TIMING, LOCATION AND POPULATION CHARACTERISTICS OF SPAWNING MONTANA ARCTIC GRAYLING (THYMALLUS ARCTICUS MONTANUS [MILNER]) IN THE BIG HOLE RIVER DRAINAGE, 1989

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by

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EXECUTIVE SUMMARY

We sampled spawning Montana Arctic grayling (Thymallus arcticus montanus [Milner]) by electrofishing within the upper Big Hole River drainage from April through May 1989. Sample sites included the main stem Big Hole River from above Wise River up to Jackson and the lower portions of three tributaries to the river were sampled from April through May. We describe the temporal and spatial distribution of spawning grayling, habitat utilized for spawning, and demographic characteristics of the spawning population.

We captured 407 grayling. The first ripe male was captured on April 21 in Swamp Creek and the first ripe female on April 25 in the Big Hole River above the Clemow Road above the town of Wisdom. The numbers of captured ripe females peaked during the period between April 26 and May 8 with the only spent female captured on May 8. The numbers of ripe males peaked during the period between April 24 and May 10. Spawning could not be correlated to river flows or water temperatures because the USGS gauge did not begin operating until May 1, 1989. The sex ratio of all captured fish identified as mature, ripe, or spent was 1.6 males:1.0 female. A large portion of age II fish were sexually mature (61%). The average lengths and weights of ripe males (n = 123) and ripe females (n = 19) were 11.8 inches and 0.52 pounds and 11.4 inches and 0.48 pounds, respectively. Grayling spawned primarily within the main stem Big Hole River from the mouth of the North Fork Big Hole River upstream to 3 miles above Wisdom, in a few scattered side channels below the North Fork, and in the lower portions of Swamp, Big Lake, and Rock creeks.

We found spawning grayling on riffles with clean surface gravel which appeared "bright" near pool or run habitats, generally within actively degrading or aggrading side channels or alluvial gravel fans at the mouth's of tributaries. We captured most spawning grayling in areas of hydrologic instability where the channel was actively down-cutting or depositing gravels. Measurements in eleven areas found spawning grayling were usually captured in sites where water velocities were faster and water depths deeper than adjacent available areas.

The age composition of the sampled population suggested that the 1986 year class (which was a strong year class recruited to the population in 1988) experienced poor survival from the spring of 1988 to the spring of 1989. The 1985 and 1987 year classes were also poor and the 1990 spawning run will likely be a poor run. Grayling hatched during 1988 made up a surprisingly good year class as evident from the high numbers of age I fish captured during the

spring of 1989 and, hopefully, this year class will remain strong and grow to maturity. It is probable that the Big Hole River grayling population will be dependent upon this 1988 year class.

Of 38 grayling recaptured during spring 1989 sampling, fifteen were tagged during the same sampling, seventeen were tagged in 1988, one was tagged in 1987, and five tagging locations could not be determined. Tagging data illustrated that movements between the lower river near Fishtrap Creek and upper river near Wisdom, and between the main stem river and its tributaries were occurring. This tag return information lends additional support to our observations that at least a segment of the Big Hole River grayling population uses the entire river above Divide on a seasonal basis. We believe a portion of the grayling population normally moves to the upper river (near Wisdom) during the spring, remains in this area of the river during the summer, before emigrating down river to winter habitats. Use of the lower portions of at least some tributaries by Big Hole River grayling was further supported.

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Any reference to product names are intended to document the type of equipment used and do not represent a product endorsement.

1990 Grayling Spawning Report

INTRODUCTION

The last riverine (fluvial) native population of Montana Arctic grayling (Thymallus arcticus montanus [Milner]) in the contiguous 48 United States exists in the upper Big Hole River of southwestern Montana (Liknes and Gould 1987). Shepard and Oswald (1989) reported the historic distribution and status of Arctic grayling in the lower 48 United States and discussed the evidence for a unique Big Hole River fluvial stock. They documented the past investigations of the Big Hole River grayling population and the recent declines observed in grayling numbers. They also reviewed the literature regarding spawning cues and habitat requirements.

