FISHERY HISTORY OF ROCK CREEK

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Introduction

Since inauguration of the Dingell-Johnson program in Montana, much time has been devoted to the inventory of streams and lakes. Rock Creek, near Billings, Montana, has been observed for factors affecting trout habitat and trout fishing since 1951. Rock Creek originates in the Beartooth Plateau of Montana and Wyoming. It flows northeasterly 59 miles to the Clarks Fork of the Yellowstone River.

The upper portion of Rock Creek is a mountain stream. It extends about 20 stream miles from the headwaters, (elevation approximately 8,050), to the town of Red Lodge. Its average gradient is approximately 128 feet per stream miles. The average recorded stream flow near Red Lodge is 170 cfs (maximum 3110 cfs, minimum 14 cfs; anonymous, 1957). Trout fishing in this section is good, and there are excellent camping and picnic sites. The stream is almost entirely within the Custer National Forest.

The middle portion of Rock Creek, between the town of Red Lodge (elevation 5,500 feet) and the mouth of Red Lodge Creek, contains about 23 stream miles. The average gradient is 66 feet per stream mile with water volume similar to the upper section. This section is important from the

fishery standpoint. While the trout fishery is in competition with agricultural, municipal, and industrial water uses, it is still producing an estimated 100 pounds of trout per surface acre in better parts of the stream. This portion is almost entirely on private agricultural land.

The lower portion of Rock Creek extends 16 stream miles from the mouth of Red Lodge Creek to the Clarks Fork of the Yellowstone River. It has a gradient of 35 feet per stream mile, average recorded flow is 133 cfs (Maximum 2310 cfs, minimum 0.0 cfs; anonymous, 1957). The trout fishery in this portion is limited by agricultural practices. The creek is subjected to severe water diversion for irrigation. It is turbid during spring run-off and remains turbid during much of the irrigation season. Stream bank and watershed erosion are more common in this section.

Historical

Records of fish abundance prior to 1950 do not exist. Management consisted of fish stocking and fish regulations. Trout populations followed the same general pattern as most Montana trout streams. Cutthorat trout (Salmo clarkii) was the only native trout in Rock Creek. The rainbow trout (Salmo gairdnerii), eastern brook trout (Salvelinus fontinalis), and brown trout (Salmo trutta), have been introduced. Each species is reported to have had periods of abundance and decline. Brown trout are currently most abundant in the middle and lower portions of Rock Creek. Eastern brook trout, rainbow trout, and cutthroat trout are found in the upper portion. Cutthroat trout are rarely taken in Rock Creek.

Parts of Rock Creek were straightened to float mine timber from the forests to the coal mines at Red Lodge, Montana. Coal mine drainage and coal slack have been observed in the middle portion of the creek. Leiberg (1904) found the Rock Creek watershed severely overgrazed by livestock prior to establishment of the National Forest in 1907. Records dating back to 1921 show nearly 60 fires have occurred on the Rock Creek watershed, one burned over 2,000 acres in 1948. The watershed on U. S. Forest Service land is recovering from former misuses.

Investigations and Observations since 1951

Since 1951 a number of observations have been made on Rock Creek with the objective of preserving or improving existing trout stream fishery and to accumulate information concerning factors adverse to stream fishing.

Opheim (1953) showed that stocked rainbow trout over a 4-year period contributed from 7 to 20 per cent of the fish harvested in the middle portion of Rock Creek. The 20 per cent harvest of hatchery fish was obtained by stocking fish over seven inches in length in the most heavily used parts of the creek at intervals during the fishing season. Hatchery fish contributed most to the creel when approximately 9,686 catchable trout weighing 1,150 pounds were stocked in one year. The year hatchery fish were most abundant in the harvest the catch per hour was lowest. During the 4-year period, wild brown trout became increasingly more important in the harvest in spite of rainbow trout stocking.

In 1954 approximately five stream miles of the middle portion were

so severely dewatered by irrigation diversion that fish loss occurred. Only some young-of-the-year brown trout, rainbow trout, white fish and suckers survived. More than 70 irrigation water diversions exist on Rock Creek but loss of fish through irrigation diversions has not been investigated. The estimated fish losses in the Gallatin Valley irrigation system was near the amount of fish taken by fishermen from lower part of the West Gallatin River in Gallatin County, Montana, (Clothier, 1952).

In view of hatchery fish contribution (Opheim, 1953) and of the irrigation dewatering that occurred in 1954, trout have not been stocked in Rock Creek since 1954. Fishing in formerly dewatered portion of Rock Creek recovered by 1956. Creel census showed an average catch of 1.1 fish per hour in all of the middle portion of Rock Creek in 1957.

