

TECHNICAL WORKPLAN

WILD FISH HABITAT INITIATIVE PHASE IV

October 1, 2005 – December 31, 2006

submitted by:
Montana Water Center
Montana State University - Bozeman

submitted to:
Division of Fish and Wildlife Management Assistance
US Fish and Wildlife Service



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WILD FISH HABITAT INITIATIVE

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INTRODUCTION

Wild Fish Habitat Initiative Background & Purpose

Degradation of fish habitat is one of the principal reasons for the listing of wild fish under the Endangered Species Act. In addition, the detrimental effects of exotic competitors and diseases such as whirling disease are exacerbated by habitat degradation. 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 (hereafter referred to as the Initiative or WFHI) 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 Initiative seeks 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.

Phase IV of the WFHI will build on the successes of previous program phases by continuing to pursue relevant research investigations and by continuing to refine our ongoing information-transfer project. Three research projects are continuing and one new research project will be initiated. Activities for each of the Phase IV actions and projects are outlined in the subsequent sections of this report.

PROGRAM 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, Assistant Director for Research, Montana Water Center; WFHI Program Director

Goal 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 the four 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 conduct outreach activities and publicize Initiative projects, research results, and program deliverables to interested parties.

Activities

During the period of October 1, 2005 to December 31, 2006, Montana Water Center administrative personnel will manage the annual USFWS contract and all research subcontracts; process invoices and track the fiscal status of each project; submit progress reports to the USFWS; submit a single compiled final project report to the USFWS; respond to USFWS requests for information or assistance; and support the research teams in acquiring information, supplies and facilities, in contractual or hiring matters, and in other ways as needed.

Milestones

Administrative milestones are shown in *Table 1*. All administrative duties are the responsibility of Montana Water Center staff—namely, the Assistant Director for Research—in consultation with the Principal Investigator, Dr. Alexander Zale. Major duties involve developing an annual Initiative contract and budget, maintaining communication with the USFWS, and submitting detailed reports on outreach activities, research investigations, and financial actions of the Initiative.

Deliverables

Deliverables for program administration as a whole are regular communication and updates to Division Chief Hannibal Bolton, two program progress reports per year, regular invoices and financial reports to the USFWS, and a compiled final project report.

TECHNOLOGY TRANSFER / TECHNICAL SUPPORT / PROGRAM OUTREACH

Technology Transfer Project

Project Team Members

Liz Galli-Noble, Program Director, Montana Water Center

Molly Boucher, Web site specialist, Montana Water Center

TBA, Program Biologist/Wild Trout Lab Manager, Montana Water Center

Kristin Keith, Case history researcher and technical writer, Montana Water Center

Anne Martell, Administrative assistant/research assistant, Montana Water Center

Introduction and Scope

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 technology transfer project—a continuing effort of the Initiative—is collating information on methods and results of various fish habitat restoration projects within the Intermountain West (Colorado, Idaho, Montana, Nevada, Utah, Wyoming, and inland areas of California, Oregon, and Washington) and in Alaska, South Dakota, and possibly in an additional complementary region. Information is organized in a searchable bibliography and case history database, which is accessible through the Initiative web site at: <http://wildfish.montana.edu/>. Web site products are being continuously updated and revised as new restoration project information is made available, and/or as monitoring data are collected and shared with project staff.

Goal and Objectives

The overall project goal of the technology transfer project is to provide useful bibliographic and case history data to those responsible for native fish habitat projects within the Partners Program and other interested parties.

Specific objectives for Phase IV of the project are:

- (1) To continue to maintain a positive and productive collaboration between the Montana Water Center and our many project partners: the Partners Program, Montana State University, Initiative research teams, tribes, private landowners, land managers, and a multitude of state and federal agencies.
- (2) To implement review-panel recommendations for our online fish habitat literature bibliography, and continue to update the bibliography with timely, pertinent literature.
- (3) To implement review-panel recommendations for our online habitat restoration manuals clearinghouse, and continue to update and maintain that resource.
- (4) To implement review-panel recommendations for our online case history database of fish habitat restoration projects, continue to update the restoration projects showcased, and expand our case histories database geographic range to include projects conducted in Alaska, South Dakota, and possibly another complementary region.

