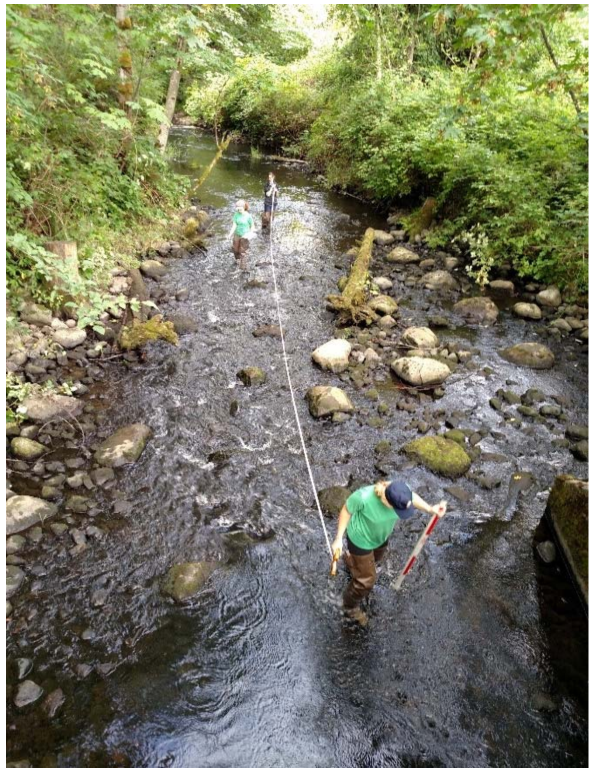
# Bellevue Summer Electrofishing 2016



Final Report

October 12, 2016

12754-03

Prepared for

City of Bellevue
Utilities Department

City of Bellevue
450 110th Avenue NE
P.O. Box 90012
Bellevue, WA 98009

Prepared by


Jim Starkes
Associate Fisheries Biologist

190 West Dayton Street, Suite 201
Edmonds, WA 98020
425-329-1169
jim.starkes@hartcrowser.com

# Contents



# Tables

# Figures

# Executive Summary

Three reaches within the Kelsey Creek basin, an urban stream in the City of Bellevue were surveyed for fish presence, absence, and diversity during the summer of 2016—two sites on mainstem Kelsey Creek (RM 0.2 and 2.1) and one site on West Tributary (RM 1.6). Two of the three sites were associated with recent capital improvement project (CIPs): a riffle reconstruction project on Kelsey Creek at RM 0.2, and a large woody debris project within the stream at RM 2.1. The site on West Tributary had to be relocated immediately downstream due to beaver activities constructing a dam between the period of first reconnaissance (March 2016) and the July survey.

Results from 2016 surveys found a total of four fish species, with cutthroat trout as the dominant species within all of the stream reaches. Length frequency analyses suggest that multiple age classes (i.e., juvenile, subadult, and adult) of cutthroat were present. Cutthroat abundance was similar in all three stream reaches, with densities ranging from 0.71 to 0.76 fish per linear foot. Length-weight condition values indicated similar physical condition of cutthroat trout in all three stream reaches. Native secondary fish abundance differed in each stream reach with moderate numbers of longnose dace found at RM 2.1, small numbers of dace and prickly sculpin at RM 0.2, and lamprey the only secondary species found within the West Tributary reach. One non-native pumpkinseed sunfish was captured at RM 2.1 in 2016.

Year 3 monitoring at the reconstructed riffle (Kelsey Creek, RM 0.2) found the highest abundance of cutthroat trout, but low abundance of sculpin. Additional monitoring will be necessary to determine if further colonization by sculpin will occur in this reconstructed riffle.

Gastric lavage was conducted at RM 2.1 to determine feeding habitats of cutthroat trout, and in particular, the level of predation on the invasive New Zealand mud snail. This is the second year of dietary monitoring in Kelsey Creek; studies were first conducted in 2014. Only 8.2 percent of cutthroat trout fed upon New Zealand mudsnail in 2016 compared to 42.5 percent in 2014. Of those fish that contained the invasive snail in 2016, only in one fish did it comprise a majority of the total diet. New Zealand mudsnails represented only 5 percent of available prey in pools in 2016, whereas they comprised 18 percent of available prey in pools in 2014. Abundance of mudsnails in riffles was approximately 3 percent in 2016, slightly lower than the 5 percent in 2014. A comparison of condition index values between fish that fed on mudsnails and those that did not found no statistically significant difference in length-weight conditions. Additional monitoring is necessary to determine the degree of predation on this invasive species, determine if lower predation in 2016 represents a trend, and the overall potential effects on fish health and populations within the basin. Additional annual monitoring of mudsnails should be undertaken to determine the degree of infestation and population trends in abundance.

Additional studies are recommended to further evaluate the effectiveness of existing and future capital projects for improving fish habitat. Below is a detailed list of recommendations for the City of Bellevue to facilitate these actions.

Below is a detailed list of recommendations for the City of Bellevue to facilitate these actions.

- Compare diversity, size, and abundance of fish species across all years for sites with historical data.
- Conduct electrofishing at low, middle, and upper reaches of creeks during the same sampling events to determine if salmonids and native fish are utilizing different habitats than in previous years. This may help determine more accurately the presence/absence of fish within a watershed.
- Continue fish condition index assessment at electrofishing sites to assess relative health of priority fish species. The index could then be compared to other Western Washington urban streams where this particular data have been collected.
- Collect additional stream habitat data within survey reaches including large and small woody debris counts, percent canopy coverage and shading, cutbank lengths, boulder cluster counts, and substrate type. Annual survey observations strongly suggest that the presence of these stream and riparian habitat attributes affect the abundance and diversity of fish in survey reaches and should be quantified over time to assess changes and trends.
- Collect gut content data from priority salmonid species at current BIBI sites to determine if aquatic or terrestrial prey items dominate and to further investigate New Zealand mudsnail predation. These data will help determine prey species availability and use by salmonids. Data collected can also help determine if riparian and/or substrate improvements are necessary.
- Compare size of coho and cutthroat fish populations to other Puget Sound lowland reference streams.
- Continue a consistent electrofishing program that visits the same sites during the same time of year to increase robustness of data for determination of status and trends of priority fish species and to determine the prevalence of non-native species.
- Implement a study to evaluate selected electrofishing sites that have shown historical changes in species diversity and density. The study should include key water-quality parameters such as temperature and flow conditions; however, other parameters also should be considered for evaluation.
- Include adult coho escapement data in the status and trends database in order to associate coho presence or absence with run size.

# 1.0 Introduction

As part of annual status and trends monitoring, the City of Bellevue (City) conducted electrofishing on three reaches within the Kelsey Creek basin in July 2016. The Kelsey Creek drainage is one of the largest stream basins draining the City, discharging into Lake Washington (Figure 1).

The purpose of electrofishing at these locations was to develop a multi-year baseline for fish species presence/absence and diversity, and evaluate trends in previously sampled locations. These sites can be revisited in coming years to determine if cumulative changes (habitat, operation of public facilities, private development, and land use regulations) are having positive or detrimental effects on fish population structures. Two of the three sites were associated with the following recent capital improvement projects (CIPs).

- At river mile (RM) 0.2 on Kelsey Creek, riffle habitats were reconstructed to improve habitats and facilitate fish passage through an existing roadway crossing located immediately upstream.

- At RM 2.1 on Kelsey Creek, a large woody debris (LWD) project was constructed to improve stream channel habitats within this relatively open reach of the stream. Some revegetation of the upper stream banks was conducted.

- At RM 1.6 on West Tributary, there is no CIP project, but this stream reach was substituted because of a beaver dam located immediately upstream. This dam was constructed during the spring 2016.

An important objective of 2016 survey work was to conduct Year 3 fish monitoring at the reconstructed riffle.

In addition, 2016 surveys included the collection and gut content analysis of cutthroat trout in Kelsey Creek, continuing the investigation of the invasive New Zealand mudsnail started in 2014.

This report describes the methods used for sampling, results from electrofishing and gut content studies in the summer of 2016, and recommendations for future actions. The data presented in this report represent a reference point from which the City can determine possible changes in the status and trends of fish populations in response to local or basinwide environmental changes.

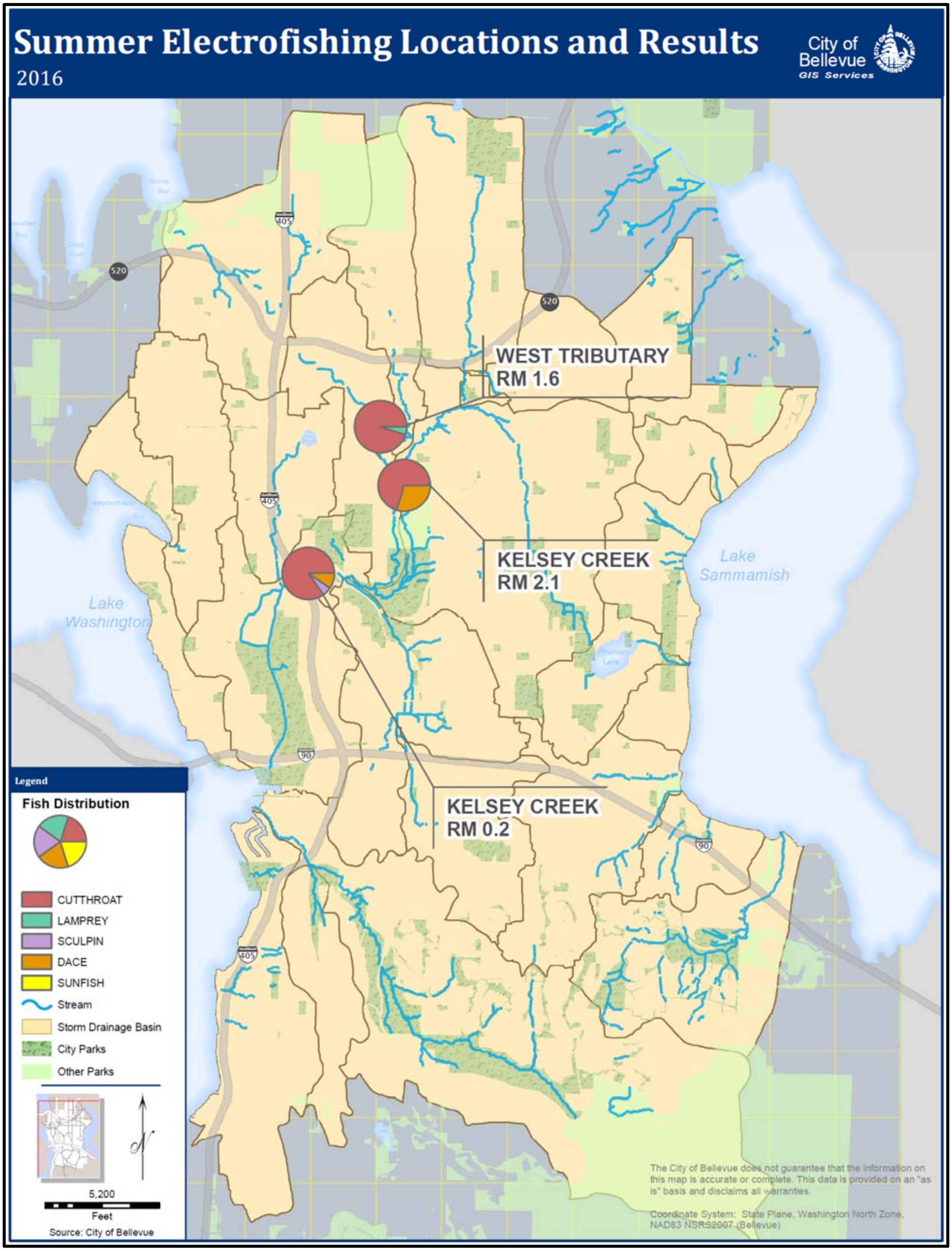



**Figure 1. Map showing locations and results of electrofishing sites sampled in July 2016.**

# 2.0 Methods

Electrofishing was performed on July 11, 14, and 15, 2016, within the Kelsey Creek basin (Figure 1). Methods of surveying in 2016 were similar to past efforts by the City. Electrofishing was conducted using a Smith-Root Backpack Electrofisher Model 12b. Settings on the electrofishing equipment were most effective at 200 volts (v), 60 Hertz (Hz), and 6 milliseconds (ms).

At all three stream reaches, block nets were placed at the downstream and upstream limits of each survey reach and a single pass was made by the electrofishing team. One of the field team members utilized the electrofisher backpack while two others used long-handled dip nets and followed closely alongside the electrofisher unit to capture stunned fish[1]. Other team members followed the electrofishing team with buckets of fresh stream water. Fish were tracked by habitat type (riffle or pool) and captured fish were placed in corresponding buckets. Captured fish were temporarily anesthetized on site using a dilute solution of MS-222 (Tricaine methanesulfonate) in water for identification and fork length measurements. Fish were then allowed to recover in fresh stream water supplied with an aerator until fully recovered. Once recovered, they were released upstream of the reach above the block net.

In addition, cutthroat trout at the Kelsey Creek, RM 2.1 reach were also subject to gastric lavage under anesthesia to collect stomach contents before placed in the recovery container. Fish capture methods were conducted in accordance with the Washington State Scientific Collection Permit # Blanchette 16-192.

At the end of each survey, habitat information was collected. This included habitat type (pool/riffle), and the length, wetted width/depth, bankfull width/depth of each habitat unit.

Temperature (° C), conductivity, and dissolved oxygen (DO) were recorded using a YSI 85 water quality probe deployed at each stream reach.

[1] Two netters were used throughout each reach. The team was comprised of a combination of at least one experienced and a second inexperienced netter, including volunteers, who were consistently swapped out.

# 3.0 Results

## 3.1 Habitat and Water Quality Measurements

A summary description of the habitat attributes at surveying locations is presented in Table 1. Riffle, pool, and stream channel data for the Kelsey basin reaches are presented in Table 2. Two of the surveyed stream reaches were composed of riffle and pool habitats while one reach was composed entirely of riffle.

The Kelsey Creek reach at RM 0.2 was composed entirely of riffle habitat reconstructed with small- to medium-sized boulder clusters that created microhabitats of small scour pools, cascades, and soft-edge habitats. The reconstructed riffle was the smallest reach in length sampled in 2016 (58 feet) but was the widest (24.5 feet) wetted width. Several pieces of large woody debris had also been placed in the stream channel and bank as part of the reconstruction. The large riffle was relatively deep with mean depths over one foot. No undercut bank habitat was present, but significant soft-edge habitats were formed by the larger rocks. This relatively wide riffle had very little overhanging vegetation, but the riparian zone was dense, composed of mature trees and shrubs that extended to the water's edge for the entire length of the riffle. The upstream end of the riffle was a bank-to-bank culvert for a roadway crossing (Table 2).

