WILD FISH HABITAT INITIATIVE

SEMI-ANNUAL REPORT

Reporting period:
January 1 to June 30, 2004

Submitted by:
Montana Water Center
Montana State University – Bozeman

July 15, 2004

Submitted to:
Division of Fish and Wildlife Management Assistance
and Habitat Restoration
US Fish and Wildlife Service

MONTANA WATER CENTER

WILD FISH HABITAT INITIATIVE

INTRODUCTION

Wild Fish Habitat Initiative 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 US 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.

Purpose—The purpose of the Wild Fish Habitat Initiative (Initiative or WFHI) is to enhance the success of restoration projects conducted through the Partners for Fish and Wildlife Program. The Initiative seeks to augment the success of the Partners Program and other habitat restoration programs through the following two activities: conducting targeted research related to habitat restoration techniques, and implementing a technology transfer program to provide technical information to landowners and project managers. Progress on each of the efforts conducted in Phase II of the Initiative is described below.

ADMINISTRATION

Wild Fish Habitat Initiative Program Administration

Principal Investigators

Dr. Alexander Zale, Montana Cooperative Fishery Research Unit Leader; Professor, Department of Ecology, Montana State University

Liz Galli-Noble, WFHI Program Director; Assistant Director for Research, Montana Water Center (4/04-present)
Michelle White, former WFHI Program Administrator; former Water Quality Specialist, Montana Water Center (10/03-3/04)

Goals and Objectives

The overall goal of WFHI program administration is to meet the needs of the USFWS Project Officer regarding the Initiative, and to support the research teams in carrying out wild fish habitat research projects (described later in this report). Specific objectives are:

- To assure that fiscal transfers are timely, clear, and appropriate,
- To keep the USFWS well-informed about the progress and results of the program,
- To identify and enter into formal relationships with additional project partners, as appropriate, and
- To publicize Initiative projects, research results, and program deliverables to interested parties.

Update
Montana Water Center administrative personnel have managed the USFWS contract and all research subcontracts; processed invoices and tracked the fiscal status of each project; invoiced the USFWS; submitted progress reports to the USFWS; responded to USFWS requests for information or assistance; and supported the research teams in acquiring information, supplies and facilities, in contractual or hiring matters, and in other ways as needed.

All administrative duties are the responsibility of Montana Water Center staff. Major duties during this reporting period involved maintaining communication with the USFWS and submitting a detailed report on all research components of the Initiative. In addition, the Principal Investigators have been developing the Phase III Technical Workplan and budget over the past two months. That report was submitted to the USFWS on June 30, 2004.

Deliverables
Deliverables for program administration as a whole are regular communication and updates to Division Chief Bolton, delivery of an annual USFWS-MSU contract and budget, two program progress reports per year, regular invoices to the USFWS, and financial reports.

TECHNOLOGY TRANSFER / TECHNICAL SUPPORT / OUTREACH

Technology Transfer Project

Research Team Members:
Molly Boucher, web site specialist
Cal Fraser, program biologist
Liz Galli-Noble, program director
Alicia Paz-Solis, Montana State University undergraduate student (bibliography)
Michelle White, former program administrator (10/03-3/04)

Figure 1. Nine WFHI focal states in the Intermountain West.

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, the Montana Water Center is collating information on methods and results of various fish habitat restoration projects completed within the Intermountain West (Colorado, Idaho, Montana, Nevada, Utah, Wyoming, and inland areas of California, Oregon, and Washington). Information collected includes narrative descriptions, project goals, restoration methods, project costs, landowner contributions, and monitoring data. It is our intent to augment the success of the Partners Program and other habitat restoration programs by providing useful bibliographic and case history information to landowners and project managers through a web-accessible database.

Goal
The overall goal of the Technology Transfer Project is to increase the long-term effectiveness of fish habitat restoration projects by providing easily accessible information on effective fish habitat restoration and monitoring techniques.

Objectives

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

Progress to Date

The Initiative web site continues to be updated with on-going research activities and newly-acquired resource information. The site now includes: summaries and progress reports of all Initiative research projects, a searchable bibliography related to fish habitat, a selection of downloadable habitat restoration manuals, and links to pertinent online habitat restoration information.