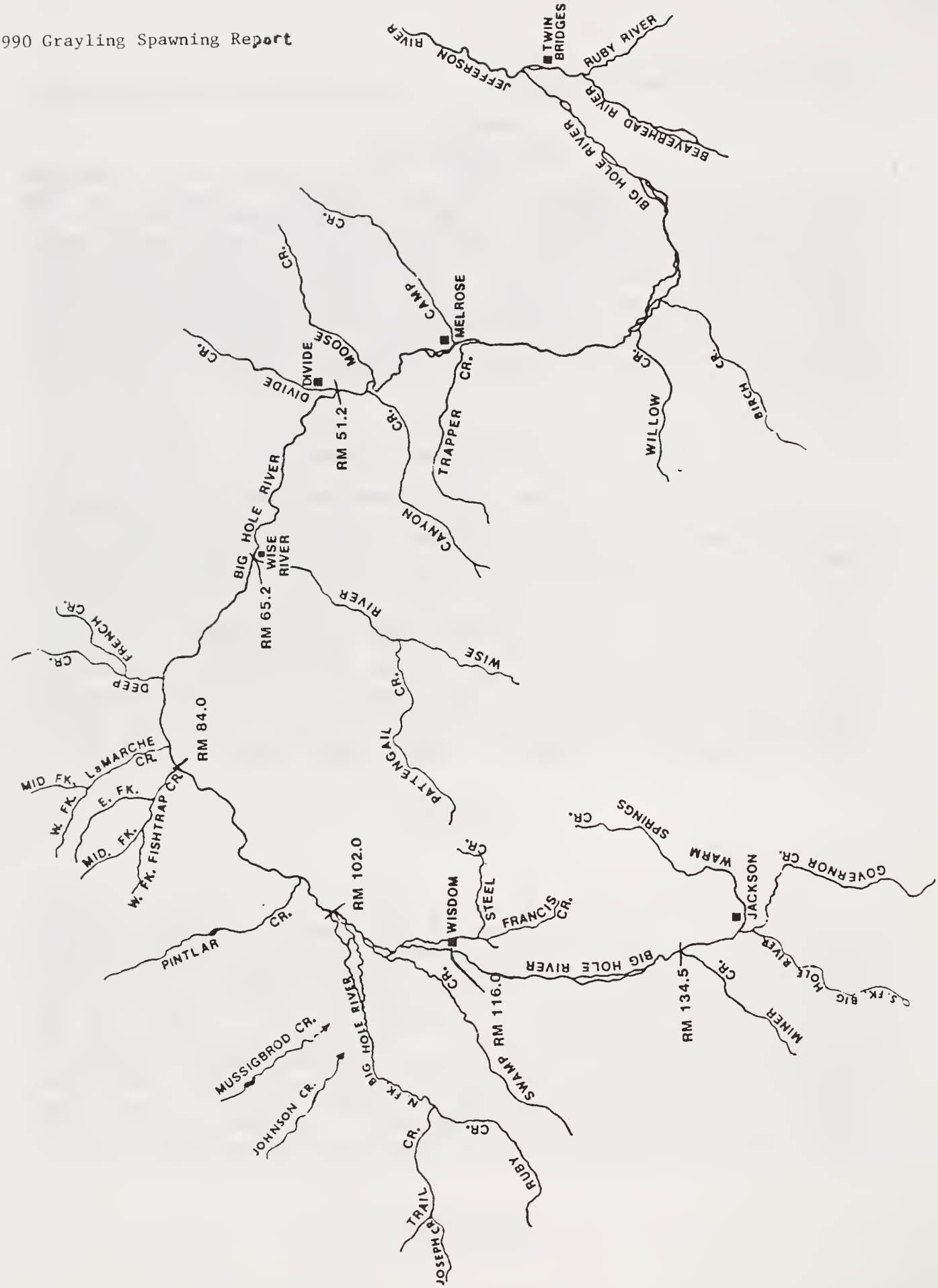
STUDY SITE DESCRIPTION

The study area included the upper Big Hole River drainage up river from Divide, Montana (Figure 1). Sampling was concentrated within the main stem Big Hole River from the towns of Wise River upstream to approximately 5.0 miles above Wisdom and in the lower portions of its tributaries including Big Lake Creek, Deep Creek, Sand Hollow Creek, Steel Creek, and Swamp Creek. Unfortunately, the USGS river flow gauge and water temperature gauge at Wisdom did not begin operation until May 1, 1989. Consequently, river flow and water temperature data were unavailable during the entire sampling of the spawning run. During May, Big Hole River flows and water temperatures ranged from 36 to 648 cfs and 41 to 61 F, respectively, using preliminary data supplied by the USGS from a gauge located at the Highway 43 bridge near Wisdom (Figure 2).

METHODS

FISH COLLECTION

Grayling were captured using either boat mounted electrofishing gear (either a Buffalo Drift boat or Coleman Crawdad outfitted with a 240 watt gas powered generator connected to a Harvey Leach constructed variable voltage pulsator with mobile anodes) or a backpack electrofisher (Coeffelt BP-1C) electrofished in a downstream direction. Sampling began on April 18 and continued through May 18 (Table 1). Two crews operated during the peak of the spawning run. A total of approximately 49 miles of river and 8 miles of tributaries were surveyed during the spawning season. We restricted our sampling during 1989 to those areas where we captured grayling during 1988. We placed red plastic survey flags at most locations where ripe or mature grayling were


TWIN BRIDGES
JEFFERSON RIVER
RUBY RIVER
BEAVERHEAD RIVER
BIG HOLE RIVER
CR.
CAMP
MELROSE
MOOSE
DIVIDE
CR.
DIVIDE
RM 51.2
CR.
TRAPPER
CR.
WILLOW
CR.
BIRCH
CR.
CANYON
BIG HOLE RIVER
WISE RIVER
RM 65.2
RIVER
WISE
FRENCH CR.
DEEP
CR.
RM 84.0
PATTENGAIL
CR.
MID FK. LaMARCHE
CR.
W. FK.
E. FK.
MID. FK.
W. FK. FISHTRAP CR.
SPRINGS
CR.
WARM
GOVERNOR CR.
JACKSON
RM 102.0
WISDOM
STEEL
CR.
FRANCIS
CR.
PINTLAR
CR.
BIG HOLE RIVER
RM 134.5
CR.
MINER
S. FK. BIG HOLE RIVER
CR.
RM 116.0
SWAMP
MUSSIGBROD CR.
JOHNSON CR.
BIG HOLE RIVER
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RUBY
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TRAIL
JOSEPH CR.

