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

State: Montana
Title: Southwest Montana Fisheries Study

Project No.: F-9-R-29
Title: Inventory and Survey of the Waters of the Jefferson and Missouri River River Drainages

Job No.: 1-d

Project Period: July 1, 1980 through June 30, 1981

Report Period : July 1, 1980 through June 30, 1981

ABSTRACT

Trout population estimates were calculated for the Toston Section of the Missouri River and the Willow Creek-Three Forks Section of the Jefferson River. The 1980 estimate shows 244 brown trout per mile in the Missouri at Toston. Annual mortality rates from 1979 to 1980 were 55 percent for age III to age IV fish. Brown trout estimates from the Jefferson River indicated a population of 452 per mile.

Discharge and water temperature were monitored on both rivers. The Missouri during 1980 was about average in flow (minimum, 1900 cfs) and the temperature reached its peak on July 23 (75.2°F). The Jefferson during the summer of 1980 had approximately an average discharge (minimum, 623 cfs) and experienced very high water temperatures (maximum, 77.0°F).

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 totaled 7,705 fishermen days annually in 1975. Canyon Ferry Reservoir supports a trout fishery (both rainbow and brown) as well as a yellow 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 used not only 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 below Ennis Dam. At present, a power generation facility is being considered 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 supports a good trout population which provided 26,374 days of angling in 1975.

Data is needed to establish base information from which to determine fisheries management direction on these rivers.

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 in these study sections. Data is presented for the Missouri and Jefferson Rivers.

3. To determine trout populations and needed instream flows for selected sections of tributary streams in the Jefferson and Missouri River drainages. Data is presented.

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 gauge 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 was analyzed using the IFG-4 hydraulic simulation and the WETP computer programs.

FINDINGS

Missouri River

Fish Populations

Toston-Deepdale Section - Brown troup population estimates are presented in Table 1 for the 7.3 mile section of the Missouri River (Figure 1). Table 1 depicts the population estimate for the spring of 1980.

Table 1. Estimated numbers and biomass by age groups for Brown Trout in the Toston-Deepdale study section (7.3 miles), spring 1980.

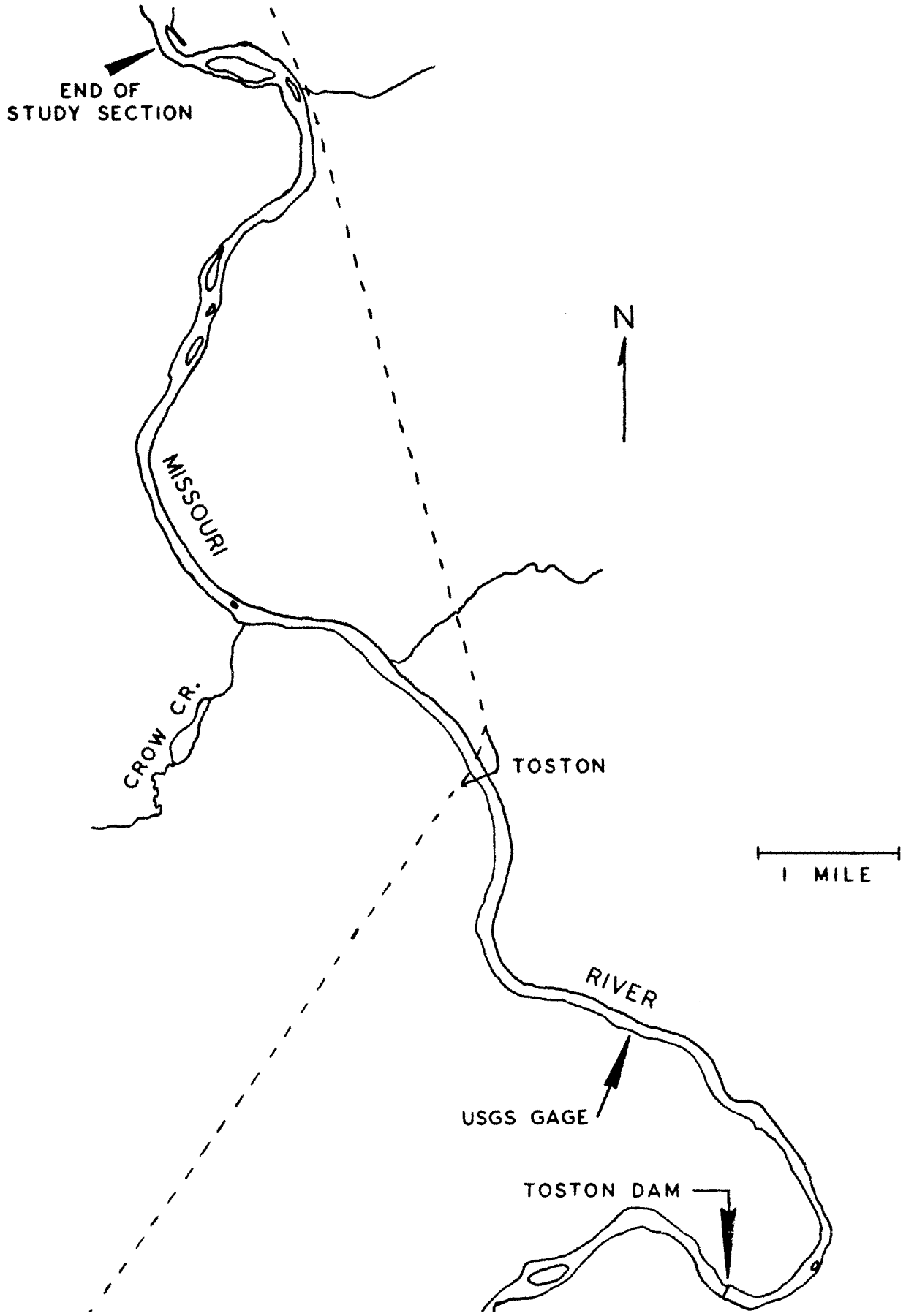
Age	Average Length(")	Number	Biomass (lbs.)	Number Per Mile
II	10.9	665	288.4	91
III	13.8	498	462.9	68
IV	16.0	402	589.3	55
V+	18.8	216	508.3	30
Total		1,781	1,484.9	244

