Technical Report No. 17-06

Aquatic Biomonitoring at the Arctic-Bornite Prospect, 2016

by Parker T. Bradley

February 2017

Alaska Department of Fish and Game **Division of Habitat**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in reports by the Divisions of Habitat, Sport Fish and of Commercial Fisheries. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

TECHNICAL REPORT NO. 17-06

AQUATIC BIOMONITORING AT THE ARCTIC-BORNITE PROSPECT, 2016

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February, 2017

Cover: Subarctic Creek, upper site, July 18, 2016. Photograph by Parker T. Bradley

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Acknowledgements

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Introduction

The Ambler mining district is located in northwest Alaska in the Kobuk River drainage along the southern end of the Brooks Range (Figure 1). There are two primary deposits currently being explored by Trilogy Metals (formally NovaCopper). The Bornite deposit is located approximately 17 km north of Kobuk, and the Arctic deposit is located approximately 37 km northeast of Kobuk. The Bornite deposit contains primarily copper while the Arctic deposit contains copper, lead, zinc, silver and gold. The Bornite deposit occurs in the drainage of Ruby Creek while the Arctic deposit occurs in the upper end of Subarctic Creek. Both Ruby and Subarctic creeks are tributaries to the Shungnak River, which flows into the Kobuk River. A large waterfall in the lower Shungnak River prevents upstream passage of fish into the area so no anadromous fish occur near the sites (Figure 2). All fish occurring in the area complete their life cycle within the Shungnak River drainage.

All sample sites occurred in the Shungnak River drainage, except for one located in Riley Creek, which flows into the Kogoluktuk River. The Riley Creek site was selected as it is being considered as an option for a tailings facility.

Figure 1. Location of the Arctic and Bornite deposits in northwest Alaska.

Figure 2. Waterfall on the Shungnak River blocking fish passage upstream, July 21, 2016.

Aquatic baseline work conducted in the area in 2010 focused on macroinvertebrate and fish species present (Tetra Tech, 2011). The fish species documented in the 2010 survey were Arctic grayling (*Thymallus arcticus*), round whitefish (*Prosopium cylindraceum*), slimy sculpin (*Cottus cognatus*), and Dolly Varden (*Salvelinus malma*). Trilogy Metals contracted the ADF&G Division of Habitat to continue the aquatic sampling in 2016. The ADF&G study plan was based on aquatic biomonitoring the Division of Habitat routinely conducts at various large hard rock mines in the state. Three primary types of data were collected: periphyton, aquatic invertebrates, and fish which included samples for whole body element analyses.

This report will summarize the samples that were collected by ADF&G in 2016, as well as water quality data that were collected by Trilogy Metals from 2008-2009 and 2012-2016.

Methods

Sampling Overview

Two sampling sites were selected in each Ruby and Subarctic creeks as they were locations where there may be changes to the system once mining begins; one site was selected in the upper Shungnak River as a reference location, and one site was selected on Riley Creek as it may be used as a future tailings disposal site (Table 1, Figure 3). Sampling occurred from July 18 – 22, 2016.

At each location replicate samples of the aquatic community were performed; including aquatic invertebrates, periphyton, and juvenile fish. The objectives of the biological monitoring program were to document in-situ productivity of aquatic communities downstream of potential project facilities.

Water Quality

Trilogy Metals has collected water quality data from many locations throughout the Arctic-Bornite Prospect project area. Samples are collected on average once per year, typically in July or August. These data were provided to ADF&G and were compiled and graphed showing median, minimum, and maximum values (Appendix 1). Only water quality data from locations in close proximity to the 2016 sample sites were used. Some sites have data dating back to 2008, such as upper Subarctic Creek, while some sites have less data, such as Riley Creek, upper Ruby Creek, and the upper Shungnak River, which only has been sampled in 2016.

Periphyton

Periphyton, or attached micro-algae, are sensitive to changes in water quality and are often used in monitoring studies to detect early changes in aquatic communities (Ott et al. 2010). The presence of periphyton in a stream system is evidence of in-situ productivity (Ott et al. 2010). Periphyton samples were collected at six locations around the Arctic Bornite area (Table 1; Figure 3).

Ten flat rocks larger than 25 cm^2 were collected from submerged areas at each site. A 5-cm x 5-cm square of high density flexible foam was placed on the rock. All the material around the foam was scrubbed off with a toothbrush. The foam square was then removed from the rock, and that section of the rock was brushed onto a 0.45 µm glass fiber filter receptacle attached to a hand vacuum pump. Material from the toothbrush was also rinsed onto the filter. The water was extracted from the periphyton using a hand vacuum pump. Just before all the water was pumped through the filter, one to two drops of Magnesium Carbonate ($MgCO_3$)was added to the water which prevented acidification and additional conversion of chlorophyll-a to phaeophytin.

Filters from each rock were folded in half, with the sample material on the inside, and placed in individual dry coffee filters. All ten coffee filters were placed in a zip-lock bag containing desiccant to absorb any remaining moisture. The bags were then wrapped in aluminum foil to prevent light from reaching the samples, placed in a cooler with ice packs, then transferred to a freezer at the Arctic Bornite camp. Samples were kept frozen until they were analyzed at the ADF&G laboratory in Fairbanks. Additional details regarding periphyton sampling and analysis methods can be found in ADF&G Technical Report No. 10-04 (Ott et al. 2010).

Table 1. Periphyton, aquatic invertebrate, and minnow trap sampling locations (WGS 84) July 18–20, 2016.

Sample Site	Latitude	Longitude
Upper Ruby Creek	67.05144	-156.92914
Lower Ruby Creek	67.09245	-156.93382
Shungnak River	67.24323	-156.61571
Upper Subarctic Creek	67.19272	-156.39093
Lower Subarctic Creek	67.17167	-156.61844
Riley Creek	67.04603	-156.80304

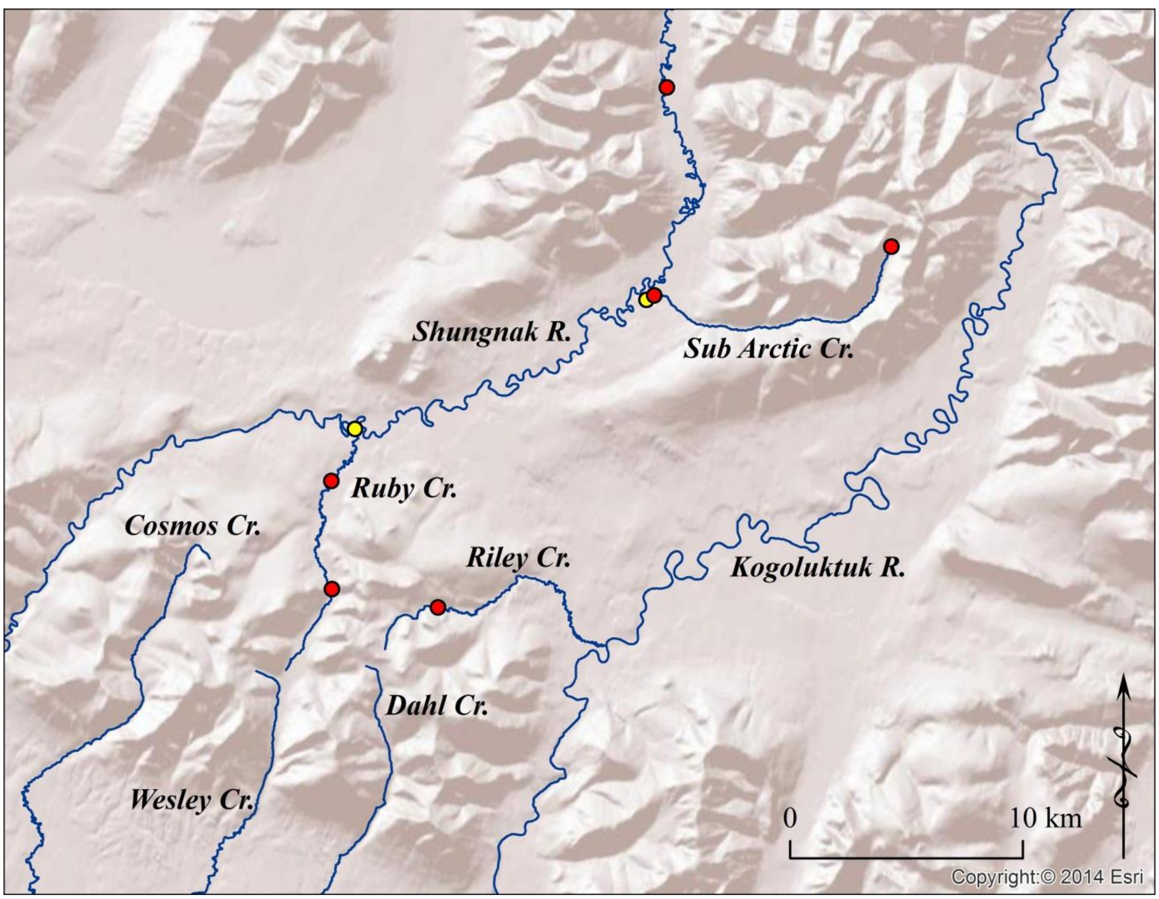

Figure 3. Periphyton, aquatic invertebrate, and minnow trap sample sites (red) and fyke net sample sites (yellow), July 2016.

Aquatic invertebrates

At each sample site, five drift nets were installed along a transect perpendicular to the flow (Table 1; Figure 4). The drift nets were 45.7 cm wide, 30.5 cm tall with 363 µm mesh size. At each net, water depth and water velocity were measured using a Marsh McBirney FH950 flow meter. By using these parameters the volume of water sampled by each net could be calculated. After one hour, the nets were removed and material was flushed into the cod end by splashing water on the outside of the net. The cod end contents were then removed and placed in individual pre-labeled Nalgene bottles. Denatured ethyl alcohol was added to each Nalgene to preserve the samples. Samples were sorted and invertebrates identified to the lowest taxonomic level, typically family or genus by a private aquatic invertebrate lab in Fairbanks. Because invertebrates belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) are sensitive to differences in water quality, percent composition of EPT's were calculated and compared to groups of other invertebrates, which are less sensitive.

Figure 4. Drift nets set for capturing aquatic invertebrates in Riley Creek July 19, 2016.

Fish

At each sample site, after the periphyton and aquatic invertebrates were sampled, ten minnow traps were baited with cured salmon roe in a perforated plastic bag and placed upstream and downstream of the periphyton and aquatic insect sampling locations (Table 1). Traps were placed in a variety of habitats, including cut banks, pools, and near submerged woody debris. Traps were allowed to soak overnight and checked about 24 hours later. All captured fish were measured for fork or total length. Some fish were retained for whole body element analyses. Those fish were handled wearing plastic gloves, and placed in individual pre-labeled plastic zip-lock bags. The fish were placed in a cooler with ice packs and transferred to a freezer in the camp. The samples remained frozen until they were analyzed by ACZ Laboratories. Results were analyzed on a dry weight basis.

In addition to the minnow traps, fyke nets were set in lower Ruby Creek and lower Subarctic Creek (Table 2, Figures 5 and 6). Two nets were set at each location in such a way to catch fish moving both upstream and downstream. Nets were set on July 20, and checked approximately 24 hours later on July 21.

Table 2. Fyke net sample locations (WGS 84) July 20–21, 2016.

Sample Site	Latitude	Longitude
Lower Ruby Creek	67.11395	-156.91669
Lower Subarctic Creek	67.16942	-156.62933

Figure 5. Fyke nets in lower Ruby Creek July 21, 2016.

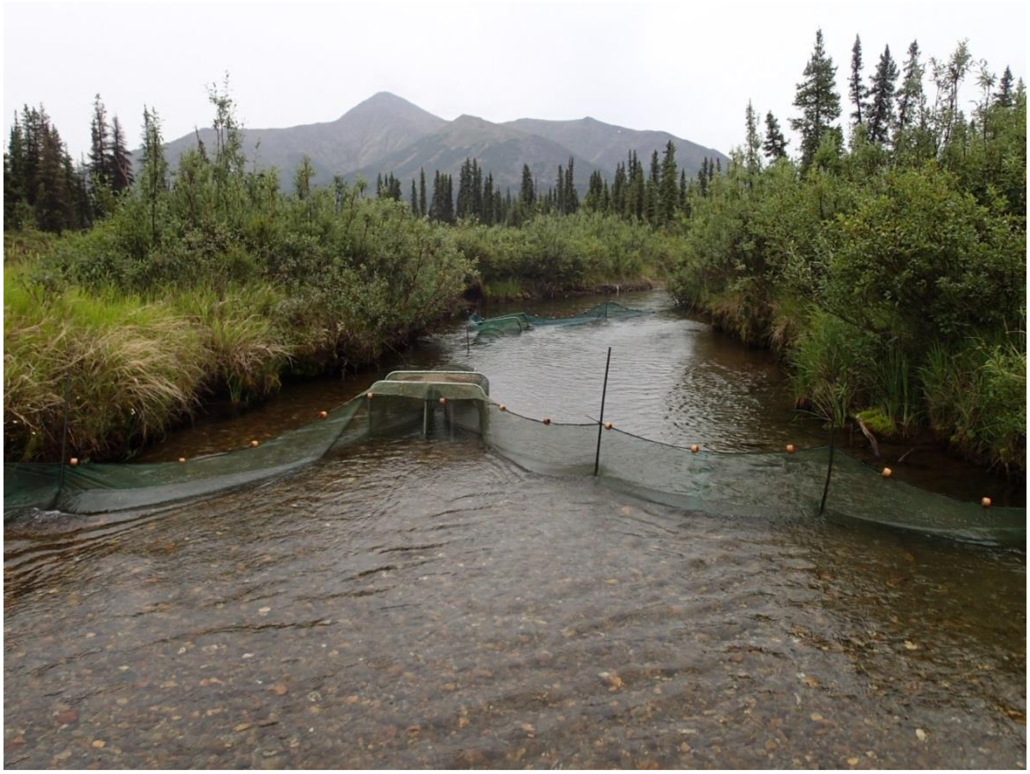

Figure 6. Looking upstream at fyke nets in lower Subarctic Creek July 21, 2016.

