

Bonneville Cutthroat Trout Restoration Study Plan

**Bear River Hydroelectric Project
FERC No. 20**

July 30, 2004

**PacifiCorp and
The Environmental Coordination Committee**

Introduction

PacifiCorp received a new license for the Bear River Hydroelectric Project (Project) (FERC No. 20) on December 22, 2003. The Project includes three hydroelectric developments located on the Bear River in Caribou and Franklin Counties, Idaho. The 30-year license allows for the continued operation and maintenance of the Soda Development, the Grace/Cove Development, and the Oneida Development.

This Bonneville cutthroat trout (BCT) Restoration Study Plan (BCT Study Plan) has been prepared as required by **Article 403** of the License Order. It consists of four research elements to provide information in support of measures to improve habitat for BCT and other aquatic species and restore healthy populations of BCT near the Project (Action Area). By studying existing BCT populations and habitat conditions, the research will help prioritize restoration needs in the Action Area. The four areas of research include genetic sample analysis, irrigation diversion/ barrier map and aerial photography, telemetry studies, and broodstock development. An additional element of the BCT Study Plan identified in Article 403, the Cove Feasibility Study, will be submitted separately from this filing as indicated in a letter from PacifiCorp to the FERC dated March 16, 2004, and confirmed in the FERC Order issued on April 13, 2004.

Results from studies performed under the BCT Study Plan will be documented in Annual Reports to the FERC and synthesized into a BCT Restoration Plan, which will be prepared beginning in year 4 of the license term. The BCT Restoration Plan will be consistent with the *Range-wide Conservation Agreement and Strategy for Bonneville Cutthroat Trout Management* (RCAS), Utah Division of Wildlife Resources Publication No. 00-19, and *Cutthroat Trout Management: A Position Paper, Genetic Considerations Associated with Cutthroat Trout Management* (CTMAPP), Utah Division of Wildlife Resources Publication No. 00-26, or any updated version of such documents.

The Environmental Coordination Committee (ECC) developed this BCT Study Plan during ECC meetings, several drafts of the plan were developed by a consultant, and the ECC was provided 30 days for review. Comments of the ECC were addressed during ECC meetings and incorporated into the Final BCT Study Plan for filing with the FERC.

Specific funding amounts have been identified in the Settlement Agreement of the Parties (signed August 28, 2002) for each of the four research elements. Funding described for each study represent the limit of PacifiCorp's obligation in accordance with the Settlement Agreement. Funding not completely expended by one element may be used to complete other elements through the eighth anniversary of the issuance of the license, whereupon funding by the licensee will be complete. Funding not expended in one year may be carried over to subsequent years through the eighth anniversary of the issuance of the license. The balance of the funds will bear interest once annually but will not escalate beyond first issuance. One half of the interest on unspent funds will belong to the licensee, and one half will be available for Study Plan elements.

The following sections outline the four research elements. Items described for each element include project goals and objectives, intended use of results, preferred methodology, and the schedule and funding.

Genetic Sample Analysis

Goals

Development of baseline genetic information for Bear River BCT to aid in the management of the species in the Bear River drainage including:

- Assessing current and future risks within BCT populations
- Determining genetic variability within and among BCT populations
- Delineating and prioritizing populations for conservation management, translocations, reintroductions, and/or broodstock development

Objectives

To determine if genetically distinct populations of BCT exist within the Bear River drainage, with a study focus on Idaho populations.

To examine the genetic health of BCT populations, including the extent of hybridization and introgression from rainbow trout and Yellowstone cutthroat trout.

To identify genetically healthy populations of BCT that may be used as stock for the Conservation Hatchery Program.

Methodology

Idaho Department of Fish and Game (IDFG) will direct the genetic studies, which will contribute to existing data. The ECC will review and approve the Scope of Work, study design, and the reports prior to final payment. The contracting process will be consistent with PacifiCorp governance, and PacifiCorp will administer the contract.

IDFG will arrange for collection and analysis of BCT genetic samples from fish sampling of the mainstem and/or tributaries of the Bear River in Idaho. Methodology will be chosen based upon experts' advice and the already ongoing work of IDFG. The genetic assessment will incorporate similar components of the ongoing IDFG work including: sample collection (IDFG uses fin tissue non-lethally sampled from BCT), DNA extraction, PCR amplification, restriction enzyme digestion, and mtDNA gene region, microsatellite amplification and allele scoring, and data analysis and methods rationale. For consistency, genetic samples will be analyzed at the same lab currently being used by IDFG. The ongoing IDFG research incorporates previously published, reviewed, and widely used fish population genetics methodology and data analysis techniques (see Appendix A, IDFG Genetics Study Design and Work Plan). USDA Forest Service, Bureau of Land Management, and IDFG field crews have already sampled most tributaries of the Bear River in Idaho. IDFG will make full use of these existing genetic samples. Researchers will look for differences between Bear River and Bear Lake BCT stock, similarities and differences between BCT populations in the Bear River drainage in

Idaho, and the overall genetic health of BCT. Study results will be compared to ongoing research in Idaho, Utah and Wyoming.

Discussion

The results of this study will help prioritize habitat restoration projects and determine the best stock(s) to use in the Conservation Hatchery program.

Ongoing research conducted by IDFG, which emphasizes inter- and intra-specific hybridization and genetic relationships between populations of BCT within the Bear River drainage in Idaho and Utah, is considered compatible with, and will complement this study. Nineteen populations within Bear River drainage and five hatchery populations have already been sampled. Additional sampling is scheduled for the summer of 2004.

Study reports will interpret findings with respect to the basic goals and objectives listed above. Results will contribute to the BCT Restoration Plan, to be prepared in 2008, and will also be included in the FERC Annual Report.

Schedule and Funds

Support for this ongoing research is planned for the summer of 2004 and will continue through year 8 or as provided by funding. PacifiCorp funding for the genetic sampling component of the BCT Study Plan is \$40,000.

Irrigation Diversion/Barrier Map and Aerial Photography

Goals

Development of baseline habitat conditions and fish passage obstruction and diversion information for the Bear River drainage in Idaho to aid in the management of BCT, including:

- Identification of habitat restoration opportunities
- Identification of factors contributing to isolation of BCT populations, and possibilities and priorities for reconnection
- Identification and prioritization of opportunities for conservation management, translocation, or reintroduction

Objectives

To identify and determine the extent of upstream and downstream barriers to BCT migration within the Bear River drainage in Idaho.

To identify and prioritize any necessary structure modifications to water diversions that would ensure fish passage and reduce fish loss from water diversions.

To examine the health of riparian habitat and instream channel features in the Bear River drainage in Idaho and prioritize needs for habitat management.

To identify potential opportunities for land and water acquisitions/easements/leases.

To quantify water use within various sub-basins within the Bear River drainage in Idaho.

Methodology

An aerial photography flight will be contracted along the Bear River and its wetted tributaries in Idaho. The photography is to be secured on color infrared positive film, with 6- inch focal length lens, at a scale of 1:4,800 in accordance with the Farm Service Agency (Pers. Commun., Jim Capurso, USFS). Photography may also include thermal imaging. (For details on thermal imagery protocol, see *Paired Color Infrared and Thermal Infrared Imaging and Analysis for Selected Idaho Streams*, IRZ Consulting 2001). Existing sources of photography will also be sought to reduce flight costs. Aerial photography prints will be provided to the ECC for their use in project planning.

Photography may include the following stream segments, as well as other areas in the State of Idaho:

Stream Name	Estimated Stream Mileage
Bear River	75
Ovid Creek	17
Sleight Creek	5
Hammond Creek	4
Miles Canyon	2
Mill Creek	5
Liberty Creek	3
Copenhagen Canyon	3
Morgan Creek	1
Emigration Creek	5
North Creek	6
Stauffer Creek	8
North Stauffer Creek	3
South Stauffer Creek	2
Co-op Creek	5
Skinner Creek	3
North Skinner Creek	1
South Skinner Creek	1
Pearl Creek	4
North Pearl Creek	1
Trail Creek	1
Eightmile Creek	15
Bailey Creek	4
Winchell Creek	1
Largilliere Creek	1
Whiskey Creek	2
Trout Creek	4
Williams Creek	4
Strawberry Creek	5
Mink Creek	7
Birch Creek	4
Worm Creek	1
Cub River	12
Foster Creek	3
Sugar Creek	5
Maple Creek	5
Crooked Creek	2
Deep Creek	2
Bennington Canyon	3
Georgetown Creek	4
Cottonwood Creek	4

Battle Creek	3
Deep Creek	3
Fivemile Creek	3
Weston Creek	5
Clarkston Creek	7
Malad River	20
Burnett Canyon	2
Elkhorn Creek	2
Elkhorn Canyon	3
Wright Creek	4
Dairy Creek	4
TOTAL	299

Aerial photography will be used to identify potential barriers to fish migration, existing diversions, and instream and riparian habitat features. The contractor may use these photos in their effort to map irrigation diversion structures.

A contractor will be hired to survey the Bear River and its tributaries in Idaho for diversions and their diversion structures. The contractor will document their findings in a GIS map with associated photographs and data digitally attached to the map. As much as possible, each diversion will be visited on the ground to determine if 1) it is screened, 2) it is a barrier to fish movement, and 3) the diversion may, at times, divert all the water such that fish movement is precluded and/or redds may be lost. If not all diversions can be visited due to resource constraints, prioritization based on potential adverse effects to BCT and opportunities for restoration in the Action Area will be provided to the contractor by the ECC. Collaborative participation between local communities and the natural resources agencies/contractor is encouraged. Landowner information and permission for accessing property will be obtained.

GIS layers will be assembled to depict diversion locations, migration barriers, and habitat conditions. Included in the GIS database will be site-specific information on each diversion and potential barrier to fish movement, including diversion photos (when available), water right information, screening/headage needs, and other information as outlined in the diversion worksheet that will be developed through the ECC. The contractor will also prepare a summary report describing findings. The report will include a description of the irrigation diversions that appear to have the most impacts to migrating native fish.

All data will be prepared for review and maintained by the ECC. Individuals operating diversion structures are welcome to the data upon request. The aerial photographs, report, and the irrigation diversion GIS map with digitally attached photos and datasheets will be provided to the ECC by January 1, 2006. Results will be used by the ECC in the BCT Restoration Plan to be prepared in 2008.

Schedule and Funds

Aerial photography and mapping will begin in the late spring or early summer of 2005 and may continue through year 8 or as provided by funding. PacifiCorp funding for both elements includes \$125,000 for aerial photography and \$13,000 for diversion survey/report, totaling \$138,000.

Telemetry Studies

Goals

Telemetry will be used to:

- Document the extent of BCT migration through space and time
- Determine habitat use patterns
- Assess connectivity within the Action Area

Objectives

To gain an understanding of seasonal locations and movement patterns of migratory BCT.

To prioritize habitat restoration and land and water right acquisitions.

To identify movement barriers and critical migration corridors of BCT.

Methodology

Under IDFG direction, a BCT telemetry study will be conducted in three different reaches of the Bear River and its tributaries over a three-year period to analyze spatial and temporal fish movement. A GIS map reflecting GPS locations of tagged fish, including the path of each tracking event will also be developed.

This research element will build from the irrigation/ diversion barrier map and aerial photography results, and existing agency habitat information to develop a systematic sampling inventory for fluvial BCT. Telemetry methods will follow existing IDFG protocol (see Appendix B).

Reaches to be sampled include from below Oneida to the Idaho/Utah border, above Oneida to Cove, and above Alexander Reservoir to the Outlet Canal. If BCT are not present, research may extend beyond the Action Area. ECC members may choose to participate in work in the field.

Basic methodology will include sampling and estimation of population density of fluvial BCT in the mainstem and lower reaches of tributaries in the winter and end of summer. All fish species sampled will be identified and enumerated, and all captured BCT will be weighed and measured. These data will then be used to target tributaries for trapping of fluvial out-migrants. At least 30 fish will be tagged in each segment during each of two years. Sampling techniques chosen will consider the health of individual fish and survivability of BCT populations. At a minimum, tracking will provide monthly locations throughout the year to address the question of habitat connectivity. Tracking for the period from April 1 through June 30 may be conducted on a weekly basis.

Schedule and Funds

Telemetry studies are expected to begin in 2005. Funding for this element is \$50,000 per year for three years.

Broodstock Development

Goal

Develop localized broodstock(s) of BCT, if results of the genetic sample analysis determine it to be necessary, for stocking in the Action Area linked to native BCT protection and restoration efforts.

Objectives

Incorporate results of the genetics study to determine if developing such stock(s) is necessary for use in the Conservation Hatchery Program.

To provide an alternative to non-native fish stocking.

Methodology

The IDFG will use data from the genetic analysis of BCT to estimate the genetic relationships between populations in the Action Area and elsewhere in the Bear River and Bear Lake systems. Based upon existing data and restoration opportunities, localized BCT broodstock(s) will be raised if determined necessary by ECC and agreed to by IDFG. Coordination will occur with Wyoming Game and Fish in conjunction with previous work that developed fluvial BCT broodstock from the upper Thomas Fork. Methodology will follow that outlined in the *Wyoming Game and Fish Department Fish Division Bear River Cutthroat Brood Stock History and Maintenance* (Anderson 2000) (Appendix C). The ECC will coordinate with IDFG and Wyoming Fish and Game to develop a plan specific to the Action Area. If genetic analysis determines all existing pure Bonneville cutthroat trout populations in the analysis area are apparently similar, one broodstock would be developed for use in the Action Area. If genetic analysis determines obvious differences in pure populations within the project area, there may be more than one broodstock developed. The broodstock(s) could be used to replace non-native fish stocking in the Action Area and/or could be used to replace naturally reproducing brook and rainbow trout in the Action Area.

Discussion

Fish stocking could be used to re-establish native BCT populations, however broodstock development would only occur if the genetic analysis determined it to be a necessary action for BCT restoration.

BCT broodstock development for this study would benefit from and build upon previous work at the Daniel Fish Hatchery, Wyoming Game and Fish Department, as well as the results of the genetics study (above).

Broodstock development is linked to Section 3.1.3 (Conservation Hatchery Program) of the Bear River Settlement Agreement, and related to BCT protection and restoration efforts that will be synthesized in the BCT Restoration Plan beginning in 2008.

Schedule and Funds

If identified as appropriate by the ECC, as determined by the genetic samples analysis, broodstock development will begin after year 5, and will be completed by year 8. Funding for this element is \$100,000 per year for three years. Funds available for broodstock development, if not used for broodstock development, may be reallocated for use under Articles 405 and 406 at the discretion of the ECC, and must be used by the end of the eighth anniversary of license issuance (December 22, 2011).

Citations

Anderson, G. 2000. *Wyoming Game and Fish Department Fish Division Bear River Cutthroat Brood Stock History and Maintenance*. Reference #00b05BRC.

IRZ Consulting. 2001. *Paired Color Infrared and Thermal Infrared Imaging and Analysis for Selected Idaho Streams*. April 25.

Appendix A – Genetics Study Work Plan

Study Design/Work Plan

Title: A genetic assessment of cutthroat trout populations within the Bear River drainage, ID and UT: Emphasis on inter- and intra-specific hybridization and introgression and genetic population structure

This study will: 1) evaluate the extent of hybridization and introgression from introduced hatchery rainbow trout and Yellowstone cutthroat trout occurring within native cutthroat populations in the Bear River drainage in Idaho and Utah. 2) Assess genetic variability and genetic population structure of cutthroat populations within the Bear River drainage.

