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TAPEWORM IN MICHIGAN WALLEYE

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Beginning in the spring of 2007, the Michigan Department of Natural Resources (MDNR) Fisheries Division received large numbers of complaints from anglers that the walleye they were catching in Saginaw Bay and its tributaries, other Great Lakes waters in eastern Michigan, and some inland lakes were infected with tapeworms. Although tapeworms in Great Lakes fishes are well known, the magnitude of the infection in walleye fisheries has led fisheries biologists to investigate these reports more closely.

Tapeworms are flat, parasitic worms belonging to the taxonomic class *Cestoidea*. Tapeworms of various species infect both cold-blooded and warm-blooded animals. Many different species of tapeworms are known to infect various fish species at some stage of their life cycles.

Most tapeworms have no common name. Scientists call them “Cestodes” and refer to them by their genus and species using unique Latin names. Regular folks just know them as tapeworms.

Two different genera of tapeworms have been positively identified from 2007 walleye samples; *Bothriocephalus* and *Proteocephalus*. Another genus, *Triaenophorus*, is also known from walleye in Lake Huron, but did not turn up in the 2007 samples. There are several species of *Bothriocephalus*, *Proteocephalus*, and *Triaenophorus* that are known to infect walleye in Lake Huron. Only a parasitologist can distinguish one species from another. For the purposes of the average angler, they are all just tapeworms and interestingly enough, their life cycles are all very much alike.

Life cycle of walleye tapeworms

(1.) The tapeworms anglers are finding in their fish are the adult stage of the parasite. Each segment of the tapeworm has both male and female sex organs and, as it matures, the segment becomes filled with eggs. Mature segments are at the back end of the worm, and are shed out of the fish with the feces. The outer covering of the segment decays and lets the eggs out into the water where some of them are eaten by tiny aquatic crustaceans known as *copepods*.

(2.) Copepods are a very common animal in a group known collectively to scientists as zooplankton, and an adult copepod is about as large as this comma [,] . Copepods and other zooplankton are extremely important components of the aquatic food chain, as they are the first food of most fish species, and many fishes feed on them throughout their lives. After being eaten by the copepod, the tapeworm egg hatches and develops into a larva. The copepod is known as the first intermediate host. The copepod must then be eaten by a fish for the life cycle to continue.
(3.) When a small fish eats the copepod, the larval tapeworm takes up residence inside the fish’s body, usually encysting itself in the muscle or amongst the internal organs. The small fish is known as the second intermediate host. The small fish must then be eaten by a larger predator fish such as a walleye for the tapeworm’s life cycle to continue.

(4.) When the walleye eats the forage fish, the larva takes up residence in the digestive tract and grows into an adult tapeworm. The walleye is known as the final host. The life cycle of the tapeworm is now complete, and starts over again.

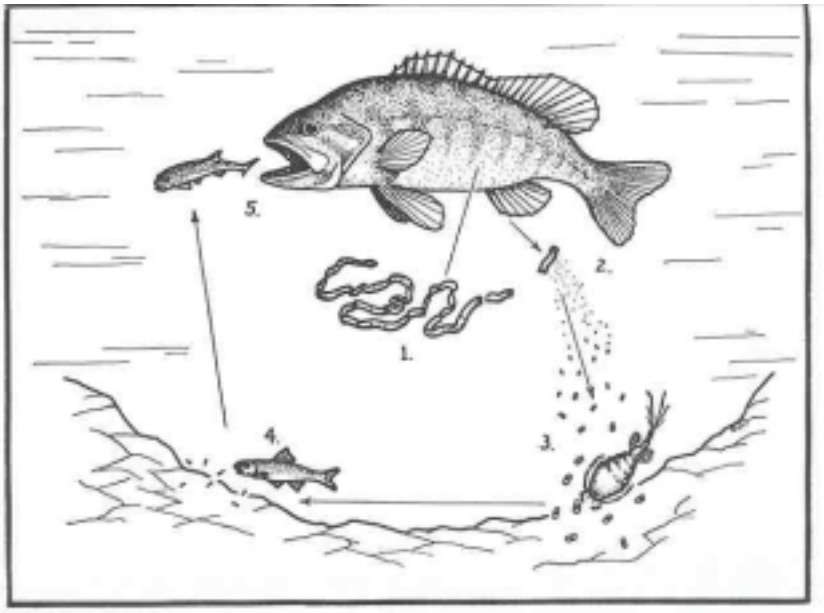

Fig. 60. LIFE CYCLE OF THE BASS TAPEWORM, *Proteocephalus ambloplitis*. (Adapted from Hunter, 1930).

NOTE: The illustration above shows the life cycle of the bass tapeworm, which is identical to the life cycle of the walleye tapeworms. Illustration taken from Lagler (1956).

So why are all of these tapeworms suddenly showing up in our walleye?

It should be noted that all of the tapeworms observed in walleye thus far are known to occur in the Great Lakes and some have been documented by parasitologists as early as 1919. These tapeworms are not a new invasive species, but biological conditions in the lake (specifically, changes in the food chain) may have changed to make them more abundant than in the past.

We believe the increased incidence of tapeworm is the result of a change in the walleye's diet due to the collapse of alewife populations in Lake Huron. Until recently, alewives were the main food source for walleye, Chinook salmon, lake trout, and many other predatory fishes in the Great Lakes.

