MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

JOB PROGRESS REPORT

State Montana

Project No. F-9-R-18 Title Southwestern Montana Fisheries Study

Job No. III-a Title Evaluation of River Fish Populations

Period Covered July 1, 1969, to June 30, 1970

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 basic Petersen mark-and-recapture formula was used to estimate the standing crop (total numbers and biomass). The age structure and mortality rates were also determined.

Population estimates were made on five sections of the East Gallatin River (875 to 10,000 feet long). No young-of-the-year trout were found in shocking samples in three sections. Annual mortality rates for trout ranged from 28% for browns in section XII to 74% for rainbows in section VII. Anglers caught and returned 3.7% of the tags in these sections during the same period. Information from tagged fish which were recaptured by electrofishing showed that detectable movement was more extensive in sections heavily polluted by sewage than in the unpolluted sections.

Whitefish population estimates were made on five sections of the East Gallatin River. Populations ranged from 1-2 pounds per acre in sewage-polluted sections to 343 pounds per acre in an unpolluted section.

Trout population estimates were made on four sections of the Madison River. Population estimates from 1967, 1968 and 1969 show that improved spring flows in 1968 and 1969 were followed by significant increases in the spring trout population on the Norris section (section IV) and large increases in the fall population of yearling trout in the Varney section (section VIIa), but due to heavy overwinter mortality, the spring population has not shown these increases.

Population estimates were made on one section of O'Dell Creek. Of 106 brown trout recaptured during electrofishing, only two (2.9%) showed movement farther than to an adjacent section. Total mortality was 41.0% for the 1968-69 winter period and 35.0% for the 1969 summer period. During the latter period, the angler tag return was 9.1%.

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 must be obtained. Mortality rates for several periods in the year, such as summer and winter, are necessary to determine when mortality is occurring and then what is causing it. Age structure information is necessary to determine if reproduction 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 and O'Dell Creek. 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 subsections 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 Petersen-type mark-and-recapture method using Chapman's modified formula (Chapman, 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 sizes 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. The various population parameters were determined

from methods described by Vincent (1969a). Movement and angler mortality were determined by the use of a plastic fish tag which was inserted in the fish just behind the dorsal fin on the back, with the barbs engaging the pterygiophores. 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, the aluminum appears to become brittle and impossible to keep repaired.

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 bottom 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 in 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 (Figure 1). Certain sections were then further divided into subsections ranging in length from 500 to 1,000 feet. Trout were tagged in 7 of the 14 sections to determine the extent of trout movement.

Population Estimates. Population estimates for brown trout, rainbow trout and mountain whitefish were made on five sections of the East Gallatin River. The shocking efficiencies (percentage of marked fish recaptured) for trout on these five sections were as follows: XIVa - (39-41%) - summer; XII - (10-15%); X - (12-19%); VII - (5-10%); and III - (4-7%). A summary of the trout and mountain whitefish population estimates for the five sections is presented in Tables 1 and 2.

