MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB PROGRESS REPORT

State Montana

Project No. F-9-R-18 Title Inventory of the Waters of the Project

Job No. I-a Area

Period Covered July 1, 1969, to June 30, 1970

ABSTRACT

Trout population estimates were conducted on a section of the Big Hole River near Melrose. A total of 86 yearling and older brown trout were present per 1,000 feet of stream, with few yearlings present in relation to older trout. Wild rainbow trout made up 30% of the total wild trout population. Estimates of hatchery rainbow trout indicated a 90% reduction in numbers from the period June-July through September. Water temperatures recorded on the Big Hole River at Reichle were in the 70's during the latter part of August, with the maximum temperature recorded being 73°. Spring and fall estimates of trout were conducted on Poindexter Slough and compared with 1968 estimates. The total standing crop for May and October was 353 trout weighing 207 pounds per 1,000 feet of stream and 249 trout with a weight of 187 pounds per 1,000 feet, respectively. Over-winter mortality for brown trout was 67.1%, as compared to 13.1% for rainbow. Mortalities for the summer period were 21.2 and 44.8% for brown and rainbow trout, respectively. Population estimates for the brook trout population in Blacktail Creek revealed that age group 0 and I fish were more abundant in 1969 than in 1968, while the number in age group II and older was nearly identical. An estimate of wild Yellowstone cutthroat trout in the Shields River indicated a standing crop of 221 cutthroat weighing 33 pounds per 1,000 feet of stream. Three gill nets fished overnight in Ruby Lake produced a total of 333 fish. Suckers accounted for nearly 84% of the catch, with white suckers predominant (81.7% of the total). Completion of the survey of the effects of the mining industry to the streams in the Jefferson River drainage revealed that of 83 streams on which mining claims were filed, 51 had stream bank or channel alterations totaling 70.5 miles. Placering occurred on 31 of the 51 altered streams and accounted for 89.4% of the total alterations.

BACKGROUND

As human population numbers explode, and as our industrial society continues to provide the essentials for the "good life", more and more demands are being placed on outdoor recreational facilities. In Montana, fishing is already the most important participating outdoor recreation activity, with over 25% of the people traveling for recreation being fishermen. Inventories of our lakes and streams yield information necessary to provide a basis for sound management recommendations. Information obtained from these surveys is important in dealing with land and water development projects. If we are to maintain and enhance our sport fishery, we must continue to monitor changes in our lakes and streams so, where applicable, recommendations can be made for protection, restoration or improvement of the habitat or for other fisheries management measures.

OBJECTIVES

The purpose of this job is to determine the physical, chemical and biological characteristics of the waters of importance to the recreational fishery of the project area.

PROCEDURES

Fish populations were sampled by gill-netting and electrofishing. Electrofishing gear with an output of 0-500 volts variable direct current was utilized in censusing stream and river fish populations. The gear was fished either from a fiberglas boat with a stationary negative electrode attached to the bottom of the boat, or from the bank of smaller streams. The captured fish were measured, weighed, marked and released near the capture site.

Population estimates were computed, using Chapman's modification of the Petersen estimator (formula 3.9, Ricker, 1958). Confidence intervals at the 95% level were computed, using formula 6 of the Michigan Institute for Fisheries Research (1960). Age composition and mortality rates for the fish populations were determined by the method outlined by Vincent (1969). Where sample sizes necessitated the capture of more fish, multiple mark and/or recapture runs were used. Fish were marked with partial fin clips or tagged with Floy Tag Co. anchor tags inserted behind the dorsal fin.

Taylor seven-day recording thermographs were operated on the Big Hole River from June through September and on the Yellowstone River from May through September. The recording sheets were changed weekly and the daily maximum-minimum temperatures were tabulated. All water temperatures were recorded in Farenheit degrees.

Stream channels influenced by mining operations in the Jefferson River drainage were measured with a 100-foot tape and extensive alterations were delineated from aerial photos. Stream alterations resulting from mining activities were categorized by Wipperman (1969b) as follows:

Placering - a form of mining in which a superficial gravel or similar deposit is washed to precipitate the mineral.

Mine or mill tailings - a fine pulverized by-product from ore-producing plants, or over-burden and discarded materials resulting from extraction or exploration of ore-bearing materials.

Mine-mill development - alteration or degradation of stream banks or channel, caused by roads, urban development, settling ponds, garbage dumps, etc.

Channel relocation - replacement of the natural stream with a length of man-made channel.

