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TRAPPER CREEK FISH PASSAGE AND SPAWNING ENHANCEMENT PROJECT AN INTERIM REPORT

PREPARED FOR

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AND

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January 18, 1993

Montana Fish, Wildlife & Parks

MEMORANDUM

TO: Karen Dimmitt

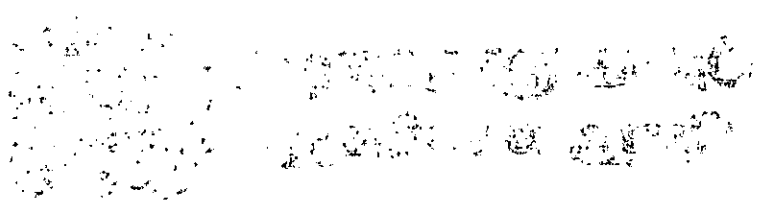
FROM: Pat Byorth

DATE: December 17, 2001

RE: Hebgen Reports

I recently obtained copies of some reports by Nick Hetrick regarding Hebgen Reservoir and tributaries. I did not have copies of these in my files, so I had some extras made. I thought perhaps we should ensure that these reports were in the Fisheries Division Library. Would you please record them and place them in the library? Thanks.

Add to library



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ABSTRACT

The Montana Department of Fish, Wildlife and Parks has established a wild trout management program for Hebgen Lake. The goal of the program is to maintain a self-sustaining population of wild rainbow trout that would eventually lead to increased size and higher catch rates. To achieve this goal, the Department, in cooperation with the U. S. Forest Service, has initiated an inventory of physical habitat conditions for the various tributary streams in the Hebgen Lake basin. Based on these data, sites are being identified where enhancement activities could increase the abundance and availability of spawning and post-emergent habitat for wild rainbow trout. Trapper Creek, a small tributary located on the west side of Hebgen Lake, is one of the streams that has been targeted for enhancement.

The Trapper Creek Fish Passage and Spawning Enhancement Project was initiated to eliminate fish passage barriers and to increase the abundance of high quality spawning habitat for wild rainbow trout in the Trapper Creek basin. To improve fish passage conditions, 7 log structures and approximately 32 rock structures were constructed within the lower 1.20 mi reach of Trapper Creek during the summer 1992. In addition, a removable baffle structure was installed in a 6 ft diameter squash culvert located 0.61 mi upstream from Hebgen Lake. Also during the summer 1992, 6 log structures were constructed at 2 spawning enhancement sites and were backed with approximately 6 yd^3 of washed, round spawning gravels. At one of the sites, a deteriorating sod-covered log bridge was removed to protect the stream from sediment degradation in the event that the bridge collapsed.

Completion of the 2 spawning enhancement sites and numerous fish passage structures during 1992 resulted in a 49 % increase in the availability of spawning habitat in the Trapper Creek basin. Four additional spawning enhancement sites are scheduled for completion during the summer 1993 which will increase the availability of spawning habitat by an additional 25 % or 60 % over the pre-project level.

ACKNOWLEDGMENTS

Success of the Trapper Creek Fish Passage and Spawning Enhancement Project is primarily due to the cooperative efforts between the Montana Department of Fish, Wildlife and Parks and the U.S. Forest Service. Claude Coffin of the Hebgen Lake Ranger District, Bruce May of the Gallatin National Forest Supervisors Office, and Dick Vincent of the Montana Department of Fish, Wildlife and Parks provided technical advise and financial support for the project. Dan Trochta and Ron Nabor and crew of the Hebgen Lake Ranger District and Jody Hupka of the Montana Department of Fish, Wildlife and Parks were largely responsible for successfully installing structures at the project site.

INTRODUCTION

Management of the trout fishery in Hebgen Lake has evolved considerably over the past several decades. During the period extending from 1954-1979, the Montana Department of Fish, Wildlife and Parks was actively involved in an annual stocking program of catchable and subcatchable domestic rainbow trout. In 1979, the Department changed its management philosophy for Hebgen Lake with the goal of establishing a self-sustaining population of wild trout. The past stocking program was altered because of poor catch rates, low numbers of rainbow trout in gill net catches, the inability of the domesticated strains of rainbow trout to successfully spawn in tributary streams, and their slow growth rates.

To achieve this management goal, the Department in cooperation with the U.S. Forest Service, initiated an active program to inventory physical habitat conditions and fish populations in the numerous tributary streams of Hebgen Lake. Based on these inventory data, streams are being identified where the abundance and availability of spawning and post-emergent habitat could be enhanced in an effort to increase recruitment of wild rainbow trout into Hebgen Lake. Trapper Creek, located on the west side of Hebgen Lake, was one such stream. In this report, the current physical and biological conditions of Trapper Creek are described in conjunction with enhancement activities planned for their improvement.

Prior to 1991, surveys of fish populations and fish habitat within the Trapper Creek drainage basin of the Gallatin National Forest have been cursory. Based on these preliminary data, biologists from the Montana Department of Fish, Wildlife, and Parks and the U.S. Forest Service identified three potential problems which may limit Trapper Creek's contribution to the total production of wild trout fry within the Hebgen Lake system:

- A culvert located at river mile (RM) 0.61 blocks upstream migration of spawning salmonids.

- A deteriorating, sod-covered log bridge spans Trapper Creek at RM 1.05. The log infrastructure of the bridge has deteriorated considerably over the years, causing concern that when it collapses it will dump the soils covering the bridge and the adjacent streambanks into the stream channel. Such an input of fine sediments into the stream may pose a serious threat to fish as it fills interstitial spaces in the substrata used by juvenile fish and macroinvertebrates (Everest et al. 1987) and decreases gravel permeability, a critical factor in determining the success of salmonid embryo survival (Everest et al. 1987; Lisle 1989).

- Abundance of suitable spawning gravels may be the limiting factor regulating fry production downstream of the culvert. This may also be true upstream of the culvert barrier if fish passage were provided.

In developing a plan to eliminate these potential problems, a detailed survey of fish populations, physical habitat, and fish passage barriers was conducted on Trapper Creek and its primary tributary stream, the West Fork of Trapper Creek. Based on these survey data, a three-phased plan was developed to correct each of the problems mentioned above. Phases I and II of the plan involved providing fish passage through the culvert and removal of the log bridge, respectively. This work was completed during August and September, 1992. Phase III of the project is ongoing and entails constructing high quality spawning sites dispersed throughout the lower 1 mi reach of Trapper Creek. Phase III was initiated during September of 1992 and will be completed in August of 1993.

POTENTIAL BENEFITS OF PROJECT

Completion of the Trapper Creek Fish Passage and Spawning Enhancement Project will increase the availability of spawning habitat in the Trapper Creek Basin through a combination of providing access to existing spawning areas and creation of additional spawning sites. The goal of these efforts is to increase the production of wild trout fry within the Hebgen Lake system. This project has an additional benefit in that it will prompt permanent closure of the spur road and non-developed campsite which are adjacent to the deteriorating log bridge. This closure is significant as the project area is located within the Grizzly Bear Recovery Zone.

RELATIONSHIP TO FOREST PLAN

This project is consistent with Forest Plan goal for the Gallatin National Forest in that it will:

1) "maintain and enhance fish habitat to provide for an increased fish population" (Gallatin National Forest Plan, Section II A 6)

2) contribute to providing "sufficient habitat for recovered populations of threatened and endangered species" (grizzly bear) (Gallatin National Forest Plan, Section II A 8).

