MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana Title: Southwestern Montana Fisheries Study

Project No. F-9-R-20 Title: Evaluation of River Fish Populations

Job No. III-a

Period Covered: July 1, 1971 to June 30, 1972

ABSTRACT

A flat-bottomed fiberglas boat was considered to be superior to a flat-bottomed aluminum boat because (1) it was easier to repair; (2) a negative can be easily fastened to the bottom; and (3) it was safer for the shocking crew because it was made of a non-conducting material.

The Peterson mark-and-recapture method was used to estimate the standing crop (total numbers and biomass). The age structure and mortality rates are also determined.

Population estimates were made on three sections of the East Gallatin River. No young-of-the-year trout and few yearling trout were found in the two upper study sections (XII and XIV), but were present in the downstream section (III). Annual mortality rates in Section XII were 42% for wild rainbow and 70% for brown trout. In Section III, the summer mortality rate for wild trout was 34% and compared with 83% for hatchery rainbow trout. Angler tag returns indicated a low fishing pressure on all three study sections of the East Gallatin River, as the tag return rate ranged from 1.0-11.1%.

Trout population estimates were made on three sections of the Madison River. Spring trout population estimates on Section IV from 1967 through 1971 show that improved spring flows from 1968 to 1971 were followed by substantial increases in total number (71%) and total biomass (24%) over the spring of 1971. Wild trout population numbers and biomass increased in Section VIIa after a 20-year catchable rainbow stocking program ended after the summer of 1969. The fall populations estimates on two-year-old and older wild trout shows a 238% increase in total numbers and a 149% increase in total biomass, since the stocking program was discontinued in Section VIIa. Angler tag returns show a low trout harvest in Sections IV (14.6%) and VIIa (12.1%).

Population estimates were made on two sections of O'Dell Creek. One section (IV-III-II) received catchable rainbow trout in 1970 and 1971 after five years of no stocking and the other (V) received no planted rainbow. The planted section showed a decline in the total number (45%) and total biomass (43%) of two-year-old and older brown trout. Mortality rates of wild brown trout were higher in the stocked section.

Population estimates were made on a section of the West Fork of the Madison River.

BACKGROUND

Effective fisheries management of larger rivers and creeks depends on the quality of the fish population data available. Information on standing crops, mortality rates, age structure, production rates, and movement should be obtained. Mortality rates for individual periods of the year, such as summer and winter, are necessary to determine when mortality is occurring and what is causing it. Age structure information is necessary to determine if reporduction or recruitment is adequate to maintain the existing standing crop. Production rates are useful in determining how much of the standing crop can be harvested before endangering the resource. Movement should be evaluated to determine the importance of spawning runs, certain spawning areas and movement as a factor in recruitment. The amount of movement sometimes indicates favorable or unfavorable habitat.

OBJECTIVES

The overall objective of this job was to develop shocking gear and techniques for sampling fish populations of large rivers and to compile data that reflect the status of river trout populations.

PROCEDURES

Electrofishing gear was used to sample fish populations in the East Gallatin River, Madison River, O'Dell Creek and West Gallatin River. These streams were divided into sections ranging in length from 875 feet to 5 miles. To aid in the detection of movement, the main population sections were then divided into sub-sections ranging in length from 500 to 2,500 feet. Electrofishing was carried out while floating through a section in a flat-bottomed fiberglas boat. The shocking boat contained a stationary negative electrode (fastened to the bottom of the boat), a mobile or stationary positive electrode, a portable 2,000 watt AC generator with a rectifying unit to change the alternating current to various forms of direct current, and a live box to retain captured fish. The captured fish were weighed, measured and marked with a fin clip or fish tag and then released at various points within each section.

Population estimates were made by using the Peterson-type mark-and-recapture method using Chapman's modified formula (Champman, 1951), which is as follows:

$$N = \frac{(M+1)\ (C+1)}{R+1}$$

Where: N = population estimate.
M = the number of fish marked.
C = the number of fish in the recapture sample.
R = the number of marked fish in the recapture sample (C).

Two or more "marking" and/or "recapture" trips were required where sample size were small. There was usually at least a two-to three-day time interval between the marking run(s) and the recapture run(s). Scales were taken to determine age and rate of growth. Total number, total biomass, age structure and mortality rates were determined for most of the study sections. The actual mathematical computations were made by an IBM computer programmed to use the methods described by Vincent (1971). This computer program enabled faster, more accurate and more thorough calculations of the various populations statistics from the raw data.

Movement and angler mortality were determined by the use of a numbered plastic fish tag which was inserted in the fish just behind the dorsal fin on the back, with the barbs engaging the ptergiophores. These tags were inserted by means of a tagging gun.

