WILD FISH HABITAT INITIATIVE

SEMIANNUAL REPORT

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Submitted by:
Montana Water Center
Montana State University – Bozeman

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Background

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

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

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

Graduate Student: Steve Gale
Principal Investigators: Al Zale and Tom McMahon
Collaborator: Christopher G. Clancy
Montana Department of Fish, Wildlife and Parks

Background

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

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

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

Objectives

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

Progress to Date

During the 2003 field season, assessments of entrainment rates of adult, juvenile, and age-0 westslope cutthroat trout are being conducted at seven irrigation ditches. To do this, 30 adults and 50 juvenile fish are being radio-tagged and followed throughout their migrations to determine whether they become entrained as they pass ditch entrances. Stationary trap nets are used in the ditches to capture age-0 fish that have already been entrained.

Adults: Electrofishing for spawning adult westslope cutthroat trout began on May 19, 2003. Five fish were captured and tagged below various diversion dams before high water made electrofishing difficult and dangerous. These fish were thought to be fluvial fish from the Bitterroot River moving upstream to spawn. Twenty-five fish were captured and tagged on spawning grounds located sporadically above the highest diversion dam. We implanted tags only in fish longer than 350 mm because most resident fish do not reach this length. As of July 1, 2003, 30 adult westslope cutthroat trout were implanted with radio transmitters. All fish will be located at least twice per week for the remainder of the field season. Entrainment of adults in the ditches has not been observed.

Age-0: Stationary trap nets are being deployed weekly at seven ditches and two sites along Skalkaho Creek to assess age-0 westslope cutthroat entrainment. Nets are set in the morning, checked in the evening, reset that evening, and then checked again the following morning. Trapping started the first week of July and will continue through the remainder of the field season. Findings to date suggest that small fish are moving downstream and become entrained during the night.

Future Activities

Radio transmitters will be implanted in 50 juvenile westslope cutthroat trout at the end of August 2003. Transmitters will be used to track migration and possible entrainment rates of these fish. Tagged fish that successfully migrate to the Bitterroot River will be tracked to locate their winter habitat. Trapping will be used to estimate abundances for entrained and down-migrating juvenile westslope cutthroat trout that are too small to be tagged. All screened and non-screened diversions will be electrofished to corroborate and supplement findings of trapping and telemetry experiments. In addition, temperature will be recorded at stations along Skalkaho Creek using HOBO temperature recorders set by the Montana Fish Wildlife and Parks. Flow for Skalkaho will be recorded at USGS gauging station #12346500. These data will be used to determine out-migration cues for westslope cutthroat trout.

Thermal Requirements of Westslope Cutthroat Trout

Graduate Student: Beth Bear
Principal Investigators: Tom McMahon and Al Zale
Collaborator: Bill Krise, Bozeman Fish Technology Center, USFWS

Background

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

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

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

Objectives

1. To define the upper lethal and optimal temperature ranges of westslope cutthroat trout.

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

Progress to Date

The first thermal trial to determine the upper lethal temperature and optimal growth temperature began on March 28, 2003 and was completed on June 26, 2003. Preliminary results suggest the upper limit for survival of WCT is near 21°C. Less than 50% of the population survived for 60 days at 22°C and far greater than 50% survived at 20°C, suggesting an ultimate upper incipient lethal temperature (UUILT) intermediate between these two temperatures. No prolonged survival occurred at temperatures from 24°C-30°C. In contrast, we observed >90% survival among WCT at temperatures of 8-20°C. Peak growth of WCT in this first trial occurred around 12°C. Both the upper lethal and optimal growth temperature for WCT was surprisingly similar to bull trout. Our previous work showed bull trout to have among the lowest upper lethal limits of North American salmonids (Selong et al. 2001).

In May, roughly 10,000 eyed rainbow trout eggs were obtained from Ennis National Fish Hatchery for use in a competition trial with pure WCT, as well as a trial to determine the UUILT of rainbow trout for comparison with WCT. In late May we attempted to produce rainbow x westslope cutthroat trout hybrids, but mortality rates of the eggs were severe. Therefore, the trial involving hybrids will be postponed until further attempts at hybridization can be made next spring. In mid-June 10,000 eyed westslope cutthroat trout eggs (Rogers Lake stock) were obtained from Flathead Lake Salmon Hatchery for use in additional trials.

Future Activities

The second thermal trial will begin in early August and be completed in late October. The objective of this trial is to further refine the UUILT and optimal growth temperature by testing temperature ranges intermediate between those used in trial one. Furthermore, brook trout eggs will be obtained this fall to test the effects of this nonnative species on the growth and survival of westslope cutthroat trout. All eggs have hatched and fry are being reared at the Bozeman Fish Technology Center and will be used in trials starting in December 2003. Therefore, we anticipate having pure westslope, pure rainbow, and pure brook trout available for temperature trials this coming year.

