March 2014
EWF-009

AgriLife Extension Solutions

My Fish Have…'Grubs?'

Digenean Trematodes and Fish

Hannah Gerke
Texas A&M AgriLife Extension Service

Todd Sink, Ph.D.
Extension Fisheries Specialist
Texas A&M AgriLife Extension Service

Have you ever caught a fish that you knew what color it was supposed to be, but it looked like it was covered in salt and pepper? Have you ever noticed little white bumps around the base or inside of its fins? Have you ever cleaned a fish and found little white or yellow capsules that look like small grains of rice in the fillets? If you have, chances are you have come into contact with a fish that has a case of the often dreaded but misunderstood 'Grubs'.

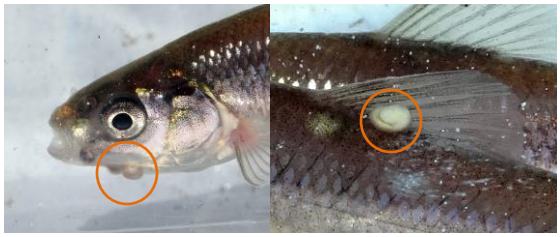

Figure 1. Digenean trematodes or 'grubs' of the operculum and dorsal fin of a fathead minnow. Fathead minnows are common forage species in farm ponds.

Digenean trematodes (formerly digenetic trematodes) in fish are commonly referred to as 'grubs'. A true grub is a larva of an insect, typically that of a beetle, but the 'grubs' we find in fish are not insects. Digenean trematodes, also known as fish flukes and grubs, are parasitic flatworms that require more than one host to complete their life cycle. They undergo asexual reproduction as a larva within a mollusk and sexual reproduction as a mature adult inside a vertebrate host (most often a fish eating bird); hence the former name "di-genetic", or two births. The grub is a larval form of the adult fluke, or flatworm, which lives in an intermediate host, the fish. Digeneans are principal fish parasites with fish serving both as intermediate (grubs) and final hosts (flukes).

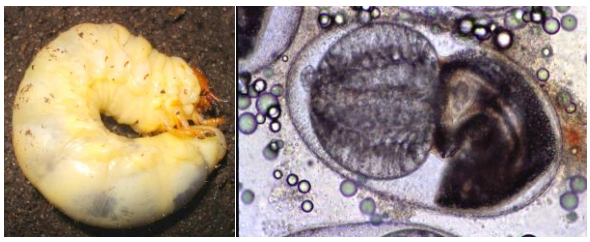

Figure 2. Insect larvae of beetles known as grubs (left image), do not infect fish. The 'grubs' that infect fish are the larvae of digenean trematodes, parasitic flatworms or flukes. While the larval flukes known as metacercaria (right image under magnification) may appear as a visible bump or bulge, they are actually very small and the visible bump is the cyst containing the metacercaria.

Photo credit: Andrew Goodwin, U.S. Fish and Wildlife Service

There are many species of digenean trematodes, with more than 9,000 species described, but we will examine four of the most common species of grubs that cause problems for pond fish in North America: yellow grub (*Clinostomum complanatum*), black grub (*Uvulifer ambloplitis*), white grub (*Posthodiplostomum minimum*), and *Bolbophorus* sp. Each of these grubs has three different hosts, a fish-eating bird, a snail, and a fish, and the effect it has on its host varies from harmless to potentially fatal. The species of bird often determines the species of grub found, as different species of birds play host to different species of grubs. The grubs frequently appear as unsightly spots or bumps on infected fish and are rejected by many consumers as a result. However, they are harmless to humans if removed or the fish is thoroughly cooked, and they do not affect the taste or texture of the fish.

Figure 3. Fish eating birds such as the belted kingfisher (left) and great egret (right) are the final host of the adult flukes life cycle, and also the beginning. Other fish 'grub' hosts include the great blue heron, green heron, great egret, little blue heron, and black-crowned night heron.

