MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: Montana TITLE: Southwest Montana Fisheries Study

PROJECT NO.: F-9-R-28

JOB NO.: 1-b TITLE: Inventory and Survey of the Waters of the Big Hole and Beaverhead Drainages

PROJECT PERIOD: July 1, 1979 through July 1, 1980

REPORT PERIOD: July 1, 1979 through July 1, 1980

ABSTRACT

Discharge was monitored at three sites on the Big Hole River. Throughout the period of July 25 through October 21, 1979, average daily flow was greatest at the Melrose site, least at the Wise River site and somewhat intermediate at the Twin Bridges site. Discharge in the Big Hole River in 1979 was considerably less than the 1978 water year. Water temperatures were monitored at the Melrose site and in general were greater than during the summer of 1978.

Brown trout numbers in the Melrose section and summer mortality rates in 1979 were similar to 1977. Numbers of age IV and older brown trout each fall appear to be related to magnitude of summer flow. Numbers of 18 inch and larger brown trout have decreased by 50-60 percent since 1969-70. Total numbers of rainbow trout in the Melrose section continue to increase; however, numbers of age III and older rainbow remain low.

Numbers of brown trout in the Heron section of the Big Hole River declined drastically from spring to fall, 1979, coincident with very low flow during the irrigation season.

Condition factors for brown trout were greater in the Melrose section than in the Heron section in the fall of 1979. Growth rates of salmonid species captured in 4 study sections of the Big Hole River indicated that salmonids grew fastest in the Melrose section, slower in the Heron and Bryant Creek sections and slowest in the Hirschy section.

Twenty-six tributaries of the Big Hole River were investigated for their fisheries and possible water allocation areas during 1979 and 1980. Fisheries data for each stream collected are included. Instream flow requests are not available at the present time.

BACKGROUND

The Big Hole River is one of Montana's blue ribbon waterways and receives a great deal of fishing pressure. The waters of the Big Hole are also used by irrigated hay and cattle ranches and during low water years this demand is sufficient to totally dewater the river near its mouth. Dams have been, or currently are, proposed for this free flowing river and many of its tributaries.

The Ruby River sustains a wild trout fishery of major importance, however, quantitative data on flow, water temperature and fish populations near the mouth of the river has not been available.

In 1973, the Montana legislature enacted the Montana Water Use Act, identifying instream flows for fish and wildlife as a beneficial use of surface waters. The process for reserving water was outlined in Sec. 85-2-316 of the act and the Yellowstone River Basin became the first drainage to complete the process (Nelson and Peterman, 1979).

Because it contains some of the nations most acclaimed wild trout rivers, the upper Missouri River Drainage above Canyon Ferry Reservoir is being considered as one of the next water allocation areas in the state. Tributaries of the Blue Ribbon Big Hole, Gallatin, Madison and Missouri Rivers are also slated for instream flow reservations, if they provide necessary flows to the major drainages or if they are in themselves an important fishery.

Twenty-six tributaries of the Big Hole River were chosen on their merits as major water-sheds, locally important fisheries, having the presence of a fish specie of "special concern," or one of the seven streams designated by the Department of Natural Resources and Conservation for potential offstream reservoir sites for the Big Hole River (DNRC, 1979).

OBJECTIVES AND DEGREE OF ATTAINMENT

1. To determine trout populations and monitor water temperatures and discharge in at least two sections of the Big Hole River and one section of the Ruby River. Data is presented.

2. To determine growth rates of trout and mountain whitefish in three sections of the Big Hole River. Data is presented.

3. To determine trout populations in selected tributaries of the Big Hole River and collect information needed to request flow reservations. Data for fish populations is presented. Data for instream flow reservations is still being analyzed.

PROCEDURES

Flow and water temperatures were monitored at three U.S.G.S. gauges on the Big Hole River and one on the Ruby River.

Fish populations in the Big Hole and Ruby Rivers were censused using a boat mounted electrofishing unit. Population and standing crop estimates were made using methods summarized by Vincent (1971 and 1974) and adapted for computer analysis.

Fish in the Big Hole River were aged using the scale method and mean length of age groups determined.

Instream flow requirements for aquatic life in tributaries of the Big Hole River were quantified using a plot of wetted perimeter versus discharge for a typical subreach of stream. Instream flow requests will follow procedures outlined by Nelson (1980).

Fish populations were surveyed using a bank electrofishing unit in the tributaries. Population and standing crop estimates were made using methods summarized by Vincent (1971 and 1974) and adapted for computer analysis.

Fish populations in ponds, lakes and reservoirs were surveyed using 125 foot experimental mesh gill nets.

FINDINGS

Big Hole River

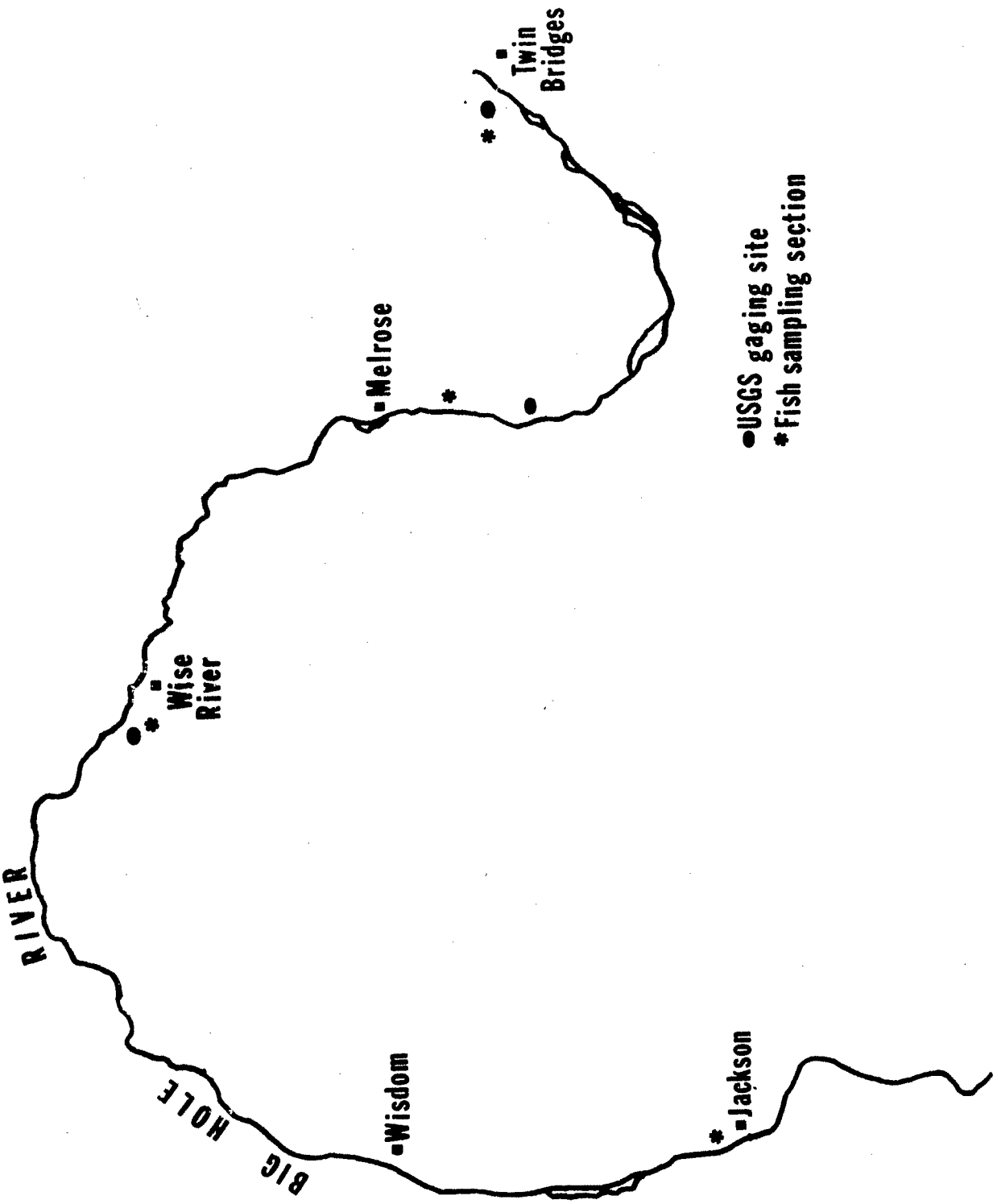
Flow

Discharge in the Big Hole River during the 1979 water year was considerably less than the 1978 water year.