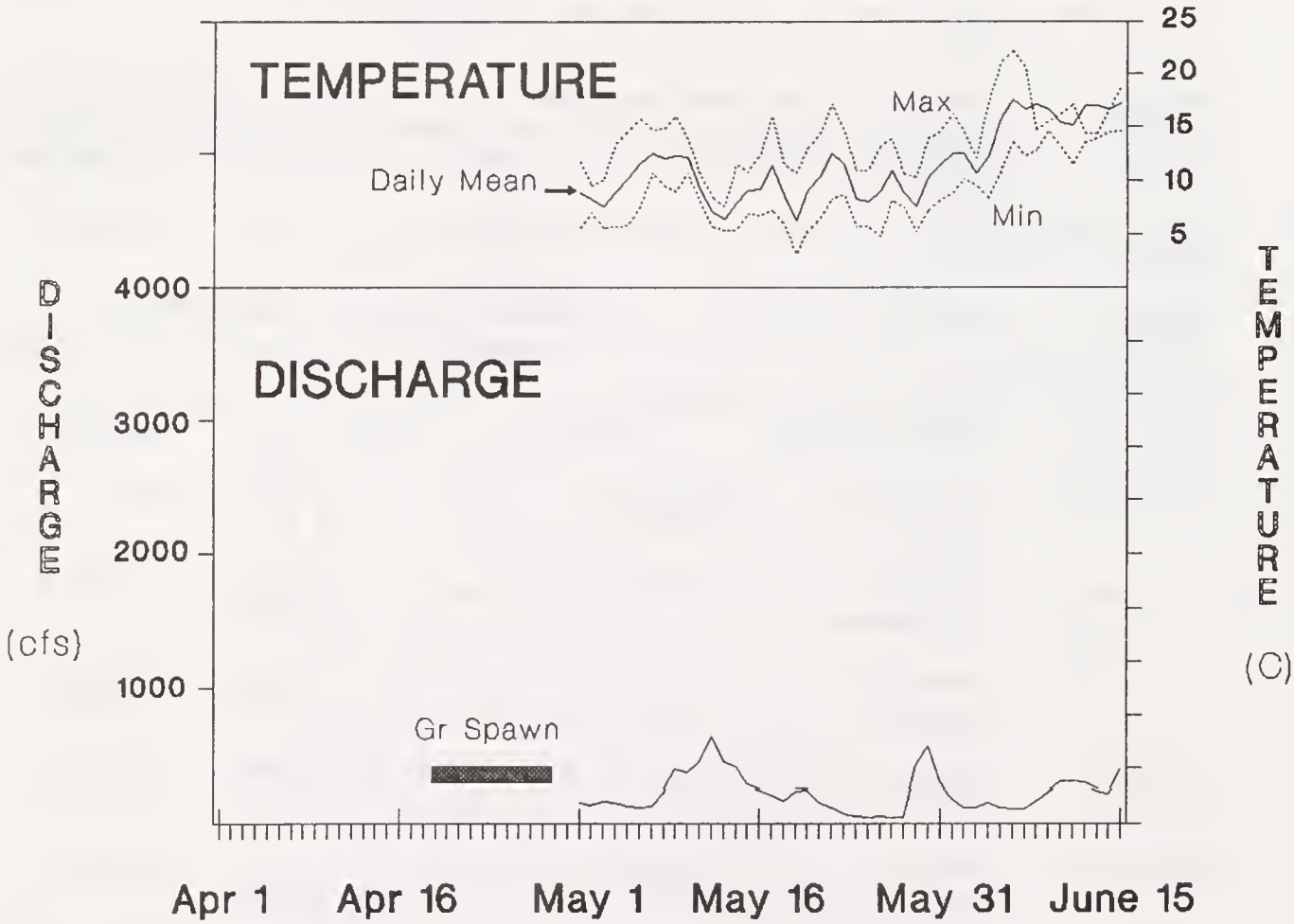

Figure 2. Daily discharge (cfs) and mean, minimum, and maximum water temperatures in the Big Hole River near Wisdom, Montana from May through July 1989. Preliminary data collected by the USGS. Timing of grayling spawning cross-hatch bar.

captured and noted the approximate distance from these flags into the channel which was the actual capture site. If we had placed a survey flag, we noted whether the fish captured at that location was ripe or mature.

Stunned grayling, rainbow trout, and brook trout were captured, except as noted on Table 1. For all captured fish, length was measured to the nearest 0.1 inch and weights were recorded to the nearest 0.01 pound.

Table 1. Electrofishing sampling dates, locations, and approximate length of sample sections for electrofishing sampling of the 1989 spawning arctic grayling population in the Big Hole River.

Date	Location	Section length (mi)	Comments
4-18-89	Big Hole R. - E channel below Wisdom	2.0	6 GR - none ripe
4-19-89	Big Hole R. - McDowell section above Wisdom	5.0	1 GR - immat 8 EBT
4-20-89	Big Hole R. - Wisdom down to Cemetery	5.4	38 GR - 3 ripe M 36 EBT
4-20-89	Swamp Creek - N Fk Big Hole Rd to mouth	2.0	9 GR - 2 ripe M 67 EBT, 3 LING
4-21-89	Big Hole R. - Swamp Ck to Sand Hollow Ck	0.2	2 GR - 1 ripe M 2 EBT
4-24-89	Big Hole R. - McDowell section above Wisdom	5.0	10 GR - 6 ripe M 10 EBT, 1 RB
4-24-89	Big Hole R. - Doolittle to Crane Ranch	3.5	13 GR - none ripe 5 EBT
4-25-89	Big Hole R. - Twin Lake Rd to Clemow Rd	4.0	2 GR - 1 ripe M - 1 ripe F 14 EBT, 2 RB
4-26-89	Big Hole R. - Wisdom section below Wisdom	5.4	24 GR - 14 ripe M - 2 ripe F 20 EBT, 1 RB, 5 LING

Table 1. (continued).

Date	Location	Section length (mi)	Comments
4-26-89	Big Hole R. - Cemetery to Doolittle Ck	6.6	57 GR - 17 ripe M - 3 ripe F 35 EBT
4-27-89	Swamp Ck - N Fk Big Hole Rd to mouth	2.0	15 GR - 6 ripe M - 2 ripe F 156 EBT, 10 LING
5-01-89	Steel Ck. - Steel Ck Rd to mouth	1.2	5 GR - none ripe 460 EBT, 31 LING
5-02-89	Big Hole R. - Steel Ck mouth to Cemetery	3.4	27 GR - 4 ripe M - 1 ripe F 34 EBT, 14 LING
5-02-89	Big Hole R. - Cemetery down to Doolittle	6.6	50 GR - 27 ripe M - 6 ripe F 42 EBT
5-03-89	Deep Ck. - French Ck down to below Ski Hill bridge	2.0	No GR 63 EBT, 42 RB, 1 LL
5-04-89	Big Hole R. - Sportsman Park down to East Bank	5.0	1 GR - immat 26 EBT, 27 RB
5-05-89	Big Hole R. - Fishtrap down to Sportsman Park	3.0	15 GR - 1 ripe F 58 EBT, 14 RB, 1 LL
5-08-89	Big Hole R. - Cemetery down to Doolittle Ck	6.6	25 GR - 16 ripe M - 1 ripe F 35 EBT
5-08-89	Big Hole R. - Wisdom to Cemetery	5.4	28 GR - 7 ripe M - 2 ripe F - 1 spnt F 46 EBT, 2 RB
5-09-89	Swamp Ck. - N Fk Big Hole Rd to mouth	2.0	8 GR - all immat 81 EBT
5-09-89	Big Hole R. - Swamp Ck to Sand Hollow Ck	0.2	1 GR - immat

Table 1. (continued).

Date	Location	Section length (mi)	Comments
5-09-89	Big Hole R. - Wisdom down to Cemetery	5.4	32 GR - 4 ripe M - 1 ripe F 63 EBT
5-10-89	Big Hole R. - Wisdom to Cemetery	5.4	12 GR - 6 ripe M 31 EBT, 2 LING
5-11-89	Big Hole R. - McDowell section above Wisdom	5.0	6 GR - 2 ripe M 15 EBT, 1 RB
5-17-89	Big Hole R. - Fishtrap to Sportsmen Park	3.0	1 GR - immat 28 EBT, 7 RB
5-18-89	Big Lake Ck. - Clemow Rd down	1.0	33 EBT

Sex and state of maturity (immature; mature, but not ripe; ripe; or spent) were recorded for all grayling. Sex determination was based on extrusion of gametes, the ability to feel eggs within the body cavity, and the shape of the dorsal fins as documented by Rawson (1950). Ripeness of female grayling was difficult to determine until immediately prior to and during spawning. It was difficult to determine if males were spent because sperm could still be extruded from spent fish.

Scale samples were removed from grayling and scale impressions were made in acetate. Scale samples were later read for age determination. Age interpretation from scale samples up to age IV was believed relatively accurate, while estimation beyond age IV was suspect. Growth interpreted from scales should be reliable because scale samples were obtained in the spring during annulus formation.

All grayling and rainbow trout longer than 8.0 inches were tagged with a "spaghetti-type" numbered anchor tag. Recaptures of previously tagged fish were noted. Points of capture for grayling were visually noted and recorded in the field. Recorded information included the general habitat type and streambed condition where fish were captured and the location by river landmark. These capture locations were later converted to river mile locations using USGS maps (scale: 1:24,000) and a River Mile index.

