COAL CREEK FISHERIES MONITORING STUDY NO. V

Prepared By:

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Kalispell, MT 59903

December 1986

Sponsored By:
USDA - Forest Service
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INTRODUCTION

This report contains information on the continued assessment and monitoring of fish populations and sediment levels in the Coal Creek Drainage. The study, funded by Flathead National Forest (FNF), was initiated by the Montana Department of Fish, Wildlife and Parks (MDFWP) in 1981 (Shepard and Graham 1982) and continued through 1982 (Shepard and Graham 1983a). These efforts resulted in the development of a program for monitoring the effects of land management activities on native fish populations and aquatic habitat in Coal Creek.

During 1983 and 1984, the study was contracted to the Cooperative Fisheries Research Unit at Montana State University (MCFRU). The original monitoring program was continued along with development of the relationship between substrate composition and bull trout embryo survival to emergence (Weaver and White 1985).

The 1985 study, conducted by MDFWP, involved only a portion of the original program including estimation of late summer fish abundance, evaluation of substrate composition in bull trout spawning areas, and assessment of the 1985 bull trout spawning run (Weaver and Fraley 1985). These activities were completed by MDFWP again in 1986 under the current contract, using existing methodologies and sampling sites to ensure comparable results. Fish abundance estimates were completed by MDFWP and FNF outside this contract, but results are included in this report. Fieldwork was conducted during late summer and early fall, 1986.

METHODS

Fish Abundance Estimates

Fish abundance estimates were completed by electrofishing two 150-m sections in the Coal Creek Drainage. The two sections (Dead Horse Bridge and South Fork Bridge) were established by MDFWP in 1981 and have been sampled annually during past studies.

Electrofishing equipment and procedures described by Shepard and Graham (1983b) were used. A two-pass population estimate (Seber and LeCren 1967) was made for the South Fork Bridge section. A mark-recapture estimate (Vincent 1971) was completed on the Dead Horse Bridge section. Estimates of numbers and densities were computed for westslope cutthroat trout and juvenile bull trout 75 mm total length or longer (Age I+) and compared to previous estimates.

Substrate Composition

Substrate samples were collected from several known bull trout spawning areas in the Coal Creek Drainage. A standard hollow core sampler (McNeil and Ahnell 1964) was used following methods described by Shepard and Graham (1982). Coring sites in the Dead Horse Bridge spawning area were located across the five transects sampled during previous studies. The new transects established during 1985 in main Coal Creek above the South Fork Bridge (N-1/2, SE-1/4, Sec. 23, T34N, R22W) and in the South Fork of Coal Creek (SE-1/4, NE-1/4, Sec. 26, T34N, R22W) were also sampled.

Samples were placed in labeled bags and transported to the Flathead National Forest Soils Lab in Kalispell for analysis by Forest Service personnel. After drying, each core sample was passed through the following sieve series:

76.1 mm	(3.00 inch)
50.8 mm	(2.00 inch)
25.4 mm	(1.00 inch)
16.0 mm	(0.62 inch)
12.7 mm	(0.50 inch)
9.52 mm	(0.38 inch)
6.35 mm	(0.25 inch)
2.00 mm	(0.08 inch)
0.85 mm	(0.03 inch)
0.063 mm	(0.002 inch)
Pan	(<0.002 inch)

All material retained on each sieve was weighed and the percent dry weight in each size class was calculated and compared with information collected during past years. Average survival to emergence in each of the spawning areas sampled was predicted using the predictive equations developed for bull trout by Weaver and White (1985).

Substrate scores were calculated using methods described in Leathe and Enk (1985).

Spawning Site Inventories

Bull trout spawning site inventories were conducted on all spawning areas in the Coal Creek Drainage during October, 1986. The sections surveyed were identical to those surveyed in 1982 (Shepard and Graham 1983a). Surveys were conducted by crews of two walking down the channel. Redds were enumerated, classified and located as described by Shepard and Graham (1983b). Counts were compared to past surveys of the same sections.

RESULTS AND DISCUSSION

Fish Abundance Estimates

Estimates of juvenile westslope cutthroat trout abundance from 1982-1986 have indicated a stable population in the South Fork Bridge section of Coal Creek (Table 1). However, the 1986 estimate for cutthroat in the Dead Horse Bridge section was the lowest on record. Cutthroat abundance has generally been low in this section, except in 1983. The large increase in cutthroat abundance during 1983 was due to an experimental fry plant during fall, 1982, and has been discussed in previous reports (Weaver and White 1984, 1985).