Work Description: The project is designed to provide baseline information on genetic variation within and among populations of cutthroat trout in the Bear River drainage and examine the effects of past stocking of hatchery rainbow trout and out of basin Yellowstone cutthroat trout in terms of hybridization and introgression. Results from this work should help managers directly in assessing current and future genetic risks, preserving existing genetic variability, delineating and prioritizing populations for conservation and management purposes, identifying suitable populations for translocations and reintroductions, identifying suitable populations for broodstock development, and addressing genetic concerns in future ESA petitions. This project will carry out its genetic assessment of Bear River drainage populations utilizing molecular genetic methods on fin tissue non-lethally sampled from cutthroat trout throughout this drainage. Up to eight diagnostic nuclear DNA loci and a diagnostic mitochondrial DNA gene region will be used to evaluate the level of introgressive hybridization between rainbow trout and native Bear River Bonneville cutthroat trout populations. A combination of mitochondrial DNA analyses (sequencing and RFLP) and microsatellite analyses will be used to evaluate the extent of hybridization from out of basin Yellowstone cutthroat trout. Additionally, genetic variation and genetic population structure among samples from these locations will be further evaluated using six microsatellite loci previously optimized on cutthroat trout. The majority of the samples that are part of this project have already been collected by the Idaho Department of Fish and Game and are awaiting analysis.

Budget: *FY 2004* – Genetic analysis of approximately 750 samples of cutthroat trout tissue (~30 fish from 25 locations) will require approximately \$40,000.

Experimental Design

Sample Collection^{3/4}Non-lethal fin clips have already been sampled from 19 populations within the Bear River drainage and from five hatchery populations for comparison purposes (Table 1). Some additional sampling will take place during the summer of 2004 to increase sample sizes at some sites and to allow for temporal comparisons. Fin clips will be stored at room temperature in 100% ethanol until genetic analyses are performed.

Table 1. Sample Location and sample size.

Drainage Basin	Sample Location	N
Bear River	Dry Creek	20
	Sugar Creek	26
	Pearl Creek	16
	Birch Creek	5
	Skinner Creek	15
	N. Canyon Creek	6
	Foster Creek	9
	Maple Creek	26
	8-mile Creek	26
	Mill Canyon Creek	5
	Williams Creek	20
	Preuss Creek	5
	Giraffe Creek	9

Drainage Basin	Sample Location	N
Bear River	Geotown Creek	11
	Cub Creek	35
	Beaver Creek	13
	St. Charles Creek	19
	Logan River	22
Hatchery	Henrys Lake	30
Hatchery	Yellowstone Lake	30
Hatchery	Daniel Fish Hatchery (Bear River)	30
Hatchery	Glenwood Hatchery	30
Hatchery	Clark Fork Hatchery	30
Hatchery	Bear Lake	35

DNA Extraction-Mitochondrial DNA and nuclear DNA will be extracted from non-lethally collected fin-clip samples using methods described by Paragamian et al. (1999), adapted from protocols by Sambrook et al. (1989) and Dowling et al. (1990).

PCR Amplification and restriction enzyme digestion of Nuclear DNA gene regions-DNA isolated from each sample will be amplified using the Polymerase Chain Reaction (PCR) with primers specific for 8 nuclear DNA gene regions (markers): Recombination activation gene (RAG 3'), Ikaros gene (IK), Occ 35, Occ 36, Occ 37, Occ 38, Occ 42, and OM 55. All eight markers are diagnostic between rainbow trout and cutthroat trout (Baker et al. 2002; Campbell et al. 2002; Ostberg and Rodriguez 2002). The RAG 3' and IK markers require a restriction enzyme digest to produce diagnostic banding patterns. For the remaining markers the amplification product results in diagnostic banding patterns. Amplification product or digests will be electrophoresed on 3% synergels with tris-acetate-EDTA buffer or 6% acrylamide gels with tris-borate-EDTA and stained with ethidium bromide and fluoresced under UV-light to visualize alleles.

PCR Amplification, restriction enzyme digestion, and sequencing of mtDNA gene region-The ND12 gene regions of the mitochondrial genome will be amplified using the Polymerase Chain Reaction (PCR) and digested with four restriction enzymes (Dpn-II, Hinf-I, Msp-I, and Rsa-I) that have previously yielded haplotype variation in Yellowstone cutthroat and Bear River cutthroat trout populations. These restriction enzymes also produce diagnostic banding patterns between cutthroat trout and rainbow trout (Idaho Department of Fish and Game, unpublished data). Digests will be electrophoresed on 3% synergels with tris-acetate-EDTA buffer or 6% acrylamide gels with tris-borate-EDTA and visualized as band patterns (fragments) when stained with ethidium bromide and fluoresced under UV-light. The fragment size in base pairs will be estimated by comparison to a 100 b.p. size standard. Amplified product, representing unique haplotypes, will also be purified and used as template DNA for cycle sequencing reactions performed using Dye Terminator Cycle Sequencing. Sequencing reactions will be run on an ABI 310 DNA Sequencer (Perkin-Elmer Corp.).

Microsatellite Amplification and allele scoring-Allele frequency variation at six microsatellite loci (Ogo 4, Omm 1036, Ots 107, Fgt 2, Ocl 1, and Ogo 3) will be examined on all collected samples. PCR conditions, and methods for scoring amplification products will follow those described by Olsen et al. 1998; Sakamoto et al. 1994; Nelson & Beacham 1999; Condrey and Bentzen 1998; and Wenburg & Bentzen 2003.

Data Analysis and Methods Rationale

Nucleotide sequence divergence among mtDNA haplotypes will be estimated using Program D of the REAP software package (McElroy et al. 1992). Resulting distance matrices will be used to construct phenograms (trees) using the KITSCH and DRAWGRAM programs in PHYLIP 3.5c (Felsenstein 1993). The DA program in REAP will be used to calculate estimates of nucleotide and haplotype diversity. The extent of geographic heterogeneity of haplotypes among populations will be examined using the MONTE program in REAP and analysis of molecular variance procedures-AMOVA (Excoffier et al. 1992). To

allow for further phylogenetic analyses and to check sequence divergence estimated from RFLP site data, all unique haplotypes will be sequenced. Sequences will be aligned using the software program Sequencher 3.1.1 (Gene Codes Corporation, Ann Arbor, MI, USA). Estimates of sequence divergence among haplotypes (p), Kimura's two-parameter distance, and construction of Neighbor-joining trees will be performed using the software program MEGA 2.1-Molecular Evolutionary Genetic Analysis (Kumar et al. 2001).

For microsatellite data, Genepop on the Web (Raymond and Rousset 1995) will be used to test each locus in each population for departures from Hardy-Weinberg equilibrium and all pairs of loci for linkage equilibrium. A sequential Bonferroni correction (Rice 1989) will be used to correct for multiple simultaneous tests using a significance level (α) of 0.05. Unbiased expected heterozygosity (H_e ; Nei 1987), observed heterozygosity (H_o), and average number of alleles per locus (A) will be calculated for each locus in each population. The number and frequency of unique alleles (Slatkin 1985) will also be documented to provide evidence for taxa (Yellowstone cutthroat versus Bear River cutthroat) and population differentiation.

Genetic differentiation will also be measured by comparing allele frequency distributions for all pairs of populations using a homogeneity test computed as an exact test in Genepop on the Web (Raymond and Rousset 1995), pairwise F_{st} estimates (Weir and Cockham 1984), and a frequency assignment test (Paetkau et al. 1994). Assessments of genetic subpopulation structuring will be also be made using an analysis of molecular variance (AMOVA, Excoffier et al., 1992), available in the software package Arlequin.

The methods and materials described above, including data analysis, have been previously published and widely used among a number of population genetic studies on fish including a variety of cutthroat trout subspecies (Nielsen and Sage 2002; Condrey and Bentzen 1998; Wenberg et al. 1998). The methods have also been extensively reviewed in several publications, including *Population Genetics and Fishery Management* (Ryman and Utter 1987) and *Microsatellites: Evolution and Applications* (Goldstein and Schlotterer 1999).

Budget

FY 2004- Genetic analysis of approximately 750 samples will cost \$43,502 (see budget below).

Budget for Genetic Analysis of Bear River Cutthroat Trout

Personnel	From	To	Hourly	Total Hrs.	Cost
Laboratory Technician (I.H.)	06/01/04	12/01/04	\$17.00	1040	\$17,680
Fringe Benefits					\$7,072
Operating Expenses					
Supplies, Materials etc.					\$18,750
chemicals, pipet tips, tubes, gloves, etc.					
TOTAL					\$43,502

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Appendix B – Proposed Methodology for Telemetry Study

Habitat Selection by Bonneville Cutthroat Trout in the Bear River Drainage

Proposed Methods for the Radio Telemetry Study

Study Objectives

- 1) Describe seasonal movements and habitat selection of fluvial Bonneville cutthroat trout in the Bear River
- 2) Identify spawning location of fluvial Bonneville cutthroat trout
- 3) Correlate Bonneville cutthroat trout movements with water temperature and flow

General Study Design

The study area begins at the confluence of the outlet canal with the Bear River, which is about 2.6 miles west of Montpelier Idaho. The study area follows the Bear River downstream to the Utah-Idaho boarder (118 river miles) and includes five dams. Between the outlet canal and Alexander Reservoir (50 miles), the river is free flowing and provides a corridor for fish migration both up and downstream. The lower section of the study area has a total of 68 river miles and contains all five dams that restrict fish movement (Figure 1). The dams in the lower reach include Alexander, Last Chance, Grace, Cove, and Oneida.

Data collection for the fish telemetry study will be completed over a two-year period. The first year, fish will be tagged and monitored in the upper free-flowing river section. During the second year, the lower section will be completed. Splitting the study area into two sections will reduce costs, (i.e., we will only buy three fixed radio receivers instead of six) and provide a logistically feasible length of river to monitor.

To complete a 365-day radio telemetry survey for the two river reaches, fish will be tagged during the spring and fall. Telemetry tags will be implanted into pre-spawn and immature BCT. The pre-spawn BCT will be tagged in the fall (October – November). The fall tags provide information on winter habitat, spring spawning migrations, and specific spawning locations. Due to tag transmitter life and anticipated post-spawning mortality, sub-adult BCT will be tagged in the spring (April – May). The spring tagging ensures that adequate samples of fish are being tracked through the summer.

Tracking BCT will be done with the use of aerial, manual (truck or foot) and stationary receivers. Aerial tracking will be done on a monthly basis. Aerial tracking can identify approximate fish locations and often is necessary to locate fish that have moved long distances not anticipated or detected from ground surveys. Manual tracking will be done at least bi-weekly. During the spawning period, tracking will be completed weekly. Manual tracking offers specific site or habitat locations (Table 1).

Fixed receivers will be stationed at the boundaries of the free-flowing and regulated reaches. The fixed receivers monitor fish leaving the study reach. Additional stationary receivers will be placed at the confluence of suspected major spawning tributaries. Fixed receivers operate continuously

and record direction of movement. The combination of fixed, manual, and aerial receivers will provide detailed information of habitat selection, migration patterns, spawning locations, and potential sources of mortality of fluvial BCT in the Bear River.

Specific Tagging methods

Radio transmitters and receivers will be purchased through advanced Telemetry Systems (ATS). ATS equipment is being used for ongoing telemetry studies by regional IDFG programs and will be compatible and complement existing equipment (<http://www.atstrack.com>).

Collection of fish will be done using two techniques, angling and electro-shocking. Angling imposes less stress. Electrofishing will be employed if sample size objectives are not met in a reasonable time period by angling. The tagging goal for each reach is 50 pre-spawn adults in the fall and 50 immature BCT in the spring (200 total tags to complete the study).

Cutthroat trout distribution in the river is likely patchy. This will make it difficult to distribute tagged fish evenly throughout the river reach. Despite the expected patchy distribution, an effort will be made to tag 10 fish within every 10-river mile section. Fish within each 10-river mile section may not be evenly distributed.

Several transmitter types will be implanted in fish. Tag size and associated duty cycle (tag life) will vary in a way to minimize tag effects on fish and ensure that there are active tags in the study area for at least a 365 d period. The general rule is that the tag weight should not exceed

2% of the fish's body weight. The largest tags purchased will be 14 grams and used for fish that weight at least 700 grams. The smallest fish tagged in the study will weigh at least 350 grams (tag size 7 grams). All tags will have mortality indicators, which are activated if no movement is detected in a 24-hour period. This type of indicator allows trackers to retrieve the fish/tag and identify possible sources of mortality.

The radio transmitters will be surgically implanted into the fish body cavity following the procedures described in Schmitterling (2001). Surgical implantation is started by anesthetizing the fish with metho-tricaine (MS-222) in a dosage of 1gram/17Litres of water. An incision is made approximately 1.5 inches long, centered between the pectoral fins and pelvic fins. A grooved directional tool approximately 4 inches long is then inserted into the incision and slid posterior, close to the flesh to prevent any contact with the internal organs, until it reaches $\frac{1}{4}$ inch behind the pelvic fins. Then a 4-inch long catheter needle is inserted behind the pelvic fins and slid up the directional tool until it exits the 1 - 1.5-inch incision made earlier. The antennae is then inserted into the catheter needle and directed out through the hole that the catheter needle made behind the pelvic fins. The body of the tag is then gently inserted into the 1.5-inch incision. At this point, 4 stitches are used to close the 1.5 inch incision and both incisions are treated with iodine. This process should take between 6-8 minutes. Then the fish is put into a live well of fresh water to recover.

Tracking Methods

Tracking will be completed using aerial, manual and stationary receivers. Each time a tracked fish is located the date, time, and GPS

location will be recorded. Idaho Department of Fish and Game has a pilot trained for telemetry work and will complete aerial tracking once a month. Aerial tracking will be completed using an Advanced Telemetry System (ATS) 2000 receiver, 2 yagi antennae and Garmin e-trex GPS. Aerial tracking does not allow for detailed habitat use, but will give creditable direction on where to manually track. Manual tracking will be done at least bi-weekly with the same ATS 2000 receiver, 1-yagi antenna and Garmin e-trex GPS. Manual tracking will be complete by truck, boat, or by foot. Stationary sites will be set up with an ATS 4500 receiver and 2 yagi antennae. These receivers record fish migration date, signal strength, and fish directionality. Fixed receiver data will be downloaded to a laptop computer bi-weekly. There will be 3-4 stationary site locations in each study reach, one at each boundary and others at potential major spawning tributaries. The stationary receivers will be necessary to determine when a fish either entered or exited the study area or tributary and what direction it was going.

Water Temperature and Flow Monitoring

Water temperature will be monitored using Hobo temp recording devices. These gages will be placed at three locations (upper, mid and lower) on the free-flowing section. On the regulated section Hobos will be placed at the tailrace of each dam and also one at the Hwy 34 bridge and one at the Idaho-Utah Stateline. In addition to correlating fixed temperature data with fish movements, specific habitat use will be recorded. When access to the river is practicable (boat or foot), telemetry equipment will be used to identify the specific location of a fish (pool, riffle, etc). At the marked location, water temperature, water depth, and Dissolved Oxygen readings will be recorded. An attempt will be made to

collect the specific habitat data on each tagged fish several times during a season (Spring, Summer, Fall, Winter).

Expected Results

- Identify tributaries used for spawning and rearing habitat
- Description of seasonal movements of BCT in the Bear River
- Identify physical or chemical barriers to migration in tributaries and the Bear River
- Develop a better knowledge of BCT abundance in the Bear River
- Description of preferred habitat type by season
- Documentation of mortality factors (predators, angling, water quality, etc.)

