MONTANA FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

State:	**MONTANA**	**Element 1:**	**FISHERIES MANAGEMENT**
Project No:	**F-78-R-4, 5, 6**	**Job No:**	**I-i**
Project Title:	**STATEWIDE FISHERIES INVESTIGATION**	**Job Title:**	**MID-YELLOWSTONE DRAINAGE INVESTIGATIONS**

PROJECT PERIOD: JULY 1, 1997 THROUGH JUNE 30, 2000

ABSTRACT

We sampled trout populations in the 5.5 mile Laurel section of the Yellowstone River in 1997 and 1999. Rainbow trout populations rebounded to 4,289 in 1999 from a low of 1,742 estimated in 1997, following two years of major floods in 1996 and 1997. Brown trout numbers (1,883) decreased about 14% from the 1997 estimates (2,179). Total trout numbers were the highest estimated in twelve years (6,172).

We completed trout population estimates in the 7.1 mile Big Timber section of the Yellowstone River in the spring of 1999. Rainbow trout population estimates for 1999 (3,805) were 63% higher than in 1997, while brown trout estimates for the period were 12% lower, 1235 versus 1399. Yellowstone cutthroat trout population estimates, which appear to be inflated, are up 228% from 1997.

According to snorkeling counts conducted in 1998, rainbow trout population in the Allers section of the Boulder River is up 74% (258) from the last survey in 1995 (148).

Rainbow trout spawning surveys were conducted in the Boulder River from Natural Bridge to the mouth of the East Boulder. During the peak of spawning, a helicopter was used to survey the spawning rainbows in this reach and also above the falls in the lower end of Allers section.

Brown trout population estimates done in the B-2 section of the Boulder River in 2000 are down about 12% from 1997 figures, 585 versus 668. Rainbow trout population estimates increased 104% over the period, although the estimate for larger rainbows appears inflated due to spawning movements. Although the ratio of browns to rainbows has recently shifted toward rainbows, the total number of trout within the section has not changed significantly over the past ten years.

Fish population estimates done in the Moraine section of the Stillwater River in 1998 and 2000 show a small increase in larger brown trout (6%) while rainbow trout decreased about 23%. Estimates for the two years are not directly comparable because age data for the 2000 estimates is not yet available.

In 1998, fish population estimates were completed in the Absarokee section of the Stillwater River. Rainbow trout population estimates for larger fish are down about 49% from 1992, while brown trout numbers increased about 22% during that time. Total trout population estimates of fish age two and older decreased about 43% between 1992 and 1998.

Fish population estimates done in 1998 in the TO-Bar Ranch section of East Rosebud Creek show an increase of about 14% in the brown trout population from 1995. Brown trout age five and older decreased about 40% during that period.

Fish population estimates done in the Mackay section of West Rosebud Creek during the spring of 1998 show a decrease of about 23% in brown trout numbers from estimates made in 1994. Larger fish, age five and older, decreased 100% during this period, but this may be somewhat related to spawning movements of these larger fish.

We attempted to complete a mark-recapture population estimate for trout in a mile and a half reach of the Clarks Fork River near the Wyoming state line during the fall of 1998. Because of the low trout numbers, we were unable to obtain a statistically reliable estimate. We collected 61 rainbow, 22 brown and one cutthroat trout.

Brown trout population estimates done in 1999 within the Fox section of Rock Creek show an increase of 70% for fish age two and older, over estimates done in 1996, increasing from 571 to 971 fish per mile. Brown trout populations are now over the ten-year average of 611 for this section.

Brown trout population estimates done in 1999 within the Joliet section of Rock Creek show a decrease of 5% from estimates completed in 1995, i.e. 780 versus 825 fish per mile. Too few rainbow trout inhabited this section to make a valid estimate.

Fish population estimates were done in a 1,200 foot section of Bluewater Creek adjacent to the State Fish Hatchery. We estimated 297 brown trout were in this section along with a small number of rainbow and cutthroat trout.

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 1998. Brown trout reproduction appears to have improved since project completion in 1992.

In the fall of 1997 and 1998, additional work was done to eliminate brook trout from the headwaters of Soda Butte Creek. Electrofishing as a removal method has been unproductive, so we are proceeding with the development of an Environmental Assessment (EA) for chemical removal.

Follow-up electrofishing in Bad Canyon Creek to check on our latest brown trout removal efforts show cutthroat are still outnumbered about 14 to 1. During 2000, an EA was prepared evaluating chemical removal of brown trout from the streams' headwaters.

A spawning enhancement project was completed on Esp Spring Creek, a small spring creek which enters the Yellowstone River near Big Timber. A remote site incubator was used to hatch Yellowstone cutthroat trout into the spring creek in 1999 and 2000.

A short section along the North Fork of Grove Creek was electrofished as part of our Yellowstone cutthroat inventory work. No cutthroat were found

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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.

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 and Bad Canyon 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 5.5 mi from Buffalo Mirage Fishing Access Site to the Laurel Bridge. The Laurel section ends about two miles upstream from the confluence of the Clarks Fork of the Yellowstone River. Fish population estimates were made in this section during the fall of 1997 following two years of record high flows, which resulted in massive erosion and deposition and greatly accelerated natural fluvial geomorphological processes. In the fall of 1997, total trout populations were the lowest estimated during the ten years we have been monitoring (Poore 1997).

Rainbow trout population estimates for 1999 (4,289) indicated they have increased from the 62% decline observed in 1997 (1,742) to near pre-flood levels estimated in 1995 (4,548). The most dramatic increases were in age classes two, three and four at 221%, 242% and 114% respectively. Figure 2 gives the results of fish population estimates over the last 13 years in the Laurel section. The 1999 estimate is based on 119 recaptures of 752 marked rainbows (16%).

Brown trout population estimates for 1999 (1,883) decreased 14% from the 1997 estimates (2,179), but were 44% higher than the estimate from 1995 (1,305). The 1999 estimate is based on 45 recaptures of 289 marked brown trout (16%). Brown trout from age class two decreased 42% between 1997 and 1999, while all older age classes, except age class four, actually increased during the two years.

Total trout numbers within the Laurel section (6,172) are the highest estimated in the twelve years we have been monitoring (Table 1). The total biomass estimate of 2,331 lb of trout is also the highest we have observed within this section. The low numbers of small fish plus the yearly variability between age classes indicate very limited reproduction and significant movement of brown and rainbow trout to and from the section. Population characteristics of both brown trout and rainbow trout inhabiting the Laurel section indicate spawning and rearing of small fish occurs elsewhere in the river system.

During 1995, we sampled 26 burbot and tagged 23 of these fish. In 1997, we sampled only eleven burbot and tagged nine. During 1999, we sampled 54 burbot and tagged 53. A simple Peterson estimate based on four recaptures from the 29 burbot marked gave us an estimate of 155 burbot within the section. Although this estimate is not very statistically reliable, it indicates relative numbers of burbot within this section. For comparison, more statistically reliable burbot estimates done in the section during 1987 (458) and 1988 (575) were much higher (Poore 1988). Even without

TABLE 1. Fish population data collected from the Laurel section of the Yellowstone River during September 1999.