Numbers of juvenile bull trout have been relatively stable in both sections of Coal Creek from 1982-1986. However, the data indicate that there could be a relationship between spawner escapement and juvenile densities in subsequent years. Peaks of juvenile abundance in 1985 and 1986 in the Dead Horse section may reflect peaks in spawner escapement in this section in 1982 and 1983. The peak in juvenile abundance in the South Fork Bridge section in 1984 could reflect the peak of spawner escapement in this section in 1981. However, we noted no increase in juvenile abundance in 1982 and 1983 resulting from the strong spawning runs in 1980 and 1981.

We do not yet have a long enough period of record to make a definite determination on the relationship between spawner escapement and juvenile abundance in Coal Creek. Movement of

Table 1. Comparison of annual late summer population estimates ($\hat{N}$) and densities (#/100 m^2) for westslope cutthroat and juvenile bull trout $\geq$ 75 mm total length from electrofishing sections in Coal Creek from 1982 through 1986.

Section	Date	Estimation Technique	$\hat{N}$	95% C.I.	$\hat{p}$	Density
Cutthroat trout						
Dead Horse Bridge	08/05/82	M&R	12	± 9	2[a]	0.6
	08/23/83	M&R	56	±15	3	2.8
	08/31/84	M&R	10	± 8	1	0.5
	08/29/85	M&R	9	± 6	5	0.6
	09/02/86	M&R	5	± 3	0	0.4
South Fork Bridge	08/04/82	Two-pass	32	± 6	0.74	2.5
	08/28/83	Two-pass	23	± 2	0.84	2.0
	08/29/84	Two-pass	31	± 9	0.65	2.8
	08/27/85	Two-pass	36	±12	0.33	3.2
	09/03/86	Two-pass	40	±11	0.64	4.3
Bull trout						
Dead Horse Bridge	08/05/82	M&R	130	±36	2[a]	5.9
	08/23/83	M&R	99	±33	1	4.1
	08/31/84	M&R	89	±27	1	4.2
	08/29/85	M&R	167	±65	0	11.2
	09/03/86	M&R	149	±45	3	10.6
South Fork Bridge	08/04/82	Two-pass	17	± 9	0.60	1.3
	08/28/83	Two-pass	18	± 3	0.78	1.5
	08/29/84	Two-pass	48	±12	0.63	3.4
	08/27/85	Two-pass	41	± 5	0.77	3.7
	09/03/86	Two-pass	29	±12	0.59	3.1

[a] These are numbers of mortalities recorded between the marking and recapture efforts and should be added to estimated numbers ($\hat{N}$) to obtain final estimates.

juveniles also could obscure the relationship within a particular section.

Substrate Composition

Comparison of the annual mean percentages of substrate material smaller than 6.35 mm in the Coal Creek Drainage spawning areas showed fluctuations of up to 5.0 percent (Table 2). Annual changes of similar magnitude have been reported for other North Fork spawning tributaries (Weaver and White 1985).

For purposes of statistical analysis, we used median values to compare yearly changes in composition. Annual fluctuations of up to 7.5 percent have been recorded in the median percentage of material smaller than 6.35 mm in the Dead Horse Bridge spawning area. Results from Mann-Whitney tests showed the 4.5 percent increase in this size material between 1981 and 1982 was significant at the 0.10 level and extremely close to significance at the 0.05 level (Table 3). No significant change was observed between 1982 and 1983. The median percentage of material smaller than 6.35 mm decreased significantly between 1983 and 1984 ($p=.05$) and another significant increase was recorded between 1984 and 1985 (Table 3). No change was observed between 1985 and 1986.

Results from the test comparing the median percentage smaller than 6.35 mm documented in 1981 with the percentage found during 1986 showed no significant change had occurred, as the increases between 1981-82 and 1984-85 were offset by the 7.5 percent decrease observed between 1983-84 (Table 3).

Table 2. Comparison of the annual mean percentages of substrate material smaller than 6.35 mm from undisturbed sites in the Coal Creek Drainage from 1981 to 1986.

Spawning Area	Year	n	% <6.35 mm
Dead Horse	1981	10	33
	1982	19	38
	1983	20	37
	1984	18	33
	1985	20	36
	1986	16	35
South Fork	1985	12	37
	1986	12	32

Table 3. Comparison of median percentages of substrate material smaller than 6.35 mm and results of Mann-Whitney tests for annual changes in the Dead Horse Bridge spawning area from 1981 to 1986.

Year	1981	1982	1983	1984	1985	1986
Median % <6.35	34.0	39.5	39.5	32.0	36.5	34.5
Test Statistic [a]	--	-1.91	-0.89	-2.56	-2.79	-1.43
Significance level	--	*↑	N.S.	**↓	**↑	N.S.