Diversion of river water for irrigation occurs throughout the length of the Big Hole, but is most apparent in the lower river from Melrose to Twin Bridges (Figure 1). Irrigation diversions generally have the greatest impact on natural flows during August, usually the most critical flow month on the lower Big Hole River. Table 1 depicts mean and minimum recorded August flows at the U.S.G.S. gauging station near Melrose from 1968-1979 and indicate 1979 to be a fairly low water year. Minimum August flow in 1979 was 200 cfs less than in 1978.

U.S. Geologic Survey flow gauges were installed in late July near Wise River, Montana and near the mouth of the river near Twin Bridges, Montana. Figure 2 depicts average daily flow (ADF) at these two sites and at the Melrose gauge from July 25 through October 21, 1979.

Figure 1. Map of the Big Hole River Study Area.



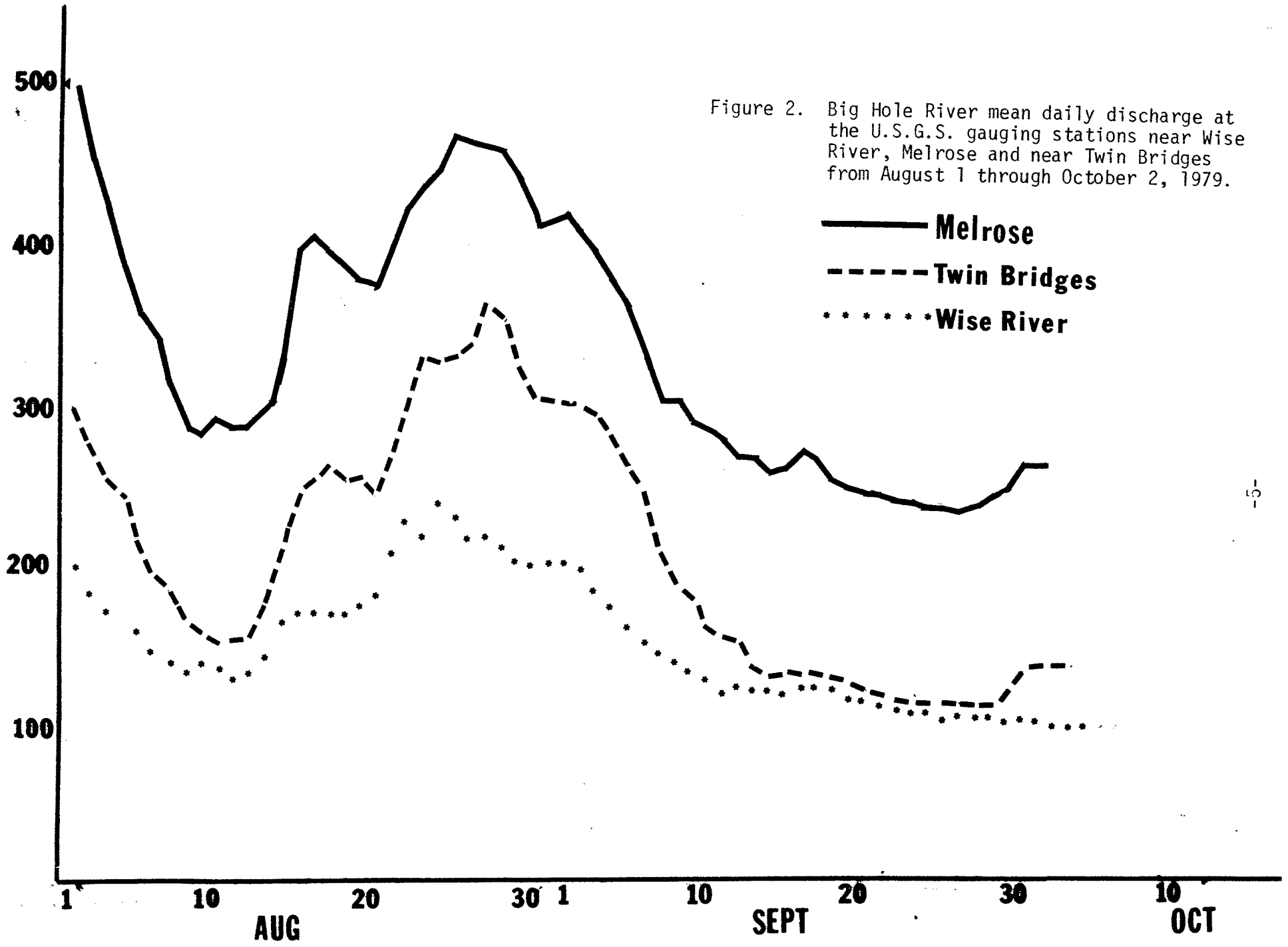


Figure 2. Big Hole River mean daily discharge at the U.S.G.S. gauging stations near Wise River, Melrose and near Twin Bridges from August 1 through October 2, 1979.

Table 1. Mean and Minimum August flow in the Big Hole River (U.S.G.S. gaging site near Melrose) from 1968-79.

Year	Mean	Minimum
1968	626	411
1969	407	230
1970	504	248
1971	611	301
1972	650	503
1973	165	113
1974	341	290
1975	1457	925
1976	927	715
1977	304	174
1978	691	479
1979	381	279

Throughout the period, ADF was greatest at the Melrose site, least at the Wise River site and somewhat intermediate at the Twin Bridges site.

The gage near Wise River is located upstream from the large irrigation diversions of the lower river and upstream from several major tributory streams including the Wise River. Flow at the Wise River site reflects upstream tributaries, diversions for agriculture purposes and ground water return.

The Melrose gage is located downstream from all major tributaries except Willow Creek, and flow reflects tributary input, diversion for agriculture and Butte municipal use and groundwater return between the Wise River and Melrose sites.

The Twin Bridges gage is located downstream from all major tributaries and flow reflects diversion for agriculture and groundwater return between the Melrose and Twin Bridges sites.

Flows at all three sites decreased markedly from August 1 through August 12 and then increased through August 25 coinciding with heavy rainfall in the Big Hole drainage (National Climatic Center, August, 1979). Flows decreased at all three sites from August 25 through September 30, a period of above normal temperatures and zero precipitation, which made September the most critical month on the lower Big Hole. Average daily temperatures at Wisdom and Dillon were 3.8° and 5.6°F above normal respectively for September, a month that normally averages 1.00 inches of precipitation in the Big Hole drainage. (National Climatic Center, September, 1979). Minimum flow at the three sites occurred in late September and was 99 cfs, 299 cfs and 110 cfs at the Wise River, Melrose and Twin Bridges sites, respectively. These flows are considerably less than those required for even low levels of aquatic habitat potential in their

respective reaches of the river (Montana Fish, Wildlife & Parks, 1979).

The reduction in flow between the Melrose and Twin Bridges sites from August 1 through the middle of October, 1979, is attributable to irrigation withdrawals and represents reductions of between 80 and 201 cfs (U.S.G.S., 1979). These reductions in flow left the river near Twin Bridges with less than half the flow considered necessary for a low level of aquatic productivity for most of September, 1979 (Montana Fish, Wildlife & Parks, 1979).

Water Temperatures

Melrose

Maximum daily water temperatures from July 27 through September 15, 1979, are compared with 1978 in Figure 3. In general, maximum daily water temperatures were from 1 to 8 degrees greater than during the high water year of 1978. Maximum recorded temperature in 1979 was on August 1 (71.8°). Highest maximums (July 31 - August 2) coincided with the highest maximum air temperatures of the period recorded at Glen, Montana (Climatological Data, 1979).

Near Wise River and Near Twin Bridges

Thermographs were placed at both these sites in the latter part of the summer of 1979. Problems with the equipment negated meaningful data collection. Data collected in 1980 will be presented in a later report.

