BIG HOLE RIVER ARCTIC GRAYLING RECOVERY PROJECT:

ANNUAL MONITORING REPORT 1996

Patrick A. Byorth

Montana Department of Fish, Wildlife, and Parks
Dillon, Montana

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Fluvial Arctic Grayling Workgroup

and

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ABSTRACT

We annually monitor the fluvial Arctic grayling population in the upper Big Hole River and other factors such as discharge, water temperatures, and abundance of potential competitors. Discharge of the upper Big Hole River was substantial in spring and early summer due to high snowpack and prolonged runoff. Sparse mid- to late summer rains resulted in lower flows than in 1995 but flows did not reach critical levels. Water temperatures approached but did not exceed lethal limits except at a single thermograph station where probes may have been exposed to air temperatures. The Arctic grayling population remained stable at 64 age 1+ per mile. This estimate was statistically robust due to improved electrofishing techniques. The age structure of the grayling population continues to be balanced, with each age class present in proper proportion. Brook trout populations are still stable to declining in the Wisdom area of the Big Hole River. Rainbow trout abundance remained stable in the Sportsmans - Eastbank section in the mid-Big Hole River. An attempt to transplant grayling into Cougar Creek, Yellowstone National Park, as fertilized eggs resulted in successful incubation, hatching, and emergence of alevins. Systematic hook and line sampling proved to be a useful technique in assessing grayling distribution in the Big Hole basin.

INTRODUCTION

The fluvial Arctic grayling (Thymallus arcticus) of the Big Hole River represent the last, strictly fluvial 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, 1995, Magee and Byorth 1994, Magee and Byorth 1995, Byorth and Magee 1996).

Objectives of the project from April 1 through October, 1996 were:

A. Monitor water temperatures and discharge in the upper Big Hole River and tributaries,

B. Maintain minimum flows by promoting water conservation among Big Hole basin water users,

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

D. Monitor the reserve stock of grayling at Axolotl Lakes and collect gametes,

E. Investigate competitive interactions between grayling and rainbow and brown trout.

Results are reported for objectives A through D in this report. Progress on objective E will be reported separately.

METHODS

Discharge and Water Temperature

Discharge of the Big Hole River was monitored by the U. S. Geological Survey (USGS) April through October at the Wisdom Gage Station. Water temperature was also monitored at the Wisdom Gage and at 9 thermograph stations (Figure 1). Four thermograph stations have been operated since 1992 and an additional 5 were established in 1995 (Byorth and Magee 1996). We used Omnidata DP-212 thermographs at five stations recording at 120 min intervals and Onset Instruments Hobotemp and Stowaway thermographs at four stations recording at 36 to 144 min intervals.

Data were downloaded into DBase IV files and reduced into daily maximum, minimum, and average temperatures using DBase IV programs.

Population Monitoring

We census 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 abundances. 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. Stunned target species were captured and held in a live well. We anesthetized fish for

processing in a Tricaine (MS-222) bath, measured total length (to 0.1 inches) and weight (to 0.01 lbs), 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 an eye.