- (5) To actively publicize web site features and products, and enhance information exchange among Partners Program personnel, tribes, land managers, fishery professionals, private landowners, university students, and other interested parties.

Activities

Four general types of technology transfer activities will be carried out in Phase IV of the project. First, Montana Water Center staff will continue to enhance our outreach efforts. We will work to broaden our communication base with Partners Program personnel, regional fisheries biologists, landowners, tribes, and habitat specialists; we will continue to solicit feedback on our accomplishments and products; we will explore more effective ways in which the Initiative web site can address our partners' and audience's needs; and we will vigorously publicize the web site and its products.

Second, we will continue to collect new and innovative restoration project information. The team will focus on filling information data gaps and provide follow-up monitoring data collected for projects already showcased on the web site. When warranted, we will seek new information or follow-up data through remote access or site visits. We will also expand our geographic focus to include projects conducted in Alaska and South Dakota, and we are considering expanding our coverage of restoration projects to include an additional geographic region. Candidate regions include: coastal areas in the western states, all of the Missouri Basin states, and the Midwestern states.

Third, team members will expand resource information availability on the Initiative web site. Several target actions for this project phase include: establishing an expertise directory; adding a search engine to the case histories database and the bibliography; adding links to other pertinent technical and non-technical conservation web sites; adding a feedback mechanism for web site visitors; restructuring the categories used for the case histories database; and developing a section within the case histories database documenting common problems in restoration project development and application.

Finally, we will continue, in Phase IV, to implement recommendations made by our web site review panel (see *Attachment H* for details of that process and recommendations made). We will use this initial review as a template to formally evaluate the program on a regular basis in the future.

Milestones

Existing Web Site Products—Most technology transfer project products are ongoing efforts that will continue to be updated and refined for years to come.

New Project Needs/Opportunities—Montana Water Center staff strive to be responsive to newly identified needs of our research and resource partners. We realized that our national audience was expanding at a fairly rapid rate when in June 2005 we were asked to share our case histories database with the International Association of Fish and Wildlife Agencies, National Fish Habitat Initiative. The Water Center was complimented on the thoroughness and technical

soundness of our product, which will be incorporated into the national habitat restoration effort in the near future.

Outreach and Program Publicity—Liz Galli-Noble and Kristin Keith will actively publicize the web site through media contact, partner correspondence, and professional outreach presentations. Molly Boucher will continue to publicize the site through online means, including linking and search engine ranking.

Montana Water Center staff are planning to attend several professional meetings in 2005/2006 to make contacts and present Initiative work products. A couple meetings already scheduled for 2005 include: (1) American Fisheries Society 135th Annual Meeting; Anchorage Alaska; September 11-15, 2005; and (2) 22nd Annual Meeting of the Montana Section of the American Water Resources Association; Bozeman, Montana; October 27-28, 2005.

We welcome additional suggestions for outreach opportunities from our project partners.

Deliverables

Deliverables for this project include: a continuously updated web-based bibliography of fish habitat literature; a continuously updated compilation of habitat restoration manuals (in PDF-format) applicable to our project areas; and continuously refined web-based case studies of completed habitat restoration projects. Case histories of various types of fish habitat restoration projects include narrative descriptions, data tables, photographs, engineering diagrams, and project cost information, insofar as this information can be collected for each case.

Potential Partners

Project information will be collected from, and disseminated to, a number of sources, including: university researchers, state fish and wildlife biologists, Federal agency personnel, tribes, private landowners, and fishery biologists employed by private and non-profit organizations in the region.

