Westslope Cutthroat Trout Restoration

in Muskrat Creek, Boulder River Drainage, Montana:

Progress Report for Period 1993 to 2003

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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. A wooden barrier (crib-type) was constructed near the Forest Service boundary (stream kilometer 12.7) in 1997. Since 1996 brook trout have been annually removed from Muskrat Creek from this constructed barrier up to a natural barrier, located about 2.4 km above this constructed barrier, using repeated electrofishing to conserve an extant WCT population in Muskrat Creek. This report summaries work completed in 2003.

A total of 18 brook trout were removed from the portion of Muskrat Creek from the constructed fish barrier upstream to the natural barrier in 2003. All these brook trout were removed during July and no brook trout were captured during an extensive effort of four electrofishing passes made in October. All the brook trout captured during July 2003 were age-2 and older fish (142 to 212 mm), confirming evidence from last year that no brook trout successfully recruited to the population during the past two to three years. The absence of brook trout during sampling conducted during October indicated that we might have been successful in totally removing brook trout from this portion of the stream. Brook trout removal has increased abundance of WCT in the portion of creek between the two barriers, despite the relocation upstream of the majority of age-1 and older WCT captured from this portion of the stream in 1997, 1998, and 2001. No adipose-clipped brook trout or WCT were captured between the constructed crib barrier and waterfall in 2003, indicating that brook trout were not moving upstream over the constructed barrier nor were WCT moving down over the waterfall.

The WCT re-located above the natural barrier survived and reproduced in the upper basin and by 2002 these WCT had expanded upstream to the extreme headwaters (to about km 21.7 or 1.0 km above the release site) and downstream throughout the stream. We estimated densities of WCT in sample sections located throughout upper Muskrat Creek above the waterfall barrier to be between 4 to 78 WCT per 100 m of stream length and WCT appear to be distributed throughout the portion of the creek from the natural barrier all the way up to the headwaters. None of these re-located WCT had moved down below the natural barrier to their original capture sites until after 2000, when severe drought conditions reduced flows in the headwater portion of the stream leading to five individuals moving downstream in 2001. No additional adipose-clipped WCT were captured below the natural barrier in 2002 or 2003. One adipose-clipped WCT was recaptured in 2002 above the natural barrier near where it had been released, but none were captured in 2003.

We have been successful in expanding the existing WCT population in both distribution and total population. We have increased their distribution above the Forest Service boundary (above stream kilometer 12.7), where the crib barrier was constructed, from 2.4 km to nearly 9.0 km. In addition, the removal of brook trout from the 2.4 km of stream between the constructed and natural barrier appears to be offering the existing WCT population some relief to increase their numbers in this portion of the stream. Our best estimate is that the WCT population (fish 75 mm and longer) has increased at least 20-fold, from less than 100 in 1997 to over 2,200 in 2003. A population level that should be considered recovered.

Introduction

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 an extant population of westslope cutthroat trout *Oncorhynchus clarki lewisi* (WCT) in Muskrat Creek (Figure 1), a tributary to the Boulder River, Montana in the Elkhorn Mountains (Spoon and Shepard 1996; Canfield and Spoon 1999; Shepard et al. 1999; Shepard and Spoon 2000; Shepard et al. 2001; Shepard and Nelson 2002). Shepard and Spoon (2000), Shepard et al. (2001) and Shepard and Nelson (2002; 2003) provided a detailed description of the Muskrat Creek drainage and detailed efforts made to restore WCT in this drainage through 2002. The tasks being implemented to conserve this WCT population include: 1) construction of a barrier to upstream fish passage at stream kilometer 12.7, near the Forest Service boundary, to prevent further invasion of habitats above this barrier by exotic brook trout; 2) removal of brook trout from approximately 2.4 km of habitat between this constructed barrier and a natural barrier (located at stream kilometer 15.1) to eliminate competition and predation from brook trout on WCT and prevent the replacement or displacement of WCT by brook trout; and 3) movement of enough WCT upstream from the area between the two barriers to habitats above the natural fish barrier to establish a self-sustaining WCT population in the approximately 6.0 km of additional suitable habitat located above this natural barrier. This report details efforts made to remove brook trout, assess the effects of these removals on the existing WCT population between the two barriers, and evaluate the translocation success of WCT to the upper basin above the upper natural barrier during 2003.

Kulp and Moore (2000) suggested that conducting multiple electrofishing removals on at least three occasions within a year might be effective at removing exotic rainbow trout from Applachian Mountain streams, thus allowing native brook trout populations in these streams to expand. Thompson and Rahel (1996) indicated that this technique had merit in the Rocky Mountains for removing brook trout to conserve cutthroat trout, but did not completely remove brook trout from a Wyoming stream where they tested this technique. To test this technique for removing brook trout from mountainous streams of the Northern Rocky Mountains, we conducted multiple electrofishing efforts on two occasions during 2001 and on five separate occasions during 2002.

