

## Research Findings 1999-2000 Whirling Disease Initiative

National Partnership on the Management of Wild and Native Cold Water Fisheries  
Montana University System Water Center, MSU-Bozeman

Category	Title	Principal Investigator	Other Partners	Award/Match
1. Field Study (3.1)	<b>Distribution and Seasonal Occurrence of <i>Myxobolus cerebralis</i> in the Lostine River, Oregon</b>	<b>Jerri L. Bartholomew</b> , Senior Researcher Oregon State University Department of Microbiology 220 Nash Hall Corvallis, OR 97331-3804 ph. 541.737.4441 fax: 541.737.0496 e-mail: bartholj@bcc.orst.edu	John L. Fryer, Professor Emeritus, Microbiology Department, Oregon State University-Corvallis	\$44,240/\$33,437  May 1, 1999 - December 31, 2000  GC004-00-Z2000
<b>Research Findings:</b> This study was undertaken to examine the effect of the whirling disease parasite among the native populations of trout and salmon in the Lostine River, Oregon. Fish became infected throughout the river, but incidence of infection was highest in the lower river. Experiments to determine the susceptibility to infection of Chinook salmon indicated that they are likely to become infected within the river, but they may be somewhat resistant to fully developing the disease.				
2. Field Study (3.2)	<b>Integrated Studies of Whirling Disease in Montana Rivers Part I: Relationship of <i>Myxobolus cerebralis</i>-Infected <i>Tubifex</i> to Infection Rates and Severity of Disease in Trout of the Rock Creek Drainage</b>	<b>Willard O. Granath, Jr.</b> , Professor of Microbiology Division of Biological Sciences University of Montana Missoula, MT 59812-1002 ph. 406/243-2975 fax: 406/243-4184 e-mail: snail@selway.umt.edu	(1) E. Richard Vincent Whirling Disease Research Coordinator, MT FWP, Bozeman (2) Billie L. Kerans, Asst. Professor, Biology Department, MSU-Bozeman (3) Charlotte Rasmussen Molecular Biologist, Western Fisheries Research Center, Seattle (4) James E. Gannon, Assoc. Professor, Biological Sciences Div., University of Montana-Missoula	\$52,788/\$92,174  May 1, 1999 - December 31, 2000  GC008-00-Z2000
<b>Research Findings:</b> One route towards control of whirling disease in trout may be through control of the parasite's alternate host, the aquatic worm known as <i>Tubifex tubifex</i> . The purpose of this study was to establish the basic relationship between infection in a trout population and infection in the resident tubificid worms of the drainage. The results show increasing infection of trout that is not mirrored by increasing infection of worms. No relationship between water quality and disease severity is evident, nor can infection of trout be correlated to the immediate presence of infected worms. More work is clearly needed to understand the fundamental ecology of the whirling disease parasite.				

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3. Field Study	<b>Assessment of the Effects of Spawning Site Selection by Snake River Cutthroat Trout on Exposure to <i>Myxobolus cerebralis</i> Triactinomyxons and Clinical Signs of Whirling Disease in Spring Streams among Age-0 Fish, Salt River Valley, Wyoming</b>	<b>Wayne A. Hubert</b> , Professor and Assistant Unit Leader Wyoming Cooperative Fish & Wildlife Research Unit University of Wyoming Box 3166, University Station Laramie, Wyoming 82071-3166 ph. 307/766-5415 fax: 307/766-5400 e-mail: whubert@uwyo.edu	(1) Robert Gipson, Fish Biologist, Wyoming Game & Fish Department (2) David Zafft, Fish Population Supervisor, WY Game & Fish Dept. (3) David Money, Fish Pathologist, WY Game & Fish Dept. (4) Deedra Hawk, Forensic Specialist, WY Game & Fish Dept.	\$49,750/\$65,475 (\$28,875--WY Game & Fish; \$16,200--USGS; \$20,400--UW)  January 1, 1999 - September 30, 2000  GC067-00-Z2000
<b>Research Findings:</b> Exposure of cutthroat trout to the parasite shortly after emergence from the gravels in which they incubated largely determines their likelihood of being infected by the parasite. During spawning season, trout move upstream, sometimes for great distances. Field and laboratory observations by Wyoming investigators established that cutthroat trout which spawn at highly-infected locations are more likely to produce young that develop whirling disease than others spawning where exposures to the parasite are less.				
4. Field Study (9.1)	<b>Spawning Areas as Loci of Infection for Whirling Disease in the Upper Madison River</b>	<b>Billie L. Kerans</b> , Assistant Professor Montana State University Biology Department Bozeman, MT 59717 ph. 406/994-3725 fax: 406/994-3190 e-mail: bkerans@montana.edu	(1) Thomas E. McMahon, Assoc. Prof., Biology Dept., MSU-Bozeman (2) James Munro, Research Assoc. (3) Patrick Byorth, Fishery Biologist, MFWP (4) E. Richard Vincent, Coordinator, Whirling Disease Program, MTFWP	\$50,251/\$58,440  May 1, 1999 - September 30, 2000  GC009-00-Z2000
<b>Research Findings:</b> Because of when and where they spawn and rear, some trout may be less susceptible to infection by whirling disease than others. Documenting where these areas are and promoting their trout populations may be one way to circumvent the disease. This study examined disease severity in trout spawning areas by determining the spawning and rearing locations of rainbow and brown trout in the Upper Madison River, Montana, and by associating spawning areas with disease severity in sentinel trout and worms.				