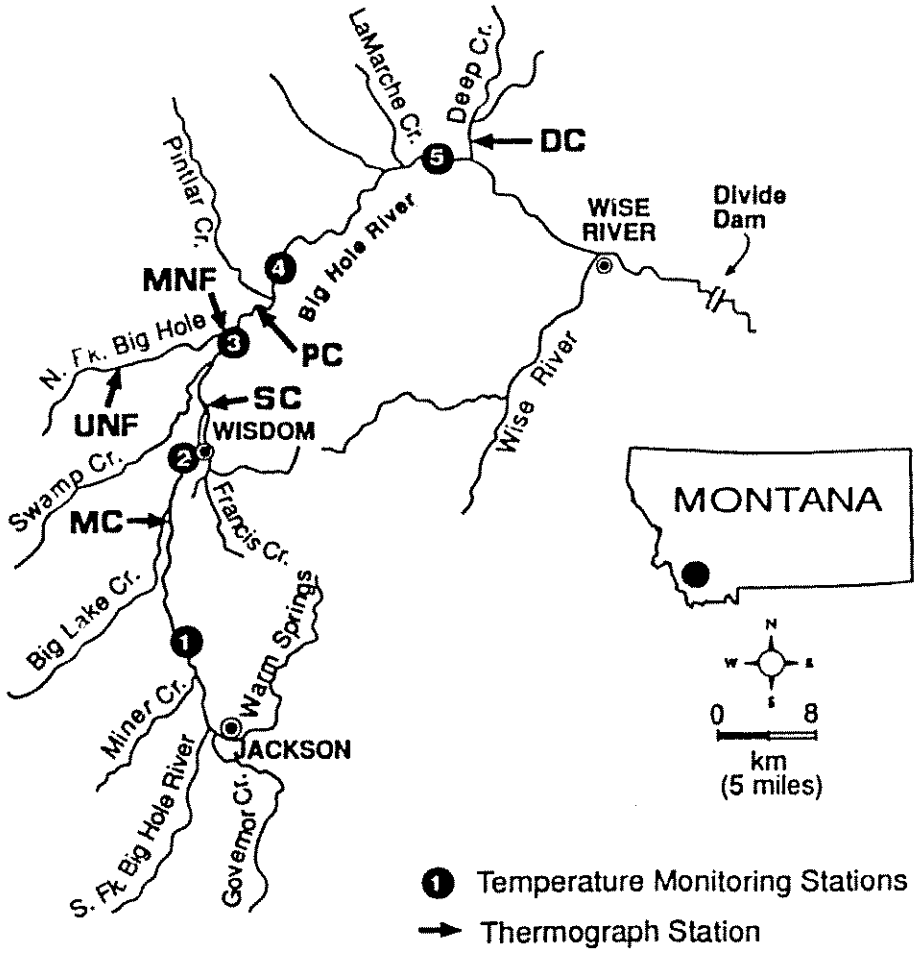

Figure 1. Map of the upper Big Hole River temperature monitoring stations. Stations are: 1 = Peterson Bridge, MC = McDowell Section, 2 = USGS gage at Wisdom, SC = Steel Creek, 3 = Buffalo Ranch, MNF = mouth of North Fork Big Hole River, UNF = Upper North Fork Big Hole River, PC = mouth of Pintlar Creek, 4 = Christianson Ranch, 5 = Sportsmans Park, DC = Deep Creek.

The spawning population of grayling was censused by electrofishing the McDowell, Wisdom East and West, North Fork, and Pintlar-Squaw sections of the Big Hole River. A single electrofishing pass was made through each section between April 15 and 24. To assess contributions of tributary spawning to recruitment, we sampled Swamp, Fishtrap, and LaMarche creeks April 17 and 18, 1996. We also electrofished the 40 Bar section on April 29, 1996 to assess the upstream extent of grayling spawning.

Fall population surveys of the McDowell and Wisdom sections have been conducted since 1983 to provide an index of grayling abundance and recruitment. In 1995, the Sportsmans-Eastbank section was established to provide additional information on the segment of the grayling population residing in mid-river reaches and to monitor rainbow trout populations. We conducted dual marking runs in each section to decrease bias and increase statistical validity of population estimates. We marked grayling and brook trout in the McDowell section September 3 and 9 and recaptured on September 23, 1996. Wisdom East and West were marked September 4-5 and 10-11 and recaptured on September 24 and 26, 1996. Sportmans-Eastbank was marked September 16 and 19 and recaptured on September 25.

Electrofishing data were entered and analyzed with Mark-Recapture 4.0 (Montana Fish, Wildlife, and Parks (MFWP) 1994). We calculated population estimates using Log-Likelihood or modified Peterson methods (Chapman 1965). Catch-per-unit-effort

(number per electrofishing pass) of young of the year grayling (YOY) was calculated as an index of recruitment.

Hook and Line Grayling Distribution Survey

As an alternative method to electrofishing, a systematic hook and line survey was used to assess the distribution and relative abundance of grayling in the upper Big Hole River basin. Five representative reaches were chosen for sampling: Jackson to Twin Lakes Road, McDowell-Wisdom Section, North Fork Big Hole River, Pintlar Creek to Sportsmans Park, and Sportsmans Park to Jerry Creek (Figure 1). Four sampling sites per reach were selected using river miles generated at random. Sampling sites were plotted on USGS quads with descriptive notes. A team of 2 to 5 anglers floated through each reach, stopped at designated sites, angled for 1 hour, and recorded each anglers catch. Grayling were held in live cars or buckets until the hour passed and were measured, tagged, and released. All other species were released immediately after capture. We calculated catch per hour for each group, by species and sampling site, and averaged catch rates by river reach.

Axolotl Lake Brood

The Arctic grayling brood reserve at Axolotl Lakes, planted in 1989 and supplemented in 1992, provides a source of fluvial grayling gametes to supplement the captive brood stock and provide young fish for reintroductions. We monitor the reserve population annually to determine abundance and collect gametes. Fyke nets and hook-and-line 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 in the lake. Grayling were spawned with assistance from personnel of the U. S. Fish and Wildlife Service (USFWS) Ennis National Fish Hatchery and MFWP Washoe Park State Hatchery. We spawned grayling on May 18 and 31. Eggs were stripped from up to five female grayling, pooled, and fertilized with milt aspirated from 2 to 5 males. After fertilization, eggs were rinsed, packed in ice, and transported to Washoe State Hatchery and to Cougar Creek, Yellowstone National Park. Personnel from MFWP Fish Health Laboratory sampled ovarian fluid, fecal matter, and various tissues for disease screening. We released remaining grayling after processing. We estimated grayling abundance in the lake with the modified Peterson model (Chapman 1965).