Two electric stream census sections were established on Rock Creek in 1957. Each section was about 300 feet in length. These were shocked with 220 volt, 60 cycle, alternating current. Captured fish were anesthetized with urethane and total lengths were determined to the nearest 0.1 inch and weights to nearest 0.01 pound. Data were taken on all fish captured in three shocking trips through each section. No fish had been artificially stocked for three fishing seasons, and shocking areas were established in the more accessible and heavily fished parts of the creek. Fishing was reported "good", especially by those who preferred brown trout. Brown trout constituted 29 per cent of all fish captured in the Red Lodge section, and 79 per cent of all fish captured in the Allen Ranch section (Table 1).

Pollution

Montana is encouraging industry, which may result in more adverse influences on trout stream habitat. A coke plant was constructed near the town of Red Lodge in 1957. Prior to construction, local fishermen questioned the effect of coke plant effluent on Rock Creek. Assurance was given by people representing industry that the effluent would be disposed of in the city sewage lagoon system. During preliminary coking operations using one retort, several water samples were taken for analysis of phenolic compounds. The coke plant effluent contained 119,000 ppb phenolic compounds. The effluent (estimated 5 cfs) from the sewage lagoon (which discharges into Rock Creek) contained 2,300 ppb phenolic compounds. At present industrial pollution is not a problem on Rock Creek. The coke plant has not operated since the preliminary operations.

Trout Habitat Losses Following the 1957 Flood

Water run-off during the spring of 1957 was reported greatest since flow records began in 1932. No quantitative information is available concerning trout habitat losses directly due to flooding. The electric stream census (Table 1) was made about three months following the flood. Trout populations within the Rock Creek census sections compared favorably with other records of trout populations in Montana (Stefanich, 1952; Holton, 1953; Nelson, 1954). The flood in 1957 resulted in damage to irrigation structures and erosion of adjoining grazing land. During 1957 and 1958 the lower 40 miles of Rock Creek were subjected to several channel clearance and realignment

projects. The county government worked in the vicinity of bridges. Several landowners undertook channel clearance and realignment with private funds. The larger portion of the channel clearance and realignment work was accomplished under the Agricultural Conservation Program, U. S. Department of Agriculture. An F-3 conservation practice was formulated and federal cost sharing funds were secured under the Montana Agricultural Conservation Program. The project was approved mainly for channel clearance and minor channel realignment work. The Soil Conservation Service was responsible for the technical phases. The cost of the program was distributed with a maximum of 70 per cent by the Federal Government and 30 per cent by the individual landowner. Approximately 72 landowners on Rock Creek participated in the program. Government agencies gave assurance that the possible effects on fish and wildlife were carefully considered. After completion of the channel projects on Rock Creek, it was obvious that trout habitat had been adversely affected. During 1958 and 1959 trout habitat losses were measured and evaluated. The basis for judging trout habitat loss was derived from experience and from a report on the relationship between trout populations and cover on a Montana trout stream (Boussu, 1954).

Almost 17 miles of the stream channel in the lower 40 miles of Rock Creek (Table 2) had been changed resulting in varying degrees of trout habitat loss. The work resulted in a stream channel that was wider, shallower, and shorter than before. Following completion of the channel work some shallow exposed pools appeared. These were

more suitable for non-game fish than trout due to absence of the normal undercut bank, brush cover and water depth.

Nearly 1,000 feet of rip-rap made from cottonwood trees was observed. This was the only work beneficial for trout habitat. Approximately 700 feet of this rip-rap was firmly anchored. The other 300 feet was not anchored.

Six stream sections were electrically sampled in 1958. Three of these were selected where channel clearance and realignment work had been done, and three where such work had not been done.

The stream census sections were sampled with the same methods used in 1957. Sections were established so approximately equal amounts of pool and riffle areas occurred within each section. All sections were located in the middle portion of the creek. The lower portion of the stream was too turbid for successful population census using alternating current.

The results of the electric stream census were summarized and converted to pounds of fish per surface acre (Table 3). The weight of trout captured in unworked sections was 37 pounds per acre greater than in the worked sections. The average weight of individual trout in unworked sections was 0.38 pound; in worked sections, 0.20 pound. The stream bed material in all sections was composed mainly of rubble (2 to 10 inches in diameter) suitable as cover for small fish. Cover for large trout was almost absent in the worked sections. Whitefish were more numerous in the worked sections; however, 6.6 pounds more per surface acre were captured in unworked sections.

The average weight of individual whitefish in unworked sections was 0.77 pound; in worked sections, 0.20 pound. Non-game fish were more abundant both numerically and in weight in the worked sections. The average weight of individual non-game fish was higher in the unworked section.

