MONTANA FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

State:	**MONTANA**	**Element 1:**	**FISHERIES MANAGEMENT**
Project No:	**F-113-R-1,2**	**Job No:**	**I-i**
Project Title:	**STATEWIDE FISHERIES INVESTIGATION**	**Job Title:**	**MID-YELLOWSTONE DRAINAGE INVESTIGATIONS**

PROJECT PERIOD: JULY 1, 2000 THROUGH JANUARY 1, 2003

ABSTRACT

Survey shocking was performed near Big Timber, Greycliff, and Laurel to determine the effects of the prolonged drought on trout populations. Low water conditions precluded performing population estimates.

Final egg stocking of Yellowstone cutthroat trout was completed in Esp Spring Creek. Eggs and juveniles survived and grew well in the spring creek. However, there was no evidence of adult fish returning to spawn. A steep and shallow outlet to the Yellowstone River may limit adults migrating back into the creek until the river begins to rise.

Lower Deer Creek and Placer Gulch were sampled and trout populations in Lower Deer Creek near the Forest Service Cabin have rebounded substantially following fires and floods in 1990. Yellowstone cutthroat trout and brown trout appear to be coexisting in this area of the creek, as both populations appear healthy. A small population of Yellowstone cutthroat trout still is present in Placer Gulch. Despite having relatively unrestricted access, brown trout have not yet colonized Placer Gulch. McBride Lake Yellowstone cutthroat trout were introduced into approximately 6 mi of habitat above a barrier waterfall in the upper creek. Previous attempts to populate this stretch of stream using wild fish appear to have failed so hatchery fish were used.

Beaver Meadows Ranch was monitored for brown and rainbow trout spawning in conjunction with Water Consulting Inc.'s monitoring of a 1000-ft bank stabilization project. Spawning counts were also performed in the Allers Section of the Boulder River, and redd numbers were nearly double those counted in 1995.

Five sites were surveyed in the East Boulder River basin as part of a cooperative effort between Montana Fish, Wildlife and Parks, Montana Trout Unlimited and the Stillwater Mine. Trout populations at all sites increased from previous estimates. The cutthroat trout population in Placer Basin appears healthy and robust.

A fish rescue operation was performed on the Lamp Nelson Ditch in the fall when the water was turned off. A total of 621 mountain whitefish, 9 rainbow trout, 169 brown trout, 29 mottled sculpin, 3 longnose dace, and 5 white suckers were returned to the river. A plan is being developed to fund a fish screen for this ditch.

Population estimates were made in the Absarokee Section of the Stillwater River for brown and rainbow trout. With the exception of age-1 fish, the population of brown and rainbow trout has increased substantially. The increase in older fish has occurred despite severe drought and high angling pressure. A larger adult population of fish has likely led to improved angling in this reach.

The rehabilitation of Bad Canyon Creek was completed. Brown trout were successfully removed from the upper 3 mi of the stream; however, rotenone escaped beyond the detoxification station and resulting in a fish kill that extended approximately 2.5 mi below the barrier. LeHardy Rapids strain of Yellowstone cutthroat trout were reintroduced into the area above the barrier and 6,000 fish were planted below the barrier to replace those inadvertently killed.

The Clarks Fork of the Yellowstone River was sampled at the Robinson Bridge in 2001. Rainbow and brown trout numbers were low, but similar to those observed in 1998. Although few in number, the trout are larger for their age than at other sites in the region, indicating good growth. Mountain whitefish continue to be the dominant fish species in the section. Whirling disease was detected upstream in Wyoming but samples have so far come back negative for fish in Montana.

The total trout population in Rock Creek at Fox is greater than any time previously sampled (1244/mi). Although brown trout numbers have declined somewhat, the rainbow population has increased 340 % since last sampled in 1999. The declines in brown trout numbers were most notable in the older age classes ($\geq$ age-3).

Surveys were performed in the Joliet Section of Rock Creek, but were unable to perform an estimate because of rising water and equipment failure prevented us from performing the recapture run. Numbers and size of fish captured were similar to data collected in 1999.

Fish population estimates were done in a 1,200-ft section of Bluewater Creek adjacent to the State Fish Hatchery. The brown trout population has increased 193% from 1,306/mi in 1998 to 2,526/mi in 2002. Rainbow trout was the only other species collected, but numbers were too few to estimate.

A Yellowstone cutthroat trout population was discovered in the headwaters of Wyoming Creek, a tributary to Rock Creek.

The upper part of Line Creek was inventoried for possible introduction of Yellowstone cutthroat trout. The stream was found to have suitable habitat for cutthroat trout and fish introduction would have minimal effects on other aquatic species. However, much of the area lies within a Forest Service designated Research Natural Area.

TABLE OF CONTENTS

TABLE OF CONTENTS

PAGE

LIST OF FIGURES

LIST OF TABLES

PROCEDURES

Trout population densities were monitored in sections of the Yellowstone, Stillwater, Clark's Fork Yellowstone, Boulder River, East Boulder drainages. Inventory electrofishing is used on portions of the mid-Yellowstone River to gather qualitative information about fish populations. Trout population densities are usually estimated using mark-recapture methods described by Vincent (1971), or in some cases on smaller streams estimates are made using two-pass depletion (Leathe 1983). Population estimates are calculated using either the log-likelihood method (MR4) or modified Peterson method (described in Vincent 1971) when mark-recapture is used. Equations described by Leathe (1983) are used to calculate two-pass depletion estimates.

In spring and fall 2001-2002, Montana Fish, Wildlife and Parks (FWP) evaluated the rainbow and brown trout spawning activity in the mid-Boulder River on the Beaver Meadows Ranch (BMR) near Natural Bridge. Twenty areas were identified as containing suitable spawning substrate (gravels 0.5-1.5 in), as determined by surveys conducted by FWP (Poore 2000). These areas were given a number and letter code representing their location within or outside of the original treatment area (see Appendix A, Figure 1, 2). For example, spawning areas outside of the treated reach were designated "C" for control, whereas areas within the treated reach were designated "T" for treatment. Numbering began at the upstream end of the control reach (1C) and the treatment reach (1T); control numbering continued in sequence below the treated reach (11C). Several areas that were not originally classified, but that subsequently were used for spawning by trout, were designated "A" and were numbered according to the sequence of their discovery (Appendix A, Figure 1, 2). The entire survey reach is approximately 3 mi long beginning at the first bridge below the Natural Bridge Falls and extending downstream to near the property boundary of the BMR. Biologists from FWP and Water Consulting Inc. surveyed both the project (treatment) and adjacent (control) reaches counting both rainbow and brown trout and their redds. To maximize in-water visibility, surveys were conducted on clear, sunny, wind-free days, when possible. However, weather conditions were variable between and within days. These surveys generally occurred between 10:00 AM and 4:00 PM to reduce both glare and shadows on the water's surface. Redd counts consisted of only redds that were clearly defined, and therefore represent a conservative representation of actual numbers. Rainbow and brown trout counts represent only fish that could be clearly identified either in the act of spawning or holding in areas adjacent to spawning activity. Both redd and rainbow trout locations were marked on aerial photos of the surveyed reaches.

A spawning survey was also conducted on the Boulder River Ranch upstream of the Natural Bridge Falls in April 2002 using the same techniques described for the Beaver Meadows Ranch Section. Limited fall spawning inventories were performed in the Stillwater River, and several new spawning locations were identified.

Five sites (Placer Basin; B-4, 5, 6; Elk Creek) (Figure 3) were sampled in the East Boulder River drainage in September 2001, ranging from the headwaters to below the mouth of Elk Creek. Two-pass electrofishing was used to estimate abundance at all five sites. Scale samples were collected at B4, B5, Placer Basin and Elk Creek from the first

10 fish captured within each 0.5 in size grouping. Individual ages of all captured fish could not be assigned, because a 2-pass model is not available that incorporates age, and often more than 10 fish were captured from each size grouping. If fewer than 10 fish were captured, ages were assigned individually. When more than 10 fish were captured, ages were assigned by taking the percent of a given age within each size class (rounded to the nearest individual). For example, if 25 fish were captured between 5.0 and 5.4 in, and the 10 fish aged revealed that 7 were age-1 and 3 were age-2 then 7/10 of the fish between 5.0 and 5.4 in would be assigned to age-1 and 3/10 would be assigned to age-2. Ages were assigned to match the length of fish aged as much as possible. Disease samples were collected and analyzed from cutthroat trout in Placer Basin.

A fish rescue operation was performed on the Lamp-Nelson Ditch on the Boulder River that originates approximately 5 mi upstream of Big Timber. The ditch was lowered prior to sampling, which concentrated fish in specific areas of deeper water (e.g., culverts, wiers and diversions). Block nets were placed above and below areas that were shocked and the length of the first 30 fish captured was measured. Following capture and measure, fish were returned to the Boulder River. A small portion of the Dry Creek Canal, the largest ditch on the Boulder River, was also electrofished, but the canal had not yet been lowered and electrofishing efficiency was substantially reduced.

The rehabilitation of Bad Canyon Creek was completed during the fall of 2002 where brown trout were removed from the upper three mi of the stream. Rotenone was used at a concentration of 2 ppm (parts per million) to remove brown trout. A bioassay was performed to determine the proper concentration of rotenone and the distance the rotenone would travel down the stream and produce a 100% kill. A bioassay was also performed for $KMnO_4$ to determine the amount needed to detoxify the rotenone. Twenty-one cutthroats were removed from the stream prior to treatment and kept in the upper parts of Trail Draw during the treatment. Rotenone was administered to the treated streams using constant flow drip stations attached to 5-gal buckets via a section of garden hose. Buckets were refilled after 4 hours, for a total of 8-hr treatment at each site. Drip stations were spaced apart at intervals of 90-min of stream travel time. The rotenone was detoxified with $KMnO_4$ at a concentration of 2 ppm using the same drip system as the rotenone application except a 65-gal tank was used instead of 5-gal bucket. FWP's helicopter was used to fiery personnel and equipment into the project area.

A 3-person crew performed fish surveys and stream inventory in the Absaroka-Beartooth Mountains with funding provided through a cooperative agreement with the US Forest Service. Electrofishing and angling were used to determine the presence/absence of fish populations and species composition. Using US Forest Service methods, habitat was characterized, including the length and frequency habitat units (e.g., riffles, pools, etc.) and their formative features. Dominant riparian vegetation was characterized by species when possible and by family for willow, grass and sedge species. If present, amphibians were noted.

RESULTS AND DISCUSSION

Yellowstone River and Small Tributaries

Big Timber Section

Normal mark-recapture population estimates were not conducted in spring 2001 as scheduled due to low river flows. However, 60 mountain whitefish, 55 longnose suckers, 5 white sucker, 58 rainbow trout, and 15 brown trout were collected for disease analysis by the U.S. Fish and Wildlife Service Wild Fish Survey. Heads from the trout were collected for whirling disease analysis by FWP. No diseases were detected in samples from the Yellowstone River.

Survey Shocking on Yellowstone River

Survey shocking on the vicinity of the Laurel Section and between Pelican FAS (Fishing Access Site) and Otter Creek FAS was performed during spring 2002. Survey shocking performed near Laurel was to determine whether the drought has had substantial effects on trout population in the lower Yellowstone River and whether the cutthroats planted the area were surviving beyond their first year. One hundred twelve Yellowstone cutthroat trout from 3.9 to 9.2 in long were captured. These were likely all 1-year-old fish that had been planted the spring of 2002. No evidence of older stocked fish was found below Laurel Bridge. All cutthroat captured were adipose clipped and released. In addition, 6 rainbow trout and one brown trout were captured during the survey. Above the Laurel Bridge one 14-in cutthroat was captured along with several rainbow and brown trout and 3 burbot. It appears that despite record low water levels, the trout population in the Laurel area is relatively intact. There did not appear to be any obvious gaps in the age classes of fish that would indicate recruitment failure and there were many juvenile fish in the river. All rainbows and burbot larger than 12 in were fitted with floy tags before being released. To date, only one tag return has been obtained from the tagged fish (14-in rainbow trout) caught by an angler in the Stillwater River at the Moraine FAS 10 days after tagging. Over the course of 10 days this fish traveled approximately 60 mi, presumably to spawn in the upper Stillwater River.

Flows were too low once again in the Big Timber Section of the Yellowstone River in 2002 to perform a population estimate, but shocking was performed as the river flows began to increase in late spring in the vicinity of the confluence of Upper Deer. Esp Spring Creek also enters the Yellowstone in this area, and attempts were made to determine whether cutthroat trout planted into the stream were staged at the mouth of the stream waiting for water levels to rise enough to allow them to enter the creek. The numbers and size of fish captured included: 155 rainbows (2.9-17.6 in), 59 brown trout (10.2-21.8 in) and two burbot (26 and 30 in). The rainbow trout >12 in and both burbot were tagged with floy tags. Similar to the lower section of river the trout population appears to be robust despite drought conditions. There were fewer juvenile brown trout captured in this section of river, which may indicate that recruitment of juvenile brown trout may be low as a result of the drought, but all ages of rainbow trout appeared to be well represented.

Esp Spring Creek

The Esp Spring Creek spawning enhancement project was completed in 1999 (Poore 2000). This small stream is a tributary to the Yellowstone River about ten mi east of Big Timber. Electrofishing surveys performed during spring 2001 found 30 juvenile Yellowstone cutthroat trout (3.1 to 4.7 in), 25 brown trout (3.3 to 7.1 in), 2 rainbow trout (2.7 to 7.1 in), 2 brook stickleback, and 3 mottled sculpin. These data indicate that the stream is functioning well as rearing habitat for juvenile trout and that the enhancement project has improved water quality and fish habitat because few fish used the stream prior to restoration (Mark Lere, FWP personal communication). Spring spawning surveys found no evidence of spawning by either rainbow or cutthroat trout.