The Kelsey Creek reach at RM 1.2 was located on the Glendale Golf Course (Table 2). This reach was relatively straight but contained three pools and two riffles within relatively steep streambanks composed primarily of rock armor. Substantial undercut bank habitats were also present through most of the stream reach. The steepened stream profile also provided for relatively deep pools ranging from 2 to 4 feet, and riffles of about 1 foot. Wetted widths ranged from 7.8 to 18 feet. Though the high pool ratio and cut banks provided good aquatic habitat, the armored streambanks provided considerably less vegetation cover relative to the other stream reaches. The riparian zone was further limited by groomed golf course fairway adjacent to one streambank and private homes on the other. Some grass vegetation extended into the stream channel.

The West Tributary reach at RM 1.6 was composed of riffle/pool habitat. This reach had the highest habitat complexity, with a side channel extending for much of the stream reach (160 feet; Table 2) and extensive dense riparian vegetation that covered the stream and side channel at 60 to near 100 percent. Complete vegetation cover prevented the surveying of the entire side channel. Dense riparian cover also provided the largest amount of large woody debris of all of the stream reaches surveyed in 2016. This stream reach was also the narrowest surveyed in 2016, with wetted widths of both mainstem and side channel habitats between 4.4 and 9.9 feet. At the upstream end of the survey reach, a beaver dam extended the width of the stream. Water elevations upstream of the dam were approximately 4 feet higher than the surveyed stream reach. At the base of the dam was the reaches only pool with mean depths of 1.7 feet and maximum depths of approximately 4 feet. Woody debris and boulder clusters were present throughout the pool, providing excellent habitat.

**Table 1. Survey dates and site summary for 2016 electrofishing.**

| Date | Stream Name | River Mile (RM) | Reach Length (feet) | Site Description |
|---|---|---|---|---|
| July 11, 2016 | Kelsey Creek | 2.1 | 211 | **Kelsey Creek LWD Project.** Located on a relatively open area on the Glendale golf course. Habitats are composed of relatively deep riffles and pools with steep, mostly rock armored banks. Vegetation is composed primarily of cultivated lawn with some small shrubs in a narrow riparian strip above steep banks and interspersed between armor. Beyond the stream banks lie cultivated golf course fairway and private homes. Upstream, the streambank is composed of rock, covered with ornamental ivy. Several pieces of LWD have been placed in the stream in this portion to improve habitat complexity. Deep under cuts are present throughout the stream reach that provide good habitat. All of the reach is open with less than 10 percent canopy cover. (Photos 1-3) |
| July 14, 2016 | West Tributary | 1.6 | 210 | **West Tributary.** This sample reach is relatively narrow (Photo 4) composed of a main channel and a substantial side channel, both densely covered with overhanging native riparian trees and shrubs (Photo 5). The density of the vegetation canopy over the stream is high (>80 percent in most areas), with woody debris occurring within and throughout much of the survey reach. Mostly relatively deep riffle with undercut banks providing good habitat. One large and deep pool at the upstream end of the survey is present, adjacent to a beaver dam upstream of the reach (Photo 6). |
| July 15, 2016 | Kelsey Creek | 0.2 | 58 | **Kelsey Creek Riffle Reconstruction**. A relatively short reach consisting entirely of a reconstructed riffle composed primarily of small to moderate sized rocks. Various shallow water habitats composed of small cascades, shallow edge habitats, a side channel, woody debris, and other shallow microhabitats (Photos 7 and 8). Relatively open, but dense native mature tree and shrub habitats line the entire riffle. Upstream end of the reach is a road crossing with a large bank to bank to culvert (Photo 9). |

**Table 2. Stream channel data for Coal and Richards Creeks survey areas.**

| Habitat Unit | Wetted Width (feet) | Wetted Depth (feet) | Length (feet) |
|---|---|---|---|
| Kelsey Creek (RM0.2) | | | |
| Riffle 1 | 24.5 | 1.1 | 58 |
| Kelsey Creek (RM2.1) | | | |
| Pool 1 | 17.0 | 3.9 | 55.0 |
| Riffle 1 | 16.0 | 1.0 | 106 |
| Pool 2 | 18.0 | 2.2 | 16.0 |
| Riffle 2 | 7.8 | 1.1 | 17.0 |
| Pool 3 | 17.0 | 2.0 | 26.0 |
| West Tributary (RM1.6) | | | |
| Riffle 1 (main channel) | 7.1 | 0.6 | 160.0 |
| Riffle 2 (side channel) | 8.7 | 1.2 | |
| Pool 1 | 9.9 | 1.7 | 20.0 |
| Riffle 3 | 4.4 | 0.6 | 30 |

Water quality parameters at all of the electrofishing stations showed typical values for urban streams during the summer. Temperatures for all sites ranged from 14.7 to 15.3° C (Table 3). The West Tributary Reach had the lowest temperatures; the extremely dense overhanging riparian vegetation and the shade it provided likely contributed to the lower water temperatures. There are also known groundwater seeps just upstream that also probably contribute to the cooler temperatures. Though the other two sites were substantially more open, water temperatures at both of these reaches fell within the acceptable range for salmonids. We found none of the warm temperatures experienced during the warm summer of 2015, which caused some reaches not to be sampled because temperatures exceeded those considered safe for fish (>18° C). Gastric lavage studies were also abandoned in 2015 because of high water temperatures. Dissolved oxygen concentrations were good, ranging from 9.85 to 10.56 mg/l.

**Table 3. Water quality parameters for electrofishing sites during July 2016.**

| Site | Temperature (°C) | Conductivity (µs/cm) | Dissolved Oxygen (mg/l) |
|---|---|---|---|
| Kelsey Creek (RM 0.2) | 15.1 | 277.4 | 10.20 |
| Kelsey Creek (RM 1.2) | 15.3 | 233.6 | 9.85 |
| West Tributary (RM 1.6) | 14.7 | 233.4 | 10.56 |

## 3.2 Species Distribution and Density

Five species of fish were captured during the 2016 electrofishing surveys—cutthroat trout (*Oncorhynchus clarki*), longnose dace (*Rhinichthys cataractae*), western brook lamprey (*Lampetra richardsoni*), and prickly sculpin (*Cottus asper*) and the non-native pumpkinseed sunfish (*Lepomis gibbosus*; Figure 2).

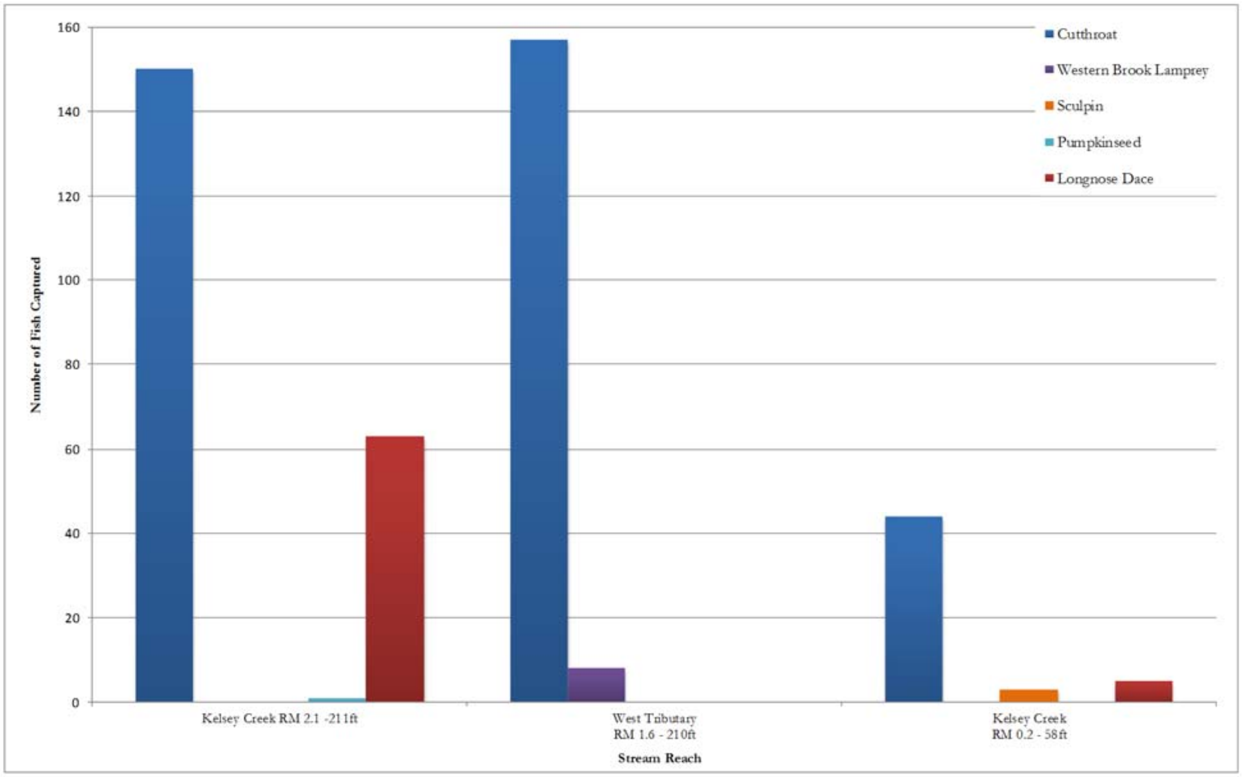



**Figure 2. Species distribution by stream reach for 2016 sampling.**

In 2016, cutthroat trout dominated catch at all three stream reaches, comprising 81.4 percent of total catch with a range of 70.1 to 95.2 percent within each stream reach (Figure 2). Table 4 shows the estimated density of fish species caught for each reach. Fish density analysis was determined by normalizing the total fish count per linear foot surveyed for each reach[2]. The density of cutthroat trout in the three stream reaches was notably consistent, ranging from 0.71 to 0.76 fish per linear foot of stream (Table 4). The relatively low total numbers of cutthroat captured at Kelsey Creek RM 0.2 occurred because this stream reach was the shortest at 58 feet; the other two stream reaches were over 200 feet in length (Table 2). This 58-foot reach was the extent of the reconstructed riffle.

Cutthroat densities observed in 2016 were near or higher than those found historically in Kelsey Creek at RM 2.1 and at RM 0.2. At RM 2.1, surveys were conducted over five years between 1996 and 2016 with densities ranging from 0.63 to 1.09 fish per linear foot. A mean of 0.82 fish per linear foot was found over those survey years, slightly higher than the 0.71 fish per linear foot found in 2016. At RM 0.2, 2016 cutthroat densities were considerably higher than those found historically. Previous data found densities ranging from 0.16 to 0.22 fish per linear foot (1996, 1997, and 2012); far lower than the 0.76 fish per linear foot found in 2016.

Longnose dace were captured in notable numbers at the Kelsey Creek reaches, comprising 29.4 percent of catch at RM 2.1 and 11.3 percent at RM 0.2. No dace were captured in West Tributary. Fish densities, when observed were between 0.1 and 0.3 fish per linear foot (Table 4). These densities were

[2] Comparison of relative abundance data between sites should be considered only on a gross level as differences in collection technique and netting efficiency can vary.

considerably higher than those found historically; at RM 2.1 densities ranged from 0 to 0.07 fish per linear foot and at RM 0.2, densities ranged from 0.01 to 0.03 fish per linear foot.

Very few prickly sculpin were observed in 2016 with only a total of three captured in one reach—Kelsey Creek at RM 0.2 (0.05 fish per linear foot). This is the same general range found historically at this reach (0.02 to 0.07 fish per linear foot). In addition, one invasive species, a juvenile pumpkinseed sunfish was captured at Kelsey Creek RM 2.1.

Notably absent in 2016 surveys were juvenile coho salmon. This species has been observed in several reaches of the basin in previous survey years. In 2014, a relatively high proportion and density of juvenile coho were captured in Kelsey Creek at RM 1.4 (28.6 percent of total catch; 0.24 fish per linear foot), which represented the highest densities observed in recent years. During that year, coho were also captured at RM 1.8, though at lower densities (0.05 fish per linear foot; Hart Crowser 2014). In 2013, coho were also captured at RM 4.0 at low densities (0.04 fish per linear foot; Hart Crowser 2013). In 17 survey between 1996 and 2016, juvenile coho have been captured in 11 of 17 years within Kelsey Creek and West Tributary.

**Table 4. Estimated density of fish species.**

| Site | Fish Density (fish/linear foot) | | | | Reach Length |
|---|---|---|---|---|---|
| | Sculpin | Cutthroat | Dace | Lamprey | |
| Kelsey Creek RM 0.2 | 0.05 | 0.76 | 0.09 | 0.0 | 58 |
| Kelsey Creek RM 2.1 | 0.0 | 0.71 | 0.30 | 0.0 | 211 |
| West Tributary RM 1.6 | 0.0 | 0.75 | 0.0 | 0.04 | 210 |

## 3.3 Cutthroat Length Distribution and Habitat Use

As noted, similar densities of cutthroat trout were captured in each of the survey reaches in 2016 (Table 4).

The majority of trout in the Kelsey Creek basin were less than 80 mm in fork length (63.4 percent); with about half sized between 60 and 80 mm (52.1 percent; Figures 3, 4, and 5). West Tributary also had a relatively large proportion of fish between the narrow size range of 80 and 90 mm (17.8 percent; Figure 5). Length frequencies suggest a separate year-class at Kelsey RM 2.1 and West Tributary between 120 and 170 mm, representing 12.7 and 13.4 percent of trout captured in each stream reach, respectively. Fish over 181 mm were limited to Kelsey Creek at RM 2.1; here a small number of older fish between 180 and 270 mm were captured (Figure 4). The total size range of fish was relatively large ranging from 39 to 270 mm, likely representing four or more year classes (Table 5). The highest number of possible year classes appear to be associated with the riffle/pool habitats found in Kelsey Creek RM 2.1 and West Tributary (Figure 4 and 5). The smallest size range and the fewest large fish were present in the reconstructed riffle at Kelsey Creek RM 0.2 (Figure 3). The lack of pool habitat at RM 0.2 probably contributed to the smaller size range and lack of larger fish at this reach.

