FISHERIES OF TRIBUTARIES TO THE UPPER YELLOWSTONE RIVER SYSTEM: ANNUAL REPORT FOR 1991 AND 1992

by

Bradley B. Shepard

November 1993

Progress Report For Federal Aid
Project F-46-R-3 and 4
Job I-f

Fisheries Division
Montana Department of Fish, Wildlife and Parks
1420 East Sixth Avenue
Helena, Montana

EXECUTIVE SUMMARY

Population estimates in the lower sample section of the Shields River, near its mouth, conducted in 1991 and 1992 indicated that brown trout populations have declined since the 1987/88 drought, probably in response to poor survival due to low flows. Estimates of rainbow trout indicated that populations of young rainbow trout have recently increased. This increase may be related to higher recruitment of rainbow trout in the Shields, movement by rainbow trout into the Shields from the Yellowstone River, a response by the rainbow population to decreased numbers of brown trout, or any combination of the above. Population estimates of brown trout in an upper section, near Wilsall, Montana, found record high numbers in 1991, but brown trout populations dropped in 1992 with numbers of age II and age IV and older sized fish dropping the most. Growth of brown trout in this upper section averaged about 3.5 inches from age II to age III, about 2.0 inches from age III to age IV, and then slowed to slightly over 1.0 inch from age IV to age V. Population estimates of mountain whitefish in both sections indicated whitefish may have either moved from the upper river to the lower river or suffered extremely high mortality in the upper in response to low flows in 1988. In 1991 and 1992 whitefish populations were re-building in the upper river, but they have not yet reached pre-drought levels.

Two sections of Fleshman Creek sampled in 1991 found that brown trout numbers in the Enterprise Section had increased from low numbers estimated in 1986 to levels estimated in 1984. Brown trout populations in the St. Mary's Section remained relatively stable. Rainbow trout populations in both sections were variable and were likely related to movement of stocked rainbow trout out of Sacajawea Lagoon located at the head of this channel.

Results from two sections of Little Mission Creek sampled in 1991 and 1992 indicated that Yellowstone cutthroat trout moved between the private land, below the Forest Service boundary, and the Forest Service portion of the stream for spawning. Sampling in 1992 found a rainbow trout which was the first recorded presence of rainbow trout that far up the drainage. Tag returns between the two years indicated little movement from August 1991 to August 1992 and growth was moderately slow with a 5.8 inch fish growing 1.9 inches and a 7.4 inch fish growing only 0.4 inches in one year.

A population estimate conducted in Little Mission Creek indicated that the abundance of Yellowstone cutthroat trout in 1991 was much lower than in previous years and documented a decline in abundance since 1982. A few cutthroat, averaging 3.1 inches long, were captured in Little Mission Creek near the trailhead where the stream is only about three feet wide. Fish populations have been monitored in four sample sections in Mill Creek since 1990. During 1991 a wildfire burned much of the Mill Creek drainage. Populations of Yellowstone cutthroat trout in the two sections closest to the area burned most intensely by the fire declined immediately after the fire. A population estimate in the West Fork of Mill Creek in 1992 found a rainbow trout, the first record of rainbow trout in the Mill Creek drainage above the Forest Service boundary. A population estimate in Mission Creek near the Triangle 7 Ranch in 1991 found that while brown trout numbers have continually increased in this section since 1985, cutthroat trout numbers may be slowly declining, probably in response to the increased numbers of brown trout. A similar, but more obvious, trend was observed in an upper section in Sixmile Creek, even though Sixmile Creek is managed under a "catch and release" angling regulation for trout.

The trend in populations of Yellowstone cutthroat trout has been a general shrinking of population abundance and range as exotic conspecific trout move into waters which have historically been occupied by cutthroat trout. Habitat degradation has likely contributed to the decline of cutthroat trout populations and replacement of cutthroat by exotic conspecific trout species. Hybridization with rainbow trout has also been a serious threat to the continued existence of cutthroat trout within the drainage.

KEYWORDS: management, population estimates, regulations, movement, salmonids, fire affects, cutthroat trout, brown trout, rainbow trout, habitat

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF FIGURES (continued)

LIST OF FIGURES (continued)

INTRODUCTION

Tributary streams support important resident fisheries. These fisheries provide dispersed angling opportunity and many pure populations of a "species of special concern", Yellowstone cutthroat trout, are supported in tributary systems. Hadley (1984) documented the shrinking distribution of Yellowstone cutthroat trout compared to their historic range. Surveys of tributary streams provide the information which will protect pure Yellowstone cutthroat trout populations; develop regulations to protect unique resident fisheries and provide for a diverse range of angling opportunities; and document instream flows needed to protect fisheries.

An important component of MDFWP's effort to protect and enhance fisheries is our ability to protect stream and river habitat under the Stream Protection Act of 1963 and the Natural Streambed and Land Preservation Act of 1975. The interaction of fisheries professionals and Conservation District Board members with permit applicants provides important protection to stream and river banks and beds. Maintaining stream and river banks and beds helps provide important fish habitat and protects fishery resources.

STUDY AREA DESCRIPTION

Shields River

The Shields River drains into the Yellowstone River at river mile 489.0 approximately eight miles down river from Livingston, Montana (Figure 1). The Shields River becomes severely dewatered during the summer irrigation season and Clancy (1984) believed that high annual mortality rates for trout were related to summer dewatering caused by irrigation withdrawals. Flows in the Shields River have been monitored by the U.S. Geologic Survey near its mouth at the Convict Grade Road bridge since 1978. Flows for the past five years at this site illustrate the typical low flows observed in the Shields River from July through the following spring peak flow period (Figure 2). Flows during 1987 and 1988 were extremely low with the lowest recorded flow of less than 20 cfs (the gauge is only capable of recording flows down to 20 cfs and flows were lower) in August and September, 1988. Flows during 1990 and 1991 were 95% and 91% of the 13 year average (1978-1991) with peak flows higher than average in 1991 and near average in 1990.

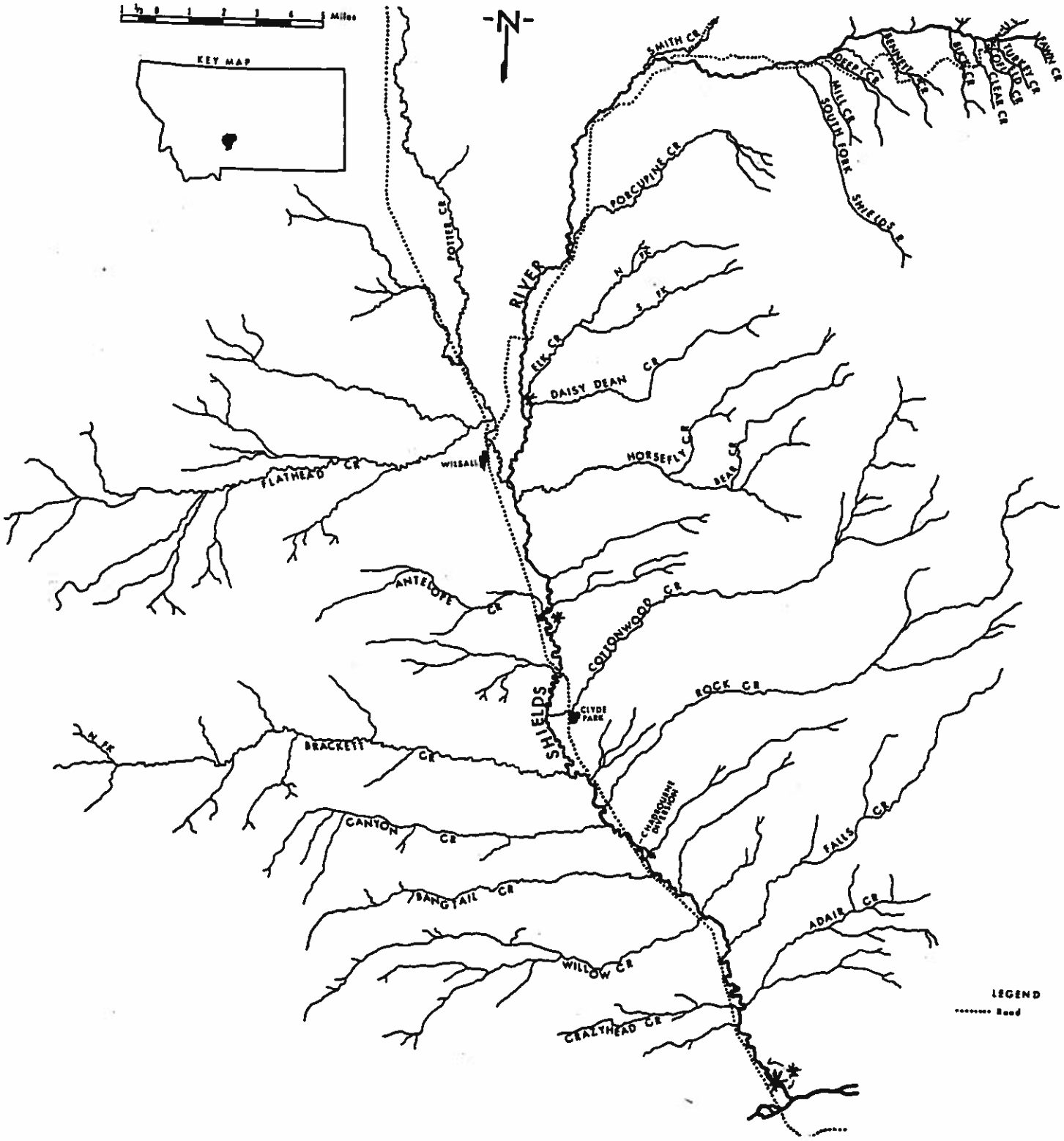
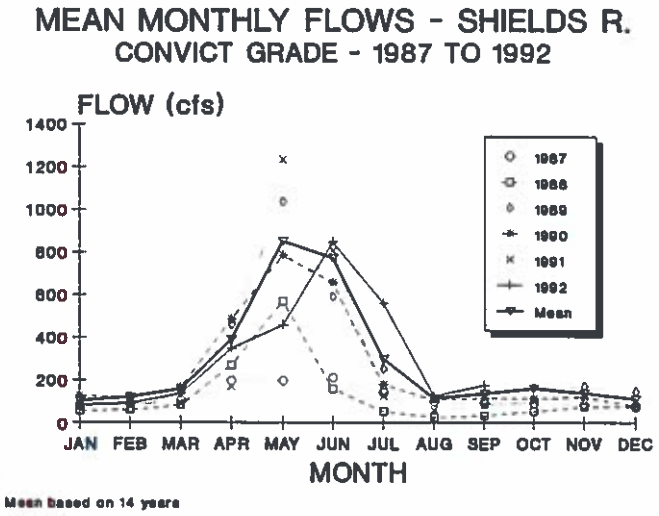


Figure 1. Map of the Shields River drainage showing electrofishing sections sampled during 1991 and 1992 (*).



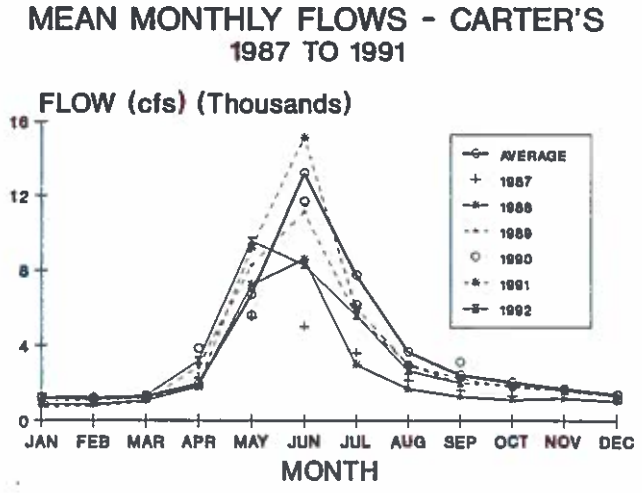


Figure 2. Monthly average flows for the Shields River at Convict Grade Bridge from 1987 to 1992 and at the Yellowstone River at Carter's Bridge from 1987 to 1992.

Two sections, Convict Grade and Zimmerman, have been electrofished annually from 1978 to the present to determine trends in fish abundance in the Shields River (Figure 1). The Convict Grade section was also sampled in 1972 and 1974. The Zimmerman section was also sampled in 1975. The Convict Grade section is located near the mouth of the Shields River at the Yellowstone River and extends up river from the Convict Grade Road bridge approximately 1.5 miles. The Zimmerman section, above Wilsall, Montana, begins at the Elk Creek Road bridge crossing of the Shields and extends down river approximately 0.6 miles to the Daisy Dean Creek Road bridge. During the spring of 1991 another section above Clyde Park was sampled to document fish populations between Wilsall and Clyde Park. This section was named the Marelius Section and is located approximately 1.5 miles above the Highway 89 bridge north of Clyde Park.

Yellowstone River Drainage Tributaries

Tributaries to the Yellowstone River sampled during 1991 and 1992 include Fleshman, Little Mission, Mill Fork Mission, Mission, Mill, Sixmile and West Fork of Mill creeks (Figure 3). Flows in the Yellowstone River during 1990 and 1991 were 90% and 100% of average, respectively based on 67 years of data from Carter's Bridge near Livingston (Shepard 1992 and Figure 2). Various fish species have been released into the Sacajawea Lagoon at the head of Fleshman Creek and into Fleshman, Mill, Little Mission, Mission, and Sixmile creeks in the past (Table 1).

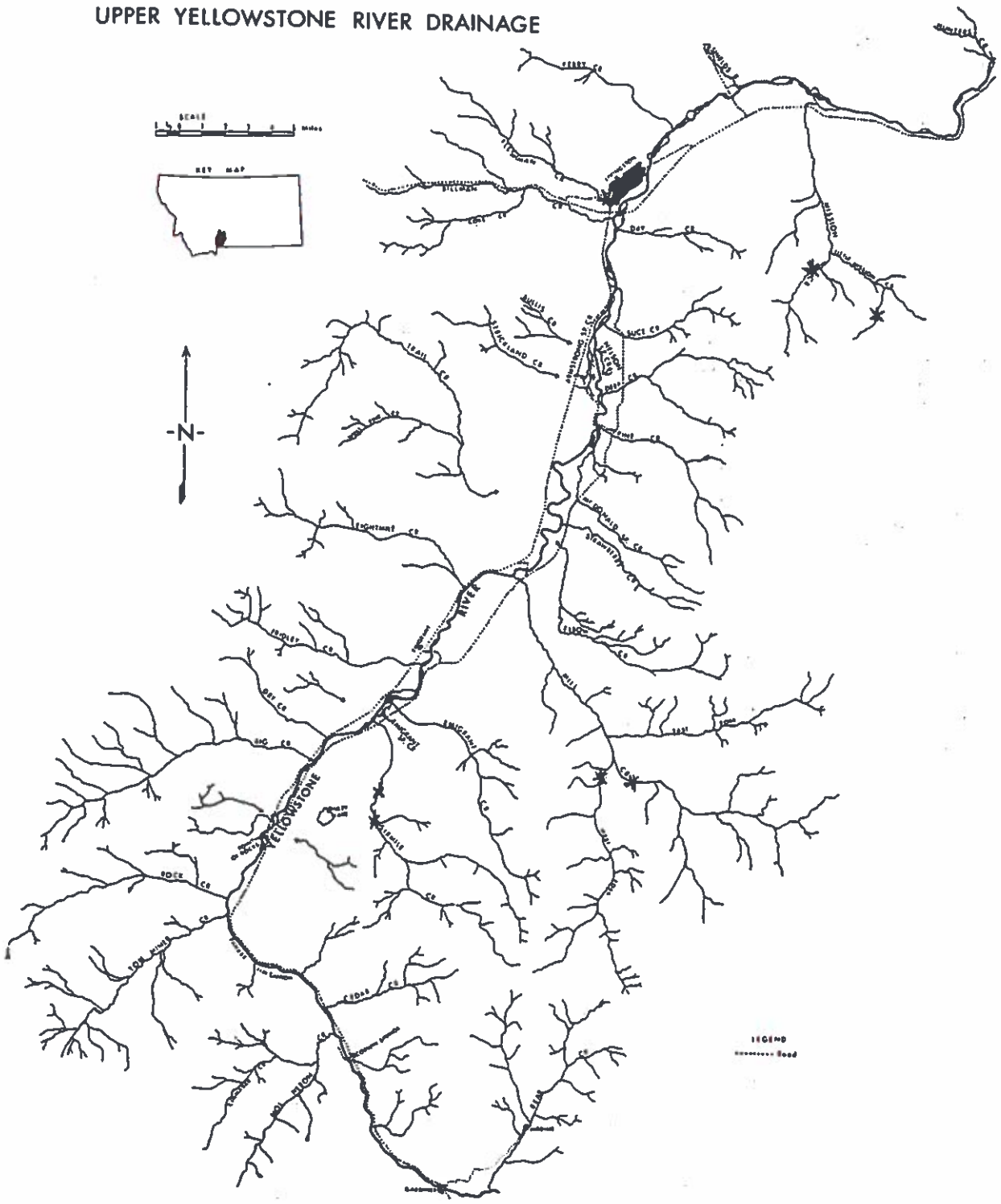


Figure 3. Map of the upper Yellowstone River drainage showing electrofishing sections sampled during 1991 and 1992 (*).

Table 1. Fish released into tributaries to the Yellowstone River sampled during 1991 and 1992. Species numeric codes are: '001' = rainbow trout; '002' = undesignated cutthroat trout; '004' = brown trout; and '013' = Yellowstone cutthroat trout. Species alpha codes (strains) are: 'A' = Arlee; 'G' = ; 'M' = McBride; and 'T'= .

Water name	Plant date	Species code	Number	Average length	Location	Marks
FLESHMAN CREEK	08/16/28	002	26250	1.0	02S09E24	
LITTLE MISSION CK	08/24/40	013	25000	0.0	02S11E33	
LITTLE MISSION CK	05/06/42	004	16000	3.0	02S11E33	
LITTLE MISSION CK	09/18/54	002	17040	1.0	02S11E33	
MILL CREEK	08/03/28	002	17500	1.0	05S09E07	
MILL CREEK	08/03/28	002	17500	1.0	05S09E07	
MILL CREEK	09/10/28	002	10000	1.0	05S09E07	
MILL CREEK	09/14/28	002	5000	1.0	05S09E07	
MILL CREEK	06/29/31	002	12150	4.0	05S09E07	
MILL CREEK	10/11/32	002	45500	0.0	05S09E07	
MILL CREEK	09/10/34	002	14220	0.0	05S09E07	
MILL CREEK	07/27/36	013	42300	0.0	05S09E07	
MILL CREEK	08/30/37	013	26142	0.0	05S09E07	
MILL CREEK	08/26/38	013	35440	0.0	05S09E07	
MILL CREEK	09/08/38	013	18750	0.0	05S09E07	
MILL CREEK	07/19/39	013	1590	5.0	05S09E07	
MILL CREEK	07/27/39	013	24000	0.0	05S09E07	
MILL CREEK	09/19/39	013	24450	0.0	05S09E07	
MILL CREEK	08/10/40	013	31200	0.0	05S09E07	
MILL CREEK	08/06/41	013	4600	5.0	05S09E07	
MILL CREEK	09/22/41	013	29053	0.0	05S09E07	
MILL CREEK	08/27/42	013	5000	2.0	05S09E07	
MILL CREEK	08/31/42	013	8250	6.0	05S09E07	
MILL CREEK	09/14/42	013	20000	2.0	05S09E07	
MILL CREEK	09/09/43	013	6000	6.0	05S09E07	
MILL CREEK	08/22/44	013	10000	5.0	05S09E07	
MILL CREEK	08/18/45	001	5600	5.0	05S09E07	
MILL CREEK	09/24/45	002	5000	2.0	05S09E07	
MILL CREEK	08/15/46	002	4728	4.0	05S09E07	
MILL CREEK	07/31/47	002	7200	3.0	05S09E07	
MILL CREEK	09/22/48	002	15000	0.0	05S09E07	
MILL CREEK	10/08/48	002	3000	0.0	05S09E07	
MILL CREEK	09/09/49	002	5000	1.0	05S09E07	
MILL CREEK	09/26/50	002	25000	1.0	05S09E07	
MILL CREEK	09/29/52	002	10000	1.0	05S09E07	
MILL CREEK	08/02/53	002	7510	3.0	05S09E07	
MILL CREEK	09/27/54	002	24000	1.0	05S09E07	
MILL CREEK	06/26/58	002	1530	0.0	05S09E30	
MILL CREEK	07/14/59	002	1504	0.0	05S09E30	
MILL CREEK	08/07/64	001	690	10.0	05S09E07	
MILL CREEK	08/12/65	001	1000	7.0	05S09E07	
MILL CREEK	07/20/66	001	1530	8.0	05S09E07	

Table 1. Continued.

Water name	Plant date	Species code	Number	Average length	Location	Marks
MILL CREEK	08/06/67	001	1020	9.0	05S09E07	
MILL CREEK	08/01/68	001	1020	10.0	05S09E07	
MILL CREEK	07/21/69	001	1101	10.0	05S09E07	
MILL CREEK	07/27/71	001	428	9.0	05S09E00	
MILL CREEK	08/09/71	001	765	9.0	05S09E07	
MILL CREEK	08/10/72	001	1020	11.0	05S09E07	
MILL CREEK	07/30/73	001	1142	8.0	05S09E07	
MISSION CREEK	08/13/28	002	36400	1.0	01S11E29	
MISSION CREEK	08/14/28	002	50000	1.0	01S11E29	
MISSION CREEK	07/03/31	002	4950	4.0	01S11E29	
MISSION CREEK	08/27/31	002	3200	6.0	01S11E29	
MISSION CREEK	10/10/32	002	45500	0.0	01S11E29	
MISSION CREEK	09/27/37	013	14225	0.0	01S11E29	
MISSION CREEK	10/15/37	013	12000	0.0	01S11E29	
MISSION CREEK	09/20/38	013	29705	0.0	01S11E29	
MISSION CREEK	07/21/39	013	1590	5.0	01S11E29	
MISSION CREEK	09/16/39	013	26500	0.0	01S11E29	
MISSION CREEK	08/23/40	013	2500	5.0	01S11E29	
MISSION CREEK	08/02/41	013	4600	5.0	01S11E29	
MISSION CREEK	09/20/41	013	32000	0.0	01S11E29	
MISSION CREEK	05/06/42	004	16000	3.0	01S11E29	
MISSION CREEK	09/13/44	013	25000	2.0	01S11E29	
MISSION CREEK	09/13/45	002	20000	2.0	01S11E29	
MISSION CREEK	10/02/45	002	22000	2.0	01S11E29	
MISSION CREEK	10/10/45	002	19000	2.0	01S11E29	
MISSION CREEK	09/23/46	002	20000	2.0	01S11E29	
MISSION CREEK	10/02/47	002	18000	0.0	01S11E29	
MISSION CREEK	07/30/48	002	5240	4.0	01S11E29	
MISSION CREEK	10/07/48	002	20000	0.0	01S11E29	
MISSION CREEK	07/08/48	004	12500	2.0	01S11E29	
MISSION CREEK	09/20/49	002	25000	1.0	01S11E29	
MISSION CREEK	09/27/50	002	25000	1.0	01S11E29	
MISSION CREEK	09/04/52	002	10000	1.0	01S11E29	
SACAJAWEA PARK LA	05/01/51	001	3000	5.0	02S09E24	
SACAJAWEA PARK LA	06/25/63	001	792	9.0	02S09E24	
SACAJAWEA PARK LA	07/13/63	001	264	9.0	02S09E24	
SACAJAWEA PARK LA	06/02/81	A001	518	9.0	02S09E24	
SACAJAWEA PARK LA	07/15/81	A001	504	9.0	02S09E24	
SACAJAWEA PARK LA	09/14/81	G001	128	23.0	02S09E24	
SACAJAWEA PARK LA	09/10/81	T001	1071	12.0	02S09E24	
SACAJAWEA PARK LA	04/26/82	M013	102	20.0	02S09E24	
SACAJAWEA PARK LA	08/11/82	A001	500	9.0	02S09E24	
SACAJAWEA PARK LA	09/08/82	A001	1600	9.0	02S09E24	
SACAJAWEA PARK LA	01/20/82	A001	1200	14.0	02S09E24	

Table 1. Continued.