Yellowstone cutthroat were planted into the stream by remote streamside incubator for the third consecutive year as part of attempts to establish a spawning population in the creek in 2001 (Poore 2000). Of 4,000 eggs incubated, 3,403 cutthroat fry (85%) successfully hatched and entered the stream. This hatching success mirrors previous years' (1999 and 2000) success of 87%. During spring 2002, the cutthroat from the 1999 year-class could have reached sexual maturity and used Esp Spring Creek for spawning. On June 10, 2002 Esp Spring Creek was evaluated for evidence of spawning cutthroat trout. Observations were made from the stream banks looking for redds or evidence of spawning and found no redds found. One of the concerns with Esp Spring Creek is that during lower flows in the Yellowstone River early in the spring, fish would not have access to the creek because of the steep drop and shallow water at the confluence. During higher flows the Yellowstone River partially backs up Esp Spring Creek allowing easy fish access to potential spawning areas. On the date the creek was sampled, the river was high enough to allow fish to enter the creek. Approximately 30 ft of the lower part of the creek was electrofished near the mouth to evaluate juvenile fish abundance. Only two brown trout were captured along with several sculpins and longnosed dace. Mechanical failure of the electrofisher prevented us from performing further sampling.

Lower Deer Creek

Lower Deer Creek from the Forest Boundary to approximately 6 mi upstream contains a fish population of brown and pure Yellowstone cutthroat trout (Poore 1994). Several barrier waterfalls 6 mi upstream of the boundary have precluded fish from inhabiting the upper 6 mi of the watershed. The stream from the US Forest Service (USFS) boundary down to the confluence with the Yellowstone River also contains Yellowstone cutthroat trout and brown trout with a few rainbows, although less is know about the fishery in this reach (Fredenberg et al. 1986). Lower Deer Creek is generally dry at the mouth because of irrigation diversion and natural subterranean flows. Yellowstone cutthroat trout were stocked into Lower Deer Creek between 1935 and 1950 below the USFS boundary, but it is possible that the cutthroats currently in Lower Deer Creek are a remnant of wild fish that originally had better access to the Yellowstone River. The earliest sampling date in the middle reaches of Lower Deer Creek was in 1987 when "a good population of Yellowstone cutthroat trout was found coexisting with brown trout" (Poore 1990). The last time this section was sampled was in 1990 when 44 brown trout and 33 cutthroat trout were captured in approximately 750 ft of stream (Poore 1994). In late

1990 a fire burned much of the west side of the drainage downstream from the West Fork of Lower Deer Creek and in the vicinity of Ellis Mountain. Subsequent erosion and sedimentation devastated the fishery below the confluence of the West Fork (Poore 1994).

During 2002, a 500-ft survey section was established in Lower Deer Creek below the barrier falls starting at the Forest Service Cabin (T3S R15E S5), approximately 1 mi upstream of the confluence with Placer Gulch. A total of 69 brown trout and 32 Yellowstone cutthroat trout were captured in the fall. Results of the population estimate indicate that 802 brown (95% CI = 908-695 fish/mi) and 399 cutthroat trout per mi (95% CI = 523-275 fish/mi) inhabit this section of stream. Mean size of brown trout was 4.5 in (range = 2.0-12.6 in) and mean size of cutthroat was 5.6 in (range = 3.8-8.8 in). It appears that the fishery in Lower Deer Creek has rebounded from the low numbers experienced following the fires of 1990. Habitat conditions in the creek appeared good and there was no evidence of overly abundant fine material in the stream bed. The bank also appeared relatively stable and there was little sign of over-grazing that has occurred in the past. In 1990, the proportion of brown trout to cutthroats was approximately 1.3:1. However, in 2002, the proportion was 2:1 in favor of brown trout. Although it appears that brown trout and cutthroat trout have co-exited in Lower Deer Creek for at least 20 years, this recent change in relative species abundance is of concern, because in other sympatric populations, brown trout have displaced cutthroats (e.g., Bad Canyon Creek).

In an effort to expand their range, Yellowstone cutthroat trout were reintroduced to Lower Deer Creek above a natural barrier falls during the summer of 2002. Prior to 1992, brown and Yellowstone cutthroat and limited numbers of rainbow trout occupied the area of Lower Deer Creek from its confluence with the Yellowstone River to a barrier waterfall (T3S S15E Sec17). In 1992, 65 cutthroats were captured from Lower Deer Creek and transported above the falls with the intention of establishing a population that could exist non-native species (Poore 1997). Surveys the following year found 12 cutthroat trout near the release site. More recent surveys revealed that cutthroat trout above the barrier failed to become established, most likely because of the low numbers of fish transported above the barrier and the possible tendency of wild fish to return to areas where they were captured (S. Shuler USFS Gallatin National Forest, personal communication). To aid in establishing a population of Yellowstone cutthroat trout in the 6 mi of habitat above the barrier waterfall, an Environmental Assessment was prepared and reviewed for the introduction of McBride Lake Yellowstone cutthroat trout reared at Big Timber Hatchery. The proposal included stocking the stream with cutthroat trout in the summer and fall. On June 14, 2002, 500 6.9 in fish were stocked from Big Timber trout hatchery. These fish were 1 year old and the direct progeny of fish collected at McBride Lake in Yellowstone National Park as part of the program to supplement the hatchery stock with wild fish. FWP's helicopter was used to fly fish from a landing location to the stream. Only two suitable locations were found to land the helicopter near the stream on the upper part of Lower Deer Creek and they are approximately 2 and 2.5 mi upstream of the falls. All fish from the June plant were stocked at the lower landing site.

On October 9, 2002 a crew returned to Lower Deer Creek to assess the condition of fish planted earlier and to stock more fish. The stream in the vicinity of the fish plant was electrofished and the fish stocked in June appeared to be in good condition. One fish was

captured that appeared to be a wild fish from the previous plant in 1992. This fish was larger, more colorful and showed no evidence of fin erosion that all other stocked fish possessed. An additional 1,664 7.62 in fish were planted at the lower and upper landing location. One load of fish experience high mortality on their flight from the hatchery truck, and approximately 300 fish died before reaching the stream (approximately 2/3 of fish in that load). Dead fish were removed from the stream to reduce the risk of a fungal outbreak affecting healthy fish. Before fish were planted at the upper landing point, cutthroats from the previous spring plant were observed in pools. Thus, fish had migrated at least 0.5 mi upstream since their planting in June. An additional 1,000 age-0 fish (2.6 in) were stocked at the lower landing point. Therefore, two age classes were stocked into Lower Deer Creek during 2002. A third age class will be planted in the stream in 2003. The intent of stocking multiple age classes is to mimic the age class structure of a wild population that will hopefully lead to increased chances of establishing a self-sustaining population.

Placer Gulch. Placer Gulch is a tributary to Lower Deer Creek that enters approximately 1.5 mi upstream of the Forest Boundary. Habitat conditions are severely limited along Placer Gulch because of past mining, road building and grazing practices. Grazing practices have improved and riparian vegetation has become established; however, past large sediment inputs and the lack of frequent flushing and channel forming flows have created extensive riffle habitats with few pools. Currently the Load Star Mine Company operates a gold mine at the top of the drainage. The location of this mining operation changed where access is gained to Placer Gulch and Lower Deer Creek in 2002 to 0.5 mi farther to the south. A new 4-wheeler trail was cut that eventually joins the previous trail.

Purestrain cutthroat trout are known to inhabit Placer Gulch, although their range up the drainage is limited (Poore 1990). Although no barrier exists, brown trout have not been found in Placer Gulch beyond the immediate area of the confluence, presumably because the outlet is often dry in the fall when brown trout may enter the stream to spawn. Placer Gulch was first sampled in 1986 approximately 1 mi upstream from its confluence with Lower Deer Creek, and 13 cutthroat trout (6.1-9.1 in) were captured (Fredenburg and Poore 1987). Placer Gulch was sampled on June 14, 2002 to evaluate if brown trout had become established in the creek and to determine if spawning was occurring in the stream. The lower reaches of the stream were electrofished from the mouth upstream approximately 500 ft. No brown trout were found, but several cutthroats were captured. One cutthroat redd was also found.

Upon returning to Placer Gulch on September 27, 2002, a two-pass population estimate was performed in the vicinity of the third road crossing leading to Lower Deer Creek (approximately 1mi upstream of the confluence with Lower Deer Creek). A 300-ft section of the stream was electrofished and at total of 28 cutthroat trout ranging in length from 3.6 to 6.6 in (mean = 4.4 in) were captured. Population estimates suggest that 496 cutthroat trout inhabit the stream per mi (95% CI = 479-512). The US Forest Service has proposed doing habitat enhancement work in Placer Gulch to increase the frequency and depth of pools in the stream. This action would likely lead to increased cutthroat abundance as the lack of deeper water habitats likely limit the number of adult fish in this population.

Greater pool frequency will also reduce the gradient of the stream and allow more deposition of gravels that will enhance spawning potential.

Boulder River

Spawning Evaluations at Beaver Meadows Ranch

A large-scale (4,600 ft) stream restoration project was proposed by Water Consulting Inc (WCI) on the Beaver Meadows Ranch (BMR), located immediately downstream of the Natural Bridge Falls. This project involved streambank stabilization along vital spawning habitat for resident and migratory trout in the Boulder and Yellowstone Rivers. Through much deliberation the project was shortened to one high, eroding bank approximately 1,000 ft in length. Stabilization efforts on the bank consisted of constructing two large rock weirs and a "J"-hook weir along the bend in the river, the construction of a bankfull bench, and installation of root-rap. The main concern with the streambank stabilization methods was that the weirs in the stream could cause increased velocities and lead to the scouring of spawning gravels in the project and adjacent areas. Therefore, a monitoring program was established prior to construction that included pre-project, as-built and post-project monitoring of stream substrate, longitudinal and cross-section profiles, and spawning counts (WCI. 2002, 2003). FWP agreed to help conduct spawning counts in the BMR reach to identify critical spawning areas and ensure data accuracy.

Rainbow Trout. Rainbow trout spawning counts were conducted during the spring of 2001 prior to project construction. Seven of the 25 (28%) areas with suitable spawning substrate were not used by spawning rainbow trout in 2001. Six sites (24%) contained 76% (68) of the redd peak count (24%) (Figure 1; also see Appendix A Table 1). The most heavily used area was 1C, containing 31% of the redd peak count (Figure 1). Primary spawning areas were relatively wide, shallow, and short riffles typified by gravel bars that divided the river channel into two or more channels. Spawning was first observed April 12 (water temperature, 3^{o}C), when 7 redds were counted throughout the surveyed reach. Peak spawning was observed April 27 (water temperature, 11^{o}C), when 89 redds and 87 spawning rainbow trout were counted. On May 6, 47 spawning rainbow and 104 redds were counted. During these surveys, only 1 redd and three rainbow trout were counted in the amended treatment area over the survey period. In general, the project area lacked small gravel suitable for rainbow trout spawning.

The following spring, after the project had been completed, spawning in the treated reach increased to 8 redds. This increase was likely due to the loosening of bed material by the machinery used during project construction, which increased inter-gravel flows and made redd construction easier. Throughout the survey reach there were substantially more redds (Figure 1) during spring 2002 than 2001 (197 vs. 101, Appendix A, Tables 1 and 2). This increase was related to increased use of previously used areas and use of formerly undocumented spawning areas.

Brown Trout. The bank stabilization project was completed in the summer of 2001, and brown trout surveys were conducted during the fall, following project completion (Figure 2). Four surveys were conducted, two by FWP and two by WCI. More brown trout redds (206) were observed during the fall of 2001 than rainbows in the spring. However, total redd numbers declined substantially from fall 2001 to 2002 (150, see Appendix A, Table 3 and 4). The Boulder River experienced a bank-full high-water event during spring runoff 2002. This runoff event led to channel adjustment within the project reach and the washing out of approximately 120 ft of the root-rap placed on the bank. The channel also adjusted by scouring out many of the smaller gravels and depositing them farther downstream. The river also constructed a point bar between the first and second rock veins. A total of five redds were observed in the reconstructed reach following construction, with the brown trout likely taking advantage of the loosened streambed. However, only one redd was counted in the reconstructed reach in 2002 following high water. This redd was located at the lower end where a riffle had been constructed, but where the river had created a run following high water. Another adjustment that appears to be occurring is headcutting of the channel upstream, which potentially could affect one of the most highly used spawning areas (2T). A substantial reduction in redd numbers was observed at 2T from 2001 to 2002 that may be related to the observed headcutting. However, substantial reductions in redd numbers occurred at other sites as well (11C, 1C). A commonality between rainbow and brown trout across the two years of the survey is that the 1C site is the most heavily used spawning location, despite having more coarse and embedded substrate than other locations. It is possible that there is ground water upwelling from the Natural Bridge area or upwelling from the active landslide on the west side of the river that makes this area attractive to spawning trout.

Allers Section

A single redd survey was performed in the Allers Section of the Boulder River, upstream of the Natural Bridge Falls on May 9th, 2002. The last redd count that was performed in this section was May 2nd, 1995 when 13 redds were counted (Poore 1997). In 2002, 26 redds were counted within the section. Weather conditions were ideal for counting redds on May 9th, with sunny skies and calm winds. Temperatures cooled and a foot of snow fell the night before the redd survey, which may have affected fish activity the day of the survey. Similar to 1995, rainbow trout spawning appeared to be completed by early May, as no trout were observed over redds or engaged in spawning behaviors. This timing is unlike Beaver Meadows, only a few mi downstream, where spawning occurs well into May. Although peak spawning tends to occur in late April in Beaver Meadows, new redds and spawning behavior are evident well into may in this section, as apposed to fish in the Allers Section that tend to complete spawning by late April. A helicopter survey was performed on April 20th 2000, between the Natural Bridge and the Allers Section where 100+ actively spawning rainbows were observed, indicating that important spawning areas are also present below the Allers Section.

