Fish Surveys of the Upper Dupuyer Creek Drainage and Cow Creek Conducted During 2003

David Moser
Montana Fish, Wildlife and Parks
Region 4
4600 Giant Springs Road
Great Falls, Montana 59405

September 2003

Executive Summary

This report summarizes fish survey information collected in upper Dupuyer Creek and its forks in 2003. This report will provide some of the background information necessary to prepare the forthcoming Draft Environmental Impact Statement for the Blackleaf Oil and Gas Project Area. Westslope cutthroat trout (WCT) were widely distributed in the upper reaches of the South Fork (SF) and the North Fork (NF) Dupuyer creeks. WCT were not found in the lower reaches of NF Dupuyer Creek and at three sites in Dupuyer Creek (one large WCT adult was found at km 2.7 of Dupuyer Creek). In the middle reaches of the NF, WCT were found in low numbers in sympatry with brook trout (EB). In the upper reaches of the NF, where brook trout were not present, numbers of WCT exceeded 25 fish per 100 m of stream. In SF Dupuyer, WCT in allopatry were widely distributed and abundant (6-19 fish per 100 m of stream; average = 14.6). The Middle Fork (MF) of Dupuyer supported a small and localized population of WCT. MF fishes are likely heavily reliant, especially in drought years, on an irrigation diversion pond for over-wintering and late summer habitat. Populations of WCT in all three streams are protected from non-native fishes (in part in the NF) by physical barriers. Brook trout in allopatry were abundant in Dupuyer and the lower sections of the NF. In the middle reaches of the NF, both EB and WCT in sympatry were found in low numbers (combined totals less than totals of either EB or WCT at upstream and downstream sites in allopatry). Rainbow trout (RBT) were found in the two lower most sections sampled in Dupuyer Creek. All RBT captured were large individuals. No WCT were captured at any of the sampling sites in Cow Creek. In 2000, Cow Creek supported a small population of nearly pure WCT. It is not known whether the WCT population in Cow Creek is extinct or we were just unsuccessful in locating individuals. Stream temperatures exceeded 20C on numerous occasions in Dupuyer Creek during July and August. Stream temperatures exceeded 20C on numerous occasions in Cow Creek during July. Stream temperatures in NF, MF and SF Dupuyer creeks were generally below levels stressful to salmonids. Stream habitat surveys indicated habitat quality was variable and site specific. Qualitative assessments of stream habitat referenced against other small stream habitats found throughout the Rocky Mountains tended to produce low habitat scores. Rocky Mountain Front streams appear to be less productive and have a flashier hydrologic regime than other streams in the Rocky Mountains west of the continental divide. Thus, low qualitative scores and low quantitative measures (e.g. pool frequency) in most cases are more a result of local geology and climate than anthropogenic influences. However, low habitat scores do indicate that these streams (and their native fish populations) likely have little capacity to tolerate human caused environmental perturbations.

Table of Contents

List of Figures

List of Tables

Introduction

Montana Fish, Wildlife and Parks (MFWP) was contracted by the United States Forest Service `and the Bureau of Land Management to conduct fish surveys in streams known to support westslope cutthroat trout within and near the proposed Blackleaf Oil and Gas Project Area. These surveys were done during 2003 to provide information for a forthcoming Draft Environmental Impact Statement.

Study Area

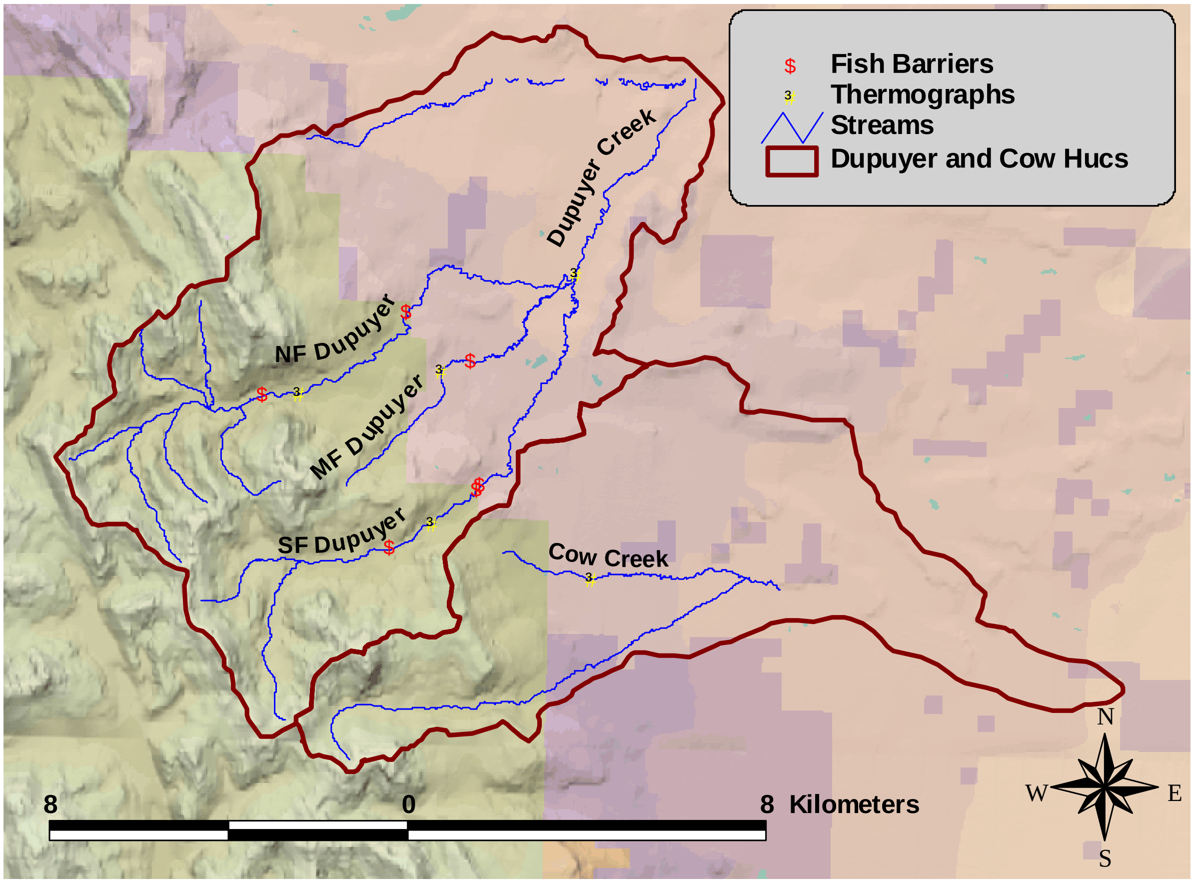
The streams surveyed included Dupuyer, North Fork Dupuyer, Middle Fork Dupuyer, and South Fork Dupuyer creeks (Two Medicine Drainage) and Cow Creek (Teton River Drainage) (Figure 1). Dupuyer Creek supported rainbow trout *(Oncorhynchus mykiss)*, brook trout *(Salvelinus fontinalis)*, westslope cutthroat trout *(Oncorhynchus clarki lewisi)*, longnose dace *(Rhinichthys cataractae)*, and sculpin *(Cottus* sp*.)*. The North Fork of Dupuyer supported westslope cutthroat trout *(Oncorhynchus clarki lewisi)*, brook trout *(Salvelinus fontinalis)*, and sculpin *(Cottus* sp*.)*. South Fork Dupuyer and Middle Fork Dupuyer supported westslope cutthroat trout *(Oncorhynchus clarki lewisi)*. Cow Creek supported longnose dace *(Rhinichthys cataractae)*, northern redbelly dace *(Phoxinus eos)*, lake chub *(Couesius plumbeus)*, white sucker *(Catostomas commersoni)*, and sculpin *(Cottus* sp*.)*.

Methods

A systematic sampling scheme was employed to estimate both the relative abundance and distribution of fishes and to quantify stream habitat characteristics. Methods and reporting format follow closely those used by Shepard (2001) in surveys of the South Fork Judith River. Sample sections ranging from 58 to 240 m were surveyed at a frequency of approximately every 0.8 km (0.5 mile) of stream length by single pass electrofishing with backpack Smith-Root electrofishers (Models SR-12A and SR-12B). At approximately 3.2 km (2 mile) intervals, we conducted depletion population estimates (Van Deventer and Platts 1985; Figure 2).

Sample section lengths were at least 30 times the average wetted stream width. Sample sites were referenced by mile above the stream's mouth, and later converted to kilometers above the mouth using X-Y data (UTM) obtained from a global positioning system (GPS; Garmin eTrex Venture). Field acquired GPS sampling locations were input as a shapefile in ARCVIEW (Version 3.2; Environmental Systems Research Institute, Inc.) to overlay a 1:100,000 stream hydrography layer (Figures 1 and 2).

Length (total length in mm) and weight were recorded for captured salmonids at population estimate sections. At relative abundance stations, lengths of fish were classified into one of three size classes (<75 mm, 75-150 mm, >150 mm). For depletion population estimates to provide reasonable results, we assumed that field-calculated probabilities of capture (calculated as 1-(C2/C1); where C1 = number captured on the first pass, and C2 = number captured the second pass) had to be 0.80 or higher (c.f., White et al. 1982; Riley and Fausch 1992).



