

WILD FISH HABITAT INITIATIVE
SEMIANNUAL REPORT

July 1 – December 31, 2003

Submitted by:
Montana Water Center
Montana State University – Bozeman

Submitted to:
Division of Fish and Wildlife Management Assistance
U.S. Fish and Wildlife Service



Background

Habitat degradation is one of the principal reasons for the listing of wild fish as “threatened” or “endangered” under the Federal Endangered Species Act. Habitat degradation can exacerbate detrimental effects of fish predators, exotic competitors, and diseases such as whirling disease. In addition, land values are diminished by habitat degradation and the subsequent loss of wild fish populations. Private landowners forego economic opportunities when land uses are restricted and resources are directed toward fish restoration. In recent years, many techniques of fish habitat enhancement have been implemented, but their long-term efficacy is not well understood because little or no evaluation and monitoring have been conducted.

The Partners for Fish and Wildlife Program, administered by the U.S. Fish and Wildlife Service, is a critical national effort to restore important fish and wildlife habitat. This is a voluntary program that works with private landowners to restore habitat on their lands. *The purpose of the Wild Fish Habitat Initiative is to enhance the success of riparian projects conducted through the Partners for Fish and Wildlife Program.* The Initiative involves two activities: conducting targeted research to assist Partners fish habitat restoration projects, and implementing a vigorous information-transfer program to provide technical results to those who plan and carry out Partners projects. Progress on each of the four projects is described below.

Evaluation of Entrainment Losses of Westslope Cutthroat Trout at Private Irrigation Diversions on Skalkaho Creek, Montana

Graduate Student: Steve Gale

Principal Investigators: Al Zale and Tom McMahon

Collaborator: Christopher G. Clancy
Montana Department of Fish, Wildlife and Parks

Background

Skalkaho Creek is a 40.4-km tributary of the Bitterroot River located in southwest Montana. The Bitterroot flows 134 km through irrigated farm and ranch land to its confluence with the Clark Fork River near Missoula, Montana. Five major diversions and numerous smaller canals remove water from the river during irrigation season. Many tributaries of the Bitterroot River are also diverted for irrigation during the summer months and contribute little streamflow to the river during that time. Both the mainstem of the Bitterroot River and its tributaries are therefore chronically dewatered during the irrigation season.

Skalkaho Creek supports a healthy population of westslope cutthroat trout (*Oncorhynchus clarki lewisi*), along with brook trout, brown trout, bull trout, mountain whitefish, redbreast shiner, and slimy sculpin. This study is examining seven lowhead dams on lower Skalkaho Creek that are believed to divert downstream migrant westslope cutthroat trout into irrigation canals. Both post-spawn adults migrating back to the Bitterroot River and juveniles emigrating downstream from nursery reaches of Skalkaho

Creek and its tributaries are likely entrained and become trapped and die in the irrigation canal system, thereby resulting in a net loss to the population. Private landowners and irrigators in the drainage have expressed concern over this possible loss and will be installing fish screens at the diversions to preclude any such losses. The magnitude and effects of entrainment by eight diversions on the westslope cutthroat trout population prior to the installation of fish screens, as well as the efficiency of the screens after installation, will be quantified. This study will provide beneficial information to project managers regarding the effectiveness of fish screens and the prevention of fish loss due to irrigation diversions.

Objectives

1. Quantify downstream migrating juvenile and adult westslope cutthroat trout entrained at irrigation diversions on Skalkaho Creek, before and after installation of fish screens.
2. Evaluate passage efficiency of fish screen structures at irrigation diversions in western Montana.

Progress to Date

To assess entrainment rates of adult, juvenile, and age-0 westslope cutthroat trout at seven irrigation ditches, 30 adult and 50 juvenile fish were radio-tagged and followed throughout their migrations during the 2003 field season. Stationary trap nets were used in ditches to estimate entrainment rates of age-0 fish. There was no entrainment of tagged adults during the 2003 field season. This may have been due to limited movement; 80% of the radio-tagged adults exhibited limited movement and were believed to be resident fish. Even though these adults were not entrained during 2003, interesting information was collected on adult westslope cutthroat trout movement in Skalkaho Creek. It appeared that during the spawning season some fluvial adults were able to migrate upstream past the seven diversion dams as well as migrate back downstream over the diversion dams. The largest loss for tagged juveniles and age-0 westslope cutthroat trout during 2003 occurred at the Highline Ditch, the furthest upstream ditch. The Highline Diversion Dam diverts a large percentage of Skalkaho Creek to the Highline Ditch during peak irrigation season, which corresponded to the peak emergence and downstream movement of age-0 westslope cutthroat trout.