In May 2004, our web site specialist obtained a new WFHI web site address: http://wildfish.montana.edu, and in June she optimized and submitted the new site to the top search engines. The anticipated result of this action is to increase search engine ranking, which in turn will result in increased use of the site. Use of the Wild Fish web site can now be tracked separately from the main Montana Water Center web site. The number of monthly visits to the web site will be reported in subsequent progress reports.

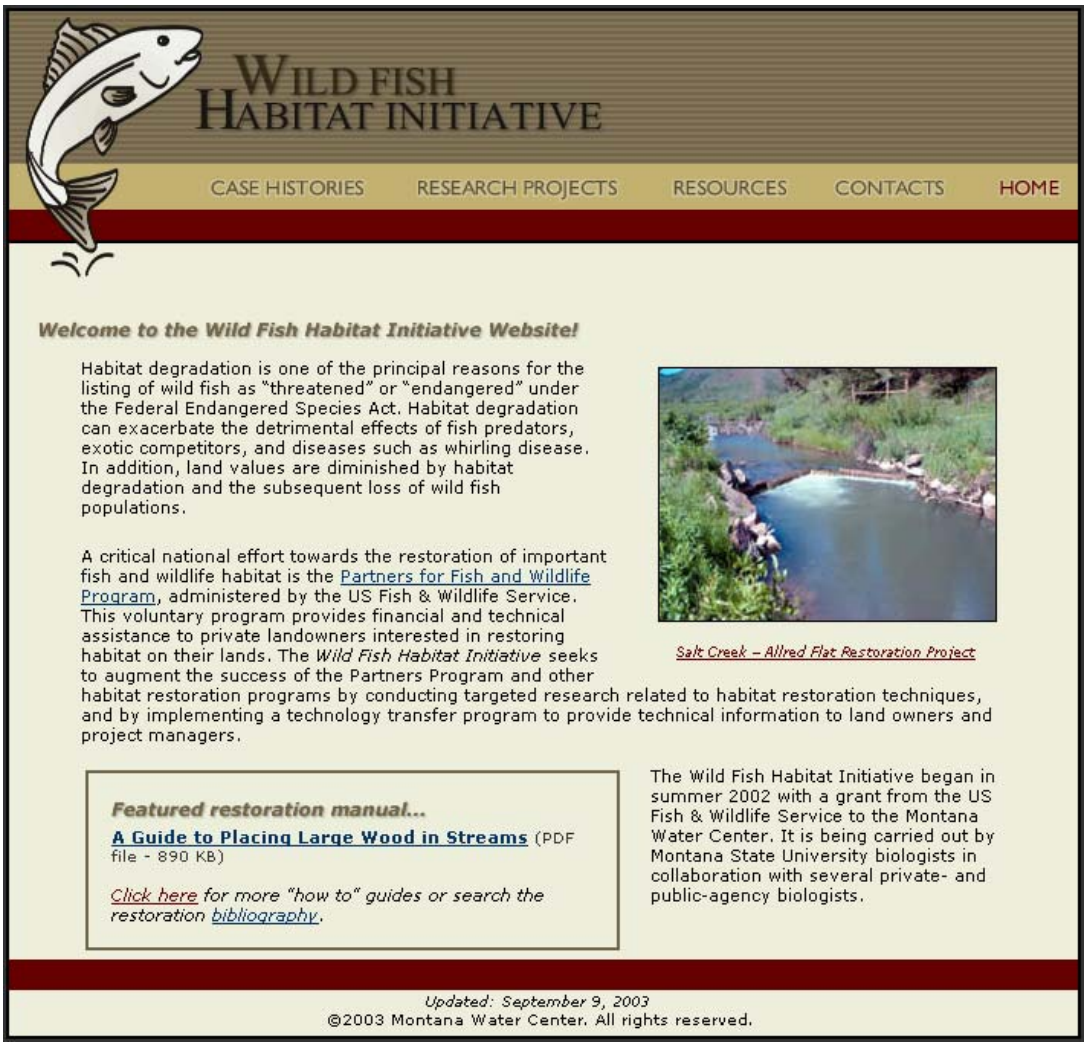

Figure 2. Wild Fish Habitat Initiative web site home page.