Fish Population Data

Melrose Section

This section was established in 1969 and its trout population described by Elser and Marcoux (1972), Peterson (1973), Wells and Nelson (1978) and Wells and Rehwinkel (1979).

Population, standing crop and mortality estimates for brown and rainbow trout in this section for spring and fall, 1979 are given in Table 2.

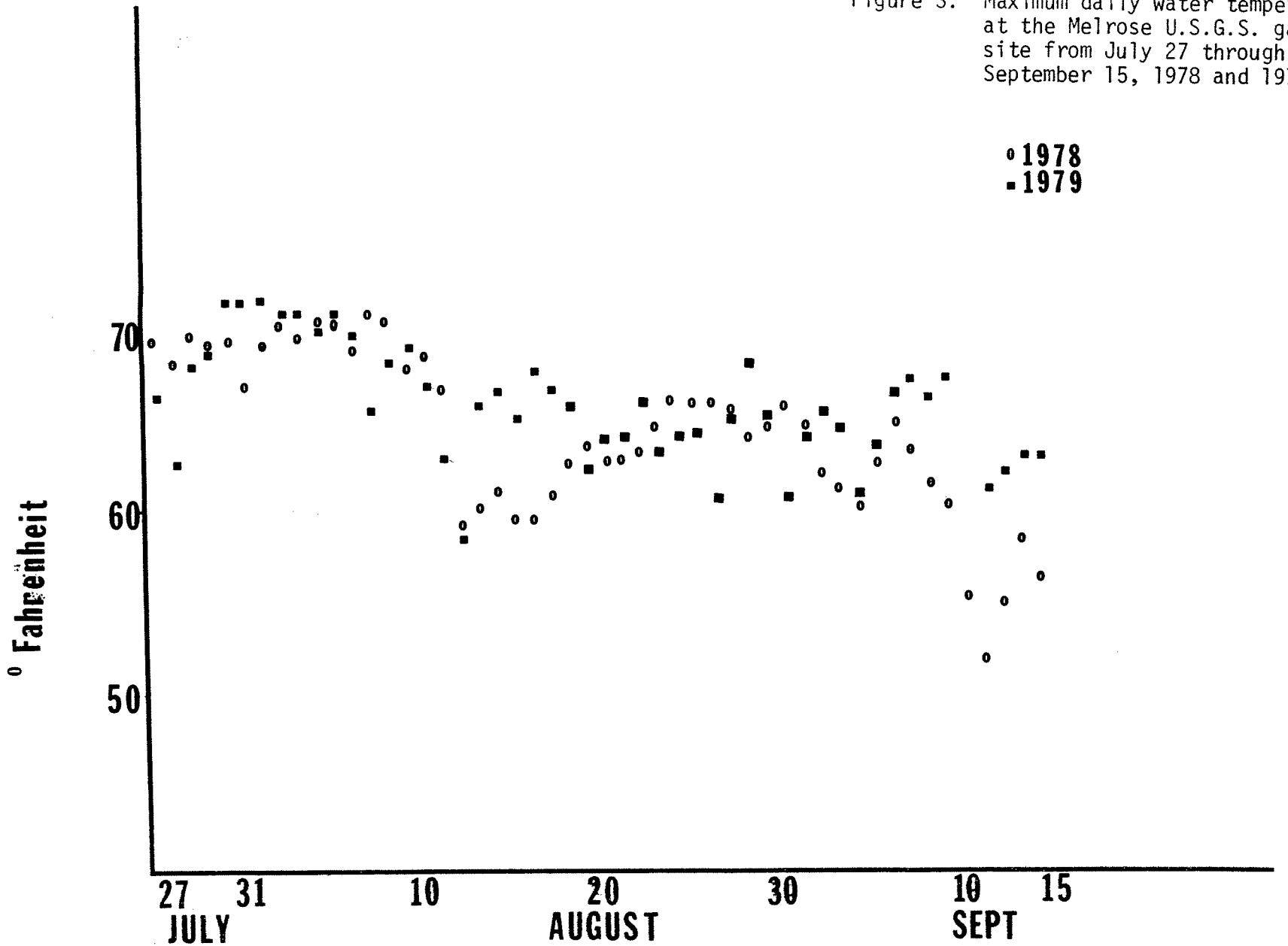


Figure 3. Maximum daily water temperatures at the Melrose U.S.G.S. gauging site from July 27 through September 15, 1978 and 1979.

Table 2. Estimated numbers, standing crops and summer mortality rates of trout by age group in the 4.5 mile Melrose Section of the Big Hole River (80% CI).

Brown Trout

	April 1979				September 1979			
Age	Average Length	Number	Biomass	Summer Mortality	Age	Average Length	Number	Biomass
II	9.4	1058	326	--	II	12.7	1440	1179
III	12.5	1177	884	48%	III	15.3	607	852
IV+	15.9	1172	1735	56%	IV+	18.3	517	1218
		3407(±801)	2945(±585)				2564 (±470)	3249 (±447)

Rainbow Trout

II	9.4	397	123	--	II	12.3	619	466
III	11.9	587	379	60%	III	14.1	233	272
IV+	14.4	442	503	70%	IV+	16.1	134	239
		1426(±433)	1005(±353)				986 (±212)	977 (±198)

Summer mortality rates for age III and age IV and older brown trout during the summer of 1979 were similar although slightly higher than during the summer of 1977 (Wells and Rehwinkel, 1979). Both 1977 and 1979 were low water years (Table 1) on the Big Hole River. Age III brown trout experienced a mortality rate of nearly 48% and age IV and older fish nearly 56% during the summer of 1979 (Table 2).

Mortality rates of brown trout in this section appear to be directly related to the magnitude of flow (Wells and Rehwinkel, 1979, Kozakiewicz, 1979). This is particularly evident with age IV and older brown trout. Figure 4 depicts estimated numbers of age IV and older brown trout in the fall of 1969, 70, 1977, 78, 79 and minimum August flow in the Big Hole River. Numbers of age IV and older brown trout were greatest in the fall of 1978, a year when August flow did not drop below 479 cfs. Numbers of age IV and older fish were lowest in the fall of 1977, a year which saw August flow drop to 177 cfs, lowest of the study years.

Simple linear regression indicated a significant (P=0.05) relationship between minimum August flow and estimated fall numbers of age IV and older brown trout. The minimum August flow explained 84% of the variation in estimated fall numbers of age IV and older brown trout.

Numbers of the larger segment of the age IV and older brown trout (18" and larger) appear to have declined markedly since 1970-71. Table 3 depicts estimated numbers and numbers marked of 18" and larger brown trout during the spring of 1970, 71, 1977, 1979. Estimated numbers and number marked during mark-recapture electrofishing runs are considerably less in 1977, 1979 than in 1970, 71. While fishermen have not been shown to be the limiting factor on age IV and older brown trout (Kozakiewicz, 1979), they may have been instrumental in reducing numbers of the larger (18"+) segment of this age group.

Table 3. Estimated spring numbers and number marked of 18 inch and larger brown trout in the Melrose Section of the Big Hole River, 1970-71, 1977, 1979.

Year	# Marked	# Marking Runs	Estimated Numbers
1970	106	2	262
1971	73	2	363
1977	34	3	188
1979	39	3	134

Summer mortality rates for rainbow trout age III and age IV and older were 60% and 70% (Table 2) respectively and similar to mortality rates in 1977 and 1978. It appears that these older rainbow trout annually suffer heavy summer mortality. Angler harvest was shown to account for nearly all of the summer mortality of these older fish in 1977 and 1978 (Wells and Rehwinkel, 1979).

Heron Section

This study section was established in the spring of 1979 and is 15,000 feet long. The section ends at the mouth of the Big Hole River. Estimated numbers, standing crop and summer mortality rates for brown trout are given in Table 4. Rainbow trout are very rare in this reach of the river.

Table 4. Estimated spring and fall, 1979, numbers, standing crops and summer mortality rates for brown trout in the Heron Section of the Big Hole River. (80% CI).