Water name	Plant date	Species code	Number	Average length	Location	Marks
SACAJAWEA PARK LA	03/11/82	A001	158	24.0	02S09E24	
SACAJAWEA PARK LA	03/11/82	M001	200	18.0	02S09E24	
SACAJAWEA PARK LA	07/13/82	T001	304	21.0	02S09E24	
SACAJAWEA PARK LA	07/13/82	T001	151	25.0	02S09E24	
SACAJAWEA PARK LA	05/20/83	M013	100	22.0	02S09E24	
SACAJAWEA PARK LA	06/28/83	A001	756	9.0	02S09E24	
SACAJAWEA PARK LA	08/29/83	A001	748	10.0	02S09E24	
SACAJAWEA PARK LA	10/04/83	T001	60	31.0	02S09E24	
SACAJAWEA PARK LA	04/26/83	M001	156	26.0	02S09E24	
SACAJAWEA PARK LA	04/26/83	M001	250	23.0	02S09E24	
SACAJAWEA PARK LA	07/18/84	A001	730	8.0	02S09E24	
SACAJAWEA PARK LA	08/09/84	A001	1110	9.0	02S09E24	
SACAJAWEA PARK LA	08/08/84	M013	497	15.0	02S09E24	
SACAJAWEA PARK LA	10/25/84	G001	200	20.0	02S09E24	
SACAJAWEA PARK LA	05/29/85	M013	125	22.0	02S09E24	
SACAJAWEA PARK LA	05/29/85	M013	102	22.0	02S09E24	
SACAJAWEA PARK LA	06/28/85	A001	2114	8.0	02S09E24	
SACAJAWEA PARK LA	06/24/86	A001	3000	5.0	02S09E24	
SACAJAWEA PARK LA	08/07/86	A001	502	8.0	02N09E24	
SACAJAWEA PARK LA	08/07/86	A001	502	8.0	02S09E24	
SACAJAWEA PARK LA	06/15/87	M013	79	22.0	02S09E24	
SACAJAWEA PARK LA	05/12/87	A001	1999	8.0	02S09E24	
SACAJAWEA PARK LA	08/07/87	A001	349	10.1	02S09E24	
SACAJAWEA PARK LA	08/07/87	A001	43	24.0	02S09E24	
SACAJAWEA PARK LA	06/21/88	M013	250	18.2	02S09E24	none
SACAJAWEA PARK LA	05/18/88	A001	1011	7.5	02S09E24	
SACAJAWEA PARK LA	06/10/88	A001	500	8.0	02S09E24	
SACAJAWEA PARK LA	08/05/88	A001	513	9.7	02S09E24	
SACAJAWEA PARK LA	06/13/89	M013	250	18.5	02S09E24	na
SACAJAWEA PARK LA	06/13/89	M013	250	18.5	02S09E24	na
SACAJAWEA PARK LA	06/29/89	M013	25	19.9	02S09E24	na
SACAJAWEA PARK LA	06/29/89	M013	54	18.5	02S09E24	na
SACAJAWEA PARK LA	05/03/89	A001	1045	7.2	02S09E24	
SACAJAWEA PARK LA	08/02/89	A001	1012	8.2	02S09E24	
SACAJAWEA PARK LA	06/13/89	M013	250	18.5	02S09E24	na
SACAJAWEA PARK LA	06/13/89	M013	250	18.5	02S09E24	na
SACAJAWEA PARK LA	06/29/89	M013	25	19.9	02S09E24	na
SACAJAWEA PARK LA	06/29/89	M013	54	18.5	02S09E24	na
SACAJAWEA PARK LA	05/03/89	A001	1045	7.2	02S09E24	
SACAJAWEA PARK LA	08/02/89	A001	1012	8.2	02S09E24	
SACAJAWEA PARK LA	06/05/90	M013	83	19.9	02S09E24	NONE
SACAJAWEA PARK LA	06/05/90	M013	92	17.5	02S09E24	NONE
SACAJAWEA PARK LA	06/12/90	M013	75	17.5	02S09E24	NONE
SACAJAWEA PARK LA	04/16/90	A001	1000	7.9	02S09E24	
SACAJAWEA PARK LA	06/26/90	A001	2035	7.2	02S09E24	
SACAJAWEA PARK LA	08/09/90	A001	1040	9.0	02S09E24	

Table 1. Continued.

Water name	Plant date	Species code	Number	Average length	Location	Marks
SACAJAWEA PARK LA	05/09/91	M013	100	20.1	02S09E24	NONE
SACAJAWEA PARK LA	06/12/91	M013	150	17.1	02S09E24	NONE
SACAJAWEA PARK LA	04/19/91	A001	1015	7.6	02S09E24	
SACAJAWEA PARK LA	08/06/91	A001	1002	9.4	02S09E24	
SIXMILE CREEK	08/08/28	002	8750	1.0	06S08E08	
SIXMILE CREEK	08/08/28	002	17500	1.0	06S08E08	
SIXMILE CREEK	08/08/28	002	8750	1.0	06S08E08	
SIXMILE CREEK	10/13/31	002	16896	2.0	06S08E08	
SIXMILE CREEK	09/10/36	013	24800	0.0	06S08E08	
SIXMILE CREEK	10/02/37	013	11904	0.0	06S08E08	
SIXMILE CREEK	09/02/38	013	21450	0.0	06S08E08	
SIXMILE CREEK	08/08/39	013	1630	5.0	06S08E08	
SIXMILE CREEK	09/19/39	013	24450	0.0	06S08E08	
SIXMILE CREEK	09/19/40	013	127500	0.0	06S08E08	
SIXMILE CREEK	08/11/41	013	4140	5.0	06S08E08	
SIXMILE CREEK	08/31/42	013	10000	6.0	06S08E08	
SIXMILE CREEK	09/09/43	013	4500	6.0	06S08E08	
SIXMILE CREEK	08/22/44	013	8000	5.0	06S08E08	
SIXMILE CREEK	10/11/45	002	21000	2.0	06S08E08	
SIXMILE CREEK	08/15/46	002	3940	4.0	06S08E08	
SIXMILE CREEK	09/17/49	002	10000	1.0	06S08E08	
SIXMILE CREEK	08/06/53	002	3000	3.0	06S08E08	
SIXMILE CREEK	07/07/54	002	3050	3.0	06S08E08	
SIXMILE CREEK	09/20/54	002	15664	1.0	06S08E08	
SIXMILE CREEK	08/17/57	002	7572	1.0	06S08E08	
SIXMILE CREEK	06/27/58	002	1530	0.0	06S08E20	
SIXMILE CREEK	07/20/59	002	1504	0.0	06S08E20	
SIXMILE CREEK	06/30/61	013	2220	0.0	06S08E00	
SIXMILE CREEK	07/23/62	013	1503	7.0	07S08E09	
SIXMILE CREEK	04/24/64	001	1500	7.0	06S08E00	

METHODS

Shields River and Large Tributaries

In the Shields River and large tributaries electrofishing was done with a 220 volt generator and VVP unit either placed in a boat or along the edge of the stream with 500 feet of cord attached to the anode. These techniques were used in Mill Creek (tributary to the Yellowstone) and the two Shields River sections. Prior to 1989, estimates were done in both Shields River sections during the spring and fall. The Convict Grade and Zimmerman sections of the Shields River were sampled during the springs of 1991 and 1992. The Zimmerman Section was also sampled during the fall of 1992.

Small Tributaries

A generator powered backpack electrofisher (Coffelt BP1C) was used in all small tributaries. Tributaries to the upper Yellowstone sampled were Fleshman, Little Mission, Mill, Mill Fork Mission, Sixmile, and the West Fork of Mill creeks. Two sections were done in each of Fleshman, Little Mission, Mill Fork Mission, and Sixmile creeks. Two electrofishing passes were made in all creek sections except for the upper section in Mill Fork Mission Creek (Table 2). The Fleshman Creek sections were located in the old Fleshman Creek channel of the Yellowstone River below Sacajawea Lagoon. In the Little Mission sections two separate estimates were made in 1991. One in the early summer (July 11) and one in the late summer (August 15) to determine if fish were moving between sections.

Mill Creek Study

Shepard (1991) explained the rationale for the Mill Creek study and described the sample sections. In Mill Creek four sections were electrofished in 1991 and 1992 (Table 2 and Figure 4). These sample sections were originally selected to evaluate the enhancement of winter habitat proposed by the Forest Service. During the summer of 1991 a wildfire, called the Thompson Creek Fire, burnt approximately 7,700 acres in the Mill Creek drainage (U.S. Forest Service letter requesting comments on Thompson Creek Fire Recovery Project Proposal, October 30, 1991). In addition to the above four sections one 1,000 foot section in the West Fork of Mill Creek was sampled in 1992.

Table 2. Sample sections of streams within the upper Yellowstone River basin electrofished during 1991 and 1992.

Stream	Section	Legal description	Length of section (ft)	Estimate type[1]/
Fleshman	Enterprise	T02SR09E;13DA	1,000	M-R
	St. Mary's	T02SR10E;18BC	1,000	M-R
Little Mission	Above F.S.	T03NR11E;14BA	700	2-pass
	Below F.S.	T03NR11E;11CD	700	2-pass
Mill Fork Mission	Cabin	T02SR11E;32DD	300	2-pass
	Trailhead	T03SR11E;04BD	360	1-pass
Mill	Debris	T06SR10E;29DC	1,000	M-R
	Pools	T06SR10E;19BC	1,000	M-R
	Mogen	T06SR10E;19DD	1,000	M-R
	Log Jam	T06SR10E;19CD	1,000	M-R
Mission	Triangle 7	T02SR11E;33BA	550	M-R
Sixmile	Bridge	T06SR08E;32AB	1,000	M-R
	Horsethief	T07SR08E;09DB	1,000	M-R
West Fork Mill	Bridge	T06SR09E;25BB	1,000	M-R

[1]/ Estimate types are: 1-pass = catch per unit effort in one electrofishing pass; 2-pass = two pass using the MICROFISH program of Van Deventer and Platts (1986); M-R = mark-recapture using MDFWP's MRSYS program (Merry 1987).

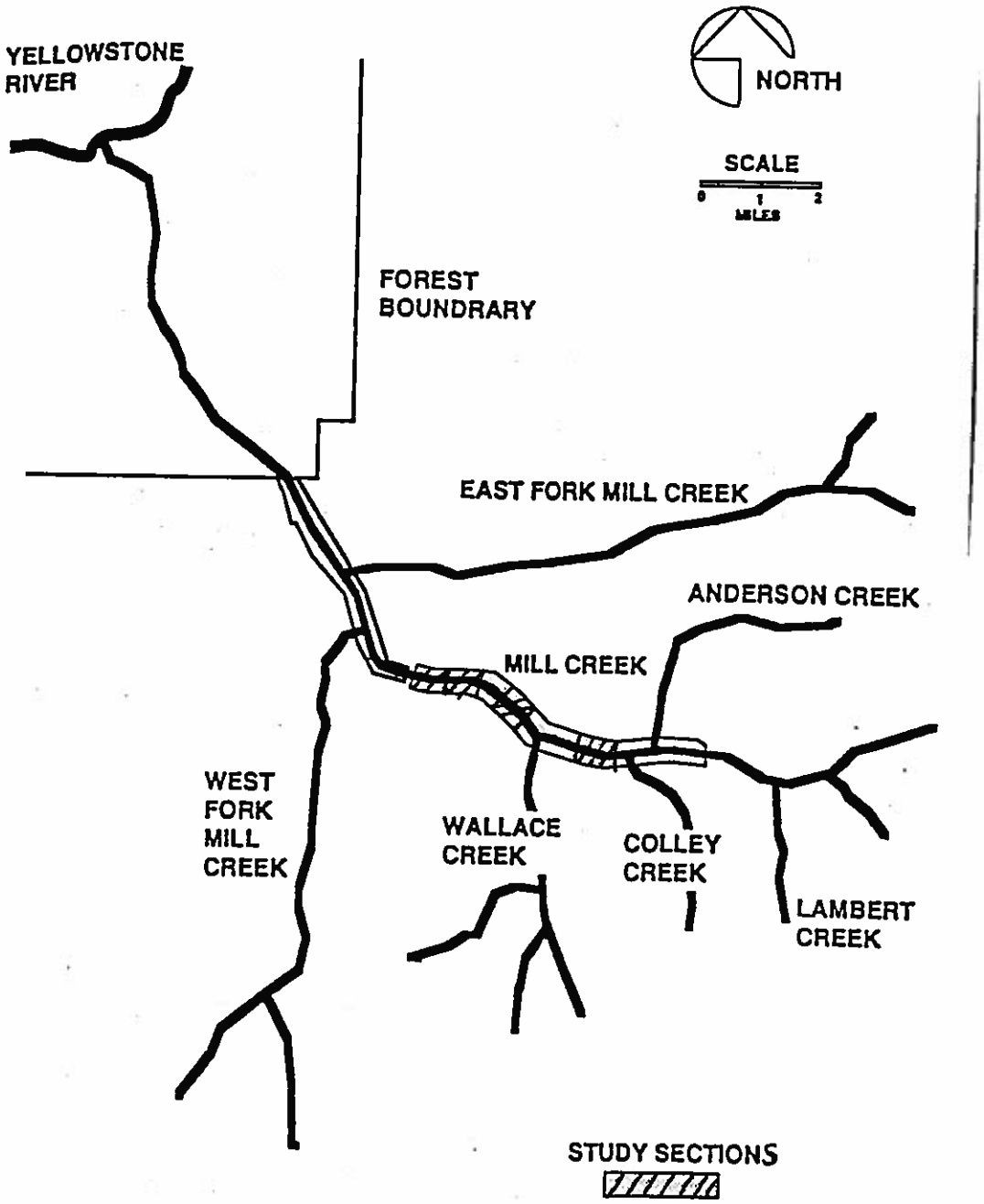


Figure 4. Map of Mill Creek showing the four electrofishing sections sampled during 1991 and 1992 (modified from Inter-fluve, Inc. 1989).

Fish Parameters

All captured fish were weighed to the nearest 0.01 pound and measured to the nearest 0.1 inch. Where mark-recapture estimates were conducted, fish were marked with a fin clip on the marking run and re-examined for marks during the recapture run. Where two-pass estimates were conducted, fish captured during the first pass were held in a live car during the second electrofishing pass. The relative abundance of fish at all sample sites was made by expanding the catch in one electrofishing pass to the number of fish which would be captured in one electrofishing pass within a 1,000 foot linear segment of stream.

In the Zimmerman section of the Shields River brown trout 5.0 to 8.0 inches in length, known to be age I during the fall and age II during the spring, were fin clipped with three separate fin clips (adipose, left pelvic, and right pelvic) to identify them as "known-age" fish. Recaptured fin clipped fish were aged and average lengths of these "known age" fish were calculated by age.

Data Analysis

Length frequency histograms were plotted for all sample sections where more than ten fish were captured using MDFWP's LENGTHGP.PRG program and Harvard Graphics software, version 2.0 (Software Publishing Corporation 1987). Average lengths and weights and their associated ranges and standard deviations were calculated. Mark-recapture population estimates were calculated using the Mark/Recapture system (MRSYS Version 1.2) software developed by MDFWP (Merry 1987). Two-pass fish population estimates were calculated using a maximum likelihood estimator within the MICROFISH population estimation software (Van Deventer and Platts 1986). While processing captured fish in Mill and Little Mission creeks, previously implanted visible implant (VI) tags were noted and new VI tags were implanted into most of the fish during 1992 to continue assessing seasonal movement patterns.

RESULTS AND DISCUSSION

Shields River

Convict Grade Section

Population estimates of brown trout in the 7,724 foot long Convict Grade Section were 202 (80% CI: ± 42) in 1991 and 195 (80% CI: ± 42) in 1992. The number of brown trout 10 inches and longer per 1,000 feet of river were 23 in 1991 and 22 in 1992 (Figure 5). This reflects a slight decline from populations observed in 1990 and a continuation of a population decline since 1988, probably a result of poor recruitment from fish spawned during 1987 and 1988 which emerged in 1988 and 1989. The low numbers of fish 7 to 10 inches in the population from 1989 to 1992 indicates poor recruitment (Figure 5). The number of brown trout longer than 14 inches has remained relatively stable (Figure 5).

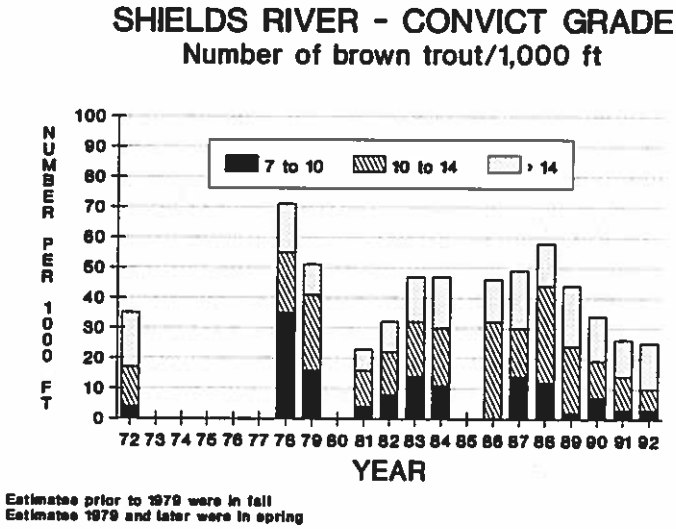


Figure 5. Estimated number of brown trout 7.0 inches and longer per 1,000 feet of river in the Convict Grade Section of the Shields River from 1972 to 1990. Estimates made prior to 1979 were made in the fall and estimates for 1979 and later were made in the spring.

Length frequency plots of brown trout captured in 1991 and 1992 showed that few fish under 9.0 inches (assumed to be age II) were captured, but a relatively strong class was seen for fish from 8.5 to 12.0 inches (assumed to be age III) in 1991 (Figure 6). In 1992 brown trout 9.0 to 12.0 inches were present, but at relatively low densities. The relatively strong 8.5 to 12.0 inch (age III) class of 1991 carried through to 1992, as seen by the relatively high number of 13.0 to 15.5 inch (age IV) fish.

Population estimates of rainbow trout in the Convict Grade Section included some rainbow trout spawners which move into the lower Shields River from the Yellowstone River to spawn. Due to this spawning movement, population estimates for rainbow trout must be considered positively biased and would be expected to be variable between years. The number of rainbow trout residents in the Convict Grade Section are likely much lower than the estimates indicate, especially for fish over 12 inches. This 7,724 foot long section contained an estimated 662 rainbow trout (80% CI: $\pm$ 172) in 1991 and 392 rainbow trout (80% CI: $\pm$ 82) in 1992. The section supported an estimated density of approximately 44 rainbow trout 10 inches and longer per 1,000 feet of river in 1991 and 40 in 1992 (Figure 7). Densities were the highest recorded in 1991 due to a relatively high abundance of fish 7 to 10 inches in length (Figures 7 and 8). This increase may be due to good recruitment of rainbow trout within the Shields River in 1988 and 1989, or movement by young rainbow trout into the lower Shields River from the Yellowstone River, or increased survival of rainbow trout as a consequence of lower numbers of brown trout, or any combination of the above.

Length frequency histograms for rainbow trout captured in 1991 illustrated a strong 8.0 to 11.0 length group (Figure 8). This strong 1991 8.0 to 11.0 length class carried through to 1992 as evidenced by the numbers of fish captured in the 11.5 to 13.5 length group in 1992 (Figure 8). It may be that because brown trout recruitment in 1988 and 1989 was poor, in response to low winter flows, survival of the 1988 and 1989 year classes of rainbow trout was higher than under the usual situation of relatively high juvenile brown trout densities.

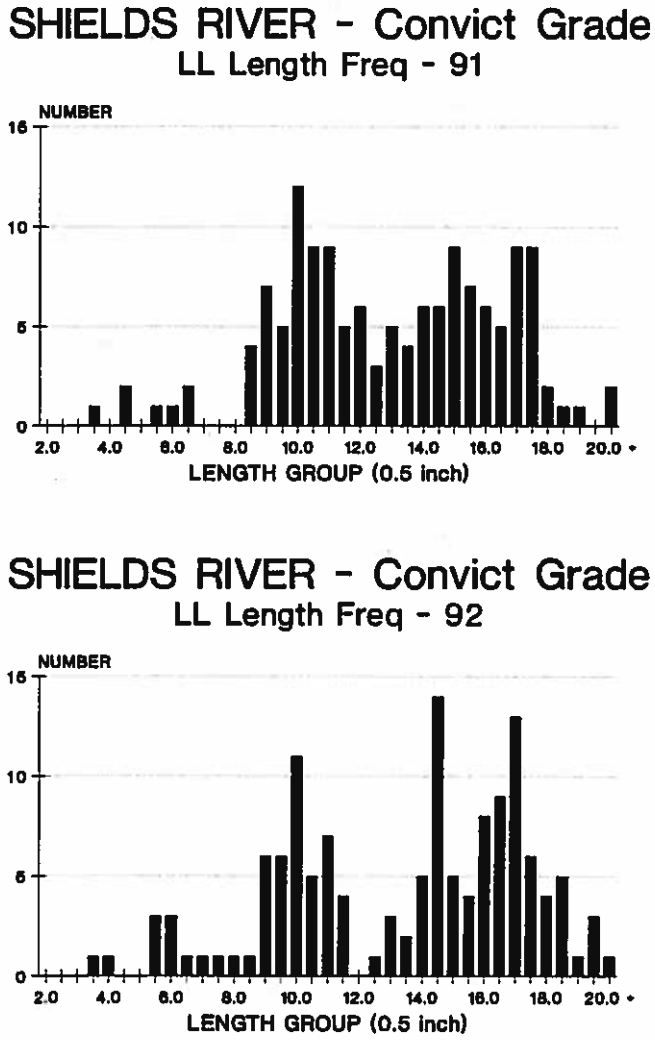


Figure 6. Length frequency histograms for brown trout captured in the Convict Grade Section of the Shields River in 1991 (top) and 1992 (bottom).

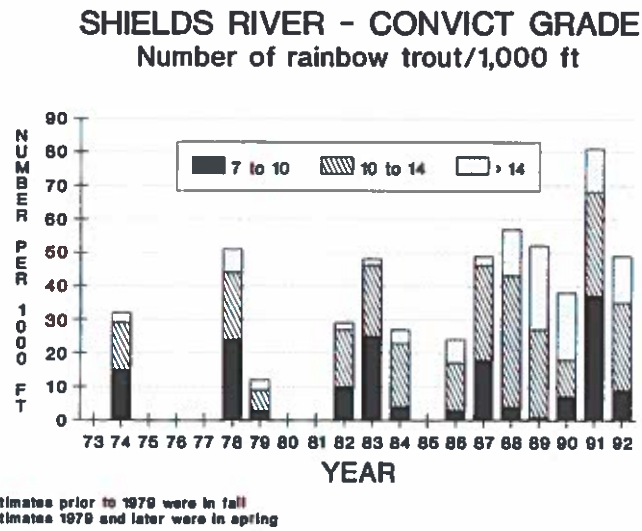


Figure 7. Estimated number of rainbow trout 7.0 inches and longer per 1,000 feet in the Convict Grade Section of the Shields River from 1974 to 1992. Estimates made prior to 1979 were made in the fall and estimates for 1979 and later were made in the spring.

Population estimates of mountain whitefish in the 7,724 foot long Convict Grade Section were 3,634 (80% CI: ± 1,002) in 1991 and 2,311 (80% CI: ± 339) in 1992. The number of mountain whitefish 10 inches and longer per 1,000 feet of river were 236 in 1991 and 146 in 1992 (Figure 9). Mountain whitefish densities in 1991 and 1992 appeared to be slightly lower than the long-term average since 1972 (Figure 9). In 1989 densities of whitefish were very high, probably related to movement as discussed by Shepard (1991). Length frequency histograms for whitefish captured in 1991 and 1992 showed relatively stable populations with fair recruitment of fish 7.0 to 9.0 inches (Figure 10).

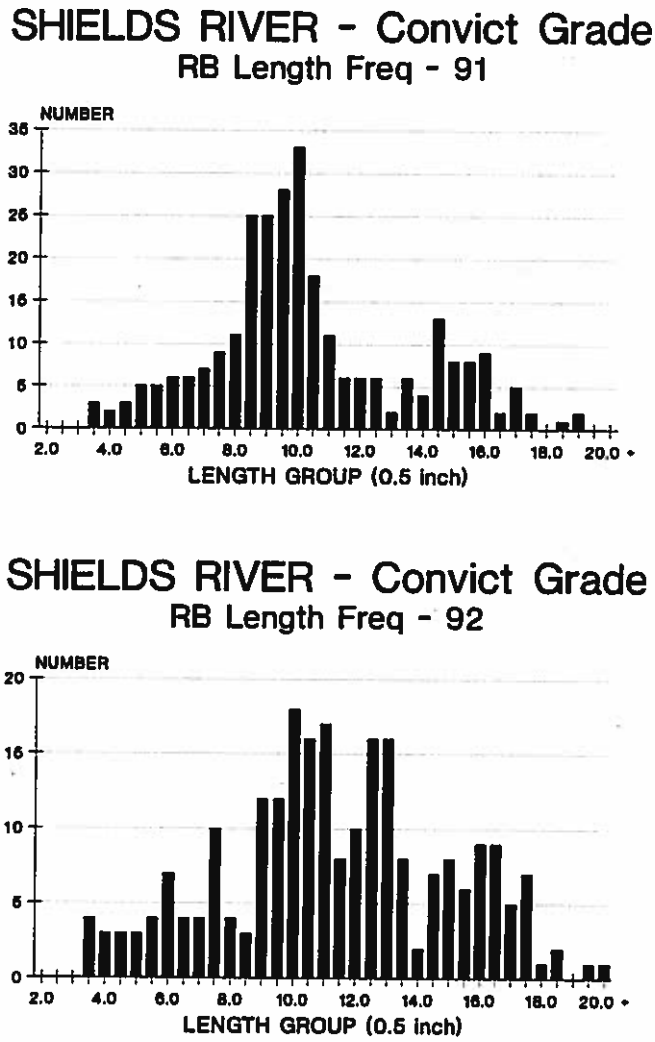


Figure 8. Length frequency histograms for rainbow trout captured in the Convict Grade Section of the Shields River in 1991 (top) and 1992 (bottom).