DESCRIPTION OF STUDY SITE

Trapper Creek is located approximately 16 mi northwest of West Yellowstone, Montana (11S; R3E; SEC 35). The Trapper Creek Fish Passage and Spawning Enhancement Project site encompasses the lower 1.05 mi reach of Trapper Creek, a second to third order tributary stream of Hebgen Lake (Figure 1). Like many of the tributary streams in the Hebgen Lake basin, Trapper Creek is used primarily for spawning by spring-run rainbow trout (*Oncorhynchus mykiss*) and hybridized cutthroat trout (*O. sp.*). An upstream adult fish trap operated by the Montana Department of Fish, Wildlife and Parks during the spring of 1989 found spring-run rainbow trout to be the primary species spawning in Trapper Creek although a remnant run of hybridized cutthroat trout was also present (Fredenberg 1991; unpublished data).

Trapper Creek exhibits the latest outmigration of rainbow trout fry of any of Hebgen Lake's tributary streams that have been sampled. Based on this observation and the extremely low, average daily water temperatures of Trapper Creek (Fredenburg, 1991), I speculate that development of salmonid embryos in Trapper Creek is a relatively slow process. Rainbow trout fry emerge from the gravels of Trapper Creek in August with the peak outmigration to Hebgen Lake occurring in late August. This peak outmigration of fry from Trapper Creek occurs approximately 7 weeks after the peak outmigration of fry from Duck Creek, yet the timing of the spawning runs in the two streams overlap considerably (Fredenburg 1991).

Total production of salmonid fry in Trapper Creek for the period extending from August 1 - August 29, 1991 was estimated to be 44,070 fish or approximately 7 % of the basin-wide total, excluding production in the Madison River (Fredenburg, 1991). A significant point is that this fry production can be attributed to the lower 0.61 mi reach of Trapper Creek as the culvert barrier blocks upstream passage of adult salmonids beyond this point. Based on these fry production data, elimination of the culvert as a fish passage

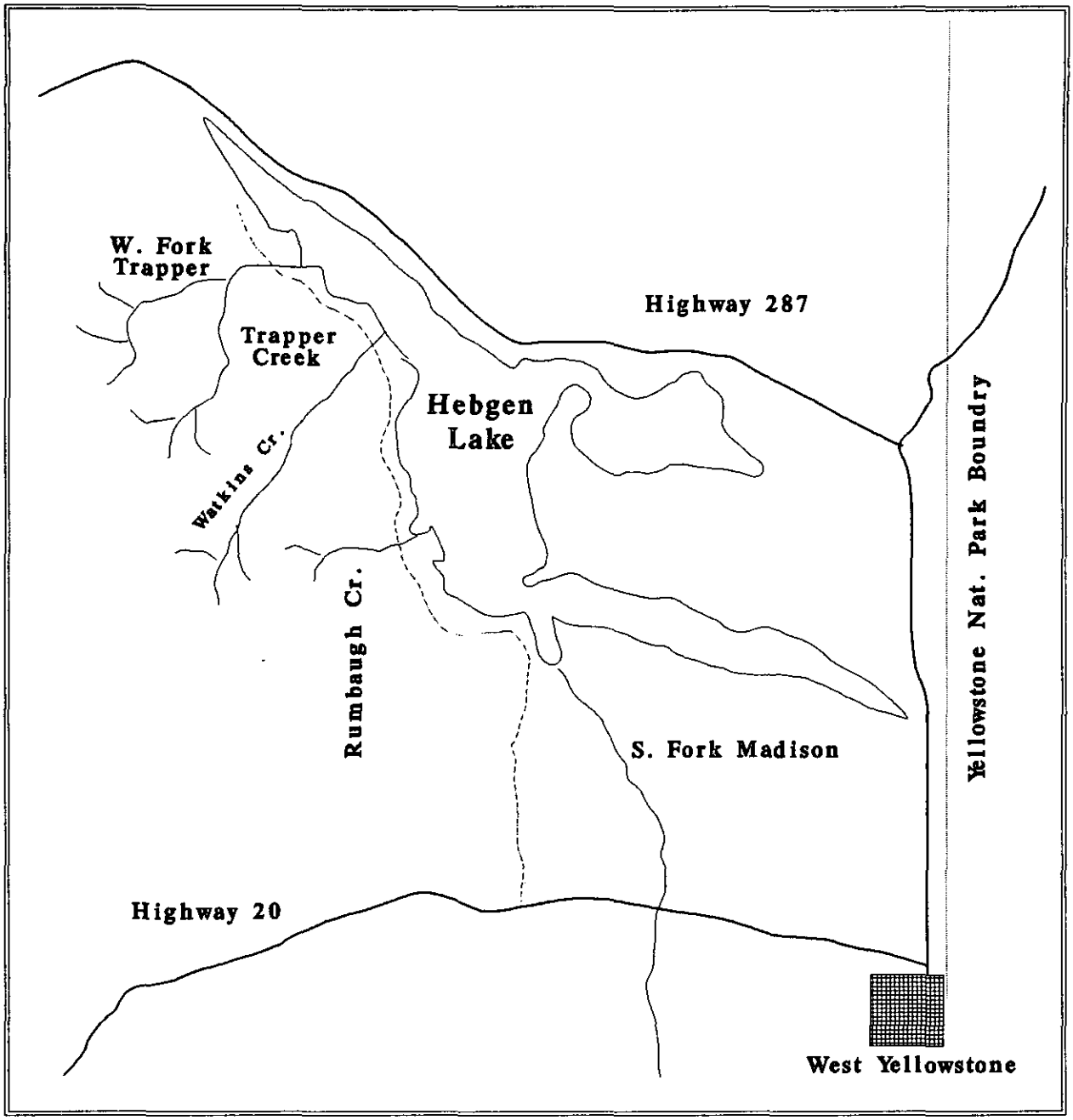

Figure 1. Location of the Trapper Creek Fish Passage and Spawning Enhancement Project site.

barrier and removal of the log bridge to protect critical spawning areas was considered a worthwhile goal as a small expenditure of time and money could potentially yield a significant increase in spawning habitat. Providing fish passage beyond the culvert barrier would also provide access to spawning areas located in the West Fork of Trapper Creek, which flows into main Trapper Creek at approximately river mi (RM) 0.70.

To justify the expense of correcting the fish passage problem at the culvert, it was first deemed necessary to conduct a detailed habitat survey of main Trapper Creek and the West Fork of Trapper Creek. The survey was completed to answer three basic questions:

- Does sufficient spawning habitat occur upstream of the culvert to justify providing fish passage?
- Do other barriers exist upstream or downstream of the culvert that have not been identified?
- Is spawning habitat limited in abundance and/or quality and if so, are there sites present where enhancement or creation of additional spawning habitat is feasible?

ANALYSIS OF EXISTING CONDITIONS

METHODS

Fish Population Survey

A survey of the fish populations upstream and downstream of the culvert barrier on Trapper Creek was conducted in October of 1991 using standard electrofishing techniques. For each reach, 1,000 ft sample sections were measured, flagged and blocked at the downstream end using a nylon net. Two passes with a gasoline powered, DC backpack electroshocker were made down each section with the fish retained separately for each pass. Captured fish were then anesthetized and fork length (nearest mm) and weights (nearest g) were measured and scale samples collected for aging (Appendix A). Following the survey, all fish were returned back into the section where they were collected. Maximum likelihood estimates of population size and 95 % confidence intervals were generated for each section based on the two-pass removal method using MICROFISH computer software described by VanDeventer and Platts (1986).

