplitis* |

MONOGENEA

| | |
|---|---|
| *Actinocleidus fergusoni* | Gills |
| *Actinocleidus gibbosus* * | Gills |
| *Actinocleidus incus* * | Gills |
| *Actinocleidus oculatus* * | Gills |
| *Actinocleidus recurvatus* * | Gills |
| *Actinocleidus scapularis* * | Gills |
| *Actinocleidus sigmoideus* * | Gills |
| *Cleidodiscus robustus* * | Gills |
| *Gyrodactylidae gen.* spp. * | Gills |
| *Gyrodactyloidae gen.* spp. * | Gills, skin |
| *Gyrodactylus avalonia* * | Gills, fins |
| *Gyrodactylus macrochiri* * | Gills |
| *Lyrodiscus longibasus* # | Fins |
| *Urocleidus acer* * | Gills |
| *Urocleidus attenuatus* * | Gills |

| | | |
|---|---|---|
| *Urocleidus dispar* | * | Gills |
| *Urocleidus ferox* | * | Gills |
| *Urocleidus megalonchus* | * | Gills |
| *Uurocleidus procax* | * | Gills |
| *Urocleidus similis* | * | Gills |
| DIGENEA | | |
| *Allocreadium* spp. | * | Intestine |
| *Alloglossidium corti* | | Cercaria in snail, Helisoma; metacercaria in dragonfly nymphs |
| *Azgia angusticauda* | * | Intestine and stomach |
| *Bundoderina sacculata* | * | Intestine |
| *Crepidostomum cooperi* | | Cercaria in clam; metacercaria in aquatic insects, mayfly nymphs or crustacea; adult in fish |
| *Crepidostomum cornutum* | * | Cercaria in clam; metacercaria in crayfish; adult in fish |
| *Crepidostomum* spp. | * | Intestine, gall bladder |
| *Homalometron armatum* | * | Intestine |
| *Proterometra macrostoma* | * | Esophagus |
| DIGENEA METACERCARIA | | |
| *Apophallus brevis* | * | Skin, fins, gills, masculature |
| *Ascocotyle tenuicollis* | | Metacercaria in this fish; adult in herons |
| *Clinostomum marginatum* | | Cercaria in snail; Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron, other birds |
| *Cryptogonimus chyli* | * | Musculature |
| *Diplostomulum scheuringi* | * | Cercaria in snail, Helisoma; metacercaria in vitreous chamber of fish, newts, also encysts in mice |
| *Diplostomulum spathaceum huronense* | * | Eye |
| *Diplostomulum* spp. | * | Eye, brain, pharynx |

| | | |
|---|---|---|
| *Heterophyidae gen.* spp. | * | Skin, gills, musculature |
| *Neascus* spp. | * | Mesenteries, gills, skin |
| *Neascus of Posthodiplostomum minimum* | # | Metacercaria in this fish, adult in herons, other birds |
| *Neascus of Uvulifer ambloplitis* | * | Cercaria in snail, Helisoma; metacercaria in fish as black spot; adult in kingfisher |
| *Posthodiplostomum cuticola* | * | Mesenteries, kidney, liver |
| *Posthodiplostomum minimum* | * | Mesenteries, kidney, liver |
| *Posthodiplostomum minimum centrarchi* | * | Liver |
| *Tetracotyle* spp. | * | Heart, pericardium, mesenteries, kidney, masculature |
| *Uvulifer ambloplitis* | * | Skin, masculature, gills, fins |
| CESTOIDEA | | |
| *Bothriocephalus claviceps* | | Procercoid in copepods; plero cercoid sometimes in small fish; adult in fish |
| *Bothriocephalus* spp. | | Pyloric caeca, intestine |
| *Dilepididae gen.* spp. | * | Plerocercoid in liver and mesenteries |
| *Diphyllobothrium* spp. | * | Plerocercoid in viscera, musculature, body cavity, blood vessels of heart |
| *Hymenolepis* spp. | * | Plerocercoid in body cavity, liver |
| *Proteocephalus ambloplitis* | * | Procercoid in copepods; plerocercoid in fish; adult in fish |
| *Proteocephalus fluviatilis* | * | Intestine |
| *Proteocephalus pearsei* | * | Intestine |
| *Triaenolphorus nodulosus* | * | Plerocercoid in liver, viscera |
| NEMATODA | | |
| *Camallanus oxycephalus* | | Larvae in copepods and other crustacea; adult in intestine, shows red from vent |
| *Camallanus* spp. | | Larvae in fish |
| *Contracaecum* spp. | * | Intestine, stomach, viscera, mesenteries, musculature |