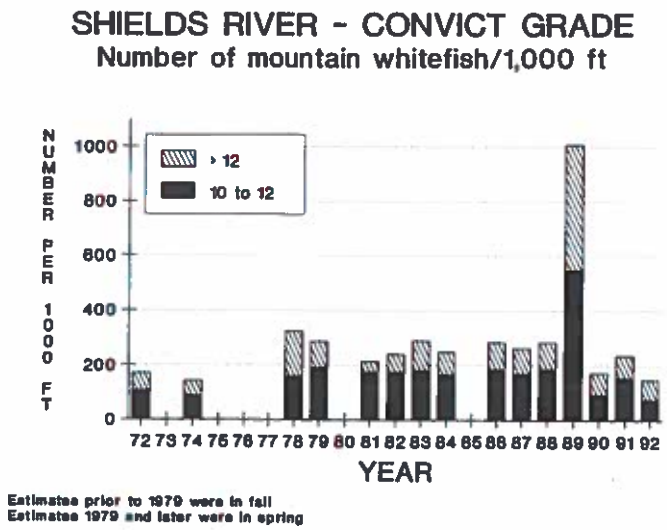


Figure 9. Estimated number of mountain whitefish 10.0 inches and longer per 1,000 feet of river in the Convict Grade Section of the Shields River from 1972 to 1992. Estimates made prior to 1979 were made in the fall and estimates for 1979 and later were made in the spring.

Marelius Section

The 7,800 feet long Marelius Section of the Shields River supported an estimated 147 brown trout 8.5 to 24.0 inches (80% CI: ± 18) and 176 mountain whitefish 7.0 to 19.0 inches (80% CI: ± 27) in 1991. The length frequency histogram for captured brown trout illustrated that few young (< 13.5 inches) brown trout resided within the section (Figure 11). More mountain whitefish larger than 14 inches were captured in the Marelius Section than in the Convict Grade Section (Figure 12 versus 10). Nineteen Yellowstone cutthroat trout were captured during the sampling, but no marked cutthroat trout were recaptured, therefore, no population estimate could be made (Figure 13). This section supported similar densities of brown trout longer than 14 inches as the Convict Grade Section (10/1,000 feet versus 12/1,000 feet)in 1991. Landowners along this section had complained that harvest had increased dramatically due to the stream access law, but population data do not support their contention. Habitat appeared to be in poor condition in the Marelius Section due to livestock and flood damage.

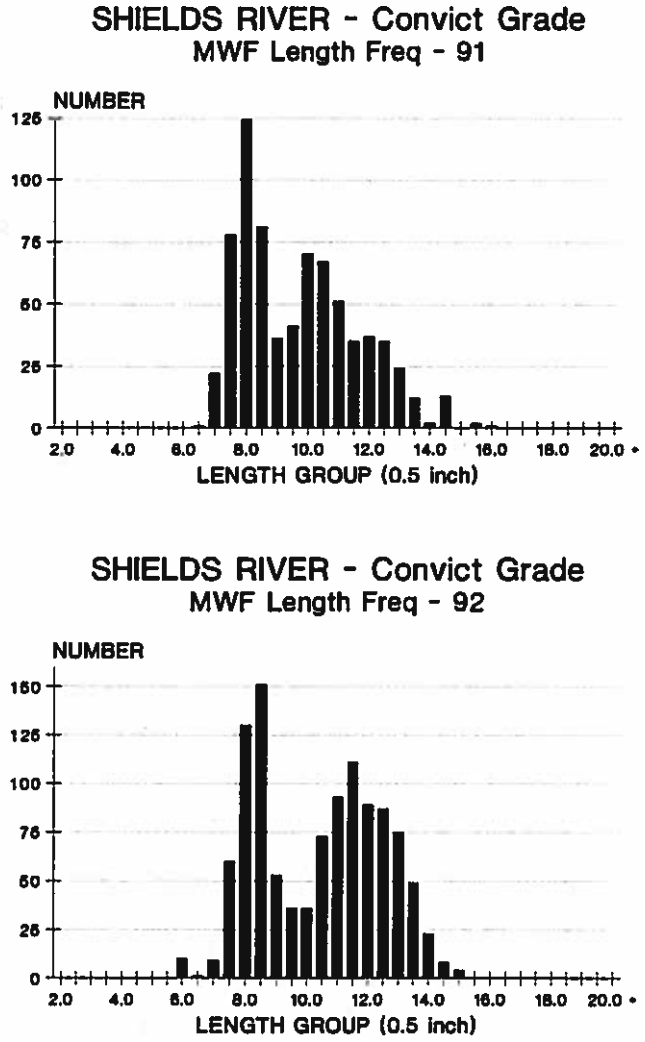


Figure 10. Length frequency histograms for mountain whitefish captured in the Convict Grade Section of the Shields River during 1991 (top) and 1992 (bottom).

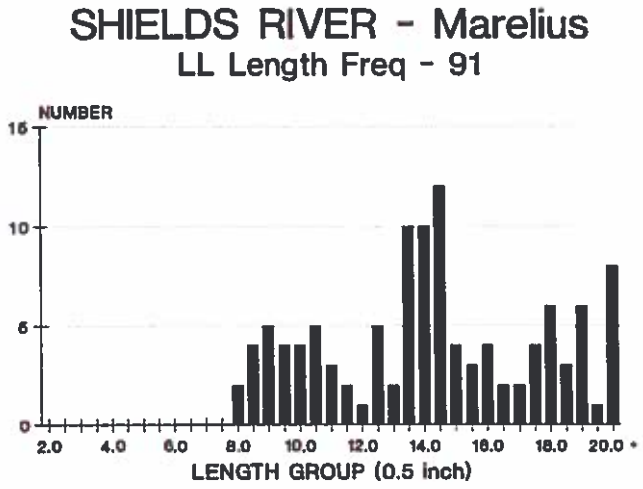


Figure 11. Length frequency histogram for brown trout captured in the Marelius Section of the Shields River during 1991.

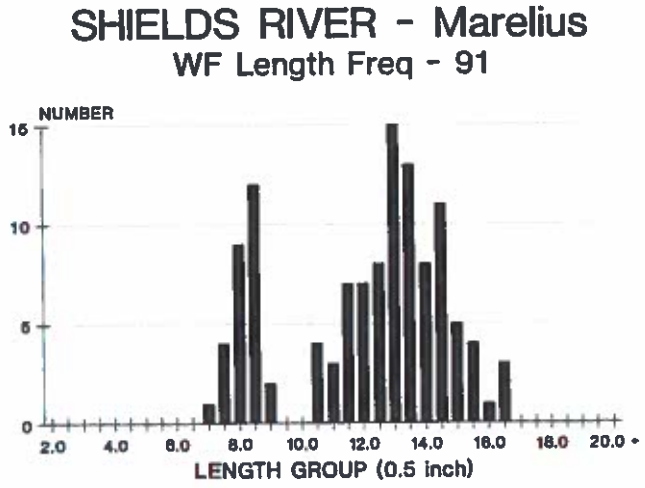


Figure 12. Length frequency histogram for mountain whitefish captured in the Marelius Section of the Shields River during 1991.

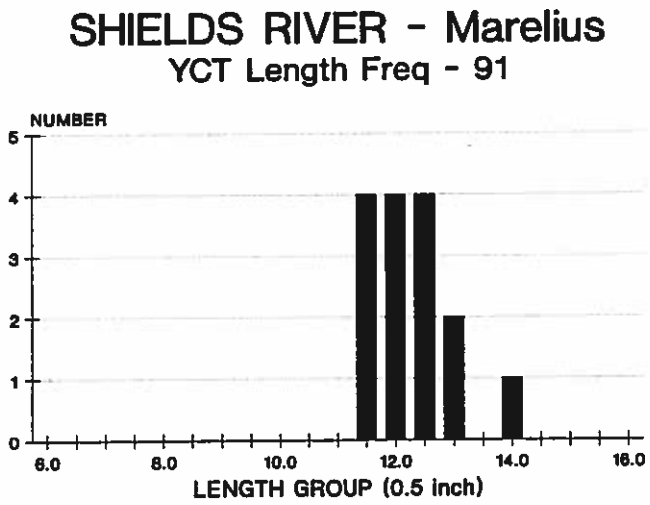


Figure 13. Length frequency histogram for Yellowstone cutthroat trout captured in the Marelius Section of the Shields River during 1991.

Zimmerman Section

Population estimates of brown trout in the 3,102 foot long Zimmerman Section were 716 (80%CI: ± 101) in 1991 and 322 (80% CI: ± 64) in 1992. The number of brown trout 10 inches and longer per 1,000 feet of river were 112 in 1991 and 76 in 1992 (Figure 14). This section supported the highest density of brown trout recorded in the spring of 1991 with relatively high numbers of all length groups (Figure 14). In 1992 the population of brown trout dropped with numbers of fish 7 to 10 inches and longer than 14 inches dropping the most (Figure 14).

Length frequency histograms for brown trout captured in 1991 and 1992 illustrated that fish 6.0 to 9.0 inches were relatively abundant in 1991, but were relatively scarce in 1992 (Figure 15). A possible explanation for the reduced numbers of this length group could be that in the summer of 1991 a major bank stabilization project by a private landowner along this portion of the river was done with an approximately 0.5 mile segment de-watered during construction.

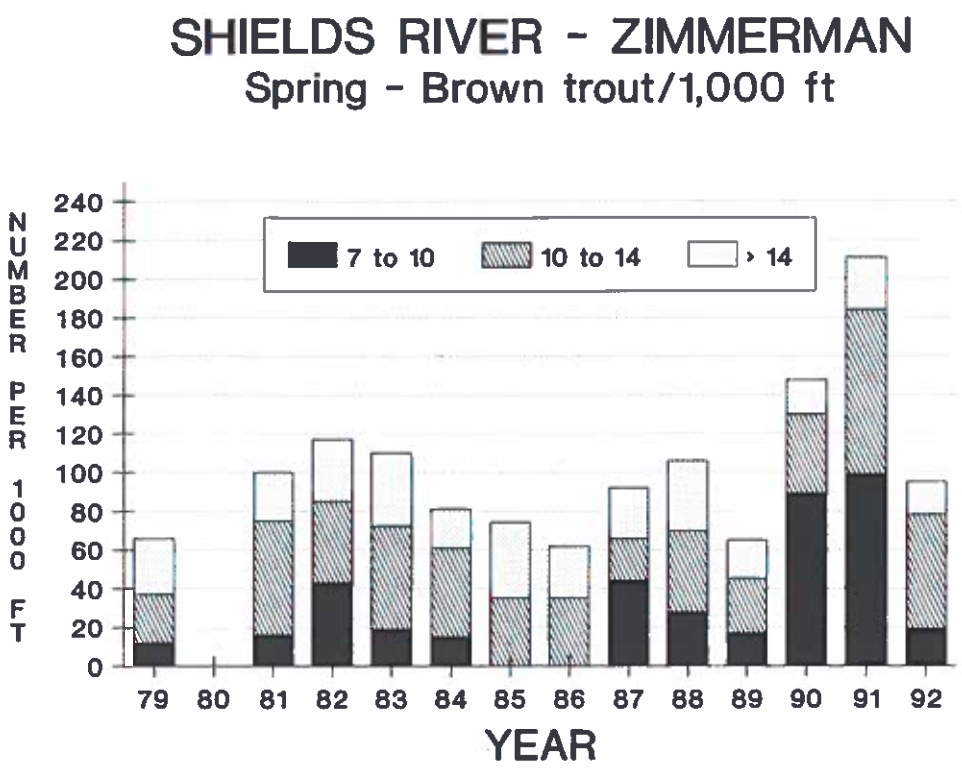


Figure 14. Estimated number of brown trout 7.0 inches and longer per 1,000 feet of river in the Zimmerman Section of the Shields River in the spring from 1979 to 1992.

Brown trout fin-clipped as age II (5.0 to 8.0 inches) grew approximately 4 inches between 1990 and 1991 and about 3.5 inches between 1991 and 1992 (Table 3). Age II brown trout may have grown slower between 1991 and 1992 because habitat conditions for age II brown trout in 1991 were impacted by the stream bank stabilization project de-watering mentioned above, or due to colder water temperatures in 1991 versus 1990. Unfortunately, there is no water temperature data for these two years.

The 1992 fall estimate was 482 brown trout 7.0 to 22.5 inches (80% CI: ± 71). This estimate was positively biased because mature spawning brown trout were moving into and out of the section between the mark and recapture electrofishings. This estimate is similar to the spring estimate, especially for fish 7.0 to 14.0 inches long (Figures 14 versus 16). No attempt was made to estimate the numbers of mountain whitefish during fall sampling.

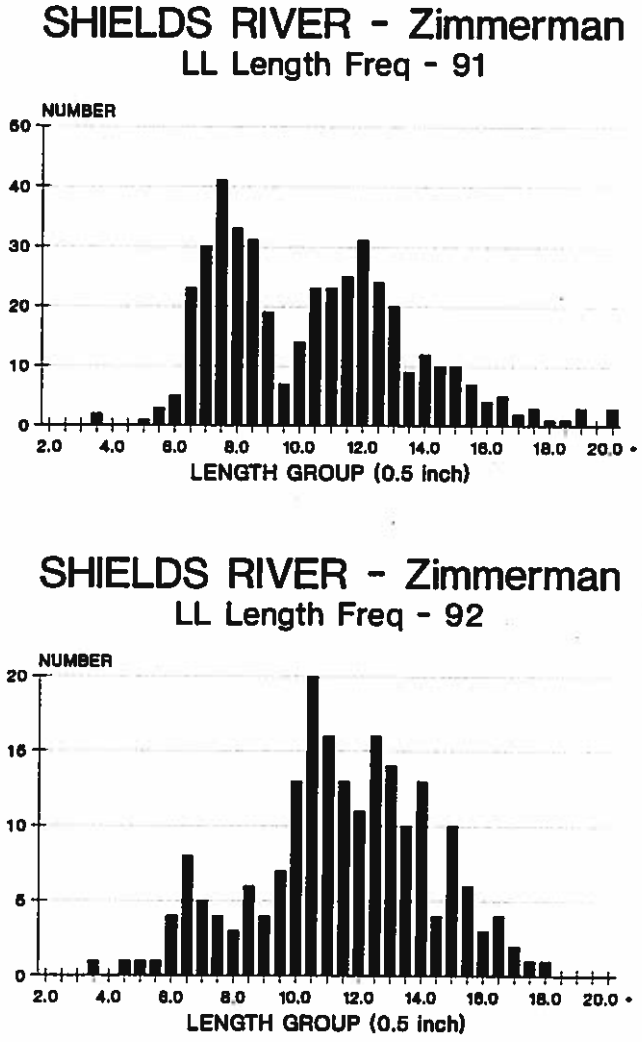


Figure 15. Length frequency histograms for brown trout captured in the Zimmerman Section of the Shields River in 1991 (top) and 1992 (bottom).

Table 3. Average length (inches) of "known-age" brown trout marked as either age I during fall sampling or age II during spring sampling and recaptured later in the Zimmerman Section of the Shields River from 1982 to 1992. Numbers in parentheses indicate sample sizes. Year classes can be followed along diagonals.

Year	Average length (in) at age					
	II[1]/	III	IV	V	VI	VII
1982	7.5 (9)	10.4 (5)				
1983	6.9 (9)	10.9 (15)	12.8 (5)			
1984	7.3 (11)	10.6 (11)	12.8 (6)	13.2 (3)		
1985	8.2 (1)	11.1 (9)	12.0 (4)			
1986	-	10.9 (7)	12.8 (6)	13.4 (2)	15.9 (1)	15.3 (1)
1987	7.4 (11)	11.1 (5)	12.9 (5)	14.9 (4)		
1988	7.4 (3)	11.6 (11)	12.8 (2)	14.3 (4)		
1989	7.1 (18)	10.9 (4)	13.7 (4)	13.6 (1)	15.0 (3)	15.4 (1)
1990	7.2 (72)	11.5 (4)	-	14.4 (3)	-	15.1 (1)
1991	7.2 (108)	11.1 (11)	13.7 (4)	14.7 (3)	15.0 (2)	-
1992	6.9 (24)	10.4 (19)	13.8 (2)	14.1 (3)	16.3 (1)	-
Averages[2]/	7.3 (44)	10.9 (101)	12.9 (38)	14.2 (23)	15.3 (7)	15.3 (3)

[1]/ From 1982 to 1988 age I fish (5.0 to 8.0 inches) were clipped during fall sampling and average length of age II fish represent fish clipped as age I the previous fall. From 1989 on, no fall sampling was done and the mean size of age II fish represent the average length of fish clipped during that year.

[2]/ Average length for age II fish do not include lengths from fish clipped as age II during the spring after 1989.

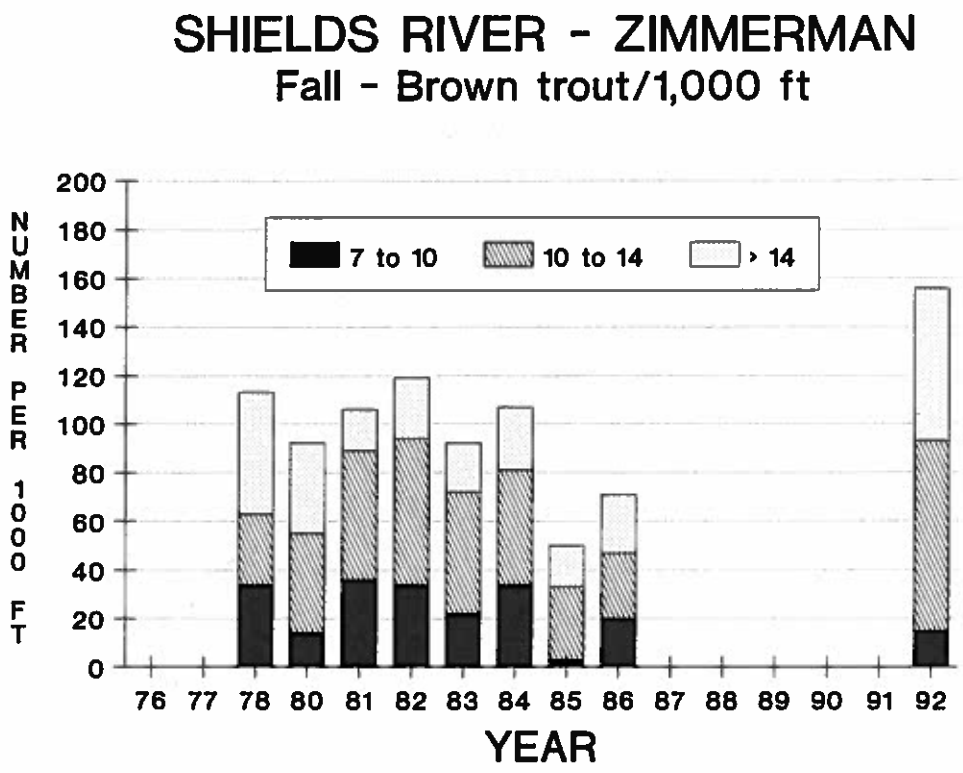


Figure 16. Estimated number of brown trout 7.0 inches and longer per 1,000 feet in the Zimmerman Section of the Shields River during the fall from 1978 to 1992.

Population estimates of mountain whitefish in the 3,201 foot long Zimmerman Section were 642 (80%CI: ± 135) in 1991 and 468 (80% CI: ± 209) in 1992. The number of mountain whitefish 10 inches and longer per 1,000 feet of river were 88 in 1991 and 150 in 1992 (Figure 17). It appears that whitefish numbers in this section are re-building after crashing in 1989 following the 1988 drought, but have not yet reached pre-drought levels (Figure 17). The whitefish population appeared to be much more sensitive to the drought conditions of 1987 and 1988 than the trout populations.

Length frequency histograms for whitefish captured in 1991 and 1992 showed a relatively strong 6.5 to 9.5 length class in 1991, but a weak length class for this group in 1992 (Figure 18). This difference may be due to the de-watering and construction conducted during the summer of 1991. The strong 6.5 to 9.5 length group in 1991 carried through to 1992 as seen in the relatively strong 9.5 to 11.5 length group. Few whitefish over 14.5 inches were captured in either year.

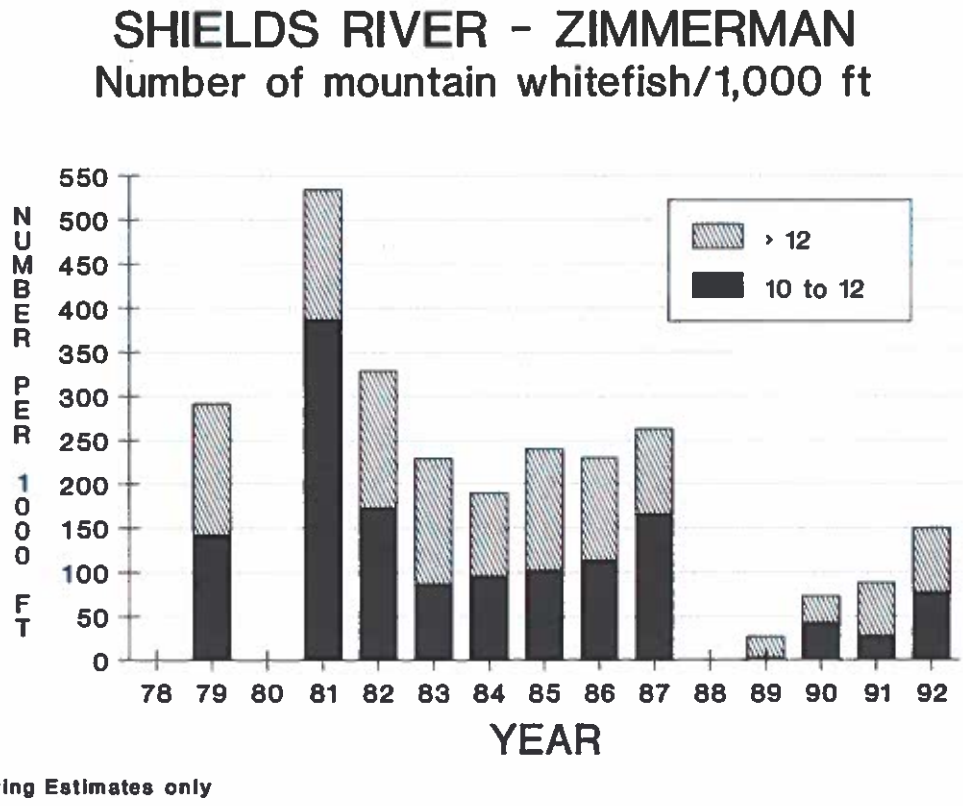


Figure 17. Estimated number of mountain whitefish 10.0 inches and longer per 1,000 feet of river in the Zimmerman Section of the Shields River from 1979 to 1992.

