

Baseline Aquatic Biomonitoring at the Arctic-Bornite Exploratory Mining Prospects, 2025

By
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July 2026

Alaska Department of Fish and Game

Habitat Section



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Weights and measures (metric)		General		Mathematics, statistics	
centimeter	cm	Alaska Administrative Code		all standard mathematical signs, symbols and abbreviations	
deciliter	dL		AAC		
gram	g	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	H _A
hectare	ha			base of natural logarithm	e
kilogram	kg	all commonly accepted		catch per unit effort	CPUE
kilometer	km	professional titles	e.g., Dr., Ph.D., R.N., etc.	coefficient of variation	CV
liter	L			common test statistics	(F, t, χ^2 , etc.)
meter	m	at	@	confidence interval	CI
milliliter	mL	compass directions:		correlation coefficient (multiple)	R
millimeter	mm	east	E	correlation coefficient (simple)	r
Weights and measures (English)		north	N	covariance	cov
cubic feet per second	ft ³ /s	south	S	degree (angular)	°
foot	ft	west	W	degrees of freedom	df
gallon	gal	copyright	©	expected value	E
inch	in	corporate suffixes:		greater than	>
mile	mi	Company	Co.	greater than or equal to	≥
nautical mile	nmi	Corporation	Corp.	harvest per unit effort	HPUE
ounce	oz	Incorporated	Inc.	less than	<
pound	lb	Limited	Ltd.	less than or equal to	≤
quart	qt	District of Columbia	D.C.	logarithm (natural)	ln
yard	yd	et alii (and others)	et al.	logarithm (base 10)	log
Time and temperature		et cetera (and so forth)	etc.	logarithm (specify base)	log ₂ , etc.
day	d	exempli gratia (for example)	e.g.	minute (angular)	'
degrees Celsius	°C	Federal Information Code	FIC	not significant	NS
degrees Fahrenheit	°F	id est (that is)	i.e.	null hypothesis	H ₀
degrees kelvin	K	latitude or longitude	lat or long	percent	%
hour	h	monetary symbols		probability	P
minute	min	(U.S.)	\$, ¢	probability of a type I error (rejection of the null hypothesis when true)	α
second	s	months (tables and figures): first three letters	Jan,...,Dec	probability of a type II error (acceptance of the null hypothesis when false)	β
Physics and chemistry		registered trademark	®	second (angular)	"
all atomic symbols		trademark	™	standard deviation	SD
alternating current	AC	United States (adjective)	U.S.	standard error	SE
ampere	A	United States of America (noun)	USA	variance	
calorie	cal	U.S.C.	United States Code	population sample	Var var
direct current	DC	U.S. state	use two-letter abbreviations (e.g., AK, WA)		
hertz	Hz				
horsepower	hp				
hydrogen ion activity (negative log of)	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

TECHNICAL REPORT NO. 26-09

**BASELINE AQUATIC BIOMONITORING AT THE ARCTIC-BORNITE
EXPLORATORY MINING PROSPECTS, 2025**

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July 2026

Cover: Slimy sculpin eggs on a rock in Lower Subarctic Creek, July 2025. Photograph by Chelsea Clawson.

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This document should be cited as:

Clawson, C. M. 2026. Baseline Aquatic Biomonitoring at the Arctic-Bornite Exploratory Mining Prospects, 2025. Alaska Department of Fish and Game, Technical Report No. 26-09, Fairbanks, Alaska.

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TABLE OF CONTENTS

LIST OF TABLES	ii
LIST OF FIGURES	iii
ACKNOWLEDGEMENTS	v
EXECUTIVE SUMMARY	1
INTRODUCTION	2
Location and Description of Monitoring Sites	4
METHODS	8
Sampling Overview	8
Water Quality	8
Periphyton	9
Field Methods	9
Laboratory Methods	10
Benthic Macroinvertebrates	11
Field Methods	11
Laboratory Methods	11
Fish	11
RESULTS AND DISCUSSION	12
Upper Shungnak River	12
Water Quality	12
Periphyton	12
Benthic Macroinvertebrates	13
Sunshine Creek	15
Water Quality	15
Periphyton	15
Benthic Macroinvertebrates	16
Fish Captures	18
Center of the Universe Creek	19
Water Quality	19
Periphyton	20
Benthic Macroinvertebrates	20
Fish Captures	22
Lower Red Rock Creek	23
Water Quality	23
Periphyton	23
Benthic Macroinvertebrates	24
Fish Captures	26
Upper Subarctic Creek	27
Water Quality	27
Periphyton	28
Benthic Macroinvertebrates	28
Fish Captures	30
Lower Subarctic Creek	31
Water Quality	31
Periphyton	32
Benthic Macroinvertebrates	32

Fish Captures	34
Upper Ruby Creek	35
Water Quality.....	35
Periphyton.....	36
Benthic Macroinvertebrates	36
Fish Captures	38
Jay Creek.....	39
Water Quality.....	39
Periphyton.....	40
Benthic Macroinvertebrates	40
Fish Captures	42
Lower Ruby Creek.....	43
Water Quality.....	43
Periphyton.....	44
Benthic Macroinvertebrates	45
Fish Captures	47
Fish Metals.....	48
Riley Creek	50
Water Quality.....	50
Periphyton.....	50
Benthic Macroinvertebrates	50
Fish Captures	52
Fish Metals.....	53
CONCLUSION.....	54
LITERATURE CITED	57
APPENDIX A. WATER QUALITY DATA.....	58
APPENDIX B. IN SITU WATER QUALITY DATA.....	61
APPENDIX C. CHLOROPHYLL DATA.....	62
APPENDIX D. BENTHIC MACROINVERTEBRATE DATA.....	64
APPENDIX E. FISH CAPTURE DATA	66
APPENDIX F. RESULTS FOR WHOLE BODY ELEMENT ANALYSIS.	68

LIST OF TABLES

Table 1.–Arctic-Bornite sampling locations (WGS 84), 2025.	5
Table 2.–In-situ water quality results for all sites, 2025.....	12

LIST OF FIGURES

Figure 1.—Location of the Arctic and Bornite deposits in northwest Alaska.....	2
Figure 2.—Waterfall on the Shungnak River blocking fish passage upstream.	3
Figure 3.—All locations sampled during aquatic biomonitoring in July 2025.....	6
Figure 4.—Sample sites on Upper Shungnak River and Sunshine Creek.	6
Figure 5.—Sample sites on Center of the Universe Creek and Lower Red Rock Creek	7
Figure 6.—Sample sites on Upper Subarctic Creek and Lower Subarctic Creek.	7
Figure 7.—Sample sites on Upper Ruby Creek and Jay Creek.	7
Figure 8.—Sample sites on Lower Ruby Creek and Riley Creek.	8
Figure 9.—Chlorophyll-a concentration boxplot by year at Upper Shungnak River.	13
Figure 10.—Mean BMI density (± 1 SD) at Upper Shungnak River.	14
Figure 11.—Mean percent EPT, Diptera, and other taxa in Upper Shungnak River	14
Figure 12.—Taxa richness in Upper Shungnak River BMI samples.....	15
Figure 13.—Chlorophyll-a concentration boxplot by year at Sunshine Creek.....	16
Figure 14.—Mean BMI density (± 1 SD) at Sunshine Creek.....	17
Figure 15.—Mean percent EPT, Diptera, and other taxa in Sunshine Creek.	17
Figure 16.—Taxa richness in Sunshine Creek BMI samples	18
Figure 17.—Total number of fish captured in minnow traps from Sunshine Creek.	19
Figure 18.—Length frequency for all fish captured in minnow traps from Sunshine Creek	19
Figure 19.—Chlorophyll-a concentration boxplot by year at Center of the Universe Creek.	20
Figure 20.—Mean BMI density (± 1 SD) at Center of the Universe Creek	21
Figure 21.—Mean percent EPT, Diptera, and other taxa in Center of the Universe Creek	21
Figure 22.—Taxa richness in Center of the Universe Creek BMI samples.....	22
Figure 23.— Total number of fish captured in Center of the Universe Creek.	22
Figure 24.—Length frequency for Dolly Varden captured in minnow traps from Center of the Universe Creek.....	23
Figure 25.—Chlorophyll-a concentration boxplot by year at Lower Red Rock Creek	24
Figure 26.—Mean BMI density (± 1 SD) at Lower Red Rock Creek.	25
Figure 27.—Mean percent EPT, aquatic Diptera, and other taxa in Lower Red Rock Creek.....	25
Figure 28.—Taxa richness in Lower Red Rock Creek BMI samples.....	26
Figure 29.—Total number of fish captured in Lower Red Rock Creek.	27
Figure 30.—Length frequency for all fish captured in minnow traps from Lower Red Rock Creek, ...	27
Figure 31.—Chlorophyll-a concentration boxplot by year at Upper Subarctic Creek	28
Figure 32.—Mean BMI density (± 1 SD) at Upper Subarctic Creek	29
Figure 33.—Mean percent EPT, aquatic Diptera, and other taxa in Upper Subarctic Creek	29
Figure 34.—Taxa richness in Upper Subarctic Creek BMI samples.....	30
Figure 35.—Total number of fish captured in Upper Subarctic Creek.....	31
Figure 36.—Length frequency for Dolly Varden captured in minnow traps from Upper Subarctic Creek.	31
Figure 37.—Chlorophyll-a concentration boxplot by year at Lower Subarctic Creek.....	32
Figure 38.—Mean BMI density (± 1 SD) at Lower Subarctic Creek.	33
Figure 39.—Mean percent EPT, aquatic Diptera, and other taxa in Lower Subarctic Creek.....	33
Figure 40.—Taxa richness in Lower Subarctic Creek BMI samples	34
Figure 41.—Total number of fish captured in Lower Subarctic Creek	35
Figure 42.—Length frequency for all fish captured in Lower Subarctic Creek.	35

Figure 43.—Chlorophyll-a concentration boxplot by year at Upper Ruby Creek.....	36
Figure 44.—Mean BMI density ($\pm$ 1 SD) at Upper Ruby Creek.....	37
Figure 45.—Mean percent EPT, aquatic Diptera, and other taxa in Upper Ruby Creek.....	37
Figure 46.—Taxa richness in Upper Ruby Creek BMI samples	38
Figure 47.—Total number of fish captured in Upper Ruby Creek.....	39
Figure 48.—Length frequency for all fish captured in minnow traps from Upper Ruby Creek	39
Figure 49.—Chlorophyll-a concentration boxplot by year at Jay Creek	40
Figure 50.—Mean BMI density ($\pm$ 1 SD) at Jay Creek	41
Figure 51.—Mean percent EPT, aquatic Diptera, and other taxa in Jay Creek.....	41
Figure 52.—Taxa richness in Jay Creek BMI samples.....	42
Figure 53.—Total number of fish captured in Jay Creek	43
Figure 54.—Length frequency for all fish captured in minnow traps from Jay Creek.....	43
Figure 55.—Element concentration data from water samples by year at Lower Ruby Creek	44
Figure 56.—Chlorophyll-a concentration boxplot by year at Lower Ruby Creek	45
Figure 57.—Mean BMI density ($\pm$ 1 SD) at Lower Ruby Creek, 2021–2025.	46
Figure 58.—Mean percent EPT, aquatic Diptera, and other taxa in Lower Ruby Creek	46
Figure 59.—Taxa richness in Lower Ruby Creek BMI samples.....	47
Figure 60.—Total number of fish captured in Lower Ruby Creek.....	48
Figure 61.—Length frequency for all fish captured in minnow traps from Lower Ruby Creek.	48
Figure 62.—Element concentration data for slimy sculpin captured in Lower Ruby Creek.....	49
Figure 63.— Chlorophyll-a concentration boxplot by year at Riley Creek=	50
Figure 64.—Mean BMI density ($\pm$ 1 SD) at Riley Creek.....	51
Figure 65.—Mean percent EPT, aquatic Diptera, and other taxa in Riley Creek BMI samples	51
Figure 66.—Taxa richness in Riley Creek BMI samples	52
Figure 67.—Total number of fish captured in Riley Creek.....	53
Figure 68.—Length frequency for all fish captured in minnow traps from Riley Creek	53
Figure 69.—Element concentration data for slimy sculpin captured in Riley Creek	54

ACKNOWLEDGEMENTS

The author would like to thank Ambler Metals for their financial support, and specifically Cal Craig for his logistical support in monitoring fish and wildlife resources at the Arctic-Bornite Prospect.

ADF&G Habitat staff Audra Brase and Chelsea Clawson performed the July aquatic biomonitoring, and Olivia Edwards and Lauren Yancy processed all periphyton samples in the ADF&G laboratory in Fairbanks. Olivia Edwards developed the R code for all data analyses and figures. Thomas House of Epeorus Environmental was responsible for sorting and identification of benthic macroinvertebrates. Cal Craig and Nolan Douglas (Ambler Metals) collected water quality samples. ACZ Laboratories was responsible for the fish whole body element analysis.

Maria Wessel, Audra Brase, and Dr. Al Ott (all ADF&G Habitat) and Cal Craig (Ambler Metals) provided constructive reviews of this report.

EXECUTIVE SUMMARY

This report summarizes results of 2025 aquatic biomonitoring work conducted in streams in the vicinity of the Arctic-Bornite exploratory mining prospects located north of Kobuk, Alaska. Aquatic biomonitoring included surveys of water quality, periphyton, benthic macroinvertebrates (BMI), and fish; these data have been collected annually from 2016–2025. Sampling locations and parameters for 2025 remained similar to 2024, although the Upper Ruby site was moved upstream since beaver activity had flooded the previous sample location. Additionally, the Lower Subarctic site was moved one bend upstream as the gravel bar previously used as a helicopter landing zone washed out.

Measurements of periphyton standing crop, BMI, and fish distribution varied among the sample sites in 2025. As in previous years, the mean chlorophyll-a concentration was highest in Upper Ruby Creek at 34.07 mg/m² (SD=28.83). The mean chlorophyll-a concentrations at the remaining sites ranged from 0.25–2.06 mg/m². BMI densities across all sites ranged from a low of 111 BMI/m² in Lower Red Rock Creek to a high of 13,665 BMI/m² in Upper Ruby Creek. Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa were present in some capacity at all sites in 2025. The percentage of Diptera exceeded the percentage of EPT taxa present in the samples at all sites except the Lower Subarctic Creek, Upper Shungnak River, and Upper Subarctic Creek. BMI taxa richness ranged from a low of 13 at Lower Red Rock Creek and Upper Shungnak River to a high of 23 at Riley Creek. Both slimy sculpin and Dolly Varden were captured at all sites except for Center of the Universe and Upper Subarctic creeks where only Dolly Varden were captured. This was the first time slimy sculpin have been captured in Jay Creek since sampling began. Among all sites, the most Dolly Varden were captured in Upper Subarctic Creek and the most slimy sculpin were captured in Upper Ruby Creek.

INTRODUCTION

The Ambler Mining District is located in the Kobuk River drainage in the southwest region of the Brooks Range (Figure 1). Ambler Metals (formerly Trilogy Metals) has explored two primary deposits in the area, but a drilling program has not occurred since 2022. The Bornite deposit, located 17 km north of Kobuk in the Ruby Creek drainage, contains primarily copper and cobalt. The Arctic deposit, located 37 km northeast of Kobuk in the upper end of the Subarctic Creek drainage, contains copper, lead, zinc, silver, and gold. Both Ruby and Subarctic creeks are tributaries to the Shungnak River, which flows into the Kobuk River. A waterfall in the lower Shungnak River prevents upstream passage of fish, therefore no anadromous fish occur in the drainage upstream of the falls and any resident species of fish upstream complete their life cycle within this isolated extent of the Shungnak River drainage (Figure 2).

All sample sites except Riley Creek are in the Shungnak River drainage. Riley Creek, a tributary to the Kogoluktuk River, is monitored since it may be impacted by future mine development.



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



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

Aquatic baseline work conducted in the area in 2010 focused on macroinvertebrate and fish presence (Tetra Tech 2011). Fish species documented in the 2010 survey were Arctic grayling (*Thymallus arcticus*), round whitefish (*Prosopium cylindraceum*), slimy sculpin (*Cottus cognatus*), and Dolly Varden (*Salvelinus malma*). Ambler Metals contracted the Alaska Department of Fish and Game (ADF&G) Habitat Section to continue aquatic sampling beginning in 2016. The ADF&G study plan is based on aquatic biomonitoring the Habitat Section conducts at various large hard rock mines throughout the state (Clawson 2026). Three primary types of data are collected: periphyton, benthic macroinvertebrates (BMI), and fish, which includes samples for whole body element analyses. In-situ water quality data have also been collected in recent years. Aquatic biomonitoring has been performed annually except for 2020 when all camp operations were suspended due to the Covid-19 pandemic.

This report summarizes the 2025 in-situ water quality, periphyton, BMI, and fish data collected by ADF&G and element concentration data in water samples collected by Ambler Metals.

LOCATION AND DESCRIPTION OF MONITORING SITES

Biomonitoring was performed at ten sites in July 2025 (Table 1; Figure 3). Sampling effort continues to be concentrated in Ruby and Subarctic creeks as these aquatic systems may be altered by projected mining development.

- **Upper Shungnak River** is characterized by outside bend cut banks and inside bend gravel bars, deep water, gravel substrate with some cobble, and forested riparian habitat (Figure 4). Sampling began at this site in 2016.
- **Sunshine Creek** is characterized by riffle/run habitats and gravel/cobble substrate. Riparian vegetation is primarily willows and grasses with mature spruce trees. The sample site is just upstream of a large beaver pond. The upper reaches of Sunshine Creek are high gradient (Figure 4). Sampling began in this creek in 2021, and the sampling site was moved in 2024 to a nearby channel with more consistent water flow.
- **Center of the Universe Creek** is a tributary of Red Rock Creek in the upper extent of the drainage. The creek is characterized by riffles and runs interspersed with pools. Substrate here is smaller gravel than at other downstream sites. Riparian habitat is mostly alpine tundra with some willows along the banks (Figure 5). Sampling began at this site in 2022.
- **Lower Red Rock Creek** is characterized by riffle/pool habitat with gravel/cobble substrate, with riparian vegetation of willows and mature spruce trees (Figure 5). This drainage is directly north of Subarctic Creek drainage on the Shungnak River and may provide alternative fish habitat if Subarctic Creek is altered by future mining activity. Sampling began at this site in 2018.
- **Upper Subarctic Creek** is characterized by high gradient with step pools and large boulders with riparian habitat of alpine tundra with some shrubby willows along the banks. This sample site is located a few hundred meters below the origin of the creek, which abruptly forms when water transitions from subsurface to surface flow (Figure 6). Sampling began at this site in 2016.
- **Lower Subarctic Creek** is wider with a much lower gradient than the upper site, characterized by riffle/pool habitat with gravel/cobble substrate, with riparian vegetation

of willows and mature spruce trees (Figure 6). Sampling began at this site in 2016. In 2025 the sampling site was moved one bend upstream as the gravel bar previously used as a helicopter landing zone had washed out.

- **Upper Ruby Creek** is characterized by beaver pond habitats, deep water, dense vegetative cover, short channels between beaver dams, and minimal gravel/cobble. The sample site was moved 0.25 km upstream in 2025 since the previous location was flooded by beaver activity (Figure 7). Sampling began at this site in 2016.
- **Jay Creek** is characterized by riffle/run habitats, gravel with some cobble substrate, and very dense mostly willow vegetation and overhanging canopy (Figure 7). Sampling began at this site in 2017.
- **Lower Ruby Creek** is characterized by pool/riffle habitat, relatively shallow water, and gravel substrate. Riparian vegetation is a mix of grasses and willows, with some mature spruce trees (Figure 8). Sampling began at this site in 2016.
- **Riley Creek** is characterized by riffle/pool habitat with gravel and cobble substrate. Riparian habitat is primarily willows and grasses with some mature trees (Figure 8). Sampling began at this site in 2016.

Table 1.–Arctic-Bornite sampling locations (WGS 84), 2025.

Sample Site	Latitude	Longitude	BMI	Periphyton	Fish
Upper Shungnak	67.2440	-156.6160	X	X	
Sunshine	67.2335	-156.6162	X	X	X
Center of the Universe	67.2010	-156.4041	X	X	X
Lower Red Rock	67.1932	-156.5991	X	X	X
Upper Subarctic	67.1926	-156.3911	X	X	X
Lower Subarctic	67.1712	-156.6115	X	X	X
Upper Ruby	67.0387	-156.9427	X	X	X
Jay	67.0804	-156.9445	X	X	X
Lower Ruby	67.1114	-156.9084	X	X	X
Riley	67.0426	-156.6923	X	X	X

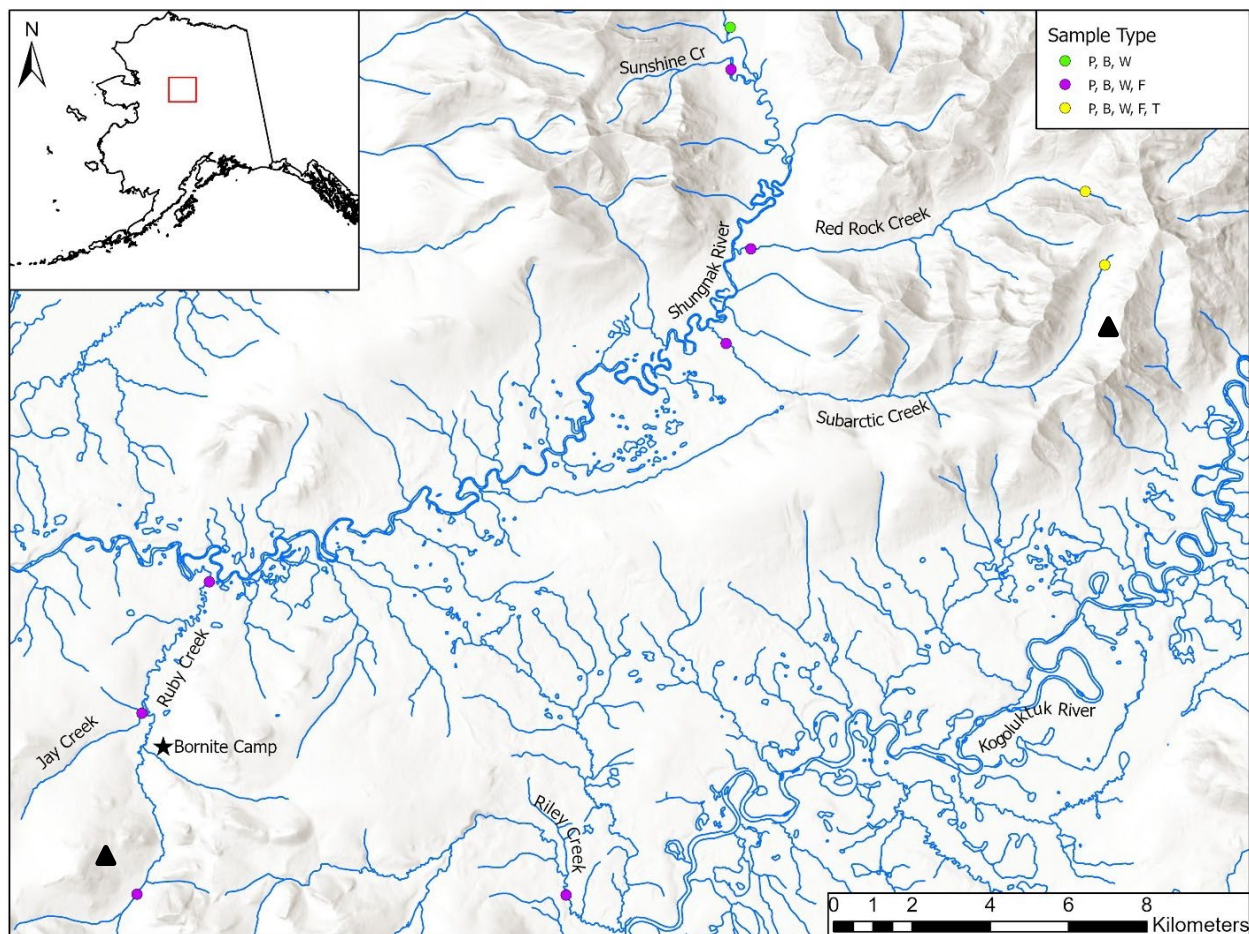


Figure 3.—All locations sampled during aquatic biomonitoring in July 2025. Sampling parameters are abbreviated as follows: P=periphyton, B=benthic macroinvertebrates, F=fish, W=water quality, and T=temperature logger placed. Black triangles depict general deposit locations.



Figure 4.—Sample sites on Upper Shungnak River (left) and Sunshine Creek (right), July 2025.



Figure 5.—Sample sites on Center of the Universe Creek (left) and Lower Red Rock Creek (right), July 2025.



Figure 6.—Sample sites on Upper Subarctic Creek (left) and Lower Subarctic Creek (right), July 2025.



Figure 7.—Sample sites on Upper Ruby Creek (left) and Jay Creek (right), July 2025.



Figure 8.—Sample sites on Lower Ruby Creek (left) and Riley Creek (right), July 2025.

METHODS

SAMPLING OVERVIEW

The objective of the Arctic Bornite aquatic biomonitoring program is to document in-situ productivity of aquatic communities at each sample site, and element concentration in the water in the vicinity and downstream of potential project facilities.

In 2025 there was one sampling event in the Arctic Bornite area which took place from July 12–17. Ambler Metals did not run an exploration program in 2025, so their camp was only operated for a short period to accomplish annual environmental monitoring. At each location replicate samples of the aquatic community were collected, including BMI, periphyton, and fish (Table 1). A subset of fish were retained for whole body element analysis from Riley and Lower Ruby creeks. An adequate predevelopment baseline data set has been obtained for Dolly Varden from Subarctic Creek, so collection of those fish was halted in 2025. At both Lower Ruby and Riley creeks, the sample size and species collected have been less consistent over the years, so to have a more complete baseline of element concentrations in slimy sculpin, fish were retained in 2025.

Beginning in 2021, BMI were collected with Hess samplers rather than drift nets to identify and quantify the in-situ community. This change was made because the benthic community is a more accurate characterization of the conditions at each sample site, rather than the conditions upstream.

WATER QUALITY

A handheld multiparameter YSI was used to measure in situ water temperature (°C), dissolved oxygen (mg/L), specific conductance (µS/cm), conductivity (µS/cm), and pH at each site

concurrent with BMI and periphyton sampling. The probe was placed in flowing water, and measurements were allowed to equilibrate before being recorded. An Orion AQUAfast Turbidity meter was used to measure turbidity (NTU) in 2022 and 2025. At each site, the sample vial was rinsed with stream water three times, then filled with flowing water. Three turbidity readings of the sample were taken, and the average value of those readings was recorded.

Ambler Metals has collected water quality data for element concentration analysis from locations throughout the Arctic-Bornite Prospect project area. The 2016 ADF&G technical report summarized all water quality data collected from 2008–2016 (Bradley 2017). This report summarizes water data collected in 2025 at Lower Ruby Creek, which was the only aquatic biomonitoring site also sampled for water quality by Ambler Metals in 2025. Alaska Department of Environmental Conservation (ADEC) water quality standards are noted in Appendix A for both acute (24 hr) and chronic (one month) aquatic life exposure limits. These vary because the element concentration limits are dependent on water hardness.

In 2025, Hobo v2 water temperature data loggers were deployed at two locations to record daily water temperatures through the winter and identify potential groundwater inputs. One Hobo logger was deployed at each of the standard monitoring locations in Center of the Universe Creek and Upper Subarctic Creek. These will be retrieved in July 2026. Locations were selected based on open water conditions observed in March 2021 and April 2023.

PERIPHYTON

Field Methods

Periphyton is composed of chlorophyll producing organisms, such as algae, attached to submerged surfaces in a waterbody. Algal density and community structure are influenced by water and sediment quality through physical chemical and biological factors that change throughout the year (Barbour et al. 1999). The concentration of chlorophyll-a pigments in periphyton samples provides an estimate of active algal biomass and is often used in monitoring studies to detect changes in aquatic communities. Periphyton samples were collected at ten locations around the Arctic-Bornite area in 2025 (Table 1; Figure 3).

Ten flat rocks, each larger than 25 cm² were collected from submerged areas at each site. A 5 cm x 5 cm square of high-density flexible foam was placed on the rock. All the material around the

foam was scrubbed off with a toothbrush and rinsed back into the stream. The foam square was then removed from the rock, and that section of the rock was brushed and rinsed onto a 0.45 μm glass fiber filter receptacle attached to a hand vacuum pump. Material from the toothbrush was also rinsed onto the filter. The water was extracted from the periphyton covered filter using a hand vacuum pump. Just before all the water was pumped through the filter, one to two drops of magnesium carbonate (MgCO_3) were added to the water to prevent acidification and additional conversion of chlorophyll-a to phaeophytin.

Filters from each rock were folded in half, with the sample material on the inside, and placed in individual dry paper coffee filters. All ten coffee filters were placed in a zip-lock bag containing desiccant to absorb remaining moisture. The bags were then wrapped in aluminum foil to prevent light from reaching the samples, placed in a cooler with ice packs, then transferred to a freezer at the Bornite camp. Samples were kept frozen until they were analyzed at the ADF&G laboratory in Fairbanks.

Laboratory Methods

In the lab, periphyton samples were removed from the freezer, the glass fiber filters were cut into small pieces and placed in individual 15 ml centrifuge tubes with 10 ml of 90% spectrophotometric grade acetone. The centrifuge tubes were secured in a vial rack covered with aluminum foil to reduce light exposure and stored in a dark refrigerator overnight. On the following day (~18-24 hours after preparation), sample tubes were placed in a centrifuge and spun at 1,600 rpm for 20 minutes. Samples were then decanted individually into cuvettes and absorption values at 750 nm, 664 nm, 647 nm, and 630 nm were recorded on a split beam spectrophotometer. Each sample was treated with 80 μL of 0.1N hydrochloric acid for 90 seconds to convert the chlorophyll to phaeophytin and then absorbance was measured at 750 nm and 665 nm.

Trichromatic equations were used to estimate chlorophyll a, -b, and -c concentrations. Phaeophytin was calculated to determine if a chlorophyll-a conversion had occurred, and to correct chlorophyll-a concentrations for the presence of phaeophytin. The numbers reported in this document are the phaeophytin-corrected chlorophyll-a values. Additional details regarding periphyton sampling and analysis methods can be found in ADF&G Technical Report No. 26-03 (Clawson 2026).

BENTHIC MACROINVERTEBRATES

Field Methods

At each benthic macroinvertebrate (BMI) sample site, five replicates were collected using a Hess sampler (Table 1). The Hess stream bottom sampler has a 0.086 m² sample area and material is captured in a 200 mL cod end, both constructed with 300 µm mesh net. Rocks within the sample area were scoured by hand, and gravel, sand, and silt were disturbed to about 10 cm depth to dislodge macroinvertebrates occupying the benthos into the net. The cod end contents were then removed and placed in individual pre-labeled Nalgene bottles with denatured ethyl alcohol to preserve the macroinvertebrates.

Laboratory Methods

Samples were sorted and invertebrates identified by a private aquatic invertebrate lab in Fairbanks. Insects of the orders Ephemeroptera, Plecoptera, Trichoptera were identified to genus. Insects of the order Diptera were identified to genus, except the nonbiting midges of the family Chironomidae. Copepoda, Collembola, and Coleoptera were identified to genus. Cladocera and Hydroida were identified to order. Oligochaeta, Ostracoda, Platyhelminthes, Nematoda, and Nematomorpha were identified to class level. Because invertebrates belonging to the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) are more sensitive to water quality, the total number of individual specimens of EPT was calculated and compared to groups of other invertebrates, which are less sensitive. The BMI density was calculated for each sample by dividing the number of invertebrates by 0.086 m², the Hess sampling area. Mean density was estimated for each site by calculating the mean density among the five samples. Density data is only reported for the years Hess samplers have been used since this method is not directly comparable to the previously used drift nets and the units differ. Taxa richness is reported as the number of taxonomic groups identified to the lowest practical level. Terrestrial organisms were excluded from all calculations.

FISH

Five baited minnow traps were placed upstream and five downstream of baseline sampling sites after collecting the periphyton and BMI samples (Table 1). Traps were baited with cured salmon eggs and were placed in a variety of habitats, including cut banks, pools, and near submerged woody debris. Traps were soaked overnight and checked about 24 hours later. All captured fish

were measured for fork or total length, depending on species. A subset of fish were retained for whole body element analyses. Those fish were handled wearing class 100 nitrile gloves and placed in individual pre-labeled plastic zip-top bags. The bagged fish were placed in a cooler with ice packs in the field and then transferred to a freezer in the camp. Samples remained frozen until they were analyzed by ACZ Laboratories, Inc.

RESULTS AND DISCUSSION

UPPER SHUNGNAK RIVER

Water Quality

In July 2025, pH was 7.55, the water temperature was 6.7°C, and the dissolved oxygen was 10.98 mg/L in the Upper Shungnak River (Table 2). In-situ water quality properties have remained consistent among years, with water temperature slightly higher in 2025. All in-situ water quality data are presented in Appendix B.

Table 2.—In-situ water quality results for all sites, 2025.

Site	Water Temp (°C)	Dissolved Oxygen (mg/L)	Conductivity (µs/cm)	Specific Conductance (µs/cm)	pH	Turbidity (NTU)
Upper Shungnak	6.7	10.98	113.8	174.3	7.55	0.18
Sunshine	6.1	11.58	82.7	129.5	7.56	0.27
Upper Center of the Universe	4.0	11.20	84.8	141.6	7.68	0.31
Lower Red Rock	7.1	11.38	123.5	187.5	7.33	0.97
Upper Subarctic	6.3	10.73	65.1	101.1	8.02	0.19
Lower Subarctic	8.1	11.17	69.0	101.9	7.37	0.07
Upper Ruby	11.0	9.60	189.5	258.9	8.23	2.63
Jay	7.1	11.28	51.7	78.7	8.00	0.63
Lower Ruby	9.6	9.95	195.4	277.1	7.64	2.15
Riley	4.9	11.66	146.5	237.8	7.73	0.88

Periphyton

In 2025, mean chlorophyll-a concentration in Upper Shungnak River was 0.96 mg/m² (SD = 0.56). This value is higher than the 2024 mean of 0.14 mg/m², but similar to the 2019 to 2022 means (Figure 9). Mean chlorophyll-a concentrations have remained below 1 mg/m² in the Upper Shungnak River since 2018. The notably higher mean concentration in 2016 was likely due to two unusually high values in the data (Figure 9). Complete periphyton data from 2025 are contained in Appendix C.

