MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana Title: Southwest Montana Fisheries Study

Project No.: F-9-R-30 Title: Inventory and Survey of the Waters

Job No.: 1-d of the Jefferson and Missouri River Drainages

Project Period: July 1, 1981 through June 30, 1982

Report Period: July 1, 1981 through June 30, 1982

ABSTRACT

Trout population estimates were calculated for the Toston and Trident sections of the Missouri River. The 1981 estimate shows 123 brown trout (Age III and older) in the Toston Section, and 150 brown trout per mile (Age III and older) in the Trident Section. Annual mortality rates in the Toston Section for 1980 to 1981 were 48% for Age III to Age IV fish.

Brown trout estimates from the Jefferson River indicate a population of 248 fish per mile (Age III and older). Annual mortality rates from 1980 to 1981 in the Willow Creek-Three Forks Section were 88.5% for Age III to Age IV fish. This is felt to be very excessive and unrelated to fishing pressure.

Discharge and water temperatures were monitored on both rivers. During 1981 the Missouri was above average in flow early and about average late (minimum 1950 cfs). The Missouri River water temperature reached its peak on July 17th (73.2°F). The Jefferson River discharge pattern was similar to the Missouri(high-early, average-late). The minimum flow was 555 cfs recorded on August 17th. The maximum water temperature in the Jefferson was 74.7°F (recorded on August 16th) and all days between August 2nd and September 26th had maximums exceeding 70°F.

BACKGROUND

The upper Missouri River in Montana is famous 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 have 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 relate salmonid growth rates to the respective temperature situations. Data is not included.

4. To mitigate or enhance habitat alterations due to agricultural, residential, mining and industrial development. 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 was gathered by the USGS at

gauge stations located at Three Forks on the Jefferson River and at Toston on the Missouri River.

FINDINGS

Missouri River

Fish Populations

Toston-Deepdale Section - Brown trout 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 1981. Age II fish were excluded due to concern about sampling efficiency.