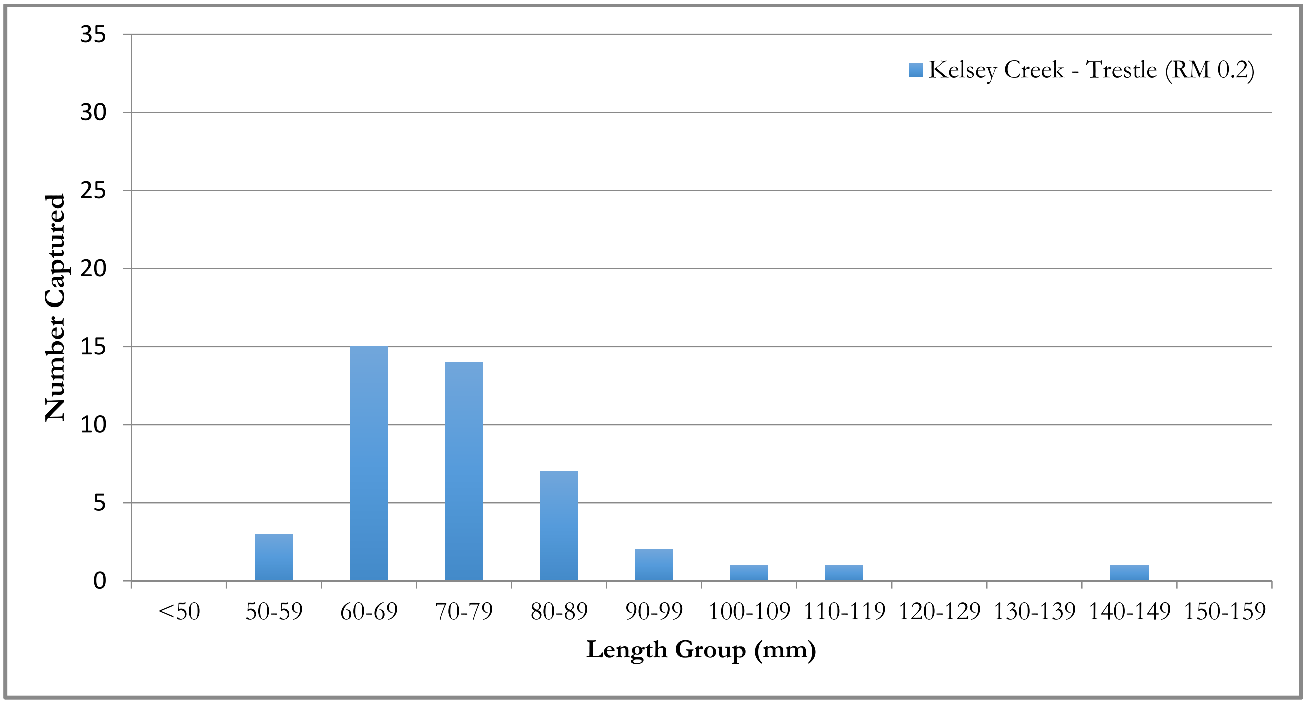



**Figure 3. Length frequency distribution of cutthroat at Kelsey Creek 2016 (RM 0.2).**

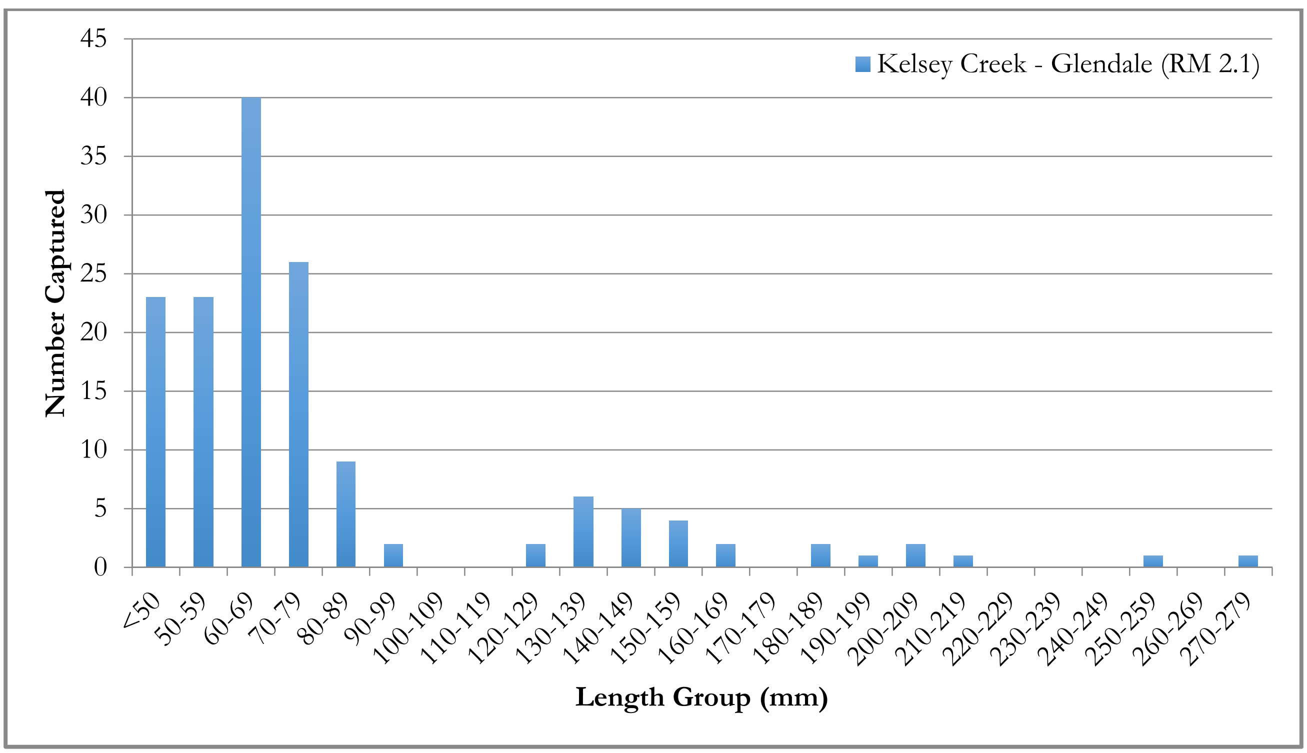



**Figure 4. Length frequency distribution of cutthroat at Kelsey Creek 2016 (RM 2.1).**

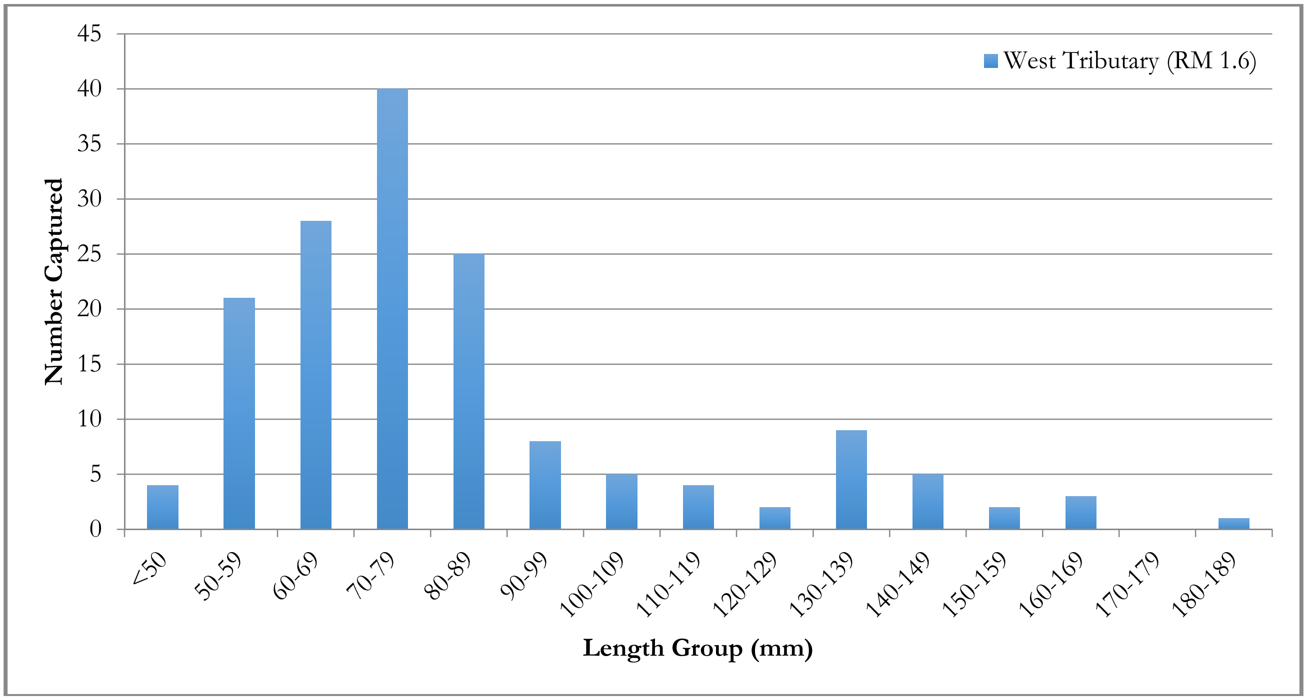



**Figure 5. Length frequency distribution of cutthroat at West Tributary 2016 (RM 1.6).**

**Table 5. Number caught and length range for cutthroat across all sites sampled.**

| Site | Number of Cutthroat Trout | Length Range (mm) |
|---|---|---|
| Kelsey Creek (RM 0.2) | 44 | 55-145 |
| Kelsey Creek (RM 2.1) | 150 | 39-270 |
| West Tributary (RM 1.6) | 157 | 44-181 |

Most fish were captured in riffle habitat, though this was likely because riffle habitats were more prevalent than pools (in linear feet) at the three sample reaches within the basin. At Kelsey Creek RM 2.1, the three pool habitats measured 41.7 percent of the total length of the reach, while the two riffle habitats measured 58.3 percent of total length. The distribution of cutthroat trout within this reach were nearly identical to these pool/riffle proportions with 42.0 percent of trout captured within pools and 58.0 percent captured in riffles. In West Tributary, more trout were captured in riffles; but a somewhat higher proportion were captured in pool habitats relative to the linear length of the pools. Pool length at West Tributary measured only 9.5 percent of the reach, but 29.3 percent of the fish were captured in pools. Only riffle habitat was present at the Kelsey Creek RM 0.2 reach.

A very consistent size difference was found between cutthroat inhabiting pools versus those inhabiting riffles with the larger fish inhabiting the pools. Within pool habitats, the mean sizes of fish were 92.0 mm in Kelsey RM 2.1 and 95.3 mm in West Tributary. In riffle habitats mean sizes were 73.5 mm at Kelsey RM 2.1, 78.5 mm at West Tributary, and 75.4 mm at Kelsey RM 0.2. Of the larger fish over 125 mm, nearly 60 percent were associated with pools at Kelsey RM 2.1 and West Tributary. Notably, however, several of the largest fish over 200 mm were associated with large wood along deeper edge habitats within riffles, showing the importance of wood debris in the basin.

At Kelsey RM 2.1, most fish captured in pools were associated with woody debris, both naturally occurring and wood placed within the channel. Fish were also pulled out of undercut banks present throughout both pool and riffle habitats. At West Tributary, most fish captured in pools were associated with naturally occurring woody debris, wood associated with the beaver dam and a large boulder cluster within the pool. Most fish collected from riffle habitats at these two stream reaches were associated with undercut banks, with some fish under overhanging vegetation and under woody debris. At the reconstructed riffle at Kelsey Creek RM 0.2, most fish were associated with microhabitats created by the larger rocks, such as small scour pools and cascades. Fish were also associated with the two pieces of large woody debris placed in the stream channel.

## 3.4 Cutthroat Length-Weight Relationship

During the 2016 fish surveys, weights (grams) of all individual cutthroat trout were collected for the first time. Weights of trout ranged from 0.7 to 184.0 grams within the Kelsey Creek basin. To evaluate the relative health and robustness of trout, a weight-length relationship was used to determine a condition index of fish. The Fulton Condition Factors Index was used (Anderson and Neumann 1996), calculated as:

$$K = (W/L^3) \times 100{,}000$$

where,

K = Condition Index
W = Weight
L = Length

This conditions index should be used to compare fish of similar size; the higher the index value, the more robust the fish. Condition index values for cutthroat trout in the Kelsey basin ranged from 0.8 to 2.2, with both the highest index values and highest variability occurring with smaller fish. The mean condition index for trout in each of the three stream reaches were identical for Kelsey reach at RM 2.1 and West Tributary and slightly higher for Kelsey reach at RM 0.2. The difference found at Kelsey RM 0.2 was not statistically significant (paired T-test; Table 6). The slightly higher index value for this reach was likely because of the smaller fish captured and the higher variability found with smaller trout.

**Table 6. Fulton Condition Factors Index values at Kelsey reaches in 2016.**

| | Kelsey (RM 0.2) | Kelsey (RM 2.1) | West Tributary (RM 1.6) |
|---|---|---|---|
| Sample Size | 44 | 150 | 156 |
| Mean condition index | 1.23 | 1.14 | 1.14 |
| Standard Dev | 0.304 | 0.223 | 0.151 |
| Standard Error | 0.046 | 0.018 | 0.012 |

## 3.5 Longnose Dace Length Distribution and Habitat Use

Over 90 percent of all longnose dace were captured in Kelsey Creek at RM 2.1 (Table 7). Length frequency distributions do not show clear year-classes, but the size range captured indicate that several are likely present (Figure 6). According to age and growth data presented by Wydoski and Whitney (2003), young of year and juvenile year classes under 50 and 60 mm, respectively, and multiple adult year classes as old as Age 5 may be present. Ninety-four percent of all dace were captured in riffles, which is the preferential habitat of this species. Most associated with moderate to large cobble and rocks rather than woody debris. Many were also captured from under cut banks associated with at least moderate currents. Perhaps surprisingly, only a few (5) were captured in the reconstructed riffle (Kelsey RM 0.2) which is composed entirely of riffle habitat with different sized rocks.

