

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: Montana PROJECT NO.: F-46-R-7
PROJECT TITLE: Statewide Fisheries Investigations JOB NO. I-G
STUDY TITLE: Survey and Inventory of Coldwater Streams
JOB TITLE: Northcentral Montana Coldwater Streams
PERIOD COVERED: July 1, 1993 through June 30, 1994

ABSTRACT

Pure westslope cutthroat trout were found in Badger Cabin Creek and upper Green Gulch. The self-sustaining population of grayling in the Sunny Slope Canal was sampled and analyzed genetically. Snorkel surveys were used to estimate trout populations in the forks of the Sun River. The North Fork has a population of 554 fish per mile while the South Fork has 425 fish per mile. Accumulative harvest of tagged fish is slightly over 3 percent for both forks. Rainbow trout population estimates in the Eagle Creek section were lower in 1993 than in 1991, while estimated numbers of rainbow trout remained steady in the Deep Creek section. Brown trout number and biomass estimates increased from 1992 levels in both sections we electrofished on the Smith River. Fall 1993 rainbow trout population estimates on the Missouri River were higher in the Craig section, but lower in the Hardy and Cascade sections than in 1992. Spring 1994 brown trout population estimates on the Craig, Hardy, and Cascade sections were obtained but not analyzed during the reporting period. A fishing pressure and harvest survey was conducted on two sections of the Missouri River from 15 June - 30 September 1992, which evaluated changes in use since 1986. Fishing pressure decreased by more than 30% in the Holter section but increased 77% in the Craig section between 1986 and 1992. Rainbow trout catch rates averaged 0.45 and 0.55 fish per hour in the Holter and Craig sections, respectively. Brown trout catch rates averaged 0.06 and 0.13 fish per hour in the Holter and Craig sections, respectively. Harvest of trout has decreased despite fishing pressure 1.8 times greater in 1992 than in 1986 on the Craig section. Sixty-eight projects under the Natural Streambed and Land Preservation Act and 27 projects under the Stream Preservation Act were reviewed.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. To establish viable trout fisheries in Marias River below Tiber Dam and in the Sun River below Diversion Dam for recreational fishing.

2. To ensure within hydrologic constraints, that flows in streams supporting trout populations do not fall below 1976-86 averages.
3. To maintain summer survival flow of at least 50 cfs in the Smith River at Camp Baker.
4. To maintain streambanks and channels in as natural a condition as possible. (State funded).
5. To maintain undisturbed riparian zones where they currently exist on Smith and Missouri Rivers. (State funded).
6. To maintain water quality at or above 1975-85 average levels as monitored at USGS stations.
7. To maintain habitat and species of special concern at present levels or better in streams affected by resource development activities. (State funded).
8. To ensure that mid-Missouri reservoir operations maintain a minimum flow of 4100 cfs 8 years out 10 in the Missouri River from Holter Dam to Ulm.
9. To evaluate contribution and influence of hatchery rainbow trout flushed from upstream reservoirs on wild trout fishery in Missouri River downstream of Holter Dam.
10. To increase rainbow and brown trout spawning habitat in three tributaries to the Missouri River from Holter Dam to Cascade. (State funded).
11. To maintain trout populations at or above 1984 levels in Tresch Section and 1978 levels in Burleigh Section of Big Spring Creek near Lewistown.
12. To provide 80,000 angler-days annually and average catch rate of 0.4 trout/hour in Missouri River between Holter Dam and Cascade.
13. To evaluate special slot-limit for trout on Smith River and modify regulations to balance angler harvest with population structure if warranted.
14. To maintain trout populations in Regional streams at present levels or higher.
15. To allow harvest of one trout over 12" in USFS streams along Rocky Mountain Front if compatible with stream fishery resources. (State funded).

16. To obtain at least two fishing access sites on the Sun River between the towns of Augusta and Sun River, and one each on the lower Dearborn River and upper Smith River. (State funded).

Progress was made on all federally funded objectives during the report period and is summarized in this report. Data for some state objectives is included to provide current information for regional streams.

PROCEDURES

Fish populations in the Choteau area were sampled by backpack shocker, hook and line, and snorkeling. Trout population estimates for the forks of the Sun River were made using the Petersen mark-recapture method (Ricker 1975). Floy tags were used to mark the trout; snorkelers visually observed fish for the recapture data. Grayling and cutthroat trout were collected for electrophoresis analysis by Dr. Robb Leary at the University of Montana, Genetics Laboratory.

Trout populations in the Smith River were surveyed using a fiberglass drift boat equipped with a mobile electrode powered by 240 volt generator. A Coffelt VVP-15 unit was used to rectify AC to straight DC. The Missouri River was electrofished at night using two aluminum jet boats. Both boats were equipped with headlights and fixed booms with stainless steel droppers suspended in front of the bow. Electricity from 240 volt portable generators was converted to pulsed or straight DC using Coffelt rectifying units. The only pulsed setting used was the Complex Pulse System (CPS). Rainbow and brown trout populations from the Smith River and the Missouri River were estimated using Chapman's modification of the Petersen mark-recapture method described by Vincent (1971) and Ricker (1975) or by the log-likelihood method which generates recapture efficiency curves for estimate production (MDFWP 1994). We analyzed mark-recapture and age data with a MDFWP computer program on an IBM-PC compatible microcomputer.

Fishing pressure estimates on the Missouri River were obtained from total angler counts completed on half the weekdays and half the weekend and holiday days in each month from 15 June - 30 September 1992. Counts of all boat and shore anglers were completed from selected shoreline vantage points. Only people actively fishing were counted; boat rowers were not included in the counts. The time of the first count on each census day was randomly selected hourly from 6:30 AM to 2:30 PM (less during shorter daylight hours) using a random numbers table. Subsequent counts on each sample day were made at three hour intervals. Weekday starting times were selected without replacement for two week periods while weekend and holiday starting times were selected without replacement on a monthly basis. Counts were considered instantaneous since a count

on each section typically required less than 45 minutes to complete (Neuhold and Lu 1957). Pressure and harvest estimates were derived using the MDFWP creel census program, which uses procedures and formulae from Neuhold and Lu (1957). Catch rates, catch composition, fishing techniques, angler and trip characteristics, and angler satisfaction were determined from direct angler interviews. These interviews were completed throughout the census area during the daylight hours. Interviewing was done between census counts and on days when counts were not completed. Creel clerks insured adequate numbers of boat anglers were interviewed by spending substantial amounts of time at the take-out boat ramps. During the interview process, harvested fish were measured to the nearest 0.1 inch. Computerized data files from the 1986 census were reviewed, so data from the same time periods could be used for precise comparisons between years.

Recommendations and alternatives for projects involving stream banks and channels were made through participation in the Stream Protection Act (SPA) and Natural Streambed and Land Preservation Act (SB310).