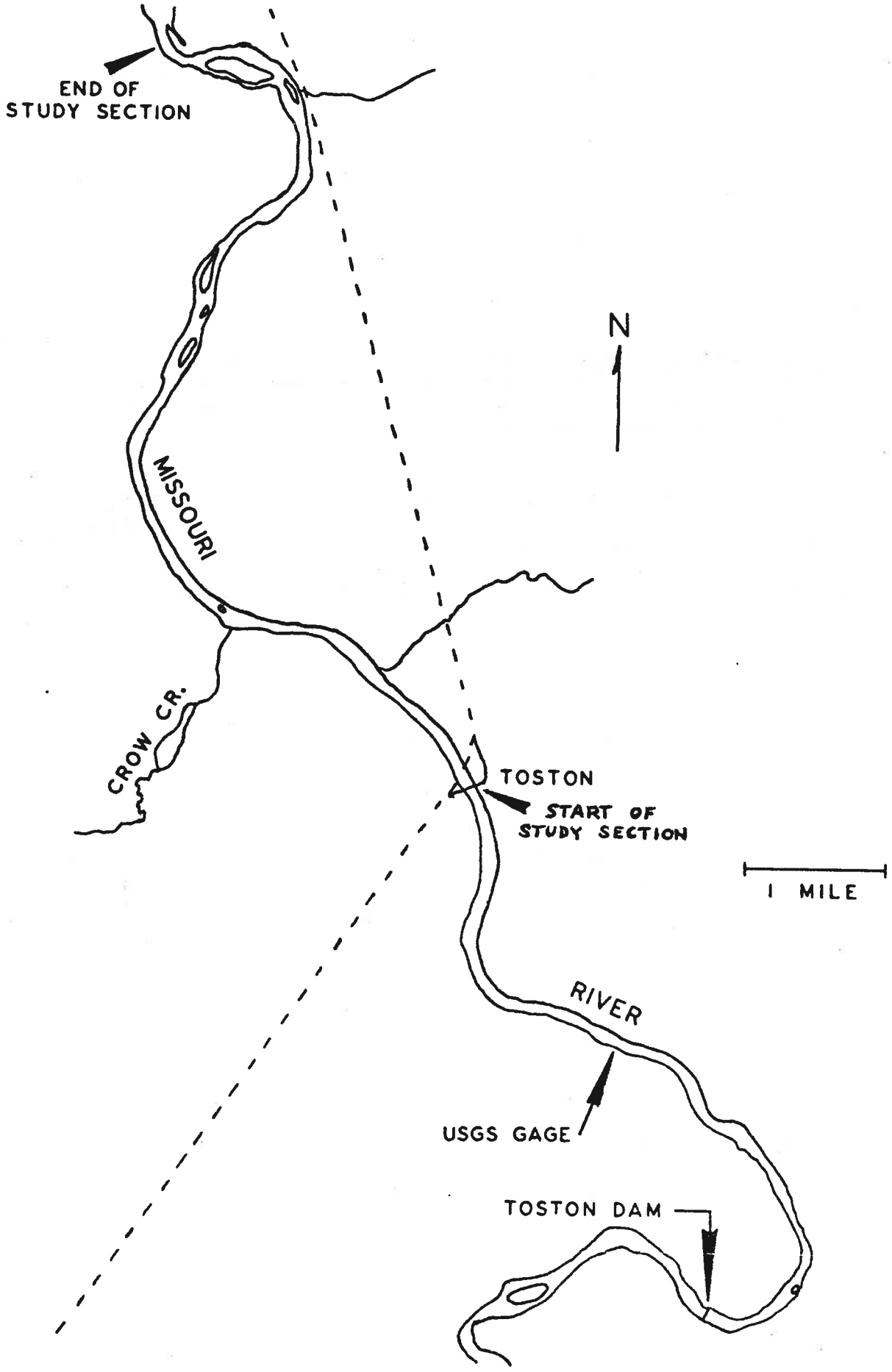
Table 1. Estimated numbers and biomass by age groups for brown trout in the Toston-Deepdale study section (7.3 miles), spring 1981 (80% confidence limits in parentheses).

Age	Average Length (In.)	Number	Biomass (Lbs)	Number Per Mile
III	13.9	319 (±105)	310.3	44
IV+	17.0	576 (±122)	1033.3	79
TOTAL		895 (±161)	1343.6	123

Table 2 depicts annual mortality rates from spring 1980 to spring 1981 for brown trout in this section of river. The annual mortality rate was greatest in the Age II to III group (52%). This figure is higher than that calculated for the 1979 to 1980 period, but is considered an acceptable level for maintainance.

Table 2. Annual mortality rates of brown trout by age group in the Toston-Deepdale section from spring 1980 to spring 1981.

Age	Spring 1980 Population Estimate	Spring 1981 Population Estimate	Annual Mortality (%)
II to III	665	319	52
III+ to IV+	1116	576	48


END OF
STUDY SECTION
N
MISSOURI
CROW CR.
TOSTON
START OF
STUDY SECTION
1 MILE
RIVER
USGS GAGE
TOSTON DAM

Trident Section - Another study section was added in the spring of 1981. This section is above Toston Dam and was added to obtain fish data upon which to consider a fish passage structure currently being proposed for Toston Dam. The section is 5.0 miles in length and runs from the town of Trident (Section 3 west line, T2N, R2E) to the middle of Section 24 (T3N, R2E). Table 3 depicts the brown trout population estimate for the spring of 1981. Table 4 shows similar calculations for rainbow trout within the same section for the same time period.

Table 3. Estimated numbers and biomass by age groups for brown trout in the Trident study section (5.0 miles), spring 1981 (80% confidence limits in parentheses).