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5. Field Study (5.3)	<b>Initial Survey of the Present Distribution of <i>Myxobolus cerebralis</i> in Yellowstone Cutthroat Trout, <i>Onchorynchus clarki bouvieri</i>, in Yellowstone Lake and Surrounding Tributaries</b>	<b>Daniel Mahony</b> , Fishery Biologist National Park Service Aquatic Resources Center Box 168 Yellowstone National Park, WY 82190 ph. 307/344-2280 fax: 307/344-2323 e-mail: dan_mahony@nps.gov	Crystal Hudson, Director Bozeman Fish Health Center, USFWS, Bozeman	\$13,500/\$15,000  May 1, 1999 - September 30, 2000  GC003-00-Z2000
<b>Research Findings:</b> This study marks the beginning of an effort to define the spatial distribution and infection severity of whirling disease in Yellowstone cutthroat trout in Yellowstone Lake, the lake's tributary streams and portions of the Yellowstone River downstream from the lake. Since this subspecies is already seriously threatened by the introduced lake trout, any detrimental effects of whirling disease are of great concern. Three groups of fish from the lake and several tributaries were assayed. The disease was found in older fish throughout the lake, suggesting that it has been present for several years, and that some proportion of young trout can survive infection.				
6. Field Study (9.2)	<b>Relation of Life History Type to Whirling Disease Susceptibility in Missouri River Rainbow Trout (Continuation)</b>	<b>Thomas E. McMahon</b> , Fisheries Biologist Biology Department Montana State University Bozeman, Montana 59717 ph. 406/994-2492 fax: 406/994-7479 e-mail: ubitm@montana.edu	(1) Billie L. Kerans, Asst. Professor, Biology Dept., MSU (2) Alexander V. Zale, Assistant Unit Leader, MT Cooperative Fishery Research Unit (3) Andrew Munro, GRA (4) James Munro, Research Assoc. (5) E. Richard Vincent, Coordinator, Whirling Disease Program, MT Fish, Wildlife, and Parks	\$43,000/ \$137,676  May 1, 1999 - December 31, 2000  GC014-00-Z2000
<b>Research Findings:</b> This work was part of an ongoing project to follow the epidemiology of whirling disease as it spreads through the upper Missouri River of Montana. The goal is to link information on rainbow trout life history, infection severity and trout population response to the disease, with the eventual aim of developing management intervention strategies that will foster productive trout populations in whirling-disease-infected streams.				

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<b>7. Laboratory and Field Study (7.5)</b>	<b>Integrated Studies of Whirling Disease in Montana Rivers Part III: Phylogenetic and Population Genetic Studies of the Oligochaete Host, <i>Tubifex tubifex</i></b>	<b>Billie L. Kerans</b> , Invertebrate Biologist Montana State University Biology Department Bozeman, Montana 59717 ph. 406/994-3725 fax: 406/994-3190 e-mail: ubibk@montana.edu	Charlotte Rasmussen, Western Fisheries Research Center, Biological Resources Division, USGS Seattle, WA 98115 ph. 206/526-6282 ext. 322 fax: 206/526-6654 e-mail: charlotte_rasmussen@usgs.gov	\$50,320/\$50,470  July 1, 1999 - September 30, 2000  GC013-00-Z2000
<b>Research Findings:</b> Whirling disease infection severity varies widely among drainages, for reasons that are not well understood. One possible cause is a difference in the strain of its alternate host, the aquatic worm <i>Tubifex tubifex</i> . This project used molecular techniques to distinguish strains of the worm, and correlate them with levels of parasite proliferation in the laboratory. In ongoing work, worms from a variety of streams are being characterized by the technique.				
<b>8. Laboratory Study (4.1)</b>	<b>Efficacy of Fumagillin to Prevent Experimentally Induced Whirling Disease in Rainbow Trout <i>Oncorhynchus mykiss</i> (Continuation Project)</b>	<b>Dave Erdahl</b> , Fisheries Biologist and Chief National INAD Office US Fish & Wildlife Service Bozeman Fish Technology Center/NIO 4050 Bridger Canyon Road Bozeman, MT 59715 ph. 406.587.9265 ext. 125 fax: 406.582.0242 e-mail: dave_erdahl@fws.gov	(1) Crystal Hudson, Fish Health Biologist and Director Bozeman FHC, USFWS (2) Jim Bowker, Fisheries Biologist and Assistant INAD Coordinator USFWS, BFTC (3) Linda Staton, Fisheries Biologist, USFWS, Bozeman FHC (4) Robert White, Director, MT Cooperative Fisheries Program, MSU	\$37,050/\$58,500  May 1, 1999 - December 31, 2000  GC017-00-Z2000
<b>Research Findings:</b> A number of hatcheries that grow trout for stocking into the wild have become infected by whirling disease. The purpose of these experiments was to evaluate the efficacy of the antibiotic fumagillin for preventing whirling disease infection in rainbow trout fry. Two fumagillin formulations were tested in several treatment regimes. A slight, but not significant, reduction in infection was noted for two of the treatments. It appears that this antibiotic will not play a role in suppressing whirling disease in hatcheries.				