FINDINGS

Electrofishing Gear and Techniques

A flat-bottomed fiberglas boat was used to carry out the electrofishing operations on the various rivers and large creeks. The fiberglas boat is more suitable for electrofishing operations than an aluminum metal boat because: (1) it is easier to maintain and repair; (2) a negative electrode can be easily fastened to the bottom without becoming dangerous to the shocking crew; and (3) it is safer for the shocking crew from the electrical standpoint because the boat is made of a non-conductor.

When electrofishing in rivers and large creeks, an occasional rock or other hard objects are hit and/or the boat must be pulled over shallow riffles. This can damage the bottom of the boat. Aluminum, which requires welding, is much more difficult to repair than fiberglas, which can be repaired quite easily by inexperienced people. After much use, aluminum appears to become brittle and impossible to repair.

The negative electrode can be easily fastened to the bottom of the fiberglas boat without the boat's becoming energized as part of the negative, as happens with metal boats. With the negative fastened to the bot tom of the boat, the cumbersome negative boom can be eliminated and a large negative surface area is practical. From the safety standpoint, placing the negative under the boat is desirable because it is in a position where no member of the crew can directly touch it when it is energized. This, then, eliminates someone from simultaneously touching both the positive and negative electrodes, which is the most dangerous situation when electrofishing. Another safety feature is that fiberglas is a non-conductor, so any contact with the boat by the positive electrode or by shocking personnel is safe.

Fish Population Data

East Gallatin River and Tributaries

The East Gallatin River was divided into 14 sections ranging in length from 4,400 to 26,000 feet (Fibure 1). Certain sections were then further divided into subsections ranging in length from 500 to 1000 feet. Trout were tagged in 3 of the 14 sections to determine the extent of trout movement within a section and percent angler harvest. Four thousand catchable rainbow trout were planted in Section IIIA during July, 1971, to facilitate a study on the effect of hatchery trout on wild trout populations.

Population Estimates: Population estimates for wild brown and rainbow trout were made on three sections (IIIA, XII and XIV) of the East Gallatin River and for hatchery rainbow trout on one section (IIIA). The shocking efficiencies (percentage of marked fish recaptured for the three sections were as follows: Section IIIA (March, 1971)- 11 to 14%; Section IIIA (Sept., 1971)- 15-23%; Section XII (July, 1971)- 12 to 19%; and Section XIV (July, 1971)- 28 to 30%. A summary of the trout population estimates for the three sections is presented in Table 1.

Age Structure: Age composition (percent) and age-group population numbers were calculated for each of the sections on which population estimates were made. A summary of the population estimates and relative abundance of each age-group of wild rainbow and brown trout for the three sections is shown in Table 2.

Effect of Habitat Conditions: Prior to March, 1971, the East Gallatin River had a serious water pollution problem emanating from the Bozeman Municipal Sewage Treatment Plant. This effluent entered the river about 1500 feet below the juncture of Bozeman Creek and Rocky Creek or 875 feet below the upstream boundary of Section XIV and 1.5 miles above the start of Section XII (Figure 1).

A new secondary sewage treatment was completed during the spring of 1971 and replaced the old plant in March, 1971. The outlet of the new treatment plant enters the river about one mile below the end of Section XII. Sections XII and XIV which used to be in the most polluted portion of the East Gallatin River are now above the new sewage outlet. The effluent from the old sewage treatment plant appeared to have a detrimental effect on trout population size, especially in the younger age groups (o to I). In Section XII, no young-of-the-year trout have been observed during electrofishing operations from 1966 through 1970, and trout population estimates show yearlings comprised less than 13% of the total population during the same period (Vincent, 1967, 1968, 1969 & 1970). This suggests that reproduction is severely limited or absent in this section. Since the sewage effluent had been absent from Section XII and XIV only four months prior to the population estimates, no improvements in trout population were expected. No young-of-the-year trout and few yearling were observed during the 1971 electrofishing operations.

Mortality Rates: Total mortality was calculated for wild rainbow and brown trout in Sections IIIA and XII, and for hatchery rainbow trout in Section IIIA (Table 3). Mortality rates were computed for the following two time periods: (1) from July, 1970 to July, 1971 for Section XII and (2) from March, 1971 to Sept., 1971 for Section IIIA. The difference in the two trout population estimates was assumed to be mainly the result of natural and angler mortality. Table 3 also shows a summary of the percent of trout harvested by anglers during the corresponding time periods.

