U.S. Department of the Interior
National Park Service

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Yellowstone National Park Westslope Cutthroat Trout Restoration Program: 2008 Field Season Strategy

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30 September 2008

Suggested citation:

Rupert, D.L. and M.E. Ruhl. 2008. Yellowstone National Park Westslope Cutthroat Trout Restoration Program: 2008 Field Season Strategy. National Park Service, Yellowstone Center for Resources, Fisheries & Aquatic Sciences Program, Yellowstone National Park, Wyoming.

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EXECUTIVE SUMMARY

In 2006, Yellowstone Fisheries was allowed to begin native species restoration on the East Fork of Specimen (EFSC) by completing an Environmental Assessment and a Finding of No Significant Impact report. Some preliminary work on the EFSC native species restoration project (the project) was completed in 2006 and 2007, including the removal of non-native fish from High Lake. The 2008 field season will be a continuation of the project, with several major stages of the EFSC project scheduled for completion. These major stages scheduled include: the stocking High Lake with Westslope cutthroat trout (WCT) eggs and adults, the constructing a fish barrier on the EFSC, and the completing the first of three piscicide treatments on the newly isolated portion EFSC (the other treatment are planned for summer 2009). Other work to be completed in 2008 will include: the monitoring of High Lake inlets for spawning fish, continued monitoring of piscicide effects at High Lake and EFSC, and investigating the Grayling Creek drainage as a future native species restoration stream

INTRODUCTION

During the past century, westslope cutthroat trout (*Oncorhynchus clarki lewisii*; WCT) have declined significantly throughout their historic range (Miller 1972, Liknes and Graham 1988). In the upper Missouri River drainage alone, they occupy less than 5% of their native range (Shepard et al. 1997). Of the 641 stream miles historically occupied by WCT within Yellowstone National Park (YNP), less than two miles are currently home to genetically pure WCT (NPS unpublished data, Ruhl and Koel 2005). The loss of WCT in YNP can be attributed to competition with non-natives including brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) and introgression with invasive rainbow trout (*Oncorhynchus mykiss*) and Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*; Varley and Schullery 1998). In 2006, steps began to reverse the declining trend of WCT populations in YNP. The completion of an Environmental Assessment (EA) and Finding of No Significant Impact report (FONSI) allowed for the implementation of the East Fork Specimen Creek (EFSC) WCT Restoration Project (the project).

The EFSC project began in 2006 with High Lake, the headwater lake of EFSC. High Lake was successfully treated with piscicide (fish poison) to remove its non-native trout, and one year later efforts to stock the lake with genetically pure WCT were begun. WCT eggs from Last Chance Creek and Sun Ranch brood stock were released into High Lake's inlet streams and adult WCT from Geode Creek were dropped into the lake from a helicopter. Work on the project will continue in 2008, with three major areas of focus: 1) Continued WCT stocking at High Lake, 2) Construction of a fish barrier on the lower EFSC, and 3) The first of three planned piscicide treatments on EFSC. Other important work will include continued monitoring of piscicide effects and investigation of potential WCT spawning at High Lake, and further investigations into other WCT restoration candidate streams, particularly Grayling Creek.

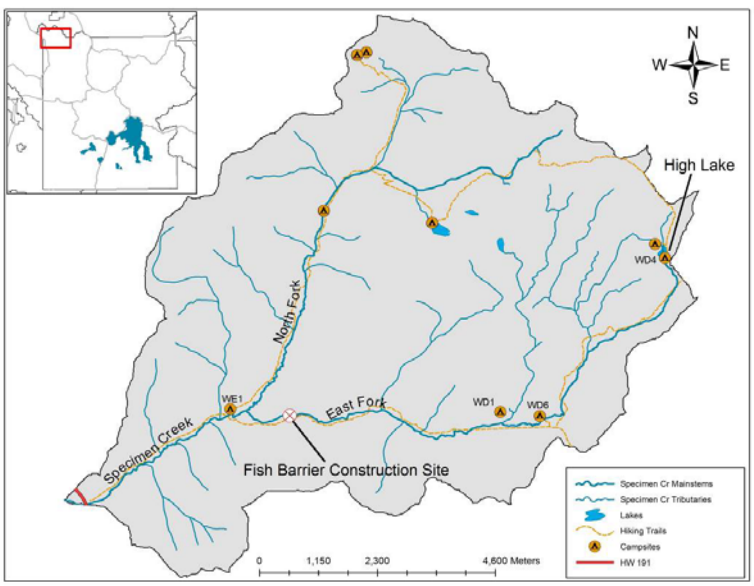


Figure 1: Specimen Creek is located in the northwest corner of Yellowstone National Park. The 2008 restoration efforts will focus on the East Fork Specimen Creek.

WCT STOCKING AT HIGH LAKE

Overview

In 2006, High Lake was successfully treated to remove the lake's non-native fish population. Stocking efforts began a year later in 2007, with the introduction of both adult fish and fish eggs. This year's High Lake stocking plans will mirror those of 2007, with the introduction of adult fish from the Geode Creek and eggs from Last Chance Creek and the Sun Ranch brood stock.

Stocking Efforts

In early to mid June eggs will be gathered from Last Chance Creek (see below). After maturing to eyed-stage at the hatchery, the eggs will be placed in Remote Site Incubators (RSIs) at High Lake sometime in early July. Eggs from the Sun Ranch brood stock may also be stocked into High Lake. Adult westslope cutthroat trout will be captured from Geode Creek and flown to High Lake. To accomplish this, the fisheries team will electrofish designated areas of Geode Creek collecting about 1000 individuals. The fish will be held in live cars overnight. The next morning a helicopter will pick up the trout and transport them to High Lake in a specially designed helicopter bucket on loan from the MT Fish, Wildlife, and Parks (Image 1). The water quality and amphibian survey crew will be at High Lake to observe the helicopter releasing the fish and estimate mortality caused by transport.