Table 2 depicts annual mortality rates from spring 1979 to spring 1980 for brown trout in this section of river. Annual mortality rate was greatest in the age III - age IV+ group (55%), and least in the age II - age III group (29%). At this point in time, annual mortality of brown trout does not appear excessive.

Table 2. Annual mortality rates of brown trout by age group in the Toston-Deepdale section from spring 1979 to spring 1980.

Age Group	Spring 1979 Pop. Estimate	Spring 1980 Pop. Estimate	Annual Mortality %
II to III	698	498	29
III+ to IV+	1,381	618	55

Figure 1. Map of Missouri River Study Section (Toston-Deepdale, 7.3 miles).



During this report period, 301 rainbow trout were tagged incidental to spring electrofishing in an effort to answer the question of rainbow residency. In the months that followed, 14 tagged fish were reported caught by anglers. Two rainbows were taken above the tagging location and twelve were returned from Canyon Ferry Reservoir. This information suggests that there is an extensive spring run of rainbow out of Canyon Ferry Reservoir. The presence of both spring and fall migrating rainbow eliminates the opportunity of enumerating resident rainbow populations during spring and fall sampling.

Flow

Summer discharge of the Missouri River at Toston during 1980 was generally above average (all except August). Mean monthly discharges were 4,885, 2,368, and 4,299 cfs for July, August and September, respectively (U.S.G.S., 1980). Mean daily discharges are given in Appendix Table 1. The low flow for 1980 occurred on August 13 and 14 (1,900 cfs). Since the minimum instream flow (based on wetted perimeter measurements) is determined to be 1,500 cfs for the low flow summer period, there appears to be no water volume problem impacting this fishery.

Temperature

Summer water temperatures of the Missouri River are commonly above those recommended for salmonid growth (Vincent, 1979). The maximum summer water temperature in 1980 was recorded on July 23 and was 75.2° F (24.0° C). During 1980, the Missouri's maximum daily water temperature exceeded 70°F on 15 days, while the daily mean temperature exceeded the 70° F level 11 days (Appendix Table 2).

Determination of the sources of these high summer water temperatures would be desireable and would require monitoring all three tributaries of the Missouri. Future effort should be applied in this direction.

