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 TITLE: Inventory and Survey of the Waters of the Jefferson and Missouri River Drainages

JOB NO.: I-d

PROJECT PERIOD: July 1, 1978 through June 30, 1980

REPORT PERIOD: July 1, 1979 through June 30, 1980

ABSTRACT

Brown trout population estimates were calculated for the Missouri River at Toston and the Jefferson River at Three Forks. In 1979, the Missouri River had a total of 320 brown trout per mile of stream while 1980 estimates showed 244. Brown trout population work in 1980 on the Jefferson indicates 775 per mile.

Discharge and water temperature were monitored on the Missouri River at Toston. The minimum flow occurred on August 11 and was 1630 cfs. The maximum water temperature for the 1979 summer was 77.9°F (July 19). The minimum discharge of the Jefferson River occurred on August 11 and was 404 cfs.

Work on instream flow determinations was begun on the Missouri, Jefferson and Gallatin River reaches and some tributaries.

BACKGROUND

The upper Missouri River in Montana is notorious for producing trophy trout. This stream was given "Blue Ribbon" status in 1959 by the Montana Department of Fish and Game. The fishing pressure on the reach between Canyon Ferry Reservoir and Three Forks totalled 7705 fishermen days annually. Canyon Ferry Reservoir supports predominately a trout fishery (both rainbow and brown) as well as a perch fishery. A brown trout spawning migration out of the reservoir occurs in the fall and rainbow run both spring and fall with the most noticeable concentrations occurring in the fall season.

The river is not only used by the recreationist, but as a source of irrigation water for agriculture. Although never totally dewatered, it suffers from indirect thermal addition resulting from dewatering upstream and Madison River temperature increases. Presently, a power generation facility is being pursued as an addition to the existing Toston irrigation dam.

In contrast, the Jefferson River, at times, suffers from total dewatering (in some reaches) and severe temperature problems. Despite this situation, the Jefferson still maintains a good trout population which supports 26,374 (1975 est.) days of angling per season.

Data is needed to establish base information in which to determine fisheries management needs in this area.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. To determine trout populations (estimates) in sections of the Missouri and Jefferson Rivers. Data is presented.

2. To monitor daily flow and summer water temperatures at these study section. Data is presented for the Missouri River. Work on the Jefferson River includes discharge information only. Temperature data was not collected due to equipment failure.

3. To determine trout populations and needed instream flows for selected sections of tributary streams in the Jefferson and Missouri River drainages. A listing of streams worked is presented. Analyzed data will be presented in next report.

PROCEDURES

Trout populations in the Missouri and Jefferson Rivers were censused using a fixed positive boat mounted electrofishing system. Population and biomass estimates were calculated using methods described by Vincent (1971 and 1974) and adapted for computer analysis.

Discharge and water temperature data were gathered by U.S.G.S. at gage stations located at Three Forks on the Jefferson River and at Toston on the Missouri River.

Instream flow information was gathered on a portion of the Missouri and Jefferson River tributaries. Data were analyzed by use of the IFG-4 hydraulic simulation computer program.

FINDINGS

Missouri River

Fish Populations

Toston-Deepdale Section. This section (see Figure 1) begins at Toston's iron bridge and runs 7.3 miles downstream to a point approximately two miles above the Deepdale Fishing Access Site. This section is five miles below the Toston irrigation diversion dam and 2.5 miles below the U.S.G.S. gage station. There are no significant tributaries between the gage station and this study section.

The river in this area is predominately confined to a single channel and the riparian zone is very restricted (limited bank cover). Segments within this section have been adversely impacted by man's activities which included overgrazing, riprapping and sediment discharge.

Fish present in this portion of the Missouri River are given in Table 1.

Table 1. Relative abundance of fish present in the Toston-Deepdale study section.

Species	Abundance
Mountain Whitefish	abundant
White Sucker	abundant
Brown Trout	common
Rainbow Trout	common
Longnose Sucker	common
Carp	common
Mottled Sculpin	rare
Cutthroat Trout	rare
Brook Trout	rare
Burbot	rare

Population estimates are presented in Tables 2, 3 and 4. Table 2 depicts the computer calculated estimate for the spring of 1979. Information in Tables 3 and 4 is based on spring 1980 determinations. These latter two estimates are hand calculated.

Table 2. Brown trout population estimates for the Toston-Deepdale study section (7.3 miles), spring 1979.