Image 1: Members of the Helitack crew load WCT from Geode Creek into the fish bucket for transportation to High Lake.

Last Chance Creek Overview

Last Chance Creek (formally referred to as unnamed tributary to Grayling Creek; figure 9), with its small aboriginal population of westslope cutthroat trout, was used in the spring of 2007 as a WCT gamete donor stream for the stocking of High Lake. Gametes will again be collected in early June or as weather allows. Also, population estimates, mirroring those conducted on the stream in 2005 (Ruhl and Koel 2005), will be completed in early September to assess potential impacts of gamete removal on the population.

Egg Collection

The collection of gametes from Last Chance Creek will be a 3 step process. First, spawning surveys will be conducted to determine when the fish are beginning their pre-spawn activities, such as pairing and redd digging. Second, when the fish are exhibiting pre-spawn behavior they will be captured using electro-fishing equipment, separated by sex, and placed in live cars. The fish will be held until they are ready to spawn. Then fish will be manually spawned onsite following the protocols found in Appendix 1. The eggs will then be transported to the Sun Ranch Hatchery, where they will develop for several weeks before being stocked in High Lake. A detailed egg collection guide can be found in Appendix 2.

Population Estimates

The population estimates will require 3 days to complete. Three 100 m reaches will be selected at random; a three pass depletion method population estimate will be performed on each reach. An overall population estimate will be formed from these data, which will be compared to the 2005 population estimate.

FISH BARRIER CONSTRUCTION

Overview

The construction of a fish barrier on the East Fork Specimen Creek (EFSC) was scheduled for the summer of 2007, but the Owl Fire prevented the operation (Image 2). The construction has been rescheduled to start in mid-July and run through the beginning of August, 2008. The construction process will likely require 4 weeks to complete, but the schedule will be flexible enough to run into late August if delays are encountered. The fisheries restoration crew will have help from the Montana Conservation Corps (MCC) and a private contractor (Intermountain Restoration Inc, Wilsal, MT). These two crews will add much needed help during the construction process.

The construction of the barrier will be a multi-stage progressive operation. The steps will include: hazard tree mitigation, removal of materials destroyed by the Owl Fire, equipment transport, diversion channel construction, barrier log and site preparation, water diversion implementation, barrier construction, splash pad construction, riprap placement and backfilling, water barrier removal, diversion removal, equipment removal, and final clean up and site rehabilitation.

Hazard Tree Mitigation

The Owl fire left thousands of standing dead trees creating dangerous conditions around the barrier construction site. To provide a safe working environment, a small team will mark and down hazard trees in the vicinity of the site. High quality logs will be felled first and moved to the construction site for use in building the barrier. Lower quality logs will be used in the construction of the diversion channel as needed, or scattered. The transportation of the logs across steep terrain will require special rigging and winches. This equipment, and the expertise to use it, will be provided by Intermountain Restoration Inc.

Image 2: Top) The barrier construction site and surrounding areas were greatly altered. Bottom) Before and after photographs of the barrier construction site shows the severity of damage caused by the Owl Fire.

Trail Clearing

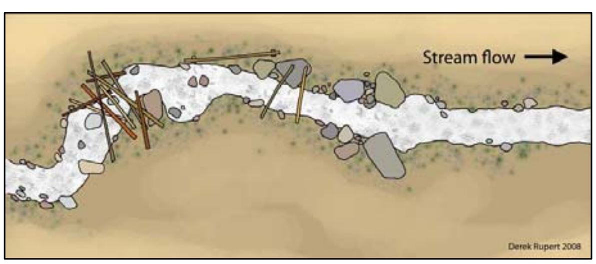
The steep terrain and dense deadfall inhibits easy access to the fish barrier construction site. Therefore a trail will be cleared to connect the hiking trail to the construction site. NPS employees will flag out a path with a gentle grade through the deadfall that will allow easy access to the construction site. The MCC crew will move or cut the deadfall, paying special attention to not cause unnecessary damage to the surrounding area.

Equipment Movement

Pack stock, lead by Park Service packers, will be used to move nearly all of the tools, materials, and gear from the Specimen Creek Trailhead to the barrier site. Moving this much equipment will required several string loads per day for a week or more. A helicopter will be used to move equipment that is too large or heavy to be transported by stock. Most of the equipment will be relatively easy to pack with some exceptions, including, water barrier diversion tunnels (2), diversion channel liner material, and generators. Each individual will be responsible for carrying their own camping gear. The crew will be staying at camp site WE1 during the construction. All the personnel equipment will be transport to this site. The large communal camp equipment (wall tent, stove, toilet system, etc.) will be brought in by pack stock or helicopter.

Owl Fire Clean Up

During the previous attempt at building this fish barrier, materials were left at the construction site and were subsequently destroyed by the extreme heat of the Owl fire. All materials will be assessed and those deemed useable will remain and unusable materials will be removed. Examples of the ruined materials include: bolts, screws, wire, melted plastic, aluminum sheets, and T-posts. Magnetic sweepers will clean up nails and wire from the ashes of the previous diversion channel. The ruined materials will be removed by outgoing pack stock and discarded.



Diversion Channel

The water diversion channel will redirect the EFSC around the barrier construction site to provide a dry streambed in which to build the fish barrier. The diversion channel construction will begin by digging out a 0.6 m deep trench. The trench will be made as straight as possible and at a consistent smooth grade, to prevent pressure points. This trench will function as the base for the diversion channel. Side walls will be built on each side of the trench to increase the diversions depth. The side walls will be built of two stacked logs, secured with T-posts and wire (figure 3). Once built, the diversion channel will be lined with an extra-strong waterproof 75 m long by 4.2 m wide tarp-like liner. To prevent leaks, this liner will run the length of the diversion channel without any seams. The channel will remain in place for the duration of the barrier construction and will be routinely checked for weak and stressed areas.