Online Bibliography—The WFHI online bibliography is a collation of information on various fish habitat restoration techniques chosen to facilitate information exchange among fisheries biologists and project managers. To date, 1033 literature entries have been added to the bibliography. These entries will be reviewed periodically and new citations will be continually added as they become available.

Habitat Restoration Manuals—Fourteen habitat restoration manuals are showcased on the web site to date. They were selected to provide information relevant to the nine focal states, and each of the manuals—or pertinent chapters within those manuals—are available to the web site visitor in an easily-downloadable PDF format. Given their large size and the, oftentimes, lengthy process of securing many of these manuals, we intentionally made these resources instantly available to the web site visitor.

Restoration Project Case Histories—The case histories database has continued to be updated and expanded over the last six months. Montana Water Center staff site visits to Oregon, Wyoming, and Colorado during August 2003 yielded information on a total of 10 projects from these states. Currently, the case history database contains 18 detailed restoration projects showcasing seven projects from Montana, five from Wyoming, four from Oregon, and one each from Idaho and California. Each case history description includes: 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. During summer 2004, we will concentrate our efforts on researching and adding projects to the web site from Colorado, Utah, Washington, Idaho, California, and Nevada.

Program Publicity/Outreach—In the past few months, the new WFHI program director has actively publicized the WFHI program and its research and web site products. Two press releases have been sent out touting the new web site and encouraging feedback from interested parties. Further, dozens of letters have been sent to fishery-based groups and partner agencies announcing the availability of this new management tool, soliciting feedback on initial web site products, and encouraging a greater exchange of ideas and sharing restoration project lessons learned.

New Project Opportunities—Montana Water Center staff strive to be responsive to newly identified needs of our research and resource partners. In the past few months, one such need has surfaced. The research team leader from the new (2004-2005) Eradication and Exclusion Project recently approached our web site specialist for assistance with developing an online interface for data collection. Although not an identified activity in our original technical workplan, we feel this is a worthwhile endeavor to pursue, and if successful, the process could be exported to other research projects, region wide. It is our intent to explore the effectiveness of these types of research-outreach collaborations and share lessons learned with our other project partners.

Future Activities

In the remaining six months of WFHI Phase II (July 1 to December 31, 2004), the Technology Transfer team will focus our efforts on the collection of information on fish habitat restoration projects for the case histories database. In October 2004, we will be hiring a part-time researcher/technical writer to work with the Technology Transfer team on a temporary basis, specifically to research hard-to-find habitat restoration case histories.

We will continue to maintain the web site as needed, with updates to the bibliographic information and restoration manuals. By September 2004, the team intends to complete case history descriptions for each of our nine focal states in the Intermountain West. We will also begin coordinating a formal review of the web site by September. A panel of fisheries biologists,

academics, Partners Program personnel, and other governmental agency personnel will be asked to critically evaluate web site design, and comment on the usefulness of products showcased and soundness of data presented. Recommendations made by that panel will be implemented in late 2004 and in Phase III of the project.

Montana Water Center staff are also planning to attend several professional meetings to make contacts and present work products, including: *Federation of Fly Fishers 2004 Conclave* in August 2004; *Wild Trout Conference 8*, September 20-22, 2004; local Trout Unlimited chapter meetings; and *21st Annual Meeting of the American Water Resources Association,* Montana Chapter, October 2004. We would welcome suggestions for additional outreach opportunities from our project partners, as well.

Finally, the new program director of the WFHI has actively publicized the Initiative web site in the past few months, and will continue to do so in summer and fall 2004. She plans on attending USFWS Partners Program meetings, whenever possible, to foster better communication between the partners and to present program updates and research deliverables.

Projected Completion Date and Deliverables

The Technology Transfer project is an ongoing effort that will continue to be expanded and polished as new and better restoration data become available. The team has already accomplished two of our three Phase II project goals: we have established an online bibliography and we have made relevant restoration manuals available to online visitors. By the end of project Phase II, we will have addressed our third project goal by developing a case history database that showcases at least one restoration project from each of our nine focal states. All three of these products will be further developed over time.

Technical Support

The Montana Water Center Wild Trout Research Laboratory manager provides technical support and research assistance to several Initiative research teams, as well as to Montana state and federal fisheries agencies. During the past six months, the laboratory manager assisted WFHI research teams with:

1. Experimental apparatus design, development, maintenance, and usage,
2. Graduate student fish-husbandry activities,
3. Disease identification,
4. Disease treatment,
5. Graduate student data collection,
6. Emergency on-call support,
7. Graduate student technician support.