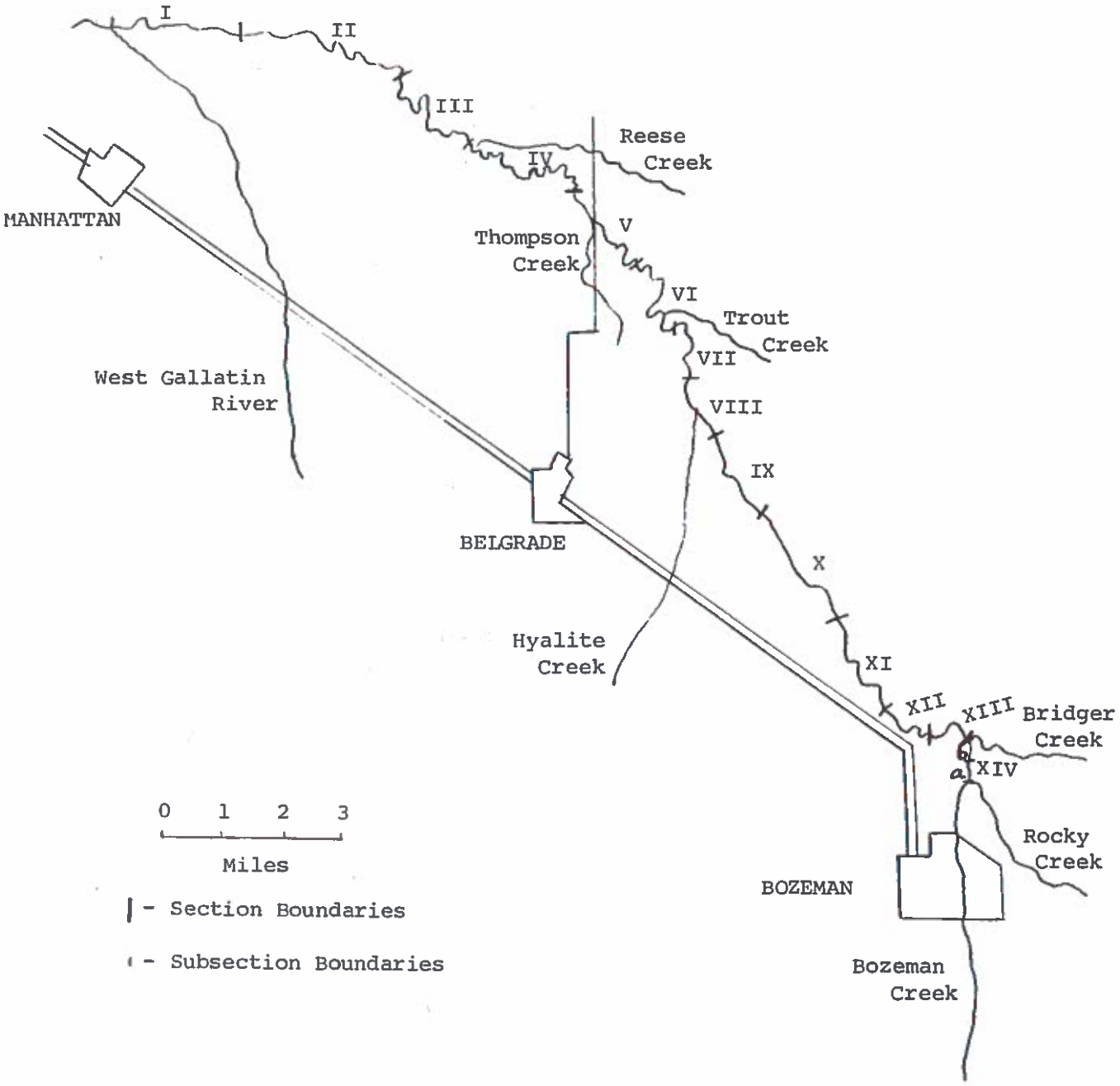

Figure 1. Map of the East Gallatin River showing study sections.

Table 1. Estimated trout populations for five sections of the East Gallatin River. Confidence intervals for the population estimates expressed at the 95% level are shown in parentheses

Section and date	Rainbow trout				Brown trout				Total trout			
	Total No.	No./ acre	Total lbs.	Lbs./ acre	Total No.	No./ acre	Total lbs.	Lbs./ acre	Total No.	No./ acre	Total lbs.	Lbs./ acre
III												
10,000 ft. 1/	1,435	118	604	50	1,411	116	695	58	2,846	234	1,299	108
August, 1969	(±1,004)				(±858)							
VII												
7,125 ft.	1,322	221	616	105	303	51	273	45	1,625	272	889	150
August, 1969	(±445)				(±156)							
X												
8,000 ft.	431	76	353	62	206	36	156	27	637	112	509	89
July, 1969	(±140)				(±170)							
XII												
8,125 ft.	820	141	330	56	521	89	148	25	1,341	230	478	81
July, 1969	(±204)				(±276)							
XIVa												
875 ft.	80	134	25	41	5	8	9	16	85	142	34	57
July, 1969	(±28)				(±2)							

1/ Length range.

Table 2. Estimated mountain whitefish populations (yearling and older) for five sections of the East Gallatin River. Confidence intervals for the population estimate expressed at the 95% level are shown in parentheses

	Section				
	III 1/ 10,000 ft. 2/ Aug., 1969	VII 7,125 ft. Aug., 1969	X 8,000 ft. July, 1969	XII 8,125 ft. July, 1969	XIVa 875 ft. July, 1969
Total No.	4,153 (±1,916)	291 (±226)	36 (15-72)	107 (±49)	5 (±2)
No./acre	344	49	6	18	8
Total lbs.	4,150	47	4	10	9
Lbs./acre	343	8	1	2	14

1/ Population estimate for two-year-old fish and older.
2/ Section length.