FINDINGS

Cutthroat Trout

Cooperative collections with the Forest Service were made of cutthroat trout from seven streams during the report period. Samples from Badger Cabin Creek and Green Gulch appear to be pure westslope cutthroat trout and should be treated as such (Leary 1993). Lost Shirt Creek, Rowe Creek, Sydney Creek and Unnamed Creek all show hybridization with rainbow trout. The North Fork of Ford Creek shows hybridization with rainbow and yellowstone cutthroat trout.

Grayling

A sample of 10 arctic grayling was collected in late March 1993 from the Sunny Slope Canal. Genetic testing indicates this population continues to lose genetic diversity. Leary (1994) feels that they may be getting into a precarious situation.

Arctic grayling are being considered for planting into Rock Creek in the Bob Marshall Wilderness. The stock will consist of progeny of Big Hole River grayling. According to a proposal, (Hill 1994), it is hoped that a self-sustaining population of fluvial grayling will establish and thereby expand the range and ensure its existence in Montana. A grayling fishery will also give wilderness users the opportunity to observe, catch and release a unique species, and will help distribute pressure within the wilderness. An earlier introduction of grayling in Rock Creek in 1983 failed,

possibly related to the fish being descendants of lake dwelling forms. A snorkel survey conducted in September of 1993 again produced negative results of the 1983 introduction.

Miscellaneous Streams

The following streams were inventoried to update or gather new information: South Fork Willow Creek, South Fork Teton River, Cutting Shed Coulee, Duck Creek and Muddy Creek (all in Teton County); Gates Creek and Falls Creek (Lewis & Clark County). The data is on file in the Choteau field office.

Sun River Drainage

Trout populations were sampled on the North and South Forks of the Sun River from August 2-4, 1993. During hook and line surveys, rainbow and cutthroat trout over eight inches were measured and tagged. Snorkel surveys later observed numbers of tagged and untagged fish. In the North Fork, 106 fish were tagged and released. The mean length of these fish was 11.7 inches (range 8.5-14.5). A total of 68 fish were tagged and released in the South Fork. They had a mean length of 12.0 inches (range 8.5-17.0). Approximately 50 percent of the fish sampled in both forks were over 12 inches. Trout populations were estimated at 554 and 425 fish per mile, respectively, for the North and South Fork. Examination of Figure 1 shows the fluctuations that have occurred in mean lengths from 1975-1993 and in population size from 1989-1993. A previous report, (Liknes et al. 1992), stated these fluctuations occur regardless of fishing regulations. Although population estimates were not made for years prior to 1989 in the South Fork and 1990 in the North Fork, similar fluctuations more than likely occurred. Population density appears to be inversely related to mean length. When numbers are highest, average size is lowest, and vice versa.

Although size and numbers fluctuate over a period of time, catch rates remain fairly stable. In recent years, the catch rate for the North Fork varied from 3.2 to 4.9 fish per hour. In 1993, the rate was 3.9 fish per hour. The South Fork catch rate has ranged from 1.3 in 1993 to 2.2 fish per hour in 1989.

During the 1993 season, anglers fishing the North Fork voluntarily reported harvesting four trout from fish tagged in 1993 (Table 1). They also released an additional four fish tagged in 1993. Accumulative harvest for 446 fish tagged from 1990-1993 from the North Fork is now 3.1%. Likewise, anglers on the South Fork reported harvesting four tagged fish, representing fish tagged in 1989, 1992 and 1993. Accumulative harvest on the South Fork is 3.3% of 459 fish tagged over a five-year period.

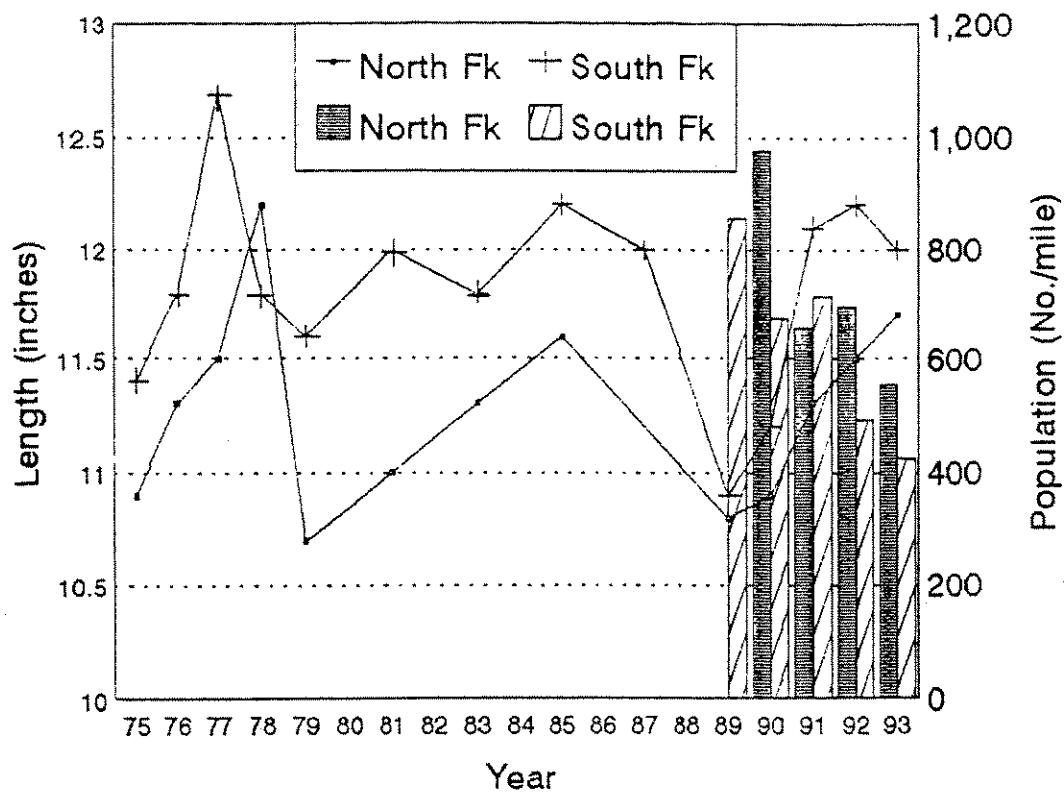


Fig. 1. Average length and population estimates of rainbow trout in the forks of the Sun River.

Table 1. Summary of tagged trout harvested and released by anglers from the forks of the Sun River, 1989-1993.