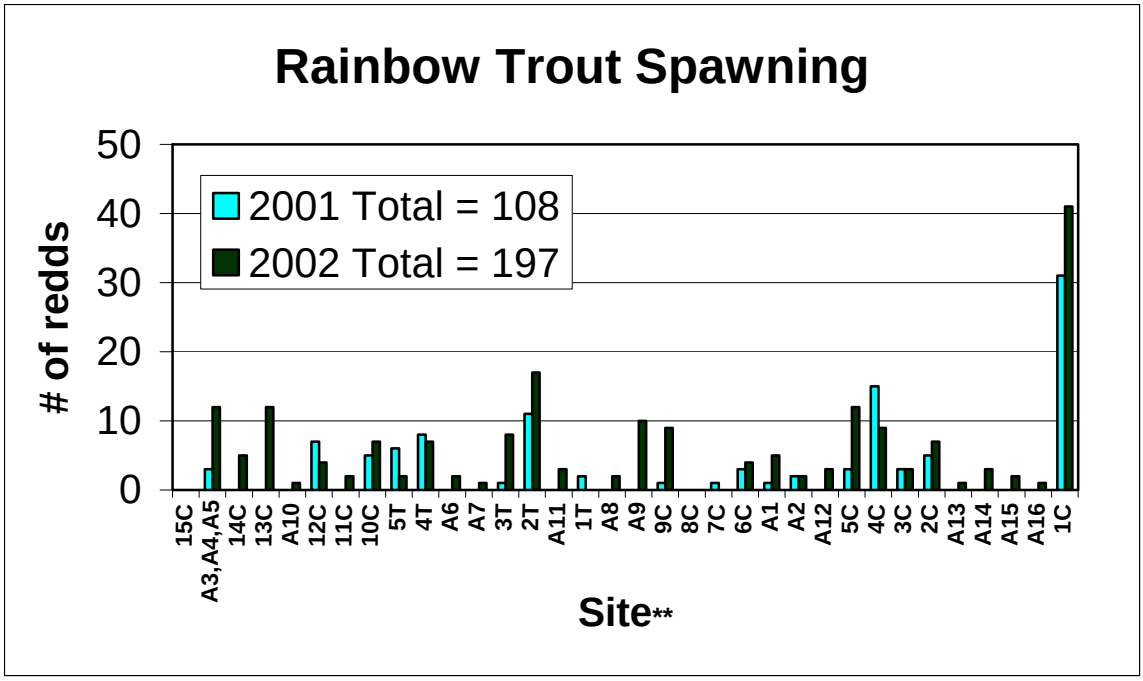

Figure 1. Rainbow trout redd numbers in Beaver Meadows Survey Reach on the Boulder River during 2001 and 2002.

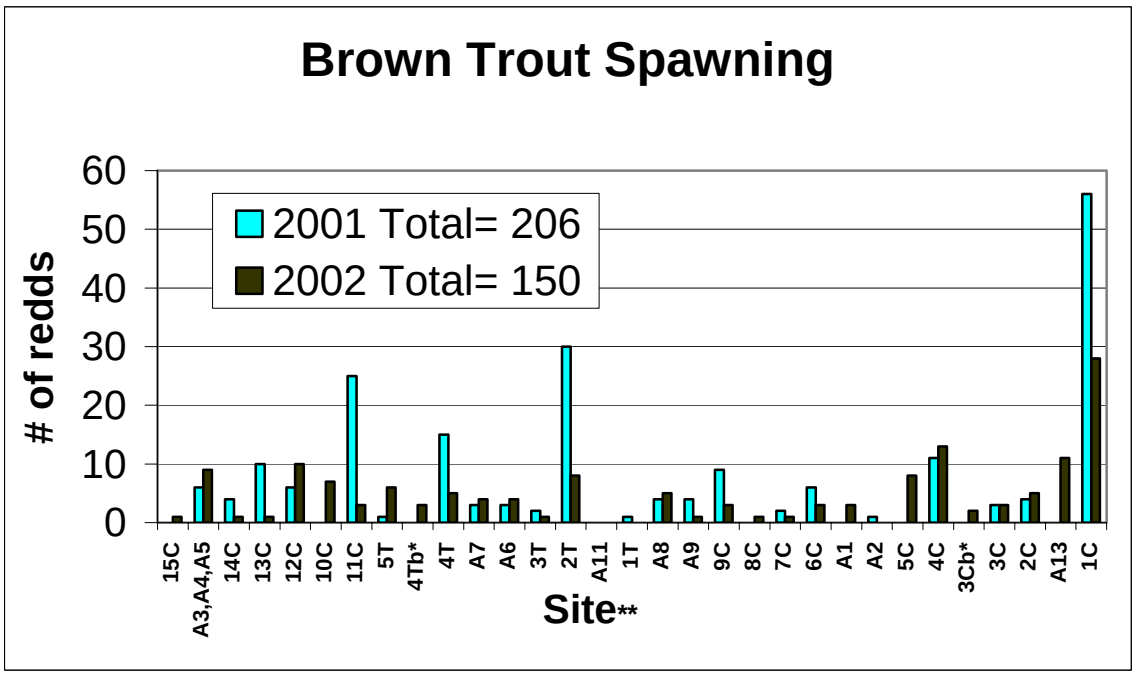

Figure 2. Brown trout redd numbers in Beaver Meadows Survey Reach on the Boulder River during 2001 and 2002.

* Indicates new redd locations used during 2002 spawning.
** Sites are shown in Appendix A Figures 1 and 2.

East Boulder River Cooperative Monitoring

Five sites (Placer Basin; B-4, 5, 6; Elk Creek) (Figure 3) were sampled in the East Boulder River drainage in September 2001, ranging from the headwaters to below the mouth of Elk Creek. Two-pass electrofishing was used to estimate abundance at all five sites. This work was done in cooperation with Montana Trout Unlimited as part of their agreement with the Stillwater Mine. Data were also analyzed by Gillin (2001) an included in a separate monitoring report.

The uppermost site in Placer Basin upstream of the East Boulder mine complex supports an excellent headwater population of pure Yellowstone cutthroat trout. The sampled reach contains over 1,300 cutthroats per mi up to 9 in long (Table 1). This population of fish appears to be very healthy and stable, as fish from all age classes were well represented. Because of the large numbers of fish in the section, it has been used as a source for supplementing other wild populations of Yellowstone cutthroat (e.g., Bad Canyon Creek). Disease samples collected from the site in 2001 indicated no pathogens present in the fish sampled, but they were suspect for *R. salmoninarum,* as two fish came back positive for this pathogen. Further testing is needed to confirm the presence of this pathogen.

In the B-6 Section located below the East Boulder Mine the dominant trout species was rainbow, followed by brown and brook trout. The rainbow trout population was estimated at 1,933/mi, and brown trout at 767/mi, for a combined total of 2,700 fish/mi ranging up to 11 in long. This number has increase substantially since the last time the section was sampled in 1997 (rainbows = 713/mi, browns= 290/mi, total = 1,003/mi), but is more similar to population numbers estimated in 1989 (rainbows = 1,214/mi, browns 979/mi, total = 2,041/mi). The reduction in population size in 1997 may have been related to the extensive high water that occurred in the spring and summer, but the population appears to have rebounded from these lower levels. Thirteen brook trout and one cutthroat trout were also captured in the section.

The section near the USFS campground (B-5) contained similar trout numbers and species composition to B-6, although more larger fish (>12 in) were captured, including a brown trout over 17 in and 2 lb. In 2001 there were 3,122 rainbow trout per mi and 829 brown trout per mi for a total of 3,951 trout per mi (Table 1). The B5 Section had the largest fish population of any of the other sections sampled in the East Boulder River. As in the case of Placer Basin and the B-6 site, all age classes of trout were well represented in the sample of fish collected (Table 1), and the population of trout appears to be healthy and stable. Twenty brook trout were also captured, but more fish were captured on the second pass than the first and a removal estimate could not be made on the population. One cutthroat trout and 16 sculpins were also captured in the section. In the past, this section has been characterized by wide fluctuations in species composition and population size, particularly between spring and fall; however, the numbers and species collected in 2001 were similar to previous fall estimates (Gillin 2001).

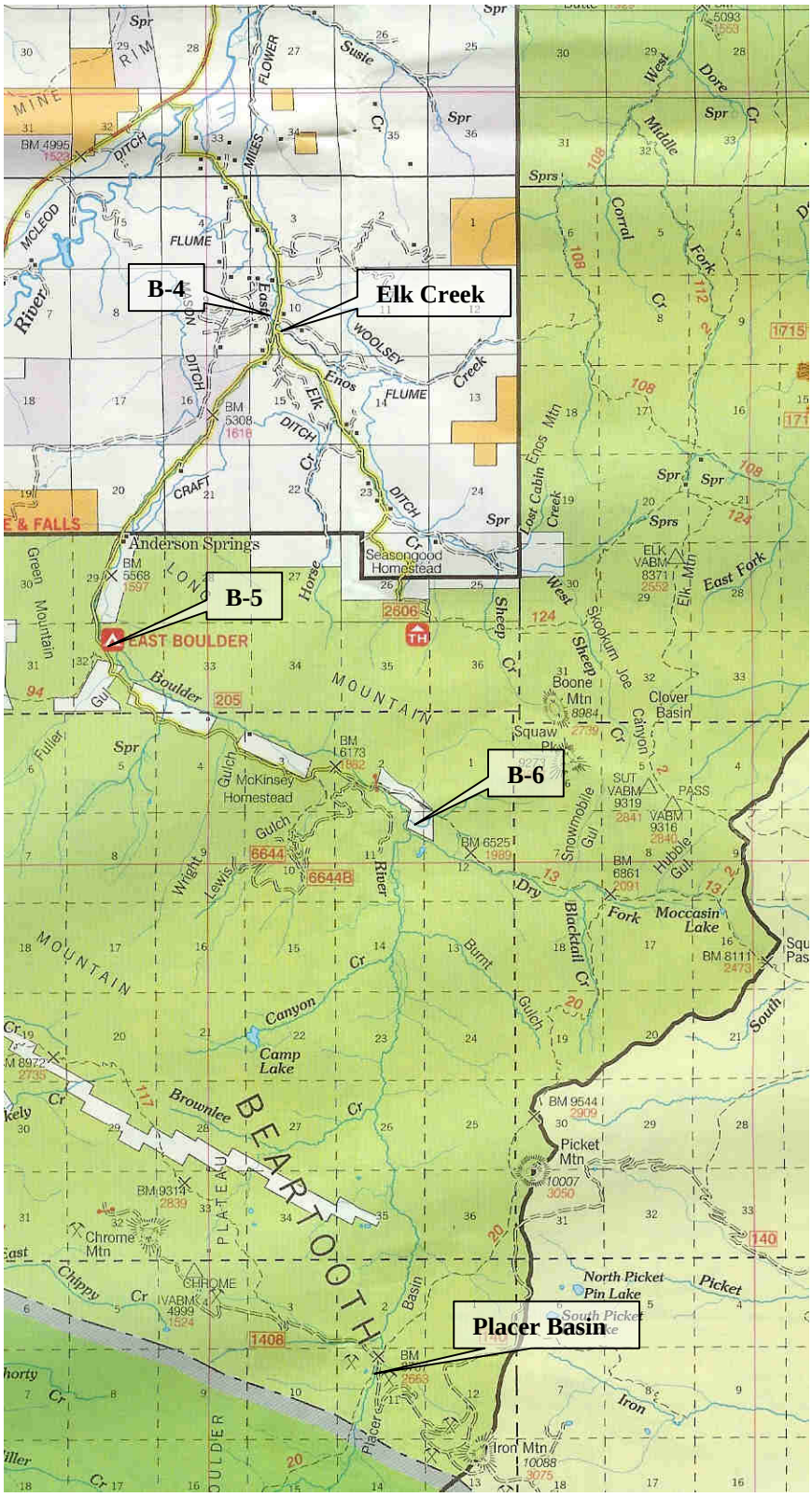

Figure 3. Map of the East Boulder River watershed showing monitoring sites sampled in 2001.

Table 1. Summary of fish population parameters collected in the East Boulder watershed during late summer 2001.

Site	Species	n*	#/mi	95% CI	Age (yr)	*n***	%	Average length (in)	Average weight (lb)
B4									
	Brown	139	1171	1048-1295	0	11	8	2.5	0.01
					1	45	32	3.2	0.02
					2	55	40	5.9	0.09
					3	10	7	8.9	0.28
					4	18	13	11.9	0.66
	Rainbow	115	1035	856-1214	0	23	25	2.2	0.01
					1	41	45	1.2	0.01
					2	38	41	3.6	0.03
					3	11	12	9.2	0.27
					4	2	2	11.9	1.74
		Total	**2206**						
B5									
	Brown	111	829	548-1111	0	24	22	3.5	0.03
					1	7	6	4.8	0.05
					2	29	26	6.8	0.13
					3	36	32	8.6	0.26
					4	11	10	10.9	0.51
					5	3	3	12.7	0.80
					6	1	1	17.1	2.00
	Rainbow	323	3122	1946-4298	0	50	15	3.0	0.02
					1	85	26	4.1	0.07
					2	13			
						3	41	6.0	0.09
					3	43	13	8.0	0.21
					4	12	4	11.1	0.55
	Cutthroat	1	na					9.7	0.3
	Brook	20	na					5.7	0.07
	Sculpin	16	na					3.1	0.03
		Total	**3951**						

* The symbol n represents the number of fish captured during the survey. CI represents the 95% confidence interval of the population estimate.

** Age date are not extrapolated to the entire population, so *n* represents only the age of the fish captured rather than the proportion of the total population. No age data were collected at the B6 site or from brook trout and sculpins.

Table 1. (Continued)

Site	Species	n*	#/mi	95% CI	Age (yr)	*n***	%	Average length (in)	Average weight (lb)
B6									
	Brown	51	767	376-1157				6.5	0.14
	Rainbow	162	1933	1728-2137				5.8	0.09
	Cutthroat	1	na					8.6	0.22
	Brook	10	na					6.1	0.11
		Total	**2700**						
Placer Basin									
	Cutthroat	277	1367	1237-1497	0	28	12	2.0	0.01
					1	61	27	3.9	0.04
					2	71	31	5.3	0.06
					3	47	21	7.2	0.14
					4	20	9	8.0	0.20
Elk Creek									
	Brown	37	604	510-699	0	16	43	3.4	0.02
					1	10	27	6.0	0.09
					2	11	30	7.2	0.16
	Rainbow	8	136	73-198	1	4	50	4.7	0.05
		Total	**740**		2	4	50	6.1	0.09

The B5 Section of the East Boulder River below Elk Creek contained nearly equal proportions of brown and rainbow trout; no brook trout were captured (Table 1). Despite substantial dewatering, the population appears to be relatively stable as all age classes from 0 to 4 were well represented in the population. Fewer larger fish (>age 4) were captured in the site than in previous sampling from the early 1980's (Gillin 2001).