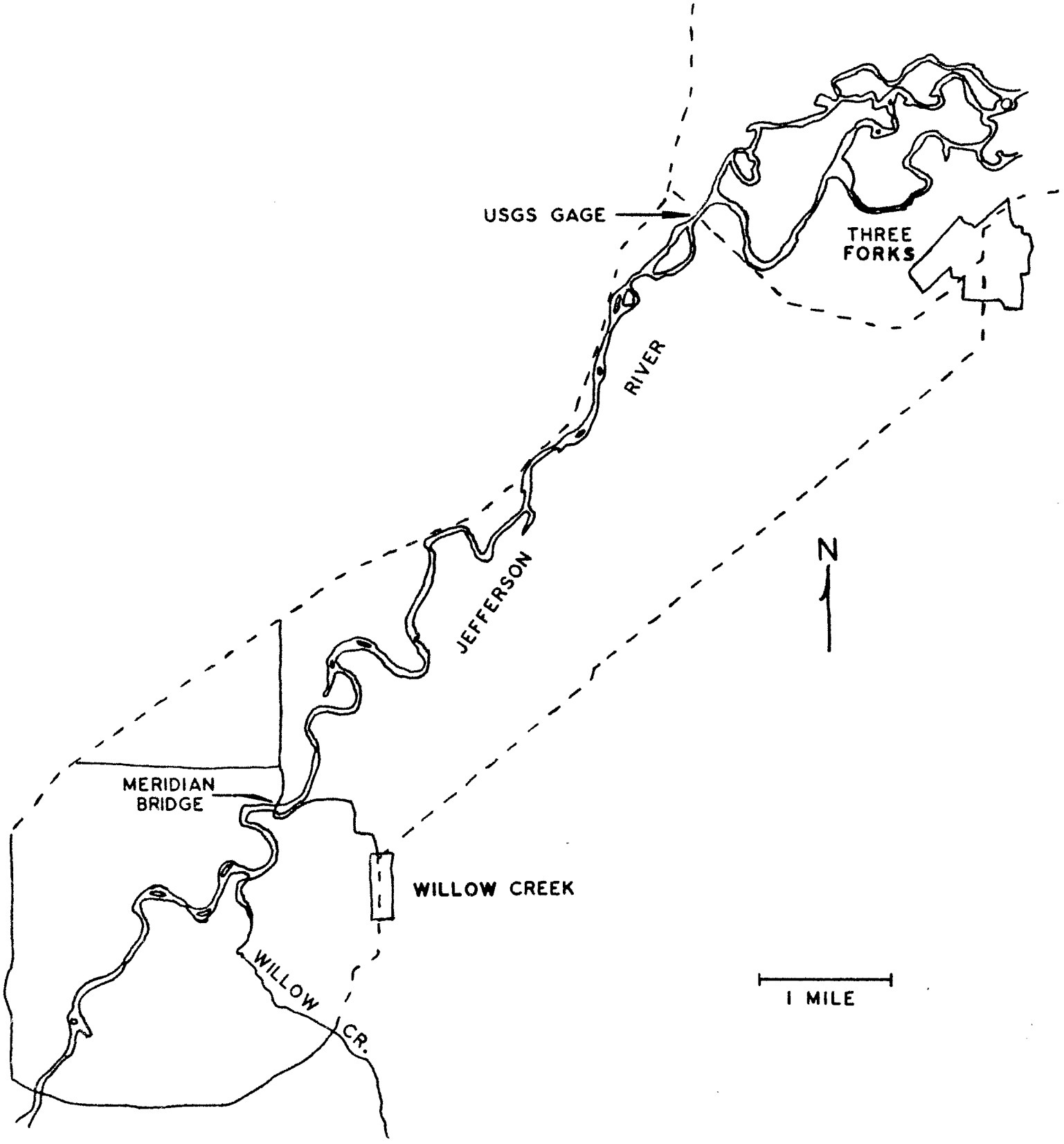
Jefferson River

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.

Brown trout constitute over 90% of the trout in this section and are the species at which management is directed.

Figure 2. Map of Jefferson River Study Section (Willow Creek-Three Forks, 7.0 miles).



Population estimates for the spring and fall of 1980 are given in Tables 3 and 4. Due to sampling problems associated with smaller fish, data is confined to age III+ fish in the spring and age II+ fish in the fall.

Table 3. Brown trout population estimates for the Willow Creek-Three Forks study section (7.0 Miles), spring 1980 (80% confidence intervals).

Age	Average Length	Number	Biomass (lbs.)	Number Per Mile
III	13.3	2,684	2,101.9	383
IV+	16.2	483	701.0	69
		3,167	2,802.9	452
		(±1,528)	(±1,271)	

Table 4. Brown trout population estimates for the Willow Creek-Three Forks study section (7.0 Miles) for fall 1980 (80% confidence intervals).