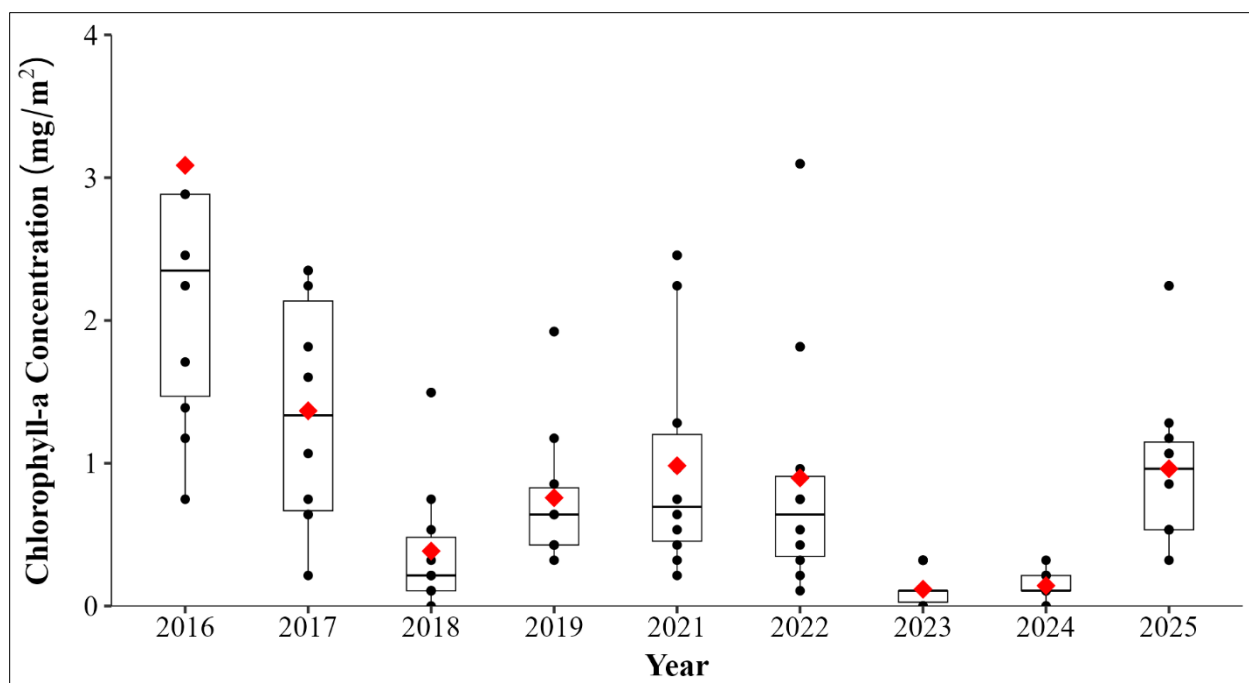


Figure 9.—Chlorophyll-a concentration boxplot by year at Upper Shungnak River, 2016–2025. Raw data are depicted by black dots and mean values are depicted in red. Note that two high values from 2016 (6.62 and 8.76 mg/m²) are excluded from this plot but not from statistical analyses.

Benthic Macroinvertebrates

Mean BMI density in the Upper Shungnak River in 2025 was 572 BMI/m² (SD = 319). This is an increase from the 2023 and 2024 mean densities but still lower than the mean densities recorded in 2021 and 2022 (Figure 10). EPT taxa dominated sample composition in the Upper Shungnak River at 65% in 2025, but no Trichoptera were present for the third year in a row (Figure 11). The proportion of Diptera was slightly lower than previous years at 22%. There were 13 taxa present in the samples from Upper Shungnak River in 2025, similar to the previous 4 years (Figure 12). Since sampling methods were switched from drift nets to a Hess sampler in 2021, taxa richness has been consistently lower than the first 4 years of sampling. BMI data from 2025 are presented in Appendix D.

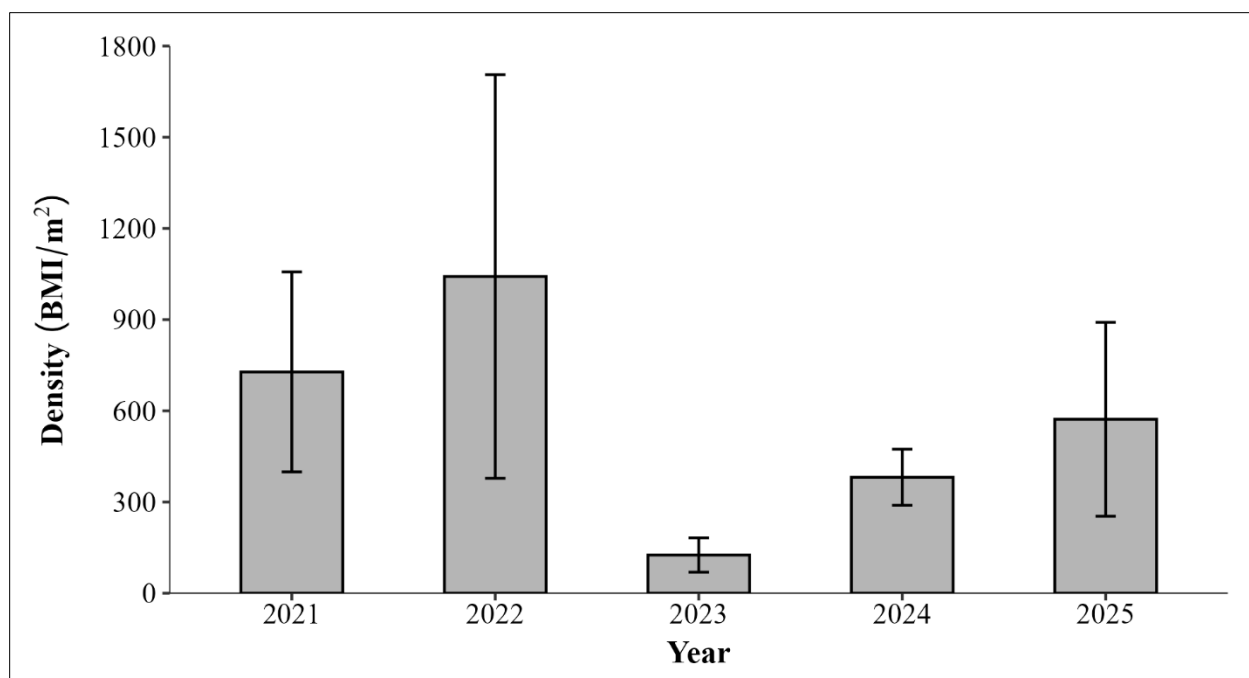


Figure 10.—Mean BMI density (± 1 SD) at Upper Shungnak River, 2021–2025.

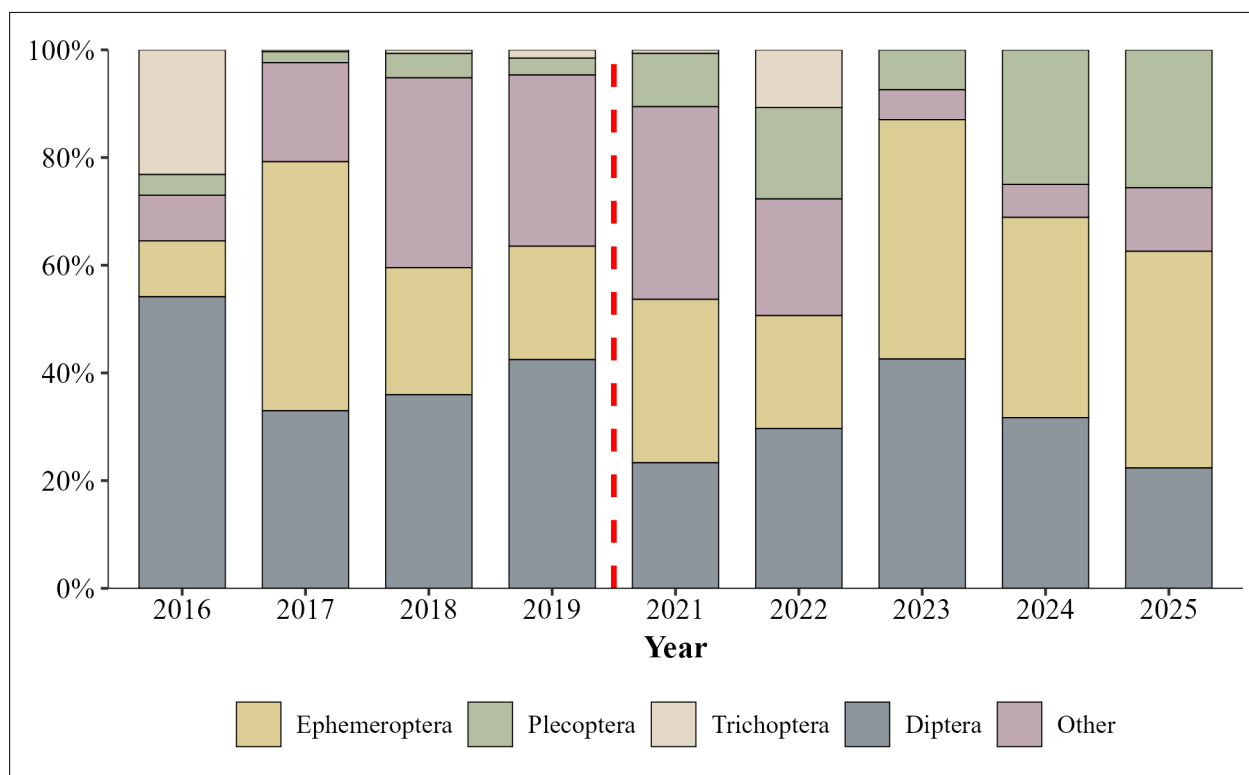


Figure 11.—Mean percent EPT, Diptera, and other taxa in Upper Shungnak River BMI samples, 2016–2025. Red dashed line denotes the change from drift nets to Hess sampler.

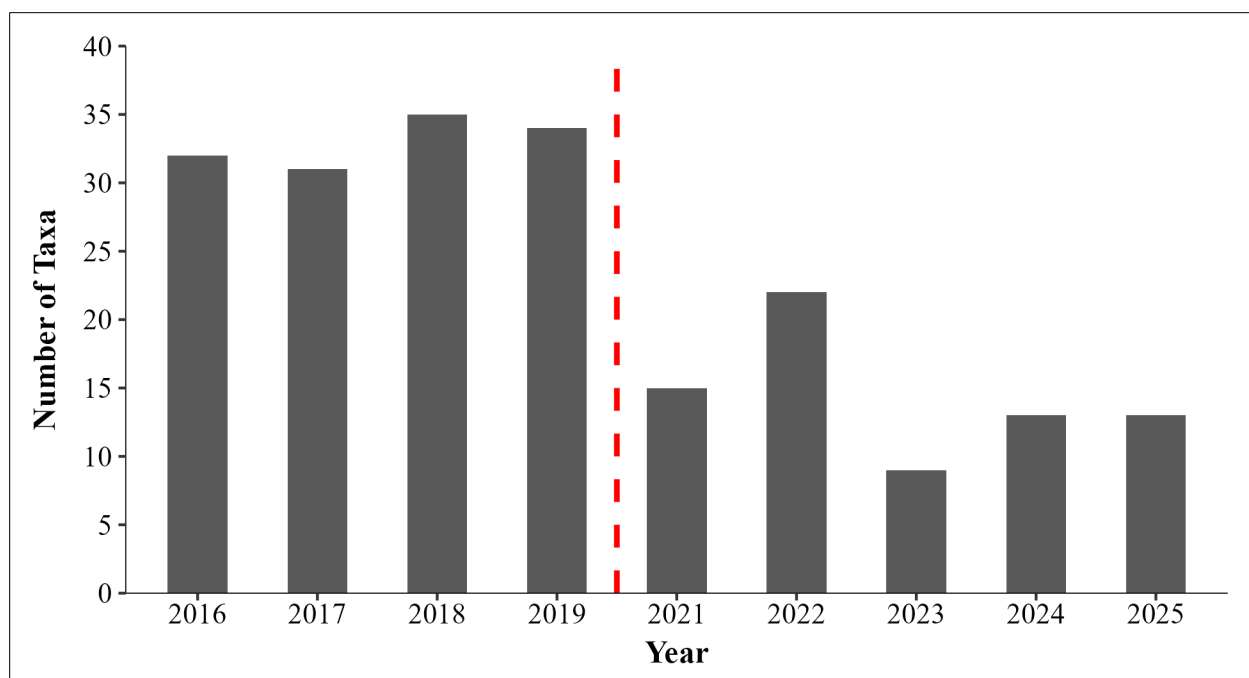


Figure 12.—Taxa richness in Upper Shungnak River BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

SUNSHINE CREEK

Water Quality

In July 2025, the pH was 7.56, the water temperature was 6.1°C, and the dissolved oxygen was 11.58 mg/L in Sunshine Creek (Table 2). In-situ water temperature has been variable among years ranging from 2.9°C in 2022 to 6.1°C in 2025. All in-situ water quality data are presented in Appendix B.

Periphyton

In 2025, mean chlorophyll-a concentration in Sunshine Creek was 0.81 mg/m² (SD = 0.47). This value is higher than the 2024 mean but similar to previous years' means which range from 0.83–1.54 mg/m² (Figure 13). The new location that was sampled in 2024 was sampled again in 2025. Complete periphyton data from 2025 are contained in Appendix C.

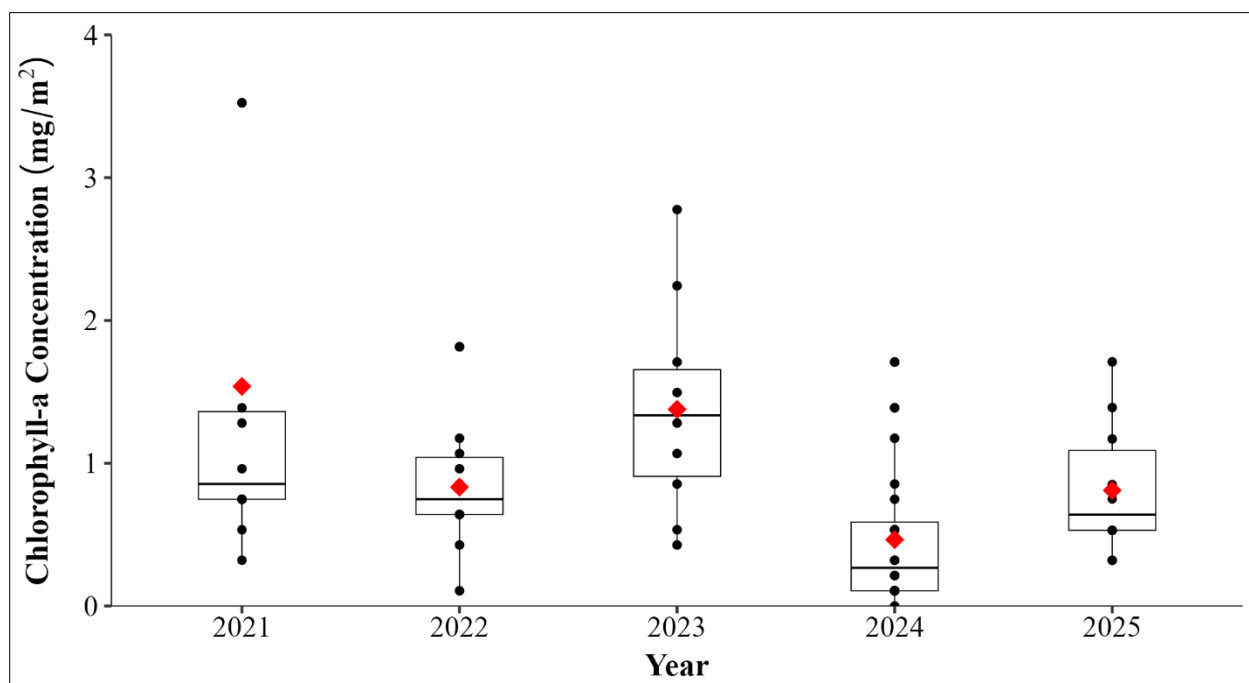


Figure 13.–Chlorophyll-a concentration boxplot by year at Sunshine Creek, 2021–2025. Raw data are depicted by black dots and mean values are depicted in red.

Benthic Macroinvertebrates

Mean BMI density in Sunshine Creek in 2025 was 1,435 BMI/m² (SD = 765). This is the lowest mean density since sampling began in 2021, although the standard deviation overlaps with some previous years' mean values (Figure 14). In 2025, Diptera made up 82% of the sample from Sunshine Creek while EPT taxa made up 11%, a lower proportion of EPT than most previous years (Figure 15). There were 16 taxa present in the samples from Sunshine Creek in 2025 which is similar to previous years (Figure 16). BMI data from 2025 are presented in Appendix D.

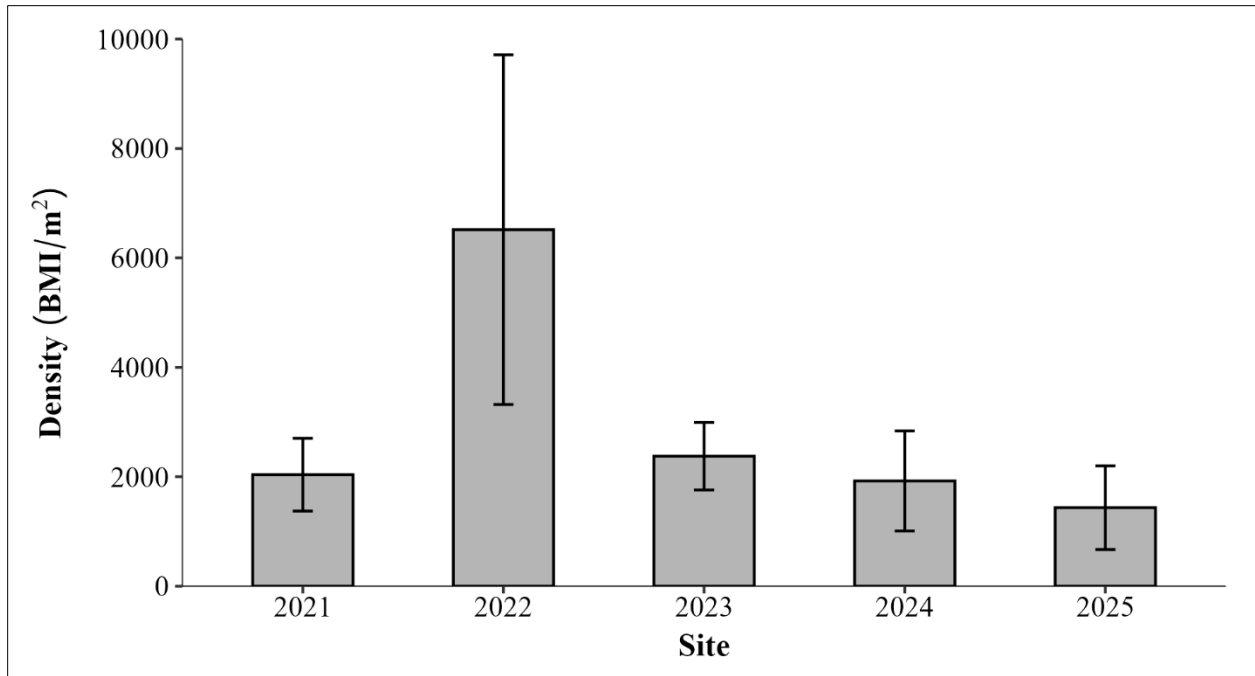


Figure 14.—Mean BMI density (± 1 SD) at Sunshine Creek, 2021–2025.

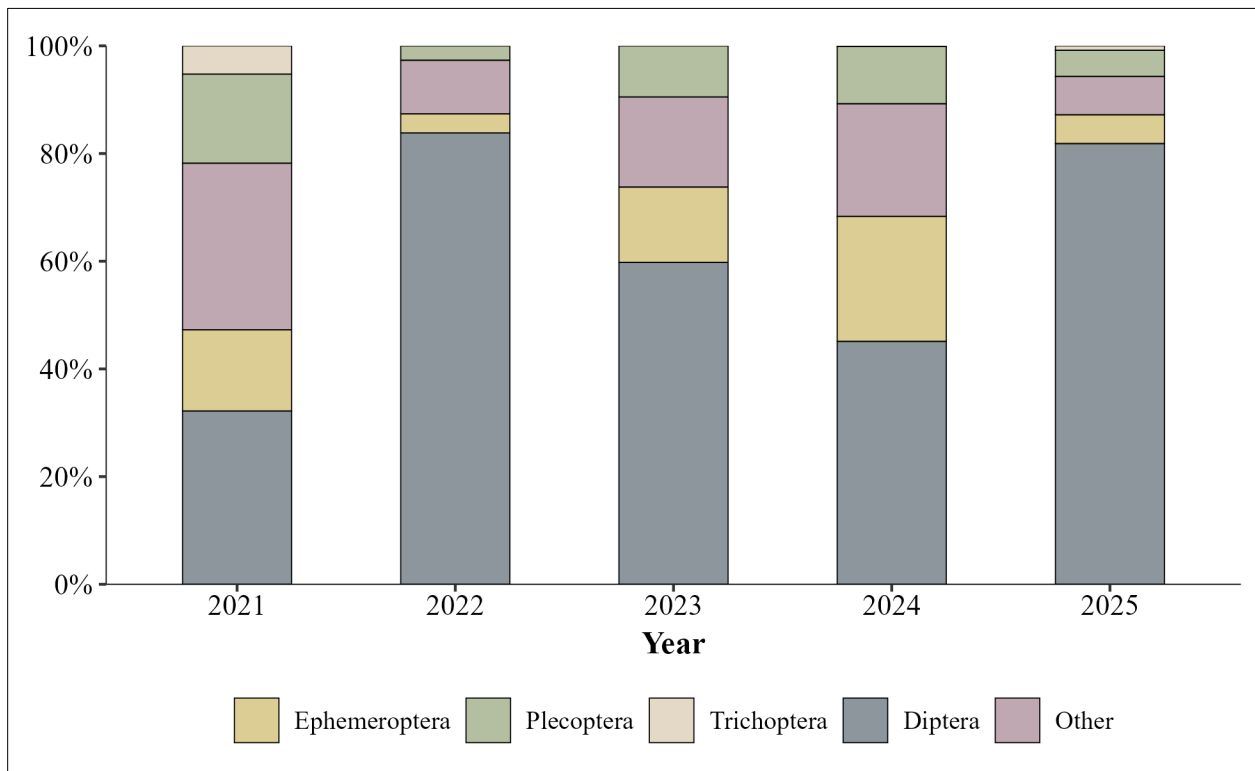


Figure 15.—Mean percent EPT, Diptera, and other taxa in Sunshine Creek BMI samples, 2021–2025.

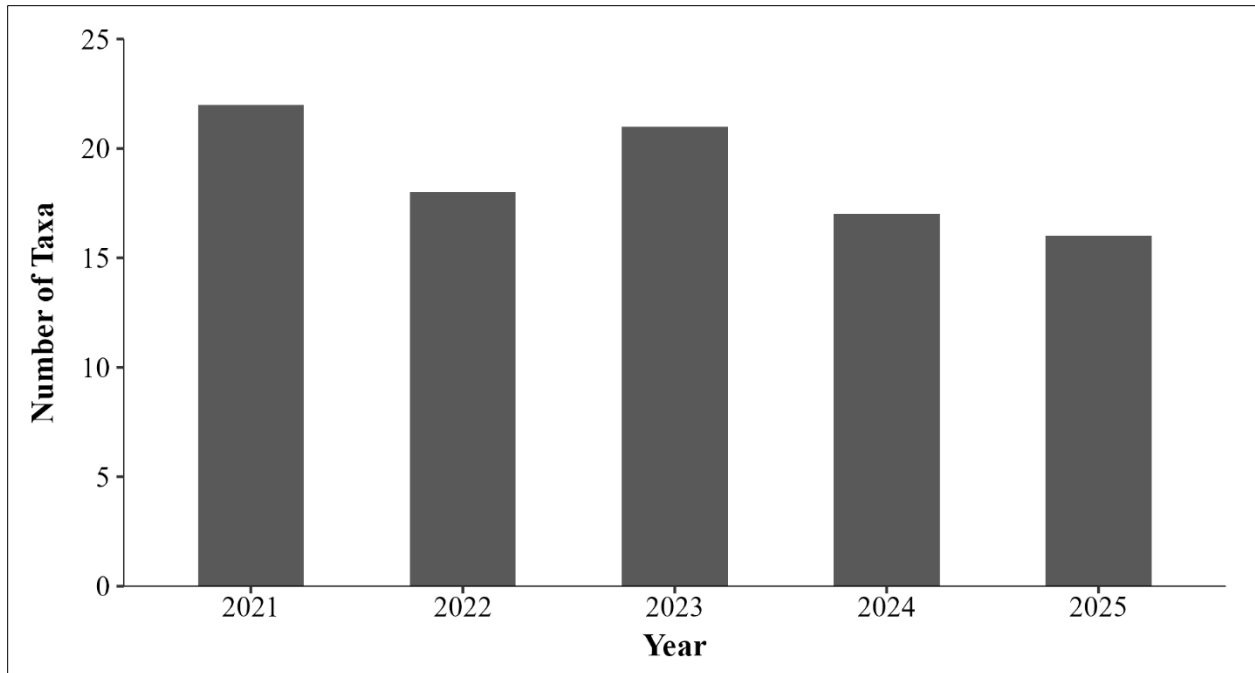


Figure 16.–Taxa richness in Sunshine Creek BMI samples, 2021–2025.

Fish Captures

A total of 3 Dolly Varden and 7 slimy sculpin were captured in Sunshine Creek in 2025. Dolly Varden captures were similar to previous years, but slimy sculpin captures were higher than 2021 – 2023 catches (Figure 17). Over all sample years, similar numbers of Dolly Varden have been captured across all length categories resulting in a uniform distribution ranging from 59–138 mm fork length with a mean of 92.6 mm (SD = 25.05; Figure 18). Slimy sculpin lengths have ranged from 50–100 mm total length, with the majority between 60–90 mm total length with a mean of 75.3 mm (SD = 11.03; Figure 18). All fish capture data are presented in Appendix E.

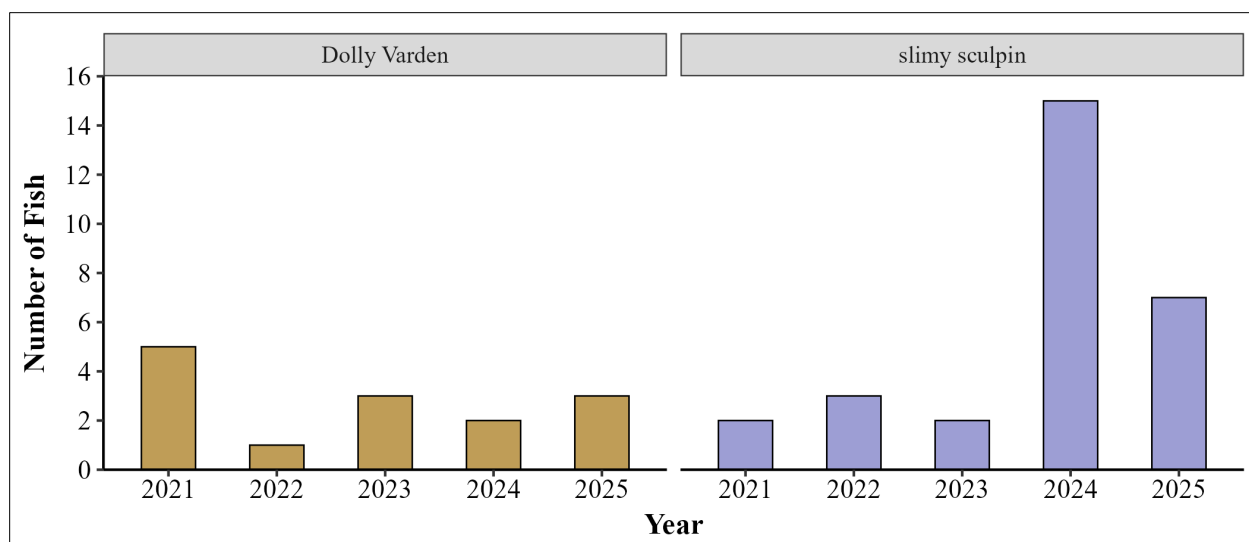


Figure 17.—Total number of fish captured in minnow traps from Sunshine Creek, 2021–2025.

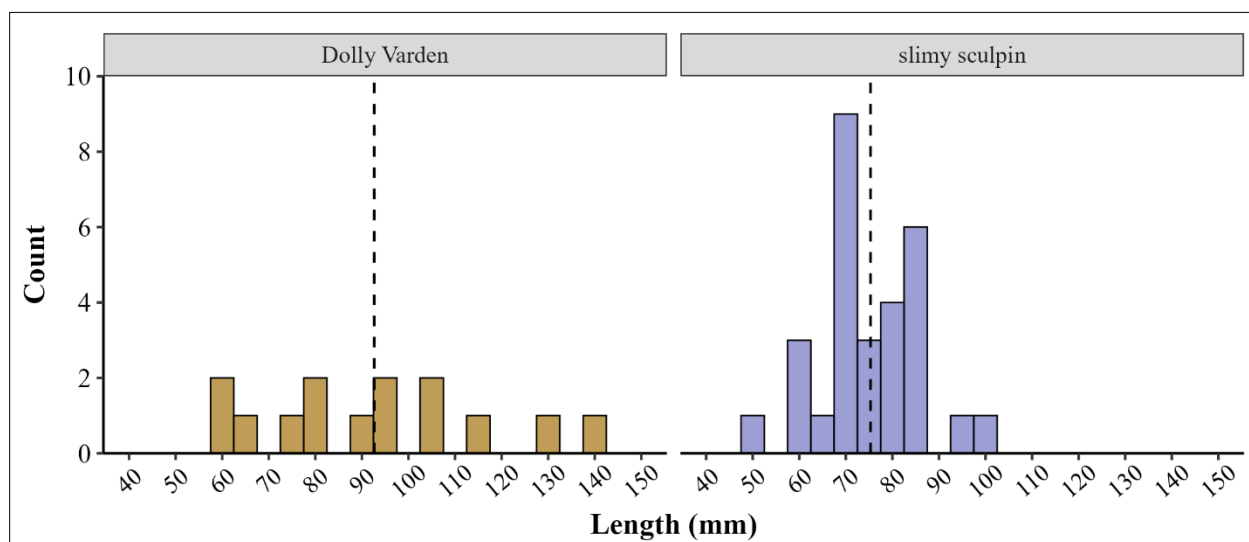


Figure 18.—Length frequency for all fish captured in minnow traps from Sunshine Creek, 2021–2025. Dolly Varden are measured to fork length and slimy sculpin are measured to total length. The vertical dashed line represents the sample mean length.

CENTER OF THE UNIVERSE CREEK

Water Quality

In July 2025, the pH was 7.68, the water temperature was 4.0°C, and the dissolved oxygen was 11.20 mg/L in Center of the Universe Creek (Table 2). At all other sites in 2025, water temperature was higher than previous years', but at Center of the Universe water temperature was slightly lower in 2025. Water temperature at this site has had a very narrow range from 4.0°C in 2025 to 4.9°C in 2024, possibly due to extensive groundwater inputs. In-situ water quality properties have remained consistent among years. All in-situ water quality data are presented in Appendix B. One

Hobo V2 logger was placed at this site in July 2025 to measure year-round water temperature and will be retrieved in 2026.

Periphyton

In 2025, the mean chlorophyll-a concentration in Center of the Universe Creek was 1.27 mg/m² (SD = 0.57). This value is similar to previous years' means (Figure 19). Complete periphyton data from 2025 are contained in Appendix C.

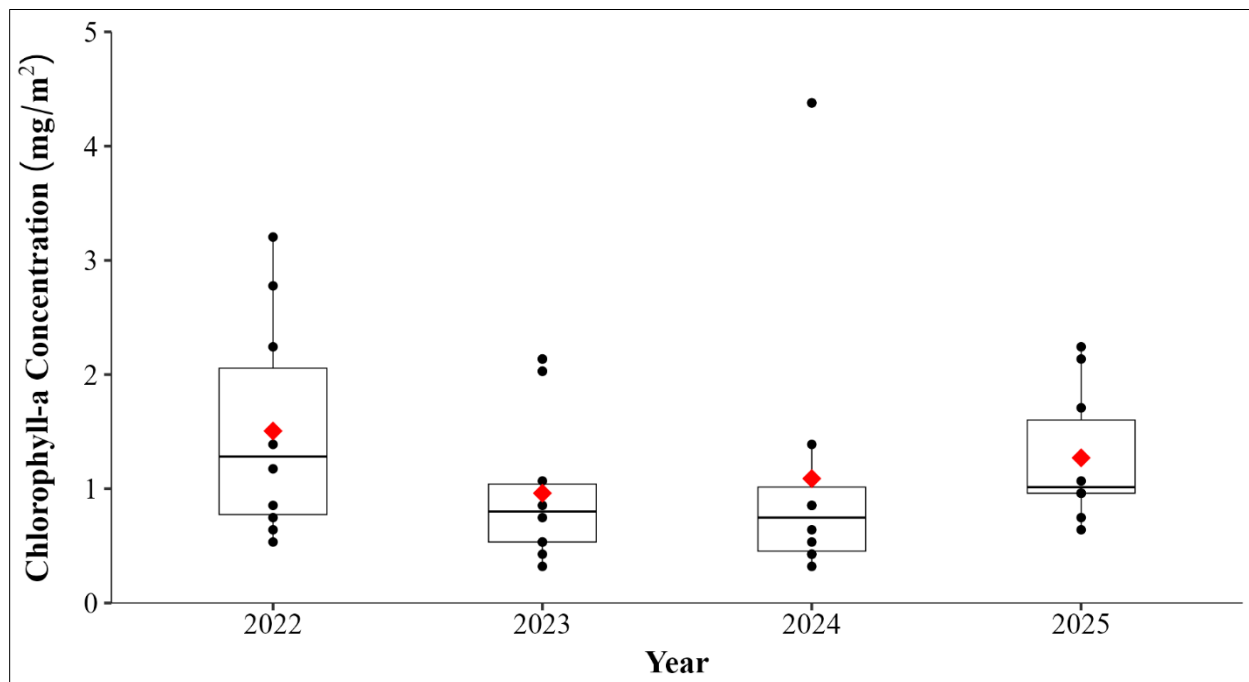


Figure 19.—Chlorophyll-a concentration boxplot by year at Center of the Universe Creek, 2022–2025. Raw data are depicted by black dots and mean values are depicted in red.

Benthic Macroinvertebrates

Mean BMI density in Center of the Universe Creek in 2025 was 3,916 BMI/m² (SD = 2,543). This was higher than the mean density in 2023 and 2024, but the standard deviation was also quite large (Figure 20). Diptera comprised 47% of the sample composition and EPT were 27% in 2025, similar to 2024 when Diptera were 56% of the sample and EPT were 30% (Figure 21). Taxa richness was higher in 2025 than the previous 2 years with 22 taxa present (Figure 22). BMI data from 2025 are presented in Appendix D.

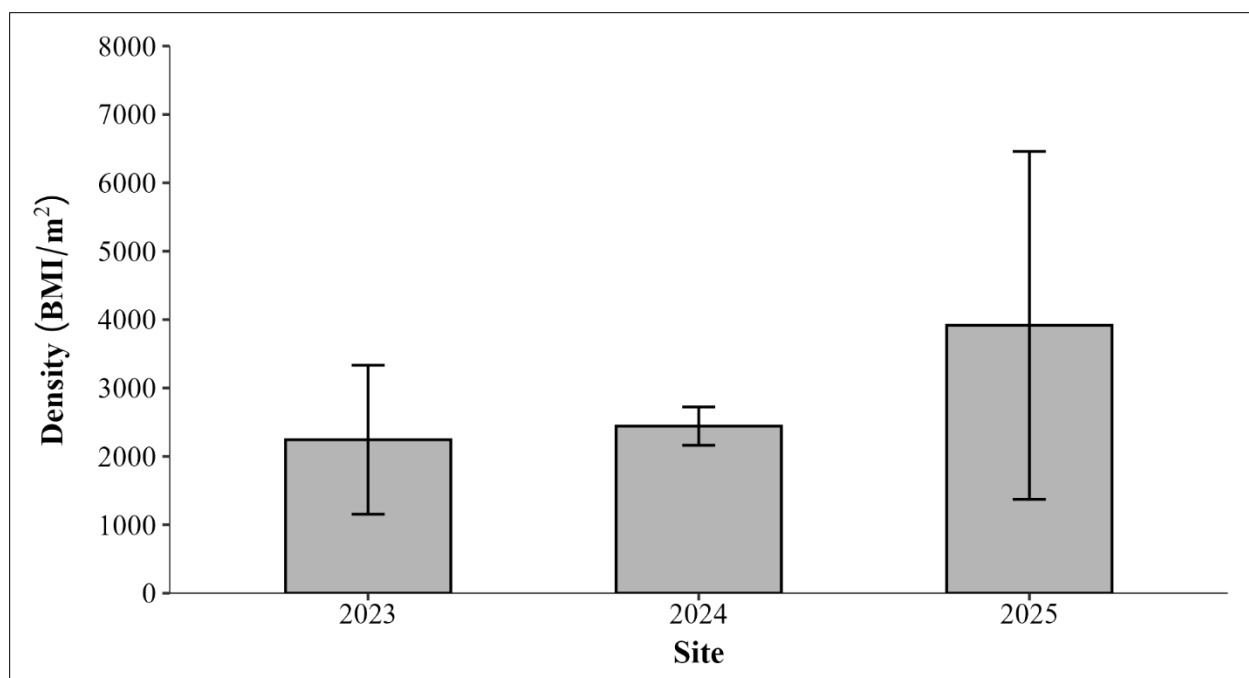


Figure 20.—Mean BMI density (± 1 SD) at Center of the Universe Creek, 2023–2025.

