ESTIMATES OF THE FALL, 2013, CUTTHROAT TROUT POPULATION DENSITIES IN ECCLES CREEK, TRIBUTARY TO SCOFIELD RESERVOIR

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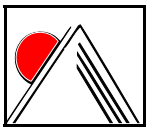

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TABLE OF CONTENTS

INTRODUCTION

In the late summer and fall of 2001, water entering Skyline Mine of Canyon Fuel Company was allowed to discharge water from an underground aquifer into Eccles Creek to prevent mine flooding. At that time, a series of studies was initiated to assess the impact of the increased flows on the biota of Eccles Creek. Most of the assessment focused on the invertebrate communities of the stream, but electrofishing surveys were included to evaluate the response of fish to the flows. In the initial qualitative sampling survey in 2001, no fish were collected. However by 2004, fish had been seen in the stream, and fish survey stations were established at each of the three benthos sampling stations in Eccles Creek In addition a very small side stream, the South Fork of Eccles Creek was sampled. This side stream is too small to hold large trout but may serve as a nursery/refuge for young of the year fish. This report compares the fish densities and species composition in the three reaches in October, 2013, with that recorded in October, 2004, October, 2007, and October, 2010.

METHODS

On October 5, 2004, three 100 meter sample stations were established at each of three sections of Eccles Creek (Table 1). A fourth station was established in the South Fork of Eccles Creek. The sites were initially marked with flagging to allow easy site location when the population estimates were conducted. The first series of population estimates were conducted in October, 2004. In 2007, samples were completed in late September and early October, in 2010 and 2013 sampling was completed in October.

Table 1. Sampling Stations on Eccles Creek

Station	GPS Coordinates Start Location	GPS Coordinates End Location
Lower Eccles Creek	N 39^0 41' 0.87" W 111^0 9' 57.47"	N 39^0 41' 0.06" W 111^0 10' 1.86"
Middle Eccles Creek (above Whisky Canyon)	N 39^0 40' 55.54" W 111^0 10' 40.11"	N 39^0 40' 54.48" W 111^0 10' 44.82"
Upper Eccles Creek	N 39^0 40' 58.20" W 111^0 11' 34.74"	N 39^0 40' 55.79" W 111^0 11' 27.39"
South Fork Eccles Creek	N 39^0 40' 55.79" W 111^0 11' 27.39"	N 39^0 40' 53.06" W 111^0 11' 30.90"

Fish population estimates were based on removal summation sampling (Moran 1951; Zippen 1956, 1958; Van Deventer and Platts 1985) applied to the measured sections of stream.

The fish were captured with a Smith-Root Model 12 battery-powered backpack electrofisher. All captured fish were transferred to buckets and were held in flow-through holding pens until two electrofishing passes had been completed. Fish were then identified and counted.

Fish from each station were also measured so that length frequency could be examined. The length frequency of the trout collected allowed separation of fish into size classes, but accurate age estimation would require scale or otolith examination. It is likely that the largest fish collected in this survey were age 2+ or 3+ age classes (in October a 2+ fish will be approximately 2 years and six months in age). The high elevation of the site suggests that the larger fish are 3+ to 4+ or older, but the increased stream temperature resulting from the mine discharge could confound the elevation effect by favoring more rapid annual growth because of an extended growing season.

RESULTS AND DISCUSSION

The trout collected in 2013 were not separated in to rainbow, hybrids, and cutthroat trout. By this sampling period the fish appeared to be well introgressed and showed a dominance of cutthroat trout characteristics. The population density was highest in the downstream-most station and was about double that found in both the Middle Eccles and Upper Eccles station. One tiger trout was collected in the Middle Eccles station, likely gaining access to the stream from Scofield Reservoir. The 2013 sampling resulted in high density estimates of trout relatively narrow confidence ranges (Table 2) indicating that the estimates made in the three sections were relatively accurate. The lower Eccles Creek station had a total population estimate of 232 fish in 2013 (Table 2). The middle Eccles station had an estimated 102 fish in 100 meters and the Upper Eccles station had an estimated 92 trout. Three young of the year trout were collected in the South Fork of Eccles Creek.