Age	Average Length	Number	Biomass (lbs.)	Number Per Mile
II	12.1	1,332	820.3	190
III	13.9	549	502.7	78
IV+	16.6	539	881.2	77
		2,420	2,204.2	345
		(± 558)	(± 628)	

Table 5. Brown trout population estimates per mile by age for the Willow Creek-Three Forks study section.

Age	Spring 1979	Spring 1980	Fall 1980
II			190
III	134	383	78
IV	68	48	36
V+	24	21	41
Total	226	452	345

Ages derived from the scale method for fall brown trout show very little growth during the previous season. It would be anticipated that the average length per age group would be very similar to the next respective age in the spring (nearly all of the growth period lies between spring and fall estimates). A review of the fall scales does not readily indicate the problem area. However, fall scales are much more difficult to read. Spring average lengths appear to be consistant with other area rivers (Gallatin and Missouri). Numbers of age V and older brown trout apparently increased from spring to fall 1980 which may be due to spawning movements in the fall.

A review of the summer river conditions show that there were 26 days where the maximum water temperature exceeded 70°F with a maximum achieved on July 22 of 77°F. The discharge of the Jefferson River also fell to 623 cfs on August 14, which is considerably below the recommended minimum of approximately 1,000 cfs (MDFWP, 1979). These two factors, although certainly cause for concern, are not felt to explain the apparent lack of growth.

It is recommended that the Jefferson River sampling be confined to spring only and that mortality rates be calculated on an annual basis.

The mortality rates given in Table 6 appear somewhat high. Given the apparent low fishing pressure in this section these rates are probably the result of natural causes.

Table 6. Mortality rates for brown trout from spring 1979 to spring 1980 in the Willow Creek-Three Forks Section of the Jefferson River.

Age Group	Number, Spring 1979	Number, Spring 1980	Annual Mortality %
III+ to IV+	1,584	483	69.5

Especially interesting are the age III fish in the spring of 1980. They would have emerged in the spring of 1977. Although flow data from the Jefferson is unavailable, that year was a very poor flow year throughout the region. The year class was very successful, however. The unique fact about that year class was not only its magnitude at emergence, but its magnitude up to age III. Other researchers (Wells, Vincent, personal communications) have witnessed strong rainbow year class following very poor flow years. Nelson (1977) in work done on the Beaverhead River showed that any given age group's size was mainly the result of its previous years magnitude (abundant age II's yielded abundant age III's). In the Jefferson River this appears correct until approximately age III or about 13.0 inches in length is achieved. This 1980 age III group was exposed to very low water on the year of emergence, followed by very high water (1978) when they were age I, followed again by very low water (1979 - 404 cfs).

It is certainly too early to draw any meaningful conclusions, but continued work with the Jefferson River's brown trout population could very possibly identify key conditions limiting growth and numbers.

Flow

Summer discharge of the Jefferson River at Three Forks during 1980 was above the 50% exceedence flow levels. Mean monthly discharges were 2,547, 889 and 2,041 cfs for July, August and September, respectively (U.S.G.S. 1980). Mean daily discharges are given in Appendix, Table 3. The low flow for 1980 occurred on August 14 (623 cfs). A total of 27 days (from July 26 to August 21) were spent below the recommended instream flow of 1,000 cfs.

Temperature

As previously stated, summer water temperatures of the Jefferson River are commonly above those recommended for salmonid growth (Vincent, 1979). The maximum water temperature in 1980 was recorded on July 22 and was 77.0°F (25.0°C). During 1980, the Jefferson's maximum daily water temperature exceeded 70°F on 26 days, while the daily mean temperature exceeded the 70°F level 11 days (Appendix Table 4).

Continued monitoring of this situation and its resultant impacts on brown trout should pin-point critical temperatures and hopefully a corrective solution.

Instream Flow Work

Most instream flow work on main rivers and tributaries in the area has been completed. The recommended instream flows and the fishery resource is given in Tables 7 through 9.

These determinations are based upon the ideas that the riffle is the source of fish food production and that the impacts of dewatering the riffle are best described by the wetted perimeter measurement. As the water in the channel decreases, this flow-wetted perimeter relationship is not reduced at a constant rate. An inflection point, or points, usually describes where the rate of impact upon the riffle is accelerated and is the point beyond which dewatering is very detrimental to the fishery.