Grub Life Cycle

Digenean grubs have a complex life cycle with 2-3 intermediate hosts, possible transfer hosts and a final host. The cycle begins when the adult trematode, also known as a fluke, produces eggs inside the final host, a fish-eating bird. The eggs are released back into the pond through the bird's feces or through contact with the water. The eggs hatch into the first free-swimming larval form, called a miracidium, and seek out their first intermediate host, a snail, at which point they burrow into the soft tissues of the snail. Once inside the snail, they reproduce asexually forming a cyst filled with rediae. After maturing within the snail, the rediae emerge from the snail as yet another free-swimming larval stage called cercaria. The cercaria has a limited period of time in which it must infect a second intermediate host, a fish, or it will not survive. Once the cercaria finds a host fish, they burrow inside of it and migrate to certain tissues. Some species merely burrow just below the skin, while other species burrow into the muscle or organs such as the kidney, liver, or ovaries. Encysted within the fish, the cercaria grows into another larval stage, metacercaria. This encysted stage found in fish is what is often referred to as a grub. When a bird eats the infested fish, the grub reaches adulthood as a fluke inside the bird's mouth, throat, or intestines, and completes the cycle - or restarts it depending on how you look at it.

Yellow Grub
Clinostomum complanatum

The yellow grub can be a significant problem in pond fisheries. The adult fluke of the yellow grub lives and reproduces in the mouth and throat of the great blue heron, green heron, great egret, little blue heron, and black-crowned night heron. Eggs are released into the water when the heron or egret feeds. The miracidia of the yellow grub only infect snails of the genus *Helisoma* (*Planorbella*), the

ramshorn snails, after which the cercaria infect a fish host. The 3 to 8 mm metacercariae, or grubs, become embedded in the muscle or under the surface of the skin and appear as yellow or white bumps sometimes described as looking like yellow grains of rice. The yellow grub can also be found in the liver or ovaries of fish, where they cause much more damage. Although yellow perch, largemouth, spotted, and smallmouth bass, bluegill, redear sunfish, green sunfish, redbreast sunfish, and channel catfish are the most common fish-hosts, yellow grubs have been found in most freshwater fish species. Unless heavily infected, the fish-host is usually unaffected by the grub's presence. In commercial fish produced for food markets, the yellow spots can render the fish unmarketable, and can be unappetizing to anglers who catch fish with grubs. The yellow color and relatively large size distinguish this grub from other grubs.

Figure 4. A channel catfish fillet and carcass demonstrating an extreme infestation of yellow grubs. The grubs have rendered the fillets unfit for sale and unappealing to anglers who catch such fish.

Black Grub
Uvulifer ambloplitis

Black grub infestation in large numbers results in "black spot disease", causing the fish to have a black peppered appearance. However, this level of infestation is uncommon and most fish will typically have only a few black spots. In commercial fish produced for food markets, the black spots can render the fish unmarketable. Like the yellow grub, it also infects snails of the genus *Helisoma* (*Planorbella*), but it resides in the intestine of the belted kingfisher as its final host. Black grubs are most commonly found in sunfish, black bass, crappie, and yellow perch, where they burrow through the skin and encyst in the muscles, tail base and fins. The black grub is only 0.36 to 0.39 mm in size (1 to 2 cm for adult flukes), but the infected fish reacts to the encysted grub's presence by surrounding it with black-pigmented tissues, resulting in noticeably raised black spots. Although in most cases the host-fish is relatively unaffected, the black grub's penetration of the skin can cause damage and possibly hemorrhage, raising the fish's susceptibility to disease. Infected fish may also have higher dissolved oxygen concentration requirements and experience weight and fat loss, thus decreasing their likelihood of surviving the winter due to

Figure 5. A hybrid sunfish with a yellow grub infestation at the base of the pectoral fin.
Photo credit: Andrew Goodwin, U.S. Fish and Wildlife Service

insufficient energy stores. More often than not, black grubs do not cause significant damage to the fish, but their effect is much more appalling to anglers who find the spots disturbing. The black grub can be differentiated from other grubs by the black color, relatively small size, and noticeable location in the fins or skin of the fish.