Table 1. Tagging and Tracking Schedule

[illegible]

Table 2. Equipment List / Budget

Item	Unit/Cost	Relicensing		IDFG	
		Qty	\$	Qty	\$
Receivers					
Mobile	\$2,500.00			1	\$2,500
Fixed	\$4,000.00	3	\$12,000.00	1	\$4,500
Transmitters	\$175.00	200	\$35,000.00		
Antennas/cables	\$100.00	6	\$600.00		
Travel					
Truck			\$10,000.00	1	
Plane Rental	\$350.00	24	\$8,400.00		
Boat Jet				1	\$2,500.00
Boat Drift				1	\$300.00
Misc			\$1,000.00		
Personnel					
Graduate Student		1	\$54,000		
Technician		1	\$20,000		

IDFG shaded areas are for equipment that can be used for the project and/or expected costs associated with using existing IDFG boats.

Table 3. Relicensing budget needs by year. Budget estimates do not include overhead.

Year	Expense Item	Relicensing Costs
First	Telemetry Equipment	\$30,100.00
	Travel	\$9,200.00
	Personnel	<u>\$28,000.00</u>
	subtotal	\$67,300.00
Second	Telemetry Equipment	\$17,500
	Travel	\$9,200.00
	Personnel	<u>\$28,000.00</u>
	subtotal	\$54,700.00
Third	Personnel	\$18,000.00
	Travel	<u>\$1,000.00</u>
	subtotal	\$19,000.00
Total		\$141,000.00

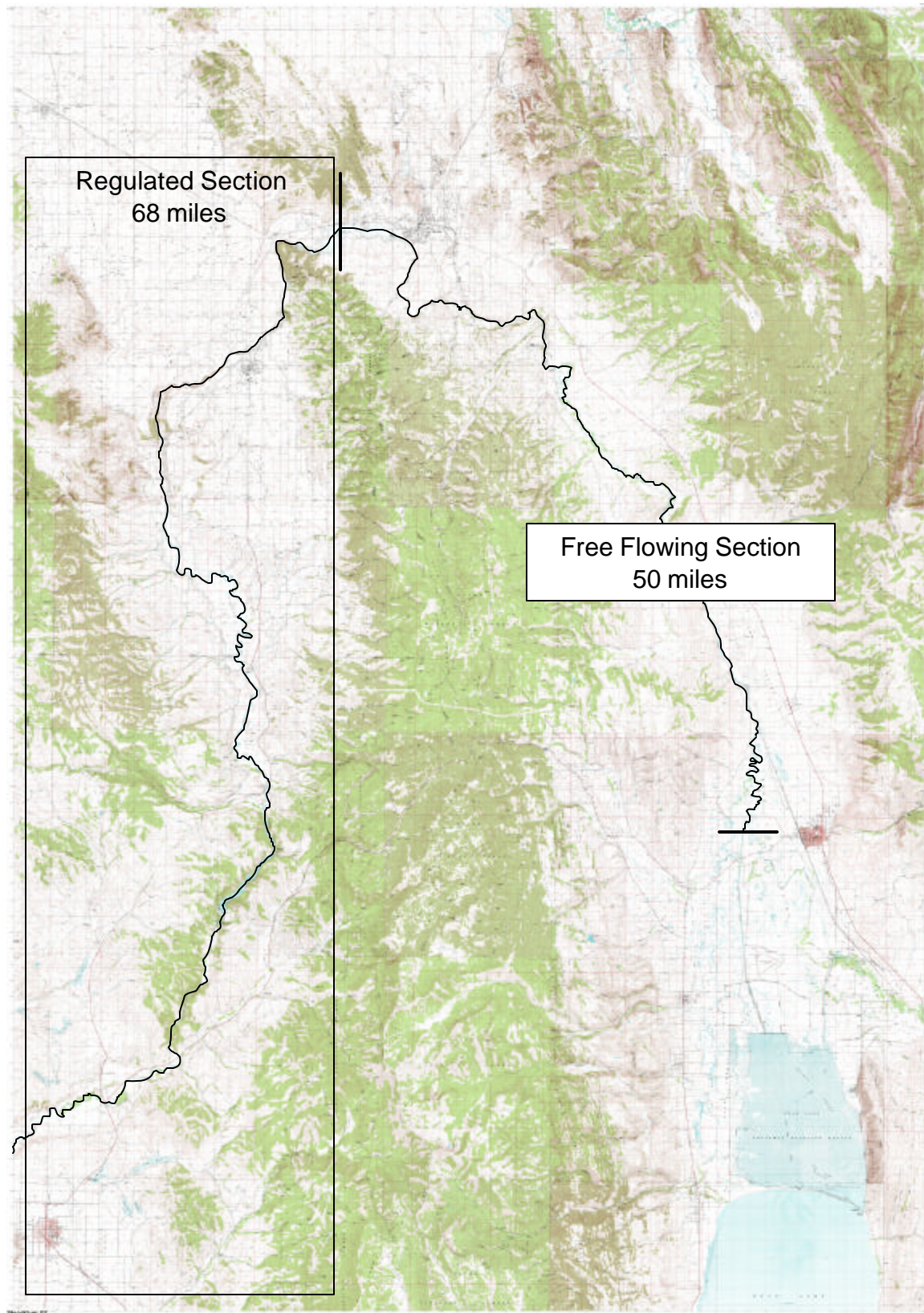


Figure 1. Study Area from Stewart Dam to Alexander Dam (free-flowing section) and downstream to the Utah-Idaho Border.

Appendix C – Wyoming Game and Fish
Bear River Broodstock History and Maintenance

WYG&F Bear River BCT Brood Stock History and Maintenance (Greg Anderson, author)

- Produces advanced fingerlings for spring and summer stocking
- Brood stock originated from wild and had limited success before being brought to Daniel Fish Hatchery (Daniel, WY—15 mi. northwest of Pinedale)
- Prior to being at Daniel BRBCT collected from Lake Alice and brought to Auburn Hatchery—unsuccessful
- Original wild stocks for Daniel taken from Raymond, Coantag, and Giraffe Creeks—current brood stock established in 1977 'after certification of genetic purity'; first brood stock spawn in April/May 1981 resulting from crosses among the three streams
- In 1979 197 YOY from Upper Giraffe and 57 YOY from Coantag transferred to Daniel to be incorporated into brood stock
- 1987 6 males were taken from Sawmill Creek and
- crossed with hatchery females to produce brood replacements
- 1989 6 females and 8 males from Water Canyon Creek were spawned and eventually eggs were combined with Raymond Creek eggs
- 1996 90% of 3, 4, and 5 year old fish were found dead—decided to supplement survivors with wild take, so...
- 1997 8 females and 10 males from Water Canyon Creek were spawned and eggs taken to Boulder Rearing Station and later transferred to Daniel
- Began renovations to hatchery in 1999 due to discovery of Whirling Disease
- Renovations completed in June 2000
- **GENETICS:** Horizontal gel electrophoresis was completed 10/14/1992 by Dr. Robb Leary (U. of Montana). No evidence of hybridization with RBT. Genetic evaluation on file at Daniel Hatchery
- 7-8 spawning 'takes' at the hatchery during the spawning season—usually at weekly intervals between mid April and the first week of June
- 'Population Size and Age Classes' section outlines measures to test for and subsequently prevent genetic drift, etc.
- **FISH HEALTH RECORD:** History of disease in brood stock
- Plans to rewrite brood plan in 2007

**WYOMING GAME AND FISH DEPARTMENT
FISH DIVISION
BEAR RIVER CUTTHROAT BROOD STOCK
HISTORY & MAINTENANCE**

REFERENCE: 00b05BRC

BROOD STOCK: Bear River Cutthroat - 05BRC, (Bonneville Cutthroat), *Oncorhynchus clarki utah*

TYPE: Captive

LOCATION: Daniel Fish Hatchery

PERSONNEL: George Gunn, Greg Anderson, Chester Bettger, and Chris Phillips
(Super.)

PLAN PERIOD: April 2000 to April 2007

*** AUTHORS:** Greg Anderson (Asst. Super.)

Daniel Fish Hatchery
P. O. Box 168, Papp Co. Rd.
Daniel, WY 83115
(307-859-8252)

BROOD STOCK PURPOSE: The Bear River Cutthroat brood stock provides for the production of advanced fingerlings available for spring and early summer stocking. The Bear River Cutthroat is a sensitive species and this brood stock is used to help supplement and maintain existing populations and reestablish extirpated populations in suitable native streams of the Bear River drainage (Chaffey, 1995).

ORIGIN HISTORY: "The Bonneville Cutthroat trout (*Salmo clarki utah* Suckley) is indigenous to the Bonneville Basin in Utah, Idaho, Nevada and Wyoming. The generally common name for these fish is Bonneville cutthroat trout. However several other common names (Utah, Bear River, or Snake Valley cutthroat trout) are in use, depending on local preference" (Binns 1981). The Bonneville Cutthroat trout is known as "Bear River Cutthroat trout" to Wyoming fisheries workers and is the native cutthroat trout of the Bear River Drainage in Wyoming.

This brood stock originated from the wild and has had limited and unsuccessful past hatchery breeding history prior to being introduced into the Daniel Fish Hatchery (Binns, 1981; Conley 1956; Hagen 1951).

The original wild stocks were founded from three streams: Raymond, Coantag and Giraffe creeks (Kunze, 1982). Past reports indicated these are all tributaries of the Thomas Fork of the Bear River and are located in Lincoln County, Wyoming, USA. This is partially accurate. (Raymond Creek flows directly into the Bear River) Coantag is a tributary to Hobble Creek and the Smiths Fork River drainage, while Giraffe is a tributary to the Thomas Fork of the Bear River. All three are found in Lincoln County, Wyoming, USA.

DEPARTMENT HISTORY: Prior to the brood stock being at the Daniel Fish Hatchery, Bear River Cutthroat spawn was collected years ago, mostly at Lake Alice. One spawning crew obtained 191,960 eggs, 474 eggs per female, but only five percent survived to fingerling size (Hagen 1951, Binns 1981). "These eggs developed normally for a time at the Auburn Hatchery; then many suddenly died" (Binns 1981).

- received permission by phone from George Gunn (Super)
to use this document - 7/19/04

"The Wyoming Game and Fish Department established the current hatchery Bear River Cutthroat brood stock in 1977. The Bear River Cutthroat, thought to be extinguished by mixing with other varieties, was found in three tributaries of the Bear River located in Lincoln County, Wyoming. The three tributaries were Raymond, Coantag and Giraffe Creeks. Green eggs of "A" rated genetically pure Bear River cutthroat were taken in April and May from 3 ripe females from Raymond Creek and crossed with an unknown number of males from Coantag and Giraffe Creeks and vice-versa to increase genetic diversity in subsequent generations. After certification of the fish's genetic purity, single introductions from each of the tributaries were made into the Daniel Fish Hatchery on June 20, 1977. The initial brood stock spawn was taken in April and May of 1981" (Kunze, 1982).

Hatchery records show that 3 females from Raymond Creek were used, but origin of males were not indicated. Personal communication (2004) with retired Daniel Fish Hatchery Superintendent Orville Landen verified that the males used were from Coantag and Giraffe Creeks. Although no records exist, females from Coantag and Giraffe Creeks were also spawned with males from Raymond Creek. This spawning operation was conducted in the field and eggs brought back to the Daniel Fish Hatchery (Orville Landen, personal communication, 2004)

Past production records indicate that the brood stock at time of the April 1981 spawn consisted of lot Bear River 1-77 147 fish @ 0.9/lb (Raymond Creek source), Bear River 3-79 55 fish @ 5.0/lb (Giraffe Creek source) and Bear River 2-79 0 (Coantag Creek source). The last of the fish from Coantag Creek had died April 1980 and were never used as brood recruitment. Bear River lot 1-77 was the only lot spawned in 1981. Bear River lot 3-79 was used later as the fish matured. The 1981 Bear River brood was sharing a pond with the Temiscamie brook trout brood stock and were separated before the initial spawn. In 1984 the first brood replacements were utilized in addition to the original stock.

"In May 1977 spawn was taken from Raymond Creek *S.c. utah* when a severe drought threatened the fishery. However only three ripe females were located by an extensive search; these fish averaged 165 eggs apiece (range 124 to 248). The 496 eggs were transferred to Daniel Hatchery as a brood stock nucleus. Of these, 45 percent died by early August when the fish reached the advanced fry (36mm, 1.4 in) stage. After five months in the hatchery, the fish had developed to the advanced fingerling size (76mm, 3in), with a 73 percent mortality rate. To add diversity to the brood stock gene pool, young-of-the-year fry were transplanted to the Daniel Hatchery from Coantag and Upper Giraffe creeks in 1979. Unfortunately, few fry survived the transplant. Those that survived will be used to cross breed the Raymond Creek brood stock" (Binns 1981).

Wild recruitment has been added to this brood stock as follows:

In 1977, the Brood stock started with 3 females (three takes) from Raymond Creek in Lincoln County (a tributary of the Thomas Fork River) crossed with an unknown number of males from Coantag Creek and Giraffe Creek that produced 496 eggs. (Lot 7729BRC01-247, 7729BRC02-124, 7729BRC03-124).

In 1979, 197 at 310/lb and 57 at 2850/lb young of the year fry (~1 ½ inches long) were transferred in from Upper Giraffe Creek and Coantag Creek respectively to the Daniel Fish Hatchery to be incorporated into the Brood stock. (Lot 2-79-Coantag, 3-79-Giraffe)

In 1987, 6 males were obtained from Sawmill Creek in Lincoln County (a tributary of the Smith's Fork River). These males were used with females from the Daniel brood and eggs were used as brood replacements.

In 1989, 1 female and 2 males spawned from Raymond Creek in Lincoln County (a tributary of the Thomas Fork). This lot (8929BRC01) produced 58 eggs and was taken for wild brood replacements. The eggs were kept in an isolated incubator at the Daniel Fish Hatchery and eventually combined with eggs from Water Canyon to form lot 8930BRCC0. August 1989 lot 8930BRCC0 (504 fish) was combined with the Daniel brood recruitment lot 8905BRC01(500 fish) and the new brood lot was called 8905BRCC0.

In 1989, 6 female and 8 males (2 takes) spawned from Water Canyon Creek in Lincoln County (a tributary of the Thomas Fork River). These lots (8930BRC01 and 8930BRC02) produced 550 and 1548 eggs respectively and were taken for wild brood replacements. The eggs were kept in an isolated incubator at the Daniel Fish Hatchery and eventually were combined with eggs from Raymond Creek to form lot 8930BRCC0. August 1989 lot 8930BRCC0 (504 fish) was combined with the Daniel brood recruitment take lot 8905BRC01(500 fish) and new brood lot was called 8905BRCC0.

In 1997 8 female and 10 males were spawned from Water Canyon Creek in Lincoln County (a tributary of the Thomas Fork River). This lot 9730BRCB1 produced 2,538 eggs and were taken for wild brood replacements. The eggs were kept and reared at the Wyoming Game and Fish Department's Boulder Rearing Station Isolation Hatchery at the Boulder Rearing Station. On December 10, 1997 Boulder Rearing Station transferred the entire lot (330 fish) to Daniel Fish Hatchery. These fish were fin clipped and will be tracked through out their time at the Daniel Fish Hatchery in order to know how many fish actually will be spawned at time of recruitment.

In 1998 3 females and 4 males were spawned from Water Canyon Creek in Lincoln County (a tributary of the Thomas Fork River). This lot 9830BRCB1 produced 360 eggs and were taken for wild brood replacements. The eggs were kept and reared at the Wyoming Game and Fish Department's Boulder Rearing Station Isolation Hatchery at the Boulder Rearing Station. On October 1, 1998 Boulder Rearing Station transferred the entire lot (344 fish) to Daniel Fish Hatchery. These fish were fin clipped and will be tracked through out their time at the Daniel Fish Hatchery in order to know how many fish actually will be spawned at time of recruitment.

