FLUVIAL ARCTIC GRAYLING MONITORING REPORT 2003

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Submitted To:

Fluvial Arctic Grayling Workgroup

And

Beaverhead National Forest
Bureau of Land Management
Montana Chapter, American Fisheries Society
Montana Council, Trout Unlimited
Montana Department of Fish, Wildlife, and Parks
U. S. Fish and Wildlife Service

June 2004

ACKNOWLEDGMENTS

The following individuals and organizations contributed valuable assistance to the project in 2003. Scott Lula, Greg Gibbons, Zachary Byram, Tracy Elam, Tim Mosolf, and Dick Oswald of Montana Fish, Wildlife, and Parks (FWP), provided able field assistance. Ken Staigmiller (FWP) collected samples for disease testing. Ken McDonald (FWP), provided administrative support, chaired the Fluvial Arctic Grayling Workgroup, reviewed progress reports and assisted funding efforts. Bob Snyder provided support as Native Species Coordinator. Dick Oswald (FWP) provided technical advice and expertise. Bruce Rich (FWP) provided direction as regional fisheries supervisor. Jim Brammer, Dennis Havig, Dan Downing, and Chris Riley (USFS) assisted with funding, provided housing for FWP technicians, and assisted with fieldwork. Bill Krise, and Ron Zitzow, Matt Toner, and the staff of the U.S. Fish and Wildlife Service (USFWS) Bozeman Fish Technology Center maintained the brood reserve stock and transported grayling to the upper Ruby River. Jack Boyce, Mark Kornick and Jim Drissell, and crew of Big Springs Hatchery assisted with egg takes at Axolotl and Green Hollow II brood lakes, and transported eyed grayling eggs for RSI use in the upper Ruby River and to Bluewater State Fish Hatchery for rearing reaches. Gary Shaver, Bob Braund, and Dave Ellis from Bluewater State Hatchery raised and transported grayling to the Ruby River and the Missouri Headwaters restoration reaches. Bob McFarland (FWP) provided technical advice for mark/recapture analysis and data entry. Wayne Black (FWP) prepared scales for age determination. Kelly Smith (FWP), Dave Yerk (FWP), and Paul Hamlin (FWP) assisted with monitoring efforts on the Sun River restoration project. Scott Opitz (FWP) and Steve Kujala (USFS) assisted with GIS analysis. Randy Gazda, (USFWS Partners for Fish and Wildlife Program), provided technical assistance in water conservation efforts, habitat improvement, financing efforts, field assistance and reviewed this report. Carter Kruse and crew of Turner Enterprises' assisted in egg takes and monitoring Green Hollow II brood lake, and maintained a barrier and trap on Green Hollow II Creek. Mike Roberts of the Department of Natural Resources (DNRC) directed the water budget study on the upper Big Hole River. Dave Amman (DNRC) assisted instream flow data collection and analysis. Members of the Fluvial Arctic Grayling Recovery Workgroup provided technical advice and direction. We appreciate the efforts of the Big Hole Watershed Committee and local water users for water conservation efforts and fine tuning the Drought Management Plan.

The Arctic Grayling Recovery Program is funded by Montana Fish, Wildlife and Parks, the National Fish and Wildlife Foundation's Bring Back the Natives Program, and the Arctic Grayling Recovery Program. Special thanks to Pam McClelland and Cynthia Johnson for acting as liaisons between the Bring Back the Natives Program and the Arctic Grayling Recovery Program. Special thanks to Montana Trout Unlimited, the Montana Chapter of the American Fisheries Society, Pennsylvania Power and Light, The Bradley Fund for the Environment of the Sand County Foundation for donations to the Arctic grayling Restoration Program, the Bureau of Land Management (BLM), the USFWS Section 6 program, and the Wildlife Conservation and Restoration Program (WCRP). We appreciate the efforts from the Patagonia Outlet in Dillon and Holly Miller for designing, providing, and selling the Arctic grayling T-shirts with all profits going to the Arctic grayling Recovery Program.

INTRODUCTION

The fluvial Arctic grayling (Thymallus arcticus) of the Big Hole River represent the last, strictly fluvial native grayling population in the continental United States. After the population severely declined in abundance during the mid-1980's, the Arctic Grayling Recovery Program was initiated to determine ecological factors limiting the population, monitor their abundance, and inform the general public of their plight. Results of monitoring and research have been reported annually since 1991 (Byorth 1991, 1993, 1994, 1995a, 1997, Magee and Byorth 1995, Byorth and Magee 1996, Magee and Byorth 1998, Magee 1999, Magee and Opitz 2000, Magee 2002, Magee and Lamothe 2003). Objectives of the project from January 1 through December 31, 2003 were to:

A. Monitor abundance and distribution of grayling and potential competitors in the upper Big Hole Basin.

B. Monitor water temperatures and discharge in the Big Hole River and tributaries.

C. Promote water and habitat conservation among Big Hole Basin water users, and serve as a technical advisor for the Big Hole Watershed Committee.

D. Monitor the broodstock reserve of grayling at Axolotl Lakes and collect gametes as needed

E. Monitor the grayling broodstock reserve in Green Hollow II Reservoir and collect gametes as needed.

F. Continue to stock and/or monitor survival and abundance of previously stocked Arctic grayling on the upper Ruby, North and South Fork of the Sun, lower Beaverhead River and Missouri River Headwaters restoration sites.

G. Continue a water budget study with DNRC to assess flow gains and losses in critical grayling habitats.

H. Complete assessment of Big Hole River grayling abundance and distribution with habitat surveyed completed in 1994 by OEA.

Results are reported for objectives A through F in this report. A progress report for the Ruby River reintroduction efforts and for objectives G and H will be reported separately.

METHODS

Habitat Evaluation

Discharge, and Water Temperatures

Discharge of the Big Hole River was monitored by the U.S. Geological Survey (USGS) from April through October at the Wisdom Station, the Mudd Creek Station, and the Melrose Station (USGS 2003) (Figure 1). Water temperature was also monitored at the Wisdom gauge and Melrose gauge and 14 thermograph stations located in the mainstem Big Hole or tributaries (Figure 2). We used Onset Hobotemp and Stowaway thermographs and recorded temperatures at 60-minute intervals. Data were downloaded into Microsoft Excel and reduced to daily maximum, minimum, and average temperatures.

Flow Enhancement Project

In 2003, we worked closely with the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program (PFWP), the Big Hole Watershed Committee (BHWC), and local landowners to fine-tune the Drought Management (DMP) and Flow Enhancement

Programs (FEP). As of January 1, 2003 nineteen wells, two springs and two pipelines involving fifteen landowners and nine diversion systems were completed and operational.

