ASARCO ROCK CREEK PROJECT

Baseline Fisheries Assessment

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ABSTRACT

The second year of this baseline fisheries project concentrated on species composition, population densities, age and growth, fish movement, spawning and some food habits. The data complemented and refined results from the previous year and are intended to assess fisheries conditions prior to development of a proposed silver mine by ASARCO, Incorporated in the Rock Creek drainage in Sanders County, Montana.

Westslope cutthroat trout (Salmo clarki lewisi), bull trout (Salvelinus confluentis), and brook trout (Salvelinus fontinalis) were collected in Rock Creek, and one rainbow trout (Salmo gairdneri). Growth rates were typical of a low productivity stream and populations were predominated by Age II westslope cutthroat trout and bull trout, and by Age I brook trout. Trout densities ranged from 3.0 to 36 fish per $100m^2$. Mayflies (Ephemeroptera), caddisflies (Trichoptera), stoneflies (Plecoptera) predominate as food items. Spawning was not directly documented due to high stream flows, but stream fish appear to be primarily resident populations with little use of the stream by reservoir fish. Upstream movement was documented for main Rock Creek along with movement between the East and West forks. Natural low flows and dewatering appeared to be a primary determinent in the distribution, density, and age composition of trout populations.

INTRODUCTION

American Smelting and Refining Company, Incorporated (ASARCO) has proposed development of a hard rock mine in the Cabinet Mountains in northwest Montana. The preferred mine site is in the Rock Creek drainage with the mine tunneling under Chicago Peak into the ore body which is within the Cabinet Mountain Wilderness area. The mine processing facilities would be located in the West Fork of Rock Creek while tailings would be piped in a slurry pipeline down Rock Creek to a tailings pond near the mouth.

This report presents the second year of baseline data and is intended to complement the first year fisheries investigation. Baseline fisheries conditions were assessed to determine conditions prior to development of the proposed hard rock mine. Parameters studied included species composition, population densities, age and growth, fish movement, food habits and spawning. The study was conducted by the Montana Department of Fish, Wildlife and Parks, Region One Fisheries Division under contract to ASARCO, Inc.

STUDY AREA

Rock Creek in western Sanders County, Montana, is a tributary of Cabinet Gorge Reservoir on the Clark Fork River. Approximately 11 kilometers (7 miles) upstream of Cabinet Gorge Reservoir, the East and West Forks combine to form the main stem Rock Creek. Several second order streams are tributary to the East Fork and West Forks (Figure 1). Rock Creek is a fourth order stream with flows normally going underground in the lower 3.3 kilometers (2 miles) during the late summer and fall. The watershed is 82.6 square kilometers (31.9 square miles) in area and provides several recreational activities. Summer activities include fishing, berry picking, hiking, and woodcutting; hunting is the dominant fall sport.

A limited fishery in the lower Clark Fork impoundments makes Rock Creek an important local fishery. Westslope cutthroat trout, bull trout, and brook trout inhabit Rock Creek; cutthroat trout are the primary fish taken by anglers. Bull trout and genetically pure westslope cutthroat trout are Species of Special Concern to the Montana Department of Fish, Wildlife and Parks because of declines in abundance and distribution statewide. These two species are the predominant residents of Rock Creek and their populations depend on maintaining quality habitat.

1.0 METHODS

1.1 - Population Estimates

Five 152m (500 foot) reaches were sampled within the same sections as the 1985 field season. Three of the sections (RC-1, RC-2, and RC-4) were on the main stem of Rock Creek with the remaining two sections on the West Fork (WF-1) and East Fork (EF-1). These reaches were chosen for resampling as the previous year's data showed fish populations in these sections (Barnard and Vashro, 1986).

All five sections were electrofished with a gas engine powered Coffelt BP2C backpack shocker. Prior to sampling, a block net of 6.3mm (1/4 inch) nylon mesh was set at the lower end of the sampling section. Fish were collected in two passes through the section with the backpack shocker, and held in live cars for processing. Fish less than 75mm (3 inches) were disregarded in the population estimate because of poor sampling efficiency. Upon completion of a pass, all fish were anesthetized, measured, weighed, and marked. Fish less than 254 mm (10 inches) total length were marked with a clip specific to a certain reach while fish 254 mm (10 inches) or longer were marked with a numbered Floy tag or jaw tag. Scales were usually taken while working the fish.