The following lists the history of the brood stock, locations, dates, numbers spawned, sex ratios, number of generations, etc. After 1990 the reporting of this information was changed to a table format and includes only brood recruitment information. Information for the year 1991 and 1992 overlap in reporting format.

In April and May 1977, 496 eggs were taken from female fish in Raymond, and male fish from Coantag and Giraffe Creeks, tributaries to the Bear River in Lincoln County, Wyoming.

04/15/81: Daniel Fish Hatchery. 7 females, 4 males spawned. 1 generation (4 year old fish).

04/29/81: Daniel Fish Hatchery. 12 females, 10 males spawned. 1 generation (4 year old fish).

05/13/81: Daniel Fish Hatchery. 18 females, 10 males spawned. 1 generation (4 year old fish).

05/25/81: Daniel Fish Hatchery. 15 females, 9 males spawned. 1 generation (4 year old fish).

04/20/82: Daniel Fish Hatchery. 5 females, 4 males spawned. 1 generation (5 year old fish).

04/28/82: Daniel Fish Hatchery. 7 females, 4 males spawned. 1 generation (5 year old fish).

05/06/82: Daniel Fish Hatchery. 4 females, 2 males spawned. 1 generation (5 year old fish).

05/27/82: Daniel Fish Hatchery. 8 females, 5 males spawned. 1 generation (5 year old fish).

06/06/82: Daniel Fish Hatchery. 7 females, 6 males spawned. 1 generation (5 year old fish).

04/11/83: Daniel Fish Hatchery. 8 females, 8 males spawned. 1 generation (6 year old fish).

04/19/83: Daniel Fish Hatchery. 8 females, 8 males spawned. 1 generation (6 year old fish).

04/25/83: Daniel Fish Hatchery. 9 females, 7 males spawned. 1 generation (6 year old fish).

05/02/83: Daniel Fish Hatchery. 4 females, 5 males spawned. 1 generation (6 year old fish).

05/10/83: Daniel Fish Hatchery. 8 females, 5 males spawned. 1 generation (6 year old fish).

04/10/84: Daniel Fish Hatchery. 22 females, 22 males spawned. 2 generations (7 year old and 3 year old fish).

04/17/84: Daniel Fish Hatchery. 14 females, 14 males spawned. 2 generations (7 year old and 3 year old fish).

04/23/84: Daniel Fish Hatchery. 10 females, 10 males spawned. 2 generations (7 year old and 3 year old fish).

05/02/84: Daniel Fish Hatchery. 17 females, 17 males spawned. 2 generations (7 year old and 3 year old fish).

05/10/84: Daniel Fish Hatchery. 10 females, 10 males spawned. 2 generations (7 year old and 3 year old fish).

05/18/84: Daniel Fish Hatchery. 9 females, 10 males spawned. 2 generations (7 year old and 3 year old fish).

04/08/85: Daniel Fish Hatchery. 36 females, 14 males spawned. 2 generations (8 year old and 4 year old fish).

04/17/85: Daniel Fish Hatchery. 20 females, 14 males spawned. 2 generations (8 year old and 4 year old fish).

04/26/85: Daniel Fish Hatchery. 11 females, 11 males spawned. 2 generations (8 year old and 4 year old fish).

05/05/85: Daniel Fish Hatchery. 13 females, 8 males spawned. 2 generations (8 year old and 4 year old fish).

05/12/85: Daniel Fish Hatchery. 5 females, 4 males spawned. 2 generations (8 year old and 4 year old fish).

*The 8-year-old fish were culled and stocked into Woodruff Reservoir on 05/01/85.

04/09/86: Daniel Fish Hatchery. 30 females, 23 males spawned. 2 generations (5 year old and 4 year old fish).

04/18/86: Daniel Fish Hatchery. 20 females, 14 males spawned. 2 generations (5 year old and 4 year old fish).

04/29/86: Daniel Fish Hatchery. 17 females, 10 males spawned. 2 generations (5 year old and 4 year old fish).

05/12/86: Daniel Fish Hatchery. 25 females, 24 males spawned. 2 generations (5 year old and 4 year old fish).

*The 5-year-old females and the 4-year-old males were culled.

03/21/87: Daniel Fish Hatchery. 20 females, 9 males spawned. 2 generations (5 year old and 4 year old fish).

04/09/87: Daniel Fish Hatchery. 68 females, 68 males spawned. 2 generations (5 year old and 4 year old fish).

04/20/87: Daniel Fish Hatchery. 61 females, 65 males spawned. 2 generations (5 year old and 4 year old fish).

04/29/87: Daniel Fish Hatchery. 65 females, 65 males spawned. 2 generations (5 year old and 4 year old fish).

05/08/87: Daniel Fish Hatchery. 6 females, 6 males spawned. The 6 males were obtained from Sawmill Creek in Lincoln County (a tributary of the Smith's Fork River). These eggs were used as brood replacements.

*The 5-year-old females and the 4-year-old males were culled.

04/06/88: Daniel Fish Hatchery. 81 females, 81 males spawned. 2 generations (5 year old and 4 year old fish).

04/15/88: Daniel Fish Hatchery. 73 females, 73 males spawned. 2 generations (5 year old and 4 year old fish).

04/25/88: Daniel Fish Hatchery. 74 females, 74 males spawned. 2 generations (5 year old and 4 year old fish).

05/04/88: Daniel Fish Hatchery. 61 females, 61 males spawned. 2 generations (5 year old and 4 year old fish).

05/17/88: Daniel Fish Hatchery. 60 females, 60 males spawned. 2 generations (5 year old and 4 year old fish).

05/27/88: Daniel Fish Hatchery. 20 females, 20 males spawned. 2 generations (5 year old and 4 year old fish). *This was the first year of 1:1 female to male spawning. **The 5-year-old females and 4-year-old males were culled.

04/11/89: Daniel Fish Hatchery. 90 females, 90 males spawned. 3 generations (4, 5 and 6 year old fish).

04/21/89: Daniel Fish Hatchery. 74 females, 74 males spawned. 3 generations (4, 5 and 6 year old fish).

05/01/89: Daniel Fish Hatchery. 55 females, 55 males spawned. 3 generations (4, 5 and 6 year old fish).

05/10/89: Daniel Fish Hatchery. 44 females, 44 males spawned. 3 generations (4, 5 and 6 year old fish).

05/22/89: Raymond Creek. 1 female, 2 males spawned. 1 generation.
These eggs were taken for wild brood replacements. The eggs were kept in an isolated incubator at the Daniel Fish Hatchery.

05/22/89: Water Canyon Creek. 2 females, 4 males spawned. 1 generation. These eggs were taken for wild brood replacements. The eggs were kept in an isolated incubator at the Daniel Fish Hatchery.

06/01/89: Water Canyon Creek. 4 females, 4 males spawned. 1 generation. These eggs were taken for wild brood replacements. The eggs were kept in an isolated incubator at the Daniel Fish Hatchery.
*The 5 and 6-year-old females and 4-year-old males were culled.

04/13/90: Daniel Fish Hatchery. 13 females, 9 males spawned. 2 generations (5 year old and 4 year old fish).

04/20/90: Daniel Fish Hatchery. 45 females, 30 males spawned. 2 generations (5 year old and 4 year old fish).

04/30/90: Daniel Fish Hatchery. 70 females, 42 males spawned. 2 generations (5 year old and 4 year old fish).

05/10/90: Daniel Fish Hatchery. 37 females, 25 males spawned. 2 generations (5 year old and 4 year old fish).

05/22/90: Daniel Fish Hatchery. 35 females, 22 males spawned. 2 generations (5 year old and 4 year old fish).
*The 5-year-old females and 4-year-old males were culled.

04/10/91: Daniel Fish Hatchery. 86 females, 86 males spawned. 2 generations (5 year old and 4 year old fish).

04/22/91: Daniel Fish Hatchery. 59 females, 59 males spawned. 2 generations (5 year old and 4 year old fish). 0.25 oz. brood replacement eggs were collected from each female during spawning.

05/01/91: Daniel Fish Hatchery. 47 females, 47 males spawned. 2 generations (5 year old and 4 year old fish). 0.25 oz. brood replacement eggs were collected from each female during spawning.

05/10/91: Daniel Fish Hatchery. 33 females, 33 males spawned. 2 generations (5 year old and 4 year old fish). 0.25 oz. brood replacement eggs were collected from each female during spawning.

05/20/91: Daniel Fish Hatchery. 23 females, 23 males spawned. 2 generations (5 year old and 4 year old fish). 0.25 oz. brood replacement eggs were collected from each female during spawning.
*The 5-year-old females and 4-year-old males were culled.

04/08/92: Daniel Fish Hatchery. 55 females, 55 males spawned. 2 generations (5 year old and 4 year old fish). 0.25 oz. brood replacement eggs were collected from each female during spawning.

04/16/92: Daniel Fish Hatchery. 32 females, 32 males spawned. 2 generations (5 year old and 4 year old fish). 0.25 oz. brood replacement eggs were collected from each female during spawning.

04/27/92: Daniel Fish Hatchery. 51 females, 51 males spawned. 2 generations (5 year old and 4 year old fish). 0.25 oz. brood replacement eggs were collected from each female during spawning.

04/29/92: Daniel Fish Hatchery. 44 females, 44 males spawned. 1 generation (3 year old fish).

05/07/92: Daniel Fish Hatchery. 33 females, 33 males spawned. 2 generations (5 year old and 4 year old fish). 0.25 oz. brood replacement eggs were collected from each female during spawning.

05/15/92: Daniel Fish Hatchery. 10 females, 10 males spawned. 2 generations (5 year old and 4 year old fish).

05/15/92: Daniel Fish Hatchery. 25 females, 25 males spawned. 1 generation (3 year old fish).
*The 5-year-old females and 4-year-old males were culled. (Wyoming Game & Fish Department. 1992)

Table for annual brood recruitment: Spawned from lots 8705BRC04 & 8605BRCD0

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9105BRCB2	91/04/22	7100	59 4&5YR F X 59 4&5YR M	Daniel	4,260
9105BRCB3	91/05/01	6096	47 4&5YR F X 47 4&5YR M	Daniel	4,953
9105BRCB4	91/05/10	4908	33 4&5YR F X 33 4&5YR M	Daniel	2,454
9105BRCB5	91/05/20	3048	23 4&5YR F X 23 4&5YR M	Daniel	1,524

Table for annual brood recruitment: Spawned from lots 8805BRC02 & 8705BRC04

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9205BRCB1	92/04/08	6,896	55 4&5YR F X 55 4&5YR M	Daniel	4,310
9205BRCB2	92/04/16	4,090	32 4&5YR F X 32 4&5YR M	Daniel	2,863
9205BRCB3	92/04/27	7,848	51 4&5YR F X 51 4&5YR M	Daniel	5,668
9205BRCB5	92/05/07	4,310	33 4&5YR F X 33 4&5YR M	Daniel	2,586

Table for annual brood recruitment: Spawned from lots 9005BRCB4, 8905BRCD0 & 8805BRC02

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9305BRCB1	93/04/07	13,088	110 Year Classes Not Recorded	Daniel	9,407
9305BRCB2	93/04/15	8,274	72 Year Classes Not Recorded	Daniel	6,304
9305BRCB3	93/04/23	5,516	54 Year Classes Not Recorded	Daniel	4,334
9305BRCB4	93/05/03	4,728	46 Year Classes Not Recorded	Daniel	3,152

Table for annual brood recruitment: Spawned from lots 9105BRCB4, 9005BRCB4 & 8905BRCD0

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9405BRCB1	94/04/12	11,760	81 Year Classes Not Recorded	Daniel	7,840
9405BRCB2	94/04/21	9,456	70 Year Classes Not Recorded	Daniel	6,698
9405BRCB3	94/05/02	9,456	71 Year Classes Not Recorded	Daniel	7,880
9405BRCB4	94/05/14	2,244	19 Year Classes Not Recorded	Daniel	1,496
9405BRCB5	94/05/20	404	9 Year Classes Not Recorded	Daniel	202

Table for annual brood recruitment: Spawned from lots 9205BRCB5, 9105BRCB4 & 9005BRCB4

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9505BRCB1	95/04/11	5,824	44 4&5YR F X 44 3&4YR M	Daniel	3,744
9505BRCB2	95/04/24	12,555	99 4&5YR F X 99 3&4YR M	Daniel	6,480
9505BRCB3	95/05/02	8,338	65 4&5YR F X 65 3&4YR M	Daniel	5,875
9505BRCB4	95/05/12	6,698	55 4&5YR F X 55 3&4YR M	Daniel	4,728

Table for annual brood recruitment: Spawned from lots 9305BRCB4, 9205BRCB5 & 9105BRCB4

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9605BRCB1	96/04/15	1,168	6 3&4 YR F X 6 3&4 YR M	Daniel	488
9605BRCB2	96/04/26	860	5 3,4&5YR F X 5 3&4YR M	Daniel	409
9605BRCB3	96/05/08	1,696	9 3,4&5YR F X 9 3&4YR M	Daniel	729
9605BRCB4	96/05/20	1,485	9 3&4YR F X 9 3&4YR M	Daniel	905

Table for annual brood recruitment: Spawned from lots 9405BRCB5, 9305BRCB4, 9205BRCB5 & 9105BRCB4

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9705BRCB1	97/04/17	6,118	42 3,4,5&6YRFX42 3,4,5&6YRM	Daniel	3,496
9705BRCB2	97/04/28	5,967	32 3,4&5YR F X 32 3&4YR M	Daniel	1,836
9705BRCB3	97/05/07	5,210	31 3,4&5YRF X 31 3,4&5YR M	Daniel	2,084
9705BRCB4	97/05/14	1,044	8 3,4&5YR F X 8 3,4&5YR M	Daniel	783
9705BRCB5	97/04/21	678	4 4&5YR F X 4 3YR M	Daniel	424
9705BRCB6	97/05/28	329	3 4&6YR F X 3 3YR M	Daniel	197

Table for annual brood recruitment: Spawned from lots 9505BRCB4, 9405BRCB5, 9305BRCB4 & 9205BRCB5

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9805BRCB1	98/04/15	10,200	55 4,5&6YRFX55 3,4,5&6YRM	Daniel	6,375
9805BRCB2	98/04/22	11,136	64 4,5&6YRFX64 3,4,5&6YRM	Daniel	8,352
9805BRCB3	98/04/29	5,208	36 4,5&6YRF X 36 3,4&5YR M	Daniel	3,472
9805BRCB4	98/05/06	5,408	35 4,5&6YRFX35 3,4,5&6YRM	Daniel	2,912
9805BRCB5	98/05/13	5,187	33 4,5&6YRFX33 3,4,5&6YRM	Daniel	4,389
9805BRCB6	98/05/20	1,695	12 4,5&6YR F X 12 3&4YR M	Daniel	1,356

Table for annual brood recruitment: Spawned from lots 9605BRCB4, 9505BRCB4, 9405BRCB5, & 9305BRCB4

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
9905BRCB1	99/04/13	16,548	139 4,5&6YRFX139 3,4,5&6YRM	Daniel	9,850
9905BRCB2	99/04/20	3,249	24 5 YR F X 24 3&4 YR M	Daniel	2,166
9905BRCB3	99/04/28	6,606	49 5&6 YR F X 49 3,4,5&6YR M	Daniel	5,138
9905BRCB4	99/05/04	3,195	29 5 YR F X 29 4 YR M	Daniel	2,485
9905BRCB5	99/05/11	6,606	41 5&6 YR F X 41 4YR M	Daniel	5,138

Table for annual brood recruitment: Spawned from lots 9705BRCB6, 9605BRCB4 & 9505BRCB4

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
0005BRCB1	00/04/18	3,536	26 4&5YR F X 26 4&5 YR M	Daniel	1,768
0005BRCB2	00/04/26	2,912	20 4&5YR F X 20 4&5YR M	Daniel	1,092
0005BRCB3	00/05/03	3,663	20 5YR F X 20 4YR M	Daniel	2,035
0005BRCB4	00/05/10	3,064	20 4&5YR F X 20 4&5YR M	Daniel	1,149
0005BRCB5	00/05/17	4,466	29 4&5YR F X 29 3,4 &5YR M	Daniel	2,030
0005BRCB6	00/05/24	2,424	31 4&5YR F X 31 3&4YR M	Daniel	1,212
0005BRCB7	00/05/31	1,260	11 5 YR F X 11 4 YR M	Daniel	420

On February 13, 1996 the brood stock suffered a set back when over 90% of the 3, 4, and 5-year-old fish from this brood stock were found dead. The brood was then located in the "Big Brood Pond", a dirt pond with a two water source system. The hatchery by-pass valve was not shut completely, thus robbing the brood pond of fresh flowing water. Ice clogging the by-pass valve was suspected. With the addition of the pond freezing over night and failure to notice the no flow situation, oxygen was unavailable to the fish resulting in suffocation. (Anderson, 1996)

After the 1996 brood loss, it was decided to go to the wild to obtain new recruitment. New recruitment from Water Canyon Creek, Lincoln County, Wyoming was obtained in 1997 and 1998. Eggs from these fish will be incorporated into the brood stock in 2001, 2002 and 2003 respectively.