Technical Research Assistance & Support

Laboratory Staff

TBA, Wild Trout Laboratory Manager, Montana Water Center

Eve Davey, Lab Technician, Montana Water Center

Tim Helwick, Lab Technician, Montana Water Center

Since the inception of the Initiative in 2002, Montana Water Center Wild Trout Research Laboratory staff have provided technical support and research assistance to many WFHI research teams, as well as Montana state and federal fisheries agencies. This collaboration will continue into Phase IV of the Initiative with the laboratory manager and the lab technicians assisting researchers with the following tasks:

1. Experimental apparatus design, development, maintenance, and use.
2. Graduate student husbandry assistance.
3. Disease identification assistance.
4. Disease treatment support.
5. Graduate student data collection assistance.

6. Emergency on-call support.
7. Graduate student technician support.

In addition to laboratory duties, the lab manager also functions as the fisheries biology advisor for other departments within the Montana Water Center, working very closely with the Technology Transfer team.

At present (June/July 2005), the Montana Water Center is in the process of hiring a new laboratory manager. It is our intent to have the position filled no later than September 1, 2005.

Wild Trout Laboratory Renovation Project—The need for a more flexible and functional research lab, one that could accommodate a broader range of fisheries-based research investigations, has been contemplated by the Water Center and MSU researchers for several years. Consequently, in fall 2004, the Water Center began to plan for the renovation of the lab. The initial plan was to add the capability of conducting multiple-temperature projects within one system, which would have allowed for native trout thermal studies to be conducted in the lab. However, after eight months of engineering and building plan development, the initial plan was scrapped because of the prohibitively high costs associated with the thermal study component. As of June 2005, a simpler and much less expensive plan is being pursued for the lab renovation. Presently, a revised plan has been developed and the project is slated to start in fall or winter 2005. The lab renovation project is projected to be completed by the 2006 experimental season. In the meantime, two research teams (one WFHI team and one Montana Fish Wildlife and Parks team) will be able to use the lab while renovations are being completed.

PHASE IV RESEARCH PROJECTS

Project 1. Evaluation of Entrainment Losses of Westslope Cutthroat Trout at Private Irrigation Diversions on Skalkaho Creek, Montana

Part I of this project was completed in mid-2005 (Phase III of the Initiative). This follow-up study builds on the results and subsequent questions raised by the initial investigation.

Principal Investigator: Alexander V. Zale, Montana Cooperative Fishery Research Unit

Partner: Christopher G. Clancy, Montana Fish, Wildlife and Parks

Graduate Research Assistant: Ryan Harnish, MS student, Montana State University

Introduction and Scope

Seven lowhead irrigation dams on Skalkaho Creek, a tributary to the Bitterroot River in western Montana, divert significant numbers of downstream migrant fluvial westslope cutthroat trout into eight irrigation canals. Both post-spawn adults migrating back to the Bitterroot River and juveniles emigrating downstream from nursery areas in upper Skalkaho Creek become trapped and die in the irrigation canal system. Private landowners and irrigators in the drainage expressed concern over the number of fish killed annually in the irrigation system and worked

with Montana Fish, Wildlife and Parks to successfully request funds from the Fish Restoration and Irrigation Mitigation Act program to install fish screens and siphons at some of the diversions to preclude such losses. The screens were installed in 2003 and became operational in April 2004. Installation of the siphons is projected for 2005 or 2006. Our goal is to estimate entrainment losses of migratory, non-anadromous westslope cutthroat trout at irrigation canals with and without fish screens. No such evaluations had been conducted and published in the peer-reviewed literature to date, thereby inhibiting private landowners and agencies throughout the Northern Rockies from investing in fish screens and siphons as part of their fish habitat management and restoration efforts.