The lab manager also works closely with USFWS Fish Technology Center staff, providing them with technical support and performing the following tasks: facility maintenance support, fish husbandry support, disease identification assistance, community outreach support, and graduate student research assistance.

RESEARCH PROJECTS

Project #1. Irrigation Diversion Project

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

Graduate Student: Steve B. Gale, Montana State University
Principal Investigators: Al Zale, Montana Cooperative Fishery Research Unit and Tom McMahon, Montana State University
Collaborator: Christopher G. Clancy, Montana Department of Fish, Wildlife and Parks

Background

Skalkaho Creek is a 40-kilometer long tributary of the Bitterroot River in southwest Montana. The Bitterroot flows 134 kilometers 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, redside 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 expressed concern over this possible loss, and three fish screens were installed in the beginning of 2004 to preclude any such losses. Research was conducted in 2003 to assess the magnitude and effects of entrainment by the diversions on the westslope cutthroat trout population prior to the installation of fish screens and work continues in 2004 to assess entrainment as well as evaluate the efficiency of the screens after installation. 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.

Goals

Provide private landowners, as well as federal/state agencies, with an in-depth evaluation of the value of fish screens to help make decisions on their use and potential value.

Objectives

1. Quantify downstream migrating age-0, 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 of Skalkaho Creek.

Progress to Date

To assess entrainment rates of adult, juvenile, and age-0 westslope cutthroat trout at the 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. No entrainment of tagged adults occurred during the 2003 field season, perhaps because they moved little; 80 percent of the radio-tagged adults were likely resident, non-migratory fish. The largest losses of 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.

Three fish screens were installed in the spring of 2004 before the start of the irrigation season at the Hughes, Ward, and Highline Ditches. As with any new equipment or technology, some problems were encountered early on with the screens. At the Highline Fish Screen, the vertical, stainless steel mesh panels had to be removed for two weeks in May because they were not self-cleaning properly. This was due in part to the high debris flow associated with spring runoff and also due to the fact that the screens on Skalkaho Creek were not designed to handle the higher flows diverted during highwater. Highwater rights, which allow the Daly Ditch Company to divert more than average flows down each ditch, were not taken into account in the design of these screens. Near the end of May, the high runoff subsided and the screens have been self-cleaning efficiently since. The paddlewheel, which powers the cleaning brushes on the screen, stopped working on the Ward Fish Screen in June. It was discovered that the gears had not been greased properly upon installation. All three paddlewheels have since been regreased and have been running smoothly.

A major incident occurred on May 22, 2004 when a local boy who lives on Skalkaho Road was caught in the paddlewheel of the Highline Ditch and pinned under water. Larry Trexler, ranch manager for Skalkaho Ranch, was able to free the boy from the wheel. Since this incident, contractors have been hired to install guards over each paddlewheel and fencing around each screen to prevent further accidents.

As of June 25, 43 adult fish have been radio-tagged in 2004 with over half of these being possible fluvial fish from the Bitterroot River. Twenty fish tagged last year still have active tags, for a total of 63 fish. This provides us with a larger sample size than last year with which we can track fish migration and estimate adult entrainment rates in Skalkaho Creek. As in 2003, it appears that during the spawning season most, but not all, fluvial adults were able to migrate upstream past the seven diversion dams as well as migrate back downstream over the diversion dams. As of July 7, 2004, nine radio-tagged adult westslope cutthroat trout have been entrained (21 percent of those tagged in 2004). Three fish were entrained in the Republican Ditch and one was entrained in the Hedge Ditch. Five fish were entrained in the Ward Ditch and all five were successfully bypassed back to Skalkaho Creek by the fish screen. Their bypass was detected by the Passive Integrated Transponder (PIT) antenna attached to the bypass pipe. It detects PIT-tags implanted in the cheeks of each radio-tagged fish.

A screw trap has been in operation in Skalkaho Creek since mid-April. Fish collected therein will help estimate when downstream migrations of all sizes of westslope cutthroat trout and other species, such as bull trout, are occurring.