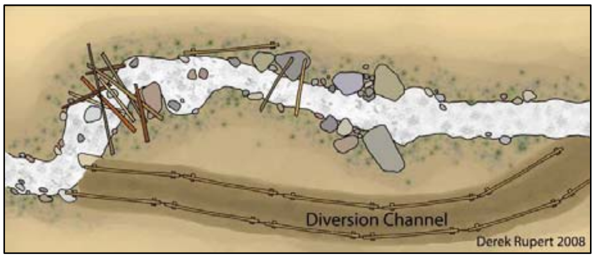


Figure 4: The diversion channel will be constructed by excavating a trench, building side walls, and installing a liner.

Water Barriers

Two water barriers (manufactured by Mega Secure International) will be used during the construction. A 1.5 m tall water barrier will redirect the flow of the EFSC into the diversion channel. Because some water loss is unavoidable, a smaller secondary water barrier will be placed about 50 feet below the first water barrier. The smaller (1 m tall) water barrier will be equipped with a diverter box which will capture the water and channel it into a 45 m tunnel, which will carrier the water around the construction site (Figure 4). The water barriers will stay in place for the duration of the barrier construction. The barriers should require little to no maintenance while in use, but will be routinely checked for weak and stressed areas. With both water barriers in place the construction site should be nearly dry. A water pump may be used to remove the pools of water that will likely form in and around the construction site.

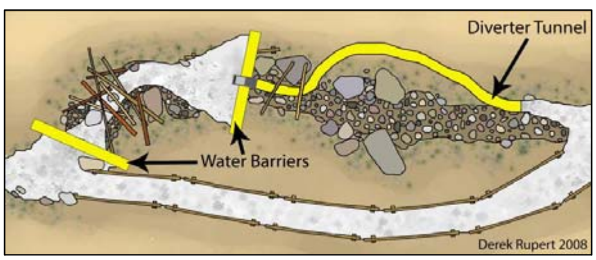


Figure 5: To keep the construction site dry, the water barriers will redirect water into the diversion channel and diversion channel.

Site Preparation

To prevent a high sediment load from entering the creek, site preparation will not start before the majority of the flow has been diverted around the site. Site preparation will include digging a trench in front of the retaining boulders perpendicular to the streambed; roughly 9 m long and wide. The fish barrier will need to be set as deep into the ground and a far into the banks as possible requiring excavation of the stream banks and fill in the streambed to create a level surface. All the loose material and rocks will be removed from around the large boulders. Then repositioning or reshaping of the boulders to allow the logs to fit. The barrier placement site will need to be level to provide the first barrier logs a sturdy base. If needed a concrete pad may be poured.

Barrier Construction

The transportation and preparation of the logs will take place before or during site preparation. Log preparation will include cutting the logs to correct length and removing their bark. The barrier will be constructed of two parallel logs staked 1.8 m high placed perpendicular to the streambed. The logs may need to be shaped to fit around the unmovable boulders. The logs will be joined with ready-rod, nuts, and steel plates. Two pieces of water proof cloth will be integrated into the barrier; one piece will fit between the log "walls", while the other will be placed on the upstream side of the barrier so that water cannot flow through small cracks and holes. A large gap or notch will be left in the top row of logs to form a distinct water channel, which will force water to cascade uniformly between the two large existing boulders (figure 5). The contractor will be responsible for much of the construction of the barrier, including overseeing site preparation, log preparation and shaping, and barrier log placement.

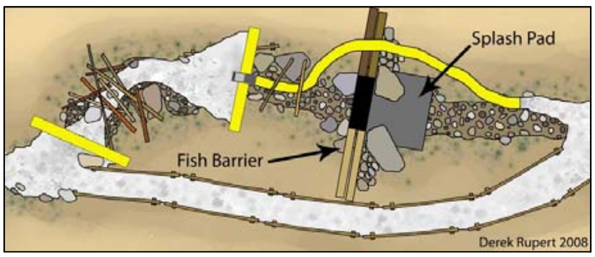


Figure 6: The fish barrier and splash pad will be built to integrate the large boulders that will act as an anchor.

Splash Pad

Directly below the barrier, a splash pad will be poured. The splash pad inhibits the falling water from forming a deep plunge pool, which would facilitate fish jumping. The pad will be made of rock and mortar (bags of pre-mixed concrete). A plastic fiber additive will be used in the concrete mortar to add strength and reduce cracking. The splash pad will be approximately 7.5 m long, 4.6 m wide, and 125 cm deep. The size will likely be limited by availability of concrete. The pad will have a slight downstream slope to direct all water downstream. The pad will be interlaced with the large boulders and smaller rocks found on-site. The use of one or multiple wheelbarrows will be necessary to mix the large amount of concrete that will be needed. The splash pad will need several days to properly cure.

Backfill and Rip-rap

Backfilling and placement of rip-rap (large rocks) will follow the completion of the barrier and splash pad. Rip-rap will be placed on the sides of the splash pad to ensure that high water events do not erode away the earth in front of the barrier. Rock and earth will be used to fill in the interstitial space found between the boulders and the barrier. It will be important that the water proof cloth on the upstream side of the barrier be correctly secured and in position.

Post-Construction Activities

After the fish barrier construction is complete, the water barriers will be removed. The smaller barrier will be removed first to allow the pool behind the barrier to slowly fill with water before removing the large water barrier, checking for problems/leaks. The large barrier, which holds most of the water, will need to be removed as slowly as possible, so that a sudden pulse of water does not damage the barrier. With the water barriers removed, the fish barrier should be functional. If problems are discovered the water barriers will need to be reinstalled while the problems fixed.

The diversion channel can be removed after the fish barrier construction is finished. The logs used to build the diversions will be scattered and the trench will be backfilled and rehabbed. Special attention will be given to filling in the mouth of the diversion to ensure that the trench will not become a water channel during high flows.

