Technical Report No. 19-07

Aquatic Biomonitoring at Greens Creek Mine, 2018

By

William J. Kane

and

Nicole M. Legere

April 2019

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 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 figures or figure captions.

Weights and measures (metric)

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

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
inch of mercury	inHg
Kilopascal	kPa
Nephelometric Turbidity Unit	NTU
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.
etalii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
idest (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)	'
no data	ND
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. 19-07

AQUATIC BIOMONITORING AT GREENS CREEK MINE, 2018

by

William J. Kane
and
Nicole M. Legere

Alaska Department of Fish and Game
Division of Habitat, Southeast Region
802 3rd Street, Douglas, Alaska, 99824

April 2019

This investigation was fully financed by Hecla Greens Creek Mining Company.

Cover: Greens Creek, looking upstream at dry Site 48 and the new stream channel (right).

Technical Reports are available through the Alaska State Library, Alaska Resources Library and Information Services (ARLIS) and on the Internet: http://www.adfg.alaska.gov/index.cfm?adfg=habitat_publications.main. This publication has undergone editorial and peer review.

Note: Product names or specific company names used in this publication are included for completeness but do not constitute product endorsement. The Alaska Department of Fish and Game, in accordance with State of Alaska ethics laws, does not favor one group over another through endorsement or recommendation.

Alaska Department of Fish and Game, Division of Habitat
802 3rd Street, Douglas, Alaska, 99824, USA

This document should be cited as:
Kane, W. J. and N. M. Legere. 2019. Aquatic biomonitoring at Greens Creek Mine, 2018. Alaska Department of Fish and Game, Technical Report No. 19-07, Douglas, AK.

TABLE OF CONTENTS

Page

LIST OF TABLES

Table **Page**

LIST OF FIGURES

LIST OF APPENDICES

ACKNOWLEDGEMENTS

Hecla Greens Creek Mining Company provided financial support and Greens Creek Mine environmental staff Dave Landes, Gunner Fredheim, and Doug Maller provided logistical support and water quality data. Environmental Manager Chris Wallace and Mr. Landes reviewed the draft report.

Several Division of Habitat staff assisted with this project. Habitat Biologist Kate Kanouse directed data collection; Habitat Biologists Greg Albrecht, Dylan Krull, Nicole Legere, Johnny Zutz, and Fish and Wildlife Technician Ben Landes collected the data; Mr. Albrecht processed the periphyton samples and verified the periphyton data; Division of Habitat Operations Manager Dr. Al Ott reviewed the report; and Ms. Kanouse prepared the Executive Summary and reviewed the report. Matthew Kern of Alder Grove Farm identified benthic macroinvertebrates.

Thank you all for your contribution.

EXECUTIVE SUMMARY

Since 2001, the Alaska Department of Fish and Game (ADF&G) has completed the aquatic biomonitoring studies the U.S. Forest Service (USFS) and Alaska Department of Environmental Conservation (ADEC) require for Hecla Greens Creek Mining Company's (Hecla) Greens Creek Mine. This partnership provides ADF&G the opportunity to gather and review data, and help identify, assess, and resolve issues that could affect aquatic resources near the mine site.

The aquatic studies include sampling periphyton, benthic macroinvertebrates, and juvenile fish in Greens Creek and Tributary Creek, two streams near mine development and operations. In 2018, we completed these studies at Greens Creek Site 63 and Site 54, and Tributary Creek Site 9.[a] In fall 2017, high discharge in Greens Creek caused river avulsion and channel abandonment at Site 48; in 2018, we sampled Site 63 as a reference site, located downstream of Site 48 and upstream of mine activities.[b] We also sampled a second site in Tributary Creek, Site 1847 near the stream mouth, to document periphyton and benthic macroinvertebrate communities as a prospective replacement for sampling Site 9, as low water levels and sediment composition at Site 9 are increasingly limiting our sampling ability.[c]

The National Weather Service (2019) reports Juneau experienced warmer and drier conditions in 2018 than normal, with annual precipitation (142 cm) about 10% below normal and snowfall (220 cm) about 24% below normal.

Among the 2018 Greens Creek samples, mean chlorophyll *a* densities, mean benthic macroinvertebrate densities, and the proportions of sensitive insects were within the ranges of values previously observed at Sites 48 and 54. At Tributary Creek Site 9, the 2018 mean chlorophyll *a* density and mean benthic macroinvertebrate density were within the ranges of values previously observed. The Tributary Site 1847 mean chlorophyll *a* density was about the same at Site 9, while the Site 1847 mean benthic macroinvertebrate density was nearly twice the mean density observed at Site 9. Of note, the mean proportion of sensitive insects among the 2018 Site 9 benthic macroinvertebrate samples was the lowest observed at the site since 2001, a result of low water flow and fine substrates present.

The 2018 Greens Creek juvenile Dolly Varden char *Salvelinus malma* population estimates were similar to previous years at Sites 48 and 54. The Site 54 juvenile coho salmon *Oncorhynchus kisutch* population estimate was similar to the 2016 estimate and capture results suggest two age classes were present. The 2018 Tributary Creek Site 9 juvenile Dolly Varden char population estimate was within the range of previous estimates and coho salmon continue to be the most

---

[a] Johnny Zutz, Habitat Biologists, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: 2018 Greens Creek Mine aquatic biomonitoring; dated September 13, 2018. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

[b] Kate Kanouse and Johnny Zutz, Habitat Biologists, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: GCM Greens Creek sampling Sites 48 and 63; dated September 7, 2018. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

[c] Kate Kanouse, Habitat Biologist, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: GCM Tributary Creek sampling site 1847; dated July 17, 2018. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd Street, Douglas, AK.

abundant juvenile fish species. Mean fish condition of Dolly Varden char and coho salmon were similar to previous years at all sites.

Whole body Dolly Varden char element concentrations were generally within the ranges of values previously observed, and we did not detect significant differences between the 2018 Greens Creek samples. Comparing all three sites, Tributary Creek Site 9 samples tend to have greater element concentrations and variability than Greens Creek samples, except copper and zinc which were generally greater among Greens Creek samples.

INTRODUCTION

The Greens Creek Mine is located about 29 km southwest of Juneau by air near Hawk Inlet on the west side of Admiralty Island, within the Tongass National Forest and the Admiralty Island National Monument (USFS 2013). The mine has operated since 1989, except between 1993 and 1996 when the mine temporarily closed, and produces gold, lead, silver, and zinc concentrates. Hecla, a subsidiary of Hecla Mining Company of Coeur d'Alene, ID, has owned and operated the mine since April 2008.

Most mine infrastructure is located in two drainages that support resident and anadromous fish: the dry-stack tailings disposal facility (TDF) at the headwaters of Tributary Creek, and the mill, mine facilities, and waste rock storage areas adjacent to Greens Creek (Figure 1). The project Plan of Operations Fresh Water Monitoring Program (FWMP; Hecla 2014, Appendix 1) and ADEC Waste Management Permit 2014DB0003 require aquatic studies in Greens Creek and Tributary Creek near mine facilities to document stream health.

The Division of Habitat began the aquatic studies for the Greens Creek Mine in 2001. Reports summarizing sampling results from previous years are in Weber Scannell and Paustian (2002), Jacobs et al. (2003), Durst and Townsend (2004), Durst et al. (2005), Durst and Jacobs (2006–2010), Kanouse (2011–2012), Kanouse and Brewster (2013–2014), Kanouse (2015), Brewster (2016), and Zutz (2017–2018).

Figure 1.–Greens Creek Mine area map.

PURPOSE

This technical report summarizes the 2018 sample results and documents the condition of biological communities in Greens Creek and Tributary Creek near mine development and operations. This report satisfies the requirements for Hecla's approved Plan of Operations (Hecla 2014) and ADEC Waste Management Permit 2014DB0003.

AQUATIC BIOMONITORING

We completed the following studies:

- chlorophyll density and composition;
- benthic macroinvertebrate density and community composition;
- juvenile fish populations and fish condition; and
- whole body juvenile Dolly Varden char element concentrations.

STUDY AREA

We completed the aquatic studies at 4 sample sites:

1. Greens Creek Site 63, reference site upstream of mine activities;
2. Greens Creek Site 54, downstream of mine activities;
3. Tributary Creek Site 9, downstream of the TDF; and
4. Tributary Creek Site 1847, downstream of Tributary Creek Site 9.

We sampled Greens Creek Site 48 and Site 54, and Tributary Site 9, annually since 2001 (Zutz 2018). Sometime in fall 2017, Greens Creek shifted river left and abandoned the channel at Site 48. The adjacent, newly carved channel was too young and dynamic for sampling biological communities as part of the aquatic biomonitoring program, so in 2018 we sampled Site 63 as a reference sampling site, downstream of Site 48. We also sampled Tributary Creek Site 1847 near the stream mouth to investigate periphyton and benthic macroinvertebrate communities in riffle habitats more suitable for sampling than at Site 9.[d]

Table 1.–2018 Aquatic biomonitoring study sample sites.

Location	Biomonitoring reach	Latitude	Longitude
Greens Creek Site 63	Fish – upper extent	58.0827	-134.6286
	Fish – lower extent	58.0832	-134.6295
	Periphyton and benthic macroinvertebrates	58.0831	-134.6300
Greens Creek Site 54	Fish – Upper extent	58.0784	-134.6469
	Fish – Lower extent	58.0784	-134.6480
	Periphyton and benthic macroinvertebrates	58.0783	-134.6466
Tributary Creek Site 9	Upper extent	58.1055	-134.7450
	Lower extent	58.1051	-134.7450
Tributary Creek Site 1847	Periphyton and benthic macroinvertebrates	58.1018	-134.7458

Note: Coordinates in WGS84 datum.

Note: At Site 9, we sample fish, periphyton, and benthic macroinvertebrates in same reach.

[d] We sampled Greens Creek Site 6 in 2001, 2006, and 2011 (Kanouse 2012).

Greens Creek

The Greens Creek watershed is about 23.1 km^2 (USGS 2019) and the main channel measures about 16 km long from the alpine headwaters to the mouth in Hawk Inlet. At each sample site, gradients range from 2% to 4%, cobble is the dominant substrate, and large woody debris is common, characteristic of a medium width mixed control channel type (Paustian 2010). The creek is fed by snowmelt and other drainages, and the magnitude of peak discharge in early summer depends on snowpack depth. Rainfall events during the fall also cause peak discharges.

The lower 10 km of Greens Creek (Stream No. 112-65-10240) provides habitat for chum salmon *O. keta*, coho salmon, pink salmon *O. gorbuscha*, and Dolly Varden char (Johnson and Blossom 2018). ADF&G Division of Commercial Fisheries staff survey returning chum and pink salmon in Greens Creek as part of their in-season assessment of salmon run strength (D. Harris, Commercial Fisheries Area Management Biologist, ADF&G, Juneau, personal communication).

Greens Creek stream flow data is recorded at USGS Site 15101490[e], located downstream of Sites 48 and 63, 1350 Creek, Cub Creek, and Hecla's water withdrawal, upstream of mining activities.

Greens Creek Site 48

We sampled Greens Creek Site 48 2001–2017 (Zutz 2018). Site 48 is located upstream of all mine activities, except exploratory drilling, near 265 m elevation and about 0.8 km upstream of the mine portal (Figure 2). Resident Dolly Varden char is the only fish species we documented at Site 48; the infiltration gallery concrete weir near the mine portal blocks upstream fish passage.

Sometime during fall 2017, high discharge in Greens Creek caused stream sediments to aggrade near the mouth of tributary Big Sore Creek, upstream of Greens Creek aquatic biomonitoring sampling Site 48, resulting in river avulsion on river left and abandonment of the main channel and Site 48 on river right (Figures 3–5). In July 2018, we documented a newly carved channel about 175 m long beginning 20 m downstream of Big Sore Creek and joining the main channel several meters downstream of the Site 48 periphyton and macroinvertebrate sample reach. We observed several recently fallen trees and vegetation in the new channel, which was too young and unstable for sampling biological communities as part of the aquatic biomonitoring program. Therefore, in 2018 we sampled Site 63, located downstream of Site 48.

[e] Prior to February 16, 1999, the gage was located 9 m upstream and at 3 m greater elevation (USGS 2018).

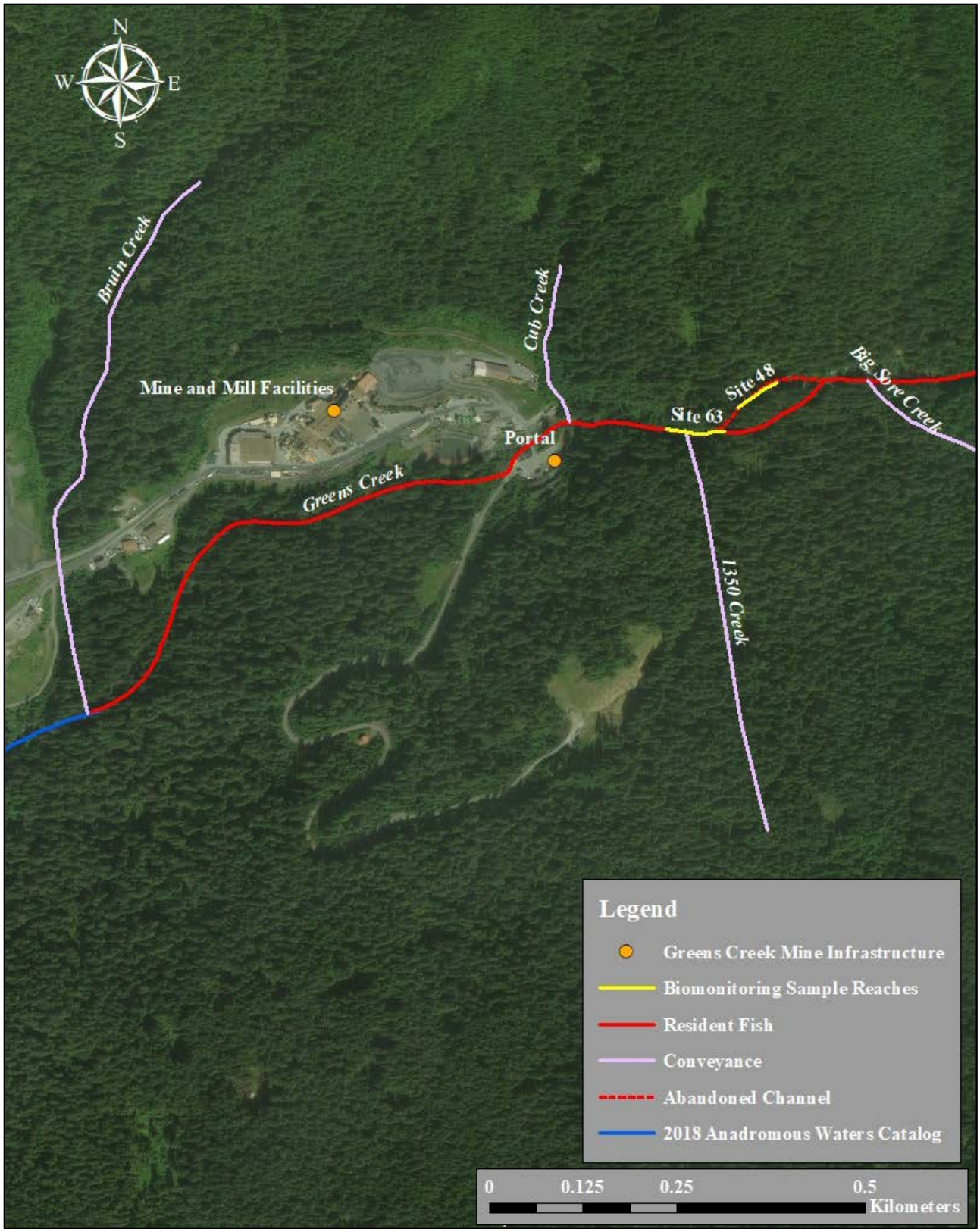


Figure 2.–Greens Creek Site 48 and Site 63 map.

Figure 3.–Greens Creek Site 48 fish sample reach.

Figure 4.–Greens Creek Site 48 periphyton and benthic macroinvertebrate sample reach.

Figure 5.–Greens Creek aerial photo, upstream of Site 48.

Greens Creek Site 63

We sampled Greens Creek Site 63 in 2018. Like Site 48, Site 63 is located downstream of Big Sore Creek and upstream of mining activities (Figure 2); unlike Site 48, 1350 Creek flows into the Site 63 sampling reach, which was unavoidable due to the limited suitable sampling areas between Big Sore Creek and the portal. Reference data collected at Site 48 and Site 63 are compared to data collected downstream at Site 54.

Resident Dolly Varden char is the only fish species we documented at Site 63; the infiltration gallery concrete weir near the mine portal blocks upstream fish passage. The upper extent of the 50 m juvenile fish study reach was located at the new channel confluence, and periphyton and macroinvertebrate sampling occur downstream of the fish sample reach (Figures 6, 7).

Figure 6.–Greens Creek Site 63 fish sample reach.

Figure 7.–Greens Creek Site 63 periphyton and macroinvertebrate sample reach.

Greens Creek Site 54

We sampled Greens Creek Site 54 2001–2018. Site 54 is located downstream of the Bruin Creek confluence and adjacent to waste rock storage Site 23, near 225 m elevation and about 1.8 km downstream of the mine portal (Figure 8). Data collected at Site 54 are compared to data collected at reference Site 48 and Site 63 to detect potential changes from waste rock storage areas, storm water ponds, and mine and mill facilities upstream. Between Site 48 and Site 54, three tributaries drain to Greens Creek: 1350 Creek, Cub Creek, and Bruin Creek.

We have documented coho salmon, Dolly Varden char, and cutthroat trout *O. clarkii* at Site 54. Anadromous fish access the site via a fish pass about 5.6 km upriver from the mouth. In 1989, Greens Creek Mining Company installed the engineered fish pass as mitigation for impacts to Tributary Creek from the TDF. Three concrete weirs provide step pools for adult coho salmon passage through a natural bedrock chute that prevents upstream fish migration. In November 2005, flood flows caused by a heavy rainstorm damaged the fish pass, limiting upstream adult coho salmon passage in subsequent years. Hecla repaired and fortified the fish pass in March 2016 and inspects the structure seasonally. During aquatic biomonitoring sampling at Site 54, in 2017, we observed young-of-year coho salmon (Zutz 2018), and in 2018, we observed two age classes, demonstrating successful adult coho salmon passage occurred during the prior fall spawning seasons.

Periphyton and benthic macroinvertebrate sampling occur about 30 m upstream of the fish sample reach (Figures 9, 10). Gallagher Creek enters Greens Creek within the fish sample reach.

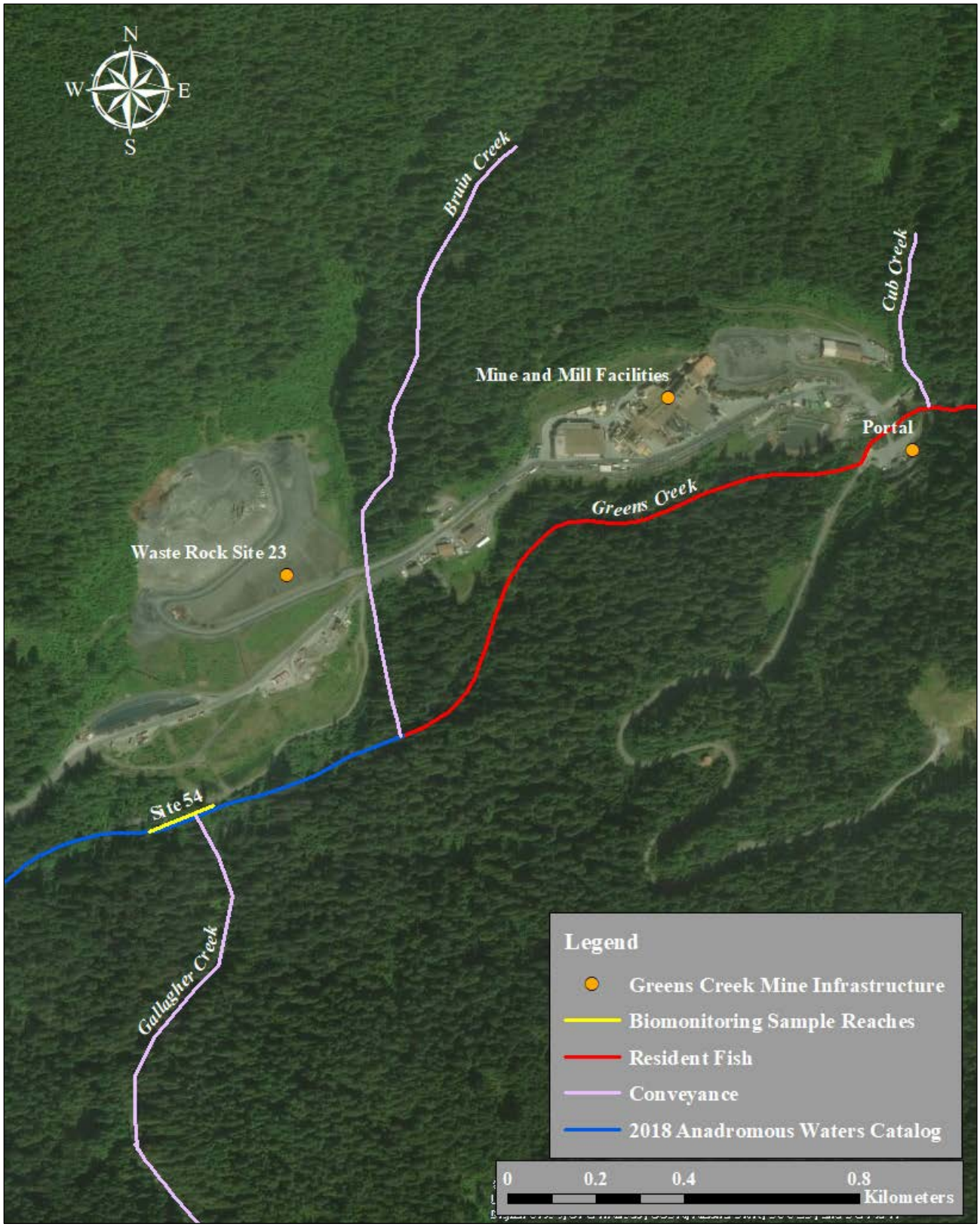


Figure 8.–Site 54 map.

Figure 9.–Greens Creek Site 54 periphyton and benthic macroinvertebrate sample reach.

Figure 10.–Greens Creek Site 54 fish sample reach.

Tributary Creek

The Tributary Creek watershed is about 1.7 km^2 (USFS 2013) and the main channel measures about 1.6 km between its headwaters and confluence with Zinc Creek (Figure 11). The TDF occupies the original headwaters of the creek. Tributary Creek is a lowland stream characterized as a narrow low gradient flood plain channel (Paustian 2010). Stream gradient varies 1–2%, organics and sand are the dominant substrates with gravel present near the mouth, and large and small woody debris are common. Discharge estimates based on field measurements and limited gage data suggest annual stream flows are less than 5 ft^3/s (USFS 2003).

Tributary Creek (Stream No. 112-65-10230-2007) provides habitat for coho salmon, pink salmon, and Dolly Varden char (Johnson and Blossom 2018).

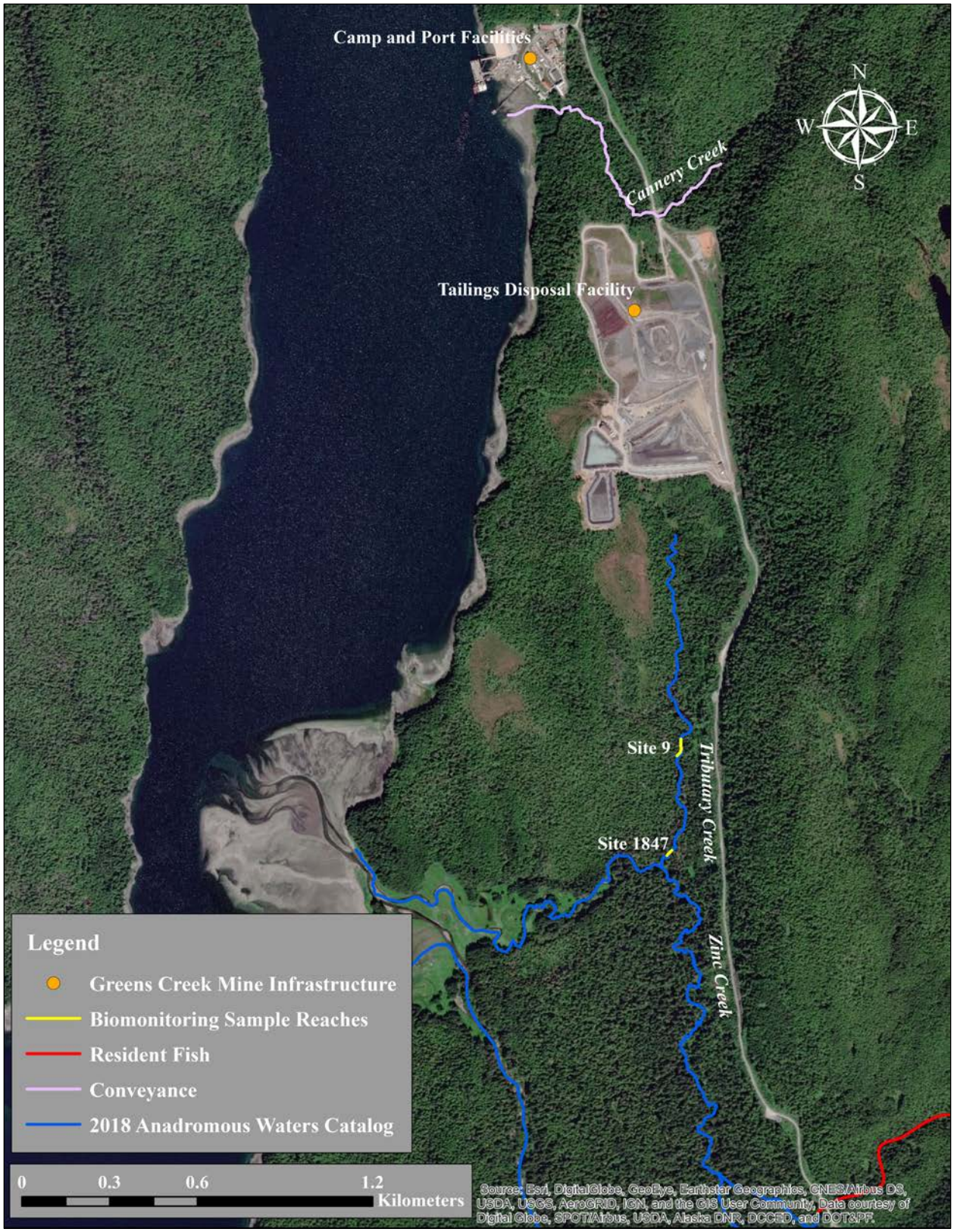


Figure 11.–Tributary Creek Site 9 and Site 1847 map.

Tributary Creek Site 9

We sampled Tributary Creek Site 9 2001–2018. Site 9 is located about 1.2 km downstream of the TDF at 25 m elevation and is sampled to detect potential changes from the TDF. We have documented coho salmon, Dolly Varden char, cutthroat trout, rainbow trout *O. mykiss*, and sculpin *Cottus* sp. at the site. Periphyton and benthic macroinvertebrate sampling occur within the fish sample reach after the juvenile fish population study is complete.

Greens Creek Mine tailings facility expansions and upstream beaver activity have changed Tributary Creek water levels and sediment composition at Site 9 since we began sampling in 2001 (Figures 12, 13). The current conditions limit our ability to sample periphyton and benthic macroinvertebrates in riffles. In 2018, we sampled periphyton and benthic macroinvertebrates at Tributary Creek Site 1847, downstream of Site 9 near the stream mouth, to investigate periphyton and benthic macroinvertebrate communities in riffle habitats more suitable for sampling than at Site 9.

Figure 12.–Tributary Creek beaver dam.

Figure 13.–Tributary Creek Site 9.

Tributary Creek Site 1847

We sampled Tributary Creek Site 1847 in 2018. Site 1847 is located within about 50 m of the Tributary Creek mouth (Figures 14, 15). We sampled periphyton and benthic and macroinvertebrates and compare the data to the Site 9 data; we plan to repeat sampling in 2019. We did not sample fish since Site 9 continues to provide suitable fish sampling conditions.

Figure 14.–Tributary Creek Site 1847 near the stream mouth.

Figure 15.–Tributary Creek Site 1847, about 50 m upstream of the stream mouth.

METHODS

We annually review data sets to ensure accuracy and consistency with methods modifications, and report corrections and updates in the document and appendices. The most recent technical report presents the current data sets and should be used to analyze data from previous years.

WATER QUALITY

Hecla staff used field meters to characterize basic water quality at each site during sampling, including temperature, pH, and conductivity. We include the 2018 results for each site in *Results*.

STREAM FLOW

Sampling and Analysis

We measured stream flow with a SonTek FlowTracker acoustic doppler velocimeter.[f] We attempted to record at least 20 measurement points in equidistant subsections and collected additional measurements where we observed changes in the stream bottom elevation and water velocity, except in Tributary Creek where we recorded as many measurements as practicable.

We strung a fiberglass measuring tape tightly across the stream perpendicular to flow and began the survey from either bank following methods described in SonTek (2007). We surveyed where stream flow was confined to one channel, and usually where the stream bottom elevation and stream flow were continuous across the channel.

Data Presentation

We present our discharge[g] measurements for each site in *Results*, and include the mean daily discharge data obtained from USGS Site 15101490.

PERIPHYTON: CHLOROPHYLL DENSITY AND COMPOSITION

Periphyton is composed of primary producing organisms such as algae, cyanobacteria and heterotrophic microbes, and detritus, attached to the submerged surfaces of aquatic ecosystems. Algal density and community structure are influenced by water and sediment quality through physical, chemical, and biological disturbances that change throughout the year (Barbour et al. 1999). The concentration of chlorophyll *a* (Chl-*a*) pigment in periphyton samples provides an estimate of active algal biomass (density), while concentrations of chlorophyll *b* (Chl-*b*) and chlorophyll *c* (Chl-*c*) pigments estimate the composition of algal organisms present, such as green algae that produce Chl-*b*, and diatoms and brown algae that produce Chl-*c*.

Requirement FWMP 5.3

The FWMP requires measuring the density (mg/m^2) of chlorophylls *a*, *b*, and *c* in each periphyton sample, comparing the Greens Creek Site 48 and Site 63 Chl-*a* reference data to the Greens Creek Site 54 Chl-*a* data each year, and tracking change over time at each sample site. We do not have reference data to compare Tributary Creek Site 9 or Site 1847 data.

---

[f] Prior to 2015 (Kanouse 2015), we measured stream flow using a Global Flow Probe Model FP101 flow meter and estimated discharge using a modification of the methods described in Platts et al. (1983).

[g] We present discharge data in Imperial units for convention.

Sample Collection and Analysis

We collected 10 smooth, flat, undisturbed, and perennially wetted rocks from submerged cobble in riffle habitats in less than 0.45 m water depth at each sample site and submerged the rocks in the creek with the sample area facing up until sampling. We held a 5 × 5 cm square of high-density foam on the sample area and scrubbed the area around the foam with a toothbrush to remove algae and other organisms outside the sample area, then rinsed the rock by dipping it in the stream while holding the foam in place. We also rinsed the toothbrush in the stream.

We placed a 47 mm diameter Type A/E 1 µm glass fiber filter into a Nalgene® filter holder attached to a vacuum pump with a gage, then removed the foam square and scrubbed the underside of the foam and the sample area with the toothbrush into the filter holder. We used stream water in a wash bottle to rinse the loosened periphyton from the foam, rock, toothbrush, and the inside of the filter holder onto the filter. We scrubbed the sample area a second time and repeated the rinse cycle. We pumped most of the water through the filter, maintaining pressure less than 34 kPa, and added a few drops[h] of saturated magnesium carbonate solution[i] to the filter before pumping the sample dry. We removed the glass fiber filter, folded it in half with the sample on the inside, and wrapped it in a white coffee filter to absorb additional water. We placed the samples in a sealed, labeled plastic bag with desiccant and stored the samples in a light-proof cooler containing frozen icepacks during transportation, in a camp freezer while onsite, and in a –20 °C ADF&G Douglas laboratory freezer until processing.

We followed U.S. Environmental Protection Agency (USEPA 1997) protocol for chlorophyll extraction and measurement, determining instrument and estimated detection limits, and data analysis.[j] We removed the samples from the freezer, cut them into small pieces, and placed the filter pieces for each sample into individual 15 mL screw cap centrifuge tubes containing 10 mL of 90% acetone. We capped the centrifuge tubes and shook each tube vigorously to submerge the filter pieces, placed them in a rack, covered them with aluminum foil, and stored them in a refrigerator overnight to extract the chlorophyll.[k]

The following day, we centrifuged the samples for 20 min at 363 rcf, individually decanted the supernatant into a cuvette, and measured each sample absorbance at wavelengths 664 nm, 647 nm, 630 nm, and 750 nm using a Shimadzu UV-1800 spectrophotometer. Prior to measuring samples, we inserted two cuvettes with 90% acetone to correct for the absorbance of the solvent at each wavelength. We treated each sample with 80 µL of 0.1 N hydrochloric acid[l], waited 90 seconds, and measured absorbance at wavelengths 665 nm and 750 nm.

We used trichromatic equations to estimate Chl-*a*, Chl-*b*, and Chl-*c* concentrations, and corrected for turbidity using the 750 nm absorbance value (APHA 2012, USEPA 1997). We corrected Chl-*a* concentrations when phaeophytin was detected. If Chl-*a* was not detected in a sample, we report the concentration at the estimated detection limit and do not report values for Chl-*b* or Chl-*c*; the

---

[h] This measurement is not exact as the amount of water and magnesium carbonate used to create a saturated solution varies and does not affect sample integrity. We used supernatant solution to avoid magnesium carbonate solids.

[i] To prevent acidification and conversion of chlorophyll to phaeophytin.

[j] Except we stored the samples longer than 3.5 weeks; we cut the sample filters to reduce acetone exposure for laboratory staff, rather than homogenize them; and we centrifuged the samples at 363 relative centrifugal force (rcf) rather than 500 rcf.

[k] We allowed samples to steep for at least 2 h and not more than 24 h.

[l] To convert the chlorophyll to phaeophytin.

2018 Chl-*a* concentration estimated detection limit was 0.19 mg/m^2. We round all values to 2 decimal places.

We performed the nonparametric Kruskal-Wallis one-way analysis of variance by ranks test, using Statistix® 10 analytical software, to test for differences of mean ranks between the 2018 Greens Creek Sites 63 and 54 data, and across years at each site (Neter et al. 1990). We used the Dunns all-pairwise comparison test to identify differences between years and report significant differences when $p \leq 0.05$.

Data Presentation

We present a figure of Greens Creek mean daily discharges three weeks prior to sampling in 2018 and include mean daily discharges for the same period, 2001–2018.[m] We also include a figure presenting the range of Greens Creek mean daily discharges three weeks prior to sampling, 2001–2018.

We present mean Chl-*a* density (mg/m^2) ± 1 SD in figures. We present the Greens Creek Site 63 data with the Site 48 data, the Greens Creek Site 54 data alone, and the Tributary Creek Site 9 data with Site 1847 data. We compare data between Greens Creek sites in *Comparisons Among Greens Creek Sites*; we do not compare Greens Creek data with Tributary Creek data as these systems provide different habitats for aquatic life, which affect productivity. We include the raw data in Appendix A.

Benthic Macroinvertebrate Density and Community Composition

Benthic macroinvertebrates (BMI) classified in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), collectively known as EPT taxa, have complex and short life cycles and many genera are sensitive to changes in water and sediment quality (Barbour et al. 1999). These organisms are secondary producers, feed on periphyton and other macroinvertebrates, and are a food source for fish.

Requirement FWMP 5.4

The FWMP requires evaluating BMI density (per m^2) and community composition by sample at each site each year. We estimate mean BMI density and community composition at each site, compare the annual data among Greens Creek sites, and track change over time at all sites. We do not have reference data to compare Tributary Creek Site 9 and Site 1847 data.

Sample Collection and Analysis

We opportunistically collected 8 BMI samples[n] from each site using a Hess sampler in riffles and runs with cobble substrate and different flow velocities—habitats that support greater taxonomic density and richness (Barbour et al. 1999). We do not sample other habitat types (e.g. pools) to reduce variability of the data.

The Hess stream bottom sampler has a 0.086 m^2 sample area and material is captured in a 200 mL cod end, both constructed with 300 µm mesh. We pushed the sampler into the stream bottom, scrubbed rocks within the sample area with a brush, and disturbed gravels, sand, and silt to about 10 cm depth to dislodge macroinvertebrates into the net. We rinsed the net in the stream to ensure

[m] Discharge data are not available for Tributary Creek.
[n] Prior to 2015, we collected 5 BMI samples each year.

all organisms floated into the Hess sampler cod end, transferred each sample from the cod end to a labeled 500 mL plastic bottle, and preserved the samples in 95% ethanol at a ratio of three parts ethanol to one part sample. We discarded all samples where sediment overfilled the cod end.

Contractor Matt Kern of Alder Grove Farm used an elutriator system and 0.5 mm and 0.3 mm sieves to sort macroinvertebrates from debris,[o, p] and identified BMIs to the lowest practical taxonomic level[q] using Merritt and Cummins (1996) and Stewart and Oswood (2006). Habitat Biologist Greg Albrecht provided quality control by verifying BMI identification of three samples.

We calculated BMI density (per m^2) for each sample by dividing the number of BMIs by 0.086 m^2, the Hess sampling area. We estimated BMI density for each site by calculating the mean density among the 8 samples. We report taxa richness as the number of taxonomic groups identified to the lowest practical level and exclude terrestrial organisms[r] from all calculations.

Data Presentation

We present mean BMI density ± 1 SD and illustrate mean community composition in figures. We present the Greens Creek Site 54 data alone, the Greens Creek Site 63 data with the Site 48 data, and the Tributary Creek Site 9 data with the Site 1847 data. We compare data between Greens Creek sites in *Comparisons Among Greens Creek Sites*; we do not compare Greens Creek data with Tributary Creek data as these systems provide different habitats for aquatic life, which affect productivity. Annual data summaries are included in Appendix B.

JUVENILE FISH POPULATION

Requirement FWMP 5.5

The FWMP requires estimating juvenile fish populations by species at each site, comparing the annual data among Greens Creek sites each year, and monitoring population change over time at all sample sites. Valid population estimates are subject to our ability to satisfy assumptions of the study design each year.

Sample Collection and Analysis

We sampled 50 m reaches isolated by natural features, such as shallow riffles and debris jams, using two-piece 6.35 mm galvanized steel minnow traps baited with disinfected salmon roe[s] following methods described in Magnus et al. (2006). We placed rocks in the bottom of each trap for weight and to provide refuge for captured fish. We used bait contained in a punctured plastic bag to prevent ingestion and reduce the possibility of sample contamination. Prior to each study, we opportunistically set several baited minnow traps within 15 m of the upstream and downstream

---

[o] Gordon Willson-Naranjo and Greg Albrecht, Habitat Biologists, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: Benthic macroinvertebrate elutriation trials amendment; dated December 17, 2013. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd St, Douglas, AK.

[p] Katrina Lee, Administrative Assistant, to Jackie Timothy, Southeast Regional Supervisor, ADF&G Division of Habitat. Memorandum: Benthic macroinvertebrate sample enumeration procedures; dated June 28, 2016. Unpublished document can be obtained from the Southeast Regional Supervisor, ADF&G Division of Habitat, 802 3rd St, Douglas, AK.

[q] Insects of the orders Ephemeroptera, Plecoptera, Trichoptera, and Diptera to genus, except nonbiting midges to family Chironomidae, and all others to class or order.

[r] Including adult terrestrial insects of the orders Ephemeroptera, Plecoptera, Trichoptera, and Diptera.

[s] We added 4 oz of Betadyne® to 3 gal of tap water to saturate roe and allowed 15 min soak time, stirring frequently.

sample reach boundaries to capture potential migrants and improve sample reach isolation.[t] These minnow traps remained undisturbed during the study, and upon study completion, we recorded fish captured by species and released fish at capture sites. We did not include fish captured in these boundary traps in the population estimates.

We sampled juvenile fish populations using a modification[u] of a depletion method described by Bryant (2000). Beginning at the downstream end of each reach, we opportunistically set baited minnow traps in all habitat types where water depth and flow allowed. We moved away from the sample site as practicable[v] to avoid disturbing fish while the traps soaked for 1.5 h. We retrieved each trap, transferred captured fish to a plastic bucket containing aerated stream water, removed the used bait bag, rebaited,[w] and reset each trap in the same location as quickly as possible. We allowed the trap to soak another 1.5 h, and completed the sequence a third time.

We processed captured fish between passes. Biologists anesthetized fish using 9 mg/L AQUI-S 20E (10% eugenol), measured and recorded FL to the nearest 1 mm, weight to the nearest 0.1 g, and species (Pollard et al. 1997). Prior to weighing each fish, we tared the scale and emptied the measuring tray to minimize water weight. We retained fish in a perforated plastic bucket secured in the creek and released captured fish[x] to the sample reach upon study completion.