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 for each age-group of rainbow trout for the five sections is given in Table 3 and for mountain whitefish in Table 4.

Table 5 shows the relative abundance of each age-group of rainbow trout in the five sections where population estimates were made.

Effect of Habitat Conditions. The East Gallatin River has several serious habitat problems of which bank erosion and water pollution are the most severe. The outlet of the Bozeman Municipal Sewage Treatment Plant enters the river about 1,500 feet below the confluence of Bozeman Creek at the end of section XIVa (Figure 1). This form of pollution appears to have a serious effect on the salmonid population in sections of the East Gallatin River below the outlet, especially on the younger age-groups (0 and I+).

The most seriously polluted portion of the river is within the first 12 miles below the sewage outlet. Two of the sections for which fish population estimates were made this year lie within this area: section XII (1.5 miles below the sewage outlet), and section X (7.5 miles below the outlet). Even section VII (12.7 miles below the sewage outlet) appears to be somewhat affected by the sewage pollution, although some dilution by Hyalite Creek occurs. Sections XII and X show a standing crop of brown and rainbow trout - 81 and 89 lbs./acre, while section VII has 150 lbs./acre.

Table 3. Estimated age structure of rainbow trout for each section or subsection of the East Gallatin River (numbers per acre are shown in parentheses)

Section and date	Age group I	II	III	IV+	Total
III Aug., 1969	4.5-9.3" 1/ 828 (68)	9.4-20.0" 607 2/ (50)			1,435 (118)
VII Aug., 1969	4.3-9.1" 641 (107)	9.2-13.2" 407 (68)	12.0-15.4" 160 (27)	14.6-20.0" 114 (19)	1,322 (221)
X July, 1969	5.9-6.7" 17 (3)	7.3-10.4" 60 (10)	9.9-15.4" 214 (38)	13.2-18.5" 140 (25)	431 (76)
XII July, 1969	4.0-6.1" 40 (7)	6.2-10.1" 326 (56)	9.0-13.9" 342 (58)	11.8-17.9" 112 (20)	820 (141)
XIVa July, 1969	4.9-7.8" 22 (37)	7.0-9.6" 31 (52)	9.1-15.0" 24 (40)	12.5-18.0" 3 (5)	80 (134)

1/ Length range.
2/ Age group includes all rainbow two-year-olds and older.

Table 4. Estimated age structure of mountain whitefish for each section or subsection of the East Gallatin River (numbers per acre are shown in parentheses)

Section and date	Age group I	II	III	IV+	Total
III	7.0- 8.6" 1/	9.6-13.1"	11.1-15.7"	14.9-20.2"	
Aug., 1969	0	1,314 (109)	1,218 (101)	1,621 (134)	4,153 (344)
VII	5.8-10.8"	10.9-12.4" 2/			
Aug., 1969	276 (46)	15 (3)			291 (49)
X	6.5- 8.1"				
July, 1969	36 (6)	0	0	0	36 (6)
XII	6.1- 7.4"				
July, 1969	107 (18)	0	0	0	107 (18)
XIV	6.2-15.6" 3/				
July, 1969	5 (8)				5 (8)

1/ Length range.
2/ Population estimate for two-year-olds and older.
3/ Population estimate for yearlings and older.

Table 5. Relative abundance for each age group of rainbow expressed as percent of total numbers

Section	Age group I	II	III	IV+
III	58	42 1/		
VII	48	31	12	9
X	4	14	50	32
XII	5	40	42	13
XIVa	28	39	30	3

1/ Percent for two-year-old rainbow and older.

