MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION
JOB PROGRESS REPORT

State Montana

Project No. F-9-R-25 Title Southwestern Montana Fisheries Study

Job No. I-b Title Inventory of Waters of the Project Area

Report Period May 1, 1976 to April 30, 1977

ABSTRACT

Fish populations of Upper and Lower Red Rock Lakes and several tributary streams were investigated. Large numbers of spawning grayling were found in Red Rock and O'Dell Creeks. Only four adult female grayling were captured in Tom Creek. No other spawning runs were found in any of the other tributaries. Grayling tagged during the spring spawning run in O'Dell Creek were later captured in Upper Red Rock Lake. No grayling were captured in Lower Red Rock Lake. This indicates that the primary year-around residency for grayling spawning in these tributaries is in the upper lake. Several management recommendations were made that may enhance the grayling population. An extensive creel survey accompanied the fish populations study and results are shown.

Trout and mountain whitefish populations were investigated in five sections of Ruby River upstream from Ruby Reservoir. Weekly maximum-minimum temperatures were collected from the Ruby and several tributary streams. This was part of a cooperative study to evaluate habitat problems in that section of river and to provide baseline data for management alternative decisions.

Extremely high concentrations of several heavy metals were found in sediment samples taken from the streambed of Grasshopper Creek. These were attributed to the stream eroding into an old historic gold mill tailings pond. These data aided in the decision to sponsor, with other cooperators, a streambank stabilization project designed to eliminate this source of heavey metals pollution.

Weekly staff gage and daily water temperature data were collected from several locations on Pintlar Creek in the Big Hole River drainage. Results are shown.

BACKGROUND

The streams of southwestern Montana are receiving ever-increasing fishing pressures. At the same time more demands for water, destruction of habitat and numerous sources of pollution makes the collection of scientific information paramount. Fisheries, water quality and habitat inventories furnish baseline data to aid management decisions and help evaluate our fish and other aquatic recreational resources.

OBJECTIVES AND DEGREE OF ATTAINMENT

The objectives of the job were:

1. To identify which tributaries of Upper and Lower Red Rock Lakes were being used by Arctic grayling for spawning, to determine the residency of these fish during non-spawning periods, and to make recommendations based on study data that could increase grayling populations.

2. To estimate fishing pressure and harvest in several of the Red Rock Lakes tributaries and area ponds.

3. To obtain trout and mountain whitefish population estimates in four sections of Ruby River and one in Warm Springs Creek and stream temperatures data from Ruby River and several of its tributaries.

4. To obtain weekly flow and daily water temperature data from selected sites in Pintlar Creek. Fish population data were to be collected only if time permitted.

All objectives stated above were accomplished except the collection of fish population data from Warm Springs Creek and weekly flow data from Pintlar Creek. Weekly staff gage data were collected from Pintlar Creek but were not calibrated to corresponding flows. Additional data collected included fishing pressure and harvest data from more waters in the Centennial Valley than planned; trout and mountain whitefish population data from one additional section of Ruby River; and heavy metals concentrations of sediment samples from numerous locations on Grasshopper Creek.

PROCEDURES

Electrofishing gear with an output of 0-500 volts variable D.C. was utilized in censuring fish populations where streams were of sufficient flow to use a boat to carry the gear. Electrofishing gear was fished from a fiberglass boat with a mobile positive electrode and a stationary negative electrode attached to the bottom of the boat in Tom Creek, because of its smaller size. A backpack unit (Smith-Root Type 5, 425 volts with a pulse frequency of 60/sec.) was used.

Captured fish were anesthetized, measured, marked and released near their capture site. Floy anchor tags where used were placed behind the dorsal fins.

Population estimates were computed using computer programs and calculations were made using modifications of "River Electrofishing and Fish Population Estimates" (Vincent, 1971a).

Experimental gill nets 125 feet long with graduated mesh sizes from 3/4 to 2-inch square were used to sample lake populations.

Fishing intensity and yields were estimated using a computer program based on Neuhold and Lu's Creel Census Method (1957).

Taylor seven-day recording thermographs were used in obtaining temperature data (^{o}F) in Pintlar Creek.

Temperatures in Ruby River and its tributaries were obtained using Taylor maximum-minimum thermometers.

Sediment samples in Grasshopper Creek were collected at selected sites in two inch diameter pipes driven to depths of six inches at random locations in each sample site.

FINDINGS

Interagency Fisheries Habitat Inventory in the Centennial Valley

The study was designed to investigate the present status of habitat and fish populations in the historically unique fisheries of the Centennial Valley of southwestern Montana. These data will provide a baseline for habitat management plans that can aid the maintenance and/or improvement of these fisheries. During the study special emphasis was placed on stream and lake populations, harvest rates and spawning migrations of Arctic grayling (Thymallus arcticus). Agencies participating in the study include the Bureau of Land Management, Soil Conservation Service, Forest Service, U. S. Fish and Wildlife Service[1/] and the Montana Department of Fish and Game. Each agency was assigned seperate portions of the data collection responsibilities. Additional assistance with gaining access to study areas on private land was given by the Beaverhead Conservation District and the Soil Conservation Service.

Historically, grayling were numerous throughout the valley. The abundance of grayling and cutthroat in the upper valley was noted by Brower (1897) and of grayling in Upper Red Rock Lake by Henshall (Bozeman Fish Cultural Station, letter, October 31, 1897). Large numbers of grayling in streams were noted by Blair (1897) and Henshall (1907).

Grayling spawning runs were documented as having occurred in 12 of the small tributaries to the mainstem stream and the lakes within the Centennial (Brown, 1938b; Nelson, 1954). According to early settlers, grayling were abundant until about 1935 to 1940 (Vincent, 1962).

Several factors may have been involved in the decline. Vincent in his comprehensive documentation of the Biogeographical and Ecological Factors Contributing to the Decline or Arctic Grayling . . . in Michigan and Montana stated that "grayling have a narrow ecological amplitude that limits their distribution to certain streams or certain sections of streams" and that "...misconceptions have arisen concerning its optimum habitat" primarily "... that swift mountain streams and very cold temperatures are required." He further stated that "there are indications that competition from recent invading fishes and man-caused habitat changes become limiting before water temperatures." The four major causes listed by Vincent as having caused the decline of grayling are climate, exploitation, introduction of exotics and habitat change and of the four only "...climatic deterioration would occur if man were not present." Vincent described the Centennial Valley stream situation thusly, "In recent years habitat deterioration in the valley has become worse. Overgrazing is pronounced and water diversion to the extent of nearly drying up the streams occurs." Since Vincent did his study, overgrazing by livestock has continued, farming practices are more intensive and grayling habitat deterioration persists.

1/ Special thanks to Service personnel for physical help, use of equipment and general cooperation above normal coordination levels.

Deterioration of lake habitat is also occuring as evidenced by the rapidly filling basin of the Upper Lake. Brower (1897) recorded depths of 10, 15, 20 and 25 feet. A more recent investigation by Paullin (1973) recorded the maximum depth of the Upper Lake as 7.1 feet. Since the majority of influent into the Upper Lake is surface runoff over easily decomposed sedimentary strata, large amounts of silt will continue to be deposited and the lake habitat for grayling will continue to deteriorate. At present, it appears that the rate of deterioration will continue at its present pace unless either drastic land use practices are employed and/or the lake is artificially deepened.