The first phase of our study involved estimation of fish losses during 2003 prior to installation of the screens. We saw significant entrainment, particularly of age-0 juveniles, at the unscreened diversions. During the second phase of this study, after installation of screens at three diversions, entrainment of both age-0 juveniles and adults was high at unscreened diversions but negligible or absent at screened diversions. However, emigration of juveniles to the Bitterroot River did not appear to be enhanced by the screens as much as anticipated, apparently because the migratory life-history component in Skalkaho Creek has been selected against for over a century. Most downstream migrating juveniles moved only a short distance downstream within the creek. Perhaps they became creek residents or emigrated to the Bitterroot River at other times. We also evaluated the efficacy of the screens to determine how quickly and efficiently they returned entrained fish to the creek, but our results were inconclusive because some fish unexpectedly swam back out of the irrigation canals through the headgates and thereby evaded detection.

Goal and Objectives

Our goal is to evaluate the efficacy of irrigation diversion fish-screen and siphon structures in western Montana in preventing entrainment of fluvial inland salmonids. Our specific objectives in Phase IV are to: (1) evaluate the efficacy of the screens using an improved study design that incorporates detection of fish moving upstream through the headgates, (2) assess the importance of canal screens to the recruitment contribution of westslope cutthroat trout to the Bitterroot River, and (3) begin evaluating the efficacy of the forthcoming siphons.

Activities

Screw traps will be deployed above and below the diversions in Skalkaho Creek to estimate abundance of the emigrating juvenile westslope cutthroat trout cohort and its recruitment contribution to the Bitterroot River. Trap nets will be deployed in all of the irrigation canals to estimate entrainment.

Selected downstream-migrant age-1 juvenile cutthroat trout captured in the upper screw trap will be fitted with radio-telemetry transmitters. Their locations and movements will be monitored several times per week to determine their success in bypassing the irrigation diversions during their downstream migrations to the Bitterroot River. The final fate of each individual will be determined (i.e., in-river mortality, canal entrainment and mortality, in-river residence, or successful emigration).

The efficiency of the fish-screen structures in returning entrained fish to the river will be evaluated by implanting age-0 juveniles captured in the upstream screw trap with passive

integrated transponder (PIT) tags. PIT-tag readers affixed to screen bypass pipes and headgates will record entrainment and return of each individual to the river and thereby allow estimation of screen-induced migration delays and emigration pathways.

Milestones

Field work will begin in April 2006 and continue through the irrigation season until autumn. Analyses and a final report will be completed by December 31, 2006.

Deliverables

A detailed final report describing the methods, findings, and management implications of the study will be produced. A manuscript will be submitted for publication in a peer-reviewed journal. Results will also be presented at scientific meetings.

Partners

The study is being conducted in close cooperation with Montana Fish, Wildlife and Parks, local irrigation companies, and local landowners.

Project 2. Evaluation of the Efficiency and Efficacy of Piscicides for use in Non-Native Fish Eradication

This project commenced in Phase II of the Initiative and is continuing into Phase IV.

Principal Investigator: Alexander V. Zale, Montana Cooperative Fishery Research Unit

Graduate Research Assistant: Peter J. Brown, PhD student, Montana State University

Introduction and Scope

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 and hybridization reduces their overall genetic integrity. Fishery restoration projects have been undertaken throughout the United States in an effort to conserve threatened and endangered species and to rid water bodies of non-native species. These projects typically use fish toxicants (piscicides) to eradicate non-native fish species. Despite the widespread use of piscicides as a management tool, little standardization of application techniques exists among restoration projects. Piscicides can also be affected by several environmental conditions such as water pH, UV radiation, and stream gradient. Whereas these environmental factors may alter the toxicity of the piscicide to fish and potentially lead to incomplete fish eradication, they have not been investigated experimentally and have been mentioned only anecdotally in the literature. Further, recommendations to maintain piscicide toxicity at different levels of these environmental conditions have not been developed. Understanding the dynamics of fish toxicants is critical in making restoration projects an effective tool to manage native fish.