After the diversion removal is complete, the pack out process will begin. The equipment will be packed out in much the same way as it is packed in, including movement of large and heavy objects by helicopter. The construction site will be rehabilitated; trails removed, saw dust scattered, etc. A magnetic sweeper will be used to pick up any small metal fragments found around the site. The majority of the rehab will be completed by the MCC crew and/or park Resource Management staff. The barrier pack-out will take place during the pack-in period of the piscicide treatment, and thus will be coordinated to maximize efficiency.

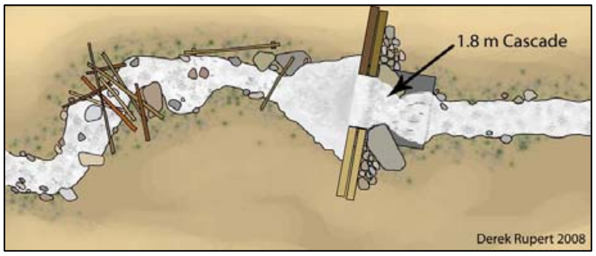


Figure 7: After the barrier and splash pad are completed the water barriers will be removed and the diversion trench will be backfilled. The stream will return to the original channel and flows over the fish barrier.

EFSC PISCICIDE APPLICATION

Overview

The initial piscicide treatment of the EFSC will coincide with the final stages of the fish barrier construction. Tributary investigations, pre-treatment surveys, and treatment preparation will take place during the weeks preceding the piscicide application. Immediately after the completion of the barrier, travel times will be determined, a neutralization station will be deployed, in-stream bioassays will be completed, and piscicide treatment will begin. The EFSC piscicide application has been broken into 4 treatment reaches and is expected to take twelve days. Application is scheduled to begin in mid-August and conclude before the end of the month.

Tributary Investigations

All EFSC tributaries will be examined and the following data will be gathered: spring emergence points, connected wetland areas, smaller tributary confluences, and potential barriers to upstream fish movement. Tributaries will also be sampled via electrofishing to estimate upstream extent of fish distribution. It is important to understand where the streams emerge and how fish are distributed so that drip stations or rotenone sand can be placed in the correct areas. During this time the crew will capture fish and hold them in live cars at the tributary mouths because over 250 sentinel fish will be needed during the piscicide operations. The bioassays will require 60+ fish, the treatment sentinel cages will require 120+ fish, neutralization sentinel cages will require 30+ fish, and 50 fish will be kept as extras. The extra fish will be stored in the untreated North Fork Specimen Creek near its confluence with EFSC.

Pre-Treatment Material Movement

The initial pack-in will coincided with the pack out of barrier construction material. As barrier materials are packed out, piscicide equipment will be packed in. The most difficult equipment to pack in will be the neutralization equipment ($KMnO_4$, chemical feeder, etc), piscicide equipment, and the water barriers. This equipment will be packed on stock. The neutralization station equipment will be transported to an area just downstream of the barrier site. The water barriers will be transported from the barrier site to the appropriate tributary mouths. The piscicide equipment and PPE will be packed to camp site WD6, six miles from the Specimen Creek Trailhead. Some of the lighter equipment (PPE) will be carried in by each individual staff members. Each individual will carry their personal camping gear and food. The crew will use campsites WD4, WD6, WD1, and WE1. Camp site WD6 will have a portable electric fence setup to hold the stock overnight.

Measuring Travel Time and Bioassays

Travel times, the amount of time it takes water to travel down a stream, will be assessed to determine distance required between piscicide application stations during the treatment. To accomplish this, liquid dye will be applied to the stream and the dye "plug" will be followed as it flows downstream. The location of the plug will be recorded by GPS at 30 minute increments.

Following measurement of travel times, bioassays will be conducted at three sites throughout the treatment zone. In each area, sentinel fish will be placed at 30 minute intervals and 1 ppm CFT Legumine will be applied upstream of the first sentinel fish cage. The sentinel fish condition will be monitored and time to mortality at each cage will be recorded. The distance, in hours of travel time, the poison retains its lethality will be used to determine the number and placement of drip stations needed for the treatment.

Neutralization

To dispense the piscicide neutralizing agent, $KMnO_4$, a volumetric feeder will be set up directly below the barrier. The feeder will be disassembled before it is packed and then be reassembled onsite. Power for the feeder will be provided by a Honda EU2000*i* generator used in conjunction with a sound shield to dampen noise and reduce impacts to wildlife and visitors. The feeder will be calibrated prior to the piscicide application to ensure accurate and consistent application of the neutralization agent. Efficacy of the neutralization station will be monitored by placing sentinel fish at 30 and 60 minutes travel time downstream, with survival of the fish at the 30 minutes indicating complete efficacy. Neutralization will occur as needed during the bioassays and treatments. If sentinel fish at 30 minutes of travel time downstream of the station die at any point during the treatments the $KMnO_4$ application rate will be increased. A portable colorimeter (Hack Pocket Colorimeter) will also be used to monitor downstream concentration of the $KMnO_4$.

Piscicide Application

The treatment area (the entire EFSC) will be split into four reaches, each requiring three days to treat; 12 days total. Treatment of each reach will be conducted as follows: Day 1 will be setup, day 2 will be treatment, and day 3 will be used to pack-up and change location. The most upstream section will be treated first with treatments progressing down the drainage. The sections will be isolated during the treatments by water barriers (see above) in order to inhibit the movement of fish from an untreated section into a previously treated section.

Each treatment will require four teams; neutralization station operators (2 staff), backpack sprayers (3-4 staff), drip station managers (4+ staff), and mobile coordinators (1-2 staff). The neutralization station operators will run the KMnO4 feeder and monitor the downstream sentinel fish. The backpack sprayers will apply piscicides to the wetland areas and dispense rotenone sand into springs. The drip station managers will run and maintain the drip dispensers and will collect dead fish from the creek. The mobile coordinators will be horse mounted and ride to wherever the other teams may need assistance, collecting the dead fish along the way for removal. Because personnel demand will likely overrun fisheries staff members the recruitment of several short term volunteers may be necessary, especially on treatment days. Help will be solicited from partner agencies and regional universities.