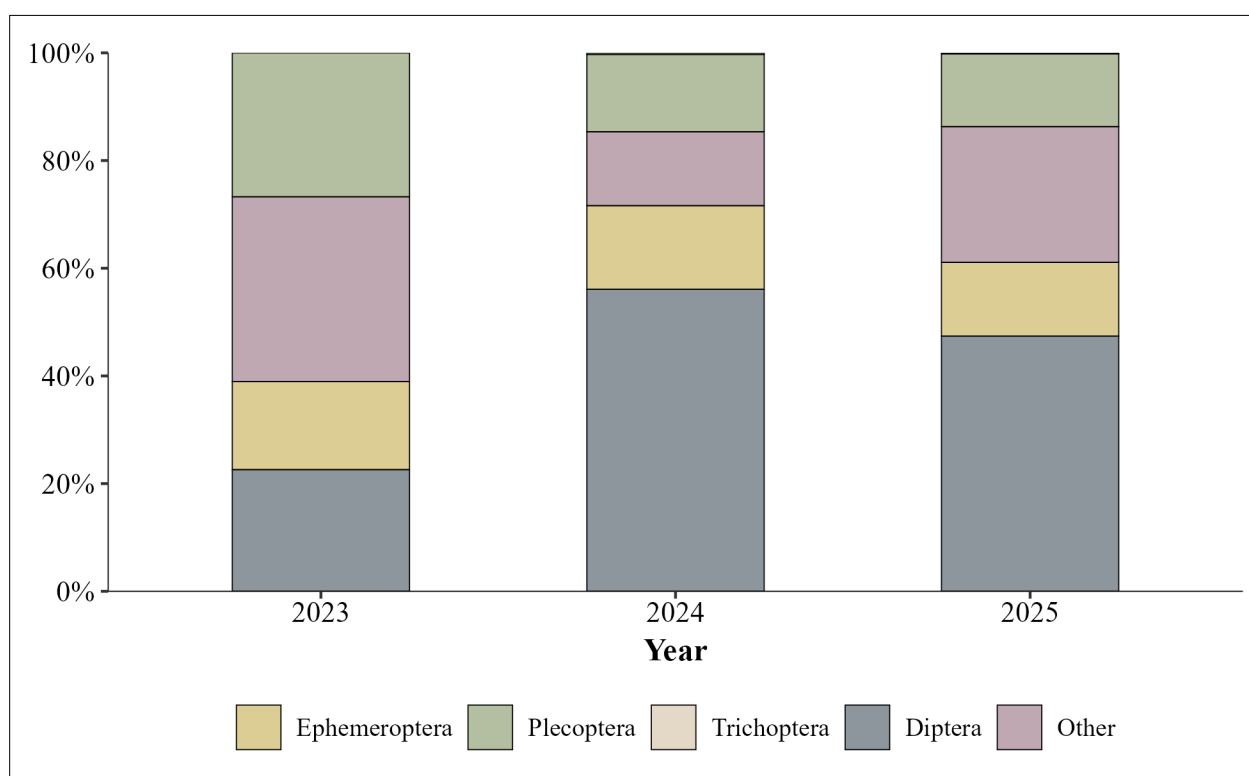


Figure 21.—Mean percent EPT, Diptera, and other taxa in Center of the Universe Creek BMI samples, 2023–2025.

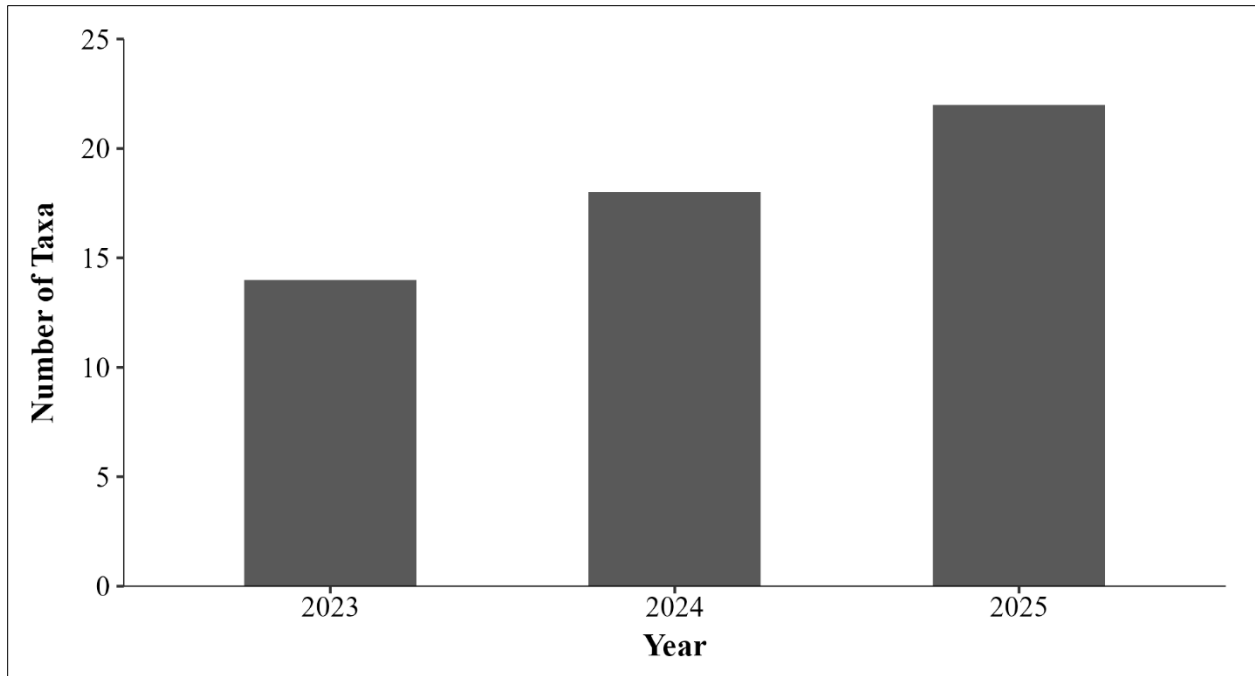


Figure 22.—Taxa richness in Center of the Universe Creek BMI samples, 2023–2025.

Fish Captures

Dolly Varden have been the only fish species captured in Center of the Universe Creek since sampling began in 2021. A total of 12 Dolly Varden were captured in 2025 which is the same number caught in 2021 (Figure 23). Multiple length classes are present in Center of the Universe Creek ranging from 63–160 mm fork length with a generally uniform distribution and mean of 118.3 mm (SD = 26.2; Figure 24). All fish capture data are presented in Appendix E.

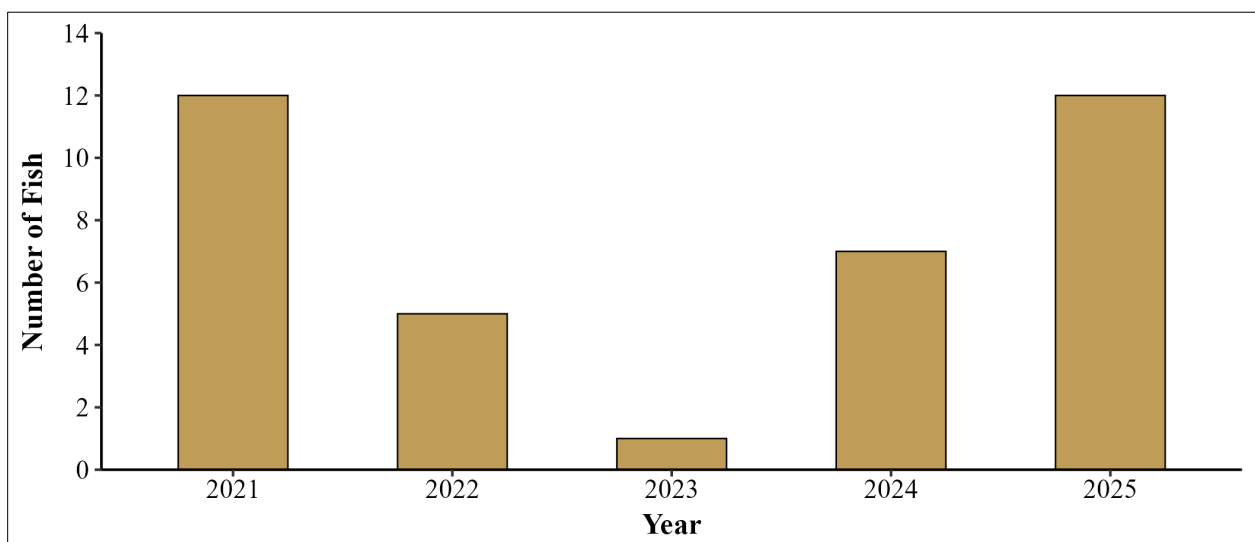


Figure 23.— Total number of fish captured in Center of the Universe Creek, 2021–2025.

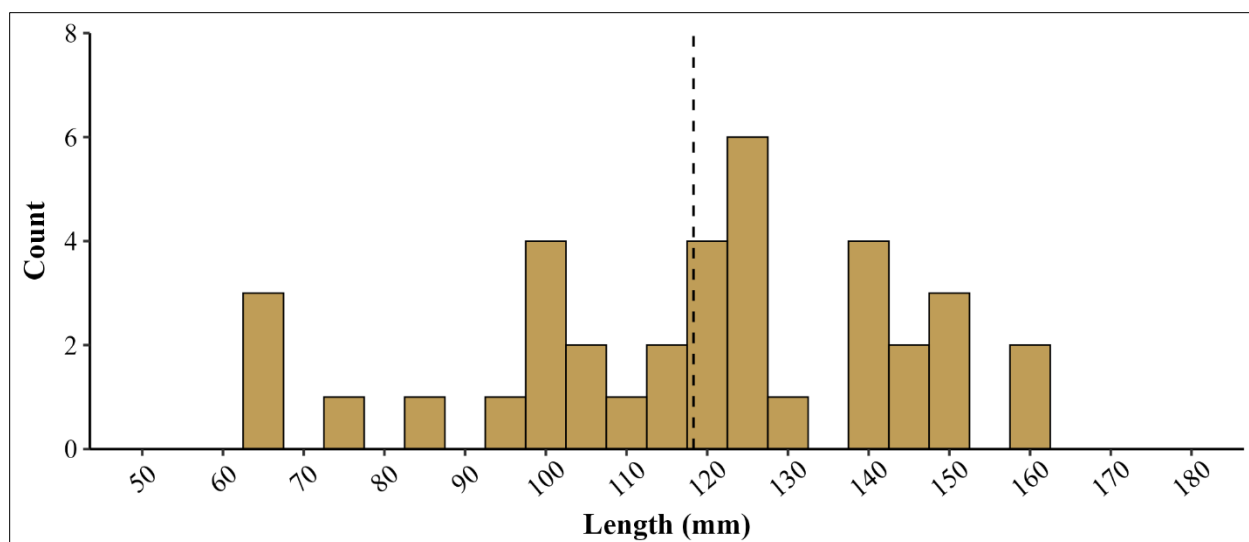


Figure 24.—Length frequency for Dolly Varden captured in minnow traps from Center of the Universe Creek, 2021–2025. The vertical dashed line represents the sample mean length.

LOWER RED ROCK CREEK

Water Quality

In July 2025, the pH was 7.33, the water temperature was 7.1°C, and the dissolved oxygen was 11.38 mg/L in Lower Red Rock Creek (Table 2). Water temperature in 2025 was higher than the previous years' values of 6.5°C in 2024 and 5.0°C in 2023. All in-situ water quality data are presented in Appendix B.

Periphyton

In 2025, mean chlorophyll-a concentration in Lower Red Rock Creek was 0.25 mg/m² (SD = 0.20). This value is similar to previous years' means which range from 0.1 mg/m² in 2023 to 0.32 mg/m² in 2021 (Figure 25). Complete periphyton data from 2025 are contained in Appendix C.

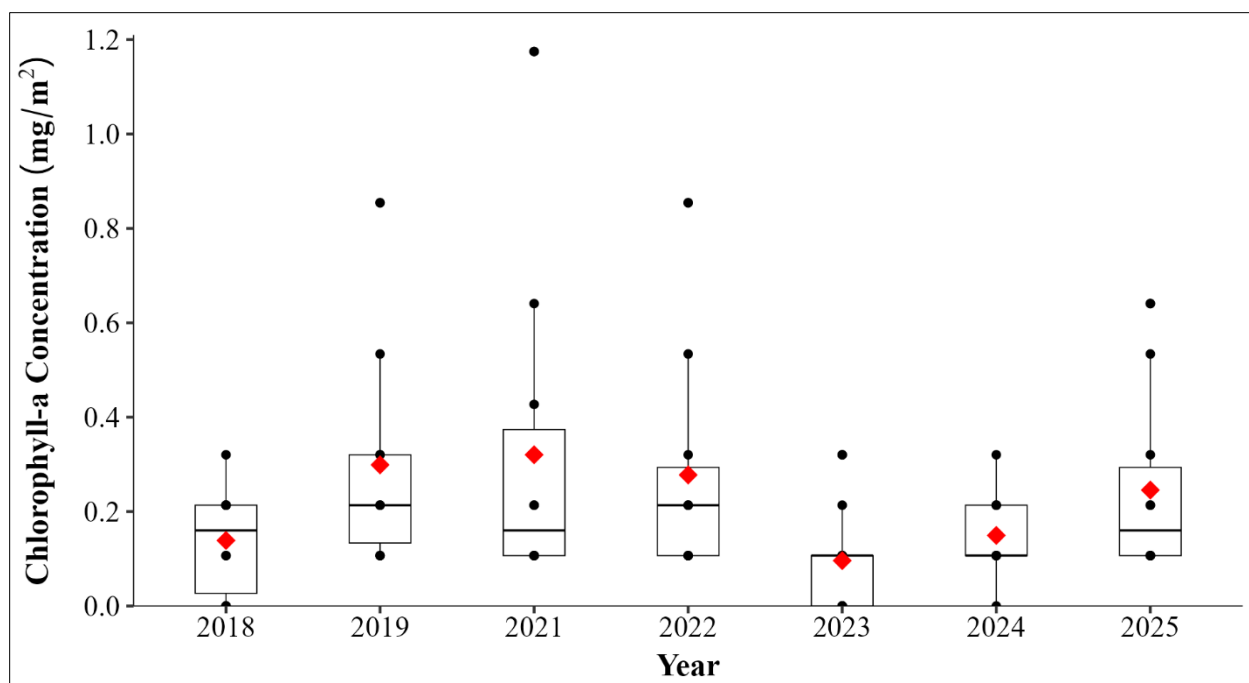


Figure 25.—Chlorophyll-a concentration boxplot by year at Lower Red Rock Creek, 2018–2025. Raw data are depicted by black dots and mean values are depicted in red.

Benthic Macroinvertebrates

Mean BMI density in Lower Red Rock Creek in 2025 was 112 BMI/m² (SD = 53). This is higher than the mean densities from the previous 3 years (Figure 26). In 2025, Diptera comprised 52% of the sample and EPT comprised 38%. Taxa composition has varied among years with EPT taxa dominating the sample in just one year (2021) and either Diptera or other taxa dominating in all other years (Figure 27). Taxa richness in 2025 was 13, an increase from the low in 2024 of 7 taxa (Figure 28). Taxa richness has been generally lower since switching to Hess samplers in 2021. BMI data from 2025 are presented in Appendix D.

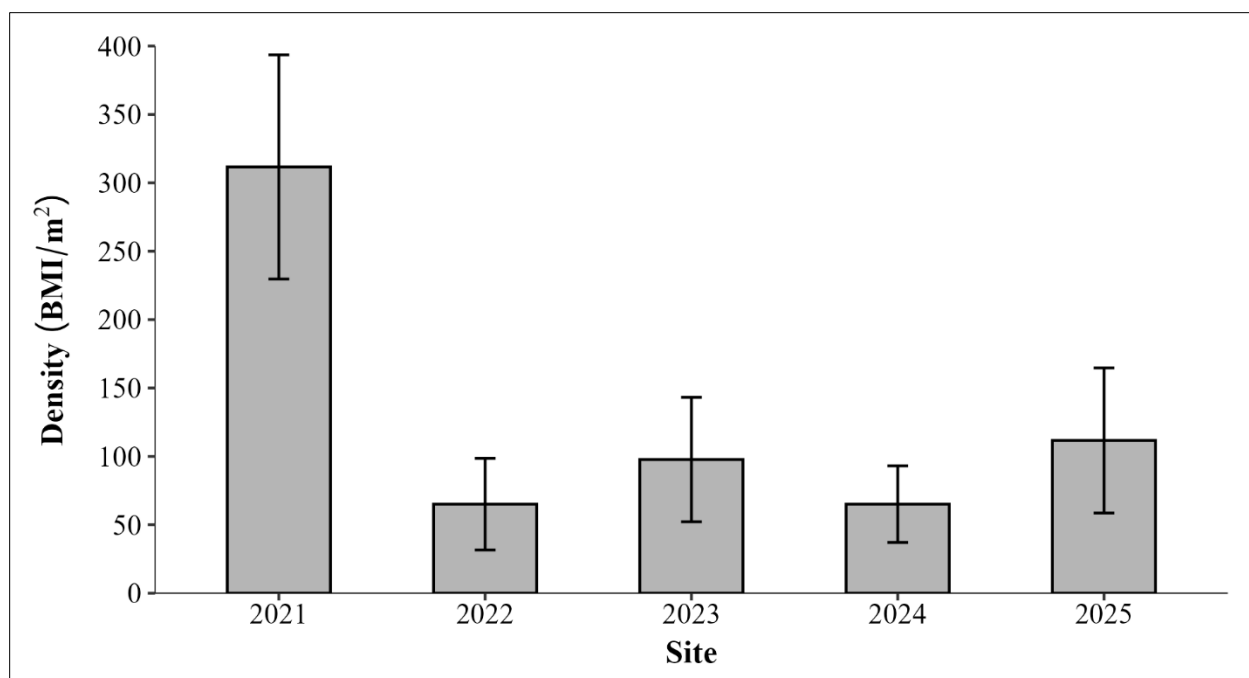


Figure 26.—Mean BMI density (± 1 SD) at Lower Red Rock Creek, 2021–2025.

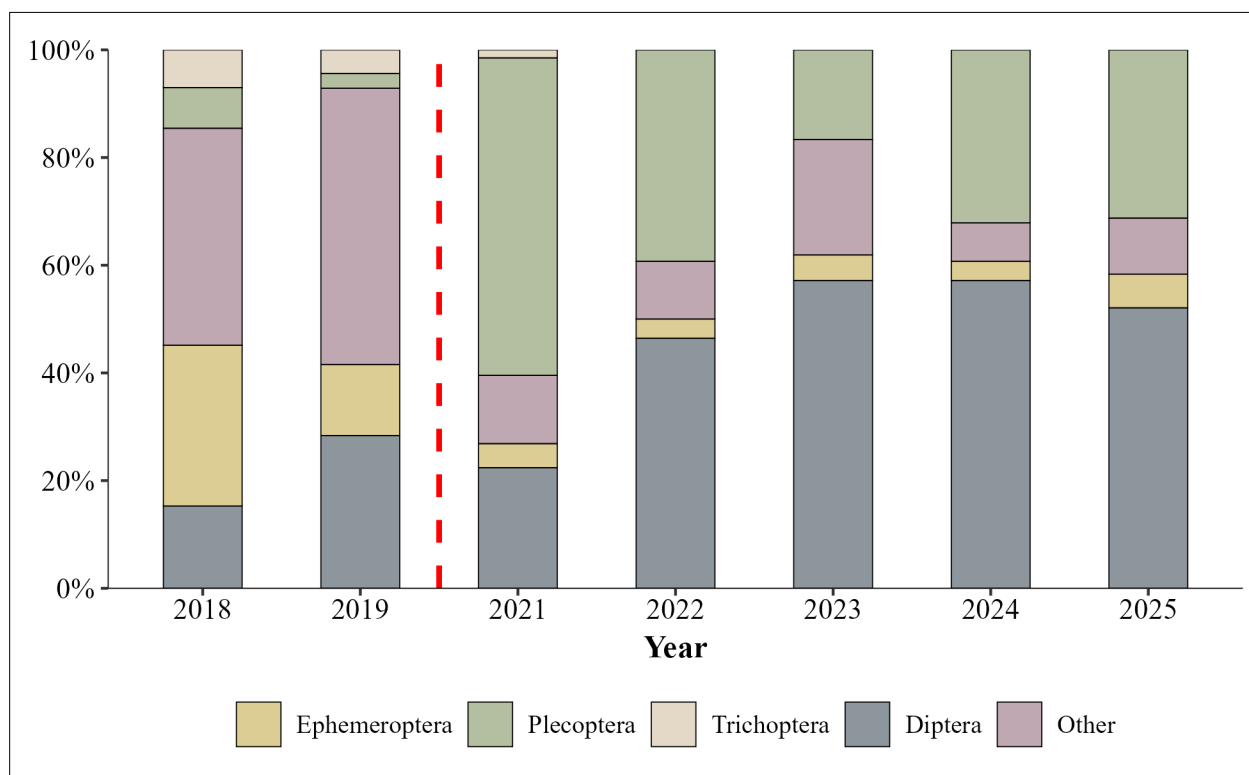


Figure 27.—Mean percent EPT, aquatic Diptera, and other taxa in Lower Red Rock Creek BMI samples, 2018–2025. The red dashed line denotes the change from drift nets to Hess sampler.

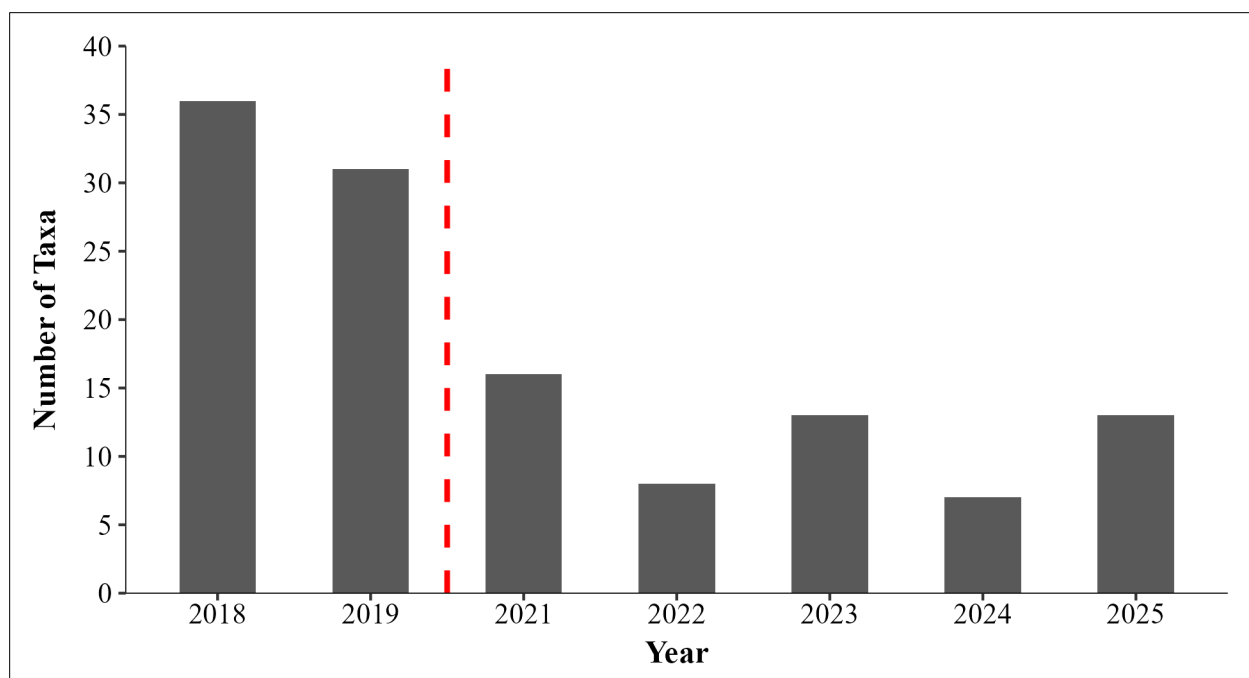


Figure 28.—Taxa richness in Lower Red Rock Creek BMI samples, 2018–2025. The red dashed line denotes the change from drift nets to Hess sampler.

Fish Captures

A total of 13 Dolly Varden and 1 slimy sculpin were captured in Lower Red Rock Creek in 2025. These catches are consistent with past years’ catch numbers (Figure 29). The Dolly Varden captured consist of multiple length classes ranging from 56–164 mm fork length with a mean of 114.4 mm (SD = 27.5; Figure 30). Captured slimy sculpin ranged from 50 – 77 mm total length, with the majority within the 60–75 mm length classes and a mean of 67.2 mm (SD = 6.2; Figure 30). All fish capture data are presented in Appendix E.

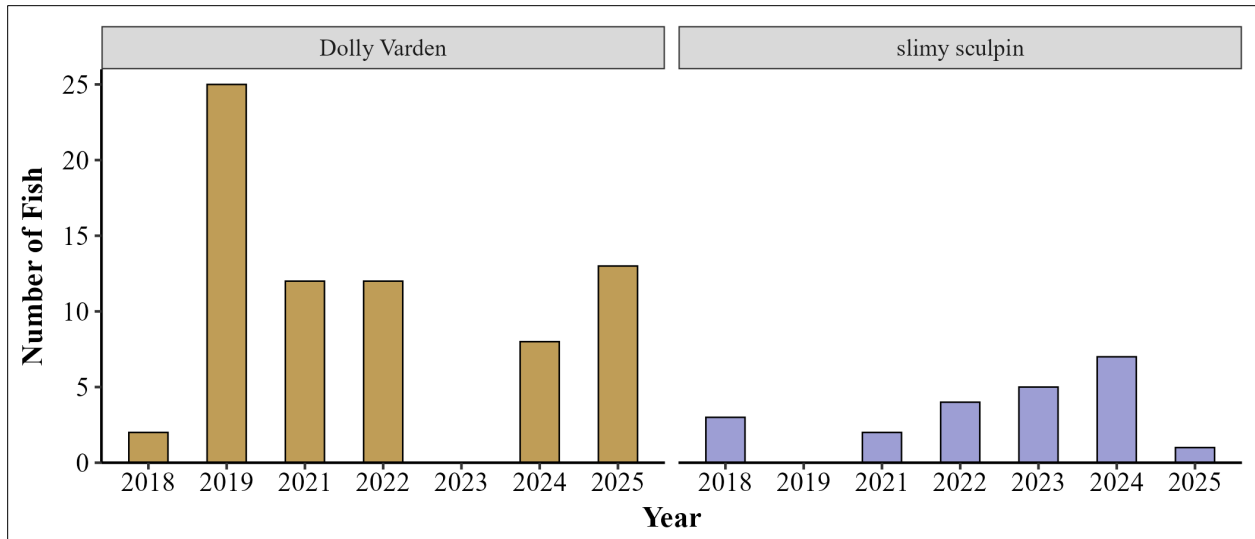


Figure 29.—Total number of fish captured in Lower Red Rock Creek, 2018–2025.

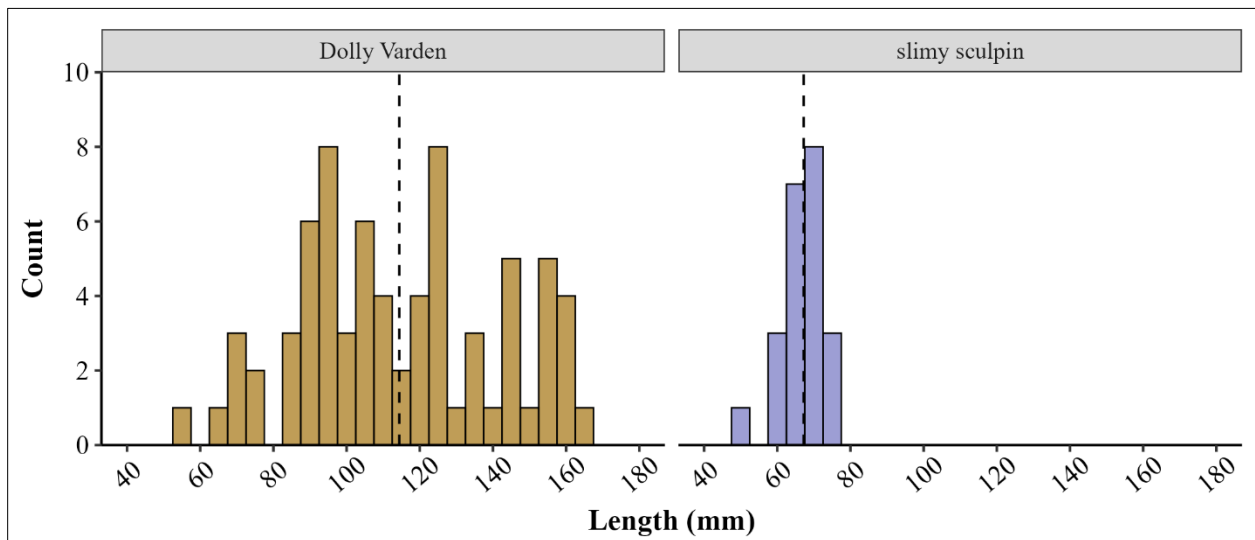


Figure 30.—Length frequency for all fish captured in minnow traps from Lower Red Rock Creek, 2018–2025. Dolly Varden are measured to fork length and slimy sculpin are measured to total length. The vertical dashed line represents the sample mean length.

UPPER SUBARCTIC CREEK

Water Quality

In July 2025, the pH was 8.02, the water temperature was 6.3°C, and the dissolved oxygen was 10.73 mg/L in Upper Subarctic Creek (Table 2). Water temperature has been relatively variable among years ranging from 3.9–6.3°C. All in situ water quality data are presented in Appendix B.

Periphyton

In 2025, mean chlorophyll-a concentration in Upper Subarctic Creek was 2.06 mg/m² (SD = 1.91). This value is within the range of previous years' means (Figure 31). Complete periphyton data from 2025 are contained in Appendix C.

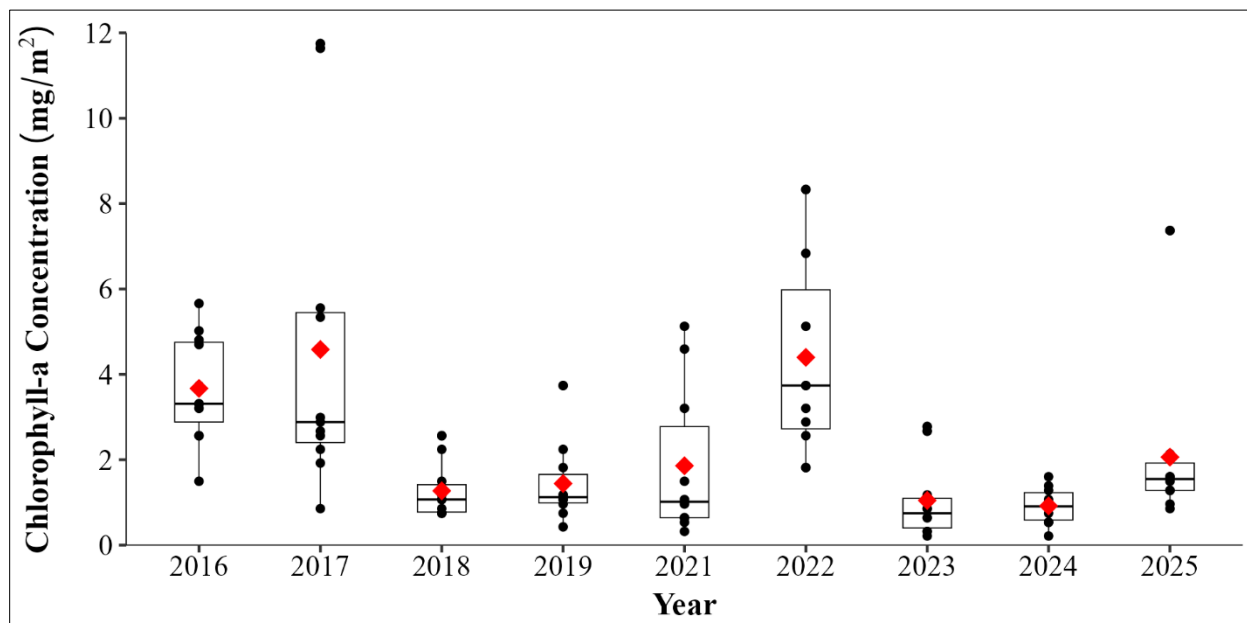


Figure 31.—Chlorophyll-a concentration boxplot by year at Upper Subarctic Creek, 2016–2025. Raw data are depicted by black dots and mean values are depicted in red.

Benthic Macroinvertebrates

Mean BMI density in Upper Subarctic Creek in 2025 was 4,007 BMI/m² (SD = 2,125). Density has been variable among years ranging from a low of 1,412 BMI/m² in 2023 to a high of 11,928 BMI/m² in 2021 (Figure 32). The proportion of EPT taxa present in samples from Upper Subarctic Creek has generally increased with time (Figure 33). In 2025, EPT taxa made up 38% and Diptera made up 26% of the sample. Taxa richness was similar to most previous years with 16 taxa present. Taxa richness has been variable among years, ranging from 11 in 2016 to 21 in 2024 (Figure 34). BMI data from 2025 can be found in Appendix D.

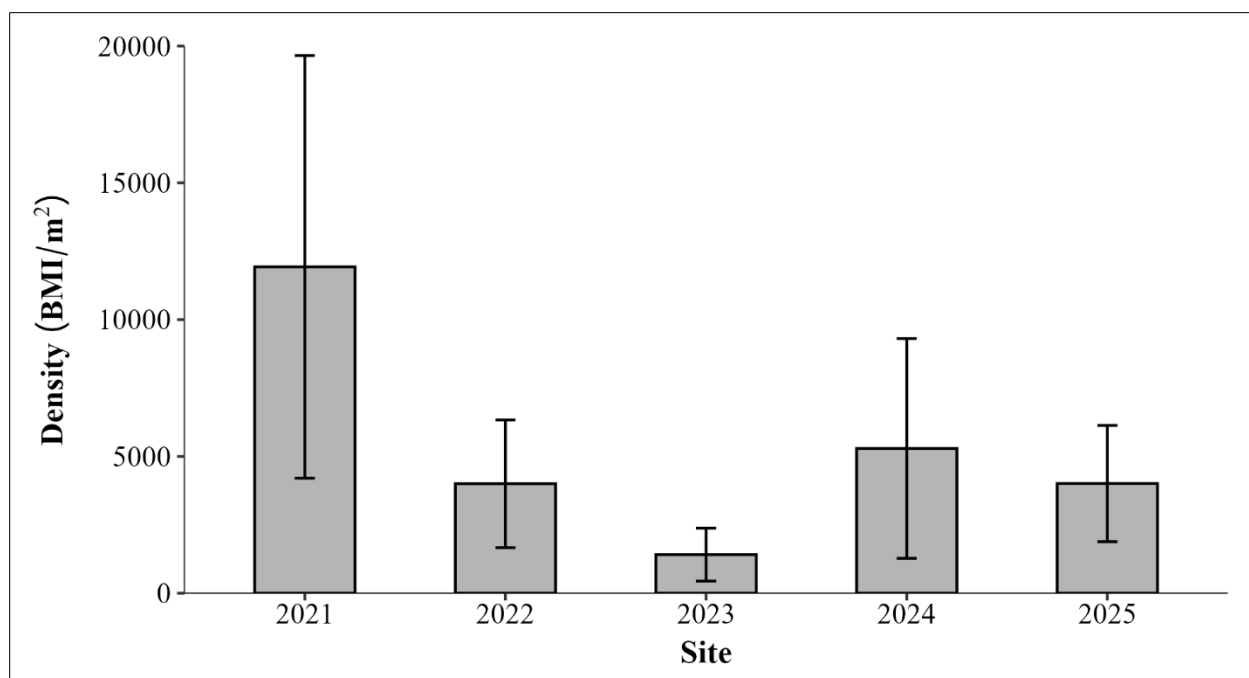


Figure 32.—Mean BMI density (± 1 SD) at Upper Subarctic Creek, 2021–2025.