The age structure of rainbow trout indicates that there was poor recruitment of younger age groups into the population in sections XII and X (Table 3). No young-of-the-year brown or rainbow trout were found in sections XII, X and VII. Young-of-the-year brown and rainbow trout were quite abundant in section III. There were few yearlings in sections XII or X, but two-year-olds and older were relatively more abundant. In a laboratory bioassay experiment, Bahls, Soltero and Turnstra, 1969, found that when East Gallatin River water contained 25% sewage effluent, approximately 75% of the eyed rainbow eggs and 60% of the rainbow fry placed in it died within the first 120 hours. This indicates that some pollutant or combination of pollutants was causing mortalities in these early-life stages. A possible pollutant is ammonia (NH_4OH), which is common in sewage effluents. A sample of water taken on February 15, 1968, showed ammonia concentrations were 0.71 ppm (section XII), 0.37 ppm (section X) and 0.05 ppm (section III). Values of ammonia lethal to young trout vary from 0.3-0.7 ppm, depending upon pH, temperature, dissolved oxygen content and time of exposure (California Water Quality Control Board, 1963). The high concentrations of ammonia found in the East Gallatin River probably eliminate any reproduction, which explains why no young-of-the-year trout are found in sections XIVb through VII. Yearling and older trout present in these sections probably move in from adjacent sections or tributary streams.

Population estimates of mountain whitefish show a paucity of whitefish in the first 12 miles of stream below the sewage effluent. Sections XII, X, and VII had a mountain whitefish standing crop of 2, 1 and 8 pounds/acre, respectively, while section III (23.5 miles below the sewage outlet) had 343 pounds/acre.

Bank erosion and destruction is a very serious problem on the East Gallatin River. Most sections show a steady decline in the amount of good bank cover and an increase in eroded banks. In section XIVa, there has been a steady decline in the amount of good bank cover since 1966, when the first population estimate was made. There has been a considerable amount of disturbance to the banks and metal debris has been accumulating. Measurements made in 1969 show that only 9% of the bank had good brushy cover and 50% of the bank had either been badly disturbed or littered with metal junk. The pounds per acre of brown and rainbow trout has decreased from 214 in 1966, to 173 in 1967, to 114 in 1968, to 57 in 1969.

Mortality Rates. Total mortality was calculated for brown and rainbow trout in four sections of the East Gallatin River for the period from August, 1968, to August, 1969. The difference in the two population estimates of the same age group was assumed to be the result of natural and angler mortality. Table 6 gives a summary of the total mortality for brown and rainbow trout in these four sections.

A total of 998 rainbow and brown trout were tagged during the July-August shocking of the East Gallatin River in 1968. Thirty-seven (3.7%) of these were caught and reported by anglers during the period from August, 1968, to July, 1969. Even though not all anglers return these fish tags, this low return rate indicates a low angler fish harvest.

Table 6. Overall mortality of brown and rainbow trout for the period August, 1968, to August, 1969 - East Gallatin River

Section	Population estimate August, 1968	Population estimate August, 1969	Mortality rate
	Age groups I-IV+	Age groups II-IV+	
	Brown trout		
III	1,027	487	53%
VII	307	174	43%
XII	328	237	28%
	Rainbow trout		
III	1,255	607	52%
VII	2,586	681	74%
XIVa	214	58	73%

Movement. During 1968, four study sections (XIV, XII, VII and III) were subdivided into smaller sections (500-800 feet in length) to study more detailed trout movement. Brown and rainbow trout were tagged in each of these subsections. Table 7 shows the degree of movement (greater than 500 feet) after one year of the 1968 tagged trout.

The degree of movement within each of the study sections of the East Gallatin River shows considerable variation from section to section. Sections within the areas affected by the Bozeman sewage effluent, XII and VII, show a greater degree of trout movement than areas above (XIVa) and below (III) the sewage pollution zone. This could be the result of the unstable environment of the pollution area. Movement was divided about equally between downstream and upstream, with the greatest downstream movement being three miles and the maximum upstream movement was 10 miles.

Madison River

The Madison River was divided into 15 sections ranging in length from four to nine miles (Figure 2). In the three sections in which trout were tagged, the major sections were divided into subsections ranging in length from 2,000 to 2,500 feet.

Population Estimates. Trout population estimates were made on four sections of the Madison River. The shocking efficiencies for these four sections were as follows: IV, April - (1.8-3.7%); VIIa, East Channels, April - (4.9-6.1%); VIIa, East Channels, September - (3.7-6.4%); VIIb, West Channels, September - (18.1-19.3%); and IX, April - (2.2-6.5%). A summary of the trout population estimates is presented in Table 8.