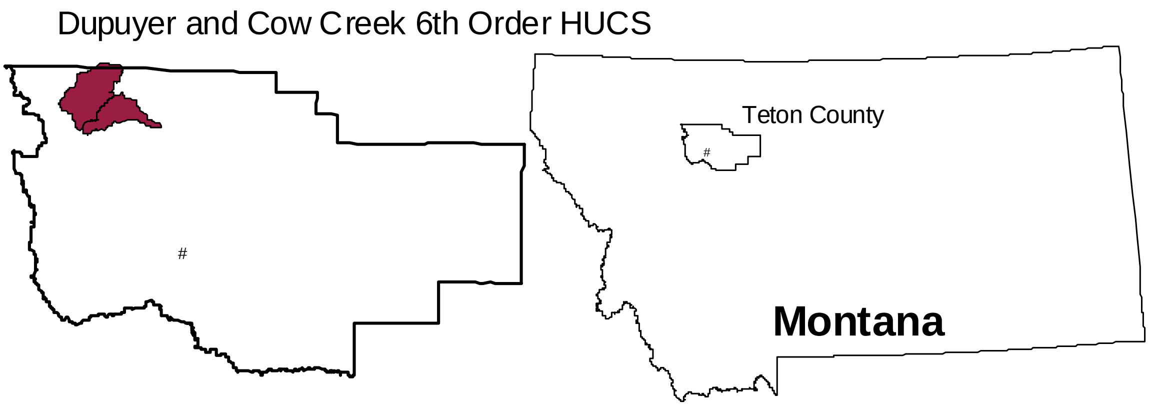


Figure 1. Map of upper Dupuyer Creek, its forks, and Cow Creek showing locations of thermographs and fish barriers.

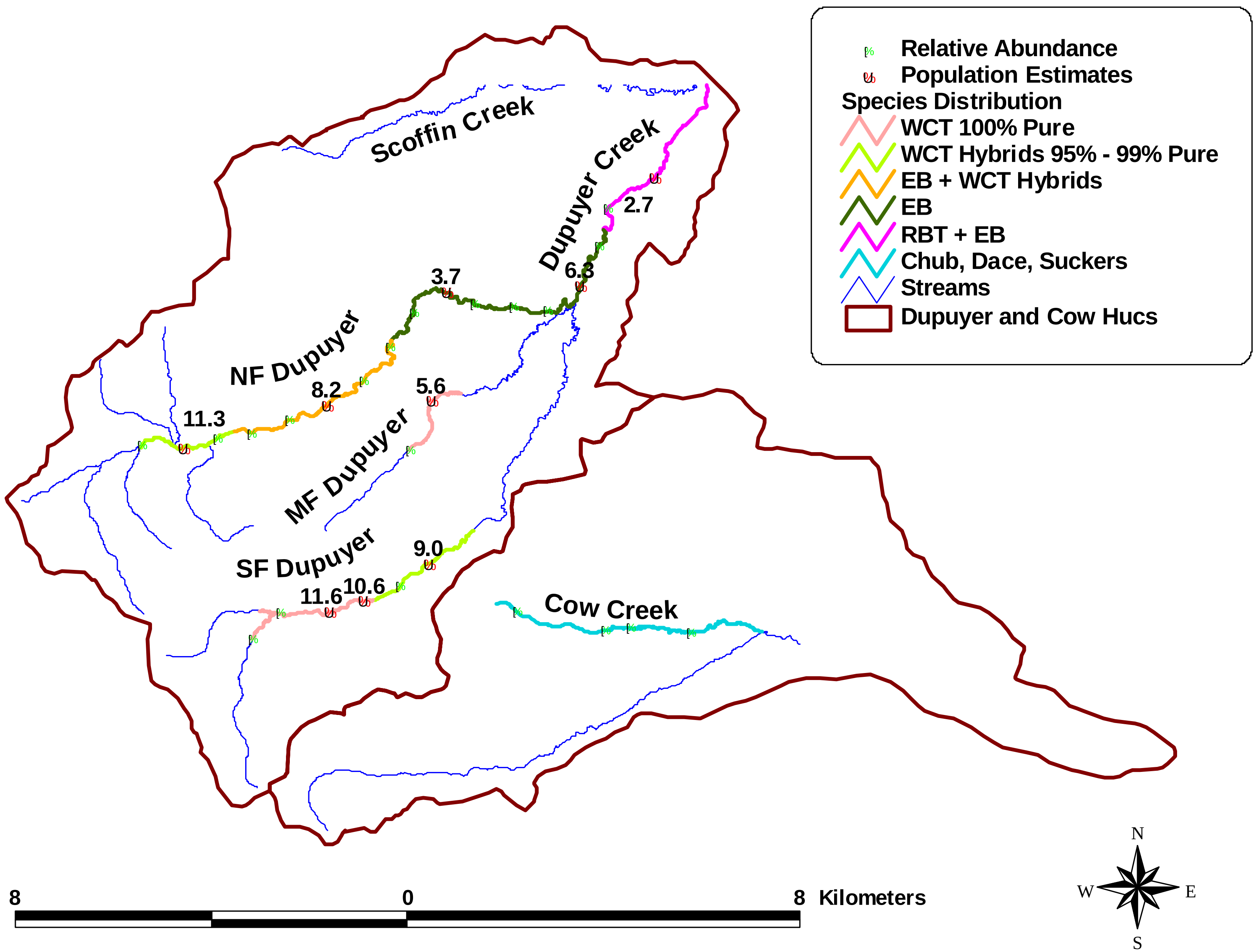


Figure 2. Map of streams sampled in upper Dupuyer Creek drainage and Cow Creek showing sampling sites, type of sampling and fish distribution.

If field calculated probabilities of capture were less than 0.80 after two passes, additional electrofishing passes were usually made. Population estimates were calculated using a maximum-likelihood estimator within the MICROFISH program (Van Deventer and Platts 1985) by species for fish 75 mm and longer. Populations estimates of fish 75 mm and longer were standardized per 100 m of stream length. Relative fish abundance was calculated as the number of fish 75 mm and longer per 100 m of stream length captured in the first electrofishing pass. Capture probabilities at one station (Dupuyer 6.2) were not adequate to present maximum-likelihood population abundance estimates; in this instance, relative abundances are reported along with length frequency data.

Fin samples from westslope cutthroat trout were taken for genetic analyses. Samples were collected from one location at NF Dupuyer Creek (n = 25), one location at MF Dupuyer Creek (n = 7), and two locations at SF Dupuyer Creek (n = 25 each; above and below fish barriers). The University of Montana, using Paired Interspersed Nuclear DNA Element-PCR (PINE) tests, will determine genetic status from these fin clips; however results were not available at the time this report was completed.

Site level habitat surveys were conducted at 3.2 km (2 mile) intervals in sample sections where fish population estimates were made. The following information was collected for each macrohabitat type (pool, riffle, or run) within a sample section: length of the macrohabitat type; wetted and channel width (width of normal bank-full channel), measured at a single location which represented an average width and depth of a habitat type; average depth, estimated by taking three depth measurements at equal distances across the single cross section where width was measured and dividing by 4; average maximum pool depth using 4 maximum (thalweg) depths measured longitudinally down the channel and averaged; residual pool depth and volume were estimated using the average maximum depth of the pool minus the maximum depth of the adjacent downstream habitat unit, along with the surface area of the pool for volume (Lisle 1987). Over the entire sample section the following information was collected: surface area of suitable spawning habitat (defined as patches of substrate dominated by material 10 to 30 mm which cover at least 0.5 m^2); number of large (>15 cm in diameter) and small (<15 cm in diameter) woody debris within the stream channel; qualitative assessment of stream bank condition that ranked relative stability from low to high (and described the composition of the stream bank and the source of instability); qualitative assessment of instream cover which ranked relative amount of instream cover from a low to high proportion of water volume with cover; qualitative assessment of bank overhead cover which ranked the amount of water's surface which is covered or shaded; estimate of surficial streambed composition size class in percentages by class; qualitative assessment of relative use of riparian areas by livestock or wildlife. Photographs were taken of typical habitat during site level habitat surveys (Appendix A).

Continuously recording digital thermographs (Optic StowAway Temp, Onset Computer Corporation, Pocasset, Massachusetts) were used to record water temperatures in Dupuyer, NF Dupuyer, MF Dupuyer, SF Dupuyer and Cow creeks (Figure 1). Thermographs were set to record temperature every hour. During mid-June, thermographs were placed in well-mixed pools, shielded from direct solar radiation, and left to record stream temperatures until mid-September. Daily stream temperatures were summarized in daily average, maximum, and minimum recorded temperatures and plotted for each thermograph site.

Results

Dupuyer Creek

Dupuyer Creek was sampled 2.7 km upstream of its confluence with Scoffin Creek to the confluence of the three forks of Dupuyer (all three forks converge at the same location). In this reach of stream, the valley is unconfined with a large undefined floodplain, channel gradient is low and riparian vegetation consists of sparsely distributed willows, dogwood and some small and large deciduous trees. Stream habitat consisted of long sections of low gradient riffle interspersed with some deeper pools. This reach of Dupuyer has very little woody debris. Fish distribution and relative abundance was assessed at river kilometers 2.7, 3.9, 5.1, and 6.3. Fish population estimates were conducted at kilometers 2.7 and 6.3 (estimates for 6.3 are not reported because of poor capture efficiencies). Habitat surveys were conducted at kilometers 2.7 and 6.3 (just downstream of fish survey segment at 2.7).