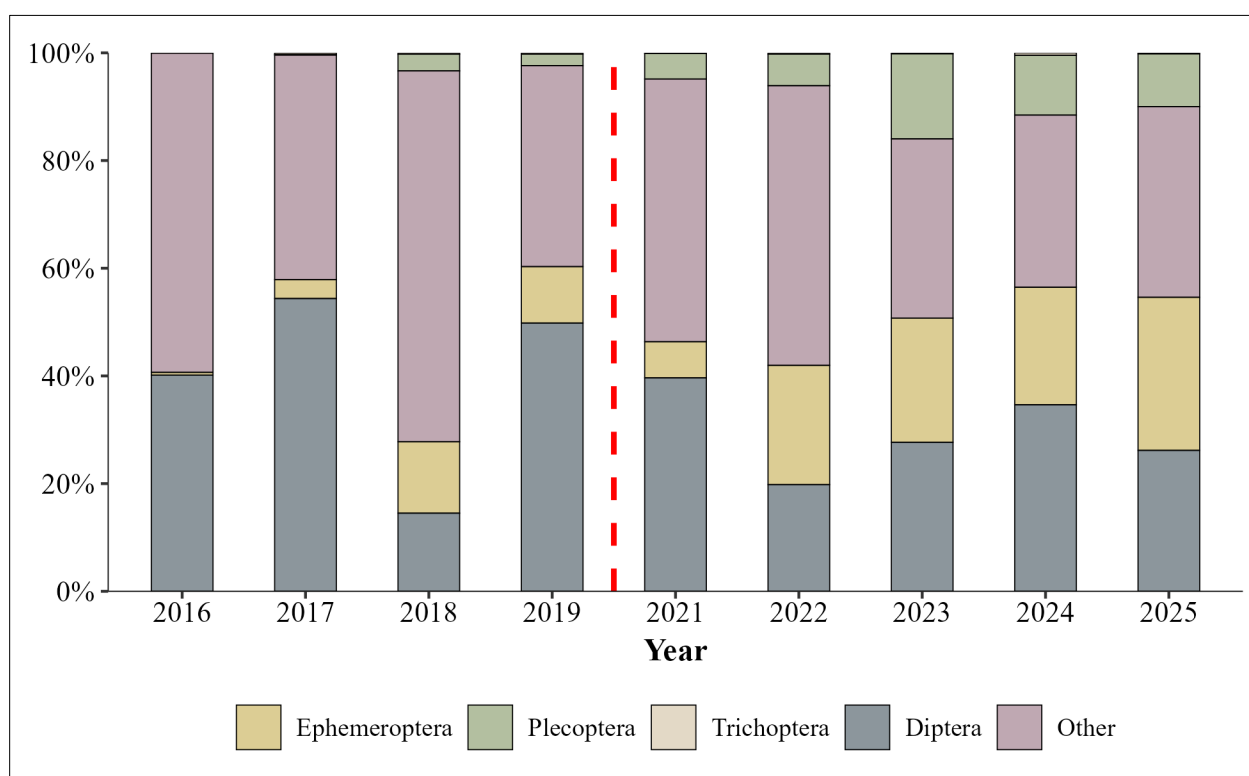


Figure 33.—Mean percent EPT, aquatic Diptera, and other taxa in Upper Subarctic Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

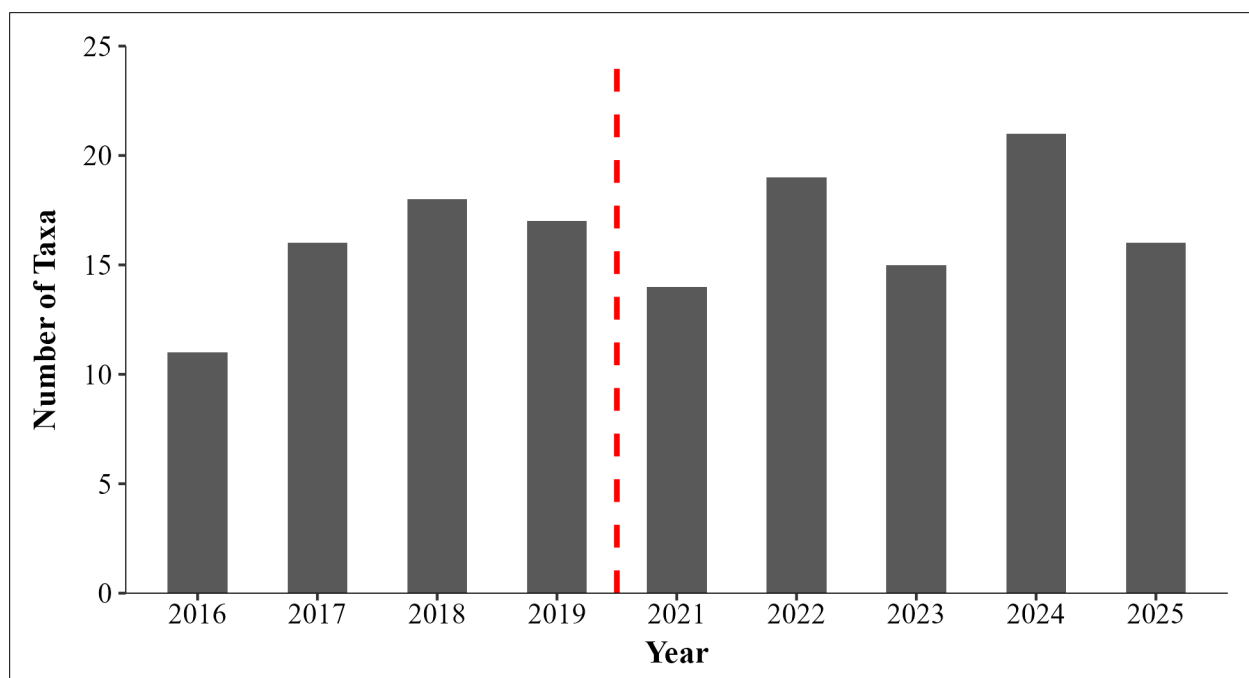


Figure 34.—Taxa richness in Upper Subarctic Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

Fish Captures

Dolly Varden have been the only fish species captured in Upper Subarctic Creek since sampling began in 2016. A total of 31 Dolly Varden were captured in 2025 which is similar to previous years' catches, except for 2019 when a bear crushed 9 out of 10 minnow traps and only 5 individuals were captured (Figure 35). Multiple length classes are present in Upper Subarctic Creek ranging from 64–165 mm fork length with a normal distribution and mean of 111.0 mm (SD = 18.7; Figure 36). All fish capture data are presented in Appendix E.

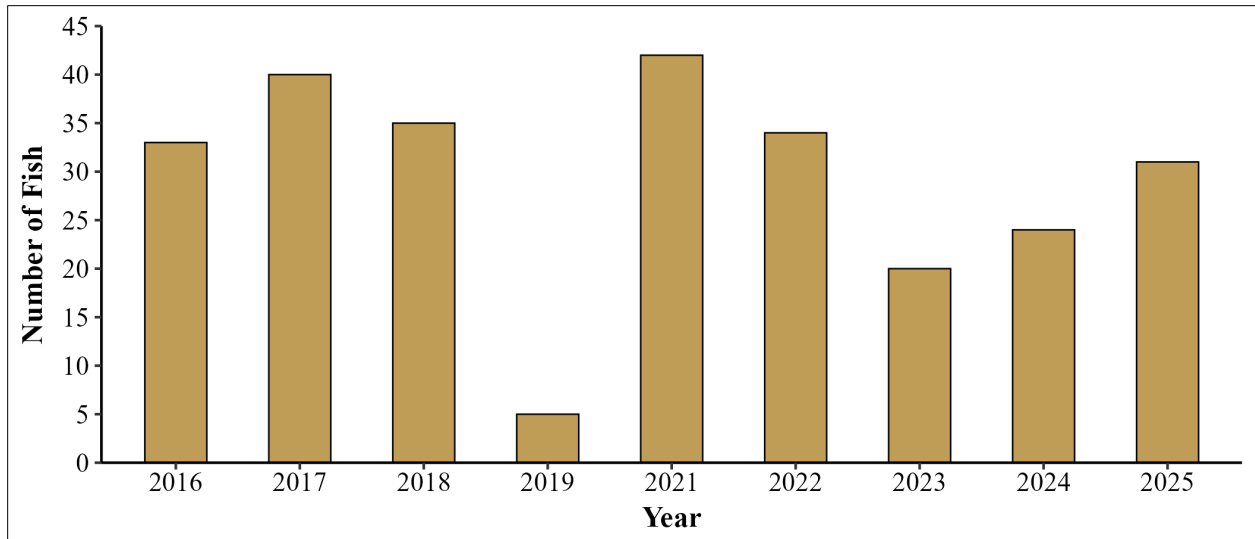


Figure 35.—Total number of fish captured in Upper Subarctic Creek, 2016–2025.

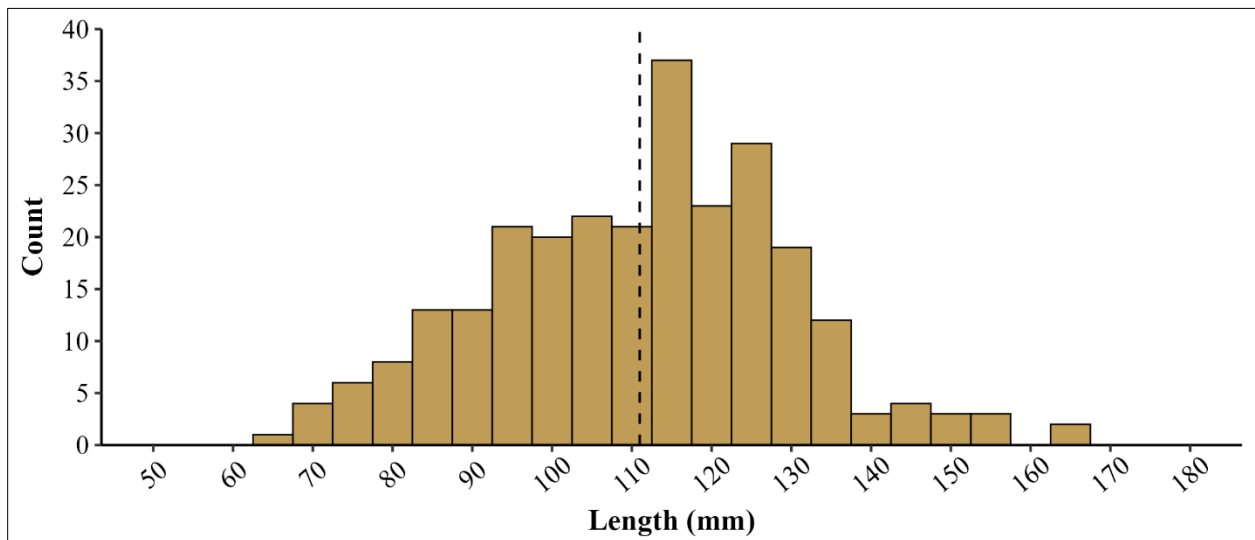


Figure 36.—Length frequency for Dolly Varden captured in minnow traps from Upper Subarctic Creek, 2016–2025. The vertical dashed line represents the sample mean length.

LOWER SUBARCTIC CREEK

Water Quality

In July 2025, the pH was 7.37, the water temperature was 8.1°C, and the dissolved oxygen was 11.17 mg/L in Lower Subarctic Creek (Table 2). Except for water temperature, which was the highest recorded during our sampling, these values are similar to previous years. All in situ water quality data are presented in Appendix B.

Periphyton

In 2025, mean chlorophyll-a concentration in Lower Subarctic Creek was 0.89 mg/m^2 ($\text{SD} = 0.42$). This value is similar to past years' means (Figure 37). Complete periphyton data from 2025 are contained in Appendix C.

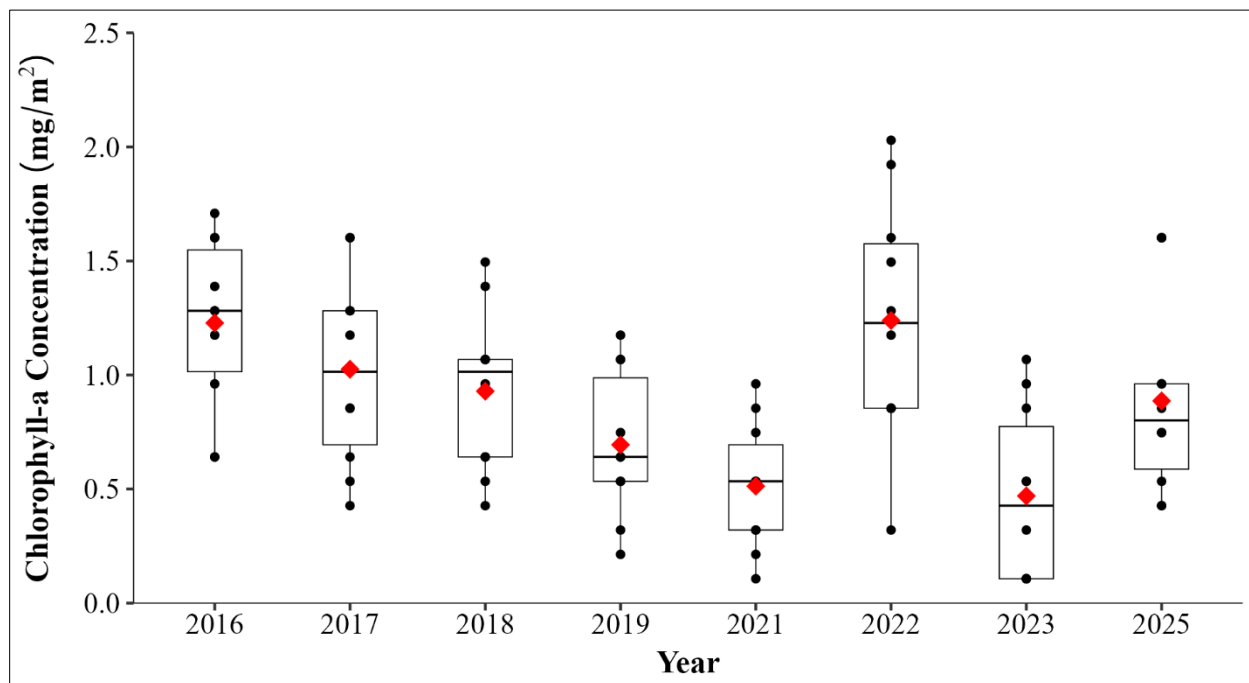


Figure 37.—Chlorophyll-a concentration boxplot by year at Lower Subarctic Creek, 2016–2025. Raw data are depicted by black dots and mean values are depicted in red.

Benthic Macroinvertebrates

Mean BMI density in Lower Subarctic Creek was the highest on record in 2025 at $3,047 \text{ BMI/m}^2$ ($\text{SD} = 2,043$). Previously, mean BMI density ranged from 667 BMI/m^2 in 2024 to $2,493 \text{ BMI/m}^2$ in 2022 (Figure 38). Beginning in 2021, EPT taxa have made up a larger proportion of the sample from Lower Subarctic Creek than Diptera (Figure 39). In 2025 EPT taxa composed 26% of the sample and Diptera composed 20% of the sample. Other species, primarily Oligochaetes, made up 53% of the sample in 2025. Taxa richness increased in 2025 to 21 taxa present, up from the low of 11 taxa present in 2024. Taxa richness has been variable among years, but is generally lower since the sampling method switched to Hess sampler in 2021 (Figure 40). BMI data from 2025 are presented in Appendix D.

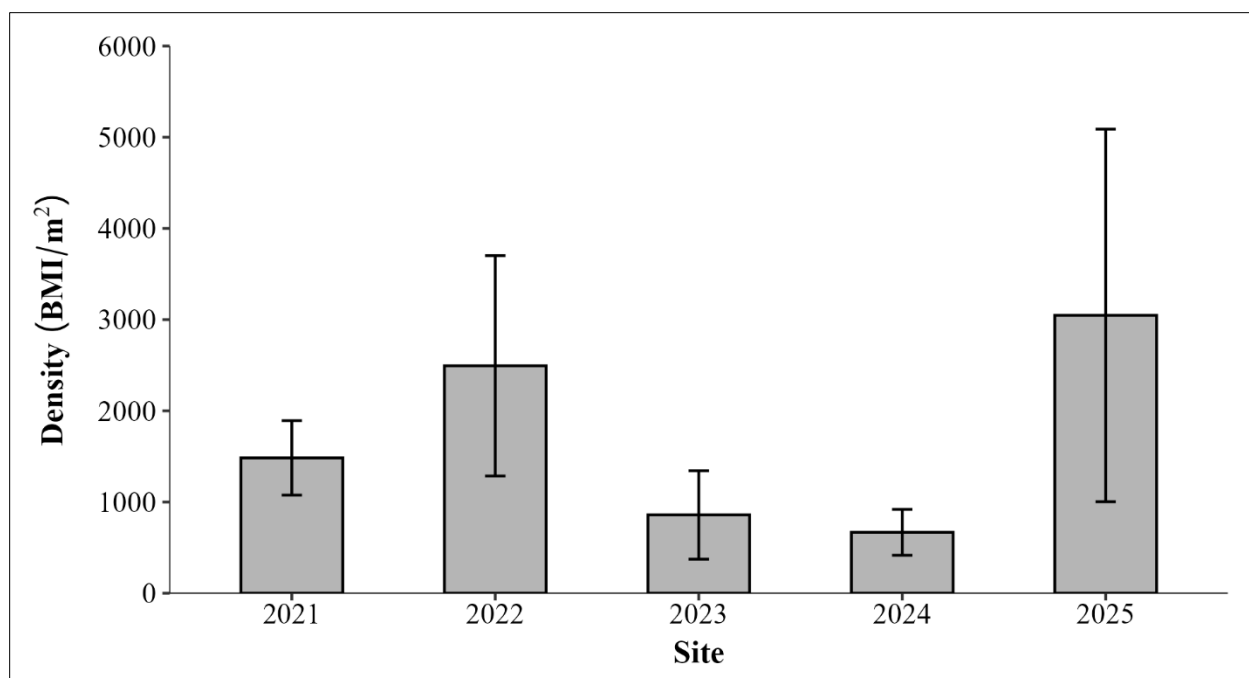


Figure 38.—Mean BMI density (± 1 SD) at Lower Subarctic Creek, 2021–2025.

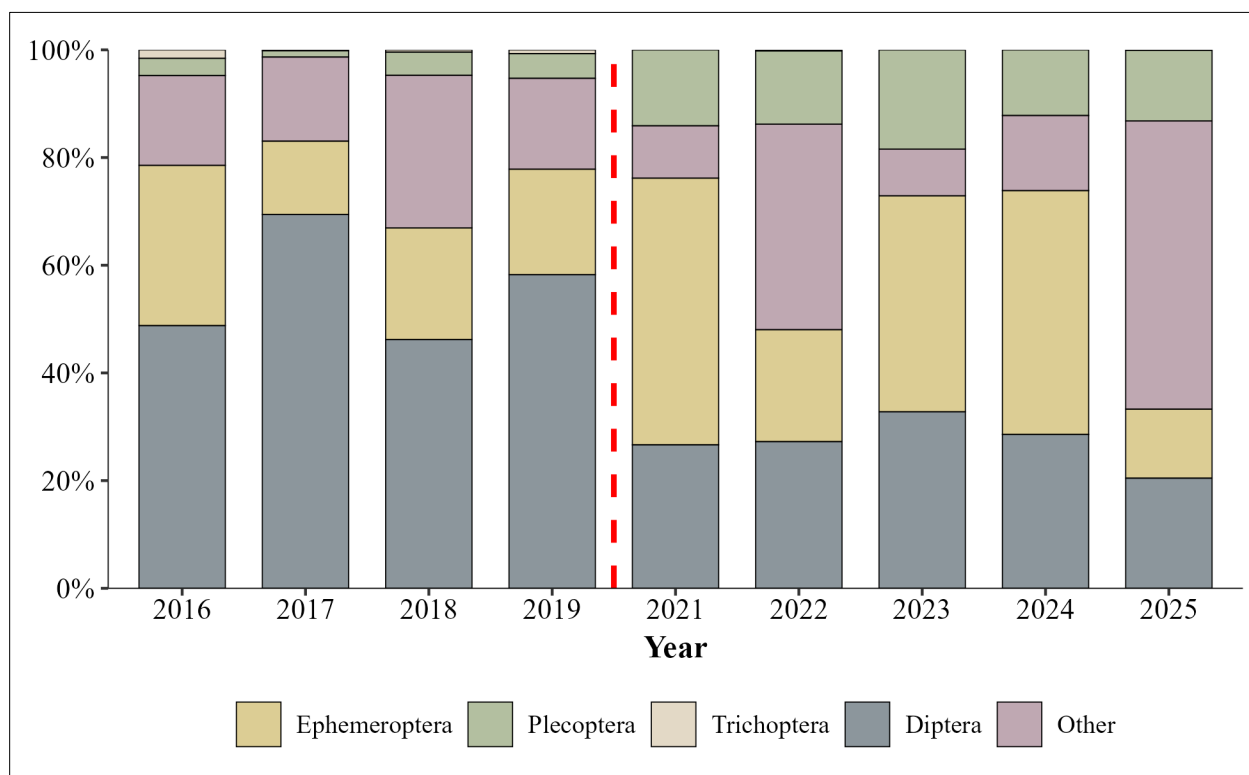


Figure 39.—Mean percent EPT, aquatic Diptera, and other taxa in Lower Subarctic Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

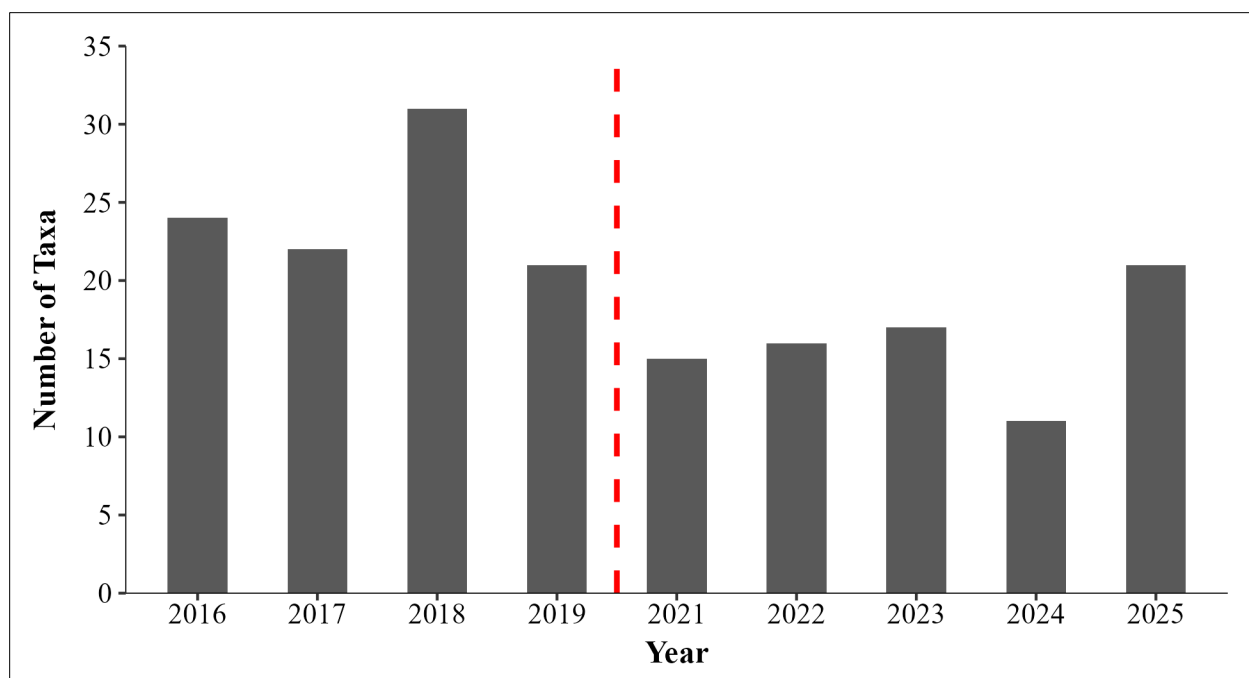


Figure 40.—Taxa richness in Lower Subarctic Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

Fish Captures

A total of 5 Dolly Varden and 3 slimy sculpin were captured in Lower Subarctic Creek in 2025. These catches are similar to previous years except for 2019 when 31 Dolly Varden were captured and 2023 when 20 slimy sculpin were captured (Figure 41). The Dolly Varden captured consist of multiple length classes ranging from 65–160 mm fork length with a mean of 102.4 mm (SD = 24.5; Figure 42). Captured slimy sculpin ranged from 41–91 mm total length, although the majority fell within the 60–75 mm length classes resulting in a normal distribution with a mean of 63.6 mm (SD = 9.0; Figure 42). All fish capture data are presented in Appendix E.

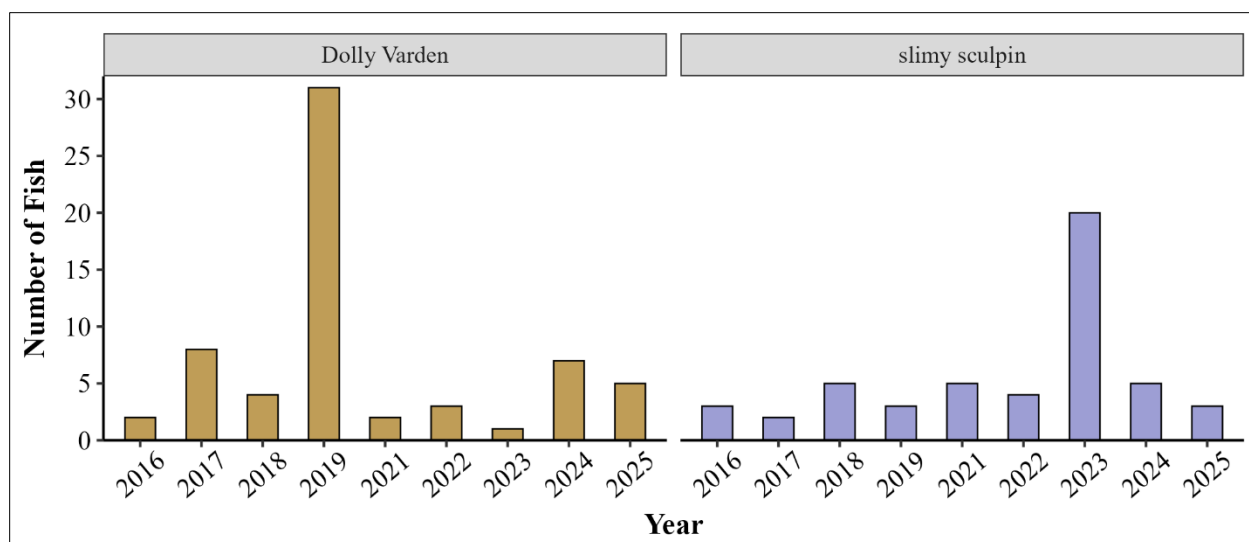


Figure 41.—Total number of fish captured in Lower Subarctic Creek, 2016–2025.

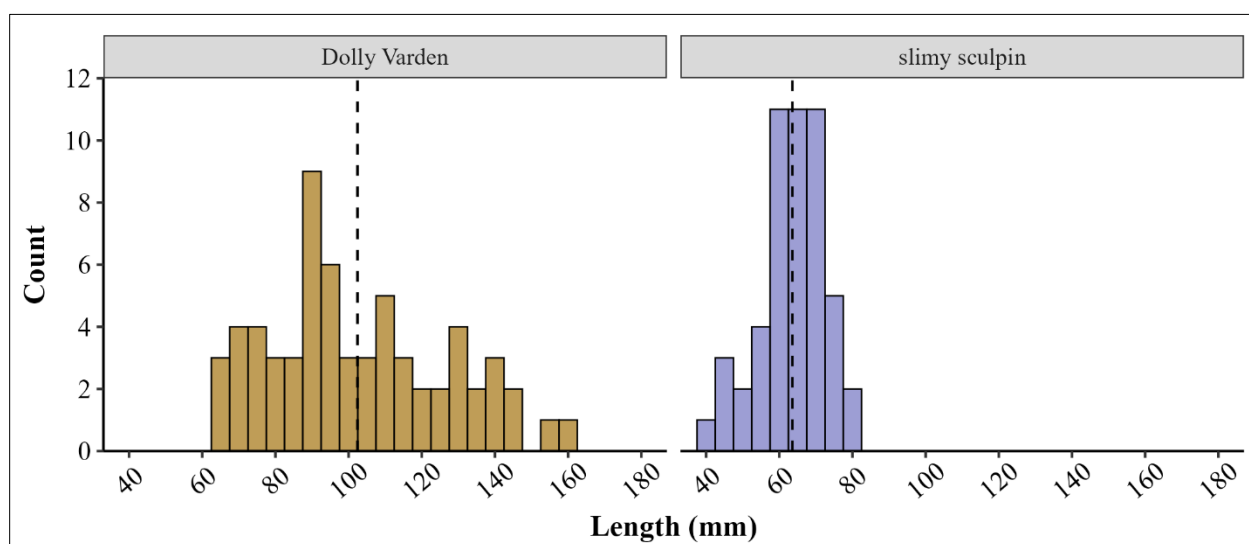


Figure 42.—Length frequency for all fish captured in minnow traps from Lower Subarctic Creek, 2016–2025. Dolly Varden are measured to fork length and slimy sculpin are measured to total length. The vertical dashed line represents the sample mean length.

UPPER RUBY CREEK

Water Quality

In July 2025, the pH was 8.23, the water temperature was 11.0°C, and the dissolved oxygen was 9.60 mg/L in Upper Ruby Creek (Table 2). This is the second year in-situ data were collected at this site, although the site was moved approximately 0.25 km upstream in 2025. All in-situ water quality data are presented in Appendix B.

Periphyton

In 2025, mean chlorophyll-a concentration in Upper Ruby Creek was 35.96 mg/m² (SD = 29.66). Since 2018, mean chlorophyll-a values have been 3 to 6 times those recorded in 2016 and 2017, but the variability among individual samples is much more pronounced (Figure 43). Complete periphyton data from 2025 are presented in Appendix C.

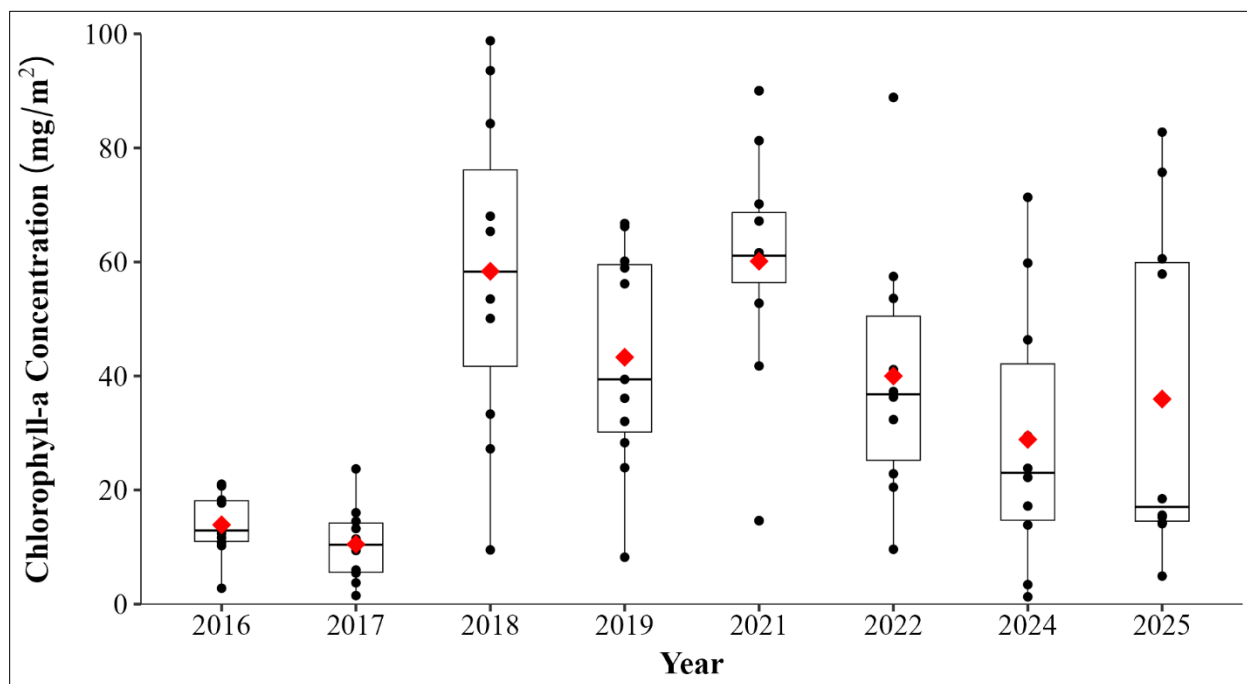


Figure 43.—Chlorophyll-a concentration boxplot by year at Upper Ruby Creek, 2016–2025. Raw data are depicted by black dots and mean values are depicted in red.

Benthic Macroinvertebrates

Mean BMI density in Upper Ruby Creek in 2025 was 13,665 BMI/m² (SD = 3,249), more than a ten-fold increase from the low of 1,128 BMI/m² (SD = 335) observed in 2024 (Figure 44). Taxa composition has varied among years, but Diptera have exceeded EPT taxa in all years of data (Figure 45). EPT taxa composition in 2025 was 7% of the sample, and Diptera was 88%. In previous years EPT taxa composition ranged from 3% in 2018, 2019, and 2021 to 22% in 2024 (Figure 45). Conversely, taxa richness has remained within a small range of 22 in 2021 and 2025 to 28 in 2017 (Figure 46). BMI data from 2025 are presented in Appendix D.