Table 7. Movement of brown and rainbow trout within the East Gallatin River over a period of one year, 1968 to 1969, as indicated by tagged fish recaptured

	Section			
	XIVa	XII	VII	III
No movement	4	1	9	17
Movement	1	3	8	0
Total	5	4	17	17
Percent movement	20	75	47	0

Age Structure. Age composition (percent) and age group population numbers were calculated for each of the sections in which population estimates were made. Table 9 gives a summary of the population estimates for each age group of brown trout in each of the four sections and for rainbow in sections IV and IX.

Effects of Habitat Conditions. The Madison River has a serious problem concerning water flow patterns in relation to water releases from Hebgen Reservoir during the late winter. Water is stored during the spring in Hebgen Reservoir and then released from July through November for electrical power generation at Ennis Dam and other downstream power dams. The storage pattern varied from year to year. In some years, 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. In other years, the storage did not begin until the spring runoff started (late April or early May). During the springs of 1968 and 1969, good flow conditions were maintained from February through May. This was in contrast to the poor flow pattern in 1967.

Population estimates made on sections IV and VIIa during 1967, 1968 and 1969 show the effect of this flow pattern change on the population (Table 10). Since the spring flow patterns were altered in 1968, section IV has shown significant population increases, while spring estimates on section VIIa show smaller increases. There have been substantial increases in the fall populations in section VIIa, primarily due to the increase in the number of yearlings (56/1,000 feet in 1967 to 121/1,000 feet in 1969). These yearling brown trout suffer high overwinter mortalities (September through March) and thus do not substantially increase the spring population numbers. Some factor other than spring flow patterns evidentally regulates the survival of this age group.

Tag Returns. An indication of angler harvest was determined by the use of angler-returned fish tags. Table 11 gives a summary of the tag returns for brown and rainbow trout during the April, 1969, to March, 1970, period for sections IV, VIIa and IX. The percent returns ranged from 7.8 in section IV to 13.6 in section VII. This low level of tag returns indicates that angling had little effect on the existing trout populations in these three sections.