**Table 7. Number caught and length range for longnose dace across all sites sampled.**

| Site | Number of dace | Length Range (mm) |
|---|---|---|
| Kelsey Creek (RM 0.2) | 5 | 76-95 |
| Kelsey Creek (RM 2.1) | 63 | 53-114 |
| West Tributary (RM 1.6) | 0 | -- |

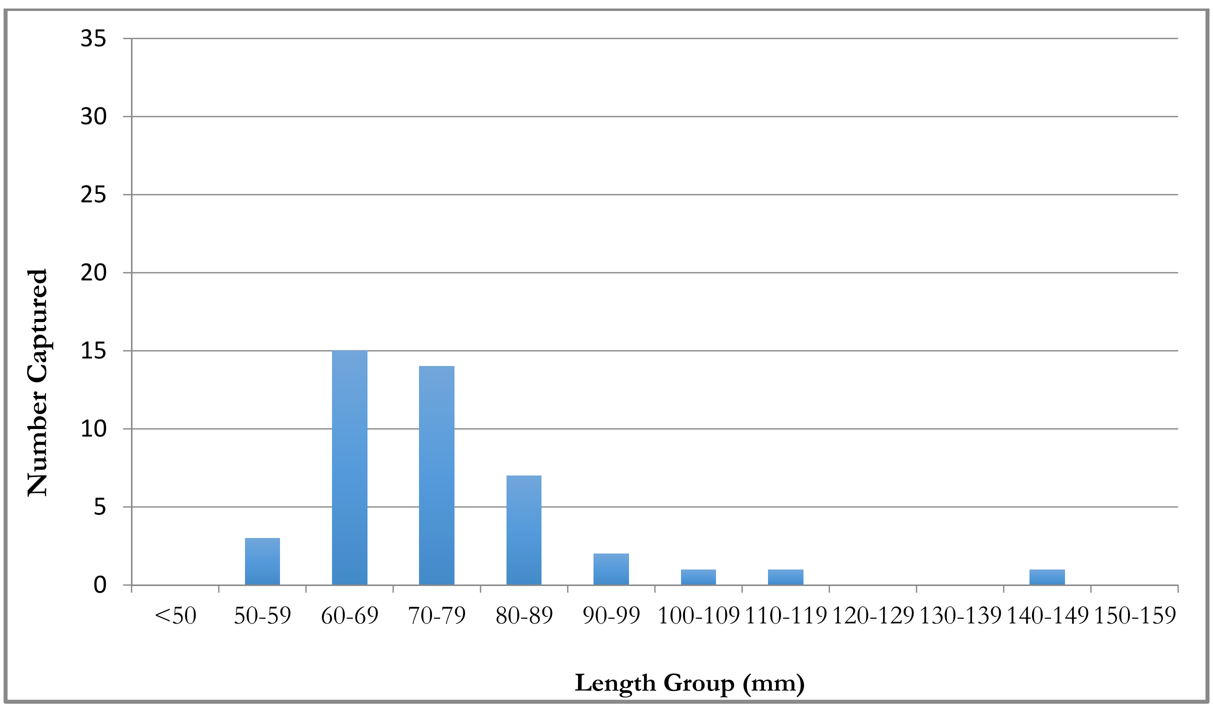



**Figure 6. Length frequency distribution of longnose dace (RM 2.1) 2016.**

## 3.6 Other Species

Only three prickly sculpin were captured in 2016, all within the reconstructed riffle at Kelsey Creek RM 0.2. All three were likely adults with lengths of 80, 123, and 140 mm. Age and growth data from Lake Washington indicate that these fish would be between Ages 2 and 4. According to references, over 90 percent of Age 2 fish were reproductively mature in the lake (Wydoski and Whitney 2003).

A total of 8 western brook lamprey were captured in West Tributary; this was the only stream reach in which lamprey were captured in 2016. The size range of lamprey captured were between 40 and 110 mm suggesting that fish were likely between 1 and 3 year old ammocoetes (Wydoski and Whitney 2003).

## 3.7 Native and Non-Native Species

The diversity of fish captured during the 2016 survey was comparable to that found in 2014 (the last year the Kelsey basin was surveyed) with the exception of coho salmon. As reported, no coho salmon were captured during 2016 surveys in the Kelsey Creek basin, while in 2014, this species was second in abundance (Hart Crowser 2014; Table 8). No coho were captured in Kelsey Creek in 2012 (Hart Crowser 2012). The lack of juvenile coho in 2016 was the result of no observed natural spawning and no hatchery releases in 2015. Juvenile coho salmon were therefore not expected in 2016.

The abundance of longnose dace was comparable in numbers to 2014, but were only found in one of three reaches in the basin in 2016 compared with two of two reaches sampled in 2014. Dace were also rather abundant in West Tributary in 2012 (RM 0.4), but were not found in the reach sampled in 2016 (RM 1.6). Threespine stickleback (*Gasterosteus aculeatus*) were also relatively abundant in West Tributary in 2012 (Hart Crowser 2013; Table 7), but were not observed in 2016. This may be survey reach related since in 2012, the tributary reach surveyed was described as low gradient with slow velocities, which are preferential habitat characteristics of stickleback.

Similarly, low abundance of western brook lamprey was observed in 2014 and 2016 in the basin. No sculpin were captured in 2014, while a few were captured in 2016. This may be a reflection of survey locations within the basin since in 2012, sculpin were captured in the lower basin at RM 0.2, the same reach they were found in this year.

Only one non-native species, a single pumpkinseed sunfish, was found in Kelsey Creek in 2016; the same low occurrence of this species was found in 2014 within the basin. Non-native species were captured in Kelsey Creek in previous years, all warm water Centrachids (sunfish and bass) or carp (*Cyprinus carpio*; Table 9).

**Table 8. Native species documented in Bellevue streams during 1983, 1996–1997, 2002, 2007, and 2010–2016 summer fish surveys.**

| | Year | Kelsey Creek | | | | | | | | | West Tributary | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species Name | River Mile | 0.2 | 1.06 | 1.4 | 1.8 | 2.1 | 2.59 | 3.81 | 3.83 | 3.97 | 0.4 | 1.01 | 1.6 | 2.2 |
| Coho Salmon *(Oncorhynchus kisutch)* | 1983 | x | | | x | x | | | | | | | | |
| | 1996 | x | | x | | x | | | | x | | x | | |
| | 1997 | x | | | | | | | | x | | | | |
| | 2002 | | | | | x | | | | | | | | |
| | 2007 | | x | | | x | | | | | | | | |
| | 2010 | | | | | | | | | | x | | | |
| | 2011 | | | | | | | x | x | | | | | |
| | 2012 | | | | | | | | | | x | | | |
| | 2013 | | | | | | | | | x | | | | |
| | 2014 | | | x | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | | |
| Cutthroat Trout *(Oncorhynchus clarki)* | 1983 | x | | | x | x | | | | | | | | |
| | 1996 | x | | x | | x | x | | | x | | x | | |
| | 1997 | x | | | | | | | | x | | | | |
| | 2002 | | x | x | | x | | | | | x | | | |
| | 2007 | | x | | x | x | | x | x | | | | | |
| | 2010 | | | x | x | x | | | | | x | | | |
| | 2011 | | | | | | | x | x | | | | | |
| | 2012 | x | | x | | | | | | | x | | | |
| | 2013 | | | | | | | | | x | | | | |
| | 2014 | | | x | x | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | x | | | | x | | | | | | | x | |
| Rainbow Trout *(Oncorhynchus mykiss)* | 1983 | x | | | x | x | | | | | | | | |
| | 1996 | | | | | | | | | | | | | |
| | 1997 | x | | | | | | | | | | | | |
| | 2002 | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | | |
| Sculpin *(Cottus spp.)* | 1983 | | | | | | | | | | | | | |
| | 1996 | x | | | | | | | | | | | | |
| | 1997 | x | | | | | | | | | | | | |
| | 2002 | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | x | | | | | | | | | | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | x | | | | | | | | | | | | |
| Three-spine stickleback *(Gasterosteus aculeatus)* | 1983 | x | | | x | x | | | | | | | | |
| | 1996 | | | | | | | | | | | | | |
| | 1997 | | | | | | | | | | | | | |
| | 2002 | | x | | | | | | | | x | | | |
| | 2007 | | x | | | | | | | | | | | |
| | 2010 | | | | | | | | | | x | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | x | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | | |

# Table 8 (cont'd)

| Species Name | Year | Kelsey Creek | | | | | | | | | West Tributary | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | River Mile | 0.2 | 1.06 | 1.4 | 1.8 | 2.1 | 2.59 | 3.81 | 3.83 | 3.97 | 0.4 | 1.01 | 1.6 | 2.2 |
| Western Brook Lamprey *(Lampetra richardsoni)* | 1983 | | | | | | | | | | | | | |
| | 1996 | | | | | | x | | | | | | | |
| | 1997 | | | | | | | | | | | | | |
| | 2002 | | x | | | | | | | | x | | | |
| | 2007 | | x | | x | | | x | x | | | | | |
| | 2010 | | | | x | | | | | | x | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | x | | x | | | | | | | x | | | |
| | 2013 | | | | | | | | | x | | | | |
| | 2014 | | | x | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | x | |
| Largescale Sucker *(Catostomus macrocheilus)* | 1983 | | | | | | | | | | | | | |
| | 1996 | | | x | | x | | | | | | x | | |
| | 1997 | | | | | | | | | | | | | |
| | 2002 | | | | | | | | | | | | | |
| | 2007 | | x | | | | | | | | | | | |
| | 2010 | | | | | | | | | | x | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | | |
| Dace (longnose or speckled) *(Rhinichthys spp.)* | 1983 | | | | | | | | | | | | | |
| | 1996 | x | | x | | | | | | | | x | | |
| | 1997 | x | | | | | | | | | | | | |
| | 2002 | | | x | | x | | | | | x | | | |
| | 2007 | | x | | x | x | | | | | | | | |
| | 2010 | | | | x | | | | | | x | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | x | | x | | | | | | | x | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | x | | | | x | | | | | | | | |
| Trout Fry (<80 mm) | 1983 | | | | | | | | | | | | | |
| | 1996 | x | | | | | | | | | | x | | |
| | 1997 | x | | | | | | | | x | | | | |
| | 2002 | | x | x | | x | | | | | x | | | |
| | 2007 | | x | | x | x | | x | x | | | | | |
| | 2010 | | | x | x | x | | | | | x | | | |
| | 2011 | | | | | | | x | x | | | | | |
| | 2012 | | | | | | | | | | | | | |
| | 2013 | | | | | | | | | x | | | | |
| | 2014 | | | x | x | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | x | | | | x | | | | | | | x | |

[grey box] = did not sample
[white box] = sampled, no fish seen
x = sampled, fish seen

**Table 9. Non-native species documented in Bellevue streams during 1983, 1996–1997, 2002, 2007, and 2010–2016 summer fish surveys.**

| | Year | Kelsey Creek | | | | | | | | | West Tributary | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species Name | River Mile | 0.2 | 1.06 | 1.4 | 1.8 | 2.1 | 2.59 | 3.81 | 3.83 | 3.97 | 0.4 | 1.01 | 1.6 | 2.2 |
| Bluegill *(Lepomis macrochirus)* | 1983 | | | | | | | | | | | | | |
| | 1996 | x | | | | x | | | | x | | | | |
| | 1997 | | | | | | | | | | | | | |
| | 2002 | | | | | x | | | | | | | | |
| | 2007 | | | | | | | | | | | | | |
| | 2010 | | | | x | x | | | | | x | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | | |
| Largemouth Bass *(Micropterus salmoides)* | 1983 | | | | | | | | | | | | | |
| | 1996 | | | | | | | | | | | | | |
| | 1997 | | | | | | | | | x | | | | |
| | 2002 | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | |
| | 2010 | | | x | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | | |
| Pumpkinseed *(Lepomis gibbosus)* | 1983 | | | | | | | | | | | | | |
| | 1996 | | | | | | | | | | | | | |
| | 1997 | | | | | | | | | | | | | |
| | 2002 | | | | | x | | | | | | | | |
| | 2007 | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | x | | | | | | | | |
| Crappie (black or white) *(Pomoxis spp.)* | 1983 | | | | | | | | | | | | | |
| | 1996 | | | | | | | | | | | | | |
| | 1997 | | | | | | | | | | | | | |
| | 2002 | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | |
| | 2010 | | | x | x | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | | |
| Carp *(Cyprinus carpio)* | 1983 | | | | | | | | | | | | | |
| | 1996 | | | | | | | | | | | | | |
| | 1997 | | | | | | | | | | | | | |
| | 2002 | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | |
| | 2010 | | | x | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | |
| | 2013 | | | | | | | | | | | | | |
| | 2014 | | | | | | | | | | | | | |
| | 2015 | | | | | | | | | | | | | |
| | 2016 | | | | | | | | | | | | | |

(shaded) = did not sample
(blank) = sampled, no fish seen
x = sampled, fish seen

## 3.8 Cutthroat Trout Stomach Analysis for New Zealand Mudsnails (*Potamopyrgus antipodarum*)

The invasive species, New Zealand mudsnail (*Potamopyrgus antipodarum*) has been documented in the Kelsey Creek drainage, as well as several others within the City of Bellevue. When fed upon by fish, this species can pass through the intestinal tract intact without providing any nutrient value, potentially decreasing condition and health. On July 11, 2016 during the fish survey on Kelsey Creek (RM 2.1), 146 cutthroat trout were subject to gastric lavage while anesthetized to flush the stomach contents and determine if fish were feeding on this invasive species. These investigations continued what was first conducted in 2014 surveys. Efforts could not be conducted in 2015 because of warm water temperatures and concerns that gastric lavage procedures would place too much of a stressor on captured fish.

Of the 146 cutthroat trout that underwent gastric lavage, New Zealand mudsnails were found in only 12 fish, just 8.2 percent of fish examined. These fish represented the general size range of all of the cutthroat captured at the Kelsey Creek RM 2.1 survey reach, ranging from 60 to 255 mm in length. With only one exception, no more than two fish from each size range contained New Zealand mudsnail (Figure 7).

