Great Basin National Park

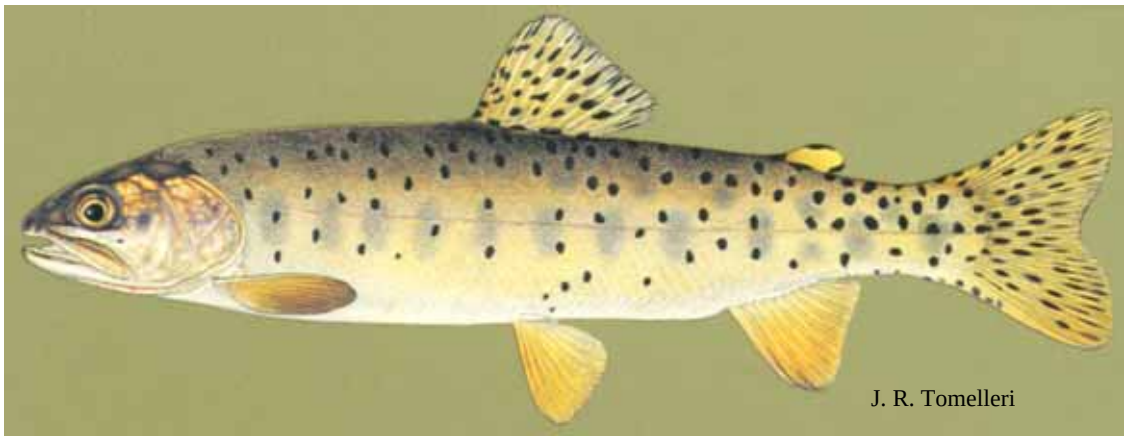
Bonneville Cutthroat Trout Reintroduction

Program

FY2002

Progress Report

October 2002



Bonneville Cutthroat Trout
(*Oncorhynchus clarki utah*)

U. S. Department of the Interior
National Park Service

Great Basin National Park

Bonneville Cutthroat Trout Reintroduction Program

FY2002

Progress Report

PREPARED BY:_____
Gretchen Schenk, Biological Science Technician

REVIEWED BY:_____
Neal Darby, Fish and Wildlife Biologist

SUBMITTED BY:_____ _____
Tod Williams, Chief, Resource Management Date

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ABSTRACT

During FY2002, Bonneville cutthroat trout (BCT) were reintroduced into Strawberry Creek, the fifth stream in the park now containing BCT. One stream was prepared for reintroduction, by treating it with antimycin to remove non-native trout. Another stream was surveyed and fish removed via electrofishing. In addition to stream treatments, park staff performed effectiveness monitoring and pretreatment surveys on four streams as described in the BCT Reintroduction Plan. Reintroduced BCT in Big Wash have grown 60% in length in two years, and several were larger than any of the fish found in the donor population. In addition, young fish were caught, indicating that the population is reproducing. Volunteers contributed over 700 hours to the project in FY02. Media coverage of the BCT project included National Geographic Channel, radio from Las Vegas and an article in the August issue of the *National Park International Bulletin.* The Park's work in BCT reintroduction was a major factor in the U.S. Fish & Wildlife Service decision to preclude the need to list the species as threatened under the Endangered Species Act (ESA). This was a significant proactive move by the Service that has eased any ESA regulatory burden from private landowners within the range of the BCT. The Park has strengthened its relationship with interagency partners and has become a leader in reestablishing BCT in Nevada. FY02 budget was $74,000 and all was expended. This included macro invertebrate analysis, genetic analysis, field crews for 6 months and all equipment and supplies needed to complete the task as designed.

INTRODUCTION

A Bonneville Cutthroat Trout Reintroduction and Recreational Fisheries Management Plan for Great Basin National Park was completed in March 1999 and signed by the Regional Director November 10, 1999. The primary objective of the plan is the reestablishment of viable populations of western Bonneville Cutthroat Trout (BCT), the only native salmonid that occurs within Great Basin National Park.

This progress report provides broad descriptions of accomplishments as outlined in the timeline. More detailed individual reports on specific tasks (i.e., mollusks, rotenone effects on macroinvertebrates, etc.) will be prepared as part of data analysis and summaries conducted during the winter of FY2003. These detailed individual reports will be distributed as completed. The report also presents other pertinent findings and activities, including using streamside incubators and developing a recreational fisheries brochure.

ACKNOWLEDGEMENTS

During the FY2002 field season, Neal Darby, wildlife/fish biologist, and Gretchen Schenk, biological technician, were joined by returning seasonal biological technician Fred Gender and new seasonal bio-tech Sabrina DeRusseau. Ray Hickey, a Student Conservation Association (SCA) volunteer, contributed over 600 hours to the BCT program. We would also like to thank numerous volunteers who spent over 250 hours assisting on a variety of projects.

WORK COMPLETED

During FY2002, we followed the Project Timeline as indicated in the implementation plan (Appendix 1), with changes noted below in the summary for each creek. A map showing the location of these creeks within the park is found in Figure 1.

Tasks that are listed for multiple months are completed in each of those months. For field activities such as baseline surveys, this is to ensure that each season is represented, since water quality varies greatly from spring runoff to late summer low-water, and macroinvertebrates peak in the spring and nearly disappear in the winter. Baseline surveys and pre- and post-treatment monitoring include collecting water quality measurements, macroinvertebrates and mollusks. Water quality measurements include temperature, dissolved oxygen, conductivity, pH, turbidity and flow, along with taking a water sample that is analyzed in our water quality lab for nitrates, phosphates, alkalinity, hardness, sulfates and silica. Physical habitat and amphibian surveys are completed when we first start working on a creek. Any changes in physical habitat or any amphibian sightings during subsequent surveys and monitoring will be documented. Amphibian surveys in FY02 were generally done separately from baseline surveys by a separate crew.

Strawberry Creek. Thirty-four BCT were moved into Strawberry Creek from Mill Creek. These fish will provide the base for the new population and will be supplemented with additional reintroductions in future years. This reintroduction followed post-treatment monitoring in May and September, including macroinvertebrate sampling (see section in "Results of Specific Parameters") and water quality testing. In addition, post-treatment monitoring included electroshocking the entire stream with the Nevada Division of Wildlife (NDOW), to ensure that it was fishless.

Snake Creek. We conducted pre-treatment monitoring of macroinvertebrates, mollusks, amphibians, and water quality of Snake Creek in May and July to prepare for the antimycin treatment in August. The last fish locations of Snake Creek in the main fork, the north fork and the south forks remained the same in 2002, which gave us great confidence in where to place the antimycin stations, since the last fish locations have remained the same as in 2000 and 2001.

On August 4, a pre-treatment safety and coordination meeting was held with personnel from NDOW, USFS, USFWS, and NPS present. Treatment started the morning of August 5 and continued through August 10. The treatment is summarized in the Upper Snake Creek Fish Eradication Progress Report in Appendix 2.

Volunteers assisting with pre-treatment fish population surveys along Snake Creek.

Mill Creek. We spent a lot of time and effort determining when BCT spawn in Mill Creek in the hopes of using streamside incubators to supplement BCT reintroduction. We were successful in finding BCT spawning in late June and early July, but the streamside incubators did not work as planned, as reported in Appendix 3.

The Wild Salmon and Trout Genetics Lab at the University of Montana reported that using the Paired Interspersed Nuclear Elements (PINE) technique, the Mill Creek trout are pure Bonneville cutthroat, as Dr. Shiozawa's lab had previously reported. Both labs also reported that Mill Creek and Pine and Ridge Creek are virtually identical genetically. These reports give more strength to the hypothesis that the fish in these creeks arrived there via the Osceola Ditch in the late 1890s.

South Fork of Big Wash. Nine trips were taken into the South Fork of Big Wash during the field season to assess any fire damage on the stream from the Granite Fire (2001). Water quality was monitored by collecting stream samples and also using stormwater samplers, which collected 800 mL samples during peak runoff. No negative effects from the fire were noted in the stream until late September, following a flash flood, when water quality samples indicated higher turbidity, nitrate and phosphate concentrations. Adult fish were found in the pools, but some of the pools had up to an inch of silt covering spawning gravel, so this year's young may not have survived. Additional electrofishing surveys in 2003 are needed to determine fish populations and distribution. These surveys will be complicated by more difficult access since several miles of road also washed out during the flash flood.

A fish survey completed in August before the flash flood found small fish, in the 50 – 100 mm range, and larger fish in the 150 mm- 260 mm range. The smaller fish appear to be young from 2001; the larger fish have increased substantially (60% in length) since they were transplanted from Mill Creek.

Bonneville cutthroat trout from the South Fork of Big Wash. These reintroduced fish have grown 60% in length since they have been moved.

