F-78-R-3 I
Region 5

MONTANA FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

State:	**MONTANA**	**Element 1:**	**FISHERIES MANAGEMENT**
Project No:	**F-78-R-3**	**Job No:**	**I-i**
Project Title:	**STATEWIDE FISHERIES INVESTIGATION**	**Job Title:**	**MID-YELLOWSTONE DRAINAGE INVESTIGATIONS**

PROJECT PERIOD: JULY 1, 1994 THROUGH JUNE 30, 1997

ABSTRACT

We sampled trout populations in the 5.5 mile Laurel section (Figure 1) of the Yellowstone River in 1995 and 1997. Estimates from 1995 are about the same as those from 1993 for all. Brown trout estimates for 1997 are up 67% from 1995 numbers, while rainbow trout populations decreased 62% from 1995 to 1997.

We completed trout population estimates in the 7.1 mile Big Timber section of the Yellowstone River in 1995 and 1997. Estimates for both brown and rainbow trout from 1995 are about the same as those from 1989. Brown trout estimates for 1997 are down 18% from 1995 numbers, while rainbow trout estimates decreased 31% from 1995 to 1997.

Snorkeling surveys of fish populations in the Aller section of the Boulder River conducted in 1995 indicate the population of rainbows over 13 inches is down about 30% from similar surveys made in 1993. The count for fish less than 13 inches is about the same for both years.

Brown trout population estimates done in the B-2 section of the Boulder River in 1997 are down about 10% from the estimates made in 1994. Rainbow trout population estimates show an increase of 55% over the same period. Total trout populations within the B-2 section are up about 20% between 1994 and 1997.

Baseline fish population data updates done in the B-5 and B-6 sections of the East Boulder River show a decrease in B-5 of 7% from a 1977 estimate and 46% from a 1982 estimate. At B-6, the combined rainbow-brown population shows a decline of 100% from the last estimate done in 1989. Stillwater Mining Company did quite a bit of mine site development work in the drainage in 1997 and plans more work in 1998.

Fish population estimates done in the Moraine section of the Stillwater River in 1996 show a 57% increase in brown trout age two and older. Brown trout over 13.0 inches within Moraine have increased 41% since 1991. This increase in the brown trout population is probably a response to the more restrictive fish limits initiated in 1990.

Fish population estimates done in 1995 in the TO-Bar Ranch section of East Rosebud Creek show a decline of about 13% in the brown trout population from 1991. Brown trout age four and older show an increase of about 20% over the same time period. More restrictive fishing regulations implemented in 1994, apparently, are helping with a harvest-related problem on this stream reach.

During the spring of 1995, a new electrofishing section (Hansberger section) downstream from Roscoe on the East Rosebud was surveyed for the first time. This work involves monitoring fish populations and their response to a fish habitat improvement project undertaken on about a half-mile of the East Rosebud. The project objective is to increase habitat for larger fish. We estimated the total trout population at 3955 fish per mile with less than 2% of the trout over 13.0 inches.

Fish population estimates done in the Mackay section of West Rosebud Creek during 1994 show an increase of 23% over estimates made in 1986. Browns age four and older increased 300% during that period.

A section of the Clarks Fork of the Yellowstone River near Bridger was survey electrofished in the fall of 1994. The most abundant species collected were mountain whitefish followed by burbot, brown trout and longnose suckers. This reach of the Clarks Fork River has a limited population of desirable sport fish species.

Brown trout population estimates done in 1995 within the Fox section of Rock Creek show an increase of 96% over the 1993 numbers and are now near the ten-year average for this section. Rainbow trout increased 160% during the same period.

Brown trout population estimates done in 1995 within the Joliet section of Rock Creek show an increase of 56% for browns age two and older over estimates made in 1990. Too few rainbow trout inhabit this section to make an estimate.

Fish population estimates done on a section of Red Lodge Creek near Highway 78 show a mixed population of brown trout and mountain whitefish. Fish habitat in the area is limited.

Survey electrofishing in a 1000 ft section of Red Lodge Creek immediately below Cooney Reservoir shows a surprisingly healthy population of rainbow trout and walleyes. Although not abundant, the fish were in excellent condition.

As part of a long-term fish monitoring project associated with a watershed water quality improvement project implemented on Otter Creek, we sampled our established section in 1994. So far, brown trout numbers have declined slightly in our monitoring section since the project was completed in 1992.

Starting in 1994, in a cooperative project with the USFS, we have electrofished the headwaters of Soda Butte Creek each year attempting to eliminate brook trout from the stream. We also surveyed four other streams near Cooke City attempting to locate additional brook trout and westslope cutthroat populations.

We sampled 32 streams throughout the region as part of an ongoing cooperative project with the USFS to inventory purestrain Yellowstone cutthroat populations. We found genetically pure cutthroat in two streams, rainbow x cutthroat hybrids in two streams, westslope x Yellowstone cutthroat hybrids in one stream, and the genetic results are still pending on two other streams.

Brown trout eradication efforts were again undertaken on Bad Canyon Creek in 1995 and 1996. Work to increase the height of the fish barrier in Bad Canyon Creek was also completed in 1996.

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Streambanks and channels are protected from poorly designed projects through Montana Fish, Wildlife and Parks' (FWP) Natural Streambed and Land Preservation Act. Information on the latest technology available on design and operation of maintenance-free permanent irrigation headgate structures are made available to local Conservation District boards and Natural Resources Conservation Service personnel for dispersal to irrigators. FWP assists in sponsoring stream dynamics workshops for riparian landowners. FWP participates in land and water use planning projects and encourages beneficial floodplain management practices. Comments are submitted to county commissioners through the county planning process on proposed subdivisions which have the potential to impact riparian and floodplain habitats.

Minimum instream flows, determined in the Yellowstone River instream reservation process, are protected through FWP review of new water use permit applications. Water discharge permits by the U.S. Environmental Protection Agency and the Montana Department of Environmental Quality are reviewed. Timber sale plans, grazing allotment management plans, environmental assessments, and environmental impact statements are also reviewed to ensure adequate protection, mitigation, and compensation for fisheries resources. FWP assists the Stillwater Mining Company with their sediment monitoring program for rainbow trout spawning areas and reviews the results annually. We count numbers of spawning rainbow trout using these areas during spawning and compare them to previous years.

Using electrofishing methods described by Vincent (1971), we monitor trout population density in sections of the Yellowstone River, Rock Creek, the Stillwater River, Rosebud Creek, and the Boulder River (Figure 1). We use inventory electrofishing on portions of the mid-Yellowstone River to gather qualitative information about fish populations. We use two-pass fish population estimates as described by Leathe (1983) to monitor fish population density in Otter Creek, Red Lodge Creek, the East Boulder River, Soda Butte Creek, and the upper Clarks Fork of the Yellowstone River.

We used dry suits and snorkeling equipment while counting trout within Allers section of the Boulder River. We used backpack electrofishing equipment for the cutthroat inventory sampling, and on Otter Creek, Bad Canyon Creek, East Boulder River and Red Lodge Creek.

We calculated fish population estimates using the new MR4 log-likelihood method. Because the new method gives a more reliable estimate of the number of small and large fish when compared to the old Peterson method, the new MR4 estimates are not directly comparable to our prior estimates. For several fish population estimates, where both the sample size and number of recaptures were small, we used the modified Peterson method or a simple Peterson mark-recapture formula.

In an effort to improve access and better distribute fishing pressure, we are pursuing acquisition of additional access sites at three or more locations along the main stem Yellowstone and on both the East and West Rosebud Drainages.

RESULTS AND DISCUSSION

Yellowstone River

Laurel Section

The Laurel section of the Yellowstone River (Figure 1) extends about 29,040 feet from Buffalo Mirage Fishing Access Site to the Laurel Bridge. Laurel section ends about two miles upstream from the confluence of the Clarks Fork River. Fish population estimates were made in this section during the fall of 1995 and 1997 (Figure 2, Table 1). Nineteen ninety-five was a dry year with moderate rainfall and relatively low river flows during fall. Recapture efficiency rates, which averaged about 7.5% in 1993 (a wet year with high fall flows), increased to over 20% in 1995. A large snowpack along with heavy rains produced record high flows of moderate duration in 1996. Then in 1997, record snowpack resulted in new record high flows that lasted for several months. Abnormally long duration flood flows within the Yellowstone Drainage resulted in massive erosion and deposition, and greatly accelerated other natural fluvial geomorphological processes. Recapture efficiency rates for estimates made during August 1997, when fall flows were about average, are also relatively high at about 19% for brown trout and 24% for rainbow trout.

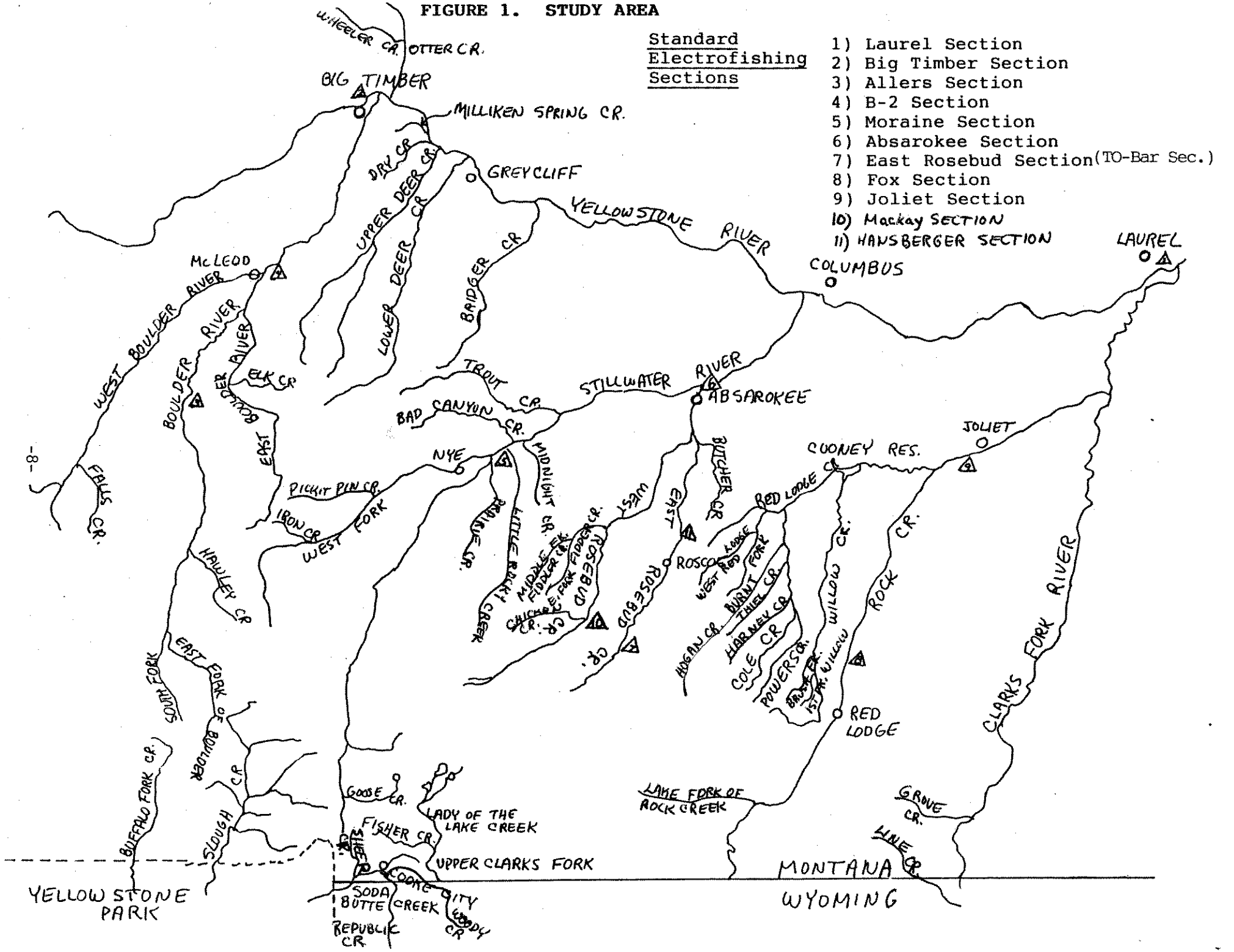
Both rainbow (4548) and brown trout (1305) estimates from 1995 are almost identical to corresponding estimates (rainbow 4572 and brown trout 1239) made in 1993 (Poore 1995). The total trout estimate for 1995 of 5853 is slightly higher than the 5811 estimated in 1993. Figure 2 gives the results of fish population estimates over the last ten years in the Laurel section.

Rainbow trout populations estimates for 1997 (1742) are down 62% from those made in 1995 (4548). All age classes declined except age one fish, with the most dramatic decline in age two and three fish 72% and 78%, respectively. This estimate is based on 83 recaptures from 349 marked fish (24%) and the standard deviations for the age classes averaged 21% which indicates a statistically reliable estimate.

Brown trout population estimates for 1997 (2179) increased 67% from those made in 1995 (1305). This estimate is based on 57 recaptures from 302 marked fish (19%) but the standard deviations for the age classes vary from 11% to 77% and average 40%, which indicates a statistically less reliable estimate. Sixty-one percent of the total recaptures are concentrated within brown trout from size group 8.0 to 9.9 inches. All age classes of brown trout increased except for the six and older age group. The most dramatic increases were in age classes two and three at 73% and 101%, respectively.

The low numbers of small fish plus the yearly variability between age classes indicate very limited reproduction and significant movement of brown trout to and from this section. Population characteristics for both brown and rainbow trout inhabiting the Laurel section indicate spawning and rearing of small fish occurs elsewhere in the river system. Another possible explanation for the

FIGURE 1. STUDY AREA



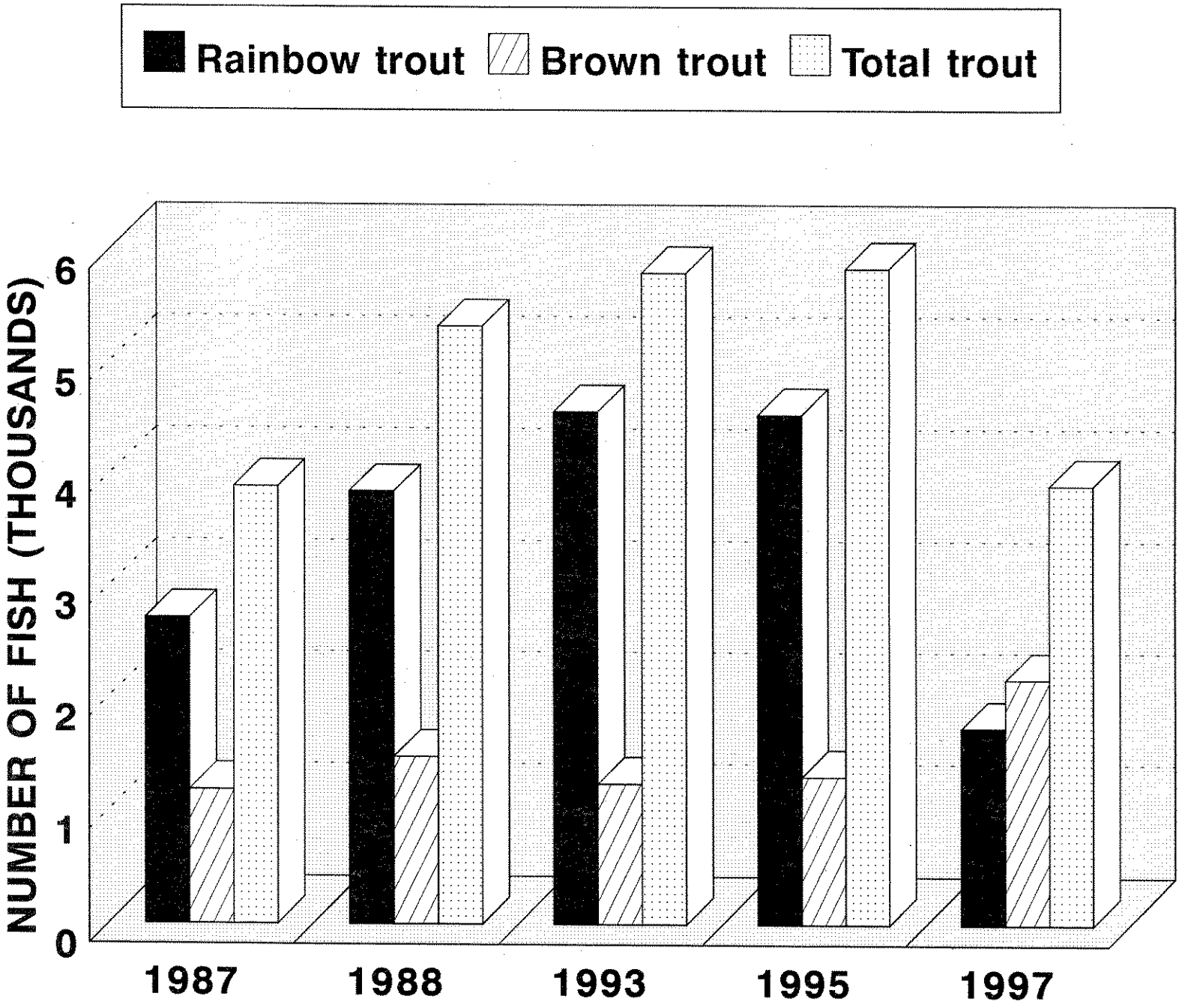


Figure 2. Fish population estimates for the Laurel section of the Yellowstone River.