Sampling in a section of lower Elk Creek confirmed it is used as rearing habitat by brown and rainbow trout (Table 1). Visual surveys indicate that upper reaches of the stream are dominated by brook trout.

Lamp Nelson Ditch Fish Rescue

On October 12, 2002 a four-person crew electrofished approximately 1.25 mi of the Lamp-Nelson Ditch. This ditch originates on Skip Herman's property on the east side of the Boulder River approximately 5 mi upstream of Big Timber. When full, the ditch carries approximately 20-30 cfs of water. In approximately 4 hr of shocking, 621 mountain whitefish (average length = 3.85 in), 9 rainbow trout (average length = 6.9 in), 169 brown trout (average length = 6.9 in), 29 mottled sculpin, 3 longnose dace, and 5 white suckers

were returned to the river. Many young-of-the-year mottled sculpins were observed, but were too small to capture given the ¼ in net mesh size.

Working with Trout Unlimited (TU), a plan is being developed to install a permanent fish screen on the Lamp-Nelson Ditch to keep fish from entering the ditch. A meeting was held at Dan Bermiester's home where Bruce Rehwinkel, formerly of FWP and now working with TU, gave a presentation about fish screen design for the water users on the ditch. There were no objections to the idea of a fish screen from the water users as long as it did not interfere with their water. It is anticipated that a Future Fisheries Improvement Grant, the Boulder Watershed Group, Skip Herman, and TU will provide funding for the project.

The Dry Creek Canal also originates on Skip Herman's ranch approximately 1 mi downstream of the Lamp-Nelson Ditch. The Dry Creek Canal is the largest diversion on the Boulder River. It runs parallel to the Boulder River then turns east and flows down the Yellowstone Valley where it irrigates pasture and hay lands. The canal was also electrofished, but because it is under separate management, the water level had not yet been lowered. At the flows the canal was running, it was difficult to wade from one side to the other even though the depth was generally less than 3 ft. These high flows impeded electrofishing efficiency with a backpack shocker so electrofishing was focused on the margins of the ditch. Despite very low efficiency, we captured 66 brown trout, 10 rainbow trout, 6 sculpin and 6. Although fish were not measured, the average size of trout was much larger than those in the Lamp-Nelson Ditch. Three brown trout were over 18 in and one female appeared to be building a redd. Also, few small young-of-the-year whitefish were observed. The Dry Creek Canal is a fairly high gradient ditch in this area, and it more resembles a natural stream with large substrate, riffles and runs than a typical slow-moving ditch. This canal may be very attractive to juvenile and adult fish during low-water conditions, because of its habitat and high volume of water. I would approximate that during low flows, 1/3 to 1/2 of the water in the Boulder River is diverted down the Dry Creek Canal.

Stillwater River

Absarokee Section

The Absarokee Section was established in 1992. This 4750 ft section begins near the confluence of Rosebud Creek and the Stillwater River and extends downstream to the abutments of the "Old Iron Bridge" near the new Riverside Inn Bridge over the Stillwater. This section is representative of reach with easy access because, a county road parallels the west bank of the river. Qualitatively, fishing pressure is relatively high in this reach because of the ease of access, numerous ranches and cabins present along the river corridor, and fishing guide services that float and fish through this reach.

Low water levels and warm water temperatures associated with the ongoing drought led to a voluntary angler closure on the mainstem Stillwater River in August 2001. Despite these conditions, September sampling in the Absarokee Section found good numbers of

rainbow and brown trout in all age classes and fish appeared to be in good physical condition. Most trout were 7-14 in (average size rainbows = 10.1 in, browns = 9.8 in), with a few larger fish up to 18 in.

In 2001, 258 rainbows were marked and 250 trout were caught on the re-capture run, of which 43 were recaptures (17% of all rainbow trout marked). By comparison, in 1998 the numbers were 227, 238 and 49 (Poore 2000). Total rainbow numbers are up in the section despite our not obtaining an estimate of age-0 fish, as was done in 1998 (Figure 4). Estimates of all age classes (except age-1fish) have substantially increased. Age-1 numbers decreased from 750/mi in to 69/mi in 2001. Electrofishing efficiency may have contributed to the observed decline in age-1 abundance, as efficiency was low during the initial marking run, and smaller fish are more difficult to catch in a larger rivers such as the Stillwater. In 1992, the first year this section was sampled, there were 2925 age-1 rainbow trout/mi, and it was suggested that the high number was related to migration of this age class to lower sections of the Stillwater and to the Yellowstone River. It is possible that by sampling the section earlier in September, population data collected may have preceded the migration of these younger fish through the section, leading to a lower estimate. It will be important to monitor the population in the future to determine if the low numbers of age-1 fish observed in 2001 will translate into fewer older fish.

The numbers of age-2, age-3 and age-4 rainbow trout have increased substantially in 2001 (399%, 286% and 327%), since the last sampling in 1998. No estimate was made on age-5 fish in 1998, but age-5 fish were estimated at 167/mi in 2001 (Table 2). The increase in numbers of larger fish has likely led to increased angler opportunities for rainbows in this reach of stream. Conversations with anglers support population findings as people have reported catching many fish from 10-14 in within this section. The increase in adult rainbows in this reach may be related to the more restrictive regulations placed on the river (2 fish, only one over 13 in) reducing harvest of larger fish, leading to increased angler opportunities to catch larger fish.

Numbers of brown trout of all sizes captured in September 2001 were much lower than numbers captured in 1998. In 2001, 154 brown trout were marked and 203 trout were caught on the recapture run, of which 16 were recaptures. In 1998, the numbers were 347, 464, and 117 respectively. Despite lower numbers of fish captured, population estimates were greater for all age classes of fish except age-1 (like the rainbow estimate). Caution must be used when interpreting these results because, although estimates are greater, they are also less precise due to the low recapture rate. Estimates for age-1 fish are down 80% from 1998 estimates (460 fish to 89), but age-2, age-3, age-4 and age ≥5 are 102%, 240%, 505% and 905%, respectively, of 1998estimates (Figure 4). Despite possible inaccuracies in the estimate, it is clear that the larger fish population in this reach has increased substantially.

Biomass estimates for total trout are greater than 1998 and near levels observed in 1992 (Figure 5). Despite the number of fish/mi being greater during 1992, the total biomass is equivalent. A large proportion of the population in 1992 was made up of juvenile (age-1) fish, whereas 2001 estimates suggest the majority of fish were older than age-2 within the site.

Table 2. Population data from the Stillwater River, Absarokee Section collected during September 2001.

Species	Age Class	Average Length (in)	Average Weight (lb)	#/mi*	Biomass (lb/mi)
Brown trout					
	1	4.2	0.02	89 (29)	1.0
	2	7.2	0.14	654 (141)	22.4
	3	9.17	0.27	688 (122)	34.6
	4	11.61	0.55	394 (66)	39.0
	5	13.82	0.96	125 (47)	56.3
	≥6	14.51	1.01	29 (19)	24.2
			Totals	**1,978** (206**)**	**645** (84)
Rainbow trout					
	1	2.8	0.02	69 (9)	1.1
	2	6.5	0.11	739 (113)	82.4
	3	9.7	0.35	418 (67)	147.2
	4	12.1	0.63	441 (70)	297.0
	≥5	13.8	0.91	167 (43)	151.9
			Totals	**1,834** (155)	**662** (76)

* Numbers in parentheses represent the standard deviation of the estimate.

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 mi, 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 mi, with 150 to 200 of these fish over 13 in. The latest rainbow trout population estimate for this river reach falls short of the total numbers goal, but meets the size goal of at least 150 fish/mi over 13 in. Given the drought conditions present over the past four years and no apparent reduction in fishing pressure, it is remarkable the fish population has held up as well as it has in the Stillwater River.

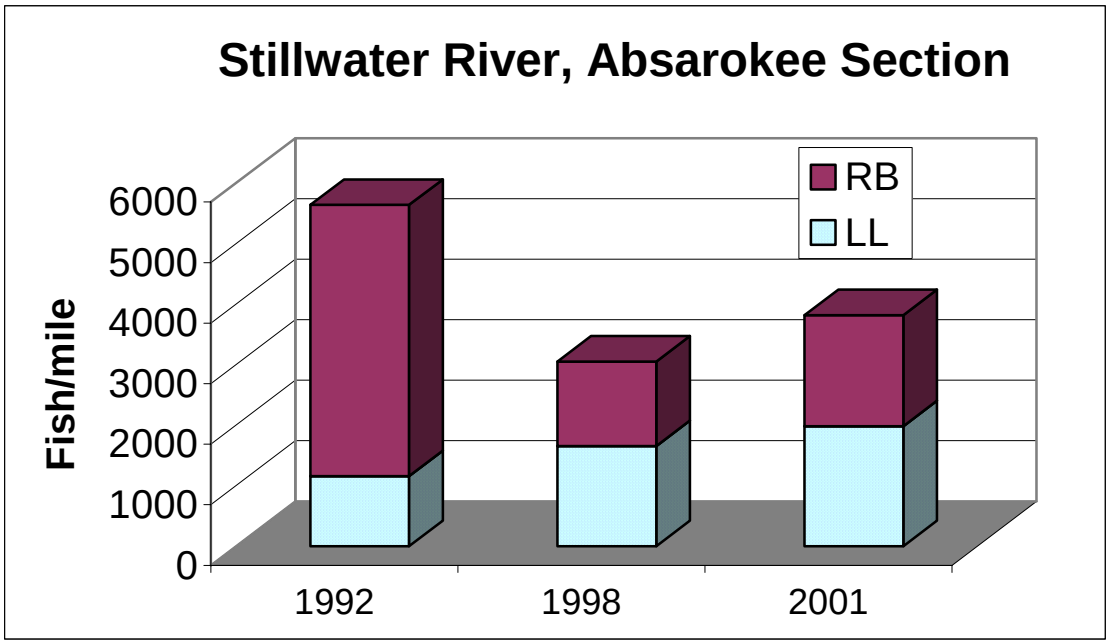

Figure 4. Trout population estimates from the Stillwater River, Absarokee Section for rainbow (RB) and brown (LL) trout during September 2001.

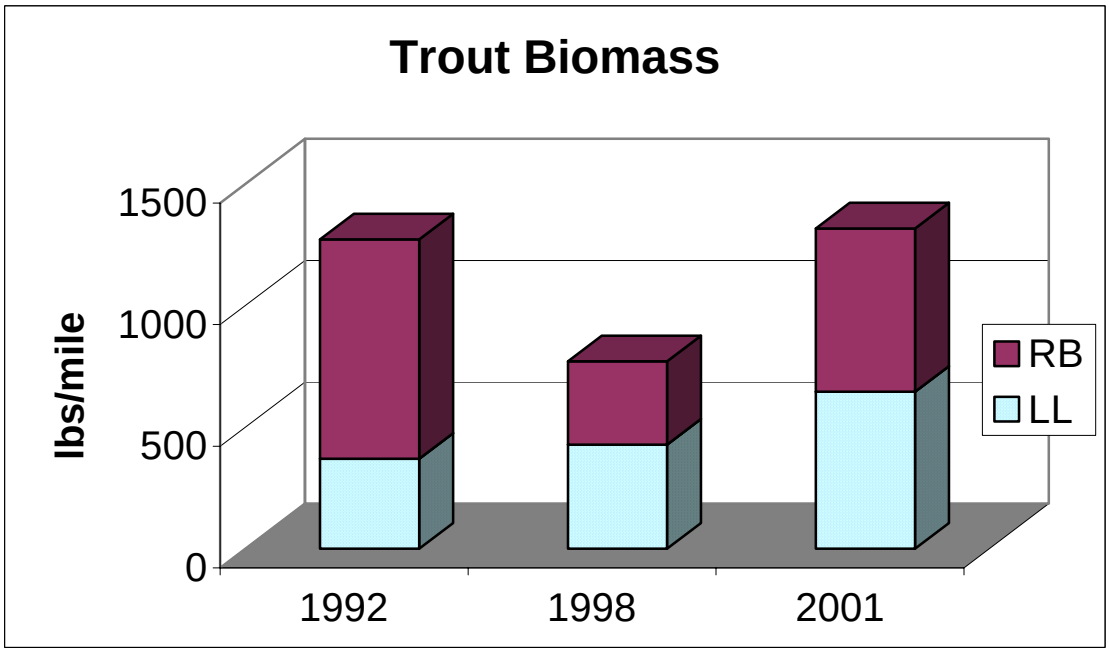

Figure 5. Trout biomass estimates from the Stillwater River, Absarokee Section for rainbow (RB) and brown (LL) trout during September 2001.

Bad Canyon Creek

Preparation continued for the chemical treatment of the headwaters section of Bad Canyon Creek. This cooperative project involving the USFS, Bureau of Land Management, FWP, and private landowners would remove brown trout for 4 stream mi above an enhanced fish-passage barrier, so that a native Yellowstone cutthroat population can be maintained. Extensive past attempts to physically remove brown trout have been unsuccessful (Poore 2000). In July, 60 brown trout were collected above the barrier for disease analysis. An environmental assessment for this project was finished and public comment was solicited.

The efficacy of the barrier was evaluated in 2001 and 2002. In September 2001, 701 brown trout were marked downstream of the fish barrier using an adipose fin clip to assess potential movement upstream over the barrier. In June 2002, after runoff we evaluated whether any adipose clipped fish had successfully negotiated the barrier to areas upstream. Forty-two brown trout were captured within first 150 yd of stream upstream of the barrier and none of these fish were adipose clipped. The pool immediately downstream of the barrier was also electrofished and 35 brown trout were captured, none of which were adipose clipped, suggesting that there had been little movement of fish from the previous fall. Thus it appeared that the barrier is functioning in preventing the movement of brown trout upstream. Due to the drought, however, the flows in Bad Canyon Creek are very low, and there was little spring runoff to trigger movement of fish in the stream.