During 2001 all stream kilometer data were updated based on Montana FWP's GIS coverage of streams (1:100,000) being updated to an identification protocol with latitude/longitude at each stream's mouth (LLID) uniquely identifying each stream along with each stream routed by stream mile. Previously, stream kilometers had been calculated based on a fixed point above the stream's mouth. This resulted in increases for all stream kilometers by 2.4 km and slight changes in distances from previous reports. The distance from the constructed barrier to the natural barrier increased from 2.2 reported in last year's report (Shepard and Nelson 2002) to 2.4 km this year due to increased precision in locating barriers on GIS maps. Stream flows during 2000 and 2001 and the winter of 2002 were extremely low due to drought conditions (Shepard and Nelson 2002); flows during the summer of 2002 were nearly average (Shepard and Nelson 2003); and flows during the summer of 2003 were very low, compared to the period of record (Figure 2).

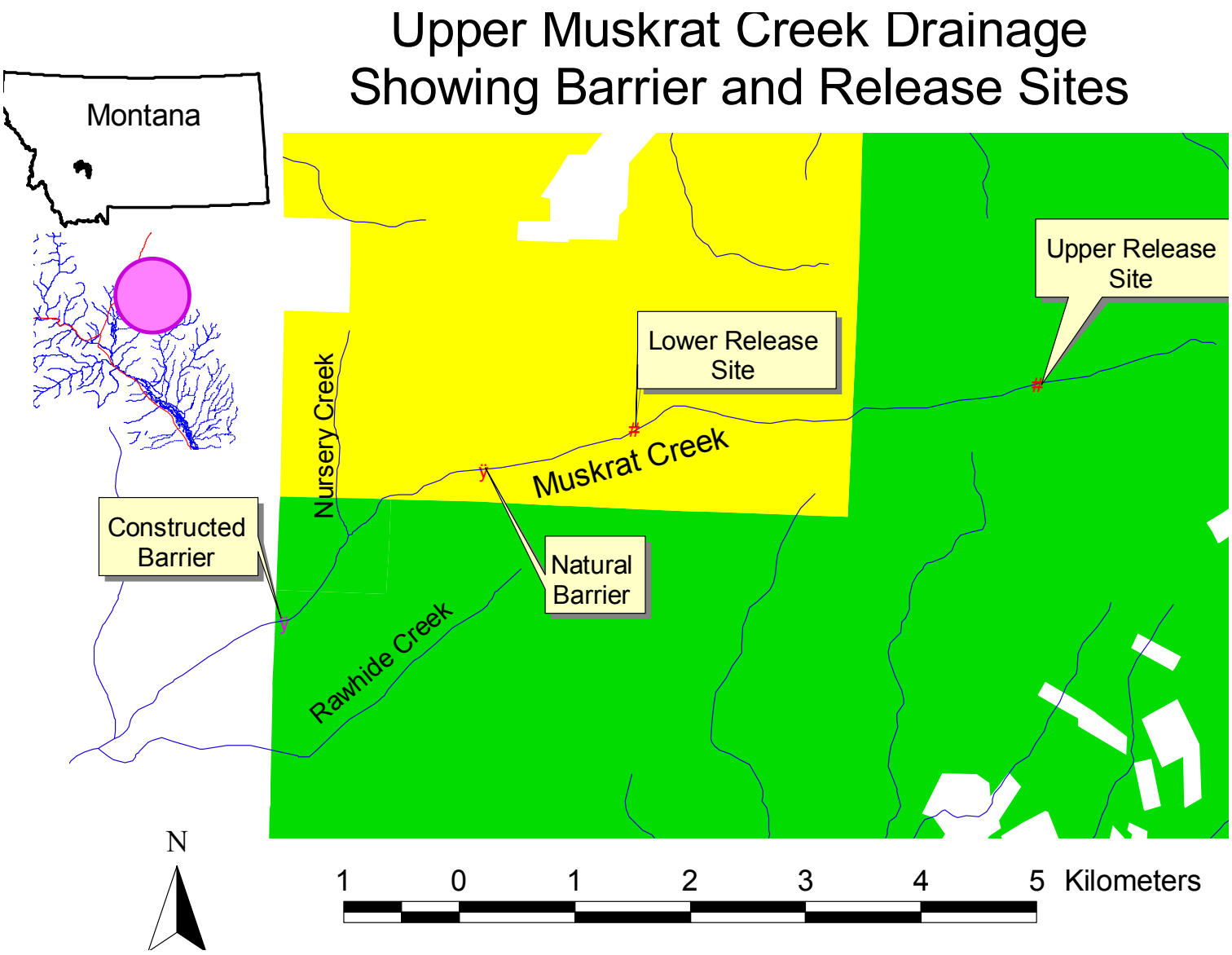

Figure 1. Map of Muskrat Creek showing land ownership, locations of constructed barrier, natural barrier (waterfall), and sites where westslope cutthroat trout were released in 1997 and 1998. BLM ownership is light gray, Forest Service ownership is dark gray, and private lands are white.