Age	Average Length"	Number	Number Per Mile	Biomass (lbs)
II	10.6	698	95.6	265.8
III	13.3	745	102.1	592.0
IV	15.4	636	87.1	798.2
V and older	18.1	257	35.2	544.6
		2336	320	

Figure 1. Map of Missouri River Study Section.

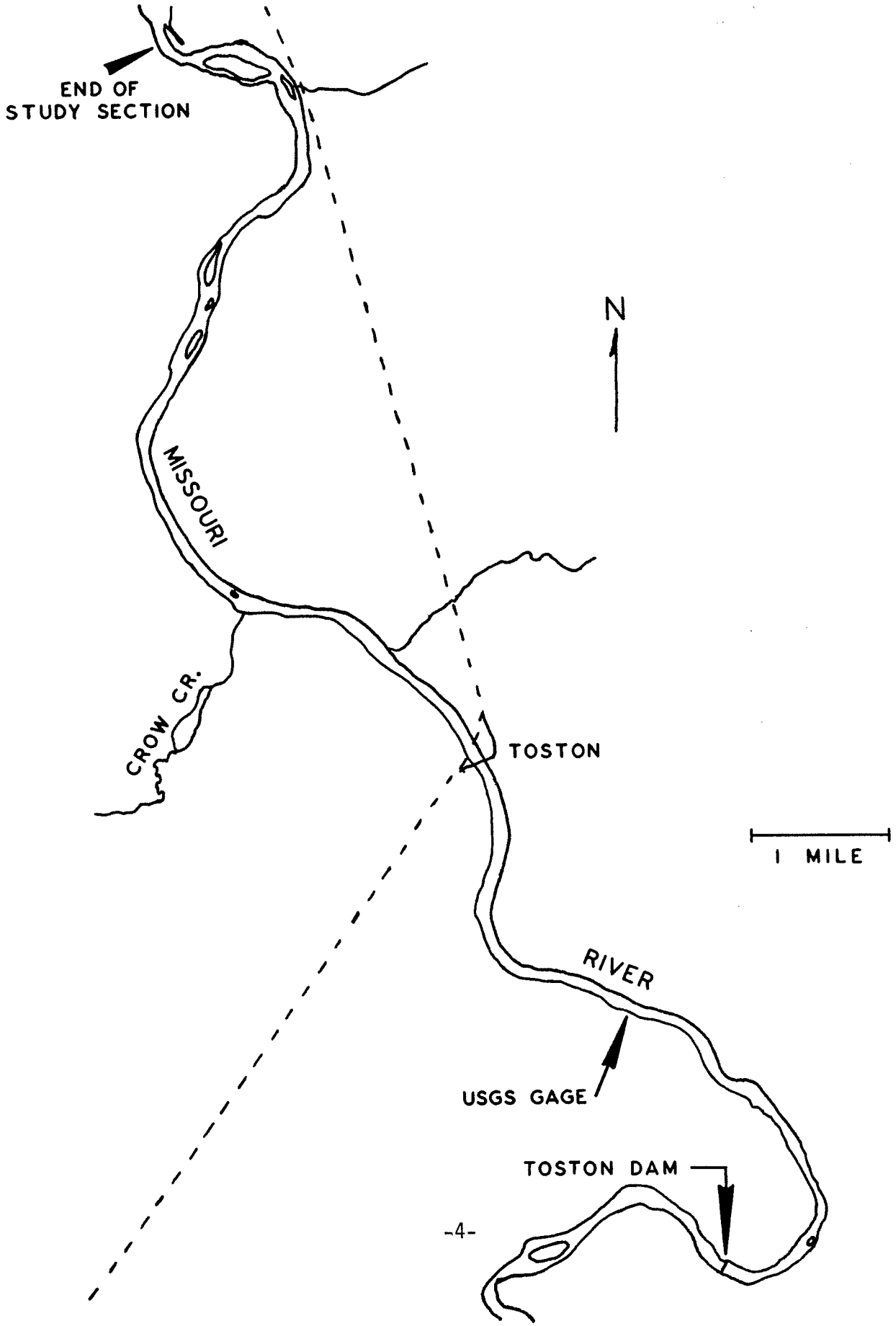


Table 3. Brown trout population estimates for the Toston-Deepdale study section (7.3 miles), spring 1980.