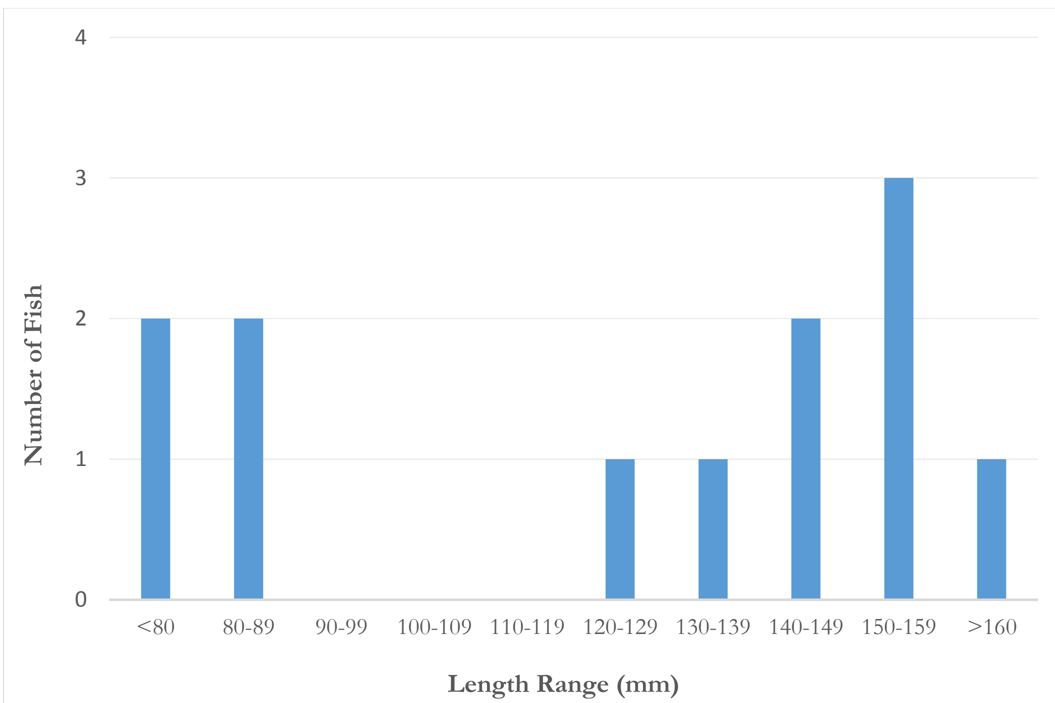



**Figure 7. Size range of cutthroat trout feeding on New Zealand mudsnails.**

All 12 trout that fed on mudsnails contained other prey in their stomachs, a combination of both aquatic and terrestrial invertebrates. Of those that fed upon New Zealand mudsnails, the snails comprised 3 to 36 percent of the total trout diet. In only one fish, a 151 mm specimen, did mudsnails make up the majority diet (36 percent). In all other specimens with mudsnails in their stomachs, their majority diet was composed of aquatic invertebrates (Figure 8).


Note: % diet is by blotted wet weight in grams.

**Figure 8. Total diet of individual cutthroat trout that fed upon New Zealand mudsnail.**

The Fulton Condition Factors Index was applied to both cutthroat trout that fed upon New Zealand mudsnails and those that did not as presented in Table 10 and Figure 9. Mean condition index values for fish that fed upon mudsnails was slightly lower relative to those that did not, but values were not statistically significant (paired T-test). As observed in Figure 9, substantial variability in the condition index values was present in fish smaller than 90 mm, and much less so for larger fish. However, values for fish that fed on mudsnails generally fell within the same ranges of fish of similar sizes that did not feed on the snails.

**Table 10. Condition index values for cutthroat trout that did and did not feed on mudsnails.**

| | Diet with NZM | Diet with no NZM |
|---|---|---|
| Sample Size | 12 | 133 |
| Mean condition index | 1.05 | 1.15 |
| Standard Dev | 0.225 | 0.225 |
| Standard Error | 0.065 | 0.019 |

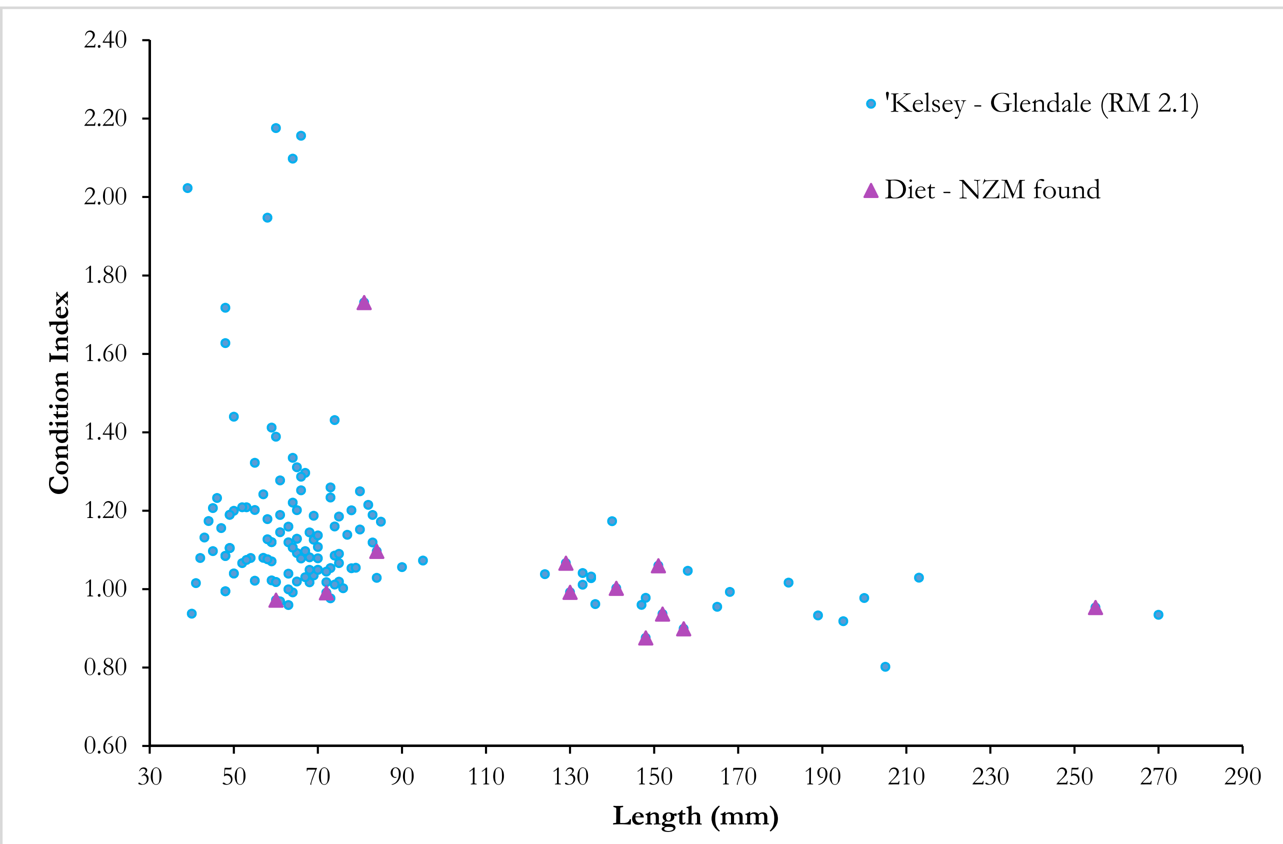



**Figure 9. Condition index values for cutthroat trout that did and did not feed on mudsnails.**

Predation on New Zealand mudsnails in 2016 was substantially less than that found in 2014. On June 30, 2014 during a fish survey on Kelsey Creek at RM 1.8, 119 cutthroat trout were subject to gastric lavage. During this survey, 42.5 percent of cutthroat trout contained New Zealand mudsnails, compared with 8.2 percent in 2016. Cutthroat feeding on mudsnails at volumes greater than 50 percent of their diets were moderately large fish between 110 and 164 mm. Only one fish under 100 mm contained mudsnails. In 2016, no fish contained mudsnails at volumes greater than 50 percent, and the few that preyed upon the species represented most size classes found in the sample reach (Figure 10).

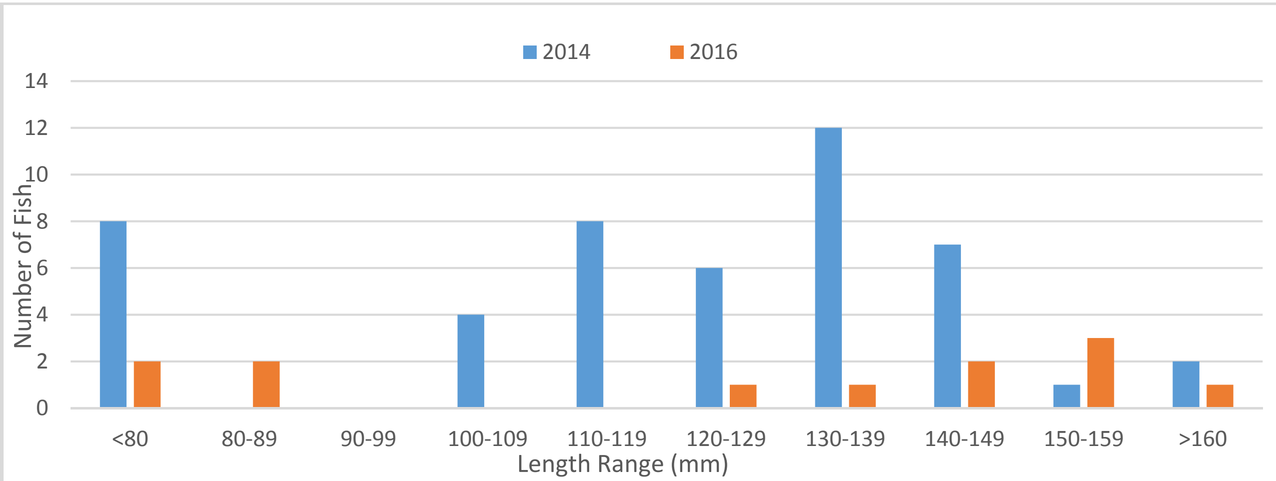



**Figure 10. Comparison of the number and size of fish feeding on New Zealand Mudsnails in 2014 and 2016.**

In 2014 and 2016, macroinvertebrate data using a surber sampler were collected at the Glendale reaches where gastric lavage was conducted. Results indicate that lower levels of New Zealand mudsnails were found in 2016 relative to 2014, particularly in pool habitats. New Zealand mudsnails represented only 5 percent of available prey in pools in 2016, whereas they comprised 18 percent of available prey in pools in 2014. Abundance of mudsnails in riffles was approximately 3 percent in 2016, slightly lower than the 5 percent in 2014 (Table 11). This may explain both the higher predation levels found in 2014 and the higher proportion of mudsnails in the diet of larger cutthroat trout during that year. Mean size of trout within pool habitats were nearly 20 mm larger relative to riffle habitats within the Glendale reaches.

**Table 11. Benthic availability of New Zealand mudsnails in Kelsey Creek in 2014 and 2016.**

| Survey Year | Percentage of New Zealand Mudsnail Abundance | |
|---|---|---|
| | Pool | Riffle |
| 2014 | 18% Mudsnails<br>82% Other Macroinvertebrates | 5% Mudsnails<br>95% Other Macroinvertebrates |
| 2016 | 5% Mudsnails<br>95% Other Macroinvertebrates | 3% Mudsnails<br>97% Other Macroinvertebrates |

Data appear to suggest that in both years, fish were not targeting the mudsnails, rather they were found with several other invertebrate taxa. The most frequent prey items found were midges, found in most all stomachs. Aquatic crane flies, may flies, isopods, and amphipods were also commonly observed.
In 2014, only two cutthroat had only mudsnails in their stomachs, and in 2016, no fish contained only mudsnails.

# 4.0 Discussion and Recommendations for Future Actions

## 4.1 Discussion

Two of the three survey reaches involved sites where stream restoration projects have been previously undertaken—woody debris placements and constructed riffles at RM 2.1 and a constructed riffle to aid fish passage at RM 0.2 (Table 1). The 2016 survey represented the third survey of the reconstructed riffle to determine the long-term performance of this habitat enhancement, and continued monitoring occurred at RM 2.1. Results indicate relatively good fish use of habitats that have been modified in association with restoration projects. Continued surveys at restoration locations and Capital Improvement Projects on Bellevue's urban streams will be necessary to determine if performance objectives are being achieved on the long-term.

At RM 1.6 on the West Tributary of Kelsey Creek, sampling occurred in a reach immediately downstream of a beaver dam that had been built during the prior spring. Despite any recent habitat alteration caused by the dam, comparable use of stream habitats below the dam were observed.

The reconstructed riffle on Kelsey Creek (RM 0.2) had very similar catch rates for cutthroat trout relative to the other two stream reaches surveyed in 2016; catch rates were also well above the average for the stream and other streams surveyed in previous years. These results are considered very good, particularly since there are no pools associated with this reach. Results are likely attributed to the moderate to large rocks used to reconstruct the riffle, creating a relatively high habitat complexity of small cascades, scour pools, edge habitats and other microhabitats within the riffle.

A weight-length conditions index applied to cutthroat trout captured in all three reaches found a similar degree of condition at all three sites. This is the first survey in which individual weights were collected for fish; collection of this metric should continue so that comparisons of fish condition can be made between the different stream basins that drain the City.

There was some expectation that more sculpin would recruit to the reconstructed riffle (only 3 were captured) since the reconstruction resulted in a relatively deep riffle with numerous microhabitats that sculpin prefer. The new riffle was similar to one constructed on Coal Creek at RM 1.8 in 2014. Survey results at this new riffle in 2015 showed relatively high catch rates of torrent sculpin (*Cottus rhotheus*) within the reconstructed reach (Hart Crowser 2015). It should be noted though that sculpin populations are higher in Coal Creek relative to Kelsey Creek, likely because of a barrier at Mercer Slough that does not allow recruitment from Lake Washington. This and other freshwater sculpin species are important and are considered sensitive indicator species relative to both water quality and optimal physical stream parameters. Further surveys at the Kelsey reconstructed rifle should be prioritized to determine the level of recruitment of these valuable species.

Two closely located stream reaches of Kelsey Creek flowing through the Glendale Golf Course have been surveyed in 2014 and 2016. Catch rates of cutthroat trout in 2016 were 38.2 percent higher than in 2014 suggesting that trout populations are holding their own or increasing within reaches on the golf course. Although the riparian zones at both reaches have been highly altered by the golf course and private homes, the relatively steep stream banks and moderate grades have produced deep pools and glides that provide good habitat for trout and longnose dace. The woody debris placed at Kelsey Creek RM 2.1 increased habitat complexity within this reach. Additional projects of this type would particularly benefit the reaches that flow through the golf course given alterations to streambank and riparian habitats.

It should also be noted that elevated stream temperatures were found in Kelsey Creek on the golf course during 2015 as a result of the abnormally warm summer that year. Proposed gastric lavage studies could not be safely conducted within golf course reaches during that year. Other streams surveyed in 2015 (Coal Creek and Richards Creek) had acceptable stream temperatures (<16$^{o}$ C). The headwaters of Kelsey Creek are in Larsen Lake, which can also experience warm summertime temperatures. In 2016, the Kelsey Creek stream reach at the golf course had the higher water temperature of the two Kelsey reaches surveyed, suggesting that lack of riparian vegetation may also be contributing to higher temperatures (Table 3).