RESULTS

Discharge and Water Temperatures

For the second consecutive year, discharge in the upper Big Hole River was ample and did not reach critically low levels. Snowpack was 120% of long-term average by early March (Natural Resource Conservation Service Snotel Surveys). Heavy snowpack resulted in a prolonged runoff, where discharge exceeded 1000 cfs on 40 days (Figure 2). Lowland and highland runoff peaked three weeks earlier than in 1995. Maximum discharge was 2960 cfs on May 19, 1996, during the predicted period of emergence of larval grayling (Table 1). Lack of mid-summer rains led to declining

flows by early July, in contrast to the 1995 hydrograph. August -September water yield in 1996 was only 77% of that in 1995 (Table 1). While flows did not reach critical levels in 1996 (minimum flow was recorded at 39 cfs on August 29 and September 14), water temperatures approached critical levels.

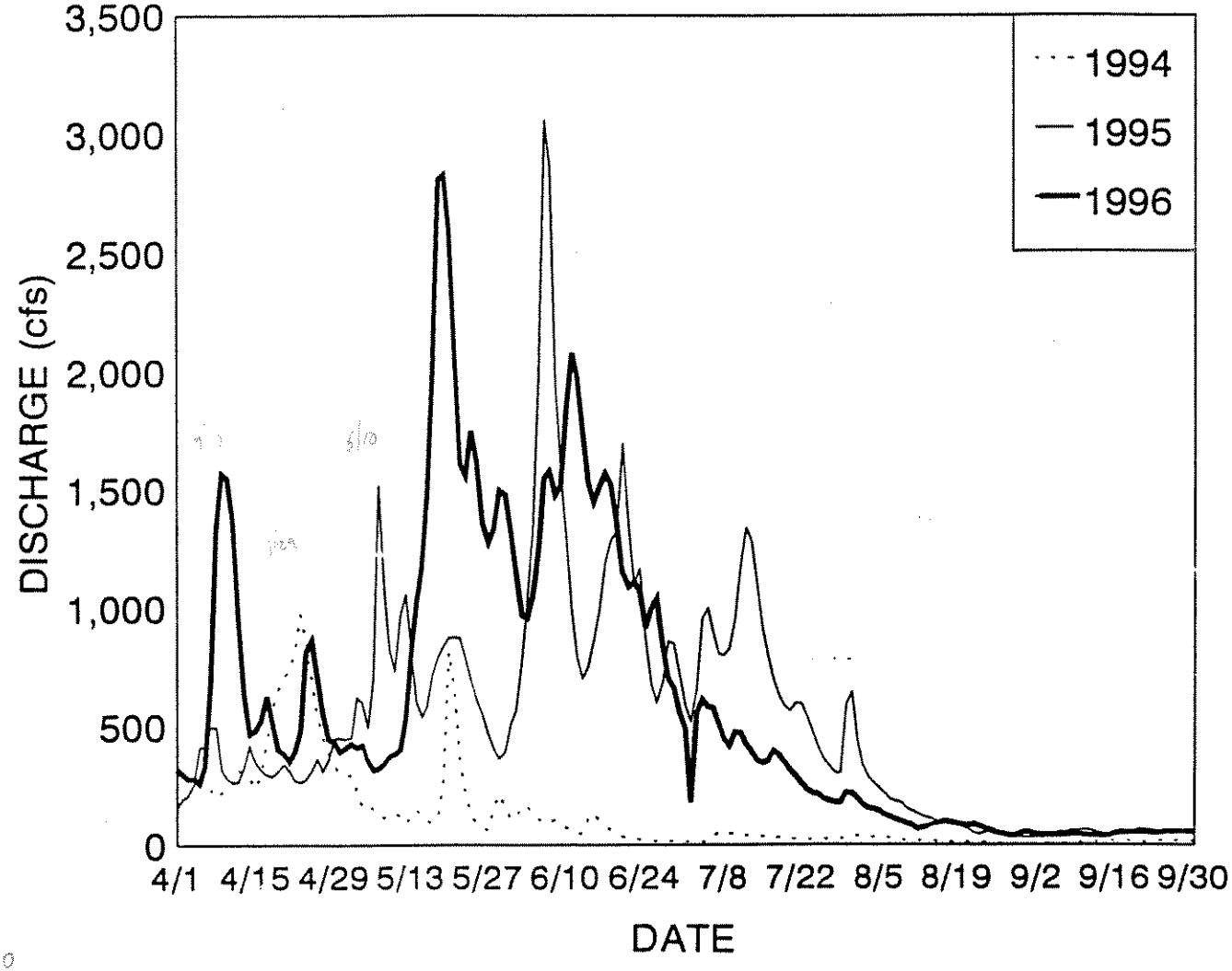

Figure 2. Hydrograph of the Big Hole River measured at the USGS gage at Wisdom, 1994 - 1996.

