F-78-R-1
Region 4

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

STATE: Montana PROJECT NO.: F-78-R-1
PROJECT TITLE: Statewide Fisheries Investigations
JOB TITLE: Northcentral Montana Coldwater Streams
PERIOD COVERED: July 1, 1994 through June 30, 1995

ABSTRACT

Cutthroat trout were collected for genetic testing from five streams along the Rocky Mountain Front and five streams in the Judith drainage. Trout populations in the forks of the Sun River were estimated by snorkeling and observing tagged fish. The North Fork population was similar to 1993 at 554 fish per mile while the South Fork increased from 425 fish per mile in 1993 to 571 fish per mile in 1994. The Tiber Dam tailwater trout fishery in the Marias River was evaluated during the reporting period. Population improvements have been anticipated since the Bureau of Reclamation began providing recommended instream flows in 1985. The estimated rainbow trout standing crop was 103 fish per mile, 420% greater than the five year average. The increase of rainbow trout largely resulted from a strong yearling age class. Fall and spring stocking of fingerling and advanced-fingerling rainbow trout did not appear to contribute directly to the population of yearling rainbow trout. Population estimates of rainbow trout 10 inches and larger in two sections of Big Spring Creek declined from 1992 levels. Brown trout declined in the Tresch section but increased in the Burleigh section. Trout populations were about four times higher in the Tresch section than in the Burleigh section. Population estimates on Big Spring Creek from 1967-1994 were summarized. Rainbow trout and mountain whitefish populations were similar to those found in 1987 on the South Fork Judith River. A population estimate was completed on Dry Wolf Creek. On the Smith River, population estimates of rainbow trout ≥10 inches increased from historic low levels in 1993 to 166 per mile in 1994 on the Eagle Creek section. In the Deep Creek section, the number of rainbow trout ≥10 inches was similar in 1993 and 1994. Brown trout numbers were steady in the Eagle Creek section for fish ≥10 inches, while in the Deep Creek section, numbers showed a pronounced decrease. Biomass estimates of brown trout decreased from 1993 levels in both sections on the Smith River. Fall 1994 rainbow trout population estimates on the Missouri River were within the normal historical range and were higher in the Craig and Cascade sections than in 1993. Spring brown trout population estimates on the Craig and Cascade sections showed an increase in the resident population over the last three years. Sampling for the parasite that causes whirling disease in Big Spring Creek, the Missouri River, and the Smith

River showed no sign of the protozoan in any fish from these waters. Approximately 146 projects were reviewed under the Natural Streambed and Land Preservation Act while another 33 projects were reviewed under the Stream Preservation Act.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. To identify and monitor the characteristics and trends of fish populations, angler harvest and preferences, habitat conditions in northcentral Montana coldwater stream ecosystems.

2. Use survey and inventory information to identify management problems and opportunities, then develop and implement management actions to maintain fish populations at levels consistent with habitat conditions or other limiting factors.

3. Review projects proposed by state, federal, and local agencies and private parties which have the potential to affect fisheries resources and aquatic habitats. Provide technical advice or decisions to reduce or mitigate resource damage.

4. Provide landowners and other private parties with technical advice and information to sustain and enhance fisheries resources and aquatic habitat.

5. Enhance public understanding and awareness of fishery and aquatic habitat resources and issues in northcentral Montana through oral and written communication.

6. Maintain and enhance public access to fishery resources in northcentral Montana.

7. To enhance trout populations and trout fishing opportunity in Marias River immediately downstream from Tiber Dam.

PROCEDURES

Fish populations in the Choteau area were sampled using an aluminum jet boat with fixed booms, a backpack shocker, hook and line, and snorkeling. Trout populations in the forks of the Sun River were estimated using the Petersen mark-recapture method (Ricker 1975). Floy tags were used to mark the trout and snorkelers visually observed fish for the recapture data. Cutthroat trout were collected for electrophoretic analysis at the University of Montana by Dr. Robb Leary.

The electroshocking system used on the Marias River to capture trout and whitefish was adapted from Novotny and Priegal (1974). The electroshocking apparatus was a boom-type mounted on a 14-foot aluminum driftboat powered with a 10 hp outboard motor. Power was supplied by a 4000-watt AC generator. A Coffelt Model VVP-10 rectifying unit produced continuous direct current. Two circular hoops, each with twelve 16-inch stainless steel droppers, comprised the positive electrode, which was supported six feet in front of the boat. The hull of the boat served as the negative. Output was typically 2-5 amps, 100-215 volts and a continuous direct current wave form. Chapman's modification of the Petersen mark/recapture method (Ricker 1975) was used to estimate trout populations in the Marias River:

$$N = \frac{(M+1)(C+1)}{(R+1)}$$

where:

N = population estimate
M = number of marked fish
C = number of fish in the recapture sample
R = number of marked fish in the recapture sample

Trout populations on Big Spring Creek were surveyed using a fiberglass drift boat equipped with a mobile electrode and Coffelt VVP-15 to rectify AC to continuous DC. Power was obtained from a 240 volt generator. Collection of fish for whirling disease sampling from Big Spring Creek and other stream population surveys were done with a backpack electrofishing unit equipped with a Honda generator and a Coffelt Mark 10 rectifying unit which converted AC to pulsed DC. The type of pulsed DC used was either complex pulse system (CPS) or 30 hertz. Big Spring Creek mark-recapture estimates of trout ≥5 inches were analyzed with the Mark Recapture Version 4.01 computer program utilizing the log-likelihood method (MDFWP 1994). A two pass electrofishing estimate was calculated on the South Fork of the Judith River using Seber's formula (Leathe 1983). A three pass electrofishing estimate was performed on Dry Wolf Creek; the POPCALC program was used to analyze the data (Jeff Hutten, MFWP, personal communication). Floy tags and adipose clips were used to mark rainbow trout planted in the Judith River. Periodic creel surveys were done on the South Fork Judith River.

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 the log-likelihood method which generates recapture efficiency curves for estimate production (MDFWP 1994). We analyzed mark-recapture and age data with a MFWP computer program on an IBM-PC compatible microcomputer.

The heads collected from rainbow trout in Big Spring Creek to determine the presence of the protozoan that produces whirling disease were cut transversely. One half of the head was frozen and sent to the USFWS lab at Fort Morgan, Colorado for analysis. The second half was preserved in Davidson's solution. Initial sampling on the Smith and Missouri rivers was handled using the same procedure as on Big Spring Creek, except that isopropyl alcohol was the preservative used. However, for later samples, whole heads were frozen and sent to Washington State University for analysis.

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

Choteau Area

Westslope Cutthroat Trout

Westslope cutthroat trout from five streams in the Choteau area were collected in cooperation with Forest Service staff. Streams sampled include Rierdon Gulch, East Fork Woods Creek, Whiterock Creek, Green Gulch, Falls Creek, and Lime Gulch. Electrophoretic test results to determine the genetic purity of the populations have not been completed.

Arctic Grayling

A Montana State University - Bozeman graduate project was initiated in spring 1994 to determine the life history of Arctic grayling in the Sunny Slope Canal. Assistance was occasionally given in the form of manpower and/or equipment. The study will conclude in spring 1996.

Sun River

Both the North and South Forks of the Sun River were electrofished and trap netted near the confluence at the upper

end of Gibson Reservoir on 14-15 June 1994. A total of 208 rainbow or cutthroat trout were tagged and released in an effort to assess harvest and movement. Fish tagged ranged in length from 8.7-15.5 inches (average=11.6 inches). Weight ranged from 0.21-1.26 lb (average=0.51 lb). We presume the majority of the fish captured were residents of Gibson Reservoir and moved into the confluence area to spawn. Most females observed were spent, suggesting spawning was nearly complete. We were unable to determine sex of the other fish handled.

Annual trout population monitoring on the North and South Forks of the Sun River was conducted from 24-28 July 1994. During hook and line surveys, rainbow and cutthroat trout >8 inches were measured and tagged. Snorkel surveys later observed numbers of tagged and untagged fish. A total of 111 fish were tagged and released in the North Fork; the mean length of the fish was 11.3 inches (range=8.0-19.0 inches). Ninety five fish were tagged and released in the South Fork, where the mean length was 12.1 inches (range=8.4-17.0 inches). Trout populations were estimated at 554 and 571 fish per mile for the North and South Forks, respectively. The North Fork population remained the same as 1993, while a significant increase occurred in the South Fork. Fluctuations have been noted in mean lengths and in population size (Figure 1).

Six fish tagged at the confluence in 1994 were reported caught by anglers. Anglers kept three, resulting in a reported harvest rate of 1.4%. Two of the fish recaptured had moved upstream in the South Fork, two moved upstream in the North Fork, and two were caught in Gibson Reservoir.

In the North Fork, anglers and fisheries crews caught ten and three tagged fish, respectively; this represented fish tagged in all years from 1991-1994. Anglers kept three of the tagged fish. Accumulative harvest for 557 fish tagged since 1990 is now 3.1% (Table 1). Ten of the tagged trout were taken in the general vicinity of the snorkel section, suggesting that they are resident fish. Two fish had moved downstream into Gibson Reservoir, while one was caught in the river below Gibson Dam.