Conditions affecting stream ecology in ways other than physical alteration, i.e., acid mine effluents and sedimentation, were also recorded. Volume of flow (cfs) of each stream was measured in the field, and streams were rated by flow on the basis of a modified rating table as follows:

Size 1 - over 1,500 cfs
2 - 500 to 1,500 cfs
3 - 100 to 500 cfs
4 - 20 to 100 cfs
5 - 5 to 20 cfs
6 - less than 5 cfs, permanent
7 - goes dry in dry years

FINDINGS

Streams

Big Hole River

A 22,500-foot section of the Big Hole River from the Melrose bridge downstream was electrofished in September, 1969. A total of four marking runs were made; two utilized a mobile positive electrode and two a stationary boom arrangement with a positive electrode on each side of the boat. Of three recapture runs, two were with the mobile positive electrode and one with a stationary boom arrangement. The mobile electrode runs averaged 187 trout per trip, while the boom averaged 103. The mobile electrode was more efficient in capturing trout in brushy and undercut types of habitat.

A total of 86 yearling and older brown trout were present per 1,000 feet of stream (Table 1). Few yearlings were present in relation to older trout. Age group III was the dominant age group both in number and pounds per 1,000 feet. Further study of this section will be necessary to evaluate the small percentage of yearlings present.

Wild rainbow trout accounted for 30% of the total wild trout population (Table 2). A slightly higher percentage may have been present, as a negative bias was introduced by a low number of recaptures.

Approximately 370 hatchery rainbow trout per 1,000 feet of stream were planted within the section in June and July. Hatchery rainbow were distinguished in the field by eroded or bent fin characteristics. By late September, 35 hatchery rainbow trout were estimated per 1,000 feet (Table 2), indicating a 90% reduction in the section for the two- to three-month period.

A total of 333 brown and 59 wild rainbow trout, 10 inches or greater in length, were tagged with Floy anchor tags. Signs in public places, newspaper reports and radio announcements were used to publicize tag return locations. For the period September through November, five tags from brown trout were returned by fishermen, for a tag return rate of 1.5%. There were no returns from rainbow trout. Even if it were assumed that only a small percentage of tags were returned, the fisherman harvest was not substantial during this period.

TABLE 1. Number and pounds of brown trout per 1,000 feet in a 22,500-foot section of the Big Hole River in September, 1969

Age group	I	II	III	IV	V	Total	95% C. I.
Number	14	24	28	17	3	86	±28
Pounds	4	20	51	42	8	125	

TABLE 2. Population estimates of wild and hatchery trout per 1,000 feet in a 22,500-foot section of the Big Hole River in September, 1969

Species	Brown trout	Rainbow trout	Hatchery rainbow trout
Number	86 ±28 1/	35 ±27	35 ±12
Pounds	124	29	14

1/ 95% confidence interval.

The five-day average maximum water temperatures at the Reichle station, located about 10 miles downstream from Glen, are graphed in Figure 1. The period of thermograph operation was from August through September. Water temperatures were over 70° F. during the latter portion of August. The highest temperature recorded was 73° F. on August 23. Maximum temperatures ranged between 72° and 73° F. for a five-day period while minimum temperatures during the same period ranged from 60.5° to 62° F.

Poindexter Slough

Poindexter Slough is located three miles from Dillon, and due to its location, the availability of access and good trout populations, it is considered one of the better trout streams in the area. Flows during the winter and spring are primarily from springs throughout the stream, while a headgate on the Beaverhead River regulates flows during the summer.

A 3,200-foot section was electrofished in May and October, 1969, to determine standing crops of trout and to evaluate mortality through the past winter and summer periods. Brown trout comprised 63.7 and 71.0% of the total trout population in May and October, respectively (Table 3). Yearling brown trout accounted