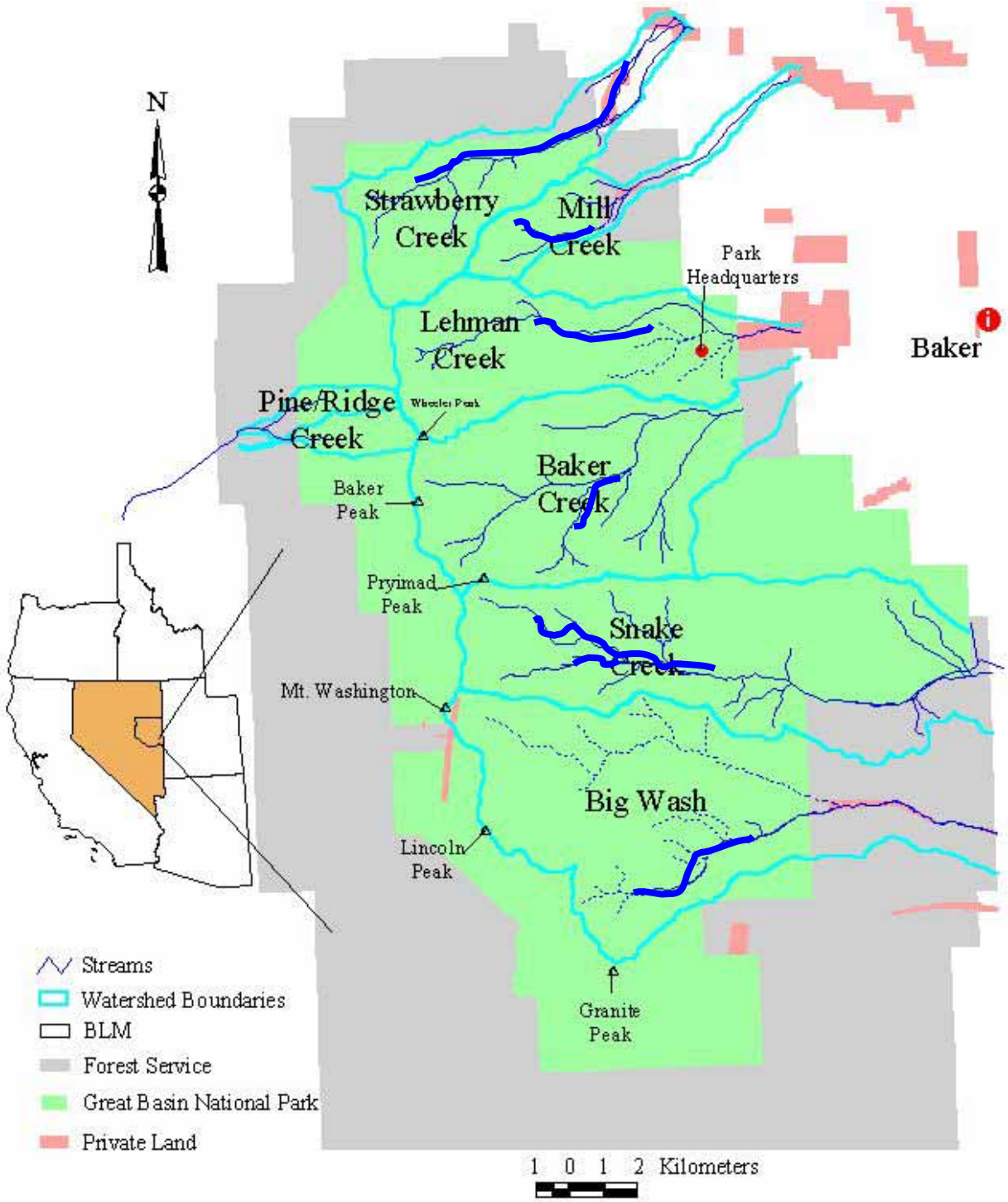

Figure 1. Existing and proposed Bonneville Cutthroat Trout watersheds in Great Basin National Park, Nevada.

South Fork of Baker Creek. An electrofishing survey completed in May showed trout in the lower areas of South Fork of Baker Creek, but only two fish in the upper meadow. No fish were located beyond the meadow. A second electrofishing survey removed four fish from the upper meadow. Two died of electrofishing burns; the other two were fin-clipped and taken lower in the stream, below a waterfall that appears to be a barrier. This area will be shocked again in FY2003 to determine if the waterfall is indeed a barrier and if this is a viable location for BCT reintroduction.

Electrofishing the meadow area of South Fork of Baker Creek.

Upper Lehman Creek. Upper Lehman Creek has been removed from the list of possible BCT reintroduction sites due to concern of downstream residents regarding treatment of water that serves as their drinking source.

Pine/Ridge Creek. Genetic results from Dr. Shiozawa at Brigham Young University and the Wild Salmon and Trout Genetics Lab at the University of Montana indicate that Pine/Ridge BCT are nearly identical to Mill Creek BCT. A diary located by local resident Kathy Rountree indicates that people used to fish the "ditch". The Osceola Ditch ran from Lehman Creek to Osceola from 1891-1901, taking water to the mining town. It crossed several other creeks and ended in a pond that connected to a ditch on the west side of the mountain. It seems likely from this written report and from the genetics that BCT from Lehman Creek swam into the ditch and escaped into Mill, Pine, and Ridge Creeks. They most likely also got into some of the other creeks, but non-native introductions have obscured or decimated those populations.

RESULTS OF SPECIFIC PARAMETERS

Macroinvertebrates. Macroinvertebrates were collected in Strawberry and Snake Creeks during FY2002 in order to compare the response of macroinvertebrates population and diversity to rotenone and antimycin. The Buglab at Utah State University analyzes the samples and returned the one-year post treatment results for Strawberry Creek. Table 1 exhibits the immediate effects of rotenone. At one-week post-treatment, overall macroinvertebrate taxa richness and abundance experienced declines up to 93 percent whereas the more pollution sensitive taxa experienced 100 percent declines. Pollution sensitive taxa include the orders Ephemeroptera, Plecoptera and Trichoptera (EPT). However, recovery began by one month post-treatment.

At one year post-treatment, taxa richness exceeded our objectives of 75 percent for both overall and EPT macroinvertebrates (Figure 3). Taxa richness was between 79 and 81 percent of pre-treatment levels. Abundance recovery did not quite meet our objectives, reaching 70 percent of pre-treatment levels (Figure 4, Table 1). The slow recovery response of EPT macroinvertebrates at only 58 percent (Table 1) was the reason abundance objectives were not met.

Table 1. Percentage declines from pre-treatment taxa richness and abundance of total macroinvertebrates and the Ephemeroptera, Plecoptera and Trichoptera (EPT) pollution sensitive macroinvertebrates.

	Total Taxa		**EPT Taxa**	
	Richness	**Abundance**	**Richness**	**Abundance**
1-day Post-treatment	- 81%	- 85%	- 98%	- 97%
1-week Post-treatment	- 89%	- 93%	- 100 %	- 100 %
1-month Post-treatment	-76%	- 84%	- 94%	- 98%
1-year Post-treatment	- 19%	- 30%	- 21%	- 42%

Further long-term monitoring of rotenone treated waters is recommended since all monitoring projects, including this one, have noted the continued absence of some genera/species. They appear to have been replaced by previously undetected genera/species. It needs to be determined if rotenone treatments permanently or temporarily alter the macroinvertebrate community.

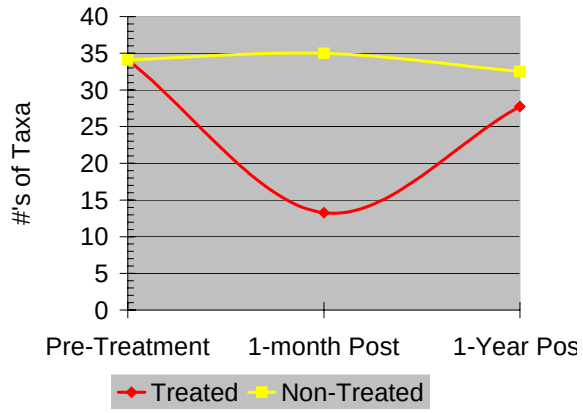

Figure 3. Macroinvertebrate Taxa Richness trends. Dashed line represents 75 percent of the number of Taxa detected from pre-treatment samples.

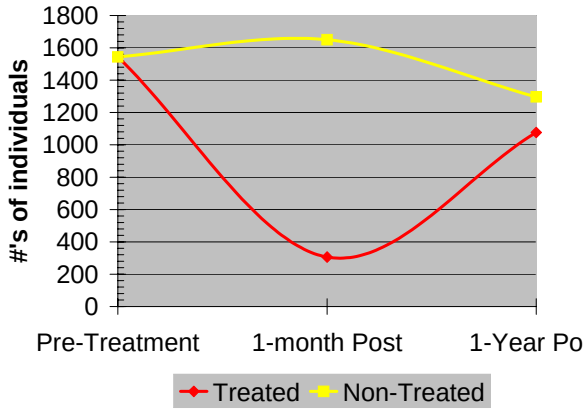

Figure 4. Trends of the numbers of individual macroinvertebrates detected. Dashed line represents 75 percent of the numbers detected pre-treatment.

Mollusks. The primary mollusk of interest is the Great Basin Spring Snail (Family: Hydrobiidae), which is under a Memorandum of Understanding for Conservation with four federal agencies and two private organizations. Surveys during the past three years have indicated that snails are uncommon in streams, although freshwater clams are rare to abundant. No spring snails have been located within the Park, so mollusk surveys have been combined with macroinvertebrate surveys, since the Buglab also identifies mollusks.

Water Quality. We improved the water quality measurements during FY2002 by expanding our quality assurance/quality control. No unusual water quality measurements were found during the season, and all were close to FY2001 water quality parameters, presented in Table 3.

Table 3. Basic Water Quality Parameters in Selected Streams

	Temp. (C^o)	pH	Dissolved O_2 (%)	Specific Conductivity (μ/s @ 25^oC)	Water Flow cfs (cms)
Strawberry Creek	**9.7**	**7.8**	**73.39**	**73.84**	**2.90 (0.08)**
Snake Creek	**9.4**	**7.8**	**73.04**	**77.5**	**3.37 (0.10)**

Amphibians. No amphibians were found in the Park, despite an intensive summer-long amphibian search by a dedicated two-person amphibian crew.