TABLE 1. Fish population data collected during fall 1995 and 1997 from the Laurel section of the Yellowstone River.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
SEPTEMBER 1995 BROWN TROUT	1	0	0	0	0	0
	2	9.11	0.26	669	122	174.9
	3	11.13	0.47	251	46	117.7
	4	13.74	0.87	192	35	167.2
	5	16.43	1.52	114	21	173.8
	6 & OLDER	17.37	1.80	79	14	141.4
			TOTAL	1305	238	775.0
SEPTEMBER 1995 RAINBOW TROUT	1	5.75	0.07	27	5	1.8
	2	7.69	0.18	2997	545	532.2
	3	11.01	0.47	783	140	371.1
	4	13.16	0.79	330	60	260.0
	5	14.92	1.13	279	51	315.2
	6 & OLDER	16.96	1.69	132	24	223.3
			TOTAL	4548	825	1703.6
AUGUST 1997 BROWN TROUT	1	7.42	0.15	62	11	9.4
	2	8.17	0.20	1158	210	230.2
	3	9.95	0.34	506	92	173.2
	4	13.30	0.88	286	52	250.7
	5	16.03	1.55	130	24	202.0
	6 & OLDER	19.33	2.83	37	7	104.7
			TOTAL	2179	396	970.2

TABLE 1. Fish population data collected during fall 1995 and 1997 from the Laurel section of the Yellowstone River.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
AUGUST 1997 RAINBOW TROUT	1	6.51	0.10	226	41.	23.6
	2	7.06	0.14	825	150.	114.3
	3	10.45	0.42	172	31.	72.5
	4	12.25	0.67	301	55.	201.2
	5	14.51	1.08	197	36.	213.4
	6 & OLDER	16.01	1.45	21	4.	30.6
			TOTAL	1742	317.	655.6

increase in brown trout numbers in 1997, at the same time rainbow trout were decreasing so dramatically, would be differential survivability between the two species. It is well documented that brown trout tolerate higher temperatures and higher turbidity than rainbow trout, and they also prefer the undercut banks, brush piles and side channels where current velocities and bedload movement are generally less severe during flooding.

Winter icing problems are common within the Laurel and Big Timber electrofishing sections, and both 1996 and 1997 were particularly severe ice years. Severe icing is often very hard on fish populations and impacts small fish particularly hard since they concentrate along the edges and in the shallows where ice does the most damage. Larger fish tend to spend the majority of their life in deeper water which is less affected by moving ice. Problems from ice often happen fast as jams can form and break up rapidly, sending water across bottomlands and into and out of the riparian zone and overflow channels. This rapid rise and fall of water and ice often strands fish away from the river and also often physically grinds them up in the process. Normal spring flooding does not impact fish populations as severely as winter icing because flood waters usually rise and fall relatively slowly, which allows fish a better opportunity to move in and out of the river channel with the slowly fluctuating water levels.

Two consecutive years of massive flooding along with two winters of severe icing conditions combined to wreck havoc on fish populations within the Laurel section. Massive amounts of bedload moved through the system during flooding literally grinding up the river bottom. Islands and bars disappeared and were rebuilt elsewhere. Channels were filled and excavated and, at one location, the river is now a half mile north of where it was a year ago. Although the total trout population declined at least 33% from 1995, trout sampled were in relatively good body condition. Suckers, on the other hand, being bottom feeders and bottom dwellers, were thin, scarred and emaciated. It appears, not only had the suckers been beaten up by the massive bedload movement, but the bottom dwelling aquatic invertebrates they depend on so heavily for food had also been ground up.

During 1995, we sampled 26 burbot and tagged 23 of these fish. One captured burbot still had an older tag, but the tag number was unreadable. In 1997, we took only eleven burbot and tagged nine of these fish. One burbot had been tagged in the Laurel section in 1995. The fish, when tagged in 1995, was 27.1 inches and 4.12 pounds; when recaptured two years later, it had grown to 30.1 inches and 6.00 pounds. For comparison, in 1987 we took 176 burbot with 21 recaptures and 180 with 20 recaptures in 1988. Even without a formal estimate, burbot numbers have clearly declined within the Laurel section.

Big Timber Section

The 7.1 mile Big timber section (Figure 1) of the Yellowstone River begins about one-half mile below the mouth of Little Timber Creek and extends downstream to one-half mile below the mouth of Otter Creek. Trout population trends within the Big Timber section over the past eleven years are presented in Figure 3. All fish population estimates were done in the spring except for the one 1992

fall estimate. Because unusually low river flows interfered with completing spring 1992 estimates and because we had problems with faulty age data (Poore 1995), this fall estimate is not directly comparable with the spring fish population numbers.

Rainbow trout population estimates (3368) completed during the spring of 1995 (Table 2) are slightly higher (7%) than estimates from 1989 (3122). Sixty-three percent of the estimate is fish over 12.0 inches. We sampled only two fish under 5.0 inches and two fish over 19.0 inches in 1995.

Icing conditions during the winters of 1995-96 and 1996-97 were quite severe along much of the mid-Yellowstone River. These two winters of severe icing impacts were separated by the record high flows of 1996. Rainbow trout population estimates completed in March 1997, just prior to the second consecutive year of extremely high river flows, are down about 31% (229) from 1995 numbers. This decline is evident across all age groups except age class one. Fifty-one percent of the rainbow estimate is fish over 12.0 inches. We sampled only two rainbows under 5.0 inches and six fish over 19.0 inches.

Brown trout population estimates (1715) completed during March 1995, are 13% lower than estimates from 1989 (1975) and 18% higher than those from March 1997 (1399). In both 1995 and 1997, 79% of the brown trout estimates are fish over 12.0 inches. In 1995, we sampled no fish under 5.0 inches and 105 over 19.0 inches, whereas in 1997, we took one fish under 5.0 inches and 103 over 19.0 inches.

Yellowstone cutthroat trout population estimates for 1995 (350) are based on 13 recaptures of 66 marked fish. Cutthroat ranged in length from 7.5-17.8 inches. Cutthroat trout population estimates for 1997 (469) are based on 19 recaptures of 58 marked fish ranging in length from 7.3-16.8 inches.

In addition to the trout, we sampled 26 burbot ranging in length from 17.4-27.1 inches in 1995. During sampling in 1997, we took 15 burbot ranging in length from 15.9-26.3 inches. Most of these burbot were tagged with individually numbered tags. One of the 41 burbot still had an old tag that had an unreadable number.

Total trout population estimates from 1995, 5433 fish with a biomass of 4864 pounds, are composed of 62% rainbow, 32% brown trout, and 6% Yellowstone cutthroat. By 1997, following two years of relatively severe environmental conditions, trout populations in the Big Timber section had declined about 23% to 4197 total fish, with a 24% drop in total biomass to 3677 pounds. The species composition in 1997 is 56% rainbows, 33% brown and 11% cutthroat trout.

Total trout per mile numbers are higher in the Laurel section of the Yellowstone River (1063 in 1995 and 713 in 1997) when compared to those from the Big Timber section (767 in 1995 and 591 in 1997). Conversely, trout from the Big Timber section average much larger (0.89 pounds in 1995 and 0.88 pounds in 1997) when compared to trout from the Laurel section (0.42 pounds in 1995 and 0.41 pounds in 1997).

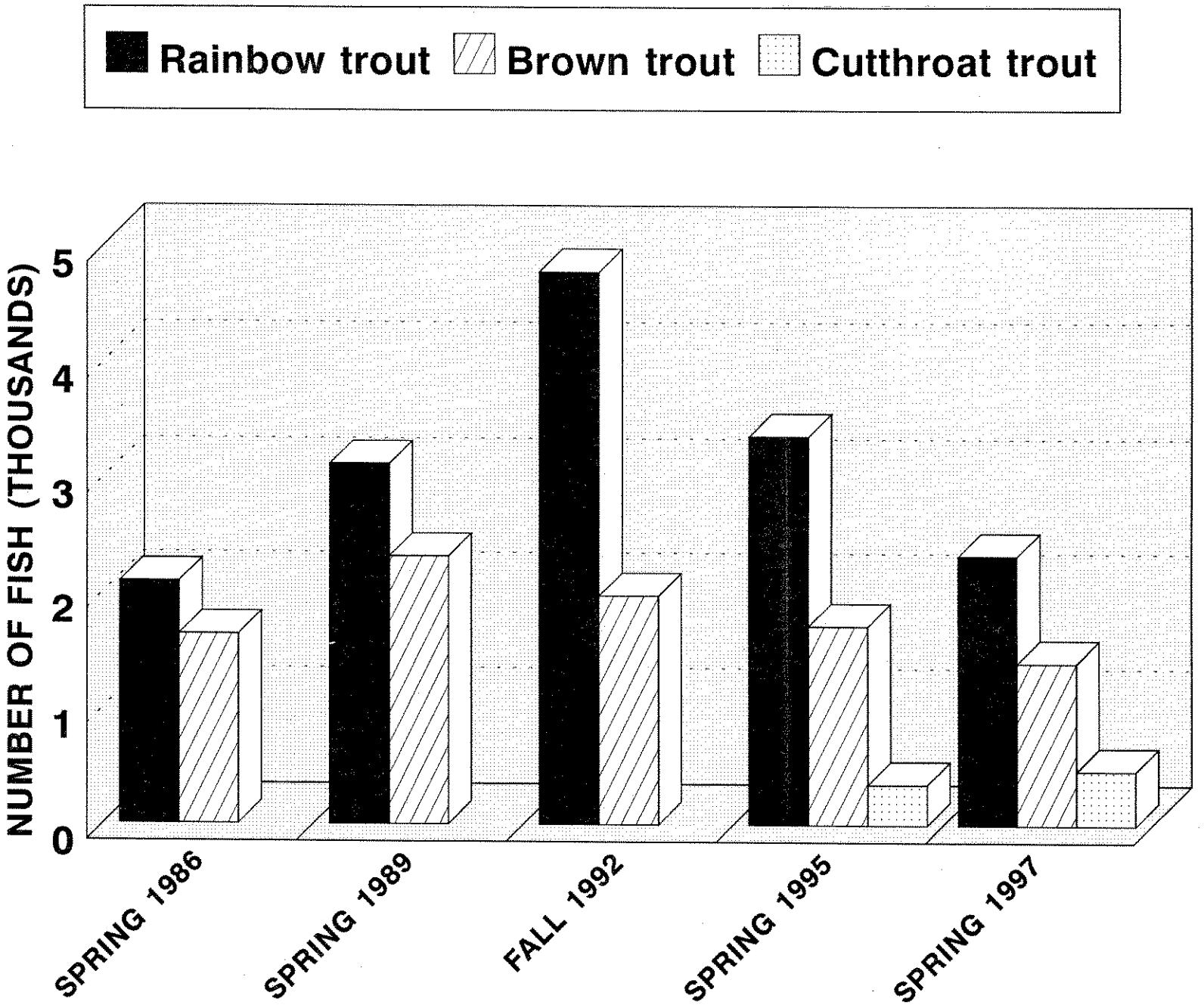


Figure 3. Fish population estimates for the Big Timber section of the Yellowstone River.

TABLE 2. Fish Population data collected during spring 1995 and 1997 from the Big Timber section of the Yellowstone River.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
MARCH 1995 BROWN TROUT	1	0	0	0	0	0
	2	9.16	0.27	82	12	22.6
	3	11.39	0.49	336	47	165.0
	4	13.45	0.83	447	63	369.6
	5	15.85	1.32	425	60	562.7
	6 & OLDER	18.94	2.20	425	60	937.4
			TOTAL	1715	242	2057.3
MARCH 1995 RAINBOW TROUT	1	7.53	0.14	2	0.3	0.3
	2	9.30	0.27	749	105	205.4
	3	11.41	0.52	702	99	363.2
	4	13.70	0.87	1083	153	945.2
	5	15.37	1.21	522	74	630.6
	6 & OLDER	17.07	1.65	310	44	513.3
			TOTAL	3368	475	2658.0
MARCH 1995 CUTTHROAT TROUT	1	0	0	0	0	0
	2	8.00	0.17	23	3	3.8
	3	9.60	0.30	229	32	69.6
	4	11.77	0.57	54	8	30.5
	5	13.90	0.99	39	6	38.9
	6 & OLDER	14.96	1.24	5	1	5.7
			TOTAL	350	50	148.7

TABLE 2 (cont.) Fish Population data collected during spring 1995 and 1997 from the Big Timber section of the Yellowstone River

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
MARCH 1997 BROWN TROUT	1	5.05	0.07	94	13	6.6
	2	9.08	0.24	84	12	20.4
	3	11.20	0.47	157	22	73.9
	4	13.68	0.89	190	27	168.2
	5	15.97	1.36	360	51	488.5
	6 & OLDER	18.34	2.02	514	72	1039.2
			TOTAL	1399	197	1796.0
MARCH 1997 RAINBOW TROUT	1	5.22	0.07	184	26	12.9
	2	9.12	0.28	514	72	143.3
	3	11.33	0.52	598	84	308.5
	4	13.59	0.87	436	61	380.2
	5	15.31	1.24	346	49	427.8
	6 & OLDER	17.31	1.77	251	35	444.6
			TOTAL	2329	327	1717.3
MARCH 1997 CUTTHROAT TROUT	1	6.02	0.11	41	6	4.6
	2	8.99	0.26	317	45	81.6
	3	10.83	0.44	72	10	31.7
	4	14.10	1.07	28	4	30.2
	5	15.74	1.45	11	2	16.0
	6 & OLDER	0	0	0	0	0
			TOTAL	469	67	164.1

Fishing pressure, based on the 1995 statewide angling pressure survey, has increased in the reach from Springdale to the Boulder River each year, as more and more anglers and guides have shifted downstream to avoid the crowding upstream. Most of this increase is resident anglers and pressure is particularly heavy on mid-summer weekends. Based on personal observations and conversations with fishing guides and other river users, pressure increased further in 1996 but dropped off somewhat in 1997. The drop in 1997 was related to the unusually high extended river flows and lower fishing success due to the reduced trout population.

Fishing pressure increased slightly in the river reach between the Boulder River and the Stillwater River in 1995 and 1996, but declined in 1997. Fishing pressure declined in the river reach between the Stillwater and Clarks Fork River during 1995, increased in 1996 and declined again in 1997. Yearly angling pressure on specific river reaches appears to be quite variable and depends on fishing success, fish population levels, weather, river flows, and crowding factors. The general long-term trend in angling pressure within the mid-Yellowstone River is for increasing use.

Boulder River

Allers Section

On September 12, 1995, we again counted fish in Allers section of the Boulder River using snorkeling equipment (Poore 1995). Counting conditions were ideal with low crystal-clear water and bright, calm sunny weather. As in 1993 when the last count was made, we are confident that, given the ideal conditions, the count, particularly of fish larger than 13 inches, is fairly reliable. We counted 148 rainbows over 13 inches and 145 between 5 and 13 inches, along with 60 brook trout. The count of fish over 13 inches was down about 30% from the count for 1993, while the count of fish less than 13 inches was the same. Small fish are much harder to count because of their smaller size and often close association with the rocky substrate, overhanging banks, logs and brush.

The moderate decline in the number of large fish should not be the result of angler harvest since catch-and-release regulations have been in effect since 1994. We would anticipate a small amount of mortality associated with handling even under catch-and-release regulations, but probably not 30%. A more likely explanation is the gradual reduction in high quality habitat that has been occurring over the past few years. Heavy grazing pressure along the riparian corridor has reduced vegetative cover resulting in increased erosion and contributed to the loss of river channel length and stability.

On May 2, 1995, we attempted to count spawning rainbows within Allers section. Most years, early May is about the peak spawning period within this reach, but in 1995, they had already finished spawning. We only observed one rainbow and 13 redds. Because of busy spring electrofishing schedules, we did not attempt to survey spawning sites at Allers in 1996 or 1997. We plan to do a snorkel survey within the section again during the fall of 1998.

B-2 Section

The B-2 section is 6040 feet long and is located approximately 8 miles downstream from the natural bridge near the mouth of the West Boulder River (Figure 1). The section has a steep-to-moderate gradient with wide, fast riffles, and large rocks and boulders creating numerous pockets of holding water. Pools and runs are widely spaced.

We sampled fish populations in B-2 during March 1997. Total brown trout estimates (Figure 4, Table 3) were down about 10% when compared to 1994 estimates, with most of the decline in yearling fish. Larger browns, age five and older, increased 50% during the same period.