SPAWNING HABITAT CHARACTERISTICS

Capture sites of ripe grayling were visually characterized including habitat type (riffle, pool, etc.) and channel type (main channel, side channel, braided channel). A survey crew returned to 11 sites where mature and/or ripe grayling were captured to detail the spawning habitat being utilized. At the point of capture a transect was run across the channel and water depth and flow at 0.6 and 0.1 of total depth were measured. In addition, streambed composition was visually estimated by classifying the streambed into silt (0 to 63 microns), sand (64 microns to 0.08 in), small gravel (0.09 to 0.25 in), gravel (0.26 to 3.0 in), and cobble (3.1 to 10.0 in) size categories.

RESULTS

TIMING OF SPAWNING

A total of 407 grayling were captured. The first ripe male grayling was captured on April 21 in Swamp Creek downstream from the lower North Fork Road near Wisdom (Figures 1 and 3). The first identified ripe female grayling was captured in the Big Hole River on April 25 up river from the Clemow Road above the town of Wisdom. The numbers of ripe females peaked during the period between April 26 and May 8 (Figure 3). The numbers of ripe males peaked during the period between April 24 to May 10. The only spent female was captured on May 8.

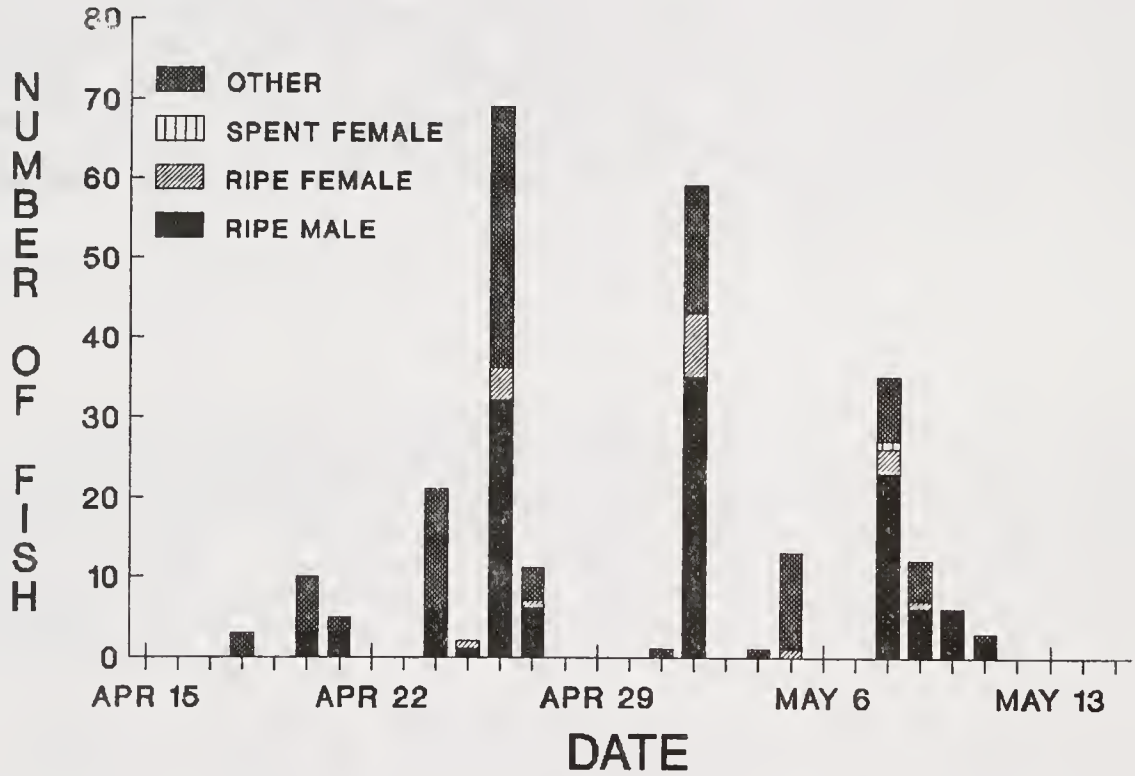

Figure 3. Catch of grayling 8.0 inches and longer in the Big Hole River and its tributaries by date during 1989. Grayling were segregated into "ripe male", "ripe female", "spent female", and "other" categories.

SPAWNING RUN CHARACTERISTICS

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The sex ratio of all fish identified as mature, ripe, or spent was 1.6 males:1.0 female, but was 1.2 males:1.0 female for those fish aged (Table 2). Length and age frequency information for mature fish illustrated that a large portion of the age II fish were sexually mature (Table 2 and Figure 4). The fact that the

Table 2. Mean length, length range, and sex ratio information by age for the portion of the Big Hole River Arctic grayling spawning run sampled during 1989.

Age class	Number sampled	Mean length (inches)	Length range (inches)	Percent mature	Sex ratio (male:female)
1	144	4.8	3.8 - 6.3	None	
2	49	8.8	7.3 - 10.4	61	2.0:1.0
3	54	11.1	9.9 - 12.8	98	0.9:1.0
4	25	12.6	11.7 - 13.8	100	1.5:1.0
5 +	9	13.5	12.9 - 14.9	100	1.3:1.0
Total	281				1.2:1.0

sex ratios change between age classes illustrates that not all female grayling were maturing at age II and that female grayling may be suffering higher mortality than males after age IV (Table 2). The average length and weight of ripe males (n = 123) was 11.8 inches and 0.52 pounds, respectively. The average length and weight of ripe females (n = 19) was 11.4 inches and 0.48 pounds, respectively. The majority of growth in length was attained at by age III with the fastest growth occurring during the first and second years of life (Figure 5).

SPAWNING DISTRIBUTION WITHIN THE DRAINAGE

Most captured grayling spawning during 1989 were found within the main stem Big Hole River between the North Fork of the Big Hole River upstream to approximately 3.0 miles above the Highway 43