Future Activities

Objectives for the 2004 field season are to assess entrainment rates of adult, juvenile, and age-0 westslope cutthroat trout at the seven irrigation ditches. Methods used to capture migrating adult fluvial westslope cutthroat trout, however, will be modified during 2004 to ensure that more fluvial than resident adult fish are radio-tagged. One such modification is that 50 adult fish will be radio-tagged instead of 30. This will provide us with a larger sample size from which we can track fish migration and estimate entrainment rates in Skalkaho Creek upstream from the Bitterroot River. In addition, the passage efficiency of three fish screens installed during the autumn of 2004 will be examined. Passive Integrated Transponder (PIT) technology will be used to determine the passage efficiency of the three installed fish screens.

Thermal Requirements of Westslope Cutthroat Trout

Graduate Student: Beth Bear

Principal Investigators: Tom McMahon and Al Zale

Collaborator: Bill Krise, Bozeman Fish Technology Center, USFWS

Background

Historically, westslope cutthroat trout (*Oncorhynchus clarki lewisi*) ranged widely over western Montana, Idaho, and portions of eastern Washington and Oregon. Like many other cutthroat and other native trout, westslope cutthroat trout now persist in only a small portion of their native range, and are listed as a “species of special concern” in Montana.

Leading causes for their decline are habitat degradation and displacement by non-native rainbow, brook, and brown trout. Water temperature is considered a key element in the abundance and distribution of cold water species like trout, yet the thermal requirements of westslope cutthroat trout, like many other native fishes, are largely unknown. In addition, increased water temperature is thought to favor non-natives in many cases, yet the effect of temperature on competition between westslope cutthroat and non-natives is unknown. Furthermore, hybridization between westslope cutthroat trout and non-native rainbow trout has resulted in a decline in populations of genetically pure westslopes. It is unclear what the thermal requirements of these hybrids are, as well as how the competitive interaction between hybrids, genetically pure westslope cutthroat trout, and non-natives is influenced by water temperature.

The goal of this laboratory study is to characterize the thermal biology of westslope cutthroat trout, specifically with respect to the lethal and optimal temperatures for this subspecies, and to compare its performance against a non-native competitor in sympatry and allopatry. We will use a laboratory design that we developed for thermal testing with bull trout (Selong et al. 2001). This design allows simultaneous assessment of fish growth and survival under many different thermal regimes over long time periods.

Objectives

1. To define the upper lethal and optimal temperature ranges of westslope cutthroat trout.
2. To determine how temperature influences the competitive interactions with non-native species such as rainbow trout (*Oncorhynchus mykiss*).
3. To contrast how thermal requirements of westslope - rainbow trout hybrids compare with pure westslope cutthroat trout and pure rainbow trout as a means of assessing why hybrids between these two species have been so successful.

Progress to Date

The first two trials to determine the upper lethal and optimum growth temperature of westslope cutthroat trout were completed in 2003. Preliminary results indicate the UUILT to be near 21°C and the optimum growth temperature to be near 13°C. Further data analysis is necessary to solidify these results. In addition, the third trial to determine

the UUILT and optimum growth temperature of rainbow trout using the acclimated chronic exposure method is currently underway. Results will allow comparisons between these two species with respect to the role water temperature may play in their survival and growth. Westslope cutthroat trout and rainbow trout are currently being maintained at the USFWS Bozeman Fish Technology Center for use in upcoming competition trials. Additional westslope cutthroat trout and brook trout will be obtained for use in a competition trial between these two species.