| | |
|---|---|
| *Contracaecum spiculigerum* | Larvae in this fish; adult in fish eating birds |
| *Eustrongylides* spp. * | Larvae in viscera, musculature, body cavity, ovary |
| *Hysterothylacium brachyurum* # | Not available |
| *Philometra spp.* * | Body cavity, intestine |
| *Rhabdochona* spp. * | Intestine |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine of fish |
| *Spinitectus gracilis* * | Intestine |
| *Spiroxys* spp. * | Viscera, mesenteries, digestive tract |
| *Thynnascaris brachyura* * | Intestine |
| ACANTHOCEPHALA | |
| *Acanthocephala thecatum* | Larvae in amphipods; if less than 30 days may encyst in fish which act as second intermediate host; adult in caeca |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days, small fish may be second intermediate host |
| *Metechinorhynchus salmonis* * | Intestine |
| *Neoechinorhynchus cylindratum* | Larvae in small crustacea and in this fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; second intermediate host, fish |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Not available |
| Illinobdellaa spp. | Not available |
| *Myzobdella moorei* * | Fins |
| *Piscicola punctata* * | Body surface, gills |
| *Placobdella montifera* * | Body surface |
| CRUSTACEA | |
| *Achtheres ambloplitis* * | Gills |
| *Achtheres micropteri* | Not available |

| | |
|---|---|
| *Argulus flavescens* | Not available |
| *Ergasilus caeruleus* | Not available |
| *Ergasilus centrarchidarum* | Not available |
| *Ergasilus* spp. | Gills |
| *Ergasilus versicolor* | Not available |
| *Lernaea cyprinacaea* * | Embedded in musculature, body protruding |

*Centrarchus macropterus* - Flier

DIGENEA

| | |
|---|---|
| *Phyllodistomum pearsii* | Cercaria in clam; metacercaria in sporocyst in clam, arthropod; adult in urinary bladder |

DIGENEA METACERCARIA

| | |
|---|---|
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |
| *Diplostomulum scheuringi* | Metacercaria in vitreous chamber of eye of fish, newt, mouse |

ACANTHOCEPHALA

| | |
|---|---|
| *Neoechinorhynchus cylindratum* | Larvae in small crustacea; some species have second intermediate host |

CRUSTACEA

| | |
|---|---|
| *Ergasilus caeruleus* | Not available |

**PERCIDAE**

*Stizostedion canadense* - Sauger

MONOGENEA

| | |
|---|---|
| *Cleidodiscus aculeatus* | Gills |
| *Gyrodactylus mizellei* | Not available |
| *Urocleidus aculeatus* * | Gills |

DIGENEA

| | |
|---|---|
| *Bucephalus pusillus* | Cercaria in clam; metacercaria in fish; adult in intestine of this fish |

| | |
|---|---|
| *Centrovarium lobotes* | Metacercaria in fish muscle; adult in stomach and intestine |
| *Crepidostomum cooperi* # | Intestine |
| *Creptotrema funduli* # | Intestine |
| *Phyllodistomum superbum* | Cercaria in clam; metacercaria in sporocysts in clam or arthropods; adult in ureters of this fish |
| *Prosorhynchoides pusilla* * | Adult in stomach, pyloric caeca, intestine |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatus* | Cercaria in snail, Helisoma; metacercaria in fish muscle; adult in heron |
| *Diplostomulum* spp. | Cercaria in snails; metacercaria in this fish; adult in herons, gulls, cormorants, fish |
| *Neascus* spp. | Metacercaria in skin |
| *Tetracotyle communis* | Mtacercaria in mesenteries and pericardium of fish; adult in birds |
| *Tetracotyle of Cotylurus communis* | Metacercaria encysted in pericardial cavity of fish |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepods; plerocercoid sometimes in small fish |
| *Bothriocephalus cuspidatus* | Procercoid in copepods; plerocercoid in small fish sometimes; adult in caeca and intestine |
| *Diphyllobothrium latum* | Procercoid in copepods; plerocercoid in this fish |
| *Proteocephalus ambloplitis* | Procercoid in copepods; plerocercoid in small fish; adult in mesenteries of this fish |
| *Proteocephalus luciopercae* | Procercoid in haemocoel of crustacea; plerocercoid in small fish |
| *Proteocephalus stizostethi* | Procercoid in haemocoel of crustacea; plerocercoid in small fish |

