Technical Report No. 15-03

Aquatic Biomonitoring at Greens Creek Mine, 2014

by

Katrina M. Kanouse

March 2015

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

Symbols and Abbreviations

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

Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

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March 2015

This project was financed by Hecla Greens Creek Mining Company.

Cover: A juvenile Dolly Varden char at Greens Creek Site 48 during sampling in 2014.

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ACKNOWLEDGEMENTS

The Alaska Department of Fish and Game thanks Hecla Greens Creek Mining Company for contracting the Division of Habitat to perform the aquatic studies at the Greens Creek Mine. Hecla Greens Creek Mining Company environmental staff, Chris Wallace, Ted Morales, and Gunnar Fredheim, provided logistical and field support and water quality data. We also thank U.S. Forest Service Fishery Technician Christina Mounce who assisted with sampling in 2014.

Division of Habitat biologists who assisted with this year's report include Benjamin Brewster, Gordon Willson-Naranjo, and Greg Albrecht. Division of Habitat Deputy Director Dr. Al Ott and Southeast Regional Supervisor Jackie Timothy reviewed the draft report, and Division of Commercial Fisheries Publication Specialist Amy Carroll prepared the report for publication. Nora Foster of NRF Taxonomic Services identified the 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 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 (attached algae), benthic macroinvertebrates (aquatic insects), and juvenile fish in Greens Creek and Tributary Creek, two streams near mine development and operations. In 2014, we completed these studies at Greens Creek sites 48 and 54, and Tributary Creek Site 9.

The 2014 summer was the wettest on record for Juneau, and overall, 2014 was the seventh warmest year on record (Richard Lam, Meteorologist, National Weather Service, personal communication).

Mean periphyton density among the 2014 samples at each site was less than most previous years, though within the range of natural variation. Benthic macroinvertebrate density and the number of taxa increased from 2013 at each sample site, and sensitive aquatic insects comprised more than 70% of samples—a healthy proportion.

The 2014 juvenile Dolly Varden char populations were similar to population estimates from previous years at each site. We captured 15 juvenile coho salmon *Oncorhynchus kitsutch* at Greens Creek Site 54, the greatest number since the fish pass was damaged in late 2005. We captured 136 juvenile coho salmon at Tributary Creek Site 9, more than the past three years, and coho salmon continue to be the most abundant species at Site 9.Whole body juvenile fish metals concentrations were similar to or less than values observed in previous years at each site.

We also sampled stream sediment at the mouths of five drainages to Greens Creek to investigate potential sources of cadmium, copper, lead, mercury, selenium, silver, and zinc near sites 48 and 54. Copper and zinc concentrations were predominant in Big Sore, Cub, and Bruin Creeks, as they were at Site 48 and Site 54 in 2013, while lead and zinc were predominant in 1350 and Gallagher Creeks.

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, and within the Tongass National Forest and the Admiralty Island National Monument (USDA Forest Service 2013). The mine has operated since 1989, except between 1993 and 1996 when the mine was temporarily closed, and produces gold, lead, silver, and zinc concentrates for export. Hecla Greens Creek Mining Company (Hecla), a subsidiary of Hecla Mining Company, Coeur d'Alene, Idaho, has owned and operated the mine since April 2008.

Most mine infrastructure is located in two drainages that support both resident and anadromous fish: the dry-stack tailings disposal facility (TDF) at the headwaters of Tributary Creek, and the mill, mine facilities, and production rock storage areas adjacent to Greens Creek (Figure 1).

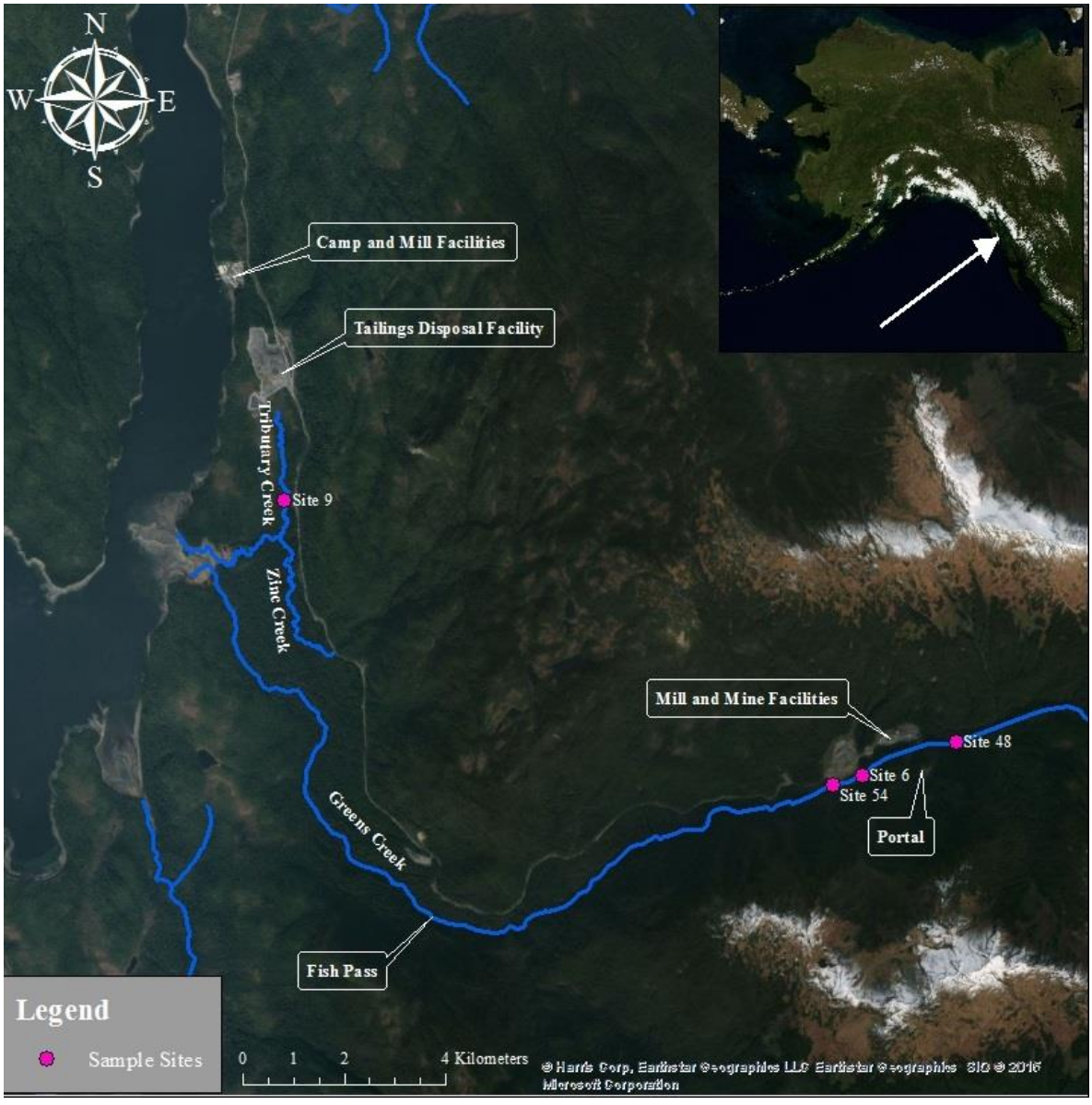

Figure 1.–Greens Creek Mine area map.

The mine's USFS approved Plan of Operations Fresh Water Monitoring Program (FWMP; KGCMC 2000, Appendix 1[a]) and ADEC Waste Management Permit 0211-BA001[b] require periphyton, benthic macroinvertebrate, and juvenile fish sampling. We assess stream health at each sample site using estimates of periphyton and benthic macroinvertebrate densities and community compositions, juvenile fish populations, fish condition, and whole body metals concentrations data.

The Division of Habitat began the aquatic studies for the Greens Creek Mine in 2001. Reports summarizing sampling results from previous years are available 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), and Kanouse and Brewster (2013–2014).

PURPOSE

The purpose of this technical report is to summarize the 2014 sample results and document the condition of biological communities in Greens Creek and Tributary Creek near mine development and operations. This report satisfies the requirements for Hecla's USFS approved Plan of Operations (KGCMC 2000) and ADEC Waste Management Permit 0211-BA001.

AQUATIC STUDIES

We completed the following studies:

- periphyton density and community composition;
- benthic macroinvertebrate density and community composition;
- juvenile fish populations and fish condition[c];
- whole body juvenile Dolly Varden char metals concentrations; and
- stream sediment metals concentrations[d] in drainages to Greens Creek.

STUDY AREA

We completed the aquatic studies at the following sample sites (Figures 2, 3):

1. Greens Creek Site 48, reference site upstream of mine activities;
2. Greens Creek Site 54, downstream of mine activities; and
3. Tributary Creek Site 9, downstream of the TDF.

We have sampled sites 48, 54, and 9 annually since 2001. We sample a fourth sample site, Greens Creek Site 6 located about 0.4 km upstream of Site 54, once every five years (2001, 2006, and 2011).[e]

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[a] Updated in November 2014.
[b] ADEC issued Hecla a new permit (2014DB003) in September 2014.
[c] Not required.
[d] Ibid.
[e] Site 6 data are summarized in the 2011 technical report (Kanouse 2012).

Figure 2.–Map of Greens Creek biomonitoring sample sites and mine facilities.

Figure 3.–Map of Tributary Creek biomonitoring sample site and mine facilities.

Greens Creek

The Greens Creek watershed is about 22.3 km^2 (USGS 2015) and the main channel measures about 16 km long from the alpine headwaters to the mouth at tidewater. At each sample site, gradients range from 2% to 4%, cobble is the dominant substrate, and large woody debris is common. The creek is largely 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.

Greens Creek Site 48

Site 48 (Figure 4) is located upstream of all mine activities, except exploratory drilling, near 265 m elevation and about 0.8 km upstream of the mine portal. Reference data collected at Site 48 are compared to data collected downstream at Site 54. Resident Dolly Varden char *Salvelinus malma* is the only fish species we have documented at Site 48; the infiltration gallery concrete weir near the mine portal blocks upstream fish passage to this site. Periphyton and benthic macroinvertebrate sampling occur in riffle habitats downstream of the fish sample reach.

Figure 4.–Greens Creek Site 48.

Greens Creek Site 54

Site 54 (Figure 5) 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. Data collected at Site 54 are compared to data collected at reference Site 48 to detect potential changes from waste rock storage areas, treatment ponds, and mine and mill facilities upstream. 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, though only partial fish passage has been available since 2005.[f] Periphyton and benthic macroinvertebrate sampling occur in riffle habitats upstream of the fish sample reach. Gallagher Creek enters Greens Creek within the fish sample reach.

Figure 5.–Greens Creek Site 54.

[f] In 1989, Greens Creek Mining Company installed an engineered fish pass as mitigation for impacts to Tributary Creek from the TDF. Three timber and concrete weirs provided step pools for adult coho salmon passage upstream through a natural bedrock chute that prevents fish migration. In November 2005, flood flows damaged the fish pass during a heavy rainstorm when discharge measured up to 272 ft^3/s; discharge during November generally ranges 20–60 ft^3/s, and annual peak snowmelt discharge is usually < 200 ft^3/s (USGS 2007).

Tributary Creek

The Tributary Creek watershed is about 1.7 km^2 (USDA Forest Service 2013) and the main channel measures about 1.6 km between the headwaters and the stream confluence with Zinc Creek. The TDF occupies the original headwaters of the creek. Tributary Creek is a low-energy, lowland stream fed by groundwater, precipitation, and a few hillside drainages. Stream gradient varies from 1% to 2%, organics and sand are the dominant substrates with gravel present near the mouth, and large and small woody debris are common. Tributary Creek provides habitat for chum salmon *O. keta,* coho salmon, pink salmon *O. gorbuscha*, cutthroat trout, rainbow trout *O. mykiss*, Dolly Varden char, and sculpin *Cottus* sp. Discharge estimates based on field measurements and limited gage data suggest annual stream flows range 1–5 ft^3/s (USDA Forest Service 2003).

Tributary Creek Site 9

Site 9 (Figure 6) is located 1.2 km downstream of the TDF at about 25 m elevation, and sampled to detect potential changes from the TDF. We have documented coho salmon, Dolly Varden char, cutthroat and rainbow trout, and sculpin at this site. Periphyton and benthic macroinvertebrate sampling occurs within the fish sample reach after the juvenile fish population study is complete.

Figure 6.–Tributary Creek Site 9.

METHODS

Deviations to methods are included as footnotes in the *Results* section. We occasionally review the long-term dataset to ensure accuracy, and report corrections in the document and appendices. The most recent technical report presents the current data set and should be used to analyze the data from previous years. In this report, we adjusted the 2001–2013 periphyton data by excluding chlorophylls *b* and *c* data when chlorophyll *a* was not detected, and verified the juvenile fish metals concentrations data set.

We performed data analyses using Statistix® 9 (Analytical Software. 2008. Statistix 9 User's Manual. Analytical Software, Tallahassee, Florida. http://www.statistix.com/features.html). We use nonparametric tests because the tests are robust when the distributions of parameters being estimated differ greatly from a Normal probability distribution. For data comparisons, we used the minimum reporting limit or estimated detection limit for results not detected. Significant differences are reported when $p \leq 0.05$.

WATER QUALITY

Hecla personnel used field meters to characterize basic water quality at each site during sampling, including temperature, pH, and conductivity. The 2014 results for each site are included in this report.

STREAM FLOW

Sampling and Analysis

We measure stream flow and calculate total discharge using a Global Flow Probe FP101 flow meter and a modification[g] of the methods described in Platts et al. (1983). We survey where stream flow is contained to one channel, and usually where the stream bottom elevation and stream flow are continuous across the channel.

We string a fiberglass measuring tape tightly across the survey site perpendicular to the stream, and begin the survey from either bank. Where we observe breaks in the stream bottom gradient or changes in water velocity, we measure and record horizontal distance (m) to the stream bank, stream depth (cm), and mean velocity (m/s) of the water column by slowly and consistently moving the flow meter throughout the water column until the mean reading stabilizes.[h] We attempt to record at least 20 measurement points, except in smaller systems where we record as many measurements as practicable.

We calculate total discharge by adding calculated discharges between measurement points using the distance (*w*), water depth (*d*), and velocity (*v*) data,

$$Q = \sum_{i=1}^{n} (w_{i+1} - w_i)\left(\frac{d_i + d_{i+1}}{2}\right)\left(\frac{v_i + v_{i+1}}{2}\right).$$

Data Presentation

We present the discharge estimate at the beginning of each sample site in the *Results* section.

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[g] We measure stream flow throughout the water column to determine mean velocity, rather than measuring at a specific depth where velocity is assumed to equal to the mean velocity of the water column.

[h] This usually takes less than 1 min.

PERIPHYTON DENSITY AND COMMUNITY COMPOSITION

Requirement FWMP 6.8

Periphyton are primary producers and include algae, cyanobacteria, heterotrophic microbes, and detritus attached to the submerged surfaces of aquatic ecosystems. Pigment chlorophyll *a* is produced by all plants and its concentration provides an estimate of active algal biomass present, while chlorophylls *b* and *c* provide information on the types of organisms present.

The FWMP requires we measure chlorophyll *a* density (mg/m^2) to estimate active algal biomass, and monitor density and proportions of accessory pigments chlorophylls *b* and *c* to detect change over time. We compare Greens Creek Site 48 reference data to Greens Creek Site 54 data, and track change over time at all sample sites. We do not have reference data to compare Tributary Creek Site 9 data.

Sample Collection and Analysis

We attempt to sample periphyton at low flow and not within three weeks after a high-flow event, which can scour and transport substrates. We collected 10 smooth, flat, undisturbed, perennially wetted rocks in riffle habitats in less than 0.45 m water depth using the collection methods described in Ott et al. (2010). We placed a 5×5 cm square of high-density foam on each rock and scrubbed the area around the foam with a toothbrush to remove attached algae outside the covered area. We rinsed the rock by dipping it with foam intact in the stream.

We removed the foam square and scrubbed the sample area with a rinsed toothbrush over a 1 µm, 47 mm glass fiber filter attached to a vacuum pump. We used stream water in a wash bottle and rinsed the loosened periphyton from the rock, the toothbrush, and the inside of the vacuum pump onto the filter. We pumped most of the water through the filter then added a few drops[i] of saturated magnesium carbonate ($MgCO_3$) to the filter to prevent acidification and conversion of chlorophyll to phaeophytin, before we pumped 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 paper 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 gel packs in the field, and in a camp freezer while onsite. Once we returned to the office, we stored the samples in a locked –20 °C freezer until we processed them in our laboratory.

We followed U.S. Environmental Protection Agency (1997) protocol[j] for chlorophyll extraction and measurement, determining instrument and estimated detection limits, and data analysis. We removed the samples from the freezer, cut them into small pieces, and transferred the filter pieces for each sample into centrifuge tubes containing 10 ml of 90% buffered acetone. We capped the centrifuge tubes, placed them in a rack, covered them with aluminum foil, and stored them in a refrigerator for less than 24 h to extract the chlorophyll. We centrifuged the samples for 20 min at 1,600 rpm and read them on a Shimadzu UV-1800 Spectrophotometer at optical densities (OD) 664 nm, OD 647 nm, and OD 630 nm, and used an acetone blank to correct for the solvent. We also read the samples at OD 750 nm to correct for turbidity. We treated the

[i] This measurement is not exact as the amount of water used to saturate the magnesium carbonate is not exact and fixes the sample regardless of the concentration and without affecting data integrity.

[j] Except, we stored our samples longer than 3.5 weeks and we cut our filters rather than homogenized them due to risk of acetone exposure (Ott et al. 2010).

samples with 80 µl of 0.1 N hydrochloric acid to convert the chlorophyll to phaeophytin, and read each sample again at OD 665 nm and OD 750 nm.

We used trichromatic equations to estimate chlorophylls *a, b,* and *c* concentrations, and corrected chlorophyll *a* concentration when phaeophytin was present. For samples with chlorophyll *a* not detected, we report the estimated detection limit. We used the Kruskal-Wallis one-way analysis of variance by ranks test, a nonparametric alternative to a one-way analysis of variance, to test for equality of population medians between years at each site, and among the current year Greens Creek sample sites (Neter et al. 1990). We used all-pairwise comparisons on the mean ranks for each group to test homogeneity between years and among Greens Creek sample sites.

Data Presentation

We include a figure of Greens Creek annual mean daily discharge three weeks prior to periphyton sampling; discharge data is not available for Tributary Creek. We also include a figure of the range of Greens Creek mean daily discharges three weeks prior to sampling.

For each sample site, we present a figure of annual mean chlorophyll *a* density (mg/m^2) ± one standard deviation, excluding potential outliers. A star (∗) in the figure represents a potential outlier, where chlorophyll *a* density in the sample exceeded the mean for the typical range of data that year by more than three times. We also present a figure of annual mean proportions of chlorophylls *a, b* and *c*. We include possible outlier values in the annual mean calculation, statistical analyses, and the raw data set (Appendix A).

We compare annual periphyton density data and chlorophyll proportions among Greens Creek sites 48 and 54 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.

BENTHIC MACROINVERTEBRATE DENSITY AND COMMUNITY COMPOSITION

Requirement FWMP 6.9

Benthic macroinvertebrates classified in the Orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), collectively known as EPT taxa, have limited mobility, complex and short life cycles, and most genera are sensitive to changes in water quality.

The FWMP requires we estimate benthic macroinvertebrate density ($insects/m^2$) and evaluate community composition at each site each year and over time. We compare among Greens Creek sites 48 and 54 data and track change over time at all sites. We do not have reference data to compare Tributary Creek Site 9 data.

Sample Collection and Analysis

We collected five benthic macroinvertebrate samples from each site using a Hess sampler in riffles with different velocities—habitat with the greatest taxonomic density and richness (Barbour et al. 1999). We do not sample other habitat types, such as pools, to reduce variability.

The Hess stream bottom sampler has a 0.086 m^2 sample area and a 363 μm mesh net and cod end. After we pushed the sampler into the stream bottom, we used a brush and scrubbed rocks within the sample area and disturbed gravels, sand, and silt to about 10 cm depth to dislodge macroinvertebrates into the net. We transferred each sample from the cod end of the sampler to a

labeled 500 mL plastic bottle and preserved the samples with minimum 70% denatured ethanol. When we returned to our laboratory, we added ethanol to each bottle to achieve a three parts ethanol to one part sample preservation ratio, and shipped the samples to a NRF Taxonomic Services in Fairbanks, Alaska, for sorting and taxonomic identification to the lowest practical[k] level.

We calculate benthic macroinvertebrate density in each sample by dividing the number of aquatic insects by 0.086 m^2, the Hess sampling area. We estimate annual benthic macroinvertebrate density for each site by calculating the mean density among the five samples. We report taxa richness as the total number of taxa observed among the five samples.

Data Presentation

We include a figure of annual mean benthic macroinvertebrate density (insects/m^2) ± one standard deviation with taxa richness, and a figure illustrating percent community composition, for each site. Annual data summaries are included in Appendix B.

We compare annual benthic macroinvertebrate density and taxa richness data among Greens Creek sites 48 and 54 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.

JUVENILE FISH POPULATIONS

Requirement FWMP 6.10

The FWMP requires estimating annual juvenile fish populations by species at each site to monitor changes in populations over time. 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[l] isolated by natural features, such as shallow riffles and debris jams, with 6.35 mm (0.25 in) minnow traps baited with whirl packs containing disinfected salmon roe (Magnus et al. 2006). Prior to each study, we opportunistically set several baited minnow traps within 15 m of the upstream and downstream sample reach boundaries to capture potential migrants and improve sample reach isolation.[m] The 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 the number of fish captured in these traps in population estimates.

We sampled juvenile fish populations using a modification[n] of a depletion method described by Bryant (2000). We saturated the sample reach with baited minnow traps in all habitat types

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[k] EPT and Diptera insects to genus, except nonbiting midges to family Chironomidae; all other insects are identified to phylum, order, or class level.

[l] We have never used a 100 m fish sample reach at any sample site as the FWMP specifies. We sampled a 28 m reach at Greens Creek Site 54, 2001–2010, and 50 m reach thereafter.

[m] 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.

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

where water depth and flow allowed, and moved away from the sample site to avoid disturbing fish while the traps soaked for 1.5 h. We retrieved each trap, transferred captured fish into plastic buckets, removed the spent bait, rebaited the trap, and reset each trap in the same location, as quickly as possible. We allowed the trap to soak another 1.5 h, then completed the sequence a third time, for a total of three passes.

We processed captured fish between passes. Biologists anesthetized fish in an aerated bucket with AQUI-SE (10% eugenol)[o], measured and recorded length (FL) to the nearest 1 mm, weight to the nearest 0.1 g, and species (Pollard et al. 1997). We retained captured fish in perforated plastic buckets secured in the stream during the study, and released captured fish[p] 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 baited minnow traps in all habitat types where water depth and flow allowed.
- Fish did not become more wary of capture with each pass.
    - Trap numbers and placement remained constant during all three passes.
    - We retrieved captures after each pass as quickly as possible.
    - We moved away from sample reaches to avoid disturbing fish while the traps soaked each pass.
- Collection effort and conditions which affect collection efficiency remained constant.
    - We retrieved fish after each pass beginning at the downstream end of each reach.
    - We moved upstream setting, retrieving, and replacing traps as quickly as possible.
    - We recorded time between passes on data sheets.
    - We replaced spent bait with fresh bait and reset each trap in the same location.

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% confidence interval.

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[o] As part of U.S. Fish and Wildlife Service Study # 11-741-14-083F, we used dosages ranging 5–18 mg/L. In previous years, we used 0.5 mL/gal diluted clove oil.

[p] Except, we retained six Dolly Varden char for whole body metals concentrations at each sample site.

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

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

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*,

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

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

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

We determined the SE of *N* by calculating the square root of the variance of *N*, and the 95% confidence interval for the MLE using $\pm$ 2(SE). The size of the 95% confidence interval depends on the number of captures each pass; a small 95% confidence interval results when fewer captures steadily occur with each pass, and a large confidence interval 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 if we capture few fish (usually < 20 fish) during the three sample events; 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 heavily on equal capture probability among passes (Bryant 2000, Carle and Strub 1978, Lockwood and Schneider 2000). To evaluate equal capture probability, we use the goodness of fit test in White et al. (1982), recommended by Lockwood and Schneider (2000), which follows the χ^2 test form. We first calculate expected numbers of fish captured for each pass ($C_1, C_{2.}, C_3$) using variables previously described:

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

Then we calculate χ^2,

[q] 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).

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

If the goodness of fit test indicates we did not achieve equal capture probability, the MLE will be biased low.

Data Presentation

We present a figure of annual juvenile fish population estimates by species for each sample site. We also present a comparison of Greens Creek sites 48 and 54 population estimates over time 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

We used juvenile fish length and weight data to calculate fish condition, an index of fish health. Age, sex, season, maturation, diet, gut fullness, fat reserve, and muscular development affect fish condition. This study is not required in the FWMP; we began this study in 2012.

Sample Collection and Analysis

We used length (mm) and weight (g) data collected for the juvenile fish population studies to calculate 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

We present mean fish condition by species for each site, compare fish condition among Greens Creek sites 48 and 54 in *Comparisons Among Greens Creek Sites*, and include annual means by species for each site in Appendix C.

JUVENILE FISH METALS CONCENTRATIONS

Requirement FWMP 6.11

The FWMP requires we sample six juvenile Dolly Varden char within the size class 85–125 mm for whole body concentrations of Ag, Cd, Cu, Pb, Se, and Zn at each site, each year.[r] This sample size is used for aquatic studies at other mines in Alaska and provides information without being cost prohibitive. A juvenile fish measuring 85 mm FL provides the minimum amount of tissue (about 5 g) required for the laboratory analyses; the maximum size of 125 mm FL improves the likelihood of sampling less than 3-year-old resident fish at sites 54 and 9 where anadromous Dolly Varden char may be present. We evaluate data for each site over time and compare data among all three sites each year.

[r] In addition, we began testing for Hg in 2012.

Sample Collection and Analysis

We retained six juvenile Dolly Varden char measuring 85–125 mm that we captured during the juvenile fish population survey, individually packed the samples in clean, labeled plastic bags, and measured fish FL to the nearest 1 mm. We stored the samples in a cooler containing gel ice packs, then in a camp freezer until we returned to our laboratory and weighed each fish in the sealed bags, correcting for bag weight. We stored the samples at –20 °C in our locked laboratory freezer until we shipped them on ice to ALS Environmental in Kelso, Washington, where they were individually digested, dried, and analyzed for total Ag, Cd, Cu, Hg, Pb, Se, and Zn on a dry weight basis.

We maintained written chain of custody documentation for the samples. The analytical laboratory provided Tier II quality assurance/quality control validation information for each analyte including matrix spikes, sample blanks and duplicates, standard reference materials, and laboratory calibration data.

We used the Kruskal-Wallis one-way analysis of variance by ranks test, a nonparametric alternative to a one-way analysis of variance, to test for equality of population medians between years and sites (Neter et al. 1990). We used all-pairwise comparisons on the mean ranks for each group to test for homogeneity between years and sites.

Data Presentation

We present a figure of maximum, median, and minimum whole body concentrations for each analyte, each site. Raw data and the current year laboratory report are included in Appendix D. We also compare data among sample sites in *Comparison Among Sites.*

SEDIMENT METALS CONCENTRATIONS

We sampled sediments to measure metals concentrations at the mouths of five drainages to Greens Creek. Sediment metals concentrations are influenced by a variety of factors, such as sediment grain size, organic content, and minerals. This study is not required in the FWMP.

Sample Collection and Analysis

We collected sediment opportunistically in areas with fine sediment deposition along the perimeter of the stream and in eddies. We collected the top 4 cm of sediment and retained the sediment that passed through a 1.7 mm sieve in a new, clean plastic bucket, and transferred the sediment sample to a labeled 100 mL glass jar the laboratory provided. Between sites, we rinsed our equipment in stream water. Hecla Environmental staff stored the samples in refrigerators onsite and shipped the samples on ice to ALS Environmental in Kelso, Washington for total metals analyses of Ag, Cd, Cu, Hg, Pb, Se, and Zn.

Data Presentation

We present a figure of sediment metals concentrations (mg/kg) for each sample in *Comparisons Among Greens Creek Sites*, and compare the values with guidelines suggested by Buchman (2008). Raw data and the laboratory report are included in Appendix E.

RESULTS AND DISCUSSION

Within three weeks prior to sampling Greens Creek in 2014, mean daily discharges were generally less than the means of the previous 24 years, except four days during mid-July and while sampling on July 25 (Figure 7). The range of mean daily discharges three weeks prior to sampling in 2014 was similar to the 2013 range and other years (Figure 8). The USDA Natural Resources Conservation Service (2014) Alaska snow pack map suggests the remaining snow pack near Greens Creek Mine on May 1, 2014 was similar to the 30-year mean (1981–2010); peak snowmelt discharge in Greens Creek occurred between May 11 and May 20, and periodic peak flows > 100 ft^3/s followed in early and late June (USGS 2015).

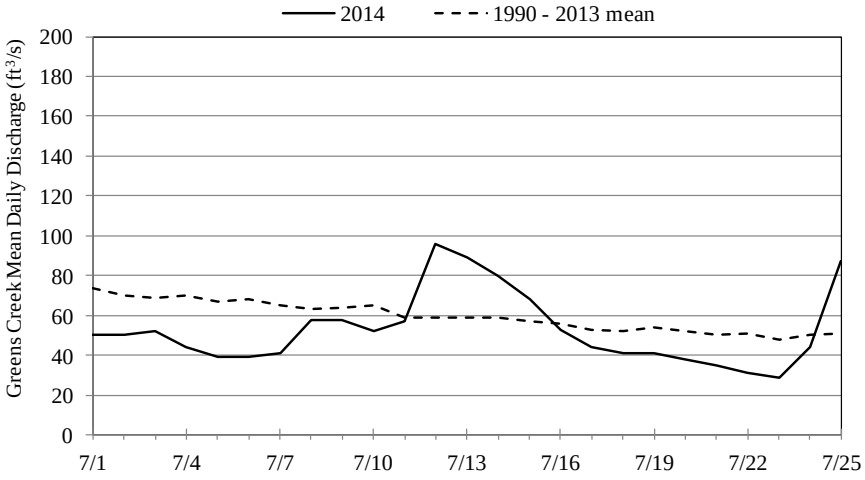

Figure 7.–Greens Creek mean daily discharge (ft^3/s) three weeks prior to sampling in 2014, and mean daily discharges for the period 1990–2013.
Source: USGS Gage 15101490 (USGS 2015).

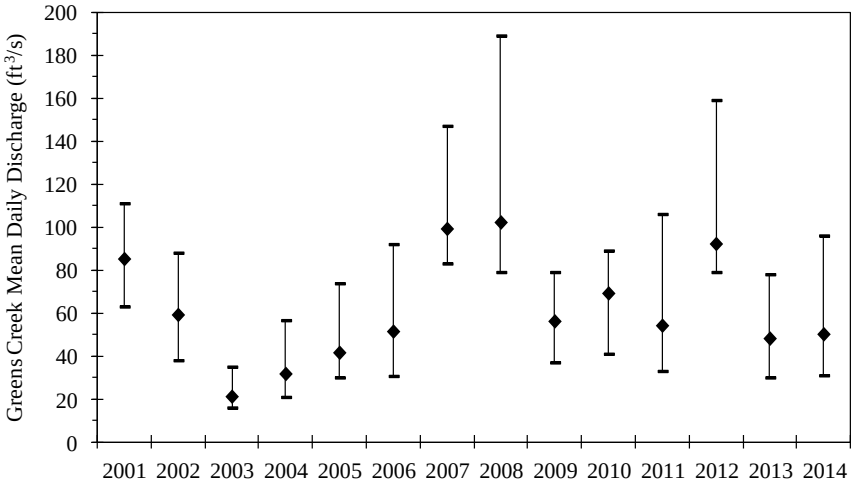

Figure 8.–Greens Creek mean daily discharges three weeks prior to sampling.
Note: Median (♦), minimum, and maximum mean daily discharges ((ft^3/s) presented.
Source: USGS Gage 15101490 (USGS 2015).

GREENS CREEK SITE 48

We sampled Greens Creek Site 48 on July 25, 2014. Hecla personnel recorded the following water quality data: water temperature 8.87 °C, conductivity 97 µS/cm, pH 7.85 units, and turbidity 6 nephelometric turbidity units (NTU). Using our flow data, we estimate discharge at the sample site was about 89 ft^3/s after sampling. The USGS gage, located downstream of Site 48 and Hecla's water withdrawal, recorded 70 ft^3/s at 1130 and a mean daily discharge of 87 ft^3/s.