Goal and Objectives

The goal of this project is to increase the success rate of native fish restoration projects through improved non-native fish eradication techniques. To achieve this goal, we will investigate the conditions that degrade the toxicity of piscicides. Three broad objectives have been set: (1) to

determine the relationship between piscicide toxicity and turbulence, ultraviolet light, and organic matter, (2) to determine the duration of piscicide toxicity when exposed to characteristics of natural streams, and (3) to develop models to predict the probability of target species eradication using piscicides. Subsequent field and laboratory research will investigate the relationships between piscicide toxicity and environmental conditions. Understanding these relationships will increase the overall effectiveness of non-native fish eradication projects.

Activities

Laboratory experiments to meet the first objective are being conducted at the Wild Trout Research Laboratory on the Montana State University campus during the summer and fall of 2005 under Phase III. We are exposing piscicide-treated water to each of the three environmental characteristics (turbulence, ultraviolet light, and organic matter) and measuring the toxicity of the piscicide-treated water directly by fish bioassay.

Activities to meet the second objective will be carried out during the summer of 2006 under Phase IV in natural stream settings. Sites of planned restoration projects will be treated with a single application of piscicide and the duration of toxicity will be measured using sentinel fish. The characteristics of the stream will be compared to the duration of piscicide effectiveness to determine which factors contribute to the detoxification of piscicides. Models will be developed using these comparisons to predict the duration of piscicide toxicity based on stream characteristics.

Activities to meet the third objective will be carried out during the spring and summer of 2007 in streams where restoration projects are planned. By measuring the physical characteristics of potential restoration streams, and applying models that predict piscicide toxicity, we will predict the probability of complete non-native fish eradication in streams. These probabilities will be tested during the subsequent eradication projects to determine the validity of the models.

Milestones

The graduate student's study proposal was completed in June 2005. Laboratory experiments will be completed by December 2005. Field sampling will be carried out from May 2006 through September 2007.

Deliverables

A detailed final report describing the methods, findings, and management implications of the study will be produced. A manuscript will be submitted for publication in a peer-reviewed journal. Results will also be presented at scientific meetings.

Partners

Critical to this study will be relationships with native-fish managers from several agencies. Relationships with Brad Shepard (Montana Fish, Wildlife and Parks), Carter Kruse (Turner Enterprises), Hilda Sexauer (Wyoming Game and Fish), Chad Mellison (US Fish and Wildlife Service), Jim Olsen (Montana Fish, Wildlife and Parks), and Todd Koel (Yellowstone National Park) are being developed.

Project 3. Evaluation of Habitat Restoration for the Conservation of Cutthroat Trout

This project commenced in Phase III of the Initiative and is continuing into Phase IV.

Principal Investigator: Alexander V. Zale, Montana Cooperative Fishery Research Unit

Graduate Research Assistant: Brad Shepard, PhD student, Montana State University

Co-Principal Investigator: Mark Taper, Department of Ecology, Montana State University

Introduction and Scope

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 therefore 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.

The first year of our study under Phase III includes (1) description of what constitutes high-quality habitat for westslope and Yellowstone cutthroat trout in central Montana, and (2) determination of how habitat condition and the presence of brook trout interact to reduce densities of cutthroat trout. To date, we have compiled a database with species presence data for brook and cutthroat trout throughout the range of cutthroat trout in collaboration with the USDA Forest Service Rocky Mountain Station and Beaverhead-Deerlodge Forest. It contains over 4,500 sites in Montana and Idaho. We have also compiled another database that consists of systematic samples conducted at intervals of from 1 to 3 kilometers in almost all tributaries within seven major basins in Montana. This second database includes fish abundance information (catch per unit effort) for each site and a subset of this database includes detailed habitat survey data. All information in these two databases is geo-referenced within a geographic information system (GIS) and we will be using GIS layers to derive estimates of many of the physical attributes we will be testing. We used ArcView to delineate watersheds above many of these sample sites for overlaying other GIS layers to derive these estimates. We have contacted Montana Fish, Wildlife and Parks, the US Forest Service, and BLM fisheries biologists to locate sites where fish habitat and stream restoration projects have occurred, or are planned, and are currently developing a sampling program for sampling habitats and fish populations within these sites. We have completed some baseline sampling at some of these sites.

