Report on Field Trip, June 13 to 17, 1955, to Study Culverts Blocking Spawning Cutthroat Trout at Hungry Horse Reservoir, Montana

Field Notes on Culverts at Hungry Horse Reservoir, Montana, June 13, 1955

Frank Stefanich and his assistant, Jim Posewitz, Montana Fish and Game biologists, picked up Ed Morris and me at 8:00 AM at Kalispell. Morris is a U. S. Forest Service Engineer who was in charge of the original installation of the culverts. We made a reconnaissance of all of the culverts around the 100 miles of the reservoir's shoreline. This took a full day. We were accompanied by John "Bud" Gaffney, who is Montana's Fish and Game project leader of the new Noxon Rapids area studies where there is also a culvert problem, and his assistant, Don Knox. We were fortunate to be able to go all of the way around the reservoir because large slides have made the west side road impassable each spring and it had been open only the last 2 or 3 days. Crews were working on these wet clay slides as we went through.

A total of 57 tributaries were observed. The most notable ones, 45 in number, are listed in table 1 in the order of their occurrence from the dam up the right bank of the South Fork of the Flathead River, referred to locally as the east side of the reservoir, and down the left bank or west side of the reservoir back to the dam. Of these 45 tributaries, 22 were too small or too steep for trout occupation and therefore presented no problem. (See Figures 1 and 2 of Baker Creek for example). Eight were large enough to require I-beam bridges (see Figure 3) instead of culvert installations. Three more had very little turbulence at their outlets (see Figures 4 and 5) and presented no problem. This left about a dozen culverts that needed further exploration as potential blocks to spawning cutthroat trout (see Figures 7, 8, 9, 11, 18, and 22). The problem of which ones had fish in them was to be taken up the next day.

A few water temperatures and three rolls of pictures were taken of the most outstanding as well as extreme conditions. Mr. Morris took gradients with an Abney level at some of these culverts for my record, and later gave me a list of the culvert dimensions. Temperature and culvert data are given in table 1. He also presented me with a copy of their new map of the Flathead National Forest showing the dam, reservoir, highways, and principal tributaries. This is attached to this report. Mr. Morris explained that the culverts were all set at about the same slope as that of the stream bed involved above and below the road culvert site. They are mostly at 4 or 5 percent grade with a few at 2 percent and some as high as 15 percent.

The tributary streams to Hungry Horse Reservoir are almost entirely of the stair step, cascade type--all white water due to fairly steep gradient--with the steps appearing to be for the most part about 1 or 2 feet high and seldom exceeding 3 feet in height. (See Figure 10 for typical example). Most of them had about 5 percent gradient. When the gradient exceeded 8 or 9 percent the stream appeared to be too steep for fish to ascend. One of these creeks (see Figures 1 and 2), which looked as if it was coming down at about a 45° angle, checked out at between 15 and 20 percent slope or gradient with the Abney level. The only resting pools were very small and turbulent. Most notable pool in sight upstream or downstream was usually at the outfall of the culverts. The only flat water observed in these tributaries was at Wounded Creek (Figure 5) where beavers had built a low dam in the intake of the big culvert there and at Clark Creek (Figure 4) where the stream and culvert gradient was only 2 percent.

At the bridge over Twin Creek we met Mr. Alan Sollid of the U. S. Geological Survey who was taking flows and temperatures of streams during the present high water. He found North Twin was flowing 360 c.f.s. with an average velocity of 8.3 ft./sec. and water temperature of 48°F. He stated that 10 feet per second was the highest velocity he had recorded on this trip and that 15 feet per second was the highest velocity he had ever recorded. He found 8.5 feet per second velocity on Twin Creek. He checks only the largest tributaries, and the discharges are printed in the regular water supply papers of the U. S. Geological Survey. He has no stream profiles of these tributary creeks, and neither has the Bureau of Reclamation to the best of his knowledge. Water temperatures for some of the streams around Hungry Horse area may be obtained from the Geological Survey at Kalispell.

While studying the culvert at North Fork of Logan Creek (Figure 18) we saw two cutthroat, each about a foot long, swim in from the one side of the outfall. They could not make any headway in the center of the flow, but did at the sides where the velocity was less. We sent half the boys to watch each end, and in a few minutes both fish were seen to emerge or wash out of the downstream end of the culvert. They couldn't make it. We felt this was a convincing demonstration that these fish were being blocked by the high velocity of these outfalls; under less flow, etc., some of them probably make it. This led us to wonder if these inland cutthroats are comparatively poor jumpers and weak swimmers against high velocities compared to their coastal cousins. Apparently they are great climbers from one low cascade to another, but have difficulty overcoming a 3 or 4-foot falls.

