MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: Montana

PROJECT TITLE: Statewide Fisheries Investigations

PROJECT NO: F-46-R-5

STUDY TITLE: Survey and Inventory of Coldwater Streams

JOB NUMBER: I-O

JOB TITLE: Upper Clark Fork EPP

PROJECT PERIOD: October 21, 1991 through June 30, 1992.

ABSTRACT

Fish trapped moving downstream in Warm Springs Creek and Racetrack Creek this spring were mostly brown trout age 2 or younger. Downstream migration increased rapidly the third week in April. Large fish movements were associated with increasing flows, but occurred prior to peak runoff. Most fish moving upstream in Warm Springs Creek were adult rainbow trout; most were captured the first week in April.

Brown trout abundance in eleven reaches of the Clark Fork River between Warm Springs Ponds and Milltown Dam was generally similar each spring and fall between 1989 and 1991. Fish numbers averaged about 800/km in the first eight kilometers immediately below the ponds. Downstream abundance was half this number, or less. Abundance this spring was similar to spring estimates the three previous years in all reaches sampled.

Seasonal abundance of brown trout in Warm Springs and Racetrack Creek between 1989 and 1991 was variable. Highest numbers (about 1000 fish/km) and lowest numbers (about 150 fish/km) probably reflect movements associated with spawning and recruitment each year in addition to environmental effects.

Brook trout were common in three tributaries of Silver Bow Creek sampled this spring. Brown trout were common in two new sections in the Little Blackfoot River, although less abundant upstream than downstream. Westslope cutthroat trout predominated in a headwaters tributary of Flint Creek.

Mean lengths at annulus formation for brown trout in the Clark Fork River and its tributaries were similar in samples collected between 1981 and 1991. Mean lengths were smaller for age 4 and older fish compared to brown trout caught in the Big Hole River in 1982 and 1983.

OBJECTIVES AND DEGREE OF ATTAINMENT

Satisfactory progress has been made towards attaining all project objectives. This progress includes the increasing availability of fish population and habitat records in various formats on microcomputers.

Data collections, compilations, and analyses during the project period that are reported here include:

A. Spring trapping of Warm Springs Creek and Racetrack Creek to assess fish movements to the Clark Fork River.

B. Spring and fall mark recapture estimates of brown trout [1] numbers in the Clark Fork River for 1989, 1990, and 1991.

C. Mark recapture estimates of brown trout numbers this spring in the Clark Fork River.

D. Multiple-pass fish population estimates in Warm Springs Creek and Racetrack Creek in 1989, 1990, and 1991.

E. Multiple-pass fish population surveys this spring in five tributaries of the Clark Fork River.

F. Brown trout age and growth based on scale collections from the Clark Fork River, selected tributaries, and the Big Hole River.

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[1] Common names are used throughout this report. Scientific names are listed in Appendix A.

PROCEDURES

A. Spring trapping of Warm Springs Creek and Racetrack Creek to assess fish movements to the Clark Fork River.

Two-way fish traps were placed in Warm Springs Creek and Racetrack Creek to monitor fish movements before and during spring runoff. Both creeks are tributaries that join the Clark Fork River between the Warm Springs Ponds and Deer Lodge. Trap boxes were located about 300 m upstream from each tributary mouth. Traps were positioned far enough upstream to reduce captures of fish moving occasionally from the river, but close enough that downstream captures were likely to be fish moving to the mainstem.

Trap boxes were steel frames covered with plywood and a 1 cm stretched metal mesh. Each trap measured about 76 x 91 x 122 cm and had a single conical wire mesh entrance about 40 cm in diameter tapering to 10 cm inside each box. Boxes were set in pairs, one facing upstream, the other downstream. A conduit pipe fence and wire leads were used to block fish passage past the traps and guide fish into either box, depending on which direction fish were moving. Openings in the fence and leads were small enough to prevent fish larger than about 100 mm total length from passing the trap; efficiency of the barrier was less for smaller fish.

Warm Springs trap was placed March 25; Racetrack Creek trap was placed April 1. Both traps were removed May 15.

Traps were checked each day, except April 25, 26, 28, and 30. Fish in both traps were identified and measured to the nearest 1.0 mm (total length). Brown trout and rainbow trout caught in the Warm Springs Trap were also weighed to the nearest 10.0 g, and marked before release to monitor recapture rates (adipose clip for fish less than 250 mm total length, Floy tag for larger fish). Fish caught in upstream traps were released upstream; fish caught in downstream traps were released downstream. Scales were collected from brown trout caught in the downstream boxes in both tributaries. Scales were used to confirm ages.

Relative water surface elevations were monitored once each day with staff gauges in both creeks. Water temperature was measured once each day when traps were checked for fish.

B. Spring and fall mark recapture estimates of brown trout numbers in the Clark Fork River for 1989, 1990, and 1991.

Mark recapture sampling to assess relative fish abundance in 11 reaches of the Clark Fork River has been ongoing since 1989. These reaches (Table 1) were selected by consultants hired by the Atlantic Richfield Company (ARCO).

Table 1. Descriptions of eleven reaches sampled in the Clark Fork River in 1989, 1990, and 1991.

Reach	Description	Approximate length (m)
0	Outflow at pond #2 to Warm Springs bridge	1,621
1	Warms Springs bridge to Perkins Lane	4,244
2	Perkins Lane to near mouth of Lost Creek	3,486
3	Sager Lane to about 3 miles downstream	4,466
4	Deer Lodge sewage plant to Mullan Gulch	6,874
5	Kohr's Bend to mouth of Little Blackfoot R.	7,025
6	Mouth of L.Blackfoot to Phosphate bridge	8,272
7	Phosphate bridge to one mile below Gold Creek	8,477
8	Robinson's boat launch to Bear Gulch	6,521
9	Bearmouth chalet to Beavertail FAS	13,522
10	One mile above Turah to Milltown slack waters	5,890

All sampling was done cooperatively with ARCO consultants. Most sections were sampled both spring and fall. Reach 0 was added in the fall of 1989. Sampling was limited to 7 of these reaches in the fall of 1991.