N.S. - not significant

* - significant at the .10 level

** - significant at the .05 level

↑ - increase

↓ - decrease

[a] Value of test statistic must be < -1.64 for significance at the .10 level and < -1.96 for significance at the .05 level for two-tailed tests.

The Mann-Whitney test comparing median percentages smaller than 6.35 mm in the South Fork of Coal Creek's spawning area showed a significant decrease had occurred between 1985 and 1986 (Table 4).

Because of the limited period of record, we do not know if the yearly changes observed in the percentage of fines in the gravels of Coal Creek are within the range of natural fluctuations.

Predictions of bull trout embryo survival to emergence for the samples from the Dead Horse Bridge spawning area ranged from 22 percent to 67 percent. Average survival to emergence predicted to occur in this area during spring, 1987 is 45.7 percent (Table 5). Predictions ranged from 9 percent to more than 75 percent for the samples collected in the South Fork of Coal Creek's spawning area. Average predicted survival to emergence during 1987 in this area is 58.7 percent (Table 5).

Substrate scores (Table 6) calculated for the three sites from 1984-1986 were above the critical standard for juvenile rearing habitat (9.0) developed from Leathe and Enk (1985). Substrate scores averaged 11.4 at the Dead Horse Bridge site for the last three years. Substrate scores of 11.0 - 15.0 are believed to be optimal (M. Enk, U.S.F.S. Personal Comm.). Continued monitoring of substrate score at these sites is required to determine the significance of yearly variation in the values.

Table 4. Comparison of median percentage of substrate material smaller than 6.35 mm and results of Mann-Whitney tests for annual change in the South Fork spawning area between 1985 and 1986.

Year	1985	1986
Median % <6.35	36.0	31.5
Test Statistic[a/]	--	33.5
Significance level	--	**↓

a/ Any value smaller than 37.0 indicates a significant difference at the .05 level for a two-tailed test when sample size is $m_1 = m_2 = 12$ (Sprent 1981).

Table 5. Mean predicted survival to emergence for bull trout spawning areas in the Coal Creek Drainage from application of the field survival equation to results of sieve analysis of spawning area core samples.

Spawning area	n	$\bar{x}$ predicted survival to emergence
Dead Horse	16	45.7
South Fork	12	58.7

Table 6. Substrate scores calculated for three sites in the Coal Creek Drainage.

Site	Substrate Score 1984	1985	1986
Coal Creek at Dead Horse Bridge	10.2	11.6	12.3
North Fork Coal Creek	12.2	13.5	14.2
South Fork Coal Creek	--	12.8	12.0

Spawning Site Inventories

Total redd counts have been conducted annually in the Coal Creek Drainage since 1980 with the exception of 1985, when only the section recommended for monitoring by Shepard and Graham (1983b) was surveyed. This year's count was the lowest observed during this period (Table 7). During past surveys, the Coal Creek Drainage has ranked second to Whale Creek in the average number of bull trout redds among North Fork tributaries, and third basin-wide.

Counts in other North Fork tributaries were also lower this year but the trend was most pronounced in Coal Creek. The total count in the Middle Fork Drainage for 1986 (523) was much higher than the average count (308) during previous basin-wide surveys in 1980-1982. Nine of the Middle Fork tributaries contained more redds than in any previous year. Overall, the 1986 basin-wide count (814) was similar to the 1980-1982 average (805). Reasons for the decrease in use of the North Fork tributaries and the increase in use of the Middle Fork tributaries are not apparent at this time.

Table 7. Total number of bull trout redds observed in the Coal Creek Drainage annually from 1980 through 1986.

	1980	1981	1982	1983	1984	1985	1986
Coal Creek							
Above the South Fork	4	7	25	13	3	---	22
Below the South Fork	34	31	71	66	58	40	13
South Fork Coal Creek	19	24	9	3	5	---	4
Mathias	10	10	17	12	8	---	10
Drainage Total	67	72	122	94	74	---	49

RECOMMENDATIONS

Based on our findings in this and previous studies, we recommend the following:

1) Continue to monitor juvenile fish populations in the two sections of Coal Creek sampled in 1986, as well as in the section below Cyclone Bridge in main Coal Creek and the section in the south fork of Coal Creek.

2) Maintain the annual measurements of substrate quality at all sites using the hollow core sampler and substrate scoring techniques.

3) Continue to count bull trout redds in the entire Coal Creek Drainage, as well as in the other recommended monitoring sites in the North and Middle Fork drainages.

The continued monitoring of these parameters in the Coal Creek Drainage will help to better define the limiting factors which act on the population. It is not clear whether the tributaries are at carrying capacity for juvenile bull trout, or whether juvenile densities are limited by spawner escapement levels. The answer to these questions will require monitoring the escapement levels and resulting juvenile densities in the tributaries over a longer period of time.

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