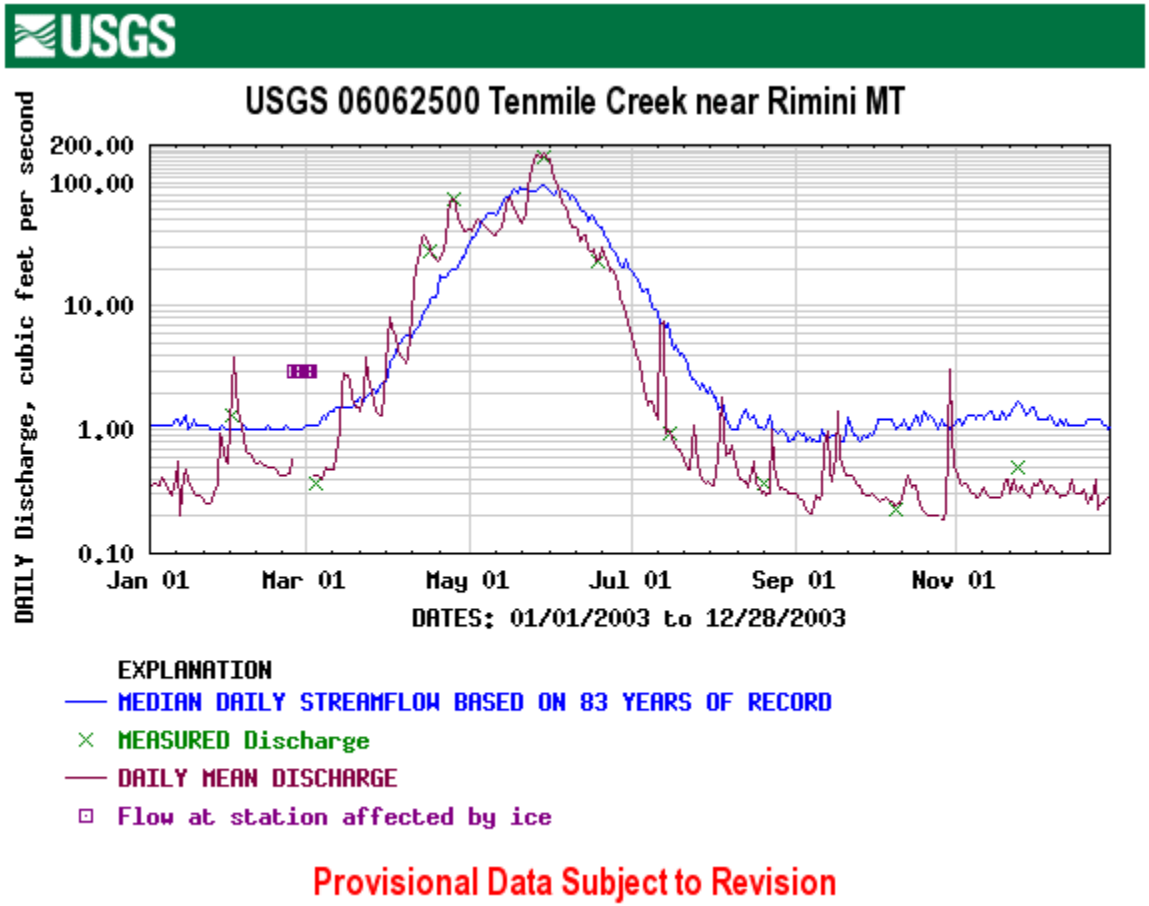

Figure 2. Provisional flow data for Tenmile Creek, the nearest flow-gauged stream, from January 1to December 28, 2003 compared to long-term average (83 years) flows. Data are courtesy of the USGS via the web (http://mt.waterdata.usgs.gov/nwis/sw).

Methods

Single-pass and multiple-pass electrofishing were used to remove brook trout and estimate fish abundance. Multiple passes consisted of two or three consecutive electrofishing passes. Each section was blocked with 6.24 mm mesh nets at both its upstream and downstream boundaries prior to electrofishing. All captured fish were measured to the nearest mm (total length) and weighed to the nearest gram using either an electronic (O'Haus Scout®) or spring (Pesola®) scale. All captured brook trout were transported downstream below the constructed crib barrier where their adipose fins were removed prior to releasing them below this barrier. During 2003 we made two or three electrofishing passes during the weeks of August 26 and October 6. Electrofishing was conducted from the constructed fish barrier up to the natural fish barrier during all sampling efforts. During late August in both 2002 and 2003 depletion population estimates were done in several 100 m long sections from the natural barrier up to just above the upper release site (Figure 1) to document the abundance of the re-founded WCT population in upper Muskrat Creek.

Population estimates were made using a Montana FWP modification of the software program MICROFISH (Van Deventer and Platts 1989). Relative abundance, expressed as the number of fish captured per 100 m of stream length during a single electrofishing pass, was computed for all sampling efforts by stream kilometer. We plotted length frequencies for all captured fish by 10 mm size groups and species for each sample event.

Results and Discussion

A total of 18 brook trout were removed from the portion of Muskrat Creek from the constructed fish barrier upstream to the natural barrier in 2003. All these brook trout were removed during August. No brook trout were captured during four electrofishing passes made in October 2003 (Figure 3). During August 2003 we estimated that the portion of Muskrat Creek from the natural barrier down to the constructed barrier supported an estimated 18 brook trout 75 mm and longer (SE: 1; Figure 3). Since we removed 18 brook trout and our estimate was 18 brook trout in August, and we subsequently did not capture any brook trout in October, we believe we have successfully removed all brook trout from this portion of the stream. We did not recapture any previously adipose-clipped brook trout in this reach of the stream, indicating that brook trout were not able to move upstream over the constructed barrier.

