

Foreword

I am deeply honored to present this revision of the "bible" of freshwater fish parasitology. In a way, I represent those who used the original 1967 edition as graduate students, as professors for a text in their own courses, and as authors for published articles in the field. All of us have referred to it thousands of times (my copy of the first edition is spineless and threadbare) and have eagerly awaited this second edition. We express our gratitude to the author for this wonderfully useful text and reference book.

This volume was and is a remarkable accomplishment. The first edition spawned and inspired countless studies. *Parasites of North American Freshwater Fishes* has been and will continue to be a major force advancing freshwater fish parasitology.

This second edition includes information from the literature through 1992, a 25-year period since the first edition. Publication was slightly delayed due to editorial changes, the necessity of obtaining additional financial support, and the medical problems of the author. The changes improved the volume, outside support was obtained, and the author's indomitable spirit overcame any physical frailties. It was well worth the wait. A few years of delay is insignificant for an important guidebook that will be used for decades to come.

The revision spans a period of high research productivity and great expansion of our knowledge in the study of freshwater fish parasites. Dr. Hoffman has melded this often fractured, contradictory, and widely scattered information and, with his unique breadth of knowledge and experience, has clarified and synthesized it into an outstanding guidebook. Many new parasites of North American freshwater fishes have been found and described since the first edition. A new edition was essential to keep pace with all these changes.

This new information combined with current methods to study parasites (electron microscopy, molecular biology) and advanced data analysis (cladistic analysis, new computer statistical analysis) are effecting monumental changes in the higher classification of many parasites. Current usage employs a somewhat awkward compromise between the "traditional" and "new" parasite taxonomic treatments, such as I followed in three recent fish parasite books (Bunkley-Williams and Williams, 1994, 1995; Williams and Bunkley-Williams, 1996). Dr. Hoffman's book lingers with the traditional categories to maintain a continuity in the classifications that have been relatively stable for more than 100 years. This preserves the historic nomenclature and allows students to more easily access the majority of fish parasite literature written before the advent of new taxonomic treatments and by those scientists who do not follow these systems. Everyone knows the old classifications, and just as one is reluctant to discard comfortable old shoes, there is still some resistance to change. For example, the concepts of "fungi" and "protozoa" are still important, even if fragments of both of these former categories have been dispersed as separate phyla in different kingdoms. The drastic new arrangement of flatworms is probably correct but has not stabilized sufficiently to be accepted by everyone. It remains in flux as new discoveries are made and is also clumsy and overly fragmented with an incredible maze of unfamiliar subgroupings. The exact taxonomic status of crustaceans is in question. Tongueworms (Pentastomida) may soon be grouped with fish lice (Branchiura), and myxozoans with sea jellies (Cnidaria). The traditional categories are still useful, however. Dr. Hoffman uses these older and more familiar categories to group similar appearing organisms together for ease of identification, explanation, and comparison, in ways that are more

Table 1. Higher Classification of the Parasites of North American Freshwater Fishes