Table 2. Population estimates and confidence intervals for Eccles Creek, October, 2013

Station	Population Estimate	Lower 95% Confidence Interval	Upper 95% Confidence Interval	Density per Linear Meter of Stream
Lower Eccles Creek	232	181	283	2.32
Middle Eccles Creek	102	84	120	1.02
Upper Eccles Creek	92	67	117	0.71
South Fork Eccles Creek	3	0	3	0.03
Total Estimate (400 m of stream)	429	332	523	1.02

The trout population density in 2013 was the highest recorded in Eccles Creek over the four sampling periods since 2004 (Table 3) with an average of 4.29 fish per linear meter of stream. The previous high count occurred in 2007 where the Lower Eccles station had a density estimate of 109 fish. In 2010 the density had fallen to 64 fish but in 2014 it increased to 232 fish, over 2-fold greater than 2010 and 3.6-fold higher than in 2010. The Middle Eccles site in 2013 had a 3.2 greater density than in 2007, and was double that recorded in 2010. The upper Eccles station in 2013 was about 30% higher than the 2007 density estimate and 2.7 times higher than the 2010 estimate.

These density estimates appear to have reversed a trend that was developing in 2010. At that time it appeared that the calcareous marl formation in the stream was beginning to significantly reduce in-stream spawning habitat and cover. Thus the physical system was reducing recruitment within the stream. However, in 2013, it appears that successful reproduction within the stream channel increased. The cause of this change is not clearly known. However during the electrofishing it was observed that the encased woody debris was in an advanced state of decay. In several cases encased logs and debris piles collapsed under the weight of the sampling crew. This made the sampling somewhat dangerous since what appeared to sure footing could collapse when stepped on or climbed upon. However such conditions also released marl particles, pea gravel in size. These could accumulate to provide spawning habitat. Likewise the breakup of the marl provided more refugia for small trout.

This condition is unlikely to be at an equilibrium state. The broken marl surface may be cemented together or flushed from the stream bed over time, but in 2013 it is clear that the trout population was doing very well in the stream. If the decomposition of woody debris is indeed the primary factor driving this change, it is likely that the trout population will benefit for a number of years into the future.

Table 3. Comparison of population estimates and densities for Eccles Creek, October, 2004, and October, 2007.

Station	Population Estimate				Density per Linear Meter of Stream			
	2004	2007	2010	2013	2004	2007	2010	2013
Lower Eccles Cr.	90	109	64	232	0.90	1.09	0.64	2.32
Middle Eccles Cr.	93	32	48	102	0.93	0.32	0.48	1.02
Upper Eccles Cr.	15	71	34	92	0.15	0.71	0.34	0.92
So. Fk. Eccles Cr.	1	0	0	3	0.01	0.00	0.00	0.03
Total (400 m of stream)	198	212	146	429	0.50	0.53	0.36	1.07

The South Fork of Eccles Creek only contained young of the year fish since it is too small to support larger trout. The size structure of the trout populations in the mainstem of Eccles Creek appears to have a good assortment of age classes present. Histograms of length frequencies (Figures 1-3) suggest that reasonable recruitment and survival is present in all three Eccles Creek stations. Comparisons of young of the year (YOY) trout from the Eccles Creek stations with those of locations with similar elevations indicates that the Eccles Creek trout grow more rapidly. The Eccles Creek stations are between 2520 to 2560 meters in elevation. The Eccles Creek YOY fish have modal standard lengths of 8 to 10 cm after approximately six to seven months of growth (Figures 1-4). Yet back-calculated standard lengths of cutthroat trout in the North Slope of the Uinta Mountains of Northeastern Utah (2475 to 3200 meters elevation) show a mean standard length of less than six cm at annulus formation (age class 1, approximately 12 months of age; Belk et al 2009). Yellowstone cutthroat trout in the Greybull River system of Wyoming (2300 to 3200 meters elevation) have age 1 fish estimated at less than 8 cm in standard length (Kruse et al. 1997). YOY cutthroat trout in Winter Quarters Creek ranged from three to seven cm in standard length in October of 2010 (Shiozawa 2010). Thus the trout in Eccles are under an accelerated growth rate. This is likely due to the elevated stream temperature from the mine groundwater. Based on the length frequency histograms, Age class 1+, in October of 2013 are about 17 cm in total length. Age class 2+ trout are about 24 to 25 cm in total length, and age class 3+ fish are about 27 to 30 cm in total length.

The length frequencies for the 2004 collection (Shiozawa 2010) covered a range from 5 cm to 29 cm with dominance of small trout, age 0+. Lower numbers of larger size classes suggested an additional 2 or more cohorts. The size structure profile of the Middle Eccles Creek population indicated high reproduction and a rapid expansion of this population. The weakest size structure profile was in the Upper Eccles station where low numbers of all size classes occurred.