The 1997 rainbow trout population estimates from B-2 (Figure 4, Table 3) increased 55% over estimates from 1994, and are about the same as those made in 1991. Most of the increase is rainbows age one and two. The estimate for larger rainbows within the section is usually somewhat inflated because many of these larger rainbows are only moving through the section enroute to upstream spawning areas, and they are seldom recaptured.

Between 1994 and 1997 total trout numbers in B-2 increased about 20%, with most of the increase being small rainbows from age class one and two. Total biomass decreased slightly (4%) over the same period.

Brown and rainbow trout populations in B-2 section have shown erratic fluctuations for many years (Figure 4). Population fluctuations are probably the result of variable spawning success and recruitment as they relate to typically low fall flows. Flow fluctuations are particularly variable within the East and West Boulder Rivers, both tributaries located close to the B-2 section. The extent of movements, interchanges, seasonal use, and spawning inter-relationships, is not obvious. Another factor related to observed population fluctuations is the result of accelerated predation on small trout from the increasing numbers of larger brown trout inhabiting the section. As in the Stillwater River, the numbers of larger brown trout have increased following implementation of more restrictive fish limits, i.e., two trout, only one of which can be over 13.0 inches.

Management goals from the Boulder River Management Plan for the river reach call for maintaining 400 resident age one and older rainbow trout and approximately 1,100 age one and older brown trout per mile (1,500 total trout). As explained above and as shown in Figure 4, fish populations in B-2 have fluctuated erratically over many years. Although the ratio of browns to rainbows has recently shifted toward rainbows, the total number of trout within the section has not changed significantly; i.e. 1589 in 1991, 1176 in 1994 and 1415 in 1997. Even when total numbers are lower, the numbers of larger rainbows and brown trout have been increasing significantly. Fish populations have responded positively to the more restrictive fish limits intended to protect more of the large fish and these large fish may have reduced the number of small fish through predation.

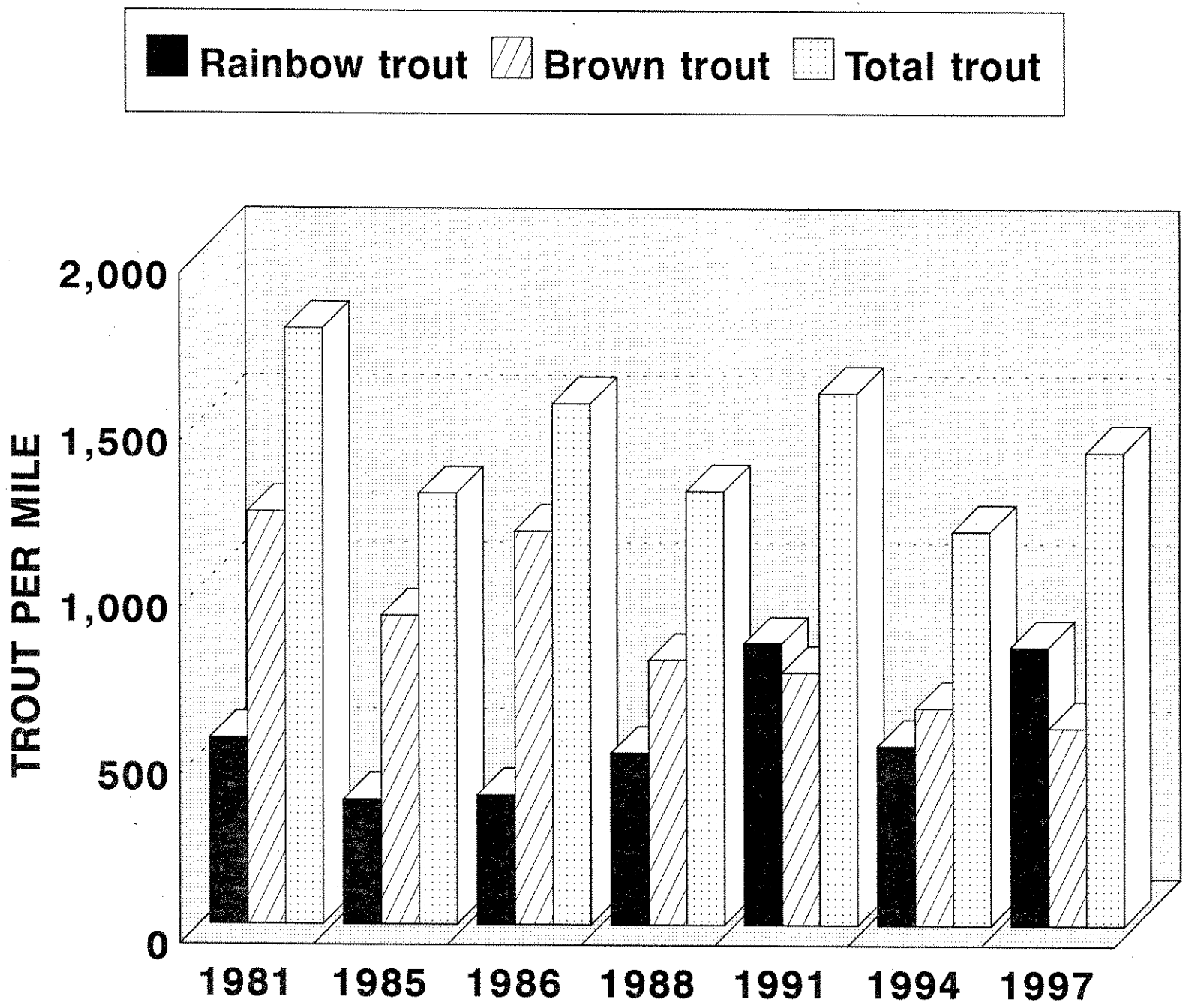


Figure 4. Fish population estimates for the B-2 section of the Boulder River.

TABLE 3. Fish Population data collected during spring 1994 and 1997 on the B-2 section of the Boulder River.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
MARCH 1994 BROWN TROUT	1	5.72	0.06	187	164	12.1
	2	8.76	0.23	88	77	20.6
	3	12.04	0.60	120	105	72.0
	4	14.19	0.95	245	215	234.2
	5	15.59	1.23	80	70	98.8
	6 & OLDER	16.79	1.51	16	14	24.0
			TOTAL	736	645	461.7
MARCH 1994 RAINBOW TROUT	1	6.22	0.08	153	134	12.6
	2	10.58	0.41	106	92	43.2
	3	13.36	0.80	132	116	105.0
	4	15.04	1.17	130	114	152.0
	5	16.31	1.49	57	50	84.8
	6 & OLDER	17.93	1.84	29	25	53.4
			TOTAL	607	531	451.0
MARCH 1997 BROWN TROUT	1	6.28	0.08	108	95	9.2
	2	8.74	0.23	81	71	18.7
	3	10.88	0.43	98	86	42.6
	4	14.08	0.94	237	208	222.2
	5	15.93	1.27	111	97	140.9
	6 & OLDER	17.60	1.60	33	29	53.1
			TOTAL	668	586	486.7

TABLE 3. Fish Population data collected during spring 1994 and 1997 on the B-2 section of the Boulder River.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
MARCH 1997 RAINBOW TROUT	1	5.51	0.06	322	282	20.7
	2	7.08	0.13	222	195	27.8
	3	11.00	0.44	174	153	76.5
	4	13.89	0.90	82	72	73.5
	5	15.52	1.23	92	81	113.2
	6 & OLDER	16.46	1.48	52	46	76.2
			TOTAL	944	829	388.0

East Boulder River

B-5 Section

Because of increased interest and subsequent mine site developments and disturbance associated with the Stillwater Mining Company's platinum-palladium mine in the East Boulder, several electrofishing sections were revisited to update our baseline fisheries database. Additional new disturbance was created when a new power line was constructed on the mine site in 1996-97, and the large tunnel-boring machine is scheduled to begin operation in 1998.

A two-pass fish population estimate was made in mid-October 1996 at the B-5 site selected during earlier fisheries baseline investigations in the East Boulder Drainage (Wiedenheft 1982). The B-5 site is located in and around the USFS East Boulder Campground. Fish population estimates for B-5 include 209 (69%) rainbow, 68 (23%) brown and 24 (8%) brook trout for a combined total trout population of 301 trout in the 1000 foot section of stream surveyed. This compares to two mark-recapture trout estimates, one made in 1974 (Stewart 1977) of 324 total trout —255 rainbow (78%) and 69 brown trout (22%)—and one from 1981 (Wiedenheft 1982) of 555 total trout—490 rainbow (86%), 49 brown trout (11%), and 16 brook trout (3%). Although the 1996 estimates are down somewhat from earlier estimates and particularly the 1981 numbers, B-5 section has a history of widely fluctuating populations over a relatively short time period. One example is a 1981 rainbow trout estimate of 490 fish that increased to 1,378 rainbows in 1982.

B-6 Section

A two-pass fish population estimate was also made in early October 1997 at our B-6 site located at the mouth of Dry Fork Creek, a small tributary to the East Boulder. The B-6 site is located just downstream from the proposed tailings impoundment, mill location, and main access adit where the tunnel-boring machine is scheduled to begin drilling.

Fish population estimates from B-6 include 135 (71%) rainbow and 55 (29%) brown trout for a combined total population of 190 trout per 1000 feet of stream. Two-pass fall estimates (Poore 1990) from 1989 of 230 (60%) rainbow and 151 (40%) brown trout with a combined total trout population of 381 fish per 1000 feet of stream are 100% higher than those from 1997. Age structure and relative abundance of both estimates indicate reproduction and recruitment are adequate. The reduced 1997 estimate may be related to an extended flow of sediment from the Dry Fork in July 1997 (Schuler 1997) which resulted when very heavy rains caused mud slides and severe erosion within the drainage. Portions of the Dry Fork Drainage, particularly along the riparian corridor, also indicate a history of heavy livestock grazing which undoubtedly contributed to the sediment problem.

Fish were also collected from this area of the East Boulder in 1997 by biologists from the USFS for heavy metal tissue analysis. Forest Service biologists collected and analyzed fine sediment core

samples from throughout the East Boulder Drainage as part of a contract paid for by the Stillwater Mining Company.

Stillwater River

Moraine Section

The 3,300 foot Moraine section (Figure 1) is located 2.7 miles below the mouth of the West Fork of the Stillwater River and about 8 miles downstream from the Stillwater Mining Complex. Moraine is located within an FWP Fishing Access Site and, consequently, receives relatively heavy fishing pressure. The Moraine section is one of several long-term fish population monitoring sites located along the Stillwater.

We ran a population estimate (Figure 5, Table 4) in the Moraine section during April 1996. Our 1996 estimate is slightly lower (9%) than the 1994 estimate but the difference is in yearling fish which falls within the standard deviation for that age class. If we exclude this yearling group and consider only fish age two and older, the 1996 estimate is 47% higher than in 1994. In 1996, estimated numbers of brown trout over 13.0 inches decreased 24% from 1994 estimates, but increased 41% over those from 1991. Figure 5 gives a comparison of population estimates within Moraine over the last 15 years.

In 1996, we recaptured seven rainbow from 67 marked fish. Because this data did not provide a reliable log-likelihood estimate, we applied a Peterson estimate instead. The Peterson estimate for rainbow trout in the section was 258 ranging in length from 5.0 to 13.9 inches. Although this estimate is not very statistically reliable, we include it to give a relative number of rainbows in the section. Although we handled 58 rainbows over 14.0 inches during the marking and recapture runs, we took no recaptures from these larger fish.

During spring electrofishing on Moraine, we always sample a number of large rainbows migrating to spawning areas located further up the Stillwater River near Nye. Because these fish are only passing through the section, they are seldom recaptured. Moraine is a rearing area for small rainbows, the majority of which apparently leave the section prior to reaching maturity.

Management objectives from the Stillwater River Management Plan for this river reach, call for maintaining 1,000 to 1,500 age one and older brown trout per mile, with 100 to 150 of these fish over 13 inches. The latest estimate for 1996 of 229 browns over 13 inches and 1438 total browns per mile, exceeds our goal for this species and probably reflects a positive response to the implementation of more restrictive fish limits in 1990. In 1990, the trout limit was reduced from five fish with one over 18 inches to two fish with only one larger than 13 inches in possession. The management plan also calls for maintaining 200 to 400 age one and older rainbow trout per mile and protecting larger rainbow trout during spawning. This goal is also met with an estimated 413 rainbows per mile and the more restrictive regulations protecting the spawning rainbows.

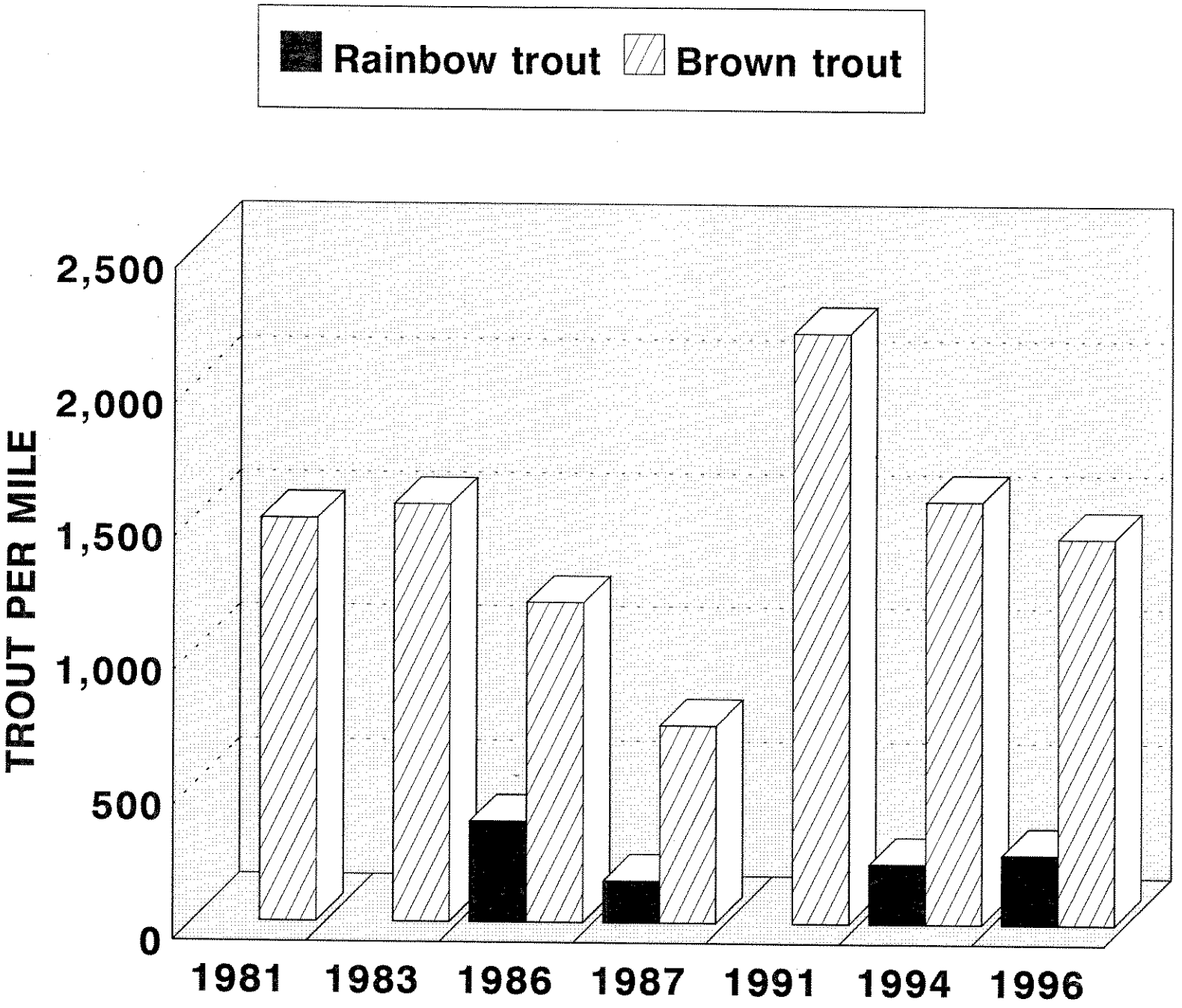


FIGURE 5. Fish population estimates for the Moraine section of the Stillwater River.

TABLE 4. Fish population data collected during spring 1994 and 1996 on the Moraine section of the Stillwater River.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
MARCH 1994 BROWN TROUT	1	6.33	0.09	591	946	51.4
	2	9.59	0.31	125	200	38.3
	3	12.53	0.64	115	184	74.0
	4	14.06	0.91	110	176	99.3
	5	15.68	1.23	36	58	44.5
	6 & OLDER	15.90	1.28	7	11	9.1
			TOTAL	984	1575	316.6
APRIL 1996 BROWN TROUT	1	6.11	0.09	282	451	24.7
	2	8.52	0.23	305	488	68.8
	3	11.25	0.47	152	243	71.4
	4	13.56	0.81	83	133	66.6
	5	15.03	1.06	69	110	72.6
	6 & OLDER	16.83	1.34	8	13	10.9
			TOTAL	899	1438	315.0

East Rosebud Creek

TO-Bar Ranch Section

The TO-Bar Ranch electrofishing section (Figure 1) of the East Rosebud is located near the Custer Forest boundary in the rolling hills where the stream leaves the steep Beartooth Mountain face. Recreation use and fishing pressure have increased significantly with the growing influx of people into this popular scenic area (Poore 1995).