Two sections of Rock Creek were electrically sampled in 1957 prior to channel working projects. Section number one was in the same area as the Red Lodge section (Table 1). The stream in section one was diverted into an abandoned channel where pools, undercut bank, and brush cover were left undisturbed, however, the boundaries were not identical.

Section three sampled in 1958 (Table 3) was also sampled in 1957 (Table 1, Allen Ranch Section). Using identical census methods, the following changes in fish population were observed in 1958: trout 75.1 pounds per acre decrease, whitefish 19.0 pounds per acre decrease, and non-game fish 0.5 pounds per acre increase. Between years a dike of stream bed materials was built that covered the stream bank (Fig. 1). No other changes were observed which would account for such a decrease in game fish. Similar decreases in fish population were observed following removal of brush cover and undercut bank in Trout Creek, Gallatin County, Montana, (Boussu, 1954).

The 1957 flood resulted in damage almost entirely within the Rock Creek flood plain. The writers believe that the flood aggravated a condition created when the land was cleared or overgrazed in the flood plain. Loss of the woody vegetation on stream banks and the

adjacent flood plain through land clearing and livestock use appear to be the basic cause for flood damage.

Six locations were selected to observe woody vegetation density and width of eroded stream channels in the lower 40 miles of Rock Creek. These were selected in relation to various amounts of land use within the flood plain. Woody vegetation (except mature cottonwood trees) was recorded in a series of 15 quadrats measuring 6.6 feet on a side, having an area of 0.001 acre. Fifteen quadrats were observed from each location. A starting point was randomly selected along the eroding side of the stream meander. Five rows of three quadrats each were laid out perpendicular to the bank. The rows were 50 feet apart, quadrats in each row were 20 feet apart. The first quadrat in each of the five rows was located with one side on the stream bank. Woody vegetation was recorded as seedlings or small shrubs (under 1 foot high); and large shrubs (1 to 14 feet high). Density of trees (15 feet or higher) was determined by 0.2 acre quadrats coinciding with the area where each series of 15 shrub quadrats were located. From this information the number per acre was estimated. All vegetative quadrats were observed prior to the growing season in 1959. The average eroded channel width was obtained along the stream where vegetative quadrats were observed. Results show a relationship between eroded channel width and woody vegetation density (Table 4). Where woody vegetation is scarce or in areas where vegetation is mainly grass and weeds interspersed with mature cottonwood trees, considerable lateral movement of the stream occurs during

peak water discharge periods. During such periods, the U. S. Geological Survey has recorded water velocities approaching 15 feet per second.

Other observations indicate channel width is influenced by erodability of stream banks, and vegetation and roots act as powerful binding agents for stream bank materials (Leopold and Wolman, 1957). Also, lateral migration of a stream across its flood plain should take place with little change in width of the stream channel (Wolman and Leopold, 1957).

Conclusions

A deterioration in quality and quantity of trout habitat is taking place in Rock Creek. In most cases the Fish and Game Department has no control over factors responsible for the deterioration. An active public education program appears one way of minimizing adverse water and watershed uses. In the case of Rock Creek, the annual $2,000 expenditure for artificial fish stocking might be used to investigate effects of land uses in the flood plain and a fishermen access program. Trout stream management has placed much emphasis on artificial propagation and imposing fishing regulations, too little recognition has been given factors that make it possible for a stream to produce wild trout populations.

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Summary

The middle portion of Rock Creek is valuable for wild trout production. Wild trout were naturally maintained and provided fishing following discontinuence of artificial propagation. Government and private stream channel clearance and realignment projects resulted in a decrease in trout habitat and wild trout abundance. Rate of stream bank erosion and lateral stream movement is believed influenced by woody vegetation in the flood plain. Recommendations for management and investigation include purchase of flood plain land and investigation of land use in the flood plain in relation to trout habitat and abundance.

Table 1. Number, weight, and pounds of fish per acre captured in Rock Creek during electric stream census, September 11, 1957.

Section and Type of Fish	Number	Weight	Pounds Per Acre
Red Lodge section			
Trout	46	9.98	36.6
Whitefish	2	2.41	8.8
Non-game fish	0		
Total	48	12.39	45.4
Allen Ranch section			
Trout	123	26.10	114.0
Whitefish	16	4.83	21.1
Non-game fish	10	1.52	6.6
Total	149	32.45	141.7

Table 2. Linear measurements of channel clearance and realignment work detrimental to trout habitat in the lower 40 miles of Rock Creek.

