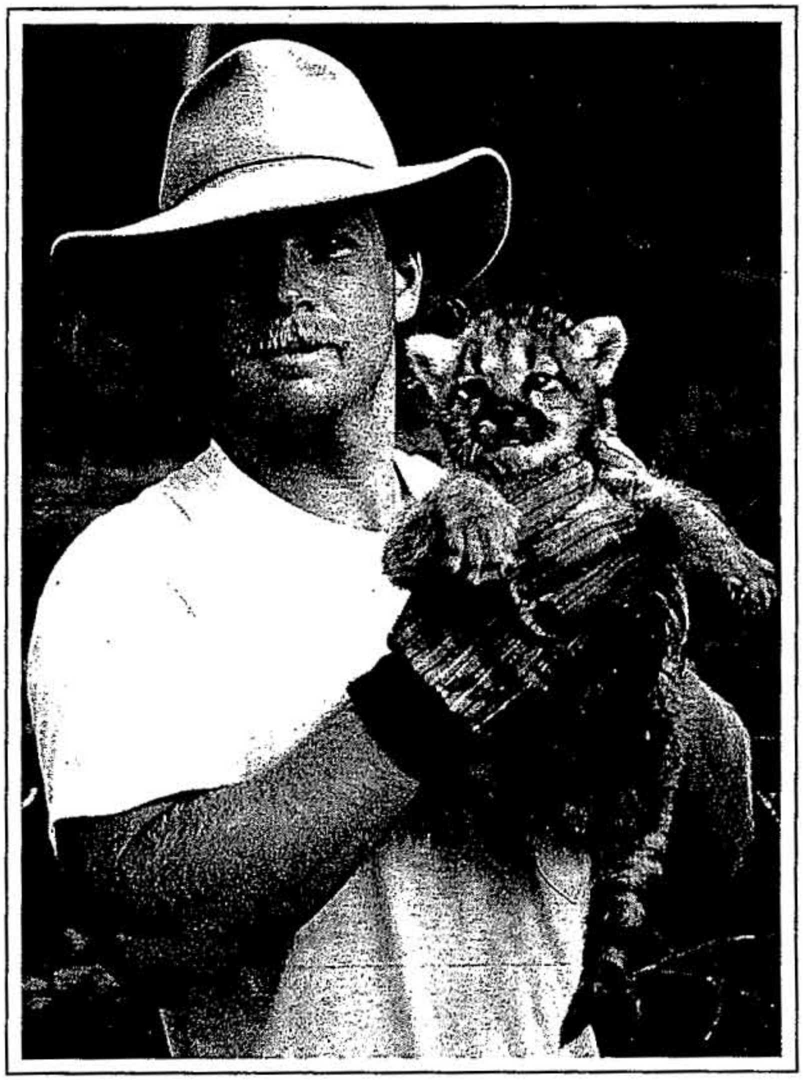
Yellowstone Science

A quarterly publication devoted to the natural and cultural sciences



Cutthroats and Parasites
The Yellowstone Lion
GYE Bald Eagles

Volume 2 Number 3

Risk and Research

The world of Yellowstone research is its own unusual community: fluid, seasonal, and as dynamic as the park's geothermal and ecological systems. Some researchers are here all year, or for many years, while others drop in once a year, or once in a career, for a grab sample or some other relatively quick gathering of information.

This makes for a disjointed sort of society, in which enduring friendships form based on infrequent but well-remembered encounters under all kinds of circumstances. Over the years, these friendships become more involved. Seasonals and graduate students finish projects, move on to jobs in new institutions and agencies, and begin to send their own students to Yellowstone for research. Over time, the community becomes "multi-generational" and relationships become traditions.

For all this diffusion, the sense of community is sometimes quite strong, so when a shock comes it is felt widely. The death of mountain lion researcher Greg Felzien in February of 1992 was one such shock. This tragedy was well covered in the media at the time, and there is no need to go into the details of the situation; Greg, a research associate of the Hornocker Wildlife Research Institute, was killed by an avalanche while tracking a lion in the park. Our interview in this issue, with Kerry Murphy, leader of the lion study and a friend of Greg's, deals at some length with the risks of research in wild country and what the loss of Greg meant to his friends and colleagues.