Fish were captured in each sampling section with a rubber raft equipped with a spherical cathode suspended from the boat, and a spherical anode mounted on an adjustable boom at the bow. A 5000 watt generator was used with a Coffelt Model VVP-15 rectifying unit.

Fish were collected in live cars, identified, measured to the nearest 1.0 mm (total length), and weighed to the nearest 10.0 g. Trout were marked with fin clips, and Floy tags if fish were larger than about 200 mm total length. All fish were returned to the stream after marking. Recapture sampling was conducted about two weeks later in each section.

Data were processed using MRSYS, a computer program developed by the Montana Department of Fish, Wildlife & Parks (MDFWP) for processing electrofishing records. Population estimates are calculated using the Chapman (1951) modification of the Peterson estimate.

C. Mark recapture estimates of brown trout numbers this spring in the Clark Fork River.

Fish were captured in each sampling section with an aluminum drift boat equipped with cable anodes suspended from twin booms at the bow. The boat hull served as the cathode. A 5000 watt generator was used with a Coffelt Model VVP-15 rectifying unit.

Sampling was done cooperatively with ARCO consultants. Fish handling, data collections, and data analyses were the same as described in PROCEDURES, section B. Sampling was limited to reaches 1, 2, 3, 4, and 6 (PROCEDURES, Section B, Table 1). A new section was also added between Galen and the Racetrack bridge.

D. Multiple-pass fish population estimates in Warm Springs Creek and Racetrack Creek in 1989, 1990, and 1991.

Brown trout were sampled using backpack mounted electrofishing gear and a hand held electrode in two sections of each creek. Lower sections were within 2 km of each creek mouth; upstream sections were approximately 1 km further upstream. Sections were approximately 100 m long, blocked at each end with 0.5 cm mesh nets. All fish within a section were removed and held in live cars during repeated passes with the electrofishing gear.

Sampling was done cooperatively with ARCO consultants. Data collections were the same as described in PROCEDURES, section B. Fish abundance was estimated using MicroFish 3.0 (Van Deventer and Platts 1985), a software package developed especially to process electrofishing data obtained by removal methods.

E. Multiple-pass fish population surveys this spring in five tributaries of the Clark Fork River.

The purpose of this sampling was to investigate reaches in each stream for which no previous data existed. Three streams (Blacktail Creek, German Gulch, and Brown's Gulch) join Silver Bow Creek above the Warm Springs Ponds. The Little Blackfoot River joins the Clark Fork near Garrison. South Boulder Creek is a tributary of Boulder Creek, which in turn is a tributary of Flint Creek that joins the Clark Fork near Drummond.

In most creeks, a single 91 m section was blocked at each end with 0.5 cm mesh nets. In the Little Blackfoot River, two 183 m sections were sampled. Approximate locations of each sampling section are listed below (Table 2).

Table 2. Sampling locations in five tributaries of the Clark Fork River surveyed in the spring of 1992.

Stream	Confluence	Distance from mouth to section sampled
Brown's Gulch	Silver Bow Creek	11.0 km
German Gulch	Silver Bow Creek	0.5 km
Blacktail Creek	Silver Bow Creek	1.6 km
S. Boulder Creek	Boulder Creek	1.6 km
Little Blackfoot River (upstream site)	Clark Fork River	35.0 km
Little Blackfoot River (downstream site)	Clark Fork River	18.0 km

Fish were sampled with boat mounted electrofishing gear. The cathode was cables suspended from the bow of the boat. The anode was a single hand held electrode connected to the power source by about 10 m of cable. A 5000 watt generator was used with a Coffelt Model VVP-15 rectifying unit.

All fish within a section were removed and held in live cars during repeated passes with the electrofishing gear. Data collections were the same as described in PROCEDURES, section B. Fish abundance was estimated using MicroFish 3.0 (Van Deventer and Platts 1985), a software package developed

especially to process electrofishing data obtained by removal methods.

F. Brown trout age and growth based on scale collections from the Clark Fork River, selected tributaries, and the Big Hole River.

Age was determined from the number of annuli on scales. Annuli were recognized by overcutting, changes in angle of formation, and circuli continuous between anterior and posterior scale fields. The distance from scale focus to each annulus and scale edge was measured from acetate impressions projected on a microfiche reader. Annuli were considered fully formed only if circuli beyond the annulus suggested renewed growth.

A linear model approach was used to backcalculate fish lengths at each annulus (Weisberg 1986). This approach uses scale measurements as the observed data, and models fish growth as the sum of age effects and yearly variation in the environment (Weisberg and Frie 1987). This technique was selected over more usual regression techniques (e.g. Hile 1970) because it incorporates an environmental component, and because the adequacy of data descriptions is readily amenable to statistical tests. Scale data were processed using software for this purpose produced by Minnesota Sea Grant, University of Minnesota (Weisberg 1989). The adequacy of data fit to these models was evaluated at alpha = 0.05.

Growth was assessed by comparing mean lengths at annulus formation between drainages for same sampling years, and within drainages for each year data were available (Student's t, alpha = 0.05 between drainages, alpha = 0.01 within drainages). Mean lengths at each annulus for fish captured in the upper reaches of the Clark Fork River in 1989 were also compared to mean lengths of fish captured this same year in downstream sections (Student's t, alpha = 0.05).

The presence of regenerated scales was recorded for each fish in all scale samples. Scales that were unreadable for reasons other than regeneration (poor mounts, scales absent, etc) were not included in these summaries.

RESULTS AND DISCUSSION

A. Spring trapping of Warm Springs Creek and Racetrack Creek to assess fish movements to the Clark Fork River.

Warm Springs Creek:

A total of 196 fish were trapped moving downstream. Most fish were brown trout (Table 3).

Table 3. Summary of fish captures in the downstream box in Warm Springs Creek in the spring of 1992.

Species	Number of fish	Trap Days
Brown Trout	185	51
Rainbow Trout	9	51
Redside Shiner	1	51
Sculpin	1	51

Most brown trout were small fish, (< 250 mm total length). Three percent were age 0, 31 percent were age 1, and 55 percent were age 2 (Figure 1).

