

Project Findings 2000-2001 Whirling Disease Initiative

National Partnership for the Management of Wild and Native Cold Water Fisheries
Water Center, MSU-Bozeman

Category	Title	Principal Investigator	Other Partners	Award/Match
1. (10.1) Parasite	Development of a Method for Collection and Quantification of the Triactinomyxon Stage of <i>Myxobolus cerebralis</i> in the Field	Frederic T. Barrows, Research Physiologist U.S. Fish & Wildlife Service 4050 Bridger Canyon Road Bozeman, MT 59715 ph. 406/587-9265 ext. 130 fax: 406/586-5942 e-mail: rbarrows@montana.campuscwix.net	(1) Alexander Zale, Acting Unit Leader, MCFRU, Biology Dept., MSU-Bozeman (2) Thomas McMahon, Associate Professor, Biology Dept., MSU-Bozeman;	\$25,878/\$29,144 May 1, 2000 - September 30, 2001 GC131-00-Z0677
Research Findings: The purpose of this project was to develop an apparatus for collecting triactinomyxons quantitatively from natural waters, so the degree of infection of a stream can be readily assessed. A treatment sequence using rotating-drum and packed-bed filters performed well with known concentrations of TAMs in the laboratory. Coupled with pre-filtration and post-concentration steps, it was then demonstrated successfully in the field. The "tamometer" is now ready for use in assessing parasite loads in streams.				
2. (11.4) Ecosystem /Fish	Effects of <i>Myxobolus cerebralis</i> Infection on Chinook Salmon and Steelhead Trout in Northeastern Oregon	Jerri L. Bartholomew, Senior Researcher Oregon State University Department of Microbiology 220 Nash Hall Corvallis, OR 97331-3804 ph. 541/737-1856 fax: 541/737-0496 e-mail: bartholj@bcc.orst.edu	Paul W. Reno, Assoc. Professor Hatfield Marine Science Center, Comes 2030 SE Marine Science Dr., Newport, OR 97365-5296 ph. 541/867-0174 fax: 541/867-0105 e-mail: paul.reno@hmsc.orst.edu	\$57,303 / \$67,809 June 1, 2000 September 30, 2001 GC123-00-Z0677
Research Findings: This study examined the impacts of whirling disease on steelhead trout and chinook salmon in northeastern Oregon. Long-term exposures were conducted with steelhead juveniles at two steelhead rearing facilities. Clinical disease signs were evident in fish held at both sites. In laboratory challenges, chinook salmon displayed an increased resistance to the parasite when compared to highly-susceptible rainbow trout. The potential for exposure of chinook salmon and steelhead smolts in acclimation facilities was investigated using sentinel rainbow trout. Exposure to the parasite was demonstrated at five of seven tested facilities. Saltwater acclimation observations indicated that whirling-disease-infected fish had an increased mortality rate when compared to uninfected fish during acclimation.				

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3. (11.1) Fish	Distribution of <i>Myxobolus cerebralis</i> during the Migration Period for Juvenile Anadromous Salmonids in the Snake and Salmon Rivers of Idaho	Ken Cain , Assistant Professor Aquaculture & Fish Health University of Idaho Department of Fish & Wildlife Moscow, ID 83844-1136 ph. 208/885-7608 fax: 208/885-9080 e-mail: kcain@uidaho.edu	Keith A. Johnson, Fish Pathologist Supervisor, ID Dept. of Fish & Game Eagle Fish Health Lab 1800 Trout Rd. Eagle, ID 83616 ph. 208/939-2413 fax: 208/939-2415 e-mail: kjohnson@idfg.state.id.us	\$29,954/\$20,885 May 1, 2000 - September 30, 2001 GC125-00-Z0677
Research Findings: This project assessed the distribution, prevalence and intensity of whirling disease infection in sentinel rainbow trout within the migration corridor of anadromous species in the Salmon and Snake Rivers in Idaho. The results show infectivity to be correlated with water chemistry and discharge. Juvenile salmonids emerging or migrating through the upper reaches of the Salmon River in April and May are exposed to the infectious stage of the parasite. A discontinuous pattern of infectivity in the upper Salmon River suggests that the parasite may be present in high concentrations in the Pahsimeroi and Lemhi tributaries, and the detection of the parasite at downriver sites indicates that distribution within the drainage may be expanding.				
4. (2.1) Ecosystem	Epidemiology of Whirling Disease and the Effects of Habitat Restoration on Infection Rates and Disease Severity in Trout: An Integrated Study of the Rock Creek Drainage, Montana	Willard O. Granath, Jr. , 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) Eric Reiland, Fisheries Biologist, MT Dept of Fish, Wildlife & Parks, Missoula (2) Billie L. Kerans, Asst Professor, Biology Dept, MSU-Bozeman (3) Charlotte Rasmussen, Molecular Biologist, Western Fisheries Research Center, Seattle	\$50,160/\$55,445 May 1, 2000 - September 30, 2001 GC122-00-Z0677
Research Findings: This project was an assessment of the relationship between whirling disease infection in trout and in the alternate worm host throughout a single drainage. Results indicated that severe habitat degradation is not necessary in order to complete the parasite life cycle through the two hosts, although infections in both hosts were more intense in degraded areas of the stream. Sampling of trout and worm populations to evaluate effects of habitat restoration was begun. Further work has indicated the presence of three genotypes of worms in the stream system, although only one was found to be infected with <i>M. cerebralis</i> .				