Contemporary or Future Classification	Traditional Classification	Taxonomy of Group
Kingdom Prokaryotae—bacteria	—	
Phylum Cyanobacteria—blue-green algae/bacteria	Kingdom Protista	
Kingdom Protista—one-celled organisms	—	
Subkingdom Protozoa—animal-like protists	Phylum Protozoa	Lom and Dyková 1992
Phylum Sarcostigophora—amoebas and flagellates	Phyla Rhizopoda & Mastigophora	
Phylum Apicomplexa—coccidians and gregarines	Group Sporozoa	
Phylum Ciliophora—ciliates, suctorans, etc.	—	
Phylum Ciliophora—ciliates, suctorans, etc.	—	
Phylum Chlorophyta—green algae	—	
Phylum Oomycota—saprolegnia fungus and allies	Kingdom Fungi	Rand 1996
Kingdom Fungi—fungi	—	Rand 1996
Phylum Microsporida(?)—microsporidians	Phylum Protozoa	not established
Phylum Zygomycota	—	
Phylum Deuteromycota	Deuteromycetes	
Kingdom undetermined—Ichthyophonus fungus and allies	Kingdom Fungi or higher taxon unknown	Ragan et al. 1996 not established
Kingdom Animalia—multicellular animals	—	
Phylum Cnidaria—sea jellies, corals, and allies	Phylum Coelenterata	
Class Myxozoa—myxosporidians	Phylum Myxospora (Protozoa)	not established
Class Hydrozoa—sturgeon hydroid, etc.	—	
Phylum Platyhelminthes—flatworms	—	Brooks and McLennan 1993
Superclass Rhabditophora—fish-associated turbellarians	Turbellaria	
Superclass Cercomeria	—	
Class Udonellidea—ectoparasitic worm	Class Monogenea	
Class Cercomeridea	—	
Subclass Trematoda	Class Trematoda	
Infraclass Aspidobothrea—soleworms	Subclass Aspidocotylea	
Infraclass Digenea—flukes	Subclass Digenea	
Superfamily Didymozoidae—tissue flukes	Subclass Didymozoidae	(status in question)
Subclass Cercomeromorphae	—	
Infraclass Monogenea—gillworms	Class Monogenea	
—	Subclass Monopisthocotylea	
Order Dactylogyridea—simple gillworms	Order Dactylogyrida	
Order Gyrodactylidea—live-bearing gillworms	Family Gyrodactylidae	
Order Capsalidea—capsalids	Family Capsalidae	
Order Mazocraeidea—polys	Subclass Polyopisthocotylida	
Infraclass Cestodaria	—	
Cohort Cestoda—tapeworms	Class Cestoidea	Khalil et al. 1994
Subcohort Amphilinea	Subclass Cestoidaria	
Subcohort Eucestoda	Subclass Eucestoda	
Phylum Nematoda—roundworms	Phylum Nematelminthes	Anderson et al. 1974–1983
Phylum Nematomorpha—horsehair worms	—	
Phylum Acanthocephala—spiny-headed worms	—	Amin 1985d
Phylum Annelida—segmented worms	—	
Class Hirudinida—leaches	Class Hirudinea	
Subclass Acanthobdellida—primitive leech	Order Acanthobdella	
Subclass Hirudinea—true leech	—	
Phylum Arthropoda	—	
Subphylum Crustacea—crustaceans	Class Crustacea	Bowman and Abele 1982
Class Maxillopoda	—	
Subclass Copepoda—copepods	Order Copepoda	
Subclass Branchiura—fish lice and tongueworms	—	
—	Phylum Pentastomida	not established
—	Pentastomid larvae	
Class Malacostraca	—	
Order Isopoda—iso-pods	—	
Subphylum Chelicerata	—	
Class Arachnids—spiders and allies	Arachnida	
Order Acari—mites and ticks	—	
Phylum Mollusca—sea shells and allies	—	Turgeon et al. 1998
Class Bivalvia—pelecypods or bivalves	—	
Order Unionida—freshwater mussels	Glochidia	
Order Veneroida—fingernail & peacocks	Sphaeriid clams	
Phylum Vertebrata—vertebrates	—	
Class Agnatha—jawless fishes	—	Robins et al. 1991
Order Petromyzontiformes—lampreys	—	Hardisty and Potter 1971

intelligible to a popular audience. For example, microsporidians superficially look like myxosporidians, despite the fact that one is apparently a fungus and the other a sea jelly.

Dr. Hoffman used the traditional, better known taxonomic treatments to produce a reference tool that would be more user friendly and enduring. Many of the new, highly technical classifications are intelligible only to specialized taxonomists and will probably soon change. The contemporary, if often controversial, higher taxonomy is presented in Table 1. Traditional categories or groups used in this book can be found in the center column and common group names in the left column. The right column cites references containing more complete new classifications of most groups. Some lack a unified reference appropriate to fish parasites.

For those unfamiliar with classification, Margulis and Schwartz's *Five Kingdoms* (1988) is a useful and entertaining introduction and a popular guide to the higher classification of life on Earth, although it is a bit dated as their five kingdoms now number at least seven.