Periphyton Density and Community Composition

The 2014 mean chlorophyll *a* density was 2.95 mg/m^2, within the range observed since 2001,[s] and proportions of chlorophylls *a, b,* and *c* were similar to previous years (Figures 9, 10).

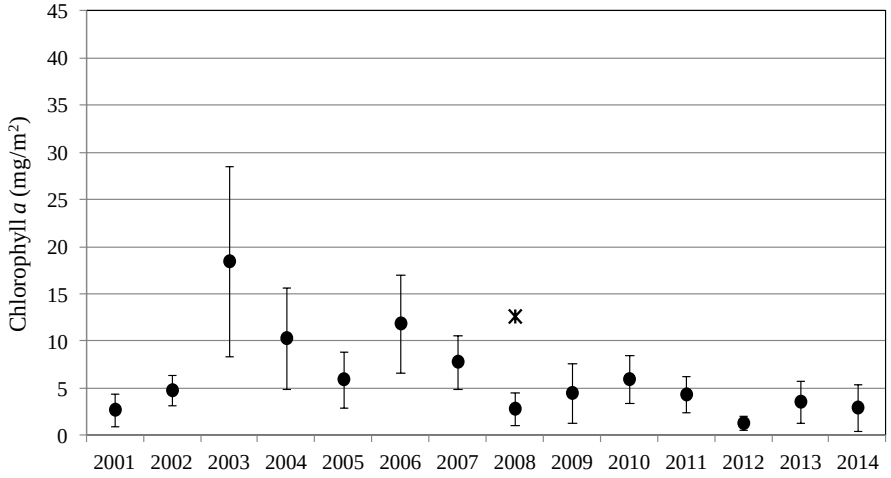

Figure 9.–Greens Creek Site 48 periphyton densities.
Note: Mean density ± one standard deviation, excludes potential outliers (∗).

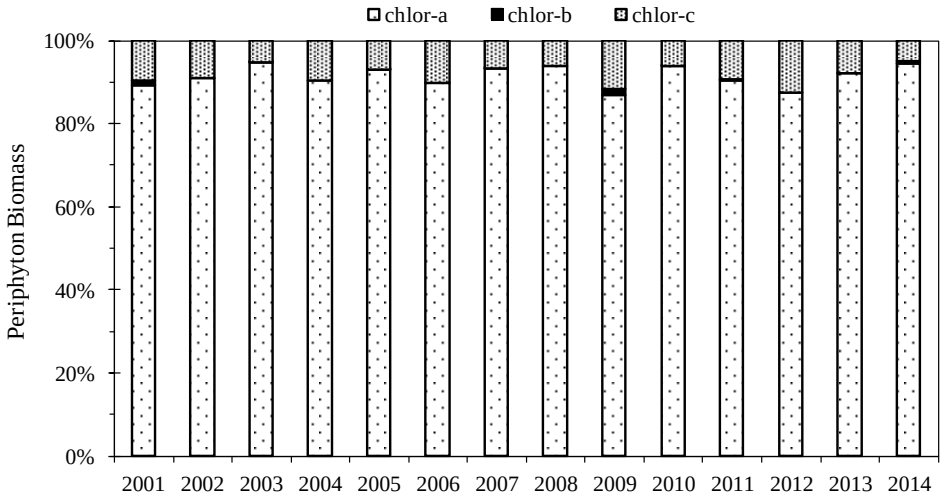

Figure 10.–Greens Creek Site 48 mean chlorophylls *a, b,* and *c* proportions.

[s] The mean rank of the 2014 Greens Creek Site 48 chlorophyll *a* sample densities was significantly less than the 2003, 2004, and 2006 mean ranks.

Benthic Macroinvertebrate Density and Community Composition

We observed more insects and taxa among the 2014 samples compared to samples from the last three years. We counted 24 taxa and estimate benthic macroinvertebrate density at 2,688 insects/m^2, of which 83% were EPT insects (Figures 11, 12). Dominant taxa were Ephemeroptera: *Baetis* and *Drunella*, representing 28% and 29% of samples.

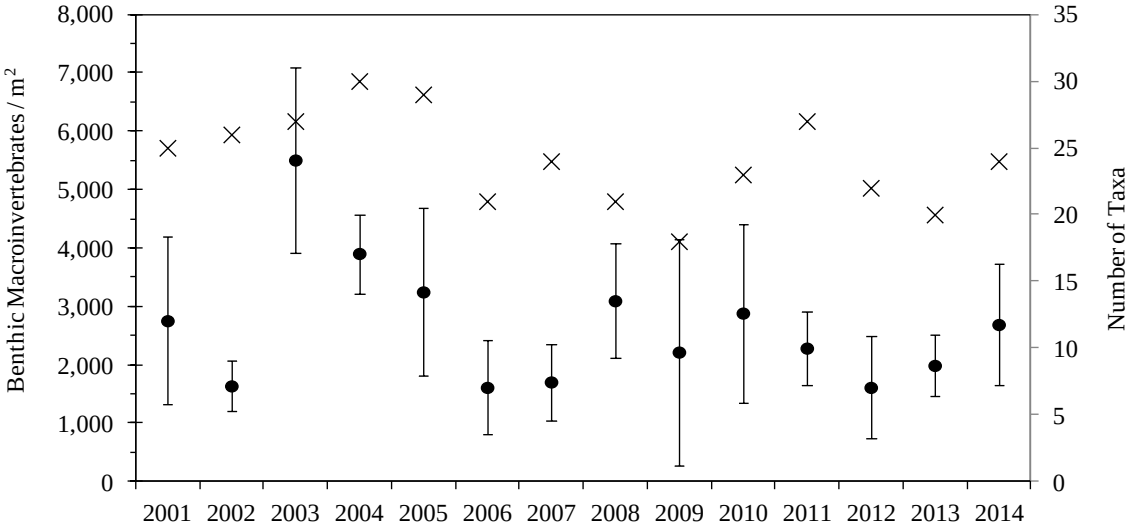

Figure 11.–Greens Creek Site 48 benthic macroinvertebrate densities and taxa.
Note: Mean density ± one standard deviation, and taxa richness (×).

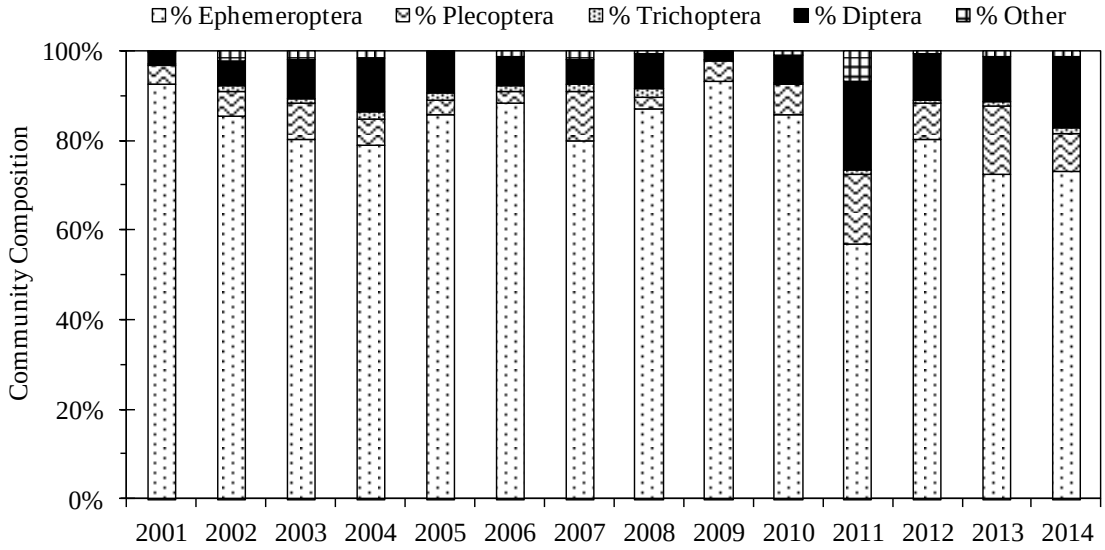

Figure 12.–Greens Creek Site 48 benthic macroinvertebrate community composition.

Juvenile Fish Populations and Fish Condition

We estimate the 2014 juvenile Dolly Varden char population at 115 ± 17 fish,[t] significantly less than the two previous estimates (Figure 13). The length frequency diagram of captured Dolly Varden char suggests multiple age classes were present, as in most[u] years. Mean fish condition among the 99 Dolly Varden char we captured was 1.03 g/mm^3, similar to mean fish condition observed in 2011 and 2012.

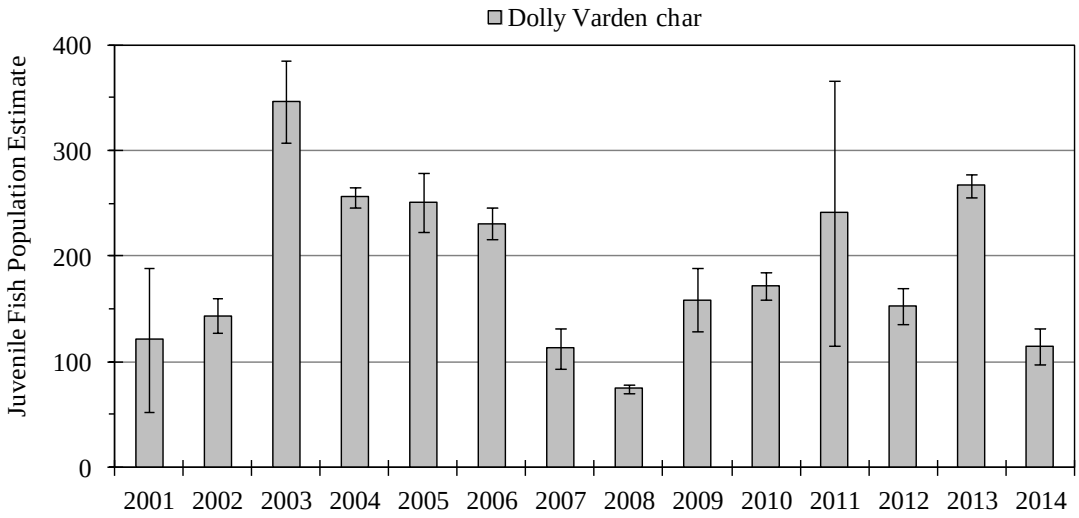

Figure 13.–Greens Creek Site 48 juvenile fish population estimates.

Juvenile Fish Metals Concentrations

Ag, Cd, Cu, Hg, Pb, Se, and Zn concentrations among the 2014 whole body juvenile Dolly Varden char samples were similar to values previously observed (Figure 14).

[t] The population estimate is biased low because increasing stream discharge while sampling displaced one minnow trap during the second pass.

[u] In 2008 and 2012 we did not capture young-of-year fry, which could have escaped the 6.35 mm (1/4 in) mesh minnow traps.

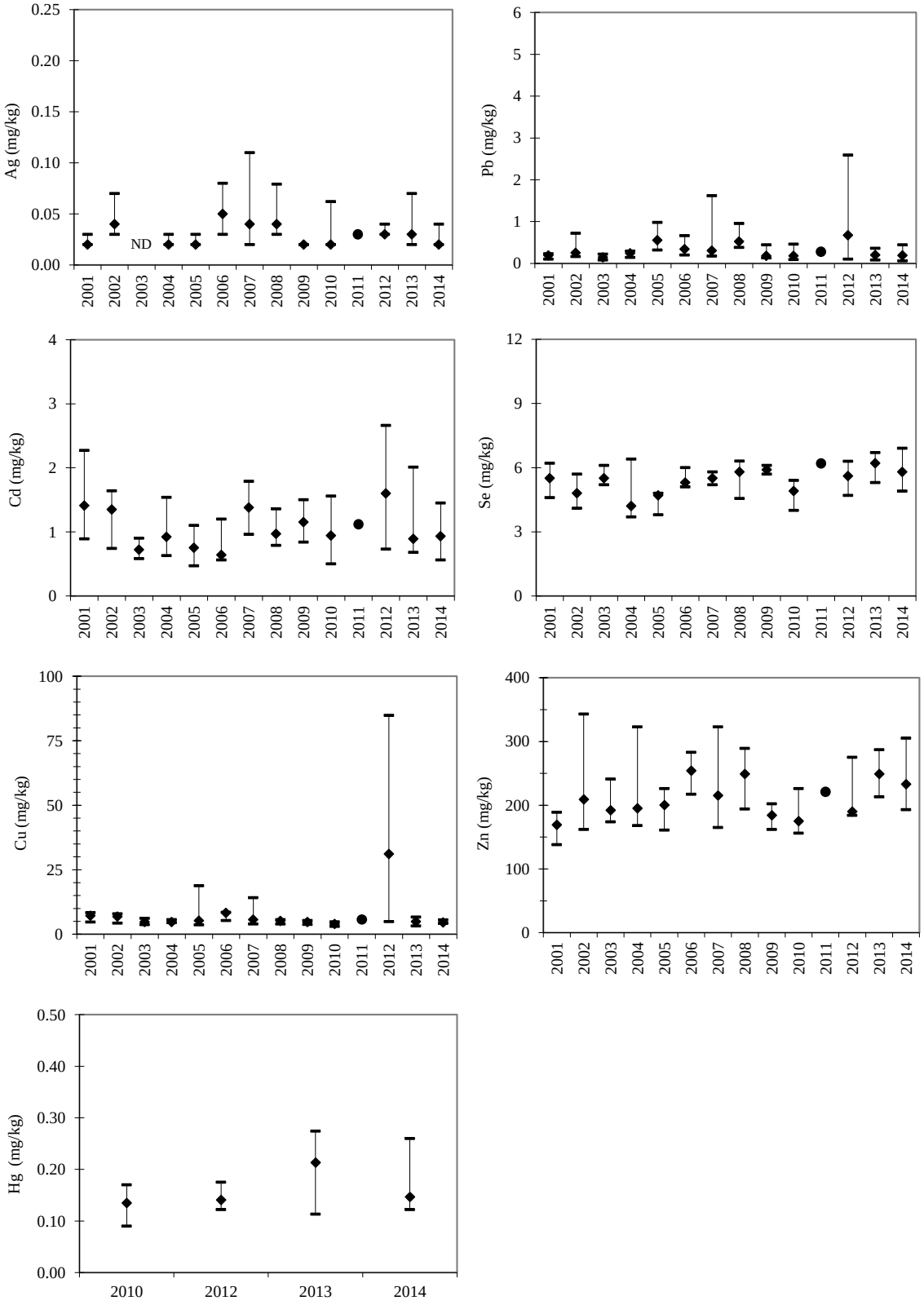

Figure 14.–Greens Creek Site 48 whole body Dolly Varden char metals concentrations.
Note: Median, minimum, and maximum concentrations (mg/kg) presented.

GREENS CREEK SITE 54

We sampled Greens Creek Site 54 on July 24, 2014. Hecla personnel recorded the following water quality data at 1340: water temperature 9.52 °C, conductivity 137 µS/cm, pH 7.92 units, and turbidity 3.7 NTU. Using our flow data, we estimate discharge at the sample site was about 52 ft^3/s after sampling. The USGS gage, located 0.8 km upstream, recorded 28 ft^3/s at 1130 and a mean daily discharge of 44 ft^3/s.

Periphyton Density and Community Composition

The 2014 mean chlorophyll *a* density was3.32 mg/m^2, within the range observed since 2001,[v] and proportions of chlorophylls *a, b*, and *c* were similar to previous years (Figures 15, 16).

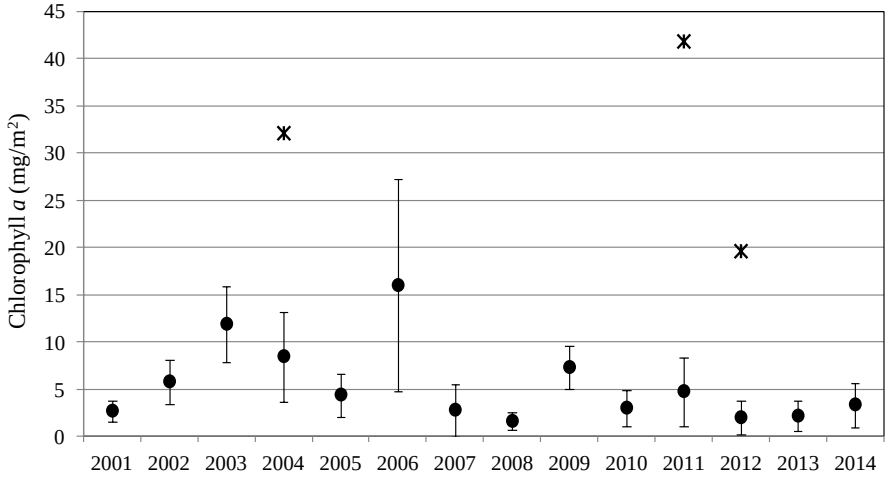

Figure 15.–Greens Creek Site 54 periphyton densities.
Note: Mean density ± one standard deviation, excludes potential outliers (∗).

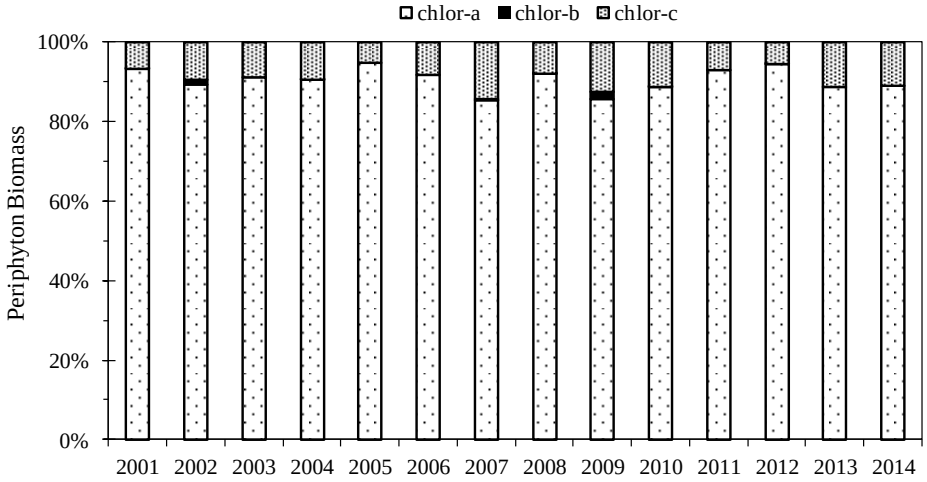

Figure 16.–Greens Creek Site 54 mean chlorophylls *a, b*, and *c* proportions.

[v] The mean rank of the 2014 Greens Creek Site 54 chlorophyll *a* sample densities was significantly less than the 2003 mean rank.

Benthic Macroinvertebrate Density and Community Composition

We observed more insects among the 2014 samples compared to samples from the last two years. We counted 26 taxa and estimate benthic macroinvertebrate density at 3,737 insects/m^2, of which 87% were EPT insects (Figures 17, 18). Dominant taxa were Ephemeroptera: *Baetis* and *Drunella*, representing 31% and 23% of samples.

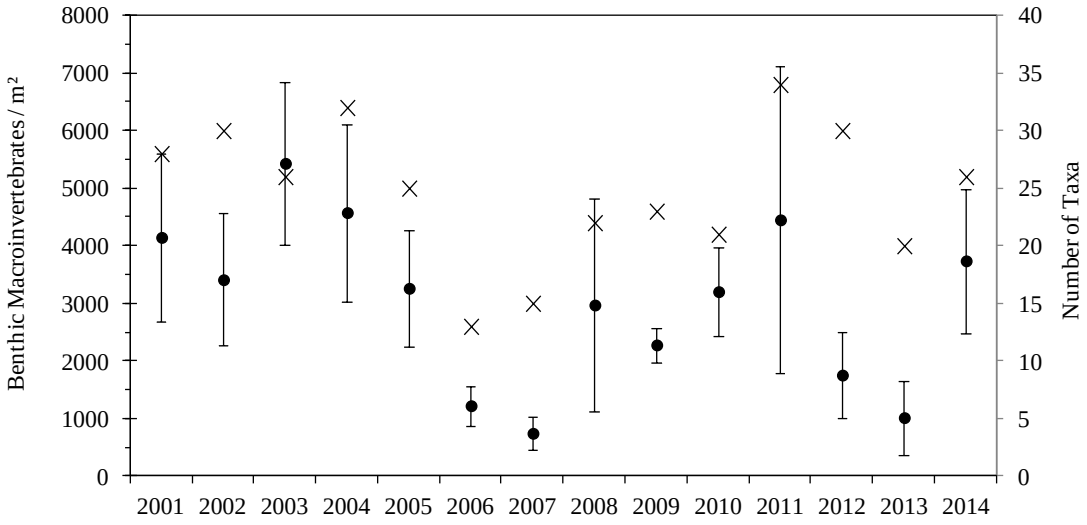

Figure 17.–Greens Creek Site 54 benthic macroinvertebrate densities and taxa.
Note: Mean density ± one standard deviation, and taxa richness (×).

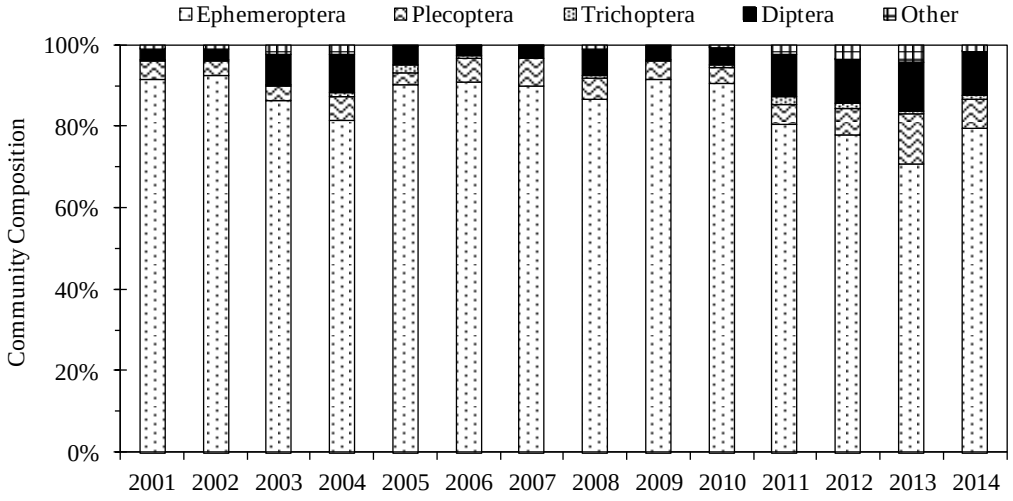

Figure 18.–Greens Creek Site 54 benthic macroinvertebrate community composition.

Juvenile Fish Populations and Fish Condition

We estimate the 2014 juvenile Dolly Varden char population at 165 ± 4 fish, significantly less than the two previous estimates (Figure 19). The length frequency diagram of captured Dolly Varden char suggests multiple age classes were present, as in previous years. Mean fish condition among 159[w] of the 162 Dolly Varden char we captured was 1.03 g/mm^3, similar to mean fish condition observed in 2011 and 2012.

We captured 15 juvenile coho salmon during the 2014 survey, the greatest number since 2005 (Figure 19). Captured fish ranged 70–85 mm and mean fish condition was 1.16 g/mm^3.

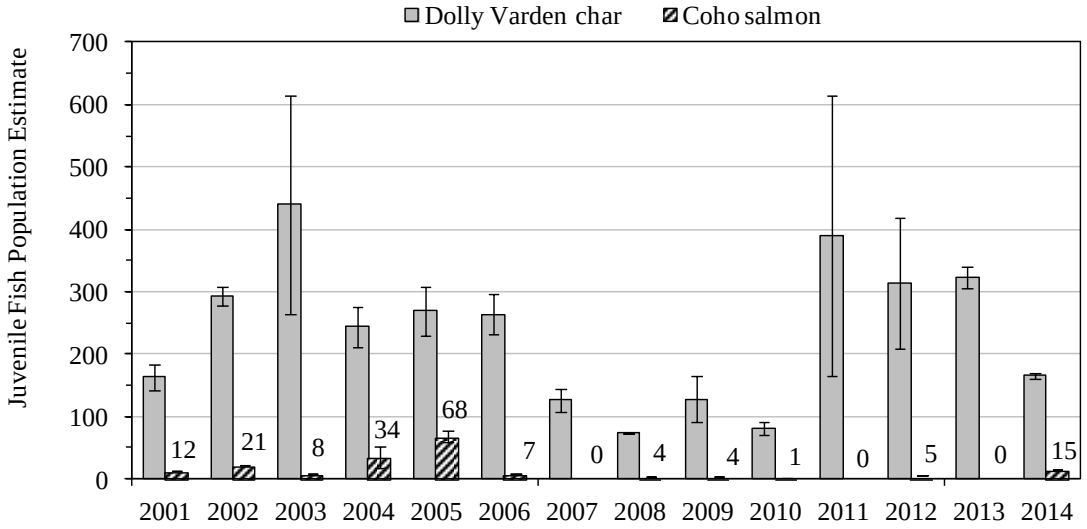

Figure 19.–Greens Creek Site 54 juvenile fish population estimates.
Note: 2001–2010 data from 28 m sample reach, 2011–2014 data from 50 m sample reach.

Juvenile Fish Metals Concentrations

Ag, Cd, Cu, Hg, Pb, and Se median concentrations among the 2014 whole body juvenile Dolly Varden char samples were similar to values observed since 2001 (Figure 20). Median Zn concentration was the greatest observed and similar to the 2013 median, and one sample contained the greatest Ag concentration (0.21 mg/kg) observed since 2001.

[w] Three Dolly Varden char we captured during the third pass escaped the transport bucket prior to measuring.

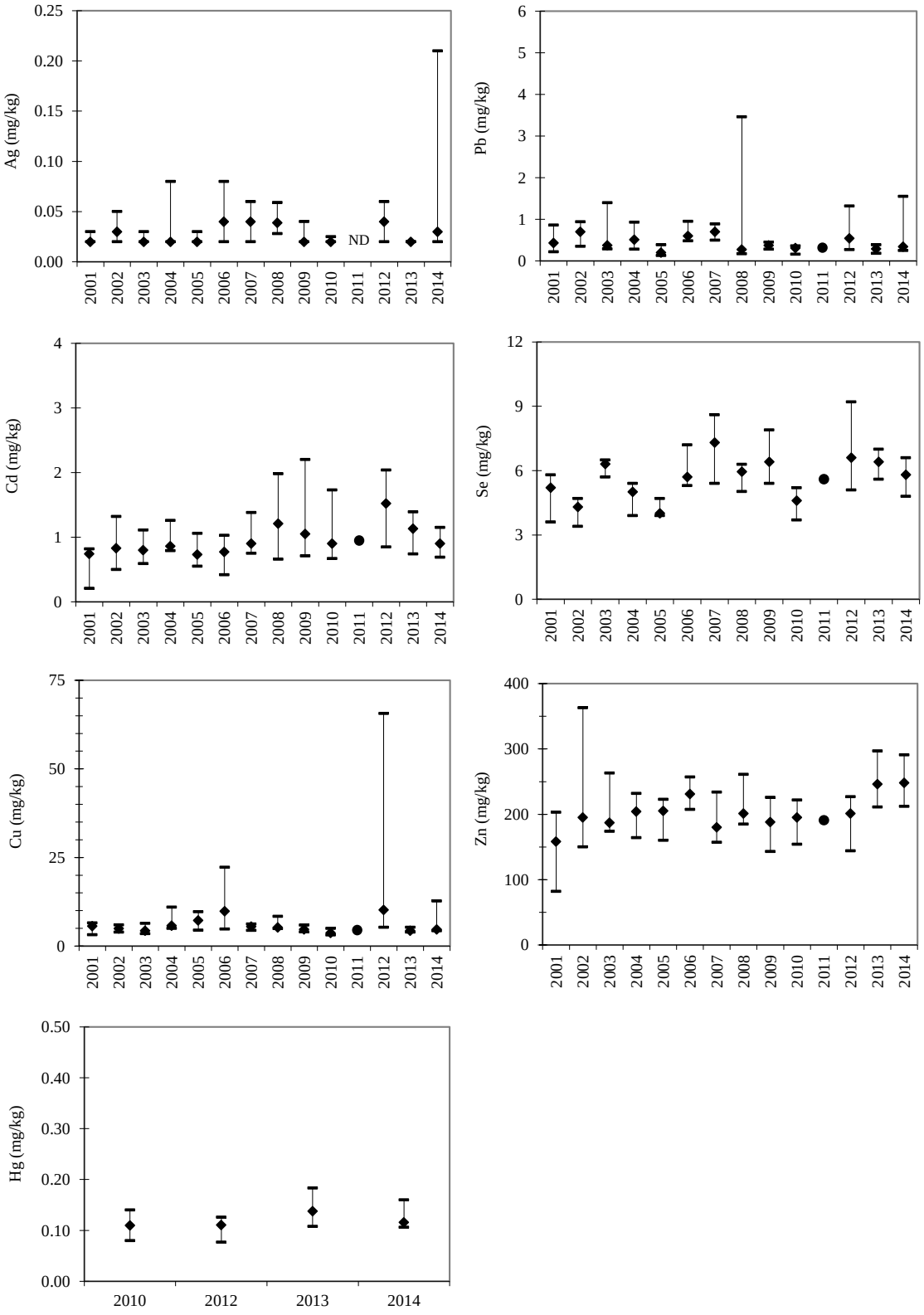

Figure 20.–Greens Creek Site 54 whole body Dolly Varden char metals concentrations.
Note: Median, minimum, and maximum concentrations (mg/kg) presented.

TRIBUTARY CREEK SITE 9

We sampled Tributary Creek Site 9 on July 23, 2014. Hecla personnel recorded the following water quality data at 1400: water temperature 14.9 °C, conductivity 89 µS/cm, pH 6.82 units, and turbidity 12.2 NTU. Using our flow data, we estimate discharge at the sample site at about 0.2 ft^3/s after sampling.

Periphyton Density and Community Composition

The 2014 mean chlorophyll *a* density was 3.39 mg/m^2, the lowest observed since sampling began in 2001[x] (Figure 21), though within the range of regional natural variation. Proportions of chlorophylls *a*, *b*, and *c* were similar to previous years (Figure 22).

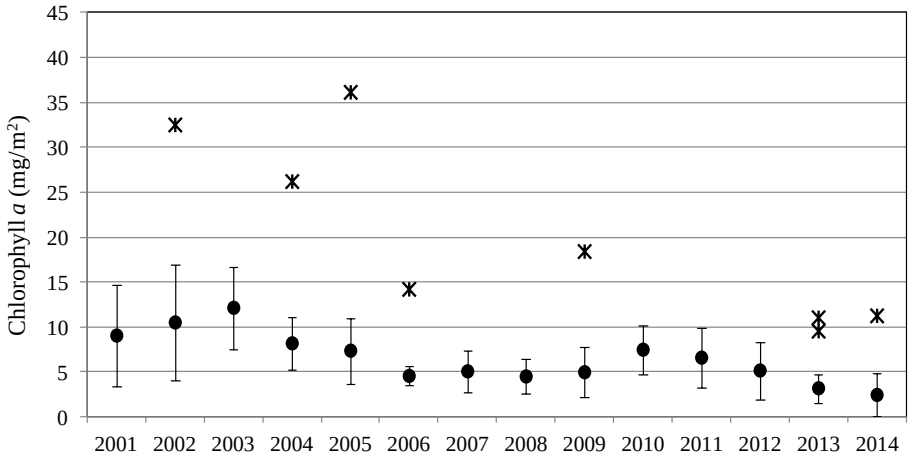

Figure 21.–Tributary Creek Site 9 mean periphyton densities.
Note: Mean density ± one standard deviation, excludes potential outliers (∗).

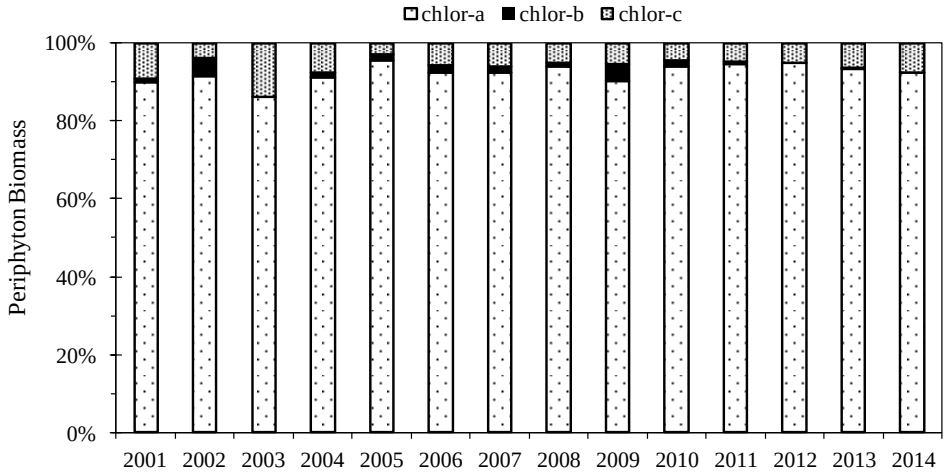

Figure 22.–Tributary Creek Site 9 mean chlorophylls *a*, *b*, and *c* proportions.