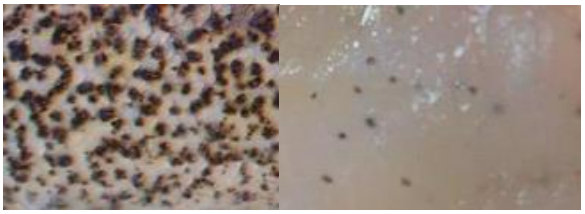

Figure 6. The belly region of a largemouth bass (left image) and the filet of a black crappie (right image) demonstrating the characteristic peppered look of a black grub infestation.

White Grub
Posthodiplostomum minimum

The adult fluke of the white grub makes its home in the intestinal tract of great blue herons, great egrets, little blue herons, snowy egrets, and black-crowned night herons, and its miracidia infect freshwater snails in the genus *Physa*. White grubs can be found in many different freshwater fish. One subspecies of white grub infects mainly centrarchids (largemouth and smallmouth bass, bluegill, reader sunfish, green sunfish, etc.), while a different subspecies infects cyprinids (minnows, shiners, carps, goldfish, etc.). Despite the white grub's small size (1 to 1.5 mm), it has more potentially harmful effects on its host-fish than other grubs because it travels through the bloodstream to live in the fish's kidneys, liver, and ovaries. In larval or severely infected fish, large numbers of white grubs can displace or rupture organs, resulting in death. Heavy infections in muscle can occur and have caused mortalities, but the main effect is on anglers who find it unappetizing and in commercial fish produced for food sales where white grub renders the fillets unmarketable. The white grub's presence can also weaken the fish's immune system and make it more vulnerable to secondary disease. The white color, relatively large size, and typical location in organs and viscera, sets this grub apart from other common grubs.

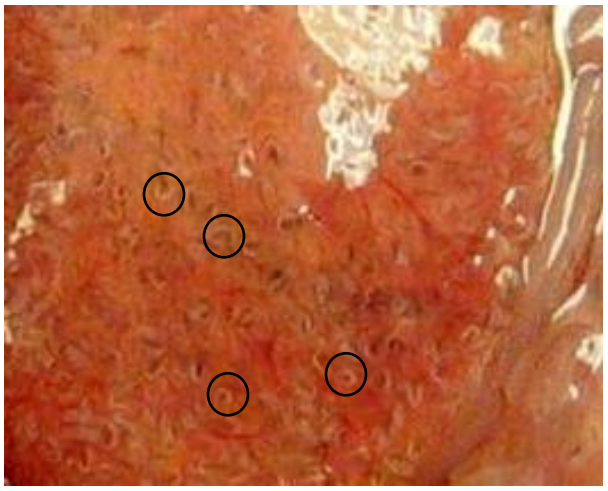

Figure 7. Hundreds of white grubs have infested the liver of this bluegill causing organ damage. Despite the white grub's small size, it is potentially more harmful to its host-fish than other grubs because it travels through the bloodstream to the fishes organs.

Bolbophorus spp.

Bolbophorus's initial larval host is the ramshorn snail (*Helisoma* or *Planorbella*) and the adult fluke lives in the gastrointestinal tract of the American white pelican. *Bolbophorus* grubs often infect fish like the channel catfish, where they encyst under the skin, in the muscle, or on the tail. Similar in size to the white grub (1 mm), *Bolbophorus* can also have detrimental effects on its host fish. The effects of *Bolbophorus* can range

from no noticeable effect on the fish population to heavy mortality. In most cases, large fish aren't as at risk unless severely affected, which results in poor feeding and loss of weight. In smaller fish, however, *Bolbophorus* infections can cause damage to the kidneys and liver, lesions in the skin, and possibly death. *Bolbophorus* has been implicated in significant mortality and major losses to the channel catfish production industry. *Bolbophorus* grubs are distinguished from other grubs by their small size and cysts that are white or red bumps either right under the skin or deeper in the muscle tissue. *Bolbophorus* grubs are similar in size to white grubs.