Species	Age Class	Average Length (in)	Average Weight (lb)	Number Estimate	Estimated Number/Mile	Weight Estimate (lb)
Brown Trout	1	4.35	0.03	43	8	1.3
	2	8.54	0.23	666	121	153.5
	3	10.37	0.40	651	118	262.8
	4	11.06	0.50	239	43	119.8
	5	14.06	1.00	194	35	193.7
	6 & older	16.56	1.60	91	17	145.6
			TOTALS	1,884	342	876.8
Rainbow Trout	1	4.20	0.03	15	3	0.4
	2	7.32	0.16	2,652	482	414.3
	3	8.96	0.28	589	107	166.9
	4	11.98	0.62	643	117	401.2
	5	14.16	1.03	252	46	258.4
	6	16.43	1.57	127	23	198.5
	7 & older	16.91	1.70	12	2	19.7
			TOTALS	4,289	780	1,459.3

a formal estimate, burbot numbers have clearly declined within the Laurel section, particularly between 1995 and 1997, which experienced flooding and severe winter icing conditions. Burbot now appear to be increasing again in response to more normal river flows. A 23.1 in channel catfish was also sampled in the section during 1999.

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. All fish population estimates have been done in the spring except for the one fall estimate during 1992. This fall estimate is not directly comparable with the spring fish population numbers (Poore 1995).

Rainbow trout population estimates (3805) completed during the spring of 1999 (Table 2) are slightly (13%) higher than estimates from 1995, and considerably (63%) higher than estimates completed in 1997. The most dramatic increases are in age classes three and six and older which increased 103% and 114%, respectively. Spring 1999 rainbow trout population estimates are the highest observed over the last thirteen years (Figure 3).

Brown trout population estimates (1,235) completed during March 1999 are 12% lower than estimates from 1997 (1,399) and 28% lower than estimates from 1995 (1,715). This decrease was noted for brown trout in age classes one, two and five while the numbers in all other age classes increased from 1997 to 1999. The brown trout estimate is based on 68 recaptures (19%) of 350 marked fish, and the standard deviations for all size classes estimated averaged 17%, which indicates a statistically reliable estimate.

Yellowstone cutthroat trout population estimates for 1999 (1,540) are 228% higher than 1997 estimates (469) and 340% higher than 1995 estimates (350). Cutthroat estimates are based on 13 recaptures (9%) of 137 marked fish which ranged in length from 6.4-17.0 in. Based on the low number of recaptures, their distribution, and the relatively high standard deviations of size classes (average 35%), this cutthroat estimate is not statistically reliable, and the estimate appears inflated.

Total trout population estimates from 1995, i.e. 5,433 fish with a biomass of 4,864 lb, 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 4,197 fish, with a 24% drop in total biomass to 3,677 lb. The species composition in 1997 was 56% rainbow, 33% brown, and 11% cutthroat trout. By the spring of 1999, total trout populations within the section had rebounded to 6,580 with a biomass of 4,678 lb. The 1999 species composition was 58% rainbow, 19% brown and 23% cutthroat trout. As discussed earlier, this 1999 species composition and total number may not be correct because of what appears to be an inflated cutthroat trout estimate. In addition to the trout, we sampled 24 burbot ranging inlength from 18.1-26.1 in in 1999. Twenty-three of these burbot were tagged with individually numbered tags before release.

Boulder River

Allers Section

On October 7, 1998, we again counted fish in the mile long Allers section of the Boulder River using snorkeling equipment (Poore 1997). Counting conditions were ideal with low, crystal-clear water and bright, calm, sunny weather. As in 1995 when the last count was made, we are confident that the count (particularly of fish larger than 13 in) is reliable, given the ideal conditions. We counted 258 rainbows over 13 in and 64 between 5 and 13 in. The count of fish over 13 in was up 74% from 1995 and 22% from the 1993 survey. The last electrofishing done in Allers section during the fall of 1991 provided an estimate of 273 fish over 13 in, which is only slightly higher than the 1998 snorkel count. The 1998 count of 64 rainbow trout between 5 and 13 in is down 56% from the 145 counted in 1995. Small fish are much harder to count because of their size and often close association with the shallow fringe areas, rocky substrate, overhanging banks, logs and brush.

On April 20, 2000, we surveyed spawning rainbow trout with a helicopter just downstream of the Natural Bridge (Appendix 1). We also flew along the river for about 1.5 mi immediately upstream of the falls to investigate rainbow spawning activity in this reach. From the Natural Bridge upstream for the first half mile, the river is deep and slow moving with limited spawning gravels, and few fish were observed during the flight. Upstream, as the river transitioned into a steeper gradient riffle-pool pattern with an abundance of optimum size spawning gravels, we counted 100+ actively spawning rainbows. Spawning rainbows were using these gravels wherever they occurred with the proper depths and velocities throughout this river reach. The reach surveyed during this helicopter flight was from the Natural Bridge to the lower end of our Allers electrofishing section, and is clearly an important spawning area for rainbows living in this section of the Boulder River.

Boulder River Rainbow Trout Spawning Evaluation

In the spring of 2000, we evaluated the rainbow trout spawning activity of the mid-Boulder River in the general vicinity of the Natural Bridge. The effort was particularly concentrated in and around the proposed 4600 ft stream reconfiguration project within the Beaver Meadows Ranch. Previous studies have shown the river reach from the Natural Bridge down to the mouth of the East Boulder is an important spawning destination for trout from the Boulder and Yellowstone Rivers. This effort to quantify rainbow spawning activity within this river reach (Appendix 1) provided good baseline information upon which to base future resource decisions. Brown trout spawning activity in this reach will be evaluated during the fall of 2000.

TABLE 2. Fish population data collected from the Big Timber section of the Yellowstone River during March 1999.

Species	Age Class	Average Length (in)	Average Weight (lb)	Number Estimate	Estimated Number/Mile	Weight Estimate (lb)
Brown Trout	2	7.77	0.17	26	4	4.3
	3	10.40	0.39	202	28	78.4
	4	12.42	0.67	244	34	162.5
	5	14.90	1.14	140	21	170.4
	6 & older	17.71	1.86	614	86	1,143.3
			TOTALS	1,235	173	1,558.9
Rainbow Trout	1	5.09	0.05	80	11	4.1
	2	7.35	0.16	396	56	62.4
	3	9.74	0.34	1,423	200	482.4
	4	11.97	0.63	764	108	478.0
	5	14.34	1.03	480	68	496.3
	6 & older	16.85	1.66	662	93	1,102.3
			TOTALS	3,805	536	2,625.5
Cutthroat Trout	2	7.38	0.13	138	19	18.1
	3	9.19	0.29	1,203	169	343.6
	4	11.52	0.59	169	24	99.4
	5 & older	14.39	1.09	30	4	32.4
			TOTALS	1,540	216	493.5

B-2 Section

The B-2 section is 6,040 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-April 2000. Total brown trout estimates (Figure 4, Table 3) were down about 12% when compared to 1997 estimates. Because age data from 2000 is not yet available, population statistics by length groups are included in Table 3. We recorded 96 recaptures from 289 marked brown trout for a recapture rate of 33%. The standard deviations for the six size classes averaged 13%, which indicates a statistically reliable estimate.