Streams

Large numbers of grayling in spawning condition were sampled in two study sections of Red Rock and O'Dell Creeks during the first week in June. Red Rock and O'Dell were the only two creeks where major grayling spawning runs were either observed or sampled. The only other stream where adult grayling were captured was Tom Creek. In streams or sections of streams that were not electrofished, observations were made in order to determine incidence and/or potential of grayling spawning. These observations were done at a time corresponding to grayling spawning in Red Rock, O'Dell and Tom Creeks.

Red Rock Creek - A total of 192 grayling were captured in Nelson Section #3 of Red Rock Creek (Fig. 1) on June 1, 1976, Three-year-old-and-older grayling were predominate in the spawning run and totalled 167 of the 192 captured (87%).

The sex ratio of all mature fish captured was 1.42 males to 1.00 females (Table 1). The sex ratio of three-year-old-and-older grayling (1.35:1,00) was slightly less than the overall ratio. Precocious two-year-old males increased the overall sex ratio. The sex ratio of the 19 mature two-year-olds captured in the sample was 2.17:1.00. However the chi-square value (X^2=0.84) of the differences between the sex ratios of two-year-olds and that of three-year-old-and-older grayling was not significant at the 95% level with these small sample sizes.

Six two-year-olds were classified as being immature. The smallest mature and immature grayling captured were 11.7 and 11.8 inches, respectively. No one-year-olds were captured.

Table 1. Arctic grayling numbers, mean length (in inches), mean weight (in pounds) and sex ratios captured during spawning migrations in Red Rock, O'Dell and Tom Creeks, Centennial Valley, June 1976.

Creek	Total	Mean Length	Mean Weight	Sex Ratio (Males : Females)
Red Rock	192	15.7	1.33	1.42 : 1.00 1/
O'Dell	67	15.5	1.39	1.58 : 1.00
Tom	4	16.8	1.76	0 : 1.00

1/ Sex ratios for Red Rock were calculated for 186 mature grayling including two-year-olds. Six two-year-olds were immature.

The length frequency "break" between two-and-three-year-olds was between 13 and 14 inches (Figure 2) but could not be exactly determined since some overlapping did occur.

Many grayling were sampled to determine their stage of spawning condition. All mature males were milting and females were ripe. Many of the females were mostly spawned out.

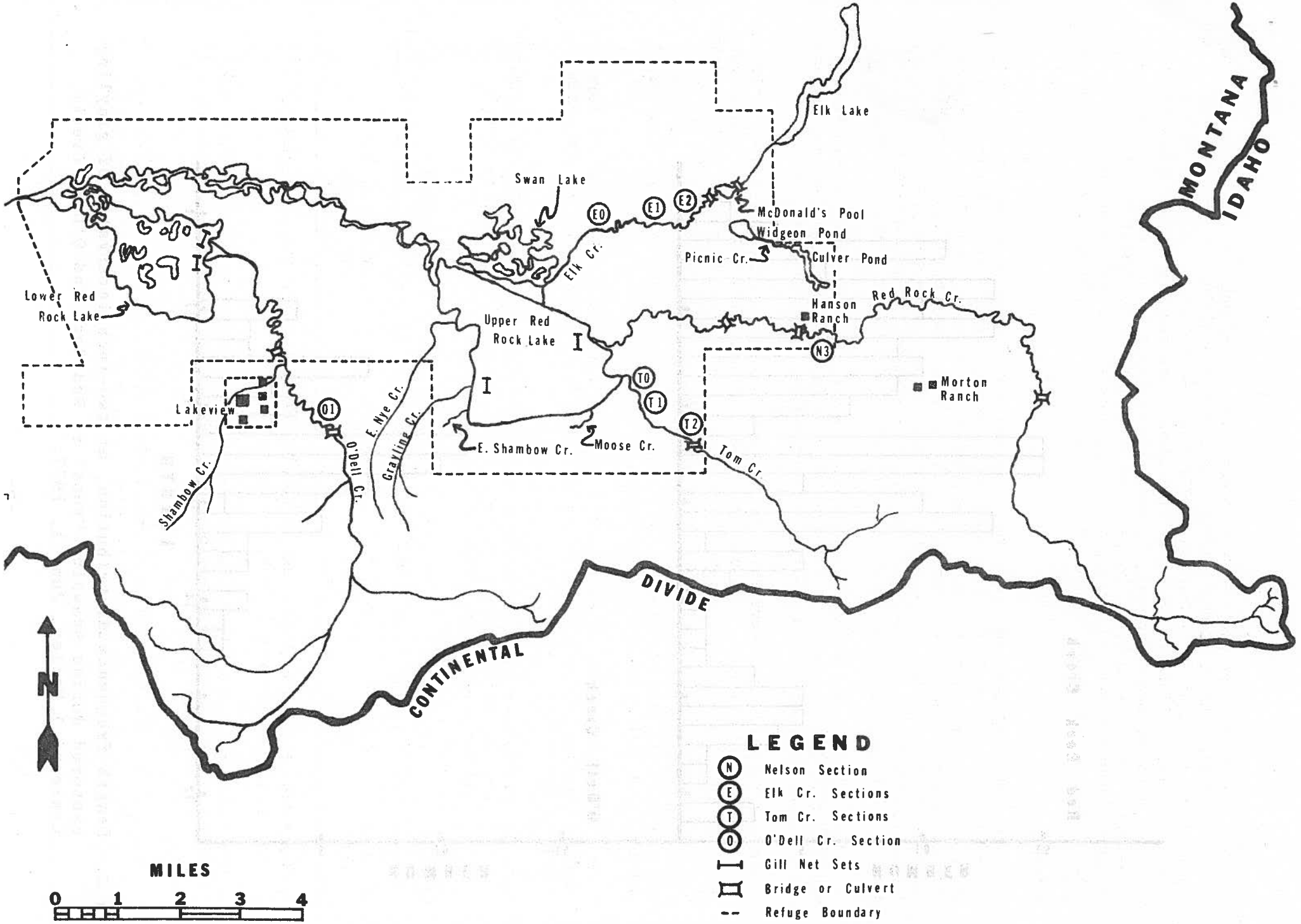

Figure 1. Stream study sections and lake gill net set locations in the Centennial Valley, Montana, 1976.