We found that our initial attempts to physically remove brook trout from Muskrat Creek using single annual multiple-pass efforts from 1997 through 2000 were not very effective in eliminating brook trout. We then increased our removal efforts to twice per year in 2001 and while those two efforts did not apparently reduce overall brook trout abundance, these removals appeared to dramatically reduce successful reproduction of brook trout (Figure 3). In an effort to totally eradicate brook trout we conducted four removal efforts during 2002, one each during April, June, July, August, and October. That level of effort was effective at almost eliminating brook trout by the end of 2002 because we found only 18 brook trout in August 2003, all of which were removed at that time. Kulp and Moore (2000) reported that concentrating several removal efforts over the course of a one or two-year period was more effective at removing

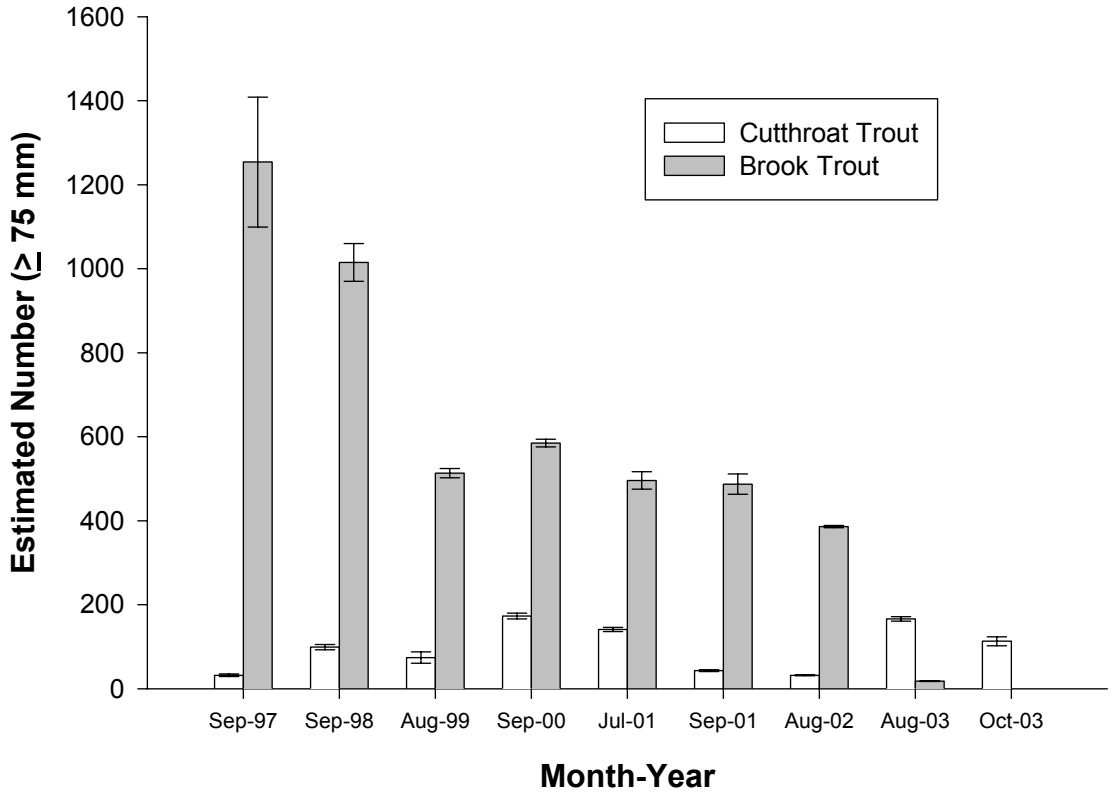

Figure 3. Estimated numbers of brook trout and westslope cutthroat trout (SE's shown as error bars) in the portion of Muskrat Creek from the constructed fish barrier up to a natural fish barrier during each removal event from 1997 through 2003. The number of westslope cutthroat trout relocated to the upper portion of the basin in 1997, 1998, and 2001 are shown above the estimates for those years as "number moved".

rainbow trout from native brook trout waters of Smokey Mountain National Park. We also found that removal efforts conducted during the late fall (late September or October) were very effective because trout, especially larger adults, were concentrated in pool habitats and age-0 brook trout had grown larger making them easier to capture. Trout, especially adults, have been shown to aggregate in pool habitats to over-winter (Bustard and Narver 1975; Cunjak and Power 1986; Brown and Mackey 1995; Jakober et al. 1998; Muhlfeld et al. 2001; Roni and Quinn 2001; Dare and Hubert 2002).

Length frequencies for captured brook trout during past years indicated that age-0 brook trout were less than 90 mm for August and October sampling events, and less than 60 mm in April, June, and July sampling events (Figure 4). Based on length frequency data we partitioned ages based on length for the sample events in August and October 2002 as follows: age-0 – less than 90 mm; age-1 – 90 to 140 mm; and age-2+ - longer than 140 mm (Figure 4). Based on these age assignments, we captured no brook trout younger than age-2 during 2003 (Figure 5). Catch of