Stream	Tagging year	No. fish tagged	No. fish harvested					Accum. harvest(%)	No. fish released				
			1989	1990	1991	1992	1993		1989	1990	1991	1992	1993
N. Fork	1990	116	4	0	1	0		4.3		0	2	3	0
	1991	125		1	4	0		4.0			0	1	0
	1992	99				0	0	0.0				0	0
	1993	106					4	3.8					4
	Totals	446						3.1					
S. Fork	1989	95	0	0	0	0	1	1.1	0	0	0	0	0
	1990	88		1	4	0	0	5.7		0	6	1	0
	1991	110			1	3	0	3.6			2	0	0
	1992	98				2	2	4.1				5	0
	1993	68					1	1.5					0
	Totals	459						3.3					

Little or no movement was detected again in 1993. Of eight angler caught tagged fish in the North Fork, all but one were taken within the tagging section. The exception was a fish that moved midway into Gibson Reservoir. Similarly, of four angler caught tagged fish in the South Fork, three were taken within the section and one moved downstream to the confluence with the North Fork. It is interesting to note (Table 1) that fish tagged in 1989 and 1992 in the South Fork were caught by anglers in 1993 in the same area as in which they were tagged.

Figure 2 is a compilation of voluntary angler returns of tagged fish from both forks from 1990-1993. Data for the North Fork is based on 30 tag returns while the South Fork is based on 37 returns (includes fish that were released). This figure shows that the majority of the trout tagged in a given area tends to reside in that area. In both forks, there is some movement downstream to the confluence of these streams and into Gibson Reservoir. Only one fish moved down the South Fork and then upstream into the North Fork.

Smith River

The total population estimate in the Eagle Creek section was lower than estimate obtained in 1991. Numbers appeared to have dropped throughout all size ranges. The number of rainbow trout estimated in the Deep Creek section were less than in the upper section (Table 2), and remained steady since 1992. However, the biomass estimate decreased. Brown trout population and biomass estimates were higher in both sections than in fall 1992. Condition factors decreased for both species in both sections when compared to condition factors calculated in 1992. The Mid-Canyon section was not electrofished. Age data from the Smith River was not obtained or analyzed soon enough to be included in this report.

Missouri River

The estimated number of rainbow trout by length was 3,133, 1,720 and 1,303 per mile in the Craig, Hardy, and Cascade sections, respectively, during fall 1993 (Table 3). This represents a slight decrease in the Cascade section and an increase in the Craig section from the 1992 population estimates; this also represents the second highest estimate ever obtained in the Hardy Section. The highest was obtained last year. Fall brown trout population estimates obtained in 1993 in the Hardy and Cascade sections increased from last year (Table 3). Although the Craig point estimate declined from last year, the confidence intervals overlapped.

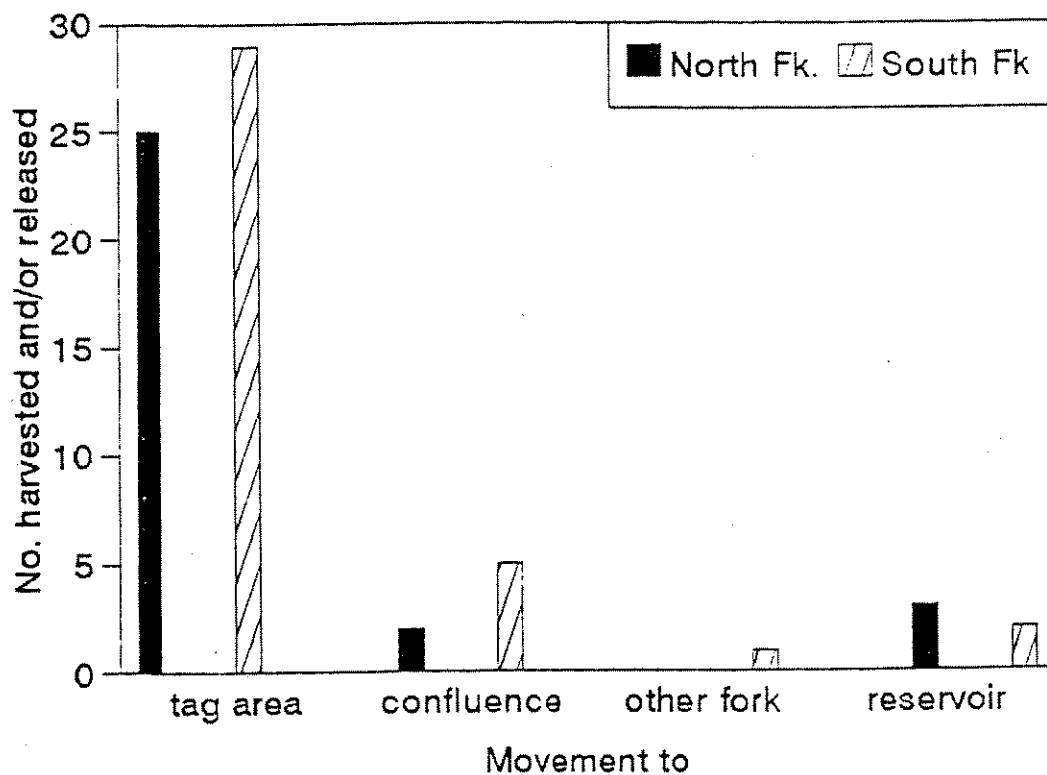


Fig. 2. Movement of tagged fish in the Sun River based on voluntary angler returns. (Accumulative returns, 1990-1993).

Table 2. Rainbow and brown trout population estimates by total size range in the Eagle Creek and Deep Creek sections of the Smith River, Montana during September 1993.

Section	Date marked	size range (inches)	Number per mile ¹	Pounds per mile	Ave.condition factor
Rainbow trout					
Eagle Creek	9/13/93	5.5-15.9	406	136	39.03
Deep Creek	9/17/93	6.0-14.9	165	79	37.82
Brown trout					
Eagle Creek	9/13/93	6.0-20.4	693	720	37.78
Deep Creek	9/09/93	6.5-20.9	466	390	38.12

¹ - estimates are calculated using Chapman's Modification of the Petersen method and MarkRecapture 2.1.

Table 3. Rainbow and brown trout population estimates by total size range in the Craig, Hardy, and Cascade sections of the Missouri River, Montana during fall 1993.

Section	Date marked	size range (inches)	Number per mile	Pounds per mile	Ave.condition factor
Rainbow trout					
Craig	10/05/93	5.0-21.4	3133±196	3269±509	41.81
Hardy	09/30/93	5.0-19.9	1720±93	1369±133	40.07
Cascade	10/07/93	5.0-20.4	1303±84	1093±96	39.98
Brown trout					
Craig	10/05/93	5.0-23.4	1042±103	1283±286	40.53
Hardy	09/30/93	5.0-23.9	514±91	839±322	38.71
Cascade	10/07/93	5.0-22.9	332±29	205±21	39.90

1 - estimates were calculated using MarkRecapture Version 4.0.

