Lower Deer Creek Fish Barrier & Yellowstone Cutthroat Trout Conservation

Final Report for the Western Native Trout Initiative

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Montana Fish, Wildlife & Parks

Executive Summary

Project Title: Lower Deer Creek Fish Barrier

Project Start Date: June 14, 2010

Project Completion Date: August 2011

Funding

Contributor	Total
Western Native Trout Initiative	$40,000
U.S. Forest Service Gallatin National Forest	$25,000
Future Fisheries Improvement Program (Montana Fish, Wildlife & Parks)	$141,957
National Fish and Wildlife Foundation – Bring Back the Natives	$75,000
National Fish and Wildlife Foundation – One Fly Partnership	$40,940
Montana Chapter of the American Fisheries Society	$5,000
Total	$327,897

Abstract

Lower Deer Creek, a tributary of the Yellowstone River, located east of Big Timber, Montana, has supported nonhybridized Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*) in sympatry with brown trout (*Salmo trutta*) for over 60 years. Historically, the relative abundance of Yellowstone cutthroat trout and brown trout varied along the longitudinal gradient, with brown trout being more abundant in the lower elevation reaches, and Yellowstone cutthroat trout increasing their proportion at higher elevations.

In 2005, first generation backcrosses of rainbow trout (*O. mykiss*) × Yellowstone cutthroat trout were found in Lower Deer Creek in a reach flowing through private lands, located several miles downstream of the Custer Gallatin National Forest Boundary. Sampling in subsequent years found hybrids were moving upstream, and putting the headwaters stronghold at risk of the irreversible effects of hybridization. Likewise, brown trout were increasing relative to Yellowstone cutthroat trout in the headwater reaches. A conservation strategy for cutthroat trout (MCTSC 2007) considers protecting nonhybridized populations of Yellowstone cutthroat trout as the highest conservation priority. Construction of a barrier and removal of brown trout were the proposed actions to secure this high conservation value fishery. In 2010, Montana Fish, Wildlife & Parks (FWP) constructed a barrier to prevent upstream movement of fish. The following summer, several collaborating state and federal agencies salvaged as many Yellowstone cutthroat

trout as possible, treated the stream with the piscicide CFT Legumine, then returned the salvaged Yellowstone cutthroat trout to Lower Deer Creek, the day after treatment was completed. Western Native Trout Initiative funds were applied to the barrier construction component of the project.

Project Location

Lower Deer Creek flows into the Yellowstone River between Big Timber and Greycliff, Montana (Figure 1). The entire stream is in Sweet Grass County. The barrier site is on state land in township 2 S, range 15 east, and section17. Its coordinates are 45.65539/-109.89276.