In the spring of 1995, we completed fish population estimates within the 8200 foot TO-Bar section. Prior to this 1995 estimate, the last estimate done in this section is from the fall of 1991. We switched to spring estimates to provide a better representation of the true predominant resident brown trout population inhabiting the section. Fall estimates are potentially influenced by brown trout spawning movements into and out of the section. The brown trout population of fish over 5.0 inches per mile is estimated at 585 in 1995 (Figure 6, Table 5) as compared to 669 in 1991. Of these fish, 83 (14%) are fish 13.0 inches or over as compared to 99 (15%) in 1991. Fish age four and older from the 1995 estimates (166) increased about 20% from 1991 (138) estimates.

In 1995, we estimated rainbow trout at 36 fish per mile using a simple Peterson formula. Because of the low number of fish (33) and recaptures (7), we were unable to use the log-likelihood method. Rainbows sampled range from 2.8 to 13.6 inches. The estimate for brook trout was 23 fish, ranging in length from 4.5 to 9.2 inches per mile of stream, again based on a simple Peterson formula. Because of the low number of fish (21) and recaptures (3), we are unable to use the log-likelihood method. Rainbow and brook trout estimates were not statistically reliable and are included only to give an idea of species relative abundance.

It appears the decline noted in larger brown trout within the section has slowed down and leveled off as reflected in the 1995 estimates. The problem appears related to angling pressure and harvest, because it selectively affects the larger fish. New fishing regulations implemented in 1994 and intended to protect larger fish, along with a landowner-promoted voluntary "catch and release" policy and improved livestock control to benefit riparian fish habitat, should have positive future benefits for the East Rosebud fishery.

Hansberger Section

In the spring of 1995, FWP was contacted by a consulting firm hired by a new landowner whose land borders about three-quarters of a mile of the East Rosebud, to explore the possibility of enhancing the wild fishery through his property. The property is located downstream about nine miles from our TO-Bar Ranch long-term monitoring section in a stream reach characterized as boulder-cobble substrate, with extensive riffle-run-riffle series. Because deeper holding water was lacking, the consulting firm proposed and designed a project to construct a series of deeper holes interspersed throughout the riffle-run pattern to serve as better holding areas for large fish. The project objective

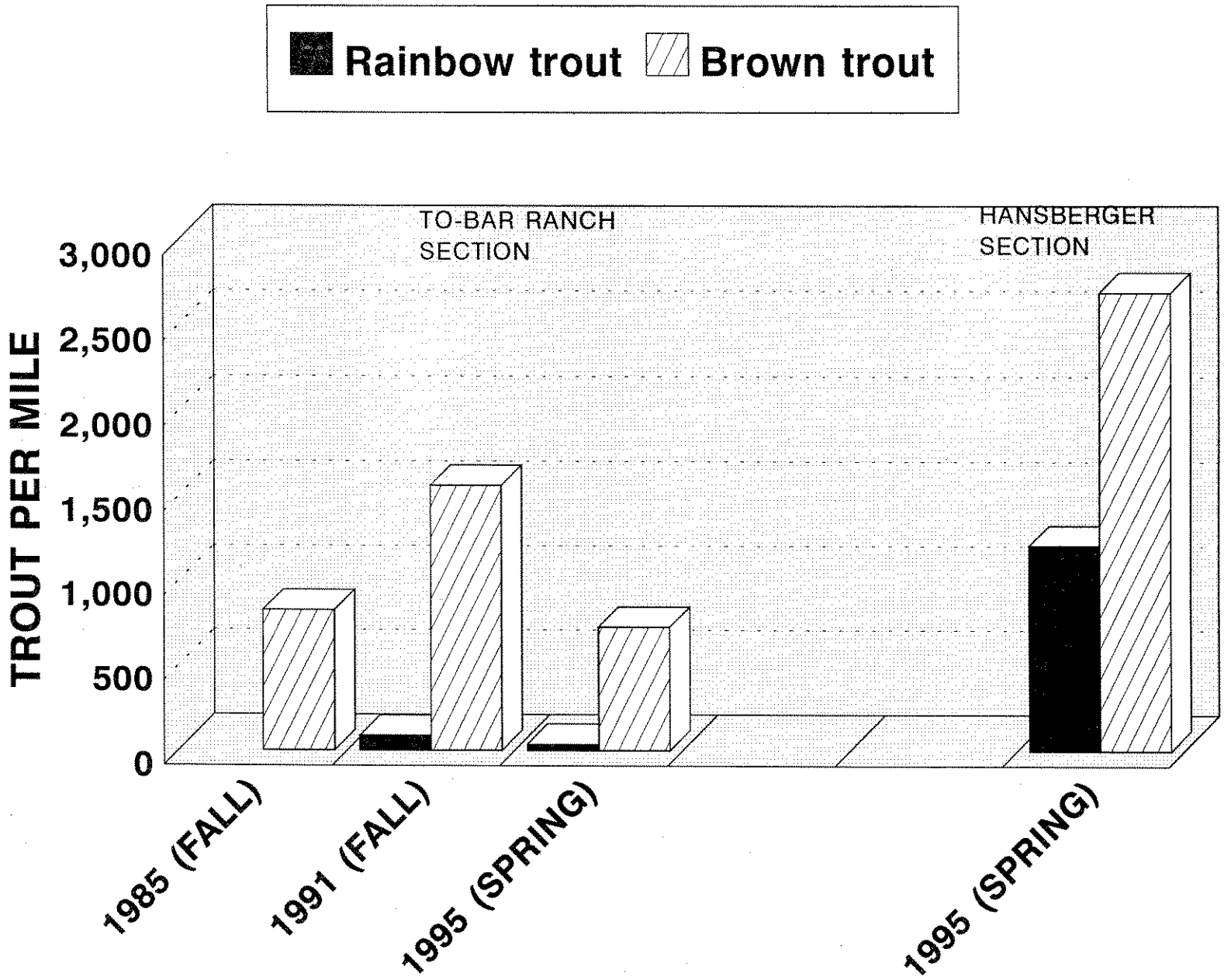


Figure 6. Fish population estimates for the TO-Bar Ranch and Hansberger sections of East Rosebud Creek.

TABLE 5. Fish population data collected during spring 1995 from the TO-Bar Ranch and Hansberger sections of East Rosebud Creek.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
APRIL 1995 BROWN TROUT (TO-BAR SECION)	1	5.25	0.05	621	397	33.3
	2	6.81	0.11	229	147	25.4
	3	9.51	0.27	78	50	21.0
	4	12.25	0.56	59	38	33.4
	5	14.57	0.99	38	24	37.5
	6 & OLDER	16.59	1.46	69	44	99.9
			TOTAL	1094	700	250.5
MARCH 1995 BROWN TROUT (HANSBERGER SECTION)	1	4.31	0.03	498	1001	13.9
	2	7.28	0.14	755	1518	103.2
	3	11.42	0.47	54	109	25.4
	4	12.76	0.64	14	28	9.2
	5	15.01	1.06	20	40	21.2
	6 & OLDER	18.26	1.77	12	21	21.2
			TOTAL	1353	2717	194.1
MARCH 1995 RAINBOW TROUT (HANSBERGER SECTION)	1	3.55	0.02	370	744	6.5
	2	6.38	0.09	142	285	12.7
	3	9.35	0.27	78	157	21.5
	4	12.25	0.61	13	26	7.9
	5	13.77	0.83	3	6	2.5
	6 & OLDER	0.	0.	0	0	0.
			TOTAL	606	1218	51.1

was to be accomplished through channel excavation and placement of structures made of large rock in key areas of the stream with a tracked excavator. Another part of the proposed project was to enhance wild trout spawning potential in the lower end of a small spring creek which enters the East Rosebud through the property.

We were interested in the project because we had no fisheries information for this reach of the East Rosebud, and also it gave us an opportunity to get a quantitative and qualitative estimates of the fish population before and after and its response to the habitat improvement project. Prior to the start of the habitat project, during March 1995, we completed a mark-recapture population estimate through the 2620 foot project area. We estimated brown trout at 2717 (68%), rainbow trout at 1218 (31%), and brook trout at 20 (1%), for a total population estimate of 3955 trout per mile of stream (Figure 6, Table 5). Less than 2% of the total trout estimate is fish over 13.0 inches, which again indicates the apparent lack of suitable habitat to support and overwinter larger fish. For comparison, the spring 1995 estimate for the TO-Bar Ranch section (Figure 6) located upstream is 700 (93%) brown trout, 37 (5%) rainbow, and 14 (2%) brook trout for a total population estimate of 751 trout per mile. In spite of heavy fishing pressure in this reach of the East Rosebud (Poore 1995), 10% of the trout are over 13.0 inches. The TO-Bar section has better habitat, including numerous deep holes, brush piles, undercut banks, and bank cover needed to support larger fish. Another obvious difference between the two sections is the differing ratios of brown trout to rainbow just discussed.

Future plans call for repeating the Hansberger estimates to determine the response of the fish populations to the habitat improvement projects. It will also be interesting to see how successfully the channel improvement projects have withstood several winters of severe icing and high spring flows.

West Rosebud Creek

Mackay Section

The Mackay electrofishing section (Figure 1) of the West Rosebud is located near the Custer Forest boundary in the rolling hills where the stream leaves the steep Beartooth Mountain face. The 7,900 foot section extends from the Pine Grove Campground downstream into the Mackay Ranch. Fishing pressure within this section, particularly on the upstream end near the USFS campground, is relatively heavy.

During September of 1994, we completed fish population estimates (Table 6) within the Mackay section of the West Rosebud. The brown trout population of fish over 5.0 inches per mile is estimated at 1164, as compared to 947 in 1986 (Figure 7). Of these fish, 107 (9%) are fish 13.0 inches and over, as compared to 54 fish (6%) in 1986. Fish age four and older from the 1994 estimates (312) increased over 300% compared to estimates done in 1986 (97).

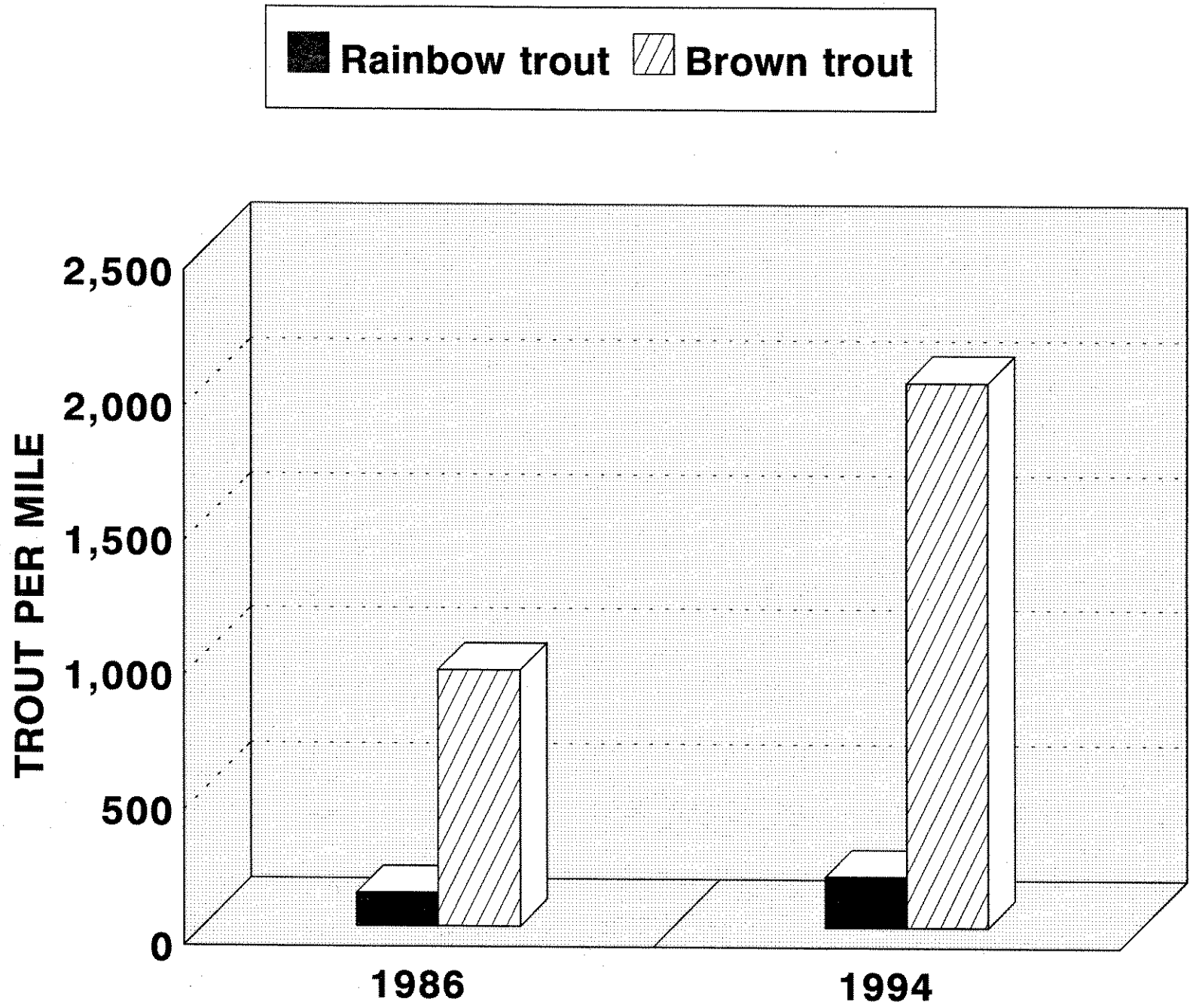


Figure 7. Fish population estimates for the Mackay section of West Rosebud Creek.

TABLE 6. Fish population data collected during fall 1994 from the Macay section of West Rosebud Creek.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
SEPTEMBER 1994 BROWN TROUT	1	3.71	0.02	1257	842	30.6
	2	5.82	0.07	1219	817	83.7
	3	8.83	0.24	226	151	54.5
	4	11.09	0.50	137	92	67.8
	5	13.44	0.86	56	38	47.9
	6 & OLDER	16.25	1.52	119	80	182.0
			TOTAL	3014	2020	466.5

In 1994, we estimated rainbow trout at 187 fish per mile using a simple Peterson formula. The estimate comprises rainbows 2.3-10.7 inches, and we sampled 75 total rainbows with five recaptures during the mark and recapture runs. This estimate is not statistically reliable, but is included to give an idea of rainbow relative abundance within this stream reach. In addition, two brook trout were sampled during electrofishing operations.

Brown trout populations in the Mackay section of the West Rosebud are about double those found in its sister stream located just to the east, the East Rosebud. One primary difference is the heavier fishing pressure concentrated on the East Rosebud. Fishing regulation changes (two trout, only one over 13 inches) implemented in 1994, are directed at protecting larger fish in both of these streams.

Clarks Fork of the Yellowstone River

Bridger Section

The Clarks Fork River (Figure 1) originates high in the Beartooth Mountains along the Montana-Wyoming border. It leaves Montana east of Cooke City, flows through the northwestern corner of Wyoming and then re-enters Montana about 15 miles southeast of Red Lodge. From that point, it flows northward for about 70 miles to its confluence with the Yellowstone River near Laurel. The upper 30 miles of river in Montana has a whitefish/trout fishery, but the lower 40 miles has only a limited population of desirable game fish species.

To gather additional fisheries information within a section of the Clarks Fork River near Bridger, we made a single-pass electrofishing survey on November 14, 1994. The section surveyed extends approximately four miles downstream from the Orchard Canal diversion structure to the John Derudder Ranch buildings. In dry years, this section of river is often severely dewatered primarily due to irrigation demands. Ninety-two mountain whitefish ranging in length from 5.4 to 19.7 inches (average length 11.9 inches) were the most abundant species collected. Since many of these whitefish were in spawning condition, their abundance within this section of river is probably explained by seasonal spawning movements. Other species collected include ten burbot from 17.3 to 27.1 inches (average 21.3), five brown trout from 10.1 to 12.6 inches (average 11.4), and two longnose suckers. Burbot collected were tagged with numbered Floy Tags prior to release.

Rock Creek

Fox Section

The 4800 foot long Fox section of Rock Creek is located approximately seven miles downstream from Red Lodge (Figure 1). Rock Creek, from Red Lodge downstream to the confluence of Red Lodge Creek, a distance of approximately 20 miles, often has major water shortages especially during late summer and early fall, the peak of the irrigation season. In addition to major water shortages,

fish populations in Rock Creek are often impacted by high flows which cause extensive erosion and movement of bedload throughout Rock Creek (Poore 1995). Fish populations in 1993 (Figure 8) within the Fox section were particularly hard hit by major flooding in June 1992, which shifted huge amounts of bedload through the section.