| | |
|---|---|
| *Triaenophorus nodulosus* | Procercoid in copepod; plerocercoid in small fish; adult in liver and mesenteries of this fish |
| *Triaenophorus* spp. | Procercoid in copepods; plerocercoid in small fish; adult in intestine of this fish |
| NEMATODA | |
| *Camallanus oxycephalus* | Larvae copepods, other crustacea; adult in intestine, shows red from vent |
| *Contracaecum brachyurum* | Adult in intestine |
| *Eustrongylides* spp. | Larvae in cysts in body cavity; adult in glands of proventriculus of fish eating birds |
| *Raphidascaris acus* # | Liver |
| *Thynnascaris brachyura* * | Larvae in liver, mesenteries of this fish; adult in intestine of this fish |
| ACANTHOCEPHALA | |
| *Echinorhynchus salmonis* | Larvae in amphipods; second intermediate host (*Osmerus mordax*) |
| *Metechinorhynchus salmonis* | Adult in intestine |
| *Neoechinorhynchus cylindratum* | Larvae in small crustacea, Ostracod?; fish, second host |
| *Neoechinorhynchus* spp. * | Adult in intestine |
| *Neoechinorhynchus strigosus* # | Intestine |
| *Neoechinorhynchus tenellus* | Larvae in small crustacea; some have second intermediate host; adult in intestine |
| OLIGOCHAETA | |
| *Illinobdella moorei* | Fins |
| *Myzobdella moorei* * | Fins |
| *Piscicola punctata* | Not available |
| CRUSTACEA | |
| *Argulus appendiculosus* | Fins |

| | |
|---|---|
| *Argulus biramosus* | Not available |
| *Argulus stizostethi* | Not available |
| *Ergasilus caeruleus* | Gills |
| *Ergasilus centrarchidarum* | Not available |
| *Ergasilus luciopercarum* | Not available |
| *Lernaea cruciata* | Not available |
| *Lernaea variabilis* | Not available |
| *Lerneocerca* spp. | Not available |

<u>*Stizostedion vitreum*</u> - Walleye

PROTOZOA

Ciliata

| | |
|---|---|
| *Carchesium* spp. | On eggs |
| *Ichthyophthirius multifiliis* | Not available |

MYXOSPORIDA

| | |
|---|---|
| *Myxobilatus asymmetricus* | Urinary bladder |
| *Myxobolus* spp. # | Heart |

MONOGENEA

| | |
|---|---|
| *Cleidodiscus aculeatus* | Not available |
| *Cleidodiscus* spp. * | Gills |

MONOGENEA

| | |
|---|---|
| *Cleidodiscus aculeatus* | Not available |
| *Cleidodiscus* spp. | Gills |
| *Gyrodactyloidea gen.* spp. | Gills |
| *Gyrodactylus mizellei* | Not available |
| *Gyrodactulus schmidti* | Not available |
| *Urocleidus aculeatus* | Gills |
| *Urocleidus adspectus* # | Gills |

DIGENEA

| | |
|---|---|
| *Azygia acuminata* | Cercaria in snail, eaten; metacercaria in host or small carrier fish; adult in stomach or intestine |
| Azygia angusticauda | Cercaria in snail; adult in stomach and intestine |
| *Azygia* spp. * | Not available |
| *Bucephaloides ozakii* | Cercaria in clam; metacercaria in fish; adult in gut |
| *Bunodera sacculata* | Adult in intestine |
| *Bunoderina sacculata* * | Metacercaria in fish flesh; adult in stomach and intestine |
| *Centrovarium lobotes* | Metacercaria in fish flesh; adult in stomach and intestine |
| *Crepidostomum cooperi* # | Intestine |
| *Crepidostomum* spp. | Cercaria in clam; metacercaria in sporocysts in clam or arthropods; adult in ureters |
| *Creptotrema funduli* # | Intestine, stomach |
| *Lissorchis kritskyi* # | Intestine |
| *Phyllodistomum superbum* | Cercaria in clam; metacercaria in sporocysts in clam or arthropods; adult in ureters |
| *Prosorhynchoides pusilla* * | Adult in stomach, pyloric caeca, intestine |
| *Rhipidocotyle papillosus* # | Intestine |
| *Sanguinicola occidentalis* | Cercaria in snail; no second host; adult in blood vessel |

