F-113-R-1
Region 3

THE FISHERY OF HYALITE RESERVOIR AND IMPACTS OF RAISING HYALITE DAM

By

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Introduction

Hyalite Reservoir is an irrigation storage impoundment on Hyalite Creek, located 14 miles south of Bozeman, MT. The Montana State Water Board began construction in of the dam in 1939, but construction was interrupted by World War II (Wells 1976). The reservoir was first filled in 1951 with the completion of the Hyalite (Middle) Creek Dam. In 1993, the dam was reconstructed raising full pool lake elevation 8.2 vertical feet. At full pool elevation of 6715 feet, the reservoir's surface area is approximately 260 acres. Summer and fall irrigation in the Gallatin Valley and municipal supply cause extreme fluctuations in pool elevation.

While westslope cutthroat trout (Oncorhyncus clarki lewisi) were the native trout species present before dam construction, pure westslope cutthroat trout are currently restricted to a tributary of Middle Creek below the dam (FWP 2000). Eastern brook trout (Salvelinus fontinalis) and rainbow trout (O. mykiss) were introduced in the Hyalite basin, as well as Yellowstone cutthroat trout (O. clarki clarki) (YCT). Wells (1976) reported rainbow-cutthroat trout hybrids in the reservoir. Brook trout still inhabit the reservoir, with YCT, which likely "genetically swamped" rainbow trout from above the dam. Montana Department of Fish and Game began planting YCT in 1953 and continues to the present. Whereas Wells (1976) documented YCT spawning in the tributaries of the reservoir, he did not detect recruitment of cutthroat fry. Zubick (1983) documented successful spawning and recruitment of YCT and recommended cessation of stocking.

Although no records were discovered in MFWP stocking databases, Arctic grayling (Thymallus arcticus) were presumably planted during the same time period as cutthroat trout. Emerald Lake, at the headwaters of the East Fork of Hyalite Creek, supports an Arctic grayling population. While no records exist, Emerald Lake was certainly stocked and is the probable original source of grayling to the reservoir. The current sport fishery is comprised mainly of YCT, Arctic grayling, and brook trout. A former state record Arctic grayling was caught in Hyalite Reservoir. The dam reconstruction and increased pool elevation flooded 80 to 90% of historical grayling spawning grounds in the West Fork of Hyalite Creek. The Montana Department of Natural Resources and Conservation (DNRC) constructed a new side channel to attempt to mitigate effects of lost spawning habitat.

Recent management efforts focused on maintaining satisfactory angler catch rates of YCT by supplementing the naturally reproducing population with McBride strain hatchery YCT. In addition, we are monitoring success of mitigation at protecting the grayling population in conjunction with the Gallatin National Forest.

Objectives

1. Assess reservoir level fluctuation and mitigation efforts' impacts on grayling reproduction,
2. Annually monitor (by spawning fish/redd counts and electrofishing) spring grayling and cutthroat trout spawning runs in East and West Forks of Hyalite Creek to assess natural reproduction,.
3. Periodically monitor fish populations by conducting fall gill netting surveys, and
4. Monitor fishery characteristics via statewide angler surveys and angler's logbooks.

Methods

To monitor the health and composition of trout and grayling populations in Hyalite Reservoir, we used a variety of surveys including spawning observations, electrofishing, and gill netting. In the East and West Forks of Hyalite Creek, pre-spawn and spawning Yellowstone cutthroat trout and Arctic grayling were enumerated by U.S Forest Service and Fish, Wildlife, and Parks (FWP) personnel walking along banks of the streams. In the West Fork, we observed the distribution of spawning grayling to determine the level of upstream pioneering achieved by spawners and to document the number of spawners using the mitigation channel. We surveyed the West Fork from the reservoir pool to Window Rock Bridge. In the East Fork, we surveyed the reach from pool elevation to a barrier near the Emerald Lake trailhead (Figure 1). Spawning activity, water temperatures, redd construction, and distribution were recorded. During spawning periods, backpack, mobile-anode, and jet-boom electrofishing gear were used to catch grayling and YCT. Traps were installed in the West Fork to capture spawners in 1993 and 1994. All fish captured were weighed, measured, and had scales samples taken for age analysis.

Hyalite Reservoir was sampled in October of 1994 and 1998 using 125' long by 6' deep experimental gill nets with a bar mesh range of 1 to 3 inches. Three surface sets and one bottom set were placed in standardized locations (Figure 1). Nets were fished overnight and pulled the following morning. Fish found alive were processed and released. All fish were identified to species, measured to nearest 0.1 inch, weighed to the nearest 0.01 lb., and examined for marks and hook scars. We collected scales for age analysis from YCT and grayling. All YCT were examined for external hatchery characteristics such as dorsal fin erosion.