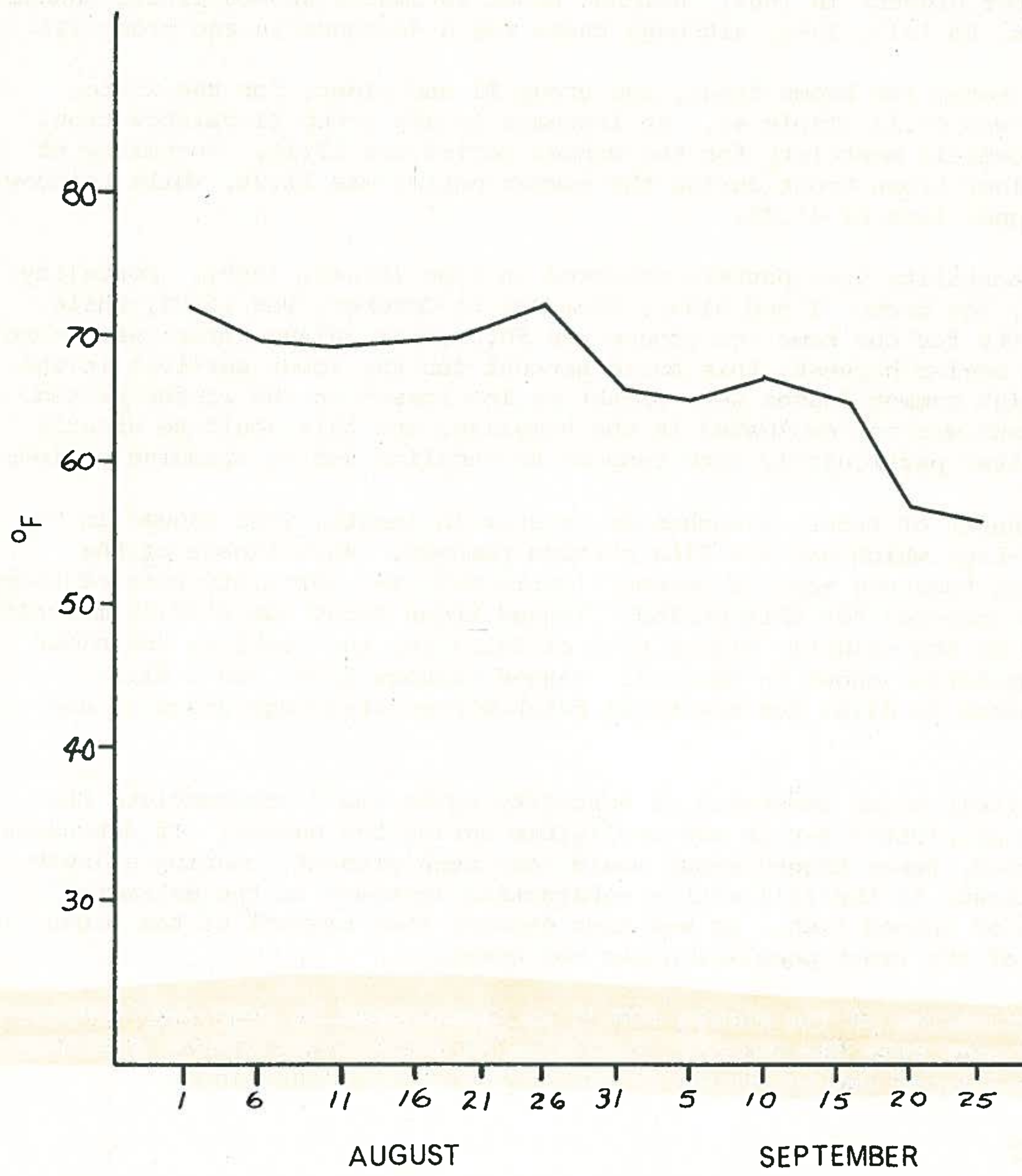

FIGURE 1. Five-day average maximum water temperatures for the Big Hole River (Reichle station) for August and September, 1969.

S69
1935

for 20.0 and 28.2% of the total brown trout populations in the spring and fall, respectively, while age group II accounted for 52.8 and 49.7% for the respective periods.

A comparison of fall, 1968, populations with fall, 1969, populations shows a decrease in the number and weight of brown trout in fall, 1969. This could have been more pronounced had yearlings been estimated in the fall of 1968. The number and weight of age group II brown trout in the fall of 1968 was nearly double the number present in 1969. Rainbow trout estimates showed little change from fall, 1968, to fall, 1969, although there was a decrease in age group III.

Mortality rates for brown trout, age group II and older, for the winter period in 1969 was 67.1% (Table 4). An increase in age group II rainbow trout occurred, and overall mortality for the winter period was 13.1%. Mortality of yearling and older brown trout during the summer period was 21.2%, while rainbow trout had a higher loss of 44.8%.

The same mortality rate pattern occurred in 1968 (Elser, 1969). Mortality of brown trout, age group II and older, from May to October, was 15.9%, while rainbow mortality for the same age groups was 50.0%. If rainbow trout were more susceptible to angler harvest, this could account for the lower survival in the summer. The high summer losses were offset by low losses in the winter period. Spawning movement was not evaluated in the sampling, and this could be greatly affecting results, particularly with respect to sampling during spawning periods.