DIGENEA METACERCARIA

| | |
|---|---|
| *Clinostomum complanatum* * | Metacercaria in musculature |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |
| *Clinostomum* spp. * | Metacercaria in musculature, viscera |

| | |
|---|---|
| *Cotylurus communis* * | Metacercaria in mesenteries, liver |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber of eye of fish and newts |
| *Diplostomulum spathaceum* # | Eye |
| *Diplostomulum* spp. * | Metacercaria in vitreous humor eye, brain, pharynx # |
| *Neascus* spp. * | Metacercaria in mesenteries, gills, skin |
| *Neascus crasssiphiala bulboglossa* | Cercaria in snail, Helisoma; metacercaria in fish as black spot skin cysts; adult in kingfisher |
| *Posthodiplostomum minimum* * | Metacercaria in mesenteries, liver, kidney |
| *Tetracotyle of Cotylurus communis* | Metacercaria in pericardial cavity of fish; adult in gull, Larus argentatus |
| *Tetracotyle diminuta* | Kidney, mesentery |
| *Uvulifer ambloplitis* # | Not available |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Procercoid in copepod; plerocercoid small fish sometimes; adult in intestine |
| *Bothriocephalus cuspidatus* | Procercoid in copepod; plerocercoid small fish sometimes; adult in intestine, pyloric caeca # |
| *Bothriocephalus formosus* # | Intestine, pyloric caeca |
| *Diphyllobothrium latum* | Procercoid in copepod; plerocercoid in fish musculature, adult in bear, dogs, man |
| *Dyphyllobothrium* spp. * | Plerocercoid in viscera, musculature, body cavity, blood vessels of heart in this fish |
| *Proteocephalus ambloplitis* | Procercoid in crustacea; plerocercoid in mesenteries and liver |
| *Proteocephalus fluviatilis* | Procercoid in crustacea; plerocercoid in mesenteries and liver |

| | |
|---|---|
| *Proteocephalus luciopercae* | Procercoids in copepods; plerocercoid in small fish |
| *Proteocephalus macrocephalus* | Procercoid in copepods; plerocercoid in small fish |
| *Proteocephalus pearsei* * | Adult in intestine |
| *Proteocephalus pinguis* * | Adult in intestine |
| *Proteocephalus* spp. * | Adult in intestine, pyloric caeca |
| *Proteocephalus stizostethi* | Procercoid in copepods; plerocercoid in small fish |
| *Triaenophorus crassus* | Plerocercoid in viscera of *Catostomus* spp., *Coregonus* spp., *Cottus cognatus*, *Esox* spp., *Eucalia inconstans*, *Roccus chrysops*, *Lepomis* spp., *Micropterus* spp., *Moxostoma* spp., *Notropis* spp., *Perca flavescens*, *Pomoxis nigromaculatus*, *Salvelinus fontinalis*, *Thymallus signifer*; adult in intestine of this fish |
| *Triaenophorus nodulosus* * | Intestine |
| *Triaenophorus* spp. * | Plerocercoid in musculature, liver, viscera |
| Triaenophorus stizostedionis | Procercoid in Cyclops; plerocercoid in viscera of Percopsis omiscomaycus; adult in intestine of this fish |

NEMATODA

| | |
|---|---|
| *Camallanus oxycephalus* * | Adult in intestine, shows red from vent |
| *Capillaria catenata* | Gut, liver, urinary bladder of vertebrates |
| *Contracaecum brachyurum* | Adult in stomach and intestine of fish eating birds, fish, mammals |
| *Contracaecum spiculigerum* | Adult in stomach and intestine of fish eating birds, fish mammals |
| *Contracaecum* spp. | Adult in intestine |
| *Cucullanellus cotylophora* * | Adult in intestine |
| *Dacnitoides cotylophora* | Adult in intestine of fish |
| *Eustrongylides tubifex* # | Muscles |

| | |
|---|---|
| *Eustrongylides* spp. | Larvae encyst in muscles of this fish; adult in glands of proventriculus of birds |
| *Hysterothylacium brachyurum* # | Liver, intestine |
| *Philometra cylindracea* | Larvae in copepods; adult in fish tissue |
| *Raphidascaris acus* * | Adult in intestine, larvae in liver, rectum, eye # |
| *Raphidascaris* spp. * | Adult in liver, digestive tract |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine of fish |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach and intestine of fish |
| *Spinitectus* spp. * | Adult in digestive tract |
| *Thynnascaris brachyura* * | Adult in intestine |
| ACANTHOCEPHALA | |
| *Echinorhynchus salmonis* | Larvae in amphipods; second intermediate host, Osmerus |
| *Leptorhynchoides thecatus* * | Larvae in amphipods; if less than 30 days a small fish may be second intermediate host; larvae may be encysted in mesenteries of this fish; adult in intestine of this fish |
| *Metechinorhynchus salmonis* | Adult in intestine |
| *Metechinorhynchus* spp. * | Adult in intestine |
| *Neoechinorhynchus crassus* * | Adult in intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish |
| *Neoechinorhynchus rutili* # | Intestine |
| *Neoechinorhynchus* spp. * | Adult in intestine |
| *Neoechinorhynchus tenellum* | Larvae in crustacea and fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod, small fish as second host |
| *Pomphorhynchus* spp. * | Adult in digestive tract |
| *Prosorhynchoides pusilla* # | Intestine |