April 1979					September 1979			
Age	Average Length	Number	Biomass	Summer % Mortality	Age	Average Length	Number	Biomass
II	9.8	590	195	--	II	12.3	670	478
III	12.2	1925	1234	76%	III	14.5	455	512
IV+	15.5	743	943	79%	IV+	17.3	158	292
		3258	2372				1283	1282
		(±949)	(±558)				(±)	(±)

Numbers of brown trout age III and age IV and older decreased by 76 and 79 percent respectively from spring to fall. These mortality rates are considerably greater than in the Melrose Section and must be considered excessive. Late summer flow in the Heron Section was extremely low (Figure 4) resulting in severe reduction in habitat and increases in water temperature. While quantitative water temperature data is not available for this section in 1979, water temperatures as high as 77°F were recorded in early September. Thermograph data in past years in this reach indicated water temperatures as high as 80° (Montana Fish and Game unpublished data). The combination of severe decrease in habitat and associated increases in late summer water temperatures appear to have resulted in extremely high summer mortality for older brown trout. The effect of this low flow and high water temperature is also evident if we compare fall condition factors for brown trout in the Melrose Section with brown trout from the Heron Section (Table 5).

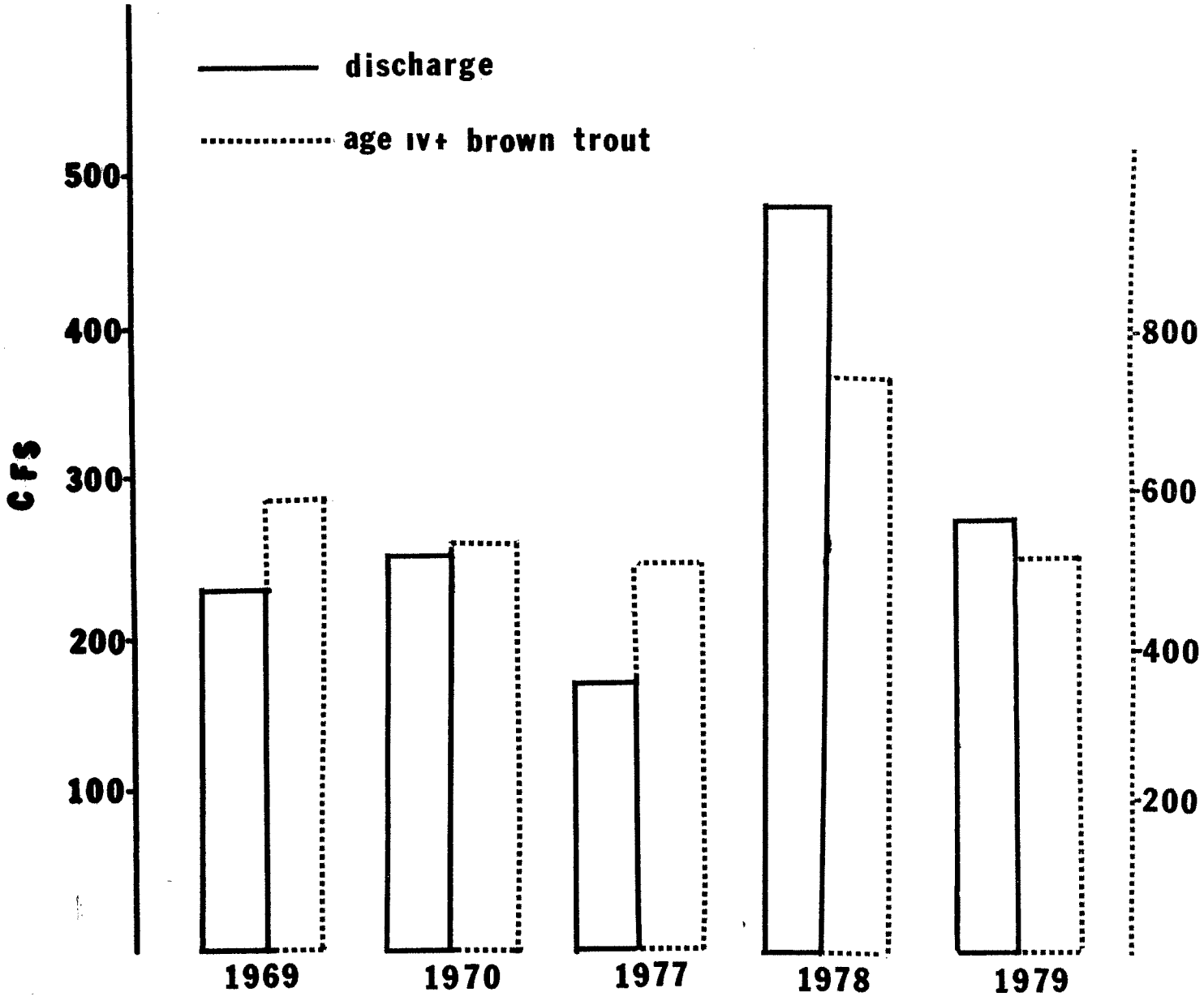
Condition factor is a means of assessing the general well being of fishes using a length/weight relationship.

Table 5. Fall condition factors (english units) for brown trout in the Melrose and Heron Sections of the Big Hole River, September, 1979.

Length Group	Section	Mean Condition Factors
6.0 - 9.9	Melrose	39.29
	Heron	37.06
10.0 - 13.9	Melrose	39.27
	Heron	36.85
14.0 +	Melrose	38.05
	Heron	35.66

Condition factors for brown trout of all length groups in the Melrose Section were considerably greater than for the Heron Section.

Figure 4. Minimum August discharge and September numbers of age IV and older brown trout in the Melrose Section of the Big Hole River, 1969, 1970 and 1977-1979.



Growth Rates

Rainbow Trout

Rainbow trout captured in the Bryant Creek and Melrose Sections of the Big Hole River in September, 1978, were aged by the scale method. Mean lengths of age II and age III rainbow are compared in Table 6.

Table 6. Mean lengths of rainbow trout by age class in the Bryant Creek and Melrose Sections of the Big Hole River, September, 1978.

Section	Age II (N)	Age III
Bryant Creek	10.0 (20)	12.6 (17)
Melrose	11.7 (51)	13.6 (?)

Mean lengths of age II and age III rainbow trout were 1.7 and 1.0 inches greater in the Melrose than in the Bryant Creek Section.

Brown Trout

Brown trout captured in the Melrose and Heron Sections of the Big Hole River during the spring and fall of 1979 were aged by the scale method. Mean lengths for age II and age III brown trout in each section are compared in Table 7.

Table 7. Mean lengths of brown trout by age class in the Melrose and Heron Sections of the Big Hole River, April and September, 1979.

Section	Age Class	April Mean Length (N)	September Mean Length (N)
Melrose	II	9.4 (64)	12.4 (82)
Heron	II	9.8 (34)	12.0 (69)
Melrose	III	12.5 (70)	15.5 (38)
Heron	III	12.2 (73)	14.8 (46)

The mean length of age II brown trout in the Heron Section was 0.4 inches greater in April than in the Melrose Section. However, by September, the mean length of age II brown trout in the Melrose Section was 0.4 inches greater than in the Heron Section. The mean lengths of age III brown trout in the Melrose Section were 0.3 and 0.7 inches greater than in the Heron Section for April and September, respectively.

Mountain Whitefish

Mean lengths of age II and age III mountain whitefish from the Hirschy and Bryant Creek Sections of the Big Hole River in September, 1978, and the Melrose and Heron Sections in September, 1979, are compared in Table 8.

Table 8. Mean September lengths of age II and age III mountain whitefish in the Hirschy and Bryant Creek Sections (1978) and the Melrose and Heron Sections (1979) of the Big Hole River.

	Mean Lengths (N)			
Age	Hirschy	Bryant Creek	Melrose	Heron
II	8.6 (14)	9.2 (43)	10.3 (47)	9.2 (26)
III	9.8 (28)	10.8 (28)	11.9 (13)	11.0 (20)

Mean lengths of age II and age III whitefish were least in the Hirschy Section, nearly equal and intermediate in the Bryant Creek and Heron Sections and greatest in the Melrose Section.