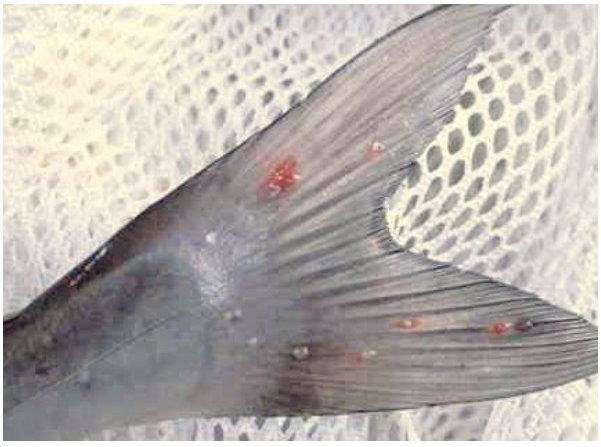

Figure 8. The caudal fin of a channel catfish exhibiting a *Bolbophorus* spp. infection. The fish may still be marketable at this stage, but any further progression of the infestation will render the fillets unfit for sale.

Grub Management

You found grubs in one or more of your fish, so what do you do? First, the bad news: there is no FDA-approved treatment for fish infested with grubs. Despite the fact that many host-fish are unaffected by the presence of grubs, the grubs can still cause huge economic losses for producers due to consumers' rejection of infected fish, and can limit angler's consumption for similar reasons. Producers and pond managers should avoid the spread of grubs in ponds if possible, because infected fish cannot be treated. Don't move water, including bait buckets, from grub infested ponds to ponds that show no signs of an infestation, because it may contain snail eggs, very small snails, or miracidium or cercaria from the grubs. Many grub species can live as long as four years encysted in a fish. The only way to limit grub infestations is to break the grub's life-cycle. There are three options: remove the fish, remove the birds, or remove the snails.

No producer or pond manager is going to remove the fish. The fish are what are desired from the pond in the first place. Therefore, in order to break the life cycle, control snail populations and scare away fish-eating birds. This is turn reduces the number of hosts and breaks the life cycle of the grubs. The Migratory Bird Treaty protects all fish-eating birds, so any tactics to discourage the presence of birds must be environmentally friendly and you cannot harm the birds. No, you cannot shoot them, unless you have a depredation permit from the U.S. Fish and Wildlife Service. The U.S. Fish and Wildlife Service are not likely to issue a depredation permit unless you can demonstrate that your livelihood is on the line or there is potential for great economic losses. Instead, visit the pond often as many fish eating birds are deterred by human presence. Use noise-making or visual tactics to scare away birds. This option is not always reliable because birds can get used to scaring mechanisms if they are used repeatedly and not moved or changed frequently. Other options, such as the use of large or active dogs, may be more effective in keeping birds away.

Snail control is often the easiest method to reduce grub populations for producers and pond managers. Decreasing the host snail populations can be achieved through several methods. Pond managers can reduce snail habitat, and therefore indirectly decrease snail populations, by applying aquatically approved herbicides to eliminate aquatic vegetation and submerged weeds along the pond margin. Grass carp (*Ctenopharyngodon idella*) are also effective aquatic vegetation controls, although their use may be restricted. In Texas, only triploid grass carp are legal and a permit from the Texas Parks and Wildlife Department is required before they can be purchased from a certified dealer.

The redear sunfish (*Lepomis microlophus*) is also known as "shellcracker" due to their voracious appetite for snails and may be utilized as a long-term biological control for snail populations. This method of control may take longer to significantly decrease snail population sizes, as the redear sunfish has a relatively small mouth that could limit its feeding to juvenile snails.

Figure 9. Redear sunfish, or 'shellcracker', are a common fish species stocked into commercial and recreational ponds to control snail population.