On January 19, 2000 again the brood stock suffered another set back as approximately 180 brood fish (62%♂, 38%♀) died as a result of a plugged inlet screen to the newly constructed East Brood Pond.

The Wyoming Game and Fish Department began major renovations at the Daniel Fish Hatchery in 1999. The renovation was prompted by circumstances concerning protection of two native cutthroat brood stocks, whirling disease and the need for modernization. The presence of the parasite *Myxobolus cerebralis* was found in Forty Rod creek in 1998. Forty Rod Creek lies within close proximity to the station and is where all effluent flows from the station. The discovery of Whirling Disease and the need for improvements prompted the Game and Fish efforts to modernize the facility.

The Daniel Fish Hatchery's renovation began in August 1999 and was completed in June 2000. This included a 127 x 220 foot non-heated metal rearing building covering the 12 older concrete raceways and two new 116 x 14 foot concrete brood ponds. Upgrades to pipelines included inline flow meters with alarm capabilities as well as new valves and pipe. Directing the effluent through two discharges to Forty Rod Creek and removing an irrigation ditch supplied by Forty Rod Creek, which ran through the facility, was also accomplished. With the addition of this new building, all rearing units for the facility are enclosed, providing long-term protection from diseases and predation.

While the work for the raceway building was contracted to R.I. Galloway and Associates of Afton, Wyoming, station personnel took advantage of the "down time" to make improvements to the hatchery. Hatchery improvements included a new 16" PVC head pipe, and replacement of old concrete troughs with fiberglass circular troughs and automated vibrating "Sweeney" feeders. The main goal for the hatchery and equipment is to be portable, and interchangeable, giving the hatchery versatility, and making efficient use of water, space, and future changing needs.

The two new concrete brood ponds are identical and each consists of 2 (an Upper and Lower section) independent ponds that have their own water inlets and drains connected by spawning channels. Both ponds are 116' x 14' with an average depth of 27 inches and volume of 3,070 cubic feet. Each brood pond has an hourglass shape with an upper and lower pond, inflows and drains, and are separated by a spawning area consisting of three 16' x 8' channels that can be divided into 6 pens. Each upper and lower pond has the capability to be divided into several pens, giving the pond flexibility to separate brood year classes and sexes. Other features include double keyways to provide the use of screens and baffles, rounded corners to aid in seining and inline pipe flow meters at each inflow pipe to set pond water flows.

The Daniel Bear River Cutthroat brood stock was moved from an earthen brood pond ("Big Brood Pond") to the newly constructed East Brood Pond in the fall of 1999. Currently, the pond is running approximately 250 gpm, giving an exchange rate of 1 turnover every 90 minutes (16 per day). Originally the pond had approximately 6" cobble in the bottom, which we evaluated for its effect on fish health and condition, sanitation, and ease of cleaning. In the fall of 2000 the rock was removed and the brood stock moved to the West Brood Pond. The rock was growing fungus and taking up the already limited pond volume.



GENETIC EVALUATION: Horizontal gel electrophoresis completed 9/2/14 by Dr. Robb Leary of Univ. of Montana. Testing showed no evidence of hybridization with rainbow trout. The genetic evaluation is on file at the Daniel Fish Hatchery.

Rearing Parameters

Water Chemistry: Past records on file at the Daniel Fish Hatchery have all indicated water chemistry, quality and temperatures suitable for trout culture. Water chemical parameters were analyzed by the Wyoming Department of Agriculture, June 1990 and are found in Appendix I.

A biannual monitoring and sampling for suspendable solids is performed as per our Department of Environmental Quality (D.E.Q) discharge permit. The station has always been within compliance.

REARING FACILITIES:

Production Stock: Daniel has two brood ponds available for rearing and spawning brood stocks. Both the East and West brood ponds are identical in shape and size and have an upper and lower section (pond). Currently 4, 5 & 6-year-old fish are held in the Lower West Brood Pond. This ponds rearing capacity measures approximately 83' x 14' x 28" and has an approximate volume of 2500 cubic feet of water. The pond is concrete and has a spawning pen structure at the head of the pond. The pond has 2 dividers to make three sections in order to separate year classes if needed. The pond is supplied with 250-300 gpm first use well water that can be supplied from the Upper West Brood Pond and/or at an inlet at the head of the Lower West Brood Pond. The annual temperature ranges from 42-45° F.

Recruitment Stock: The 3 year old fish are held in the Upper West Brood Pond that measures 23'x14'x28" and has an approximate rearing volume of 735 cubic feet of water. The pond is concrete. The pond has 1 divider to make two sections in order to separate the spawning holdovers from the three year olds. The pond is supplied with 250-300 gpm first use well water at the head end. The annual temperature ranges from 42-45° F.

The 2 year old fish are held in the Upper East Brood Pond with a flow of 200 gpm and annual temperatures ranges from 42-45° F.

FEED REQUIREMENTS AND REGIME: The fish are started on feed using a semi moist feed, either Biodiet or Silver Cup Soft Moist. When they reach approximately 2000 fish/lb. in size they are switched to Silver Cup brand feeds (closed formula) sizes #1, #2, #3, #4, 3.0mm Extruded Slow Sink and 5.5mm Extruded Floating until they are approximately 2.0 fish/lb. in size. At this point they are fed 7.5mm Extruded Floating brood feed mixed with canthaxanthin.

The fish are initially fed by hand 6 times/day. Once they are up and feeding well, they are large enough to be switched to size #1 or #2 feed and fed with timed automatic "Sweeney" vibrating feeders or Belt Feeders. The fish are trained to use these feeders in the hatchery. When moved to outside raceways fish are fed either by hand 3-4 times a day or with "Babbington" demand self feeders through 3 years of age. Due to the non-aggressive feeding behavior the feeders are checked daily and filled as needed. Once the fish have reached spawning age (4 years of age), they are again fed by hand, twice daily. The 4 & 5 yr olds are fed 7.5mm Extruded Floating brood pellets, 3 yr olds 5.5mm Extruded Floating pellets and 2 yr olds 3.0 Extruded Slow Sink pellets. All feed amounts are determined through calculations using Haskell's formula based on percent body weight.

Population Size and Age Classes

RECRUITMENT: Generally there are 7 to 8 takes during the spawning season. During the spawning season, brood recruitment eggs are taken at weekly intervals starting April 15th from up to 10 to 15 pairs from the 4 middle takes. A 1:1 sex ratio of 4 and 5-year-old fish is used. In some years, when shortages occur, 3 year old males are used. Approximately 20,000 eyed eggs are obtained from at least 250-300 pairs of fish. These eggs are kept as separate lots from the production lots. At age 1 approximately 3,500 fish are randomly selected for brood replacement. At age 2 approximately 625 fish are randomly selected for brood replacement.

To assure that genetic drift is minimized, equal representation of parental stock is necessary. A standardized egg amount from each pair is taken from the spawn pan so each pair is represented with approximately the same amount of eggs (typically 200-350 eggs). Spawning brood recruitment pairs are selected from weeks representing an estimate of when 60% of the spawning population occurs. This can be illustrated by a bell curve plotting time on the x-axis and number of fish spawned on the y-axis. Each brood recruitment take should closely mirror the percentage the corresponding spawn represents in the overall spawning population.

Baseline recruitment is 5 years of external recruitment from the source of origin followed by 7 years of internal recruitment. Genetic evaluation of the progeny from the 6th year of internal recruitment measures any level of genetic drift from the original genetic samples before the 7th year is spawned. The 12th year spawn would be the second time that internal recruitment is taken from all year classes

representing the domestic brood. A genetic evaluation for genetic drift on the 11th year is used as a measure for any genetic loss that has occurred without the influence of external recruitment. The resulting sample would dictate if external recruitment is needed, and for how many years. If sufficient genetic variation loss occurred, the 12th year can receive external recruitment to augment the genetic composition of the stock. Rotational sequence would be 5 external, 7 internal, 5 external etc. These methods are practiced to minimize genetic drift.

PRODUCTION: The Bear River production and brood stock at Daniel Fish Hatchery are reared in linear and circular fiberglass troughs, concrete raceways and concrete ponds. The fish are normally reared in the hatchery in a small fiberglass linear troughs (approximately 8 cubic feet) and an assortment of 4, 5 and 6 foot fiberglass circular troughs, until it is determined they need more space (approximately 1 year). At this time, they are moved outside to the Rearing Building into 560 cubic foot cement raceways. Shades are provided to reduce stress.

The Brood recruitment lot, at 2 years, is moved to the upper end of the West Brood Pond where they remain for one year. As 3 year old fish, they remain there until post spawning. During spawning, the 4 and 5 year old fish are spawned in the Lower West Brood Pond. Following spawning, the 3 year old fish are mixed with the holdover 4 year old fish in the lower West Brood Pond and remain there until the following spawning season. Five year old fish are culled.

Two-year classes are kept for spawning, 4 & 5 year males and 4 & 5 year females (3 year old recruitment male and females are kept but are not used until age 4).

	Available	Culled	Saved
3yr males	1000	375	625
3yr females	1000	375	625
4yr males	625	125	500
4yr females	625	125	500
5yr females	500	500	0

CULLS:

Culls are used for annual disease inspection samples and remainders are stocked out. Table shows available fish.


1yr	16,000-20,000
2yr	1,750-3,000
3yr	600-700
4yr	200-250
5yr	400-500

Spawning Facilities

CAPTURE METHOD: A pond seine is used to crowd fish into the spawning pens for sorting age classes and sex. Each week "green" females are seined into the pens, and checked for "ripeness"

OPERATION FACILITIES: The brood stock is located in the rearing building at the Daniel Fish Hatchery. The concrete brood pond has a concrete spawning area located within the brood pond and contains 3 channels and 6 pens for sorting fish.

Spawning Operations

 **SPAWNING PERIOD:** The spawning time for the Bear River Cutthroat at the Daniel Fish Hatchery usually runs from mid April to the end of May or first week of June each year. The average beginning date is about April 15th. Usually 7 to 8 takes are spawned at weekly intervals.

SPAWNING METHOD (Production): The average water temperature during spawning is 43°F. The fish develop spawning colors with the males becoming especially colorful. The 4 and 5-year-old fish run approximately 0.6 - 0.7 fish/lb. (approximately 15 - 16 inches in length) at the time of spawning. The 3-year-old fish run approximately 1.0 - 1.2 fish/lb. (approximately 12 - 13 inches in length) at the time of spawning. The 3-year-old fish are not normally spawned, as egg numbers and quality has been found to be poor with these fish. The 3-year-old fish are spawned on occasion however, to provide additional eggs above and beyond those that are provided by the 4 and 5 year old fish. Fish that are found to have deformities at the time of spawning are not spawned and are culled at that time.

Preparation -- Prior to the 1st take the spawning structure is cleaned. The 3yr old fish are crowded to the uppermost pen of the upper West brood pond. The 4 & 5yr old fish are then seined into the spawning structure and sorted, putting the 4 year and 5 year old males in separate pens along one channel and the ripe 4 and 5 year old females in separate pens in another channel. The green females are returned to the upper section of the lower West brood pond.

Spawning method -- Fish are spawned using a semi-dry one on one method. A single female is stripped into a 2qt. pan and fertilized with a single male. A one-tablespoon scoop is removed for brood recruitment and placed in a separate pan. The fertilized production eggs are then poured into a common pan; when a total of 5 pairs are in this pan the eggs are washed and placed in a cooler to water harden for 2 hours

Pairing Ratio -- 1:1 for all brood recruitment and for production unless males are limited.

Age Class Crosses -- Random 4 & 5yr old males on 4 & 5yr old females.

Green Egg Care -- After washing and water hardening for 2 hours, the eggs are disinfected with 100 ppm PVP iodine for 10 minutes and placed in jars or drip incubators in the Daniel Fish Hatchery's Incubator Room. If Robertson drip incubators are used, eggs are treated with 500cc formalin over a 15 min period every other day. All lots, whether incubated in jars or drips are treated with 500cc formalin before leaving the incubator room.

EGG PRODUCTION (Estimated):

Total Green Eggs Available – 900,000 to 1,600,000 annually

Green Egg Demand -- 300,000 to 625,000 annually

Eggs/Female Available by each age class spawned --

Some records have been kept separating age classes, but not every year. The average egg per female from 1987-2000 was 2,275.

Fecundity -- Percentages of viable females per year class, of immature females and rejected females.

4 Year female:

% To survive from sorting and successfully spawn	88%
% Viable from those available during spawning season	95%
% Immature	0%
% Rejected	5%

5 Year female:

% To survive from sorting and successfully spawn	80%
% Viable from those available during spawning season	95%
% Immature	0%
% Rejected	5%

Stock Recruitment Procedures

TOTAL PAIRS: A minimum of 50 pairs is used each year to maintain genetic diversity. We attempt to pair 25 5yr females X 25 4yr males and 25 4yr females X 25 5yr males.

Internal recruitment -- One tablespoon of recruitment eggs are taken from each pair spawned at weekly intervals from all takes, except the first and last of the spawning season. A 1:1 sex ratio of 4 and 5-year-old fish is used. Generally there are 7 to 8 takes during the spawning season.

Genetic source recruitment -- As follows and is the same information found above under "DEPARTMENT HISTORY"

In 1977, the Brood stock started with 3 females (three takes) from Raymond Creek in Lincoln County (a tributary of the Thomas Fork River) crossed with an unknown number of males from Coantag Creek and Giraffe Creek that produced 496 eggs. (Lot 7729BRC01-247, 7729BRC02-124, 7729BRC03-124).

In 1979, 197 at 310/lb and 57 at 2850/lb young of the year fry (~1 ½ inches long) were transferred in from Upper Giraffe Creek and Coantag Creek respectively to the Daniel Fish Hatchery to be incorporated into the Brood stock. (Lot 2-79-Coantag, 3-79-Giraffe)

In 1987, 6 males were obtained from Sawmill Creek in Lincoln County (a tributary of the Smith's Fork River). These males were used with females from the Daniel brood and eggs were used as brood replacements.