Age	Average Length (In.)	Number	Biomass (Lbs)	Number Per Mile
III	13.7	343 (±55)	304.1	69
IV+	16.2	404 (±61)	584.5	81
TOTAL		747 (±82)	888.6	150

Table 4. Estimated numbers and biomass by age groups for rainbow trout in the Trident study section (5.0 miles), spring 1981 (80% confidence limits in parentheses).

Age	Average Length (In.)	Number	Biomass (Lbs)	Number Per Mile
III	13.2	291 (±60)	235.0	58
IV+	14.3	143 (±40)	142.8	29
TOTAL		434 (±72)	377.8	87

This data indicates that the brown trout numbers are comparable in the two sections although the average size for the IV+ fish is less in the Trident Section. The Trident Section also has a resident rainbow population large enough to be enumerated.

Flow

Late spring and summer flows of the Missouri River at Toston during 1981 were unusual--May and June had exceptionally high discharges resulting from heavy precipitation; July and August were slightly below average. Mean monthly discharges were 4327 and 2108 cfs for July and August, respectively (USGS provisional data, 1981). Mean daily discharges are given in Appendix Table 1. The low flow for 1981 occurred on August 17th and 18th (1950 cfs). Since the minimum recommended instream flow was determined to be 1500 cfs for the low flow summer period, there does not appear to be a water shortage 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 1981 was recorded on July 17th (73.2°F--22.9°C). During 1981, the maximum daily water temperature of the Missouri equaled or exceeded 70.0°F on 40 days, while the daily mean temperature equaled or exceeded the 70.0°F level 12 days (Appendix Table 2).

Salmonid Growth Related to Water Temperature

Temperature and age-growth data was collected on the Missouri River at the Toston Site since 1979. This information will be presented in a future report after analysis is completed.

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 rock rip-rap, highway construction, some denuded streambanks, and sediment discharge.

Brown trout constitute over 95% of the trout in this section and are the species at which management is directed.

Population estimates for the spring of 1981 are given in Table 5. Brown trout numbers per mile for the past four population estimates are given in Table 6.