OTHER SPECIFIC WORK COMPLETED

Upper Snake Creek Fish Eradication Progress Report. See report in Appendix 2.

Attempt to Use Streamside Incubators. See report in Appendix 3 and protocols in Appendix 4.

Recreational Fisheries Brochure
The recreational fisheries brochure has expanded to include both the North and South Snake Ranges. The Unicor company Kota has been selected to design and print the brochure, and NDOW, BLM, USFS, and NPS are all contributing funds for the production. If all parties come through with the promised funds, the final brochure should be ready for distribution in spring of 2003.

Media Coverage/Publications/Presentations
We informed the public of our project by writing articles for the Park newspaper and resource management newsletter. In addition, National Geographic Explorer filmed a segment on BCT reintroduction, including an interview with Neal Darby and footage of BCT in Mill Creek. The segment aired on its *National Geographic Today* program in September. *The National Park International Bulletin* published an article written by Gretchen Schenk about BCT reintroduction. In addition, Radio720 from Las Vegas did a live broadcast featuring local park issues, including an interview with Gretchen Schenk about BCT. Neal Darby showed a poster about macroinvertebrate response to rotenone at the West by Northwest conference in March.

FUTURE WORK
In FY2003, we will continue the BCT reintroduction program by following the timeline in the implementation plan. The most important components of this plan are:

- Continue monitoring Snake Creek.
- Reintroduce BCT into Snake Creek.

Changes to 2003 Project Timeline:

- All activities associated with Lehman Creek will be deleted.
- Chemical treatment of South Fork Baker Creek is not indicated at this time; instead electrofishing will be used to remove any last fish, unless conditions change.
- All other timeline tasks remain the same.

APPENDIX 1

PROJECT TIMELINE		
FISCAL YEAR	MONTH	TASKS
2001	OCT	Conduct the one-month post-Treatment monitoring on Strawberry Creek.
		Data summary analysis.
	NOV	Data Summary analysis.
		Conduct second month post-Treatment monitoring on Strawberry Creek, if possible.
	DEC	Data Summary analysis. Database modifications.
		Conduct post-Treatment monitoring on Strawberry Creek, if possible.
	JAN	Data Summary analysis. Database modifications.
		Conduct post-Treatment monitoring on Strawberry Creek, if possible.
	FEB	Data Summary analysis. Database modifications.
		Conduct second month post-Treatment monitoring on Strawberry Creek, if possible.
	MAR	Conduct post-Treatment monitoring on Strawberry Creek, if possible.
		Conduct Spring baseline surveys on Snake Creek.
	APR	Conduct post-Treatment monitoring on Strawberry Creek, if possible.
		Monitor for BCT spawning in Mill Creek and S Fk Big Wash.
	MAY	Conduct post-Treatment monitoring on Strawberry Creek.
		Tag 100-150 nonnative fish for movement study on South Fork of Baker Creek and Upper Lehman Creek.
		Conduct baseline surveys on Snake Creek.
		Conduct Amphibian surveys of South Fork of Baker Creek and Lehman Creek.
	JUN	Conduct post-Treatment monitoring on Strawberry Creek.
		Survey for mollusks in springs and seeps along Snake Creek, South Fork of Baker Creek and Upper Lehman Creek.
		Collect tissue samples of BCT in Pine/Ridge Creek and Hendry's Creek for genetic analyses.
	JUL	Conduct post-Treatment monitoring on Strawberry Creek.
		Survey for mollusks in springs and seeps along Snake Creek, South Fork of Baker Creek and Upper Lehman Creek.
	AUG	Conduct post-Treatment monitoring on Strawberry Creek.
		Survey for mollusks in springs and seeps along Snake Creek, South Fork of Baker Creek and Upper Lehman Creek.
		Conduct baseline surveys on Snake Creek, South Fork of Baker Creek and Upper Lehman Creek.
	SEP	Conduct post-Treatment monitoring on Strawberry Creek.
		Conduct baseline surveys on Snake Creek, South Fork of Baker Creek and Upper Lehman Creek.

PROJECT TIMELINE		
FISCAL YEAR	MONTH	TASKS
2002	OCT	Conduct the one-year post-Treatment monitoring on Strawberry Creek.
		Data summary analysis and completion of 2001 progress report.
	NOV	Macroinvertebrate samples to National Aquatic Monitoring Center.
		Data Summary analysis.
		Attend annual rangewide BCT accomplishments meeting.
	DEC	Data Summary analysis. Database modifications.
	JAN	Data Summary analysis. Database modifications.
		Attend annual Nevada BCT meeting.
	FEB	Data Summary analysis. Database modifications.
	MAR	Data Summary analysis. Database modifications.
		Participate in West by Northwest NPS conference, including submitting a poster
		Attend annual rangewide BCT meeting
	APR	Conduct spring baseline surveys on Snake Creek, S Fk Baker Creek
		Assist NDOW with obtaining fin clips from Hendrys Creek.
		Shock Strawberry Creek to ensure that no fish remain.
	MAY	Conduct post-Treatment spring monitoring on Strawberry Creek.
		Conduct Amphibian surveys on Snake Creek and S Fk of Baker Creek
		Monitor BCT spawning in Mill Creek and S Fork of Big Wash. Use streamside incubators, if indicated.
		Monitor WQ and macros in S Fk Big Wash to measure effects of Granite Fire.
	JUN	Survey for mollusks in springs and seeps along Snake Creek, S Fk Baker Creek
		Monitor for BCT spawning in Mill Creek and S Fk Big Wash; Use streamside
		incubators, if indicated.
		Monitor WQ and macros in S Fk Big Wash to measure effects of Granite Fire.
	JUL	Conduct pre-treatment surveys on Snake
		Monitor WQ in S Fk Big Wash to measure effects of Granite Fire.
		Conduct fish population surveys on Snake/Baker/Lehman Creeks
	AUG	Treat Upper Snake Creek with Antimycin. Conduct post-treatment monitoring.
		Conduct baseline surveys on South Fork of Baker Creek.
		Tag fish on SF Baker and Lehman.
		Monitor WQ in S Fk Big Wash to meaure effects of Granite Fire.
	SEP	Conduct baseline surveys on South Fork of Baker Creek
		Conduct two-year post-tx monitoring on Strawberry Creek
		Conduct post-Treatment monitoring on Snake Creek.
		Conduct removal depletion survey of BCT in S Fk Big Wash. Monitor WQ in S Fk Big Wash to meaure effects of Granite Fire.

PROJECT TIMELINE		
FISCAL YEAR	MONTH	TASKS
2003	OCT	Conduct post-Treatment monitoring on Snake Creek.
		Data summary analysis and completion of 2002 progress report.
		Reintroduce BCT to S Fk Big Wash and Strawberry Creek, if needed.
	NOV	Macroinvertebrate samples to National Aquatic Monitoring Center.
		Data Summary analysis.
		Conduct post-Treatment monitoring on Snake Creek, if possible.
		Attend annual rangewide BCT accomplishments meeting
	DEC	Data Summary analysis. Database modifications.
	JAN	Data Summary analysis. Database modifications.
		Attend annual Nevada BCT meeting
	FEB	Data Summary analysis. Database modifications.
	MAR	Data Summary analysis. Database modifications.
		Attend annual rangewide BCT planning meeting
	APR	
		Conduct post-Treatment monitoring on Snake Creek.
	MAY	Conduct post-Treatment monitoring on Snake Creek.
		Conduct amphibian and electrofishing surveys on South Fork of Baker.
		Conduct spring baseline surveys on S Fk Baker Creek and Upper Lehman Creek
		Monitor for BCT spawning in Mill Creek, S Fk Big Wash and Strawberry. Use streamside incubators, if indicated.
	JUN	
		Monitor for BCT spawning in Mill Creek, S Fk Big Wash and Strawberry
		Creeks. Use streamside incubators, if indicated.
		Conduct post-Treatment monitoring on Snake Creek.
	JUL	Survey for mollusks in springs and seeps along South Fork of Baker Creek
		Monitor for spawning.
		Conduct post-Treatment monitoring on Snake Creek.
	AUG	Conduct pre-treatment monitoring on South Fork of Baker
		Treat S Fk Baker Creek with appropriate piscicide, if surveys indicate appropriate
		Conduct one-year post-Treatment monitoring on Snake Creek.
	SEP	
		Conduct two-year post-Treatment monitoring on Strawberry Creek.
		Completion of Final Report for submittal in October, including database template and GIS themes.

APPENDIX 2:
Upper Snake Creek Fish Eradication Progress Report

DATE: August 5 – 10, 2002

FIELD PARTY: Project Leaders
Neal W Darby, Great Basin National Park
Steve E. Moore, Great Smoky Mountains National Park
Matt Kulp, Great Smoky Mountains National Park
Gretchen Schenk, Great Basin National Park

Project Support
Chris Crookshanks, Nevada Division of Wildlife
Bob Layton, Nevada Division of Wildlife
Corey Hawkins, Nevada Division of Wildlife
Brian Hobbs, Nevada Division of Wildlife
Alan Jenne, Nevada Division of Wildlife
Mike Sevon, Nevada Division of Wildlife
Jim Heinrich, Nevada Division of Wildlife
Brandon Miller, Humboldt National Forest
W. Doug Larson, Humboldt National Forest
Mark Maley, U.S. Fish and Wildlife Service
Fred Gender, Great Basin National Park
Ray Hickey, Great Basin National Park
Bryan Hamilton, Great Basin National Park
Karinne Knutsen, Great Basin National Park
Melissa Brickl, Great Basin National Park
Chris Kuhnel, Great Basin National Park

PREPARED BY: Neal W Darby _____
Gretchen Schenk_____

OBJECTIVE

- To eradicate the nonnative Brook Trout (*Salvelinus fontinalis*) population in 4.2 miles of Upper Snake Creek within Great Basin National Park using the fish toxicant antimycin, brand name Fintrol.
- To re-establish genetically pure Bonneville cutthroat trout (*Oncorhynchus clarki utah*) populations in Upper Snake Creek once the creek has recovered.
- Maintain the brown trout (*Salmo trutta*) fisheries in the 2.3 miles of lower Snake Creek within Great Basin National Park and beyond to Garrison, Utah.