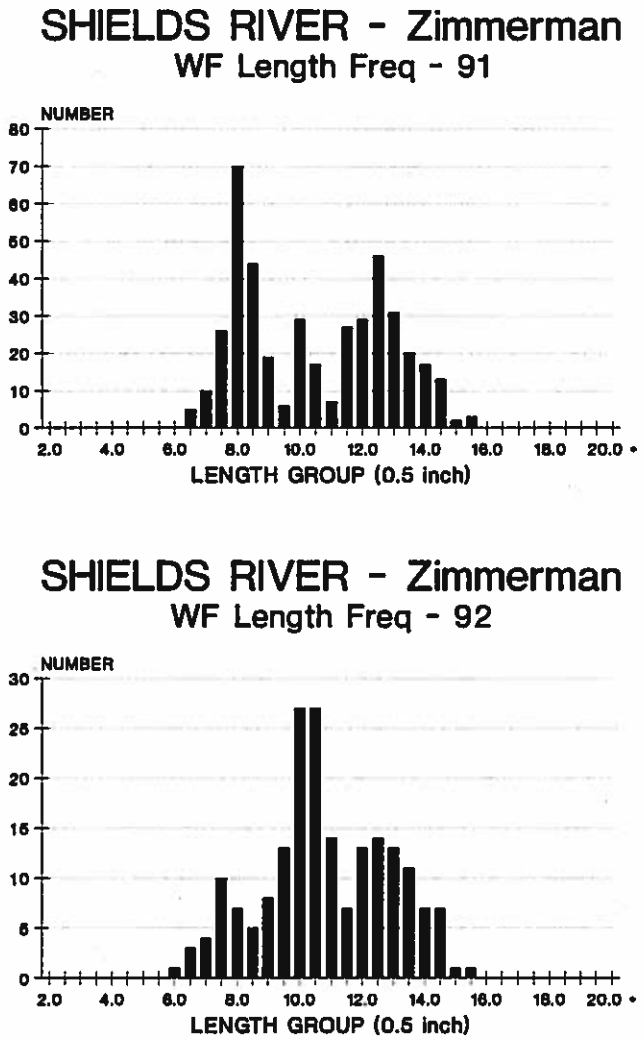


Figure 18. Length frequency histograms for mountain whitefish captured in the Zimmerman Section of the Shields River in 1991 (top) and 1992 (bottom).

Fleshman Creek

Fleshman Creek flows into the Yellowstone River near Ninth Street in Livingston, Montana. A portion of Fleshman Creek is also diverted into Sacajawea Lagoon which was originally created in 1939 and rehabilitated in 1980. The outflow of Sacajawea Lagoon is now called Fleshman Creek even though this channel was a historic Yellowstone River channel. During rehabilitation the channel below the lagoon was entirely de-watered. The channel immediately below the dam was rehabilitated during the renovation of the lagoon by placing sediments dredged from the lagoon adjacent to the channel to lengthen the channel by creating a series of meander bends with a narrower and deeper channel cross-section than the original channel.

Two sections of Fleshman Creek below Sacajawea Lagoon were originally sampled by Clancey (1983) and re-sampled by Clancy (1985) to evaluate the impacts of rehabilitation of the Sacajawea Lagoon and Fleshman Creek on fish populations in Fleshman Creek. Monitoring these two sections documented the recovery of salmonid populations following de-watering. One sample section is located immediately below the Lagoon and is called the "Enterprise" Section because it flows past the Enterprise newspaper building. The other section is located about 0.5 mile below Sacajawea Lagoon and runs from "F" Street to "H" Street. This section is called "St. Mary's" Section because it flows past the St. Mary's school.

Enterprise Section

On September 5 and 19, 1991 a 1,350 foot long section of Fleshman Creek below Sacajawea Lagoon was electrofished to estimate salmonid populations (Table 4). A total of 102 brown trout, 63 rainbow trout, 61 mountain whitefish, and three Yellowstone cutthroat trout were captured (Figure 19). The brown trout averaged 9.9 inches (range: 6.1-14.8) and 0.42 pounds. The rainbow trout averaged 9.0 inches (range: 4.5-14.7) and 0.29 pounds. The whitefish averaged 10.4 inches (range: 6.0-14.5) and 0.45 pounds. The cutthroat trout averaged 6.8 inches (range: 5.7-7.8) and 0.11 pounds. Length frequency histograms for brown and rainbow trout and mountain whitefish illustrated that the brown trout and whitefish populations consisted of several length (age) groups, while the rainbow trout were dominated by a single 7.0 to 10.0 inch length group (Figure 19). Most of the rainbow trout probably originated from hatchery releases of rainbow into

Table 4. Summary of electrofishing information for the Enterprise Section (T02S;R09E;Sec13DB) of Fleshman Creek including stream, legal description of sample site, date electrofished, species (YCT = Yellowstone cutthroat trout, RB = rainbow trout, LL = brown trout, RBxYCT = hybrid between rainbow and cutthroat trout, EBT = eastern brook trout, LNS = longnose sucker, MWF = mountain whitefish), total number of fish captured in first pass (and standardized to number captured per 1,000 feet of stream length), number of fish 6 inches and longer captured in first pass (and standardized to number captured per 1,000 feet of stream length), estimated total number of fish, estimated number of fish 6 inches and longer, and average length (in) and weight for captured fish.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1		Estimated number		Average length (range)	Average weight (range)
			Total (range) #/1,000'	6 in + (range) #/1,000'	Total (range) #/1,000'	6 in + (range) #/1,000'		
FLESHMAN CREEK T02SR09E13DB (07/16/82)	1350	RB	42	42	73	73	8.4	0.28
			(6.6-13.8)		(6.0-13.8)		(6.6-13.8)	(0.12- 1.16)
			31	31	54	54		
		LL	25	25	48	48	7.7	0.22
			(6.5-11.7)		(6.0-11.7)		(6.5-11.7)	(0.11- 0.68)
			19	19	36	36		
		YCT	4	2	-	-	6.6	0.14
			(4.9- 9.0)				(4.9- 9.0)	(0.04- 0.30)
			3	1				
FLESHMAN CREEK T02SR09E13DB (07/28/83)	1350	RB	58	56	109	105	8.4	0.28
			(5.1-13.1)		(5.0-13.1)		(5.1-13.1)	(0.06- 1.02)
			43	41	81	78		
		LL	50	46	82	81	8.2	0.27
			(2.6-12.5)		(5.5-12.5)		(2.6-12.5)	(0.02- 0.80)
			37	34	61	60		
		YCT	4	3	-	-	6.0	0.10
			(5.0- 7.2)				(5.0- 7.2)	(0.08- 0.14)
			3	2				
		MWF	12	10	-	-	6.8	-
			(3.3- 8.1)				(3.3- 8.1)	
			9	7				
FLESHMAN CREEK T02SR09E13DB (09/12/84)	1350	RB	85	20	292	38	4.9	0.13
			(2.4-14.3)		(2.0-14.3)		(2.4-14.3)	(0.01- 1.04)
			63	15	216	28		
		LL	123	96	311	128	6.7	0.17
			(3.0-13.2)		(2.5-13.2)		(3.0-13.2)	(0.01- 0.84)
			91	71	230	95		
		YCT	4	2	-	-	6.6	0.14
			(4.9- 9.0)				(4.9- 9.0)	(0.04- 0.30)
			3	1				
		MWF	22	17	-	-	8.6	0.28
			(3.9-11.3)				(3.9-11.3)	(0.03- 0.52)
			16	13				

Table 4. Continued.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1: Total (range) #/1,000'	Number captured in pass 1: 6 in + (range) #/1,000'	Estimated number: Total (range) #/1,000'	Estimated number: 6 in + (range) #/1,000'	Average length (range)	Average weight (range)
FLESHMAN CREEK T02SR09E13DB (09/02/86)	1350	RB	29	29	59	59	8.4	0.31
			(6.1-13.8)		(6.0-13.8)		(6.1-13.8)	(0.10- 1.00)
			21	21	44	44		
		LL	46	46	67	37	10.4	0.49
			(6.5-14.6)		(6.5-14.6)		(6.5-14.6)	(0.12- 1.22)
			34	34	50	27		
FLESHMAN CREEK T02SR09E13DB (04/08/88)	1350	RB	40	34	81	73	8.8	0.38
			(4.3-16.4)		(5.0-16.4)		(4.3-16.4)	(0.04- 1.67)
			30	25	60	54		
		LL	84	80	148	148	9.7	0.40
			(4.7-15.3)		(6.0-15.3)		(4.7-15.3)	(0.05- 1.28)
			62	59	110	110		
		YCT	1	1	-	-	8.4	0.26
			(8.4- 8.4)				(8.4- 8.4)	(0.26- 0.26)
			1	1				
		MWF	29	29	42	42	11.1	0.54
			(9.8-12.7)		(9.5-12.7)		(9.8-12.7)	(0.37- 0.77)
			21	21	31	31		
FLESHMAN CREEK T02SR09E13DB (09/05/91)	1350	RB	36	34	88	88	9.0	0.29
			(4.5-14.7)		(7.0-14.7)		(4.5-14.7)	(0.05- 1.18)
			27	25	65	65		
		LL	71	71	111	111	9.9	0.42
			(6.1-14.8)		(6.0-14.8)		(6.1-14.8)	(0.08- 1.18)
			53	53	82	82		
		YCT	0	0	-	-	6.8	0.11
							(5.7- 7.8)	(0.06- 0.17)
			-	-				
		MWF	48	48	67	67	10.4	0.45
			(6.0-14.5)		(6.0-14.5)		(6.0-14.5)	(0.08- 1.04)
			36	36	50	50		

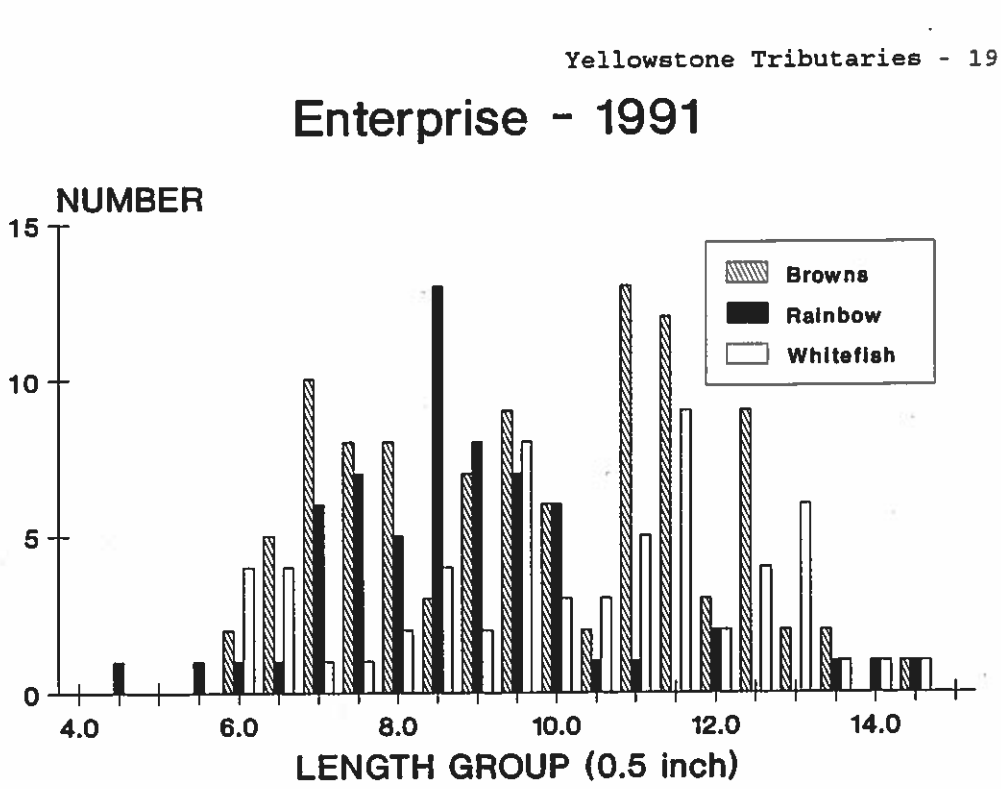


Figure 19. Length frequency histograms for brown and rainbow trout and mountain whitefish captured in the Enterprise Section of Fleshman Creek during September 1991.

In April 1988 this section supported an estimated 148 (SE: 11) brown trout 6.0 to 15.4 inches, 81 (SE: 10) rainbow trout 5.0 to 17.4 inches, and 42 (SE: 5) whitefish 9.5 to 12.5 inches (Table 4). In September 1986 this section supported an estimated 67 (SE: 5) brown trout 6.5 to 14.9 inches and 59 (SE: 13) rainbow trout 6.0 to 13.9 inches. In September 1984 this sections supported an estimated 105 (SE: 9) brown trout 7.0 to 15.4 inches and 39 (SE: 6) rainbow trout 5.0 to 14.4 inches. In July 1983 this section supported an estimated 82 (SE: 8) brown trout 5.5 to 12.9 inches and 110 (SE: 13) rainbow trout 5.0 to 14.9 inches. In July 1982 this section supported an estimated 48 (SE: 11) brown trout 6.0 to 11.9 inches and 73 (SE: 14) rainbow trout 6.0 to 13.9 inches. Clancey (1983) estimated this section supported only 4 brown trout 4.4 to 5.0 inches in 1981, following rehabilitation, and 64 brown trout 5.9 to 16.9 inches in 1980, prior to rehabilitation. Rainbow trout numbers were too low to estimate in either 1980 or 1981.

St. Mary's Section

On September 5 and 19, 1991 a 1,400 foot long section of Fleshman Creek below Sacajawea Lagoon was electrofished to estimate salmonid populations (Table 5). A total of 178 brown trout, 37 rainbow trout, and 7 Yellowstone cutthroat trout were captured (Figure 20). The brown trout averaged 9.6 inches (range: 5.0-14.8) and 0.36 pounds. The rainbow trout averaged 9.2 inches (range: 3.5-14.3) and 0.31 pounds. The cutthroat averaged 8.6 inches (range: 6.0-10.2) and 0.24 pounds. Length frequency histograms for brown and rainbow trout showed that the brown trout population consisted of several length (age) groups, while the rainbow trout were dominated by a single length group (Figure 20). As mentioned above, most of the rainbow trout probably originated from hatchery releases of rainbow into Sacajawea Lagoon (Table 1). This section supported an estimated 183 (SE: 4) brown trout 6.5 to 14.9 inches in length, 40 (SE: 3) rainbow trout 7.0 to 14.4 inches in length, and 7 (SE: 1) Yellowstone cutthroat trout 6.0 to 10.4 inches in length in 1991.

In April 1988 this section supported an estimated 181 (SE: 18) brown trout 5.0 to 14.4 inches and 101 (SE: 14) rainbow trout 5.0 to 17.4 inches (Table 5). In September 1986 this section supported an estimated 156 (SE: 12) brown trout 7.0 to 13.9 inches and 9 (SE: 1) rainbow trout 6.0 to 13.9 inches. In September 1984 this section supported an estimated 268 (SE: 10) brown trout 6.5 to 14.9 inches and 19 (SE: 3) rainbow trout 5.5 to 14.4 inches. In July 1983 this section supported an estimated 257 (SE: 32) brown trout 5.5 to 12.9 inches and 42 (SE: 10) rainbow trout 5.0 to 14.9 inches. In July 1982 this section supported an estimated 81 (SE: 8) brown trout 5.5 to 10.4 inches and 123 (SE: 32) rainbow trout 6.0 to 11.9 inches. Clancey (1983) estimated this section contained 79 brown trout 3.9 to 12.0 inches in 1981 and 86 brown trout 3.0 to 12.4 inches in 1980. Rainbow trout numbers were too low to estimate in either 1980 or 1981.

Trends in Populations

The number of brown trout 7.0 inches and longer per 1,000 feet of stream in both sections increased from 1982 to 1984 following rehabilitation (Figure 21). In 1986 the numbers of brown trout declined, but by 1991 brown trout numbers had rebounded to 1984 levels in the Enterprise Section and remained relatively stable in the St. Mary's Section (Figure 21). In April 1988 a record high number of brown trout were estimated to inhabit the Enterprise Section, while very low numbers inhabited

Table 5. Summary of electrofishing information for the St. Mary's (T02S;R10E;Sec18BD) Section of Fleshman Creek including stream, legal description of sample site, date electrofished, species (see Table 4 for codes plus 'WS' = white sucker), total number of fish captured in first pass (and standardized to number captured per 1,000 feet of stream length), number of fish 6 inches and longer captured in first pass (and standardized to number captured per 1,000 feet of stream length), estimated total number of fish, estimated number of fish 6 inches and longer, and average length (in) and weight for captured fish.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1		Estimated number		Average length (range)	Average weight (range)
			Total (range) #/1,000'	6 in + (range) #/1,000'	Total (range) #/1,000'	6 in + (range) #/1,000'		
FLESHMAN CREEK T02SR10E18 (11/10/76)	500	RB	1 (16.5-16.5) 2	1 2	-	-	16.5 (16.5-16.5)	1.66 (1.66- 1.66)
		LL	1 (9.5- 9.5) 2	1 2	-	-	9.5 (9.5- 9.5)	0.33 (0.33- 0.33)
		MWF	1 (7.8- 7.8) 2	1 2	-	-	7.8 (7.8- 7.8)	0.10 (0.10- 0.10)
		LNS	25 (4.4-12.0) 50	23 46	-	-	7.9 (4.4-12.0)	-
		WS	93 (4.0-12.8) 186	68 136	-	-	7.8 (4.0-12.8)	-
FLESHMAN CREEK T02SR10E18BD (07/16/82)	1400	RB	42 (6.3-10.2) 30	42 30	123 (6.0-10.2) 88	123 88	8.2 (6.3-10.2)	0.25 (0.11- 0.52)
		LL	59 (4.0-10.0) 42	54 39	82 (5.7-10.0) 59	77 55	7.4 (4.0-10.0)	0.20 (0.05- 0.44)
		YCT	4 (5.5-11.2) 3	2 1	-	-	7.3 (5.5-11.2)	0.22 (0.08- 0.60)
		MWF	8 (2.6- 9.6) 6	2 1	-	-	4.5 (2.6- 9.6)	0.11 (0.02- 0.38)
FLESHMAN CREEK T02SR10E18BD (07/28/83)	1400	RB	20 (6.9-12.5) 14	20 14	42 (6.5-12.5) 30	42 30	9.9 (6.9-12.5)	0.48 (0.16- 0.90)
		LL	93 (2.7-13.1) 66	68 49	257 (2.0-13.1) 184	145 104	7.3 (2.7-13.1)	0.23 (0.02- 0.90)
		YCT	4 (6.3-10.9) 3	4 3	-	-	9.7 (6.3-10.9)	0.38 (0.10- 0.50)
		MWF	4 (3.7- 7.4) 3	2 1	-	-	5.5 (3.7- 7.4)	-

Table 5. Continued.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1 Total (range) #/1,000'	Number captured in pass 1 6 in + (range) #/1,000'	Estimated number Total (range) #/1,000'	Estimated number 6 in + (range) #/1,000'	Average length (range)	Average weight (range)
FLESHMAN CREEK T02SR10E18BD (09/12/84)	1400	RB	19 (2.9-14.3) 14	12 9	19 (5.5-14.3) 14	18 13	7.8 (2.9-14.3)	0.32 (0.01- 1.04)
		LL	184 (4.5-14.5) 131	176 126	240 (6.5-14.5) 171	128 91	8.6 (4.5-14.5)	0.25 (0.05- 1.16)
		YCT	3 (6.6-10.1) 2	3 2	0 (0.0-10.1) 0	0 0	8.8 (6.6-10.1)	0.27 (0.09- 0.36)
		MWF	1 (4.8- 4.8) 1	0 0	0 (0.0- 4.8) 0	0 0	4.8 (4.8- 4.8)	0.05 (0.05- 0.05)
FLESHMAN CREEK T02SR10E18BD (09/02/86)	1400	RB	7 (7.5-16.0) 5	7 5	9 (7.0-16.0) 6	9 6	11.5 (7.5-16.0)	0.72 (0.18- 1.65)
		LL	104 (4.8-13.8) 74	100 71	156 (7.0-13.8) 111	156 111	10.3 (4.8-13.8)	0.47 (0.05- 0.95)
		YCT	2 (6.8- 7.5) 1	2 1	0 (0.0- 7.5) 0	0 0	7.2 (6.8- 7.5)	0.14 (0.12- 0.15)
FLESHMAN CREEK T02SR10E18BD (04/08/88)	1400	RB	51 (4.5-17.1) 36	38 27	101 (5.0-17.1) 72	78 56	9.1 (4.5-17.1)	0.35 (0.04- 1.42)
		LL	108 (4.2-14.2) 77	80 57	180 (5.0-14.2) 129	126 90	8.4 (4.2-14.2)	0.25 (0.03- 1.08)
		YCT	2 (7.1- 8.8) 1	2 1	0 (0.0- 8.8) 0	0 0	8.0 (7.1- 8.8)	0.19 (0.15- 0.22)
FLESHMAN CREEK T02SR10E18BD (09/05/91)	1400	RB	29 (3.5-14.3) 21	28 20	40 (7.0-14.3) 29	40 29	9.2 (3.5-14.3)	0.31 (0.03- 1.08)
		LL	151 (5.0-14.8) 108	149 106	183 (6.5-14.8) 131	183 131	9.6 (5.0-14.8)	0.36 (0.05- 0.97)
		YCT	4 (6.0-10.2) 3	4 3	7 (6.0-10.2) 5	7 5	8.6 (6.0-10.2)	0.24 (0.09- 0.37)

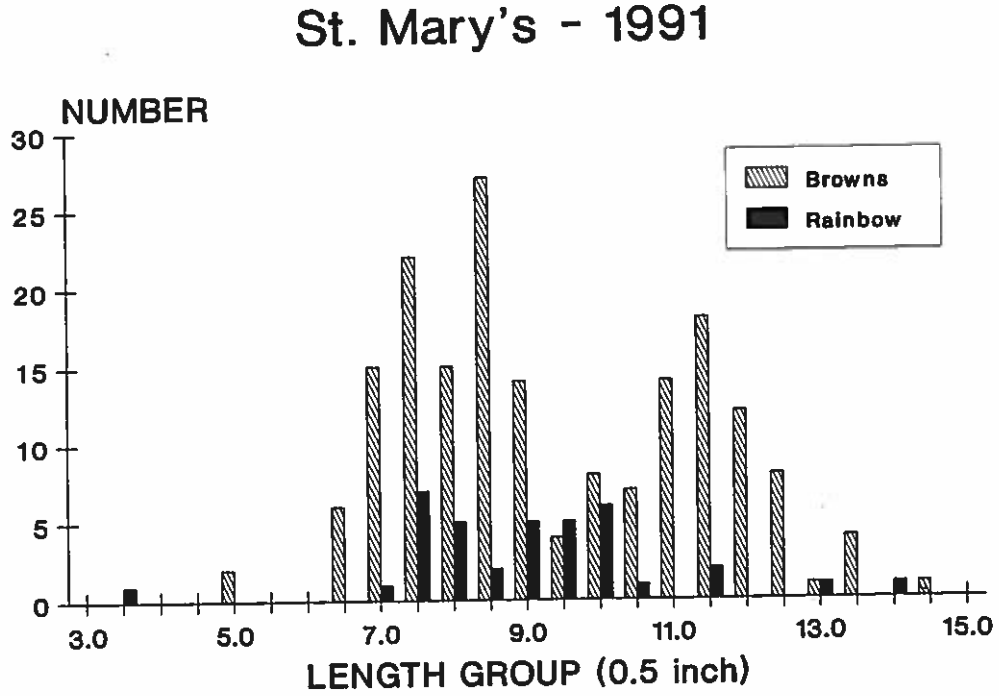


Figure 20. Length frequency histograms for brown and rainbow trout captured in the St. Mary's Section of Fleshman Creek during September 1991.

the St. Mary's Section of Fleshman Creek. I suspect that brown trout moved up Fleshman Creek to the Enterprise Section (at the base of the Sacajawea Lagoon Dam) from lower Fleshman Creek and, possibly, the Yellowstone River in response to drought conditions. The number of rainbow trout in both sections has been variable and is likely related to stocking levels in Sacajawea Lagoon and movement of rainbow trout out of the lagoon (Figure 21).

Little Mission Creek

Two sections of Little Mission Creek were electrofished during 1991 and 1992 to estimate fish populations and document movement between privately owned lands and Forest Service lands (Table 6). On July 11 and August 15, 1991 and August 13, 1992 two 700 foot sections, one from the Forest Service boundary upstream (T03S;R11E;Sec14) and another from the road culvert below the Forest boundary downstream (T03S;R11E;Sec11), were each electrofished twice each sample day.