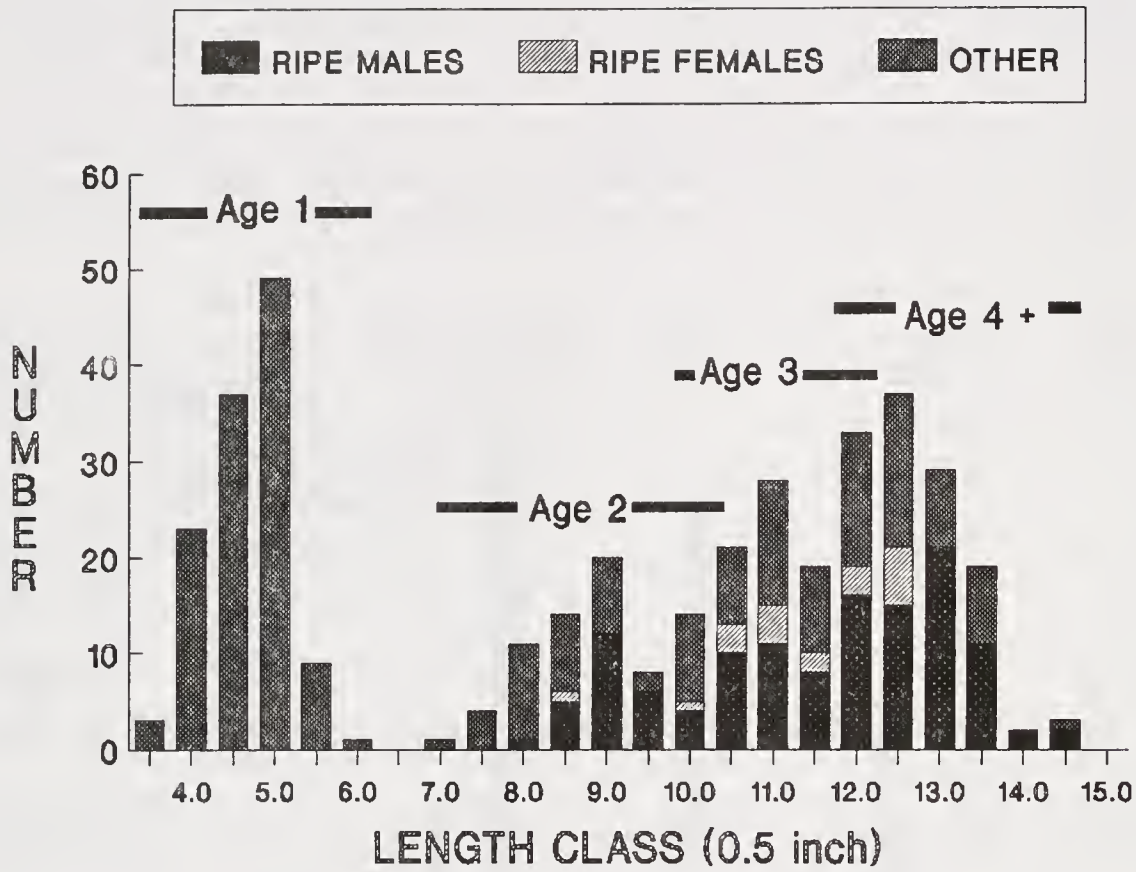


Figure 4. Length frequencies of Arctic grayling captured during the 1989 spawning run (by half inch length group). Ripe grayling included all fish identified as either ripe, mature, or spent.

bridge near the town of Wisdom and in the lower portions (generally from their mouth upstream one to two miles) of Swamp, Big Lake, and Rock creeks (Figure 1). Isolated spawning areas were observed in side channels within the main stem Big Hole River above the Highway 43 bridge near Squaw Creek and between Sawlog and Fishtrap creeks.

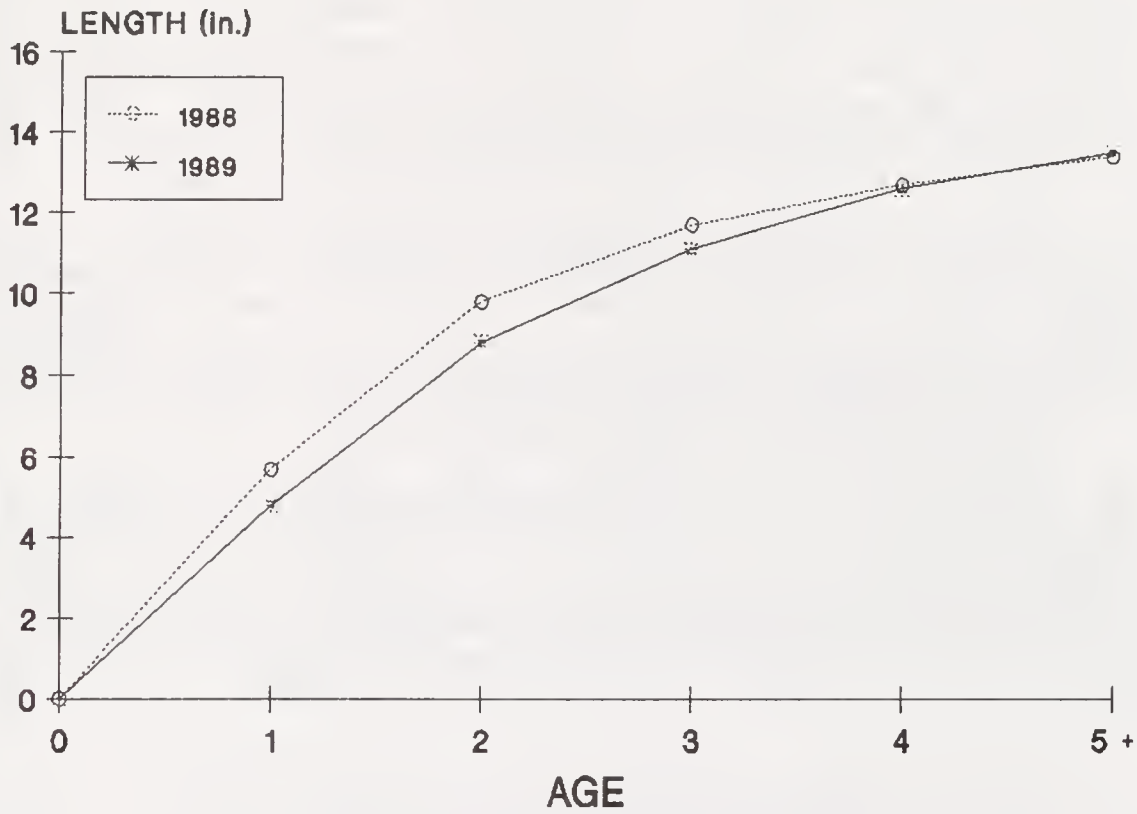


Figure 5. Growth of grayling from the Big Hole River drainage during 1988-89 estimated from mean lengths at age.

Figure 5. Growth of grayling in the Big Hole River drainage during 1988-89 estimated from mean lengths at age.

MOVEMENT ASSESSED USING TAG RETURNS

A total of 42 grayling were recaptured during this sampling. Of these 42, four were multiple recaptures of tags captured more than once during 1989, leaving 38 recaptures to identify. Fifteen of these recaptures were tagged within the same year (1989) and 23 were tagged in previous years (Table 3). Of the 23 tagged in previous years, seventeen were tagged in 1988, one was tagged in 1987, and five tagging locations could not be determined. Of the

seventeen grayling tagged during the spring of 1988 and recaptured during the spring of 1989, three were tagged near Fishtrap Creek (a distance of at least 18 river miles), seven were tagged close to their recapture location, two were tagged between five and ten miles above their recapture location, and four were tagged between five and ten miles below their recapture location. One grayling recaptured on May 9, 1989 was tagged on August 9, 1988 approximately two miles above the recapture location.