Results and Discussion

Water Quality

A summary of sample dates and water quality results are shown in Appendix 1. Alaska Department of Environmental Conservation (ADEC) water quality standards are presented for some metals for both acute (24 hr) and chronic (one month) aquatic life exposure limits (Appendix 1).

Cadmium values from water quality testing at all sites were at or below the detection limit of 0.15 µg/L so were not included in results. Additionally, selenium values were at or below the detection limit of 1.5 µg/L except for one sample in lower Subarctic Creek in 2015 where the value was 1.65 µg/L. In 2008 and 2009, detection limits for selenium were 1 µg/L. The current water quality standard for aquatic life for selenium is 20 µg/L for acute and 5 µg/L for chronic.

Median copper values were similar among all sites and ranged from 0.42 µg/L at upper Subarctic Creek to 1.21 µg/L at lower Subarctic Creek (Figure 7). The highest maximum value for copper was 6.15 µg/L and occurred in lower Ruby Creek in 2012. Acute and chronic water quality standards for aquatic life for copper depend on water hardness. Based on water hardness values, copper concentrations were below the acute and chronic standards at all sites for all years (Appendix 1). Copper concentrations in Riley Creek were at or below the detection limit of 0.31 µg/L.

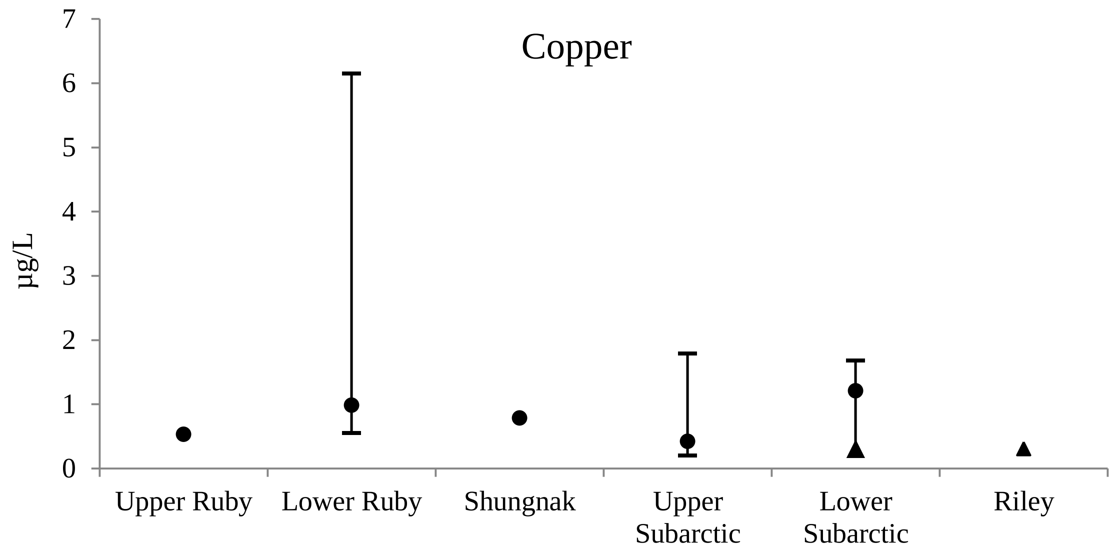

Figure 7. Median, minimum, and maximum copper concentrations at sample sites. Triangles indicate value at the detection limit.

Mercury values were low at all sample sites (Figure 8). Values ranged from a low of 0.5 ng/L, which was the detection limit, at lower Ruby Creek, upper Subarctic Creek, lower Subarctic Creek, and Riley Creek, to a high of 1.59 ng/L at lower Ruby Creek. All mercury values were below the water quality standards for aquatic life for mercury which are 2,400 ng/L for acute and 12 ng/L for chronic.

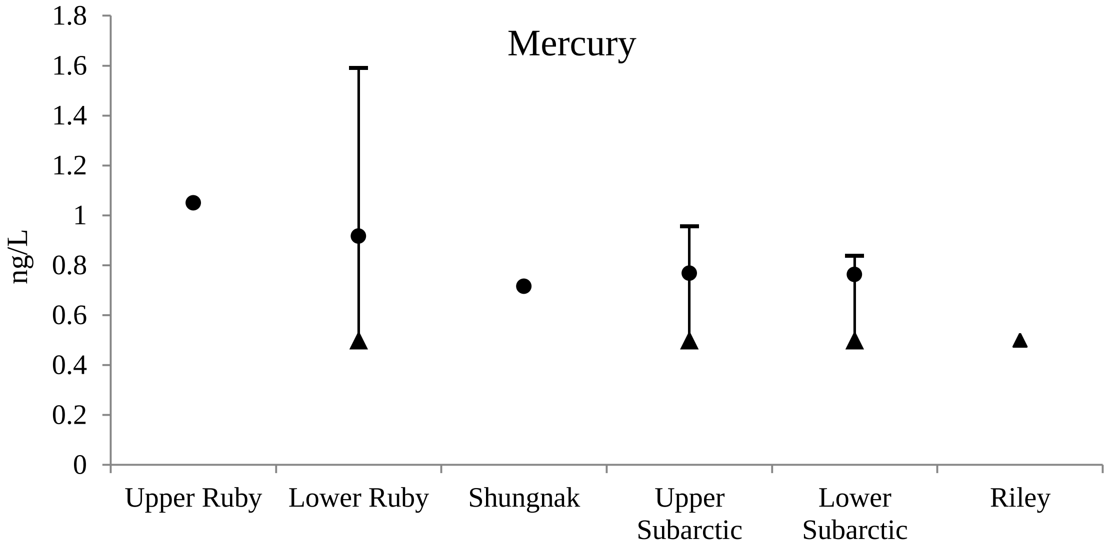

Figure 8. Median, minimum, and maximum mercury concentrations at sample sites. Triangles indicate value at detection limit.

Median zinc concentrations were lowest in upper Subarctic Creek (3.1 µg/L) and highest in lower Ruby Creek (10.7 µg/L) (Figure 9). Zinc concentrations were at or below the detection of 2.5 µg/L in Riley Creek. The water quality standard for aquatic life for zinc depends on water hardness, but all values were below the acute and chronic standard (Appendix 1).

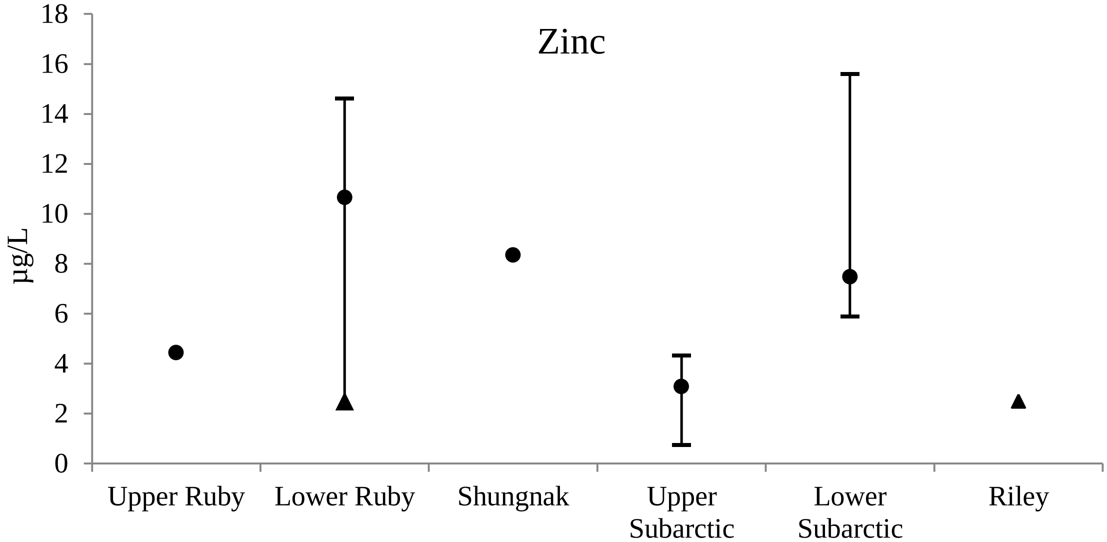

Figure 9. Median, minimum, and maximum zinc concentrations at sample sites. Triangles indicate value at detection limit.

Total Dissolved Solids (TDS) were lowest in upper Subarctic Creek (median = 42.8 mg/L) and highest in upper Ruby Creek (194 mg/L) (Figure 10).

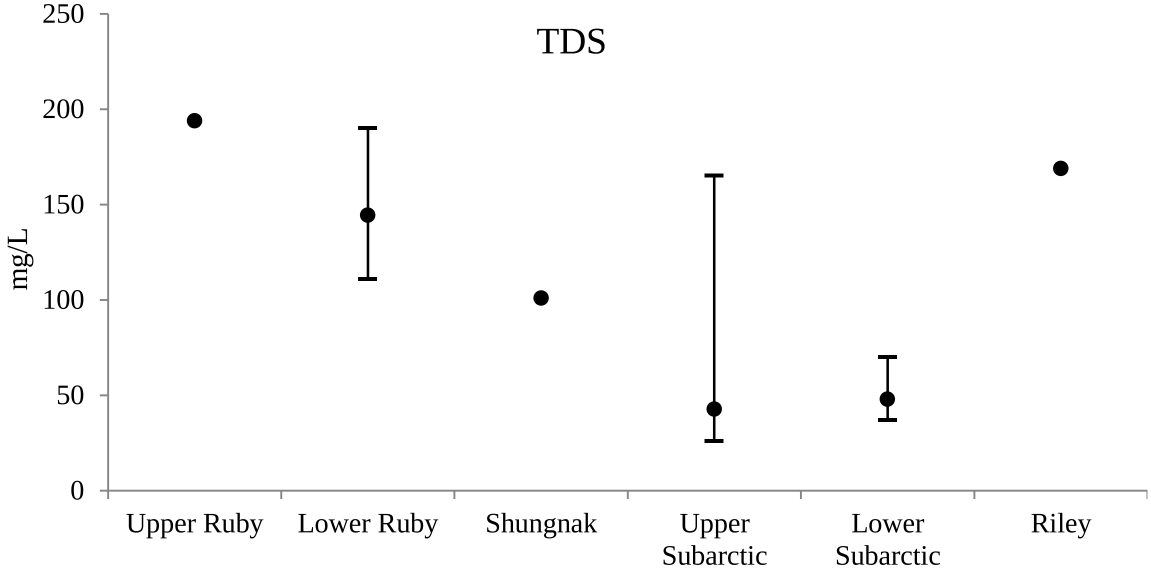

Figure 10. Median, minimum, and maximum TDS concentrations at sample sites.

Periphyton

Mean chlorophyll-a concentrations were highest in upper Ruby Creek (13.9 mg/m^2) and lowest in lower Subarctic Creek (1.2 mg/m^2) (Figure 11). The mean chlorophyll-a concentrations at the remaining sites ranged from 3.1 mg/m^2 to 7.2 mg/m^2.

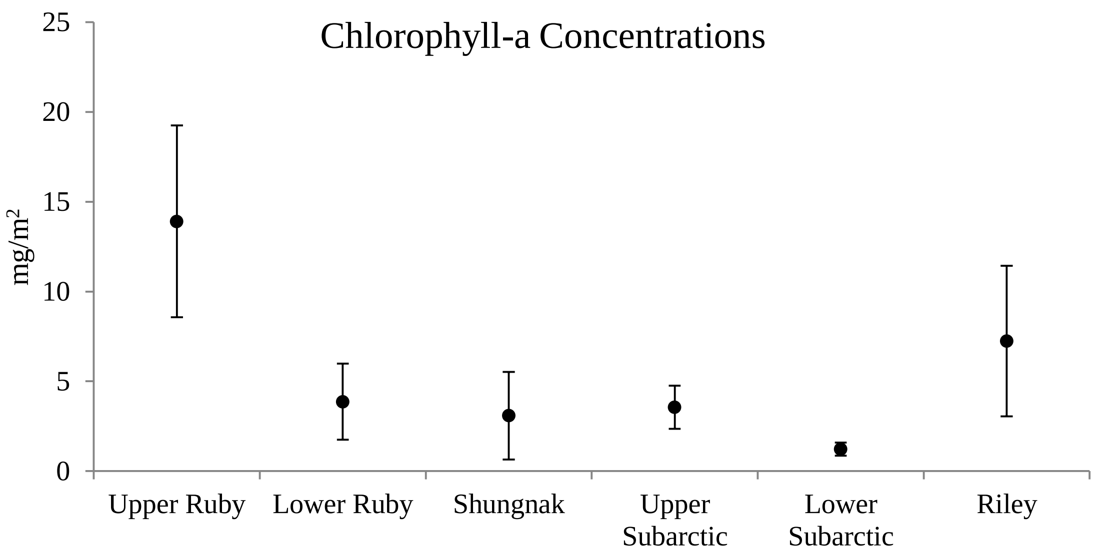

Figure 11. Mean chlorophyll-a concentrations (± 1 SD), July 2016.