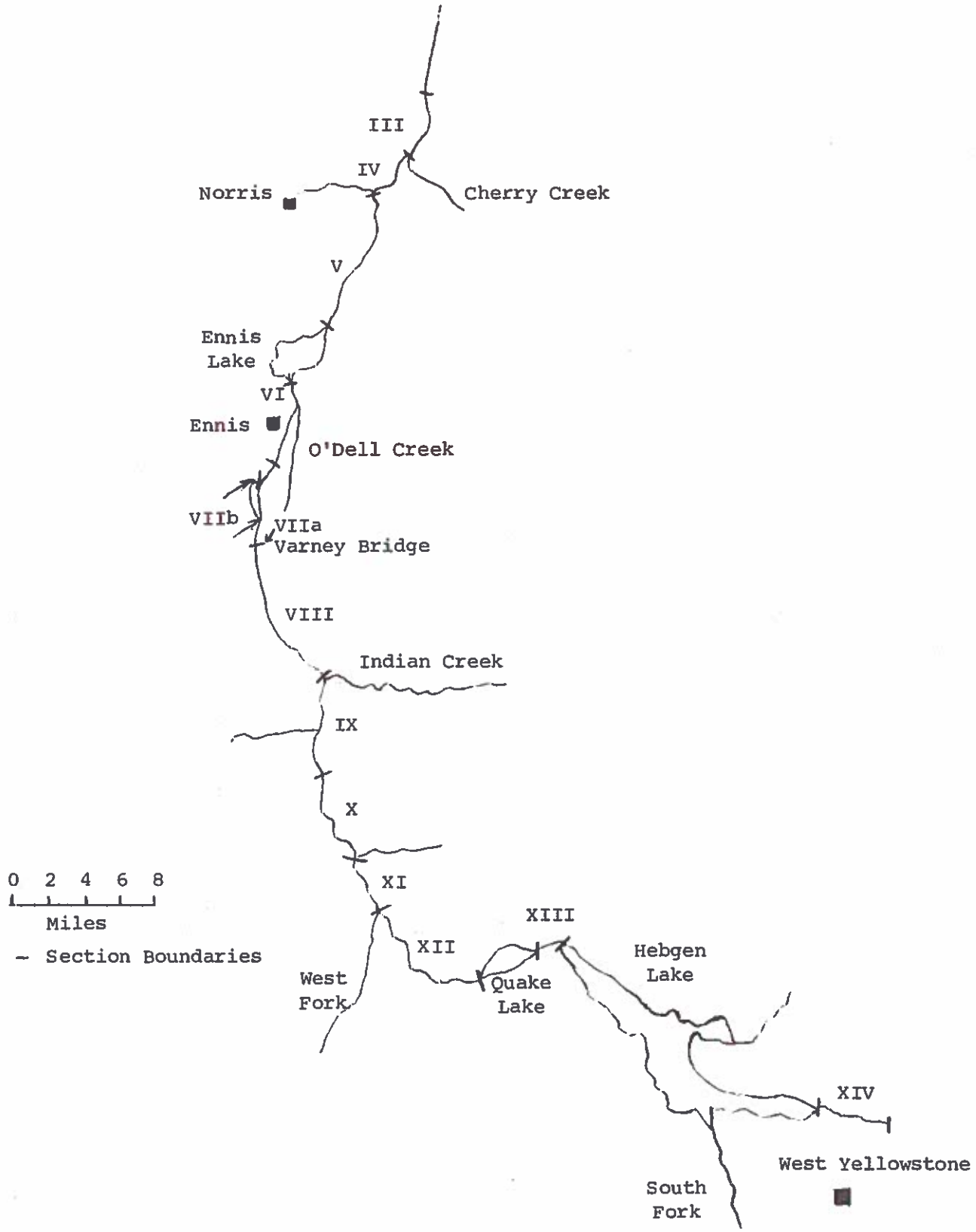

Figure 2. Map of the Madison River showing study sections.

Table 8. Estimated trout populations for four sections of the Madison River. Confidence intervals for the population estimated expressed at the 95% level are shown in parentheses

Section, length and date	Brown trout				Rainbow trout				Total trout			
	Total No.	No./ 1,000 ft.	Total lbs.	Lbs./ 1,000 ft.	Total No.	No./ 1,000 ft.	Total lbs.	Lbs./ 1,000 ft.	Total No.	No./ 1,000 ft.	Total lbs.	Lbs./ 1,000 ft.
IV 4.0 miles 1/ March, 1969	6,944 (±1,940)	323	5,561	259	2,681 (±1,738)	125	1,271	59	9,625	448	6,832	318
VIIa E.C. 2/ 5.0 miles April, 1969	2,252 (±1,036)	85	1,889	72	Insufficient data for estimate				2,252	85	1,889	72
VIIa E.C. 2/ 5.0 miles Sept., 1969	4,476 (±940)	169	2,249	85	766 (±680)	29	345	13	5,242	198	2,594	98
VIIb W.C. 2/ 3.0 miles Sept., 1969	3,407 (±578)	215	1,987	125	Insufficient data for estimate				3,407	215	1,987	125
IX 5.0 miles April, 1969	1,463 (±702)	55	935	35	1,359 (±1,188)	52	707	27	2,822	107	1,643	62

1/ Section length.
2/ E.C. means East Channel; W.C., West Channel.

Table 9. Estimated age structure of brown trout in five sections and rainbow trout in two sections of the Madison River (numbers per 1,000 feet are shown in parentheses). Figures in inches are length range (T.L.) of fish

Section and date	Age group I	II	III	IV+
		Brown trout		
IV March, 1969		6.8-11.5" 2,943 (137)	11.4-16.9" 3,090 (144)	15.6-24.1" 911 (42)
VIIa E.C. April, 1969		7.0-12.1" 1,224 (46)	11.3-16.4" 619 (23)	15.4-23.2" 419 (16)
VIIa E.C. Sept., 1969	5.4-10.5" 1/ 3,203 (121)	10.0-15.5" 1/ 821 (31)	14.2-18.5" 1/ 319 (12)	17.0-25.3" 1/ 133 (5)
VIIb W.C. Sept., 1969	2,300 (145)	561 (35)	357 (23)	189 (12)
IX April, 1969		6.5-11.6" 1,062 (40)	11.0-25.5" 2/ 401 (15)	
		Rainbow trout		
IV March, 1969		7.0-11.6" 2,068 (96)	10.5-14.8" 509 (24)	14.6-22.7" 104 (5)
IX April, 1969		6.6-12.3" 1,023 (39)	11.1-19.0" 2/ 336 (13)	

1/ Data was combined for sections VIIa E.C., Sept., 1969, and VIIb W.C., Sept., 1969.