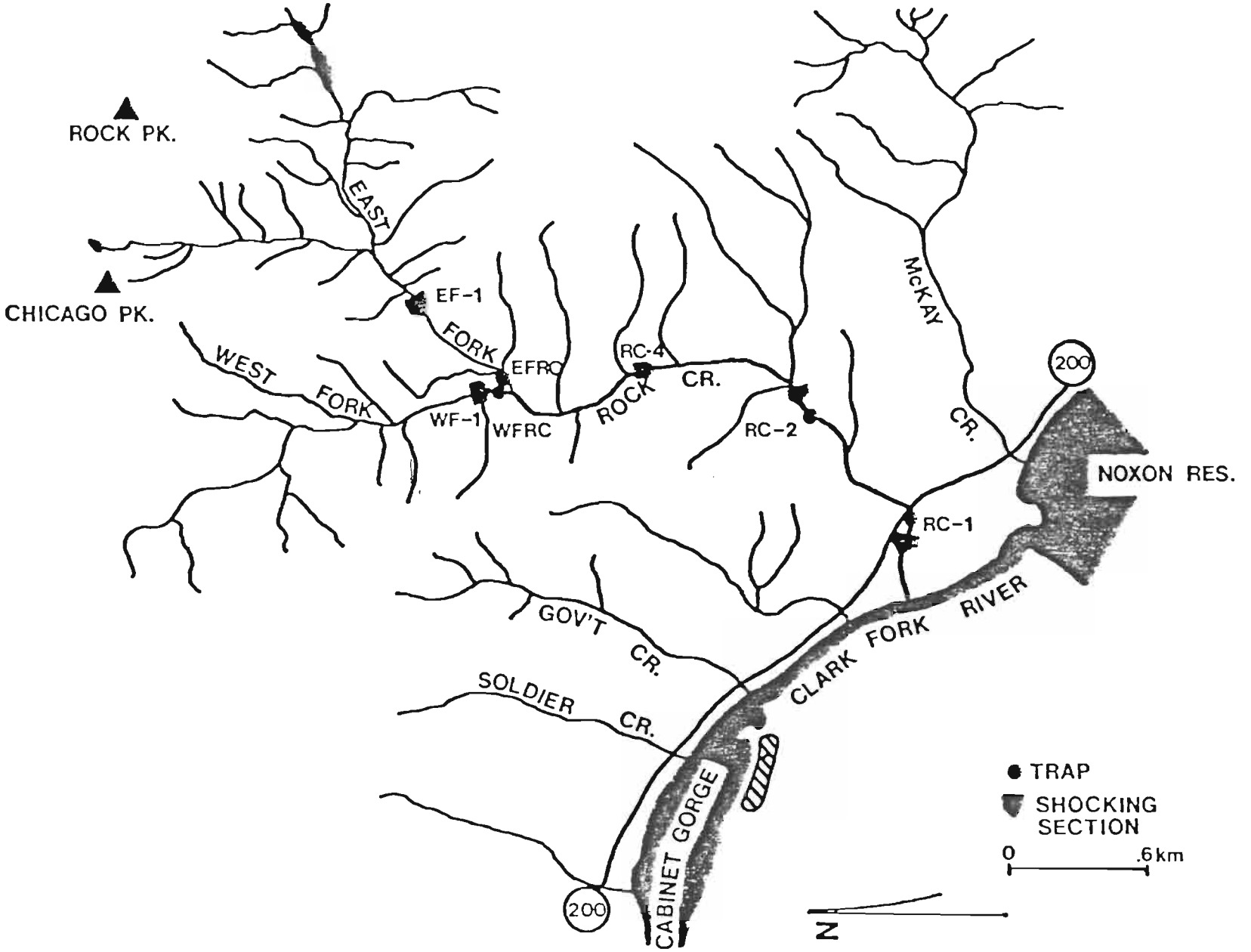

Figure 1. Location of shocking areas and trap sites on Rock Creek.

Two methods for obtaining population estimates were used. The first was the two-pass method described by Leathe (1983). Two electrofishing passes were made in a section on the same day with all fish captured during the first pass held in live cars until the second pass was completed. The number of fish in each pass was used to calculate the estimate. If the probability of capture ($\hat{p}$) was less than 0.6, the mark/recapture method was then used. For the mark/recapture estimate, all fish captured during the initial electrofishing runs were marked with a fin clip and redistributed within the sampled section. Seven to 10 days later a recapture run was done using the same methods. Mark/recapture estimates were then calculated as the ratio of marked to unmarked fish using Chapman's modification of the Peterson formula (Vincent 1971).

1.2 - Age and Growth

Scales for age and growth analyses were collected, placed in individual envelopes and labeled with the species, fish length and weight, date, stream section and means of capture. Scale impressions were made on heated acetate strips using a hydraulic press. These impressions were then aged and measured along a standard radius using a microfiche reader for back-calculation of length at annulus. Age and measurement data were stored and analyzed on a micro- computer using programs developed by Montana Department of Fish, Wildlife and Parks, Region One, Fisheries Division, Kalispell.