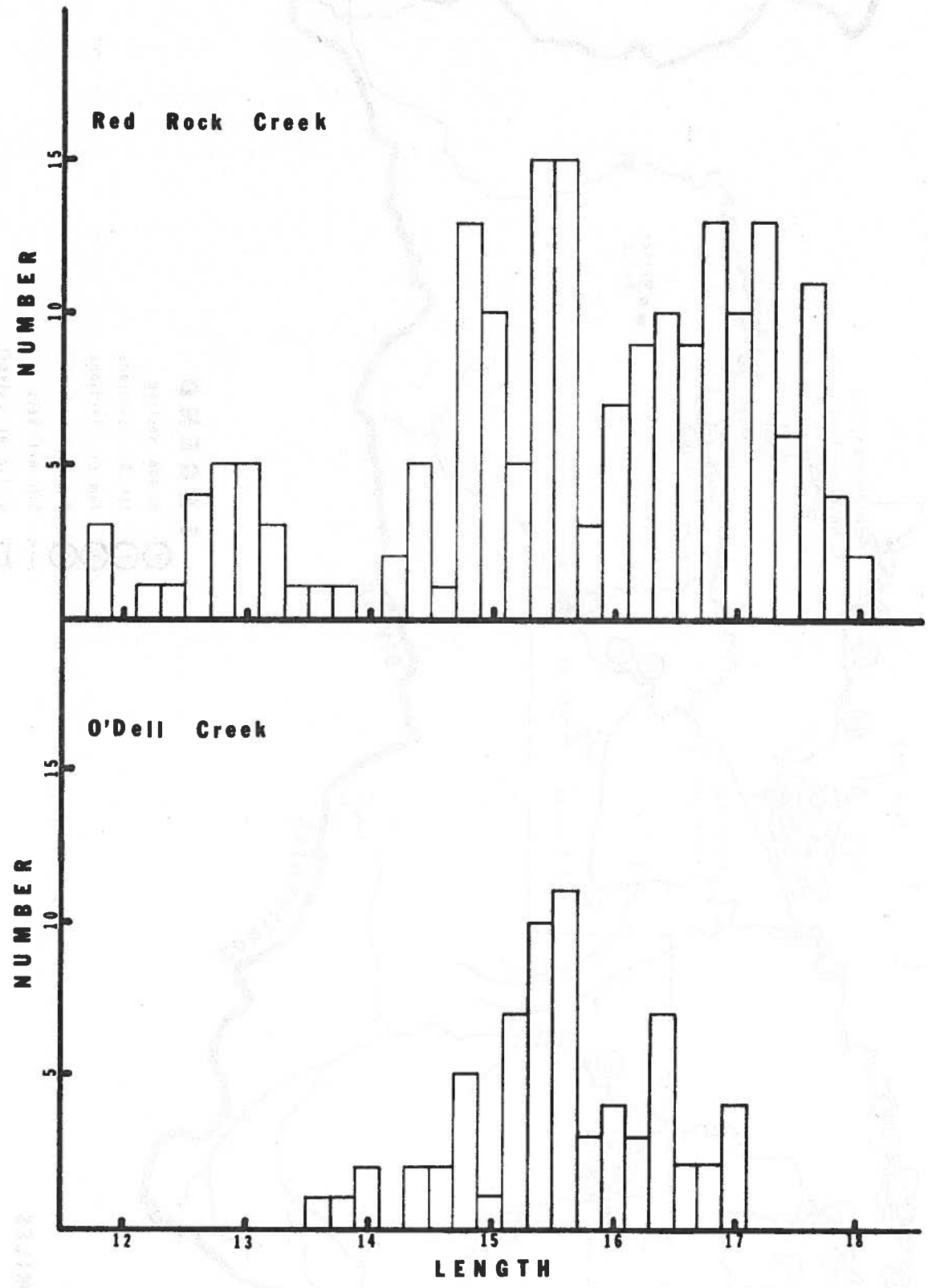

Figure 2. Length frequency distribution, at two-inch intervals, of grayling captured during spawning "runs" in Red Rock and O'Dell Creeks, Centennial Valley, June 1, 1977.

All captured grayling were tagged with red filamentous Floy T-tags for future identification.

Only two cutthroat trout were captured in this sample. Their average length and weight was 18.3 inches and 2.43 pounds, respectively. They were tagged for future identification.

On June 25, 1976 an approximate 500-foot section of Nelson #3 was again electrofished for demonstration purposes and only one grayling was captured indicating grayling emigration since the June 1 sampling.

O'Dell Creek - On June 2, 1976 O'Dell Creek Section #1 was electrofished. The section extended from the county road downstream to the Brigg's Ranch bridge.

Sixty-seven mature grayling, all in spawning condition, were captured. No grayling were captured in the first two subsections, a portion of stream that is generally dewatered each year for irrigation. From the third subsection to the end of the section, grayling were captured.

The length frequency distribution of this run differed from that of Red Rock Creek (Figure 2) in that no two-year-olds were captured in O'Dell. No hypothesis will be advanced for this difference until further investigation.

The sex ratio in the O'Dell Creek sample was 1.58 males to 1.00 females (Table 1). The chi-square value for the difference between the sex ratio of the O'Dell Creek sample and the three-year-old-and-older sample from Red Rock Creek was $X^2=0.27$ and not significant at the 95% level. Therefore, there is no evidence with these sample sizes that the sex ratio of Red Rock and O'Dell spawning runs of three-year-old-and-older grayling are significantly different.

All captured grayling were tagged with yellow filamentous Floy-tags for purposes of future identification.

Two rainbow-cutthroat hybrids and 39 brook trout were also captured. The brook trout averaged 7.8 inches and 0.23 pounds; and the hybrids averaged 11.6 inches and 1.17 pounds.

Tom Creek - On June 8, 1976, three sections of Tom Creek were electrofished. No grayling were captured in Sections 0 or 2 (Figure 1). In Section 1, four mature female grayling were taken. These four were between 16.5 and 17.1 inches in total length and had mean lengths and weights of 16.8 inches and 1.76 pounds, respectively.

In Section 0 old beaver dams appeared not to be high enough to block spawning runs. However, there was little gradient and therefore this section was little more than a settling basin for sediments. The potential for grayling spawning success appeared to be nil in this reach.

In Section 2, the gradient was greater than in Section 1 but appeared to be not so severe as to negate spawning. The reason for no grayling being captured in this section is not known. It does appear, however, that there is a much greater potential for grayling spawning than is presently being realized.

The four grayling captured in Section 1 were tagged with blue filamentous Floy-T-tags for future identification.

A few brook trout were captured in each of the three sections.

Elk Creek - Only Section 1 (Figure 1) was electrofished. Two brook and two rainbow trout were captured. No grayling were observed or taken. The streambed consisted mostly of fine sediments and grayling spawning success would be doubtful.

Both Sections 0 and 2 were observed but not electrofished. Section 0 appeared to have little gradient and the streambed was mostly fine sediments. It appeared to offer little to no opportunity for grayling spawning success. In Section 2, rainbow and brook trout but no grayling were observed. The bottom was similar to Section 1 and offered little to no apparent opportunity for grayling spawning success.

Grayling Creek - That section of stream on the refuge was observed on June 1, 1976. No grayling and very few brook trout were seen. The streambed consisted of clay and fine sediments. This section of stream had little gradient and offered little potential for grayling spawning success.

East Shambow Creek - The stream was observed from Shambow Pond to the mouth. No grayling and few brook trout were seen. The streambed was mostly fine sediments; however, the first approximately 100 feet downstream from the pond had fine gravels. No physical barriers were present that would block a spawning migration between the mouth and the pond. No speculation will be advanced for the reason why the fine gravel section was not being used by grayling for spawning, but it does appear that this section has a limited potential for grayling spawning success.

Shambow Creek - That portion that flows through the refuge headquarters appears to have good gradient and substrate for grayling spawning. This potential is negated primarily by the section near the mouth which flows through a marshy area and where the channel becomes indistinct. In addition, the major flow in this lower section is utilized for irrigation. Therefore, although the potential for grayling spawning appears excellent near and above the refuge headquarters, water use for irrigation and channel blockage near the mouth by thick marsh vegetation appears to reduce the potential to nil. Unless more water becomes available and the channel is cleared in this lower section of stream the potential will not be realized.

Moose Creek - This stream was observed near the mouth. No fish were seen in this section, two beaver dams appeared large enough to block any attempt at spawning ingress. The stream here was for the most part less than six inches deep. The streambed consisted entirely of fine sediment and debris. Even if beaver dams were removed the potential for grayling spawning success would be very small.

East Nye Creek - The stream flows into a large marshy area near the mouth. The channel at this point and for several hundred feet upstream is totally indistinct. Only channel clearance management could increase the grayling spawning potential above zero.

Lakes

Two gill nets were set overnight during August 1976, in each of the lakes. Locations of sets are shown in Figure 1. The results are shown in Table 2.

Upper Red Rock Lake - Eight grayling, only three of which exceeded 10 inches in total length, were captured in set number 1 (Table 2). The mean length of these grayling was 11.5 inches.