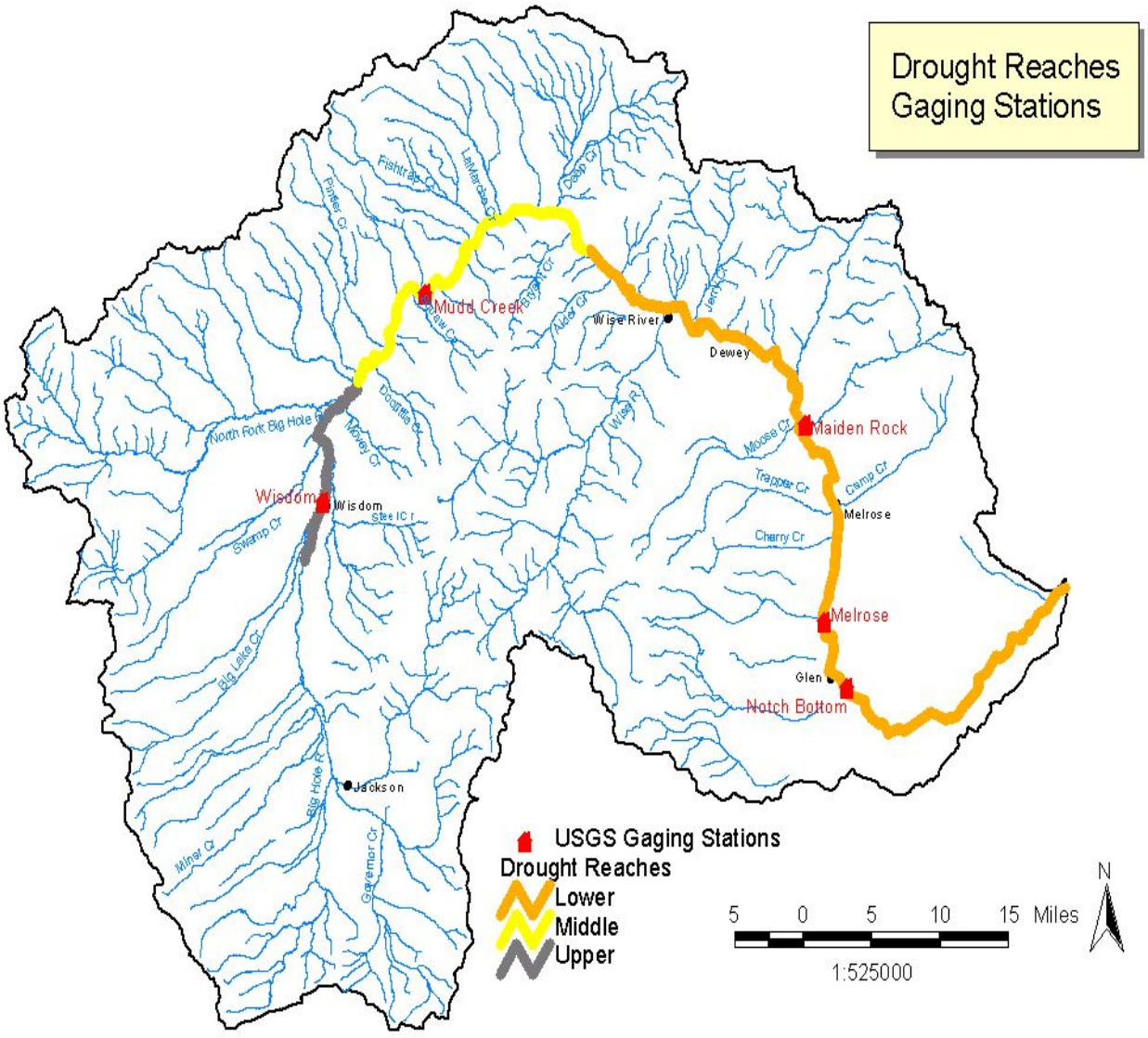

Figure 1. Map of the Big Hole River delineating Drought Management Reaches and USGS gauges.