Aquatic Invertebrates

Upper Ruby Creek was characterized by beaver pond habitats, deep water, dense vegetative cover, short channels between beaver dams, and minimal gravel/cobble. Densities in upper Ruby Creek averaged 3.0 aquatic invertebrates/m^3 of water (Figure 12). A total of 26 taxa were identified in the upper Ruby Creek samples. Samples were dominated by aquatic diptera (62%) which were primarily chironomids, followed by other species (25%), and EPT species (15%) (Table 3; Figure 13).

Lower Ruby Creek where sampling took place was characterized by pool/riffle habitat, shallower water, gravel/cobble substrate, and grass riparian habitats. Densities in lower Ruby Creek averaged 4.4 aquatic invertebrates/m^3 of water (Figure 12). A total of 26 taxa were identified in lower Ruby Creek. Samples were dominated by aquatic diptera (58%) which were primarily chironomids, followed by other species (32%), and EPT species (10%) (Table 3; Figure 13). Despite having very different habitat characteristics, the aquatic invertebrate community was relatively similar between upper and lower Ruby Creek.

The Shungnak River averaged 3.4 aquatic invertebrates/m^3 and had the highest species richness among all the sites with 30 total different taxa identified (Table 3; Figure 12). This site also had the highest percentage of EPT species at (37%) (Figure 13). The remaining samples were comprised of aquatic diptera, primarily chironomids (54%), and other species (8%).

The highest numbers of invertebrates were found in upper Subarctic Creek which averaged 23.9 aquatic invertebrates/m^3 (Figure 12). However, this site had the lowest species richness with 11 total taxa identified. Chironomids accounted for an average of 40%, EPT accounted for approximately 1%, and other species, primarily Ostracods and Cladocerans, accounted for 59% (Figure 13). This sample site was located a few hundred yards below the origin of the creek, which abruptly forms when water goes from subsurface to surface flows.

The second highest density occurred in Riley Creek which averaged 13.5 aquatic invertebrates/m^3 (Figure 12). A majority of the invertebrates (71%) were chironomids, followed by mayflies (17%), stoneflies (6%), and other (6%) (Figure 13).

Table 3. Total taxa and percent community composition of aquatic invertebrates by site.

	Upper Ruby	Lower Ruby	Shungnak	Upper Subarctic	Lower Subarctic	Riley
Total taxa	26	26	30	11	24	29
% other	25%	32%	8%	59%	17%	6%
% Ephemeroptera	3%	7%	10%	<1%	30%	17%
% Plecoptera	5%	1%	4%	<1%	3%	6%
% Trichoptera	5%	2%	23%	0%	2%	<1%
% Aquatic Diptera	62%	58%	54%	40%	49%	71%

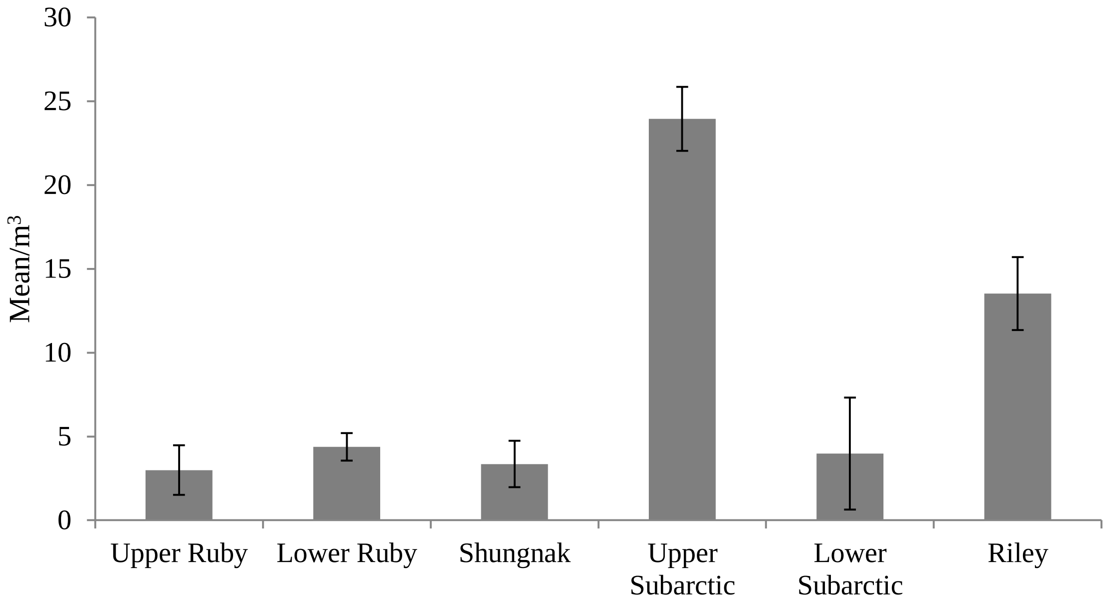

Figure 12. Mean number of aquatic invertebrates/m^3 (± 1 SD) at each sample site, July 2016.

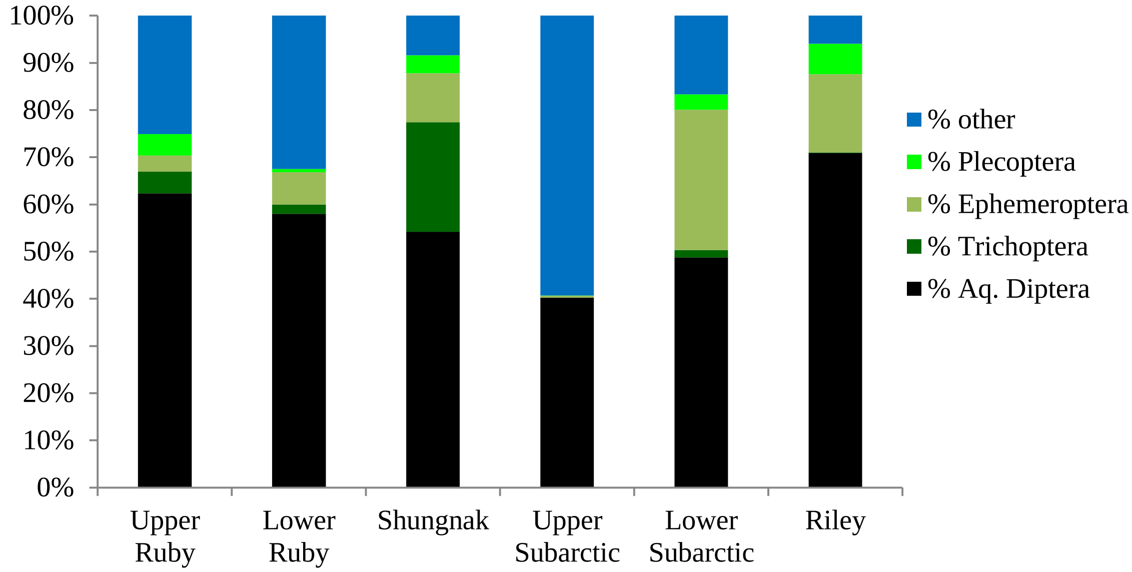

Figure 13. Mean percent EPT, aquatic diptera, and other species in the aquatic invertebrate samples, July 2016.

Fish Captures

Minnow Traps

In upper Ruby Creek, a total of 13 slimy sculpin and six Dolly Varden were captured in minnow traps (Table 4). Both the largest and smallest Dolly Varden were captured at this site. Based on size and time of capture, one 60 mm Dolly Varden was assumed to be a young-of-the-year fish (Figure 14). There are many beaver dams in this drainage which likely prevents upstream passage of fish, particularly for young-of-the-year fish. The beaver dams create deep pools so it is likely fish occurring here are capable of overwintering in upper Ruby Creek. With the capture of the young-of-the-year Dolly Varden, it is also likely they spawn in this area of Ruby Creek. Three specimens of each species were retained for element analyses.

Table 4. Number, mean length, and length range of slimy sculpin and Dolly Varden captured in minnow traps at six sites, July 2016.

	Slimy Sculpin			Dolly Varden		
Sample site	Number	Mean total length (mm)	Range (mm)	Number	Mean fork length (mm)	Range (mm)
Upper Ruby	13	73	39-100	6	139	60-189
Lower Ruby	20	74	50-95	-	-	-
Shungnak	8	67	60-74	1	73	-
Upper Subarctic	-	-	-	33	114	86-135
Lower Subarctic	3	64	59-72	2	77	74-80
Riley	-	-	-	-	-	-

Figure 14. Young-of-the-year Dolly Varden captured in upper Ruby Creek, July 2016

In lower Ruby Creek, slimy sculpin was the only species captured in minnow traps (Table 4). A total of 20 were captured averaging 74 mm (range 50–95 mm).

In the Shungnak River, one 73 mm Dolly Varden was captured and eight slimy sculpin were captured averaging 67 mm (range 60–74 mm) (Table 4). The Dolly Varden was retained for element analysis.

In upper Subarctic Creek, 33 Dolly Varden were captured averaging 114 mm (range 86–135) (Table 4). A total of 10 fish were retained for element analyses. In addition, eight fish were retained for age and maturity analysis. Five of the fish were males, two were females, and one was immature. All fish were 3-4 years old, except for one female that was 5 years old. The male and female fish were in pre-spawning condition suggesting they may spawn in upper Subarctic Creek (Figure 15).

Figure 15. Female (left) and male (right) Dolly Varden captured in upper Subarctic Creek July 21, 2016. Gonads are removed and placed below each fish.

Catches were low in lower Subarctic Creek. Two Dolly Varden were captured (74 and 80 mm) which were retained for element analysis. Three slimy sculpin also were captured (mean 64 mm; range 59–72 mm). Additionally, 20 larval slimy sculpin were captured in the aquatic invertebrate drift nets. This indicates that the sample site was below and/or close to spawning habitat for slimy sculpin.

No fish were captured in minnow traps in Riley Creek. However, one larval sculpin was captured in the drift nets designed for aquatic invertebrates. We flew over Riley Creek with the helicopter looking for fish barriers, and found none until we reached the mouth, which had a very large beaver dam. However, two fish were observed, likely Arctic grayling, by air in the large pond created by the dam.

Fyke nets

A total of 96 Arctic grayling were captured in lower Ruby Creek in fyke nets. Mean length of captured Arctic grayling was 74 mm (range: 49–240 mm). A majority of the fish were captured moving upstream (Figure 16). Based on length and time of capture, we believe that 71 of the 96 captured Arctic grayling were young-of-the-year which averaged 56 mm (range: 49–66 mm) (Figure 17). Based on direction of movement, we believe it is likely these young-of-the-year fish came from further up the Shungnak River drainage, and swam up into lower Ruby Creek, which had relatively low velocity near the mouth where the nets were set. This suggests Arctic grayling spawning occurs in the Shungnak drainage upstream of Ruby Creek. Additionally, a series of large beaver dams occur a few hundred feet upstream of the fyke net which likely serve as a fish barrier to fish moving upstream suggesting that if Arctic grayling spawning does occur in Ruby Creek, it is limited to the lower 200 meters below the first beaver dam.

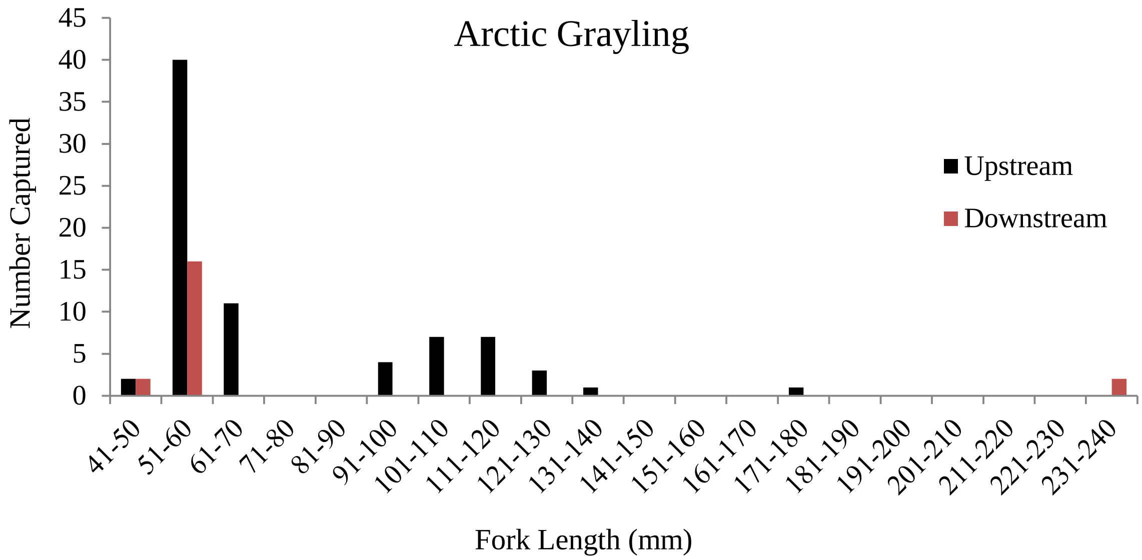

Figure 16. Length frequency distribution of Arctic grayling captured in lower Ruby Creek and direction of movement, July 2016.

Figure 17. Young-of-the-year round whitefish (top) and Arctic grayling (bottom) captured in lower Ruby Creek, July 2016.