In the South Fork, anglers and fisheries crews reported catching a total of nine tagged trout (five by anglers). Anglers kept two tagged trout (Table 1). Accumulative harvest of 554 fish tagged since 1989 is also 3.1%. Returns in 1994 represent fish tagged in 1989, 1992, and 1993. A resident trout population is also suggested in the South Fork as evidenced by eight tagged fish taken in or close to the snorkel section. One tagged fish was taken at the confluence of the North and South forks.

Scale analysis of trout taken at the confluence and both forks indicates that the majority were two to four years old (Tables 2-4). These age groups were represented by 10-13 inch fish.

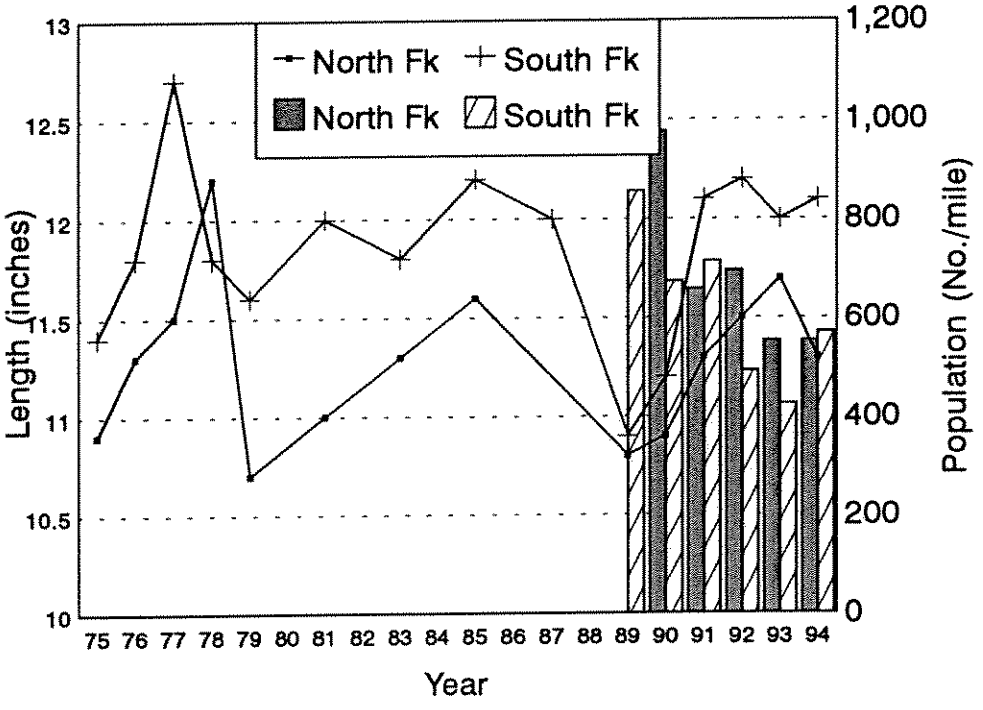

Figure 1. Average length (lines) from 1975-1994 and population estimates (vertical bars) from 1989-1994 of rainbow trout in the North and South Forks of the Sun River, Montana.

Table 1. Summary of tagged fish harvested or released by anglers from the Forks of the Sun River, 1989-1994.

	Tagging	No. fish	No. fish harvested						Accum.	No. fish released					
Stream	year	tagged	1989	1990	1991	1992	1993	1994	harvest(%)	1989	1990	1991	1992	1993	1994
No. Fork	1990	116		4	0	1	0	0	4.3		0	2	3	0	0
	1991	125			1	4	0	1	4.8			0	1	0	3
	1992	99				0	0	1	1.0				0	0	0
	1993	106					4	0	3.8					4	4
	1994	111						1	0.9						0
Totals		557							3.1						
So. Fork	1989	95	0	0	0	0	1	1	2.1	0	0	0	0	0	0
	1990	88		1	4	0	0	0	5.7		0	1	0	0	0
	1991	110			1	3	0	0	3.6			0	0	0	0
	1992	98				2	2	1	5.1				5	0	0
	1993	68					1	0	1.5					0	3
	1994	95						0	0.0						0
Totals		554							3.1						

Table 2. Age composition of rainbow and cutthroat trout at the confluence of the North and the South forks of Sun River, 1994.

		Number of fish per age group					
		Age of fish					
No. fish per length group	Length group(in)	1	2	3	4	5	6
2	4.0	2					
1	5.0	1					
0	6.0						
1	7.0		1				
3	8.0		3				
6	9.0		4	2			
26	10.0		12	13	1		
36	11.0		6	27	3		
24	12.0		1	5	16	1	1
11	13.0			2	6	2	1
1	14.0						1
1	15.0					1	
112	Totals	3	27	49	26	4	3

Table 3. Age composition of rainbow and cutthroat trout, North Fork Sun River, 1994.

		No. fish/age group				
		Age of fish				
No. fish per length group	Length group(in)	2	3	4	5	6
1	6.0	1				
2	7.0	2				
10	8.0	10				
6	9.0	6				
18	10.0	9	8	1		
23	11.0	5	18			
28	12.0	1	11	13	3	
9	13.0		1	5	3	
5	14.0			4		1
4	15.0			2	1	1
0	16-18					
1	19					1
107	Totals	34	38	25	7	3

Table 4. Age composition of rainbow and cutthroat trout, South Fork Sun River, 1994.

No. fish per length group	Length group(in)	No. fish/age group Age of fish 2	3	4	5	6	7
2	7.0	2					
2	8.0	2					
1	9.0	1					
14	10.0	12	2				
26	11.0	8	14	4			
23	12.0		10	12	1		
17	13.0		3	8	6		
2	14.0			2			
2	15.0			1		1	
2	16.0				1	1	
1	17.0						1
92	Totals	25	29	27	8	2	1

Catch rates (based on fisheries crews) continue to remain fairly stable. In recent years, the catch rate for the North Fork varied from 3.2-4.9 fish per hour. In 1994, the rate was 4.9 fish per hour. The South Fork catch rate has ranged from 1.3-2.2 fish per hour, with 1.4 fish per hour observed in 1994.

Table 1 is a collection of new data as well as corrected data from that which appeared in Tewes et al. (1994).

Marias River - Tiber Dam Tailwater

The Tiber Dam tailwater study area extends over a 21 mile reach of the Marias River from the dam to the Circle Bridge at Highway 223. Tiber Reservoir is a water storage reservoir with no hydroelectric power generation. Flows in the river downstream are completely controlled by discharges from the dam.

A trout fishery in the 21 mile reach of Marias River immediately below Tiber Dam is maintained by coldwater release. Prior to 1985 the coldwater fishery existed far below its potential because of inadequate instream flows and periodic surface warmwater releases from the dam (Gardner and Berg 1983). The Montana Fish Wildlife and Parks has recommended a minimum instream flow of 500 cfs be maintained in the river below Tiber Dam for the trout fishery.

The trout fishery had improved substantially from 1985-1988, probably in response to better flow and temperature conditions

(Gardner 1988). Field studies in 1987 showed marked improvements in trout numbers, sizes, and reproductive success. However, results from the 1988-94 surveys indicated that the trout populations had stabilized and did not continue to improve as anticipated.

Mountain whitefish, brown, and rainbow trout were processed during the population estimates (Table 5). Size statistics show that for all three species, 1994 means were lower than the 5 year averages. We attributed this to the relatively high numbers of yearling fish which dominated the catch for all three species. The 1994 trout standing crop estimates show that rainbow trout had high numbers of yearlings (Table 6). The 1994 yearling rainbow trout estimate (6.0-10.9 inches) was the greatest ever recorded and was 420% greater than the 5 year average. We believe that brown trout yearling numbers were also higher this year compared to the 5 year average. Unfortunately, a brown trout yearling estimate was not obtained since adequate numbers of marked fish were not captured in the recapture sample. However, based on the number of representatives in the mark and recapture samples (16 and 17, respectively) it is believed that yearling brown trout numbers were greater than 150, far exceeding the 5 year average of 28. The increased numbers of yearling rainbow trout were probably due to the successful spawning and rearing in the river the previous year. Although stocking of young-of-year and yearling rainbow trout occurred during this period, the lack of marked fish in the sample indicated natural reproduction produced the majority of the yearlings handled.

Both rainbow and brown trout numbers are less than the expected potential for this fishery. However, indications show the fishery is improving. In both 1993 and 1994, yearling rainbow and brown trout numbers substantially exceeded the 5-year averages. The increase in yearlings has changed the size distribution of the population. For example, in 1993, the year with higher numbers of yearling trout, the 12-14 inch group of rainbows comprised 9% of the total sample of adult fish compared to 65% in 1994. This was the result of the 1993 yearlings, now a year older, growing into the 12-14 inch group in 1994. Another two years will be needed before we can determine whether the trout fishery has improved satisfactorily.

In response to the declining rainbow trout population, a plan was developed in 1990 to stock the Marias River with hatchery-reared fingerling and yearling rainbows of Madison River origin. This action was taken to: 1) increase numbers of rainbow trout available to anglers, 2) possibly enhance natural reproduction by introducing rainbow from a population known to reproduce effectively by spawning in a mainstem river, and 3) determine whether or not survival of juvenile fish during the first year is a critical limiting factor. A total of 47,785 rainbow trout were stocked in this reach from 1990-94.