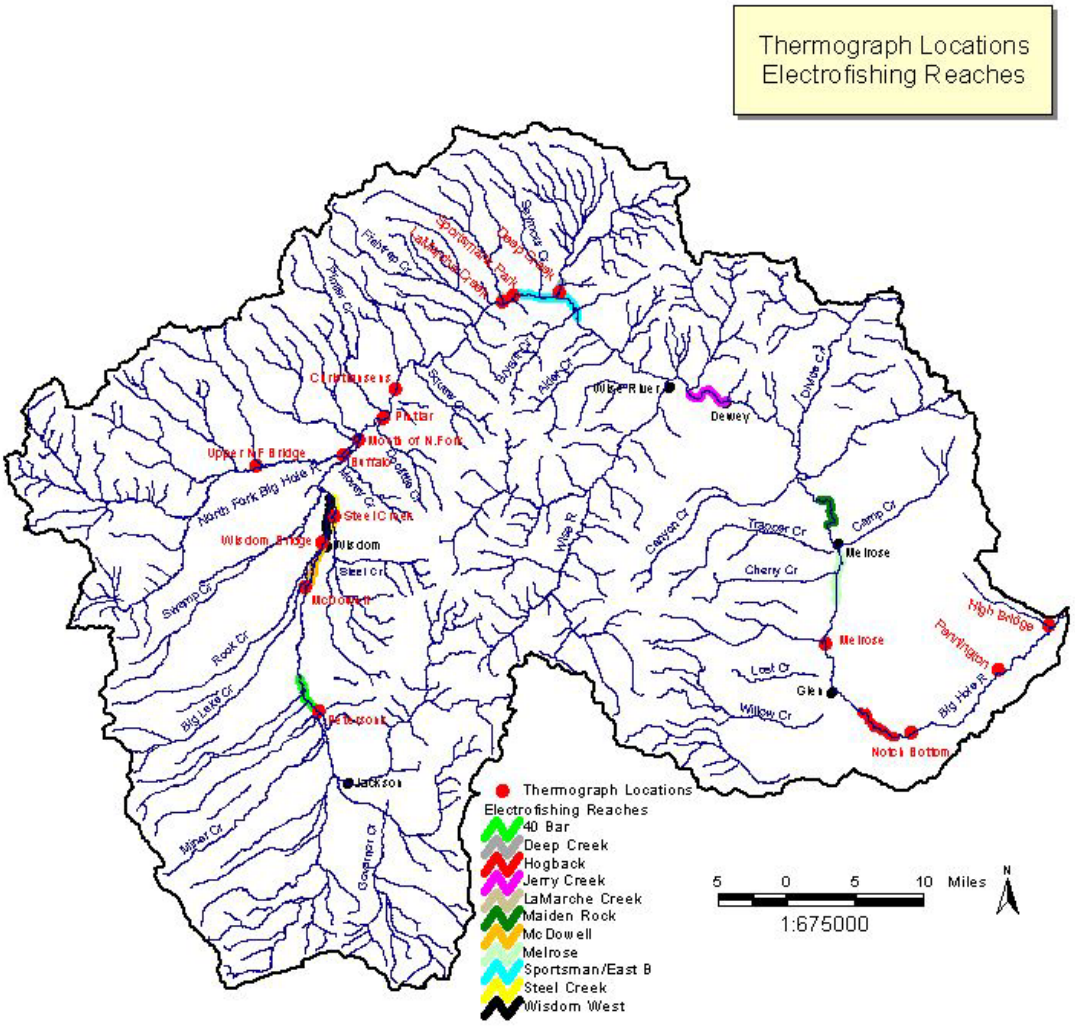

Figure 2. Map of the Big Hole River showing 15 thermograph locations and traditional Montana Fish, Wildlife, and Parks electrofishing reaches.

The majority of the efforts during Summer 2003 involved contacting water users, measuring instream flows and temperatures, evaluating conservation efforts and implementing the DMP and FEP. There were no new stock water projects implemented in 2003, however, a pump on the Spokane Ranch was replaced to due to mechanical failure. Additional riparian enhancement, fish passage, or irrigation efficiency projects were initiated or planned for 2004.

Population Monitoring

We sample the Arctic grayling population of the Big Hole River each spring and fall to document population abundance, recruitment, age class strength, and distribution. Rainbow trout (Oncorhynchus mykiss), brown trout (Salmo trutta), brook trout (Salvelinus fontinalis), and burbot (Lota lota) are also sampled to document densities and relative abundance. We electrofished with a mobile-anode DC system powered by 4,000 watt generator coupled with a Coffelt Mark XXII-M rectifying unit mounted on a drift boat or Coleman Crawdad. Target species were captured and held in a live well. We anesthetized fish for processing in a Tricaine Methanesulfonate (MS-222) bath, measured total length (± 0.1 in.) and weight (± 0.01 lb.), notched a fin as a temporary mark, and collected scales. We tagged grayling with a visible-implant (VI) tag in transparent adipose tissue immediately posterior to the eye.

Spring surveys have been conducted since 1983 to assess spawning population age and movement demographics. In spring 2003, the spawning population of grayling was surveyed by electrofishing the McDowell, Wisdom West, Buffalo - Pintlar, Pintlar-Mudd Creek and Sportsmans – Eastbank Sections of the Big Hole River, and Swamp and Steel Creek tributaries sections. A single electrofishing pass was made through each

section between April 22 and May 6, 2003. Mark/Recapture surveys were completed in the Maiden Rock, Melrose and Notch sections from March - April 30, 2003.

Twenty-eight tributaries to the Big Hole River were visually surveyed for the presence of Arctic grayling and for habitat suitability. The presence and abundance of Arctic grayling was determined using visual surveys from the stream bank and snorkeling. A sub-sample of these streams were also sampled using a mobile-anode DC system powered by 4,000 watt generator coupled with a Coffelt Mark XXII-M rectifying unit mounted on a Coleman Crawdad.

Fall population surveys of the McDowell-Wisdom sections have been conducted since 1983 to provide an index of grayling abundance and recruitment. We completed electrofishing surveys from Septmber 11- October 29, 2003. We used one pass surveys rather than mark recapture surveys on most sections to better assess spatial population demographics of grayling by expanding sampling efforts to new areas. One pass surveys were completed in McDowell, Wisdom West, Airport side channels 1 & 2, the North Fork, Wisdom East (Steel Creek), Seymour Creek, Pintlar Creek, Pintlar and Ralstons pools. Two pass surveys were completed in Sawlog pools 1 & 2, Fishtrap pool, Sportsmans Park pools 1& 2, and Eastbank pools. We completed mark/recapture surveys in LaMarche and Deep Creeks. LaMarche Creek was marked on September 18 and recaptured on September 29, 2003. Deep Creek was marked on September 24 and recaptured on October 7, 2003.

A Montana Fish, Wildlife & Parks crew that annually monitors trout populations in the lower river completed surveys on the Jerry Creek and Melrose Sections. Multiple mark and recapture runs were completed between September 16- October 3, 2003 (Figure

2). Electrofishing data were entered and summarized with Mark/Recapture 4.0 (Montana Fish, Wildlife and Parks 1994). Density estimates are reported as number per mile with the standard deviation at p = 0.05 presented in parentheses. Catch-per-unit-effort (number per electrofishing pass (CPUE)) of young of year (yoy) grayling in fall surveys was calculated as an index of recruitment. CPUE was also calculated for combined age classes to show trends of grayling population abundance for fall surveys in traditional reaches since 1983.

Brood Reserve

Axolotl Lake Brood

The Arctic grayling brood reserve at Axolotl Lakes, first planted in 1989 and supplemented in 1993, 1997, 1999, and 2000 with Big Hole River fish or gametes from those fish, provides a source of fluvial grayling gametes to supplement the captive brood stock and provide young fish and eggs for reintroductions. We monitor the brood reserve population annually to determine abundance and collect gametes. Fyke nets and hook-and-line techniques were employed to capture grayling. Most captured grayling were processed as described above, marked for population estimates, and released. As grayling became gravid, they were sorted by sex and retained in separate live cars. Big Springs Trout Hatchery personnel directed gamete collection on May 22, 2003.

Due to uncertainties of the origin of Bacterial Kidney Disease (BKD) infected gametes brought into Big Springs State Fish Hatchery in the 2002, the MFWP Fish Health Committee recommended increasing numbers of fish for disease analysis from 60 to 150 fish. In order to assess disease concerns prior to bringing gametes into the hatchery, samples were taken one month before gamete collections. We collected 117

grayling on April 22, 2003 for disease analysis and 33 grayling during gamete collection on May 22, 2003. One hundred and fifty samples of ovarian fluid were also collected during gamete collections.

Eggs were stripped from female grayling, pooled, and fertilized with milt from males. After fertilization, eggs were rinsed, packed in ice, and transported to Big Springs State Fish Hatchery. We released the remaining grayling after processing. Grayling abundance in the lake was estimated with the modified Peterson model (Ricker 1958). In order to reduce densities, and assess survival and behavioral differences between hatchery raised grayling from the Bozeman Fish Technology Center and grayling reared in Axolotl brood lake, we transported 200 grayling from the Axolotl brood lake to the upper Ruby River on June 24, 2003 (See Lamothe and Magee 2004). The MFWP Fish Health Committee approved a wild fish transfer.