Spring 1994 brown trout estimates were obtained in all three sections, but the data has not been analyzed. Age data from the Missouri River was not obtained and analyzed soon enough to be included in this report.

1992 Missouri River Creel Census

A fishing pressure and harvest survey was conducted on two sections of the Missouri River from 15 June - 30 September 1992. The Holter section, 2.5 miles long, extended from immediately below Holter Dam to the first bridge downstream, which will be referred to as Wolf Creek Bridge. The Craig section began at Wolf Creek Bridge and extended downstream 5.6 miles to the Craig Bridge. The census evaluated changes since 1986, when a similar census was completed in the same area (Leathe and Hill 1987). Also, angler satisfaction was characterized and perceived management problems with the fishery from Holter Dam to Cascade were identified.

Fishing Pressure

The distribution of fishing pressure changed substantially between 1986 and 1992; fishing pressure in the Holter section declined by more than 30%. However, a 77% increase in pressure was observed in the Craig section between the two censuses. Consequently, total fishing pressure was almost twice as high in the Craig as in the Holter section in 1992 (Tables 1 and 2). In 1986, fishing pressure

was highest in the Holter section (Tables 1 and 2). The decrease in the Holter section was due to large declines in the number of shore anglers; boat pressure was similar in 1992 and 1986. In the Craig section, shore and boat angler estimates increased by 72% and 82% respectively, between 1986 and 1992. In the Craig section, angler pressure was elevated during all months of the survey in 1992, but pressure more than doubled in June and July (Table 2). July was the busiest month in both sections. In the Holter section the greatest number of anglers observed during a single count was on 27 July; 30 shore and 3 boat anglers were counted. The largest number of anglers counted in the Craig section was 49 on July 15 which included 19 boats and 3 float tubes. The greatest count of boats, which was 39, was recorded on 1 August in the Craig section. It should be noted that both July 15 and 27 were weekdays. In 1986 the highest number of anglers counted were 39 and 30 in the Holter and Craig sections, respectively (Leathe and Hill 1987). In 1992, 7% and 18% of the boats seen in the Holter and Craig sections, respectively, were not fishing.

The total number of angler-hours from 15 June - 30 September 1992 was 42,033 or a total of 12,073 angler days. Pressure averaged 2,035 angler days per mile on the Holter section and 1,258 per mile on the Craig section. This compares with 11,149 angler-days in 1986, 2,917 per mile in the Holter section and 689 per mile in the Craig section.

Harvest and catch rates

Rainbow trout catch rates averaged 0.45 per hour in the Holter section and 0.55 per hour in the Craig section, which was almost identical to those calculated in 1986 (Tables 3 and 4). Additional creel surveys done in 1980, 1981 and 1987 in sections identical or very similar to those used in 1992 provide additional fishing trend information (Berg 1981; Berg 1982; Leathe and Hill 1987; Leathe et al. 1988) (Tables 3 and 4). The percent of boat interviews is shown, but due to sampling bias' (as discussed in Leathe and Hill 1987) these percentages may not reflect the actual numbers of boat anglers. In the Holter section rainbow trout catch rates ranged from 0.38 to 0.46 per hour and were lowest in 1987. In the Craig section catch rates have increased from 0.32 per hour in 1980 to 0.55 per hour in 1986 and 1992 (Tables 3 and 4). In 1992, rainbow catch rates were highest in June and lowest in September in both sections (Tables 5 and 6). Boat anglers on the Holter section had the highest catch rates, which were more than three times the catch rate of shore anglers in the Holter section and 1.7 times the average catch rate in the Craig section (Tables 5 and 6). This catch pattern differs from the one found in 1986 when catch rates were highest in June and September and lowest in August in the

Table 1. Fishing pressure estimates (angler-hours) by month for the Holter section of the Missouri River, Montana from 15 June - 30 September in 1986 and 1992.

Month	Year					
	1986			1992		
	Shore	Boat	Total	Shore	Boat	Total
June 15-30	3456	622	4079	2187	661	2848
July	7173	1518	8691	3946	2275	6221
August	3962	1358	5320	2468	826	3294
September	2184	538	2722	1428	353	1781
Total	16775	4036	20811	10030	4115	14145

Table 2. Fishing pressure estimates (angler-hours) by month for the Craig section of the Missouri River, Montana from 15 June - 30 September in 1986 and 1992.

Month	Year					
	1986			1992		
	Shore	Boat	Total	Shore	Boat	Total
June 15-30	582	1109	1691	1909	2613	4523
July	2230	3022	5252	5343	6771	12115
August	2457	3537	5994	2539	4604	7143
September	1386	1394	2780	1646	2461	4107
Total	6655	9062	15717	11438	16450	27888

Table 3. Number of anglers interviewed and catch information for the Holter section of the Missouri River, Montana during 1980, 1981, 1986, 1987 and 1992.

Survey dates	Year				
	1980	1981	1986	1987	1992
	April-October	April-November	6/15-9/30 ¹	4/5-9/20	6/15-9/30
Number of interviews	273	1374	587	570	297
Rainbow catch/hour	0.46	0.41	0.46	0.38	0.45
Percent Rainbow harvested	83	88	67	50	12
Brown trout catch/hour	0.01	0.01	0.01	0.02	0.06
Percent brown trout harvested	0 ²	-	50	50	0
Percent boat/tube interviews	15 ²	88 ²	10	7	24

1 - Actual survey dates were 5/1-10/15 but only data from 6/15-9/30 is shown for precise comparison with 1992 data.

2 - Data not available by section, percentage for entire reach Holter Dam to Smith River.

Table 4. Number of anglers interviewed and catch information for the Craig section of the Missouri River, Montana during 1980, 1981, 1986, 1987 and 1992.

	Year				
	1980	1981	1986	1987	1992
Survey dates	April-October	April-November	6/15-9/30 ¹	4/5-9/20	6/15-9/30
Number of interviews	239	581	469	683	464
Rainbow catch/hour	0.32	0.39	0.55	0.48	0.55
Percent rainbow harvested	66	62	18	27	6
Brown trout catch/hour	0.02	0.03	0.09	0.05	0.13
Percent brown trout harvested	100 ₂	33 ₂	12	20	1
Percent boat/tube interviews	15 ₂	88 ₂	68	30	57

1 - Actual survey dates were 5/1-10/15 but only data from 6/15-9/30 is shown for precise comparison with 1992 data.

2 - Data not available by section, percentage for entire reach Holter Dam to Smith River.

Table 5. Monthly comparisons of 1986 and 1992 rainbow trout catch rates in Holter section of the Missouri River, Montana. Number of anglers interviewed are in parenthesis.