In 2007 the Middle Eccles Creek station had a significant drop in the proportion of small trout in the population as well as a significant reduction in the density of fish. Approximately half of the fish were YOY, and the others were over 20 cm in length. This skewing of the size distribution may be an artifact of the low frequency of fish at this station. Only one fish appeared to be a hybrid, and no rainbow trout were collected at this station. The Upper Eccles station had a length frequency distribution that was more similar to the 2004 Middle Eccles station. While several rainbow trout were collected, they were small and likely immature. No evidence of F1 hybrids was detected. Despite the decline in fish in the Middle Eccles station, the overall size structure of the stations in 2007 suggested that the stream trout population was robust, possibly in better condition than in 2004.

In 2010 both the Lower and the Upper Eccles Creek stations had shown significant declines in numbers of trout. This was thought to be related to a gradual shift in habitat conditions as the calcareous marl precipitation worked its way downstream. This would progressively eliminate spawning habitat as well as cover for both invertebrates and small fish. At this point it appeared that the population in the stream could continue in decline, potentially having very little successful reproduction and thus relying on recruitment from surrounding downstream drainages.

The 2013 electrofishing surveys indicate a significant reversal of the trends observed in 2010. The fish populations were the most robust recorded in the stream system since the surveys began. All stations had YOY fish present and they made up from 40% to 62% of the fish population. Densities were the highest recorded at all stations over the study period. As noted earlier, this change appears to be due to the increased decomposition of the marl encrusted wood which has allowed for more spawning habitat in the stream. At this point in time the cutthroat trout population appears to be healthy. Of course this system is obviously very dynamic and the community has not yet reached an equilibrium.

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Figure 1. Length Frequency, Lower Eccles Creek, 2013.

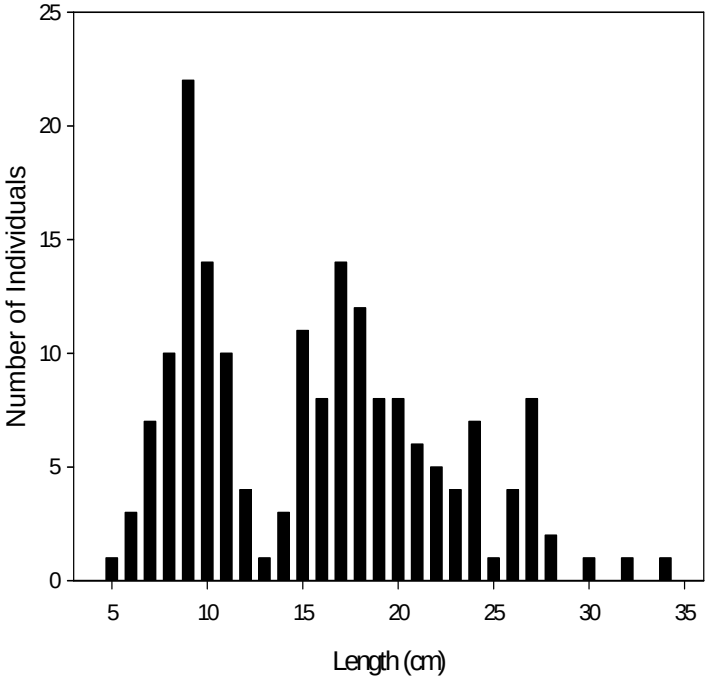


Figure 2. Length Frequency, Middle Eccles Creek, 2013.