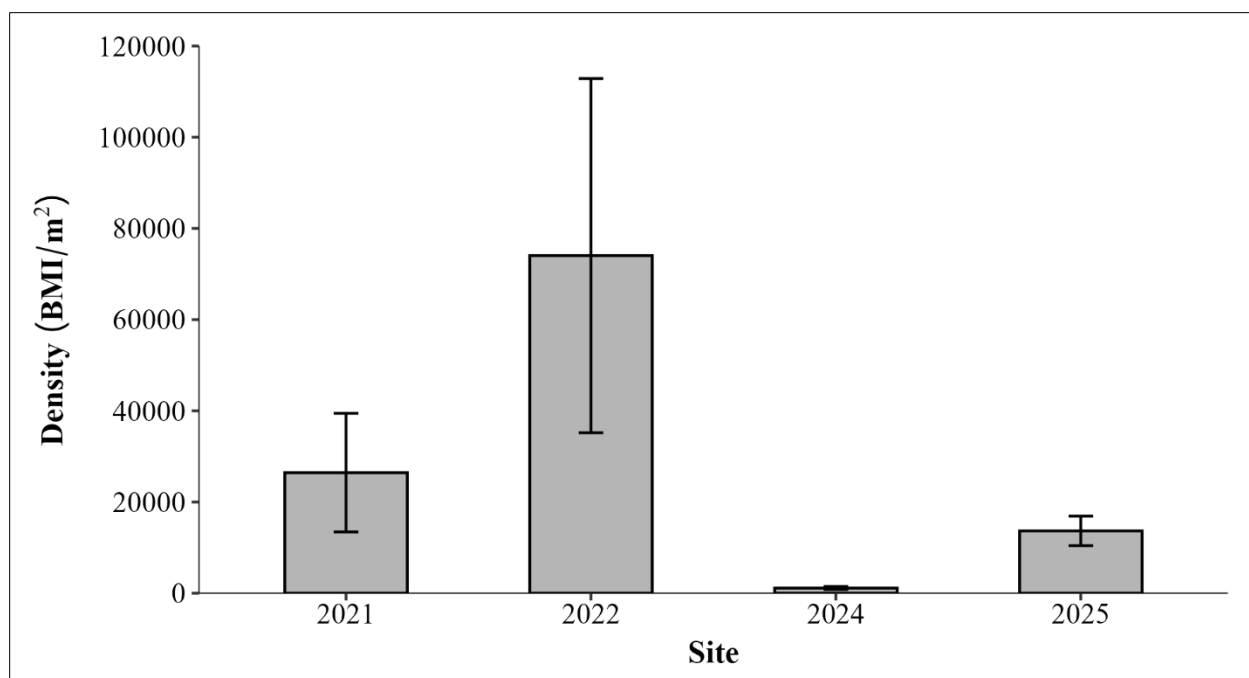


Figure 44.—Mean BMI density (± 1 SD) at Upper Ruby Creek, 2021–2025. Not sampled in 2023.

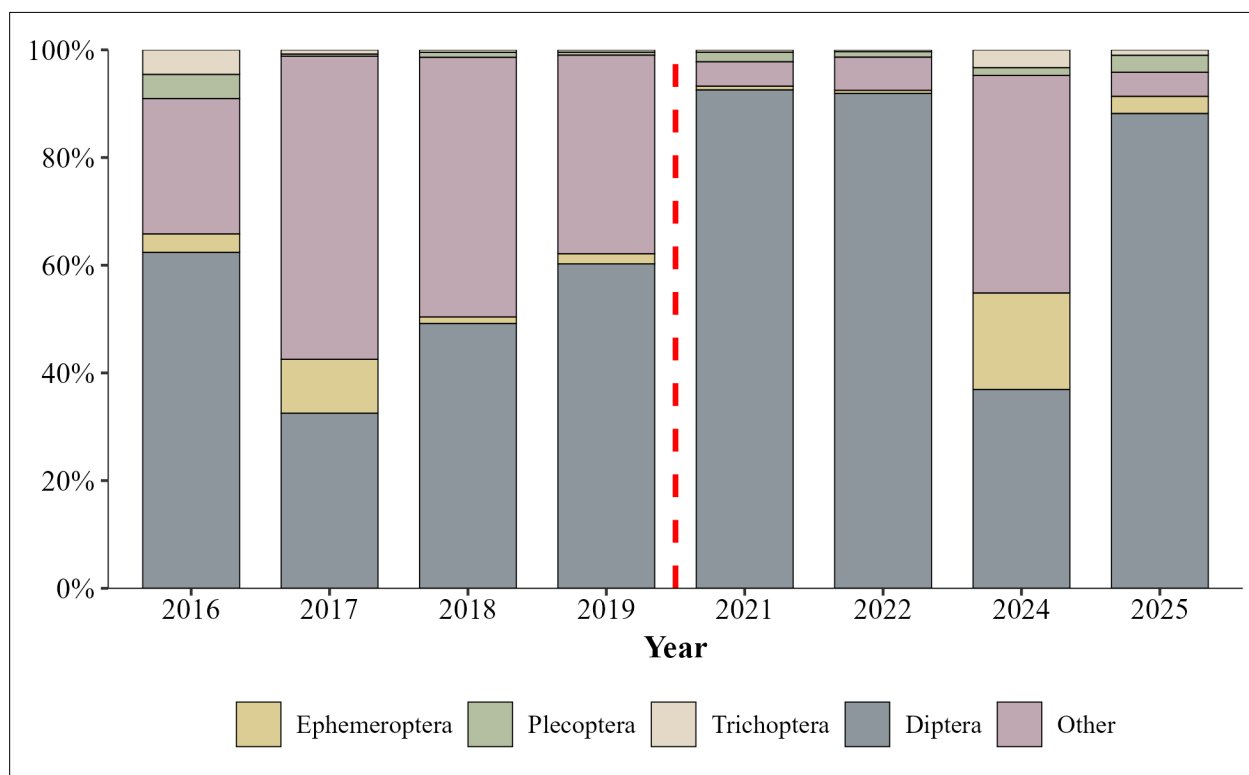


Figure 45.—Mean percent EPT, aquatic Diptera, and other taxa in Upper Ruby Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

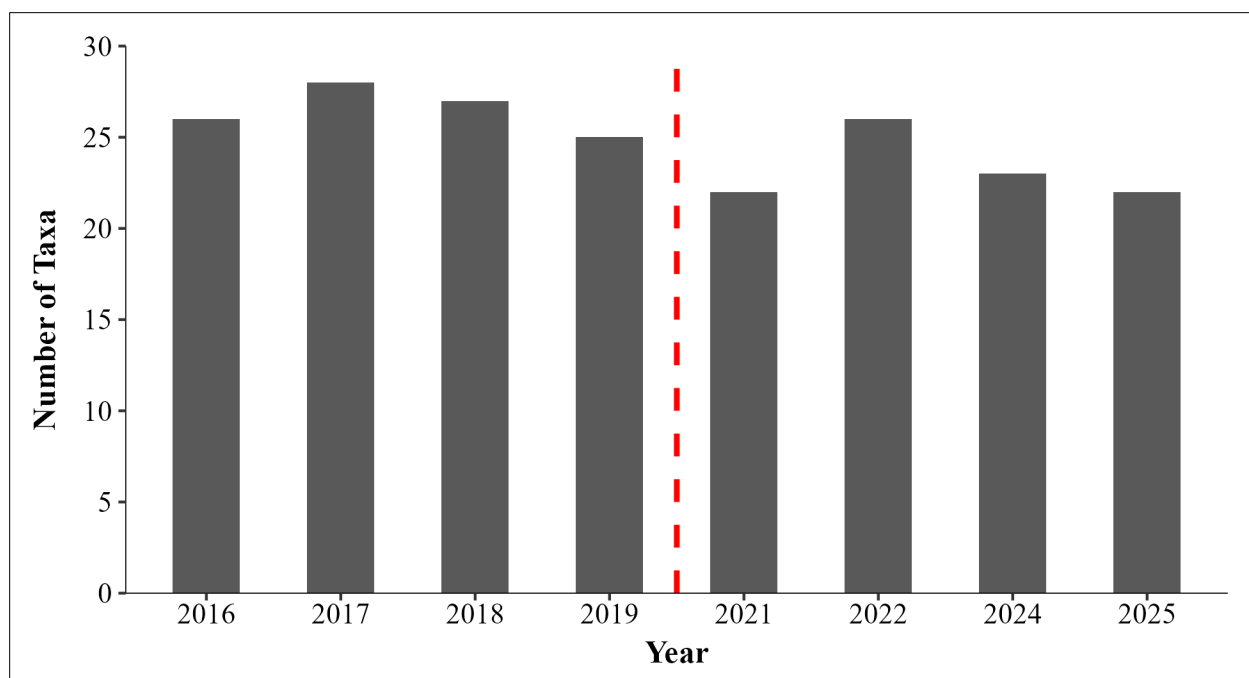


Figure 46.—Taxa richness in Upper Ruby Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

Fish Captures

Slimy sculpin continued to comprise the majority of fish captures in Upper Ruby Creek in 2025. A total of 58 slimy sculpin and 3 Dolly Varden were captured in 2025, which is similar to previous years' catches (Figure 47). The majority of Dolly Varden captured have been greater than 110 mm fork length with a mean of 139.8 mm (SD = 28.3; Figure 48). Slimy sculpin length frequency exhibits a normal distribution with a range of 28–110 mm total length and a mean of 73.6 mm (SD = 12.2; Figure 48). All fish capture data are presented in Appendix E.

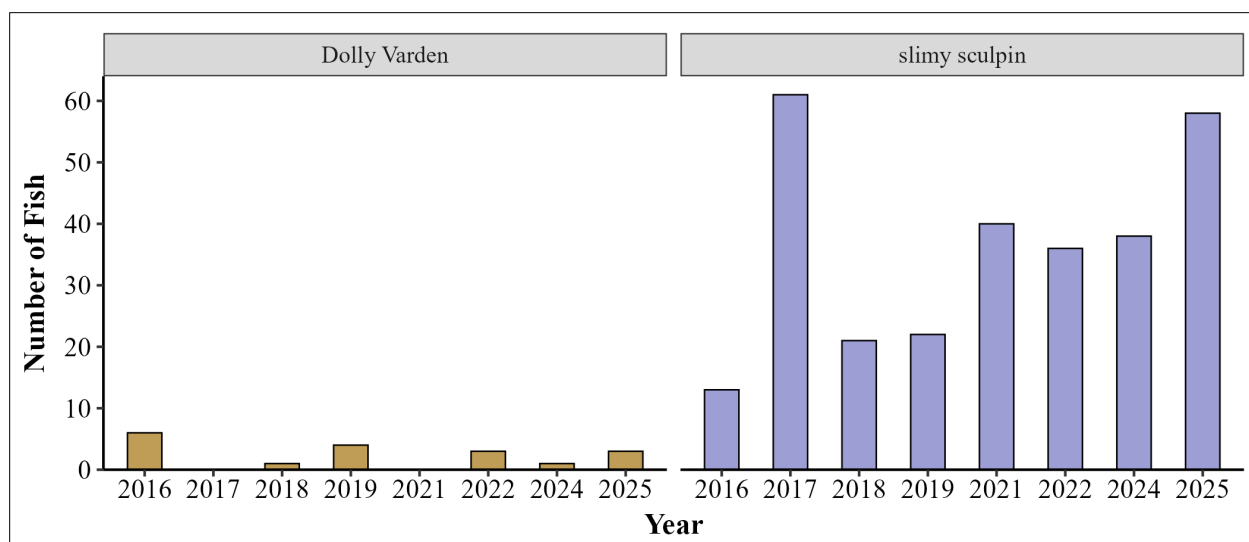


Figure 47.—Total number of fish captured in Upper Ruby Creek, 2016–2025.

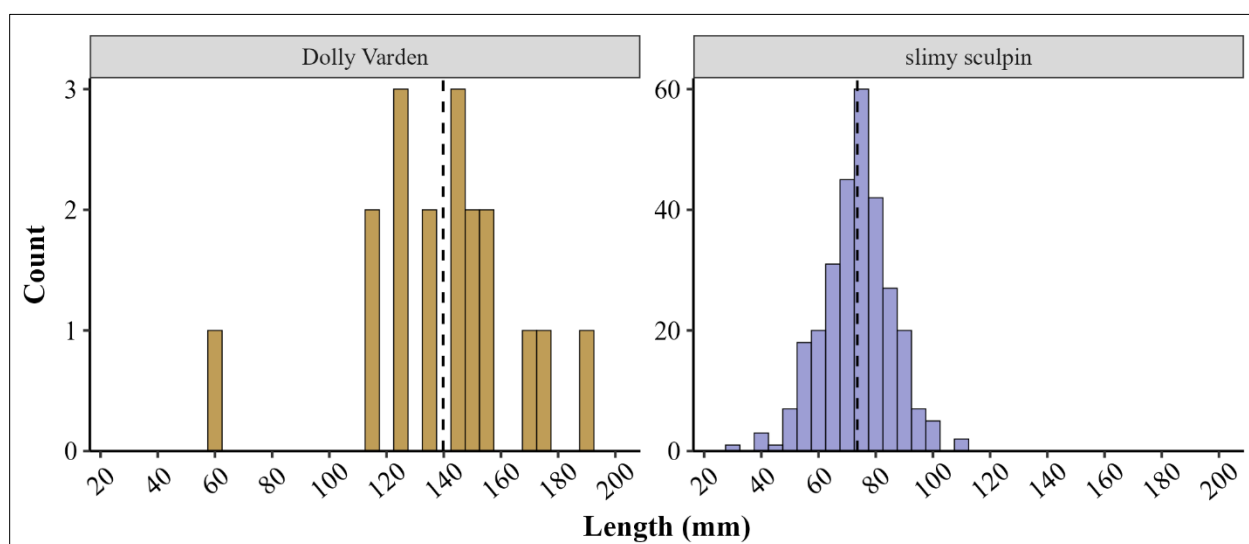


Figure 48.—Length frequency for all fish captured in minnow traps from Upper Ruby Creek, 2016–2025. Dolly Varden are measured to fork length and slimy sculpin are measured to total length. The vertical dashed line represents the sample mean length. Note difference in y-axis scale between species.

JAY CREEK

Water Quality

In July 2025, the pH was 8.0, the water temperature was 7.1°C, and the dissolved oxygen was 11.28 mg/L in Jay Creek (Table 2). Water temperature has ranged from 5.6–7.1°C. Other water quality parameters have remained similar among years. All in situ water quality data are presented in Appendix B.

Periphyton

In 2025, mean chlorophyll-a concentration in Jay Creek was 2.06 mg/m² (SD = 0.84). This is the lowest mean concentration on record (Figure 49). Notably higher means in 2017 and 2021 were likely due to two high value concentrations in the data (Figure 49). Complete periphyton data from 2025 are contained in Appendix C.

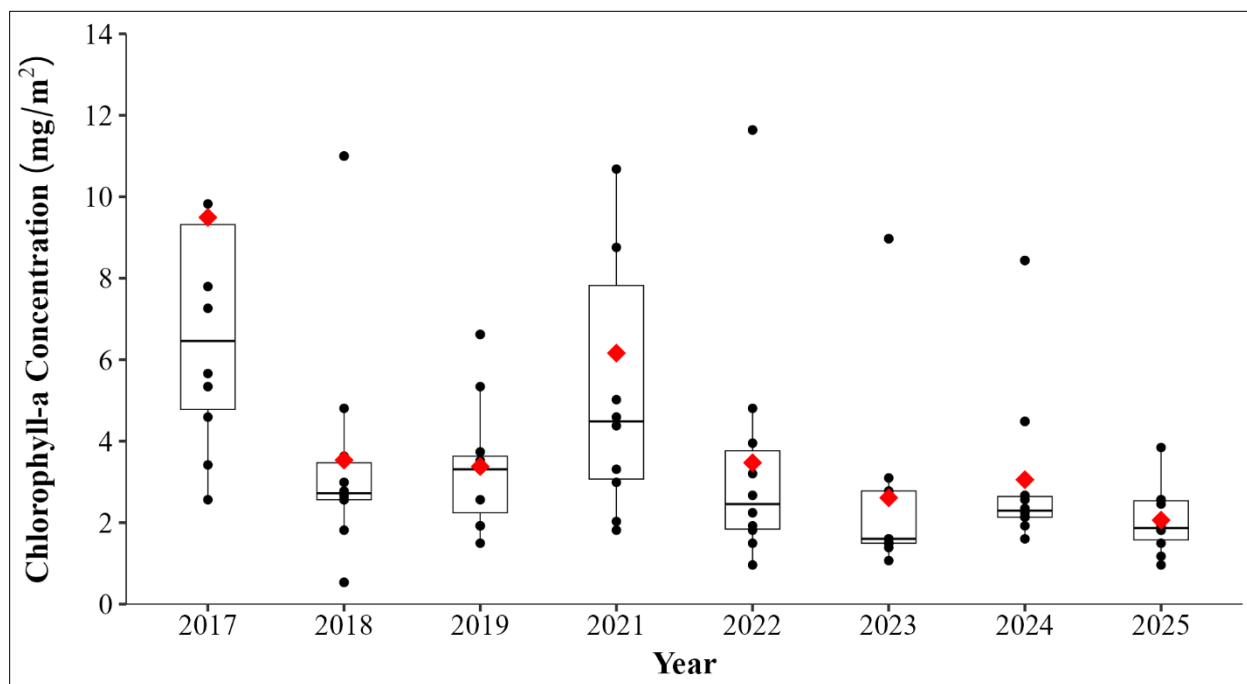


Figure 49.—Chlorophyll-a concentration boxplot by year at Jay Creek, 2017–2025. Raw data are depicted by black dots and mean values are depicted in red. Note that two high values from 2017 (21.78 and 26.7 mg/m²) and one high value from 2021 (18.05 mg/m²) are excluded from this plot but not from statistical analyses.

Benthic Macroinvertebrates

Mean BMI density in 2025 was 2,012 BMI/m² (SD = 373) which is similar to the mean in 2024 and falls within the range among all years of data (Figure 50). Taxa composition has varied among years. In 2025 the proportion of EPT taxa was 38% of the sample and Diptera was 50% (Figure 51). Taxa richness in 2025 was 21 taxa, similar to previous years. Taxa richness has remained within a small range of 19–26 among years (Figure 52). BMI data from 2025 are presented in Appendix D.

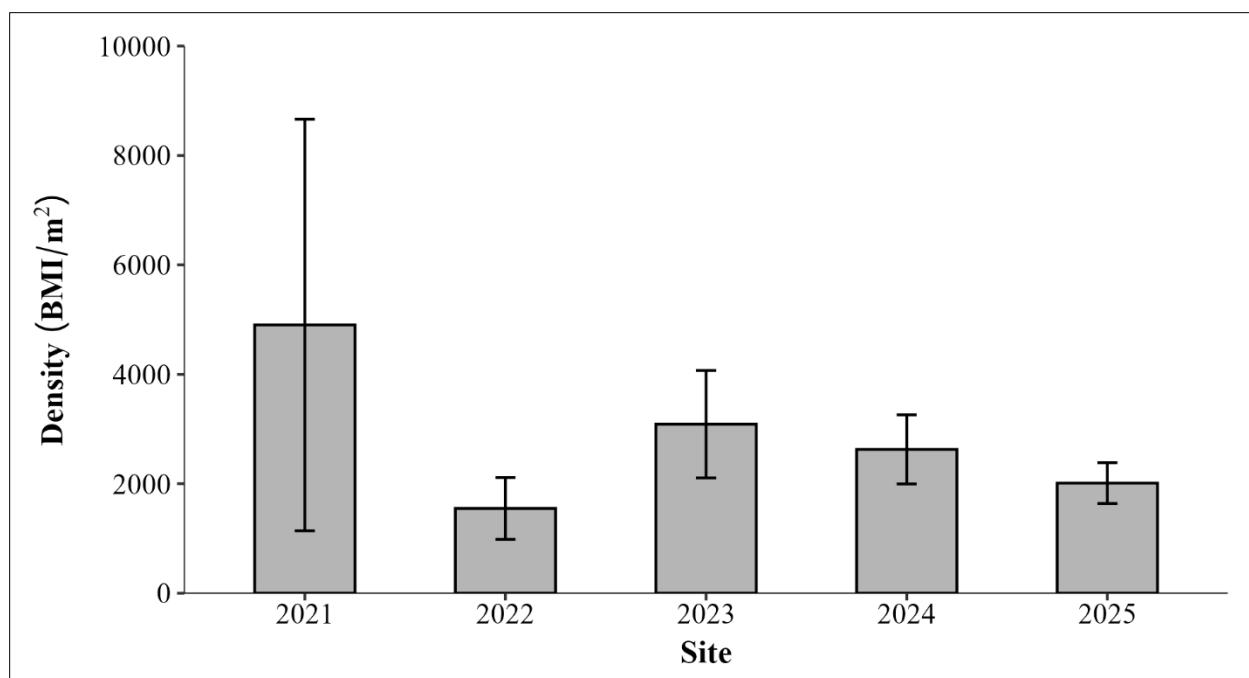


Figure 50.—Mean BMI density (± 1 SD) at Jay Creek, 2021–2025.

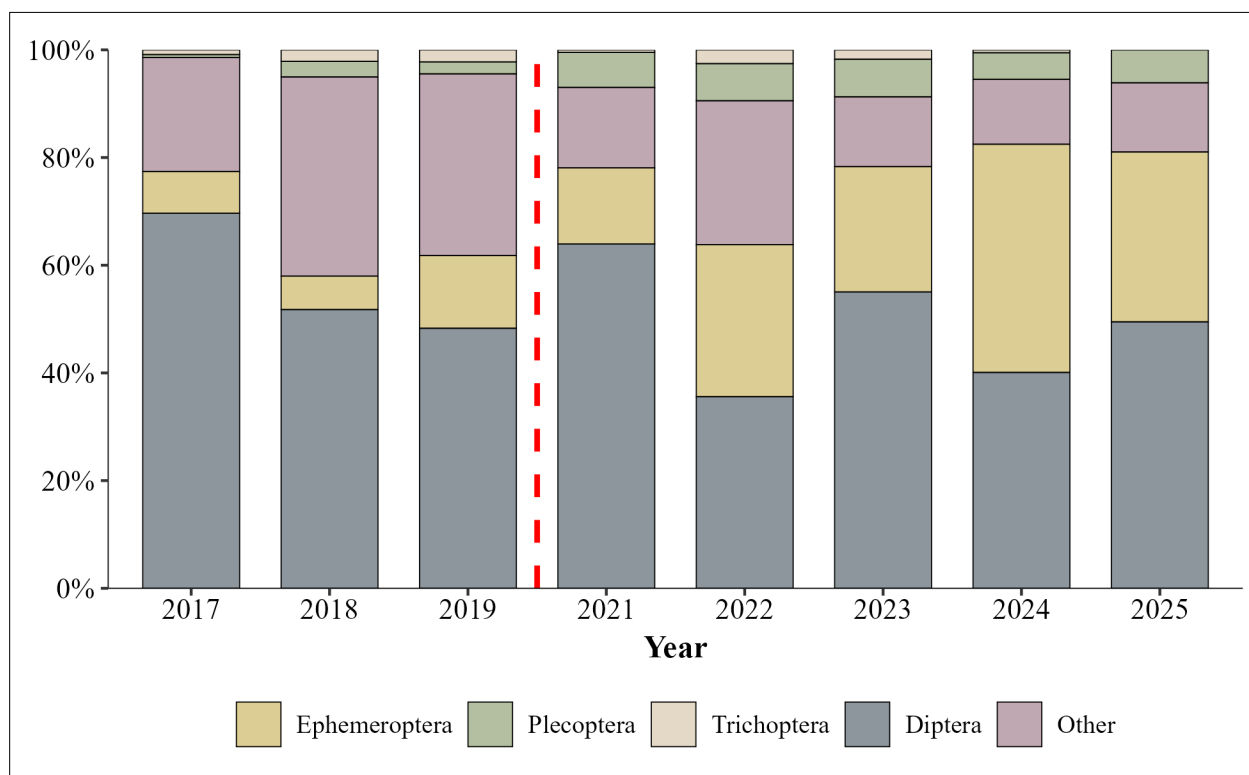


Figure 51.—Mean percent EPT, aquatic Diptera, and other taxa in Jay Creek BMI samples, 2017–2025. The red dashed line denotes the change from drift nets to Hess sampler.

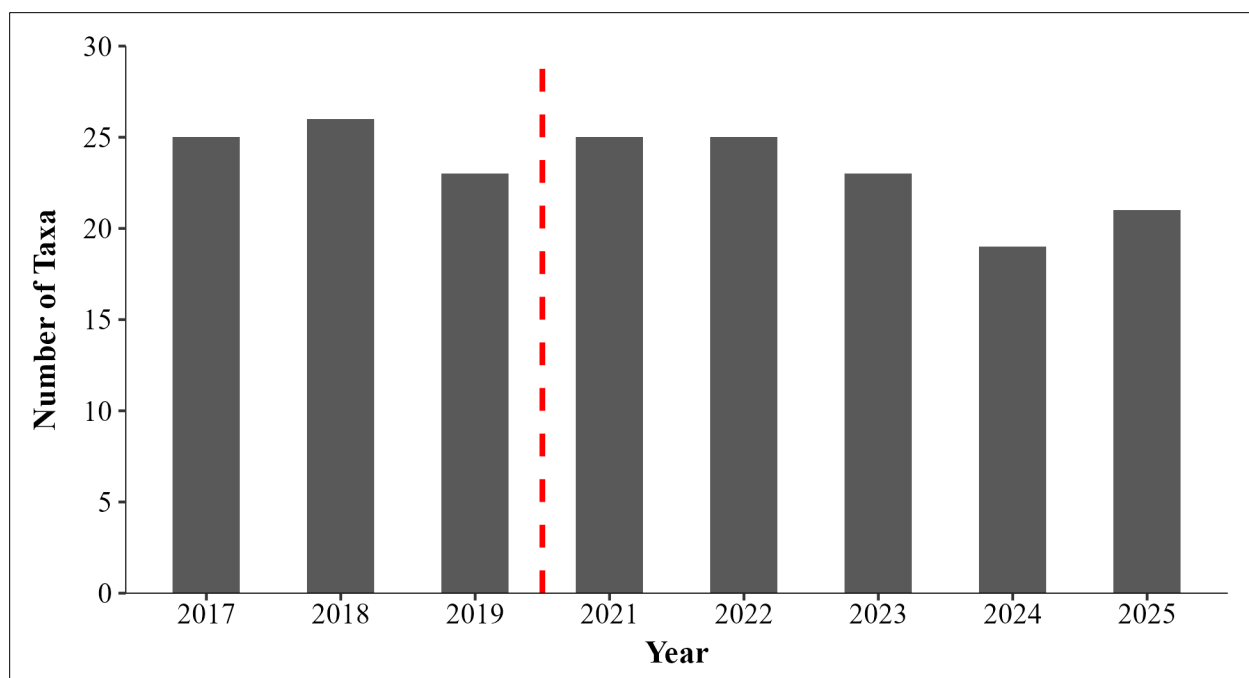


Figure 52.–Taxa richness in Jay Creek BMI samples, 2017–2025. The red dashed line denotes the change from drift nets to Hess sampler.

Fish Captures

Slimy sculpin were captured for the first time in Jay Creek in 2025. The new capture of slimy sculpin may be related to the changing flow path of Jay Creek, where the creek is now flowing in a braided fashion through swampier habitat downstream of the trail crossing. A total of 3 Dolly Varden and 4 slimy sculpin were captured in Jay Creek in 2025 (Figure 53). Previous years’ total Dolly Varden catch ranged from 1–11 individuals. The Dolly Varden length frequency exhibits a uniform distribution with a range of 79–168 mm and a mean of 121.7 mm fork length (SD = 23.5; Figure 54). Slimy sculpin length ranged from 65–87 mm total length, with a mean of 74.3 mm (SD = 9.9; Figure 54). All fish capture data are presented in Appendix E.

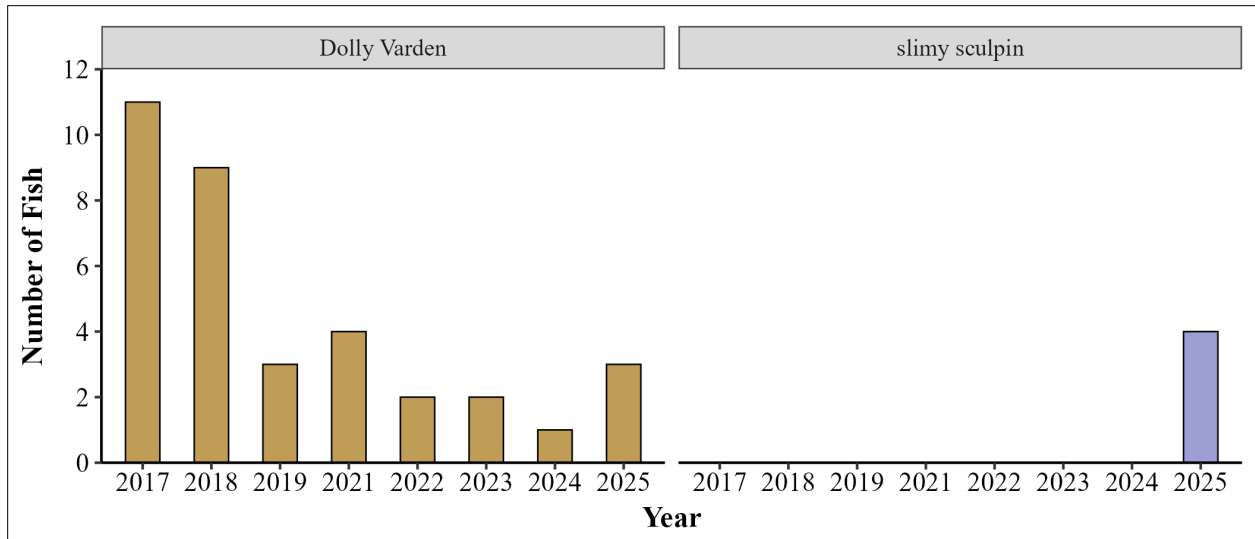


Figure 53.—Total number of fish captured in Jay Creek, 2017–2025.

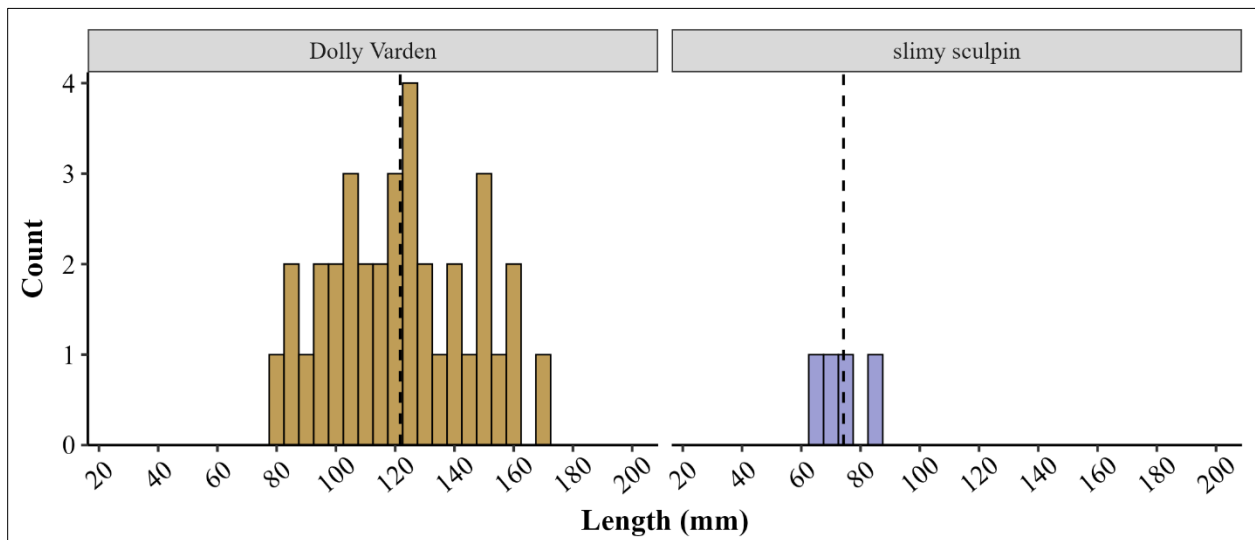


Figure 54.—Length frequency for all fish captured in minnow traps from Jay Creek, 2017–2025. The vertical dashed line represents the sample mean length.

LOWER RUBY CREEK

Water Quality

In-Situ Data

In July 2025, the pH was 7.64, the water temperature was 9.6°C, and the dissolved oxygen was 9.95 mg/L in Lower Ruby Creek (Table 2). Water quality parameters have remained similar among years. All in situ water quality data are presented in Appendix B.

Element Concentration

Copper and total dissolved solids (TDS) values have remained generally similar among years, while cadmium, mercury, selenium, and zinc have shown more variability. However, since 2023 parameters only have one data point due to limited sampling (Figure 55). All water quality samples collected in Lower Ruby Creek have been below the acute aquatic life exposure limit for element concentrations (Appendix A). Water quality element concentration data and associated sample dates are presented in Appendix A.

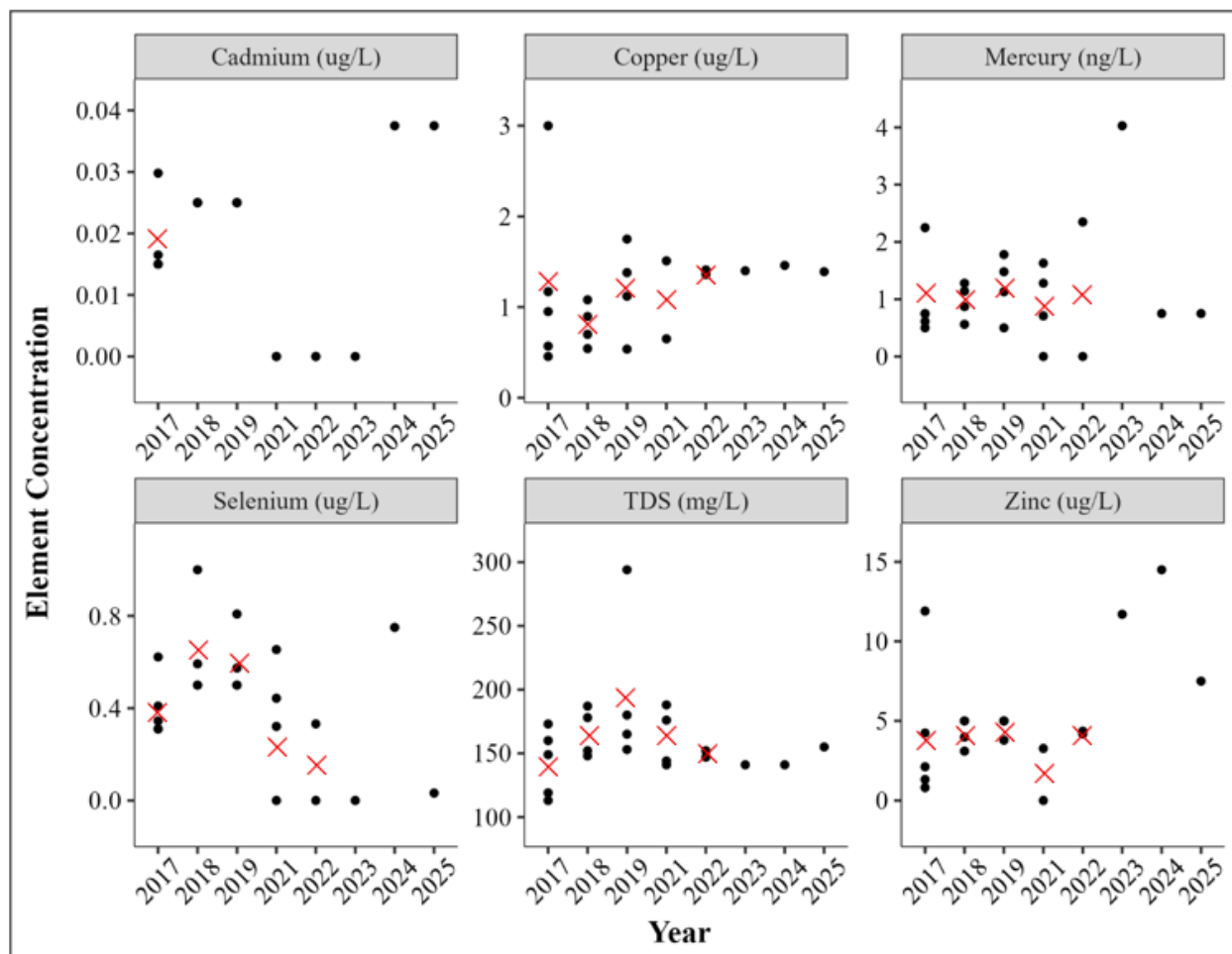


Figure 55.—Total recoverable element concentration data from water samples by year at Lower Ruby Creek, 2017–2025. Raw data are depicted by black dots and mean values are depicted in red.