BACKGROUND

The Bonneville cutthroat trout is one of three subspecies of cutthroat trout native to Nevada. It is native to pluvial Lake Bonneville whose drainages covered parts of Nevada, Idaho, Wyoming, and Utah. Its native habitat in Nevada is limited to the extreme eastern

border of the state and the only portion of this area that is known to have been occupied by Bonneville cutthroat trout (BCT) is the Snake Valley drainage.

Written in 1999, an objective of the Conservation Agreement and Strategy for Bonneville Cutthroat Trout in the State of Nevada (Haskins) is to "establish additional populations of BCT in Nevada within its historic range." The completion of this objective is required in order to attain the goal of the conservation agreement, which is to "ensure the long-term conservation of BCT in Nevada." Furthermore, an objective of the Great Basin National Park BCT Reintroduction and Recreational Fisheries Management Plan (Williams, 1999) is to "reestablish viable populations of Western BCT in Great Basin National Park."

Upper Snake Creek was determined to be one of the reintroduction sites (Figure 1). Snake Creek can be divided into three sections, Upper, pipeline and lower sections. Upper Snake Creek includes the headwaters which arise in three separate forks. The North Fork of Snake Creek becomes perennial at 9600 feet, below Johnson Lake. The Middle Fork of Snake Creek becomes perennial at 9200 feet, below Dead Lake. The South Fork of Snake Creek becomes perennial at 9000 feet. The North Fork and Middle Fork join at 8600 feet and are met by the South Fork at 8100 feet. The stream then descends to 7610 feet where it enters a three-mile long pipeline. There are over five total stream miles in Upper Snake Creek.

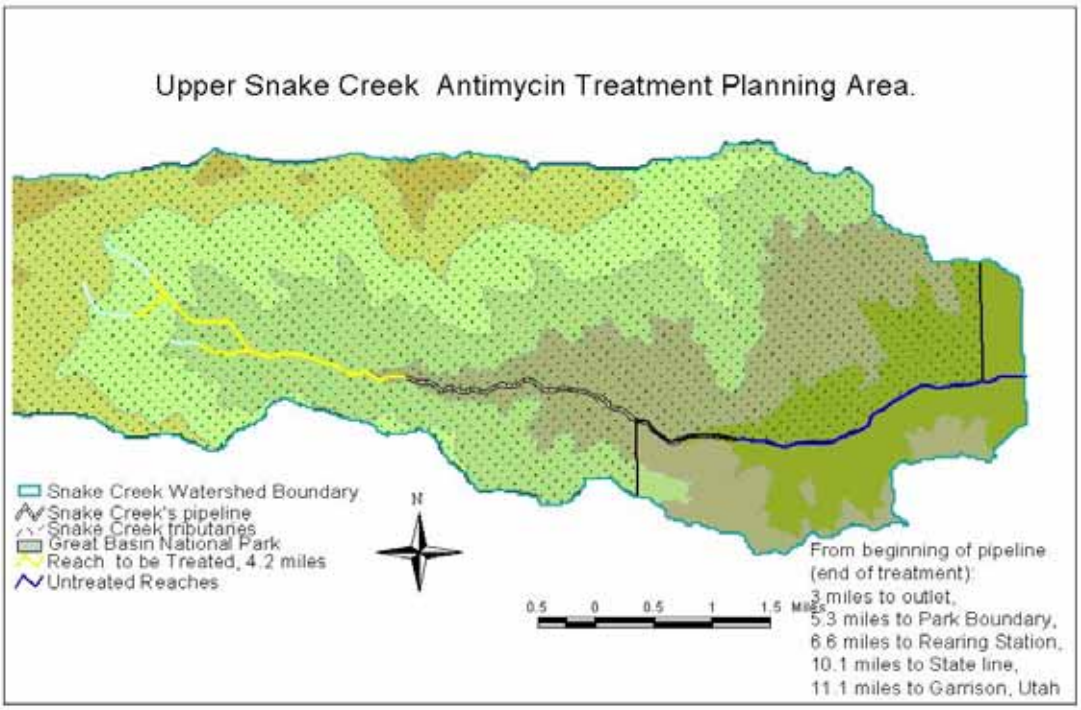

Figure 1. Upper Snake Creek antimycin treatment planning area.

The Pipeline section is a diversion of Snake Creek into a pipe in order to bypass karst geology that may lose water. The pipeline section is three miles long. At the end of the pipe water is released into the original stream channel. As a result of the pipe, three miles of the original stream channel is dry 11 months of the year, and carries water only during snow runoff in late May and June.

After exiting the pipe, the lower section of Snake Creek runs for 2.3 miles before leaving Great Basin National Park. It then crosses 1.3 miles on U.S. Forest Service land, 0.5 miles of State Land (Spring Creek Rearing Station NDOW) and 3.0 miles on Bureau of Land Management land to the stateline of Utah and Nevada. Snake Creek goes for an additional one mile in Utah where it is then used for irrigating crops near Garrison, Utah. In all, Snake Creek flows for 9.5 miles in GBNP and an additional 5.8 miles on other federal, state and private lands.

PROCEDURES

Pretreatment

Surveys to obtain baseline conditions on physical and biological attributes in Snake Creek were begun in 2000 and completed prior to treatment. Physical characteristics, including pebble counts, pool/riffle ratio, and water quality parameters were measured. Biological surveys included fish, macroinvertebrate, mollusk and amphibian surveys. Fish surveys determined distribution, density and species composition using spot surveys and multipass-depletion surveys. Macroinvertebrates were sampled at eight locations throughout Snake Creek to determine density and species composition. Surveys for mollusks, particularly Great Basin spring snails (Family Hydrobidiia) were conducted within Snake Creek and in adjacent springs. Finally amphibians surveys were conducted along Snake Creek.

Overall, the results of these surveys showed that the planned treatment area of Upper Snake Creek contained excellent water quality and flows. The treatment area contained only one fish species, brook trout, at densities exceeding 2,000 fish per mile and to elevations of 8,800 feet. Lower Snake Creek contained brown trout at densities exceeding 2000 fish per mile. A few brook trout were documented at the pipe outlet. No Great Basin spring snails were found within Snake Creek, however, three springs adjacent to lower Snake Creek but outside the planned treatment area contain spring snails. No amphibians have been observed.

Other pre-treatment activities included the construction of equipment to dispense antimycin and potassium permanganate into the stream at desired rates. In addition, Snake Creek was walked and flagged every 100 meters (Figure 2). At each flag the elevation in feet was recorded using an altimeter. Macroinvertebrates were again sampled for pretreatment densities and flows in cubic feet per second were recorded. A toxicity test was done July 22-25 to determine the amounts of antimycin and potassium permanganate needed in Snake Creek waters (Photo 1). Prior to the treatment fish were

captured and placed in cages for a source of fish for live cages to be used in tracking the treatment.

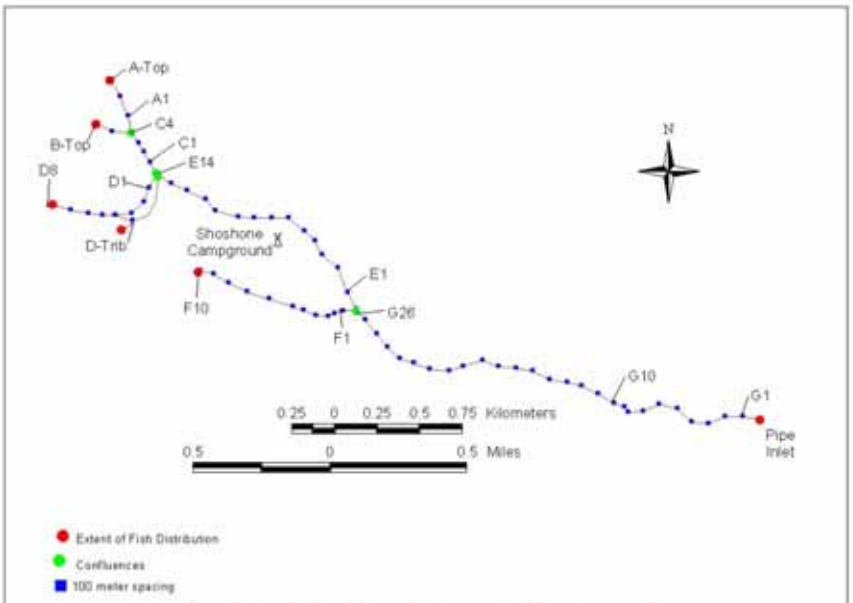

Figure 2. Upper Snake Creek treatment area with 100 meter segments.

Four validation surveys were conducted to attempt to test the validity of our fish population estimates. Multi-pass depletion surveys were conducted and all fish captured had the right pelvic fin clipped and returned to the survey reach. Block nets remained up throughout the treatment. Fish were then collected from the survey reaches after the treatment, their length measured and fin clip noted. At least three passes would be done to collect fish.