Table 5. Comparison of size statistics for mountain whitefish and trout sampled in the Marias River below Tiber Dam from 1988-94.

Year	Number	Mean length (in)	Mean weight (lb)	Mode (in)	Median (in)
Mountain whitefish					
5 yr Avg*	524	13.3	1.01	12	13.5
1993	100	13.3	1.01	14	14.5
1994	101	12.1	0.81	11	11.4
Rainbow trout					
5 yr Avg *	452	13.5	0.97	13	13.7
1993	103	11.1	0.61	8	8.9
1994	110	11.0	0.69	8	9.7
Brown trout					
5 yr Avg *	458	16.6	1.66	16	16.7
1993	68	14.6	1.32	8	17.5
1994	84	13.9	1.38	9	13.6

* - 5 year average for 1988-92

Table 6. Total standing crop estimate statistics of trout populations for a 4 mile reach of the Marias River below Tiber Dam from 1987- 1994.

Size group (in)	Total population estimate 1994	1993	5 Year Average *	Maximum	Minimum
Rainbow trout					
(6.0 - 10.9)	336	306	80	202	0
(11.0 - 20.4)	76	68	152	222	105
Brown trout					
(6.0 - 10.9)	**	55	28	50	0
(11.0 - 32.0)	64	99	158	200	105

* - the years 1987-92
** - no estimate could be made because no marked fish were found in the recapture sample

Stocking appeared to have provided little, if any, direct results that improved numbers of rainbow trout in the study reach. The yearling rainbow population in 1994 was estimated at 336 fish. A total of 62 yearlings were examined for marks. Only 10 yearlings (16%) had marks showing hatchery origin. A total of 24,000 rainbows previously stocked would have been yearlings during the time of the estimate. Using the 16% figure it is estimated that 54 hatchery yearlings, or 0.2%, remained in the study reach after stocking. For 1991, 1992, and 1993 the percent of stocked rainbows remaining in the study reach after the first year were >0.1, 0.4 and 0.5%.

Rainbow trout were stocked both as fingerlings (2.5 inch) and 9 month old (5.3 inch) fish. It was thought older fish would provide a better return rate in the study area. Results from the stocking evaluation for four years demonstrated that stocking success was very poor. Also, there was no advantage of stocking older, larger fish. The number of young rainbows does not appear to limit this population; however, other factors such as juvenile cover habitat or food may be limiting.

There has been an increase of yearling rainbow and brown trout numbers coinciding with the increased stocking of hatchery rainbow trout. Table 7 shows that following the last two years of heavy stocking, yearling rainbow numbers increased an average of 446% compared to that of 1992-93, the years when fewer hatchery fish were stocked. The estimate data for yearling brown trout is not complete enough for comparisons between years, but comparisons of total catch in the samples over the past 4 years show a similar trend as mentioned for yearling rainbows. A total of 5, 4, 21, and 33 fish were caught during 1991, 1992, 1993, and 1994 estimate samples, respectively. It is possible that the stocked fish provided a buffer for the wild fish, thereby decreasing the amount of predation that would have normally occurred on the naturally produced juvenile trout.

Lewistown Area

Big Spring Creek

Mark recapture estimates were made by electrofishing two sections of Big Spring Creek in August and September 1994. Aging of rainbow and brown trout scales from 1992 and 1994 was completed and is summarized in Tables 8-11. Ages have not been validated. Population estimates were rerun for Big Spring Creek data from 1967-1994 using MR4. Graphic representation of these estimates are shown in Figures 2 and 3. Appendix Tables 1-2 give statistics of population estimates in the Tresch and Burleigh sections from 1967-1994.

Table 7. Summary of rainbow trout stocking and success, and yearling rainbow trout estimates in the Marias River, Montana, downstream of Tiber Dam, 1990-94.

Date stocked	Number stocked	Mean length (in)	Date sampled	Yrlg Rb estimate	Number sampled	Number with marks			
						Ap[1/]	P2[2/]	CWT[3/]	Adt[4/]
9/90	5,085	2.8	9/91	48	18	1	-	-	-
10/91	4,400	2.7	8/92	24	7	5	-	-	0
10/92	4,300	2.8							
4/93	10,000	5.3	8/93	306	65	8	6	-	1
10/93	11,000	2.5							
5/94	13,000	5.3	8/94	336	62	5	-	5	2

1/ - yearling with adipose clip, stocked as a fingerling
2/ - yearling with pelvic clip, stocked as a 9-month-old
3/ - yearling with a coded wire mark, stocked as a 9-month-old
4/ - 2-year-old with an adipose clip, stocked as a fingerling

Table 8. Rainbow and brown trout population estimates by age class, calculated using the log-likelihood method, in the Burleigh section of Big Spring Creek which was marked on 3 September 1992.

Age class	Number per mile(SD)	Biomass (lb) per mile(SD)	Mean length(in)	Mean weight(lb)	Condition factor
			Rainbow trout		
0	23±13	2.1±1.4	6.1	0.10	43.0
1	63±22	9.5±3.2	6.7	0.15	49.7
2	195±26	160.7±25.9	12.6	0.83	41.4
3	156±26	156.7±30.2	13.6	1.00	40.2
4	17±8	20.9±10.8	14.5	1.21	39.7
Total	454±46	349.9±41.3			
			Brown trout		
1	11±11	4.2±4.2	9.4	0.39	47.3
2	20±10	19.6±9.6	13.1	0.98	43.2
3	22±11	41.7±21.9	16.6	1.88	41.3
4	15±9	30.2±19.3	17.2	2.06	40.6
5	7±6	15.1±12.0	17.2	2.06	40.6
Total	75±21	110.8±33.3			

low age sample for rainbow trout size classes: 7.0-7.9, 8.0-8.9, 9.0-9.9, 10.0-10.9 in; low age sample for brown trout size classes: 5.0-5.9, 7.0-7.9, 8.0-8.9, 9.0-9.9, 10.0-10.9, 11.0-11.9, 13.0-13.9, 14.0-14.9 in.

Table 9. Rainbow and brown trout population estimates by age class, calculated using the log-likelihood method, in the Tresch Section of Big Spring Creek which was marked on 3 September 1992.

Age class	Number per mile(SD)	Biomass (lb) per mile(SD)	Mean length(in)	Mean weight(lb)	Condition factor
		Rainbow trout			
0	339±44	29.9±5.6	5.9	0.09	43.9
1	534±50	178.7±21.7	8.7	0.33	50.1
2	705±73	560.8±73.2	12.0	0.80	45.8
3	560±80	614.3±94.5	13.5	1.10	44.7
4	424±62	584.5±85.8	14.6	1.38	44.1
5	108±32	170.8±48.1	15.3	1.57	43.9
6&older	10±6	19.3±11.9	16.3	1.86	43.2
Total	2681±145	2158.4±156.8			
		Brown trout			
0	62±13	4.3±1.2	5.6	0.07	39.7
1	269±36	121.4±17.5	10.0	0.45	45.7
2	348±32	341.4±36.5	13.2	0.98	43.1
3	107±22	140.2±27.3	14.6	1.31	42.4
4	17±6	32.2±12.2	16.6	1.90	41.4
5	9±4	19.0±9.5	17.1	2.06	41.2
Total	812±55	658.5±51.2			

size classes with low rainbow trout age samples: 17.0-17.9 in;
size classes with low brown trout age samples: 5.0-5.9, 6.0-6.9, 8.0-8.9 in.

Table 10. Rainbow and brown trout population estimates by age class, calculated using the log-likelihood method, in the Burleigh section of Big Spring Creek marked on 22 August 1994.

Age class	Number per mile(SD)	Biomass (lb) per mile(SD)	Mean length(in)	Mean weight(lb)	Condition factor
		Rainbow trout			
0	49±22	3.0±2.2	5.4	0.06	39.0
1	105±24	19.4±4.6	7.6	0.19	42.9
2	58±11	31.4±6.0	11.2	0.54	38.1
3	166±25	153.6±31.8	13.9	0.93	34.8
4	66±20	68.3±24.4	14.5	1.04	34.1
Total	443±47	275.6±40.8			
		Brown trout			
1	14±4	3.7±1.4	8.9	0.28	39.7
2	55±9	58.7±10.8	13.9	1.06	39.1
3	47±9	67.6±14.5	15.7	1.43	37.2
4	30±10	59.9±21.9	17.9	1.99	34.8
5	3±3	5.3±6.0	18.1	2.05	34.5
Total	149±17	195.3±29.1			

Rainbow trout size classes with low age samples: 5.0-5.9, 7.0-7.9, 8.0-8.9, 9.0-9.9, 10.0-10.9 in;
Brown trout size classes with low age samples: 7.0-7.9, 8.0-8.9, 9.0-9.9, 10.0-10.9, 11.0-11.9, 12.0-12.9, 16.0-16.9 in.

Table 11. Rainbow and brown trout population estimates by age class, calculated using the log-likelihood method, in the Tresch Section of Big Spring Creek which was marked on 22 August 1994.