Future Activities

Starting June 28, 2004, stationary trap nets are again being used to estimate entrainment rates of age-0 westslope cutthroat trout as they emerge from the gravel, drift downstream, and become vulnerable to entrainment. The nets will be operated until the end of the irrigation season.

Passive Integrated Transponder technology will be used to determine the passage efficiency of each fish screen in August 2004. PIT-tagged fish will be released into the ditch above the screen just downstream of the headgate. An antenna attached to the bypass pipe of each fish screen will record the time and date when each PIT-tagged fish is successfully bypassed back into Skalkaho Creek. Fish that are not bypassed in a timely manner may be more susceptible to predation by piscivorous fish and birds. Two to three trials will be conducted at each fish screen.

By the end of August 2004, 50 age-1 juvenile westslope cutthroat trout will again be radio-tagged and followed during their autumn outmigration to estimate juvenile entrainment.

Projected Completion Date and Deliverables
December 2004, final report.

Project #2. Thermal Requirements of Westslope Cutthroat Trout

Project Title: Thermal Requirements of Westslope Cutthroat Trout

Graduate Student:	Beth Bear, Montana State University
Principal Investigators:	Tom McMahon, Montana State University and Al Zale, Montana Cooperative Fishery Research Unit
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 native trout species, 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 influencing the abundance and distribution of coldwater species like trout, yet the thermal requirements of westslope cutthroat trout are largely unknown. Proper conservation and management of westslope cutthroat trout requires detailed knowledge of its temperature requirements.

Goals
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 thermal biology with that of rainbow trout, a non-native competitor. We are using 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 temperatures over long time periods. In addition, the thermal preferences of both species are being determined to better aid in characterizing the thermal requirements of each species.

Objectives
1. To define the upper lethal and optimal temperature ranges of westslope cutthroat trout.
2. To define the upper lethal and optimal temperature ranges of rainbow trout.
3. To determine the thermal preference of westslope cutthroat trout and rainbow trout.

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 ultimate upper incipient lethal temperature (UUILT) to be near 21°C and the optimum growth temperature to be near 13°C. The third trial to determine the UUILT and optimum growth temperature of rainbow trout using the acclimated chronic exposure method was completed in March 2004. Preliminary results indicate the UUILT for rainbow trout to be near 24°C. The optimum growth temperature for rainbow trout was not conclusive from this trial due to ration conditions below satiation. Therefore, a fourth trial is currently underway to refine the information previously obtained for westslope cutthroat trout and rainbow trout and to determine the optimum growth temperature for both species under satiation conditions. Satiation in this trial will be ensured by quantifying the actual consumption of test fish over a range of temperatures.

Results will allow comparisons between these two species with respect to the role water temperature may play in their survival and growth.

Future Activities
The fourth and final experiment to refine the upper lethal limit and growth optimum temperature of westslope cutthroat trout and rainbow trout is currently underway and will be completed in mid-September 2004. In October, a newly designed laboratory apparatus will be used to determine the thermal preference of several salmonid species including westslope cutthroat trout, rainbow trout, and brook trout.

Projected Completion Date and Deliverables
A final report on the westslope thermal project will be submitted by December 31, 2004. This report will detail the information gathered on the specific upper lethal temperature for westslope cutthroat trout and rainbow trout. In addition, the growth of both species at temperatures ranging from 8° to 24°C will have been determined and an optimum growth temperature established. To date, this information is completely lacking in the literature for westslope cutthroat trout.

References
Selong, J. H., T. E. McMahon, A. V. Zale, and F. T. Barrows. 2001. Effect of temperature on growth and survival of bull trout, with application of an improved method for determining thermal tolerance in fishes. Transactions of the American Fisheries Society 130:1026-1037.