To monitor characteristics of the Hyalite Reservoir fishery, we use results of two statewide surveys. One random sample mail survey is sent annually to 10,000 resident and non-resident fishing license holders. Participants were asked where they fished, number of days fished, and catch. Every odd year (i.e. 1995, 1997) pressure estimates are formulated for each FWP water code (McFarland and Meredith 2000). Another source of information on the fishery is the Fisherman's Log program, in which volunteers record their angling experiences in logbooks provided by FWP.

Results

Yellowstone Cutthroat Trout

Yellowstone cutthroat trout are the mainstay of the Hyalite Reservoir fishery. Fisherman's Logs from 1994 to 1997 indicated that YCT comprised 78 – 89% of the catch, followed by grayling (3-9%) and brook trout (2-7%) (FWP files). Angling pressure increased significantly from 1995 to 1997, doubling in pressure, but declined slightly by 1999 (McFarland and Hughes 1996, McFarland and Meredith 1998, McFarland and Meredith 2000) (Table 1).

Since 1953, FWP has stocked nearly 1 million YCT into Hyalite Reservoir to maintain the fishery. Approximately 30,000 fry per year have been stocked since the mid -1970's (Appendix A), based on the presumption that enhancement was necessary to sustain the fishery. While Wells (1976) did not document natural

reproduction by YCT, Zubik (1983) documented substantial reproduction by 1982 and recommended cessation of stocking. A significant natural spawning run and fry recruitment still occurs in both forks of Hyalite Creek.

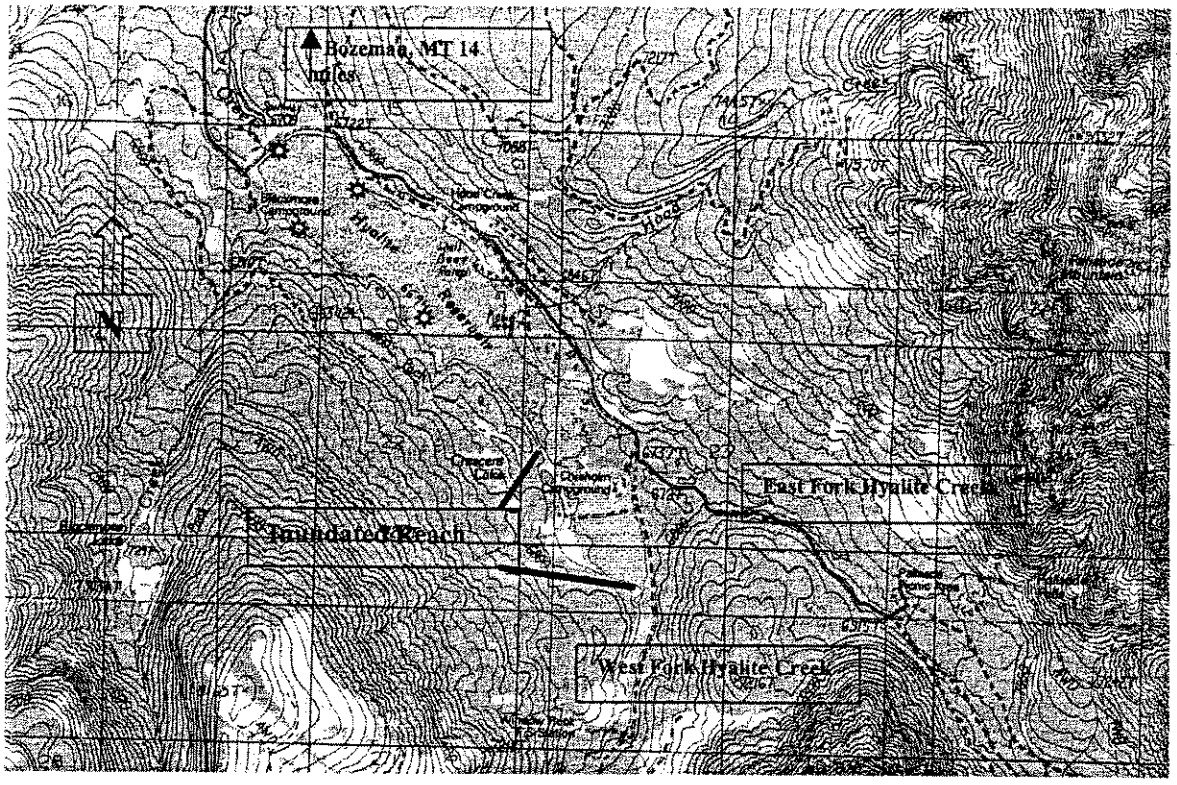

Figure 1. Map of Hyalite Reservoir. Stars indicate gill net sites and scale is approximately 1 inch = 0.5 miles.