We collected data to meet the assumptions of closure and equal probability of capture (Lockwood and Schneider 2000) during the three passes by ensuring the following:

- Fish emigration and immigration during the sampling period was negligible.
    - Sample reaches were isolated by natural stream features, and we set traps upstream and downstream of sample reaches to capture potential migrants.
- All fish were equally vulnerable to capture during each pass.
    - We set traps in all habitat types where water depth and flow allowed.
- Fish did not avoid capture with each pass.
    - We maintained trap numbers and placement during all three passes.
    - We completed all three passes as quickly as possible.
    - To avoid disturbing fish, we moved away from sample reaches while the traps soaked.
- Collection effort and conditions which affect collection efficiency remained constant.
    - We retrieved traps beginning at the downstream end of each reach.
    - We moved upstream setting, retrieving, and replacing traps as quickly as possible.
    - We timed each pass exactly 1.5 h.
    - We replaced used bait bags with fresh bait bags and reset each trap in the same location.

---

[t] Greens Creek discharge is usually too high to efficiently and effectively isolate sample reaches using a 6.35 mm (0.25 in) mesh net across the stream. Though a mesh net could effectively isolate the Tributary Creek Site 9 sample reach, we also used baited minnow traps.

[u] We sampled shorter reaches, used more minnow traps, and completed three passes instead of four.

[v] Location dependent on our ability to visually monitor the traps and potential bear interference.

[w] On occasion, we did not have enough bait bags for the third pass, so we poked a few more holes in the freshest bags and reused them for the study.

[x] Except, we retained 10 Dolly Varden char for whole body element concentrations at each sample site.

We estimated juvenile fish populations using the multiple-pass depletion method developed by Lockwood and Schneider (2000), based on methods developed by Carle and Strub (1978). The repetitive method produces a maximum likelihood estimate (MLE) of fish with a 95% CI.

Let *X* represent an intermediate sum statistic where the total number of passes, *k*, is reduced by the pass number, *i*, and multiplied by the number of fish caught in the pass, C_i, for each pass:

$$X = \sum_{i=1}^{k} (k - i)C_i$$

Let *T* represent the total number of fish captured in the minnow traps, all passes. Let *n* represent the predicted population of fish, using *T* as the initial value tested. Using *X*, we calculated the MLE, *N*, by repeated estimations of *n*. The MLE is the smallest integer value of *n* greater than or equal to *T* which satisfies[y] the following:

$$\left[\frac{n+1}{n-T+1}\right] \prod_{i=1}^{k} \left[\frac{kn - X - T + 1 + (k-i)}{kn - X + 2 + (k-i)}\right]^{i} \leq 1.000$$

The probability of capture, *p*, is given by the total number of fish captured, divided by an equation where the number of passes is multiplied by the MLE and subtracted by the intermediate statistic, *X*,

$$p = \frac{T}{kN - X}$$

The variance of *N*, a measure of variability from the mean, is given by:

$$Variance\ of\ N = \frac{N(N-T)T}{T^2 - N(N-T)\left[\frac{(kp)^2}{(1-p)}\right]}$$

We determined the SE of *N* by calculating the square root of the variance of *N*, and the 95% CI for the MLE using ± 2(SE). The size of the 95% CI depends on the number of captures each pass; a small 95% CI results when fewer captures steadily occur with each pass, and a large 95% CI results when captures do not steadily decrease and when the number of fish captured on the second or third pass exceed the number of fish captured on the previous pass. A MLE cannot be generated from samples from small populations if we capture few fish (e.g. ≤ 20) during the three passes; in these cases, we present the number of fish captured as the result and do not include a MLE.

Calculating a MLE using three-pass depletion data relies on equal capture probability among passes (Bryant 2000, Carle and Strub 1978, Lockwood and Schneider 2000). To evaluate equal capture probability, we used the goodness of fit test (White et al. 1982) recommended by Lockwood and Schneider (2000), which follows the χ^2 test form. We first calculated expected numbers of fish captured for each pass (C_1, C_2, C_3) using variables previously described:

$$E(C_1) = N(1-p)^{i-1}p$$

[y] Lockwood and Schneider (2000) suggest the result should be rounded to one decimal place (1.0). We use three decimal places (1.000) which is an option in Carle and Strub (1978).

Then we calculated χ^2,

$$\chi^2 = \frac{[C_1 - E(C_1)]^2}{E(C_1)} + \frac{[C_2 - E(C_2)]^2}{E(C_2)} + \frac{[C_3 - E(C_3)]^2}{E(C_3)}$$

We compare the χ^2 test result against $\chi^2_{0.95}$ with one degree of freedom (Lockwood and Schneider (2000), and if the χ^2 value is lower, the goodness of fit test suggests we achieved equal capture probability; if not, the MLE will be biased low.

Data Presentation

We present juvenile fish population estimates by species each year in figures. We present the Greens Creek Site 63 data with the Site 48 data, the Greens Creek Site 54 data alone, and the Tributary Creek Site 9 with the Site 1847 data. We compare population estimates between Greens Creek sites in *Comparisons Among Greens Creek Sites.* We do not compare Greens Creek data with Tributary Creek data as these systems provide different habitats for aquatic life, which affect productivity. Capture data summaries and length frequency diagrams of captured fish are included in Appendix C.

JUVENILE FISH CONDITION

Age, sex, season, maturation, diet, gut contents, fat reserve, and muscular development affect fish condition. We used juvenile fish length and weight data to calculate fish condition, an index of fish health.

Requirement FWMP 5.5

The FWMP requires we report mean fish condition by species each year.

Sample Collection and Analysis

We used FL and weight data of fish captured during the juvenile fish population studies, excluding fish measuring less than 40 mm FL. We calculated Fulton's condition factor (*K*) using the equation given in Anderson and Neumann (1996), where the weight (*W*) of each fish is divided by the cubed length (*L*) of the fish, and the product multiplied by 100,000,

$$K = \frac{W}{L^3} \times 100{,}000$$

Data Presentation

For each sample site, we present mean fish condition by species, compare fish condition among Greens Creek sites in *Comparisons Among Greens Creek Sites,* and include mean condition by species by site and year in Appendix C.

JUVENILE FISH ELEMENT CONCENTRATIONS

Requirement FWMP 5.6

The FWMP requires we annually sample[z] 10 juvenile Dolly Varden char within the size range 85–125 mm FL for whole body concentrations of silver (Ag), cadmium (Cd), copper (Cu), mercury[aa] (Hg), lead (Pb), selenium (Se), and zinc (Zn) at each site. A 85 mm fish provides the minimum amount of tissue (about 5 g) required for laboratory analyses, while the maximum fish size of 125 mm improves the likelihood of sampling less than 3-year-old fish at Site 54 and Site 9 where anadromous Dolly Varden char may be present. We evaluate the data for each site over time and compare the data among all three sites each year.

Sample Collection and Analysis

We wore latex gloves when handling fish and retained 10 juvenile Dolly Varden char measuring 85–125 mm FL captured during the juvenile fish population survey. We retained fish in individually labeled plastic bags, and measured FL and fish weight, correcting for bag weight. We placed all samples from each site in a larger plastic bag labeled with the sample location. We stored the samples in a cooler containing frozen ice packs during transport, in a camp freezer while onsite, and in a –20 °C ADF&G Douglas laboratory freezer.

We shipped the samples in a cooler with frozen ice packs to ALS Environmental in Kelso, WA, and maintained written chain of custody documentation. ALS Environmental individually digested, dried, and analyzed each sample for total Ag, Cd, Cu, Hg, Pb, Se, and Zn on a dry weight basis following USEPA (2002) method 1631E for Hg, and USEPA (1994) method 200.8 for other elements. ALS Environmental provided Tier II quality assurance/quality control information including results for matrix spikes, sample blanks, sample duplicates, and standard reference materials.

We performed the nonparametric Kruskal-Wallis one-way analysis of variance by ranks test, using Statistix® 10 analytical software, to test for equality of population medians between sites (Neter et al. 1990). We used the Dunns all-pairwise comparison test to identify differences between sites and report significant differences when $p \leq 0.05$.

Data Presentation

For each sample site, we present a figure of minimum, median, and maximum whole body concentrations (mg/kg) for each element by year. We present the Greens Creek Site 63 data with the Site 48 data, the Greens Creek Site 54 data alone, and the Tributary Creek Site 9 with the Site 1847 data. We also compare the data among sample sites in *Comparison Among Sites*. We include the raw data, presenting the mean value for duplicate sample results, and the laboratory report in Appendix D.

[z] Prior to 2015, we collected 6 Dolly Varden char samples at each site.

[aa] We began annually testing for Hg in 2012, and incidentally received Hg data in 2010.

RESULTS

Greens Creek mean daily discharges three weeks prior to sampling in 2018 were below the previous 17-year average, and the median daily discharge during the three-week period was less than most previous sampling years (USGS 2018; Figures 16, 17).

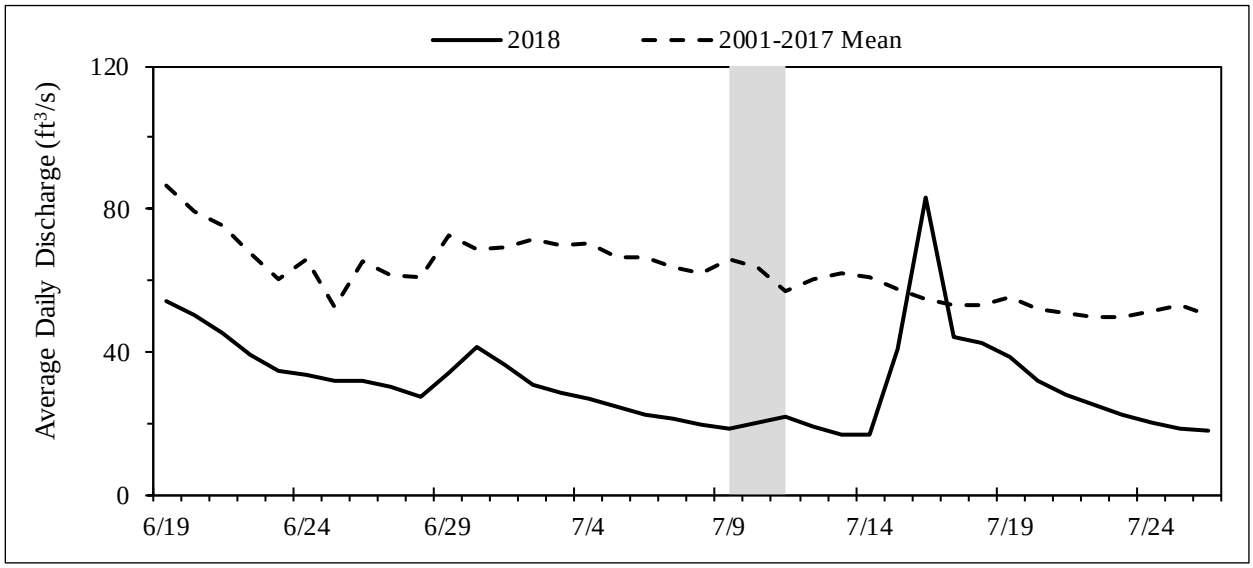


Figure 16.–Greens Creek average daily discharge three weeks prior to sampling in 2018.
Source: USGS 15101490 (USGS 2018).
Note: 2018 sampling days highlighted in gray.

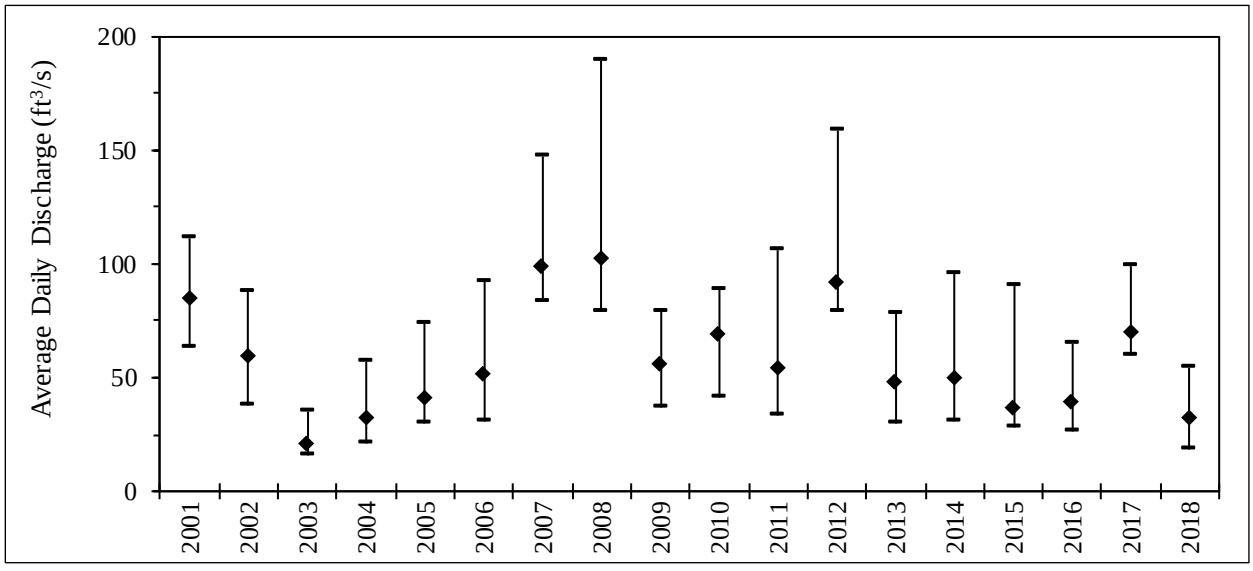


Figure 17.–Greens Creek average daily discharge three weeks prior to sampling, 2001–2018.
Source: USGS 15101490 (USGS 2018).
Note: Minimum, median, and maximum discharges presented.

GREENS CREEK SITE 48 AND SITE 63

We sampled Greens Creek Site 63 on July 11, 2018. Hecla environmental staff measured basic water quality data at 1145: water temperature 8.7 °C, conductivity 140.6 µS/cm, and pH 7.60. We measured stream flow in a single channel and estimate discharge was 16.6 ft^3/s at 1040; the USGS stream gage recorded 21.6 ft^3/s at the same time.

Periphyton: Chlorophyll Density and Composition

The 2018 mean Chl-*a* density at Site 63 was 10.93 mg/m^2, greater than most mean densities observed at Site 48 (Figure 18).[bb, cc] The samples contained about 87% Chl-*a*, 13% Chl-*c*, and zero Chl-*b*, similar to mean composition in previous years.

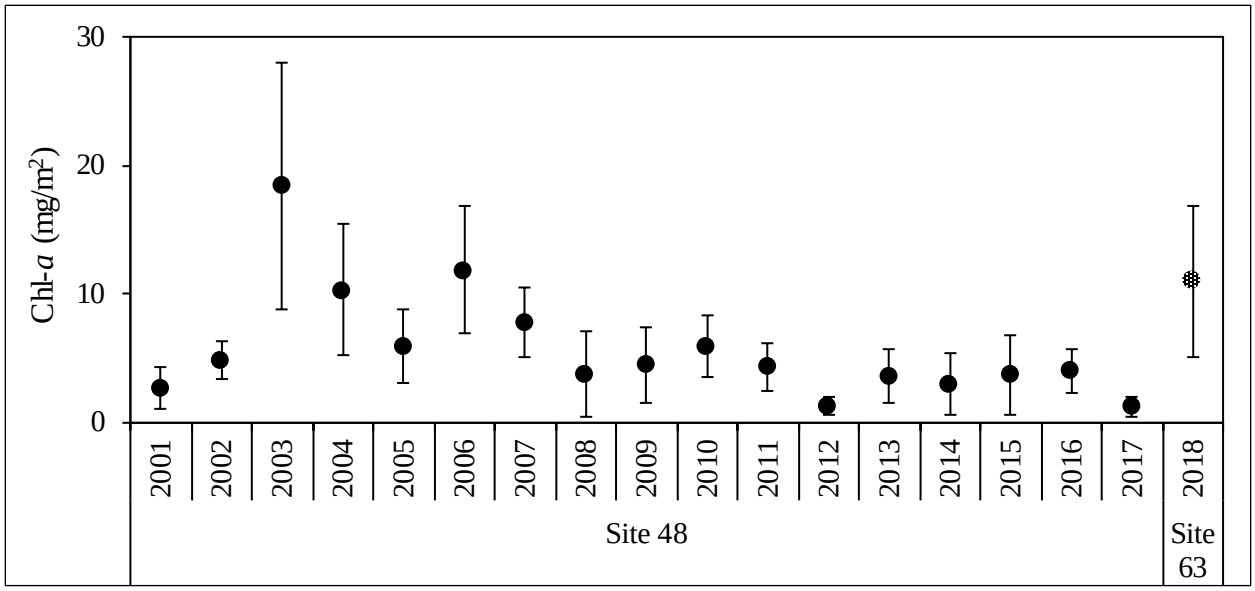


Figure 18.–Greens Creek Site 48 and Site 63 mean chlorophyll *a* densities ± 1 SD.

Benthic Macroinvertebrate Density and Community Composition

Among the 2018 Site 63 BMI samples, we counted 27 taxa and estimate mean density at 3,737 BMI/m^2, of which 93% were EPT insects, all greater than observed most previous years at Site 48 (Figures 19, 20). Dominant taxa were Ephemeroptera: *Baetis* and *Drunella*, representing 30% and 31% of the samples.

[bb] We usually find significant differences in Site 48 Chl- *a* densities between the current year and the 2003 and 2006 data. Chl-*a* densities in 2003 and 2006 were the greatest observed since 2001, which we attribute to natural variation.

[cc] The 2018 Site 63 data set includes 8 valid sample results, as we experienced turbidity errors for 2 samples during laboratory processing.

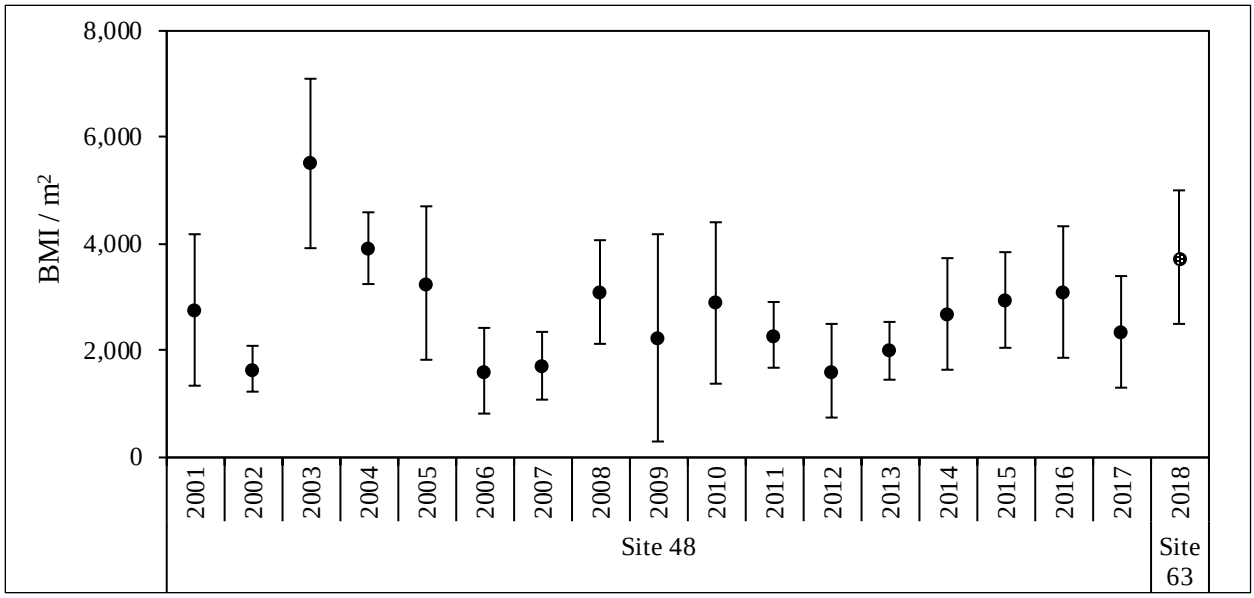


Figure 19.–Greens Creek Site 48 and Site 63 mean benthic macroinvertebrate densities ± 1 SD.

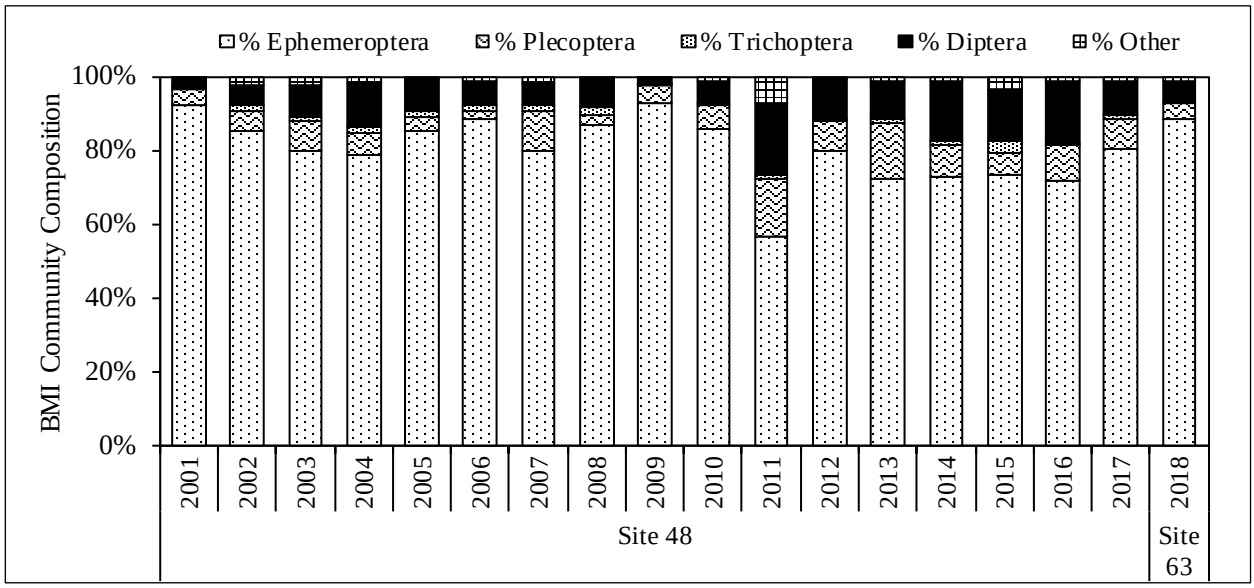


Figure 20.–Greens Creek Site 48 and Site 63 mean benthic macroinvertebrate community composition.

Juvenile Fish Populations and Fish Condition

We estimate the 2018 Site 63 Dolly Varden char population at 155 ± 17 fish, within the range of previous estimates at Site 48 (Figure 21). Mean fish condition among the 136 Dolly Varden char we captured was 1.0, and the length frequency diagram suggests multiple age classes were present, as in previous years at Site 48.

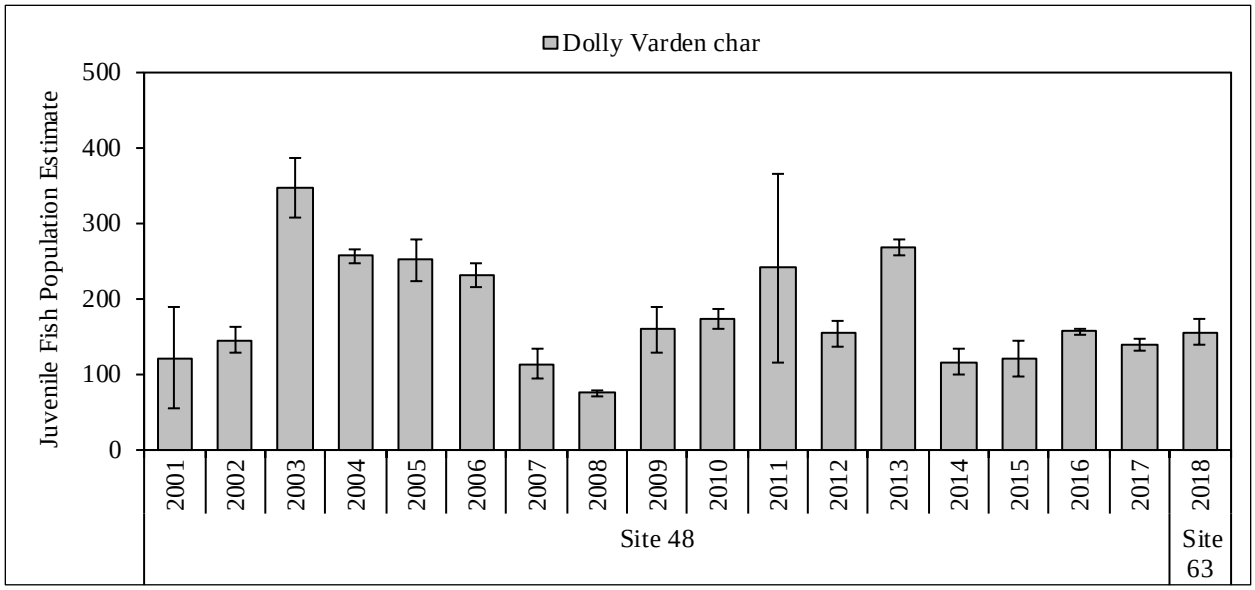


Figure 21.–Greens Creek Site 48 and Site 63 Dolly Varden char population estimates ± 95% CI.

Juvenile Fish Element Concentrations

Ag, Cd, Cu, Hg, Pb, and Zn concentrations among the 2018 Site 63 whole body Dolly Varden char samples were within the ranges of values previously observed in samples from Site 48. The 2018 median and maximum Se concentrations were greater than observed at Site 48 (Figures 22, 23).

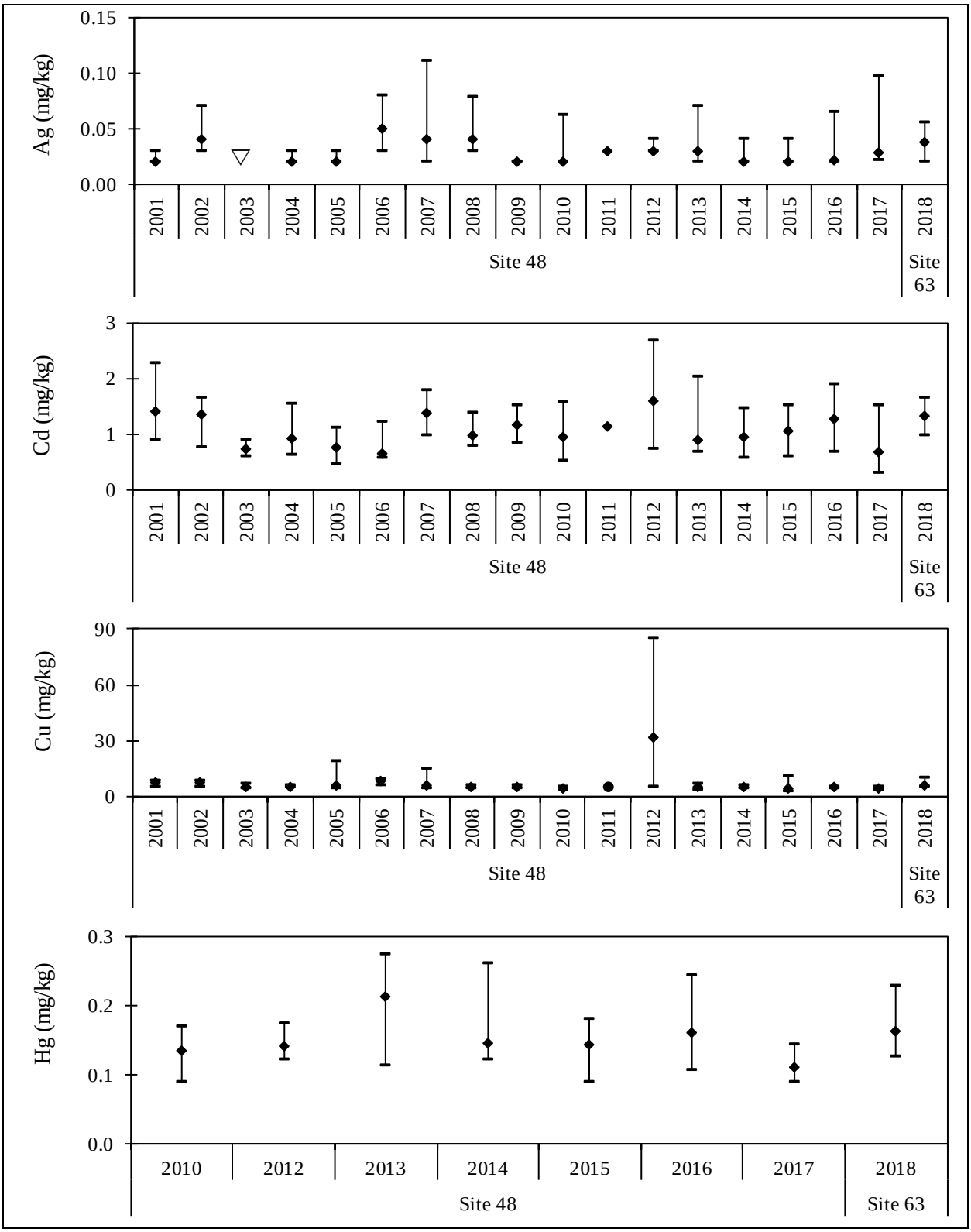


Figure 22.–Greens Creek Site 48 and Site 63 whole body Dolly Varden char Ag, Cd, Cu, and Hg concentrations.

Note: Minimum, median, and maximum concentrations presented; element concentrations undetected (▽) are presented at the method reporting limit.

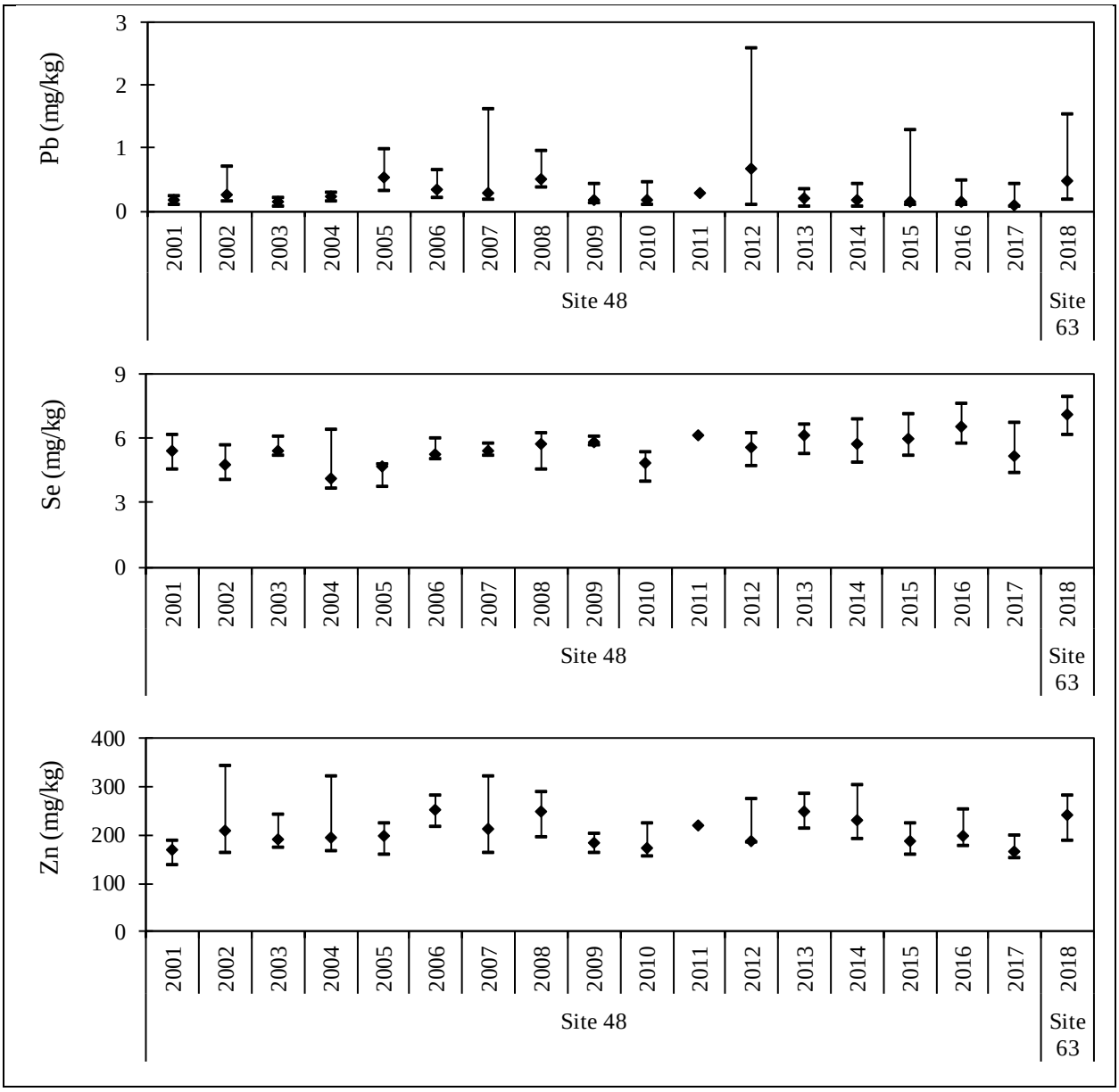


Figure 23.–Greens Creek Site 48 and Site 63 whole body Dolly Varden char Pb, Se, and Zn concentrations.

Note: Minimum, median, and maximum concentrations presented.

GREENS CREEK SITE 54

We sampled Greens Creek Site 54 on July 10, 2018. Hecla environmental staff measured basic water quality data at 1011: water temperature 9.4ºC, conductivity 153 µS/cm, and pH 7.7. Stream flow was lower than in 2017; we measured stream discharge downstream of the crossing log and estimated 15.4 ft^3/s at 1039. The USGS gage measured 17.7 ft^3/s at 1025.

Periphyton: Chlorophyll Density and Composition

The 2018 mean Chl-*a* density was 7.04 mg/m^2, the greatest mean density observed since 2011 (Figure 24).[dd] The samples contained about 86% Chl-*a*, 14% Chl-*c*, and zero Chl-*b*, similar to mean composition in previous years.

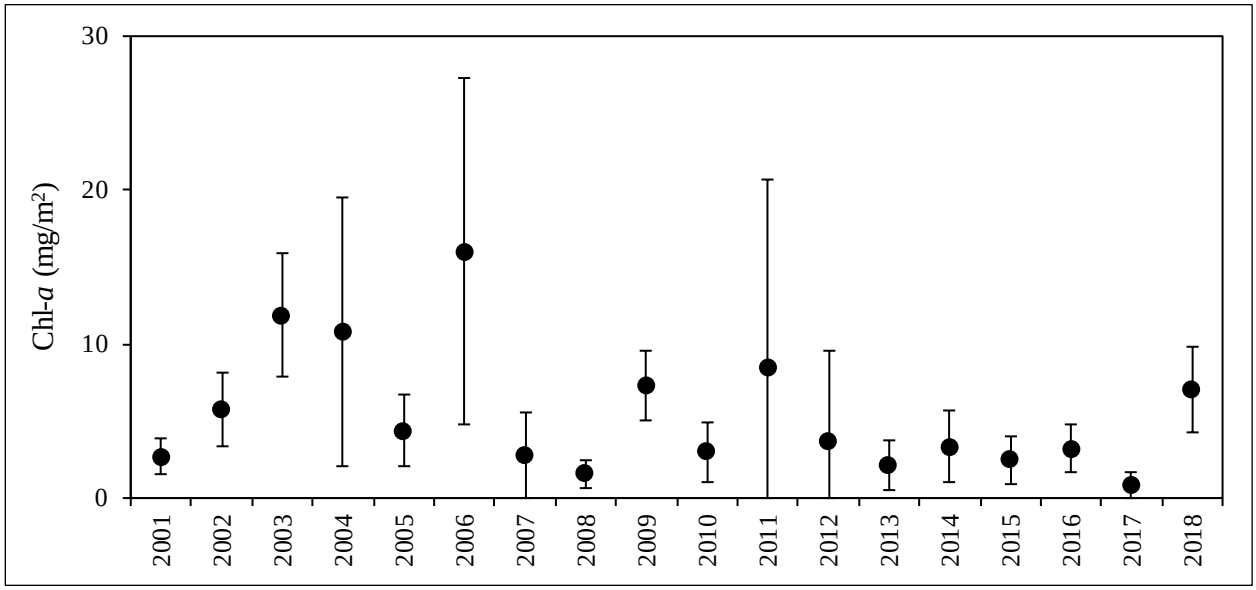


Figure 24.–Greens Creek Site 54 mean chlorophyll *a* densities ± 1 SD.

Benthic Macroinvertebrate Density and Community Composition

Among the 2018 BMI samples, we counted 29 taxa and estimate mean density at 3,647 BMI/m^2, of which 94% were EPT insects, all similar to previous years (Figures 25, 26). Dominant taxa were Ephemeroptera: *Drunella* and *Epeorus*, representing 29% and 27% of the samples.

[dd] We usually find significant differences in Site 54 Chl-*a* densities between the current year and the 2003 and 2006 data. Chl-*a* densities in 2003 and 2006 were the greatest observed since 2001, which we attribute to natural variation.

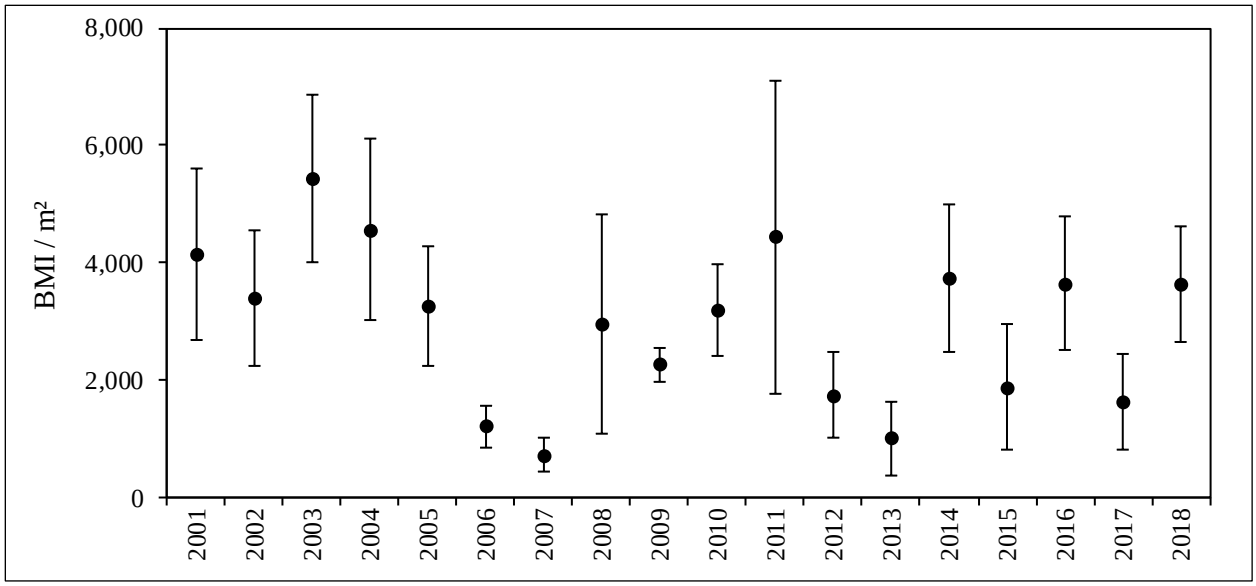


Figure 25.–Greens Creek Site 54 mean benthic macroinvertebrate densities ± 1 SD.

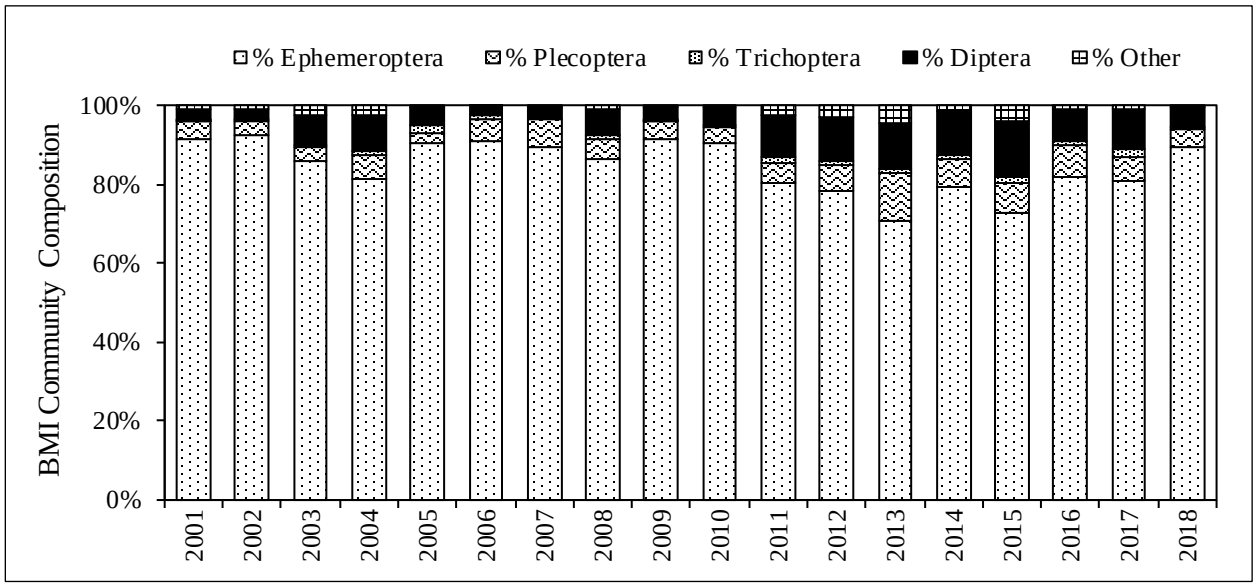


Figure 26.–Greens Creek Site 54 mean benthic macroinvertebrate community composition.