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5. (9.1) Worm	The Use of Molecular Genetic Markers to Study Susceptible and Non-susceptible <i>Tubifex</i> Species to <i>Myxobolus cerebralis</i> in Various Colorado Drainages	Ronald P. Hedrick , Professor of Fish Pathology University of California-Davis School of Veterinary Medicine Department of Medicine & Epidemiology Davis, CA 95616-8737 ph. 530/752-3411 fax: 530/752-0414 e-mail: rphedrick@ucdavis.edu	(1) Katherine A. Beauchamp, Post-doctoral R.A., UC-Davis (2) R. Barry Nehring, Research Biologist, CO Division of Wildlife	\$48,000/\$15,062 May 1, 2000 - September 30, 2001 GC128-00-Z0677
Research Findings: Tubifex worms were collected from seven Colorado sites, exposed to whirling disease in the laboratory, and differentiated by molecular genetics into four distinct lineages. Genetically mixed populations of worms coexisted at most of the sample sites. Laboratory exposures of worms to <i>M. cerebralis</i> spores showed low levels of infection; however, worms from two lineages were more resistant than the others. These two lineages predominated at sites with relatively low levels of disease, suggesting that their disease resistance may ameliorate the effects of whirling disease in trout, where they are abundant.				
6. (2.2) Ecosystem	Assessment of the Effects of Landscape Features on the Distribution of <i>Myxobolus cerebralis</i> and Occurrence of Whirling Disease among Age-0 Trout in the Salt River Drainage, Wyoming-Idaho	Wayne A. Hubert , 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.	\$50,000/\$63,000 May 1, 2000 - September 30, 2001 GC126 -00-Z0677
Research Findings: Age-0 trout (brown, cutthroat, rainbow, and brook trout) were collected in streams of all sizes throughout the drainage. Trout not infected with whirling disease were only found in the headwaters of four mountain tributaries, all upstream from barriers to fish movement. Disease infection rates and histological evidence of whirling disease were highest at sites with large amounts of fine sediments and low channel slopes. Such sites were found in some spring streams with very low channel slopes, some spring streams with higher channel slopes and habitat improvements that resulted in numerous deep pools with abundant aquatic vegetation, and mountain tributaries downstream from complexes of beaver dams.				