The 2000 rainbow trout population estimates from B-2 (Figure 4, Table 3) increased 104% over estimates from 199, and are the highest noted over the last 19 years. Most of this increase is larger rainbows from size classes 12.50-14.99 in (498), and 15.00-22.49 in (510). The estimate for larger rainbows within the section is probably somewhat inflated, because many of these larger rainbows are only moving through the section enroute to upstream spawning areas, and they are seldom recaptured. Several redds and numerous ripe spawning rainbows were noted within the B-2 section during the electrofishing surveys. We recorded 28 recaptures from 211 marked rainbows for a recapture rate of 13%. The standard deviations for the six size classes averaged 27%, which indicates a less statistically reliable rainbow estimate when compared to the brown trout estimate.

Brown and rainbow trout populations in the B-2 section have fluctuated 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 being 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 in.

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). 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. 1,589 in 1991, 1,176 in 1994, 1,415 in 1997 and 1,994 in 2000. Even when total numbers are lower, the numbers of larger rainbows and brown trout have been increasing. Fish populations have apparently 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.

TABLE 3. Fish population data collected from the B-2 section of the Boulder River during March-April 2000.

SPECIES	SIZE CLASS (IN)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
Rainbow Trout	2.50 – 4.99	105	92	2.8
	5.00 – 7.49	242	212	23.3
	7.50 – 9.99	127	111	26.4
	10.0 – 12.49	206	181	99.7
	12.50 – 14.99	498	437	444.4
	15.00 – 22.49	510	447	712.3
	TOTALS	**1,688**	**1,480**	**1,308.9**
Brown Trout	6.00 – 7.99	76	67	9.1
	8.00 – 9.99	67	59	16.5
	10.00 – 11.99	87	76	38.1
	12.00 – 13.99	122	107	89.4
	14.00 – 15.99	198	174	206.3
	16.00 –17.99	35	31	46.8
	TOTALS	**585**	**514**	**406.2**

***Age data from scale samples is not yet available**

Stillwater River

Moraine Section

The 3,300 ft Moraine section (Figure 1) is located 2.7 mi below the mouth of the West Fork of the Stillwater River and about 8 mi 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 March of 1998 and 2000. If we consider brown trout age one and older, the 1998 estimate is up 13% from estimates made in 1996, and the 2000 estimate (based on size classes since no age data is yet available), increased slightly over 1996 estimates. If we consider brown trout 12 in and larger, the 1998 estimate increased 38% and the 2000 estimate increased 44%, over 1996 numbers. This increase in the number of larger brown trout within the section is also reflected in the brown trout biomass estimates, which also increased each year (315 lb in 1996, 366 lb in 1998 and 392 lb in 2000). Figure 5 gives a comparison of population estimates within Moraine over the last 19 years.

In 1998, we recaptured nine rainbows from 55 marked fish, and in 2000, 12 rainbows from 89 marked fish. Because this data did not provide a reliable log-likelihood estimate, we ran a simple Peterson estimate instead. The Peterson estimate for rainbow trout in the section was 277, ranging in length from 5.0 to 13.9 in in 1998, and 214 for rainbows with the same length range for 2000. Although these estimates are not very statistically reliable, we include them to give a relative number for rainbows in the section. Although we handled 26 rainbows over 14.0 in during the marking and recapture runs in 1998 and 42 in 2000, we only recaptured one in 1998 and two in 2000.

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 in. These latest estimates for 1998 and 2000 fall within the goals for brown trout, and probably reflect 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 in) to two fish (with only one larger than 13 in) 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 was also met for this river reach.

TABLE 4. Fish population data collected from the Moraine section of the Stillwater River during March 1998 and 2000.

Species	Age Class	Average Length (in)	Average Weight (lb)	Number Estimate	Estimated Number/Mile	Weight Estimate (lb)
Brown Trout	0	4.44	0.04	8	13	0.3
	1	6.25	0.09	368	589	31.3
	2	9.47	0.29	264	422	76.1
	3	12.37	0.61	312	499	191.3
	4	14.35	0.91	70	112	63.5
	5 & older	14.69	0.96	4	6	3.5
			TOTALS	1,026	1,641	366.1

Species	Size Class	Number Estimate	Estimated Number/Mile	Weight Estimate (lb)
Brown Trout	3.0-4.49	692	1107	22.7
	4.50-5.99	46	74	2.7
	6.00-7.49	231	370	26.4
	7.50-8.99	111	178	21.3
	9.00-10.49	103	165	32.4
	10.50-11.99	144	230	67.8
	12.00-13.49	177	283	114.8
	13.50-17.99	113	181	103.7
	TOTALS	1,617	2,588	391.7

***Age data from scale samples is not yet available.**

Absarokee Section

We established a new long-term fish population monitoring section near Absarokee in the fall of 1992. The 4,750 foot Absarokee section was selected to replace the 16,900 foot Whitebird section located several miles downstream. The new Absarokee section begins at the confluence of the Stillwater River and Rosebud Creek and extends downstream about a mile to the "Old Iron Bridge." The Absarokee section receives more fishing pressure than Whitebird. A county road parallels the river, and numerous ranches and cabins are located along the river corridor.

Rainbow trout population estimates for the section in 1998 (Table 5) are considerably lower than those from 1992, but the 1992 estimates appear inflated due to movement of smaller marked fish from the section between the marking and recapture runs (Poore 1994). Population estimates in 1992 are based on handling 237 rainbows in the marking run, 258 in the recapture run, and 27 total recaptures. Population estimates in 1998 (based on approximately equal effort) took 227 rainbows during the marking run, 238 in the recapture run and 49 total recaptures. In 1992, only 4 (15%) recaptures were fish less than 8.0 in, and 23 (85%) were fish 8.0 in and larger; whereas, in 1998, 30 (61%) recaptures were fish less than 8.0 in, and 19 (39%) were fish 8.0 in and larger. Based on this data, plus the distribution of recaptures, the 1992 estimate for rainbows less than 8.0 in was not statistically reliable; whereas, the estimate for rainbows over 8.0 in is more reliable data. Conversely, the 1998 estimate for rainbows less than 8.0 in is more statistically reliable data; whereas, the estimate for rainbows larger than 8.0 in is less reliable. If we consider just larger (10 in and larger) rainbows, the 1998 estimate is down about 49% from the 1992 estimate. Considering rainbows 12.0 in and larger, the 1998 estimate is down 26% from the 1992 estimate. The reasons for this observed rainbow decline are not readily apparent. Fishing pressure and floating use on the Stillwater has increased, but fish limits of two fish (only one over 13.0 in) are fairly restrictive, and many anglers release all the fish they catch.