Month	1986			1992		
	Shore	Boat	Combined	Shore	Boat	Combined
June (15-30)	0.55 (58)	0.69 (2)	0.55(60)	0.44(57)	1.50 (5)	0.56(62)
July	0.43(193)	0.38(17)	0.42(210)	0.20(63)	0.92(30)	0.43(93)
August	0.35(147)	0.42(31)	0.36(178)	0.23(62)	1.10(13)	0.39(75)
September	0.51(127)	0.94(12)	0.55(149)	0.32(49)	0.62(18)	0.37(67)
Total	0.44(525)	0.54(62)	0.46(587)	0.29(231)	0.92(66)	0.45(297)

Table 6. Monthly comparisons of 1986 and 1992 rainbow trout catch rates in Craig section of the Missouri River, Montana. Number of anglers interviewed are in parenthesis.

Month	1986			1992		
	Shore	Boat	Combined	Shore	Boat	Combined
June (15-30)	0.38 (8)	0.35 (15)	0.36 (23)	0.53(25)	0.75(20)	0.67 (45)
July	0.43(43)	0.56 (76)	0.53(119)	0.59(64)	0.64(84)	0.63(148)
August	0.45(59)	0.53(144)	0.52(203)	0.59(65)	0.48(60)	0.53(125)
September	0.58(42)	0.66 (82)	0.63(124)	0.49(67)	0.43(79)	0.46(146)
Total	0.47(152)	0.57(317)	0.55(469)	0.55(221)	0.54(243)	0.55(464)

Holter section and highest in September and lowest in June in the Craig section (Tables 5 and 6). Flow pattern differences between the two years likely contributed to this variation.

The most striking change in the fishing profile over the last 12 years has been dramatic declines in the percent of captured trout

harvested. In the early 1980's, 83-88% of rainbows caught were harvested in the Holter section. By 1992, that percentage had dropped to 12% for the Holter section (Table 3). During the same time period, harvest in the Craig section decreased from 66 to 6% of the catch (Table 4). The increasing predominance of catch-and-release fishing in the Missouri from Holter Dam to Craig, has resulted in rainbow harvest at about 21% of the level found in 1986. Estimated rainbow trout harvest declined from 6,928 to 844 (88%) in the Holter section (Table 7) and 1,836 to 1,040 or about 57% in the Craig section between 1986 and 1992 (Tables 7 and 8). In the Holter section the decline in harvest may be partially attributed to declines in fishing pressure. However, in the Craig section, harvest declined despite fishing pressure that was nearly 80% higher and catch rates that were similar to those found in 1986.

Rainbow trout measured in the Holter section during the 1992 creel averaged 15.6 inches and ranged from 12.8-18.7 inches (n=31). During 1986, harvested rainbow trout which were measured ranged from 7.7-19.2 inches and averaged 14.2 inches (n=322). Much of the 1986 trout harvest in the Holter section was attributed to hatchery fish from spill over Holter Dam (Leathe and Hill 1987), but abnormally low flow in 1992 would have prevented influx of many hatchery rainbow into this reach. In the Craig section, rainbow trout found in the creel averaged 14.8 inches and ranged from 9.4-18.5 inches (n=50) as compared with a 15.0 inch average and 10.8-19.7 inch (n=122) range found in 1986. Comparison of size and harvest data from the Craig section indicates that harvest of rainbow trout in the 12-14 inch range approached 14% of the population (Table 9). Harvest ranged from 2.3-7.6% for other sizes and averaged 7.0% of the population. Though pressure in the Craig section had increased 1.8 times between 1986 and 1992, 1992 harvest rates were less than half of the 15% harvest found by Leah and Hill (1987).

Catch rates for brown trout increased from 1980-1992 in both sections, but continued to remain much lower than rainbow catch in these reaches (Table 3 and 4). This is reasonable since the brown trout population was estimated at 435 per mile, about 15% of the rainbow population (Liknes and Hill 1993). Catch rates for brown trout in 1992 were the highest on record in both sections; 0.06 and 0.13 per hour in the Holter and Craig sections, respectively. As mentioned before for 1992, both 1986 and 1992 censuses showed that the Craig section had more than twice the overall brown trout catch rate of the Holter section (Tables 10 and 11). In 1992, brown trout catch rates were highest in June in the Craig section and highest in July and September in the Holter section (Tables 10 and 11). The catch rate for brown trout increased 6 fold in the Holter section and by about 44% in the Craig section between 1986 and 1992. In the Craig section, the brown trout population increased by 1.8 times during this period (Leathe and Hill 1987, Liknes and Hill 1993). Brown trout harvest has declined

Table 7. Monthly comparison of rainbow trout harvest estimates for the Holter section of the Missouri River, Montana from 15 June - 30 September in 1986 and 1992.

Month	Year					
	1986			1992		
	Shore	Boat	Total	Shore	Boat	Total
June 15-30	1522	424	1946	145	321	466
July	2293	575	2868	41	202	243
August	954	442	1396	89	0	89
September	513	205	718	45	0	45
Total	5282	1646	6928	321	522	844

Table 8. Monthly comparison of rainbow trout harvest estimates in the Craig section of the Missouri River, Montana from 15 June - 30 September, 1986 and 1992.

Month	Year					
	1986			1992		
	Shore	Boat	Total	Shore	Boat	Total
June 15-30	139	68	207	130	0	130
July	421	495	916	108	658	766
August	189	369	558	36	43	78
September	77	79	155	31	34	65
Total	826	1011	1836	305	735	1040

Table 9. Rainbow trout harvest from 15 June - 30 September 1992 compared to 1992 fall population estimates in the Craig section.

Length group (inches)	Percent of size in angler creel (N=50)	Estimated harvest	Estimated population size ¹	Percent harvested
9-12	6.0	62	2666	2.3
12-14	26.0	270	1954	13.8
14-16	36.0	274	4978	7.5
16-18	28.0	291	3836	7.6
>=18	4.0	42	1327	3.2
Total	100.0	1040	14762	7.0

¹ - unpublished data for rainbow >8"; total population = 16447 or 2937 per mile.

Table 10. Monthly comparison of 1986 and 1992 brown trout catch rates in the Holter section of the Missouri River, Montana. Number of anglers interviewed are in parenthesis.

Month	1986			1992		
	Shore	Boat	Combined	Shore	Boat	Combined
June (15-30)	0.01 (58)	0.00 (2)	0.01 (60)	0.05(57)	0.00 (5)	0.05(62)
July	0.01(193)	0.00(17)	0.01(210)	0.06(63)	0.13(30)	0.08(93)
August	0.01(147)	0.02(31)	0.01(178)	0.03(62)	0.08(13)	0.04(75)
September	0.04(127)	0.00(12)	0.03(149)	0.06(49)	0.18(18)	0.08(67)
Total	0.01(525)	0.01(62)	0.01(587)	0.05(231)	0.12(66)	0.06(297)

Table 11. Monthly comparison of 1986 and 1992 brown trout catch rates in Craig section of the Missouri River, Montana. Number of anglers interviewed are in parenthesis.