The growth rate data presented above for trout and mountain whitefish indicate that salmarids in the Big Hole River grow slowest in the Hirschy Section, somewhat intermediate in the Bryant Creek and Heron Sections and fastest in the Melrose Section. The slow growth rates in the Hirschy Section appear to be due to water temperatures that are in general colder than those conducive for rapid growth during the summer months (Wells and Rehwinkel, 1979). Growth rates in the Bryant Creek and Heron Sections reflect lower flows and consequent higher summer water temperatures than in the Melrose Section (Wells and Nelson, 1978)(Wells and Rehwinkel, 1979). Increases in irrigation season flow in the Bryant Creek and Heron Sections of the river would probably result in increased growth rates for both trout and mountain whitefish.

Big Hole River Tributary Streams

During the field season of 1979-1980, 26 tributaries of the Big Hole River were selected for investigation of their fisheries and as potential water allocation areas. The following streams were selected: Birch Creek, Canyon Creek, Deep Creek, Divide Creek, Fishtrap Creek, Francis Creek, French Creek, Governor Creek, Joseph Creek, Johnson Creek, LaMarche Creek, Miner Creek, Moose Creek, Mussigbrod Creek, North Fork Big Hole River, Pattingail Creek, Pintlar Creek, Ruby Creek, South Fork Big Hole River, Steel Creek, Swamp Creek, Trail Creek, Trapper Creek, Warm Springs Creek, Willow Creek, and Wise River. (Figure 5).

Instream Flow Requests

Data is presently being analyzed for instream flow requests and is not available at this time.

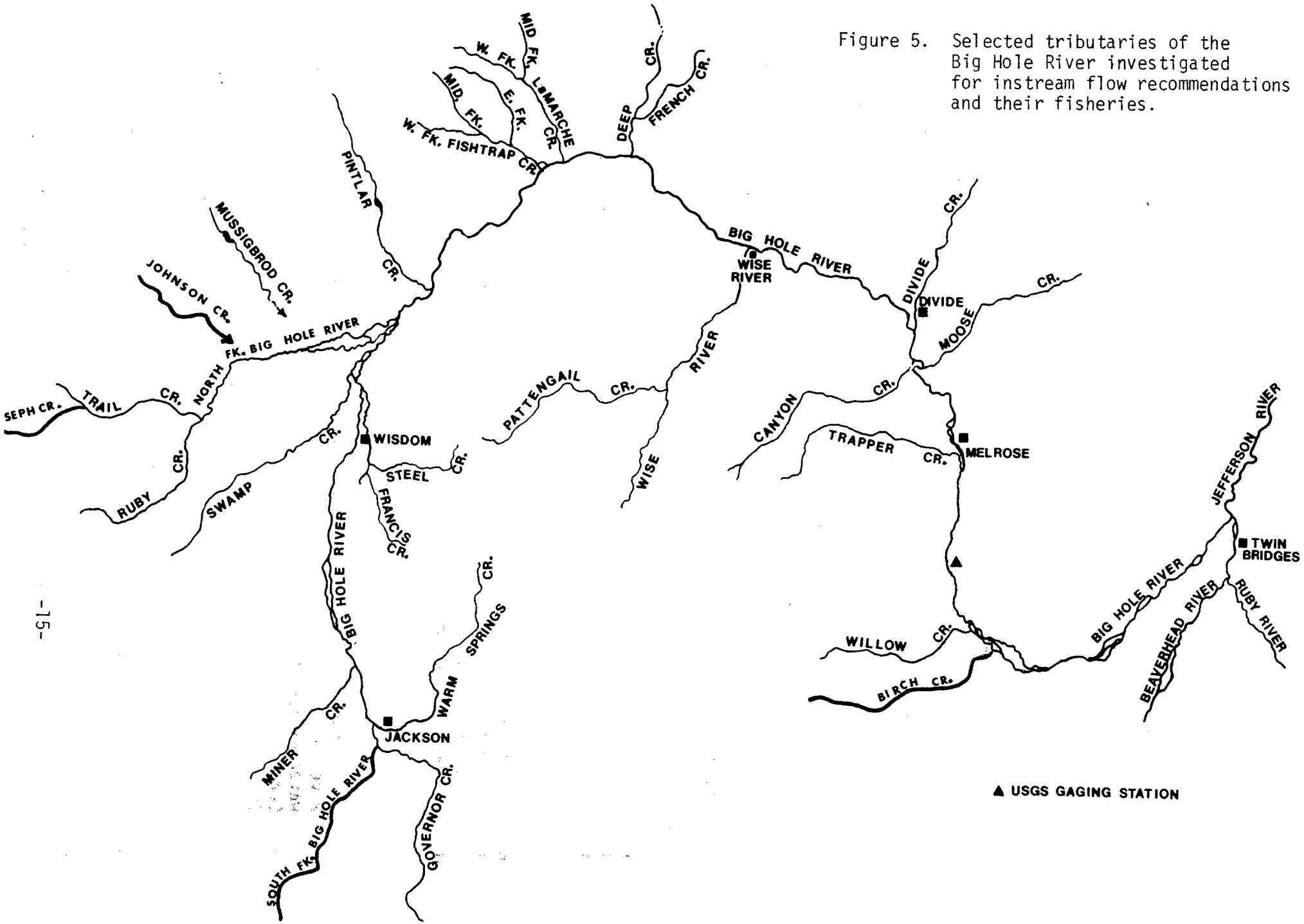


Figure 5. Selected tributaries of the Big Hole River investigated for instream flow recommendations and their fisheries.

Fisheries Surveys - Big Hole River Tributaries

Game fish species present in the tributaries of the Big Hole River electrofished were brook trout (Salvelinus fontinalis), rainbow trout (Salmo gairdneri), cutthroat trout (Salmo clarki), cutthroat X rainbow hybrids, brown trout (Salmo trutta), arctic grayling (Thymallus arcticus), mountain whitefish (Prosopium williamsoni), and burbot (Lota lota). Nongame species included longnose sucker (Catostomos catostomos), white sucker (Catostomus commersoni), mountain sucker (Catostomus platyrhynchus), mottle sculpin (Cottus bairdi), and longnose dace (Rhinichthys cataractae).

Brook trout were captured in all streams electrofished (Table 9). This specie was numerically predominant in 23 of the 26 streams surveyed. Numbers of brook trout captured in two 1,000 ft. runs varied from a low of 12 in Birch Creek to a high of 462 in Steel Creek. Length of the individuals captured varied between 1.0 - 15.9 inches.

Rainbow trout were present in 13 of the 26 tributaries of the Big Hole River electrofished. This species exhibited a higher frequency of occurance as distance from the headwaters of the Big Hole River increased. Rainbow trout were found in their greatest numbers in tributaries below Divide, Montana. Rainbow trout were the dominant trout species in only 3 of the 26 streams electrofished. Numbers of rainbow trout captured in two 1,000 ft. runs varied from five fish in LaMarche Creek to 157 in Moose Creek.

Cutthroat trout were captured only in Moose Creek. Hybrids of this species and rainbow trout were present in Canyon, Pintlar, Ruby, Trapper, and Willow Creeks.

Although once widely distributed throughout the Big Hole River and its tributaries, arctic grayling were captured in only four streams during the present study. Francis, Governor and Steel Creeks and the North Fork Big Hole River appear to contain remnant populations of arctic grayling in their lower reaches.

Mountain whitefish were present in 11 of the streams electrofished. They were captured only in tributaries above Divide, Montana. Mountain whitefish were present in Deep, Francis, French, Governor, Johnson, Steel, Swamp and Trail Creeks and the North and South Forks of the Big Hole River and Wise River. Total length ranged from 2.5" to 16.6".

Population and standing crop estimates of brook and rainbow trout were calculated using a mark-recapture method (Table 10). Population estimates of brook trout per 1,000 ft. ranged from 54 trout weighing 10 pounds in Wise River to 1,183 trout totaling 150 pounds in Steel Creek. Fish length ranged between 3.5" to 15.9".

Population estimates of rainbow trout per 1,000 ft. varied from 40 trout in Divide Creek to 143 trout in Moose Creek. Total biomass ranged between seven pounds in Divide Creek to 16 pounds in Moose and Willow Creeks. Total length varied between 4.0" to 12.9" for rainbow trout.

Table 9. Numbers and length ranges of gamefish species captured in two 1,000 ft. electrofishing runs on selected tributaries of the Big Hole River.