An additional problem identified at the barrier during 2002 was the deterioration of the left side (looking upstream) where the water has begun to head cut through the loose materials near the cliff face on the right side of the stream. The source of this rock material on this side of the barrier was from the cliff face above that was blasted down into the stream, damming the creek and forcing the water to flow over the large boulders. The loose unconsolidated nature of this material may have led to the stream cutting through it. Despite the head-cut, the falls still appeared to be functioning as a barrier. The water that ran through the rock still dropped vertically approximately 2 ft onto the tops of large rocks with, no pool from which fish could jump from. Despite its functionality, repairs will be necessary to ensure its integrity.

The rehabilitation of Bad Canyon Creek was completed in September of 2002 by treating the upper 3 mi of the stream and its tributaries with the pesticide rotenone. Bioassays were performed in Smith Coulee (a tributary to Bad Canyon Creek), first with the pesticide antimycin and then with rotenone to determine the proper concentration of each chemical to use and the proper spacing of application stations along the stream. Also, the stream demand for potassium permanganate ($KMnO_4$) was determined. This was done to find out the appropriate concentration of $KMnO_4$ to effectively detoxify each pesticide. Rotenone was selected as the toxicant of choice because bioassay results indicated that the chemical antimycin did not remain effectively toxic for a sufficient time to make the project feasible and cost effective. Therefore, the decision was made to use rotenone, which breaks down slower and remains toxic to fish longer than antimycin.

The treatment of Bad Canyon Creek occurred the week of September 9th. Twenty-one cutthroat trout were removed from the creek prior to treatment and stored in Trail Draw above the barrier waterfall during the treatment. It took 5 days to ferry equipment in and out using the helicopter, and to treat the entire reach of stream and its tributaries. Despite having a detoxification station it functioning properly during the entire treatment, approximately 3 mi of stream below the barrier waterfall were inadvertently affected. It appears that the reason for the rotenone traveling past the detoxification station were: 1) overestimation of stream flows and subsequent overdosing of rotenone, 2), inadequate contact time between the rotenone and $KMnO_4$ at the detoxification location to adequately oxidize the rotenone, and 3) lack of organic material in Bad Canyon Creek in the lower 2/3 of the treated section leading to reduced absorption and breakdown of the chemical. This caused the concentration of rotenone to increase at each drip station in the lower creek to the point where the detoxification station could not adequately detoxify all of the rotenone going past the barrier.

Stream flows were calculated two weeks prior to the treatment by measuring the average length, width and depth of a straight section of stream and stream stage gages were placed in the creek to determine if there were subsequent changes in stream flow. Flow (cfs) was determined by adding dye to the stream to estimate the velocity of the water and by multiplying the length, width, depth and velocity. The stream flow, using was estimated at 2.06 cfs at Smith Coulee, 1.1 cfs at Trail Draw and 1.4 cfs near Tepee Creek. Stream stages were checked at these measuring locations prior to treatment and there was only a very small drop in stage over the two weeks (1/8 in at Smith Coulee and 9/16 in at Tepee Creek). The decision was made that there was little change in flow and that the flow measurements made two weeks earlier were appropriate for the treatment. Therefore, all areas upstream of Tepee Creek were treated based upon 1.5 cfs flow and all areas below Tepee Creek at 2 cfs. All tributaries were treated assuming 0.1 cfs, which was the flow in Smith Coulee and Trail Draw at the falls and approximately the same at Tepee Creek. Ten days post-treatment the flow in stream was measured at the barrier to be 0.72 cfs, and the stage meter had dropped an additional ¼ in from the week of the treatment. Therefore, I would approximate that flows during the treatment were near 1 cfs in the creek below Tepee Creek and, therefore, concentration of rotenone was doubled. However, this does not explain the rotenone escaping the treated reach, because the calculations of $KMnO_4$ were based on the same 2 cfs flow measurements and should have been adequate to detoxify the rotenone below the barrier.

There was not sufficient contact time between the potassium permanganate (used to detoxify the rotenone) and the rotenone treated waters to sufficiently detoxify the rotenone. Testing with $KMnO_4$ in Smith Coulee (within the Bad Canyon Creek drainage) in rotenone free waters indicated that 95 to 99% of the chemical was reduced (i.e., lost its detoxifying effect) within 20 minutes of stream travel time. This natural reduction of the $KMnO_4$ is called the stream bottom demand. Therefore, it was necessary to apply permanganate at a concentration of 2 ppm to effectively detoxify the rotenone applied at 2 ppm for a distance of 20 minutes of stream travel time. However, post treatment investigations indicated that there was only approximately 10 minutes of stream travel time before the $KMnO_4$ was reduced ($KMnO_4$ turns from bright purple to a rusty brown color when reduced) below the

barrier. Therefore, it would have been necessary to operate two detoxification drip stations to ensure 20 min of contact time at 2 ppm of $KMnO_4$ and rotenone treated waters.

The stream sediments and quantity of organic matter and fine-grained bed material on the stream bottom appeared to be different along Bad Canyon Creek from its headwaters to the barrier. Therefore, the bioassay tests led to incorrect travel time intervals for drip stations at the lower end (lower 2 mi) of the treatment area where there were fewer sediments and organic material. Thus, the rotenone was not naturally broken down and/or stored in the lower 2/3 of the stream as it was in the upper 1/3 and in the tributaries as calculated during the bioassay, resulting in an increased concentration of rotenone in the stream at each successive application site. By the time the treated waters reached the barrier to be detoxified, they may have been at concentrations greater than 2 ppm, exacerbating the ineffectiveness of the detoxification station.

Electrofishing was performed below the barrier to determine the extent of the fish kill. There was a complete kill at Ekwortzel Draw approximately 2 mi below the barrier. Live fish were present in relatively good numbers approximately 1 mi downstream of Ekwortzel Draw, although there were many dead fish around. Live cars of fish were placed at Ekwortzel Draw and 1 mi below the draw the Saturday (9/14/03) following the treatment. On Sunday all the fish at Ekwortzel Draw were dead indicating rotenone was still present in the water. All fish were alive at the lower liver car. Yellowstone cutthroat trout were brought in from Bluewater State Fish hatchery and placed in live cars at the same locations on Monday (9/16/03). All fish were alive at both locations the following day and two days later suggesting that the rotenone was no longer present in the water. Water samples were collected and analyzed for rotenone during and following the treatment.

A 120-ft section of Bad Canyon Creek was electrofished on June 29,2003 at Ekwortzel Draw and 4 fish were captured (3 brown trout between 4 and 6 in and 1 cutthroat, which was one of the fish that escaped from the live car the previous fall). Further electrofishing was performed 1 mi below Ekwortzel Draw (the location where the fish kill ended) and 27 fish in 35 ft of stream captured. The invertebrate population in the stream was very abundant. Caddis fly, mayfly and stonefly larva and adults were noted in the stream and in the air. All fish were in excellent condition. The one cutthroat captured had grown from 3 in to approximately 5 in over the winter.

On July 12, 2003, the area above the barrier was electrofished to assess the effectiveness of the treatment. The entire stream from Smith Coulee to Boundary Draw 0.75 mi) just upstream of the barrier falls, was electrofished. Four 4 cutthroat trout were captured, three of which were hatchery fish from a live car experiment the previous fall, as indicated by fin erosion, and the other was one that was rescued from Bad Canyon Creek prior to treatment. Electrofishing was also performed in Bad Canyon Creek from approximately 0.5 mi below Tepee Creek (0.75 mi) to the headwaters and no fish were captured or seen. Therefore, it was concluded that a complete kill had been accomplished and restocking was in order. That same day, 3,000 age-1 LeHardy Rapids Yellowstone cutthroat trout were transported from Wyoming and flown into the creek via helicopter. On July 11, 2003, 6,000 age-1 Lehardy Rapids fish were transported from Wyoming and

stocked into the lower portion of the creek below the barrier. These fish were stocked in an effort to replace the brown trout inadvertently killed the previous year. There are approximately 1000 fish/mi in Bad Canyon Creek and the fish in approximately 6 mi of stream were inadvertently killed, therefore, 6000 fish were restocked.

Stillwater River Spawning Evaluations

A previously unidentified spawning area on the Stillwater River was documented in the fall of 2002. A side channel of the Stillwater River begins at the Swinging Bridge Fishing Access site and flows for approximately 0.75 mi across the Beartooth Ranch before reentering the Stillwater River. Twenty redds were counted in this section of side channel, with most redds located in the vicinity of the Beartooth Ranch bridge over the side channel. Normally this side channel would act as only a high water channel, however, water is maintained in this side channel during low flows because of a headgate. Maintaining water in this channel during low flows also provide a spawning benefit to trout in the lower Stillwater River where spawning habitat is limited.

Clarks Fork of the Yellowstone River

Robinson Bridge Section

The Robinson Bridge Section begins at Robinson Bridge, about 7 mi upstream of Belfry, and extends 1.6 mi downstream to just below the confluence of Dilworth Creek. The channel in this reach is entirely single-thread and is characterized by large cobble armoring.

The Clarks Fork of the Yellowstone River downstream from the Wyoming border is chronically dewatered, especially downstream of Belfry, but it was even lower than usual in 2001 because of the continuing drought. Despite these severe conditions, October sampling in the Robinson Bridge Section revealed rainbow and brown trout in excellent condition. Trout densities in this reach are low, apparently because of limited spawning habitat: only 69 rainbow and 23 brown trout were captured and a modified Petersen estimate (as described in Vincent 1971) was performed combining brown and rainbow trout into 4-inch size groups. Although scales were collected and analyzed, an age-based estimate was not practical because of the low numbers of recaptures. The Modified Petersen method estimated there to be 170 trout/mi within this section. This estimate is not particularly reliable because of the low number of recaptures (5) and because age classes were lumped, but it still clearly demonstrates the low numbers of trout in this reach. Although densities are low, trout growth is exceptional. Rainbow trout averaged 12 in and 1 lb, whereas brown trout averaged 11 in and 0.6 lb. The largest rainbow was 21 in and 4 lb (size at age data are summarized in Table 3). This section of river was also sampled in 1998 and rainbow and brown trout numbers (61 and 22) and size (5.1-21.5 and 5.3-17.9) captured were nearly identical, indicating there has been little change in the population in the past 3 years. The most common fish species in this section of river by far is mountain whitefish, making this a great destination for whitefish anglers. Mountain suckers, longnose dace and longnose suckers are also common in this reach of river.

Whirling disease was discovered in the Clarks Fork of the Yellowstone River and Bennett Creek in Wyoming in 2002. Mountain whitefish were tested for pathogens, including whirling disease, in 2001 and were found to be pathogen free. Rainbow trout and mountain whitefish will be collected during 2003 and analyzed for whirling disease to monitor for the presence of the disease in Montana. If the parasite is found, it would become the first river in Region 5 infected with the disease.

Table 3. Length at age data for trout in the Robinson Bridge Section of the Clarks Fork of the Yellowstone River during fall 2001.

Species	Age Class	Average Length (in)	Average Weight (lb)
Brown trout			
	2	10.9	0.48
	3	12.3	0.69
	≥4	12.5	0.72
Rainbow trout			
	1	6.2	0.10
	2	8.4	0.30
	3	12.5	0.85
	4	15.5	1.53
	≥5	16.1	1.73

Rock Creek

Fox Section. The 4,800 ft long Fox Section of Rock Creek is located approximately seven mi downstream from Red Lodge. Rock Creek, from Red Lodge downstream 20 mi 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 within the Fox Section were particularly hard hit by major flooding in June 1992, which shifted huge amounts of bedload through the section.

Fish populations in the Fox Section of Rock Creek were sampled during April of 2002. Total trout numbers have increased from a peak of 1,137/mi in 1999 to 1,244/mi in 2002 (Figure 6). Lower spring flows (due to the drought) have likely led to increased survival of eggs and juveniles. This is evidenced by the increase of age-1 and age-2 brown trout; estimates (Table 4) for fish age one and two increased 59 % (443) since 1999 (263), and are now 160% of the 12-year average for this section (276). Older age classes of catchable sized fish (> age 3) have decreased 67% from the highest level measured (706/mi) in 1999 to 472/mi in 2002, which is still 137% of the 12-year average. Despite a

decrease in larger brown trout in this section, the total biomass of trout has increased. The increase in fish biomass from 1999 to 2002 was related entirely to the increase in the rainbow trout population (Figure 7). Rainbow trout numbers increased from approximately 97/mi in 1999 to 329 in 2002, which is more than double the highest density of rainbows observed in the Fox Section (161 in 1996). Lower spring flows during the drought likely benefit rainbow trout more than brown trout, because rainbow eggs incubate in the gravel during high flows and reduced scouring and transportation of bed load likely increases rainbow survival. On the other hand, because brown trout fry have emerged from the gravel before spring runoff and, therefore, may be less affected by high runoff. Rainbows may also be able to take advantage of other habitat and food resources in the creek that are not used by brown trout, thus allowing for greater biomass in the stream than would be present with browns alone. Mottled sculpin and longnose dace are also abundant in the site and mountain whitefish and brook trout are present but at low numbers.

Table 4. Fish population data collected at the Fox Section of Rock Creek, April 2002.

Species	Age Class	Average Length (in)	Average Weight (lb)	#/mi*	Biomass (lb/mi)
Brown trout					
	1	3.8	0.03	134 (10)	3.5
	2	6.8	0.12	309 (12)	36.7
	3	10.4	0.39	221 (13)	85.4
	4	13.4	0.78	200 (24)	156.0
	5	15.7	1.24	41 (19)	50.8
	≥6	15.7	1.24	10 (10)	12.7
			Totals	**914** (38)	345
Rainbow trout					
	1	3.6	0.02	21 (5)	0.1
	2	7.4	0.16	117 (10)	2.7
	3	9.9	0.36	92 (15)	7.8
	4	12.2	0.60	81 (38)	24.7
	≥5	12.4	0.62	18 (14)	8.8
			Totals	**330** (44)	112.7

* Numbers in parentheses represent the standard deviation of the estimate.