A fish recaptured on April 27, 1989 approximately 1.5 miles up Swamp Creek was initially tagged on April 27, 1988 (exactly one year earlier) in the main stem Big Hole River near the mouth of the North Fork Big Hole River (a distance of approximately eight miles). This female was 12.2 inches and 0.54 pounds when tagged and 12.5 inches and 0.56 pounds when recaptured a year later.

One grayling was recaptured twice. Once on April 26, 1989 in the main stem Big Hole River near McVey Creek and again on April 27, 1988 in the Big Hole River near McVey Creek. This fish was tagged on October 23, 1987 in the main stem Big Hole River near Fishtrap Creek (the movement from Fishtrap to McVey Creek was 20 miles). This female was 10.8 inches and 0.45 pounds when tagged and 11.2 inches and 0.42 pounds when recaptured in 1988 and 12.7 inches and 0.58 pounds when recaptured in 1989.

Table 3. Summary of locations, lengths, and weights of tagged fish recaptured during the spring, 1989 sampling and locations, lengths, and weights at the time they were tagged.

	Tagging information				Recapture information			
Tag	Length	Weight	Date	Location	Length	Weight	Date	Location
DB 1479	11.2	0.44	05/10/88	BHR - RM 99.0	13.3	0.72	05/02/89	BHR - RM 107.0
DB 1480	9.9	0.28	05/10/88	BHR - RM 99.0	11.7	0.52	05/08/89	BHR - RM 107.0
DB 1495	12.6	0.59	06/15/88	BHR - RM 83.9	12.8	0.68	04/26/89	BHR - RM 102.0
G 28	10.8	0.45	10/23/87	BHR - RM 84.0	12.7	0.58	04/26/89	BHR - RM 104.4
G 53	11.7	0.45	05/04/88	BHR - RM 115.0	13.4	0.71	05/08/89	BHR - RM 113.0
G 97	9.4	0.22	05/04/88	BHR - RM 112.0	11.2	0.43	05/09/89	BHR - RM 111.0
G 105	10.0	0.31	04/29/88	BHR - RM 116.0	11.7	0.50	04/26/89	BHR - RM 113.5
G 113	10.0	0.30	04/29/88	BHR - RM 117.5	10.7	0.39	05/02/89	BHR - RM 98.0
G 166	9.4	0.22	05/02/88	BHR - RM 111.0	10.8	0.38	04/20/89	BHR - RM 111.0
G 185	9.3	0.25	04/27/88	BHR - RM 114.0	11.5	0.43	05/09/89	BHR - RM 113.0
G 201	8.9	0.21	05/01/88	BHR - RM 116.0	10.5	0.37	05/11/89	BHR - RM 117.2
G 238	14.6	1.00	05/02/88	BHR - RM 113.0	14.6	1.10	04/26/89	BHR - RM 107.0
G 2019	9.9	0.33	08/09/88	BHR - RM 113.0	10.2	0.34	05/09/89	BHR - RM 111.0
G 2037	12.8	0.72	04/26/89	BHR - RM 114.0	13.0	0.66	05/02/89	BHR - RM 107.0
G 2046	13.8	0.80	04/26/89	BHR - RM 111.0	13.5	0.71	05/10/89	BHR - RM 114.0
G 2050	12.4	0.63	04/26/89	BHR - RM 110.5	12.7	0.60	05/02/89	BHR - RM 111.5
G 2087	8.9	0.23	04/20/89	BHR - RM 110.0	8.7	0.24	05/09/89	BHR - RM 115.0
G 2107	9.0	0.21	04/27/89	SWAMP - CM 0.7	8.9	0.19	05/02/89	BHR - RM 104.4
G 2116	11.0	0.41	05/02/89	BHR - RM 111.0	10.6	0.39	05/09/89	BHR - RM 113.0
G 2586	13.8	0.72	04/24/89	BHR - RM 107.0	13.8		05/02/89	BHR - RM 107.0
G 2612	13.1	0.86	04/26/89	BHR - RM 107.0	13.5	0.71	05/08/89	BHR - RM 107.0
G 2613	13.7	0.82	04/24/89	BHR - RM 107.0	13.7		05/02/89	BHR - RM 107.0
G 2621	13.1	0.86	04/26/89	BHR - RM 107.0	12.5		05/08/89	BHR - RM 107.0
G 2622	12.6	0.59	04/26/89	BHR - RM 107.0	12.7		05/02/89	BHR - RM 107.0
G 2623	13.2	0.68	04/26/89	BHR - RM 107.0	13.3		05/02/89	BHR - RM 107.0
G 2624	12.9	0.67	04/26/89	BHR - RM 107.0	12.9		05/02/89	BHR - RM 107.0
G 2653	13.7	0.79	04/26/89	BHR - RM 102.0	13.7		05/02/89	BHR - RM 102.0
G 2669	11.4	0.41	05/02/89	BHR - RM 107.0	11.2		05/08/89	BHR - RM 107.0
LB 89	12.8	0.74	04/27/88	BHR - RM 107.0	12.9	0.73	04/20/89	BHR - RM 112.0
LB 187	12.2	0.54	04/27/88	BHR - RM 102.0	12.5	0.56	04/27/89	SWAMP - CM 1.5
Y 199	9.3	0.23	05/04/88	BHR - RM 110.0	10.8	0.52	05/09/89	BHR - RM 111.0
Y 219	9.7	0.29	05/09/88	BHR - RM 84.0	10.6	0.40	05/08/89	BHR - RM 107.0

CHARACTERISTICS OF SPAWNING HABITAT

Visual Characteristics

Ripe grayling usually were found in riffle areas over gravel which appeared "bright" due to the absence of periphyton and/or silt and sand sized material on the surface of the streambed. These riffle areas of "bright" gravel were often associated with recently created side channels, below beaver dams and irrigation diversion structures, and/or near mouths' of tributaries where alluvial gravel fans had formed. Electrofishers became relatively efficient at identifying areas where ripe grayling were likely to be captured by the middle of the spawning season. These areas could be characterized as being in areas of hydrologic instability, often in recently cut side channels where a riffle with "bright" gravel was situated near a pool or run, or over recently deposited gravels.

Measured Characteristics

Velocity, depth, and substrate composition measurements were taken across eleven sites where ripe grayling were captured. Ripe grayling were captured at depths averaging 2.2 feet with water velocities averaging 1.9 fps at 0.6 depth and 1.1 fps at 0.1 depth (Table 4). Substrate composition at capture sites averaged 11% silt, 20% sand, 32% small gravel, 31% large gravel, and 6% cobble (Table 4). Available velocities, depths, and substrate compositions in adjacent areas were also measured. Available velocities averaged 1.6 fps at 0.6 depth and 0.9 fps at 0.1 depth (Table 4). Available depths averaged 1.8 feet. Available substrate composition averaged 14% silt, 23% sand, 32% small gravel, 24% large gravel, and 7% cobble. From these measurements it appears that grayling may select deeper, and possibly, faster

Table 4. Average depth (ft.), velocities at 0.6 and 0.1 depth (fps), and surface substrate composition (%) at capture locations of ripe and mature grayling (USED) and at adjacent (AVAIL) areas. Sample sizes in parentheses. Data from 11 capture site locations sampled during the 1989 spawning run.