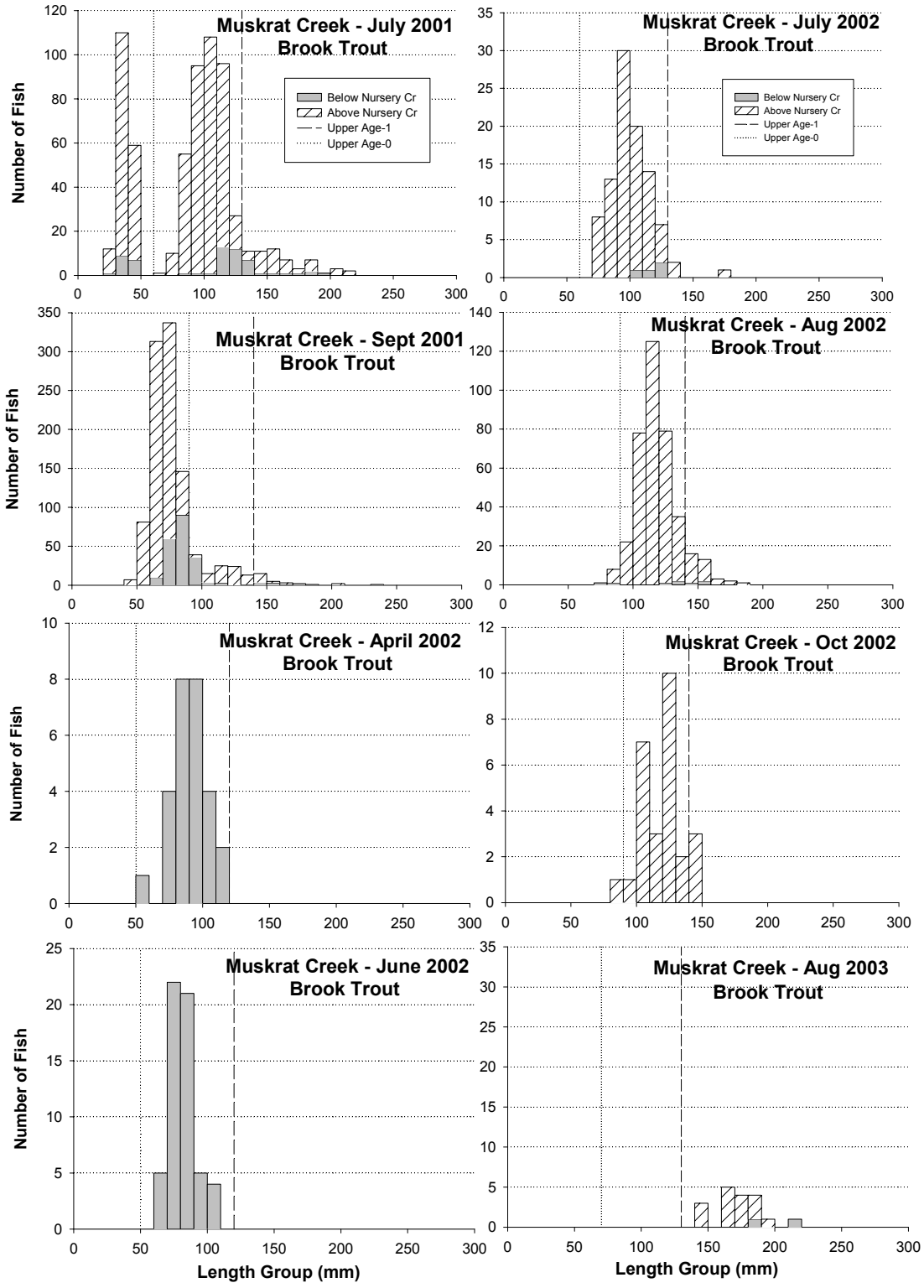

Figure 4. Length frequency histograms for brook trout captured in Muskrat Creek in 2001, 2002 and 2003. Vertical lines indicate assigned upper limits for age-0 (dotted line) and age-1 (dashed line) brook trout. September 2001 and August 2002 dates were very similar for comparing length frequencies since they occurred only three weeks apart.