A thermograph recorded water temperatures in Dupuyer at river km 6.4 (Figure 1). Average water temperatures below the confluence of the three forks reached 18.0 degrees and were generally between 15 and 20 C during the summer months. Maximum water temperatures exceeded 20 C frequently during July and August (Figure 3).

Brook trout (EB), rainbow trout (RBT), longnose dace, numerous sculpin, and 1 westslope cutthroat trout (WCT) were captured in Dupuyer Creek. There were twice as many brook trout as rainbow trout in section 2.7 (8.9 EB and 4.4 WCT > 75 mm per 100 m of stream length). RBT were found in the two downstream sampling sections (2.7 and 3.9). Only EB were found in the two upstream sampling sections (km 5.1 and 6.3). All RBT captured were > 150 mm in length. Densities of EB in the first three sampling sections were less than 10 per 100 m of stream length (Table 1; Figure 4 and 5). Densities at stream km 6.3 were higher than 10 fish per 100 m of stream (total number of fish captured per 100 m after three passes = 14.5; capture efficiencies did not allow calculation of a SE). A 180 m sample section located at river km 2.7 supported an estimated 10 (SE: 0.9) and 6 (SE: 0.7) EB 75-150 mm and 151 mm and longer, respectively, and supported an estimated 8 (SE: 3.0) RBT 151 mm and longer. Length of EB captured at river km 2.7 ranged from 61 to 230 mm. Length of RBT captured ranged from 173 to 261 (Table 2 and 3).

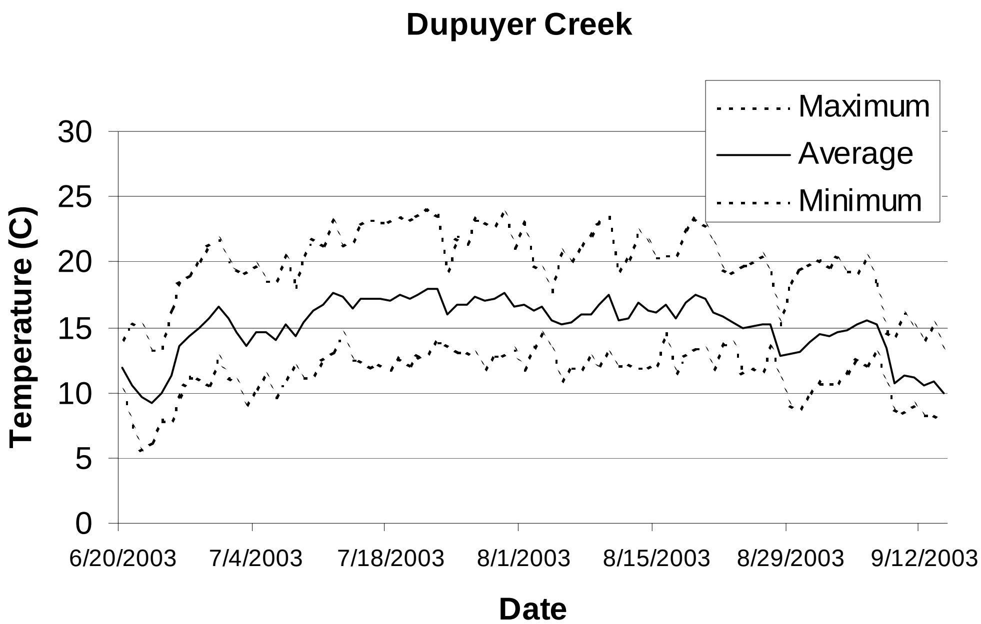


Figure 3. Average, minimum, and maximum water temperatures in Dupuyer Creek immediately downstream of the confluence of all three Dupuyer forks at km 6.4.

Habitat surveys were conducted at km 2.7 and 6.3. At km 2.7, the streambed was comprised primarily of large gravel making up about 80% of the streambed's surface. Small gravel and silt made up the remainder of the streambed's surface in equal proportions. At km 6.3, streambed composition was identical save that the proportion of silt was 10% greater (20%, remainder of total). Small and large woody debris was very scarce in both sections. There were approximately 40 pieces of small woody debris per 100 m at km 6.3. Small woody debris consisted almost entirely of decaying willows in pool habitats. Spawning habitat was poor at km 2.7 and extremely poor at km 6.3. Spawning gravel and larger substrates were embedded approximately 50% (Table 4). Pool habitats made up 36% by number and 28% by length of all habitat types at km 2.7; 33% by number and 28% by length at km 6.2. Wetted width averaged 6.0 and 5.8 m at km 2.7 and 6.3. Average residual pool volumes at km 2.7 and 6.3 were 45.0 and 26.9 m^3, respectively, average depths of pools were 0.5 and 0.6 m (Table 5). Instream cover, bank stability, and bank cover were poor for both habitat sections. There was little to no riparian use in section 2.7. Riparian use in section 6.3 was heavy with obvious bank trampling and erosion caused by livestock (Table 6).

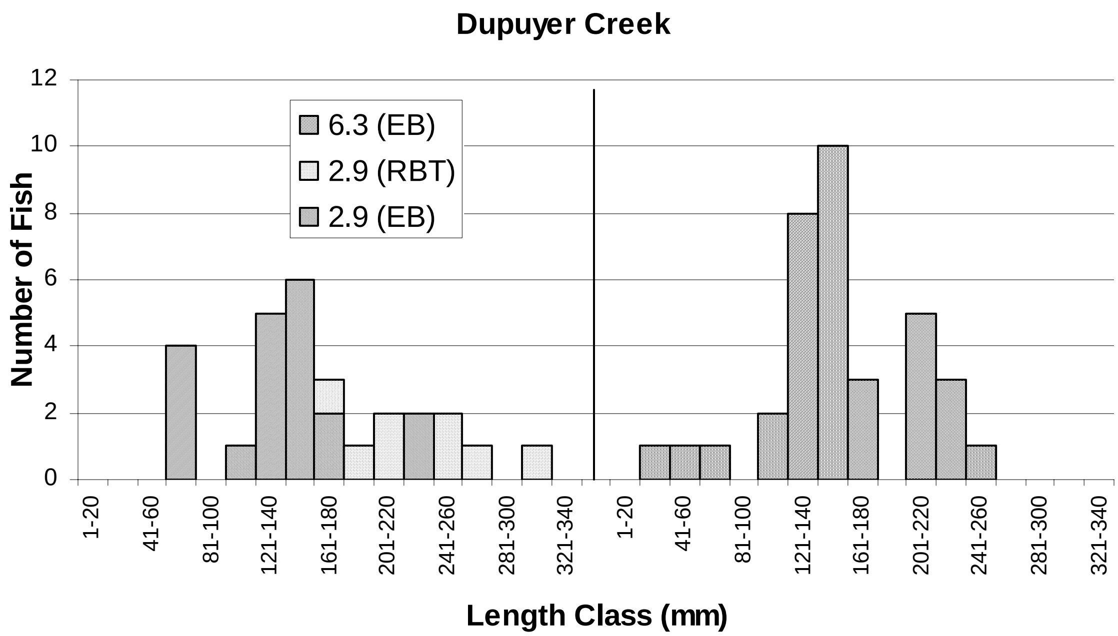


Figure 4. Length frequencies of rainbow trout (RBT) and brook trout (EB) captured at two sites on Dupuyer Creek during 2003.

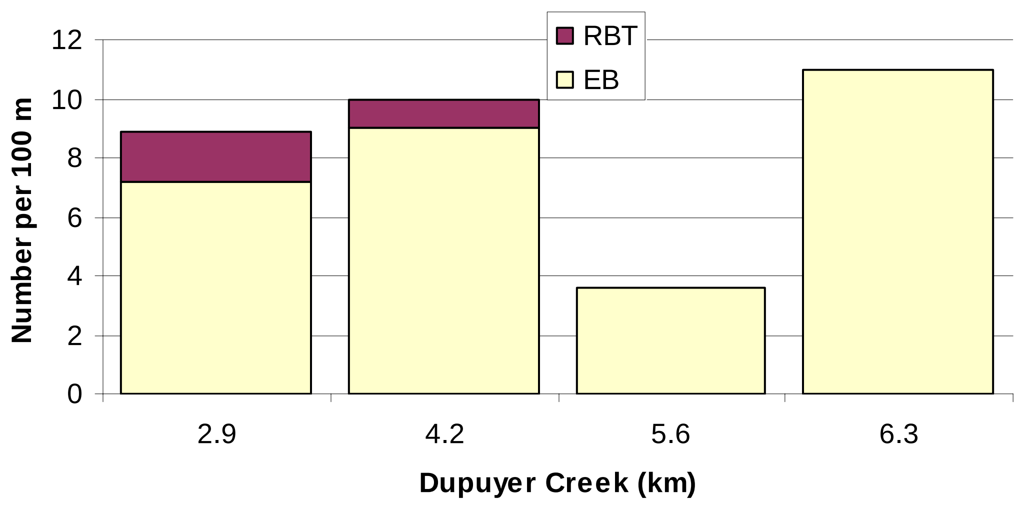


Figure 5. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) for rainbow trout (RBT) and brook trout (EB) in four sections of Dupuyer Creek.

Table 1. Relative abundance by size class of fish captured during fish sampling in Dupuyer Creek and its forks and specific conductance (*u*S) by stream and stream kilometer, and date.