		Velocity (fps)		Surface substrate (%)				
	Depth (ft)	0.6 depth	0.1 depth	Silt	Sand	Small gravel	Large gravel	Cobble
AVAIL	1.8	1.6	0.9	14	23	32	24	7
	(84)	(76)	(72)	(80)				
USED	2.2	1.9	1.1	11	20	32	31	6
	(28)	(28)	(27)	(28)				

water (Figure 6 and 7) for spawning and also select areas over cleaner (less sand and silt) substrate which contains higher percentages of large gravel. The stream substrate results tend to support the supposition (based on limited hollow core data) of Shepard and Oswald (1989) that grayling may need relatively clean substrate with a small percentage of fine sediment on the surface for spawning. These results must be viewed with caution because there is no way to determine exact spawning locations using electrofishing.

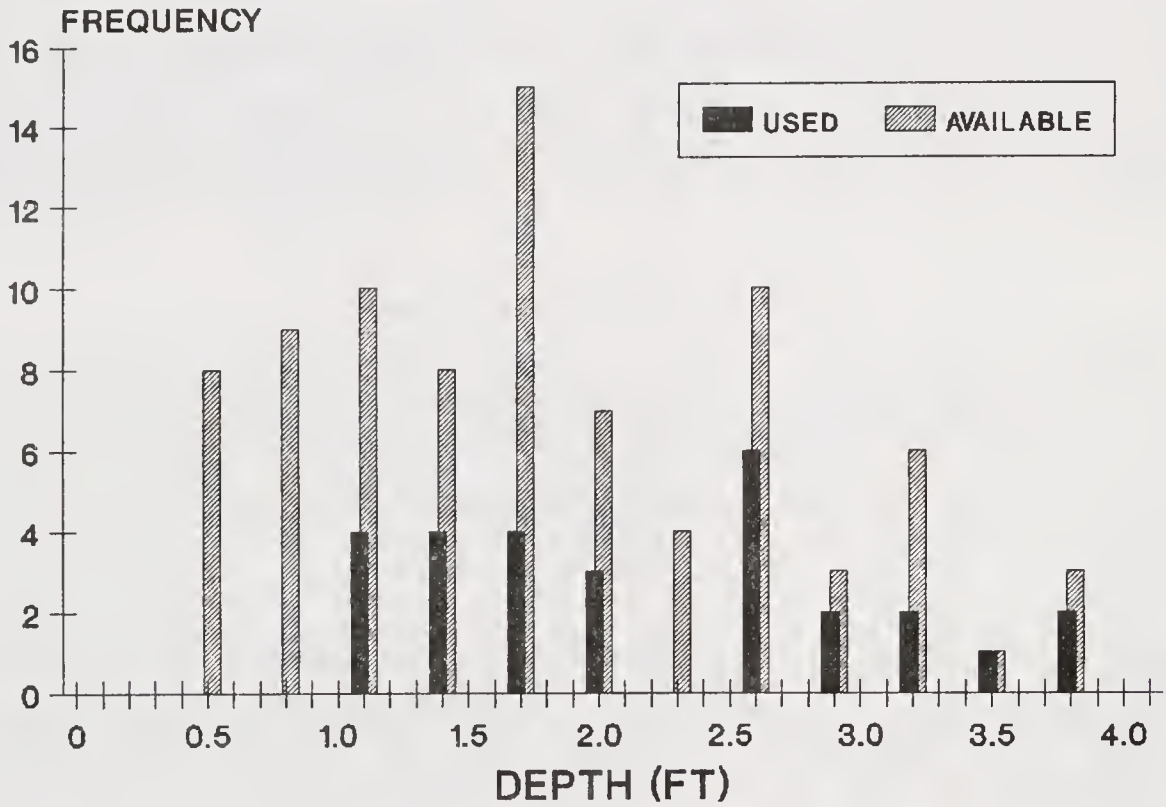
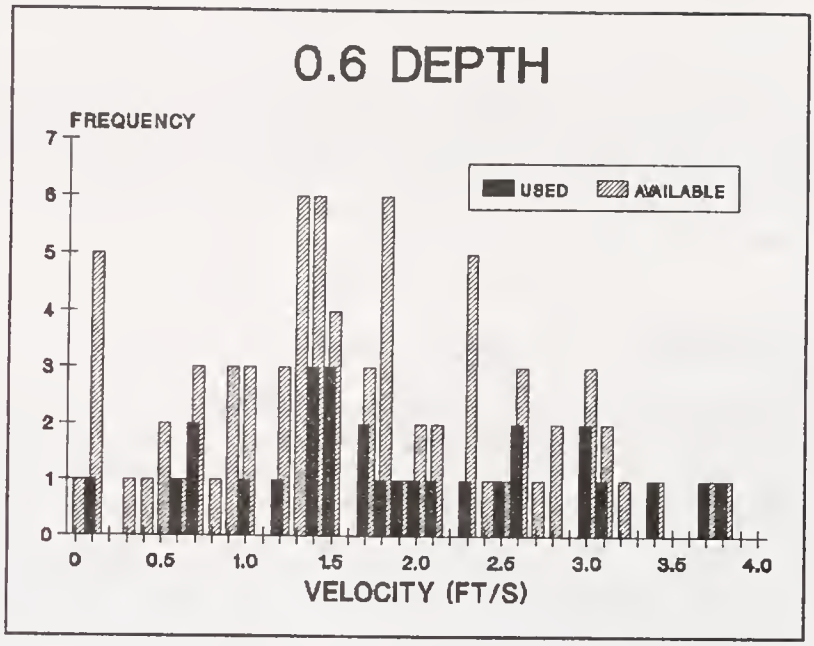


Figure 6. Depths at grayling spawner capture sites (USED) compared to depths at adjacent unused sites (AVAILABLE) for eleven sites sampled during 1989.