Juvenile Fish Populations and Fish Condition

We estimate the 2018 Dolly Varden char population at 264 ± 11 fish, within the range of previous estimates (Figure 27). Mean condition for the 250 Dolly Varden char we captured was 1.0, and the length frequency diagram suggests multiple age classes were present, as in previous years.

We estimate the 2018 coho salmon population at 35 ± 5 fish, similar to the 2016 estimate (Figure 27). Mean condition for the 32 coho salmon we captured was 1.2 and the length frequency diagram suggests two age classes were present, as in previous years.

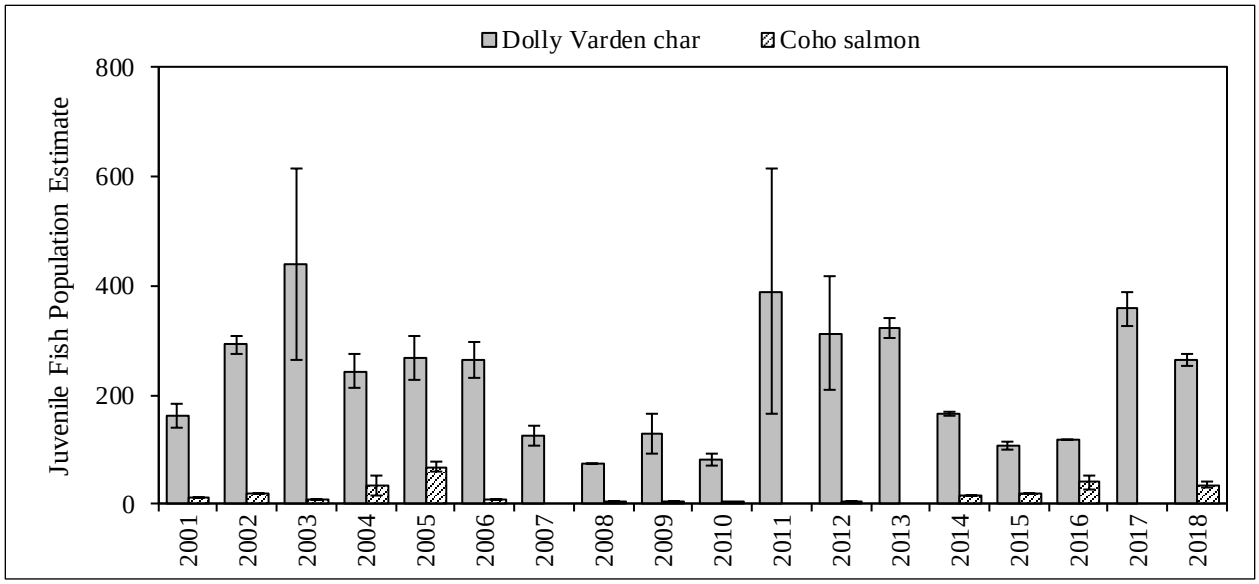


Figure 27.–Greens Creek Site 54 juvenile fish population estimates ± 95% CI.

Note: 2001–2010 data from a 28 m reach, 2011–2018 data from a 50 m reach.

Note: Though we did not capture juvenile coho salmon at Site 54 in 2017, we observed many young-of-year within the sampling reach.

Juvenile Fish Element Concentrations

Ag, Cd, Cu, Hg, Pb, Se, and Zn concentrations among the 2018 whole body Dolly Varden char samples generally were within the ranges of values observed since 2001 (Figures 28, 29).

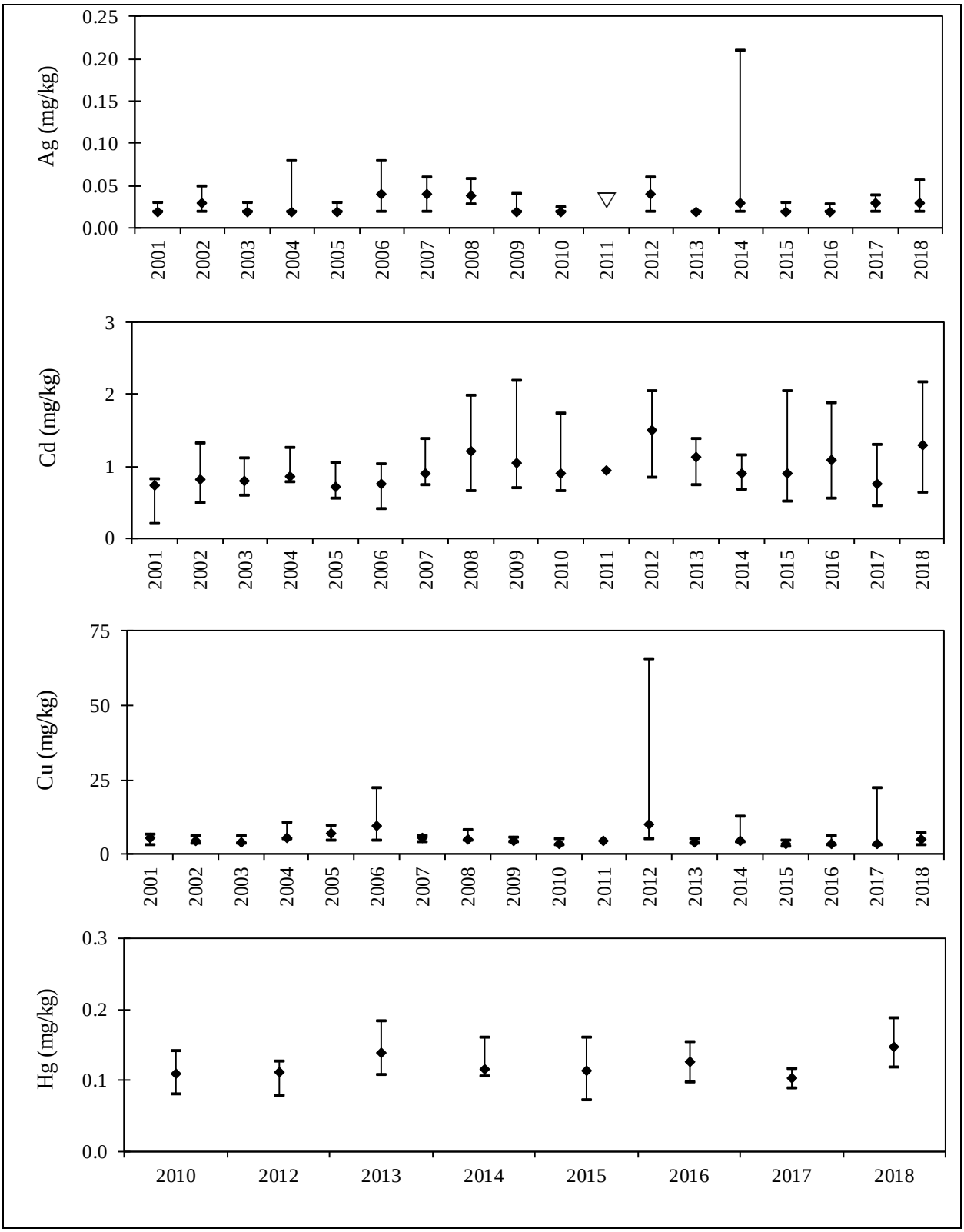


Figure 28.–Greens Creek Site 54 whole body Dolly Varden char Ag, Cd, Cu, and Hg concentrations.

Note: Minimum, median, and maximum concentrations presented; element concentrations undetected (▽) are presented at the method reporting limit.

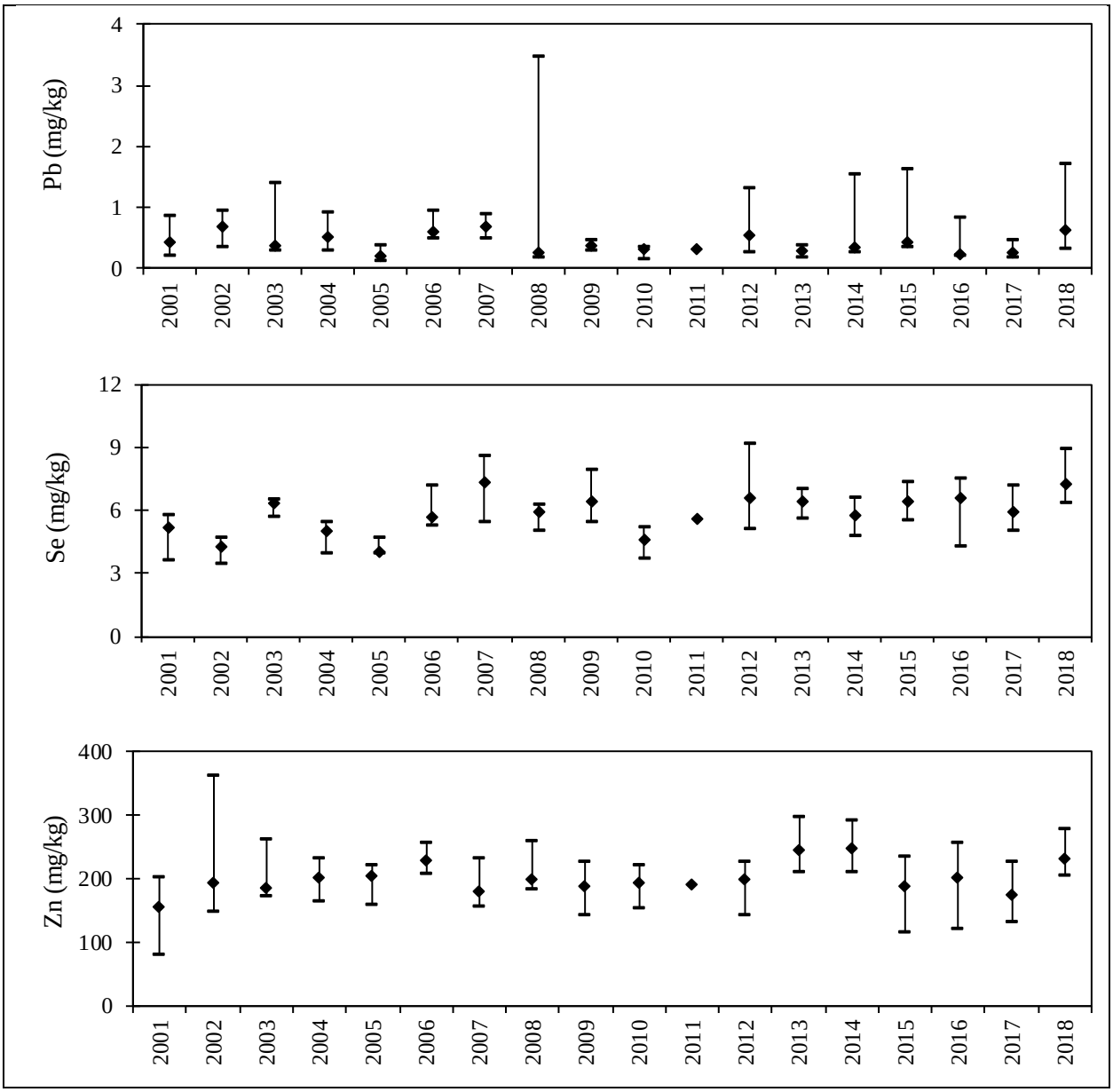


Figure 29.–Greens Creek Site 54 whole body Dolly Varden char Pb, Se, and Zn concentrations.
Note: Minimum, median, and maximum concentrations presented.

TRIBUTARY CREEK SITE 9 AND SITE 1847

We sampled Tributary Creek Site 9 on July 12, 2018. Hecla environmental staff measured basic water quality at 1227: water temperature 13.1 ºC, conductivity 102.7 µS/cm, and pH 7.20. We estimate stream discharge was 0.168 ft^3/s at 0830.

We sampled Tributary Creek Site 1847 on July 12, 2018. Hecla environmental staff measured basic water quality at 1011: water temperature 11.8 ºC, conductivity 109.2 µS/cm, and pH 7.63. We estimate stream discharge was 0.158 ft^3/s at 1245.

Periphyton: Chlorophyll Density and Composition

At Site 9, the 2018 mean Chl-*a* density was 7.69 mg/m^2, within the range observed since 2001 (Figure 30). The samples contained about 88% Chl-*a*, 12% Chl-*c*, and nearly zero Chl-*b*, similar to mean composition in previous years.

At Site 1847, the 2018 mean Chl-*a* density was 8.15 mg/m^2 (Figure 30).[ee] The samples contained about 87% Chl-*a*, 13% Chl-*c*, and nearly zero Chl-*b*.

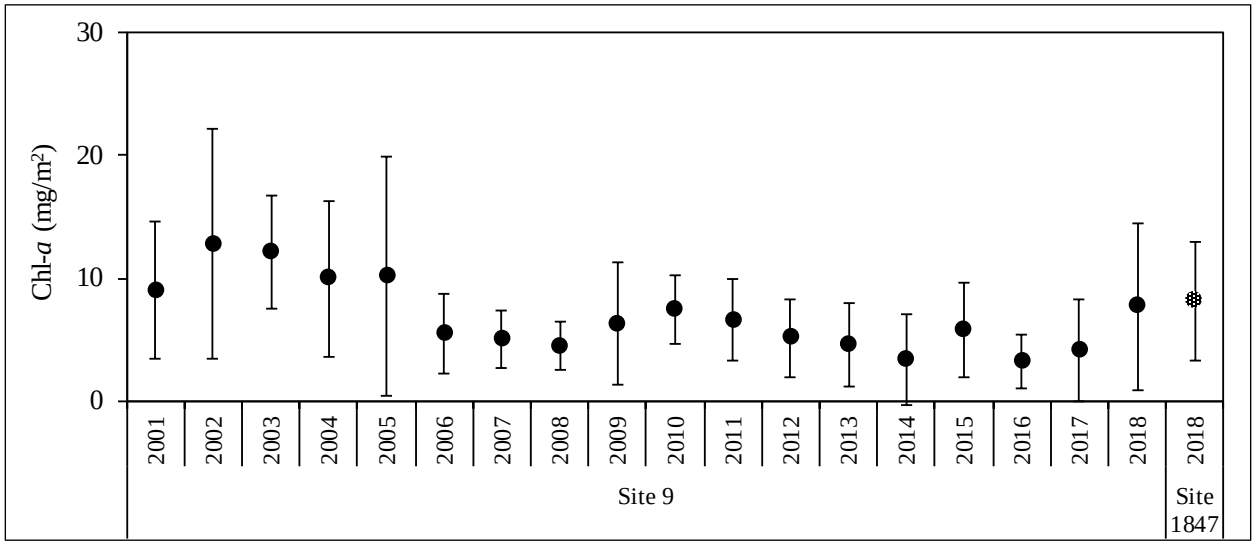


Figure 30.–Tributary Creek Site 9 and Site 1847 mean chlorophyll *a* densities ± 1 SD.

Benthic Macroinvertebrate Density and Community Composition

Among the 2018 Site 9 BMI samples, we counted 25 taxa and estimate mean density at 1,243 BMI/m^2, similar to previous years (Figure 31). EPT insects accounted for 32% of the samples, the lowest percentage observed since 2001 (Figure 32). Dominant taxa were Diptera: Chironomidae and *Prosimulium*, representing 35% and 13% of the samples.

Among the 2018 Site 1847 BMI samples, we counted 29 taxa and estimate mean density at 2,192 BMI/m^2. EPT insects accounted for 53% of the samples (Figure 32). Dominant taxa were Diptera: Chironomidae and Ephemeroptera: *Cinygmula*, representing 29% and 23% of the samples.

[ee] The 2018 Site 1847 data set includes 9 valid sample results, as we experienced a turbidity error for 1 sample during laboratory processing.

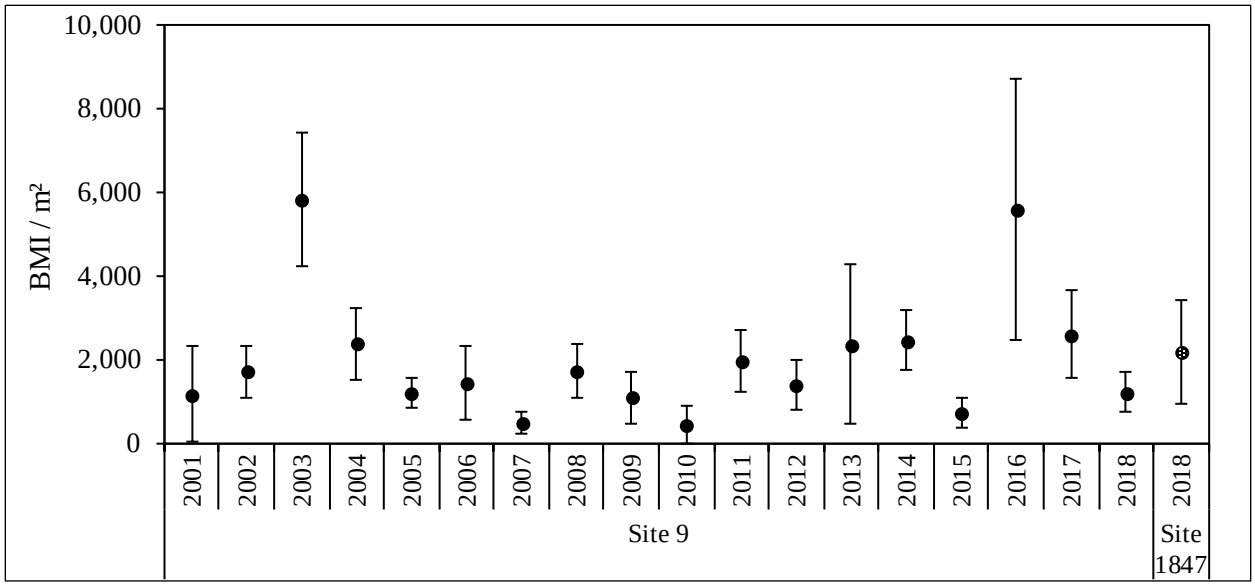


Figure 31.–Tributary Creek Site 9 and Site 1847 mean benthic macroinvertebrate densities ± 1 SD.

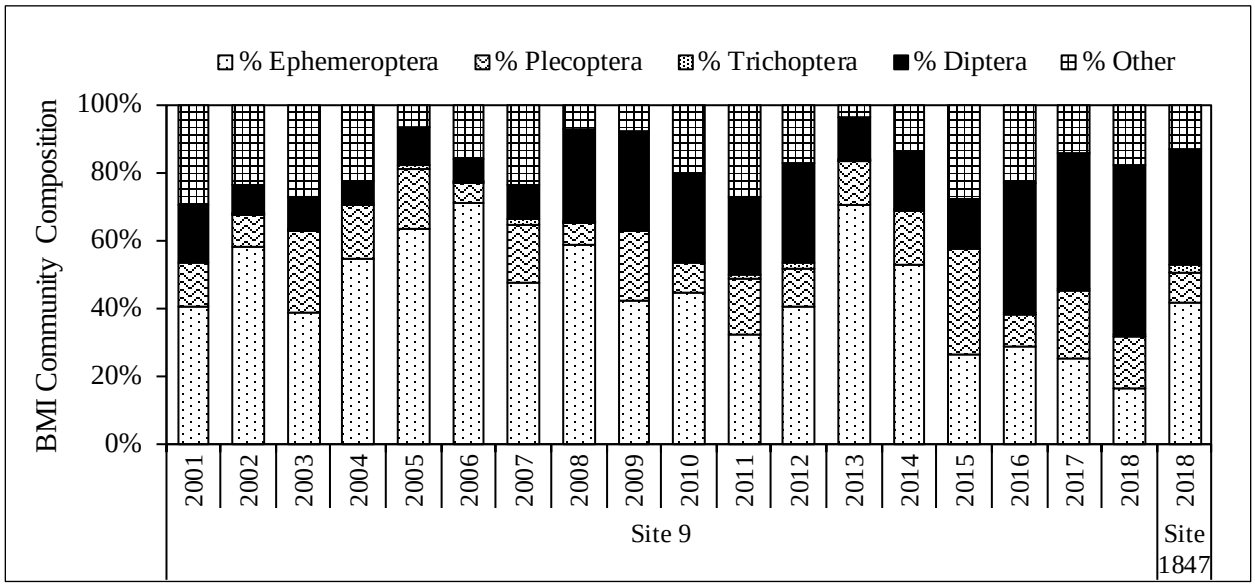


Figure 32.–Tributary Creek Site 9 and Site 1847 mean benthic macroinvertebrate community composition.

Juvenile Fish Populations and Fish Condition

At Site 9, we estimate the 2018 Dolly Varden char population was 33 ± 2 fish, similar to previous years (Figure 33). Mean condition for the 32 Dolly Varden char we captured was 1.0 and the length frequency diagram suggests multiple age classes were present, as in previous years. We estimate the coho salmon population at 59 ± 9 fish, within the range observed since 2001 (Figure 33). Mean condition for the 53 coho salmon we captured was 1.1 and the length frequency diagram suggests two age classes were present, as in previous years.

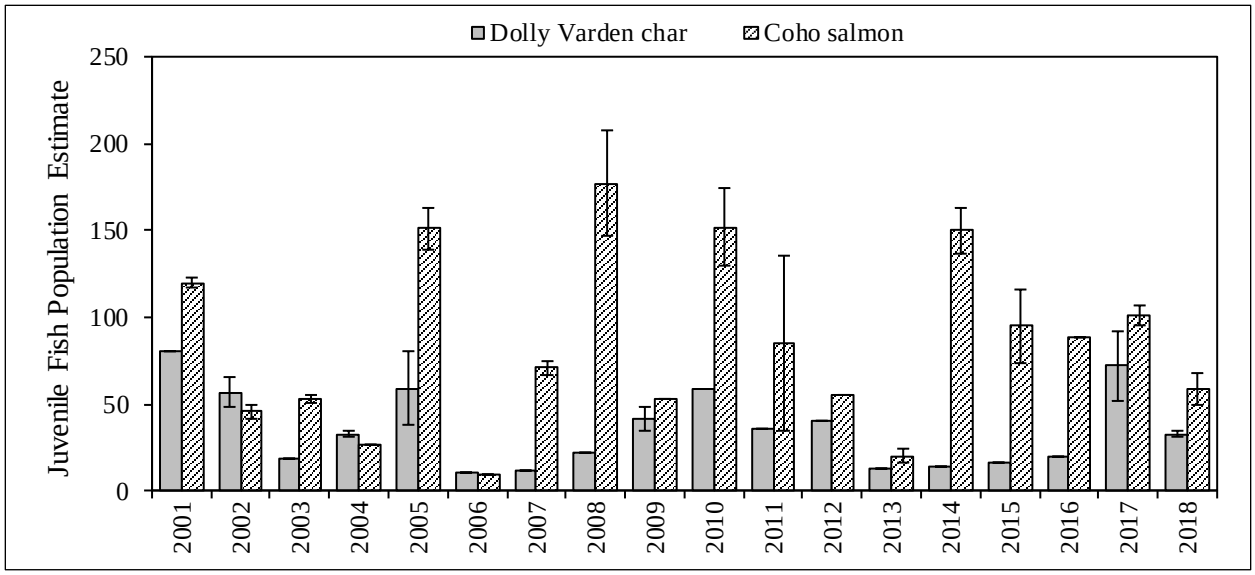


Figure 33.–Tributary Creek Site 9 juvenile fish population estimates ± 95% CI.

Juvenile Fish Element Concentrations

Ag, Cd, Cu, Hg, Pb, Se, and Zn concentrations among the 2018 whole body Dolly Varden char samples generally were within the range of values observed since 2001 (Figures 34, 35).

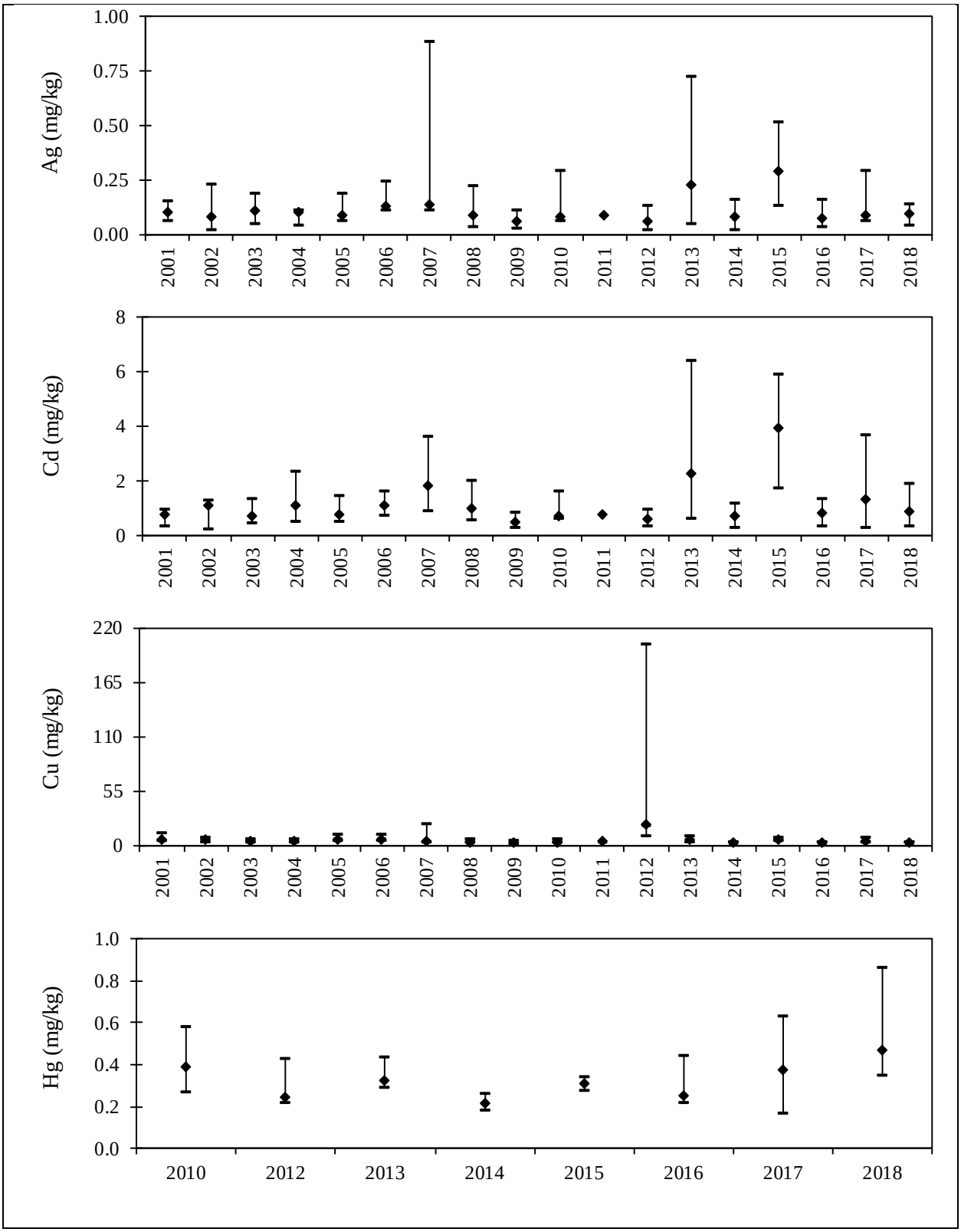


Figure 34.–Tributary Creek Site 9 whole body Dolly Varden char Ag, Cd, Cu, and Hg concentrations.
Note: Minimum, median, and maximum concentrations presented.

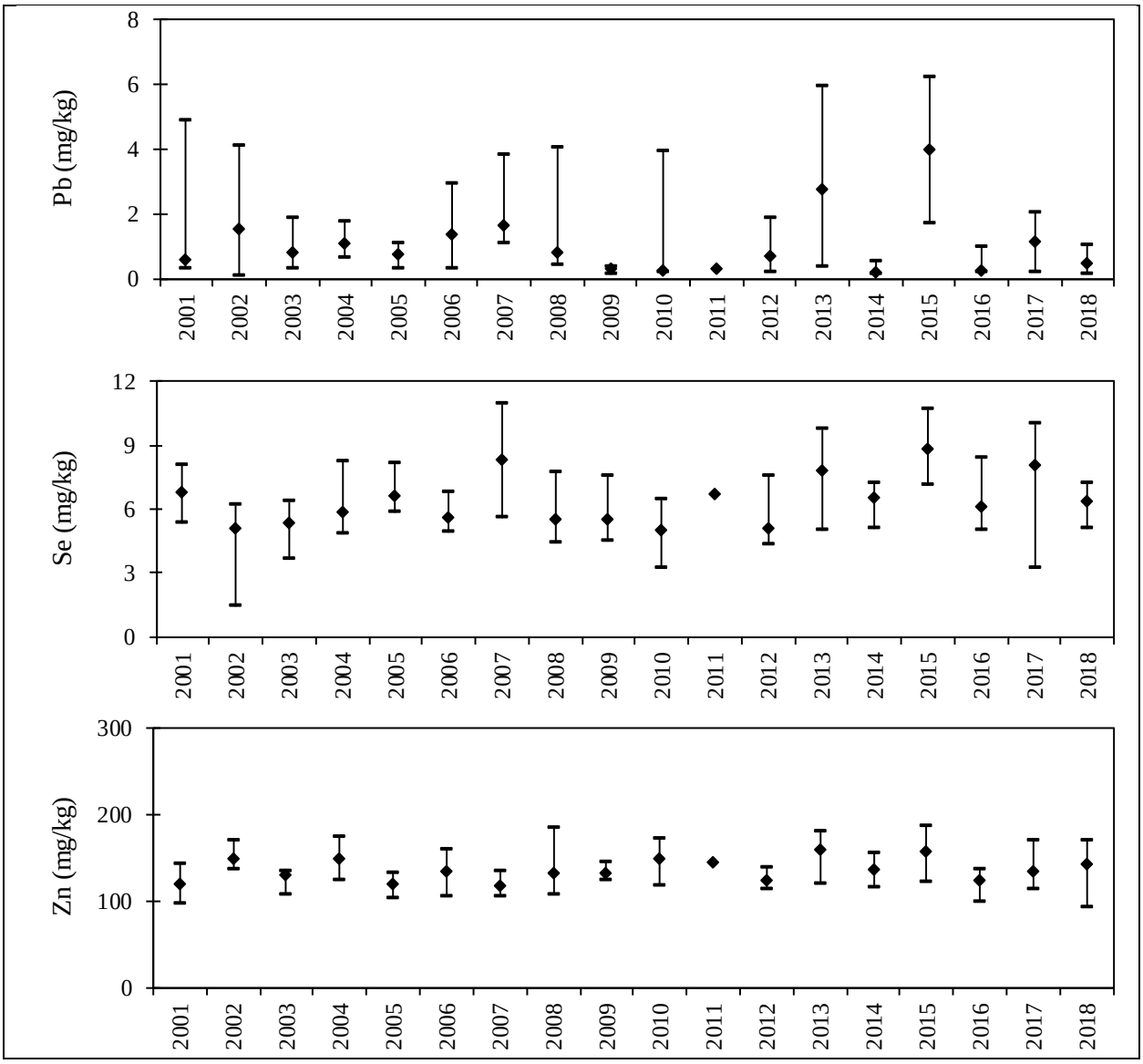


Figure 35.–Tributary Creek Site 9 whole body Dolly Varden char Pb, Se, and Zn concentrations.
Note: Minimum, median, and maximum concentrations presented.

COMPARISONS AMONG GREENS CREEK SITES

Periphyton: Chlorophyll Density and Composition

The 2018 Site 63 Chl-*a* sample densities were not significantly different when compared to the 2018 Site 54 sample data. Mean Chl-*a* densities at Site 48 and Site 54 generally followed a similar trend 2001–2017, and the 2018 mean Chl-*a* densities at Site 63 and Site 54 were elevated (Figure 36). Greens Creek discharges were low prior to sampling in 2003, 2004, and 2018 and may have contributed to greater Chl-*a* densities those years, while greater discharges prior to sampling in 2007, 2008, 2012, and 2017 may explain lower Chl-*a* densities observed those years.

Periphyton samples collected at Site 48, Site 63, and Site 54 generally contained about 90% Chl-*a*, zero or nearly zero Chl-*b*, and about 10% Chl-*c* each year.

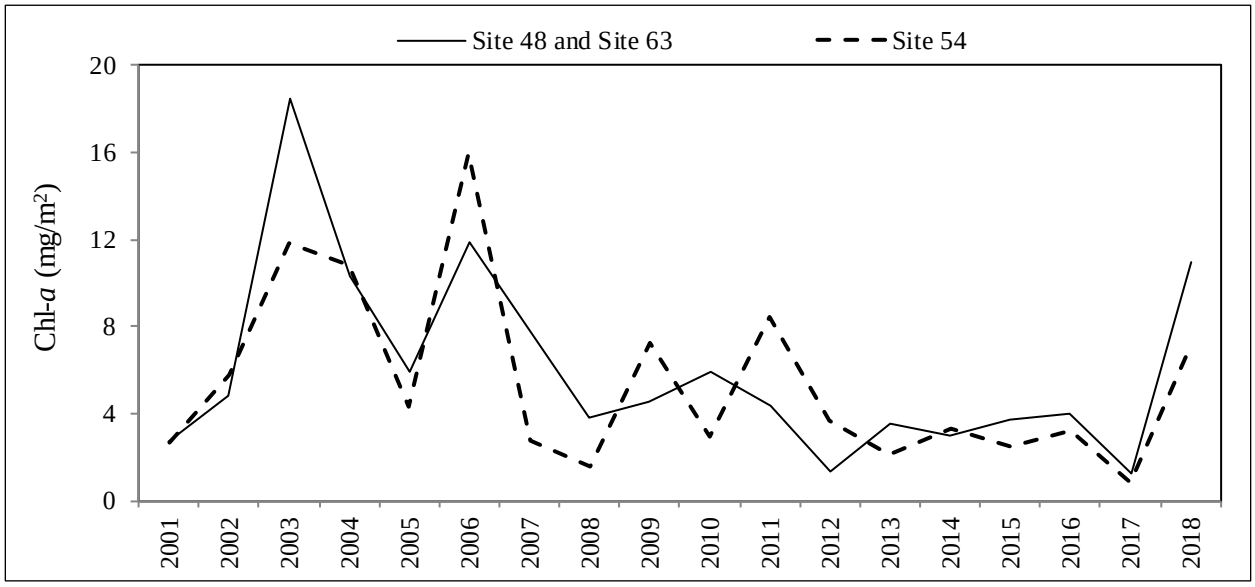


Figure 36.–Greens Creek mean chlorophyll *a* densities.
Note: Site 48 data collected 2001–2017, and Site 63 data collected in 2018.

Benthic Macroinvertebrate Density and Community Composition

Mean benthic macroinvertebrate density and taxonomic richness among Site 48 and Site 54 samples generally followed similar trends 2001–2017, and we observed similar mean densities and richness at Site 63 and Site 54 in 2018 (Figures 37, 38). EPT insects usually comprised more than 80% of the organisms among samples at each site, each year.

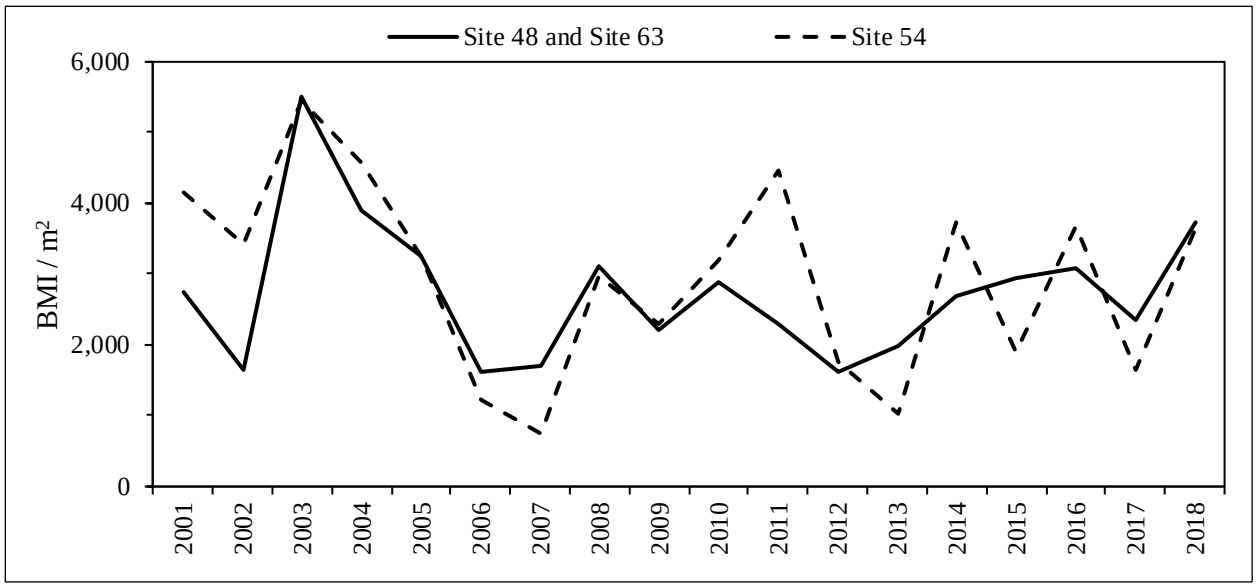


Figure 37.–Greens Creek mean benthic macroinvertebrate densities.
Note: Site 48 data collected 2001–2017, and Site 63 data collected in 2018.

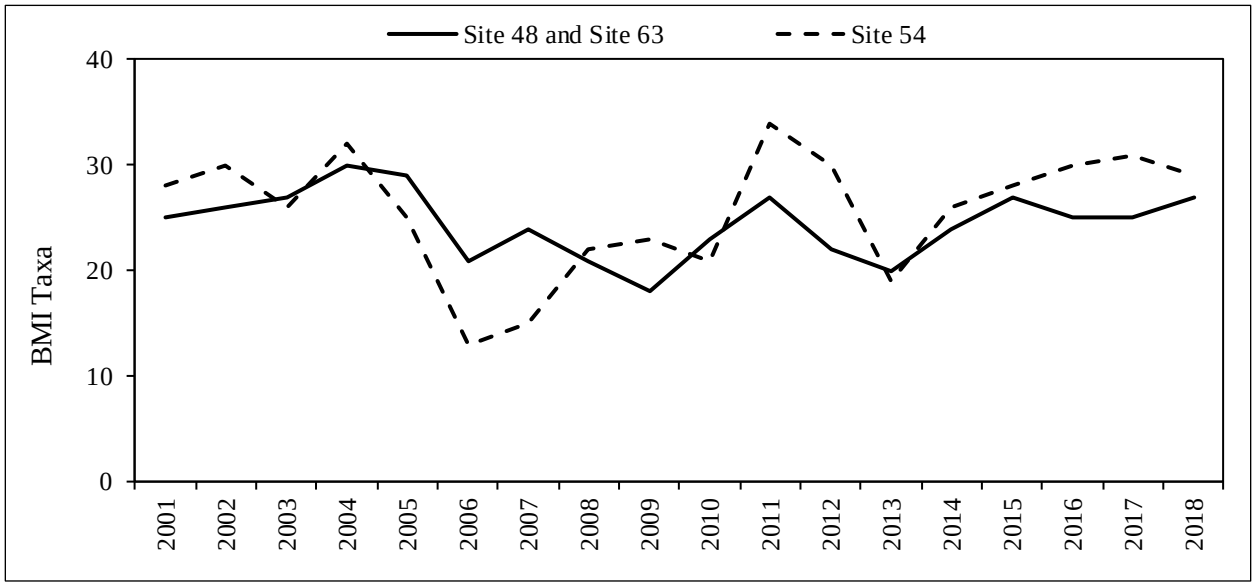


Figure 38.–Greens Creek benthic macroinvertebrate taxa richness.
Note: Site 48 data collected 2001–2017, and Site 63 data collected in 2018.

Juvenile Fish Populations and Fish Condition

The 2018 Site 54 Dolly Varden char population estimate was greater than the Site 63 population estimate. Population estimates among Site 48 and Site 54 generally followed a similar trend from 2001 to 2016, and we usually captured more Dolly Varden char at Site 54 (Figure 39). We captured several age classes of Dolly Varden char at all sites most years, and mean fish condition was similar among sites each year, about 1.0.