Table 1. Estimated fishing pressure at Hyalite Reservoir, 1995 – 1999, based on biennial statewide mail surveys McFarland and Hughes 1996, McFarland and Meredith 1998 and 2000).

YEAR	Angling Pressure (angler-days)			Statewide Rank	Region 3 Rank
	Total	Resident	Non-resident		
1995	6847	5801	1046	75	19
1997	13319	11711	1608	48	15
1999	10138	9075	1063	71	20

Spawning runs have been monitored intermittently since 1975. Yellowstone cutthroat trout have been observed to initiate spawning when water temperatures reach 3°C. Over the years, YCT spawners entered the West Fork as early as May 11 (1998) and as late as June 10 (1982), with a median date of May 28. Spawning peaked as

early as June 2 (1996) and as late as June 26 (1982), with a median peak spawning date of June 12. While spawner counts have focused on grayling, we have counted YCT spawners intermittently since 1995 (Table 2). In 1995 and 1996, YCT spawner counts were incomplete. However, a decline in spawner numbers per observation occurred, from 56 per day in 1995 to only 4.3 per day in 1996. However, on June 2, 1996 observers recorded "many YCT" but did not count them. By 1997, an average of 45.5 per day was counted. Yellowstone cutthroat trout spawner numbers increased to present: 112 per day in 1998, 155 per day in 1999, and 182 per day in 2000. The YCT population has apparently been able to compensate for the impact of increased lake elevations on loss of spawning habitat. Daily spawning observations are listed in Appendix B.

Table 2. Numbers of Yellowstone cutthroat trout (YCT) observed during spawner counts in the West Fork Hyalite Creek, 1995 – 2000, * indicates years of incomplete surveys.

Year	Number of Surveys	Number YCT Observed	Number YCT Per Survey	Peak Spawning Date
1995	8	224	56*	June 12*
1996	4	13	4.3*	*
1997	8	364	45.5	June 23
1998	17	1905	112	May 28
1999	11	1704	155	June 11
2000	9	1640	182	June 2

In 1999, YCT were captured during an electrofishing survey of the grayling spawning run. While the YCT spawning was nearly over, we captured 12 YCT ranging from 13.5 to 18.9 inches long , averaging 16.3 inches and 1.39 pounds. Sampling the spawning run obviously excludes juvenile and immature YCT. This is illustrated in the night electrofishing catch of 6/17/99, when we captured 97 YCT, mean length of 15.5 inches and ranging from 9.0 to 18.9 inches long.

Gill netting in 1994 and 1998 indicate a fairly stable YCT population in Hyalite Reservoir. In 1994, a total of 73 YCT were captured ranging in length from 8.3 to 20.8 inches and weighing 0.23 to 3.85 pounds. Mean length was 12.2 inches and average weight was 0.82 pounds. Catch per effort was 18.3 YCT per net in floaters and 18.0 YCT per net in the sinking net. In 1998, the catch was 58 YCT, 15 YCT per net in floaters and 14 in the sinking net. Length of YCT captured averaged 11.5 inches, ranging from 6.8 to 18.7 inches. YCT weighed 0.12 to 2.5 pounds with a mean of 0.71 pounds. While catch rates declined, average size decreased as well. The length-frequency distribution of gill net catches shifted to smaller sized YCT, although the total number of YCT over 15 inches long remained consistent between 1994 and 1998 (Figure 2).

Generally, the YCT population of Hyalite Reservoir appears to be stable to increasing. While spawner counts indicate a temporary decline in response to inundation of spawning grounds, recent surveys suggest a strong spawning run in recent years. Annual supplementation with hatchery fish will ensure that the fishery is well supported. However, natural reproduction may be sufficient to maintain a healthy population. During 1998 gill netting surveys, 16 of 58 YCT (27.6%) were identified as having dorsal fin erosion characteristic of hatchery fish. In 1999 electrofishing surveys 8 of 99 (8%) were classified as hatchery fish. Thus, a majority of fish in the population is apparently of natural origin.