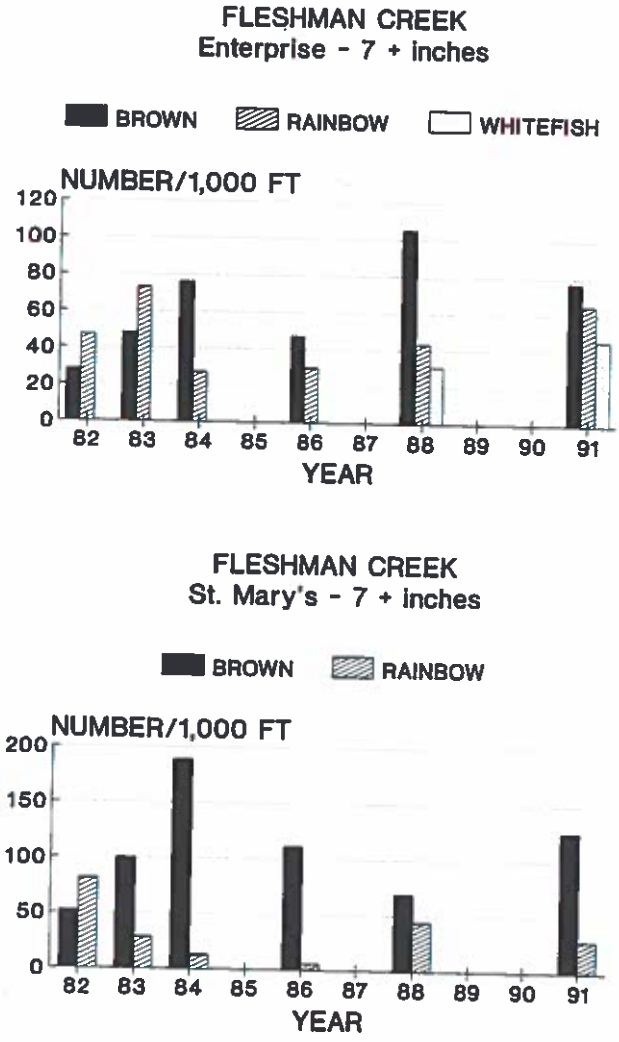


Figure 21. Estimated number of brown and rainbow trout 7.0 inches and longer per 1,000 feet of stream length in the Enterprise (top) and St. Mary's (bottom) sections of Fleshman Creek from 1982 to 1991. Estimates were conducted in September in 1984, 1986 and 1991; in July in 1982 and 1983; and in April in 1988.

On July 11, 1991 a total of 18 Yellowstone cutthroat were captured in the section above the Forest Service boundary. These 18 cutthroat averaged 6.2 inches in length (range: 3.9-10.7) and 0.14 pounds (range: 0.02-0.51) (Figure 22). This 700 foot section supported an estimated 11 cutthroat trout 3.0 to 5.9 inches long (SE: not estimated because all fish were captured on the first pass) and 7 cutthroat trout 6.0 to 10.7 inches long (SE: 0.4). On August 15, 1991 a total of 26 Yellowstone cutthroat were captured in this same section. These 25 cutthroat averaged 6.3 inches in length (range: 2.4-8.7) and 0.12 pounds (range: 0.01-0.27) (Figure 22). This 700 foot section supported an estimated 11 cutthroat trout 3.0 to 5.9 inches long (SE: 0.2) and 14 cutthroat trout 6.0 to 8.7 inches long (SE: 0.6) (Table 6). It was interesting to note that two cutthroat trout longer than 9.0 inches captured during the July sampling were not recaptured during the August sampling even though electrofishing efficiency for these larger trout was very high. This result suggests that adult spawners from elsewhere in Little Mission Creek may be moving into or through this section during the spawning season.

On August 13, 1992 a total of 41 cutthroat trout and two rainbow trout were captured in this section. The rainbow trout were killed in an attempt to prevent introgression with cutthroat trout. It is the first time rainbow trout were sampled in this portion of the creek. The 41 cutthroat trout averaged 5.8 inches in length (range: 2.3-9.8) and 0.12 pounds (range: 0.01-0.40) (Figure 23). This 700 foot sample section supported an estimated nine cutthroat under 3.0 inches (SE: 0.8), 10 cutthroat 3.0 to 5.9 inches in length (SE: 0.7), and 22 cutthroat 6.0 inches and longer (SE: 0.2). The numbers of cutthroat trout 6.0 inches and longer increased from 1991 to 1992 (Table 6).

On July 11, 1991 a total of 12 Yellowstone cutthroat trout were captured in the section on private land below the road culvert. These 12 cutthroat trout averaged 5.6 inches in length (range: 3.0-7.9) and 0.09 pounds (range: 0.02-0.22) (Figure 24). This section supported an estimated 8 cutthroat trout 3.0 to 5.9 inches long (SE: 0.4) and 4 cutthroat trout 6.0 to 7.9 inches long (SE: not estimated because all fish were captured on the first pass). On August 15, 1991 a total of 28 Yellowstone cutthroat trout were captured in this same section. These 28 cutthroat trout averaged 5.0 inches in length (range: 2.4-10.0) and 0.08 pounds (range: 0.01-0.46) (Figure 24). This section supported an estimated 8 cutthroat trout 3.0 to 5.9 inches long (SE: not estimated because all fish were captured on the first pass) and 11 cutthroat trout 6.0 to 7.9 inches long (SE: not

Table 6. Summary of electrofishing information for Little Mission and Mill Fork creeks including stream, legal description of sample site, date electrofished, species (see Table 4 for codes), total number of fish captured in first pass (and standardized to number captured per 1,000 feet of stream length), number of fish 6 inches and longer captured in first pass (and standardized to number captured per 1,000 feet of stream length), estimated total number of fish, estimated number of fish 6 inches and longer, and average length (in) and weight for captured fish.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1 Total (range) #/1,000'	Number captured in pass 1 6 in + (range) #/1,000'	Estimated number Total (range) #/1,000'	Estimated number 6 in + (range) #/1,000'	Average length (range)	Average weight (range)
LITTLE MISSION CREEK T03SR11E02 (10/30/74)	250	YCT	148 (4.5-11.9) 592	146 584	-	-	9.0 (4.5-11.9)	0.27 (0.05- 0.60)
LITTLE MISSION CREEK T03SR11E02DC (09/26/85)	1000	RB	8 (6.3- 7.8) 8	8 8	-	-	7.1 (6.3- 7.8)	0.13 (0.10- 0.15)
		YCT	191 (1.8-10.6) 191	50 50	436 (3.0-10.6) 436	100 100	5.2 (1.8-10.6)	0.08 (0.01- 0.39)
LITTLE MISSION CREEK T03SR11E14BA (Above F.S.) (06/12/87)	1000	YCT	21 (3.4- 8.4) 21	10 10	-	-	6.0 (3.4- 8.4)	-
LITTLE MISSION CREEK T03SR11E14BA (Above F.S.) (07/11/91)	700	YCT	17 (3.9-10.7) 24	6 9	18 (3.0-10.7) 26	7 10	6.2 (3.9-10.7)	0.14 (0.02- 0.51)
LITTLE MISSION CREEK T03SR10E14BA (Above F.S.) (08/13/92)	700	RB	2 (7.8- 8.9) 3	2 3	-	-	8.4 (7.8- 8.9)	0.28 (0.21- 0.34)
		YCT	36 (2.3- 9.8) 51	21 30	41 (2.1- 9.8) 59	22 31	5.8 (2.3- 9.8)	0.12 (0.01- 0.40)
LITTLE MISSION CREEK T03SR11E11CD (Below F.S.) (07/11/91)	700	YCT	11 (3.0- 7.9) 16	4 6	12 (3.0- 7.9) 17	4 6	5.6 (3.0- 7.9)	0.09 (0.02- 0.22)
LITTLE MISSION CREEK T03NR11E11CD (Below F.S.) (08/15/91)	700	YCT	19 (2.4-10.0) 27	11 16	19 (3.0-10.0) 27	11 16	5.0 (2.4-10.0)	0.08 (0.01- 0.46)
LITTLE MISSION CREEK T03SR10E11CD (Below F.S.) (08/13/92)	700	RB	1 (7.4- 7.4) 1	1 1	-	-	7.4 (7.4- 7.4)	0.16 (0.16- 0.16)
		YCT	84 (2.1- 9.8) 120	10 14	140 (2.1- 9.8) 200	12 17	3.9 (2.1- 9.8)	0.05 (0.01- 0.38)

Table 6. Continued.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1: Total (range) #/1,000'	Number captured in pass 1: 6 in + (range) #/1,000'	Estimated number: Total (range) #/1,000'	Estimated number: 6 in + (range) #/1,000'	Average length (range)	Average weight (range)
FORK MISSION CK 102SR11E32DD (Cabin) (08/05/82)	1000	YCT	92 (2.4- 9.8) 92	17 17	252 (2.0- 9.8) 252	29 29	4.8 (2.4- 9.8)	0.06 (0.02- 0.38)
MILL FORK MISSION CK T02SR11E32DD (Cabin) (07/19/84)	1000	YCT	51 (2.3- 9.4) 51	21 21	114 (3.0- 9.4) 114	38 38	5.5 (2.3- 9.4)	0.09 (0.02- 0.30)
MILL FORK MISSION CK T02SR11E32DD (Cabin) (07/18/85)	1000	YCT	40 (2.4- 8.9) 40	10 10	97 (3.0- 8.9) 97	13 13	4.9 (2.4- 8.9)	0.08 (0.02- 0.30)
MILL FORK MISSION CK T02SR11E32DD (Cabin) (08/20/91)	300	LL	1 (9.5- 9.5) 3	1 3	-	-	9.5 (9.5- 9.5)	0.35 (0.35- 0.35)
		YCT	8 (3.2- 5.5) 27	0 0	10 (3.0- 5.5) 33	-	4.2 (3.2- 5.5)	0.04 (0.02- 0.08)
MILL FORK MISSION CK T03SR11E04BD (Trailhead) (09/03/91)	360	YCT	6 (1.3- 4.2) 17	0 0	-	-	3.1 (1.3- 4.2)	0.03 (0.01- 0.04)

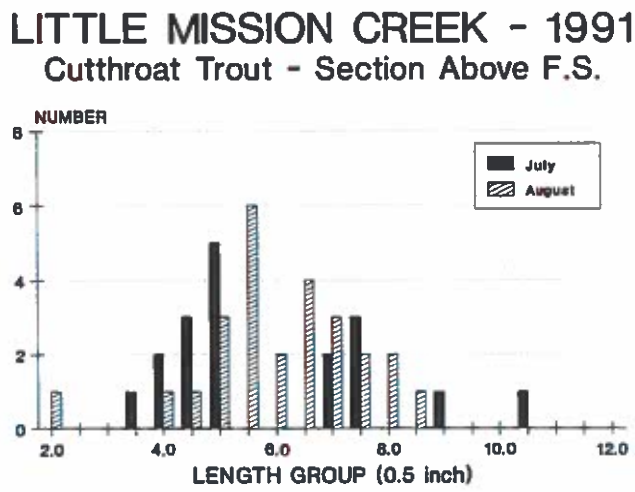


Figure 22. Length frequency histograms for Yellowstone cutthroat trout captured above the Forest Service boundary in Little Mission Creek in July and August 1991.

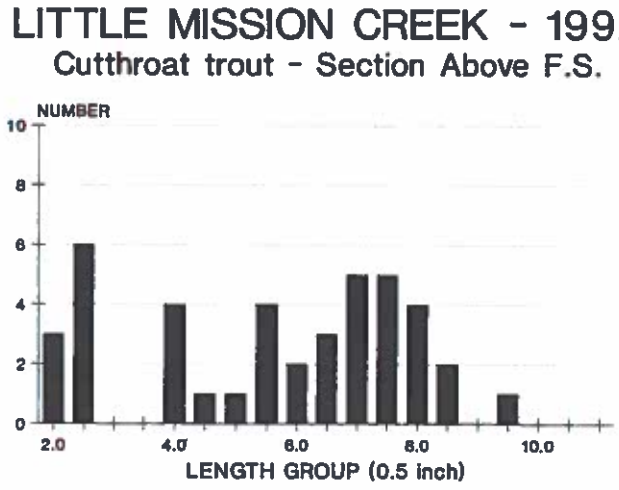


Figure 23. Length frequency histograms for Yellowstone cutthroat trout captured above the Forest Service boundary in Little Mission Creek in August 1992.

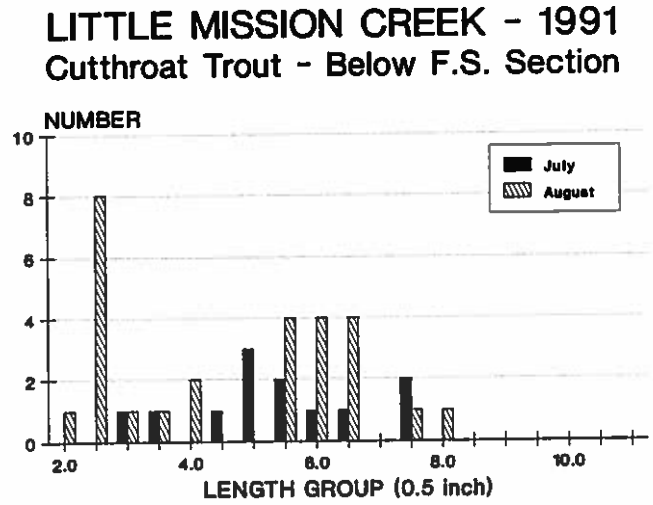


Figure 24. Length frequency histograms for Yellowstone cutthroat trout captured below the Forest Service boundary in Little Mission Creek in July and August 1991.

estimated because all fish were captured on the first pass). In this section no cutthroat longer than 8.0 inches were captured in July, but one cutthroat 8.2 inches long and one fish identified as a cutthroat X rainbow hybrid 10.0 inches long was captured in August. This hybrid was killed to reduce the potential for introgression. The presence of cutthroat trout 8.0 inches and longer suggests that mature fish are moving within Little Mission Creek for spawning.

On August 13, 1992 a total of 107 cutthroat trout and one rainbow trout were captured in the 700 foot sample section below the Forest Service boundary. A total of 53 of these cutthroat trout were less than 3.0 inches in length. These 107 cutthroat averaged 3.9 inches long (range: 2.1-9.8) and 0.05 pounds (range: 0.01-0.38) (Figure 25). This 700 foot section supported an estimated 77 cutthroat trout less than 3.0 inches in length (SE:

21), 51 cutthroat trout 3.0 to 5.9 inches (SE: 2), and 12 cutthroat trout 6.0 inches and longer (SE: 1). The numbers of cutthroat 3.0 to 5.9 inches increased from 1991 to 1992, but the numbers of 6.0 inch and longer cutthroat were similar between years.

Movement and Growth

Cutthroat trout were tagged in both sections during all 1991 electrofishings to document movement. Only two fish tagged during July 1991 were recaptured during August 1991. Both of these fish were recaptured within the same section in which they were tagged. One was 7.4 inches in length when tagged on July 11 in the section above the Forest Service boundary and 7.8 inches in length when recaptured within the same section on August 15. The other was 5.7 inches in length when tagged on July 11 in the section on private land and 6.2 inches when recaptured in the same section on August 15.

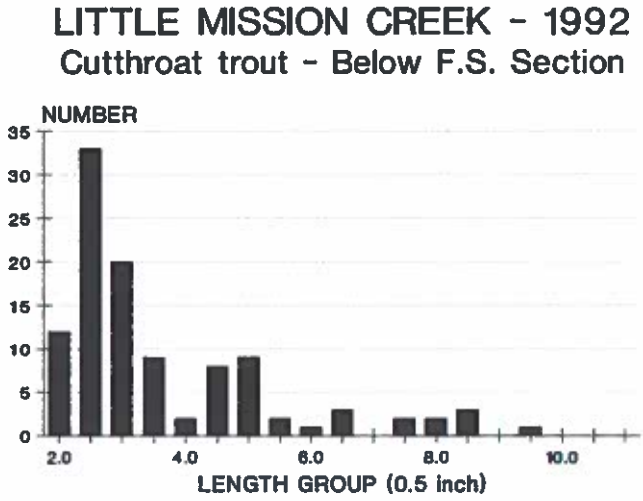


Figure 25. Length frequency histograms for Yellowstone cutthroat trout captured below the Forest Service boundary in Little Mission Creek in August 1992.

Two cutthroat tagged during 1991 were recaptured during 1992 in the section above the Forest Service boundary. One fish was 5.8 inches and 0.07 pounds when tagged on August 15, 1991 and 7.7 inches and 0.16 pounds when recaptured on August 13, 1992. This fish grew 1.9 inches in one year. The other was 7.4 inches and 0.19 pounds when tagged on July 11, 1991, 7.8 inches and 0.17 pounds when recapped on August 15, 1991, and 8.2 inches and 0.24 pounds when recaptured on August 13, 1992. This fish only grew 0.4 inches between August 15, 1991 and August 13, 1992.

Mill Fork Mission Creek

In 1991 a sample section located above and below the County Road bridge near some private cabins (T03S;R11E,Sec02) was electrofished to estimate the population (Table 6). On August 20, 1991 a 300 foot section at this location supported an estimated 10 Yellowstone cutthroat trout 3.0 to 5.5 inches in length (SE: 1). All captured cutthroat trout were between 3.0 and 6.0 inches (Figure 26).

On August 5, 1982 a 1,000 foot sample section in this same area supported an estimated 252 Yellowstone cutthroat trout 2.0 to 9.9 inches in length (SE: 52). On July 19, 1984 this section supported 114 Yellowstone cutthroat trout 3.0 to 9.4 inches in length (SE: 21). On July 18, 1985 this section supported 98 Yellowstone cutthroat trout 3.0 to 8.9 inches in length (SE: 15). Expansion of the above 1991 estimate to number per 1,000 feet yielded an estimate of 34 cutthroat per 1,000 feet of stream. The 1991 estimate is much lower than previous years and a downward trend in estimated cutthroat trout numbers was observed in this section from 1982 to 1991 (Figure 27).

Another 360 foot section near the trailhead (T03S;R11E; Sec04) was electrofished once on September 3, 1991. Six Yellowstone cutthroat trout were captured. They averaged 3.1 inches long (range: 1.3-4.2) and 0.03 pounds (Figure 28).

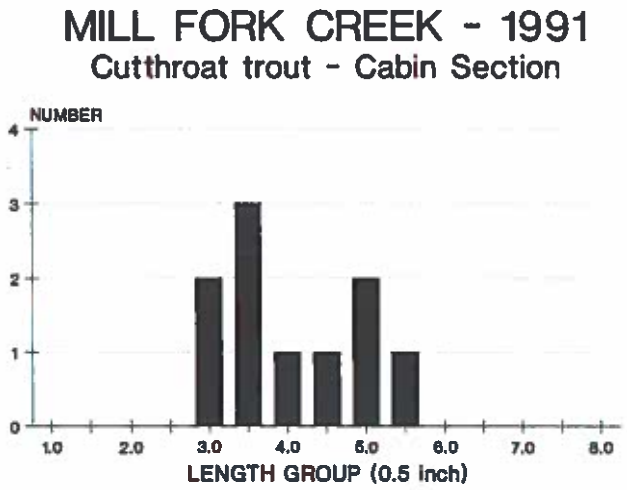


Figure 26. Length frequency histogram for Yellowstone cutthroat trout captured at the Cabin Section of Mill Fork Creek in August 1992.

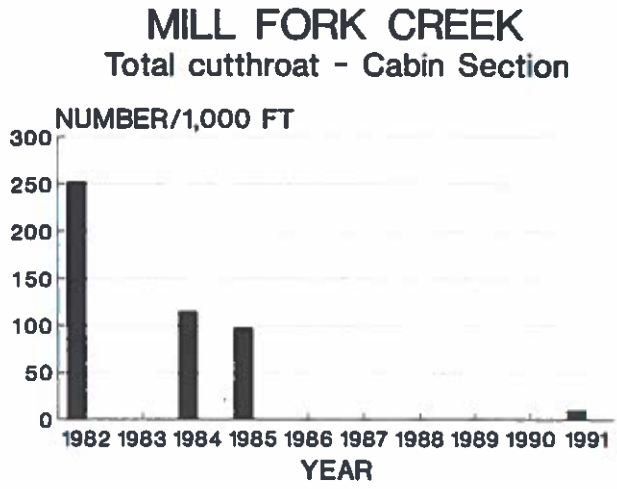


Figure 27. Estimated number of Yellowstone cutthroat trout per 1,000 feet of Mill Fork Mission Creek within the Cabin Section from 1982 to 1991.

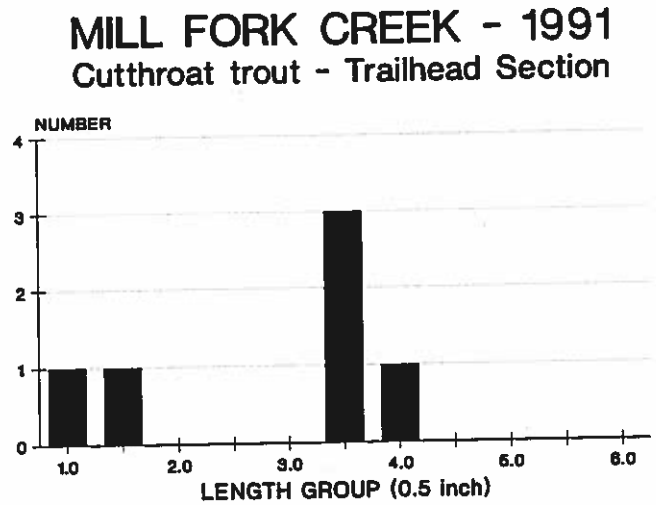


Figure 28. Length frequency histogram for Yellowstone cutthroat trout captured in the Trailhead Section in Mill Fork Creek in August 1992.

Stream bed sampling in Mill Fork Mission Creek has documented relatively high percentages of fine material within the stream bed. The Forest Service found lower Mill Fork spawning areas had nearly 48% of the streambed composed of material 0.25 inch and smaller, while upper Mill Fork spawning areas contained almost 55% fines (Tie Creek Timber Sale EA). MDFWP sampled cobble embeddedness in 1987 and found cobbles were 25% embedded with 56% free matrix particles present. The level of fine sediments found through streambed sampling suggests that fine sediments within the streambed could likely be impacting cutthroat trout reproductive success (Irving and Bjornn 1984) and possibly macroinvertebrate production (Prather 1971).

Mill Creek (Yellowstone drainage) Study

Four different sections of Mill Creek have been sampled annually from 1990 to 1992 to collect baseline fish population information prior to planned enhancement of over-wintering habitat by the Livingston Ranger District of the Gallatin National Forest. The four sections included three sections where habitat enhancement is proposed and one control section. Mark-recapture population estimates were made in all four sections. The sections were named according to the proposed enhancement activity (Log Jam, Pools, Debris) and one section was established as a control section (Mogen). In addition, a single electrofishing pass was done in 500 feet of the control section (Mogen) during the late fall of 1990 to document possible movement of fish and determine types of habitats used immediately prior to winter. In 1991, prior to 1991 fish population estimates, a fire, the Thompson Creek fire, burned approximately 7,700 acres of upper Mill Creek.

Log Jam Section

This 1,000 foot section was electrofished twice on September 5 and 11, 1990 (Table 7). This section was located approximately 0.2 miles above the Snowbank Campground (T06S;R10E;Sec19CD). A total of 62 Yellowstone cutthroat trout were captured in these two electrofishing passes. Average lengths and weights of the 62 cutthroat trout were 8.0 inches (range: 2.8-13.6) and 0.25 pounds (range: 0.03-0.94) (Figure 29). This 1,000 foot section supported an estimated 126 cutthroat trout 4.0 inches and longer (SE: 29) with 105 of these fish being 6.0 inches and longer.

The section was electrofished twice on August 21 and 28, 1991. A total of 72 Yellowstone cutthroat were captured in these two electrofishing passes. The average length and weight of these 72 cutthroat trout were 8.0 inches (range: 3.1-12.5) and 0.24 pounds (Figure 30). This 1,000 foot section contained an estimated 89 cutthroat trout 6.5 inches and longer (SE: 12). An estimate of 116 was calculated for cutthroat trout 4.0 inches and longer, but no reliable estimate of error could be made because no recaptures were under 6.5 inches.