After the treatment is complete the equipment will be packed out. Stock animals will move most of the equipment out to the trailhead. Large and/or heavy equipment will be backhauled via helicopter.

OTHER IMPORTANT WORK

Continued Monitoring of Piscicide Effects at High Lake

High Lake's invertebrate and amphibian populations are being monitored to examine the effects of rotenone on non-target organisms. Sampling at High Lake began prior to the piscicide treatment in 2006, then again post-treatment. Non-target surveys will continue in 2008. EFSC will also be sampled, both pre- and post-treatment.

High Lake Spawning Monitoring

It is currently unknown if adult fish introduced to High Lake from Geode Creek will spawn and when potential spawning in High Lake is likely to occur. In 2008 High Lake will be monitored for natural WCT reproduction. Determining if and when High Lake's new resident WCT spawn may make it possible to use High Lake as a brood source for future restoration projects. To assess potential spawning, a small trap will be set up in each of the Lake's two largest inlet streams (figure ?). The simple trap will be constructed of ¼ inch "chicken fencing" and steel T-posts. Two pieces of fencing will form an upstream pointing **V**, with a small gap between them allowing fish to easily enter, while another piece of fencing placed upstream will block the entire width of the stream. A crew will stay at the Lake to monitor the trap. Snow and ice will most likely still be found on and around the lake, so special cold weather camping gear will be necessary. The conditions of the trails leading to High Lake may be difficult to pass if snow persists into late-May. The use of a helicopter to move a load of equipment may be required.

Grayling Creek Investigations

Given its potential for future native species restoration, Grayling Creek will be surveyed throughout its upper reaches. Investigations will focus on the portions of the stream above the 2 m high waterfall, which is located just below the confluence with Last Chance Creek (figure ?). In early or mid-September, a backcountry trip will be made to the headwaters of Grayling Creek. Full backpacking gear will be required as well as electro-fishing equipment. Complete genetic samples (30 or more fin clips) will be collected from several sites throughout the drainage. Population estimates will be performed at pre-specified locations. Large tributaries will be followed to find their origins. An accurate count and GPS locations of tributaries and other notable locations will be recorded. Several temperature loggers will be placed throughout the drainage, including the large tributaries and the waterfall (barrier). The trip will likely last one week (5-7 days) and yield information critical to future restoration efforts.

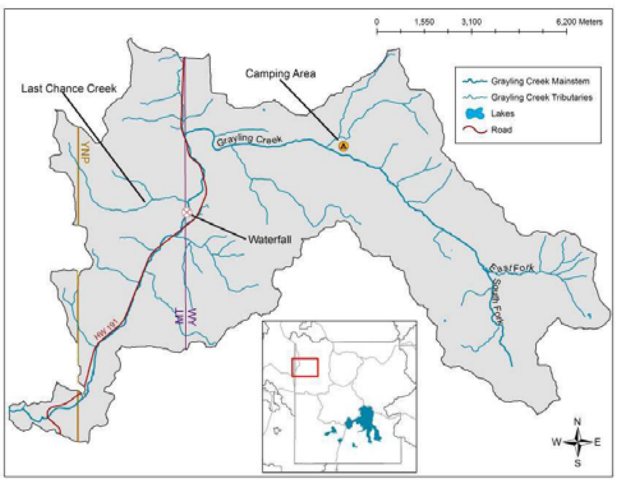


Figure #: The fish population in Grayling Creek will be thoroughly sampled in 2008.

REQUIRED EQUIPMENT FOR 2008 FIELD SEASON

High Lake

The equipment required to set up and monitor the inlet fish traps will be minimal. The traps would be made of chicken fencing, T-posts, and fencing wire. A hammer and wire cutters would be necessary to construct the trap onsite. A dip net and collapsible bucket will be needed to capture the trapped fish. A length board, balance, and camera will be needed to record data on the captured specimens. Personal winter camping gear will be required including: cold weather sleeping bags, 4-season tents, and heavily insulated clothing.

Last Chance Creek

The gamete collection on Last Chance Creek will require a variety of simple equipment. Including, a complete set of electrofishing gear (electrofisher, probe, rat tail, batteries, nets, rubber gloves, waders, wader boots, GPS, camera, live car, length board, scale, genetics vials, clippers, scale cards, and wool glove), large opaque live cars with lids, as well as all the equipment listed in Appendix 1.

Geode Creek

The adult fish collection/transportation process will require the following equipment: complete electro-fishing gear, helicopter and crew, helicopter fish transport bucket (with all required accessories), fish data collection gear, live cars, buckets, clean water reservoir (filled with well water), and backpack mounted coolers (with aerators; for on the ground fish movement). A large crew (10+) is needed during the fish collection days to fulfill all the necessary positions.

Barrier Construction

Large amounts of equipment will be needed for the barrier construction. This equipment can be divided into five categories: personal protective equipment (PPE), diversion construction, barrier construction, and miscellaneous gear.

Personal protective equipment is the most important gear used during the barrier construction. To keep workers safe, they will all wear hard hats, gloves, and boots. If ash from the Owl Fire becomes airborne, dust masks and safety goggles may be necessary.

The diversion channel will require: chain saws, picks, shovels, digging bars, sledge hammers, nail hammers, wood working tools, T-posts, construction wire, 6.3 mm steel cable, nails, screws, drills, level, spikes, log tongs, liner material, and water barriers.