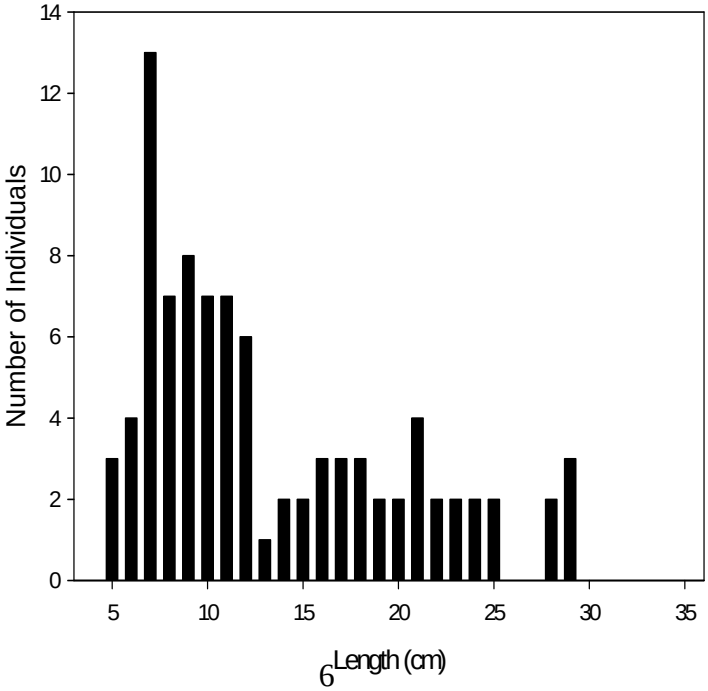


Figure 3. Length Frequency, Upper Eccles Creek, 2013

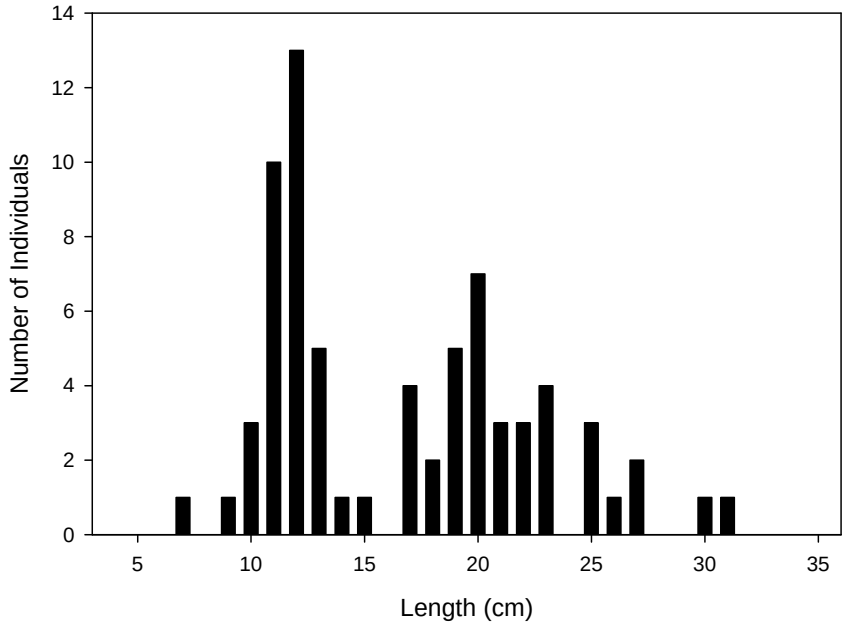
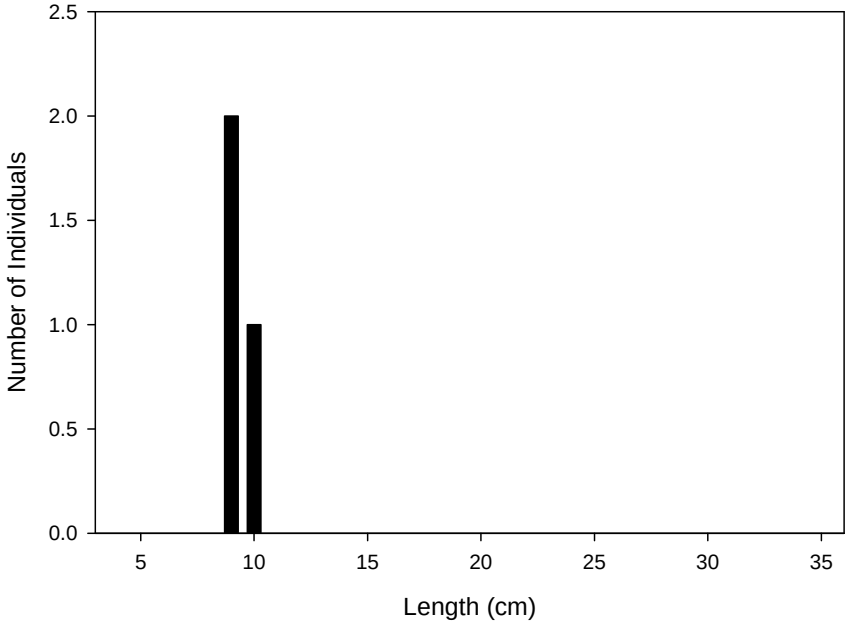


Figure 4. Length Frequency, South Fork Eccles Creek, 2013



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