Green Hollow II Lake Brood

The Arctic grayling brood reserve at Green Hollow II Lake on Turner Enterprises' Flying D Ranch was first planted with age one fluvial Axolotl brood stock in 1998. Additional yoy plants from the fluvial grayling broodstock located at the Bozeman Fish Technology Center were planted in 1999 and 2000. We monitor the brood reserve population annually to determine abundance and collect gametes.

Fyke nets, and hook-and-line techniques were employed to capture grayling. Captured grayling were processed as described above, and marked for a population abundance estimate. Grayling were sorted by sex and retained in separate live cars. Big Springs Trout Hatchery personnel directed gamete collection on May 15, 2003. Similar to Axolotl Lakes we increased the number of disease samples in Green Hollow II Lake. In order to assess disease concerns prior to bringing gametes into the hatchery, samples were taken one month before gamete collections. On April 16, 2003 we

collected 135 grayling and 60 eastern brook trout for disease analysis. Samples of ovarian fluid were taken from 150 females during gamete collections.

To reduce the risk of BKD, as per request of the Fish Health Committee, we initiated an aggressive brook, rainbow, and rainbow/cutthroat hybrid trout removal program from both Green Hollow II Lake and Green Hollow Creek. All fish except grayling were removed from the lake during population surveys. Turner Enterprises constructed a trap to capture and remove all trout migrating downstream from Green Hollow Creek, and initiated electrofishing removal of all trout in Green Hollow Creek.

RESULTS

Water Temperatures and Stream Discharge

The summer of 2003 can be characterized by above average temperatures and below average precipitation. Maximum instream temperatures for most thermograph stations occurred between July 8 and July 21, 2003 (Table 1, Figure 3). Water temperatures rose above 70°F at all mainstem monitoring stations during the summer. Temperatures at this level are considered stressful to salmonids. The "warmed reach" stations (Pintlar, Buffalo, Christansens, and Sportsmans) exceeded upper incipient lethal temperatures (77°F) for Arctic grayling. Nearby tributaries were cooler and provided thermal refugia. LaMarche and Fishtrap Creeks were noticeably cooler than adjacent mainstem section and other tributaries Steel Creek and Deep Creek (Figure 4).

Table 1. Thermograph station, maximum temperature, and number of days maximum daily temperatures exceeded 70°F and 77°F for the Big Hole River and tributaries from April-October in 2003.

Station	Max °F	Day > 70°	Days> 77°
TRIBS			
LaMarche Cr..	69	0	0
Fishtrap Cr.	72.5	8	0
Deep Cr.	77.3	33	1
Steel Cr.	78.7	50	6
MAINSTEM			
McDowell	78	51	2
Pintlar	80.1	53	17
Christiansons	79.4	67	15
Sportsmans	79.4	54	8
Pennington	78	47	2

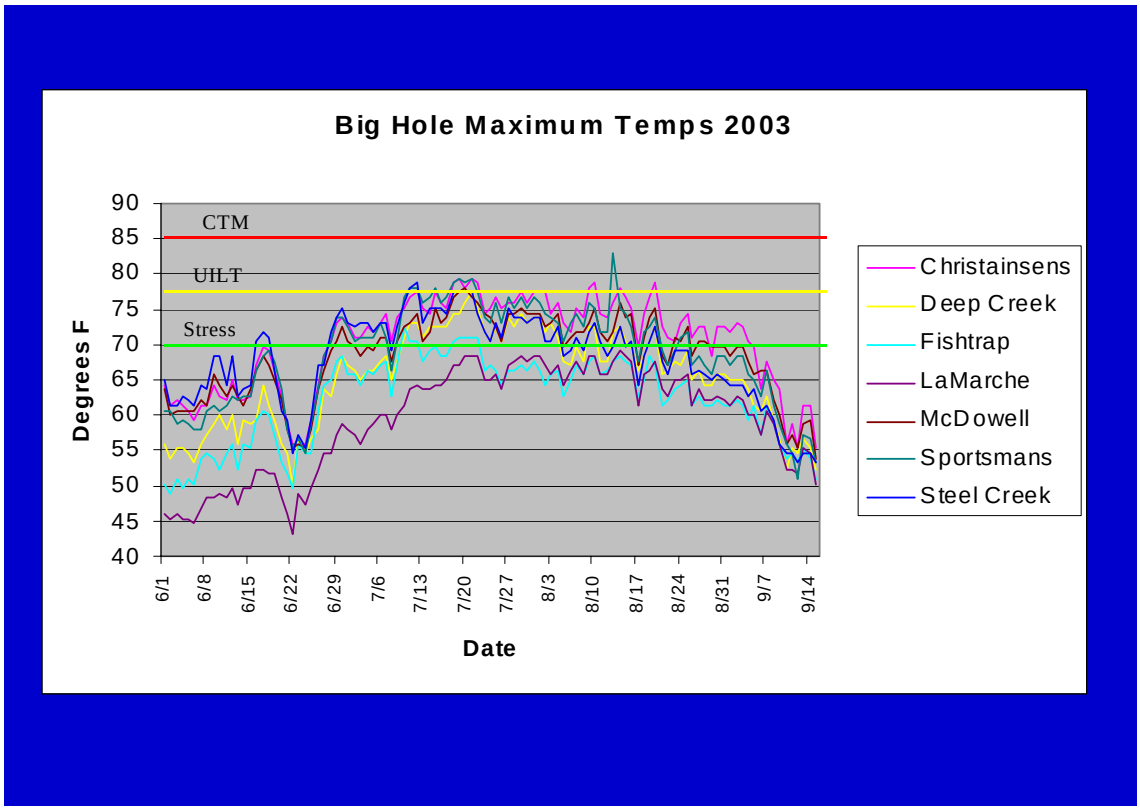

Figure 3. Big Hole River instream temperatures from MFWP Hobo temp-loggers on the Big Hole River, Montana in 2003.