Age class	Number per mile(SD)	Biomass (lb) per mile(SD)	Mean length(in)	Mean weight(lb)	Condition factor
		Rainbow trout			
0	130±29	8.3±2.2	5.5	0.06	38.2
1	622±57	145.1±16.7	8.1	0.23	44.4
2	541±49	360.6±41.2	11.7	0.67	41.8
3	454±46	467.3±52.9	13.9	1.03	38.6
4	113±26	146.5±32.5	15.1	1.30	38.0
5	9±4	14.9±7.0	16.3	1.62	37.4
Total	1867±97	1142.7±76.7			
		Brown trout			
0	29±8	1.5±0.5	5.1	0.05	38.3
1	84±13	32.7±6.2	9.8	0.39	41.4
2	223±22	155.2±17.6	12.0	0.69	39.8
3	103±17	112.7±20.7	14.3	1.09	37.5
4	20±9	28.0±13.8	15.8	1.43	36.0
5	7±6	9.3±8.5	15.8	1.43	36.0
Total	466±34	339.3±32.2			

Rainbow trout size class with low age samples: 5.0-5.9 in;
Brown trout size classes with low age samples: 5.0-5.9, 7.0-7.9, 8.0-8.9, 14.0-14.9, 15.0-18.9 in.

Significant changes in fisheries management and in Big Spring Creek itself occurred in the 1970's. Fisheries management of Big Spring Creek was changed in 1973 from a stocked trout fishery to a wild trout fishery. A major flood control project which included dams on four tributaries of Big Spring Creek and a diversion channel through Lewistown was initiated in 1970 and completed in 1977 (Jackson, date unknown). After these changes, rainbow trout numbers increased in the Tresch section. No obvious changes in numbers of brown trout or in trout numbers in the Burleigh section were seen. Numbers of rainbow trout ≥10 inches peaked in the Tresch section in 1983 and 1984 while in the Burleigh section the peak was observed in 1988. Numbers of brown trout >10 inches peaked in the Tresch section in 1988 and 1992 and in the Burleigh section in 1968 and 1988 (Figures 2 and 3).

In 1994, the Tresch section showed a decline in rainbow and brown trout from 1992; however numbers of trout ≥10 inches were similar to those found during several other years in the 1980's and 1990's (Figure 2). In the Burleigh section, rainbow trout numbers remained low in 1994, but were similar to populations in 1979 and 1992. Brown trout numbers in the Burleigh section were the second highest since the 1960's (Figure 3). The Tresch section typically contains several times more trout than the Burleigh section and in 1994 the Tresch section had nearly four times more trout than the Burleigh section (Figures 2 and 3).

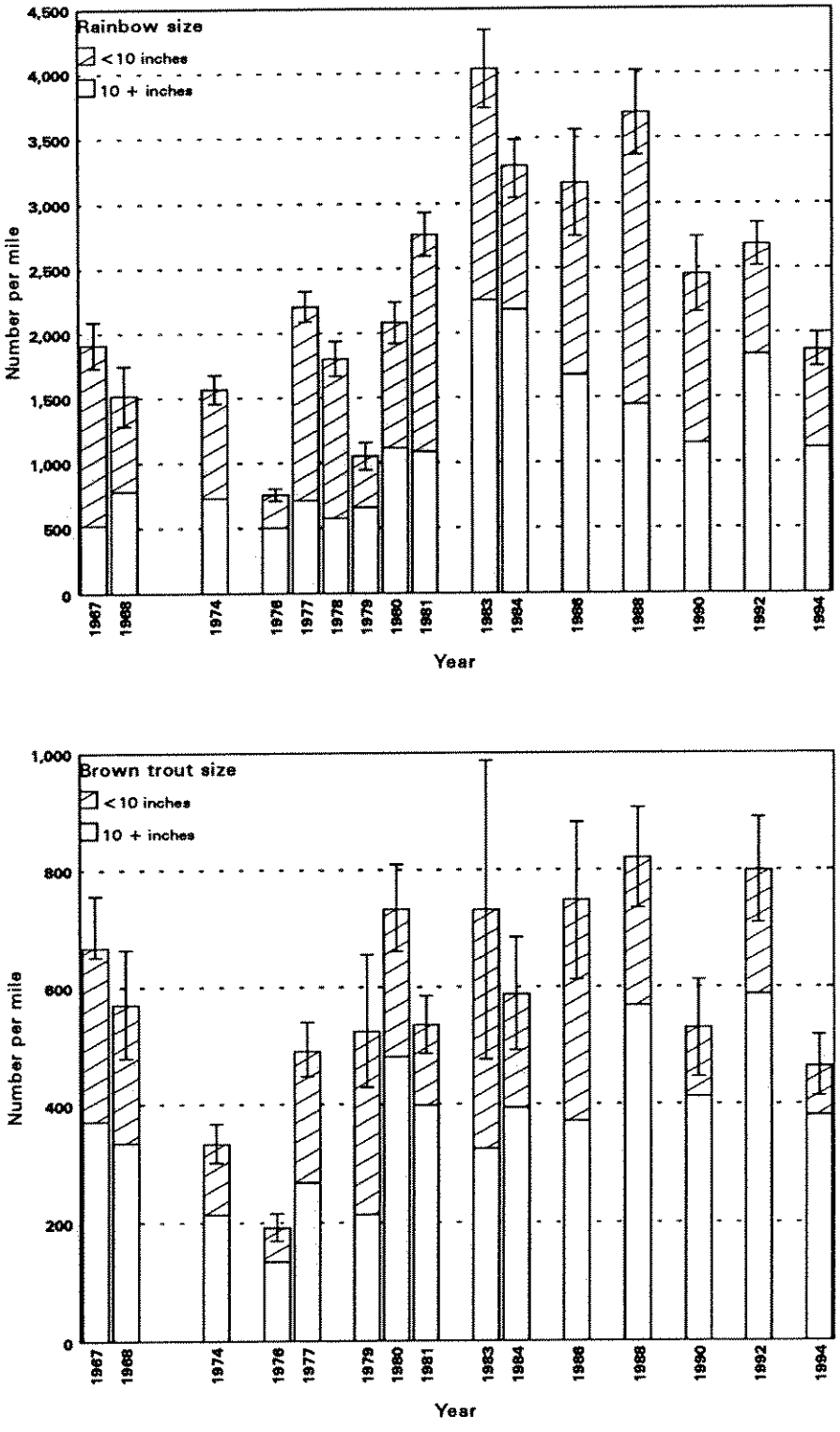

Figure 2. Population trends of wild rainbow and brown trout on the Tresch Section of Big Spring Creek from 1967-1994. Ninety-five percent confidence intervals for entire population are shown.