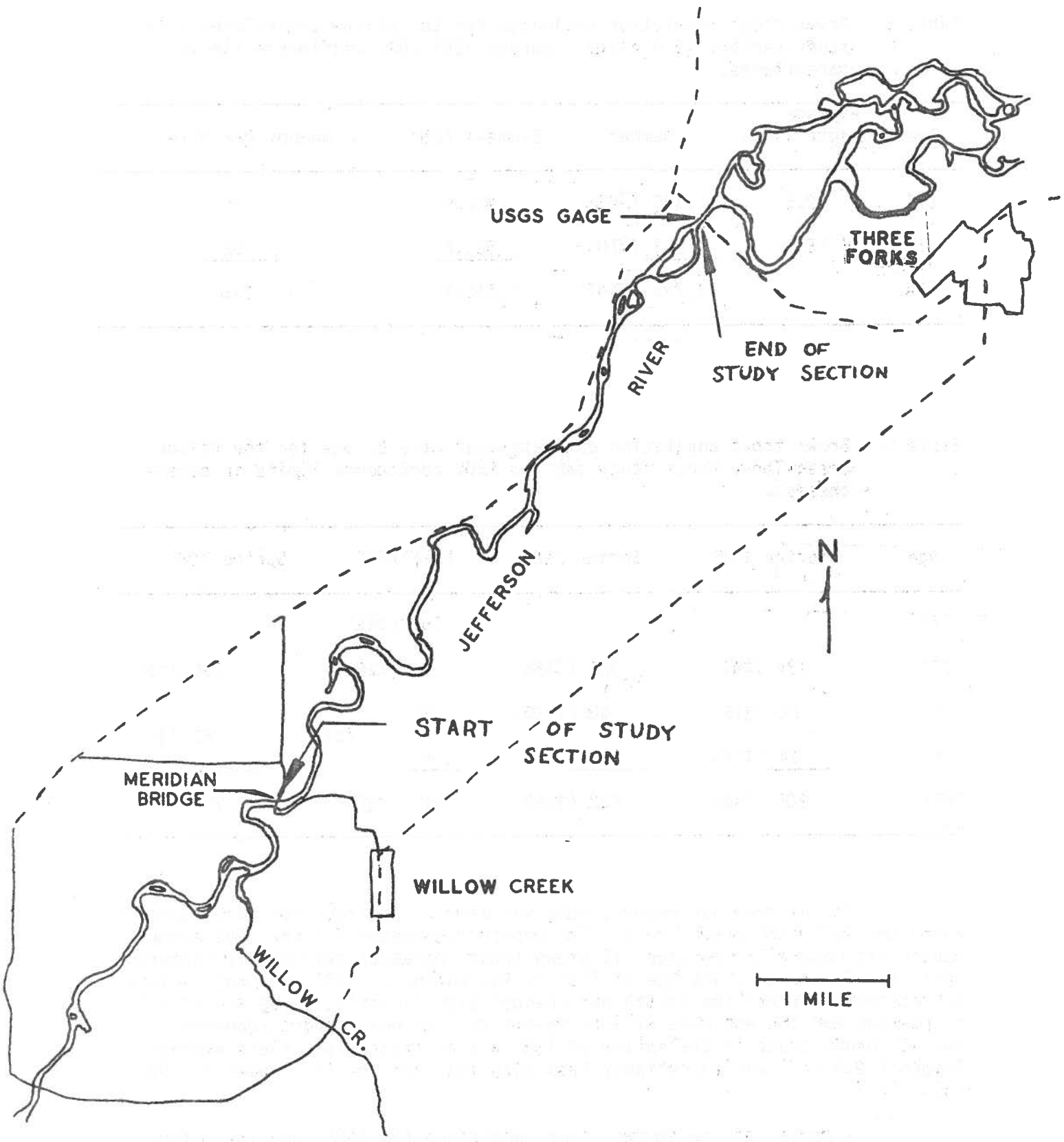


Figure 2. The Willow Creek-Three Forks Study Section of the Jefferson River.

Table 5. Brown trout population estimates for the Willow Creek-Three Forks study section (7.0 miles), spring 1981 (80% confidence limits in parentheses).

Age	Average Length (In.)	Number	Biomass (Lbs)	Number Per Mile
III	12.5	1,370 (±435)	910.4	196
IV+	15.9	363 (±101)	501.8	52
TOTAL		1,733 (±447)	1,412.2	248

Table 6. Brown trout population estimates per mile by age for the Willow Creek-Three Forks study section (80% confidence limits in parentheses).

Age	Spring 1979	Spring 1980	Fall 1980	Spring 1981
II			190 (±41)	
III	134 (±41)	383 (±166)	78 (±26)	196 (±62)
IV	68 (±16)	48 (± 26)	36	
V+	24 (±18)	21	41 > (±23)	52 (±11)
TOTAL	226 (±48)	452 (±168)	345 (±54)	248 (±64)

In the previous report, note was made of difficulties encountered in aging the fall 1980 brown trout. The growth documented for the 1980 summer season was unusually low (Age III brown trout increased only 0.6 in. between April and September). The Age IV fish in the spring of 1981 were not isolated to determine whether the length had changed significantly. These scales will be re-read and the estimate will be re-run for the next report. However, if Age III brown trout in the spring of 1981 are an indication, their average length (12.5 in.) was appreciably less than that for Age III browns in 1980 (13.3 in.).

A review of the summer river conditions for 1981 show that there were 20 days where the maximum water temperature exceeded 70°F with the max-

imum of 74.7°F achieved on August 16th. This is undoubtedly an underestimate since data for 29 days was unavailable due to USGS equipment failure. Daily water temperature data is given in Appendix Table 4. The discharge of the Jefferson River also fell to 555 cfs on August 17th, which is less than 1980 (623 cfs) and considerably below the recommended minimum of 1000 cfs (MDFWP, 1979).