[x] The mean rank of the 2014 Tributary Creek Site 9 chlorophyll *a* sample densities was significantly less than the 2003 mean rank.

Benthic Macroinvertebrate Density and Community Composition

We observed a similar number of insects among the 2014 and 2013 samples, both greater than most previous years. We counted 22 taxa and estimate benthic macroinvertebrate density at 2,479 insects/m^2, of which 69% were EPT insects (Figures 23, 24). Dominant taxa were Ephemeroptera: *Baetis* and *Cinygmula*, representing 18% and 15% of samples.

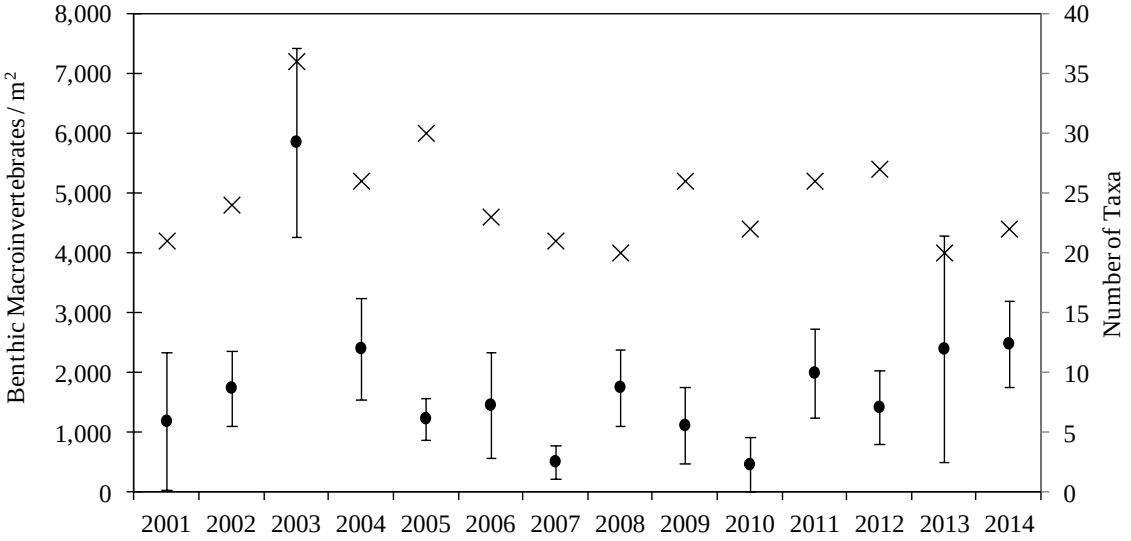

Figure 23.–Tributary Creek Site 9 benthic macroinvertebrate densities and taxa.
Note: Mean density ± one standard deviation, and taxa richness (×).

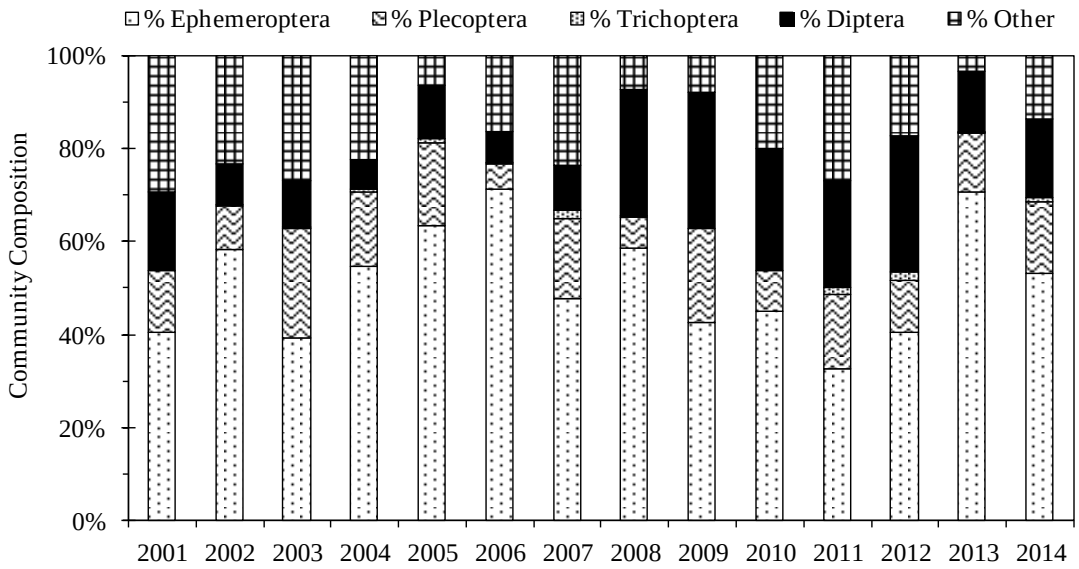

Figure 24.–Tributary Creek Site 9 benthic macroinvertebrate community composition.

Juvenile Fish Populations and Fish Condition

We captured 14 juvenile Dolly Varden char during the 2014 survey (Figure 25), similar to the 2013 survey results. The length frequency diagram of captured fish suggests two age classes were present, and mean fish condition was 0.99 g/mm^3.

We estimate the 2014 juvenile coho salmon population at 150 ± 13 fish, significantly greater than the previous three years (Figure 25). The length frequency diagram of captured fish suggests two age classes of fish were present, and mean fish condition was 1.16 g/mm^3.

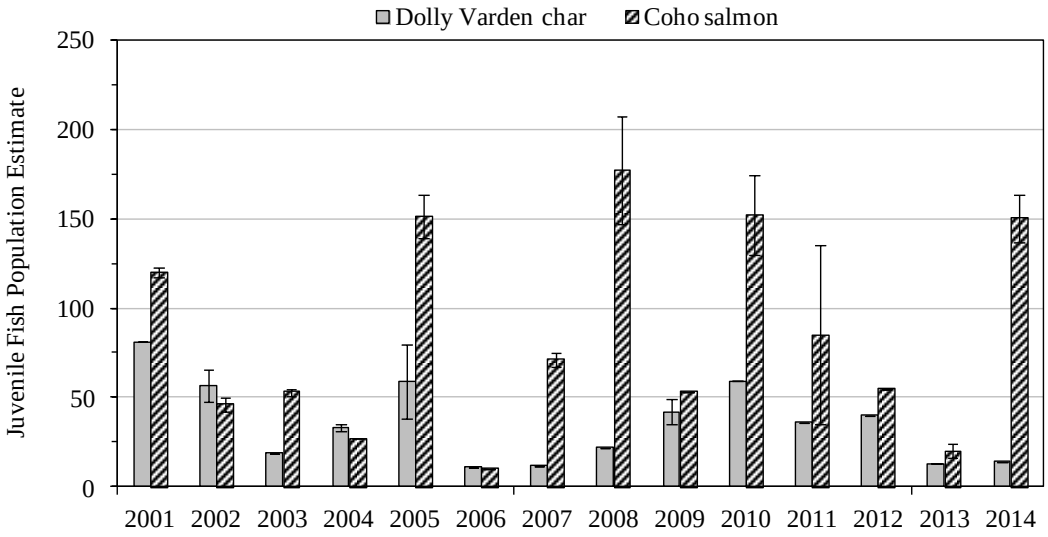

Figure 25.–Tributary Creek Site 9 juvenile fish population estimates.

Juvenile Fish Metals Concentrations

Ag, Cd, Cu, Hg, Pb, Se, and Zn concentrations among the 2014 whole body juvenile Dolly Varden char samples were similar to values previously observed (Figure 26).

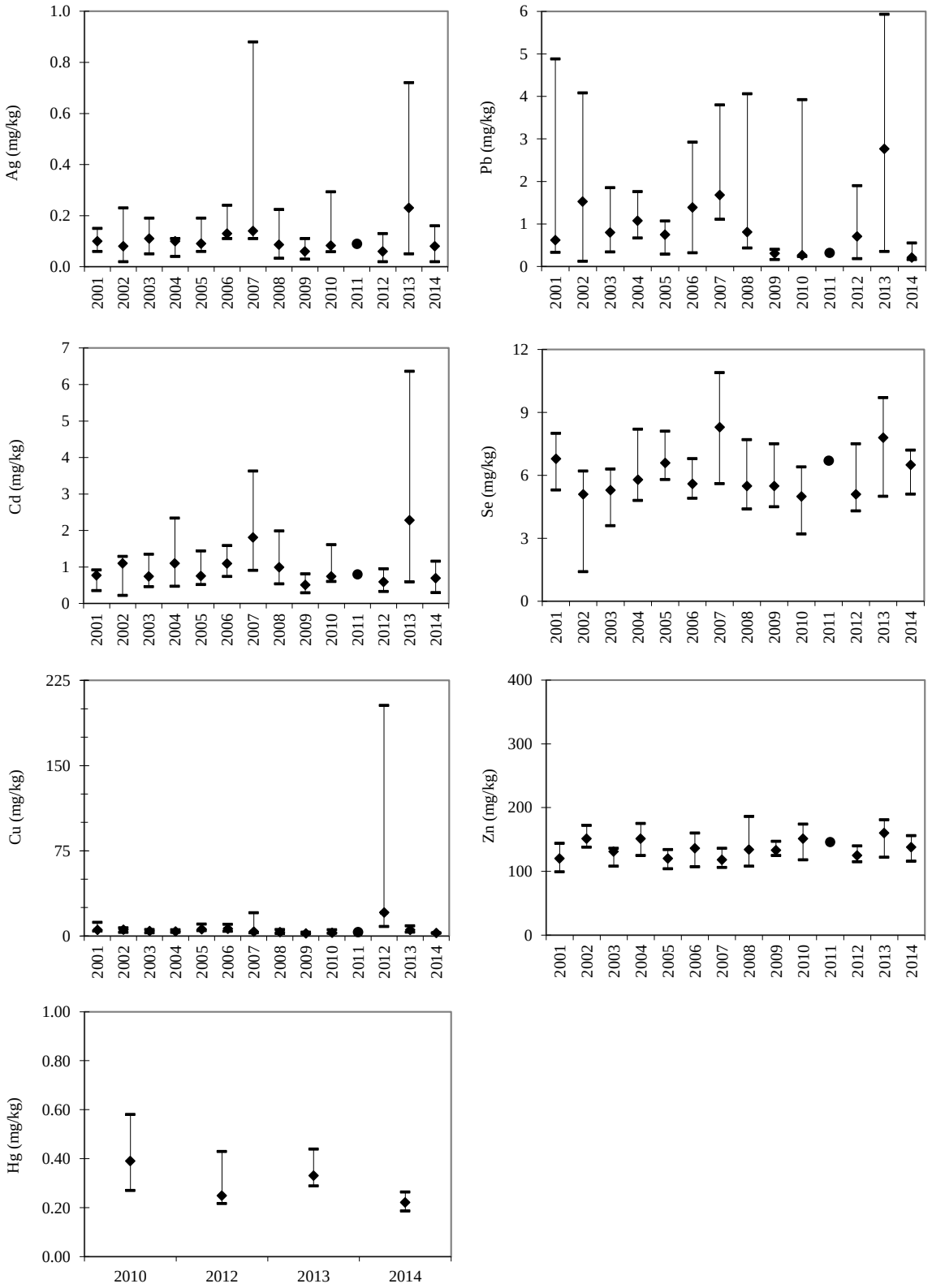

Figure 26.–Tributary Creek Site 9 whole body Dolly Varden char metals concentrations.
Note: Median, minimum, and maximum concentrations (mg/kg) presented.

COMPARISONS AMONG GREENS CREEK SITES

Periphyton Density and Community Composition

Periphyton densities among the 2014 samples from Greens Creek sites 48 and 54 were not significantly different. Mean periphyton densities at sites 48 and 54 between 2001 and 2014 generally followed a similar trend (Figure 27), with peak densities observed in 2003, 2004, and 2006. Greens Creek discharges prior to sampling in 2003 and 2004 were low and may explain the greater periphyton densities those years, while greater discharges during 2007, 2008, and 2012 may explain the lower periphyton densities observed those years.

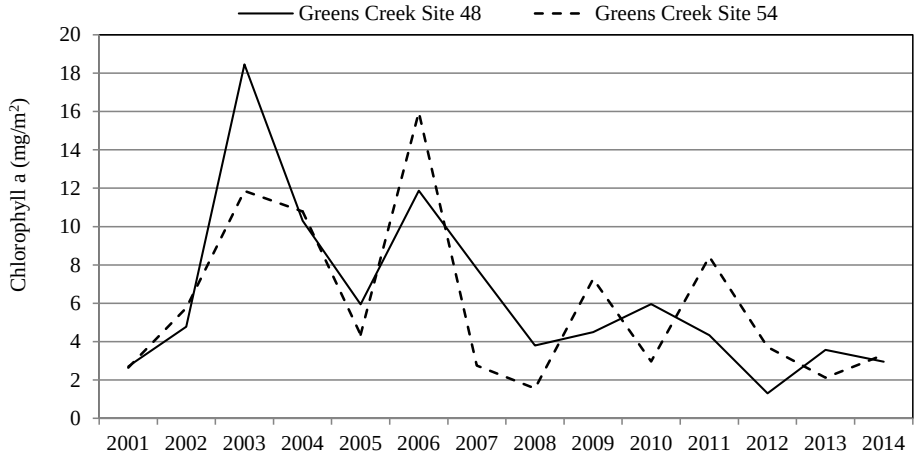

Figure 27.–Greens Creek periphyton densities comparison.

Periphyton samples collected at Greens Creek sites 48 and 54 have generally contained > 90% chlorophyll *a*, zero or nearly zero chlorophyll *b*, and < 10% chlorophyll *c* each year.

Benthic Macroinvertebrate Density and Community Composition

Benthic macroinvertebrate density (Figure 28) and taxonomic richness (Figure 29) among samples collected at Greens Creek sites 48 and 54 generally follow similar trends between years, and EPT insects usually comprise less than 80% of samples.

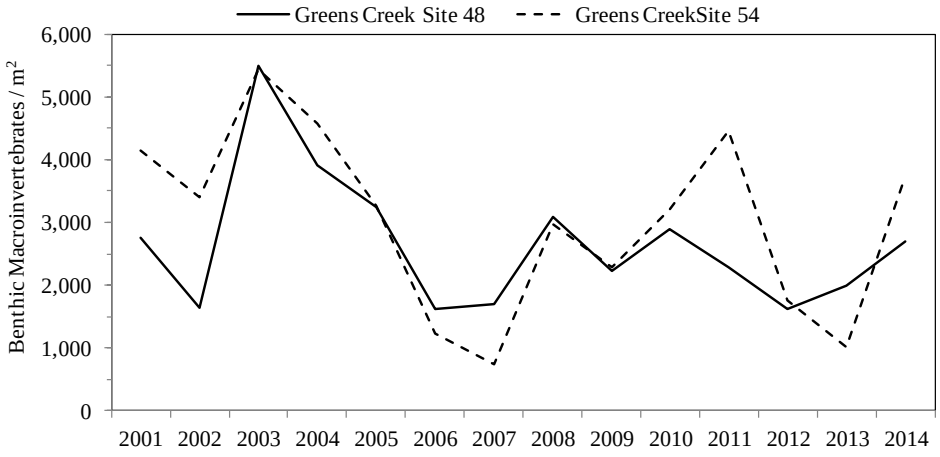

Figure 28.–Greens Creek benthic macroinvertebrate densities comparison.

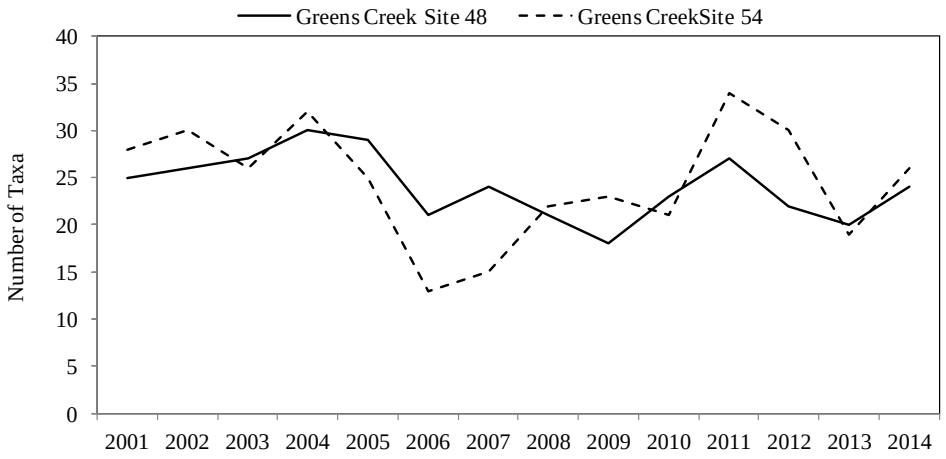

Figure 29.–Greens Creek benthic macroinvertebrate taxa richness comparison.

Juvenile Fish Populations and Fish Condition

The Site 54 juvenile Dolly Varden char population estimates were significantly greater than the Site 48 population estimates from 2012 to 2014. Population estimates among sites followed a similar trend from 2001 to 2014 (Figure 30). We captured several age classes of Dolly Varden char at both sites most years, and mean fish condition was similar among sites each year.

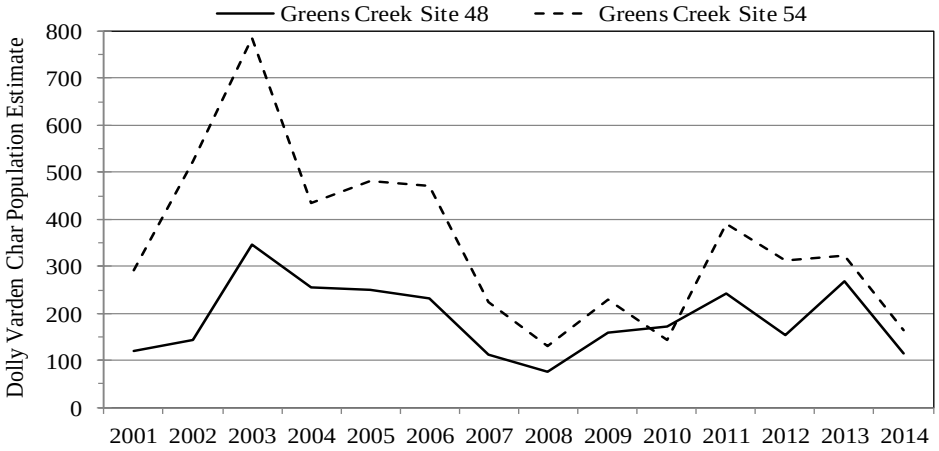

Figure 30.–Greens Creek sites 48 and 54 juvenile Dolly Varden char population estimates.
Note: Site 54 2001–2010 data extrapolated to a 50 m sample reach for comparison.

Sediment Metals Concentrations

In 2013, we sampled stream sediment at Greens Creek sites 48 and 54 and Tributary Creek Site 9 for Ag, Cd, Cu, Hg, Pb, Se, and Zn. We found Cu and Zn concentrations were predominant among the analytes, and concentrations of all analytes were lowest at Site 9.

In 2014, we sampled stream sediment at the mouths of five drainages to Greens Creek near sites 48 and 54 for the same analytes to investigate variability within the watershed between sites 48 and 54, as follows:

- Big Sore Creek, located upstream of Site 48;
- 1350 Creek, located downstream of Site 48 and upstream of Cub Creek;
- Cub Creek, located downstream of 1350 Creek and upstream of the mine portal;
- Bruin Creek, located downstream of the mine portal and upstream of Site 54; and
- Gallagher Creek, located within the Site 54 fish sample reach.

We found Cu and Zn concentrations were predominant among the analytes in Big Sore, Cub, and Bruin Creeks, while Zn and Pb were predominant in 1350 and Gallagher Creeks. Comparing the 2013 and 2014 data, the greatest concentration of each analyte was present in the drainages—not at Greens Creek Site 48 or Site 54 (Table 1, Figure 31). Cd and Zn concentrations in the 1350 Creek sample, and Zn concentration in the Big Sore Creek sample, were above the National Oceanic and Atmospheric Administration guidelines[y] for freshwater sediments (Buchman 2008; MacDonald et al. 2000). Briefly,

- Ag concentration was greatest in Big Sore Creek;
- Cd and Zn concentrations were greatest in 1350 Creek;
- Cu concentration was greatest in Cub Creek;
- Hg concentration was greatest in Big Sore and Bruin Creeks; and
- Pb and Se concentrations were greatest in Gallagher Creek.

Table 1.–Sediment metals concentration data for Greens Creek and drainage sample sites.

		Analytical Data (mg/kg dry weight)						
Sample Site	Sample Date	Ag	Cd	Cu	Hg	Pb	Se	Zn
Big Sore Creek	7/25/2014	**0.59**	3.49	61.5	**0.19**	38.2	3.5	485
Greens Creek Site 48	7/25/2013	0.384	1.84	60.8	0.0476	12.8	2.59	232
1350 Creek	7/25/2014	0.497	**5.42**	40.0	0.05	43.1	2.1	**581**
Cub Creek	7/25/2014	0.342	1.39	**87.2**	0.116	33.2	1.9	206
Bruin Creek	7/24/2014	0.422	2.30	55.7	**0.18**	30.3	3.2	328
Gallagher Creek	7/24/2014	0.45	3.23	45.0	0.09	**101.0**	**6.7**	304
Greens Creek Site 54	7/24/2013	0.339	3.63	51.7	0.0784	29.8	4.44	232

Note: Bold values are the greatest concentrations observed among the seven sample sites.

[y] Guidelines for Ag and Se concentrations have not been developed so we could not evaluate those values.

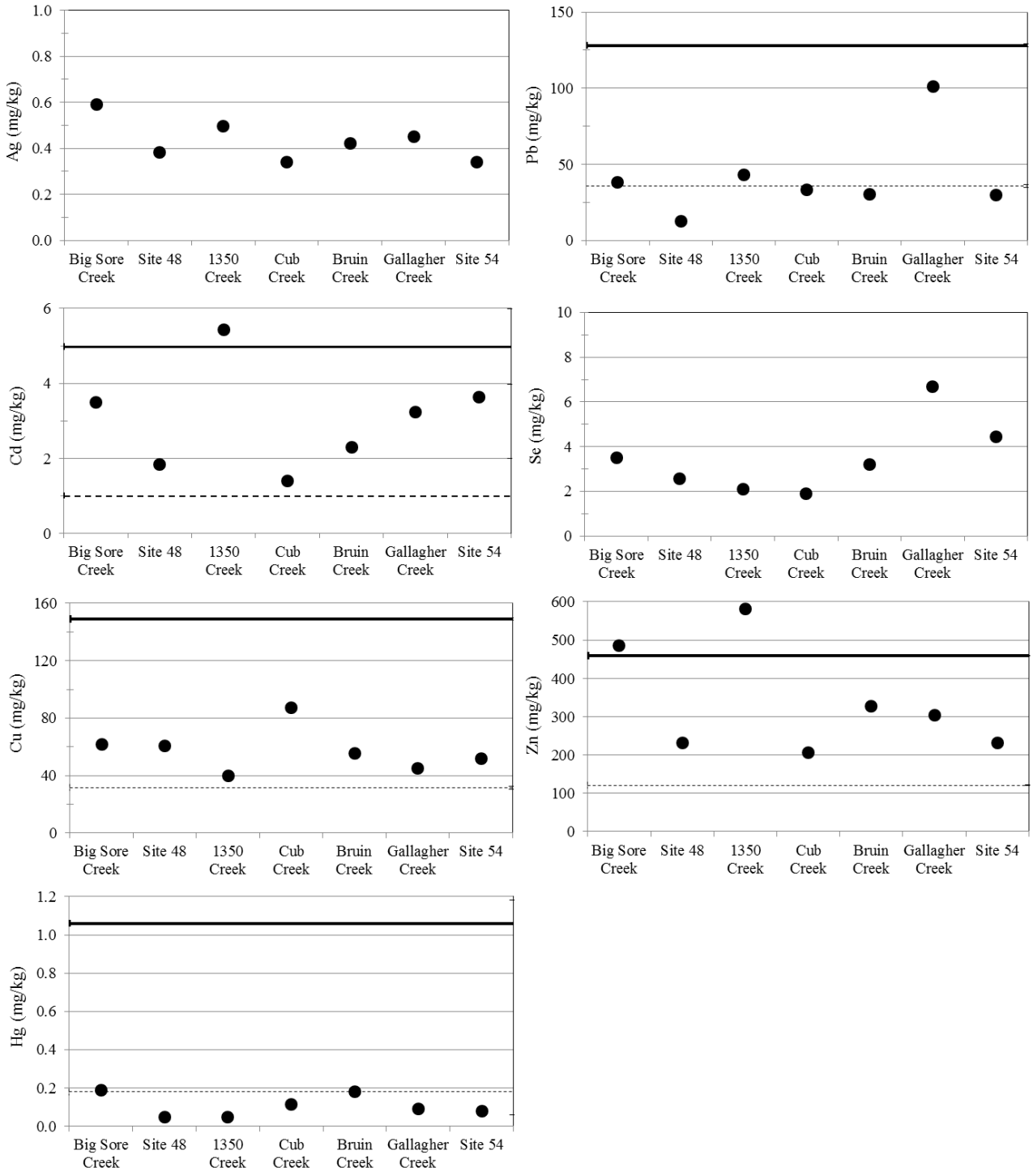

Figure 31.–Sediment metals concentrations (mg/kg) for Greens Creek and tributary sample sites.
Note: Site 48 and Site 54 sampled in 2013, all others in 2014. The dashed line represents the threshold effect concentration (mg/kg), and the solid line represents the probable effect concentration (mg/kg), specified in Buchman (2008) for freshwater sediments.

COMPARISON AMONG SITES

Juvenile Fish Metals Concentrations

Comparing the 2014 Greens Creek juvenile Dolly Varden char whole body metals data, the Site 48 mean rank of Hg concentrations was significantly greater than the Site 54 mean rank. We observed greater ranges of Ag, Cu, and Pb concentrations among the Site 54 samples than the Site 48 samples, and similar ranges of Cd, Se, and Zn concentrations.

Comparing the 2014 Greens Creek and Tributary Creek data, the Site 9 mean ranks for Cu and Zn concentrations were significantly less than the Site 48 and 54 mean ranks, and the Site 9 mean rank for Hg concentrations was significantly greater than the Site 54 mean rank. The 2014 median values of metals at all three sites were greater than or similar to median values observed among the samples collected from 2011 to 2013 in Upper Slate Creek (Figure 32) near Kensington Gold Mine (Timothy and Kanouse 2014).

Since 2001, Tributary Creek Site 9 whole body juvenile fish samples had greater concentrations and variability than Greens Creek samples, except Cu and Zn which were generally greater at Site 48 (Figure 33).

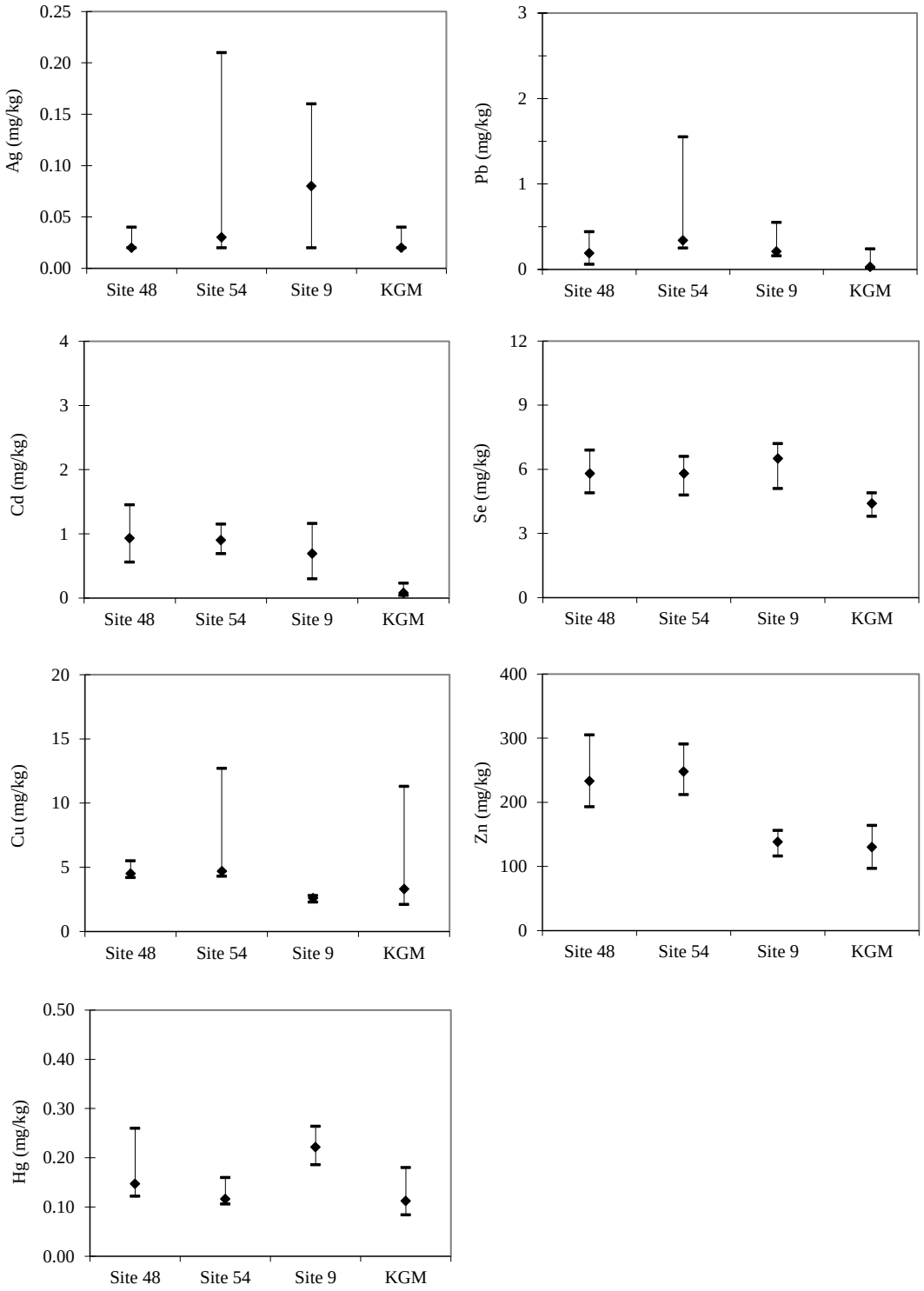

Figure 32.–2014 Greens Creek and Tributary Creek whole body juvenile Dolly Varden char metals concentrations.

Note: Median, minimum, and maximum concentrations (mg/kg) presented. Reference data (KGM) are Upper Slate Creek whole body juvenile Dolly Varden char samples collected 2011–2013 near Kensington Gold Mine (Timothy and Kanouse 2014).