Under Phase IV, we will evaluate past and on-going habitat restoration and enhancement projects that specifically targeted conservation of cutthroat trout to assess whether these projects resulted in increased densities or distributions of cutthroat trout.

Goal and Objectives

Our goal 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. Our 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.

Activities

Fish population abundances and habitat variables will be estimated at numerous sample sites throughout western Montana during summer 2006, specifically where habitat restoration projects have been conducted or are planned, to evaluate the effectiveness of habitat restoration projects on the conservation of cutthroat trout. We will focus on habitat restoration projects that targeted cutthroat trout populations and for which pre-project population estimates exist. In addition, we will collect pre-treatment estimates at sites where habitat restoration is proposed. Pre- and post-restoration estimates will be compared to habitat parameters that were changed by each habitat restoration project. Previous work we have done suggests that increased frequencies of woody debris may favor brook trout over westslope cutthroat trout; we will further test this hypothesis.

Milestones

Field work began in June 2005 (under Phase III) and will continue during summer 2006 under Phase IV. Analyses and a final report will be completed by December 31, 2006.

Deliverables

A detailed final report describing the methods, findings, and management implications of the study will be produced. At least one manuscript based on this study will be submitted for publication in a peer-reviewed journal. Results will also be presented at scientific meetings.

Partners

The study is being conducted in close cooperation with Montana Fish, Wildlife and Parks, the US Forest Service, the US Bureau of Land Management, and local landowners.

Project 4. Effects of Coalbed Methane Development on Great Plains Fish Assemblages

This project is starting in Phase IV of the Initiative.

Principal Investigator: Alexander V. Zale, Montana Cooperative Fishery Research Unit

Graduate Research Assistant: Windy N. Davis, MS student, Montana State University

Co-Principal Investigator: Robert G. Bramblett, Department of Ecology, Montana State University

Introduction and Scope

The recent development of coalbed methane resources has created a need for scientifically sound information by agency, tribal, and industry resource managers in Montana and Wyoming regarding its potential effects on affected environments. Because coalbed methane development involves production and disposal of coalbed groundwater often characterized by high concentrations of dissolved ions, elevated sodium adsorption ratios, and high electrical conductivity, as well as surface environment modifications (roads, pipelines), the potential exists for substantial effects on aquatic environments and fauna. Little research has been conducted on the effects of coalbed methane development on fish assemblages, and no research has compared effects resulting from different product-water management strategies (e.g., direct discharge, treatment, disposal in evaporation ponds, re-injection).

Goal and Objectives

Our goal is to better understand the influence of coalbed methane development on the aquatic biota and habitats of southeast Montana and northeast Wyoming. Our specific objective is to determine the effect of coalbed methane development on intermittent prairie stream fish assemblages.

Activities

The research process will include five complementary approaches:

1. Treatment versus control streams. We will compare fish assemblages in streams with coalbed methane development to those in streams without development. Comparison will only be made where appropriate, for example, in similar sized streams with similar expected physical and biological conditions. Samples will be collected by seining according to Montana Prairie Riparian Native Species Study protocols.
2. Upstream versus downstream comparisons. We will compare fish assemblages in areas upstream of development to those in areas downstream of development within the same stream. In the absence of effects, the expected condition is for fish species richness to stay the same or increase in downstream areas. Reductions in species richness at downstream sites would suggest deleterious effects.
3. Pre-development versus post-development samples. If we identify areas that are as yet without development, but will soon be developed, we will sample them before and after development to monitor fish assemblage changes, if any. We will also compare existing fish

assemblage data from streams sampled in the early 1990s (prior to development) to samples that will be taken at the same locations in 2004 and 2005. We will sample both in streams with development and in streams without development to assess if any observed changes are attributable to development or to unrelated temporal trends.