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7. (2.3) Ecosystem	Assessment of the Effects of Landscape Features on the Distribution of <i>Myxobolus cerebralis</i> and Occurrence of Whirling Disease among Age-0 Mountain Whitefish in the Salt River Drainage, Wyoming-Idaho	Wayne A. Hubert , 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) David Zafft, Fish Population Supervisor, WY Game & Fish Dept., 528 S. Adams, Laramie, WY 82070; 307/745-5180; 307/745-5180 (p), 307/745-8720 (f); dzafft@state.wy.us; (2) Kevin Gelwicks, Fish Biologist, WY Game & Fish Dept. (3) Deedra Hawk, Forensic Specialist, WY Game & Fish Dept.	\$10,750/\$4,850 May 1, 2000 - September 30, 2001 GC127 -00-Z0677
Research Findings: Age-0 mountain whitefish infected with whirling disease were collected from the river, mountain tributaries, and near the mouths of spring streams flowing on the floor of the valley, all locations where age-0 infected trout were also found. Histological evidence of whirling disease among age-0 mountain whitefish was rarely observed. No relations between landscape or in-stream habitat features and the rate of occurrence of whirling disease or histological evidence of the disease in mountain whitefish were found. The investigators suspect that high mortality among very young whitefish exposed to WD may have confounded efforts to relate habitat features to whirling disease among mountain whitefish.				
8. (6.1) Fish	Cross Protection Against <i>Myxobolus cerebralis</i> infections by exposure to <i>Myxobolus arcticus</i>	Michael L. Kent , Director Oregon State University Center for Salmon Disease Research 220 Nash Hall Corvallis, OR 97331-3804 ph. 541/737-5045 fax: 541/737-2166 e-mail: kentm@bcc.orst.edu	(1) Ronald P. Hedrick, Medicine & Epidemiology, UC-Davis (2) Robert Olfason, Biochemistry, University of Victoria, Victoria, BC	\$17,480/\$6,075 May 1, 2000 - September 30, 2001 GC129 -00-Z0677
Research Findings: The purpose of this project was to learn whether previous exposure to the myxozoan parasite <i>Myxobolus arcticus</i> confers protection against whirling disease on young rainbow trout. Twenty-five fingerlings were subject to each of four treatments: no parasite exposure, <i>M. arcticus</i> exposure only, whirling disease exposure only, or whirling disease exposure following <i>M. arcticus</i> exposure. After five months all fish were sacrificed and prepared for disease assay. The results of these tests have not been returned to the investigators.				

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9. (3.1) Ecosystem	Whirling Disease in the Madison River: Research for Solutions	Billie L. Kerans , Assistant Professor Montana State University Biology Department Bozeman, MT 59717 ph. 406/994-3725 fax: 406/994-3190 e-mail: bkerans@montana.edu	(1) Charlotte Rasmussen, Western Fisheries Research Station, Seattle	\$55,579/\$31,100 May 1, 2000 - September 30, 2001 GC118 -00-Z0677
Research Findings: This project was part of a long-term study to track the severity of whirling disease in the Madison River of Montana, and to establish environmental and biological correlates of disease severity. The results showed that risk of whirling disease to rainbow trout was high in all but one side channel examined in 2000, and only a small proportion of the worms present need to be infected to produce severe risk of disease in rainbow trout.				
10. (11.3) Fish	Epidemiology of Whirling Disease in the Missouri River Ecosystem	Thomas E. McMahon , Fisheries Biologist Biology Department Montana State University Bozeman, Montana 59717 ph. 406/994-2492 fax: 406/994-7479 e-mail: ubitm@montana.edu	(1) Alexander Zale, Assistant Unit Leader, MT Cooperative Fishery Research Unit (2) Andrew Munro, GRA, Biology Dept., MSU- Bozeman (3) Stephen Leathe, Regional Fisheries Mgr., MFWP, Gr. Falls	\$41,781/\$126,250 May 1, 2000 - September 30, 2001 GC119 -00-Z0677
Research Findings: This work was part of a long-term study assessing the spread of whirling disease among rainbow trout in the Missouri River near Helena, Montana. The disease was not observed to spread significantly between 1999 and 2000. It showed a widely varying effect on recruitment of yearling fish from tributary streams. Its effects have now spread to several year classes, such that a collapse of the fishery appears imminent. Fish otolith microchemistry did not demonstrate sufficiently fine discrimination to allow individual fish to be traced to their tributaries of origin. Wild yearling fish were shown to be quite susceptible to infection as they migrate downstream.				