Stream	Species	Numbers Captured	Length Range (inches)
Birch Creek	Brook Trout	12	3.6 - 6.4
Canyon Creek	Rainbow and Rainbow X Cutthroat Hybrids	92	2.6 - 12.7
	Brook Trout	64	4.0 - 11.7
Deep Creek	Brook Trout	16	1.6 - 9.9
	Rainbow Trout	18	5.2 - 10.2
	Mountain Whitefish	19	10.2 - 12.5
Divide Creek	Brook Trout	298	1.0 - 11.9
	Rainbow Trout	28	4.0 - 10.9
Fishtrap Creek	Brook Trout	224	1.6 - 14.0
	Rainbow Trout	9	5.0 - 7.8
Francis Creek	Brook Trout	413	1.6 - 14.0
	Mountain Whitefish	7	2.9 - 6.4
	Arctic Grayling	1	8.3
French Creek	Rainbow Trout	17	4.1 - 10.2
	Brook Trout	13	5.5 - 10.4
	Mountain Whitefish	9	8.3 - 11.5
Governor Creek	Brook Trout	54	2.9 - 12.8
	Mountain Whitefish	28	3.0 - 10.8
	Rainbow Trout	3	5.0 - 6.2
	Arctic Grayling	2	7.7 - 8.7
Johnson Creek	Brook Trout	250	2.2 - 10.4
	Mountain Whitefish	4	11.1 - 11.2
Joseph Creek	Brook Trout	183	2.0 - 11.1
LaMarche Creek	Brook Trout	253	2.4 - 12.4
	Rainbow Trout	5	4.0 - 8.3
Miner Creek	Brook Trout	28	2.8 - 8.6
Moose Creek	Rainbow Trout	157	1.0 - 11.9
	Brook Trout	73	1.0 - 11.9
	Cutthroat Trout	6	5.9 - 8.5
Mussigbrod Creek	Brook Trout	107	1.8 - 11.2
North Fork Big Hole River	Brook Trout	96	1.0 - 15.9
	Mountain Whitefish	28	3.0 - 16.6
	Arctic Grayling	1	9.6

Pattengail Creek	Brook Trout	11	4.0 - 9.5
	Rainbow Trout	2	6.1 - 6.6
Pintlar Creek	Brook Trout	74	1.7 - 10.6
	Rainbow X Cutthroat Hybrids	8	5.7 - 9.5
Ruby Creek	Brook Trout	229	2.0 - 10.3
	Rainbow X Cutthroat Hybrids	2	6.2 - 6.5
South Fork Big Hole River	Brook Trout	319	3.6 - 10.7
	Rainbow Trout	6	5.3 - 12.0
	Mountain Whitefish	5	12.1 - 15.0
Steel Creek	Brook Trout	462	1.2 - 14.7
	Mountain Whitefish	9	3.1 - 5.8
	Arctic Grayling	2	7.4 - 12.6
Swamp Creek	Brook Trout	78	2.0 - 13.9
	Mountain Whitefish	4	2.5 - 3.3
Trail Creek	Brook Trout	15	2.3 - 10.3
	Mountain Whitefish	13	7.2 - 15.6
Trapper Creek	Brook Trout	156	2.6 - 8.8
	Cutthroat X Rainbow Hybrids	10	4.0 - 9.8
	Rainbow Trout	7	2.6 - 9.3
	Cutthroat Trout	5	7.0 - 11.9
	Brown Trout	2	6.9 - 7.7
Warm Springs Creek	Brook Trout	90	2.2 - 11.2
Willow Creek	Rainbow Trout	96	3.0 - 12.5
	Brook Trout	83	3.7 - 10.6
Wise River*	Brook Trout	69	4.9 - 10.8
	Mountain Whitefish	25	4.5 - 13.7
	Rainbow Trout	11	4.3 - 13.0

*Due to low numbers of fish present, a 4,200 foot section was electrofished.

Table 10. Estimated standing crops of trout in a 1,000 ft. section for selected tributaries of the Big Hole River. Eight percent confidence intervals are in parentheses.

Stream	Species	Length Group (inches)	Per 1,000 ft Number	Pounds
Canyon Creek	Rainbow Trout	4.0 - 5.9	43	
		6.0 - 9.9	64	
		10.0 - 12.7	6	
			113(±29)	16(±4)
	Brook Trout	4.0 - 5.9	59	
		6.0 - 9.9	36	
		10.0 - 11.7	3	
			98(±28)	11(±2)
	Total Trout		211(±40)	27(±5)
Divide Creek	Brook Trout	4.0 - 5.9	177	
		6.0 - 9.9	144	
		10.0 - 11.9	2	
			323(±69)	36(±7)
	Rainbow Trout	4.0 - 5.9	23	
		6.0 - 9.9	13	
		10.0 - 10.9	2	
			40(±18)	7(±3)
	Total Trout		363(±71)	43(±8)
Fishtrap Creek	Brook Trout	4.0 - 5.9	241	
		6.0 - 9.9	65	
		10.0 - 14.0	4	
			310(±76)	27(±5)
Francis Creek	Brook Trout	4.0 - 5.9	259	
		6.0 - 9.9	462	
		10.0 - 14.0	37	
			758(±171)	111(±20)
Governor Creek	Brook Trout	5.0 - 5.9	18	
		6.0 - 9.9	99	
		10.0 - 12.8	13	
			130(±61)	29(±13)
Joseph Creek	Brook Trout	4.0 - 5.9	89	
		6.0 - 9.9	47	
		10.0 - 11.1	1	
			137(±25)	14(±3)

LaMarche Creek	Brook Trout	4.0 - 5.9	289	
		6.0 - 9.9	198	
		10.0 - 12.4	18	
			505(±100)	54(±11)
Moose Creek	Rainbow Trout	4.0 - 5.9	81	
		6.0 - 9.9	53	
		10.0 - 11.9	3	
			137(±32)	16(±3)
	Brook Trout	4.0 - 5.9	35	
		6.0 - 9.9	49	
		10.0 - 11.9	2	
			86(±27)	11(±3)
	Total Trout		223(±42)	27(±4)
Mussigbrod Creek	Brook Trout	4.0 - 5.9	143	
		6.0 - 9.9	105	
		10.0 - 11.2	3	
			251(±118)	27(±13)
North Fork Big Hole River	Brook Trout	4.0 - 5.9	43	
		6.0 - 9.9	84	
		10.0 - 15.9	41	
			168(±65)	52(±21)
Pintlar Creek	Brook Trout	4.0 - 5.9	68	
		6.0 - 9.9	17	
		10.0 - 10.6	2	
			87(±29)	8(±3)
Ruby Creek	Brook Trout	4.0 - 5.9	237	
		6.0 - 9.9	266	
		10.0 - 10.3	2	
			505(±101)	52(±11)
South Fork Big Hole River	Brook Trout	5.0 - 5.9	115	
		6.0 - 9.9	311	
		10.0 - 10.7	17	
			443(±82)	64(±12)
Steel Creek	Brook Trout	4.0 - 5.9	646	
		6.0 - 9.9	490	
		10.0 - 14.7	47	
			1,183(±291)	150(±34)
Trapper Creek	Brook Trout	4.0 - 5.9	121	
		6.0 - 8.8	32	
			153(±27)	12(±2)

Warm Springs Creek	Brook Trout	4.0 - 5.9	108	
		6.0 - 9.9	128	
		10.0 - 11.2	20	
			256(±139)	43(±23)
Willow Creek	Brook Trout	3.7 - 5.9	85	
		6.0 - 9.9	68	
		10.0 - 10.6	1	
			154(±47)	17(±4)
	Rainbow Trout and Rainbow X Cutthroat Hybrids	5.0 - 5.9	26	
		6.0 - 9.9	52	
		10.0 - 12.5	6	
			84(±21)	16(±4)
	Total Trout		238(±51)	33(±6)
Wise River	Brook Trout	5.0 - 5.9	13	
		6.0 - 9.9	36	
		10.0 - 10.8	5	
			54(±24)	10(±5)

Ruby River

Sailor Section

This study section was established in the spring of 1979 and is 16,500 feet long. It begins at the county bridge located in T4S, R6W, S23 and extends downstream. A U.S.G.S. stream gauging station was installed just downstream from the study section in July, 1979. The long term objective of this study section will be to investigate the relationships between stream flow, water temperature and trout populations.