Periphyton

In 2025, mean chlorophyll-a concentration in Lower Ruby Creek was 1.24 mg/m² (SD = 0.57). This is the second lowest mean concentration on record, although sample values are well within the range seen in previous years (Figure 56). Complete periphyton data from 2025 are contained in Appendix C.

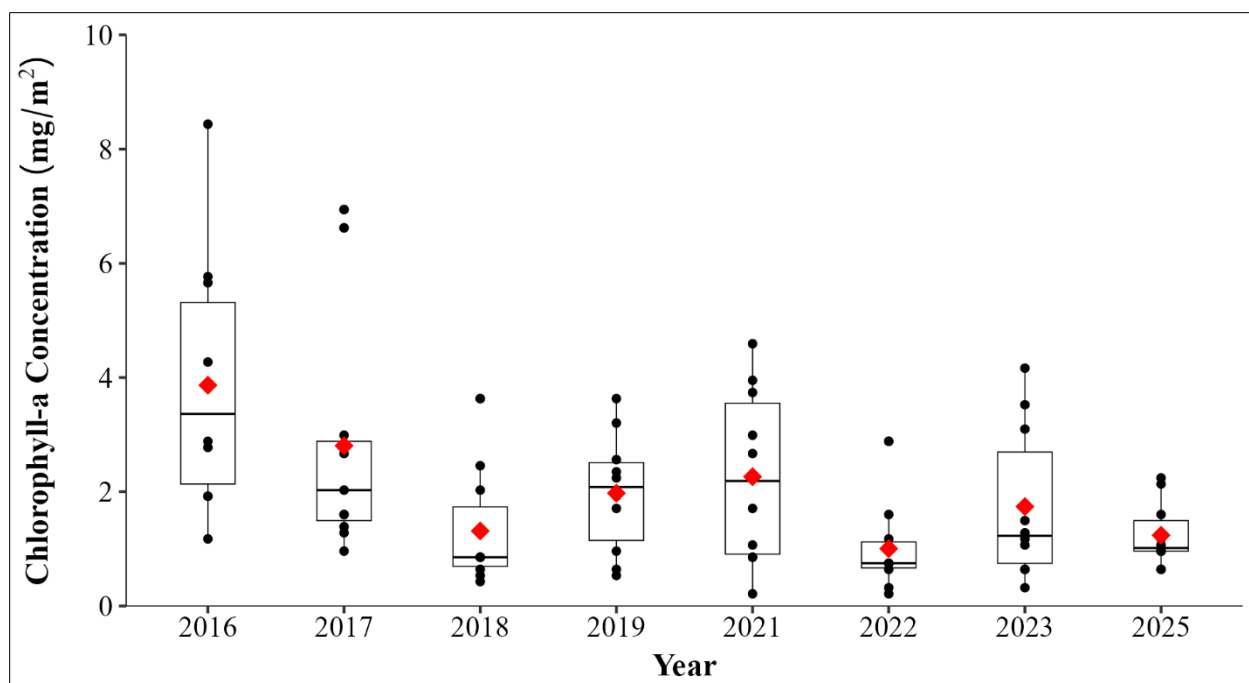


Figure 56.—Chlorophyll-a concentration boxplot by year at Lower Ruby Creek, 2017–2025. No sampling occurred in 2024. Raw data are depicted by black dots and mean values are depicted in red.

Benthic Macroinvertebrates

Mean BMI density in 2025 was 1,233 BMI/m² (SD = 530), an increase from the low of 330 BMI/m² (SD = 123) in 2024 (Figure 57). Diptera or other taxa have dominated sample composition in all years of data (Figure 58). EPT taxa proportion was the highest on record in 2025 at 29% of the sample. In previous years, EPT proportion has ranged from 4% in 2017 to 17% in 2019. Taxa richness in 2025 was 22, more than double the taxa richness of 10 in 2024 (Figure 59). BMI data from 2025 are presented in Appendix D.

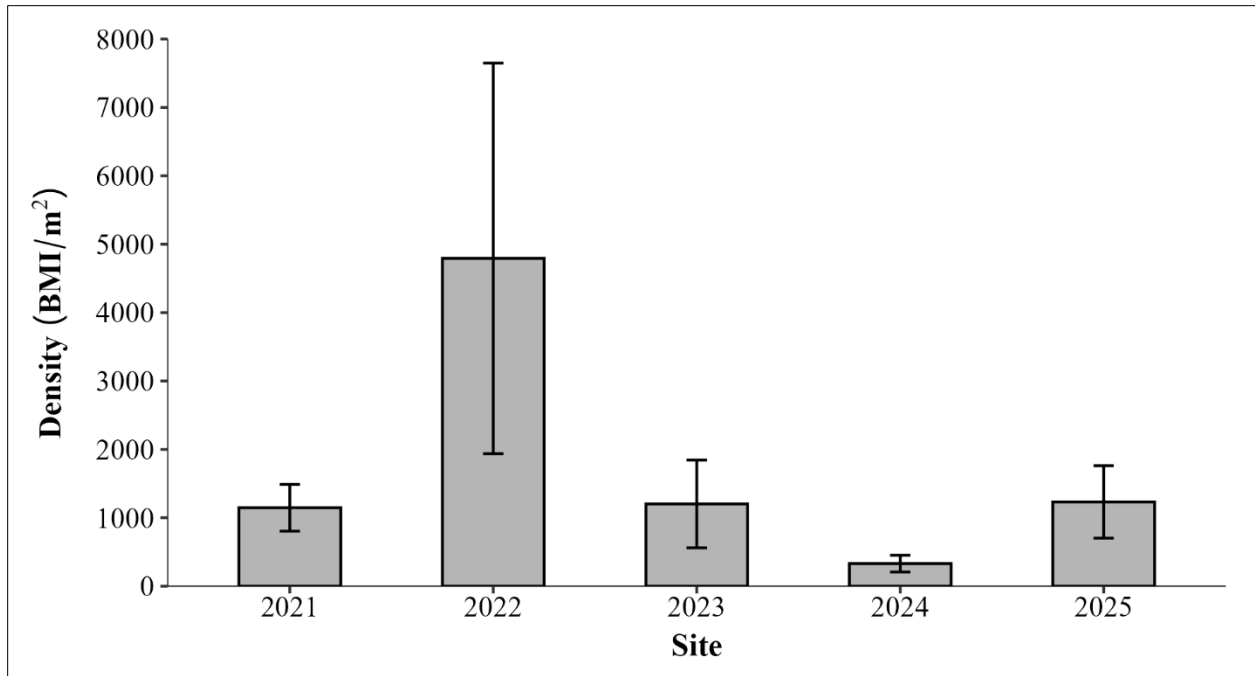


Figure 57.—Mean BMI density (± 1 SD) at Lower Ruby Creek, 2021–2025.

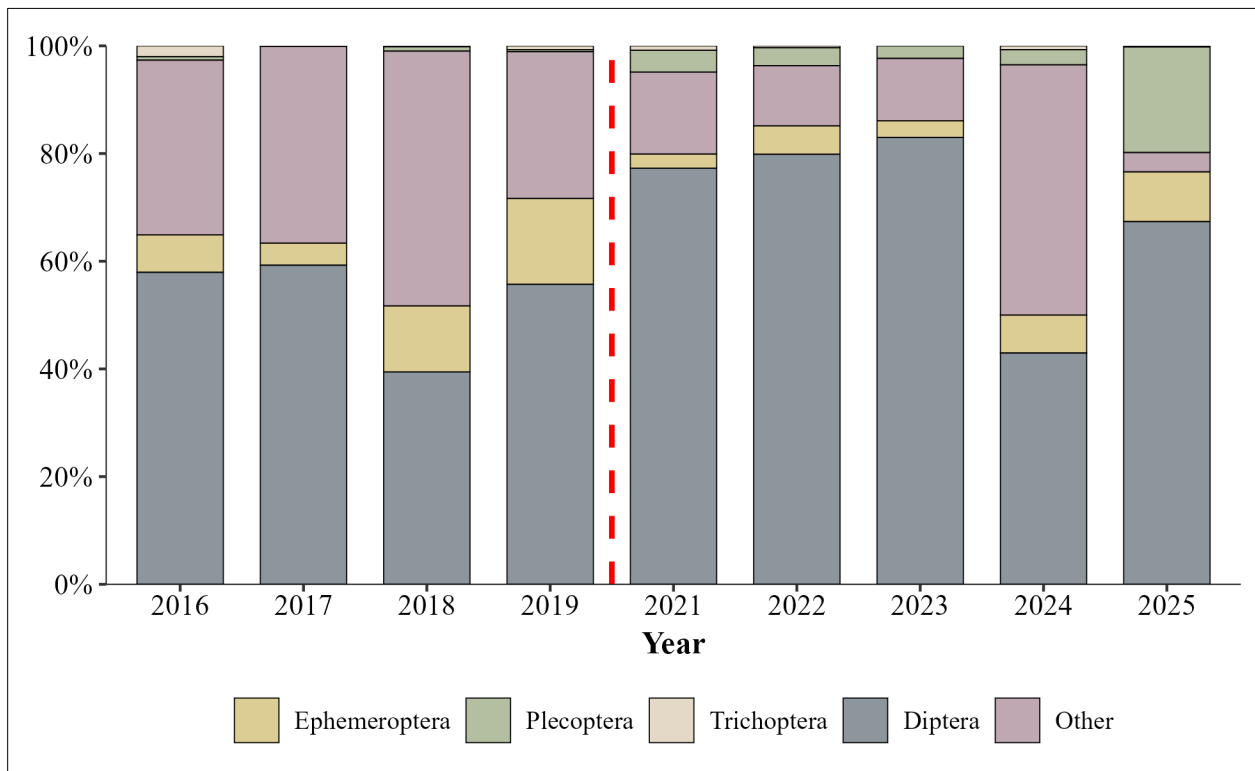


Figure 58.—Mean percent EPT, aquatic Diptera, and other taxa in Lower Ruby Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

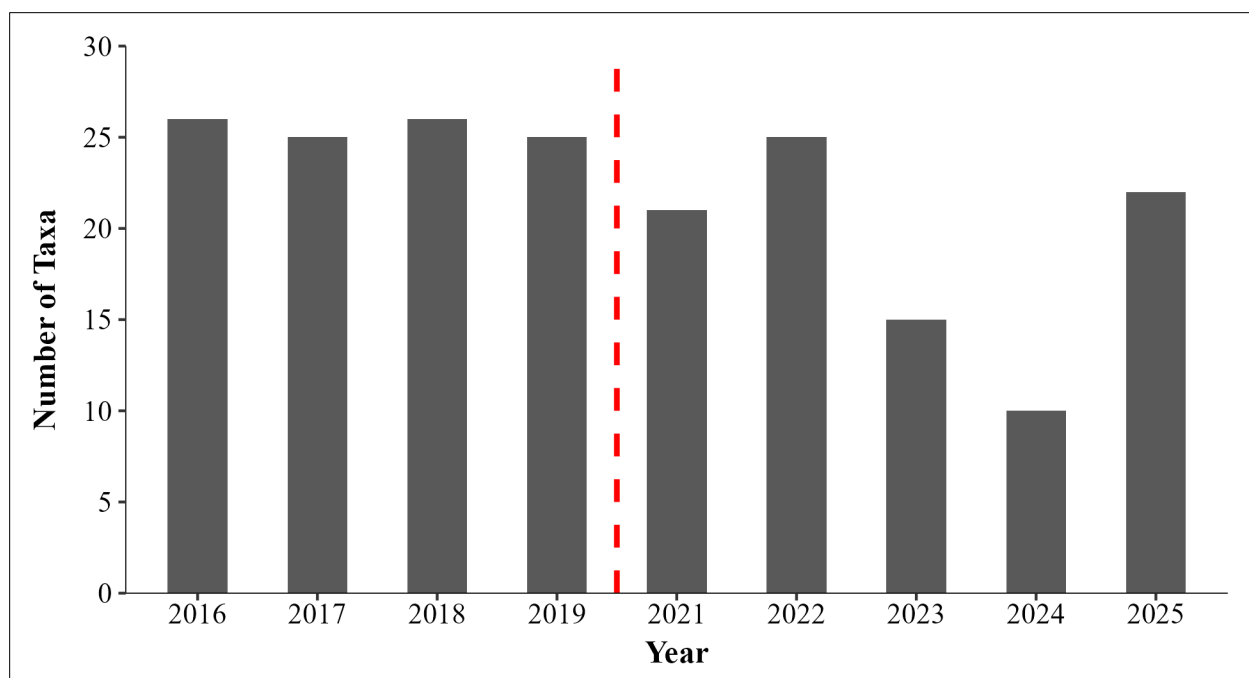


Figure 59.—Taxa richness in Lower Ruby Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

Fish Captures

Slimy sculpin continued to comprise the majority of fish captured in Lower Ruby Creek in 2025. A total of 45 slimy sculpin were captured, which is the highest slimy sculpin catch on record, while just 1 Dolly Varden was captured (Figure 60). In most years, no Dolly Varden have been captured in Lower Ruby Creek. A small number of other fish species have been previously captured in Lower Ruby Creek including Alaska blackfish in 2018 and 2023, longnose sucker in 2018, and round whitefish in 2019. The Dolly Varden length frequency exhibits a uniform distribution with range of 72–136 mm and a mean of 102.1 mm fork length (SD = 24.7; Figure 61). Slimy sculpin length frequency exhibits a normal distribution with a range of 45–95 mm and a mean of 65.6 mm total length (SD = 9.4; Figure 61). All fish capture data are presented in Appendix E.

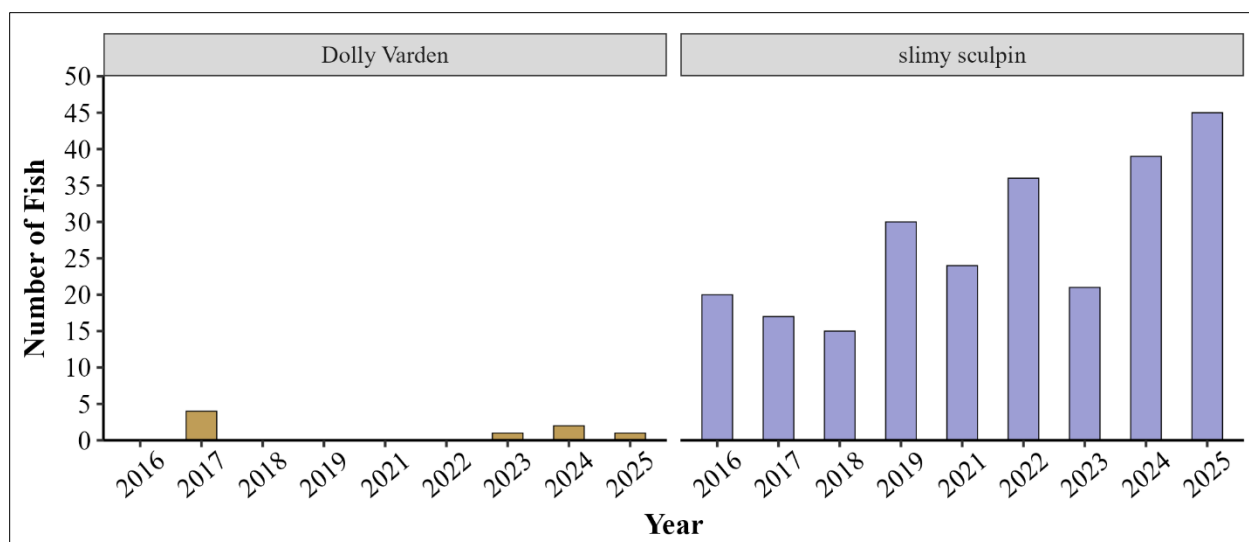


Figure 60.—Total number of fish captured in Lower Ruby Creek, 2016–2025.

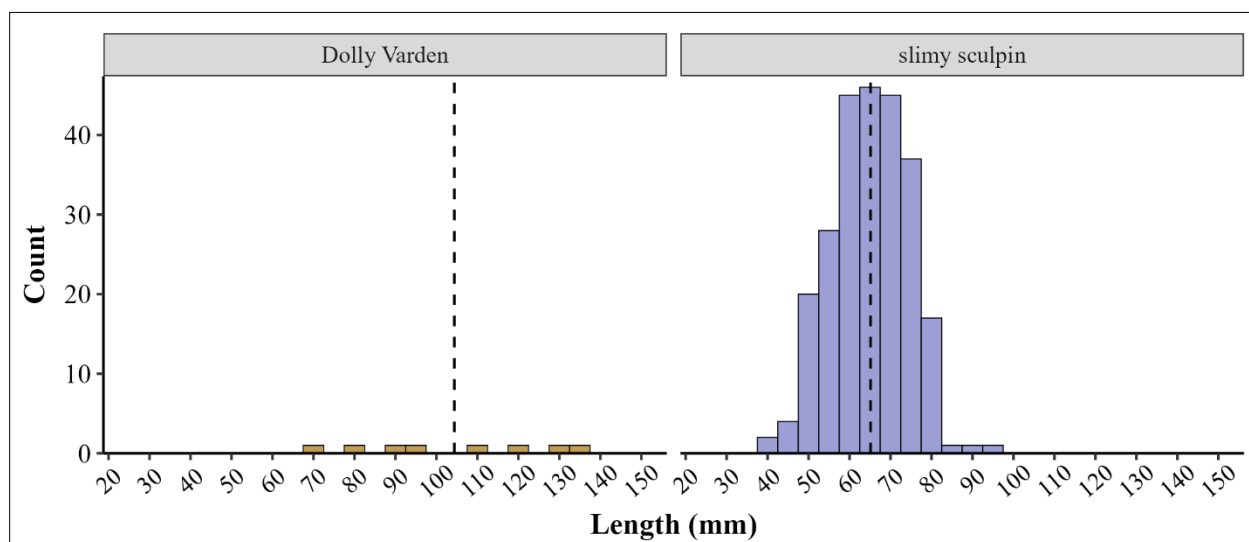


Figure 61.—Length frequency for all fish captured in minnow traps from Lower Ruby Creek, 2016–2025. Dolly Varden are measured to fork length and slimy sculpin are measured to total length. The vertical dashed line represents the sample mean length.

Fish Metals

Fifteen slimy sculpin were retained from Lower Ruby Creek for element analysis in 2025. Mean concentrations for cadmium, copper and mercury fell between previous years' means, while selenium, and zinc had the lowest means on record, although the mean concentration for zinc was very close to the 2024 mean (Figure 62). In general element concentrations have remained consistent among years. Mean element concentrations in slimy sculpin from Lower Ruby Creek in 2025 are as follows: cadmium was 0.14 mg/kg (SD = 0.05); copper was 3.02 mg/kg (SD = 0.67);

mercury was 0.25 mg/kg (SD = 0.13); selenium was 4.18 mg/kg (SD = 0.73); and zinc was 109.62 mg/kg (SD = 23.25). Element analysis data from 2025 are presented in Appendix F.

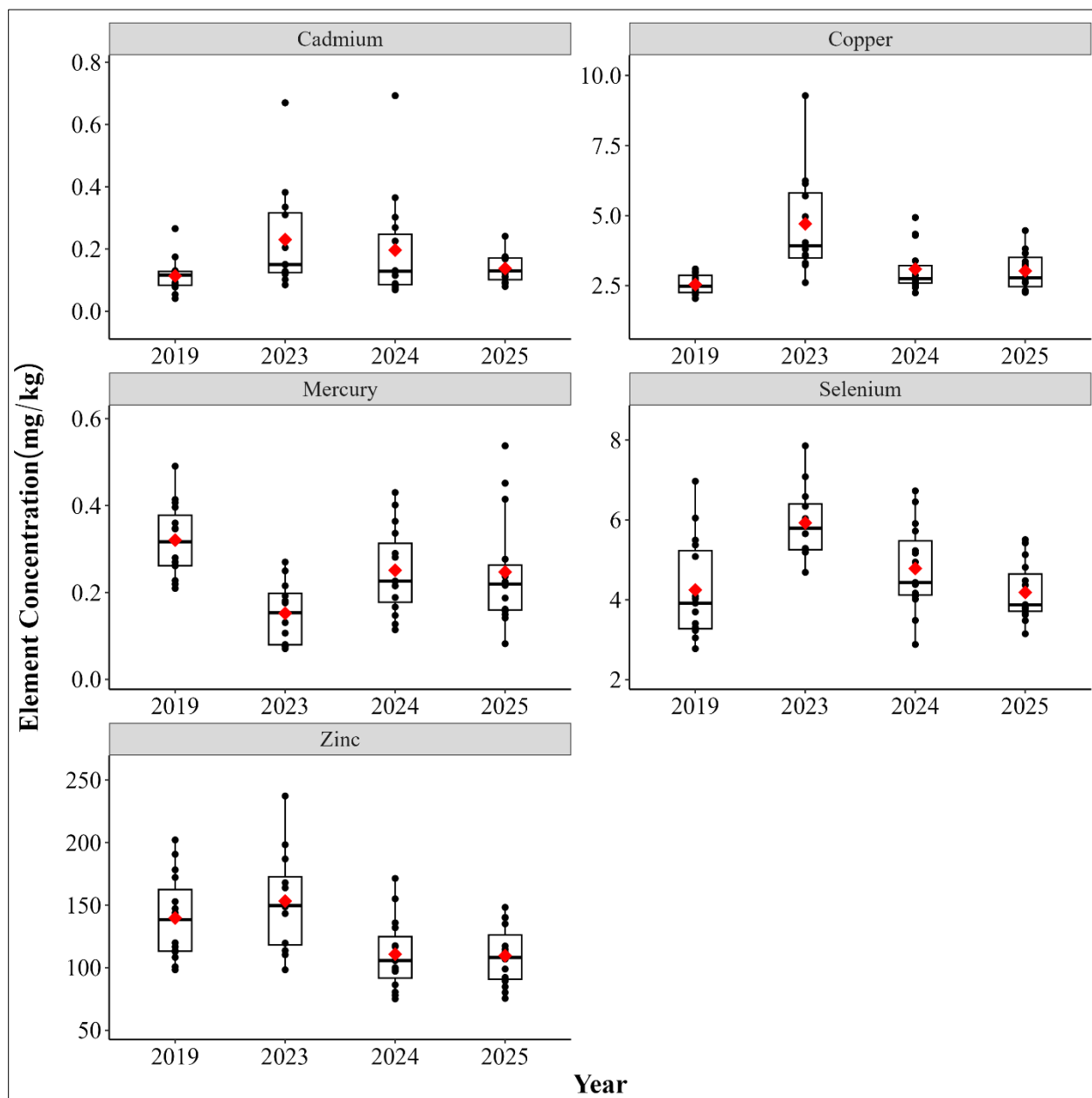


Figure 62.—Boxplots depicting element concentration data for slimy sculpin captured in Lower Ruby Creek, 2019–2025. Raw data are in black dots and mean values are depicted in red. Note that y-axis scales vary among elements.

RILEY CREEK

Water Quality

In July 2025, the pH was 7.73, the water temperature was 4.9°C, and the dissolved oxygen was 11.66 mg/L in Riley Creek (Table 2). Water quality parameters have remained similar among years. Water temperature has been especially consistent, with a narrow range from 4.4°C to 4.9°C. All in situ water quality data are presented in Appendix B.

Periphyton

In 2025, mean chlorophyll-a concentration in Riley Creek was 1.55 mg/m² (SD = 0.59). This value is similar to all years' means since 2018 (Figure 63). Notably higher means in 2016 and 2017 were due in large part to two very high value concentrations in each year (Figure 63). Complete periphyton data from 2024 are contained in Appendix C.

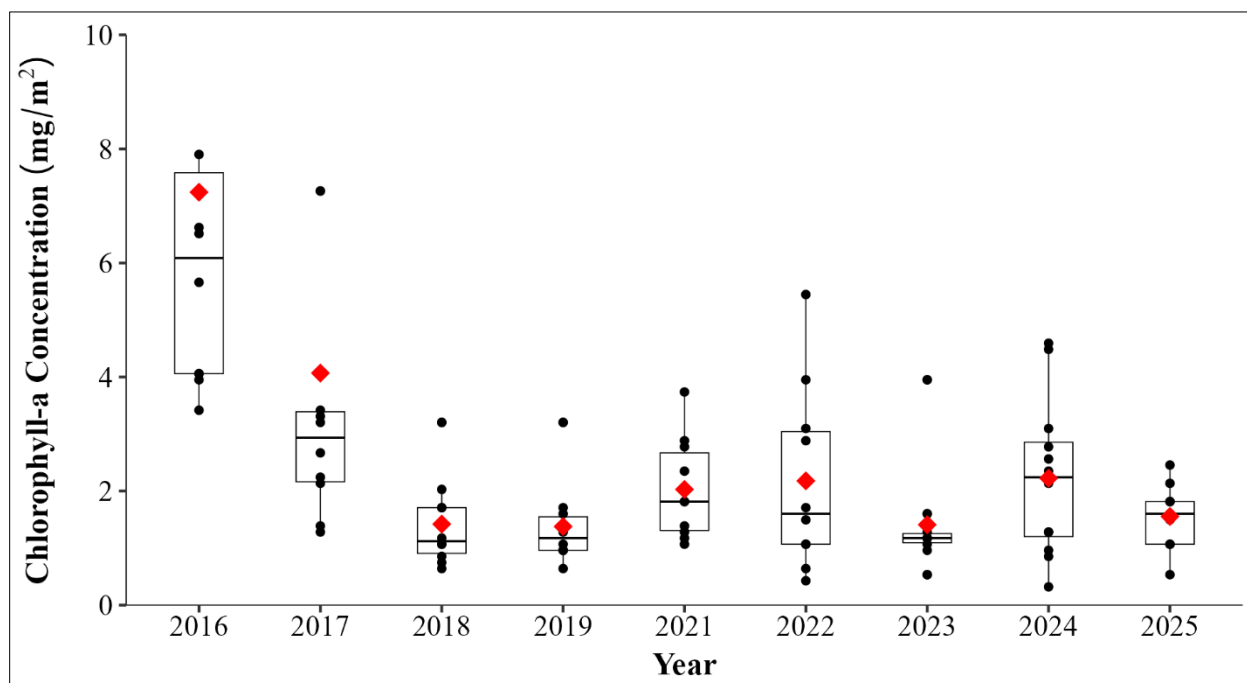


Figure 63.— Chlorophyll-a concentration boxplot by year at Riley Creek, 2016–2025. Raw data are depicted by black dots and mean values are depicted in red. Note that two high values from 2016 (14.2 and 16.02 mg/m²) and one high value from 2017 (13.78 mg/m²) are excluded on this plot but not from statistical analyses.

Benthic Macroinvertebrates

Mean BMI density in 2025 at Riley Creek was 4,709 BMI/m² (SD = 695), similar to previous years (Figure 64). Taxa composition has varied among years, but Diptera have made up the highest proportion of the sample in all years except 2021 when the EPT proportion was 49% (Figure 65).

The proportions of Diptera and EPT taxa in 2025 were 42% and 36%, respectively. Taxa richness in 2025 was 23 which is within the range among all years of 18–29 (Figure 66). BMI data from 2025 are presented in Appendix D.

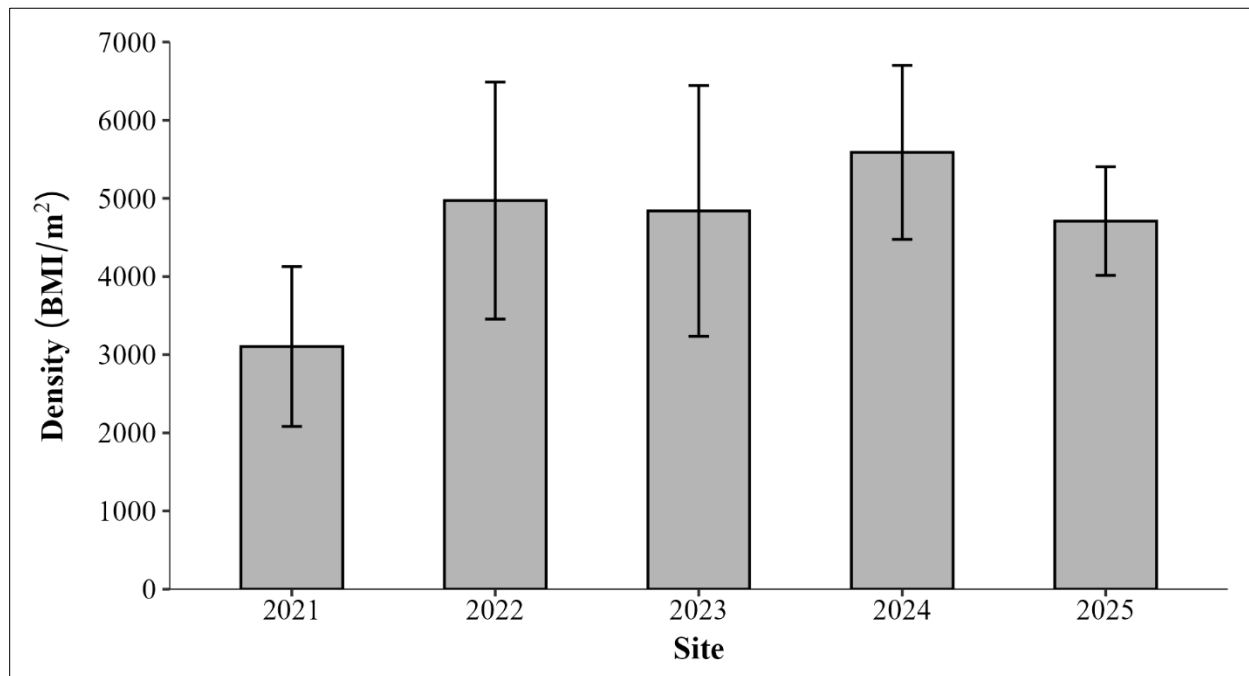


Figure 64.—Mean BMI density (± 1 SD) at Riley Creek, 2021–2025.

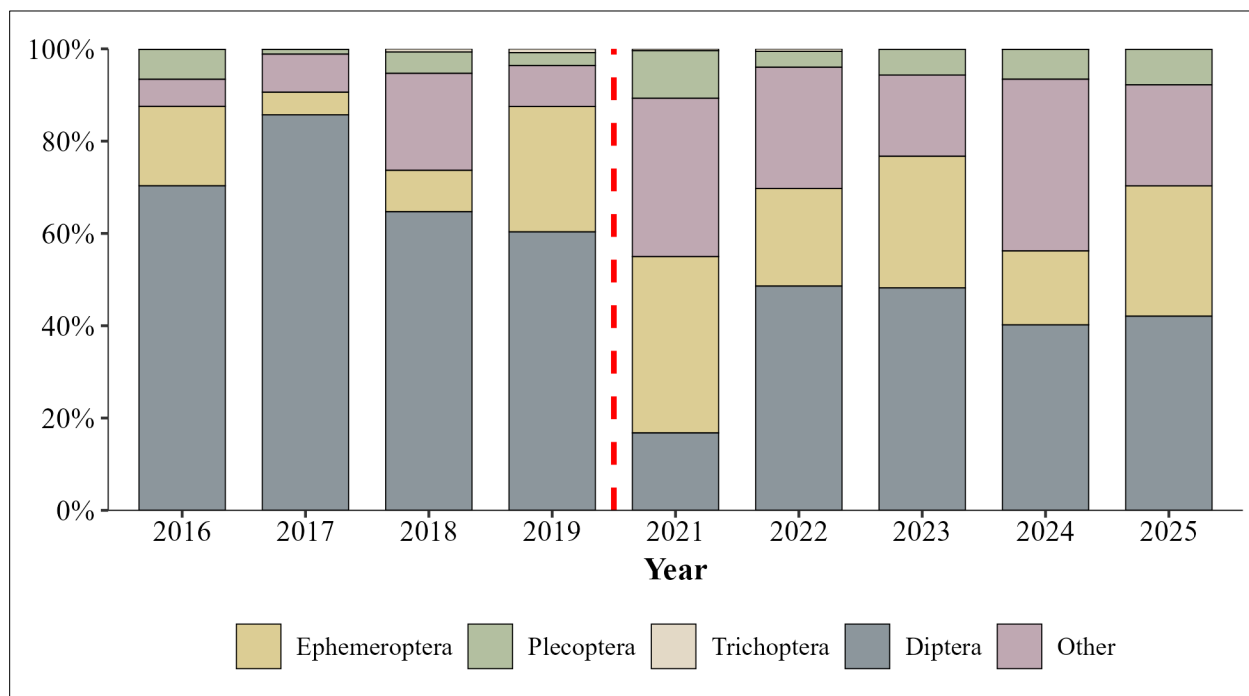


Figure 65.—Mean percent EPT, aquatic Diptera, and other taxa in Riley Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

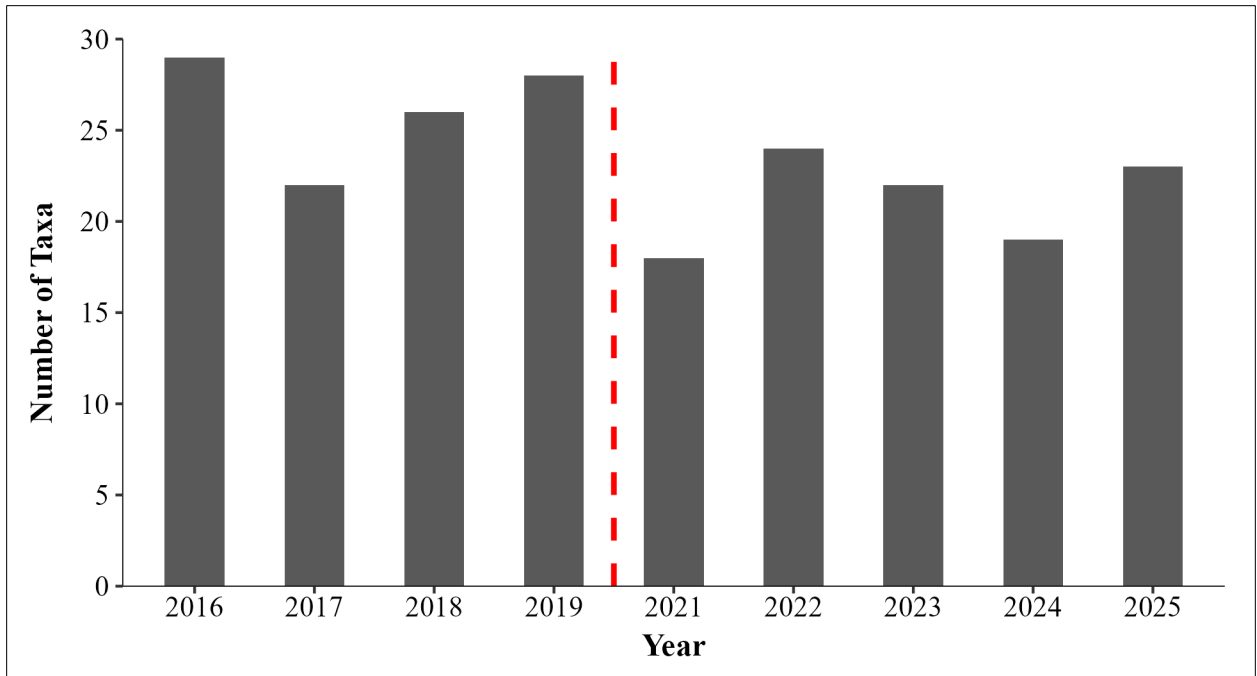


Figure 66.—Taxa richness in Riley Creek BMI samples, 2016–2025. The red dashed line denotes the change from drift nets to Hess sampler.