2/ Age group comprised all fish three years old and older.

Table 10. Comparison of 1967, 1968 and 1969 brown trout population estimates for sections IV and VIIa. Estimates are expressed as numbers and pounds per 1,000 feet

	Section IV (April)		Section VIIa (April)		Section VIIa (Sept.)	
	Number	Pounds	Number	Pounds	Number	Pounds
1967 1/	222	200	62	59	99	85
1968 2/	388	238	90	82	218	96
1969	323	259	85	72	169	85

1/ Data from Vincent, 1968.
2/ Data from Vincent, 1969b.

Table 11. Percent of fish tags returned by anglers for the period April, 1969, through March, 1970

Section	Number tagged	Tags returned	Percent of tags returned
IV			
Brown trout	593	43	7.2
Rainbow trout	155	15	9.6
Total	748	58	7.8
VIIa			
Brown trout	380	46	12.1
Rainbow trout	119	22	18.4
Total	499	68	13.6
IX			
Brown trout	133	8	6.0
Rainbow trout	76	9	11.8
Total	209	17	8.1

O'Dell Creek

Population Estimates. Population estimates were made on one section of O'Dell Creek during the spring prior to fishing season (May) and then again in September. Table 12 gives a summary of the population estimates and the age structure for the two population estimates.

Movement. A total of 841 brown and 53 rainbow trout have been tagged in O'Dell Creek from November, 1966, through May, 1968. To study movement, the main section was divided into eight subsections ranging in length from 1,250 feet to 2,450 feet. During 1968, 106 tagged trout were recaptured by electrofishing and these were used to determine movement. The returns were from trout which had been tagged three to 34 months prior to recapture.

Recapture data shows that there is little major movement of brown trout within the section of O'Dell Creek studied. Of 106 brown trout recaptured, only two (2.9%) showed movement farther than to an adjacent section.

Mortality Rates. Total mortality was calculated for brown trout for two time periods: October, 1968, through April, 1969, and May, 1969, through September, 1969. A summary of the mortality rates and angler tag returns is given in Table 13.

Total mortality is a combination of natural mortality and angler harvest. Angler harvest was estimated by using angler returns of tagged fish. Table 13 shows that the summer mortality was 35.0%, while anglers only took 9.1% of the trout. Winter mortality was 41.0%, and there was no angler-caused mortality because the fishing season was closed. This low level of angler harvest suggests that anglers are probably underharvesting this population.

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 and O'Dell Creek and started on the West Gallatin River, the Jefferson River and the Missouri River. Population parameters should be used in studying the effects of habitat destruction, pollution and water flows.

Table 12. Estimated brown trout populations and age structure during the spring and fall time periods on O'Dell Creek. Confidence intervals for the population estimated expressed at the 95% level are shown in parentheses

	Age group				Total No.	No./ acre	Total lbs.	Lbs./ acre
	I	II	III	IV+				
May, 1968	3.7- 7.6" 1/ 967	7.9-13.1" 582	11.8-16.8" 236	15.5-21.4" 72	1,857 (±462)	157	653	55
Sept., 1969	6.3-10.1" 649	10.2-13.9" 320	13.2-17.2" 192	16.3-22.1" 45	1,206 (±169)	102	752	64

1/ Length range.

Table 13. Total mortality and percent tag returns of brown trout for two time periods

Time period	Initial population estimate	Final population estimate	Mortality rate (percent)	Percent tag return
	Age-groups I-IV+	Age-groups II-IV+		
Oct., 1968-Apr., 1969	1,510	890	41.0	0.0
	Age-groups I-IV+	Age-groups I-IV+		
May, 1969-Sept., 1969	1,857	1,206	35.0	9.1

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Waters Referred To

9-1710-1
13-3400-1
13-3440-1
13-4400-1

Prepared by E. Richard Vincent

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