Physical Habitat Survey

Habitat surveys were conducted in the Trapper Creek basin during periods of low flow in 1991 and 1992 using a modified version of the methodology developed by Hankin and Reeves (1988). Parameters sampled that are of special interest with regard to this enhancement project include location and type of barriers and quality and distribution of spawning sites (Appendix B). Information on other parameters that were sampled in the survey such as habitat types and their relative abundance, cover types and abundance, pool types and their formative features, etc. have yet to be analyzed and as such, will be presented at a later date.

The survey of main Trapper Creek started at its confluence with Hebgen Lake and continued upstream for approximately 1.20 mi. Upstream of this point, the gradient increased significantly and potential fish passage barriers formed by debris jams and large

rock were prevalent. The survey on the West Fork of Trapper Creek began at its confluence with main Trapper Creek and continued upstream for approximately 0.20 mi. A cursory survey upstream from this point revealed little usable fish habitat due to a combination of numerous fish passage barriers and lack of sufficient flow.

Fish Passage Barriers

Sites that would deter or inhibit the upstream migration of spawning rainbow trout were classified as being potential barriers or definite barriers. Sites were classified as being potential barriers if they were considered to decrease the success of upstream passage by adult rainbow trout. Definite barriers were those that have been documented in the past as blocking upstream passage of adult rainbow trout. At each barrier site, photographs were taken to document pre-enhancement conditions.

Spawning Habitat

Spawning habitat abundance was estimated by measuring the average length and width of sites that were subjectively determined to be suitable for spawning by rainbow trout. The average length and width of each site were then multiplied to determine the total surface area of the site. In addition, each site was classified with regard to spawning habitat quality into one of the following categories:

Good average substrata ranging in size from 1/4 - 2 in, having a low percentage of fines and less than 25 % embedded.

Fair average substrata ranging in size from 1/8 - 3 in. May have a moderate amount of fines but mostly less than 25 % embedded.

Poor average substrata ranging in size from 1/8 - 4 in. May have a moderate amount of fines and embeddedness may exceed 25 % in localized areas.

RESULTS

Fish Population Survey

I found very low densities of resident adult and rearing juvenile trout both above and below the culvert barrier (Figure 2). Densities were, however, significantly higher below the culvert than upstream of the culvert. In both of the stream sections, rainbow trout was the primary species observed. Rainbow-cutthroat hybrids comprised the next most abundant group found in the upper reach, followed by what appeared to be Westslope cutthroat trout (based on visual characteristics). In the lower reach, rainbow-cutthroat hybrids and cutthroats were found in equal numbers. Juvenile brown trout (*Salmo trutta*) were also captured in the lower reach, comprising 4 % of the total catch. No brown trout were captured in the upper reach. Mountain whitefish (*Prosopium williamsoni*) which are present in some of the larger tributary streams in the Hebgen Lake basin, were not observed in either of the two reaches sampled.

The rainbow trout population below the culvert had a smaller average fork length than the population sampled above the culvert (Figure 3). For the population below the culvert, the 10 mm size class having the greatest frequency of occurrence was in the 71-80 mm category (33 %). Rainbow trout above the culvert, although less abundant than below the culvert, had the highest frequency of occurrence in the 111-120 mm category (29 %). Rainbow trout captured above the culvert were primarily age 1 fish (67 %) followed by age 0 fish (28 %). In the section below the culvert, age 0 and age 1 rainbow trout were found in near equal proportions, comprising 95% of the total population (Figure 4).

Physical Habitat Survey

Fish Passage Barriers

The culvert was the only site identified in the survey that was considered a definite barrier (Table 1). One potential barrier was located between the lake and the culvert, two between the culvert and the log bridge, and three upstream of the log bridge to the end of

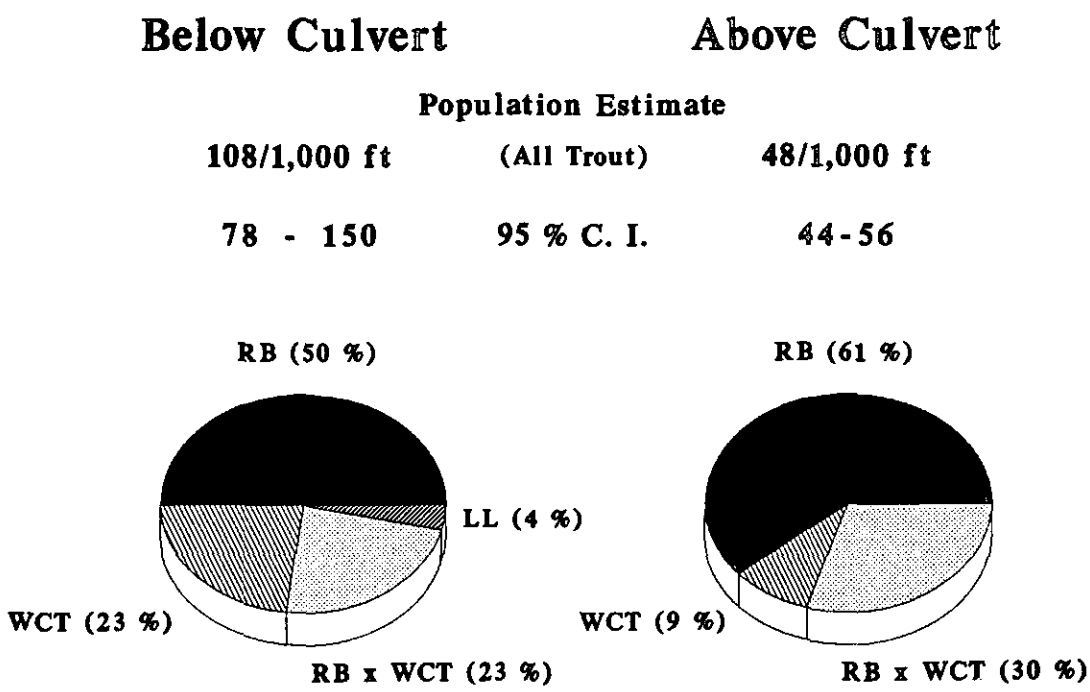

Figure 2. Population estimates, 95 % confidence intervals (C.I.), and relative species composition of salmonid populations located above and below the culvert barrier on Trapper Creek during fall, 1991. Species abbreviations are as follows: rainbow trout (RB), Westslope cutthroat trout (WCT), rainbow - cutthroat hybrids (RB x WCT), and brown trout (LL).