We sampled fish populations in the Fox section of Rock Creek during April of 1995. Brown trout estimates (Table 7) for fish age two and older show an increase of 96% (571) over the 1993 number (292) and are now back near the ten-year average for the section (611). With the exception of browns from age class six and older, all age classes show an increase. Fish from age class two and three show a significant increase at 165% and 134%, respectively. Twenty-five percent of the brown trout in this section are over 13.0 inches.

Rainbow trout numbers within the section show an increase of 160% from 62 in 1993 to 161 in 1995 and the increase is evident over all age classes. Sixty-eight percent of the rainbow estimate is fish from age class two and three, and only two fish larger than 13.0 inches were sampled. We sampled too few brook trout (19), ranging in length from 4.1 to 10.4 inches, to make an estimate. Mottled sculpins and longnose dace are abundant throughout the section.

Total trout populations within the Fox section (665) show an increase of about 106% between 1993 and 1996 and are now back to near the ten-year average of 635 fish. Total trout population estimates in 1993 are down about 45% from the long-term average, but appear to have recovered.

Joliet Section

Joliet section of Rock Creek extends from the Highway 212 bridge located a mile southwest of Joliet downstream for about 5300 feet (Figure 1). In addition to increased water availability, the Joliet section has a higher sediment load, warmer summer temperatures, and greater nutrient levels when compared to the Fox section.

Brown trout and mountain whitefish are the primary game fish species found in this section. In April 1995, we estimated brown trout numbers at 825 fish per mile (Figure 9, Table 8) as compared to 307 in 1990 (Poore 1990). In 1990, we were unable to estimate age-one fish, as we only sampled one brown less than 5.0 inches and twelve fish less than 8.0 inches. In our 1995 estimate, 42% (347) of the fish were age one, and we sampled 16 browns less than 5.0 inches and 52 less than 8.0 inches. Considering only brown trout two and older, the estimate from 1995 is 56% higher than the one from 1990. Browns from age class two, three, and four increased 149%, 251%, and 23%, respectively. Brown trout age five and older decreased about 50% during that period (Figure 9).

In addition to brown trout, a few rainbow trout inhabit the section with twelve ranging from 9.1 to 16.8 inches collected during the 1995 sampling. Other fish species that are abundant throughout the Joliet section include mountain whitefish of all sizes, longnose dace and suckers.

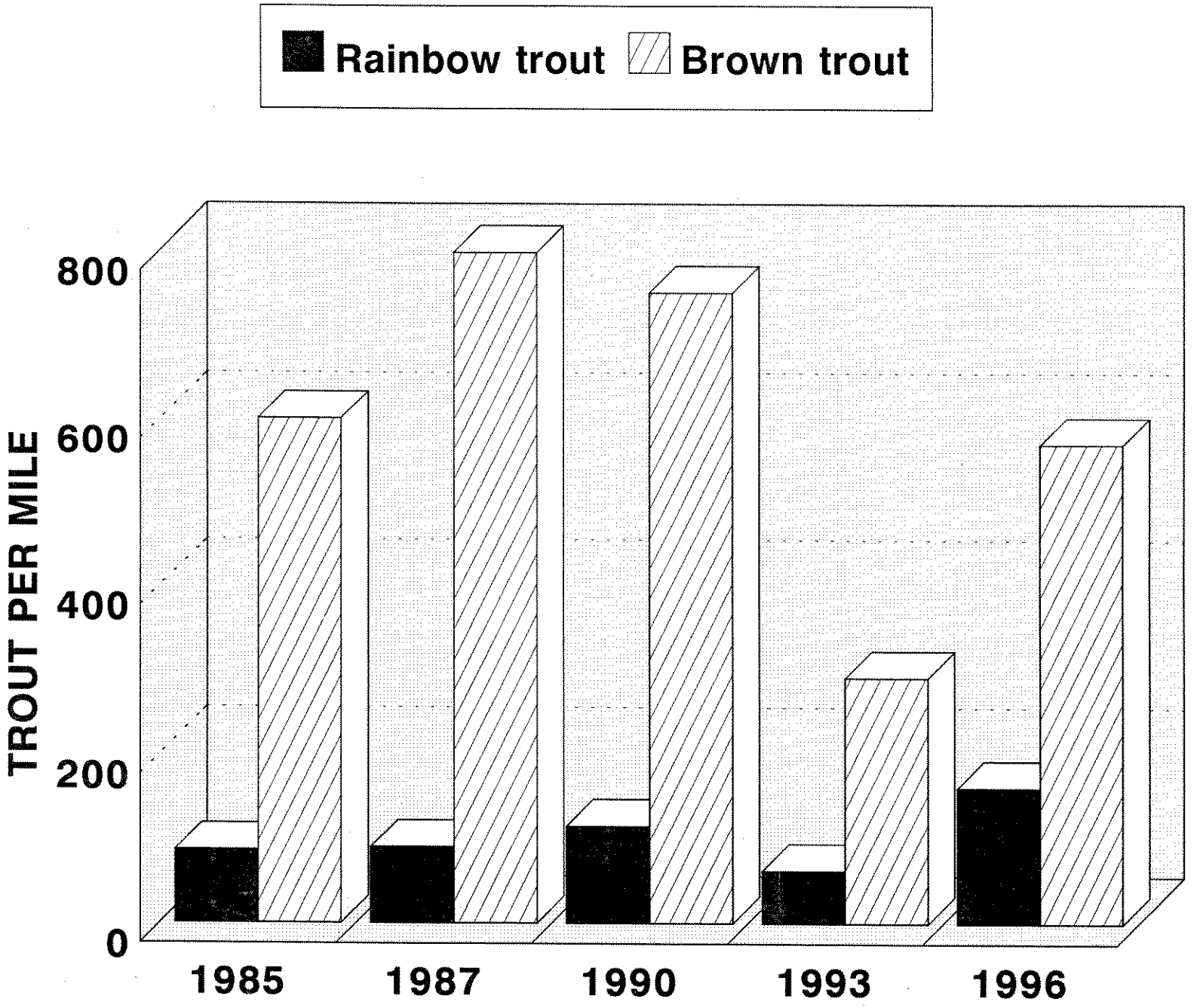


Figure 8. Fish population estimates for the Fox section of Rock Creek.

TABLE 7. Fish population data collected during spring 1996 from the Fox section of Rock Creek.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
APRIL 1996 BROWN TROUT	1	0	0	0	0	0
	2	6.82	0.12	228	251	26.8
	3	10.18	0.36	110	121	40.2
	4	12.83	0.70	96	106	67.2
	5	15.11	1.14	72	79	82.1
	6 & OLDER	15.60	1.24	13	14	15.5
			TOTAL	519	571	231.8
APRIL 1996 RAINBOW TROUT	1	5.60	0.07	26	29	1.8
	2	6.72	0.11	59	65	6.7
	3	9.72	0.35	41	45	14.5
	4	11.22	0.54	16	18	8.8
	5	14.50	1.07	4	4	4.3
	6 & OLDER	0	0	0	0	0
			TOTAL	146	161	36.1

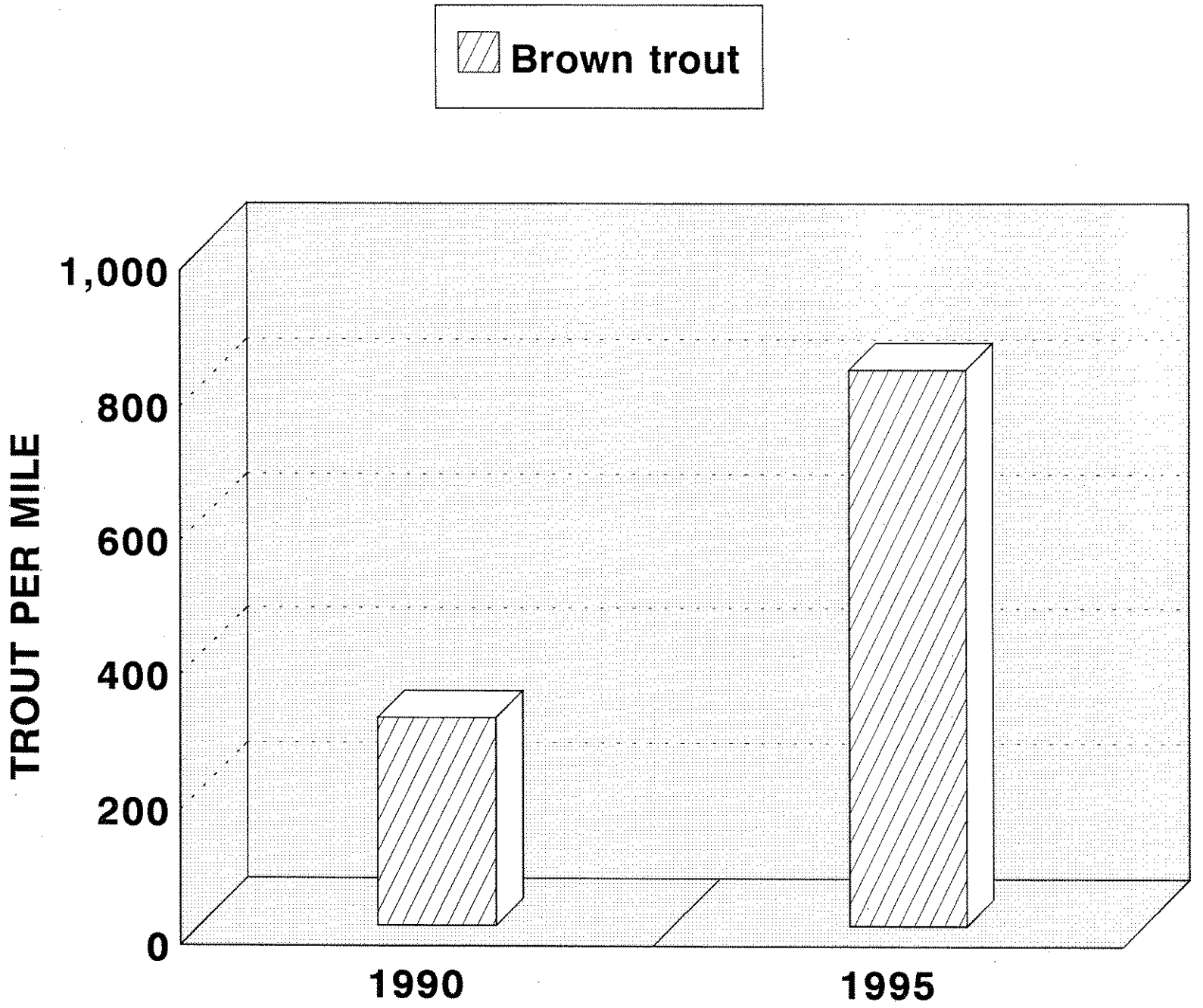


Figure 9. Fish population estimates for the Joliet section of Rock Creek.

TABLE 8. Fish population data collected during spring 1995 from the Joliet section of Rock Creek.

DATE AND SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
APRIL 1995 BROWN TROUT	1	5.02	0.05	347	347	17.1
	2	8.58	0.22	152	152	34.0
	3	10.38	0.38	165	165	62.2
	4	13.63	0.85	103	103	87.9
	5	15.58	1.24	48	48	59.9
	6 & OLDER	18.71	2.27	10	10	21.6
			TOTAL	825	825	282.7

Faced with severe irrigation-related water shortages throughout many reaches of Rock Creek, fish are probably forced to move into this reach where stream flows are usually more reliable, particularly during drought years. Average size and growth of trout is considerably better within this more productive nutrient-rich section of Rock Creek than in sections located further upstream. If we consider only fish age two and older, the brown trout population in the Joliet section (478) is about 16% lower than in the Fox section (571) located about seventeen miles upstream.

Red Lodge Creek

Nelson Ranch

At the landowner's request and to collect additional fisheries information on Red Lodge Creek, in mid-September 1994 we did a two-pass fish population estimate on a 340 foot section of stream about a mile downstream from where highway 78 crosses near Luther. Red Lodge Creek in the area is wide and rocky with eroding banks and few holes, and is characterized as primarily a flat shallow riffle. Bank cover consists of a few large cottonwoods with limited bushy vegetation, due to a long history of heavy grazing.

The most abundant fish sampled within the 340 foot section were brown trout with an estimated population of 169 fish ranging from 2.3 to 14.4 inches in length. Mountain whitefish were the only other game fish sampled and were estimated at eight fish ranging in length from 4.1 to 9.6 inches. Other common fish species taken included longnose dace, sculpins, mountain suckers and lake chubs.

Below Cooney Dam

During October 1996, in order to check on the downstream movement of fish out of Cooney Reservoir, we electrofished a 1000 foot section of Red Lodge Creek from the outlet structure downstream to 100 feet below the county road bridge. The upper 200 feet of stream, immediately below Cooney, is a riprap-lined ditch extending down to a six foot high concrete drop structure, which is a barrier to upstream fish movement. In this reach, fish sampled in order of decreasing abundance include eleven white suckers, six black crappie (2.3 to 3.3 inches), three rainbow trout (12.6 to 17.6 inches), two brown trout (15.3 to 15.7 inches), and one longnose sucker.

Downstream from the drop structure, Red Lodge Creek is rich in nutrients with dense mats of aquatic vegetation, an abundance of aquatic invertebrates and a diversity of fish species. The most common fish species collected within this 800 foot stream reach included hundreds of mountain whitefish and suckers. Suckers sampled, listed in order of decreasing abundance, included white, longnose and mountain. Lake chubs and longnose dace were also common. Species of particular interest to anglers included eight rainbow trout (11.7 to 20.8 inches), five black crappie (2.2 to 3.3 inches), four brown trout (8.2 to 12.6 inches), and three walleyes (18.9 to 21.6 inches). The rainbow trout were in particularly good condition averaging 1.86 pounds, with one 20.8 inch rainbow weighing over

6.0 pounds. As expected, with the abundance of forage fish, the walleyes were also in excellent condition.

Although most fish species present have access to this part of Red Lodge Creek from downstream, black crappies, walleyes, and most rainbow trout undoubtedly, come downstream through the outlet structure or over the spillway from Cooney Reservoir. The number of fish moving downstream out of Cooney depends on outflows, water levels, timing of irrigation drawdowns, reservoir fish population levels and reproductive success within the reservoir. Once fish are in Red Lodge Creek below Cooney, they appear to do very well in the nutrient-rich stream with its abundant forage base.

Otter Creek

Otter Creek, a tributary of the Yellowstone River which enters about a mile and a half east of Big Timber, has a long history of nonpoint source water quality problems. In 1989, the Otter Creek drainage was selected, as one of two watersheds in Montana, as a demonstration project to receive funding from federal and state programs for developing conservation plans and implementing solutions to help solve water quality problems. Potential beneficial management practices identified include fencing, irrigation water management, riparian restoration, grazing management, off-stream water development, riprap, bank shaping, vegetation plantings and waste management.

Many erosion problems in the drainage are related to the altered flow regime resulting form the inter-basin transfer of water from Sweetgrass Creek. Two reservoirs built about 75 years ago store this water, which is released when needed into Otter Creek. Otter Creek then serves as the delivery canal for the irrigated acres. This excess water moving down a fragile drainage, which already has many problems, causes major erosion. As a result, Otter Creek is a highly sediment-laden stream, especially in its lower 20 miles. Streambank erosion in Otter Creek is contributing to the sediment load entering the Yellowstone River, and a significant plume is often visible where the stream enters the river.

Due to its size, altered flow regime, and heavy sediment load, Otter Creek does not support a substantial sport fishery. This proposed project, if successful at significantly reducing the sediment load, appears to have the potential to improve the trout population in Otter Creek and also in this portion of the Yellowstone River. In the fall of 1988, prior to any work on the project, Chris Clancy collected fisheries data at two locations along Otter Creek (Clancy 1989). He concluded, "Indicators showed that the creek has a healthy macro-invertebrate population, although it would probably be more diverse if siltation was reduced. The condition of fish sampled was normal, indicating that food is not limiting. The sections sampled were dominated by white and longnose suckers. The small number of trout captured were mostly longer than 12 inches in size, suggesting an environmental problem for the survival and growth of smaller, younger trout."

Most of the project proposals and practices were completed and implemented by 1992. In September 1994, we again completed fish population estimates within the Favinger section where Clancy had sampled in 1988. Fisheries information from these two estimates is summarized in Table 9. Between

Table 9. Fish population data collected during fall 1988 and 1994 from the Favinger section of Otter Creek.