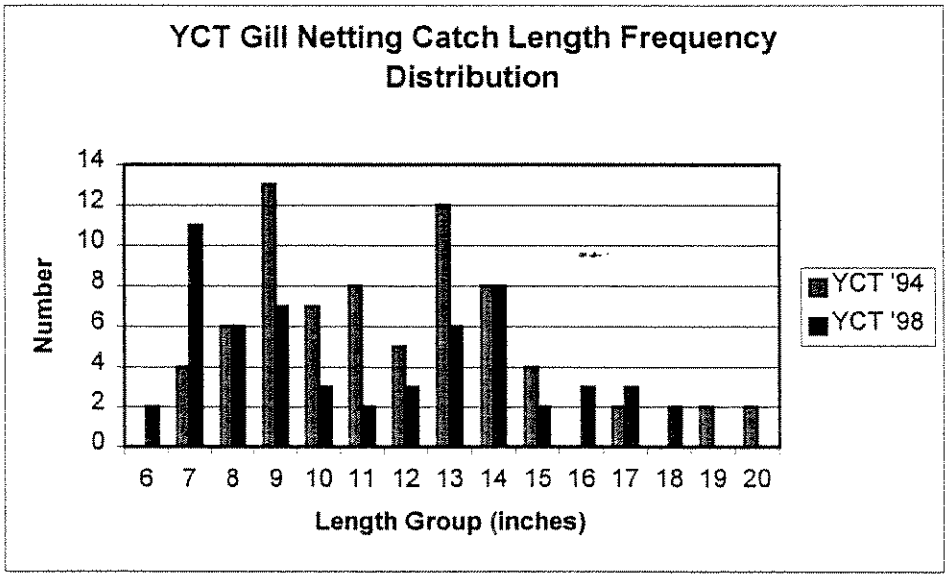

Figure 2. Length frequency distribution of Yellowstone cutthroat trout captured in gill nets at Hyalite Reservoir, Montana, 1994 and 1998.

Arctic Grayling

The origin of the Arctic grayling population of Hyalite Reservoir is unknown, although they were native to the Gallatin drainage. Anglers caught Arctic grayling in the area as early as 1952 (FWP Files). Due to concern over inundation of spawning grounds by dam rehabilitation, spawning surveys were conducted through the 1990's. The number of spawning grayling observed per survey declined significantly after the reservoir reached new pool elevation in 1994 (Table 3). Spawner counts averaged 70 per survey between 1986 and 1994, ranging from 34 to 152 per survey. A single night of fry trapping in July 1994 captured over 2200 grayling fry, evidence of substantial spawning success. In 1996, spawner counts dropped to a low of 0 in 9 surveys. Subsequent surveys have observed an increase between 1998 and 2000. Surveys of the East Fork Hyalite Creek were done less frequently, but 90 graying were observed in 1994, 7 in 1998, 92 in 1999, and 16 in 2000. Wells (1976) captured only 1 grayling in six surveys of the East Fork in 1975.

Inundation of historic spawning grounds in the West Fork apparently disrupted grayling spawning for a period of 3 years. Since 1994, spawning grayling have been observed as far upstream as Window Rock bridge in

the West Fork of Hyalite Creek and in the East Fork of Hyalite Creek upstream as far as the Emerald Lake trailhead. A side channel was constructed in the West Fork Hyalite Creek to mitigate for the loss of spawning habitat by increasing the reservoir levels. In 1994, 32 grayling were observed in the side channel or near vicinity. However, only a few grayling have entered the channel since: 3 in 1998 and 2 in 1999. The side channel does not apparently provide habitat suitable for graying spawning. Yellowstone cutthroat trout have been observed in the side channel: 261 in 1994, which declined to 61 in 2000. Only a few redds have been observed in the mitigation side channel. The channel has been impacted by gravel and debris deposits at its inlet and a beaver dam at its outlet.

Table 3. Numbers of Arctic grayling observed during spawner counts in the West Fork Hyalite Creek, 1986, 1989 – 2000, * indicates years of incomplete surveys.

Year	Number of Surveys	Number Grayling Observed	Number Grayling Per Survey	Peak Spawning Date
1986	1	152	152	June 16
1989	*	85	*	*
1990	3	180	60	June 26
1991	1	50	50	June 26
1992	2	154	77	June 10
1993	16	555	34	June 21
1994	20	945	47	June 6
1995	1	9	9	June 29
1996	4	0	0	*
1997	8	5	0.6	June 23
1998	17	457	39	June 22
1999	6	203	33	June 24
2000	9	130	14.4	June 13 – 19

Growth and age composition of the grayling population was characterized from scale samples collected by trapping, netting and electrofishing. Grayling grow rapidly in Hyalite Reservoir, reaching 16.0 inches by age 4 (Figure 3). This growth pattern is typical of Arctic grayling in Montana (Brown 1943). This pattern of growth makes it difficult to assess age by length alone, necessitating scale analysis to determine age composition of the population. Figure 4 illustrates age composition of the spawning grayling population derived from sampling in the

West Fork Hyalite Creek and Hyalite Reservoir. Typically a majority of grayling are sexually mature by Age 3. Spawning grayling in 1975 and 1990 were predominately Age 3 spawners, with a smaller component of Age 4 and older grayling, a typical spawning population. However, since 1991 the spawning population has been predominated by a single year class of grayling, either 4 or 5 years old, suggesting intermittent spawning success and an imbalanced spawning population. This tends to put a population at risk of extinction if more than one successive year class has poor recruitment.