1.3 - Fish Movement and Spawning

Two-way box traps were installed at three sites in the Rock Creek drainage one below RC-2 and one in each stream near the junction of the West Fork (WF-1) and East Fork (EF-RC) for documentation of upstream and downstream movement (Figure 1). The boxes and leads were constructed from 12.7 mm (1/2 inch) hardware cloth. This mesh size generally captured all fish larger than 100 mm in length.

Stream discharge conditions dictated when the traps could be installed. The WF-1 trap was operational 19 May 1986, RC-2 became operational 25 June 1986 and the EFRC trap on 26 June 1986. The traps were fished until mid-October. Traps were initially checked twice daily, but one check per day became sufficient as the stream flow decreased. Trapped fish were weighed, measured, scales taken, and an identifying clip/tag put on the fish, and the fish were then released upstream or downstream as appropriate. Two fyke traps were fished in Rock Creek from 10 April 1986 to 16 August 1986, in a large pool below the culvert under Highway to assess

upstream movement. The fyke traps were able to better withstand the high flows common at this site than box traps.

The traps also provided information on possible trout spawning activity. Stream reaches with trout movement were visually searched in the spring for cutthroat trout redds and in the fall for bull trout redds.

Hook and line sampling was used during high flows to increase the sample of marked and recaptured fish. Fish caught were quickly brought in, worked, and released.

1.4 - Food Habits

Stomachs were obtained for food habits examination only from fish killed during electrofishing or from fish creeled by fishermen. The stomachs were removed and stored in a 10 percent formalin solution with labels indicating the date, stream section, species, length, and weight. Stomach contents were removed and prey items identified to order under a binocular dissecting microscope (40x). Stomach samples were analyzed to obtain qualitative data only.

2.0 RESULTS AND DISCUSSION

2.1 - Fish Populations

Westslope cutthroat trout, bull trout, and brook trout were collected in the Rock Creek drainage. Cutthroat and bull trout were distributed throughout the drainage and were the only species present in the upper watershed. Brook trout were only found in the main stem of Rock Creek. One rainbow trout was captured in RC-4. All sections had fish populations with fish greater than 75mm (3 inches), therefore population estimates were obtained at each site. Locations, sampling dates and gradient for each section are listed in Table 1.

Table 1. The gradient, locations, and electrofishing dates for the five sample sections in the Rock Creek watershed.

Section	Gradient	Location T	R	S	Marking Run	Recapture Run[1]
RC-1	2.9%	26N	32W	28,33	08/04/86	None
RC-2	1.8%	26N	32W	27	08/05/86	None
RC-4	2.5%	26N	32W	15	08/08/86	None
EF-1	5.5%	26N	32W	02	08/07/86	08/19/86
WF-1	3.6%	26N	32W	S10	07/31/86	None

[1]All samples are two-pass estimates except the EF-1 sample which used the mark/recapture method.

2.1.1 - RC-1

Section RC-1 was inhabitated by all three species. Cutthroat trout were predominant, comprising 78 percent of the estimated population (Table 2). Brook trout were next in abundance, making up 13 percent of the population with bull trout comprising the remaining 9 percent. The density of these three species was 9.2 fish per $100m^2$. A population estimate was not made in 1985 because no fish over 75mm (3 inches) were sampled. It should be noted the entire reach from Highway 200 to the mouth of Rock Creek (approximately 1 km) was completely dry by 1 September.

Table 2. Population estimates (two-pass), densities, and average total lengths (mm), weights (g), and condition factors for westslope cutthroat trout (Wct), bull trout (DV), and brook trout (EB) from area RC-1. Ninety-five percent confidence intervals and ranges are given in parentheses.

Species	Population Estimate (95% C.I.)	Density: Number per $100m^2$	Average Length (range)	Average Weight (range)	Average Condition Factor
Wct	56 (±13)	7.2	117 (88-145)	19 (9-36)	1.11
DV	6 (±1)	0.8	157 (141-172)	39 (27-54)	0.97
EB	9 (±1)	1.2	104 (66-282)	23 (5-181)	1.14
Total	71 (±15)	9.2			

The overall habitat is a shallow stream with substrate mostly of large gravel and small boulders. Larger rocks create some small pools. Limited bank cover is present, but this section of Rock Creek, when sampled, was essentially a smooth, shallow run broken by some riffles.