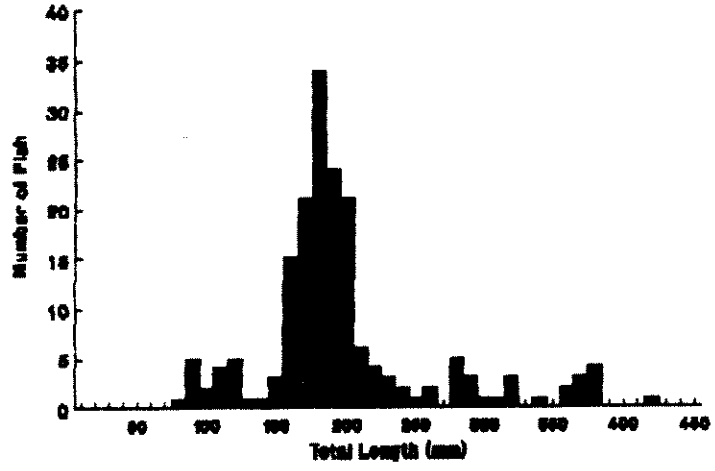

Figure 1. Length frequency distribution by 10 mm size classes for 185 brown trout caught in the downstream box in Warm Springs Creek in the spring of 1992.

Daily brown trout captures in the downstream box in Warm Springs Creek are summarized below (Figure 2).

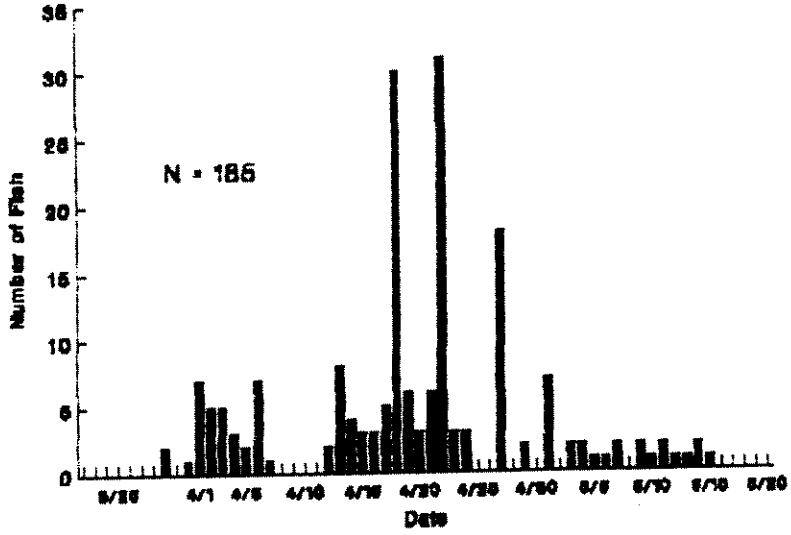

Figure 2. Number of brown trout caught each day in the downstream box in Warm Springs Creek in the spring of 1992. Trap was not checked April 25, 26, 28, or 30.

A total of 30 fish were trapped moving upstream. Most fish were rainbow trout (Table 4).

Table 4. Summary of fish captures in the upstream box in Warm Springs Creek in the spring of 1992.

Species	Number of fish	Trap Days
Brown Trout	7	51
Rainbow Trout	20	51
Largescale Sucker	3	51

All rainbow trout were mature fish, presumably moving up Warm Springs Creek to spawn. A female marked April 4 was recaptured in the downstream trap on April 18. This fish was ripe moving upstream, and returned in spawned out condition. A male marked April 5 was recaptured in the downstream trap April 27. This fish had a large bite wound, was covered with

fungus, and was one of only 3 mortalities in either trap the entire sampling period.

Rainbow trout were first caught March 29. Sixty-five percent of all rainbow trout were trapped by April 6. Upstream captures continued at a low rate through April 27 (Figure 3).

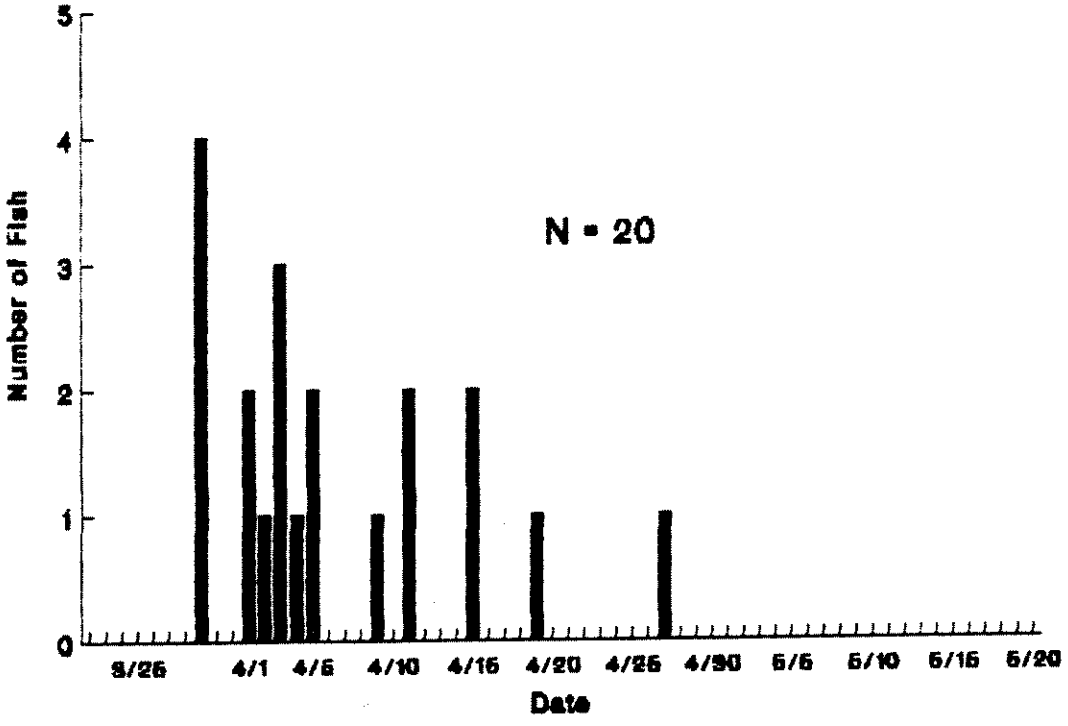

Figure 3. Number of rainbow trout caught each day in the upstream box in Warm Springs Creek in the spring of 1992. Trap was not checked April 25, 26, 28, or 30.