Project #3. Bacterial Coldwater Disease Project

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

Principal Investigators: Eileen K.N. Ryce, Montana State University and Al Zale, Montana Cooperative Fishery Research Unit

Background
Bacterial coldwater disease, caused by the gram-negative bacterium *Flavobacterium psychrophilum*, is a septicemic infection that originated in the northwestern United States and is responsible for significant losses of hatchery-reared salmonids worldwide. It is especially problematic at hatcheries rearing fish for native species restoration, because the wild, undomesticated strains used for restoration are prone to stress in the hatchery environment and stress induces the disease. Currently, bacterial coldwater disease is the only fish disease found in State fish hatcheries in Montana. The Washoe Park State Fish Hatchery in Anaconda, Montana, is the only facility in the state that produces westslope cutthroat trout (*Oncorhynchus clarki lewisi)* suitable for restoration programs. However, the severity of bacterial coldwater disease at this hatchery limits fish production and therefore implementation of the westslope cutthroat trout restoration program. Losses typically occur in three episodes among young fish from shortly after swim-up until they reach a length of about 75 millimeters. The first outbreak occurs in indoor raceways at first feeding, the second about three weeks later also indoors, and the third about three weeks after the juvenile fish are moved to outdoor raceways. In aggregate, the three outbreaks can achieve losses of about 30 to 45 percent annually. Successful control of bacterial coldwater disease at Washoe Park State Fish Hatchery would therefore facilitate restoration of native westslope cutthroat trout in Montana.

Goal
To better understand the ecology of *F. psychrophilum* in hatcheries and thereby facilitate development and testing of control measures, eventually leading to increased and enhanced restoration efforts.

Objectives
1. To determine where the pathogen occurred in the hatchery.
2. To determine avenues of transmission within the hatchery.
3. To determine what factors cause disease outbreaks.

Abstract
Bacterial coldwater disease, caused by the gram-negative bacterium *Flavobacterium psychrophilum*, is responsible for significant losses of hatchery-reared salmonids worldwide. We used Washoe Park State Fish Hatchery in Anaconda, Montana, as a case study to enhance understanding of the disease in a hatchery setting and to develop practical hatchery-management strategies to better control the pathogen and the disease. Washoe Park typically loses 30 to 45 percent of its westslope cutthroat trout (*Oncorhynchus clarki lewisi)* production to the disease annually. Our objectives were to determine where the pathogen was located in the hatchery system, how it was transmitted, and what factors caused disease outbreaks. We found the bacterium in the warm-spring water source, in the degassing water tower, and in production and broodstock fish. It was transmitted both horizontally and vertically, with both male and female parents passing the pathogen on to their offspring. Transmission from females was vertical only, but both horizontal and vertical transmission from males occurred. Iodine surface-disinfection post-fertilization eliminated the pathogen from egg surfaces, thereby limiting horizontal transmission. Chronic and mild acute stress did not result in disease outbreaks, but a combination of acute stress events associated with moving juvenile production fish from indoor to outdoor raceways did. These fish harbored the pathogen, primarily in cranial tissues, prior to the outbreak. Measures resulting from our findings implemented at Washoe Park to reduce horizontal transmission included cleaning and sterilization of hatchery structures and iodine surface-disinfection of eggs post-fertilization. Eradication of the pathogen from the hatchery is unlikely, but efforts to reduce the frequency and intensity of stress events should reduce the frequency of disease outbreaks; management to reduce the number of fish carrying the pathogen may minimize losses during outbreaks.

Completion Date and Products
June 2004, final report (attached).

Need for Further Study
Hatchery personnel are currently (2004) attempting to reduce prevalence of the pathogen in male broodstock through oxytetracycline and fluorofenicol injections and oxytetracycline-coated feed. These actions are aimed at reducing vertical transmission. Sperm washing techniques, as commonly used in animal husbandry of domestic mammals to eliminate pathogens, may warrant future investigation also.

Project #4. Fan Creek Project / Eradication and Exclusion Techniques Project

Project Title: Fan Creek Westslope Cutthroat Trout Restoration Project
Revised Title: Evaluation of the Efficiency and Efficacy of Non-native Fish Eradication and Exclusion Techniques for Native Fish Restoration

Graduate Student: Peter Brown, Montana State University
Principal Investigator: Al Zale, Montana Cooperative Fishery Research Unit
Summer Technician: John Olson, Montana State University