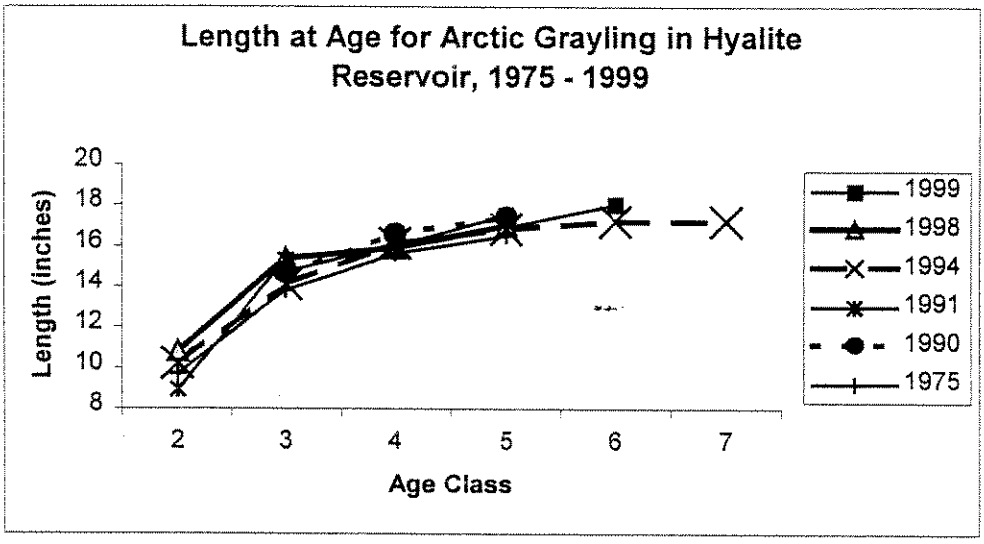

Figure 3. Length at age of Arctic grayling in Hyalite Reservoir, Montana, 1975 to 1999.

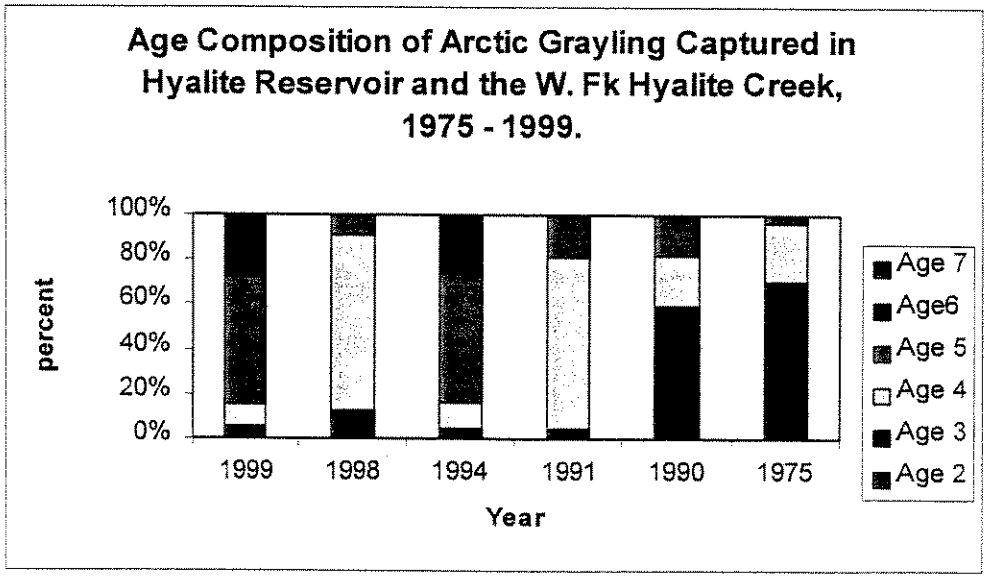

Figure 4. Age composition of Arctic grayling captured in Hyalite Reservoir and the West Fork of Hyalite Creek, 1975 to 1999.

Few grayling and brook trout were caught in 1994 and 1998 gill net series. Gill net catches are summarized in Figure 5. Only 2 grayling were gill netted, one 10.7 inches and another 14.0 inches long. Brook trout were caught in low numbers reflecting their low numbers in the reservoir. Fewer brook trout were caught in 1998 than in 1994. Gill netting is not an adequate sampling method to characterize the brook trout and grayling populations.