In 1989, 1 female and 2 males spawned from Raymond Creek in Lincoln County (a tributary of the Thomas Fork). This lot (8929BRC01) produced 58 eggs and was taken for wild brood replacements. The eggs were kept in an isolated incubator at the Daniel Fish Hatchery and eventually combined with eggs from Water Canyon to form lot 8930BRCCO. August 1989 lot 8930BRCC0 (504 fish) was combined with the Daniel brood recruitment lot 8905BRC01(500 fish) and the new brood lot was called 8905BRCD0.

In 1989, 6 female and 8 males (2 takes) spawned from Water Canyon Creek in Lincoln County (a tributary of the Thomas Fork River). These lots (8930BRC01 and 8930BRC02) produced 550 and 1548 eggs respectively and were taken for wild brood replacements. The eggs were kept in an isolated incubator at the Daniel Fish Hatchery and eventually were combined with eggs from Raymond Creek to form lot 8930BRCCO. August 1989 lot 8930BRCC0 (504 fish) was combined with the Daniel brood recruitment take lot 8905BRC01(500 fish) and new brood lot was called 8905BRCD0.

In 1997 8 female and 10 males were spawned from Water Canyon Creek in Lincoln County (a tributary of the Thomas Fork River). This lot 9730BRCB1 produced 2,538 eggs and were taken for wild brood replacements. The eggs were kept and reared at the Wyoming Game and Fish Department's Boulder Rearing Station Isolation Hatchery at the Boulder Rearing Station. On December 10, 1997 Boulder Rearing Station transferred the entire lot (330 fish) to Daniel Fish Hatchery. These fish were fin clipped and will be tracked through out their time at the Daniel Fish Hatchery in order to know how many fish actually will be spawned at time of recruitment.

In 1998 3 females and 4 males were spawned from Water Canyon Creek in Lincoln County (a tributary of the Thomas Fork River). This lot 9830BRCB1 produced 360 eggs and were taken for wild brood replacements. The eggs were kept and reared at the Wyoming Game and Fish Department's Boulder Rearing Station Isolation Hatchery at the Boulder Rearing Station. On October 1, 1998 Boulder Rearing Station transferred the entire lot (344 fish) to Daniel Fish Hatchery. These fish were fin clipped and will be tracked through out their time at the Daniel Fish Hatchery in order to know how many fish actually will be spawned at time of recruitment.

Recruitment in spawning seasons 2001, 2002 and possibly 2003 will have fish from the 1997 and 1998 Water Canyon Creek source incorporated into the stock.

SELECTION SCHEDULE: Recruitment eggs are generally taken from 10 to 15 pairs from the middle takes of the spawning period. There are generally 7 to 8 takes at weekly intervals starting April 15th.

SELECTION PROCEDURES: Pairs of fish are selected at random, with the only criteria being healthy appearing eggs and milt. After the female is stripped and the eggs are fertilized one tablespoon of eggs are removed from each brood pair and placed in a separate pan to be washed. These eggs are placed in a separate cooler to be water hardened. These individuals are always maintained separately from production lots.

SELECTION INCUBATION: All recruitment lots are kept in the Daniel Fish Hatchery incubator room. Jars and Robertson vertical drip incubators are used. No specialized incubation timing is implemented with recruitment lots.

PRIMARY REARING FACILITY: The Daniel Fish Hatchery is the rearing facility for all brood recruitment lots.

Fish Health Record

HEALTH REQUIREMENTS: Wyoming Game and Fish Commission Chapter X regulations (section 4, subsection z, page 105) and (appendix I, section 2, subsection d, paragraphs i and iii, pages 106.2 and 106.21). The following samples are taken each year by the state pathologist: 60 lethals
150 ovarians

HEALTH HISTORY:

The following is a history of diseases that the brood lots has had, documented by the Wyoming Game and Fish Department Fish Health Lab.

7/7/83	Gas bubble disease
1/6/86	Environmental stress, abnormal livers observed.
8/15/88	Gas bubble disease
5/23/90	Severe fungal infection, loss of 4 to 5% of lot.
5/30/91	Fungal infection of skin and motile aeromonas septicemia
5/8/96	Bacterial gill disease
7/8/98	Bacterial gill disease
3/10/99	Clinical furunculosis
3/17/99	Clinical furunculosis
4/29/99	Clinical furunculosis
5/10/00	Sub clinical whirling disease

The fish remain relatively disease free throughout their life cycle at the Daniel Hatchery. There are occasional bacterial gill problems when the fish are small and beginning to feed. Peduncle disease can also occasionally be a problem. The major problem in the hatchery however, is gas bubble disease, which can cause serious mortality in the Bear River Cutthroats. Young fish are very susceptible to gas bubble disease. This problem is currently being alleviated through the use of packed columns. All influent water from both sources to the hatchery and outside raceways and ponds is treated with packed columns to help increase dissolved oxygen and decrease nitrogen gas in the water.

The brood fish also have problems with Motile Aeromonas Septicemia (MAS) following spawning due to the handling of the fish. This problem has been fought by feeding the fish medicated feed (with Romet-30) through spawning and for several weeks following spawning.

Health problems associated with the brood stock have been fungal infections due to post spawning stress. Post spawning brood fish show susceptibility to MAS and secondary fungal infections causing about 10% mortality in 4 and 5 year olds. Post spawn fungal infections have been significantly reduced by putting all holdover fish in completely covered raceways with shades, holding them off feed, and using salt treatments. Mortality has gone from approximately 10% to around 1%.

Recently, holdover brood fish have been placed in the upper West Brood Pond and provided shade. This change, along with minimal feeding during post spawn, reduced the fungus problem dramatically.

In 1999 the brood stock was diagnosed with Furunculosis just prior to the spawning season. Medicated feed (Romet) was used to treat the brood. However this was not successful because the fish went off feed for the spawn, were stressed with the disease, and the right size of medicated feed was not available. Approximately 1100 brood fish were inoculated with Liquamycin (Oxytetracycline) at a rate of 20mg/lb of fish, which eliminated the disease. MS-222 was used as an anesthetic. Personnel involved in the inoculation process were George Gunn, Greg Anderson, Chester Bettger, Joe Gillis, Dave Money and Katie Bardsley.

During the 2000 Daniel Fish Hatchery annual disease inspection, the Bear River Cutthroat brood and recruitment lots 9705BRCBC, 9805BRCB6 and 9830BRCB1 were found to be infected with Whirling Disease. These lots had been transferred, in 1999 to the Dubois Fish Hatchery prior to and in order for the construction of the new rearing building and brood ponds. While at Dubois, the brood and recruitment lots were exposed to *Myxobolus cerebralis*. These lots had been transferred back to Daniel Fish Hatchery in November 1999. The infected brood lot 9705BRCBC was combined with the main brood lot 9305BRCB4 on April 15, 2000 and name changed to 9505BRCBC by the time the diagnosis was made. The decision was made to use the infected brood lot year classes through the spawning seasons. Disinfection protocols to include chlorination of gear and equipment were put in place to limit the transfer of the disease to the rest of the station.

FISH HEALTH INSPECTIONS: Completed annually on all lots of fish by the Wyoming Game and Fish Department Fish Pathologist in accordance with Chapter X State Regulation. Viral assays are conducted on ovarian samples once a year commencing with the first take of eggs from the brood. No prohibited pathogens have been diagnosed by fish health inspections.

Brood Stock Population Evaluation

BROOD STOCK ATTRIBUTES: This stock displays wild characteristics and does not like human contact. It prefers to hide under shade, and feeds well with demand or belt feeders. They have pure genetic diversity, and no hybridization. The brood stock is docile and no anesthesia is used during the spawn.

Growth and condition factors of the Bear River brood stock are good throughout the life cycle at the Daniel Fish Hatchery.

A new brood pond with a first use water source, and improved culture practices will aid in prevention of stress related mortality and disease.

Incorporation of wild brood recruitment from healthy native populations (to maintain pure, genetically diverse fish) and the continuation of sound brood recruitment practices will aid in keeping a healthy brood stock.

Past information from fisheries managers indicate length at ages I, II, III and IV: 3.5, 6.2, 9.3 and 11.9 inches respectively. Bear River cutthroats commonly reach 16 - 19 inches in length in the wild. They are opportunistic feeders. Bear River cutthroats can tolerate environmental extremes better than most other species of trout. They can do well in warm, turbid waters, etc. They seem to prefer deep pools and undercut banks similar to brown trout (Wyoming Game & Fish Department, 1992.).

BROOD STOCK SHORTCOMINGS: An anomaly noted in the Bear River cutthroat is a fairly high incidence of albinism. Albinos found in the brood replacements are culled prior to spawning. However, a fairly high percentage of the progeny from the brood fish are albinos. These fish normally die before stocking.

Mortality following spawning varies from year to year in both the culled fish and the holdovers. The MAS problem from past years seems to be under control using shades and salt during post spawn. Past problems with sunburn and associated bacterial problems are hoped to be alleviated with the brood being held in concrete ponds inside a building, the brood stock receiving first use water and the use of quality feeds with vitamin packs. The gas bubble disease problems that arise in the hatchery are being alleviated by new management strategies of holding the fish in lower densities amounts in the hatchery and moving the fish to outside raceways in the Rearing Building sooner (February) than in the past.

The brood stock males are extremely variable in milt production and this may contribute to the stocks low average percent eye of 63.1%.

Although the brood stock crowds the head end of their pond, a trap has not been tried as a means of capture. Instead they are seined each week for sorting and spawning. In the future, the use of a trap may be beneficial to reduce stress from seining.

The brood stock is harder to rear than other strains and exhibit a definite preference for feeds. Since this brood stocks inception at the Daniel Fish Hatchery the fish seem to be "domesticating" and past problems with rearing have been improved and corrected.

Maintaining an adequate size of brood stock to meet or exceed eyed egg requests has been a problem in the past. This will be addressed through a more stringent regime of culture practices to include a night watch of the station and use of separate brushes, nets and spawning equipment between spawning areas and production rearing areas.

MAINTENANCE RECOMMENDATIONS:

Insure a minimum of 50 pairs is used for brood recruitment.

Continue to incorporate wild brood recruitment from original sources.

Maintain an adequate size of brood stock to meet or exceed eyed egg requests.

Prevention of stress related mortality and diseases.

SCHEDULE STUDIES: None.

ADDITIONAL INFORMATION SOURCE: A recognized source in the USFWS National Fish Strain Registry-Trout.

Appendices II-VIII will be added to this report for the years 2000-2006 to include, but not limited to, information, spawning activity, data and decisions or changes to management of this brood stock. Plans are to rewrite the brood plan in 2007.

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- Personal communication - 01/06/04 Brian King, Spawning Coordinator. Wyoming Game and Fish Department 117 S. Sublette, Ave. Pinedale, WY 82941
- Personal communication - 01/07/04 Ed Berry, Hatchery Superintendent, Auburn Fish Hatchery, Wyoming Game and Fish Department. PO Box 130. Auburn, WY 83111
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Appendix I.

Water analysis by WY Dept. Agriculture: June 1990.

	Inflow	Outflow
Calcium	3.59 - 72.0	3.59 - 72.0
Magnesium	1.48 - 8.0	1.48 - 8.0
Sodium	0.08 - 1.8	0.09 - 2.0
Potassium	0.06 - 2.2	0.06 - 2.2
Total cations	5.21	
Conductance (umho/cm)	489	490
PH	7.7	7.8
REO	315	315
Carbonate	0.0	0.0
Bicarbonate	4.10 - 250.0	4.10 - 50.0
Sulfates	1.17 - 56.0	1.15 - 55.0
Chloride	0.06	2.3
Nitrates as N	0.02 - 0.3	0.02 - 0.3
Fluoride	0.01 - 0.2	0.01 - 0.2
Chloride		0.05 - 1.8
Total Cations		5.22
Total anions	5.36	5.33

Appendix II.

**WYOMING GAME AND FISH DEPARTMENT
FISH DIVISION
BROOD STOCK HISTORY AND MAINTENANCE**

APPENDIX 2000 ADDITION

REFERENCE CODE: 00b05BRC

BROOD STOCK: Bear River Cutthroat, 05BRC, (BRC), (Bonneville Cutthroat), *Oncorhynchus clarki*
utah

TYPE: Domestic

LOCATION: Daniel Fish Hatchery

PLAN PERIOD: April 2000 to April 2007

AUTHOR: Greg Anderson

Spawning Season: 2000

Lots Spawned	9705BRCB6, 9730BRCB1, 9605BRCB4 & 9505BRCB4
Production Eggs Lots	0005BRC01-0005BRC10 (445 pairs)
Brood Egg Lots	0005BRCB1-0005BRCB7 (140 pairs)
Spawning trap installed	Not Used
Spawning Period	April 18, 2000-June 20, 2000
Total Females Spawned	445 199-3 year olds Lot 9705BRCB6 9-3 year olds Lot 9730BRCB1 156-4 year olds Lot 9605BRCB4 81-5 year olds Lot 9505BRCB4
Total Green Eggs Taken	918,439

Recruitment Eggs

Table for annual brood recruitment: Spawned from lots 9705BRCB6, 9605BRCB4 & 9505BRCB4

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
0005BRCB1	00/04/18	3,536	26 4&5YR F X 26 4&5 YR M	Daniel	1,768
0005BRCB2	00/04/26	2,912	20 4&5YR F X 20 4&5YR M	Daniel	1,092
0005BRCB3	00/05/03	3,663	20 5YR F X 20 4YR M	Daniel	2,035
0005BRCB4	00/05/10	3,064	20 4&5YR F X 20 4&5YR M	Daniel	1,149
0005BRCB5	00/05/17	4,466	29 4&5YR F X 29 3,4 &5YR M	Daniel	2,030
0005BRCB6	00/05/24	2,424	31 4&5YR F X 31 3&4YR M	Daniel	1,212
0005BRCB7	00/05/31	1,260	11 5 YR F X 11 4 YR M	Daniel	420

Holdover Brood Fish

Females	Males	Lot	Age 2000-2001
29	9	9505BRCB4	5-6
103	105	9605BRCB4	4-5
242	96	9705BRCB6	3-4
77	45	9730BRCB1	3-4

Total: 448 females, 255 males - combined, new Lot Number 9505BRCBC

Three year old fish from recruitment Lot 9805BRCB6 & 9830BRCB1 are planned to be held in the Upper West Brood Pond until 2001 spawning season after which they will be combined with holdovers from the 2001 spawn.

Plan on culling 5 year old fish from Lot 9505BRCB4 after spawning in 2001.

Spawning Statistics: *

Age/Gender	% Survival Of holdovers	% Avail with good eggs	Number of individuals spawned	Average eggs per female	Average egg size (eggs/ounce)
3yo Female	70.0	NA	208	NA	NA
4yo Female	89.0	NA	156	NA	NA
5yo Female	69.7	NA	81	NA	NA
3yo Male	89.5	-	138	-	-
4yo Male	109.6	-	151	-	-
5yo Male	54.2	-	64	-	-

*Spawning methods used at Daniel Fish Hatchery do not lend themselves to a break out of information per year class for some information.