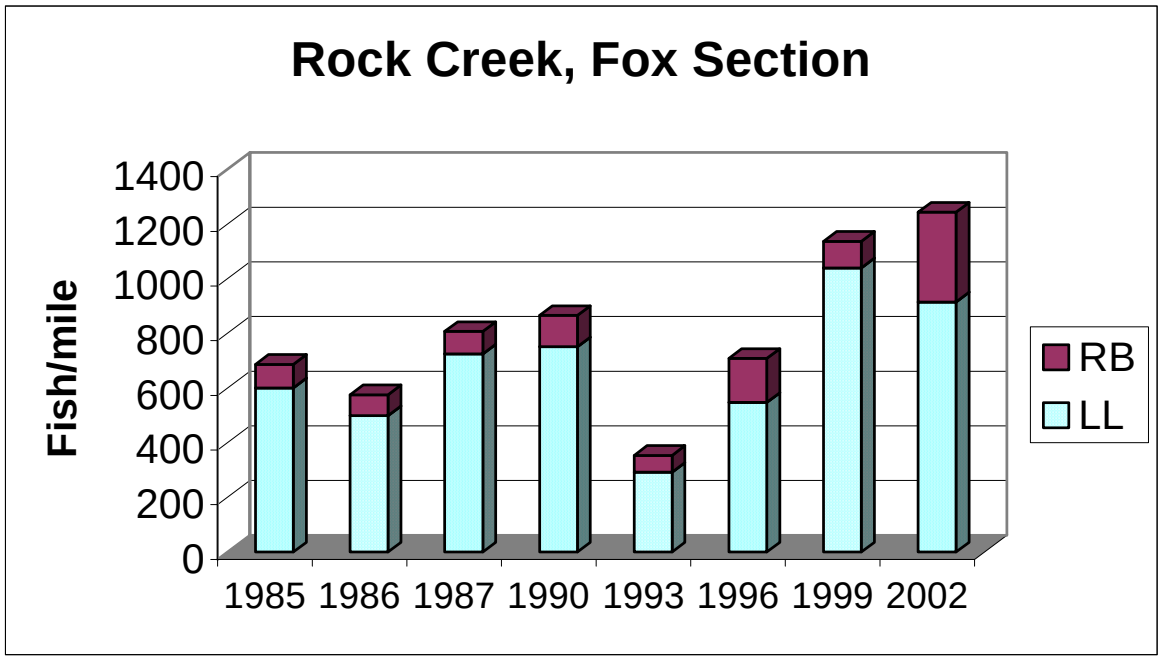

Figure 6. Rainbow (RB) and brown (LL) trout population estimates for the Fox Section of Rock Creek.

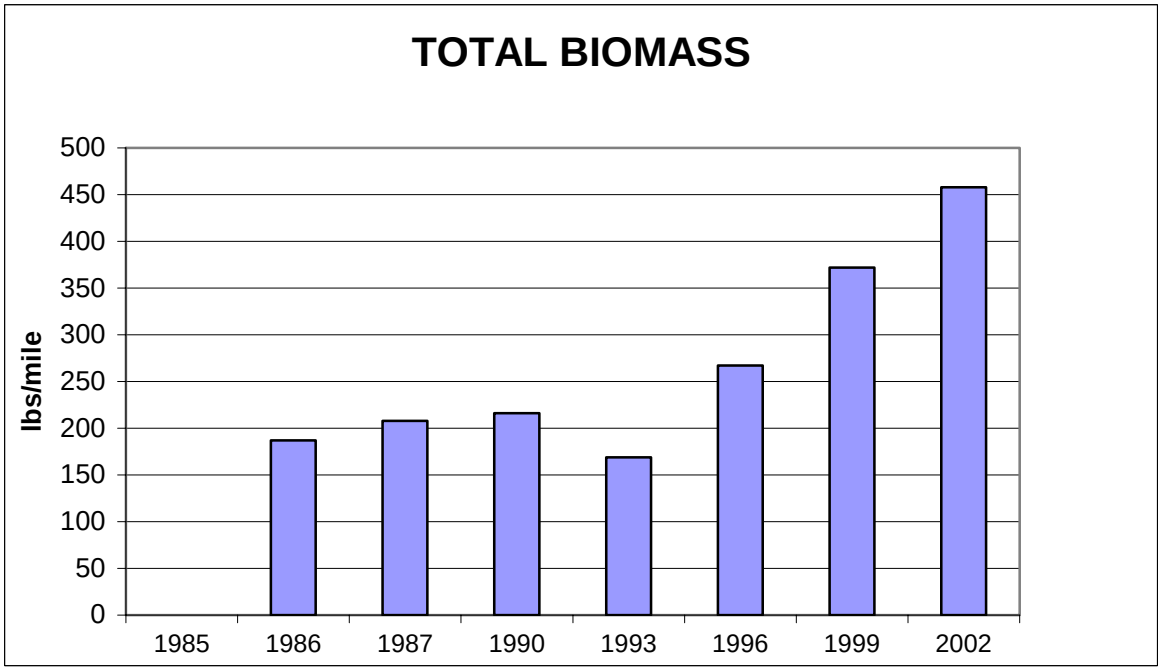

Figure 7. Combined biomass estimates for brown and rainbow trout in the Fox Section of Rock Creek.

Joliet Section. The Joliet Section of Rock Creek extends from the Highway 212 bridge 1 mi southwest of Joliet downstream for about 5,300 ft This section has higher fine sediment load, warmer summer temperatures, and greater nutrient levels than the Fox Section. In addition, substantial amounts of water are released into Rock Creek from Cooney Reservoir via Red Lodge Creek, which enters approximately 3.5 mi upstream of the site. Because of these large inputs of water, this portion of Rock Creek does not experience the severe dewatering like areas upstream and areas farther downstream (i.e., downstream of Rockvale). Brown trout and mountain whitefish are the primary game species found in this reach; a few rainbow trout are also present. Longnose dace and longnose, white and mountain sucker are also common.

The Joliet Section was last sampled in 1999, and it appeared then that several high water events prior to 1999 led to substantial reductions in two year classes of brown trout. To determine if these poor year classes were translating into fewer older fish three years later and to determine the effects of the ongoing drought (2002 was the fourth year of below average precipitation), a population estimate in the Joliet Section was attempted on April 15, 2002. Unfortunately, after initially marking fish in the section, problems with our equipment arose and the recapture run was not performed prior to high water. During the marking run 103 brown trout (average length = 12.6 in, range 6.3-19.5 in) and 4 rainbow trout (average length = 14.2 in, range 12.5-16.3 in) were marked. These numbers were similar to the numbers collected in 1999.

Fish Passage Investigation on Rock Creek Between Boyd and Roberts. A large concrete diversion dam spans Rock Creek between Roberts and Boyd. While performing a 310 inspection at the dam, inquiry was made whether the dam was passable to fish. The dam is approximately 6 ft tall and has a large plunge pool at the base. The top of the structure consists of a vertical 15 in lip that tapers to approximately 8 in at the western side of the dam. Water runs over the vertical lip of the dam onto an apron that is tapered at approximately 30 degrees for about 8ft, where it drops another 15 in vertically to the plunge pool below. The dam is used to divert water to a pond and hydroelectric facility. The headgate is located on the eastern side of the creek and a substantial amount of water is diverted to the pond. During the 310 inspection, fish were observed jumping onto apron of the dam but they could not negotiate the top lip of the dam. The dam owner was agreed to allow FWP to investigate whether the dam was passable and to provide passage if the dam proved to be a barrier to fish migration. This would be a very important location to re-establish fish passage, if indeed the dam is a barrier, because it is located in the middle one of the most dewatered stretches of Rock Creek. It is important for fish to be able to move to more suitable habitat when water levels are extremely low because of irrigation diversions and drought.

As part to the fish passage investigation an approximately 1,000-ft reach of stream immediately below the irrigation diversion was electrofished to determine fish species composition, size, and whether there appeared to be a concentration of fish below the dam. The timing of shocking was planned to coincide with the spawning migrations of brown trout, but sampling did not occur until 11/5/02, witch was during the brown trout spawning. Fish collected included: 43 brown trout (6.6-17.3 in), 7 rainbow trout (11.4-13.4 in), 85 mountain whitefish (8.9-16.0 in), 9 white suckers, 1 mountain sucker, and 1 longnose

sucker. There was little evidence of fish congregating below the dam, but it appeared that the brown trout were past peak spawning in Rock Creek. Mountain whitefish, however, may have congregated below the dam attempting to move upstream to spawn, as densities appeared to be greater than expected for this location in the drainage.

Bluewater Creek

Bluewater Creek is an 18-mi, mostly spring-fed tributary to the Clarks Fork of the Yellowstone River that enters near the town of Fromberg. The nutrient-rich waters of Bluewater Creek support abundant macrophytes, aquatic invertebrates, and trout near the Bluewater State Fish Hatchery. Farther downstream, the creek becomes more degraded due to water diversions and other uses, and the species composition changes to those fish more tolerant of warmer, turbid and silty habitat. An extensive longitudinal investigation of the effects of temperature and sediment in Bluewater Creek showed a decrease in trout abundance from the headwaters to the confluence with the Clarks Fork (Marcuson, 1979). This trend may be related to reduced trout egg survival rates in the silty substrate at the lower end.

A 1200-ft population monitoring section was established in Bluewater Creek in 1998 starting near the Hatchery and extending downstream to the county road crossing (Poore 2000). This section was electrofished in the spring of 2002 and a 2-pass population estimate was performed. Four hundred seventy seven brown trout were captured (mean length = 7.2 in, range = 3.8-18.2) and the population estimate indicated there were 574 (505-644, 95%CI) brown trout within the section (2,526/mi). This section was previously sampled in 1998, when a mark-recapture population estimate was performed. Because of the different methodologies used to estimate the fish population sizes the estimates are not directly comparable. In 1998, 239 brown trout were sampled during both the marking and recapture runs and the population was estimated at 297 fish in the section (1306/mi). Although estimates are not directly comparable, it is apparent that the population size of brown trout in Bluewater Creek has increased dramatically since 1998. Scale samples were collected from fish during 2002 and have been sent in for mounting. It appears that the large population increase has occurred primarily within the size classes of 4-7 in fish (likely age-1 and age-2). When age data are available, a more direct comparison between 1998 and 2002 population size can be made. It is possible that the ongoing drought and lack of high turbid flows in the spring have increased brown trout recruitment over the last three years.

In 1998, 26 rainbow trout and 3 Yellowstone cutthroat trout were captured. In 2002, 18 rainbow trout and no cutthroats were captured. Sufficient depletion was not made during the 2 electrofishing passes to obtain a reliable population estimate for rainbow trout. Disease samples were collected from rainbow and brown trout, and no pathogens were detected in samples submitted for testing.

Mountain Stream Sampling

Mountain Stream Crew

Working in cooperation with the USFS, a 3-person crew was hired during the summer of 2002 to survey the high elevation streams of the Absaroka-Beartooth Mountains (A-B). This crew worked in conjunction with the mountain lakes crew that surveys lakes in the A-B. The goal of hiring this crew was to identify streams in the A-B that support undocumented populations of Yellowstone cutthroat trout and to identify fishless streams with suitable habitat for potential introduction of cutthroat. Additionally, habitat information was collected at each stream surveyed. From July to August the crew surveyed 15 streams and habitat information was collected on approximately 14.5 miles of stream (Table 5).

Wyoming Creek. As part of the Mountain Streams Survey, a new population of Yellowstone cutthroat trout was identified in Wyoming Creek in the Absaroka-Beartooth Mountains. Wyoming Creek is a tributary of Rock Creek that flows off the Line Creek Plateau toward the north. Its headwaters are in the Highline Lakes area of Wyoming. A very high gradient reach with multiple impassable barriers has precluded fish movement from Rock Creek upstream into the upper reaches of Wyoming Creek. Wyoming Creek is moderate gradient with primarily willow and grass riparian vegetation through the reach that contains Yellowstone cutthroat trout (T9S R19E Sec28, 21). The dominant substrate type is large cobble and small boulders with pockets of gravels suitable for spawning. Habitat data were collected in the stream and electrofishing was performed. Apparently due to the low conductivity of the water and fast stream flows, electrofishing was ineffective at capturing fish. Fish were seen while electrofishing, but could not be captured. However, Yellowstone cutthroats were angled, and fish caught ranged in size from 7 to 13 in. Because electrofishing was ineffective, and it is difficult to catch juvenile fish by angling, the relative abundance or the presence or absence of younger age classes of fish could not be determined. Adult fish captured when angling were in excellent condition.

Line Creek. Line Creek is a small tributary of the Clarks Fork of the Yellowstone River, approximately 60 air mi southwest of Billings, Montana. The North Fork Line Creek begins at Line Lake, about 14 mi south of Red Lodge, Montana. The lake is near the Montana, Wyoming border, and is accessed by a 1.5-mi hike from the Beartooth Highway. An intermittent stream flows out of the lake to form the headwaters. The South Fork (or main fork) of Line Creek begins approximately 2 mi south of Line Lake, in Wyoming. The two tributaries converge in Montana, 4 mi east of Line Lake, and just north of the Montana-Wyoming border (GPS 12T 0633873 4985142). The entire stream is 13-18 mi long. Line Creek is inhabited by an abundant brook trout population in Wyoming below the joining of the two forks. Near the state line a high gradient reach has precluded book trout invasion, and the upper parts of the two forks are currently fishless, except for Line Lake that is stocked with Yellowstone cutthroat trout. Line Creek was investigated for the potential of introducing Yellowstone cutthroat trout the fishless areas in Montana and Wyoming. Much of the upper watershed is within the Research Natural Area, as designated by the Forest Service in 1999.

Table 5. Data collected by the mountain stream crew during summer 2002.