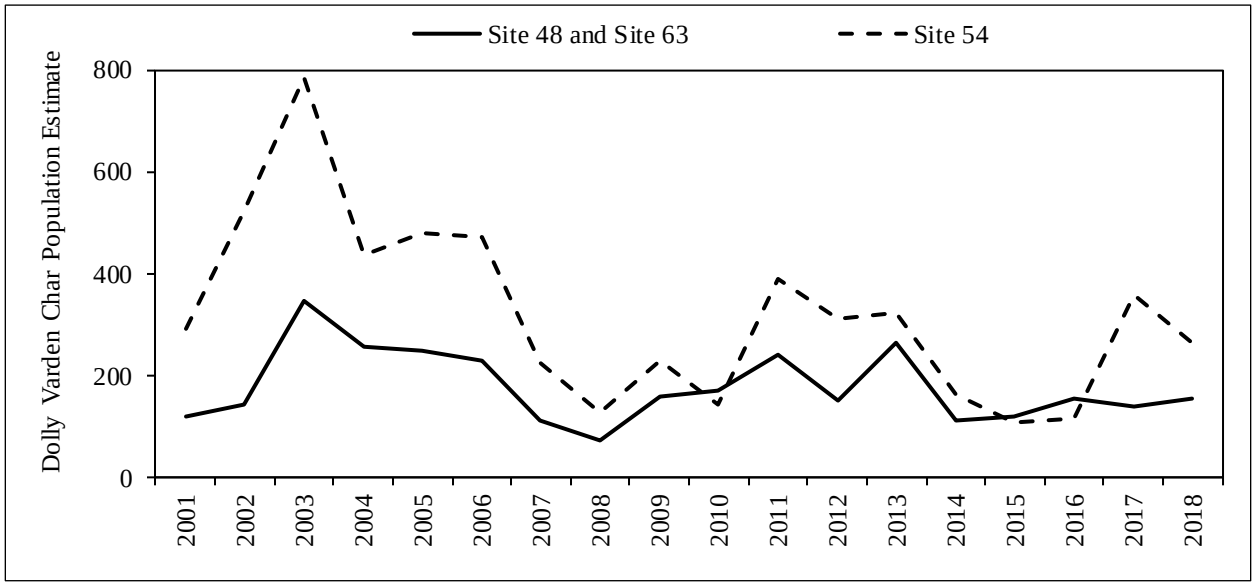


Figure 39.–Greens Creek Dolly Varden char population estimates.
Note: Site 54 2001–2010 data extrapolated to 50 m sample reach for comparison.
Note: Site 48 data collected 2001–2017, and Site 63 data collected in 2018.

Juvenile Fish Element Concentrations

We did not find significant differences between the 2018 Greens Creek Site 63 and Site 54 whole body Dolly Varden char element concentrations data.

COMPARISONS AMONG SITES

Juvenile Fish Element Concentrations

Comparing the 2018 Greens Creek and Tributary Creek whole body Dolly Varden char element concentrations data (Figure 40), the Site 9 mean ranks for Ag, Cu, Hg, Se, and Zn concentrations were significantly different than the mean ranks for Site 63 and Site 54.

The 2018 results were within the range of values reported for reference and exploration sites elsewhere in Alaska (Legere and Timothy 2016).

Since 2001, the Tributary Creek Site 9 whole body Dolly Varden char samples contained greater concentrations and variability than the Greens Creek samples, except Cu and Zn which were generally greater at Site 48 (Figures 41, 42).

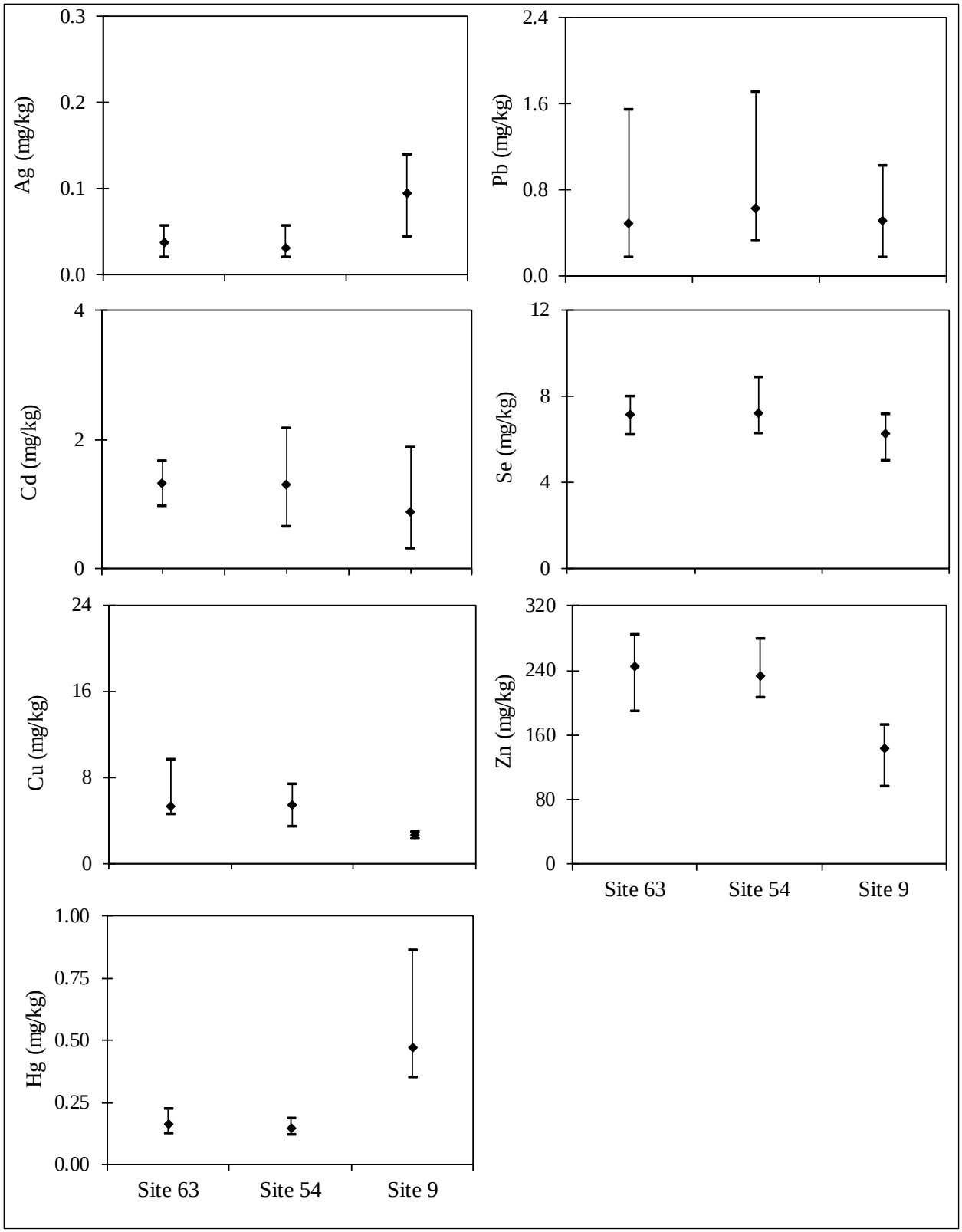


Figure 40.–2018 Greens Creek and Tributary Creek whole body Dolly Varden char element concentrations.

Note: Minimum, median, and maximum whole body concentrations presented.

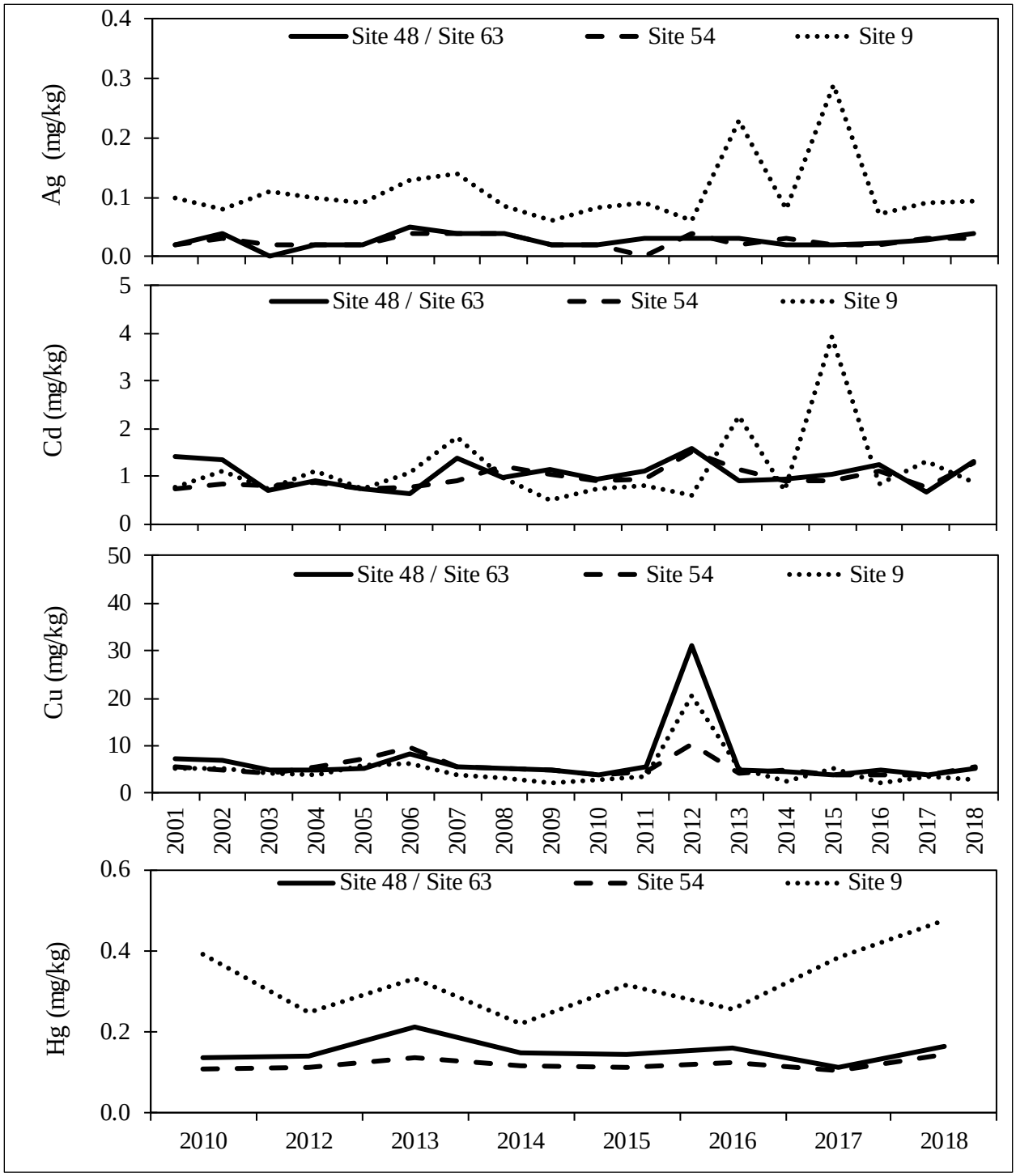


Figure 41.–Greens Creek and Tributary Creek whole body Dolly Varden char median Ag, Cd, Cu, and Hg concentrations.

Note: Solid line 2001–2017 is Site 48 and 2018 is Site 63.

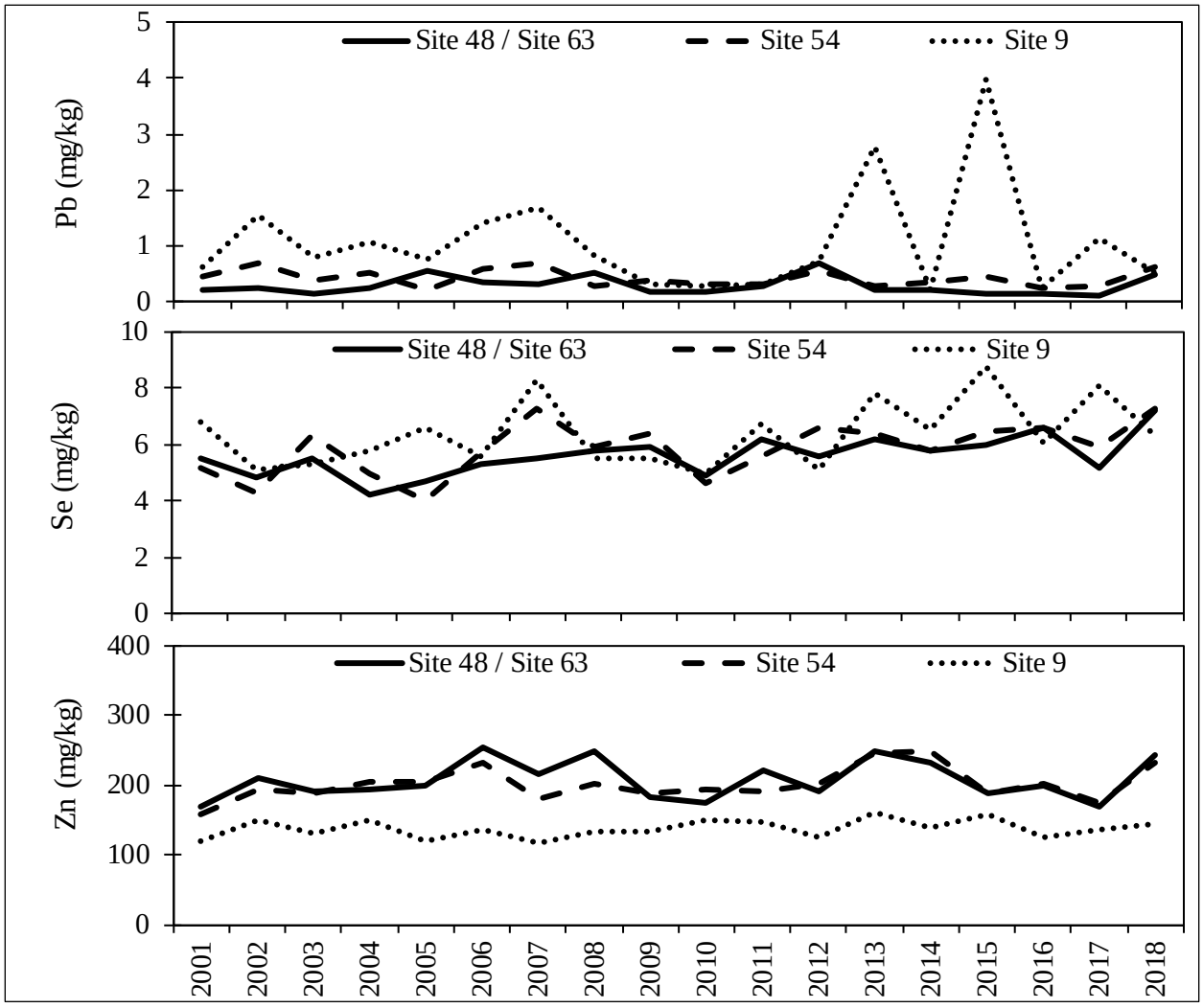


Figure 42.–Greens Creek and Tributary Creek whole body Dolly Varden char median Pb, Se, and Zn concentrations.

Note: Solid line 2001–2017 is Site 48 and 2018 is Site 63.

REFERENCES CITED

Anderson, R. O. and R. M. Neumann, 1996. Length, weight, and associated structural indices. Pages 447–481 [*In*] B. R. Murphy and D.W. Willis, editors. Fisheries Techniques. 2nd edition. American Fisheries Society, Bethesda, MD.

APHA (American Public Health Association). 2012. Standard Methods for the examination of water and wastewater. Section 1020.H.2. 22nd Edition. American Public Health Association, Washington DC.

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J. B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates and fish. 2nd edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Brewster, B. P. 2016. Aquatic biomonitoring at Greens Creek Mine, 2015. Alaska Department of Fish and Game, Technical Report No. 16-04, Douglas, AK.

Bryant, M. D. 2000. Estimating fish populations by removal methods with minnow traps in Southeast Alaska streams. North American Journal of Fisheries Management 20:923–930.

Carle, F. L., and M. R. Strub. 1978. A new method for estimating population size from removal data. Biometrics 34:621–630.

Durst, J. D., and A. H. Townsend. 2004. Aquatic biomonitoring at Greens Creek Mine, 2003. Alaska Department of Natural Resources, Office of Habitat Management and Permitting, Technical Report No. 04-04, Juneau, AK.

Durst, J. D., A. H. Townsend, and J. P. Cariello. 2005. Aquatic biomonitoring at Greens Creek Mine, 2004. Alaska Department of Natural Resources, Office of Habitat Management and Permitting, Technical Report No. 05-04, Juneau, AK.

Durst, J. D., and L. L. Jacobs. 2006. Aquatic biomonitoring at Greens Creek Mine, 2005. Alaska Department of Natural Resources, Office of Habitat Management and Permitting, Technical Report No. 06-01, Juneau, AK.

Durst, J. D., and L. L. Jacobs. 2007. Aquatic biomonitoring at Greens Creek Mine, 2006. Alaska Department of Natural Resources, Office of Habitat Management and Permitting, Technical Report No. 07-02, Juneau, AK.

Durst, J. D., and L. L. Jacobs. 2008. Aquatic biomonitoring at Greens Creek Mine, 2007. Alaska Department of Natural Resources, Office of Habitat Management and Permitting, Technical Report No. 08-03, Juneau, AK.

Durst, J. D., and L. L. Jacobs. 2009. Aquatic biomonitoring at Greens Creek Mine, 2008. Alaska Department of Fish and Game, Technical Report No. 09-02, Juneau, AK.

Durst, J. D., and L. L. Jacobs. 2010. Aquatic biomonitoring at Greens Creek Mine, 2009. Alaska Department of Fish and Game, Technical Report No. 10-03, Juneau, AK.

Hecla. 2014. General plan of operations. Appendix 1: Integrated Monitoring Plan.

Jacobs, L. L., P. W. Scannell, and B. Morris. 2003. Aquatic biomonitoring at Greens Creek Mine, 2002. Alaska Department of Fish and Game, Technical Report No. 03-04, Juneau, AK.

Johnson, J. and B. Blossom. 2018. Catalog of waters important for the spawning, rearing, or migration of anadromous fishes – Southeastern Region. Effective June 1, 2018. Alaska Department of Fish and Game, Special Publication No. 18-05, Anchorage, AK.

Kanouse, K. M. 2011. Aquatic biomonitoring at Greens Creek Mine, 2010. Alaska Department of Fish and Game, Technical Report No. 11-02, Douglas, AK.

Kanouse, K. M. 2012. Aquatic biomonitoring at Greens Creek Mine, 2011. Alaska Department of Fish and Game, Technical Report No. 12-03, Douglas, AK.

Kanouse, K. M. and B. P. Brewster. 2013. Aquatic biomonitoring at Greens Creek Mine, 2012. Alaska Department of Fish and Game, Technical Report No. 12-11. Douglas, AK.

Kanouse, K. M. and B. P. Brewster. 2014. Aquatic biomonitoring at Greens Creek Mine, 2013. Alaska Department of Fish and Game, Technical Report No. 14-05, Douglas, AK.

REFERENCES CITED, CONTINUED

Kanouse, K. M. 2015. Aquatic biomonitoring at Greens Creek Mine, 2014. Alaska Department of Fish and Game, Technical Report No. 15-03, Douglas, AK.

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

Lockwood, R. N., and J. C. Schneider. 2000. Stream fish population estimates by mark-and-recapture and depletion methods. [*In*] J. C. Schneider, editor. 2000. Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor, MI.

Magnus, D. L., D. Brandenburger, K. F. Crabtree, K. A. Pahlke, and S. A. McPherson. 2006. Juvenile salmon capture and coded wire tagging manual. Alaska Department of Fish and Game, Special Publication No. 06-31, Anchorage, AK.

Merritt, R. W. and K. W. Cummins, editors. 1996. An introduction to the aquatic insects of North America. 3rd edition. Kendall/Hunt Publishing Co., Dubuque, IA.

Neter, J., W. Wasserman, and M. H. Kutner. 1990. Applied linear statistical models: Regression, analysis of variance, and experimental designs. Homewood, IL: Irwin.

National Weather Service. 2019. Preliminary annual and monthly climatological reports. https://w2.weather.gov/climate/index.php?wfo=pajk (Accessed March 27, 2019).

Paustian, S. 2010. Channel type user guide revision 2010. U.S. Department of Agriculture, Forest Service, R-10-TP-26.

Platts, W. S., W. F. Megahan, and G. W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. Gen. Tech. Rep. INT-138. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 70 p.

Pollard, W. R., G. F. Hartman, C. Groot, and P. Edgell. 1997. Field identification of coastal juvenile salmonids. Department of Fisheries and Oceans, Vancouver, BC.

SonTek YSI Inc. 2007. FlowTracker Handheld ADV Technical Manual. San Diego, CA. https://www.uvm.edu/bwrl/lab_docs/manuals/Flow_Tracker_Manual.pdf. (accessed April 5, 2017).

Stewart, K. W. and M. W. Oswood. 2006. The stoneflies (Plecoptera) of Alaska and Western Canada. The Caddis Press, Columbus, OH.

USEPA. 1994. Method 200.8, Revision 5.4: Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry. U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Office of Research and Development, Cincinnati, OH.

USEPA. 1997. Method 446.0: In vitro determination of chlorophylls a, b, c1 + c2 and pheopigments in marine and freshwater algae by visible spectrophotometry. Adapted by Elizabeth J. Arar, Revision 1.2, September 1997. U.S. Environmental Protection Agency, National Exposure Research Laboratory, Cincinnati, OH.

USEPA. 2002. Method 1631 Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry. U. S. Environmental Protection Agency, Office of Water, Washington, D.C.

USFS. 2003. Greens Creek tailings disposal final environmental impact statement. U.S. Department of Agriculture, Forest Service, Alaska Region.

USFS. 2013. Greens Creek Mine tailings disposal facility expansion final environmental impact statement and record of decision. U.S. Department of Agriculture, Forest Service, Alaska Region.

USGS. 2019. National Water Information System: USGS 15101490 Greens Creek at Greens Creek Mine near Juneau, AK. http://waterdata.usgs.gov/nwis/uv?site_no=15101490 (Accessed March 14, 2019).

Weber Scannell, P., and S. Paustian. 2002. Aquatic biomonitoring at Greens Creek Mine, 2001. Alaska Department of Fish and Game, Technical Report No. 02-03, Juneau, AK.

REFERENCES CITED, CONTINUED

White, G. C., D. R. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory LA-8787-NERP, Los Alamos, NM.

Zutz, J. 2017. Aquatic biomonitoring at Greens Creek Mine, 2016. Alaska Department of Fish and Game, Technical Report No. 17-03, Douglas, AK.

Zutz, J. 2018. Aquatic biomonitoring at Greens Creek Mine, 2017. Alaska Department of Fish and Game, Technical Report No. 18-01, Douglas, AK.

APPENDIX A: CHLOROPHYLL DATA

Appendix A.1.–Greens Creek Site 48 chlorophylls *a*, *b*, and *c* densities, 2001–2017.

	7/23/2001			7/23/2002			7/22/2003			7/21/2004		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	1.91	0.01	0.14	5.34	0.00	0.29	12.92	0.00	1.26	18.05	0.00	2.03
	1.83	0.00	0.18	4.27	0.00	0.21	8.65	0.03	1.57	6.73	0.00	0.69
	5.61	0.00	0.69	6.62	0.00	0.71	3.84	0.09	0.39	8.97	0.00	0.90
	0.31	0.08	0.06	2.99	0.00	0.25	12.18	0.01	0.64	12.82	0.00	1.45
	2.96	0.04	0.36	5.34	0.00	0.75	17.19	0.00	0.72	5.45	0.00	0.62
	5.44	0.00	0.62	6.62	0.00	0.75	17.19	0.02	0.86	20.40	0.00	2.15
	3.38	0.00	0.47	6.09	0.00	0.73	33.21	0.00	2.14	6.30	0.00	0.45
	1.87	0.03	0.15	ND	ND	ND	24.24	0.13	0.99	11.64	0.00	1.38
	2.63	0.14	0.14	2.99	0.00	0.36	19.76	0.00	0.57	7.48	0.00	0.65
	1.23	0.02	0.16	2.78	0.00	0.15	35.35	0.00	0.89	5.23	0.00	0.55
mean	2.72	0.03	0.30	4.78	0.00	0.47	18.45	0.03	1.00	10.31	0.00	1.09
minimum	0.31	0.00	0.06	2.78	0.00	0.15	3.84	0.00	0.39	5.23	0.00	0.45
maximum	5.61	0.14	0.69	6.62	0.00	0.75	35.35	0.13	2.14	20.40	0.00	2.15

	7/22/2005			7/20/2006			7/20/2007			7/22/2008		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	0.85	0.00	0.01	8.33	0.00	0.80	6.62	0.00	0.16	1.50	0.00	0.09
	4.70	0.00	0.51	11.43	0.00	0.71	5.55	0.00	0.23	4.70	0.00	0.16
	6.62	0.00	0.27	10.68	0.00	1.25	7.48	0.00	0.33	2.67	0.00	0.24
	6.19	0.00	0.51	20.08	0.00	2.04	11.64	0.00	1.39	2.14	0.00	0.17
	11.11	0.00	0.92	10.57	0.00	0.98	6.94	0.00	0.47	0.85	0.00	0.02
	5.66	0.00	0.51	14.10	0.00	1.72	11.11	0.00	0.54	12.60	0.00	0.33
	7.69	0.00	0.53	16.98	0.00	1.76	11.75	0.01	0.60	2.78	0.00	0.19
	5.13	0.00	0.29	5.23	0.00	1.74	4.81	0.00	0.29	6.30	0.00	0.74
	2.46	0.02	0.28	16.87	0.00	1.73	8.12	0.00	1.10	1.28	0.00	0.14
	9.08	0.00	0.63	4.38	0.00	0.54	4.06	0.00	0.43	3.20	0.00	0.37
mean	5.95	0.00	0.45	11.87	0.00	1.33	7.81	0.00	0.55	3.80	0.00	0.25
minimum	0.85	0.00	0.01	4.38	0.00	0.54	4.06	0.00	0.16	0.85	0.00	0.02
maximum	11.11	0.02	0.92	20.08	0.00	2.04	11.75	0.01	1.39	12.60	0.00	0.74

	7/21/2009			7/20/2010			7/21/2011			7/21/2012		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	3.20	0.00	0.49	8.54	0.00	0.44	4.49	0.00	0.50	**0.36**	ND	ND
	1.50	0.00	0.25	4.59	0.00	0.61	6.51	0.00	0.59	0.69	0.00	0.10
	4.17	0.11	0.59	5.13	0.00	0.27	2.88	0.00	0.30	1.29	0.00	0.12
	5.66	0.07	0.73	3.10	0.00	0.26	2.59	0.17	0.05	2.56	0.00	0.39
	3.42	0.06	0.50	7.58	0.00	0.29	3.31	0.00	0.36	0.85	0.00	0.00
	8.22	0.13	0.95	5.55	0.00	0.55	5.13	0.00	0.55	1.60	0.00	0.26
	0.43	0.11	0.11	10.68	0.00	0.64	7.16	0.00	1.06	1.82	0.00	0.29
	1.39	0.18	0.29	7.69	0.00	0.41	5.66	0.00	0.49	1.92	0.00	0.28
	7.80	0.00	0.89	3.63	0.00	0.25	0.85	0.00	0.11	0.32	0.00	0.08
	9.18	0.17	1.19	3.10	0.02	0.15	4.81	0.00	0.49	1.60	0.00	0.16
mean	4.50	0.08	0.60	5.96	0.00	0.39	4.34	0.02	0.45	1.30	0.00	0.19
minimum	0.43	0.00	0.11	3.10	0.00	0.15	0.85	0.00	0.05	0.32	0.00	0.00
maximum	9.18	0.18	1.19	10.68	0.02	0.64	7.16	0.17	1.06	2.56	0.00	0.39

-continued-

	7/24/2013			7/24/2014			7/15/2015			7/12/2016		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	2.03	0.00	0.12	4.81	0.00	0.31	2.14	0.00	0.18	4.38	0.00	0.60
	1.50	0.00	0.11	0.60	0.00	0.12	11.96	0.00	0.90	3.84	0.00	0.43
	4.59	0.00	0.33	1.60	0.00	0.10	4.70	0.00	0.31	7.58	0.00	0.88
	2.03	0.00	0.19	6.62	0.00	0.00	3.31	0.00	0.24	6.51	0.00	0.75
	6.94	0.00	0.38	ND	ND	ND	5.55	0.00	0.25	2.24	0.00	0.26
	6.62	0.00	0.39	5.66	0.00	0.33	2.46	0.00	0.18	2.99	0.00	0.47
	1.60	0.00	0.26	0.55	0.00	0.02	1.38	0.00	0.08	3.20	0.00	0.45
	1.39	0.00	0.07	0.43	0.00	0.07	2.35	0.00	0.05	2.35	0.00	0.31
	3.74	0.00	0.46	1.24	0.00	0.03	2.99	0.00	0.22	2.67	0.00	0.31
	5.23	0.00	0.70	5.02	0.24	0.38	0.43	0.00	0.03	4.49	0.00	0.61
mean	3.57	0.00	0.30	2.95	0.03	0.15	3.73	0.00	0.24	4.03	0.00	0.51
minimum	1.39	0.00	0.07	0.43	0.00	0.00	0.43	0.00	0.03	2.24	0.00	0.26
maximum	6.94	0.00	0.70	6.62	0.24	0.38	11.96	0.00	0.90	7.58	0.00	0.88

	7/12/2017		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*
	0.55	0.00	0.02
	0.64	0.00	0.07
	0.43	0.01	0.04
	2.99	0.00	0.39
	0.96	0.00	0.09
	0.64	0.00	0.16
	2.14	0.00	0.28
	1.70	0.00	0.26
	0.96	0.00	0.09
	0.96	0.00	0.10
mean	1.20	0.00	0.15
minimum	0.43	0.00	0.02
maximum	2.99	0.01	0.39

Appendix A.2.–Greens Creek Site 63 chlorophylls *a*, *b*, and *c* densities, 2018.

	7/11/2018		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*
	ND	ND	ND
	5.45	0.00	0.79
	9.29	0.00	1.77
	7.37	0.00	0.87
	ND	ND	ND
	23.07	0.00	4.01
	8.22	0.00	0.96
	4.38	0.00	0.64
	15.06	0.00	2.28
	14.63	0.00	2.28
mean	10.93	0.00	1.70
minimum	4.38	0.00	0.64
maximum	23.07	0.00	4.01

Appendix A.3.–Greens Creek Site 54 chlorophylls *a*, *b*, and *c* densities, 2001–2018.

	7/23/2001			7/23/2002			7/22/2003			7/21/2004		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	1.60	0.01	0.15	2.88	0.00	0.30	13.24	0.00	1.05	17.19	0.00	2.02
	3.10	0.05	0.41	9.61	0.00	1.02	8.33	0.00	0.79	9.72	0.00	0.93
	3.61	0.00	0.21	8.12	0.00	0.24	14.20	0.00	1.45	8.76	0.00	0.67
	2.97	0.00	0.29	4.49	0.00	0.38	6.09	0.00	0.62	32.04	0.00	3.66
	1.88	0.00	0.01	5.34	0.00	0.53	15.49	0.00	1.74	5.23	0.00	0.42
	1.78	0.00	0.19	2.46	0.87	1.26	10.68	0.00	1.06	3.74	0.00	0.31
	4.95	0.00	0.22	6.51	0.00	0.64	5.55	0.00	0.39	12.82	0.00	1.35
	1.46	0.00	0.10	4.91	0.00	0.40	16.34	0.00	1.72	1.92	0.03	0.09
	1.69	0.00	0.14	4.81	0.00	0.45	12.60	0.00	1.07	10.47	0.00	1.09
	3.48	0.00	0.16	8.44	0.00	0.79	16.02	0.00	1.75	5.98	0.00	0.53
mean	2.65	0.01	0.19	5.76	0.09	0.60	11.85	0.00	1.16	10.79	0.00	1.11
minimum	1.46	0.00	0.01	2.46	0.00	0.24	5.55	0.00	0.39	1.92	0.00	0.09
maximum	4.95	0.05	0.41	9.61	0.87	1.26	16.34	0.00	1.75	32.04	0.03	3.66

	7/22/2005			7/20/2006			7/20/2007			7/22/2008		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	10.36	0.00	0.54	19.54	0.00	1.62	0.43	0.04	0.04	2.99	0.00	0.29
	2.56	0.00	0.26	5.66	0.00	0.76	**0.24**	ND	ND	1.17	0.02	0.00
	3.31	0.00	0.17	28.73	0.00	1.19	1.39	0.04	0.11	1.50	0.00	0.19
	2.88	0.00	0.12	23.28	0.00	2.63	4.27	0.00	0.48	1.71	0.00	0.13
	5.66	0.00	0.38	4.59	0.00	0.47	**0.24**	ND	ND	2.24	0.00	0.09
	2.99	0.00	0.13	27.34	0.00	2.22	3.31	0.00	0.38	2.14	0.00	0.11
	4.27	0.00	0.18	4.27	0.00	0.38	8.01	0.00	0.98	2.46	0.00	0.25
	4.38	0.00	0.31	8.86	0.00	0.94	**0.24**	ND	ND	0.96	0.00	0.01
	4.06	0.00	0.16	31.72	0.00	3.17	2.99	0.00	0.39	**0.24**	ND	ND
	3.10	0.00	0.16	5.55	0.00	0.68	6.41	0.00	0.81	**0.24**	ND	ND
mean	4.36	0.00	0.24	15.95	0.00	1.41	2.75	0.01	0.46	1.57	0.00	0.13
minimum	2.56	0.00	0.12	4.27	0.00	0.38	0.24	0.00	0.04	0.24	0.00	0.00
maximum	10.36	0.00	0.54	31.72	0.00	3.17	8.01	0.04	0.98	2.99	0.02	0.29

	7/21/2009			7/20/2010			7/21/2011			7/21/2012		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	8.01	0.11	1.06	2.67	0.00	0.29	9.61	0.00	0.64	5.54	0.00	0.24
	7.58	0.11	1.13	6.73	0.00	0.69	0.43	0.00	0.06	0.11	0.00	0.04
	6.84	0.07	0.89	4.38	0.00	0.74	3.42	0.00	0.32	2.65	0.00	0.11
	9.18	0.09	0.96	2.14	0.00	0.25	3.42	0.00	0.33	1.82	0.00	0.10
	ND	ND	ND	5.23	0.00	0.67	41.76	0.00	3.02	1.07	0.00	0.04
	8.33	0.15	1.11	1.71	0.04	0.25	5.23	0.00	0.64	1.17	0.00	0.13
	11.32	0.20	1.57	1.39	0.02	0.11	10.36	0.00	0.45	0.75	0.00	0.06
	5.34	0.17	0.66	3.20	0.00	0.46	7.16	0.00	0.53	19.54	0.00	1.10
	4.49	0.10	0.63	2.04	0.00	0.21	0.64	0.00	0.07	4.06	0.00	0.30
	4.38	0.10	0.43	0.21	0.01	0.05	2.24	0.00	0.29	0.43	0.01	0.04
mean	7.27	0.12	0.94	2.97	0.01	0.37	8.43	0.00	0.64	3.71	0.00	0.22
minimum	4.38	0.07	0.43	0.21	0.00	0.05	0.43	0.00	0.06	0.11	0.00	0.04
maximum	11.32	0.20	1.57	6.73	0.04	0.74	41.76	0.00	3.02	19.54	0.01	1.10

-continued-

	7/24/2013			7/24/2014			7/15/2015			7/12/2016		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	2.56	0.00	0.26	6.51	0.00	0.60	1.07	0.00	0.13	2.46	0.00	0.19
	2.14	0.00	0.23	4.91	0.00	0.92	1.60	0.00	0.23	3.42	0.00	0.36
	1.28	0.00	0.24	4.59	0.00	0.42	1.82	0.00	0.21	5.66	0.00	0.87
	2.14	0.00	0.37	1.82	0.00	0.11	4.27	0.00	0.34	1.17	0.00	0.11
	0.53	0.00	0.02	7.05	0.00	0.56	6.09	0.00	0.43	1.92	0.00	0.17
	0.43	0.00	0.07	2.67	0.00	0.45	2.46	0.00	0.15	5.77	0.00	0.57
	ND	ND	ND	1.50	0.00	0.17	2.24	0.00	0.16	2.24	0.00	0.27
	2.03	0.00	0.28	2.46	0.00	0.20	1.92	0.00	0.10	2.14	0.00	0.12
	5.87	0.00	0.76	**0.05**	ND	ND	1.33	0.00	0.08	3.52	0.00	0.45
	2.14	0.00	0.21	1.60	0.00	0.26	1.71	0.00	0.15	3.74	0.00	0.36
mean	2.12	0.00	0.27	3.32	0.00	0.41	2.45	0.00	0.20	3.20	0.00	0.35
minimum	0.43	0.00	0.02	0.05	0.00	0.11	1.07	0.00	0.08	1.17	0.00	0.11
maximum	5.87	0.00	0.76	7.05	0.00	0.92	6.09	0.00	0.43	5.77	0.00	0.87

	7/12/2017			7/10/2018		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	1.17	0.00	0.08	10.57	0.00	2.03
	0.19	ND	ND	7.05	0.00	1.13
	0.64	0.00	0.11	9.93	0.00	1.57
	2.99	0.00	0.38	8.12	0.00	1.55
	0.43	0.00	0.07	6.84	0.00	0.84
	0.96	0.00	0.09	1.51	0.00	0.29
	0.85	0.00	0.11	8.54	0.00	1.03
	0.19	ND	ND	6.09	0.00	0.98
	0.37	0.00	0.18	3.63	0.00	0.50
	0.55	0.00	0.12	8.12	0.00	1.16
mean	0.83	0.00	0.14	7.04	0.00	1.11
minimum	0.19	0.00	0.07	1.51	0.00	0.29
maximum	2.99	0.00	0.38	10.57	0.00	2.03

Note: Bold value is the spectrophotometer estimated detection limit; chlorophyll *a* was not detected.

Appendix A.4.–Tributary Creek Site 9 chlorophylls *a*, *b*, and *c* densities, 2001–2018.

	7/23/2001			7/23/2002			7/23/2003			7/21/2004		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	6.62	0.00	0.79	8.91	0.00	0.52	9.61	0.00	1.26	9.40	0.22	0.80
	11.15	0.00	1.20	16.43	0.95	1.28	17.19	0.00	0.79	5.77	0.00	0.42
	15.05	0.00	1.47	12.65	0.17	0.00	7.69	0.00	0.29	5.45	0.00	0.48
	16.58	0.23	1.51	5.44	0.45	0.07	8.76	0.00	1.11	6.09	0.03	0.38
	3.15	0.00	0.33	23.72	1.21	0.84	10.47	0.00	1.92	14.52	0.02	1.40
	2.59	0.06	0.28	12.75	0.40	0.22	10.79	0.00	1.88	6.51	0.17	0.40
	1.61	0.00	0.01	32.53	0.00	1.89	22.64	0.00	3.98	10.36	0.13	0.80
	6.66	0.00	0.43	4.40	1.50	0.00	12.39	0.00	2.43	6.84	0.04	0.36
	15.21	0.81	1.44	2.94	0.30	0.17	8.54	0.00	1.69	26.17	0.51	2.61
	11.55	0.00	1.51	8.01	1.47	0.27	13.03	0.00	3.86	8.44	0.22	0.53
mean	9.02	0.11	0.90	12.78	0.65	0.53	12.11	0.00	1.92	9.96	0.13	0.82
minimum	1.61	0.00	0.01	2.94	0.00	0.00	7.69	0.00	0.29	5.45	0.00	0.36
maximum	16.58	0.81	1.51	32.53	1.50	1.89	22.64	0.00	3.98	26.17	0.51	2.61

	7/23/2005			7/21/2006			7/20/2007			7/23/2008		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	6.09	0.00	0.25	3.42	0.25	0.19	ND	ND	ND	2.35	0.00	0.12
	8.01	1.28	0.18	4.08	0.40	0.20	5.45	0.08	0.23	6.94	0.00	0.27
	1.82	0.13	0.07	6.94	0.00	0.40	7.26	0.00	0.54	6.30	0.24	0.34
	9.08	0.06	0.29	4.11	0.01	0.32	ND	ND	ND	6.41	0.00	0.25
	4.70	0.00	0.10	4.17	0.00	0.39	ND	ND	ND	2.46	0.12	0.19
	4.70	0.00	0.12	4.78	0.00	0.29	0.85	0.16	0.11	6.19	0.05	0.39
	7.80	0.00	0.20	14.16	0.00	0.57	6.41	0.06	0.24	4.06	0.00	0.13
	14.85	0.00	0.46	4.34	0.01	0.21	7.05	0.24	0.65	4.59	0.00	0.37
	36.10	0.10	1.12	5.23	0.00	0.56	5.02	0.00	0.26	1.60	0.00	0.00
	8.97	0.00	0.26	3.66	0.37	0.26	3.20	0.00	0.23	3.74	0.00	0.28
mean	10.21	0.16	0.31	5.49	0.10	0.34	5.03	0.08	0.32	4.46	0.04	0.23
minimum	1.82	0.00	0.07	3.42	0.00	0.19	0.85	0.00	0.11	1.60	0.00	0.00
maximum	36.10	1.28	1.12	14.16	0.40	0.57	7.26	0.24	0.65	6.94	0.24	0.39

	7/22/2009			7/20/2010			7/20/2011			7/26/2012		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	2.03	0.10	0.16	12.82	0.00	0.39	4.81	0.47	0.08	3.63	0.00	0.25
	5.45	0.17	0.38	6.62	0.00	0.39	3.84	0.00	0.12	8.97	0.00	0.33
	4.38	0.24	0.30	7.69	0.00	0.43	4.91	0.00	0.34	10.68	0.00	0.48
	7.05	0.58	0.33	5.66	0.12	0.32	10.47	0.03	0.50	3.74	0.00	0.25
	9.08	0.36	0.49	9.72	0.88	0.40	5.13	0.00	0.37	1.28	0.00	0.04
	8.76	0.41	0.62	5.98	0.00	0.20	1.71	0.00	0.01	1.71	0.00	0.12
	2.14	0.08	0.09	5.55	0.00	0.40	6.30	0.00	0.44	5.66	0.00	0.29
	18.37	0.66	0.78	10.57	0.28	0.34	9.61	0.00	0.35	6.09	0.00	0.26
	2.35	0.18	0.16	4.06	0.05	0.16	12.50	0.00	0.87	2.14	0.00	0.21
	3.20	0.20	0.33	5.77	0.00	0.32	6.30	0.00	0.17	7.37	0.00	0.40
mean	6.28	0.30	0.36	7.44	0.13	0.34	6.56	0.05	0.33	5.13	0.00	0.26
minimum	2.03	0.08	0.09	4.06	0.00	0.16	1.71	0.00	0.01	1.28	0.00	0.04
maximum	18.37	0.66	0.78	12.82	0.88	0.43	12.50	0.47	0.87	10.68	0.00	0.48

-continued-

	7/23/2013			7/23/2014			7/14/2015			7/11/2016		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	11.00	0.00	0.64	ND	ND	ND	5.13	0.00	0.33	5.66	0.00	0.35
	2.88	0.00	0.19	11.21	0.00	0.63	15.06	0.00	0.94	2.24	0.00	0.13
	5.45	0.00	0.40	1.60	0.00	0.17	2.67	0.00	0.14	1.88	0.00	0.21
	5.02	0.00	0.40	5.87	0.00	0.37	3.63	0.00	0.09	1.82	0.00	0.22
	2.24	0.00	0.15	5.98	0.00	0.60	5.55	0.00	0.47	7.80	0.00	0.90
	2.99	0.00	0.17	0.75	0.00	0.06	2.56	0.00	0.11	1.92	0.00	0.26
	9.51	0.00	0.66	1.71	0.00	0.15	2.88	0.21	0.10	1.33	0.00	0.08
	0.32	0.05	0.15	**0.05**	ND	ND	9.29	0.00	0.87	1.55	0.03	0.16
	3.52	0.00	0.19	0.11	0.00	0.00	6.62	0.00	0.52	3.10	0.00	0.21
	2.78	0.00	0.17	3.20	0.00	0.23	4.06	0.00	0.30	4.91	0.00	0.46
mean	4.57	0.01	0.31	3.39	0.00	0.28	5.75	0.02	0.39	3.22	0.00	0.30
minimum	0.32	0.00	0.15	0.05	0.00	0.00	2.56	0.00	0.09	1.33	0.00	0.08
maximum	11.00	0.05	0.66	11.21	0.00	0.63	15.06	0.21	0.94	7.80	0.03	0.90

	7/11/2017			7/12/2018		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*	Chl-*a*	Chl-*b*	Chl-*c*
	12.82	0.00	1.07	15.59	0.00	1.74
	1.39	0.00	0.02	4.49	0.00	0.51
	1.50	0.00	0.07	20.40	0.00	2.90
	8.44	0.00	0.56	0.21	0.00	0.00
	3.31	0.07	0.15	5.13	0.00	0.61
	1.39	0.00	0.03	10.25	0.00	1.80
	0.43	0.00	0.00	11.64	0.00	1.82
	0.96	0.00	0.06	7.80	0.00	1.31
	3.10	0.00	0.28	0.43	0.01	0.04
	7.58	0.00	0.69	0.96	0.00	0.05
mean	4.09	0.01	0.29	7.69	0.00	1.08
minimum	0.43	0.00	0.00	0.21	0.00	0.00
maximum	12.82	0.07	1.07	20.40	0.01	2.90

Note: Bold value is the spectrophotometer estimated detection limit; chlorophyll *a* was not detected.