A total of 46 round whitefish were captured in the fyke nets in lower Ruby Creek. Mean length of captured round whitefish was 110 mm (range: 52–395 mm). All of the fish moving upstream were likely young-of-the-year which averaged 60 mm (range: 52–66 mm) (Figures 17 and 18). Similar to Arctic grayling, this suggests round whitefish spawning occurs further up the Shungnak River drainage.

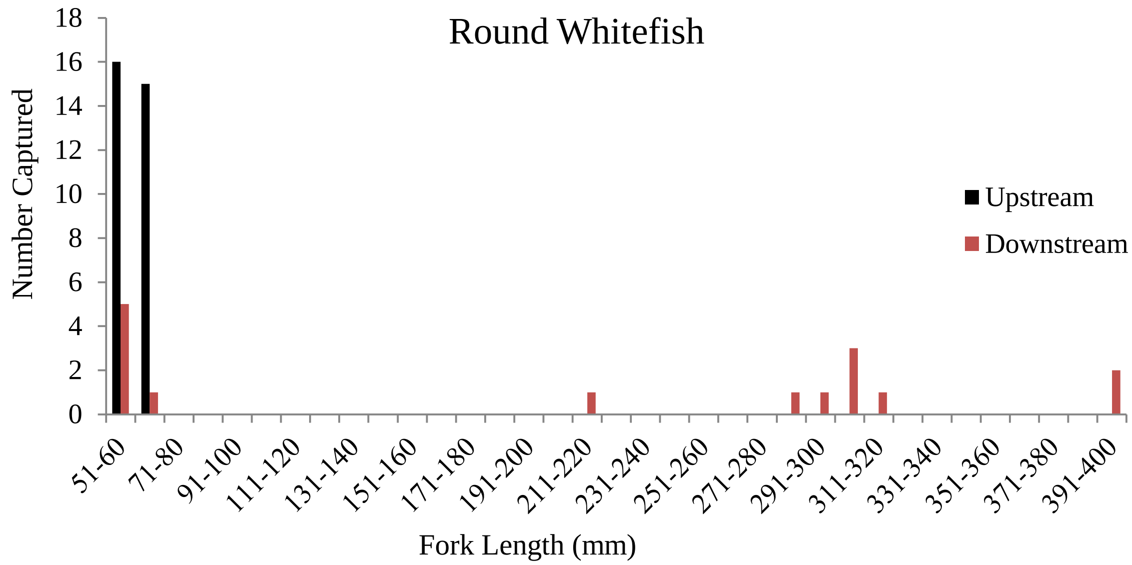

Figure 18. Length frequency distribution of round whitefish captured in lower Ruby Creek and direction of movement, July 2016.

One Dolly Varden (156 mm) was captured moving downstream and seven slimy sculpin (mean length: 68 mm; range: 56–76 mm) were captured moving upstream in lower Ruby Creek.

In lower Subarctic Creek, 10 Arctic grayling were captured (mean length: 156 mm; range: 110–416 mm), of which two were captured moving upstream and eight were captured moving downstream. Eight Arctic grayling were retained for whole body element analysis. In addition, two slimy sculpin were captured (52 and 64 mm), one moving upstream and one moving downstream.

Fish Metals

A list of fish retained for element analysis are listed in Appendix 2 and results for each fish are listed in Appendix 3. The same species were not captured at every location, making direct comparisons between sample sites difficult. Additionally, sample sizes were low at some locations. However, results provide a good start for a baseline data set regarding metals concentrations in fish. Similar metals have been examined in whole body juvenile Dolly Varden around the state including Tulsequah Chief Mine, the Pebble prospect, Red Dog Mine, Greens Creek Mine, and Kensington Gold Mine and provide a good data set for comparative purposes (Legere and Timothy, 2016). Additionally, whole body juvenile Arctic grayling from Red Dog Mine are analyzed annually for metal concentrations (Ott et al., 2016) and may be useful for comparisons.

Cadmium concentrations in juvenile Arctic grayling were similar between lower Subarctic creek and lower Ruby Creek (Figure 19). These concentrations also are similar to those found in Bons Pond at Red Dog Mine (Ott et al., 2016). Cadmium concentrations were highest, but variable, in upper Subarctic Creek, which averaged 1.05 mg/kg. These values are slightly above average concentrations at other locations across the state, but similar to some control sites with no mining influence at Red Dog and Greens Creek Mine (Legere and Timothy, 2016). Concentrations were lowest in upper Ruby Creek where all values were below the detection limit of 0.08 mg/kg. Slimy sculpin from upper Ruby Creek averaged 0.13 mg/kg in cadmium concentrations.

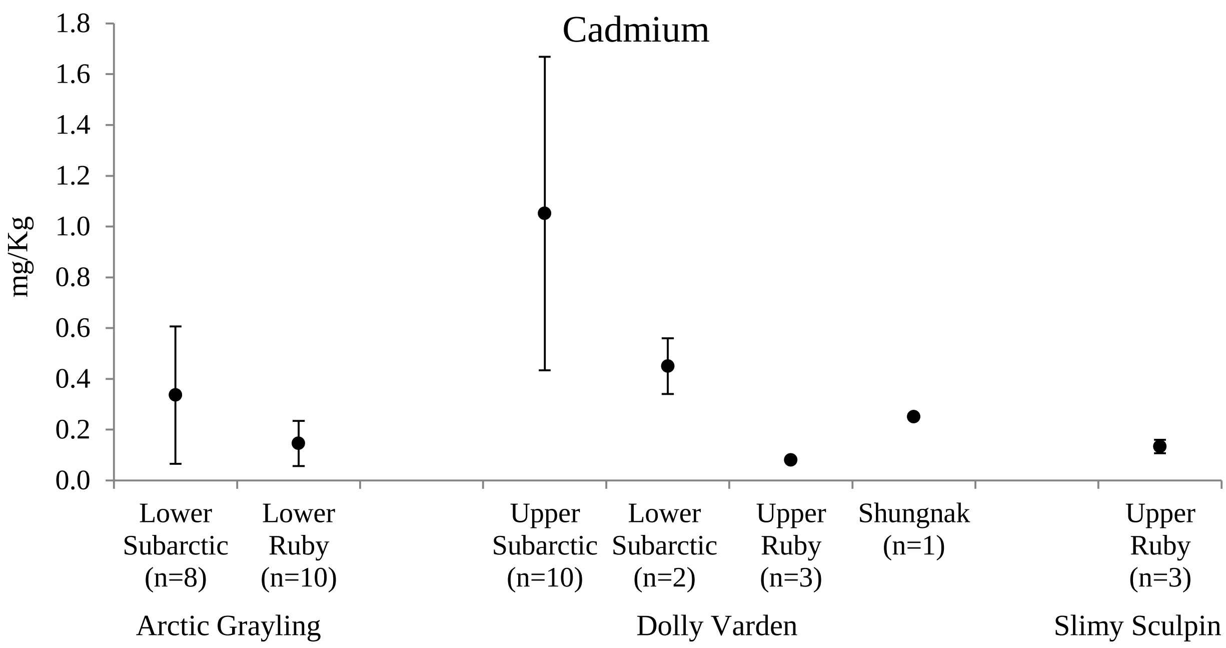

Figure 19. Mean whole body dry weight concentrations of cadmium (mg/kg) (± 1 SD) in Arctic grayling, Dolly Varden, and slimy sculpin from various sample sites, July 2016.

Copper concentrations were fairly similar among all fish at all sample sites (Figure 20). Copper is not typically tested for at Red Dog Mine, but the results found for Dolly Varden at Arctic-Bornite are similar to other locations from across the state (Legere and Timothy, 2016).

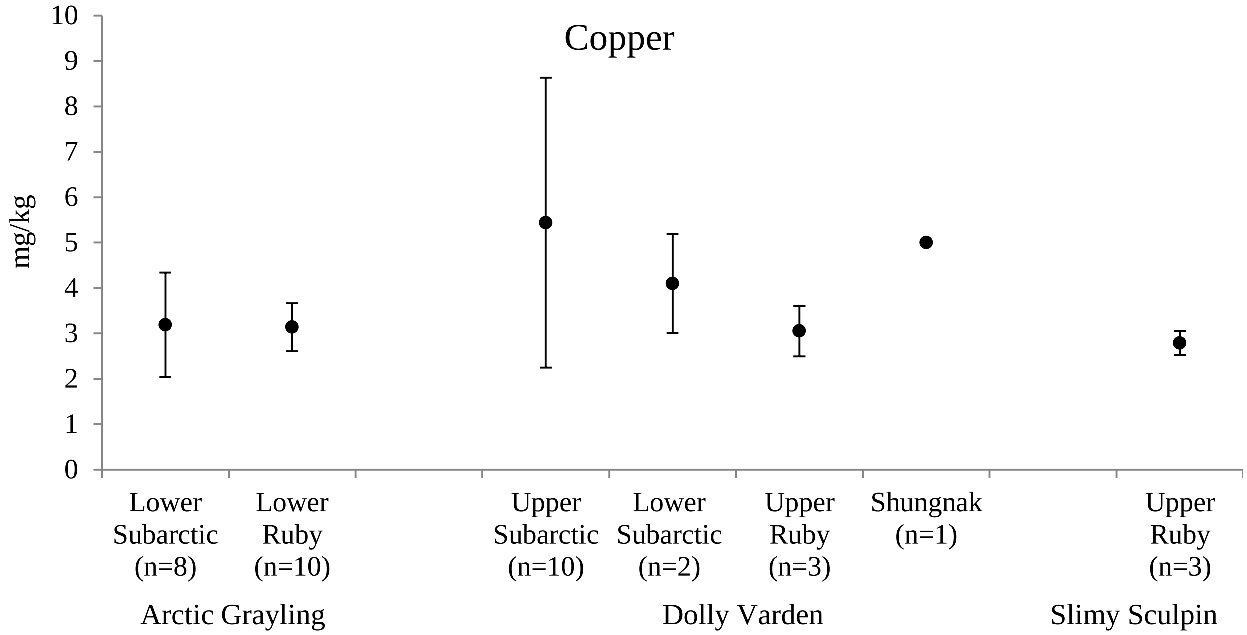

Figure 20. Mean whole body dry weight concentrations of copper (mg/kg) (± 1 SD) in Arctic grayling, Dolly Varden, and slimy sculpin from various sample sites, July 2016.

Mercury concentrations were similar between the Arctic grayling from lower Subarctic Creek and lower Ruby Creek, which averaged 0.08 and 0.09 mg/kg respectively (Figure 21). These values are slightly higher than the average values found in Arctic grayling at Red Dog Mine, which have ranged from the detection limit of 0.02 mg/kg to 0.05 mg/kg (Ott et al. 2016). Mercury concentrations were similar in juvenile Dolly Varden from upper Subarctic Creek, lower Subarctic Creek, and the Shungnak River, with values slightly higher in Upper Ruby Creek. These values are comparable to the values found at other mines and prospect sites across the state (Legere and Timothy, 2016). The highest values for mercury were seen in slimy sculpin in upper Ruby Creek.

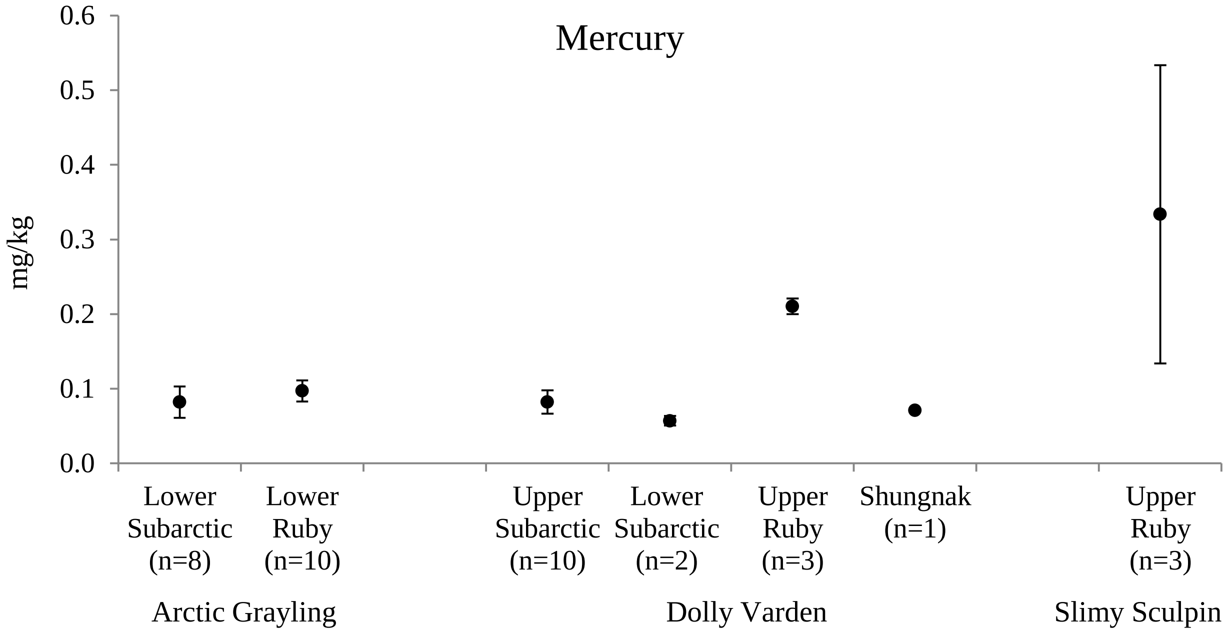

Figure 21. Mean whole body dry weight concentrations of mercury (mg/kg) (± 1 SD) in Arctic grayling, Dolly Varden, and slimy sculpin from various sample sites 2016.