Angling pressure on the East Gallatin River is rather light as shown by low tag return rates from Section XII and IIIA (5.9% - 8.6%). The annual total mortality of wild trout is considerably larger than the angler harvest which would indicate most of the total mortality is due to factors other than angling pressure. This is also true of hatchery rainbow trout in Section IIIA, as the total summer mortality is 83%, while the angler harvest is only 11.1%. This data shows that few of the hatchery trout are utilized by anglers before they die of natural causes.

Madison River

The Madison River was divided into 15 sections ranging in length from four to nine miles (Figure 2). The three study sections were divided into subsections ranging in length from 200 to 2500 feet for more detailed study of movement.

Population Estimates: Trout population estimates were made on three sections of the Madison River. Trout population estimates were made both in the spring and fall on the Varney section (VIIa), only in the spring on the Norris section (IV) and only in the fall on the Burnt Tree section (VI). A summary of the trout population estimates is presented in Table 4.

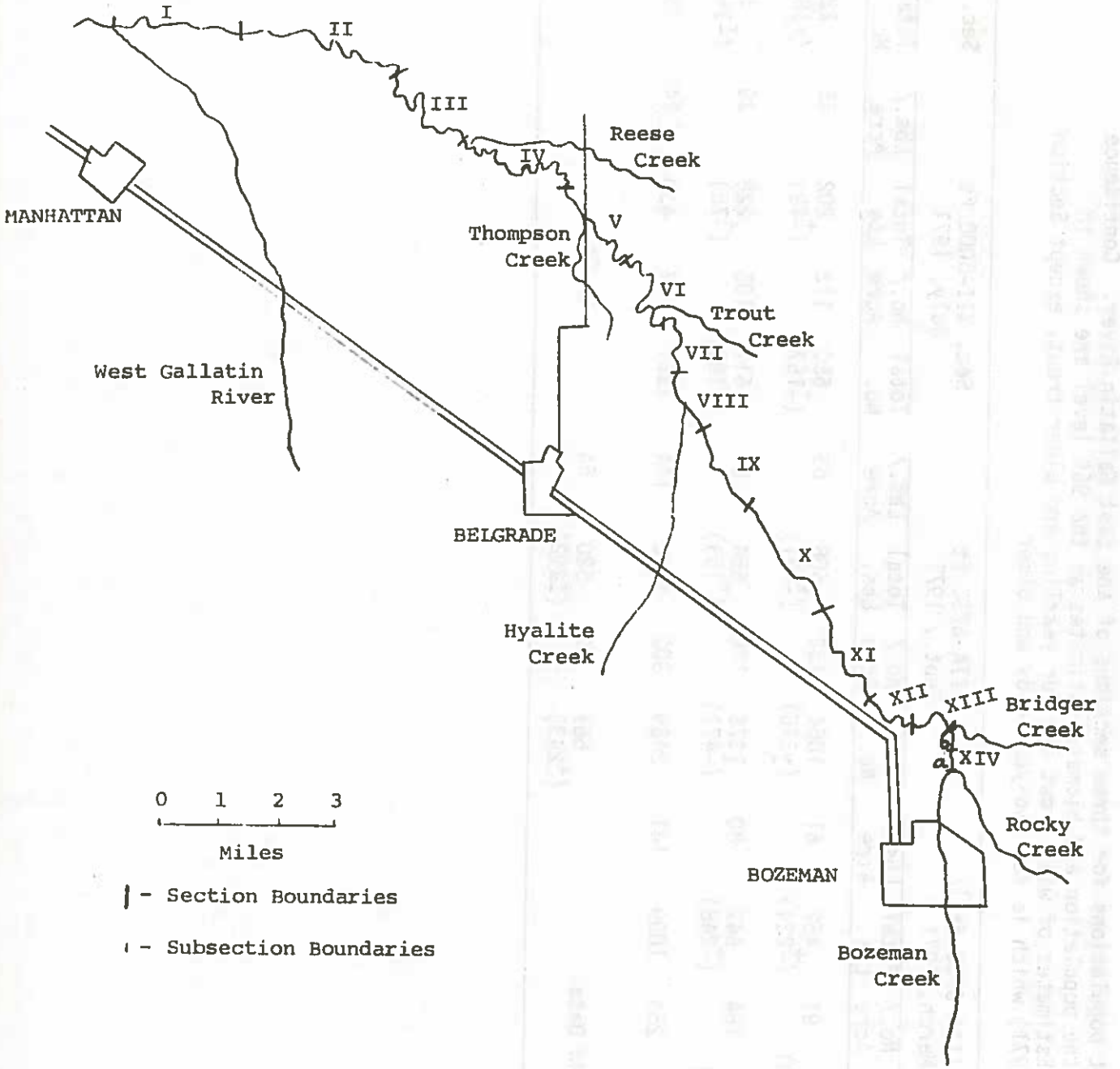

Figure 1. Map of the East Gallatin River showing study sections.