Table 1. Comparisons of Big Hole River discharge parameters measured at the USGS gage at Wisdom, 1988 to 1996. Yield is the total volume of water passing the Wisdom gage during August and September.

Year	# Days less than 20 cfs		Max Flow (cfs)	Min Flow (cfs)	Dates at Min	Yield Aug-Sept (ac-ft)
	Apr-June	July-Sept				
1988	0	78	1080	0	8/27-9/21	213
1989	0	4	978	12	8/20	3790
1990	1	0	667	18	5/23	5820
1991	0	16	4300	10	9/4	3690
1992	18	32	479	3.3	5/26	2760
1993	0	0	1700	55	10/5	17490
1994	11	55	976	1.9	8/30	1821
1995	0	0	4200	31	9/3	11150
1996	0	0	2960	39	8/29, 9/14	8600

18,910

Water temperature peaked at almost every thermograph station on July 28, 1996 (Table 2). Three thermographs were rendered inoperable or probes were exposed to air temperatures and data is suspect. The thermograph at McDowell malfunctioned entirely. station 3 (Buffalo Ranch) was exposed to air temperatures July 31 to September 13, 1996. Similarly, station 4 (Christianson Ranch) was exposed from August 5 through September 13. At station 4, water temperatures reached the lethal level of 77°F reported by Lohr et al. (1996) on July 23, 24 and 26 for 2 to 4 hours. On July 28, the maximum water temperature of 78.8°F was recorded at Station 4. However, the temperature probe at station 4 was

exposed to air temperatures within a few days and the high temperatures were likely due to a backwater effect and may not be representative of thalweg temperature. Furthermore, the maximum water temperature in 1995 was recorded at the Pintlar station; whereas, in 1996 the maximum temperature at Pintlar was 75.1°F, well below the temperature recorded at station 4. No fish kills were observed or reported in that area. Thus, it is unlikely that lethal thresholds were actually significantly surpassed.

Table 2. Maximum daily (T_{max}) and maximum mean daily water temperature at thermograph stations in the Big Hole River 1996. Stations are: 1 = Peterson Bridge, 2 = USGS gage at Wisdom, SC = Steel Creek, 3 = Buffalo Ranch, MNF = mouth of North Fork Big Hole River, UNF = Upper North Fork Big Hole River, PC = mouth of Pintlar Creek, 4 = Christianson Ranch, 5 = Sportsmans Park, DC = Deep Creek.

Station	T_{max} (°F)	Max T_{mean} (°F)
1	68.9	62.4
2	74.3	67.1
SC	74.4	67.0
3	74.3	67.5
MNF	76.0	66.5
UNF	70.2	64.1
PC	75.1	67.8
4	78.8	68.2
5	69.8	62.0
DC	72.9	64.7

In the future, maintaining minimum flows during dry years will be facilitated using stockwater developments. Seven wells have been drilled since 1995. Each well will be developed by

June 1997. A test of the effects of using wells while closing ditches is planned for August, 1997.

Population Monitoring

Spawning and Recruitment

Spring spawning surveys captured 120 grayling, 41 of which were juveniles (age 1). We sampled from April 15 to 24 and did not encounter any ripe female grayling. Overall sex ratio was skewed toward males at 1.7:1, which is also indicative of pre-spawning ratios. The small sample size of spawners is typical of sampling conducted before the peak of spawning. Peak spawning was probably delayed by low water temperatures until April 28 to May 6, when daily mean temperatures ranged from 37.4 to 42.8°F. Grayling normally spawn in the Big Hole River when daily maximum temperatures exceed 50°F. In 1996, water temperatures didn't reach that threshold until May 5. Discharge averaged 393 to 429 cfs. Predicted time of emergence of larval grayling is May 13 to 18. Within a week of predicted emergence, discharge increased to a peak of over 2800 cfs. The sudden rise in streamflows may have affected survival of larval grayling.

The age distribution of grayling captured during spawning surveys indicates continued stability in the population. Approximately 75% of spawning age grayling captured were Age 3 and older (Table 3). This proportion of mature grayling in the spawning population has been stable since 1992. Length frequency distribution also reflects the stable age distribution (Figure 3). While sample sizes were low in 1994 and 1996, the proportion

of age 3+ grayling (> 11.5 inches) is comparable to 1995. A high number of immature (age 1) grayling in the sample reflects good potential recruitment to 1997 spawning.

Three tributaries of the Big Hole River were sampled during Spring 1996, resulting in yearling grayling being captured in Swamp Creek and LaMarche Creek. Five age 2+ spawners were captured in Swamp Creek. No grayling were captured in Fishtrap Creek or the 40 Bar section.