Fish barrier construction will require: chain saws, cross-cut saws, picks, shovels, digging bars, sledge hammers, wood working tools, rock-breaking tools (feathers and shims, and masonry drill bits), electric drills, drill bits, bolts, screws, ready-rod, hacksaws, nuts, washers, bracing plates, geo-textile, concrete (w/ reinforcement fibers), 2x6 lumber, a wheelbarrow, and

EFSC Piscicide Application

Equipment needed for the piscicide treatment can be divided into three components: neutralization, application, and camping. Neutralization equipment will include: Crystalline $KMnO_4$, volumetric feeder, feeder stand, feeder and cover, 2000watt generator, generator cover/sound shield, necessary wiring, chemical tent, personnel tent, calibrating tools (i.e. graduated cylinder and balance), and PPE (gloves, respirators, and goggles). Application equipment will include: rotenone (liquid and powdered), drip stations, backpack sprayers, liquid dyes, filter bags, gelatin, sand, buckets, paper clips, PPE (respirators, gloves, goggles, chemical coveralls, eyewash stations, and first aid), Nalgene containers, plastic bags, dip nets, and graduated cylinders. Camping gear required includes: tents, sleeping bags, sleeping pads, and all other personal gear (clothing, food, toiletries, etc). Other miscellaneous equipment includes: horse tack, portable horse fence, and panniers.

Grayling Creek Investigation

Equipment needed to complete the Grayling Creek investigations will include: complete electrofishing gear, genetics vials, detailed maps of the drainage, and backcountry camp gear.

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Appendix 1: Wild Trout Egg Collection

After a successful removal of invasive fish species from a waterway the restocking of the native fish(s) can begin. One method of stocking is to collect eggs from a wild, pure strain population then placing them into the reclaimed waters. Egg collection begins by collecting the wild trout just before they begin spawning. They are held, separated by sex, where they remain until they are able to be manually spawned. Then, each fish is gently squeezed to collect their gametes. The females' ova are fertilized with the males' sperm. The eggs are disinfected and then transported to a hatchery until the eggs mature. The mature eggs will then be ready to be stocked into the native, reclaimed waters.

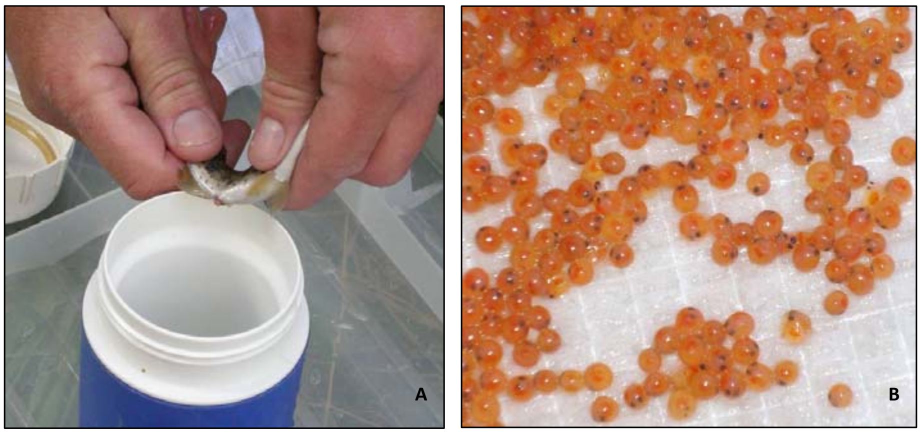

Image 1. A) A westslope cutthroat trout female being manually spawned. B) Mature trout eggs ready to reintroduce into their native waters.

Materials:

Part	Component	Quantity	Supplier	Price(each)
A	Live Car - Clear Rubbermaid container	3+		$25.00
B	5 Gallon Bucket	3	Consolidated Plastics	$17.92
C	Aerators - Frabill Min-O2-Life Air Pump	3	Cabela's	$19.99
D	Clove Oil or MS-22 (Tricane)			$10.00
E	Soft Towel	1		$2.00
F	Thermoses (one per female)	5+	Target	$10.99
G	Crochet Hook	1		$1.00
H	Ovadine - Disinfecting Iodine Solution	Gallon	Western Chemical Inc.	$23.50
I	Dispensing Syringe – 30cc	1	US Plastics Corp.	$0.50
J	Soft Side Cooler	1	Target	$26.99
			Total:	$137.89

Egg Collection Method Defined:

1) Have pre-spawn fish collected in live cars (A), sorted by sex, for a few days before taking eggs. Place cages holding males upstream of those with females.
2) Find a cool, shady (no direct sunlight), flat area that is close to a clean water source.
3) Cool all thermoses (F) with stream water.
4) Fill multiple buckets with clean water and add aerators (C).
5) Fill one bucket (B) with water and clove oil (D), to anesthetize fish.
6) Remove 3 to 4 females from a live car.
7) Add one fish to the clove oil solution, remove her when sedated.
8) Rinse fish with clean water, and dry with soft towel (E).
9) Gently squeeze eggs into a clean dry thermos (one fish's eggs per thermos).
10) Set thermos aside, repeat steps 6-9 with up to four females.
11) Return all females to live car(s).
12) Replace water in buckets with clean water.
13) Remove a few males from a live car.
14) Add one fish to clove oil bucket, remove him when sedated.
15) Rinse fish with clean water, and dry with soft towel.
16) Select a thermos with eggs.
17) Squeeze milt from fish, add a few drops to eggs (crochet hook (G) works well to "scoop" milt).
18) For increased genetic diversity, use multiple males per each female.
19) Add clean water (about a cup).
20) Gently swirl eggs and milt together.
21) Let eggs and milt mix for 45-60 seconds (eggs become sticky when fertilized), then rinse repeatedly with clean water.
22) Fill thermos with clean water, set aside.
23) Repeat steps 13-19, until the female's eggs are all fertilized.
24) Immediately after all the eggs are fertilized and thermos filled with water, add the correct amount of iodine (idophore) to each thermos. If using *Ovadine* (H), mix 1 part *Ovadine* to 200 parts water. Dispense with Syringe (I).
25) Let eggs water-harden for 30-60 minutes.
26) Rinse eggs repeatedly with clean water.
27) Repeat steps 1-23 for each group of four females.
28) Pack thermos in cooler (J).
29) Quickly transport the eggs to a hatchery for maturation.