SPECIES	1988 (LENGTH RANGE) IN INCHES	1994 (LENGTH RANGE) IN INCHES
WHITE SUCKERS	147 (4.4-15.2)	93 (3.7-15.9)
LONGNOSE SUCKERS	79 (6.6-15.4)	130 (2.5-18.0)
MOUNTAIN SUCKERS	19 (4.6-7.5)	428 (2.6-7.3)
BROWN TROUT	10 (4.0-18.5)	2 (12.1-12.4)
YELLOW PERCH	1 (6.2)	1 (5.0)
BROOK TROUT		1 (7.8)
LAKE CHUBS		12 (2.6-6.2)
LONGNOSE DACE	1 (4.8)	
TOTALS	257	667

1988 and 1994 about half the length of the Favinger electrofishing section was altered as part of the Otter Creek Water Quality Improvement Project. Banks were sloped and riprapped and willows planted. The primary change in the fisheries involved a big shift in the species composition of the sucker populations. Changing the substrate from silt to rock heavily favors longnose and mountain suckers over white suckers. Brown trout populations actually decreased over the period, but their numbers are so low, no conclusions can be made. Subsequent years of data will be required to determine whether or not the Otter Creek Project has had a beneficial effect on the stream's trout population.

Soda Butte Creek

Of particular concern to the various fish management agencies involved with Soda Butte Creek, which includes the U.S. Fish and Wildlife Service within Yellowstone Park, U.S. Forest Service, Wyoming Game and Fish, and FWP, are the brook trout and westslope cutthroat hybrids in the headwaters. With the partial cleanup of the McLaren tailings and resultant improvements in the water quality, the likelihood of brook trout and hybrid cutthroat contamination spreading further downstream into the Yellowstone cutthroat population of the Lamar Valley increases. Because neither of these scenarios is desirable and because of potential impacts to the Park's native fish species, a joint project (involving all the agencies) to locate and eliminate these problem species from the headwaters of Soda Butte Creek was conducted in August of 1994 (Poore 1995). The results of this interagency project were summarized in the "Soda Butte Drainage Reconnaissance Fish Survey 1994" report prepared by Scot Schuler (Appendix A). Information on sampling in other waters including Woody Creek, Republic Creek, Hayden Creek, Miller Creek, Sheep Creek and Guitar Lake is also found in Scot's report.

Following the eradication in 1994 of 13 brook trout from the two-mile reach of Soda Butte Creek, from the USFS campground downstream to Woody Creek, the same reach was electrofished again in 1995. Electrofishilng crews in 1995 found seven brook trout and 78 Yellowstone cutthroat trout within the same two-mile reach. In August 1996, electrofishing crews found two brook trout and 26 cutthroat in this reach. Later in 1996, brook trout were observed in several holes in the very upper headwaters of Soda Butte Creek, approximately a half-mile upstream from where any brook trout have been found during the previous three years of removal efforts. This area is also upstream from several barriers to upstream fish movement, which indicates the original brook trout introduction was made in this area. These brook trout have served as the source of fish which have been slowly filtering downstream through the stream system.

Adjacent to Highway 212, Soda Butte Creek has a steep gradient with plunge pools and several drops high enough to act as barriers to upstream fish movement. Further upstream, the gradient lessens and the creek passes through a meadow area denuded of live trees following the Yellowstone fires of 1988 which burned through this area. The effectiveness of the 1997 removal effort is questionable due to the water depth, number of log jams, and amount of woody debris within the stream channel. Another problem is the abundance of small brook trout which are very difficult to locate and remove. Future plans include exploring the possibility of chemical removal to eliminate the remaining brook trout from the headwaters of Soda Butte Creek.

Cutthroat Trout Inventory and Special Projects

Stillwater River

Yellowstone cutthroat trout were inventoried in several locations in the headwaters of the Stillwater River (Table 10). In addition, a larger sample of cutthroat trout was collected from Goose Creek in 1995 and sent in for genetic analysis. Genetic testing of a small number of cutthraot trout sampled earlier in Goose Creek showed possible slight hybridization with rainbow trout. The genetic results on this latest sample are still pending.

Beartooth Mountain Face Sampling

Yellowstone cutthroat trout were also sampled in 20 small streams scattered eastward across the foothills of the Beartooth Mountains from the Stillwater River to the Wyoming line (Table 10). This inventory effort is part of an ongoing cooperative project with the Forest Service to locate purestrain cutthroat populations in this region (Poore 1988, 1990, 1995 and Foster and May 1990). Genetic analysis of fish collected from the Brush Fork of Willow Creek confirm the presence of pure Yellowstone cutthroat trout. Planting records show this stream was planted with cutthroat trout at the highway in the 1930's. This population is at risk because the cutthroats cohabit with brook trout and the immediate area around the stream is being subdivided. Genetic analysis of fish collected from the headwaters of the Lake Fork of Rock Creek confirm these fish are also pure Yellowstone cutthroat trout. This self-sustaining population is located in the stream reach between First and Second Rock Lakes. Although they cohabit with brook trout, this cutthroat population appears to be fairly healthy. Genetic analysis on a small sample of fish collected form Picket Pin Creek shows possible slight hybridization with rainbow trout.

Crazy Mountains Sampling

Four small streams draining a portion of the east side of the Crazy Mountains north of Big Timber Creek were sampled (Table 10). A sample of what appears to be Yellowstone cutthroat trout was collected from the isolated headwaters of Wheeler Creek, a small tributary to Otter Creek. These fish were sent in for genetic analysis, and the results are still pending.

Cooke City Area Waters

As discussed earlier in this report in the section on Soda Butte Creek, additional information on the results of cutthroat inventory work involving the joint interagency effort to locate and eliminate problem species form the headwaters of Soda Butte Creek, is presented in Appendix A. No cutthroat trout were located in Republic Creek, Woody Creek or Hayden Creek within either the Montana or Wyoming portions of these streams (Table 10). Cutthroat trout were collected from the lower end of Sheep Creek and from Soda Butte Creek. Genetic analysis on fish collected from Soda Butte Creek show a slight degree of hybridization with westslope cutthroat in a few specimens.

Table 10. Streams inventoried for cutthroat trout from 1994 through 1996.

STREAM (DATE)	SAMPLING LOCATION	RESULTS
BARLOW CREEK (10/14/94)	T6S; R19E; SEC. 32 (BEARTOOTH FACE)	NO FISH
BRUSH FORK WILLOW CREEK (10/12/94)	T7S; R20E; SEC. 17 (BEARTOOTH FACE)	EB, YCT - GENETICALLY PURE
BURNT FORK CREEK (4/20/94)	T7S; R19E; SEC. 18 (BEARTOOTH FACE)	EB-PRESENT
CHICKEN CREEK (10/7/94)	T7S; R16E; SEC. 2 (BEARTOOTH FACE)	LL, EB, RB - PRESENT
DRY CREEK (10/3/96)	T4N; R13E; SEC. 18 (CRAZY MTNS)	NO FISH - POSSIBLE STREAM FOR YCT INTRODUCTION
EAST FORK FIDDLER CREEK (10/7/94)	T6S; R17E; SEC. 8 (BEARTOOTH FACE) T6S; R17E; SEC. 4	EB - PRESENT EB, LL - PRESENT
EAST FORK WEST RED LODGE CREEK (10/11/94)	T7S; R18E; SEC. 12 (BEARTOOTH FACE)	NO FISH
FIRST FORK WILLOW CREEK (4/20/94)	T7S; R20E; SEC. 29 (BEARTOOTH FACE)	EB - PRESENT
GOOSE CREEK (7/20/94 & 9/13/95)	T8S; R15E; SEC. 30 (STILLWATER RIVER)	YCT - POSSIBLE SLIGHT HYBRIDIZATION WITH RB(GENETIC VERIFICATION PENDING)
GROVE CREEK (10/17/94)	T8S; R20E; SEC. 26 (BEARTOOTH FACE)	NO FISH
HARNEY CREEK (10/14/94)	T7S; R19E; SEC. 15 (BEARTOOTH FACE)	NO FISH
HOGAN CREEK (10/14/94)	T7S; R19E; SEC. 4 (BEARTOOTH FACE)	EB - PRESENT
LAKE FORK ROCK CREEK (HEADWATERS) (7/8/94)	T8S; R18E; SEC. 31 (BEARTOOTH FACE)	YCT- GENETICALLY PURE
LINE CREEK (10/17/94)	T9S; R20E; SEC. 30 (BEARTOOTH FACE)	NO FISH
LITTLE ROCKY CREEK (10/6/94)	T5S; R16E; SEC. 21 (BEARTOOTH FACE) T5S; R16E; SEC. 10	NO FISH NO FISH
MIDDLE FORK FIDDLER CREEK (10/7/94)	T6S; R17E; SEC. 5 (BEARTOOTH FACE) T6S; R17E; SEC. 4	EB - PRESENT EB - PRESENT
MIDNIGHT CREEK (10/6/94)	T4S; R17E; SEC. 18 (BEARTOOTH FACE)	LL, RB - PRESENT
NORTH FORK OTTER CREEK (10/3/96)	T4N; R13E; SEC. 20 (CRAZY MTNS)	EB - PRESENT
PICKET PIN CREEK (9/21/94)	T4S; R14E; SEC. 25 (BEARTOOTH FACE)	YCT - POSSIBLE SLIGHT HYBRIDIZATION WITH RB

Table 10 (cont.). Streams inventoried for cutthroat trout from 1994 through 1996.

STREAM (DATE)	SAMPLING LOCATION	RESULTS
PRAIRIE CREEK (10/6/94)	T5S; R16E; SEC. 17 (BEARTOOTH FACE) T5S; R16E; SEC. 6	NO FISH NO FISH
SODA BUTTE CREEK (8/16/94)	T9S; R14E; SEC. 26 (COOKE CITY AREA)	YCT - POSSIBLE SLIGHT HYBRIDIZATION WITH WESTSLOPE CUTTHROAT
STILLWATER RIVER (10/19/94)	T6S; R14E; SEC. 35 (STILLWATER T7S; R14E; SEC. 10 RIVER)	RB - PRESENT EB - PRESENT
THIEL CREEK (10/11/94)	T7S; R19E; SEC. 10 (BEARTOOTH FACE)	EB - PRESENT
VOLNEY CREEK (10/11/94)	T6S; R19E; SEC. 19 (BEARTOOTH FACE)	EB, LAKE CHUBS, LONGNOSE DACE - PRESENT
WHEELER CREEK (10/3/96)	T4N; R13E; SEC. 33 (CRAZY MTNS)	YCT - HYBRIDIZATION WITH RB
WILLOW CREEK (10/12/94)	T7S; R20E; SEC. 31 (BEARTOOTH FACE)	EB - PRESENT

EB - BROOK TROUT
RB - RAINBOW TROUT
LL - BROWN TROUT
YCT - YELLOWSTONE CUTTHROAT TROUT

Bad Canyon Creek

During fall 1993, the Custer National Forest, BLM, and FWP jointly attempted to physically remove the brown trout from the headwaters of Bad Canyon Creek and also to enhance a natural barrier to deny brown trout access to the treated headwaters (Poore 1995). Following this original project work, 63 purestrain Yellowstone cutthroat trout were taken from the upper East Boulder in 1993, and an additional 110 were collected in September 1994 and transferred via helicopter into the headwaters of Bad Canyon Creek.

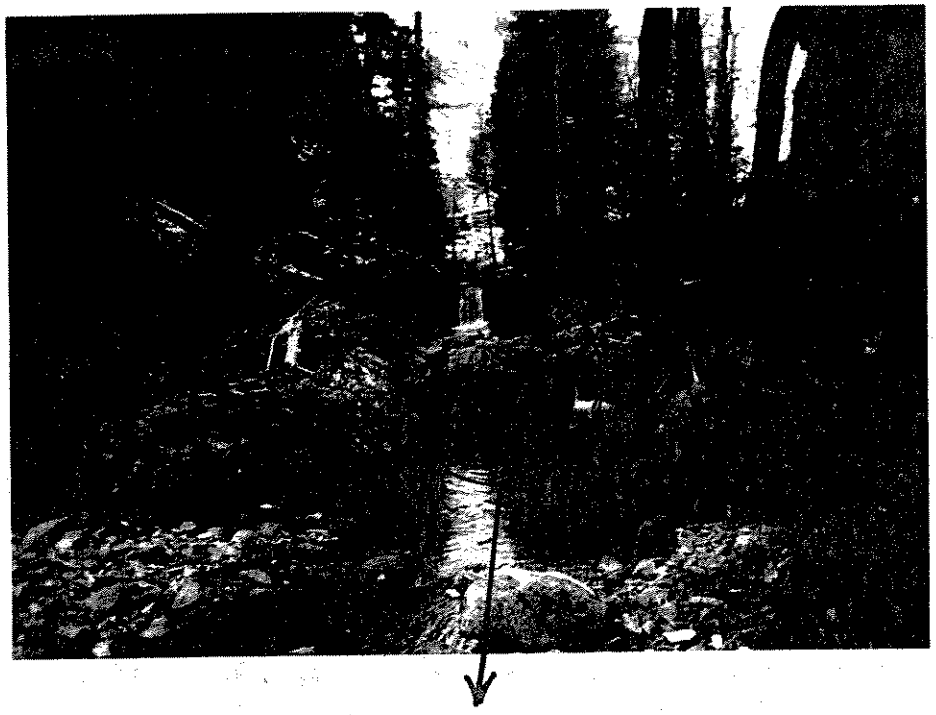
During the summer of 1995, we packed several backpack electrofishing units into the headwaters of Bad Canyon Creek to check on the status of the brown trout population. To our dismay, we found about as many brown trout upstream from the barrier as were there during the initial removal in 1993. Management agencies involved decided to attempt another brown trout removal effort during October, 1995. Nine volunteers from the agencies removed an estimated 2500 brown trout from Bad Canyon Creek above the barrier. We made two passes through the lower half of this reach and one pass through the upper half where flows were considerably less. We also removed approximately 200 brown trout from Smith Coulee up to a 30-foot barrier falls, and an estimated 50 from Trail Draw up to a 20-foot barrier falls. With the added effort in these two tributaries, we have now removed brown trout, at least once, from all the tributaries to Bad Canyon Creek upstream from the barrier falls. We found 45 Yellowstone cutthroat in Bad Canyon Creek during 1995.

During the summer of 1996, to eliminate the concern that the barrier (Figure 10) wasn't completely blocking fish passage, an interagency team worked on the falls to create a greater vertical hydraulic jump. This was accomplished by the removal of several large boulders and small bed material which served as a channel control for the plunge pool below the barrier. Through drilling, blasting and hand removal of material, we lowered the plunge pool at least a foot, thus creating a much more effective block to present upstream movement of brown trout.

During late September 1996, following completion of the latest barrier improvement project, twelve volunteers from the agencies removed an estimated 2150 brown trout from Bad Canyon Creek upstream of the barrier. We completed two electrofishing passes through the main stem of Bad Canyon Creek but, due to time constraints, were unable to redo Smith Coulee or Trail Draw. In 1996, we found 54 Yellowstone cutthroat trout in Bad Canyon Creek.

Following a lot of effort, it was clear this type of removal effort is extremely difficult to accomplish. Efficiency of electrofishing crews varies widely and even highly experienced crews are only about 80% efficient, at best. It is nearly impossible to get all the fish out of log jams, brush piles, deep holes and from undercut banks. Size of fish is another major efficiency factor, with large fish much more easily removed than fry and young of the year. Equipment failures, weather and difficult access all contribute to the problem.

We now have a complete barrier to upstream fish passage. Despite initial resistance to the project by several landowners and livestock permittees, they now accept the project and have even helped the agencies with some of the work, allowed access, and done an excellent job of managing livestock along the riparian zone. We also have a much better understanding of the extreme difficulty of mechanically removing the brown trout from this system. Our next step is to explore the possibility of chemical removal upstream of the barrier, along with neutralization at the falls. This plan also includes capturing and holding the cutthroat population until it is safe for their release upstream of the barrier.



Area to be treated with blasting and hand removal of rock. Project objective is associated with lowering of water surface elevation to increase height of water fall.

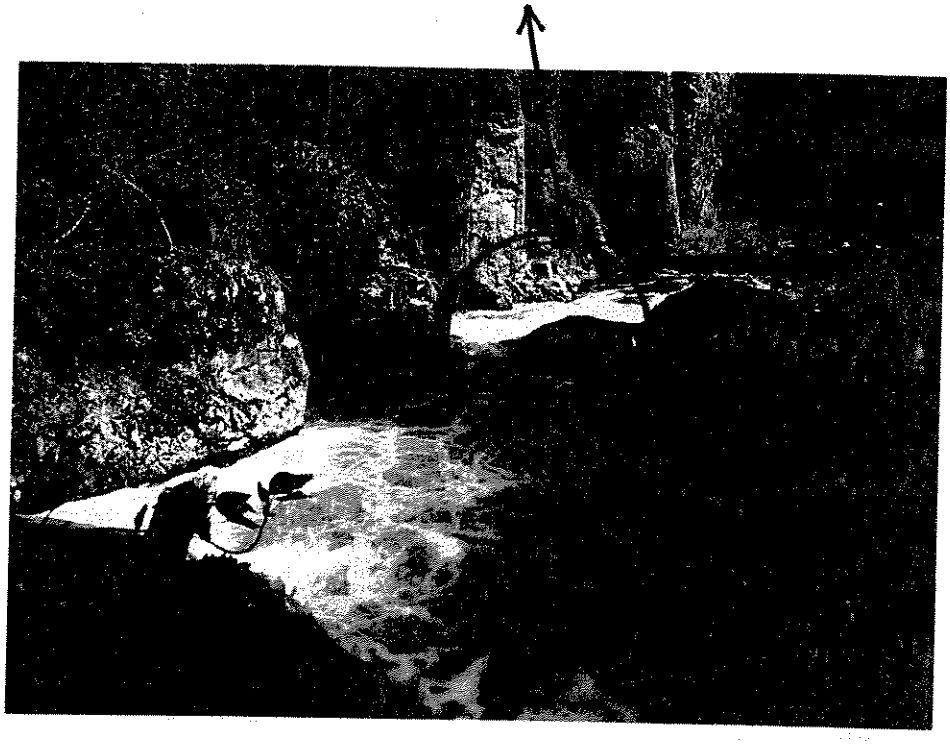


Figure 10. Photographs of the fish barrier on Bad Canyon Creek.