Length Interval "	Number Per Mile
7.0-10.9	42.6
11.0-13.4	71.4
13.5-15.9	77.6
16.0-18.4	30.8
18.5-25.4	22.1
	244.5

Table 4. Rainbow trout population estimates for the Toston-Deepdale study section (7.3 miles), spring 1980.

Length Interval "	Number Per Mile
13.0-15.9	44.6
16.0-17.4	32.3
17.5-18.9	13.5
	90.4

Trout population work on this reach of the Missouri is in its early stages. With that in mind, a legitimate question exists as to the validity of these estimates. The Missouri is a large river and if this data is correct, the population is not particularly large. However, since three estimates have been calculated thus far, a reserved confidence is beginning to develop as to the general accuracy of these estimates. One area of particular concern still remains and that is over the small brown trout estimate (either II's or the 7.0-10.4" group). This question will be answered as the years of data accumulate, so the year classes can be followed.

The rainbow trout estimate for the spring 1980 is of questionable value. One of the basic assumptions in conducting population estimates is that marked fish remain within the area for potential recapture. Tag return information (Table 5) indicates this may not be completely true. In this reach of the Missouri, water temperatures limit sampling to either spring or fall and during both seasons some rainbow movement does occur. Work done during 1978 and 1979 (Fredenberg, 1980) suggests that substantial numbers of rainbow do not move far upstream. Future work, including extensive tagging, will clarify this situation.

Table 5. Summary of fish tagging in the Missouri River between Toston Dam and Canyon Ferry Reservoir.

Tagging Location	Species	No. Tagged	Time	Return Information		Location			
				No. Returned	% Returned	River Above	Same Area	River Below	In Reservoir
Toston-Deepdale	Ll	191	Fall '78	5	2.6	1	1	--	3
Toston-Deepdale	Rb	56	Fall '78	4	7.1	2	1	1	--
Deepdale-Townsend	Ll	79	Fall '78	3	3.8	--	1	--	2
Deepdale-Townsend	Rb	70	Fall '78	6	8.6	1	2	1	2
Townsend-Canyon Ferry	Ll	48	Fall '78	4	8.3	--	3	--	1
Townsend-Canyon Ferry	Rb	187	Fall '78	28	15.0	1	6	--	21
Toston-Deepdale	Rb	83	Spring '79	3	3.6	3	--	--	--
Townsend-Canyon Ferry	Rb	6	Spring '79	1	16.7	--	1	--	--

Probable causes for the depressed trout population are very speculative at this point. However, several obvious areas of consideration include water temperature problems, low flow, depressing impacts due to large trout migrations from the reservoir, or sedimentation. The decrease in brown trout numbers from spring 1979 to spring 1980 occurred when minimum summer discharge reached as low as 1630 cfs (August 11, U.S.G.S.) and maximum water temperature reached as high as 77.9°F (July 19, U.S.G.S.). Both of these values are felt to be undesirable. Future work will follow this situation to determine what exactly are these critical points.

Flow

Discharge of the Missouri River has been monitored by U.S.G.S. at Toston since 1941. The minimum flow was 562 cfs on April 30, 1941. Since a sufficient period of record existed, a monthly flow duration hydrograph has been calculated (Table 6). This hydrograph is essentially an average flow year.

Table 6. Monthly mean 50% exceedence flows (cfs) for the Missouri River at Toston, Montana (U.S.G.S.).

Month	Discharge	Month	Discharge
October	4,230	April	4,940
November	4,800	May	7,810
December	3,740	June	11,700
January	3,400	July	4,500
February	3,740	August	2,460
March	3,880	September	3,430

Mean daily discharges are given in Appendix, Table 1. A brief review of the summer 1979 mean monthly discharges compared to the monthly 50% exceedence values (Table 6) indicates that flows during that time were far below average. The most critical time period occurs between mid-July and mid-September. The low flow for 1979 occurred on August 11 and 12 (1630 cfs). This period coincides with peak irrigation demand and low precipitation.

Temperature

As previously stated, summer water temperatures of the Missouri River at Toston are commonly above those recommended for optimum salmonid growth (Vincent, 1979). The maximum water temperature in 1979 was recorded on July 19 and was 77.9°F (25.5°C). The daily maximum, minimum, and mean water temperatures are given in Appendix, Table 2.

