WILD FISH HABITAT INITIATIVE
Semi-Annual Report

Reporting period:

January - June, 2008

Submitted by:

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July 30, 2008

INTRODUCTION

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.

Established in 2002, the Wild Fish Habitat Initiative is a cooperative effort between the US Fish and Wildlife Service, Partners for Fish and Wildlife Program and the Montana Water Center (housed on the campus of Montana State University-Bozeman). Research conducted through the Wild Fish Habitat Initiative (Initiative) is being carried out by Water Center staff and Montana State University biologists in collaboration with private landowners and private and public-agency biologists.

The Partners for Fish and Wildlife Program, administered by the USFWS, is a critical national effort to restore important fish and wildlife habitat. This voluntary program provides financial and technical assistance to private landowners wanting to restore habitat on their lands.

The purpose of the Initiative is to augment the success of the Partners Program and other fish habitat restoration programs by conducting targeted research related to native fish habitat restoration techniques, and by implementing a technology transfer program to provide technical information to landowners and project managers. Progress on each of the efforts conducted for the Initiative is described in detail in later sections of this report.

Focus on Native Fish Populations—*Wild fish can be either native or introduced exotic species that reproduce and are self-sustaining in the wild. Non-native fish can have significant recreational and economic value; however, in some instances (locations), non-native fish may not be appropriate where conservation of native fish is a goal. This Initiative has given special consideration to habitat restoration projects targeted for native fish populations. Projects to benefit exotic fish have been taken up, if such techniques are useful in benefiting native fish.*

Defining Restoration—Stream restoration has become a multi-billion-dollar industry, and a diversity of techniques have been developed and practiced. Various perceptions exist as to what is meant by the term "restoration." Wohl *et al.* (2005) emphasized that these perceptions reflect the wide range of stakeholder interests, scientific knowledge, scales of interest, and system constraints encountered in practice. In recent years, river managers and scientists have proposed the term "restoration" be used only for projects with the objective of assisting in the establishment of improved hydrologic, geomorphic, and ecological processes in a degraded watershed system and replacing lost, damaged, or compromised elements of the natural system (Wohl *et al.* 2005; Kauffman *et al.* 1997; Palmer *et al.* 2005; and Roni *et al.* 2002). Recently, Palmer *et al.* (2005) proposed standards for measuring and guiding restoration success, with emphasis on a watershed-scale, ecological approach. These standards were endorsed by an international group of river scientists (Jansson *et al*. 2005) and practitioners (Gillilan *et al*. 2005). Reports of the Fish Habitat Initiative use the term restoration to address any river or stream projects aimed to improve fish habitat.

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RESEARCH PROJECTS

During this period three research projects were underway. Project updates follow.

Evaluation of the Efficiency and Efficacy of Non-native Fish Eradication and Exclusion Techniques for Native Fish Restoration 2005-2008

Principal Investigator: Alexander V. Zale, Unit Leader, Montana Cooperative Fishery Research Unit
Graduate Student: Peter Brown, PhD student, Montana State University
Technicians: Jenifer Ard and Patrick Odenbeck, 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 extinct, 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 fish toxins (piscicides) to eradicate non-native fish species, and physical barriers to prevent their reinvasion. The use of fish toxicants has been shown to be very effective; however, there are many unknown variables in their use. For example, the toxicity of piscicides has been assessed in separate studies using juvenile and adult rainbow trout but has not been compared across a wide range of fish sizes. Similarly, no guidance exists for the most efficient placement of a drip station within a channel (i.e., center or edge). Currently, without more specific piscicide application guidelines, applicators frequently apply too much piscicide in an effort to insure complete eradication. Over-application of piscicides can be costly and result in high mortality of aquatic invertebrates. After piscicide application protocols are better defined, non-native fish eradication will be more effective. This research team is investigating the toxicants used to eradicate non-native fish to better define piscicide application guidelines.

Goal and Objectives

The goal of this project is to increase the success rate of native fish restoration projects. The research team hopes to increase the efficiency and efficacy of native fish restoration by making piscicide use more efficient and effective. Researchers are carrying out a thorough investigation of the techniques used to eradicate non-native fish, specifically addressing the efficiency of piscicide use.

Specific short-term objectives are to: (1) Test models developed to predict the toxicity of piscicides (2) determine if drip station placement predicted by piscicide persistence models can prevent areas of non toxic water during piscicide application.

Progress to Date

Piscicide persistence simulations were carried out using a piscicide persistence model to study the potential for actual stream application. Model testing showed that the predictions closely matched actual piscicide performance. The model predicted piscicide persistence to within 200 m of the actual degradation point at four of five test sites. At the fifth site, the model predicted that piscicides would remain effective 500 m further downstream than they actually did. This prediction was not accurate because the study stream was physically different (low-gradient meadow habitat) from the streams the model used to make the prediction (high-gradient freestone habitats). These tests showed that a margin of safety of about 200 m should be added to any prediction and that the models should only be used on streams similar to those used to the develop model.