Appendix A.5.–Tributary Creek Site 1847 chlorophylls *a*, *b*, and *c* densities, 2018.

	7/12/2018		
mg/m^2	Chl-*a*	Chl-*b*	Chl-*c*
	16.98	0.00	3.10
	9.29	0.00	1.66
	6.09	0.00	0.70
	3.63	0.00	0.28
	12.82	0.00	2.14
	3.63	0.02	0.57
	2.24	0.00	0.33
	ND	ND	ND
	8.01	0.00	0.66
	10.68	0.00	1.29
mean	8.15	0.00	1.19
minimum	2.24	0.00	0.28
maximum	16.98	0.02	3.10

APPENDIX B: BENTHIC MACROINVERTEBRATE DATA

Appendix B.1.–Greens Creek Site 48 BMI data summary, 2001–2017.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total BMI Taxa	25	26	27	30	29	21	24	21	18	23	27	22	20	24	27	25	25
Mean BMI Taxa / Sample	12	13	18	19	16	11	13	13	10	15	17	13	12	13	17	13	15
Total Ephemeroptera Taxa	6	6	7	6	6	6	7	6	7	7	7	7	7	7	8	8	7
Total Plecoptera Taxa	7	11	6	9	8	4	5	3	5	6	7	7	5	6	6	5	6
Total Trichoptera Taxa	2	2	4	2	4	2	1	2	1	1	2	2	1	1	2	2	3
Total Counts																	
Ephemeroptera	1,094	599	1,897	1,034	902	495	428	887	852	937	558	555	618	844	1,488	1,520	1,300
Plecoptera	49	41	191	74	36	10	75	20	40	81	151	55	131	98	122	209	128
Trichoptera	7	9	20	22	15	7	8	24	1	4	12	5	8	14	62	14	22
Aquatic Diptera	31	39	206	169	101	38	34	79	15	71	193	73	86	184	291	352	146
Other	3	16	53	25	5	10	15	11	2	8	68	5	12	16	65	28	18
% Ephemeroptera	92%	85%	80%	79%	86%	88%	80%	87%	93%	86%	57%	80%	72%	73%	73%	72%	81%
% Plecoptera	4%	6%	8%	6%	3%	3%	11%	2%	5%	7%	15%	8%	15%	8%	6%	10%	8%
% Trichoptera	1%	1%	1%	2%	2%	1%	2%	2%	0%	0%	1%	1%	1%	1%	3%	1%	1%
% Aquatic Diptera	3%	6%	9%	12%	9%	6%	6%	8%	2%	6%	20%	11%	10%	16%	14%	17%	9%
% Other	0%	2%	2%	2%	1%	1%	2%	1%	0%	1%	7%	1%	1%	1%	3%	1%	1%
% EPT	97%	92%	89%	86%	90%	92%	92%	92%	98%	93%	73%	89%	89%	83%	82%	82%	90%
% Chironomidae	1%	4%	7%	11%	8%	3%	4%	6%	1%	5%	17%	9%	9%	15%	9%	14%	9%
% Dominant Taxon	41%	35%	30%	28%	30%	37%	36%	58%	46%	31%	21%	37%	25%	31%	28%	27%	24%
Total BMI	1,184	704	2,367	1,679	1,396	693	733	1,331	953	1,240	982	693	855	1,156	2,028	2,123	1,614
Total Terrestrial Invertebrates	0	4	5	1	24	5	2	8	2	11	4	0	14	32	6	4	27
Total Invertebrates	1,184	708	2,372	1,680	1,420	698	735	1,339	955	1,251	986	693	869	1,188	2,034	2,127	1,641
% Sample BMI	100%	99%	99%	99%	98%	99%	99%	99%	99%	99%	99%	100%	98%	97%	99%	99%	98%
% Sample Terrestrial	0%	1%	1%	1%	2%	1%	1%	1%	1%	1%	1%	0%	2%	3%	1%	1%	2%
Total Sample Area (m^2)	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.69	0.69	0.69
Mean Invertebrates / m^2	2,753	1,647	5,516	3,907	3,302	1,623	1,709	3,114	2,221	2,909	2,293	1,612	2,021	2,763	2,956	3,092	2,385
Mean BMI / m^2	2,753	1,637	5,505	3,905	3,247	1,612	1,705	3,095	2,216	2,884	2,284	1,612	1,988	2,688	2,948	3,086	2,346
± 1 SD	1,435	434	1,579	677	1,441	807	648	980	1,939	1,530	630	872	526	1,043	892	1,219	1,034

Appendix B.2.–Greens Creek Site 63 BMI data summary, 2018.

	2018
Total BMI Taxa	27
Mean BMI Taxa / Sample	14
Total Ephemeroptera Taxa	8
Total Plecoptera Taxa	7
Total Trichoptera Taxa	2
Total Counts	
Ephemeroptera	2,271
Plecoptera	110
Trichoptera	20
Aquatic Diptera	144
Other	26
% Ephemeroptera	88%
% Plecoptera	4%
% Trichoptera	1%
% Aquatic Diptera	6%
% Other	1%
% EPT	93%
% Chironomidae	5%
% Dominant Taxon	39%
Total BMI	2,571
Total Terrestrial Invertebrates	4
Total Invertebrates	2,575
% Sample BMI	99%
% Sample Terrestrial	1%
Total Sample Area (m^2)	0.69
Mean Invertebrates / m^2	3,743
Mean BMI / m^2	3,737
± 1 SD	1,240

Appendix B.3.–Greens Creek Site 54 BMI data summary, 2001–2018.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total BMI Taxa	28	30	26	32	25	13	15	22	23	21	34	30	19	26	28	30	31	29
Mean BMI Taxa / Sample	15	14	16	19	15	9	8	14	13	13	18	14	9	11	14	15	14	14
Total Ephemeroptera Taxa	7	6	7	6	8	5	6	8	7	6	8	7	5	7	7	8	8	8
Total Plecoptera Taxa	7	7	7	10	7	3	4	4	7	5	7	10	6	7	6	6	8	7
Total Trichoptera Taxa	2	2	1	3	3	2	0	2	2	2	5	4	1	3	2	3	4	3
Total Counts																		
Ephemeroptera	1,627	1,352	2,011	1,601	1,265	477	286	1,105	895	1,247	1,536	591	308	1,277	941	2,072	917	2,249
Plecoptera	80	54	82	117	37	30	22	65	43	53	96	49	54	109	99	204	72	105
Trichoptera	7	6	12	19	31	4	0	9	4	8	32	9	3	15	24	18	22	11
Aquatic Diptera	53	39	173	184	65	13	10	85	32	61	203	81	52	177	182	201	111	134
Other	15	15	57	46	4	1	1	13	5	8	46	24	19	24	52	22	14	10
% Ephemeroptera	91%	92%	86%	81%	90%	91%	90%	87%	91%	91%	80%	78%	71%	80%	72%	82%	81%	90%
% Plecoptera	4%	4%	4%	6%	3%	6%	7%	5%	4%	4%	5%	6%	12%	7%	8%	8%	6%	4%
% Trichoptera	0%	0%	1%	1%	2%	1%	0%	1%	0%	1%	2%	1%	1%	1%	2%	1%	2%	0%
% Aquatic Diptera	3%	3%	7%	9%	5%	2%	3%	7%	3%	4%	11%	11%	12%	11%	14%	8%	10%	5%
% Other	1%	1%	2%	2%	0%	0%	0%	1%	1%	1%	2%	4%	4%	1%	4%	1%	1%	0%
% EPT	96%	96%	90%	88%	95%	97%	97%	92%	96%	95%	87%	86%	84%	87%	82%	91%	89%	94%
% Chironomidae	2%	2%	6%	8%	4%	2%	2%	5%	2%	3%	9%	9%	10%	10%	11%	6%	8%	5%
% Dominant Taxon	52%	43%	40%	38%	40%	31%	34%	53%	40%	35%	43%	30%	30%	35%	32%	25%	23%	37%
Total BMI	1,782	1,466	2,335	1,967	1,402	525	319	1,277	979	1,377	1,913	754	436	1,607	1,298	2,517	1,136	2,509
Total Terrestrial Invertebrates	0	4	7	1	3	1	6	1	8	9	14	5	8	12	6	3	24	4
Total Invertebrates	1,782	1,470	2,342	1,968	1,405	526	325	1,278	987	1,386	1,927	759	444	1,619	1,304	2,520	1,160	2,513
% Sample BMI	100%	99%	99%	99%	99%	99%	98%	100%	99%	99%	99%	99%	98%	99%	99%	99%	98%	99%
% Sample Terrestrial	0%	1%	1%	1%	1%	1%	2%	0%	1%	1%	1%	1%	2%	1%	1%	1%	2%	1%
Total Sample Area (m^2)	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.69	0.69	0.69	0.69
Mean Invertebrates / m^2	4,144	3,419	5,447	4,577	3,267	1,223	756	2,972	2,295	3,223	4,481	1,765	1,033	3,765	1,895	3,663	1,686	3,653
Mean BMI / m^2	4,144	3,409	5,430	4,575	3,260	1,221	742	2,970	2,277	3,202	4,449	1,753	1,014	3,737	1,887	3,658	1,651	3,647
± 1 SD	1,464	1,148	1,422	1,540	1,016	345	293	1,855	297	772	2,668	738	642	1,253	1,065	1,139	809	973

Appendix B.4.–Tributary Creek Site 9 BMI data summary, 2001–2018.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total BMI Taxa	21	24	36	26	30	23	21	20	26	22	26	27	20	22	23	29	29	25
Mean BMI Taxa / Sample	14	15	21	14	14	11	10	14	13	10	12	15	11	12	11	18	16	14
Total Ephemeroptera Taxa	6	7	8	5	9	7	5	7	8	7	6	5	7	6	6	7	7	8
Total Plecoptera Taxa	5	5	5	6	5	2	3	4	5	5	6	6	4	3	6	4	5	3
Total Trichoptera Taxa	0	2	3	3	4	1	2	1	0	0	2	3	1	3	0	5	3	2
Total Counts																		
Ephemeroptera	205	436	981	562	334	444	104	441	203	89	277	245	726	565	137	1,128	452	143
Plecoptera	68	69	593	166	95	35	37	50	97	17	138	69	130	166	160	359	365	128
Trichoptera	0	2	7	5	4	2	4	1	0	0	13	10	2	8	0	22	7	4
Aquatic Diptera	86	66	256	66	60	42	21	206	141	52	196	179	135	181	73	1449	727	427
Other	150	175	679	233	35	102	52	55	38	40	232	106	36	146	145	896	255	153
% Ephemeroptera	40%	58%	39%	54%	63%	71%	48%	59%	42%	45%	32%	40%	71%	53%	27%	29%	25%	17%
% Plecoptera	13%	9%	24%	16%	18%	6%	17%	7%	20%	9%	16%	11%	13%	16%	31%	9%	20%	15%
% Trichoptera	0%	0%	0%	0%	1%	0%	2%	0%	0%	0%	2%	2%	0%	1%	0%	1%	0%	0%
% Aquatic Diptera	17%	9%	10%	6%	11%	7%	10%	27%	29%	26%	23%	29%	13%	17%	14%	38%	40%	50%
% Other	30%	23%	27%	23%	7%	16%	24%	7%	8%	20%	27%	17%	3%	14%	28%	23%	14%	18%
% EPT	54%	68%	63%	71%	82%	77%	67%	65%	63%	54%	50%	53%	83%	69%	58%	39%	46%	32%
% Chironomidae	7%	5%	5%	5%	8%	4%	1%	1%	22%	23%	21%	26%	11%	14%	11%	29%	24%	35%
% Dominant Taxon	26%	29%	26%	44%	37%	40%	26%	33%	32%	32%	24%	30%	38%	30%	28%	29%	24%	45%
Total BMI	509	748	2,516	1,032	528	625	218	753	479	198	856	609	1,029	1,066	515	3,854	1,806	855
Total Terrestrial Invertebrates	0	5	15	3	12	33	1	5	50	22	2	9	13	13	6	18	3	8
Total Invertebrates	509	753	2,531	1,035	540	658	219	758	529	220	858	618	1,042	1,079	521	3,872	1,809	863
% Sample BMI	100%	99%	99%	99%	98%	95%	99%	99%	91%	90%	99%	99%	99%	99%	99%	99%	99%	99%
% Sample Terrestrial	0%	1%	1%	1%	2%	5%	1%	1%	10%	11%	1%	1%	1%	1%	1%	1%	1%	1%
Total Sample Area (m^2)	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.69	0.69	0.69	0.69
Mean Invertebrates / m^2	1,184	1,751	5,886	2,407	1,256	1,530	509	1,763	1,230	512	1,995	1,437	2,423	2,509	757	5,628	2,629	1,254
Mean BMI / m^2	1,184	1,740	5,851	2,400	1,228	1,453	507	1,751	1,114	460	1,991	1,416	2,393	2,479	749	5,602	2,625	1,243
± 1 SD	1,148	620	1,579	851	357	878	268	631	636	463	447	615	1,897	727	348	3,133	1,059	464

Appendix B.5.–Tributary Creek Site 1847 BMI data summary, 2018.

	2018
Total BMI Taxa	29
Mean BMI Taxa / Sample	18
Total Ephemeroptera Taxa	7
Total Plecoptera Taxa	4
Total Trichoptera Taxa	4
Total Counts	
Ephemeroptera	631
Plecoptera	134
Trichoptera	34
Aquatic Diptera	512
Other	197
% Ephemeroptera	42%
% Plecoptera	9%
% Trichoptera	2%
% Aquatic Diptera	34%
% Other	13%
% EPT	53%
% Chironomidae	29%
% Dominant Taxon	38%
Total BMI	1,508
Total Terrestrial Invertebrates	5
Total Invertebrates	1,513
% Sample BMI	99%
% Sample Terrestrial	1%
Total Sample Area (m^2)	0.69
Mean Invertebrates / m^2	2,199
Mean BMI / m^2	2,192
± 1 SD	1,248

APPENDIX C: JUVENILE FISH DATA

Appendix C.1.–Greens Creek Site 48 Dolly Varden char capture data, 2001–2017.

Year	FL (mm)	Number of Fish Captured				Population Estimate	Condition Factor
		Set 1	Set 2	Set 3	Total		
2001	48-139	30	16	22	68	121±68	ND
2002	45-160	74	29	23	126	144±17	ND
2003	54-180	157	72	56	285	347±39	ND
2004	54-158	168	48	28	244	256±10	ND
2005	50-149	118	56	38	212	251±28	ND
2006	49-150	138	40	34	212	231±15	ND
2007	53-154	50	29	16	95	113±19	ND
2008	77-137	54	10	9	73	75±4	ND
2009	47-142	67	31	28	126	159±30	ND
2010	47-170	97	41	20	158	172±13	ND
2011	54-155	56	28	41	125	241±125	ND
2012	64-148	85	22	28	135	153±17	1.0
2013	35-154	167	61	25	253	267±11	1.0
2014	52-146	59	19	21	99	115±17	1.0
2015	54-165	48	32	17	97	120±23	1.0
2016	36-163	119	17	17	153	156±4	1.2
2017	52-156	84	36	12	132	139±8	1.1

Appendix C.2.–Greens Creek Site 63 Dolly Varden char capture data, 2018.

		Number of Fish Captured				Population	Condition
Year	FL (mm)	Set 1	Set 2	Set 3	Total	Estimate	Factor
2018	49-144	69	54	13	136	155±17	1.0

Appendix C.3.–Greens Creek Site 54 Dolly Varden char capture data, 2001–2018.

		Number of Fish Captured				Population	Condition
Year	FL (mm)	Set 1	Set 2	Set 3	Total	Estimate	Factor
2001	27-162	70	49	19	138	163±21	ND
2002	33-160	168	72	31	271	293±16	ND
2003	51-184	92	81	59	232	440±175	ND
2004	52-161	118	36	47	201	244±32	ND
2005	52-146	111	59	43	213	269±40	ND
2006	49-158	116	61	40	217	264±33	ND
2007	50-145	64	19	24	107	126±19	ND
2008	45-131	50	15	6	71	73	ND
2009	47-101	42	32	19	93	128±37	ND
2010	52-151	46	13	14	73	81±10	ND
2011	43-150	73	43	57	173	390±224	ND
2012	47-143	92	39	58	189	313±105	1.0
2013	50-150	188	67	42	297	323±17	1.1
2014	50-158	121	28	13	162	165±4	1.0
2015	54-150	64	29	9	102	108±7	1.0
2016	55-156	31	52	36	119	ND	1.1
2017	48-151	169	88	49	306	358±32	1.1
2018	50-158	162	64	24	250	264±11	1.0

Appendix C.4.–Greens Creek Site 54 coho salmon capture data, 2001–2018.

		Number of Fish Captured				Population	Condition
Year	FL (mm)	Set 1	Set 2	Set 3	Total	Estimate	Factor
2001	32-95	2	6	4	12	ND	ND
2002	59-85	14	6	1	21	21	ND
2003	44-52	5	3	0	8	ND	ND
2004	70-95	9	9	6	24	34±17	ND
2005	66-93	33	20	8	61	68±9	ND
2006	62-88	6	0	1	7	ND	ND
2007	ND	0	0	0	0	ND	ND
2008	53-69	4	0	0	4	ND	ND
2009	67-73	2	2	0	4	ND	ND
2010	77	1	0	0	1	ND	ND
2011	ND	0	0	0	0	ND	ND
2012	67-71	0	3	2	5	ND	1.1
2013	ND	0	0	0	0	ND	ND
2014	70-85	10	4	1	15	ND	1.2
2015	44-100	15	5	1	21	ND	1.1
2016	68-100	14	12	6	32	40±13	1.3
2017	ND	0	0	0	0	ND	ND
2018	38-90	17	11	4	32	35±5	1.2

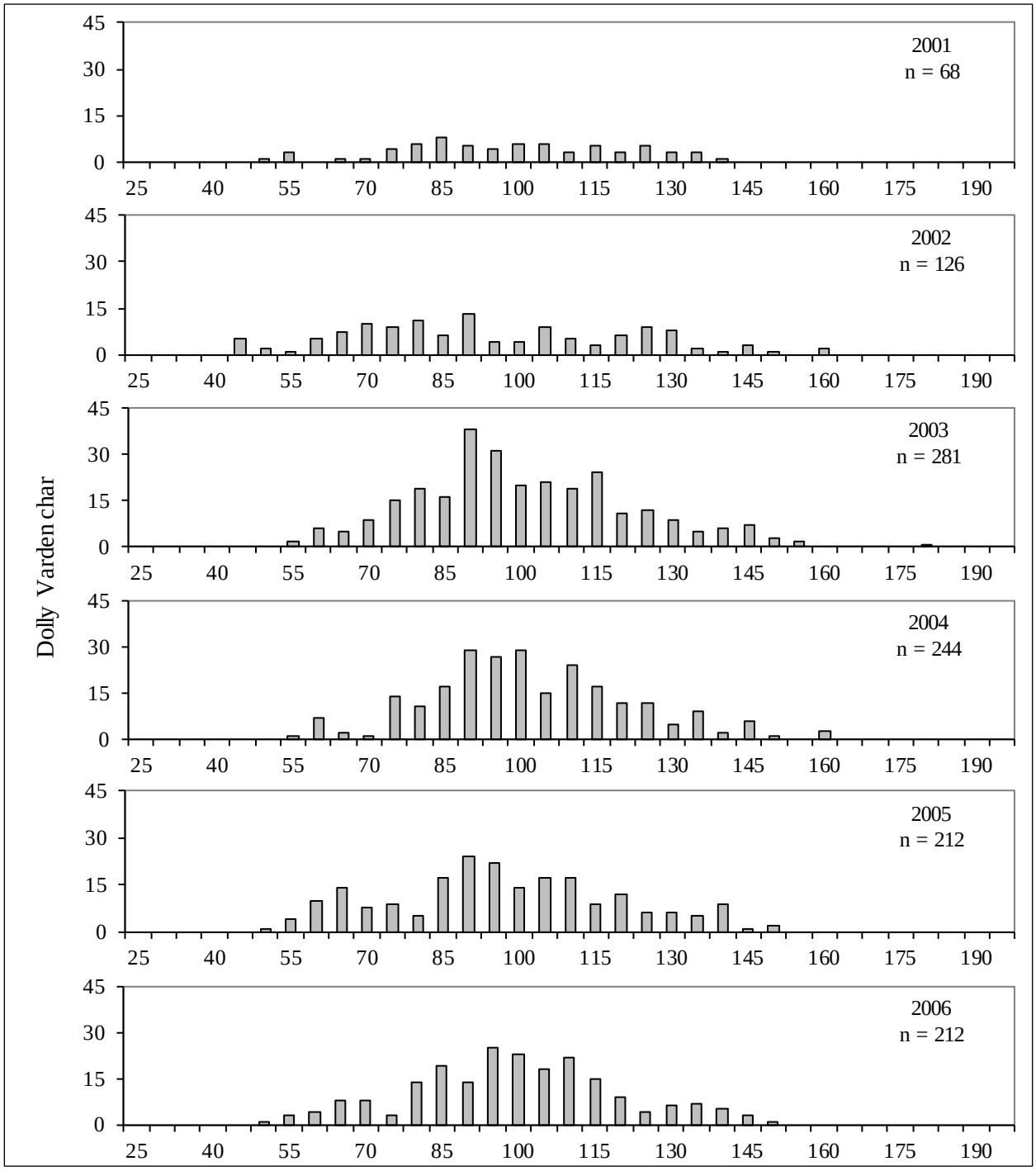
Appendix C.5.–Tributary Creek Site 9 resident fish capture data, 2001–2018.

			Number of Fish Captured				Population	Condition
Year	Species	FL (mm)	Set 1	Set 2	Set 3	Total	Estimate	Factor
2001	DV	58-110	70	4	7	81	81	ND
	CT	124	1	0	0	1	ND	ND
2002	DV	38-147	29	14	8	51	57±9	ND
	CT	124	0	0	1	1	ND	ND
2003	DV	54-114	13	4	2	19	ND	ND
	CT	122	1	0	0	1	ND	ND
2004	DV	64-109	21	6	5	32	33±2	ND
	CT	122	1	0	0	1	ND	ND
	RT	86-106	3	1	0	4	ND	ND
2005	DV	59-131	21	12	11	44	59±21	ND
	CT	91-103	1	1	0	2	ND	ND
2006	DV	85-117	7	3	1	11	ND	ND
2007	DV	81-158	7	5	0	12	ND	ND
	CT	138	0	0	1	1	ND	ND
2008	DV	60-108	15	4	3	22	22	ND
	CT	82-112	1	0	2	3	ND	ND
2009	DV	48-98	24	5	9	38	42±7	ND
	CT	97	1	0	0	1	ND	ND
2010	DV	58-108	21	7	31	59	59	ND
	CT	64-89	4	1	0	5	ND	ND
2011	DV	50-125	15	7	14	36	36	ND
	CT	115	1	0	0	1	ND	ND
2012	DV	66-112	17	11	12	40	40	1.0
	CT	63-93	4	0	1	5	ND	1.0
2013	DV	52-92	9	2	2	13	ND	1.2
	CT	73-80	0	2	0	2	ND	1.0
2014	DV	37-115	1	12	1	14	ND	1.0
	CT	110-110	0	1	1	2	ND	0.9
	RT	105-110	1	0	1	2	ND	0.7
2015	DV	55-84	10	5	1	16	ND	1.2
2016	DV	76-114	15	2	3	20	ND	1.1
2017	DV	55-117	31	9	16	56	72±20	1.1
2018	DV	54-109	20	9	3	32	33±2	1.0

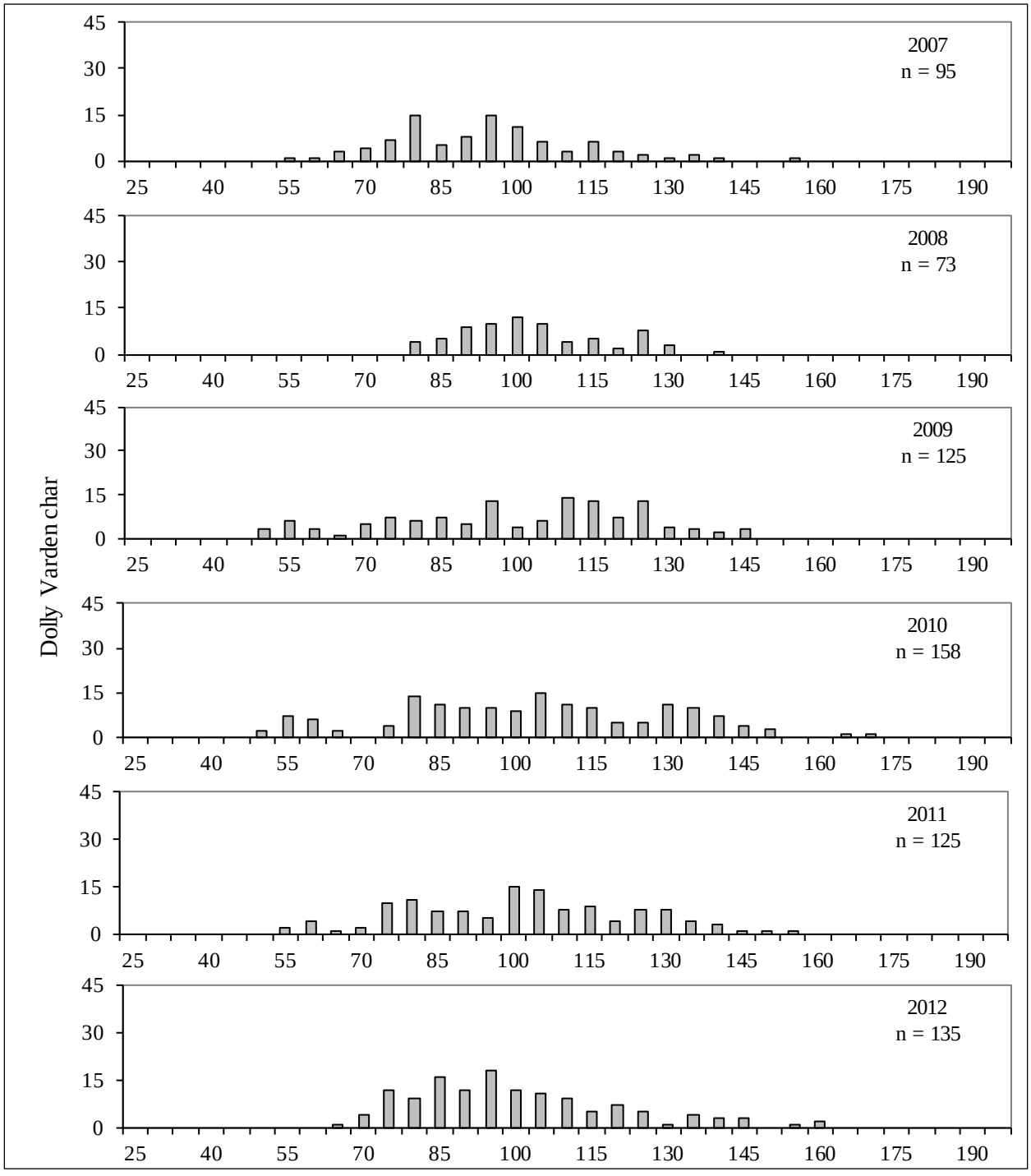
Appendix C.6.–Tributary Creek Site 9 coho salmon capture data, 2001–2018.

Year	FL (mm)	Number of Fish Captured				Population Estimate	Condition Factor
		Set 1	Set 2	Set 3	Total		
2001	39-101	89	18	11	118	120±3	ND
2002	27-85	29	9	6	44	46±4	ND
2003	46-88	37	11	4	52	53±2	ND
2004	40-94	23	2	2	27	27	ND
2005	39-103	82	42	15	139	151±12	ND
2006	69-108	5	4	1	10	ND	ND
2007	38-104	50	10	9	69	71±4	ND
2008	41-100	72	44	26	142	177±30	ND
2009	38-116	42	9	2	53	53	ND
2010	39-90	77	21	30	128	152±22	ND
2011	38-100	18	18	13	49	85±50	ND
2012	46-105	39	9	7	55	55	1.1
2013	50-91	9	6	3	18	20±4	1.4
2014	39-92	86	26	24	136	150±13	1.2
2015	38-95	36	27	13	76	95±21	1.4
2016	44-97	75	6	7	88	88	1.3
2017	35-94	67	14	15	96	101±6	1.3
2018	37-92	32	11	10	53	59±9	1.1

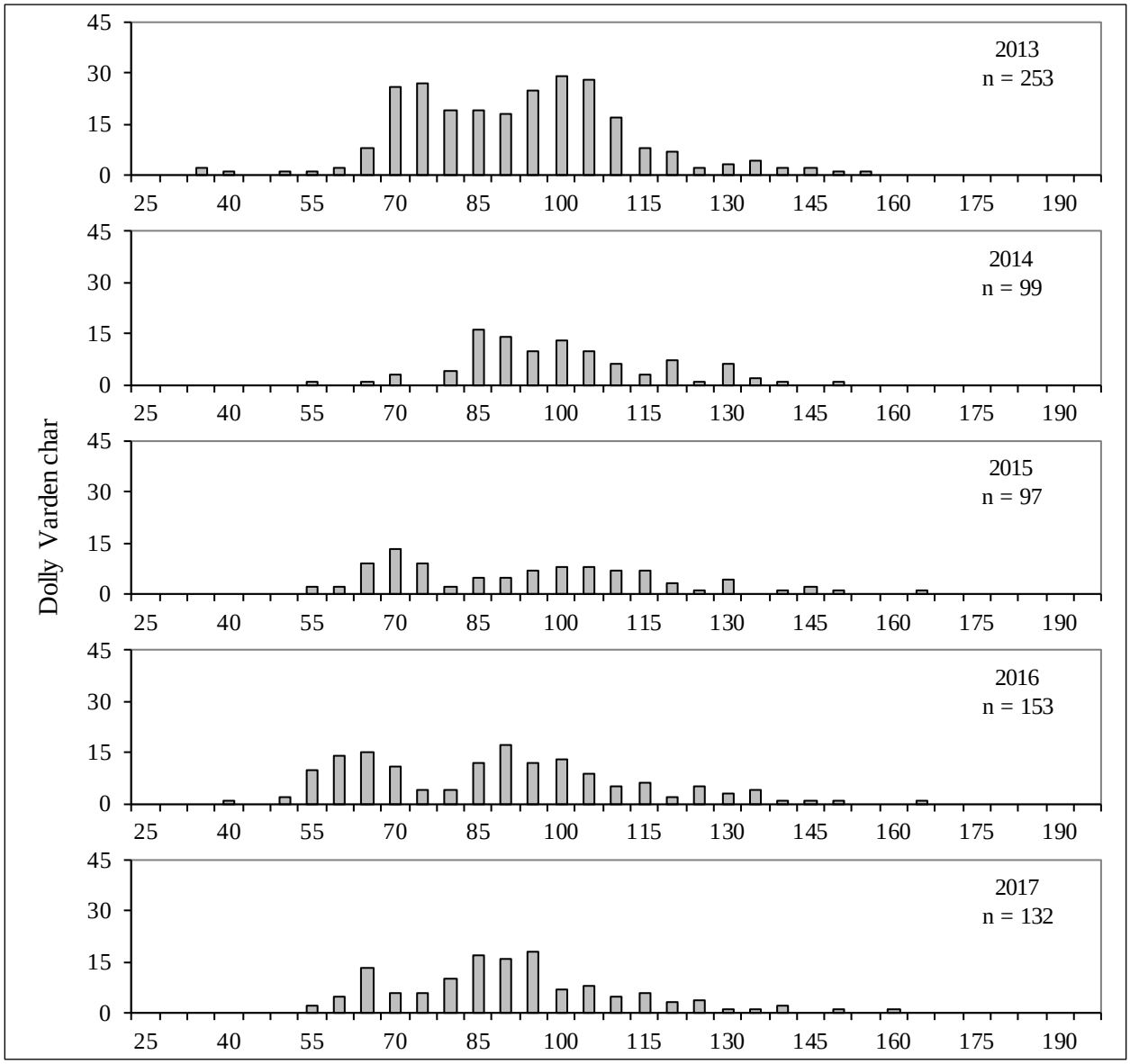
Appendix C.7.–Greens Creek Site 48 Dolly Varden char length frequency, 2001–2017.



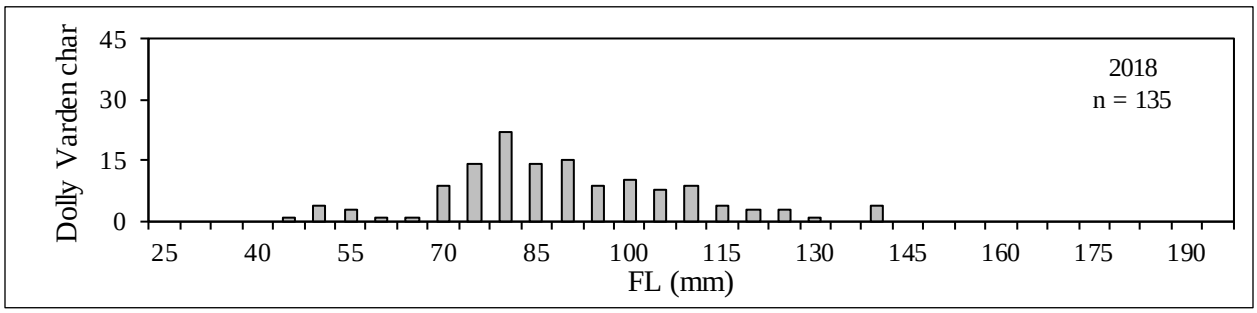
-continued-


Dolly Varden char
2007
n = 95
2008
n = 73
2009
n = 125
2010
n = 158
2011
n = 125
2012
n = 135
0
15
30
45
25
40
55
70
85
100
115
130
145
160
175
190

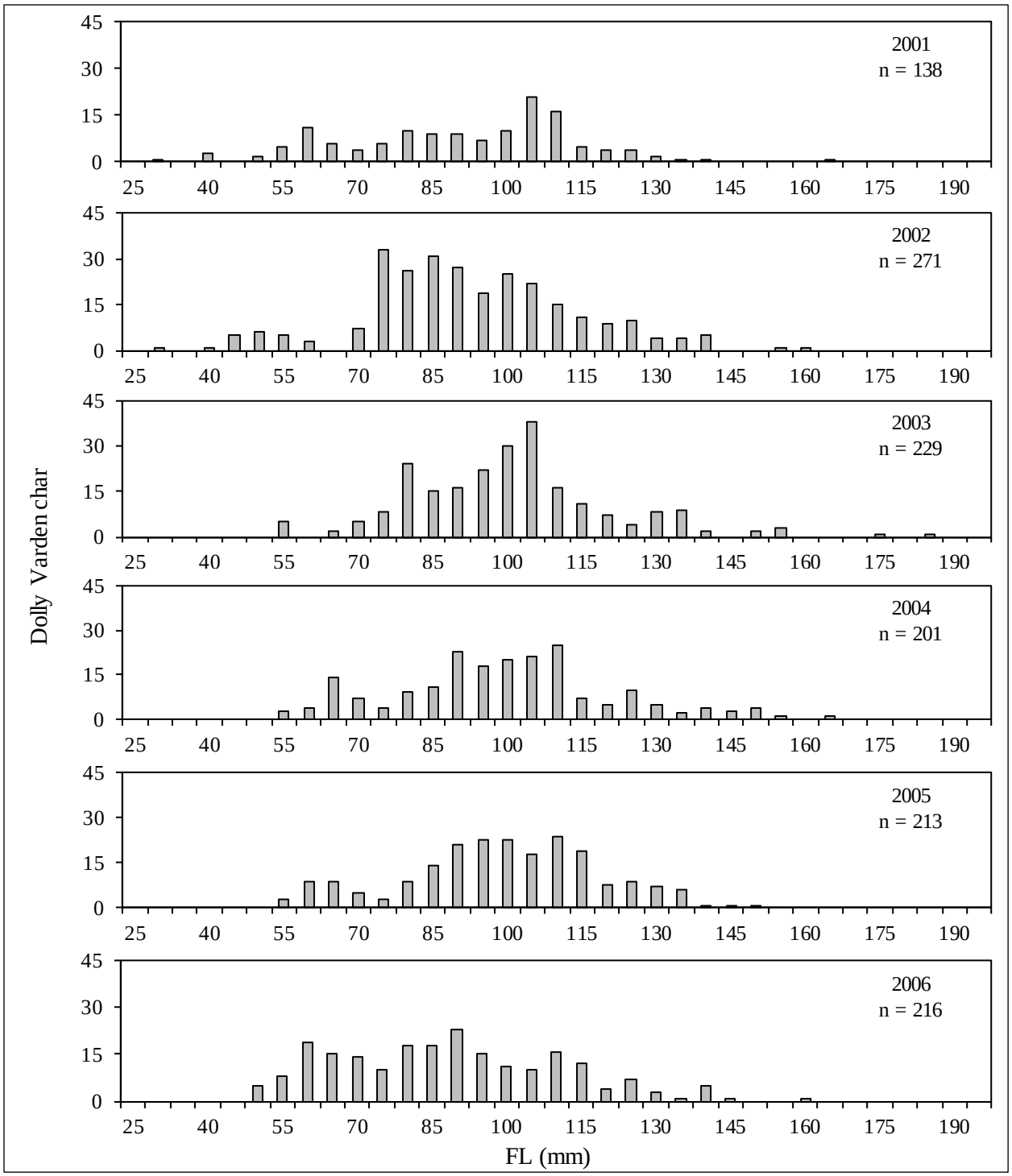
-continued-


Dolly Varden char
2013
n = 253
2014
n = 99
2015
n = 97
2016
n = 153
2017
n = 132
0
15
30
45
25
40
55
70
85
100
115
130
145
160
175
190

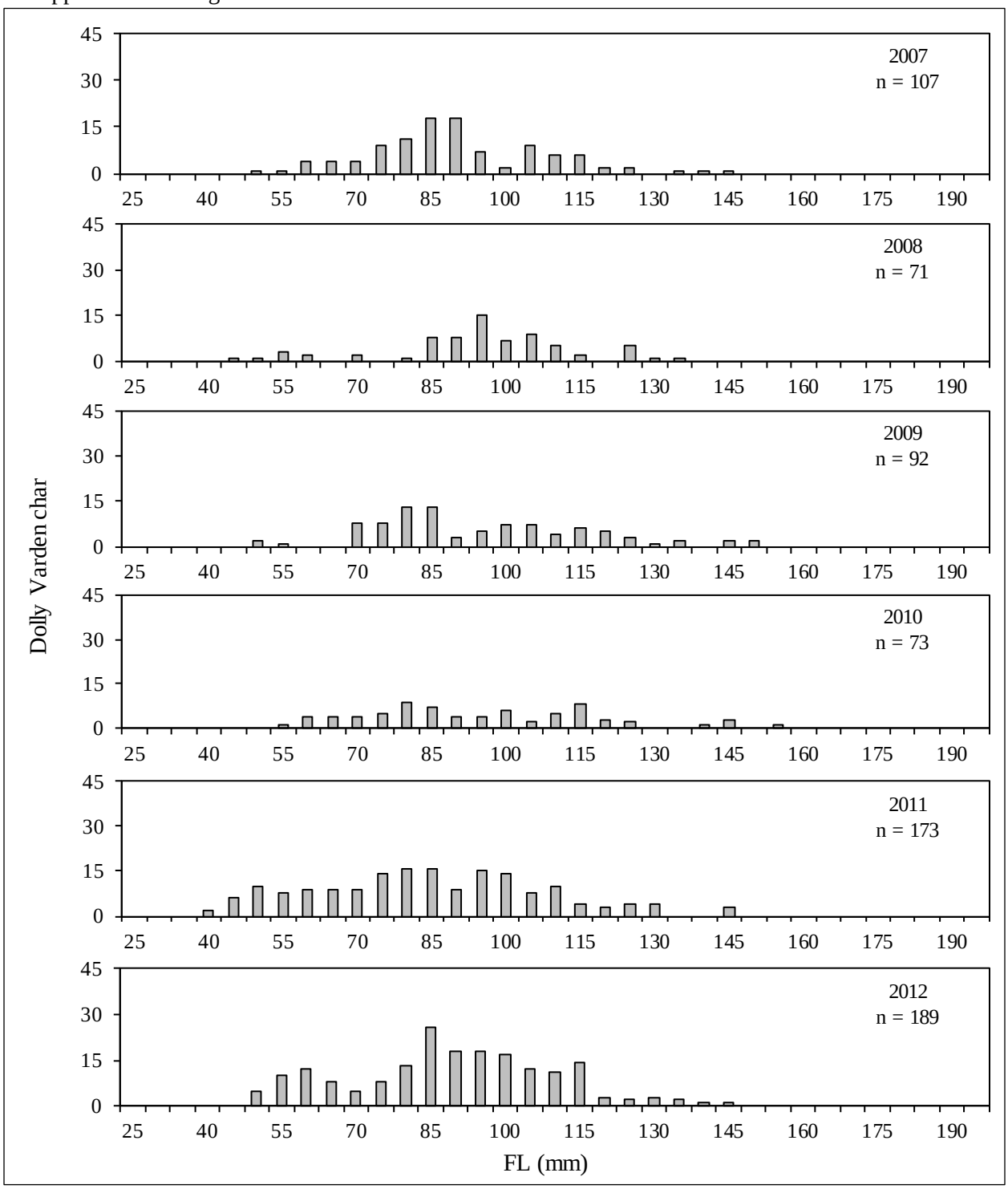
Appendix C.8.–Greens Creek Site 63 Dolly Varden char length frequency, 2018.