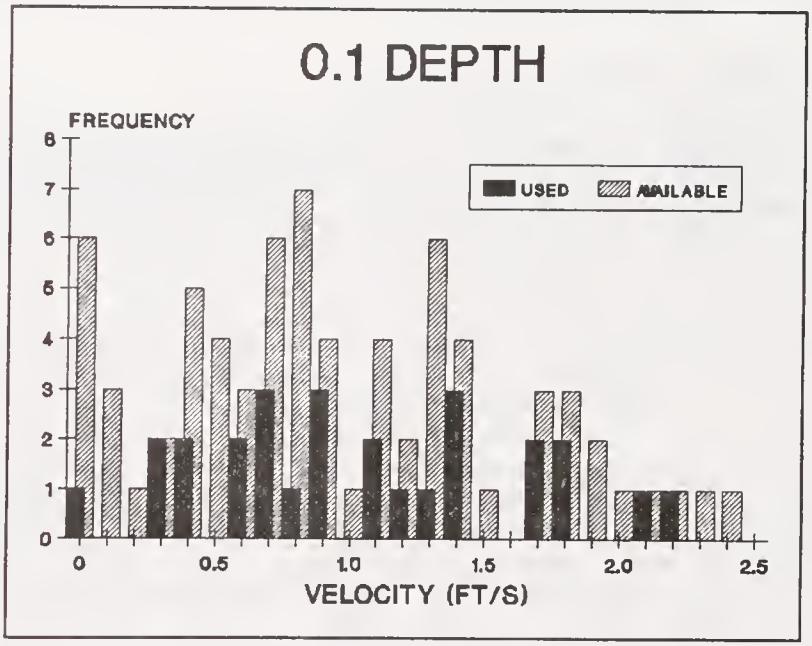


Figure 7. Both 0.6 and 0.1 depth velocities at grayling spawner capture sites (USED) compared to 0.6 and 0.1 depth velocities at adjacent unused sites (AVAILABLE) for eleven sites sampled during 1989.

DISCUSSION

A detailed discussion of Big Hole River grayling spawning population characteristics and timing, with a comparison to results from studies on other grayling populations was made in last year's report (Shepard and Oswald 1989). Only information not presented previously or interpreted differently from the previous report is presented below.

TIMING OF SPAWNING

The numbers of ripe females during the 1989 spawning run peaked during the period between April 26 and May 8. This corresponds very closely to the period of peak spawning activity (April 27 to May 10) observed during 1988 (Shepard and Oswald 1989). Unfortunately, during 1989 the USGS gauge at Wisdom was not operated until May 1, 1989. This late start for gauge information prevented us from evaluating effects of flow and water temperature on grayling movement and spawning. MDFWP has alerted the USGS that we need to have the gauge begin operating April 1 of each year.

CHARACTERISTICS OF THE SPAWNING RUN

The sex ratio of grayling identified as mature, ripe, or spent was 1.6 males:1.0 female during 1989. Sex ratios for the Big Hole grayling spawning population in 1988 was 2.0 males:1.0 females (see last year's report [Shepard and Oswald 1989] for a comparison to other grayling populations).

The growth curve for grayling in the Big Hole system illustrates that the majority of growth occurs during their first two years (Figure 5). The presence of some juveniles in tributaries to the river and the interpretation of early growth from a few scales suggests that a small segment of the juvenile population may remain (rear) for up to two years in tributaries to the river. Growth of fish captured during the spring of 1989 was slower than for those captured during the spring of 1988. The drought of 1988 was probably a major factor which contributed to this reduced fish growth in the Big Hole River system.

The relatively strong 1986 year class (age 2 fish) that was seen in 1988 did not appear to carry over to 1989 which provides further evidence of the stress the 1988 drought put on the grayling population (Figure 4). Fortunately, it appears the grayling hatched out during 1988 (1988 year class) contributed to a relatively strong year class and experienced relatively high survival through their first year (Figure 4). We are unsure why

age II fish experienced poor survival, while age 0 fish experienced good survival, from the spring of 1988 to the spring of 1989. This differential survival between age 0 and age II fish warrants further investigation. We found the numbers of fish age two and older were very low and it appears that once the age 4 and older fish die, there will be few mature fish to spawn during 1990 and 1991.

DISTRIBUTION OF SPAWNING WITHIN THE DRAINAGE

The distribution of grayling spawning within the Big Hole drainage was similar in 1988 and 1989. Areas in the main stem above the North Fork of the Big Hole River and lower Swamp Creek were used for spawning. Sample electrofishing in the portion of the Big Hole River between Fishtrap Creek and the East Bench BLM access indicated that rainbow trout were utilizing spawning habitats where grayling were typically found in the Wisdom portion of the river. We speculate that rainbow spawners may compete with grayling spawners and have successfully excluded them from spawning sites in the lower portion of their range within the Big Hole.

MOVEMENT

The movement patterns observed through recaptures of tagged fish in the Big Hole suggests that a segment of the riverine Big Hole grayling population spends the winter in deep pools in the portion of the river down river from the Wisdom area as far as the Divide dam and perhaps in some tributaries with deep pools or areas of groundwater recharge. During the spring, some of the mature grayling from the lower river move up river and spawn in the portion of the river from the mouth of the North Fork up to immediately above Wisdom, and in the lower portions of Swamp, Steel, Big Lake, Rock, and Sand Hollow creeks.

From tag return data it is difficult to determine if the grayling population within the upper Big Hole River consists of one or more discrete stocks. It is apparent that some grayling in the Big Hole system move between the lower and upper river seasonally for spawning and, perhaps, to seek over winter habitat. Seasonal movement patterns indicate that some grayling adults move into spawning areas located in the upper river above the North Fork from the lower river near Fishtrap Creek. We are unsure if these fish move immediately down river after spawning, or if they remain in the upper river over the summer before moving back down during the fall. Past information indicated mature-sized grayling spent the entire summer within the upper portion of the drainage in the Wisdom area as documented by summer and fall electrofishing (Liknes 1978; Oswald 1984; Oswald 1986). There may be two discrete life-

history patterns followed by Big Hole River grayling. One segment of the population may move seasonally between the lower and upper river and one segment may remain in the upper and/or lower river year round.

Tag return evidence from one tagged fish also suggests that Big Hole River grayling use the lower portion of Swamp Creek for spawning. We infer from movement exhibited by this fish that it is likely that grayling populations in the lower portions of Steel, Swamp, Big, and Rock creeks are probably very similar, if not a direct subset, of the Big Hole River population. We believe it is likely that grayling populations within the lower portions of Big Hole River tributaries receive enough genetic transfer with Big Hole River grayling that grayling in these tributaries should be considered as members of the Big Hole River grayling population.

We are unsure of the status of isolated grayling populations inhabiting the upper portions of tributaries such as Mussigbrod Creek, upper Wise River, and Wyman and Bobcat creeks. We believe that these populations originated with outmigrants from lake populations, but are unsure how long they have been genetically isolated and the result of potential genetic isolation and adaption.

SPAWNING HABITAT CHARACTERISTICS

We found ripe Big Hole grayling over gravel that was very clean on the surface located in riffle areas in close proximity to pool or deep run habitats. This observation made in 1988 was further substantiated in 1989 by classifying substrate composition. Ripe grayling also appeared to seek areas where water velocities were faster and water was deeper than was generally available (Figures 6 and 7).

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