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<b>9. Laboratory Study (7.1)</b>	<b>Development and Characterization of Strains of <i>Tubifex tubifex</i> that Differ in Susceptibility to <i>Myxobolus cerebralis</i></b>	<b>Willard O. Granath, Jr.</b> , Professor of Microbiology University of Montana Division of Biological Sciences Missoula, MT 59812-1002 ph. 406.243.2975 fax: 406.243.4184 e-mail: snail@selway.umt.edu	none	\$10,973/\$0  May 1, 1999 - December 31, 2000  GC007-00-Z2000
<b>Research Findings:</b> If environmental conditions could be controlled to favor worm hosts that are not susceptible to whirling disease, its spread could be somewhat inhibited. In this project, Montana researchers developed worm strains from different areas, characterized them genetically, and evaluated their susceptibility to whirling disease. The next step will be to characterize the environmental conditions that favor the disease-resistant strains.				
<b>10. Laboratory Study (8.1)</b>	<b>Purification of Selected Proteins from Different Developmental Stages of <i>Myxobolus cerebralis</i> for Use in Antigenic Characterization, Assay Development and Studies of the Immune Response in Trout</b>	<b>Ronald P. Hedrick</b> , Professor of Fish Pathology University of California-Davis School of Veterinary Medicine Department of Medicine and Epidemiology Davis, CA 95616-8737 ph. 530/752-3411 fax: 530/752-0414 e-mail: rphedrick@ucdavis.edu	Mark A. Adkison Research Associate, UC-Davis, School of Veterinary Medicine, Dept. of Medicine and Epidemiology	\$4,500/\$0  May 1, 1999 - December 31, 2000  GC006-00-Z2000
<b>Research Findings:</b> This California project was part of a larger effort to characterize the protein antigens in the different developmental stages of the whirling disease parasite. The overall goal is to find antigens that may have a role in stimulating the development of protective immunity against the parasite. This project provided funds for equipment involved in the purification and analysis of these protein antigens.				

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<b>11. Laboratory Study (6.1)</b>	<b>The Use of Molecular Biological Methods to Study the Pathogenesis of <i>Myxobolus cerebralis</i></b>	<b>Ronald P. Hedrick</b> , Professor of Fish Pathology University of California-Davis School of Veterinary Medicine Department of Medicine and Epidemiology Davis, CA 95616-8737 ph. 530/752-3411 fax: 530/752-0414 e-mail: rphedrick@ucdavis.edu	Karl B. Andree, Research Associate Dept. of Medicine & Epidemiology, Tupper Hall University of California-Davis Ph. 530/752-9318 Fax: 530/752-0414 e-mail: kbandree@ucdavis.edu	\$37,000/\$0  May 1, 1999 - December 31, 2000  GC005-00-Z2000
<b>Research Findings:</b> This study was one of a series of investigations into the molecular mechanisms by which the whirling disease parasite causes disease. The overall goal is to identify the gene products that are involved, to allow a better understanding of the disease process, and to provide avenues for developing vaccines and other prophylactics. This project used the molecular technique known as subtractive hybridization to identify mRNA transcripts of the early stages of the parasite in fish.				
<b>12. Laboratory Study (6.3)</b>	<b>An Experiment to Determine if Living Brown Trout (<i>Salmo Trutta</i>) are capable of expelling viable <i>Myxobolus cerebralis</i> Myxospores</b>	<b>R. Barry Nehring</b> , Life Sciences Researcher IV Colorado Division of Wildlife 2300 S. Townsend Montrose, CO 81401 ph. 970.252.6008 fax: 970.252.6053 e-mail: barry.nehring@state.co.us	none	\$37,000/\$10,450  May 1, 1999 - September 30, 2000  GC042-00-Z2000
<b>Research Findings:</b> Under what circumstances are viable <i>Myxobolus cerebralis</i> spores released from infected fish? Older literature indicated this only happens when fish die and decompose or are consumed by predators. A set of Colorado experiments demonstrated that living, infected brown trout may expel viable spores that can subsequently be taken up by tubificids. These results could have ramifications for both hatchery and wild fish management.				