Man's presence is plainly visible in this area of Rock Creek. A power line right-of-way and a railroad bridge cross the streambed. From the highway to the mouth, the streambed is strewn with concrete, cable,

and other metal debris discarded in past construction activities.

2.1.2 - RC-2

Section RC-2 is inhabited by the same three fish species as RC-1 and had the second highest population density (Table 3). An estimate of 19.8 fish per $100m^2$ for all three species was calculated with the two-pass method (Table 3). This estimate is similar to an electrofishing estimate in the same general area by May (1982). However, it is considerably lower than the 32.4 fish per $100m^2$ obtained in last year's estimate (Barnard and Vashro, 1986). Cutthroat trout were the predominant species, accounting for 55 percent of the population estimate, followed by brook trout, at 40 percent, and bull trout at 5 percent.

Table 3. Population estimates (two-pass), densities, and average total lengths (mm), weights (g), and condition factors for westslope cutthroat trout (Wct), bull trout (DV), and brook trout (EB) from area RC-2. Ninety-five percent confidence intervals and ranges are given in parentheses.

Species	Population Estimate (95% C.I.)	Density: Number per $100m^2$	Average Length (range)	Average Weight (range)	Average Condition Factor
Wct	121 (±16)	10.9	134 (68-241)	32 (4-145)	1.00
DV	11 (±3)	0.9	130 (78-148)	17 (4-23)	0.75
EB	89 (±8)	8.0	118 (56-236)	24 (4-150)	1.07
Total	221 (±27)	19.8			

The section has the lowest overall gradient of 1.8 percent and is characterized by deep pools, several log jams, and excellent bank cover. The substrate varies from cobble to sand and fines (silt and clay).

2.1.3 - RC-4

Cutthroat trout, brook trout, bull trout, and one rainbow trout were found in RC-4. A total population estimate of 3.6 fish per $100m^2$ was calculated with the two-pass method (Table 4). This estimate is close to the previous year's estimate of 4.0 fish per $100m^2$. Cutthroat trout were predominant, making up 70 percent of the estimated population. Bull trout accounted for 23 percent of the estimate with brook trout and rainbow comprising the remaining 7 percent. The probability of capture ($\hat{p}$) was 0.53 which is just below the desired p of 0.6 for calculation of a two-pass estimate. However when the section was revisited for the recapture run, the stream in and around the section was reduced to a series of pools connected by trickles of water. This drastic change in stream flow violated an important assumption of no migration for use of the mark-recapture methods. Therefore the original two-pass sample was used to calculate the population estimate.

Table 4. Population estimates (two-pass), densities, and average total lengths (mm), weights (g), and condition factors for westslope cutthroat trout (Wct), bull trout (DV), brook trout (EB), and one rainbow (Rb) from area RC-4. Ninety-five percent confidence intervals and ranges are given in parentheses.

Species	Population Estimate (95% C.I.)	Density: Number per $100m^2$	Average Length (range)	Average Weight (range)	Average Condition Factor
Wct	21 (±15)	2.5	115 (98-140)	14 (9-41)	0.90
DV	9 (±4)	0.8	161 (148-172)	38 (9-41)	0.92
EB*	2	0.2	198 (196-200)	80 (77-82)	1.04
Rb**	1		230	136	1.12
Total	40	3.6			

*Only 2 fish sampled.
**Only 1 fish sampled.

Deep pools, numerous log jams and a moderate overall gradient of 2.5 percent combine to provide good habitat in this section. However, seasonal low flows and total dewatering this year only allowed seasonal use of this section. The substrate is mostly cobbles, gravels, and fines with some boulders present.

2.1.4 - West Fork (WF-1)

Cutthroat and bull trout were the only species collected in this section. The two-pass method gave an estimate of 3.0 fish per $100m^2$ (Table 5) which is somewhat lower than the 1985 estimate of 4.5 fish per $100m^2$ (Barnard and Vashro 1986). Bull trout comprised 70 percent of the population, with cutthroat making up the remaining 30 percent. This compares favorably with the earlier estimate of 82 percent bull trout and 18 percent cutthroat (Barnard and Vashro 1986).

Table 5. Population estimates (two-pass), densities, and average total lengths (mm), weights (g), and condition factors for westslope cutthroat trout (Wct), and bull trout (DV) from area WF-1. Ranges are given in parentheses.

Species	Population Estimate[a]	Density: Number per $100m^2$	Average Length (range)	Average Weight (range)	Average Condition Factor
Wct	3	0.9	168 (115-204)	43 (9-68)	1.33
DV	7	2.1	110 (78-171)	23 (4-54)	0.80
Total	10	3.0			

[a]No confidence intervals reported because no fish were captured in the second pass.