Description of changes	Location and amount (feet)	
	Middle portion	Lower portion
1. Bulldozing out channel and building single dike of stream-bed material within present channel, or on stream bank resulting in loss of brush cover and undercut bank, (Fig. 1).	36,474	21,281
2. Same as 1 but with dikes on both sides of channel, (Fig. 2).	9,849	4,133
3. Bulldozing fallen trees from channel, removing obstructions that form pools, filling pools with bed material, with little alteration of stream banks, (Fig. 3).	2,615	14,568
Total	48,939	39,982
Total miles ...	9.26	7.57

(Fig. 4 Unworked stream channel)

Table 3. Number, weight, and pounds of fish per acre captured in worked and unworked sections of Rock Creek during electric stream census, September 3, 4, 5, 1958.

Worked				Unworked			
Section number and type of fish	Number	Total Pounds	Pounds Per Acre	Section number and type of fish	Number	Total Pounds	Pounds Per Acre
Section 3				Section 1			
Trout	60	8.24	38.9	Trout	23	13.26	48.9
Whitefish	5	.39	2.1	Whitefish	0		
Non-game fish	16	1.52	7.1	Non-game fish	0		
Total	81	10.15	48.1	Total	23	13.26	48.9
Section 5				Section 2			
Trout	18	4.51	18.0	Trout	28	15.57	64.7
Whitefish	30	7.28	29.1	Whitefish	5	2.70	11.2
Non-game fish	473	35.21	140.8	Non-game fish	0		
Total	521	47.00	187.9	Total	33	18.27	75.9
Section 6				Section 4			
Trout	33	9.49	29.3	Trout	73	18.75	86.0
Whitefish	53	9.63	29.7	Whitefish	22	18.13	83.2
Non-game fish	260	75.20	232.0	Non-game fish	44	44.29	203.1
Total	346	94.32	291.0	Total	139	81.17	372.3
Totals				Totals			
Trout	111	22.24		Trout	124	47.58	
Weighted average			28.3	Weighted average			65.3
Whitefish	88	17.30		Whitefish	27	20.83	
Weighted average			22.0	Weighted average			28.6
Non-game fish	749	111.93		Non-game fish	44	44.29	
Weighted average			142.4	Weighted average			60.8

Table 4. Estimated number of woody plants per acre and average eroded stream channel width at various locations on Rock Creek.

Location	1	2	3	4	5	6
Seedling, small shrubs	440	20,100	0	28,000	5,000	29,900
Large shrubs	280	27,100	266	15,100	2,130	15,060
Trees	275	255	130	385	125	275
Total number	995	47,455	396	43,485	7,255	45,235
Stream channel width (feet)	105	77	300	82	250	90

Figure 1. Appearance of stream channel after clearance and realignment work at electric stream census section 3.

Figure 2. Appearance of stream channel after clearance and realignment work at electric stream census section 6.

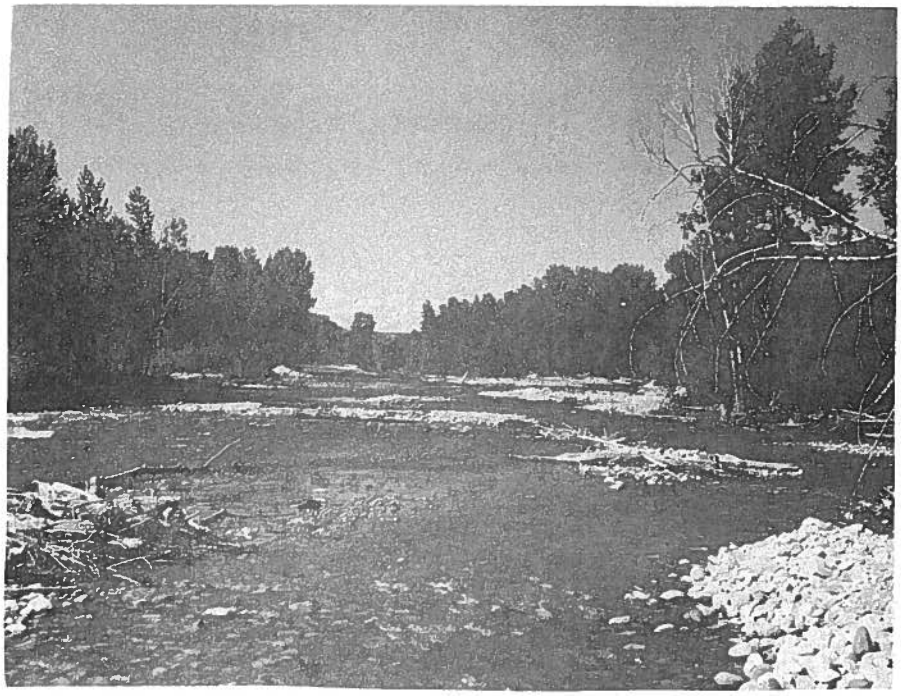

Figure 3. Appearance of stream channel after clearance work.

Figure 4. Unworked stream.

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