Brown trout population estimates within the section are more statistically reliable, and fish age 1 and older increased about 22% between 1992 and 1998. We took 117 (34%) recaptures from the 347 brown trout marked during the marking run. Numbers of brown trout larger than 12.0 in increased slightly (4%) from 1992 to 1998. In spite of the moderate increase in brown trout, total trout populations of fish age two and older decreased about 43% between 1992 and 1998.

Extensive fish population work on the Stillwater River over the past twenty years has shown that the river upstream from the confluence of Rosebud Creek does not support a very large resident rainbow population (Poore 1988). Although the upper river is heavily used for spawning by rainbows, at some point most of the offspring from these fish move back into the lower Stillwater and Yellowstone rivers when they reach a certain size and age. The population work in the Absarokee section in 1992 indicated this movement of small rainbows may take place in the fall as days shorten and water temperatures start to drop, but this trend was not evident in the 1998 population work. Additional sampling is required to confirm the timing and extent of this rainbow trout movement within the Stillwater River system.

TABLE 5. Fish population data collected from the Absarokee section of the Stillwater River during October 1998.

Species	Age Class	Average Length (in)	Average Weight (lb)	Number Estimate	Estimated Number/Mile	Weight Estimate (lb)
Rainbow Trout	0	4.32	0.04	117	130	5.0
	1	6.12	0.09	676	750	63.5
	2	9.63	0.33	185	205	61.9
	3	12.26	0.68	146	162	99.7
	4	13.29	0.84	135	150	113.3
	5 & older	0	0	0	0	0
			TOTALS	1,259	1,397	343.4
Brown Trout	0	4.19	0.03	207	230	6.3
	1	7.01	0.13	414	460	53.8
	2	9.33	0.28	522	579	146.8
	3	11.54	0.53	258	286	137.0
	4	13.99	0.98	70	78	68.5
	5 & older	14.31	1.05	15	17	15.2
			TOTALS	1,486	1,650	427.6

Management goals from the Stillwater River Management Plan for the river reach call for maintaining 500 to 1,000 age one and older brown trout per mile, with 100 to 150 of these fish over 13 in. The latest population estimates of brown trout in this river reach exceed these criteria. The plan also calls for maintaining 2,000 to 2,500 age one and older rainbow trout per mile, with 150 to 200 of these fish over 13 in. The latest rainbow trout population estimate for this river reach falls short of these goals.

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 over the last ten years, with the growing influx of people into this popular scenic area (Poore 1997). The area is one of the most picturesque locations in Montana and has become an increasingly popular area for summer cabins and retirement homes. Several hundred acres along the stream bottom have been sub-divided, and each year more development takes place. Two homeowner associations representing approximately 100 property owners have been formed.

In the spring of 1998, we completed fish population estimates within the 8200 ft TO-Bar Ranch section. The brown trout population was estimated at 800 fish per mile (Figure 6, Table 6) as compared to 700 in 1995, an increase of 14%. Most of this increase was trout from age class two, while brown trout age five and older decreased about 40% during that period.

In 1998, we estimated rainbow trout at 95 fish per mile using a simple Peterson formula. Because of the low numbers of marked fish (37) and recaptures (8), and high average standard deviation for all size classes (43%), we were unable to use the log-likelihood method. Rainbows sampled ranged from 4.1 to 15.5 in. The estimate for brook trout was 11 fish per mile of stream, ranging in length from 4.3 to 11.2 in, again based on a simple Peterson formula. Because of the low number of marked fish (17) and recaptures (3), we were 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 these species relative abundance.

It appears the decline previously noted in larger brown trout (Poore 1994) has continued and is again reflected in the 1998 estimate. The decline in larger fish suggests the problem is related to angling pressure and harvest, which normally selectively affects this group. The lack of quality bank cover, increased erosion of undercut banks resulting from uncontrolled livestock grazing, and clear water make the larger fish particularly vulnerable to angling pressure. Because the stream is not very productive, the population of larger fish is slow to recover. To date, fishing regulations implemented in 1994 to protect larger fish, along with a landowner-promoted voluntary "catch and release" policy

and improved livestock control to benefit riparian fish habitat, have not yet begun to benefit the fishery.

West Rosebud Creek

Mackay Section

The Mackay electrofishing section (Figure 1) of the West Rosebud is located near the Custer Forest boundary where the stream leaves the steep Beartooth Mountain face. The 7,900 ft 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 April 1998, we completed fish population estimates (Table 7) within the Mackay section of the West Rosebud. Prior to this 1998 estimate, other estimates (1986 and 1994) were done in the fall. We switched to spring estimates to provide a better representation of the predominant resident brown trout population inhabiting the section. Fall estimates were potentially influenced by brown trout spawning movements into and out of the section. The spring brown trout population of fish over 5.0 in is estimated at 901 per mile, as compared to fall estimates of 1,164 in 1994, and 947 in 1986 (Figure 7). Of these brown trout, 71 (8%) are fish 13.0 in and over as compared to 107 (9%) in 1994 and 54 (6%) in 1986. Fish age five and older from the 1998 estimate (56) decreased 100% compared to estimates done in 1994 (175). Because the 1994 estimate was from fall, it may be inflated due to possible spawning movements of these larger brown trout.

In 1998, we estimated rainbow trout at 107 fish per mile using a simple Peterson formula. The estimate consisted of rainbows 4.5-17.2 in, and we handled 70 total rainbows with seven 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 section. In addition, 13 brook trout and one Yellowstone cutthroat were sampled during electrofishing operations.

Clarks Fork of the Yellowstone River

Robinson Bridge 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.

TABLE 6. Fish population data collected from the TO-Bar Ranch section of East Rosebud Creek during March- April 1998.

Species	Age Class	Average Length (in)	Average Weight (lb)	Number Estimate	Estimated Number/Mile	Weight Estimate (lb)
Brown Trout	1	4.26	0.03	282	176	9.4
	2	6.02	0.08	759	474	59.1
	3	8.65	0.25	154	96	27.9
	4	11.88	0.55	23	14	12.8
	5	15.87	1.26	38	24	47.4
	6 & older	18.00	1.80	26	16	46.8
			TOTALS	1,282	800	213.4

TABLE 7. Fish population data collected from the Mackay section of West Rosebud Creek during April 1998.