The mortality rate in Table 7 is extremely high. When re-examining the 1980 data, the spring-to-fall mortality rate for Age III and older brown trout was 65.7%. The total mortality rate for Age III and older fish from spring 1980 to spring 1981 was 88.5% with approximately three-fourths of it occurring between April and September. While the specific causes of high mortality in older fish are not clear, the combination of low summer flow and associated high water temperatures undoubtedly have adverse effects on the brown trout population.

Table 7. Mortality rates for brown trout from spring 1980 to spring 1981 in the Willow Creek-Three Forks section of the Jefferson River.

Age Group	Number Spring 1980	Number Spring 1981	Annual Mortality (%)
III+ to IV+	3,167	363	88.5

During the summer of 1979, lower flows (430 cfs) were encountered; no temperature data is available. The mortality rates for brown trout III and older from the spring of 1979 to IV and older in the spring of 1980 was 69.5%. During 1981, though the temperature data is incomplete, it seems safe to assume the number of days where the maximum water temperature was over 70°F would be at least 30 days. The warmest water usually occurs in late July and early August (i.e., Missouri) during the equipment failure. Summer low flow was 555 cfs, 68 cfs less than 1980.

In conclusion, it appears the Jefferson River brown trout population is limited by recruiting fish across the third year of life. The least likely explanation is angling pressure, while the most likely seems to be flow (approximately one half of minimum recommended instream flow) and/or temperature. This situation will be monitored closely to precisely locate the cause and hopefully in time find a remedy.

Given the low fishing pressure, the most likely factors limiting the population are low flow and associated high summer water temperatures.

Flow

Spring discharge of the Jefferson River at Three Forks during 1981 was

unusually high while summer flow was approximately at the mean level. Early fall flows were below normal due to a lack of the usual September precipitation. Mean monthly discharges were 6809, 8528, 697, and 766 cfs for May, June, August and September, respectively (USGS, 1981). Mean daily discharges are given in Appendix Table 5. The low flow for 1981 occurred on August 17th (555 cfs). A total of 55 days from August 2 to September 26 were below the recommended instream flow of 1000 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 1981 was recorded on August 16th (74.7°F). Caution is recommended in the use of this data since a 29-day period is missing. During 1981 the Jefferson River maximum daily water temperature exceeded 70°F on at least 20 days, while the daily mean temperature exceeded the 70°F level on at least seven days (Appendix Table 4).

Salmonid Growth Related to Water Temperature

Temperature and age-growth data has been collected on the Jefferson River at the Three Forks Site since 1980. The same information has been collected at the Twin Bridges location since 1981. This will be presented in a future report.

Mitigation of Habitat Alterations

This objective falls under the responsibilities of the Natural Streambed and Land Preservation Act of 1975. These responsibilities are handled in conjunction with local conservation districts. In the area adjacent to the Missouri and Jefferson rivers there are three conservation districts: Broadwater, Jefferson Valley, and Mile High.

During 1981, a total of 41 alteration projects were reviewed and eventually approved. Table 8 summarizes the types of projects mitigated in the three conservation districts.

Table 8. Summary of habitat alteration projects by conservation district.

	TYPE OF PROJECT					
District	Agricultural	Residential	Mining	Industrial*	Roads	Total
Mile High	1		1			2
Broadwater	1				1	2
Jefferson Valley	20	3	7	5	4	39

* Includes logging.

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Prepared by: Bruce J. Rehwinkel
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Trout Biomass
Mortality Rates
Brown Trout
Water Temperature
Rainbow Trout

APPENDIX

Appendix Table 1. Water temperatures (°F) of the Missouri River at Toston, Montana, 1981 (U.S.G.S.).