Racetrack Creek:

A total of 142 fish were trapped moving downstream. Most fish were brown trout (Table 5).

Table 5. Summary of fish captures in the downstream box in Racetrack Creek in the spring of 1992.

Species	Number of Fish	Trap Days
Brown Trout	113	44
Brook Trout	4	44
Mountain Whitefish	11	44
Largescale Sucker	4	44
Redside Shiner	8	44
Sculpin	2	44

Most brown trout were small fish, (< 250 mm total length). Twelve percent were age 0, 61 percent were age 1, and 23 percent were age 2 (Figure 4).

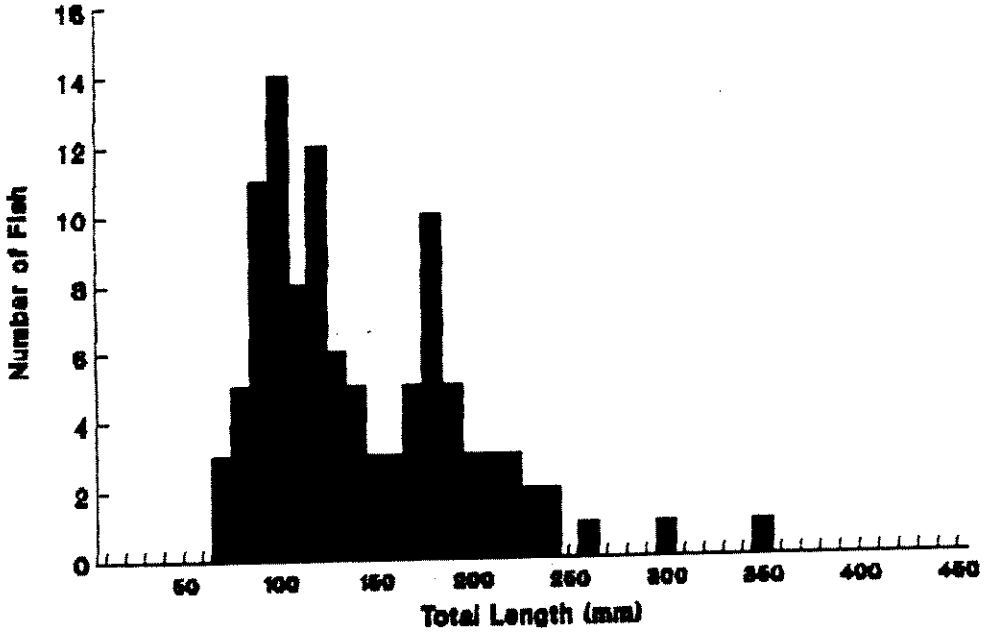

Figure 4. Length frequency distribution by 10 mm size classes for 113 brown trout caught in the downstream box in Racetrack Creek in the spring of 1992.

Daily brown trout captures in the downstream box in Racetrack Creek are summarized below (Figure 5).

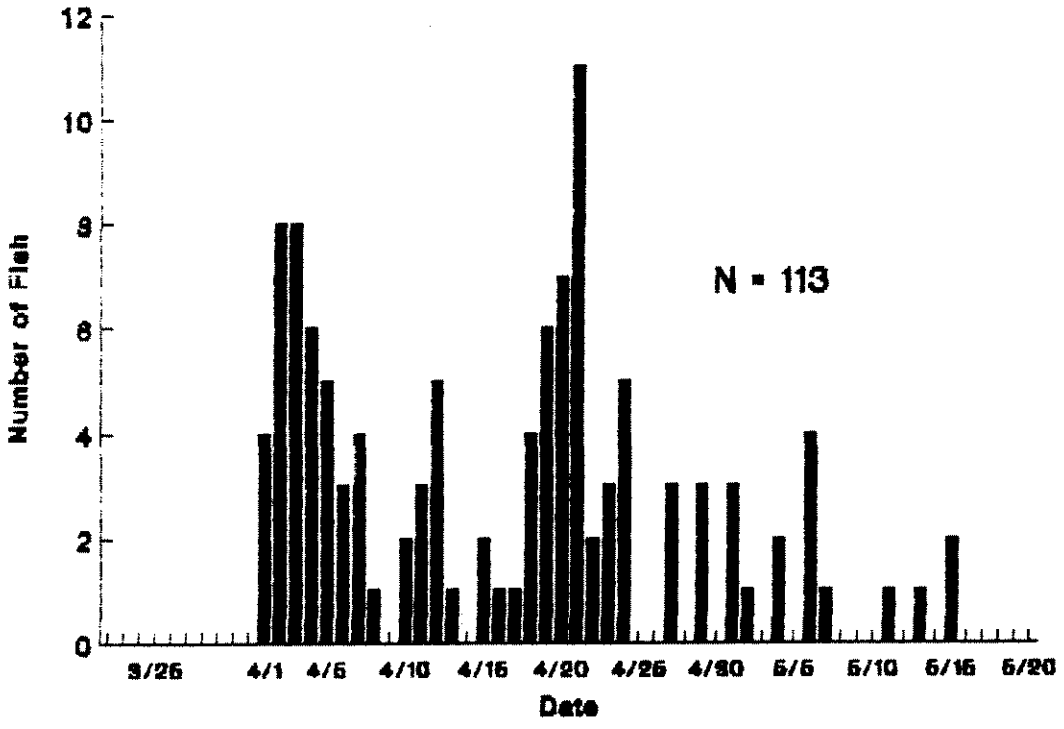

Figure 5. Number of brown trout caught each day in the downstream box in Racetrack Creek in the spring of 1992. Trap was not checked April 25, 26, 28, or 30.

A single sculpin was caught in the upstream box during the entire sampling period.