Our previous experiments on mixing distances of piscicides showed that they should be applied to the center of a stream channel to minimize mixing distance. Further analyses showed the mean ratio of mixing distance to stream width was 6.8 (95% CI= 4.8-8.8) at center applications and 13.1 (95% CI= 8.9-17.3) at edge applications. We recommend that piscicides be applied at the center of a stream; when application from the edge is unavoidable, piscicide applications should be overlapped 13 stream widths.

Future Activities
The predictive ability of the models developed during stream studies of piscicide toxicity is being tested at multiple locations in six streams during summer 2008. The graduate student will be completing his dissertation during fall 2008 and spring 2009.

Projected Completion Date and Deliverables
Completion of the overall project is expected in 2009 pending continued funding; reports will be issued accordingly. Publication of research results and presentations at scientific meetings will take place as research is completed.

Evaluation of Habitat Restoration for the Fluvial Arctic Grayling in the Big Hole River, Montana 2006-2009

Principal Investigator: Alexander V. Zale, Unit Leader Montana Cooperative Fishery Research Unit
Co-PI: Robert E. Gresswell, USGS Northern Rocky Mountain Science Center, Bozeman, Montana
Graduate Student: Shane Vatland, PhD student, Montana State University
Project Partners: Montana Fish Wildlife and Parks, Arctic Grayling Recovery Program, Big Hole Watershed Committee, US Fish and Wildlife Service, and local landowners

Background
Historically, two disjunct populations of the circumpolar Arctic grayling (*Thymallus arcticus)* occurred in Michigan and Montana. Grayling became extinct in Michigan in the late 19th century, and although the species still occurs in Montana, the fluvial (permanently stream dwelling) form has been extirpated from about 95 percent of its historic range. The last remaining reproductively-viable assemblage of this grayling life-history type is limited to the upper 130 kilometers of the Big Hole River and its tributaries.

Fluvial grayling in the Big Hole and Madison rivers were classified by the US Fish and Wildlife Service as a Distinct Population Segment under the Endangered Species Act in 1994. Following subsequent review in 2004, this assemblage was elevated to the highest listing priority that can be given to a Distinct Population Segment. However, in 2007, the US Fish and Wildlife Service determined the fluvial Artic grayling was not an endangered species. In contrast, the grayling in the Big Hole River remains a species of "special concern" according to the Endangered Species Committee of the American Fisheries Society, the Montana Chapter of the American Fisheries Society, Montana Fish, Wildlife, and Parks, and the Montana Natural Heritage Program of the Nature Conservancy.

Because most of the habitat occupied by grayling in the Big Hole River watershed is on or adjacent to private land, a close relationship between private landowners and regulatory agencies has been developing since the 1980s. The prior potential for listing under the Endangered Species Act and the critical need to engage the majority of landowners in watershed-scale solutions to conserve and restore grayling have resulted in variety of integrated conservation

programs, including one of the largest Candidate Conservation Agreement with Assurances in the United States. Specifically, these programs are attempting to increase instream flow, lower summer water temperatures, and improve riparian habitat conditions throughout the upper Big Hole River Watershed.

Goals

Our primary goal is to investigate relationships between stream habitat conditions, fish assemblage composition, and Arctic grayling distribution, abundance, and movement patterns in the upper Big Hole River. By gaining further knowledge about the basic population ecology and movement patterns of Artic grayling and other fish species in the Big Hole River and its tributaries, we aim to provide essential information for grayling conservation planning and ongoing habitat restoration efforts.

Objectives

1. To consolidate and analyze past sampling data on Arctic grayling in the upper Big Hole River.
2. To determine seasonal distribution and movement patterns of grayling in the upper Big Hole River.
3. To determine the frequency and timing of fish movement between mainstem and tributary habitats in the upper Big Hole River.
4. To investigate the relationship between fish movement, habitat use patterns, and stream habitat conditions.

Progress to Date

Through a series of ongoing planning meetings and communications, we are collaborating with biologists from Montana Fish, Wildlife and Parks (MFWP) and other scientists involved in the Arctic Grayling Recovery Program (AGRP) to achieve the goals and objectives of this research project. As a result of these efforts, AGRP has purchased about $10,500 in passive integrated transponder (PIT) equipment for our use during this research project and donated $5,200 to support 2008 field research. In addition, we have been working in close collaboration with MFWP to implement field work and consolidate past sampling data.