Dr. Hoffman's distinguished career spans over 50 years. He became the leading expert on the parasites of North American freshwater fishes during a series of research appointments. He received a B.A. degree from the University of Iowa in 1942 and then served as Lieutenant and Laboratory Director for the U.S. Army Sanitary Corps until 1946. For 2 months of this service he worked at Dr. Jonas Salk's virus research laboratory in Munich. He received his Ph.D. degree in 1950 from the University of Iowa and became an Assistant Professor at the University of North Dakota Medical School Microbiology Department, where he received an Outstanding Teacher award. In 1958, he was appointed as a Research Parasitologist at the National Fish Health Research Laboratory (then called the Eastern Fish Disease Laboratory) in Leetown, West Virginia. In 1974, he transferred to the U.S. Fish and Wildlife Service Fish Farming Experimental Station at Stuttgart, Arkansas. He retired from the Fish and Wildlife Service in late 1985, but his fish parasitology work continues (Overstreet and Meyer 1986).

The breadth and influence of his publications, which include more than 200 scientific articles and four books, have been profound. He has been instrumental in producing English translations of many parasite books and articles. He has served or continues to serve on various scientific committees and the editorial boards of nine scientific journals.

His original research involved a variety of fish parasites and diseases but focused on flukes and their life cycles, particularly those that encysted as metacercaria in fishes. By 1959, whirling disease had become a major threat to salmonid culture in the United States, and naturally, the federal government called on its leading expert to save the day. From that time to 1974, Dr. Hoffman conducted extensive investigations detailing the biology and control of this disease. As other diseases threatened fish culture in the United States, he investigated and provided the information to solve these prob-

lems. The Asian tapeworm's threat to the U.S. baitfish industry is a prominent example of this work. Many of these dangerous epizootics invaded from overseas, and Dr. Hoffman thus became an expert on exotic diseases and the prevention of introductions. His review articles on parasites of exotic fishes, strigeid flukes, and whirling disease, on the treatment and prevention of disease, and on other fish diseases have been widely used by scientists. Meanwhile his numerous popular circulars and Fish Health Leaflets have explained fish diseases to the general public.

Dr. Hoffman has often freely given his expert advice and encouragement and transmitted his enthusiasm about parasites. He has presented his work at more than 100 symposia and meetings around the world and has conducted collaborative research with numerous fish disease professionals in the United States and more than 20 other countries. The fish health training courses he conducted and his many other endeavors have helped develop, mold, and inspire a generation of fish health specialists and fish parasitologists worldwide. Many of the existing programs in these fields were either created or fomented by his actions.

Dr. Hoffman has received numerous awards and honors. He was one of the first honorees enshrined in the National Fish Culture Hall of Fame in Spearfish, South Dakota, and he also received Distinguished Service Awards from the Wildlife Disease Association (1974), the American Fisheries Society (AFS) Fish Health Section (1982), and the AFS Fish Culture Section (1985). The following parasites were named in his honor: *Biacetabulum hoffmani* Mackiewicz, 1972 (tapeworm); *Cercaria hoffmaniensis* Brooks, 1948 (fluke); *Eimeria hoffmani* Molnár and Hanek, 1974 (coccidian); *Gyrodactylus hoffmani* Wellborn and Rogers, 1967 (gillworm); *Myxidium hoffmani* Jayasri, 1981 (myxosporidian); *Myxosoma hoffmani* Meglitsch, 1963 (myxosporidian); *Neascus hoffmani* Pandey, 1973 (fluke); *Thecamoeba hoffmani* Sawyer, Hnath, and Conrad, 1974 (amoeba); *Trichodina hoffmani* Wellborn, 1967 (ciliate).

We should be grateful that the always generous and genteel Dr. Hoffman took time from his retirement to update this important book. Everyone interested in fishes, from scientists to aquarium hobbyists, must have a copy. Fishery laboratories will need both shelf and field copies of this hands-on text.

Ernest H. Williams Jr.

Selected additional literature:

R. C. Anderson et al. (1974–1983), Bowman and Abele (1982), Brooks and McLennan (1993), Bunkley-Williams and Williams (1994–1995), Hardisty and Potter (1971), Khalil et al. (1994), Overstreet and Meyer (1986), Ragan et al. (1996), Rand (1996), Turgeon et al. (1988), E. H. Williams and Bunkley-Williams (1996).