Table 3. Percent composition by age class of Arctic grayling captured during spawning surveys in the upper Big Hole River, 1989 - 1996.

Year	N	% by Age Class				
		2	3	4	5	6
1989	143	25	63	6	6	1
1990	150	46	20	32	1	1
1991	144	44	35	13	8	0
1992	120	19	53	28	0	0
1993	122	12	39	42	6	0
1994	80	30	26	26	16	1
1995	145	15	39	27	15	2
1996	81	24	24	41	10	0

Catch rates of YOY grayling during fall electrofishing surveys provides an index of recruitment. In 1996, catch rates were the same as 1995 in the Wisdom section, but decreased in the McDowell section (Table 4)(Byorth 1996). In the Sportmans-Eastbank section catch-per-run was higher in 1996 (3.7) than in 1995 (0.33). Runoff patterns in 1996 appeared potentially unfavorable to larval grayling.

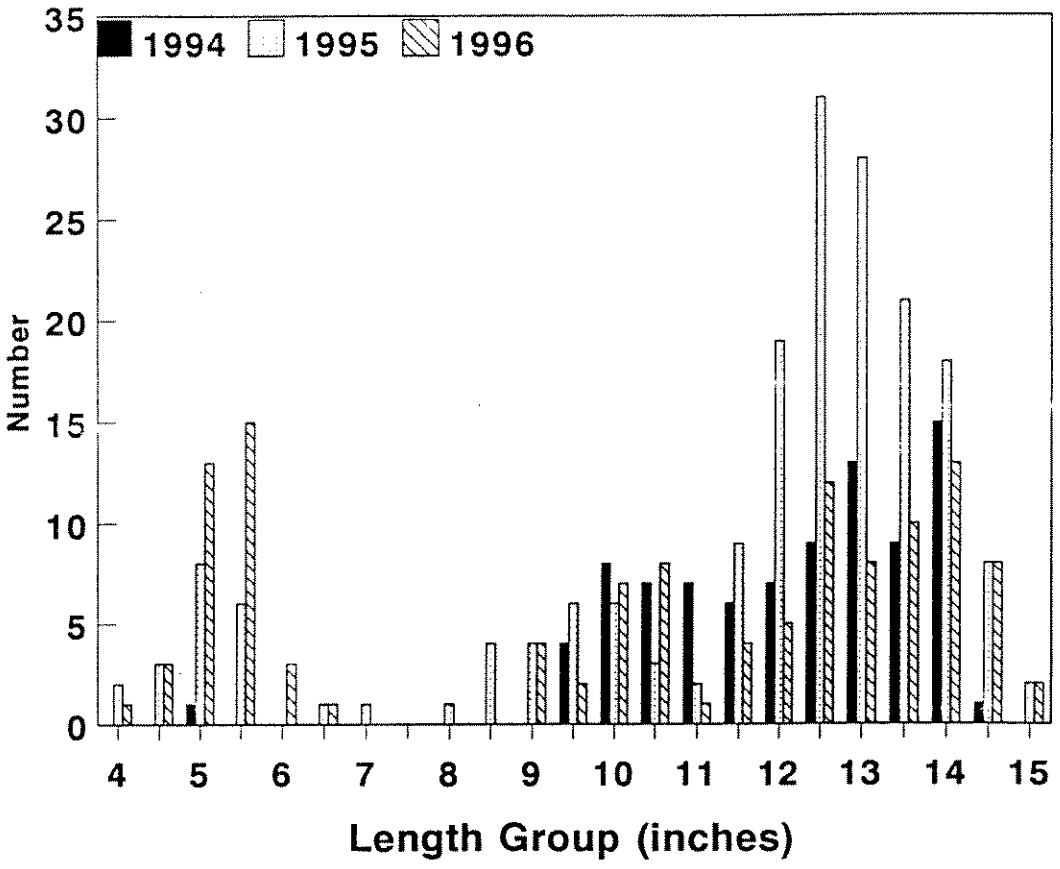

Figure 3. Length-frequency histogram of Arctic grayling captured during Big Hole River spawning surveys, 1994 - 1996.

Table 4. Catch rates (catch-per-effort (CPE)) of young-of-the-year (YOY) grayling captured in the McDowell and Wisdom sections of the Big Hole River, 1983 - 1996.