To achieve research objectives 1 and 2, we compiled a database of over 6,500 individually marked Artic grayling in the Big Hole River from 1986-2005. Analyses of mark-recapture locations suggest that fluvial Arctic grayling in the Big Hole River watershed exhibited two distinct seasonal distribution patterns from 1985 to 2005. Grayling either tended to remain in the same area of the stream network (independent of season), or grayling occupied an upstream section of the network in the spring and subsequently moved downstream by the fall. Grayling also exhibited strong interannual fidelity to seasonal habitat. Spring distribution patterns suggest most spawning occurred in an upstream section of the system, and similar distribution patterns of age-0 grayling in the fall suggests these fish reared near the spawning areas. Smaller fish ($\leq$250 mm) tended to occupy the same locations, independent of season, but larger fish (>250 mm) often exhibited extensive movement among seasons (0-80 km). Movement distances were highly variable during years of moderate and high flows, but during years of low discharge, grayling primarily moved greater distances between spring and fall habitats. We presented these findings and our future research plans at three professional meetings in 2007 (annual AGRP

meeting in February, American Fisheries Society Parent Society Annual Meeting in September, and Wild Trout Symposium in October).

Passive integrated transponder (PIT) technology has provided us with a robust tool to assess distribution and movement patterns of fish in the Big Hole River. In riverine systems where opportunities for snorkel and electrofishing surveys are limited, PIT-tagging provides the means for passive monitoring at a fine temporal scale (nearly continuous) with fixed antennas and at a fine spatial scale with portable PIT antennas. Compared to traditional mark-recapture approaches that require physical handling at each recapture event, this approach greatly reduces the amount of handling necessary to collect information from individual fish. However, effects of PIT-tagging on Arctic grayling were unknown and MFWP precluded our use of the technique until more information was available.

In order to provide evidence concerning the effects of PIT-tagging on Arctic grayling, we initiated an experiment investigating the effects of PIT tags on Arctic grayling growth, survival, and swimming performance in April 2007 at the Aquatic Sciences Laboratory. Unfortunately, these grayling suffered from a parasitic infection of the gastrointestinal tract, and we were unable to complete the experiment. We plan to repeat the experiment and further evaluate tag-effects on smaller fish (see Future Activities).

In addition to the laboratory experiment, a short-term mortality experiment was conducted at the Green Hollow Artic grayling brood pond on Turner Enterprise's Flying D Ranch. A total of 41 fish were held for 4 days, and 100% of control and PIT-tagged fish survived (excluding one individual killed by an avian predator). We also observed 100% retention of PIT tags, and implantation wounds were healing well on day 4. We presented a detailed evaluation of PIT-tagging Arctic grayling to MFWP personnel. Subsequently, MFWP permitted us to PIT-tag one-half of the age-1 and older Arctic grayling and all other stream fish (of sufficient size) captured in autumn sampling. We presented results from the short-term mortality experiment at the Montana AFS chapter meeting in February 2008.

Seven fixed-antenna stations were installed in the Big Hole River and its tributaries to monitor PIT-tagged fish in the Big Hole River and its tributaries. In 2007, four of these stations were equipped with two channel-spanning antennas to detect direction of movement, and three other stations had single antennas. We are currently reinstalling all seven stations and equipping each with two channel-spanning antennas. In 2007, we also assisted MFWP personnel in assembling three additional PIT antenna stations (each with two stream-wide antennas), and MFWP personnel have installed five additional stations in 2008. Permission to access and install all PIT antenna stations was acquired from private landowners and collaborating government agencies.

Timing and extent of fluvial Artic grayling activity in tributaries to the upper Big Hole River was assessed by snorkeling from June through September 2007. To identify factors influencing this potential mainstem-tributary dynamic, we conducted continuous snorkel and habitat surveys of two tributaries, Fish Trap Creek and LaMarche Creek. These tributaries were selected because 1) in the past few years, the relative abundance of grayling (as measured by fall electrofishing catch per unit effort), was higher in sample sections of these streams than in other sampled portions of the Big Hole River watershed, and 2) visibility in these two tributaries provides the

opportunity for quantitative snorkel surveys. We identified, enumerated, and estimated the size of all stream fish observed in continuous snorkel surveys in late June, late July, and late September. We also completed a continuous hierarchical habitat survey of Fish Trap Creek in late June and LaMarche Creek in late July 2007.

To assess water temperature patterns in some portions of the study area, we conducted spatially-continuous temperature surveys of Fish Trap Creek, LaMarche Creek, and the adjacent mainstem Big Hole River in mid-August 2007. These surveys provided a longitudinal profile of summer stream temperatures, and in combination with our fish and habitat surveys, will be used to compare seasonal trends in the fish assemblage of tributaries with fine-resolution water temperature and flow data.