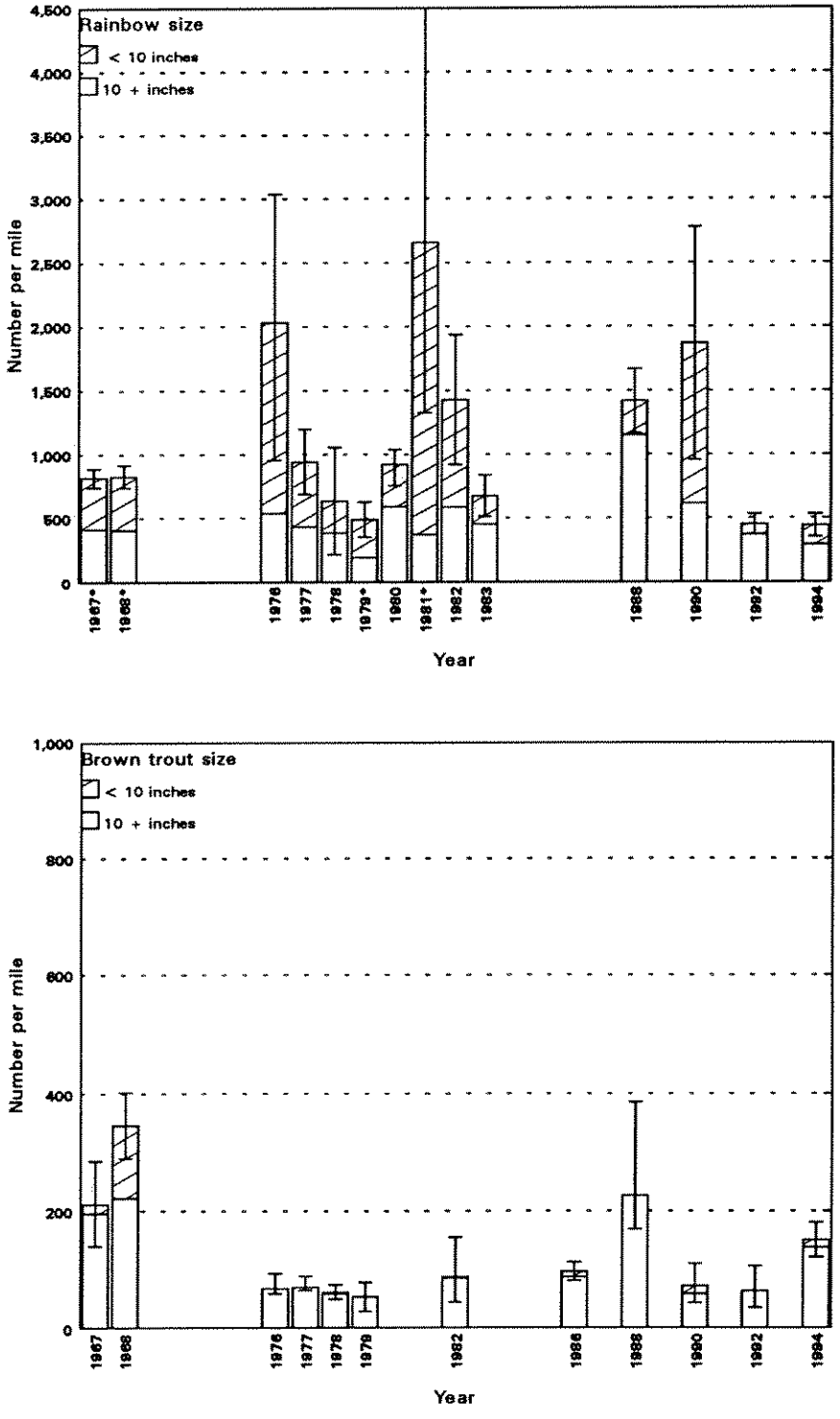

Figure 3. Population trends of wild rainbow and brown trout on the Burleigh Section of Big Spring Creek from 1967-1994. Ninety-five percent confidence intervals for entire population are shown. (* represents years when rainbow trout were stocked.)

The cause of lower trout numbers in the Burleigh section is not understood. However, a sewer treatment facility enters Big Spring Creek just upstream from the Tresch section and previous stocking in the Burleigh section has not increased trout numbers. In 1979 and 1981, 20,000 4-6 inch rainbow trout were marked and planted to enhance the Burleigh reach trout fishery. Due to poor survival and recruitment of these fish, it was concluded that 500-600 wild fish was the carrying capacity of the Burleigh section (Poore 1984). Creel survey data is very limited for Big Spring Creek. However, the Montana statewide mail survey data indicates little change in angler use in the past 12 years (Table 12). The statistical error of these numbers is quite high, i.e., MDFWP (1993), but provide trend information that indicates angler pressure probably is not responsible for recent reductions of trout numbers.

In September 1994, Inter-fluve Inc. of Bozeman was retained by the Fergus County Conservation District and MFWP to complete a feasibility study for remeandering Big Spring Creek on the Brewery Flats Fishing Access Site. In 1907 Big Spring Creek was straightened in this reach which has resulted in the poor fish habitat present today. Remeandering the channel would increase channel length, increase habitat value and should result in increased fishing use in the area. Results from the feasibility study will be summarized in next year's report.

Dry Wolf Creek

Rainbow trout stocking was discontinued in Dry Wolf Creek in 1995 to ensure the continued survival, well-being, and genetic purity of pure westslope cutthroat trout present in the drainage. Additional cutthroat were also captured for genetic analysis to expand the sample size of 4 which had been previously tested, all of which were pure. Genetic analysis results are not available for inclusion in this report and will be summarized next year.

A population estimate was completed on 11 July 1994 about 0.5 miles above the USFS campground. A triple pass estimated 17±10 rainbow trout, 10±5 brook trout, and 11±5 westslope cutthroat trout in the 664 foot reach (Table 13). We electrofished another section, approximately 350 feet long, located about 2 miles above the campground on 27 September 1995 for 70 minutes. Neither survey found evidence of rainbow reproduction; the smallest rainbow sampled was 11.3 inches. Cutthroat trout were captured as small as 3.75 inches and brook trout to 5.8 inches (Tables 13 and 14).

Table 12. Angler pressure estimates of Big Spring Creek as determined by Montana statewide angling pressure mail survey, 1982-1993.

Year	Angler days
1982	13,268
1983	15,163
1984	17,329
1985	10,631
1989	13,199
1991	8,854
1993	12,360
Average	13,036

Table 13. Size statistics and population estimates from Dry Wolf Creek, above the USFS campground, surveyed 11 July 1994.

Species	Number	Total length (in) mean (range)	Estimated Number per 1000 feet (all fish)
Rainbow trout	8	12.4(11.3-12.9)	17±10
Brook trout	6	8.1(5.8-8.9)	10±5
Westslope cutthroat trout	11	7.2(5.6-8.7)	11±5

Table 14. Streams in the Lewistown area surveyed with one pass electrofishing in 1994.

Stream (location)	Date sampled	Section length(ft)[1]	Temp (°F)	Conductivity (µohms/cm)[4]	Species	Number captured	Length (inches) mean	range
Yogo Creek	7/28/94	225	45	283	EB	49[2]	6.1	3.1-9.8
(T13NR10ES5,6)	7/28/94	600			CT	8	6.2	4.9-8.1
Elk Creek	7/28/94	300	54	183	EB	5	-	3.2-7.1
(T13NR9ES4)					CT	4	5.8	4.9-6.8
Running Wolf Creek (T14NR10ES1)	8/12/94	600	46	360	EB	24	-	4.0-9.0
N.F.Running Wolf Creek (T14NR10ES10)	8/12/94	225	58	325	CT	14	5.8	2.0-8.0[3]
Placer Creek (T14NR9ES1,2)	8/12/94	200	51	150	CT	12	7.6	5.9-9.9
Dry Wolf Creek	9/27/94	350			EB	2		
(T14NR9ES23)					CT	14		3.7-9.8
					Rb	1		13.2

Species: EB = brook trout, CT = cutthroat trout, Rb = rainbow trout.
1 Estimated length - not measured, DQR=2
2 Netted about 60% of fish seen in this area
3 Some fish had estimated length, DQR=5
4 Corrected to 77°F

South Fork Judith River

In 1994, hatchery rainbow trout were either tagged with floy tags or had the adipose fin clipped prior to stocking in the South Fork Judith River. Intermittent creel surveys indicated many fish were captured a week after stocking with numbers declining at later dates. A two pass estimate was done on a 530 foot section that started just below the Indian Water Gap Bridge. Seventy percent or more of rainbow trout and mountain whitefish were caught during the first pass, indicating the methodology used was adequate (Leathe 1983). Size statistics for all species of fish captured, except the white sucker, were similar (Table 15). Total population estimates for rainbow trout and mountain whitefish were 74±4 and 32±13, respectively (Table 15). Results are similar to that found in 1987 on the same section of stream; MDFWP (1989) estimated 63 rainbow trout, which included both wild and hatchery fish, and 24 mountain whitefish >4 inches per 1,000 feet compared to 55 and 26 per 1,000 feet, respectively, in 1994. Numerous mottled sculpins were also captured.

Other Lewistown Area Streams

In cooperation with the Lewis and Clark National Forest fisheries staff, westslope cutthroat trout were captured and samples for genetic analysis were obtained from North Fork Running Wolf, Yogo, Placer, and Elk creeks. Results from these tests are not yet available and will be summarized in the next report. Most of these streams also contain brook trout. Running Wolf Creek was surveyed for cutthroat, but none were found (Table 14).

Great Falls Area

Smith River

The total population estimates in 1994 for both rainbow and brown trout from the Eagle Creek section (Table 16) were lower than the estimates obtained in 1993 (Tews et al. 1994). However, the number of brown trout ≥10 inches were relatively steady in the Eagle Creek section (Figure 4); the point estimate decreased from 494 per mile in 1993 to 481 per mile in 1994. Total rainbow trout numbers decreased almost 50 per mile in the Eagle Creek section; however, this was due to a reduction in the estimated number of smaller fish which can contain substantial error and also because the smallest size estimated was 0.5 inches greater in 1994. Rainbow trout estimates for fish ≥10 inches increased from a historic low in 1993 (120 per mile) to 166 per mile in September 1994 (Figure 4).

Table 15. Size statistics and population estimates from the South Fork of the Judith River, 28 September 1994.

Species	Number captured	Total length (in) Mean (range)	Number per 1000 feet >4inch (wild)	>4inch (wild+hatch)	all fish
Rainbow trout	38	6.8(2.3-10.6)	47±3	55±3	74±4*
Mountain whitefish	15	7.1(3.1-12.7)	26±8	-	32±13
Brook trout	1	6.8 -	-	-	-
Cutthroat trout	1	7.0 -	-	-	-
Longnose sucker	4	7.6(7.2-8.0)	-	-	-
White sucker	1	12.0 -	-	-	-

* includes one approximately 2 inch rainbow trout that was seen but not captured on run number 2.

Table 16. 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 1994.