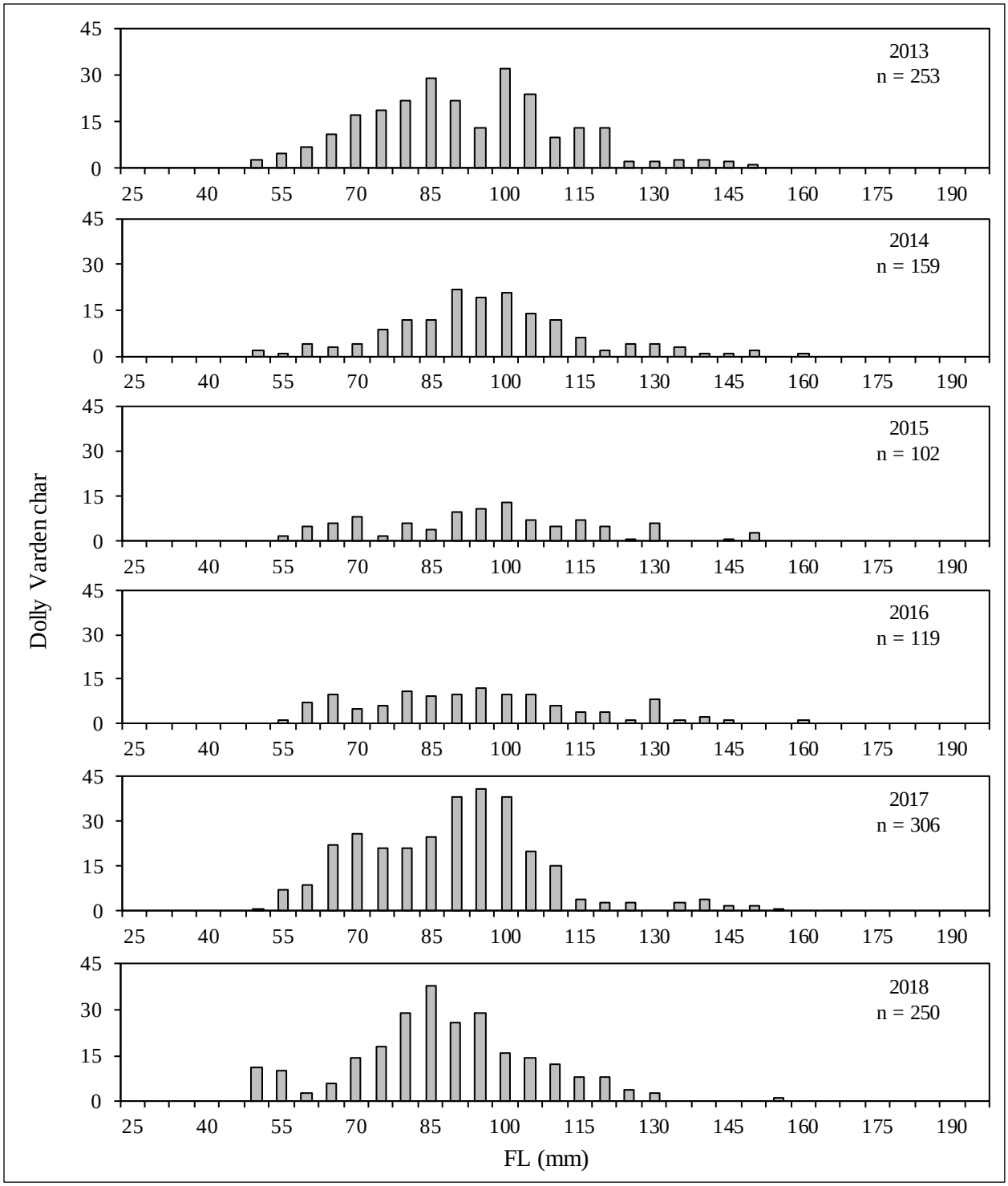
Appendix C.9.–Greens Creek Site 54 Dolly Varden char length frequency, 2001–2018.



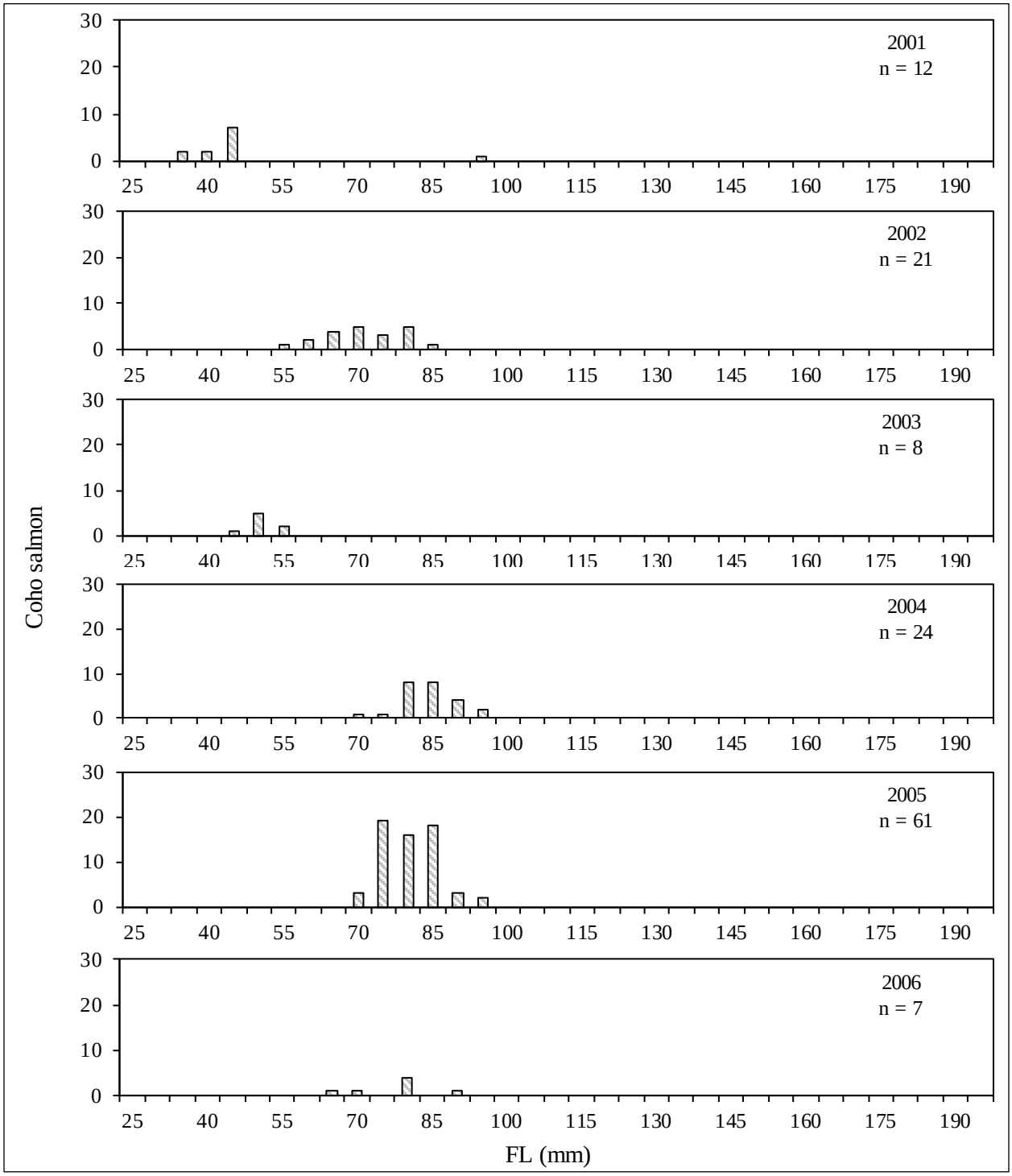
-continued-


Dolly Varden char
2007
n = 107
2008
n = 71
2009
n = 92
2010
n = 73
2011
n = 173
2012
n = 189
0
15
30
45
25
40
55
70
85
100
115
130
145
160
175
190
FL (mm)

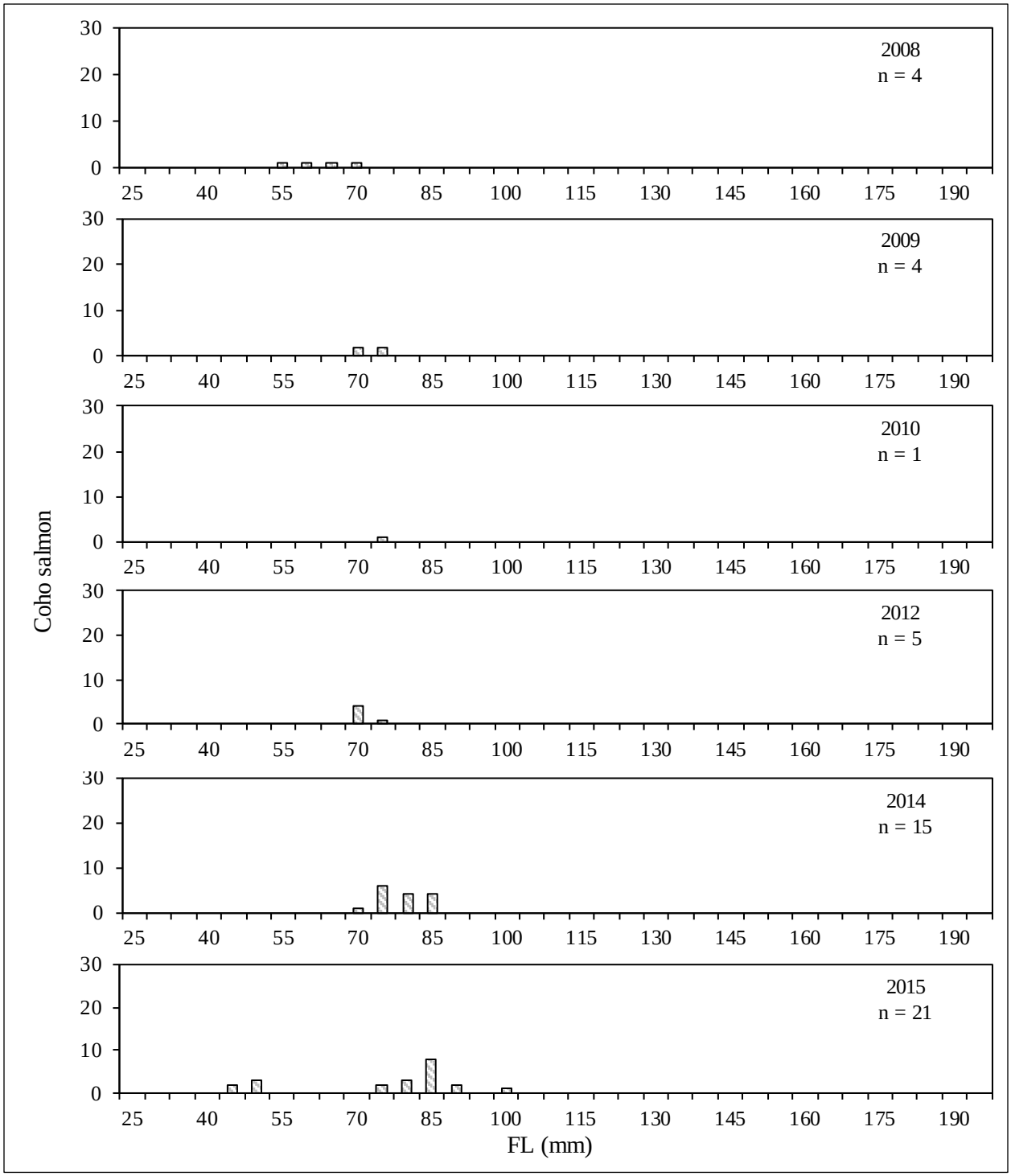
-continued-


Dolly Varden char
2013
n = 253
2014
n = 159
2015
n = 102
2016
n = 119
2017
n = 306
2018
n = 250
0
15
30
45
25
40
55
70
85
100
115
130
145
160
175
190
FL (mm)

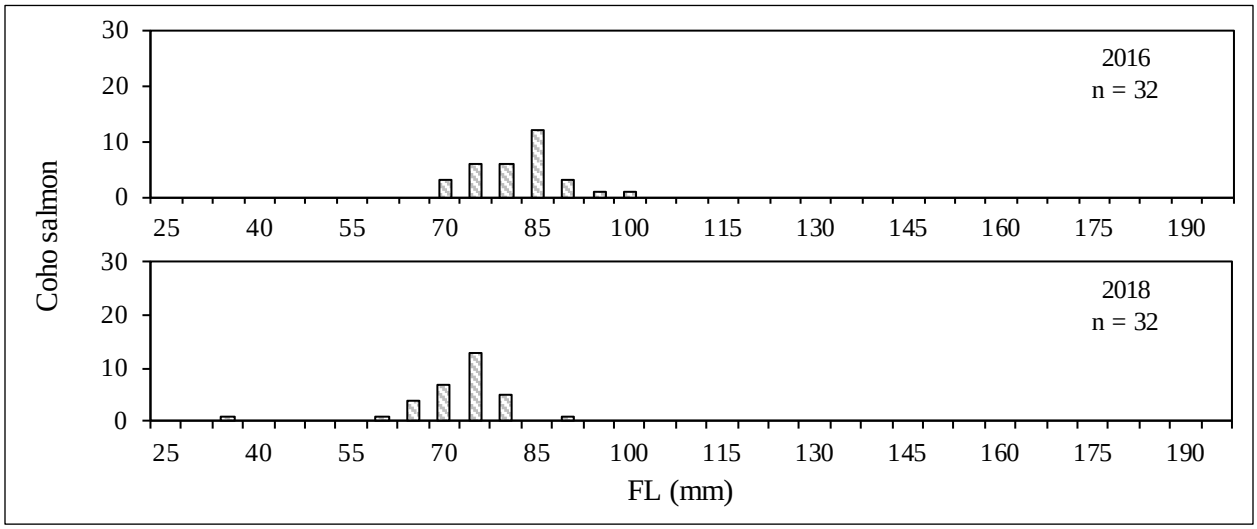
Appendix C.10.–Greens Creek Site 54 coho salmon length frequency, 2001–2018.



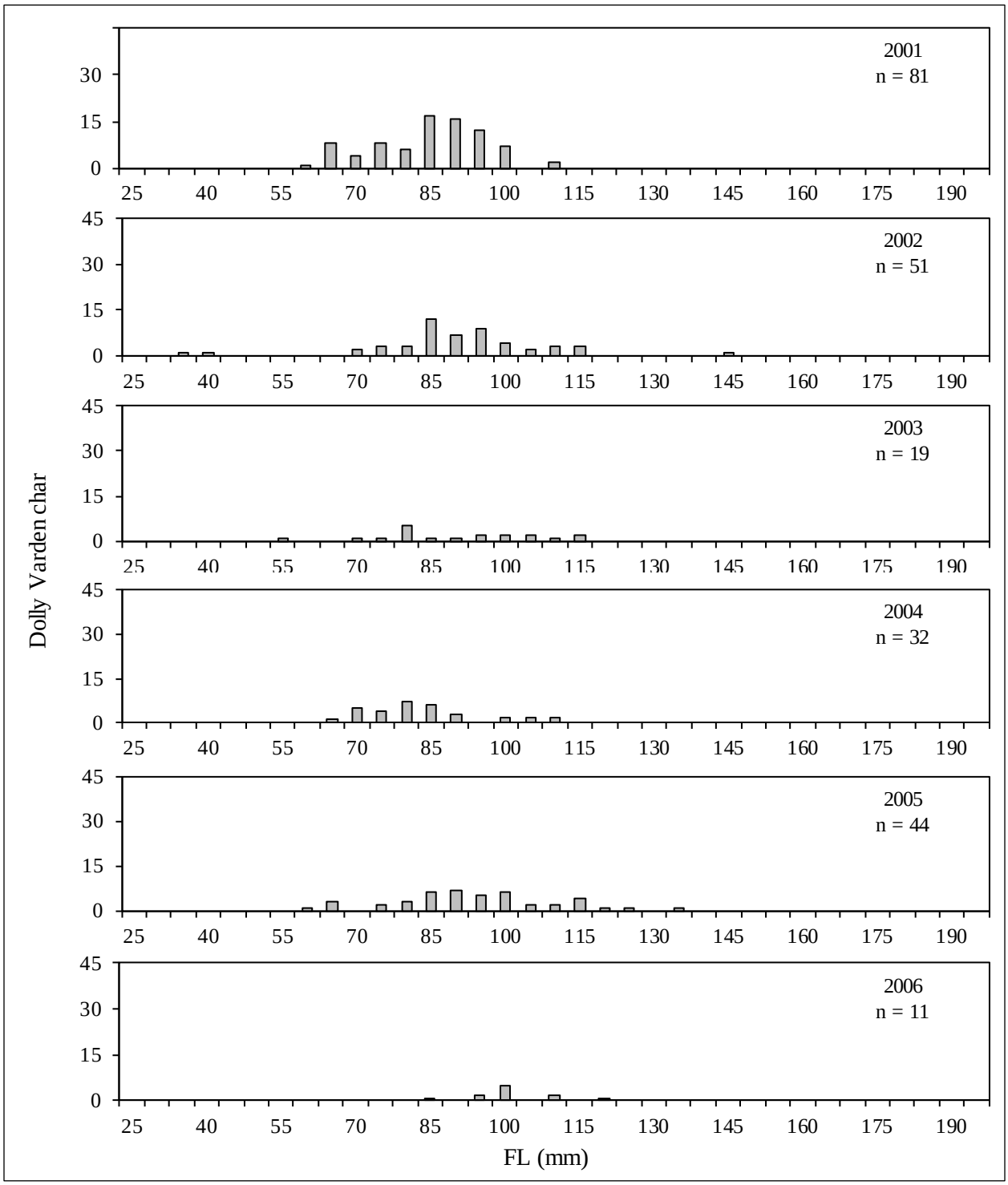
-continued-


Coho salmon
2008
n = 4
2009
n = 4
2010
n = 1
2012
n = 5
2014
n = 15
2015
n = 21
0
10
20
30
25
40
55
70
85
100
115
130
145
160
175
190
FL (mm)

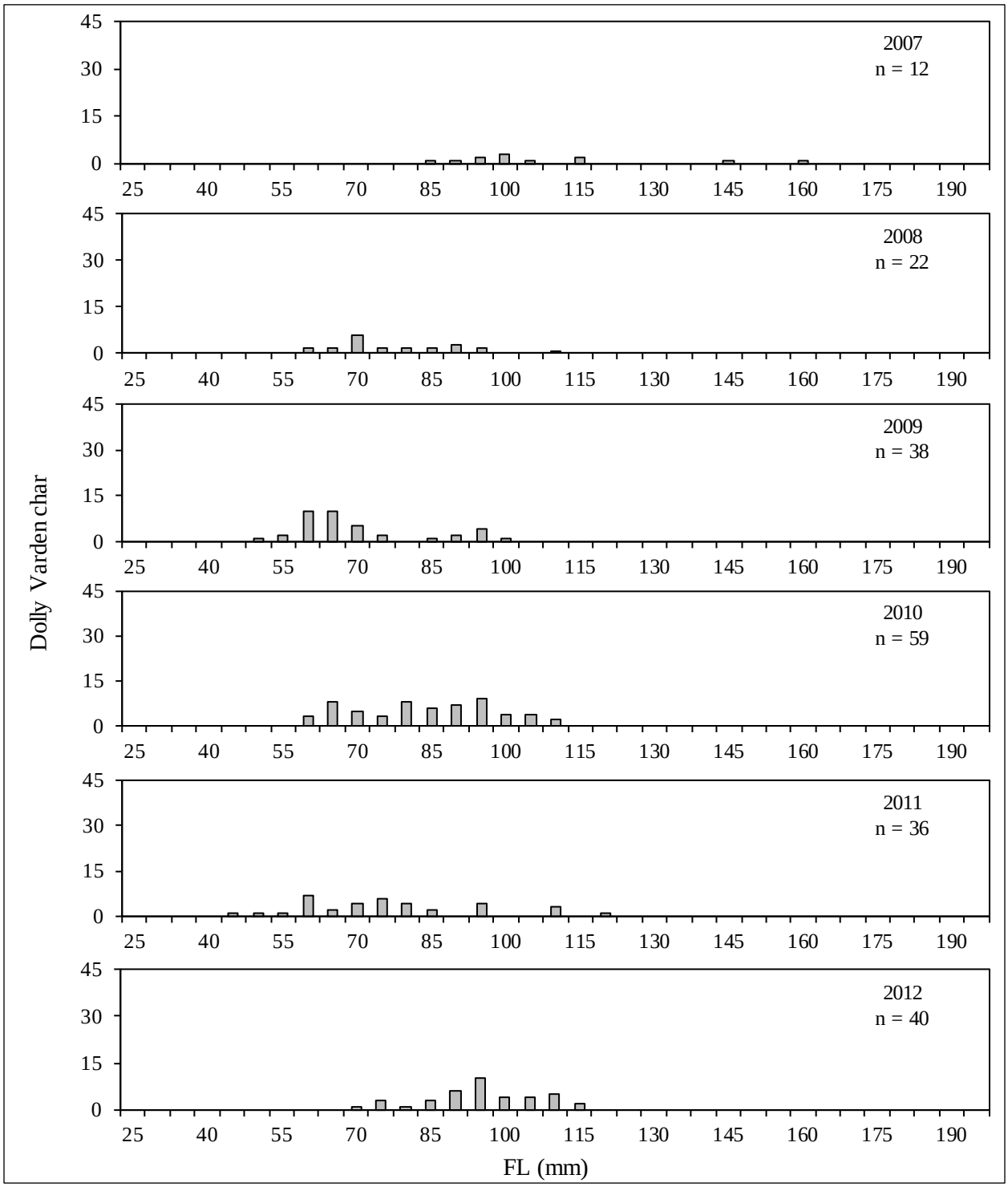
-continued-


Coho salmon
2016
n = 32
2018
n = 32
0
10
20
30
25
40
55
70
85
100
115
130
145
160
175
190
FL (mm)

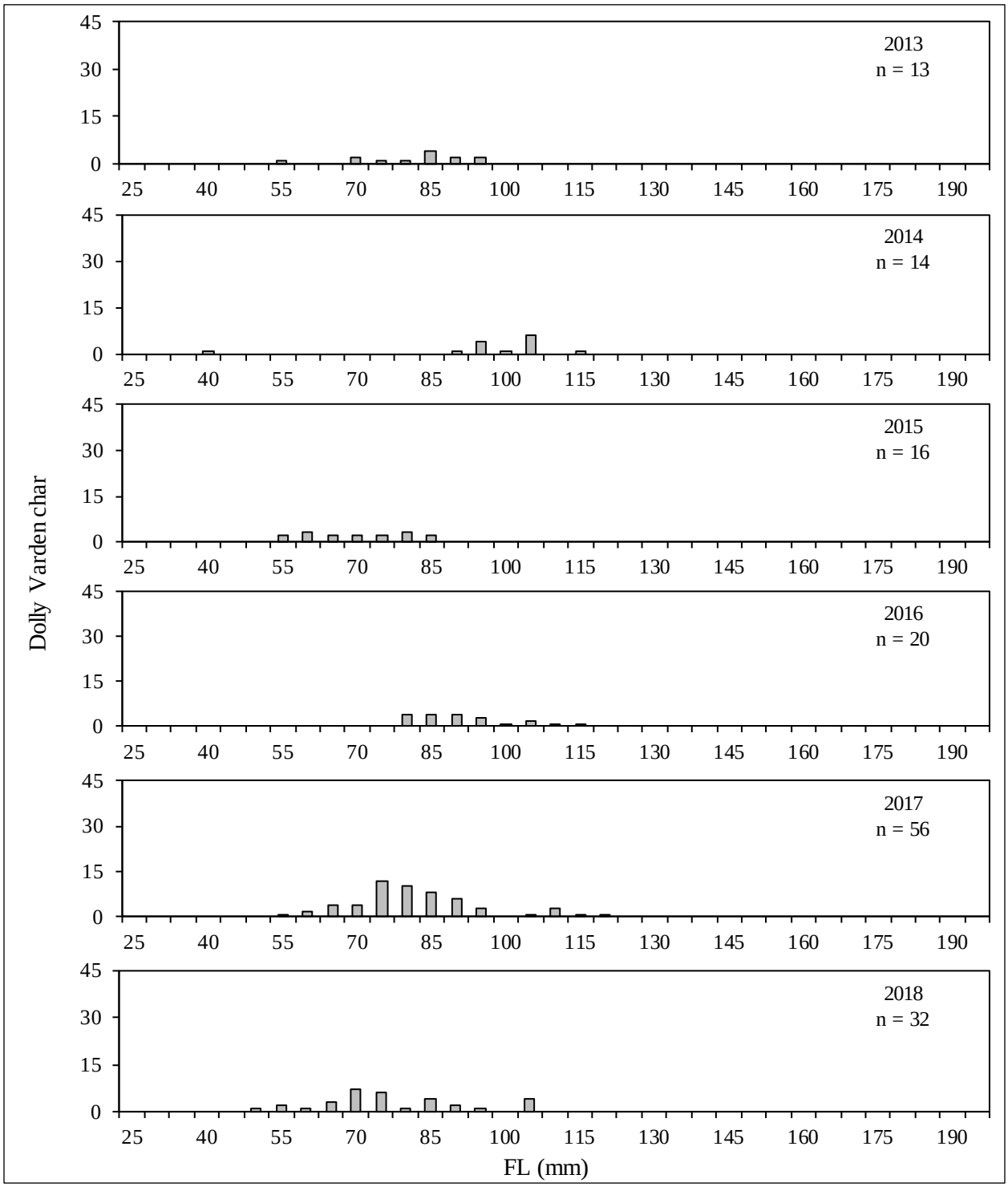
Appendix C.11.–Tributary Creek Site 9 Dolly Varden char length frequency, 2001–2018.



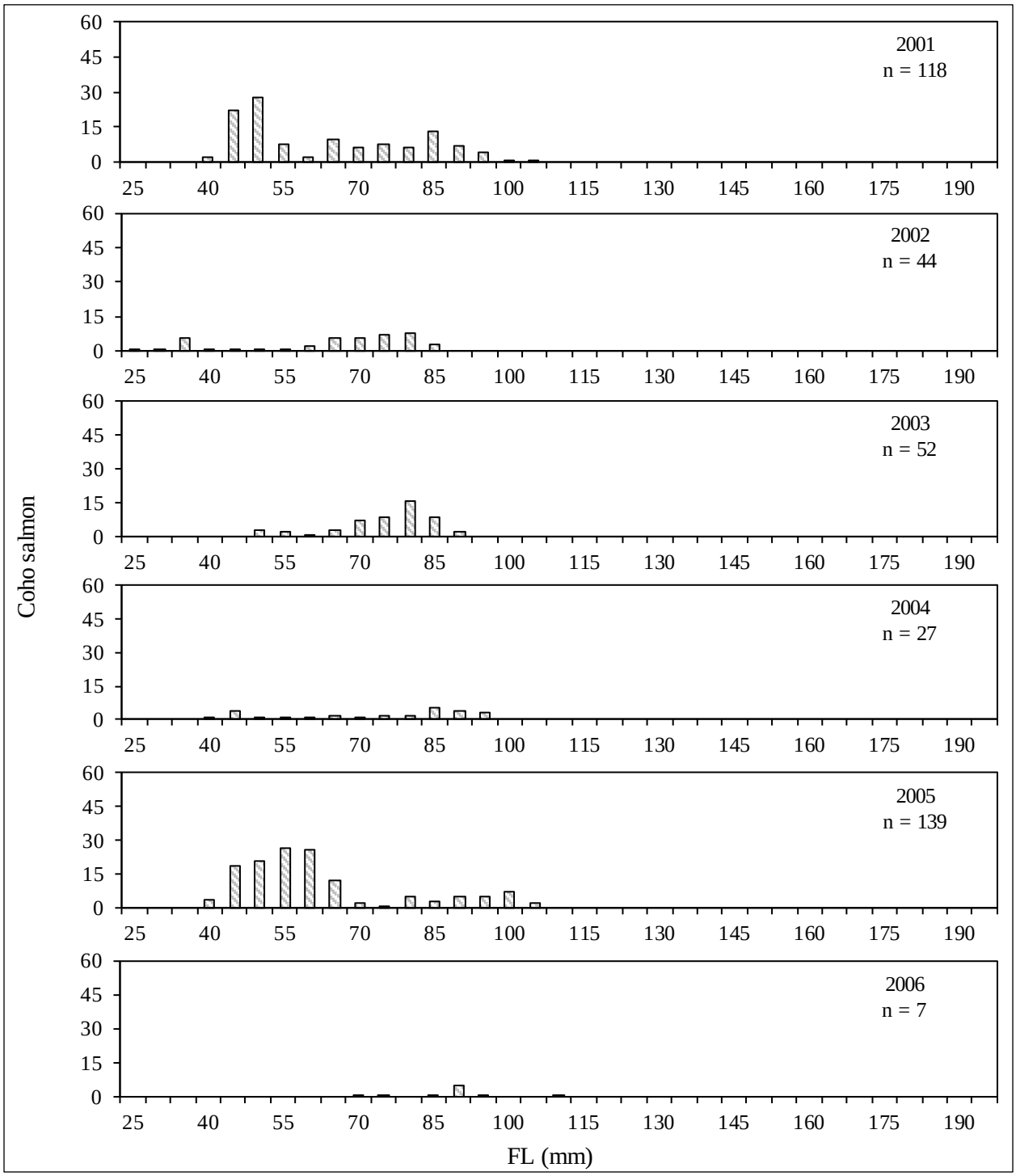
-continued-


Dolly Varden char
2007
n = 12
2008
n = 22
2009
n = 38
2010
n = 59
2011
n = 36
2012
n = 40
0
15
30
45
25
40
55
70
85
100
115
130
145
160
175
190
FL (mm)

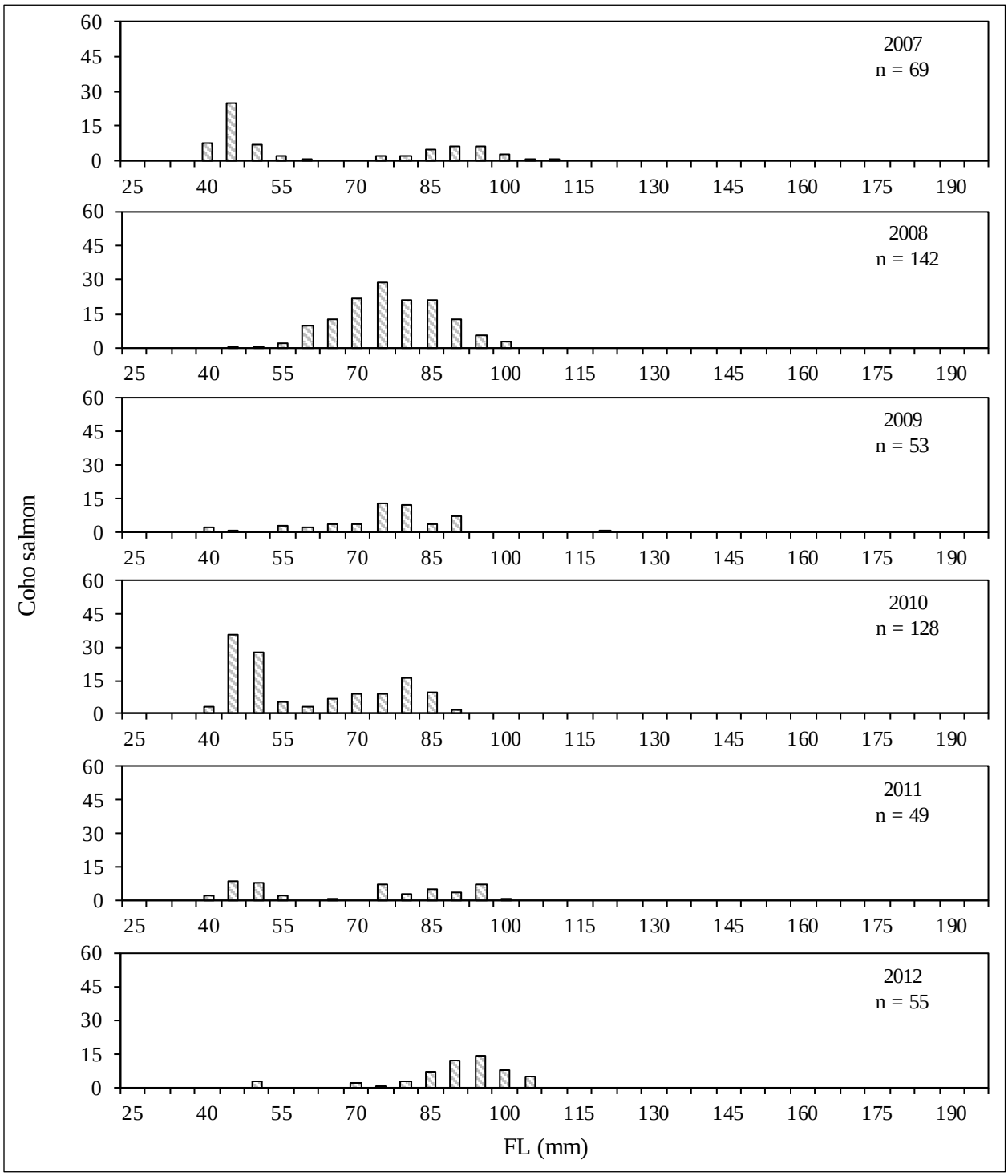
-continued-


Dolly Varden char
2013
n = 13
2014
n = 14
2015
n = 16
2016
n = 20
2017
n = 56
2018
n = 32
0
15
30
45
25
40
55
70
85
100
115
130
145
160
175
190
FL (mm)

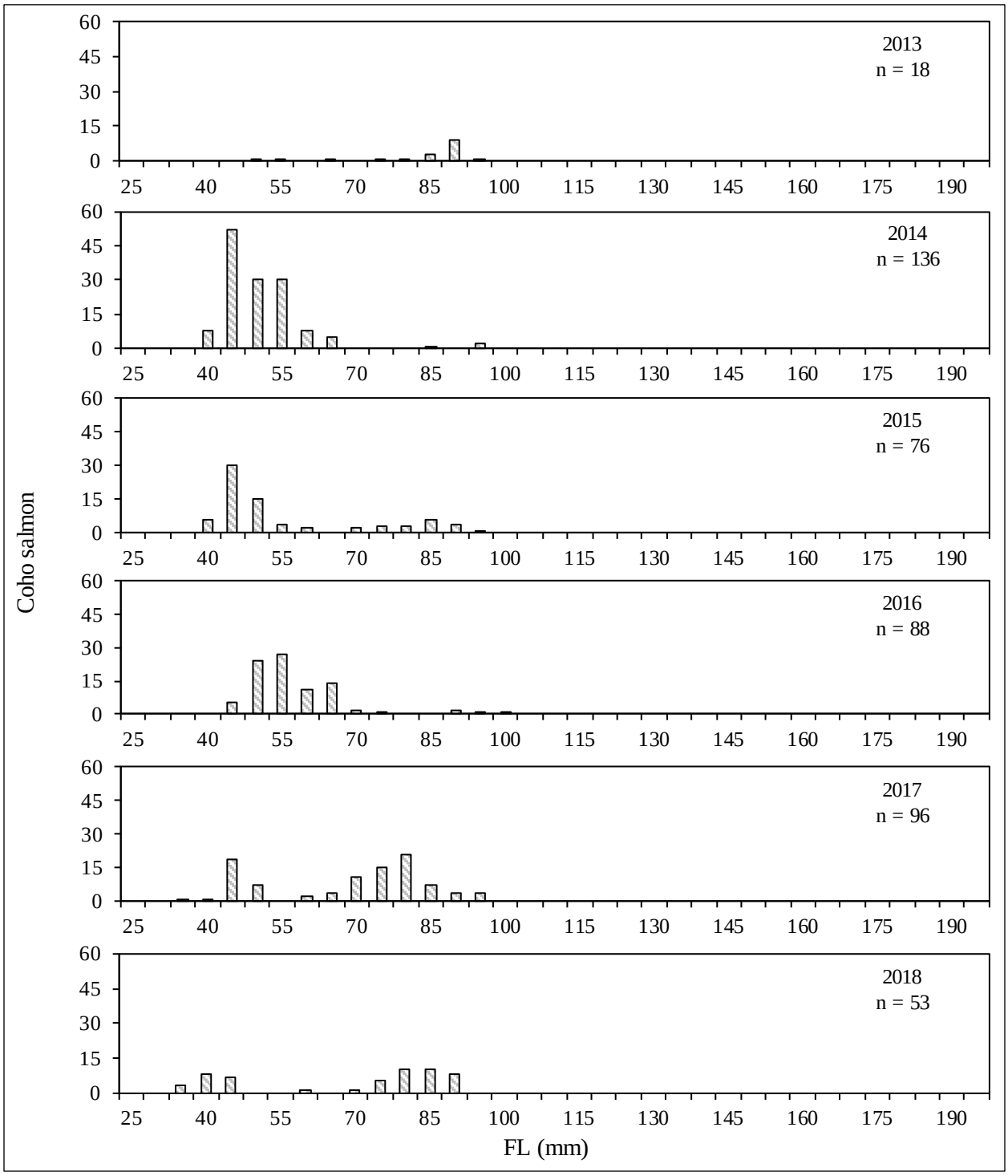
Appendix C.12.–Tributary Creek Site 9 coho salmon length frequency, 2001–2018.



-continued-


Coho salmon
2007
n = 69
2008
n = 142
2009
n = 53
2010
n = 128
2011
n = 49
2012
n = 55
0
15
30
45
60
25
40
55
70
85
100
115
130
145
160
175
190
FL (mm)

-continued-


Coho salmon
2013
n = 18
2014
n = 136
2015
n = 76
2016
n = 88
2017
n = 96
2018
n = 53
0
15
30
45
60
25
40
55
70
85
100
115
130
145
160
175
190
FL (mm)

APPENDIX D: JUVENILE FISH ELEMENT CONCENTRATIONS DATA AND LAB REPORT

Appendix D.1.–Greens Creek Site 48 Dolly Varden char element concentrations, 2001–2017.