4. Sampling product water streams. Some formerly ephemeral streams now flow perennially as a result of product water discharge. We will sample these streams to determine which, if any, fishes occupy these unique habitats.
5. In-situ acute toxicity testing. We will test the acute toxicity of stream water in areas of development using wild-caught fish held in sentinel cages. This approach will complement observations of fish distributions made during treatment versus control and upstream versus downstream surveys. If for example, fish are present in areas without development, but absent in areas with development, we will capture fish in the area without development and place them in cages in the area with development to test for acute toxicity. We will also place fish in cages in areas without development to control for effects of capturing and caging fish.

Milestones

Field work began in summer 2005 with funding from BLM and will continue during summer 2006 under Phase IV. Analyses and a final report will be completed by December 31, 2006.

Deliverables

A detailed final report describing the methods, findings, and management implications of the study will be produced. At least one manuscript based on this study will be submitted for publication in a peer-reviewed journal. Results will also be presented at scientific meetings.

Partners

Partners include Montana Fish, Wildlife and Parks, Montana Department of Environmental Quality, US Bureau of Land Management, US Environmental Protection Agency, US Fish and Wildlife Service, Wyoming Fish and Game, US Forest Service, and the coalbed methane industry.

Project Personnel

Dr. Alexander Zale will serve as Wild Fish Habitat Initiative principal investigator. 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 principal investigator of all four of the Phase IV research investigations. Dr. Zale's research interests center on applied aquatic ecology and fisheries management. A brief curriculum vita for Dr. Zale accompanies this proposal (*Attachment I*).

Dr. Thomas McMahon will serve as 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.

Liz Galli-Noble is the Assistant Director for Research at the Montana Water Center, and serves as the Wild Fish Habitat Initiative program director. She has a Bachelor's degree from the University of Montana and a Master's degree from the Yale University School of Forestry and Environmental Studies. Her chief professional interests are landscape ecology and watershed management, and she has more than 20 years of experience in the natural resource management field—nationally and internationally. A brief curriculum vita for Ms. Galli-Noble accompanies this proposal (*Attachment J*).

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

Kristin Keith is the case history researcher and technical writer for the Wild Fish Habitat Initiative. She has a Bachelor of Science degree in Biology and a Master's degree in Soil Science with an emphasis in water quality.

Anne Martell is the administrative assistant for the Wild Fish Habitat Initiative. She has a Bachelor of Arts degree in Elementary Education from MSU. Before coming to the Water Center Anne worked extensively for the US Forest Service and other departments at MSU.

The Wild Trout Laboratory Manager is a member of the Technology Transfer project and functions as the fisheries biology advisor to the other departments within the Montana Water Center. The Manager also provides technical support and research assistance to many Initiative research teams, as well as Montana state and federal fisheries agencies.

Eve Davey is the Trout Lab Technician. She has a Bachelor of Arts degree in English from Vassar College and a Master's degree in English from the University of Iowa. Currently Eve is pursuing a Bachelor of Science degree in Wildlife Management at MSU.

Tim Helwick is the Trout Lab Technician. He is currently a senior in Fish and Wildlife Management at MSU. His lab duties include maintenance of the tanks and filtration system and daily feeding and treatment of the fish.

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.

Brad Shepard is a PhD student at Montana State University and a fisheries biologist with the Montana Department of Fish Wildlife and Parks. He is working with Dr. Alexander Zale and Dr. Mark Taper on the Habitat Restoration project.

Ryan A. Harnish 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.

Windy N. Davis is a Graduate Research Assistant with the Montana Cooperative Fishery Research Unit at Montana State University. She is working with Dr. Zale on the Coalbed Methane Development project.