Future Activities

During 2004, a thermal trial to determine the influence of competition by rainbow trout, *Oncorhynchus mykiss*, on the growth of westslope cutthroat trout will be conducted. Following this trial, a thermal trial will be conducted to determine the influence of competition by brook trout, *Salvelinus fontinalis*, on the growth of westslope cutthroat trout. Understanding possible mechanisms, such as increased water temperature, leading to the dominance of these nonnative trout over westslope cutthroat trout in nature may provide insight into preserving remaining westslope cutthroat trout populations. During spring 2004, an additional attempt will be made to produce rainbow trout - westslope cutthroat trout hybrids for use in a final thermal trial. Knowledge of hybrid thermal requirements may lead to an increased understanding of the role of thermal tolerance as a genetic trait and aid in determining why hybrids are so successful in nature.

Bacterial Coldwater Disease in Westslope Cutthroat Trout: Hatchery Epidemiology and Control

Principle Investigators: Eileen K. N. Ryce and Al Zale

Background

Bacterial coldwater disease, caused by the gram-negative bacterium *Flavobacterium psychrophilum*, is a septicemic infection that has caused significant losses of hatchery-reared salmonids worldwide. Currently, bacterial coldwater disease is the only disease found in State fish hatcheries in Montana. Increasingly, these hatcheries are being asked to help restoration programs for rare and sensitive species. The Washoe Park State Fish Hatchery in Anaconda, MT, is currently the only facility in the state producing westslope cutthroat trout suitable for restoration programs. However, the severity of bacterial coldwater disease at this hatchery inhibits its use for westslope cutthroat trout restoration projects. Successful control of bacterial coldwater disease in the hatchery would help facilitate restoration of native westslope cutthroat trout in Montana.

Typical clinical signs of bacterial coldwater disease include lethargy, dorsal skin erosion, ascites (accumulation of fluid in the peritoneal cavity), bilateral exophthalmia, very pale gills, and hemorrhagic vent with trailing mucoid casts. Concurrent problems, such as infestation with parasites, are common (Branson 1998). Internally, the most obvious finding in fish with this condition is splenomegaly, where the spleen can be 2 to 5 times its normal size and is usually friable in nature. The surrounding peritoneum and fat are usually red in color and kidneys may be pale and slightly swollen. Intestines often contain yellow or white mucoid discharge and the terminal gut may be congested.

Damage to the spleen can be seen histologically and the bacteria can be seen within the damaged tissue (Branson 1998). Signs associated with neurological disruptions can also occur including whirling behavior around the longitudinal axis, post cephalic protrusion of the cranium, spinal deformities, and loss of melanocyte control in the posterior body (also known as black-tail) (Kent et al. 1989; Meyers 1989). Microscopic features of the neurologic lesions include fibrous inflammation of the vertebral canal at the junction of the spinal cord and the medulla oblongata. The inflammation causes an upward compression of the anterior position of the spinal cord. Erosion and necrosis of vertebral bone and cartilage is also apparent (Meyers 1989). Many of the clinical signs associated with bacterial coldwater disease are also clinical signs of other fish diseases; therefore, a positive identification of the bacterium is necessary for confirmation of the disease.

Traditionally, oxytetracycline incorporated into fish food was the most common form of treatment for bacterial coldwater disease. The drug is usually effective in hatcheries experiencing the condition for the first time, but resistance towards this drug is developing (Branson 1995). The drug amoxicillin is now commonly used in Europe to control the disease; however, resistance to this drug is also increasing (Branson 1998). Although resistant bacteria are developing, oxytetracycline remains the treatment of choice in North America. Increasing incidence of the resistant bacteria and recurrent outbreaks of disease shortly after a treatment are continual problems, and no alternative treatments are currently available (Dalsgaard and Madsen 2000). A *F. psychrophilum* vaccine has been developed using the immunogenic outer membrane fraction of the bacteria; however, this vaccine is not yet commercially available and needs to be further investigated for viability and economical production on a large scale (Rahman et al. 2002). At present, the most effective form of disease control is to prevent outbreaks from occurring by reducing stress on the fish. The goal of this research is to better understand the ecology of *F. psychrophilum* in hatcheries so that control measures can be developed and tested.

Objectives

1. To identify the source of *F. psychrophilum* at Washoe Park State Fish Hatchery;
2. To determine where in the hatchery production process *F. psychrophilum* is most prevalent and at what life stages westslope cutthroat trout are susceptible; and
3. To identify and evaluate measures at Washoe Park to eradicate or control the bacterium such that production, and consequently native species restoration efforts, are no longer hindered by the disease.