Downstream movement of brown trout in both creeks increased rapidly the third week in April. Forty-one percent of all brown trout caught in Warm Springs Creek, and 27 percent of all brown trout caught in Racetrack Creek moved downstream between April 18 and 22 (Figure 6). A smaller pulse (24 percent of total captures) occurred in Racetrack Creek between April 2 and 5. Pulse movements in both creeks were associated with higher flows, but occurred prior to peak runoff (Figure 7).

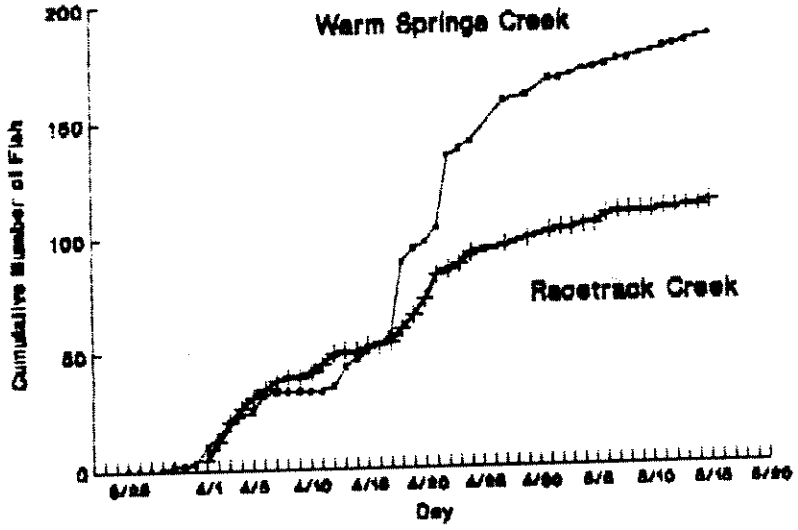

Figure 6. Cumulative number of brown trout caught each day in the downstream box in Warm Springs Creek and Racetrack Creek in the spring of 1992.

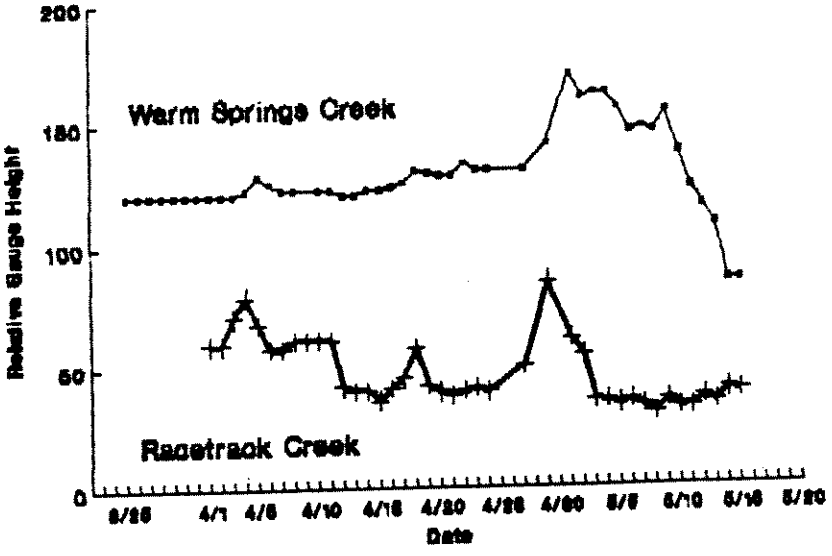

Figure 7. Relative gauge height each day in Warm Springs and Racetrack Creeks in the spring of 1992
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Differences in the relative frequency of small and large fish caught in these creeks may be an artifact of trap efficiency: flow volume in Warm Springs Creek exceeds Racetrack Creek. Also, the traps do not catch small fish efficiently. Downstream movement of young of the year fish was undoubtedly greater than numbers contained in these data.

In Warm Springs Creek, the first age 0 fish was captured April 17. Captures continued at a low rate through May 15. Fry traps placed in the mouth of Warm Springs Creek on April 11 were monitored through April 24 as part of a different sampling procedure. These traps first caught age 0 brown trout April 14, and continued to catch low numbers of fish through April 21. It appears that downstream movement of brown trout fry was greatest the last two weeks in April. This peak coincides with peak downstream movements of larger fish. None of the fish caught in the fry traps was marked.

In Racetrack Creek, age 0 fish were first caught April 2, and no age 0 fish were caught after April 13. It appears that most age 0 fish moved downstream earlier in Racetrack Creek than Warm Springs Creek.

Only three fish were recaptured in Warm Springs Creek the entire sampling period. No fish were recaptured in Racetrack Creek.

Recaptures were two rainbow trout already mentioned, and a single adult brown trout. This brown trout was caught May 13 in the upstream box, and was recaptured in the downstream box May 14. This fish had a head wound covered with fungus.

Both Creeks were dewaterd by irrigation withdrawals in May. By May 15, Warm Springs Creek lacked adequate water to continue operating the trap.

Temperature variations in both creeks were similar throughout the sampling period (Figure 8).