The photo of Greg on the cover of this issue of *Yellowstone Science* hangs in the entryway of the Yellowstone Center for Resources, with an appropriate tribute to his memory. We dedicate this issue of *Yellowstone Science* to his memory as well.

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On the cover: Greg Felzien, Yellowstone mountain lion researcher killed by an avalanche in 1992, with lion kitten. See previous page, and interview with Kerry Murphy beginning on page 8. Photo by Todd Fredricksen.

Yellowstone Science is published quarterly, and submissions are welcome from all investigators conducting formal research in the Yellowstone area. Editorial correspondence should be sent to the Editor, *Yellowstone Science*, Yellowstone Center for Resources, P.O. Box 168, Yellowstone National Park, WY 82190.

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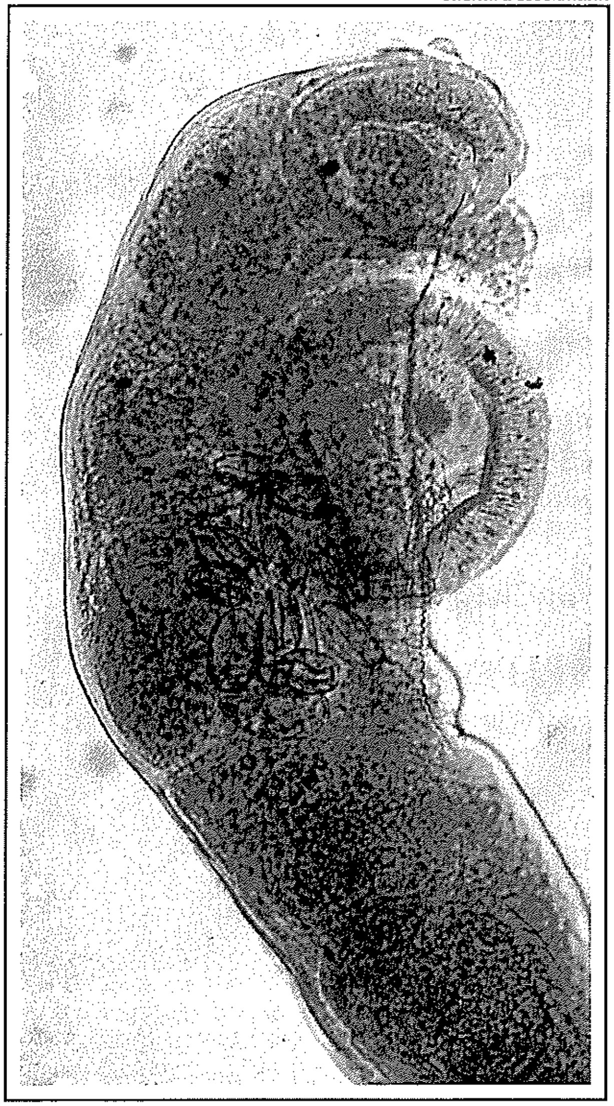
Cutthroats and Parasites

Yellowstone Lake's complex community of fish and companion organisms

Richard Heckmann



Crepidostomum farionis, *an adult trematode found in the intestine, bile duct, and gall bladder of Yellowstone Lake cutthroat trout, at 100X magnification.*

by Richard Heckmann

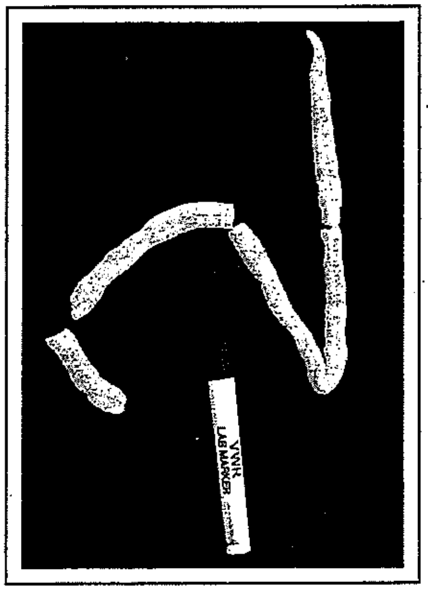
I was first introduced to Yellowstone Lake cutthroat trout and their close companions during a Boy Scout trip shortly after World War II. We rented a rowboat at West Thumb, rowed off shore, and fished with Colorado spinners. We all caught fish and cooked them over an open fire for dinner.