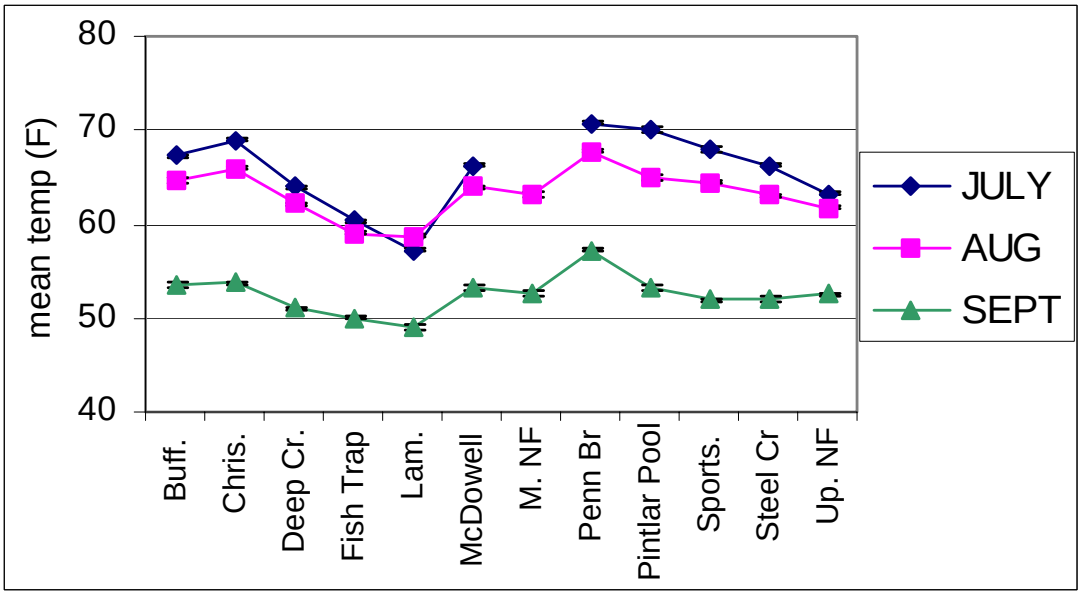

Figure 4. Spatial variation in monthly mean stream temperatures in the Big Hole River (2003).

The snowpack in the Big Hole basin was 139% of the Period of Record (POR) on May 21, 2003. Above average air temperatures in late May accelerated peak flows and decreased runoff duration. The instantaneous peak of 1,680 cfs occurred on June 1. Summer months (June - September) were characterized by below average precipitation (54% of POR) and stream flows (49% of the POR) (Figure 5). June flows were 70%, July 10.5%, August 19.3% and September 34.3 % of the POR mean. Average daily flows dropped below 20 cfs for 61 days from June - September and declined to 9.4 cfs on September 4-5 (Table 2).

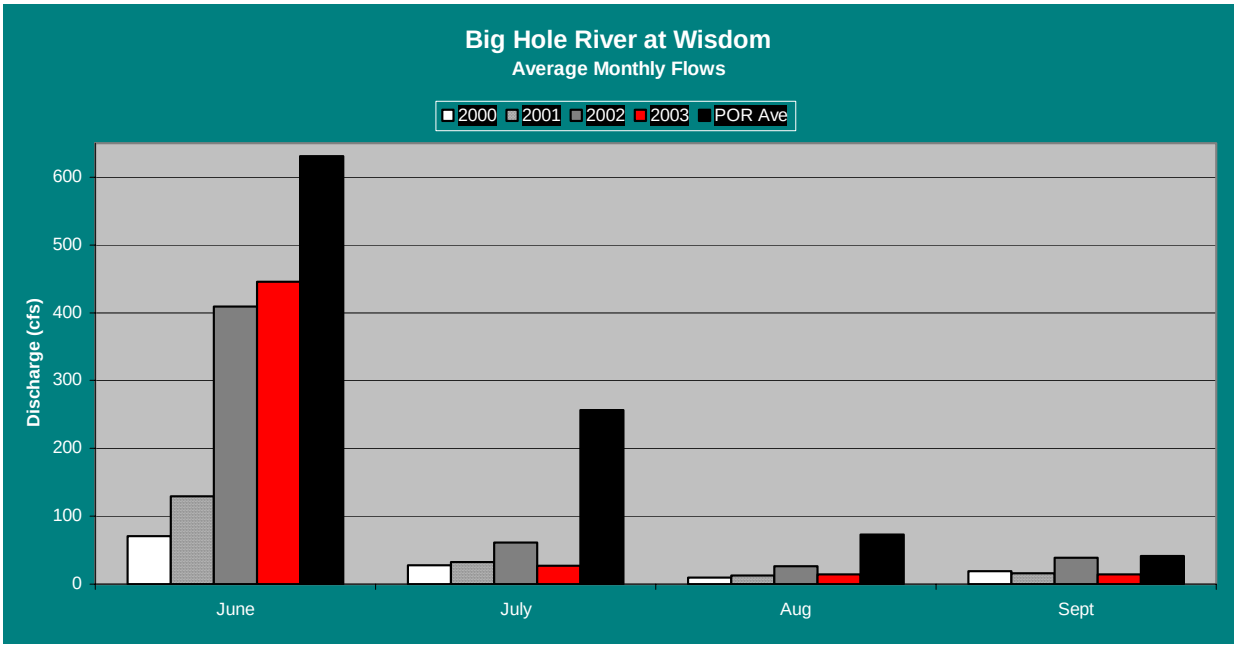

Figure 5. Average monthly flows at the USGS Wisdom Gauge on the Big Hole River, Montana, from 2000-2003 and Period-of-Record (POR).

Table 2. Instream flows for June –September from the USGS Wisdom Gauge for maximum, minimum and days with average daily flow less than 20 cfs for 1988, and 2000-2003.

Year	Max	Min	Day<20 CFS
1988	1,080	0	78
2000	649	7.3	55
2001	563	6.0	65
2002	1,330	13.0	6
2003	1,680	9.4	61

Big Hole River Drought Management Plan and flow conservation efforts

Conservation efforts outlined in the Big Hole Watershed Drought Management Plan were implemented beginning in June and continued throughout the summer to alleviate poor instream flows, high water temperatures, and below average precipitation. An angling closure was implemented on the upper reach due to low flows and stressful temperatures on July 24, 2003. A warm and dry fall resulted in continued closure in the upper reach until November 6, 2003. An angling closure was implemented in the middle reach when flows declined below 60 cfs on August 23 and remained in effect until flows improved to over 80 cfs for seven consecutive days on September 26, 2003. The lower reach did not decline to closure flows in 2003.

The Flow Enhancement Program utilized 19 wells and two springs to provide water for up to 12,858 cattle from April-January. Stock water well use reduces the demands of water from the river, reduces the impact of livestock on riparian vegetation, and enhances communication and conservation education with landowners.

Stream Habitat Improvement Projects

We initiated five stream habitat improvement projects in 2003 to increase the carrying capacity of the upper Big Hole River for Arctic grayling and other fish species. Revegetation of riparian areas and fencing of stream banks was conducted along Deep, LaMarche, and Steel Creeks. Eight pools were created to a channeled section of lower Fishtrap Creek. We also installed a fish ladder to allow upstream migration through a pin and plank diversion installed in the North Fork of the Big Hole River.