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

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

Background

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

Typical clinical signs of bacterial coldwater disease include lethargy, dorsal skin erosion, ascites (accumulation of fluid in the peritoneal cavity), bilateral exopthalmia, very pale gills, and hemorrhagic vent with trailing mucoid casts. Concurrent problems, such as infestation with parasites, are common (Branson 1998). Internally, the most obvious finding in fish with this condition is splenomegaly, where the spleen can be 2 to 5 times its normal size and is usually friable in nature. The surrounding peritoneum and fat are usually red in color and kidneys may be pale and slightly swollen. Intestines often contain yellow or white mucoid discharge and the terminal gut may be congested. Damage to the spleen can be seen histologically and the bacteria can be seen within the damaged tissue (Branson 1998). Signs associated with neurological disruptions can also occur including whirling behavior around the longitudinal axis, post cephalic protrusion of the cranium, spinal deformities, and loss of melanocyte control in the posterior body (also known as black-tail) (Kent et al. 1989; Meyers 1989). Microscopic features of the neurologic lesions include fibrous inflammation of the vertebral canal at the junction of the spinal cord and the medulla oblongata. The inflammation causes an upward compression of the anterior position of the spinal cord. Erosion and necrosis of vertebral bone and cartilage is also apparent (Meyers 1989). Many of the clinical signs associated with bacterial coldwater disease are also clinical signs of other fish diseases; therefore, a positive identification of the bacterium is necessary for confirmation of the disease.

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

Objectives

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

Progress to Date

The causative agent of bacterial coldwater disease, *Flavobacterium psychrophilum*, was isolated from the spring head used as the main water source to the hatchery. The bacterium was also found in the hatchery water tower where the incoming spring water is degassed and oxygenated. Degassing and oxygenation of the water in the tower is aided by plastic Koch rings, which inadvertently provide a large surface area for bacteria to grow. Subsequently, the Koch rings were removed and all incoming pipes from the water tower to the hatchery were sterilized. During periods of low oxygenation, a small number of clean Koch rings are placed in the water tower. New hatchery policy is to replace all used Koch rings and sterilize all incoming pipes on an annual basis. These procedures appear to have reduced the numbers of bacteria entering the hatchery.

The bacterium was also isolated from the hatchery broodstock. It was not isolated from the ovarian fluid of females, but a large proportion of male milt tested positive. Tests were conducted to determine if the bacterium could be transmitted via the egg surface and if so, whether it could be reduced using an iodine bath. Only 2 % of unfertilized eggs were positive on their surface for the bacterium, whereas 60% of fertilized eggs were positive. A 30-minute iodine treatment reduced the frequency of fertilized eggs testing positive to 17%. The bacteria present on the surface of the eggs are therefore likely coming from the milt used to fertilize the eggs. Whole, surface-disinfected testes removed from the fish also tested positive. Contents of eggs known to have no *F. psychrophilum* on their surface are currently being tested to evaluate vertical transmission by female broodstock; some egg-contents samples have already tested positive.

Future Activities

Tests are currently underway to determine whether the hatchery water used during fertilization confers infection to the eggs. Tests are also underway to determine whether increasing the time of the iodine bath increases egg surface-disinfection rates. Stocking densities, water temperature and feeding regimes will be varied under controlled conditions to determine what conditions are most favorable for the survival of the fish in the presence of the pathogen.

Technology Transfer

Contributors: Michelle White, Cal Fraser, and Molly Boucher

Background

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

Objectives

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

Progress to Date

Partners Program personnel from Montana, Idaho, Washington, Oregon, Colorado, and Wyoming have been contacted. The Partners Program has an extensive website with useful information; we are actively working to collect additional information on fish habitat restoration projects not currently posted on the Partners' web site.

The Initiative website is fully functional and includes a searchable bibliography related to fish habitat, a list of habitat restoration manuals, and links to pertinent on-line habitat restoration information. The on-line bibliography is a collation of information on various fish habitat restoration techniques and will facilitate information exchange among fisheries biologists and project managers. The list of habitat restoration manuals includes information relevant to the northwestern United States; each manual is available on the website in PDF format. Resource information will continue to be updated as new information becomes available. The address for the Initiative website is: http://water.montana.edu/wildfish/.

The case histories database currently contains detailed information on seven restoration projects from Montana. Case history descriptions include the following information: narrative descriptions, project goals, restoration methods, project costs, landowner contributions, photographs, and monitoring data. The intent of the database is to share information and learn from examples of previous restoration work. It is searchable by project title, project type, and location. Currently, we are working to post projects completed in Idaho, Oregon, and Washington.

Future Activities

Our efforts continue to focus on the collection of information on fish habitat restoration projects for the case histories database. On-site visits to projects in Oregon, Idaho, and Colorado have been planned to collect information and photographs and minimize the work required by project managers to supply us with information. We will continue to update the bibliographic information, and update and maintain the website as needed. By spring 2004 we intend to have case histories projects representing each state in the northwestern United States. During fall 2004 we will coordinate a formal review of the website by fisheries biologists and Partners Program personnel.

Project Personnel

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

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

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

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

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

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

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

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

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