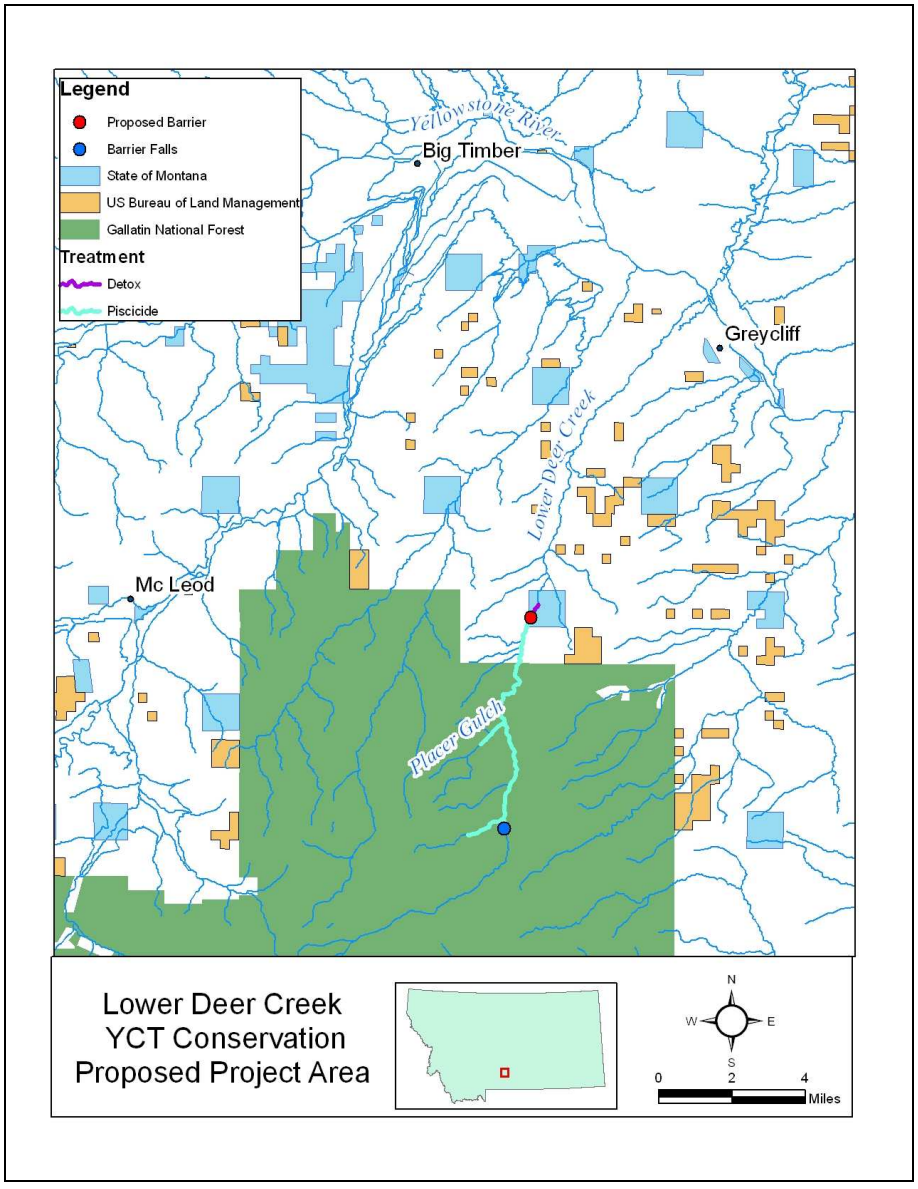

Figure 1. Map of the Lower Deer Creek watershed

Project Summary

Lower Deer Creek, a tributary of the Yellowstone River downstream of Big Timber, Montana (Figure 1), supports a nonhybridized population of Yellowstone cutthroat trout that was in imminent threat of hybridization with rainbow trout. Hybrids were first discovered in privately owned portions of the stream in 2005, with several fish testing as first generation backcrosses (Leary 2006). Sampling in 2007 found no evidence of hybridization within the Gallatin National Forest (Leary 2007); however, in 2008, genetic analysis identified a hybrid near Placer Gulch (Leary 2008) indicating upstream invasion of hybridized fish. These results confirmed an urgent need to intervene in order to secure this imperiled population.

Lower Deer Creek's Yellowstone cutthroat trout have considerable conservation value, and protecting this population is consistent with the strategy for Yellowstone cutthroat trout in Montana (Endicott et al. 2013) and a conservation agreement developed to promote conservation of westslope cutthroat trout and Yellowstone cutthroat trout in Montana (MCTSC 2007). Securing genetically pure populations is the highest conservation priority, and failing to do so increases justification to include the species for protection under the Endangered Species Act.

Brown trout presented another threat to the long-term persistence of Yellowstone cutthroat trout in Lower Deer Creek. In 2008, a brown trout suppression effort was initiated to relieve competition and predation pressures on Yellowstone cutthroat trout residing in Lower Deer Creek within the Gallatin National Forest boundary. The objective was to allow Yellowstone cutthroat trout numbers to increase within Lower Deer Creek. Brown trout were increasing in numbers in the headwaters of Lower Deer Creek, which caused concern for the nonhybridized Yellowstone cutthroat trout. Justification for construction of a barrier, and removal of nonnative brown trout, and hybrids The combination of hybridization, and its contribution of deleterious alleles that decrease fitness (Muhfeld et al. 2015), and the presence of brown trout, justified construction of a barrier, and removal of brown trout and hybrids.

A fish barrier is a small dam that creates a vertical drop between 5 and 6 feet. Properly designed barriers create velocity and leap barriers to fish. Fish from downstream cannot ascend the barrier, although fish can move downstream over the barrier.

Selection of an appropriate site for barrier placement requires consideration of a number of factors. Bedrock control of the stream channel is a primary requirement. Sites fortified by bedrock walls prevent the stream from migrating around the structure in high water. A relatively steep reach of stream upstream of the barrier site is also important. High gradient lessens the backwater effect downstream of the dam that can occur during high water. The backwater effect occurs when flows are great enough to cause the stream to leave its banks. As it does this, the depth of the water downstream of the dam increases, lessening the jump distance for a fish to clear the dam. The higher the gradient of the stream the less backwater effect is present at the

barrier structure. In other words, relatively high gradient maintains the impassibility of the barrier at higher flows.