Population Monitoring

Spring spawning surveys

We captured 43 age 1+ grayling during spawning surveys (Figure 6). One pass surveys were conducted on the McDowell, Wisdom West, Steel Creek, Swamp Creek, Buffalo-Pintlar, Pintlar-Mudd Creek, and Sportsmans – Eastbank Sections. Based on length-frequency and verified by scale analysis 74% of captured grayling were Age 3 and older, and 26% captured grayling were age 1 and age 2 fish (Figure 6).

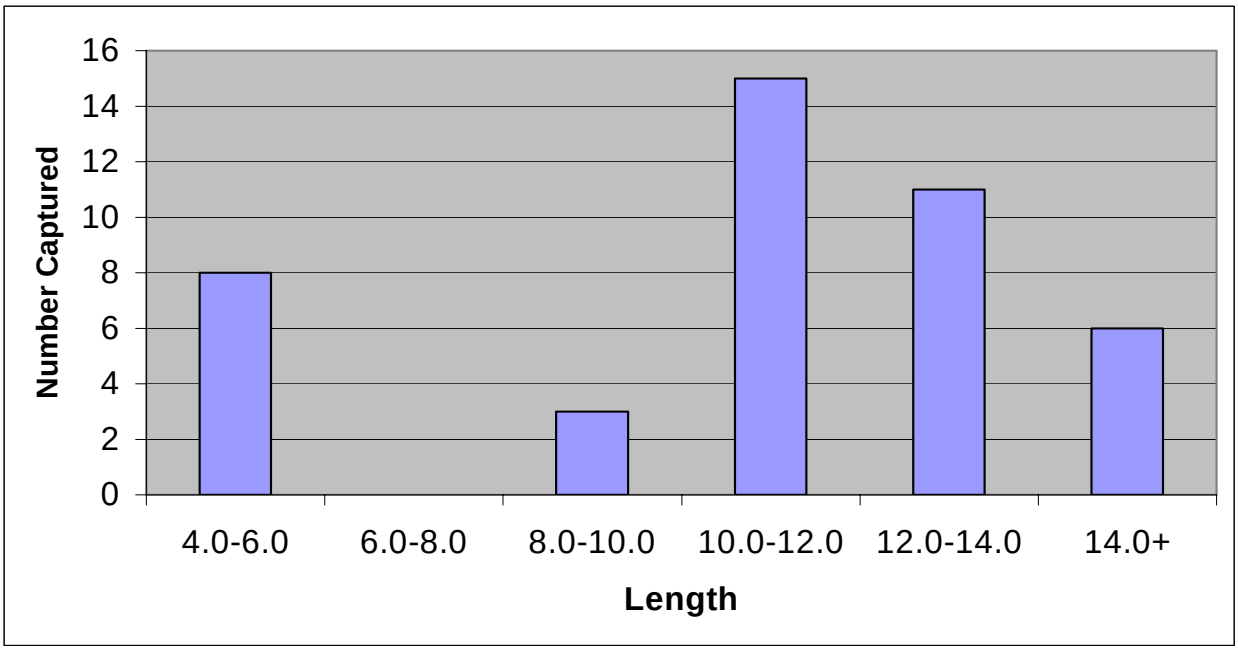

Figure 6. Length frequency histogram of captured Arctic grayling in the Big Hole River from MFWP Spring 2003 electrofishing surveys.

Fall population monitoring

We captured 502 grayling in fall electrofishing surveys of which 363 (72%) were yoy (Figure 7). The abundance of yoy grayling improved from recent years in tributary, side channels, and mainstem reaches. Adult grayling numbers remain at low levels, especially age 2+ grayling (Figure 7, 8, 9) as indicated by catch-per-unit-effort (CPUE) in the pools and the McDowell and Wisdom sections. Tributary and side channel habitats have proven critical to recruitment and possibly serve as temperature and flow refugia (Figure 9).

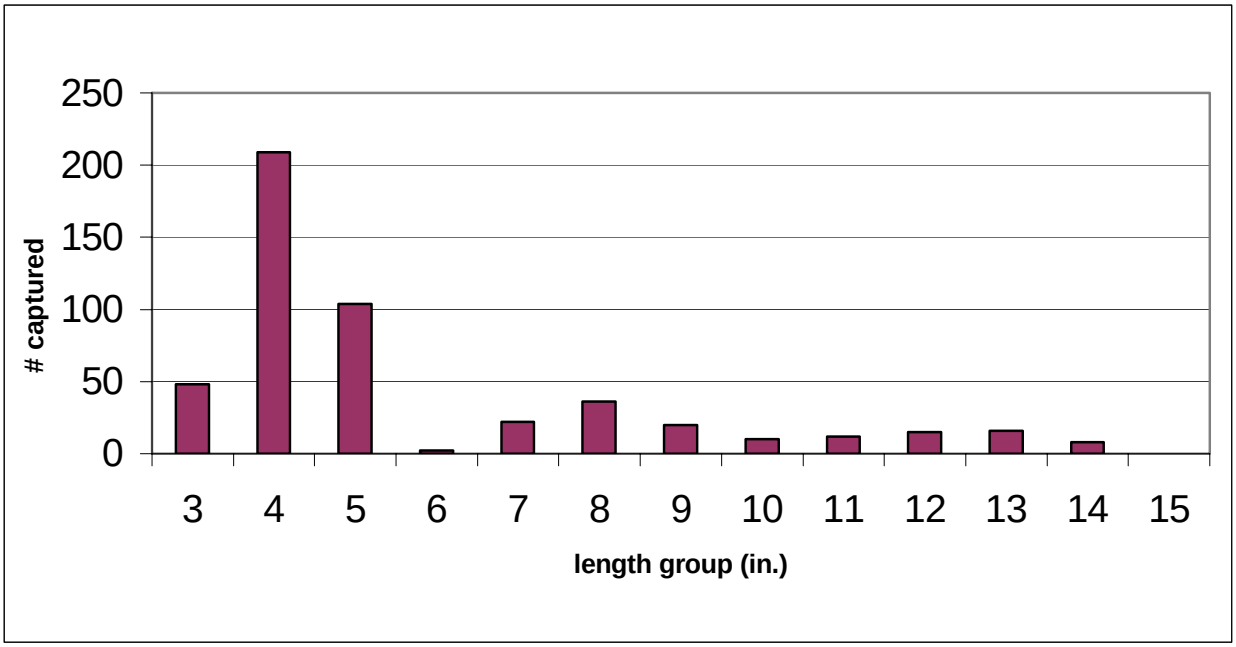

Figure 7. Length Frequency Histogram for Arctic grayling from MFWP electrofishing surveys on the Big Hole River, Montana Fall 2003.