Set number 2 yielded 15 grayling with a mean length of 13.4 inches. Two captured grayling in set number 2 were tagged with yellow tags. This indicates grayling tagged during the 1976 spawning run in O'Dell Creek, had migrated through Lower Red Rock

Lake and the stream channel between the lakes and were resident in the Upper Lake at time of capture. Set 2 also yielded several other "trophy sized" game fish including brook, cutthroat and rainbow-cutthroat hybrid trout (Table 2).

Table 2. Game fish species[1/] composition, numbers captured and size range (in inches) gill netted in Upper and Lower Red Rock Lake, August 1976.

Lake	Set No. 2[2/]	Gr		Eb		Ct		Rb X Ct		Burbot	
		No.	Range	No	Range	No.	Range	No.	Range	No.	Range
Upper	1	8	8.4-17.2	-	-	-	-	-	-	1	13.5
	2	15	7.5-17.3	4	15.4-17.8	12	12.6-20.5	2	15.1-15.3	1	16.2
Lower	1	-	-	-	-	-	-	-	-	-	-
	2	1	9.0	-	-	-	-	-	-	-	-

1/ Gr = Arctic grayling, Eb = brook trout, Ct = cutthroat trout, RbXCt = rainbow/-cutthroat hybrids, Burbot (ling)

2/ Two nets were set in each lake. Number 1 in the upper lake was set near the mouth of Grayling Creek and Number 2 was set near the mouth of Red Rock Creek. Both sets in the lower lake were near the mouth of O'Dell Creek, but Number 1 was set north of Number 2 (see Figure 1).

All grayling between 7.5 and 9.4 inches were aged as belonging in age group 1. Those grayling between 13.5 and 13.8 were classified as II's and those 15.4 and longer were III's and older.

Ten of the twelve cutthroat captured in set 2 (Table 2) were aged as being III's and older. The other two were classified as II's.

The brook trout and hybrids were aged as II's and older.

In addition to the game fish species shown in Table 2, 41 and 40 white suckers (Catostomus commersoni) were netted in set numbers 1 and 2, respectively. Two longnose suckers (Catostomus commersoni) were netted in set 2 but none were taken in set 1.

Lower Red Rock Lake - Only one 9.0-inch grayling was taken in set number 2. No other game fish species were captured in either set.

A total of 54 and 22 white suckers were taken in set numbers 1 and 2, respectively.

Creel Survey

This portion of the study was designed to estimate the yield of game fish from the most heavily fished streams and ponds within the study area. The majority of stream sections and all ponds were on the refuge. The list of selected waters on the refuge are as follows: Red Rock, O'Dell, Tom, Elk, East Shambow, Grayling and Picnic Creeks and Culver, McDonald's and Widgeon Ponds. The following portions

of streams off the refuge were studied: Red Rock Creek from the refuge boundary upstream to Hell Roaring Canyon and O'Dell and Tom Creeks from the refuge upstream as far as could be seen from the county road.

Daily distribution of fishing intensity was estimated by counting fishermen at two-hour intervals from 6:00 a.m. to 8:00 p.m. from June 17 to September 15. Wayne Fitzwater, Montana Department of Fish and Game Warden, observed no fishermen during routine warden checks on four days between May 15 and June 13. This coupled with the fact that the refuge fishing season opened June 9 and closed in November, a period when area cold weather greatly decreases fishing activities, support the assumption that very little or no fishing activity occurred outside the dates of the study period.

Survey days were randomly selected and included 10 days in June and September and 18 days in July and August for a total of 56 days. As many fishermen as practicable were interviewed each census day between fishermen counts. Information obtained from interviews included length of time fished, total number in fishermen party, methods of fishing and species, number, weight, and total length of fish caught. All fish in the creel were measured to the nearest 0.1 inches, weighed to the nearest 0.01 pounds and checked for presence of anchor tags.

Computations of creel census and fishing intensity data were done by a computer using methods described by Newhold and Lu (1957). All estimates were from pooled data and confidence intervals are at the 95% level.

Total fishermen-hours was estimated to be 4483 (± 479) within the total study area and period. On-refuge fishing pressure was heaviest early in the season, in June, but remained fairly constant thereafter (Table 3). However, off-refuge pressure appeared to drop off somewhat in August and very dramatically in September.

Table 3. Estimate of fisherman hours1/ on and off the Refuge within the study area of the Centennial Valley, June 18-Sept. 15, 1976.

Area	Months				Total Hrs.	Total Percent
	June	July	August	September		
On-Refuge2/	885.8	1197.1	1083.9	629.9	3796.7	84.7%
Off-Refuge2/	118.5	363.2	185.3	18.8	685.8	15.3%

1/ Hours were estimated to be a direct percentage of observations with the average length of day as 16 hours.

2/ Study area described at beginning of Creel Survey section.

Off-refuge pressure amounted to only 685.8 hours (15.3%) of the total pressure within the study area.

All fishing was done from shore or by wading, no boats were observed.

Table 4 shows relative fishing pressures on each section within the study area by month and total. McDonald's and Culver Ponds were consistently the heaviest fished ponds, while Red Rock Creek was by far the heaviest fished stream. Widgeon Pond had little pressure until September when it picked up dramatically. Few fishermen were observed on O'Dell Creek, although it is one of the largest streams in the valley and has relatively fair sized game fish populations.

Table 4. Estimates 1/ of fishermen-hours by study section based on fishermen observations within the study area of the Centennial Valley, June 18 - Sept. 15, 1976.

Streams or Ponds (on/off Refuge)	June (13 days) Fisherman Hrs. (Use Days)	July (31 days) Fisherman Hrs. (Use Days)	August (31 days) Fisherman Hrs. (Use Days)	September (15 days) Fisherman Hrs. (Use Days)	TOTALS Fisherman Hrs. (Use Days) 2/
Culver Pond (on)	158 (105)	119 (59)	98 (47)	34 (10)	409 (221)
E. Shambow Cr. (on)	0 (0)	17 (8)	15 (7)	8 (2)	40 (17)
Elk Cr. (on)	96 (64)	47 (24)	60 (29)	41 (13)	244 (130)
Grayling Cr. (on)	16 (11)	0 (0)	15 (7)	8 (2)	39 (20)
McDonald Pond (on)	452 (301)	538 (269)	389 (185)	345 (105)	1724 (860)
O'Dell Cr. (on)	0 (0)	10 (5)	0 (0)	0 (0)	10 (5)
(off)	13 (9)	0 (0)	0 (0)	0 (0)	13 (9)
Picnic Cr. (on)	51 (34)	17 (8)	0 (0)	15 (5)	83 (47)
Red Rock Cr. (on)	77 (52)	427 (214)	457 (218)	8 (2)	969 (486)
(off)	105 (70)	369 (184)	185 (88)	19 (6)	678 (348)
Tom Cr. (on)	0 (0)	0 (0)	23 (11)	0 (0)	23 (11)
(off)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Widgeon Pond (on)	35 (23)	17 (8)	26 (13)	173 (52)	251 (96)
TOTALS	1003 (669)	1561 (779)	1268 (605)	651 (197)	4483 (2250)
Mean Length of Fisherman Day	1.5	2.0	2.1	3.3	2.2
Mean Fishing Party Size	4.8	3.2	2.5	2.7	3.3

1/ These are estimates of relative fishing pressures only and based upon the percentage of observations and monthly pressure estimates. Confidence intervals would be meaningless in many cases because of small number of observations.