We collaborated with MFWP personnel and captured stream fish by electrofishing throughout the upper Big Hole River watershed in September and October of 2007. These efforts coincided with annual MFWP fish monitoring surveys. We implanted 23-mm PIT tags in 932 fish >120 mm (total length). These PIT-tagged fish included 27 Arctic grayling, 72 burbot *Lota lota*, 372 brook trout *Salvelinus fontinalis*, 207 rainbow trout *Oncorhynchus mykiss*, 140 brown trout *Salmo trutta*, 58 mountain whitefish *Prosopium williamsoni*, and 56 white and longnose suckers, *Catostomus commersonii* and *Catostomus catostomus*, respectively. To monitor the movement of these fish, we maintained the operation of seven PIT-tag stations from mid-September to late-November/early December, and 254 PIT-tagged fish were detected at one or more stations. We will continue to analyze detection data to provide information on the movement, habitat use, growth, and demography of these fish species. In a joint effort with MFWP, we presented preliminary results of our PIT-tagging efforts to the Big Hole Watershed Committee in December 2007. We also wrote a brief article on our PIT-tagging efforts for the Big Hole River Foundation fall newsletter.

Our research project was awarded a grant from the Big Hole Watershed Committee to assemble three portable PIT antenna units for use in evaluating fish movement and habitat use patterns in the study area. We successfully designed and assembled one of these portable units for use in wadeable streams, and we are continuing to develop two other units, including a larger unit for use in non-wadeable streams.

Guided by 2007 research results, continued collaboration with management agencies, and peer-reviewed literature, we developed a hierarchical survey design for evaluating stream habitat conditions and fish movement patterns throughout the upper Big Hole River Valley in 2008 and 2009 (see future activities). We also presented a summary of the research described in this report at the annual meeting of the AGRP in February 2008.

Future Activities

We will continue to analyze the historic grayling tagging-recapture database for patterns of movement, trends in abundance, survival, habitat characteristics, and fish species composition. The database requires further quality-control work to identify data entry errors and discrepancies. In addition, we will add the 2006 grayling data collected by MFWP and sampling-tagging data for grayling we obtained in 2007 to the database.

Analysis of the 2007 field data is ongoing, as we continue to investigate relationships between stream habitat conditions, fish assemblage composition, and Arctic grayling distribution, abundance, and movement patterns in the upper Big Hole River. We will also continue outreach to the popular press and presentation of research findings at professional and public meetings.

Field work is continuing in 2008. We plan to install two additional stream-wide PIT stations in the Big Hole River to better monitor fish movement in the mainstem of the river. These PIT stations will be installed in the summer during baseline flow conditions. In the summer, we will expand our continuous temperature surveys to include additional tributaries and more of the main-stem Big Hole River. In addition, we will install a network of fixed temperature loggers throughout the study area. These data, in combination with remote sensing data from a forward looking infrared survey of stream temperature, will be compared to fish movement information obtained using fixed PIT stations and past monitoring data. In the fall of 2008, we will continue our collaborative PIT-tagging efforts with MFWP. We will also evaluate portable PIT antenna techniques and directly estimate detection efficiencies. In an effort to gain insight into winter movement patterns, we plan to identify PIT-tagged fish locations through the ice and snow in LaMarche and Fish Trap creeks with a portable PIT antenna in 2009. Portable PIT antenna surveys will continue in tributaries to the Big Hole River (and possibly the mainstem) in the spring, summer and fall of 2009.

An additional lab experiment will be implemented to evaluate the effects of implanting PIT tags on Arctic grayling growth, survival, and swimming performance. The timeline of this experiment is dependent on the source of fish, research priorities, and duration of acclimation prior to treatment.

Projected Completion Date and Deliverables

An annual report on the Artic grayling movement and habitat use project will be submitted by January 15, 2009. This report will detail the past and present information gathered on Arctic grayling movement and habitat use in the upper Big Hole River basin. The results of our PIT-tag experiments will also be included. We will pursue publishing at least one article based on this research in a peer-reviewed journal.

Evaluation of Habitat Restoration for the Conservation of Cutthroat Trout 2005-2008

Principal Investigator: Alexander V. Zale, Unit Leader, Montana Cooperative Fishery Research Unit
Faculty Consultant: Mark Taper, Quantitative Ecologist, Ecology Department, Montana State University
Graduate Student: Bradley B. Shepard, PhD student, Montana State University
Technicians: Jake Ferguson and Jacquelyn Jones, Montana State University

Background

The distributions and abundances of native westslope and Yellowstone (*Oncorhynchus clarkii lewisi* and *O. c. bouvieri*) cutthroat trout in the Northern Rocky Mountain region have declined from historical levels, and both subspecies are considered at risk for listing under the Endangered

Species Act. Efforts are currently underway to conserve these subspecies throughout the region. One important conservation strategy is that of habitat restoration and enhancement, but few studies have quantitatively assessed the responses of cutthroat trout populations following habitat restoration. In fact, few studies have described what constitutes ideal habitat for these subspecies, making restoration imprecise and unpredictable. In addition, competition and predation by non-native trout species, particularly brook trout that frequently occur in sympatry with both subspecies, is another major threat to their conservation. Interactions between brook and cutthroat trout are likely regulated by habitat condition, but little is known about these relationships.