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/23/01	131	26.0	0.02	1.76	8.3	ND	0.20	6.1	180
7/23/01	137	28.8	0.03	0.89	7.2	ND	0.17	4.6	146
7/23/01	119	18.8	0.02	2.27	5.7	ND	0.20	6.2	189
7/23/01	121	21.1	0.02	1.56	6.9	ND	0.17	5.2	182
7/23/01	111	13.7	0.03	0.89	4.7	ND	0.23	5.4	138
7/23/01	121	21.1	<0.02	1.26	7.4	ND	0.10	5.6	157
7/24/02	133	23.2	0.03	1.64	6.8	ND	0.72	4.8	239
7/24/02	120	15.0	0.07	0.85	7.0	ND	0.28	4.1	210
7/24/02	122	17.5	0.03	0.74	4.3	ND	0.17	4.9	162
7/24/02	127	20.8	0.04	1.40	6.1	ND	0.16	4.7	185
7/24/02	134	24.8	0.05	1.30	7.9	ND	0.46	4.3	208
7/24/02	128	21.7	0.04	1.56	6.8	ND	0.22	5.7	343
7/22/03	90	8.9	<0.02	0.65	4.2	ND	0.14	5.6	191
7/22/03	98	9.9	<0.02	0.90	5.1	ND	0.22	5.5	180
7/22/03	103	12.1	<0.02	0.82	5.6	ND	0.16	5.4	241
7/22/03	112	12.5	<0.02	0.78	6.1	ND	0.11	6.1	192
7/22/03	108	11.9	<0.02	0.63	3.9	ND	0.14	5.2	174
7/22/03	100	10.5	<0.02	0.58	3.7	ND	0.08	5.5	218
7/22/04	96	8.6	<0.02	0.63	4.7	ND	0.15	4.3	206
7/22/04	88	6.8	<0.02	0.83	5.6	ND	0.26	4.0	175
7/22/04	101	11.5	<0.02	1.54	4.6	ND	0.21	4.1	183
7/22/04	98	9.3	<0.02	0.80	5.2	ND	0.28	3.7	168
7/22/04	93	7.6	<0.02	1.25	4.4	ND	0.14	6.4	220
7/22/04	91	7.5	0.03	1.01	4.5	ND	0.29	5.6	323
7/22/05	103	19.7	0.02	0.66	4.4	ND	0.44	4.2	183
7/22/05	96	13.1	<0.02	0.84	14.5	ND	0.98	4.8	220
7/22/05	119	15.6	0.02	0.89	4.4	ND	0.66	4.8	226
7/22/05	114	17.1	0.02	0.59	6.0	ND	0.32	4.8	178
7/22/05	111	15.3	0.03	1.10	18.8	ND	0.79	4.6	217
7/22/05	125	16.9	0.03	0.47	3.6	ND	0.36	3.8	161
7/20/06	110	15.8	0.04	0.56	8.5	ND	0.37	5.4	244
7/20/06	110	15.4	0.05	1.20	8.3	ND	0.31	6.0	217
7/20/06	113	16.1	0.04	0.65	6.3	ND	0.24	5.4	264
7/20/06	132	25.0	0.06	0.63	8.1	ND	0.66	5.2	232
7/20/06	104	12.8	0.08	0.96	8.5	ND	0.37	5.1	283
7/20/06	114	16.7	0.03	0.63	5.3	ND	0.20	5.1	270

-continued-

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/21/07	122	17.9	0.03	1.16	5.5	ND	0.17	5.5	221
7/21/07	95	10.4	0.02	1.42	3.9	ND	0.29	5.8	165
7/21/07	135	22.8	0.09	1.35	14.1	ND	1.37	5.3	166
7/21/07	98	9.9	0.03	0.96	5.7	ND	0.27	5.2	269
7/21/07	105	13.2	0.11	1.79	11.4	ND	1.62	5.4	323
7/21/07	99	10.0	0.04	1.43	5.2	ND	0.31	5.7	208
7/22/08	112	16.4	0.069	1.23	5.2	ND	0.95	5.72	289.0
7/22/08	123	21.3	0.039	0.79	3.9	ND	0.57	4.56	194.0
7/22/08	105	14.0	0.079	0.82	4.6	ND	0.52	5.88	199.5
7/22/08	124	20.6	0.041	0.87	4.9	ND	0.42	6.31	244.0
7/22/08	115	16.9	0.030	1.36	5.3	ND	0.51	5.36	254.0
7/22/08	122	19.8	0.037	1.07	5.6	ND	0.38	6.11	260.0
7/21/09	120	20.1	<0.02	1.05	5.2	ND	0.22	5.9	186
7/21/09	121	20.7	<0.02	1.40	5.3	ND	0.44	5.7	173
7/21/09	119	17.9	0.02	1.10	4.5	ND	0.13	5.9	182
7/21/09	108	13.6	<0.02	1.20	4.1	ND	0.15	5.7	162
7/21/09	109	14.6	<0.02	1.50	4.9	ND	0.17	5.9	186
7/21/09	110	15.2	<0.02	0.84	3.8	ND	0.18	6.1	202
7/21/10	103	11.9	0.020	1.56	4.8	0.09	0.16	5.0	226
7/21/10	109	16.1	<0.020	0.50	3.0	0.15	0.20	5.4	170
7/21/10	108	13.9	0.040	0.91	4.2	0.17	0.30	5.0	180
7/21/10	105	13.8	<0.020	0.98	3.4	0.13	0.09	4.6	163
7/21/10	98	10.8	0.062	0.90	4.8	0.14	0.46	4.8	213
7/21/10	93	9.1	<0.020	0.96	3.6	0.10	0.09	4.0	156
7/22/11	88-112	ND	0.03	1.12	5.7	ND	0.28	6.2	221
7/24/12	109	11.3	0.03	2.26	27.0	0.134	0.16	5.5	186
7/24/12	123	18.3	0.03	1.37	4.9	0.122	0.10	5.7	184
7/24/12	110	9.8	0.03	1.83	25.6	0.159	2.59	5.6	275
7/24/12	103	10.6	0.03	0.99	76.8	0.175	0.30	5.1	189
7/24/12	104	10.7	0.03	2.66	84.8	0.122	1.05	6.3	242
7/24/12	116	15.8	0.04	0.73	35.1	0.148	1.03	4.7	190
7/25/13	145	20.6	<0.02	0.68	3.7	0.214	0.17	5.3	237
7/25/13	115	17.9	0.07	0.97	6.1	0.238	0.24	5.8	239
7/25/13	115	14.3	<0.02	0.81	4.0	0.180	0.08	6.7	258
7/25/13	105	11.4	<0.02	0.68	3.2	0.213	0.14	6.4	213
7/25/13	109	13.0	0.04	2.01	6.6	0.113	0.36	6.2	271
7/25/13	105	12.4	0.04	1.75	5.7	0.274	0.22	6.2	287

-continued-

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/25/14	110	13.0	0.04	0.55	4.5	0.146	0.11	5.3	234
7/25/14	100	10.5	<0.02	0.93	4.2	0.148	0.19	6.9	213
7/25/14	106	10.7	<0.02	1.22	4.8	0.199	0.38	5.7	232
7/25/14	105	11.3	<0.02	1.45	4.2	0.122	0.44	6.1	193
7/25/14	100	10.4	<0.02	0.92	4.5	0.134	0.06	4.9	237
7/25/14	120	14.8	0.04	0.75	5.5	0.260	0.18	5.9	305
7/16/15	105	12.4	<0.02	0.60	2.5	0.114	0.13	6.2	159
7/16/15	104	11.7	0.04	1.11	10.7	0.100	1.30	5.8	205
7/16/15	100	11.7	0.03	1.05	3.8	0.152	0.14	6.1	187
7/16/15	105	11.3	0.03	1.39	4.2	0.154	0.36	6.1	198
7/16/15	105	12.7	<0.02	1.06	4.0	0.128	0.12	5.7	169
7/16/15	100	10.4	0.02	1.49	3.9	0.165	0.37	5.4	191
7/16/15	104	9.6	<0.02	0.85	3.1	0.091	0.09	5.2	175
7/16/15	85	8.6	0.03	0.90	3.6	0.139	0.27	5.9	172
7/16/15	102	10.3	<0.02	1.51	3.7	0.180	0.15	7.2	192
7/16/15	120	16.3	<0.02	0.86	4.0	0.150	0.14	6.4	223
7/14/16	84	7.3	<0.020	1.28	4.72	0.180	0.157	7.63	252
7/14/16	82	6.1	0.023	0.921	4.82	0.160	0.147	5.83	222
7/14/16	98	10.1	0.021	1.09	3.99	0.108	0.150	6.30	189
7/14/16	93	7.9	<0.020	1.44	4.49	0.163	0.205	6.77	197
7/14/16	88	6.9	0.035	1.50	4.65	0.243	0.493	7.63	185
7/14/16	84	7.3	0.023	0.681	4.12	0.150	0.088	6.42	200
7/14/16	94	8.8	0.065	1.21	4.69	0.172	0.143	7.19	194
7/14/16	86	7.6	0.022	1.89	4.96	0.210	0.295	7.27	251
7/14/16	93	9.4	<0.020	1.23	4.85	0.127	0.193	5.8	205
7/14/16	101	9.8	<0.020	1.32	4.72	0.114	0.134	6.28	178
7/13/17	95	8.7	0.054	0.649	3.74	0.115	0.189	5.79	172
7/13/17	91	8.0	0.097	1.51	3.86	0.118	0.417	5.98	169
7/13/17	102	10.0	0.024	0.746	3.92	0.0919	0.089	5.37	168
7/13/17	105	13.1	0.022	1.00	4.98	0.143	0.237	6.78	194
7/13/17	94	8.6	<0.020	0.456	2.81	0.106	0.064	4.5	166
7/13/17	99	9.9	0.023	1.03	3.93	0.111	0.087	5.39	200
7/13/17	98	10.8	0.022	0.462	2.68	0.101	0.064	4.4	168
7/13/17	124	18.8	0.034	0.655	3.77	0.123	0.087	5.02	154
7/13/17	99	10.7	<0.020	0.673	3.48	0.0893	0.067	4.69	165
7/13/17	95	9.8	0.044	0.305	3.18	0.112	0.126	4.73	159

Appendix D.2.–Greens Creek Site 63 Dolly Varden char element concentrations, 2018.

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/13/18	92	7.0	0.038	1.55	6.52	0.175	0.635	7.50	283
7/13/18	95	8.0	0.056	1.13	5.15	0.169	0.906	6.56	236
7/13/18	105	11.5	0.045	1.63	7.10	0.181	1.29	7.5	250
7/13/18	87	6.5	0.021	1.65	4.65	0.127	0.263	7.4	244
7/13/18	97	8.2	0.044	1.44	5.42	0.157	1.54	7.38	244
7/13/18	90	6.8	0.026	1.18	4.60	0.149	0.324	7.00	195
7/13/18	105	10.6	0.025	1.10	5.33	0.178	0.172	6.2	247
7/13/18	95	8.1	<0.02	1.43	4.89	0.134	0.187	8.0	189
7/13/18	110	13.0	0.037	0.964	9.61	0.146	0.340	6.6	190
7/13/18	104	10.1	0.043	1.21	5.57	0.228	1.30	6.40	250

Appendix D.3.–Greens Creek Site 54 Dolly Varden char element concentrations, 2001–2018.

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/23/01	121	21.5	0.03	0.46	4.3	ND	0.33	5.7	126
7/23/01	119	19.3	0.02	0.21	3.2	ND	0.22	3.6	82
7/23/01	107	15.7	0.03	0.73	6.3	ND	0.59	4.7	144
7/23/01	109	13.6	0.02	0.82	5.4	ND	0.86	4.9	172
7/23/01	105	13.5	<0.02	0.79	6.5	ND	0.45	5.8	203
7/23/01	138	27.5	<0.02	0.74	5.8	ND	0.40	5.4	171
7/24/02	118	18.0	0.03	0.50	4.4	ND	0.94	3.4	363
7/24/02	128	22.3	0.03	0.52	4.5	ND	0.35	4.7	150
7/24/02	115	17.7	0.05	0.95	6.0	ND	0.66	4.4	161
7/24/02	115	18.9	0.03	1.03	5.2	ND	0.66	4.2	216
7/24/02	124	21.1	0.05	1.32	5.2	ND	0.74	3.9	194
7/24/02	123	20.9	0.02	0.70	3.9	ND	0.78	4.4	195
7/22/03	123	21.1	0.03	0.85	6.4	ND	1.40	6.1	188
7/22/03	101	10.6	<0.02	0.67	4.2	ND	0.32	6.4	174
7/22/03	88	9.2	<0.02	0.75	4.3	ND	0.35	6.5	186
7/22/03	109	14.8	<0.02	1.11	5.8	ND	0.38	5.7	188
7/22/03	95	10.6	<0.02	0.59	3.5	ND	0.29	5.7	174
7/22/03	92	9.7	<0.02	0.91	4.1	ND	0.43	6.5	263
7/21/04	103	9.9	0.02	0.79	11.0	ND	0.57	4.6	232
7/21/04	104	10.0	<0.02	0.88	5.5	ND	0.54	5.0	206
7/21/04	86	6.6	<0.02	1.26	5.1	ND	0.36	5.3	164
7/21/04	96	9.3	0.03	0.79	5.9	ND	0.28	5.4	191
7/21/04	93	9.9	<0.02	0.83	5.0	ND	0.48	3.9	202
7/21/04	104	12.9	0.08	1.12	7.0	ND	0.93	4.9	217
7/22/05	120	12.3	0.03	0.72	5.0	ND	0.27	4.0	160
7/22/05	106	12.1	0.02	0.63	4.5	ND	0.13	3.9	200
7/22/05	113	20.8	<0.02	0.73	8.8	ND	0.17	4.7	223
7/22/05	114	17.9	<0.02	0.82	9.7	ND	0.17	3.9	222
7/22/05	112	16.1	0.03	1.06	8.8	ND	0.22	4.4	209
7/22/05	118	22.3	0.02	0.55	5.5	ND	0.39	3.9	185
7/20/06	137	27.3	0.06	0.42	4.8	ND	0.51	5.7	208
7/20/06	112	14.9	0.04	0.75	16.0	ND	0.95	7.2	223
7/20/06	102	12.0	0.02	0.93	22.2	ND	0.52	6.3	239
7/20/06	114	19.6	0.04	1.03	7.6	ND	0.85	5.3	252
7/20/06	98	12.3	0.08	0.54	10.9	ND	0.48	5.4	223
7/20/06	115	16.9	0.04	0.78	8.6	ND	0.68	5.6	257

-continued-

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/20/07	102	11.8	0.04	0.88	5.3	ND	0.54	5.6	157
7/20/07	125	21.1	0.03	0.97	5.2	ND	0.83	7.5	234
7/20/07	97	10.7	0.06	0.81	5.7	ND	0.89	8.6	185
7/20/07	123	19.7	0.02	0.75	4.4	ND	0.50	7.1	175
7/20/07	104	12.5	0.03	0.92	5.6	ND	0.57	7.8	174
7/20/07	110	15.1	0.04	1.38	6.2	ND	0.82	5.4	191
7/22/08	123	21.9	0.039	0.66	5.3	ND	0.26	5.53	185.0
7/22/08	94	10.8	0.039	1.04	5.1	ND	0.28	6.07	203.0
7/22/08	123	21.5	0.028	1.53	4.9	ND	3.46	6.29	261.0
7/22/08	97	11.2	0.029	1.34	5.0	ND	0.17	5.90	198.5
7/22/08	108	16.0	0.045	1.98	6.3	ND	0.23	5.97	220.0
7/22/08	108	14.2	0.059	1.07	8.4	ND	1.31	5.03	195.0
7/21/09	132	26.9	0.04	1.10	4.8	ND	0.33	5.4	213
7/21/09	141	32.3	0.02	0.71	4.5	ND	0.45	7.9	143
7/21/09	116	17.9	<0.02	0.99	4.2	ND	0.40	6.3	153
7/21/09	117	17.7	0.03	1.00	5.9	ND	0.39	6.8	200
7/21/09	119	22.1	<0.02	1.20	4.0	ND	0.28	6.5	176
7/21/09	103	13.0	0.02	2.20	5.3	ND	0.35	5.9	226
7/20/10	115	16.0	<0.020	0.80	3.4	0.08	0.37	4.6	159
7/20/10	112	12.8	0.022	0.67	3.1	0.09	0.34	3.7	154
7/20/10	118	12.6	<0.020	0.98	3.6	0.12	0.25	5.2	190
7/20/10	108	10.6	<0.020	1.31	3.8	0.10	0.16	4.1	212
7/20/10	115	12.3	<0.020	1.73	5.0	0.12	0.36	4.4	222
7/20/10	94	9.0	0.025	0.77	4.0	0.14	0.31	4.8	199
7/21/11	95-117	ND	<0.02	0.95	4.5	ND	0.32	5.6	191
7/23/12	132	24.2	0.02	0.85	7.7	0.0768	0.41	9.2	144
7/23/12	118	17.3	0.04	1.03	7.7	0.109	0.57	6.3	199
7/23/12	109	13.1	0.06	2.04	19.2	0.112	1.32	7.4	215
7/23/12	97	9.1	0.03	2.04	65.6	0.126	0.50	6.2	227
7/23/12	115	15.4	0.04	1.22	12.6	0.123	1.10	6.9	202
7/23/12	119	18.3	0.03	1.81	5.3	0.0798	0.27	5.1	191
7/24/13	117	16.9	<0.02	1.39	4.2	0.131	0.30	5.6	247
7/24/13	117	17.6	0.02	0.74	3.9	0.183	0.39	7.0	297
7/24/13	94	11.3	<0.02	1.27	4.3	0.172	0.28	6.6	262
7/24/13	118	18.9	<0.02	0.89	3.9	0.145	0.33	6.0	211
7/24/13	105	10.3	0.02	1.18	5.3	0.108	0.27	6.4	245
7/24/13	116	15.3	0.02	1.07	4.5	0.126	0.18	6.4	225

-continued-

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/24/14	125	21.2	0.08	0.93	12.7	0.121	1.55	5.7	212
7/25/14	104	10.8	0.04	1.15	4.5	0.111	0.37	4.8	247
7/25/14	110	11.5	0.21	0.85	4.3	0.119	0.30	6.2	291
7/25/14	110	14.9	<0.02	0.69	4.8	0.113	0.25	5.9	248
7/25/14	104	10.5	<0.02	1.03	5.0	0.106	0.28	5.7	250
7/25/14	135	24.1	0.02	0.86	4.4	0.160	0.49	6.6	243
7/15/15	110	11.3	0.02	0.92	4.7	0.121	0.59	6.3	236
7/15/15	105	11.5	<0.02	0.52	2.5	0.116	0.36	7.0	117
7/15/15	110	11.7	<0.02	0.67	3.0	0.106	0.36	6.4	171
7/15/15	105	12.0	0.03	1.16	3.8	0.109	1.62	7.3	221
7/15/15	100	10.7	<0.02	2.06	4.9	0.106	0.37	6.6	198
7/15/15	95	8.4	<0.02	0.91	3.4	0.096	0.38	5.5	176
7/15/15	100	8.2	<0.02	0.60	3.6	0.119	0.49	5.8	219
7/15/15	92	9.9	0.02	0.84	4.7	0.072	0.47	6.5	153
7/15/15	90	7.1	0.03	1.32	3.9	0.159	1.08	7.2	204
7/15/15	88	6.2	0.02	1.13	4.0	0.119	0.39	6.4	179
7/12/16	127	21.5	<0.020	0.913	3.24	0.0958	0.194	4.29	122
7/12/16	113	16.2	0.024	1.01	3.49	0.130	0.295	6.23	154
7/12/16	117	15.8	<0.020	1.44	4.22	0.146	0.232	7.03	210
7/12/16	104	12.1	<0.019	0.626	3.39	0.153	0.220	6.18	173
7/12/16	101	9.0	<0.020	1.49	4.57	0.129	0.305	6.66	257
7/12/16	95	8.7	<0.020	0.558	3.26	0.101	0.226	6.01	194
7/12/16	99	11.1	0.029	1.89	5.98	0.110	0.820	7.47	210
7/12/16	86	8.8	0.022	1.52	5.21	0.101	0.359	6.48	226
7/12/16	107	10.0	<0.020	0.983	3.60	0.127	0.239	7.10	182
7/12/16	97	8.9	<0.019	1.18	4.60	0.124	0.215	6.93	244
7/12/17	103	11.5	0.028	0.745	3.39	0.0996	0.189	6.36	173
7/12/17	96	8.8	0.030	0.771	3.69	0.103	0.327	5.9	160
7/12/17	93	8.1	0.039	0.487	3.25	0.116	0.468	5.1	133
7/12/17	96	10.4	0.020	0.674	3.30	0.107	0.173	5.7	177
7/12/17	84	6.5	0.028	0.724	3.72	0.110	0.403	5.18	192
7/12/17	109	14.1	0.033	0.454	3.29	0.0882	0.212	5.05	150
7/12/17	90	9.0	0.035	1.30	5.34	0.0929	0.281	7.16	227
7/12/17	97	9.9	0.029	0.893	3.79	0.0901	0.246	6.3	178
7/12/17	101	10.6	0.031	0.869	4.27	0.104	0.222	6.4	167
7/12/17	115	14.1	0.039	1.20	22.2	0.109	0.444	5.9	191

-continued-

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/12/18	125	18.7	0.024	1.11	5.65	0.171	0.325	6.3	230
7/12/18	90	6.3	<0.02	2.17	6.05	0.154	1.15	7.86	260
7/12/18	90	7.5	0.032	1.75	5.47	0.139	1.08	8.0	225
7/12/18	95	8.1	0.037	0.729	3.37	0.183	1.70	6.46	278
7/12/18	110	14.1	0.040	0.639	3.82	0.156	0.568	6.4	208
7/12/18	95	9.7	0.026	1.28	7.36	0.119	0.769	7.32	258
7/12/18	95	7.1	0.023	1.31	4.78	0.130	0.452	7.2	234
7/12/18	85	6.9	0.029	0.726	4.22	0.118	0.675	6.84	206
7/12/18	100	10.1	0.056	1.35	5.40	0.186	0.421	7.99	241
7/12/18	105	12.9	0.036	1.45	6.08	0.136	0.538	8.9	217

Appendix D.4.–Tributary Creek Site 9 Dolly Varden char element concentrations, 2001–2018.

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/21/01	97	9.1	0.09	0.35	4.3	ND	0.56	6.8	127
7/21/01	97	9.7	0.10	0.77	5.2	ND	0.67	8.0	118
7/21/01	97	9.5	0.15	0.92	5.4	ND	4.88	5.3	144
7/21/01	98	10.4	0.15	0.86	6.7	ND	2.19	ND	99
7/21/01	86	6.4	0.08	0.76	4.9	ND	0.33	6.2	106
7/21/01	93	7.8	0.06	0.37	12.0	ND	0.38	6.8	122
7/24/02	103	10.8	0.02	0.22	3.7	ND	0.12	1.4	144
7/24/02	97	10.4	0.07	1.20	5.5	ND	1.66	3.3	172
7/24/02	100	11.2	0.13	1.06	6.1	ND	3.40	5.0	138
7/24/02	90	7.9	0.23	1.29	7.1	ND	4.08	5.2	168
7/24/02	90	9.2	0.08	1.15	5.2	ND	1.39	6.2	150
7/24/02	100	9.3	0.04	0.84	3.2	ND	0.33	5.4	152
7/23/03	106	10.7	0.06	0.46	2.8	ND	0.34	6.3	134
7/23/03	89	6.8	0.10	1.01	4.0	ND	0.82	6.0	131
7/23/03	112	17.4	0.16	1.35	4.4	ND	1.85	5.7	108
7/23/03	95	11.6	0.19	0.69	5.6	ND	1.30	3.6	136
7/23/03	91	9.5	0.05	0.72	4.4	ND	0.56	4.9	131
7/23/03	84	8.4	0.12	0.76	3.9	ND	0.78	4.7	125
7/21/04	84	5.5	0.10	0.96	3.2	ND	1.19	5.4	169
7/21/04	96	8.5	0.10	1.24	3.8	ND	0.67	5.9	138
7/21/04	105	14.1	0.10	2.02	4.0	ND	1.76	5.8	125
7/21/04	85	5.8	0.04	0.47	3.7	ND	0.93	4.8	175
7/21/04	81	6.4	0.09	2.34	4.3	ND	1.44	8.2	140
7/21/04	86	10.4	0.11	0.83	5.5	ND	0.97	5.8	161
7/23/05	97	11.1	0.06	0.70	10.4	ND	0.29	6.4	104
7/23/05	113	16.8	0.10	0.63	4.7	ND	0.97	6.1	122
7/23/05	115	18.8	0.07	0.52	6.3	ND	0.53	5.8	109
7/23/05	117	20.5	0.19	0.79	9.9	ND	1.07	6.7	117
7/23/05	101	11.7	0.07	1.44	5.2	ND	1.00	8.1	130
7/23/05	107	13.7	0.10	1.29	4.6	ND	0.46	8.0	134
7/21/06	99	12.9	0.12	0.74	4.0	ND	0.32	6.3	120
7/21/06	96	11.6	0.12	0.76	7.7	ND	1.32	6.8	157
7/21/06	94	10.9	0.18	1.59	10.3	ND	2.48	4.9	160
7/21/06	100	10.9	0.11	1.34	8.5	ND	1.46	5.2	142
7/21/06	97	11.7	0.14	0.88	4.6	ND	0.96	5.2	107
7/21/06	117	20.8	0.24	1.29	4.3	ND	2.92	5.9	130

-continued-

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/20/07	98	12.4	0.11	0.91	2.7	ND	1.10	7.8	106
7/20/07	89	8.9	0.12	1.72	3.3	ND	1.80	5.6	136
7/20/07	114	14.1	0.15	2.76	3.4	ND	1.28	8.7	122
7/20/07	81	7.1	0.14	1.90	4.2	ND	2.03	7.0	114
7/20/07	114	14.6	0.88	3.63	3.9	ND	1.56	10.9	131
7/20/07	93	10.6	0.14	1.50	20.3	ND	3.80	9.4	107
7/23/08	103	12.9	0.224	1.99	4.2	ND	3.47	7.66	169.0
7/23/08	108	14.8	0.095	0.96	3.2	ND	0.86	5.82	143.0
7/23/08	88	8.9	0.076	0.93	3.3	ND	0.75	4.41	186.0
7/23/08	86	9.3	0.220	1.91	5.7	ND	4.06	5.71	119.0
7/23/08	92	9.6	0.073	1.01	2.7	ND	0.61	5.20	125.0
7/23/08	90	8.7	0.033	0.54	2.2	ND	0.43	4.80	108.0
7/22/09	83	6.9	0.04	0.29	1.7	ND	0.24	5.4	127
7/22/09	91	8.6	0.06	0.55	2.1	ND	0.16	5.1	137
7/22/09	91	8.5	0.11	0.36	2.0	ND	0.23	7.5	138
7/22/09	98	10.3	0.09	0.81	3.4	ND	0.38	5.8	147
7/22/09	91	8.6	0.03	0.47	2.2	ND	0.40	4.5	125
7/22/09	90	7.8	0.06	0.60	2.2	ND	0.38	5.6	129
7/20/10	87	7.4	0.293	1.61	5.4	0.43	3.92	6.4	151
7/20/10	94	10.9	0.124	0.82	2.5	0.58	0.24	5.7	174
7/20/10	90	8.5	0.084	0.73	2.9	0.35	0.29	5.3	125
7/20/10	90	8.2	0.059	0.60	2.3	0.27	0.33	4.7	151
7/20/10	108	13.5	0.081	0.66	2.6	0.54	0.25	3.2	118
7/20/10	105	11.6	0.076	0.75	3.1	0.27	0.23	3.9	150
7/21/11	85-115	ND	0.090	0.80	3.4	ND	0.32	6.7	146
7/26/12	89	7.3	<0.02	0.33	18.4	0.429	0.18	4.3	123
7/26/12	122	16.5	0.03	0.60	8.4	0.257	0.54	4.8	126
7/26/12	74,75	8.1	0.05	0.76	42.4	0.217	1.65	4.9	140
7/26/12	105	11.7	0.13	0.57	22.6	0.241	0.74	7.5	128
7/26/12	98	9.9	0.07	0.95	203	0.235	1.90	5.5	115
7/26/12	86,112	20.2	0.06	0.53	8.5	0.278	0.67	5.3	116
7/23/13	90	10.1	0.72	6.36	7.5	0.418	5.93	9.7	179
7/23/13	92	10.4	0.27	1.57	3.8	0.329	1.60	6.9	122
7/23/13	85	7.8	0.19	2.41	5.8	0.297	3.90	8.6	153
7/23/13	82,52	8.0	0.05	0.59	3.3	0.439	0.35	5.0	152
7/23/13	82	6.6	0.48	4.67	8.9	0.332	4.87	9.6	181
7/23/13	81	5.5	0.13	2.14	4.6	0.289	1.64	5.6	166

-continued-

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/23/14	105	13.1	0.16	0.82	2.7	0.186	0.16	7.1	145
7/23/14	105	11.5	0.02	0.69	2.3	0.188	0.18	5.1	140
7/23/14	104	9.1	0.09	0.69	2.6	0.247	0.22	7.2	116
7/23/14	94	8.4	0.06	1.16	2.4	0.264	0.33	6.7	156
7/23/14	95	8.3	0.12	0.54	2.8	0.215	0.55	6.2	135
7/23/14	105	11.4	0.04	0.30	2.6	0.228	0.19	5.3	117
7/14/15	77,60	12.4	0.22	3.92	3.8	0.285	3.30	7.1	188
7/14/15	77	5.7	0.33	4.40	5.2	0.321	4.93	9.1	157
7/14/15	84	7.2	0.22	2.54	5.3	0.338	2.84	7.9	134
7/14/15	63,69	81.0	0.48	4.73	6.7	0.338	6.20	10.6	173
7/14/15	82	6.9	0.36	3.76	4.6	0.342	4.80	8.5	153
7/14/15	55,75	7.7	0.25	4.03	5.3	0.280	3.42	7.8	165
7/14/15	90	9.3	0.28	1.81	3.4	0.304	1.69	9.2	124
7/14/15	80	6.8	0.30	3.92	5.1	0.312	4.87	9.7	159
7/14/15	75,75	8.9	0.13	1.69	4.2	0.322	1.86	7.2	142
7/14/15	75,75	12.8	0.51	5.86	5.1	0.293	4.54	10.7	175
7/11/16	97	8.1	0.057	0.341	1.99	0.250	0.222	6.34	136
7/11/16	90	6.3	0.068	0.898	2.68	0.219	0.493	5.61	115
7/11/16	105	11.5	0.139	0.438	2.23	0.315	0.333	7.48	124
7/11/16	94	9.4	0.134	1.30	2.76	0.234	0.982	7.12	134
7/11/16	94	10.3	0.078	0.783	2.35	0.334	0.189	6.62	125
7/11/16	114	16.4	0.109	1.03	2.19	0.232	0.285	5.83	131
7/11/16	87	6.5	0.051	0.494	2.09	0.363	0.190	4.99	101
7/11/16	89	6.5	0.034	0.577	2.17	0.249	0.198	5.61	138
7/11/16	102	11.1	0.156	0.892	3.29	0.443	0.368	5.4	127
7/11/16	87	6.1	0.059	1.35	2.27	0.263	0.179	8.34	125
7/11/17	109	12.9	0.080	1.15	2.76	0.269	0.484	10.0	114
7/11/17	78	5.4	0.191	2.78	3.60	0.408	2.04	8.8	145
7/11/17	78	5.7	0.089	2.34	6.71	0.310	1.57	7.89	160
7/11/17	109	12.4	0.094	1.29	2.40	0.631	0.413	6.15	122
7/11/17	84	6.2	0.079	1.16	2.62	0.400	0.412	7.39	121
7/11/17	117	17.8	0.288	3.68	3.21	0.439	1.72	9.25	148
7/11/17	87	7.4	0.191	2.02	4.01	0.261	1.30	8.6	126
7/11/17	94	9.2	0.068	0.292	3.55	0.169	0.183	3.2	163
7/11/17	73	4.1	0.062	0.817	3.85	0.364	0.988	5.5	172
7/11/17	83	6.7	0.096	1.33	3.44	0.457	1.80	8.25	118

-continued-

Sample Date	FL (mm)	Weight (g)	Ag (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Pb (mg/kg)	Se (mg/kg)	Zn (mg/kg)
7/12/18	105	12.4	0.096	0.705	2.31	0.490	0.385	6.3	154
7/12/18	81	6.7	0.115	1.09	2.80	0.577	0.963	7.2	160
7/12/18	92	9.4	0.070	0.313	2.90	0.406	0.196	5.03	109
7/12/18	106	11.9	0.044	0.509	2.32	0.457	0.353	5.40	137
7/12/18	85	7.5	0.085	1.30	2.80	0.353	1.02	6.00	171
7/12/18	92	8.3	0.108	0.969	2.84	0.863	0.381	6.70	94.8
7/12/18	85	6.4	0.093	1.36	2.73	0.364	0.871	6.31	144
7/12/18	108	11.6	0.084	0.793	2.53	0.435	0.162	6.2	143
7/12/18	86	5.8	0.096	1.88	2.63	0.771	0.636	6.4	128
7/12/18	109	12.5	0.139	0.708	2.37	0.664	0.945	6.4	154

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T : +1 360 577 7222
F : +1 360 636 1068
www.alsglobal.com

September 20, 2018 **Analytical Report for Service Request No:** K1807739

Kate Kanouse
Alaska Department of Fish and Game
Division of Habitat
802 3rd Street
P.O. Box 110024
Douglas, AK 99811-0024

RE: 2018 Greens Creek Mine Biomonitoring

Dear Kate,

Enclosed are the results of the sample(s) submitted to our laboratory August 15, 2018
For your reference, these analyses have been assigned our service request number **K1807739.**

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3356. You may also contact me via email at Kurt.Clarkson@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Kurt Clarkson
Sr. Project Manager

ALS Environmental
ALS Group USA, Corp
1317 South 13th Avenue
Kelso, WA 98626
T : +1 360 577 7222
F : +1 360 636 1068
www.alsglobal.com

Table of Contents

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEH	http://dec.alaska.gov/eh/lab/cs/csapproval.htm	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L16-58-R4
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	http://health.hawaii.gov/	-
ISO 17025	http://www.pjlabs.com/	L16-57
Louisiana DEQ	http://www.deq.louisiana.gov/page/la-lab-accreditation	03016
Maine DHS	http://www.maine.gov/dhhs/	WA01276
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/enforcement/oqa.html	WA005
New York - DOH	https://www.wadsworth.org/regulatory/elap	12060
North Carolina DEQ	https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/laboratory-certification-branch/non-field-lab-certification	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/EnvironmentalLabCertification/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wyoming (EPA Region 8)	https://www.epa.gov/region8-waterops/epa-region-8-certified-drinking-water-	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

1317 South 13th Ave, Kelso, WA 98626 | 1-360-577-7222 | www.alsglobal.com

Client: Alaska Department of Fish and Game
Project: 2018 Greens Creek Mine Biomonitoring
Sample Matrix: Animal Tissue

Service Request: K1807739
Date Received: 08/15/2018

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier IV validation deliverables including summary forms and all of the associated raw data for each of the analyses. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt:

Thirty animal tissue samples were received for analysis at ALS Environmental on 08/15/2018. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored frozen at -20ºC upon receipt at the laboratory.

Metals:

No significant anomalies were noted with this analysis.