2/ Additive of monthly use days. (A use day is equal to the estimate of fisherman hours divided by the mean length of a fisherman day.)

The mean length of a fisherman day appeared to increase as the season progressed; whereas, fishing party size appeared to decrease during the same period.

Table 5. Estimates of average number of game fish1/ caught and kept per fisherman hour and total yields within the study area of the Centennial Valley, June 18 - Sept. 15, 1976. (95% confidence intervals in parentheses)

	Gr	Rb	Ct	RbxCt	Eb	Average and Total
Catch rate2/	0.14 3/	0.57 (± 0.30)	0.53 3/	0.80 3/	0.40 (± 0.10)	0.50 (± .10)
Yield	71 (±60)	259 (±150)	28 3/	31 3/	1784 (±679)	2262 (±742)

1/ Gr = Arctic grayling, Rb = rainbow trout, Ct = cutthroat trout, Rb x Ct = rainbow/cutthroat hybrid, Eb = brook trout.

2/ Catch rate includes only those fish caught and kept.

3/ Too few caught for meaningful confidence intervals.

Game fish yield estimates are shown in Table 5. Brook trout predominated the total yield followed by rainbow. Mountain whitefish were present in small numbers in several ponds and streams but were not observed in the creel.

Grayling were taken in small numbers and at a low catch rate. They were observed to be taken only in Red Rock Creek. Two grayling tagged earlier in Red Rock Creek and observed in the creels were caught off the refuge on June 20 and July 1. One tagged grayling caught on the refuge was observed on July 5. The last Red Rock Creek grayling observed in fisherman creels was taken on the refuge on August 17. This indicated that some grayling are resident in the creek or remain there for extended periods following spawning migration from the lake.

A total of 25 game fish were creeled per day for the entire study area. This total appears to be extremely low for such a large area with a multitude of fishing opportunities.

No grayling from O'Dell Creek were observed in creels. Minimal fisherman contacts may have contributed to this situation.

No grayling were observed to be taken from Tom Creek.

Recommendations

It now appears that Upper Red Rock Lake is the residence of most grayling most of the year. With the lake filling with sediment at an accelerated rate and without mitigative measures to correct this situation the long-term outlook for grayling and other lake-dependent game fish species appears very dim. In the interim several management alternatives to increase grayling recruitment should be investigated. These would include beaver dam removal or other channel clearance activities in several streams; negotiating for more water to be left in the streams at critical periods; attempting to imprint fry in several streams, especially Tom Creek, when channel clearance is completed; and constructing a spawning channel in the presently abandoned but previously straightened section of Red Rock Creek. A strict monitoring program should accompany any of these procedures to determine degree of success. Activities should be discontinued if they are unsuccessful.

There are trophy fish in the upper lake that are virtually unexploited at present. They provide fishing opportunities only when they enter the tributary streams. A trophy fishery might be created by allowing catch and release fishing from shore or from motorless boats at times that don't conflict with primary Refuge goals and objectives.

Ruby River Fisheries and Water Quality Study

The study was designed to provide baseline water quality and fish population data with which to assess problems and determine problem drainages in the Ruby River watershed within the Beaverhead National Forest.[1/] The data are then to be used to aid in a management plan for the restoration of the upper Ruby River drainage aquatic resource. The Beaverhead National Forest and the Montana Department of Fish and Game are cooperating agencies on the study with each having separate data collection responsibilities. The department's data collection portion concluded following the 1976 field season.

Sturges (1975) stated that "a basic tenet underlying all land management decisions is to maintain erosion as near a geologic or 'natural' rate as possible". In recent years, the channel of the Ruby River has undergone unnatural erosion and movement. Marcoux (Elser and Marcoux, 1972) found average turbidity readings in the Ruby highest of four drainages studies in 1970. Extensive gravel deposits, numerous channel cut-offs and a general widening of the channel indicate that the dynamic equalibrium of the watershed has been upset. The reasons for the changes could be related, in varying degrees, to increased runoffs; higher peak flows and other "natural" changes, as well as man-caused events such as large scale manipulation of woody vegetation and overgrazing by domestic livestock. Whatever the causes, it appears that some threshold value (Schumm, 1972) has been exceeded.

The effect of these recent geomorphic changes on the aquatic resources of the Ruby River and its tributaries, at the present time, is unknown. It is known, however, that sediment deposition has an adverse effect on trout production (Peters, 1967) and their food supply (Cordone and Kelly, 1961). This study was designed to provide some answers and point to positive land mangement alternatives.

Streams

Fish populations were sampled in five sections of the Ruby River during August 1976. There was no visible spawning activity and no fish were ripe. It was therefore assumed that movements due to spawning activities would have no effect upon sampling results.

Fish scales were extremely difficult to age primarily due to the high degree of erosion on the edge of scales.

Location and length of the study sections are as follows in order from down-to-upstream: 1) Ice Creek Section, begins approximately 200 feet below the Ice Creek bridge and continues downstream for 4,750 feet. 2) Section 1, begins approximately 3,000 feet upstream from and continues through Canyon Camp and totals 4,100 feet in total length. 3) Vigilante Section, begins at Vigilante Ranger Station and continues for 5,190 feet downstream and ends about 300 yards upstream from the confluence of Warm Springs Creek. 4) Section 2, begins approximately one-half mile downstream from the confluence of Cottonwood Creek and continues for 6,000 feet. 5) Bear Creek Section, begins at Bear Creek Ford, continues downstream for 7,125 feet and ends at the confluence of Cottonwood Creek. Exact location maps are filed with 1975 and 1976 field data.

1/ Special thanks for assistance in gathering weekly maximum-minimum stream temperature readings.

Rainbow trout were the most abundant game fish from Vigilante Section downstream (Tables 6, 7 and 8). Section 1 had by far the largest population of rainbows (Table 6). It is believed that several factors including the influence of Warm Springs Creek, a short distance upstream, and better appearing habitat caused this difference. Temperatures in this reach may have also affected this population.

Brown trout (Table 7) were present in the lower three sections; however, Vigilante's population was relatively small in number and contained only age group II and older fish, Two browns in 1976 and one in 1975 (Peterson, 1976) were captured in Section 2. It is therefore believed that this is near the uppermost extension of their range in Ruby River.

Whitefish populations (Table 8) were fairly constant in all sections except Vigilante. Speculation will not be advanced for this gross deviation that occurred in a section located between the other four. Temperatures (Figures 3 and 4) within the study period did not appear to be a factor in this section compared to tributaries and other sections upstream.

Other game fish species collected included one brook trout in Ice Creek Section; two RbxCt hybrids and two Ct in Vigilante; four RbxCt hybrids and six Ct in Section 2; and eight each of RbxCt hybrids and Ct in Bear Creek Section. RbxCt and Ct increased proportionally to rainbow populations in each of the next two study sections upstream from Vigilante.

Maximum temperatures (Figures 3 and 4) in Basin, Poison, and Burnt Creeks and the Ruby below Three Forks Cow Camp appeared near the upper limit of tolerance to most of the game fish species present if exposure lasted for more than a few hours. A combination of low flows and limited streamside vegetation probably combined to contribute to these high stream temperatures.

Recommendations

Although inconclusive, the data appear to indicate that Warm Springs Creek is a major contributor to increased productivity in Ruby River for some distance downstream from their confluence. Local ranchers indicate that Warm Springs Creek is heavily used by both rainbow and brown trout during spawning. If these contentions are true, this stream and its watershed should receive special considerations in future management decisions. Any future study in the Ruby drainage should include an intensive study of Warm Springs Creek to help determine its significance to Ruby River.