Section	Date marked	Size range (inches)	Number per mile	Pounds per mile	Mean condition factor
		Rainbow trout			
Eagle Creek	9/17/94	6.0-16.9	360±22	154±16	38.0
Deep Creek	9/09/94	6.0-16.9	205±57	106±58	40.8
		Brown trout			
Eagle Creek	9/17/94	8.0-20.9	534±30	565±53	37.3
Deep Creek	9/09/94	7.0-19.9	315±59	185±83	39.4

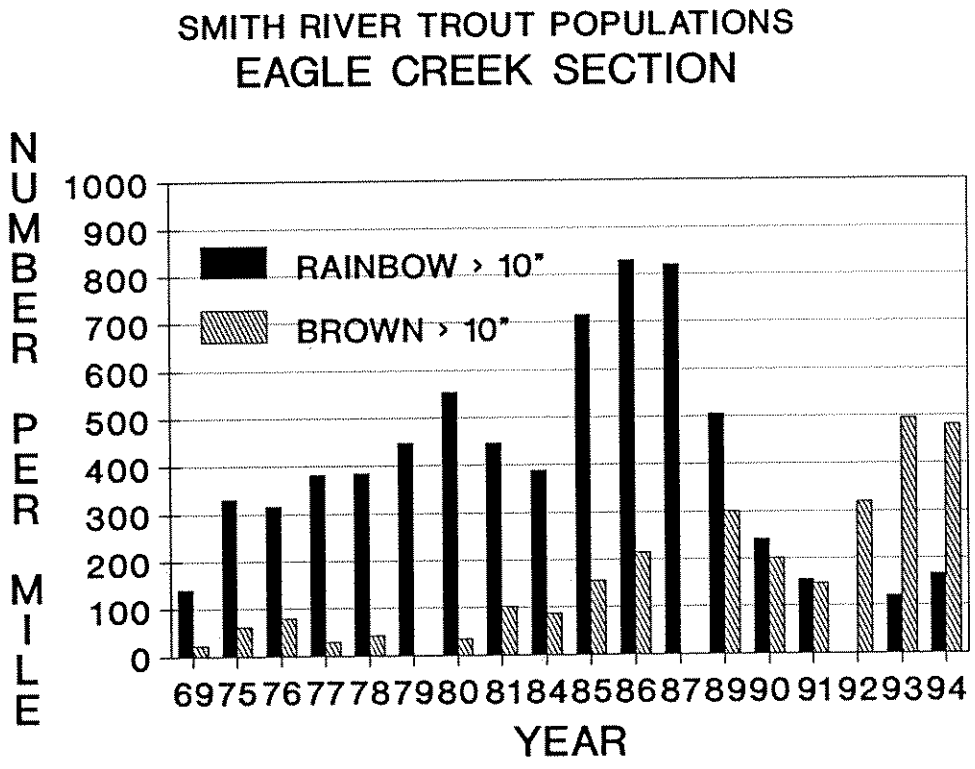

Figure 4. Population estimates of rainbow and brown trout ≥10 inches on the Eagle Creek section of the Smith River, Montana, 1969-1994.

The number of rainbow trout estimated in the Deep Creek section was about 30% less than in the upper section (Table 16), and at 205±57, was slightly higher than estimates from the Deep Creek section in 1992-93, which averaged 164 per mile. The number of rainbow trout ≥10 inches in the Deep Creek section was similar to the estimate obtained in 1993, but less than the recent high of 137 per mile in 1992 (Figure 5). Total brown trout numbers decreased from 466 per mile in 1993 to 315±59 in 1994. Brown trout ≥10 inches also showed a substantial decrease; numbers decreased from 302 per mile in 1993 to 121 per mile in 1994.

The biomass estimate for brown trout in the Eagle Creek section was substantially higher than any other estimate in 1994 (Table 16). Rainbow trout biomass estimates were lower in both sections in 1994 when compared to 1993 (Tews et al. 1994) but appear to have overlapping confidence intervals. Brown trout biomass estimates underwent substantial decreases in both sections between 1993 and 1994. Average condition factors were higher in the Deep Creek section than in the Eagle Creek section (Table 16). The Mid-Canyon section was not electrofished. Age data for the last several years will be analyzed and population estimates by age group will be included in next year's report.

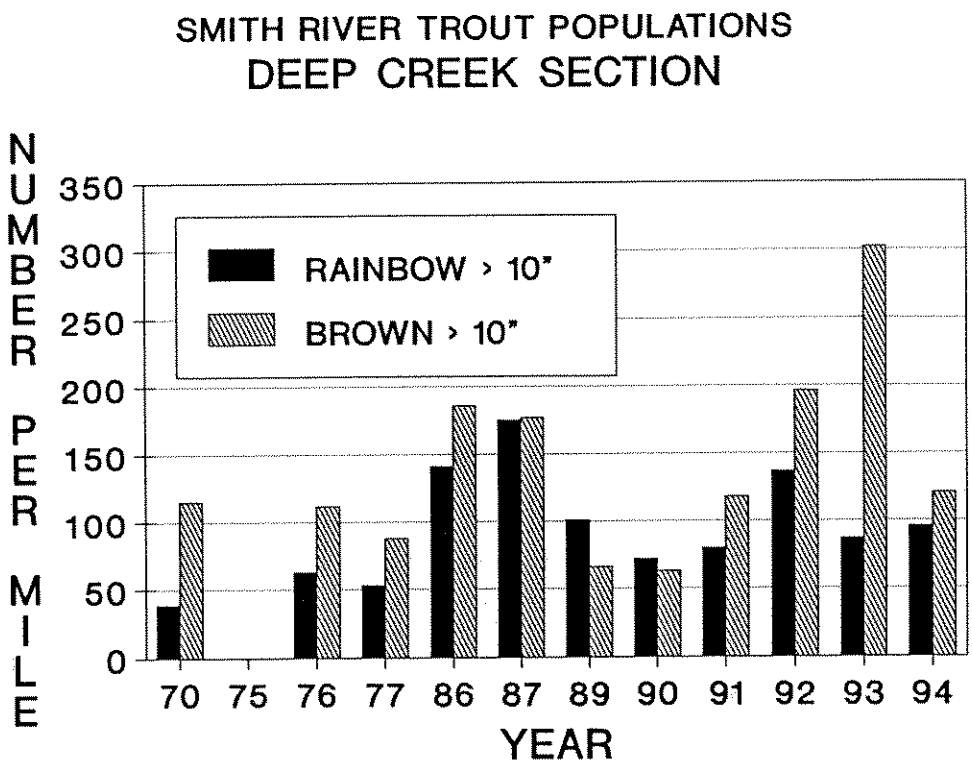

Figure 5. Population estimates of rainbow and brown trout ≥10 inches on the Deep Creek section of the Smith River, Montana, 1970-1994.

Missouri River

The estimated number of rainbow trout by length was 4,279±403 and 1,940±205 per mile in the Craig and Cascade sections, respectively, during fall 1994 (Table 17). This represents increases in both sections from the 1993 population estimates. Both estimates are considered to be in the upper end of the normal historical range of population levels for the sections. The rainbow trout population estimates for catchable fish ≥10 inches for the Craig section were higher than fall 1994 levels (2,899 per mile) in 1984, 1987, and 1988 (Figure 6). In the Cascade section, the estimated number of catchable fish were greater in 1987 and 1992 (Figure 7). Fall brown trout population estimates obtained in 1994 in the Craig and Cascade sections were higher than spring estimates (Table 17).

Spring 1994 brown trout estimates showed a substantial increase in numbers in the Craig section while in the Hardy and Cascade section, numbers remained steady. Additional increases were noted in both sections sampled in 1995. In the Craig section, spring brown trout estimates increased from slightly more than 400 fish per mile in 1992 and 1993 (Tews et al. 1994) to 743±38 in 1994 and 1,016±53 in spring 1995 (Table 17). The brown trout

Table 17. Rainbow and brown trout population estimates by total size range in the Craig, Hardy, and Cascade sections of the Missouri River, Montana during spring 1994, fall 1994, and spring 1995.

Section	Date marked	size range (inches)	Number per mile	Pounds per mile	Mean condition factor
		Spring 1994 - brown trout			
Craig	4/28/94	5.0-23.9	743±38	623±60	36.3
Hardy	5/04/94	5.0-24.9	307±25	334±49	36.2
Cascade	4/29/94	6.0-24.9	300±45	434±136	36.6
		Fall 1994 - rainbow trout			
Craig	9/30/94	6.0-21.9	4279±403	3870±498	41.9
Cascade	10/06/94	6.0-21.9	1940±205	1776±478	39.7
		Fall 1994 - brown trout			
Craig	9/30/94	6.0-29.9	1212±151	1912±757	41.1
Cascade	10/06/94	6.0-22.9	360±68	412±184	38.7
		Spring 1995 - brown trout			
Craig	4/26/95	6.0-25.9	1016±53	1236±124	39.0
Cascade	4/27/95	6.0-26.9	557±76	839±162	37.8