Many of the streams or river reaches addressed here, as well as the technique, are described in more depth in the Instream Flow Evaluation For Selected Waterways in Western Montana, 1981 and Instream Flow Evaluation For Selected Streams In The Upper Missouri River Basin, 1979.

Table 7. Instream flow determinations and fish populations for selected tributaries of the Missouri River.

Stream	Location of wetted perimeter inflection points (cfs)	Recommended minimum discharge (cfs)	Fish Present	Dominate Species estimate (per 1,000') (with 80% C.I. in parenthesis) Number	Pounds
Beaver Creek	4-15	6	Brook Trout & Mottled Sculpin	Brook 3.7 - 5.9 332 6.0 - 8.9 126 458(±101)	30(±6)
Crow Creek	11-25	14	Rainbow, Brook, Brown, Mottled Sculpin	Rainbow 4.0 - 5.9 215 6.0 - 9.9 193 10.0 - 11.3 1 409(±52)	40(±4)
Dry Creek	2	2	Rainbow, Brook, Mottled sculpin	Rainbow 2.5 - 5.9 571 6.0 - 9.9 224 795	
Deep Creek	25-50	35	Rainbow, Brook, Brown, Mottled sculpin	Rainbow 4.0 - 5.9 83 6.0 - 9.9 88 10.0 - 13.0 11 182(±18)	25(±2)
Duck Creek	4-9	8	Brook, Rainbow, Mottled Sculpin	Brook 2.5 - 5.9 154 6.0 - 9.9 52 206	

Table 8. Instream flow determinations and fish populations of selected tributaries of the Jefferson River.

Stream	Location of wetted perimeter inflection points (cfs)	Recommended minimum discharge (cfs)	Fish Present	Dominate Species estimate (per 1,000') (with 80% C.I. in parenthesis) Number	Pounds
Boulder River -above Basin	18-22	22	Brook, Rainbow, Whitefish, Mottled sculpin	35-403	6.2-56.7
Boulder River -below Little Boulder	10-24	16	Brook, Rainbow, Brown, Mottled sculpin, Longnose Dace, White sucker, Longnose sucker	39-242	15.2-70.2
Boulder River -below Cold Spring	60-100	100	Rainbow, Brown, Mottled sculpin, Longnose Dace, White sucker, Longnose sucker		
Little Boulder River	8-19	10	Brook, Rainbow, Brown	Brook 5.0 - 5.9 11 6.0 - 9.9 46 10.0 - 10.9 1 58(±12)	9(±2)
South Boulder River	15-40	25	Rainbow, Brook	Rainbow 2.5 - 5.9 204 6.0 - 9.9 129 10.0 - 11.3 10 343(±76)	40(±8)

Table 7 continued.

Stream	Location of wetted perimeter inflection points (cfs)	Recommended minimum discharge (cfs)	Fish Present	Dominate Species estimate (per 1,000') (with 80% C.I. in parenthesis) Number	Pounds
Confederate Creek	5-14	6	Brook, Cutthroat, Mottled sculpin	Brook 3.0 - 5.9 102 6.0 - 11.4 23 125	
Avalanche Creek	1.5-4	3	Rainbow, Mottled sculpin	Rainbow 3.8 - 5.9 75 6.0 - 9.9 55 10.0 - 10.6 2 132(±14)	13(±2)

Table 8 continued.

Stream	Location of wetted perimeter inflection points (cfs)	Recommended minimum discharge (cfs)	Fish Present	Dominate Species estimate (per 1,000') (with 80% C.I. in parenthesis) Number	Pounds
Whitetail Creek	4-7	7	Brown, Rainbow, Mottled sculpin	Brown 4.5 - 5.9 15 6.0 - 9.9 200 10.0 - 15.4 103 318(±43)	107(±15)
Hell's Canyon Creek	3-7	6	Rainbow, Cutthroat	Rainbow 2.1 - 5.9 209 6.0 - 9.4 72 281	
North Willow Creek	2.5-7	6	Brook, Brown, Rainbow, Mottled sculpin	Brook 3.2 - 5.9 140 6.0 - 9.9 177 10.0 - 10.5 8 325(±66)	45(±11)
South Willow Creek	14-17	14	Rainbow, Brook, Brown	Rainbow 3.3 - 5.9 195 6.0 - 9.9 123 10.0 - 12.9 7 325(±56)	38(±5)
Willow Creek	18-22	22	Brown, Rainbow, Mottled sculpin, White sucker, Longnose sucker, Longnose dace	Rainbow 3.5 - 5.9 6.0 - 9.9 113 10.0 - 15.9 292 405	

Table 9. Instream flow determinations for selected reaches of the Jefferson and Missouri Rivers.