Goal and Objectives

The goal of this project is to identify habitat conditions that will promote the continued persistence and conservation of westslope and Yellowstone cutthroat trout in the Northern Rocky Mountains through habitat restoration and enhancement projects. Specific objectives are: (1) to evaluate how habitat condition interacts with brook trout presence and abundance to affect the abundance and distribution of cutthroat trout, and (2) to evaluate the effect of presence of non-native fishes on success of cutthroat trout habitat restoration projects.

Progress to Date

We collected fish abundance data at 103 sample sections throughout Montana during 2005-2007 (Table 1). We now have a database with 1,078 sites that have been sampled from 1993 through 2007. Of these sites, about 240 have both fish population estimates and field habitat data collected at the site during at least one year. We have delineated catchment basins above all 1,078 sites using a geographic information system (GIS) and have derived estimates of numerous variables associated with these sample sites using various GIS layers (i.e., roads, land productivity, vegetation, etc.). We are now conducting statistical analyses of associations among these habitat variables and the presence and abundance of cutthroat and brook trout.

Table 1. Numbers of sections sampled by year, mean lengths of sampled sections (m), numbers of sections where field habitat surveys were completed, and total number of sections sampled by year by WFHI researchers from 2005 through 2007.

	Catch per Unit Effort		Estimates		Number of	Total sample
Year	Number	Mean L	Number	Mean L	Habitat Surveys	sections
2005	25	110	78	141	67	103
2006	9	108	58	124	27	67
2007	26	190	40	116	12	66

We have nearly completed analyses of studies that describe successful eradication of brook trout from 2.3 to 3.0-km reaches in three different streams and the response of cutthroat trout populations during and following the removal of brook trout. We found that standing crops (weight per stream surface area; g/m^2) of cutthroat trout 75 mm and longer will rebound to levels similar to levels of brook and cutthroat trout combined (Figure 1). This suggests that the niche that brook trout 75 mm and longer occupy is nearly identical to that occupied by similar-sized cutthroat trout, and that brook trout will displace cutthroat trout on a one-for-one basis. Another important finding from this research is that weight of brook trout at any given length is higher than cutthroat trout when the two species are together in sympatry, but that after removal of

brook trout weights of cutthroat trout by length increase until the population again reaches the carrying capacity of the habitat at which point the weight at length for cutthroat trout declines. This finding suggests that inter-specific competition between brook and cutthroat trout occurs with brook trout being more successful, and that after removal of brook trout, cutthroat trout at densities under habitat capacity weigh more at a given length until they reach the habitat's capacity. After cutthroat trout reach the habitat's capacity, their weight declines indicating that intra-specific competition is likely more intense than inter-specific competition (Figure 2). This finding supports much of the theoretical species-competition literature. The results for the other two streams were consistent with the example shown for Whites Creek.

Future Activities

We continue to analyze our data and will prepare at least three manuscripts for eventual publication. We are nearly ready to submit our first two manuscripts. The PhD dissertation of Brad Shepard will contain these two manuscripts as chapters, as well as two other chapters that will be submitted as publication manuscripts later. This PhD dissertation will be completed by December 31, 2008 and will be submitted to WFHI as our final report. We presented findings of a temperature analysis at the 2008 Montana Chapter AFS meeting and the WFHI was acknowledged in this presentation. We will be presenting additional results during the remainder of 2008 and through 2009. We will always acknowledge the support of the WFHI in all publications, the PhD dissertation, and presentations based on these data and analyses.

Projected Completion Date and Deliverables

This project will be completed by December 31, 2008. To meet contractual agreements, researchers will deliver a final report and manuscript, a CD containing the report and manuscripts, all the raw and summarized data, and GIS maps showing all sample sites along with GIS shapefiles and metadata for the sample sites, thermograph sites, and drainage polygons.

Figure 1. Standing crop estimates (g/m2) of westslope cutthroat and brook trout 75 mm and longer by year in sample sections within sections of a treatment reach in Whites Creek where brook trout were removed (EBT = brook trout; WCT = westslope cutthroat trout). Brook trout were successfully eradicated from this reach in 2000.