Catch rates of trout at West Tributary reach were equivalent to the two other Kelsey reaches surveyed in 2016 despite having the smallest wetted channel and shallowest riffles (Table 2). The trout densities observed were likely the result of the extremely dense riparian zone, very high riparian cover over the stream, (70 to near 100 percent for much of the survey reach), large amounts of woody debris within the channel, and substantial cut bank habitats. Despite the smallest water volumes, West Tributary also had the lowest water temperatures of the three reaches, likely due to both riparian coverage and nearby groundwater springs. These results provide ample evidence of the importance of maintaining native riparian coverage and the high habitat complexities of woody debris within the channel.

Lower predation rates on New Zealand mudsnails by cutthroat trout were found in 2016 relative to 2014; reduced predation may be due to lower snail abundances found in pool habitats in 2016. It is not known why lower abundances were observed, but additional surveys of both gut content and macroinvertebrates will be necessary to determine if this is a positive trend. Analysis of fish condition should also continue to determine the long-term potential effects on fish health.

## 4.2 Recommendations

It is recommended that the City continue studies on the reaches sampled this year and in previous years. Conducting additional surveys on reaches where capital projects were undertaken will be important to determine the long-term success of these projects relative to stream health and function, as well as on the effectiveness of future capital projects designed to improve fish habitat and passage. Continued studies to track the diversity, size, and abundance of native and non-native fish species for use as an indicator of overall stream health is also advised. In addition, it is recommended that the City continue stomach content studies to determine if New Zealand mudsnails are a substantial component of the diet of cutthroat trout and juvenile coho salmon. Additional data are necessary to determine why a decrease in predation was observed in 2016 relative to 2014, and to determine if this is a trend. As well, mudsnail densities within infested index reaches should continue to determine trends in abundance and ultimate availability to fish. In addition, it is recommended that fish condition assessments, including weight and health observations continue to evaluate impacts on fish health.

Below is a detailed list of recommendations for the City of Bellevue to facilitate these actions.

- Compare diversity, size, and abundance of fish species across all years for sites with historical data.
- Conduct electrofishing at low, middle, and upper reaches of creeks during the same sampling events to determine if salmonids and native fish are utilizing different habitats than in previous years. This may help determine more accurately the presence/absence of fish within a watershed.
- Continue fish condition index assessment at electrofishing sites to assess relative health of priority fish species. The index could then be compared to other Western Washington urban streams where this particular data have been collected.
- Collect additional stream habitat data within survey reaches including large and small woody debris counts, percent canopy coverage and shading, cutbank lengths, boulder cluster counts, and substrate type. Annual survey observations strongly suggest that the presence of these stream and riparian habitat attributes affect the abundance and diversity of fish in survey reaches and should be quantified over time to assess changes and trends.
- Collect gut content data from priority salmonid species at current BIBI sites to determine if aquatic or terrestrial prey items dominate and to further investigate New Zealand mudsnail predation. These data will help determine prey species availability and use by salmonids. Data collected can also help determine if riparian and/or substrate improvements are necessary.
- Compare size of coho and cutthroat fish populations to other Puget Sound lowland reference streams.
- Continue a consistent electrofishing program that visits the same sites during the same time of year to increase robustness of data for determination of status and trends of priority fish species and to determine the prevalence of non-native species.
- Implement a study to evaluate selected electrofishing sites that have shown historical changes in species diversity and density. The study should include key water-quality parameters such as temperature and flow conditions; however, other parameters also should be considered for evaluation.
- Include adult coho escapement data in the status and trends database in order to associate coho presence or absence with run size.

Data collected for native and non-native fish species presence, status, and trends in urban streams can be a useful tool in determining the health of urban streams. Changes in these attributes can also be used to determine if cumulative alterations in land use, habitat restoration activities, and supplementation efforts are influencing fish populations. However, fish use (or lack thereof) in urban streams can be due to many variables, including temporal and spatial changes, habitat type and condition, water quality, and climate. Changes to any one of these variables, without collecting data on each of them, make it difficult to determine what might be causing changes in fish densities and species composition. However, collecting consistent data on habitat change, fish use, and diets (both temporally and spatially), would help ascertain if changes in fish populations and density are due to natural environmental changes, beneficial habitat modifications, or changes in land use. Implementing the recommendations mentioned above would help the City of Bellevue further answer these questions about its local, urban streams.

# 5.0 Literature Cited

Anderson, R.O. and R.M. Neumann. 1996. Length Weight and Associated Structural Indices. Pages 447-482 in B.R. Murphy and D.W. Willis, editors. Fisheries Techniques, 2nd Edition. American Fisheries Society, Bethesda, Maryland

Hart Crowser. 2014. Bellevue Electrofishing 2014. Final Report. Prepared for the City Bellevue Utilities Department, Bellevue, Washington.

Hart Crowser. 2014. Bellevue Electrofishing 2014. Final Report. Prepared for the City Bellevue Utilities Department, Bellevue, Washington.

Hart Crowser. 2013. Bellevue Electrofishing 2014. Final Report. Prepared for the City Bellevue Utilities Department, Bellevue, Washington.

Hart Crowser. 2012. Bellevue Electrofishing 2012. Final Report. Prepared for the City Bellevue Utilities Department, Bellevue, Washington.

Wydoski, R.S. and R.R. Whitney. 2003. Inland Fishes of Washington. Second Edition, Revised and Expanded. American Fisheries Society, Bethesda, Maryland in association with University of Washington Press, Seattle, Washington.

\\edmsrv\data\NOTEBOOKS\1275403_Bellevue 2015-2018 Electrofish Survey\Deliverables\Reports\Final 2016 Bellevue Electrofishing Report 2016_20161012.docx

# Appendix A – 2015 Raw Data

[This page intentionally left blank.]

| | |
|---|---|
| Date: | 7/11/2016 |
| Stream: | Kelsey Creek |
| Site: | Glendale Golf Course |
| River Mile: | 2.1 |
| Latitude: | 47.6141 |
| Longitude: | -122.1638 |
| Visibility: | Good |
| Air: | 15.6 ° C |
| Water: | 15.3 ° C |
| pH: | 8.0 |
| Turbidity | N/A |
| Conductivity: | 233.6 µs/cm |
| DO: | N/A |
| Total Reach Length: | 211.0 |
| Electrofishing Setting: | 200 v, 60 Hz, 6 mS |
| Start Time | 8:25 a.m. |
| End Time | 10:05 a.m. |
| Fishing Time: | 6000 seconds |
| Netter 1 Success: | High |
| Netter 2 Success: | High |
| | |
| Electrofishing: | Jim Starkes (Hart Crowser) |
| Netter 1: | Bethany Craig (DFW) |
| Netter 2: | Casey Costello (DFW) |
| | |
| Habitat Assessment: | Haley Koesters (CoB Intern) |
| | Gary Emerson (Volunteer) |
| | Bethany Craig (DFW) |

| Fish # | Species | Length [mm] | Habitat Type | Weight [g] |
|---|---|---|---|---|
| B1 | Cutthroat | 60 | P | 3.0 |
| B2 | Cutthroat | 55 | P | 1.7 |
| B3 | Cutthroat | 72 | P | 3.7 |
| B4 | Cutthroat | 75 | P | 4.5 |
| B5 | Cutthroat | 58 | P | 2.3 |
| B6 | Cutthroat | 65 | P | 3.6 |
| B7 | Cutthroat | 189 | P | 63.0 |
| B8 | Cutthroat | 255 | P | 158.1 |
| B9 | Cutthroat | 135 | P | 25.3 |
| B10 | Cutthroat | 213 | P | 99.5 |
| B11 | Cutthroat | 65 | P | 3.3 |
| B12 | Cutthroat | 45 | P | 1.0 |
| B13 | Cutthroat | 75 | P | 5.0 |
| B14 | Cutthroat | 195 | R | 68.1 |
| B15 | Cutthroat | 64 | R | 2.6 |
| B16 | Cutthroat | 60 | R | 2.2 |
| B17 | Cutthroat | 45 | R | 1.1 |
| B18 | Cutthroat | 67 | R | 3.9 |
| B19 | Cutthroat | 70 | R | 3.6 |
| B20 | Cutthroat | 55 | R | 2.2 |
| B21 | Cutthroat | 46 | R | 1.2 |
| B22 | Cutthroat | 65 | R | 3.0 |
| B23 | Cutthroat | 68 | R | 3.2 |
| B24 | Cutthroat | 72 | R | 3.7 |
| B25 | Cutthroat | 64 | R | 3.5 |
| B26 | Cutthroat | 73 | R | 3.8 |
| B27 | Cutthroat | 63 | R | 2.4 |
| B28 | Cutthroat | 81 | R | 9.2 |
| B29 | Cutthroat | 58 | R | 3.8 |
| B30 | Cutthroat | 85 | R | 7.2 |
| B31 | Cutthroat | 64 | R | 5.5 |
| B32 | Cutthroat | 48 | R | 1.8 |
| B33 | Cutthroat | 40 | R | 0.6 |
| B34 | Cutthroat | 73 | R | 4.8 |
| B35 | Cutthroat | 66 | R | 3.7 |
| B36 | Cutthroat | 48 | R | 1.9 |
| B37 | Cutthroat | 82 | R | 6.7 |
| B38 | Cutthroat | 74 | R | 5.8 |
| B39 | Cutthroat | 270 | R | 184.0 |
| B40 | Cutthroat | 80 | R | 6.4 |

| | | | | |
|---|---|---|---|---|
| B41 | Cutthroat | 49 | R | 1.4 |
| B42 | Cutthroat | 61 | R | 2.7 |
| B43 | Cutthroat | 59 | R | 2.9 |
| B44 | Cutthroat | 200 | R | 78.2 |
| B45 | Cutthroat | 73 | R | 4.9 |
| B46 | Cutthroat | 66 | R | 6.2 |
| B47 | Cutthroat | 60 | R | 4.7 |
| B48 | Cutthroat | 147 | R | 30.5 |
| B49 | Cutthroat | 60 | R | 2.1 |
| B50 | Cutthroat | 84 | R | 6.5 |
| B51 | Cutthroat | 75 | R | 4.3 |
| C1 | Cutthroat | 157 | P | 34.8 |
| C2 | Cutthroat | 182 | P | 61.3 |
| C3 | Cutthroat | 141 | P | 28.1 |
| C4 | Cutthroat | 129 | P | 22.9 |
| C5 | Cutthroat | 158 | P | 41.3 |
| C6 | Cutthroat | 124 | P | 19.8 |
| C7 | Cutthroat | 148 | P | 28.4 |
| C8 | Cutthroat | 136 | P | 24.2 |
| C9 | Cutthroat | 205 | P | 69.1 |
| C10 | Cutthroat | 76 | P | 4.4 |
| C11 | Cutthroat | 73 | P | 4.1 |
| C12 | Cutthroat | 90 | P | 7.7 |
| C13 | Cutthroat | 69 | P | 3.4 |
| C14 | Cutthroat | 48 | P | 1.2 |
| C15 | Cutthroat | 55 | P | 2.0 |
| C16 | Cutthroat | 133 | P | 23.8 |
| C17 | Cutthroat | 42 | R | 0.8 |
| C18 | Cutthroat | 44 | R | 1.0 |
| C19 | Cutthroat | 50 | R | 1.5 |
| C20 | Cutthroat | 53 | R | 1.8 |
| C21 | Cutthroat | 49 | R | 1.4 |
| C23 | Cutthroat | 61 | R | 2.2 |
| C24 | Cutthroat | 68 | R | 3.6 |
| C25 | Cutthroat | 64 | R | 3.2 |
| C26 | Cutthroat | 77 | R | 5.2 |
| C27 | Cutthroat | 49 | R | 1.3 |
| C28 | Cutthroat | 68 | R | 3.4 |
| C29 | Cutthroat | 50 | R | 1.3 |
| C30 | Cutthroat | 49 | R | 1.3 |
| C31 | Cutthroat | 52 | R | 1.7 |
| C32 | Cutthroat | 48 | R | 1.2 |

| | | | | |
|---|---|---|---|---|
| C33 | Cutthroat | 63 | R | 2.5 |
| C34 | Cutthroat | 65 | R | 3.1 |
| C36 | Cutthroat | 50 | R | 1.3 |
| C37 | Cutthroat | 59 | R | 2.3 |
| C38 | Cutthroat | 74 | R | 4.7 |
| C39 | Cutthroat | 83 | P | 6.4 |
| C40 | Cutthroat | 72 | P | 3.8 |
| C41 | Cutthroat | 48 | P | 1.1 |
| C42 | Cutthroat | 59 | P | 2.1 |
| C43 | Cutthroat | 52 | P | 1.5 |
| C44 | Cutthroat | 60 | P | 2.2 |
| C45 | Cutthroat | 59 | P | 2.3 |
| C46 | Cutthroat | 68 | P | 3.3 |
| C48 | Cutthroat | 61 | P | 2.6 |
| C49 | Cutthroat | 67 | P | 3.3 |
| C50 | Cutthroat | 49 | P | 1.3 |
| C51 | Cutthroat | 48 | P | 1.2 |
| C52 | Cutthroat | 41 | P | 0.7 |
| C53 | Cutthroat | 59 | P | 2.2 |
| C54 | Cutthroat | 64 | P | 2.9 |
| C55 | Cutthroat | 84 | P | 6.1 |
| C56 | Cutthroat | 133 | P | 24.5 |
| C57 | Cutthroat | 152 | P | 32.9 |
| C58 | Cutthroat | 140 | P | 32.2 |
| C59 | Cutthroat | 47 | P | 1.2 |
| C60 | Cutthroat | 80 | P | 5.9 |
| C61 | Cutthroat | 66 | P | 3.1 |
| C62 | Cutthroat | 69 | P | 3.7 |
| D1 | Cutthroat | 49 | P | 1.3 |
| D2 | Cutthroat | 72 | P | 3.9 |
| D3 | Cutthroat | 61 | P | 2.9 |
| D4 | Cutthroat | 58 | P | 2.2 |
| D5 | Cutthroat | 130 | P | 21.8 |
| D6 | Cutthroat | 43 | P | 0.9 |
| D7 | Cutthroat | 67 | P | 3.1 |
| D8 | Cutthroat | 165 | P | 42.9 |
| D9 | Cutthroat | 63 | P | 2.8 |
| D10 | Cutthroat | 74 | P | 4.1 |
| D11 | Cutthroat | 65 | P | 2.8 |
| D12 | Cutthroat | 66 | R | 3.6 |
| D13 | Cutthroat | 65 | R | 3.1 |
| D14 | Cutthroat | 54 | R | 1.7 |