Average daily flow from July 24 through September 30, 1979 and maximum daily water temperature from September 5 through September 30, 1979, are dipicted in Figure 6. Average daily flow was lowest on August 5 (83 cfs) and greatest on August 27 (243 cfs). The maximum daily water temperature was 62.8° on September 9.

Numbers and standing crops of brown trout during March and September, 1979 are given in Table 11.

Other species captured in order of relative abundance were mountain whitefish, mottled sculpin, longnose sucker, white sucker, longnose dace and rainbow trout.

Table 11. Numbers and standing crops of brown trout in the Sailor Section of the Ruby River, March and September, 1979.

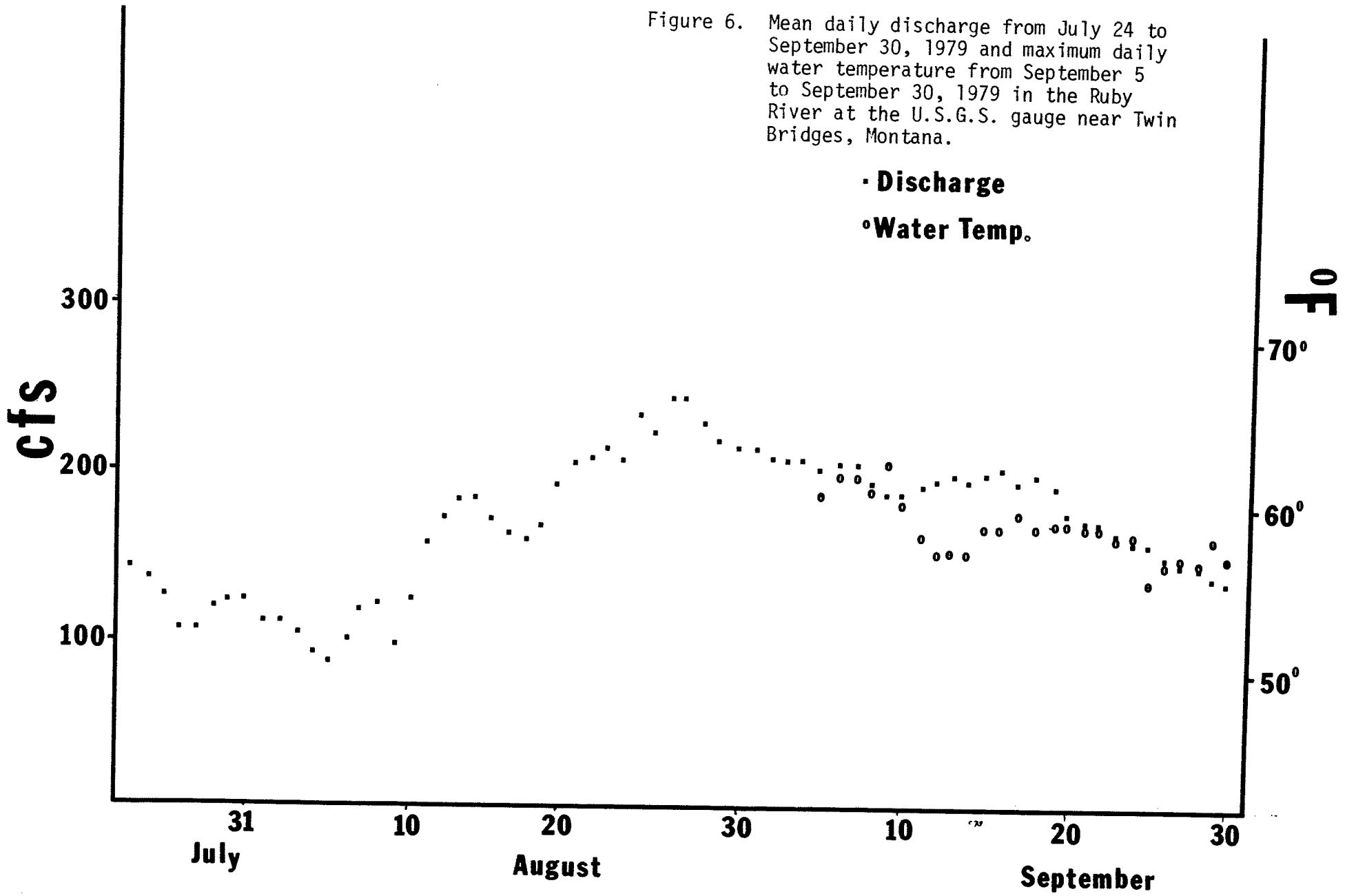
March				September			
Age	Average Length	Number	Biomass(lbs)	Age	Average Length	Number	Biomass(lbs)
II	9.5	406	122	II	11.6	428	252
III	11.7	1361	757	III	14.2	298	323
IV+	14.8	365	409	IV+	15.9	148	226
		2132 (±582)	1289 (±292)			874 (±249)	801 (±265)

Centennial Valley

Red Rock Creek

Historically, grayling populations were extensive in both the streams and lakes of the upper Centennial Valley (Brower, 1897)(Nelson, 1954) (Henshall, 1907). These populations have declined drastically and today the only major population on the Red Rock Lakes National Refuge exists in upper Red Rock Lake. This population is also threatened by the rapid filling of this lake with sediment. The maximum depth of this lake in 1973 was recorded as 7.1 feet (Paullin, 1973). Red Rock Creek is the major spawning

Figure 6. Mean daily discharge from July 24 to September 30, 1979 and maximum daily water temperature from September 5 to September 30, 1979 in the Ruby River at the U.S.G.S. gauge near Twin Bridges, Montana.



stream for this population and each spring large numbers of adult grayling migrate up this stream to spawn. The spawning migration was monitored with electrofishing equipment in 1976 and captured grayling tagged with red, filamentous T-tags (Peterson, 1979).

This grayling spawning migration was electrofished on May 23, 1978, May 21, 1979 and May 19, 1980, from the mouth of Corral Creek downstream for approximately one mile. Number, sex ratios and lengths of these fish are presented in Table 12.

Table 12. Numbers, sex ratios and mean lengths by sex and number of tagged (1976 tags) Artic Grayling captured in Red Rock Creek during May of 1978, 79, 80.

Date	Total	Sex Ratio (Males:Females)	Mean Length M	Mean Length F	Red Tags
5-23-78	91	1.28:1.00	16.0	16.3	6
5-21-79	112	1.00:1.95	16.1	16.2	1
5-19-80	36	6.20:1.00	16.5	15.7	1

Total numbers captured and sex ratios are not comparable from year to year due to the differences in chronology of the spawning migrations. In 1978, the majority of both males and females were ripe, in 1979 most captured females were spawned out and in 1980 none of the females had yet reached spawning condition.

Mean lengths for all three years are similar or slightly greater than Peterson (1979) found in 1976. Six grayling with red T-tags from 1976 were captured in 1978, one in 1979 and one in 1980.

Red Rock grayling were spawned by hatchery personnel from the Washoe Park hatchery in Anaconda in 1978. Approximately 100,000 swim-up-fry were transferred to Yellowstone National Park in an effort to reestablish stream-dwelling artic grayling in the park. The remainder of the fry were lost in the hatchery to an outbreak of IPN virus. Tests for IPN in Centennial Valley fishes in 1979-80 have since proved negative (Jim Peterson, personal communication). Fish captured in 1980 were tagged with individually numbered yellow T-tags.

The limiting factor to this grayling population continues to be the decreasing depth of upper Red Rock Lake. Until measures are taken to mitigate this sedimentation, the future for this unique grayling population will remain dim.

Upper Red Rock Lake

Table 13 depicts species, numbers and length ranges of fish captured in three overnight gill net sets on May 22, 1979.

Numbers of grayling and cutthroat trout captured per net were less than that taken by Peterson(1979).

Culver Pond

Culver Pond, also known as the Widows Pool, has historically been the most famous of the pond fisheries of the Red Rock Lakes refuge. Though it is managed primarily for trumpeter swans, it also has been prized as a trophy brook trout fishery.