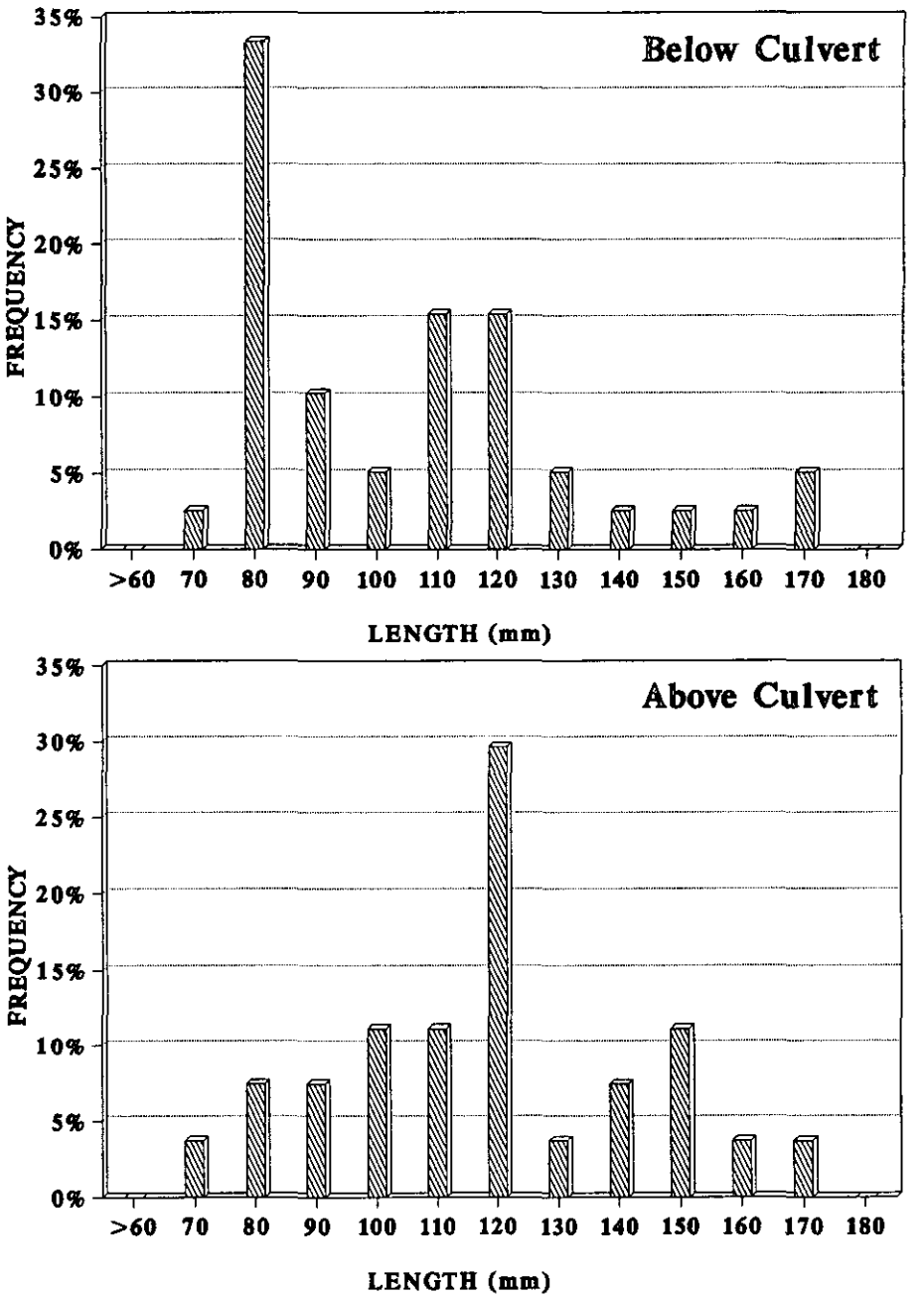

Figure 3. Relative frequency of 10 mm size groups of rainbow trout captured above and below the culvert barrier on Trapper Creek during fall, 1991.

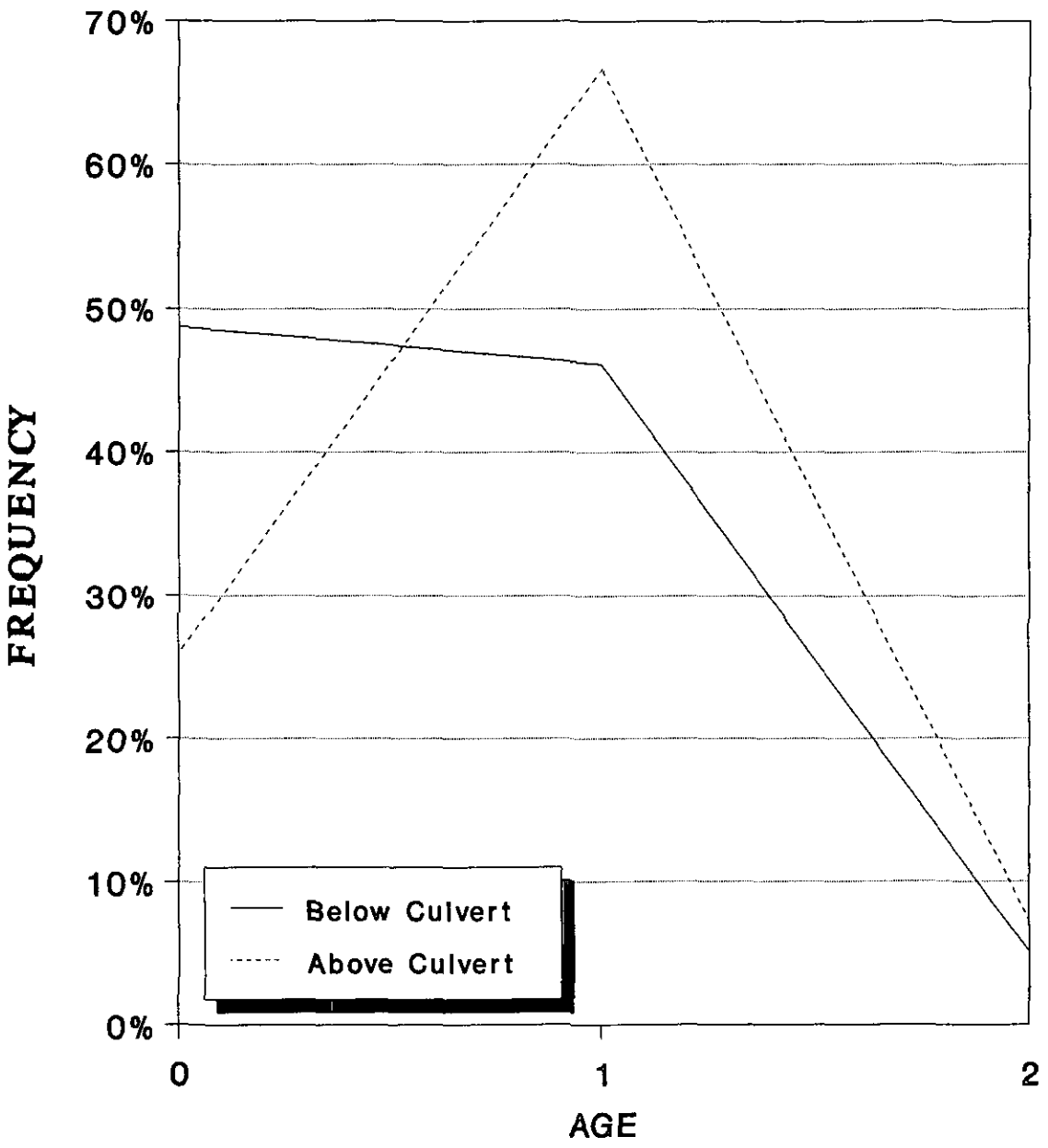

Figure 4. Relative frequency of age groups of rainbow trout located above and below the culvert barrier in Trapper Creek during the fall, 1991.

Table 1. Summary of fish passage barriers observed during surveys conducted on lower Trapper Creek and the West Fork of Trapper Creek during the summers of 1991 and 1992.