MANAGEMENT RECOMMENDATIONS

1) Continue to monitor the Yellowstone, Boulder and Stillwater River Drainages to follow the effects of drought, flooding, fishing pressure and management changes on fish populations. This information will be used to update the Stillwater and Boulder River Fishery Management Plans and determine whether fish population objectives established in these plans are being met.

2) Continue to pursue development of potential spawning areas in spring creeks entering the Yellowstone River near Big Timber.

3) Continue monitoring fish populations in the TO-Bar section of East Rosebud Creek to assess the results of management changes implemented to improve the fishery. Sampling within the TO-Bar section is next scheduled for the spring of 1998 and then every three years. Sampling the Hansberger section is scheduled for the spring of 1999 and then every three years.

4) Continue monitoring fish populations in the Mackay section of West Rosebud Creek to assess the results of management changes implemented to improve the fishery. Sampling is next scheduled for the spring of 1998 and then every three years.

5) Coordinate with the USFS and Noranda Mining Company to gather additional fisheries information related to the proposed cleanup of impacted waters from old mining activity around Cooke City.

6) Continue to monitor fish populations at established sections along Rock Creek. Sampling the Fox and Joliet sections is next scheduled for the spring of 1999 and then every three years.

7) Collect fisheries information from the Clarks Fork River between Belfry and the Wyoming line in the fall of 1998 and again in 2002.

8) Continue the cooperative project in 1998 with the USFS to eliminate brook trout and westslope cutthroat trout from the headwaters of Soda Butte Creek. Poisoning should be evaluated as an alternative for 1999.

9) Continue the cooperative project with the USFS to inventory and assess cutthroat populations throughout Region 5. This project should be completed by the year 2000.

10) Pursue the possible introduction of Yellowstone cutthroat trout upstream from the third falls on the West Boulder River into Trout Creek, upstream from the falls and Dry Creek in the Crazy Mountains.

11) Coordinate with the USFS to collect and transfer additional purestrain Yellowstone cutthroat trout into the headwaters of Bad Canyon Creek. Additional work is also planned to remove the remaining brown trout from the stream, upstream from the fish barrier. Poisoning should be evaluated as an alternative for 1999.

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Waters Referred To:

Bad Canyon Creek	5-22-0168-01
Boulder River Sec. 01	5-22-0742-01
Boulder River Sec. 02	5-22-0756-01
Brush Fork of Willow Creek	5-22-0865-01
Burnt Fork Creek	5-22-0910-01
Chicken Creek	5-22-1124-01
Clarks Fork River Sec. 01	5-22-1162-02
Clarks Fork River Sec. 02	5-22-1176-01
Dry Creek	5-22-1855-10
Dry Fork East Boulder	5-22-1904-01
East Boulder River	5-22-2002-01
East Fork Fiddler Creek	5-22-2044-01
East Fork West Red Lodge Creek	5-22-2192-01
East Rosebud Creek	5-22-2240-01
Goose Creek	5-22-2758-01
Grove Creek	5-22-2884-01
Harney Creek	5-22-2996-01
Hogan Creek	5-22-3136-01
Lake Fork Rock Creek	5-22-3472-01
Line Creek	5-22-3643-01
Little Rocky Creek	5-22-3752-01

Waters Referred To:

Middle Fiddler Creek	5-22-4046-01
Midnight Creek	5-22-4144-10
Otter Creek	5-22-4550-01
Picket Pin Creek	5-22-4648-01
Prairie Creek	5-22-4788-10
Red Lodge Creek	5-22-4886-01
Rock Creek Sec. 01	5-22-4928-01
Rock Creek Sec. 02	5-22-4942-01
Soda Butte Creek	5-22-5684-01
Stillwater River Sec. 01	5-22-6104-01
Stillwater River Sec. 03	5-22-6132-01
Thiel Creek	5-22-6272-01
Volney Creek	5-22-6496-01
Wheeler Creek	5-22-6818-01
Willow Creek	5-22-6916-01
Yellowstone River Sec. 04	5-22-7014-01
Yellowstone River Sec. 07	5-22-7056-01

Soda Butte Drainage
Reconnaissance Fish Survey 1994

APPENDIX A

Soda Butte Drainage
Reconnaissance Fish Survey 1994

Project Completion Report

Implemented by:

Gardiner Ranger District; U.S.D.A Forest Service

Montana Department of Fish,Wildlife and Parks

Wyoming Game and Fish Department

Shoshone National Forest; U.S.D.A

U.S. Fish and Wildlife Service; Fisheries Assistance Office YNP

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January 1995

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Introduction

Recent fish population surveys (Poore 1993) and angler reports dating back to 1979 (Mahoney pers. comm.) demonstrate that brook trout (*Salvelinus fontinalis)* inhabit upper reaches of Soda Butte Creek near Cooke City, Montana. Genetic analysis of cutthroat trout in Soda Butte Cr. near Silvergate, MT (Leary 1989) also suggests the recent intrusion of westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Exotic salmonids in the upper Soda Butte drainage pose a serious threat to the native Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) inhabiting Soda Butte Creek and the upper Lamar River. Non-native salmonids can outcompete native trout for available food and habitat resources. This competition often results in displacement of native trout with subsequent population declines. Furthermore, west-slope cutthroat can interbreed with Yellowstone cutthroat, which results in genetic introgression and loss of genetic viability.

In August 1994, a reconnaissance survey was completed for all streams and lakes within the Soda Butte drainage, including Soda Butte Creek proper, to determine the distributional extent and possible origin of exotic salmonids. Sample sites included four locations in Soda Butte Creek, Woody Creek, Republic Creek, Hayden Creek, Sheep Creek and Guitar Lake.

Benefits of Project

Genetically pure Yellowstone cutthroat trout currently inhabit less than 8 percent of their historic lake and stream habitats. Because of this significant reduction from their historical distribution, Yellowstone cutthroat are designated as a "sensitive species" by the US Forest Service and are also considered a "species of special concern" by the Montana Department of Fish, Wildlife and Parks. Protection is the primary management emphasis for Yellowstone cutthroat trout. This emphasis is consistent with the goals and objectives outlined in the Forest Service Manual, the Gallatin National Forest Land and Resource Management Plan, and the interagency Yellowstone Cutthroat Trout Management Guide (currently in draft). Specifically, this management emphasis is intended to preserve the inherent values of maintaining pure populations of native trout in the Yellowstone drainage and to preserve the unique recreational values associated with angling for native trout. Preserving these values provides the underlying stimulus for this project. Information gained will aid in future native trout preservation and protection planning efforts in the Soda Butte drainage.

Management Direction

Consistent with these preservation goals, the desired condition of the YCT population inhabiting Soda Butte Creek and its tributaries is to maintain or enhance population health and genetic purity. The desired salmonid species composition is one of native Yellowstone cutthroat trout only, all other trout species in the Soda Butte drainage are non-native. This desired condition and hence the impetous for this project is in part based on objectives and policies outlined in the Forest Service Manual (FSM 2670) for management of "Sensitive Species". These are:

A. Objectives (FSM 2670.22)

1. Develop and implement management practices to ensure that sensitive species do not become threatened or endangered because of Forest Service actions.

2. Maintain viable populations of all native fish species in habitats distributed throughout their geographic range on National Forest System lands.

3. Develop and implement management objectives for populations and/or habitat of sensitive species.

B. Policy (FSM 2670.32)

1. Assist states in achieving their goals for conservation of endemic species.

2. Establish management objectives in cooperation with the state when projects on National Forest system lands may have a significant effect on sensitive species population numbers, or distributions. Establish objectives for Federal candidate species, in cooperation with the FWS, or NMFS and the states.

The Gallatin National Forest Land and Resource Management Plan (Forest Plan, Record of Decision signed 9/23/87) provides broad direction for management of fisheries resources on the Gallatin National Forest. The following Forest Plan direction provides some basis for this study.

A. Forest Plan goals (FP, p.II-1):

1. Provide for a broad spectrum of recreational opportunities in a variety of forest settings.

*note: A broad spectrum of recreational opportunities from a fisheries perspective can be viewed as providing users the opportunity to catch native trout species. Native YCT provide anglers recreational opportunities not offered outside the species historic range.

2. Provide habitat for viable populations of all indigenous wildlife species...

B. Forest Plan standards (FP, pII-17):

1. The Gallatin National Forest will coordinate management of the wildlife and fish resources with the Montana Department of Fish, Wildlife and Parks; the U.S. Fish and Wildlife Service; Yellowstone National Park; private landowners; and other agencies.

2. Habitat that is essential for species identified in the Sensitive Species list developed for the Northern Region will be managed to maintain these species.

Specific objectives linked to the desired condition are also found in the interagency Yellowstone cutthroat trout management guide (in draft) and the Gallatin National Forest's Action Plan for Implementation of the Yellowstone Cutthroat Trout Management Guide. Objectives found in the Action Plan relative to this project are:

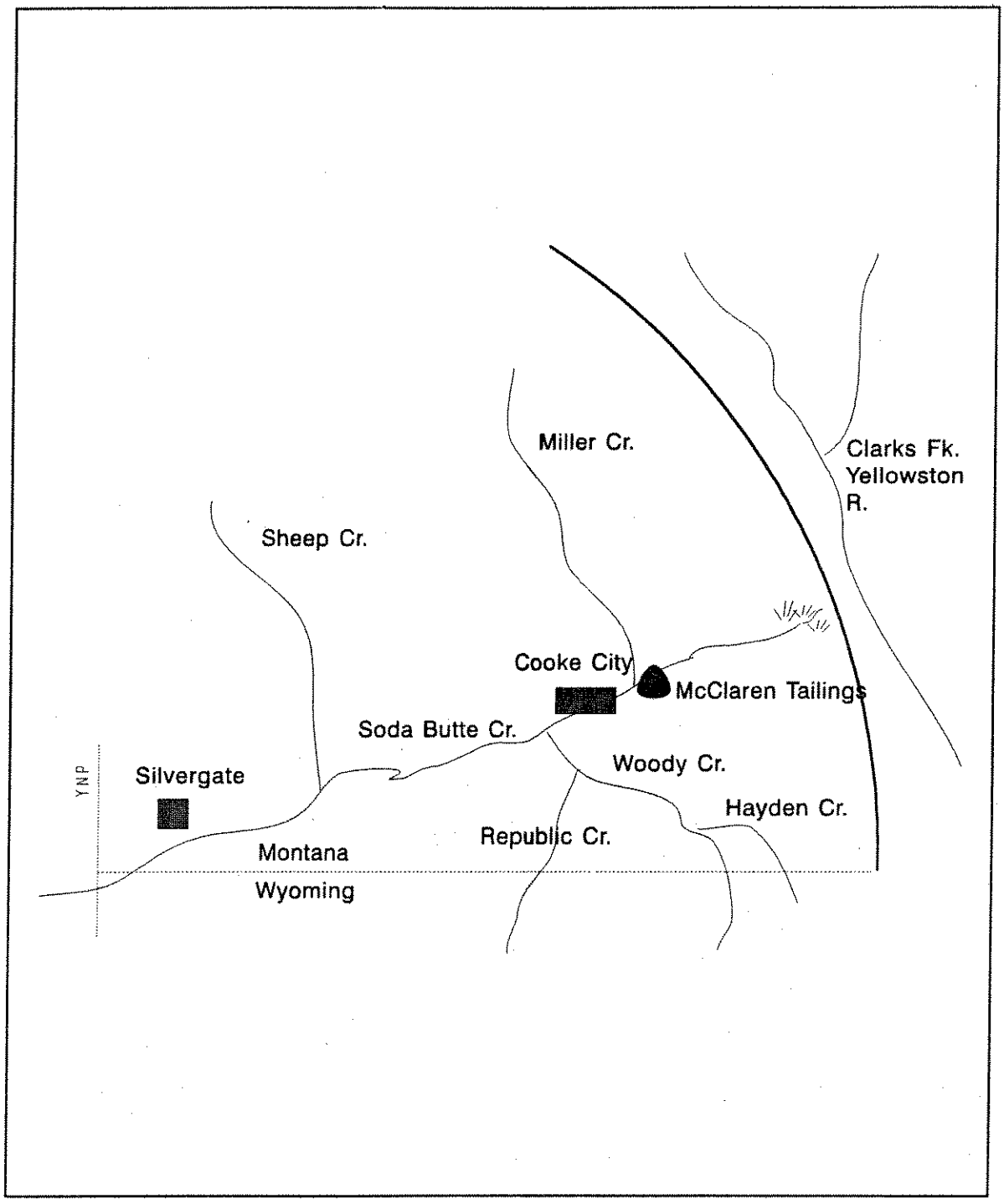
A. Provide for the protection of remaining pure populations and provide appropriate management of habitat located on the Gallatin NF.

B. Restoration and establishment of Yellowstone cutthroat trout populations within suitable lakes and streams within the Yellowstone River ecosystem.

C. Inform both agency leadership and the general public on the unique attributes and habitat requirements of Yellowstone cutthroat trout. Encourage support for protection and conservation of this subspecies of cutthroat.

The MDFW&P has primary authority to manage fish populations in the state. Their management emphasis includes establishing and maintaining self perpetuating populations of sensitive species in all appropriate locations.

Study Area Map



Site Descriptions and Synopsis of Existing Information

Soda Butte Creek - above McClaren Tailings

Soda Butte Creek originates from several springs near Colter Pass below the Cooke City Guard Station. About one mile downstream from its source it flows through a channelized section through the old McClaren Mine tailings. Upstream from the tailings the stream is generally characterized by a A2 type channel (Rosgen 1993), with well defined pools and riffles. Streambank vegetation consists of a dense overstory of subalpine fir and shrubs. Large woody debris and boulders provide pool formative features, instream cover for fish and considerable channel and habitat complexity. Streambed substrates consist of boulders, large to small cobbles and isolated pockets of suitable spawning gravel. Bankfull width averages seven feet. There is a diverse and abundant macroinvertebrate community. Water and habitat quality is rated good, and is suitable for fish inhabitance.

In 1972 two stations were electrofished above the mine tailings, one at Soda Butte campground and one further upstream. No fish were found at either of these two sites (Duff 1972). However there were angler reports of small fish being caught near the campground. In 1974 the Montana Department of Fish, Wildlife and Parks electrofished 250 feet at Soda Butte campground with negative results; however, one five inch brook trout was visually observed.

Soda Butte Creek - below McClaren Tailings

Soda Butte Creek below the old milling and tailings area is severely impacted by acid mine drainage. The mine tailings have long been identified as a source of pollution in Soda Butte Creek, and numerous studies have been undertaken to determine the effects on the creek's ecology. Miller Creek, a clean water tributary which joins Soda Butte Creek near the tailings, dilutes the acid drainage. However, noticeable biological recovery doesn't occur until after the Woody Creek confluence below Cooke City. Soda Butte Creek below the tailings is characterized by a B4 type channel (Rosgen 1993) with coarse gravel and small cobble substrate predominating. Stream substrates are coated with ferrous precipitates resulting from the acid rock drainage. Width to depth ratio is high and there is little structural or habitat diversity. The benthic fauna consists of a few adverse chemistry and sediment tolerant species; insect diversity and abundance is considered low.

In 1990 the MDFW&P electrofished a 300 ft. reach of Soda Butte Creek upstream from Miller Creek near the tailings area and found

no fish. In 1993 the MDFW&P electrofished a 1000 ft. station downstream of Miller Creek and found one cutthroat and one brook trout.

Soda Butte Creek - below Woody Creek

Below the Woody Creek confluence, Soda Butte Creek meanders with a lower energy gradient through a small willowed valley. The channel is characterized by a C4 channel type with a mixture of gravel, small cobble, sand and silt. Extremely high levels of fine sediment enter the stream from Woody Creek and is deposited in the form of medial and lateral silt bars. Width to depth ratio is high and habitat complexity is low. Scattered log jams are present throughout the reach and provide the majority of habitat for trout. There is little visible evidence of acid mine drainage. Benthic diversity and abundance remains low owing mainly to the heavy sediment loads from Woody Creek. Water quality and physical habitat requirements appear adequate for salmonids.