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11. (4.2) Fish	A Study to Determine the Effects of Fish Size and Release Location on the Survival of Rainbow Trout <i>Oncorhynchus mykiss</i> Fingerlings Stocked in the Colorado River Drainage	R. Barry Nehring , Aquatic Wildlife 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	Kevin G. Thompson, Research Associate, CO Cooperative Fish & Wildlife Research Unit c/o CO Division of Wildlife	\$29,613/\$0 May 1, 2000 - September 30, 2001 GC124 -00-Z0677
Research Findings: Rainbow trout fingerlings of two sizes were stocked into three reaches of the Colorado and Williams Fork Rivers, then sampled by electrofishing over the next year and a half. The objective was to learn what size of fingerling survives best in waters of different whirling disease infectivity. Fingerling survival was not clearly correlated with infectivity, but the investigators were able to define the best size class for stocking.				
12. (9.3) Worm	Molecular Examination of the Species Complex and Geographic Population Structure of <i>Tubifex tubifex</i>, the Oligochaete Host of the Whirling Disease Parasite	Charlotte Rasmussen , Affiliate Faculty Montana State University Department of Biology Bozeman, MT 59717 <i>Western Fisheries Research Center USGS-BRD 6505 NE 65th St. Seattle, WA 98115</i> ph. 206/526-6282 ext. 322 fax: 206/526-6654 e-mail: charlotte_rasmussen@usgs.gov	(1) James R. Winton, Chief, Fish Disease Section, Western Fisheries Research Center, Seattle (2) Alison E. L. Colwell, Microbiologist, Western Fisheries Research Center, Seattle (3) Billie L. Kerans, Asst. Professor, Biology Dept., MSU-Bozeman (4) Willard O. Granath Jr., Professor of Microbiology, Div. of Biological Sciences, UM-Missoula	\$50,115/\$53,300 May 1, 2000 - September 30, 2001 GC130 -00-Z0677
Research Findings: Laboratory experiments and field studies were used to determine whether genetic differences among worm populations contribute to the distribution and variable levels of disease severity seen among wild fish populations. Genetic analyses of the worms uncovered genomic patterns that appeared to predict the level of parasite production. Preliminary results indicate that the genetic composition of worm lineages within river drainages appears to be stable through time and over significant distances. Moreover, the epidemiology of whirling disease within streams appears to correlate with the genetic composition of the worm populations found within the stream.				

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13. (9.4) Worm/ Parasite	Distribution of <i>Myxobolus cerebralis</i> Infections in <i>Tubifex tubifex</i>, its Secondary Host	Anne C. Rusoff , Associate Professor Department of Biology Montana State University WWAMI Regional Medical Program Bozeman, MT 59717-0346 ph. 406/994-4595 fax: 406/994-3190 e-mail: rusoff@montana.edu	none	\$18,179/\$0 May 1, 2000 - September 30, 2001 GC121 -00-Z0677
Research Findings: The investigators developed a rapid technique for sectioning the worm host of whirling disease to examine the course of infection within individual worms. Three strains of worms with varying susceptibility to infection were examined. The new technique allowed the investigators to trace the differing courses of infection they exhibited. It also allowed them to identify infected worms at an earlier stage than was previously possible. This should permit researchers to rapidly determine if worms taken from streams are or will shortly be releasing triactinomyxons.				
14. (7.1) Fish	Effects of Size versus Age on the Development of Whirling Disease in Rainbow Trout	Alexander V. Zale , Acting Unit Leader and Affiliate Associate Professor Montana Cooperative Fishery Research Unit Department of Biology Montana State University Bozeman, MT 59717 ph. 406/994-2380 fax: 406/994-7479 e-mail: zale@montana.edu	Eileen K.N. Ryce, GRA MT Cooperative Fishery Research Unit, Biology Dept., MSU-Bozeman	\$52,554/\$29,680 May 1, 2000 - September 30, 2001 GC120 -00-Z0677
Research Findings: Some weeks after hatching, rainbow trout develop resistance to infection by whirling disease. The purpose of this project was to ascertain whether fish age or size is the better indicator of the development of resistance. The results indicate that both age and size are good surrogate measures for the development of resistance, but fish age has better explanatory power. This suggests that maturation of the immune system is more important than bone development in fighting off the disease.				

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15.	Modeling Stream Temperatures with the GIS System in the National Wild Fish Health Survey Data Base Report to the MSU Water Center	Daniel Goodman , Ecology Professor Department of Ecology Montana State University Bozeman, MT 59717 ph. 406/994-3231 fax: 406/994-3190 email: goodman@rivers.oscs.montana.edu	none	\$20,000/\$0 May 1, 2000 - September 30, 2001 Contract
<p><u>Research Findings:</u> The seasonal pattern of stream temperatures is a key determinant of the distribution, spread, and intensity of the whirling disease epizootic. The investigators used a validation database of Montana stream temperatures to develop a model and database to calculate the mean daily water temperature for any location on any stream in Montana, for any day in the past 21 years. For a particular stream of interest, one week of calibration data is needed. This model will allow statistical examination of the disease epidemiology as it relates to water temperature.</p>				