TABLE 1. Estimated trout populations for three sections of the East Gallatin River. Confidence intervals for the population and biomass estimates at the 95% level are shown in parentheses. Estimates of wild trout are for yearling and older trout, except Section IIIA (March, 1971) which is for two-year-olds and older.

Species	Sec. IIIA-6750 ft 1/ March, 1971				Sec. IIIA-6750 ft Sept., 1971				Sec. XII-8000 ft July, 1971				Sec. XIV-3925 ft July, 1971			
	Total No.	No./ Acre	Total Lbs.	Lbs./ Acre	Total No.	No./ Acre	Total Lbs.	Lbs./ Acre	Total No.	No./ Acre	Total Lbs.	Lbs./ Acre	Total No.	No./ Acre	Total Lbs.	Lbs. Acre
Wild rainbow trout	731 (±340)	91	452 (±224)	61	1064 (±376)	132	508 (±191)	63	650 (±157)	112	202 (±49)	35	720 (±185)	257	214 (±40)	77
Wild Brown trout	1327 (±646)	164	647 (±248)	80	1375 (±471)	170	654 (±153)	81	611 (±195)	105	228 (±75)	39	39 (±34)	14	23 (±20)	8
Total wild trout	2058	255	1099	141	2439	302	1162	144	1261	217	430	74	759	271	237	85
Hatchery rainbow trout	No Data				667 (±243)	82	520 (±202)	64	No Data				No Data			

1/ Length of Section

TABLE 2. Estimated age structure of wild rainbow and brown trout for Sections IIIA, XII and XIV. Relative abundance of each age group expressed as percent of total numbers are shown in parentheses.

Section and Date	Age Group I	II	III	IV+	Total
		Rainbow Trout			
IIIA March, 1971		6.8-11.0" 1/	8.5-12.8"	11.7-17.2"	
		233 (32)	231 (32)	267 (36)	731
IIIA Sept, 1971	5.9-9.7"	8.8-12.1"	9.8-14.5"	13.4-17.7"	
	347 (33)	454 (43)	223 (21)	40 (3)	1064
XII July, 1971	3.2-6.3"	6.1-10.4"	8.6-12.6"	10.9-16.4"	
	70 (11)	318 (49)	142 (22)	120 (18)	650
XIV July, 1971	3.6-6.4"	5.5-10.2"	8.5-11.7"	10.6-15.7"	
	110 (15)	325 (45)	157 (22)	128 (18)	720
		Brown Trout			
IIIA March, 1971		7.0-11.2"	9.5-14.1"	12.1-26.0"	1327
		690 (52)	439 (33)	198 (15)	
IIIA Sept., 1971	6.8-10.1"	8.2-13.5"	11.2-15.3"	14.0-23.0"	
	736 (54)	310 (23)	249 (18)	80 (5)	1375
XII July, 1971	4.7-6.9"	7.0-11.4"	9.8-14.7"	14.8-20.9"	
	144 (23)	269 (44)	186 (31)	12 (2)	611

1/ Length range.

TABLE 3. Total mortality rates of wild rainbow and brown trout for the July, 1970 to July, 1971 time period in Section XII and for wild rianbow, wild brown and hatchery rainbow trout for Section IIIA during the March, 1971 to September, 1971 time period. Angler harvest rates are shown for corresponding time periods.

Section	First Population Estimate	Second Population Estimate	Mortality Rate	Tag Return Rate
	Age Groups II-IV+ July, 1970	Age Groups III-IV+ July, 1971		
	Rainbow Trout			
XII	996	262	74%	5.9%
	Brown Trout			
XII	661	198	70%	1.0%
	Age Groups II-IV+ March, 1971	Age Groups II-IV+ Sept., 1971		
	Wild Trout[1/]			
IIIA	2058	1356	34%	8.6%
	Hatchery Rainbow Trout			
IIIA	4000[2/]	667	83%	11.1%

1/ Combined wild rainbow and brown trout.
2/ Number stocked as 10-12" in July, 1971.

Age Structure: Age composition (percent) and age group population numbers were calculated for Sections IV (Norris), Spring, 1971; for VI (Burnt Tree), Fall, 1971; and for Section VII (Varney), Spring and Fall, 1971. Table 5 gives a summary of the population estimates and percent composition for each age group of wild brown and rainbow trout.