Photo 1. Toxicity test to determine amounts of antimycin and potassium permanganate needed for the treatment.

Treatment

Starting August 4th, each day water flows (discharge) were recorded and used to determine the amount of Fintrol to dispense at each station on the following day. Because of rains on August 2nd, flows increased to seven cfs at the pipe inlet on August 4th.

For the first day of treatment, antimycin stations were placed approximately 100 meters above the last known fish locations on the middle and north forks of Snake Creek. Stations consisted of five gallon buckets with an outlet controlled by an on/off valve. A hose ran from the outlet to a dog waterer that is suspended over the stream. The dog waterer has a float that controls the flow of Fintrol into the dish. A 1/16 inch hole was drilled in the bottom of the dish to allow Fintrol to drain into the stream. The flow is monitored and maintained at one gallon per hour for eight hours with a concentration of eight parts per billion (ppb) (Photo 2).

Photo 2. Measuring out antimycin for the drip station.

Fish cages with live fish were placed at approximately 100 meter intervals on the stream to monitor how far the antimycin carried in the stream. The cages were monitored each morning (Photo 3) to determine where to place that day's antimycin stations. For example, if mortality was complete in three cages (300 meters) below a station but not complete at the fourth cage after 24 hours, the next station would be set up just above the third cage on the following day.

Photo 3. Checking a fish cage.

Table 1 provides an overview of the number of stations run and the amount of Fintrol dispensed from each station. A total of 4,005 ml of Fintrol was dispensed from the antimycin stations. Concentrations in the headwater streams exceeded 8 ppb because springs added to the flow below the station. To maintain 8 ppb for the length of the proposed treated reach, Fintrol concentration needed to be higher at the station.

Date	Location	Flow (cfs)	ml of Fintrol	Antimycin concentration at station (ppb)	ml Fintrol dispensed in backpack sprayers
Aug. 5, 2002	Top A	0.3	33	13.4	32
	Top B	0.3	33	13.4	
	Top D	0.8	130	20.3	
Aug. 6, 2002	C-2	0.12	33	33.8	35
	C-0	0.12	33	33.8	
	D-6	0.7	65	11.4	
	D-4	0.7	65	11.4	
	D-2	0.7	65	11.4	
	D-Trib top	0.09	13	17.8	
Aug. 7, 2002	C-1	0.12	33	33.8	36
	D-5	0.7	96	16.8	
	D-4	0.7	80	14.0	
	E-14	1.3	96	9.1	
	E-10	1.3	96	9.1	
	E-7	1.3	96	9.1	
	D-Trib. #1	0.09	30	40.1	
	D-Trib. #2	0.09	36	49.2	
Aug. 8, 2002	E-4	1.3	98	9.26	69
	E-2	1.0	85	10.5	
	F-10	2.3	176	9.4	
	F-8	2.3	176	9.4	
	F-6	2.7	176	8.0	
	F-3	2.7	176	8.0	
	F-1	2.7	215	9.8	
	G-25	3.0	215	8.8	
Aug. 9, 2002	G-22	3.0	195	8.0	78
	G-19	3.0	195	8.0	
	G-17	3.0	195	8.0	
	G-12	3.0	195	8.0	
	G-9	3.0	195	8.0	
	G-5	3.0	195	8.0	
Aug. 10, 2002	E-8	3.0	113	7.4	0
	F-7	2.7	176	8.0	
	G-14	3.0	196	8.1	
Total			4005		250

Table 1 Amount of Fintrol dispensed each day at each station. Refer to Figure 2 map for locations.

In addition to the fixed stations, a backpack sprayer was used to treat back eddies of the streams and adjacent springs and seeps with potential to support fish (Photo 4). A total of 250 ml of Fintrol was sprayed over the five days. Areas sprayed corresponded to the treated reach for that day.

Photo 4. Using a backpack sprayer to treat a seep.

Although antimycin in some streams carries within an elevation drop of 250 ft., in Upper Snake Creek the antimycin completely broke down and became non-toxic at approximately every 60 feet drop in elevation. Stations had to be added and moved closer together to accomplish effective treatment, requiring us to run up to eight stations a day to finish the project in the planned timeframe. Since we had anticipated using no more than three antimycin stations a day, this increase also upped the amount of antimycin we had planned on using (1,700 ml stated in the permit application).

Because we wanted to maintain the brown trout fisheries below the pipeline in lower Snake Creek, antimycin needed to be detoxified as it came out of the pipe. A detoxification station to dispense potassium permanganate was set up at the pipe outlet. Original plans were to set the detox station at the pipe inlet, but after discussions concerning the 50 year old galvanized pipe and the fact that potassium permanganate is a very strong oxidizer, concerns over damaging the pipe led to the decision to place the detox station at the pipe outlet. The detox station was made with two 35 gallon drums connected by hoses to float boxes suspended over the stream, which dispensed the potassium permanganate in an even flow to maintain the appropriate concentrations.

Table 2 exhibits the amount and concentration of potassium permanganate that was maintained through the treatment. A total of 32, 538 grams were dispensed. This was far below that anticipated in the permit application (82,000+ g.), due to the rapid degradation of the antimycin. Antimcyin only reached the detox station Friday, Aug. 9th and Saturday, Aug. 10th. This was known because a cage with fish was placed between the detox station and the pipe outlet. No mortality occurred until Friday afternoon when the fish succumbed to obvious exposure to antimycin. The nearest antimycin station was at G-5 or 500 meters above the pipe inlet, 3.3 miles from the detox station. Despite the rapid breakdown of antimycin in Snake Creek, the pipe apparently allowed antimycin to remain intact despite the distance and over 1,000 foot loss in elevation.

Table 2. Amounts of Potassium Permanganate and concentrations dispensed.

Date	Flow (cfs)	KmnO4 used (grams)	Concentration at dispensing station (ppm)
Aug. 5, 2002	3.5	2244	1.5
Aug. 6, 2002	2.8	1224	1
Aug. 7, 2002	2.9	1224	1
Aug. 8, 2002	3.0	8262	3
Aug. 9, 2002	2.9	12240	4
Aug. 10, 2002	2.9	7344	3
Total		32538	

Potassium permanganate can also be toxic to fish at concentrations exceeding 4 ppm. Cages with fish were placed 150 meters, 0.9 miles, 2.3 miles (the Park Boundary) and at 3.6 miles (the Snake Creek diversion box to the Nevada Division of Wildlife Spring Creek Rearing Station) below the detox station. No mortality occurred at any station on any day except Friday when fish mortality occurred at the 150 meter cage. On that day the detox station was running at a concentration of 4 ppm. These fish exhibited no signs of antimycin toxicity. Cages at the Rearing Station, Park boundary and 0.9 miles below detox station experienced no mortality throughout the treatment. Clearly fish were affected by the potassium permanganate up to 150 meters below the detox station to cause significant mortality. However, the potassium permanganate visibly broke apart before reaching the 0.9 mile cage and had completely dissipated by the time it reached the park boundary.

Antimycin drip station

CONCLUSIONS

- This treatment would not have been possible without the assistance of the many people who came to help with it. A huge thanks goes out to all the Nevada Division of Wildlife, Humboldt-Toiyabe National Forest, US Fish and Wildlife Service, Great Smoky Mountain National Park and Great Basin National Park participants. Thank you letters were sent to all participants the first week of September.
- A total of 4255 mL of Fintrol was dispensed into Upper Snake Creek. This was beyond the 1700 mL projected because Fintrol oxidized and detoxified with every 60 foot drop in elevation. Careful observation through use of fish cages ensured complete coverage of the stream.
- A total of 32,538 grams of potassium permanganate was dispensed to detoxify the Fintrol. Fish mortality occurred up to 150 meters below the detox station when concentrations were 4 ppm.
- Within 10 days after the treatment, the entire treatment area was electroshocked to look for remaining fish. No live fish were found. The treatment area will be electroshocked again in 2003 to double-check these first results.
- Macroinvertebrate surveys conducted 10 days and one month after the treatment were collected from two control locations above the treatment, three areas in the treatment, and one area below the detox station. Official results will be returned from the Buglab at Utah State University in 2003, but observations by the collectors noted a large diversity of macroinvertebrates, including pollution intolerant species such as mayflies, stoneflies and caddisflies.

APPENDIX 3:
Attempt to Use Streamside Incubators

INTRODUCTION

Due to the difficulty of finding large numbers of donor Bonneville cutthroat trout (BCT) for reintroductions, Great Basin National Park proposed to use streamside incubators to assist with recruitment and to supplement transplants. Streamside incubators have been successfully used in the Deep Creek Range, north of the Park, in conjunction with rearing ponds. Hatching rates of eggs as high as 95% have been noted from streamside incubators. This is compared with less than 30% in nature. Park personnel visited Buck Douglass, Chairman of the Goshute Tribe's Natural Resource Program and owner of Deep Creek Mountain Ranch, who is using streamside incubators for the Goshute Reservation. We also consulted with Don Duff, Trout Unlimited/Forest Service representative. They provided us with equipment and information to use the streamside incubators.

Research indicated that successful collection of eggs from a wild, stream resident population could be difficult, particularly if the population is of a rare and sensitive species such as BCT. This is partially due to little information being available on the biology of BCT. The Utah Division of Wildlife Resource found use of instream incubators on wild populations extremely frustrating (D. Hepworth, personal communication, 2002). Most successful instream incubator systems are used where there is a readily accessible source of eggs and milt such as a rearing pond or hatchery. Thus, this project was implemented with an understanding that success may be limited and a steep learning curve would be followed, possibly for several years.