The mean selenium concentrations in Arctic grayling were similar between lower Subarctic Creek (5.86 mg/kg) and lower Ruby creek (5.61 mg/kg) (Figure 22). These values are lower than average selenium concentrations in Arctic grayling at Red Dog mine which range from approximately 10 to 15 mg/kg (Ott et al. 2016). Average selenium concentrations were also similar between the sites for Dolly Varden, and ranged from 4.46 mg/kg at upper Ruby Creek to 6.06 mg/kg in lower Subarctic Creek. These values are slightly higher than those found at Tulsequah Chief Mine and the Pebble Prospect, and comparable to those found in juvenile Dolly Varden at Red Dog Mine, Greens Creek Mine, and Kensington Gold Mine (Legere and Timothy, 2016). The average selenium concentration in slimy sculpin (5.28 mg/kg) was similar to the other species at other sample sites.

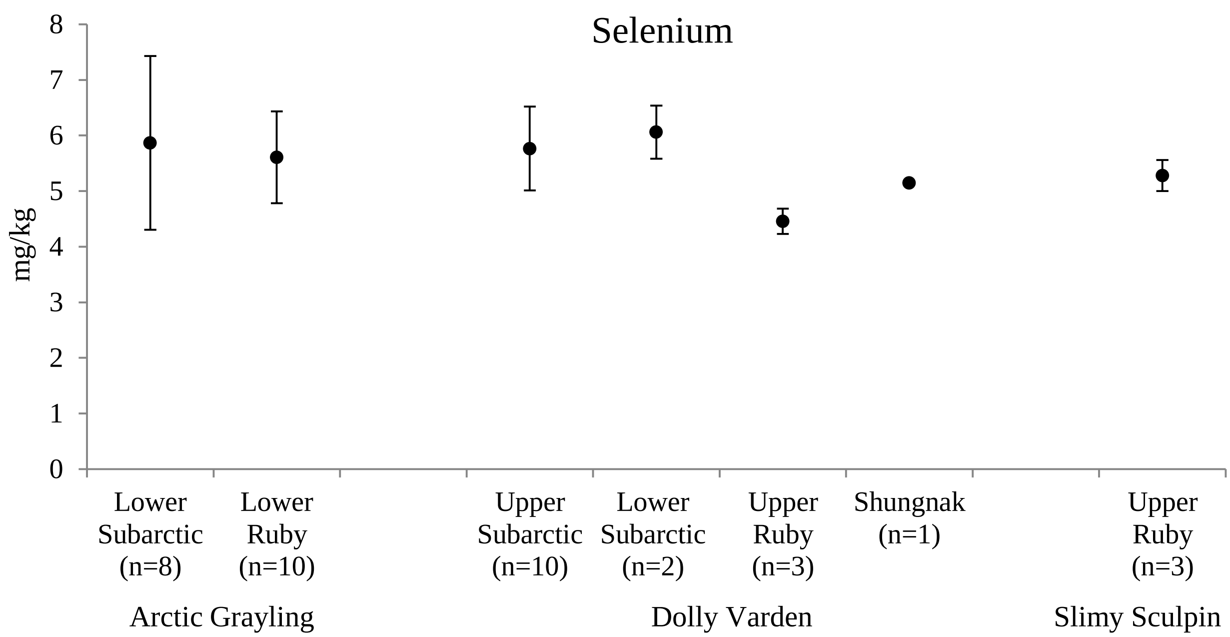

Figure 22. Mean whole body dry weight concentrations of selenium (mg/kg) (± 1 SD) in Arctic grayling, Dolly Varden, and slimy sculpin from various sample sites 2016.

The average zinc concentrations were similar in Arctic grayling between lower Subarctic Creek (90.82 mg/kg) and lower Ruby Creek (89.33 mg/kg) (Figure 23). These values are also similar to those found in Arctic grayling at Red Dog Mine which have ranged between 68 mg/kg and 97 mg/kg (Ott et al. 2016). Average zinc concentrations were more variable among sample sites with Dolly Varden, and ranged from a low of 87.93 mg/kg in upper Ruby Creek to a high of 184.97 mg/kg in lower Subarctic Creek. These values all fall within the range of concentrations found in other regions of the state (Legere and Timothy, 2016). Zinc concentrations in slimy sculpin in upper Ruby Creek were slightly higher than zinc concentrations of Dolly Varden in upper Ruby Creek.

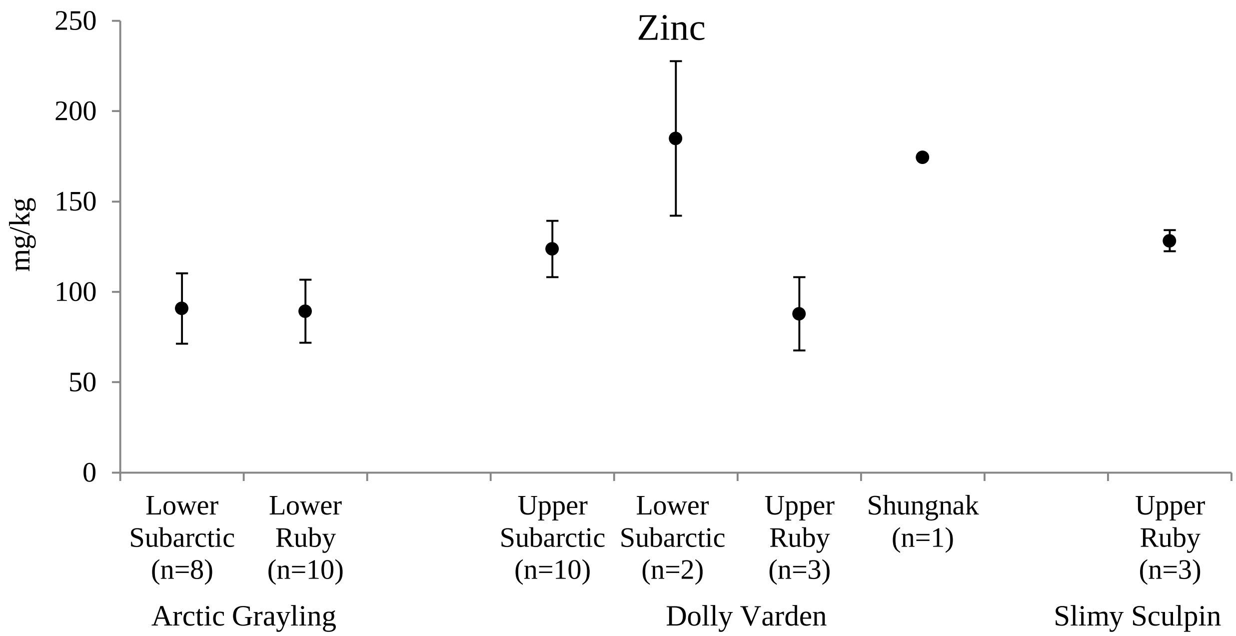

Figure 23. Mean whole body dry weight concentrations of zinc (mg/kg) (± 1 SD) in Arctic grayling, Dolly Varden, and slimy sculpin from various sample sites 2016.

Conclusion

Despite being isolated from the Kobuk River by a large waterfall, the Shungnak drainage supports self-sustaining populations of Arctic grayling, Dolly Varden, round whitefish and slimy sculpin. Slimy sculpin occurred at every sample site other than upper Subarctic Creek. It is likely slimy sculpin spawn in upper Ruby Creek, and with the capture of the larval sculpin in the drift nets in upper Riley Creek and lower Subarctic Creek, it is likely they spawn in those systems as well.

Upper Subarctic Creek was unique as the fish catches were dominated by Dolly Varden, and it contained the highest density of aquatic insects. It is likely the Dolly Varden move into the upper reaches of Subarctic Creek to feed on the abundant aquatic insects, and with the confirmation of fish in pre-spawning condition, they potentially remain there to spawn. Additionally, Dolly Varden spawning likely occurs in upper Ruby Creek as well, with the capture of a young-of-the-year fish, and many barriers occurring downstream making upstream passage of small fish highly unlikely. Confirmation of Dolly Varden spawning in upper Subarctic would require a fall survey to observe spawning fish, or a spring survey targeting newly hatched fish.

With the large number of young-of-the-year Arctic grayling and round whitefish captured in lower Ruby Creek, spawning of those fish may occur anywhere upstream in the Shungnak River drainage. Arctic grayling spawning could potentially occur in lower Subarctic Creek, but unlikely in the upper reaches near the deposit due to the high gradient. Additionally, water temperature data indicates lower Subarctic Creek warms up later in the spring than the Shungnak River, so spawning may be limited to the Shungnak River based on temperatures.

If future aquatic sampling is planned, we recommend continuation of periphyton and aquatic invertebrate sampling so changes can be detected. Additional fish work should be focused on continuing our understanding of how and when fish utilize target areas around the Arctic and Bornite deposits. Obtaining greater sample sizes for fish whole body element analysis along with collecting fin clips from Dolly Varden for genetics analysis are additional recommendations.

Literature Cited

Legere, N. M. and J. Timothy. 2016. Tulsequah Chief acid mine drainage and Dolly Varden char whole body metals concentrations. Alaska Department of Fish & Game, Technical Report No. 16-06, Douglas, AK.

Ott, A. G., P. T. Bradley, and H. L. Scannell. 2016. Aquatic biomonitoring at Red Dog Mine, 2015. Alaska Department of Fish & Game, Technical Report No. 16-01, Fairbanks, AK.

Ott, A. G., W. A. Morris, and L. L. Jacobs. 2010. Methods for aquatic life monitoring to satisfy requirements of 2010 NPDES permit, Red Dog Mine Site (Revision #1). Alaska Department of Fish & Game, Technical Report No. 10-04, Fairbanks, AK.

Tetra Tech, Inc. 2011. Arctic Deposit Access Environmental Baseline Data Collection Aquatics. Ambler Mining District, Alaska. Prepared for: Nova Gold Resources Inc.

Appendix 1. Water quality data for the six sample sites. Only metals data used in fish whole body element analyses are shown. Blanks indicate no data. Acute and chronic water quality standards for aquatic life are shown for copper and zinc, which are dependent on water hardness.

Site	Date	Cadmium µg/L	Copper µg/L	Copper Acute limit µg/L	Copper Chronic Limit µg/L	Mercury ng/L	Selenium µg/L	Zinc µg/L	Zinc Acute Limit µg/L	Zinc Chronic Limit µg/L	Hardness mg/L	TDS mg/L
Upper Ruby	7/12/2016	*0.15	0.534	18.7	12.13	1.05	*1.5	4.44	155.48	155.48	136	194
Lower Ruby	9/5/2012	*0.15	6.15	13.9	9.32	0.969	*1.5	14.6	119.71	119.71	99.9	120
Lower Ruby	3/28/2013	*0.15	0.551	16.75	10.98	*0.5	*1.5	*2.5	140.82	140.82	121	190
Lower Ruby	7/20/2013	*0.15	1.12			0.749	*1.5	*2.5				137
Lower Ruby	7/25/2014	*0.15	1.84	12.56	8.45	1.59	*1.5	6.72	108.65	108.65	89.1	111
Lower Ruby	8/5/2015	*0.15	0.626	20	12.89	0.512	*1.5	*2.5	165.11	165.11	146	152
Lower Ruby	7/13/2016	*0.15	0.846	19.22	12.44	0.917	*1.5	*2.5	159.34	159.34	140	183
Upper Shungnak	7/14/2016	*0.15	0.787	12.54	8.44	0.716	*1.5	8.35	108.55	108.55	89	101
Upper Sub Arctic	7/15/2008	*0.15	0.236	4.36	3.24		*1	0.734	41.98	41.98	29	42.5
Upper Sub Arctic	7/30/2009	*0.15	0.203	4.2	3.13		*1	2.39	40.62	40.62	27.9	25.9
Upper Sub Arctic	9/5/2012	*0.15	0.446	5.29	3.86	*0.5	*1.5	3.26	49.94	49.94	35.6	49
Upper Sub Arctic	7/20/2013	*0.15	0.564	4.15	3.1	0.769	*1.5	4.33	40.13	40.13	27.5	29
Upper Sub Arctic	7/25/2014	*0.15	0.401	5.18	3.79	0.626	*1.5	3.68	48.99	48.99	34.8	40
Upper Sub Arctic	8/6/2015	*0.15	1.79	18.18	11.83	*0.5	*1.5	2.69	151.59	151.59	132	165
Upper Sub Arctic	8/6/2015	*0.15	0.507	7	4.79	*0.5	*1.5	3.06	64.22	64.22	47.9	43
Upper Sub Arctic	7/15/2016	*0.15	0.343	6.54	4.68	0.956	*1.5	3.1	60.45	60.45	44.6	62
Lower Sub Arctic	9/5/2012	*0.15	1.68	4.64	3.43	0.505	*1.5	15.6	44.42	44.42	31	46
Lower Sub Arctic	3/28/2013	*0.15	*0.31			*0.5	*1.5	7.54				70
Lower Sub Arctic	7/20/2013	*0.15	0.985	5.88	4.25	0.732	*1.5	9.43	54.89	54.89	39.8	48
Lower Sub Arctic	7/25/2014	*0.15	1.43	4.67	3.45	0.839	*1.5	13.1	44.6	44.6	31.2	37
Lower Sub Arctic	8/5/2015	*0.15	*0.31	7	4.97	*0.5	1.65	5.89	64.22	64.22	47.9	48
Lower Sub Arctic	7/14/2016	*0.15	0.435	6.38	4.57	0.794	*1.5	7.12	59.07	59.07	43.4	69
Riley	7/16/2016	*0.15	*0.31	19.09	12.36	*0.5	*1.5	*2.5	158.38	158.38	139	169

* Indicates value at or below detection limit.