OLIGOCHAETA

| | |
|---|---|
| *Illinobdella moorei* | Not available |
| *Macrobdella decora* * | Body surface |
| *Myzobdella moorei* * | Fins |
| *Myzobdella* spp. | Not available |
| *Percymoorensis mamorata* * | Body surface |
| *Placobdella montifera* # | Skin |
| *Piscicola punctata* * | Body surface, gills |
| *Placobdella pediculata* | Not available |

CRUSTACEA

| | |
|---|---|
| *Argulus appendiculosus* | Not available |
| *Argulus biramosus* | Not available |
| *Argulus canadensis* | Not available |
| *Argulus* spp. | Not available |
| *Argulus stizostethi* | Not available |
| *Argulus versicolor* | Not available |
| *Ergasilus caeruleus* | Gills |
| *Ergasilus centrarchidarum* | Not available |
| *Ergasilus lucio*percarum | Not available |
| *Ergasilus* spp. * | Gills |

*Perca flavescens* - Yellow perch

FUNGI

| | |
|---|---|
| *Ichthyosporidium* spp. | Internal organs |

PROTOZOA

Flagellata

| | |
|---|---|
| *Spironucleus* spp. * | Intestine |
| *Trypanosoma percae var canadensis* * | Blood |
| *Trpanosoma* spp. | Blood |

| | |
|---|---|
| Ciliata | |
| *Balantidium* spp. | Intestine |
| *Glossatella megamicronucleata* # | Fins, gills |
| *Ichthyophthirius multifiliis* | Body, gills, fins # |
| *Trichodina algonquinensis* # | Ureters, urinary, bladder |
| *Trichodina oviformis* # | Gills |
| *Trichodina rectangli* # | Fins, nares |
| *Trichodina* spp. | Ureters |
| *Trichodina symmetrica* # | Fins, gills, skin |
| *Trichodina tumefaciens* # | Fins, gills, nares, skin |
| *Trichodina urinaria* # | Ureters |
| Coccidia | |
| *Apiosoma triangularis* # | Fins, gills, nares |
| *Eimeria laureleus* * | Intestine |
| *Eimeria tedlai* * | Intestine |
| *Goussia laureleus* # | Caecum, gallbladder, gut, liver |
| MYXOSPORIDA | |
| *Henneguya doori* | Gills |
| *Henneguya percae* | Gills |
| *Henneguya* spp. * | Gills |
| *Myxidium percae* | Subdermal |
| *Myxidium umbri* | Renal tubules |
| *Myxidium* spp. # | Gall bladder |
| *Myxobilatus wisconsinensis* | Urinary bladder |
| *Myxobolus aureatus* # | Brain, gut, swimbladder |
| *Myxobolus percae* | Base of pectoral fin |
| *Myxobolus neurophila* # | Brain |
| *Myxobolus scleroperca* | Sclerotic cartilage |

MONOGENEA

| | |
|---|---|
| *Cleidodiscus adspectus* | Gills |
| *Cleidodiscus* spp. | Gills |
| *Gyrodactylidae gen.* spp. * | Gills |
| *Gyrodactyloidea gen.* spp. * | Gills, skin |
| *Gyrodactylus freemani* | Fins |
| *Urocleidus adspectus* | Gills |

*DIGENEA*

| | |
|---|---|
| *Asymphylodora amnicolae* | Cercaria in snail, Amnicola; metacercaria progenesis in snail; adult in intestine |
| *Azygia angusticauda* | Adult in intestine and stomach |
| *Azygia longa* | Cercaria in snail, eaten; metacercaria in host fish or small carrier fish; adult in intestine and stomach |
| *Azygia* spp. | Cercaria in snail, eaten; metacercaria in small carrier fish or host fish; adult in host fish |
| *Bucephaloides pusillus* | Cercaria in clam; metacercaria in fish; adult in intestine of fish |
| *Bucephalus elegans* | Cercaria in clam; metacercaria in fish; adult in intestine of fish |
| *Bunodera luciopercae* | Cercaria in clam; metacercaria in crustacea, copepods and crayfish; adult in intestine and caeca |
| *Bunodera sacculata* | Cercaria in clam; metacercaria in Cladocera, crayfish; adult in intestine |
| *Centrovarium lobotes* | Metacercaria in fish muscle; adult gastrointestinal |
| *Crepidostomum cornutum* # | Not available |
| *Crepidostomum cooperi* | Cercaria in clam; metacercaria in insect or crustacea |
| *Creptotrema funduli* # | Intestine, stomach |
| *Creptottrema farionis* | Cercaria in clam; metacercaria in mayfly nymphs and Gamarus; adult in gall bladder |