Rainbow populations were lower upstream from the confluence with Warm Springs Creek. The reasons for this are not known but if habitat destruction is a major factor, future fish population and stream temperature monitoring at periodic intervals is necessary to document recovery.

If future land use management includes streambank fencing, willow planting or other habitat restoration attempts, intensive aquatic and temperature monitoring studies should be conducted before and after in these selected locations.

Intensive sediment/discharge studies should be conducted in areas referred to in Marcoux's study (Elser and Marcoux 1972) in order to determine if changing land use management procedures have had effects upon soil stability.

Point sources of extensive sedimentation should be evaluated in order to determine if management alternatives are presently available that could stabilize these unknown problem areas.

Table 6. Rainbow trout population estimates and condition factors in five study sections of Ruby River, August 1976. (80% confidence intervals in parentheses)

Section	Length Interval (inches)	Estimated Number per 1,000 ft.	Estimated Pounds per 1,000 ft.	Condition Factors(.5" and over)
Ice Creek	3.8 - 6.7[1/]	85.9(± 43.4)	4.8(± 2.5)	37.10(± 4.13)
	6.8 - 9.9[2/]	56.6(± 19.8)	13.7(± 4.8)	36.46(± 3.30)
	10.0 -13.9	13.7(± 4.4)	7.2(± 2.3)	34.46(± 2.75)
Total or Average		156.2(± 48.0)	25.7(± 5.9)	36.26(± 3.68)
Section 1	3.4 - 6.6[1/]	332.7(± 110.5)	19.5(± 6.6)	38.38(± 5.28)
	6.7 - 8.9[2/]	166.8(± 63.7)	33.9(±12.9)	37.39(± 4.14)
	9.0 - 9.9[3/]	31.0(± 11.0)	9.3(± 3.2)	36.06(± 3.89)
	10.0 -13.9	40.5(± 11.5)	20.7(± 5.9)	35.01(± 3.40)
Total or Average		571.0(± 128.5)	83.4(±15.9)	37.23(± 4.77)
Vigilante[4/]	5.4 - 7.6[1/]	16.6(± 5.4)	1.9(± 0.6)	38.59(± 4.23)
	7.7 -15.7[3/]	38.7(± 3.9)	19.3(± 1.9)	36.62(± 3.82)
Total or Average		55.3(± 6.7)	21.2(± 2.2)	37.10(± 4.06)
Section 2[5/]	4.4 - 6.7[1/]	3.8(± 2.7)	0.2(± 0.2)	38.42(± 4.44)
	6.8 - 9.9[3/]	5.8(± 1.8)	1.5(± 0.5)	38.54(± 3.72)
	10.0 -15.9	12.0(± 2.0)	7.0(± 1.2)	37.30(± 3.97)
Total or Average		21.6(± 3.8)	8.7(± 1.3)	37.74(± 3.97)
Bear Creek[6/]	7.7 -16.9[7/]	18.7(± 3.1)	9.1(± 1.5)	38.21(± 4.07)

1/ 100% age one.
2/ Mostly age two with very few ones and threes.
3/ Age two and older.
4/ Includes two RbxCt hybrids and two Ct or 1.7% of "new" fish in both mark & recapture runs.
5/ Includes four RbxCt hybrids and six Ct or 10.3% of "new" fish in both mark & recapture runs
6/ Includes eight RbxCt hybrids and eight Ct or 15.2% of "new" fish in both mark & recapture runs.
7/ Age two and older. No estimate of age group one because of small numbers.

Table 7. Brown trout population estimates and condition factors in three study sections of Ruby River, August 1976. (80% confidence intervals in parentheses)

Section	Length Interval (inches)	Estimated Number per 1,000 ft.	Estimated Pounds per 1,000 ft.	Condition Factors
Ice Creek	7.1 - 16.6[1/]	15.8 (± 4.8)	13.9 (± 4.4)	37.00 (± 3.75)
Section 1	11.9 - 18.2[1/]	17.3 (± 6.7)	23.9 (±10.7)	36.81 (± 3.97)
Vigilante	15.3 - 24.0[2/]	2.3 (± 0.4)	5.8 (± 1.2)	38.73 (± 4.26)

1/ Age group two and older.

2/ Older than age group two.

Table 8. Mountain whitefish population estimates and condition factors in five study sections of Ruby River, August 1976. (80% confidence intervals in parentheses)

Section	Length Interval (inches)	Estimated Number per 1,000 ft.	Estimated Pounds per 1,000 ft.	Condition Factors
Ice Creek	7.5 - 15.7[1/]	21.9 (± 7.2)	15.2 (± 5.1)	36.97 (± 6.96)
Section 1	8.3 - 15.5[1/]	53.7 (±18.5)	39.0 (±13.4)	35.89 (± 4.87)
Vigilante	7.8 - 16.8	9.1 (± 3.9)	7.1 (± 3.1)	37.59 (± 4.53)
Section 2	5.0 - 7.9	6.5 (± 3.5)	0.7 (± 0.3)	36.52 (± 3.19)
	8.0 - 12.9	14.0 (± 3.7)	6.8 (± 1.7)	39.80 (± 3.52)
	13.0 - 19.9	5.0 (± 0.7)	6.3 (± 0.8)	37.38 (± 4.37)
Total or Average		25.5 (± 5.0)	13.8 (± 2.0)	38.44 (± 4.11)
Bear Creek	7.7 - 19.0[1/]	32.4 (± 2.9)	27.1 (± 2.5)	40.04 (± 3.90)

1/ Age group two and older.