In commercial aquaculture production ponds only, not recreational fishing ponds, chemical treatments such as hydrated lime and copper sulfate offer a more immediate way to reduce snail numbers, but they must be reapplied as the snails repopulate. Chemical treatments are most effective when applied in a band along the pond's margin, with additional treatments in areas with dense vegetation. Since only snails within this area will be affected, aquatic vegetation outside of the treated band should be removed beforehand with herbicide. Small fish may not be able to avoid the chemical treatment, so ponds recently stocked with fry should not be treated.

Dry hydrated lime should be applied at a rate of 50 pounds per 75 to 100 feet of pond bank. Treat a band 3 to 4 feet from the bank, or 1 to 2 feet beyond vegetation extending into the pond. If hydrated lime is mixed with water, it can be applied as slurry. At a concentration of 4.0 to 4.7 pounds per gallon of water, apply 20 gallons of the hydrated lime slurry per 100 feet of bank. Hydrated lime should be used with extreme caution. Hydrated lime can be very dangerous to use. If high concentrations of hydrated lime dust are inhaled, irritation to the respiratory tract will occur. Dermatitis can result from prolonged exposure and repeated skin contact and a risk of severe and permanent eye damage exists if hydrated lime comes in contact with the eyes. The product can cause burns in the presence of moisture and will cause irritation of the gastrointestinal tract when ingested. Personal protective equipment should be worn at all times when using hydrated lime. Hydrated lime can also be dangerous to fish as a rapid pH change can occur resulting in mortality or lost production when used improperly. Hydrated lime is not for use to control snails in recreational fishing ponds.

Copper sulfate can be toxic to fish, so do not treat ponds with a total alkalinity less than 150 parts per million or smaller than 7 acres. To reduce the impact on phytoplankton and avoid oxygen depletion, treat half the pond at a time, with several days in between treatments. Use a mix of 10 pounds of dry copper sulfate, 1 pound of citric acid, and 70 gallons of water per each 250 feet of pond bank. Copper sulfate should be applied in a 6-foot band around the pond's margin. It is not recommended to use copper treatments during warm summer months due to the possibilities of oxygen depletions after treatments are applied. Copper sulfate is not for use to control snails in recreational fishing ponds.

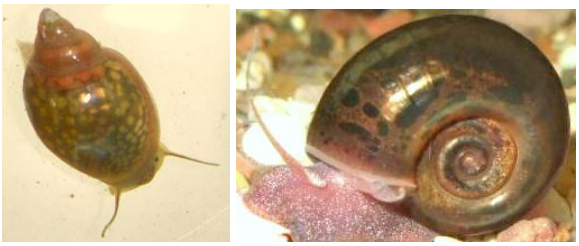

Figure 10. Semi-aquatic snails in the genus *Physa* (left image) or *Planorbella* (right image) are the initial intermediate host of fish grubs.

Summary

Severe grub infestations can pose a serious threat to fish production farms and private fishing ponds alike, and it is imperative that pond managers be proactive in monitoring for and preventing infestations by discouraging the presence of fish-eating birds. However, if an infestation does occur, the use of proper management strategies can interrupt the 'grub' life cycle and decrease the longevity of the infestation. If grubs have been discovered, producers should use a combination of chemical treatments, biological control species, and aquatic weed management to control and reduce snail populations.

References

Bunkley-Williams L. and E.H. Williams Jr. 1994. Parasites of Puerto Rican Freshwater Sport Fishes. Mayaguez (Puerto Rico): Antillean College Press, pp 48-84.

J.W. Warren. 1991. Diseases of Hatchery Fish. U.S. Fish and Wildlife Service, Pacific Region, Sixth Edition.

Lane, R. L. and J.E. Morris. 2000. Biology, Prevention, and Effects of Common Grubs (Digenetic trematodes) in Freshwater Fish. USDA's Cooperative State Research Education and Extension Service, Technical Bulletin Series # 115.

Terhune, J.S., D.J. Wise, J.L Avery, L.H. Khoo and A.E. Goodwin. 2003. Infestations of the Trematode *Bolbophorus* sp. in Channel Catfish. Southern Regional Aquaculture Center Publication No. 1801.