Species	Age Class	Average Length (in)	Average Weight (lb)	Number Estimate	Estimated Number/Mile	Weight Estimate (lb)
Brown Trout	1	5.31	0.05	430	287	22.2
	2	6.64	0.10	506	337	50.3
	3	8.88	0.24	275	183	65.6
	4	11.80	0.54	143	95	77.3
	5	14.53	0.98	25	23	34.7
	6 & older	16.47	1.38	21	14	28.4
			TOTALS	1,410	939	278.5

To gather additional fisheries information within a section of the Clarks Fork of the Yellowstone River about two miles downstream from the Wyoming State line, we attempted to do a mark-recapture population estimate in late September and early October 1998. This part of the river is wide, rocky and relatively shallow, with long homogeneous runs interspersed with fast riffle areas. We were unable to mark and recapture enough trout to make a statistically reliable estimate. Trout collected included 61 rainbow trout (5.1-21.5 in) with six recaptures, 22 brown trout (5.3-17.9 in) with three recaptures, and one cutthroat trout (12.7 in) with one recapture. Mountain whitefish were the most abundant fish sampled within the section . All fish of all species were in excellent condition, indicating food is plentiful and not a limiting factor for fish populations. The primary factor limiting trout abundance within this river section appears to be inadequate reproduction.

Rock Creek

Fox Section

The 4,800 ft long Fox section of Rock Creek (Figure 1) is located approximately seven miles downstream from Red Lodge. Rock Creek, from Red Lodge downstream 20 miles to the confluence of Red Lodge Creek 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 (Poore 1997). During 1993, fish populations (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 1999. Brown trout per mile estimates (Table 8) for fish age two and older increased 70% (971) since 1996 (571), and are now over the ten-year average for this section (611). With the exception of browns from age class six and older, all age classes have increased. Except for fish from age class two, all age classes show an increase. Fish from age class three and four show a significant increase at 175% and 226%, respectively.

In 1999, we estimated rainbow trout over 5.0 in at 97 fish per mile using a simple Peterson formula. Rainbows sampled ranged in length from 2.5-15.0 in, and we sampled 58 total rainbows with 12 recaptures during the mark and recapture runs. This estimate is not statistically reliable, but is included to indicate of rainbow relative abundance within this stream reach. In addition, four brook trout were sampled during electrofishing operations. Mottled sculpins and longnose dace are abundant throughout the section.

Total trout populations within the Fox section (1,033) show an increase of about 55% between 1996 and 1999. Total numbers in 1999 are 63% higher than the ten-year average of 635 trout within the section.

Joliet Section

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

Since the last section estimate in 1995, Rock Creek has experienced several high water events. At one location, the channel shortened by about 400 ft in a 1,000 ft reach and resulted in massive headcutting and bank erosion. The new channel downcut four to five feet through alluvial gravel deposits to underlying bedrock. As a result, considerable bedload was moved through the stream system, grinding up the bottom and depositing downstream of the channel change while headcutting upstream.

Brown trout and mountain whitefish were the primary game fish species found within this section. In April 1999, we estimated brown trout numbers at 780 fish per mile (Figure 9, Table 8) as compared to 825 in 1995, a 5% decrease. In our 1999 estimate, age one fish increased 27%, while numbers of age two and three browns decreased 50% and 61%, respectively, from 1995 estimates. The numbers of age four and older fish remained about the same, indicating these larger fish were better able to cope with the flood events and resultant major habitat changes.

We also collected eight rainbow trout ranging from 9.0-16.2 in during the 1999 sampling. Other fish species that are abundant throughout the Joliet section include mountain whitefish of all sizes, longnose dace, longnose suckers, white suckers, and mountain suckers.

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, particularly fish age three and older, is considerably better within this more productive, nutrient-rich section of Rock Creek than in the Fox section located seventeen miles upstream. If we consider only fish three and older, the average weight of brown trout from the Joliet section (1.03 lb) is significantly larger than those from the Fox section (0.45 lb). Brown trout, however, are more abundant in the Fox section (1,040 per mi) than in the Joliet section (780 per mi).

TABLE 8. Fish population data collected from the Fox and Joliet sections of Rock Creek during April 1999.

Species	Age Class	Average Length (in)	Average Weight (lb)	Number Estimate	Estimated Number/Mile	Weight Estimate (lb)
			FOX SECTION			
Brown Trout	1	5.49	0.06	63	69	3.8
	2	6.09	0.09	176	194	14.7
	3	8.70	0.24	302	332	71.1
	4	11.63	0.53	313	344	164.6
	5	14.05	0.86	75	83	64.5
	6 & older	14.88	0.99	16	18	15.5
			TOTALS	1,884	342	876.8
			JOLIET SECTION			
Brown Trout	1	4.74	0.04	440		18.3
	2	5.58	0.06	102		6.4
	3	10.92	0.45	64		28.4
	4	14.68	1.09	117		127.8
	5	16.18	1.48	48		70.4
	6 & older	17.50	2.06	9		18.5
			TOTALS	780		269.8

Bluewater Creek

Bluewater Creek is a small spring-fed, nutrient-rich, 18 mile-long stream that originates on the west side of the Pryor Mountains and flows westerly to its confluence with the Clarks Fork of the Yellowstone River near Fromberg. An extensive stream sediment investigation was conducted from 1959-1970 (Marcuson, 1979) to measure effects of sediment, discharge and water temperature on trout populations, bottom fauna and trout egg incubation. Sampling at intervals from the headwaters to its confluence with the Clarks Fork showed a progressive decrease in trout and an increase in rough fish. Survival of trout eggs was nearly 100% in the headwaters near the Bluewater Springs Fish Hatchery and totally unsuccessful at the mouth.

During late March and early April 1998, we completed fish population estimates in a 1200 foot section of Bluewater Creek extending from near the state hatchery downstream to the county road crossing. We sampled 239 total brown trout during the mark and recapture runs with 90 recaptures (79%) of the 114 marked brown trout. Brown trout sampled ranged from 5.0-20.6 in. We estimated 297 brown trout (Table 9) inhabited this stream section.

In addition, we sampled 26 rainbow trout ranging in length from 3.2-16.1 in with six recaptures. We also found three Yellowstone cutthroat trout (which probably escaped from the nearby state hatchery) and one white sucker.

Otter Creek Project

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 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 included 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 from the inter-basin transfer of water from Sweetgrass Creek. Two reservoirs were built about 75 years ago to 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.

TABLE 9. Fish population data collected from Bluewater Creek during March-April 1998.

SPECIES	AGE CLASS	AVERAGE LENGTH (IN)	AVERAGE WEIGHT (LB)	NUMBER ESTIMATE	ESTIMATED NUMBER/MILE	WEIGHT ESTIMATE (LB)
Brown Trout	1	5.47	0.06	48	211	2.8
	2	6.62	0.11	71	312	7.6
	3	8.29	0.20	140	616	27.5
	4	10.21	0.34	30	132	10.2
	5 & older	14.35	1.22	8	35	9.8
			TOTALS	297	1,306	57.9

TABLE 10. Fish population data collected from the Favnger section of Otter Creek during the fall of 1988, 1994 and 1998.