Species, numbers and length ranges of fish taken in single overnight gill net sets in May of 1979 and 1980 are presented in Table 13.

The brook trout population in Culver Pond is characterized by the presence of some large, trophy size fish. Condition factors for these brook trout are excellent with 17 inch fish weighing nearly 3 pounds.

MacDonald Pond

MacDonald Pond was poisoned by the Montana Fish and Game Department in 1955 and planted with grayling in 1956-57. However, gill netting in later years has collected only rainbow trout and suckers. The population of wild rainbow has been characterized by the presence of large, trophy size fish.

Species, numbers and length ranges of fish taken in single, overnight gill net sets in May of 1979 and 1980 are given in Table 13.

Widgeon Pond

Widgeon Pond is the newest pond on the refuge, established in 1964.

The pond was thought to be nearly barren of game fish and gill netting in 1979 suggested a small population of brook trout. Yellowstone cutthroat trout fry were introduced to the pond in 1979 in attempt to create a cutthroat fishery.

Species, numbers, and length ranges of fish captured in one overnight gill net set in May 1979 and two overnight sets in May 1980 are given in Table 13.

Elk Lake

Elk Lake is located north of the Red Rock Lakes Refuge on the Beaverhead National Forest. Its fish population has been described by Lund (1973).

On May 23, 1979, five gill nets were fished overnight. Species, numbers and length ranges of fish captured are given in Table 13.

The limiting factor to the naturally reproducing grayling population continues to be the magnitude of flow in Narrows Creek during their spawning season as discussed by Lund (1973).

Clark Canyon Reservoir

Fish species, numbers and length ranges taken in twelve overnight sets in May, 1979, and eleven overnight sets in April, 1980, are given in Table 14.

Table 13. Fish species, numbers and length ranges captured in overnight gill net sets in the Centennial Valley,1979-80.

Lake or Pond	No. Sets	Date	Grayling No.	Grayling Range	Cutthroat Trout No.	Cutthroat Trout Range	Rainbow Trout No.	Rainbow Trout Range	Brook Trout No.	Brook Trout Range	Lake Trout No.	Lake Trout Range	Burbot No.	Burbot Range	White Sucker No.	White Sucker Range
Upper Red Rock Lake	3	5-22-79	16	12.7-17.1	3	6.0-7.0			4	8.7-17.5			3	14.3-15.5	184	11.9-16.2
Culver Pond	1	5-22-79							13	9.2-17.7					57	12.0-18.0
	1	5-22-80							60	7.0-18.5					18	----
MacDonald Pond	1	5-22-79					9	8.4-17.6							7	10.0-16.0
	1	5-20-80					8	13.9-22.0							3	----
Widgeon Pond	1	5-22-79							4	8.4-18.3					117	8.0-16.1
	2	5-20-80	1	14.5					7	12.1-17.6					188	----
Elk Lake	5	5-23-79	34	6.7-17.3	12	14.3-19.5					11	10.5-17.5	7	10.5-15.8	261	----

Table 14. Fish species, numbers and length ranges taken in twelve overnight gill net sets in May, 1979, and eleven overnight sets in April, 1980, in Clark Canyon Reservoir.

Date	No. Sets	Rainbow No.	Rainbow Range	Brown trout No.	Brown trout Range	White Fish No.	White Fish Range	Burbot No.	Burbot Range	W. Suckers No.	W. Suckers Range
5/8/79, 5/15/79	12	7	6.2-18.5	44	9.2-22.2	37	10.8-20.0	10	14.7-26.0	348	5.7-20.5
4/29/80, 4/30/80	11	23	12.7-16.0	13	6.2-23.2	2	19.0-19.9	4	15.0-25.0	654	----

In addition to the species listed above, small numbers of longnose suckers were taken in both years and one northern squawfish was taken in 1979.

Numbers of rainbow trout and white suckers per net increased from 1979 to 1980 while numbers of brown trout, whitefish and burbot decreased. The increase in numbers of rainbow trout captured appears to indicate increased survival of the plant made in 1979. Beginning in 1979, hatchery rainbow were not planted until water temperatures had reached 50^{0}.

Red Rock River

During late October of 1979 and 1980, three miles of the river immediately upstream from Clark Canyon Reservoir was electrofished to determine the magnitude of the brown trout spawning migration from the reservoir. Brown trout were identified as lake fish by coloration and tagged with yellow, individually numbered floy tags. Small numbers of lake rainbow trout were also captured and tagged. Species, numbers, length ranges and mean lengths of brown trout by sex are given in Table 15.

Table 15. Numbers of reservoir brown and rainbow trout, length ranges and mean lengths of brown trout by sex captured in the Red Rock River October 25, 1979 and October 27, 1980.

	Brown Trout						Rainbow Trout	
Date	Female	Mean Length In.	Range	Male	Mean Length In.	Range	Number	Length Range
10-25-79	117	19.5	15.4-24.3	32	19.5	14.5-24.8	11	15.7-23.3
10-27-80	124	20.3	14.3-24.5	23	20.3	17.7-24.3	5	19.3-25.1

During the summer of 1980, six brown trout tagged in the river in 1979 were caught by fishermen in the reservoir. In early November, 1980, a male brown trout tagged in 1979 was caught by a fisherman in the Red Rock River approximately eight miles upstream from the reservoir.

Ruby River Reservoir

Six overnight gill net sets were made in Ruby River Reservoir on May 11, 1979. Species, numbers and length ranges of fish captured are shown in Table 16.

Table 16. Fish species, numbers and length ranges taken in six overnight gill net sets on May 11, 1979, in Ruby River Reservoir.

Date	Rainbow Trout		Brown Trout		White Fish		White Suckers		Longnose Suckers	
	No.	Range	No.	Range	No.	Range	No.	Range	No.	Range
5-11-79	16	9.0-17.4	23	11.5-20.0	24	7.1-15.7	167	6.6-15.0	14	9.8-15.0

The reservoir was nearly completely drained in the fall of 1979. Beginning in 1980, the annual plant of rainbow trout was eliminated and Yellowstone cutthroat trout were introduced to the reservoir.

RECOMMENDATIONS

This project should be continued. Efforts should be continued to assess the effects of flow and water temperatures on trout populations in the Big Hole River.

Instream flow needs and trout population should be determined in the tributaries of the Beaverhead and Ruby Rivers.

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Waters Referred to:

Big Hole River Sec. 1	3-02-0425-01
Big Hole River Sec. 2	3-02-0450-01
Big Hole River Sec. 3	3-02-0475-01
Birch Creek	3-02-0575-01
Canyon Creek	3-02-1075-01
Deep Creek	3-01-1980-01
Divide Creek	3-02-1725-01
Fish Trap Creek	3-02-2200-01
Francis Creek	3-02-2325-01
French Creek	
Governor Creek	3-02-2525-01
Joseph Creek	3-02-3025-01
Johnson Creek	3-02-3000-01
LaMarche Creek	3-02-3175-01
Miner Creek	3-02-3950-01
Moose Creek	3-02-4050-01
Mussigbrod Creek	3-02-4150-01
North Fork Big Hole River	3-02-4275-01
Pattengail Creek	3-02-4500-01
Pintlar Creek	3-02-4550-01
Ruby Creek	3-02-5000-01
South Fork Big Hole River	3-02-0475-01
Steel Creek	3-02-5950-01
Swamp Creek	3-02-6175-01
Trail Creek	3-02-6450-01
Trapper Creek	3-02-6475-01
Warm Springs Creek	3-02-6750-01
Willow Creek	3-02-6950-01
Wise River	3-02-7025-01
Ruby River Sec. 1	3-01-6360-01
Red Rock River Sec. 1	3-01-6140-01
Red Rock River Sec. 3	3-01-6180-01
Clark Canyon Reservoir	3-01-8610-05
Ruby River Reservoir	3-01-9440-05
Culver Pond	3-01-8680-05
Elk Lake	3-01-8780-03
MacDonald Pond	3-01-9100-07
Upper Red Rock Lake	3-01-9780-03
Widgeon Pond	3-01-9820-07

Key Words:

Flow regime
Trout - numbers
Trout - biomass
Trout - population dynamics