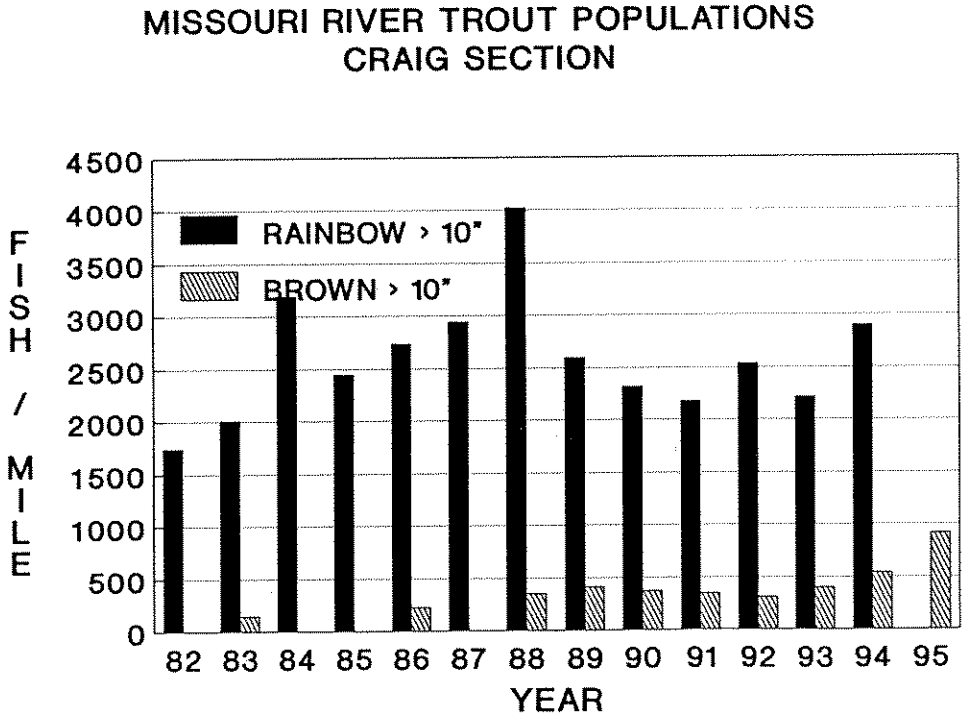

Figure 6. Population estimates of rainbow and brown trout ≥10 inches on the Craig section of the Missouri River, Montana, 1982-1995.

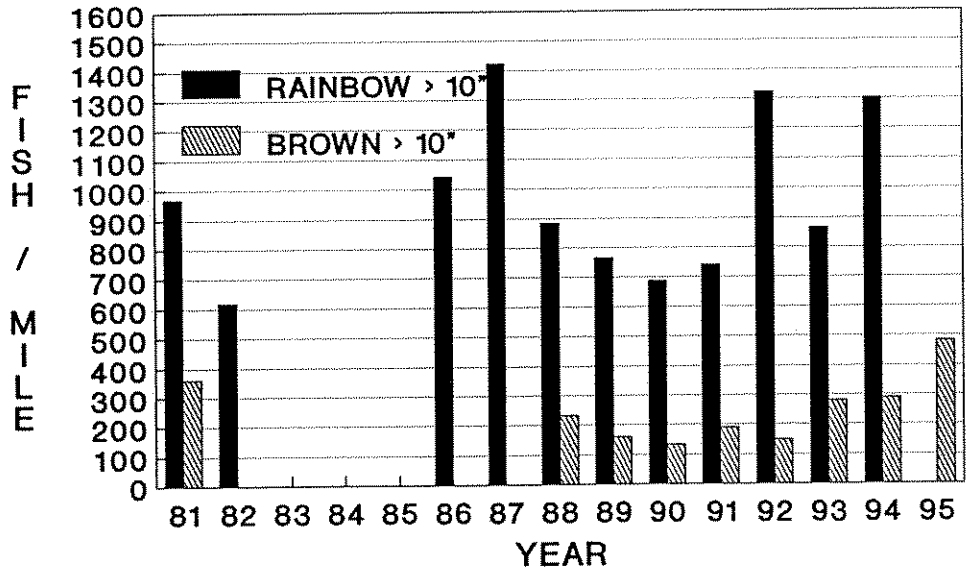

Figure 7. Population estimates of rainbow and brown trout ≥10 inches on the Cascade section of the Missouri River, Montana, 1982-1995.

population level in the Cascade section was maintained at about 300 per mile from 1992-1994; numbers increased to 557±76 per mile in 1995 sampling (Table 17). The number of brown trout ≥10 inches in both section also show the trend in increased numbers (Figures 6 and 7). Age data for the Missouri River population estimates will be compiled as soon as possible and included in a future report.

Region Wide Activities

Whirling Disease Monitoring

On 21 February and 4-5 April 1995, a total of 55 rainbow trout from 2.3-6.2 inches in total length were captured from the Burleigh section downstream to about 10 miles below Lewistown for whirling disease analysis. None of these fish tested positive for whirling disease. Fish were also collected from the Missouri and Smith rivers from February - May 1995 to determine if the parasite responsible for whirling disease, *Myxobolus cerebralis*, was present in the cartilage of salmonids or mottled sculpins in these waters. Large sample sizes of rainbow trout, brown trout,

and mountain whitefish were obtained in the Missouri River below Holter Dam (Table 18). Lower numbers of mottled sculpin were also collected and analyzed. The Smith River was sampled near or in the Eagle Creek section; adequate sample sizes of rainbow trout, brown trout, mountain whitefish, and mottled sculpin were obtained (Table 18). All fish sampled tested negative for the presence of *M. cerebralis*. However, mottled sculpin from the Smith River did contain a *Myxobolus sp.* in bone that is different in morphology than *M. cerebralis* and is not thought to be a causative agent of whirling disease.

Habitat Protection

Providing input and recommendations about alterations of streambeds or banks by private individuals or government entities are handled through a permit process. The 1975 Natural Streambed and Land Preservation Act (310) involves the private sector while the Stream Protection Act of 1963 (SPA) covers government agencies. In the Choteau area, a total of 28 projects were reviewed and processed under "310" while 5 projects were handled under SPA. During the reporting period, there were 50 Natural Streambed and Land Preservation Act (310) permits for Judith Basin, Fergus, and Petroleum Counties processed through the Lewistown office. In addition, 14 Stream Preservation Act (124) permits were processed through the Lewistown Office. Also, 68 "310's" and 14 "124" permits were processed through the Great Falls office. This resulted in a total of 146 "310's" and 33 "124" permits. Site inspections were made on most of the 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

Streams which may contain potentially pure westslope cutthroat trout populations should continue to be evaluated in conjunction with the U.S. Forest Service. Collection and genetic testing of westslope populations should be performed as needed in all areas of Region Four as deemed necessary.

Trout populations in the Forks of the Sun River continue to be healthy, with increased numbers in the South Fork. Based on tag return information and the presence of fish tagged in years dating back to 1989, the populations appear to be resident. Populations should continue to be monitored in the Forks of the Sun River as well as obtaining data when possible on the population that moves from Gibson Reservoir into the confluence area.

Table 18. A partial list of Region Four waters in the Great Falls area sampled for the presence of Myxobolus cerebralis in the first half of 1995.

DATE COLLECTED	WATER	SECTION	LEGAL DESCRIPTION	SPECIES	SAMPLE SIZE	AGE GROUP	LENGTH (INCHES) MEAN	LENGTH (INCHES) RANGE	WEIGHT (LBS) MEAN	WEIGHT (LBS) RANGE	TEST RESULTS
2/24/95	MISSOURI RIVER	CRAIG	S32,29,28,T15N,R3W	RAINBOW TROUT	60	1-2	4.9	2.7-10.1	-	-	NEGATIVE
"		CRAIG	"	BROWN TROUT	30	1-2	7.0	4.3-10.8	-	-	NEGATIVE
2/9/95	SMITH RIVER	CAMP BAKER /ELK CANYON	S2,13,T12N,R4E	RAINBOW TROUT	2	1-2	7.3	4.5-10.1	0.21	0.03-0.39	NEGATIVE
5/4/95	SMITH RIVER	EAGLE CREEK	S14,11,2,T12N,R4E	RAINBOW TROUT	31	1-2	7.0	2.7-11.4	0.18	0.01-0.54	NEGATIVE
"		EAGLE CREEK	"	BROWN TROUT	22	1-2	5.2	3.7-9.4	0.07	0.02-0.33	NEGATIVE
"		EAGLE CREEK	"	MOUNTAIN WHITEFISH	27	1-2	5.2	4.2-9.5	0.07	0.02-0.19	NEGATIVE
"		EAGLE CREEK	"	MOTTLED SCULPIN	37	?	?	?	?	?	NEGATIVE
4/25-5/11/95	MISSOURI RIVER	CRAIG	S32,29,28,21,16	RAINBOW TROUT	60	1-2?	5.0	2.7-8.3	0.07	0.01-0.25	NEGATIVE
"		CRAIG	15,10,T15N,R3W	BROWN TROUT	67	1	5.4	3.6-7.4	0.07	0.02-0.20	NEGATIVE
"		CRAIG	"	MOUNTAIN WHITEFISH	58	1	6.6	5.0-7.7	0.11	0.05-0.21	NEGATIVE
"		CRAIG	"	MOTTLED SCULPIN	5	?	-	-	-	-	NEGATIVE
4/27-5/9/95	MISSOURI RIVER	CASCADE	S36,25,T15N,R2W&	RAINBOW TROUT	84	1	4.7	2.5-7.6	0.05	0.01-0.20	NEGATIVE
"		CASCADE	S30,29,20,17,	BROWN TROUT	77	1	5.9	3.8-7.6	0.09	0.02-0.21	NEGATIVE
"		CASCADE	T15N,R1W	MOUNTAIN WHITEFISH	73	1	6.1	4.4-7.1	0.08	0.03-0.14	NEGATIVE
"		CASCADE	"	MOTTLED SCULPIN	6	?	3.3	-	0.03	-	NEGATIVE

We should continue to monitor trout population trends, success of wild rainbow trout fingerling plants, and the extent of natural reproduction in the Tiber Dam tailwater section by obtaining biannual standing crop estimates at least through 1997. As more information becomes available, we will develop management recommendations (such as changes in Tiber Dam operations or habitat improvements) to address limiting factors and enhance the rainbow trout population.