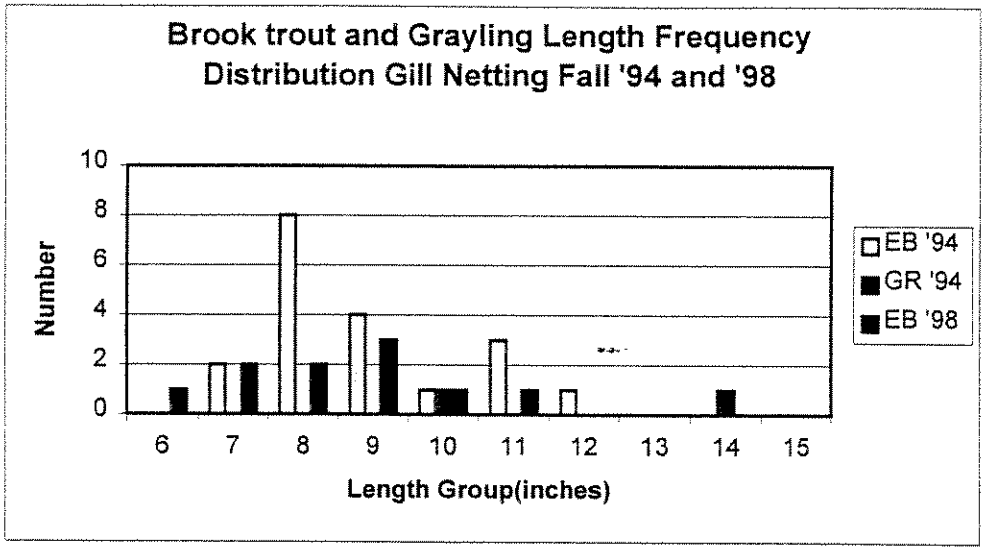

Figure 5. Length frequency distribution of brook trout and Arctic grayling captured in gill nets at Hyalite Reservoir, 1994 and 1998.

Discussion

The fishery at Hyalite Reservoir continues to provide excellent angling opportunities to residents and visitors to the Gallatin Valley. The fishery is supported by Yellowstone cutthroat trout, which reproduce naturally and are supplemented with annual plants. Fishing pressure at Hyalite reservoir increased through the 1990's, but appeared to stabilize by 1999.

Raising Hyalite Dam in 1993 inundated historic spawning habitats for YCT and grayling in West Fork Hyalite Creek. This action appears to have disrupted spawning of both species for a period of several years. However, the YCT population appears to have adjusted well and is stable as indicated by spawner counts and gill netting. Supplementation by annual plants of 30,000 YCT contributes approximately 8 to 25% to the population. Zubick (1983) questioned the necessity of stocking to support the fishery. Indeed, planting YCT may be unnecessary to support the fishery and could be detrimental to wild fish, but more information is necessary to determine the impacts and benefits of hatchery supplementation. Gill netting is a useful tool for assessing the health and composition of the YCT population, although it has limited utility for assessing grayling and brook trout populations. Gill net sets should be repeated every 2 to 3 years.

Inundation of historic spawning grounds had a much more significant impact on the grayling population. Within 3 years of reaching the new full pool elevation, the number of spawning grayling observed in the West Fork declined to near zero. In recent years, a substantial spawning run has reappeared, although not to historic levels. Grayling have been observed up to 1 km upstream of the new mouth of the West Fork. Fernet (1986) did not observe any grayling spawning outside of the newly inundated reach. Thus, grayling have pioneered into new spawning habitats to compensate for lost historic spawning grounds. Similarly, more grayling have been observed in the East Fork of Hyalite Creek in recent years. Wells (1976) reported finding only 1 grayling in the East Fork in 6 electrofishing surveys.

While the grayling population has expanded its spawning range, reproductive success is very inconsistent. The age composition of the population demonstrates that in any given year a single age class dominates the population, with very few juvenile grayling being captured. This composition tends to leave the grayling population highly susceptible to catastrophic events. For example: two poor year classes in a row could severely depress the population. This may be due to flow limitations that change year to year, or other abiotic factors impacting spawning success. It appears that typical grayling spawning habitat as described by Fernet (1986) is limited up to Window Rock Bridge. A lack of woody debris and other large obstructions that promote scour and fresh deposition of gravel may be limiting grayling success. Introduction of coarse wood or rock elements into the channel may improve spawning success in the West Fork by providing more spawning sites less susceptible to runoff. The side channel constructed to mitigate for inundated spawning habitat is not being used by grayling for spawning. Other forms of mitigation are necessary to ensure the long-term persistence of this grayling population. A comprehensive study of grayling spawning life history and ecology would be useful in guiding future actions.

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APPENDIX A

Fish Planting History in Hyalite Reservoir 1953 – 1999.