This estimate is the lowest of all sections electrofished. The West Fork is the smallest section sampled with an average width of 2.2 meters. The section is subject to seasonal low flows and was observed totally dry in late October. The habitat is good but can only be used seasonally by trout. The section was under a conifer canopy and surrounded in parts by a dense shrub community. Bank cover is excellent and small pools and log jams are common. The substrate is largely gravels and fines with some cobbles.

2.1.5 - East Fork (EF-1)

As in the West Fork, cutthroat and bull trout were the only species sampled. This section had the highest density of 36 fish per $100m^2$ (Table 6). This estimate is about three times the previous year's estimate of 12.8 fish per $100m^2$ (Barnard and Vashro 1986). Cutthroat trout are predominant, comprising 70 percent of the population estimate, with bull trout making up the remaining 30 percent.

Table 6. Population estimates (mark/recapture), densities, and average total lengths (mm), weights (g), and condition factors for westsloped cutthroat trout (Wct) and bull trout (DV) from area EF-1. Ninety-five percent confidence intervals and ranges are given in parentheses.

Species	Population Estimate (95% C.I.)	Density: Number per $100m^2$	Average Length (range)	Average Weight (range)	Average Condition Factor
Wct	245 (±58)	25.3	150 (80-219)	36 (4-91)	0.88
DV	104 (±54)	10.7	159 (109-252)	36 (9-150)	0.77
Total	349 (±112)	36			

The habitat in this section is different from any other section sampled. The steep overall gradient of 5.5 percent produces a swift, cascading stream. The substrate is coarse, but small pools are formed behind the larger rocks and log jams. Bank cover is provided by overhanging vegetation with brushy vegetation crowding the bank in several parts of the section.

2.2 - Age and Growth

2.2.1 - Westslope Cutthroat Trout

A total of 329 scales from cutthroat trout were collected, aged, and measured. The scales were taken

throughout the field season within the entire Rock Creek watershed.

The regression formula describing the predicted length at any annulus is Predicted Length = 16.29233 x scale radius $^{.8507959}$ (r = .886).

The average growth increment of Age II, III, IV, and V fish are 49 mm, 57 mm, 64 mm, and 50 mm respectively (Table 7). These data were back calculated from measurements along standard scale radii using a nomograph with a zero intercept.

Table 7. The age, average length at time of capture, and the back-calculated average length at annulus for westslope cutthroat trout in the Rock Creek watershed.

		Avg.	Average Length at Annulus				
Age	No.	Length	I	II	III	IV	V
I	48	97	70	-	-	-	-
II	87	142	70	116	-	-	-
III	160	206	71	121	176	-	-
IV	25	262	64	113	178	247	-
V	8	307	46	88	145	210	282
VI	1	413	76	114	179	266	348
Total:							
	329		69	118	175	239	289

The number and age of cutthroat trout collected for the population estimates is presented in Table 8 by sample section. Overall, Age II fish predominate the cutthroat trout populations in main Rock Creek. In sections RC-1, RC-2, and RC-4, the latter the only section with perennial flow, Age II fish were followed in abundance by Age I fish. In the uppermost section, EF-1, Age II fish were followed in abundance by Age III fish with few Age I fish, respectively. Only 3 cutthroat trout were sampled in the West Fork (WF-1); 2 were Age I and the other was Age III.

Table 8. The number and age of westslope cutthroat trout collected from each sample section in the Rock Creek study area. The percent contribution of each age class is given in parentheses. The average length is based on total length at time of capture.

Section	Age Class I	II	III	IV
RC-1	15	34	-	-
	(31)	(69)	-	-
RC-2	28	41	15	3
	(32)	(47)	(17)	(3)
RC-4	6	16	-	-
	(27)	(73)	-	-
WF-1	2	-	1	-
	(67)	-	(33)	-
EF-1	8	54	28	-
	(9)	(60)	(31)	-
All	59	145	44	3
	(24)	(58)	(17)	(1)
Avg. Length (mm)	96	130	190	256

2.2.1.1 - RC-1

The cutthroat trout in section RC-1 were all Age I and Age II fish with Age II fish predominant by a 2:1 ratio. In the 1985 field season no fish larger than 75 mm were observed in this section. The section is typically dry in the late summer or fall. This dynamic flow regime and relatively poor habitat, i.e. shallow and general lack of pools, may partially explain the change in age classes and the young age structure.