SPECIES	1988 (NUMBER AND LENGTH RANGE IN INCHES)	1994 (NUMBER AND LENGTH RANGE IN INCHES)	1998 (NUMBER AND LENGTH RANGE IN INCHES)
White Suckers	147 (4.4-15.2)	93 (3.7-15.9)	136 (1.9–16.2)
Longnose Suckers	79 (6.6–15.4)	130 (2.5–18.0)	28 (6.7-16.0)
Mountain Suckers	19 (4.6-7.5)	428 (2.6-7.3)	555 (2.7-7.5)
Brown Trout	10 (4.0-18.5)	2 (12.1-12.4)	16 (2.6-17.3)
Yellow Perch	1 (6.2)	1 (5.0)	—-
Brook Trout	—-	1 (7.8)	—-
Lake Chubs	—-	12 (2.6-6.2)	3 (4.0-4.7)
Longnose Dace	1 (4.8)	—-	1,097
TOTALS	**257**	**667**	**1,835**

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, has the potential to improve the trout population in Otter Creek, as well as in this portion of the Yellowstone River. In the fall of 1988, prior to any work on the project, FWP biologist 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 in in size, suggesting an environmental problem for the survival and growth of smaller, younger trout.

Most of the project proposals and practices were implemented or completed by 1992. In September 1994, we again completed fish population estimates within the Favinger section where Clancy had sampled in 1988. We again electrofished the Favinger section in the fall of 1998, and this information along with the data collected in 1988 and 1994 is included in Table 10. Between 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. Since this work, the primary change in the fisheries has involved shifts in the longnose dace and sucker populations. Changing the substrate from silt to rock has favored longnose dace, and longnose and mountain suckers over white suckers, although longnose sucker numbers actually dropped significantly between 1994 and 1998.

Brown trout reproductive success apparently improved somewhere in the stream system between 1994 and 1998, as twelve of thirteen brown trout sampled were between 2.6 and 5.3 in. Brown trout numbers are so low, however, 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 Project

Brook trout and westslope cutthroat trout hybrids in the headwaters of Soda Butte Creek are of particular concern to fish management agencies, including the U.S. Fish and Wildlife Service (USFWS) within Yellowstone National Park, U.S. Forest Service (USFS), Wyoming Game and Fish, and FWP. 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 both may impact the Park s native fish species, a cooperative project 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" (Shuler 1994).

Information on sampling in other waters, including Woody Creek, Republic Creek, Hayden Creek, Miller Creek, Sheep Creek and Guitar Lake, is also found in Shuler s report.

Following the 1994 eradication of 13 brook trout from a two-mile reach of Soda Butte Creek (from the USFS campground downstream to Woody Creek), the reach was electrofished again in 1995. electrofishing 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 had been found during the previous three years. 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.

In the fall of 1997 and 1998, we again attempted to remove brook trout from this headwaters area with electrofishing equipment. The effectiveness of the 1997 and 1998 efforts was questionable due to the water depth, number of log jams and amount of woody debris within the stream channel. Another problem was the abundance of small brook trout which are very difficult to locate and remove. During the summer and fall of 2000, we began preparation of an EA to evaluate the chemical removal of brook trout from the headwaters of Soda Butte Creek.

Bad Canyon Creek Project

During fall 1993, the Custer National Forest, U.S. Bureau of Land Management, and FWP jointly attempted to physically remove the brown trout which co-habit the headwaters of Bad Canyon Creek with Yellowstone cutthroat trout, and also to enhance a natural barrier to deny the brown trout access to the treated headwaters (Poore 1994, 1997). Additional removal efforts and barrier enhancement projects have followed but the brown trout still remain the dominant trout species in the headwaters. In July 1998, we again packed a backpack shocker into the headwaters above the barrier near Smith Draw where we electrofished about 900 feet of Bad Canyon Creek. In this 900 feet we took 115 brown and eight cutthroat, a ratio of 14:1.

Complete removal efforts based solely upon electrofishing are extremely difficult to accomplish. Efficiency of electrofishing crews varies widely, and even highly experienced crews are at best about 80% efficient. It is nearly impossible to get all the fish out of log jams, brush piles, deep holes and undercut banks. Large fish are much more easily removed than fry and young of the year. Equipment failures, weather and difficult access all contributed to reduced success in Bad Canyon Creek.

Following our last enhancement effort, 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, have allowed access, and have even helped the agencies with some of the work, as well as effectively managing livestock along the riparian zone. We also have a much better

understanding of just how difficult it is to remove brown trout from this system. During 2000, an EA was prepared to address the chemical removal of brown trout upstream of the barrier, along with neutralization at the falls to protect the downstream fishery. This plan also includes capturing and holding the cutthroat population until it is safe for their release upstream of the barrier. In addition to the EA, a project protocol for chemical treatment of Bad Canyon Creek was prepared. This treatment is on hold until statewide issues regarding the use of pesticides in streams is resolved.

Esp Spring Creek Project

In 1989, we identified and evaluated trout spawning potential in four spring creeks which enter the Yellowstone River just downstream from Big Timber (Poore 1994). In 1999, a cooperative project funded by the Natural Resources Conservation Service, USFWS and FWP was completed on Esp/Chambers Spring Creek, a small 1,500 ft spring-fed stream which enters the Yellowstone River just east of Upper Deer Creek. The project involved: protecting the spring source area; fencing; providing alternate livestock water; recontouring and constructing meaders, pools, and riffles; importing spawning gravels; planting willows; and installing a fish passage structure at the mouth.

Following project completion in 1999, we installed a remote site incubator into which we placed 4000 Yellowstone cutthroat eggs from the Yellowstone River Trout Hatchery in Big Timber. The incubator provided about 87% hatching success. In October 1999, we electrofished the small stream and found 15 cutthroat from 2.5-3 in, and 12 brown trout 4.0 to 16.0 in. (Brown trout were removed from the stream.) We again electrofished Esp/Chambers Spring Creek during May 2000, and found six Yellowstone cutthroat 3.5 to 5.0 in, two rainbow trout 5.0 and 5.5 in, sixteen brown trout 1.5 to 7.5 in and three sculpins. In 2000, we again used the remote site incubator to hatch cutthroat eggs directly into the stream with about the same hatching success as in 1999.

North Fork Grove Creek Project

In October 1999, we electrofished a short section on the North Fork of Grove Creek, a small tributary to the Stillwater River near Absarokee, searching for cutthroat trout which had been reported by a landowner. Sampling was difficult because of the dense brush, extensive beaver dams, and limited effectiveness of our backpack shocker. We found no cutthroat trout, but additional sampling is probably warranted to confirm the accuracy of the report.