OBJECTIVES

Our objectives for this project was to:

1. Determine the spawning period of the Mill Creek population and record physical stream habitat attributes (e.g., air and water temperature, water flows) that may help predict future spawning activity.
2. Determine the least intrusive but appropriate observation methods (e.g., behavior, physical appearances, handling) that indicate BCT are ready to spawn.
3. Determine size classes of BCT and their reproductive status and output.
4. Determine proper streamside incubator installation and maintenance.
5. Development of a protocol to guide the implementation of an instream incubator project.
6. Supplement transplants of mature fish.

Fish crewmember searching for spawning BCT and redds.

RESULTS

Search for Spawning BCT, Objectives 1 and 2.

The first step in using streamside incubators was to obtain spawning Bonneville cutthroat trout. Since BCT had never been observed spawning in the Park and literature is lacking on BCT reproductive biology, this required park personnel to go out and observe BCT two-four days a week from late April to early July. On each trip air and water temperatures and water flows were measured. In addition, a Hobo Temperature pack recorded water temperatures every hour. It is hoped that this information will provide the means to narrow search times for spawning in future years. Currently, searching for spawning behavior is labor and time consuming, and using environmental cues would lead to considerable time and personnel savings.

Spawning BCT had been observed in the Deep Creek Mountains when water temperatures reached 10° C (50° F), so we made the assumption that the BCT in Mill Creek would spawn at a similar temperature. Warm weather in late April and early May made us think that the BCT would spawn by the end of May. However, a cold front moved in and the air and stream temperatures dropped considerably. We noted that the stream temperatures closely followed the air temperatures, and each time the stream temperature seemed to be nearing that magic 10° C, more cold weather would arrive.

Finally, the temperatures did arrive at 10° C, but we still did not observe spawning indications in the Mill Creek BCT. Instead, spawning occurred about June 26th -July 3rd when the average daily stream temperature reached nearly 12°C (Figure 1), with maximums near 14° C and minimums near 8° C.

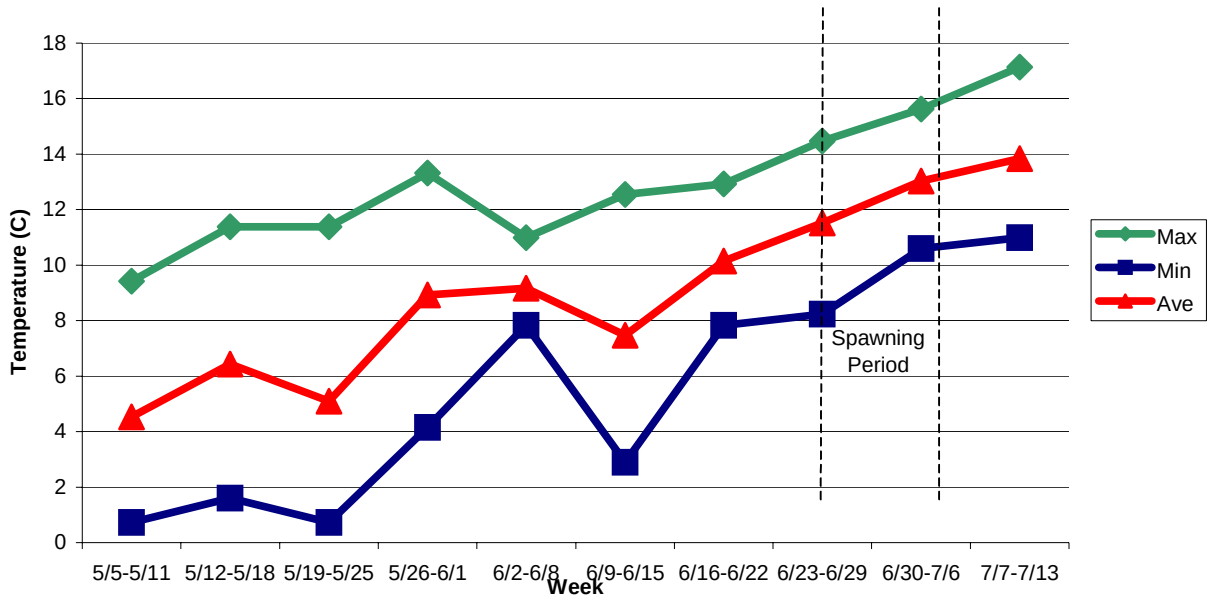

Figure 1. Weekly Mill Creek Temperatures, 2002 Spawning Season

We wanted to monitor for spawning behavior in the least intrusive manner. Narrowing the search time down by measuring physical habitat attributes as listed above was one way of doing this. Another way was to find a reliable means to accurately observe reproductive activity or ripeness. Park personnel looked for the following spawning indications:

- Construction of redds
- BCT pairing
- Morphological changes in BCT such as a hooked jaw and increased reddening
- Capture of BCT through electrofishing or on hook and line and physically assessing ripeness.
- Use of a fish trap.

Mill Creek was difficult to monitor in this respect due to its small size, good habitat and streambank vegetation cover. Mill Creek averages less than 0.5 meters wide and has many undercut banks. Cessation of livestock grazing has increased herbaceous cover along banks and shrub and forest cover is dominant in the higher elevations.

The only way to accurately determine ripeness of BCT was through directly handling and gently squeezing the belly region towards the anus and noting the expulsion of milt or eggs. Electrofishing was most efficient method of capturing BCT followed by hook and line. Just netting the fish was possible but was most intrusive through harassment and chasing the fish. Staff noted differences in reddishness and hooked-jaw on several searches but this was difficult to quantify. Some pairing was noted but when some were captured, no signs of ripeness were observed. Several potential redds were identified.

Another method used consisted of placing a fish trap. The idea was fish moving upstream could be searching for mates or spawning gravels, thus, ripening. Capturing them in a trap would then allow us to collect fish ready for spawning. The cage was successful at capturing fish but none showed signs of spawning, in addition, one died after getting caught between the bars. Due to the mortality and concern that the cage could disrupt normal movements as well as natural spawning, the cage was removed.

Spawning fish, Objective 3.

Spawning occurred about June 26th -July 3rd. This was based on noting the first eggs at this time. Park personnel electrofished Mill Creek and collected 39 BCT on June 25. The BCT were sexed, put into separate live cars and left for 48 hours. Park personnel returned to the site and spawned the fish. Each female was weighed, measured, and gently squeezed. Only one female was ripe (FL 156 mm), and she deposited 74 eggs into the stainless steel bowl. Three males were then squeezed to contribute milt to the eggs. The milt was left with the eggs for about a minute to fertilize them, and then drained out. Water was added to water harden the eggs for

Spawning, weighing, and measuring BCT

Spawning female BCT

transport. After 45 minutes of water hardening, the fertilized eggs were placed in cheesecloth, packed on ice and taken to the previously installed streamside incubator at Strawberry Creek. In addition, another 12 fish were gathered July 3rd. One female provided 23 eggs (FL 180mm), however, some eggs were deformed leaving only 12 eggs. Another fish produced 3 eggs (FL 156 mm). This suggested to us that spawning was past and the female was reabsorbing her remaining eggs. Two males were producing milt (FL 165 &195 mm).

Fertilized eggs

Streamside incubators, Objective 4.

Incubator with intake pipe.

The streamside incubators are made of converted Coleman coolers. Water is filtered and then flows into a baffled chamber, providing plenty of oxygenated water for the fertilized eggs while minimizing the amount of sediment. We set up incubators on Strawberry Creek in May to test them and work out problems. The largest problem was the deposition of fine sediment in the incubator. To combat this problem, sediment traps were constructed and installed upstream of the incubator. These sediment traps reduced the amount of sediment entering the incubator but also restricted water flow. Daily maintenance was required to clean out the sediment traps and incubator.

Putting fertilized eggs into the Whitlock-Vibert box.

The fertilized eggs were put into a Whitlock-Vibert box (W-V Box), designed to keep the eggs off the bottom of the incubator, on June 27. Each day we checked on the eggs, ensuring that when we did so, no direct sunlight hit them. If we found any eggs with fungus, we removed them with an eyedropper. Two eggs were found with fungus on 7/01. An additional 15 eggs were added to the incubator on 7/05 from a second spawning attempt, and on that same day 22 eggs were found with fungus and removed. On 7/08, 9 more eggs had fungus and were removed.

Silt accumulation in streamside incubator after one day.

On July 10, we took a solution of formaldehyde to disinfect the incubator using protocols developed by Trout Unlimited. Unfortunately all the eggs had succumbed to fungus. We put dye into the incubator and found that it took 20 minutes for the water to run through it.

Four factors likely contributed to the failure.
1). The incubators loaned to us were old and the wrong sealant was used to seal the inlet and outlet pipes. The outlet pipe failed after eggs were placed, causing water levels to fall at or just below the eggs. This necessitated exchanging incubators, exposing the eggs at a vulnerable time.

2). Water flows in Strawberry Creek began to drop rapidly after eggs were placed in the incubator. This caused a loss of pressure that pushed water through the sediment traps, greatly reducing the flow rate. Though no more sediment accumulated in the sediment traps than before, the loss in pressure failed to keep water moving adequately up through to the next visit.
3). Very fine sediments still found its way into the incubator, just enough to coat everything between visits. Though it wasn't felt that this sediment smothered the eggs, it was possibly enough to stress the eggs.
4). Fungus ultimately claimed the final eggs, but some eggs had died prior to fungus occurrence leading us to deduce that other factors listed above contributed to the loss. At first it was felt that with so few eggs widely spaced and in separate W-V boxes, that treatment for fungus could be delayed. This appeared to be the case until the above listed problems surfaced. However, we would now recommend treatment immediately at the first sign of fungus.