Work done elsewhere (Vincent, personal communication) has shown a high correlation ($\tilde{-}$.90) between ambient air temperature and water temperature. Much of the unaccounted for variability was inversely related to discharge. The

correlation between mean daily air temperature (period when Q <4000 cfs) and maximum water temperature (Toston) for 1978 and 1979 was .859 and .799, respectively. When a multilinear regression was run with air temperature and discharge versus water temperature, only .654 to .763 of the variability was accounted for.

This unusually low value for these two factors was therefore the result of other influences being involved during this low flow period. A potential explanation might be the Madison River-Ennis Lake temperature problem. This explanation appears more credible when the discharges of the Madison and Missouri Rivers are considered. During July, August and September, 1979, the Madison accounted for between 42 and 53% of the Missouri River's discharge. Further work with the Missouri River temperature situation must be accomplished before conclusions can be made.

Jefferson River

Fish Populations

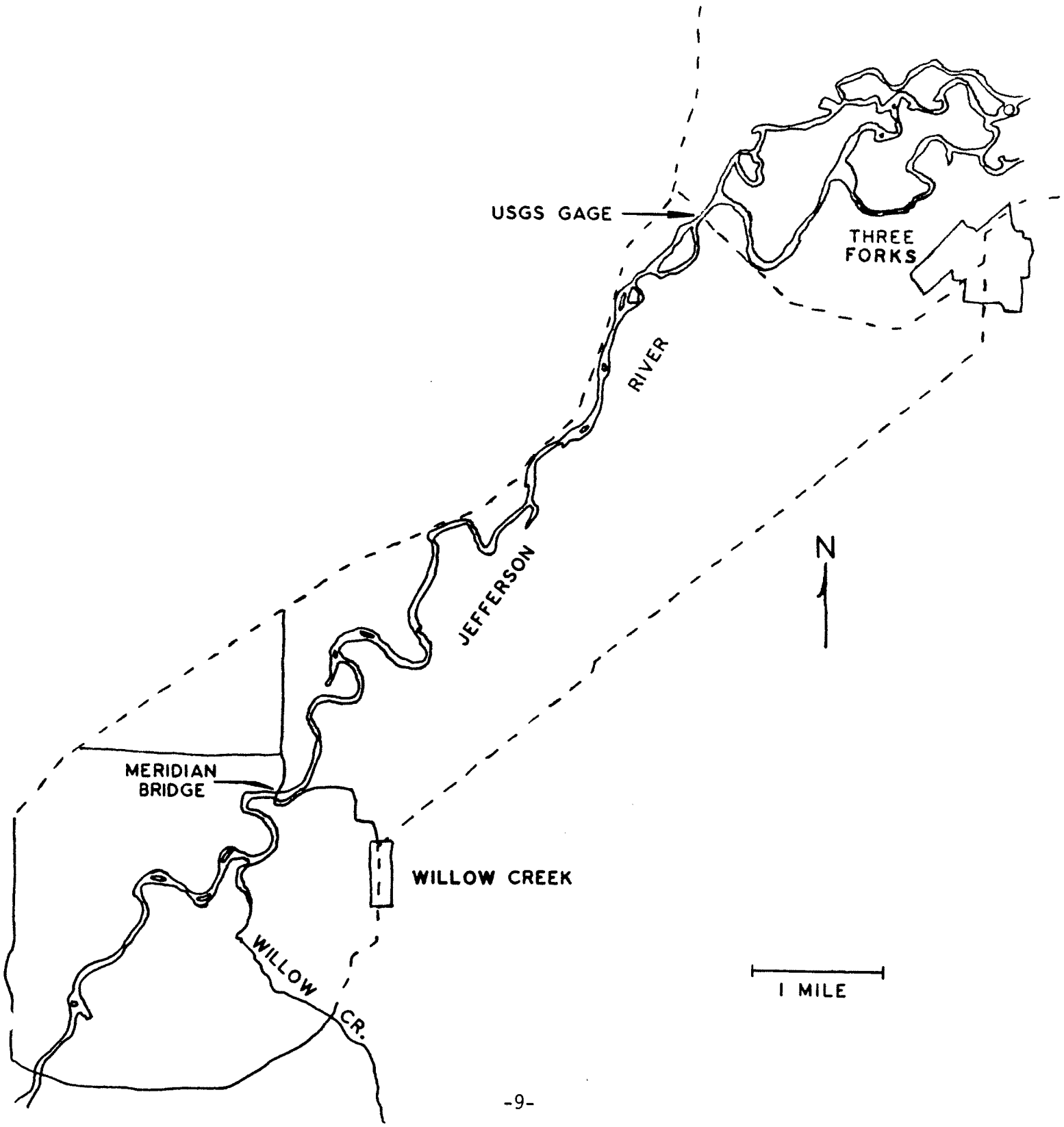
Willow Creek-Three Forks Section. This section begins at Meridian Bridge and runs 7.0 miles to the Three Forks Highway No. 10 Bridge (Figure 2). During the non-runoff period, there are no significant tributaries entering this reach. The river in this area is mainly confined to a single large channel, although several small side channels are present. Man has impacted this section with riprap, highway construction, denuded streambanks and sediment discharge.