In 1972 a 1/10 mile section was electrofished just above the Sheep Creek confluence with negative results (Duff 1972). A 1/10 mile section electrofished below Sheep Creek yielded three cutthroat (9-12 in.) in good condition. Numerous other trout were attracted but were unable to be netted due to size and discharge of the stream (Duff 1972). In 1974 the MDFW&P electrofished a 300 ft. station below Woody Creek with negative results. In 1993 the MDFW&P electrofished a 1000 ft. station below Woody Creek and found numerous (N=33) cutthroat trout and no brook trout, indicating some biological recovery has occurred since the last tailings reclamation effort.

In 1989, the Gallatin National Forest and the MDFW&P collected cutthroat trout from Soda Butte Creek near Silvergate (T9S,R14E, sec 33) to determine genetic purity. Of 25 fish analyzed for genetic purity, 20 were found to have alleles characteristic of pure Yellowstone cutthroat, 4 were first generation Yellowstone/west-slope hybrids and 1 fish was determined to be pure west-slope cutthroat (Leary 1989).

Soda Butte Creek - near the YNP boundary

According to Duff (1972), residents of Silvergate, MT were reporting catches of 12 inch cutthroat trout near town in 1971. In 1974, the MDFW&P electrofished a 300 ft. section near Sivergate with negative results; however, one adult trout (unknown spp.) was visually observed and there were local reports of frequent cutthroat and brook trout catches. The US Fish and Wildlife Service, Fisheries Assistance Office (YNP) has been conducting population surveys in Soda Butte Creek near the

Yellowstone National Park boundary annually since 1981 (see Table 1). Yellowstone cutthroat trout abundance for a 305 m reach has fluctuated between a low of 29 fish in 1981 to a high of 729 in 1992 (Table 1). No brook trout have ever been sampled during these surveys. However, for several years there have been infrequent angler reports of brook trout caught in Soda Butte Creek in the Park (Mahoney pers. comm.).

Table 1. Electrofishing results from the Northeast boundary section of Soda Butte Creek (near the Northeast boundary of Yellowstone Park). The only fish species captured was Yellowstone cutthroat trout *Oncorhynchus clarki bouvieri*.

YEAR	# CAUGHT (305 m)	POPULATION ESTIMATE	95 % C.L.[a]	MEAN LENGTH[b]	LENGTH RANGE
1981[c]	22	29	22-46	201	64-352
1984[d]	163	362	231-598	205	112-360
1985[d]	88	288	143-630	222	139-335
1986[d]	23	[e]	[e]	251	201-342
1987[d]	26	[e]	[e]	255	121-315
1988[d]	23	[e]	[e]	223	114-353
1989[d]	51	180	73-450	208	68-342
1990[d]	156	441	278-736	177	67-332
1991[d]	155	518	300-971	209	83-352
1992[d]	137	729	362-1594	226	88-341
1994[d]	212	337	242-483	228	114-367

[a] 95% confidence limits of population estimate; number is estimate for length of sample section (305m).
[b] mean total length in mm.
[c] Section located approximately 1 mile downstream from YNP boundary; population estimate derived from a three pass removal method.
[d] Section located adjacent to Northeast Entrance ranger station; population estimate derived from mark and recapture method.
[e] No marked trout were recaptured, therefore a population estimate could not be made.
[d] Section located adjacent to Northeast Entrance ranger station; population estimate derived from mark and recapture method.
[e] No marked trout were recaptured, therefore a population estimate could not be made.

Woody Creek

Woody Creek drains the mountains south of Cooke City in the North Absaroka Wilderness, Wyoming, and enters Soda Butte Creek at the west end of Cooke City. The mainstem of Woody Creek is in Montana but two tributary streams originate in Wyoming on the Shoshone National Forest. The creek is about three miles long. A barrier falls approximately 100 ft. high exists above the Mohawk mine 1.5 miles from the mouth. From the falls downstream the stream is very high gradient and is characterized by an A1a+ channel type. Pools scoured out of bedrock exist throughout the lower reach and provide some habitat for fish. Approximately 200 yards above the falls the valley opens into a high elevation cirque basin. Here the stream is less confined and is characterized by a B3 channel type. Streambank vegetation consists primarily of grasses, willows and sparse conifers. Bankfull width exceeds 50 ft. in some areas; however, stream width at low flow averages only 13 ft. The Woody Creek watershed has a high percentage of extremely erosive land comprised of glacial till derived from volcanic rocks (Shovic et. al. 1988). High snowmelt rates and summer thunderstorms readily erode the oversteepened volcanic cirque headwalls and scarps to form a dense dendritic drainage pattern of intermittent channels. During a thunderstorm event on August 1, 1994 the wetted channel width increased from 13 ft. (5-10 cfs, visual estimate) to 30-40 ft (75-100 cfs, visual estimate) in minutes. High water and sediment discharges resulting from these frequent high intensity rainfall events have formed a channel with little structural complexity or habitat diversity for fish. The channel is predominately riffle with few low quality pools. Instream cover in the form of large wood, boulders, or undercut bank is lacking throughout most of the reach. Fine sediment levels are high with little potential for recruitment. There are no habitat or population data recorded in the Montana Rivers Information database for Woody Creek.

Duff (1972) electrofished Woody Creek from its mouth upstream to the road crossing but found no fish. MDFW&P and WG&F stocking records indicate that no fish have been stocked in Woody Creek; however, Scott Riley of Irma Mines indicated that brook trout were stocked above the falls when the Mohawk Mine was operational (presumably pre-1970). Prior to this study no fish population surveys have been conducted in Woody Creek to determine the success of early stocking attempts.

Hayden Creek

Hayden Creek is a first order tributary to Woody Creek and originates in the North Absaroka Wilderness, Wyoming on the Shoshone National Forest. The stream is approximately one mile

long. Like Woody Creek, habitat quality is poor and potential to support a fishery is low. Wyoming Game and Fish and MDFW&P stocking records indicate that fish have not been stocked in Hayden Creek. There are no habitat or population data recorded in the Montana Rivers Information database. Wyoming Game and Fish wardens that routinely visit the area do not believe there are fish in Hayden Creek.

Republic Creek

Republic Creek enters Woody Creek about 3/4 mile above the Woody Cr./Soda Butte Cr. confluence and originates in the North Absaroka Wilderness, Wyoming on the Shoshone National Forest. The stream is about four miles long. The lower reach flows through a deep, narrow conifered canyon with moderate gradient and is characteristic of an A1 type channel. Boulders and large woody debris provide suitable habitat for trout. Higher in the watershed the stream flows through a cirque basin with lower valley and stream gradient. This upper reach is characteristic of a B3 type channel. Large wood, boulders and some undercut bank provide limited habitat for trout. Riparian vegetation consists of grasses, willows and sparse conifers. Like Woody Creek, Republic Creek is subject to extreme flash flood events, though the channel in the upper valley is more defined and stable. Bankfull width averages 20 ft. Low flow wetted width during the time of the survey averaged 9 ft. Duff (1972) determined that habitat conditions for salmonids were adequate throughout most of the stream. There are no habitat or population data recorded in the Montana River Information database for Republic Creek.

Wyoming Game and Fish and MDFW&P records indicate that no fish have been stocked in Republic Creek. However, Scott Riley of Irma Mines stated that fish were present in a meadow further upstream from the Wyoming border. Prior to this study, there have been no population surveys done in the meadow reach to verify this claim. Duff (1972) surveyed a 1/10 mile reach in the moderate gradient reach below the meadow and found no fish.

Sheep Creek

Sheep Creek is a first order tributary to Soda Butte Creek and enters approximately 1 3/4 miles upstream from Silvergate. The entire stream is within the Gallatin National Forest. Approximately 1000 ft. of stream below the highway has habitat conditions suitable for trout. Upstream from the highway gradient increases and habitat suitability declines. Habitat conditions in a low gradient reach approximately one mile from its mouth are suitable for trout. There are no habitat or population data recorded in the Montana Rivers Information

database for Sheep Creek.

Guitar Lake

Guitar Lake is located on the northeast side of Amphitheater Mountain. Wyoming Game and Fish stocking records indicate that the lake has never been stocked, nor has it ever been surveyed for trout presence. There is an unnamed tributary to Soda Butte Creek that originates from the lake. There is potential that fish inhabiting the lake could enter Soda Butte Creek via this tributary.

Survey Results

Soda Butte Creek

Fish abundance and species composition was determined for three locations in Soda Butte Creek. The uppermost station was a 530 ft reach just below the cemetery. A two pass removal estimate yielded six cutthroat and five brook trout during the first pass and no fish were captured during the second pass (Table 2), therefore a population estimate could not be made. All fish were healthy and robust, and all brook trout were sexually mature. All cutthroat trout had spotting and coloration patterns indicative of pure Yellowstone cutthroat. Brook trout were removed from the stream.

A second population survey was conducted downstream of Cooke City near the powerline crossing where the stream meanders through a willowed valley. A two pass removal estimate was made for 1000 ft. of stream. Sixty six cutthroat trout were captured during the first pass and seven were captured during the second pass (Table 2). A length frequency histogram (Figure 1.) suggests atleast four year classes are represented in the population. Scale samples were collected for all fish for future age and growth analysis.

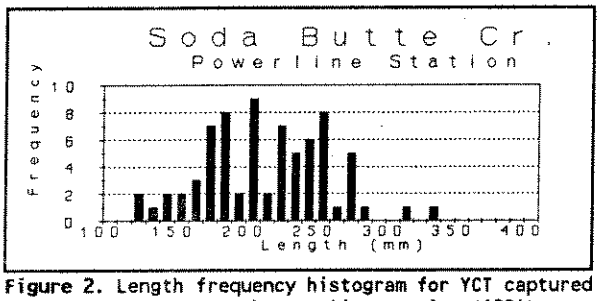


Figure 2. Length frequency histogram for YCT captured at the Soda Butte Creek Powerline station (1994)

All fish were healthy and robust. All cutthroat trout had spotting and coloration patterns indicative of pure Yellowstone cutthroat. Five juvenile and fifteen adult fish were sacrificed to determine bioconcentrations of lead, mercury, selenium, copper, aluminum, zinc, arsenic and cadmium. Bioaccumulation

study results can be found in the New World Project DEIS. There were no brook trout captured or observed.

A third station was surveyed by the USFWS near the Park boundary adjacent to the Northeast entrance. A mark-recapture estimate (1 pass for each)was made for 1000 ft. of stream. A total of 212 cutthroat trout were captured (Table 2.). The length frequency analysis (Figure 2.) also demonstrates atleast four distinct year classes were represented. No brook trout were captured or observed.

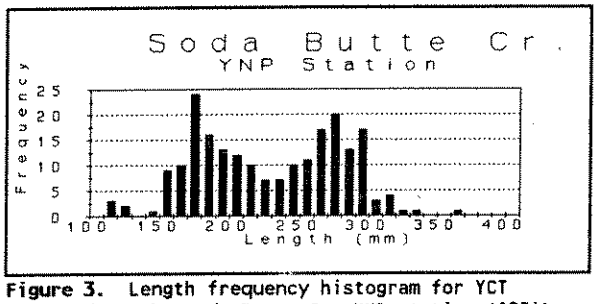


Figure 3. Length frequency histogram for YCT captured at the Soda Butte Cr. YNP station (1994)

Because brook trout were found in Soda Butte Creek below the cemetery the MDFW&P decided to determine their distributional extent by electrofishing the entire stream from the Woody Creek confluence updrainage to where the stream became to narrow and shallow for fish. Eight additional brook trout were captured and removed from the stream.

Woody and Hayden Creeks

For Woody Creek, a 1000 ft. section in the low gradient meadow reach above the falls was electrofished to determine if trout were present. No fish were captured or observed. The survey crew walked the entire length of stream to its confluence with Hayden Creek and visually observed no fish. An additional 500 ft. station was electrofished in Hayden Creek and no fish were found. Furtherore, a 500 ft. reach from the bridge at the Mohawk mine upstream was electrofished with negative results.

Republic Creek

Two stations were electrofished in Republic Creek to determine if trout were present. The first station was approximately 2000' ft. long and located in the low gradient meadow reach about 1 1/2 miles from the Wilderness boundary. No fish were captured or observed. An additional 2000 ft. reach was electrofished higher in the watershed. Though habitat conditions appeared suitable for trout, no fish were captured or observed.

Table 2. Population estimates by stream, study section and species for streams and lakes in upper Soda Butte drainage August 1994.

SITE	SPECIES	# CAUGHT	ESTIMATE	95% CI	MEAN LENGTH (in.)	RANGE
Soda Butte Cemetery	YCT	6	[a]	-	9.7	9.3-10.3
	BKT	5	[a]	-	7.4	5.5-10.6
Soda Butte Powerline	YCT	69	74	73-75	221	116-327
	BKT	0	-	-	-	-
Soda Butte YNP boundary	YCT	212	337	242-483	9.0	4.5-14.4
	BKT	0	-	-	-	-
Woody Cr.	No fish captured or observed					
Hayden Cr.	No fish captured or observed					
Republic Cr.	No fish captured or observed					
Sheep Cr. below highway	YCT	7	8	8-9	10.5	9.2-11.5
	BKT	0	-	-	-	-
Sheep Cr. above highway	No fish captured or observed					
Guitar Lake	No fish captured or observed					

[a] No fish were captured on the second pass, therefore a population estimate could not be made.

Sheep Creek

Two stations were electrofished in Sheep Creek, one below the highway and one in a low gradient reach further upstream. A two pass removal estimate was made for a 750 ft. reach from the highway culvert downstream to its confluence with Soda Butte Creek. Five cutthroat trout were captured during the first pass and two cutthroat were captured on the second pass (Table 2.). All cutthroat had spotting and coloration patterns typical of pure Yellowstone cutthroat trout. No brook trout were observed. Although habitat conditions appeared suitable for trout, none were found in the upper low gradient reach.

Guitar Lake

Guitar Lake is 1/2 to 3/4 acres in size with a maximum depth of 17 feet. A 12.5 ft. sinking experimental gillnet was set for 4 hours with negative results. There was no visible evidence of fish in the lake.

Conclusions

The distributional extent of brook trout throughout the Soda Butte drainage appears to be limited to Soda Butte Creek proper, as no fish were found to inhabit Woody, Republic and Hayden creeks, or Guitar Lake. The longitudinal distribution of brook trout in Soda Butte Creek extends from its origin at Colter Pass downstream atleast as far as Silvergate, MT. Results from this study demonstrate that the heaviest concentration of brook trout is in the uppermost reaches on the Gallatin National Forest, although densities are low (i.e., 13 brook trout found from Colter Pass downstream to Woody Creek, approximately 2 miles). Sporadic angler reports of brook trout catches suggests that they may inhabit the entire length of Soda Butte Creek through Yellowstone National Park. However, annual population surveys from 1981-1994 near the Northeast Entrance indicate otherwise.

The origin of brook trout in Soda Butte Creek is still uncertain, however there are two possible explanations. First, although it is uncertain exactly when brook trout were introduced into Woody and Republic creeks, and the extent to which they became established, credible accounts of Scott Riley make this a likely explanation. Second, during spring snowmelt runoff there may be potential for the Clark's Fork of the Yellowstone and the Soda Butte drainages to be hydrologically connected via several flooded channels throughout the wetland area near Colter Pass. Boyd Bernard, a Cooke City resident, believes that spring flooding on the divide yields a potential conduit for brook trout in the Clark's Fork drainage to move into the Soda Butte drainage. This potential needs to be verified, and should be considered when developing a plan to monitor brook trout in Soda Butte Creek.

The genetic test results (Leary 1989) suggesting the recent introgression of west-slope cutthroat trout in Soda Butte Creek remain a mystery. Fish stocking records queried for both the MDFW&P and WG&F agencies indicate that west-slope cutthroat have never been introduced to the drainage. Hence, there is no plausible explanation for the cause or source of this recent intrusion. All cutthroat trout sampled during this study had

spotting and coloration patterns characteristic of pure Yellowstone cutthroat.

Monitoring Recommendations

The status of brook trout in Soda Butte Creek should continue to be monitored, especially throughout the headwater reaches on National Forest. To date, most of the population surveys have been conducted during late summer and early fall. It is possible that brook trout residing in lower reaches of the creek migrate upstream to spawn during fall. Upstream migration may explain why brook trout have only been found in headwater reaches during electrofishing surveys. If upstream migration and concentration does occur, then previous surveys may have resulted in a biased estimate of brook trout distribution. However, it also provides an excellent opportunity to sample, and eradicate, a high percentage of the brook trout inhabiting Soda Butte Creek. Because the MDFW&P has primary authority over fish population management, they would be responsible for establishing a brook trout monitoring or eradication schedule for stream reaches outside YNP. It would be the USFWS decision to monitor within YNP. The Gallatin National Forest's intent is to work with both agencies to accomplish common preservation goals.

Because there is no plausible explanation for the presence of west-slope cutthroat, a more rigorous study is warranted to validate their presence. Study objectives would be aimed at determining their distribution and degree of introgression with Yellowstone cutthroat. No less than 25 samples should be analyzed for genetic make-up from atleast two locations in Soda Butte Creek. A rigorous validation would require samples be sent to more than one genetic lab. Depending on final 1995 budget allocations, a genetic validation study may be implemented during the summer of 1995.