Stream-Reach	Location of wetted perimeter inflection points (cfs)	Recommended minimum discharge (cfs)	Fish present
Jefferson River -above mouth of Boulder River	600-1200	1000	Brown trout Rainbow trout Whitefish Longnose sucker White sucker Longnose dace Golden shiner Flathead chub Carp Mottled sculpin Stonecat Yellow perch Black crappie Largemouth bass Burbot
Jefferson River -Boulder River to Sappington	600-1000	1000	
Jefferson River -Sappington to Missouri River	850-1000	1000	
Missouri River -above Canyon Ferry Reservoir		1500	Brown trout Rainbow trout Brook trout Whitefish Burbot Longnose sucker White sucker Carp Mottled sculpin Yellow perch
Gallatin River -Confluence of Forks to Missouri River		850	Brown trout Rainbow trout Brook trout Whitefish Longnose Sucker Longnose Dace White sucker Carp Mottled sculpin

LITERATURE CITED

Fredenberg, W.A., 1980. The fishery for fall-running rainbow trout in the Missouri River near Townsend, Montana, M.S. thesis, Montana State University, Bozeman, Montana, 62 pp.

Montana Department of Fish, Wildlife and Parks, 1979. Instream flow evaluation for selected streams in the upper MIssouri River Basin. Montana Department of Fish, Wildlife and Parks, Helena.

Montana Department of Fish, Wildlife and Parks, 1981. Instream flow evaluation for selected waterways in western Montana. Montana Department of Fish, Wildlife and Parks, Helena.

Nelson, F.A., 1977. Beaverhead River and Clark Canyon Reservoir fishery study. Montana Department of Fish and Game. 118 pp.

U.S. Department of Interior, Geological Survey, 1980. Water Resources Data for Montana, Surface Water Records.

Vincent, E.R., 1971 a. River electrofishing and fish population estimates. Progressive Fish Culture. 33(3): 163-167.

Vincent, E.R., 1974. Addendum to river electrofishing and fish population estimates. Progressive Fish Culture.

Vincent, E.R., 1979. Madison River Temperature Study. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts. Montana Project No. F-9-R-27, Job IIa, 7 pp.

Prepared by: Bruce J. Rehwinkel

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Waters Referred to:

Missouri River 17-4944	Jefferson River 10-3840
Gallatin River 9-2090	Boulder River [illegible]
Little Boulder River [illegible]	Hell's Canyon Creek 10-[illegible]3080
Whitetail Creek 10-7920	South Boulder River 10-6760
Willow Creek 10-8000	North Willow Creek 10-5160
South Willow Creek 10-6880	Beaver Creek 17-[illegible]420
Crow Creek 17-1888	Deep Creek 17-3090
Duck Creek 17-2432	Confederate Creek [illegible]
Avalanche Creek 17-0160	

Key Words:

Trout Numbers
Trout Biomass
Mortality Rates
Flow Regime
Brown Trout
Water Temperature
Age-growth

Appendix Table 1. Missouri River mean daily discharges (cfs), March through September, 1980 (U.S.G.S.).

Day	March	April	May	June	July	August	September
1	4760	3790	10100	12200	7780	2150	3190
2	4500	3910	10500	12100	7330	2320	3200
3	4290	4000	9940	12200	7010	2320	3260
4	3810	3980	9870	12900	8000	2320	3260
5	2820	3910	9780	13500	9060	2270	3240
6	3120	3990	9670	13800	9270	2160	3150
7	3540	4120	10100	13700	8560	2090	3130
8	4030	4160	10700	13500	7590	2010	3240
9	3920	4130	11500	12800	6590	1960	3590
10	3980	4050	12900	12400	6820	1940	3380
11	4090	3990	13400	12600	6660	1960	3540
12	4200	3970	13000	13700	5990	1950	4150
13	3870	3970	11800	14700	5450	1900	4940
14	3780	4070	9850	14800	5280	1900	5080
15	4010	4270	8420	15100	5100	1940	5180
16	3870	4240	7610	15700	4640	2020	5160
17	3720	4460	7970	15800	4050	2180	5010
18	3510	4690	8350	15600	3520	2300	4800
19	3540	5060	8280	14500	3360	2320	4800
20	3520	5710	7970	14000	3200	2450	4790
21	3530	6960	8120	14000	3120	2610	4940
22	3650	8290	9340	14000	2970	2680	5050
23	3810	9320	11000	13700	2770	2790	5030
24	3790	9380	12200	13600	2350	2780	5040
25	3780	8950	14700	13200	2340	2700	4930
26	3760	9550	16700	12400	2270	2680	4910
27	3720	9850	16000	11300	2150	2690	4860
28	3750	9620	14300	10400	2120	2790	4820
29	3750	9440	13000	9300	2050	3030	4670
30	3860	9520	12600	8340	2000	3100	4640
31	3820		12500		2020	3110	
Mean	3810	5845	11040	13190	4885	2368	4299