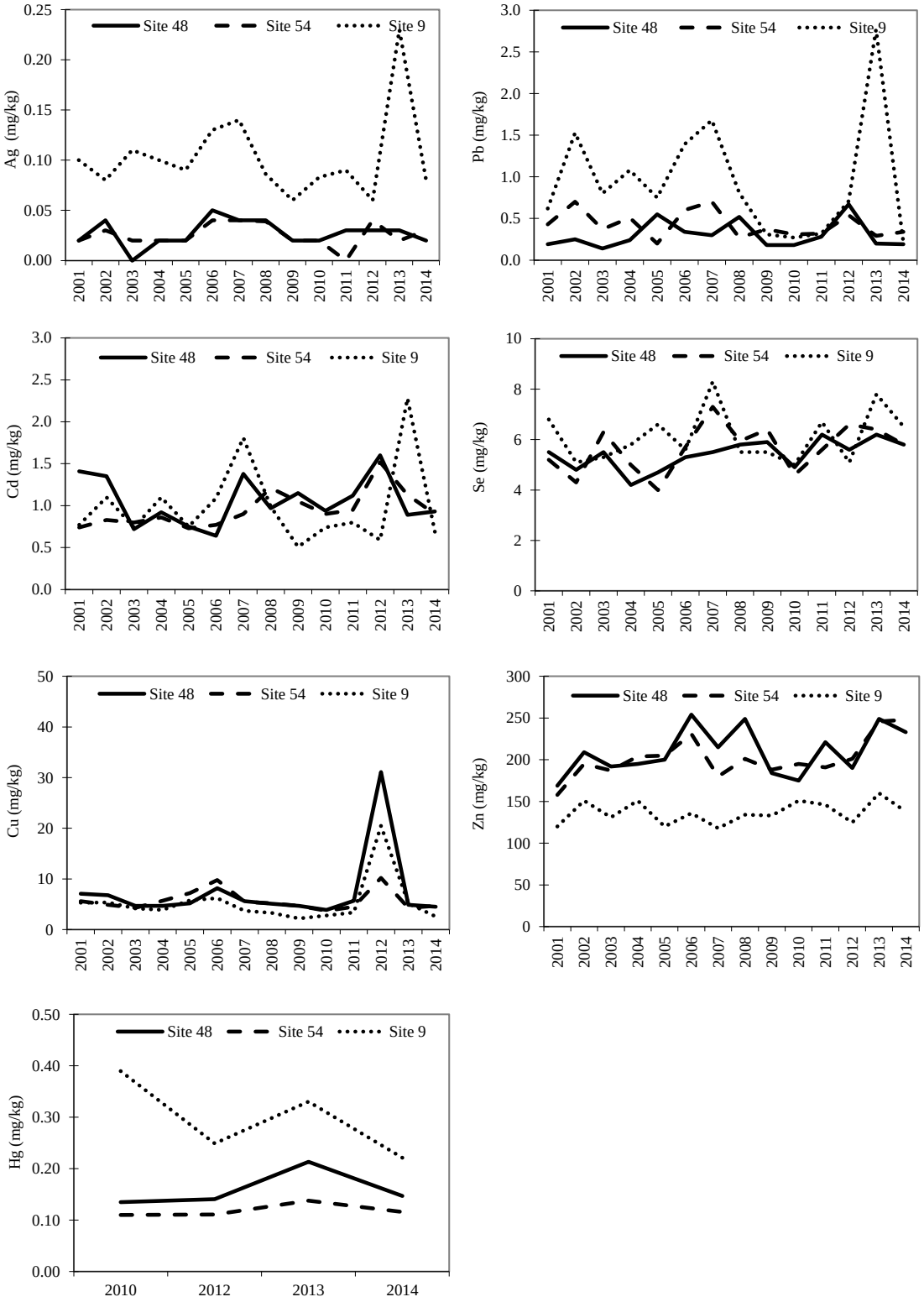

Figure 33.–Greens Creek and Tributary Creek whole body juvenile Dolly Varden char median metals concentrations.

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APPENDIX A: PERIPHYTON DATA

Appendix A.–Greens Creek Site 48 chlorophylls *a*, *b*, and *c* densities, 2001–2014.

	2001			2002			2003			2004		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*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	---	---	---	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	18.46	0.03	1.00	10.31	0.00	1.09
median	2.27	0.02	0.17	5.34	0.00	0.36	17.19	0.00	0.88	8.22	0.00	0.79
max	5.61	0.14	0.69	6.62	0.00	0.75	35.35	0.13	2.14	20.40	0.00	2.15
min	0.31	0.00	0.06	2.78	0.00	0.15	3.84	0.00	0.39	5.23	0.00	0.45

	2005			2006			2007			2008		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*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
median	5.93	0.00	0.51	11.05	0.00	1.49	7.21	0.00	0.45	2.73	0.00	0.18
max	11.11	0.02	0.92	20.08	0.00	2.04	11.75	0.01	1.39	12.60	0.00	0.74
min	0.85	0.00	0.01	4.38	0.00	0.54	4.06	0.00	0.16	0.85	0.00	0.02

	2009			2010			2011			2012		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	3.20	0.00	0.49	8.54	0.00	0.44	4.49	0.00	0.50	**0.36**	---	---
	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
median	3.79	0.09	0.55	5.34	0.00	0.35	4.65	0.00	0.49	1.45	0.00	0.16
max	9.18	0.18	1.19	10.68	0.02	0.64	7.16	0.17	1.06	2.56	0.00	0.39
min	0.43	0.00	0.11	3.10	0.00	0.15	0.85	0.00	0.05	0.32	0.00	0.00

	2013			2014		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	2.03	0.00	0.12	4.81	0.00	0.31
	1.50	0.00	0.11	0.60	0.00	0.12
	4.59	0.00	0.33	1.60	0.00	0.10
	2.03	0.00	0.19	6.62	0.00	0.00
	6.94	0.00	0.38	---	---	---
	6.62	0.00	0.39	5.66	0.00	0.33
	1.60	0.00	0.26	0.55	0.00	0.02
	1.39	0.00	0.07	0.43	0.00	0.07
	3.74	0.00	0.46	1.24	0.00	0.03
	5.23	0.00	0.70	5.02	0.24	0.38
mean	3.57	0.00	0.30	2.95	0.03	0.15
median	2.88	0.00	0.29	1.60	0.00	0.10
max	6.94	0.00	0.70	6.62	0.24	0.38
min	1.39	0.00	0.07	0.43	0.00	0.00

Note: Bold value is the estimated detection limit, chlorophyll *a* was not detected in the sample.

Appendix A2.–Greens Creek Site 54 chlorophylls *a*, *b*, and *c* densities, 2001–2014.

	2001			2002			2003			2004		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*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
median	2.42	0.00	0.17	5.13	0.00	0.49	12.92	0.00	1.07	9.24	0.00	0.80
max	4.95	0.05	0.41	9.61	0.87	1.26	16.34	0.00	1.75	32.04	0.03	3.66
min	1.46	0.00	0.01	2.46	0.00	0.24	5.55	0.00	0.39	1.92	0.00	0.09

	2005			2006			2007			2008		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*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**	---	---	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**	---	---	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**	---	---	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**	---	---
	3.10	0.00	0.16	5.55	0.00	0.68	6.41	0.00	0.81	**0.24**	---	---
mean	4.36	0.00	0.24	15.96	0.00	1.40	2.75	0.01	0.46	1.57	0.00	0.13
median	3.68	0.00	0.17	14.20	0.00	1.06	2.19	0.00	0.39	1.61	0.00	0.12
max	10.36	0.00	0.54	31.72	0.00	3.17	8.01	0.04	0.98	2.99	0.02	0.29
min	2.56	0.00	0.12	4.27	0.00	0.38	0.24	0.00	0.04	0.24	0.00	0.00

	2009			2010			2011			2012		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*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
	---	0.47	2.21	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	2.03	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	0.16	1.06	2.97	0.01	0.37	8.43	0.00	0.64	3.71	0.00	0.22
median	7.58	0.11	1.01	2.41	0.00	0.27	4.33	0.00	0.39	1.50	0.00	0.10
max	11.32	0.47	2.21	6.73	0.04	0.74	41.76	0.00	3.02	19.54	0.01	1.10
min	4.38	0.07	0.43	0.21	0.00	0.05	0.43	0.00	0.06	0.11	0.00	0.04

	2013			2014		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	2.56	0.00	0.26	6.51	0.00	0.60
	2.14	0.00	0.23	4.91	0.00	0.92
	1.28	0.00	0.24	4.59	0.00	0.42
	2.14	0.00	0.37	1.82	0.00	0.11
	0.53	0.00	0.02	7.05	0.00	0.56
	0.43	0.00	0.07	2.67	0.00	0.45
	---	---	---	1.50	0.00	0.17
	2.03	0.00	0.28	2.46	0.00	0.20
	5.87	0.00	0.76	**0.05**	---	---
	2.14	0.00	0.21	1.60	0.00	0.26
mean	2.12	0.00	0.27	3.32	0.00	0.41
median	2.14	0.00	0.24	2.56	0.00	0.42
max	5.87	0.00	0.76	7.05	0.00	0.92
min	0.43	0.00	0.02	0.05	0.00	0.11

Note: Bold values are the estimated detection limits, chlorophyll *a* was not detected in the samples.

Appendix A3.–Tributary Creek Site 9 chlorophylls *a*, *b*, and *c* densities, 2001–2014.

	2001			2002			2003			2004		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*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	0.64	0.53	12.11	0.00	1.92	9.95	0.14	0.82
median	8.90	0.00	0.99	10.78	0.43	0.25	10.63	0.00	1.78	7.64	0.09	0.51
max	16.58	0.81	1.51	32.53	1.50	1.89	22.64	0.00	3.98	26.17	0.51	2.61
min	1.61	0.00	0.01	2.94	0.00	0.00	7.69	0.00	0.29	5.45	0.00	0.36

	2005			2006			2007			2008		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	6.09	0.00	0.25	3.42	0.25	0.19	---	---	---	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	---	---	---	6.41	0.00	0.25
	4.70	0.00	0.10	4.17	0.00	0.39	---	---	---	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
median	7.90	0.00	0.23	4.25	0.00	0.30	5.45	0.06	0.24	4.33	0.00	0.26
max	36.10	1.28	1.12	14.16	0.40	0.57	7.26	0.24	0.65	6.94	0.24	0.39
min	1.82	0.00	0.07	3.42	0.00	0.19	0.85	0.00	0.11	1.60	0.00	0.00

	2009			2010			2011			2012		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*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
median	4.91	0.22	0.33	6.30	0.00	0.37	5.71	0.00	0.35	4.70	0.00	0.26
max	18.37	0.66	0.78	12.82	0.88	0.43	12.50	0.47	0.87	10.68	0.00	0.48
min	2.03	0.08	0.09	4.06	0.00	0.16	1.71	0.00	0.01	1.28	0.00	0.04

	2013			2014		
mg/m²	chlor-*a*	chlor-*b*	chlor-*c*	chlor-*a*	chlor-*b*	chlor-*c*
	11.00	0.00	0.64	---	---	---
	2.88	0.00	0.19	11.21	0.00	0.63
	5.45	0.00	0.40	1.60	0.00	0.17
	5.02	0.00	0.40	5.87	0.00	0.37
	2.24	0.00	0.15	5.98	0.00	0.60
	2.99	0.00	0.17	0.75	0.00	0.06
	9.51	0.00	0.66	1.71	0.00	0.15
	0.32	0.05	0.15	**0.05**	---	---
	3.52	0.00	0.19	0.11	0.00	0.00
	2.78	0.00	0.17	3.20	0.00	0.23
mean	4.57	0.00	0.31	3.39	0.00	0.28
median	3.26	0.00	0.19	1.71	0.00	0.20
max	11.00	0.05	0.66	11.21	0.00	0.63
min	0.32	0.00	0.15	0.05	0.00	0.00

Note: Bold value is the estimated detection limit, chlorophyll *a* was not detected in the sample.

APPENDIX B: BENTHIC MACROINVERTEBRATE DATA

Appendix B1.–Greens Creek Site 48 benthic macroinvertebrate data summaries, 2001–2014.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total Aquatic Insect Taxa Counted	25	26	27	30	29	21	24	21	18	23	27	22	20	24
Ephemeroptera Counted	1094	599	1897	1034	902	495	428	887	852	937	558	555	618	844
Plecoptera Counted	49	41	191	74	36	10	75	20	40	81	151	55	131	98
Trichoptera Counted	7	9	20	22	15	7	8	24	1	4	12	5	8	14
Aquatic Diptera Counted	31	39	206	169	101	38	34	79	15	71	193	73	86	184
Other Insects Counted	3	16	53	25	5	10	15	11	2	8	68	5	12	16
% Ephemeroptera	92%	85%	80%	79%	86%	88%	80%	87%	93%	86%	57%	80%	72%	73%
% Plecoptera	4%	6%	8%	6%	3%	3%	11%	2%	5%	7%	15%	8%	15%	8%
% Trichoptera	1%	1%	1%	2%	2%	1%	2%	2%	0%	0%	1%	1%	1%	1%
% Aquatic Diptera	3%	6%	9%	12%	9%	6%	6%	8%	2%	6%	20%	11%	10%	16%
% Other	0%	2%	2%	2%	1%	1%	2%	1%	0%	1%	7%	1%	1%	1%
% EPT	97%	92%	89%	86%	90%	92%	92%	92%	98%	93%	73%	89%	89%	83%
% Chironomidae	1%	4%	7%	11%	8%	3%	4%	6%	1%	5%	17%	9%	9%	15%
% Dominant Taxon	41%	35%	30%	28%	30%	37%	36%	58%	46%	31%	21%	37%	25%	31%
Total Terrestrial Insects Counted	0	4	5	1	24	5	2	8	2	11	4	0	855	32
Total Aquatic Insects Counted	1,184	704	2,367	1,679	1,396	693	733	1,331	953	1,240	982	693	14	1,156
Total Insects Counted	1,184	708	2,372	1,680	1,420	698	735	1,339	955	1,251	986	693	869	1,188
% Sample Aquatic	100%	99%	100%	100%	98%	99%	100%	99%	100%	99%	100%	100%	98%	97%
% Sample Terrestrial	0%	1%	0%	0%	2%	1%	0%	1%	0%	1%	0%	0%	2%	3%
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
Est. Number of Total Insects / 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
Est. Number of Aquatic Insects / 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
± 1 Standard Deviation	1,435	434	1,579	677	1,441	807	648	980	1,939	1,530	630	872	526	1,043

Appendix B2.–Greens Creek Site 54 benthic macroinvertebrate data summaries, 2001–2014.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total Aquatic Insect Taxa Counted	28	30	26	32	25	13	15	22	23	21	34	30	19	26
Ephemeroptera Counted	1627	1352	2011	1601	1265	477	286	1105	895	1247	1536	591	308	1,277
Plecoptera Counted	80	54	82	117	37	30	22	65	43	53	96	49	54	109
Trichoptera Counted	7	6	12	19	31	4	0	9	4	8	32	9	3	15
Aquatic Diptera Counted	53	39	173	184	65	13	10	85	32	61	203	81	52	177
Other Insects Counted	15	15	57	46	4	1	1	13	5	8	46	24	19	24
% Ephemeroptera	91%	92%	86%	81%	90%	91%	90%	87%	91%	91%	80%	78%	71%	80%
% Plecoptera	4%	4%	4%	6%	3%	6%	7%	5%	4%	4%	5%	6%	12%	7%
% Trichoptera	0%	0%	1%	1%	2%	1%	0%	1%	0%	1%	2%	1%	1%	1%
% Aquatic Diptera	3%	3%	7%	9%	5%	2%	3%	7%	3%	4%	11%	11%	12%	11%
% Other	1%	1%	2%	2%	0%	0%	0%	1%	1%	1%	2%	4%	4%	1%
% EPT	96%	96%	90%	88%	95%	97%	97%	92%	96%	95%	87%	86%	84%	87%
% Chironomidae	2%	2%	6%	8%	4%	2%	2%	5%	2%	3%	9%	9%	10%	10%
% Dominant Taxon	52%	43%	40%	38%	40%	31%	34%	53%	40%	35%	43%	30%	30%	35%
Total Terrestrial Insects Counted	0	4	7	1	3	1	6	1	8	9	14	3	8	12
Total Aquatic Insects Counted	1,782	1,466	2,335	1,967	1,402	525	319	1,277	979	1,377	1,913	764	436	1,607
Total Insects Counted	1,782	1,470	2,342	1,968	1,405	526	325	1,278	987	1,386	1,927	797	444	1,619
% Sample Aquatic	100%	100%	100%	100%	100%	100%	98%	100%	99%	99%	99%	100%	98%	99%
% Sample Terrestrial	0%	0%	0%	0%	0%	0%	2%	0%	1%	1%	1%	0%	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
Est. Number of Total Insects / 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
Est. Number of Aquatic Insects / 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 Standard Deviation	1,464	1,148	1,422	1,540	1,016	345	293	1,855	297	772	2,668	738	642	1,253

Appendix B3.–Tributary Creek Site 9 benthic macroinvertebrate data summaries, 2001–2014.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total Aquatic Insect Taxa Counted	21	24	36	26	30	23	21	20	26	22	26	27	20	22
Ephemeroptera Counted	205	436	981	562	334	444	104	441	203	89	277	245	726	565
Plecoptera Counted	68	69	593	166	95	35	37	50	97	17	138	69	130	166
Trichoptera Counted	0	2	7	5	4	2	4	1	0	0	13	10	2	8
Aquatic Diptera Counted	86	66	256	66	60	42	21	206	141	52	196	179	135	181
Other Insects Counted	150	175	679	233	35	102	52	55	38	40	232	106	36	146
% Ephemeroptera	40%	58%	39%	54%	63%	71%	48%	59%	42%	45%	32%	40%	71%	53%
% Plecoptera	13%	9%	24%	16%	18%	6%	17%	7%	20%	9%	16%	11%	13%	16%
% Trichoptera	0%	0%	0%	0%	1%	0%	2%	0%	0%	0%	2%	2%	0%	1%
% Aquatic Diptera	17%	9%	10%	6%	11%	7%	10%	27%	29%	26%	23%	29%	13%	17%
% Other	30%	23%	27%	23%	7%	16%	24%	7%	8%	20%	27%	17%	3%	14%
% EPT	54%	68%	63%	71%	82%	77%	67%	65%	63%	54%	50%	53%	83%	69%
% Chironomidae	7%	5%	5%	5%	8%	4%	1%	1%	22%	23%	21%	26%	11%	14%
% Dominant Taxon	26%	29%	26%	44%	37%	40%	26%	33%	32%	32%	24%	30%	38%	30%
Total Terrestrial Insects Counted	0	5	15	3	12	33	1	5	50	22	2	9	13	13
Total Aquatic Insects Counted	509	748	2,516	1032	528	625	218	753	479	198	856	609	1,029	1,066
Total Insects Counted	509	753	2,531	1035	540	658	219	758	529	220	858	618	1,042	1,079
% Sample Aquatic	100%	99%	99%	100%	98%	95%	100%	99%	91%	90%	100%	99%	99%	99%
% Sample Terrestrial	0%	1%	1%	0%	2%	5%	0%	1%	10%	11%	0%	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
Est. Number of Total Insects / 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
Est. Number of Aquatic Insects / 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
± 1 Standard Deviation	1,148	620	1,579	851	357	878	268	631	636	463	447	615	1,897	727

APPENDIX C: JUVENILE FISH CAPTURE DATA

Appendix C1.–Greens Creek Site 48 juvenile fish capture data, 2001–2014.

			Number of Fish Captured				Population	Condition
Year	Species	FL (mm)	Set 1	Set 2	Set 3	Total	Estimate	(g/mm^3)
2001	DV	48-139	30	16	22	68	121±68	n/a
2002	DV	45-160	74	29	23	126	144±17	n/a
2003	DV	54-180	157	72	56	285	347±39	n/a
2004	DV	54-158	168	48	28	244	256±10	n/a
2005	DV	50-149	118	56	38	212	251±28	n/a
2006	DV	49-150	138	40	34	212	231±15	n/a
2007	DV	53-154	50	29	16	95	113±19	n/a
2008	DV	77-137	54	10	9	73	75±4	n/a
2009	DV	47-142	67	31	28	126	159±30	n/a
2010	DV	47-170	97	41	20	158	172±13	n/a
2011	DV	54-155	56	28	41	125	241±125	n/a
2012	DV	64-148	85	22	28	135	153±17	1.03
2013	DV	35-154	167	61	25	253	267±11	1.01
2014	DV	52-146	59	19	21	99	115±17	1.03

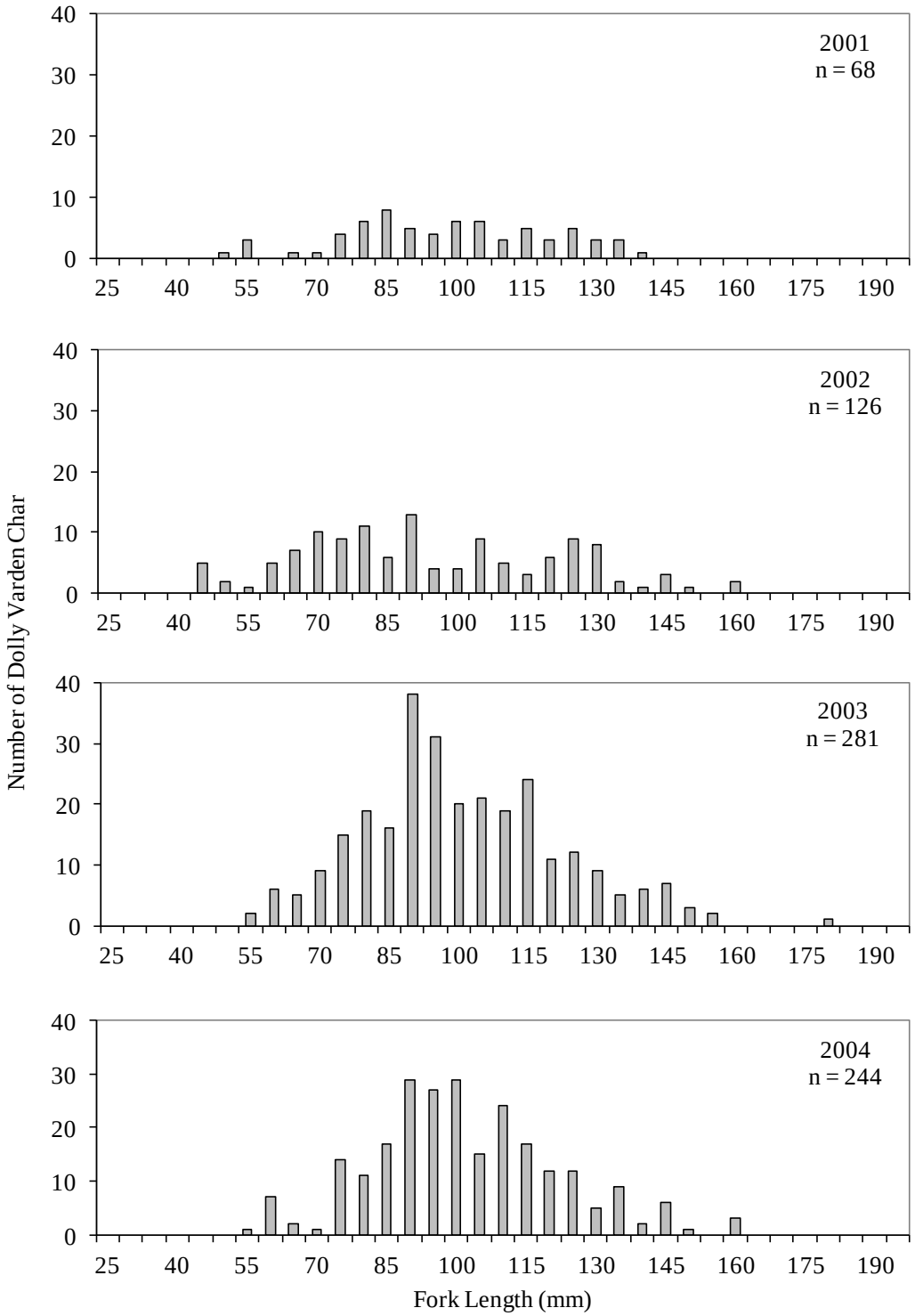
Appendix C2.–Greens Creek Site 54 juvenile fish capture data, 2001–2014.

			Number of Fish Captured				Population	Condition
Year	Species	FL (mm)	Set 1	Set 2	Set 3	Total	Estimate	(g/mm^3)
2001	DV	27-162	70	49	19	138	163±21	n/a
	CO	32-95	2	6	4	12	---	n/a
2002	DV	33-160	168	72	31	271	293±16	n/a
	CO	59-85	14	6	1	21	21	n/a
2003	DV	51-184	92	81	59	232	440±175	n/a
	CO	44-52	5	3	0	8	---	n/a
2004	DV	52-161	118	36	47	201	244±32	n/a
	CO	70-95	9	9	6	24	34±17	n/a
2005	DV	52-146	111	59	43	213	269±40	n/a
	CO	66-93	33	20	8	61	68±9	n/a
2006	DV	49-158	116	61	40	217	264±33	n/a
	CO	62-88	6	0	1	7	---	n/a
2007	DV	50-145	64	19	24	107	126±19	n/a
	CO	---	0	0	0	0	---	n/a
2008	DV	45-131	50	15	6	71	73	n/a
	CO	53-69	4	0	0	4	---	n/a
2009	DV	47-101	42	32	19	93	128±37	n/a
	CO	67-73	2	2	0	4	---	n/a
2010	DV	52-151	46	13	14	73	81±10	n/a
	CO	77	1	0	0	1	---	n/a
2011	DV	43-150	73	43	57	173	390±224	n/a
	CO	---	0	0	0	0	---	n/a
2012	DV	47-143	92	39	58	189	313±105	0.99
	CO	67-71	0	3	2	5	---	1.08
2013	DV	50-150	188	67	42	297	323±17	1.05
	CO	---	0	0	0	0	---	n/a
2014	DV	50-158	121	28	13	162	165±4	1.03
	CO	70-85	10	4	1	15	---	1.16

Appendix C3.–Tributary Creek Site 9 juvenile fish capture data, 2001–2014.

			Number of Fish Captured				Population	Condition
Year	Species	FL (mm)	Set 1	Set 2	Set 3	Total	Estimate	(g/mm^3)
2001	DV	58-110	70	4	7	81	81	n/a
	CO	39-101	89	18	11	118	120±3	n/a
	CT	124	1	0	0	1	---	n/a
2002	DV	38-147	29	14	8	51	57±9	n/a
	CO	27-85	29	9	6	44	46±4	n/a
	CT	124	0	0	1	1	---	n/a
2003	DV	54-114	13	4	2	19	19	n/a
	CO	46-88	37	11	4	52	53±2	n/a
	CT	122	1	0	0	1	---	n/a
2004	DV	64-109	21	6	5	32	33±2	n/a
	CO	40-94	23	2	2	27	27	n/a
	CT	122	1	0	0	1	---	n/a
	RT	86-106	3	1	0	4	---	n/a
2005	DV	59-131	21	12	11	44	59±21	n/a
	CO	39-103	82	42	15	139	151±12	n/a
	CT	91-103	1	1	0	2	---	n/a
2006	DV	85-117	7	3	1	11	---	n/a
	CO	69-108	5	4	1	10	---	n/a
	CT	---	0	0	0	0	---	n/a
2007	DV	81-158	7	5	0	12	---	n/a
	CO	38-104	50	10	9	69	71±4	n/a
	CT	138	0	0	1	1	---	n/a
2008	DV	60-108	15	4	3	22	22	n/a
	CO	41-100	72	44	26	142	177±30	n/a
	CT	82-112	1	0	2	3	---	n/a
2009	DV	48-98	24	5	9	38	42±7	n/a
	CO	38-116	42	9	2	53	53	n/a
	CT	97	1	0	0	1	---	n/a
2010	DV	58-108	21	7	31	59	59	n/a
	CO	39-90	77	21	30	128	152±22	n/a
	CT	64-89	4	1	0	5	---	n/a
2011	DV	50-125	15	7	14	36	36	n/a
	CO	38-100	18	18	13	49	85±50	n/a
	CT	115	1	0	0	1	---	n/a
2012	DV	66-112	17	11	12	40	40	1.00
	CO	46-105	39	9	7	55	55	1.14
	CT	63-93	4	0	1	5	---	0.97
2013	DV	52-92	9	2	2	13	---	1.23
	CO	50-91	9	6	3	18	20±4	1.43
	CT	73-80	0	2	0	2	---	0.97
2014	DV	37-115	1	12	1	14	---	0.99
	CO	39-92	86	26	24	136	150±13	1.16
	CT	110-110	0	1	1	2	---	0.87
	RT	105-110	1	0	1	2	---	0.69

Appendix C4.–Length frequency diagrams of Dolly Varden char captured at Greens Creek Site 48, 2001–2014.