This section was electrofished twice on October 1 and 16, 1992. A total of 43 Yellowstone cutthroat trout were captured in these two passes. The average length and weight of 37 cutthroat trout were 9.6 inches (range: 3.7-12.2) and 0.39 pounds (Figure 31). This 1,000 foot section supported an estimated 53 cutthroat trout 8.5 inches and longer (SE: 12). For cutthroat trout 4.0 inches and longer an estimated 69 inhabited the section, but no

Table 7. Summary of electrofishing information for Mill Creek including stream, legal description of sample site, date electrofished, species (see Table 4 for codes), total number of fish captured in first pass (and standardized to number captured per 1,000 feet of stream length), number of fish 6 inches and longer captured in first pass (and standardized to number captured per 1,000 feet of stream length), estimated total number of fish, estimated number of fish 6 inches and longer, and average length (in) and weight for captured fish.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1		Estimated number		Average length (range)	Average weight (range)
			Total (range) #/1,000'	6 in + (range) #/1,000'	Total (range) #/1,000'	6 in + (range) #/1,000'		
MILL CREEK T05SR09E28 (08/14/68)	340	LL	1 (15.3-15.3) 3	1 3	-	-	15.3 (15.3-15.3)	1.64 (1.64- 1.64)
		YCT	1 (14.1-14.1) 3	1 3	-	-	14.1 (14.1-14.1)	1.22 (1.22- 1.22)
		MWF	4 (10.3-13.6) 12	4 12	-	-	12.0 (10.3-13.6)	0.71 (0.47- 1.11)
MILL CREEK T06SR10E33 (08/14/68)	315	YCT	2 (3.1- 3.5) 6	0 0	-	-	3.3 (3.1- 3.5)	0.03 (0.03- 0.03)
MILL CREEK T05SR09E0708 (07/17/74)	500	RB	6 (6.3-19.0) 12	6 12	-	-	11.9 (6.3-19.0)	0.89 (0.10- 2.28)
		YCT	3 (6.9-16.6) 6	3 6	-	-	10.3 (6.9-16.6)	-
MILL CREEK T05SR09E0708 (06/30/83)	3960	YCT	3 (7.4-13.6) 1	3 1	-	-	9.8 (7.4-13.6)	0.49 (0.20- 1.26)
MILL CREEK T05SR09E0708 (07/06/83)	3960	RB	4 (8.8-16.8) 1	4 1	-	-	12.3 (8.8-16.8)	1.00 (0.30- 2.12)
		YCT	1 (12.7-12.7) 0	1 0	-	-	12.7 (12.7-12.7)	0.91 (0.91- 0.91)
MILL CREEK T05SR09E0708 (07/13/83)	3960	RB	3 (14.6-16.3) 1	3 1	-	-	15.4 (14.6-16.3)	1.49 (1.20- 1.84)
MILL CREEK T05SR09E0708 (07/20/83)	3960	RB	3 (12.5-15.8) 1	3 1	-	-	13.7 (12.5-15.8)	1.10 (0.83- 1.62)
		YCT	1 (13.6-13.6) 0	1 0	-	-	13.6 (13.6-13.6)	1.00 (1.00- 1.00)

Table 7. Continued.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1 Total (range) #/1,000'	Number captured in pass 1 6 in + (range) #/1,000'	Estimated number Total (range) #/1,000'	Estimated number 6 in + (range) #/1,000'	Average length (range)	Average weight (range)
MILL CREEK T05SR09E07 (06/19/85)	300	RB	1 (17.5-17.5) 3	1 3	-	-	17.5 (17.5-17.5)	-
MILL CREEK T06SR10E19CD (Log Jam) (09/05/90)	1000	YCT	34 (2.8-13.6) 34	28 28	126 (4.0-13.6) 126	105 105	8.1 (2.8-13.6)	0.25 (0.03- 0.94)
MILL CREEK T06SR10E19CD (Log Jam) (08/21/91)	1000	YCT	37 (3.1-12.3) 37	35 35	89 (6.5-12.3) 89	89 89	8.0 (3.1-12.3)	0.24 (0.03- 0.67)
		MWF	10 (11.7-15.9) 10	10 10	-	-	13.1 (11.7-15.9)	0.84 (0.58- 1.32)
MILL CREEK T06SR10E19CD (Log Jam) (10/01/92)	1000	YCT	24 (3.7-12.2) 24	23 23	53 (8.5-12.2) 53	53 53	9.6 (3.7-12.2)	0.39 (0.04- 0.76)
		MWF	17 (10.6-16.0) 17	17 17	-	-	12.9 (10.6-16.0)	0.88 (0.41- 1.57)
MILL CREEK T06SR10E19DD (09/25/85)	1000	YCT	4 (9.0-13.1) 4	4 4	-	-	11.3 (9.0-13.1)	0.66 (0.36- 1.00)
		MWF	18 (10.7-14.2) 18	18 18	-	-	12.4 (10.7-14.2)	0.75 (0.42- 1.28)
MILL CREEK T06SR10E19DD (Mogen) (08/31/90)	1000	YCT	47 (2.2-13.0) 47	38 38	121 (4.0-13.0) 121	99 99	8.6 (2.2-13.0)	0.25 (0.01- 0.85)
MILL CREEK T06SR10E19DD (Mogen) (10/15/90)	500	YCT	34 68	32 64	-	-		
MILL CREEK T06SR10E19DD (Mogen) (08/21/91)	1000	YCT	50 (2.3-12.9) 50	41 41	106 (5.0-12.9) 106	101 101	8.2 (2.3-12.9)	0.28 (0.03- 0.80)
		MWF	6 (11.2-13.5) 6	6 6	-	-	12.3 (11.2-13.5)	0.77 (0.58- 0.96)

Table 7. Continued.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1 Total (range) #/1,000'	Number captured in pass 1 6 in + (range) #/1,000'	Estimated number Total (range) #/1,000'	Estimated number 6 in + (range) #/1,000'	Average length (range)	Average weight (range)
MILL CREEK T06SR10E19DD (Mogen) (10/01/92)	1000	YCT	51 (3.3-12.8) 51	44 44	95 (7.5-12.8) 95	95 95	9.1 (3.3-12.8)	0.35 (0.03- 0.82)
		MWF	28 (10.6-15.8) 28	28 28	70 (10.5-15.8) 70	70 70	12.9 (10.6-15.8)	0.84 (0.43- 1.60)
MILL CREEK T06SR10E29BC (Pools) (09/05/90)	1000	YCT	45 (3.0-11.9) 45	27 27	145 (4.0-11.9) 145	90 90	6.8 (3.0-11.9)	0.16 (0.02- 0.72)
MILL CREEK T06SR10E29BC (Pools) (08/22/91)	1000	YCT	33 (3.7-12.4) 33	29 29	63 (6.0-12.4) 63	63 63	7.5 (3.7-12.4)	0.22 (0.04- 0.73)
		MWF	10 (11.7-14.3) 10	10 10	- -	- -	12.7 (11.7-14.3)	0.83 (0.62- 1.03)
MILL CREEK T06SR10E29BC (Pools) (10/02/92)	1000	YCT	37 (3.8-12.0) 37	34 34	56 (7.0-12.0) 56	56 56	8.8 (3.8-12.0)	0.30 (0.04- 0.69)
		MWF	15 (10.5-14.5) 15	15 15	- -	- -	12.5 (10.5-14.5)	0.77 (0.41- 1.28)
MILL CREEK T06SR10E29DC (Debris) (09/05/90)	1000	YCT	47 (3.6-11.5) 47	30 30	174 (4.0-11.5) 174	102 102	6.7 (3.6-11.5)	0.14 (0.04- 0.65)
MILL CREEK T06SR10E29DC (Debris) (08/22/91)	1000	YCT	39 (3.4-10.3) 39	29 29	101 (4.0-10.3) 101	80 80	7.3 (3.4-10.3)	0.19 (0.03- 0.45)
		MWF	4 (11.9-14.2) 4	4 4	- -	- -	12.9 (11.9-14.2)	0.82 (0.63- 0.97)
MILL CREEK T06SR10E29DC (Debris) (10/19/92)	1000	YCT	39 (3.0-12.4) 39	35 35	83 (5.5-12.4) 83	81 81	8.5 (3.0-12.4)	0.28 (0.03- 0.70)
MILL CREEK T06SR10E33 (09/25/85)	1000	YCT	11 (5.2-11.7) 11	10 10	- -	- -	9.1 (5.2-11.7)	0.36 (0.08- 0.68)
MILL CREEK T05NR10E27 (08/05/74)	300	YCT	17 (3.4- 7.5) 57	4 13	- -	- -	5.0 (3.4- 7.5)	-
MILL CREEK T05NR10E27DA (07/27/90)	310	YCT	21 (3.8- 7.7) 68	4 13	28 (3.8- 7.7) 90	4 13	5.3 (3.8- 7.7)	0.07 (0.02- 0.20)

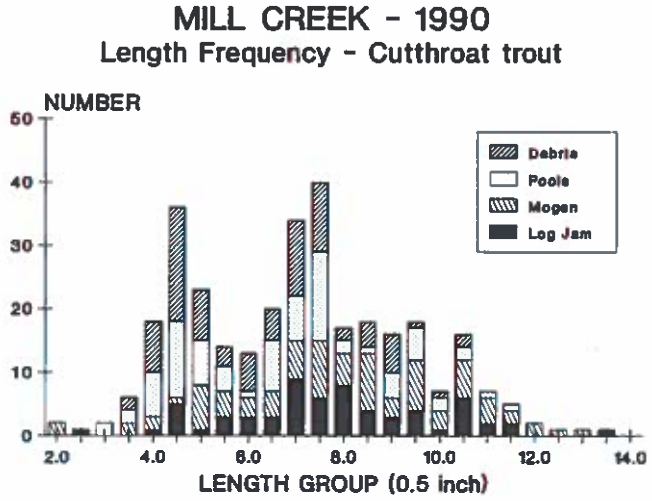


Figure 29. Length frequency distribution of cutthroat trout captured in four sections of Mill Creek during 1990.

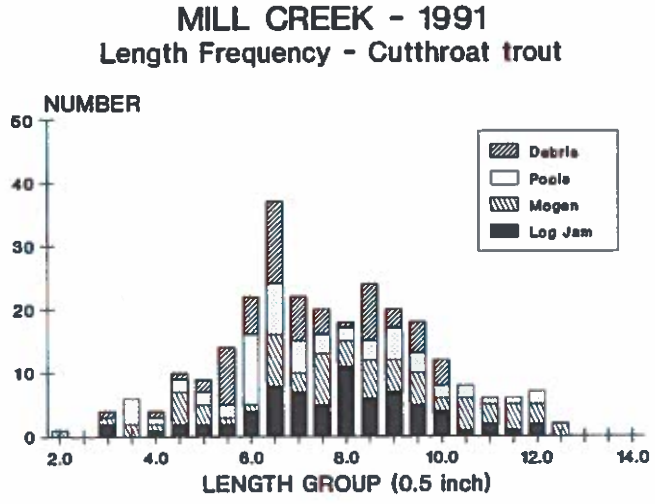


Figure 30. Length frequency distribution of cutthroat trout captured in four sections of Mill Creek during 1991.

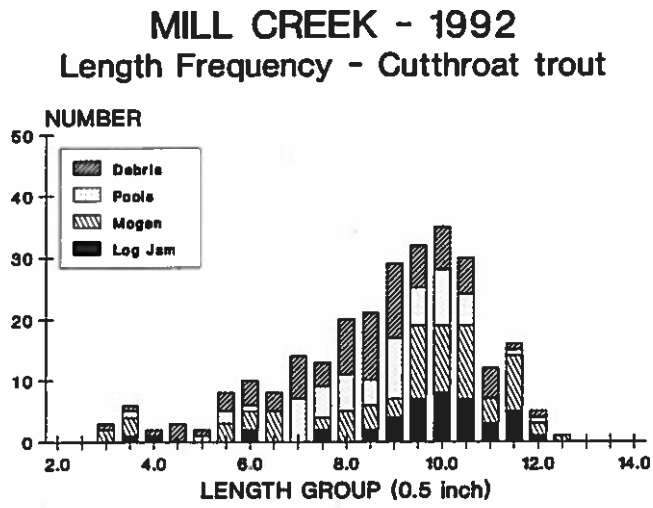


Figure 31. Length frequency distribution of cutthroat trout captured in four sections of Mill Creek during 1992.

recaptures were under 9.5 inches and only 6 fish were recaptured so the estimates must be considered unreliable. Thirty-five mountain whitefish were also captured, but many of these fish were moving into and out of the study section so no population estimate was calculated. The average length and weight of 32 newly captured whitefish were 12.9 inches (range: 10.6-16.0) and 0.88 pounds.

Mogen (Control) Section

This 1,000 foot section was electrofished three times on August 31, September 11, and October 15, 1990. This section was located approximately 0.3 miles above the Snowbank Campground (T06S;R10E;Sec19). A total of 84 cutthroat trout were captured in the mark-recapture electrofishing passes on August 31 and September 11. Average lengths and weights of the 84 captured cutthroat trout were 8.1 inches (range: 2.2-13.0) and 0.26 pounds (range: 0.01-0.85)(Figure 29). This 1,000 foot section contained an estimated 121 cutthroat trout 4.0 inches and longer (SE: 15) with 99 of these being 6.0 inches and longer.

This section was electrofished twice on August 31 and September 11, 1991. A total of 73 cutthroat trout were captured in the two electrofishing passes. Average lengths and weights of the 73 captured cutthroat trout were 8.2 inches (range: 2.3-12.9) and 0.28 pounds (Figure 30). This 1,000 foot section contained an estimated 106 cutthroat trout 5.0 inches and longer (SE: 18) with an estimated 101 being 6.0 inches and longer.

This section was electrofished twice on October 1 and 16, 1992. A total of 79 Yellowstone cutthroat trout were captured in these two passes. The average length and weight of 71 cutthroat trout were 9.1 inches (range: 3.3-12.8) and 0.35 pounds (Figure 31). This 1,000 foot section supported an estimated 95 cutthroat trout 7.5 inches and longer (SE: 18). For cutthroat trout 4.0 inches and longer an estimated 128 inhabited the section, but no recaptures were under 7.5 inches. Sixty-six mountain whitefish were also captured. The section supported an estimated 70 mountain whitefish 10.5 to 15.5 inches long (SE: 9), but many whitefish were probably moving into and out of the study section so the population estimate should be viewed with caution. The average length and weight of 51 newly captured whitefish were 12.9 inches (range: 10.6-15.8) and 0.84 pounds.

Pools Section

This 1,000 foot section was electrofished twice on September 5 and 14, 1990. This section was located at the road to the Temple Hills camp (T06S;R10E;Sec19). A total of 82 cutthroat trout were captured in two electrofishing passes. Average lengths and weights of the 82 captured cutthroat trout were 6.7 inches (range: 3.0-11.9) and 0.16 pounds (range: 0.02-0.72) (Figure 29). This 1,000 foot section contained an estimated 145 cutthroat trout 4.0 inches and longer (SE: 25) with an estimated 90 of these being 6.0 inches and longer.

This section was electrofished twice on August 22 and 30, 1991. A total of 59 cutthroat trout were captured in these two electrofishing passes. Average lengths and weights of the 59 captured cutthroat trout were 7.5 inches (range: 3.7-12.3) and 0.22 pounds (Figure 30). This 1,000 foot section contained an estimated 63 cutthroat trout 6.0 inches and longer (SE: 7). An estimate of 77 was made for cutthroat trout 4.0 inches and longer, but no reliable estimate of error could be made because no recaptures were under 6.0 inches.

This section was electrofished twice on October 2 and 19, 1992. A total of 59 Yellowstone cutthroat trout were captured in these two passes. The average length and weight of 53 cutthroat trout were 8.8 inches (range: 3.8-12.0) and 0.30 pounds (Figure 31). This 1,000 foot section supported an estimated 56 cutthroat trout 7.0 to 9.9 inches (SE: 13). For cutthroat trout 10.0 inches and longer no reliable estimate could be made because no fish in this size group were recaptured. Applying the six recaptured fish over the entire size range of fish marked resulted in an estimate of 120 cutthroat 5.0 to 12.4 inches. Forty-two mountain whitefish were also captured, but many of these fish were moving into and out of the study section so no population estimate was calculated. The average length and weight of 39 newly captured whitefish were 12.5 inches (range: 10.5-14.5) and 0.77 pounds.

Debris Section

This 1,000 foot section was electrofished twice on September 5 and 14, 1990. This section was located immediately below Passage Creek (T06S;R10E;Sec29). A total of 90 cutthroat trout were captured in these two electrofishing passes. Average lengths and weights of the 90 captured cutthroat trout were 6.5 inches (range: 3.6-11.4) and 0.14 pounds (range: 0.04-0.65) (Figure 29). This 1,000 foot section contained an estimated 174 cutthroat trout 4.0 inches and longer (SE: 31) with 102 being 6.0 inches and longer. No mountain whitefish were captured in this section.

This section was electrofished twice on August 22 and 30, 1991. A total of 66 cutthroat trout were captured in these two electrofishing passes and 15 cutthroat trout were recaptured in the second pass. Average lengths and weights of the 66 captured cutthroat trout were 7.3 inches (range: 3.4-10.2) and 0.19 pounds (Figure 30). This 1,000 foot section contained an estimated 101 cutthroat trout 4.0 inches and longer (SE: 15) with 80 being 6.0 inches and longer.

This section was electrofished twice on October 2 and 19, 1992. A total of 87 Yellowstone cutthroat trout were captured in these two passes. The average length and weight of 67 cutthroat trout were 8.5 inches (range: 3.0-12.4) and 0.28 pounds (Figure 31). This 1,000 foot section supported an estimated 83 cutthroat trout 5.5 inches and longer (SE: 10). For cutthroat trout 4.0 inches and longer an estimated 89 inhabited the section, but no recaptures were under 5.5 inches. An estimated 81 cutthroat were 6.0 inches and longer.

Movement and Growth

Tag return information indicated that little movement was occurring between sections as most tag recaptures were tagged within the same section as the fish was recaptured (Table 8). In 1991 five cutthroat trout which had been tagged in 1990 in the Log Jam Section were recaptured within the same section. In 1992 two cutthroat trout which had been tagged in previous years within the Log Jam Section were recaptured in the Log Jam Section. Eight cutthroat trout tagged in the Mogen Section in 1990 were recaptured within the same section in 1991. The only tag return in 1992 from the Mogen Section was a fish that had been tagged in the Log Jam Section in 1990 and then recaptured again in the Log Jam Section on October 1, 1992. Five cutthroat trout previously tagged in 1990 in the Debris Section were recaptured in 1991 within the same section. Only two cutthroat previously tagged in the Debris Section were recaptured within the Debris Section in 1992. Mountain whitefish movement was also documented in 1992 when 3 of 24 new whitefish in the recapture run within the Pools Section had moved up from the Log Jam Section.

Fall electrofishing of 500 feet within the Mogen Section on October 15, 1990 captured 34 cutthroat trout. Recaptured cutthroat tagged during early September (when fish were still inhabiting their summer habitats) had not moved out of the section (a total of eight recaptured tags of 35 tags put out on September 11). Almost all 34 fish captured during the fall electrofishing were captured in two deep pools, suggesting that deep pools provide important winter habitat. One 6.7 inch fish which was tagged on September 5 in the Log Jam section (downstream) was recaptured in the Mogen section during the October 15 shocking. This fish had moved approximately 2,000 feet upstream to a pool within the Mogen section, probably to over winter.

In 1992 some cutthroat trout had moved between the mark and recapture electrofishings. We recaptured a cutthroat trout in the Log Jam Section with a fin clip used in the section above, Temple Hills (Pools), during the recapture run. One fish clipped during the marking run in the Log Jam Section was recaptured in the Pools Section. Both these fish had lost their VI tags. Movement was probably a response to declining water temperatures to seek overwinter habitat in pools, as mentioned above.

Table 8. Recaptures of fish VI tagged within four sections of Mill Creek from 1990 to 1992.

Tag number	Tagging information			Recapture information			Growth (in)
	Length	Weight	Date	Length	Weight	Date	
Tagged in Log Jam Section and Recaptured in Log Jam Section							
BLK E32	9.1	0.28	9/5/90	10.3	0.43	8/21/91	1.2
BLK E34	9.8	0.38	9/5/90	11.5	0.60	10/1/92	1.7
Recaptured in Mogen Section				11.5	0.60	10/16/92	
BLK E38	10.9	0.47	9/5/90	11.3	0.54	8/21/91	0.4
BLK E75	11.9	0.64	9/5/90	11.9	0.57	8/21/91	-
BLK H09	10.6	0.48	9/11/90	10.9	0.45	8/21/91	0.3
				11.7	0.60	10/1/92	0.8
BLK H11	9.5	0.40	9/11/90	10.0	0.38	8/21/91	0.5
Tagged in Pools Section and Recaptured in Pools Section							
BLK J02	7.5	0.18	9/14/90	8.8	0.27	8/30/91	1.3
BLK J05	9.3	0.32	9/14/90	9.9	0.39	8/22/91	0.6
BLK J09	9.3	0.36	9/14/90	9.8	0.41	8/30/91	0.5
BLK J10	6.9	0.14	9/14/90	9.5	0.30	10/2/92	2.6
BLK J11	6.4	0.11	9/14/90	8.0	0.24	8/22/91	1.6
Tagged in Mogen Section and Recaptured in Mogen Section							
BLK H56	10.4	0.50	9/11/90	10.6	0.48	8/21/91	0.2
BLK H66	9.1	0.32	9/11/90	9.3	0.32	8/21/91	0.2
BLK H69	11.4	0.52	9/11/90	11.7	0.60	8/28/91	0.3
BLK H73	10.7	0.46	9/11/91	11.1	0.50	8/28/91	0.4
BLK H78	8.6	0.24	9/11/90	9.6	0.44	8/21/91	1.0
BLK H83	8.5	0.24	9/11/90	10.1	0.39	8/21/91	1.6
BLK H94	10.7	0.61	9/11/90	11.2	0.55	8/28/91	0.5
BLK H99	9.5	0.36	9/11/90	9.9	0.37	8/21/91	0.4
Tagged in Debris Section and Recaptured in Debris Section							
BLK J25	8.7	0.24	9/14/90	10.8	0.45	10/2/92	2.1
BLK J29	7.4	0.14	9/14/90	8.7	0.23	8/22/91	1.3
				10.5	0.47	10/19/92	1.8
BLK J30	7.7	0.15	9/14/90	9.7	0.42	8/30/91	2.0
BLK J35	7.6	0.17	9/14/90	8.5	0.23	8/30/91	0.9
BLK J36	6.8	0.12	9/14/90	8.5	0.26	8/30/91	1.7
BLK J90	8.9	0.28	9/5/90	9.2	0.33	8/22/91	0.3

Growth of cutthroat trout appears to be relatively slow, from one to two inches per year, up to a length of about 9 inches, when growth usually slows even more to under one inch per year (Table 8). Growth of the fish tagged with black (BLK) VI tag H09 recaptured one and two years later suggest that annual growth was extremely variable with growth from 1990 to 1991 of only 0.3 inches and growth from 1991 to 1992 increasing to 0.8 inches. Perhaps some cutthroat spawn in alternate years which could explain this variable growth. One fish tagged and recaptured within the Debris Section (BLK J29) grew 1.3 inches between 1990 and 1991 and 1.8 inches between 1991 and 1992 even though this fish was over nine inches long.

Retention of VI Tags

A total of 128 cutthroat were tagged with VI tags during the marking runs in 1992. Of 35 fish tagged during the marking runs and recaptured from 15 to 17 days later during recapture runs, a total of 7 had lost their tags. Of the fish which had lost tags, 4 of 5 had been tagged by a technician who was inexperienced in using VI tags (80% loss). The overall tag loss rate was 20%, but for fish tagged by experienced personnel the tag loss rate was only 10%.

Population Trends

Populations of cutthroat trout were extremely depressed within the Mill Creek drainage in the early to mid-1980's (Table 9) based on estimates made by Clancy (1985 and 1987). Cutthroat trout populations have nearly doubled in all sections surveyed between Clancy's estimates and estimates conducted in 1990 to 1992. I am unsure of the exact cause of the low densities of cutthroat in the early to mid-1980's, but Clancy speculated that winter conditions may have caused excessive mortalities.

It appears that most of the recruitment for Mill Creek above Snowbank Campground comes from the area of Temple Hills and above as evidenced by the higher numbers of cutthroat trout under 6.0 inches in these sections (Figure 32). The section near Snowbank Campground (Log Jam) and the Mogen Section had relatively higher numbers of 6.0 inch and longer fish than those under six inches when contrasted to the other two sections. The Temple Hills (Pool Section) and Debris sections were the sections which were located closest to the fire that burned during 1991. It appears that the cutthroat trout populations within these sections, especially fish 4.0 to 5.9 inches, were reduced from 1990 to 1991, probably as a result of the Thompson Creek fire and suppression efforts involved with that fire (Figure 32). We observed streambank damage caused by heavy equipment in this area.

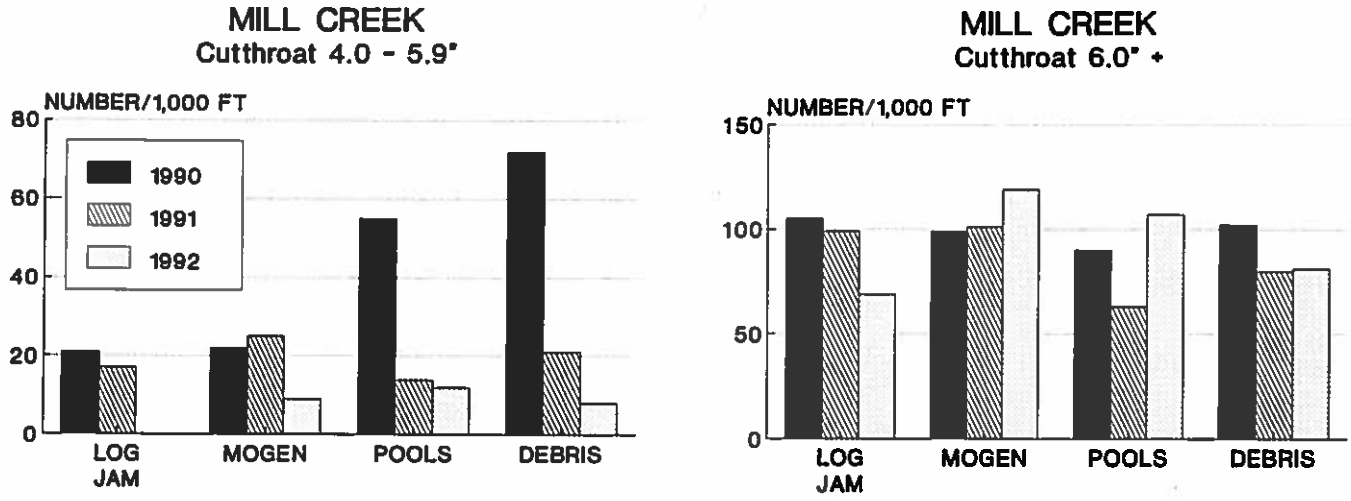


Figure 32. Estimated number of two length groups of cutthroat trout per 1,000 feet in four sections of Mill Creek during 1990, 1991 and 1992.