Fish present in this section of the Jefferson River are given in Table 7.

Table 7. Relative abundance of fish present in the Willow-Creek-Three Forks study section.

Species	Abundance
Brown Trout	common
Rainbow Trout	rare
Mountain Whitefish	abundant
White Sucker	abundant
Longnose Sucker	common
Sculpin	rare
Carp	common
Yellow Perch	rare

Figure 2. Map of the Jefferson River Study Section.



Brown trout estimates are presented in Tables 8 and 9. The information in Table 8 is the computer calculated estimate for the spring of 1979. Table 9 are hand calculated estimates for the spring of 1980.

Table 8. Brown trout population estimates for the Willow Creek-Three Forks study section (7.0 miles), spring 1979.

Age	Average Length	Number	Number Per Mile	Biomass (lbs)
III	13.1	937.9	134.0	667.6
IV	15.5	479.5	68.5	557.8
V and Older	17.5	166.9	23.8	295.2
		1584.3	226.3	

Table 9. Brown trout population estimates for the Willow Creek-Three Forks study section (7.0 miles), spring 1980.

Length Interval	Number Per Mile
8.0-11.4	198.2
11.5-13.4	389.9
13.5-15.9	152.2
16.0 and larger	35.3
	775.6

The first year of trout population work on the Jefferson River was 1979. The nature of this river (deep pools, hazardous "snags" and side channels too shallow to navigate) presented difficult sampling problems. It appears probable that the first work (spring 1979) is questionable when comparing it to the spring 1980 estimate. The only technique changes that occurred between these two years was a more dependable outboard motor (which allowed more thorough sampling) and a more experienced crew. These changes resulted in increased sample sizes. It is concluded that the reliability of these estimates is still uncertain and that it will take several years to verify.

However, both years work points to the difficulty in sampling the smaller fish. Unless this changes, it appears that estimates will have to be limited to III and older trout in the spring and II and older fish in the fall.

As for the rainbow trout population, insufficient numbers were sampled to calculate an estimate. Rainbow trout did constitute 4.8% of the trout sampled on the three marking runs. There size ranged from 8.1 to 15.5 inches.

Flow

Discharge of the Jefferson River was monitored by U.S.G.S. at Sappington from 1941 to 1969. Since a sufficient period of record existed, a monthly flow duration hydrograph has been calculated (Table 10). This provides an approximation of an average water year.

Table 10. Monthly mean 50% exceedence flows (cfs) for the Jefferson River at Sappington, Montana (U.S.G.S.).

Month	Discharge	Month	Discharge
October	1,280	April	2,260
November	1,640	May	3,880
December	1,370	June	5,500
January	1,090	July	2,100
February	1,210	August	690
March	1,350	September	1,000

Mean daily discharges are given in Appendix, Table 3. In general, 1979 was a low flow year. The monthly means were 999, 779, and 793 cfs for July, August, and September, respectively. This is substantially below average for July and September, while August remains just above average. The low flow for 1979 occurred on August 11 and 12 (404 cfs).

Temperature

Temperature data is not available due to equipment failure.

Instream Flow Work

All major rivers in the area were divided into unique reaches. In addition, all tributary streams which supported a fishery of recreational magnitude were designated. In brief, each tributary or river reach was measured at five distinct cross-sections at each of three different discharges, then a mark and recapture population estimate was conducted. Table 11 shows the area that must be worked and those which have been completed. Analyzed data will be available in the next progress report.

Table 11. Waterways where instream flow cross-sections and fish population work has been completed as well as those which must yet be done.