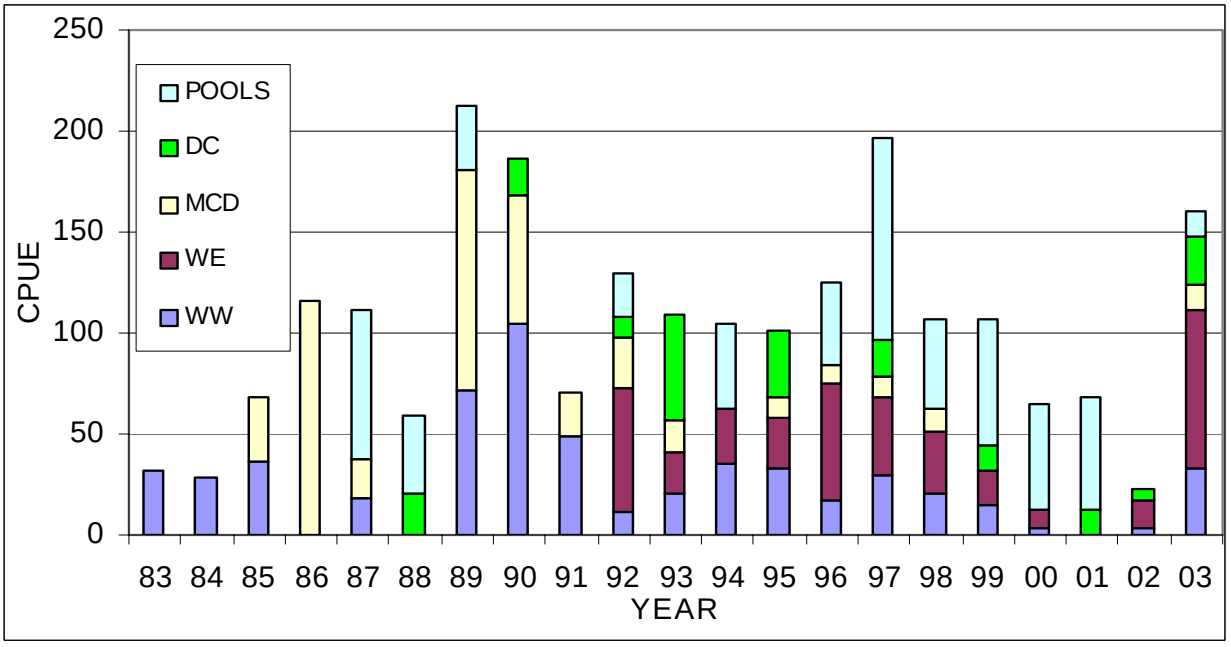

Figure 8. Catch-per-unit-effort of Arctic grayling from MFWP fall electrofishing surveys in the pools, Deep Creek (DC), McDowell (MCD), Wisdom East (WE), and Wisdom West (WW) section in the Big Hole River, Montana from 1983-2003.

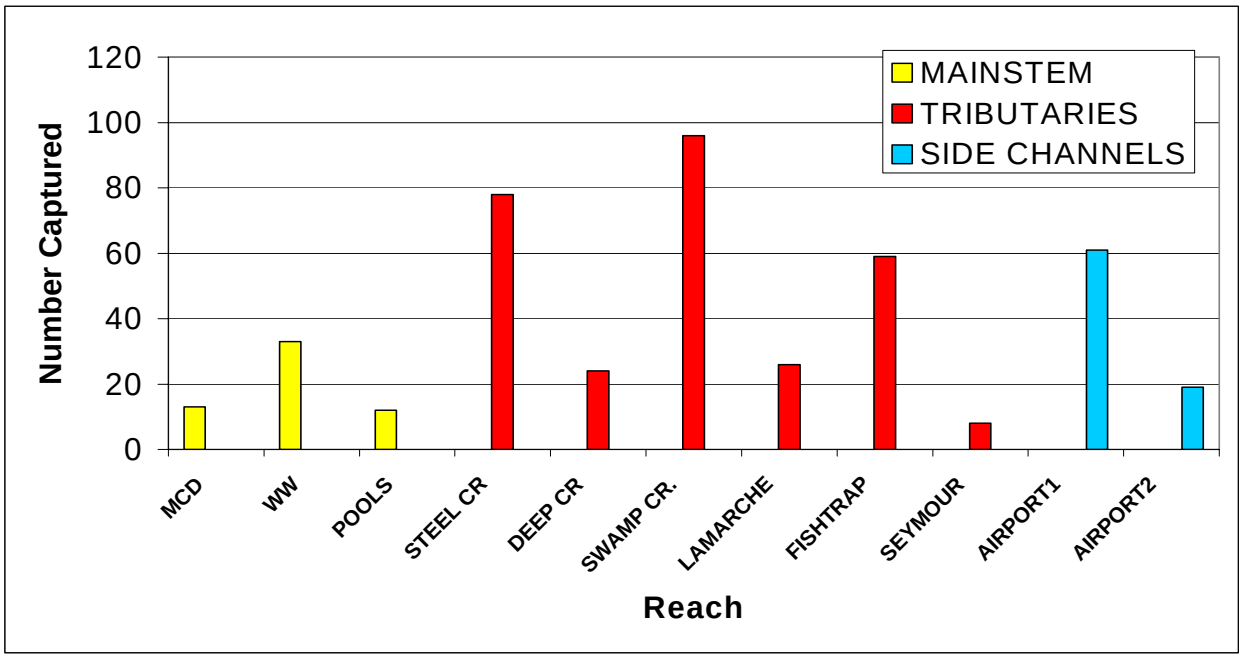

Figure 9. The number of Arctic grayling captured by reach type from fall 2003 MFWP electrofishing surveys in the Big Hole River, Montana.

Brood Program

Axolotl Lakes Brood:

All 150 grayling and 150 ovarian samples submitted for disease analysis tested negative for pathogens.

We captured 1,421 Arctic grayling for gamete collection and population estimates. Grayling captured were ages 3, 5 and 6 with no age 11 or age 15 grayling captured. Average length for all grayling was 9.97 in. Mark-recapture analysis estimated 2,125 (±91) grayling in the Axolotl Brood Lake. On May 22, we spawned 500 females and 230 males and collected 669,000 eggs. Due to larger, older fish, fecundity increased dramatically from 419 eggs per female in 2002 to 1,338 eggs per female in 2003. Fertilized eggs were taken to Big Springs State fish hatchery for development to eye-up. On May 29, 30,000-eyed eggs were transported to the upper Ruby River and placed in

remote site incubators (Lamothe and Magee 2004). The remaining eggs were transported to Bluewater State Fish Hatchery. A total 163,000 grayling were available for restoration efforts for fall 2003 and spring 2004.