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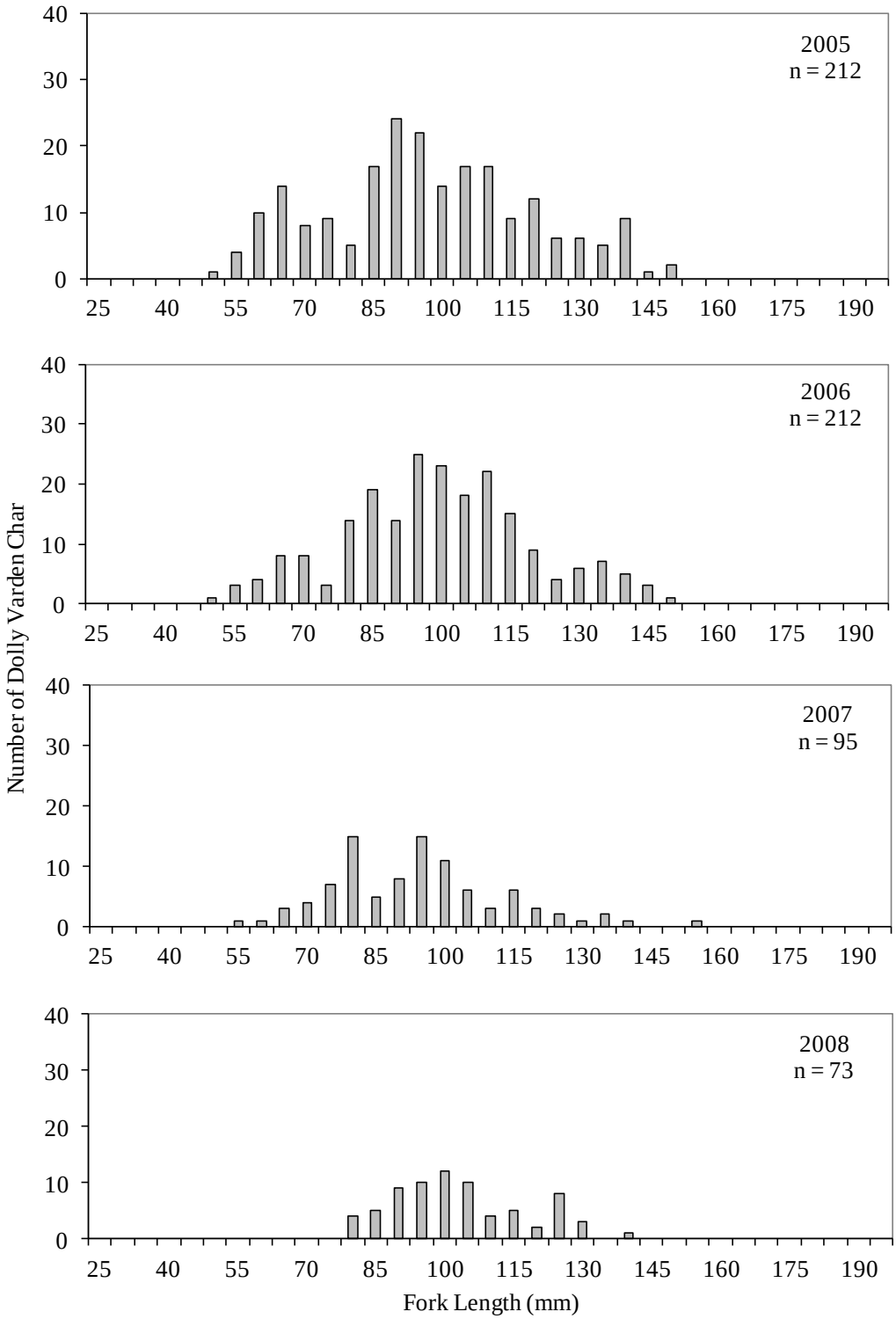
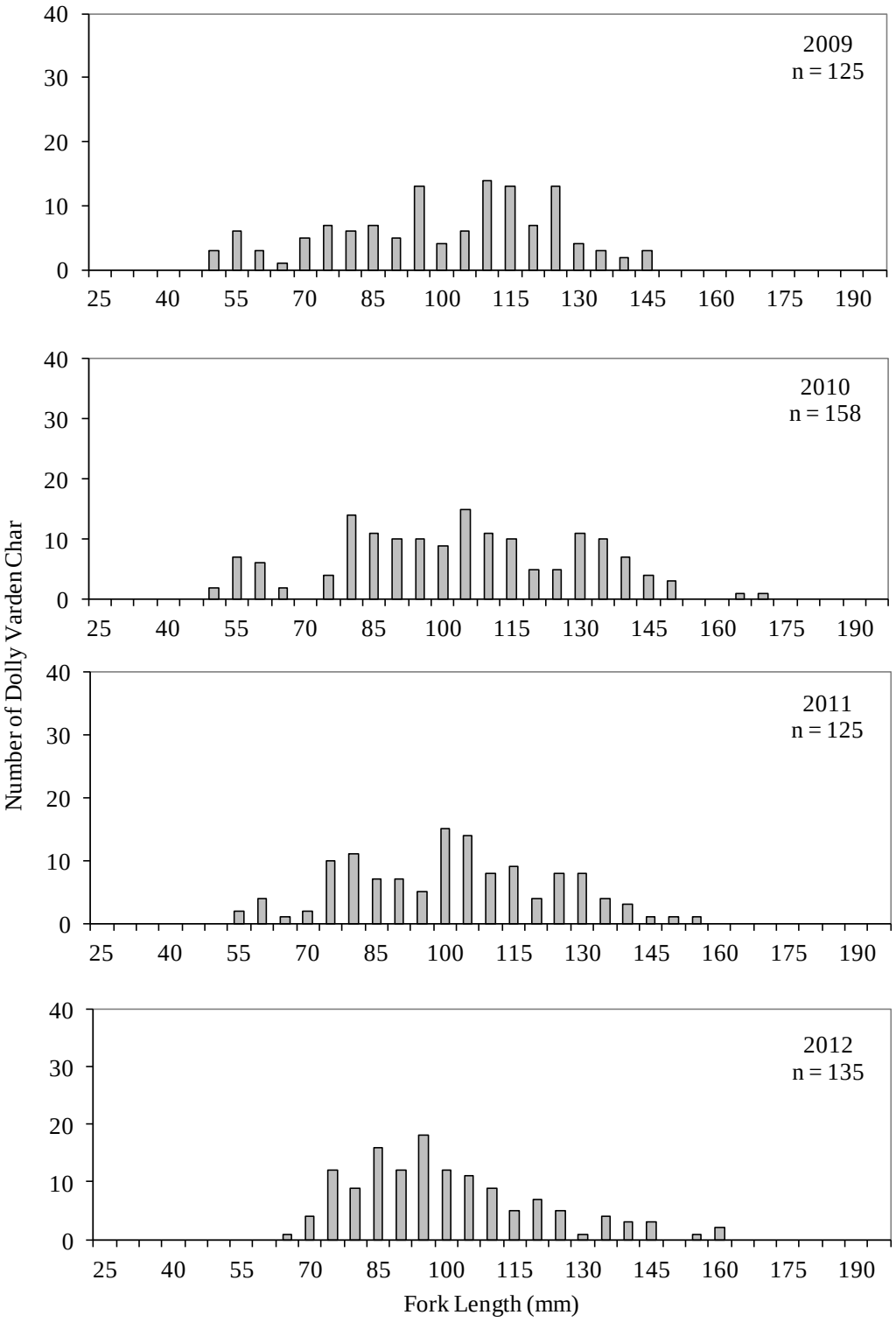
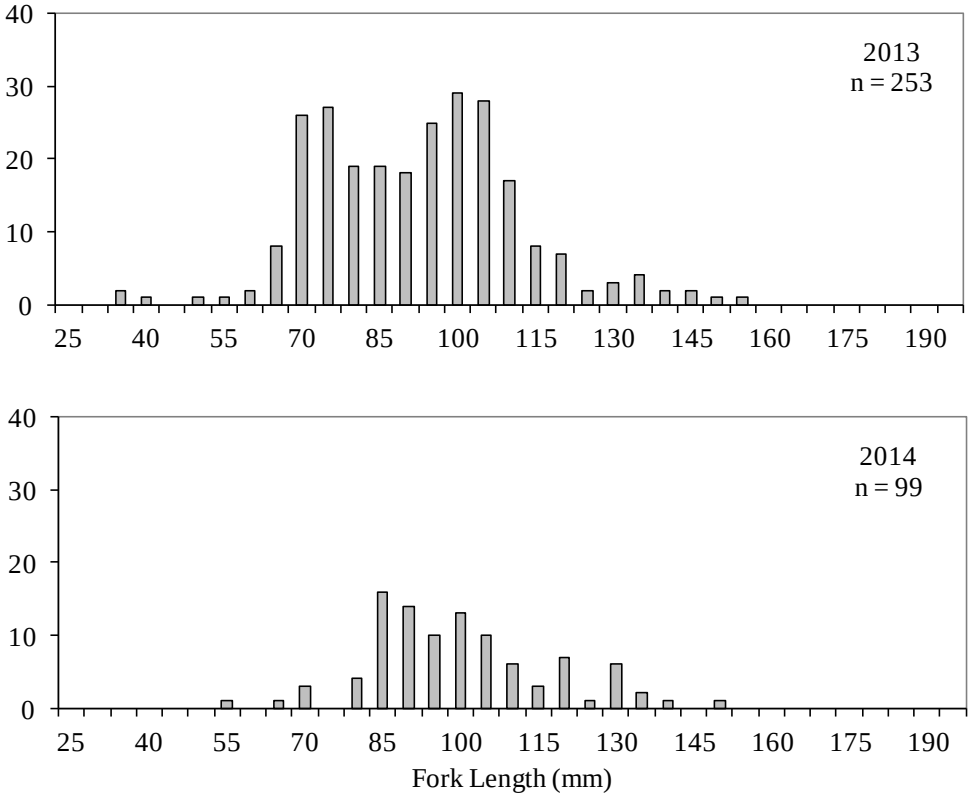

2005
n = 212
2006
n = 212
2007
n = 95
2008
n = 73
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

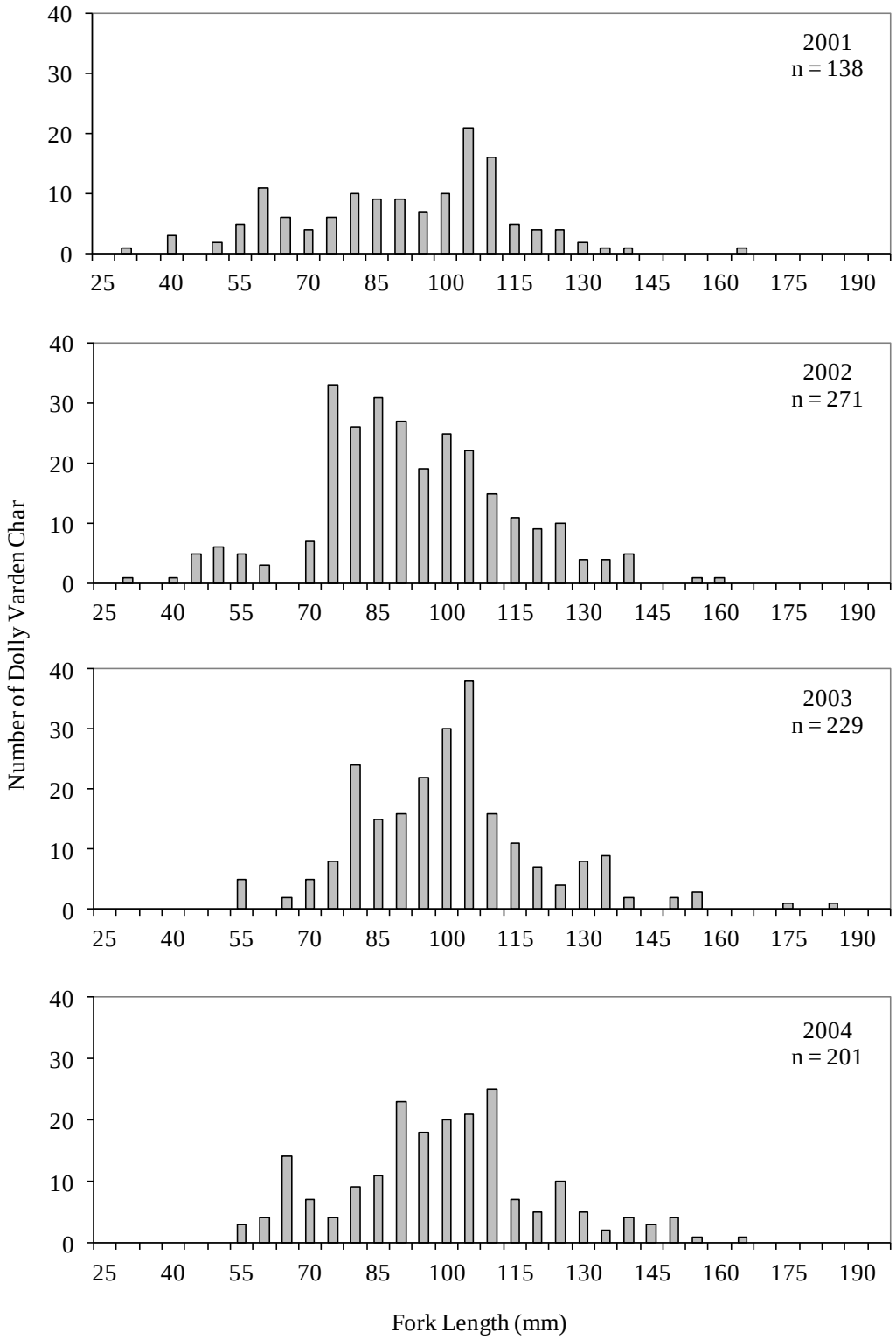
-continued-


2009
n = 125
2010
n = 158
2011
n = 125
2012
n = 135
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


2013
n = 253
2014
n = 99
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

Appendix C5.–Length frequency diagrams of Dolly Varden char captured at Greens Creek Site 54, 2001–2014.



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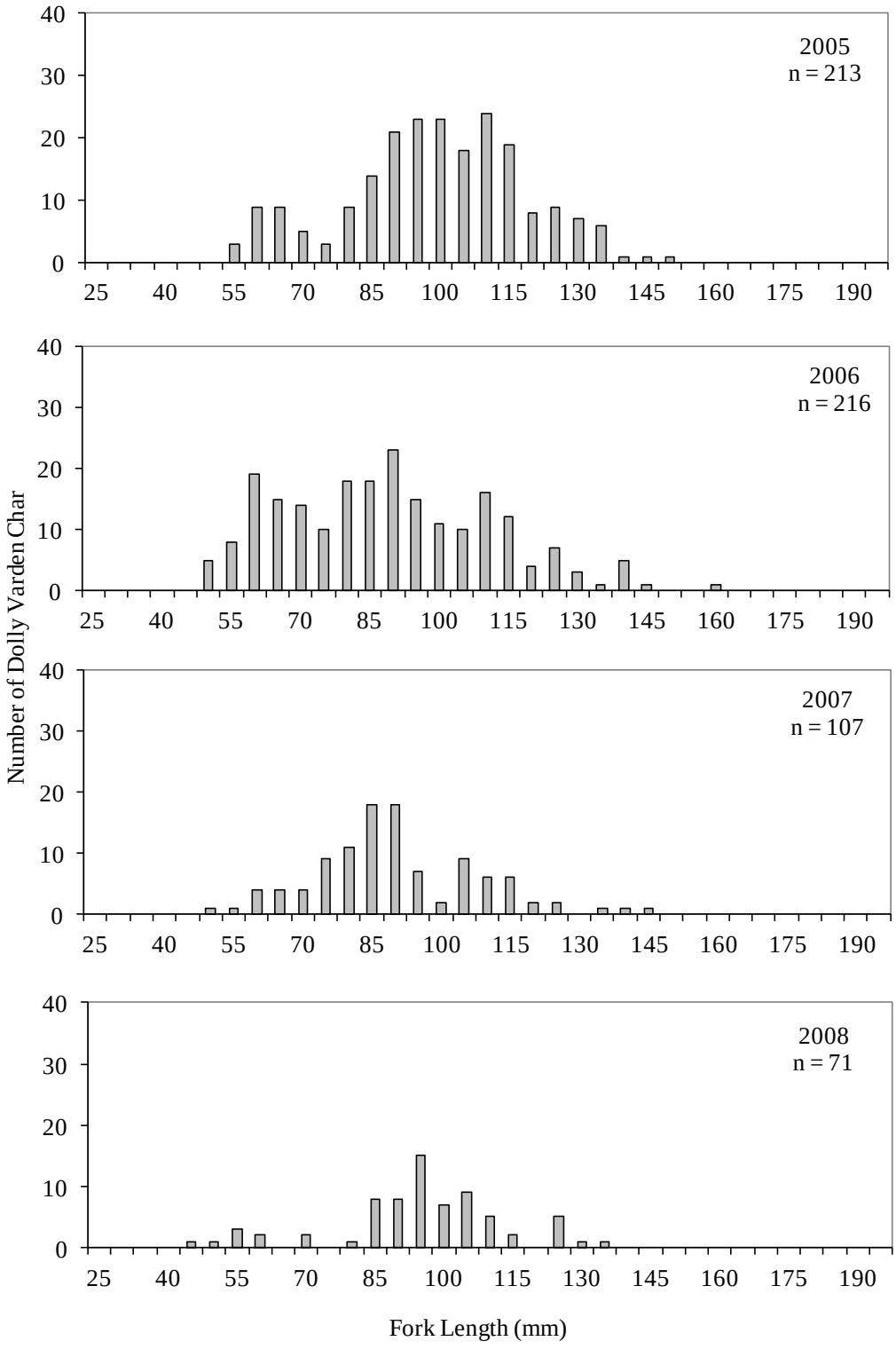
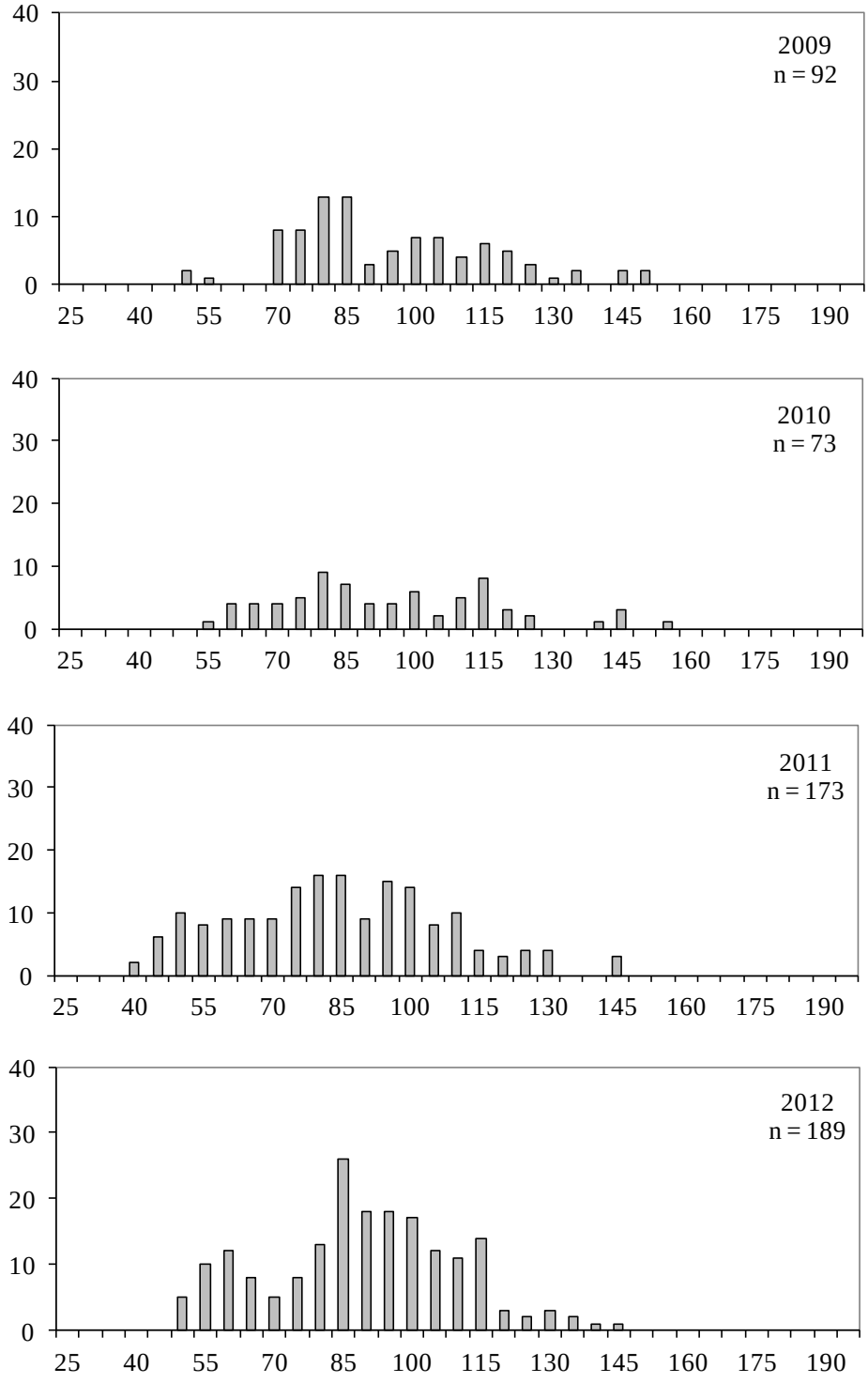
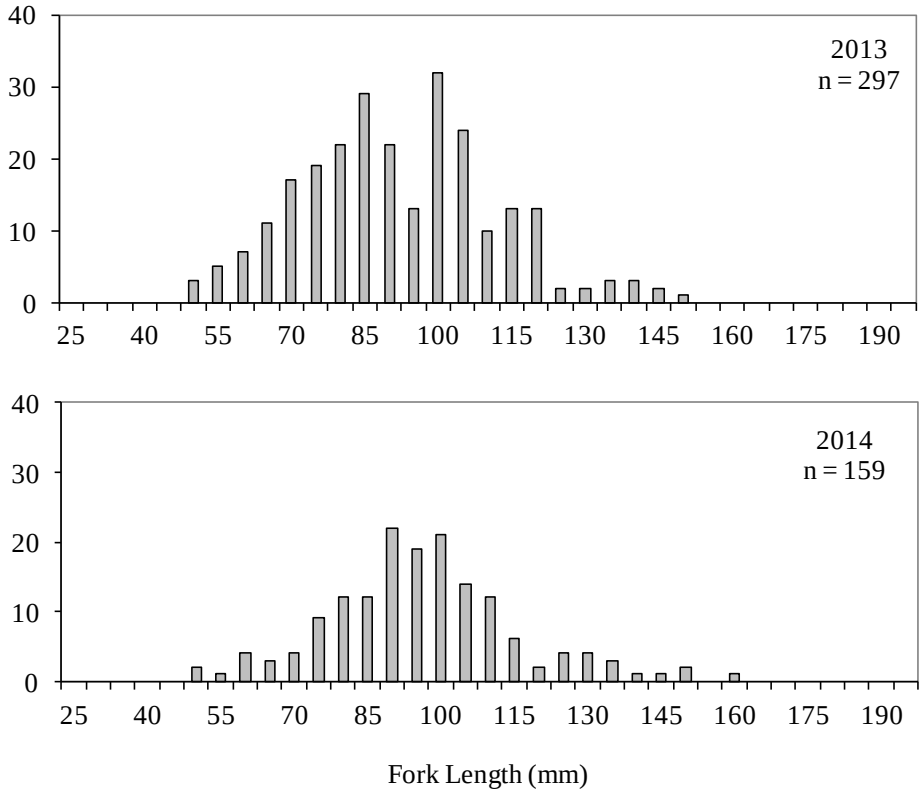

2005
n = 213
2006
n = 216
2007
n = 107
2008
n = 71
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

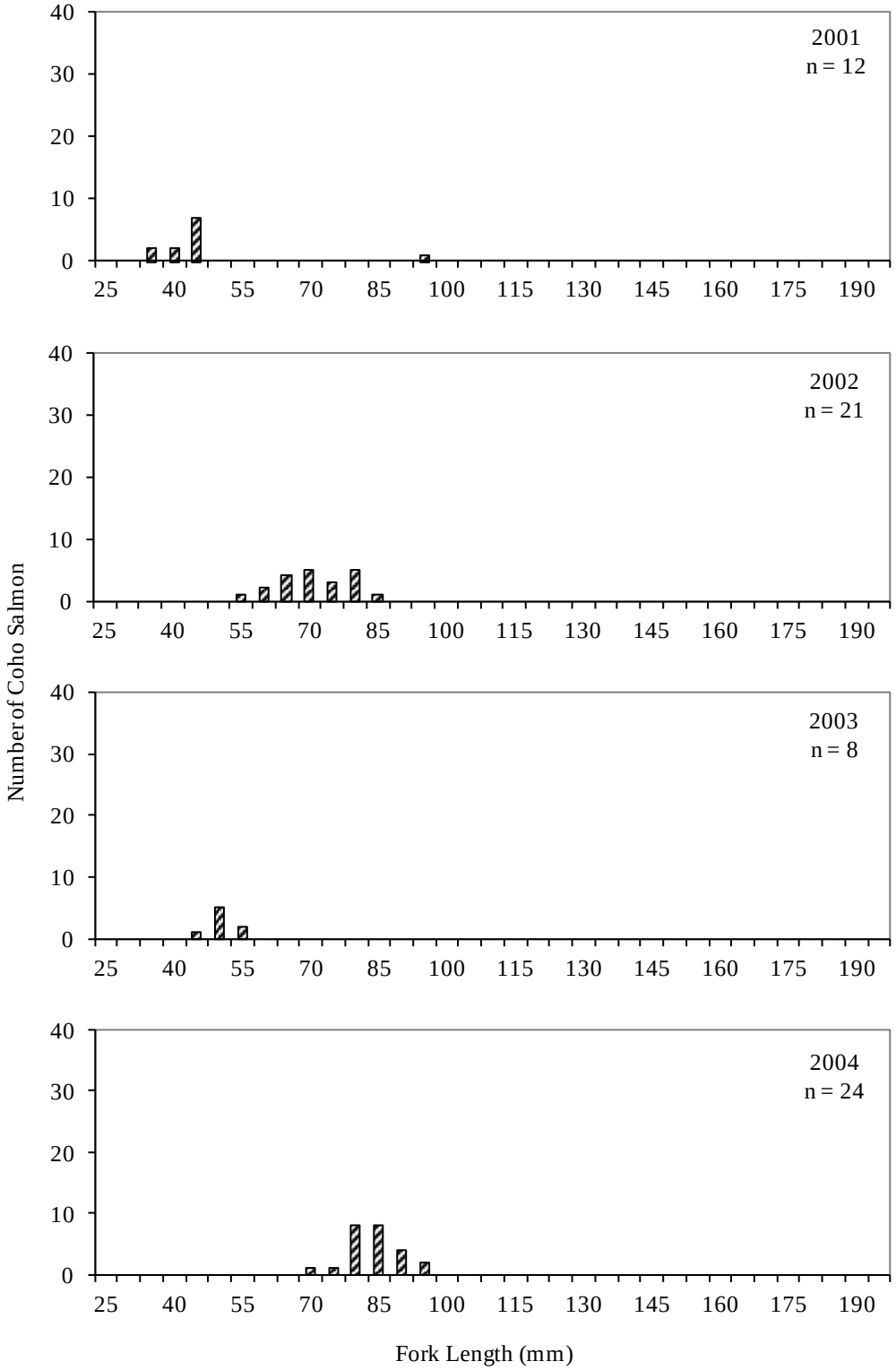
-continued-


2009
n = 92
2010
n = 73
2011
n = 173
2012
n = 189
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

-continued-


2013
n = 297
2014
n = 159
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

Appendix C6.–Length frequency diagrams of coho salmon captured at Greens Creek Site 54, 2001–2014.



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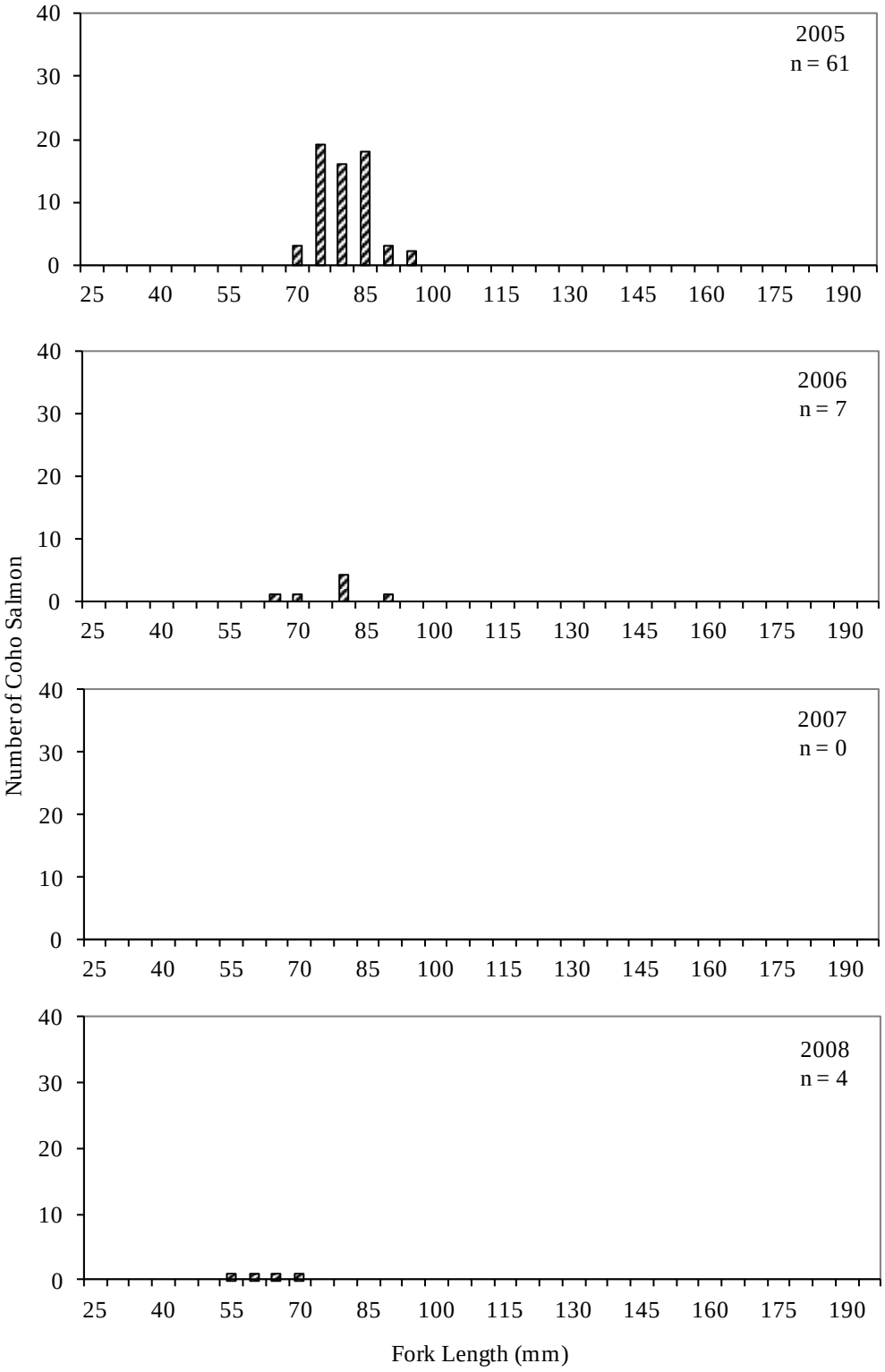
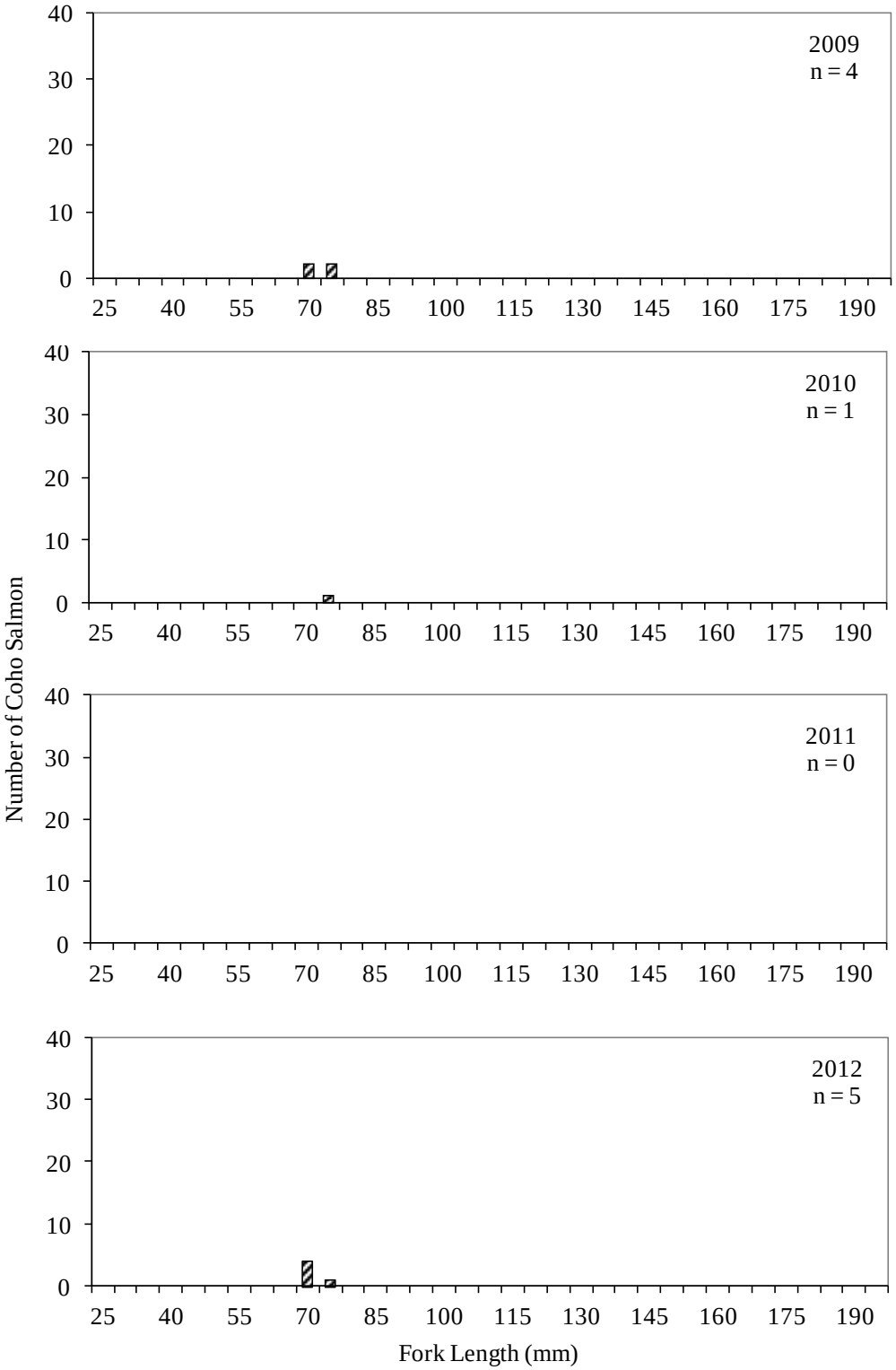
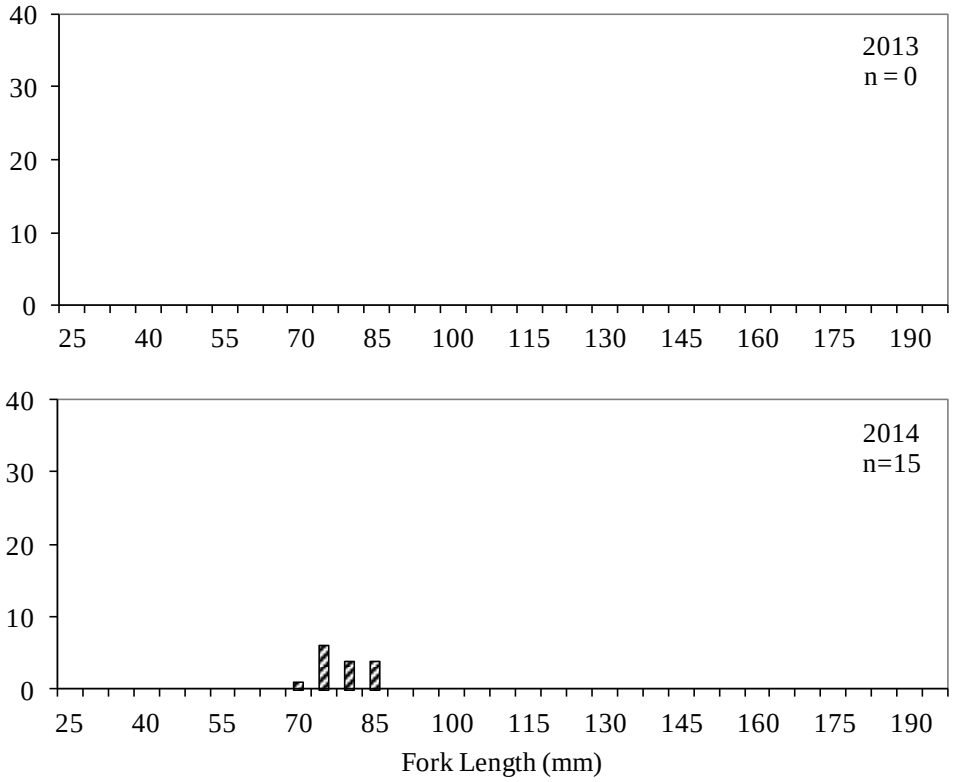