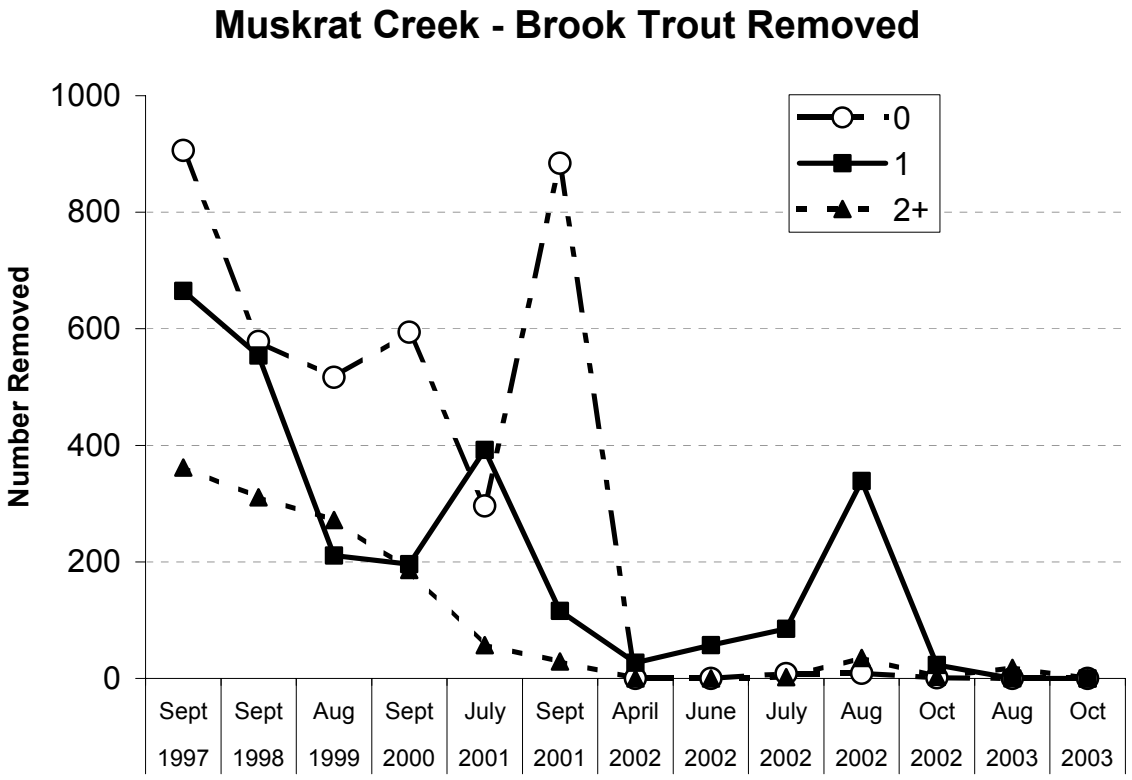

Figure 5. Number of brook trout age-0, age-1, and age-2 and older (see text for explanation of age assignments) removed from the portion of Muskrat Creek from the constructed fish barrier up to a natural fish barrier during each removal event from 1997 through 2003.

brook trout by age during each sampling event shows that we successfully eliminated reproduction of brook trout by 2002 and thus were able to totally eliminate brook trout this year once age-1 brook trout from 2002 had reached age-2 in 2003 (Figure 5).

We suggest that a good strategy for removing brook trout is that during the first year as many adults as possible be removed prior to spawning, before September 7, with another removal effort occurring as late in the fall as possible to take advantage of aggregating behavior of adults, moving into pools seeking over-winter habitats, higher electrofishing efficiencies experienced at colder water temperatures, and increased size of age-0 brook trout later in the year making them more vulnerable to electrofishing. We recommend capturing and eliminating as many younger brook trout as possible during the first year, but efforts should focus on eliminating reproductive adults. We found our removal efforts in 2001 were effective at removing adult (> 140 mm or age-3 and older) brook trout (Figure 4). Once these adult trout had been removed, we were able to concentrate our efforts to remove smaller brook trout. This finding was consistent with results reported by Kulp and Moore (2000) for removal of rainbow trout and Thompson and Rahel (1996) and Shepard et al. (2002) for removal of brook trout. Following brook trout removal efforts in 2001, it appeared that only the 2001 year-class of brook trout (spawned in the fall of

2000) remained in 2002 (Figure 4). Consequently, once fish in this 2001 year-class reached a size where they were more vulnerable to backpack electrofishing (>100 mm) later in 2002, they were effectively removed. No successful brook trout reproduction appeared to occur above the barrier after 2001.

We estimated that 166 (SE: 5.5) WCT 75 mm and longer inhabited the reach of Muskrat Creek between the constructed and natural barriers during August 2003 (Figure 3). This represents an increase of about five-fold from the August 2002 estimate of 32. While 78 age-1 and older WCT captured in this reach during July 2001 were moved to the upper release site above the natural barrier, it appeared the population rebounded well from 2002 to 2003 in this reach. However, estimates conducted in October estimated that the reach between the constructed and natural barriers only supported an estimated 113 (SE: 10.7) WCT 75 mm and longer. We adipose-clipped all WCT that we moved into the upper portion of Muskrat Creek, 48 in 1997, 100 in 1998, and 78 in 2001. We did not recapture any previously adipose-clipped WCT in the portion of Muskrat Creek between the two fish barriers, indicating that WCT re-located above the natural barrier had not moved downstream into the portion of the creek below this barrier.