| | |
|---|---|
| *Cryptogonimus chyli* | Metacercaria in fish muscle; adult gastrointestinal |
| *Leuceruthrus* spp. * | Adult in digestive tract |
| *Microphallidae gen.* spp. * | Not available |
| *Microphallus opacus* | Metacercaria in crayfish |
| *Phyllodistomum americanum* | Cercaria in clam; metacercaria in arthropods, sporocyst in clam; adult in urinary bladder |
| *Phyllodistomum superbum* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in urinary bladder, ureters |
| *Proterometra autraini* # | Cercaria from the snail Elimia livescens |
| *Sanguinicola occidentalis* | Cercaria in snail; no second host; adult in blood vessel |

DIGENEA METACERCARIA

| | |
|---|---|
| *Apophallus brevis* | Metacercaria in skin, fins, gills, musculature, black spot # |
| *Apophallus itascensis* | Metacercaria in muscle of fish, are shaped like balloon tire; adult unknown |
| *Apophallus venustus* * | Metacercaria in musculature |
| *Caecincola* spp. # | Vitreous humor of eye |
| *Clinostomum complanatum* * | Metacercaria in gills, musculature |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |
| *Clinostomum* spp. * | Metacercaria in musculature, viscera |
| *Crassiphiala bulboglossa* | Metacercaria in fins, integument of this fish as black spot; adult in kingfisher |
| *Diplostomulum flexicaudum* | Cercaria in snail; metacercaria in lens of fish; adult in gulls, other birds |
| *Diplostomulum scheuringi* | Cercaria in snail, Helisoma; metacercaria in vitreous chamber and brain of fish and newts |

| | |
|---|---|
| *Diplostomulum of Diplostomum huronense* | Snail not known; metacercaria in lens and vitreous chamber; adult in gulls |
| *Diplostomum adamsi* | Cercaria in snail, Lymnaea; metacercaria in periphery of retina of fish; adult experimentally in gull |
| *Diplostomum spathaceum huronense* * | Metacercaria in eye |
| *Diplostomum* spp. * | Metacercaria in vitreous humor of eye |
| *Echinochasmus donaldsoni* | Cercaria in snail; metacercaria in gills; adult in grebes |
| *Euparyphium melis* | Cercaria in snail; metacercaria in nares and cloaca of fish; adult in mink |
| *Metorchis conjunctus* * | Metacercaria in musculature |
| *Neascus ellipticus* | Metacercaria as non-pigmented muscle cyst |
| *Neascus longicallis* | Metacercaria as pigmented cyst in skin |
| *Neascus pyrifomis* | Metacercaria as pigmented cyst in skin |
| *Neascus* spp. | Metacercaria in fins, flesh, integument, eye socket, cranial cavity, mesentery, peritoneum of gut of this fish |
| *Neascus of Crassiphiala bulboglossa* | Cercaria in snail, Helisoma; metacercaria in fish as black spot skin cysts; adult in kingfisher |
| *Ornithodiplostomum ptychocheilus* | Cercaria in snail, Physa; adult in some ducks |
| *Petasiger nitidus* | Cercaria in Helisoma, eaten; metacercaria in fish; adult in intestine of this fish |
| *Posthodiplostomum minimum* * | Metaceraria in mesenteries, liver, kidney |
| *Posthodiplostomum minimum centrarchi* * | Metacercaria in liver |
| *Rhipidocotyle papillosa* * | Metacercaria in musculature |