Montana Fish Wildlife and Parks

Fish Planting Report

Query:

Water Codes: 098512

Date	Water	Species	Strn	Number	Length	Weight	Marks	Tmp	R	County	Location
08/26/53	HYALITE RESERVOIR	CUTTHROAT TROUT		33270	1.0	40.00			3	GALLATIN	04S06E00
09/10/53	HYALITE RESERVOIR	CUTTHROAT TROUT		16767	1.0	20.00			3	GALLATIN	04S06E00
09/27/61	HYALITE RESERVOIR	CUTTHROAT TROUT		86000	2.0	219.00			3	GALLATIN	04S06E00
09/19/62	HYALITE RSSERVOIR	CUTTHROAT TROUT		67112	2.0	285.00			3	GALLATIN	04S06E15
09/16/63	HYALITE RESERVOIR	CUTTHROAT TROUT		45436	2.0	148.00			3	GALLATIN	04S06E15
09/08/64	HYALITE RESERVOIR	CUTTHROAT TROUT		40718	2.0	260.00			3	GALLATIN	04S06E00
08/30/67	HYALITE RESERVOIR	CUTTHROAT YLST		3000	3.0	60.00			3	GALLATIN	04S06E15
09/12/68	HYALITE RESERVOIR	CUTTHROAT TROUT		9750	4.0	325.00			3	GALLATIN	04S06E14
11/12/68	HYALITE RSSERVOIR	CUTTHROAT YLST		3400	5.0	200.00			3	GALLATIN	04S06E15
09/23/69	HYALITE RESERVOIR	CUTTHROAT YLST		5012	5.0	179.00			3	GALLATIN	04S06E15
10/06/69	HYALITE RESERVOIR	CUTTHROAT YLST		5030	5.0	190.00			3	GALLATIN	04S06E15
10/14/70	HYALITE RESERVOIR	CUTTHROAT YLST		10030	5.0	590.00			3	GALLATIN	04S06E15
07/27/71	HYALITE RESERVOIR	CUTTHROAT YLST		10175	4.0	185.00			3	GALLATIN	04S06E15
09/06/72	HYALITE RESERVOIR	CUTTHROAT YLST		4948	4.0	156.00			3	GALLATIN	04S06E15
09/06/72	HYALITE RESERVOIR	CUTTHROAT YLST		5012	4.0	179.00			3	GALLATIN	04S06E15
06/12/73	HYALITE RESERVOIR	CUTTHROAT YLST		5000	10.0	2000.00			3	GALLATIN	04S06E05
06/29/76	HYALITE RESERVOIR	CUTTHROAT YLST	M	20070	2.0	45.00			3	GALLATIN	04S06E15
08/26/77	HYALITE RESERVOIR	CUTTHROAT YLST	M	19834	3.0	131.00			3	GALLATIN	04S06E15
08/29/78	HYALITE RESERVOIR	CUTTHROAT YLST	M	19534	3.0	98.00			3	GALLATIN	04S06E15
09/04/79	HYALITE RESERVOIR	CUTTHROAT YLST	M	21006	2.0	117.00			3	GALLATIN	04S06E15
07/23/80	HYALITE RESERVOIR	CUTTHROAT YLST	M	21269	2.0	88.00			3	GALLATIN	04S06E15
08/18/81	HYALITE RESERVOIR	CUTTHROAT YLST	M	22178	2.0	128.00			3	GALLATIN	04S06E15
09/26/83	HYALITE RESERVOIR	CUTTHROAT YLST	M	21328	3.0	172.00			3	GALLATIN	04S06E15
10/02/84	HYALITE RESERVOIR	CUTTHROAT YLST	M	30047	3.0	284.00			3	GALLATIN	04S06E15
08/28/85	HYALITE RESERVOIR	CUTTHROAT YLST	M	25116	3.0	182.00			3	GALLATIN	04S06E15
09/10/87	HYALITE RESERVOIR	CUTTHROAT YLST	M	27015	2.1	89.60			3	GALLATIN	04S06E15
10/04/88	HYALITE RESERVOIR	CUTTHROAT YLST	M	12432	1.9	27.20	None	56	3	GALLATIN	04S06E15
10/04/88	HYALITE RESERVOIR	CUTTHROAT YLST	M	31789	1.7	516.90	none	56	3	GALLATIN	04S06E15
09/25/90	HYALITE RESERVOIR	CUTTHROAT YLST	M	35145	2.0	98.00	TET	58	3	GALLATIN	04S06E15
09/10/91	HYALITE RESERVOIR	CUTTHROAT YLST	M	30236	2.7	210.95	TET	65	3	GALLATIN	04S06E15
09/15/92	HYALITE RESERVOIR	CUTTHROAT YLST	M	23644	2.5	123.77	TET	54	3	GALLATIN	04S06E15
09/15/92	HYALITE RESERVOIR	CUTTHROAT YLST	M	6356	2.6	38.90	TET	54	3	GALLATIN	04S06E15
09/07/93	HYALITE RESERVOIR	CUTTHROAT YLST	M	30000	2.7	208.10	TS	56	3	GALLATIN	04S06E15
07/07/94	HYALITE RESERVOIR	CUTTHROAT YLST	M	28805	2.0	74.60	TS	59	3	GALLATIN	04S06E15
07/07/94	HYALITE RESERVOIR	CUTTHROAT YLST	M	1195	2.0	3.29	TS	59	3	GALLATIN	04S06E15
07/28/94	HYALITE RESERVOIR	CUTTHROAT YLST	M	425	6.0	40.00			3	GALLATIN	04S06E15
09/12/95	HYALITE RESERVOIR	CUTTHROAT YLST	M	21354	2.0	55.10	TS	0	3	GALLATIN	04S06E15