Consideration of a number of fisheries concerns is essential in identifying appropriate barrier locations. Long-term persistence of fish populations is directly related to population size, and population size is often directly related to the length of stream occupied by the fish (Hilderbrand and Kershner 2000) and the combination of the quantity and quality of the available habitat (Peterson et al. 2008). In other words, the larger the population is, and the more miles of habitat it occupies, the less likely it will be to go extinct over time. Smaller populations are more vulnerable to inbreeding and random events, such as fire, drought, and disease. Furthermore, migration barriers may also isolate important habitats such as spawning areas from fish that are either upstream or downstream of the barrier. The possibility of excluding fish from important habitat is reduced by maximizing the amount of habitat located upstream of the barrier. The Lower Deer Creek barrier protects 11 miles of habitat for Yellowstone cutthroat trout, which exceeds the recommended minimum of 5 miles (Hilderbrand and Kershner 2000). Moreover, application of a Bayesian belief model (Petersen et al. 2008) predicted a high probability for the long-term persistence of a cutthroat trout population within the project area. Finally, the barrier location would give fish occupying 11 miles of habitat access to Placer Gulch, a heavily used spawning tributary.

Until relatively recently, barriers built in Montana were flat-fronted weirs, often with a concrete apron downstream. Observations of rainbow trout breaching a flat fronted barrier resulted in changes in barrier design to eliminate the hydraulics that allowed rainbow trout to clear the barrier. The jet of water pouring over the structure would hit the concrete apron, and form a standing wave behind the curtain of water. Rainbow trout that could get to this upwelling were able to use its upward force to leap vertically over the barrier. The Lower Deer Creek barrier is the first ogee-fronted barrier constructed in Montana.

The design (Figure 2) to prevent upstream passage of fish employs 4 impassable features. The face of the barrier is an ogee, or backwards S shape. Water flowing over this curve clings to its shape, and there is no room for the formation of a backwater eddy that allows fish to breach barriers. In addition, the ogee weir is a leap and velocity barrier, as the height exceeds the leaping ability of rainbow trout, and the velocity is greater than the burst speed of a rainbow trout. The apron is the final impassible feature as it maintains either especially shallow flows during low flow, or high velocity flows when stream levels rise. Any fish able to make it past the apron, would still need to leap the 5.5-ft barrier, and would not have the advantage of deep, turbulent water to leap that high.