Mission Creek

In 1985, 1986, 1987, and 1991 a 550 foot sample section of Mission Creek located immediately below the County Road bridge near the Triangle 7 Ranch (T02S;R11E,Sec33) was electrofished twice each year to obtain population estimates. On August 20, 1991 the Triangle 7 section supported an estimated 36 Yellowstone cutthroat trout 6.5 to 12.9 inches in length (SE: 6) and 319 brown trout 4.0 to 14.4 inches in length (SE: 15). Nine rainbow trout were also captured. The nine rainbow trout averaged 8.6 inches (range: 5.8-10.0) and 0.24 pounds. These rainbow trout probably originated from a private fish pond owned by the 63 Ranch and located within the Mission Creek channel upstream from the section. The average length and weight of the 41 captured Yellowstone cutthroat were 7.5 inches (range: 3.2-12.8) and 0.19 pounds (Figure 33). The average lengths and weights of the 272 captured brown trout were 9.4 inches (range: 1.7 - 14.4) and 0.35 pounds (Figure 34).

Table 9. Summary of electrofishing information for Mission Creek including stream, legal description of sample site, date electrofished, species (see Table 4 for codes), total number of fish captured in first pass (and standardized to number captured per 1,000 feet of stream length), number of fish 6 inches and longer captured in first pass (and standardized to number captured per 1,000 feet of stream length), estimated total number of fish, estimated number of fish 6 inches and longer, and average length (in) and weight for captured fish.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1		Estimated number			
			Total (range) #/1,000'	6 in + (range) #/1,000'	Total (range) #/1,000'	6 in + (range) #/1,000'	Average length (range)	Average weight (range)
MISSION CREEK T01SR11E29 (05/21/74)	1000	RB	2	1	0	0	5.9	0.06
			(5.7- 6.0)		(0.0- 6.0)		(5.7- 6.0)	(0.04- 0.07)
			2	1	0	0		
		LL	39	27	0	0	10.9	0.69
			(4.1-18.5)		(0.0-18.5)		(4.1-18.5)	(0.03- 2.08)
			39	27	0	0		
		MWF	16	8	0	0	9.1	0.44
			(3.5-15.2)		(0.0-15.2)		(3.5-15.2)	(0.02- 1.26)
			16	8	0	0		
MISSION CREEK T01SR11E29 (07/10/74)	1000	LL	4	4	0	0	12.9	0.94
			(8.9-17.3)		(0.0-17.3)		(8.9-17.3)	(0.29- 1.85)
			4	4	0	0		
		RB	3	3	0	0	8.8	0.31
			(7.7-11.0)		(0.0-11.0)		(7.7-11.0)	(0.18- 0.52)
			3	3	0	0		
		MWF	19	18	0	0	10.5	0.59
			(5.9-17.0)		(0.0-17.0)		(5.9-17.0)	(0.07- 1.71)
			19	18	0	0		
MISSION CREEK T02SR11E17 (10/30/74)	350	LL	11	9	0	0	9.5	0.42
			(2.7-14.2)		(0.0-14.2)		(2.7-14.2)	(0.01- 0.97)
			31	26	0	0		
		YCT	1	0	0	0	5.0	0.04
			(5.0- 5.0)		(0.0- 5.0)		(5.0- 5.0)	(0.04- 0.04)
			3	0	0	0		
		RB	1	0	0	0	5.3	0.05
			(5.3- 5.3)		(0.0- 5.3)		(5.3- 5.3)	(0.05- 0.05)
			3	0	0	0		
MISSION CREEK T02SR11E (06/20/83)	7900	LL	49	49	0	0	13.7	1.02
			(8.7-17.1)		(0.0-17.1)		(8.7-17.1)	(0.26- 1.78)
			6	6	0	0		
		RB	9	9	0	0	13.0	0.82
			(10.6-15.5)		(0.0-15.5)		(10.6-15.5)	(0.38- 1.26)
			1	1	0	0		
		LL	10	10	0	0	13.0	0.88
			(8.2-16.7)		(0.0-16.7)		(8.2-16.7)	(0.21- 1.52)
			1	1	0	0		
MISSION CREEK T02SR11E (06/30/83)	7900	RB	1	1	0	0	11.3	0.46
			(11.3-11.3)		(0.0-11.3)		(11.3-11.3)	(0.46- 0.46)
			0	0	0	0		
		YCT	1	1	0	0	10.6	0.44
			(10.6-10.6)		(0.0-10.6)		(10.6-10.6)	(0.44- 0.44)
			0	0	0	0		

Table 9. Continued.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1: Total (range) #/1,000'	Number captured in pass 1: 6 in + (range) #/1,000'	Estimated number: Total (range) #/1,000'	Estimated number: 6 in + (range) #/1,000'	Average length (range)	Average weight (range)
MISSION CREEK T02SR11E33BA (07/24/85)	550	YCT	22 (3.7-11.1)	17	40 (6.0-11.1)	40	7.9 (3.7-11.1)	0.24 (0.03- 0.52)
			40	31	73	73		
		LL	69 (4.1-15.8)	61	121 (6.0-15.8)	121	10.1 (4.1-15.8)	0.49 (0.04- 1.35)
			125	111	220	220		
MISSION CREEK T02SR11E33BA (09/05/86)	550	YCT	21 (5.9-10.6)	20	54 (6.0-10.6)	54	8.4 (5.9-10.6)	0.24 (0.09- 0.46)
			38	36	98	98		
		LL	126 (4.2-14.8)	94	247 (4.5-14.8)	141	9.0 (4.2-14.8)	0.35 (0.04- 1.20)
			229	171	449	256		
MISSION CREEK T02SR11E33BA (09/08/87)	550	YCT	24 (3.5-12.6)	17	36 (6.5-12.6)	36	7.7 (3.5-12.6)	0.23 (0.04- 0.64)
			44	31	65	65		
		RB	11 (6.7-10.2)	11	0 (0.0-10.2)	0	8.2 (6.7-10.2)	0.00 (0.00- 0.00)
			20	20	0	0		
		LL	156 (4.8-15.3)	134	280 (4.5-15.3)	238	8.8 (4.8-15.3)	0.31 (0.05- 1.36)
			284	244	509	433		
MISSION CREEK T02SR11E33BA (08/20/91)	550	YCT	25 (3.2-12.8)	16	36 (6.5-12.8)	36	7.7 (3.2-12.8)	0.19 (0.03- 0.63)
			45	29	65	65		
		LL	184 (1.7-14.4)	161	319 (4.0-14.4)	262	9.7 (1.7-14.4)	0.35 (0.02- 1.03)
			335	293	580	476		
		RB	7 (5.8-10.0)	7	0 (0.0-10.0)	0	8.6 (5.8-10.0)	0.24 (0.07- 0.42)
			13	13	0	0		
MISSION CREEK T02SR11E32 (07/24/85)	100	RB	5 (11.7-13.5)	5	0 (0.0-13.5)	0	12.9 (11.7-13.5)	0.00 (0.00- 0.00)
			50	50	0	0		
		LL	2 (7.8-13.2)	2	0 (0.0-13.2)	0	10.5 (7.8-13.2)	0.00 (0.00- 0.00)
			20	20	0	0		
		YCT	2 (9.6-10.2)	2	0 (0.0-10.2)	0	9.9 (9.6-10.2)	0.00 (0.00- 0.00)
			20	20	0	0		

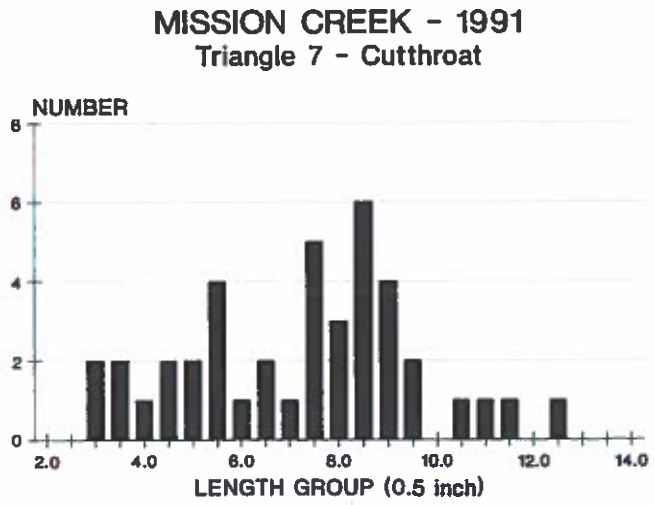


Figure 33. Length frequency histogram for Yellowstone cutthroat trout captured in the Triangle 7 Section of Mission Creek in 1991.

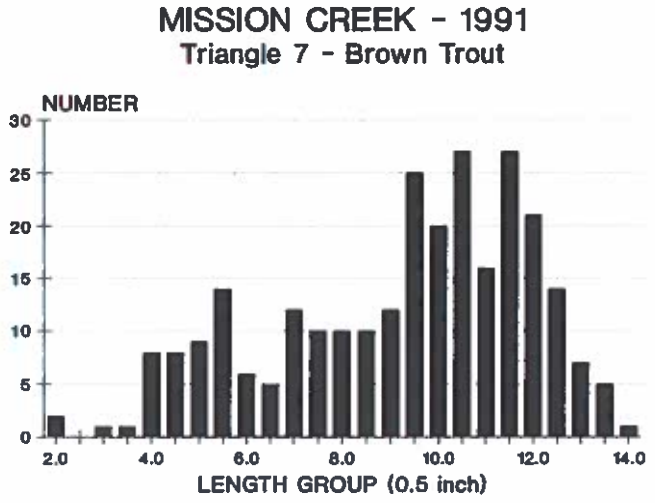


Figure 34. Length frequency histogram for brown trout captured in the Triangle 7 Section of Mission Creek in 1991.

On September 8, 1987 this section contained an estimated 36 Yellowstone cutthroat trout 6.5 to 13.5 inches in length (SE: 8), and 280 brown trout 4.5 to 15.9 inches in length (SE: 18). A total of 17 rainbow trout were captured, of which seven were identified as being of hatchery origin.

On September 5, 1986 this section supported an estimated 54 Yellowstone cutthroat trout 6.0 to 11.9 inches in length (SE: 12), and 247 brown trout 4.5 to 14.9 inches in length (SE: 33). Five rainbow trout and one rainbow/cutthroat hybrid were captured. Two of the rainbow trout were identified as hatchery fish, but three rainbow between 5.6 and 8.7 inches long may have been naturally produced in the system.

On July 24, 1985 this section supported an estimated 40 Yellowstone cutthroat trout 6.0 to 11.4 inches in length (SE: 8), and 121 brown trout 6.0 to 15.9 inches in length (SE: 10). Four rainbow trout identified as hatchery fish likely originating from the 63 Ranch pond were also captured. Two of the captured cutthroat trout were believed to have been hybridized to a certain degree with rainbow trout based on external morphological characteristics.

A sample section approximately 100 feet long was electrofished once on July 24, 1985. This section was located at the upper County Road crossing of Mission Creek (T02S;R11E; Sec32). A total of five rainbow, two brown (7.8 and 13.2 inches), and two cutthroat trout (9.6 and 10.2 inches) were captured. The five captured rainbow trout averaged 12.9 inches (range: 11.7-13.5) and most likely originated from the private fish pond on the 63 Ranch.

In 1983 a 1,000 foot section located near the mouth of Mission Creek (at the Hui ranch buildings) was electrofished twice, on June 20 and June 30, to document if spawning Yellowstone cutthroat or rainbow trout from the river were ascending Mission Creek. On June 20, 1983 49 brown, nine rainbow, and one cutthroat trout were captured. On June 30, 1983 ten brown, one rainbow (length of 11.3 inches), and one cutthroat trout (length of 10.6 inches) were captured.

Three sections of Mission Creek were sampled by Berg (1975) in 1974. On May 21, 1974 the 1,000 foot lower section (Section 1) located below the Interstate 90 bridge (T01S;R11E;Sec29) was electrofished once to document if Yellowstone cutthroat trout

spawners from the Yellowstone River were ascending Mission Creek to spawn. No Yellowstone cutthroat were captured, but two rainbow and 39 brown trout, along with 16 mountain whitefish, 3 longnose and 5 white suckers were captured. The average lengths (ranges) of captured fish were 5.9 inches (5.7-6.0) for rainbow trout, 10.9 inches (4.1-18.5) for brown trout, 9.1 inches (3.5-15.2) for mountain whitefish, and 14.9 (10.1-16.7) for longnose and 11.6 (8.2-14.9) for white suckers.

Another 500 foot section located near the railroad bridge (T01S;R11E;Sec29) was electrofished once on July 10, 1974, to again document if any Yellowstone cutthroat spawners ascended Mission Creek. Again, no cutthroat were captured, but 19 whitefish, four brown trout, and three rainbow trout were captured. Average lengths (ranges) of captured fish were 10.5 inches (6.1-17.0) for mountain whitefish, 12.9 inches (8.9-17.3) for brown trout, and 8.8 inches (7.7-11.0) for rainbow trout.

On October 30, 1974 a 350 foot section (Section 2) located approximately six miles up Mission Creek (T02S;R11E;Sec17) was electrofished once. A total of 11 brown, one Yellowstone cutthroat (length of 5.0 inches), four hybrids between cutthroat and rainbow, and one rainbow trout (length of 5.3 inches) were captured. The average lengths (ranges) were 9.5 inches (2.7-14.2) for captured brown trout and 7.4 (4.8-9.6) for captured rainbow/cutthroat hybrids.

The owners of the 63 Ranch voluntarily agreed to convert their private pond from a rainbow trout fishery to a Yellowstone cutthroat trout fishery in 1991. On July 1, 1991 MDFWP electrofished their pond to remove as many rainbow trout as possible. A total of 38 rainbow trout were taken out of the pond and 15 were removed from Mission Creek within 500 feet immediately above the pond. The presence of rainbow trout fry (1.7 to 3.2 inches) and one year old rainbow (5.8 to 6.1 inches) in this portion of the creek indicated some natural rainbow trout reproduction had occurred.

Population Trends

Based on sample surveys done in the 1970's Mission Creek apparently did not support significant, if any, spawning runs of Yellowstone cutthroat trout. Recent fry trapping during 1991 and 1992 also failed to document any cutthroat trout fry moving out of Mission Creek to the Yellowstone River. Mission Creek

supports primarily brown and rainbow trout in its lower reaches, but Yellowstone cutthroat trout are present at low numbers. The Triangle 7 Section of Mission Creek has a brown trout population which has progressively increased since 1985 (Figure 35). The Yellowstone cutthroat trout population in this section is presently co-existing with brown trout, but the recent trend in cutthroat numbers indicates the population may be slowly declining (Figure 35).

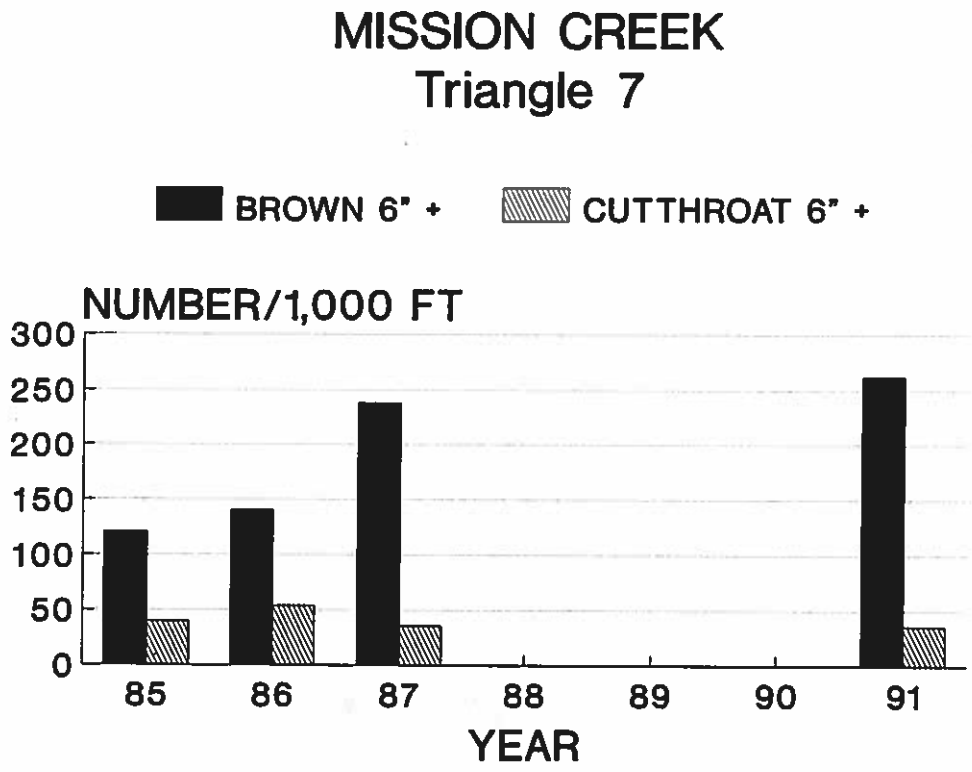


Figure 35. Estimated number of Yellowstone cutthroat and brown trout per 1,000 feet of Mission Creek within the Triangle 7 Section from 1985 to 1991.

Sixmile Creek

Two 1,000 foot long sections of Sixmile Creek have been electrofished in recent years to estimate fish populations. The Bridge Section (T06S;R08E;Sec32) extends 500 feet on each side of the Forest Service Road #348 bridge. The Horsethief Section (T07S;R08E;Sec09) is located at the mouth of the North Fork.

Bridge Section

A mark-recapture population estimate was conducted on the Bridge Section on August 19 and 26, 1991. A total of 162 brown trout and four Yellowstone cutthroat trout were captured. The 162 brown trout averaged 7.8 inches long (range: 3.5-13.3) and 0.23 pounds (Figure 36). The four cutthroat trout averaged 7.3 inches long (range: 5.0 - 11.4) and 0.21 pounds. The section supported an estimated 221 brown trout from 3.5 to 13.5 inches in length (SE: 17)(Table 10). No estimate was made for cutthroat trout.

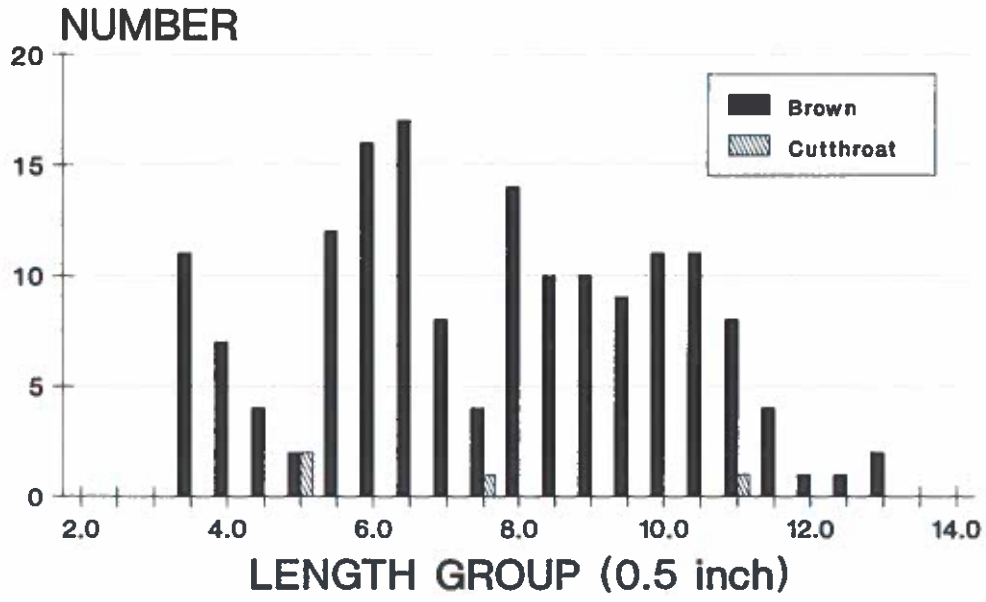


Figure 36. Length frequency histograms of brown and cutthroat trout captured in the Bridge Section of Sixmile Creek during August 1991.

Table 10. Summary of electrofishing information for Sixmile Creek including stream, legal description of sample site, date electrofished, species (see Table 4 for codes), total number of fish captured in first pass (and standardized to number captured per 1,000 feet of stream length), number of fish 6 inches and longer captured in first pass (and standardized to number captured per 1,000 feet of stream length), estimated total number of fish, estimated number of fish 6 inches and longer, and average length (in) and weight for captured fish.

Stream Legal (Date)	Section length (ft)	Species	Number captured in pass 1 Total (range) #/1,000'	Number captured in pass 1 6 in + (range) #/1,000'	Estimated number Total (range) #/1,000'	Estimated number 6 in + (range) #/1,000'	Average length (range)	Average weight (range)
SIXMILE CREEK	500	LL	38	28	0	0	7.6	0.23
T06SR08E29			(3.8-13.8)		(0.0-13.8)		(3.8-13.8)	(0.02- 0.82)
(08/09/74)			76	56	0	0		
SIXMILE CREEK	340	LL	3	3	0	0	7.6	0.19
T06SR08E32			(6.5- 9.1)		(0.0- 9.1)		(6.5- 9.1)	(0.11- 0.31)
(08/14/68)			9	9	0	0		
SIXMILE CREEK	1000	LL	76	65	168	158	9.0	0.36
T06SR08E32			(4.1-15.5)		(5.0-15.5)		(4.1-15.5)	(0.04- 2.08)
(09/06/85)			76	65	168	158		
		YCT	4	2	0	0	7.6	0.26
			(5.5-11.1)		(0.0-11.1)		(5.5-11.1)	(0.07- 0.62)
			4	2	0	0		
SIXMILE CREEK	1000	LL	118	108	215	215	8.5	0.27
T06SR08E32			(4.5-13.0)		(6.0-13.0)		(4.5-13.0)	(0.04- 0.83)
(09/02/87)			118	108	215	215		
		YCT	11	7	0	0	7.8	0.24
			(3.5-11.1)		(0.0-11.1)		(3.5-11.1)	(0.03- 0.51)
			11	7	0	0		
SIXMILE CREEK	1000	YCT	3	1	0	0	7.3	0.21
T06SR08E32			(5.0-11.4)		(0.0-11.4)		(5.0-11.4)	(0.05- 0.57)
(08/19/91)			3	1	0	0		
		LL	104	87	221	169	7.8	0.23
			(3.5-13.3)		(3.5-13.3)		(3.5-13.3)	(0.03- 1.00)
			104	87	221	169		
SIXMILE CREEK	340	YCT	3	1	0	0	5.0	0.07
T07SR08E09			(4.5- 6.0)		(0.0- 6.0)		(4.5- 6.0)	(0.05- 0.11)
(08/14/68)			9	3	0	0		
		LL	2	2	0	0	9.2	0.42
			(6.1-12.2)		(0.0-12.2)		(6.1-12.2)	(0.11- 0.73)
			6	6	0	0		
SIXMILE CREEK	1000	YCT	41	36	65	65	7.8	0.23
T07SR08E09			(4.7-11.4)		(6.0-11.4)		(4.7-11.4)	(0.05- 0.72)
(09/24/85)			41	36	65	65		
		LL	11	10	0	0	10.3	0.57
			(5.4-14.7)		(0.0-14.7)		(5.4-14.7)	(0.05- 1.21)
			11	10	0	0		
SIXMILE CREEK	1000	LL	55	36	109	60	7.6	0.23
T07SR08E09			(3.2-12.9)		(3.5-12.9)		(3.2-12.9)	(0.03- 0.76)
(08/19/91)			55	36	109	60		
		YCT	35	18	66	31	6.4	0.16
			(3.8-11.2)		(3.5-11.2)		(3.8-11.2)	(0.03- 0.62)
			35	18	66	31		

Streambed substrate embeddedness (Burns 1984) was measured near the Forest Service Road #348 bridge on October 20, 1986 (Clancy 1987). He found that the embeddedness averaged 22% and the percentage of "free matrix particles" was 49%. This result indicates a relatively healthy streambed free of fine material.