Year	McDowell Section			Wisdom Section		
	# YOY	# Runs	CPE	#YOY	# Runs	CPE
1983	---	---	---	2	6	0.33
1984	---	---	---	5	7	0.71
1985	0	3	0	0	3	0
1986	145	4	38.2	---	---	---
1987	3	1	3.0	0	1	0
1988	---	---	---	---	---	---
1989	178	2	89.0	90	2	45.0
1990	58	2	29.0	98	4	24.5
1991	10	2	5.0	41	2	20.5
1992	42	2	21.0	83	4	20.75
1993	2	2	1.0	31	4	7.75
1994	---	---	---	39	2	17.5
1995	12	3	4.0	97	6	16.2
1996	6	3	2.0	97	6	16.2

Fall Population Surveys

The status of the fluvial grayling population of the upper Big Hole River remains stable to increasing. Efforts were successful in decreasing bias and improving statistical validity of population estimates by conducting dual consecutive marking runs followed by a recapture run within a week. The population estimate for the Wisdom sections was 64 age 1+ per mile (95% confidence interval: ± 26). This is the least biased and most statistically valid estimate since 1984. Estimates in 1994 (65 ± 50 per mile) and 1995 (70 ± 62 per mile) were clouded by low recapture rates. The apparent decline since last year is due to the bias and does not represent an actual decline in abundance. Improved recapture rates in the Sportsmans-Eastbank section also resulted in an improved estimate. We estimated 47 ± 35 age 1+ grayling per mile in the Sportsmans-Eastbank section, which is an increase over 1995 (37 ± 33). Estimates have not been calculable in the McDowell section for several years, since few or no grayling were recaptured. A single 14.3 inch male grayling was captured in the 40 Bar section.

The length frequency of the population sample supports spawning survey data in indicating stability and a balanced age structure (Figure 4). Older age classes of grayling predominated in the Pools and Sportsmans-Eastbank section, which is consistent with past surveys. Yearling and YOY grayling were primarily captured in the Wisdom section, while age 2 and 3 grayling were distributed throughout the mid- and upper Big Hole River.

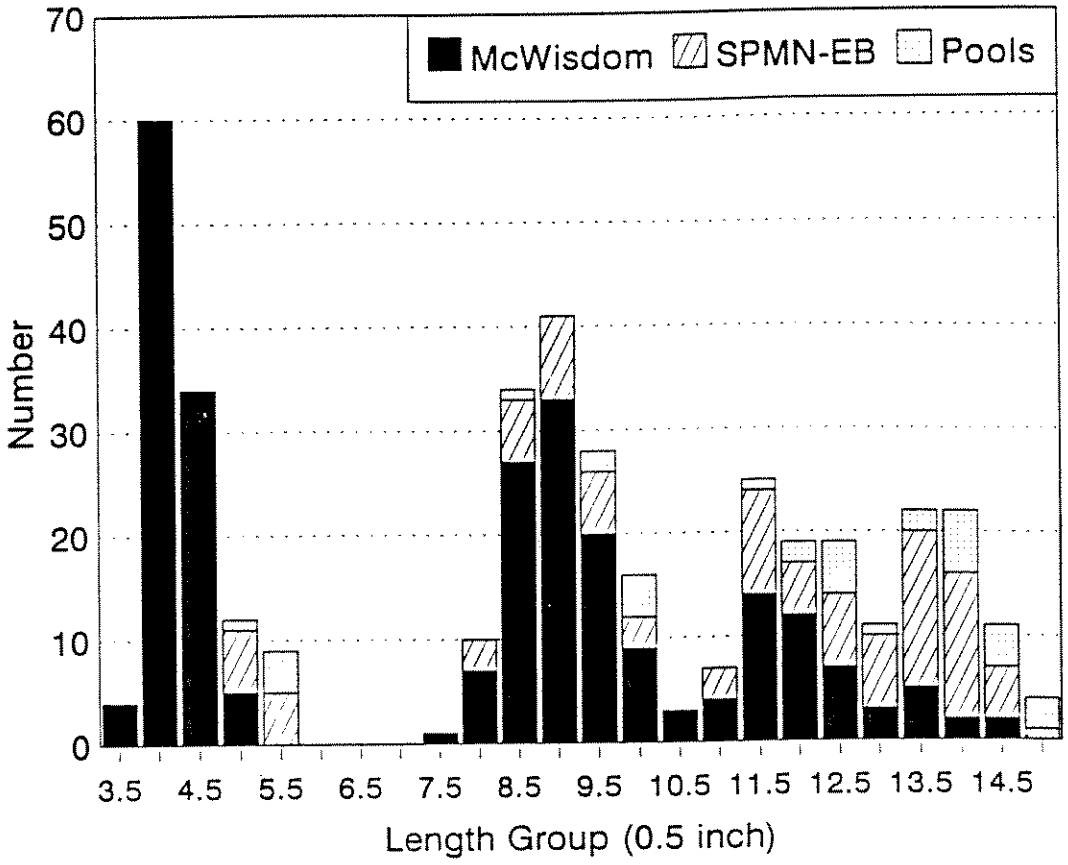

Figure 4. Length-frequency histogram of Arctic grayling captured in Fall population surveys in the Big Hole River sampling sections, 1996.