Averages for the spawning season for all spawned: Average eggs/female= 2,016
Average eggs/ounce= 448

Average Brood Sizes

Age/Sex	Avg. Length (in)	Avg. Weight (lbs)	Avg. No/lb
3yo Female	Not Collected	Not Collected	Not Collected
3yo Male	Not Collected	Not Collected	Not Collected
4yo Female	Not Collected	Not Collected	Not Collected
4yo Male	Not Collected	Not Collected	Not Collected
5yo Female	Not Collected	Not Collected	Not Collected
5yo Male	Not Collected	Not Collected	Not Collected

Average Length and No/ lb for spawning lot was 16.55 in and 0.63/lb.

Spawning Report:

The Bear River Cutthroat brood was moved from the old earthen brood pond ("Big Brood Pond") to the new West Brood Pond in 1999 and spawned there. The East Brood Pond was built as future home for a Colorado River Cutthroat Brood Stock and as no Colorado River Cutthroat brood was established the pond was used for hold over Bear River brood and thus the entire Bear River brood was transferred to the East Brood pond after the 1999-spawning season.

The Bear River Cutthroat were spawned in the East Brood pond for the 2000 season. Prior to the spawn, on January 19, 2000 the brood stock suffered a set back as approximately 180 brood fish died from result of a plugged inlet screen to the newly constructed East Brood Pond. With this loss it was decided to use 3-year-old fish in addition to the 4 & 5 year old fish for the spawning season.

This was also the first year that the 3-year-old Water Canyon source of Bear River Cutthroat may be ripe and needed to be checked for ripeness and spawning time. No recruitment was planned to use Water Canyon source fish for brood pairings this year. A total of 95 females and 76 males were sorted from the Water Canyon Lot 9830BRCB1 at the beginning of the 2000 season. A total of 9 female spawned beginning June 7th. This was considerable later than their captive counterparts.

Some of the 4 and 5-year males that were available were used multiple times through out the spawning season for production lots. All brood pairings were destroyed through out the spawning season.

The Bear River Cutthroat brood was moved from the East Brood Pond to the West Brood pond as holdover were placed in the West Brood Pond each week during the 2000 spawning season.

Beginning 2001 a revised protocol for brood recruitment pairs was established. Instead of taking 50 pairs for brood recruitment we will strive for 100 pairs to ensure a good genetic bases for the brood stock.. This may take several years as we continue to rebuild the brood stock after 2 separate fish kills and bouts with Whirling Disease and Furunculosis.

The following "Basic Assumptions & Protocol" were used as a guide for the 2001 spawning season

BASIC ASSUMPTIONS & PROTOCOL

1. There will be close to a 50/50 sex ratio in the brood stock.
2. 75% -80% of all 4 and 5 year old females will ripen and be available to spawn.
3. The brood stock will maintain a minimum N_e of 100.
4. Spawning will be done using a 1:1 male: female sex ratio.
5. Brood Recruitment lots will be taken from spawning takes #3 (10 pairs spawned), #4 (15 pairs spawned), #5 (15 pairs spawned), and #6 (10 pairs spawned). If fewer than 8 spawning takes are required to meet egg requests, then the brood recruitment takes may be adjusted to conform to roughly the middle of the spawning run, but always maintaining a N_e of 100.
6. Spawning for brood recruitment will be across age classes.
7. Brood contributions from each fish will be approximately 1 oz. of fertilized eggs that will be pooled and maintained as a lot separate from production lots.
8. When available, wild recruitment lots will be incorporated into the brood stock by crossing wild and "domestic" lots.
9. After fish are used for a brood recruitment lot, they will be discarded and not retained in the brood stock.
10. Approximately 8 spawning takes will be conducted on a weekly time interval, starting around April 15, and continuing until egg requests have been met or fish are no longer available.
11. Eye up will be at least in the range of 60-70%.
12. Egg size will be 300 or more eggs per oz.
13. Average number of eggs per female will be at least 2,000.
14. Under normal conditions, only 4 and 5 year old fish will be spawned, and all 5 year old and 5+ year old fish will be culled or destroyed after spawning.

BROODSTOCK COMPOSITION

AGE	#REQUIRED TO HOLD	COMMENTS
Eggs	Approx. 15,000 green Approx. 5,500 eyed	Brood recruitment from middle of spawning run May hold more if required for stocking size 4 or 5 later
1 year	5,500	May hold more if needed for sub-catchable or catchable plants
2 year	2,000	May hold more if needed for sub-catchable or catchable plants
3 year	1,600	Normal mortality, inventory errors etc.
4 year	1,500	Normal mortality, disease certification, post spawn stress etc.
5 year	1,000	All post spawning fish to be culled or discarded.

FISH AVAILABLE TO SPAWN; APRIL, 2001

Lot number	Age	Males	Females
9730BRC	4	45	77
9705BRC	4	96	242
9605BRC	5	105	103
9505BRC	6	<u>9</u>	<u>26</u>
		255	448

FOR BROOD RECRUITMENT

9730BRC will be crossed with the 9605BRC both ways. If not enough fish are available during an individual take, then 9705BRC may be crossed (either or both ways) with 9605BRC to get the necessary number of matings. We will not use 9505BRC because of the possibility of their having been used as brood recruitment last year, and no pairings of same year classes will be used. All fish used for brood recruitment purposes this year will be removed from the brood lot.

FOR PRODUCTION FISH

Crosses will be made utilizing different age classes. Under normal conditions, no same year class crosses will be used. All 5 year and 5+ year old fish will be removed from the brood lot during or following the spawning season. When a small number of eggs are taken from a pairing for brood recruitment purposes, the remaining eggs of that mating will be added to the production lot and utilized.

Ref:01spawn.doc

Appendix III.

**WYOMING GAME AND FISH DEPARTMENT
FISH DIVISION
BROOD STOCK HISTORY AND MAINTENANCE**

APPENDIX 2001 ADDITION

REFERENCE CODE: 00b05BRC

BROOD STOCK: Bear River Cutthroat, 05BRC, (BRC), (Bonneville Cutthroat), *Oncorhynchus clarki* *utah*

TYPE: Domestic

LOCATION: Daniel Fish Hatchery

PLAN PERIOD: April 2000 to April 2007

AUTHOR: Greg Anderson

Spawning Season: 2001

Lots Spawned	9705BRCB6, 9730BRCB1, 9605BRCB4 & 9505BRCB4
Production Eggs Lots	0105BRC01-0105BRC11 (352 pairs)
Brood Egg Lots	0105BRCB2-0105BRCB0 (101 pairs)
Spawning trap installed	Not Used
Spawning Period	April 18, 2001-July 02, 2001
Total Females Spawned	352 218-4 year olds Lot 9705BRCB6 14-4 year olds Lot 9730BRCB1 101-5 year olds Lot 9605BRCB4 19-6 year olds Lot 9505BRCB4
Total Green Eggs Taken	901,759

Recruitment Eggs

Table for total annual brood recruitment: Spawned from lots 9705BRCB6, 9730BRCB1, 9605BRCB4 & 9505BRCB4. This includes both source (05) and (30).

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
0105BRCB2	01/04/25	2,065	11 4&5 YR F X 11 4&5 YR M	Daniel	826
0105BRCB3	01/05/02	2,616	16 4&5 YR F X 16 4&5 YR M	Daniel	2,180
0105BRCB4	01/05/09	3,360	18 4&5 YR F X 20 4&5 YR M	Daniel	1,680
0105BRCB5	01/05/16	2,586	18 4&5 YR F X 18 4&5 YR M	Daniel	862
0105BRCB6	01/05/23	1,696	12 4&5 YR F X 12 4&5 YR M	Daniel	1,060
0105BRCB7	01/05/30	412	05 4&5 YR F X 05 4&5 YR M	Daniel	309
0105BRCB8	01/06/08	671	03 5 YR F X 03 4 YR M	Daniel	192
0105BRCB9	01/06/15	2,364	13 4&5 YR F X 13 4&5 YR M	Daniel	1,576
0105BRCB0	01/06/22	1,269	05 4&5 YR F X 05 4&5 YR M	Daniel	846

Table: Break out of Water Canyon source (30's) that were crossed with Daniel source (05) and contributed to the annual brood recruitment take: Spawned from lots 9705BRCB6, 9730BRCB1, 9605BRCB4 & 9505BRCB4.

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
0105BRCB4	01/05/09	NA	7 (05) 5YR F X 7 (30) 4YR M	Daniel	NA
0105BRCB5	01/05/16	NA	5 (05) 5YR F X 5 (30) 4YR M	Daniel	NA
0105BRCB6	01/05/23	NA	2 (05) 5YR F X 2 (30) 4YR M	Daniel	NA
0105BRCB7	01/05/30	NA	1 (05) 5YR F X 1 (30) 4YR M	Daniel	NA
0105BRCB8	01/06/08	NA	3 (05) 5YR F X 3 (30) 4YR M	Daniel	NA
0105BRCB9	01/06/15	NA	10 (05) 5YR F X 10 (30) 4YR M 3 (30) 4YR F X 3 (05) 5YR M	Daniel	NA
0105BRCB0	01/06/22	NA	2 (05) 5YR F X 2 (30) 4YR M 3 (30) 4YR F X 3 (05) 5YR M	Daniel	NA

A total of 36 individuals for source (30) contributed to the 2001 brood recruitment lot.

Holdover Brood Fish

Females	Males	Lot	Age 2001-2002
21	29	9605BRCB4	5-6
173	34	9705BRCB6	4-5
59	18	9730BRCB1	4-5
667	608	9805BRCB6	3-4
84	79	9805BRCB1	3-4

Total: 1,004 females, 768 males - combined, new Lot Number 9605BRCBC

Three year old fish from recruitment Lot 9805BRCB6 (667 female, 608 males) & 9830BRCB1 (84 females, 79 males) were combined with holdovers and held in the West Brood Pond for the 2002 spawning season.

Culled and buried all 6 year old fish from Lot 9505BRCB4, all fish used for brood pairings and any culled during the spawning season.

Spawning Statistics: *

Age/Gender	% Survival of holdovers	% Avail with good eggs	Number of individuals spawned	Average eggs per female	Average egg size (eggs/ounce)
4yo Female	NA	NA	232	NA	NA
5yo Female	NA	NA	101	NA	NA
6yo Female	0	NA	19	NA	NA
4yo Male	44.2	-	NA	-	-
5yo Male	43.3	-	NA	-	-

*Spawning methods used at Daniel Fish Hatchery do not lend themselves to a break out of information per year class for some information.

Averages for the spawning season for all spawned: Average eggs/female= 2,505
Average eggs/ounce= 435

Average Brood Sizes

Age/Sex	Avg. Length (in)	Avg. Weight (lbs)	Avg. No/lb
4yo Female	Not Collected	Not Collected	Not Collected
4yo Male	Not Collected	Not Collected	Not Collected
5yo Female	Not Collected	Not Collected	Not Collected
5yo Male	Not Collected	Not Collected	Not Collected
6yo Female	Not Collected	Not Collected	Not Collected
6yo Male	Not Collected	Not Collected	Not Collected

Average Length and No/ lb for spawning lot was 16.3 in and 0.65/lb.

Spawning Report:

The Bear River Cutthroat were spawned in the West Brood pond for the 2001 season. 4, 5 and 6-year-old fish were used for the spawning season.

In 1997 8 females and 10 males from Water Canyon Creek were spawned and 2,326 eggs produced. This lot, 9730BRCB1 was received at the Boulder Rearing Station Isolation Hatchery. Of these 2,326 eggs 330 fish were transferred and received at the Daniel Fish Hatchery. 2001 was the first year in which eggs from the 1997 Water Canyon Creek (4year old) fish were taken and incorporated into the Daniel Brood recruitment lots. A total of 352 pairs of fish were spawned this year, 101 pairs being used for brood recruitment. Of those 101 pairs, a total of 36 individual fish from Water Canyon Creek contributed gametes to the Brood stock. Of these 36, 6 were females that spawned beginning June 15th. This was considerably later than their captive counterparts.

Some of the 4 and 5-year males that were available were used multiple times through out the spawning season for production lots. All brood pairings were destroyed through out the spawning season.

On 07/05/01 during the Daniel Fish Hatchery annual station disease inspection, the Bear River Cutthroat brood stock was found to be infected with Clinical Furunculosis. Disinfection protocols were put in place and on July 16th, 2001 the entire hold over brood lot of 337 fish were inoculated with Liqumycin (Oxytetracycline) at a rate of 20mg/lb of fish. MS-222 was used as a anesthetic. Personnel involved in the inoculation process were George Gunn, Greg Anderson, Chris Phillips, Chris Praamsma, Brian King and assistance from summer temporaries from the Pinedale Fish Management Crew.

After inoculation the Lot was combined on July 31st, 2001 with the 9805BRCB6 and 9805BRCB1 which were held in the Lower West Brood Pond recruitment lots to make new lot 9605BRCBC.

Beginning 2002 a revised protocol for brood recruitment pairs was established. Instead of taking 100 pairs for brood recruitment we will strive for 250 pairs to ensure a good genetic bases for the brood stock.. This may take several years as we continue to rebuild the brood stock after 2 separate fish kills and bouts with Whirling Disease and Furunculosis.

Appendix IV.

**WYOMING GAME AND FISH DEPARTMENT
FISH DIVISION
BROOD STOCK HISTORY AND MAINTENANCE**

APPENDIX 2002 ADDITION

REFERENCE CODE: 00b05BRC

BROOD STOCK: Bear River Cutthroat, 05BRC, (BRC), (Bonneville Cutthroat), *Oncorhynchus clarki*
utah

TYPE: Domestic

LOCATION: Daniel Fish Hatchery

PLAN PERIOD: April 2000 to April 2007

AUTHOR: Greg Anderson

Spawning Season: 2002

Lots Spawned	9805BRCB6, 9830BRCb1, 9705BRCB6, 9730BRCB1 & 9605BRCB4
Production Eggs Lots	0205BRC01-0205BRC09 (544 pairs)
Brood Egg Lots	0205BRCB2-0205BRCB9 (164 pairs)
Spawning trap installed	Not Used
Spawning Period	April 17, 2002-June 12, 2002
Total Females Spawned	544 410-4 year olds Lot 9805BRCB6 3-4 year olds Lot 9830BRCB1 121-5 year olds Lot 9705BRCB6 9-5 year olds Lot 9730BRCB1 1-6 year olds Lot 9605BRCB4
Total Green Eggs Taken	1,135,042

Recruitment Eggs

Table for total annual brood recruitment: Spawned from lots 9805BRCB6, 9830BRCB1, 9705BRCB6, 9730BRCB1 & 9605BRCB4. This includes both source (05) and (30).

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
0205BRCB2	02/04/24	3,672	26 4&5 YR F X 26 4&5 YR M	Daniel	3,213
0205BRCB3	02/05/01	4,064	26 4&5 YR F X 26 4&6 YR M	Daniel	1,544
0205BRCB4	02/05/08	3,255	20 4&5 YR F X 20 4,5&6 YR M	Daniel	1,860
0205BRCB5	02/05/15	2,712	22 4&5 YR F X 22 4,5&6 YR M	Daniel	1,808
0205BRCB6	02/05/21	3,038	20 4&5 YR F X 20 4,5&6 YR M	Daniel	1,953
0205BRCB7	02/05/29	2,828	23 5 YR F X 23 4 YR M	Daniel	1,616
0205BRCB8	02/06/06	2,765	15 5 YR F X 15 4 YR M	Daniel	1,185
0205BRCB9	02/06/12	2,418	12 5 YR F X 12 4 YR M	Daniel	1,209

Table: Break out of Water Canyon source (30's) that were crossed with Daniel source (05) and contributed to the annual brood recruitment take: Spawned from lots 9805BRCB6, 9830BRCB1, 9705BRCB6, 9730BRCB1 & 9605BRCB4.