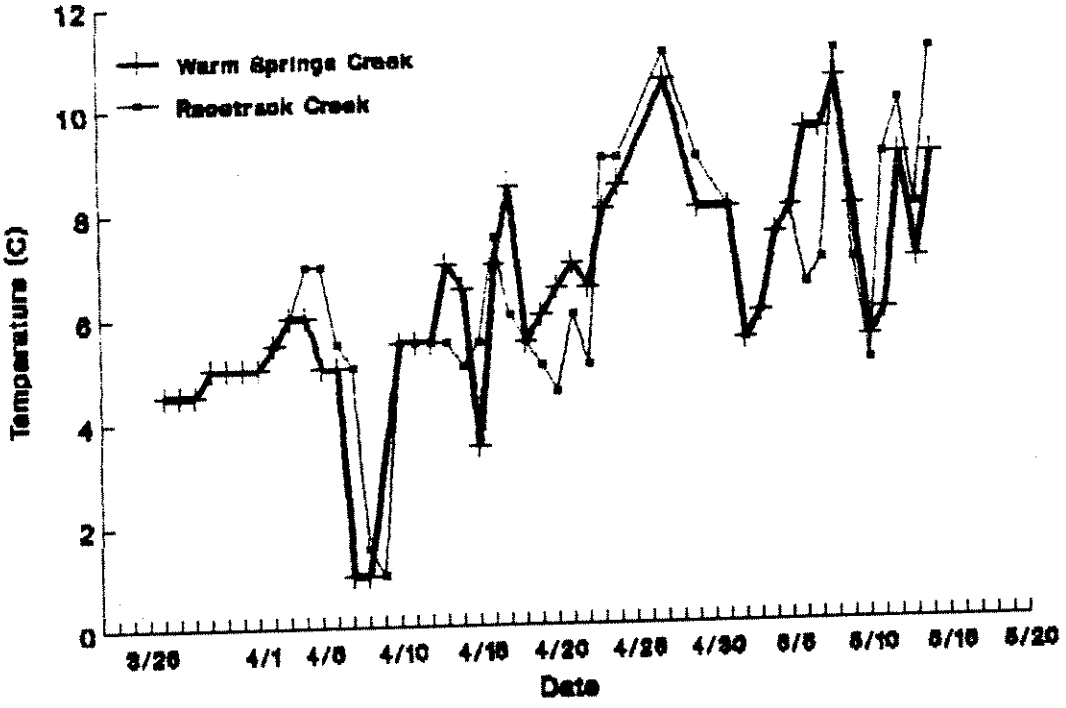

Figure 8. Daily water temperature in Warm Springs Creek and Racetrack Creek in the spring of 1992.

B. Spring and fall mark recapture estimates of brown trout numbers in the Clark Fork River for 1989, 1990, and 1991.

Relative brown trout abundance was generally similar ($p > 0.05$) in all river reaches each year and each season. Fish numbers in the uppermost reaches (0 and 1) were much larger than in other reaches, a pattern identified in previous reports (Hadley 1989).

In reach 1 and 2, fish numbers in the fall of 1990 exceeded numbers in earlier samples ($p < 0.05$). By the spring of 1991, fish numbers in reach 1 and 2 were similar to each estimate prior to the fall 1990 survey (Table 6; Table 7).

Table 6. Total brown trout abundance in eleven reaches of the Clark Fork River based on spring sampling in 1989, 1990, and 1991.

	1989		1990		1991	
Reach	N [1]	95% CI [2]	N	95% CI	N	95% CI
0	not sampled		not sampled		916	233
1	655	114	616	104	611	201
2	196	69	124	40	259	133
3	274	108	129	41	219	149
4	198	46	170	47	247	102
5	226	93	152	53	144	64
6	146	45	95	25	224	122
7	88	27	99	31	188	102
8	40	23	57	27	35	27
9	37	26	24	9	17	13
10	not sampled		68	23	83	42

1 Number of fish/km
2 95 percent confidence interval

Table 7. Total brown trout abundance in eleven reaches of the Clark Fork River based on fall sampling in 1989, 1990, and 1991.

	1989		1990		1991	
Reach	N [1]	95% CI [2]	N	95% CI	N	95% CI
0	668	124	1,160	457	875	135
1	622	143	1,564	560	691	135
2	85	66	622	204	296	80
3	257	95	246	71	336	95
4	265	57	266	55	311	52
5	153	50	145	39	not sampled	
6	259	75	259	65	327	93
7	202	53	193	63	not sampled	
8	32	12	13	5	not sampled	
9	no estimate		12	7	30	24
10	121	51	not sampled		not sampled	

1 Number of fish/km
2 95 percent confidence interval

Fish numbers in reach 8 were down a little in the fall of 1990 from the fall 1989 and spring 1990 estimates ($p < 0.05$). Total brown trout abundance in this reach averaged only about 35 fish/km between 1989 and 1991.

C. Mark recapture estimates of brown trout numbers this spring in the Clark Fork River.

Fish numbers in each reach sampled in 1992 were similar to spring estimates for 1989, 1990, and 1991 ($p > 0.05$). The 1992 estimate in reach 2 was slightly less than the fall 1990 estimate ($p < 0.05$). Fish numbers in reach 6 were down a little from the fall estimates in 1990 and 1991 ($p < 0.05$; Table 8).

Table 8. Total brown trout abundance in five reaches of the Clark Fork River based on spring sampling in 1992.

Reach [1]	N [2]	95% CI [3]	Reach	N	95% CI
1	1,027	312	3	202	83
2	244	165	4	271	104
2a [4]	142	50	6	139	45

1 Described in PROCEDURES, Section B, Table 1
2 Number of fish/km
3 95 percent confidence interval
4 New sampling reach between Galen and the Racetrack bridge

D. Estimated brown trout numbers in Warm Springs Creek and Racetrack Creek in 1989, 1990, and 1991.

Although fish numbers were not reliably estimated every year or season (probability of capture < 0.60), it is clear that brown trout abundance in these tributaries varies throughout the year (Table 9; Table 10).

Table 9. Brown trout abundance in Warm Springs Creek in 1989, 1990, and 1991.

Section: Season/Year	Removal pattern (1st,2nd,3rd)	N [1]	SE [2]	P [3]	Fish/km
Upstream section (98 m):					
Fall/1989	(84,17)	104	3	0.815	1,061
Spring/1990	(65,9,8)	83	1	0.745	847
Fall/1990	(52,34,15)	120	10	0.455	1,224
Spring/1991	(46,14,11)	76	4	0.582	776
Fall/1991	(19,10,10)	54	14	0.342	551
Downstream section (122 m):					
Fall/1989	(47,21)	82	10	0.581	672
Spring/1990	(107,31,19)	165	4	0.628	1,352
Fall/1990	(62,43,11)	130	7	0.520	1,066
Spring/1991	(30,26,13)	97	20	0.337	795
Fall/1991	———	no estimate		———	

1 Estimated number of fish in the section sampled
2 Standard error
3 Probability of capture

Table 10. Brown trout abundance in Racetrack Creek in 1989, 1990, and 1991.