2005
n = 61
2006
n = 7
2007
n = 0
2008
n = 4
Number of Coho Salmon
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

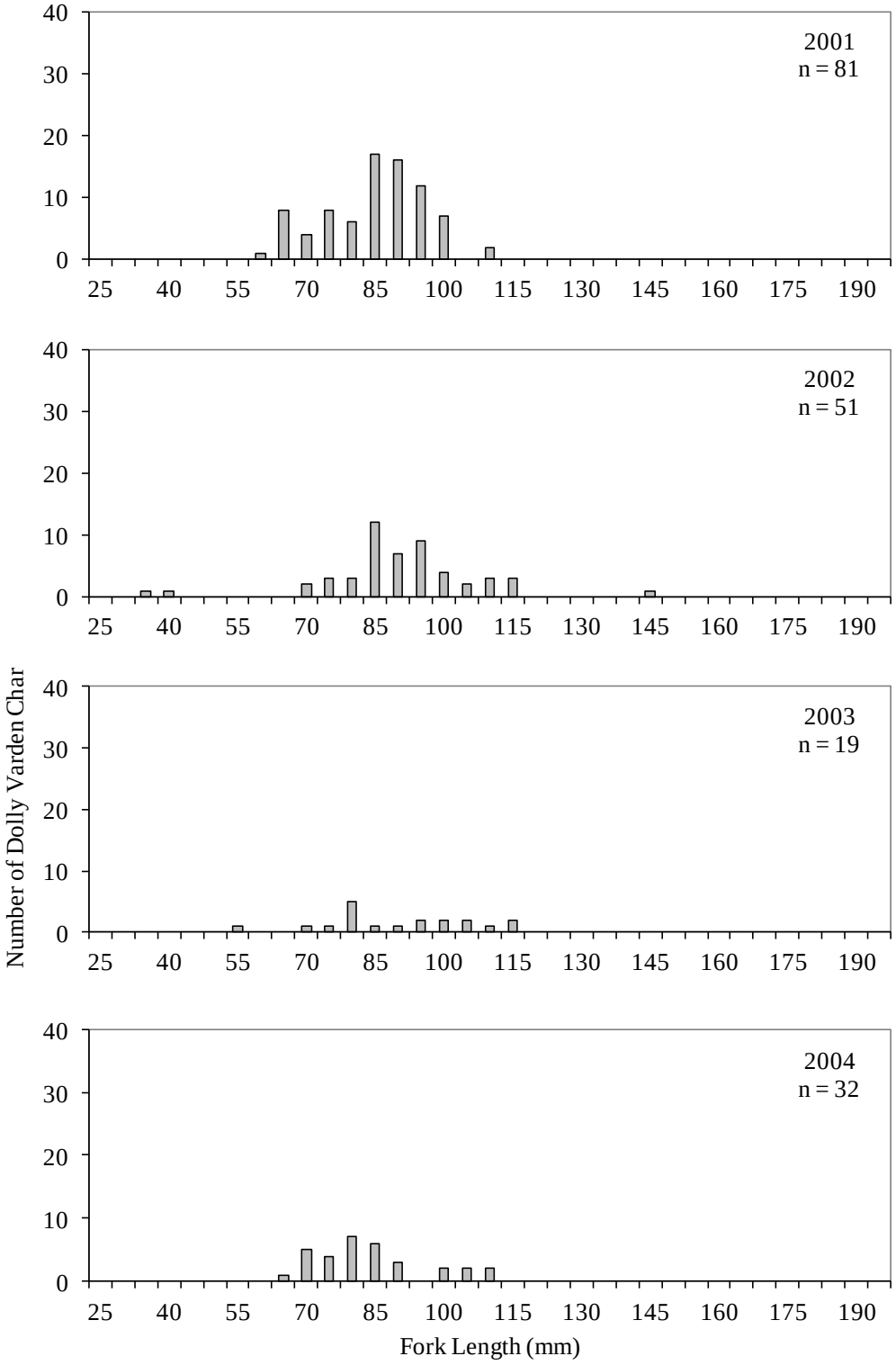
-continued-


2009
n = 4
2010
n = 1
2011
n = 0
2012
n = 5
Number of Coho Salmon
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


2013
n = 0
2014
n=15
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

Appendix C7.–Length frequency diagrams of Dolly Varden char captured at Tributary Creek Site 9, 2001–2014.



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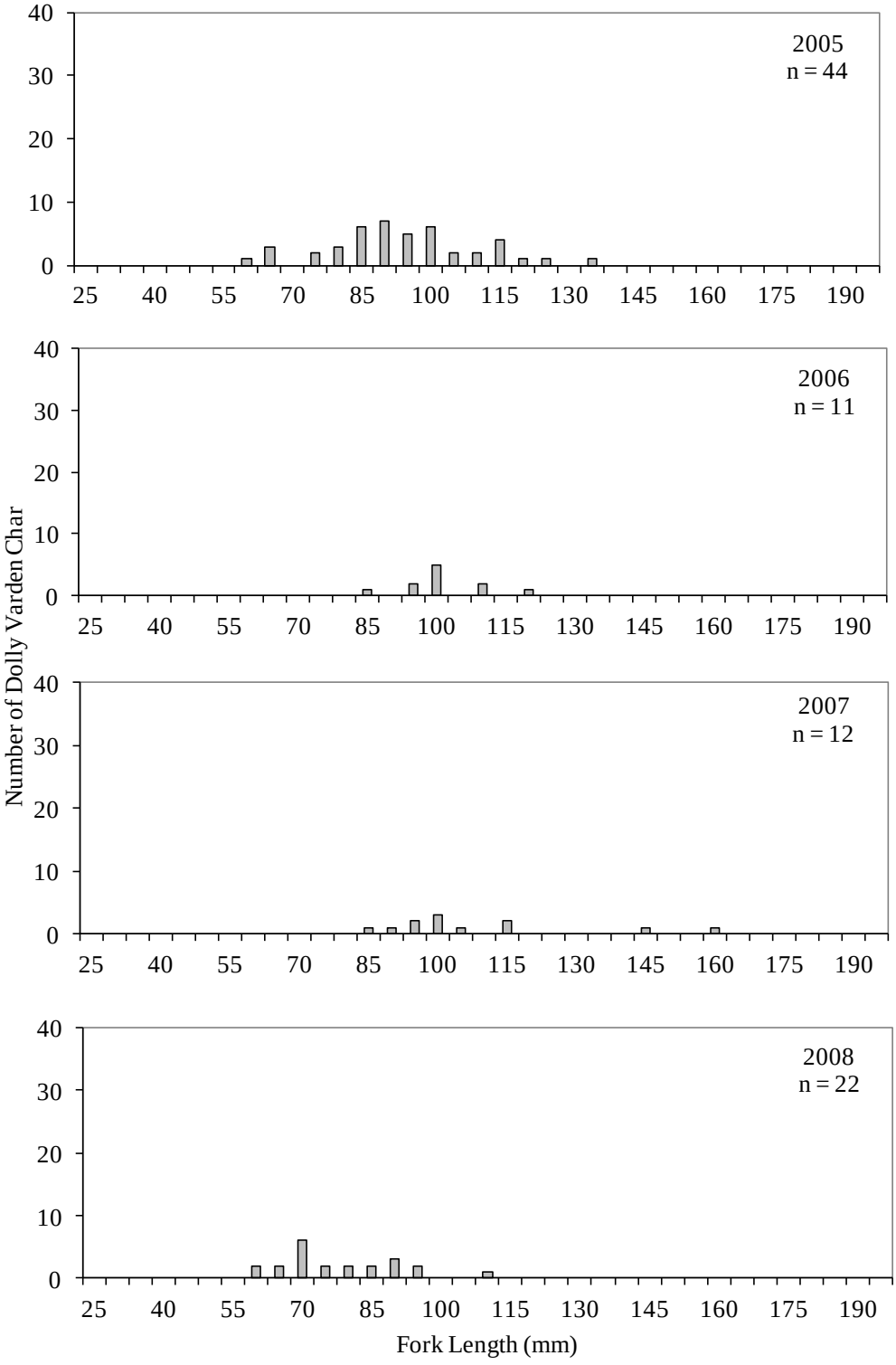
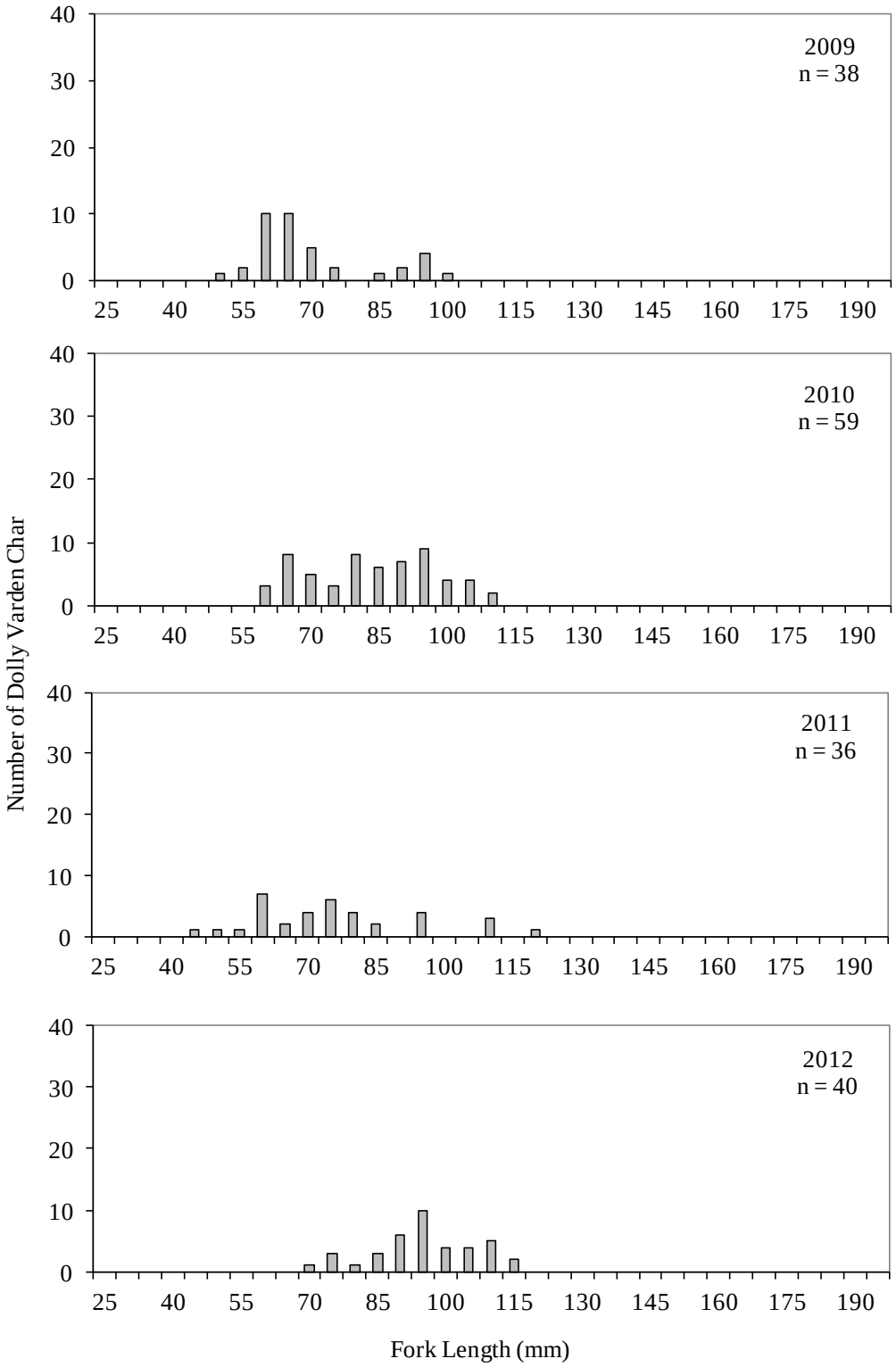
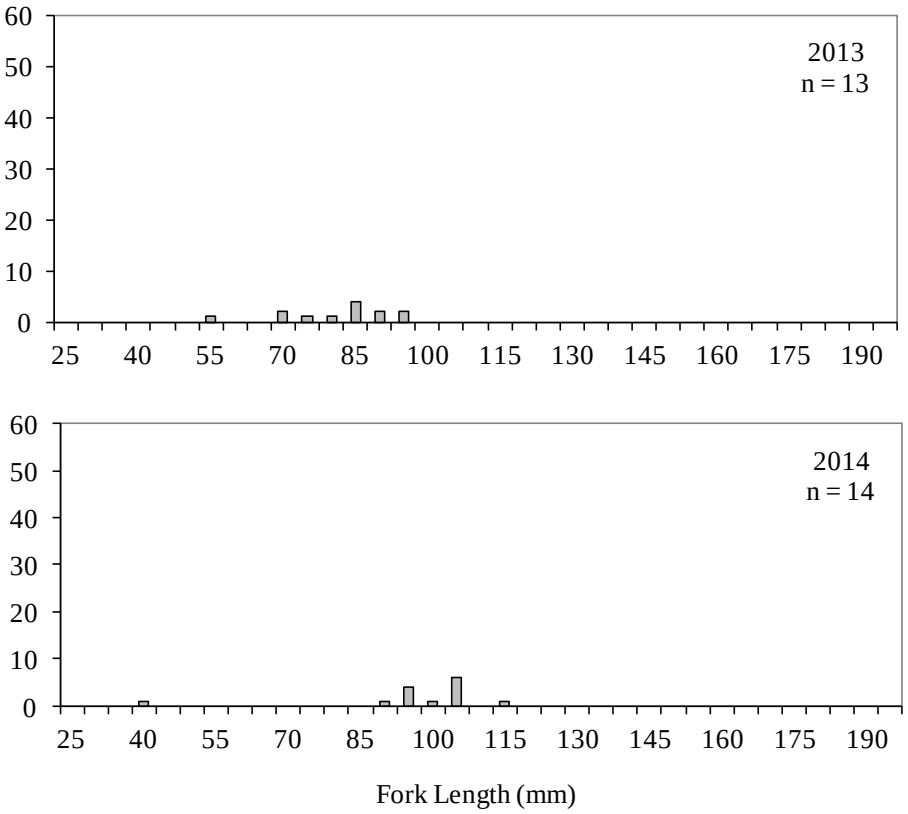

2005
n = 44
2006
n = 11
2007
n = 12
2008
n = 22
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

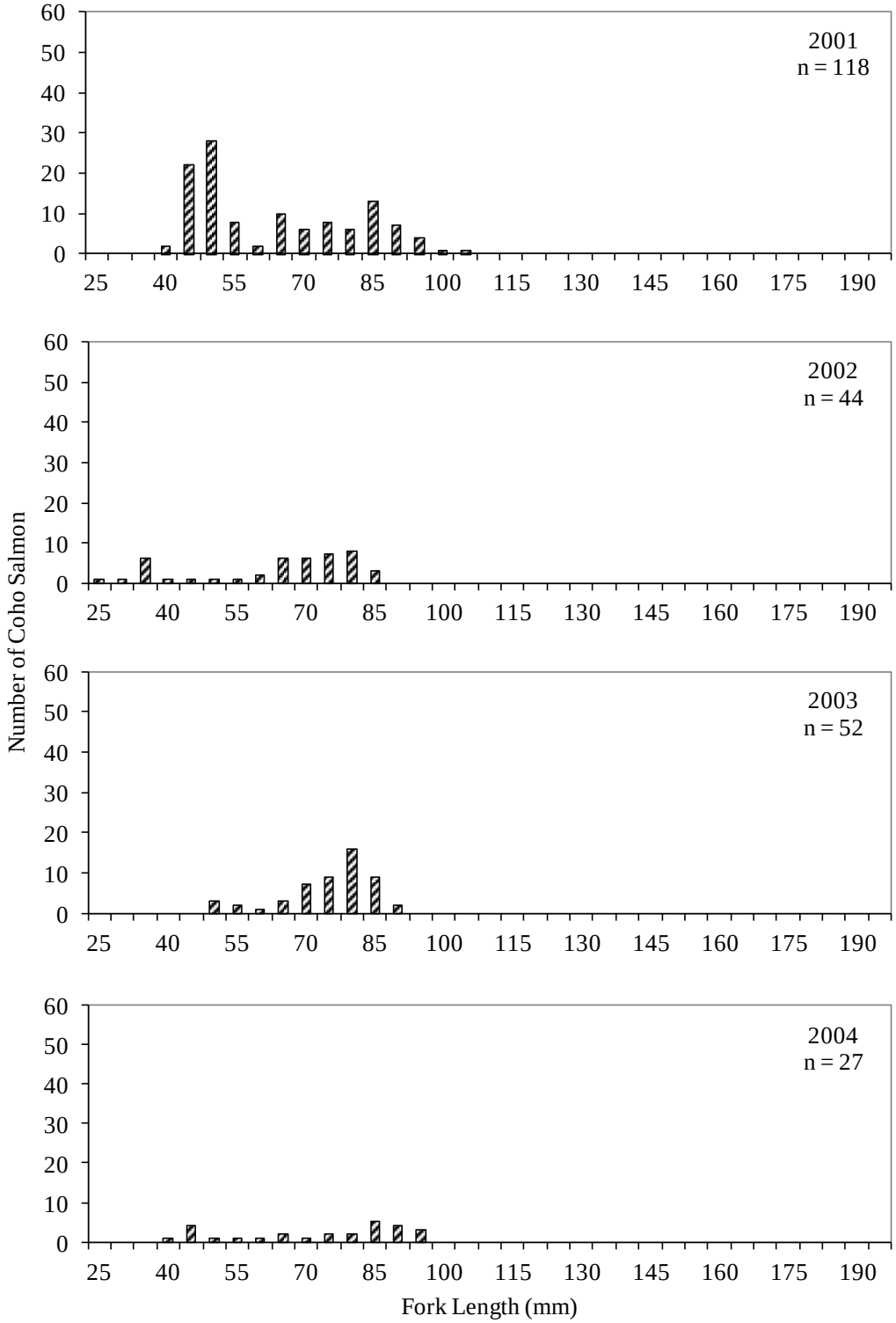
-continued-


2009
n = 38
2010
n = 59
2011
n = 36
2012
n = 40
Number of Dolly Varden Char
Fork Length (mm)
0
10
20
30
40
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


2013
n = 13
2014
n = 14
0
10
20
30
40
50
60
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

Appendix C8.–Length frequency diagrams of coho salmon captured at Tributary Creek Site 9, 2001–2014.



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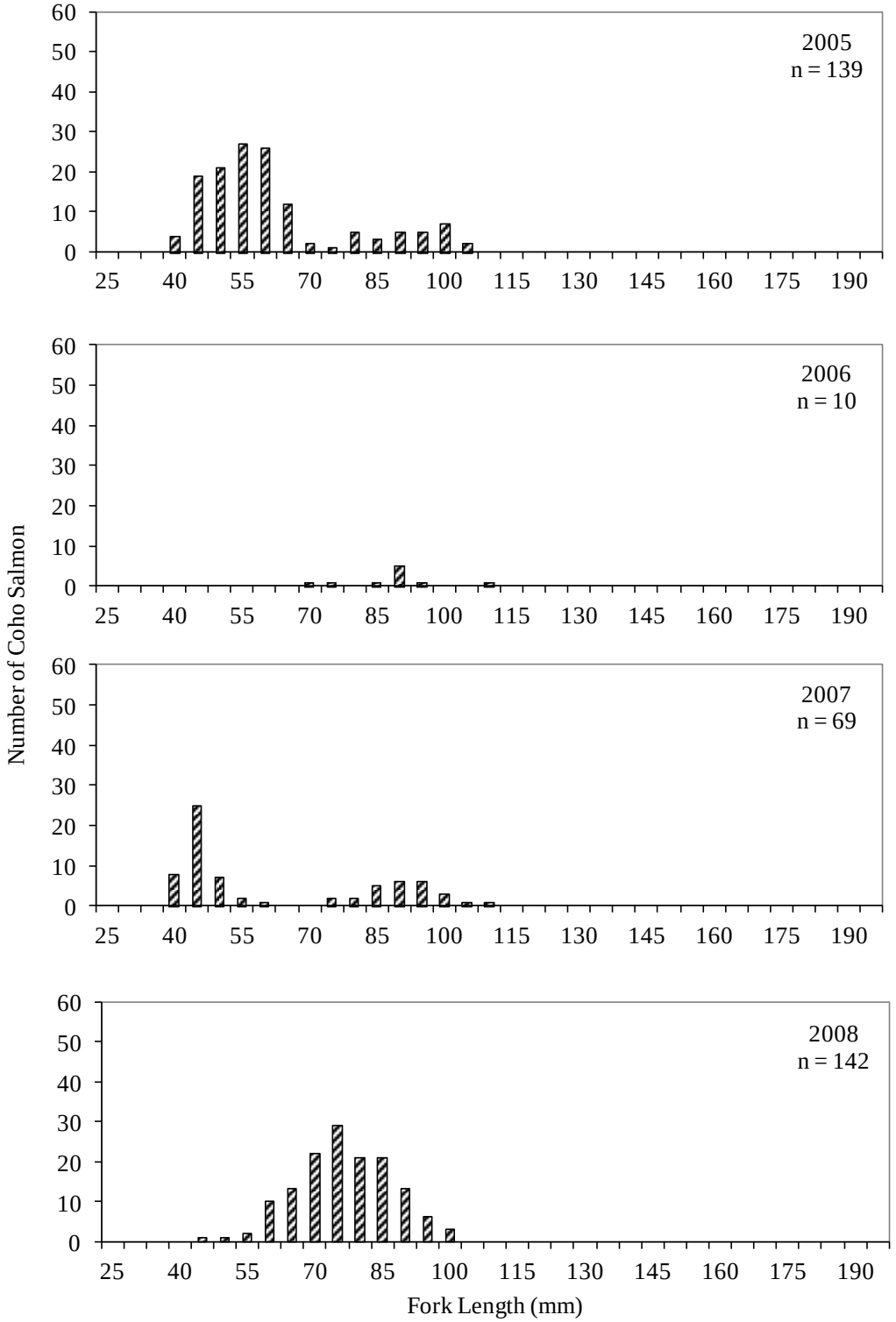
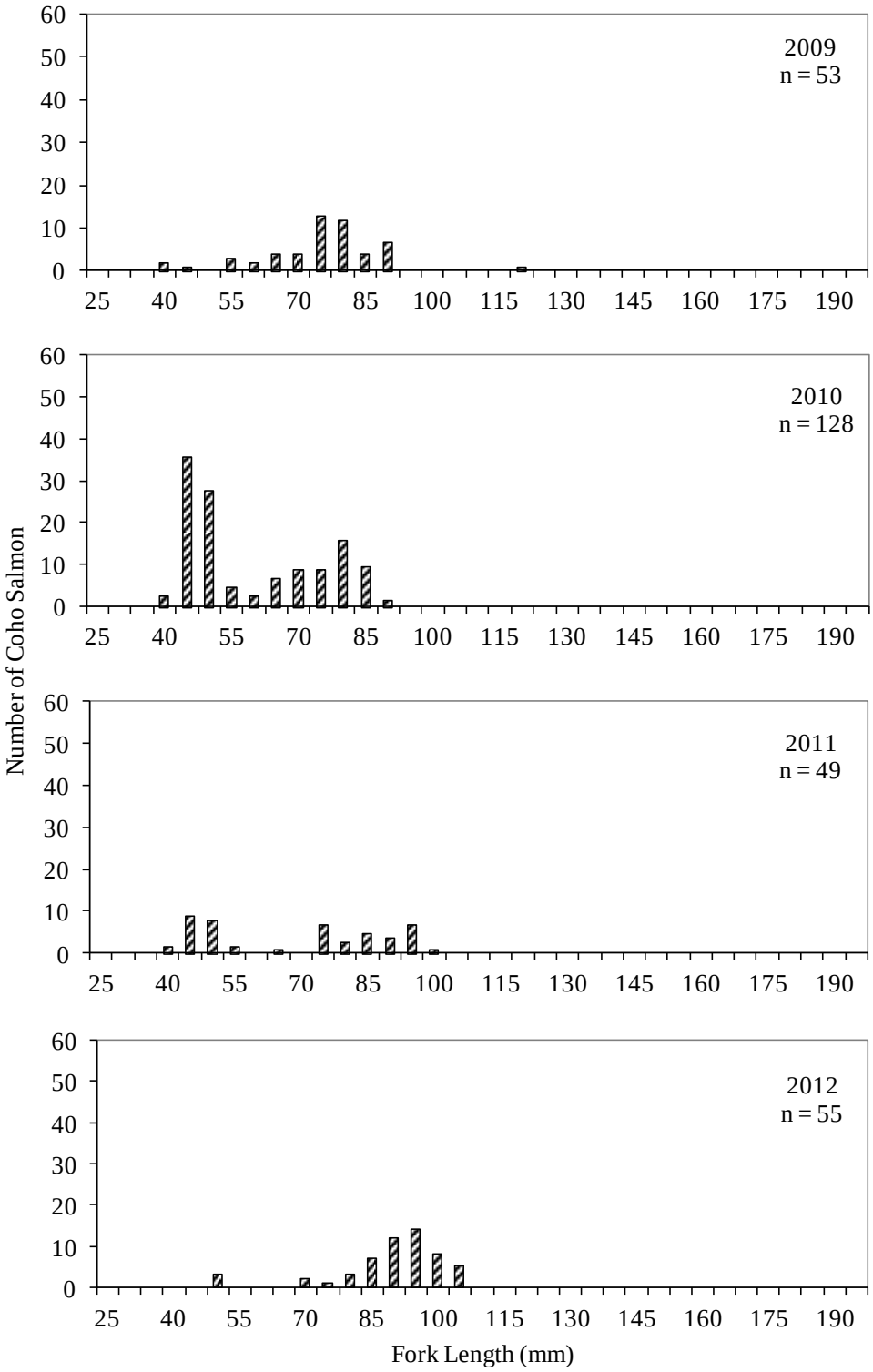
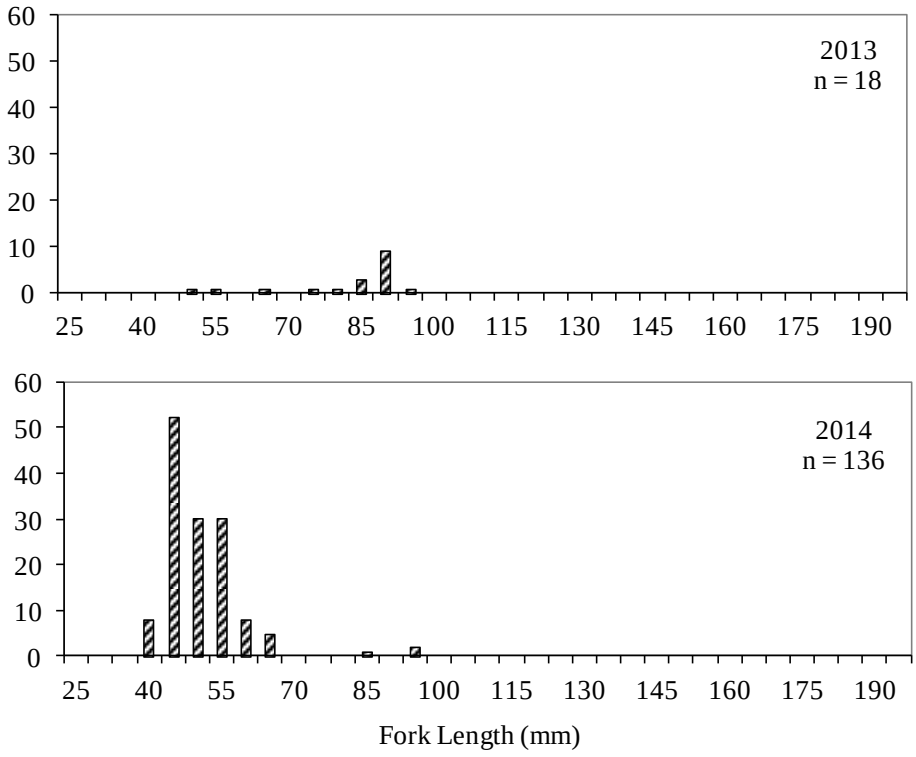

2005
n = 139
2006
n = 10
2007
n = 69
2008
n = 142
Number of Coho Salmon
Fork Length (mm)
0
10
20
30
40
50
60
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


2009
n = 53
2010
n = 128
2011
n = 49
2012
n = 55
Number of Coho Salmon
Fork Length (mm)
0
10
20
30
40
50
60
25
40
55
70
85
100
115
130
145
160
175
190

-continued-


2013
n = 18
2014
n = 136
0
10
20
30
40
50
60
25
40
55
70
85
100
115
130
145
160
175
190
Fork Length (mm)

APPENDIX D: JUVENILE FISH METALS CONCENTRATIONS DATA AND LABORATORY REPORT

Appendix D1.–Whole body metals and Se concentrations data for juvenile Dolly Varden char samples collected at Greens Creek Site 48, 2001–2014.