Effects of Habitat Conditions: The Madison River had a serious problem, involving water releases from Hebgen Reservoir during the late winter and early spring months. Water was stored during this period for later releases (July through October) to downstream hydroelectric dams. The storage pattern varied from year to year. In some years, such as in 1967, water storage began in late February or early March prior to spring runoff. This created a serious low-water condition in the Madison River channel downstream from Hebgen Reservoir. In other years, the storage did not begin until the spring runoff started (late April or early May). Through an agreement with Montana Power, improved flows were maintained from February through May during the years 1968-1971. This was in contrast to the poor flow pattern in 1967.

Population estimates made on Section IV from 1967 through 1971 show the effect of this flow pattern change on the wild trout population. Table 6 shows the change in the numbers of two-uear-old and older brown and rainbow trout in the spring. Since the spring flow patterns were altered in 1968, Section IV (Norris) has shown significant increases in the total wild trout population, as the total pounds of wild trout has increased 24% and the total numbers 71%. Since 1969, the population size (biomass) has leveled off indicating that the continued good spring water flow conditions have maintained the initial

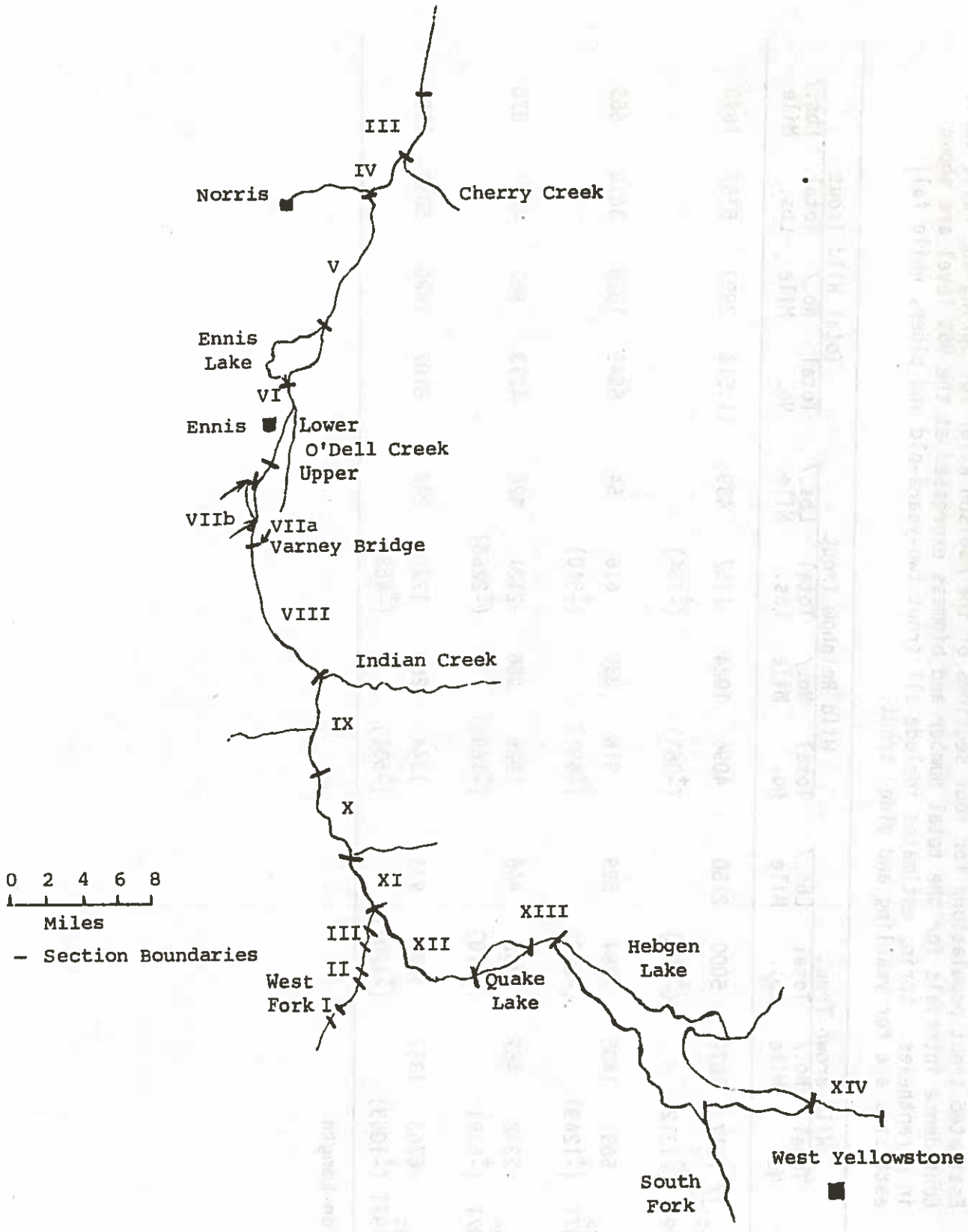

Figure 2. Map of the Madison River showing study sections.

