Asian Tapeworm (ATW)
(*Bothriocephalus acheilognathi*) Biosheet
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Hosts[1, 1a, 2, 3, 4,5,6,7,8]

Potential hosts are any fish that eat the intermediate copepod hosts (*Cyclops, Diaptomus*). Primary hosts are cyprinoids (carps, minnows, suckers, etc.). It also infects some centrarchids (sunfish), percids (perch), poecilids (live bearers), siluroids (catfishes), sleepers (Eleotridae), and gobies (Gobidae). The ATW is not host specific. It only requires two hosts, instead of the usual three hosts required by most cestodes.[4] The ATW has not yet been reported in salmonids.

North American hosts include the following **cyprinoids**: grass carp (*Ctenopharygodon idella*), common carp and koi (*Cyprinus carpio*), roundtail chub (*Gila robusta*), bonytail chub (*Gila elegans*), humpback chub (*Gila cypha*), virgin spinedace (*Lepidomeda mollispinis*), peamouth (*Mylocheilus*), golden shiner (*Notemigonus crysoleucas*), emerald shiner (*Notropis atherinoides*) red shiner (*Notemigonus lutrensis*), spotfin shiner (*Notropis spilopterus*), fathead minnow (*Pimephales promelas*), woundfin minnow (*Plagopterus argentissimus*), Colorado squawfish (*Ptychocheilus lucius*), speckled dace (*Rhinichthys osculus*), plains killifish (*Fundulus zebrinus*); **centrarchid:** green sunfish (*Lepomis cyanellus*); **poecilids:** mosquito fish (*Gambusia affinis*), green swordtail (*Ziphophorus hellerii*); guppies (*Poecilia reticulata*); **Eleotridae:** sleeper (*Eleotris* sandwicensis), **gobiid:** goby (*Awaous guamensis*). [1a,5]

Utah hosts include roundtail chub, woundfin minnow, speckled dace, red shiner, and virgin spine dace, all cyprinids in the Virgin River. The source of infection to hosts in the Virgin River and Lake Meade was from infected bait minnows from the Midwest by fishermen. In Utah Valley, hosts are grass carp and fathead minnow.[1,3]

Mexican hosts include 49 species from 26 genera and 7 families.[6]

European hosts are perch (*Stizostedion*), catfish (*Silurus glanus*), crucian carp (*Carassius carassius*), guppies (*Poecilia*), mosquito fish (*Gambusia*).[1a]

The total number of hosts is 102 in 14 families and 7 orders of freshwater fishes around the world. [6]

The worm has never been detected in bass. It has not been found in the following percids: yellow perch, walleye, sauger, pike, muskie in North America. Goldfish (*Carassius auratus*) appear to be refractory to infection in the US. [1a]

Epizootiology[1, 1a, 5]

The ATW in one instance caused up to 80% mortality in cultured larval fish. Although the ATW rarely kills fish, [1a] it may shorten the life span and stunt the growth of feral fish. [1] Dr. Heckmann believes it can also kill wild fish. Death is caused by perforation of the host intestine by the worm's scolex (head), especially in heavy infections. The ATW causes the most damage in new hosts that have not developed compatible host-parasite relationships.

Present distribution[1, 2, 5]

The ATW is found in found in Asia, Europe, South Africa, Mexico, British Columbia, US (lower half of the US, New Hampshire, New York, Nebraska, Colorado, Utah, Nevada, Arizona). The introduction and spread of the ATW in Utah County was purportedly the result of importations of certified grass carp and fathead minnows. Several Utah hosts were listed as threatened or endangered prior to the ATW introduction (roundtail chub, woundfin minnow, and virgin spinedace).

Habitat preferences[5]

The ATW thrives in water temperatures from 20-30 C, although it also lives in cooler water temperatures.

Synonyms[5]

Names of the ATW include Chinese tapeworm, *Bothriocephalus opsariichthydis* (*= B. opsalichthydis), Bothriocephalus fluviatilis, Schyzocotyle fluviatilis, Bothriocephalus gowkongensis,* and *Bothriocephalus phoxini.*

Transport recommendation[1a]

The safest method to import susceptible species is to allow the importation of fry from spawn-induced adults (non feeding fry, sac fry, fry fed commercial diet) AND held in clean (well) water for their entire life since hatching. Do not allow fingerling or larger, susceptible fish from ATW endemic areas to be imported.

Field collection

Live fish are best for examination. If dead fish are collected, carefully remove and fix the anterior intestine in 10% buffered formalin[5] or formal saline (10 ml jug strength formalin, 0.9 g NaCl, 90 ml H_2O).

Safest Transport Method[1a]

The safest method is to allow import of non feeding fry, sac fry, or fry fed commercial diet collected from fish that have been induced to spawn AND held in clean water for their entire life. Larger susceptible fish from a tapeworm endemic area or water are not to be imported.