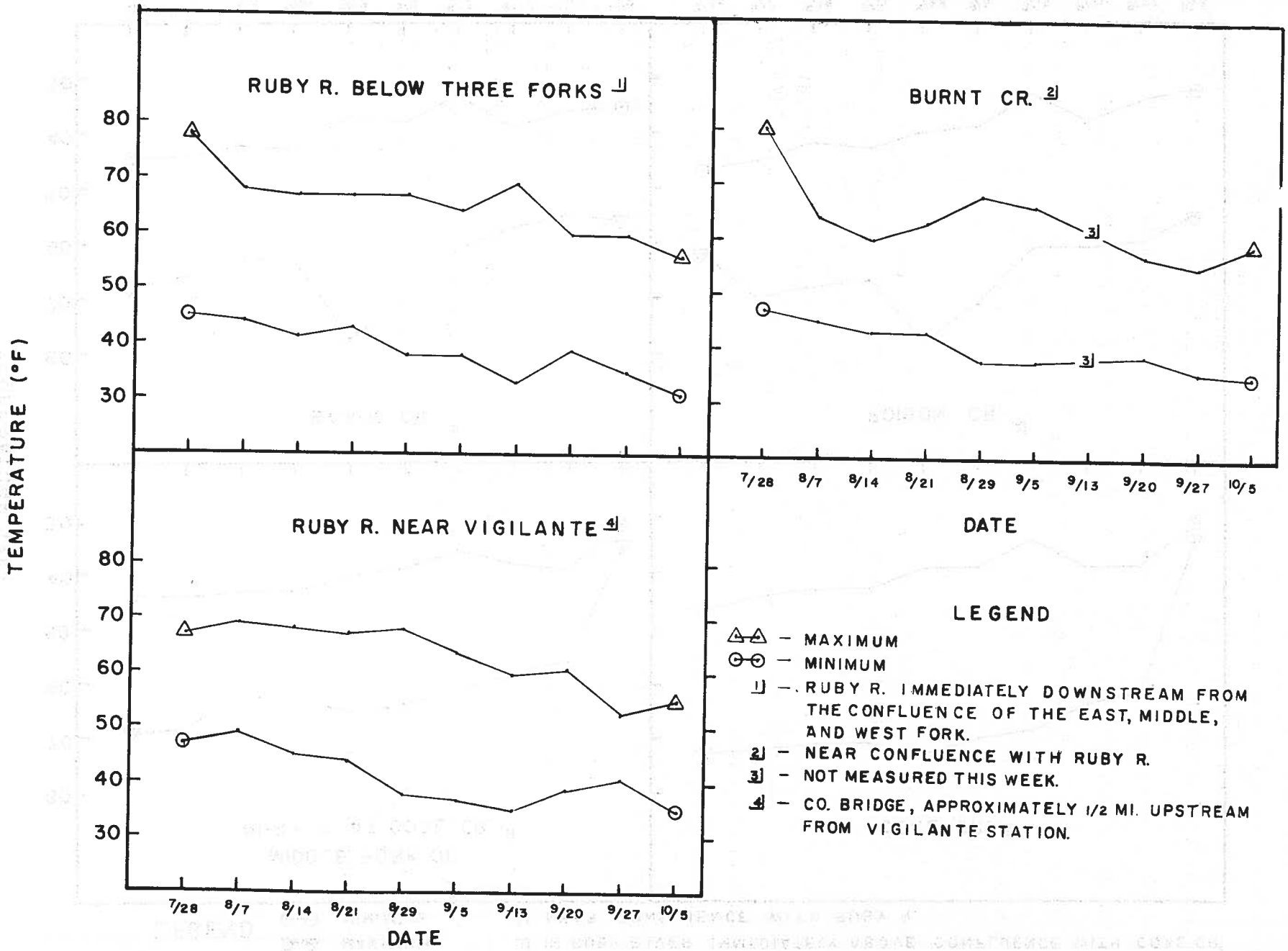

Figure 4. Stream temperatures in Ruby River and tributary streams. July - October 1976.

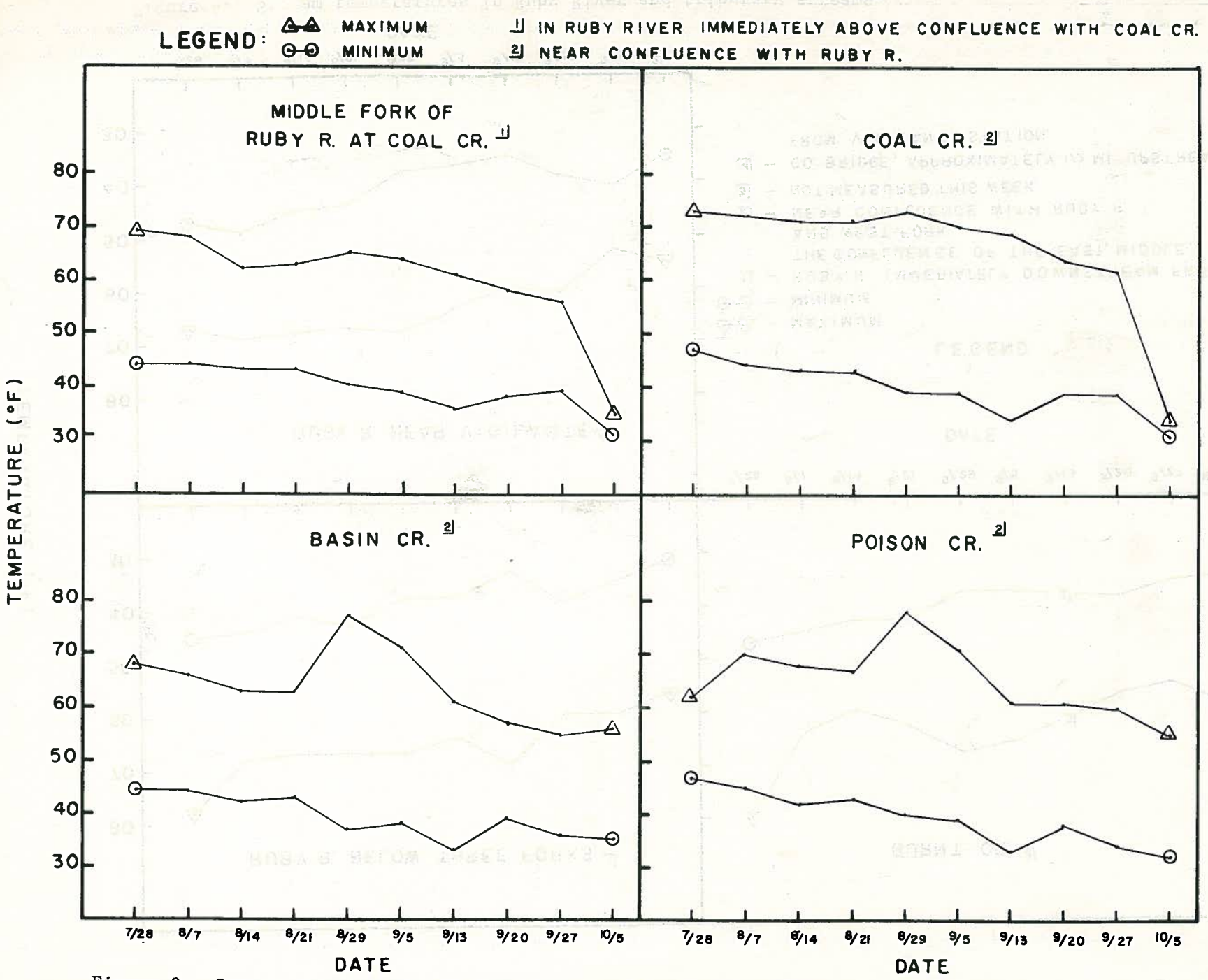

Figure 3. Stream temperatures in Ruby River and tributary streams, July - October 1976.

Grasshopper Creek Heavy Metals Study

High concentrations of mercury were found in fish taken in the Beaverhead River near the mouth of Grasshopper Creek in 1970. Water quality analyses in Beaverhead and Grasshopper conducted that year by an Environmental Protection Agency crew out of Denver, Colorado, failed to detect mercury in solution. In years following, it was hypothesized that mercury could have entered the fish flesh by first being assimilated into the food chain and then into the fish upon ingestion of aquatic organisms. Once in a digestive tract with its low pH the methyl form of mercury would result and this form could then be assimilated by fish.

Limited time and finances negated an intensive study of this hypothesis. Instead, fine sediments were collected selectively in one-liter containers up- and downstream from the Golden Leaf Mill Tailings Ponds located one-half mile below Bannack, Montana. Sediment samples were also collected up- and downstream from the mouth of Grasshopper in Beaverhead River. Samples were additionally collected at the Bannack Mill and Gold Leaf Mill tailings ponds.

Grasshopper had been eroding into the tailings at an ever-increasing rate for years. Total surface area of the tailings was 7.5 acres deposited to depths of 3 to 10 feet deep. Once washed from the banks these sediments were then carried until settling out on the streambeds downstream.

The sediment samples were sent to the Montana Bureau of Mines and Geology in Butte, Montana for analysis. The results are shown in Table 9.

The analysis shows that the tailings at Golden Leaf Mill did in fact contain extremely high concentrations of mercury as well as other heavy metals. It also showed that streambed sediments immediately downstream from the tailings and at the mouth contained relatively high concentrations of most metals that were analyzed. The influence of these high concentrations upon the aquatic ecosystem although speculative is assumed to be significant if assimilation through the food chain is real.