River Mile	Barrier Type	Formative Feature	Action
	MAIN TRAPPER CREEK		
0.00	Start Survey		
0.34	potential	debris/boulders	corrected
0.61	definite	culvert	corrected
0.70	West Fork Confluence		
0.83	potential	debris	corrected
1.03	potential	rock from FS road	corrected
1.05	Log Bridge		
1.10	potential	debris jam	none
1.13	potential	debris jam	none
1.17	potential	debris jam	none
1.20	End Survey		
	WEST FORK TRAPPER CREEK		
0.00	Start Survey		
0.04	potential	debris/rock	none
0.20	End Survey		

the survey. In addition, approximately 20 sites were identified as being passable by adult rainbow trout, but could be altered to ease the difficulty of passage, thereby reducing stress and decreasing energy exerted by the spawning adults.

Spawning Habitat

Spawning habitat was more abundant and of better quality downstream of the culvert than upstream of the culvert (Table 2). Considering the short distance that is passable by adult rainbow trout on the West Fork of Trapper Creek, spawning sites classified as being of "fair quality" were moderately abundant. No sites were identified as being of "good quality" in the West Fork. The lower section of Main Trapper Creek that extends upstream from the Hebgen Lake to the culvert accounted for 80 % of the total spawning habitat identified in the survey. Approximately 11 % of the total spawning habitat identified in the survey was located between the culvert and the end of the survey on Main Trapper Creek while the West Fork of Trapper Creek accounted for 9 % the total spawning habitat.

Below the culvert barrier, spawning sites were clumped near the lower end of the section by Hebgen Lake and near the upper end of the section, just below the culvert (Figure 5). The few spawning sites observed upstream of the culvert on Main Trapper Creek were located primarily just downstream of the log bridge. Spawning sites observed in the West Fork of Trapper Creek occurred near the middle and at the end of the short survey reach.

Table 2. Summary of spawning habitat abundance and quality in lower Trapper Creek and the West Fork of Trapper Creek determined from physical habitat surveys conducted during the summers of 1991 and 1992.

Quality	Count	Surface Area (ft^2)	Area/1000 ft Channel (ft^2/1000 ft)
		Main Trapper - Lake Upstream to Culvert (3,200 ft)	
Good	3	132	41
Fair	20	965	302
Poor	5	200	63
Total	28	1,297	406/1,000 ft
		Culvert Upstream to End of Survey (3,142 ft)	
Good	2	16	5
Fair	4	92	29
Poor	3	76	24
Total	9	184	58/1,000 ft
		West Fork Trapper - Confluence to End of Survey (1,031 ft)	
Good	0	0	0
Fair	6	101	97
Poor	7	35	34
Total	13	136	131/1,000 ft
Overall Total		1,617	219/1,000 ft

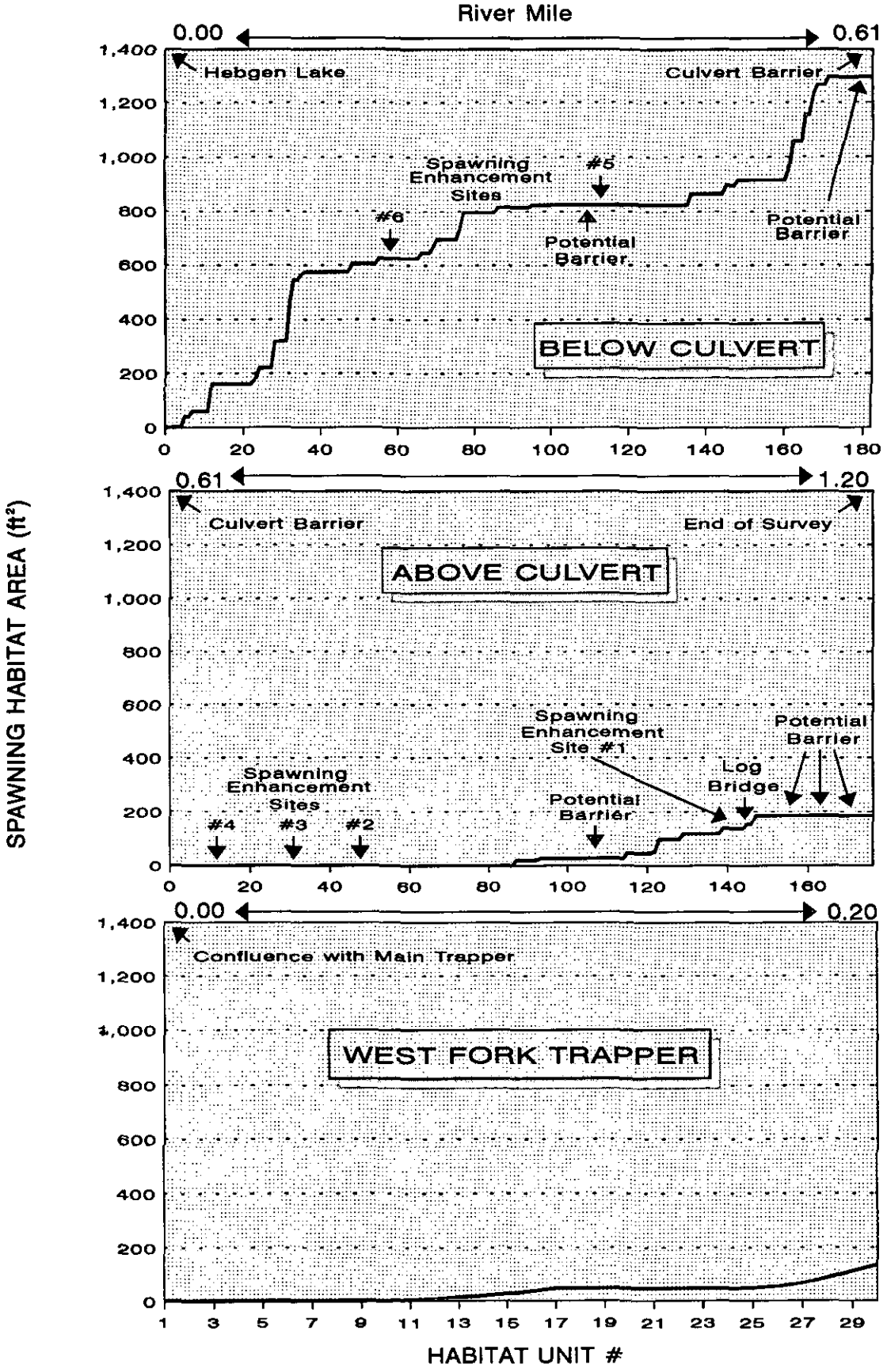

Figure 5. Cumulative distribution of spawning gravels below (a) and above (b) the culvert barrier on Main Trapper Creek and on the West Fork of Trapper Creek (c) determined from habitat surveys conducted in 1991 and 1992.

DESCRIPTION OF ENHANCEMENT ACTIVITIES

The Trapper Creek Fish Passage and Spawning Enhancement Project was designed to be implemented in three distinct phases. Phases I and II were completed during the August of 1992. Phase III is scheduled for installation during mid-summer, 1993.