Progress to Date

We confirmed that *F. psychrophilum*, the causative agent of bacterial coldwater disease, occurred inside the eggs from westslope cutthroat trout at the Washoe Park State Fish Hatchery. Accordingly, the pathogen can be transmitted vertically from the female parent. The bacterium was found within the contents of unfertilized and fertilized eggs, although in all incidences it was found at low levels. The incidence of the bacterium in the fertilized eggs (28%) was slightly higher than that found in the unfertilized eggs (23%). Surface disinfection with iodine after fertilization did not reduce the presence of the pathogen inside the egg.

A high proportion of milt from the Washoe Park hatchery tested positive for the bacterium, and fertilized eggs tested positive externally at a higher rate than unfertilized eggs (60% fertilized were positive, only 2 % of unfertilized were positive). We confirmed that the fertilized eggs were becoming infected from the milt and not from either the ovarian fluids or from the hatchery water used during the fertilization procedures. Knowing that the eggs are externally infected by the males provides us with opportunities to control the spread of infection through treatment of the males with antimicrobial drugs or direct disinfection of the milt prior to fertilization.

Disinfection of eggs was found to be very useful at controlling the presence of the bacterium on the egg surface. An iodine bath of 30 minutes post-fertilization was found to be sufficient at killing all surface *F. psychrophilum*. The surface-disinfected eggs showed no change in eye up rate when compared to eggs that were not surface-disinfected.

Bacterial coldwater disease was controlled more successfully at the Washoe Park State Fish Hatchery this year than ever before. By implementing management strategies to reduce the probability of horizontal transmission, no outbreaks of disease occurred within the hatchery building. The hatchery manager implemented a strategy to clean the incoming water supply and also included an iodine surface-disinfection procedure for all eggs after fertilization. Both of these changes in hatchery management probably account for the success of rearing the fish within the hatchery building with no outbreaks of disease. Normally, while in the hatchery building, there would be at least three outbreaks of coldwater disease with a loss of 10% of the fish during each outbreak. No outbreaks of disease occurred in 2003 until the fish were moved from the hatchery building to the outside raceways. Three weeks after the fish were moved outside a coldwater disease outbreak occurred and 10% of the fish died during the outbreak. Fish that remained inside the hatchery from the same lot did not incur any disease.

Fish in the hatchery displaying no signs of disease were carrying the pathogen, primarily in the cranium. In addition, it was confirmed that chronic stress did not induce the disease in infected individuals; however, an acute stress event such as moving the fish to the outside raceways could induce the disease. Minimizing the exposure of fish to the pathogen by cleaning water supply pipes, disinfecting eggs, and reducing vertical transmission will reduce the number of fish carrying the bacterium. Minimizing the number of fish that carry the pathogen will ultimately reduce losses during acute stress events that induce disease outbreaks.

Future Activities

Analyses of all samples collected during the study have been completed and final report preparation is underway.

Technology Transfer

Contributors: Michelle White, Cal Fraser, and Molly Boucher

Background

In recent years, many techniques regarding fish habitat enhancement and restoration have been implemented but project results generally have not been shared or exist only in “gray literature” where they are difficult to access. To address this problem, we are collating information on methods and results of various fish habitat restoration projects completed within the intermountain west (Idaho, Montana, Nevada, Wyoming, Utah, Colorado, eastern Washington, eastern Oregon, and eastern California). The information we are collecting includes narrative descriptions, project goals, restoration methods, project costs, landowner contributions, and monitoring data. We hope to augment the success of the Partners Program and other habitat restoration programs by providing useful bibliographic and case history information to land owners and project managers through a web-accessible database. By providing easily accessible information on effective fish habitat restoration and monitoring techniques, the overall project goal is to increase long-term effectiveness of such projects.

Objectives

1. Alert Partners biologists to the project and solicit their information needs.
2. Provide a web-accessible resource on fish habitat restoration, including bibliographic information of pertinent literature.
3. Provide a web-accessible case history database of fish habitat projects pertinent to Partners activities in the northwestern United States.