Appendix Table 2. Water temperatures (F) of the Missouri River at Toston, Montana, 1980 (U.S.G.S.).

	July			August			September		
Day	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
1	65.3	60.8	62.6	72.5	68.9	70.7	59.9	58.1	59.0
2	68.0	64.4	66.2	72.5	69.8	70.7	60.8	59.0	59.9
3	68.0	64.4	66.2	69.8	66.2	68.9	59.0	57.2	58.1
4	65.3	62.6	64.4	66.2	63.5	64.4	59.9	58.1	59.0
5	66.2	65.3	65.3	68.0	63.5	65.3	60.8	58.1	59.9
6	68.0	64.4	66.2	68.0	64.4	66.2	62.6	59.9	61.7
7	69.8	67.1	68.0	68.0	64.4	66.2	63.5	62.6	62.6
8	69.8	68.0	68.9	69.8	64.4	67.1	62.6	60.8	61.7
9	68.9	66.2	67.1	70.7	66.2	68.0	60.8	59.9	59.9
10	69.8	68.0	68.9	69.8	66.2	68.0	61.7	60.8	61.7
11	69.8	67.1	68.0	69.8	66.2	68.0	61.7	59.9	60.8
12	69.8	66.2	68.0	68.9	65.3	67.1	60.8	59.0	59.9
13	66.2	65.3	66.2	68.9	65.3	66.2	61.7	59.9	60.8
14	66.2	64.4	64.4	70.7	65.3	68.0	59.9	59.0	59.0
15	65.3	63.5	64.4	69.8	67.1	68.0	60.8	57.2	59.9
16	67.1	65.3	66.2	68.9	65.3	67.1	57.2	55.4	56.3
17	68.0	67.1	68.0	68.9	66.2	67.1	58.1	56.3	57.2
18	68.0	66.2	67.1	67.1	63.5	65.3	58.1	57.2	57.2
19	68.9	67.1	68.0	62.6	59.9	61.7	56.3	56.3	56.3
20	68.0	66.2	67.1	63.5	60.8	61.7	56.3	55.4	55.4
21	70.7	68.0	69.8	64.4	60.8	62.6	54.5	53.6	54.5
22	73.4	70.7	72.5	64.4	62.6	63.5	63.6	52.7	52.7
23	75.2	72.5	73.4	62.6	60.8	61.7	53.6	52.7	53.6
24	74.3	70.7	72.5	65.3	62.6	63.5	53.6	52.7	53.6
25	73.4	69.8	71.6	64.4	61.7	62.6	53.6	52.7	52.7
26	74.3	71.6	72.5	65.3	61.7	63.5	54.5	53.6	53.6
27	74.3	70.7	72.5	65.3	62.6	64.4	56.3	54.5	55.4
28	74.3	70.7	71.6	62.6	59.9	61.7	56.3	54.5	55.4
29	74.3	70.7	71.6	61.7	59.9	59.9	55.4	53.6	54.5
30	73.4	68.9	70.7	60.8	59.9	59.9	56.3	55.4	56.3
31	72.5	68.9	69.8	59.9	58.1	59.0			

Appendix Table 3. Jefferson River mean daily discharge (cfs), March through September, 1980 (U.S.G.S.).