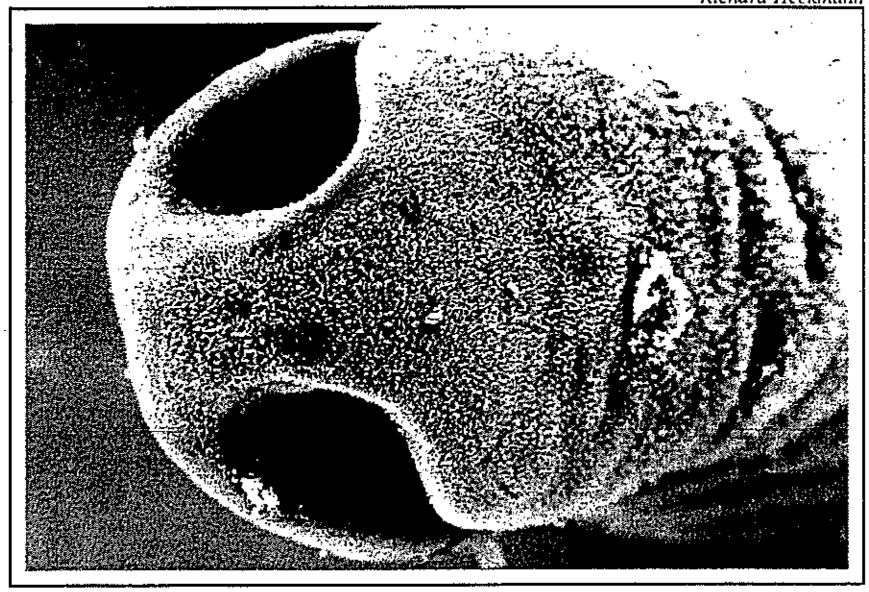
I asked my scoutmaster about the white, ribbon-like structures that crawled out of a blister area in the fish's muscle. He did not know what they were, but he said they would be no problem if we cooked the fish to where no blood or pink meat was visible. Welcome to the parasites of Yellowstone Lake cutthroat trout.

Approximately 25 years later, as a graduate student from Montana State University, I was completing research for my Ph.D. on the same host species, the cutthroat trout. Since my Boy Scout days, I had greatly expanded my knowledge of the symbionts (organisms that live in symbiotic relationships) inhabiting and attaching to cutthroat trout. I now knew that the white ribbon-like structures were tapeworms, one of many parasites I consistently found in Yellowstone cutthroat trout.

Many cutthroat trout are unnecessarily discarded each year in Yellowstone National Park due to the unsightly infections of parasites such as the cestode larvae (tapeworms). Cutthroat trout caught from Yellowstone Lake have ended up in trash cans or thrown into the trees due to parasites, especially the tapeworms. Until bearproof trash cans were installed, park bears had many free meals because fishermen were fearful of the effects of eating trout with such visible parasites. Recent "catch and release" policies for the trout in Yellowstone Lake have helped to alleviate the waste of fish.

Richard Heckmann





Above: Plerocercoid (larval stage) of Diphyllobothrium *tapeworm that infects many cutthroat trout. Right: Head of tapeworm at 50X magnification.*

Since 1891, when Linton published two papers pertaining to tapeworms he had observed in trout from Yellowstone Lake, there have been many articles published about this host and its "close companions." Larval tapeworms (*Diphyllobothrium*) present in most trout more than six inches in length, have been of great concern to many fishermen. The most current list (see table on page 5) includes 18 different species of parasites of the Yellowstone Lake cutthroat trout. This does not include bacteria and viruses that may be present. In 1964 it was estimated that 75 percent of the trout in Yellowstone Lake were infested or infected with parasites.

Most people are aware that all species of animals, including humans, harbor some form of parasite. Parasites often serve as a check for overpopulation numbers, culling out the weak and ultimately building a stronger population. All wild fish populations are hosts for parasites, from the tapeworms in bass in the southern United States to *Diphyllobothrium* in Yellowstone Lake cutthroat trout.