TABLE 4. Estimated trout populations for four sections of the Madison River for Spring and Fall, 1971. Confidence intervals for the total number and biomass expressed at the 95% level are shown in parentheses. Spring estimates include all trout two-years-old and older, while fall estimates are for yearling and older trout.

Section Length and Date	Wild Brown Trout				Wild Rainbow Trout				Total Wild Trout			
	Total No.	No./ Mile	Total Lbs.	Lbs./ Mile	Total No.	No./ Mile	Total Lbs.	Lbs./ Mile	Total No.	No./ Mile	Total Lbs.	Lbs./ Mile
IV 4.0 miles 1/ March, 1971	7517 (±1312)	1879	5000 (±958)	2150	4096 (±863)	1024	1757 (±354)	439	11,613	2903	6757	1690
VI 4.0 miles Aug., 1971	5631 (±1249)	1408	2394 (±629)	599	918 (±691)	230	616 (±510)	54	6549	1638	3010	653
VIIa 5.0 miles Apr., 1971	2348 (±659)	467	2232 (±810)	446	1925 (±1694)	386	2121 (±2266)	424	4273	853	4353	870
VIIa 5.0 miles Sept., 1971	6763 (±1053)	1351	4674 (±1207)	935	1344 (±531)	269	1220 (±469)	246	8107	1620	5894	1181

1/ Section Length

TABLE 5. Estimated age structure of brown and rainbow trout in four sections of the Madison River. Relative abundance of each age group expressed as percent of total numbers are shown in parentheses.

Section and Date	Age Group I	II	III	IV+	Total
		Brown Trout			
IV March, 1971[1/]		6.1-11.0" 3077 (41)	10.5-16.9" 3675 (49)	14.0-22.8" 765 (10)	7517
VI August, 1971	5.0-9.7" 3474 (62)	8.9-13.5" 1357 (24)	11.9-17.0" 548 (10)	15.5-20.4" 252 (4)	5631
VIIa April, 1971[1/]		5.7-11.5" 892 (38)	11.0-16.8" 788 (34)	14.4-21.4" 688 (28)	2348
VIIa Sept., 1971	4.4-10.1" 3687 (55)	9.5-15.4" 1635 (24)	12.9-17.7" 807 (12)	16.5-20.8" 634 (9)	6763
		Rainbow Trout			
IV March, 1971[1/]		7.2-11.3" 3197 (78)	10.4-14.8" 786 (19)	14.2-19.4" 113 (3)	4096
VI Aug., 1971	6.2-9.2" 170 (19)	9.3-12.0" 509 (55)	11.8-16.5[2/] 239 (26)		918
VIIa March, 1971[1/]		5.3-12.2" 257 (13)	11.3-15.5" 931 (48)	13.8-19.2" 737 (39)	1925
VIIa Sept., 1971	6.2-19.3" 225 (17)	10.2-14.5" 729 (54)	12.9-17.5% 243 (18)	16.3-21.3" 147 (11)	

1/ Spring estimates do not include the yearling age group.
2/ Estimate includes trout three-years-old and older.

population increases found in 1968 and 1969. The population will probably maintain itself at the present levels as long as habitat conditions remain stable.

Effect of Hatchery Rainbow Trout: Section VIIa (Varney) which is located above Ennis Reservoir, did not show an increase during the 1968-1970 period following flow adjustments, which did occur in the Norris section from 1968 through 1970. One of the differences in the two sections is that the Varney section has received 10,000-15,000 catchable rainbows per year prior to 1970, while the Norris section has not been stocked with catchables since 1959. It is possible that the stocking of catchable rainbows may adversely affect the wild trout populations.

In 1970, stocking of catchable rainbows in the Varyney section (VIIa) was discontinued to determine the effect on the wild trout populations. Table 7 shows the wild brown and rainbow trout population size before and after the stocking of catchable rainbows was discontinued.

Since the stocking of catchable trout in the Varney section ceased with the 1969 plant, the wild trout populations have shown significant increases in both

TABLE 6. Comparison of 1967, 1968, 1969, 1970 and 1971 brown and rainbow trout populations for Section IV. Estimates include trout two-years-old and older.

Year	Brown Trout		Rainbow Trout		Total Trout	
	Number	Pounds	Number	Pounds	Number	Pounds
1967 1/	4707	4297	2072	1154	6779	5451
1968 2/	8341	5117	1477	634	9818	5751
1969 3/	6944	5561	2681	1272	9625	6833
1970 4/	8947	5548	3301	1255	12,248	6803
1971	7517	5000	4096	1757	11,613	6757

1/ Data from Vincent, 1968.
2/ Data from Vincent, 1969.
3/ Data from Vincent, 1970.
4/ Data from Vincent, 1971.