On June 14, Stefanich, Gaffney, Knox, Rosewitz, and I arrived at Felix Creek about noon. Stefanich feels that Felix Creek is the stream most in need of improvement. After lunch we set up the generator on the roadside (Figure 13) and the men got into their waders and went to work below the outlet of the culvert (Figure 14). Within an hour

they had 7 female (12"-14" long) (Figure 15), and one male cutthroat trout (18" long) and two Rocky Mountain whitefish (10" long). The big male (Figure 16) had a large mouth, yellow sides, bright red dentary slash, and was very ripe. The females were darker with smaller heads, with silver and rose sides, gray-green above with characteristic dark spots, and they were not ripe yet, i.e., they were just beginning to soften a little--no eggs could be extruded--they were "green" but beautiful fish. I saw two fish drift past the dippers below the pool and would guess that perhaps 4 or 5 got away. It is my rough estimate that not over 15 trout were resting in the hole and that this might constitute at least half of the total population that would enter this little creek from the reservoir to spawn. However, I cannot say for sure how many fish slipped by the netters, nor can I say for sure that the entire bottom of the pool was covered by the electric field, although I feel we did as thorough a job as was possible under the rather difficult conditions involved. I have also learned since returning to Portland that the shocking machine may have been selective of larger fish. Stefanich said no fish had ever been taken above the culvert to his knowledge. We shocked 3 pools above the culvert very thoroughly and didn't get a fish of any kind. No other streams were sampled with the shocker.

Stefanich provided the following notes on the streams he made observations on in 1954 and where he had found fish:

Emery Creek. Creel census a year ago showed 80 fish taken on opening day by anglers and the State later took 15 or 20 with the shocker. Emery Creek has a bridge and therefore offers no problem.

Margaret Creek, tributary to Hungry Horse Creek. Took several last spring with shocker.

Lost Mare Creek. Took several below the culvert last spring although the stream runs dry in summer.

Riverside Creek. Caught a few in 1954 by angling.

Harris Creek. Last opening day an angler took 6 below the culvert--all big ones--and threw them back to spawn.

Felix Creek. This creek has shown the most fish present next to Emery (see notes above).

Sullivan Creek. Anglers helped obtain brood stock from this creek for Creston hatchery last year. This creek is heavily fished. It has a bridge and therefore is no problem.

Graves Creek. Has good fishing--no bridge and no problem except that it has a violent cascade at its mouth (see photo).

Of these west side streams, only Graves Creek and Sullivan Creek are known to have trout in them. No samples have been obtained at any other creeks because the road has never been open in the spring during high water when the fish might be delayed at the culverts. None were obtained in 1955 because the State men did not have the time nor equipment available to finish the job while I was there.

The fishing season opening date has been delayed at Hungry Horse Reservoir until June 22, 1955, in order to permit some of these fish to get through the culverts and up the streams as far as possible. However, the deep holes below the culverts are soon cleaned out after opening day.

Water temperatures taken June 13th ranged from 47° to 48°F. on the east side and 41° to 42°F. in streams on the west side. This may cause trout to move into the east side streams earlier than into the west side streams.

Discussion

Of the 45 or more tributaries observed (table 1), about 32 were considered too small or too steep for fish to ascend or, as in Clark or Murray Creeks, the gradients were low and they could be ascended easily by fish. Nine of them are marked questionable primarily because they were large enough to contain spawners, but it had not been determined whether or not fish actually moved into them. Two of this group--Tin and Soldier Creeks--do not flow into the reservoir but enter the South Fork of Flathead River above the reservoir.

The five culverts that are definitely recommended for further attention, and which are known to harbor spawning fish, are Margaret Creek (a tributary of Hungry Horse Creek), Riverside Creek, Harris Creek, Felix Creek, and North Fork of Logan Creek. Of this group the most urgent case for improvement is believed to be Felix Creek.

Mr. Stefanich believes the best solution would be to remove the Felix Creek culvert and replace it with a bridge or a rectangular culvert (say 6' high by 15' wide in cross section) with a baffled bottom that would cut the velocity of high water and concentrate the flow of low water into a small channel deep enough for fish to swim through. Another possibility would be to build a series of baffles or dams below the outlet so that the first one would break the velocity at the outfall. These dams could have submerged orifices for fish passage or grooves in their centers for the same purpose. The culvert should have some baffles say 12" high at the center with 6-inch gaps between them to cut the velocity further. Or, as Mr. Holmes suggested, perhaps one dam with a fish ladder in it would be cheaper to construct and be just as efficient.