PHASE I

Phase I involved installation of removable baffles in the culvert barrier located at RM 0.61 on Main Trapper Creek. Due to the small size of the Trapper Creek watershed, I did not consider that the baffle structure would decrease the capacity of the culvert enough to exceed maximum flood flows for the stream. Steel angle iron and rebar were used to construct the overall structure which consisted of six 5 ft sections and one 4 ft section. Baffle sections were transported to the project site and the first section was placed in the downstream end of the culvert. This section was pushed into the culvert and the next section was bolted on. This process continued until all seven sections were connected. Once assembled, the structure was attached to the upstream lip of the culvert using the hooks welded on the first section. Large rocks were then positioned against the rock holders to created a series of S-shaped switchbacks and resting areas within the culvert (Figure 6). In addition, the average water depth in the culvert was increased by approximately 5 in.

It was also necessary to alter the culvert inlet and outlet controls to insure that adult fish could successfully pass into and out of the culvert. A log deflector was placed just upstream of the culvert entrance to increase the length of the channel thalweg, thereby decreasing the channel gradient and water velocity. In addition, rocks that were partially blocking the entrance to the culvert were either removed or repositioned to increase water depth, deflect and decrease water velocity, and to create resting areas for migrant fish.

At the outlet control, the difference between the jump pool elevation and the water surface elevation in the culvert was approximately 1.3 ft. Although a jump of this height

Figure 6. View of the Trapper Creek culvert interior following placement of the baffle structure and rocks.

Figure 7. View of the culvert outlet on Trapper Creek following installation of the log sill used to increase the elevation of the jump pool by approximately 4.5 in.

is feasible for adult rainbow trout, I decided to decrease the difference in elevation to insure successful passage into the culvert. The jump height was decreased by raising the water surface elevation of the jump pool by approximately 4.5 in. The elevation of the jump pool was raised by installing a 20 in diameter log at the downstream end of the pool (Figure 7). The log was set into one stream bank approximately 3.5 ft and was anchored at the opposite end by large boulders. To minimize leakage under the log, a 4 ft wide apron of 1/4 in hardware cloth was attached to the upstream side of the log. The apron was layered with fine gravels that were subsequently covered with large cobbles and boulders. Passage was provided around the log by creating a series of step pools adjacent to a 2 ft deep undercut bank that will provide resting areas and cover for adult trout. The control point for the water elevation in the jump pool was set to keep the entire length of the log covered with water. This was done to increase the longevity of the structure as logs covered with water deteriorate at a much slower rate than those exposed to the air (Orsborn 1991).

In addition to modifying fish passage conditions at the culvert, the channel was modified at the two potential barriers located between the lake and the culvert and at the one potential barrier that occurred between the culvert and the log bridge. Due to the occurrence of numerous potential fish passage barriers and a lack of spawning gravels above the log bridge, no enhancement activities were done upstream of this point. At the lowermost potential fish passage barrier, passage conditions were enhanced by repositioning large boulders using pry bars and removing debris that was partially blocking the channel (Figure 8). At the potential barrier located just below the culvert, a 20 in diameter log was placed across the channel parallel to the water surface (Figure 9). A hardware cloth apron was attached to the upstream side of the log as previously described. A notch was then cut into the log that was large enough to scour a jump pool below the log but small enough to keep water flowing over the entire surface of the log. The log sill formed a dam which raised the elevation of the pool by approximately 6 in, thereby

Figure 8. View of the lowermost potential barrier on Trapper Creek before (top) and after (bottom) alterations were made in the channel to improve fish passage conditions.

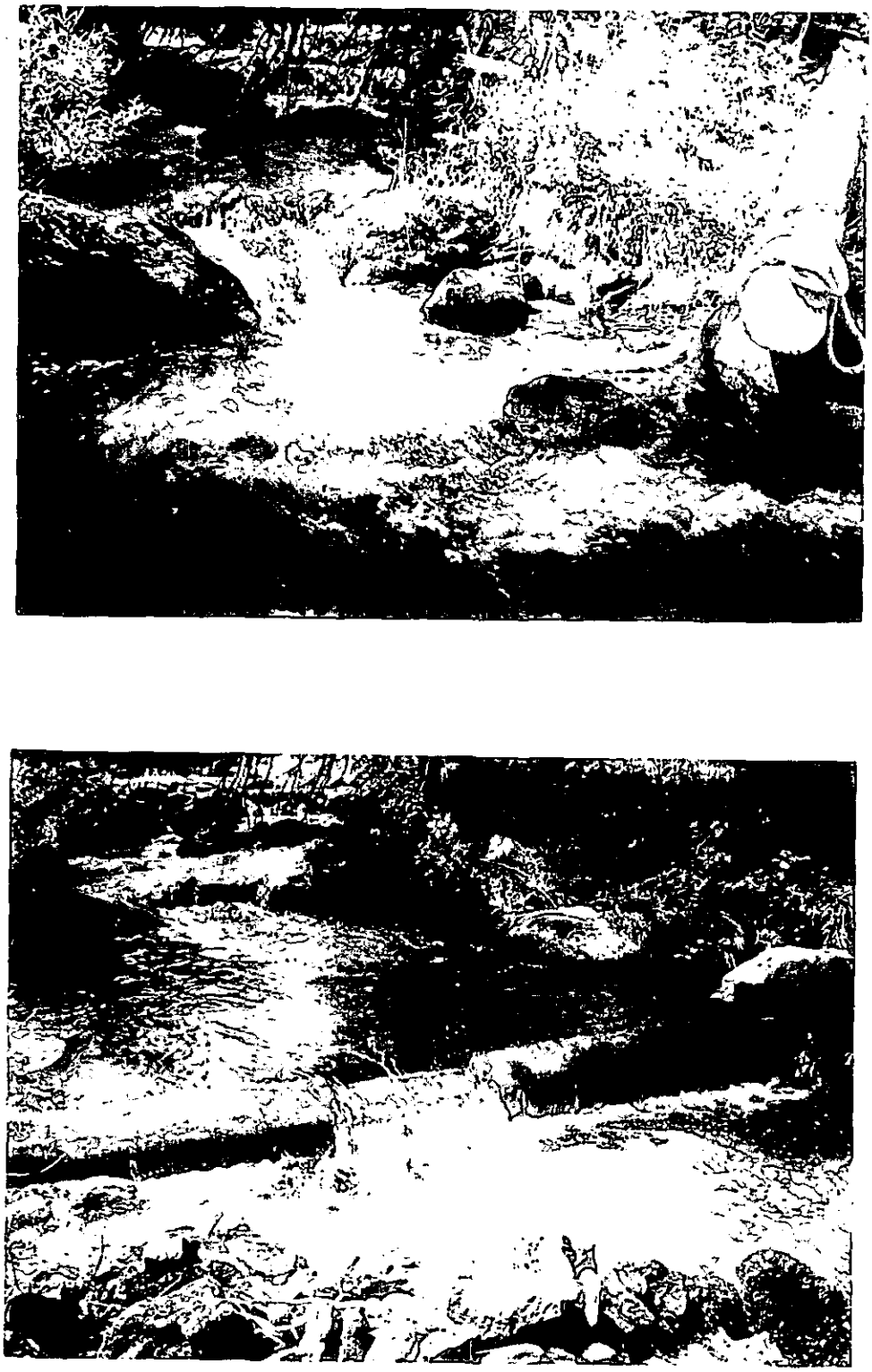

Figure 9 View of the potential fish passage barrier located just downstream of the culvert barrier on Trapper Creek before (top) and after (bottom) alterations were made in the channel to improve fish passage conditions.

inundating the barrier site.

The potential barrier located between the culvert and the log bridge was formed by large rocks that had sluffed-off of Forest Service road # 2540. Passage at this site was created by repositioning the boulders to form a series of 2 ft deep step-pools.