Table 1. Phase IV Milestones—October 1, 2005 to December 31, 2006.

Project / Task	Deliverables / Outputs	2005	2006			
		4	1	2	3	4
I. Program Administration						
Provide administrative & management services	USFWS-MSU Contract—Work plan & budget Communication w/USFWS Managing subcontracts Maintain financial records Reporting: Semi-annual report Final report Manage WFHI staff & maintain office	X On going On going On going On going On going	X X X X X X	X X X X X X	X X X X X X	X X X X X X
Research project management & technical oversight	Meetings with PIs Communication w/research teams Reporting: Web site project updates Briefings	On going On going On going On going	X X X X	X X X X	X X X X	X X X X
II. Technology Transfer Project						
Update & maintain web site	Web site maintenance Implement panel recommendations	On going X	X X	X X	X X	X X
Update & maintain bibliography	Bibliography updates Export/add references Establish expertise dictionary	On going X X	X X	X X	X X	X X
Showcase habitat manuals	Manual updates	On going	X	X	X	X
Research & showcase case histories	Make project contacts Case history updates Site visits	On going On going X	X X X	X X X	X X X	X X X
Outreach / project promotion	Presentations Publicity, media contact Correspondence	2 On going On going	1 X X	1 X X	1 X X	1 X X
III. Technical Research Assistance						
Assistance to WFHI research teams	Student research assistance Student technical support Disease ID & treatment	On going On going On going	X X X	X X X	X X X	X X X
IV. Wild Trout Lab Renovation	Revised engineering (system & facilities design) Interior renovation: electrical installation, construction, installation of tanks, etc. Setting up new research projects	X X	 X	 X	 X	 X

Table 1 continued

Project / Task	Deliverables / Outputs	2005	2006			
		4	1	2	3	4
V. Research Projects						
Project 1. Entrainment Losses of Westslope Cutthroat Trout at Private Irrigation Diversions						
Project set up and preliminary research		X				
Field work (deploy screw traps & trap nets, implant radio-telemetry transmitters, monitor)				X	X	
Data analyses & reporting	Final report				X	
					X	
Project 2. Evaluation of the Efficiency & Efficacy of Piscicides for use in Non-Native Fish Eradication						
Lab experiments (determine relationship between piscicide toxicity and turbulence ultraviolet light, and organic matter)		X	X			
Barrier Design Manual		X				
Field work (determine duration of piscicide toxicity and environmental conditions)				X	X	
Data analyses, develop models, & reporting	Interim report				X	
					X	
Project 3. Evaluation of Habitat Restoration for the Conservation of Cutthroat Trout						
Analyses of 2005 data		X	X			
Field work				X	X	
Data analyses and reporting	Final report				X	
					X	
Project 4. Effects of Coalbed Methane Development on Great Plains Fish Assemblages						
Project set up and preliminary research		X	X			
Field work				X	X	
Data analyses and reporting	Final report				X	
					X	

ATTACHMENTS

- Attachment A. Phase IV Program Budget**
- Attachment B. Budget Justification**
- Attachment C. Budget: Program Administration and Technology Transfer Project**
- Attachment D. Research Project Budget: Evaluation of Entrainment Losses of Westslope Cutthroat Trout at Private Irrigation Diversions on Skalkaho Creek, Montana**
- Attachment E. Research Project Budget: Evaluation of the Efficiency and Efficacy of Piscicides for Use in Non-Native Fish Eradication**
- Attachment F. Research Project Budget: Evaluation of Habitat Restoration for Conservation of Cutthroat Trout**
- Attachment G. Research Project Budget: Effects of Coalbed Methane Development on Great Plains Fish Assemblages**
- Attachment H. Panel Review of Wild Fish Habitat Initiative Web Site**
- Attachment I. Dr. Alexander V. Zale's Curriculum Vita**
- Attachment J. Elizabeth Galli-Noble's Curriculum Vita**