TABLE 7. Comparison of 1967 through 1971 fall population numbers and biomass for Section VIIa (Varney), Madison River. Estimates are for two-years-old and older.

Year	Brown Trout		Rainbow Trout		Total Trout	
	Number	Biomass	Number	Biomass	Number	Biomass
1967 1/	1379	1938	138	118	1517	2056
1968 2/	1126	1396	406	421	1532	1817
1969 3/	1196	1490	191	197	1387	1687
1970 4/	1818	2806	925	844	2743	3650
1971	3076	3949	1119	1172	5125	5121

1/ Data from Vincent, 1968.
2/ Data from Vincent, 1969.
3/ Data from Vincent, 1970.
4/ Data from Vincent, 1971.

number and biomass. The brown trout have increased 149% in total number and 145% in total biomass, while the wild rainbow trout have increased 357% in total number and 378% in total biomass from the 1967-69 average.

Tag Returns: An indication of angler harvest was determined by the use of angler-returned fish tags. Wild trout were tagged with numbered T-tags during the spring electrofishing period. Hatchery rainbow trout were tagged prior to stocking with numbered plastic T-tags. Hatchery trout were planted in all sections of the Madison River between Quake Lake and Ennis Dam, except for an area around the study section (VIIa-Varney). A total of 35,745 hatchery rainbows were stocked from May 28, 1971 through August 26, 1971. Table 8 gives a summary of the tag returns for wild brown and rainbow trout during the April, 1971 through March, 1972 period for Sections IV and VIIa; plus hatchery rainbow for Sections VI and VII

through XII.

Tag returns indicate a low harvest rate of both wild and hatchery trout in the Madison River. It appears that angling pressure at the present levels has little effect on the existing wild trout populations.

TABLE 8. Percent of fish tags returned by anglers for the period April 1, 1971 through March, 1972.

Section	Number Tagged	Tags Returned	Percent of Tags Returned	Adjusted Tag Return Rate 1/
IV - Brown Trout	404	47	11.6	15.6
Rainbow Trout	229	24	10.4	14.0
Total	633	71	11.2	15.1
VIIIa-Brown Trout	278	25	9.0	12.3
Rainbow Trout	98	10	10.2	13.3
Total	376	35	9.3	12.5
VI & VIII-XII Hatchery Trout	194	22	11.3	15.5

1/ Adjusted rate includes 26% of tags not returned by angler (Vincent, 1971).

O'Dell Creek

Population Estimates: Population estimates were made on two section of O'Dell Creek during the spring prior to fishing season (May) and again in September (Figure 2). One section was located below Highway 287 (Lower) a nd one was located above the highway (Upper). Table 9 gives a summary of the population estimates for the two sections during the spring and fall periods.

Effect of Hatchery Rainbow Trout: In the summer of 1970, the Lower Section of O'Dell Creek received the first stocking of catchable rainbow trout since 1964. During the summer of 1971, 4500 additional catchables were stocked in this section of O'Dell Creek. The stocking of catchable rainbow trout into the Lower Section of O'Dell Creek after five years of no stocking was part of the study to determine the effect of hatchery reared fish on wild trout populations. Table 10 shows the wild brown trout population size before and after stocking catchables.

After two summers of stocking catchables, the brown trout population size in the fall of 1971 had declined 45% by number and 43% by weight. This data would indicate that the stocking of catchables has a detrimental effect on wild trout populations.

Mortality Rates: Total mortality was calculated for wild brown trout in the Upper and Lower sections and hatchery rainbow trout for the Lower Section. The mortality rates covered two time periods (1) September 18, 1970 to April 22, 1971 and (2) April 23, 1971 to September 10, 1971. A summary of the mortality rates and angler tag returns is given in Table 11.

TABLE 9. Estimated brown trout population and age structure during the spring and fall time periods on the Upper and Lower Sections of O'Dell Creek. Confidence intervals for the total population and total biomass expressed at the 95% level are shown in parentheses.

Section	Age Group I	II	III	IV+	Total No.	No./ Acre	Total Lbs.	Lbs./ Acre
Lower May, 1971	3.4-6.9" 1/ 1559	7.0-11.9" 451	10.5-15.9" 166	14.0-20.1" 82	2258 (±467)	191	441 (±103)	37
Lower Sept., 1971	6.6-10.8" 882	9.6-12.7" 132	11.0-15.4" 110	14.3-20.3" 83	1207 (±165)	102	529 (±87)	45
Upper May, 1971	3.5-7.7" 2857	7.0-12.9" 418	11.1-16.2" 181	14.9-21.8" 45	3501 (±766)	1062	481 (±86)	150
Upper Sept, 1971	5.5-10.6" 885	9.3-13.8" 179	12.4-16.7" 113	15.9-24.0" 75	1252 (±125)	378	568 (±121)	172

1/ Length range.