Appendix 2. List of fish retained for whole body element analysis.

Sample ID	Stream	Site	Date Collected	Fish Spp[1]	Length (mm)	Weight (g)	Metals to be analyzed				
							Cu	Hg	Se	Cd	Zn
072016LSADVJ01	Sub Arctic	Lower site	7/20/2016	DV	80	5.3	x	x	x	x	x
072016LSADVJ02	Sub Arctic	Lower site	7/20/2016	DV	74	4.5	x	x	x	x	x
072116LSAAGJ01	Sub Arctic	Lower site	7/21/2016	AG	113	13	x	x	x	x	x
072116LSAAGJ02	Sub Arctic	Lower site	7/21/2016	AG	124	19.5	x	x	x	x	x
072116LSAAGJ03	Sub Arctic	Lower site	7/21/2016	AG	110	12.3	x	x	x	x	x
072116LSAAGJ04	Sub Arctic	Lower site	7/21/2016	AG	176	60.2	x	x	x	x	x
072116LSAAGJ05	Sub Arctic	Lower site	7/21/2016	AG	115	13.9	x	x	x	x	x
072116LSAAGJ06	Sub Arctic	Lower site	7/21/2016	AG	152	33.3	x	x	x	x	x
072116LSAAGJ07	Sub Arctic	Lower site	7/21/2016	AG	116	15	x	x	x	x	x
072116LSAAGJ08	Sub Arctic	Lower site	7/21/2016	AG	114	13	x	x	x	x	x
072116USAJDV07	Sub Arctic	Upper site	7/21/2016	DV	130	22.1	x	x	x	x	x
072116USAJDV08	Sub Arctic	Upper site	7/21/2016	DV	100	9.6	x	x	x	x	x
072116USAJDV09	Sub Arctic	Upper site	7/21/2016	DV	116	16.1	x	x	x	x	x
072116USAJDV10	Sub Arctic	Upper site	7/21/2016	DV	100	8.4	x	x	x	x	x
072116USAJDV11	Sub Arctic	Upper site	7/21/2016	DV	95	7.2	x	x	x	x	x
072116USAJDV12	Sub Arctic	Upper site	7/21/2016	DV	124	15.3	x	x	x	x	x
072116USAJDV13	Sub Arctic	Upper site	7/21/2016	DV	134	23.6	x	x	x	x	x
072116USAJDV14	Sub Arctic	Upper site	7/21/2016	DV	135	26	x	x	x	x	x
072116USAJDV15	Sub Arctic	Upper site	7/21/2016	DV	107	11.1	x	x	x	x	x
072116USAJDV18	Sub Arctic	Upper site	7/21/2016	DV	124	18.4	x	x	x	x	x
072116LRCAGJ01	Ruby	Lower site	7/21/2016	AG	179	62.3	x	x	x	x	x
072116LRCAGJ02	Ruby	Lower site	7/21/2016	AG	131	22.7	x	x	x	x	x
072116LRCAGJ03	Ruby	Lower site	7/21/2016	AG	117	15.8	x	x	x	x	x
072116LRCAGJ04	Ruby	Lower site	7/21/2016	AG	121	19	x	x	x	x	x
072116LRCAGJ05	Ruby	Lower site	7/21/2016	AG	127	21.1	x	x	x	x	x
072116LRCAGJ06	Ruby	Lower site	7/21/2016	AG	118	16.1	x	x	x	x	x
072116LRCAGJ07	Ruby	Lower site	7/21/2016	AG	121	17.1	x	x	x	x	x
072116LRCAGJ08	Ruby	Lower site	7/21/2016	AG	119	16.9	x	x	x	x	x
072116LRCAGJ09	Ruby	Lower site	7/21/2016	AG	112	13.1	x	x	x	x	x
072116LRCAGJ10	Ruby	Lower site	7/21/2016	AG	110	13	x	x	x	x	x
072216URCSS01	Ruby	Upper site	7/22/2016	SS	85	7.8	x	x	x	x	x
072216URCSS02	Ruby	Upper site	7/22/2016	SS	86	7.6	x	x	x	x	x
072216URCSS03	Ruby	Upper site	7/22/2016	SS	100	11.3	x	x	x	x	x
072216URCDVJ01	Ruby	Upper site	7/22/2016	DV	153	35.5	x	x	x	x	x
072216URCDVJ02	Ruby	Upper site	7/22/2016	DV	133	23.3	x	x	x	x	x
072216URCDVJ03	Ruby	Upper site	7/22/2016	DV	123	19.3	x	x	x	x	x
072016SHUDVJ01	Shungnak	Upper site	7/20/2016	DV	73	3.9	x	x	x	x	x

[1] Dolly Varden (DV), Arctic grayling (AG), and slimy sculpin (SS)

Appendix 3. Results for whole body element analysis. Results used in this report are highlighted.

Upper Ruby Creek

Sample ID	Species[1]	Collect Date	Analyte	Method	Wet Wt. Result	QUAL[2]	Units	MDL[3]	PQL[3]	%solids	Dry Wt. Result	Dry Wt. MDL[3]
072216URCDVJ01	DV	7/22/2016	Cadmium	M6020 ICP-MS		U	mg/Kg	0.02	0.1	24.8	0.08	0.08
072216URCDVJ02	DV	7/22/2016	Cadmium	M6020 ICP-MS		U	mg/Kg	0.02	0.1	23.8	0.08	0.08
072216URCDVJ03	DV	7/22/2016	Cadmium	M6020 ICP-MS		U	mg/Kg	0.02	0.1	26.2	0.08	0.08
072216URCDVJ01	DV	7/22/2016	Copper	M6020 ICP-MS	0.7		mg/Kg	0.1	0.5	24.8	2.82	0.40
072216URCDVJ02	DV	7/22/2016	Copper	M6020 ICP-MS	0.6		mg/Kg	0.1	0.5	23.8	2.52	0.42
072216URCDVJ03	DV	7/22/2016	Copper	M6020 ICP-MS	1		mg/Kg	0.1	0.5	26.2	3.82	0.38
072216URCDVJ01	DV	7/22/2016	Mercury	M7473	52.7	H	ng/g	2.46	12.3	24.8	212.5	9.92
072216URCDVJ02	DV	7/22/2016	Mercury	M7473	52.8	H	ng/g	1.56	7.8	23.8	221.85	6.55
072216URCDVJ03	DV	7/22/2016	Mercury	M7473	51.5	H	ng/g	2.4	12	26.2	196.56	9.16
072216URCDVJ01	DV	7/22/2016	Moisture Content	D2216-80	75.2		%	0.1	0.5	24.8		0.40
072216URCDVJ02	DV	7/22/2016	Moisture Content	D2216-80	76.2		%	0.1	0.5	23.8		0.42
072216URCDVJ03	DV	7/22/2016	Moisture Content	D2216-80	73.8		%	0.1	0.5	26.2		0.38
072216URCDVJ01	DV	7/22/2016	Selenium	M6020 ICP-MS	1.05		mg/Kg	0.02	0.05	24.8	4.23	0.08
072216URCDVJ02	DV	7/22/2016	Selenium	M6020 ICP-MS	1.04		mg/Kg	0.02	0.05	23.8	4.37	0.08
072216URCDVJ03	DV	7/22/2016	Selenium	M6020 ICP-MS	1.25		mg/Kg	0.02	0.05	26.2	4.77	0.08
072216URCDVJ01	DV	7/22/2016	Zinc	M6020 ICP-MS	15		mg/Kg	0.4	1	24.8	60.48	1.61
072216URCDVJ02	DV	7/22/2016	Zinc	M6020 ICP-MS	22.5		mg/Kg	0.4	1	23.8	94.54	1.68
072216URCDVJ03	DV	7/22/2016	Zinc	M6020 ICP-MS	28.5		mg/Kg	0.4	1	26.2	108.78	1.53
072216URCSS01	SS	7/22/2016	Cadmium	M6020 ICP-MS	0.03	B	mg/Kg	0.02	0.1	25.3	0.12	0.08
072216URCSS02	SS	7/22/2016	Cadmium	M6020 ICP-MS	0.03	B	mg/Kg	0.02	0.1	26.1	0.11	0.08
072216URCSS03	SS	7/22/2016	Cadmium	M6020 ICP-MS	0.04	B	mg/Kg	0.02	0.1	23.7	0.17	0.08
072216URCSS01	SS	7/22/2016	Copper	M6020 ICP-MS	0.8		mg/Kg	0.1	0.6	25.3	3.16	0.40
072216URCSS02	SS	7/22/2016	Copper	M6020 ICP-MS	0.7		mg/Kg	0.1	0.5	26.1	2.68	0.38
072216URCSS03	SS	7/22/2016	Copper	M6020 ICP-MS	0.6		mg/Kg	0.1	0.6	23.7	2.53	0.42
072216URCSS01	SS	7/22/2016	Mercury	M7473	48.1	H	ng/g	1.43	7.15	25.3	190.12	5.65
072216URCSS02	SS	7/22/2016	Mercury	M7473	50.9	H	ng/g	2.65	13.25	26.1	195.02	10.15
072216URCSS03	SS	7/22/2016	Mercury	M7473	146	H	ng/g	1.82	9.1	23.7	616.03	7.68
072216URCSS01	SS	7/22/2016	Moisture Content	D2216-80	74.7		%	0.1	0.5	25.3		0.40
072216URCSS02	SS	7/22/2016	Moisture Content	D2216-80	73.9		%	0.1	0.5	26.1		0.38
072216URCSS03	SS	7/22/2016	Moisture Content	D2216-80	76.3		%	0.1	0.5	23.7		0.42
072216URCSS01	SS	7/22/2016	Selenium	M6020 ICP-MS	1.26		mg/Kg	0.02	0.06	25.3	4.98	0.08
072216URCSS02	SS	7/22/2016	Selenium	M6020 ICP-MS	1.36		mg/Kg	0.02	0.05	26.1	5.21	0.08
072216URCSS03	SS	7/22/2016	Selenium	M6020 ICP-MS	1.34		mg/Kg	0.02	0.06	23.7	5.65	0.08
072216URCSS01	SS	7/22/2016	Zinc	M6020 ICP-MS	32.2		mg/Kg	0.5	1	25.3	127.27	1.98
072216URCSS02	SS	7/22/2016	Zinc	M6020 ICP-MS	31.8		mg/Kg	0.4	1	26.1	121.84	1.53
072216URCSS03	SS	7/22/2016	Zinc	M6020 ICP-MS	32.2		mg/Kg	0.4	1	23.7	135.86	1.69

[1]Dolly Varden (DV) and slimy sculpin (SS)
[2]U=The material was analyzed for, but was not detected above the level of the associated value. H=Analysis exceeded method hold time. B=Analyte concentration detected at a value between MDL and PDL. The associated value is an estimated quantity.
[3]MDL=Method Detection Limit. PQL=Practical Quantitation Limit