A known number of trout, 9 inches or greater in length, were tagged in May with plastic T-tags which had the flag portion removed. An estimate of the number retaining tags was made in October (Table 5). The mortality rate of tagged trout was then computed for this period. Tagged brown trout had a 12.4% mortality rate, compared to the slightly higher rate of 21.2% for the yearling and older brown trout population shown in Table 4. Tagged rainbow trout had a 51.2% mortality compared to 44.8% for the total rainbow population age group II and older.

The relatively close agreement of mortality rates would substantiate the fact that loss of plastic T-tags was negligible during the summer. If extensive loss had occurred, fewer tagged trout would have been present, causing a lower population estimate in the fall with a substantial increase in the estimated mortality rate of tagged fish. It was also evident that harvest of the brown trout segment of the trout population was not great.

Trout populations of the slough should be inventoried at quarterly intervals throughout the year with the specific objective of opening the stream as a winter fishery and evaluating the resulting effect on the trout population.

Blacktail Creek

An estimate of the trout population in the control section (1,090 feet) of the Blacktail Creek dewatering study area (described by Wipperman, 1969a) was computed from October electrofishing data (Table 6). Age groups were delineated by length frequency analysis (age group 0) and previous fin clips (age group I). Trout II and older were placed in age group II+.

TABLE 3. Population estimates, showing number and pounds per 1,000 feet, of rainbow and brown trout for a 3,200-foot section of Poindexter Slough (95% confidence in parentheses)

Species	Age group	Fall, 1968 1/		Spring, 1969		Fall, 1969	
		Number	Pounds	Number	Pounds	Number	Pounds
Brown trout	I	-	-	45	5	50	18
	II	153	135	119	73	88	70
	III	44	124	56	53	32	44
	IV+	5	13	5	8	7	12
Total brown trout		202 2/ (±38)	272	225 (±47)	139	177 (±33)	144
Rainbow trout	I	-	-	46	5	27	8
	II	26	14	37	18	27	17
	III	27	23	39	37	17	17
	IV+	2	3	6	8	1	1
Total rainbow trout		55 2/ (±13)	40	128 (±43)	68	72 (±34)	43
Grand total		257 2/	312	353	207	249	187

1/ Elser, 1969.
2/ Total for age group II and older.

TABLE 4. Mortality rates for rainbow and brown trout in Poindexter Slough in 1969

	Winter period October - May			Summer period May - October	
Age group	Brown trout	Rainbow trout	Age group	Brown trout	Rainbow trout
II-III	.633	.000 (1.53) 1/	I	.000 (1.13) 1/	.419
III-IV+	.901	.767	II	.262	.277
weighted mean II-IV+	.671	.131	III	.424	.428
			IV+	.000 (1.64) 1/	.900
			weighted mean I-IV+	.212	.448

1/ An increase occurred.

TABLE 5. Mortality rates from population estimates of tagged rainbow and brown trout in Poindexter Slough from May to October, 1969 (95% confidence interval in parentheses)

Species	Number tagged in May	Number estimated in October	Mortality rate
Brown trout	169	148 (116-181)	.124
Rainbow trout	86	42 (14- 80)	.512

TABLE 6. Estimated number of brook trout per 1,000 feet of stream in the control section on Blacktail Creek (pounds per 1,000 feet in parentheses)

Age group	Fall, 1968 1/	Fall, 1969
0	347 ±82 2/ (4.8)	666 ±125 (7.3)
I	106 ±31 (8.3)	141 ± 7 (9.9)
II+	145 ±22 (37.6)	146 ± 31 (41.1)

1/ Wipperman, 1969a.
2/ 95% confidence interval.

Higher numbers of age group 0 and I brook trout were present in 1969 than in 1968, but the number in age group II+ was nearly identical. Fisherman-related mortality would be negligible, as this area has been closed to fishing for over five years. If only natural mortality factors were acting on the population, it would follow from McFadden's (1961) work on brook trout that fluctuations in numbers of age group 0 and I would occur as mortality from a density-dependent relationship, while age group II+ trout would have a density-independent relationship with respect to mortality, and numbers should remain somewhat stable if no unnatural mortality factors or habitat alterations were affecting the population.

Rainbow trout increased from 18 in September, 1968 (Wipperman, 1969a), to 74 in 1969. Whitefish numbers were identical for both years (28).

This study area should be reopened to fisherman use and the trout populations followed to determine the effects of the liberalized brook trout limit on a population that has been unharvested for five years.

Shields River

A section of the Shields River was sampled to obtain parameters for a wild Yellowstone cutthroat trout population. The section was located approximately 20 miles northwest of Wilsall (Township 5 North, Range 10 East, Section 24) and was 1,500 feet in length. The average width of the section was 16 feet, with a pool-riffle periodicity of 6.9 times the average width (a pool every 111 feet). Cover, including overhanging brush, undercut banks and debris was measured, revealing a total of 528 feet^2 of usable trout cover per 1,000 feet of stream.