Published pamphlets and books on the fishes in Yellowstone Lake do not contain much information about the parasites and diseases of these fish; nor do the fishing regulations. In this article, I will discuss many of the most important or abundant parasites. If you would like more detailed information on these parasites and their ecology, some technical sources are listed in the box on page 7.

Protozoa

There have been six species of protozoan parasites reported for the trout from Yellowstone Lake. Microscopes are required to observe these parasites. None of them are dangerous to humans, and most have been found on or in other fish species as well.

A ciliate, *Trichophrya*, is common on the gills of the fish (cilia are fine, hair-like projections extending out from the surface of the organism—thus the name ciliate is applied to protozoans having cilia). It was found on the gills of all cutthroat trout examined by the author from all sites on Yellowstone Lake during collection trips beginning in 1969. This parasite does only limited damage to the host. *Trichophrya* commonly infests the gill surface of fishes, and apparently feeds on the gill mucus.

Blood parasites occupy either the blood cells or swim free in the fluid channeled through the cardiovascular system. For cutthroat trout, these parasitic protozoa are rare. Only one of approximately 300 Yellowstone Lake fish examined during several research trips contained red blood cells infected with the blood parasite *Hemogregarina*. The vector (that is, the organism that transports it to the host) for this parasite is usually a leech, and leeches are present in Yellowstone Lake. It is not a common parasite for trout in general and does not infect humans, but blood parasites are of interest to fish parasitologists, and are similar to the parasites that cause malaria in humans.

Trichodina is another common ciliated protozoan. It occurs in the gills of many species of fish, as well as in amphibians, crustaceans, mollusks, and even coelenterates (jellyfish, hydra, sea anenomes, and coral). *Trichodina* often results in diseases known as trichodiniasis, which are quite common in food and aquarium fish. It sometimes results in considerable mortality of fish, but is nonpathogenic (that is, nondisease-causing) in Yellowstone Lake cutthroat trout.

Tapeworms: *Diphyllobothrium* plerocercoids

One of the most interesting and visible parasites found in cutthroat trout is a white, flat, ribbon-like tapeworm. This cestode, or flatworm, is perhaps the most famous of Yellowstone's fish parasites, and is the reason many fish have been unnecessarily discarded. It is a plerocercoid, which is a larval form rather than an adult.

No study has been done on the effect of nonfatal infections of this parasite on the fish of Yellowstone Lake, and quite heavy loads of plerocercoids are sometimes carried by young, vigorous fish without visible harm. However, moderate loads of plerocercoids may be reducing the vitality of even the most vigorous fish. I examined a fish taken from the West Thumb of Yellowstone Lake that contained more than 400 plerocercoids.

This cestode has a complex life cycle; it spends parts of its life in three different hosts. The cestode occupies the first two, which are called the first intermediate host and second intermediate host, in its larval form. It then occupies the third host, called the natural definitive host, as an adult.

The first intermediate host for this common cestode remains unidentified, though several aquatic zooplanktonic species (very small crustaceans in this case) in Yellowstone Lake are strongly suspected to be hosts in the life cycle. Once an egg has been eaten by this host, it passes through the stomach wall and encysts in the host's body cavity tissues, where it enters its first larval form.

The parasite remains within this host until the crustacean is eaten by a trout, the second intermediate host. The larva is released when the trout digests the crustacean, and then migrates through the wall of the fish's alimentary tract, where it develops into its second larval form, called the plerocercoid.

The plerocercoid encysts in the trout's abdominal organs, and grows until it can break from the cyst and become free in the abdominal cavity of the fish. The plerocercoid may then migrate into the flesh and become encapsulated. In some cases, part of the plerocercoid remains in the body cavity and part is in the muscle.

A variety of animals, including pelicans, gulls, and bears, have been identified as the natural definitive hosts. When one of these hosts, usually a bird, eats and digests the fish, the plerocercoid is again released and develops into an adult cestode within the bird's intestine. It eventually produces eggs, which are released with the bird's feces into the lake, starting the cycle again.