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
0205BRCB2	02/04/24	NA	09 (05) 5YR F X 09 (30) 4YR M	Daniel	NA
0205BRCB3	02/05/01	NA	15 (05) 5YR F X 15 (30) 4YR M	Daniel	NA
0205BRCB4	02/05/08	NA	01 (05) 5YR F X 01 (30) 4YR M	Daniel	NA
0205BRCB5	02/05/15	NA	06 (05) 5YR F X 06 (30) 4YR M 01 (30) 4YR F X 01 (05) 5YR M	Daniel	NA
0205BRCB6	02/05/21	NA	06 (05) 5YR F X 06 (30) 4YR M 02 (30) 5YR F X 02 (05) 4YR M	Daniel	NA
0205BRCB7	02/05/29	NA	01 (30) 5YR F X 01 (05) 4YR M	Daniel	NA
0205BRCB8	02/06/05	NA	01 (05) 5YR F X 01 (30) 4YR M 06 (30) 5YR F X 06 (05) 4YR M	Daniel	NA
0205BRCB9	02/06/	NA	04 (30) 5YR F X 04 (05) 4YR M	Daniel	NA

A total of 52 individuals for source (30) contributed to the 2002 brood recruitment lot.

Holdover Brood Fish

Females	Males	Lot	Age 2002-2003
38	0	9730BRCB1	5-6
526	432	9805BRCB6	4-5
76	4	9830BRCB1	4-5
1049	973	9905BRCB5	3-4

Total: 1,689 females, 1,409 males - combined, new Lot Number 9705BRCBC

Three year old fish from recruitment Lot 9905BRCB5 (1049 females, 973 males) were held separate in the Lower East Brood Pond. These fish are free of disease while the holdovers from the 2002 spawn were held separate in the

Lower West Brood Pond for the 2003 spawning season. These fish are positive for Whirling disease and Furunculosis.

Culled and buried all 6 year old fish from Lot 9605BRCB4, all fish used for brood pairings and any culled during the spawning season.

Spawning Statistics:*

Age/Gender	% Survival of holdovers	% Avail with good eggs	Number of individuals spawned	Average eggs per female	Average egg size (eggs/ounce)
4yo Female	83.0	NA	413	NA	NA
5yo Female	15.4	NA	130	NA	NA
6yo Female	0	NA	1	NA	NA
4yo Male	77.2	-	NA	-	-
5yo Male	0	-	NA	-	-
6yo Male	0	-	NA	-	-

*Spawning methods used at Daniel Fish Hatchery do not lend themselves to a break out of information per year class for some information.

Averages for the spawning season for all spawned: Average eggs/female= 2,018
Average eggs/ounce= 444

Average Brood Sizes

Age/Sex	Avg. Length (in)	Avg. Weight (lbs)	Avg. No/lb
4yo Female	Not Collected	Not Collected	Not Collected
4yo Male	Not Collected	Not Collected	Not Collected
5yo Female	Not Collected	Not Collected	Not Collected
5yo Male	Not Collected	Not Collected	Not Collected
6yo Female	Not Collected	Not Collected	Not Collected
6yo Male	Not Collected	Not Collected	Not Collected

Average Length and No/ lb for spawning lot was 15.2 in and 0.80/lb.

Spawning Report:

The Bear River Cutthroat were spawned in the West Brood pond for the 2002 season. 4, 5 and 6-year-old fish were used for the spawning season.

In 1997 8 females and 10 males from Water Canyon Creek were spawned and 2,326 eggs produced. This lot, 9730BRCB1 was received at the Boulder Rearing Station Isolation Hatchery. Of these 2,326 eggs 330 fish were transferred and received at the Daniel Fish Hatchery.

In 1998 3 females and 4 males from Water Canyon Creek were spawned and 504 eggs produced. This lot, 9830BRCB1 was received at the Boulder Rearing Station Isolation Hatchery. Of these 504 eggs 344 fish were transferred and received at the Daniel Fish Hatchery.

This year eggs were taken from both the 1997 and 1998 Water Canyon Creek 4 & 5 year old fish and incorporated into the Daniel 2002 Brood recruitment lot. A total of 544 pairs of fish were spawned this year, 164 pairs being used for brood recruitment. Of those 164 pairs, a total of 52 individual fish from Water Canyon Creek sources contributed gametes to the Brood stock. Of these 52, 14 were females that spawned beginning May 15th. Have noticed each year the timing for spawn for source 30 is getting earlier.

Some of the 4 and 5-year males that were available were used multiple times through out the spawning season for production lots. All brood pairings were destroyed through out the spawning season.

Continued disinfection protocols were used through out the season and since the Bear River Cutthroat brood had been found to be infected with both Whirling disease and Furunculosis, it was decided not to inoculate the brood but use them and keep them separate from the upcoming recruitment lots.

On 02/04/02 after another disease inspection by the Wyoming Game and Fish Department Fish Health Lab, again the brood stock was found to have Clinical Furunculosis.

Lots 9730BRCB1, 9805BRCB6 and 9805BRCB1 were held in the infected Lower West Brood Pond, while the 3 year old 9905BRCB5 recruitment lot was held in the Lower East Brood Pond. While not physically combined together they were combined for record keeping to make new lot 9705BRCBC.

The goal of taking 250 brood pairs for brood recruitment will continue for the brood stock.

Appendix V.

**WYOMING GAME AND FISH DEPARTMENT
FISH DIVISION
BROOD STOCK HISTORY AND MAINTENANCE**

APPENDIX 2003 ADDITION

REFERENCE CODE: 00b05BRC

BROOD STOCK: Bear River Cutthroat, 05BRC, (BRC), (Bonneville Cutthroat), *Oncorhynchus clarki*
utah

TYPE: Domestic

LOCATION: Daniel Fish Hatchery

PLAN PERIOD: April 2000 to April 2007

AUTHOR: Greg Anderson

Spawning Season: 2003

Lots Spawned	9905BRCB5, 9805BRCB6, 9830BRCB1, 9705BRCB6 & 9730BRCB1
Production Eggs Lots	0305BRC01-0305BRC09 (869 pairs)
Brood Egg Lots	0305BRCB2-0305BRCB8 (250 pairs)
Spawning trap installed	Not Used
Spawning Period	April 15, 2003-June 30, 2003
Total Females Spawned	869 584-4 year olds Lot 9905BRCB5 263-5 year olds Lot 9805BRCB6 6-5 year olds Lot 9830BRCB1 11-6 year olds Lot 9705BRCB6 5-6 year olds Lot 9730BRCB1
Total Green Eggs Taken	1,609,967

Recruitment Eggs

Table for total annual brood recruitment: Spawned from lots 9905BRCB5, 9805BRCB6, 9830BRCB1, 9705BRCB6 & 9730BRCB1. This includes both source (05) and (30).

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
0305BRCB2	03/04/23	3,393	25 4,5&6 YR F X 25 4&5 YR M	Dubois	1,603
0305BRCB3	03/04/30	4,059	28 4&5 YR F X 28 4&5 YR M	Dubois	1,845
0305BRCB4	03/05/07	6,768	53 4&5 YR F X 53 4&5 YR M	Dubois	3,760
0305BRCB5	03/05/13	6,032	51 4&5 YR F X 51 4&5 YR M	Dubois	3,582
0305BRCB6	03/05/21	5,409	40 4,5&6 YR F X 40 4&5 YR M	Dubois	3,357
0305BRCB7	03/05/28	3,917	30 4,5&6 YR F X 30 4&5 YR M	Dubois	2,984
0305BRCB8	03/06/04	3,105	23 4,5&6 YR F X 23 4&5 YR M	Dubois	2,071

Table: Break out of Water Canyon source (30's) that were crossed with Daniel source (05) and contributed to the annual brood recruitment take: Spawned from lots 9905BRCB5, 9805BRCB6, 9830BRCB1, 9705BRCB6, & 9730BRCB1.

Lot	Date	Green Eggs	Pairs Spawned	Incubator	Eyed eggs
0305BRCB2	03/04/23	NA	01 (30) 6YR F X 01 (05) 4YR M	Dubois	NA
0305BRCB3	03/04/30	NA	03 (05) 4YR F X 03 (30) 5YR M	Dubois	NA
0305BRCB4	03/05/07	NA	01 (05) 4YR F X 01 (30) 5YR M 02 (30) 5YR F X 02 (05) 4YR M	Dubois	NA
0305BRCB5	03/05/13	NA	01 (05) 4YR F X 01 (30) 5YR M 01 (30) 5YR F X 01 (05) 4YR M	Dubois	NA
0305BRCB6	03/05/21	NA	04 (05) 4YR F X 04 (30) 5YR M 01 (30) 5YR F X 01 (05) 4YR M	Dubois	NA
0305BRCB7	03/05/28	NA	01 (05) 4YR F X 01 (30) 5YR M 02 (30) 6YR F X 02 (05) 5YR M	Dubois	NA
0305BRCB8	03/06/05	NA	01 (05) 4YR F X 01 (30) 5YR M 02 (30) 6YR F X 02 (05) 5YR M	Dubois	NA

A total of 20 individuals for source (30) contributed to the 2003 brood recruitment lot.

Holdover Brood Fish

Females	Males	Lot	Age 2003-20043
538	500	9905BRCB5	4-5
625	625	0005BRCBR	3-4

Total: 1,163 females, 1,125 males - combined, new Lot Number 9905BRCBC

Three year old fish from recruitment Lot 0005BRCBR (625 ♂ & 625 ♀) which were held separate in the Upper East Brood pond during the 2003 spawn and are free of disease will be combined with the "clean" holdovers from the 2003 spawn and held in the Lower East Brood Pond for the 2004 spawning season.

Culled and buried all 5&6 year old fish from Lots 9805BRCB6, 9830BRCB1, 9705BRCB6, & 9730BRCB1 and fish used for brood pairings, and any culled during the spawning season

Spawning Statistics:*

Age/Gender	% Survival of holdovers	% Avail with good eggs	Number of individuals spawned	Average eggs per female	Average egg size (eggs/ounce)
4yo Female	83.0	NA	584	NA	NA
5yo Female	15.4	NA	269	NA	NA
6yo Female	0	NA	16	NA	NA
4yo Male	77.2	-	211	-	-
5yo Male	0	-	288	-	-

*Spawning methods used at Daniel Fish Hatchery do not lend themselves to a break out of information per year class for some information.

Averages for the spawning season for all spawned: Average eggs/female= 1,900
Average eggs/ounce= 400

Average Brood Sizes

Age/Sex	Avg. Length (in)	Avg. Weight (lbs)	Avg. No/lb
4yo Female	Not Collected	Not Collected	Not Collected
4yo Male	Not Collected	Not Collected	Not Collected
5yo Female	Not Collected	Not Collected	Not Collected
5yo Male	Not Collected	Not Collected	Not Collected
6yo Female	Not Collected	Not Collected	Not Collected
6yo Male	Not Collected	Not Collected	Not Collected

Average Length and No/ lb for spawning lot was 15.0 in and 0.88/lb.

Spawning Report:

The Bear River Cutthroat were spawned in the East and West Brood ponds for the 2003 season. 4 year olds, lot (9905BRCB5) were held in the East Brood Pond while 5 and 6-year-old fish lots 9805BRCB6, 9830BRCB1, 9705BRCB6, & 9730BRCB1 were held in the West Brood Pond.

In 1997 8 females and 10 males from Water Canyon Creek were spawned and 2,326 eggs produced. This lot, 9730BRCB1 was received at the Boulder Rearing Station Isolation Hatchery. Of these 2,326 eggs 330 fish were transferred and received at the Daniel Fish Hatchery.

In 1998 3 females and 4 males from Water Canyon Creek were spawned and 504 eggs produced. This lot, 9830BRCB1 was received at the Boulder Rearing Station Isolation Hatchery. Of these 504 eggs 344 fish were transferred and received at the Daniel Fish Hatchery.

This year eggs were again taken from both the 1997 and 1998 Water Canyon Creek 5 & 6 year old fish and incorporated into the Daniel 2003 Brood recruitment lot. A total of 869 pairs of fish were spawned this year, 250 pairs being used for brood recruitment. Of those 250 pairs, a total of 20 individual fish from Water Canyon Creek source contributed gametes to the brood stock. Of these 20, 9 were females that spawned beginning April 23rd

Some of the 4 and 5-year males that were available were used multiple times through out the spawning season for production lots. All brood pairings were destroyed through out the spawning season.

Continued disinfection protocols were used through out the season and since the 5 & 6 year old Bear River Cutthroat brood had been found to be infected with both Whirling disease and Furunculosis, it was decided not to inoculate the brood but to destroy and bury them after the spawning season.

Lots 9705BRCB6, 9730BRCB1, 9805BRCB6 and 9805BRCB1 were held in the infected Lower West Brood Pond, while the 4 year old 9905BRCB5 was held in the Lower East Brood Pond. While not physically combined together they were combined for record keeping to make new lot 9705BRCBC. Recruitment lot 0005BRC was held in the Upper East Brood Pond.

This was the first year since the 2000 Brood Stock Management plan that the goal for taking 250 brood pairs for brood recruitment was met and that the brood recruitment lots were not incubated at Daniel. All recruitment lots were incubated at the Dubois Fish Hatchery. Dubois Fish Hatchery has a chiller unit and is able to adjust their water temperature for egg incubation. This allows for brood recruitment lots to be "timed" in order to hatch out at approximately the same time. The ability to have all recruitment lots timed to hatch out together will hopefully gain a better representation of individuals and their genetic representation to the brood stock, and reduce the different size variations in the recruitment lot

This years spawning methods were unique in that the actual spawning took place in pans on a table above ground between the two brood ponds. The brood stock consisted of the 5 and 6 year old Whirling disease and Furunculosis infected lots. Lots 9705BRCB6, 9730BRCB1, 9805BRCB6 and 9805BRCB1 held in the Lower West Brood Pond and the "clean" 4 year old, lot 9905BRCB5 held in the Lower East Brood Pond. In order to not infect the clean lot with infected fish and still maintain genetic crossing of fish for brood and production lots, a unique spawning protocol was adopted.

The spawning operation consisted of 7 or 8 people making up two crews. Additional personnel from other hatcheries, sections and divisions of the department were needed to make up crews. Crew were split with at least 3 people assigned to each pond and one person assigned for record keeping. The ponds were "roped off" and personnel assigned a pond had to stay in that pond until the spawning was over. Each pond had two people in the pond and one person above ground to hand pans of eggs or milt back and forth. Spawning of females occurred in their respective ponds and the pans handed to the crew in the West Brood Pond for washing. All eggs were washed and put in coolers using water from the infected West Brood pond. This limited the chance of contaminating the East Brood pond and its fish.

Personnel disinfected their equipment and gear (waders, raincoats, gloves, etc.) in a chlorine based solution of HTH, and then hung them out to dry. The Daniel Fish Hatchery supplied all equipment and gear.

After the eggs were water hardened they were disinfected as per normal Fish Division procedures in an iodine treat and brood lots were disinfected and shipped to the Dubois Fish Hatchery for timing.

All infected 5 & 6 year old fish from lots 9705BRCB6, 9730BRCB1, 9805BRCB6 and 9805BRCB1 were culled during the spawn as used, and the rest that didn't spawn were culled at the end of the season. This then eliminated all Furunculosis and Whirling diseased fish. The remaining brood was inspected by the Fish health lab on 09/08/03 and received a Specific Pathogen Free (SPF) certification.

Next years recruitment of lot of 9905BRCB5 will continue to stay in the Lower East Brood pond and the West Brood pond will be thoroughly cleaned and disinfected.