The section supported a total of 221 wild Yellowstone cutthroat trout per 1,000 feet of stream (Table 7). Young-of-the-year and yearling fish made up nearly 80% of the total cutthroat population number, indicating good age-class distribution. Brown trout in this section added five fish weighing two pounds, for a total standing crop of 226 trout weighing 35 pounds per 1,000 feet of stream. Another section of the Shields River near Wilsall, censused in 1967, revealed a predominantly brown trout population (89.5%), with age III fish comprising over 50% of the total number and yearlings and two-year-olds adding only 11.6 and 5.1%, respectively (Wipperman and Elser, 1968).

$\frac{111}{16} = 6.9$

TABLE 7. Estimated numbers of Yellowstone cutthroat trout from 1,500 feet of the Shields River, expressed as numbers and pounds per 1,000 feet of stream. Confidence intervals at the 95% level

Age group	Number	% of total	Weight	% of total
0	104	47.1	3	9.1
I	69	31.2	5	15.2
II	30	13.6	8	24.2
III	11	5.0	10	30.3
IV	7	3.1	7	21.2
Total	221	100.0	33	100.0
Confidence interval	±69			

Yellowstone River

Two thermograph stations were maintained on the Yellowstone River, May-September, 1969. The stations were: Corwin Springs, located 8.2 river miles below the Yellowstone National Park boundary; and Carter's Bridge, 46.5 miles downstream from the Corwin Springs station and 6.4 miles upstream from Livingston. The Carter's Bridge station is approximately four miles upstream from the proposed Allenspur Dam site.

The five-day average maximum water temperatures for the two stations are shown in Figure 2. Temperature profiles were similar to those reported in 1968 (Elser, 1969). The highest temperatures recorded in 1969 at Corwin Springs were 65° in mid-August, compared to 62° for the same time in 1968. At Carter's Bridge, the maximum temperatures recorded were 67° in early August, compared to 65° recorded in late July, 1968.

Lakes

Ruby Lake

Ruby Lake is located seven miles south of Alder, Montana. Full storage capacity is listed as 38,950 acre feet, but this fluctuates in the summer, as heavy drawdown occurs during the irrigation season. Consequently, the lake does not have adequate boat launching areas and the fishing pressure is light compared to lakes of the same size in the general area. Heavy sediment deposition is prevalent in the upper reaches of the lake.

Three 125-foot experimental gill nets were fished overnight in November, 1969. All nets were bottom sets. Suckers accounted for nearly 85% of the catch (Table 8), with white suckers predominating (81.7% of the total catch). Rainbow trout