Numerous other channel modifications were done between the lake and the log bridge to decrease the difficulty of upstream fish passage by adult salmonids. Within this reach, 4 more log structures and approximately 30 rock structures were constructed. These structure were used to eliminate passage problems associated with debris jams, split channels, and large drops formed by boulders. Whenever possible, large woody debris that created fish passage problems was repositioned in the channel rather than removed.

PHASE II

Phase II of the Trapper Creek Fish Passage Enhancement Project involved removing the deteriorating log bridge that was located at RM 1.05. A rubber tired backhoe and operator was contracted to remove the topsoil from the supporting bridge timbers and backcast the soil away from the stream channel. Once the soil surface was removed from the bridge, chains were placed on the supporting timbers which were pulled out of the stream channel using the backhoe bucket. The stream banks were then sloped and drainage channels dug on the old road to divert surface water flow away from the newly formed streambanks. Large rocks were brought to the site and used to stabilize the newly formed stream banks and narrow the channel. Following all construction activities, the area was seeded with a mixture of wetlands grass species.

PHASE III

At the log bridge removal site (spawning enhancement site # 1), three log sills were placed in the channel, ranging in diameter from 10-17 in measured at their midpoint (Figure 10). The backhoe was used to dig a shallow trench in the streambed that extended into each bank approximately 3 ft. The logs were then chained to the backhoe bucket and

Figure 10. View of the deteriorating log bridge on Trapper Creek prior to its removal (top) and following its removal and placement of log sills to hold spawning gravels (bottom).

positioned into the trenches. The bucket was then used to level the logs to and place large rocks on each end to hold them in place. The elevation of the logs in relation to the low-flow water surface was such that water was flowing over the entire surface of the log. Following placement of the logs in the stream channel, large rocks were placed behind them to create the sill. A 4 in deep bed of washed round gravels was placed on top of the large rock that extended upstream of each of the three log sills. Hardware cloth aprons were not used on these structures as they tend to trap fines that decrease the permeability of the overlying spawning gravels (Orsborn 1991). Approximately two weeks after the logs were positioned in the stream, notches were cut in each to facilitate fish passage. At the site of the removed log bridge, approximately 500 ft^2 of high quality spawning habitat was created.

Work at spawning enhancement site # 2 located just upstream of the culvert on Main Trapper Creek was also completed during the summer 1992. At this site, two log sills were placed across the channel which were backed with large rock and covered with gravel (Figure 11) as previously described for site # 1. In addition, the channel width was decreased by anchoring a log into the streambank at the top of the site that angled out into the main channel. The log was positioned to increase water depth and velocity to create optimal spawning conditions as described by (Smith 1973). Rocks were also removed from one streambank, creating a 2 ft deep undercut to provide overhead cover for spawning fish. Approximately 450 ft^2 of high quality spawning habitat were created at spawning enhancement site # 4.

Spawning habitat enhancement at sites # 2, 3, 5 and 6 are scheduled for completion during summer of 1993 (Figure 5). Spawning habitat at these sites will be created using the same methods as previously described for sites # 1 and # 4. As these sites are located away from roads, volunteers from the community of West Yellowstone will be used to transport buckets of gravel to the sites.

Completion of spawning habitat enhancement sites # 1 and # 4 and providing

Figure 11. View of spawning enhancement site # 1 on Trapper Creek following placement of log structures used to hold spawning gravels. Note the log structure parallel the to channel in the right of the picture that was used to decrease the width of the channel, thereby increasing water velocity and depth to optimal conditions as described by (Smith 1973)

fish passage upstream of the culvert barrier increased the availability of spawning habitat in the Trapper Creek basin by an estimated 49 % (5 % West Fork of Trapper Creek, 7 % Main Trapper Creek upstream of the culvert, and 37 % by enhancement sites # 1 and # 4). Completion of sites # 2, 3, 5 and 6 will provide an additional 500 - 700 ft^2 of high quality spawning habitat that will be distributed in areas where spawning sites are limited. This represents a 25 % increase over post-construction 1992 levels or 60 % increase over the pre-construction abundance of available spawning habitat.

MAINTENANCE SCHEDULE

Limited maintenance is anticipated. As part of the follow-up monitoring, maintenance needs will be identified.

MONITORING AND EVALUATION

Success of the Trapper Creek Fish Passage and Spawning Enhancement Project will be determined by the following criteria:

1) Determination of fish passage success through the culvert.
2) Utilization of spawning enhancement sites determined by conducting redd counts in the spring.
3) Comparison of outmigrant fry trap data with that collected prior to completion of the enhancement activities.

COSTS

PHASE I

MATERIALS		
1 1/2 x 2 x 2 1/4 in steel angle iron	4 - 20 ft lengths	$ 78.64
1 x 1 x 1 1/4 in. steel angle iron	3 - 20 ft lengths	$ 30.84
5/8" rebar	1 - 20 ft length	$ 4.10
1 1/2 x 1/4 in. flat stock	1 - 20 ft length	$ 7.41
Welding Rod	2 Canisters	$ 50.40
Misc		$ 50.00
TOTAL COST MATERIALS		$ 221.39
LABOR		
Technician	5 days @ $ 80/day	$ 400.00
Biologist	2 days @ $ 100/day	$ 200.00
TOTAL COST LABOR		$ 600.00
PHASE I COST		$ 821.39

PHASE II

MATERIALS		
Washed Gravel (delivered)	12 yrd^3	$ 320.00
4 x 4 ft 1/4 in Hardware Cloth	1 roll	$ 39.10
Misc		$ 50.00
TOTAL COST MATERIALS		$ 409.10
LABOR		
Technician	25 days @ $ 80/day	$ 2,000.00
Biologist	22 days @ $ 100/day	$ 2,200.00
Backhoe and Operator		$ 540.00
TOTAL COST LABOR		$ 4,740.00
TOTAL COST PHASE II		$ 5,149.10

PHASE III		
Misc.		$ 50.00
TOTAL COST MATERIALS		$ 50.00
LABOR		
Technician	10 days @ $80/day	$ 800.00
Biologist	10 days @ 100/day	$ 1,000.00
TOTAL LABOR COST		$ 1,800.00
TOTAL COST PHASE III		$ 1,850.00
OVERALL PROJECT COST		$ 7,820.49

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APPENDIX A

Fish Population Survey Data for Trapper Creek

TRAPPER CREEK FISH DATA COLLECTED IN 1991
DATA ANALYZED 1/12/93
FOR INCLUSION IN THE TRAPPER CR. ENHANCEMENT RPT.
Reach 1 = Below Culvert...Reach 2 = Above Culvert
Species Code: 1= Rainbow, 4= Brown, 11 Rainbow x WS Cutthroat, 12= WS Cutthroat

REACH = 1 SPECIES = 1 ESTIMATED AGE FROM SCALES = 0

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	68	7	2.226	1	
	70	6	1.749	1	
	70	6	1.749	2	
	71	7	1.956	2	
	72	7	1.875	1	
	73	7	1.799	2	
	73	7	1.799	1	
	73	7	1.799	2	
	75	7	1.659	1	
	76	6	1.367	1	
	76	7	1.595	1	
	77	7	1.533	2	
	77	7	1.533	2	
	78	7	1.475	2	
	80	8	1.563	1	
	82	8	1.451	1	
	83	7	1.224	1	
	85	7	1.140	1	
	94	9	1.084	1	
Average-------->	76	7	1.609		19
Standard Dev--->	6.1	0.7	0.279		