Progress to Date

The Initiative website (<http://water.montana.edu/wildfish/>) continues to be updated with recent research and new and revised resource information. The site includes summaries and progress reports of all Initiative research projects, a searchable bibliography related to fish habitat, a list of habitat restoration manuals, and links to pertinent on-line habitat restoration information. The on-line bibliography is a collation of information on various fish habitat restoration techniques and will facilitate information exchange among fisheries biologists and project managers. The list of habitat restoration manuals includes information relevant to the northwestern United States; each manual is available on the website in PDF format.

The case histories database also continues to be updated and expanded. Site visits to Oregon, Wyoming, and Colorado during August 2003 yielded information on a total of 10 projects from these states. Currently the on-line database contains detailed information on seven restoration projects from Montana, five from Wyoming, and one from Oregon. Additional projects from Idaho, California, Colorado, and Oregon are near completion. Each case history description includes the following information: narrative descriptions, project goals, restoration methods, project costs, landowner contributions, photographs, and monitoring data. The intent of the database is to share information and learn from examples of previous restoration work. It is searchable by project title,

project type, and location. We continue to work with agency personnel, fisheries biologists, and project managers to collate information and present it in a constructive and useful manner.

Future Activities

Although our efforts continue to focus on the collection of information on fish habitat restoration projects for the case histories database, we are also planning to attend several professional meetings to make additional contacts and present the results of our work thus far. We will present posters at the Western Division and Montana Chapter annual meetings of the American Fisheries Society. In addition, we will continue to update the bibliographic information, and update and maintain the website as needed. By fall 2004 we intend to have case history projects representing each state in the northwestern United States. During fall 2004 we will begin coordinating a formal review of the website by fisheries biologists and Partners Program personnel.

Fan Creek Westslope Cutthroat Trout Restoration Project

Graduate Student: Peter Brown

Principle Investigator: Al Zale

Background

Westslope cutthroat trout currently occupy a small portion of their historical range in the upper Missouri River drainage. Introduced trout species have contributed to this decline, especially through loss of genetic integrity arising from hybridization with rainbow trout. The Aquatic Resources Center, Yellowstone National Park, has been working to restore westslope cutthroat trout to headwater tributaries of Yellowstone National Park in the upper Missouri River drainage. As part of this effort, Aquatic Resources Center staff collected genetic samples from putative westslope cutthroat trout in streams of the Gallatin River and Madison River drainages in the northwest region of Yellowstone National Park. Of all the streams sampled, only the North Fork of Fan Creek was found to contain a genetically pure population. A telemetry study conducted by the Montana Cooperative Fishery Research Unit, in collaboration with the Aquatic Resources Center, characterized seasonal movements of the genetically pure westslope cutthroat trout in the North Fork of Fan Creek and compared these movements to nearby hybridized populations in the mainstem of Fan Creek. No evidence was found to suggest that hybrids entered the North Fork of Fan Creek or the upper portions of the mainstem. Movements of most westslope cutthroat trout tagged in the North Fork were limited. Westslope cutthroat trout tagged in the upper mainstem either made short spawning migrations upstream within the mainstem or made longer migrations to the North Fork. Overall these findings suggested that spatial reproductive isolation is responsible for maintaining the genetic purity of westslope cutthroat trout in the North Fork of Fan Creek.

Unfortunately, continued isolation of this population cannot be assured due to the introgression of species in the East Fork. Therefore, it was recommended that the genetically pure North Fork population be protected from introgression by the placement

of a semi-permanent artificial barrier on the lower North Fork. Although such a barrier will prevent westslope cutthroat trout residing in the mainstem from returning to the North Fork to spawn, relatively few fish make such a migration. The greater danger is from a single hybrid entering the North Fork, and the installation of an artificial passage barrier will prevent such an occurrence. Chemical reclamation of the East Fork and part of the mainstem of Fan Creek also was recommended to increase the amount of habitat occupied by genetically pure westslope cutthroat trout. This will improve the long-term viability and abundance of the population. Stepwise downstream reclamation, in conjunction with temporary barriers, will allow practicable-sized stream segments to be exterminated entirely. These segments then will be restocked with fish from the North Fork. After complete reclamation, the barrier on the North Fork will be removed and a permanent barrier will be installed in the mainstem, thereby restoring pure westslope cutthroat trout throughout the upper Fan Creek drainage. Our goal is to use the Fan Creek Restoration Project as a demonstration of a native fish restoration project involving chemical removal and movement inhibition of an exotic competitor.