Protocol Development, Objective 5.
Although the streamside incubators were unsuccessful this year, we compiled an impressive list of do's and don'ts. We now know that we must have higher streamflow (more than 0.5 cfs) than was present in Strawberry Creek. We also know that we will have to find more efficient sediment traps or use spring sources with less sediment and constant flows and disinfect the incubators at the first indication of fungus. From this a detailed protocol was developed to guide personnel through determining the onset of spawning, collecting and fertilizing the eggs and incubator set-up and monitoring eggs (Attached).

Fungus on the eggs.

CONCLUSION

We were able to complete five of our six objectives in FY2002. Temperature and flow information indicated that average daily temperatures corresponding to spawning were approximately 12° C. Water flows had peaked and were receding when spawning appeared to begin. There is only one previous record of spawning BCT in the Snake Range, from Hendry's Creek in the 1950s. Several more years of observation is needed to determine if there is indeed a relationship between temperature, flows and the onset of spawning.

Determination of spawning behavior was best done by electrofishing and physically handling BCT. Visual observations were difficult and tended to not discern ripeness of the fish.

Once milt and eggs were observed from fish we collected BCT to obtain and fertilize eggs. However, because spawning onset varied between fish, gathering ripe fish was difficult. We tried gathering fish by electrofishing selected 100 meter reaches but few fish were gathered that were ripe. For example, only two females and six to ten males were gathered from two 100-meter reaches. Thus, gathering sufficient numbers of fish would require covering larger segments of stream. It should be noted Mill Creek is a small population of approximately 500 fish in almost two miles of stream.

Incubator set-up is strongly encouraged as soon as possible in the spring and long before eggs will be placed. Sufficient time is needed to ensure everything is in working order and any problems can be corrected. Sedimentation problems we encountered were largely due to drawing water directly out of the mainstream channel. Though our sediment traps worked they required constant maintenance to clean filters. As water levels receded, flow rates decreased due to sediment buildup on filters requiring significant increase in water pipe inlet lengths upstream to maintain pressure. We would recommend that a spring source feeding the stream be used as a water source for the incubator. Sediment loads should be less and flows more constant. If a spring source isn't available, such as in our case, then a significant investment in a water collection system with sediment traps will be needed.

Fungus growth on eggs has been recognized as a serious problem with instream incubators. We experienced the same concern here. Using fungicide treatment protocols developed by Fred Eames and Don Duff (used with permission in our protocols) should be adhered to with the first sign of fungus and continued as needed. We did not do this and that is what ultimately caused the demise of our eggs.

We completed protocols for determining spawning activity, collecting eggs and incubator maintenance from our experience. This is considered to be an adaptive protocol to allow differing conditions. However, for a small stream containing wild BCT this protocol should be sufficient to get started.

Due to the loss of the eggs, we did not obtain objective 6 – to supplement reintroduction efforts of BCT into Strawberry Creek. Though we were able to collect some eggs and fertilize them, the time and effort was considerable. The small population of BCT in Mill Creek, its remoteness and excellent habitat conditions with undercut banks and overhanging vegetation make observations and gathering fish difficult. Lack of knowledge on biology and habitat use in Mill Creek also made work difficult. It is felt that if a stream system were available with high populations (> 1,000 fish per mile) better success in collecting eggs would be achieved.

APPENDIX 4:

Bonneville Cutthroat Trout Egg Collection and Instream Incubator Protocols for the Bonneville Cutthroat Trout Reintroduction Program in Great Basin National Park, Nevada

Neal W. Darby

Fish and Wildlife Biologist
Great Basin National Park
100 Great Basin National Park
Baker, Nevada 89311

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Introduction

This protocol outlines a plan to use instream incubators as a means to supplement wild Bonneville cutthroat trout source stock transplants and ensure adequate restocking efforts in the time frame of restoration funding. Sensitive salmonid restoration can be hampered by lack of source stocks for reintroductions. Being a sensitive and rare fish, their low population numbers and limited distribution limits the availability of wild source stocks for transplants. Hatchery production is limited or nonexistent due to other priorities involving recreational fisheries. Furthermore, funding for BCT restoration can be generous but short term, necessitating full-scale restoration efforts preparing streams for reintroductions beyond wild source stock capabilities for transplants in the same time frame.

The genetic integrity of newly translocated populations is also of concern. Sufficient numbers of eggs and "milk" (sperm) can be obtained from just two individuals. Such practices can lead to genetic bottlenecks and/or founder affects, which can seriously restrict future production and population establishments. Thus, any reintroductions using instream incubators need to ensure that adequate genetic representation of the donor population is maintained.

The use of instream incubators as a means to supplement transplants of wild source stocks appears to be the most feasible alternative. The use of instream incubators has been shown to greatly increase the number of fry that successfully move into the stream environment. The fry are wild salmonids and labor can be limited to current staff with no special training required. Other alternatives include use of fish hatchery facilities or using source stocks from outside the immediate geographic area. Using fish hatcheries would be labor intensive, expensive and questionable due to a lack of space availability. The use of outside source stocks goes against policies of using only native genetic strains and poses higher risks of failure due to non-adaptive stocks. Eastern Nevada BCT evolved under unique environmental conditions, which differ from other locations within the BCT historic range.

The objectives of using instream incubators are:

- Supplement wild source stock transplants during years that wild source stocks are not available.
- Increase reproductive output for reintroduced populations for the first five years.
- Maintain the genetic integrity of translocated populations with that of the parent population.

Site selection for collecting spawning BCT or wild stock is important for maintaining genetic integrity. Collection sites will be distributed both spatially and temporally. BCT will be collected from different sections of a stream over time, to ensure that representative reaches are used. It is recommended that eggs or wild stock be collected over a period of time sufficient to

obtain fish from throughout the population (i.e., upper, middle and lower sections of stream).

Methods

List of Materials
The following list of materials are broken down by activity (observations, egg collection and incubator monitoring) and are required for the completion of each activity:

Observations

Air Thermometer	^{o} Celsius, using the Kestrel 3000 Pocket Weather Meter allows to observe air temp, Relative Humidity, wind speed, average wind speed and maximum wind speed.
Water Thermometer	^{o} Celsius
Flow Meter	
Measuring Tape	To measure stream width and depth for water flows

Optional equipment to better observe fish

Fishing pole	If fish are hard to observe, take a fishing pole w/artificial lures to catch and note their physical appearance. Release after observance.
Electrofisher	To gather fish from select pools to observe and note physical appearance.

Egg Collection

Cheese Cloth	Square foot size to wrap and transfer eggs in.
Stainless Steel Bowls	Numbers determined by number of female fish to spawn, 4-quart size.
Live wells	To hold fish in stream until ripe, numbers determined by amount of fish collected per site. As a rule, one for males, one for females and one for unknowns.
Cooler	Ice chest with trays. Ice sits in bottom and trays hold eggs in cheese cloth.
Electrofisher	For collecting fish
Block nets	For blocking the stream while collecting fish.

Measuring Board	To measure fish on
Scale with pan	To weigh fish
Tarp or Umbrella	To cover work area so as to keep direct sunlight off fish and eggs.
Dissecting scissors	To fin clip fish spawned.
Material used for Observations	

Incubator Monitoring

Instream Incubator	Cooler set up as incubator
WV Boxes	To set eggs
Various pipe fittings	
Filters	
Wide Mouth Droplet	Used to remove dead eggs.
Siphon hose	To siphon out sediments.
30% Formalin solution	Used to treat fungus in incubator.
YSI Meter	Measure water temperature and dissolved oxygen.
Rebar	To anchor incubator and pipe.
Digital Camera	
Tarp or Umbrella	

Standard Operating Procedures for Observations

In mid-April observations of BCT on collection streams and set-up of instream incubators at release sites should begin. The purpose is to observe fish behavior and obtain water flows and temperatures. Actual environmental conditions that regulate spawning behavior of BCT in eastern Nevada are unknown, though it is likely that photoperiodism, water temperatures and water flows are major triggering mechanisms. Measurement of water flows and temperatures in conjunction with observations of BCT behavior should shed light on actual environmental conditions that set off spawning behavior in Great Basin NP streams and allow for less intensive pre-spawning monitoring in the future. Spawning isn't expected to occur until mid-May and could extend up to July depending on elevation and water temperatures. However, until data

provides better means of predicting spawning times, starting observations in mid-April will insure it is not missed.

Water flows and temperatures can be taken at already established BCT monitoring sites while fish observations should occur throughout the stream. Water temperatures should be taken at specific sites where BCT are exhibiting spawning behavior. If BCT are difficult to observe, use of a fishing pole with artificial lures or electrofishing equipment should be used to capture and observe BCT. Once signs of spawning are obvious, preparations should immediately be made to capture BCT and collect and fertilize eggs.

Instream incubators need to be cleaned and repaired as needed (See SOP's for Fungus control below) prior to set-up in the field. Incubators should then be taken to release sites and setup approximately one month before egg collection. Incubators can then be checked every other week or so to ensure operation and water flow are adequate and the buildup of silt is not occurring. If silt is entering the incubator, changing the location or type of intake valve will be necessary. Small amounts of silt can be removed by using a siphon hose. It is important these problems be found now before eggs are ready to be placed inside.