| | |
|---|---|
| *Ribeiroia ondatrae* | Cercaria in snail, Helisoma; metacercaria in lateral line of this fish; adult in osprey, hawks, muskrats |
| *Tetracotyle diminuta* | Metacercaria encysted in pericardial cavity and adipose tissue behind eye; adult reared in unfed chicks |
| *Tetrracotyle intermedia* * | Metacercaria in heart, mesenteries |
| *Tetracotyle* spp. | Metacercaria in mesenteries of fish; adult in birds, pericardium |
| *Uvulifer ambloplitis* * | Metacercaria in skin, musculature, fins, gills |
| CESTOIDEA | |
| *Bothriocephalus cuspidatus* | Procercoid in copepod; plerocercoid in small fish sometimes; adult in intestine |
| *Bothriocephalus* spp. * | Adult in pyloric caeca, intestine |
| *Corallobothrium* spp. * | Adult in intestine |
| *Cyathocephalus truncatus* | Procercoid in amphipod; plerocercoid in small fish; adult in pyloric caeca |
| *Diphyllobothrium latum* | Procercoid in copepod; plerocercoid in fish; adult in bear, dogs, man |
| *Ligula intestinalis* | Procercold in copepod; plerocercoid in fish; adult in fish eating birds |
| *Proteocephalus ambloplitis* | Procercoid in crustacea; plerocercoid in small fish and mesenteries of this fish |
| *Proteocephalus pearsei* | Procercoid in copepods; plerocercoids in many fish |
| *Proteocephalus pinguis* | Procercoid in copepods; plerocercoids in fish |
| *Schistocephalus solidus* * | Plerocercoid in body cavity |
| *Triaenophorus nodulosus* | Procercoid in copepod; plerocercoid in forage fish and this fish in liver; adult in Esox lucius # |

| | |
|---|---|
| *Trianophorus* spp. | Plerocercoid in musculature, liver, viscera |
| NEMATODA | |
| *Agamospirura* spp. # | Mesenteries |
| *Camallanus oxycephalus* | Larvae in copepod; adult in intestine, shows red from vent |
| *Camallanus* spp. * | Not available |
| *Capillaria catenata* | Gut, liver, urinary bladder of vertebrates |
| *Contracaecum* spp. * | Intestine, stomach, viscera, mesenteries, musculature |
| *Contracaecum spiculigerum* | Larvae in fish; adult in cormorants, mergansers, gulls, pelicans |
| *Cucullanellus cotylophora* * | Adult in intestine |
| *Dacnitoides cotylophora* | Adult in intestine |
| *Dichelyne cotylophora* | Adult in intestine |
| *Eustrongylides* spp. | Larvae in fish as cysts attached to viscera |
| *Eustrongylides tubifex* # | Mesenteries |
| *Hysterothlacium brachyurum* # | Liver |
| *Philometra cylindracea* | Larvae in copepods; adult in fish tissue |
| *Philometra* spp. | Larvae in copepods; adult in fish tissue |
| *Rhabdochona acus* # | Stomach, intestine, larvae in liver # |
| *Rabdochona cascadilla* | Larvae probably in Hyallela (amphipod); adult in intestine |
| *Rhabdochona ovifilamenta* * | Adult in intestine |
| *Rhabdochona* spp. | Larvae in aquatic insects |
| *Raphidascaris* spp. * | Adult in liver, digestive tract |
| *Spinitectus carolini* | Larvae in mayfly larvae; adult in stomach and intestine |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach and intestine |

| | |
|---|---|
| *Spinitectus* spp. * | Adult in digestive tract |
| *Spiroxys contortus* * | Larvae in intestinal serosa of fish |
| *Spiroxys* spp. | First host Cyclops; larvae in mesenteries of fish and amphibia, dragonfly nymphs, snails |

ACANTHOCEPHALA

| | |
|---|---|
| *Acanthocephalus dirus* # | Intestine |
| *Acanthocephalus jacksoni* * | Adult in intestine |
| *Acanbthocephalus lateralis* | Larvae in Asellus and Gammarus |
| *Echinorhynchus leidyi* | Larvae in amphipods |
| *Echinorhynchus salmonis* | Larvae in amphipods; second intermediate host, Osmerus |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days, small fish may be second intermediate host |
| *Metechinorhynchus salmonis* * | Adult in intestine |
| *Neoechinorhynchus cylindratum* | Larvae in crustacea and fish; adult in intestine |
| *Neoechinorhynchus pungitius* * | Adult in stomach, intestine |
| *Neoechinorhynchus rutili* | Larvae in crustacea and fish; adult in intestine |
| *Neoechinorhynchus* spp. * | Intestine |
| *Neoechinorhynchus strigosus* # | Intestine |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod, small fish and this fish |
| *Prosorhynchoides pusilla* # | Intestine |