Section: Season/Year	Removal pattern (1st,2nd,3rd)	N [1]	SE [2]	P [3]	Fish/km
Upstream section (91 m)					
Fall/1989	(76,21)	104	5	0.735	1,143
Spring/1990	(107,33,12)	156	3	0.688	1,714
Fall/1990	(102,22,4)	128	1	0.810	1,407
Spring/1991	(171,55,13)	244	3	0.713	2,681
Fall/1991	(204,69,51)	357	11	0.545	3,923
Downstream section (91 m)					
Fall/1989	———	no estimate			
Spring/1990	(46,6,3)	55	1	0.821	604
Fall/1990	(9,5,1)	15	1	0.682	165
Spring/1991	(34,9,5)	49	2	0.686	538
Fall/1991	(71,20,13)	109	4	0.630	1,198

1 Estimated number of fish in the section sampled
2 Standard error
3 Probability of capture

Relative changes in fish numbers seem likely to be related to fish movements associated with spawning in the fall, new recruitment, and downstream movements of fish to the Clark Fork River in the spring. These data contrast with relatively more stable population numbers in the mainstem Clark Fork River during these years (RESULTS AND DISCUSSION, section B), and emphasize the important role of tributaries in the fish population dynamics of the system. We know that at least some portion of the brown trout population spawned in these tributaries remain in the tributaries for up to two years (RESULTS AND DISCUSSION, section A).

E. Multiple-pass fish population surveys this spring in five tributaries of the Clark Fork River.

Dominant trout species in all tributaries sampled reflect differences in each stream's habitat and location in the drainage. Brook trout were most common in all three tributaries of Silver Bow Creek, although total numbers in German Gulch and Brown's Gulch were not reliably estimated

(probability of capture < 0.60). Brown trout predominated in both sections sampled in the Little Blackfoot River, and were more abundant in the downstream reach. Westslope cutthroat trout were most common in South Boulder Creek, although the probability of capture in this creek was also less than 0.60 (Table 11).

Table 11. Total trout numbers in five tributaries in the upper Clark Fork drainage sampled in the spring of 1992.

Location	Species [1]	Removal pattern (1st,2nd,3rd)	N [2]	SE [3]	P [4]	Fish/km
German Gulch	EBT	(14,6,9)	45	19	0.287	492
	WCT	(9,3,3)	16	2	0.556	175
Blacktail Creek	EBT	(97,33,10)	144	3	0.683	1,575
Brown's Gulch	EBT	(34,18)	68	13	0.510	744
Little Blackfoot	LL	(9,3)	12	1	0.800	131
Little Blackfoot	LL	(42,17)	68	7	0.628	744
S.Boulder Creek	WCT	(49,30,10)	99	6	0.527	1,083

1 EBT = brook trout, WCT = westslope cutthroat trout, LL = brown trout
2 Estimated number of fish in the section sampled
3 Standard error
4 Probability of capture

F. Brown trout age and growth based on scale collections from the Clark Fork River, selected tributaries, and the Big Hole River.

Oldest brown trout with readable scales were age 6, regardless of where fish were collected. Samples from the Clark Fork River and its tributaries were the most difficult to interpret, primarily because of the large number of regenerated scales (Table 12). Growth checks and other scale marks resembling annuli were common. Regenerated scales were less common in samples from the Big Hole River.

Table 12. Summary of scale regeneration in brown trout samples from the Clark Fork River, selected tributaries, and the Big Hole River.

Stream: Year	Some scales regenerated	All scales regenerated	No scales regenerated	Total sample	Percent regenerated scales
Clark Fork River:					
1981	20	84	244	348	29.9 *
1982	17	60	213	290	26.6 *
1983	41	44	176	261	32.6 *
1989	179	38	53	270	80.4 **
1990	375	77	16	468	96.6 **
1991	387	57	33	477	93.1 **
Rock Creek:					
1981	9	29	86	124	30.6 *
1982	8	45	167	220	24.1 *
Flint Creek:					
1991	69	11	5	85	94.1 **
Little Blackfoot River:					
1991	41	6	0	47	100 **
Big Hole River:					
1981	6	16	413	435	< 0.1 *
1982	12	30	188	230	18.3 *
1983	13	16	211	240	12.1 *
1989	2	1	241	244	< 0.1 *

* Attempts were made to mount only readable scales
** Sales were mounted without regard to scale quality

Mean lengths at annulus formation in the Clark Fork River samples were similar in all years examined ($p > 0.05$; Table 13).

Table 13. Mean length at annulus formation for brown trout sampled from the Clark Fork River.

Year		Annulus 1	2	3	4	5	6
1981	TL:[1]	138.0	197.1	263.6	330.6	378.4	-----
	SE:	11.0	14.6	16.8	18.9	22.1	-----
	N:	32	80	100	64	12	0
1982	TL:	121.0	201.8	263.8	318.4	360.7	410.3
	SE:	9.7	13.3	15.4	17.1	19.2	24.6
	N:	19	77	64	70	20	4
1983	TL:	142.3	189.8	237.9	303.0	369.8	431.4
	SE:	12.2	9.8	11.5	12.8	14.5	18.3
	N:	1	33	32	107	48	7
1989	TL:	114.5	193.6	259.8	352.7	415.2	474.1
	SE:	8.4	11.3	13.6	15.4	17.4	26.0
	N:	22	57	65	60	24	3
1990	TL:	146.9	208.2	284.4	352.6	408.9	444.7
	SE:	4.0	5.2	6.1	6.8	7.5	8.4
	N:	46	68	111	80	67	19
1991	TL:	136.5	206.4	275.4	349.5	414.5	435.2
	SE:	9.0	12.2	14.1	15.7	17.9	21.4
	N:	58	60	106	144	39	11

1 TL = total length (mm), SE = standard error (mm), N = sample size

F tests for equal slopes in age groups (a test of the linear model's adequacy for estimating lengths) were large ($p > 0.05$) for the 1982, 1990, and 1991 samples. Length estimates for these years are therefore questionable.

Mean lengths in the Clark Fork tributaries were similar to the mainstem collections ($p > 0.05$; Table 14). All tributary data were adequately described by the linear models ($p < 0.05$).

Table 14. Mean length at annulus formation for brown trout sampled from selected tributaries of the Clark Fork River.