The Brewery Flats channel remeandering project on Big Spring Creek should be evaluated further and funding should be pursued. Monitoring of the Tresch and the Burleigh sections on Big Spring Creek should continue at least on an every other year basis. The Brewery Flats section should also be surveyed annually for the next few years to provide baseline data for an evaluation of the channel remeandering project. Additional sections should be monitored on occasion. A creel census on Big Spring Creek is necessary to determine how angler pressure impacts trout populations. Additional fieldwork on Big Spring Creek should include identification of spawning areas, trout movement patterns, and the importance of tributary streams.

Trout stocking of several streams in the Lewistown area should be evaluated to determine if stocking is beneficial or necessary. Streams that need to be evaluated include the North Fork Flatwillow Creek, the Judith River near Utica, and Cottonwood Creek. Stocking of the South Fork Judith River should be terminated since the upper reaches of this stream contain 98% pure westslope cutthroat trout and rainbow reproduce in the stream. Dry Wolf Creek and South Fork Judith River should be evaluated to determine the influence rainbow trout stocking had on these streams.

Monitoring of the Eagle and Deep Creek sections on the Smith River should continue. We will continue to electrofish two sections on the Missouri River to obtain population estimates.

Stream protection/preservation activities will continue to be processed as projects occur.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the assistance of many individuals in completing work on this project. Paul Hamlin, Kelly Smith, and Troy Humphrey assisted in both field and office activities. Dave Yerk, George Anderson, Bruce Auchly, Gerry Downey, Jim Drissell, Randy Rodencal, Jerry O'Hara, Jimmy Forrest, and Steve Leathe assisted in collecting field data. Portia Jelinek, Pat Finnegan, Mike Enk, Philip White Clay, and Dave Pilliod of the U.S. Forest Service assisted with backpack shocking on forest lands for westslope cutthroat trout. Dr. Robb Leary (University of Montana) conducted labwork for testing of genetic purity of westslope cutthroat trout.

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

Date: September, 1995

Principal Fish Species Involved: Rainbow trout, westslope cutthroat trout, Arctic grayling, brown trout, brook trout, mountain whitefish.

Code Numbers of Waters Referred to in Report:

14-2240	Green Gulch
14-3240	Marias River
14-4600	Rierdon Gulch
14-6600	Whiterock Creek
14-6760	East Fork Woods Creek
16-0310	Big Spring Creek Section 2
16-0900	Cottonwood Creek
16-1260	Dry Wolf Creek
16-1460	Elk Creek
16-1820	Judith River
16-2760	Placer Creek
16-	North Fork Running Wolf Creek
16-3160	Running Wolf Creek
16-3520	South Fork Judith River
16-4260	Yogo Creek
17-2688	Falls Creek
17-4896	Missouri River Section 09
17-6832	Smith River Section 02
18-4560	North Fork Flatwillow Creek
20-3450	Lime Gulch
20-4400	North Fork Sun River
20-5600	South Fork Sun River
20-6110	Sunny Slope Canal

Appendix 1. Mark recapture statistics from population estimates on the Tresch Section of Big Spring Creek, 1967-1994.

Rainbow trout

	Number of fish			Fish not used		Number per mile			
Year	M	C	R	# size(inches)	Pooled(P)	<10	>10	All	(95% CI)
1994	437	400	131	all used	.069	754	1108	1865	(1734-1996)
1992	531	572	161	all used	.139	851	1831	2682	(2516-2848)
1990	381	333	71	all used	.277	1306	1145	2452	(2160-2744)
1988	571	525	116	all used	.162	2253	1442	3695	(3369-4021)
1986	370	388	72	all used	.109	1481	1673	3155	(2748-3562)
1984	634	673	163	all used	.519	1107	2181	3288	(3092-3484)
1983	551	627	119	all used	.149	1782	2253	4034	(3732-4336)
1981	583	488	138	all used	.650	1680	1082	2761	(2592-2930)
1980	428	594	186	all used	.911	967	1113	2079	(1919-2239)
1979	186	266	59	all used	.322	393	658	1049	(944-1154)
1978	355	429	106	all used	.094	1228	573	1801	(1666-1936)
1977	577	534	186	all used	.269	1495	711	2206	(2087-2325)
1976	293	244	125	all used	.064	252	502	755	(708-802)
1974	350	462	132	all used	.986	838	729	1567	(1456-1678)
1968	249	177	36	4 (< 7")	.077	735	783	1517	(1286-1748)
1967	331	351	86	all used	.847	1342	460	1804	(1637-1971)

Brown trout

	Number of fish			Fish not used		Number per mile			
Year	M	C	R	# size(inches)	Pooled(P)	<10	>10	All	(95% CI)
1994	120	147	49	all used	.734	84	381	466	(414-518)
1992	185	169	52	1 (7)	.377	211	588	799	(709-899)
1990	121	118	34	1 (7)	.302	118	413	530	(447-613)
1988	208	193	60	4 (7-7.9)	.483	251	569	820	(735-905)
1986	122	111	27	2 (5-5.9)	.213	377	371	747	(613-881)
1984	101	107	23	1 (5-5.9)	.183	194	394	589	(493-685)
1983	102	72	17	1 (8-8.9)	.513	408	324	732	(477-987)
1981	154	137	49	1 (5-5.9)	.051	138	398	536	(487-585)
1980	149	249	66	all used	.532	251	482	735	(661-809)
1979	75	93	17	all used	.264	312	213	543	(430-656)
1978	111	116	35	2 (6-6.9)	.023[A]				
1977	139	130	45	all used	.49	224	267	493	(448-541)
1976	74	57	28	4 (7-7.9)	.20	57	134	192	(169-215)
1974	85	129	44	all used	.173	119	213	334	(301-367)
1968	119	121	31	all used	.28	237	334	572	(480-664)
1967	174	161	53	all used	.60	296	371	687	(652-756)

A=log likelihood model not accurate with 95% confidence;

Appendix 2. Mark recapture statistics from population estimates on the Burleigh Section of Big Spring Creek, 1967-1994.

Rainbow trout

Year	Number of fish M	C	R	Fish not used # size(inches)	Pooled(P)	Per mile size class <10	>10	All	(95% CI)
1994	150	86	29	all used	.637	152	291	443	(354-532)
1992	180	109	41	6 (7-7.99)	.258	84	370	453	(373-533)
1990	140	138	20	all used	.102	1253	615	1868	(957-2779)
1988	251	209	38	all used	.536	267	1152	1418	(1168-1668)
1986	165	139	11	all used	.029[A]			3510	
1984	247	202	39	all used	.004[A]			1227	
1983	113	118	19	all used	.192	220	453	676	(514-830)
1982	146	140	13	all used	.355	840	588	1428	(921-1935)
1981	130	118	15	all used	.156	2286	371	2656	(1328-4516)
1980	101	100	14	all used	.289	331	592	923	(756-1040)
1979	102	74	16	all used	.818	296	193	489	(351-627)
1978	65	91	9	all used	.23	250	385	636	(216-1056)
1977	101	88	13	all used	.109	509	434	942	(688-1196)
1976	99	109	15	all used	.169	1490	509	1999	(957-3040)
1974	224	214	46	all used	.013[A]			1301	
1968	248	199	60	all used	.058	420	408	829	(740-919)
1967	312	251	95	all used	.36	404	414	817	(744-890)

Brown trout

Year	Number of fish M	C	R	Fish not used # size (inches)	Pooled(P)	Per mile size class <10	>10	All	(95% CI)
1994	74	43	18	3 (10-10.99)	.849	13	137	150	(120-180)
1992	26	18	5	4 (7-8.9)	.62[B]	0	62	62	(34-105)
1990	25	23	8	1 (11-11.9)	.697	14	57	72	(42-109)
1988	59	47	12	all used	.072	0	227	227	(168-286)
1986	49	42	21	2 (10-10.99)	.892	9	86	95	(80-112)
1984	30	31	13	1 (5-5.9)	.017 (.222)[D]			68	
1983	19	13	6		C				
1982	28	23	8	1 (10-10.99)	.319	2	84	85	(43-155)
1981	25	19	5		C				
1980	24	31	7		C				
1979	24	21	8	1 (9-9.9)	.056[B]	0	52	52	(27-77)
1978	26	29	11	1 (12-12.9)	.646	3	57	60	(48-73)
1977	37	39	16	6 (11+&13+)	.337	0	68	68	(49-87)
1976	26	40	13	3 (10-10.99)	.255[B]	0	66	66	(40-92)
1974	44	36	13	1 (8-8.99)	.029[C]			104	
1968	67	53	15	all used	.067	15	196	212	(139-285)
1967	107	90	30	all used	.085	124	222	346	(290-402)

A=log likelihood model not accurate with 95% confidence;
B=not suitable for pooled test overall Chi square shown;
C=can not use Chi square test;
D = non-pooled overall Chi square

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