River Sub-Reach or Tributary	Cross-Sections	Fish Populations
Missouri River (above Canyon Ferry Reservoir)	X	X
Gallatin River (Three Forks to Manhattan)		X
Jefferson River (Three Forks to Sappington)		X
Jefferson River (Sappington to Boulder River)	X	
Jefferson River (Boulder River to Mouth of Big Hole)	X	
Boulder River (Mouth to Cold Spring)	X	X
Boulder River (Cold Spring to Mouth of Little Boulder)		X
Boulder River (Mouth of Little Boulder to Source)		X
Little Boulder River		X
Hell's Canyon Creek		
Whitetail Creek		
South Boulder River	X	
Willow Creek		
North Willow Creek		
South Willow Creek		
Beaver Creek	X	
Crow Creek	X	
Dry Creek	X	
Deep Creek	X	
Duck Creek	X	
Confederate Creek	X	
Avalanche Creek		

LITERATURE CITED

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Waters Referred to:

09-2090 Gallatin River
17-0160 Avalanche Creek
17-0480 Beaver Creek
17-1664 Confederate Creek
17-1888 Crow Creek
17-2096 Deep Creek
17-2432 Duck Creek
17-4928 Missouri River Sec 11
10-8000 Willow Creek
10-0840 Boulder River
10-3280 Hells Canyon Creek
10-3840 Jefferson River
10-4160 Little Boulder R.
10-5160 North Willow Creek
10-6760 South Boulder River
10-6880 South Willow Creek
10-7920 Whitetail Creek

Key words:

Flow regime
Trout biomass
Trout numbers

Appendix Table 1. Missouri River mean daily discharge, March through September, 1979 (U.S.G.S.).

Day	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4020	5170	9530	10800	5460	1820	2820
2	3930	4970	9700	9340	5170	1780	2800
3	3940	4920	9640	8290	4710	1730	2760
4	3760	4880	9330	7860	4400	1690	2700
5	3750	4870	9260	7950	4010	1660	2690
	3820	5110	9400	8110	3830	1670	2690
	4860	5810	9370	8860	3760	1650	2690
	5770	6210	8820	8490	3480	1640	2640
	5690	6210	8060	7690	3110	1670	2510
	5310	6220	7400	7050	2880	1660	2460
	5120	6080	6970	6640	2710	1630	2450
	5160	5800	6530	6400	2640	1630	2430
	5540	5620	6330	6450	2500	1660	2430
	5370	5570	6300	6870	2030	1830	2450
	5130	5570	6490	7070	2120	1980	2450
	5040	5710	6970	6710	2060	2190	2430
	5290	5800	7840	6260	1960	2300	2420
	5480	6600	8620	6260	1850	2320	2400
	5280	7320	9080	7800	1740	2250	2330
	5000	7420	9380	10000	1680	2340	2230
	4750	6970	9390	9700	1700	2410	2200
	4720	6480	9380	8950	1660	2620	2170
	5220	6640	9820	8440	1720	2610	2220
	5270	7200	10700	7970	1770	2520	2270
	5440	7770	11600	7450	1740	2630	2300
	5400	7730	12300	7040	1740	2670	2350
	5300	7400	13000	6690	1730	2640	2440
	5220	7430	14300	6470	1730	2790	2510
	5230	8060	16400	6190	1860	2840	2520
	5250	8930	15300	5550	1930	2810	2410
	5240	---	12900	---	1860	2750	---
Total	154300	190470	300110	229350	81540	66390	74170
mean	4977	6349	9681	7645	2630	2142	2472
Max	5770	8930	16400	10800	5460	2840	2820
Min	3750	4870	6300	5550	1660	1630	2170
Ac-Ft.	306100	377800	595300	454900	161700	131700	147100

Appendix Table 2. Water temperatures (°C) of the Missouri River at Toston, Montana, 1979 (U.S.G.S.).