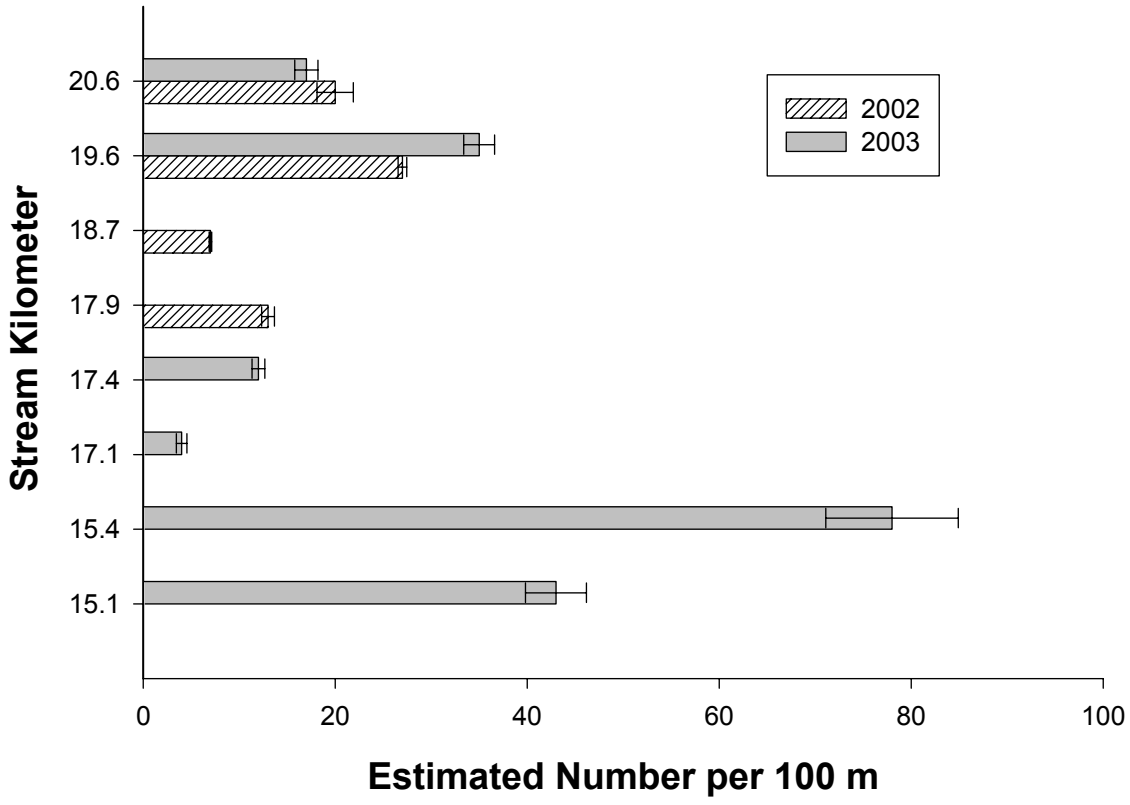

Figure 6. Estimated populations (SE's as error bars) of westslope cutthroat trout 75 mm and longer in eight 100 m long sample sections (located by stream kilometer) in upper Muskrat Creek in 2002 and 2003.

Population estimates conducted above the natural barrier indicated that the WCT population in upper Muskrat Creek has dramatically expanded from the approximately 220 fish that were originally released into this area of the creek (Figure 6). The upper portion of the stream now supports an estimated 4 to 78 WCT per 100 m of stream length and WCT appear to be distributed throughout the portion of the creek from the natural barrier all the way up to the headwaters. We observed WCT in the very headwaters (at about stream km 21.7; where the uppermost two first order tributaries join to form Muskrat Creek) of Muskrat Creek during August 2002. Expanding averages of our estimates based on lengths of three reaches of Muskrat Creek resulted in an estimated population of about 2,100 WCT 75 mm and longer inhabiting this portion of the stream (Table 1). Adding the population between the natural and constructed barrier to this estimate brings the total estimated number of WCT in the Muskrat Creek above the constructed barrier to over 2,200 fish 75 mm and longer. We believe the current population level represents a successful effort to conserve this WCT population. We base this conclusion, in part, on suggestions by Hilderbrand and Kershner (2000) that a population of 2,500 should be adequate for long-term persistence. We also did not recapture any previously adipose-clipped WCT in the portion of Muskrat Creek above the natural barrier. It is possible that few WCT that were trans-located during 2001 remain in this reach of stream. Almost all WCT trans-located in 2001 were age-2 or older, so these fish would be age-4 and older in 2003. Downs et al. (1997) found that the longevity of stream-dwelling WCT was from 5 to 8 years, something the lack of recaptured adipose-clipped age-4 and older fish that we found in upper Muskrat Creek during 2003 would support.

Table 1. Expanded estimate of westslope cutthroat trout inhabiting Muskrat Creek from the natural fish barrier at kilometer 14.9 up to the headwaters at kilometer 21.7.

Reach (km)		Distance	Site		Estimate		Average	Total	Average
From	To	(m)	(km)	Date	(#/100 m)	SE	estimate	estimate	length (mm)
14.9	17.0		15.13	8/28/2003	43	3.2			119
			15.55	8/28/2003	78	6.9			91
		2090					60.5	1260	
17.0	19.0		16.99	8/28/2003	4	0.5			145
			17.38	8/28/2003	12	0.7			81
			17.87	8/27/2003	13	0.7			119
			18.68	8/27/2003	7	0.1			131
		2000					9.0	180	
19.0	21.7		19.58	8/27/2003	35	1.6			109
			19.61	8/29/2002	27	0.5			114
			20.64	8/29/2002	20	1.9			124
			20.70	8/27/2003	17	1.2			105
		2700					24.8	670	
Total Estimate								2110	

Length frequencies for WCT captured during 2003 indicated that all age classes of WCT were present in most reaches of Muskrat Creek (Figure 7). Especially encouraging was the relatively high number of smaller age-1 fish that were 60 to 100 mm in August and 80 to 110 mm in October 2003. This finding shows that WCT are successfully reproducing in the upper basin and supports other work suggesting that young brook trout, particularly age-0 fish, may compete with young WCT and displace or replace them (Griffith 1972; Cummings 1987; Cowley 1987; Strach and Bjornn 1989; Behnke 1992; Thomas 1996; Sabo and Pauley 1997; Shepard et al. 2002). In addition, the presence of all age classes between the two barriers indicates that this population is reproducing and will likely recover fully now that brook trout have probably been eliminated. We are very interested to see if biomasses of WCT in this reach attain levels comparable to those when brook and cutthroat trout were in sympatry. We found that this rebounding of WCT biomass to levels nearly equal to biomasses of both WCT and brook trout occurred in White's Creek, a tributary to Canyon Ferry Reservoir, three years after total elimination of brook trout had been accomplished (Shepard et al. 2002).