Day	JULY			AUGUST			SEPTEMBER		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
1	68.5	67.6	68.2	70.9	66.7	68.5	64.8	60.6	62.4
2	68.2	65.7	67.1	71.8	68.2	69.4	64.4	61.2	62.6
3	68.9	67.5	68.4	71.2	67.8	69.3	65.1	61.5	62.8
4	69.8	68.4	69.1	71.4	68.0	69.3	64.6	61.9	62.8
5	70.7	69.6	70.0	71.2	67.6	69.3	62.8	60.3	61.9
6	71.1	69.3	70.2	71.2	67.8	69.3	63.0	59.4	60.8
7	70.0	65.5	68.4	72.5	68.4	70.2	64.4	60.8	62.4
8	65.3	61.3	62.6	72.1	68.5	70.2	65.3	62.2	63.5
9	65.8	63.7	64.6	69.8	66.7	68.5	66.0	63.0	64.4
10	67.3	66.0	66.7	70.9	66.7	68.4	66.2	63.5	64.8
11	67.5	65.3	66.2	72.1	67.6	69.4	66.0	63.1	64.4
12	68.5	66.9	67.8	72.7	68.4	70.0	66.2	63.1	64.4
13	70.3	68.7	60.6	72.3	68.7	70.3	66.4	63.3	64.6
14	70.0	68.0	68.7	72.7	68.7	70.3	66.2	63.3	64.6
15	68.9	67.3	68.4	71.4	68.7	69.8	66.0	62.6	64.2
16	70.2	68.0	69.1	72.0	68.0	68.4	65.3	62.6	63.7
17	71.1	68.5	69.4	73.2*	68.5	70.3	64.9	62.4	63.5
18	70.3	67.8	68.9	72.3	68.4	69.8	64.8	62.1	63.1
19	68.5	66.4	67.3	70.5	68.0	68.7	63.1	60.3	62.1
20	70.0	66.9	68.4	69.4	66.7	67.8	60.3	56.6	58.5
21	70.9	68.2	69.3	70.3	66.4	68.2	57.0	55.4	56.3
22	71.2	68.5	69.8	70.7	67.6	68.9	55.2	52.2	54.0
23	71.4	68.9	70.0	70.7	66.9	68.7	52.3	51.6	52.0
24	69.6	67.1	68.4	71.2	67.3	68.9			
25	67.6	65.1	66.2	70.5	68.4	69.4			
26	64.9	63.7	64.4	71.4	68.5	70.0			
27	66.6	64.6	65.5	72.1	68.9	70.5			
28	70.0	66.2	67.6	71.4	68.4	70.0			
29	70.3	67.1	68.4	69.8	62.3	69.1			
30	69.1	66.0	67.6	67.8	63.3	66.2			
31	69.4	66.4	67.5	63.7	59.9	61.9			

* Maximum temperature recorded during summer 1981.

Appendix Table 2. Missouri River mean daily discharge (cfs), May through August, 1981, USGS gage at Toston.

Day	May	June	July	August
1	7 910	21 800	8 310	2 340
2	8 650	22 400	7 840	2 290
3	9 650	22 600	7 050	2 250
4	9 830	22 500	7 130	2 190
5	9 170	20 600	6 720	2 120
6	8 490	19 500	6 300	2 110
7	7 950	20 300	6 380	2 120
8	7 340	21 300	6 230	2 090
9	6 830	22 200	5 820	2 090
10	6 290	22 400	5 250	2 050
11	6 580	21 500	4 840	2 020
12	7 320	20 600	4 670	1 990
13	7 420	20 500	4 480	2 080
14	7 410	19 800	4 190	2 070
15	7 670	18 200	3 920	2 070
16	8 120	17 000	3 520	1 970
17	9 130	17 000	3 050	1 950*
18	9 400	16 300	3 000	1 950*
19	9 300	15 600	3 000	2 070
20	9 760	15 500	2 960	2 120
21	10 400	15 300	2 890	2 130
22	15 700	14 600	2 850	2 150
23	22 000	14 400	2 760	2 180
24	26 200	13 800	2 610	2 190
25	25 000	12 600	2 610	
26	23 900	11 700	2 760	
27	23 900	11 300	2 830	
28	24 200	10 900	2 740	
29	23 400	10 300	2 620	
30	22 400	9 270	2 450	
31	21 800		2 360	
Mean	13 004	17 392	4 327	2 108**

* Low summer discharge.