The essential role of birds in the life cycle of this parasite has long been recognized. If water birds were somehow prevented from preying on the fish population, one effect might be the disappearance of *Diphyllobothrium*, which is directly dependent upon water birds for part of its life cycle. At one time, several decades ago, park managers even proposed to eliminate pelicans from Yellowstone Lake, thus eliminating the tapeworm.

NPS Photo Archives

Certainly a heavy tapeworm infection is harmful to some individual trout. Tapeworms can cause considerable damage to internal organs, lead to reduction of vigor of individual fish, and possibly affect reproduction. But control of the parasite would be extremely difficult. More important, removal of this natural element could lead to a disruption of Yellowstone's aquatic ecosystem.

The potential for human infection by plerocercoids in Yellowstone Lake cutthroat trout has long been of major concern. However, fisheries biologist Lowell Woodbury, writing in 1932, claimed that the plerocercoids of *D. cordiceps* were not infective to man. Late in the summer of 1931, Woodbury intentionally ate eight small plerocercoids, some free and some encapsulated, in order to test the potential for infection. He found no evidence of infection, and repeated the experiment the next year by eating six larger plerocercoids (20-70 mm in length) with the same negative results.

Another investigator, John W. Scott, also ate plerocercoids from Yellowstone Lake trout at various times with negative results, but a third, Rolf Vik, ingested plerocercoids and later passed adult worms, indicating that human infections are possible. In 1970, another researcher, C. W. Crosby, found that plerocercoids from Yellowstone Lake cutthroat trout fed to laboratory dogs resulted in viable, egg-producing adults.

Pelicans nesting on the Molly Islands in the Southeast Arm of Yellowstone Lake were long ago recognized as an important link in the life cycle of the trout tapeworm Diphyllobothrium. *Because of public distaste for the tapeworms, and because of the great popularity of trout fishing on Yellowstone Lake, early National Park Service managers actually planned the destruction of the pelican population in order to eliminate the tapeworm. Though some pelican eggs were destroyed, public opposition ended such activities. In the above photograph, taken by NPS naturalist George Bagley in 1932, park personnel band the young birds, one of which is pictured below.*

Known Parasites of Cutthroat Trout, *Onchorhynchus clarki*, from Yellowstone Lake, YNP

Protozoa:

Name of Parasite	Location on or in host
Costia pyriformis	Gills
Haemogregarina sp.	Blood Stream Red Blood Cells
Myxosoma sp.	Skin & Muscle
Myxosporidan sp.	Gills & Skin
Trichophrya clarki	Gills
Trichodina truttae	Gills

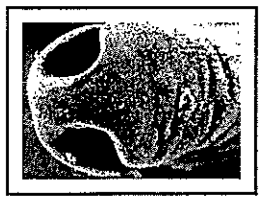
Richard Heckmann

Myxosoma

Cestoda: Tapeworms

Name of Parasite	Location on or in host
Diphyllobothrium cordiceps L	Muscle, Viscera
**Diphyllobothrium ditrenum* L	Muscle, Viscera
**Diphyllobothrium dendriticum* L	Muscle, Viscera
Diphyllobothrium sp.	Muscle, Viscera

*Recently described—replaced *Diphyllobothrium cordiceps*



Diphyllobothrium

Acanthocephala: Spiny headed worms

Name of Parasite	Location on or in host
Neoechinorhynchus rutili	Intestine

Digenea: Trematodes—Flukes

Name of Parasite	Location on or in host
Crepidostomum farionis	Intestine, Gall Bladder, Bile Duct
Diplostomum spathaceum L	Eyes
Diplostomum baeri buccelentum L	Eyes
Nanophyetus salmincola	Intestine
Posthodiplostomum minimum L	Viscera

Diplostomum

Nematoda: Roundworms

Name of Parasite	Location on or in host
Bulbodactnitis scotti	Intestine

Irudinea: Leeches

Name of Parasite	Location on or in host
Illinobdella sp.	Surface of fish, Gills, Fins
Piscicola salmositica	Surface of fish, Gills, Fins

Crustacea: Copepods (Lice)

Name of Parasite	Location on or in host
Salmincola sp.	Head region, Gills

Mollusca: Bivalves

Name of Parasite	Location on or in host
Glochidia L	Gills

L = larval stage