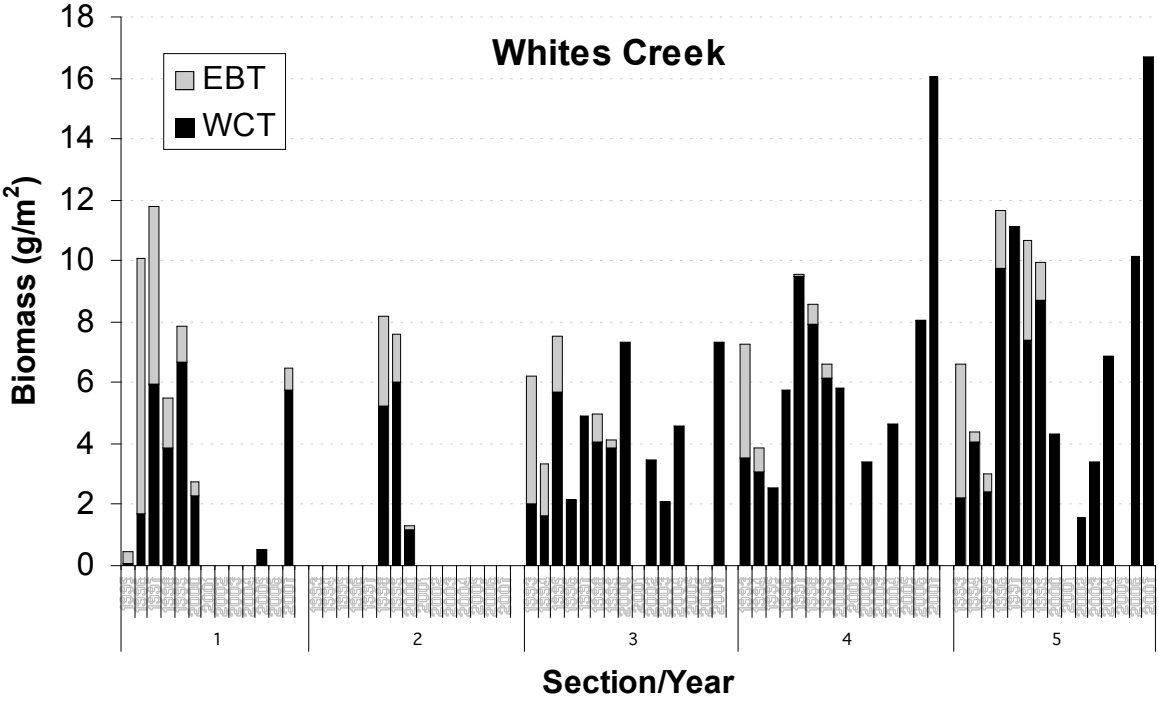
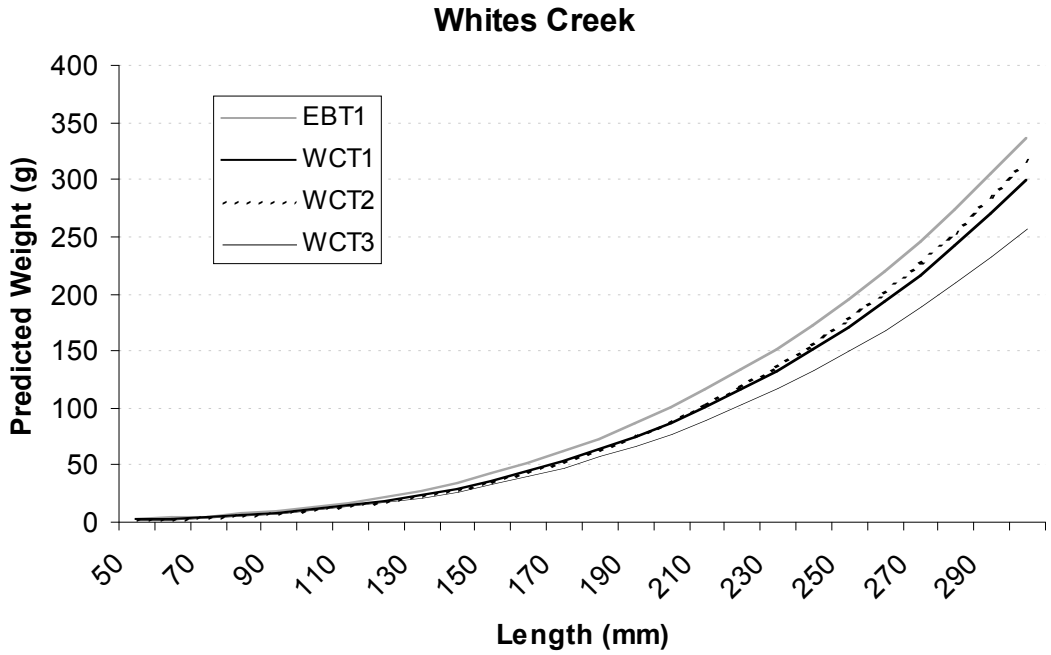