OLIGOCHAETA

| | |
|---|---|
| *Actinobdella* spp. | Not available |
| *Illinobdella alba* * | Body surface |
| *Illinobdella moorei* | Not available |
| *Illinobdella* spp. | Fins |
| *Myzobdella moorei* * | Fins |
| *Piscicolaria* spp. | Not available |
| *Piscicola punctata* * | Body surface, gills |

| | |
|---|---|
| *Piscicola* spp. * | Body surface |
| *Placobdella montifera* # | Not available |
| *Placobdella parasitica* * | Body surface |
| CRUSTACEA | |
| *Argulus appendiculosus* | Not available |
| *Argulus biramosus* | Not available |
| *Argulus canadensis* | Fins |
| *Argulus stizostethi* * | Body surface, fins |
| *Ergasilus caeruleus* | Gills |
| *Ergasilus centrarchidarum* * | Gills |
| *Ergasilus confusus* | Not available |
| *Ergasilus luciopercarum* * | Gills |
| *Ergasilus* spp. * | Gills |
| ARTHROPODA | |
| *Hydrachna* spp. * | Larvae on gills |
| *Hydrozetes* spp. | Gills, nonparasitic |

**SCIAENIDAE**

*Aplodinotus grunniens* - Freshwater drum

| | |
|---|---|
| PROTOZOA | |
| Ciliata | |
| *Epistylis niagarae* # | Not available |
| *Ichthyophthirius multifiliis* | Not available |
| MYXOSPORIDA | |
| *Myxidium macrocapsulare* | Gall bladder |
| *Myxobilatus caudalis* | Urinary bladder |
| MONOGENEA | |
| *Cotylogaster occidentalis* # | Intestine |
| *Lintaxine cokeri* | Gills |
| *Microcotyle eriensis* | Gills |

| | |
|---|---|
| *Microcotyle spinicirrus* | Gills |
| DIGENEA | |
| *Bunodera luciopercae* * | Intestine |
| *Centrovarium lobotes* | Metacercaria in fish muscle; adult in stomach and small intestine |
| *Cotylogaster occidentalis* # | Intestine |
| *Crepidostomum* spp. * | Intestine, gall bladder |
| *Homalometron armatum* * | Intestine |
| *Homalometron grunniens* | Metacercaria in clams; adult in intestine |
| *Microcreadium parvum* | Cercaria in snail; adult in intestine |
| *Phyllodistomum fausti* | Cercaria in clam; metacercaria in sporocysts in clam, arthropods; adult in urinary bladder |
| *Phyllodistomum* spp. | Cercaria in clam; metacercaria in sporocysts in clams or arthropods |
| *Sanguinicola* spp. | Cercaria in snail; adult in blood vessels |
| DIGENEA METACERCARIA | |
| *Clinostomum marginatum* | Cercaria in snail, Helisoma; metacercaria in fish as yellow grub; adult in mouth, esophagus of heron |
| *Diplostomum spathaceum* # | Eye |
| *Diplostomum* spp. # | Vitreous humor of eye |
| *Neascus* spp. | Metacercaria in mesenteries, gills, skins |
| *Tetracotyle* spp. * | Metacercaria in heart, pericardium, mesenteries, kidney, musculature |
| CESTOIDEA | |
| *Bothriocephalus claviceps* | Intestine |
| *Bothriocephalus cuspidatus* | Pyloric caeca, intestine |
| *Proteocephalus pearsei* | Intestine |

| | |
|---|---|
| NEMATODA | |
| *Agamospirura* spp. # | Mesenteries |
| *Camallanus oxycephalus* | Larvae in copepods; adult intestine seen as red from anus |
| *Cucullanellus cotylophora* * | Intestine |
| *Cystidicola serratus* | Intestine |
| *Eustrongylides tubifex* # | Mesenteries |
| *Philometra cylindracea* * | Peritoneium, body cavity |
| *Philometra* spp. | Larvae in copepods; adult in fish tissue |
| *Spinitectus gracilis* | Larvae in mayfly larvae; adult in stomach and intestine |
| ACANTHOCEPHALA | |
| *Leptorhynchoides thecatum* | Larvae in amphipod; if less than 30 days intermediate host may be small fish |
| *Pomphorhynchus bulbocolli* | Larvae in amphipod; intermediate host, small fish |
| OLIGOCHAETA | |
| *Illinobdella* spp. | Not available |
| *Piscicola punctata* * | Body surface, gills |
| CRUSTACEA | |
| *Argulus appendiculosus* | Fins |

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## INDEX OF PARASITE GENERA*

*For species within a genus see designated page of genus. Fish hosts are indexed in Table of Contents.