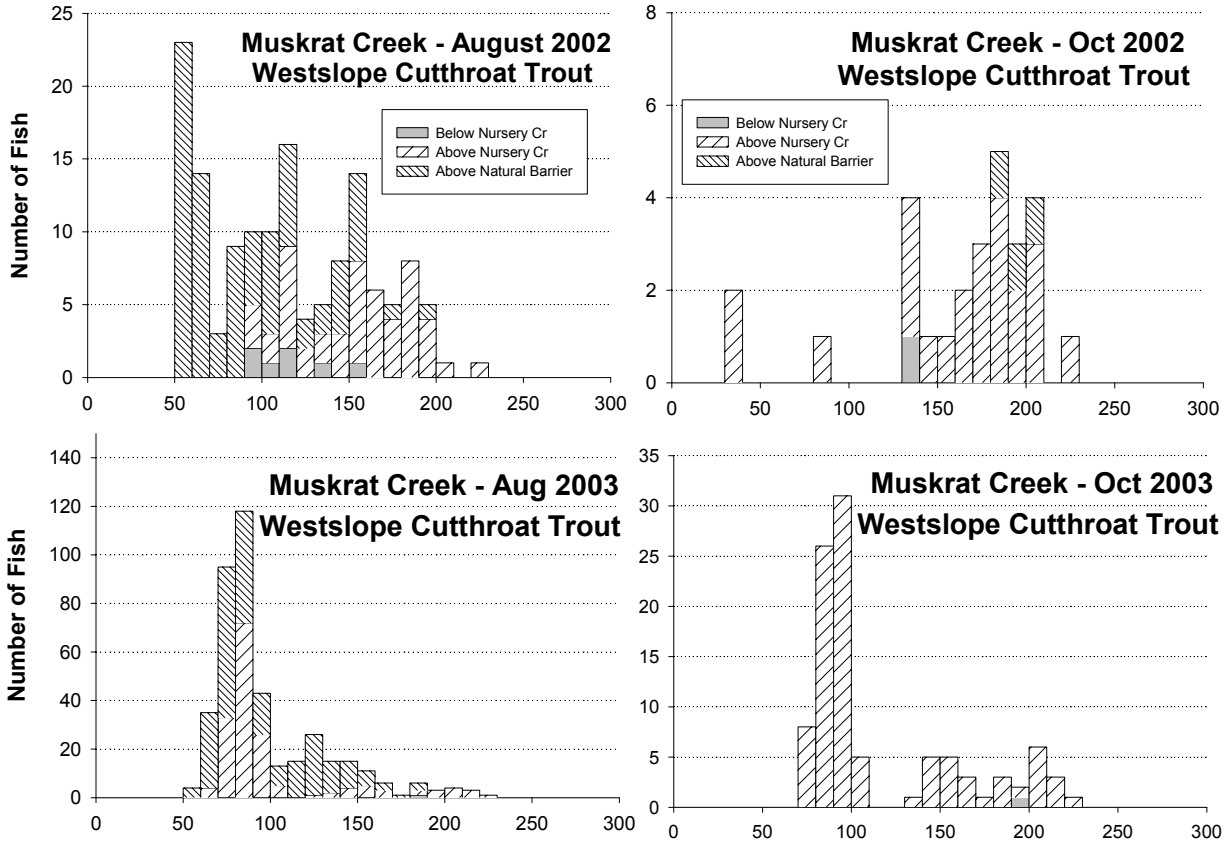

Figure 7. Length frequency histograms for westslope cutthroat trout captured in Muskrat Creek during August and October of 2002 and 2003 between the constructed barrier and Nursery Creek (Below Nursery Cr), between Nursery Creek and the Natural Falls (Above Nursery Cr), and above the Natural Falls. Note differences in y-axis scales.

Conclusions and Recommendations

Based on information summarized to date, electrofishing appears to have been successful in totally removing brook from the portion of Muskrat Creek between the two barriers. The removal of brook trout has provided relief to the WCT population, especially for recruitment of young age classes into the population. We strongly recommend that the entire reach between the two barriers be sampled by multiple-pass (at least two passes) at least once during 2004 to confirm the absence of brook trout and to provide a reliable estimate of the total population of WCT.

We did not recapture any previously adipose-clipped brook trout or WCT in the portion of Muskrat Creek between the constructed and natural fish barriers. This result indicates that brook trout did not pass upstream over the constructed fish barrier, nor did WCT that were re-located above the natural barrier move downstream past this natural barrier during 2003. We recaptured a single WCT that had been previously adipose-clipped near the trail-crossing footbridge over Muskrat Creek in October 2002, but recaptured none in 2003 with a more extensive sampling effort.

The WCT that were re-located to the upper portion of Muskrat Creek above the natural fish barrier appear to be doing very well. This upper WCT population is obviously reproducing, as indicated by the numerous age-1 WCT captured during 2003, and this population has expanded both up and downstream. We estimate that the upper 9.0 km portion of the drainage likely supported over 2,100 WCT 75 mm and longer during 2003. This estimate was based on expansion of a several population estimates and the documented distribution and relative abundance of WCT throughout this upper reach of stream. While this population expansion formula has limitations, we believe this WCT population estimate is reasonable and represents a success in conservation of this population.

Acknowledgements

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