Objectives

1. Assess the current fishery characteristics of Fan Creek to provide a pre-treatment baseline condition against which the success of the management program can be judged.
2. Guide project management incorporating state-of-the-art stream reclamation techniques.

Progress to Date

Activities since inception of the project include recruitment of a PhD student (Peter J. Brown) to conduct components of the study, attendance by the PI of a workshop on removal projects conducted by Montana Fish, Wildlife & Parks in Missoula, Montana, during December 2003, and several scoping meetings with state, federal, and private biologists to identify additional study sites on both public lands (e.g., National Forests) and private properties (e.g., Turner Enterprises). Also, arrangements were made with Dr. Steven Kalinowoski, a conservation geneticist with the Department of Ecology at Montana State University, to perform analyses of genetic samples associated with this study.

Future Activities

Abundance, distribution, and genetic composition of westslope cutthroat trout and hybrid trout throughout the Fan Creek system will be assessed during summer 2004 before and after reclamation work is conducted. Recently collected data and samples of relevance have not been fully analyzed; we will complete the analyses in addition to conducting a comprehensive survey of existing salmonid populations in the system. Surveys will be repeated after reclamation efforts to assess the effectiveness of the project. The primary sampling tool will be multiple-pass electrofishing of isolated stream reaches to estimate absolute fish abundances therein. All captured fish will be weighed, measured, and tissue-sampled for genetic analyses. Comparisons of abundance, size, and genetic integrity of fishes before and after the reclamation will determine the effectiveness of restoration activities. Efficacy of barriers installed to prevent upstream migration of

exotics will be evaluated through tagging experiments. Project activities will be fully documented to assist in the planning of subsequent restoration efforts.

Project Personnel

Dr. Alexander Zale is the Principal Investigator. Dr. Zale is the Cooperative Fishery Research Unit Leader for Montana and an Affiliate Associate Professor in the Department of Ecology at Montana State University. Besides exercising overall leadership, he is the leader of the Irrigation Diversions project, the Fan Creek project, and co-leader for the Bacterial Coldwater Disease project. Dr. Zale's research interests center on applied aquatic ecology and fisheries management.

Dr. Thomas McMahon is the Project Biologist. Dr. McMahon is an Associate Professor in the Ecology Department at Montana State University whose principal research interests are wild trout management, fish-habitat relationships, winter ecology, and conservation biology of salmonids. He is the leader of the Westslope Cutthroat Thermal Testing project.

Eileen Ryce, Post-Doctoral Associate in the Ecology Department at Montana State University, is co-leader for the Bacterial Coldwater Disease project. Dr. Ryce specializes in fish health issues.

William C. Fraser is directing the Technology Transfer project. Mr. Fraser is a fishery biologist who serves as Manager of the Wild Trout Research Laboratory at the Montana Water Center. His chief professional interests are salmonid ecology and culture.

Michelle D. White is a Water Quality Specialist with the Montana Water Center. She has degrees in general biology and marine science, and manages water quality projects for the Center. She is working on the Technology Transfer project and serving as project administrator for the Wild Fish Habitat Initiative.

Molly Boucher is a Program Specialist with the Montana Water Center. She has a degree in environmental studies and develops websites and databases for the Center. She is the website developer for the Wild Fish Habitat Initiative and works with William Fraser and Michelle White on the Technology Transfer project.

Beth Bear is a Graduate Research Assistant with the Montana Cooperative Fishery Research Unit at Montana State University. She is working with Dr. Thomas McMahon on the Westslope Cutthroat Thermal Testing project.

Steve Gale is a Graduate Research Assistant with the Montana Cooperative Fishery Research Unit at Montana State University. He is working with Dr. Alexander Zale and Dr. Thomas McMahon on the Irrigation Diversions project.

Peter Brown is a Graduate Research Assistant with the Montana Cooperative Fishery Research Unit at Montana State University. He is working with Dr. Alexander Zale on the Fan Creek Project.

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