| | | | | |
|---|---|---|---|---|
| D15 | Cutthroat | 70 | R | 3.9 |
| D16 | Cutthroat | 78 | R | 5.0 |
| D17 | Cutthroat | 57 | R | 2.3 |
| D18 | Cutthroat | 83 | R | 6.8 |
| D19 | Cutthroat | 70 | R | 3.6 |
| D20 | Cutthroat | 74 | R | 4.4 |
| D21 | Cutthroat | 48 | R | 1.1 |
| D22 | Cutthroat | 75 | R | 4.6 |
| D23 | Cutthroat | 64 | R | 2.9 |
| D24 | Cutthroat | 70 | R | 3.8 |
| D25 | Cutthroat | 78 | R | 5.7 |
| D26 | Cutthroat | 39 | R | 1.2 |
| D27 | Cutthroat | 70 | R | 3.7 |
| D28 | Cutthroat | 57 | R | 2.0 |
| D29 | Cutthroat | 79 | R | 5.2 |
| D30 | Cutthroat | 63 | R | 2.9 |
| D31 | Cutthroat | 63 | R | 2.6 |
| D32 | Cutthroat | 135 | R | 25.4 |
| D33 | Cutthroat | 58 | R | 2.1 |
| D34 | Cutthroat | 95 | R | 9.2 |
| D35 | Cutthroat | 69 | R | 3.9 |
| D36 | Cutthroat | 151 | R | 36.5 |
| D37 | Cutthroat | 53 | R | 1.6 |
| D38 | Cutthroat | 168 | R | 47.1 |
| D39 | Cutthroat | 50 | R | 1.8 |
| D40 | Cutthroat | 148 | R | 31.7 |
| BO1 | Longnose Dace | 69 | P | 3.5 |
| BO2 | Longnose Dace | 65 | R | 3.8 |
| BO3 | Longnose Dace | 69 | R | 3.9 |
| BO4 | Longnose Dace | 67 | R | 2.3 |
| BO5 | Longnose Dace | 68 | R | 3.3 |
| BO6 | Signal Crayfish | 69 | R | - |
| BO7 | Longnose Dace | 95 | R | 9.0 |
| BO8 | Longnose Dace | 74 | R | 4.1 |
| BO9 | Longnose Dace | 89 | R | 8.4 |
| BO10 | Longnose Dace | 105 | R | 10.6 |
| BO11 | Longnose Dace | 68 | R | 4.4 |
| BO12 | Longnose Dace | 74 | R | 4.3 |
| BO13 | Longnose Dace | 84 | R | 6.8 |
| BO14 | Longnose Dace | 87 | R | 6.9 |
| BO15 | Longnose Dace | 88 | R | 11.0 |
| BO16 | Longnose Dace | 54 | R | 2.4 |

| | | | | |
|---|---|---|---|---|
| BO17 | Longnose Dace | 95 | R | 9.8 |
| BO18 | Longnose Dace | 69 | R | 3.6 |
| BO19 | Longnose Dace | 84 | R | 7.2 |
| BO20 | Longnose Dace | 66 | R | 5.3 |
| BO21 | Longnose Dace | 69 | R | 3.5 |
| BO22 | Longnose Dace | 81 | R | 5.7 |
| BO23 | Longnose Dace | 71 | R | 4.6 |
| BO24 | Longnose Dace | 77 | R | 5.5 |
| BO25 | Longnose Dace | 89 | R | 6.7 |
| BO26 | Longnose Dace | 70 | R | 5.3 |
| BO27 | Longnose Dace | 98 | R | 9.3 |
| BO28 | Longnose Dace | 110 | R | 14.4 |
| BO29 | Longnose Dace | 86 | R | 7.0 |
| BO30 | Signal Crayfish | 72 | R | 7.3 |
| BO31 | Longnose Dace | 62 | R | 3.1 |
| CO1 | Pumpkinseed | 67 | P | 5.8 |
| CO2 | Longnose Dace | 56 | R | 2.0 |
| CO3 | Longnose Dace | 68 | R | 3.3 |
| CO4 | Longnose Dace | 76 | R | 5.2 |
| CO5 | Longnose Dace | 69 | R | 3.2 |
| CO6 | Longnose Dace | 77 | R | 4.6 |
| CO7 | Longnose Dace | 64 | R | 2.5 |
| CO8 | Longnose Dace | 65 | R | 3.0 |
| CO9 | Longnose Dace | 72 | R | 3.9 |
| CO10 | Longnose Dace | 73 | R | 4.1 |
| CO11 | Longnose Dace | 77 | R | 4.7 |
| CO12 | Signal Crayfish | 31 | P | - |
| CO13 | Longnose Dace | 62 | P | 2.3 |
| CO14 | Longnose Dace | 64 | P | 2.8 |
| CO15 | Longnose Dace | 72 | P | 3.9 |
| DO1 | Signal Crayfish | 20 | R | 2.5 |
| DO2 | Longnose Dace | 75 | R | 4.8 |
| DO3 | Longnose Dace | 69 | R | 3.3 |
| DO4 | Longnose Dace | 71 | R | 3.8 |
| DO5 | Longnose Dace | 67 | R | 3.6 |
| DO6 | Longnose Dace | 68 | R | 3.5 |
| DO7 | Longnose Dace | 74 | R | 5.1 |
| DO8 | Longnose Dace | 72 | R | 4.5 |
| DO9 | Longnose Dace | 101 | R | 10.2 |
| DO10 | Longnose Dace | 92 | R | 7.9 |
| DO11 | Longnose Dace | 67 | R | 3.2 |
| DO12 | Longnose Dace | 70 | R | 4.0 |

| | | | | |
|---|---|---|---|---|
| DO13 | Longnose Dace | 64 | R | 3.1 |
| DO14 | Longnose Dace | 53 | R | 1.2 |
| DO15 | Signal Crayfish | 34 | R | 13.4 |
| DO16 | Longnose Dace | 69 | R | 3.4 |
| DO17 | Longnose Dace | 67 | R | 3.5 |
| DO18 | Longnose Dace | 114 | R | 13.8 |
| DO19 | Longnose Dace | 67 | R | 3.1 |
| DO20 | Longnose Dace | 66 | R | 3.3 |
| DO21 | Longnose Dace | 70 | R | 3.5 |
| DO22 | Longnose Dace | 79 | R | 4.8 |
| DO23 | Longnose Dace | 71 | R | 3.9 |

| | |
|---|---|
| Date: | 7/14/2016 |
| Stream: | West Tributary |
| | |
| River Mile: | 1.6 |
| Latitude: | 47.6176 |
| Longitude: | -122.1682 |
| Visibility: | Very good (some limitations with glare and high sediment load) |
| Air: | 18.0 ° C |
| Water: | 14.7 ° C |
| pH: | N/A |
| Turbidity | N/A |
| Conductivity: | 233.4 µs/cm |
| DO: | N/A |
| Total Reach Length: | 210.0 |
| Electrofishing Setting: | 200 v, 60 Hz, 6 mS |
| Start Time | 9:05 a.m. |
| End Time | 11:10 a.m. |
| Fishing Time: | 7500 seconds |
| Netter 1 Success: | High |
| Netter 2 Success: | Moderate-High |
| | |
| Electrofishing: | Jim Starkes (Hart Crowser) |
| Netter 1: | Laurie Devereaux (CoB Employee) |
| Netter 2: | Gary Emerson (Volunteer) |
| Netter 2: | Jason Emerson (Volunteer) |
| | |
| Habitat Assessment: | Haley Koesters (CoB Intern) |
| | Pauline Mogilevsky (CoB Intern) |
| | Alisha Piazza (CoB Intern) |

| Fish # | Species | Habitat Type | Length [mm] | Weight [g] |
|---|---|---|---|---|
| 1 | Cutthroat | Riffle | 181 | 60.0 |
| 2 | Cutthroat | Riffle | 76 | 6.4 |
| 3 | Cutthroat | Riffle | 65 | 3.7 |
| 4 | Cutthroat | Riffle | 72 | 5.1 |
| 5 | Cutthroat | Riffle | 88 | 9.6 |
| 6 | Cutthroat | Riffle | 66 | 3.8 |
| 7 | Cutthroat | Riffle | 70 | 4.5 |
| 8 | Cutthroat | Riffle | 136 | 22.5 |
| 9 | Cutthroat | Riffle | 68 | 3.6 |
| 10 | Cutthroat | Riffle | 60 | 2.5 |
| 11 | Cutthroat | Riffle | 77 | 5.7 |
| 12 | Cutthroat | Riffle | 69 | 3.9 |
| 13 | Cutthroat | Riffle | 73 | 5.1 |
| 14 | Cutthroat | Riffle | 68 | 3.7 |
| 15 | Cutthroat | Riffle | 70 | 4.0 |
| 16 | Cutthroat | Riffle | 86 | 7.4 |
| 17 | Cutthroat | Riffle | 56 | 2.3 |
| 18 | Cutthroat | Riffle | 54 | 1.8 |
| 19 | Cutthroat | Riffle | 90 | 8.8 |
| 20 | Cutthroat | Riffle | 89 | 9.7 |
| 21 | Cutthroat | Riffle | 72 | 4.2 |
| 22 | Cutthroat | Riffle | 66 | 3.2 |
| 23 | Cutthroat | Riffle | 83 | 7.5 |
| 24 | Cutthroat | Riffle | 68 | 4.8 |
| 25 | Cutthroat | Riffle | 59 | 2.6 |
| 26 | Cutthroat | Riffle | 77 | 5.8 |
| 27 | Cutthroat | Riffle | 56 | 2.2 |
| 28 | Cutthroat | Riffle | 70 | 4.7 |
| 29 | Cutthroat | Riffle | 54 | 1.9 |
| 30 | Cutthroat | Riffle | 73 | 4.5 |
| 31 | Cutthroat | Riffle | 77 | 5.1 |
| 32 | Cutthroat | Riffle | 80 | 7.0 |
| 33 | Cutthroat | Riffle | 52 | 2.0 |
| 34 | Cutthroat | Riffle | 69 | 3.7 |
| 35 | Cutthroat | Riffle | 70 | 4.9 |
| 36 | Cutthroat | Riffle | 101 | 11.2 |
| 37 | Cutthroat | Riffle | 152 | 30.4 |
| 38 | Cutthroat | Riffle | 53 | 1.9 |
| 39 | Cutthroat | Riffle | 74 | 4.3 |
| 40 | Cutthroat | Riffle | 50 | 1.6 |

| | | | | |
|---|---|---|---|---|
| 41 | Cutthroat | Riffle | 83 | 6.8 |
| 42 | Cutthroat | Riffle | 75 | 5.7 |
| 43 | Cutthroat | Riffle | 47 | 1.5 |
| 44 | Cutthroat | Riffle | 81 | 7.0 |
| 45 | Cutthroat | Riffle | 55 | 2.0 |
| 46 | Cutthroat | Riffle | 55 | 2.3 |
| 47 | Cutthroat | Riffle | 74 | 4.6 |
| 48 | Cutthroat | Riffle | 53 | 1.8 |
| 49 | Cutthroat | Riffle | 134 | 23.8 |
| 50 | Cutthroat | Riffle | 55 | 2.3 |
| 51 | Cutthroat | Riffle | 68 | 4.6 |
| 52 | Cutthroat | Riffle | 148 | 32.7 |
| 53 | Cutthroat | Riffle | 75 | 6.3 |
| 54 | Cutthroat | Riffle | 69 | 3.2 |
| 55 | Cutthroat | Riffle | 66 | 3.8 |
| 56 | Cutthroat | Riffle | 63 | 2.9 |
| 57 | Cutthroat | Riffle | 50 | 1.7 |
| 58 | Cutthroat | Riffle | 87 | 8.3 |
| 59 | Cutthroat | Riffle | 80 | 7.1 |
| 60 | Cutthroat | Riffle | 62 | 3.3 |
| 61 | Cutthroat | Riffle | 59 | 2.5 |
| 62 | Cutthroat | Riffle | 44 | 1.0 |
| 63 | Cutthroat | Riffle | 67 | 3.2 |
| 64 | Cutthroat | Riffle | 65 | 3.3 |
| 65 | Cutthroat | Riffle | 47 | 1.3 |
| 66 | Cutthroat | Riffle | 138 | 25.1 |
| 67 | Cutthroat | Riffle | 141 | 30.7 |
| 68 | Cutthroat | Riffle | 95 | 9.0 |
| 69 | Cutthroat | Riffle | 143 | 29.8 |
| 70 | Cutthroat | Riffle | 85 | 7.2 |
| 71 | Cutthroat | Riffle | 87 | 6.9 |
| 72 | Cutthroat | Riffle | 105 | 11.4 |
| 73 | Cutthroat | Riffle | 162 | 41.5 |
| 74 | Cutthroat | Riffle | 134 | 22.6 |
| 75 | Cutthroat | Riffle | 50 | 2.0 |
| 76 | Cutthroat | Riffle | 48 | 1.4 |
| 77 | Cutthroat | Riffle | 70 | 4.0 |
| 78 | Cutthroat | Riffle | 60 | 3.2 |
| 79 | Cutthroat | Riffle | 83 | 5.7 |
| 80 | Cutthroat | Riffle | 66 | 3.4 |
| 81 | Cutthroat | Riffle | 80 | 5.7 |
| 82 | Cutthroat | Riffle | 55 | 2.1 |

| | | | | |
|---|---|---|---|---|
| 83 | Cutthroat | Riffle | 55 | 2.1 |
| 84 | Cutthroat | Riffle | 97 | 11.9 |
| 85 | Cutthroat | Riffle | 70 | 3.7 |
| 86 | Cutthroat | Riffle | 88 | 7.5 |
| 87 | Cutthroat | Riffle | 63 | 3.5 |
| 88 | Cutthroat | Riffle | 74 | 5.5 |
| 89 | Cutthroat | Riffle | 132 | 27.2 |
| 90 | Cutthroat | Riffle | 90 | 8.4 |
| 91 | Cutthroat | Riffle | 67 | 3.6 |
| 92 | Cutthroat | Riffle | 54 | 2.0 |
| 93 | Cutthroat | Riffle | 92 | 9.9 |
| 94 | Cutthroat | Riffle | 60 | 3.3 |
| 95 | Cutthroat | Riffle | 129 | 23.7 |
| 96 | Cutthroat | Riffle | 77 | 5.3 |
| 97 | Cutthroat | Riffle | 54 | 2.2 |
| 98 | Cutthroat | Riffle | 73 | 5.0 |
| 99 | Cutthroat | Pool | 80 | 6.0 |
| 100 | Cutthroat | Pool | 105 | 12.9 |
| 101 | Cutthroat | Pool | 151 | 31.3 |
| 102 | Cutthroat | Pool | 144 | 30.5 |
| 103 | Cutthroat | Pool | 59 | 2.5 |
| 104 | Cutthroat | Pool | 80 | 6.1 |
| 105 | Cutthroat | Pool | 143 | 26.2 |
| 106 | Cutthroat | Pool | 85 | 7.0 |
| 107 | Cutthroat | Pool | 83 | 7.0 |
| 108 | Cutthroat | Pool | 118 | 17.2 |
| 109 | Cutthroat | Pool | 135 | 25.2 |
| 110 | Cutthroat | Pool | 57 | 2.1 |
| 111 | Cutthroat | Pool | 130 | 23.1 |
| 112 | Cutthroat | Pool | 90 | 8.7 |
| 113 | Cutthroat | Pool | 64 | 3.6 |
| 114 | Cutthroat | Pool | 107 | 12.9 |
| 115 | Cutthroat | Pool | 168 | 46.3 |
| 116 | Cutthroat | Pool | 85 | 7.0 |
| 117 | Cutthroat | Pool | 89 | 8.1 |
| 118 | Cutthroat | Pool | 82 | 5.8 |
| 119 | Cutthroat | Pool | 72 | 5.2 |
| 120 | Cutthroat | Pool | 79 | 6.0 |
| 121 | Cutthroat | Pool | 81 | 5.9 |
| 122 | Cutthroat | Pool | 73 | 4.3 |
| 123 | Cutthroat | Pool | 76 | 5.0 |
| 124 | Cutthroat | Pool | 115 | 16.5 |