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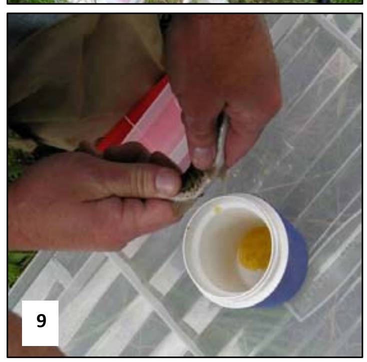
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Acknowledgements:

Special thanks to Lee Nelson of Montana Fish, Wildlife, and Parks for providing the bulk of the information found here. The process defined here is a direct copy of the method he demonstrated.

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Appendix 2: Remote Site Incubators: Construction and Installation

Remote Site Incubators (RSI) are used to rear fish eggs in isolated locations. They provide the eggs and developing fry with protection and habitat, increasing their survival rates. The general design of the RSI described here is a five gallon bucket fitted with an upstream inlet pipe and an outlet hole. Freshwater enters at the inlet pipe that directs the water into the bottom of the bucket, where the water percolates up thought the bucket and out the outlet hole. The internal components of the bucket include a basket that contains a layer of gravel, on which the eggs are placed and a layer of neutrally buoyant bio-media that cover the eggs. The gravel simulates the natural spawning habitat of many trout species and the bio-media provides habitat for the fry to develop in before escaping through the outlet hole.

Image 1: A) RSI setup in an inlet stream of High Lake. B) Recently emerged fry in a RSI.

Materials (per one RSI):

Part	Component	Quantity	Supplier	Price (each)
A	20' of 1'' Inch PCV schedule 40 piping	1	Mountain Supply Co.	$6.48
B	1''PVC Cross fitting	1	Mountain Supply Co.	$1.95
C	1''PVC End caps	4	Mountain Supply Co.	$0.36
D	1''PVC Threaded female end fitting	2	Mountain Supply Co.	$0.36
E	1''PVC Tee fitting	1	Mountain Supply Co.	$0.59
F	1''PVC Threaded male end fitting	4	Mountain Supply Co.	$0.40
G	1''PVC Shut off valve fitting	1	Mountain Supply Co.	$9.02
H	Bottle (1liter round squirt bottle)	1		$2.00
I	2'' Hose clamp	1		$2.00
J	Black 5 gallon buckets w/ press-on lid	2	U.S. Plastic Corp.	$6.56
K	12''x 12'' Stainless mesh (size 14) screen	1	TWP Inc.	$6.95
L	12'' Nylon string	2		$1.00
M	Bio-media, Intalox saddles poly-pro 35% $CaCO3$	1ft^3	Kock Glitsch	$85.00
N	PVC Primer	1	Mountain Supply Co.	$8.52
O	PVC Glue	1	Mountain Supply Co.	$7.12
			Total:	$147.51

Required Tools:

- Reciprocating saw.
- Electric drill.
- Grinder.
- 1 1/4'' inch hole saw.
- Propane torch.
- Large 1/8'' thick metal plate.
- 3/8'' drill bit.
- 1/8'' drill bit.
- Tin snips.
- Sand paper.
- Utility knife.
- PPE.

Building the RSI:

Part 1 – Inner Plumbing – See Figure 1.

1. Cut three 2.75'' pieces (A1) and one 3'' piece (A2) of 1'' pipe. Use sand paper to remove burrs and rough spots.
2. Prime and glue the four pieces of pipe into the cross fitting.
3. Prime and glue three end caps (C) to the ends of the 2.75'' pipe pieces (A1).
4. Prime and glue a threaded female end fitting (D) to the remaining 3'' pipe piece (Image 2).
5. Drill eight 3/8'' holes into one side of part 1 as seen in Image 2.

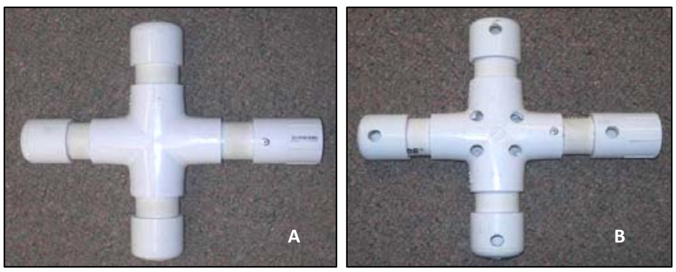


Image 2. A) Top side of part 1. B) Bottom side of part 1, notice location of the drilled holes.

Part 2 – Outer Plumbing- See Figure 1.

6. Cut two 3'' pieces of 1'' pipe (A2). Use sand paper to remove burrs and rough spots.
7. Prime and glue two 3'' pipe pieces into the sides of the tee fitting (E).
8. Cut a 12'' pipe piece (A3). Use sand paper to remove burrs and rough spots.
9. Prime and glue the 12'' pipe piece (A3) into the top of the tee fitting.
10. Prime and glue two threaded male end fittings (F) onto the 3'' pipe pieces (A2).
11. Prime and glue an end cap fitting (C) onto the 12'' pipe piece (A3).
12. Drill a 1/8'' hole through the top of the end cap fitting (C) attached to the 12'' pipe piece (A3).
13. Screw on shutoff valve fitting (G) on to one of the threaded male ends (F) (Image 3).

Image 3. Outer plumping assembly.

Part 3 – Inlet Pipe(s) and Straining Bottle.