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. Particular emphasis should be placed upon determining the present status of fish populations in the Absarokee section, where fishing pressure has significantly increased and the latest fish population estimates show a decline.

2) Continue to pursue development of potential spawning areas in spring creeks entering the Yellowstone River near Big Timber. Continue using the remote site incubator in Esp Spring Creek and monitor the success of the project.

3) Continue monitoring fish populations in the TO-Bar section of East Rosebud Creek and the Mackay section of West Rosebud Creek to assess the results of management changes implemented to improve the fishery.

4) Continue monitoring fish populations in the Fox and Joliet sections along Rock Creek.

5) Collect additional fisheries information from the Clarks Fork River between Belfry and the Wyoming line.

6) Continue the cooperative project with the USFS to eliminate brook trout and westslope cutthroat trout from the headwaters of Soda Butte Creek. Complete the EA required to evaluate the use of chemicals for this project.

7) Continue the cooperative project with the USFS to inventory and assess cutthroat populations throughout Region 5 and, where feasible, participate in efforts to enhance these populations.

8) 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 into Dry Creek in the Crazy Mountains.

9) When authorized, continue with the project to chemically remove brown trout from Bad Canyon Creek and transplant additional cutthroat upstream from the fish barrier.

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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
Clarks Fork River Sec. 01	5-22-1162-02
Clarks Fork River Sec. 02	5-22-1176-01
East Boulder River	5-22-2002-01
East Rosebud Creek	5-22-2240-01
Grove Creek	5-22-2884-01
Otter Creek	5-22-4550-01
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
West Rosebud Creek	5-22-6804-01
Yellowstone River Sec. 04	5-22-7014-01
Yellowstone River Sec. 07	5-22-7056-01

APPENDIX 1

Boulder River
Rainbow Trout Spawning Evaluation

Boulder River Rainbow Spawning Evaluation

In the spring of 2000 we evaluated the rainbow trout spawning activity of the mid-Boulder River in the general vicinity of the Natural Bridge. The effort was particularly concentrated in and around the proposed 4600' stream re-configuration project within the Beaver Meadow Ranch. Previous studies have shown the river reach from the Natural Bridge down to the mouth of the East Boulder is an important spawning destination for trout from the Boulder and Yellowstone Rivers. This effort to quantify rainbow spawning activity within this river reach should provide good baseline information upon which to base future resource decisions.

Because the Boulder River in this reach is usually low and clear during the spring rainbow trout spawning period, Montana Fish, Wildlife and Parks (FWP) decided to count the spawning fish and monitor spawning redd construction activity visually. This method appeared the least intrusive to the spawning rainbow trout. Another part of this evaluation was to determine the distribution, extent and use of optimum sized (½" – 1½") spawning gravels located within this river reach. We counted redds and/or fish seven times between March 27 and April 25 as discussed below. (An additional evaluation was made by Brian Riggers of Watermark Consulting LLC and submitted in a separate report.)

FWP conducted spawning counts about once a week on clear, sunny, wind-free days (when possible) to maximize visibility. On every count day the wind created some problems with visibility. The wind was usually calm early but generally increased as the day progressed. We conducted most surveys between 10:00 AM and 4:00 PM to reduce problems with shadows and glare on the water surface. Because weather conditions for observing fish were highly variable between count days and even within the same day, it was impossible to duplicate weekly counts under the same visibility conditions. Weekly ground counts and observations provided fish numbers as well as information about potential spawning areas, gravel distribution and abundance, stage of spawning, and redd construction activity and locations. This information was then used to coordinate a helicopter flight to coincide with the peak of spawning activity. Ground surveys done both pre and post helicopter survey were used to confirm information collected during the flight and vice versa.

Depending on their location, individual redds were sometimes hard to see and count. Some spawning rainbows appeared to use a larger general area of loose gravel rather than a well defined "spot location." For this reason, we noted and counted redds when we saw them, but usually concentrated on counting the large rainbows using the shallow riffle areas for spawning. We did make a special effort to count and note redd locations within the proposed project area and the half mile of river immediately downstream. During the helicopter survey flight, we counted the larger spawning rainbows and noted their locations on a map. This gave us better information because fish sometimes scattered at the close approach of the helicopter and not all rainbows were

located directly on redds at the time of the flight. It was difficult to get accurate fish counts and map locations without simultaneously attempting to count redds.

Rainbow Spawning Counts and Findings

I. March 27 – Clear, sunny, some wind 5-10 mph (some locations difficult to see). River low and clear.

Areas Surveyed:

1) Project Area – Counted – 33 rainbow trout (Rb), 22 brown trout (LL)
2) From Project Area downstream ≈ ½ mile – 12 Rb, 31 LL
3) From Main House upstream ≈ ¾ mile – 43 Rb, 19 LL, 5 redds (noted as main spawning area on map)

Generally fish not very active, mostly located in runs and pools.

II. April 3 – Clear, sunny, windy 15-20 mph (some locations difficult to see). River low and clear.

Areas surveyed:

1) Project Area – Counted 32 Rb, 30 LL
2) Above Project Area upstream ¼ mile from first hole below lower bridge – counted 6 Rb, 9 LL
3) Below Project Area downstream ½ mile – counted 20 Rb 23 LL + 35 trout unclassified due to windy conditions.
4) Walked downstream ½ mile from upper bridge on ranch. Several deep holes full of whitefish, suckers and trout but could not count or classify due to wind.

Generally fish not very active yet, redds hard to find, some redd building activity evident but no fish observed on redds. Fish mostly located in runs and pools.

III. April 11 – Clear, sunny, light east wind 5-10 mph (some locations difficult to see). River low and clear, water temperature 48º F.

Areas Surveyed:

1) Project Area – Counted 45 Rb, 26 LL. Some fish active on redds (particularly in area noted as main spawning area on map.)
2) Downstream from Project Area – difficult to see due to wind – 2 Rb, 6 LL
2 redds in side channel just downstream from project area on west side.
3) Upstream from main ranch in area noted as main spawning area on map – 16 Rb

3) Upstream from main ranch in area noted as main spawning area on map –
16 Rb on redds and just upstream in small side channel, 11 Rb on redds – most fish very active.

Generally fish very actively spawning, chasing and redd building. Rainbows located in riffles, pool tailouts and around shallow mid-channel bars.

IV. April 18 – Conditions for counting fish were very difficult. River was low and clear but a cold front had dropped river temperatures to 45º F. Weather was cold, cloudy, windy and threatening rain. Met at the project area with Doug McDonald (Corps), Jeff Ryan (DEQ), Dick Blodnick (EPA) and Tom Hughes (DNRC). We walked the project area observing spawning fish, redd locations and evaluating spawning gravel distribution and use. Spawning activity had declined, due to the drop in water temperature, but some fish were still located on redds within the project area. We also surveyed stream channel elevations and evaluated the feasibility of re-connecting the cutoff meader loop as part of the proposed project. We didn't attempt to count fish because of the inclement weather and poor conditions for making observations.