Sample Date	Sample Number	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	1	131	26.0	0.02	1.76	8.3	---	0.20	6.1	180
7/23/01	2	137	28.8	0.03	0.89	7.2	---	0.17	4.6	146
7/23/01	3	119	18.8	0.02	2.27	5.7	---	0.20	6.2	189
7/23/01	4	121	21.1	0.02	1.56	6.9	---	0.17	5.2	182
7/23/01	5	111	13.7	0.03	0.89	4.7	---	0.23	5.4	138
7/23/01	6	121	21.1	<0.02	1.26	7.4	---	0.10	5.6	157
7/24/02	1	133	23.2	0.03	1.64	6.8	---	0.72	4.8	239
7/24/02	2	120	15.0	0.07	0.85	7.0	---	0.28	4.1	210
7/24/02	3	122	17.5	0.03	0.74	4.3	---	0.17	4.9	162
7/24/02	4	127	20.8	0.04	1.40	6.1	---	0.16	4.7	185
7/24/02	5	134	24.8	0.05	1.30	7.9	---	0.46	4.3	208
7/24/02	6	128	21.7	0.04	1.56	6.8	---	0.22	5.7	343
7/22/03	1	90	8.9	<0.02	0.65	4.2	---	0.14	5.6	191
7/22/03	2	98	9.9	<0.02	0.90	5.1	---	0.22	5.5	180
7/22/03	3	103	12.1	<0.02	0.82	5.6	---	0.16	5.4	241
7/22/03	4	112	12.5	<0.02	0.78	6.1	---	0.11	6.1	192
7/22/03	5	108	11.9	<0.02	0.63	3.9	---	0.14	5.2	174
7/22/03	6	100	10.5	<0.02	0.58	3.7	---	0.08	5.5	218
7/22/04	1	96	8.6	<0.02	0.63	4.7	---	0.15	4.3	206
7/22/04	2	88	6.8	<0.02	0.83	5.6	---	0.26	4.0	175
7/22/04	3	101	11.5	<0.02	1.54	4.6	---	0.21	4.1	183
7/22/04	4	98	9.3	<0.02	0.80	5.2	---	0.28	3.7	168
7/22/04	5	93	7.6	<0.02	1.25	4.4	---	0.14	6.4	220
7/22/04	6	91	7.5	0.03	1.01	4.5	---	0.29	5.6	323
7/22/05	1	103	19.7	0.02	0.66	4.4	---	0.44	4.2	183
7/22/05	2	96	13.1	<0.02	0.84	14.5	---	0.98	4.8	220
7/22/05	3	119	15.6	0.02	0.89	4.4	---	0.66	4.8	226
7/22/05	4	114	17.1	0.02	0.59	6.0	---	0.32	4.8	178
7/22/05	5	111	15.3	0.03	1.10	18.8	---	0.79	4.6	217
7/22/05	6	125	16.9	0.03	0.47	3.6	---	0.36	3.8	161
7/20/06	1	110	15.8	0.04	0.56	8.5	---	0.37	5.4	244
7/20/06	2	110	15.4	0.05	1.20	8.3	---	0.31	6.0	217
7/20/06	3	113	16.1	0.04	0.65	6.3	---	0.24	5.4	264
7/20/06	4	132	25.0	0.06	0.63	8.1	---	0.66	5.2	232
7/20/06	5	104	12.8	0.08	0.96	8.5	---	0.37	5.1	283
7/20/06	6	114	16.7	0.03	0.63	5.3	---	0.20	5.1	270
7/21/07	1	122	17.9	0.03	1.16	5.5	---	0.17	5.5	221
7/21/07	2	95	10.4	0.02	1.42	3.9	---	0.29	5.8	165
7/21/07	3	135	22.8	0.09	1.35	14.1	---	1.37	5.3	166
7/21/07	4	98	9.9	0.03	0.96	5.7	---	0.27	5.2	269
7/21/07	5	105	13.2	0.11	1.79	11.4	---	1.62	5.4	323
7/21/07	6	99	10.0	0.04	1.43	5.2	---	0.31	5.7	208

-continued-

Sample Date	Sample Number	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)
7/22/08	1	112	16.4	0.069	1.23	5.2	---	0.95	5.72	289.0
7/22/08	2	123	21.3	0.039	0.79	3.9	---	0.57	4.56	194.0
7/22/08	3	105	14.0	0.079	0.82	4.6	---	0.52	5.88	199.5
7/22/08	4	124	20.6	0.041	0.87	4.9	---	0.42	6.31	244.0
7/22/08	5	115	16.9	0.030	1.36	5.3	---	0.51	5.36	254.0
7/22/08	6	122	19.8	0.037	1.07	5.6	---	0.38	6.11	260.0
7/21/09	1	120	20.1	<0.02	1.05	5.2	---	0.22	5.9	186
7/21/09	2	121	20.7	<0.02	1.40	5.3	---	0.44	5.7	173
7/21/09	3	119	17.9	0.02	1.10	4.5	---	0.13	5.9	182
7/21/09	4	108	13.6	<0.02	1.20	4.1	---	0.15	5.7	162
7/21/09	5	109	14.6	<0.02	1.50	4.9	---	0.17	5.9	186
7/21/09	6	110	15.2	<0.02	0.84	3.8	---	0.18	6.1	202
7/21/10	1	103	11.9	0.020	1.56	4.8	0.09	0.16	5.0	226
7/21/10	2	109	16.1	<0.020	0.50	3.0	0.15	0.20	5.4	170
7/21/10	3	108	13.9	0.040	0.91	4.2	0.17	0.30	5.0	180
7/21/10	4	105	13.8	<0.020	0.98	3.4	0.13	0.09	4.6	163
7/21/10	5	98	10.8	0.062	0.90	4.8	0.14	0.46	4.8	213
7/21/10	6	93	9.1	<0.020	0.96	3.6	0.10	0.09	4.0	156
7/22/11	1-6	88-112	---	0.03	1.12	5.7	---	0.28	6.2	221
7/24/12	1	109	11.3	0.03	2.26	27.0	0.134	0.16	5.5	186
7/24/12	2	123	18.3	0.03	1.37	4.9	0.122	0.10	5.7	184
7/24/12	3	110	9.8	0.03	1.83	25.6	0.159	2.59	5.6	275
7/24/12	4	103	10.6	0.03	0.99	76.8	0.175	0.30	5.1	189
7/24/12	5	104	10.7	0.03	2.66	84.8	0.122	1.05	6.3	242
7/24/12	6	116	15.8	0.04	0.73	35.1	0.148	1.03	4.7	190
7/25/13	1	145	20.6	<0.02	0.68	3.7	0.214	0.17	5.3	237
7/25/13	2	115	17.9	0.07	0.97	6.1	0.238	0.24	5.8	239
7/25/13	3	115	14.3	<0.02	0.81	4.0	0.180	0.08	6.7	258
7/25/13	4	105	11.4	<0.02	0.68	3.2	0.213	0.14	6.4	213
7/25/13	5	109	13.0	0.04	2.01	6.6	0.113	0.36	6.2	271
7/25/13	6	105	12.4	0.04	1.75	5.7	0.274	0.22	6.2	287
7/25/14	1	110	13.0	0.04	0.55	4.5	0.146	0.11	5.3	234
7/25/14	2	100	10.5	<0.02	0.93	4.2	0.148	0.19	6.9	213
7/25/14	3	106	10.7	<0.02	1.22	4.8	0.199	0.38	5.7	232
7/25/14	4	105	11.3	<0.02	1.45	4.2	0.122	0.44	6.1	193
7/25/14	5	100	10.4	<0.02	0.92	4.5	0.134	0.06	4.9	237
7/25/14	6	120	14.8	0.04	0.75	5.5	0.260	0.18	5.9	305

Appendix D2.–Whole body metals and Se concentrations data for juvenile Dolly Varden char samples collected at Greens Creek Site 54, 2001–2014.

Sample Date	Sample Number	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	1	121	21.5	0.03	0.46	4.3	---	0.33	5.7	126
7/23/01	2	119	19.3	0.02	0.21	3.2	---	0.22	3.6	82
7/23/01	3	107	15.7	0.03	0.73	6.3	---	0.59	4.7	144
7/23/01	4	109	13.6	0.02	0.82	5.4	---	0.86	4.9	172
7/23/01	5	105	13.5	<0.02	0.79	6.5	---	0.45	5.8	203
7/23/01	6	138	27.5	<0.02	0.74	5.8	---	0.40	5.4	171
7/24/02	1	118	18.0	0.03	0.50	4.4	---	0.94	3.4	363
7/24/02	2	128	22.3	0.03	0.52	4.5	---	0.35	4.7	150
7/24/02	3	115	17.7	0.05	0.95	6.0	---	0.66	4.4	161
7/24/02	4	115	18.9	0.03	1.03	5.2	---	0.66	4.2	216
7/24/02	5	124	21.1	0.05	1.32	5.2	---	0.74	3.9	194
7/24/02	6	123	20.9	0.02	0.70	3.9	---	0.78	4.4	195
7/22/03	1	123	21.1	0.03	0.85	6.4	---	1.40	6.1	188
7/22/03	2	101	10.6	<0.02	0.67	4.2	---	0.32	6.4	174
7/22/03	3	88	9.2	<0.02	0.75	4.3	---	0.35	6.5	186
7/22/03	4	109	14.8	<0.02	1.11	5.8	---	0.38	5.7	188
7/22/03	5	95	10.6	<0.02	0.59	3.5	---	0.29	5.7	174
7/22/03	6	92	9.7	<0.02	0.91	4.1	---	0.43	6.5	263
7/21/04	1	103	9.9	0.02	0.79	11.0	---	0.57	4.6	232
7/21/04	2	104	10.0	<0.02	0.88	5.5	---	0.54	5.0	206
7/21/04	3	86	6.6	<0.02	1.26	5.1	---	0.36	5.3	164
7/21/04	4	96	9.3	0.03	0.79	5.9	---	0.28	5.4	191
7/21/04	5	93	9.9	<0.02	0.83	5.0	---	0.48	3.9	202
7/21/04	6	104	12.9	0.08	1.12	7.0	---	0.93	4.9	217
7/22/05	1	120	12.3	0.03	0.72	5.0	---	0.27	4.0	160
7/22/05	2	106	12.1	0.02	0.63	4.5	---	0.13	3.9	200
7/22/05	3	113	20.8	<0.02	0.73	8.8	---	0.17	4.7	223
7/22/05	4	114	17.9	<0.02	0.82	9.7	---	0.17	3.9	222
7/22/05	5	112	16.1	0.03	1.06	8.8	---	0.22	4.4	209
7/22/05	6	118	22.3	0.02	0.55	5.5	---	0.39	3.9	185
7/20/06	1	137	27.3	0.06	0.42	4.8	---	0.51	5.7	208
7/20/06	2	112	14.9	0.04	0.75	16.0	---	0.95	7.2	223
7/20/06	3	102	12.0	0.02	0.93	22.2	---	0.52	6.3	239
7/20/06	4	114	19.6	0.04	1.03	7.6	---	0.85	5.3	252
7/20/06	5	98	12.3	0.08	0.54	10.9	---	0.48	5.4	223
7/20/06	6	115	16.9	0.04	0.78	8.6	---	0.68	5.6	257
7/20/07	1	102	11.8	0.04	0.88	5.3	---	0.54	5.6	157
7/20/07	2	125	21.1	0.03	0.97	5.2	---	0.83	7.5	234
7/20/07	3	97	10.7	0.06	0.81	5.7	---	0.89	8.6	185
7/20/07	4	123	19.7	0.02	0.75	4.4	---	0.50	7.1	175
7/20/07	5	104	12.5	0.03	0.92	5.6	---	0.57	7.8	174
7/20/07	6	110	15.1	0.04	1.38	6.2	---	0.82	5.4	191

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Sample Date	Sample Number	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)
7/22/08	1	123	21.9	0.039	0.66	5.3	---	0.26	5.53	185.0
7/22/08	2	94	10.8	0.039	1.04	5.1	---	0.28	6.07	203.0
7/22/08	3	123	21.5	0.028	1.53	4.9	---	3.46	6.29	261.0
7/22/08	4	97	11.2	0.029	1.34	5.0	---	0.17	5.90	198.5
7/22/08	5	108	16.0	0.045	1.98	6.3	---	0.23	5.97	220.0
7/22/08	6	108	14.2	0.059	1.07	8.4	---	1.31	5.03	195.0
7/21/09	1	132	26.9	0.04	1.10	4.8	---	0.33	5.4	213
7/21/09	2	141	32.3	0.02	0.71	4.5	---	0.45	7.9	143
7/21/09	3	116	17.9	<0.02	0.99	4.2	---	0.40	6.3	153
7/21/09	4	117	17.7	0.03	1.00	5.9	---	0.39	6.8	200
7/21/09	5	119	22.1	<0.02	1.20	4.0	---	0.28	6.5	176
7/21/09	6	103	13.0	0.02	2.20	5.3	---	0.35	5.9	226
7/20/10	1	115	16.0	<0.020	0.80	3.4	0.08	0.37	4.6	159
7/20/10	2	112	12.8	0.022	0.67	3.1	0.09	0.34	3.7	154
7/20/10	3	118	12.6	<0.020	0.98	3.6	0.12	0.25	5.2	190
7/20/10	4	108	10.6	<0.020	1.31	3.8	0.10	0.16	4.1	212
7/20/10	5	115	12.3	<0.020	1.73	5.0	0.12	0.36	4.4	222
7/20/10	6	94	9.0	0.025	0.77	4.0	0.14	0.31	4.8	199
7/21/11	1-6	95-117	---	<0.02	0.95	4.5	---	0.32	5.6	191
7/23/12	1	132	24.2	0.02	0.85	7.7	0.0768	0.41	9.2	144
7/23/12	2	118	17.3	0.04	1.03	7.7	0.109	0.57	6.3	199
7/23/12	3	109	13.1	0.06	2.04	19.2	0.112	1.32	7.4	215
7/23/12	4	97	9.1	0.03	2.04	65.6	0.126	0.50	6.2	227
7/23/12	5	115	15.4	0.04	1.22	12.6	0.123	1.10	6.9	202
7/23/12	6	119	18.3	0.03	1.81	5.3	0.0798	0.27	5.1	191
7/24/13	1	117	16.9	<0.02	1.39	4.2	0.131	0.30	5.6	247
7/24/13	2	117	17.6	0.02	0.74	3.9	0.183	0.39	7.0	297
7/24/13	3	94	11.3	<0.02	1.27	4.3	0.172	0.28	6.6	262
7/24/13	4	118	18.9	<0.02	0.89	3.9	0.145	0.33	6.0	211
7/24/13	5	105	10.3	0.02	1.18	5.3	0.108	0.27	6.4	245
7/24/13	6	116	15.3	0.02	1.07	4.5	0.126	0.18	6.4	225
7/24/14	1	125	21.2	0.08	0.93	12.7	0.121	1.55	5.7	212
7/25/14	2	104	10.8	0.04	1.15	4.5	0.111	0.37	4.8	247
7/25/14	3	110	11.5	0.21	0.85	4.3	0.119	0.30	6.2	291
7/25/14	4	110	14.9	<0.02	0.69	4.8	0.113	0.25	5.9	248
7/25/14	5	104	10.5	<0.02	1.03	5.0	0.106	0.28	5.7	250
7/25/14	6	135	24.1	0.02	0.86	4.4	0.160	0.49	6.6	243

Appendix D3.–Whole body metals and Se concentrations data for juvenile Dolly Varden char samples collected at Tributary Creek Site 9, 2001–2014.

Sample Date	Sample Number	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	1	97	9.1	0.09	0.35	4.3	---	0.56	6.8	127
7/21/01	2	97	9.7	0.10	0.77	5.2	---	0.67	8.0	118
7/21/01	3	97	9.5	0.15	0.92	5.4	---	4.88	5.3	144
7/21/01	4	98	10.4	0.15	0.86	6.7	---	2.19	---	99
7/21/01	5	86	6.4	0.08	0.76	4.9	---	0.33	6.2	106
7/21/01	6	93	7.8	0.06	0.37	12.0	---	0.38	6.8	122
7/24/02	1	103	10.8	0.02	0.22	3.7	---	0.12	1.4	144
7/24/02	2	97	10.4	0.07	1.20	5.5	---	1.66	3.3	172
7/24/02	3	100	11.2	0.13	1.06	6.1	---	3.40	5.0	138
7/24/02	4	90	7.9	0.23	1.29	7.1	---	4.08	5.2	168
7/24/02	5	90	9.2	0.08	1.15	5.2	---	1.39	6.2	150
7/24/02	6	100	9.3	0.04	0.84	3.2	---	0.33	5.4	152
7/23/03	1	106	10.7	0.06	0.46	2.8	---	0.34	6.3	134
7/23/03	2	89	6.8	0.10	1.01	4.0	---	0.82	6.0	131
7/23/03	3	112	17.4	0.16	1.35	4.4	---	1.85	5.7	108
7/23/03	4	95	11.6	0.19	0.69	5.6	---	1.30	3.6	136
7/23/03	5	91	9.5	0.05	0.72	4.4	---	0.56	4.9	131
7/23/03	6	84	8.4	0.12	0.76	3.9	---	0.78	4.7	125
7/21/04	1	84	5.5	0.10	0.96	3.2	---	1.19	5.4	169
7/21/04	2	96	8.5	0.10	1.24	3.8	---	0.67	5.9	138
7/21/04	3	105	14.1	0.10	2.02	4.0	---	1.76	5.8	125
7/21/04	4	85	5.8	0.04	0.47	3.7	---	0.93	4.8	175
7/21/04	5	81	6.4	0.09	2.34	4.3	---	1.44	8.2	140
7/21/04	6	86	10.4	0.11	0.83	5.5	---	0.97	5.8	161
7/23/05	1	97	11.1	0.06	0.70	10.4	---	0.29	6.4	104
7/23/05	2	113	16.8	0.10	0.63	4.7	---	0.97	6.1	122
7/23/05	3	115	18.8	0.07	0.52	6.3	---	0.53	5.8	109
7/23/05	4	117	20.5	0.19	0.79	9.9	---	1.07	6.7	117
7/23/05	5	101	11.7	0.07	1.44	5.2	---	1.00	8.1	130
7/23/05	6	107	13.7	0.10	1.29	4.6	---	0.46	8.0	134
7/21/06	1	99	12.9	0.12	0.74	4.0	---	0.32	6.3	120
7/21/06	2	96	11.6	0.12	0.76	7.7	---	1.32	6.8	157
7/21/06	3	94	10.9	0.18	1.59	10.3	---	2.48	4.9	160
7/21/06	4	100	10.9	0.11	1.34	8.5	---	1.46	5.2	142
7/21/06	5	97	11.7	0.14	0.88	4.6	---	0.96	5.2	107
7/21/06	6	117	20.8	0.24	1.29	4.3	---	2.92	5.9	130
7/20/07	1	98	12.4	0.11	0.91	2.7	---	1.10	7.8	106
7/20/07	2	89	8.9	0.12	1.72	3.3	---	1.80	5.6	136
7/20/07	3	114	14.1	0.15	2.76	3.4	---	1.28	8.7	122
7/20/07	4	81	7.1	0.14	1.90	4.2	---	2.03	7.0	114
7/20/07	5	114	14.6	0.88	3.63	3.9	---	1.56	10.9	131
7/20/07	6	93	10.6	0.14	1.50	20.3	---	3.80	9.4	107

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Appendix D3.–Page 2 of 2.

Sample Date	Sample Number	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)
7/23/08	1	103	12.9	0.224	1.99	4.2	---	3.47	7.66	169.0
7/23/08	2	108	14.8	0.095	0.96	3.2	---	0.86	5.82	143.0
7/23/08	3	88	8.9	0.076	0.93	3.3	---	0.75	4.41	186.0
7/23/08	4	86	9.3	0.220	1.91	5.7	---	4.06	5.71	119.0
7/23/08	5	92	9.6	0.073	1.01	2.7	---	0.61	5.20	125.0
7/23/08	6	90	8.7	0.033	0.54	2.2	---	0.43	4.80	108.0
7/22/09	1	83	6.9	0.04	0.29	1.7	---	0.24	5.4	127
7/22/09	2	91	8.6	0.06	0.55	2.1	---	0.16	5.1	137
7/22/09	3	91	8.5	0.11	0.36	2.0	---	0.23	7.5	138
7/22/09	4	98	10.3	0.09	0.81	3.4	---	0.38	5.8	147
7/22/09	5	91	8.6	0.03	0.47	2.2	---	0.40	4.5	125
7/22/09	6	90	7.8	0.06	0.60	2.2	---	0.38	5.6	129
7/20/10	1	87	7.4	0.293	1.61	5.4	0.43	3.92	6.4	151
7/20/10	2	94	10.9	0.124	0.82	2.5	0.58	0.24	5.7	174
7/20/10	3	90	8.5	0.084	0.73	2.9	0.35	0.29	5.3	125
7/20/10	4	90	8.2	0.059	0.60	2.3	0.27	0.33	4.7	151
7/20/10	5	108	13.5	0.081	0.66	2.6	0.54	0.25	3.2	118
7/20/10	6	105	11.6	0.076	0.75	3.1	0.27	0.23	3.9	150
7/21/11	1-6	85-115	---	0.090	0.80	3.4	---	0.32	6.7	146
7/26/12	1	89	7.3	<0.02	0.33	18.4	0.429	0.18	4.3	123
7/26/12	2	122	16.5	0.03	0.60	8.4	0.257	0.54	4.8	126
7/26/12	3	74,75	8.1	0.05	0.76	42.4	0.217	1.65	4.9	140
7/26/12	4	105	11.7	0.13	0.57	22.6	0.241	0.74	7.5	128
7/26/12	5	98	9.9	0.07	0.95	203	0.235	1.90	5.5	115
7/26/12	6	86,112	20.2	0.06	0.53	8.5	0.278	0.67	5.3	116
7/23/13	1	90	10.1	0.72	6.36	7.5	0.418	5.93	9.7	179
7/23/13	2	92	10.4	0.27	1.57	3.8	0.329	1.60	6.9	122
7/23/13	3	85	7.8	0.19	2.41	5.8	0.297	3.90	8.6	153
7/23/13	4	82,52	8.0	0.05	0.59	3.3	0.439	0.35	5.0	152
7/23/13	5	82	6.6	0.48	4.67	8.9	0.332	4.87	9.6	181
7/23/13	6	81	5.5	0.13	2.14	4.6	0.289	1.64	5.6	166
7/23/14	1	105	13.1	0.16	0.82	2.7	0.186	0.16	7.1	145
7/23/14	2	105	11.5	0.02	0.69	2.3	0.188	0.18	5.1	140
7/23/14	3	104	9.1	0.09	0.69	2.6	0.247	0.22	7.2	116
7/23/14	4	94	8.4	0.06	1.16	2.4	0.264	0.33	6.7	156
7/23/14	5	95	8.3	0.12	0.54	2.8	0.215	0.55	6.2	135
7/23/14	6	105	11.4	0.04	0.30	2.6	0.228	0.19	5.3	117

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November 21, 2014

Analytical Report for Service Request No: K1410689

Kate Kanouse
Alaska Department of Fish and Game
Division of Habitat/ Billy Ray Center
1008 F Street
P.O. Box 110024
Juneau, AK 99801

RE: Hecla Greens Creek Biomonitoring

Dear Kate:

Enclosed are the results of the sample(s) submitted to our laboratory on October 1, 2014. For your reference, these analyses have been assigned our service request number **K1410689**.

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 Environmental 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 3363. You may also contact me via email at Lisa.Domenighini@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

Lisa A Domenighini

Lisa Domenighini
Project Manager

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 DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	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	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
ISO 17025	http://www.pjlabs.com/	L14-50
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	03016
Maine DHS	Not available	WA01276
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	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/envserv/	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
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
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.

ALS ENVIRONMENTAL

Client:	Alaska Department of Fish and Game	**Service Request No.:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Sample Matrix:	Animal Tissue		

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 II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), and Matrix/Duplicate Matrix Spike (MS/DMS).

Sample Receipt

Eighteen animal tissue samples were received for analysis at ALS Environmental on 10/01/14. 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.

Total Metals

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of Zinc for sample Site 54 sample #1 were not applicable. The analyzed concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for the replicate analysis of Lead in sample Site 54 sample #1 was outside the Method control limits. The variability in the results was attributed to the heterogeneous distribution of Lead in the sample. Freeze drying, grinding in combination with standard mixing techniques were used, but were not sufficient for complete homogenization of this sample.

No other anomalies associated with the analysis of these samples were observed.

Approved by_ Lisa A Domenighini

CHAIN OF CUSTODY

ALS Environmental

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# _____ PAGE _____ OF _____ COC# _____

PROJECT NAME: Herla Greens Creek Bycatch
PROJECT NUMBER:
PROJECT MANAGER: Kate Kanouse
COMPANY NAME: Alaska Dept. of Fish and Game
ADDRESS: 1255 F Street
CITY/STATE/ZIP: Juneau / AK / 99801
E-MAIL ADDRESS: bbell@numbidt.edu
PHONE #: 907-465-6160 FAX #:
SAMPLER'S SIGNATURE: Benjamin Brewster

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐ Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics 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) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, 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☐			REMARKS
See attached list of					18							X											
Juvenile fish whole																							
Baly samples																							

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

P.O. # HGMC Chum
Bill To: Wallace P.O. Box 32199 Juneau, AK 99803

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 day
X Standard (15 working days)
___ Provide FAX Results

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:

Dry Weight basis. Report % solids
Send eDD to Kate Kanouse, ADFG Habitat
Kate.Kanouse@alaska.gov.

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

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Signature: Benjamin Brewster	Date/Time: 9/30/14 0730	Signature: Kaylie Smith	Date/Time: 10/1/14 1000	Signature:	Date/Time:	Signature:	Date/Time:
Printed Name: Benjamin Brewster	Firm: ADFG	Printed Name: Kaylie Smith	Firm: ALS	Printed Name:	Firm:	Printed Name:	Firm:

Greens Creek Biomonitoring 2014
Juvenile Fish for Whole Body Metals
Basis, all samples: Dry Weight, Report %Solids
Requested Analysis: Ag,Cd,Cu,Hg,Pb,Se,Zn

K1410689

Matrix	Collector	Date Collected	Sample Number	Sample Location	Analysis Requested	FK Length (mm)	Weight (g)
Whole Body	ADF&G	7/25/2014	Greens Creek Site 48 sample #1	Greens Creek Site 48	Ag,Cd,Cu,Hg,Pb,Se,Zn	110	13
Whole Body	ADF&G	7/25/2014	Greens Creek Site 48 sample #2	Greens Creek Site 48	Ag,Cd,Cu,Hg,Pb,Se,Zn	100	10.5
Whole Body	ADF&G	7/25/2014	Greens Creek Site 48 sample #3	Greens Creek Site 48	Ag,Cd,Cu,Hg,Pb,Se,Zn	106	10.7
Whole Body	ADF&G	7/25/2014	Greens Creek Site 48 sample #4	Greens Creek Site 48	Ag,Cd,Cu,Hg,Pb,Se,Zn	105	11.3
Whole Body	ADF&G	7/25/2014	Greens Creek Site 48 sample #5	Greens Creek Site 48	Ag,Cd,Cu,Hg,Pb,Se,Zn	100	10.4
Whole Body	ADF&G	7/25/2014	Greens Creek Site 48 sample #6	Greens Creek Site 48	Ag,Cd,Cu,Hg,Pb,Se,Zn	120	14.8
Whole Body	ADF&G	7/24/2014	Greens Creek Site 54 sample #1	Greens Creek Site 54	Ag,Cd,Cu,Hg,Pb,Se,Zn	125	21.2
Whole Body	ADF&G	7/24/2014	Greens Creek Site 54 sample #2	Greens Creek Site 54	Ag,Cd,Cu,Hg,Pb,Se,Zn	104	10.8
Whole Body	ADF&G	7/24/2014	Greens Creek Site 54 sample #3	Greens Creek Site 54	Ag,Cd,Cu,Hg,Pb,Se,Zn	110	11.5
Whole Body	ADF&G	7/24/2014	Greens Creek Site 54 sample #4	Greens Creek Site 54	Ag,Cd,Cu,Hg,Pb,Se,Zn	110	14.9
Whole Body	ADF&G	7/24/2014	Greens Creek Site 54 sample #5	Greens Creek Site 54	Ag,Cd,Cu,Hg,Pb,Se,Zn	104	10.5
Whole Body	ADF&G	7/24/2014	Greens Creek Site 54 sample #6	Greens Creek Site 54	Ag,Cd,Cu,Hg,Pb,Se,Zn	135	24.1
Whole Body	ADF&G	7/23/2014	Tributary Creek Site 9 sample #1	Tributary Creek Site 9	Ag,Cd,Cu,Hg,Pb,Se,Zn	105	13.1
Whole Body	ADF&G	7/23/2014	Tributary Creek Site 9 sample #2	Tributary Creek Site 9	Ag,Cd,Cu,Hg,Pb,Se,Zn	105	11.5
Whole Body	ADF&G	7/23/2014	Tributary Creek Site 9 sample #3	Tributary Creek Site 9	Ag,Cd,Cu,Hg,Pb,Se,Zn	104	9.1
Whole Body	ADF&G	7/23/2014	Tributary Creek Site 9 sample #4	Tributary Creek Site 9	Ag,Cd,Cu,Hg,Pb,Se,Zn	94	8.4
Whole Body	ADF&G	7/23/2014	Tributary Creek Site 9 sample #5	Tributary Creek Site 9	Ag,Cd,Cu,Hg,Pb,Se,Zn	95	8.5
Whole Body	ADF&G	7/23/2014	Tributary Creek Site 9 sample #6	Tributary Creek Site 9	Ag,Cd,Cu,Hg,Pb,Se,Zn	105	11.4

PC Lisa

Cooler Receipt and Preservation Form

Client / Project: Hecla Greens Creek Service Request *K14* 10689

Received: 10/1/14 Opened: 10/1/14 By: KD Unloaded: 10/1/14 By: KD

1. Samples were received via? *Mail* *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, Side
   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
-.2	-.4	—	—	-.2	342		8065 0227 7908	

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. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
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: _____

Page ____ *of* ____

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	07/23/14 - 07/25/14
Sample Matrix:	Animal Tissue	**Date Received:**	10/1/14
Analysis Method:	Freeze Dry	**Units:**	Percent
Prep Method:	None	**Basis:**	Wet

Total Solids

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
Site 48 sample #1	K1410689-001	**22.9**	-	1	10/23/14 13:15	
Site 48 sample #2	K1410689-002	**22.2**	-	1	10/23/14 13:15	
Site 48 sample #3	K1410689-003	**23.5**	-	1	10/23/14 13:15	
Site 48 sample #4	K1410689-004	**22.3**	-	1	10/23/14 13:15	
Site 48 sample #5	K1410689-005	**23.0**	-	1	10/23/14 13:15	
Site 48 sample #6	K1410689-006	**21.9**	-	1	10/23/14 13:15	
Site 54 sample #1	K1410689-007	**29.8**	-	1	10/23/14 13:15	
Site 54 sample #2	K1410689-008	**23.2**	-	1	10/23/14 13:15	
Site 54 sample #3	K1410689-009	**21.2**	-	1	10/23/14 13:15	
Site 54 sample #4	K1410689-010	**21.3**	-	1	10/23/14 13:15	
Site 54 sample #5	K1410689-011	**23.3**	-	1	10/23/14 13:15	
Site 54 sample #6	K1410689-012	**22.3**	-	1	11/03/14 16:05	
Site 9 sample #1	K1410689-013	**23.1**	-	1	10/23/14 13:15	
Site 9 sample #2	K1410689-014	**23.4**	-	1	10/23/14 13:15	
Site 9 sample #3	K1410689-015	**22.5**	-	1	10/23/14 13:15	
Site 9 sample #4	K1410689-016	**23.8**	-	1	10/23/14 13:15	
Site 9 sample #5	K1410689-017	**25.7**	-	1	10/23/14 13:15	
Site 9 sample #6	K1410689-018	**25.6**	-	1	10/23/14 13:15	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project	Hecla Greens Creek Biomonitoring	**Date Collected:**	07/24/14
Sample Matrix:	Animal Tissue	**Date Received:**	10/01/14
		Date Analyzed:	11/03/14

Replicate Sample Summary
Inorganic Parameters

Sample Name:	Site 54 sample #6	**Units:**	Percent
Lab Code:	K1410689-012	**Basis:**	Wet

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1410689-012DUP Result	Average	RPD	RPD Limit
Total Solids	Freeze Dry	-	22.3	22.2	22.3	<1	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
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	07/23-07/25/14
Sample Matrix:	Animal tissue	**Date Received:**	10/01/14

Mercury, Total

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

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
Site 48 sample #1	K1410689-001	9.7	0.6	10	10/30/14	11/02/14	146	
Site 48 sample #2	K1410689-002	9.6	0.6	10	10/30/14	11/02/14	148	
Site 48 sample #3	K1410689-003	9.8	0.6	10	10/30/14	11/02/14	199	
Site 48 sample #4	K1410689-004	9.9	0.6	10	10/30/14	11/02/14	122	
Site 48 sample #5	K1410689-005	9.8	0.6	10	10/30/14	11/02/14	134	
Site 48 sample #6	K1410689-006	9.5	0.6	10	10/30/14	11/02/14	260	
Site 54 sample #1	K1410689-007	9.7	0.6	10	10/30/14	11/02/14	121	
Site 54 sample #2	K1410689-008	10.0	0.6	10	10/30/14	11/02/14	111	
Site 54 sample #3	K1410689-009	9.9	0.6	10	10/30/14	11/02/14	119	
Site 54 sample #4	K1410689-010	10.0	0.6	10	10/30/14	11/02/14	113	
Site 54 sample #5	K1410689-011	9.4	0.6	10	10/30/14	11/02/14	106	
Site 54 sample #6	K1410689-012	9.5	0.6	10	10/30/14	11/02/14	160	
Site 9 sample #1	K1410689-013	9.9	0.6	10	10/30/14	11/02/14	186	
Site 9 sample #2	K1410689-014	9.2	0.6	10	10/30/14	11/02/14	188	
Site 9 sample #3	K1410689-015	9.4	0.6	10	10/30/14	11/02/14	247	
Site 9 sample #4	K1410689-016	9.7	0.6	10	10/30/14	11/02/14	264	
Site 9 sample #5	K1410689-017	10.0	0.6	10	10/30/14	11/02/14	215	
Site 9 sample #6	K1410689-018	9.5	0.6	10	10/30/14	11/02/14	228	
Method Blank 1	K1410689-MB1	1.0	0.06	1	10/30/14	11/02/14	0.07	J
Method Blank 2	K1410689-MB2	1.0	0.06	1	10/30/14	11/02/14	0.09	J
Method Blank 3	K1410689-MB3	1.0	0.06	1	10/30/14	11/02/14	0.18	J

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	07/24/14
Sample Matrix:	Animal tissue	**Date Received:**	10/01/14
		Date Extracted:	10/30/14
		Date Analyzed:	11/02/14

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	Site 54 sample #1	Units:	ng/g
Lab Code:	K1410689-007MS, K1410689-007MSD	Basis:	Dry
Test Notes:			

				Spike Level		Sample	Spike Result		Percent Recovery		ALS Acceptance	Relative Percent	
Analyte	**Prep Method**	**Analysis Method**	**MRL**	**MS**	**DMS**	**Result**	**MS**	**DMS**	**MS**	**DMS**	**Limits**	**Difference**	**Result Notes**
Mercury	METHOD	1631E	9.9	245	248	121	341	368	90	100	70-130	10	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	NA
Sample Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	10/30/14
		Date Analyzed:	11/02/14