The State of Washington recommends that all new culverts be laid on a zero gradient with the invert of the outfall 6" below the normal stream bed at the point of outfall. Baffles are required in culverts with gradients of over 0.5%. (Letter, Heg to Barnaby, 5/9/55).

Summary

(1) The larger tributaries of the South Fork of Flathead River that now enter Hungry Horse Reservoir probably have the largest runs of spawning cutthroat trout each spring or early summer. These streams (Emery, Hungry Horse, Twin, Sullivan, Wheeler, and Graves Creeks) all have I-beam bridges and present no obstruction to upstream migrants.

(2) About 12 of the larger streams with culverts have a combination of sufficient flow and velocity to block significant numbers of cutthroat trout (for want of a definition, 10 female fish) from upstream spawning beds.

(a) We observed two fish attempting to swim up through the culvert in North Fork Logan Creek, and both failed.

(b) We took 8 fish from the pool below the culvert in Felix Creek but none from three pools above the culvert.

(3) The resident cutthroat trout appear able to ascend only small drops, and these culverts were apparently a fairly effective block to the native Montana cutthroats. None of the outfalls had a drop of over 3 feet, but their velocities may exceed 10 feet per second.

(4) Of the 12 streams in question, we have no information as to whether or not six of them have fish moving into them. In many cases there was no convenient pool below the outfall which could be shocked. In other cases we did not have time to make such tests on the trip. Our determination of which streams have fish in them was incomplete, and we will probably have to wait another year to test them as these spawning fish move in on the spring flood waters to spawn. The streams on the west side have been inaccessible so far each spring.

(5) Felix Creek is the stream most in need of culvert improvement because of its size and known run of fish, and all the evidence indicates that the culvert is an impassable barrier to a significant number of spawning cutthroat trout.

(6) Most of the remainder of the tributaries entering the reservoir are too steep or too small to support significant numbers of spawning trout. A few are of fairly low gradient and offer no obstruction to fish passage.

TABLE I - SUMMARY OF CULVERT AND TEMPERATURE DATA COLLECTED AT HUNGRY HORSE RESERVOIR, MONTANA, JUNE 12-17, 1955

Name of Tributary	Fish Present	Fish Problem	Culvert Size	Estimated Flow CFS	Sp. Area 3/	Notes
Right Bank or East Side Tributaries:						
Emery Creek	Yes	No 1/	-	30	3½	Trout move in to upper ro
Hungry Horse Creek	Yes	No 1/	-	20	2	
Margaret Creek	Yes	Yes	72"x42'	20	2 3/4	4% slope
Tiger Creek	-	No 2/	-	10	1¼	
Lost Mare Creek	Yes	?	54"x40'	5	1	Goes dry
Dudley Creek	-	No 2/	60"x66'	5	-	
Ryle Creek	-	No 2/	60"x80'	5	1	Twin culverts
Seagrid Creek	-	No 2/	60"x50'	5	3/4	
Riverside Creek	Yes	Yes	120"x108'	50	3¼	4-5% slope
Murray Creek	? 4/	No	60"x78'	15	1½	Only 2% slope in culvert
McInernie Creek	-	No 2/	60"x88'	-	1¼	
Deep Creek	? 4/	? 4/	96"x108'	-	3/4	
Clarinda Creek	-	No 2/	48"x104'	-	3/4	
No Name (trib of Harris)	-	No 2/	48"x60'	-	-	
Harris (Canyon) Creek	Yes	Yes	72"x100'	25	1	

TABLE I - Continued

Name of Tributary	Fish Present	Fish Problem	Culvert Size	Estimated Flow CFS	Sp. Area 3/	Notes
Paint Creek	-	No 2/	60"x92'	5	1½	
N.F. Logan Creek	Yes	Yes	96"x92'	15	1¼	Water temp. 47° 5% slope
S.F. Logan Creek	-	? 4/	72"x100'	10	1	
Devils' Corkscrew Creek	-	No 2/	60"x6[illegible]'	5	½	
Hoke Creek	-	No 2/	60"x5[illegible]'	5	1 3/8	
Baptiste Creek	-	No 2/	60"x54'	5	1¼	
Deadhorse Creek	-	No 2/	48"x40'	5	1¼	Twin culverts
Brush Creek	-	No 2/	48"x58'	3	1	Goes dry
Peters Creek	-	No 2/	48"x54'	5	3/4	Goes dry
Dry Park Creek	-	No 2/	48"x72'	3	½	Goes dry
Lower Twin Creek	Yes	No 1/	-	300	2½	
Upper Twin Creek	Yes	No 1/	-	350	-	
Left Bank or West Side Tributaries:						
Tin Creek	-	? 4/	72"x44"x48'	20	-	Twin arch
Soldier Creek	-	? 4/	72"x44"x48'	20	-	Twin arch
Clark Creek	-	No	62"x42'	20	-	Only 2% gradient
Sullivan Creek	Yes	No 1/	-	500	3½	