Month	1986			1992		
	Shore	Boat	Combined	Shore	Boat	Combined
June (15-30)	0.00 (8)	0.12 (15)	0.09(23)	0.19(25)	0.35(20)	0.29 (45)
July	0.05(43)	0.09 (76)	0.08(119)	0.15(64)	0.11(84)	0.12(148)
August	0.07(59)	0.08(144)	0.08(203)	0.19(65)	0.10(60)	0.14(125)
September	0.21(42)	0.10 (82)	0.12(124)	0.10(67)	0.06(79)	0.08(146)
Total	0.10(152)	0.09(317)	0.09(469)	0.15(221)	0.11(243)	0.13(464)

dramatically in the interim. In 1992, nearly all brown trout captured were released and total harvest of brown trout was estimated at only 28 fish (1%). This contrasts with 1986 when estimated harvest was 362 brown trout and constituted about 28% of the brown trout population in the Craig section (Leathe and Hill 1987). Special brown trout regulations, instituted in 1990, have forced harvest reductions. Brown trout only 22 inches or longer are legally harvestable and less than 1% of the brown trout population in the Craig section fit this criteria (unpublished data). Not one of the 3 brown trout measured during the survey was a legal fish, and the longest brown trout measured during the 1986 census was less than 20 inches.

Angler Characteristics and Satisfaction

Non-residents were the most frequently interviewed anglers in both sections. Their numbers increased substantially from approximately 30% of total anglers in 1986 to about 50% in 1992 (Table 12). Percentages of most other angler groups dropped from 1986-1992.

Table 12. Comparisons between angler residency and other angler characteristics in the Holter and Craig sections of the Missouri River, Montana from 15 June - 30 September in 1986 and 1992.

	<u>Holter</u>		<u>Craig</u>	
	1986	1992	1986	1992
Number interviewed	587	297	469	464
<u>Residency (Percent of total)</u>				
Cascade Co.	44	26	17	10
Lewis & Clark Co.	12	15	28	18
Other Montana	14	9	19	14
Non-resident	29	48	34	54
Foreign	<u>1</u>	<u>1</u>	<u>1</u>	<u>4</u>
Total	100	99	99	100
Percent of anglers guided	1	9	14	15
<u>Percent of total interviews that were:</u>				
boat interviews	10	22	68	52
tube interviews	0	2	0	6
<u>Hours per completed fishing trip (N):</u>				
Shore anglers	2.8(52)	2.7(45)	3.1(44)	3.1(87)
Boat/tube anglers	3.7(30)	3.0(47)	5.3(246)	4.9(203)
All anglers	3.1(82)	2.9(92)	5.0(290)	4.4(290)

dropped from 44-26% of total use in the Holter section and from 17-10% in the Craig section. In the Holter section this decrease reflects a true loss in numbers of Cascade County anglers, since fishing pressure dropped between 1992 and 1986. Lewis and Clark County anglers in the Holter Section were the only group of residents that showed an increase from 1986 to 1992; they increased 3%.

The percentage of guided anglers was 9 and 15% in the Holter and Craig sections, respectively. This reflects an 8% increase in the Holter section but only a 1% rise in the Craig section since 1986 (Table 12). Eighty and nearly one hundred percent of the guided anglers used boats in the Holter and Craig sections, respectively. Their catch rates were slightly lower than those of the average boat angler. Nearly 100% of guided anglers used flies (95 of 97 interviews). Float tubes were a new phenomena on the river and were used by 6% of the anglers interviewed in the Craig section. As we would expect, a large majority of anglers were fishing for trout in both 1986 and 1992. In the Holter section, 82% in 1986

and 90% in 1992 were trout fishermen while in the Craig section, the percentage varied from 95-97%. Most of the remainder were targeting any species. Less than one percent were specifically seeking whitefish or walleye.

Average trip length on the shorter Holter section was less than in the Craig section during both years. Trip length declined in both sections between 1992 and 1986. Anglers tended to fish the area regularly; the average number of days fished in 1991 between Holter Dam and Cascade was 11.5 and 8.5 days for Holter and Craig section anglers, respectively. The number of days fished in 1992 was slightly less; by September it averaged 8.0 and 7.8 days for Holter and Craig anglers, respectively.

The recent popularity of fly fishing was exemplified by the type of anglers found on the Missouri River. Fly fishermen dominated both reaches. Fly fishing increased by over 100% in the Holter section from 1986-1992, and the percentage of anglers using flies on the Craig section increased from 70% in 1986 to 86% in 1992 (Tables 13 and 14). Fly fishers had high capture rates, but kept far fewer trout than other anglers. Lure, bait and combination fisherman kept at least 47% of the trout captured, in contrast to fly fishers which kept 1-2%. Success of bait and combo anglers varied from 0.02-0.63 rainbows/hour (Tables 13 and 14). Combination anglers had the poorest success.

From 21 June - 29 September 1992, anglers were asked to rate their satisfaction with the number and size of fish they caught that day. In the Holter section, 40% of the anglers rated their trip as satisfactory or very satisfactory (Tables 15 and 16). Satisfaction was higher in the Craig section with 61% rating their trip as satisfactory or very satisfactory (Tables 15 and 16). As expected, angler satisfaction increased greatly when trout were caught. When at least 3 trout were caught, a minimum of 89% of anglers were satisfied or very satisfied. Some anglers were somewhat satisfied and most had no strong opinion even when they did not catch a single trout (Table 15). Satisfaction varied greatly with angler origin. Cascade County anglers were the most dissatisfied with only 3% and 12% very satisfied in the Holter and Craig sections. With the exception of foreign anglers in the Holter section (N=3) over 20% of each of the other groups were very satisfied (Table 16). The large decline in Cascade County anglers in the Holter section (Table 12) reflects this dissatisfaction. The Cascade county angler differed from the average angler on this reach; seventy-four percent of the Cascade County anglers used bait or combination gear in contrast to a 23% use of this gear by other groups; this may be the basis for their discontent.

Anglers were asked what they felt were the major problems (if any) on the Missouri River between Holter Dam and Cascade. Sixty-five percent of the anglers saw no major problems with the fishery (Table 17). Motorboats were most commonly criticized with 14% and

Table 13. Comparison between 1986 and 1992 catch and harvest of rainbow trout by fishing method on the Holter reach of the Missouri River, Montana from 15 June - 30 September.