Stream	Reach	Status*	Fish Species**	Comments
Chalice Creek	Outlet of Chalice Lake T6 R13 S14	F		Fish present in out let of stream until high gradient cascade
Flood Creek	T6 R13 S25 downstream of Bill Lake	F	?	
Great Falls Creek	Downstream of Great Falls Creek Lakes	B		No fish in stream and no fish captured in lakes. Rainbow that inhabited lakes have died out. Good potential to reestablish YCT
Inlet Stream to Rachel Lake		B		No fish found in stream
Line Creek	State line upstream in both forks 1 mile	B		Stream is fishless, high gradient, but suitable habitat for YCT introduction
Outlet of Gallery Lake	Clarks Fork	F	EB	
Sedge Creek	Inlet to Kersey Lake upstream 1 mile	F	EB	Brook trout are also present downstream of lake to the Broadwater River.
Sky Top Creek	Downstream of Lone Elk Lake	F	EB	Barrier located downstream of Lone Elk Lake. One fish observed in lake
Sodalite Creek	0.75 mi upstream of Curl Lake T9 R15 S11	F	EB	Many small brook trout present upstream of high gradient reach above Curl Lake
Star Creek	T8 R15 S32	F	?	Fish observed but not identified
Unnamed Creek between Lady of The Lake and Corner Lake	T9 R15 S8	F	YCT/EB	A barrier exists between Lady of the Lake and Corner Lake, EB below and only YCT above. Creek is small and possibly ephemeral
Wyoming Creek	T9S R19E S28	F	YCT	Undocumented population. Genetics needed to determine if pure YCT
West Fork West Boulder River	T5 R10 S13	B		High gradient stream, potentially support small population of fish.

* F = Fish bearing, B = Barren of fish

** EB = brook trout, YCT = Yellowstone cutthroat trout, ? = species was not determined.

A physical and biological assessment was conducted during the summer and fall of 2002 to determine: (1) if the proposed project area was fishless, (2) the potential habitat suitability for introduction of YCT and (3) the potential biological impacts of introducing fish on macro invertebrates and amphibians. To determine the extent of brook trout movement into the upper watershed, electrofishing was performed starting at the second road crossing in Wyoming. A 100-ft section of stream was electrofished and 27 brook trout were captured. Approximately 200 yd upstream from this point is the Montana/Wyoming border and no fish were found in this area. Electroshocking continued to the third road stream crossing (approximately another 300 yards upstream) and no fish were found. The gradient of the stream is less upstream of the third ford. The stream area between the second and third ford is very high gradient with large boulders. Despite the high gradient, there was not one specific point at which could be classified as a true barrier under all flow conditions. However, the high gradient, large cascades and the length of the reach appear to have precluded brook trout invasion from downstream because brook trout have been present for over 40 years. No fish were found 100 yard above the second road crossing in Wyoming up to the third stream crossing in Montana. An additional 500 ft of stream were electrofished above the gradient barrier reach with the same equipment used to capture the brook trout below and no fish were captured. Two 300 ft sections of stream were evaluated for the presence of fish in the North and South Forks of Line Creek approximately 1 mi upstream of their confluence, and no fish were found.

Three survey crews assessed the habitat conditions in Line Creek for possible YCT introduction. Physical stream conditions were recorded such as habitat unit type, length, width, average and maximum depth of pools, bankfull measurements, bank stability, undercut bank, pool frequency, large woody debris counts and riparian vegetation characteristics. Spawning areas and fish migration barriers were also noted. Data were collected in Line Creek upstream of the barrier reach and in the two forks of the stream. Approximately 300-400 yd of stream were surveyed in each reach. Using these data it was determined that there was adequate habitat to support all life stages of YCT in Line Creek and the North and South forks. The stream banks are very stable and there is abundant riparian vegetation. Although much of the stream is medium to high gradient, pool depth, undercut banks, and the presence of gravel areas suitable for spawning suggest that once introduced, YCT should find habitat conditions favorable for establishing of a self-sustaining population.

Biological data were collected during the physical habitat inventory of the streams. Crews searched for amphibian adults, eggs, or tadpoles while collecting habitat data. No amphibian life stages were found in Line Creek or the North and South Forks. The failure to detect amphibian eggs and larvae in Line Creek is consistent with the life histories and known habitat use of amphibian species known to inhabit the Absaroka-Beartooth Mountains. These species would not breed in higher gradient streams without backwaters and would only potentially use higher gradient streams as overwintering habitat (Bryce Maxell, University of Montana, personal communication). Thus, the stream-dwelling amphibian species that may be present in the Line Creek drainage are only likely to be found at higher densities in areas with abundant shallow, warm backwaters. Few of these habitats exist in Line Creek because of its high gradient and abundant canopy cover. Additionally, YCT introduced into Line Creek will not have access to any shallow lakes or

other wetland areas that may be suitable breeding habitat for amphibians. No amphibians in the Beartooth Mountains are stream obligates for their entire life history

Aquatic macroinvertebrate samples were collected from the North and South forks of Line Creek and sent to McGuire Consulting for analysis of rare or endangered taxa that may be unique to a fishless stream in this area. Individuals were identified down to species when possible and counted. Results of their analysis indicated Line Creek contains a macroinvertebrate community similar to that of most small, mountain streams of southwest Montana (McGuire 2003). Fifty-seven taxa were identified of which 54 were insects. Dipterans, mayflies, caddis flies and stoneflies were numerically co-dominant in the samples, comprising 96% of the individuals. No taxa were rare, endangered or unique to fishless streams. Line Creek supports a robust invertebrate fauna and a healthy benthic community indicative of good substrate and water quality. The quality of the invertebrate fauna and the lack of rare or endangered taxa make Line Creek a prime candidate for the introduction of YCT. If cutthroat trout were introduced into Line Creek, it would be the only population of fluvial cutthroat in the entire Clarks Fork drainage that would be free from competition and predation from non-natives.

MANAGEMENT RECOMMENDATIONS

1) Continue to monitor the Yellowstone, Boulder, and Stillwater River drainages to determine the effects of drought, flooding, disease (especially whirling disease), fishing pressure, and management changes on fish populations. Maintain the current regulations on lower Boulder and Stillwater rivers of 2 fish only one over 13 in, as lower limits have likely led to a more stable fishery given high fishing pressure and drought. Pursue studies and funding of fish entrainment in ditches in the Boulder and Stillwater rivers, and look for ways to reduce fish loss in ditches.

2) Conduct population estimates in the Laurel Section of the Yellowstone River to determine effects of drought on fishery.

3) Continue spawning evaluations in Esp Spring Creek and electrofish stream to determine if juvenile cutthroats are present in the stream. Pursue opportunities to facilitate fish passage at the confluence with the Yellowstone River at low flows.

4) Continue to monitor cutthroat trout in Lower Deer Creek and Placer Gulch for evidence of possible impacts from brown trout. Monitor introduced population above falls to determine success of plants, dispersion from the point of stocking and natural reproduction. Investigate possibility of barrier construction and elimination of brown trout from the barrier falls downstream to the USFS boundary.

5) Pursue similar YCT introduction/restoration projects in the Boulder River drainage that includes: genetic swamping/elimination of rainbow/cutthroat hybrids in Silver Lake and Four Mile Creek in the upper main Boulder; pursue introduction of YCT into the fishless upper West Boulder River; resample Great Falls Creek and lakes for presence of fish and potentially restock lakes and stream with YCT.

6) Continue monitoring trout spawning at Beaver Meadows for potential impacts of bank stabilization on spawning areas

7) Monitor Bad Canyon Creek for the presence of non-native brown trout post-treatment. Continue to stock YCT from LeHardy Rapids into Bad Canyon Creek at approximately 1000 fish/year for two or three additional years. Repair barrier falls to ensure that it continues to function as a migration barrier for brown trout.

8) Obtain funding and design a creel/recreational survey on the Stillwater River to determine the amount and types of uses and fishing pressure/harvest. Perform similar survey on the Yellowstone River to determine the amount of fish harvest and whether there is evidence of increasing fishing pressure and high harvest rates due to liberal number-and size-limits.

9) Initiate a tagging study to help identify fish movements, catch and harvest rates in the Boulder, Stillwater, Clarks Fork and Yellowstone Rivers.

10) Work with Pat Byorth, biologist responsible for cutthroat work on private lands, to develop restoration projects that will benefit YCT on private lands in R5.

11) Continue collecting fisheries information from the Clarks Fork River to assist in developing a fishery in the river and to assist native species management. Work to provide fish passage at diversion dams on the Clarks Fork and Rock Creek and at impassible stream crossings on tributary streams. Discuss option to introduce YCT into Line Creek. Monitor the Clarks Fork for the presence of whirling disease detected in Wyoming and determine potential impact on trout and whitefish fishery.

12) Continue the cooperative project with USFS to eliminate brook and westslope cutthroat trout from the headwaters of Soda Butte Creek. Complete the EA and procure permits necessary to complete this project.

13) Continue to work with the USFS to identify streams in the Absaroka-Beartooth that contain cutthroat and fishless streams that are suitable for cutthroat introduction. Pursue opportunities to rehabilitate streams and lakes to convert them from non-native species to YCT.

Prepared by: James R. Olsen

Date: September 22, 2003

LITERATURE CITED

Fredenberg, W.A., M. D. Poore and S.L. McMullin. 1986. Inventory of waters of the project area. Montana Department of Fish Wildlife and Parks Report F-20-R-30, Job I-a

Gillin, G. 2001. East Boulder fisheries monitoring, 2001. Apex Aquatics, Missoula, MT.

Leathe, S. 1983. Specific information on two-catch fish population estimation technique. Montana Fish, Wildlife, and Parks internal memorandum.

Marcuson, P. 1979. Summary of aquatic studies on Bluewater Creek, Montana. Special publication. Montana Department of Fish and Game.

Poore, M. D. 2000. Mid-Yellowstone Drainage investigations, survey and inventory of coldwater streams. Montana Fish, Wildlife and Parks Job Progress Report F-46-R-4, 5, 6, Job I-i.

Poore, M. D. 1997. Mid-Yellowstone Drainage investigations, survey and inventory of coldwater streams. Montana Fish, Wildlife and Parks Job Progress Report F-78-R-3, Job I-i.

Poore, M.D. 1994. Mid-Yellowstone Drainage investigations, survey and inventory of coldwater streams. Montana Fish, Wildlife and Parks Job Progress Report F-46-R-7, Job I-i.

Poore, M.D. 1990. Mid-Yellowstone Drainage investigations, survey and inventory of coldwater streams. Montana Fish, Wildlife and Parks Job Progress Report F-46-R-3, Job I-i.

Poore, M. D. and K. Frazer. 2001. Survey and inventory of coldwater and warmwater ecosystems, south-central Montana coldwater fisheries investigations. Montana Fish, Wildlife, and Parks Job Progress Report F-78-R-3, 4, 5, 6, Job 3531.

Vincent, E. R. 1971. River electrofishing and fish population estimates. Progressive Fish Culturist 33(3): 163-167.

Water Consulting Inc. 2001. As-built monitoring report for the Beaver Meadows Ranch fish habitat improvement project on the Boulder River. Water Consulting Inc. 120 S. 5th St., Suite 201, Hamilton, MT 59052.

Water Consulting Inc. 2002. Year 2002 monitoring report for the Beaver Meadows Ranch habitat improvement project on the Boulder River habitat improvement project on the Boulder River. Water Consulting Inc. 120 S. 5th St., Suite 201, Hamilton, MT 59052.

WATERS REFERRED TO:

Bad Canyon Creek
Bluewater Creek
Boulder River (Beaver Meadows)
Boulder River (Allers)
Chalice Creek
Clarks Fork River (Robinson Bridge)
East Boulder River (B4)
East Boulder River (B5)
East Boulder River (B6)
East Boulder River (Placer Basin)
Elk Creek (East Boulder)
Flood Creek (Stillwater)
Great Falls Creek (Boulder)
Line Creek (Clarks Fork)
Lower Deer Creek
Placer Gulch (Lower Deer Creek)
Rock Creek
Sedge Creek (Clarks Fork)
Sky Top Creek (Clarks Fork)
Sodalite Creek (Clarks Fork)
Star Creek (Clarks Fork)
Stillwater River (Absarokee)
Wyoming Creek
West Fork West Boulder River
Yellowstone River (Big Timber)
Yellowstone River (Greycliff)
Yellowstone River (Laurel)

Appendix A – Beaver Meadows Ranch Spawning Survey Information

Table 1. Rainbow trout redd and fish count data collected by visual counts at Beaver Meadows Ranch on the Boulder River during spring 2001.

	4/6/01		4/12/01		4/20/01		4/27/01		5/6/01		Totals*			
Location	Redds	Fish	Redds	Fish	Redds	Fish	Redds	Fish	Redds	Fish	Redds	%	Fish	%
15C	NS**	NS	0	0	0	0	0	0	0	0	0	0	0	0
A3,A4,A5	0	0	0	0	0	0	3	3	NS	NS	3	3	3	4
14C	NS	NS	0	0	0	0	0	0	0	0	0	0	0	0
13C	0	0	0	0	0	0	0***	0	0***	0	0	0	0	0
A10														
12C	0	0	0	0	-1	0	4	4+	7	10	7	7	10	13
11C	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10C	0	0	-2	0	-2	0	-5	0	2	5	2	2	5	6
5T	0	0	0	0	0	0	6	6+	0	0	6	6	0	0
4T	8	0	-1	0	-2	0	6	10+	1	4	8	8	4	5
A6														
A7														
3T	0	0	0	0	0	0	0	0	-1	0	0	0	0	0
2T	2	0	2	2	-4	0	11	8+	2	0	11	11	2	3
A11											0	0	0	0
1T	2	0	0	0	0	0	0	0	0	0	2	2	0	0
A8														
A9														
9C	0	0	0	0	0	0	0	0	1	1	1	1	1	1
8C	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7C	0	0	0	0	-1	0	-1	0	0	0	0	0	0	0
6C	2	0	0	0	0	0	3	1	0	0	3	3	1	1
A1	0	0	0	0	-1	0	-1	0	0	0	0	0	0	0
A2	0		0	0	0	0	2	1	2	0	2	2	1	1
A12														
5C	2	0	0	0	0	0	3	1	0	0	3	3	1	1
4C	5	0	0	0	-4	0	9	8+	15	13	15	15	13	17
3C	1	0	0	0	0	0	2	1	3	3	3	3	3	4
2C	1	0	0	0	1	5	-5	0	4	0	4	4	5	6
A13														
A14														
A15														
A16														
1C	0	0	-2	0	1	4	31	28	8	28	31	31	28	36
										Total	101		77	

* Totals equal the maximum number of redds and fish observed at each site.