Stream km	Date	Species	Section Length (m)	Cond. (*u*S)	Relative abundance per 100 m <75 mm	75-150 mm	151 +
Dupuyer Creek							
2.7							
	7/14/2003	EB	180	380	1	4	4
	7/14/2003	RBT	180		0	0	2
3.9							
	7/14/2003	EB	100	390	0	5	5
	7/14/2003	RBT	100		0	0	1
5.1							
	7/14/2003	EB	110	390	0	4	0
6.3							
	7/15/2003	EB	240	380	0	3	2
MF Dupuyer Creek							
5.6							
	7/21/2003	WCT	58	360	0	10	2
6.8							
	7/21/2003	WCT	75	400	0	0	0
NF Dupuyer Creek							
1.0							
	7/15/2003	EB	100	320	0	2	0
1.6							
	7/15/2003	EB	90	320	1	8	3
2.7							
	7/15/2003	EB	90	300	0	2	0
3.7							
	7/15/2003	EB	127	310	2	17	5
4.7							
	7/15/2003	EB	120	310	0	8	1
6.0							
	7/16/2003	EB	120		0	0	3
	7/16/2003	WCT	120	310	0	0	1
7.2							
	7/16/2003	EB	120	300	0	3	0
	7/16/2003	WCT	120		0	1	0
8.2							
	7/16/2003	EB	140	310	0	2	2
	7/16/2003	WCT	140		0	1	1
9.2							
	7/16/2003	EB	90	290	0	1	0
10.1							
	7/16/2003	EB	90	270	0	3	0

10.9							
	7/16/2003	WCT	119	280	0	0	1
11.3							
	7/16/2003	WCT	90	270	0	12	13
12.6							
	7/16/2003	WCT	100	270	0	2	1
SF Dupuyer Creek							
9.0							
	7/22/2003	WCT	140	290	1	4	11
9.8							
	7/22/2003	WCT	110	310	0	3	15
10.6							
	7/23/2003	WCT	138	300	0	7	12
11.6							
	7/23/2003	WCT	109	290	0	9	6
12.4							
	7/23/2003	WCT	100	290	0	3	3

Table 2. Catch of brook trout (EB), rainbow trout (RBT), and westslope cutthroat trout (WCT) per electrofishing pass, estimated number per section (standard error; SE), and section length (m) by stream, stream kilometer (km), species, and date during 2003.

Stream km	Date	Species	Section Length (m)	Catch per pass 1	 2	 3	Estimate	SE
Dupuyer Creek								
2.7	7/14/2003	EB	180	12	2	2	16	0.7
2.7	7/14/2003	RBT	180	3	2	2	8	2.9
2.7	7/14/2003	WCT	180	0	0	1	1	
MF Dupuyer Creek								
5.6	7/21/2003	WCT	58	7	0		7	0.0
NF Dupuyer Creek								
3.7	7/15/2003	EB	127	27	5		32	1.0
8.2	7/16/2003	EB	140	6	1	0	7	0.1
8.2	7/16/2003	WCT	140	2	2	0	5	0.8
10.9	7/16/2003	WCT	119	23	4		27	0.9
SF Dupuyer Creek								
9.0	7/22/2003	WCT	140	22	4		26	0.9
10.6	7/23/2003	WCT	138	27	3		30	0.6
11.4	7/22/2003	WCT	109	16	2		18	0.5

Table 3. Population estimates and standard errors (SE) from Upper Dupuyer Creek and its forks during 2003 by stream kilometer, date, species, and length group. Blanks indicate estimates could not be made because catches did not decrease on subsequent passes.

Stream km	Date	Section length	Species [Passes]	Estimate (SE) by Length <75 mm	75-150	150 + mm	Length Range Min	Max	Total (75 mm +) (SE)	Estimated number/ 100 m	Hectare
Dupuyer Creek											
2.7											
	7/14/2003	180	EB 3		10 (0.9)	6 (0.7)	61	230	16 (0.7)	9	162
	7/14/2003	180	RBT 3	0 (0.0)	0 (0.0)	8 (3.0)	173	261	8 (2.9)	4	81
	7/14/2003	180	WCT 3	0 (0.0)	0 (0.0)		310	310	1	1	10
MF Dupuyer Creek											
5.6											
	7/21/2003	58	WCT 2	0 (0.0)	6 (0.0)	1 (0.0)	87	181	7 (0)	16	1,286
NF Dupuyer Creek											
3.7											
	7/15/2003	127	EB 3	4 (0.6)	26 (1.1)	1 (0.0)	44	228	32 (1.0)	25	941
8.2											
	7/16/2003	140	EB 2	0 (0.0)	2 (0.0)	4 (0.2)	100	208	7 (0.1)	5	117
	7/16/2003	140	WCT 2	0 (0.0)	1 (0.0)	4 (1.0)	99	315	5 (0.8)	4	83
11.7											
	7/16/2003	119	WCT 2	0 (0.0)	14 (1.0)	13 (0.3)	76	235	27 (0.9)	23	628
SF Dupuyer Creek											
9.0											
	7/22/2003	140	WCT 2		7 (0.4)	18 (0.8)	69	263	26 (0.9)	19	565
10.6											
	7/23/2003	138	WCT 2	0 (0.0)	12 (0.7)	18 (0.2)	112	301	30 (0.6)	22	769
11.4											
	7/22/2003	109	WCT 2	0 (0.0)	12 (0.7)	6 (0.0)	89	194	18 (0.5)	17	545

Table 4. Streambed composition, frequency of small (< 150 mm) and large (>= 150 mm) woody debris per 100 m, and square meters of spawning habitat per 100 m by stream, stream kilometer, and date.

Stream km	Date	Boulder	Cobble	Lg. Gravel	Sm. Gravel	Sand	Silt	Woody debris (#/100 m) Small	Woody debris (#/100 m) Large	m^3 of spawning habitat per 100 m
Dupuyer Creek										
2.7	7/14/2003	0%	0%	80%	10%	0%	10%	1	0	5
6.3	7/15/2003	0%	0%	70%	10%	0%	20%	41	1	2
MF Dupuyer Creek										
5.6	7/21/2003	0%	10%	30%	10%	0%	50%	172	0	0
NF Dupuyer Creek										
3.7	7/15/2003	0%	0%	35%	35%	0%	30%	5	0	55
8.2	7/16/2003	3%	5%	60%	20%	10%	2%	0	0	7
11.7	7/16/2003	0%	10%	70%	10%	10%	0%	0	0	13
SF Dupuyer Creek										
9.0	7/22/2003	5%	10%	70%	10%	5%	0%	0	0	14
10.6	7/22/2003	0%	10%	80%	5%	5%	0%	36	0	4
11.4	7/23/2003	0%	5%	10%	60%	10%	0%	0	0	6

Size Classes (mm): Silt < 0.62; Sand 0.62 to 2.0; Small Gravel 2.0 to 6.4; Large Gravel 6.4 to 64; Cobble 64 to 256; Boulder > 256

Table 5. Total length (m), average length (m), average depth (m), and average residual pool volume (cubic meters) by stream, stream kilometer, and date.

Stream Date	Habitat Type	n	Total Length	Average Width	Average Depth	R. Pool Volume
Dupuyer Creek						
7/14/2003	**Stream Kilometer**		**2.7**			
	Pool	8	155.5	5.6	0.6	45.0
	Riffle	8	241.8	6.5	0.1	
	Run	6	148.6	5.8	0.1	
	For Entire Section		545.9	6.0	0.3	
7/15/2003	**Stream Kilometer**		**6.3**			
	Pool	4	68.2	4.6	0.5	26.9
	Riffle	4	66.8	7.2	0.1	
	Run	4	111.2	5.4	0.1	
	For Entire Section		246.2	5.8	0.2	
MF Dupuyer Creek						
7/21/2003	**Stream Kilometer**		**5.6**			
	Pool	4	12.0	1.4	0.2	1.0
	Riffle	5	41.7	1.0	0.1	
	Run	1	3.8	1.1	0.1	
	For Entire Section		57.5	1.2	0.1	
NF Dupuyer Creek						
7/15/2002	**Stream Kilometer**		**3.7**			
	Pool	8	46.9	2.1	0.4	2.0
	Riffle	5	51.8	3.5	0.1	
	Run	4	28.5	2.9	0.2	
	For Entire Section		127.2	2.7	0.3	
7/16/2002	**Stream Kilometer**		**8.2**			
	Pool	7	39.8	4.2	0.4	3.5
	Riffle	6	86.2	4.4	0.2	
	Run	1	13.8	4.3	0.2	
	For Entire Section		139.8	4.3	0.3	
7/16/2002	**Stream Kilometer**		**11.7**			
	Pool	2	14.2	2.6	0.3	1.3
	Riffle	4	69.3	4.0	0.1	
	Run	2	35.7	4.0	0.1	
	For Entire Section		119.2	3.6	0.2	
SF Dupuyer Creek						
7/22/2003	**Stream Kilometer**		**9.0**			
	Pool	5	18.3	3.3	0.4	2.6
	Riffle	6	105.3	3.5	0.2	
	Run	2	16.0	3.0	0.2	
	For Entire Section		139.6	3.3	0.2	

7/23/2003	**Stream Kilometer**		**10.6**			
	Pool	6	33.0	3.1	0.3	2.4
	Riffle	4	71.9	2.5	0.1	
	Run	3	33.0	2.6	0.2	
	For Entire Section		137.9	2.8	0.2	
7/22/2003	**Stream Kilometer**		**11.4**			
	Pool	1	4.2	3.0	0.4	3.0
	Riffle	1	105.0	3.0	0.1	
	For Entire Section		109.2	3.0	0.2	

Table 6. Rankings (0 = none or lowest to 9 = highest) of spawning habitat, instream cover, pool habitat, bank stability, and bank cover, by stream, kilometer and date (riparian use rankings are from 0 to 3).

Stream km	**Date**	**Spawning Habitat**	**Instream Cover**	**Pool Habitat**	**Bank Stability**	**Bank Cover**	**Riparian Use**
Dupuyer Creek							
2.7	7/14/200	4	1	3	5	2	0
6.3	7/15/200	1	2	1	3	1	3
MF Dupuyer Creek							
5.6	7/21/200	1	3	2	7	7	0
NF Dupuyer Creek							
3.7	7/15/200	6	4	6	4	5	0
8.2	7/16/200	3	3	5	5	3	0
11.7	7/16/200	6	2	2	4	5	0
SF Dupuyer Creek							
9.0	7/22/200	8	2	4	3	7	0
10.6	7/22/200	2	2	2	3	5	0
11.4	7/23/200	5	3	3	6	6	0

North Fork Dupuyer Creek

North Fork Dupuyer Creek (NF) was sampled from its confluence with Dupuyer Creek to river km 12.6 where the stream went dry. From the confluence to km 3.7, the stream is low gradient the valley is unconfined with an extensive floodplain, and a dense riparian of small overhanging vegetation (willows, birch), small deciduous trees, and some sedges. The river splits and braids in this section. From km 3.7 to 9.2 stream gradient increases. The stream canopy is much more open in this reach with sparse riparian vegetation consisting of mostly willows and birch. From river km 9.2 to 10.9, the NF passes through the Walling Reef of the Rocky Mountain Front where it is completely confined and has little floodplain. One probable fish barrier exists between km 10.1 and 10.9. West of the Walling Reef the valley is once again unconfined and the stream is free to move throughout a large floodplain. The streambed gradually changes from bedrock to gravel upstream of the Walling Reef. Riparian vegetation is still sparse with small willows, young conifers, and deciduous trees. Most of the stream (save the section upstream and downstream of km 3.7) has little overhanging vegetation and very little large or small woody debris. Moreover, the majority of the stream (except the confined canyon section) actively moves laterally in a large unconfined floodplain. First order tributaries to the NF above km 10.9 were too small to support fish during low water and after an extended period of drought. These tributaries may hold fish at other times of the year when water levels are higher.

A thermograph recorded water temperatures in the NF at river km 9.6 (Figure 1). Average water temperatures in the NF reached 9.7 degrees and were generally between 7 and 9 C during the summer months. Maximum water temperatures exceeded 10 C frequently during July and August (Figure 6).

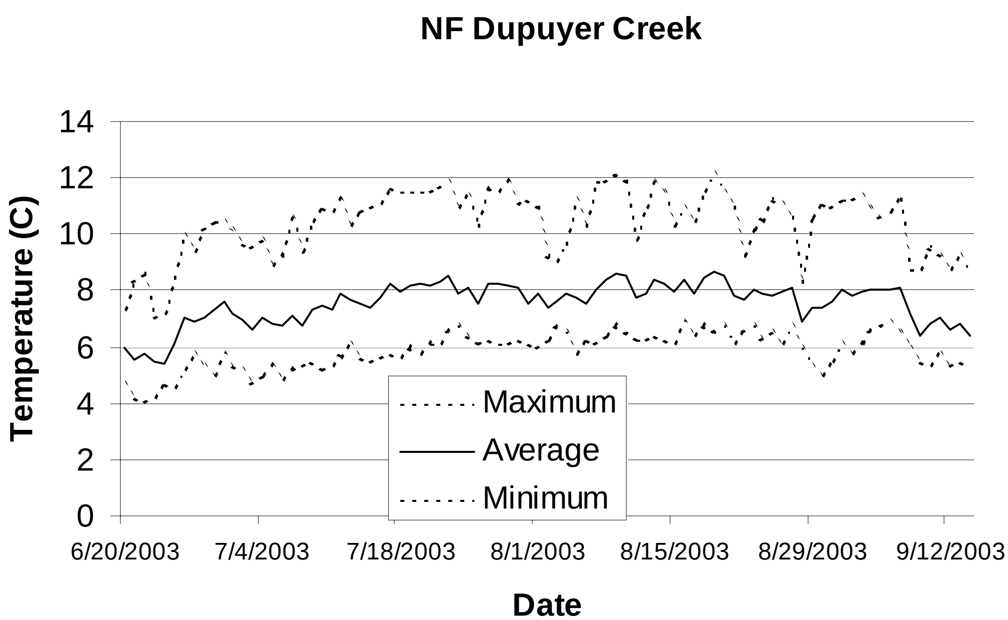


Figure 6. Average, minimum, and maximum water temperatures in NF Dupuyer Creek at river km 9.6.

Westslope cutthroat trout, brook trout, and sculpin were captured in the NF. 25 genetic samples (fin clips) were collected at km 11.7. In 1997, 10 genetic samples were collected from the NF near km 11.7 (above probable fish barrier) and tested using PINE. Tests indicated that fish were slightly hybridized with rainbow trout. These fish are likely currently protected from further genetic introgression by a downstream fish barrier (Figure 1; Table 7). Introgression in these fish is either because fish were moved (stocked) above the barrier or large fish can pass at high flows.

Table 7. Number of fish from which fin clips were taken for PINE genetic analyses from streams in the upper Dupuyer Creek basin and genetic information from previous years testing at similar locations by stream, stream kilometer, and date.

Stream km	Date	Legal	n	Previous Purity	Test	n	Previous Collection Date
Cow Creek							
3.9		T26N, R8W, sec 6		99.50%	PCR	17	5/5/2000
MF Dupuyer Creek							
5.6	7/21/2003	T27N, R9W, sec 26	7	100%	Allozyme	21	12/2/1997
NF Dupuyer Creek							
11.7	7/16/2003	T27N, R9W, sec 29	25	<100%	PCR	10	9/22/1997
SF Dupuyer Creek							
9.0	7/22/2003	T27N, R9W, sec 35	25	98%	Allozyme	14	9/1/1991
10.6	7/22/2003	T26N, R9W, sec 3	25	Transferred from MF	N/A	N/A	N/A

Relative abundance of EB was highest at km 3.7 with approximately 22 fish 75 mm and longer per 100 m. Densities of WCT were highest at km 11.3 with approximately 25 fish 75 mm and longer per 100 m. Densities of both EB and WCT at all other sampling locations were much lower than these two stations (densities from about 2 to 5 fish per 100 m). WCT did not appear in samples downstream of km 6.0 and EB did not appear in samples upstream of km 10.1 (Table 1; Figure 7 and 8). Sculpin were found up to km 9.2. A 127 m sample section located at river km 3.7 supported an estimated 26 (SE: 1.1) and 1 (SE: 0.0) EB trout 75-150 mm and 151 mm and longer, respectively. A 140 m section at km 8.2 supported an estimated 2 (SE: 0.0) and 4 (SE: 0.2) EB trout 75-150 mm and 151 mm and longer, respectively, and 1 (SE: 0.0) and 4 (SE: not computed/catch rate did not decrease) WCT trout 75-150 mm and 151 mm and longer, respectively. A 119 m section at km 11.7 supported an estimated 14 (SE: 1.0) and 13 (SE: 0.3) WCT trout 75-150 mm and 151 mm and longer, respectively (Table 2 and 3). In 1997, USFS personnel sampled near km 11.7 and found 3.4 WCT 75 mm and longer per 100 m. Lengths of WCT in all three sections ranged from 99 to 235 mm. Lengths of EB in all three sections ranged from 44 to 208 mm.

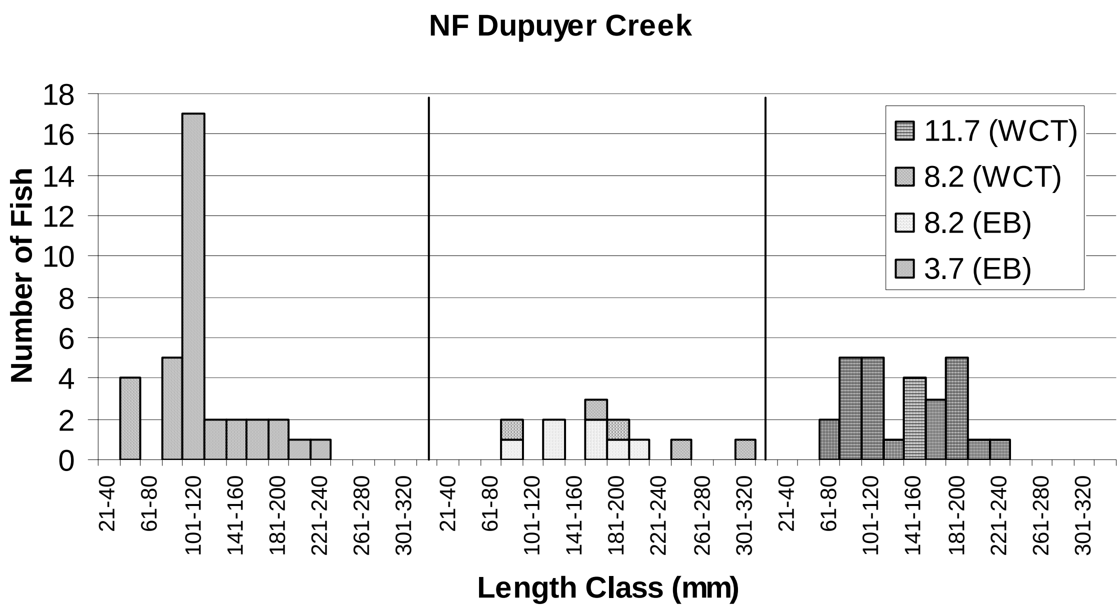


Figure 7. Length frequencies of westslope cutthroat trout (WCT) and brook trout (EB) captured at three sites on NF Dupuyer Creek during 2003.

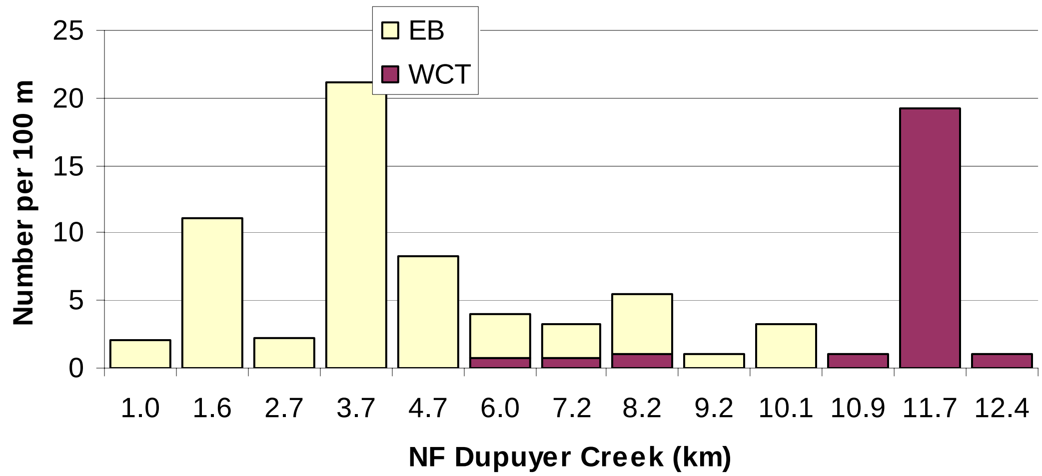


Figure 8. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) for westslope cutthroat trout (WCT) and brook trout (EB) in 13 sections of NF Dupuyer Creek.

Habitat surveys were conducted at km 3.7, 8.2, and 11.7. At km 3.7, the streambed was comprised equally of large gravel and small gravel making up about 70% of the streambed's surface. Silt made up the remainder of the streambed's surface. At km 8.2, the majority of streambed was comprised of large gravel (60%), the remainder was made up of 3% boulder, 5% cobble, 20% small gravel, 10% sand, and 2 % silt. At km 11.7, the streambed was 70% large gravel and 10% each of cobble, small gravel, and sand. Small and large woody debris was essentially non-existent in both sections. Spawning habitat was fair at km 3.7 and 11.7, and very poor at km 8.2. Spawning gravel and larger substrates were embedded approximately 20-30% at all sites (Table 4).

Pool habitats made up 21% by number and 40% by length of all habitat types at km 3.7, 50% by number and 28% by length at km 8.2, and 25% by number and 11% by length of all habitat types at km 11.7. Wetted width averaged 2.7, 4.3, and 3.6 m at km 3.7, 8.2, and 11.7, respectively. Residual pool volumes averaged 2.0, 3.5, and 1.3 m^3 from km 3.7 to 11.7; average depths of pools were 0.3, 0.3, and 0.2 m (Table 5). Instream cover was poorest at km 11.7 and improved slightly in a downstream direction. Bank stability was poor for all habitat sections. Bank cover was moderate at km 3.7 and 11.7 and poor at km 8.2. There was very little riparian use in any of the sections (Table 6).

Middle Fork Dupuyer Creek

MF Dupuyer Creek (MF) was sampled approximately 0.8 km above a dammed diversion pond (km 5.6) up to km 6.8. A private landowner did not grant access to sample downstream reaches of the MF. The MF is a very small stream above the diversion pond (<0.5 cfs) and diminished to less than 0.25 cfs at km 6.8. The valley is somewhat confined, channel gradient is low, and riparian vegetation is dense and consists of birch, willows, and a few conifers. A culvert draining the irrigation diversion pond is a fish barrier and protects pure WCT upstream. A fish population estimate was conducted at km 5.6. No fish were observed at km 6.8.

A thermograph recorded water temperatures in the MF at river km 5.6 (Figure 1). Average water temperatures in the MF reached 13.9 degrees and were generally between 11 and 14 C during the summer months. Maximum water temperatures exceeded 16 C frequently during July and August (Figure 9).

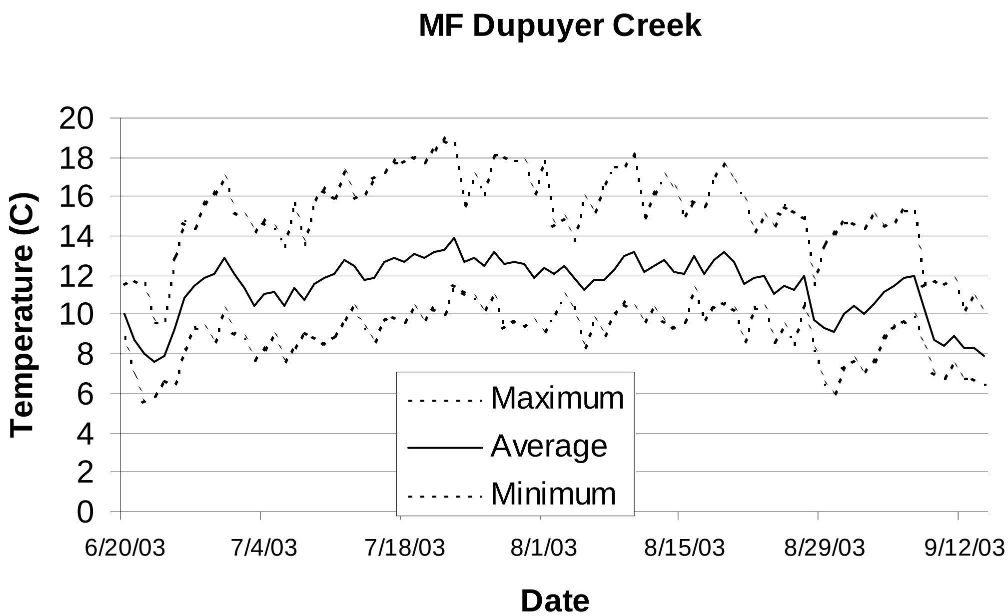


Figure 9. Average, minimum, and maximum water temperatures in MF Dupuyer Creek at river km 5.6.

WCT were captured in the MF. Fin clips were collected from 7 fish captured at km 5.6. In 1997, 21 fish were collected from the same area of the MF and tested as genetically pure using allozyme electrophoresis (Table 7).

There were approximately 15 WCT 75 mm and longer at km 5.6 (Table 1). No fish were collected at km 6.8. A 58 m sample section located at river km 5.6 supported an estimated 5 (SE: 0.0) and 1 (SE: 0.0) WCT 75-150 mm and 151 mm and longer, respectively (Table 2 and 3). In 1997, USFS personnel sampled a section of stream upstream of km 6.8 and found approximately 22 WCT 75 mm and longer per 100 m of stream. In addition, mark/recapture sampling of the irrigation diversion pond in 1997 indicated it supported approximately 400 WCT. Three years of drought have clearly affected WCT numbers and upstream extent in the MF. Lengths of WCT in the MF ranged from 87 to 181, with all but one fish being 75-150 mm in length.

A habitat survey was conducted at km 5.6. At km 5.6, the streambed was comprised primarily of silt (50%). The remainder of the streambed consisted of 10% cobble, 30%

large gravel, and 10% small gravel. Small woody debris (willows in pools) was abundant at this site; approximately 172 pieces per 100 m of stream length. There was no spawning habitat at this site and the streambed was at least 50% embedded (Table 4). Pool habitats made up 40% by number and about 21% by length of all habitat types at km 5.6. Wetted width averaged 1.2 m and depth averaged 0.1 m. Residual pool volume averaged 1.0 m^3. Average depth of pools was 0.2 m (Table 5). Instream cover was poor, bank stability was good, and bank cover was abundant. There was very little riparian use in the MF (Table 6).

South Fork Dupuyer Creek

South Fork Dupuyer Creek (SF) was sampled from where it enters National Forest Lands at km 7.8 to river km 12.8 where fish passage was blocked by a large beaver dam complex (over 7 dams some greater than 3 meters in height). A private landowner did not grant access to sample reaches downstream of National Forest Land. From the streams entry onto National Forest to river km 9.8 the stream is relatively low gradient, the valley is unconfined, and the riparian consists of dense pockets of willows, birch and small deciduous trees. The stream margins also support grasses and sedges. From km 9.8 to 10.6, the valley is confined and the stream passes through a steep walled canyon (the Volcano Reef). As it passes through the canyon, stream gradient increases, and numerous bedrock falls and chutes are barriers to fish passage. The stream canopy is much more open in this reach with very little riparian vegetation. From river km 10.6 to 12.4, the valley is once again somewhat unconfined, stream gradient decreases and the streambed gradually changes from bedrock to gravel in an upstream direction. Riparian vegetation is sparse with small willows, birch, and a few deciduous trees and conifers. Most of the stream from km 9.8 to km 12.8 has little overhanging vegetation and very little large or small woody debris.

A thermograph recorded water temperatures in the SF at river km 9.2 (Figure 1). Average water temperatures in the SF reached 12.0 degrees and were generally between 9 and 12 C during the summer months. Maximum water temperatures exceeded 15 C infrequently during July and August (Figure 10).

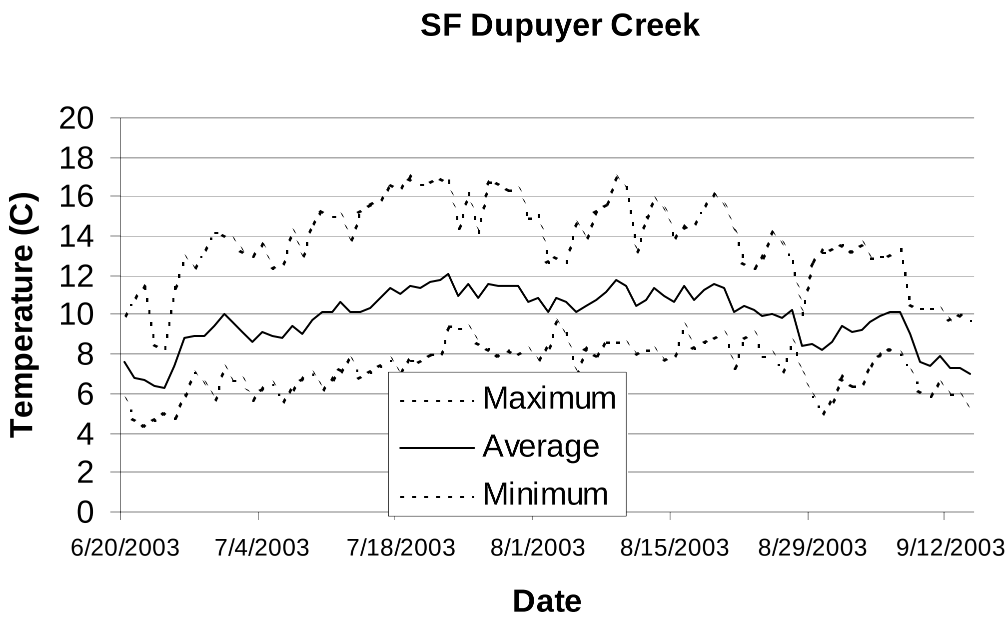


Figure 10. Average, minimum, and maximum water temperatures in SF Dupuyer Creek at river km 9.2.

Westslope cutthroat trout were captured in the SF. 25 genetic samples (fin clips) were collected at km 9.0 and 25 genetic samples were collected at km 10.6 (7 fin clips) and 11.4 (18 fin clips). In 1991 and 1996, 14 and 6, respectively, genetic samples were collected from the SF near km 9.8 and tested using allozyme electrophoresis. Tests indicated that fish were slightly hybridized with Yellowstone cutthroat trout (1996; 94% WCT x 6% YCT; 1991; 98% WCT x 2% YCT) (Table 7). From 1998 to 2000, 153 WCT were transplanted from MF Dupuyer Creek to the previously fishless SF upstream of the fish barriers in the canyon reach.

Densities of WCT were highest at km 10.6 with approximately 19 fish 75 mm and longer per 100 m. Densities of WCT at km 9.0, 9.8, and 11.4 were between 15 and 18 fish 75 mm and longer per 100 m (Table 1; and Figure 11 and 12). No fish were collected from Rival Creek 0.8 km upstream of its confluence with the SF. A 140 m sample section located at river km 9.0 supported an estimated 7 (SE: 0.4) and 18 (SE: 0.8) WCT trout 75-150 mm and 151 mm and longer, respectively. A 138 m section at km 10.6 supported an estimated 12 (SE: 0.7) and 18 (SE: 0.2) WCT trout 75-150 mm and 151 mm and longer, respectively. A 109 m section at km 11.4 supported an estimated 12 (SE: 0.7) and 6 (SE: 0.0) WCT trout 75-150 mm and 151 mm and longer, respectively (Table 2 and 3). In 1996, USFS personnel sampled near km 9.0 and found 18.6 WCT 75 mm and longer per 100 m. Lengths of WCT in all three sections ranged from 69 to 301 mm.

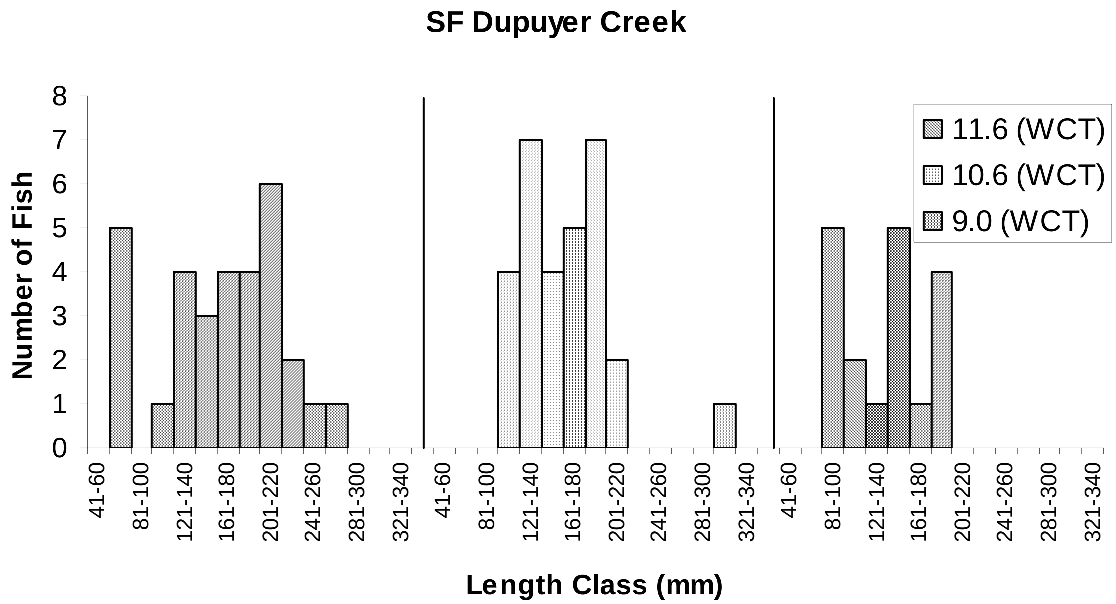


Figure 11. Length frequencies of westslope cutthroat trout (WCT) captured at three sites on SF Dupuyer Creek during 2003.

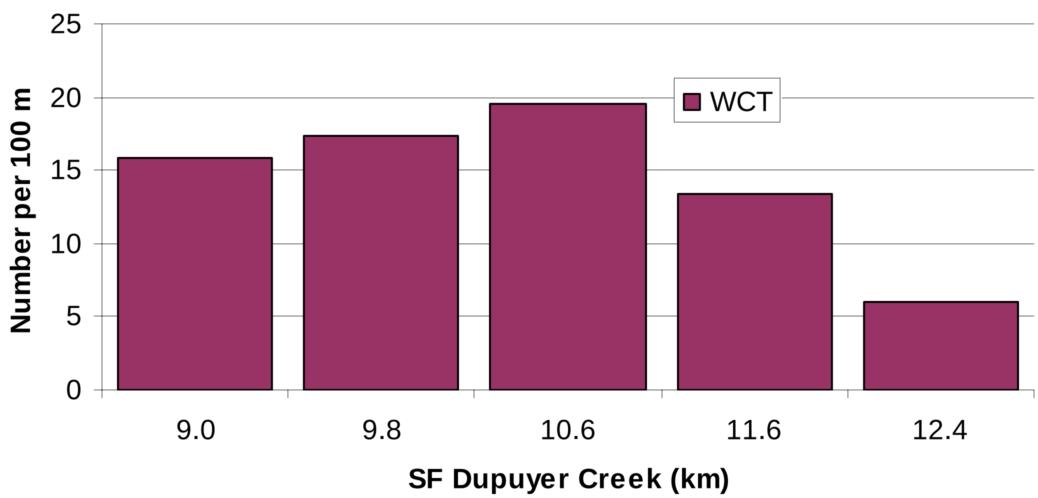


Figure 12. Relative abundance (number of fish 75 mm and longer captured on the first electrofishing pass per 100 m of stream length) for westslope cutthroat trout (WCT) in 5 sections of SF Dupuyer Creek.

Habitat surveys were conducted at km 9.0, 10.6, and 11.6. At km 9.0, the streambed was comprised primarily of large gravel making up about 70% of the streambed's surface. Boulder (5%), cobble (10%), small gravel (10%), and sand (5%) made up the remainder of the streambed's surface. At km 10.6, the majority of streambed was comprised of large gravel (80%), the remainder was made up of cobble (10%), small gravel (5%), and sand (5%). At km 11.4, the streambed was comprised primarily of small gravel making up about 60% of the streambed's surface. The remainder of the streambed was comprised of 5% cobble, 10% large gravel, and 10% sand. There was some small woody debris at km 10.6. There was no small or large woody debris at km 9.0 and 11.4. Spawning habitat was good at km 9.0 and poor to moderate at km 10.6 and 11.4, respectively. Spawning gravel and larger substrates were embedded less than 10% at all sites (Table 4).