| | | | | |
|---|---|---|---|---|
| 125 | Cutthroat | Pool | 76 | 5.5 |
| 126 | Cutthroat | Pool | 165 | 45.6 |
| 127 | Cutthroat | Pool | 85 | 7.8 |
| 128 | Cutthroat | Pool | 76 | 5.6 |
| 129 | Cutthroat | Pool | 69 | 3.5 |
| 130 | Cutthroat | Pool | 76 | 5.5 |
| 131 | Cutthroat | Pool | 73 | 5.2 |
| 132 | Cutthroat | Pool | 66 | 4.2 |
| 133 | Cutthroat | Pool | 97 | 10.5 |
| 134 | Cutthroat | Pool | 100 | 12.2 |
| 135 | Cutthroat | Pool | 74 | 5.4 |
| 136 | Cutthroat | Pool | 75 | 5.8 |
| 137 | Cutthroat | Pool | 83 | 6.9 |
| 138 | Cutthroat | Pool | 115 | 18.1 |
| 139 | Cutthroat | Pool | 70 | 4.3 |
| 140 | Cutthroat | Pool | 131 | 22.3 |
| 141 | Cutthroat | Pool | 136 | 27.9 |
| 142 | Cutthroat | Pool | 75 | 4.9 |
| 143 | Cutthroat | Pool | 119 | 14.8 |
| 144 | Cutthroat | Pool | 70 | 4.2 |
| 145 | Cutthroat | Riffle (Side channel, R2) | 73 | 5.1 |
| 146 | Cutthroat | Riffle (Side channel, R2) | 89 | 9.0 |
| 147 | Cutthroat | Riffle (Side channel, R2) | 68 | 4.0 |
| 148 | Cutthroat | Riffle (Side channel, R2) | 77 | 5.9 |
| 149 | Cutthroat | Riffle (Side channel, R2) | 69 | 4.5 |
| 150 | Cutthroat | Riffle (Side channel, R2) | 90 | 8.8 |
| 151 | Cutthroat | Riffle (Side channel, R2) | 75 | 6.3 |
| 152 | Cutthroat | Riffle (Side channel, R2) | 69 | 4.5 |
| 153 | Cutthroat | Riffle (Side channel, R2) | 73 | 5.9 |
| 154 | Cutthroat | Riffle (Side channel, R2) | 120 | 19.5 |
| 155 | Cutthroat | Riffle (Side channel, R2) | 72 | 4.4 |
| 156 | Cutthroat | Riffle (Side channel, R2) | 60 | 2.6 |
| 157 | Cutthroat | Riffle (Side channel, R2) | 70 | 5.2 |
| 158 | Lamprey | Riffle | 110 | 2.0 |
| 159 | Lamprey | Riffle | 40 | 0.3 |
| 160 | Signal crayfish | Riffle | 44 | 15.1 |
| 161 | Lamprey | Riffle | 86 | 1.3 |
| 162 | Signal crayfish | Riffle | 30 | 5.0 |
| 163 | Signal crayfish | Riffle | 35 | 6.7 |
| 164 | Signal crayfish | Riffle | 10 | 0.3 |
| 165 | Lamprey | Riffle | 85 | 1.1 |
| 166 | Signal crayfish | Riffle | 37 | 12.1 |

| | | | | |
|---|---|---|---|---|
| 167 | Lamprey | Pool | 55 | 0.5 |
| 168 | Signal crayfish | Pool | 33 | 7.2 |
| 169 | Signal crayfish | Pool | 26 | 4.6 |
| 170 | Lamprey | Pool | 80 | 0.9 |
| 171 | Lamprey | Pool | 60 | 0.6 |
| 172 | Lamprey | Pool | 52 | 0.7 |

| | | |
|---|---|---|
| Date: | 7/15/2016 | |
| Stream: | Kelsey Creek | |
| Site: | Trestle | |
| River Mile: | 0.2 | |
| Latitute: | 47.603 | |
| Longitude: | -122.1807 | |
| Visibility: | Clear | |
| Air: | 16.1 ° C | |
| Water: | N/A | |
| pH: | N/A | |
| Turbidity | N/A | |
| Conductivity: | 277.4 µs/cm | |
| DO: | N/A | |
| Total Reach Length: | 58 | ft |
| Electrofishing Setting: | 200 v, 60 Hz, 6 mS | |
| Start Time | 8:45 a.m. | |
| End Time | 10:10 a.m. | |
| Fishing Time: | 5100 seconds | |
| Netter 1 Success:* | Low-Moderate | |
| Netter 2 Success:* | Low | |

*Note: Several cutthroat and crayfish got away and were unable to be caught.

| | | |
|---|---|---|
| Sampling done by: | Electrofishing: | Jim Starkes (Hart Crowser) |
| | Netter 1: | Laurie Devereaux (CoB Employee) |
| | Netter 2: | Haley Koesters, Pauline Mogilevsky, Alisha Piazza, Kathleen Ericksen (CoB Interns) |
| | Habitat Assessment: | Haley Koesters, Pauline Mogilevsky, Alisha Piazza (CoB Interns) |

| Fish # | Species | Length [mm] | Habitat Type | Weight [g] |
|---|---|---|---|---|
| 1 | Cutthroat | 70 | Riffle | 3.5 |
| 2 | Cutthroat | 68 | Riffle | 3.6 |
| 3 | Cutthroat | 55 | Riffle | 2.1 |
| 4 | Cutthroat | 73 | Riffle | 4.2 |
| 5 | Cutthroat | 79 | Riffle | 5.7 |
| 6 | Cutthroat | 88 | Riffle | 8.1 |
| 7 | Cutthroat | 99 | Riffle | 9.8 |
| 8 | Cutthroat | 76 | Riffle | 4.9 |
| 9 | Cutthroat | 74 | Riffle | 4.5 |
| 10 | Cutthroat | 86 | Riffle | 7.1 |
| 11 | Cutthroat | 80 | Riffle | 6.8 |
| 12 | Cutthroat | 69 | Riffle | 3.8 |
| 13 | Cutthroat | 62 | Riffle | 2.5 |
| 14 | Cutthroat | 90 | Riffle | 8.1 |
| 15 | Cutthroat | 75 | Riffle | 4.6 |
| 16 | Cutthroat | 145 | Riffle | 33.7 |
| 17 | Cutthroat | 82 | Riffle | 6.0 |
| 18 | Cutthroat | 59 | Riffle | 2.3 |
| 19 | Cutthroat | 74 | Riffle | 4.8 |
| 20 | Cutthroat | 84 | Riffle | 8.1 |
| 21 | Cutthroat | 111 | Riffle | 15.5 |
| 22 | Cutthroat | 72 | Riffle | 4.3 |
| 23 | Cutthroat | 66 | Riffle | 3.2 |
| 24 | Cutthroat | 85 | Riffle | 7.2 |
| 25 | Cutthroat | 70 | Riffle | 3.4 |
| 26 | Cutthroat | 66 | Riffle | 3.1 |
| 27 | Cutthroat | 55 | Riffle | 2.0 |
| 28 | Cutthroat | 64 | Riffle | 2.7 |
| 29 | Cutthroat | 65 | Riffle | 2.8 |
| 30 | Cutthroat | 68 | Riffle | 3.6 |
| 31 | Cutthroat | 66 | Riffle | 3.7 |
| 32 | Cutthroat | 103 | Riffle | 11.9 |
| 33 | Cutthroat | 74 | Riffle | 5.6 |
| 34 | Cutthroat | 65 | Riffle | 3.3 |
| 35 | Cutthroat | 60 | Riffle | 2.6 |
| 36 | Cutthroat | 76 | Riffle | 5.4 |
| 37 | Cutthroat | 71 | Riffle | 4.0 |
| 38 | Cutthroat | 64 | Riffle | 3.4 |
| 39 | Cutthroat | 63 | Riffle | 3.0 |
| 40 | Cutthroat | 79 | Riffle | 5.3 |
| 41 | Cutthroat | 66 | Riffle | 3.2 |

| | | | | |
|---|---|---|---|---|
| 42 | Cutthroat | 75 | Riffle | 4.3 |
| 43 | Cutthroat | 80 | Riffle | 6.0 |
| 44 | Cutthroat | 67 | Riffle | 3.3 |
| 45 | Dace | 92 | Riffle | 8.3 |
| 46 | Dace | 89 | Riffle | 8.4 |
| 47 | Dace | 76 | Riffle | 4.8 |
| 48 | Dace | 81 | Riffle | 7.7 |
| 49 | Signal Crayfish | 10 | Riffle | - |
| 50 | Prickly Sculpin | 140 | Riffle | 28.1 |
| 51 | Signal Crayfish | 23 | Riffle | 3.9 |
| 52 | Dace | 95 | Riffle | 9.8 |
| 53 | Signal Crayfish | 26 | Riffle | 6.6 |
| 54 | Prickly Sculpin | 80 | Riffle | 6.4 |
| 55 | Signal Crayfish | 23 | Riffle | 2.8 |
| 56 | Signal Crayfish | 43 | Riffle | 19.1 |
| 57 | Signal Crayfish | 10 | Riffle | 0.3 |
| 58 | Signal Crayfish | 26 | Riffle | 4.5 |
| 59 | Prickly Sculpin | 123 | Riffle | 24.1 |
| 60 | Signal Crayfish | 32 | Riffle | 7.2 |
| 61 | Signal Crayfish | 20 | Riffle | 3.0 |
| 62 | Signal Crayfish | 19 | Riffle | 2.6 |
| 63 | Signal Crayfish | 43 | Riffle | 19.3 |
| 64 | Signal Crayfish | 33 | Riffle | 8.4 |

# Appendix B – Project Photos

[This page intentionally left blank.]


Photo 1. Kelsey Creek (RM 2.1) at Glendale Golf Course. Stream is relatively open with steep slopes and limited native riparian vegetation


Photo 2. Kelsey Creek (RM 2.1) at Glendale Golf Course. Stream is relatively open with steep slopes and limited native riparian vegetation. Background shows an artificial rockwall.

Photo 3. Electrofishing team at Kelsey Creek (RM 2.1) at Glendale Golf Course. Mostly open stream channel but some undercut banks and overhanging/submerged vegetation is present.

Photo 4. West Tributary—Densely vegetated and relatively narrow stream channel.

Photo 5. West Tributary at mainstem and side channel that runs much of the length of the sample reach.

Photo 6. West Tributary at beaver dam at upstream end of sample reach.

Photo 7. Reconstructed riffle habitat at Kelsey Creek RM 0.2. Sample reach relatively short but inclusive of entire riffle.

Photo 8. Reconstructed riffle at Kelsey Creek RM 0.2. Relatively open, but with dense riparian zone.

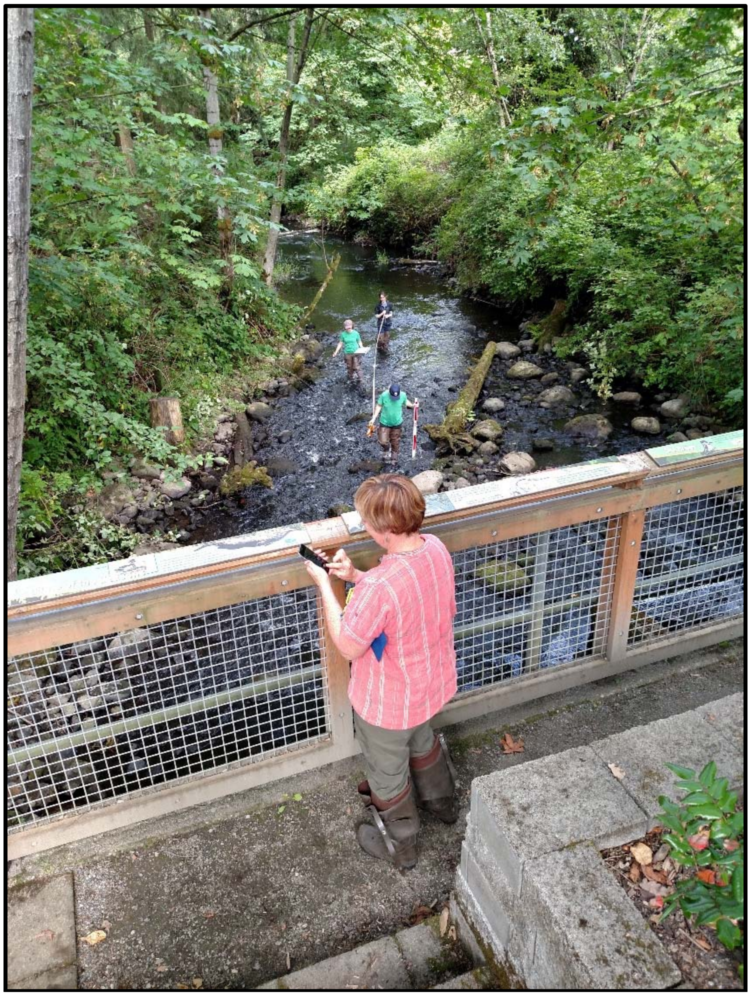


Photo 9. Downstream end of Kelsey Creek RM 0.2 reach at roadway crossing.

Photo 10. Typical cutthroat trout within the Kelsey Creek drainage.

Photo 11. Gastric lavage procedure performed on anesthetized fish.