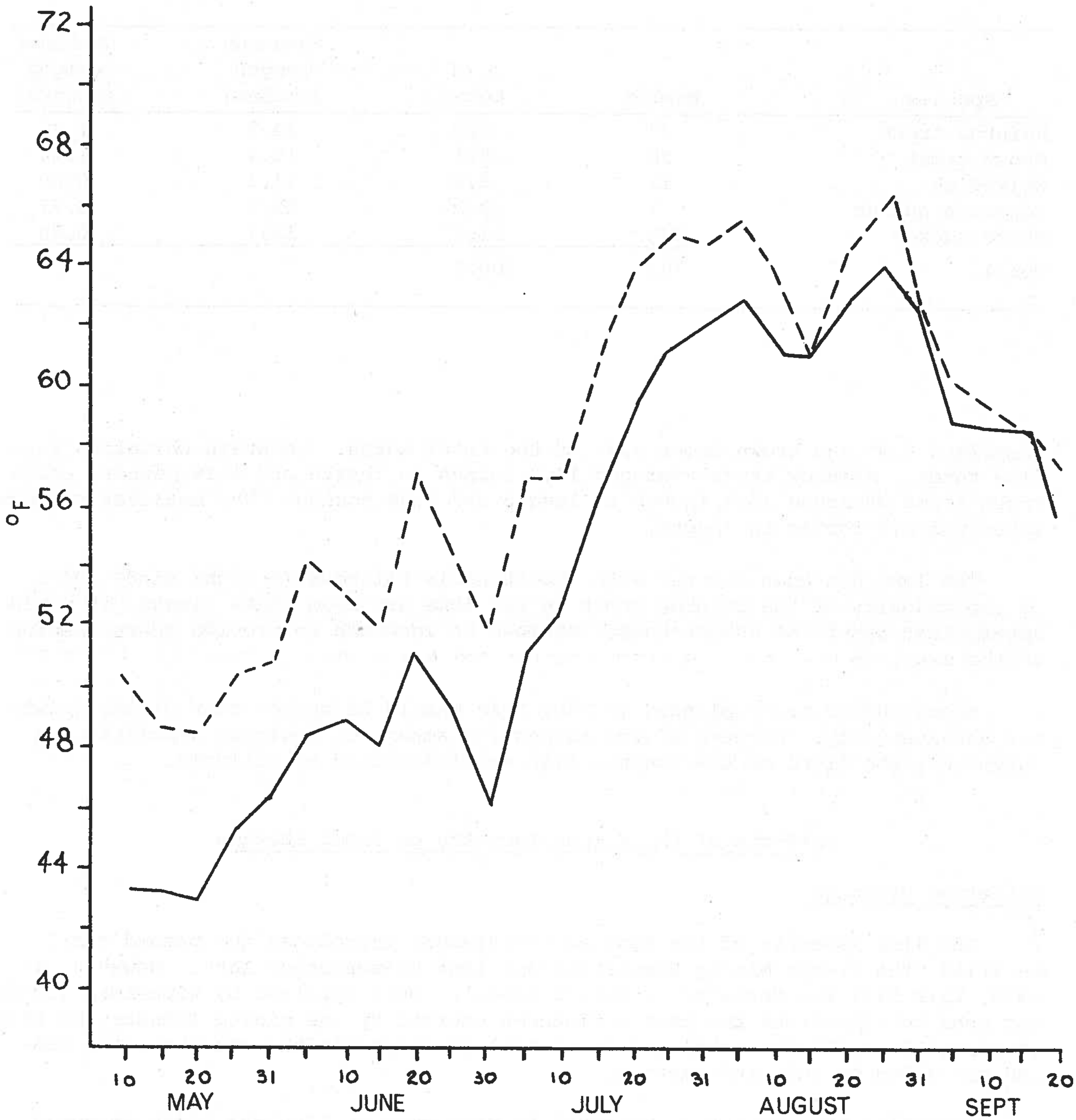

FIGURE 2. Five-day average maximum water temperatures from the Yellowstone River at Carter's Bridge (broken line) and Corwin Springs (solid line), 1969.

TABLE 8. Summary of three gill-net sets from Ruby Lake, November, 1969

Species	Number	% of total	Average length (inches)	Average weight (pounds)
Rainbow trout	23	6.9	14.3	1.28
Brown trout	18	5.4	15.4	1.44
Whitefish	13	3.9	11.5	0.60
Longnose sucker	7	2.1	12.0	0.77
White sucker	272	81.7	12.7	0.79
Total	333	100.0		

comprised 6.9% and brown trout 5.4% of the total catch. Mountain whitefish were also taken. Rainbow trout averaged 14.3 inches in length and 1.28 pounds, while brown trout averaged 15.4 inches in length and 1.44 pounds. The smallest rainbow taken was 8.9 inches in length.

The lake has been planted with subcatchable rainbows (5-inch) since 1967. If the majority of the rainbow trout in the lake are from these plants, it would appear that growth of subcatchable rainbows is adequate to provide sport fishing in the lake.

Subcatchable trout planted in Ruby Lake should be marked to evaluate growth and survivability. Because of the increasing amount of sediment deposition in Ruby Lake, the trend of the nongame fish species should be followed.

Effects of the Mining Industry on Trout Streams

Jefferson Drainage

The 41st Assembly of the Montana Legislature introduced and passed a bill entitled "The Dredge Mining Regulation and Land Preservation Act". However, in 1970, this bill was declared unconstitutional. Data obtained by Wipperman (1969b) was used to illustrate the past influences exerted by the mining industry on trout streams. Surveys were completed in several drainages in the study area in 1969 and are added to this information.

Combining the parameters measured by Wipperman in 1968 and those measured in 1969 revealed that of 83 streams on which mining claims were filed, 51 had streambank or channel alterations totaling 70.5 miles. A summary of streams altered by mining activities and surveyed in 1968 and 1969 is presented in Tables 9 and 10, respectively.

Placering occurred on 31 of the 51 altered streams and accounted for 89.4% of the total alterations in terms of stream length (Table 11). Stream sedimentation resulting from placering was prevalent on 17.5 miles of Grasshopper Creek

(Wipperman, 1969b). Mine-mill tailings caused extensive sediment deposition in several streams, primarily the North Boulder River, Basin Creek, Elkhorn Creek and High Ore Creek, a tributary of the North Boulder River, where the stream was cutting directly through large tailing piles.