2.2.1.2 - RC-2

The age composition of cutthroat trout in section RC-2 is somewhat similar to the previous year's results. Age II fish comprised nearly 50 percent of the population, followed by Age I fish accounting for a third of the population. About half of all Age I fish were found in this section

which indicates this section may be good habitat for juveniles and subadults. The Age III composition (17 percent) was about half of the previous year's estimate (Barnard and Vashro 1986).

2.2.1.3 - RC-4

Seventy-three percent of the cutthroat trout in RC-4 were Age II with Age I trout making up the remaining 27 percent. In the previous year (Barnard and Vashro 1986), Age III fish were predominant at 63 percent followed almost entirely by Age II fish. This section had a similar age composition as RC-1. Both sections suffered from low flows and dewatering which may explain the absence of older fish.

2.2.1.4 - WF-1

West Fork (WF-1) cutthroat trout were 67 percent Age I and 33 percent Age III fish. However, the low sample size (3) probably does not allow for a quantitative analysis.

2.2.1.5 - EF-1

Cutthroat trout age class composition for section EF-1 was similar to the results from the 1985 sampling (Barnard and Vashro 1986). Age II fish were predominant in this population followed by Age III fish. In both years, Age I fish made up a small part of the population. The lack of Age I fish may be due to the high gradient (5.5 percent) and the associated high water velocities.

2.2.2 - Bull Trout

A total of 112 scales from bull trout were collected, aged, and measured. The scales were collected from bull trout throughout the Rock Creek drainage during the entire 1986 field season.

The regression formula describing the predicted length at any annulus is Predicted Length = 16.10502 x scale radius $^{.8865637}$ ($r = .809$).

The average annual growth increments of Age II and Age III fish were 50 and 64 mm respectively. The calculated growth increments for Age IV and older fish may not be reliable due to low sample sizes (Table 9). These data were generated by back calculating lengths along a standard scale radius using a nomograph with a zero intercept.

Table 9. The age, average length at time of capture and the back-calculated average length at annulus for bull trout in the Rock Creek watershed.

		Avg.	Average Length at Annulus					
Age	No.	Length	I	II	III	IV	V	VI
II	71	149	74	120	-	-	-	-
III	38	211	70	124	184	-	-	-
IV	-	-	-	-	-	-	-	-
V	2	382	74	149	206	262	370	-
VI	1	464	82	155	217	289	371	464
Total:								
	112		72	122	186	271	370	464

The number and age of bull trout collected in the population estimates is presented by sample section in Table 10. Overall, Age II fish predominate the population (76 percent) followed by Age III fish (23 percent). In the upper sections, EF-1 and WF-1, Age III bull trout made up 30 percent of the population. Age I fish are essentially absent, but this may be due to poor sampling efficiencies for smaller and younger fish. Due to small sample sizes, little can be said about bull trout in the individual sections with the exception of the East Fork. This section maintained a perennial flow and supported an excellent bull trout population, except for the absence of Age I fish.

Table 10. The number and age of bull trout collected from each sample section in the Rock Creek study area. The percent contribution of each age class is given in parentheses. The average length is based on total lengths at time of capture.

	Age Class			
Section	I	II	III	IV
RC-1	-	6 (100)	-	-
RC-2	1 (10)	9 (90)	-	-
RC-4	-	2 (100)	-	-
WF-1	-	5 (71)	2 (29)	-
EF-1	-	40 (70)	17 (30)	-
All	1 (1)	62 (76)	19 (23)	-
Avg.Lgth. (mm)	78	147	194	

2.2.3 - Brook Trout

A total of 66 scales from brook trout were collected, aged, and measured. The scales were collected in RC-1, RC-2, and RC-4 (one fish).

The regression formula describing the predicted length at any annulus is Predicte Length = 27.33523 x scale radius $^{.6854084}$ ($r = .622$).

The average annual growth increments of Age I, II, and III fish were 49 mm, 63 mm, and 91 mm respectively (Table 11). Part of these data were from brook trout collected in RC-1, a section that typically becomes dewatered. Possibly these fish were from Cabinet Gorge Reservoir. The largest brook trout, 282 mm and Age IV, was collected in RC-1 and had the largest average growth increment of 91 mm.

Table 11. The age, average length at time of capture and the back-calculated average length at annulus for brook trout (EB) in the Rock Creek watershed.

Age	No.	Avg. Length	Average Length at Annulus I	II	III	IV
I	42	107	78	0	0	0
II	15	148	80	123	0	0
III	8	206	79	130	187	0
IV	1	282	89	193	223	282
Total:	66		79	128	191	282

The age and number of brook trout collected for the population estimates by sample section is given in Table 12. Age I fish predominate in all sections, with the exception of RC-4, comprising 71 percent of the population. Age II and Age III fish make up 20 and 10 percent of the population respectively. Interestingly, the age class structures in RC-1 and RC-2 are nearly identical, yet RC-1 typically becomes dewatered in the late summer and fall and the RC-2 section has perennial flows.