REACH = 1 SPECIES = 1 ESTIMATED AGE FROM SCALES = 1

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	96	8	0.904	1	
	100	9	0.900	1	
	102	11	1.037	1	
	106	10	0.840	2	
	106	12	1.008	2	
	106	11	0.924	2	
	109	18	1.390	2	
	111	13	0.951	1	
	112	18	1.281	1	
	113	17	1.178	1	
	113	12	0.832	1	
	115	10	0.658	1	
	115	19	1.249	1	
	124	17	0.892	1	
	126	20	1.000	2	

	137	23	0.894	1	
	143	38	1.299	1	
	150	38	1.126	2	
Average--------->	116	17	1.020		18
Standard Dev--->	14.4	8.5	0.189		

REACH = 1 SPECIES = 1 ESTIMATED AGE FROM SCALES = 2

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	160	42	1.025	1	
	165	48	1.069	1	
Average--------->	163	45	1.047		2
Standard Dev--->	2.5	3.0	0.022		

REACH = 1 SPECIES = 4 ESTIMATED AGE FROM SCALES = 1

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	105	10	0.864	1	
	106	11	0.924	1	
	123	19	1.021	1	
Average--------->	111	13	0.936		3
Standard Dev--->	8.3	4.0	0.065		

REACH = 1 SPECIES = 11 ESTIMATED AGE FROM SCALES = 0

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	77	7	1.533	1	
	84	8	1.350	1	
	90	9	1.235	2	
Average--------->	84	8	1.373		3
Standard Dev--->	5.3	0.8	0.123		

REACH = 1 SPECIES = 11 ESTIMATED AGE FROM SCALES = 1

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	102	9	0.848	1	
	103	10	0.915	2	
	108	11	0.873	1	
	114	16	1.080	2	
	116	15	0.961	1	
	116	18	1.153	2	
	124	19	0.997	2	

	128	19	0.906	1	
	128	21	1.001	2	
	132	28	1.217	1	
	132	23	1.000	1	
Average-------->	118	17	0.996		11
Standard Dev--->	10.6	5.5	0.110		

REACH = 1 SPECIES = 11 ESTIMATED AGE FROM SCALES = 2

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	161	48	1.150	2	
	164	44	0.998	1	
	165	48	1.069	1	
	185	71	1.121	1	
Average-------->	169	53	1.085		4
Standard Dev--->	9.5	10.7	0.058		

REACH = 1 SPECIES = 12 ESTIMATED AGE FROM SCALES = 0

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	56	5	2.847	2	
	72	7	1.875	1	
Average-------->	64	6	2.361		2
Standard Dev--->	8.0	1.0	0.486		

REACH = 1 SPECIES = 12 ESTIMATED AGE FROM SCALES = 1

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	105	11	0.950	1	
	106	9	0.756	2	
	111	12	0.877	2	
Average-------->	107	11	0.861		3
Standard Dev--->	2.6	1.2	0.080		

REACH = 1 SPECIES = 12 ESTIMATED AGE FROM SCALES = 2

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	122	19	1.046	1	
	123	17	0.914	2	
	126	20	1.000	1	
	130	22	1.001	2	
	135	23	0.935	2	

	135	22	0.894	1	
	136	22	0.875	2	
	146	34	1.092	2	
	159	38	0.945	1	
	161	52	1.246	1	
	161	51	1.222	1	
	181	69	1.164	1	
	190	81	1.181	1	
Average--------->	147	36	1.040		13
Standard Dev--->	21.3	20.1	0.124		

REACH = 2 SPECIES = 1 ESTIMATED AGE FROM SCALES = 0

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	63	3	1.200	2	
	71	4	1.118	2	
	76	4	0.911	1	
	82	8	1.451	1	
	85	8	1.303	1	
	91	8	1.062	2	
	95	9	1.050	1	
Average--------->	80	6	1.156		7
Standard Dev--->	10.4	2.3	0.166		

REACH = 2 SPECIES = 1 ESTIMATED AGE FROM SCALES = 1

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	99	10	1.031	2	
	104	11	0.978	1	
	105	13	1.123	1	
	106	13	1.092	2	
	111	12	0.877	1	
	113	15	1.040	1	
	114	18	1.215	1	
	116	16	1.025	1	
	116	16	1.025	1	
	117	15	0.937	2	
	117	15	0.937	1	
	118	15	0.913	1	
	120	18	1.042	1	
	130	23	1.047	1	
	132	25	1.087	1	
	140	27	0.984	1	
	145	33	1.082	1	
	147	34	1.070	2	
Average--------->	119	18	1.028		18
Standard Dev--->	13.6	7.0	0.080		

REACH = 2 SPECIES = 1 ESTIMATED AGE FROM SCALES = 2

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	153	39	1.089	1	
	167	45	0.966	1	
Average--------->	160	42	1.028		2
Standard Dev--->	7.0	3.0	0.062		

REACH = 2 SPECIES = 11 ESTIMATED AGE FROM SCALES = 0

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	94	9	1.084	2	
Average--------->	94	9	1.084		1
Standard Dev--->	0.0	0.0	0.000		

REACH = 2 SPECIES = 11 ESTIMATED AGE FROM SCALES = 1

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	109	14	1.081	1	
	110	14	1.052	1	
	111	13	0.951	2	
	112	13	0.925	1	
	119	19	1.127	1	
	120	16	0.926	1	
	127	18	0.879	1	
	132	25	1.087	2	
Average--------->	118	17	1.004		8
Standard Dev--->	8.0	3.8	0.087		

REACH = 2 SPECIES = 11 ESTIMATED AGE FROM SCALES = 2

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	143	30	1.026	2	
	146	34	1.092	1	
	162	47	1.105	1	
	206	80	0.915	1	
Average--------->	164	48	1.035		4
Standard Dev--->	25.2	19.7	0.075		

REACH = 2 SPECIES = 12 ESTIMATED AGE FROM SCALES = 0

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	76	4	0.911	1	
	96	9	1.017	1	
Average--------->	86	7	0.964		2
Standard Dev--->	10.0	2.5	0.053		

REACH = 2 SPECIES = 12 ESTIMATED AGE FROM SCALES = 2

	LENGTH (mm)	WEIGHT (g)	K Factor	PASS	n
	121	17	0.960	1	
	179	47	0.819	1	
Average--------->	150	32	0.890		2
Standard Dev--->	29.0	15.0	0.070		

APPENDIX B

Physical Habitat Inventory Data Form Used For the Trapper Creek Survey

STREAM HABITAT INVENTORY DATA FORM

Stream name:________________ Reach____ of____ Date__________ Discharge: H M L (________ cfs) Page____ of____

Crew: Recorder________________ Estimator________________ Gradient________ Confinement________

Reach Boundary: · Upper________________________ Lower________________________

Unit Info		Dimensions		Pocket water		Pool information				Spawning substrate		Cover			Large woody debris			Bank shape Left & right				Comments
Unit Type	Unit Number	Length (thalweg)	Width (ft)	Total number	Total area	Formative feature	Type	Maximum depth / TAIL CREST Depth	Mean depth	Total area (sq ft)	Classification (1,2,3)	Overhead (sq ft)	Instream boulders (sq ft)	Instream woody (sq ft)	Single pieces	Aggregate (1-4 pieces)	Group (4 pieces)	Undercut (ft)	Eroding (ft)	Trampling (ft)	Turblance Cover (sq ft)