Highly acidic effluents were found on Elkhorn Creek, a tributary of the Wise River and Uncle Sam Gulch, a tributary of Cataract Creek. Chemical analyses revealed pH determinations of 4 or less from the effluent at the Crystal Mine on Uncle Sam Gulch.

Biological information should be gathered on streams that have acid effluents entering from mine shafts or tailing piles to determine the length of stream affected by the effluents.

RECOMMENDATIONS

Stream and lake inventories should be continued, with particular emphasis placed on larger trout streams such as the Big Hole River. Information obtained from the surveys is important for dealing with land and water development projects and is a basis for management of the sport fishery.

TABLE 9. Streams altered by mining operations in the Jefferson River drainage (surveyed in 1968) 1/

River drainage Stream (code No.)	Location T.	Location R.	Stream size	Type of alteration(s)	Length of alteration(s) (ft.)	Remarks
Beaverhead						
Grasshopper Cr. (01-3100)	8S	11W	4	Placering	41,135	Sediment problem. Placer abandoned 1967.
	8S	10W		Channel relocation	2,340	
Dyce Cr. (01-2340)	6S	12W	6	Placering	9,670	
West Fork	6S	12W	6	Placering	2,784	
Horse Prairie Cr.						
Jeff Davis Cr. (01-3700)	11S	13, 14W	6	Placering	25,377	Most of flood-plain placered.
Rattlesnake Cr. (01-6120)	6S	10W	5	Mill tailings	1,124	Sediment problem.
French Cr. (01-2800)	5, 6S	11W	6	Placering	5,780	
Watson Gulch (01-8060)	5S	11W	6	Placering	5,760	
Ruby River						
Alder Gulch Cr. (01-0040)	6, 7S	3, 4W	5	Placering	84,480	Most of flood-plain placered. Active placering, 1968.
Bachelor Gulch	7S	3W	6	Placering	2,790	
Brown's Gulch (01-0960)	6, 7S	3W	6	Placering	30,624	Active placering, 1968.
				Mine tailings	1,584	Sedimentation, active, 1968.
Granite Cr. (01-3080)	5S	3W	5	Placering	270	
Barton Gulch (01-0300)	7S	4W	6	Placering	4,750	
Bivins Cr. (01-0860)	5S	3, 4W	6	Placering	35,376	Active placers upper watershed.
California Cr. (01-1140)	5S	4W	6	Placering	8,705	Siltation problem.

TABLE 9. Continued

River drainage Stream (code No.)	Location T.	Location R.	Stream size	Type of alteration(s)	Length of alteration(s) (ft.)	Remarks
Beaverhead						
Idaho Gulch (01-3560)	7S	3W	6	Placering	1,714	Sedimentation, abandoned 1967.
				Channel relocation	1,310	
				Mine-mill development	310	
Mill Cr. (01-5020)	4S	4W	5	Mine-mill development	450	
Ramshorn Cr. (01-6080)	4, 5S	3, 4W	5	Placering	9,475	
				Channel relocation	1,000	
Currant Cr. (01-1840)	4S	4W	6	Mine-mill development	540	
Warm Springs Cr. (01-8020)	8, 9S	3W	5	Placering	3,090	
Wisconsin Cr. (01-8380)	4S	4W	5	Placering	2,500	
	3S	4W		Mill tailings	334	
Noble Cr. (01-5280)	3S	4W	5	Mill tailings	180	
Big Hole						
Big Hole R. (02-0450)	1, 2S	9W	3	Mine-mill development	1,240	Active.
Birch Cr. (02-0575)	5S	10W	5	Mill tailings	144	
N. Fork Big Hole R.						
Pioneer Cr. (02-4575)	3S	18W	6	Placering	2,340	
Nugget Cr. (02-4350)	3S	18W	6	Placering	720	
Trapper Cr. (02-6475)	2S	10W	5	Mine-mill development	2,110	Glendale millsite.
	3S	11W		Channel relocation	455	
			5	Mine-mill development	3,455	Hecla townsite - active, sedimentation.
	3S	10W	1	Mill tailings	990	