Fishing method	1986			1992		
	Number of interviews(%)	Catch per hour	Percent kept	Number of interviews(%)	Catch per hour	Percent kept
Lures	46 (8)	0.40	51	7 (2)	0.00	0
Flies	140 (24)	0.55	40	155 (52)	0.63	1
Bait	365 (62)	0.47	80	109 (37)	0.29	51
Combo	36 (6)	0.16	83	24 (8)	0.02	50
Total	587(100)	0.46	67	295	0.45	12

Table 14. Comparison between 1986 and 1992 of catch and harvest of rainbow trout by fishing method on the Craig reach of the Missouri River, Montana from 15 June - 30 September.

Fishing method	1986			1992		
	Number of interviews(%)	Catch per hour	Percent kept	Number of interviews(%)	Catch per hour	Percent kept
Lures	57 (12)	0.39	62	23 (5)	0.36	80
Flies	326 (70)	0.63	10	398 (86)	0.56	2
Bait	64 (14)	0.32	80	24 (5)	0.63	62
Combo	22 (5)	0.18	83	19 (4)	0.26	47
Total	469(101)	0.55	18	464(100)	0.55	6

Table 15. Angler satisfaction with catch from 21 June - 29 September 1992, based on section fished and number of trout caught.

Section	Number of trout caught	Number of anglers surveyed (%)	Percent satisfaction ¹				
			1	2	3	4	5
Holter	0	166 (59)	1	8	59	13	18
	1-2	70 (25)	23	54	3	18	1
	3-4	18 (6)	72	22	0	6	0
	5-10	20 (7)	65	35	0	0	0
	>10	5 (2)	100	0	0	0	0
	Total	279	18	22	36	13	11
Craig	0	158 (34)	2	12	52	16	17
	1-2	126 (27)	21	57	6	12	3
	3-4	75 (16)	45	44	3	8	0
	5-10	60 (13)	63	33	2	2	0
	>10	27 (4)	63	37	0	0	0
	Total	446	27	34	21	11	7

¹ - 1 = very satisfied, 2 somewhat satisfied, 3 = no strong opinion, 4 = somewhat dissatisfied, 5 = very dissatisfied

Table 16. Angler satisfaction with catch from 21 June - 29 September 1992, based on section fished and angler origin.

Section	Angler origin	Number of anglers surveyed (%)	Percent satisfaction ¹				
			1	2	3	4	5
Holter	Cascade County	71 (25)	3	8	54	18	17
	Lewis & Clark County	44 (16)	23	18	36	4	18
	Other Montana	27 (10)	26	18	37	11	7
	Out-of-State	134 (48)	22	31	27	13	6
	Foreign	3 (1)	0	67	0	0	33
	Total	279	18	22	36	13	11
Craig	Cascade County	42 (9)	12	38	26	12	12
	Lewis and Clark County	83 (19)	23	25	30	13	8
	Other Montana	61 (14)	36	44	10	8	2
	Out-of-State	242 (54)	28	34	21	11	7
	Foreign	18 (4)	39	44	6	6	6
	Total	446	27	34	21	11	7

1 - 1 = very satisfied, 2 somewhat satisfied, 3 = no strong opinion,
4 = somewhat dissatisfied, 5 = very dissatisfied

10% complaining in the Holter and Craig sections. This was the only issue which had a complaint rate of at least 10%. Motorboats represented a fairly high percentage on the Holter section where during census counts, seventy of 249 boats (28%) were motorized. The percentage of motorboats on the Craig section was only 4% with 46 of 1176 boats motorized. Most motors were 15 horse power or less. The most commonly cited other problems concerned crowds, and too liberal fishing regulations; comments included statements such as it "should be catch and release" and "don't allow bait fishing." Limited complaints were heard concerning too many guides and outfitters (Table 17).

The surveys done in 1992 and 1986 used nearly identical methodologies to allow for precise comparison of trend information between the two years. Variation in river flow patterns in 1986 and 1992 surely influenced angler usage and catch rates. In 1986 flows peaked at 11,000 cfs on 15 June and were above 4,000 cfs throughout September. In 1992, discharge from Holter Dam remained near 3,000 cfs from June - September. The numbers of shore fisherman, the lack of hatchery rainbow trout flushed from Holter Reservoir, and the increased early summer catch rates were likely factors that had major impacts on use patterns in the study area. The most notable differences between years were the large increases in catch-and-release fishing, fly fishing, the number of out-of-state anglers, and increase in fishing pressure on the Craig section. Harvest of about 7% of rainbow trout population, 1,040 fish, suggests that special, more restrictive regulations would have little or no effect on the population. Documented harvest of brown trout was extremely low (about 1% of the population). This should ensure that even with illegal harvesting of brown trout, mortality from harvesting will have very little effect on the

Table 17. Summary of what Missouri River anglers mentioned most commonly as "major" problems with management of the Missouri River between Holter Dam and Cascade. Surveyed in the Holter and Craig sections from 21 June - 29 September 1992.

Area where surveyed	Holter N = 280	Craig N = 447
Comment	Number (%) ¹	Number (%)
No Comment	183 (65)	292 (65)
Too many motorboats	40 (14)	45 (10)
Too crowded	5 (2)	25 (6)
Should be catch and release	14 (5)	25 (6)
Shouldn't allow bait fishing	8 (3)	16 (4)
Too much "moss"/algae/aquatic plants	5 (2)	16 (4)
Too many guides/outfitters	0	13 (3)
Fishing regulations too liberal	6 (2)	12 (3)
Water level too low	12 (4)	11 (2)
Too many pelicans	10 (4)	6 (1)
Too many boats	1 (<1)	5 (1)
Too much litter	4 (1)	5 (1)
Inadequate enforcement	0	3 (1)
Not enough fish	4 (1)	3 (1)
Should be flies only	2 (1)	3 (1)
Too many float tubes	0	3 (1)

1 - Percentages not additive since multiple comments by individuals allowed.

population, and allow the population to expand up to a biological limit.

Hooking mortality increases levels of human-caused trout fatalities above harvest levels. Using catch rates and pressure estimates we estimated 16,093 rainbow trout and 4,093 brown trout were caught in the Craig section. Theoretically, almost every rainbow trout in the population could have been caught once and every brown trout caught 1.7 times. Assuming a 4% mortality rate during catch and release fly fishing (Wydoski 1980), an additional 644 rainbow and 164 brown trout would be killed. Including this hooking mortality with the harvest would increase total mortality of rainbow trout to 11% and brown trout mortality to 8% of the population on the Craig section. The 4% mortality rate for catch and release fishing is simply an assumption, since mortality rates vary greatly with

factors such as, gear type, water temperature, and trout size, strain or species (Wydoski 1980; Kerasote 1992). However, the increase in mortality rate was not large enough to have an impact on the populations.