Horsethief Section

A mark-recapture population estimate was conducted on the Horsethief Section on August 19 and 26, 1991. A total of 72 brown trout and 59 Yellowstone cutthroat trout were captured. The 72 brown trout averaged 7.2 inches long (range: 3.2-12.9) and 0.20 pounds (Figure 37). The 59 cutthroat trout averaged 6.1 inches long (range: 2.4-11.2) and 0.14 pounds (Figure 37). The section supported an estimated 109 brown trout from 3.5 to 12.9 inches in length (SE: 18). The section supported an estimated 65 cutthroat trout from 3.5 to 11.4 inches in length (SE: 6).

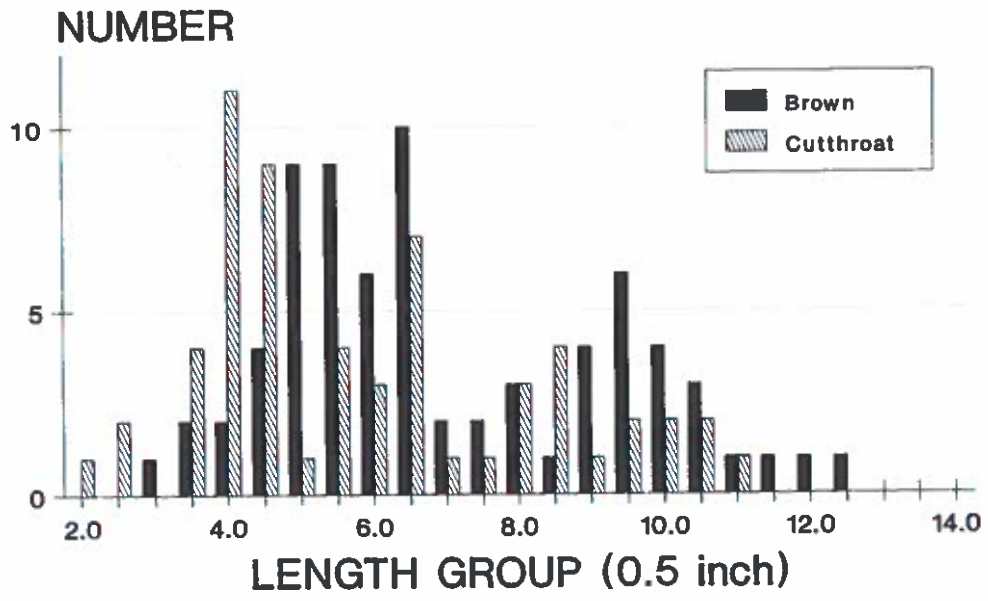


Figure 37. Length frequency histograms of brown and Yellowstone cutthroat trout captured in the Horsethief Section of Sixmile Creek during August, 1991.

Clancy (1987) and MDFWP information (files, Livingston) found that the Horsethief Section supported 65 (SE: 8) Yellowstone cutthroat trout 6.0 inches and longer in 1985 and 42 (SE: 5) 7.0 inches and longer in 1987. There were an estimated 31 and 18 cutthroat trout six inches and longer and seven inches and longer, respectively, in 1991.

Population Trends

It appears that cutthroat trout numbers have declined in upper Sixmile Creek within the last few years, in spite of the regulation change in 1988 to catch and release for all trout species in the Sixmile drainage. Part of the reason for initiating this catch and release regulation was because public access into the Sixmile Creek drainage was opened up in 1988 by the Forest Service. MDFWP information (files, Livingston) indicated that brown trout numbers could not be estimated in 1985 (a total of 13 were captured during electrofishing) and brown trout numbers increased to an estimated 89 (SE: 10) fish 6.0 inches and longer in 1987. While the number of brown trout declined slightly in 1991, probably because of the drought conditions in 1987 and 1988, their numbers are still high compared to 1985 (Figure 38). The probable poor 1988 and 1989 year classes caused by low water during the winter incubation periods of 1987/88 and 1988/89 were probably the reason for the lower numbers of brown trout in 1991 compared to 1987.

The shift in species abundance within the Horsethief Section from a trout population dominated by cutthroat trout in 1985 to one dominated by brown trout in 1991 probably was a result of several factors (Figure 38). Brown trout populations are probably pioneering up into Sixmile Creek and cutthroat trout are likely being out-competed and/or preyed upon by brown trout. The additional fishing pressure resulting from increased public access into the upper drainage may be causing more angling related mortality on cutthroat trout than brown trout. The drought years of 1987 and 1988 probably reduced habitat availability and may have resulted in more intense competition between cutthroat and brown trout and increased predation by brown trout on cutthroat trout.

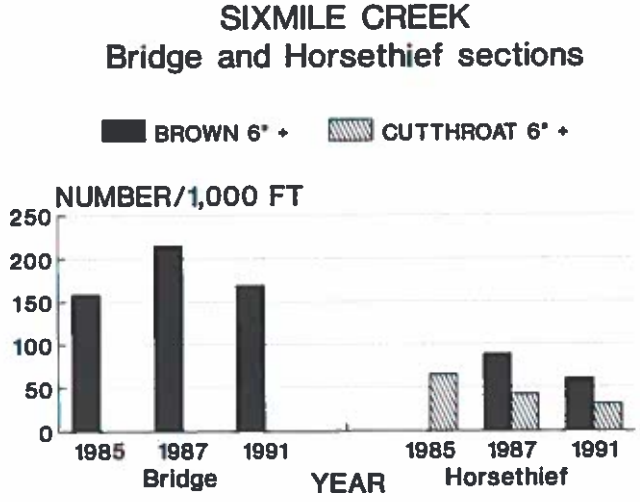


Figure 38. The number of Yellowstone cutthroat and brown trout 6.0 inches and longer (7.0 inches and longer for brown trout in the Horsethief Section during 1987) in the Bridge and Horsethief sections of Sixmile Creek from 1985 to 1991.

Streambed substrate embeddedness (Burns 1984) was measured near the North Fork on October 20, 1986 (Clancy 1987). He found that the embeddedness averaged 16% and the percentage of "free matrix particles" was 58%. This result indicates a relatively healthy streambed free of fine material.

West Fork Mill Creek

A 1,000 foot long section at the first bridge over the West Fork Mill Creek on the Forest Service Road (T06S;R09E;Sec25) was electrofished three times on October 23 and 28 and November 5, 1992 to estimate fish populations within this portion of the creek. A total of 52 cutthroat trout and one rainbow trout were

captured. This rainbow trout represented the first documented rainbow trout within the Mill Creek drainage above the National Forest boundary. The rainbow trout was killed to minimize the potential for hybridization with native Yellowstone cutthroat trout. Perhaps the old irrigation diversion structure located near the Forest boundary which was replaced as part of the Mill Creek irrigation pipeline project acted as an effective barrier to upstream movement by rainbow trout from lower in the basin. Replacement of this barrier should be considered if maintenance of a genetically pure resident Yellowstone cutthroat trout population in upper Mill Creek is a management goal.

The 52 cutthroat trout averaged 8.2 inches in length (range: 3.3-12.7) and 0.28 pounds (range: 0.03-0.86). This 1,000 foot section supported an estimated 65 (SE: 9) cutthroat from 4.5 to 12.9 inches long using a mark-recapture estimator. Of these 65 cutthroat, an estimated 53 were 6.0 inches and longer and an estimated 37 were 8.0 inches and longer. Only five fish under 5.0 inches were captured (Figure 39).

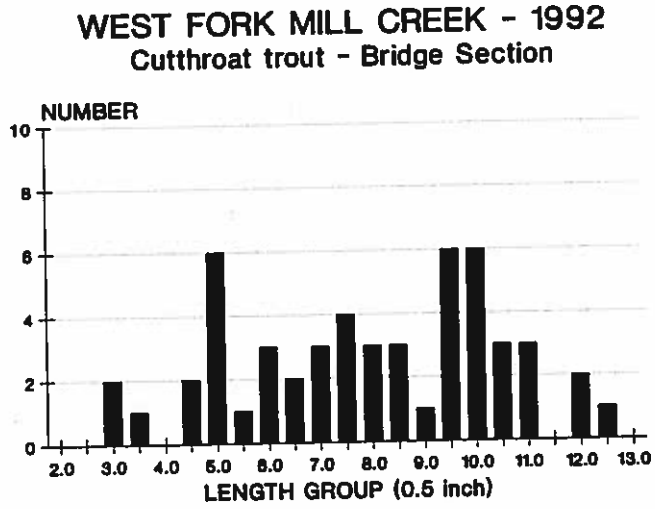


Figure 39. Length frequency distribution of cutthroat trout captured in the West Fork of Mill Creek during 1992.

Clancy (1985) estimated this same section of the West Fork of Mill Creek supported 27 (SE: 5) cutthroat trout 6.5 inches and longer in September 1984. The estimated number of cutthroat 6.5 inches and longer in 1992 was 52, almost double the 1984 estimate. This result is similar to the population increases observed in main Mill Creek cited above.

Administration of 310 Permits

A total of 46 310 permit applications were reviewed in 1991 and 69 were reviewed through September 1992.

TRENDS IN YELLOWSTONE CUTTHROAT POPULATIONS

In general, Yellowstone cutthroat trout populations within the upper Yellowstone River basin of Montana has been declining since, at least, 1974. While cutthroat trout populations in the main Yellowstone River appear to be strong and improving, most of the cutthroat trout within the Yellowstone River have hybridized to varying degrees with rainbow trout (Shepard 1992). Comparing population trends for tributaries sampled over time found that while cutthroat populations have increased recently at some sites, most notably the Mill Creek drainage (Table 9), population trends for many sites have declined (Shepard 1991). Within the Mill Creek drainage, the cutthroat population may be at risk due to the presence of rainbow trout in the drainage. This was documented in 1992 by the capture of a rainbow trout in the West Fork Mill Creek. It is likely that this rainbow moved up from the lower drainage past an irrigation diversion which was replaced with an underground collection facility. The old diversion was probably a barrier to upstream fish movement. The hybridization of rainbow with cutthroat has occurred in many waters once containing pure populations of cutthroat trout (Table 11).

The Shields River drainage above Clyde Park has historically been a relatively secure refuge for Yellowstone cutthroat trout because few, if any, rainbow trout successfully moved up the Shields River past the Chadbourne diversion below Clyde Park. Rainbow trout are present in private fish ponds within the Shields River drainage above Clyde Park. Unfortunately most of these ponds were licensed prior to 1988, when Yellowstone cutthroat trout were made commercially available. Rainbow trout

Table 11. Genetic status of cutthroat trout populations in the upper Yellowstone River drainage. Information is based on samples submitted for electrophoretic analysis; additional samples will be collected and analyzed in the future. Y = pure Yellowstone cutthroat trout; YxR = hybridization between Yellowstone cutthroat and rainbow trout; YxW = hybridization between Yellowstone and westslope cutthroat trout; YxRxW = hybridization between all three trout.

Water	Sample location	Collection date	Sample size	Genetic status	Hadley classification[1]/
YELLOWSTONE RIVER (below Springdale)					
Boulder River	T6S;R12E;S28	08/01/89	24	Y	NC
	T4S;R13E;S23	08/17/90	26	Y	NC
Bridge Creek	T6S;R12E;S21	08/02/89	25	YxR	NC
Crooked Creek				Y	4
Davis Creek	T3S;R11E;S26	09/26/89	25	YxR	NC
E.Boulder River	T5S;R13E;S11	08/22/89	29	Y	NC
E.F.Boulder River	T6S;R12E;S28	08/02/89	26	YxW	NC
	T7S;R12E;S03	09/06/90	23	YxW	NC
Hawley Creek	T6S;R12E;S01	09/06/90	2	Y	NC
Lower Deer Creek	T2S;R15E;S29	08/31/89	25	Y	4
Placer Gulch	T2S;R15E;S31	08/02/90	10	Y	NC
S.F.Boulder River	T7S;R12E;S17	08/01/89	7	Y	NC
Upper Deer Creek	T3S;R14E;S15	08/15/89	26	Y	3
W.Boulder River	T4S;R11E;S28	09/21/89	25	YxRxW	5
YELLOWSTONE RIVER (above Springdale)					
Anderson Creek	T6S;R10E;S34	10/10/86	25	Y	4
Area Creek	T2S;R08E;S11	10/14/86	25	YxR	2
Bear Creek	T9S;R09E;S04	08/20/81	?	Y 3/	5
Big Creek	T6S;R06E;S23	07/02/87	14	YxR	5
	T6S;R06E;S24	07/02/87	11	YxR	5
Billman Creek	T2S;R08E;S13	10/09/86	19	Y	5
Cinnabar Creek	T8S;R07E;S32	10/03/86	15	YxR	NC
Coke Creek	T2S;R08E;S26	07/31/86	25	YxR	NC
Donahue Creek	T7S;R07E;S06	09/29/89	26	Y	NC
E.F. Bear Creek	T9S;R09E;S04	10/01/86	10	YxR	NC
E.F. Mill Creek	T6E;R10E;S18	07/22/87	20	Y	NC
Eagle Creek	T9S;R08E;S13	10/01/86	25	YxR	2
Little Mission Creek	T3S;R11E;S14	06/12/87	21	Y	4
	T3S;R11E;S14	09/11/89	25	YxR	4
Little Trail Creek	T9S;R08E;S09	10/01/86	4	YxR	4
Mill Creek	T6S;R10E;S32/34	08/31/86	8	Y	NC
		09/29/88	15	Y	NC
Mill Fork Mission Creek	T3S;R11E;S04	10/ /86	21	Y	NC
Miner Creek	T2S;R08E;S27	10/09/86	28	Y	NC
Mission Creek	T2N;R11E;S33	09/29/88	12	YxR	5
Mol Heron Creek	T8S;R07E;S25	10/03/86	29	YxR	5
N.F. Bear Creek	T9S;R09E;S04	10/01/86	10	YxR	NC
Passage Creek	T7S;R10E;S08	09/29/88	23	Y	NC
Reese Creek		07/26/90	25	YxR	NC
Rock Creek	T7S;R07E;S19	09/30/86	25	Y	4
Sheep Creek	T8S;R06E;S17	09/07/89	17	Y	NC
Sixmile Creek	T7S;R08E;S09	10/10/86	25	Y	4
Skully Creek	T8S;R06E;S07	09/07/89	25	Y	NC

Table 11. Continued.

Water	Sample location	Collection date	Sample size	Genetic status	Hadley classification[1]/
Soda Butte Creek	T9S;R14E;S33	09/06/89	25	YxW	4
Suce Creek	T3S;R10E;S16	06/12/87	16	Y	5
Tom Miner Creek	T8S;R06E;S09	09/30/86	25	Y	4
	T8S;R06E;S09	09/30/89	25	Y	4
	T8S;R06E;S17	09/07/89	25	Y	4
Trail Creek	T8S;R05E;S24	08/30/89	25	Y	NC
W.F. Mill Creek	T6E;R09E;S35	07/22/87	20	Y	NC
West Pine Creek	T4S;R08E;S05	09/29/88	21	YxR	NC
Yellowstone River	T3S;R09E;S01 T7S;R07E;S20	11/02/83	40	YxR	NC
SHIELDS RIVER DRAINAGE					
Bangtail Creek	T1N;R09E;S29	08/07/90	12	Y	3
Bennett Creek	T5N;R10E;S24	08/16/90	10	Y	4
Brackett Creek	T1N;R07E;S05	06/19/87	20	Y	4
Carrol Creek	T3N;R07E;S34	09/10/90	19	Y	NC
Deep Creek	T5N;R10E;S26	07/27/90	10	Y	4
E.F.Smith Creek	T6N;R10E;S06	10/20/88	9	Y	NC
Fairy Creek	T2N;R06E;S24	08/13/90	3	Y	NC
Flathead Creek	T2N;R07E;S26	09/10/90	9	Y	4
Lodgepole Creek	T5N;R11E;S16	86	4	Y	4
M.F. Brackett Creek	T1N;R07E;S07	07/23/87	21	Y	NC
Mill Creek	T5N;R10E;S27	07/29/90	11	Y	NC
N.F. Brackett Creek	T1N;R07E;S05	07/23/87	21	Y	NC
Rock Creek	T2N;R11E;S08/09	10/06/88	19	Y	4
S.F. Carrol Creek	T2N;R07E;S08	08/07/90	7	Y	NC
S.F.Flathead Creek	T3N;R06E;S34	07/03/90	7	Y	NC
Scofield Creek	T5N;R11E;S21	08/16/90	10	Y	2
Shields River	T5N;R11E;S18	10/20/88	22	Y	4
	T5N;R11E;S18	07/28/89	25	Y	4
Smith Creek	T6N;R10E;S06	10/20/88	23	Y	NC
Turkey Creek	T5N;R11E;S21	86	13	Y	NC
POPULATIONS OUTSIDE OF HISTORIC RANGE					
Hellroaring Creek	T5S;R03E;S25	08/27/90	14	Y	NC
Ramshorn Lake	T8S;R04E;S09	89	25	Y	NC

1/ Hadley classification system as follows: NC = no classification; 1 = genetically pure verified by electrophoresis; 2 = genetic purity based on external characteristics and absence of contaminating or competing species; 3 = genetic purity based on external characteristics and no record of contaminating species present or stocked in the past; 4 = genetic purity based on external characteristics and an absence of contaminating species, but contaminating species may have been stocked in the past; 5 = genetic purity based on external characteristics and contaminating species known to be present.

2/ Based on an unknown number of samples collected by Dick Oswald and identified by Jim Roscoe (Oswald 1982).

have been captured in some waters of the upper Shields River. These rainbow trout probably originated from private fish ponds. The presence of rainbow trout places the genetic purity of conspecific cutthroat trout populations at risk. Recent sampling has also documented the movement of brook and brown trout into waters not previously inhabited by these species and population expansion by these species in waters which they co-inhabit with cutthroat trout.

The risks to Yellowstone cutthroat trout populations inhabiting the upper Yellowstone River basin in Montana have increased due to:

1) expansion of exotic brook, rainbow, and brown trout populations into habitat historically occupied by cutthroat trout;

2) habitat degradation caused by improper subdivision and homesite development (especially construction and stocking of private fish ponds), logging, road building, grazing, and farming practices; and

3) increased angling pressure due to increases in local and regional populations.

Rieman and McIntyre (1993) suggested strategies for conserving bull trout which should apply to Yellowstone cutthroat trout. Several of these strategies are being incorporated into a management guide for Yellowstone cutthroat trout being prepared by a Work Group under the direction of the MDFWP (YCTWG in prep.). Until that Guide is completed and implemented I recommend an aggressive program to preserve existing populations of Yellowstone cutthroat trout including:

1) Designating the upper Shields River from the Chadbourne diversion upriver as a special Yellowstone Cutthroat Trout Management area and emphasize fishery management actions which protect Yellowstone cutthroat trout.

2) Within the upper Shields River from the South Fork of the Shields River upstream, creating a Yellowstone Cutthroat Trout Refuge where an aggressive policy of instream flow and habitat protection ensures the continued connectivity of the river-tributary system and maintaining existing areas of high quality habitat.

3) Changing the fishing regulations to allow only catch-and-release fishing for Yellowstone cutthroat trout in streams and rivers (NOTE: This was proposed and adopted).

4) Consider re-constructing a fish barrier in Mill Creek in the vicinity of the old irrigation diversion structure to prevent rainbow trout from moving up into the drainage.

5) Test the feasibility of removing exotic conspecific trout from waters inhabited by Yellowstone cutthroat trout. Priority should be given to waters in the upper Shields River basin above the South Fork Shields.

ACKNOWLEDGEMENTS

Bob Wiltshire and Gary Senger were the field technicians during all of this study. Their assistance in the field and office was appreciated. Scot Shuler of the Gallatin Forest assisted with the Mill Creek study. Bob McFarland assisted with data entry and analyses.

REFERENCES

Berg, R.K. 1975. Fisheries inventory and plan, Job I-a. Pages 4-125 in Fish and Game Planning, Upper Yellowstone and Shields River Drainages. Federal Aid to Fish and Wildlife Restoration Project FW-3-R, Montana Department of Fish and Game, Environment and Information Division, Helena, Montana.

Clancy, C.G. 1984. Southwest Montana fisheries investigations: Inventory and survey of waters in the project area. Job Number 1-c, Project Number F-9-R-32, Federal Aid to Fisheries Job Progress Report, Fisheries Division, Montana Department of Fish, Wildlife and Parks, Bozeman, Montana.

Clancy, C.G. 1985. Southwest Montana fisheries investigations: Inventory and survey of waters in the project area. Job Number 1-c, Project Number F-9-R-33, Federal Aid to Fisheries Job Progress Report, Fisheries Division, Montana Department of Fish, Wildlife and Parks, Bozeman, Montana.

Clancy, C.G. 1987. Southwest Montana fisheries investigations: Inventory and survey of waters in the project area. Job Number 1-c, Project Number F-9-R-35, Federal Aid to Fisheries Job Progress Report, Fisheries Division, Montana Department of Fish, Wildlife and Parks, Bozeman, Montana.

Clancey, T.P. 1983. Effects of renovation on the Sacajawea Park Lagoon system in Livingston, Montana. M.S. thesis, Montana State University, Bozeman, Montana.

Foster, G.M. and B.E. May. 1990. Distribution of Yellowstone and westslope cutthroat trout in the Gallatin National Forest (Update). Gallatin National Forest, Bozeman, Montana.

Hadley, K. 1984. Status report on the Yellowstone cutthroat trout (Salmo clarki bouvieri) in Montana. Fisheries Division, Montana Department of Fish, Wildlife, and Parks, Helena, Montana.

Inter-Fluve, Inc. 1989. Design specifications for enhancement of trout winter habitat in Mill Creek. Inter-fluve, Inc., Bozeman, Montana.

Irving, J.S. and T.C. Bjornn. 1984. Effects of substrate size composition on survival of kokanee salmon and cutthroat and rainbow trout. Technical Report 84-6, Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow.

Leary, R.F., Allendorf, F.W. and K.L. Knudsen. 1987. Genetic divergence among populations of Yellowstone cutthroat trout in the Yellowstone River drainage, Montana. Population Genetics Laboratory Report 87/2. University of Montana, Missoula, Montana.

Merry, R. 1987. Mark/recapture system MRSYS version 1.2. Research Bureau, Fisheries, Montana Department of Fish, Wildlife and Parks, Bozeman, Montana.

Oswald, R.A. 1982. A fisheries inventory of Bear Creek prior to proposed mineral mining at Jardine, Montana. Prepared for Homestake Mining Company, Golden, Colorado by Montana Department of Fish, Wildlife and Parks, Bozeman, Montana.

Prather, K.V. 1971. The effects of stream substrates on the distribution and abundance of aquatic insects. M.S. thesis, University of Idaho, Moscow, Idaho.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302, U.S. Deparmtent of Agriculture, Forest Service, Intermountain Research Station, Boise, Idaho.

Sage, G.K. and R.F. Leary. 1990. Genetic analysis of trout populations in the Yellowstone, Gallatin, and Madison river drainages, Montana. Population Genetics Laboratory Report 90/1, Division of Biological Sciences, University of Montana, Missoula, Montana.

Shepard, B.B. 1991. Fisheries of tributaries to the upper Yellowstone River system: Annual report for 1989 and 1990. Progress Report for Federal Aid Project F-46-R-2, Job I-f, Montana Department of Fish, Wildlife and Parks, Bozeman, Montana.

Shepard, B.B. 1992. Fisheries of the upper Yellowstone River including tributary recruitment: Annual Report for 1989, 1990, and 1991. Progress Report for Federal Aid Project F-46-R-2, Job I-f, Montana Department of Fish, Wildlife and Parks, Bozeman, Montana.

Software Publishing Corporation. 1987. Harvard Graphics, version 2.0. Mountain View, California.

Van Deventer, J.S. and W.S. Platts. 1986. Documentation for MICROFISH 2.2: A software package for processing electrofishing data obtained by the removal method. Forestry Sciences Laboratory, Boise, Idaho.

YCTWG. in prep. DRAFT - Yellowstone cutthroat trout (Oncorhynchus clarki bouvieri) management guide for the Yellowstone River drainage. Montana Department of Fish, Wildlife and Parks, Helena, Montana.

WATERS REFERENCED

Water name	Water code
Fleshman Creek	22-2562
Little Mission Creek	22-3724
Mill Creek	22-4172
Mill Fork Creek	22-4221
Mission Creek	22-4242
Shields River	22-5334
Shields River	22-5362
Sixmile Creek	22-5502
West Fork Mill Creek	22-6636