Brook trout populations are stable to declining in the upper Big Hole River. Numbers of brook trout 4 inches and longer in the McDowell section decreased from 186 per mile in 1995 to 109 (±59) per mile in 1996, the third consecutive year of decline. However, low recapture rates and spawning movements rendered estimates unreliable in the McDowell section (Byorth and Magee 1996). In the Wisdom section, the brook trout population (≥ 4.0 inches) remained stable from 202 per mile (±68) in 1995 to 194 per mile (± 31) in 1996.

Brook trout population estimates in the Sportmans-Eastbank section are low and biased by spawning movements. The Fall 1996 estimate of 68 (±63) per mile is realistic considering this reach

is transitional from brook trout to rainbow trout predominance.

We sampled the 40 Bar section to assess distribution of grayling and gather baseline data on brook trout densities. Brook trout are more abundant in the 40 Bar section at 282 per mile ≥ 8.0 inches (± 160) than in the Wisdom area. While it is possible that higher brook trout densities discourage grayling from using the reach, it is more likely due to habitat related factors, barriers, or entrainment of YOY grayling (Skaar 1989, OEA 1995). Grayling have been documented to coexist with brook trout at equivalent or higher densities in the Wisdom section and Deep Creek (FWP Files, Byorth and Magee 1996)

Rainbow trout densities remain low in the upper Big Hole River. In the McDowell, Wisdom, and 40 Bar sections, we estimated abundance at less than 10 rainbow trout per mile. In the Sportsmans-Eastbank section, rainbow trout densities are stable. Byorth and Magee (1996) reported densities of 390 per mile. That estimate was calculated using Log-likelihood estimators and was suspect. We used a modified Peterson Estimate to recalculate rainbow trout abundance in 1995 and analyzed 1996 data with the same method. The results were 226 per mile (± 92) ≥ 6.0 inches in 1995 and 222 per mile (± 64) in 1996.

Hook and Line Distribution Surveys

Electrofishing is an intensive technique subject to variables which can diminish its efficiency in capturing grayling. To assess the distribution of grayling throughout the upper Big Hole basin we used hook-and-line sampling. Grayling

are highly catchable which makes hook-and-line sampling more efficient than electrofishing during summer, when water temperatures are too warm for efficient electrofishing. Catch-per-unit-effort, too, is subject to vagaries of weather and fishes' feeding cycles, but still proved useful to assess relative abundance and distribution of fishes throughout the upper basin. Catch rates are summarized in Table 6.

Table 6. Catch per unit effort (number per angler hour) of fish species captured in upper Big Hole River hook-and-line surveys, July 1996. Species codes are: GR-grayling, EB-brook trout, MWF-mountain whitefish, RB-rainbow trout, LL-brown trout.

Reach	N_{ang}	N_{hr}	GR	EB	MWF	RB	LL	All Fish
Jackson-40 Bar	4	16	0	0.31	0.25	0	0	0.56
McDowell-Wisdom	3	12	0.25	0	0	0	0	0.2
N. Fork Big Hole River	5	20	0.15	4.35	2.45	0	0	6.95
Pintlar to Sportsmans Park	2	8	0.75	0	0.13	0.13	0	1.0
Sportsmans Park to Jerry Creek	4	16	0.38	0.19	1.00	0.88	0.13	2.56

The North Fork of the Big Hole River is a spawning and rearing area. Three grayling were caught in that reach, all yearlings, between 6.9 and 8.5 inches long. While catch rates are not necessarily representative of relative abundance, catch rates in the North Fork reach were comparable to catch rates in McDowell-Wisdom reach, the core area for grayling in the Big Hole basin. Three yearling grayling were also captured in the

McDowell-Wisdom reach ranging from 7.8 to 8.3 inches long. No grayling were caught in the Jackson - 40 Bar reach during designated sampling periods, but a single grayling was captured in the reach after the sampling period by a persistent angler. The highest catch rate for grayling was attained in the Pintlar-Sportsmans reach. Six grayling were caught by 2 anglers in 8 hours of effort. Anglers caught 3 yearlings (7.2 to 8.3 inches) and 3 age 2 grayling (11.0 to 11.8 inches). Six grayling were also caught in the Sportsmans to Jerry Creek section in 16 hours of effort. All 6 were yearling grayling between 6.4 and 8.4 inches long.

In general, catch rates of grayling and other species was representative of their distribution and similar to fall electrofishing results. Brook trout were predominant in the 3 upper reaches. In the North Fork of the Big Hole River, catch rates of brook trout were over 4 per hour. Rainbow trout were captured only in the lower sections, where they are the predominant trout. Mountain whitefish are ubiquitous in the Big Hole River and were caught in each but the McDowell-Wisdom section.