Montana Fish Wildlife and Parks

Fish Planting Report

Date	Water	Species	Strn	Number	Length	Weight	Marks	Tmp	R	County	Location
09/12/95	HYALITE RESERVOIR	CUTTHROAT YLST	M	8646	2.6	50.80	TS	0	3	GALLATIN	04S06E15
09/18/96	HYALITE RESERVOIR	CUTTHROAT YLST	M	30000	2.5	153.00	TS	0	3	GALLATIN	4S6E15
09/17/97	HYALITE RESERVOIR	CUTTHROAT YLST	M	30000	2.6	186.60	TS	0	3	GALLATIN	04S06E15
09/18/98	HYALITE RESERVOIR	CUTTHROAT YLST	M	17540	3.0	162.18	TS	0	3	GALLATIN	04S06E15
09/18/98	HYALITE RESERVOIR	CUTTHROAT YLST	M	12460	2.2	45.97	TS	0	3	GALLATIN	04S06E15
09/15/99	HYALITE RESERVOIR	CUTTHROAT YLST	M	31500	2.6	198.90	TS	0	3	GALLATIN	04S06E15
	Report Total:			929584		8664.86					

Cold Water Summaries:	Fry(0-2")	Fingerling(2-8")	Catchables(8"+)	Total Fish	Weight	Distribution Cost
CUTTHROAT TROUT :	50037	249016	0	299053	1297	0.00
CUTTHROAT YLST :	44221	581310	5000	630531	7368	544.55

APPENDIX B.

Daily Arctic Grayling and Yellowstone Cutthroat Trout Spawning Observations in the West Fork Hyalite Creek 1995-1999.

DATE	YCT	GR	COMMENTS
5/30/95	NC	0	MANY YCT
6/5/95	NC	0	MANY YCT
6/8/95	NC	0	
6/12/95	80	0	
6/16/95	29	0	POOR VIS
6/20/95	36	1	
6/21/95	79	0	
6/24/95	NC	8	
1995 TOTALS	224	9	NO GR RUN OBSERVED
5/15/96	0	0	
5/20/96	1	0	
5/28/96	12	0	
6/2/96	NC	0	MANY YCT
1996 TOTALS	13	0	INCOMPLETE
5/27/97	9	0	POOR VIS
6/9/97	74	0	
6/16/97	53	0	
6/19/97	96	0	
6/23/97	131	5	
6/30/97	7	0	
7/7/97	1	0	
7/9/97	0	0	
1997 TOTALS	364	5	NO GR RUN OBSERVED
5/16/98	11	0	
5/19/98	9	0	
5/20/98	109	0	
5/22/98	141	32	
5/26/98	353	0	
5/28/98	438	0	
6/3/98	17	0	POOR VIS
6/4/98	320	0	
6/11/98	274	16	
6/15/98	92	66	
6/16/98	43	42	
6/20/98	16	39	
6/22/98	19	108	
6/24/98	30	82	POOR VIS
6/26/98	1	9	POOR VIS
6/29/98	22	27	
7/1/98	10	36	POOR VIS
1998 TOTALS	1905	457	

Appendix B. Continued

DATE	YCT	GR	COMMENTS
6/4/99	265	0	
6/8/99	318	0	
6/11/99	429	0	
6/14/99	282	0	
6/15/99	85	0	
6/16/99	138	17	
6/18/99	40	14	
6/21/99	59	43	
6/24/99	71	87	
7/2/99	12	28	
7/6/99	5	14	
1999 TOTALS	1704	200	
5/16/00	205	0	
5/22/00	90	0	
5/26/00	117	0	
5/30/00	335	0	
6/2/00	584	0	
6/6/00	28	0	
6/13/00	223	61	
6/19	55	61	
6/27	3	8	
2000 TOTALS	1640	130	

NC – NO COUNT

PEAK SPAWNING PERIODS BY OBSERVATION

YEAR	YCT	GR
1995	6/12	NO RUN OBSERVED
1996	UNKNOWN	UNKNOWN
1997	6/23	NO RUN OBSERVED
1998	5/28	6/22
1999	6/11	6/24
2000	6/2	6/19

NUMBER OF FISH COUNTED AT PEAK PERIOD

YEAR	YCT	GR
1995	80	NA
1996	NA	NA
1997	131	NA
1998	438	108
1999	429	87
2000	584	61