Approved by _____ Date 09/20/2018

Chain of Custody

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

CHAIN OF CUSTODY

SR# K180 7739

ALS Environmental
1317 South 13th Ave., Kelso, WA 98626 | +1 360 577 222 | +1 800 695 7222 | +1 360 636 1068 (fax)

PROJECT NAME	2018 Greens Creek Mine Biomonitoring
PROJECT NUMBER	
PROJECT MANAGER	Johnny Zutz
COMPANY NAME	ADF&G, Division of Habitat
ADDRESS	802 3rd Street
CITY/STATE/ZIP	Douglas, AK 99824
E-MAIL ADDRESS	johnny.zutz@alaska.gov
PHONE #	(907) 465-6474 FAX#
SAMPLER'S SIGNATURE	

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS		Semivolatile Organics by GC/MS (625 8270 SIM PAH 8270LL)	Volatile Organics (624 8260 BTEX 8021)	Hydrocarbons (*see below) (Gas Diesel Oil)	Oil & Grease/TRPH (1664 HEM 1664 SGT)	PCBs (Aroclors Congeners)	Pesticides/Herbicides (608 8081 8141 8151)	Chlorophenolics - 8151M (Tri Tetra PCP)	Metals, Total or Dissolved (See list below)	Cyanide Hex-Chrom	(circle) pH, Cond., Cl, SO_4, PO_4, F, NO_2, NO_3, BOD, TSS, TDS, Turb.	(circle) NH3-N, COD, TKN, TOC, DOC, NO2+NO3, T-Phos	TOX 9020 AOX 1650 506	Alkalinity CO_3 HCO_3	Dioxins / Furans (1613 8290)	Dissolved Gases CO_2 (RSK 175 Methane Ethane Ethene)	asdfasdfadf	adfadf	sdfasdfsdfa	REMARKS
attachment 1 of 1					30									X											
see comments below																									
																									adfasdf

REPORT REQUIREMENTS

- ____ I. Routine Report: Method Blank, Surrogate, as required
- X II. Report Dup., MS, MSD as required
- ____ III. CLP Like Summary (no raw data)
- ____ IV. Data Validation Report
- ____ V. EDD

INVOICE INFORMATION

PO #

Bill To:

TURNAROUND REQUIREMENTS

- ____ 24 hr.
- ____ 48 hr.
- ____ 5 day
- X Standard (15 working days)

Requested Report Date

Circle which metals are to be analyzed:

Total Metals: Al As Sb Ba Be B Ca (Cd) Co Cr (Cu) Fe (Pb) Mg Mn Mo Ni K (Ag) Na (Se) Sr Tl Sn V (Zn) (Hg)

Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg

*** INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)**

SPECIAL INSTRUCTIONS/COMMENTS:

Note: see attachement 1 of 1 of whole metal juvenile fish individual samples

Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:	RELINQUISHED BY:
Signature	Signature	Signature	Signature
Date/Time: 8/13/18	Date/Time: 8-15-18 0845	Date/Time	Date/Time
Printed Name: Johnny Zutz	Printed Name: DANIEL Pawson	Printed Name	Printed Name
Firm	Firm: ALS-K	Firm	Firm

K1807739

Project Name:	2018 Greens Creek Mine Biomonitoring		**Attachment 1 of 1**
Project Manager:	Johnny Zutz	Sample Type:	Whole body juvenile Dolly Varden char
Company Name:	Alaska Department of Fish and Game	Analysis:	Total metals, dry weight basis, report percent solids
Contact Information:	johnny.zutz@alaska.gov; (907) 465-6474		

Caculations to account for measuring fish while in storage bag with label weight below

Matrix	Sample Date	Sample Name	Sample ID	Total Metals	Fork Length (mm)	Weight: fish & bag (g)	Weight: fish (g)
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #1	2018TC9DV1	Ag, Cd, Cu, Hg, Pb, Se, Zn	105	19.0	12.4
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #2	2018TC9DV2	Ag, Cd, Cu, Hg, Pb, Se, Zn	81	13.3	6.7
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #3	2018TC9DV3	Ag, Cd, Cu, Hg, Pb, Se, Zn	92	16.0	9.4
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #4	2018TC9DV4	Ag, Cd, Cu, Hg, Pb, Se, Zn	106	18.5	11.9
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #5	2018TC9DV5	Ag, Cd, Cu, Hg, Pb, Se, Zn	85	14.1	7.5
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #6	2018TC9DV6	Ag, Cd, Cu, Hg, Pb, Se, Zn	92	14.9	8.3
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #7	2018TC9DV7	Ag, Cd, Cu, Hg, Pb, Se, Zn	85	13.0	6.4
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #8	2018TC9DV8	Ag, Cd, Cu, Hg, Pb, Se, Zn	108	18.2	11.6
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #9	2018TC9DV9	Ag, Cd, Cu, Hg, Pb, Se, Zn	86	12.4	5.8
Whole Body	7/12/2018	Tributary Creek Site 9 DV Metals Fish #10	2018TC9DV10	Ag, Cd, Cu, Hg, Pb, Se, Zn	109	19.1	12.5
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #1	2018GC54DV1	Ag, Cd, Cu, Hg, Pb, Se, Zn	125	25.3	18.7
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #2	2018GC54DV2	Ag, Cd, Cu, Hg, Pb, Se, Zn	90	12.9	6.3
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #3	2018GC54DV3	Ag, Cd, Cu, Hg, Pb, Se, Zn	90	14.1	7.5
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #4	2018GC54DV4	Ag, Cd, Cu, Hg, Pb, Se, Zn	95	14.7	8.1
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #5	2018GC54DV5	Ag, Cd, Cu, Hg, Pb, Se, Zn	110	20.7	14.1
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #6	2018GC54DV6	Ag, Cd, Cu, Hg, Pb, Se, Zn	95	16.3	9.7
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #7	2018GC54DV7	Ag, Cd, Cu, Hg, Pb, Se, Zn	95	13.7	7.1
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #8	2018GC54DV8	Ag, Cd, Cu, Hg, Pb, Se, Zn	85	13.5	6.9
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #9	2018GC54DV9	Ag, Cd, Cu, Hg, Pb, Se, Zn	100	16.7	10.1
Whole Body	7/12/2018	Greens Creek Site 54 DV Metals Fish #10	2018GC54DV10	Ag, Cd, Cu, Hg, Pb, Se, Zn	105	19.5	12.9
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #1	2018GC48DV1	Ag, Cd, Cu, Hg, Pb, Se, Zn	92	13.6	7.0
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #2	2018GC48DV2	Ag, Cd, Cu, Hg, Pb, Se, Zn	95	14.6	8.0
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #3	2018GC48DV3	Ag, Cd, Cu, Hg, Pb, Se, Zn	105	18.1	11.5
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #4	2018GC48DV4	Ag, Cd, Cu, Hg, Pb, Se, Zn	87	13.1	6.5
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #5	2018GC48DV5	Ag, Cd, Cu, Hg, Pb, Se, Zn	97	14.8	8.2
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #6	2018GC48DV6	Ag, Cd, Cu, Hg, Pb, Se, Zn	90	13.4	6.8
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #7	2018GC48DV7	Ag, Cd, Cu, Hg, Pb, Se, Zn	105	17.2	10.6
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #8	2018GC48DV8	Ag, Cd, Cu, Hg, Pb, Se, Zn	95	14.7	8.1
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #9	2018GC48DV9	Ag, Cd, Cu, Hg, Pb, Se, Zn	110	19.6	13.0
Whole Body	7/13/2018	Greens Creek Site 48 DV Metals Fish #10	2018GC48DV10	Ag, Cd, Cu, Hg, Pb, Se, Zn	104	16.7	10.1

PC Kurt

Cooler Receipt and Preservation Form

Client ADF&G, Division of Habitat Service Request K18 07739

Received: 8-15-18 Opened: 8-15-18 By: DSP Unloaded: 8-15-18 By: DSP

1. Samples were received via? *USPS* (*Fed Ex*) *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) (*Cooler*) *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA (Y) N If yes, how many and where? 1 Top Front
   If present, were custody seals intact? (Y) N If present, were they signed and dated? (Y) N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID (NA)	Tracking Number NA	Filed
3.0	2.8	Frozen	Frozen	-0.2	322		7822 9429 7371	

4. Packing material: *Inserts* *Baggies* (*Bubble Wrap*) (*Gel Packs*) *Wet Ice* *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
6. Were samples received in good condition (temperature, unbroken)? *Indicate in the table below.* NA (Y) N
   If applicable, tissue samples were received: (*Frozen*) *Partially Thawed* *Thawed*
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA (Y) N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA (Y) N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* (NA) Y N
11. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
12. Was C12/Res negative? (NA) Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____

Total Solids

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18 - 07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18
Analysis Method:	Freeze Dry	**Units:**	Percent
Prep Method:	None	**Basis:**	Wet

Total Solids

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
2018TC9DV1	K1807739-001	**20.8**	-	1	08/31/18 13:20	
2018TC9DV2	K1807739-002	**18.4**	-	1	08/31/18 13:20	
2018TC9DV3	K1807739-003	**20.4**	-	1	08/31/18 13:20	
2018TC9DV4	K1807739-004	**21.6**	-	1	08/31/18 13:20	
2018TC9DV5	K1807739-005	**21.0**	-	1	08/31/18 13:20	
2018TC9DV6	K1807739-006	**22.5**	-	1	08/31/18 13:20	
2018TC9DV7	K1807739-007	**19.8**	-	1	08/31/18 13:20	
2018TC9DV8	K1807739-008	**21.6**	-	1	08/31/18 13:20	
2018TC9DV9	K1807739-009	**23.0**	-	1	08/31/18 13:20	
2018TC9DV10	K1807739-010	**22.2**	-	1	08/31/18 13:20	
2018GC54DV1	K1807739-011	**20.0**	-	1	08/31/18 13:20	
2018GC54DV2	K1807739-012	**20.7**	-	1	08/31/18 13:20	
2018GC54DV3	K1807739-013	**20.4**	-	1	08/31/18 13:20	
2018GC54DV4	K1807739-014	**19.4**	-	1	08/31/18 13:20	
2018GC54DV5	K1807739-015	**22.1**	-	1	08/31/18 13:20	
2018GC54DV6	K1807739-016	**23.5**	-	1	08/31/18 13:20	
2018GC54DV7	K1807739-017	**21.8**	-	1	08/31/18 13:20	
2018GC54DV8	K1807739-018	**20.9**	-	1	08/31/18 13:20	
2018GC54DV9	K1807739-019	**19.5**	-	1	08/31/18 13:20	
2018GC54DV10	K1807739-020	**19.9**	-	1	08/31/18 13:20	
2018GC48DV1	K1807739-021	**37.1**	-	1	08/31/18 13:20	
2018GC48DV2	K1807739-022	**21.2**	-	1	08/31/18 13:20	
2018GC48DV3	K1807739-023	**20.8**	-	1	08/31/18 13:20	
2018GC48DV4	K1807739-024	**39.2**	-	1	08/31/18 13:20	
2018GC48DV5	K1807739-025	**21.2**	-	1	08/31/18 13:20	
2018GC48DV6	K1807739-026	**21.5**	-	1	08/31/18 13:20	
2018GC48DV7	K1807739-027	**21.0**	-	1	08/31/18 13:20	
2018GC48DV8	K1807739-028	**23.0**	-	1	08/31/18 13:20	
2018GC48DV9	K1807739-029	**21.5**	-	1	08/31/18 13:20	
2018GC48DV10	K1807739-030	**21.3**	-	1	08/31/18 13:20	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18 - 07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18
Analysis Method:	Freeze Dry	**Units:**	Percent
Prep Method:	None	**Basis:**	Wet

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Lab Code:	MRL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
2018GC54DV1	K1807739-011DUP	-	20.0	19.8	19.9	1	20	08/31/18
2018GC48DV9	K1807739-029DUP	-	21.5	21.7	21.6	<1	20	08/31/18

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Metals

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal tissue	**Date Received:**	08/15/18

Mercury, Total

Prep Method: METHOD
Analysis Method: 1631E
Test Notes:

Units: ng/g
Basis: Dry

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
2018TC9DV1	K1807739-001	10	10	09/12/18	09/14/18	490	
2018TC9DV2	K1807739-002	9.9	10	09/12/18	09/14/18	577	
2018TC9DV3	K1807739-003	10	10	09/12/18	09/14/18	406	
2018TC9DV4	K1807739-004	9.9	10	09/12/18	09/14/18	457	
2018TC9DV5	K1807739-005	9.9	10	09/12/18	09/14/18	353	
2018TC9DV6	K1807739-006	9.7	10	09/12/18	09/14/18	863	
2018TC9DV7	K1807739-007	9.6	10	09/12/18	09/14/18	364	
2018TC9DV8	K1807739-008	10	10	09/12/18	09/14/18	435	
2018TC9DV9	K1807739-009	9.9	10	09/12/18	09/14/18	771	
2018TC9DV10	K1807739-010	9.8	10	09/12/18	09/14/18	664	
2018GC54DV1	K1807739-011	10	10	09/12/18	09/14/18	171	
2018GC54DV2	K1807739-012	9.9	10	09/12/18	09/14/18	154	
2018GC54DV3	K1807739-013	10	10	09/12/18	09/14/18	139	
2018GC54DV4	K1807739-014	9.6	10	09/12/18	09/14/18	183	
2018GC54DV5	K1807739-015	9.8	10	09/12/18	09/14/18	156	
2018GC54DV6	K1807739-016	9.9	10	09/12/18	09/14/18	119	
2018GC54DV7	K1807739-017	9.8	10	09/12/18	09/14/18	130	
2018GC54DV8	K1807739-018	9.9	10	09/12/18	09/14/18	118	
2018GC54DV9	K1807739-019	9.6	10	09/12/18	09/14/18	186	
2018GC54DV10	K1807739-020	9.8	10	09/12/18	09/14/18	136	
Method Blank	K1807739-MB1	1.0	1	09/12/18	09/14/18	ND	
Method Blank	K1807739-MB2	1.0	1	09/12/18	09/14/18	ND	
Method Blank	K1807739-MB3	1.0	1	09/12/18	09/14/18	ND	

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal tissue	**Date Received:**	08/15/18

Mercury, Total

Prep Method:	METHOD	Units:	ng/g
Analysis Method:	1631E	Basis:	Dry
Test Notes:			

Sample Name	Lab Code	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
2018GC48DV1	K1807739-021	13	1	09/12/18	09/14/18	175	
2018GC48DV2	K1807739-022	9.8	1	09/12/18	09/14/18	169	
2018GC48DV3	K1807739-023	9.8	1	09/12/18	09/14/18	181	
2018GC48DV4	K1807739-024	9.9	1	09/12/18	09/14/18	127	
2018GC48DV5	K1807739-025	9.9	1	09/12/18	09/14/18	157	
2018GC48DV6	K1807739-026	9.8	1	09/12/18	09/14/18	149	
2018GC48DV7	K1807739-027	9.9	1	09/12/18	09/14/18	178	
2018GC48DV8	K1807739-028	9.8	1	09/12/18	09/14/18	134	
2018GC48DV9	K1807739-029	9.9	1	09/12/18	09/14/18	146	
2018GC48DV10	K1807739-030	9.9	1	09/12/18	09/14/18	228	
Method Blank	K1807739-MB1	1.0	1	09/12/18	09/14/18	ND	
Method Blank	K1807739-MB2	1.0	1	09/12/18	09/14/18	ND	
Method Blank	K1807739-MB3	1.0	1	09/12/18	09/14/18	ND	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal tissue	**Date Received:**	08/15/18
		Date Extracted:	09/12/18
		Date Analyzed:	09/14/18

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	2018TC9DV4	Units:	ng/g
Lab Code:	K1807739-004MS, K1807739-004DMS	Basis:	Dry
Test Notes:			

				Spike Level		Sample	Spike Result		Percent Recovery		ALS Acceptance	Relative Percent	Result
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Result**	**MS**	**DMS**	**MS**	**DMS**	**Limits**	**Difference**	**Notes**
Mercury	METHOD	1631E	10	248	249	457	744	690	116	94	70-130	8	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal tissue	**Date Received:**	08/15/18
		Date Extracted:	09/12/18
		Date Analyzed:	09/14/18

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	2018GC54DV5	Units:	ng/g
Lab Code:	K1807739-015MS, K1807739-015DMS	Basis:	Dry
Test Notes:			

				Spike Level		Sample	Spike Result		Percent Recovery		ALS Acceptance	Relative Percent	Result
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Result**	**MS**	**DMS**	**MS**	**DMS**	**Limits**	**Difference**	**Notes**
Mercury	METHOD	1631E	9.9	246	248	156	390	426	95	109	70-130	9	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	09/14/18

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Initial)

Units: ng/g
Basis: NA

Test Notes:

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	5.00	5.45	109	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	09/14/18

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Final)

Units: ng/g
Basis: NA

Test Notes:

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	5.00	4.95	99	70-130	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	09/12/18
		Date Analyzed:	09/14/18

Quality Control Sample (QCS) Summary
Total Metals

Sample Name:	Quality Control Sample	Units:	ng/g
Lab Code:		Basis:	Dry
Test Notes:	Tort-3 Solids = 99.1%		

Source: TORT-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	292	271	93	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal tissue	**Date Received:**	08/15/18
		Date Extracted:	09/12/18
		Date Analyzed:	09/14/18

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	2018GC48DV3	Units:	ng/g
Lab Code:	K1807739-023MS, K1807739-023DMS	Basis:	Dry
Test Notes:			

									Percent Recovery				
				Spike Level		Sample	Spike Result				ALS Acceptance	Relative Percent	Result
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Result**	**MS**	**DMS**	**MS**	**DMS**	**Limits**	**Difference**	**Notes**
Mercury	METHOD	1631E	9.9	249	246	181	461	429	112	101	70-130	7	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	09/14/18

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Initial)

Units: ng/g
Basis: NA

Test Notes:

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	5.00	5.04	101	70-130	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	09/14/18

Ongoing Precision and Recovery (OPR) Sample Summary
Total Metals

Sample Name: Ongoing Precision and Recovery (Final)

Units: ng/g
Basis: NA

Test Notes:

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	5.00	5.35	107	70-130	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	09/12/18
		Date Analyzed:	09/14/18

Quality Control Sample (QCS) Summary
Total Metals

Sample Name:	Quality Control Sample	Units:	ng/g
Lab Code:		Basis:	Dry
Test Notes:	Tort-3 Solids = 99.1%		

Source: TORT-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	292	291	100	70-130	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV1	**Basis:**	Dry
Lab Code:	K1807739-001		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.701**	mg/Kg	0.020	5	09/13/18 15:24	09/04/18	
Copper	200.8	**2.34**	mg/Kg	0.10	5	09/13/18 15:24	09/04/18	
Lead	200.8	**0.365**	mg/Kg	0.020	5	09/13/18 15:24	09/04/18	
Selenium	200.8	**6.27**	mg/Kg	1.0	5	09/13/18 15:24	09/04/18	
Silver	200.8	**0.096**	mg/Kg	0.020	5	09/13/18 15:24	09/04/18	
Zinc	200.8	**149**	mg/Kg	0.50	5	09/13/18 15:24	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV2	**Basis:**	Dry
Lab Code:	K1807739-002		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.09**	mg/Kg	0.020	5	09/13/18 15:31	09/04/18	
Copper	200.8	**2.80**	mg/Kg	0.10	5	09/13/18 15:31	09/04/18	
Lead	200.8	**0.963**	mg/Kg	0.020	5	09/13/18 15:31	09/04/18	
Selenium	200.8	**7.2**	mg/Kg	1.0	5	09/13/18 15:31	09/04/18	
Silver	200.8	**0.115**	mg/Kg	0.020	5	09/13/18 15:31	09/04/18	
Zinc	200.8	**160**	mg/Kg	0.50	5	09/13/18 15:31	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV3	**Basis:**	Dry
Lab Code:	K1807739-003		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.313**	mg/Kg	0.020	5	09/13/18 15:34	09/04/18	
Copper	200.8	**2.90**	mg/Kg	0.099	5	09/13/18 15:34	09/04/18	
Lead	200.8	**0.196**	mg/Kg	0.020	5	09/13/18 15:34	09/04/18	
Selenium	200.8	**5.03**	mg/Kg	0.99	5	09/13/18 15:34	09/04/18	
Silver	200.8	**0.070**	mg/Kg	0.020	5	09/13/18 15:34	09/04/18	
Zinc	200.8	**109**	mg/Kg	0.50	5	09/13/18 15:34	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV4	**Basis:**	Dry
Lab Code:	K1807739-004		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.509**	mg/Kg	0.020	5	09/13/18 15:36	09/04/18	
Copper	200.8	**2.32**	mg/Kg	0.10	5	09/13/18 15:36	09/04/18	
Lead	200.8	**0.353**	mg/Kg	0.020	5	09/13/18 15:36	09/04/18	
Selenium	200.8	**5.40**	mg/Kg	1.0	5	09/13/18 15:36	09/04/18	
Silver	200.8	**0.044**	mg/Kg	0.020	5	09/13/18 15:36	09/04/18	
Zinc	200.8	**137**	mg/Kg	0.50	5	09/13/18 15:36	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV5	**Basis:**	Dry
Lab Code:	K1807739-005		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.30**	mg/Kg	0.020	5	09/13/18 15:39	09/04/18	
Copper	200.8	**2.80**	mg/Kg	0.10	5	09/13/18 15:39	09/04/18	
Lead	200.8	**1.02**	mg/Kg	0.020	5	09/13/18 15:39	09/04/18	
Selenium	200.8	**6.00**	mg/Kg	1.0	5	09/13/18 15:39	09/04/18	
Silver	200.8	**0.085**	mg/Kg	0.020	5	09/13/18 15:39	09/04/18	
Zinc	200.8	**171**	mg/Kg	0.50	5	09/13/18 15:39	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV6	**Basis:**	Dry
Lab Code:	K1807739-006		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.969**	mg/Kg	0.020	5	09/13/18 15:46	09/04/18	
Copper	200.8	**2.84**	mg/Kg	0.099	5	09/13/18 15:46	09/04/18	
Lead	200.8	**0.381**	mg/Kg	0.020	5	09/13/18 15:46	09/04/18	
Selenium	200.8	**6.70**	mg/Kg	0.99	5	09/13/18 15:46	09/04/18	
Silver	200.8	**0.108**	mg/Kg	0.020	5	09/13/18 15:46	09/04/18	
Zinc	200.8	**94.8**	mg/Kg	0.50	5	09/13/18 15:46	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV7	**Basis:**	Dry
Lab Code:	K1807739-007		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.36**	mg/Kg	0.020	5	09/13/18 15:48	09/04/18	
Copper	200.8	**2.73**	mg/Kg	0.10	5	09/13/18 15:48	09/04/18	
Lead	200.8	**0.871**	mg/Kg	0.020	5	09/13/18 15:48	09/04/18	
Selenium	200.8	**6.31**	mg/Kg	1.0	5	09/13/18 15:48	09/04/18	
Silver	200.8	**0.093**	mg/Kg	0.020	5	09/13/18 15:48	09/04/18	
Zinc	200.8	**144**	mg/Kg	0.50	5	09/13/18 15:48	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV8	**Basis:**	Dry
Lab Code:	K1807739-008		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.793**	mg/Kg	0.020	5	09/13/18 15:51	09/04/18	
Copper	200.8	**2.53**	mg/Kg	0.10	5	09/13/18 15:51	09/04/18	
Lead	200.8	**0.162**	mg/Kg	0.020	5	09/13/18 15:51	09/04/18	
Selenium	200.8	**6.2**	mg/Kg	1.0	5	09/13/18 15:51	09/04/18	
Silver	200.8	**0.084**	mg/Kg	0.020	5	09/13/18 15:51	09/04/18	
Zinc	200.8	**143**	mg/Kg	0.50	5	09/13/18 15:51	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV9	**Basis:**	Dry
Lab Code:	K1807739-009		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.88**	mg/Kg	0.020	5	09/13/18 15:53	09/04/18	
Copper	200.8	**2.63**	mg/Kg	0.10	5	09/13/18 15:53	09/04/18	
Lead	200.8	**0.636**	mg/Kg	0.020	5	09/13/18 15:53	09/04/18	
Selenium	200.8	**6.4**	mg/Kg	1.0	5	09/13/18 15:53	09/04/18	
Silver	200.8	**0.096**	mg/Kg	0.020	5	09/13/18 15:53	09/04/18	
Zinc	200.8	**128**	mg/Kg	0.50	5	09/13/18 15:53	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018TC9DV10	**Basis:**	Dry
Lab Code:	K1807739-010		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.708**	mg/Kg	0.020	5	09/13/18 15:56	09/04/18	
Copper	200.8	**2.37**	mg/Kg	0.10	5	09/13/18 15:56	09/04/18	
Lead	200.8	**0.945**	mg/Kg	0.020	5	09/13/18 15:56	09/04/18	
Selenium	200.8	**6.4**	mg/Kg	1.0	5	09/13/18 15:56	09/04/18	
Silver	200.8	**0.139**	mg/Kg	0.020	5	09/13/18 15:56	09/04/18	
Zinc	200.8	**154**	mg/Kg	0.50	5	09/13/18 15:56	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV1	**Basis:**	Dry
Lab Code:	K1807739-011		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.14**	mg/Kg	0.020	5	09/13/18 15:58	09/04/18	
Copper	200.8	**5.69**	mg/Kg	0.10	5	09/13/18 15:58	09/04/18	
Lead	200.8	**0.314**	mg/Kg	0.020	5	09/13/18 15:58	09/04/18	
Selenium	200.8	**6.32**	mg/Kg	1.0	5	09/13/18 15:58	09/04/18	
Silver	200.8	**0.024**	mg/Kg	0.020	5	09/13/18 15:58	09/04/18	
Zinc	200.8	**236**	mg/Kg	0.50	5	09/13/18 15:58	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV2	**Basis:**	Dry
Lab Code:	K1807739-012		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**2.17**	mg/Kg	0.020	5	09/13/18 16:06	09/04/18	
Copper	200.8	**6.05**	mg/Kg	0.10	5	09/13/18 16:06	09/04/18	
Lead	200.8	**1.15**	mg/Kg	0.020	5	09/13/18 16:06	09/04/18	
Selenium	200.8	**7.86**	mg/Kg	1.0	5	09/13/18 16:06	09/04/18	
Silver	200.8	ND U	mg/Kg	0.020	5	09/13/18 16:06	09/04/18	
Zinc	200.8	**260**	mg/Kg	0.50	5	09/13/18 16:06	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV3	**Basis:**	Dry
Lab Code:	K1807739-013		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.75**	mg/Kg	0.020	5	09/13/18 16:08	09/04/18	
Copper	200.8	**5.47**	mg/Kg	0.10	5	09/13/18 16:08	09/04/18	
Lead	200.8	**1.08**	mg/Kg	0.020	5	09/13/18 16:08	09/04/18	
Selenium	200.8	**8.0**	mg/Kg	1.0	5	09/13/18 16:08	09/04/18	
Silver	200.8	**0.032**	mg/Kg	0.020	5	09/13/18 16:08	09/04/18	
Zinc	200.8	**225**	mg/Kg	0.50	5	09/13/18 16:08	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV4	**Basis:**	Dry
Lab Code:	K1807739-014		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.729**	mg/Kg	0.020	5	09/13/18 16:15	09/04/18	
Copper	200.8	**3.37**	mg/Kg	0.099	5	09/13/18 16:15	09/04/18	
Lead	200.8	**1.70**	mg/Kg	0.020	5	09/13/18 16:15	09/04/18	
Selenium	200.8	**6.46**	mg/Kg	0.99	5	09/13/18 16:15	09/04/18	
Silver	200.8	**0.037**	mg/Kg	0.020	5	09/13/18 16:15	09/04/18	
Zinc	200.8	**278**	mg/Kg	0.50	5	09/13/18 16:15	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV5	**Basis:**	Dry
Lab Code:	K1807739-015		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.639**	mg/Kg	0.020	5	09/13/18 16:18	09/04/18	
Copper	200.8	**3.82**	mg/Kg	0.10	5	09/13/18 16:18	09/04/18	
Lead	200.8	**0.568**	mg/Kg	0.020	5	09/13/18 16:18	09/04/18	
Selenium	200.8	**6.4**	mg/Kg	1.0	5	09/13/18 16:18	09/04/18	
Silver	200.8	**0.040**	mg/Kg	0.020	5	09/13/18 16:18	09/04/18	
Zinc	200.8	**208**	mg/Kg	0.50	5	09/13/18 16:18	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV6	**Basis:**	Dry
Lab Code:	K1807739-016		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.28**	mg/Kg	0.020	5	09/13/18 16:20	09/04/18	
Copper	200.8	**7.36**	mg/Kg	0.099	5	09/13/18 16:20	09/04/18	
Lead	200.8	**0.769**	mg/Kg	0.020	5	09/13/18 16:20	09/04/18	
Selenium	200.8	**7.32**	mg/Kg	0.99	5	09/13/18 16:20	09/04/18	
Silver	200.8	**0.026**	mg/Kg	0.020	5	09/13/18 16:20	09/04/18	
Zinc	200.8	**258**	mg/Kg	0.50	5	09/13/18 16:20	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV7	**Basis:**	Dry
Lab Code:	K1807739-017		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.31**	mg/Kg	0.020	5	09/13/18 16:23	09/04/18	
Copper	200.8	**4.78**	mg/Kg	0.10	5	09/13/18 16:23	09/04/18	
Lead	200.8	**0.452**	mg/Kg	0.020	5	09/13/18 16:23	09/04/18	
Selenium	200.8	**7.2**	mg/Kg	1.0	5	09/13/18 16:23	09/04/18	
Silver	200.8	**0.023**	mg/Kg	0.020	5	09/13/18 16:23	09/04/18	
Zinc	200.8	**234**	mg/Kg	0.50	5	09/13/18 16:23	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV8	**Basis:**	Dry
Lab Code:	K1807739-018		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.726**	mg/Kg	0.020	5	09/13/18 16:25	09/04/18	
Copper	200.8	**4.22**	mg/Kg	0.099	5	09/13/18 16:25	09/04/18	
Lead	200.8	**0.675**	mg/Kg	0.020	5	09/13/18 16:25	09/04/18	
Selenium	200.8	**6.84**	mg/Kg	0.99	5	09/13/18 16:25	09/04/18	
Silver	200.8	**0.029**	mg/Kg	0.020	5	09/13/18 16:25	09/04/18	
Zinc	200.8	**206**	mg/Kg	0.50	5	09/13/18 16:25	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV9	**Basis:**	Dry
Lab Code:	K1807739-019		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.35**	mg/Kg	0.020	5	09/13/18 16:28	09/04/18	
Copper	200.8	**5.40**	mg/Kg	0.10	5	09/13/18 16:28	09/04/18	
Lead	200.8	**0.421**	mg/Kg	0.020	5	09/13/18 16:28	09/04/18	
Selenium	200.8	**7.99**	mg/Kg	1.0	5	09/13/18 16:28	09/04/18	
Silver	200.8	**0.056**	mg/Kg	0.020	5	09/13/18 16:28	09/04/18	
Zinc	200.8	**241**	mg/Kg	0.50	5	09/13/18 16:28	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC54DV10	**Basis:**	Dry
Lab Code:	K1807739-020		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.45**	mg/Kg	0.020	5	09/13/18 16:30	09/04/18	
Copper	200.8	**6.08**	mg/Kg	0.10	5	09/13/18 16:30	09/04/18	
Lead	200.8	**0.538**	mg/Kg	0.020	5	09/13/18 16:30	09/04/18	
Selenium	200.8	**8.9**	mg/Kg	1.0	5	09/13/18 16:30	09/04/18	
Silver	200.8	**0.036**	mg/Kg	0.020	5	09/13/18 16:30	09/04/18	
Zinc	200.8	**217**	mg/Kg	0.50	5	09/13/18 16:30	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV1	**Basis:**	Dry
Lab Code:	K1807739-021		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.57**	mg/Kg	0.020	5	09/13/18 16:45	09/04/18	
Copper	200.8	**6.70**	mg/Kg	0.10	5	09/13/18 16:45	09/04/18	
Lead	200.8	**0.614**	mg/Kg	0.020	5	09/13/18 16:45	09/04/18	
Selenium	200.8	**7.51**	mg/Kg	1.0	5	09/13/18 16:45	09/04/18	
Silver	200.8	**0.039**	mg/Kg	0.020	5	09/13/18 16:45	09/04/18	
Zinc	200.8	**276**	mg/Kg	0.50	5	09/13/18 16:45	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV2	**Basis:**	Dry
Lab Code:	K1807739-022		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.13**	mg/Kg	0.020	5	09/13/18 16:52	09/04/18	
Copper	200.8	**5.15**	mg/Kg	0.099	5	09/13/18 16:52	09/04/18	
Lead	200.8	**0.906**	mg/Kg	0.020	5	09/13/18 16:52	09/04/18	
Selenium	200.8	**6.56**	mg/Kg	0.99	5	09/13/18 16:52	09/04/18	
Silver	200.8	**0.056**	mg/Kg	0.020	5	09/13/18 16:52	09/04/18	
Zinc	200.8	**236**	mg/Kg	0.50	5	09/13/18 16:52	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV3	**Basis:**	Dry
Lab Code:	K1807739-023		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.63**	mg/Kg	0.020	5	09/13/18 16:54	09/04/18	
Copper	200.8	**7.10**	mg/Kg	0.10	5	09/13/18 16:54	09/04/18	
Lead	200.8	**1.29**	mg/Kg	0.020	5	09/13/18 16:54	09/04/18	
Selenium	200.8	**7.5**	mg/Kg	1.0	5	09/13/18 16:54	09/04/18	
Silver	200.8	**0.045**	mg/Kg	0.020	5	09/13/18 16:54	09/04/18	
Zinc	200.8	**250**	mg/Kg	0.50	5	09/13/18 16:54	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV4	**Basis:**	Dry
Lab Code:	K1807739-024		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.65**	mg/Kg	0.020	5	09/13/18 16:57	09/04/18	
Copper	200.8	**4.65**	mg/Kg	0.10	5	09/13/18 16:57	09/04/18	
Lead	200.8	**0.263**	mg/Kg	0.020	5	09/13/18 16:57	09/04/18	
Selenium	200.8	**7.4**	mg/Kg	1.0	5	09/13/18 16:57	09/04/18	
Silver	200.8	**0.021**	mg/Kg	0.020	5	09/13/18 16:57	09/04/18	
Zinc	200.8	**244**	mg/Kg	0.50	5	09/13/18 16:57	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV5	**Basis:**	Dry
Lab Code:	K1807739-025		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.44**	mg/Kg	0.020	5	09/13/18 16:59	09/04/18	
Copper	200.8	**5.42**	mg/Kg	0.10	5	09/13/18 16:59	09/04/18	
Lead	200.8	**1.54**	mg/Kg	0.020	5	09/13/18 16:59	09/04/18	
Selenium	200.8	**7.38**	mg/Kg	1.0	5	09/13/18 16:59	09/04/18	
Silver	200.8	**0.044**	mg/Kg	0.020	5	09/13/18 16:59	09/04/18	
Zinc	200.8	**244**	mg/Kg	0.50	5	09/13/18 16:59	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV6	**Basis:**	Dry
Lab Code:	K1807739-026		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.18**	mg/Kg	0.020	5	09/13/18 17:07	09/04/18	
Copper	200.8	**4.60**	mg/Kg	0.10	5	09/13/18 17:07	09/04/18	
Lead	200.8	**0.324**	mg/Kg	0.020	5	09/13/18 17:07	09/04/18	
Selenium	200.8	**7.00**	mg/Kg	1.0	5	09/13/18 17:07	09/04/18	
Silver	200.8	**0.026**	mg/Kg	0.020	5	09/13/18 17:07	09/04/18	
Zinc	200.8	**195**	mg/Kg	0.50	5	09/13/18 17:07	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV7	**Basis:**	Dry
Lab Code:	K1807739-027		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.10**	mg/Kg	0.020	5	09/13/18 17:09	09/04/18	
Copper	200.8	**5.33**	mg/Kg	0.10	5	09/13/18 17:09	09/04/18	
Lead	200.8	**0.172**	mg/Kg	0.020	5	09/13/18 17:09	09/04/18	
Selenium	200.8	**6.2**	mg/Kg	1.0	5	09/13/18 17:09	09/04/18	
Silver	200.8	**0.025**	mg/Kg	0.020	5	09/13/18 17:09	09/04/18	
Zinc	200.8	**247**	mg/Kg	0.50	5	09/13/18 17:09	09/04/18	

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV8	**Basis:**	Dry
Lab Code:	K1807739-028		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.43**	mg/Kg	0.020	5	09/13/18 17:12	09/04/18	
Copper	200.8	**4.89**	mg/Kg	0.10	5	09/13/18 17:12	09/04/18	
Lead	200.8	**0.187**	mg/Kg	0.020	5	09/13/18 17:12	09/04/18	
Selenium	200.8	**8.0**	mg/Kg	1.0	5	09/13/18 17:12	09/04/18	
Silver	200.8	ND U	mg/Kg	0.020	5	09/13/18 17:12	09/04/18	
Zinc	200.8	**189**	mg/Kg	0.50	5	09/13/18 17:12	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV9	**Basis:**	Dry
Lab Code:	K1807739-029		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**0.964**	mg/Kg	0.020	5	09/13/18 17:14	09/04/18	
Copper	200.8	**9.61**	mg/Kg	0.10	5	09/13/18 17:14	09/04/18	
Lead	200.8	**0.340**	mg/Kg	0.020	5	09/13/18 17:14	09/04/18	
Selenium	200.8	**6.6**	mg/Kg	1.0	5	09/13/18 17:14	09/04/18	
Silver	200.8	**0.037**	mg/Kg	0.020	5	09/13/18 17:14	09/04/18	
Zinc	200.8	**190**	mg/Kg	0.50	5	09/13/18 17:14	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18 09:45
Sample Name:	2018GC48DV10	**Basis:**	Dry
Lab Code:	K1807739-030		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	**1.21**	mg/Kg	0.020	5	09/13/18 17:17	09/04/18	
Copper	200.8	**5.57**	mg/Kg	0.10	5	09/13/18 17:17	09/04/18	
Lead	200.8	**1.30**	mg/Kg	0.020	5	09/13/18 17:17	09/04/18	
Selenium	200.8	**6.40**	mg/Kg	1.0	5	09/13/18 17:17	09/04/18	
Silver	200.8	**0.043**	mg/Kg	0.020	5	09/13/18 17:17	09/04/18	
Zinc	200.8	**250**	mg/Kg	0.50	5	09/13/18 17:17	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
Sample Matrix:	Animal Tissue	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1812205-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	ND U	mg/Kg	0.020	5	09/13/18 15:17	09/04/18	
Copper	200.8	ND U	mg/Kg	0.10	5	09/13/18 15:17	09/04/18	
Lead	200.8	ND U	mg/Kg	0.020	5	09/13/18 15:17	09/04/18	
Selenium	200.8	ND U	mg/Kg	1.0	5	09/13/18 15:17	09/04/18	
Silver	200.8	ND U	mg/Kg	0.020	5	09/13/18 15:17	09/04/18	
Zinc	200.8	ND U	mg/Kg	0.5	5	09/13/18 15:17	09/04/18	

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
Sample Matrix:	Animal Tissue	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	KQ1812206-01		

Total Metals

Analyte Name	Analysis Method	Result	Units	MRL	Dil.	Date Analyzed	Date Extracted	Q
Cadmium	200.8	ND U	mg/Kg	0.020	5	09/13/18 16:37	09/04/18	
Copper	200.8	ND U	mg/Kg	0.10	5	09/13/18 16:37	09/04/18	
Lead	200.8	ND U	mg/Kg	0.020	5	09/13/18 16:37	09/04/18	
Selenium	200.8	ND U	mg/Kg	1.0	5	09/13/18 16:37	09/04/18	
Silver	200.8	ND U	mg/Kg	0.020	5	09/13/18 16:37	09/04/18	
Zinc	200.8	ND U	mg/Kg	0.5	5	09/13/18 16:37	09/04/18	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18
		Date Analyzed:	09/13/18

Replicate Sample Summary
Total Metals

Sample Name:	2018TC9DV1	**Units:**	mg/Kg
Lab Code:	K1807739-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1812205-05 Result	Average	RPD	RPD Limit
Cadmium	200.8	0.020	0.701	0.708	0.705	<1	20
Copper	200.8	0.10	2.34	2.28	2.31	3	20
Lead	200.8	0.020	0.365	0.404	0.385	10	20
Selenium	200.8	1.0	6.3	6.3	6.3	<1	20
Silver	200.8	0.020	0.096	0.095	0.096	1	20
Zinc	200.8	0.5	149	158	154	6	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 9/17/2018 3:40:18 PM Superset Reference:

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18
		Date Analyzed:	09/13/18

Replicate Sample Summary
Total Metals

Sample Name:	2018GC54DV1	**Units:**	mg/Kg
Lab Code:	K1807739-011	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1812205-07 Result	Average	RPD	RPD Limit
Cadmium	200.8	0.020	1.14	1.08	1.11	5	20
Copper	200.8	0.10	5.69	5.60	5.65	2	20
Lead	200.8	0.020	0.314	0.335	0.325	6	20
Selenium	200.8	1.0	6.3	6.3	6.3	<1	20
Silver	200.8	0.020	0.024	0.024	0.024	<1	20
Zinc	200.8	0.5	236	224	230	5	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18
		Date Analyzed:	09/13/18

Replicate Sample Summary
Total Metals

Sample Name:	2018GC48DV1	**Units:**	mg/Kg
Lab Code:	K1807739-021	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample KQ1812206-05 Result	Average	RPD	RPD Limit
Cadmium	200.8	0.020	1.57	1.52	1.55	3	20
Copper	200.8	0.10	6.70	6.33	6.52	6	20
Lead	200.8	0.020	0.614	0.656	0.635	7	20
Selenium	200.8	1.0	7.51	7.48	7.50	<1	20
Silver	200.8	0.020	0.039	0.037	0.038	5	20
Zinc	200.8	0.5	276	289	283	5	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 9/17/2018 3:40:18 PM Superset Reference:

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18
		Date Analyzed:	09/13/18
		Date Extracted:	09/4/18

Matrix Spike Summary
Total Metals

Sample Name:	2018TC9DV1	**Units:**	mg/Kg
Lab Code:	K1807739-001	**Basis:**	Dry
Analysis Method:	200.8		
Prep Method:	PSEP Metals		

Matrix Spike
KQ1812205-06

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Cadmium	0.701	5.54	5.00	97	70-130
Copper	2.34	25.0	25.0	91	70-130
Lead	0.365	46.3	50.0	92	70-130
Selenium	6.3	23.5	16.7	103	70-130
Silver	0.096	5.24	5.00	103	70-130
Zinc	149	194	50.0	90	70-130

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 9/17/2018 3:40:18 PM Superset Reference:

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/12/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18
		Date Analyzed:	09/13/18
		Date Extracted:	09/4/18

Matrix Spike Summary
Total Metals

Sample Name:	2018GC54DV1	**Units:**	mg/Kg
Lab Code:	K1807739-011	**Basis:**	Dry
Analysis Method:	200.8		
Prep Method:	PSEP Metals		

Matrix Spike
KQ1812205-08

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Cadmium	1.14	5.96	5.00	96	70-130
Copper	5.69	29.2	25.0	94	70-130
Lead	0.314	46.2	50.0	92	70-130
Selenium	6.3	24.0	16.7	106	70-130
Silver	0.024	5.22	5.00	104	70-130
Zinc	236	293	50.0	113 #	70-130

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 9/17/2018 3:40:18 PM Superset Reference:

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	07/13/18
Sample Matrix:	Animal Tissue	**Date Received:**	08/15/18
		Date Analyzed:	09/13/18
		Date Extracted:	09/4/18

Matrix Spike Summary
Total Metals

Sample Name:	2018GC48DV1	**Units:**	mg/Kg
Lab Code:	K1807739-021	**Basis:**	Dry
Analysis Method:	200.8		
Prep Method:	PSEP Metals		

Matrix Spike
KQ1812206-06

Analyte Name	Sample Result	Result	Spike Amount	% Rec	% Rec Limits
Cadmium	1.57	6.60	4.98	101	70-130
Copper	6.70	29.7	24.9	92	70-130
Lead	0.614	48.0	49.8	95	70-130
Selenium	7.51	25.6	16.6	109	70-130
Silver	0.039	5.54	4.98	110	70-130
Zinc	276	351	49.8	151 #	70-130

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Printed 9/17/2018 3:40:18 PM Superset Reference:

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client: Alaska Department of Fish and Game
Project: 2018 Greens Creek Mine Biomonitoring
Sample Matrix: Animal Tissue

Service Request: K1807739
Date Analyzed: 09/13/18

Lab Control Sample Summary
Total Metals

Units:mg/Kg
Basis: Dry

Lab Control Sample
KQ1812205-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cadmium	200.8	4.84	5.00	97	85-115
Copper	200.8	23.1	25.0	92	85-115
Lead	200.8	47.6	50.0	95	85-115
Selenium	200.8	15.8	16.7	95	85-115
Silver	200.8	5.35	5.00	107	85-115
Zinc	200.8	46.4	50.0	93	85-115

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client: Alaska Department of Fish and Game
Project: 2018 Greens Creek Mine Biomonitoring
Sample Matrix: Animal Tissue

Service Request: K1807739
Date Analyzed: 09/13/18

Lab Control Sample Summary
Total Metals

Units:mg/Kg
Basis: Dry

Lab Control Sample
KQ1812206-02

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cadmium	200.8	4.82	5.00	96	85-115
Copper	200.8	23.8	25.0	95	85-115
Lead	200.8	46.7	50.0	93	85-115
Selenium	200.8	16.3	16.7	98	85-115
Silver	200.8	5.36	5.00	107	85-115
Zinc	200.8	46.8	50.0	94	85-115

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	09/04/18
		Date Analyzed:	09/13/18

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	KQ1812205-04	Basis:	Dry
Test Notes:	Tort-3 Solids = 99.1%		

Source: N.R.C.C. Tort-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Cadmium	PSEP Tissue	200.8	42.3	40.6	96	32.4-52.9	
Copper	PSEP Tissue	200.8	497	476	96	380-623	
Lead	PSEP Tissue	200.8	0.225	0.203	90	0.166-0.292	
Selenium	PSEP Tissue	200.8	10.9	11.1	102	7.9-14.3	
Zinc	PSEP Tissue	200.8	136	130	96	104-170	

ALS Group USA, Corp.
dba ALS Environmental
QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1807739
Project:	2018 Greens Creek Mine Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	09/04/18
		Date Analyzed:	09/13/18

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	KQ1812206-04	Basis:	Dry
Test Notes:	Tort-3 Solids = 99.1%		

Source: N.R.C.C. Tort-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Cadmium	PSEP Tissue	200.8	42.3	40.7	96	32.4-52.9	
Copper	PSEP Tissue	200.8	497	474	95	380-623	
Lead	PSEP Tissue	200.8	0.225	0.193	86	0.166-0.292	
Selenium	PSEP Tissue	200.8	10.9	10.8	99	7.9-14.3	
Zinc	PSEP Tissue	200.8	136	126	93	104-170	