TABLE 9. Continued

River drainage Stream (code No.)	Location T.	Location R.	Stream size	Type of alteration(s)	Length of alteration(s) (ft.)	Remarks
Big Hole						
Sappington Cr. (02-5130)	3S	10W	6	Mine-mill development	815	Sediment from settling pond.
Wise River						
Elkhorn Cr. (02-2100)	4S	12W	5	Channel relocation	3,245	Acid effluent from mine shaft enters stream.
				Mine-mill development	1,200	
Jefferson						
S. Boulder River (10-6760)	2S	3W	4	Mill tailings	650	Sedimentation.
Willow Cr.						
Norwegian Cr. (10-5200)	2, 3S	2W	6	Placering	7,032	Sedimentation - mined in 1940-41.
N. Willow Cr.						
Cataract Cr. (10-1560)	2S	3W	5	Mill tailings	1,440	
Pony Cr. (10-5680)	2S	3W	6	Mine-mill development	360	Possible acidic effluent from mine shaft.
				Mill tailings	220	
N. Boulder River (10-0840)	6N	5W	4	Mine-mill development	381	
				Mill tailings	3,915	

1/ Wipperman, 1969b.

TABLE 10. Streams altered by mining operations in the Jefferson River drainage (surveyed in 1969)

River drainage Stream (code No.)	Location T.	Location R.	Stream size	Type of alteration(s)	Length of alteration(s) (ft.)	Remarks
Big Hole						
Big Hole River						
Camp Cr. (02-1000)	2S	8W	6	Placering	350	
Wickeyup Cr. (02-6925)	1S	8W	6	Mine-mill tailings	25	Acidic effluent enters stream.
Moose Cr. (02-4050)	1S	8W	6	Placering	1,650	Channel straightened while placering.
Rochester Cr.	2S	7W	6	Mill tailings	300	Sedimentation.
	3S	7W	6	Mill tailings	100	Sedimentation.
Jefferson						
N. Boulder River (10-0840)	6N	5W	4	Mill tailings	1,585 1/	
	6N	4W	4	Placering	4,500	
Basin Cr. (10-0160)	6N	6W	4	Mill tailings	240	
	7N	6W	4	Placering	17,720	
	7N	6W	4	Mine-mill development	135	
	7N	6W	4	Mine-mill tailings	210	
	8N	6W	5	Mine-mill development	300	
	8N	6W	5	Mine-mill tailings	1,500	Sedimentation.
Jack Cr. (10-3800)	7N	6W	4	Placering	1,680	Channel straightened.
Unnamed tributary	6N	3W	6	Placering	30	
Joe Bowers Cr.	7N	6W	5	Mine-mill tailings	320	

TABLE 10. Continued

River drainage Stream (code No.)	Location T.	Location R.	Stream size	Type of alteration(s)	Length of alteration(s) (ft.)	Remarks
Jefferson						
Cataract Cr. (10-1600)	6N	5W	4	Mine-mill tailings	630	Sedimentation.
	7N	5W	4	Mine-mill tailings	1,110	Acidic effluent from tailings pile.
Uncle Sam Gulch	7N	5W	6	Mine-mill tailings	300	Acidic effluent from mine shaft.
Elkhorn Cr. (10-2640)	6N	3W	6	Mine-mill tailings	1,125	Sedimentation. Active, 1969.
	6N	3W	6	Placering	1,300	
	6N	3W	6	Channel change	1,300 pre 1,100 post	
	6N	3W	6	Mine-mill development	150	
High Ore Cr.	6N	5W	6	Mine-mill tailings	2,100	Sedimentation and acidic drainage.
Little Boulder R. (10-4160)						
N. Fork (10-5120)	5N	5W	5	Placering	1,400	Channel straight-ened.
Lowland Cr. (10-4440)	7W	6N	4	Placering	11,300	
Kit Carson Gulch (10-1520)	5N	7W	5	Mine-mill tailings	40	
Big Pipestone Cr. (10-0680)	3N	6W	4	Mine-mill tailings	100	
Homestake Cr. (10-3480)	2N	7W	7	Placering	300	
Fish Cr. (10-2770)	1N	7W	5	Placering	8,350	Appeared active, 1968.

1/ Added to Wipperman's (1969b) total.

TABLE 11. Length of stream channel altered by mining operations in the Jefferson River drainage (surveyed in 1968 and 1969)

Mining operation	Number of streams	Miles affected	Percent of total
Placering	31	63.06	89.4
Mine-mill development	11	2.17	3.1
Mine-mill tailings	20	3.48	4.9
Channel relocation	6	1.83 (0.18) 1/	2.6
Total	68	70.54	100.0

1/ Figure in parentheses is loss of channel due to channel relocation.

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List of waters:

Big Hole River	02-0425
Blacktail Creek	01-0720
Poindexter Slough	01-9320
Shields River	22-5362
Yellowstone River	22-7070
Ruby Lake	01-9440

Note also the list of waters in Tables 9 and 10.

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