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<b>13. Laboratory Study (6.5)</b>	<b>The Effect of Initial Exposure to <i>Myxobolus cerebralis</i> on the Development of Resistance to Re-infection in Rainbow Trout</b>	<b>Eileen K. N. Ryce, GRA</b> Montana State University Montana Cooperative Fishery Research Unit Biology Department Bozeman, MT 59717 ph. 406/994-1823 fax: 406/994-7479 e-mail: eryce@montana.edu	(1) Alexander V. Zale Asst. Unit Leader and Affiliate Associate Professor, Montana State University-Bozeman, MT Cooperative Fishery Research Unit (2) Elizabeth MacConnell, Fisheries Biologist (Pathologist), MTFWP, Bozeman	\$61,651/\$28,680  May 1, 1999 - November 30, 2000  GC012-00-Z2000
<b>Research Findings:</b> During the phase of cartilage destruction, fish show an immune response to the whirling disease parasite. This project evaluated the level of immune protection provided by initial exposure, and potential differences in protection depending on parasite dose and the time of exposure. In rainbow trout, it appears that significant immune protection does not develop until the fish are so old that they are no longer susceptible to infection, for other reasons.				
<b>14. Laboratory Study (8.4)</b>	<b>Biochemistry and Ultrastructure of the Adhesion Molecules Involved in Infection, Migration and Propagation of <i>Myxobolus cerebralis</i> in Salmonids</b>	<b>C.A. Speer, Professor</b> Montana State University Veterinary Molecular Biology Bozeman, MT 59717-3610 ph. 406/994-6389 fax: 406/994-6389 e-mail: uvscs@gemini.oscs.montana.edu	Crystal Hudson, Director Bozeman Fish Health Center, USFWS, Bozeman, MT	\$40,533/\$40,442  April 1, 1999 - December 31, 2000  GC011-00-Z2000
<b>Research Findings:</b> The goals of this project were to identify and characterize the adhesion molecules involved in infection, migration and development of whirling disease parasites in their fish hosts. Laboratory cultures of fish cells were used to study the mechanisms of adhesion and development of the different parasite forms. In addition, electron microscopy was used to describe the structure of the parasite as it changed form within infected fish. This information will be needed for the development of vaccines or other therapies to combat whirling disease.				

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<b>15. Laboratory Study (8.6)</b>	<b>Non-Lethal Sampling of Salmonid Species by Operculum Punch for the Identification of <i>Myxobolus cerebralis</i> by Polymerase Chain Reaction (PCR)</b>	<b>Linda Vannest</b> , Biological Technician U.S. Fish and Wildlife Service Bozeman Fish Health Laboratory 920 Technology Blvd., Suite G Bozeman, MT 59718 ph. 406/582-8656 fax: 406/587-3998 e-mail: r6ffa_fhc@mail.fws.gov	(1) C.A. Speer, Professor, VMB, MSU-Bozeman (2) Crystal Hudson, Director, Bozeman Fish Health Lab, USFWS (3) Linda Staton, Microbiologist, Bozeman Fish Health Lab	\$11,377/\$9,637  May 1, 1999 - December 31, 2000  GC010-00-Z2000
<b>Research Findings:</b> The purpose of this project was to develop a means to diagnose whirling disease infection in a fish without killing the fish. Young rainbow trout were exposed to the disease under controlled conditions. The test procedure was used at specific periods after exposure and the fish were monitored for complications. Preliminary results indicate the test has promise for non-lethal diagnosis of whirling disease.				
<b>16. Laboratory Study (6.8)</b>	<b>The Effect of Water Quality Variables on Viability of the <i>Myxobolus cerebralis</i> Actinospore</b>	<b>Eric J. Wagner</b> , Director of Research Utah Division of Wildlife Resources Fisheries Experiment Station 1465 W. 200 North Logan, UT 84321 ph. 435/752-1066 ext. 22 fax: 435/752-6977 e-mail: ewagner@sisna.com	none	\$32,655/\$0  May 1, 1999 - June 30, 2000  GC002-00-Z2000
<b>Research Findings:</b> These Utah experiments evaluated the effects of fundamental water chemistry characteristics on the survivorship of the infectious form of the disease known as the TAM. Several parameters showed an affect on TAM viability, especially water acidity and alkalinity. This may partially account for differences in the severity of whirling disease among geographic regions.				