V. April 18 – Because it appeared the peak of spawning was near, we called in the helicopter for this bright, clear, sunny day. The river was still low and clear and conditions were nearly ideal, except for a light wind. In the helicopter, along with the pilot, were Tom Hughes (DNRC), Dave Hergenrider (FWP), who has had considerable experience counting fish from the air, and myself. We flew the Boulder River from the mouth of the East Boulder to the Natural bridge and then continued upstream for about another mile where we observed additional (100+) rainbows spawning above the falls. Following several warm days, water temperatures had again increased to 54º F, and the rainbows were actively spawning. Dave and I counted spawning rainbows and marked their locations on separate maps independent of each other. Following the helicopter flight, we compared and combined information onto maps (enclosed).

Map 1 is a topographic map of the entire reach we counted below the Natural Bridge. Map 2 is a series of aerial photos from Brian Riggers' spawning survey that primarily shows the river reach within the Beaver Meadow Ranch in greater detail. Within the entire reach from the Natural Bridge to the East Boulder, we counted 181 spawning rainbows. Within the project area, we counted 33 rainbows associated with 12 redds. The redd count data was derived from the helicopter flight information plus ground confirmation surveys done over several weeks both pre- and post-flight. Map 2 combines all the fish count and redd count information from Brian's survey and from the helicopter survey done by FWP for the upper river.

VI. April 24 – Brian Riggers conducted his spawning survey.

VII. April 24 – While doing other work just downstream from the confluence of the East Boulder, I noticed flows in the main Boulder had increased somewhat following several warm days and the river was slightly off color when compared to river conditions experienced during all the previous surveys we conducted.

VIII. April 25 – Weather was cold, cloudy and windy with light rain falling. Due to the approaching cold front, water temperatures had dropped to 42º F. Flows in the Boulder were up 6" to 8" and the river was slightly stained compared to conditions during all the previous surveys. Rainbows were not very active due to the sharp drop in water temperature, and had moved off most redds where they were observed on April 20. I walked downstream several miles from about the middle of the project area to the bridge near the north edge of section 7 (Map #). I walked this area to get additional ground confirmation of spawning locations and activity observed during the fight on April 20. Conditions were poor for observing fish and with the exception of a few rainbows actively spawning in several side channels just downstream of the project area, not many active fish or redds were observed. Most of the fish and spawning were confined to the first half-mile downstream of the project area. A few rainbows were also observed near the bridge. This information was consistent with what we had observed in this area during the April 20 flight.

Discussion and Findings

Spawning activity in 2000 appeared to peak around mid-April, which is a little earlier than normal, and probably due to an early spring where water temperatures warmed faster than normal. Intensity of rainbow spawning activity varied somewhat with fluctuating water temperatures. Activity appeared to peak as water temperatures reached the low to mid 50º F range. At our B-2 electrofishing section, located approximately seven miles downstream near the mouth of the West Boulder, we handled several rainbows that were already spawned out on March 23. Information collected indicates rainbow spawning extended from at least mid-March through late April in 2000. Spawning rainbows counted ranged from approximately 12 to 20 inches in length, consistent with rainbow trout measured at our B-2 section. We measured several precocious males as small as 8 inches.

Spawning information for the Beaver Meadow Ranch, and particularly for the project area and next mile downstream, is based on numerous visits to the area plus the helicopter flight. Spawning information from the lower three miles of river down to the East Boulder is based primarily on the helicopter survey and two visits to the river around the Engle Ranch, where rainbow spawning activity was observed while reviewing proposed bank stabilization projects.

Information from the 2000 survey compares fairly closely with that collected in the 1989 float survey. Some spawning locations have shifted slightly upstream or downstream, as optimum sized spawning gravels have moved and been redistributed through natural erosional and stream building processes. Some spawning locations are identical from both surveys. Numbers of spawning fish and redds counted within the Beaver Meadow Ranch increased from 73 to 97 fish and from 18 to 46 redds from 1989 to 2000. Fish and redd numbers within the proposed project area increased from 6 to 33 and 2 to 13, respectively, from 1989 to 2000, although considerably more time was devoted to collecting and validating information in 2000,

and the spawning counts made on May 5, 1989 may have been past the peak of spawning fish numbers.

Much of the river bottom material throughout the Beaver Meadow Ranch is too large and imbedded for fish spawning. As shown on Map 2, several long reaches of river have little or no spawning use. Fish and redd count locations delineated on Map 2 are coincident with spawning gravel distribution throughout the Beaver Meadow Ranch. Spawning rainbows eventually used these gravels wherever they occurred with the proper depths and velocities throughout this river reach. Spawning rainbows preferred the looser gravels located in areas of recent deposition or disturbance. Even though some of these gravels were intermixed with finer sands and sediments, redd building activity appeared to flush and clean the gravels fairly effectively. Spawning fish and spawning gravels were concentrated in three general areas within the ranch: one located just downstream of the upper ranch bridge; a second located just downstream of the slide area; and the third, more dispersed area, involving the lower half of the proposed project area and extending downstream for about a half mile. Spawning fish preferred areas where the optimum sized gravels (½" to 1½") were present in side channels, pool tailouts, mid-channel bars and along the river edges. Spawning rainbows particularly selected side channels and pool tailouts.

Fish counts made from the helicopter or from the ground likely underestimate the actual number of rainbows spawning within this river reach for several reasons. First, trying to determine all the fish using this river reach based on a single count or several counts is not completely accurate because spawning is spread out over at least a 6 week period. This method tends to miss the early and late spawners. Once spawning is completed, these early spawning fish move back into deeper water or out of the count area. Second, factors like water temperatures, weather conditions, moving fish, deep water, prop wash from the helicopter rotor, individual experience with fish counting, etc. can also affect the count accuracy. One example of fish we missed during the helicopter survey were those noted by Brian Riggers just downstream of the upper ranch bridge. Fish spawning at this location was noted when we planted this reach in 1989. Nevertheless, this 2000 spring survey provides good baseline information about relative numbers of spawning rainbows, spawning locations, and redds, as well as spawning gravel abundance distribution and use, particularly within the Beaver Meadow Ranch and proposed project area.

Conclusion

FWP has long maintained that the Boulder River from the mouth of the East Boulder River to the Natural Bridge is an important spawning area for trout. This baseline spawning survey report from spring 2000 confirms that position. Habitat enhancements should be directed at improving spawning conditions. Stabilizing eroding banks, providing additional streambank cover and habitat, and managing grazing in the riparian zone for maximum vegetative benefits, will no doubt have positive impacts to the exiting fishery. Activities intended to speed up velocities and potentially move and redistribute optimum sized spawning gravels will probably have negative impacts on spawning fish.