Day	March	April	May	June	July	August	September
1	1650	1230	5160	7060	3870	741	1340
2	1470	1220	5000	7130	3880	766	1330
3	1430	1220	4790	7640	3980	802	1350
4	1330	1220	4800	8700	4510	805	1370
5	1000	1220	4990	9220	5500	809	1330
6	1170	1250	4990	9250	5600	788	1280
7	1250	1260	5200	8610	4990	734	1280
8	1400	1260	5540	8190	4170	702	1290
9	1400	1240	6330	7780	3690	684	1350
10	1370	1240	7080	7410	3530	676	1370
11	1380	1250	7600	7300	3260	667	1520
12	1380	1260	7930	7530	2950	660	2170
13	1290	1260	7160	7950	2710	632	2730
14	1280	1260	5710	8370	2600	623	2720
15	1320	1310	4920	8370	2590	655	2770
16	1290	1400	4530	8550	2430	708	2660
17	1220	1510	4640	9320	2230	797	2510
18	1220	1600	4970	9080	1940	867	2430
19	1240	1810	4860	8020	1740	884	2350
20	1230	2350	4520	7460	1590	905	2350
21	1220	3340	4450	7140	1520	978	2380
22	1220	4750	4640	7010	1380	1040	2440
23	1230	5310	5000	6840	1220	1110	2480
24	1220	5080	5960	6820	1100	1140	2460
25	1210	4710	7580	7660	1020	1120	2420
26	1190	4970	8400	7040	946	1110	2390
27	1190	5200	8880	6130	894	1150	2360
28	1210	5010	8540	5470	857	1210	2320
29	1220	4730	7980	4710	771	1260	2260
30	1230	4720	7360	4140	742	1270	2210
31	1230		7040		754	1280	
Mean	1280	2506	6018	7530	2547	889	2041

Appendix Table 4. Water temperatures (F) of the Jefferson River at Three Forks, Montana, 1980 (U.S.G.S.).

	July			August			September		
Day	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
1	65.3	59.9	62.6	74.3	67.1	70.7	62.6	55.4	59.0
2	68.0	62.6	65.3	74.3	66.2	70.7	59.9	57.2	58.1
3	66.2	63.5	65.3	70.7	66.2	68.0	60.8	55.4	58.1
4	67.1	61.7	64.4	68.9	60.8	65.3	61.7	54.5	58.1
5	66.2	63.5	65.3	68.9	61.7	65.3	63.5	55.4	59.9
6	68.9	63.5	66.2	68.9	61.7	65.3	64.4	58.1	61.7
7	69.8	65.3	68.0	69.8	62.6	66.2	65.3	60.8	62.6
8	69.8	68.1	68.0	70.7	63.5	67.1	63.5	59.9	61.7
9	70.7	65.3	68.0	70.7	64.4	68.0	63.5	59.0	60.8
10	69.8	67.1	68.0	71.6	64.4	68.0	62.6	59.9	60.8
11	71.6	66.2	68.9	71.6	64.4	68.0	61.7	59.0	59.9
12	68.9	66.2	67.1	71.6	64.4	68.0	61.7	57.2	59.9
13	67.1	63.5	65.3	71.6	64.4	68.0	59.9	59.0	59.0
14	66.2	62.6	64.4	71.6	64.4	68.0	61.7	58.1	59.0
15	67.1	60.8	63.5	69.8	66.2	67.1	59.9	57.2	59.0
16	69.8	61.7	65.3	70.7	63.5	67.1	58.1	54.5	56.3
17	69.8	65.3	67.1	70.7	64.4	68.0	59.9	54.5	57.2
18	69.8	64.4	67.1	68.0	60.8	63.5	57.0	56.3	56.3
19	69.8	65.3	67.1	64.4	59.0	61.7	57.2	54.5	56.3
20	71.6	63.5	67.1	62.6	59.0	60.8	56.3	53.6	54.5
21	74.3	65.3	69.8	67.1	59.0	63.5	54.5	52.7	53.6
22	77.0	68.0	72.5	64.4	60.8	61.7	53.6	49.1	51.8
23	76.1	69.8	73.4	65.3	58.1	61.7	53.6	50.9	51.8
24	75.2	68.9	72.5	66.2	59.9	63.5	54.5	50.9	52.7
25	76.1	68.9	71.6	66.2	59.0	62.6	55.4	50.9	52.7
26	76.1	68.9	72.5	67.1	59.9	63.5	55.4	50.9	53.6
27	76.1	68.0	71.6	64.4	60.8	62.6	58.1	52.7	55.4
28	76.1	68.0	72.5	63.5	59.0	61.7	56.3	53.6	54.5
29	74.3	68.9	71.6	63.5	57.2	60.8	57.2	52.7	54.5
30	73.4	67.1	70.7	60.8	57.2	59.0	58.1	53.6	55.4
31	73.4	65.3	68.9	59.9	55.4	57.2			