Figure 2. Length-weight relationships of cutthroat and brook trout prior to and following removal of brook trout. EBT1 = brook trout immediately prior to their removal; WCT1 = westslope cutthroat trout immediately prior to brook trout removal; WCT2 = westslope cutthroat trout immediately following initial brook trout removal effort when total population was below assumed carrying capacity; and WCT3 = westslope cutthroat trout at least two years following the successful eradication of brook trout after the total population had rebounded to assumed carrying capacity.



TECHNOLOGY TRANSFER / OUTREACH / TECHNICAL SUPPORT

Team Members:

Trey Kucherka, Aquatic Sciences Laboratory Manager
Dr. Thomas McMahon, Technical Advisor
Dr. Alexander Zale, Technical Advisor
Gretchen Rupp, Project Director

Background: In recent years, many techniques regarding stream restoration and fish habitat enhancement 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 in the field of stream/riparian restoration science, with an emphasis on recovery of wild fish populations. Information collected includes a database of more than 1,000 publications and manuals reporting techniques and research in the field of restoration science. We also have a collection of detailed case histories on outstanding stream restoration projects completed within the Intermountain West (Colorado, Idaho, Montana, Nevada, Utah, Wyoming, and inland areas of California, Oregon, and Washington) and more recently in Alaska. Our intent is to augment the success of the USFWS Partners Program and other restoration efforts by providing useful, highly-technical bibliographic and case history information through a web-accessible database (http://wildfish.montana.edu).

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 program personnel, private landowners, tribes, land managers, and fisheries 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 states, Alaska, and South Dakota. Projects selected: (1) are well-designed, based on investigation of the causes of degradation of fish habitat and/or stream hydrologic, geomorphic, and ecological processes, and (2) have an effectiveness monitoring component assessing the "success" of the restoration project.

Progress to Date:

Wild Fish Habitat Initiative Web Site: During this period we conducted no updates to the Initiative web site. The site currently includes: summaries and progress reports of all Initiative research projects, a collection of native fish habitat restoration case histories, a searchable bibliography related to fish habitat and restoration science, a selection of downloadable habitat restoration manuals, and links to pertinent online habitat restoration information. Also available are fact sheets related to: the definition of the term "restoration," "wild fish" versus "native fish,"

and a fact sheet providing information on common problems addressed in the field of stream and fish habitat restoration.

Since January 2006, use of the Initiative web site has been tracked on a quarterly basis. This past biennium, because of our declining support for the site, its visitation declined somewhat and the time spent by site users decreased (Table 2).

Table 2. General statistics for visitor sessions on the Wild Fish Habitat Initiative web site.

PERIOD	Visitor Sessions	Average Per Day	Average Session Duration (min)
January-June 2006	30,041	165	13
July-December 2006	30,355	165	14
January-June 2007	60,475	334	18
July-December 2007	43,574	236	21
January-June 2008	39,355	215	4

Online Resources: The Initiative online bibliography is a collation of information on fish habitat restoration techniques chosen to facilitate information exchange among fisheries biologists and project managers. There are 1075 references available in the bibliography, including several manuals of best practice for stream restoration. Links to outside organizations and resources can now be located by keyword; for example, the "Tools" category provides links to 16 computational techniques ranging from simple desktop approximation methods to three-dimensional transient-flow hydraulic models.

Fish Habitat Restoration Case Histories: The intent of the case histories compendium is to share information so that working restoration professionals can learn from previous native fish habitat restoration projects. Each case history description includes narrative descriptions, project goals, restoration methods, project costs, landowner contributions, photographs, and monitoring data. There is now detailed information from 49 projects. Three of these have minimal post-project monitoring data, and so are "archived." The documented projects took place in Montana, Wyoming, California, Oregon, Idaho, Colorado, Washington, Utah, Nevada, South Dakota and Alaska. No new case histories have been added since January.

During this period we continued work on an overview paper, based on the case histories, to draw general conclusions about the lessons that can be learned from these projects. This will be completed and submitted for publication, most likely in *Fisheries*, in the coming months.

Program Publicity and Outreach: These presentations were made during the period January-June, 2008:

Shepard, B. B., A. V. Zale, and M. L. Taper. 2008. Distribution and abundance patterns of cutthroat and brook trout: are headwater thermal refuges a myth? 41st Annual Meeting of the Montana Chapter American Fisheries Society. Billings, Montana, 12-15 February, 2008.