Table 12. The number and age of brook trout (EB) collected from each sample section in the Rock Creek study area. The percent contribution of each age class is given in parentheses.

Section	Age Class I	II	III
RC-1	10 (71)	3 (21)	1 (7)
RC-2	67 (71)	18 (19)	9 (10)
RC-4	- -	- -	1 (100)
All	77 (71)	21 (19)	11 (10)
Average length (mm)	96	146	213

2.3 - Spawning

Spawning still has not been documented in the Rock Creek drainage. High flows in the spring made it virtually impossible to observe cutthroat redds or maintain a trap to monitor possible spawning movement. Fyke traps, placed below the culvert at Highway 200, captured only one cutthroat trout. However, some inferences on spawning can still be made from observations and the limited data collected.

Populations of westslope cutthroat trout and brook trout appear to be permanent residents of Rock Creek. Most bull trout are residents of Rock Creek, but it does appear that fish larger than 380 mm are migrants from Cabinet Gorge Reservoir. Adequate spawning habitat appears to exist in the drainage, especially in the RC-2 section (Barnard and Vashro 1986). The use of Rock Creek by spawning runs originating in Cabinet Gorge Reservoir is probably limited. A small waterfall of approximately 2m drop exists about 50m upstream from the mouth of Rock Creek and this waterfall may limit access to the stream. The waterfall is the result of a log jam, but the Forest Service notched the log in 1986 as part of their barrier removal program. The ephemeral nature of flows in Rock Creek would make it difficult for a species to establish a permanent spawning run. It is suspected that some trout from Cabinet Gorge Reservoir do spawn in Rock Creek. A 69.5cm (27 inch) bull trout that appeared to be from Cabinet Gorge Reservoir because of its size, was caught in the upstream trap at RC-2. May (1982) and Barnard (Barnard and Vashro 1986) both caught large bull trout in the main stem Rock Creek. Electrofishing in the mouth of Rock Creek in late October, 1986 found large brown trout. Huston (personal comment, 1986) also reported observing bull trout and brown trout redds in the Rock Creek delta.

2.4 - Fish Movement

The three trap sites in Rock Creek provide some data on fish movement. The data indicate mainly upstream movement of cutthroat trout with the exception of the West Fork (WFRC) trap (Table 13). In the West Fork of Rock Creek, bull trout accounted for most of the upstream movement. Downstream fish movement may not have been observed due to the difficulty of trapping during periods of high water when most downstream movement would be expected. The traps also selected for larger fish as smaller fish could pass through the wire mesh.

Table 13. The number of captures, direction of movement, species composition, and average total length (mm) of all fish captured at the three trap sites. Percent composition and size ranges are given in parentheses.

	Captures		Species Composition			Lengths		
Location	Upstream	Downstream	Wct	DV	EB	Wct	DV	EB
RC-2	15	5	15 (75)	3 (15)	2 (10)	200 (145-272)	368 (150-695)	173 (145-200)
EFRC	225	4	198 (86)	31 (14)	-	208 (144-305)	206 (127-385)	-
WFRC	63	8	27 (38)	44 (62)	-	181 (100-236)	165 (116-244)	-

2.4.1 - West Fork of Rock Creek

The WFRC trap became operational 19 May 1986 and was taken out of operation 16 October 1986. A total of 71 fish were captured; 44 bull trout and 27 cutthroat trout (Table 14). The highest total fish movement was in June with 14 cutthroat and 11 bull trout moving upstream through the trap. However, August had the highest bull trout movement as 19 moved upstream along with 1 cutthroat trout. Downstream movement was very low, with only 2 bull trout and 3 cutthroat captured in 5 months. Some movement within the section was observed as 1 cutthroat and 1 bull trout passed through the trap in both directions.

Table 14. The month, species captured, direction of movement (upstream/downstream), and recaptures for the West Fork trap site.

	Captures		
Month	WCT	DV	Recaptures
May	3/2	1/1	1 Wct and 1 DV--movement within the reach
June	14/1	11/1	
July	8/0	4/0	
August	1/0	19/0	
Sept.	0/0	3/0	

WCT = westslope cutthroat trout; DV = bull trout

2.4.2 - Rock Creek

The trap in the RC-2 section recorded the least activity with only 20 fish captured (Table 15). Cutthroat was the species caught most, followed by brook trout and bull trout. The trap was operational from 25 June 1986 until 16 October 1986.