Matrix Spike/Duplicate Matrix Spike Summary
Total Metals

Sample Name:	Batch QC	Units:	ng/g
Lab Code:	K1410322-002MS, K1410322-002MSD	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	9.7	247	243	751	968	977	88	93	70-130	6	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	11/02/14

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	4.71	94	70-130	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Water	**Date Received:**	NA
		Date Extracted:	NA
		Date Analyzed:	11/02/14

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	4.42	88	70-130	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Animal tissue	**Date Received:**	NA
		Date Extracted:	10/30/14
		Date Analyzed:	11/02/14

Quality Control Sample (QCS) Summary
Total Metals

Sample Name:	Quality Control Sample	Units:	ng/g
Lab Code:		Basis:	Dry
Test Notes:			

Source: TORT-3

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	ALS Percent Recovery Acceptance Limits	Result Notes
Mercury	METHOD	1631E	292	263	90	70-130	

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/25/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 48 sample #1** **Lab Code:** **K1410689-001**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.55		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.5		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.11		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	5.3		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.04		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	234		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/25/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 48 sample #2** **Lab Code:** **K1410689-002**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.93		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.2		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.19		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	6.9		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	213		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/25/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 48 sample #3** **Lab Code:** **K1410689-003**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	1.22		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.8		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.38		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	5.7		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	232		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/25/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: Site 48 sample #4 **Lab Code:** K1410689-004

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	1.45		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.2		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.44		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	6.1		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	193		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/25/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 48 sample #5** **Lab Code:** **K1410689-005**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.92		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.5		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.06		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	4.9		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	237		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/25/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 48 sample #6** **Lab Code:** **K1410689-006**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.75		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	5.5		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.18		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	5.9		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.04		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	305		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/24/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 54 sample #1** **Lab Code:** **K1410689-007**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.93		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	13.2		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	2.33		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	5.3		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.08		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	204		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/24/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 54 sample #2** **Lab Code:** **K1410689-008**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	1.15		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.5		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.37		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	4.8		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.04		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	247		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/24/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 54 sample #3** **Lab Code:** **K1410689-009**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.85		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.3		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.30		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	6.2		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.21		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	291		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/24/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 54 sample #4** **Lab Code:** **K1410689-010**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.69		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.8		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.25		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	5.9		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	248		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/24/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 54 sample #5** **Lab Code:** **K1410689-011**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	1.03		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	5.0		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.28		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	5.7		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	250		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/24/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 54 sample #6** **Lab Code:** **K1410689-012**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.86		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	4.4		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.49		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	6.6		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	243		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/23/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 9 sample #1** **Lab Code:** **K1410689-013**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.82		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	2.7		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.16		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	7.1		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.16		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	145		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/23/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 9 sample #2** **Lab Code:** **K1410689-014**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.69		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	2.3		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.18		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	5.1		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	140		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/23/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 9 sample #3** **Lab Code:** **K1410689-015**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.69		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	2.6		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.22		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	7.2		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.09		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	116		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/23/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 9 sample #4** **Lab Code:** **K1410689-016**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	1.16		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	2.4		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.33		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	6.7		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.06		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	156		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/23/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 9 sample #5** **Lab Code:** **K1410689-017**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.54		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	2.8		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.55		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	6.2		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.12		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	135		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Alaska Department of Fish and Ga	**Service Request:**	K1410689
Project No.:	NA	**Date Collected:**	07/23/14
Project Name:	Hecla Greens Creek Biomonitoring	**Date Received:**	10/01/14
Matrix:	TISSUE	**Units:**	mg/Kg
		Basis:	DRY

Sample Name: **Site 9 sample #6** **Lab Code:** **K1410689-018**

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.30		
Copper	200.8	0.1	5.0	11/05/14	11/19/14	2.6		
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.19		*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	5.3		
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.04		
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	117		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Alaska Department of Fish and Ga
Service Request: K1410689
Project No.: NA
Date Collected:
Project Name: Hecla Greens Creek Biomonitoring
Date Received:
Matrix: TISSUE
Units: mg/Kg
Basis: DRY

Sample Name: Method Blank
Lab Code: K1410689-MB

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Cadmium	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	
Copper	200.8	0.1	5.0	11/05/14	11/19/14	0.1	U	
Lead	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	*
Selenium	200.8	1.0	5.0	11/05/14	11/19/14	1.0	U	
Silver	200.8	0.02	5.0	11/05/14	11/19/14	0.02	U	
Zinc	200.8	0.5	5.0	11/05/14	11/19/14	0.5	U	

Comments:

Metals
- 5A -
SPIKE SAMPLE RECOVERY

Client: Alaska Department of Fish and Ga **Service Request:** K1410689

Project No.: NA **Units:** MG/KG

Project Name: Hecla Greens Creek Biomonitoring **Basis:** DRY

Matrix: TISSUE

Sample Name: Site 54 sample #1S **Lab Code:** K1410689-007S

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Cadmium	70 - 130	6.09		0.93		4.87	106.0		200.8
Copper	70 - 130	37.6		13.2		24.4	100.0		200.8
Lead	70 - 130	44.23		2.33		48.70	86.0		200.8
Selenium	70 - 130	22.5		5.3		24.4	70.5		200.8
Silver	70 - 130	4.74		0.08		4.87	95.7		200.8
Zinc		258.3		203.9		48.7	111.7		200.8

An empty field in the Control Limit column indicates the control limit is not applicable

Metals

- 6 -

DUPLICATES

Client: Alaska Department of Fish and Ga **Service Request:** K1410689

Project No.: NA **Units:** MG/KG

Project Name: Hecla Greens Creek Biomonitoring **Basis:** DRY

Matrix: TISSUE

Sample Name: Site 54 sample #1D **Lab Code:** K1410689-007D

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Cadmium	30	0.93		0.93		0.0		200.8
Copper	30	13.2		12.2		7.9		200.8
Lead	30	2.33		0.77		100.6	*	200.8
Selenium	30	5.3		6.1		14.0		200.8
Silver		0.08		0.02		120.0		200.8
Zinc	30	203.9		220.2		7.7		200.8

An empty field in the Control Limit column indicates the control limit is not applicable.

Metals

- 7 -

LABORATORY CONTROL SAMPLE

Client: Alaska Department of Fish and Ga **Service Request:** K1410689

Project No.: NA

Project Name: Hecla Greens Creek Biomonitoring

Aqueous LCS Source: **ALS MIXED** **Solid LCS Source:**

Analyte	Aqueous (ug/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Cadmium	50.0	50.1	100.2					
Copper	250.0	267.2	106.9					
Lead	500.0	503.8	100.8					
Selenium	167.0	156.8	93.9					
Silver	50.0	51.9	103.8					
Zinc	500.0	546.5	109.3					

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	11/05/14
		Date Analyzed:	11/19/14

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	K1410689-SRM1	Basis:	Dry
Test Notes:	Dorm-4 Solids = 94.5%		

Source: N.R.C.C. Dorm-4

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	Control Limits	Result Notes
Cadmium	PSEP Tissue	200.8	0.306	0.314	103	0.233 - 0.385	
Copper	PSEP Tissue	200.8	15.9	16.2	102	12.0 - 20.2	
Lead	PSEP Tissue	200.8	0.416	0.299	72	0.290 - 0.563	
Selenium	PSEP Tissue	200.8	3.56	4.22	119	2.58 - 4.68	
Zinc	PSEP Tissue	200.8	52.20	60.17	115	39.2 - 66.5	

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

Client:	Alaska Department of Fish and Game	**Service Request:**	K1410689
Project:	Hecla Greens Creek Biomonitoring	**Date Collected:**	NA
LCS Matrix:	Tissue	**Date Received:**	NA
		Date Extracted:	11/05/14
		Date Analyzed:	11/19/14

Standard Reference Material Summary
Total Metals

Sample Name:	Standard Reference Material	Units:	mg/Kg (ppm)
Lab Code:	K1410689-SRM2	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	41.2	97	32.4-52.9	
Copper	PSEP Tissue	200.8	497	472	95	380-623	
Lead	PSEP Tissue	200.8	0.225	0.195	87	0.166 - 0.292	
Selenium	PSEP Tissue	200.8	10.90	10.57	97	7.9 - 14.3	
Zinc	PSEP Tissue	200.8	136	145	107	104 - 170	

APPENDIX E: SEDIMENT METALS CONCENTRATIONS LABORATORY REPORT

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

August 26, 2014 Analytical Report for Service Request No: K1407853

Kate Kanouse
Alaska Department of Fish and Game
Division of Habitat/ Billy Ray Center
1008 F Street
P.O. Box 110024
Juneau, AK 99801

RE: Bio Monitoring Seds

Dear Kate:

Enclosed are the results of the samples submitted to our laboratory on July 30, 2014. For your reference, these analyses have been assigned our service request number K1407853.

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 call if you have any questions. My extension is 3363. You may also contact me via Email at Lisa.Domenighini@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

Lisa Domenighini
Project Manager

LD/aj

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 DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	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	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
ISO 17025	http://www.pjlabs.com/	L14-50
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	03016
Maine DHS	Not available	WA01276
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	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/envserv/	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
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
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.

ALS ENVIRONMENTAL

Client:	Alaska Department of Fish and Game	**Service Request No.:**	K1407853
Project:	Bio Monitoring Seds	**Date Received:**	07/30/14
Sample Matrix:	Sediment		

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 II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), and Matrix/Duplicate Matrix Spike (MS/DMS).

Sample Receipt

Five sediment samples were received for analysis at ALS Environmental on 07/30/14. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

No anomalies associated with the analysis of these samples were observed.

Total Metals

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of Zinc for sample Gallagher Cr. were not applicable. The analyte concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

No other anomalies associated with the analysis of these samples were observed.

Approved by____ Lisa A Domenighini

ALS Environmental

CHAIN OF CUSTODY
51118

001

SR# K1407853

COC Set____of____

COC#_____

1317 South 13th Ave, Kelso, WA 98626 Phone (360) 577-7222 / 800-695-7222 / FAX (360) 636-1068
www.alsglobal.com

Project Name: Bio Monitoring Seds	Project Number:
Project Manager	
Company: Hecla Greens Creek Mining Co	
Address: 3000 Vintage Blvd, Juneau, AK 99801	
Phone #: 790-8472	email: Tmorales@hecla-mining.com
Sampler Signature: Ted Morales	Sampler Printed Name: T. Morales

CLIENT SAMPLE ID	LABID	SAMPLING Date	SAMPLING Time	Matrix	NUMBER OF CONTAINERS	14D: 821/R-91-100 / Sulfide AVS	14D: PSEP TOC / PSEP TOC T	28D: 7471B / Hg	180D: 200.8 / Metals T	180D: ASTM D422 / Part Size	999D: TS-MET / Total Solids	1	2	3	4	5	Remarks
1. Gallagher Cr.		07-24-14			3	X	X	X	X	X	X						
2.																	
3. Bruin Cr.		07-24-14			3	X	X	X	X	X	X						
4.																	
5. Cub Cr.		07-25-14			3	X	X	X	X	X	X						
6.																	
7. 1350 Cr.		07-25-14			3	X	X	X	X	X	X						
8.																	
9. Big Sore Cr.		07-25-14			3	X	X	X	X	X	X						
10.																	

Report Requirements

___ I. Routine Report: Method Blank, Surrogate, as required

___ II. Report Dup., MS, MSD as required

___ III. CLP Like Summary (no raw data)

___ IV. Data Validation Report

X V. EDD

Invoice Information

P.O.#_____

Bill To:_____

_____

_____

Turnaround Requirements

___ 24 hr. ___ 48 hr.

___ 5 Day

X Standard

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

Special Instructions/Comments:

*Indicate State Hydrocarbon Procedure: AK CA WI Northwest Other____(Circle One)

Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature: T. Morales	Signature:	Signature	Signature	Signature	Signature
Printed Name: T. Morales	Printed Name: ALS	Printed Name	Printed Name	Printed Name	Printed Name
Firm: HGCMC	Firm: 7/30/14 0930	Firm	Firm	Firm	Firm
Date/Time: 07-29-14 1840	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

PC LISA

Cooler Receipt and Preservation Form

Client / Project: Hocla Service Request K14 7853

Received: 7/30/14 Opened: 7/30/14 By: [illegible] Unloaded: 7/30/14 By: [illegible]

1. Samples were received via? *Mail* *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? _____

   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
1.9	1.8	3.9	3.8	-0.1	316			X

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. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N
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: _____

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	07/24/14 - 07/25/14
Sample Matrix:	Sediment	**Date Received:**	07/30/14
Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry
Pre-Prep Method:	821/R-91-100		
Pre-Prep Date:	08/6/14		

Sulfide, Acid-Volatile

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Date Extracted	Q
Gallagher Cr.	K1407853-001	ND U	0.032	1	08/06/14 20:33	8/6/14	
Bruin Cr.	K1407853-002	ND U	0.029	1	08/06/14 20:33	8/6/14	
Cub Cr.	K1407853-003	ND U	0.031	1	08/06/14 20:33	8/6/14	
1350 Cr.	K1407853-004	ND U	0.031	1	08/06/14 20:33	8/6/14	
Big Sore Cr.	K1407853-005	ND U	0.026	1	08/06/14 20:33	8/6/14	
Method Blank	K1407853-MB	ND U	0.016	1	08/06/14 20:33	8/6/14	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project	Bio Monitoring Seds	**Date Collected:**	07/24/14
Sample Matrix:	Sediment	**Date Received:**	07/30/14
		Date Analyzed:	08/06/14

Replicate Sample Summary

General Chemistry Parameters

Sample Name:	Gallagher Cr.	**Units:**	uMole/g
Lab Code:	K1407853-001	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1407853-001DUP Result	Average	RPD	RPD Limit
Sulfide, Acid-Volatile	821/R-91-100	0.18	ND	ND	NC	NC	45

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:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	07/24/14
Sample Matrix:	Sediment	**Date Received:**	07/30/14
		Date Analyzed:	08/6/14
		Date Extracted:	08/6/14

Duplicate Matrix Spike Summary
Sulfide, Acid-Volatile

Sample Name:	Gallagher Cr.	**Units:**	uMole/g
Lab Code:	K1407853-001	**Basis:**	Dry
Analysis Method:	821/R-91-100		
Prep Method:	Method		

		Matrix Spike			Duplicate Matrix Spike					
		K1407853-001MS			K1407853-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfide, Acid-Volatile	ND U	21.2	22.6	94	20.4	21.9	93	56-142	4	45

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.

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Analyzed:**	08/06/14
Sample Matrix:	Sediment	**Date Extracted:**	08/06/14

Lab Control Sample Summary
Sulfide, Acid-Volatile

Analysis Method:	821/R-91-100	**Units:**	uMole/g
Prep Method:	Method	**Basis:**	Dry
		Analysis Lot:	405415

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1407853-LCS	0.200	0.221	90	60-115

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	7/24/2014
Sample Matrix:	Sediment	**Date Received:**	7/30/2014
		Date Analyzed:	8/8/2014

Particle Size Determination
ASTM D422

Sample Name: Gallagher Cr.
Lab Code: K1407853-001

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	99.98
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	99.98
Gravel, Medium	**No.4 (4.75 mm)**	0.0000	99.98
Gravel, Fine	**No.10 (2.00 mm)**	0.5612	99.26
Sand, Very Coarse	**No.20 (0.850 mm)**	11.8553	84.13
Sand, Coarse	**No.40 (0.425 mm)**	14.3185	65.85
Sand, Medium	**No.60 (0.250 mm)**	12.7644	49.55
Sand, Fine	**No.140 (0.106 mm)**	15.3818	29.91
Sand, Very Fine	**No.200 (0.0750 mm)**	2.5482	26.66

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	25.85
0.005 mm	2.23
0.001 mm	0.00

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	7/24/2014
Sample Matrix:	Sediment	**Date Received:**	7/30/2014
		Date Analyzed:	8/11/2014

Particle Size Determination
ASTM D422

Sample Name: Bruin Cr.
Lab Code: K1407853-002

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	100.00
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	100.00
Gravel, Medium	**No.4 (4.75 mm)**	0.0000	100.00
Gravel, Fine	**No.10 (2.00 mm)**	0.0690	99.91
Sand, Very Coarse	**No.20 (0.850 mm)**	10.8079	85.04
Sand, Coarse	**No.40 (0.425 mm)**	22.2256	54.48
Sand, Medium	**No.60 (0.250 mm)**	10.6336	39.86
Sand, Fine	**No.140 (0.106 mm)**	10.7710	25.05
Sand, Very Fine	**No.200 (0.0750 mm)**	1.7994	22.58

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	23.92
0.005 mm	6.28
0.001 mm	0.00

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	7/25/2014
Sample Matrix:	Sediment	**Date Received:**	7/30/2014
		Date Analyzed:	8/11/2014

Particle Size Determination
ASTM D422

Sample Name: Cub Cr.
Lab Code: K1407853-003

Gravel and Sand
(Sieve Analysis)

Description		Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)		**No.3/4"(19.0 mm)**	0.0000	100.00
Gravel (9.50 mm)		**No.3/8"(9.50 mm)**	0.0000	100.00
Gravel, Medium		**No.4 (4.75 mm)**	0.0000	100.00
Gravel, Fine		**No.10 (2.00 mm)**	0.0000	100.00
Sand, Very Coarse		**No.20 (0.850 mm)**	3.2993	93.81
Sand, Coarse	#DIV/0!	**No.40 (0.425 mm)**	7.3474	80.03
Sand, Medium	#DIV/0!	**No.60 (0.250 mm)**	4.1741	72.21
Sand, Fine	#DIV/0!	**No.140 (0.106 mm)**	12.9216	47.97
Sand, Very Fine		**No.200 (0.0750 mm)**	5.8252	37.05

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	40.16
0.005 mm	6.89
0.001 mm	0.00

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	7/25/2014
Sample Matrix:	Sediment	**Date Received:**	7/30/2014
		Date Analyzed:	8/11/2014

Particle Size Determination
ASTM D422

Sample Name: 1350 Cr.
Lab Code: K1407853-004

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	100.00
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	100.00
Gravel, Medium	**No.4 (4.75 mm)**	0.0000	100.00
Gravel, Fine	**No.10 (2.00 mm)**	0.0000	100.00
Sand, Very Coarse	**No.20 (0.850 mm)**	4.1873	90.81
Sand, Coarse	**No.40 (0.425 mm)**	9.9293	69.03
Sand, Medium	**No.60 (0.250 mm)**	5.2557	57.50
Sand, Fine	**No.140 (0.106 mm)**	8.7487	38.30
Sand, Very Fine	**No.200 (0.0750 mm)**	2.3289	33.19

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	34.75
0.005 mm	8.73
0.001 mm	0.00

ALS Group USA, Corp.
dba ALS Environmental
Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	7/25/2014
Sample Matrix:	Sediment	**Date Received:**	7/30/2014
		Date Analyzed:	8/11/2014

Particle Size Determination
ASTM D422

Sample Name: Big Sore Cr.
Lab Code: K1407853-005

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	100.00
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	100.00
Gravel, Medium	**No.4 (4.75 mm)**	0.0000	100.00
Gravel, Fine	**No.10 (2.00 mm)**	0.0353	99.95
Sand, Very Coarse	**No.20 (0.850 mm)**	7.3507	90.01
Sand, Coarse	**No.40 (0.425 mm)**	18.9907	64.31
Sand, Medium	**No.60 (0.250 mm)**	10.9081	49.54
Sand, Fine	**No.140 (0.106 mm)**	18.3464	24.72
Sand, Very Fine	**No.200 (0.0750 mm)**	2.6446	21.14

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	18.46
0.005 mm	4.85
0.001 mm	0.00

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	7/25/2014
Sample Matrix:	Sediment	**Date Received:**	7/30/2014
		Date Analyzed:	8/11/2014

Particle Size Determination
ASTM D422

Sample Name: Big Sore Cr.
Lab Code: K1407853-004 DUP

Gravel and Sand
(Sieve Analysis)

Description	Sieve Size	Weight (g)	Percent Passing
Gravel (19.0 mm)	**No.3/4"(19.0 mm)**	0.0000	100.00
Gravel (9.50 mm)	**No.3/8"(9.50 mm)**	0.0000	100.00
Gravel, Medium	**No.4 (4.75 mm)**	0.0000	100.00
Gravel, Fine	**No.10 (2.00 mm)**	0.0000	100.00
Sand, Very Coarse	**No.20 (0.850 mm)**	4.6185	90.10
Sand, Coarse	**No.40 (0.425 mm)**	10.4870	67.61
Sand, Medium	**No.60 (0.250 mm)**	5.7910	55.20
Sand, Fine	**No.140 (0.106 mm)**	9.3465	35.16
Sand, Very Fine	**No.200 (0.0750 mm)**	3.3696	27.93

Silt and Clay
(Hydrometer Analysis)

Particle Diameter	Percent Passing
0.074 mm	28.18
0.005 mm	9.60
0.001 mm	0.00

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	07/24/14 - 07/25/14
Sample Matrix:	Sediment	**Date Received:**	07/30/14
Analysis Method:	PSEP TOC	**Units:**	Percent
Prep Method:	ALS SOP	**Basis:**	Dry, per Method

Carbon, Total Organic (TOC)

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Date Extracted	Q
Gallagher Cr.	K1407853-001	**1.08**	0.050	1	08/04/14 13:45	8/1/14	
Bruin Cr.	K1407853-002	**0.815**	0.050	1	08/04/14 13:45	8/1/14	
Cub Cr.	K1407853-003	**0.625**	0.050	1	08/04/14 13:45	8/1/14	
1350 Cr.	K1407853-004	**1.11**	0.050	1	08/04/14 13:45	8/1/14	
Big Sore Cr.	K1407853-005	**0.662**	0.050	1	08/04/14 13:45	8/1/14	
Method Blank	K1407853-MB	ND U	0.050	1	08/04/14 13:45	8/1/14	

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	NA
Sample Matrix:	Sediment	**Date Received:**	NA
		Date Analyzed:	8/ 4/14

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	Batch QC	**Units:**	Percent
Lab Code:	K1407714-001	**Basis:**	Dry, per Method

Analyte Name	MRL	Sample Result	Batch QCDUP Duplicate Sample K1407714-001DUP Result	Batch QCTRP Triplicate Sample K1407714-001TRP Result	Average	RSD	RSD Limit
Carbon, Total Organic (TOC)	0.050	0.781	0.816	0.840	0.812	4	27

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	N/A
Sample Matrix:	Sediment	**Date Received:**	N/A
		Date Analyzed:	08/4/14
		Date Extracted:	08/1/14

Duplicate Matrix Spike Summary
Carbon, Total Organic (TOC)

Sample Name:	Batch QC	**Units:**	Percent
Lab Code:	K1407714-001	**Basis:**	Dry, per Method
Analysis Method:	PSEP TOC		
Prep Method:	ALS SOP		

		Matrix Spike K1407714-001MS			Duplicate Matrix Spike K1407714-001DMS				
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Carbon, Total Organic (TOC)	0.781	3.73	3.01	98	3.84	3.12	98	69-123	<1	27

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.

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Analyzed:**	08/04/14
Sample Matrix:	Sediment	**Date Extracted:**	08/01/14

Lab Control Sample Summary
Carbon, Total Organic (TOC)

Analysis Method:	PSEP TOC	**Units:**	Percent
Prep Method:	ALS SOP	**Basis:**	Dry, per Method
		Analysis Lot:	405980

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1407853-LCS	0.261	0.275	95	74-118

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Analytical Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project:	Bio Monitoring Seds	**Date Collected:**	07/24/14 - 07/25/14
Sample Matrix:	Sediment	**Date Received:**	07/30/14
Analysis Method:	160.3 Modified	**Units:**	Percent
Prep Method:	None	**Basis:**	As Received

Solids, Total

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
Gallagher Cr.	K1407853-001	**69.4**	-	1	08/05/14 10:02	
Bruin Cr.	K1407853-002	**72.9**	-	1	08/05/14 10:02	
Cub Cr.	K1407853-003	**70.1**	-	1	08/05/14 10:02	
1350 Cr.	K1407853-004	**71.6**	-	1	08/05/14 10:02	
Big Sore Cr.	K1407853-005	**76.9**	-	1	08/05/14 10:02	

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QA/QC Report

Client:	Alaska Department of Fish and Game	**Service Request:**	K1407853
Project	Bio Monitoring Seds	**Date Collected:**	07/25/14
Sample Matrix:	Sediment	**Date Received:**	07/30/14
		Date Analyzed:	08/05/14

Replicate Sample Summary

General Chemistry Parameters

Sample Name:	Big Sore Cr.	**Units:**	Percent
Lab Code:	K1407853-005	**Basis:**	As Received

Analyte Name	Analysis Method	MRL	Sample Result	Duplicate Sample K1407853-005DUP Result	Average	RPD	RPD Limit
Solids, Total	160.3 Modified	-	76.9	76.5	76.7	<1	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.

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Analytical Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	07/24/14
Project No. :	NA	**Date Received :**	07/30/14
Matrix :	Sediment	**Date Extracted :**	08/07-13/14

Total Metals

Sample Name :	Gallagher Cr.	**Units :**	mg/Kg (ppm)
Lab Code :	K1407853-001	**Basis :**	Dry

Analyte	Analysis Method	MRL	Date Analyzed	Sample Result	Result Notes
Cadmium	200.8	0.01	08/18/14	3.13	
Copper	200.8	0.1	08/18/14	47.1	
Lead	200.8	0.05	08/18/14	92.9	
Mercury	7471B	0.01	08/07/14	0.09	
Selenium	200.8	0.5	08/18/14	6.3	
Silver	200.8	0.01	08/18/14	0.46	
Zinc	200.8	0.2	08/18/14	294	

Comments:

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Analytical Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	07/24/14
Project No. :	NA	**Date Received :**	07/30/14
Matrix :	Sediment	**Date Extracted :**	08/07-13/14

Total Metals

Sample Name :	Bruin Cr.	**Units :**	mg/Kg (ppm)
Lab Code :	K1407853-002	**Basis :**	Dry

Analyte	Analysis Method	MRL	Date Analyzed	Sample Result	Result Notes
Cadmium	200.8	0.009	08/18/14	2.30	
Copper	200.8	0.09	08/18/14	55.7	
Lead	200.8	0.05	08/18/14	30.3	
Mercury	7471B	0.02	08/07/14	0.18	
Selenium	200.8	0.5	08/18/14	3.2	
Silver	200.8	0.009	08/18/14	0.422	
Zinc	200.8	0.2	08/18/14	328	

Comments:

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Analytical Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	07/25/14
Project No. :	NA	**Date Received :**	07/30/14
Matrix :	Sediment	**Date Extracted :**	08/07-13/14

Total Metals

Sample Name :	Cub Cr.	**Units :**	mg/Kg (ppm)
Lab Code :	K1407853-003	**Basis :**	Dry

Analyte	Analysis Method	MRL	Date Analyzed	Sample Result	Result Notes
Cadmium	200.8	0.009	08/18/14	1.39	
Copper	200.8	0.09	08/18/14	87.2	
Lead	200.8	0.05	08/18/14	33.2	
Mercury	7471B	0.008	08/07/14	0.116	
Selenium	200.8	0.5	08/18/14	1.9	
Silver	200.8	0.009	08/18/14	0.342	
Zinc	200.8	0.2	08/18/14	206	

Comments:

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Analytical Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	07/25/14
Project No. :	NA	**Date Received :**	07/30/14
Matrix :	Sediment	**Date Extracted :**	08/07-13/14

Total Metals

Sample Name :	1350 Cr.	**Units :**	mg/Kg (ppm)
Lab Code :	K1407853-004	**Basis :**	Dry

Analyte	Analysis Method	MRL	Date Analyzed	Sample Result	Result Notes
Cadmium	200.8	0.009	08/18/14	5.42	
Copper	200.8	0.09	08/18/14	40.0	
Lead	200.8	0.05	08/18/14	43.1	
Mercury	7471B	0.01	08/07/14	0.05	
Selenium	200.8	0.5	08/18/14	2.1	
Silver	200.8	0.009	08/18/14	0.497	
Zinc	200.8	0.2	08/18/14	581	

Comments:

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Analytical Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	07/25/14
Project No. :	NA	**Date Received :**	07/30/14
Matrix :	Sediment	**Date Extracted :**	08/07-13/14

Total Metals

Sample Name :	Big Sore Cr.	**Units :**	mg/Kg (ppm)
Lab Code :	K1407853-005	**Basis :**	Dry

Analyte	Analysis Method	MRL	Date Analyzed	Sample Result	Result Notes
Cadmium	200.8	0.01	08/18/14	3.49	
Copper	200.8	0.1	08/18/14	61.5	
Lead	200.8	0.07	08/18/14	38.2	
Mercury	7471B	0.02	08/07/14	0.19	
Selenium	200.8	0.7	08/18/14	3.5	
Silver	200.8	0.01	08/18/14	0.59	
Zinc	200.8	0.3	08/18/14	485	

Comments:

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Analytical Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	NA
Project No. :	NA	**Date Received :**	NA
Matrix :	Sediment	**Date Extracted :**	08/07-13/14

Total Metals

Sample Name :	Method Blank	**Units :**	mg/Kg (ppm)
Lab Code :	K1407853-MB	**Basis :**	Dry

Analyte	Analysis Method	MRL	Date Analyzed	Sample Result	Result Notes
Cadmium	200.8	0.02	08/18/14	ND	
Copper	200.8	0.2	08/18/14	ND	
Lead	200.8	0.1	08/18/14	ND	
Mercury	7471B	0.02	08/07/14	ND	
Selenium	200.8	1.0	08/18/14	ND	
Silver	200.8	0.02	08/18/14	ND	
Zinc	200.8	0.5	08/18/14	ND	

Comments:

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QA/QC Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	NA
Project No. :	NA	**Date Received :**	NA
Matrix :	Sediment	**Date Extracted :**	08/07/14
		Date Analyzed :	08/07/14

Duplicate Summary
Total Metals

Sample Name :	Batch QC	**Units :**	mg/Kg (ppm)
Lab Code :	K1408113-001D	**Basis :**	Dry

Analyte	Analysis Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	Result Notes
Mercury	7471B	0.02	0.08	0.08	0.08	<1	

Comments:

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QA/QC Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	NA
Project No. :	NA	**Date Received :**	NA
Matrix :	Sediment	**Date Extracted :**	08/07/14
		Date Analyzed :	08/07/14

Matrix Spike Summary
Total Metals

Sample Name :	Batch QC	**Units :**	mg/Kg (ppm)
Lab Code :	K1408113-001S	**Basis :**	Dry

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits	Result Notes
Mercury	0.02	0.55	0.08	0.59	92	75-125	

Comments:

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QA/QC Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	07/24/14
Project No. :	NA	**Date Received :**	07/30/14
Matrix :	Sediment	**Date Extracted :**	08/13/14
		Date Analyzed :	08/18/14

Duplicate Summary
Total Metals

Sample Name :	Gallagher Cr.	**Units :**	mg/Kg (ppm)
Lab Code :	K1407853-001D	**Basis :**	Dry

Analyte	Analysis Method	MRL	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	Result Notes
Cadmium	200.8	0.01	3.13	3.34	3.23	6	
Copper	200.8	0.1	47.1	42.9	45.0	9	
Lead	200.8	0.05	92.9	108	101	15	
Selenium	200.8	0.5	6.3	7.1	6.7	12	
Silver	200.8	0.01	0.46	0.44	0.45	4	
Zinc	200.8	0.2	294	313	304	6	

Comments:

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QA/QC Report

Client :	Alaska Department of Fish and Game	**Service Request :**	K1407853
Project Name :	Bio Monitoring Seds	**Date Collected :**	07/24/14
Project No. :	NA	**Date Received :**	07/30/14
Matrix :	Sediment	**Date Extracted :**	08/13/14
		Date Analyzed :	08/18/14

Matrix Spike Summary
Total Metals

Sample Name :	Gallagher Cr.	**Units :**	mg/Kg (ppm)
Lab Code :	K1407853-001S	**Basis :**	Dry

Analyte	MRL	Spike Level	Sample Result	Spiked Sample Result	Percent Recovery	CAS Percent Recovery Acceptance Limits	Result Notes
Cadmium	0.01	4.76	3.13	8.0	102	70-130	
Copper	0.1	23.8	47.1	63.7	70	70-130	
Lead	0.05	47.6	92.9	153	126	70-130	
Selenium	0.5	47.6	6.3	54.8	102	70-130	
Silver	0.01	4.76	0.46	5.1	98	70-130	
Zinc	0.2	47.6	294	326	NA	70-130	

Comments: