Westslope Cutthroat Trout Restoration in Muskrat Creek, Boulder River Drainage, Montana: Progress Report for Period 1993 to 1999

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Executive Summary

Montana Fish, Wildlife and Parks (FWP), the Bureau of Land Management (BLM), and the Forest Service (FS) are collaborating in an on-going effort to conserve westslope cutthroat trout *Oncorhynchus clarki lewisi* (WCT) in Muskrat Creek, a tributary to the Boulder River, Montana in the Elkhorn Mountains. This effort has resulted in the construction of a wooden crib barrier to prevent the upstream movement of fish movement in 1997. In addition, brook trout *Salvelinus fontinalis* from above this constructed barrier were removed by electrofishing and moved below the constructed barrier. During 1997 and 1998 WCT captured during electrofishing were moved to the upper portion of the drainage, above a natural waterfall barrier, which was not inhabited by fish. The crib fish barrier was constructed in 1997 using "Bring Back the Natives" and Montana Fish, Wildlife and Parks' Future Fisheries Improvement funds. Brook trout removal and translocation of WCT were also done collaboratively between FWP, BLM, and the FS. "Bring Back the Natives" funding has contributed to this effort. Brook trout were removed from the portion of stream between the constructed fish barrier located near stream kilometer 10.4 and a natural waterfall located at stream kilometer 12.9. A total of 1,937 brook trout were removed in 1997, another 1,475 were removed in 1998, and another 1,000 were removed in 1999. A total of 48 WCT were moved into the upper drainage in 1997 and another 100 were moved in 1998. No WCT were moved in 1999. Our monitoring suggests the removal of brook trout has increased abundance of WCT in the portion of creek between the two barriers, despite the removal of age 1 and older WCT from this portion of the stream in 1997 and 1998. We have also found that the re-located WCT have survived and reproduced in the upper basin and none of these fish have moved back down to the original capture site. In August of 1999 we captured a single adipose-clipped brook trout immediately above Nursery Creek. At this time we are uncertain if this adipose-clipped brook trout actually was re-located below the barrier and made it upstream (either by jumping the barrier or being moved by human intervention), or if this brook trout had jumped out of one of our holding pens located just above the mouth of Nursery Creek. Expansion of the WCT population from a weak population occupying about 2.5 km (1.5 miles), in sympatry with brook trout that were apparently driving them to extinction, to occupy an additional 6.0 km (3.7 miles) of habitat above a natural barrier appears to be working. In addition, removal of brook trout from the 2.5 km of habitat immediately above the Forest Service boundary appears to be offering the existing WCT population some relief to increase their numbers in this portion of the stream.

Introduction

Muskrat Creek, a tributary to the Boulder River, Montana drains the southwestern portion of the Elkhorn Mountains (Figure 1). Hadley (1981) was contracted by Montana Fish, Wildlife and Parks (FWP) to survey streams draining the Elkhorn Mountains for westslope cutthroat trout (*Oncorhynchus clarki lewsisi*; WCT). He captured no fish in upper Muskrat Creek (Section 33;T07N;R03W). He believed that Muskrat Creek was barren of fish above a high gradient section located in the SW1/4 of Section 32 (T07N;R03W) and recommended that the 6.3 km (3.9 mile) portion of Muskrat Creek above this high-gradient area be considered as a site for introduction of an allopatric population of WCT. Hadley did not isolate the precise location of any barrier to fish movement from lower Muskrat Creek, where he found relatively high densities of brook trout (*Salvelinus fontinalis*) and only one cutthroat trout. During 1994 we isolated this natural fish barrier by snorkeling. This barrier is a rock drop (waterfall) located just above BLM riparian monitoring site #24 (SE1/4 of the SE1/4 of Section 31) at about stream kilometer 12.9.

The Bureau of Land Management (BLM) was interested in implementing Hadley's (1981) recommendation and began working with Montana FWP and the Montana Cooperative Fisheries Research Unit (Unit) in 1991 to obtain the necessary background information to introduce WCT into a believed "fishless" portion of upper Muskrat Creek. The Deerlodge National Forest's Butte District (FS) became involved in this effort in 1994. Restoration efforts were begun in 1996 when an environmental assessment (Spoon and Shepard 1996) was prepared that explored various alternatives for conserving and restoring WCT in the drainage. This analysis and public comment resulted in the construction of a wooden crib barrier near the Forest Service boundary (stream kilometer 10.4) in 1997; physical removal, and relocation downstream, of brook trout from this constructed barrier up to the waterfall; and the relocation of WCT from lower Muskrat Creek to the portion of the creek above the waterfall (Figure 1). The purpose of the constructed barrier is to prevent upstream movement of nonnative fish into upper Muskrat Creek. This barrier was constructed using "Bring Back the Natives" and Montana Fish, Wildlife and Parks' Future Fisheries Improvement funds.

In 1997,1998, and 1999 repeated electrofishing sampling was done in Muskrat Creek from this constructed fish barrier up to the waterfall, and in lower Nursery Creek, a tributary to Muskrat Creek. During these electrofishing efforts brook trout were removed and relocated below the constructed barrier and captured WCT were relocated above the waterfall. Fish population estimates were also obtained during these removals. We looked for WCT that had been moved into the upper creek during July of 1998 and 1999. This report summarizes data collected from 1994 through July 1999.

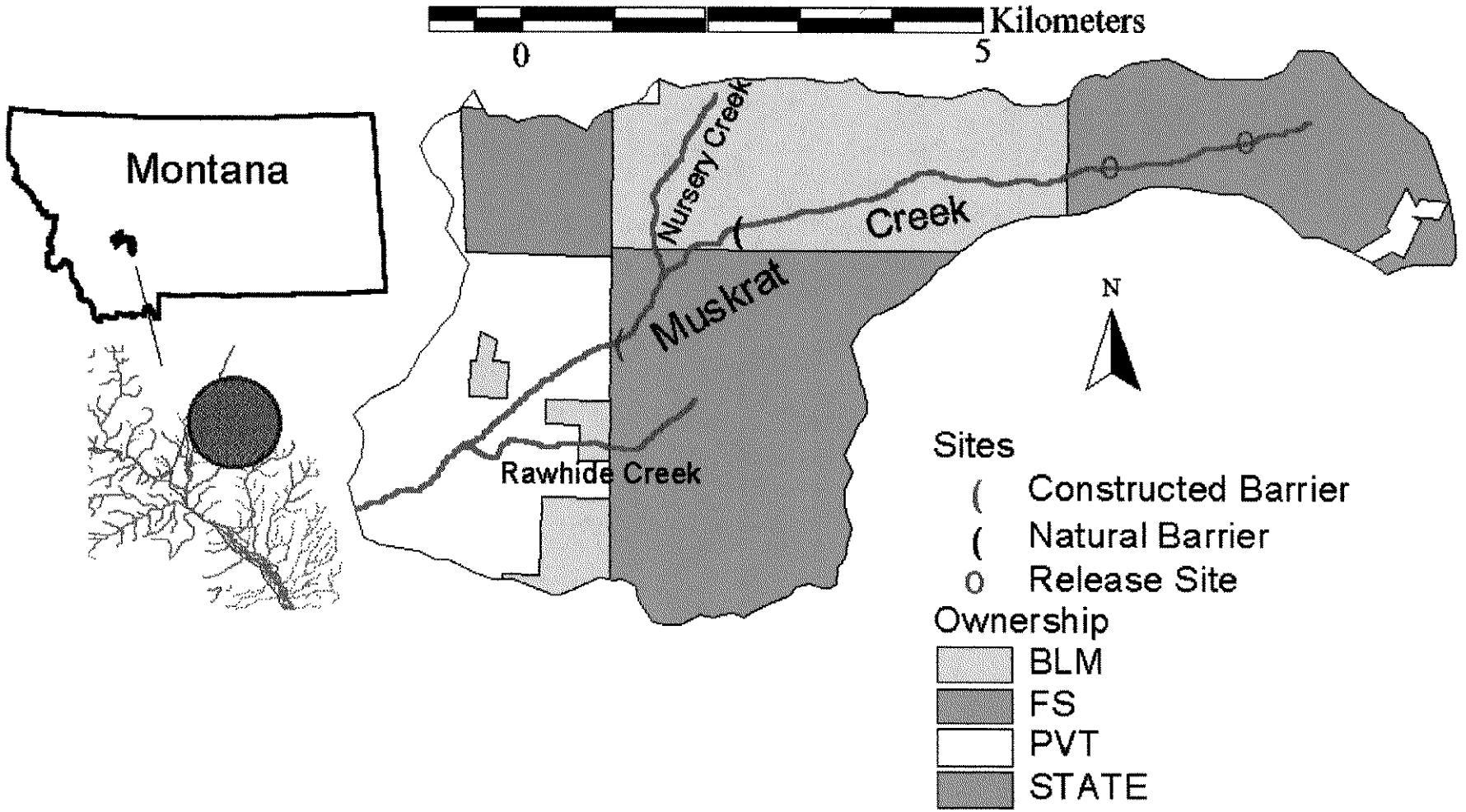

Figure 1. Map of Muskrat Creek showing land ownership, locations of constructed barrier, natural barrier (waterfall), and sites where westslope cutthroat trout were released in 1997 and 1998.

Fish Habitat

Habitat data were collected in three portions of Muskrat Creek (Table 1). Pools comprised from 16 to 29 percent of classified habitat types in all three sections. Ratings of pool quality indicated very few high quality pools were available in most sections. The habitat survey data suggests that the proportion of pool habitats in the upper portion of Muskrat Creek above the barrier was similar to the lower section near Nursery Creek (18% versus 16%; Table 1) where relatively high densities of fish were observed. Spawning habitat was abundant in the lower two sections, but sparse in the upper section. More extensive ocular surveys conducted in the upper portion of Muskrat Creek during 1997 and 1998 found that adequate spawning habitat was present, but it was patchy in its distribution. These ocular surveys also discovered that some high quality pool and run habitats existed within this upper reach. A fish barrier was constructed in Muskrat Creek near the Forest Service boundary at about stream kilometer 10.4 in the fall of 1997.

Table 1. Location, length, and percentages of each major habitat type in three surveyed sections of Muskrat Creek based on surveys done in 1990 by Spoon (MFWP files).

Location	Length (km)	Percentage of each type			
		Pool	Riffle	Run	Pocket
Road crossing to Nursery Creek	0.8	16	31	31	22
Trail crossing in Section 32	0.6	29	9	18	44
Trail crossing in Section 33	0.8	18	0	16	66

Aquatic Macroinvertebrates and Amphibians

In 1994 we collected aquatic macroinvertebrates to determine the species composition of the invertebrate community above and below the identified waterfall. The species composition of Muskrat Creek was typical of many low-productivity, high-diversity mountain streams in the area and throughout the central Rocky Mountains (Table 2). Mayflies, stoneflies and caddis flies dominated. There were undoubtedly many more species, especially of Plecoptera and Trichoptera than were detected by our mid-summer benthic samples. There were no unusual, rare or threatened species. A collection of voucher specimens has been archived at Montana State University's

Table 2. Macroinvertebrates identified above and below a falls in Muskrat Creek from samples collected in 1994.

Order	Family	Species	below	above
TRICLADIDA	PLANARIIDAE	?	+	+
ACARI	?	?	+	0
EPHEMEROPTERA	LEPTOPHEBIIDAE	*Paraleptophlebia vaciva* (Eaton)	+	+
	EPHEMERELLIDAE	*Caudatella hystrix* (Traver)	+	0
		Drunella doddsi (Needham)	+	0
		Drunella spinifera (Needham)	+	+
		Drunella coloradensis (Dodds)	+	+
		Serratella tibialis (McDunnough)	+	0
	HEPTAGENIIDAE	*Cinygmula* sp.	+	+
		Cinygma integrum Eaton	0	+
		Epeorus deceptivus (McDunnough)	+	+
		Epeorus grandis (McDunnough)	+	+
		Epeorus longimanus (Eaton)	+	+
		Rhithrogena robusta Dodds	0	+
	BAETIDAE	*Baetis bicaudatus* Dodds	+	+
		Baetis tricaudatus Dodds	+	0
	SIPHLONURIDAE	*Ameletus* sp. 1	+	+
		Ameletus sp. 2	+	+
PLECOPTERA	LEUCTRIDAE	*Paraleuctra* sp.	+	0
	NEMOURIDAE	*Visoka cataractae* (Neave)	+	+
		Zapada columbiana (Claassen)	+	+
	PELTOPERLIDAE	*Yoraperla brevis* (Banks)	+	+
	CHLOROPERLIDAE	*Sweltsa* spp.	+	+
	PERLODIDAE	*Isoperla fusca* Needham & Claassen	0	+
		Megarcys watertoni (Ricker)	+	+
		Setvena bradleyi (Smith)	0	+
	PERLIDAE	*Doroneuria theodora* (Needham & Claassen)	+	+
COLEOPTERA	ELMIDAE	*Heterlimnius corpulentus* (LeConte)	+	+
		Zaitzevia parvula (Horn)	+	+
TRICHOPTERA	GLOSSOSOMATIDAE	*Glossosoma* sp.	+	+
	RHYACOPHILIDAE	*Rhyacophila verrula* Milne	+	+
		Rhyacophila vao Milne	+	+
		Rhyacophila vaccua Milne	+	+
		Rhyacophila narvae Navas	+	0
		Rhyacophila hyalinata Banks	0	+
		Rhyacophila sp.	+	+
	PHILOPOTAMIDAE	Dolophilodes aequalis (Banks)	+	0
	HYDROPSYCHIDAE	*Parapsyche elsis* Milne	+	+
	LIMNEPHILIDAE	*Ecclisiomyia maculosa* Banks	0	+
		Chyranda centralis (Banks)	0	+
		Homophylax sp.	0	+
		Limnephilus sp.	+	+
		Psychoglypha sp.	+	+
	UENOIDAE	*Neothrema alicia* Dodds & Hisaw	+	+
	LEPIDOSTOMATIDAE	*Lepidostoma spicatum* Denning	+	+
	BRACHYCENTRIDAE	*Micrasema bactro* Ross	+	+
DIPTERA	TIPULIDAE	*Dicranota* sp.	0	+
		?	+	0
	PELECORHYNCHIDAE	*Glutops* sp.	+	0
	SIMULIDAE	?	+	+
	EMPIDIDAE	?	+	+
	CHIRONOMIDAE	?	+	+

Entomology Collection (Lewis Hall, Bozeman, Montana).

The differences between the 2 stream stretches reflected normal altitudinal progression of species from high mountain areas to the foothills. Some of the species that occurred above the falls (especially *Cinygma integrum, Isoperla fusca, Setvena bradleyi and Homophylax* sp.) normally occur only in areas that are too high (small, cold, harsh) to support fish populations. Most of the macroinvertebrates were collected at a site about 2 km above the trail crossing in Section 33 (5.4 km above the falls).

A survey of Muskrat Creek by underwater and above water observation was also completed above and below the fish barrier during 1994. The purpose of this survey was to document the presence of any amphibian species. Neither survey observed any amphibians in the drainage.

Fish

Hadley (1981) sampled four sections of Muskrat Creek and two sections of Nursery Creek. He found low densities of brook trout in the two Nursery Creek sample sections and relatively high densities of brook trout and only one WCT in Muskrat Creek between the Forest Service boundary and the high-gradient section in two years of sampling. He found no fish above the high-gradient section of Muskrat Creek. Subsequent sampling documented that a few WCT inhabited the lower portion of Muskrat Creek up to 1993 and confirmed no fish were present above kilometer 12.9 (Table 3). Genetic analyses of 9 cutthroat collected on October 18, 1990 in Muskrat Creek by Spoon found that these cutthroat trout were genetically pure WCT (letter of January 23, 1991 from Robb Leary to R. Spoon, files, FWP, Townsend). Relatively high densities of brook trout were found in Muskrat Creek from the Forest Service boundary up to the BLM boundary during 1990. However, low densities of brook trout were observed in the BLM portion of Muskrat Creek below the high-gradient area. Sampling in 1993 documented that WCT densities were extremely low and brook trout densities were relatively high in the portion of Muskrat Creek from the Forest Service boundary (km 10.4) upstream to BLM administered lands (Table 3 and Figure 2). We found no fish in the upper portion of Muskrat Creek (above the Forest Service/BLM boundary; km 12.9) during 1990 and 1993 despite sampling numerous sections of the stream.

In 1997 a total of 1,930 brook trout were removed from the 2.4 km (1.5 mile) portion of Muskrat Creek from a temporary fish barrier up to the waterfall and placed below the temporary barrier. In 1998 and 1999 a total of 1,469 and 1,000 brook trout were removed from 2.5 km of Muskrat Creek in this same area after the permanent fish barrier was constructed. In addition, seven brook trout were removed from the lower 300 m portion of Nursery Creek in 1997 and another 26 were removed from about 350 m of the lower creek in 1998. All brook trout moved below the constructed barrier in 1999 had their adipose fin removed so we could determine if any of these fin-clipped fish moved back up over the barrier.

Table 3. Summary of catches (number in 1 pass) and population estimates of westslope cutthroat (WCT) and eastern brook trout (EBT) 75 mm (3 inch) and longer in Muskrat Creek during 1990 and 1993.

Stream		Length	Catch per 100 m		Estimate per 100 m	
Km[1/]	Date	(m)	EBT	WCT	EBT	WCT
10.5	10/21/1993	31	142	3	-	-
10.7	10/21/1993	10	110	10	-	-
10.8	10/18/1990	91	28	1	50	-
10.9	10/21/1993	61	54	6	-	-
11.1	10/21/1993	31	81	0	-	-
11.2	10/21/1993	20[2/]	360	30	-	-
11.4	10/21/1993	20	80	5	-	-
11.5	10/18/1990	61	56	3	64	3
11.5	8/5/1993	80	70	5	155	8
11.5	10/21/1993	80	56	4	-	-
12.6	8/5/1993	69	26	0	35	0
12.9	8/5/1993	35	0	0	-	-
14.6	10/15/1990	91	0	0	-	-
14.7	10/15/1990	91	0	0	-	-
15.9	10/15/1990	152	0	0	-	-
16.1	8/4/1993	70	0	0	-	-

1/ Stream Km are stream kilometers up from the mouth of Muskrat Creek at the Boulder River measured from a 1:24,000 scale USGS map sheet.

2/ This represented one high quality pool habitat type that was sampled in the fall after numerous fish had moved into this pool for the winter.

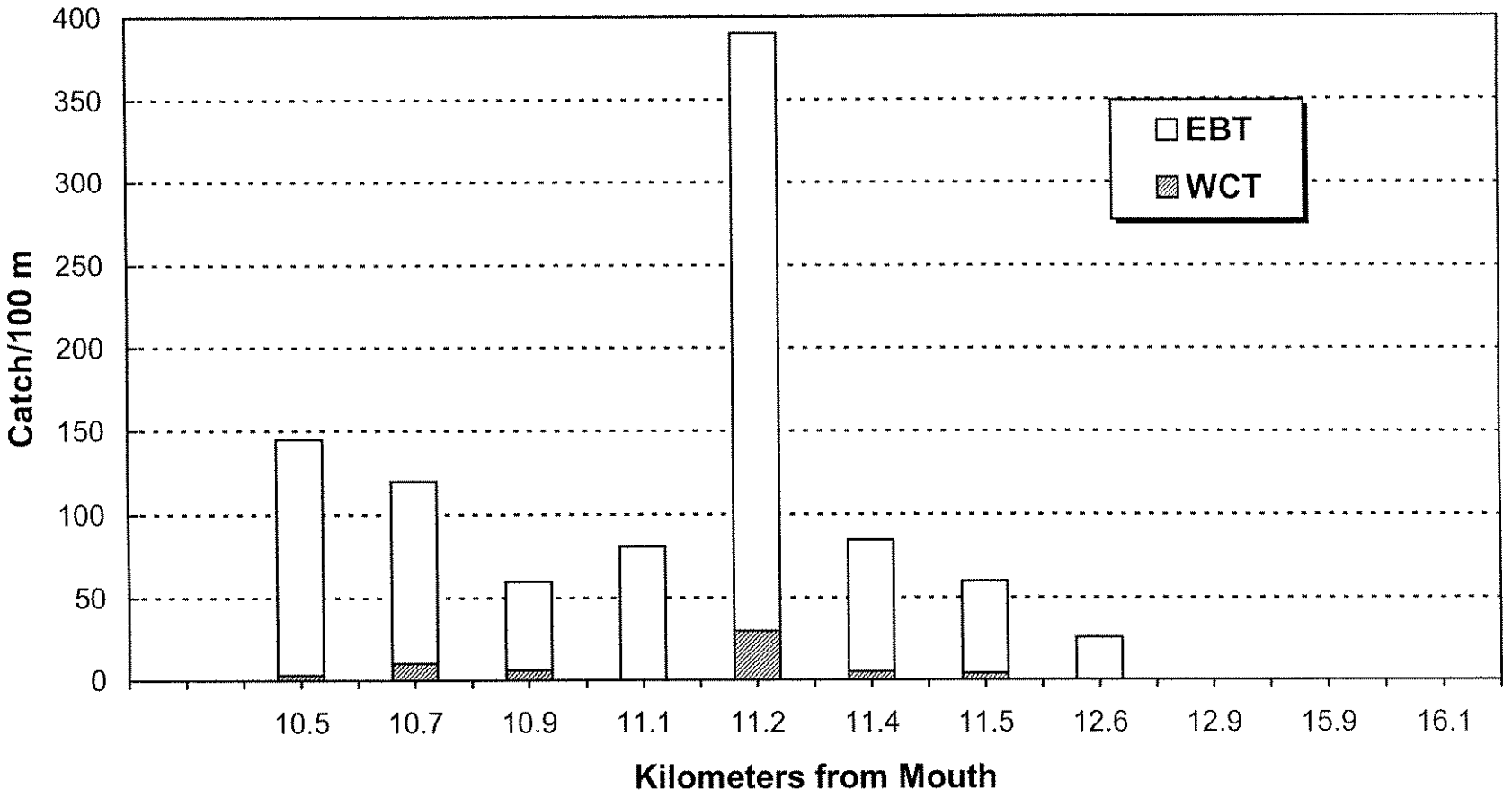

Figure 2. Relative abundance (number of fish per 100 m of stream captured in one electrofishing pass) of westslope cutthroat (WCT) and brook trout (EBT) captured in Muskrat Creek during the fall of 1993. The lower Forest Service boundary is just below kilometer 10.4, Nursery Creek enters Muskrat Creek near stream kilometer 11.5, the lower BLM boundary is near kilometer 11.9, and the upper BLM boundary is near kilometer 12.9. A single high-quality pool was sampled at kilometer 11.2.

In 1997 a total of 38 WCT were relocated from the portion of stream between the constructed barrier and the waterfall to a release site located at about stream kilometer 18.0 (about 6 km above the waterfall) with another 10 relocated to a release site at about stream kilometer 14.2. In 1998 another 100 WCT were transported to the upper release site (km 18) from between the constructed barrier and waterfall. All translocated WCT had their adipose fins excised so we could identify them.

In July of 1998 cursory snorkel surveys were conducted in upper Muskrat Creek near the upper release site to document if any translocated WCT had survived the winter of 1997/98. Two cutthroat trout were observed in pools below the upper release site. In July of 1999 we looked for WCT for approximately one kilometer below the upper release site by walking along the stream channel. We observed 11 WCT inhabiting Muskrat Creek in this portion of the creek. No adipose fin-clipped WCT were recaptured below the waterfall during 1998-99 sampling. This finding indicates translocated fish did not move back downstream from their release sites to areas where they had originally been captured.

In August 1999 the release site in upper Muskrat Creek was again surveyed using limited electrofishing and walking the banks to look for recently emerged fry. A total of 840 seconds of shocking time was spent during electrofishing. We captured three age 1 WCT (< 76 mm in length) that had their adipose fins. Since all WCT moved to this site had their adipose fin clipped and no age 0 fish were moved, we concluded that these three fish were the result of successful spawning from some of the 38 WCT re-located to this area in September 1997. In addition to these age 1 WCT, two age 0 (young-of-the-year) WCT were observed indicating that some successful spawning also occurred in 1999. The documentation of successful spawning from translocated fish is very important and bodes well for the successful establishment of a healthy WCT population in the upper portion of Muskrat Creek.

In July of 1998 and 1999 sampling was done below the constructed fish barrier to determine if any WCT remained below the barrier and to mark brook trout to confirm that no brook trout could move over the barrier. No WCT were captured immediately below the constructed barrier. In addition, visual surveys in June of 1998 and 1999, when spawning adult WCT might be moving upstream to spawn, saw no adults immediately below the barrier. Sampling in July of 1999 recaptured seven adipose fin-clipped brook trout below this barrier; however, at that time no adipose fin-clipped brook trout were captured above the barrier. In August of 1999 we captured a single adipose-clipped brook trout immediately above Nursery Creek. At this time we are uncertain if this adipose-clipped brook trout actually was re-located below the barrier and made it upstream (either by jumping the barrier or being moved by human intervention), or if this brook trout had jumped out of one of our holding pens located just above the mouth of Nursery Creek. Our preliminary conclusion is that this fish barrier is effective at preventing the re-invasion of upper Muskrat Creek by brook trout and that few WCT have either remained below, or moved down over, the barrier. We will continue to monitor the stream above the barrier to confirm this conclusion.
Relative catches of brook and WCT from 1997 to 1999 indicated that removal of brook

trout provided some positive relief to WCT from 1997 to 1998 (Table 4 and Figure 3). The relative abundance ratio of brook trout to WCT (based on average catches per 100 m) has decreased from about 45:1 in 1997, to 9:1 in 1998, and then to 8:1 in 1999, even after removing age 1 and older WCT in 1997 and 1998. Population estimates indicated that brook trout removals in 1997 were not very effective; however, it appears that brook trout abundance was more affected between 1998 and 1999 after 1998 removals (Figure 3 and Appendix A).

Length frequencies of brook trout indicate age 0 fish were from 30 to 70 mm in length, while age 1 fish were about 80 to 130 mm long (Figure 4). It appeared age 1 brook trout reached slightly longer lengths in 1999 than in either 1997 or 1998. We are not sure if that was due to the removal of brook trout allowing for faster growth, or some other environmental factor(s). Age 0 WCT were under 50 mm, while age 1 fish were 60 to 100 mm long. These length frequencies were based on late summer sampling, so these fish had obtained most of their growth for the year they were sampled.

Conclusions and Recommendations

Based on information summarized to date, it appears that electrofishing removals of brook trout provided some relief to the WCT population, especially for recruitment of young age classes into the population. However, electrofishing removal of brook trout is not 100% effective and probably needs to be repeated on a minimum of two to three year intervals to keep brook trout populations low enough to increase survival of young WCT. We recommend that some type of piscicide treatment be conducted in Muskrat Creek between the waterfall and constructed barrier, and in Nursery Creek, to permanently eliminate brook trout from this portion of the drainage. Prior to the treatment, as many WCT as possible should be captured by electrofishing and temporarily moved and held out of the treated area. Brook trout captured during this electrofishing could also be moved below the constructed barrier prior to treatment. This recommendation was formally proposed in the Environmental Assessment for the westslope cutthroat trout restoration project in the Elkhorn Mountains (Appendix C, Table 5; Canfield and Spoon 1999).

At least some of the WCT moved into upper Muskrat Creek have remained near their release site and have reproduced successfully. No relocated WCT have yet been found down below the waterfall where they were originally captured. One fin-clipped brook trout was found above the constructed barrier, but we are uncertain at this time if this brook trout had actually been transported below the barrier. It may have escaped a holding facility located by its capture location.

Table 4. Summary of catches (number in 1 pass) and population estimates of westslope cutthroat (WCT) and eastern brook trout (EBT) 75 mm (3 inch) and longer in Muskrat Creek from 1997 through 1999.

Stream		Length	Catch per 100 m		Estimate per 100 m	
Km[1/]	Date	(m)	EBT	WCT	EBT	WCT
	1997					
10.5	9/2/1997	200	26	1	50	-
10.7	9/2/1997	200	58	1	77	1
10.9	9/2/1997	200	74	3	92	3
11.1	9/3/1997	265	50	2	65	2
11.4	9/3/1997	200	36	4	67	7
11.6	9/3/1997	200	40	0	65	-
11.8	9/3/1997	200	32	1	47	1
	1998					
10.4	9/8/1998	100	32	4	53	14
10.5	9/8/1998	150	18	7	28	11
10.6	9/8/1998	100	34	8	72	10
10.7	9/8/1998	100	37	8	75	10
10.8	9/8/1998	100	51	8	62	13
10.9	9/8/1998	100	30	2	50	3
11.0	9/8/1998	100	46	14	66	18
11.1	9/8/1998	100	47	3	74	-
11.2	9/8/1998	100	12	0	-	-
11.4	9/9/1998	100	24	2	32	3
11.5	9/9/1998	100	23	1	44	-
11.6	9/9/1998	100	21	1	34	1
11.7	9/9/1998	100	28	2	42	2
11.8	9/9/1998	100	32	2	40	2
11.9	9/9/1998	100	25	1	30	1
12.0	9/9/1998	100	19	0	24	-
12.1	9/9/1998	100	27	2	34	2
12.2	9/9/1998	100	14	0	20	-
12.3	9/9/1998	100	20	1	29	1
12.4	9/9/1998	100	20	0	62	-
12.5	9/9/1998	100	30	0	43	-
	1999					
10.4	8/23/1999	225	10	0	12	-
10.7	8/23/1999	200	9	4	15	4
10.9	8/23/1999	200	25	3	28	3

Stream		Length	Catch per 100 m		Estimate per 100 m	
Km[1/]	Date	(m)	EBT	WCT	EBT	WCT
11.1	8/23/1999	200	18	2	23	2
11.3	8/24/1999	200	19	1	22	1
11.5	8/24/1999	200	24	2	37	2
11.7	8/24/1999	200	15	1	20	1
11.9	8/24/1999	200	11	1	13	1
12.1	8/25/1999	200	12	0	16	-
12.3	8/25/1999	200	10	10	11	22
12.5	8/25/1999	200	18	3	21	3
12.7	8/25/1999	230	24	0	34	-

1/ Stream Km are stream kilometers up from the mouth of Muskrat Creek at the Boulder River measured from a 1:24,000 scale USGS map sheet.

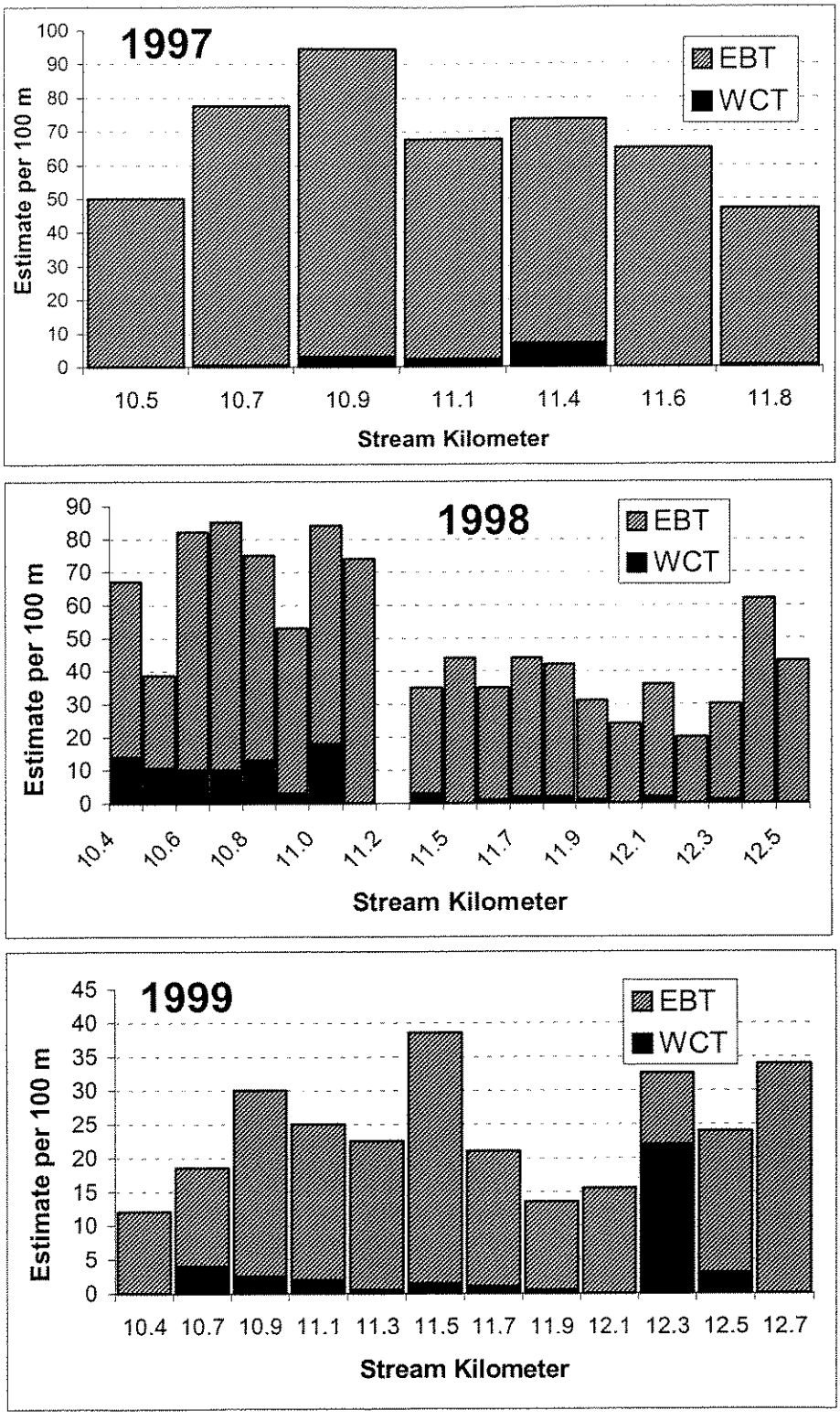

Figure 3. Estimated numbers of brook trout (EBT) and westslope cutthroat trout (WCT) 75 mm and longer per 100 m of stream length by stream kilometer in Muskrat Creek during 1997 (top), 1998 (middle) and 1999 (bottom).

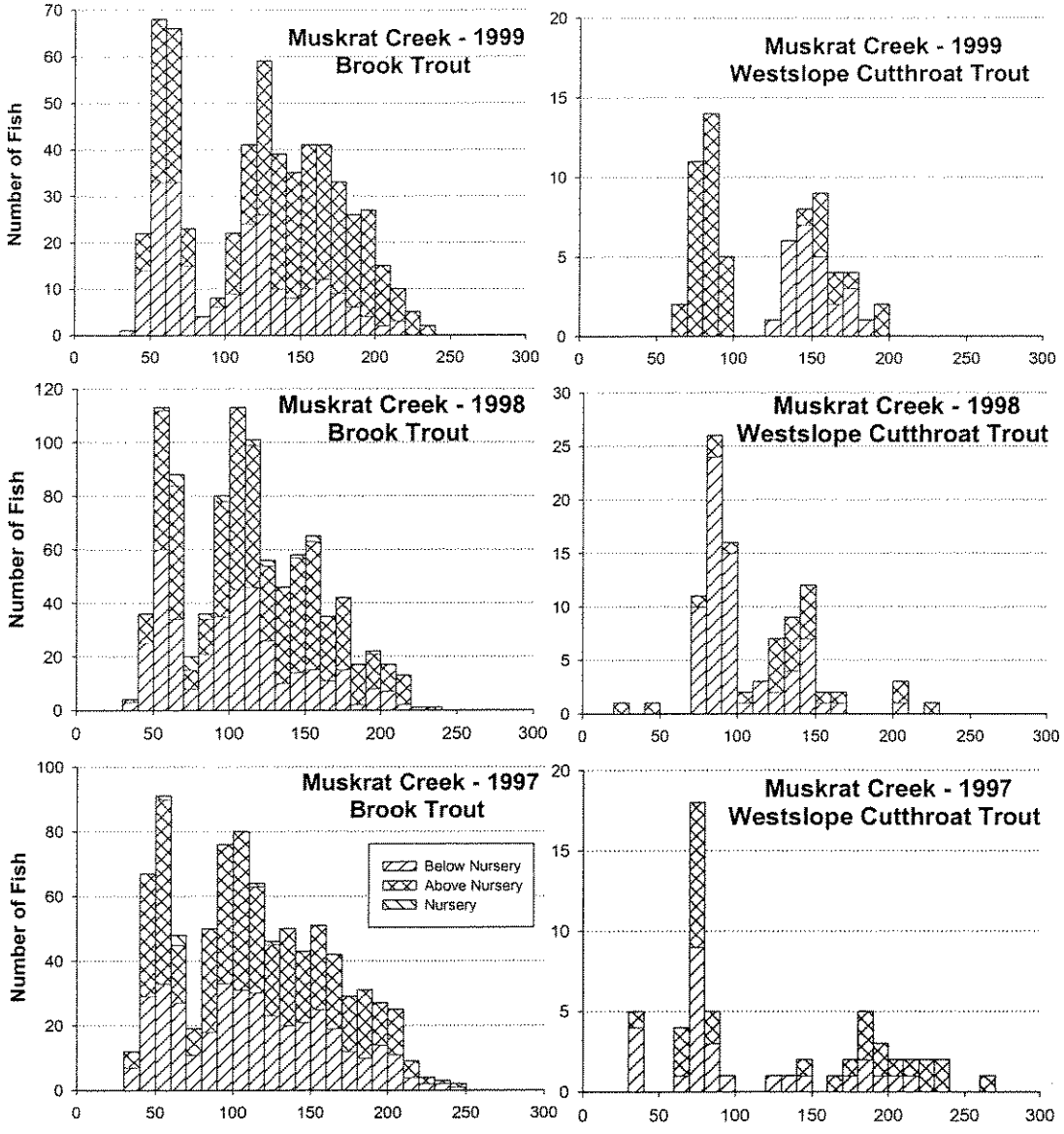

Figure 4. Length frequency histograms of brook trout (left column) and westslope cutthroat trout (right column) in Muskrat Creek above and below Nursery Creek, and in Nursery Creek, in 1997 (bottom), 1998 (middle), and 1999 (top).

Acknowledgements

This work was supported by the USDA Forest Service (FS), Beaverhead-Deerlodge National Forest, the "Bring Back the Natives" program, USDI Bureau of Land Management's Butte District (BLM), the Montana Cooperative Fishery Research Unit at Montana State University (MSU), the Montana Youth Conservation Corps (MYCC), and Montana Department of Fish, Wildlife and Parks (FWP). We appreciate the assistance of staff from MSU, FWP, BLM, FS, and MYCC to complete field removals of brook trout. Brian Sanborn of the Beaverhead-Deerlodge Forest and Sally Sovey and Bill Dean of the BLM's Butte District assisted with funding and fieldwork.

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Appendix A

Fish Population Estimates in Muskrat Creek 1997-199

Table A1. Population estimates and standard errors (SE) made in Muskrat Creek from 1997 through 1999 by stream kilometer, date, species (EBT = brook trout; WCT = westslope cutthroat trout), and length group. Section lengths, estimator (number of passes to compute maximum likelihood depletion estimates), minimum and maximum length ranges of captured fish, total estimate (for fish 75 mm and longer), and estimated number of fish 75 mm and longer per 100 m of stream length and per hectare are also shown. Blank estimates indicate an estimate could not be made because because catches did not decrease on subsequent capture passes.

STREAM		Section	Species	Estimate (SE) by Length Group			Length Range (mm)		Total	Estimated number/	
Stream km	Date	length (m)	Estimator	< 75 mm	75-150 mm	150 + mm	Min	Max	estimate (SE)	100 m	Hectare
MUSKRAT CR											
10.40	09/08/1998	100.0	EBT	186	33	19	36	212	53	53	1514
			3	(17.1)	(1.1)	(3.2)			(2.9)	(2.9)	
10.40	09/08/1998	100.0	WCT	0	12	1	80	167	14	14	400
			3	(0.0)	(4.2)	(0.0)			(5.6)	(5.6)	
10.40	08/23/1999	225.0	EBT	83	25	2	40	157	27	12	
			2	(8.7)	(1.2)	(0.0)			(1.1)	(0.5)	
10.50	09/02/1997	200.0	WCT	0	0	--	180	216	--	--	
			2	(0.0)	(0.0)						
10.50	09/02/1997	200.0	EBT	44	73	24	38	229	100	50	1667
			2	(4.4)	(10.1)	(11.3)			(15.8)	(7.9)	
10.50	09/08/1998	150.0	EBT	38	33	9	47	202	42	28	800
			3	(9.7)	(2.6)	(0.5)			(2.4)	(1.6)	
10.50	09/08/1998	150.0	WCT	0	16	0	81	149	16	11	305
			3	(0.0)	(0.9)	(0.0)			(0.9)	(0.6)	
10.60	09/08/1998	100.0	EBT	41	71	8	38	195	72	72	2057
			2	(2.8)	(26.6)	(0.4)			(16.2)	(16.2)	
10.60	09/08/1998	100.0	WCT	1	10	0	74	131	10	10	286
			2	(0.0)	(0.7)	(0.0)			(0.7)	(0.7)	

STREAM Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
10.70	09/02/1997	200.0	WCT	5	1	0	31	87	1	0.5	17
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
10.70	09/02/1997	200.0	EBT	104	114	39	38	218	154	77	2567
			2	(18.9)	(4.8)	(1.8)			(5.3)	(2.6)	
10.70	09/08/1998	100.0	EBT	60	77	4	41	173	75	75	2143
			2	(17.9)	(21.3)	(0.0)			(14.7)	(14.7)	
10.70	09/08/1998	100.0	WCT	1	10	0	71	135	10	10	286
			2	(0.0)	(0.8)	(0.0)			(0.8)	(0.8)	
10.70	08/23/1999	200.0	EBT	--	19	10	45	219	29	15	
			2		(6.9)	(0.7)			(5.2)	(2.6)	
10.70	08/23/1999	200.0	WCT	0	2	6	136	175	8	4	
			2	(0.0)	(0.0)	(0.5)			(0.4)	(0.2)	
10.80	09/08/1998	100.0	WCT	0	12	1	78	205	13	13	371
			2	(0.0)	(2.7)	(0.0)			(2.6)	(2.6)	
10.80	09/08/1998	100.0	EBT	48	53	9	44	210	62	62	1771
			2	(10.0)	(1.7)	(0.8)			(1.8)	(1.8)	
10.90	09/02/1997	200.0	WCT	1	5	--	71	197	6	3	94
			2	(0.0)	(0.0)				(0.5)	(0.2)	
10.90	09/02/1997	200.0	EBT	108	135	45	37	239	183	92	2859
			2	(10.7)	(3.6)	(0.7)			(3.4)	(1.7)	
10.90	09/08/1998	100.0	EBT	17	38	--	51	223	50	50	1429
			2	(1.2)	(3.6)				(6.7)	(6.7)	
10.90	09/08/1998	100.0	WCT	0	3	0	78	93	3	3	86
			2	(0.0)	(0.8)	(0.0)			(0.8)	(0.8)	

STREAM Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
10.90	08/23/1999	200.0	WCT 2	0 (0.0)	4 (0.0)	1 (0.0)	125	154	5 (0.0)	2.5 (0.0)	114
10.90	08/23/1999	200.0	EBT 2	122 (7.7)	36 (0.7)	19 (0.5)	46	214	55 (0.9)	28 (0.5)	1250
11.00	09/08/1998	100.0	EBT 2	36 (14.5)	53 (5.6)	14 (0.6)	45	212	66 (4.9)	66 (4.9)	1886
11.00	09/08/1998	100.0	WCT 2	0 (0.0)	16 (1.2)	2 (0.0)	78	157	18 (1.1)	18 (1.1)	514
11.10	09/03/1997	265.0	WCT 2	--	6 (1.1)	0 (0.0)	31	149	6 (1.1)	2.3 (0.4)	71
11.10	09/03/1997	265.0	EBT 2	278 (19.5)	137 (6.9)	39 (0.3)	36	245	173 (5.1)	65 (1.9)	2040
11.10	09/08/1998	100.0	EBT 2	32 (7.4)	56 (3.3)	--	50	213	74 (6.9)	74 (6.9)	2114
11.10	09/08/1998	100.0	WCT 2	0 (0.0)	--	0 (0.0)	77	140	--	--	
11.10	08/23/1999	200.0	EBT 2	147 (32.4)	28 (2.0)	17 (0.8)	42	215	46 (2.5)	23 (1.3)	
11.10	08/23/1999	200.0	WCT 2	0 (0.0)	2 (0.0)	2 (0.0)	135	162	4 (0.0)	2 (0.0)	
11.20	09/08/1998	100.0	WCT 2	0 (0.0)	--	0 (0.0)	136	136	--	--	
11.20	09/08/1998	100.0	EBT 2	10 (0.8)	--	--	46	215	--	--	

STREAM Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
11.30	08/24/1999	200.0	EBT 2	108 (14.2)	24 (0.7)	20 (0.8)	42	221	44 (1.0)	22 (0.5)	
11.30	08/24/1999	200.0	WCT 2	0 (0.0)	0 (0.0)	1 (0.0)	155	155	1 (0.0)	0.5 (0.0)	
11.40	09/03/1997	200.0	WCT 3	5 (1.2)	10 (4.7)	5 (0.4)	66	239	14 (2.5)	7 (1.2)	212
11.40	09/03/1997	200.0	EBT 3	169 (43.0)	105 (11.3)	32 (0.8)	41	224	133 (7.8)	67 (3.9)	2015
11.40	09/09/1998	100.0	WCT 2	0 (0.0)	3 (0.8)	0 (0.0)	107	145	3 (0.8)	3 (0.8)	100
11.40	09/09/1998	100.0	EBT 2	7 (0.0)	23 (2.0)	9 (0.8)	53	199	32 (2.1)	32 (2.1)	1067
11.50	08/05/1993	79.5	EBT 2	11 (0.3)	109 (24.1)	13 (2.6)	1	127	124 (24.1)	160 (30.3)	4727
11.50	08/05/1993	79.5	WCT 2	0 (0.0)	4 (1.4)	2 (0.0)	103	178	6 (1.1)	7.5 (1.4)	229
11.50	09/09/1998	100.0	EBT 2	39 (5.4)	36 (6.9)	5 (1.2)	46	177	44 (9.4)	44 (9.4)	1467
11.50	09/09/1998	100.0	WCT 2	0 (0.0)	--	--	126	158	--	--	
11.50	08/24/1999	200.0	EBT 2	--	42 (6.2)	31 (2.8)	52	217	74 (6.9)	37 (3.5)	
11.50	08/24/1999	200.0	WCT 2	0 (0.0)	1 (0.0)	2 (0.0)	144	177	3 (0.0)	1.5 (0.0)	

STREAM Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
11.60	09/03/1997	200.0	EBT 2	350 (51.9)	116 (15.7)	20 (0.5)	31	212	130 (10.8)	65 (5.4)	2167
11.60	09/09/1998	100.0	WCT 2	0 (0.0)	1 (0.0)	0 (0.0)	130	130	1 (0.0)	1 (0.0)	33
11.60	09/09/1998	100.0	EBT 2	23 (0.5)	17 (1.2)	16 (5.6)	52	220	34 (4.8)	34 (4.8)	1133
11.70	09/09/1998	100.0	WCT 2	0 (0.0)	2 (0.0)	0 (0.0)	130	139	2 (0.0)	2 (0.0)	67
11.70	09/09/1998	100.0	EBT 2	60 (5.2)	27 (8.4)	17 (0.5)	39	207	42 (4.3)	42 (4.3)	1400
11.70	08/24/1999	200.0	WCT 2	0 (0.0)	0 (0.0)	2 (0.0)	156	196	2 (0.0)	1 (0.0)	
11.70	08/24/1999	200.0	EBT 2	37 (3.7)	17 (1.2)	22 (2.0)	50	231	40 (2.8)	20 (1.4)	
11.80	09/03/1997	200.0	EBT 2	23 (0.2)	81 (5.3)	11 (1.1)	44	210	93 (5.7)	47 (2.9)	1409
11.80	09/03/1997	200.0	WCT 2	1 (0.0)	1 (0.0)	0 (0.0)	34	78	1 (0.0)	0.5 (0.0)	15
11.80	09/09/1998	100.0	EBT 2	9 (0.4)	28 (1.1)	11 (0.7)	53	202	40 (1.8)	40 (1.8)	1333
11.80	09/09/1998	100.0	WCT 2	0 (0.0)	1 (0.0)	1 (0.0)	125	208	2 (0.0)	2 (0.0)	67
11.90	09/09/1998	100.0	EBT 2	--	24 (0.7)	6 (1.1)	61	175	30 (1.1)	30 (1.1)	1000

STREAM Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
11.90	09/09/1998	100.0	WCT 2	0 (0.0)	1 (0.0)	0 (0.0)	140	140	1 (0.0)	1 (0.0)	33
11.90	08/24/1999	200.0	WCT 2	0 (0.0)	0 (0.0)	1 (0.0)	170	170	1 (0.0)	0.5 (0.0)	
11.90	08/24/1999	200.0	EBT 2	18 (0.8)	14 (0.9)	12 (0.7)	60	214	26 (1.1)	13 (0.6)	
12.00	09/09/1998	100.0	EBT 2	8 (3.2)	17 (1.2)	7 (0.4)	63	172	24 (1.2)	24 (1.2)	800
12.10	09/09/1998	100.0	EBT 2	2 (0.0)	24 (1.9)	10 (0.3)	60	204	34 (1.7)	34 (1.7)	1133
12.10	09/09/1998	100.0	WCT 2	0 (0.0)	2 (0.0)	0 (0.0)	90	126	2 (0.0)	2 (0.0)	67
12.10	08/25/1999	200.0	EBT 2	6 (0.5)	10 (0.3)	22 (3.3)	49	223	31 (2.1)	16 (1.1)	
12.20	09/09/1998	100.0	EBT 2	--	15 (2.3)	5 (0.5)	46	206	20 (2.2)	20 (2.2)	571
12.20	09/09/1998	100.0	WCT 2	1 (0.0)	--	0 (0.0)	26	141	--	--	
12.30	09/09/1998	100.0	EBT 2	--	16 (3.9)	13 (0.6)	60	215	29 (2.9)	29 (2.9)	967
12.30	09/09/1998	100.0	WCT 2	0 (0.0)	0 (0.0)	1 (0.0)	162	162	1 (0.0)	1 (0.0)	33
12.30	08/25/1999	200.0	EBT 2	4 (0.6)	10 (0.3)	11 (0.3)	55	209	21 (0.5)	11 (0.3)	

STREAM Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
12.30	08/25/1999	200.0	WCT 2	--	44 (15.1)	1 (0.0)	66	193	44 (13.4)	22 (6.7)	
12.40	09/09/1998	100.0	WCT 2	1 (0.0)	0 (0.0)	0 (0.0)	47	47	0 (0.0)	0 (0.0)	0
12.40	09/09/1998	100.0	EBT 2	4 (0.0)	72 (76.1)	5 (0.5)	45	177	62 (34.5)	62 (34.5)	2067
12.50	09/09/1998	100.0	EBT 2	5 (1.2)	26 (3.2)	16 (0.9)	54	218	43 (3.5)	43 (3.5)	1433
12.50	08/25/1999	200.0	EBT 2	24 (7.3)	19 (2.3)	24 (0.2)	51	227	42 (1.1)	21 (0.6)	
12.50	08/25/1999	200.0	WCT 2	1 (0.0)	5 (0.5)	1 (0.0)	72	153	6 (0.5)	3 (0.3)	
12.60	08/05/1993	68.9	EBT 2	0 (0.0)	21 (2.1)	3 (0.7)	1	70	24 (2.2)	35 (3.2)	917
12.70	08/25/1999	230.0	EBT 2	14 (0.6)	23 (3.2)	54 (3.2)	46	235	78 (4.8)	34 (2.1)	