Day	JULY MAX	JULY MIN	JULY MEAN	AUGUST MAX	AUGUST MIN	AUGUST MEAN	SEPTEMBER MAX	SEPTEMBER MIN	SEPTEMBER MEAN
1	19.5	18.0	18.5	24.5	21.0	22.5	16.5	15.5	16.0
2	18.0	16.5	17.0	24.0	21.0	22.5	19.0	16.5	17.5
3	19.0	17.5	18.0	23.5	20.5	22.0	19.5	18.0	18.5
4	20.5	19.0	20.0	24.0	20.5	21.5	18.5	17.0	17.5
5	20.5	19.5	20.0	24.5	20.5	22.0	17.5	16.0	16.5
	21.5	20.5	21.0	24.0	20.5	22.0	18.5	16.5	17.5
	21.0	19.5	20.0	23.5	20.0	21.5	19.5	17.5	18.5
	21.5	20.5	20.5	22.5	20.0	21.0	20.0	18.5	19.0
	22.0	20.5	21.0	22.0	18.0	20.0	19.5	17.5	18.5
	22.5	21.5	22.0	23.5	18.5	20.5	17.5	15.5	17.0
	22.0	20.5	21.0	24.0	20.0	21.5	17.0	15.0	15.5
	21.0	19.5	20.5	21.0	19.0	20.0	15.5	14.0	15.0
	21.5	19.5	20.5	19.0	17.0	18.5	15.5	14.5	15.0
	23.0	19.5	21.0	19.5	17.0	18.0	16.0	14.5	15.0
	21.0	19.0	20.0	20.5	17.0	19.0	16.0	14.5	15.0
	22.5	19.5	20.5	21.5	19.5	20.0	16.5	15.0	15.5
	23.5	20.5	22.0	21.0	19.0	20.0	17.5	15.5	16.0
	24.5	21.5	22.5	21.5	19.5	20.0	17.0	15.5	16.5
	25.5	21.5	23.0	21.0	19.0	20.0	17.0	15.5	16.5
	25.0	21.5	23.0	21.0	19.0	20.0	17.0	15.0	15.5
	24.5	21.0	22.5	20.5	18.5	19.5	17.0	15.0	15.5
	23.0	21.5	22.0	20.5	18.5	19.5	17.0	15.0	16.0
	23.0	20.0	21.5	21.5	19.5	20.0	17.0	15.0	16.0
	24.0	20.0	21.5	20.5	19.0	20.0	17.0	15.0	15.5
	23.5	19.5	21.5	20.5	18.5	19.5	16.0	15.0	15.5
	23.5	19.5	21.5	20.5	19.0	19.5	16.0	15.0	15.5
	24.0	20.5	21.5	19.5	17.5	18.5	15.5	14.0	15.0
	23.0	20.0	21.0	18.5	17.0	17.5	15.5	14.0	14.5
	22.0	19.5	20.5	19.5	17.5	18.5	15.5	14.0	14.5
	23.0	19.5	21.5	20.5	19.0	19.5	15.5	14.5	15.0
	24.0	21.0	22.0	19.0	16.5	18.0	---	---	---

Appendix Table 3. Jefferson River mean daily discharges, March through September, 1979 (U.S.G.S.).

Day	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1600	1780	4900	6080	1950	662	1130
2	1600	1730	5120	5170	1930	648	1140
3	1500	1710	5170	4470	1870	597	1130
4	1500	1670	5080	4140	1820	556	1090
5	1500	1670	4910	4130	1710	516	1060
	1700	1720	4940	4270	1680	507	1040
	2000	1860	4900	4450	1620	492	1020
	2100	1980	4600	4150	1520	491	945
	2100	2050	4230	3770	1360	457	894
	2000	2100	3860	3440	1260	418	852
	1900	2130	3590	3200	1170	404	804
	1900	2040	3330	3080	1070	404	794
	2000	2030	3200	3020	929	421	796
	1900	2020	3110	3000	842	497	797
	1850	2000	3310	3060	758	691	798
	1880	2040	3630	2890	711	875	805
	1970	2120	4110	2690	664	939	799
	2010	2430	4620	2670	603	895	789
	1970	2970	4950	3320	559	878	725
	1910	3090	4980	4010	568	925	672
	1850	2770	4870	3980	551	953	619
	1860	2560	4880	3610	503	972	587
	1840	2690	5150	3490	504	1000	591
	1840	3260	5610	3340	533	1030	577
	1890	3500	6250	3090	573	1050	571
	1900	3490	7040	2830	581	1080	548
	1880	3440	7430	2590	596	1100	543
	1860	3500	7910	2380	580	1170	549
	1850	4060	8320	2210	632	1200	555
	1870	4670	7970	2040	662	1190	567
	1840	---	7040	---	664	1130	---
Total	57370	75080	159010	104570	30973	24148	23787
mean	1851	2503	5129	3486	999	779	793
max	2100	4670	8320	6080	1950	1200	1140
min	1500	1670	3110	2040	503	404	543
Ac-Ft.	113800	148900	315400	207400	61430	47900	47180