Standard Operating Procedures for Locating Egg Collection Sites

Criteria for initial site selection should be based on presence of adult fish between mid-April and mid-June. No known specific spawning areas exist so spawning is assumed to occur throughout the populated stream reaches. Areas where BCT exhibit spawning behavior can be another indicator for site selection. However, spawning behavior would be more difficult to detect due to its short duration.

Procedures for selecting collection locations will begin with a base map. The map will depict the populated extent of the stream. Areas with further information on densities, size class distribution and habitat quality should further be highlighted. A 100-meter reach should be drawn from which fish will be collected and sorted. The number of 100-meter reaches needed each season will be dependent on the number of adult fish collected. If more than one 100-meter reach is needed to acquire the needed fish, subsequent 100-meter reaches can be established adjacent to the initial reach. In subsequent years, 100-meter reaches will be delineated farthest away from the previous collection site, particularly when the release site for the fry is the same. If wild source stocks are collected for transplant then that reach from which fish were collected should be delineated on the map and noted on the GIS maps as a collection site. No reach where eggs or fish were collected will be collected from twice until all other areas have been used.

Standard Operating Procedures for Egg Collection

At first indication of spawning behavior (i.e., pairing, ripe males or females) a 100-meter reach will be designated and a multi-pass electrofishing survey will be conducted (see SOP for site selection below). All fish will be collected and placed in buckets. Clove oil? will be applied to the bucket to sedate fish prior to handling. Fish will then be measured, weighed and sorted by age. Adult male and female fish appearing ready for spawning will be separated and placed in live wells in the stream. Live wells would be visible to each other but greater than one meter

apart. Females in one well and males in the other. Other adult fish whose sex is uncertain can be placed in a third live well until sex can be determined. The remaining fish will be measured and weighed and returned to the stream following SOPs for fish surveys. Before returning fish to the stream or live well, place in bucket with fresh water for 15 minutes for them to recover from sedation. The adults will be left in the live wells a minimum 48 hours prior to spawning to ensure recovery from electrofishing. They could be held longer depending on their condition or "ripeness." When the fish are ripe they will be "milked" to obtain eggs and sperm.

All egg handling will occur under a tarp or umbrella; at no time should eggs be exposed to direct sunlight. Prior to handling the fish, place fish in a bucket full of water and expose them to clove oil? to sedate them. After sedated gather one female fish being careful not to squeeze the midsection. Eggs will be deposited in individual 4-quart stainless steel mixing bowls filled with water. Only obtain those eggs that easily fall out. Do not try to get every last egg. One stroke down the sides of the female is all that will be required. The female should then be returned to a bucket with fresh water to recover from sedation for 15 minutes and then released into the stream to finish off her eggs. Two male fish should then be selected, sedated and their milk, most easily obtained, poured in with the eggs. Again, one stroke down the male's sides is all that is needed. The males are then placed in a bucket with fresh water to recover for 15 minutes and then returned to the stream. If no eggs or milk can be obtained then the fish should go back into the live well.

After eggs and sperm have been exposed together for one minute, fluid can be drained and replaced with fresh water. The eggs should then be set aside to water harden for a minimum 45 minutes. Cover each bowl with moist cheesecloth. After eggs are hardened, the water is drained and the eggs poured onto the moist cheesecloth. Wrap the eggs in the cheesecloth and place on a tray to fit in an ice chest with ice for transport to the instream incubator set up at the release site. Transport immediately.

Eggs from each female will remain separated during fertilization. The goal each season that instream incubators are used is to obtain a minimum 250 eggs. This could require as many as seven female fish and up to 14 males assuming 40 eggs per female with two males for each female to ensure complete fertilization.

Standard Operating Procedures for Instream Incubator Monitoring

At the instream incubator place eggs into a Whitlock Vibert Box (WV box). Up to 100 eggs can be placed in the incubator portion of the box. A digital photo should be taken of the eggs in each WV box so eggs can be counted on a print out. Then place the box in one of the raceways in the incubator. Eggs and WV boxes should be distributed between several incubators so that if something happens all eggs will not be lost. Incubators should then be checked at least once a week. Water temperatures should be taken at each visit. Siphon any silt from the incubator using a siphon hose and remove any dead eggs to reduce fungus development. Record the numbers of all dead eggs removed from each WV box. If fungus development is occurring preparations and treatment should occur the next day following SOPs for fungus control. Monitor incubator until eggs hatch and fry have left the incubator. Record any remaining eggs

in WV boxes after fry have emerged.

Standard Operating Procedures for Fungus Control
The following is adapted from Fred Eales, DVM, Flaming Gorge-Lower Green River Chapter, Trout Unlimited and Don Duff, Forest Service/Trout Unlimited National Partnership Coordinator (May 5, 2002).

Streamside Incubators: Disinfecting and Treatment for Fungus

Incubators, whether the 'ole fridge' or Coleman cooler type, should be disinfected annually, and/or upon each subsequent usage with new eggs. This also includes "new" units to be used for the first time.

Prior to use, Whitlock-Vibert boxes (WV box), should be disinfected with a solution of 10% Clorox bleach. The WV boxes can be placed into a bucket or other appropriate container, with the 10% bleach solution, and left for one hour, and then air-dried. Do not use the Clorox bleach treatment in the incubator units.

The WV boxes can also be disinfected by placing them inside the incubator and treating with a 37% formaldehyde solution. This will disinfect both the incubator as well as the WV boxes before use. All incubator units should be disinfected with the formaldehyde solution before use. Treatment by this method is described as follows.

Incubators of the "old fridge" type should be disinfected before any use, or they may need to be treated periodically once the eggs are present to prevent the spread of fungus developing on green or eyed eggs. Fungus usually begins to become prevalent about 10 days after eggs in WV boxes are placed in the “fridge.” Formalin, a natural biodegradable ingredient, is used to disinfect the eggs. The use of the "new" upweller egg bottles in the incubator units may lessen the ability of fungus to develop as the eggs are in continuous swirling motion. However, some units may have both the WV boxes and the upweller bottle(s) present, hence, the WV box eggs may develop a fungus which necessitates a treatment.

For a typical “fridge,” with a volume-size of about 4-feet long by 2-feet wide by 6-inches high will require a 300-milliliter (ml) volume of 37% formalin for 10 minutes. Corresponding treatment of Coleman coolers will be somewhat less depending on the size, from 150-ml to about 75-ml, but the same procedure, as outlined below, is followed.

Immediately prior to pouring the dosage into the “fridge,” turn off the water inlet valve to stop water inflow into the incubation chamber. Pour the 300-ml volume into the fridge at the inlet flow entry channel of the incubator. It is suggested to add a few drops of some food coloring (i.e. red, green, etc.) so the flow of the solution can be tracked to assure it becomes well dispersed throughout the incubator, from inflow to outflow.

After 10 minutes, reopen the inlet water valve so water again begins to flow into the incubation

chamber. Place a bucket under the outlet pipe to collect the formalin solution, and discard it after all the "colored" solution has passed through the outlet. Or, with the outlet pipe or hose, allow the solution to drain to the ground adjacent to the stream.

If fungus appears to be continuing, repeat this procedure every 7 days thereafter, or as necessary to assure fungus does not reappear.

Data Collection

All data are entered into an Access database after completion of monitoring, therefore, a data log form must be completed for each observation, egg collection and incubator monitoring event at each location. The sample data forms (Appendix 7-1) may be modified at your discretion; however, certain information is required to assure that proper data are collected for observation, egg collection and incubator monitoring:

Required Observation Data

1. Location. This is the name of the stream you are observing for spawning behavior. Include drainage name, wash or canyon, county, and description of location (miles from..., or Township, Range, Section).

2. Date. Indicate the day, month, and year that your observation event occurred.

3. Weather conditions. Include cloud cover, estimated wind speed, humidity (muggy, dry, etc.), and air temperature at start.

4. Water temperature. Record water temperature.

5. Flows. Record the depth and average velocity of the water following SOPs for determining cubic meters per second of water flow.

6. Fish Behavior. Record the fish behavior as 1 – nothing significant; 2 – significant coloration; 3 – Physical appearance (i.e., fat, hooked jaw); 4 – pairing, two fish together side by side.

7. Means of Observation. Record observation as visual only or captured.

8. Collective notes. Record comments and other remarks regarding overall observations. Note areas observed and methods to observe fish.

Required Egg Collection Data

1. Location ID. Create a unique location identifier.
2. Start UTMxy. Determine the UTM coordinates for the start (downstream end) of the 100-meter reach.
3. EndUTMxy. Determine the UTM coordinates for the end (upstream end) of the 100-meter reach.

4. Elevation. Determine the elevation of the start of the 100-meter reach.
5. Weather conditions. Include cloud cover, estimated wind speed, humidity (muggy, dry, etc.), and air temperature at start.
6. Water temperature. Record water temperature.
7. Flows. Record the depth and average velocity of the water following SOPs for determining cubic meters per second of water flow.
8. Fish physique. Measure the length in millimeters (fork length) and weight in grams **after** eggs collected.
9. Eggs Collected. After eggs collected from single female a digital photo of the eggs should be taken for later determination of numbers or, if few eggs, directly counted.
10. Collective notes. Record comments and other remarks regarding overall egg collection.

Required incubator Monitoring Data

1. Location.
2. Date.
3. Weather conditions.
4. Water Temperature.
5. WV Box ID
6. Eggs Removed
7. Fry present?
8. Fungus Treatment?
9. Eggs Remaining.

Report Preparations

After all fry have left the incubator a report detailing spawning period, water temperatures and numbers of eggs collected and hatching success will be done. Incubators should then be dismantled, returned to office disinfected and stored until the following year.