Lower Ruby Creek

Sample ID	Species[1]	Collect Date	Analyte	Method	Wet Wt. Result	QUAL[2]	Units	MDL[3]	PQL[3]	%solids	Dry Wt. Result	Dry Wt. MDL[3]
072116LRCAGJ01	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.02	B	mg/Kg	0.02	0.1	23.4	0.09	0.09
072116LRCAGJ02	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.03	B	mg/Kg	0.02	0.1	25.4	0.12	0.08
072116LRCAGJ03	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.03	B	mg/Kg	0.02	0.1	23	0.13	0.09
072116LRCAGJ04	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.02	B	mg/Kg	0.02	0.1	24.3	0.08	0.08
072116LRCAGJ05	AG	7/21/2016	Cadmium	M6020 ICP-MS		U	mg/Kg	0.02	0.1	23	0.09	0.09
072116LRCAGJ06	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.08	B	mg/Kg	0.02	0.1	22.4	0.36	0.09
072116LRCAGJ07	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.02	B	mg/Kg	0.02	0.1	22	0.09	0.09
072116LRCAGJ08	AG	7/21/2016	Cadmium	M6020 ICP-MS		U	mg/Kg	0.02	0.1	22.3	0.09	0.09
072116LRCAGJ09	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.03	B	mg/Kg	0.03	0.1	21.9	0.14	0.14
072116LRCAGJ10	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.06	B	mg/Kg	0.02	0.1	22.1	0.27	0.09
072116LRCAGJ01	AG	7/21/2016	Copper	M6020 ICP-MS	0.6		mg/Kg	0.1	0.5	23.4	2.56	0.43
072116LRCAGJ02	AG	7/21/2016	Copper	M6020 ICP-MS	0.8		mg/Kg	0.1	0.6	25.4	3.15	0.39
072116LRCAGJ03	AG	7/21/2016	Copper	M6020 ICP-MS	0.7		mg/Kg	0.1	0.5	23	3.04	0.43
072116LRCAGJ04	AG	7/21/2016	Copper	M6020 ICP-MS	0.7		mg/Kg	0.1	0.5	24.3	2.88	0.41
072116LRCAGJ05	AG	7/21/2016	Copper	M6020 ICP-MS	0.7		mg/Kg	0.1	0.6	23	3.04	0.43
072116LRCAGJ06	AG	7/21/2016	Copper	M6020 ICP-MS	1		mg/Kg	0.1	0.6	22.4	4.46	0.45
072116LRCAGJ07	AG	7/21/2016	Copper	M6020 ICP-MS	0.7		mg/Kg	0.1	0.5	22	3.18	0.45
072116LRCAGJ08	AG	7/21/2016	Copper	M6020 ICP-MS	0.6		mg/Kg	0.1	0.6	22.3	2.69	0.45
072116LRCAGJ09	AG	7/21/2016	Copper	M6020 ICP-MS	0.6		mg/Kg	0.1	0.6	21.9	2.74	0.46
072116LRCAGJ10	AG	7/21/2016	Copper	M6020 ICP-MS	0.8		mg/Kg	0.1	0.6	22.1	3.62	0.45
072116LRCAGJ01	AG	7/21/2016	Mercury	M7473	27.4	H	ng/g	2.64	13.2	23.4	117.09	11.28
072116LRCAGJ02	AG	7/21/2016	Mercury	M7473	19.4	H	ng/g	1.96	9.8	25.4	76.38	7.72
072116LRCAGJ03	AG	7/21/2016	Mercury	M7473	24	H	ng/g	1.57	7.85	23	104.35	6.83
072116LRCAGJ04	AG	7/21/2016	Mercury	M7473	27.9	H	ng/g	1.2	6	24.3	114.81	4.94
072116LRCAGJ05	AG	7/21/2016	Mercury	M7473	23.4	H	ng/g	2.05	10.25	23	101.74	8.91
072116LRCAGJ06	AG	7/21/2016	Mercury	M7473	16.6	H	ng/g	1.94	9.7	22.4	74.11	8.66
072116LRCAGJ07	AG	7/21/2016	Mercury	M7473	19.9	H	ng/g	2.41	12.05	22	90.45	10.95
072116LRCAGJ08	AG	7/21/2016	Mercury	M7473	21.2	H	ng/g	1.92	9.6	22.3	95.07	8.61
072116LRCAGJ09	AG	7/21/2016	Mercury	M7473	19.5	H	ng/g	2.06	10.3	21.9	89.04	9.41
072116LRCAGJ10	AG	7/21/2016	Mercury	M7473	24	H	ng/g	1.85	9.25	22.1	108.6	8.37
072116LRCAGJ01	AG	7/21/2016	Moisture Content	D2216-80	76.6		%	0.1	0.5	23.4		0.43
072116LRCAGJ02	AG	7/21/2016	Moisture Content	D2216-80	74.6		%	0.1	0.5	25.4		0.39
072116LRCAGJ03	AG	7/21/2016	Moisture Content	D2216-80	77		%	0.1	0.5	23		0.43
072116LRCAGJ04	AG	7/21/2016	Moisture Content	D2216-80	75.7		%	0.1	0.5	24.3		0.41
072116LRCAGJ05	AG	7/21/2016	Moisture Content	D2216-80	77		%	0.1	0.5	23		0.43
072116LRCAGJ06	AG	7/21/2016	Moisture Content	D2216-80	77.6		%	0.1	0.5	22.4		0.45
072116LRCAGJ07	AG	7/21/2016	Moisture Content	D2216-80	78		%	0.1	0.5	22		0.45
072116LRCAGJ08	AG	7/21/2016	Moisture Content	D2216-80	77.7		%	0.1	0.5	22.3		0.45
072116LRCAGJ09	AG	7/21/2016	Moisture Content	D2216-80	78.1		%	0.1	0.5	21.9		0.46
072116LRCAGJ10	AG	7/21/2016	Moisture Content	D2216-80	77.9		%	0.1	0.5	22.1		0.45
072116LRCAGJ01	AG	7/21/2016	Selenium	M6020 ICP-MS	1.42		mg/Kg	0.02	0.05	23.4	6.07	0.09
072116LRCAGJ02	AG	7/21/2016	Selenium	M6020 ICP-MS	1.21		mg/Kg	0.02	0.06	25.4	4.76	0.08
072116LRCAGJ03	AG	7/21/2016	Selenium	M6020 ICP-MS	1.59		mg/Kg	0.02	0.05	23	6.91	0.09
072116LRCAGJ04	AG	7/21/2016	Selenium	M6020 ICP-MS	1.18		mg/Kg	0.02	0.05	24.3	4.86	0.08
072116LRCAGJ05	AG	7/21/2016	Selenium	M6020 ICP-MS	1.31		mg/Kg	0.02	0.06	23	5.7	0.09
072116LRCAGJ06	AG	7/21/2016	Selenium	M6020 ICP-MS	1.29		mg/Kg	0.02	0.06	22.4	5.76	0.09
072116LRCAGJ07	AG	7/21/2016	Selenium	M6020 ICP-MS	0.91		mg/Kg	0.02	0.05	22	4.14	0.09
072116LRCAGJ08	AG	7/21/2016	Selenium	M6020 ICP-MS	1.14		mg/Kg	0.02	0.06	22.3	5.11	0.09
072116LRCAGJ09	AG	7/21/2016	Selenium	M6020 ICP-MS	1.42		mg/Kg	0.03	0.06	21.9	6.48	0.14
072116LRCAGJ10	AG	7/21/2016	Selenium	M6020 ICP-MS	1.39		mg/Kg	0.02	0.06	22.1	6.29	0.09
072116LRCAGJ01	AG	7/21/2016	Zinc	M6020 ICP-MS	15.9		mg/Kg	0.4	1	23.4	67.95	1.71
072116LRCAGJ02	AG	7/21/2016	Zinc	M6020 ICP-MS	18.7		mg/Kg	0.5	1	25.4	73.62	1.97
072116LRCAGJ03	AG	7/21/2016	Zinc	M6020 ICP-MS	19.2		mg/Kg	0.4	1	23	83.48	1.74
072116LRCAGJ04	AG	7/21/2016	Zinc	M6020 ICP-MS	20.1		mg/Kg	0.4	1	24.3	82.72	1.65
072116LRCAGJ05	AG	7/21/2016	Zinc	M6020 ICP-MS	30.5		mg/Kg	0.5	1	23	132.61	2.17
072116LRCAGJ06	AG	7/21/2016	Zinc	M6020 ICP-MS	16.6		mg/Kg	0.5	1	22.4	74.11	2.23
072116LRCAGJ07	AG	7/21/2016	Zinc	M6020 ICP-MS	20.3		mg/Kg	0.4	1	22	92.27	1.82
072116LRCAGJ08	AG	7/21/2016	Zinc	M6020 ICP-MS	20.1		mg/Kg	0.5	1	22.3	90.13	2.24
072116LRCAGJ09	AG	7/21/2016	Zinc	M6020 ICP-MS	21.3		mg/Kg	0.5	1	21.9	97.26	2.28
072116LRCAGJ10	AG	7/21/2016	Zinc	M6020 ICP-MS	21.9		mg/Kg	0.5	1	22.1	99.1	2.26

[1]Arctic grayling (AG)

[2]U=The material was analyzed for, but was not detected above the level of the associated value. H=Analysis exceeded method hold time. B=Analyte concentration detected at a value between MDL and PDL. The associated value is an estimated quantity.

[3]MDL=Method Detection Limit. PQL=Practical Quantitation Limit

Shungnak River

Sample ID	Species[1]	Collect Date	Analyte	Method	Wet Wt. Result	QUAL[2]	Units	MDL[3]	PQL[3]	%solids	Dry Wt. Result	Dry Wt. MDL[3]
072016SHUDVJ01	DV	7/20/2016	Cadmium	M6020 ICP-MS	0.05	B	mg/Kg	0.02	0.1	20	0.25	0.1
072016SHUDVJ01	DV	7/20/2016	Copper	M6020 ICP-MS	1		mg/Kg	0.1	0.6	20	5	0.5
072016SHUDVJ01	DV	7/20/2016	Mercury	M7473	14.2	H	ng/g	2.83	14.15	20	71	14.15
072016SHUDVJ01	DV	7/20/2016	Selenium	M6020 ICP-MS	1.03		mg/Kg	0.02	0.06	20	5.15	0.1
072016SHUDVJ01	DV	7/20/2016	Zinc	M6020 ICP-MS	34.9		mg/Kg	0.5	1	20	174.5	2.5
072016SHUDVJ01	DV	7/20/2016	Moisture Content	D2216-80	80		%	0.1	0.5	20		0.5

[1]Dolly Varden (DV)

[2]H=Analysis exceeded method hold time. B=Analyte concentration detected at a value between MDL and PDL. The associated value is an estimated quantity.

[3]MDL=Method Detection Limit. PQL=Practical Quantitation Limit

Upper Subarctic Creek

Sample ID	Species[1]	Collect Date	Analyte	Method	Wet Wt. Result	QUAL[2]	Units	MDL[3]	PQL[3]	%solids	Dry Wt. Result	Dry Wt. MDL[3]
072116USAJDV07	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.19		mg/Kg	0.02	0.1	24	0.79	0.08
072116USAJDV08	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.15		mg/Kg	0.02	0.1	22.7	0.66	0.09
072116USAJDV09	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.31		mg/Kg	0.02	0.1	22.4	1.38	0.09
072116USAJDV10	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.36		mg/Kg	0.02	0.1	23.6	1.53	0.08
072116USAJDV11	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.46		mg/Kg	0.01	0.07	25.4	1.81	0.04
072116USAJDV12	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.28		mg/Kg	0.02	0.1	23.2	1.21	0.09
072116USAJDV13	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.07	B	mg/Kg	0.02	0.1	23.2	0.3	0.09
072116USAJDV14	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.1		mg/Kg	0.02	0.1	22.6	0.44	0.09
072116USAJDV15	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.48		mg/Kg	0.02	0.1	22.7	2.11	0.09
072116USAJDV18	DV	7/21/2016	Cadmium	M6020 ICP-MS	0.06	B	mg/Kg	0.02	0.09	21.4	0.28	0.09
072116USAJDV07	DV	7/21/2016	Copper	M6020 ICP-MS	1		mg/Kg	0.1	0.5	24	4.17	0.42
072116USAJDV08	DV	7/21/2016	Copper	M6020 ICP-MS	0.8		mg/Kg	0.1	0.6	22.7	3.52	0.44
072116USAJDV09	DV	7/21/2016	Copper	M6020 ICP-MS	1.3		mg/Kg	0.1	0.6	22.4	5.8	0.45
072116USAJDV10	DV	7/21/2016	Copper	M6020 ICP-MS	1.1		mg/Kg	0.1	0.5	23.6	4.66	0.42
072116USAJDV11	DV	7/21/2016	Copper	M6020 ICP-MS	1.31		mg/Kg	0.07	0.4	25.4	5.16	0.28
072116USAJDV12	DV	7/21/2016	Copper	M6020 ICP-MS	3.4		mg/Kg	0.1	0.6	23.2	14.66	0.43
072116USAJDV13	DV	7/21/2016	Copper	M6020 ICP-MS	0.8		mg/Kg	0.1	0.6	23.2	3.45	0.43
072116USAJDV14	DV	7/21/2016	Copper	M6020 ICP-MS	0.8		mg/Kg	0.1	0.6	22.6	3.54	0.44
072116USAJDV15	DV	7/21/2016	Copper	M6020 ICP-MS	1.3		mg/Kg	0.1	0.6	22.7	5.73	0.44
072116USAJDV18	DV	7/21/2016	Copper	M6020 ICP-MS	0.79		mg/Kg	0.09	0.5	21.4	3.69	0.42
072116USAJDV07	DV	7/21/2016	Mercury	M7473	21.4	H	ng/g	1.68	8.4	24	89.17	7.00
072116USAJDV08	DV	7/21/2016	Mercury	M7473	19	H	ng/g	1.63	8.15	22.7	83.7	7.18
072116USAJDV09	DV	7/21/2016	Mercury	M7473	20.8	H	ng/g	1.28	6.4	22.4	92.86	5.71
072116USAJDV10	DV	7/21/2016	Mercury	M7473	20.1	H	ng/g	1.84	9.2	23.6	85.17	7.80
072116USAJDV11	DV	7/21/2016	Mercury	M7473	16	H	ng/g	1.46	7.3	25.4	62.99	5.75
072116USAJDV12	DV	7/21/2016	Mercury	M7473	21.7	H	ng/g	1.34	6.7	23.2	93.53	5.78
072116USAJDV13	DV	7/21/2016	Mercury	M7473	18.9	H	ng/g	1.79	8.95	23.2	81.47	7.72
072116USAJDV14	DV	7/21/2016	Mercury	M7473	12.6	H	ng/g	2.29	11.45	22.6	55.75	10.13
072116USAJDV15	DV	7/21/2016	Mercury	M7473	15.1	H	ng/g	2.14	10.7	22.7	66.52	9.43
072116USAJDV18	DV	7/21/2016	Mercury	M7473	23.8	H	ng/g	2.26	11.3	21.4	111.21	10.56
072116USAJDV07	DV	7/21/2016	Moisture Content	D2216-80	76		%	0.1	0.5	24		0.42
072116USAJDV08	DV	7/21/2016	Moisture Content	D2216-80	77.3		%	0.1	0.5	22.7		0.44
072116USAJDV09	DV	7/21/2016	Moisture Content	D2216-80	77.6		%	0.1	0.5	22.4		0.45
072116USAJDV10	DV	7/21/2016	Moisture Content	D2216-80	76.4		%	0.1	0.5	23.6		0.42
072116USAJDV11	DV	7/21/2016	Moisture Content	D2216-80	74.6		%	0.1	0.5	25.4		0.39
072116USAJDV12	DV	7/21/2016	Moisture Content	D2216-80	76.8		%	0.1	0.5	23.2		0.43
072116USAJDV13	DV	7/21/2016	Moisture Content	D2216-80	76.8		%	0.1	0.5	23.2		0.43
072116USAJDV14	DV	7/21/2016	Moisture Content	D2216-80	77.4		%	0.1	0.5	22.6		0.44
072116USAJDV15	DV	7/21/2016	Moisture Content	D2216-80	77.3		%	0.1	0.5	22.7		0.44
072116USAJDV18	DV	7/21/2016	Moisture Content	D2216-80	78.6		%	0.1	0.5	21.4		0.47
072116USAJDV07	DV	7/21/2016	Selenium	M6020 ICP-MS	1.42		mg/Kg	0.02	0.05	24	5.92	0.08
072116USAJDV08	DV	7/21/2016	Selenium	M6020 ICP-MS	1.28		mg/Kg	0.02	0.06	22.7	5.64	0.09
072116USAJDV09	DV	7/21/2016	Selenium	M6020 ICP-MS	1.52		mg/Kg	0.02	0.06	22.4	6.79	0.09
072116USAJDV10	DV	7/21/2016	Selenium	M6020 ICP-MS	1.54		mg/Kg	0.02	0.05	23.6	6.53	0.08
072116USAJDV11	DV	7/21/2016	Selenium	M6020 ICP-MS	1.45		mg/Kg	0.01	0.04	25.4	5.71	0.04
072116USAJDV12	DV	7/21/2016	Selenium	M6020 ICP-MS	1.45		mg/Kg	0.02	0.06	23.2	6.25	0.09
072116USAJDV13	DV	7/21/2016	Selenium	M6020 ICP-MS	1.21		mg/Kg	0.02	0.06	23.2	5.22	0.09
072116USAJDV14	DV	7/21/2016	Selenium	M6020 ICP-MS	0.91		mg/Kg	0.02	0.06	22.6	4.03	0.09
072116USAJDV15	DV	7/21/2016	Selenium	M6020 ICP-MS	1.2		mg/Kg	0.02	0.06	22.7	5.29	0.09
072116USAJDV18	DV	7/21/2016	Selenium	M6020 ICP-MS	1.34		mg/Kg	0.02	0.05	21.4	6.26	0.09
072116USAJDV07	DV	7/21/2016	Zinc	M6020 ICP-MS	27.8		mg/Kg	0.4	1	24	115.83	1.67
072116USAJDV08	DV	7/21/2016	Zinc	M6020 ICP-MS	30		mg/Kg	0.5	1	22.7	132.16	2.20
072116USAJDV09	DV	7/21/2016	Zinc	M6020 ICP-MS	34.7		mg/Kg	0.5	1	22.4	154.91	2.23
072116USAJDV10	DV	7/21/2016	Zinc	M6020 ICP-MS	31.3		mg/Kg	0.4	1	23.6	132.63	1.69
072116USAJDV11	DV	7/21/2016	Zinc	M6020 ICP-MS	26.5		mg/Kg	0.3	0.7	25.4	104.33	1.18
072116USAJDV12	DV	7/21/2016	Zinc	M6020 ICP-MS	25.4		mg/Kg	0.4	1	23.2	109.48	1.72
072116USAJDV13	DV	7/21/2016	Zinc	M6020 ICP-MS	24.4		mg/Kg	0.4	1	23.2	105.17	1.72
072116USAJDV14	DV	7/21/2016	Zinc	M6020 ICP-MS	31.5		mg/Kg	0.5	1	22.6	139.38	2.21
072116USAJDV15	DV	7/21/2016	Zinc	M6020 ICP-MS	29		mg/Kg	0.5	1	22.7	127.75	2.20
072116USAJDV18	DV	7/21/2016	Zinc	M6020 ICP-MS	24.8		mg/Kg	0.4	0.9	21.4	115.89	1.87