14. Cut one 15' piece of 1'' pipe (A4). Use sand paper to remove burrs and rough spots. Note: Cut three 5' sections if easier transportation is required, also if RSI will be in a low gradient area add more 5' sections for extended reach.
15. Prime and glue a threaded male (F) and female end fitting (D) onto the ends of the 15' pipe piece (A4).
16. Cut off the top of the bottle (H), so that the top of the bottle fits on the end of the 15' pipe piece (A4).
17. Drill several dozen 1/8'' holes into the side of bottle (H).
18. Using the pipe clam (I), attach the bottle to the female end fitting (D) of the 15' pipe piece (A4) (Image 4).

Image 4. Straining bottle attached to end of inlet

Part 4 – Bucket and Lid.

19. Drill one 1 1/4'' hole into the side of one bucket (J1) about 1'' from the bottom.
20. Drill one 1 1/4'' hole into the side of the same bucket (J1), on the opposite side of the first hole, near the top (Image 5A).
21. Cut lid (J2) tabs (little holes around edge). Remove all tabs except two, on opposite sides (Image 5B).

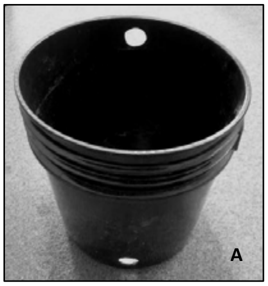
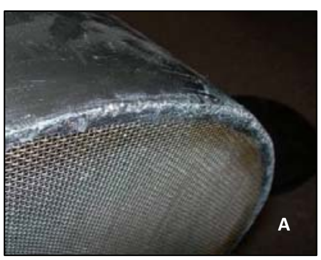


Image 5. A) Bucket with hole drilled into opposite sides. B) Bucket lid with all but two tabs removed; provides easy access into the inner workings.

Part 5 – Egg Basket.

22. Using the reciprocating saw cut the bottom out of a 5 gallon bucket (J1). Use 1 1/4'' hole saw to cut starter hole. Cut the burrs and high spots off with a sharp knife.
23. Measure and mark up 6'' from the bottom of the second bucket (J). Cut around the side of the bucket at the line.
24. Keep only the bottom half of the bucket (J3). Use sand paper and knife to remove burrs and rough spots.
25. Heat the bottom of the metal plate with the blow torch until the top of the metal plate is hot enough to melt the bucket plastic (Use a piece of scrap bucket as a test).
26. Place the mesh screen onto the metal plate, then push the bottom of the bucket section (J3) into the screen, so that the plastic melts into the mesh (K).
27. Continue rotating the bucket section until the entire bottom of the bucket section is melted into the mesh. Let cool. Note, mesh will likely warp to a bow shape.
28. Trim off mesh round bottom of bucket section with tin snips. Use grinder to remove sharp edges (Image 6A).
29. Drill two 1/8'' holes (one on each side) near the top of the bucket section (J3).
30. Tie a loop through each of the 1/4'' hole with nylon strings (L) (Image 6B).



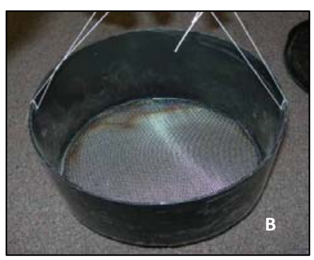


Image 6. A) Mesh melted into the plastic bucket. B) Finished egg basket.

Final Assembly – See Figure 2.

31. Place the inner plumbing into the bucket, with the holes faced down.
32. Push the male end of the outer plumbing into the hole at the bottom of the bucket.

33. Screw the male end of the outer plumbing into the female end of the inner plumbing (make sure holes in part 1 are faced down)
34. Screw the male end of the inlet pipe into the female end of the outer plumbing.
35. Insert the egg basket into the bucket.
36.

Add bio-saddles into the egg basket.

37. Attach lid.

Image 7: RSI setup properly in a small stream, water flowing from right to left.

Deployment:

1. Set RSI in a stream with the bucket downstream.
2. Make sure that the bottle at the end of the pipe is higher than the top of the bucket or the water will not flow correctly.
3. If necessary, make a small dam in the creek to create a collecting pool and to gain needed head pressure.
4. Use rocks to stabilize and level the bucket and hold down piping.
5. Once water is flowing correctly, allow RSI to run for a few minutes to flush out debris.
6. Remove the eggs basket. Fill basket with a 1'' layer of small spawning size gravel.
7. Rinse gravel repeated, until all loose debris is removed.
8. Place egg basket w/ gravel back in the bucket.
9. Add a 6'' layer of bio-media into the eggs basket.
10. Let RSI run for several minutes or until water is flowing clear.
11. Remove bio-media.
12. Turn off valve.
13. Lift egg basket until gravel is just under the surface of the water, then gently wash eggs onto the gravel layer.
14. Lower basket so that the eggs "swirl" and evenly distribute on the gravel.
15. Place bio-media on top of eggs.
16. Turn on valve.
17. Place lid on bucket.

Image 8: A) Looking upstream at a RSI, notice the amount of drop from the straining bottle to the bucket. B) Eggs on the gravel layer before the addition of the bio-media.

Monitoring and Maintenance:

After eggs are introduced into the RSI, it may take several weeks before the all fish have exited. During this period conditions will change, which may require alterations to the RSI's setup. The most important factor in the monitoring of the RSI is making sure they maintain water movement. If water stops flowing the eggs and fry will die. Water can stop flowing correctly for several reasons. If the stream flow drops considerably water may drop below the intake pipe, stopping flow. Similarly, if the small dam, built to increase the size of the collecting pool and gain head pressure, fails it may cause the inlet pipe to no longer properly gather water. Also, if the stream is high in debris, partials may plug the holes in the straining bottle slowing or stopping flow. It is important to regularly check the RSI to catch and fix any problems that may occur.

Acknowledgements:

Special thanks to Lee Nelson of Montana Fish, Wildlife, and Parks for sending providing the bulk of the information found here. The RSI shown here is a direct copy of the example he sent.