Tributary: Year		Annulus 1	2	3	4	5	6
Rock Creek:							
1981	TL:[1]	138.0	188.1	254.9	320.2	374.4	425.3
	SE:	13.7	18.4	21.8	24.1	26.5	31.0
	N:	15	30	41	42	17	3
1982	TL:	129.4	189.0	248.6	316.5	364.4	409.6
	SE:	10.9	14.9	17.8	19.9	22.5	16.1
	N:	36	39	37	60	14	5
Flint Creek:							
1991	TL:	137.4	188.3	266.8	330.9	371.3	448.2
	SE:	22.0	28.4	32.4	36.6	38.8	48.1
	N:	6	19	25	6	17	1
Little Blackfoot River:							
1991	TL:	149.0	176.5	285.1	354.2	426.9	-----
	SE:	32.7	41.4	51.3	58.3	67.8	-----
	N:	3	18	10	8	2	0

1 TL = total length (mm), SE = standard error (mm), N = sample size

Mean length at annulus formation in samples from the Big Hole River exceeded lengths in the Clark Fork mainstem at the fourth, fifth, and sixth annulus in 1982 and 1983 ($p < 0.05$; Table 15). Mean lengths were similar in 1981 and 1989. The linear model adequately described Big Hole samples ($p < 0.05$) only in 1982.

Table 15. Mean length at annulus formation for brown trout sampled from the Big Hole River.

Year		Annulus 1	2	3	4	5	6
1981	TL:[1]	161.6	222.6	308.9	390.8	458.7	496.1
	SE:	12.6	15.0	17.9	20.0	22.3	24.7
	N:	3	38	59	79	23	10
1982	TL:	103.2	225.3	296.9	381.4	454.8	519.5
	SE:	14.6	11.1	12.4	14.1	15.6	19.2
	N:	1	21	64	56	57	13
1983	TL:	156.0	218.4	300.3	391.0	459.3	505.8
	SE:	17.7	16.9	20.0	22.8	24.8	28.3
	N:	1	36	77	60	53	9
1989	TL:	136.8	201.6	283.3	373.5	447.5	499.2
	SE:	9.5	12.7	15.2	17.4	19.4	22.7
	N:	8	56	76	59	35	10

1 TL = total length (mm), SE = standard error (mm), N = sample size

Mean length at annulus formation was similar for brown trout caught upstream (reaches 1 and 2) and downstream (reaches 8 and 9) in the Clark Fork River in 1989 ($p > 0.05$; Figure 9).

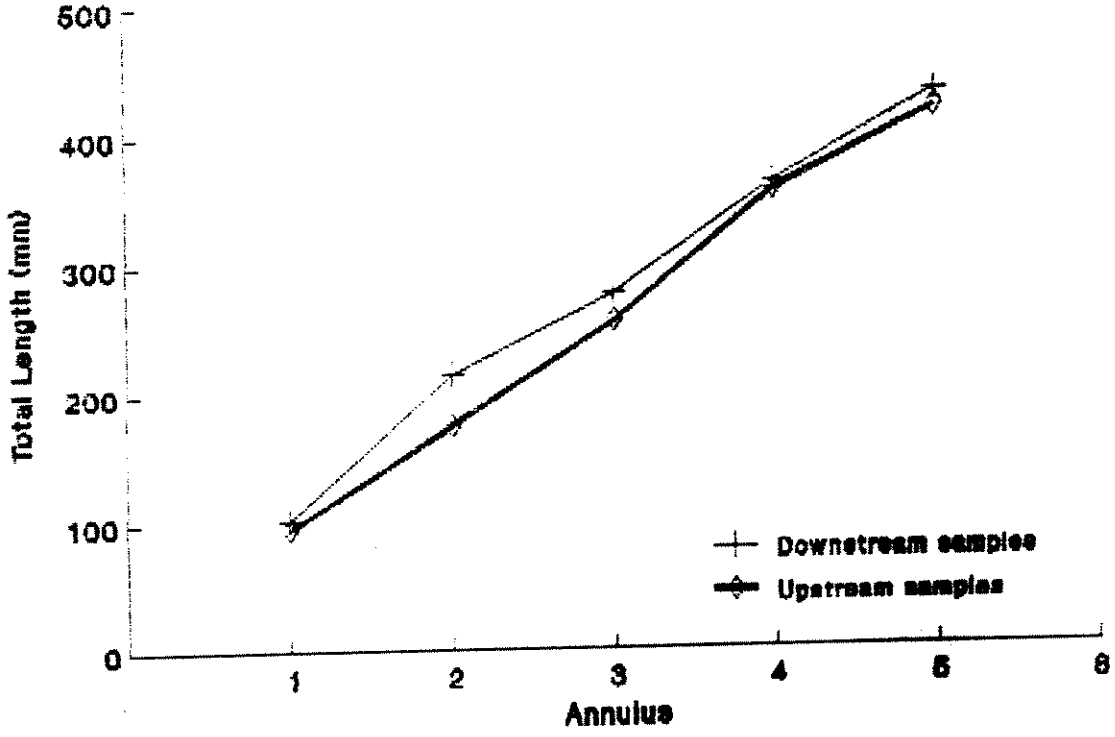

Figure 9. Mean length at annulus formation for Clark Fork brown trout caught in 1989 in upstream reaches (1 and 2), compared to same lengths for brown trout caught in downstream reaches (8 and 9).

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Waters Referred To:

Clark Fork River
Warm Springs Creek
Racetrack Creek
Silver Bow Creek
Brown's Gulch Creek
German Gulch Creek
Blacktail Creek
Little Blackfoot River
Flint Creek
Boulder Creek
South Boulder Creek
Rock Creek

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APPENDIX A

Table A1. Common names and scientific names of fish referred to in this report.

Common name	Scientific name
Brook Trout	*Salvelinus fontinalis*
Brown Trout	*Salmo trutta*
Largescale Sucker	*Catostomus macrocheilus*
Mountain Whitefish	*Prosopium williamsoni*
Rainbow Trout	*Oncorhynchus mykiss*
Redside Shiner	*Richardsonius balteatus*
Sculpin	(family: Cottidae)
Westslope Cutthroat	*Oncorhynchus clarkii lewisi*