Name of Tributary	Fish Present	Fish Problem	Culvert Size	Estimated Flow CFS	Sp. Area 3/	Notes
Battery Creek	-	No 2/	96"x108'	15	½	
Clear Creek	-	No 2/	-	10	½	
Wheeler Creek	-	No 1/	-	100	3½	
Forest Creek	-	No 2/	-	10	3/4	
Baker Creek	-	No 2/	48"x68'	15	½	Water temp. 41°, 15% grad culvert, 20% in streamb
Graves Creek	Yes	No 1/	-	400	4 3/4	Water temp. 42°
Pearl Creek	-	No 2/	-	3	-	
Clayton Creek	? 4/	?	96"x96'	50	1½	
No Name	-	No 2/	-	5	-	
Wounded Buck Creek	? 4/	?	120"x80'	50	1 3/4	2% grade in culvert, Beav above culvert intake
Lost Johnny Creek	? 4/	?	84"x56'	50	1½	2% grade in culvert. Whit above and below
Doris Creek	? 4/	?	120"x78'	50	-	2% grade in culvert, 42° White water above and b
No Name (Alpha(?)	-	No 2/	-	25	-	

1/ No culvert; I-beam bridge

2/ Too small or too steep

3/ Miles of spawning stream from edge of reservoir (3500' elev.) in first 500 feet of fall (to 4000' cont an indication of stream gradient and therefore availability to spawning trout.

Figure 1

Steep gradient of Baker Creek above the culvert intake.

Figure 2

Steep gradient of Baker Creek below culvert outfall - also impassable drop at outfall.

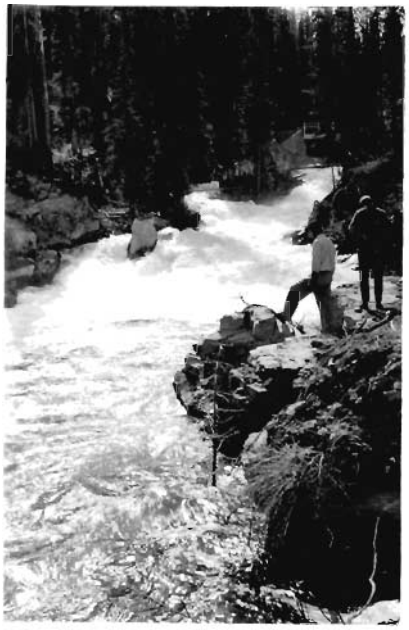

Figure 3

Steep cascades at its mouth in Hungry Horse Reservoir - below the I-beam road bridge in the upper background.

Figure 4

Clark Creek - low gradient of streams and culvert at intake.

Figure 5

Clark Creek - Low gradient of culvert and little turbulence at outfall.

Figure 6

Wounded Buck Creek - Beaver pond at intake

Figure 7

Mounded Buck Creek - High velocity of culvert outfall.

Figure 8

Margaret Creek - Outfall at culvert.

Figure 9

Riverside Creek - Outfall at high water.

Figure 10

Riverside Creek - Looking upstream from culvert at typical "white" water of these creeks.

Figure 11

Felix Creek - Outfall impassible to cutthroa trout at high water.

Figure 12

Felix Creek - Looking downstream from culvert to reservoir.

Figure 13

Felix Creek - Montana Biologists Preparing to Shock the Pool.

Figure 14

Felix Creek - Crew in action below outfall.

Figure 15-a

Felix Creek - Cutthroat trou and mountain whitefish taker by dip net after shocking pool.

Figure 15-b

Felix Creek - Looking upstr during shocking operations.

Figure 16

Felix Creek - Large male cutthroat.

Figure 17

North Fork of Logan Creek - Culvert intake.

Figure 18

North Fork of Logan Creek - Culvert outfall-impassable to cutthroat trout.

Figure 19 -

Soldier Creek - Intake of twin arch type culverts - Typical gravel bar has formed in right foreground. (Mr. Morris demonstrated by tossing in black marker.)

Figure 20.

Soldier Creek - Outfall of twin arch type culvert.

Figure 21

Tin Creek - Outfall of twin culverts (note typical bar in foregrou that develops at intake outlets of these twin culverts.

Figure 22

Deadhorse Creek - Outfall of twin culverts - at steeper gradient.