Control[1a,8]

Utah only allows importation of fish that are completely free of the Asian tapeworm. Prevention is the best control. One should seek to import as recommended above under “safest transport method.” If importation of larger fish is necessary and the fish are potential carriers (whether they are certified clean or from an endemic area or not), then the importer must treat using the following method before a COR and entry permit may be received from Utah. Extra-labeled prescription treatment should be handled by a licensed veterinarian. The entry permit and shipment should be accompanied with a statement signed by the veterinarian verifying the treatment. Following the fish importation, fish in the receiving waters should be checked periodically for the tapeworm.

The following method has been shown 100% effective in multiple field and lab tests under Drew Mitchell's supervision.[8] Utah requires that the Praziquantel used must have been stored frozen.[8]

> Use 56.8 mg / ml Praziquantel (Droncit, Bayvet Div., Cutter Lab; Sigma Chemical) with final minimum concentration of 0.67 ppm in the treatment water (1.0 ml of injectable Droncit / 20 gal water) is 0.75 ppm;
> Mix Droncit in ~200 ml isopropyl alcohol before adding it to the treatment water;
> Maintain fish densities no greater than 60 gm of fish / liter (higher densities negate effective treatment);
> Treat fish for a minimum of 24 hr;
> Aerate the water;
> After 24 hrs, filter and waste some of the treatment water onto the ground, then replace it with fresh, clean water (filtration is done because treatment may not kill the eggs in the proglottids);
> Discard worm parts appropriately (autoclave, etc.);
> Continue holding the fish for up to 72 hrs and observe;
> At the end of the treatment period, waste the holding water, replace it with clean water, discard worm parts as above;
> Transport the fish in a decontaminated container in clean, well water that has always been fish free.

Bath treatments for test periods less than 24 hrs, not recommended by Drew Mitchell[1a], because they lacked proper replication, have now been adequately tested. Mitchell[8] does not recommend treatments for less than 24 hrs if complete Asian tapeworm kill is required.

Treatments using less of the drug for the same period were unsuccessful. Higher concentrations of Droncit (up to 10 ppm final concentration) have not proven effective in providing adequate kill at reduced (<12 hours) treatment times. Dr. Heckmann[4] has directly added 1-2 ml of injectable Droncit / 20 gallons, resulting in 0.75-1.5 ppm final concentration bath.[4] Treatments at higher concentrations are more expensive, may be more harmful than beneficial to the animal, and may not be wise for threatened and endangered species.

Utah does not allow importation of fish after oral feedings or injection of Droncit. Oral feedings are not effective, because not all animals feed and attain the correct dosage. Injections and oral tube feeding experimentations are not tried and proven 100% effective.[1a]

Application of broad generalizations in choosing a treatment is not biologically sound. What works for one parasite may not control another. What is critical for complete control of the Asian tapeworm is not only the concentration of treatment, but the length of treatment time and maintaining proper fish densities. [1a]

If a population of fish in Utah is known to be infected with the worm, the best control tactic is to prevent further introductions of fish from that source, dilute out the problem, and attempt to break the life cycle. If infected fish are capturable (grass carp in distinct ponds), this should be done. Following this, they should be destroyed or treated. Even very large fish carry the parasite.[1] Restocking treated fish into the same waters would cause reinfection because the intermediate host is infected. Removing the fish may break the life cycle.

Droncit is not approved by the US Food & Drug Administration for use as a fish therapeutant.

Fish cannot be consumed as food after treatment with Droncit.

References

1. Personal communications between A. K. Hauck and Dick Heckmann, Professor of Zoology, BYU, in October 1993, June 1994, April & June 1996.

1a. Personal communications between A. K. Hauck and Drew Mitchell, US National Biological Survey, Stuttgart, AR, in October 1993, August 1994, June 1995, and April 1996.

2. Thoeson, John C., Editor. 1994. Suggested procedures for the detection and identification of certain finfish and shellfish pathogens. 4th ed., Version 1, Fish Health Section, American Fisheries Society.

3. Heckmann, R. A., Greger, P. D. and J. E. Deacon. The Asian Fish Tapeworm Infecting Endangered Fish Species from the Virgin River, Utah, Nevada, and Ariznoa. FHS/AFS Newsletter, 1986. 14(1):5.

4. Heckmann, R. A. Praziquantel for Treatment of Grass Carp infected with *Bothriocephalus acheilognathi.* FHS/AFS Newsletter, 1995. 23(3):11-12.

5. Mitchell, A. 2004. Bothriocephalosis In AFS/FHS (American Fisheries Society – Fish Health Section). FHS blue book: suggested procedures for the detection and identification of certain fish and shellfish pathogens, 2004 Edition. AFS-FHS, Bethesda, Maryland.

6. Salgado-Maldonado, G. & R.F. Pineda-Lopez. 2004. The Asian fish tapeworm *Bothriocephalus acheilognathi:* a potential threat to native freshwater fish species in Mexico. Biological Invasions 5(3):261-268.

7. Zollweg, E. (Editor) 2008 (winter). NY Chapter of AFS Newsletter.

8. Mitchell, A. & A. Darwish. 2009. Efficacy of 6-, 12-, and 24-h Praziquantel bath treatments against Asian tapeworms *Bothriocephalus acheilognathi* in grass carp. NA J Aquaculture 71:30-34.