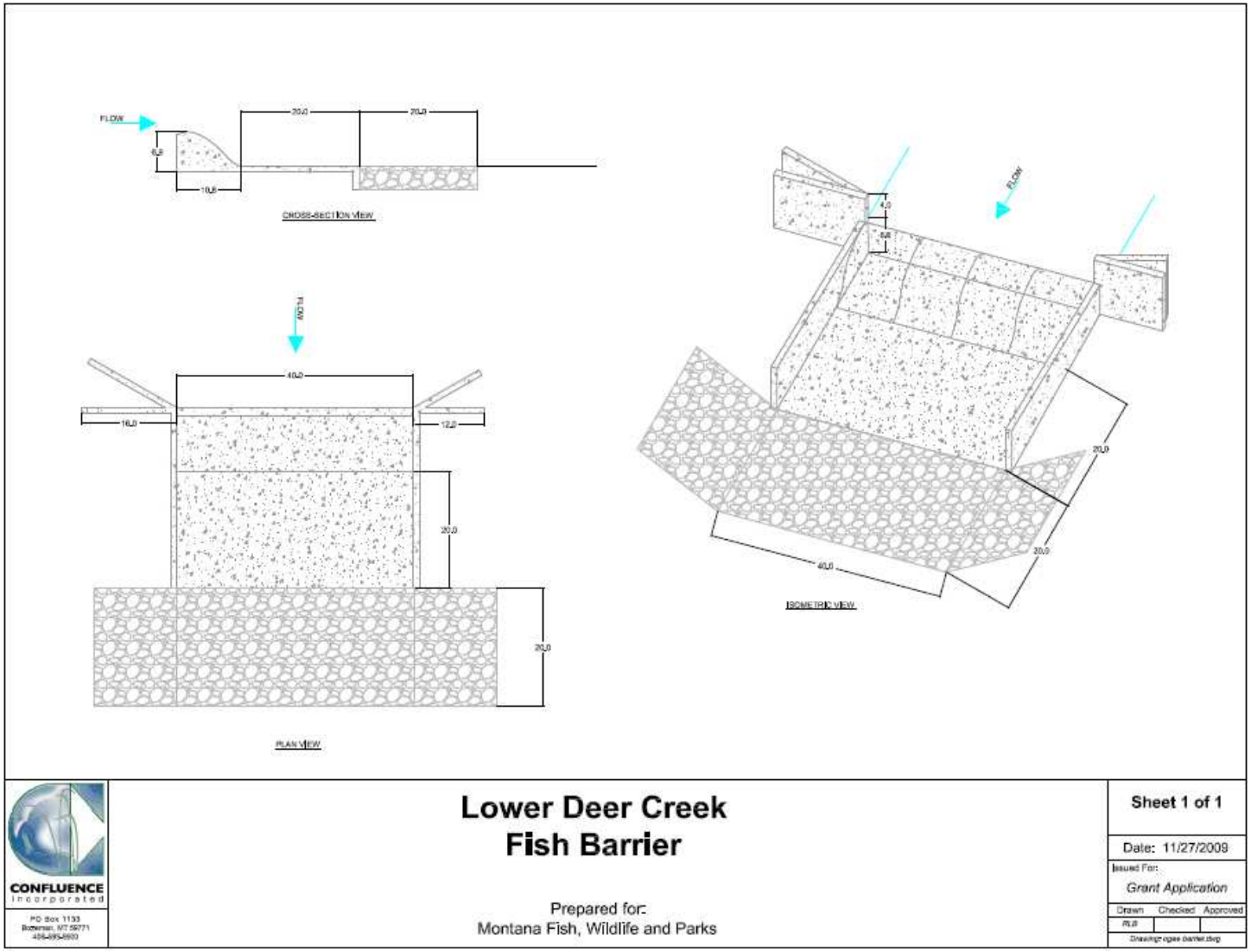

Figure 2. Conceptual design for the Lower Deer Creek fish barrier

Construction

Construction began in November of 2010. The following photographs present a visual narrative of construction.

Figure 3. Barrier site showing lateral confinement by vertical walls of bedrock.

Figure 4. Installation of the foundation of the apron and stream bypass pipe.

Figure 5. Concrete apron and bypass pipe

Figure 6. Plywood form for ogee face and constructed wing walls.

Figure 7. Close up of plywood formed ogee face.

Figure 8. The bypass pipe has been plugged, and water is becoming impounded behind the barrier.

Figure 9. Completed fish barrier.

Fish Salvage and Piscicide Treatment

In August of 2011, FWP, the Custer Gallatin National Forest, and U.S. Geological Service collaborated on a fish salvage effort, followed by treatment with the piscicide CFT Legumine. Fieldworkers electrofished upstream portions of Lower Deer Creek where no hybrids had been caught and captured all Yellowstone cutthroat trout. These fish were held in live cars in waters that would not be treated with CFT Legumine. Approximately 2,000 Yellowstone cutthroat trout were captured.

Piscicide treatment followed the immediately after completion of the salvage operation. Treatment entailed a step-wise approach that began in the headwaters and continued downstream (Figure 10). A detoxification station that released potassium permanganate was established at the barrier. A back-up station was place 0.5 hours travel time downstream of the first detoxification station. As sentinel fish showed no signs of toxicity, Yellowstone cutthroat trout were returned to Lower Deer Creek the day after treatment stopped.