Beginning in 2002, alewife numbers in Lake Huron went into a sharp decline. The reasons for this decline included major changes in the aquatic food chain brought on by other invasive species, principally zebra mussels and quagga mussels. These invasive species directly competed for resources with the principal food of the alewife; a small shrimp-like creature called *Diporeia*. This in turn has caused a decline in alewife numbers in Lake Huron. Some predator fishes that depended primarily on alewives for food, most notably the Chinook salmon, also have declined sharply in numbers in Lake Huron. Other predators that were more adaptable, such as walleye and lake trout, simply started eating other kinds of forage fish.

The collapse of alewife proved to be a big advantage to several of our native fish species. Alewives fed heavily on newly hatched fish fry, and when they disappeared several native species including yellow perch, walleye, and emerald shiners began reproducing in numbers such as we had not seen in 30 years of research on Lake Huron.

Before their collapse, alewives were one of the primary foods of adult walleye. However, like many of our native Great Lakes fishes, walleye are very adaptable to changing conditions. When there were no alewives, the walleyes switched to whatever small fish were available. In Saginaw Bay, the most abundant forage fishes were young yellow perch, round gobies, gizzard shad (in late summer) and emerald shiners (in fall, winter and spring).

The changes in the walleye's diet are reflected in its parasite community. Parasitologists have long known that many species of shiner minnows (including the emerald shiner) and yellow perch are second intermediate hosts for tapeworms. Walleyes are becoming infected with tapeworms because they are now eating more emerald shiners, yellow perch, and other forage species which carry the tapeworm larvae.

Is it safe to eat walleyes that have tapeworms?

YES, as long as the fish are thoroughly cooked, smoked, or pickled using normal food preparation practices. We have consulted with Dr. Patrick Muzzall (Michigan State University, Fish Parasitologist), and with a veterinarian from the Michigan Department of Agriculture. We have also searched pertinent literature. All agree with this recommendation.

It is, however, a very bad idea to eat any freshwater fish raw or poorly cooked as many fish parasites use fish eating mammals and birds as hosts and it is not known if humans can also be hosts. We do not recommend making sushi from any species of freshwater fish as the risk to humans is not known.

Even if they are not harmful, these tapeworms are disgusting. How can anglers handle their catch to minimize contact with the tapeworms?

Tapeworms often crawl out of the vent or the mouth of the walleye after the fish dies. Sometimes they can be seen hanging out of the fish's gills. The worm exits its dead host because it senses the change in internal conditions. As a result, anglers find the worms in their coolers along with their catch.

If you know you are going to keep your catch, we recommend gutting it immediately and putting the gutted fish on ice in your cooler. DO NOT throw the guts overboard as this is illegal. It will also allow the tapeworms to release their eggs back into the water. Put the guts in a plastic bag in your cooler and dispose of them properly when you get home. A simple slit in the belly is all that's necessary to remove the digestive tract. Do not fillet your fish while on the water, as it is illegal to possess fish on the water or at dockside that cannot be identified or measured to determine whether or not they are of legal size.

Why have tapeworms in walleye suddenly appeared in some of our inland lakes?

Again, it is important to note that tapeworm in walleye have been observed in Michigan's inland waters for a long time. It may be that the rate of infection has recently increased, or it may be that people who

have heard about tapeworm in Great Lakes walleye are simply looking more closely for them now than in the past.

Another likely reason is that baitfish (principally emerald and spottail shiners) taken from the Great Lakes have been used by anglers and released in these lakes. Large quantities of shiners are harvested annually from Lake Huron and up to now, their distribution by the wholesale bait industry has been largely unregulated. As noted earlier, these shiners are the second intermediate host of the tapeworms and carry the larvae in their bodies. Anglers often release unused minnows into the lakes at the end of their fishing trip, and unwittingly inoculate the lake with whatever pathogens those minnows may carry.

New regulations concerning the use and distribution of baitfish were approved by the Director on June 7, 2007 and will be implemented on June 28, 2007. These regulations are primarily designed to slow the spread of Viral Hemorrhagic Septicemia (VHS) and prohibit the release of minnows that are not on a hook. The regulations also restrict the locations where uninspected bait can be used so be sure to check our website on these regulations (http://www.michigan.gov/dnr/0,1607,7-153-10364_10950_46202---,00.html). These regulations will also help to slow the spread of all fish pathogens including these tapeworms.

Is there anything that can be done to get rid of tapeworms in the Great Lakes?

No. Tapeworms have been in the Great Lakes as long as the fish and are a natural component of these inland seas. As long as there are fish, there will be fish parasites. It is up to anglers to: understand these parasites; learn to how to be partners in managing them; and help to prevent their unnatural spread. Currently, environmental and biological factors in the eastern Great Lakes have come together to favor the tapeworms' life cycle. Changes in these environmental and biological factors may eventually cause tapeworm numbers to decline and allow another parasite species to become predominant. Like many of the other less than desirable aquatic species in the Great Lakes, we are just going to have to learn to live with them.

Most of the information in this white paper came as personal communication from Dr. Patrick Muzzall, a Fish Parasitologist at Michigan State University. We are greatly indebted to Dr. Muzzall for identifying tapeworms taken from Saginaw Bay walleye and providing details of their life cycles.

LITERATURE CITED: Lagler, K.F. 1956. Freshwater Fishery Biology. 2nd ed. Wm. C. Brown, Co. Dubuque, IA.

For more information please contact: Mr. Jim Baker, Southern Lake Huron Unit Manager, (989)684-9141 ext 8070.