TABLE 10. Comparison of 1967 through 1971 brown trout population numbers and biomass for the Lower Section of O'Dell Creek. Estimates are for two-years-old and older.

Year	Spring		Fall	
	Number	Biomass	Number	Biomass
1967	831	553	596	570
1968	965	656	771	728
1969	911	620	545	525
1970 1/	1063	648	702	621
1971	699	368	325	327

1/ First year stocked.

Total mortality is a combination of natural mortality and angler harvest. Angler harvest was estimated by using angler returns of tagged fish. Table 11 shows that total mortality of wild brown trout in the Lower and Upper Sections was considerably higher than the angler harvest during the April to September, 1971 period (64 & 51% to 3.8 & 9.5%) and in the winter period when no angler harvest occurred the natural mortality was still high (54-43%). This data suggests anglers are having no apparent effect on wild trout population in either the Lower or Upper Sections.

A total of 4500 catchable rainbow trout were stocked in the Lower Section during June and July of 1971. By September, 1971, only 284 survived (94% mortality), and 11.1% were caught by anglers. This indicates that few of the catchables were actually caught before they were lost. Also, the presence of hatchery catchable trout appeared to have an effect on the wild brown trout mortality rate, as total annual mortality was higher in the stocked section than the unstocked section.

West Fork Madison River

Three sections on the West Fork of the Madison River were electrofished during the 1971 (Figure 2). On two of the sections, only one shocking run was made to determine species composition and growth data. On the third section (III) a wild brown and rainbow trout estimate was made. The location of the three sections on the West Fork of the Madison River are as follows: (1) Section I - 11.0 miles upstream from the mouth; (2) Section II - 6.0 miles upstream from the mouth; and (3) Section III - 0.75 miles upstream from the mouth.

Population Estimate: A wild brown rainbow trout population estimate was made on Section III. A summary of this population and age structure estimate is shown in Table 12.

Species Composition: Three species of trout were found in the portion of the West Fork which was electrofished. Table 13 shows the species of trout present in the three study sections.

TABLE 11. Total Mortality and percent tag return of brown trout for the Lower and Upper Sections; plus hatchery rainbow trout for the Lower Section.

Section	Initial Population Estimate	Final Population Estimate	Mortality Rate (Percent)	Percent Tag Return
		Sept. 18, 1970 to April 22, 1971		
		Brown Trout		
	Age Groups I-IV+	Age Groups II-IV+		
Lower	1959	699	64	0
Upper	1308	644	51	-
		Hatchery Rainbow Trout		
Lower	431 1/	28	94	0
		April 23, 1971 to Sept. 19, 1971		
		Brown Trout		
	II-IV+	II-IV+		
Lower	699	325	54	3.8
Upper	644	367	43	9.5
		Hatchery Rainbow		
Lower	4500 2/	284	94	11.1

1/ Survivors from 4000 stocked in June, 1970
2/ Number stocked in June-July, 1971.

TABLE 12. Estimated brown and rainbow trout population and age structure for Section II on the West Fork of the Madison River. Confidence intervals for the total population and total biomass expressed at the 95% level are shown in parentheses.

Species	I	II	III	IV+	Total No.	No/ Mile	Total Lbs.	Lbs/ Mile
Brown Trout	122	70	29	3	224 (±116)	448	71 (±32)	142
Rainbow Trout	339	129	14	2	484 (±304)	968	72 (±33)	144

TABLE 13. Species composition of trout in three sections of the West Fork Madison River.

Section	Rainbow Trout	Brown Trout	Cutthroat Trout
I	12%	6%	82%
II	73%	20%	7%
III	61%	39%	0

RECOMMENDATIONS

There should be continued work to improve shocking equipment and techniques. Various types of boom electrodes should be tried on the larger rivers to determine if there is a satisfactory way to sample these waters. Estimates of standing crops, age structure, mortality rates, production rates and species composition should be continued on the East Gallatin River, the Madison River, O'Dell Creek and the West Gallatin River and started on the Jefferson River and the Missouri River. The effects of habitat destruction, pollution and wa ter flows on trout populations should be studied.

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Waters Referred to:

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9-6878-1	13-4400-1
13-3400-1	13-5400-1
	13-6640-1