** NS = Not Surveyed

***12C, 13C were counted together and presented under 12 C for 4/27/01 and 5/6/01

Table 2. Rainbow trout redd and fish count data collected by visual counts at Beaver Meadows Ranch on the Boulder River during spring 2002.

	4/5/02		4/26/02 (WCI)*		5/10/02		Totals**			
Reach	Redds	Fish	Redds	Fish	Redds	Fish	Redds	%	Fish	%
15C	0	0	0	0	0	0	0	0	0	0
A3,A4,A5	0	0	0	0	12	3	12	6	3	5
14C	3	0	5	0	2	0	5	3	0	0
13C	0	0	6	0	12	2	12	6	2	3
A10	0	0	1	0	0	0	1	1	0	0
12C	0	0	0	0	4	2	4	2	2	3
11C	0	0	0	0	2	1	2	1	1	2
10C	3	0	7	0	7	2	7	4	2	3
5T	2	0	1	0	2	0	2	1	0	0
4T	1	0	7	0	4	0	7	4	0	0
A6	0	0	0	0	2	0	2	1	0	0
A7	0	0	1	0	0	0	1	1	0	0
3T	0	0	3	5	8	7	8	4	7	11
2T	0	1	15	2	17	12+	17	9	12	19
A11	0	0	3	0	2	0	3	2	0	0
1T	0	0	0	0	0	0	0	0	0	0
A8	0	0	0	0	2	1	2	1	1	2
A9	0	0	7	0	10	2	10	5	2	3
9C	0	0	6	0	9	9	9	5	9	15
8C	0	0	0	0	0	0	0	0	0	0
7C	0	0	0	0	0	0	0	0	0	0
6C	0	0	4	0	0	0	4	2	0	0
A1	3	0	1	4	5	1	5	3	4	6
A2	0	0	2	0	0	0	2	1	0	0
A12	0	0	0	0	3	0	3	2	0	0
5C	4	4	4	1	12	6	12	6	6	10
4C	0	0	9	6	7	3	9	5	6	10
3C	0	0	0	0	3	2	3	2	2	3
2C	0	0	4	0	7	1	7	4	1	2
A13	0	0	0	0	1	0	1	1	0	0
A14	0	0	0	0	3	1	3	2	1	2
A15	0	0	0	0	2	0	2	1	0	0
A16	0	0	0	0	1	0	1	1	0	0
1C	2	0	24	1	41	1	41	21	1	2
						Total	197		62	

* Spawning survey conducted on 4/26/02 was by Water Consulting Inc. (WCI).
** Totals equal the maximum number of redds and fish observed at each site.

Table 3. Brown trout redd and fish count data collected by visual surveys at Beaver Meadows Ranch on the Boulder River during Fall 2001. Two redd surveys were performed by FWP, but only the summary data are shown here.

Site	Redds	%	Fish	%
15C	0	0	0	0
A3,A4,A5	6	3	0	0
14C	4	2	0	0
13C	10	5	0	0
12C	6	3	0	0
10C	0	0	0	0
11C	25	12	1	5
5T	1	0	0	0
4Tb	0	0	0	0
4T	15	7	5	24
A7	3	1	3	14
A6	3	1	0	0
3T	2	1	0	0
2T	30	15	5	24
A11	0	0	0	0
1T	1	0	0	0
A8	4	2	0	0
A9	4	2	0	0
9C	9	4	0	0
8C	0	0	0	0
7C	2	1	1	5
6C	6	3	4	19
A1	0	0	0	0
A2	1	0	0	0
5C	0	0	0	0
4C	11	5	0	0
3Cb	0	0	0	0
3C	3	1	0	0
2C	4	2	0	0
A13	0	0	0	0
1C	56	27	2	10
Total	206		21	

Table 4. Brown trout redd and fish count data collected by visual counts at Beaver Meadows Ranch on the Boulder River during Fall 2001.

	10/23/02		11/8/02		Doug Esp Survey		Totals*			
Site	Redds	Fish	Redds	Fish	Redds	Fish	Redds	%	Fish	
15C	0	0	1	0			1	1	0	0
A3,A4,A5	0	0	2	0	9	9	9	6	9	14
14C	1	0	0	0			1	1	0	0
13C	0	0	1	0			1	1	0	0
12C	0	0	3	0	10	7	10	7	7	11
10C	1	0	7	0	5	2	7	5	2	3
11C	0	0	3	0			3	2	0	0
5T	0	0	1	0	6	6	6	4	6	9
4Tb**	2	0	3	0			3	2	0	0
4T	0	0	5	0	10+	1	5	3	1	2
A7	0	0	4	0			4	3	0	0
A6	4	0	4	0			4	3	0	0
3T	0	0	0	0	1		1	1	0	0
2T	8	0	8+	0	8+	2	8	5	2	3
A11	0	0	0	0			0	0	0	0
1T	0	0	0	0			0	0	0	0
A8	0	0	5	0			5	3	0	0
A9	0	0	0	0	1	1	1	1	1	2
9C	0	0	3	0			3	2	0	0
8C	0	0	0	0	1		1	1	0	0
7C	0	0	0	0	1	3	1	1	3	5
6C	0	0	3	0	1		3	2	0	0
A1	0	0	3	0	1	2	3	2	2	3
A2	0	0	0	0	0	0	0	0	0	0
5C	0	0	12+	0	8	2	8	5	2	3
4C	6+	0	11+	2	13	15	13	9	15	23
3Cb***	1	0	2	1			2	1	1	2
3C	0	0	0	0	3	3	3	2	3	5
2C	0	0	3	3	5	4	5	3	4	6
A13	0	0	11	0			11	7	0	0
1C	9	0	20	0	28	8	28	19	8	12
						Total	150		66	

* Totals equal the maximum number of redds and fish observed at each site.

** on left hand side of island, new good gravels on this side of island ideal for spawning (see Figures 1 and 2).

*** this area is on the left side of the island (see Figures 1 and 2).

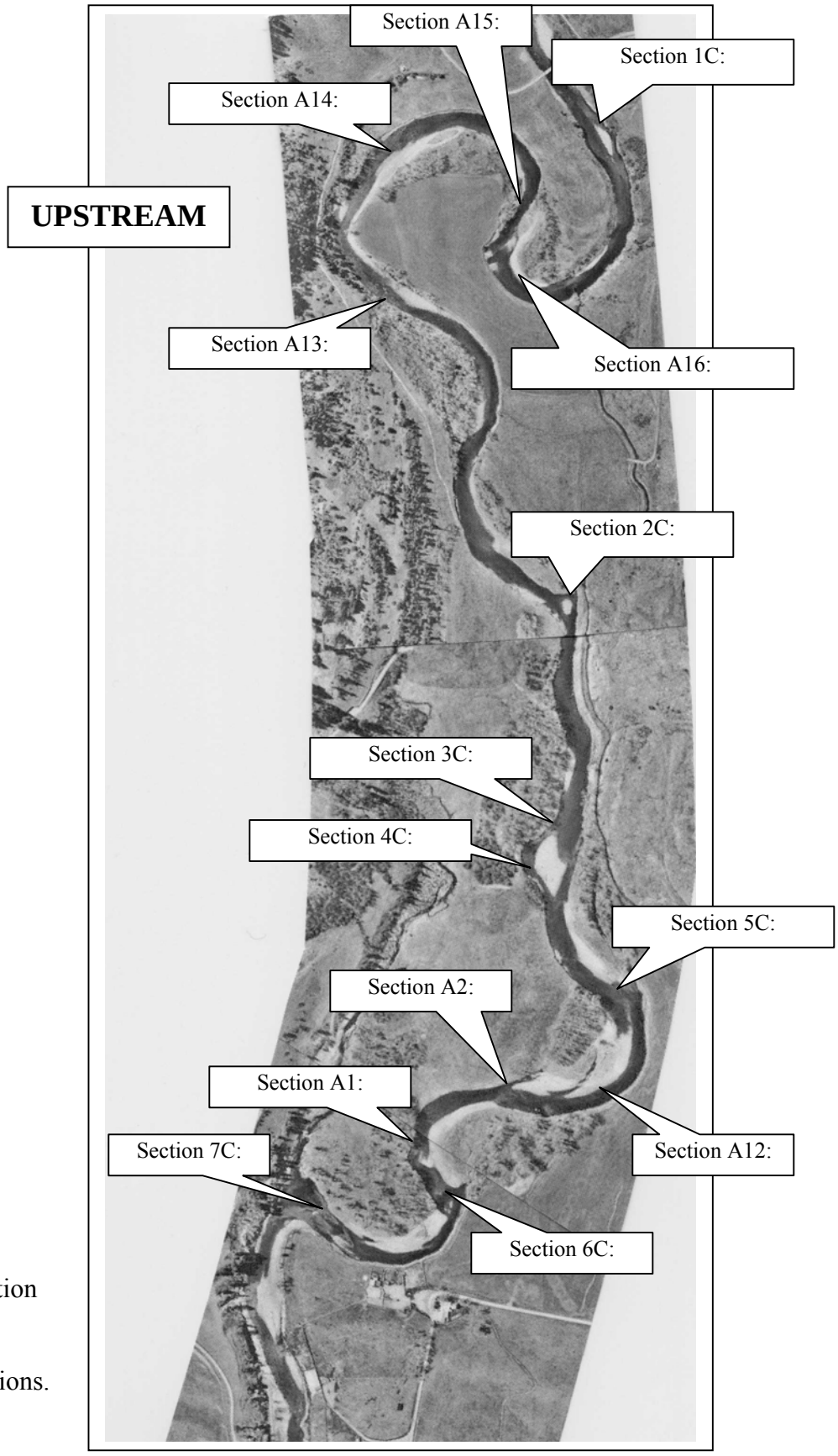

Figure 1. Upstream portion of the Beaver Meadows Ranch, Boulder River, showing spawning locations.

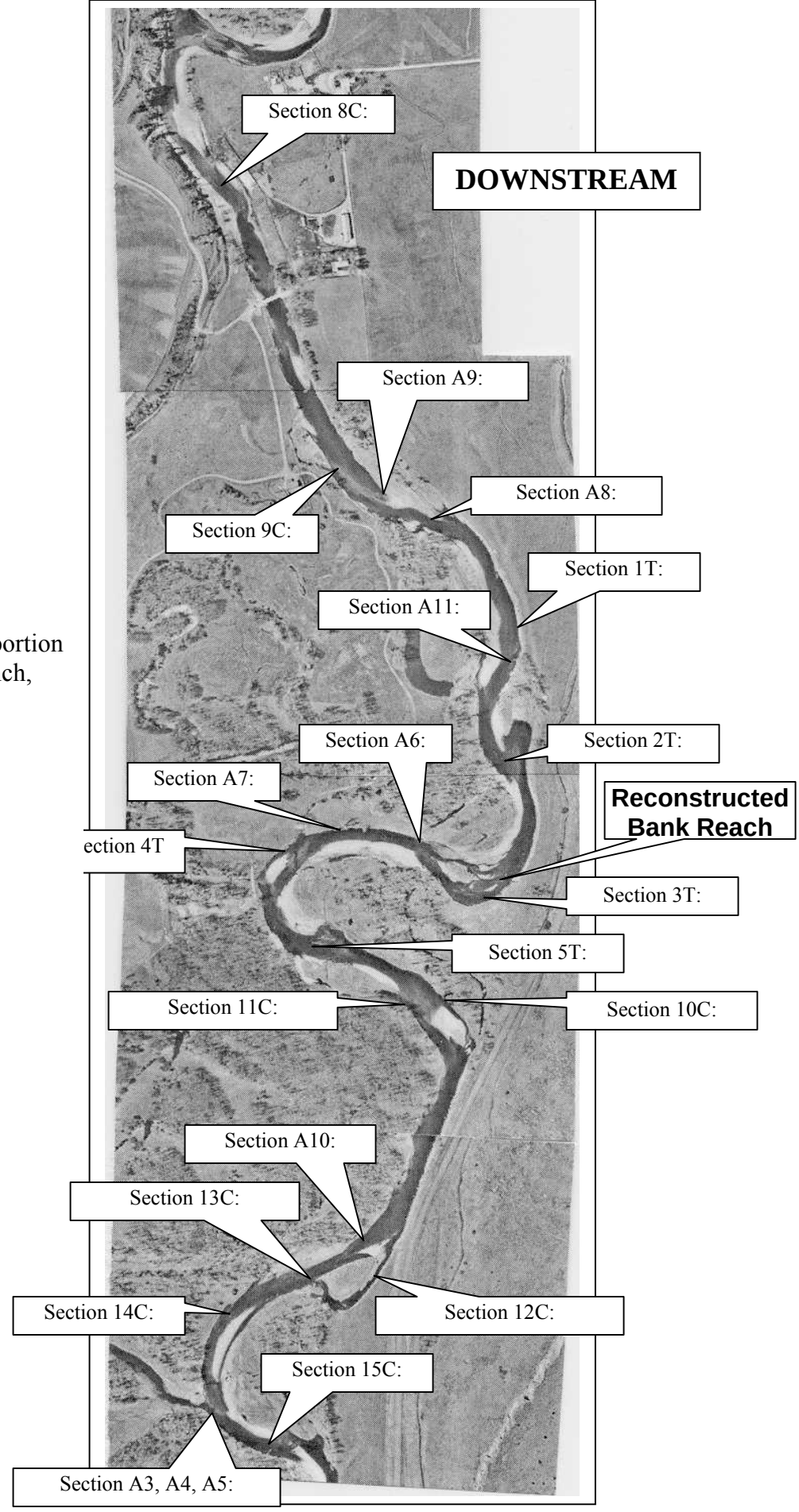

Figure 2. Downstream portion of Beaver Meadows Ranch, Boulder River, showing spawning areas.