** Based on incomplete daily flows.

Appendix Table 3. Jefferson River mean daily discharges (cfs), May through September, 1981. USGS gage near Three Forks.

Day	May	June	July	August	September
1	4 570	10 800	3 750	1 030	687
2	4 960	11 500	3 480	989	657
3	5 620	11 300	3 290	922	620
4	5 880	11 000	3 200	861	637
5	5 430	10 300	3 050	833	641
6	4 910	9 640	2 850	801	664
7	4 630	9 660	2 790	743	662
8	4 140	10 500		736	661
9	3 680	10 700		715	651
10	3 260	11 300		671	648
11	3 430	11 500		665	621
12	3 720	11 400		661	630
13	3 900	10 700		650	618
14	3 880	9 600	1 890	621	619
15	3 950	9 040	1 780	595	647
16	4 150	8 960	1 630	562	637
17	4 630	8 540	1 500	555*	638
18	4 730	8 120	1 440	582	632
19	4 580	7 900	1 410	605	625
20	4 610	7 850	1 420	593	608
21	5 360	7 430	1 370	618	652
22	7 250	7 010	1 280	647	671
23	10 400	6 430	1 200	675	737
24	14 900	5 950	1 140	682	765
25	13 300	5 520	1 150	697	855
26	12 900	5 110	1 160	689	1 040
27	12 500	4 850	1 190	655	1 250
28	12 100	4 730	1 190	654	1 330
29	11 700	4 440	1 150	633	1 410
30	11 200	4 070	1 120	616	1 480
31	10 800		1 970	643	
Mean	6 809	8 528		697	766

* Low summer discharge.

Appendix Table 4. Water temperatures (°F) of the Jefferson River at Three Forks, Montana, 1981 (USGS).

Day	JULY			AUGUST			SEPTEMBER		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
1							66.2	60.6	63.5
2							66.2	60.4	63.0
3							65.8	59.5	62.8
4							64.8	60.3	63.0
5							63.0	60.8	61.9
6							64.9	58.1	61.5
7	67.6						65.8	59.5	62.8
8	66.4	59.0	63.0				67.1	60.3	64.0
9	67.6	60.4	64.0				68.0	61.9	65.1
10	67.5	63.5	65.7				68.0	62.8	65.3
11	69.1	64.4	66.4				67.5	61.5	64.8
12	71.2	64.2	67.5	73.0			68.0	62.1	65.1
13	72.7	66.4	69.1	73.2	66.4	70.2	67.8	62.4	65.1
14	72.3	66.4	69.1	72.9	67.3	70.2	67.8	62.6	65.3
15		64.8		72.0	65.8	69.3	66.6	61.3	64.2
16				74.7*	67.3	71.1	66.2	60.6	63.7
17				73.8	68.0	71.1	65.8	60.1	63.3
18				72.9	67.1	69.8	66.2	60.1	63.3
19				69.3	66.4	68.2	64.0	59.0	61.2
20				72.0	65.5	68.5	58.8	66.2	57.4
21				72.3	66.6	69.4	57.7	54.3	55.6
22				72.3	66.6	69.4	54.1	51.4	53.1
23				72.5	65.8	69.4	55.8	51.1	53.8
24				72.5	66.6	69.8	54.7	51.4	53.6
25				72.0	66.2	69.4	53.6	51.3	52.5
26				73.6	66.6	70.3	50.9	48.7	50.0
27				73.6	68.0	71.1	53.1	48.7	50.9
28				73.2	67.6	70.5	56.7	51.3	53.8
29				70.9	66.7	68.9	55.2	51.6	53.1
30				68.2	62.4	64.9		49.5	50.5
31				65.7	58.3	62.1			
Mean	72.7			74.7			68.0		

* Maximum temperature recorded during summer, 1981.