Axolotl Lakes Brood

We monitored the Axolotl Lake brood and gathered gametes for reintroductions. The 1988 year class has dwindled from the 2,800 planted in 1989 down to 37 (± 18). All age 8 grayling captured were senescent. While mean length increased slightly to 13.8 inches, condition factor decreased.

The 1992 cohort was estimated to have 1,067 (± 187) grayling remaining of the 3,000 planted. The 1995 estimate of 687 (± 650) was based on poor mark/recapture ratios and is unreliable (Byorth and Magee 1996). While survival of the cohort has been stable, growth has been slow. Mean length was 10.6 inches compared to 9.5 inches in 1995. For comparison, the 1988 cohort averaged 12.9 inches at age 4.

On May 18, 1996 we collected an estimated 150,953 eggs from 85 females and spawned them with approximately 60 males. Fecundity averaged 1,776 eggs per female (R. Snyder, Washoe Park State Hatchery, Personal Communication). Approximately 95,900 eggs were transported to Washoe Park State Hatchery where they eventually all died. The remaining 55,053 were taken to Cougar Creek in Yellowstone National Park and released, by hand, into two small spring-fed tributaries. On June 11, 1996, we returned to Cougar Creek and found live, eyed-up larvae and dead eggs in various stages of development. During a follow-up trip on July 1, 1996, we observed free-swimming alevins in the springs and Cougar Creek. No further monitoring was conducted.

Due to complete mortality of the eggs taken to Washoe Park State Hatchery, we returned to Axolotl Lakes to attempt to gather more eggs. We captured and spawned 4 females with viable eggs. We were able to collect approximately 6,000 eggs, which were used for whirling disease bioassays.

After five years of monitoring the Axolotl grayling brood, we have observed a general progression of behavior that will

enable us to better predict when spawning can be conducted. Ice-off has occurred as early as April 27 and as late as May 10. Males tend to ripen within a few days of ice-off, as documented between May 7 and 14. Usually within five days of males becoming ripe, grayling begin to school, cruise the shallows, and feed voraciously. Often during this period an angler can capture grayling at rates exceeding 10 per hour. We have observed this behavior from May 12 to 19. Within three to four days, the feeding behavior abruptly ends. Within a few days of cessation of feeding, female grayling become gravid and are ready to spawn. We have spawned grayling from May 14 to 24. This year, we were able to spawn on May 31, but only a few females were still gravid.

DISCUSSION

For the second consecutive year, stream flow was ample in the upper Big Hole River. Near record snowpack yielded prolonged runoff that extended into July. Due to sparse mid-summer rains, discharge dropped to low of 39 cfs. The wetted channel width was observed to decrease substantially below 40 cfs, which supports this flow as a goal for minimum acceptable habitat. Further investigation on minimum flows should be conducted.

While water temperatures appeared to approach or exceed lethal levels at one thermograph station, it was probably the result of a thermograph probe being nearly exposed to air temperatures in shallow water. However, this illustrates the relatively narrow margin between sublethal and lethal

temperatures in the "warmed reach" of the Big Hole River.

The fluvial Arctic grayling population of the Big Hole River has remained stable since 1994. A balanced age structure and moderately successful recruitment has maintained the population in the Wisdom area and bolstered increases in the mid-river reaches. While recruitment may have been hindered somewhat due to high flows during emergence of larval grayling, catch rates of YOY grayling were comparable to last year. Spawning and fall census data indicate the grayling population will probably continue to thrive at current levels into next year, barring severe winter losses.

We were successful in acquiring a statistically valid fall population estimate in the Wisdom area by conducting dual, consecutive marking runs followed in 7 to 10 days by a recapture run. This sampling method should be used each fall. Byorth and Magee (1996) reported that using 2 marking runs 10 days apart was unsuccessful in obtaining unbiased estimates.

Hook and line surveys largely reflected known species distribution in the upper Big Hole River. The North Fork of the Big Hole River, documented as a spawning and rearing stream in the past, also provides summer feeding habitat. The Big Hole River above the McDowell section supports few grayling. A single grayling was captured in the upper Big Hole River in the vicinity of the 40 Bar section during spring, summer hook and line, and fall censuses. Certain parts of this upper reach have suffered habitat degradation but several areas are in excellent condition

(OEA 1995). Densities of brook trout are higher than in the Wisdom area but probably not high enough to prevent grayling from re-establishing in that 30 miles of river. This reach should be investigated to determine if fish passage is restricted or entrainment of young fish limits reproduction.

Transplanting fertilized eggs may have potential as a reintroduction technique. We documented successful incubation and hatching of eggs planted by hand into Cougar Creek. This technique may be useful under limited hatchery space and if problems with disease occur in the hatchery environment. Further analysis of the Cougar Creek plant and this technique should be conducted in the future.

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