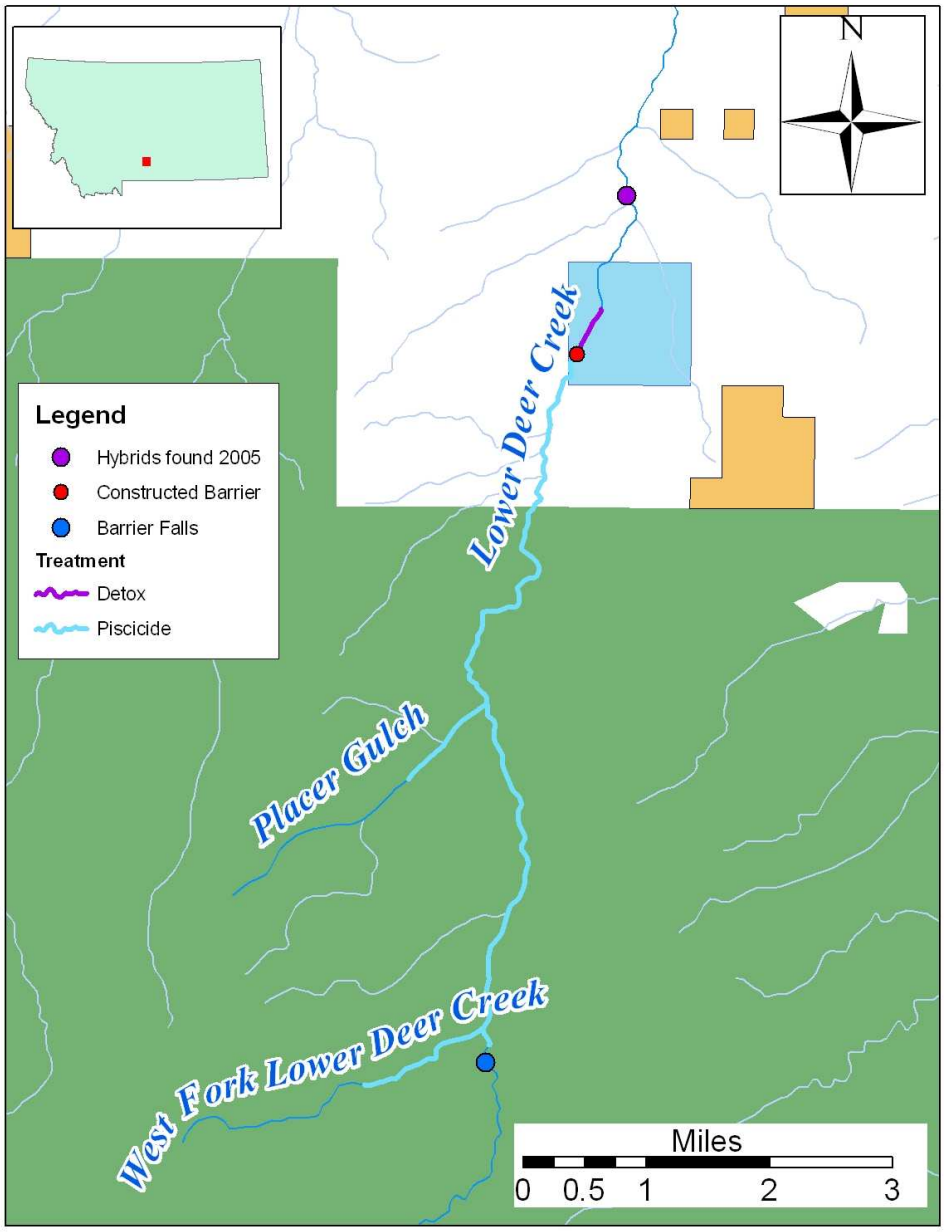

Figure 10. Reaches in the Lower Deer Creek watershed that were treated with CFT Legumine and the detoxification reach.

Monitoring

Monitoring of the fishery began in 2014. Starting at the barrier, fieldworkers electrofished upstream for 5 miles in single pass. They captured 2,805 apparently nonhybridized Yellowstone cutthroat trout (hybridized fish had been easily recognizable), and no brown trout. Over 1,511 Yellowstone cutthroat trout, mostly age-1 fish, were captured in 1.5 miles of Placer Gulch, a small stream that is an important spawning tributary for Yellowstone cutthroat trout. Monitoring will be repeated in the next 3 to 5 years. This interval would allow for detection of brown trout, should the fish kill have been incomplete, and a few brown trout survived to spawn.

Analysis of the genetic status of the Yellowstone cutthroat trout in Lower Deer Creek will determine if salvage and piscicide treatment were successful in eradicating hybridized fish. Genetic analyses of fish identified in the field indicated 100% success in distinguishing between hybridized and nonhybridized fish.

Summary

The Lower Deer Creek fish barrier and brown trout removal project appears to have been successful. Electrofishing in 2014 found no brown trout, which suggests that the barrier works as designed, and that the piscicide treatment was likely effective in eradicating brown trout. Resurgence of Yellowstone cutthroat trout, including the impressive recruitment found in Placer Creek, indicates this project is likely meeting the highest conservation goal for Yellowstone cutthroat trout, specifically, securing nonhybridized populations of Yellowstone cutthroat trout.

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