Table 15. The month, species captured, direction of movement (upstream/downstream) and recaptures for the RC-2 trap site.

	Captures			
Month	WCT	DV	EB	Recaptures
June	2/3	1/0	1/0	
July	7/0	1/1	1/0	1 Wct from RC-1-- tagged 15 June 1986
August	0	0	2/1	1 Wct movement within the reach

WCT = westslope cutthroat trout; DV = bull trout; EB = brook trout

Some movement between sections was observed. A westslope cutthroat trout, 262mm in length, tagged 15 June 1986 in a large pool above the upper end of RC-1, was captured in the upstream trap at RC-2 on 3 July 1986, a distance of about 3 km (1.5 miles). A bull trout, 695mm in length, that appeared to originate from Cabinet Gorge Reservoir because of its large size was captured in the upstream trap on 12 July 1986.

2.4.3 - East Fork

Most fish movement was observed at the East Fork (EFRC) trap site (Table 16). The trap was operational from 26 June 1986 until 12 October 1986. Most movement occurred in July with 152 fish captured as they moved upstream. The capture rate dropped in August but cutthroat trout were still the main species moving upstream. In September, almost all movement was by bull trout moving upstream. Instream movement was noted with the capture of two cutthroat trout and one bull trout originally marked in the West Fork of Rock Creek. While electrofishing

at EF-1, two cutthroat trout and one bull trout were collected that had been marked as they moved upstream through the East Fork trap, about 1.5km downstream.

Table 16. The month, species captured, direction of movement (upstream/downstream), and recaptures for the East Fork trap site.

	Captures		
Month	WCT	DV	Recaptures
June	16/0	0	
July	138/2	14/1	1 Wct within stream movement 1 Wct, 1 DV from WFRC
August	36/0	5/0	1 Wct from WFRC
September	1/0	11/0	1 DV from WFRC

WCT = westslope cutthroat trout; DV = bull trout

2.5 - Food Habits

Fourteen stomachs were collected and examined from fish in Rock Creek. Westslope cutthroat trout stomachs contained insects from the following taxa: Ephemeroptera (mayflies), Trichoptera (caddisflies), Plecoptera (stoneflies), with some Homoptera (leaf hoppers) and Diptera (true flies). Bull trout stomachs contained Trichoptera, Plecoptera, and Homoptera.

3.0 SUMMARY AND CONCLUSIONS

Westslope cutthroat trout and bull trout were well distributed throughout Rock Creek drainage. Brook trout and one rainbow trout were found in main stem Rock Creek. The upper section (EF-1) had the highest density of cutthroat and bull trout. Brook trout were most abundant in RC-2. One rainbow trout was captured in RC-4, as well as a brook trout; neither species were observed in the section the previous year.

Fish growth in Rock Creek is typical for a low productivity mountain stream. Most westslope cutthroat trout and bull trout are Age II while most brook trout are Age I. Low numbers of Age I fish could be due to sampling inefficiency for small fish. The perennially flowing sections, RC-2 and EF-1, supported fish of Ages I-IV, whereas, in general the sections with ephemeral flows held predominately younger

fish, Ages I and II. The virtual absence of Age I cutthroat and bull trout should warrant further study.

The evidence indicates that Rock Creek is used by low numbers of adfluvial fish. Possible stream barriers and the ephemeral nature of flows in some reaches would make it difficult for fish to establish a permanent spawning run. High flows made it impossible to hold traps for downstream migration documentation or to observe redds. Trout redds have been observed in the Rock Creek delta.

Movement within a reach and upstream was documented for westslope cutthroat trout and bull trout. Bull trout moved between the West Fork and East Fork and moved 1.5 km upstream of the trap on the East Fork. One westslope cutthroat trout moved upstream approximately 3 km from a pool above RC-1 to the trap at RC-2. The bull trout captured at RC-2 (695 mm) and May's (1982) confirmation of large bull trout in this section indicates adfluvial fish movement into Rock Creek. The trap in the East Fork had the most fish movement of all traps. Most movement was upstream and was probably due to the extensive dewatering downstream of the trap. The stream was walked from just below the trap (approx. 25m) to downstream about 3.0km (approx. 2 miles) and confirmed dry in August. Area RC-1 was also dry in late August. The West Fork went dry by mid-October.

Insects were collected from trout stomach samples and were identified from the following taxa: Ephemoptera (mayflies), Trichoptera (caddisflies), Plecoptera (stoneflies), Homoptera (leaf hoppers) and Diptera (true flies). These food items were identified in bull trout and westslope cutthroat trout stomachs.

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