Green Hollow II Brood

All 133 grayling and 60 trout and 150 grayling ovarian samples submitted for disease analysis tested negative for the pathogens.

We collected 1,061 grayling for gamete collection and population estimates. Grayling captured were age 3 and age 4, with only one age 5 grayling captured. Mean length for grayling was 9.92 inches. Mark/recapture efforts estimated 1,692 (±113) grayling in the brood lake. On May 15, 2003 we spawned 266 females with 166 males and collected 222,600 eggs. Fecundity averaged 837 eggs per female. All eggs collected from Green Hollow II in 2003 were taken directly to the upper Ruby River and distributed into RSIs (Lamothe and Magee 2004).

A total of 1,404 trout were removed from the lake and creek including 1,265 brook trout, 124 rainbow trout and 15 rainbow/cutthroat trout hybrids.

DISCUSSION

Despite above average snowpack the Big Hole River suffered from drought conditions for the fifth consecutive year with summer monthly stream flows of approximately 49% of the period of record. Mainstem stream temperatures warmed to above desired levels for Arctic grayling and other salmonid species. Fortunately, there are reaches with cooler temperatures and more favorable flow conditions. These “refugia” reaches are often located in tributaries such as Fishtrap and LaMarche Creeks.

Fall surveys indicate an excellent reproductive year with high numbers of yoy captured. Numbers of yoy grayling captured were the highest since 1991 and can be attributed to adequate temperature and flow regimes during May and June. Flows in June remained above the recommended optimum wetted perimeter flow of 160 cfs until June 25. At these flows newly emerged fry can take advantage of protective and productive stream margins and lateral habitats. Abundance of adult grayling (age 3+) in the McDowell, Wisdom and pool surveys remained at low levels.

CPUE was higher in tributaries and side channels than mainstem reaches. Tributary flow, temperature, and riparian conditions provide productive grayling habitat and may be especially important during drought periods. Braided channel geomorphology near Wisdom creates erosive/depositional reaches that provide important spawning substrate and rearing habitats for juvenile grayling.

In 2004, conservation efforts will be expanded to additional reaches to promote grayling habitat, riparian health, and fish passage and irrigation efficiency. Continued grayling plants will be made on the Ruby and Missouri Headwaters restoration reaches. Remote stream incubators will be used in the North Fork of the Sun River and in the Ruby River to provide juvenile grayling developed on site. Montana Fish, Wildlife and Parks and the Fluvial Grayling Workgroup will continue to work with agencies, land owners, watershed and interest groups to conserve, protect, and enhance fluvial grayling in Montana.

Reintroduction Efforts

The long-term restoration goal for Montana Arctic grayling is to establish five populations (including the Big Hole) within historic drainages by 2020. Restoration

efforts were initiated in 1997 in the upper Ruby River and have expanded to the North and South forks of the Sun, the lower Beaverhead and the Missouri River Headwaters since 1999. Due to the on-going drought, limited resources, and some success in the Ruby River, the FGW in 2002 recommended focusing reintroduction efforts on the upper Ruby River. A Ruby River 2003 status report has been completed (Lamothe and Magee 2004). In 2003, we also continued to assess limiting factors and survival of previous plants or continued to plant grayling in the lower Beaverhead, the North and South Forks of the Sun River, and the Missouri River Headwaters.

Sun River

A total of 34,700 grayling were planted in the forks of the Sun River from 1999-2001. To assess population demographics, distribution, survival and natural reproduction, in June 2003 we electrofished at the confluence of the North and South Forks and near Scattering Springs, and set 5 trapnets in Gibson Reservoir (Table 3). A total of 26 grayling were captured ranging from 9.4 - 12.7 inches. Thirteen of the grayling had adipose clips indicating they were planted in 2000 and were age 4 grayling. The remaining grayling were either age 3 or age 5.

Table 3. Number captured and percentage of total catch for MFWP trapnets set in Gibson Reservoir and electrofishing surveys at the confluence of the North and South Forks and near Scattering Springs in Gibson Reservoir, Montana in June 2003.

Species/Age	Number Captured	Percent of Total
Rainbow Trout	134	8 %
White Suckers	1,460	90 %
Grayling	26	2 %
Brook trout	4	< 1 %
Total	1,624	100%

To asses if grayling were moving over Gibson dam into Diversion Reservoir we set 3 trap nets and captured 5 rainbow trout, 4 brook trout and 526 white suckers. We completed visual surveys of Gibson reservoir tributaries and counted five grayling in Big George Gulch and numerous (>100) grayling in Lange Creek. We observed grayling in Lange Creek spawning in the majority of pool tailouts and riffles. Follow-up snorkel surveys in July found no grayling in Lange Creek, however there were many fry (30-50 mm) that could not be identified.

To assess whether grayling were remaining in the North Fork we snorkeled approximately five miles between Moose Creek and Circle Creek and observed no grayling. Similarly, no grayling were captured during MFWP population estimates on the North Fork in 2003. Angler creel surveys reported that a few grayling are still being caught in the Moose Creek vicinity of the North Fork. To assess temperature regimes for potential use of remote site incubators eight thermographs were distributed in the North and South Fork and in tributaries.

Beaverhead River

A total of 78,00 yearling and 5,000 yoy grayling were planted in the lower Beaverhead River from 1999-2002. Grayling survival has been poor, as efforts have been hampered by severe drought with accompanying low instream flows and high temperatures. In 2003 spring surveys in Anderson Lane, Mule Shoe and Silverbow Lane captured only one grayling. A few anglers reported capturing grayling and a MFWP employee captured two grayling upstream of the restoration reach near Dillon. Some grayling may have moved out of the restoration reach to find locations with better temperature and flow regimes. Due to prolonged warm temperatures and low instream flows no surveys were completed in fall 2003.

Missouri River Headwater

The Missouri River Headwater has been stocked with grayling on an annual basis from 2000-2003. In September 2003, 93,000 yoy grayling were planted as follows; Jefferson River 8,000, Madison River 44,000, and the Gallatin River 42,000. Grayling were raised at Bluewater State Fish Hatchery and were approximately 3 inches in length. Sampling was not completed in 2003 due to low flow and high temperature regimes and time and workload constraints. Monitoring of these plants will begin in 2004.

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