[1]Dolly Varden (DV)
[2]H=Analysis exceeded method hold time. B=Analyte concentration detected at a value between MDL and PDL. The associated value is an estimated quantity.
[3]MDL=Method Detection Limit. PQL=Practical Quantitation Limit

Lower Subarctic Creek

Sample ID	Species[1]	Collect Date	Analyte	Method	Wet Wt. Result	QUAL[2]	Units	MDL[3]	PQL[3]	%solids	Dry Wt. Result	Dry Wt. MDL[3]
072116LSAAGJ01	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.06	B	mg/Kg	0.02	0.1	22.7	0.26	0.09
072116LSAAGJ02	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.04	B	mg/Kg	0.02	0.08	23	0.17	0.09
072116LSAAGJ03	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.04	B	mg/Kg	0.02	0.09	22.3	0.18	0.09
072116LSAAGJ04	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.08	B	mg/Kg	0.02	0.1	27.3	0.29	0.07
072116LSAAGJ05	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.05	B	mg/Kg	0.02	0.1	23	0.22	0.09
072116LSAAGJ06	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.09	B	mg/Kg	0.02	0.1	24.1	0.37	0.08
072116LSAAGJ07	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.22		mg/Kg	0.02	0.1	21.3	1.03	0.09
072116LSAAGJ08	AG	7/21/2016	Cadmium	M6020 ICP-MS	0.04	B	mg/Kg	0.02	0.08	22.9	0.17	0.09
072116LSAAGJ01	AG	7/21/2016	Copper	M6020 ICP-MS	0.8		mg/Kg	0.1	0.6	22.7	3.52	0.44
072116LSAAGJ02	AG	7/21/2016	Copper	M6020 ICP-MS	0.67		mg/Kg	0.08	0.4	23	2.91	0.35
072116LSAAGJ03	AG	7/21/2016	Copper	M6020 ICP-MS	0.53		mg/Kg	0.09	0.5	22.3	2.38	0.40
072116LSAAGJ04	AG	7/21/2016	Copper	M6020 ICP-MS	0.8		mg/Kg	0.1	0.6	27.3	2.93	0.37
072116LSAAGJ05	AG	7/21/2016	Copper	M6020 ICP-MS	0.6		mg/Kg	0.1	0.6	23	2.61	0.43
072116LSAAGJ06	AG	7/21/2016	Copper	M6020 ICP-MS	0.6		mg/Kg	0.1	0.5	24.1	2.49	0.41
072116LSAAGJ07	AG	7/21/2016	Copper	M6020 ICP-MS	1.3		mg/Kg	0.1	0.6	21.3	6.1	0.47
072116LSAAGJ08	AG	7/21/2016	Copper	M6020 ICP-MS	0.59		mg/Kg	0.08	0.4	22.9	2.58	0.35
072116LSAAGJ01	AG	7/21/2016	Mercury	M7473	16.8	H	ng/g	2.31	11.55	22.7	74.01	10.18
072116LSAAGJ02	AG	7/21/2016	Mercury	M7473	22.3	H	ng/g	1.91	9.55	23	96.96	8.30
072116LSAAGJ03	AG	7/21/2016	Mercury	M7473	25.3	H	ng/g	1.62	8.1	22.3	113.45	7.26
072116LSAAGJ04	AG	7/21/2016	Mercury	M7473	30.1	H	ng/g	1.4	7	27.3	110.26	5.13
072116LSAAGJ05	AG	7/21/2016	Mercury	M7473	11.8	BH	ng/g	2.52	12.6	23	51.3	10.96
072116LSAAGJ06	AG	7/21/2016	Mercury	M7473	18.5	H	ng/g	1.99	9.95	24.1	76.76	8.26
072116LSAAGJ07	AG	7/21/2016	Mercury	M7473	14.6	H	ng/g	1.68	8.4	21.3	68.54	7.89
072116LSAAGJ08	AG	7/21/2016	Mercury	M7473	14.9	H	ng/g	1.28	6.4	22.9	65.07	5.59
072116LSAAGJ01	AG	7/21/2016	Moisture Content	D2216-80	77.3		%	0.1	0.5	22.7		0.44
072116LSAAGJ02	AG	7/21/2016	Moisture Content	D2216-80	77		%	0.1	0.5	23		0.43
072116LSAAGJ03	AG	7/21/2016	Moisture Content	D2216-80	77.7		%	0.1	0.5	22.3		0.45
072116LSAAGJ04	AG	7/21/2016	Moisture Content	D2216-80	72.7		%	0.1	0.5	27.3		0.37
072116LSAAGJ05	AG	7/21/2016	Moisture Content	D2216-80	77		%	0.1	0.5	23		0.43
072116LSAAGJ06	AG	7/21/2016	Moisture Content	D2216-80	75.9		%	0.1	0.5	24.1		0.41
072116LSAAGJ07	AG	7/21/2016	Moisture Content	D2216-80	78.7		%	0.1	0.5	21.3		0.47
072116LSAAGJ08	AG	7/21/2016	Moisture Content	D2216-80	77.1		%	0.1	0.5	22.9		0.44
072116LSAAGJ01	AG	7/21/2016	Selenium	M6020 ICP-MS	0.56		mg/Kg	0.02	0.06	22.7	2.47	0.09
072116LSAAGJ02	AG	7/21/2016	Selenium	M6020 ICP-MS	1.6		mg/Kg	0.02	0.04	23	6.96	0.09
072116LSAAGJ03	AG	7/21/2016	Selenium	M6020 ICP-MS	1.44		mg/Kg	0.02	0.05	22.3	6.46	0.09
072116LSAAGJ04	AG	7/21/2016	Selenium	M6020 ICP-MS	1.53		mg/Kg	0.02	0.06	27.3	5.6	0.07
072116LSAAGJ05	AG	7/21/2016	Selenium	M6020 ICP-MS	1.87		mg/Kg	0.02	0.06	23	8.13	0.09
072116LSAAGJ06	AG	7/21/2016	Selenium	M6020 ICP-MS	1.58		mg/Kg	0.02	0.05	24.1	6.56	0.08
072116LSAAGJ07	AG	7/21/2016	Selenium	M6020 ICP-MS	1.23		mg/Kg	0.02	0.06	21.3	5.77	0.09
072116LSAAGJ08	AG	7/21/2016	Selenium	M6020 ICP-MS	1.14		mg/Kg	0.02	0.04	22.9	4.98	0.09
072116LSAAGJ01	AG	7/21/2016	Zinc	M6020 ICP-MS	17.1		mg/Kg	0.5	1	22.7	75.33	2.20
072116LSAAGJ02	AG	7/21/2016	Zinc	M6020 ICP-MS	19.1		mg/Kg	0.3	0.8	23	83.04	1.30
072116LSAAGJ03	AG	7/21/2016	Zinc	M6020 ICP-MS	20.5		mg/Kg	0.4	0.9	22.3	91.93	1.79
072116LSAAGJ04	AG	7/21/2016	Zinc	M6020 ICP-MS	18.9		mg/Kg	0.5	1	27.3	69.23	1.83
072116LSAAGJ05	AG	7/21/2016	Zinc	M6020 ICP-MS	29.9		mg/Kg	0.5	1	23	130	2.17
072116LSAAGJ06	AG	7/21/2016	Zinc	M6020 ICP-MS	17.1		mg/Kg	0.4	1	24.1	70.95	1.66
072116LSAAGJ07	AG	7/21/2016	Zinc	M6020 ICP-MS	21.3		mg/Kg	0.5	1	21.3	100	2.35
072116LSAAGJ08	AG	7/21/2016	Zinc	M6020 ICP-MS	24.3		mg/Kg	0.3	0.8	22.9	106.11	1.31
072016LSADVJ01	DV	7/20/2016	Cadmium	M6020 ICP-MS	0.13		mg/Kg	0.02	0.1	23.1	0.56	0.09
072016LSADVJ02	DV	7/20/2016	Cadmium	M6020 ICP-MS	0.07	B	mg/Kg	0.02	0.08	20.6	0.34	0.10
072016LSADVJ01	DV	7/20/2016	Copper	M6020 ICP-MS	1.2		mg/Kg	0.1	0.6	23.1	5.19	0.43
072016LSADVJ02	DV	7/20/2016	Copper	M6020 ICP-MS	0.62		mg/Kg	0.08	0.4	20.6	3.01	0.39
072016LSADVJ01	DV	7/20/2016	Mercury	M7473	11.7	H	ng/g	1.98	9.9	23.1	50.65	8.57
072016LSADVJ02	DV	7/20/2016	Mercury	M7473	13.1	H	ng/g	2.62	13.1	20.6	63.59	12.72
072016LSADVJ01	DV	7/20/2016	Moisture Content	D2216-80	76.9		%	0.1	0.5	23.1		0.43
072016LSADVJ02	DV	7/20/2016	Moisture Content	D2216-80	79.4		%	0.1	0.5	20.6		0.49
072016LSADVJ01	DV	7/20/2016	Selenium	M6020 ICP-MS	1.51		mg/Kg	0.02	0.06	23.1	6.54	0.09
072016LSADVJ02	DV	7/20/2016	Selenium	M6020 ICP-MS	1.15		mg/Kg	0.02	0.04	20.6	5.58	0.10
072016LSADVJ01	DV	7/20/2016	Zinc	M6020 ICP-MS	52.6		mg/Kg	0.5	1	23.1	227.71	2.16
072016LSADVJ02	DV	7/20/2016	Zinc	M6020 ICP-MS	29.3		mg/Kg	0.3	0.8	20.6	142.23	1.46

[1]Dolly Varden (DV) and Arctic grayling (AG)

[2]H=Analysis exceeded method hold time. B=Analyte concentration detected at a value between MDL and PDL. The associated value is an estimated quantity.

[3]MDL=Method Detection Limit. PQL=Practical Quantitation Limit