Brown, P. J., and A. V. Zale. 2008. Effects of fish size and stream characteristics on piscicide effectiveness. 41st Annual Meeting of the Montana Chapter American Fisheries Society. Billings, Montana, 12-15 February, 2008.

Ard, J. L., P. J. Brown, and A. V. Zale. 2008. Piscicide drip station placement efficiency. Poster presented at the 41st Annual Meeting of the Montana Chapter American Fisheries Society. Billings, Montana, 12-15 February, 2008.

Vatland, S. and R. Gresswell. 2008. Short-term mortality from PIT-tagging of fluvial Arctic grayling. 41st Annual Meeting of the Montana Chapter American Fisheries Society. Billings, Montana, 12-15 February, 2008.

One article based on Initiative research was published in the peer-reviewed literature:

McMahon, T., E. Bear and A. Zale. 2008. Use of an annular chamber for testing thermal preference of cutthroat trout and rainbow trout. *Journal of Freshwater Ecology* 23(1): 55-63.

Cutthroat DVD Distribution: In early 2007 the Western Division of the American Fisheries Society produced the documentary film *Rising from the Shadows: the Return of the Cutthroat Trout.* This documentary was produced by filmmakers at Montana State University, with the support of several American Fisheries Society chapters, state fish and wildlife agencies, and federal resource management agencies. During the first half of 2008 we continued to distribute DVDs of the film on request.

LABORATORY AND TECHNICAL SUPPORT

A major focus of the Aquatic Sciences Laboratory is its involvement in Initiative research projects. Peter Brown, a doctoral student with Al Zale, uses lab facilities for his project *Evaluation of the efficiency and efficacy of non-native fish eradication and exclusion techniques for native fish restoration.* Under full operating study conditions he uses two 64-tank recirculating systems, as well as two specially designed experimental systems housed at the lab. Both the Lab Manager and the Water Center Director have assisted Peter in technical issues related to laboratory equipment operation and with guidance on assessing how photolysis, hydrolysis, complexation, diffusion, and dispersion might determine the behavior of piscicides in natural streams.

The Lab Manager has partnered with the Western Transportation Institute (WTI) to pursue funding for research projects related to stream passage design and for toxicology studies to analyze the effects of road deicers on trout. They have planned two projects: one analyzing the impacts road deicers have on water quality in local water bodies; the other an LC50 toxicity study of common deicers on rainbow and cutthroat trout species at various life stages. Neither study currently has funding support.

PLANS FOR JULY-DECEMBER 2008

With minimal funding remaining, Initiative personnel will focus on a small number of activities during the last six months of the program:

- The piscicide efficacy study will continue, and will conclude at the end of the year
- The study of native cutthroat trout conservation is also scheduled to finish at the end of 2008
- The examination of fluvial Arctic grayling range and habitat will continue
- The synthesis paper of lessons learned from past habitat projects will be completed and submitted for journal publication
- The *Rising From the Shadows* DVD will be distributed on demand
- As resources allow, more references and habitat-restoration manuals will be added to the online bibliography.

PROGRAM PERSONNEL

Dr. Alexander Zale is the Principal Investigator for the Wild Fish Habitat Initiative. He is the Cooperative Fishery Research Unit Leader for Montana and a Professor in the Department of Ecology at Montana State University. Dr. Zale's research interests center on applied aquatic ecology and fisheries management.

Dr. Robert Gresswell is a Research Biologist at the USGS Northern Rocky Mountain Research Center in Bozeman, Montana. He is a fisheries ecologist specializing in salmonids of the Greater Yellowstone Ecosystem.

Dr. Mark Taper is an Associate Professor in the Ecology Department at Montana State University, specializing in ecological statistics and conservation biology.

Gretchen Rupp is an engineer and biologist who serves as Director of the Montana University System Water Center at Montana State University, and Project Manager of this initiative.

Trey Kucherka is the Aquatic Sciences Laboratory Manager who functions as the fisheries biology advisor to the other departments within the Montana Water Center, providing technical support and research assistance to many Initiative research teams. Trey has a BS degree in Biology (Marine emphasis) and a Master's degree in Mariculture.

Peter Brown is a PhD student with the Montana Cooperative Fishery Research Unit at MSU. He is working with Dr. Zale on the Eradication and Exclusion Project.

Brad Shepard is a PhD student at MSU and a cutthroat trout specialist with the Montana Department of Fish, Wildlife and Parks. He is working with Dr's Zale and Taper on the Cutthroat Habitat Restoration Evaluation.

Shane Vatland is a PhD student at MSU working with Dr's Zale and Gresswell on the Arctic grayling project.