Fish Captures

A total of 3 Dolly Varden and 14 slimy sculpin were captured in Riley Creek in 2025 which is similar to previous years' catches (Figure 67). Similar numbers of Dolly Varden have been captured across all length categories resulting in a uniform distribution with a range of 60–133 mm and a mean of 98.5 mm fork length (SD = 22.6; Figure 68). Slimy sculpin length frequency exhibits a normal distribution with a range of 45–93 mm and a mean of 66.5 mm total length (SD = 11.4; Figure 68). All fish capture data are presented in Appendix E.

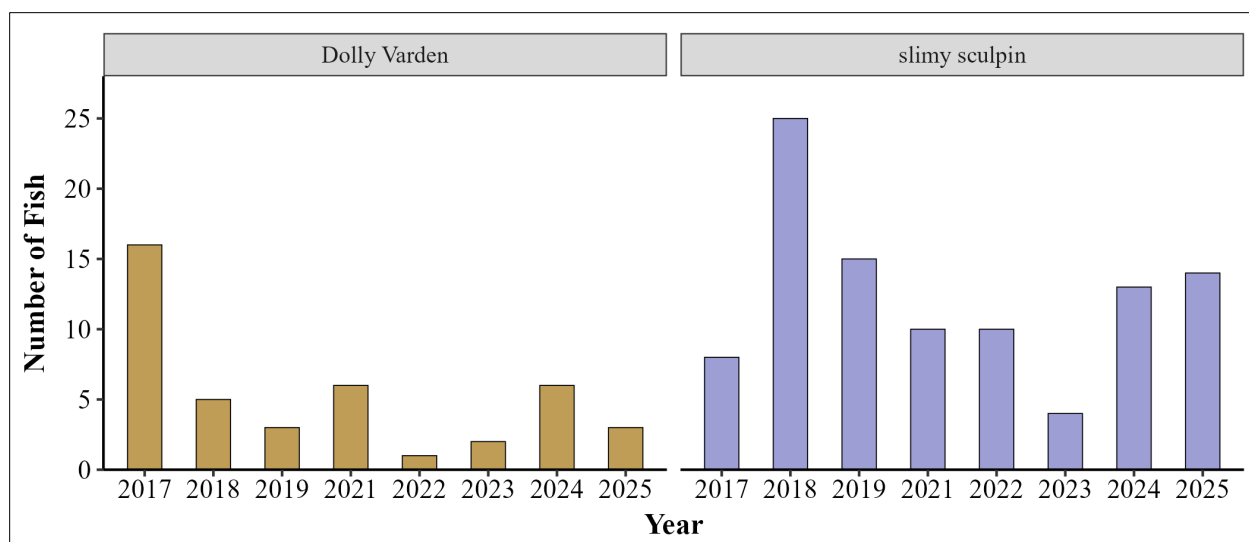


Figure 67.—Total number of fish captured in Riley Creek, 2018–2025.

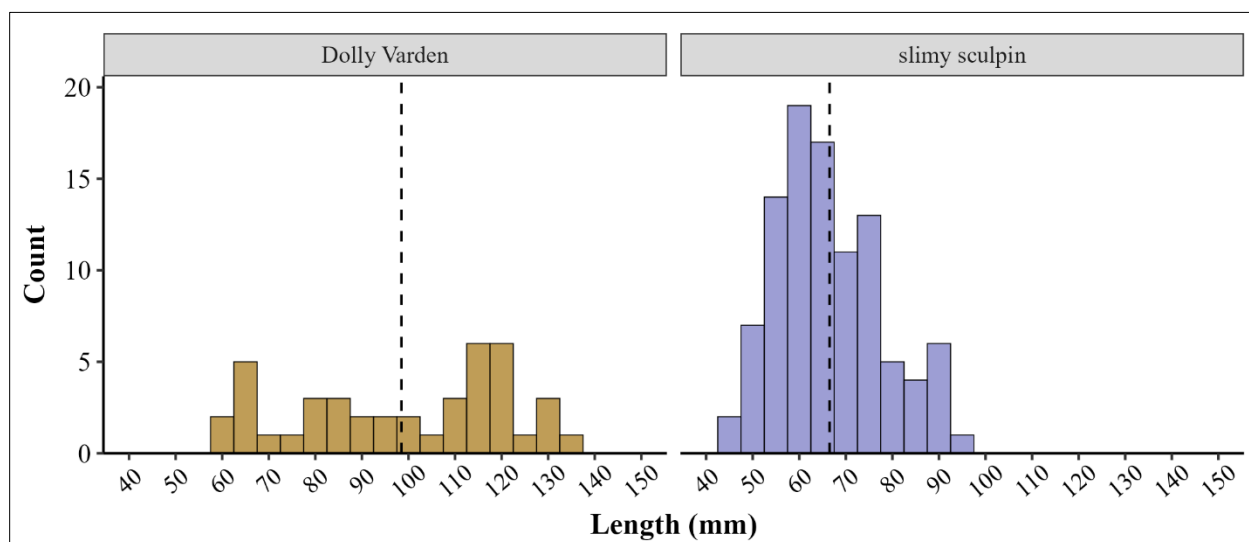


Figure 68.—Length frequency for all fish captured in minnow traps from Riley Creek, 2016–2025. Dolly Varden are measured to fork length and slimy sculpin are measured to total length. The vertical dashed line represents the sample mean length.

Fish Metals

Twelve slimy sculpin were retained from Riley Creek for element analysis in 2025. Mean cadmium concentration in 2025 was 0.42 mg/kg (SD = 0.25), within the previous years' means that range from 0.12–0.45 mg/kg (Figure 69). Mean copper concentration was similar to previous years at 3.39 mg/kg (SD = 0.89; Figure 69). Mean mercury concentration in 2025 was the highest on record at 0.30 mg/kg (SD = 0.15) with a larger range of values than previous years, although many values overlapped with prior years' numbers (Figure 69). Mean selenium concentration was similar to previous year at 5.90 mg/kg (SD = 0.94). Previous selenium means ranged from 4.55–8.16 mg/kg

(Figure 69). Mean zinc concentration fell within all previous years' means at 121.78 mg/kg (SD = 25.81; Figure 69). Element concentration data from 2025 are presented in Appendix F.

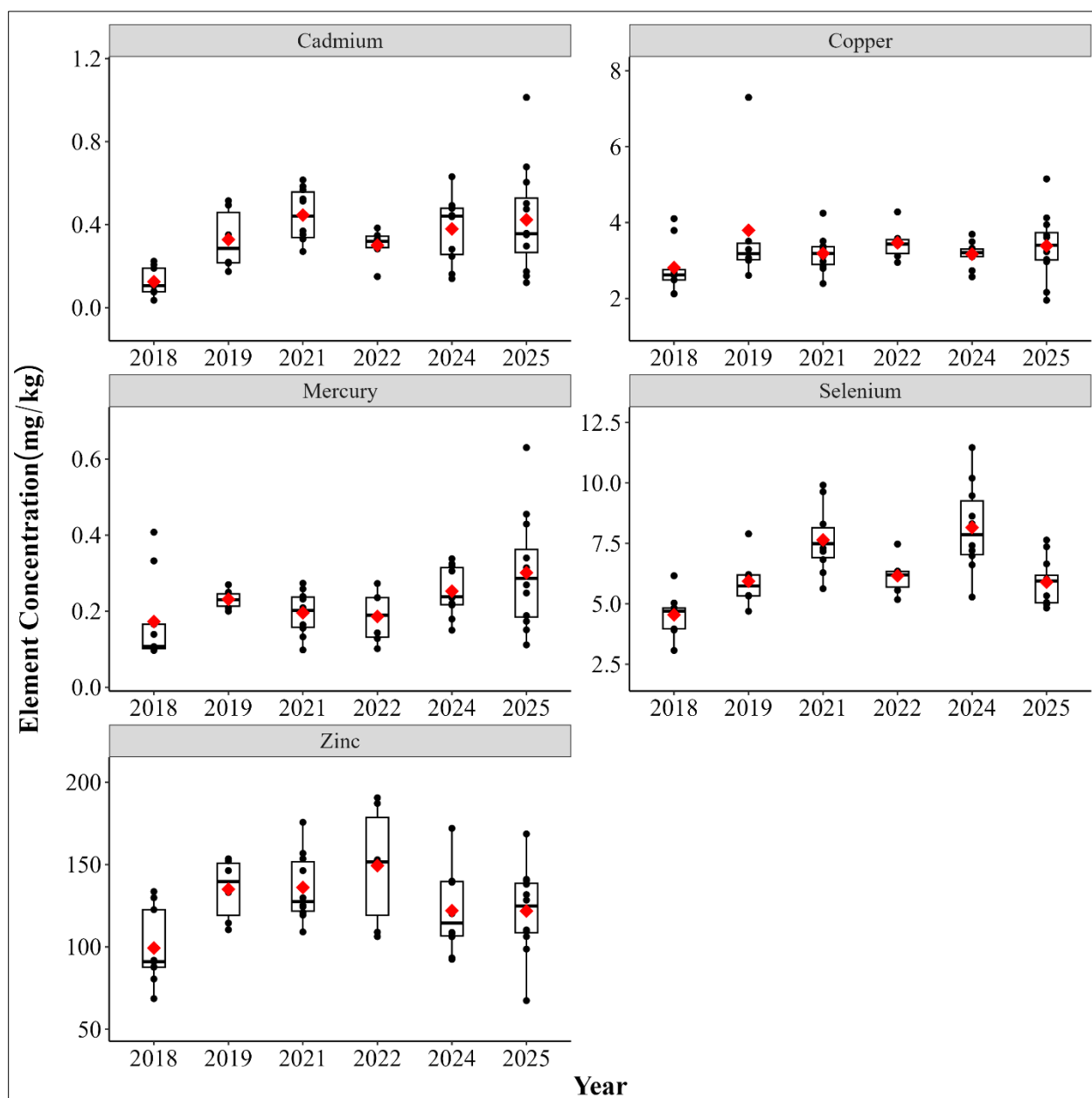


Figure 69.—Boxplots depicting element concentration data for slimy sculpin captured in Riley Creek, 2018–2025. Raw data are in black dots and mean values are depicted in red. Note that y-axis scales vary among elements.

CONCLUSION

All water quality samples analyzed for cadmium, copper, mercury, selenium, and zinc concentrations at Lower Ruby Creek were below the chronic aquatic life exposure limits. In-situ

pH, dissolved oxygen, and water temperature at all sites were favorable for aquatic life in all years of available data. The chlorophyll-a values recorded in the vicinity of the Arctic-Bornite exploratory mining prospects across all years and sites fall in the middle of the range seen near Red Dog Mine, where there are several highly productive sites with average chlorophyll-a concentrations above 5.0 mg/m² and several low production sites with concentrations below 0.10 mg/m² (Clawson 2026b). Similar to mean chlorophyll-a concentrations, BMI results fall in the middle of the ranges seen near Red Dog Mine, where there are several highly productive sites with average densities above 5,000 BMI/m² and several lower production sites with densities below 1,000 BMI/m² (Clawson 2026b). The taxa richness at Arctic-Bornite sites in 2025 ranged from 13 to 23 species, and is generally higher than at Red Dog sites. At the ten sites sampled near Red Dog Mine in 2025, BMI taxa richness varied from 5 to 17 species (Clawson 2026b).

Despite being isolated from the Kobuk River by a large waterfall, the upper Shungnak River drainage supports self-sustaining populations of Arctic grayling, Dolly Varden, round whitefish, slimy sculpin, longnose sucker, and Alaska blackfish. Fish are consistently captured at all aquatic biomonitoring sites from year to year. Resident Dolly Varden spawning is known to occur in Red Rock, Upper Subarctic, and Center of the Universe creeks as a very small young of the year fish was captured in Red Rock Creek in July 2018 and ripe males and females have been captured in the creeks during fall sampling (Clawson 2019). The Dolly Varden captured in Riley Creek in July have the potential to be anadromous as no permanent physical barrier exists downstream, but fall aerial surveys conducted in 2019 and 2022 did not document any anadromous fish upstream on the rapids (Clawson 2020 and Clawson 2023). Overwintering Dolly Varden presence was confirmed in Upper Subarctic and Center of the Universe creeks in March 2021 and April 2022 (Clawson 2022 and Clawson 2023). This is likely facilitated by the year-round groundwater input confirmed via Hobo logger data that revealed water temperatures above 0°C through the winter (Edwards 2025).

Mean element concentrations in fish tissues from streams in the vicinity of the Arctic-Bornite exploratory mining prospects have remained generally static among years and fall within concentrations documented in other regions of the state (Legere and Timothy 2016). Mean cadmium, copper, and selenium concentrations in fish tissues are comparable to those in the vicinity of Red Dog Mine (Ott et al. 2016; Clawson 2026b). Mean mercury concentrations are

generally higher than those in the vicinity of Red Dog Mine (Clawson 2026b). Zinc concentrations in fish tissues are similar to those in Anxiety Creek, but lower than those in Mainstem Red Dog and Buddy creeks, all in the vicinity of Red Dog Mine (Clawson 2026b).

Results of aquatic biomonitoring in the vicinity of the Arctic-Bornite exploratory mining prospects indicate considerable variability in chlorophyll-a concentrations and BMI density and composition among years. This illustrates the importance of continued in-situ water quality, periphyton, BMI, and fish sampling to capture the magnitude of natural variability at these sites prior to development, in order to better assess conditions post-development. Future fish work should be focused on expanding our understanding of how and when fish utilize target areas around the Arctic and Bornite deposits, including for overwintering and spawning habitat. Additional temperature logger deployments could be used to identify potential overwintering habitat. If full scale exploration begins again, we suggest re-implementing fall aerial surveys in the Kogoluktuk River drainage to monitor anadromous fish spawning distribution. Additionally, if the Riley Creek area becomes slated for mine facility development, we suggest genetic sampling to compare Riley Creek Dolly Varden to Subarctic Creek resident Dolly Varden and Kobuk River drainage anadromous Dolly Varden. Since Dolly Varden in the Riley Creek drainage have the potential to be anadromous, this genetic sampling could help determine if the captured Dolly Varden are anadromous or resident.

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APPENDIX A. WATER QUALITY DATA FROM LOCATIONS NEAR THE ARCTIC-BORNITE EXPLORATORY MINING PROSPECTS, 2017–2025.

These data were collected by Ambler Metals personnel. Only element data corresponding with those used in fish whole body element analyses are shown. Acute and chronic water quality standards for aquatic life are shown for cadmium, copper, and zinc, which are dependent on water hardness. Values highlighted in yellow were the only samples that exceeded the more stringent chronic aquatic life exposure limit. Values highlighted in green are below the method detection limit.

Year	Date	Site	Cadmium			Copper			Mercury	Selenium	Total Dissolved	Zinc (µg/L)	Zinc		Hardness as CaCO3 (mg/L)
			Cadmium (µg/L)	Acute Limit (µg/L)	Chronic Limit (µg/L)	Copper (µg/L)	Acute Limit (µg/L)	Chronic Limit (µg/L)					Acute Limit (µg/L)	Chronic Limit (µg/L)	
2025	7/15/2025	Lower Ruby	0.038	3.411	0.358	1.39	22.402	14.235	0.75	0.032	155.000	7.500	185.532	187.049	172.000
2024	7/12/2024	Lower Ruby	0.038	2.326	0.273	1.460	15.456	10.167	0.750	0.750	141.000	14.500	132.883	133.970	116.000
2023	7/11/2023	Lower Ruby	0.000	2.482	0.286	1.400	16.459	10.763	4.030	0.000	141.000	11.700	140.608	141.759	124.000
2022	10/18/2022	Lower Ruby	0.000	3.025	0.329	1.360	19.939	12.808	2.350	0.332	152.000	4.180	167.083	168.449	152.000
2022	8/19/2022	Lower Ruby	0.000	2.443	0.282	1.410	16.208	10.614	0.000	0.000	147.000	4.350	138.684	139.819	122.000
2021	9/30/2021	Lower Ruby	0.000	2.676	0.301	0.650	17.706	11.500	0.000	0.443	176.000	0.000	150.159	151.387	134.000
2021	8/31/2021	Lower Ruby	0.000	2.131	0.256	1.510	14.198	9.413	1.280	0.000	144.000	3.270	123.111	124.118	106.000
2021	6/9/2021	Lower Ruby							1.630	0.321	141.000				111.000
2021	1/28/2021	Lower Ruby							0.709	0.654	188.000				159.000
2019	12/9/2019	Lower Ruby	0.025	4.083	0.408	1.120	26.673	16.676	1.130	0.808	294.000	3.790	217.059	218.834	207.000
2019	9/2/2019	Lower Ruby	0.025	2.948	0.323	1.380	19.444	12.520	1.480	0.500	165.000	5.000	163.350	164.686	148.000
2019	6/22/2019	Lower Ruby	0.025	2.735	0.306	1.750	18.080	11.720	1.780	0.500	153.000	5.000	153.002	154.254	137.000
2019	3/30/2019	Lower Ruby	0.025	2.793	0.311	0.536	18.452	11.939	0.500	0.574	180.000	5.000	155.837	157.111	140.000
2018	12/10/2018	Lower Ruby	0.025	2.870	0.317	0.542	18.949	12.230	0.871	0.592	187.000	5.000	159.601	160.907	144.000
2018	8/24/2018	Lower Ruby	0.025	2.326	0.273	1.080	15.456	10.167	1.280	0.500	152.000	5.000	132.883	133.970	116.000
2018	6/28/2018	Lower Ruby	0.025	2.540	0.290	0.896	16.834	10.985	1.140	0.500	148.000	3.980	143.486	144.659	127.000
2018	3/22/2018	Lower Ruby	0.025	2.890	0.318	0.699	19.073	12.302	0.562	1.000	178.000	3.100	160.540	161.853	145.000
2017	11/30/2017	Lower Ruby	0.015	2.812	0.312	0.569	18.577	12.012	0.749	0.622	160	1.32	156.779	158.062	141
2017	9/22/2017	Lower Ruby	0.015	2.326	0.273	0.95	15.456	10.167	0.744	0.31	113	11.9	132.883	133.970	116
2017	8/26/2017	Lower Ruby	0.0165	2.365	0.276	1.17	15.707	10.316	0.612	0.409	149	2.12	134.822	135.925	118
2017	7/24/2017	Lower Ruby	0.0298	1.804	0.227	3	12.080	8.130	2.25	0.31	119	4.24	106.466	107.337	89.3
2017	4/27/2017	Lower Ruby	0.015	2.948	0.323	0.455	19.444	12.520	0.5	0.345	173	0.808	163.350	164.686	148
2022	8/12/2022	Lower Subarctic	0.104	0.978	0.147	0.699	6.677	4.749	0.000	0.380	66.000	21.000	62.473	62.984	47.600
2022	4/19/2022	Lower Subarctic	0.052	1.136	0.163	0.286	7.717	5.415	0.000	0.713	60.000	5.750	71.153	71.735	55.500
2021	9/29/2021	Lower Subarctic	0.107	0.904	0.139	0.702	6.187	4.432	0.000	0.725	71.000	13.700	58.333	58.810	43.900
2021	8/22/2021	Lower Subarctic	0.107	0.807	0.128	1.070	5.548	4.014	0.000	0.452	73.000	12.400	52.882	53.314	39.100
2021	6/20/2021	Lower Subarctic								0.446	36.000				41.000
2019	12/11/2019	Lower Subarctic	0.063	1.022	0.151	0.655	6.968	4.936	2.020	0.620	65.000	7.830	64.911	65.442	49.800
2019	6/7/2019	Lower Subarctic	0.085	0.557	0.098	2.230	3.873	2.898	1.210	0.420	34.000	11.300	38.277	38.590	26.700

Year	Date	Site		Cadmium	Cadmium		Copper	Copper			Total		Zinc	Zinc	Hardness
			Cadmium (µg/L)	Acute Limit (µg/L)	Chronic Limit (µg/L)	Copper (µg/L)	Acute Limit (µg/L)	Chronic Limit (µg/L)	Mercury (ng/L)	Selenium (µg/L)	Dissolved Solids (mg/L)	Zinc (µg/L)	Acute Limit (µg/L)	Chronic Limit (µg/L)	as CaCO3 (mg/L)
2018	8/26/2018	Lower Subarctic	0.078	0.834	0.131	0.705	5.721	4.128	0.672	0.711	59.000	9.610	54.368	54.813	40.400
2018	6/27/2018	Lower Subarctic	0.102	0.628	0.107	1.610	4.349	3.219	0.859	0.337	47.000	16.400	42.488	42.835	30.200
2018	6/27/2018	Lower Subarctic	0.103	0.686	0.114	1.580	4.742	3.482	0.965	0.500	44.000	14.200	45.920	46.296	33.100
2018	3/24/2018	Lower Subarctic	0.042	1.030	0.152	0.303	7.021	4.970	0.500	1.000	73.000	4.490	65.352	65.887	50.200
2017	9/20/2017	Lower Subarctic	0.102	0.755	0.122	1.33	5.200	3.785	0.746	0.398	41	15.3	49.887	50.295	36.5
2017	8/24/2017	Lower Subarctic	0.0829	0.797	0.127	1.02	5.481	3.970	0.5	0.402	44	11.5	52.308	52.736	38.6
2017	7/19/2017	Lower Subarctic	0.161	0.958	0.145	3.22	6.545	4.664	0.95	0.315	62	16.1	61.359	61.861	46.6
2017	4/27/2017	Lower Subarctic	0.0415	1.046	0.154	0.306	7.126	5.038	0.5	0.704	68	4.32	66.234	66.776	51
2022	4/18/2022	Riley	0.000	3.237	0.345	0.345	21.296	13.596	0.000	0.000	190.000	0.000	177.273	178.723	163.000
2021	9/30/2021	Riley	0.000	2.560	0.292	0.404	16.958	11.059	0.000	0.819	167.000	0.000	144.442	145.624	128.000
2021	8/21/2021	Riley	0.000	2.151	0.258	0.581	14.324	9.489	0.000	0.740	132.000	0.000	124.094	125.109	107.000
2021	6/9/2021	Riley							0.793	0.635	125.000				99.900
2019	8/21/2019	Riley	0.025	2.307	0.271	0.602	15.331	10.092	1.440	0.593	143.000	5.000	131.912	132.991	115.000
2019	6/11/2019	Riley	0.025	1.892	0.235	0.618	12.653	8.479	0.500	0.700	151.000	5.000	110.995	111.903	93.800
2018	8/28/2018	Lower Riley	0.025	2.268	0.268	0.714	15.079	9.942	1.420	0.473	121.000	5.000	129.966	131.029	113.000
2018	7/1/2018	Lower Riley	0.025	1.992	0.244	0.513	13.300	8.872	0.890	0.825	106.000	3.100	116.087	117.037	98.900
2018	7/1/2018	Lower Riley	0.034	2.151	0.258	0.863	14.324	9.489	0.976	0.685	111.000	3.100	124.094	125.109	107.000
2017	9/20/2017	Riley	0.015	1.980	0.243	0.808	13.224	8.825	0.783	0.464	115	1.12	115.490	116.435	98.3
2017	8/22/2017	Riley	0.015	2.248	0.266	0.651	14.954	9.866	0.5	0.781	123	1.29	128.990	130.046	112
2017	7/19/2017	Riley	0.015	2.151	0.258	0.453	14.324	9.489	0.645	0.546	129	1.15	124.094	125.109	107
2022	8/14/2022	Upper Ruby	0.000	2.773	0.309	0.000	18.328	11.866	0.000	0.000	182.000	10.700	154.893	156.160	139.000
2022	4/18/2022	Upper Ruby	0.000	3.834	0.390	0.338	25.092	15.777	0.000	0.000	228.000	0.000	205.452	207.132	194.000
2021	8/29/2021	Upper Ruby	0.000	2.502	0.287	0.300	16.584	10.837	0.000	0.456	186.000	0.000	141.569	142.727	125.000
2021	6/8/2021	Upper Ruby							1.440	0.500	155.000				114.000
2019	12/5/2019	Upper Ruby	0.025	3.160	0.339	0.370	20.803	13.311	2.190	0.536	198.000	5.000	173.580	175.000	159.000
2019	8/29/2019	Upper Ruby	0.025	2.676	0.301	0.287	17.706	11.500	0.736	0.391	165.000	5.000	150.159	151.387	134.000
2019	6/6/2019	Upper Ruby	0.025	2.346	0.274	0.527	15.582	10.242	0.677	0.596	147.000	5.000	133.853	134.948	117.000
2019	3/30/2019	Upper Ruby	0.025	3.122	0.336	0.273	20.556	13.167	0.831	0.382	198.000	5.000	171.728	173.133	157.000
2018	12/10/2018	Upper Ruby	0.025	2.909	0.320	0.500	19.197	12.375	0.606	0.459	176.000	5.000	161.477	162.798	146.000
2018	12/10/2018	Upper Ruby	0.025	3.044	0.331	0.500	20.063	12.880	0.500	0.532	158.000	5.000	168.014	169.388	153.000
2017	12/2/2017	Upper Ruby	0.015	2.773	0.309	0.819	18.328	11.866	0.5	0.588	166	4.36	154.893	156.160	139
2017	9/18/2017	Upper Ruby	0.015	2.190	0.261	0.529	14.576	9.640	0.876	0.385	132	1.66	126.057	127.088	109
2017	8/23/2017	Upper Ruby	0.015	2.482	0.286	0.413	16.459	10.763	0.5	0.547	136	1.43	140.608	141.759	124
2017	7/18/2017	Upper Ruby	0.015	2.754	0.308	0.472	18.204	11.793	0.605	0.329	163	1.25	153.948	155.208	138
2017	4/27/2017	Upper Ruby	0.015	2.967	0.324	0.329	19.568	12.592	0.5	0.31	169	1.56	164.284	165.628	149

Year	Date	Site		Cadmium	Cadmium		Copper	Copper			Total		Zinc	Zinc	Hardness
			Cadmium	Acute	Chronic	Copper	Acute	Chronic	Mercury	Selenium	Dissolved	Zinc	Acute	Chronic	as CaCO3
			(µg/L)	Limit (µg/L)	Limit (µg/L)	(µg/L)	Limit (µg/L)	Limit (µg/L)	(ng/L)	(µg/L)	Solids (mg/L)	(µg/L)	Limit (µg/L)	Limit (µg/L)	(mg/L)
2022	8/13/2022	Upper Shungnak	0.413	1.943	0.240	2.170	12.983	8.680	0.000	0.447	128.000	32.700	113.596	114.525	96.400
2022	4/18/2022	Upper Shungnak	0.221	1.967	0.242	1.650	13.135	8.772	0.000	0.544	129.000	35.300	114.793	115.732	97.600
2021	9/29/2021	Upper Shungnak	0.370	1.928	0.238	2.140	12.881	8.618	0.000	0.695	121.000	30.100	112.797	113.720	95.600
2021	8/20/2021	Upper Shungnak	0.391	1.647	0.213	2.130	11.058	7.504	0.000	0.624	112.000	28.800	98.327	99.132	81.300
2021	6/20/2021	Upper Shungnak								0.465	115.000				75.500
2019	8/24/2019	Upper Shungnak	0.369	1.774	0.225	2.160	11.889	8.013	0.544	0.393	75.000	29.000	104.949	105.807	87.800
2019	6/27/2019	Upper Shungnak	0.239	1.570	0.206	1.440	10.557	7.195	0.671	0.341	124.000	19.300	94.316	95.088	77.400
2018	8/26/2018	Upper Shungnak	0.227	1.727	0.220	1.420	11.582	7.826	0.513	0.595	104.000	17.200	102.513	103.352	85.400
2018	6/27/2018	Upper Shungnak	0.219	1.467	0.196	1.820	9.887	6.780	1.040	0.521	86.000	18.000	88.919	89.646	72.200
2017	9/20/2017	Upper Shungnak	0.217	1.503	0.200	1.53	10.120	6.924	0.701	0.31	92	16.7	90.794	91.536	74
2017	8/24/2017	Upper Shungnak	0.219	1.599	0.209	1.45	10.750	7.314	0.5	0.563	97	17.1	95.862	96.647	78.9
2017	7/22/2017	Upper Shungnak	0.13	1.690	0.217	0.88	11.339	7.677	0.5	0.369	116	7.45	100.577	101.400	83.5
2017	4/27/2017	Upper Shungnak	0.097	1.688	0.217	0.665	11.326	7.669	0.5	0.334	108	8.39	100.475	101.297	83.4
2023	7/11/2023	Upper Subarctic	0.017	0.920	0.140	0.000	6.293	4.501	0.000	0.000	46.000	11.400	59.233	59.717	44.700
2022	8/12/2022	Upper Subarctic	0.015	1.016	0.151	0.000	6.928	4.911	0.000	0.000	56.000	10.500	64.579	65.108	49.500
2022	4/22/2022	Upper Subarctic	0.063	1.074	0.157	0.766	7.310	5.155	0.000	0.000	93.000	4.750	67.771	68.325	52.400
2021	9/29/2021	Upper Subarctic	0.018	0.952	0.144	0.000	6.506	4.638	0.000	0.000	62.000	0.000	61.024	61.523	46.300
2021	8/22/2021	Upper Subarctic	0.020	0.922	0.141	0.000	6.307	4.509	0.000	0.000	72.000	4.050	59.345	59.830	44.800
2021	6/20/2021	Upper Subarctic								0.000	32.000				38.200
2021	3/11/2021	Upper Subarctic							0.610	0.000	77.000				47.300
2021	1/26/2021	Upper Subarctic							0.518	0.395	64.000				61.400
2019	12/8/2019	Upper Subarctic	0.025	1.076	0.157	0.203	7.323	5.164	0.733	0.500	67.000	5.000	67.881	68.436	52.500
2019	8/23/2019	Upper Subarctic	0.018	0.954	0.144	0.247	6.519	4.647	0.500	0.500	51.000	5.000	61.136	61.636	46.400
2019	6/7/2019	Upper Subarctic	0.018	0.541	0.096	0.250	3.763	2.823	1.940	0.500	23.000	5.000	37.303	37.608	25.900
2019	4/1/2019	Upper Subarctic	0.047	1.000	0.149	0.305	6.823	4.843	0.707	0.409	63.000	5.000	63.694	64.215	48.700
2018	12/7/2018	Upper Subarctic	0.017	1.034	0.153	0.250	7.047	4.987	0.601	0.500	56.000	5.000	65.573	66.109	50.400
2018	8/26/2018	Upper Subarctic	0.025	0.928	0.141	0.249	6.347	4.535	0.773	0.450	56.000	5.000	59.681	60.170	45.100
2018	6/24/2018	Upper Subarctic	0.025	0.703	0.116	0.323	4.850	3.554	0.889	0.500	38.000	3.100	46.859	47.242	33.900
2018	3/25/2018	Upper Subarctic	0.015	1.080	0.158	0.250	7.350	5.181	0.500	1.000	72.000	3.100	68.100	68.657	52.700
2017	9/20/2017	Upper Subarctic	0.0166	0.848	0.133	0.263	5.815	4.189	0.695	0.31	48	1.35	55.165	55.616	41.1
2017	8/21/2017	Upper Subarctic	0.0963	1.026	0.152	0.691	6.994	4.953	0.5	0.426	58	3.29	65.132	65.664	50
2017	7/21/2017	Upper Subarctic	0.0165	0.870	0.135	0.219	5.961	4.285	0.5	0.31	55	0.958	56.413	56.875	42.2

APPENDIX B. IN SITU WATER QUALITY DATA FROM LOCATIONS NEAR THE ARCTIC-BORNITE EXPLORATORY MINING PROSPECTS, 2022–2025.

In 2023, only water temperature was recorded with a handheld thermometer. A multiparameter handheld YSI was used for all other years.

Year	Date	Site	Water	Dissolved	Conductivity (µs/cm)	Specific	pH	Turbidity (NTU)
			Temperature (°C)	Oxygen (mg/L)		Conductance (µs/cm)		
2025	7/13/2025	Center of the Universe	4	11.2	84.8	141.6	7.68	0.31
2024	7/11/2024	Center of the Universe	4.9	11.83	83.3	135.5	7.99	
2023	7/12/2023	Center of the Universe	4.8					
2022	7/20/2022	Center of the Universe	4.3	12.04	95.3	157.7	7.93	0.19
2025	7/16/2025	Jay	7.1	11.28	51.7	78.7	8	0.63
2024	7/14/2024	Jay	6.7	11.63	61.5	94.5	7.81	
2023	7/12/2023	Jay	7					
2022	7/21/2022	Jay	5.6	12.26	59.7	94.9	7.82	1.49
2025	7/13/2025	Lower Red Rock	7.1	11.38	123.5	187.5	7.33	0.97
2024	7/11/2024	Lower Red Rock	6.5	11.8	113.6	175.5	8.05	
2023	7/11/2023	Lower Red Rock	5					
2025	7/14/2025	Lower Ruby	9.6	9.95	195.4	277.1	7.64	2.15
2024	7/13/2024	Lower Ruby	8.6	10.52	150.8	219.3	8.03	
2022	7/19/2022	Lower Ruby	10.7	11.55	203.6	280	8.01	3.46
2025	7/13/2025	Lower Subarctic	8.1	11.17	69	101.9	7.37	0.07
2024	7/11/2024	Lower Subarctic	6.9	11.82	61.1	93.4	7.4	
2023	7/11/2023	Lower Subarctic	5					
2022	7/19/2022	Lower Subarctic	6.6	13.02	77.8	120.1	7.63	0.3
2025	7/15/2025	Riley	4.9	11.66	146.5	237.8	7.73	0.88
2024	7/13/2024	Riley	4.6	12.04	138.9	227.7	8.37	
2023	7/13/2023	Riley	4.6					
2022	7/22/2022	Riley	4.4	12.35	159.5	263.2	8.07	0.49
2025	7/14/2025	Sunshine	6.1	11.58	82.7	129.5	7.56	0.27
2024	7/12/2024	Sunshine	5.5	12.14	77.8	123.9	7.85	
2023	7/11/2023	Sunshine	6					
2022	7/22/2022	Sunshine	2.9	9.59	81.2	140.4	6.92	1.15
2025	7/15/2025	Upper Ruby	11	9.6	189.5	258.9	8.23	2.63
2024	7/13/2024	Upper Ruby	8.4	10.88	166.2	243.6	8.14	
2025	7/14/2025	Upper Shungnak	6.7	10.98	113.8	174.3	7.55	0.18
2024	7/12/2024	Upper Shungnak	5	11.83	113.1	182.9	7.89	
2023	7/11/2023	Upper Shungnak	5					
2022	7/22/2022	Upper Shungnak	5.4	11.8	127.4	203.7	7.82	0.17
2025	7/13/2025	Upper Subarctic	6.3	10.73	65.1	101.1	8.02	0.19
2024	7/11/2024	Upper Subarctic	5.6	11.54	59	93.7	7.97	
2023	7/11/2023	Upper Subarctic	4.5					
2022	7/20/2022	Upper Subarctic	3.9	12.02	56	93.9	7.73	0.02

APPENDIX C. CHLOROPHYLL DATA FROM LOCATIONS NEAR THE ARCTIC-BORNITE EXPLORATORY MINING PROSPECTS, 2025.

The values reported and analyzed in this report are in the phaeo-corrected chlorophyll-a column. Values highlighted in green are below the detection limit (IDL) of 0.08.