Big Spring Creek

No sampling on Big Spring Creek occurred during this reporting period. Monitoring is scheduled for next year.

Habitat Protection

Alterations of streambeds or banks are handled through a permit process. The 1975 Natural Streambed and Land Preservation Act (310) involves the private sector while the Stream Preservation Act of 1963 (SPA) regulates government agencies' actions. A total of 58 projects that would alter streambeds or banks in coldwater streams were processed and logged under the 1975 Natural Streambed and Land Preservation Act (310) out of the Great Falls office, which combined with the 10 projects processed in the Choteau field office, totals 68. Thirty-seven of these projects were in Cascade County. The number of projects processed in Fergus County was unavailable and not included in this report. A total of 27 projects were reviewed on coldwater streams under the Stream Preservation Act of 1963 (SPA); twenty-five of these were processed through the Great Falls office. Site inspections were made on most but not all of the "310" and SPA projects. No significant water discharge permit applications or renewals were received and no significant pollution complaints were received during the report period.

DISCUSSION AND RECOMMENDATIONS

Sampling of trout populations in the forks of the Sun River show that various parameters fluctuate from year to year. Mean length and population size appear to be inversely related. It is recommended to continue sampling efforts on these waters to monitor any changes. It is also recommended to determine whether or not the populations in the forks are migratory.

Cooperative studies with the Forest Service should continue in documenting streams containing pure westslope cutthroat trout. The success/failure of establishing grayling in Rock Creek should be monitored. Additional grayling from the Sunny Slope Canal should be collected and analyzed to determine genetic diversity.

Monitoring of the Eagle and Deep Creek sections on the Smith River will continue. In addition, monitoring of water temperatures and other physical parameters should be implemented if cheap, low maintenance, dependable equipment can be obtained. Population

levels in both sections of Big Spring Creek should be continued to be monitored on at least an every other year basis. Two sections on the Missouri River will be electrofished to obtain population estimates.

The substantial increase in fishing pressure on the Craig section where pressure increased 1.8 times in 6 years was particularly interesting. Use on the Missouri from Holter Dam to Craig should continue to be periodically monitored so potential future crowding problems or changes in the fishery would be detected and management adjusted accordingly.

Stream preservation activities should continue to be processed as they occur.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of several individuals in completing work on this project. Paul Hamlin, Kelly Smith and Troy Humphrey assisted in both field and office activities. Howard Johnson, Dave Yerk, George Anderson, Rick Bryant, Jimmy Forrest, Matt Baxter, Randy Rodencal, and James Bond assisted in collecting field data. Kandi Epps collected field data for the Missouri River creel census. The following Forest Service personnel assisted in collecting cutthroat specimens: Portia Jelinek, Ben Graham, Caroline Fine, Seth Diamond and Pat Finnegan. Dr. Robb Leary (U of M) conducted labwork for testing of genetic purity of westslope cutthroat trout.

LITERATURE CITED

- Berg, R.K. 1981. Middle Missouri River planning project. Montana Department of Fish, Wildlife and Parks. Job Progress Report. Project FW-3-R-9, Job 1-a. Helena, Montana.
- Berg, R.K. 1982. Middle Missouri River planning project. Montana Department of Fish, Wildlife and Parks. Job Progress Report. Project FW-3-R-10, Job 1-a. Helena, Montana.
- Hill, William J. 1994. Proposal to stock arctic grayling in Rock Creek. Montana Department of Fish, Wildlife and Parks. Helena. 2 pp.
- Kerasote, T. 1992. Catch and release: is it working. Sports Afield. March 1992:19-21
- Leary, Robb. 1993. Personal communication. (Reports of electrophoretic analysis). Univ. of Montana. Division of Biological Sciences.

- Leary, Robb. 1994. Personal communication. (Reports of electrophoretic analysis). Univ. of Montana. Division of Biological Sciences.
- Leathe, S.A. and W.J. Hill. 1987. Northcentral Montana fisheries study-inventory and survey of cold water fish populations in rivers and streams. Montana Department of Fish, Wildlife and Parks, Job Progress Report, Project F-5-R-36, Job II. Helena, Montana.
- Leathe, S.A., W.J. Hill and A. Wipperman. 1988. Northcentral Montana fisheries trout stream investigations. Montana Department of Fish, Wildlife and Parks, Job Progress Report, Project F-46-R-1, Job I-q. Helena, Montana.
- Liknes, G. A., W.J. Hill and S. A. Leather. 1992. Survey and inventory of coldwater streams. Montana Department of Fish, Wildlife and Parks. Job Progress Report, F-46-R-5, Job No. I-G. Helena. 12 pp.
- Liknes, G.A. and W.J. Hill. 1993. Statewide Fisheries Investigations. Survey and Inventory of Coldwater streams. Northcentral Montana coldwater streams. Montana Department of Fish, Wildlife and Parks, Job Progress Report, Project F-46-R-6, Job I-G. Helena, Montana.
- Montana Department of Fish, Wildlife, and Parks. 1994. MarkRecapture Version 4.0. A software package for fishery population estimates. Montana Department of Fish, Wildlife, and Parks. Helena. 45 pp.
- Neuhold, J. M. and K. H. Lu. 1957. Creel census method. Publication No. 8 of the Utah Dept. of Fish and Game. Salt Lake City, Utah.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191.
- Vincent, E.R. 1971. River electrofishing and fish population estimates. Progressive Fish Culturist 33(3):163-169.
- Wydoski, R.S. 1980. Relation of hooking mortality and sublethal hooking stress to quality fishery management. Pages 48-87 in R.A. Barnhart and T.D. Roelofs, editors. Catch-and-release fishing as a management tool. California Cooperative Fishery Research Unit, Humboldt State University.

Prepared by: Anne Tews, George A. Liknes and William J. Hill

Date: September 1994

Principal Fish Species Involved: Rainbow trout, cutthroat trout, grayling, brown trout, brook trout.

Code Numbers of Waters Referred to in Report:

14-0065	Badger Cabin Creek
14-2240	Green Gulch
14-3200	Lost Shirt Creek
14-	Rowe Creek
14-5080	Sidney Creek
14-5640	So. Fk. Teton River
14-5690	So. Fk. Willow Creek
14-	Unnamed Creek
16-0310	Big Spring Creek, Sec. 2
17-2064	Dearborn River
17-2688	Falls Creek
17-4896	Missouri River Section 09
17-6832	Smith River Section 02
20-0750	Muddy Creek
20-	Cutting Shed Coulee
20-1800	Duck Creek
20-2350	Gates Creek
20-4400	No. Fk. Sun River
20-5100	Rock Creek
20-5600	So. Fk. Sun River
20-6110	Sunny Slope Canal

rpt3411.93