A program to stabilize the eroding banks with blanket riprap was sponsored by Beaverhead Conservation District, Headwaters RC&D Project, and the Montana Department of Fish and Game with technical assistance from the U.S. Soil Conservation Service. The project has since been completed.

Recommendations

The streambed sediments and fish populations of Grasshopper Creek should be monitored at periodic intervals to determine the rate at which high heavy metals concentrations dissipate from the sediments and the rate at which fish populations respond.

Table 9. Heavy metals concentrations (μg/g or ppm) in samples from streambed sediments in Grasshopper Creek, Beaverhead River and two mill tailings ponds. collected April 20, 1976.

	Arsenic	Mercury	Copper	Lead	Zinc	Iron	Cadmium	Nickel	Aluminum
Grasshopper									
Sediment one mile upstream from Bannack	≤ 40	1.5	16.5	45.0	165.0	26,510	0.85	11.5	13,750
Bannack Mill Pond tailings	56	0.8	12.0	16.5	72.5	27,500	0.5	6.8	7,550
Tailings material at Golden Leaf (G.L.) mill	880	7.1	1375.0	1175.0	1095.0	226,840	6.0	23.5	6,950
Sediment immediately downstream from G.L. tailings	220	3.2	505.0	404.0	375.0	105,070	1.5	13.9	7,500
Sediment at mouth	166	6.4	215.0	1110.0	1115.0	27,500	14.0	21.3	3,000
Beaverhead									
Sediment one-half mile upstream from mouth of Grasshopper Creek	42	0.7	9.0	7.5	45.0	19,640	0.8	14.0	6,250
Sediment one mile downstream from mouth of Grasshopper Creek	50	0.8	12.0	10.0	56.5	23,570	<0.5	10.3	7,250
Sediment at Tash Bridge upstream from Dillon	≤ 40	0.6	7.0	15.0	93.5	33,390	<0.5	10.4	5,250

Pintlar Creek Study

Staff gages placed at four locations in Pintlar Creek were read[1/] from late June to early October 1976 (Figure 5). The readings indicate that the lake apparently had a "smoothing" effect on stream fluctuations recorded upstream below Pintlar Falls.

Large fluctuations begin occurring again downstream by the time they get to Sparrow Association bridge. This is apparently due to irrigation. However, there is an obvious recovery of flow stability in a portion of stream from Sparrow bridge to the mouth. Ground water returns must be the reason for this stabilized flow condition.

Temperature data, although collected, were not compiled for this report and will be presented in a forthcoming report.

Recommendations

Staff gage measurements should be calibrated to corresponding flows and fish populations estimated at the four study sites.

Waters Referred To:

Basin Creek	01-0320	Pintlar Creek	02-4550
Beaverhead River	01-0500	Poison Creek	01-5920
Burnt Creek	01-1060	Red Rock Creek (River Section 3)	01-6180
Coal Creek	01-1420		
East Nye Creek	01-2565	Ruby River (Section 2)	01-6380
E. Shambow Creek	01-2570	Shambow Creek	01-6700
Elk Creek	01-2620	Tom Creek	01-7750
Grasshopper Creek	01-3100	Warm Springs Creek	01-8020
Grayling Creek	01-3115	Culver Pond	01-8680
Middle Fork Ruby River	01-6380	Lower Red Rock Lake	01-9080
Moose Creek	01-5082	McDonald's Pond	01-9100
O'Dell Creek	01-5600	Upper Red Rock Lake	01-9780
Picnic Creek		Widgeon Pond	01-9820

1/ Special thanks to Beaverhead National Forest, Wise River District, personnel for gathering weekly data.

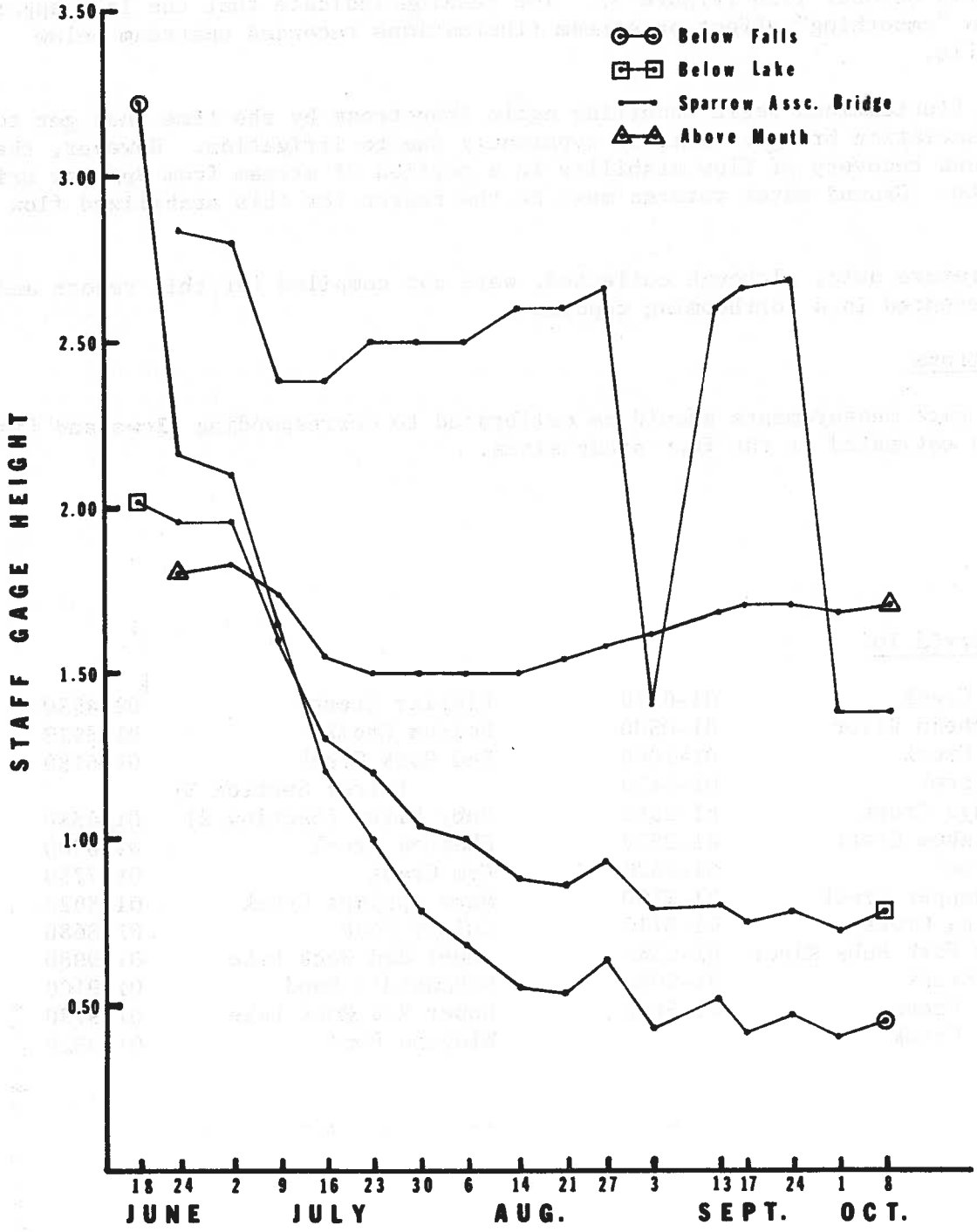

Figure 5. Staff gage readings from four locations in Pintlar Creek, June-October, 1976.

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