Background

Native fish conservation has become a pressing issue for resource managers, often because of threats posed by non-native fish species. Predation and competition for resources can drive native populations to extinction while hybridization reduces the overall genetic integrity of native populations. Fishery restoration projects have been undertaken throughout the United States to conserve threatened and endangered species as well as to rid water bodies of non-native species. These projects use a combination of techniques to eradicate non-native fish species usually using fish toxicants, and prevent their reinvasion, usually with a physical barrier. Despite their widespread use as a management tool, little standardization of techniques exists and evaluations of success or failure are rarely conducted. An evaluation of the techniques used to eradicate and exclude non-native fish was to be carried out in Fan Creek, Yellowstone National Park. However, recent findings have made the planned restoration unfeasible. Cutthroat trout in Fan Creek were thought to be genetically pure (i.e., containing no genetic material from rainbow trout) and the National Park Service had planned to protect this "pure" population by removing the rainbow trout from Fan Creek and excluding rainbow trout from elsewhere in the drainage. Protection of the cutthroat trout population became a low priority after recent studies showed that cutthroat trout in Fan Creek contain a small amount of rainbow trout genetic material. The planned restoration of Fan Creek was therefore canceled. We are replacing Fan Creek with several restoration projects that are being carried out elsewhere and are available for research. These include Costilla Creek, New Mexico; Labarge Creek, Wyoming; and Cherry Creek, Montana. Understanding the dynamics of fish toxicants and effective barrier design is critical in making restoration projects an effective tool in managing native fish.

Goals

The goal of this project is to increase the success rate of native fish restoration projects. To achieve this goal this project will carry out a thorough investigation of the techniques used to eradicate and exclude non-native fish.

Objectives

Our specific short-term objectives to reach this goal are to: 1) identify the current methods used for fish eradication and exclusion, and 2) identify the qualities of both successful and unsuccessful native fish restoration projects. Subsequent field and laboratory research will focus on increasing the efficiency of fish eradication and exclusion through direct experimentation. Understanding the inefficiencies of fish eradication and exclusion will increase the overall effectiveness of native fish management.

Progress to Date

This project is in the process of identifying current eradication and exclusion efforts in the United States. Several restoration projects have been identified and will be studied in more detail through summer 2004. We are also in the process of surveying non-native fish exclusion techniques. An Internet-based survey has provided a great deal of information on a variety of exclusion devices and construction techniques.

Future Activities

Future activities include writing an exclusion manual, evaluating past restoration projects, and experimental tests of eradication and exclusion techniques. Using results of the ongoing exclusion survey and analysis of the failure of barriers, we will write a manual on how to design an effective fish exclusion device. During the 2005 field season, we will be visiting past restoration projects in an effort to evaluate their success. By using standardized sampling techniques and recreating any evaluation techniques used at the site in the past, we will determine if eradication and exclusion was effective. Subsequent research will directly test the effectiveness of eradication and exclusion techniques.

Projected Completion Date and Deliverables

Completion of the overall project is expected in 2009 pending continued funding; reports will be issued accordingly. The exclusion manual will be completed in fall 2005. Publication of research results will take place as research is completed.

PROJECT PERSONNEL

Dr. Alexander Zale is the Principal Investigator for the Wild Fish Habitat Initiative. Dr. Zale is the Cooperative Fishery Research Unit Leader for Montana and a Professor in the Department of Ecology at Montana State University. In addition to exercising overall program leadership, he is the research leader of the Irrigation Diversions project, the Eradication and Exclusion project (formerly, 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 a 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.

Liz Galli-Noble is the Assistant Director for Research at the Montana Water Center. She is responsible for the management of the Center's aquatic biology research programs and administration of the Wild Fish Habitat Initiative. Ms. Galli-Noble attended the University of Montana for her undergraduate studies and received a Master's degree from Yale University in 1995.

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

Molly Boucher is a Web Site Specialist with the Montana Water Center. She has a degree in environmental studies and develops web sites and databases for the Center. Ms. Boucher is the web site developer for the Wild Fish Habitat Initiative and works on the Technology Transfer project.

Michelle D. White is the former Water Quality Specialist with the Montana Water Center. She has degrees in general biology and marine science, and managed water quality projects for the Center. She worked on the Technology Transfer project and served as project administrator for the Wild Fish Habitat Initiative until April 2004.

Beth Bear is a Graduate Research Assistant with the Montana Cooperative Fishery Research Unit at Montana State University. She is working with 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. Zale and Dr. 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. Zale on the Eradication and Exclusion Project (formerly, Fan Creek Project).

John Olson is student technician working with Peter Brown and Dr. Zale on the Eradication and Exclusion Project (formerly, Fan Creek Project) during the summer 2004.