IDL = 0.08 mg/m ² EDL = 0.41 mg/m ²		Linear Check Maximum = 73.89 mg/m ²						
Daily Vial #	Site	Date Analyzed	Vial Chl a	Chl a mg/m ²	Phaeo corrected Chl a mg/2	Phaeo corrected 664/665 ratio	Chl b mg/m ²	Chl c mg/m ²
2	Lower Red Rock	10/07/25	0.122	0.490	0.534	1.833	0.150	0.069
3	Lower Red Rock	10/07/25	0.156	0.626	0.641	1.750	0.169	0.018
4	Lower Red Rock	10/07/25	0.010	0.041	0.107		0.052	0.061
5	Lower Red Rock	10/07/25	0.022	0.088	0.214		0.030	0.054
6	Lower Red Rock	10/07/25	0.024	0.095	0.107	2.000	0.000	0.000
7	Lower Red Rock	10/07/25	0.012	0.047	0.107		0.000	0.000
8	Lower Red Rock	10/07/25	0.078	0.313	0.320	1.750	0.079	0.058
9	Lower Red Rock	10/07/25	0.012	0.047	0.107		0.000	0.091
10	Lower Red Rock	10/07/25	0.010	0.041	0.107		0.052	0.061
11	Lower Red Rock	10/07/25	0.034	0.136	0.214	3.000	0.008	0.048
12	Center of the Universe	10/07/25	0.479	1.914	1.709	1.615	0.012	0.139
13	Center of the Universe	10/07/25	0.261	1.045	0.961	1.643	0.036	0.124
14	Center of the Universe	10/07/25	0.250	0.998	0.961	1.692	0.058	0.131
15	Center of the Universe	10/07/25	0.216	0.862	0.748	1.583	0.049	0.083
16	Center of the Universe	10/07/25	0.193	0.774	0.641	1.545	0.009	0.127
17	Center of the Universe	10/07/25	0.273	1.093	1.068	1.714	0.014	0.117
18	Center of the Universe	10/07/25	0.567	2.268	2.136	1.667	0.154	0.160
19	Center of the Universe	10/07/25	0.577	2.309	2.243	1.700	0.205	0.221
20	Center of the Universe	10/07/25	0.239	0.957	0.961	1.750	0.006	0.070
21	Center of the Universe	10/07/25	0.344	1.377	1.282	1.667	0.000	0.175
22	Jay	10/07/25	0.670	2.682	2.456	1.639	0.105	0.236
23	Jay	10/07/25	0.524	2.097	1.922	1.643	0.000	0.278
24	Jay	10/07/25	0.490	1.961	1.816	1.654	0.000	0.329
25	Jay	10/07/25	0.694	2.776	2.563	1.649	0.030	0.517
26	Jay	10/07/25	1.025	4.100	3.845	1.667	0.041	0.374
27	Jay	10/07/25	0.421	1.683	1.495	1.609	0.037	0.203
28	Jay	10/07/25	0.309	1.235	1.175	1.688	0.000	0.195
29	Jay	10/07/25	0.706	2.823	2.563	1.632	0.019	0.412
30	Jay	10/07/25	0.480	1.920	1.816	1.680	0.000	0.170
31	Jay	10/07/25	0.239	0.957	0.961	1.750	0.006	0.070
32	Lower Subarctic	10/07/25	0.171	0.685	0.748	1.875	0.000	0.072
33	Lower Subarctic	10/07/25	0.160	0.638	0.534	1.556	0.000	0.079
34	Lower Subarctic	10/07/25	0.171	0.685	0.748	1.875	0.000	0.072
35	Lower Subarctic	10/07/25	0.114	0.455	0.427	1.667	0.014	0.038
36	Lower Subarctic	10/07/25	0.241	0.963	0.854	1.615	0.000	0.100
37	Lower Subarctic	10/07/25	0.424	1.696	1.602	1.682	0.000	0.166
38	Lower Subarctic	10/07/25	0.251	1.005	0.961	1.692	0.000	0.063
39	Lower Subarctic	10/07/25	0.102	0.407	0.427	1.800	0.036	0.045
40	Lower Subarctic	10/07/25	0.205	0.821	0.961	2.000	0.000	0.022
41	Lower Subarctic	10/07/25	0.434	1.737	1.602	1.652	0.000	0.227
42	Upper Shungnak	10/07/25	0.309	1.235	1.282	1.800	0.000	0.097
43	Upper Shungnak	10/07/25	0.149	0.597	0.534	1.625	0.000	0.018
44	Upper Shungnak	10/07/25	0.263	1.052	1.068	1.769	0.000	0.154
45	Upper Shungnak	10/07/25	0.126	0.502	0.534	1.833	0.000	0.031
46	Upper Shungnak	10/07/25	0.126	0.502	0.534	1.833	0.000	0.031
47	Upper Shungnak	10/07/25	0.582	2.328	2.243	1.700	0.000	0.215
48	Upper Shungnak	10/07/25	0.307	1.229	1.175	1.688	0.033	0.067
49	Upper Shungnak	10/07/25	0.207	0.828	0.854	1.800	0.000	0.052
50	Upper Shungnak	10/07/25	0.287	1.146	1.068	1.667	0.000	0.141
51	Upper Shungnak	10/07/25	0.080	0.319	0.320	1.750	0.000	0.089

IDL = 0.08 mg/m ² EDL = 0.41 mg/m ²						Linear Check Maximum = 73.89 mg/m ²		
Daily Vial #	Site	Date Analyzed	Vial Chl a	Chl a mg/m ²	Phaeo corrected Chl a mg/2	Phaeo corrected 664/665 ratio	Chl b mg/m ²	Chl c mg/m ²
52	Upper Subarctic	10/07/25	0.640	2.561	2.136	1.541	0.421	0.716
53	Upper Subarctic	10/07/25	0.411	1.642	1.602	1.714	0.000	0.240
54	Upper Subarctic	10/07/25	0.512	2.050	2.029	1.731	0.010	0.285
55	Upper Subarctic	10/07/25	1.907	7.630	7.369	1.690	1.004	0.480
55	Upper Subarctic duplicate	10/07/25	1.918	7.671	7.476	1.700	1.067	0.443
56	Upper Subarctic	10/07/25	0.365	1.459	1.282	1.600	0.000	0.199
57	Upper Subarctic	10/07/25	0.421	1.683	1.602	1.682	0.037	0.203
58	Upper Subarctic	10/07/25	0.397	1.588	1.495	1.667	0.069	0.315
59	Upper Subarctic	10/07/25	0.251	1.004	0.961	1.692	0.000	0.161
60	Upper Subarctic	10/07/25	0.239	0.957	0.854	1.615	0.000	0.168
61	Upper Subarctic	10/07/25	0.343	1.370	1.282	1.667	0.000	0.243
2	Lower Ruby	10/08/25	0.629	2.518	2.243	1.618	0.000	0.188
3	Lower Ruby	10/08/25	0.273	1.093	1.068	1.714	0.025	0.019
4	Lower Ruby	10/08/25	0.433	1.731	1.602	1.652	0.025	0.098
5	Lower Ruby	10/08/25	0.263	1.052	0.961	1.643	0.000	0.056
6	Lower Ruby	10/08/25	0.171	0.685	0.641	1.667	0.000	0.072
7	Lower Ruby	10/08/25	0.149	0.597	0.641	1.857	0.000	0.116
8	Lower Ruby	10/08/25	0.239	0.957	0.961	1.750	0.006	0.070
9	Lower Ruby	10/08/25	0.261	1.046	0.961	1.643	0.047	0.026
10	Lower Ruby	10/08/25	0.560	2.240	2.136	1.690	0.000	0.160
11	Lower Ruby	10/08/25	0.273	1.093	1.175	1.846	0.025	0.019
12	Upper Ruby	10/08/25	4.107	16.430	15.593	1.685	0.000	0.984
13	Upper Ruby	10/08/25	15.792	63.168	57.886	1.645	0.000	3.543
14	Upper Ruby	10/08/25	22.534	90.136	82.770	1.649	0.000	5.921
15	Upper Ruby	10/08/25	3.811	15.243	14.098	1.657	0.000	0.488
16	Upper Ruby	10/08/25	3.804	15.216	14.311	1.673	0.000	1.151
17	Upper Ruby	10/08/25	1.337	5.348	4.913	1.648	0.000	0.336
18	Upper Ruby	10/08/25	21.310	85.239	75.721	1.613	0.000	4.188
19	Upper Ruby	10/08/25	16.539	66.157	60.556	1.645	0.000	3.491
20	Upper Ruby	10/08/25	4.898	19.594	18.476	1.678	0.000	0.595
21	Upper Ruby	10/08/25	3.979	15.914	15.272	1.698	0.000	1.088
21	Upper Ruby duplicate	10/08/25	3.989	15.955	15.166	1.686	0.000	1.149
22	Riley	10/08/25	0.535	2.139	2.136	1.741	0.061	0.143
23	Riley	10/08/25	0.390	1.560	1.495	1.700	0.000	0.118
24	Riley	10/08/25	0.275	1.099	1.068	1.714	0.000	0.148
25	Riley	10/08/25	0.628	2.511	2.456	1.719	0.000	0.255
26	Riley	10/08/25	0.456	1.826	1.816	1.739	0.000	0.183
27	Riley	10/08/25	0.453	1.814	1.816	1.739	0.150	0.024
28	Riley	10/08/25	0.411	1.643	1.602	1.714	0.000	0.142
29	Riley	10/8/2025	0.273	1.093	1.068	1.714	0.025	0.019
30	Riley	10/8/2025	0.170	0.679	0.534	1.500	0.052	0.140
31	Riley	10/8/2025	0.687	2.749	2.563	1.667	0.000	0.026
32	Sunshine	10/8/2025	0.205	0.821	0.854	1.800	0.000	0.218
33	Sunshine	10/8/2025	0.126	0.502	0.534	1.833	0.000	0.031
34	Sunshine	10/8/2025	0.103	0.414	0.320	1.500	0.000	0.000
35	Sunshine	10/8/2025	0.149	0.597	0.534	1.625	0.000	0.018
36	Sunshine	10/8/2025	0.458	1.832	1.709	1.667	0.000	0.115
37	Sunshine	10/8/2025	0.366	1.466	1.388	1.684	0.000	0.132
38	Sunshine	10/8/2025	0.078	0.313	0.320	1.750	0.079	0.058
39	Sunshine	10/8/2025	0.114	0.455	0.534	2.000	0.014	0.038
40	Sunshine	10/8/2025	0.193	0.774	0.748	1.700	0.009	0.127
41	Sunshine	10/8/2025	0.309	1.235	1.175	1.688	0.000	0.097

APPENDIX D. BENTHIC MACROINVERTEBRATE DATA FROM LOCATIONS NEAR THE ARCTIC-BORNITE EXPLORATORY MINING PROSPECTS, 2025.

Year	Order	Family	Genus	Lower Ruby	Lower Subarctic	Riley	Upper Ruby	Upper Shungnak	Upper Subarctic	Jay	Lower Red Rock	Sunshine	Center of the Universe
2025	Acari	Acarina	spp	8	18	6	26	3	1	3	0	12	7
2025	Collembola	Isotomidae	spp	1	0	1	2	2	1	0	0	0	0
2025	Copepoda	Cyclopoida	spp	0	0	3	18	0	0	0	0	0	0
2025	Copepoda	Harpacticoida	spp	0	0	3	4	0	0	1	0	1	0
2025	Diptera	Ceratopogonidae	spp	31	1	32	12	13	0	2	1	0	0
2025	Diptera	Chironomidae	spp	281	237	780	5055	41	437	419	24	499	639
2025	Diptera	Empididae	Chelifera	2	17	3	15	1	0	0	0	0	2
2025	Diptera	Empididae	Oreogeton	0	2	1	0	0	6	0	0	2	151
2025	Diptera	Ephydriidae	spp	0	0	0	1	0	0	0	0	0	0
2025	Diptera	Limoniidae	Ormosia	0	0	0	5	0	0	0	0	0	0
2025	Diptera	Simuliidae	spp	31	10	35	6	0	7	2	0	0	5
2025	Diptera	spp	spp	0	0	0	0	0	0	1	0	0	0
2025	Diptera	Tipulidae	Dicranota	11	1	1	87	0	1	2	0	4	1
2025	Diptera	Tipulidae	Tipula	1	0	0	0	0	0	2	0	0	0
2025	Ephemeroptera	Ameletidae	Ameletus	0	2	0	2	0	357	1	0	5	33
2025	Ephemeroptera	Baetidae	Baetis	16	31	28	33	19	94	86	2	3	174
2025	Ephemeroptera	Baetidae	Acentrella	0	0	0	114	0	0	0	0	0	0
2025	Ephemeroptera	Ephemerellidae	Ephemerella	0	0	0	14	0	0	0	0	0	0
2025	Ephemeroptera	Ephemerellidae	spp	3	0	10	2	0	0	0	0	1	0
2025	Ephemeroptera	Heptageniidae	Cinygmula	27	88	320	19	70	39	168	1	17	21
2025	Ephemeroptera	Heptageniidae	Epeorus	2	47	213	4	10	0	17	0	7	3
2025	Ephemeroptera	spp	spp	1	0	1	0	0	0	1	0	0	0
2025	Gastropoda	spp	spp	0	0	0	1	0	0	0	0	0	0
2025	Hymenoptera	Symphyta	spp	0	0	0	0	0	0	0	0	0	1
2025	Nematoda	spp	spp	4	0	2	41	0	0	15	1	0	4
2025	Oligochaeta	spp	spp	5	644	423	99	20	23	34	3	16	209
2025	Ostracoda	spp	spp	0	33	5	57	4	585	27	1	8	179
2025	Platyhelminthes	spp	spp	0	6	0	0	0	0	31	0	7	24

APPENDIX E. FISH CAPTURE DATA FROM LOCATIONS NEAR THE ARCTIC-BORNITE EXPLORATORY MINING PROSPECTS, 2016– 2025.

Year	Site	Dolly Varden	Arctic grayling	slimy sculpin	Alaska blackfish	longnose sucker	round whitefish
2025	Center of the Universe	12	0	0	0	0	0
2024	Center of the Universe	7	0	0	0	0	0
2023	Center of the Universe	1	0	0	0	0	0
2022	Center of the Universe	5	0	0	0	0	0
2021	Center of the Universe	12	0	0	0	0	0
2025	Jay	3	0	4	0	0	0
2024	Jay	1	0	0	0	0	0
2023	Jay	2	0	0	0	0	0
2022	Jay	2	0	0	0	0	0
2021	Jay	4	0	0	0	0	0
2019	Jay	3	0	0	0	0	0
2018	Jay	9	0	0	0	0	0
2017	Jay	11	0	0	0	0	0
2025	Lower Red Rock	13	0	1	0	0	0
2024	Lower Red Rock	8	0	7	0	0	0
2023	Lower Red Rock	0	0	5	0	0	0
2022	Lower Red Rock	12	0	4	0	0	0
2021	Lower Red Rock	12	0	2	0	0	0
2019	Lower Red Rock	25	0	0	0	0	0
2018	Lower Red Rock	2	0	3	0	0	0
2025	Lower Ruby	1	0	45	0	0	0
2024	Lower Ruby	2	0	39	0	0	0
2023	Lower Ruby	1	0	21	3	0	0
2022	Lower Ruby	0	0	36	0	0	0
2021	Lower Ruby	0	0	24	0	0	0
2019	Lower Ruby	0	0	30	0	0	1
2018	Lower Ruby	0	0	15	3	1	0
2017	Lower Ruby	4	0	17	0	0	0
2016	Lower Ruby	0	0	20	0	0	0
2025	Lower Subarctic	5	0	3	0	0	0
2024	Lower Subarctic	7	0	5	0	0	0
2023	Lower Subarctic	1	0	20	0	0	0
2022	Lower Subarctic	3	0	4	0	0	0
2021	Lower Subarctic	2	0	5	0	0	0
2019	Lower Subarctic	31	0	3	0	0	0
2018	Lower Subarctic	4	0	5	0	0	0
2017	Lower Subarctic	8	0	2	0	0	0
2016	Lower Subarctic	2	0	3	0	0	0
2025	Riley	3	0	14	0	0	0
2024	Riley	6	0	13	0	0	0
2023	Riley	2	0	4	0	0	0
2022	Riley	1	0	10	0	0	0
2021	Riley	6	0	10	0	0	0
2019	Riley	3	1	15	0	0	0
2018	Riley	5	0	25	0	0	0
2017	Riley	16	1	8	0	0	0

Year	Site	Dolly Varden	Arctic grayling	slimy sculpin	Alaska blackfish	longnose sucker	round whitefish
2025	Sunshine	3	0	7	0	0	0
2024	Sunshine	2	0	15	0	0	0
2023	Sunshine	3	0	2	0	0	0
2022	Sunshine	1	0	3	0	0	0
2021	Sunshine	5	0	2	0	0	0
2025	Upper Ruby	3	0	58	0	0	0
2024	Upper Ruby	1	0	38	0	0	0
2022	Upper Ruby	3	0	36	0	0	0
2021	Upper Ruby	0	0	40	0	0	0
2019	Upper Ruby	4	0	22	0	0	0
2018	Upper Ruby	1	0	21	0	0	0
2017	Upper Ruby	0	0	61	0	0	0
2016	Upper Ruby	6	0	13	0	0	0
2025	Upper Subarctic	31	0	0	0	0	0
2024	Upper Subarctic	24	0	0	0	0	0
2023	Upper Subarctic	20	0	0	0	0	0
2022	Upper Subarctic	34	0	0	0	0	0
2021	Upper Subarctic	42	0	0	0	0	0
2019	Upper Subarctic	5	0	0	0	0	0
2018	Upper Subarctic	35	0	0	0	0	0
2017	Upper Subarctic	40	0	0	0	0	0
2016	Upper Subarctic	33	0	0	0	0	0

APPENDIX F. RESULTS FOR WHOLE BODY ELEMENT ANALYSIS FOR FISH FROM RUBY AND RILEY CREEKS, 2025.

Collection Date	Sample ID	Site	Species	Analyte	Dry Wt Result (mg/kg)	Dry Wt MDL (mg/kg)	% Solid	Fish Length (mm)	Fish Weight (g)
7/12/2025	0712525LRUBSS01	Lower Ruby	slimy sculpin	Cadmium	0.13	0.05	20.4	70	5.3
7/12/2025	0712525LRUBSS02	Lower Ruby	slimy sculpin	Cadmium	0.09	0.03	25.9	71	5.8
7/12/2025	0712525LRUBSS03	Lower Ruby	slimy sculpin	Cadmium	0.11	0.04	23	73	5.5
7/12/2025	0712525LRUBSS04	Lower Ruby	slimy sculpin	Cadmium	0.17	0.05	22.5	73	5.1
7/12/2025	0712525LRUBSS05	Lower Ruby	slimy sculpin	Cadmium	0.12	0.05	17.2	71	5.8
7/12/2025	0712525LRUBSS06	Lower Ruby	slimy sculpin	Cadmium	0.17	0.03	24.6	70	5.3
7/12/2025	0712525LRUBSS07	Lower Ruby	slimy sculpin	Cadmium	0.24	0.04	25.3	78	4.6
7/12/2025	0712525LRUBSS08	Lower Ruby	slimy sculpin	Cadmium	0.17	0.04	19.4	72	5.8
7/12/2025	0712525LRUBSS09	Lower Ruby	slimy sculpin	Cadmium	0.08	0.04	24.4	77	5.9
7/12/2025	0712525LRUBSS10	Lower Ruby	slimy sculpin	Cadmium	0.09	0.04	26.3	66	4.5
7/12/2025	0712525LRUBSS11	Lower Ruby	slimy sculpin	Cadmium	0.18	0.04	27.9	76	4.7
7/12/2025	0712525LRUBSS12	Lower Ruby	slimy sculpin	Cadmium	0.11	0.04	24.7	72	5.3
7/12/2025	0712525LRUBSS13	Lower Ruby	slimy sculpin	Cadmium	0.13	0.06	17.4	74	5.8
7/12/2025	0712525LRUBSS14	Lower Ruby	slimy sculpin	Cadmium	0.18	0.05	21.9	65	4.6
7/12/2025	0712525LRUBSS15	Lower Ruby	slimy sculpin	Cadmium	0.09	0.04	27.1	71	4.9
7/16/2025	071625RILSS01	Riley	slimy sculpin	Cadmium	0.15	0.05	25.9	72	4.4
7/16/2025	071625RILSS02	Riley	slimy sculpin	Cadmium	0.35	0.05	22.5	62	2.9
7/16/2025	071625RILSS03	Riley	slimy sculpin	Cadmium	0.47	0.05	23.8	76	5.1
7/16/2025	071625RILSS04	Riley	slimy sculpin	Cadmium	0.35	0.04	20.7	90	9.1
7/16/2025	071625RILSS05	Riley	slimy sculpin	Cadmium	0.30	0.05	23.4	90	9.3
7/16/2025	071625RILSS06	Riley	slimy sculpin	Cadmium	0.17	0.05	19.4	80	6.7
7/16/2025	071625RILSS07	Riley	slimy sculpin	Cadmium	0.50	0.05	25.7	83	6.1
7/16/2025	071625RILSS08	Riley	slimy sculpin	Cadmium	0.60	0.05	23.5	75	5.5
7/16/2025	071625RILSS09	Riley	slimy sculpin	Cadmium	1.01	0.05	23.3	77	5.2
7/16/2025	071625RILSS10	Riley	slimy sculpin	Cadmium	0.12	0.05	23.3	72	5.3
7/16/2025	071625RILSS11	Riley	slimy sculpin	Cadmium	0.36	0.04	22.4	75	5.8
7/16/2025	071625RILSS12	Riley	slimy sculpin	Cadmium	0.68	0.05	23.3	67	4.3

Collection Date	Sample ID	Site	Species	Analyte	Dry Wt Result (mg/kg)	Dry Wt MDL (mg/kg)	% Solid	Fish Length (mm)	Fish Weight (g)
7/12/2025	0712525LRUBSS01	Lower Ruby	slimy sculpin	Copper	3.66	0.78	20.4	70	5.3
7/12/2025	0712525LRUBSS02	Lower Ruby	slimy sculpin	Copper	2.63	0.56	25.9	71	5.8
7/12/2025	0712525LRUBSS03	Lower Ruby	slimy sculpin	Copper	2.75	0.61	23	73	5.5
7/12/2025	0712525LRUBSS04	Lower Ruby	slimy sculpin	Copper	3.27	0.78	22.5	73	5.1
7/12/2025	0712525LRUBSS05	Lower Ruby	slimy sculpin	Copper	3.36	0.77	17.2	71	5.8
7/12/2025	0712525LRUBSS06	Lower Ruby	slimy sculpin	Copper	3.65	0.52	24.6	70	5.3
7/12/2025	0712525LRUBSS07	Lower Ruby	slimy sculpin	Copper	4.47	0.60	25.3	78	4.6
7/12/2025	0712525LRUBSS08	Lower Ruby	slimy sculpin	Copper	3.21	0.66	19.4	72	5.8
7/12/2025	0712525LRUBSS09	Lower Ruby	slimy sculpin	Copper	2.26	0.59	24.4	77	5.9
7/12/2025	0712525LRUBSS10	Lower Ruby	slimy sculpin	Copper	2.29	0.70	26.3	66	4.5
7/12/2025	0712525LRUBSS11	Lower Ruby	slimy sculpin	Copper	2.29	0.60	27.9	76	4.7
7/12/2025	0712525LRUBSS12	Lower Ruby	slimy sculpin	Copper	2.61	0.71	24.7	72	5.3
7/12/2025	0712525LRUBSS13	Lower Ruby	slimy sculpin	Copper	2.78	0.94	17.4	74	5.8
7/12/2025	0712525LRUBSS14	Lower Ruby	slimy sculpin	Copper	3.82	0.88	21.9	65	4.6
7/12/2025	0712525LRUBSS15	Lower Ruby	slimy sculpin	Copper	2.32	0.66	27.1	71	4.9
7/16/2025	071625RILSS01	Riley	slimy sculpin	Copper	2.97	0.74	25.9	72	4.4
7/16/2025	071625RILSS02	Riley	slimy sculpin	Copper	3.23	0.87	22.5	62	2.9
7/16/2025	071625RILSS03	Riley	slimy sculpin	Copper	3.61	0.79	23.8	76	5.1
7/16/2025	071625RILSS04	Riley	slimy sculpin	Copper	3.67	0.64	20.7	90	9.1
7/16/2025	071625RILSS05	Riley	slimy sculpin	Copper	3.03	0.85	23.4	90	9.3
7/16/2025	071625RILSS06	Riley	slimy sculpin	Copper	1.95	0.76	19.4	80	6.7
7/16/2025	071625RILSS07	Riley	slimy sculpin	Copper	4.12	0.75	25.7	83	6.1
7/16/2025	071625RILSS08	Riley	slimy sculpin	Copper	3.37	0.85	23.5	75	5.5
7/16/2025	071625RILSS09	Riley	slimy sculpin	Copper	5.15	0.77	23.3	77	5.2
7/16/2025	071625RILSS10	Riley	slimy sculpin	Copper	2.16	0.81	23.3	72	5.3
7/16/2025	071625RILSS11	Riley	slimy sculpin	Copper	3.43	0.68	22.4	75	5.8
7/16/2025	071625RILSS12	Riley	slimy sculpin	Copper	3.94	0.82	23.3	67	4.3

Collection Date	Sample ID	Site	Species	Analyte	Dry Wt Result (mg/kg)	Dry Wt MDL (mg/kg)	% Solid	Fish Length (mm)	Fish Weight (g)
7/12/2025	0712525LRUBSS01	Lower Ruby	slimy sculpin	Mercury	0.19	0.02	20.4	70	5.3
7/12/2025	0712525LRUBSS02	Lower Ruby	slimy sculpin	Mercury	0.15	0.01	25.9	71	5.8
7/12/2025	0712525LRUBSS03	Lower Ruby	slimy sculpin	Mercury	0.14	0.02	23	73	5.5
7/12/2025	0712525LRUBSS04	Lower Ruby	slimy sculpin	Mercury	0.22	0.01	22.5	73	5.1
7/12/2025	0712525LRUBSS05	Lower Ruby	slimy sculpin	Mercury	0.24	0.01	17.2	71	5.8
7/12/2025	0712525LRUBSS06	Lower Ruby	slimy sculpin	Mercury	0.41	0.02	24.6	70	5.3
7/12/2025	0712525LRUBSS07	Lower Ruby	slimy sculpin	Mercury	0.54	0.01	25.3	78	4.6
7/12/2025	0712525LRUBSS08	Lower Ruby	slimy sculpin	Mercury	0.22	0.02	19.4	72	5.8
7/12/2025	0712525LRUBSS09	Lower Ruby	slimy sculpin	Mercury	0.28	0.01	24.4	77	5.9
7/12/2025	0712525LRUBSS10	Lower Ruby	slimy sculpin	Mercury	0.16	0.01	26.3	66	4.5
7/12/2025	0712525LRUBSS11	Lower Ruby	slimy sculpin	Mercury	0.45	0.01	27.9	76	4.7
7/12/2025	0712525LRUBSS12	Lower Ruby	slimy sculpin	Mercury	0.08	0.01	24.7	72	5.3
7/12/2025	0712525LRUBSS13	Lower Ruby	slimy sculpin	Mercury	0.22	0.02	17.4	74	5.8
7/12/2025	0712525LRUBSS14	Lower Ruby	slimy sculpin	Mercury	0.25	0.02	21.9	65	4.6
7/12/2025	0712525LRUBSS15	Lower Ruby	slimy sculpin	Mercury	0.16	0.01	27.1	71	4.9
7/16/2025	071625RILSS01	Riley	slimy sculpin	Mercury	0.25	0.01	25.9	72	4.4
7/16/2025	071625RILSS02	Riley	slimy sculpin	Mercury	0.30	0.02	22.5	62	2.9
7/16/2025	071625RILSS03	Riley	slimy sculpin	Mercury	0.63	0.01	23.8	76	5.1
7/16/2025	071625RILSS04	Riley	slimy sculpin	Mercury	0.34	0.02	20.7	90	9.1
7/16/2025	071625RILSS05	Riley	slimy sculpin	Mercury	0.17	0.02	23.4	90	9.3
7/16/2025	071625RILSS06	Riley	slimy sculpin	Mercury	0.19	0.01	19.4	80	6.7
7/16/2025	071625RILSS07	Riley	slimy sculpin	Mercury	0.46	0.01	25.7	83	6.1
7/16/2025	071625RILSS08	Riley	slimy sculpin	Mercury	0.27	0.02	23.5	75	5.5
7/16/2025	071625RILSS09	Riley	slimy sculpin	Mercury	0.43	0.02	23.3	77	5.2
7/16/2025	071625RILSS10	Riley	slimy sculpin	Mercury	0.11	0.01	23.3	72	5.3
7/16/2025	071625RILSS11	Riley	slimy sculpin	Mercury	0.31	0.02	22.4	75	5.8
7/16/2025	071625RILSS12	Riley	slimy sculpin	Mercury	0.15	0.02	23.3	67	4.3

Collection Date	Sample ID	Site	Species	Analyte	Dry Wt Result (mg/kg)	Dry Wt MDL (mg/kg)	% Solid	Fish Length (mm)	Fish Weight (g)
7/12/2025	0712525LRUBSS01	Lower Ruby	slimy sculpin	Selenium	3.88	0.10	20.4	70	5.3
7/12/2025	0712525LRUBSS02	Lower Ruby	slimy sculpin	Selenium	3.63	0.07	25.9	71	5.8
7/12/2025	0712525LRUBSS03	Lower Ruby	slimy sculpin	Selenium	3.48	0.08	23	73	5.5
7/12/2025	0712525LRUBSS04	Lower Ruby	slimy sculpin	Selenium	5.42	0.10	22.5	73	5.1
7/12/2025	0712525LRUBSS05	Lower Ruby	slimy sculpin	Selenium	4.81	0.10	17.2	71	5.8
7/12/2025	0712525LRUBSS06	Lower Ruby	slimy sculpin	Selenium	3.77	0.07	24.6	70	5.3
7/12/2025	0712525LRUBSS07	Lower Ruby	slimy sculpin	Selenium	3.66	0.08	25.3	78	4.6
7/12/2025	0712525LRUBSS08	Lower Ruby	slimy sculpin	Selenium	4.48	0.08	19.4	72	5.8
7/12/2025	0712525LRUBSS09	Lower Ruby	slimy sculpin	Selenium	3.87	0.07	24.4	77	5.9
7/12/2025	0712525LRUBSS10	Lower Ruby	slimy sculpin	Selenium	3.15	0.09	26.3	66	4.5
7/12/2025	0712525LRUBSS11	Lower Ruby	slimy sculpin	Selenium	3.80	0.08	27.9	76	4.7
7/12/2025	0712525LRUBSS12	Lower Ruby	slimy sculpin	Selenium	5.51	0.09	24.7	72	5.3
7/12/2025	0712525LRUBSS13	Lower Ruby	slimy sculpin	Selenium	4.37	0.12	17.4	74	5.8
7/12/2025	0712525LRUBSS14	Lower Ruby	slimy sculpin	Selenium	3.82	0.11	21.9	65	4.6
7/12/2025	0712525LRUBSS15	Lower Ruby	slimy sculpin	Selenium	5.13	0.08	27.1	71	4.9
7/16/2025	071625RILSS01	Riley	slimy sculpin	Selenium	5.06	0.09	25.9	72	4.4
7/16/2025	071625RILSS02	Riley	slimy sculpin	Selenium	5.33	0.11	22.5	62	2.9
7/16/2025	071625RILSS03	Riley	slimy sculpin	Selenium	6.01	0.10	23.8	76	5.1
7/16/2025	071625RILSS04	Riley	slimy sculpin	Selenium	4.98	0.08	20.7	90	9.1
7/16/2025	071625RILSS05	Riley	slimy sculpin	Selenium	6.03	0.11	23.4	90	9.3
7/16/2025	071625RILSS06	Riley	slimy sculpin	Selenium	5.00	0.10	19.4	80	6.7
7/16/2025	071625RILSS07	Riley	slimy sculpin	Selenium	4.82	0.09	25.7	83	6.1
7/16/2025	071625RILSS08	Riley	slimy sculpin	Selenium	7.36	0.11	23.5	75	5.5
7/16/2025	071625RILSS09	Riley	slimy sculpin	Selenium	6.01	0.10	23.3	77	5.2
7/16/2025	071625RILSS10	Riley	slimy sculpin	Selenium	5.88	0.10	23.3	72	5.3
7/16/2025	071625RILSS11	Riley	slimy sculpin	Selenium	6.65	0.08	22.4	75	5.8
7/16/2025	071625RILSS12	Riley	slimy sculpin	Selenium	7.64	0.10	23.3	67	4.3

Collection Date	Sample ID	Site	Species	Analyte	Dry Wt Result (mg/kg)	Dry Wt MDL (mg/kg)	% Solid	Fish Length (mm)	Fish Weight (g)
7/12/2025	0712525LRUBSS01	Lower Ruby	slimy sculpin	Zinc	75.49	5.88	20.4	70	5.3
7/12/2025	0712525LRUBSS02	Lower Ruby	slimy sculpin	Zinc	92.28	4.17	25.9	71	5.8
7/12/2025	0712525LRUBSS03	Lower Ruby	slimy sculpin	Zinc	84.78	4.57	23	73	5.5
7/12/2025	0712525LRUBSS04	Lower Ruby	slimy sculpin	Zinc	117.33	5.87	22.5	73	5.1
7/12/2025	0712525LRUBSS05	Lower Ruby	slimy sculpin	Zinc	148.26	5.76	17.2	71	5.8
7/12/2025	0712525LRUBSS06	Lower Ruby	slimy sculpin	Zinc	140.24	3.90	24.6	70	5.3
7/12/2025	0712525LRUBSS07	Lower Ruby	slimy sculpin	Zinc	139.92	4.51	25.3	78	4.6
7/12/2025	0712525LRUBSS08	Lower Ruby	slimy sculpin	Zinc	98.97	4.95	19.4	72	5.8
7/12/2025	0712525LRUBSS09	Lower Ruby	slimy sculpin	Zinc	89.34	4.43	24.4	77	5.9
7/12/2025	0712525LRUBSS10	Lower Ruby	slimy sculpin	Zinc	80.23	5.25	26.3	66	4.5
7/12/2025	0712525LRUBSS11	Lower Ruby	slimy sculpin	Zinc	114.70	4.52	27.9	76	4.7
7/12/2025	0712525LRUBSS12	Lower Ruby	slimy sculpin	Zinc	106.88	5.34	24.7	72	5.3
7/12/2025	0712525LRUBSS13	Lower Ruby	slimy sculpin	Zinc	135.06	7.07	17.4	74	5.8
7/12/2025	0712525LRUBSS14	Lower Ruby	slimy sculpin	Zinc	108.22	6.58	21.9	65	4.6
7/12/2025	0712525LRUBSS15	Lower Ruby	slimy sculpin	Zinc	112.55	4.98	27.1	71	4.9
7/16/2025	071625RILSS01	Riley	slimy sculpin	Zinc	140.15	5.56	25.9	72	4.4
7/16/2025	071625RILSS02	Riley	slimy sculpin	Zinc	98.67	6.53	22.5	62	2.9
7/16/2025	071625RILSS03	Riley	slimy sculpin	Zinc	106.30	5.92	23.8	76	5.1
7/16/2025	071625RILSS04	Riley	slimy sculpin	Zinc	168.60	4.78	20.7	90	9.1
7/16/2025	071625RILSS05	Riley	slimy sculpin	Zinc	138.03	6.41	23.4	90	9.3
7/16/2025	071625RILSS06	Riley	slimy sculpin	Zinc	110.31	5.72	19.4	80	6.7
7/16/2025	071625RILSS07	Riley	slimy sculpin	Zinc	128.40	5.60	25.7	83	6.1
7/16/2025	071625RILSS08	Riley	slimy sculpin	Zinc	121.28	6.38	23.5	75	5.5
7/16/2025	071625RILSS09	Riley	slimy sculpin	Zinc	131.76	5.79	23.3	77	5.2
7/16/2025	071625RILSS10	Riley	slimy sculpin	Zinc	67.38	6.05	23.3	72	5.3
7/16/2025	071625RILSS11	Riley	slimy sculpin	Zinc	141.07	5.09	22.4	75	5.8
7/16/2025	071625RILSS12	Riley	slimy sculpin	Zinc	109.44	6.18	23.3	67	4.3