Pool habitats made up 38% by number and 13% by length of all habitat types at km 9.0, 46% by number and 24% by length at km 10.6, and 50% by number and 4% by length of all habitat types (only two habitat types: very homogenous with long low gradient riffles) at km 11.4. Wetted width averaged 3.3, 2.8, and 3.0 at km 9.0, 10.6, and 11.4, respectively. Residual pool volumes averaged 2.1, 2.8, and 3.0 m^3 from km 9.0 to 11.4, average depths of pools were 0.4, 0.3, and 0.4 m (Table 5). Instream cover was poorest at km 9.0 and improved slightly in a upstream direction. Bank stability was poor at km 9.0 and 10.6, and good at km 11.4. Bank cover was moderate to good for all three sections. There was very little riparian use in any of the sections (Table 6).

Cow Creek

Cow Creek was sampled from river km 1.8 to 5.9. At km 5.9 above a large beaver dam complex the streams surface was dry. The majority of the surveyed area of Cow Creek is interspersed with large beaver dam complexes. The stream is low gradient with an unconfined wide valley. Numerous springs and seeps drain into Cow Creek along the length surveyed. Discharge in Cow Creek was less than 0.5 cfs but was difficult to estimate because of the abundance of beaver ponds. Fish distribution was assessed at river km 1.8, 3.3, and 3.9.

A thermograph recorded water temperatures in Cow Creek at river km 4.2 (Figure 1). Average water temperatures reached 18.3 degrees and were generally between 14 and 17 C during the summer months. Maximum water temperatures exceeded 20 C frequently during July (Figure 13).

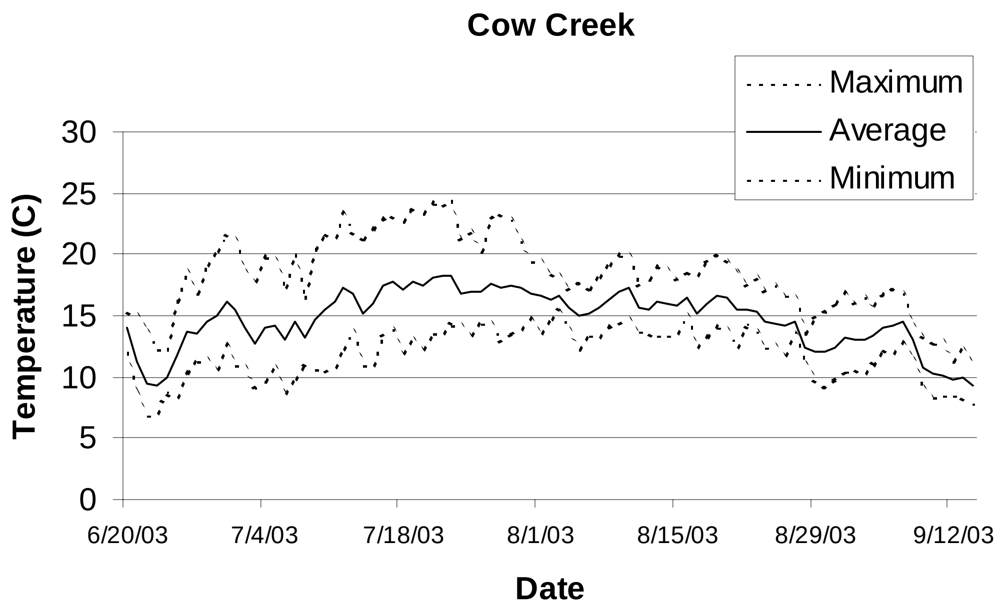


Figure 13. Average, minimum, and maximum water temperatures in Cow Creek at river km 4.2.

Longnose dace *(Rhinichthys cataractae)*, northern redbelly dace *(Phoxinus eos)*, lake chub *(Couesius plumbeus)*, and sculpin *(Cottus* sp.*)* were captured at river km 1.8 immediately downstream of a large beaver pond. Longnose dace *(Rhinichthys cataractae)*, white sucker *(Catostomas commersoni)*, and sculpin *(Cottus* sp.*)* were captured at km 3.3. Lake chub *(Couesius plumbeus)*, white sucker *(Catostomas commersoni)*, and sculpin *(Cottus* sp.*)* were captured at km 3.9. No WCT were captured at any of the sampling sites. In 2000, Cow Creek supported a small population of nearly pure WCT. It is not known whether the WCT population in Cow Creek is extinct or we were just unsuccessful in locating individuals.

Discussion

Site Level Habitat Surveys

Qualitative assessments (scores) of stream habitat were based on experience with other small stream habitats found throughout the Rocky Mountain West. Estimating habitat quality in relation to other streams tended to produce low habitat scores despite a lack of negative human caused impacts. Rocky Mountain Front streams appear to be less productive and have a flashier hydrologic regime than other streams in the Rocky Mountains west of the continental divide. Thus, low qualitative scores and low quantitative measures (e.g. pool frequency) in most cases are more a result of local geology and climate than anthropogenic impacts. However, low habitat scores do indicate that these streams (and their native fish populations) likely have little capacity to tolerate human caused environmental perturbations.

Stream temperatures exceeded 20C on numerous occasions in Dupuyer Creek during July and August. Stream temperatures exceeded 20C on numerous occasions in Cow Creek during July. Stream temperatures in NF, MF and SF Dupuyer were generally below levels stressful to salmonids.

Fish Distribution and Abundance

Westslope cutthroat trout were widely distributed in the upper reaches of the SF and NF of Dupuyer Creek. WCT were not found in the lower reaches of the NF and at three sites in Dupuyer Creek (one large WCT adult was found at km 2.7 of Dupuyer Creek) In the middle reaches of the NF, WCT were found in low numbers in sympatry with EB. In the upper reaches of the NF past barriers to brook trout, numbers of WCT exceeded 25 fish per 100 m of stream. Tews et al. (2000) estimated approximately 12.9 km of the NF was inhabited by nearly pure WCT. Surveys conducted in 2003 indicate that WCT currently occupy 6.4 km of stream. In the SF, WCT in allopatry were widely distributed and abundant (6-19 fish per 100 m of stream; average = 14.6). Tews et al. (2000) estimated approximately 8.0 km of the SF was inhabited by nearly pure WCT. Surveys conducted in 2003 indicate that WCT currently occupy 2.3 km of stream. WCT were present in the MF, though not widely distributed. Tews et al. (2000) estimated approximately 3.2 km of the MF was inhabited by nearly pure WCT. Surveys conducted in 2003 indicate that WCT currently occupy 1 km of stream. MF fishes are likely heavily reliant, especially in drought years, on the irrigation diversion pond for over-wintering and late summer habitat. Populations of WCT in all three streams are protected at least in part by barriers to upstream movement of non-native fishes. Brook trout were widely distributed in the NF of Dupuyer and Dupuyer creeks downstream of fish barriers. Brook trout in allopatry were abundant in Dupuyer and the NF. In the middle reaches of the NF, both EB and WCT in sympatry were found in low numbers (combined totals less than totals at other sites in allopatry). Rainbow trout (RBT) were found in the first two sections sampled in Dupuyer Creek. All RBT captured were large individuals. No WCT were found in Cow Creek (four warm water species and sculpin were found). Tews et al. (2000) estimated approximately 2.4 km of Cow Creek was inhabited by nearly pure WCT. Three years of drought and warm water temperatures (intensified by the opening of the stream canopy by livestock and the creation of large beaver ponds) may have caused the small WCT population in Cow Creek to go extinct. WCT populations in the three forks of Dupuyer Creek are clearly not as robust and extensive, and concomitantly not as resilient to disturbance, as was previously thought.

Acknowledgements

Jim Boyd, Scott Hawxhurst, and Kate McLaughlin, of MFWP collected much of the field data. Aaron Green, Jim Zadick, American Fisheries Society Hutton Scholars, and one volunteer also gathered field data.

References

Environmental Systems Research Institute, Inc.1999. ArcView GIS program, version 3.2.

Lisle, T.E. 1987. Using residual depths to monitor pool depths independently of discharge. Research Note PSW-394, USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkley, California.

Riley, S.C. and K.D. Fausch. 1992. Underestimation of trout population size by maximum likelihood removal estimates in small streams. North American Journal of Fisheries Management 12:768-776.

Shepard, B.B. 2001. Fish surveys of the Upper South Fork Judith River and its tributaries conducted during 2000. Montana, Fish Wildlife and Parks and Montana Cooperative Fishery Research Unit, Bozeman, Montana.

Tews, A., M. Enk, S. Leathe, W. Hill, S. Dalbey, and G. Liknes. 2000. Westslope cutthroat trout *(Oncorhynchus clarki lewisi)* in northcentral Montana: Status and restoration strategies. Montana, Fish Wildlife and Parks, Great Falls, Montana.

Van Deventer, J.S. and W.S. Platts. 1985. A computer software system for entering managing and analyzing fish capture data from streams. Research Note INT-352. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah.

White, G.C., D.R. Anderson, K.P. Burnham, and D.L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. LA-8787-NERP. UC-11. U.S. Department of Energy, Los Alamos National Laboratory, Los Alamos, New Mexico.